

沿岸海洋生態系の保護と管理に関する 国際シンポジウム報告書



*International Symposium on Protection
and Management of Coastal Marine Ecosystem*



International EMECS Center
財団法人 国際エメックスセンター

沿岸海洋生態系の保護と管理に関する国際シンポジウム (エメックス国際シンポジウム in バンコク)

開 会 式



基調講演



分科会－科学



分科会－社会経済



分科会－立法と政策



パネル討論



シンポジウム質疑応答



沿岸海洋生態系の保護と管理に関する国際シンポジウム (エメックス国際シンポジウム in バンコク) の開催結果の概要 the International Symposium on Protection and Management of Coastal Marine Ecosystem

財団法人国際エメックスセンターは、国連環境計画(UNEP)とともに「沿岸海洋生態系の保護と管理に関する国際シンポジウム」をタイ国バンコク市内で平成12年12月12日及び13日の2日間にわたって開催しました。

本シンポジウムの開会式では、主催者あいさつとともに、タイ副首相 ウィロー氏及び在タイ日本国特命全権大使 赤尾信敏氏から祝辞を頂きました。4つの基調講演の後、3つの分科会で、東アジア地域の国々や国際機関から招待した延べ38名の有識者より発表等が行われました。2日間を通じて、マングローブの伐採や水産資源の乱獲、水質汚濁等で危機に瀕している東アジア地域の沿岸海洋生態系に関する現状やその解決に向けた各国や国際機関、研究者の取組状況及び問題点、並びに将来への展望について、一般市民及び学識経験者、政策立案者、学生等、延べ約200名の参加を得て議論を深めることができ、シンポジウムは大きな成功を収めました。

当センターでは、このシンポジウムを通じて、タイ国における将来のエメックス会議開催に向けた地元の意欲を確認できました。

1 シンポジウム名称

沿岸海洋生態系の保護と管理に関する国際シンポジウム
(通称：エメックス国際シンポジウム in バンコク)

2 主催者

財団法人国際エメックスセンター
UNEP EAS/RCU

3 後援団体

タイ海洋政策及び回復に関する委員会
タイ科学技術環境省
チュラロンコン大学
東南アジア海洋法・政策・管理プログラム (SEAPOL)

UNEP EAS/RCU and International EMECS Center held "the International Symposium on Protection and Management of Coastal Marine Ecosystem" in Bangkok, Thailand from December 12, 2000 through December 13, 2000.

In the Opening Session, Police Lieutenant General Viroj Pao-In, the Deputy Prime Minister of Thailand, chairman of the Thai Marine Policy and Restoration Committee and H.E. Mr. Akao Nobutoshi gave the opening addresses. After the 4 keynote speeches, the invited 38 participants from ASEAN countries, China, Korea and Japan made presentations in the three parallel sessions. During this 2 days symposium, about 200 participants including citizens, researchers, administrators, and students, etc. had deep discussion the future approach with each other to solve the Ecosystem problems in this region such as Mangrove protection, Over-fishing, Water Quality, and recognized the present status.

Title

International Symposium on Protection and Management
of Coastal Marine Ecosystems

Organiser

United Nations Environment Programme (UNEP)
East Asian Seas Action Plan Regional Coordinating Unit
(EAS/RCU)
International Center for the Environment Management
of Enclosed Coastal Seas (International EMECS
Center)

Coorganiser

The Thai Marine Policy and Restoration Committee
Office of Environmental Policy and Planning (OEPP),
Ministry of Science, Technology and Environment
Chulalongkorn University
Southeast Asia Programme in Ocean Law, Policy and
management(SEAPOL)

4 助成団体

環境事業団地球環境基金

5 開催趣旨

アジア太平洋地域の人口の60%以上は沿岸域に住んでおり、沿岸海洋生態系はこの人口を養うのに不可欠な資源を提供している。しかしながら、増大する圧力に対して、沿岸及び海洋生態系は、警戒すべき速度で崩壊している。沿岸海洋生態系の保護と適切な管理は、沿岸資源の合理的な利用と持続的な発展のための重要な要素である。

6 開催日

2000年12月12日及び13日（2日間）

7 場 所

タイ王国バンコク市内（サイアム・シティ・ホテル）

8 概 要

(1) 開会式

- ・主催者あいさつ
国連環境計画アジア太平洋地域所長
ニルマル・アンドリュース氏
(財)国際エメックスセンター副理事長
寺畑 建雄

- ・来賓あいさつ
タイ国副首相・タイ海洋政策及び回復に関する委員会委員長
ウィロー・パオイン氏
在タイ日本国特命全権大使
赤尾 信敏氏

(2) 基調講演

立法と政策、科学、社会経済のテーマで4名の基調講演が行われました。

＜基調講演者と講演テーマ＞

- ・ロバート・ベックマン氏
(シンガポール国立大学法学部教授)
「沿岸生態系の保護における法律の役割」
- ・大和田紘一氏（東京大学海洋研究所教授）
「日本における水産養殖に関する多くの閉鎖性水域の環境比較の試み」
- ・スパチット・マノピモク氏
(タマサート大学経済学部教授)
「発展途上国における沿岸海洋資源の経済価値」
- ・ヒュー・カークマン氏（UNEP EAS/RCU）
「東アジア地域の沿岸海洋生態系の保護と管理における地域調整について」

Sponser

the Japan Environment Corporation's Japan Fund for Global Environment

Objectives

More than 60% of the population of the Asian and Pacific region live in coastal areas, and coastal marine ecosystems provide critical resources to support this population. However, due to increasing pressure, the coastal and marine ecosystems are degrading at an alarming rate. Protection and proper management of marine coastal ecosystems are essential elements for the rational use of coastal resources and sustainable development.

Date

12-13 December, 2000 (2 days)

Venue

Siam City Hotel, Bangkok, Thailand

Opening Address

Police Lieutenant General Viroj Pao-In
The Deputy Prime Minister of Thailand
Chairman of the Thai Marine Policy and Restoration Committee
H.E. Mr. AKAO Nobutoshi
The Japanese Ambassador to Thailand
Mr. Nirmal Andrews
The Regional Director
for Asia and the Pacific of the United Nations Environment Programme
Mr. Takeo TERAHATA
Vice-Chairman of the Board of Directors,
International EMECS Center, Japan

Keynote speech

No.1

The Role of Law in the Protection of Coastal Ecosystems,
by **Dr. Robert Beckman, Singapore**

No.2

Attempt to Compare Environmental Quality of Many Enclosed Water Areas Related to Aquacultural Activities in Japan - An Example of Coastal Management of Environmental Conditions Using Principal Component Analysis, by **Professor Dr. Kouichi Ohwada, Japan**

No.3

Economic Valuation of Coastal Marine Resources in Developing Countries : Some Observations, by **Dr. Supachit Manopimoke, Thailand**

No.4

Regional Co-ordination in Protection and Management of Coastal Marine Ecosystem in the East Asian Seas Region, by **Dr. Hugh Kirkman, Co-ordinator, UNEP East Asian Seas Regional Coordinating Unit**

(3) 分科会

第1日目の午後及び第2日目の午前では、社会経済、立法と政策、科学のテーマに基づく3つの分科会が同時開催されました。

ア) 社会経済の分科会

「マングローブや珊瑚礁、藻場、干潟などの生態系評価を含む海洋沿岸生態系の社会経済的な重要性」

- (a) 海洋沿岸生態系の保全と回復
- (b) 海洋沿岸生態系の持続的利用
- (c) 沿岸生態系の経済上の評価
- (d) 沿岸資源の地域レベルでの管理

発表者：盛岡 通氏（大阪大学大学院工学研究科教授）を含む延べ10名

イ) 立法と政策の分科会

「沿岸海洋生態系の保護と管理のための法律上の要件と関係」

- (a) 沿岸海洋生態系の保護と管理のための立法と政策策定
- (b) 法的要求と施行
- (c) 調整された政策展開のための省庁間協力

発表者：荏原 明則氏（神戸学院大学法学部教授）を含む延べ10名

ウ) 科学の分科会

「沿岸海洋生態系の保護と管理のための科学的及び技術的理解」

- (a) モニタリングと海洋生物生息地のアセスメント
- (b) 海洋保護地域
- (c) 沿岸海洋生態系の消滅による環境影響
- (d) 海洋汚染の沿岸資源に対する影響

発表者：柳 哲雄氏（九州大学応用力学研究室教授）を含む延べ14名

(4) 全体会議と閉会式

第2日目の午後からは全体会議が以下のとおり行われました。

- ・各分科会での発表並びに討議の概要報告
- ・基調講演者によるパネル討論
- 進行役 熊本 信夫氏（北海学園大学長）
- ・主催者によるとりまとめ

9 発表者・参加者

基調講演者を含め、日本からは4名、中国、韓国からは3名、アセアン諸国からは1カ国2名を原則に選定を行った。また、ASEAN事務局、START Regional Center、Wetland International等からの発表も含めた。

Session Theme

1. Socio-economic importance of marine coastal ecosystems including ecosystem valuation, e.g. mangroves, coral reef, seagrass and wetlands ;

- (i) Conservation and restoration of marine coastal ecosystems ;
- (ii) Sustainable use of marine coastal ecosystems ;
- (iii) Economic valuation of coastal ecosystems ;
- (iv) Community-based management of coastal resources

2. Legal requirements and implications for protection and management of coastal marine ecosystems ;

- (i) Legislation and policy making for protection and management of coastal marine ecosystems ;
- (ii) Legal requirement and enforcement ;
- (iii) Agency collaboration for Co-ordinated policy development

3. Scientific and technical understanding for protection and management of coastal marine ecosystems

- (i) Monitoring and marine habitat assessment ;
- (ii) Marine protected areas ;
- (iii) Impact on the environment caused by the loss of coastal marine ecosystems ;
- (iv) Impact of marine pollution on coastal resources



プログラム PROGRAMME



第1日目 12月12日(火) (Day 1 - Tuesday 12 December 2000)

- 09 : 00-10 : 00 開会式
Opening Session
- 10 : 00-10 : 20 休憩
Coffee break
- 10 : 20-10 : 50 基調講演 1
「沿岸生態系の保護における法律の役割」
ロバート・C・ベックマン (シンガポール国立大学法学部、准教授)
Keynote speech 1 :
The Role of Law in the Protection of Coastal Ecosystems, by Dr. Robert Beckman, Singapore
- 10 : 50-11 : 20 基調講演 2
「日本における水産養殖に関する閉鎖性水域の環境比較の試みー主要構成要素分析を用いた沿岸域環境状態管理の例ー」
大和田 紘一 (東京大学海洋研究所、教授)
Keynote speech 2 :
Attempt to Compare Environmental Quality of Many Enclosed Water Areas Related to Aquacultural Activities in Japan - An Example of Coastal Management of Environmental Conditions Using Principal Component Analysis, by Professor Dr. Kouichi Ohwada, Japan
- 11 : 20-11 : 50 基調講演 3
「発展途上国における沿岸海洋資源の経済評価」
スパチット・マノピモケ (タマサット大学経済学部、教授)
Keynote speech 3 :
Economic Valuation of Coastal Marine Resources in Developing Countries : Some Observations, by Dr. Supachit Manopimoke, Thailand
- 11 : 50-12 : 20 基調講演 4
「東アジア海域諸国の沿岸域海洋生態系保護と管理の地域調整」
ヒュー・カークマン (国連環境計画東アジア海域地域調整機構、コーディネーター)
Keynote speech 4 :
Regional Co-ordination in Protection and Management of Coastal Marine Ecosystem in the East Asian Seas Region, by Dr. Hugh Kirkman, Co-ordinator, UNEP East Asian Seas Regional Coordinating Unit
- 12 : 30-14 : 00 昼食
Lunch

14 : 00-18 : 00

分科会

1 社会経済の分科会

マングローブや珊瑚礁、藻場、干潟などの生態系評価を含む海洋沿岸生態系の社会経済的な重要性

2 立法と政策の分科会

沿岸海域生態系の保護と管理のための法律上の要件と関係

3 科学の分科会

沿岸海洋生態系の保護と管理のための科学的及び技術的理解

Parallel Sessions

Session 1 : Socio-economic importance of marine coastal ecosystems including ecosystem valuation, e.g. mangroves, coral reefs, seagrass and wetlands

Session 2 : Legal requirements and implications for protection and management of coastal marine ecosystems

Session 3 : Scientific and technical understanding for protection and management of coastal marine ecosystems

18 : 30-20 : 00

レセプション

Symposium Reception

第2日目 12月13日(水) (Day 2 - Wednesday 13 December 2000)

08 : 30-12 : 30

分科会 (続き)

Parallel Session (cont.)

12 : 30-14 : 00

昼食

Lunch

14 : 00-15 : 30

各分科会からの報告

Reports of the Parallel Sessions

15 : 30-15 : 50

休憩

Coffee break

15 : 50-16 : 50

パネル討論

Panel Discussion

16 : 50-17 : 30

シンポジウムとりまとめ

Summary of the Symposium

17 : 30-18 : 00

閉会式

Closing of the meeting

1 社会経済の分科会 PROGRAMME FOR SESSION 1

マングローブや珊瑚礁、藻場、干潟などの生態系評価を含む海洋沿岸生態系の社会経済的な重要性
Socio-economic Importance of Marine Coastal Ecosystems Including Ecosystem
Valuation, e.g. Mangroves, Coral Reefs, Seagrass and Wetlands

第1日目 12月12日(火) (Day 1 - Tuesday 12 December 2000)

座長 スパチット・モノピモケ Chairman : *Supachit Manopimoke*

- 14 : 00-14 : 25 「瀬戸内海における沿岸域環境資源の保存と回復
盛岡 通 (大阪大学大学院工学研究科環境工学科、教授)
Conservation and Restoration of Coastal Environment Resources in the Seto
Inland Sea, by *Tohru Morioka*, Japan
- 14 : 25-14 : 50 「韓国における沿岸域の持続可能な管理に向けて」
ナム・ジェンゴ (韓国海事研究所)
Towards the Sustainable Management of Coastal Areas in Korea, by *Jungho
Nam*, R. Korea
- 14 : 50-15 : 15 「インドネシア東部における共同体を基盤とした管理「サジ」の復活」
アグス・ヘリ・ブルノモ (農業・社会・経済センター、インドネシア)
Refashioning Sasi, a Community-based Management in Eastern Indonesia,
by *Agus Heri Purnomo*, Indonesia
- 15 : 15-15 : 45 休憩
Coffee break
- 15 : 45-16 : 10 「カンボジア・コーコン県のペアム・クラサオップ自然保護地域におけるマング
ローブ資源の参加型管理に関する技術レポート」
キム・ノン (カンボジア環境省)
Technical Report on Participatory Management of Mangrove Resources in
Peam Krasaop Wildlife Sanctuary, Koh Kong Province, Cambodia, by *Kim
Nong*, Cambodia
- 16 : 10-16 : 35 「ベトナムにおける海洋保護域の状況と将来」
ヴォ・シ・チュアン (海洋学研究所、ベトナム)
Status and Prospective of Marine Protected Areas in Viet Nam, by *Vo Si
Tuan*, Viet Nam
- 16 : 35-17 : 00 「タイにおける沿岸域統合管理の推進」
チュニ・スリスアクチャイラク (国連環境計画 RRC-AP、アジア工科研究所)
Enhancement of integrated Coastal Zone Management in Thailand : institutional
Aspects, by *Tunnie Srisakulchairak*, Thailand

第2日目 12月13日(水) (Day 2 - Wednesday 13 December 2000)

座長 盛岡 通 Chairman : *Tohru Morioka*

- 09 : 00-09 : 25 「ブルネイ・ダルサラーム国の海洋生態系の社会経済的重要性」
サブリ・ハジ・モハメッド・タハ (ブルネイ・ダルサラーム漁業省漁業局)
The Socio-economic Importance of the Marine Ecosystems of Brunei Darussalam,
by *Sabri Haji Mohd. Taha*, Brunei Darussalam
- 09 : 25-09 : 50 「メコン川河口域におけるマングローブの持続可能な管理のための解決策に関す
る考察」
ヴォ・トリィ・チュング (森林資源・環境センター、ベトナム)
How and What Solutions for Sustainable Management of the Mangroves in
Mekong River Estuaries, by *Vo Tri Chung*, Viet Nam

- 09 : 50-10 : 15 「沿岸域及び海洋環境におけるASEANの国際協力」
ケスラット・スカサム（ASEAN事務局、環境担当上級職員）
ASEAN Co-operation on Coastal and Marine Environment, by Kesrat Sukasam, ASEAN Secretariat
- 10 : 15-10 : 35 休憩
Coffee Break
- 10 : 35-12 : 30 グループ討議
Group discussion

2 立法と政策の分科会 PROGRAMME FOR SESSION 2

沿岸海洋生態系の保護と管理のための法律上の要件と関係
Legal Requirements and Implications for Protection and Management of Coastal Marine Ecosystems

第1日目 12月12日(火) (Day 1 - Tuesday 12 December 2000)
座長 ロバート・ベックマン Chairman : Robert Beckman

- 14 : 00-14 : 25 「生物多様性条約のジャカルタ・マンドートおよび東アジア海域におけるその実施」
イナ・ビナリ・プラノト*、ザイナル・アリフィン**
（*国家環境省、インドネシア、**海洋学研究開発センター-LIPL、インドネシア）
The Jakarta Mandate of the Convention on Biological Diversity and its Implementation for the East Asian Seas Region, by Ina Binari Pranoto, Indonesia
- 14 : 25-14 : 50
Legal Requirements and Implication on Protection of Coastal Ecosystem, by Qiulin Zhou, China
- 14 : 50-15 : 15 「韓国における沿岸海洋生態系の保護と管理の法的枠組み」バン・タエ・ジン
（海洋環境部、海事問題・漁業省、韓国）
Legislative Framework for the Protection and Management of Coastal Marine Ecosystems in Korea, by Taejin Bang, Korea
- 15 : 15-15 : 45 休憩
Coffee break
- 15 : 45-16 : 10 「沿岸域海洋生態系の保護と管理に関するミャンマーの環境関連法と規制の役割問題と制約」
ウ・ウィン・ラット（養殖開発と環境コンサルタント、アクアボンド社）
The Role of Myanmar's Environment Related Laws and Regulations in Protection and Management of Coastal Marine Ecosystems : Issues and Constraints, by U Win Latt, Myanmar
- 16 : 10-16 : 35 「日本における沿岸管理システムと生態系保護」
荏原 明訓（神戸学院大学法学部）
Coastal Management System and Ecological Preservation in Japan, by Ebara Akinori, Japan

16 : 35-17 : 00

「カンボジアの沿岸域・海洋環境の現状「新規政策と管理戦略」」
ヴァン・モニネス（沿岸域調整機構長官、ナショナルコーディネーター沿岸域環境管理－カンボジア計画、環境省、カンボジア）
The Status of Cambodia's Coastal and Marine Environment : "Emerging Policies and Management Strategies", by Vann Monyneath, Cambodia

第2日目 12月13日(水) (Day 2 - Wednesday 13 December 2000)

座長 ヴァン・モニネス Chairman : Vann Monyneath

09 : 00-09 : 25

「沿岸海洋システム利用における軋轢：タイ」
スラポル・スダラ（チュラロンコン大学海洋科学部、タイ）
Conflict in Coastal Marine Systems Utilization : Thailand, by Suraphol Sudara, Thailand

09 : 25-09 : 50

「社会・経済・文化的観点から見たタム・ギアン・ラグーンの生物資源管理」
トン・タット・パプ（フエ科学大学生物学部、ベトナム）
Management Biological Resources in Tam Giang Lagoon from a Socio-Economic Cultural Viewpoint, by Ton That Phap, Viet Nam

09 : 50-10 : 15

休憩
Coffee Break

10 : 15-10 : 35

「マングローブを過小評価する途上国政府」
J.E. オング*、W.K. ゴング&H.C. チャン（マレーシア大学海洋・沿岸研究センター・政策研究センター）
Governments of Developing Countries Grossly Undervalue Their Mangroves? by Ong Jin Eong, Malaysia

10 : 35-11 : 00

「マレーシアにおけるマングローブ資源の保全と開発と管理問題と挑戦と機会」
タン・キム・ホイ*、モード・ニザム・バシロン（マレーシア海事研究所、沿岸・海洋研究センター）
Conservation, Development and Management of Mangrove Resources in Malaysia - Issues, Challenges and Opportunities, by Tan Kim Hooi, Malaysia

11 : 00-12 : 30

グループ討議
Group discussion

3 科学の分科会 PROGRAMME FOR SESSION 3

**沿岸海洋生態系の保護と管理のための科学的及び技術的理解
Scientific and Technical Understanding for Protection and Management of Coastal Marine Ecosystems**

第1日目 12月12日(火) (Day 1 - Tuesday 12 December 2000)

座長 ジャエ・リョン・オウ Chairman : Jae Ryoung Oh

14 : 00-14 : 25

「タイ湾における海洋の状態の季節的変動」
柳 哲雄（九州大学応用力学研究所）
Seasonal Variation of Oceanic Condition in the Gulf of Thailand, by Tetsuo Yanagi, Japan

14 : 20-14 : 50

「南シナ海の資源の減少は回復可能か？持続可能な管理へのアプローチ」
E.D. ゴメス（フィリピン大学海洋化学研究所）
Is the Degradation of Resources in the South China Sea Reversible? : Approaches to Sustainable Management, by Edgardo Gomez, Philippines

- 14 : 50-15 : 15 休憩
Coffee Break
- 15 : 15-15 : 45 「沿岸域のダイナミックな環境の監視と分析におけるRSとGIS技術の利用」 ジェ・チェン*、チャオヤン・ファン、リシン・ファン（青島海洋大学リモートセンシング研究所、中華人民共和国）
Use of Remote Sensing and GIS Technology in the Monitoring and Analysis of Coastal Dynamic Environment, by Ge Chen, China
- 15 : 45-16 : 10 「タイ湾における汚染問題」
ピアムサック・メナスヴェタ（チュラロンコン大学科学部海洋科学科、タイ）
Pollution Problems in the Gulf of Thailand, by Piamsak Menasveta, Thailand
- 16 : 10-16 : 35 「沿岸生態系の保護における法的要件およびその含意 中国の事例」
リアンミン・ファン（中国科学アカデミー南シナ海海洋研究所）
Legal Requirements and Implications on the Protection of Coastal Ecosystems - A Case in China, by Liangming Huang, China
- 16 : 35-17 : 00 「パール河口域でのプランクトン生態系の最大汚濁域の動的課程の影響に関する予備研究」
ジアピン・ファン（中国科学アカデミー南シナ海海洋学研究所）
Preliminary Study on The Effect of Dynamical Processes of The Maximum Turbidity Zone on Plankton Ecology in The Pearl River Estuary, by Xiaoping Huang, China

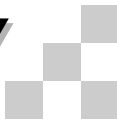
第2日目 12月13日(水) (Day 2 - Wednesday 13 December 2000)

座長 E.D.ゴメス Chairman : **Edgardo Gomez**

- 09 : 00-09 : 25 「韓国の沿岸域環境における有機スズの影響」
ジャエ・リョン・オウ*、ウォン・ジュン・シム（韓国海洋研究開発研究所（KORDI））
Effects of Organotins in the Coastal Environment of Korea, by Jae Ryoung Oh, Korea
- 09 : 25-09 : 50 「香港と中国における藻場の保全と管理の困難さ」
フォン・チン・ワイ（環境資源管理、香港）
Difficulties of Seagrass Conservation and Management in Hong Kong and China, by Fong Ching Wai, Terence, Hong Kong, China
- 09 : 50-10 : 15 「SEAMCAT：東アジア海洋沿岸生態系の保全と管理支援のためのメタデータカタログ」
ジュディス・カークマン（チュラロンコン大学環境研究所東南アジアSTART地域センター）
SEAMCAT : A Metadata Catalogue to Assist the Conservation and Management of East Asian Marine Coastal Ecosystems, by Judith Kirkman, START Regional Center
- 10 : 15-10 : 35 休憩
Coffee Break
- 10 : 35-11 : 00 「岩礁修復、保全、設置のための珊瑚苗床」
ウォルフ・ヒルバーツ（ISPMCME）
Biorock Coral Nurseries for Reef Restoration, Conservation, and Initiation, by Wolf Hilbertz, ISPMCME
- 11 : 00-12 : 30 グループ討議
Group discussion



開会式あいさつ Opening Ceremony



[ウィロー・パオイン副首相]

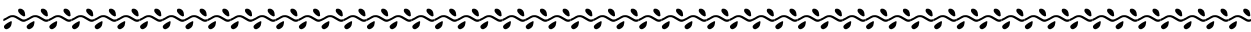
日本国大使赤尾閣下、参加者の皆様、ならびに会場の皆様。

タイ国政府を代表致しまして、このシンポジウムの開会を宣言できますことはこの上ない喜びでございます。冒頭にあたりまして、関係各機関、各地域センター、各組織の皆様、特に国連環境計画、財団法人国際エメックスセンター、チュラロンコン大学、タイ海洋政策及び回復に関する委員会（The Thai Marine Policy and Restoration Committee）、タイ科学技術環境省環境政策計画局（OEPP）、東南アジア海洋法・政策・管理プログラム（SEAPOL）の皆様方に対し、このシンポジウム開催に際し、ご尽力ならびにご協力を頂きましたことを感謝申し上げます。このシンポジウムは、沿岸海洋生態系の保

護と適切な管理により、沿岸資源の合理的な利用と持続可能な発展を目指す重要な一歩でございます。タイ国政府は常にこれらの活動に注目しているということを、皆様方にお知らせしておきたいと思えます。皆様方にはこのシンポジウムだけでなく、サイド・エンタテインメントの活動にも参加し、楽しいひと時を過ごされますよう祈ってやみません。このシンポジウムが成功のうちに終わりますように、お祈り申し上げます。ありがとうございました。

[赤尾信敏大使]

ウィロー副首相閣下、アンドリュース国連環境計画アジア太平洋地域所長、ご来賓の皆様ならびに会場の皆様。この沿岸海洋生態系に関する国際シンポジウムの開会にあたり、皆様方に奉仕できますこと



[Mr. Pao-In]

His Excellency, Mr. Akao, from Japanese Embassy, participants, Ladies and Gentlemen. On behalf of the Thai government, I am pleased to open this symposium. I would like to congratulate these agencies, regional centres, and organizing bodies: the United Nation Environment Programmes, International Centre for Environment Management on Enclosed Coastal Sea, EMECS, Chulalongkorn University, Thai Marine Policy and Restoration Committee, Office of the Environment Policy and Planning, and South Eastern Asian Programme on Ocean Law, Policy and Management, for the cooperative efforts in organizing this symposium. This symposium marks important step to rational use of coastal resources and sustainable development by means of protection and proper management of marine

coastal ecosystem. Please note that the Thai Government always keeps eye apparently to these activities. I sincerely hope that the participants will enjoy this symposium and that they may find time to enjoy activities of side entertainment as well. I wish this symposium will be successful. Thank you.

[Mr. Akao]

Thank you very much, Your Excellency, Deputy Prime Minister Mr. Viroj, Mr. Andrews, Regional Director of UNEP, guests, ladies and gentlemen. It is my pleasure to serve you as opening of the International Symposium on Protection and Management of Coastal Marine Ecosystems. The symposium has been sponsored by UNEP, International EMECS Centre in Japan, with close cooperation of the Government of Thailand,

はこの上ない喜びでございます。このシンポジウムは国連環境計画、日本の財団法人国際エメックスセンターが主催し、タイ国政府、チュラロンコン大学およびSEAPOLとの協力により開催されたものでございます。

まず最初に、お忙しいスケジュールにも関わらず、副首相閣下にご臨席の栄を賜りましたことに対して、心からの感謝の意を表したいと存じます。バンコクに住んでいる人なら誰でも知っていることですが、政治家、特に副首相のように政府や党の要職についておられる方は、現在選挙運動の真っ最中であり、大変忙しくしておられます。それにも関わらず、時間を割いてこちらに駆けつけて頂きましたことを大変感謝いたしております。

私は今日二つの点についてお話したいと思っております。まず最初に、東アジアの国際協力についてお話しします。このシンポジウムの参加者は主として東アジアの学者と専門家であり、中には若干の国際

機関からの出席者もいらっしゃいます。東アジアの政府間協力は、過去2年の間に着実に増加しており、特にちょうど1年前のマニラでの国家元首・政府首脳会議を期に進展しております。そのとき国家元首・政府首脳の方々が、様々な分野において協力を強化していくことを決めました。これには、経済、貿易、政治、人材開発、文化の分野が含まれております。そのとき環境の分野については、特に言及はされませんでした。しかしながら、環境の保護と保全なくしては経済開発は意味をなしません。それゆえ、私は環境保護もかならず東アジア国際協力の主要な議題となるものと確信しております。この意味におきまして、私は本日そして明日のシンポジウムが東アジア諸国間の将来にわたる協力の礎になるものと考えております。

第二点といたしまして、議論自体の内容に関してお話し申し上げます。太平洋周辺諸国の人口の60%以上が沿岸地域に居住しています。沿岸地域開発の

Chulalongkorn University, and SEAPOL.

At this point, I particularly would like to express sincere gratitude to Deputy Prime Minister for coming to this session, in spite of his very busy campaign. As everybody living Bangkok knows that politicians, particularly somebody at high post in government or party like Deputy Prime Minister must be very busy because he is in the midst of election campaign, but we are very grateful for his taking some time to come here.

I have two points that I want to say today. One is the East Asian Cooperation. This symposium is attended by scholars and experts primarily from East Asia, some from International Organisations. East Asian cooperation at government level has been steadily increasing in particularly last two years, starting from the head of states and governments meeting which took place in Manila just one year ago. The head of states and governments at that time committed themselves

to strengthen their cooperation in various areas: economic area, trade area, political area, human resource development, and cultural area. They didn't specifically mention environmental area but without protection of environment and conservation, economic development doesn't have a meaning therefore I am sure that environmental protection will also emerge as one of the major subject of such East Asian cooperation. In that sense, I think today's and tomorrow's symposium here is to set a good stage for future cooperation of East Asian countries.

Secondly, for the substance of discussion itself, more than 60% of the population of Pacific Ocean region lives in coastal areas. As a result of increasing pressure to develop coastal areas, there are many reports that coastal regions and marine ecosystem have been destroyed at alarming rate. There are also warnings about the danger of rise in sea level due to global warming. Therefore a response from global basis will

圧力が増した結果、沿岸地域と海洋の生態系の破壊が極めて深刻化しているという報告がなされています。また地球温暖化による海面上昇の危機に対する警告も出されております。それゆえ、このような問題の解決のためにグローバルな対応が必要となってきております。このような理由から、沿岸地域を共有する東アジア諸国は、より一層広範な協力を促進し、情報交換を進めて行かなければなりません。日本国政府は、環境保護と保全の分野において、国際協力を促進する用意があり、それには沿岸海洋生態系の保護と管理が含まれております。日本国政府は、政府開発援助（ODA）の供与に際して、沿岸保護を含む環境の保全を優先するようになってきております。このような状況のもとで、財団法人国際エメックスセンターが国連環境計画とともに、このバンコクの地において、本日そして明日、シンポジウムを開催いたしますことは大変時宜にかなったことでございます。

このシンポジウムでは、それぞれのセッションのテーマは、この地域において長きにわたり存在する問題を浮き彫りにしています。それは海洋生態系の社会経済的重要性、沿岸海洋生態系の保護と管理の法的要件およびその言外の意味、ならびに沿岸海洋生態系の保護と管理のための科学的・技術的理解でございます。この場におきまして、本日そして明日、報告者と参加者の間で情報と意見の交換がおこなわれますが、これにより東アジア諸国の密接かつ広範囲にわたる関係を構築することができるようになることが期待されております。将来において、東アジア地域において沿岸海洋生態系に関する、さらにグローバルなネットワークを構築する動きが高まることを私は希望しております。また、沿岸資源の有効利用と持続可能な発展の要となる、沿岸海洋生態系の保護と管理の重要性に対する認識が高まることも期待しております。このシンポジウムのような活動を通じて、これらの目標の達成に必要なパート



be needed to resolve these problems. For this reason, greater efforts to promote wide ranging cooperation and exchanging of information in this field are needed by East Asian countries which share common coastal region. The Government of Japan is prepared to promote international cooperation in the area of environment protection and conservation including the protection and management of coastal marine ecosystems. The Government of Japan has been shifting its priority in the provision of its Official Development Assistance more in favour of conservation of environmental protection including coastal protection. Under these circumstances, it is indeed timely that International EMECS Centre has joined with UNEP in sponsoring the symposium in Bangkok today and tomorrow.

The themes of individual sessions for this symposium reflect long standing problems in this region, that is the social economic importance of marine ecosystems, legal requirement and implications

for protection and management of coastal marine ecosystems, and scientific and technical understanding for the protection and management of coastal marine ecosystems. It is expected that exchanging the information and views among speakers and participants here today and tomorrow will contribute to the building cross and wide ranging relationships among the nations in East Asia. It is my hope that in future further progress will be made toward the formation of global-based network relating to coastal marine environment in East Asian region. I also expect that the awareness will be raised on the importance of protection and management of coastal marine ecosystems as a key element for the rational use of coastal resources and sustainable development. I wish the partnership which is needed to achieve these goals will be established through activities such as this symposium. Thank you very much.

ナーシップが構築されることを願ってやみません。
ありがとうございました。

[ニルマル・アンドリュース所長]

敬愛するウィロー・パオ・イン副首相閣下、赤尾信敏日本国大使閣下、寺畑建雄様、私の同僚であるカークマン氏、熊本教授、卓越した代表団の皆様、ならびに会場の皆様。本日、皆様方をこの極めて重要なシンポジウムにお迎えすることができますことは、この上ない喜びでございます。また、冒頭にあたりまして、環境という分野は、国境という政治的な区分があいまいになってきている分野ではなかろうかということを申し上げておきたいと存じます。万人の理解するところでは、特に大気や国際水域といった領域において、これら諸問題の越境的な性格がより明確になってきております。さらに、環境問題の多くの分野における挑戦に立ち向かうためには、多くの国々、主要な活動主体、ならびに利害関係者

がコンセンサスに基づいて採択し、受け入れることができる世界的な価値観が必要になってきております。

国際水域の問題につきましては、大気汚染に関する国連気候変動枠組み条約の問題に関して、世界が歩んできた道にそって発言をしたいと存じます。現在明らかになりつつあるのは、世界は多くの問題に非常に強い関心を払っているということでございます。最も重要なのはもちろん社会経済的な要因です。私はシンポジウムの一つのセッションが、全面的に社会経済問題、沿岸海洋生態系に関する諸問題にいかに関与力を行使するかというテーマに焦点を絞っていることを大変嬉しく思っております。1995年には世界は初めて陸上の活動による海洋汚染の問題を取り上げました。それ以来、より慎重で保守的な行動を取りながら、グローバルな計画を実行して行こうとするコンセンサスが生まれています。このグローバルな計画実施の行動は、今ではさらに後退してい

[Mr. Andrews]

Honourable Deputy Prime Minister, Mr. Viroj Pao-In, His Excellency, Mr. Nobutoshi Akao, the honourable ambassador of Japan in Thailand, Mr. Takeo Terahata, my colleague, Mr. Kirkman, Prof. Kumamoto, Distinguished delegates, ladies and gentlemen. I'll be most happy to welcome all of you to this very important seminar today. I am also urged to say that perhaps one area where the political demarcations provided by boundaries of countries become quite blur is the area of environment. We all see, more and more especially in the areas such as air and international waters, the trans-boundary nature of all these problems makes it more and more clear to everybody. And what is required to face up to the challenges in many such areas of environment is in fact a world view, which is acceptable, which is adopted through consensus by the countries, major groups, and by stakeholders.

I would like to say, as far as the question of

international water is concerned, exactly on the lines that world has proceeded on the question of the United Nations Framework Convention of the Climate Change put into air pollution. It is becoming more and more evident that there are number of things which the world is very very concerned about. The most, of course, significant one is the social-economic factor. I am very glad to see that one of the sessions is being devoted entirely for the social-economic factors, how to impinge on different issues concerning coastal and marine ecosystems. In 1995, the world first took up the question of land-based pollution of the oceans. There has been a consensus to go ahead with a more deliberate and more concertive action on the global planning action. The global planning action has receded much further now that the governments are absolutely resolute that the resolution has to be found, and they thought while we will see a lot of action on that front. In 1997, two years later, in the Rio+5, the

ますので、諸国の政府は解決を模索する決意を固め、この方面において数多くの活動がおこなわれるものと予想しております。2年後の1997年には、リオ＋5において、世界はリオプロセスの見直しという大きな出来事を経験しました。この会議では諸国の政府が集まり、どのような問題が発生しているのかを自ら決定し、調べようとしたが、会議出席者全員が一致して認めたのは、海洋の問題が最も重要な問題であるということでした。陸上の活動による海洋の汚染と同様に沿岸問題が扱われ、また船舶や海洋交通等による海洋汚染の問題も扱われました。全てが一つの問題、つまりどのようにして世界はこの問題に取り組むのか、ということに絞られました。これもまた、私が最初に特定の問題が国境を越えた問題であることを主張した時に、なぜその重要性を強調したかという理由であります。しかし、同時に多くのことが国家レベルでなされるべきであるという主張もあります。環境問題とは、まさにその解決

を地元で、また国境の内側で見出さなければならぬ問題なのです。しかし、この点は優れた代表であり、専門家である皆様方に、国際水域と沿岸海洋生態系に必要な国家の活動と国際活動の協働作業と統合をいかに成し遂げるか、というテーマでさらに議論を深めて頂かなければなりません。国連環境計画における私の同僚であり、名高い科学者であるヒュー・カークマン氏が過去数年にわたって、有能なチームと共に、南シナ海におけるジョイントプロジェクトやその他の活動を通して、これらの問題に継続的に取り組んでこられたことに誇りを感じております。

財団法人国際エメックスセンターはこの問題に対して非常に大きな関心を示していますが、私もこのシンポジウムが成功するものと確信しております。財団法人国際エメックスセンターと我々国連環境計画の過去の活動の経験は、日本国政府がこの問題に関心を寄せるのに貢献しました。私はこのことを喜

world also witnessed a great event, that was a review of the Rio process. At that meeting when the governments got together to decide for themselves and see what are the various emerging issues. The number 1 issue which everybody realised with paramount importance was the Oceans. The land-based pollution of oceans as well as the coastal issues, and, of course, the question of pollution within oceans from things such as ships, marine transports etc. All get down to one question, how does the world tackle these issues. That also brings me to the point why I did highlight the importance in my first point of trans-boundary nature of certain issues. There is also a point that many things have to be tackled at national level. The environment indeed is one area where the solution has to be found locally and within national boundaries. But this, I think, has to be further elaborated upon by the distinguished delegates and experts how asynergisation, how integration can bring about

between the national actions and international actions required for international waters and coastal marine ecosystems. I am very proud to say that my colleague within UNEP, Mr. Hugh Kirkham, a scientist with a great reputation, is continuously working with these issues and through joint projects in South China Sea as well as many other endeavours which has taken place last three, four years and his able team.

As well as what the great interest in this matter shown by the EMECS, I have no doubt this is going to be a successful seminar. The past experience of EMECS activities as well as our own have greatly encouraged the Government of Japan. I am one of those who are really happy, and this moment to say that, while in Japan, there is a reorganisation of ministries next year. Number of ministries has been downsized to make it more rational. I could be wrong, but I think a number of ministries that is finally going to be there is fourteen, and one of the ministry

ばしく思っている中の一人であり、今この場で、日本では来年省庁再編がおこなわれると言えるのを嬉しく思っています。省庁の数が合理化により減られるわけです。間違っているかもしれませんが、最終的に14の省庁が残り、そのうち、環境省だけが新たに設置されると聞いております。これはまた現在の環境庁が省に昇格することを意味しています。国連環境計画と環境問題、特に沿岸海洋生態系に関する事業への日本の多大なる援助と支援、そしてホスト国であるタイの支援に対して、私は国連環境計画の同僚と共に、感謝の意を表したいと思います。また私共はその支援がこれからも続くことを期待しております。我々は、このシンポジウムに引き続き、それに相応しい活動を実行していくこととお約束いたします。本日および明日の皆様方の討論が成功の内に終わり、将来の世界を導いて行くことができる成果が得られますことを待ち望んでおります。ありがとうございました。

[寺畑建雄副理事長]

ウィロー副首相閣下、アンドリュース国連環境計画アジア太平洋地域所長、日本国大使赤尾閣下、ならびに会場の皆様。

沿岸海洋生態系に関する国際シンポジウムの開会にあたり、ここバンコクのサイアム・シティ・ホテルで、皆様に一言申し上げることはこの上ない喜びでございます。私は、このシンポジウムを国連環境計画とともに主催します財団法人国際エメックスセンター副理事長でございます。

まず、ウィロー副首相並びにタイ海洋政策及び回復に関する委員会委員長閣下、日本国大使赤尾信敏閣下におかれましては、お忙しいスケジュールの中、このシンポジウムにご臨席賜りましたことを感謝申

is going to be the Ministry of Environment which is the only new ministry. That also means the appropriation of the Environment Agency of Japan to a ministry. Based on our experience of great assistance and support provided by Japan to all the work of UNEP as well as the work on environment, especially in coastal and marine ecology, as well as a great support that we find is from the host country, Thailand, I have this very happy moment to announce that my colleague from the UNEP and myself greatly appreciate the support, and we look forward to its continuous availability to us in the coming years. We, on our part, promise that this seminar will be followed up with the action that it deserves. I wish you all the success today and tomorrow in your deliberations and look forward to the results which no doubt can guide us in the future world. Thank you very much.

[Mr. Terahata]

Your excellency Mr. Viroj Pao-In, Deputy Prime Minister of Thailand; Dr. Nirmal Andrews, Regional Director and Representative of the United Nations Environment Programme, Your excellency Mr. Akao Nobutoshi, Japanese Ambassador to Thailand, and many other distinguished guests, ladies and gentlemen:

It's my great pleasure to say a few words to you here at the Siam City Hotel in Bangkok, upon the occasion of this International Symposium on Protection and Management of Coastal Marine Ecosystems. I am speaking to you as a representative of the International EMECS Center, the sponsor of the symposium together with the United Nations Environment Programme.

I would like to extend a special welcome to your excellency Mr. Viroj Pao-In, who, in addition to his position as Deputy Prime Minister, is also the chair

し上げます。

また、東南アジア諸国及び中国、韓国、日本からの発表者の皆様、並びにアセアン事務局や南東アジア海洋法・政策・管理プログラム (SEAPOL)、その他の国際機関の代表者の皆様、そして今日シンポジウムにお越し頂きました会場の皆様に感謝申し上げます。

国際エメックスセンターは、1994年11月に神戸で生まれました。その目的は、瀬戸内海やタイ湾、バルト海等の世界の閉鎖性海域における環境管理に新しい展望をもたらすことにあります。センターでは、「エメックス会議」として知られる世界閉鎖性海域環境保全会議を、1990年に神戸で、第1回会議を開催したのを皮切りに、引き続いて、1993年にメリー

ランド州ボルチモア、さらに1997年にスウェーデン・ストックホルム、そして1999年にトルコ・アンタルヤで開催することを通じ世界の科学者、研究者等のネットワークを構築してきました。センターでは又、調査事業やニュースレターの発行、ホームページの作成などを促進しています。さらに国際協力事業団の研修を実施し、今日、母国で活躍している多くの研修生を受け入れてきました。

これらの実績が認められて、この4月に財団法人国際エメックスセンターは日本の内閣総理大臣に認められた非営利団体となり、それによって一層の活動を促進することとなりました。当センターの活動については、配布しているパンフレットを見ていただければ幸いです。



of the Thai Marine Policy and Restoration Committee, as well as your excellency Mr. Akao Nobutoshi, the Japanese ambassador to Thailand. Thank you for taking time from your busy schedules to attend today's symposium.

I would also like to take this opportunity to again thank the speakers from the ASEAN nations, China, Korea and Japan. I would also like to welcome the representatives from the ASEAN secretariat, the Southeast Asia Programme in Ocean Law, Policy and Management (SEAPOL) and other international organizations. And finally, I would like to express my gratitude to all of you for coming to this symposium today.

The International EMECS Center was set up in the city of Kobe in November, 1994. Its purpose is to bring about new prospects for the environmental

management of the Seto Inland Sea, the Gulf of Thailand, the Baltic Sea and other enclosed or substantially enclosed coastal regions in the world. The Center has carried on the tradition of the first two International Conferences on the Environmental Management of Enclosed Coastal Seas, known as the EMECS conferences, held in Kobe in 1990, and in Baltimore, Maryland in 1993, by sponsoring the third EMECS conference in Stockholm, Sweden in 1997, and the fourth EMECS conference in Antalya, Turkey in 1999, and by working to create an international network of academic researchers. The Center also promotes survey activities and issues a newsletter, and has created a web site. In addition, the Center offers training courses for the Japan International Corporation Agency (or JICA) that accept many trainees from the nations represented here today.

In recognition of these activities, in April, 2000 the

国連環境計画と当センターのジョイントで主催するこのシンポジウムは、アジア・太平洋地域に焦点を当てた財団法人化後の最初の国際活動であります。この会議のテーマ、つまりは沿岸海洋生態系の保護と管理の問題解決のためには、異なる政治体制、社会条件を持つアジア・太平洋地域の国々が広域的な協力や情報交換を促進し、南は珊瑚海から北は日本海にいたる私たちが共有するアジアの沿岸地域における持続的な開発の展望を維持することが重要です。

このような状況のもとで、環境事業団地球環境基金の助成によって、国連環境計画とともにこのシンポジウムを主催することができますことは喜ばしい限りです。プログラムをご覧頂ければ、各分科会テーマがこの地域の長期的な問題を反映していることを

理解していただけたと思います。会場のみなさん!! 今ここに成功疑いなしのシンポジウムを当地バンコクで開催しますが、これが、将来エメックス会議をタイで開催するための布石、あるいは第一歩になるものと期待しております。こういった期待を胸に、財団法人国際エメックスセンターは、アジア地域における沿岸海洋環境に関する広域的なネットワークの構築やこの地域の国々との親密で広域的な関係構築を一層進めていきたいと思っています。

さらに、財団法人国際エメックスセンターは、第5回エメックス会議を11月19日から23日にかけて、神戸市内において開催します。会議の詳細の情報は、配布している第1回アナウンスメントをご覧ください。来年、皆様に神戸でお会いできることを楽しみ



International EMECS Center was granted approval by the Prime Minister of Japan to become a nonprofit foundation, an event which will aid the Center in further promoting its activities. We have distributed International EMECS Center pamphlets today, so please take a look at them to learn more about the Center's activities.

This symposium, organized jointly by the International EMECS Center and the United Nations Environment Programme, is the first international activity focused on The Asia-Pacific region to be undertaken by the Center since it became a nonprofit foundation. To resolve the theme of this conference, namely, the environmental problem of the protection and management of coastal marine ecosystems, it is crucial that the countries in the Asia-Pacific region with very different political systems and social and economic conditions, promote wide-ranging cooperation

and informational exchanges, and that they maintain the perspective of sustainable development in Asia, in which they share a common coastal region from the Coral Sea and South China Sea in the south up to the Sea of Japan in the north.

Under these circumstances, I am gratified that the International EMECS Center, through grants provided by the Japan Environment Corporation's Japan Fund for Global Environment, has organized this symposium in Bangkok, together with the United Nations Environment Programme. As you see in the Program, the session themes reflect the long-standing problems of the region. Now ladies and gentlemen! Now that we hold the sure-to-be-successful symposium here in Bangkok, I hope this symposium can pave the way for and develop into the EMECS Conference to be held in Thailand. With this hope in mind, the International EMECS Center will continue to work

にしています。

最後になりましたが、本日のシンポジウム開催にあたり、多大なご協力をいただきましたタイ政府、チュラロンコン大学、SEAPOLに感謝申し上げます。ありがとうございました。



for further progress in the construction of a wide-ranging network relating to coastal marine environments in the Asian region, and to build close and wide-ranging relationships with the countries in this region.

symposium a reality.

Thank you very much.

In addition, the International EMECS Center will sponsor the 5th EMECS Conference to be held from November 19th through November 23rd, 2001 in the city of Kobe, Japan. Detailed information on the conference is contained in the First Announcement that has been distributed to you. I very much look forward to seeing you all at the conference in Kobe next year.

Finally, I would like to express my deepest gratitude to the government of Thailand, Chulalongkorn University and the Southeast Asia Programme in Ocean Law, Policy and Management (SEAPOL) for their immense cooperation in helping to make today's

沿岸生態系の保護における法律の役割

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序 論

沿岸域生態系保護における法の役割は、グローバルな視野に立って考察しなければならない。1982年の国連海洋法条約や1992年の生物多様性条約といったグローバルな条約は、海洋および沿岸域環境とその生物多様性を保護・保全する法的枠組みを確立している。いくつかのグローバルな行動計画には、沿岸資源の持続可能な開発と保全のために、海洋環境の保護を目指す統合的・有機的視野にたったアプローチおよび統合地域管理と海洋保護区域といった管理手段の採用が必要である。他のグローバルな文書も、沿岸域生態系の保護について規定している。これら

文書には、ラムサール条約、世界遺産条約、UNESCO生物圏計画、IMO国際海事機構条約およびFAOの責任ある漁業に関する行動規範がある。本稿第1部では、これらの国際文書について検討し、沿岸域生態系との関わりを明らかにする。

多くの沿岸諸国は、グローバルな領域において必要とされるアプローチや行動計画を採択し、それらを実施することがきわめて困難であり、その原因が自国の制度上、法律上の問題にあると認識している。各国による沿岸域生態系のよりよい保護のために、グローバルな組織は様々なガイドラインを作成し、勧告を行ってきた。その中には、海洋保護区域の

THE ROLE OF LAW IN THE PROTECTION OF COASTAL ECOSYSTEMS

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INTRODUCTION

The role of law in the protection of coastal ecosystems must be viewed in its global context. Global conventions such as the 1982 UN Convention on the Law of the Sea and the 1992 Biodiversity Convention establish a legal framework governing the protection and preservation of the marine and coastal environment and its biological diversity. Several global programmes of action call for the adoption of an integrated holistic approach to the protection of the marine environment, and for the adoption of management tools such as Integrated Area Management and Marine Protected Areas in order to sustainably develop and conserve coastal resources. Other global instruments also provide for the protection of coastal ecosystems.

These instruments include the Ramsar Convention, the World Heritage Convention, the UNESCO Biosphere Programme, IMO Conventions and the FAO Code of Conduct on Responsible Fisheries. In the first part of this paper I examine these international instruments and explain their relevance to the protection of coastal ecosystems.

Many Coastal States find it extremely difficult to adopt and implement the approaches and action plans called for in the global area because of institutional and legal problems within their countries. Global organizations have issued guidelines and recommendations to enable States to better protect coastal ecosystems, including guidelines for establishing a legal framework for Marine Protected Areas. In the second part of this

法的枠組みを確立するためのガイドラインが含まれている。本稿第2部では、沿岸域諸国の制度的・法的問題および沿岸域生態系を保護するための法体系をいかに確立するかについてのガイドラインと勧告について説明する。

本稿第3部では、沿岸域生態系の保護に際して、地域協力の推進が必要あるいは望ましいものかについて考察する。まず最初に、東アジア海域における協力推進のモデルとしうる国連環境計画（UNEP）地域海域計画について概説する。さらに、地域協力の利点について考え、この地域の国々が地域海域条約および保護区域に関する議定書の採択を検討するように提言する。

海洋・沿岸域生態系保全のためのグローバル・レジーム グローバルな枠組みレジームと行動計画

1982年国連海洋法条約

国連海洋法条約（1982 UNCLOS）¹は1982年に採択され、1994年に発効した。2000年10月30日現在、同条約締約国は135カ国にのぼり、その中にはカンボジアとタイを除く東アジア海域のすべての国々が

含まれている。

国連海洋法条約は、沿岸域諸国が主権を主張する様々な種類の海域、およびその区域における沿岸域諸国の権利、管轄権および義務を定めた。本条約によって、沿岸域諸国には、12海里の領海と200海里の排他的経済水域を主張する権利が認められた。領海は沿岸国の主権に属するが、このような主権は、領海を航行するすべての国の船舶の権利を認めなければならない。沿岸国は、領海内の海洋および沿岸域環境の保全のために法令を制定することができるが、ここでもまた、領海の無害通航権を規制する権利に制限があることを認めなければならない。

200海里の排他的経済水域は、沿岸国の主権に属さない。この水域は「特別な法制度」に服し、沿岸国は同水域において生物資源や非生物資源の探査および開発をおこなうことができる。沿岸国には法令を制定する管轄権があるが、制定可能な法令は、生物資源および非生物資源の探査、および開発する権利に関連するものに限られている。他の国々には航行の自由および上空飛行といった伝統的な公海上の

paper I explain the institutional and legal problems in Coastal States, and the guidelines and recommendations on how they can establish a legal regime to protect coastal ecosystems.

In the third part of this paper I consider whether enhanced regional cooperation is necessary or desirable in the protection of coastal ecosystems. I first review the UNEP Regional Seas Programmes that might be used as models for further cooperation in the East Asian Seas region. I then examine the advantages of regional cooperation, and propose that States in this region should consider adopting a Regional Seas Convention and a Protocol on Protected Areas.

GLOBAL REGIMES TO CONSERVE MARINE & COASTAL ECOSYSTEMS

Global Framework Regimes and Action Plans

1982 UNCLOS

The 1982 United Nations Convention on the Law of the Sea (1982 UNCLOS)¹ was adopted in 1982 and entered into force in 1994. As of 30 October 2000, there were 135 Parties to the Convention, including all of the States in the East Asian Seas region except Cambodia and Thailand.

1982 UNCLOS established the types of maritime zones that can be claimed by Coastal States, as well as the rights, jurisdiction and obligations of Coastal States in the various zones. It gave Coastal States the right to claim a Territorial Sea of 12 nautical miles and an Exclusive Economic Zone of 200 nautical miles. The Territorial Sea is under the sovereignty of the Coastal State, but such sovereignty is subject to the right of ships of all States to pass through the Territorial Sea. The Coastal State has the right to pass laws and regulations to protect and preserve the marine and coastal environment within its Territorial Sea, subject to restrictions on its right to regulate ships exercising passage rights through its waters.

The 200 nautical mile EEZ is not under the sovereignty of the Coastal State. It is a 'specific legal regime' in which the Coastal State has the right to explore and exploit the living and non-living resources. The Coastal State has jurisdiction to pass laws and regulations only in so far as they are connected to its right to explore and exploit the living and non-living resources. Other States have the right to exercise traditional high seas freedoms in the EEZ, such as freedom of navigation and freedom of overflight. The

自由を排他的経済水域で行使する権利がある。沿岸国が排他的経済水域において他国船舶による汚染を規制するための法令制定権は、きわめて制限されている。

海洋および沿岸域の生物生息地と生態系の保全に関して、国連海洋法条約にはいくつかの重要な規定がある。まず、締約国は海洋環境を保護し、保全する一般的な義務を有するとされる。第2に、いずれの国もあらゆる発生源からの海洋環境の汚染を防止するため、利用することができる実行可能な最善の手段を使い、かつ自国の能力に応じ、すべての必要な措置をとらなければならない。第3に第194条(5)の規定であり、このような措置には、「希少又はぜい弱な生態系及び減少しており、脅威にさらされており、又は絶滅のおそれのある種その他の海洋生物の生息地を保護し及び保全するために必要な」ものが含まれる。

この規定は、海洋環境の保護および保全に際し、締約国は生態系アプローチを採らなければならないとした、本条約で唯一の規定である。

国連海洋法条約にはまた、権利の行使および義務の履行において、締約国は相互協力しなければならないとする幾つかの規定がある。南シナ海に面した国にとって最も重要な規定の一つが第123条である。この規定によると、半閉鎖海に面した国は、直接にまたは適当な地域的機関を通じて、次のことにつとめる。

- ・ 海域の生物資源の管理、保全、探査及び開発を調整すること
- ・ 海洋環境の保護及び保全に関する自国の権利の行使及び義務の履行を調整すること

アジェンダ21、第17章 (1992年)

リオ・デ・ジャネイロで開催された、「1992年球サミット」で採択された行動計画であるアジェンダ21²の第17章は、幾つかの点において重要な前進となった。

第一に、それにより明らかになった事実は、海洋および沿岸域資源の管理を目ざす最近のアプローチが、必ずしも持続可能な開発の達成を可能にするものではない点が明らかになった。さらに、世界の多

right of Coastal States to pass laws to regulate pollution from ships of other States in the EEZ is severely restricted.

With respect to the conservation of marine and coastal habitats and ecosystems, 1982 UNCLOS has several important provisions. First, it provides that States have a general obligation to protect and preserve the marine environment. Second, it provides that States have an obligation to take all measures as are necessary to prevent pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities. Third, it provides in article 194(5) that such measures :

shall include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life.

This is the only provision in 1982 UNCLOS which recognizes that States should take an ecosystem approach in protecting and preserving the marine environment.

1982 UNCLOS also has several provisions placing obligations on States to cooperate with each other in

the exercise of their rights and in the performance of their obligations. One of the most important as far as States bordering the South China Sea are concerned is Article 123. It provides that States bordering a 'semi-enclosed sea' shall endeavour, directly or through an appropriate regional organization :

- ・ to co-ordinate the management, conservation, exploration and exploitation of the living resources of the sea;
- ・ to co-ordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment.

Agenda 21, Chapter 17 (1992)

Chapter 17 of Agenda 21², the programme of action adopted by States at the 1992 Earth Summit in Rio de Janeiro, was a significant advance in several respects.

Firstly, it made it clear that current approaches to the management of marine and coastal resources have not always proved capable of achieving sustainable development, and that coastal resources and the coastal environment are being rapidly degraded and eroded in many parts of the world. (paragraph 17.4)

くの地域で沿岸域資源の状況や環境が急速に悪化し、蝕まれつつあるということも明らかになった。(第17節4)

第二は、このアジェンダが規制または統合的管理という体制を確立するためのアプローチを示唆しているという点である。その規定によると、各沿岸国は沿岸域と海洋地域およびその資源の統合的管理と持続可能な開発を目的とした適切な調整方法を、地域レベルおよび国家レベルで確立し、また必要とあらば、その方法の強化を考えなければならないということである。アジェンダはまた、統合的沿岸域管理と開発のための国別ガイドラインを作成するにあたって、締約国がこれまでの経験に鑑み、状況に応じて協力しなければならないと述べる。(第17節6)

第三に、小地域、地域間、地域もしくはグローバルな枠組みにおける国際協力や調整の役割は、沿岸域や海域での統合的管理および持続可能な開発を促進する沿岸国の努力を支援し、補うこととした。(第17節. 10)

第四に、アジェンダは、沿岸域の国が、国内管轄

権下にある、海洋生物の生物多様性と多産性および生息地を守るための措置を講じなければならないとした。これらの措置には、海洋生物多様性の調査、絶滅の危機に瀕している種および危機的状況にある沿岸域・海洋の生物生息地の調査一覧表、保護区域の設定と管理、科学研究の支援およびその成果の広報活動が含まれる。(第7節7)

1992年生物多様性条約

生物多様性に関する条約(生物多様性条約)は、1992年にリオ・デ・ジャネイロで開催された地球サミットで採択された。2000年12月5日現在、同条約の締約国は179カ国で、そのなかにはブルネイ・ダルサラーム、タイを除く東アジア海域のすべての国が含まれている。

生物多様性条約の目的は、生物の多様性の保全、その構成要素の持続可能な利用および遺伝資源の利用から生じる利益の公正かつ衡平な配分にある。生物多様性条約は、生物多様性のあらゆる側面に着目した、法的拘束力をもつ初めてのグローバルな包括的協定であり、この場合の多様性とは、種内、種間

Second, it suggested an approach for establishing a situation of governance or integrated management. It provided that each coastal State should consider establishing, or where necessary strengthening, appropriate co-ordinating mechanisms for integrated management and sustainable development of coastal and marine areas and their resources, at both the local and national levels. It also stated that States should cooperate, as appropriate, in the preparation of national guidelines for integrated coastal zone management and development, drawing on existing experience. (paragraph 17.6)

Third, it provided that the role of international cooperation and coordination within a subregional, interregional, regional or global framework, is to support and supplement national efforts of coastal States to promote integrated management and sustainable development of coastal and marine areas. (paragraph 17.10).

Fourthly, it provided that Coastal States should undertake measures to maintain biological diversity and productivity of marine species and habitats under national jurisdiction. These measures might include surveys of marine biodiversity, inventories of endangered

species and critical coastal and marine habitats; establishment and management of protected areas; and support of scientific research and dissemination of its results. (paragraph 7.7)

1992 Biodiversity Convention

The 1992 Convention on Biological Diversity (Biodiversity Convention) was adopted at the Earth Summit in Rio de Janeiro in 1992³. As of 5 December 2000, 179 States were Parties to the Convention, including all of the States in the East Asian Seas Region are Parties except Brunei Darussaleem and Thailand.

The objectives of the Biodiversity Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The Biodiversity Convention is the first global, legally binding comprehensive agreement to address all aspects of biological diversity : genetic resources, species, and ecosystems. It establishes a proactive, holistic, cross-sectoral and ecosystem-based approach to conserving and sustainably using their biological resources.

The Biodiversity Convention establishes a framework of general obligations that Parties are obligated to

および生態系の多様性をいう。同条約は生物資源の保全と持続可能な利用のためのアプローチを確立したが、それは、生態系に基づき、積極的で有機的な、しかも分野の違いを超えたアプローチである。

生物多様性条約は様々な義務の枠組みを確立しており、締約国は国家レベルでさらに詳しく義務を制定していかなければならない。締約国は包括的、国家的な生物多様性戦略および行動計画を作成し、それを実施することが求められている。さらに次のことも求められている。つまり、締約国は自国の生物多様性を特定し、研究し、監視すること、保護区域を設定すること、生物多様性に対して重大な影響を及ぼす活動を規制もしくは管理すること、そして提案されているプロジェクトの生物多様性に対する影響を判断すること、である。同条約はまた、締約国が特別な措置を講じて、通常の資源の利用を守ると共に、地元先住民の共同体に残る知識、技術革新および慣習を保護するように求めている。生物多様性条約は、国家による条約の実施を助け、継続的な国際協力を促進するための国際的な構造を確立した。

国際的レベルでは、本条約に基づいて、締結国の条約実施を手助けするための制度が設けられている。その制度には、事務局、開発途上国への援助を行なう資金供与制度、情報センターおよび科学的問題と技術的問題に関する補助機関（科学上・技術上の助言に関する補助機関で、SBSTTAの名で知られている。）が含まれている。さらに同条約は、条約を批准したすべての締約国から成る締約国会議（COP）を設立した。COPの役割は条約の管理であり、目下のところ、年1回の会議を行って、条約の実施状況を検討し、実施を担保することである。

生物多様性条約は、国連海洋法条約により確立された法的枠組みおよび他の国際的文書との一貫性を保つように起草された。条約は、国連海洋法条約で具体化された海洋法に矛盾しないように、締約国は一貫して同条約を実施しなければならないと明確に規定している。

ジャカルタ・マンデート 1995)

生物多様性条約には、海洋および沿岸域における生物多様性の維持に関していかなる特定の規定も含

elaborate in more detail at the national level. Parties are required to develop and implement comprehensive national biodiversity strategies and action plans. Parties are also required to identify, research and monitor their biodiversity; to establish protected areas; to regulate or manage activities with significant adverse effects on biodiversity; and to conduct assessments of the biodiversity impacts of proposed projects. The Convention also requires Parties to take special measures to protect customary resource uses, and the knowledge, innovations and practices of local and indigenous communities.

The Biodiversity Convention establishes an international structure to support national implementation and to promote continued international cooperation. At the international level, institutional mechanisms are set up under the Convention to assist the Parties in their implementation efforts. The institutional mechanisms include a Secretariat, a financial mechanism to provide assistance to developing countries, an information clearinghouse, and an advisory body on scientific and technical matters (known as the Subsidiary Body on Scientific, Technical and Technological Advice, or SBSTTA). In addition, the Convention established a

Conference of the Parties (COP) comprised of all the States that have ratified the Convention. The COP serves as the Convention's governing body, and currently meets once a year to review and strengthen implementation of the Convention.

The Biodiversity Convention was drafted so as to be consistent with the legal framework established in 1982 UNCLOS and with other international instruments. It expressly provides that Parties shall implement it consistently with the law of the sea, which is embodied in 1982 UNCLOS.

The Jakarta Mandate (1995)

The Biodiversity Convention does not contain any specific provisions on the conservation of marine and coastal biodiversity. At their second Conference of Parties (COP) in Jakarta in 1995, the Parties agreed on a programme of action for implementing the Biodiversity Convention with respect to marine and coastal biodiversity. This programme is referred to as the Jakarta Mandate on Marine and Coastal Biodiversity, or "The Jakarta Mandate".⁴

The Jakarta Mandate recommended a "checklist" of actions that Parties should take to fulfill their obligations under the Biodiversity Convention in marine

まれていない。1995年にジャカルタで開催された第2回締約国会議（COP）において、締約国は、海洋および沿岸域における生物多様性に関する生物多様性条約実施のための行動計画に合意した。この計画は、「海洋および沿岸域における生物多様性に関するジャカルタ・マンデート」あるいは「ジャカルタ・マンデート」と呼ばれている。

ジャカルタ・マンデートは、海洋および沿岸域環境において、生物多様性条約上の義務を履行するために、締約国がとるべき行動の「チェックリスト」を勧告した。勧告のテーマは特に5つの分野に及んでいる。すなわち、海洋および沿岸域の統合的管理、養殖、異種、海洋生物資源および海洋保護区域である。海洋・沿岸域生物生息地の保護に最も関連が深い2つの分野は、海洋および沿岸域の統合的管理（IAM）と海洋保護区域（MPA）である。

ジャカルタ・マンデートは、海洋および沿岸域における生物多様性に対する人間の影響、さらにはこの生物多様性の維持と持続可能な利用という問題に取り組むうえで最もふさわしい枠組みとして、IAM

の活用を奨励した。IAMには、海洋および沿岸域での資源管理をめざす、分野の違いを超えて統合された調整的アプローチが含まれている。それはまた広範囲にわたる利害関係者に影響を及ぼし、その関係者の中には、地域、地方政府機関、連邦政府の機関、地域および先住民の共同体、非政府組織、そして民間組織が含まれている。ジャカルタ・マンデートは広範囲に及ぶ活動および脅威という問題に焦点を当てているが、それには森林伐採、農業、土地利用計画、産業活動、自治体の活動、漁業がある。

海洋および沿岸の保護区域（MPA）は、保護を目的として指定され、そこでは、保護目的達成のために、活動や資源利用が規制されている。資源利用と活動に対する制限の種類やレベルに応じて、様々なMPAが存在する。MPAについては本稿第2部において詳細に論じる。

地理的地域保全に関するグローバルな文書

海洋および沿岸域の生物生息地と生態系の保護に関するグローバルな制度でも、特定の地理的地域の保護・保全を目的とした多くのグローバルな文書が

and coastal environments. The recommendations cover, in particular, five thematic areas : integrated marine and coastal area management, mariculture, alien species, living marine resources and marine protected areas. The two areas that are of the most relevance to the conservation of marine and coastal habitats are Integrated Marine and Coastal Area Management (IAM) and Marine Protected Areas (MPAs).

The Jakarta Mandate encouraged the use of IAM as the most suitable framework for addressing human impacts on marine and coastal biodiversity and for promoting conservation and sustainable use of this biodiversity. IAM involves an integrated, cross-sectoral, and coordinated approach to managing marine and coastal resources. It is a process that involves a wide variety of stakeholders, including local, provincial and federal government agencies, local and indigenous communities, non-governmental organizations, and the private sector. It addresses a wide range of activities and threats, including logging, agriculture, land-use planning, industrial and municipal activities, and fisheries.

Marine and Coastal Protected Areas (MPAs) are areas that have been designated for protection, in

which activities and uses of the resources in the area are regulated to achieve conservation objectives. Many different categories of MPAs exist, based on the type and level of restrictions on resource uses and activities. MPAs will be discussed in more detail in the second part of this paper.

Global Instruments on Conservation of Geographic Areas

The global legal regime relevant to the protection of marine and coastal habitats and ecosystems also includes a number of global instruments designed to conserve and protect specific geographic areas.

1971 Ramsar Convention on Wetlands

The 1971 Convention on Wetlands of International Importance, Especially for Waterfowl, was adopted in Ramsar, Iran, on 2 February 1971. It is popularly referred to as the Ramsar Convention. The Ramsar Convention entered into force in 1975, and as of 27 November 2000, has 123 Parties⁵, including all of the States in the East Asian Seas Region except Brunei and Singapore. More than 1000 wetlands have been designated for inclusion in the List of Wetlands of International Importance (Ramsar Sites), covering some 73 million hectares.

存在する。

湿地に関する1971年ラムサール条約

「特に水鳥にとり国際的に重要な湿地に関する条約」は、1971年2月2日にイランのラムサールで採択された。この条約は一般にラムサール条約と呼ばれている。ラムサール条約は1975年に発効し、2000年11月27日現在、締約国5は123カ国で、その中にはブルネイとシンガポールを除くすべての東アジア海域の国が含まれている。1000以上の湿地が、国際的に重要な湿地（ラムサール・サイト）に係る登録簿に掲げられ、その総面積は7300万ヘクタールにおよぶ。

ラムサール条約の主な意思決定機関は、すべての締約国の代表からなる締約国会議である。UNESCOが本条約の寄託先であり、条約の運営は、「ラムサール事務局」として知られる事務局に委ねられている。事務局はスイスのグランドにある国際自然保護連盟・世界自然保護連合（IUCN-The World Conservation Union）の本部内に置かれている。事務局は、締約国会議および条約常任委員会の権限下で活動

をおこなっている。

条約の正式名を見れば、もともこの条約が、水鳥に生息地を提供するための湿地の保全と賢明な利用に重きをおいていたことがわかる。しかし、長年にわたり条約はその適用範囲を広げ、湿地の保全と賢明な利用に関わるあらゆる側面を対象とするようになり、さらに、生物多様性全般の維持と人間の共同体の福祉のために、湿地は極めて重要な生態系であると認識するにいたった。

東アジア海域の国々にある沿岸湿地には、ラムサール・サイトの指定を受けたものがあり、その中には以下の湿地が含まれている。

コー・カピクおよび提携諸島（カンボジア）
ドンチャイガン自然保護区（中国・海南省）
マイ・ポ沼沢およびインナー・ディープ・ベイ（中国・香港）
オランゴ島野生生物保護区（フィリピン・セブ島）
トゥバタハ・リーフ国立海洋公園（フィリピン）
スアン・トゥイ自然湿地保護区（ベトナム、ナムハ）
1972年世界遺産条約

The main decision-making body of the Ramsar Convention is the Conference of the Parties, which is comprised of delegates from all the Member States. UNESCO serves as Depositary for the Convention, but its administration has been entrusted to a secretariat known as the "Ramsar Bureau", which is housed in the headquarters of IUCN-The World Conservation Union in Gland, Switzerland. The Secretariat acts under the authority of the Conference of the Parties and the Standing Committee of the Convention.

The official name of the Convention reflects its original emphasis on the conservation and wise use of wetlands primarily to provide habitat for waterbirds. Over the years, however, the Convention has broadened its scope to cover all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well being of human communities.

Several coastal wetlands in countries in the East Asian Seas have been designated as Ramsar Sites, including the following : Koh Kapik & Associated Islets (Cambodia), Dongzhaigang Nature Reserve (Hainan, China), Mai Po Marshes & Inner Deep Bay (Hong

Kong, China), Olango Island Wildlife Sanctuary (Cebu, Philippines), Tubbataha Reefs National Marine Park (Philippines), and Xuan Thuy Natural Wetland Reserve (Nam Ha, Vietnam).

1972 World Heritage Convention

The Convention Concerning the Protection of the World Cultural and Natural Heritage is a UNESCO Convention that was adopted by the General Conference of UNESCO in 1972. It is popularly known as the World Heritage Convention.⁶ As of 1 October 2000, 161 States are Parties to the Convention, including all of the States in the East Asian Seas Region except Brunei Darussalam and Singapore.

The Convention covers both cultural heritage and natural heritage sites of outstanding value. Sites which can be designated as natural heritage sites under the Convention include sites with outstanding physical, biological, and geological features; habitats of threatened plants or animal species and areas of value on scientific or aesthetic grounds or from the point of view of conservation. The criteria for selecting natural heritage sites require that they be of sufficient size and contain the necessary elements to ensure the integrity of ongoing ecological and biological processes. For

世界の文化遺産および自然遺産の保護に関する条約は、1972年のUNESCOの総会で採択されたUNESCOの条約であり、一般には世界遺産条約6として知られている。2000年10月1日現在、161カ国が条約締約国となっており、その中にはブルネイ・ダルサラームとシンガポールを除く東アジア海域のすべての国々が含まれている。

条約の保護の対象となるのは、きわめて価値の高い文化遺産や自然遺産を持つ地域である。条約に基づいて自然遺産に指定されうる地域には、際立った地形学的、生物学的、地質学的特長を持つもの、絶滅の危機に瀕している動植物の種の生息地および学術上、保存上、または景観上の観点から見て、価値の高い地域が含まれる。自然遺産選定の基準は、その地域が十分の広さを持ち、生態的および生物学的プロセスの進行を担保するために必要な要素を含んでいることである。例えば、この基準に基づいて珊瑚礁として指定されるためには、海藻、マングローブあるいは近接する他の生態系が必要となろう。こうした地域の選定は、関係国の同意を得て、政府代表

からなる世界遺産委員会がおこなう。

本条約は、世界遺産一覧表に記載された文化遺産および自然遺産の保全を行なうための基金を設立している。この基金は、さまざまな種類の援助や技術協力のために使うことができ、その目的には、保護措置を立案するための専門的研究の実施、保全もしくは修復技術についての地元専門家の養成および自然公園保護のための機材の供与がある。東アジア海域においては、海洋および沿岸域の数カ所が世界遺産に指定されている。この中にはウジュン・クロン国立公園（インドネシア）、コモド国立公園（インドネシア）、トゥバタ・リーフ海洋公園（フィリピン）およびハ・ロング湾（ベトナム）がある。

UNESCO 人間と生物圏プログラム

人間と生物圏（MAB計画）は、法的拘束力のある条約に基づくものではない。これはいわば、研究および研修のための学際的計画の一つであり、その目的は、自然科学および社会科学において、生物圏資源の合理的利用と保全、さらには人間と環境とのグローバルな関係改善のための基盤作りにある。

example, the criteria may require that a coral reef designation should include seagrass, mangrove or other adjacent ecosystems. An international committee of government representatives selects the sites with the consent of the State concerned.

The Convention establishes a fund for the conservation of the cultural and natural sites on the list of World Heritage Sites. The fund can be used for various kinds of aid and technical co-operation, including the conduct of expert studies to plan conservation measures, the training of local specialists in conservation or renovation techniques, and the supplying of equipment for the protection of a natural park.

In the East Asian Seas Region, several sites in marine and coastal areas have been designated as World Heritage Sites. These include Ujung Kulon National Park (Indonesia), Komodo National Park (Indonesia), Tubbatha Reef Marine Park (Philippines), and Ha Long Bay (Vietnam).

UNESCO Man and the Biosphere Programme

The Man and the Biosphere (MAB) Programme⁷ is not based on a legally binding treaty or convention. It is an interdisciplinary programme of research and training intended to develop the basis, within the

natural and the social sciences, for the rational use and conservation of the resources of the biosphere, and for the improvement of the global relationship between people and the environment. The overall programme is guided by the MAB International Coordinating Council consisting of 34 Member States elected by the UNESCO General Conference. Programme activities are conducted in more than 100 countries under the direction of their MAB National Committees or focal points.

Biosphere Reserves include terrestrial as well as coastal and marine ecosystems. Biosphere Reserves are areas where, through appropriate zoning patterns and management mechanisms, the conservation of ecosystems and their biodiversity is combined with the sustainable use of natural resources for the benefit of local communities. The programme for Biosphere Reserves includes relevant research, monitoring, education and training activities. Biosphere Reserves are intended as a tool for implementing the concerns of Agenda 21, the Convention on Biological Diversity and other international agreements.

The future development of the World Network of Biosphere Reserves is guided by the Strategy and

この計画全体の運営は、UNESCO総会で選ばれた34の加盟国からなるMAB国際調整協議会（MAB International Co-ordinating Council）によって行なわれる。計画に明記された活動は、MAB重点活動全国委員会（MAB National Committees or focal points）の指示に従って、100カ国以上で行われている。

生物圏保護区には、陸上、沿岸域および海洋の生態系がある。生物圏保護区とは、適切な線引きと管理機構によって、生態系とその生物多様性の保全が、地元共同体に有益な天然資源の持続可能な利用と一体化する地域である。生物圏保護区のための計画には、関連の研究、監視、教育および研修活動がある。生物圏保護区は、アジェンダ21、生物多様性条約およびその他の国際条約での関心事を実行するための手段とみなされている。

生物圏保護区的世界的ネットワークの将来は、1995年3月セビリャで開催された「生物圏保護区に関する国際会議」で作成された世界的ネットワークのための戦略的および法的枠組みによって決まる。

2000年11月現在、94カ国に391の生物圏保護区が存在した。一部の生物圏保護区は、全体あるいはその一部が、ラムサール・サイトもしくは世界遺産にも指定されている。東アジア海域の国々にある生物圏保護区で、以下に述べるものには沿岸域と海洋域が含まれている。ヤンチェン（中国）Nanji諸島（中国）、シャンコウ・マングローブ（中国）、コモド（インドネシア）、シベルト《Siberut》（インドネシア）、プエルト・ガレラ（フィリピン）、パラワン（フィリピン）、ラノング（タイ）およびカン・ギオ《Can Gio》マングローブ（ベトナム）。

その他の関連するグローバルな文書

陸上での活動から海洋環境を保護するためのグローバルな行動計画（1995年）（GPA）

陸上での活動から海洋環境を保護するグローバル行動計画（GPA）は、1995年9月にワシントンで開催されたグローバルな政府間会議で採択された。国連環境計画（UNEP）に授けられた任務は、調整のための努力を率先して行い、GPA調整事務所を設立することであった。GPAの包括的で多岐にわた

Statutory Framework for the world network drawn up at the International Conference on Biosphere Reserves held in Seville in March 1995.

As of November 2000 there were 391 biosphere reserve sites in 94 countries. Some Biosphere Reserve sites are also wholly or partially Ramsar sites or World Heritage sites. The following Biosphere Reserve sites in States in the East Asian Seas Region include coastal and marine areas : Yancheng (China) Nanji Islands (China), Shankou Mangrove (China), Komodo (Indonesia), Siberut (Indonesia), Puerto Galera (Philippines), Palawan (Philippines), Ranong (Thailand), and Can Gio Mangrove (Vietnam).

Other Relevant Global Instruments

Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, 1995 (GPA)

The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) was adopted at a global inter-governmental conference in Washington in 1995.⁸ The United Nations Environment Programme (UNEP) was tasked to lead the coordination effort and to establish a GPA Coordination Office. The comprehensive,

multi-sectoral approach of the GPA reflects the desire of Governments to strengthen the collaboration and coordination of all agencies with mandates relevant to the impact of land-based activities on the marine environment.

The GPA is designed to be a source of conceptual and practical guidance to be drawn upon by national and/or regional authorities for devising and implementing sustained action to prevent, reduce, control and/or eliminate marine degradation from land-based activities.

One of the issues addressed by the GPA is Physical Alterations and Destruction of Habitat. The objective of the GPA on this issue is to :

- (a) Safeguard the ecosystem function, maintain the integrity and biological diversity of habitats which are of major socio-economic and ecological interest through integrated management of coastal areas;
- (b) Where practicable, restore marine and coastal habitats that have been adversely affected by anthropogenic activities.

The GPA suggests several actions, policies and measures that should be taken at the global, regional and national levels to address the issue of physical alteration and destruction of habitats. At the national

るアプローチは、陸上での活動が海洋環境に及ぼす影響についての指示をうけたあらゆる機関の協力と調整を強化したいという、各国政府の願いを反映したものである。

GPAは、陸上での活動による海洋環境の悪化を防止、減少、規制および/あるいは除去するために、持続的な活動を考え、実施するために、国および/または地域当局が作成する概念や実践に関する指針の基本とするために制定された。

GPAが取り組む問題の一つに、動植物生息地の物理的変化および破壊がある。この問題に関するGPAの目標は次のとおりである：

- (a) 沿岸域の総合的管理により、生態系の機能を保護し、社会経済上および生態学上のおもな関心事である、生物生息地の保全と生物多様性を維持すること
- (b) 実行が可能な場合は、人為改変的活動による悪影響を受けた海洋および沿岸域の生物生息地を回復すること

GPAは、動植物生息地の物理的改変および破壊

という問題に取り組むために、グローバルな規模で、地域でさらに国家で実施すべき幾つかの行動、政策、措置を提案している。国家について、GPAは、アジェンダ21第17章に従って、国家による活動、政策および対策には、沿岸域の統合的管理のための計画の作成、採択、実施が含まれなければならないとする。GPAはさらに、このような計画には以下の事柄が含まれなければならないとする。

- (a) 生物生息地の保全および生物多様性を維持するための、沿岸域における海洋保護区域の設定
- (b) 人間の活動によって、動植物が減少もしくは絶滅した沿岸域の生物生息地の回復

GPAはまた、この問題について地域レベルで行なうべき特定の活動について勧告する。GPAは、このような地域的行動には、危機的状況にある生物生息地の保護を目的とする、次のような地域的規模のアプローチの決定と採用が含まれなければならないと規定する。

- (a) 海洋および沿岸保護区域の地域的システム

level, the GPA recommends that the actions, policies and measures of States should include the formulation, adoption and implementation of programmes for integrated coastal area management, in accordance with Agenda 21, Chapter 18. The GPA further states that the programmes should include (a) the establishment of Marine Protected Areas in coastal areas to maintain the integrity and biological diversity of their habitats; and (b) restoration of coastal habitats that have suffered decline or loss as a result of human activities.

The GPA also recommends specific actions at the regional level to deal with this issue. It provides that regional actions should include formulation and adoption of regional-scale approaches to safeguarding critical habitats such as :

- (a) Regional systems of marine and coastal protected areas;
- (b) Regional programmes of action and protocols on important species and habitats.

FAO Code of Conduct on Responsible Fisheries

The Code of Conduct for Responsible Fisheries⁹ was unanimously adopted on 31 October 1995 by the FAO Conference. The Code provides a necessary

framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment and in a manner that is consistent with applicable global instruments. It is global in scope, and is directed toward members and non-members of FAO, fishing entities, subregional, regional and global organizations, whether governmental or non-governmental, and all persons concerned with the conservation of fishery resources and management and development of fisheries. It provides principles and standards applicable to the conservation, management and development of all fisheries.

The General Principles stated in the Code include two which are of particular relevance to the conservation of marine and coastal ecosystems and habits :

- All critical fisheries habitats in marine and fresh water ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas, should be protected and rehabilitated as far as possible and where necessary.
- Particular effort should be made to protect such habitats from destruction, degradation, pollution and other significant impacts resulting from

(a) 重要な種と生物生息地に関する地域的な行動計画および議定書

FAO責任ある漁業に関する行動規範

「責任ある漁業に関する行動規範」10は1995年10月31日に、FAOの会議において満場一致で採択された。この規範は、環境との調和をはかりつつ、適用可能なグローバルな文書に矛盾しない方法で、水生生物資源の持続可能な開発を確実にするための、国家的および国際的努力に必要な枠組みを規定する。同規範の範囲はグローバルであり、FAOの加盟国および非加盟国、漁業を行なう政治的実体（台湾を指す）、政府・非政府機関を問わず小地域、地域およびグローバルな機関、および水産資源の保全と漁業の管理と発展に関わるすべての個人に向けられている。同規範はすべての漁業の保全、管理および発展のために適用可能な原則と基準を規定している。

規範に述べられている一般原則には、特に、海洋および沿岸域の生態系と生物生息地の維持に関連する2つの原則が含まれている。

- ・ 海洋および淡水生態系にある、湿地帯、マング

ローブ、珊瑚礁、潟湖、養殖場および産卵場のような、すべての重要な漁業資源の生息地は、可能な限り、かつ必要な場合には、保護され回復されなければならない。

- ・ とりわけ、水産資源の健全性、生育能力を脅かす人間の活動に起因する破壊、劣化、汚染およびその他の重大な影響から、それらの生息地を保護するために努力が払われるべきである。

国際海事機関条約

国際海事機構（IMO）条約は、汚染による影響をうけやすい特定の地域において、船舶による油濁汚染の脅威を軽減するための様々な制度を確立する機会を沿岸国に与えている。IMO条約において、船舶に特別な規則が適用される2種類の海域が存在する。両方とも沿岸国が科学的・技術的証拠を提出した後にIMOが設定する。

第1の海域は、「船舶による汚染の防止のための国際条約73/78」²（MARPOL 73/78）に規定される「特別海域」である。この海域は次のように定義



human activities that threaten the health and viability of the fishery resources.

Conventions of the International Maritime Organization

The conventions of the International Maritime Organization (IMO) give Coastal States an opportunity to establish regimes in certain vulnerable coastal areas to reduce the threat of oil pollution from ships. Under the IMO conventions there are two types of areas that can be established where special rules will apply to ships. Both types are established by the IMO after the submission of scientific and technical evidence by the Coastal State.

The first is "Special Areas" under the International Convention on the Prevention of Pollution from Ships, or MARPOL 73/78.¹⁰ A Special Area under MARPOL 73/78 is defined as follows:

a sea area where, for recognized technical reasons in relation to its oceanographic and ecological condition and to the particular character of its traffic, the adoption of special mandatory methods for the prevention of sea pollution by oil, noxious liquid substances, or garbage, as applicable, is required.

Special Areas are provided with a higher level

of protection from such discharges from ships that other areas of the sea. Special Areas can be established by the IMO if it can be shown by scientific and technical evidence that they are vulnerable to pollution by discharges from ships, and that special mandatory measures of protection are required. Several areas, such as the Black Sea, Mediterranean Sea, Baltic Sea and the Wider Caribbean Area, have been designated by the IMO as Special Areas.¹¹

The second area where special IMO rules can apply to ships are Particularly Sensitive Sea Areas, or PSSAs. A PSSA is

an area that needs special protection through the IMO because of its significance for recognized ecological or socio-economic or scientific reasons and which may be vulnerable to damage by international maritime activities.

If an area is designated as a PSSA, "associated protective measures" may be ordered by the IMO. Associated protective measures are international rules and standards that are within the purview of the IMO which regulate international maritime activities for the protection of the area at risk. Examples of such measures are discharge restrictions, routing measures,

されている。

海洋学上および生態学上の条件並びに交通の特殊性に関連すると認められた技術上の理由により、石油、有毒液体または廃物による海洋汚染の防止のため、適用可能な場合、特別の義務的な方法を採用することが要求される海域

特別海域は他の海域に比べ、船舶からのこのような廃棄物から高度に保護されている。科学的・技術的証拠により、海域が船舶からの廃棄物による汚染の影響を受けやすいこと、そして保護のための特別な強制措置が必要であることが証明できる場合、IMOは特別海域を設定することができる。黒海、地中海、バルト海および大カリブ海域のような海域が、IMOによって特別海域12に指定されている。

船舶にIMOの特別な規則を適用できる第2の地域は、特別過敏海域（PSSA）である。PSSAの定義は次のとおりである：

条約が認める生態学上、または社会経済的あるいは科学的理由により、IMOによる特別な保護を必要とし、かつ国際的航海活動の被害を受けやすい可能性

のある海域

海域が特別過敏海域に指定されると、IMOが「関連保護措置」を発令することとなる。関連保護措置とは、危険にさらされている海域を保護するために、国際航海活動を規制するIMOの権限内の国際的規則および基準のことをいう。

このような措置の例として、廃棄物の制限、ルート設定措置、運行基準および禁止される活動の特定がある。これらの措置の内容は、個々のPPSAの必要性に応じて決定されなければならない。現在までに、2つの海域がIMOからPSSAとして指定されており、それはオーストラリアのグレート・バリア・リーフ海洋公園とキューバのサバナ・カマゲー群島の海域³である。

特別海域およびPSSAは、沿岸から12海里以遠にある、沿岸国の排他的経済水域内に位置する海洋保護区域にとって重要な制度である。海洋保護区域が特別海域もしくはPSSAの指定を受けなければ、船舶は、船舶による汚染防止および船舶航行の安全に関するIMOの通常の規則に従えばよいのだ。国連

operational criteria and prohibited activities. Such measures must be specially tailored to meet the needs of the particular PPSA. To date two areas have been designated by the IMO as PSSAs — the Great Barrier Reef Marine Park in Australia and the Sabana-Camaguey Archipelago in Cuba.¹²

Special Areas and PSSAs are important tools for Marine Protected Areas that are located beyond 12 nautical miles from the coast, in the EEZ of a Coastal State. Unless a Marine Protected Area is designated as a Special Area or PSSA, ships need only comply with the normal IMO rules on the prevention of pollution from ships and the safety of navigation of ships. Coastal States are not permitted under 1982 UNCLOS to impose regulations on ships in their EEZ which are stricter than the normal standards under the IMO conventions.

NATIONAL MEASURES TO CONSERVE COASTAL ECOSYSTEMS

Common Institutional and Legal Problems

Almost all of the global instruments discussed above call for an integrated, holistic approach to the conservation and management of marine and coastal resources. Unfortunately, the institutional framework

and legislation in many countries make such an integrated approach extremely difficult. Among the common problems with respect to laws and institutional arrangements are :

- (a) Most governments are organised along sectoral lines, with departments such as fisheries, agricultural, forestry, mining, transportation, tourism, industry, etc, and there is usually little integrated planning and coordination among the various sectors.
- (b) There are usually different laws and institutions governing marine areas and land areas, as well as fresh water resources and marine resources. Although the marine and land ecosystems in the coastal zone are closely interrelated, this is often not reflected in the law due to long-standing reasons founded on property law systems and institutional tradition.
- (c) There is often an overlap in the powers of the local, provincial and national governments with respect to planning and regulation of activities in the coastal zone. National governments are usually responsible for planning ocean space, and provincial and local governments are responsible for land use planning in the coastal zone.

海洋法条約に基づき、沿岸国は、排他的経済水域を航行する船舶に対して、IMO条約に基づく通常の基準よりも厳しい規制を課すことは許されない。

沿岸域の生態系維持のための国家による措置 各国に共通する制度的および法的問題

上述のグローバルな文書の大部分は、海洋および沿岸域における資源の保全と管理を目ざす統合的で有機的なアプローチを必要としている。残念ながら、多くの国の制度的枠組みと法律が、このような統合的アプローチの実現を極めて難しくしている。法律および制度的取り決めに関する各国に共通の問題には、以下に述べるようなものがある。

- (a) どの国の政府組織も縦割りに分野分けされ、漁業、農業、林業、鉱業、運輸省、観光、産業などの担当機関がおかれている。このため、通常は、さまざまな部門の間で統一的な計画立案や調整はほとんどおこなわれない。
- (b) 海洋と陸上、さらには淡水水産資源や海洋資源は、すべて異なる法律や制度で規律される。沿岸域の海洋生態系と陸上生態系は互いに密

接に関連しているが、この事実は財産法制度および制度的伝統に基づいた古くからの理由により、法律にあまり反映されていない。

- (c) 沿岸域での活動の計画と規制に関して、地元、地方および中央政府の権限はしばしば重複する。通常、中央政府が海域の利用計画の責任を負っており、地元および地方自治体が沿岸域の土地利用計画の責任を負っている。
- (d) 一部の国では、地元先住民の伝統的権利を含めて、沿岸域および海域の所有権や利用に関する深刻な問題が生じる場合がある。このため、沿岸域生態系の保全と管理を目的とした統合的で有機的なアプローチを取ることが難しくなっている。

要約すれば、多くの国で、沿岸域において制度的および法的混乱が存在するということである。さまざまなレベルの政府が制定する分野の異なる法令のモザイク状態が存在することが多々あり、それが沿岸域の土地、水域および資源に適用されている。また、これらの法令の執行責任を有する組織もさまざま



- (d) In some countries there may be serious issues with respect to the ownership and use of coastal land and marine areas, including traditional customary rights of local and indigenous peoples, that make it difficult to adopt an integrated holistic approach to the conservation and management of coastal ecosystems.

In summary, in many countries there is institutional and legal disorder in the coastal zone. There is often a mosaic of sectoral laws and regulations from various levels of government which are applicable to coastal land, waters and resources. There is also a range of institutions responsible for the implementation of these laws and regulations. This results in legislative overlaps, inconsistencies, gaps and uncertainties, as well as failures in the administration and enforcement of laws and regulations.

This situation makes it extremely difficult for States to adopt an integrated holistic approach to planning, conserving and managing resources and habitats and ecosystems in marine and coastal areas. Therefore, it is often very difficult for governments to actually implement the recommendations set out in the global instruments discussed above, even when they have

the political will to do so.

Legislative approaches for the conservation of ecosystems

Before new institutional and legal approaches to conservation of coastal ecosystems such as Marine Protected Areas can be adopted, it is usually necessary to do a thorough review of the existing legal and institutional framework in that country. The legal approach to take in a given country will depend in part on the existing institutional framework and laws, as well as on the country's culture, tradition and legal processes. Before adopting model legislation from other countries, it is important for governments to ensure that such legislation is consistent with the existing legal framework in their country, and that the new legislation being proposed can be effectively administered and enforced in their country.

Various approaches can be considered in order to conserve coastal habitats and ecosystems. Which approach is best for a particular country will depend upon its existing legislative framework and its legal traditions and procedures. Among

までである。この結果、法律の重複や一貫性のなさ、内容の食い違いやあいまいさだけでなく、法令の運用と執行に不備が生ずる。

こうした状況から、海洋および沿岸域の資源、生物生息地および生態系に関する計画立案、保全、管理を目的とした、統合的で有機的なアプローチを国家がとりづらくなっている。それゆえ、各国政府が実際に上記のグローバルな文書に述べられた勧告を実施することは、それをおこなおうとする政治的意思があるとしても、極めて困難であることが多い。

生態系保全のための立法的アプローチ

海洋保護区域のような、沿岸域生態系保護を目ざす新たな制度的および法的アプローチの採用が可能になる前に、通常その国の現行の法的および制度的枠組みを徹底的に検証することが必要となる。ある国がとるべき法的アプローチは、その国の文化、伝統および法的プロセス同様に、現行の制度的枠組みや法律にある程度左右されるものとなろう。モデルとなる他国の法律を採用する前に、各国政府がこのような法律と自国の現行の法的枠組みとの矛盾をな

くし、しかも提案される新たな法律を効果的に運用し、執行できるようにすることが重要である。

沿岸域生物生息地および生態系を保全するために、さまざまなアプローチが考えられる。どのアプローチが個々の国家にとって最適であるかは、現行の法的枠組み、法的伝統および手続きに依る。その選択肢としては以下のものが考えられる。

- (a) 特別な沿岸域管理立法
- (b) 特別な沿岸域保全規定を含む資源管理立法
- (c) 環境に関する一般的な法律における沿岸保全規定
- (d) 海事および漁業に関する法律における沿岸域保全規定
- (e) 沿岸水域に適用可能な土地利用計画法
- (f) 海洋に関する補足計画手続き
- (g) 公的な海事領域に対する特別な法制度

沿岸域生態系保全のための計画

沿岸域生態系の保全と持続可能な開発を計画するに際し、自然の残る地域と生態系の保護について規定することは極めて重要である。沿岸域の土地利用

the options are the following :¹³

- (a) special coastal management legislation;
- (b) resource management legislation with specific coastal conservation provisions;
- (c) coastal conservation provisions under general environmental legislation;
- (d) coastal conservation measures under marine or fisheries legislation;
- (e) land-use planning legislation that is applicable to coastal waters;
- (f) complementary planning procedures for the sea;
- (g) special legal regimes for the public maritime domain.

Planning for conservation of coastal ecosystems

It is critically important to provide for the protection of natural areas and ecosystems when planning the conservation and sustainable development of coastal ecosystems. When preparing strategic and local planning documents that define land use and occupation in the coastal area, competent public authorities must give priority attention to protecting sensitive sites and biological corridors. Coastal planning should define all areas important for conservation and precisely delimit sites to be protected in order to build a system

of protected areas within the broader context of coastal conservation and management.

It is important to consider what types of protected areas should be established. This will depend in part on the conservation objectives that are to be achieved in each area. When considering the management objectives of protected areas, it is useful to consider classification categories established by the IUCN World Commission on Protected Areas. The ICUN classifies protected areas into six management categories, according to their conservation objectives, as follows :¹⁴

- (a) Strict nature reserves or wilderness areas
- (b) National parks
- (c) Natural monuments
- (d) Habitat/species management areas
- (e) Protected landscapes/seascapes
- (f) Managed resource protected areas

The designation of sites to implement international conventions may also support coastal planning objectives. Governments should seriously consider the pros and cons of designating particular areas in the coastal zone as Ramsar Sites, World Heritage Sites or Biosphere Reserves. If sites are designated under such special international regimes, it may bring needed financial

と占有を規定する戦略的および地域的計画文書を作成する場合、権限ある公的機関は、環境悪化の影響を受けやすい地域や生物回廊の保護を優先しなければならない。沿岸域の計画立案では、保護区域制度を構築するために、沿岸域保全および管理という幅広い視野にたつて、環境保全に重要なすべての地域を指定し、保護の対象となる地域を厳密に画定しなければならない。

どのような種類の保護区域を設定しなければならないかを考慮することは重要である。保護区域のタイプは、それぞれの地域で達成されなければならない保全目的にある程度左右されるだろう。保護区域の管理目的を考える場合、国際自然保護連盟の世界保護区域委員会（IUCN World Commission on Protected Areas）が定めた分類が役に立つ。IUCNは、自らの定めた保護目的に従って、保護区域を以下17の6つの管理範疇に分類している

- (a) 厳密な自然保護区もしくは原生環境保全地域
- (b) 国立公園
- (c) 天然記念物

(d) 生物生息地/種の管理地域

(e) 景観保護地域/海域

(f) 管理資源保護区域

国際条約を実施する地域の指定が、沿岸域計画立案の目的を支援する場合もある。各国政府は、ラムサール・サイト、世界遺産地域もしくは生物圏保護地域として沿岸域の特定地域を指定することについて、賛否両論を真摯に考慮しなければならない。このような特別の国際的管理制度に基づいてサイトが指定された場合、必要な財政的および技術的援助がその国にもたらされる場合がある。しかし、海洋および沿岸域における保護区域の設定は、国際的に重要なサイトのみに限定されてはならない。保護区域は、国家および地域にとって重要な生物生息地のために設定されなければならない。

沿岸域生態系保全のための海洋保護区域の設定

海洋および沿岸域の生物生息地や生態系を保全するための海洋保護区域の設定を目ざす場合、各国は上述の幾つかの制度的・法的問題に取り組まざるを得ないだろう

and technical assistance into the country. However, the establishment of protected areas in marine and coastal areas should not be limited to the to internationally important flagship sites. Protected areas should also be established for habitats of national and local importance.

Establishing Marine Protected Areas to conserve coastal ecosystems

In order to establish Marine Protected Areas to conserve habitats and ecosystems in marine and coastal areas, States will have to address some of the institutional and legal problems discussed above.

First, jurisdictional problems will have to be addressed. In many countries the authorities competent to take regulatory conservation measures on land (e.g. nature conservation agency, provincial governments) often have no mandate or delegated authority to take complementary measures in maritime areas. It is therefore impossible to extend terrestrial protected areas beyond the high water mark or to enact protection measures for intertidal or marine habitats unless new legislation is enacted.

Second, there may be uncertainties relating to the ownership of the sites. If the sites are in private

hands, it may not be possible to guarantee their long-term protection through exclusively regulatory controls. It may be necessary to formalise long-term rights of public ownership over such sites and develop a mechanism to make ownership of such sites inalienable.

Third, there may be problems of a lack of secure title and control because of customary ownership and usage rights of local and indigenous peoples. Where customary law and practices are consistent with the goals and objectives of the MPAs, they should be recognised. Whenever possible, the local communities should be brought into the planning, management and enforcement processes for MPAs.

Fourth, there are likely to weaknesses or gaps in the legislation necessary to establish MPAs. Many countries have no legal basis for the establishment of MPAs or Biosphere Reserves. Therefore, new legislation will usually be required.

IUCN Guidelines on Developing a Legal Framework for MPAs

In 1999 the IUCN published GUIDELINES FOR MARINE PROTECTED AREAS, World Commission on Protected Areas, Best Practice Protected Area Guidelines Series No. 3 (Edited and coordinated by

第一に、管轄権をめぐる問題に取り組まなければならない。多くの国々では、土地保全のための規制措置決定権を有する当局（例えば、自然保護事務所や地方政府）が、海洋での補足措置を講じるだけの権限を委任もしくは委譲されていないことがよくある。それゆえ、新たな法律が制定されない限り、陸上保護区域を高水位線以遠にまで拡大したり、潮間あるいは海洋の生物生息地の保護策を制定することは不可能である。

第二に、その区域の所有権がはっきりしない場合がありうる。当該区域が私有地である場合、もっぱら規制での管理によって、長期的な保護の保証は難しいだろう。このような区域に対して、長期的な公的所有権を正式に設定し、所有権譲渡が不可能となるような制度が必要かもしれない。

第三に、地元原住民に習慣上の所有権と使用権があるために、安定した所有権の主張や管理ができないという問題が生じよう。慣習法や実行がMPAの目標や目的に合致する場合、これを承認しなければならない。可能な場合はいつでも、MPAのための

計画立案、管理および実施に、地元共同体を参加させるべきである。

第四に、MPA設定に必要な法律に問題点がありうる。多くの国々には、MPAもしくは生物圏保護区を設定するための法的基盤がまったく存在しない。それゆえ、通常は、新しい法律の制定が必要となる。

MPAのための法的枠組みの創設に関する国際自然保護連盟 (IUCN) のガイドライン

1999年にIUCNは、「海洋保護区域設定のガイドライン、保護区域に関する世界委員会、最高実践保護区域ガイドライン・シリーズNo. 3」を発表した。

(Graeme Kelleher編集・共著)。IUCNのガイドラインにより、MPAの法的枠組みの創設に関して、以下の勧告がおこなわれた。

1. 極めて大規模なMPAを設定するというアプローチをとる場合、それぞれのMPAを、個別の法律文書により創設するのか、MPA全般におよぶ包括的な法律により創設するのかを決定しなければならない。

Graeme Kelleher). The IUCN Guidelines made the following recommendations on developing a legal framework for MPAs :

- 1.If the approach of very large MPAs is chosen, decide whether each MPA will be created by a separate legal instrument or whether to create umbrella legislation for MPAs in general.
- 2.If the approach of a network of small MPAs is chosen, consider establishing them on the basis of community action, supported by legislation.
- 3.Whichever of the above options is chosen, a policy for conservation and management of the marine environment as a whole is needed. This may have to take a legal form.
- 4.Make sure that the legislation states explicitly that conservation is the primary objective of the MPAs.
- 5.Changing the primary objective should be decided only by recourse to the highest body responsible for legislative matters in the country.
- 6.Ensure the legal framework is consistent with the nation's traditions.
- 7.The legislation should take an international perspective.
- 8.The legislation should create the legal foundation for the institutions that will establish and manage

the MPAs.

- 9.The legislation should address directly the coordination and linkage with other bodies, especially in the management of the coast and of fishing rights.
- 10.Legislation should include provisions to control activities which occur outside an MPA and which may adversely affect features, natural resources or activities within an MPA.
- 11.National legislation should have the following attributes :
 - Use of terms
 - Management and Zoning Plans
 - Public participation
 - Preliminary research and survey
 - Research, monitoring and review
 - Compensation
 - Financial arrangements
 - Regulations
 - Enforcement, Incentives and Penalties
 - Education and Public Awareness

REGIONAL MEASURES TO CONSERVE COASTAL ECOSYSTEMS

UNEP Regional Seas Programme

UNEP's Regional Seas Programme was first

2. 小規模なMPAのネットワークを構築するというアプローチをとる場合、法律の後押しを受け、地域共同体の活動に基づいてMPAの設定することを考えなければならない。
3. 上記のいずれのアプローチを選んでも、全体としての海洋環境の保全と管理のための政策が必要である。このような政策は、法という形態をとらなければならないだろう。
4. MPA設定の主たる目的が保全にあることを、必ず法律に明記しなければならない。
5. 主たる目的の変更は、その国の法律制定に関する事柄に責任を有する機関によってのみ、決定されるものでなければならない。
6. 法的枠組みが国民的伝統に必ず合致するようにしなければならない。
7. 法律制定は国際的視野に立っておこなわなければならない。
8. 法律は、MPAを設定し管理する制度のための法的基礎を作らなければならない。
9. 法律は、特に沿岸域および漁業権の管理において、他の機関との調整および連携に直接取り組まなければならない。
10. 法律には、MPAの外で起こり、かつMPAの特色、天然資源もしくは活動に悪影響を及ぼす恐れのある活動を規制するための規定がなければならない。
11. 各国が定める法律には以下のような特質がなければならない。
 - ・ 用語の用い方
 - ・ 管理および区分計画
 - ・ 大衆の参加
 - ・ 予備研究および調査
 - ・ 研究、監視および検証
 - ・ 補償
 - ・ 資金調達
 - ・ 規則
 - ・ 実施、優遇策および罰則
 - ・ 教育および一般市民の認識の向上

**沿岸域生態系保全のための地域対策
国連環境計画 (UNEP) 地域海域計画**

launched in 1974.¹⁵ Since then, 14 Regional Seas Areas Programmes have been established under UNEP auspices : Black Sea, Caribbean, East Africa, East Asia, Kuwait, Mediterranean, North East Pacific, North West Pacific, Red Sea and Gulf of Aden, South Asia, South-East Pacific, South Pacific, Upper South-West Atlantic, and West and Central Africa. Three similar agreements amongst developed countries are also in place (Arctic, OSPAR for the North-East Atlantic, and HELCOM for the Baltic). Of the 14 UNEP Regional Seas Programmes, all have action plans except the North-East Pacific and the Upper South-West Atlantic.

Of the 14 Regional Seas areas, 9 have adopted regional conventions - Black Sea, Wider Caribbean, Eastern Africa, Kuwait, Mediterranean, Red Sea & Gulf of Aden, South-East Pacific, South Pacific, and West and Central Africa. There are no regional conventions for East Asia, South Asia or the North East Pacific.¹⁶

These regional conventions are more comprehensive than the global environmental conventions. They cover issues ranging from chemical wastes and coastal development to the conservation of marine animals

and ecosystems. The regional conventions often provide a broad framework for cooperation. They are supplemented by protocols on specific issues or problems such as pollution from land-based activities.

UNEP has recognized that the Regional Seas conventions and the Global Programme of Action the Prevention of Pollution of the Marine Environment from Land-Based Activities (GPA) need to be closely linked. Some of the goals of the GPA can be realized through the activities of the Regional Seas Programmes, and the GPA can help to promote greater support for activities and coordination at the regional level. There is also recognition that collaboration between the Regional Seas conventions and action plans and the global conventions on the marine environment should be strengthened.

There are two Regional Seas Programmes that might be looked upon as models for the conservation of coastal and marine habitats and ecosystems in East Asia. The first is the Wider Caribbean Region. The basic legal framework for the cooperation is set out in the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention).¹⁷ The legal instru-

国連環境計画（UNEP）の地域海域計画にはじめて着手したのは、1974¹⁸年のことだった。それ以来、14の地域海域計画がUNEPの後援を得て創設された。それは黒海、カリブ海、東アフリカ、東アジア、クウェート、地中海、北東太平洋、北西太平洋、紅海およびアデン湾、南アジア、南東太平洋、南太平洋、北部南西太平洋および西部中央アフリカである。先進諸国の間でも同様の協定が3つ締結されている（北極、北東大西洋に関するOSPAR、およびバルト海に関するHELCOM）。UNEPの14の地域海域計画のうちで、北東太平洋および北部南西大西洋を除いて、すべての計画には行動計画ができています。

14の地域海域のうちで、9つの海域は地域条約を採択している。その地域は、黒海、大カリブ、東アフリカ、クウェート、地中海、紅海およびアデン湾、南東太平洋、南太平洋および西部中央アフリカである。東アジア、南アジアもしくは北東太平洋18については、地域条約は存在しない。

これら地域条約は、グローバルな環境条約に比べて、より包括的である。地域条約が対象とする問題

は、化学廃棄物や沿岸域開発から、海洋動物と生態系の保全にまでおよぶ。しばしば地域条約では、協力のための幅広い枠組みが提起され、陸上での活動による汚染といった特定の問題に関する議定書が詳細を補っている。

UNEPは、地域海域条約および陸上での活動による海洋環境汚染の防止のためのグローバルな活動計画（GPA）を密接に結びつける必要性をすでに認識していた。GPAの目標の中には、地方海域計画に基づく活動を通じて実現しうるものがあり、さらにGPAは、地域レベルでの活動と調整に対する幅広い支援の促進に貢献することができる。また、地域海域条約と行動計画および海洋環境に関するグローバルな条約との間の協調関係を強化しなければならないとも考えられている。

東アジアにおける沿岸域および海洋の生物生息地と生態系の保全のためのモデルと見なされる地域海域計画が2つある。一つは、大カリブ地域である。協力のための基本的法的枠組みが、「大カリブ海域の海洋環境保護と開発のための条約」（カルタヘナ

ment which is of special interest is the 1990 Protocol Concerning Specially Protected Areas and Wildlife (1990 SPAW Protocol).¹⁸ The 1990 SPAW Protocol has been internationally recognized as the most comprehensive treaty of its kind. Adopted in Kingston, Jamaica by the member governments of the Caribbean Environment Programme on 18 January 1990, the 1990 SPAW Protocol preceded other international environmental agreements in utilizing an ecosystem approach to conservation.

The 1990 SPAW Protocol acts as a vehicle to assist with regional implementation of the broader and more demanding global Biodiversity Convention. The objective of the Protocol is to protect rare and fragile ecosystems and habitats, thereby protecting the endangered and threatened species residing therein. The Caribbean Regional Co-ordinating Unit pursues this objective by assisting with the establishment and proper management of protected areas, by promoting sustainable management (and use) of species to prevent their endangerment and by providing assistance to the governments of the region in conserving their coastal ecosystems.

The second region that might be used as a

model is the Mediterranean Region. The basic legal framework for cooperation is set out in the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention).¹⁹ It was adopted on 16 February 1976 and entered into force on 12 February 1978. It was revised in Barcelona, Spain, in June 1995 as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean.²⁰ The 1995 Convention is not yet in force. In addition to the Regional Convention, several protocols dealing with specific issues have been adopted for the Mediterranean. Of particular interest is the Protocol Concerning Mediterranean Specially Protected Areas (Mediterranean SPA Protocol),²¹ which was adopted in Geneva Switzerland, on 2 April 1982, and which entered into force in 1986. This Protocol was revised in Barcelona on 9-10 June 1995, and is known as the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (1995 Mediterranean SPA Protocol).²²

The 1995 Mediterranean SPA Protocol is noteworthy for two reasons. First, it is the first regional marine instrument to incorporate many elements from the

条約) 19で明らかにされた。特に興味深いのは、「特別保護区域および野生生物に関する議定書」(1990年SPAW議定書) 20である。同議定書は、この種の条約としては最も包括的な条約として国際的に承認されている。この条約は1990年1月18日に、ジャマイカのキングストンでカリブ海環境計画参加国政府が採択したものであり、他の国際的環境条約に先がけて、環境保全のために生態系上のアプローチを採用した。

1990年SPAW議定書は、より包括的で、しかも要求の高いグローバルな生物多様性条約の地域の実施を後押しするための手段として機能している。同議定書の目的は、希少で、しかも外部からの影響を受けやすい生態系および生物生息地を保護することであり、その結果、そこに生息する種で、絶滅の危機に瀕しているものを保護することにある。カリブ海地域調整ユニットは、保護区域の設定と適切な管理を支援し、種が絶滅の危機に直面しないように、種の持続可能な管理(および利用)を促し、さらに沿岸域生態系の保全にあたって、地域政府を援助す

ることにより、この目的の実現を目指している。

モデルとなりうる第2の地域は、地中海地域である。協力のための基本的法的枠組みは、「地中海の海洋環境および沿岸地域の保護のための条約」(バルセロナ条約)²¹に述べられている。同条約は1976年2月16日に採択され、1978年2月12日に発効した。その後、1995年6月に、スペインのバルセロナで、「地中海の海洋環境および沿岸地域の保護のための条約」²²として改定された。1995年条約はまだ発効していない。地中海については、この地域条約のほかに、特定の問題に関する幾つかの議定書が採択された。特に興味を引くのが、「地中海の特別保護区域に関する議定書」(地中海SPA議定書)²³である。この議定書は、1982年4月2日にスイスのジュネーブで採択され、1986年に発効した。その後、1995年6月9日、10日の両日、バルセロナで改定され、「地中海の特別保護区域および生物多様性に関する議定書」(1995年地中海特別保護区域議定書)²⁴として知られている。

1995年の地中海SPA議定書は、2つの点で注目

Biodiversity Convention. In this respect it is a regional vehicle for implementing the Biodiversity Convention in marine and coastal areas in the Mediterranean. Second, it contemplates the possibility of designating areas lying partly or wholly on the high seas. This reflects the fact that most of the Mediterranean remains high seas because EEZ boundaries have yet to be agreed upon by the bordering States.

Advantages of Regional Cooperation

There is general recognition in the global instruments that regional cooperation is necessary to protect and conserve marine and coastal habitats and ecosystems. In fact, as pointed out earlier, because the South China Sea can be considered a semi-enclosed sea under 1982 UNCLOS, States bordering the South China Sea that are Parties to 1982 UNCLOS may be under a legal obligation to cooperate in order to fulfill their obligations to protect and preserve the marine environment.

The 1995 GPA also called for action at the regional level to deal with pollution of the marine environment from land-based activities. Chapter 17 of Agenda 21 also called for regional cooperation.

International experts such as the IUCN have also

recognized that regional cooperation is desirable in the establishment of Marine Protected Areas. The marine and coastal ecosystems of countries within the same geographic region often extend across maritime boundaries of States. They also have common ecological and oceanographic characteristics. What happens in one country's marine and coastal zone may have a significant impact on a marine and coastal ecosystem in a neighboring country. The destruction of breeding grounds of marine living resources in one country could effect the sustainable development of such resources in other countries. Also, many marine species, such as sea birds and marine turtles, migrate across the maritime zones of several States. For these reasons, all of the Coastal States within a region have a common interest in cooperating to safeguard marine and coastal ecosystems and habitats.

By cooperating with one another and by coordinating the establishment and management of MPAs, the countries within a region can address common problems and deal with issues of common interest. Experts are of the view that MPAs work best when they are developed within an integrated coastal area or a large marine ecosystem management plan.

に値する。第一に、同議定書が、生物多様性条約の多くの要素を地域海域に初めて取り入れたことである。この点に関して、本議定書は、地中海の海洋および沿岸域における生物多様性条約実施のための地域的な手段である。第二に、この議定書は、その一部もしくは全部が公海上にある地域を、特別保護区に指定する可能性を想定していることである。このことは、排他的経済水域の境界について、まだ近隣諸国が合意に達していないために、地中海の大部分が依然として公海であるという現実を反映している。

地域協力の利点

一般的に、グローバルな文書では、海洋および沿岸域の生物生息地と生態系の保護・保全のために地域協力が必要と考えられている。実際、すでに指摘したとおり、国連海洋法条約では、南シナ海が半閉鎖海とみなされるため、同条約の締約国である南シナ海周辺諸国は、海洋環境を保護・保全する義務を履行するために、協力をおこなう法的義務を負うことになる。

1995年のGPAも、陸上での活動による海洋環境

の汚染に取り組むため、地域レベルでの活動を求めている。さらにアジェンダ21の第17章も、地域協力を呼びかけている。

国際自然保護連盟のような国際的な専門家集団も、海洋保護区域設定において、地域協力が望ましいと認めた。同じ地理的地域内にある諸国の海洋および沿岸域生態系は、しばしば海洋上の国家の境界を越えて存在する。しかも共通の生態的特徴や海洋学的特徴を持っている。ある国の海洋および沿岸域での出来事が、隣国の海洋および沿岸域生態系に重大な影響をもたらす場合もある。ある国の海洋生物資源の繁殖地が破壊され、他の国々による同じ資源の持続可能な開発に影響を及ぼすこともありうる。また、海鳥やウミガメのような海洋に棲む種の多くは、数カ国の海洋を移動する。このような理由から、ある地域の沿岸国はすべて、海洋および沿岸域生態系と生物生息地を保護するための協力に共通の関心を抱いている。

互いに協力し、MPAの設定と管理について調整をおこなうことで、一つの地域内の国々は共通の問



There may be several practical reasons why countries in the East Asian Seas Region may want to consider adopting a regional action plan or convention to establish a network of MPAs. First, it would enable them to share experiences and to develop models that are the most suitable for the region. Second, it would create public awareness about the need to protect and preserve marine and coastal habitats and ecosystems and the benefits of regional cooperation. Third, if MPAs are placed on the regional agenda under regional conventions, national government officials are likely to give them a higher priority. Fourth, if MPAs are part of a regional programme, it is more likely that funding and technical assistance will be available from international development agencies.

An Action Plan for the East Asian Seas Region²³ was adopted in 1981.²⁴ Within the past two years the Regional Coordinating Unit for the East Asian Seas has made significant progress in developing its programme, especially in the South China Sea. Therefore, the time may be ripe for the countries in this region to draft and adopt a regional framework convention as well as a Protocol on Specially Protected

Areas and Biological Diversity.

CONCLUSION

There are numerous global instruments which provide States in this region with a framework for preserving and protecting the marine environment in general, and for conserving and managing marine and coastal resources in a sustainable manner. The ratification and effective implementation of these instruments should be a priority for all countries in the region.

The conservation of marine and coastal habitats and ecosystems is for the most part a matter for governments at the national, provincial and local levels. The two most important management tools are integrated coastal area management and the establishment of MPAs. The global instruments have provided guidelines that can be followed by States in developing a comprehensive, integrated holistic approach to the problem.

At the same time, enhanced cooperation at the regional level is also necessary to protect and conserve marine and coastal habitats and ecosystems. As has been demonstrated in the Mediterranean and in the Wider Caribbean, the UNEP Regional Seas Programme can be an important mechanism for enhancing regional

題に対処し、共通の関心事である問題に取り組むことができる。専門家の見解では、MPAが最も円滑に機能するのは、一つにまとまった沿岸域もしくは大々的な海洋生態系管理計画においてMPAを創設する場合である。

東アジア海域の国々が、MPAのネットワークを設定するために地域行動計画もしくは条約の採択を考えようとしているのには、幾つかの実際的な理由があろう。まず、そうすることで、様々な経験を共有し、地域に最もふさわしいモデルを生み出すことができるだろう。第二に、海洋および沿岸域の生物生息地や生態系保護の必要性や地域協力の恩恵が、一般的に認識されるようになるだろう。第三に、MPAが地域条約で地域の課題として取り上げられれば、国家政府がそれをこれまで以上に優先する可能性がある。第四に、MPAが地域計画の一部になると、国際的開発機関から資金や技術の援助がうけられる可能性がさらに高くなる。

東アジア海域のための行動計画²⁵は1981年²⁶に採択された。過去2年間で、東アジア海域のための地

域調整ユニットは、特に南シナ海における計画の作成において、重要な進歩を遂げた。それゆえ、この地域の国々が特別保護区域と生物多様性に関する議定書および地域的枠組みに関する条約を起草し、採択する時期は熟しているかもしれない。

結 論

この地域の国々に、海洋環境全般の保全と保護、および持続可能な方法で海洋資源と沿岸域資源を保全・管理するための枠組みを提供する、多くのグローバルな文書がある。これらの批准と効果的な実施は、この地域の全ての国々にとって最優先課題でなければならない。

海洋および沿岸域生物生息地と生態系の保全は、主として国、地方、地元政府がおこなうべき職務である。2つの最も重要な管理手段とは、沿岸域の統合管理とMPAの設定である。グローバルな文書は、この問題に対する包括的で統合的な、しかも有機的でもあるアプローチの検討にあたって、国家が従い

うるガイドラインを提供してきた。

同時に、地域レベルにおける協力の強化も、海洋

cooperation in marine conservation. Therefore, the time may be ripe for the countries in this region to adopt a Regional Convention and Protocol for Specially Protected Areas.

- 1 For the text and current status of 1982 UNCLOS, see the web page of the UN Division for Ocean Affairs and the Law of the Sea at <http://www.un.org/Depts/los/losconv1.htm>
- 2 For the text of Agenda 21 and other UNCED documents, see <http://www.igc.apc.org/habitat/agenda21/index.html>
- 3 For the text, current status and other information on the Biodiversity Convention, see the web page of the Secretariat in Montreal at <http://www.biodiv.org>.
- 4 For information on the Jakarta Mandate, see <http://www.biodiv.org/jm.html>
- 5 For text, status and other information on the Ramsar Convention, see <http://www.ramsar.org/>
- 6 For text, status and other information on the World Heritage Convention, see <http://www.unesco.org/whc/nwhc/pages/home/pages/homepage.htm>
- 7 For information on the UNESCO Man & Biosphere

Programme, see <http://www.unesco.org/mab/>

- 8 For information on the 1995 Global Programme of Action, see <http://www.gpa.unep.org/>
- 9 For the text and other information on the FAO Code of Conduct for Responsible Fisheries, see <http://www.fao.org/fi/agreement/codecond/codecon.asp>
- 10 For information on MARPOL 73/78, see the background article from IMO Focus on the IMO web page: <http://www.imo.org/imo/focus/1997/marpol.pdf>
- 11 For the guidelines on the designation of Special Areas, see IMO Assembly Resolution A.720 (17th Session, 1991), Guidelines for the Designation of Special Areas and the Identification of Particularly Sensitive Sea Areas.
- 12 For guidelines on the designation of PSSAs, see IMO Assembly Resolution A.720 (17th Session, 1991), *ibid.*, and IMO Assembly Resolution A.885 (21st Session, 1999), Procedures for the Identification of Particularly Sensitive Sea Areas and the Adoption of Associated Protective Measures and Amendments to the Guidelines Contained in Resolution A.720(17).
- 13 From draft document by Clare Shine of the Cent-

および沿岸域生物生息地と生態系の保護のために必要である。地中海や大カリブ海域で実証されたとおり、国連環境計画の地域海域計画は、海洋保全での地域協力を促進するための重要な手段になりうる。それゆえ、この地域の国々が、地域条約および特別保護区域のための議定書を採択する時期は熟しているかもしれない。

1 For the text and current status of 1982 UNCLOS, see the web page of the UN Division for Ocean Affairs and the Law of the Sea at <http://www.un.org/Depts/los/losconv1.htm>

2 For information on MARPOL 73/78, see the background article from IMO Focus on the IMO web page : <http://www.imo.org/imo/focus/1997/marpol.pdf>

3 For guidelines on the designation of PSSAs, see IMO Assembly Resolution A. 720 (17th Session, 1991), *ibid.*, and IMO Assembly Resolution A.885 (21st Session, 1999), Procedures for the Identification of Particularly Sensitive Sea Areas

and the Adoption of Associated Protective Measures and Amendments to the Guidelines Contained in Resolution A. 720 (17).

er for Environmental Law, entitled Environmental Security of Coastal, Marine and Island Ecosystems. Coastal Conservation : Policy and Legal Tools (draft copy provided to the author by Clare Shine).

14 For Guidelines on the management categories, see the following IUCN publication on the IUCN web page : <http://wcpa.iucn.org/pubs/pdfs/IUCNCategories.pdf>

15 For general information on the Regional Seas Programme, see <http://www.unep.ch/seas/rshome.html>

16 For a full list of Conventions and Protocols, see <http://www.unep.ch/seas/main/hconlist.html>

17 For the text of the Cartagena Convention, see <http://www.cep.unep.org/law/cartnut.html>

18 For the text of the 1990 SPAW Protocol, see <http://www.cep.unep.org/law/spawnut.html>

19 For the text of the Barcelona Convention, see <http://www.unep.ch/seas/main/med/medconvi.html>

20 For 1995 revised text, see <http://www.unep.ch/seas/main/med/medconvii.html>

21 For the text of the 1982 SPA Protocol, see <http://www.unep.ch/seas/main/med/medspap.html>

22 For the 1995 revised text, see <http://www.unep.ch/seas/main/med/medspaii.html>

[ch/seas/main/med/medspaii.html](http://www.unep.ch/seas/main/med/medspaii.html)

23 For background on the East Asian Seas Region, see the A Global Representative System of Marine Protected Areas - Volume 3, Marine Region 13 : East Asian Seas, A Report to the World Bank Environment Department (Editors : Chris Bleakley and Sue Wells) http://www.environment.gov.au/marine/marine_protected/nrsmmpa/mpa/chap13.html

24 For background information see the web page of the Regional Coordinating Unit for the East Asian Seas Action Plan at <http://www.roap.unep.org/easrcu/index.htm>

日本の養殖事業における閉鎖水域の環境質の診断 主要構成要素分析を用いた環境状態の沿岸域管理例

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日本水産資源保護協会は長期にわたる研究をおこない、養殖にかかわる閉鎖水域の環境状態の診断と全体的な質の比較をおこなってきた。「有機物汚染指標」は水底特性志向環境ファクターを選択してまず計算された。これにはCOD、全硫化物（TS）、イグニッション・ロス（IL）、全窒素（TN）、全リン（TP）、および含水率が含まれる。そしてこれに水産庁がおこなった10の閉鎖水域から得られた選択さ

れた環境データの主要構成要素分析がデータとして加えられたのである。この分析の質的向上と残された課題について論じる。

1. 日本の盛んな養殖事業

1998年の日本漁業白書の報告によると、6,684千トンの総漁獲高のうち、1,227千トン（18%）が養殖によるものである。その漁獲高は、のり（Porphyra）が397千トン、ホタテ貝が226千トン、牡蠣が199千

DIAGNOSIS OF ENVIRONMENTAL QUALITY OF ENCLOSED WATER AREAS RELATED TO AQUACULTURAL ACTIVITIES IN JAPAN

- AN EXAMPLE OF COASTAL MANAGEMENT OF ENVIRONMENTAL CONDITION USING PRINCIPAL COMPONENT ANALYSIS -

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Abstract

Japan Fisheries Resources Conservation Association has long been conducting a study to make diagnosis of environmental conditions of enclosed water areas related to aquaculture and compare the qualities as a whole. 'Organic Pollution index' was first calculated from the selection of bottom quality oriented environmental factors, such as COD, Total Sulfide (TS), Ignition Loss (IL), Total Nitrogen (TN), Total Phosphorus (TP) and Mud Content (MC), and from principal component analysis of the environmental data from 10 representative enclosed areas surveyed by Japanese Fisheries Agency in 1985. Improvements have been made for obtaining Organic Pollution Index,

Z1, from 1995 with 10 another representative enclosed water areas, reducing the numbers of environmental factors for principal component analysis, and precise definition of sampling and analysis methods. Calculation methods and some remaining problems will be discussed.

1. High activity of aquaculture in Japan

Japanese Fisheries and Aquaculture Production Annual Statistics for 1998 (2000)¹⁾ reports that in 6,884 thousand tons of the total production, 1,227 thousand tons or 18% come from marine aquacultural activity. The aquaculture production was obtained from culture of Porphyra (397 thousand tons), scallops (226 thousand tons), oysters (199 thousand tons), yellowtails

トン、ブリが147千トン、赤鯛が83千トン、わかめ（Undaria）が77千トン、こんぶ（Laminaria）が51千トン等である。全漁獲高を円換算すると、1998年で5460億円となり、その内訳はブリ（1420億円（26%））、海藻類（Porphyra, Undaria, Laminaria）（1160億円（21.2%））、赤鯛（651億円（11.9%））、ホタテ貝（400億円（7.3%））、真珠（353億円（6.5%））、牡蠣（329億円（6.0%））等となっており、日本における重要な水産資源となっている。このような養殖を営む海域が日本中、ほぼ津々浦々に存在している。

2. 環境の状態

日本で養殖がおこなわれているほとんどの地域は、比較的閉じられた湾や浅海沿岸水域に点在している。

この水域での水循環は、沈殿物を取り除くのに十分な強さはない。これら地域がかかえる最も深刻な問題は、海底での有機物の堆積であり、それは魚が食べ残した餌の魚籠からの大量流出、および貝類の養殖による沈殿物に加えて、陸上の栄養物の排出による富栄養化に起因するものである。このような条件が時として魚病や赤潮を引き起こすのである。ItoとImai（1995）は、底質での有機物の堆積と底質から水中へ放出される硫化水素の毒性の影響によって、繰り返される養殖牡蠣床生産が減少していることを指摘している。牡蠣床の条件悪化と改善の試みがKusuki（1981）によって研究されまとめられた。表1は減少する底質の有害影響をまとめている。（Hata 1962）



(147 thousand tons), red seabreams (83 thousand tons), Undaria (77 thousand tons), Laminaria (51 thousand tons) and so on. Total production counted by Japanese Yen were 546 billion yen in 1998, which have been occupied by yellowtails (142 billion yen, 26.0%), seaweeds (Porphyra, Undaria and Laminaria) (116 billion yen, 21.2%), red seabreams (65.1 billion yen, 11.9%), scallops (40.0 billion yen, 7.3%), pearls (35.3 billion yen, 6.5%), oysters (32.9 billion yen, 6.0%) and so on. These items are the main important aquaculture in Japan. Such culture areas distributed in the enclosed water areas in almost whole Japan from north to south.

2.Environmental conditions

Most of the aquaculture areas in Japan are located in relatively enclosed bays and coastal waters with a

neritic environment. Water circulation in such areas is not strong enough to remove deposited substances. The most serious problem is the accumulation of organic matter on the bottom due to vast discharge of unconsumed food from fish cages and deposited substances from shellfish cultures in addition to an eutrophication caused by discharge of nutrients from land sources. Ito and Imai (1955)²⁾ reported the decline in productivity of oyster beds by repeated culture, due to accumulation of organic matter in the sediments and toxic effects of hydrogen sulfide released from the sediments into the water. Deteriorated conditions of oyster beds and efforts for their improvement have been studied and summarized by Kusuki (1981).³⁾ Table 1 summarizes harmful effects of decreased bottom quality (Hata 1962).⁴⁾

Table 1 Harmful effects of deteriorated bottom quality

Surface Water	Regeneration of nutrients and organic matter	⇒	Eutrophication
Bottom	Liberation of vitamins, Fe-chelate, and minute organic matter	⇒	Occurrence of
	Decrease of Oxygen	⇒	ed tides
	Liberation of H ₂ S	⇒	Death of mid-& bottom-water
		⇒	Layer fish
Sediment	Decomposition of Org matter	⇒	Consumption of DO → Death of Benthic fish
	Sulfate reduction	⇒	↑ H ₂ S

3. 水底特性志向環境ファクターを取り入れた閉鎖

水域環境特性比較の試み

日本の水産庁では、1974年以来、多くの閉鎖性水域における環境状況を調査するため、3年間の大きなプロジェクト「漁場改善に関する基礎環境調査」を実施した。これらのデータは、日本漁業資源保護協会によって解析され、1985年に「底質環境質の改善のためのガイドライン」として発表された。この課程において、主要要素解析が、このプロジェクトで調べられた6つの底質に起因する環境指標、すなわち、COD、全硫化物（TS）、イグニッション・ロス（IL）、全窒素（TN）、全リン（TP）、および泥率を用いて紹介された。代表的な10の水域における1,231の観測点から得られた全てのデータから主

な要素であるZ1が次式で得られた。

$$Z1 = a(\text{COD}) + b(\text{IL}) + c(\text{TS}) + d(\text{TN}) + e(\text{TP}) + f(\text{MC})$$

$$a : 0.310 \quad b : 0.170 \quad c : 0.868 \quad d : 0.273$$

$$e : 0.141 \quad f : 0.166$$

主要要素（Z1）は、76.3%の分散で説明できることが分かった。全データは標準化され、それぞれの観測点から得られた標準Z1は、「有機汚濁指標（Organic Pollution Index）」と呼ばれ、次のように算出される。

$$\text{Organic Pollution Index} = 0.310 \times (\text{COD} - 23.5) / 23.5 + 0.170 \times (\text{IL} - 11.7) / 11.7 + 0.868 \times (\text{TS} - 0.504) / 0.504 + 0.273 \times (\text{TN} - 1.82) / 1.82 + 0.141 \times (\text{TP} - 0.618) / 0.618 + 0.166 \times (\text{MC} - 68.3) / 68.3$$

3. Attempt to make diagnosis of environmental quality of enclosed areas with bottom quality oriented environmental factors

Japanese Fisheries Agency has conducted 3-years big project "Basic Environmental Survey for the Improvement of Fisheries Grounds" to assess environmental conditions of a lot of enclosed water areas since 1974. These data have been analyzed by Japan Fisheries Resources Conservation Association and "Guideline for the Improvement of Bottom Environmental Quality" was announced in 1985.⁵⁾ In this process, principal component analysis was introduced with 6 bottom oriented environmental factors observed during the above project, namely COD, Ignition Loss(IL), Total Sulfide(TS), Total Phosphorus(TP), Total Nitrogen(TN) and Mud Content(MC). Inputting all the data from 1,231 stations in the 10 representative enclosed water areas, principal component, Z1, was obtained with the following formula;

$$Z1 = a(\text{COD}) + b(\text{IL}) + c(\text{TS}) + d(\text{TN}) + e(\text{TP}) + f(\text{MC})$$

$$a : 0.310 \quad b : 0.170 \quad c : 0.868 \quad d : 0.273 \quad e : 0.141$$

$$f : 0.166$$

It was found that principal component (Z1) explains 76.3% of variances. All the data were standardized,

and the standardized score, Z1, from each station was called 'Organic Pollution Index', and was calculated as follows;

$$\text{Organic Pollution Index} = 0.310 \times (\text{COD} - 23.5) / 23.5 + 0.170 \times (\text{IL} - 11.7) / 11.7 + 0.868 \times (\text{TS} - 0.504) / 0.504 + 0.273 \times (\text{TN} - 1.82) / 1.82 + 0.141 \times (\text{TP} - 0.618) / 0.618 + 0.166 \times (\text{MC} - 68.3) / 68.3$$

To evaluate the Organic Pollution Index obtained through principal component analysis, COD and TS data were selected as external criteria for evaluation, because COD and TS values have been used for the Water Quality Criteria for the Protection of Aquatic Living Resources (1983),⁶⁾ in which the areas below 20 mg/dry g in COD and 0.2 mg/dry g in TS are considered as clean, the areas between 20 and 30 mg/dry g in COD and between 0.2 and 1.0 mg/dry g in TS as starting eutrophication, and the areas above 30 mg/dry g in COD and 1.0 mg/dry g in TS as eutrophicated. So the COD and TS data from all the stations in the 10 representative enclosed water areas were plotted on a graph with COD as abscissa and TS as ordinate as shown in Fig. 1. The Z1 scores obtained from the same 10 representative enclosed

$$\times (\text{MD}-68.3) / 68.3$$

主要要素の解析によって得られた有機汚濁指標を評価するため、CODとTSデータが外部評価のための判断基準として選別された。なぜならば、CODとTS値は水生生物資源の保護のための水質基準に使用されてきたからである。その中で、CODで20mg/dry g、TSで0.2mg/dry g未満は良好な水域と考えられ、CODで20-30mg/dry g、TSで0.2-1.0mg/dry gは富栄養化が始まっていると考えら

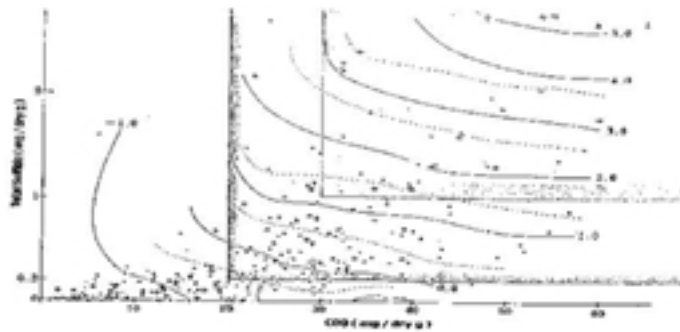


図1：日本における10の代表的な閉鎖性水域での全ての状態から得られたCOD,TSに関する有機汚濁指標、Z1値の分布。異なる印は水域の違いを示す。

Fig.1 Distribution of values of 'Organic Pollution Index', Z1 scores, related to COD and TS taken from all the stations in the 10 representative enclosed water areas in Japan. Various marks show the differences of the areas.

areas were also plotted on the same graph. From the comparison of Z1 scores with water quality criteria, Z1 scores could be evaluated as follows :

AClean areas	Z1 scores<0
Areas starting eutrophication	0<Z1 scores<1
AAreas eutrophicated	1<Z1 scores

In this guideline two important comments have been pointed out for future consideration. First comment was the lack of direct measurement of microbial activity leading to oxygen-deficient bottom waters in all the bottom environmental factors observed during the project. Second one was the lack of method to clarify how deteriorated bottom environment would influence harmful effects to benthic organisms mediated by bottom water current.

Then another committee for the conservation of bottom environment was organized in Japan Fisheries Resources Conservation Association in 1993, and a

れる。また、CODで30mg/dry g、TSで1.0mg/dry g以上は富栄養化状態である。従って、10の代表的な閉鎖性水域における全ての観測点からのCODとTSデータを横軸にCOD,縦軸にTSでプロットした図が図1である。Z1値も、同じグラフ上に記している。Z1値と水質基準の比較から、Z1値は次のように評価されるであろう。

良好	Z1値 < 0
富栄養化進行	0 < Z1値 < 1
富栄養化状態	1 < Z1値

このガイドラインでは、ふたつの重要なコメントが将来の課題として指摘されている。

1つ目は、プロジェクトを通じて得られた全底質環境ファクターでの底水域の貧酸素状況



new approach for the diagnosis of environmental quality of enclosed waters have been discussed until 2000. Improvements have been made for obtaining Organic Pollution Index, Z1, as follows ; (1) collection of environmental data from 10 another representative enclosed water areas, (2) precise definition of sampling and analysis methods, (3) reducing the numbers of environmental factors for principal component analysis, (4) introduction of diversity index for macrobenthos, H', (5) preparing four combinations of data sets for calculation of Z1, (6) use of the lowest concentration of dissolved oxygen above 1 m from the bottom as external criteria for the evaluation of Z1 scores. When applying this diagnosis method for environmental quality to a new water area, data of precise environmental factors are not always available. So only four measurements of environmental factors were selected; COD and Ignition Loss (IL) for indication of organic matter content, Total Sulfide(TS) for degree of anaerobic condition, Mud Content (MC) for bottom water current. In addition diversity index of macrobenthos (H') was introduced to know if the conditions permit any organisms to survive or not. Calculation of Z1 scores from four combinations of parameters, namely two sets of three

による微生物活動の直接的な測定値がないことである。2つ目は、底質の劣化した環境がどのようにベントスへ底水流によって引き起こされる悪影響をもたらすかを明確にする方法がないことである。

底質環境の保全のためのもうひとつの委員会が日本漁業資源保護協会によって1993年に設置され、閉鎖性水域における環境質の診断のための新しい手法が2000年まで議論された。有機汚濁指標Z1を得るために次のような改善が施された。(1)さらにもう10地点の代表的な閉鎖性水域の環境データを収集した、(2)サンプリング及び解析手法の正確な定義をおこなった、(3)主要要素解析の環境ファクター数を減少させた、(4)マイクロベントス多様性指標Hの導入を行った、(5)Z1算出のための4

つのデータセットを準備した、(6)Z1値評価のための外部基準として底から1 m上の最も低い溶存酸素濃度を利用した。新しい水域に対する環境質診断手法を採用するとき、正確な環境ファクターのデータはいつも得られるとはかぎらない。そこで、環境ファクターの4つの測定値、つまり、有機物濃度の指標としてのCODとイグニション・ロス (IL)、anaerobic状況のための全硫黄 (TS)、底水流のための泥率 (MC) だけが選択された。加えて、マイクロベントスの多様性指標Hがその状況下で有機物が生存できるか否かを知るために導入された。3つのパラメータの2セットと各セットへのHの追加である4つのパラメータセットからのZ1値の算出がこのプロジェクトで試行された。もうひとつの重要

parameters, and addition of H' to each set, were tried in this project. Another important point was the change of external criteria for the evaluation of Z1 scores from concentrations of COD and TS to the lowest concentration of dissolved oxygen above 1 m from the bottom in that area. Special attention was focussed for the frequent analysis of vertical profile of DO concentrations in the worst seasons, such as July,

August and September. Table 2 shows a manual for the data collection during the new test surveys at the new 10 representative enclosed water areas from 1995 to 1999. Table 3 shows the methods of principal component analysis and the results of the proportion of Z1 scores (%) obtained. It was found most of the Z1 scores calculated with these methods explained at least 73.8 % of the variances.

Table 2 Manual for the data collection

Periods of sampling	: Summer time when water physically stratifies and bad bottom condition occurs
Sediment sampling	: Eckman-Birge or Smith-McIntire grab sampler
Chemical study	→ surface 0-2 cm
Macrobenthos	→ 1/10 m ² or 1/50 m ²
Analysis	
COD	: O ₂ consumption by alkaline KMnO ₄
TS (Total Sulfide)	: AVS test column (Gastec 201H)
IL (Ignition Loss)	: Loss of weight (%) after ignition at 550°C for 6hr
MC (Mud Content)	: Remaining weight (%) after passed through a 250 mesh (0.063mm)
H' (Diversity index of macrobenthos)	: $-\sum_{i=1}^s p_i \log_2 p_i^*$
DO at a depth above 1m from bottom	: the lowest concentration through one week interval
	Observation during summer

s : number of species in the sample

p_i : probability of one individual belongs to species *i*

な点は、底から1 m上の最も低い溶存酸素濃度に対するCODとTS濃度から算出されるZ1値評価のための外部基準の変更である。7月、8月、9月といった悪条件でのDO濃度の縦方向のプロファイルの頻繁な解析に特別な注意が払われた。表2は、1995年から1999年にかけて実施された新しい10の代表的な閉鎖性水域における調査でのデータ収集方法を示している。表3は、主要要素解析の方法と得られたZ1値(%)割合の結果を示している。これらの方法で算出された大部分のZ1は、少なくとも73.8%の分散値で説明できることが判明した。図2は、10の代表的な日本の閉鎖性水域で得られたIL, TS, MC, H指標(それぞれを横軸に、また縦軸には底から1 mでの最低DO濃度をプロットしている)で算出さ

れたZ1値を示している。非常に良い相関が得られていることから、Z1aとZ1eはDO濃度に関連づけて算出された。同様な関係がIL, TS, MC, COD指標とZ1b及びTS, MC指標とZ1fの関係でも得られている。(図3) この関係から次の条件が導かれる。

正常な沈殿物 $Z1 < 0$ 及び 最低DO $> 4.3\text{mg/L}$ 又は 3.0 ml/L

栄養化した沈殿物 $Z1 > 0$ 及び 最低DO $< 4.3\text{mg/L}$ 又は 3.0 ml/L

表4は、環境ファクターセットに基づく新しい水域に適用したZ1値算出令のいくつかを示している。底から1 m上の最も低い溶存酸素濃度とZ1値算出に基づく新しい環境状況の判断を行うことはむしろ容易である。1985年の「底質環境質の改善のための

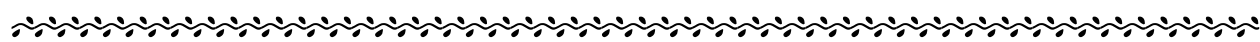


Table 3 Methods of Principal Component Analysis (PCA) and the Results

Explanatory variables	Method of analysis	Formula of principal component	Proportion (%)
IL, TS, MC, H'IL, TS, MC	PCA with correlation matrix	Z1a=0.508(IL)+0.510(TS)+0.513(MC)-0.466(H') Z1b=0.588(IL)+0.559(TS)+0.584(MC)	74.7 81.2
COD, TS, MC, H'COD, TS, MC	PCA with correlation matrix	Z1e=0.504(COD)+0.513(TS)+0.506(MC)-0.474(H') Z1f=0.582(COD)+0.568(TS)+0.580(MC)	74.2 79.9
Calculations for Z1 scores			

$$\begin{aligned}
 Z1a &= 0.508(\text{IL}-7.99)/4.52+0.510(\text{TS}-0.51)/0.60+0.513(\text{MC}-64.9)/30.5-0.466(\text{H}'-2.69)/1.30 \\
 Z1b &= 0.588(\text{IL}-7.99)/4.52+0.559(\text{TS}-0.51)/0.60+0.584(\text{MC}-64.9)/30.5 \\
 Z1e &= 0.504(\text{COD}-20.9)/15.4+0.513(\text{TS}-0.51)/0.60+0.506(\text{MC}-64.9)/30.5-0.474(\text{H}'-2.69)/1.30 \\
 Z1f &= 0.582(\text{COD}-20.9)/15.4+0.568(\text{TS}-0.51)/0.60+0.580(\text{MC}-64.9)/30.5
 \end{aligned}$$

Fig. 2 shows the Z1 scores obtained from the 10 representative enclosed waters in Japan calculated with Index of IL, TS, MC and H', and COD, TS, MC and H' respectively, and plotted on graphs Indices as abscissa and the lowest concentrations of DO at 1 m above bottom as ordinate. From the very good correlations observed, Z1a and Z1e were calculated with relation to DO concentrations. Similar relationships were obtained in Z1b and Z1f scores calculated with Indices of IL, TS and MC, and COD, TS and MC respectively (Fig. 3). These relationships lead to the following diagnosis;

Sediments of normal condition

Z1 score<0 and Lowest DO>4.3mg/L or 3.0ml/L

Eutrophic sediments

Z1 score>0 and Lowest DO<4.3mg/L or 3.0ml/L

Table 4 shows some examples of calculation of Z1 scores applied to new water areas based on the combinations of environmental factor sets. It is rather easy to make diagnosis of environmental condition of the new water areas based on calculation of Z1 scores and the lowest DO concentration of those areas at 1 m above the bottom.

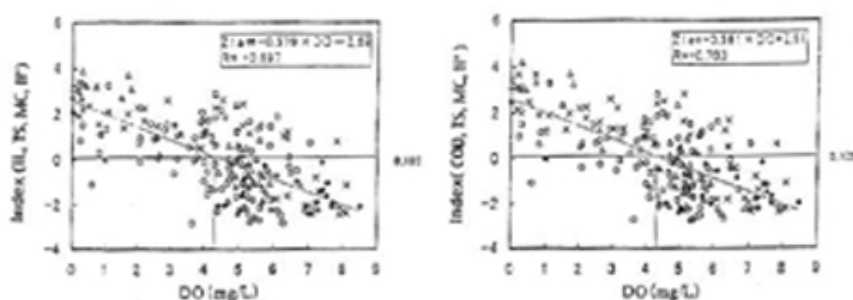


図2：日本の代表的な新しい10の閉鎖性水域の全状況から算出されたZ1値、横軸にZ1値、縦軸に最低DO濃度をプロットしている。異なる印は水域の違いを示す。

左：IL,TS,MC,Hで算出されたZ1a

右：COD,TS,MC,Hで算出されたZ1e

Fig. 2 Z1 scores calculated from all the station in the 10 new representative enclosed areas in Japan plotted as Z1 value as abscissa and lowest DO concentrations as ordinate. Various marks show the differences of the areas.

Left : Z1a calculated with IL, TS, MC and H'

Right : Z1e calculated with COD, TS, MC and H'

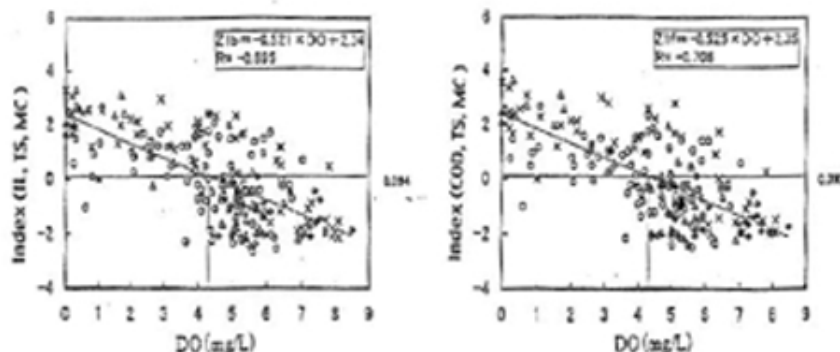


図3：日本の代表的な新しい10の閉鎖性水域の全状況から算出されたZ1値、横軸にZ1値、縦軸に最低DO濃度をプロットしている。異なる印は水域の違いを示す。

左：IL,TS,MCで算出されたZ1b

右：COD,TS,MCで算出されたZ1f

Fig. 3 Z1 scores calculated from all the station in the 10 new representative enclosed areas in Japan plotted as Z1 value as abscissa and lowest DO concentrations as ordinate. Various marks show the differences of the areas.

Left : Z1b calculated with IL, TS and MC

Right : Z1f calculated with COD, TS and MC

Table 4 Examples of calculation of Z1 scores

1.Sediment with 21.8 mg/g in COD, 1.26 mg/g in TS, 85.4% in MC and 2.21 bit in H'

$$Z1e = 0.504 \times (21.8 - 20.9) / 15.4 + 0.513 \times (1.26 - 0.51) / 0.60 \\ + 0.506 \times (85.4 - 64.9) / 30.5 - 0.474 \times (2.21 - 2.69) / 1.30 = 1.19$$

2.Sediment with 9.71% in IL, 1.26 mg/g in TS, 85.4% in MC and 2.2 bit in H'

$$Z1c = 0.508 \times (9.71 - 7.99) / 4.52 + 0.510 \times (1.26 - 0.51) / 0.60 \\ + 0.513 \times (85.4 - 64.9) / 30.5 - 0.466 \times (2.21 - 2.69) = 1.98$$

3.Sediment with 3.7 mg/g in COD, 0.01 mg/g in TS and 20.0% in MC

$$Z1f = 0.582 \times (3.7 - 20.9) / 15.4 + 0.568 \times (0.01 - 0.51) / 0.60 \\ + 0.580 \times (20.0 - 64.9) / 30.5 = -1.98$$

4.Sediment with 2.10% in IL, 0.01 mg/g in TS and, 20.0% in MC

$$Z1d = 0.588 \times (2.10 - 7.99) / 4.52 + 0.559 \times (0.01 - 0.51) / 0.60 \\ + 0.584 \times (20.0 - 64.9) / 30.5 = -2.09$$

ガイドライン」で指摘された環境ファクターの選定についてはいくつかの問題がまだ残っているが、この手法は、診断の要求に応じて、日本漁業資源保護協会から全国の水産関係者や自治体に配布された。これは、主要要素解析を利用した閉鎖性水域の環境状況に関する沿岸管理の一例である。この手法は日本や少なくとも温帯地域で利用できる。しかし、熱帯地域の水域での環境質の診断に対しては、たぶん、その気候条件に応じた他の手法を作る必要がある。熱帯に属するアジア諸国において、マングローブやエビ養殖等の環境状況の診断ために、そのような手法が必要となるであろう。

(事務局仮訳)

Although there still have some problems for the selection of the environmental factors pointed out in the Guideline for the Improvement of Bottom Environmental Quality 1985,⁵⁾ this manual has been distributed to each prefecture and aquaculture people in Japan from Japan Fisheries Resources Conservation Association for the request of diagnosis. This is one example of coastal management of environmental conditions of enclosed water areas using principal component analysis. This manual can be used in Japan or at least in the temperate regions. However, for diagnosis of environmental quality in the tropical waters, probably other methods fitting to this climate condition are necessary to be produced. I hope such methods will become available here to make diagnosis of the environmental conditions of shrimp culture and other aquaculture areas as well as mangrove swamps in the tropical Asian countries.

Acknowledgement

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発展途上国における沿岸海洋資源の経済評価

スパチット・マノピモケ

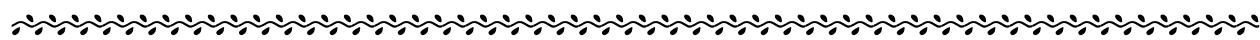
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本稿の基礎となる前提は、多くの途上国で起こっている沿岸域海洋資源の破壊は深刻であり、資源の希少性と環境保護の機会コストを考えると、政策決定者が資源の総合的な経済的価値および問題予防策または軽減策の利益とコストを考慮することが重要である、ということである。本稿は途上国において沿岸域海洋資源の経済的評価をおこなう際の概念的、実証的側面に関する文献および概念の使用法、政策形成と実施に関する研究を概説するものである。明

らかな事実は、十分な実証的研究がまだおこなわれておらず、途上国が抱える緊急の課題に取り組むための政策を、経済的に評価することができないということである。また本稿は、途上国の沿岸域海洋資源の経済的評価をめぐって存在する深刻なギャップおよび概念的問題を明らかにするものであり、これを裏付ける詳細なデータと議論を用いて、いくつかの考察をおこなうことにする。



ECONOMIC VALUATION OF COASTAL MARINE RESOURCES IN DEVELOPING COUNTRIES : SOME OBSERVATIONS

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This paper is based on the premises that the degradation of coastal marine resources in many parts of the developing world are potentially serious, and that the scarcity of resources and the opportunity costs of environmental protection make it important for policy makers to consider the total economic value of the resources as well as the benefits and costs of preventing or reducing the problem. The paper reviews the literature on both the conceptual and empirical aspects of the economic valuation of coastal marine resources in developing countries and the use of the

concepts and studies for policy formulation and implementation. It is found that there is yet an adequate body of empirical studies to support the economic assessment of policies to deal with the most pressing issues facing developing countries today. The paper also identifies the serious gaps and the conceptual issues surrounding economic valuation of coastal marine resources in developing countries. A number of observations are provided with supporting detail and discussion.

沿岸域・海洋生態系の保護と管理における地域での調整

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概要

UNEPは、世界の環境保護における国連の指導的機関である。このような役割を担う機関として、UNEPは天然資源の保護、回復、持続可能な資源利用および管理を、指導し調整し、時として規制しなければならない。東アジア海域調整ユニット（EAS/RCU）は、東アジア海域の海洋および沿岸域での環境保護について、加盟各国から権限を委任されている。加盟国は、会合を開いて、その行動計画の実施を認め、提案し、これを援助する。実際には、東

アジア海域調整機構の加盟国の要件はUNEPのそれとは異なる場合がある。

理想論を言えば、EAS/RCUは、この地域の沿岸域におけるすべての保全、管理もしくは改善計画の実態を把握したいと考えている。それは必ずしも計画へのEAS/RCUの参加を意味するものではないが、調整、意思の確認、そしてある程度の関与は可能であろう。EAS/RCUのビジョンは、同じ計画ができたり、計画が重複する可能性を少なくしたり、あるいは防ぐ目的で、海洋環境の回復・保護・管理のた

REGIONAL COORDINATION IN PROTECTION AND MANAGEMENT OF COASTAL MARINE ECOSYSTEMS

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Abstract

UNEP is the lead UN agency in environmental protection in the world. As such it must direct, coordinate and sometimes control the protection, restoration, sustainable resource use and management of natural resources. The East Asian Seas Regional Coordinating Unit (EAS/RCU) has a mandate from its member countries to protect the marine and coastal environment of East Asian Seas. Member countries endorse, suggest and assist with implementation of the Action Plan at their meetings. In fact, the requirements of the Coordinating Body of the Seas of East Asia member countries may differ from those of

UNEP.

Ideally, the EAS/RCU would like to know of every conservation, management or amelioration plan in the coastal areas of the Region. This knowledge would not necessarily mean participation but it could involve coordination, communication and some involvement. The EAS/RCU vision is for a regional metadata base on all marine parameters and coordination of efforts to restore, protect and manage marine environments to reduce or prevent overlapping and duplication of projects.

Other UNEP agencies with a keen interest in the East Asian Seas are Global International Waters

めのさまざまな努力の調整と海洋に関するすべての要素について、地域メタデータベースの作成に関するものである。

東アジア海域に強い関心を持つ他のUNEP機関としては、グローバル国際水域アセスメント、海洋汚染の原因となる陸上での活動のためのグローバル行動計画、ならびにさまざまな国連開発計画に基づく活動がある。国連以外ではNGOや政府機関がある。NGOの活動は、特定の分野に限られたり、国連と同じ目的をもつ場合があろう。政府機関が、海洋環境の保全を唯一の目的としていることはあまりない。どちらかといえば、政府機関は、開発、経済成長、資源開発や多くの社会経済的事項を優先するであろう。

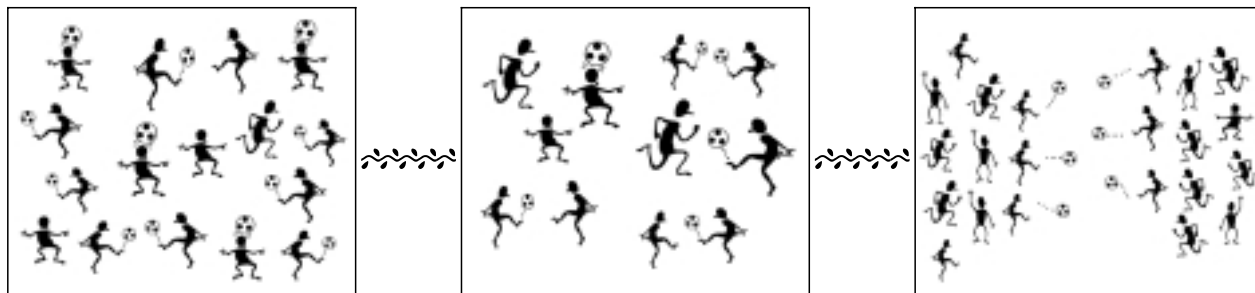
EAS/RCUはまた、海洋環境の保全に役立つ計画を率先して行なうよう、加盟国から求められている。海洋環境の悪化を緩和するための重要な資金源はGEFである。また、資金提供機関には拠出国や基

金なども含まれている。

本稿ではEAS/RCUの役割および将来の目標と義務について述べる。

序 論

東アジア海域における海洋環境問題解決への努力は、どちらから言えば、私が考えるフットボール発祥の様子に似ている。たくさんの人々がーその多くがフットボールを持ってー、大きな不規則な形をしたフィールドで、好き勝手にボールを蹴っている姿を想像してみよう。フットボールがなくて、ボールがほしいと思っている人がいる。そうかと思えば、とんでもない方向へボールを蹴ってしまった人がいる。そのボールを受けたのが、ボールを持っていない人で、持ち主に向かってボールを蹴り返す者もいれば、そうでない者もいる。これが、地域の環境問題を解決しようというビジョンを持っていた人々が30年前におこなっていた、今と違って、どちらかと言えばでたらめな努力なのだ。



Assessment, Global Plan of Action for Land-based Activities that pollute the sea and various United Nations Development Program activities. Outside the UN are NGO's and government agencies. NGO's may be very specific in their activities or have similar aims to the UN. Government departments very often do not have as their sole requirement the conservation of marine environments. Rather they may have development, growth, resource extraction and many socio-economic priorities

The EAS/RCU is also asked by member countries to initiate projects that may help preserve marine environments. GEF is the main source of large funds for reducing marine environmental degradation. Funding agencies also include donor countries and foundations.

This paper describes the role of the EAS/RCU and its future aims and obligations.

Introduction

Efforts at solving marine environmental problems

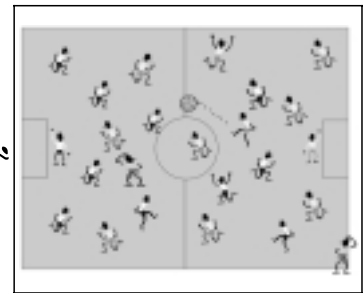
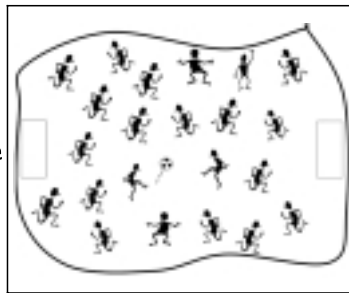
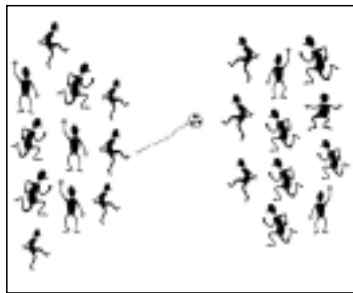
in the East Asian Seas were rather like the way that I imagine football to have originated. Imagine a number of people, many with footballs, kicking them indiscriminately around a large irregularly shaped field. Some don't have footballs and want one to kick. Others kick their balls out of control and the balls are taken by those without balls and may or may not be kicked back to the owners. These are the different, rather haphazard efforts that were being made by people of vision thirty years ago to solve the region's environmental problems.

Then the people kicking the footballs back realise that it is fun to direct a ball somewhere and that the receiver can admire their expertise at returning the ball. Now develops a partnership with the balls being kicked between two. Some of the environmental groups are beginning to realise that sharing efforts can make a larger impact on the issues.

Soon, returning to the football analogy, this pairing broadens to the ball being kicked between more than

そこでフットボールを蹴り返す人は、ボールをどこかにめがけて蹴れば面白いということに気がつく。さらに、見事にボールを蹴り返せば、ボールの受け手は感心する、ということも。かくして、二人の間でボールを蹴りあうことで、パートナーシップが生まれる。一部の環境グループは、ともに努力すれば、環境問題により大きな影響を与えることができるということに気づき始めている。

ここでフットボールの喩えに話を戻すと、二人で蹴りあっていたボールを、やがてそれ以上の人数で蹴るようになる。すると、二人一組になって巧みにパスを繰り返してボールを支配すれば、別のグループからボールを奪い、自分たちのものにできると気づく。こうして2つのチームが別々に動くようになり、ますますフットボールがおもしろくなるわけだ。今や環境グループは、より大きな問題に取り組んでおり、チームを組むことによってさらに多くの成果をあげている。



two. Then, a partnership realises it can take a ball away from another group and keep it from them by skilful passing and ball control. The two groups are now working as two separate teams and having more fun. Environmental groups are now tackling larger problems and achieving more by forming teams.

Some rules are made, the ground is marked out for ease of playing and limits put on the teams' activities and the idea of goals presented and accepted. Now we have a football team - but a very unskillful, unfit and haphazard team with no real roster as to with whom the game is played. This is where countries make agreements between themselves in the form of conventions or, in the case of the EAS/RCU an action plan.

People start to watch teams oppose each other and money is asked for from the spectators. The team wants a uniform, transport to other venues and a knowledge of who to play and who not to play - a manager is required. The team will improve with

幾つかの規則が作られ、プレーしやすいようにグラウンドには線が引かれ、チームの動作が規制され、ゴールを決めるというアイデアが提案され、受け入れられる。これでフットボールのチームができあがるわけだが、まだまだへたくそで、試合などできそうにないにでたらめなチームで、しかも出場選手の名簿もろくに備えていないときている。これが、諸国が条約というかたちで—EAS/RCUの場合には行動計画というかたちで—合意を結ぶ場合の実態なのだ。

チーム同士の対戦を見物する観客が現われ、やがて彼らは、金を払えと要求される。チームは、ユニフォームが欲しくなり、他の競技場への移動の手段が必要となり、誰が試合に出場し、誰が控えにまわるかが知りたくなる—監督が必要になるのだ。経験と訓練を積みばチームの力は向上するのだから、今度はコーチが必要になる。こうしてプロのフットボールチームができあがるわけだ。このフットボール・

experience and education so a coach is needed. Now you have a professional football team. In this rather loose analogy of the football team, the coach and manager is the EAS/RCU. In the case of the manager, finding funding and setting directions for the team and, in the case of the coach, as a coordinator of activities going on in the region.

COBSEA in East Asian Seas

The Coordinating Body of the Seas of East Asia (COBSEA) secretariat had, as its mandate, the Action Plan of the COBSEA. This Plan set out the necessary directions that the East Asian Seas Regional Coordinating Unit should take for a regional body to coordinate efforts at conservation and management of the East Asian Seas. The EAS/RCU is responsible to focal points in each country and it is its duty to communicate all activities carried out by the EAS/RCU to these focal points. Since 1981, when the Action Plan was first conceived, until 1994 five countries

チームのたとえで言えば、コーチと監督がEAS/RCUにあたる。監督については、資金を調達しチームに指示を与えることが仕事であって、コーチは、地域でおこなわれている活動の調整役にあたる。

東アジア海域のCOBSEA

東アジア海域調整委員会（COBSEA）事務局は、COBSEA行動計画に関する権限を委任された。この計画は、地域機関が東アジア海域の保全と管理のために行なう努力を調整するために、東アジア海域地域調整機構が下すべき必要な指示を明らかにしている。EAS/RCUは各国での中心となるべき活動に責任を負い、自らが行なうすべての活動を、これらの活動現場に伝える義務を負う。行動計画が初めて考えられた1981年から1994年までの間に、5カ国がCOBSEAに参加した。その5カ国とは、インドネシア、マレーシア、フィリピン、シンガポールおよびタイである。1994年には、さらに5ヶ国が加わった。それは、オーストラリア、カンボジア、中国、大韓民国およびベトナムである。そして1999年には、改定された行動計画および長期計画がこれら諸国に

よって承認され、現在のEAS/RCUの指針となっている。

COBSEAは、毎年開催される会議で参加国が指定した金額を、寄付国が払い込む信託基金の設置に同意した。寄付を行なうこの10カ国からの寄付金では、EAS/RCUの人件費や運営費を賄うことができない。不足分として、UNEPによって、環境基金の一部が供与されている。参加国は専門的意見、技術的知識、そして時には活動計画の活動に参加するよう求められる。参加国が広い範囲に分散しており、時として活動への参加がままならないため、各国間の関係は、必ずしも理想どおりではない。

東アジア海域の多岐にわたる問題を特定するために召集された様々な専門家会議で、参加国からの専門家は、動植物生息地の消失、汚染および水産資源の乱獲といった問題があることを認めた。これらの問題が、長期計画（UNEP 2000）、および「南シナ海およびタイ湾における環境悪化傾向からの回復」のためにGEFが資金提供した新しい計画の基礎となった。さらに、陸上での活動の影響から東アジア

participated in COBSEA - Indonesia, Malaysia, Philippines, Singapore and Thailand. In 1994 five more countries joined - Australia, Cambodia, China, Republic of Korea and Viet Nam. In 1999 a revised Action Plan and Long-term Plan was endorsed by the countries and this is the direction of the EAS/RCU now.

The COBSEA agreed upon setting up a Trust Fund into which contributing countries paid a contribution nominated by them at the annual COBSEA meetings. The sum of this amount from the ten contributing countries is not enough to support the EAS/RCU in staff and office expenses. The difference is provided by UNEP from the Environment Fund. The member countries are asked to contribute expertise, technical knowledge and sometimes actions to the Action Plan. Relationships are not always ideal due to the wide spread of the countries and the lack of commitment, in some cases, of member countries.

At various experts' meetings called to clearly identify the various issues in East Asian Seas, experts from member countries identified habitat loss, pollution

and overexploitation of fisheries. These issues are the base of the Long-term Plan (UNEP, 2000) and the new GEF funded project for "Reversing Environmental Degradation Trends in the South China Sea and the Gulf of Thailand". Furthermore, the Global Programme of Action Regional Programme of Action for the Protection of the Marine Environment of the East Asian Seas from the Effects of Land-based Activities (Nollkaemper, 1992) specifies pollution as a major issue and is concentrating on the socio-economic effects of sewage at the moment. The International Coral Reef Action Network (ICRAN) and funding from the US is also pointed at reversing degradation of coral reefs and developing sustainable management practices.

The Issues

Sometimes I feel that the efforts made by all the government departments, NGOs and UN agencies are rather like a band-aid on the problems of the East Asian Seas. In one place 80,000 ha of mangrove have been removed for shrimp farms and, in another, 100 ha have been restored by a community group.

海域の海洋環境を保護するための地域行動計画のグローバルな行動計画 (Nollkaemper, 1992) は、汚染を重要な問題と位置づけ、現在は、下水の社会経済的影響に全力を注いでいる。国際珊瑚礁活動ネットワーク (ICRAN) と合衆国からの資金も、珊瑚礁の状態を改善し、持続可能な管理の方法を編み出すことに向けられている。

様々な問題

時として私は、あらゆる政府機関、NGOや国連機関による努力が、どちらかと言うと、東アジア海域の諸問題にとっては一時凌ぎにすぎないのではないかと思うことがある。ある場所では、海老の養殖のためにマングローブが80,000ヘクタールにわたって伐採され、またある場所では地域共同体のグループの手で、100ヘクタールが再生されている。伐採されるマングローブの総数は、間接的にはあるが、アメリカ、欧州および日本での海老の価格で決まる。他の要素も、間接的に動植物生息地の消失に影響を及ぼしている。

珊瑚礁が爆破されたり、シアン化物で汚染された

りしているが、それは、このようなことをする人々が食物を必要としているからである。彼らにほかに何ができようか。珊瑚の白化がこの地域全体で起こっており、再生する珊瑚もあるが、再生しない珊瑚もある。珊瑚が死滅するのは、おそらく陸地から流れ出た過剰な栄養物によって藻類が繁殖したからであろう (Done, 1992 : Hughes, 1994)。他の珊瑚や海藻類は、光合成を妨げるかあるいは直接生物を窒息させる、過剰な堆積物が原因で死滅する。土木工事、森林伐採や農業での悪しき慣行において、流去水を予防する措置がとられなかったために堆積物の量が増加した (Nowlis他 1997)。

多くの業務用および食用の魚、甲殻類が養殖されている地域は、こうした資源の実態を我々が把握しないうちに破壊されつつある。海藻床は海中にあり、旅行者にとって魅力的なものではないが、そこには最終産物—人間の食べ物—に至る生物連鎖の一部を形成する生物があふれているのだ (ErftemeijerおよびAllen共著1993)。押し網や堆積物、そしてここでもまた高栄養物が海藻を死滅させると言われてい

The amount of mangrove cut depends indirectly on the price of shrimp in the US, Europe and Japan. Other factors also indirectly affect the loss of habitats.

Coral reefs are being blasted or poisoned with cyanide because the people doing this need to eat. What else can they do? Coral bleaching is occurring throughout the region, some corals will recover, some won't. The corals that die will probably have been killed by algal turfs enhanced by excess nutrients run off from the land (Done, 1992 : Hughes, 1994). Other corals and seagrasses are killed by excess sediment loads which either prevent photosynthesis or directly smother the living organisms. Sediment loads increased by lack of run-off precautions in civil engineering, deforestation and bad farming practices (Nowlis et al., 1997).

The nursery areas for many commercial and food fish and crustacea are being destroyed before we even know how much of these resources are there. Seagrass beds lie below the sea and are not attractive to tourists but are teeming with life that is part of the chain of organisms leading to the end product -

human food (Erftemeijer and Allen, 1993). Push nets, sediment loads, again, and high nutrients are known to kill seagrasses (Chansang and Poovachirano, 1994). A flag for seagrasses is the dugong which has almost disappeared in most countries.

Fishing effort, we are told by FAO, is so great that 60% of the fishing fleet could be removed and the same number and volume of fish would be caught. What do we do with the people who worked those 60% of the fishing fleet? How do they live? Then again how will future generations live when the stocks are gone?

Communities that happily and sustainably lived by the coast and used the organisms from coral reefs, seagrass beds and mangroves have now grown in size where their previous practices are unsustainable. Better health care, higher birth survival, migration to the coast and plain greed has led these communities to overexploit their limited resources.

I said earlier that the efforts being carried out currently in the East Asian Seas are rather like a band-aid on a great wound. What can be done? Rather

る (ChansangおよびPoovachirano共著1994)。海藻のありかを教えてくれるのは、ほとんどの国で絶滅しかかっているジュゴンである。

FAOによると、漁業努力は非常に盛んで、漁船の数を60%削減しても、現在と同じ漁獲高を上げることができる。削減される60%の船で操業していた人々をどうすればいいのか。彼らはどうやって暮らしていくのか。それでは、もう一度尋ねよう。今いる動植物がいなくなってしまうたら、未来の人間はどのようにして暮らしていくのだろうか。

珊瑚礁、海藻床、マングローブ林から取れる生物を利用してずっと幸せに暮らしてきた共同体が、かつての暮らしを続けられなくなる例が、最近増えてきている。医療が向上し、乳幼児の死亡率が低下し、沿岸域に人々が移住して過食気味になると、これらの共同体は限られた資源を乱獲するようになる。

今、東アジア海域でおこなわれている努力が単なる一時凌ぎにすぎないことは、すでに述べた。では、我々に何ができるのだろうか。かなり理想的ではあるが、近年、東アジア海域に供与されているあらゆる

る援助を利用して、人々にお金を払い、海洋環境の悪化させる行為を止めさせることができるだろう。しかし、もちろんそんなことは許されないし、社会構造と人間の尊厳の破壊につながる。しかし、この原則に関連する様々なテーマは機能するかもしれない。何事をするにも、上からも下からも刺激があるはずだ。共同体自身がこれら生態系を持続不可能な方法で利用している事実気づき、それに変わる方法を見つけることができるようにしなければならない。各国政府は、常に適切な法律を執行し、地域共同体に関連する新しい政策を生み出していく必要がある。支払った金が、実際に環境管理と回復のために使われるような利用者負担の政策を導入すべきである。環境に対する影響の評価を真摯におこない、独立した機関が検証しなければならない。

我々には何ができるだろうか。まず、資源の実態を把握し、海洋国立公園としてふさわしい地域を残しておくために、海洋動植物生息地の正確な地図を作らなければならない (Kirkman, 2000)。このような公園は、単なる公園以上の役割を果たすに違い

idealistically, we could use all the aid that is currently coming into East Asian Seas and pay people not to do the things that are degrading the marine environment. This is not, of course, acceptable and destroys social structure and dignity but themes on this principle may work. For anything to be done the impetus must come from the top and the bottom. The communities themselves must be taught to see the unsustainable use they are now putting these ecosystems to and be able see alternatives. The governments must start enforcing their usually adequate legislation and developing new policies that involve the communities. User pays policies should be introduced where the payments are actually returned for environmental management and restoration. Environmental Impact Assessments should be taken seriously and reviewed by independent reviewers.

What can be done? First the marine habitats should be accurately mapped so that resources can be measured and representative areas for marine national parks set aside (Kirkman, 2000). These parks must serve a purpose other than just being parks. They

may be buffer areas for fishing, conservation areas for large numbers of species, areas set aside as demonstrations for education, research or to illustrate the productivity that can be achieved given suitable management. Second the marine environment should be monitored to detect trouble spots, to determine background information when there is no disturbance, to determine the quantities of a pollutant entering the systems, and to determine the effects of remedial operations once it is decided to act to reduce pollution or disturbance.

The sea has been used as a dumping ground for decades, we cannot completely stop that but how much pollution and disturbance can the marine environment take? The usual definition of this is the assimilative or carrying capacity of the marine environment (Masini et al., 1992; GESAMP, 1986). This is the amount of a non-toxic man-made pollutant that can be dumped without unacceptable change. Of course "unacceptable" is a qualitative term that must be defined by managers before scientists and regulators can set a limit on the amount of pollution. Assimilative capacity ensures

ない。また、漁業のための緩衝地帯、多数の種の保全地域となる可能性があるし、あるいは環境教育や研究用に、または適切な管理がおこなわれれば達成できる多様な動植物の繁殖を分かりやすく説明するための場として確保しておくことになるかもしれない。第二に、問題の起こりやすい地域を見つけるために、環境に混乱が起これない場合はその遠因となる情報を確定するために、生態系に入り込んだ汚染物質の量を確定するために、そして汚染もしくは環境の混乱を削減するべく何らかの行動を起こすとの決定ができれば環境回復作業の効果を判断するために、海洋環境を監視しなければならない。

海は何十年もの間、ゴミ捨て場となってきた。我々は完全にそれをやめることはできない。しかし、海洋環境は、どの程度の汚染や環境の混乱に耐えられるのだろうか。これは通常、海洋環境の同化もしくは許容能力として定義される (Masini他1992; GESAMP, 1986)。これは、投棄しても受け入れられないほどの変化を起こさない、非毒性の人工汚染物の量である。もちろん、「受け入れられない」と

いう言葉は、科学者や規制担当者が汚染量の上限を決める前に、管理者が定義しなければならない量に関する用語である。同化能力がわかれば、それぞれの汚染源から入る量ではなく、汚染物質の総量が必ず考慮されることになる。すなわち、ある海藻の消失が受け入れられないほどの変化と判断され、1リットル中に含まれる2マイクログラムを超える硝酸性窒素 (nitrogen nitrate) が原因で、海中の植物を覆うように海藻が増え、結局海中の植物は死滅すると判断される場合、水中の濃度が2マイクログラム・アトムをこえないあいだは、何トンの硝酸塩を投棄できるかをただちに計算しなければならない。工場や下水からの出る全ての硝酸の合計を考慮したうえで、必要な規制をおこなわなければならない。

東アジア海域におけるUNEP EAS/RCUの役割

結論として、EAS/RCUの事務局には、参加各国からの支援と同じような価値しかないといえる。地域調整という概念は理解がむずかしく、その実施はもっとむずかしい。では、我々に何ができるのだろうか。我々は調整という言葉にどのような意味をこ

that the sum of pollutants is taken into account not the amount going in from each source i.e. if it is decided that loss of any seagrass is an unacceptable change and that nitrogen nitrate over 2 micrograms per liter will cause growths of seaweed over the seagrass which will eventually kill the seagrass, then a calculation has to be made as to how many tons of nitrate can be dumped before the water concentration exceeds 2 microgram atoms. The total of all the nitrate from factories and sewage dumping must then be taken into account and the necessary regulations made.

UNEP EAS/RCU'S role in East Asian Seas

In conclusion, the secretariat of the EAS/RCU can only be as good as the support from member countries. Regional coordination is a difficult concept to grasp and an even more difficult task to implement. What do we mean by coordination? Is the EAS/RCU expected to bring together every government agency, non government organisation, consultancy and donor to ensure that there is no overlap or duplication in projects designed to assist the marine environment.

Even if this were possible it is not likely that the EAS/RCU is large enough in staff and resources to carry out the task. The EAS/RCU is a UNEP agency whose mandate is to work on a regional basis. There is conflict between many government agencies and this is well out of a regional mandate to solve, as are the conflicts between different levels of government.

Ideally, the EAS/RCU should know of every activities directed towards managing, conserving, restoring and exploring the science of the East Asian Seas. This is impossible but it is always worthwhile having a dream.

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めているのだろうか。EAS/RCUは、すべての政府機関、非政府組織、諮問機関、資金提供者を協力させ、海洋環境を守る目的で作られた様々な計画が、部分的にあるいは全体的に重複しないようにすると思われているのだろうか。たとえそれが可能だとしても、EAS/RCUがその任にあたれるほど、十分なスタッフを擁し、十分な財源を持つことはないだろう。EAS/RCUは、UNEPの一機関であり、地域に基盤をおいた活動を任されている。多くの政府機関の間に対立があり、異なったレベルの政府間の対立と同じように、地域的な活動を行なう組織にゆだねられた権限では、その解決は不可能である。

理想を言えば、EAS/RCUは、東アジア海域の科学の管理、保全、回復および探査のためのあらゆる活動を把握しておくべきだろう。これは不可能なことだが、夢を持つことは、いつでもそれだけの価値があるものだ。



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瀬戸内海における沿岸域環境資源の保存と回復

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1. 瀬戸内海的环境変化

過去十年で瀬戸内海の水質は向上したが、干拓に起因する、藻場や干潟のような海生生物が豊富な地域での沿岸域環境資源の悪化が見られた。

1.1 水質

瀬戸内海の水質向上のために、特定のプラントの設置と稼働、COD物質の総排出量の規制、窒素とリン削減の行政指導といった規制同意システムの導入によって分離水及び非分離水の領域で汚染物質の排出は減少している。

これらの措置によって、産業部門からのCOD汚染物質の排出は瀬戸内海環境保全特別措置法が成立したときと比べると半分以下になり、污水处理場の建設や他の汚染防止措置が家庭から排出される汚水の量を着実に減らしている。

「赤潮」の発生は、瀬戸内海全体で頻繁に発生していた頃と比較すると、年間で平均発生数が40%に減少している。その結果、水を取り巻く環境は深刻な危機的汚染状態から比較的改善された状態に転じたと判断できる。

しかしながら、瀬戸内海の富栄養化の原因は、海

CONSERVATION AND RESTORATION OF COASTAL ENVIRONMENT RESOURCES IN THE SETO INLAND SEA

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1.Environmental Changes in the Seto Inland Sea

Past decade shows improved water quality but deteriorated coastal environmental resources in terms of most biologically productive areas such as seaweed beds or tidal flats due to land recreation in the Seto Inland Sea.

1.1 Water Quality

In order to improve water quality in Seto Inland Sea, pollutants emissions have been reduced by means of regulation-compliance system concerning installation and operation of specified plants, total mass flow control of COD matters, and administrative guiding for nitrogen and phosphorous reduction in all point

and non-point sources sectors.

Attributable to these measures, the COD pollutant loads from industrial sectors have been reduced to less than half the amount recorded when the Seto Inland Sea Environmental Conservation Act first went into effect, and progress in sewerage construction and other pollution prevention practices have also caused a steady reduction in the amount of domestic sewage loadings.

"Red tides" are also down to 40% of the average yearly number of occurrences compared to when these occurred frequently across the entire Seto Inland Sea. Consequently, water environment is judged to be turned into the relatively improved from severely polluted crisis situation.

に流れ込む有機汚染物質およびいわゆる「内部生産」と呼ばれるものである。これは窒素とリンの排出増による植物プランクトンの繁殖によって引き起こされている。その結果、近年ではCODの環境目標達成値においても、毎年の赤潮の発生においても変化がほとんどなく、瀬戸内海の水質は満足の行くレベルには達していない。さらに、減酸素塊がいくつかの海域で季節的に発生している。

1.2 藻場・干出平底地

保全特別法は、かなりの程度、藻場と干出平底地の保全に貢献しており、これは海洋生物資源の保護と渡り鳥の生息地での生存にとり重要な条件である。瀬戸内海保全特別法の発効以来、藻場と干出平底地の消失の進行は緩やかになったが、約1,300ヘクタールの藻場（全国消失面積の21%）および約800ヘクタールの干出平底地（全国消失面積の21%）が、1978年から1991年の13年間に瀬戸内海から失われている。

このうち、藻場の40%と干出平底地の70%は干拓および産業開発、港湾開発などによる浚渫等の人間の活動によって失われたものである。

1999年現在、瀬戸内海沿岸には約17,500ヘクタールの藻場と約11,700ヘクタールの干出平底地があり、それぞれ全国の9%および22%を占めている。

2. 環境政策の新しい潮流

日本では1993年に新しい環境基本法が、それまでの公害防止基本法に変わり制定された。これは環境管理に関する全国レベルでの基本理念、さまざまな経済部門の役割、主要政策および政策推進の措置を定めたものである。1994年にはこの法律を基礎にして環境基本計画が確立された。

環境基本法は、社会・経済活動に起因する環境への負荷を軽減する活動を呼びかけており、これは自発的な、あるいは同意に基づいた責任をすべての経済部門が等しく分かち合い、共同体、地域、および

However, eutrophication in the Seto Inland Sea results both from organic pollutants inflowing to the sea and from the so-called "internal production," i.e., phytoplankton propagation due to increase loading of nitrogen and phosphorous. As a result, there has been little change in recent years in either the level of achievement in environmental goals of COD or occurrences of red tides each year, and so the water quality in the Seto Inland Sea does not show satisfactory level. Moreover, oxygen-depleted masses occur on a seasonal basis in some areas.

1.2 Seaweed Beds/tidal Flats

The Conservation Act contributes to preserve, to the considerable extent possible, the seaweed beds and tidal flats that are important for conserving marine biological resources and fostering migratory birds in habitation space. Although the rate at which seaweed beds and tidal flats are disappearing has slowed since the Seto Inland Sea Conservation Act went into effect, approximately 1,300 hectares of seaweed beds (amounting to 21% of the loss nationwide) and approximately 800 hectares of tidal flats (21% of the loss nationwide) have disappeared from the Seto Inland

Sea during the 13 years between 1978 and 1991. Of these, 40% of the seaweed beds and 70% of the tidal flats were lost due to changes brought about by anthropological activities in the form of land reclamation, or dredging for industrial or port/harbor development.

There were only approximately 17,500 hectares of seaweed beds and approximately 11,700 hectares of tidal flats in the Seto Inland Sea coastal regions in 1999, amounting to 9% and 22% of the total in Japan.

2. New Trends in Environmental Policy

In Japan, in 1993 the new Basic Environment Law was established in place of the Basic Pollution control Law to indicate nationwide fundamental philosophy on environmental management, the role of various economic sectors, principal policies and means for promotion. In 1994, a Basic Environmental Plan based on this law was established.

The Basic Environment Law calls for actions to reduce the burden on the environment caused by socio-economic activities with the voluntary or compliance-based responsibilities equally shared by all economic

社会が環境、社会、経済の面で持続可能な発展を遂げることを目的とするものである。

この新法の掲げる究極的環境管理目標は、汚染防止や自然保護のような従来の概念よりはるかに進んだものである。環境管理の概念に関して、この法律は以下に述べる点の必要性を明らかにしている。

2.1 人間の住む環境の中の大気、水、土壌、生物圏、および自然環境の質、レベルおよび状態が十分満足の得られるものであることを確保する。

2.2 動植物の生物多様性を確保し、地域の自然と社会の状況に合致するさまざまなタイプの特徴的な自然環境を計画的に保全する。

2.3 レクリエーション、エコツアー、環境志向の高い活動などに一般市民が参加する機会を増やす。

3. 過去数十年に失われた環境回復の対策

藻場や干出平底地やその他の貴重な生態学的空間を回復する試験的試みが実践されてきた。さらに、

自然砂浜、釣り場およびその他の失われた自然と触れ合う場が回復され、環境にやさしいデザイン原則によって再開発されている。これらの活動は、次に述べる基本指針に基づき、十分に考慮して進めていかなければならない。

3.1 ターゲット地域

悪化した環境を回復するという観点から、これらの対策を進めるには、産業開発や港湾開発によって深刻な自然環境の悪化が起こった地域に焦点を当てなければならない。

3.2 プロジェクト遂行の組織

瀬戸内海の海域は公的に所有された土地であり、現在まで、環境管理の努力は国および地方公共団体によっておこなわれてきた。国および地方公共団体は、過去において損なわれた環境の回復に主導的役割を果たし続けなければならないが、同様に市民や

sectors, in order to develop communities, regions and societies with environmental and socio-economic sustainability.

The new law extends ultimate environmental management goals much further than the previous concepts of preventing pollution and protecting nature. Regarding environmental management concept, the law identifies the public need to :

2.1 Ensure the air, water, soil, biosphere and natural medium of human environment being maintained in satisfactory quality, level and condition ;

2.2 Ensure biodiversity of fauna and flora and preserve many types of characteristic natural environments systematically in accordance with the natural and societal conditions of the region ; and

2.3 Provide accessible opportunities for people to come in contact friendly with nature in recreation, eco-tours or environment-conscious actions.

3. Measures to Restore Environment Damaged in Past Decades

There have been trial practices to restore the seaweed beds, tidal flats and other precious ecological

spaces. Furthermore, natural sandy beaches, fishing spots and other places for contact with nature that have been lost, have been restored and sometimes re-developed on environment-conscious design principles. These activities must be based on the following basic guides for full consideration approach.

3.1 Targeted Regions

From the standpoint of restoring deteriorated environment, these measures promotion should focus on areas whose natural environment has been remarkably deteriorated due to industrial or port/harbor development.

3.2 Organization for Project Implementation

The ocean regions in the Seto Inland Sea are publicly owned, and up to now environmental management efforts have been conducted mainly by the national government and local governments. While the national government and local governments should continue to play a leading role in restoring the environments that have been damaged in past, it is important for them to coordinate these efforts with voluntary actions of citizens and private business sectors.

民間企業の自発的な活動との協調も重要である。

3.3 計画の実施

過去の活動の正の側面と負の側面を将来の目標とする環境を作るために必要とされる活動と統合することが重要である。藻場や干出平底地などの環境回復には時間がかかるため、これらの回復活動は中長期的な計画に基づいておこなわれなければならない。

3.4 適切な技術の選択

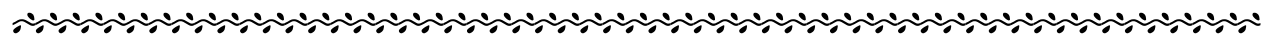
地形、資源利用パターン、水質、潮流、地域に生息する生物など、陸地と海洋の特性に基づいて適切な技術を選択しなければならない。環境改善の技術開発および回復工学の達成レベルは、工学的パフォーマンスと社会経済的実現可能性の視点から評価しなければならない。また、新しい視点から見たデザイン技術、建築技術の研究やパイロットケースによる試験的実験を通じた効果の確認も期待されている。

このような場合は、十分な研究をおこない環境に悪影響を与えない適切な時と場所でテストがおこなえるようにしなければならない。

3.5 持続可能な管理の適切な維持

自然環境は、回復されたものにせよ、包括的な保全措置によって一部開発されたものにせよ、適切に管理をおこない環境の完全な回復を図らなければならない。さらに、流体力学とエコロジカルな潜在効果が自然環境の人工的回復に関して、まだ科学的に実証されていないため、環境回復の効果とインパクトに関する研究は適切な監視を通しておこなわれなければならない。持続可能な沿岸管理のための健全な環境技術を開発し、改良し、蓄積していかなければならない。

(事務局仮訳)



3.3 Execution on Planned Scheme

It is important to integrate the past efforts having beneficial impacts and adverse effects with required actions towards target environment in the future. As environmental restoration of seaweed beds, tidal flats etc. will take time, these restoration actions must be done on a planned basis from a medium-and long-term perspective.

3.4 Selection of Adequate Technologies

Appropriate technologies must be selected based on land and ocean characteristics : topography, resources use patterns, water quality, tidal currents, the biological habitats in the area in the process of choosing measures. Achievement level of technologies development of environmental remediation and restoration engineering should be considered in this evaluation process from the viewpoint of engineering performance and socio-economic feasibility. Also promising is the study of design and construction technologies from new perspectives and the confirmation of their effectiveness through demonstration tests or pilot practices. In such cases, sufficient study should be conducted to ensure that the tests are done at an appropriate time and in

a location where they will not give adverse effects to the environment.

3.5 Adequate Maintenance for Sustainable Management

The natural environments that have been restored or partially developed in the comprehensive conservation practices must be appropriately maintained so that the environment continues to fully recover. In addition, as hydrodynamical and ecological potential effects of artificially recovering natural environments are not yet understood on the scientific base, the effects and impacts of restoring environments must be studied through appropriate monitoring, for the purpose of developing, improving and accumulating environmentally sound technologies for sustainable coastal management.

韓国における沿岸域の持続可能な管理に向けて

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開発志向の沿岸利用の結果、海洋生態系の悪化、干出泥質平底地の喪失、大規模かつ長期にわたる赤潮の発生などを引き起こした。このような問題およびその他の海事関連問題に、より効率的に対処するため統合的沿岸域管理（ICM）が1990年代中頃より国家計画要綱に取り入れられ、韓国政府は包括的な海洋問題を取り扱う海事問題・漁業省を1996年に設立した。

さまざまな沿岸域問題に適切に対応するため、海事省は1996年から1998年にかけて沿岸域評価プロジェクトを実施し、1999年初頭には沿岸域管理法を制定した。沿岸域管理法の機能は、沿岸域資源と空間の合理的利用に関する基本的・包括的ガイドラインを提供することである。本法は主として沿岸域の範囲、他の法律との関係、制定のプロセスおよび国家と地域レベルにおけるICM計画の内容、および沿岸域改

善計画ならびに定期的見直しを含むものである。

この法を基礎にして国家ICM計画が2000年9月に立てられた。国家ICM計画実施に伴う活動は既に実行されており、これらの活動には、例えば、沿岸域開発計画の中止、地方でのICM計画の立案、干出湿地帯保護地域指定のための包括的評価、沿岸環境管理地域（CEMA）の指定と管理、オーシャン・ 코리아21（海洋の持続可能な開発のための国家的枠組み計画）などが含まれている。こうした活動に加えて、海洋資源の持続可能な利用への一般市民の意識が高まり、地方政府を含む利害関係者がICMの実施に大きな関心を寄せている。故に、沿岸域管理法を含むICM計画が窓口となり、韓国沿岸域の持続可能な利用の機会が開かれることを期待することができる。



TOWARDS THE SUSTAINABLE MANAGEMENT OF COASTAL AREAS IN KOREA

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The development-oriented coastal utilization results in deterioration of marine ecosystem, loss of tidal mudflat, occurrence of large-scale and long-standing red-tides etc. To deal with such problems and other maritime related affairs more efficiently, integrated coastal management (ICM) system has been incorporated into national planning regime since the mid 1990s, and Korean government created the Ministry of Maritime affairs and Fisheries in 1996 for comprehensive handling of marine issues.

To adequately respond to various coastal issues, the Ministry carried out coastal assessment projects from 1996 to 1998, and enacted the Coastal Management Act in early 1999. Coastal Management Act functions as a framework act that provides fundamental and comprehensive guidelines on rational use of coastal resources and space. Main components of the Act include the scope of coastal areas, relationship to other laws, establishment process and contents of ICM

plan at national and local levels, and coastal improvement projects and periodic evaluation.

The National ICM plan based on the Act was established in September 2000. Concomitant actions to the National ICM plan implementation are being executed, e.g., cancellation of major coastal development projects, establishment of local ICM plans, comprehensive assessment for designation of tidal wetland protected areas, designation and management of Coastal Environmental Management Areas (CEMA), establishment of Ocean Korea 21 (the national framework plan for the sustainable development of ocean) etc. In addition to the above actions, public awareness on sustainable use of marine resources has been enhanced and stakeholders including local governments have paid serious attention to ICM implementation. Thus it can be expected that the ICM regime inclusive of Coastal Management Act will be a window of opportunity for sustainable use of coastal areas in Korea.

インドネシア東部における共同体を基盤とした管理 「サジ」の復活

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本稿はインドネシア東部沿岸域における高瀬貝 (Trochus niloticus) の管理問題を明らかにし、政策オプションを提案するものである。本稿では二つの管理システムを検討する。そのひとつは「限定的収穫プラン」であり、これは「サジ」という共同体の伝統を引き継ぐものである。もうひとつはインドネシア政府の立案による「非収穫政策」である。

「サジ」のシステムでは、収穫制限が地方固有の価値に基づいた規制に従って、共同体が実施する強制力を伴った形で行われる。このシステムは、かつてはうまく機能していたが、現在では高瀬貝の繁殖を持続させるには非効率的なものになっている。その理由は地元共同体が高瀬貝の価格変化に対応する適切な収穫調整を行う基盤を失いつつあるからである。政府の政策では、政府諸機関の強制により収穫禁止が実施されているが、この政策も非効率的になって

きている。その理由はそれが収穫を維持したいという地元住民からの圧力と衝突するからである。ここで提示される政策オプションは、共同管理の枠組みを通じて「サジ」に科学的見識を与え、収穫禁止を解除するというものである。また、本稿では、このオプションを実施する広範な機会が存在することが述べられている。コンピューターによるシミュレーションの結果、収穫禁止をするよりもある程度収穫をする方がよいという結果がでている。さらに、ある調査によるとこのシミュレーションの結果や他の科学的情報を「サジ」に組み込むことが望ましいという指摘がある。こうしたシミュレーションで得た科学的情報を、外部の専門家のものでなく共同体のものにする共同管理を成功に導くほとんどの要因は成功の可能性を示唆している。

REFASHIONING SASI, A COMMUNITY-BASED MANAGEMENT IN EASTERN INDONESIA

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This paper exposes management problems of trochus (Trochus niloticus) in coastal areas of Eastern Indonesia, and suggests a policy option. Two management systems are reviewed : limited harvest plans which follows a community tradition called sasi ; and no-harvest policy designed by the Indonesian government. In the sasi system, harvest restrictions are placed with enforcement carried out by communities according to regulations derived from local values. This system, once worked quite well, has now become ineffective in promoting trochus sustainability because communities are loosing basis to make proper harvest adjustments in response to changes in trochus price. In the government policy, harvest banning is in effect with enforcement performed by government agents.

This policy, too is ineffective because it collides with local pressures to maintain harvests. The policy option proposed here is that scientific knowledge is added to sasi through a co-management framework, and that harvest banning should be canceled. It is shown in this paper that there is a range of opportunity to implement such an option : A computer simulation shows that certain rates of harvest are better than banning. Furthermore, a survey indicates that the prospect of incorporating this simulation result, or other scientific information, into sasi is good : Most factors determining success of co-management that would allow transfer of such simulation scientific inputs, to communities from external experts are positive.

南シナ海における沿岸域および海洋環境管理 ADB5712REGの諸目的 第二段階－カンボジア・コンポーネント

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本稿はカンボジア王国における、アジア開発銀行による地域技術援助の第一段階において行われた、幾つかの重要な勧告を実施するためにおこなわれたプログラム（ADB 5552-REG、南シナ海における沿岸域および海洋環境管理/1994年2月から1996年6月実施）の活動を要約したものである。この地域に対する技術支援の目的は以下のとおりである。

- 1) 南シナ海の西側における沿岸域・海洋資源の持続可能な利用の推進
- 2) 沿岸域・海洋環境資源の保護と管理の地域協力の推進
- 3) 沿岸域・海洋環境資源の持続可能な管理のための地域的技術支援の参加国の能力の向上

環境省（MoE）がカンボジアにおけるこのプログラムの執行機関であった。環境省は1999年2月から2000年3月まで、グローバル環境コンサルタント（GEC）株式会社およびウェットランド・インターナショナル－アジア太平洋からの技術支援を受けていた。カンボジアにおけるこのプロジェクトの主要な成果は沿岸域・海洋環境管理および沿岸・海洋保護地域設立の国家的戦略プランであった。これらの計画の準備は、幾つかの活動の支援を受けており、その中にはプレア・シアヌーク国立公園における実験プロジェクトが含まれ、これは戦略的保護地域の計画において推奨されている幾つかの主要な手法を試すためのものであった。

OBJECTIVES OF ADB5712REG COASTAL AND MARINE ENVIRONMENTAL MANAGEMENT IN THE SOUTH CHINA SEAS, PHASE II - CAMBODIA COMPONENT

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This paper summarizes the activities conducted in the Kingdom of Cambodia under the Asian Development Bank programme designed to implement a number of the important recommendations made in the first Phase of this regional technical assistance (ADB 5552-REG, Coastal and Marine Environmental Management in the South China Sea, February 1994 to June 1996). The objectives of this regional technical assistance were to i) promote the sustainable use of coastal and marine resources in the western portion of the South China Sea ; ii) promote regional cooperation in the protection and management of coastal and marine environmental resources ; and iii) increase the capacity of countries participating in the regional technical assistance to manage their coastal and marine

environmental resources on a sustainable basis. The Ministry of Environment (MoE) was the Executing Agency in Cambodia for the programme. It was supported by technical assistance from GEC Global Environmental Consultants Ltd. and Wetlands International - Asia Pacific from February 1999 to March 2000. The major outputs of the project in Cambodia were a national strategic plan for coastal and marine environmental management and a national coastal and marine protected area plan. The preparation of these plans was supported by a number of activities including a demonstration project in Preah Sihanouk National Park to test some of the key approaches recommended in the strategic and protected area plans.

カンボジア・コーコン県のペラム・クラサオップ自然保護地域における マングローブ資源の参加型管理に関する技術レポート

キム・ノン

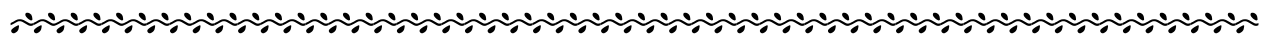
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マングローブ資源の参加型管理 (PMMR) のプロジェクトが1997年12月にコーコン県にあるペラム・クラサオップ自然保護地域 (PKWS) において実施された。国家環境省スタッフ、県の技術スタッフおよびカナダ人プロジェクト・アドバイザーにより構成された学際的チームが、持続可能な生計および管理の問題に焦点を当てたPKWSの参加型研究 (PR) のプロセスを促進している。資金提供者であるカナダの国際研究開発センター (IDRC) の提示した条件の一つは、PMMRの研究を技術レポートの形式で文書化するというものであった。それゆえ、この技術レポートは1997年12月から2000年2月までPMMRチームによって行われた研究の集大成となっている。

また、コーコン県、保護地域 (PA's) 管理、共同体を基盤とした沿岸域資源管理 (CBCRM) イニシアチブ、および持続可能な生計の問題に関心のある人たちが、この事例から学びさらに研究を進めることが期待されている。

PKWSはユニークなマングローブ生態系を誇りにしており、1993年にはカンボジアの保護地域 (PA's) のシステムの一部に指定された。この地域はかつては天然資源が豊富であったが、違法な採取活動によりマングローブ生態系およびその資源に依存する共同体の生計は脅威にさらされている。このプロジェクトはPKWSの資源利用について理解を深める試みとして、また生計と資源管理活動に関して、共同体



TECHNICAL REPORT ON PARTICIPATORY MANAGEMENT OF MANGROVE RESOURCES IN PEAM KRASAOP WILDLIFE SANCTUARY, KOH KONG PROVINCE, CAMBODIA

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The Participatory Management of Mangrove Resources (PMMR) project was implemented in Peam Krasaop Wildlife Sanctuary (PKWS), Koh Kong province in December 1997. Consisting of national Ministry of Environment staff, provincial technical staff and Canadian project advisors, this inter-disciplinary team facilitates a participatory research (PR) process in PKWS focusing on sustainable livelihood and management issues. One of the requirements from the funder, Canada's International Research Development Center (IDRC), is that PMMR's research be documented in the form of a Technical Report. Hence, this Technical Report compiles research undertaken by the

PMMR team from December 1997 until February 2000. It is hoped that those interested in Koh Kong province, Protected Areas (PA's) Management, Community-based Coastal Resource Management (CBCRM) initiatives and sustainable livelihood issues can learn and further this research.

PKWS boasts a unique mangrove ecosystem, and was designated as part of Cambodia's system of PA's in 1993. Although this area was once rich in natural resources, illegal extraction activities threaten the mangrove ecosystem and the livelihood of communities dependent upon its' resources. This project was established as an attempt to learn more about resource

との協力を推進する試みとして設立されたものである。このレポートは読者にPMMRプロジェクトの目的と活動を紹介するものである。さらに重要なことは、このレポートでは、このリサーチ・プロセスを通じて用いられた研究の方法論が議論され、分析されているという点である。このプロジェクトはPMMRチームによって進められ、地元のイニシアチブおよび可能な選択肢を文化の視点から見て適切な形で支援するものである。このプロジェクトは過程と結果の両方を重視して実施されている。

コーコン県はカンボジアの他の諸地域とは隔離しており、比較的人口が少ない。近年までPMMRプロジェクトが行われているコーコン県の東部地域にはボートでしかアクセスできなかった。破壊をもたらしたクメール・ルージュ（KR）の政権が倒れた後、一部の農民がカンボジア各地の土地不足のために、沿岸域にある豊潤な資源により生計を立てることを期待して、コーコン県に移住して来た。しかしながら、マングローブと水辺資源に関心を抱いたの

は移住者と地元住民だけではなかった。タイからのビジネスの圧力もあったのである。水辺資源、木材、違法に生産されたマングローブの木炭を含む、PKWSのほとんどの資源は、タイの市場に売られていったのである。カンボジア人は金儲けをすることを期待して、この地域に魅力を感じ続けているのである。不幸なことに、資源は急速に枯渇し、現在ではPKWSの資源から生計を立てることは困難になっている。

PMMRチームはPKWSにあるいくつかの村で調査をおこなった。自然保護地域の村人たちは、それぞれの村の固有の特徴にもかかわらず、互いに結びついている。PKWSに村人が住むにはさまざまな理由があった。あるものは長期的居住者として、また資源を利用しやすいために、また漁業に従事できるので、また政府の公務員なので（海軍、陸軍、警察、政府職員）、あるいはまたこの地域に住む家族を頼って移り住んだのである。ここに移り住んだ移住者の一部はPKWSを故郷と考えている。その一方で自分の生まれ故郷に帰るプランを持っている人もいる。

usage in PKWS, and to work with communities on livelihood and resource management activities. This report introduces the reader to PMMR project goals and activities. Importantly, the research methodology employed throughout the research process is discussed and analyzed. This project is driven by the PMMR team, and supports local initiatives and potential alternatives in a culturally appropriate manner. This project is both process and output driven.

Koh Kong province is isolated from other parts of Cambodia and relatively unpopulated. Until recently, one could only access eastern Koh Kong province, the area where the PMMR project works, via boat. After the catastrophic Khmer Rouge (KR) regime some villagers, faced with landlessness in other parts of Cambodia, migrated into Koh Kong hoping to earn a living from the lush resources found in the coastal area. However, migrants and local villagers were not the only people interested in mangrove and aquatic

resources - there is also business pressure from Thailand. Most resources from PKWS, including aquatic resources, logs and illegally produced mangrove charcoal, are sold to the Thai market. Cambodian's continue to be lured to the area in the hopes of making a profit. Unfortunately, resources have been rapidly depleted, and it is now difficult for local people to earn a livelihood from resources in PKWS.

The PMMR team has worked in a series of villages in PKWS. Villages in the Wildlife Sanctuary are inter-connected, although villages definitely hold their own unique characteristics. Villagers live in PKWS for a variety of reasons : as long-term residents, for resource extraction opportunities, for fishing opportunities, for government work (navy, military, police, government officials) or following family to the area. Some in-migrants consider PKWS their home whereas others plan to return to their birth province. Understandably, villagers hold different interests and

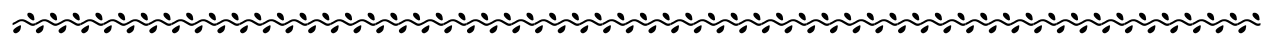
村人たちの環境に対する関心と関係が異なるのは当然のことである。環境への関心が高まるにつれ、村人たちにも政府機関にもPKWSのマングローブ資源を保護するために行動を起こさなければならないという要求が高まってきている。これ自体は積極的な一歩であるが、資源の利用により大きな利潤を得ている「権力者」集団に、資源保護イニシアチブが長期的には利益になるということを説得することが、依然として残された課題である。

PKWSにはさまざまなマングローブ種、水辺生物、陸上生物、サンゴ、海藻、水鳥が生息しており、これは極めて多様なすばらしい生態系である。PKWSの地元住民が持っている伝統的知識の多くはKRと急速な移住民の流入によって失われてしまった。しかしながら、この地域への新参者でも環境に関する断片的な知識は持っており、長年の努力の蓄積の結果、人々は異なるマングローブ種とその利用に関する知識を持つようになってきている。マングローブ種の主要な用途は木炭の生産であり、それはタイの市場

に売られて行く。また、マングローブの木材は家屋の建築、木炭と緑のイガイ類の養殖に用いられている。

残念なことに、水辺資源は急速に枯渇してもいる。カンボジアとタイの트롤船による非合法的な沖合い底引き網漁は、海底を壊し、水生動植物の深刻な減少を助長している。地元の漁民の漁にでる時間は、10年前と比べて非常に長くなっている。魚の減少に伴って、一部の漁師は漁獲高を増やすために、非合法的なシアン化合物や手榴弾を使った漁法をおこなうようになってきている。

これらの問題を解決する方法はおそらくあるだろう。例えば、小さな漁具を使って海藻床やサンゴを守り、捕らえた魚が無駄になるのを最小限にすることができる。木炭生産のための植林も、考えられる解決策の一つである。また、政府当局や地元住民がマネージメント・イニシアチブを考慮しているので、そうすると養殖事業もおこなうことができる。限定されたテストが過去2年間におこなわれてきたが、



connections with their environment. As environmental awareness has increased, there is a growing demand from both villagers and government authorities to work towards measures that will protect the mangrove resources of PKWS. While this is a positive step, it remains a challenge to convince 'power' players who benefit greatly from resource extraction of the long-term benefits of resource conservation initiatives.

PKWS is diverse in mangrove species, aquatic species, upland species, corals, sea grass and waterfowl. This is a diverse, fascinating ecosystem. Much of the traditional knowledge held by local residents in PKWS has been lost because of the KR and the rapid immigration into the area. However, even new-comers to the area hold bits and pieces of environmental knowledge, and as a cumulative effort people are able to shed insights into different mangrove species and how they can be used. The predominant use of mangrove species is for charcoal production that is

then sold to the Thai market. Also, mangrove wood is used for house construction, charcoal and green mussel culture.

Unfortunately, aquatic resources are also rapidly depleting. Illegal offshore trawling activities from both Cambodian and Thai trawlers wreck the sea-bottom and contribute to the significant decline in aquatic species. Local fishers now spend far more time fishing than they did ten years ago. In response to fish declines, some local fishers are resorting to illegal cyanide and grenade fishing in the hopes of earning higher fish returns.

Perhaps there are ways to address some of these issues. For example, small-scale fishing gear helps to maintain sea grass beds, corals and minimize the waste fish that are caught. Silviculture for charcoal production is another possibility. And, as government authorities and local people consider management initiatives, aquaculture activities can then be possible.

夜間のPKWSには安全上の問題がある。さらに市場調査を進めれば、市場の変動およびタイ市場に出荷できる可能性のある種が分かるようになるであろう。

環境保護を支援する立法には限界がある。一部の法案は起草中であつたり、つい最近成立したばかりであるが、こうした法的文書の配布は最小限に抑えられている。さらに、文書がプノンペンで作られているので、しばしば地方や沿岸諸共同体のニーズに適合しないことがあるのである。「保護地域管理の準法令」案は、どの資源がどこで利用可能なのかを示すゾーニング・システムを通じてPKWSの住民に影響を与えることになるだろう。法律は重要ではあるが、それと同様に重要なのは、地元住民が資源保護策に基づき行動することを可能にするシステムの構築である。幸運なことに、このコンセプトはカンボジアにおいて支持を得つつあり、共同体が資源保護策に関して関連する諸機関と共に活動することが期待される。

この技術レポートの最終的承認は、PMMRプロ

ジェクト・レビューの第一段階と時を同じくしておこなわれた。新たな共同体を基礎とした沿岸域資源管理(CBCRM)および参加型研究(PR)のコンセプトがマングローブ資源参加型管理(PMMR)チームにとっていかなるものかを考え、ベアム・クラサオップ自然保護地区(PKWS)がどれほど隔絶した地域にあるかを考えると、非常に多くのことがこの2年間で達成されたと言える。このチームは更に技術支援を必要としているが、PMMRチームの努力によって、地元、県、国家レベルの機関が地元住民から学び、対話することが可能になるプロセスが促進されていったのである。住民は地元でイニシアチブを取ることを奨励されているため、実際に、PKWSの共同体から学べるが多くなっている。村人たちが自らの問題を分析し、ますます自信をもって自らの考えや解決方法を発表して行くにつれて、資源保護の技法を維持しながら、収入を生み出す活動を可能にする方法が見つけられるようになっている。

A limited amount of testing was introduced during the past two-years, although siting is a problem given security issues in PKWS at night. Further market surveys will shed insight into how the market fluctuates and potential species that could be sold to the Thai market.

Legislation supporting environmental protection is limited. Although some legislation is either being drafted or has just been passed, dissemination of these legal instruments is minimal. Moreover, legislation is drafted in Phnom Penh and often does not meet the needs of rural, coastal communities. The draft sub-decree on Protected Area's Management will affect villagers in PKWS through a zoning system that dictates what resources can be used where. Although legislation is important, it is equally important to develop systems that allow local villagers to work on resource protection measures. Fortunately, this concept is gaining ground in Cambodia and it is hoped that

communities will be able to work with relevant authorities in resource protection measures.

The finalizing of this Technical Report coincided with an internal phase 1 PMMR project review. Considering how new Community-based Coastal Resource Management (CBCRM) and PR concepts are for the PMMR team and how isolated PKWS is, a lot has been accomplished over the two-year period. While the team continues to need more technical support, the PMMR team has facilitated a process that enables local, provincial and national level government authorities to learn from and dialogue with local people. Villagers are being encouraged to take local initiatives ; indeed, a lot can be learned from the communities of PKWS. As villagers analyze their problems and become more confident in voicing their ideas and solutions, measures allowing for income generation activities while supporting resource conservation techniques can be found.

ベトナムにおける海洋保護域の状況と将来

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ベトナムにはすでに沿岸と海洋地域に位置する23の保護地域がある。この中で、1ヶ所は世界遺産として、もう1ヶ所はユネスコの生物圏保護地域、後の1ヶ所はラムサール地域として、また2ヶ所は国立公園として指定されている。しかしながら、海洋保護地域システムは公式にはまだ確立されていない。R@Rプロジェクトの基準に基づくと、良く管理されていると考えられる地域は2ヶ所に過ぎず、13ヶ所の管理効率は中程度とされている。ADB5712-REGプロジェクトはベトナム沿岸域・海洋保護地域(MPA)プランおよび海洋保護地域(MPA)プランを作成したが、それによると8ヶ所の既存の保護地域の海洋部分の拡大が提案され、6ヶ所の新しい保護地域を設け、20ヶ所の優先エリアの管理を実

施している。このプランの実施によって保護されるべき海洋エリアは43,400ヘクタールから263,312ヘクタールへと拡大されることになる。漁業省に権限が与えられ、11ヶ所の新しい保護地域の設定とともに、さらに海洋環境に焦点を当てたMPAシステムの作成を命じられた。近年、ベトナム政府と海外の援助機関はベトナムの海洋保護地域にさらに多くの関心を払っている。例えば、世界銀行はホン・ムン地域を「ベトナムにおける試験的海洋保護地域(MPA)」プロジェクトを実施する地域として選んだ。将来の沿岸域生態系の効率的管理のために、MPAの発展にさらなる支援が得られるものと期待されている。

STATUS AND PROSPECTIVE OF MARINE PROTECTED AREAS IN VIET NAM

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Viet Nam has 23 existing protected areas located in the coastal and marine regions. Among them, there were one area recognized as World Heritage, one as UNESCO Biosphere Reserve, one as Ramsar site and two as National Park. The marine protected area system, however, has not been established formally. Based on the criteria of R@R project, only two areas were considered being good management and 13 ones belong to medium level of management effectiveness. The project ADB 5712-REG compiled the Viet Nam Coastal and Marine Protected Area (MPA) Plan, in which there were proposals to extend marine component of 8 existing areas, new establishment of 6 areas and management enforcement of 20 priority

areas. The marine areas to be protected will increase from 43,400ha to 263,312ha after implementing the plan. The Ministry of Fisheries has been authorized to prepare the Plan for MPA System with more focus to marine environment with 11 areas proposed as new establishment. Recently, Viet Nam Government and oversea donors are paying more attention to marine protected areas in Viet Nam. For example, World Bank selected Hon Mun to implement the project "Pilot Marine Protected Area (MPA) in Viet Nam". More support has been expected to develop MPAs for effective management of coastal ecosystems in near future.

ブルネイ・ダルサラーム国の海洋生態系の社会経済的重要性

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ブルネイ・ダルサラーム国は南シナ海に面した小さな沿岸国である。ブルネイ・ダルサラームは大きな汚染から保護され、台風の進路から離れた自然のままの海洋生態系に恵まれている。その130キロの海岸線から広がる38,600平方キロメートル以上の海洋環境を有し、海洋生態系とそれに伴う資源は管理と持続可能な保存の最優先事項となっている。ブルネイ・ダルサラームは、海洋資源がほとんど開発されていないという点で幸運である。

しかしながら、これらの資源を十分に開発しよう

とする圧力が、政府の方針である経済の多角化により徐々に強まっている。近隣諸国の経験から見て、ブルネイ・ダルサラームはこれらの資源を持続可能な方法で開発する覚悟を決めることができる。ブルネイ・ダルサラームの沿岸域の統合的管理プランは、国がこれらの資源を無制限な開発から確実に保護することに努力をしている証拠である。このプランの下で、生態系と資源の管理に十分な注意が払われている。



THE SOCIO-ECONOMIC IMPORTANCE OF THE MARINE ECOSYSTEMS OF BRUNEI DARUSSALAM

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Brunei Darussalam is a small coastal state fronting the South China Sea. Brunei Darussalam is blessed with pristine marine ecosystems that are well protected from major pollution and away from the path of typhoons. With an area of more than 38,600 sq. km of marine environment projected by its 130 km coastline, the marine ecosystems and associated resources are of prime concern to be managed and conserved sustainably. Brunei Darussalam is fortunate that most of its marine resources remain under exploited.

However, the pressure to fully exploit these resources is increasing in line with the government's effort to diversify its economy. With lessons learned from neighbouring countries, Brunei Darussalam can prepare itself to develop these resources in a sustainable manner. The Integrated Management Plan for the Coastal Zone of Brunei Darussalam is a testimony of the country's effort to ensure that these resources are safeguarded against uncontrolled exploitation. Under the Plan, the management of the ecosystems and resources are given due attention.

メコン川河口域におけるマングローブの持続可能な管理のための 解決策に関する考察

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メコン川には主要な河口が9つあり、南ベトナムのメコンデルタの沿岸地域におけるユニークな河口域を形成している。この河口域は地元住民によって巨大な米作地帯に横たわる「9匹の竜」と呼ばれており、ほとんどがメコン川河口域の沈泥の沖積土であり、マングローブが長い時間をかけて生育している。

マングローブは生態学的バランスを維持するダイナミックな役割を果たしており、沿岸域における自然災害を軽減するのに役立っている。一方、マングローブ林を切り倒すことなく、豊かな実りが地元共同体の生計を助けている。

この地域のマングローブは、戦争とそれに続く常

軌を逸した新経済地域開発計画によって非常に大きな打撃を受けた。1990年以來のベトナムの国家戦略の見直しの期間に、最重要政策の一つとして「エコロジーと経済の安定したバランスを保ち、環境破壊に敏感な沿岸地域および上流の分水嶺地域に焦点を当てる」という政策が打ちだされた。メコン川河口域のマングローブは、いくつかの成功を収めた政策と地元住民とのマングローブの共同管理と開発に重点をおいた効果的な解決策によって、開発され保護されてきた。ベトナム最大の都市であるホー・チ・ミン市の近くにある30,000ヘクタールのマングローブ林の一部はユネスコの生物圏保護地域に指定されたばかりである。

HOW AND WHAT SOLUTIONS FOR SUSTAINABLE MANAGEMENT OF THE MANGROVES IN MEKONG RIVER ESTUARIES

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There are nine major mouths of the Mekong River as unique estuaries on Coastal zone of Mekong delta in Southern Viet Nam, which was named by local people as "Nine Dragons" laying in large rice-field. Almost alluvium of the Mekong river silt on estuarine areas where mangroves develop time by time.

The mangrove have functional dynamic role in ecological balance maintaining and could mitigate so much natural disasters in coastal zones. Other side, almost wealthy useful products without logging in mangrove forest could be real livelihood for local communities.

The mangroves of those areas used to be destroyed seriously by warfares and next unreasonable new economic zone development planning. During

renovation of state strategy trend in Viet Nam, since 1990 up to now, one of the most importance policies as "Must keeping the stable balances between Ecology and Economy, focused sensitive areas Coastal Zones and upper Watershed Areas". The mangroves of Mekong river estuaries have being developed and protected with different successful policies and effective solutions which emphasize on local communities joint management and development of mangroves, where are their clear benefits and responsibilities. One part of that mangrove system as over 30,000 hectares of area nearby of biggest city of Viet Nam as Ho Chi Minh City has just identified by UNESCO as Biosphere Protected Areas.

生物多様性条約のジャカルタ・マンデートおよび 東アジア海域におけるその実施

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海洋と沿岸域生物多様性に関するジャカルタ・マンデートは、海洋と沿岸域の生物多様性の重要性に関するグローバルなコンセンサスであり、生物多様性条約の実施に関する閣僚宣言の一部である。これは1995年11月にジャカルタで開かれた締約国会議（COP）の第二回会合で採択されたものである。ジャカルタ・マンデートのプログラムには五つのテーマが含まれ、統合的海洋・沿岸域管理（IMCAM）、海洋・沿岸域生物資源（MCLR）、海洋・沿岸域保護区域（MCPA）、海中養殖/海面養殖および不明

種であり、これらは海洋と沿岸域の生態系が直面する問題の軽減を支援する目的で展開されたものである。本稿は海洋と沿岸域の生物多様性の重要性およびこの地域の海洋と沿岸域の資源の現状を概説するものである。COPの第四回会合で採択されたジャカルタ・マンデートの作業プログラムおよび最近開かれた第五回会合で採択されたプログラムも詳述する。



THE JAKARTA MANDATE OF THE CONVENTION ON BIOLOGICAL DIVERSITY AND ITS IMPLEMENTATION FOR THE EAST ASIAN SEAS REGION

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The Jakarta Mandate on Marine and Coastal Biological Diversity is a global consensus on the importance of marine and coastal biological diversity and is a part of the Ministerial Declaration on the implementation of the Convention on Biological Diversity, as adopted by the Conference of the Parties (COP) at its second meeting held in Jakarta in November 1995. The programme of the Jakarta Mandate covering the five themes namely Integrated Marine and Coastal Area Management (IMCAM), Marine and Coastal Living Resources (MCLR), Marine and Coastal Protected Areas (MCPA), Mariculture, and Alien

Species, are developed to assist in mitigating the problem faced by marine and coastal ecosystem. The paper outlines the importance of marine and coastal biological diversity and status of the marine and coastal resources in the region. The programme of work for the Jakarta Mandate as adopted during the fourth meeting of COP as well as the recent programme adopted at COP5 will be elaborated.

Qiulin Zhou

韓国における沿岸海洋生態系の保護と管理の法的枠組み

バン・タエ・ジン

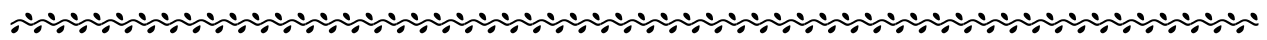
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1996年に統合的海洋管理のために海事問題・漁業省 (MOMAF) が創設されて以来、韓国政府は沿岸域海洋生態系の保護と管理のための法的枠組みを強化してきた。政府が取った主なイニシアチブには、「湿地帯保存法 (1999)」、「沿岸域管理法 (1999)」および「海洋汚染防止法」の修正が含まれている。これらのイニシアチブは、海洋生態系の質の低下や人の手による損傷に関して、さまざまな利害関係者が存在するという認識によって推進されてきた。本稿は沿岸海洋生態系の保護と管理に対する韓国の法

的枠組みの分析を試みるものである。分析の焦点は、「海洋汚染防止法」、「自然環境保存法」、ならびに「湿地帯保存法」にあてられており、これらは沿岸海洋生態系に関する三つの主要な法律である。包括的な概論が、それぞれの法の枠組み、沿岸海洋生態系の保護と管理に関する主要な介入および関連する諸機関の責任について展開され、さらに、それぞれの法に基づいて実行される政策実施手段および実施活動を説明し、評価をおこなう。



LEGISLATIVE FRAMEWORK FOR THE PROTECTION AND MANAGEMENT OF COASTAL MARINE ECOSYSTEMS IN KOREA

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Since the creation of integrated ocean governance, the Ministry of Maritime Affairs and Fisheries (MOMAF) in 1996, Korean government has strengthened the legislative framework for the protection and management of coastal marine ecosystems. Major initiatives include the enactment of 'Wetland Conservation Act (1999)' and 'Coastal Management Act (1999)' and the amendment of 'Marine Pollution Prevention Act'. These initiatives have been fostered by a wide recognition of various stakeholders on the degraded quality of marine ecosystem and the impaired human uses. This paper attempts to analyze the

legislative framework of Korea for the protection and management of coastal marine ecosystem. The focus of analysis has been given on 'Marine Pollution Prevention Act', 'Nature Environment Conservation Act' and 'Wetland Conservation Act', which are the three major laws regarding coastal marine ecosystem. Comprehensive description is given on the framework of each law, major interventions for protection and management of coastal marine ecosystem, and responsibilities of concerned agencies. In addition, policy measures and implementation activities taken according to each law are described and evaluated.

沿岸域海洋生態系の保護と管理に関する ミャンマーの環境関連法と規制の役割 問題と制約

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ミャンマーでは、環境問題担当の省庁を創設する過程に入っているが、一方では環境問題国家委員会(NCEA)が環境問題を扱う政府の中核・調整機関として活動している。環境保護法はまだ公布されていないが、現在のところ環境保護の内容を持つ部門別のいくつかの法律と規則がある。これらの既存法規は、持続可能な海洋資源の管理という視点が欠けているか、沿岸域海洋生態系の保全と管理に関して、効力がないものとみなされている。地域の事情に合わせて作られた、一つの経済部門だけを開発する沿岸地域全体に見られる開発活動は、部門別に定められた環境保護法規に必ずしも一致するものではない。さらに、地方の社会経済的活動、越境貿易、国境地域の再居住化プログラムが生態系の全面的な環境悪化を助長していないとは言えない。社会経済的發展

と沿岸域海洋生態系との調和を達成するために、こうした問題は適切に取り組みなければならないが、さまざまな障害が依然として残っている。それゆえ、既存の環境関連法の役割が生態系の保護にとって極めて重要になっている。しかしながら、実際には、これらの法規の実施と執行の効果はその限界により大きく減少するのである。不十分な財政と人的資源、弱い執行力と法律の適切なメカニズムの欠如あるいはその不完全さが重大な困難の原因としてあげられるように思える。法の執行と沿岸域の管理が非効率的になれば、ベンガル湾とアンダマン海の生態系は極めて大きな危険に直面することになると言える。本稿は関連する主要な問題と制約について論じ、あわせて現在の諸問題に対処するために採りうる管理戦略を提案するものである。

THE ROLE OF MYANMAR'S ENVIRONMENT RELATED LAWS AND REGULATIONS IN PROTECTION AND MANAGEMENT OF COASTAL MARINE ECOSYSTEMS : ISSUES AND CONSTRAINTS

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Myanmar is in the process of forming Ministry level Environment body while National Commission for Environmental Affairs (NCEA) serves as a national focal point and coordinating agency for environmental matters. Although environmental protection law is yet to be promulgated, currently, there are several sectoral laws and regulations that contain portions on environmental protection. These existing laws are either lacked in vision of sustainable management of marine resources or considered weak especially in the area of prevention and management of coastal and marine ecosystems. Localized uni-sectoral development activities across nation's coastal areas are not always in line even with environmental regulations defined in sectoral laws. In addition, local socio-economic activities, trans-boundary trade and border area rehabilitation programmes are not less in contributing overall environmental degradation to the ecosystems. Whilst the issues need

to be addressed properly in order to achieve harmony between socio-economic development and protection and management of coastal marine ecosystems, various obstacles still remain. Therefore, the role of currently available environment related laws have become vital in protection of the ecosystems. However, in practice the effectiveness in implementation and enforcement of those laws are largely reduced by limitations. Insufficient financial and human resources, weak enforcement and lack or incomplete appropriate mechanism in laws appear as major difficulties. If enforcement of the laws and management of coastal zones become ineffective, the future of the Bay of Bengal and the Andaman Sea ecosystems are at high risk. This paper discusses related major issues and constraints, and provides with possible management strategy to deal with current problems.

日本における沿岸管理システムと生態系保護

荏原明訓

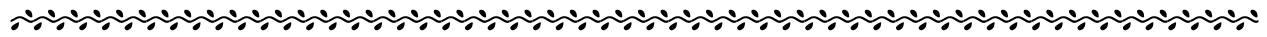
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1999年、国会は海岸法改正をおこなったが、2000年2月には国土庁が日本のすべての沿岸域を含む「総合的沿岸域管理計画作成のガイドライン」を作成した。これらは日本における新たな沿岸域管理システムを明らかにするものである。ここでは日本における沿岸域管理システム、特に法体系を紹介しようと思う。また、新しい法体系の概念も提示したい。

まず、三つの主要な点について指摘しよう。第一に歴史的、基本的問題、第二に1999年以前の法令および法的諸原則、第三に新たな法制度である。第一の歴史的基本的問題とは、誰が沿岸域を所有しているのか、誰が沿岸域管理の責任を持っているのか、諸機関はどのように沿岸域の管理をおこなうのか、ということである。第二に、1999年以前の法規と法的原則について論じる。わが国には包括的な沿岸域管理法はなかったが、四つの管理法、すなわち海岸

法、港湾法、漁港法および河川法があった。しかしながら、これらの法規は限定的な沿岸域にしか適用されない。我々は建設省ないし都道府県知事が「公物法」の原則に基づいてその地域の公的利用を管理すべきであると考えてきた。第三が新海岸管理システムである。改正海岸法は「公共海岸区域」のシステムを導入している。その結果、すべての海岸が4つの法律で規制され管理されている。国土庁が「総合的沿岸管理プラン作成のガイドライン」を作成し、それがすべての沿岸に適用されている。したがって、総合的な沿岸管理協議会が数年のうちに発足し、総合的な沿岸管理計画を作成することになるだろう。結論として、私は日本の経験のメリットとデメリットを指摘し、新たな沿岸管理システムにいくつかのアイディアを提案したい。



COASTAL MANAGEMENT SYSTEM AND ECOLOGICAL PRESERVATION IN JAPAN

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In 1999, the Diet passed the Coastal Act Amendment, and in February 2000, National Land Agency makes "the guideline to make the Integrated Coastal Management Plan" which covers all coastal area in Japan. They reveal new coastal management system in Japan. I would like to introduce the coastal management system, especially legal system in Japan. And I will present new ideas of legal system. I will point out three major points. The first is historical and fundamental issues, second is Acts and legal doctrines before 1999 and third is new legal system. The first point is historical and fundamental issues, e.g., who is an owner of coastal land, who has responsibility of maintain coastal lands, how do the agencies maintain coastal lands? The second is Acts and legal doctrines before 1999. We did not have comprehensive coastal management act, but four management laws, the Coastal Act, the Harbor Act,

the Fishery Port Act and the River Act, though four Acts apply the limited coastal area. There is extensive coastal area where four acts did not apply. We think that Departments of Construction or Governors maintain that area for the public use on the basis of "Kobutsu-ho" doctrine. The third is new coastal management system. The Coastal Act Amendment adopts "public coast" system. So all coastal area is regulated and maintained by four acts. National Land Agency makes "the guideline to make the Integrated Coastal Management Plan" which covers all coastal area in Japan. So integrated coastal management conferences will be established in order to make comprehensive coastal management plans in a few years. In my conclusion, I will point out some merits and demerits of Japanese experiences and propose some ideas to new coastal management system.

カンボジアの沿岸域・海洋環境の現状 「新規政策と管理戦略」

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本稿はカンボジアにおける現在の主要な沿岸域および海洋環境の問題を提示し、迫り来る開発の圧力に対して沿岸域と海洋資源の適切な管理をおこなう政策、法律、制度的能力の欠如に焦点を当て、これらの問題に対処するために政府が打ちだした政策上の反応に言及するものである。本稿はカンボジアにおいて未だ形成途上にある沿岸政策と管理戦略に含まれる諸要素および現在現れつつある沿岸域管理の枠組みの設定について検討するものである。

THE STATUS OF CAMBODIA' S COASTAL AND MARINE ENVIRONMENT : " EMERGING POLICIES AND MANAGEMENT STRATEGIES"

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This paper presents the major current coastal and marine environmental problems in Cambodia and highlights the present lack of policy, and legal and institutional capacity to properly manage coastal and marine resources in the face of increasing development pressures and touches on the policy response being developed by the government to address these problems. The paper looks at the elements involved in the coastal policies and management

strategies in Cambodia, which are still to be formulated, and the beginning of a coastal zone management framework, which is emerging.

タイにおける環境管理政策および沿岸域海洋生態系の持続可能な利用計画

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タイがグローバリゼーションの波に打ち勝つ、経済開発をおこなう圧力を受け始めたのは30年以上も昔のことであった。開発活動によって沿岸域・海洋資源の濫用と枯渇が起こり、環境の悪化が生じた。マングローブ林、サンゴ礁、藻場ならびに海洋生物資源は、不健全な沿岸域水産養殖、観光、施設開発プロジェクトにより収奪されていった。1987年の中頃になってやっと沿岸域・海洋資源の保全と復元の努力がおこなわれ、「沿岸域資源管理の実験行動計画」が作成された。続いて10年の間に、いくつかの沿岸海洋資源と環境管理に関する政策と計画が、関連政府諸機関と内閣によって承認された。国家環境

水準の向上と保全に関する政策および将来へのプラン（1997-2016）は、マングローブ林、サンゴ礁、藻場ならびに絶滅の危機に瀕している動植物などの沿岸域生態系のバランスの維持を強調しながら、沿岸域の資源管理と保全を目指したものである。一連の個別の管理プランもこれらの問題に対処するため作成され、導入されている。しかしながら、これらの政策や計画に基づく沿岸海洋生態系の持続可能な利用は、ある程度は可能である。最大の障害は、我々が常に求めている地元共同体の参加と協力ではなく、政治的意思の欠如と行政上の問題なのである。



ENVIRONMENTAL MANAGEMENT POLICY AND PLANNING FOR SUSTAINABLE USE OF COASTAL MARINE ECOSYSTEMS IN THAILAND

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It was more than 30 years that Thailand had undergone through economic development pressure to compete with globalization. Development activities have caused the overuse and depletion of coastal and marine resources, and its environmental degradation. Mangrove forests, coral reefs, seagrass beds, as well as living marine resources, have been exploited from unsound coastal aquaculture, tourism and facility development projects. It was not until mid 1987 that an effort to conserve and rehabilitate coastal and marine resources was initiated, and then a "Pilot Action Plan for Coastal Resources Management" was formulated. Subsequently, within a 10-year time, several policies and plans for coastal marine resources and environmental management have been endorsed

by concerned government agencies and the Cabinet. Policy and Prospective Plans for Enhancement and Conservation of National Environmental Quality (1997-2016) aims for coastal resources management and conservation with an emphasis on the balance of coastal ecosystem, such as mangrove forests, coral reefs, seagrass beds, endangered flora and fauna. Series of particular management plans have also developed and being initiated to cope with the problems. However, a sustainable use of coastal marine ecosystems under those management policies and plans is, to some degree, implementable. A major hindrance is lacking of political will and administration problems rather than participation and cooperation of local communities, which all of us always seek for.

沿岸海洋システム利用における軋轢：タイ

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タイ湾とアンダマン海を含むタイ海域は世界の中でも最も海洋資源の豊かな海として知られていた。タイ人は自らが消費する分だけでなく、輸出用としてもこれら天然資源を収穫してきた。そして近年ではタイは世界市場でも最大の海産物の輸出国になっている。しかし、この過程で適切な管理が行われず、現在ではタイ海域における乱獲の問題が指摘されている。沿岸域資源の減少の原因は多すぎる漁船により、漁へ強い圧力がかかるだけでなく、沿岸域の生態系の悪化にもよるものである。マングローブ、

藻場、サンゴ礁の環境悪化や泥質の海底などが資源の減少の原因となっている。マングローブの破壊の原因はさまざまな活動によるものであるが、特に急速に拡大したえびの水産養殖が主な原因である。底引き網漁業とさで網漁により、藻場と泥質の海底の条件が破壊されたのである。これらの漁では海底の表面を網で引いたり押ししたりするため、海面より上の生態系に変化をもたらしたのである。これらの漁で捕獲される魚には、貴重な種ではあるが雑魚と呼ばれている若い成魚や稚魚も含まれている。これが



CONFLICT IN COASTAL MARINE SYSTEMS UTILIZATION : THAILAND

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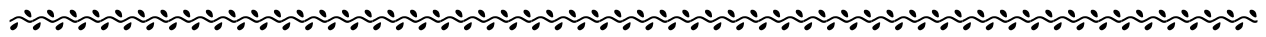
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Thai waters, both in the Gulf of Thailand and the Andaman Sea, used to be considered among the most productive areas of the world. Thais have been harvesting natural resources from coastal areas not only enough for their consumption but also for export and lately the marine products exported from Thailand rank top in the world market. Doing so, without proper management, there are now evidence of over-fishing in the Thai waters. The cause of deterioration to the coastal resources is not only through the high pressure of catch by too many vessels but the degradation of coastal ecosystems ; mangroves, seagrass

beds, coral reefs as well as the muddy bottom, all contributing to the reduction of resources. Mangroves had been destroyed by various activities but rapid shrimp farming expansion seems to be the major cause. Bottom trawlers as well as push-net boats have been causing destruction to the seagrass beds as well as the muddy bottom condition. Since they would be dragging or pushing their nets through the surface level of the sea bottom, changing the top level ecosystems. Their catches contain trash fish which usually included the young adult or juvenile stages of valuable species. This is a major cause of

沿岸漁業資源の破壊の主たる要因である。沿岸域生態系は実際に互いに結びついているのである。一つの生態系の破壊、例えばマングローブの破壊は、沿岸漁業資源の減少をもたらすものなのである。それゆえ、沿岸資源の保護においては沿岸域生態系全体の保全を目指さなければならない。そればかりではなく、沿岸域の土地利用もまた海洋資源の破壊をもたらすことがある。栈橋、防波堤等の構造物も設計を誤ると、浜の深刻な侵食を引き起こすことがあるのである。沿岸域の開墾も大量の堆積物が、近隣の沿岸生態系に流出する主な原因となることがある。海岸線から遠く離れた人間の居住地や、家庭排水や工業廃棄物も沿岸資源を破壊することがある。したがって、このような問題の予防や解決のためには統合的沿岸域管理が極めて重要なのである。



destruction to coastal fisheries resources. The coastal ecosystems actually interconnected to each other. Destruction to one, such as mangroves, could result in the deduction of coastal fisheries resources. Therefore, protection of the coastal resources must aim at conservation of the whole coastal ecosystems altogether. Not only that, coastal land use could also result in destruction to marine resources. Coastal constructions, such as piers, wave protection walls, etc., if improperly designed could result in severe erosion of the beaches. Coastal land clearing could be the major course of heavy sediment transported on to the near by coastal ecosystems which would lead to destruction. Human settlements, even though some might be further away from the coast line but domestic as well as industrial pollution could result in destruction to coastal resources. Therefore, integrated coastal zone management is very important to prevent or to solve such problems.

社会・経済・文化的観点から見た タム・ギアン・ラグーンの生物資源管理

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タム・ギアン・ラグーンはアジア最大のラグーン（潟湖）のひとつであり、チュア・ティエンフエ県にある面積22,000ヘクタールのラグーンである。このラグーンは、直接・間接的に周辺地域や湖上の舟に住む30万人の人々に生活の糧を提供している。ラグーンの生態系は非常に複雑であり、その理由は人間の活動が多様であり、集中しているだけでなく、多様な自然環境が存在しているからである。天然水生資源の枯渇と増加する住民のニーズを満たすため、ラグーンでは水産養殖が発達した。地元の政府は養殖がラグーンに住む人たちの収入を増やし、ラグー

ンの資源の乱開発を減らす方法と考えている。人口が増加した結果、環境条件は悪化している。水産養殖はラグーンの資源管理に厄介な問題をもたらしている。

本稿はラグーン資源の特性と水面権に関する政策、ラグーン資源の管理に伴う社会経済的变化を提示するものであり、ラグーンの資源管理に適していると考えられる管理レベルについて議論するものである。共同体を基盤とした沿岸域資源管理（CBCRM）は、一見すると、近年のラグーン管理の中心的戦略であるが、これについても焦点を当てて検討する。

MANAGEMENT BIOLOGICAL RESOURCES IN TAM GIANG LAGOON FROM A SOCIO-ECONOMIC CULTURAL VIEWPOINT

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The Tam Giang lagoon, one of the biggest in Asia, is located in Thua Thien-Hue province, Vietnam with an area of 22,000 ha. It provides sources of living directly or indirectly for about 300,000 habitants living around its surrounding land and on boats on the lagoon. The lagoon ecosystem is very complex because not only human activities are diverse and intensive but also natural environment displays very high heterogeneity. Aquaculture is being developed in the lagoon to overcome the depletion of natural aquatic resources and to satisfy the demand of the increasing population. The local government considers it an alternative measure to improve lagoon dwellers income and a means of reducing random exploitation

of the lagoon resources. As a consequence of the increased exploitation, environmental conditions have deteriorated. Aquaculture entails complicated problems in lagoon resources management.

This paper presents the lagoon resource properties and the policies on water area rights, the socio-economic changes related to the management of lagoon resources. The management levels, which would be considered as suitable for lagoon resources management, are discussed. Community-Based Coastal Resources Management (CBCRM), apparently, as a central strategy of the lagoon management in recent years, is also highlighted.

マングローブを過小評価する途上国政府

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熱帯では大きな割合（例えばマレーシアでは約50%）で、マングローブが海岸線に生えている。これが与える印象は、マングローブ生態系が非常によく見かけられるということである。しかし現実には（陸域の割合から計算すれば）もっともマングローブが豊かな南・東南アジアとオーストラリア（合計すると世界のマングローブの50%を占める）でも、マングローブの生息地域は全体の0.4%でしかない。それゆえ、マングローブ生態系が存在するのは非常に稀なのである。この事実、マングローブの数ある経済的役割（林業と漁業資源）および生態的役割（炭素吸収や沿岸保護）を加えると、マングローブは極めて高い価値を持つ商品であるということになる。歴史的に見て、マングローブは蚊や害虫のあふれるひどい湿地帯として見られており、他の用途に使うのが一番よいと考えられていた。こうした考え

方は既に流行遅れとなっているが、マングローブは依然として過小評価されており、特に途上国政府の評価は低い。しかし、マングローブが自生する幾つかの途上国では、法律によって万全に保護されている。（オーストラリアとアメリカ合衆国）。なぜ先進国だけがマングローブの価値を認識しているのだろうか？なぜ新興富裕国であるシンガポールや香港は、破壊されたマングローブの再生のために資金を出す準備をしているのだろうか？途上国政府がこのことに目覚めるのはもう遅すぎるのであろうか？ここでは「政府」という言葉が重要である。なぜならこのようなことをすべて実行するには強い政治的意思が必要だからである。基本的な前提であるかもしれないが、エコロジーや経済以上に重要なのである。以下にその議論を続ける。

GOVERNMENTS OF DEVELOPING COUNTRIES GROSSLY UNDERVALUE THEIR MANGROVES?

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In the tropics, mangroves fringe a large percentage (e.g. close to 50% in Malaysia) of the coastline. This gives the impression that the mangrove ecosystem is very common. In reality (measured as a percentage of land area), even in a region where they are most abundant like South & Southeast Asia and Australia (where some 50% of the world's mangroves occur, mangroves constitute a mere 0.4% of the land area of this region. Thus mangrove ecosystems are rare. This, combined with their numerous economic (e.g. forestry and fisheries resources) and ecologic (e.g. carbon sink and coastal protection) roles, should make mangroves a highly valued commodity. Historically, mangroves have been considered as bad swampland full of mosquitoes and other vermin and so is best reclaimed for other uses. Although this concept is no longer in vogue, mangroves are still

very much undervalued, especially by governments of developing countries. In much of the world, mangroves are not considered to be a valuable asset by governments. Yet in the few developed countries where mangroves occur, they are completely protected by law (e.g. Australia and the U.S.A.). Why is it that only the developed countries recognise this value? And why are some newly rich like Singapore and Hong Kong prepared to spend millions to restore their mangroves that have been destroyed? Is it too late for the developing countries' governments to wake up to this? "Governments" is the operative word because the whole exercise requires strong political will. Much more so than ecology and economics, though they may be the fundamental reasons. Discussion follows.

マレーシアにおけるマングローブ資源の保全と開発と 管理問題と挑戦と機会

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本稿はマレーシアにおけるマングローブの現状、管理システム、政策、法規、およびガイドラインを概説し、マングローブ、漁業とマングローブの関係およびその経済的評価の環境的、社会・経済的重要性を議論し、マングローブの喪失と衰退の根源的な原因と帰結を検証し、教育、現実認識、共同体参加（共同管理）、統合的沿岸域管理（ICZM）および地域協力に焦点をあてるものである。

マングローブとそれに関連する動植物の居住環境は、一般大衆のこれら貴重な資源の社会的経済的重要性についての理解の高まりにも関わらず、悪化し続けている。原因として含まれるものには、人口増加、土地利用の変化、不適切で矛盾の多い政府の政策、持続不可能な木材の伐採、沿岸の埋め立て、および水産養殖・工業・都市・港湾開発への産業構造の転換などがある。マングローブ開発に代わる代替



CONSERVATION, DEVELOPMENT AND MANAGEMENT OF MANGROVE RESOURCES IN MALAYSIA - ISSUES, CHALLENGES AND OPPORTUNITIES

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This paper reviews the status, management systems, policy, legislation and guidelines for mangroves in Malaysia ; discusses environmental and socio-economic importance of mangroves, fisheries-mangrove connection and their valuation ; examines underlying causes and consequences of mangrove loss and degradation ; provides the prospects for more sustainable use of mangrove resources ; and highlights the importance of education and awareness,

community participation (co-management), integrated coastal zone management (ICZM) and regional cooperation.

Mangroves and associated habitats continue to be degraded despite the general public's better understanding of the complex social, economic, and environmental importance of these invaluable resources. The causes include population pressure and landuse changes, inappropriate and conflicting government policies,

的開発案を、政策決定者に比較してもらうためのより良い情報の提供をねらったマングローブの価値に関する調査が、過去十年の間に、大学や援助機関によって活発に行われてきた。予知可能な将来においてマングローブの減少を防止することはできないが、これを管理し、悪影響を最小限にとどめる機会はいくさんある。代替案の中には既存のマングローブ林の保護と管理、マングローブ・エコ・ツーリズムの振興、マングローブにやさしい水産養殖、地元共同体の積極的な関与による喪失地域の復元、ICZMの実施および地域協力の拡大などが含まれる。



unsustainable logging activities, coastal reclamation, and conversion to aquaculture, industrial, urban and port development. Research on mangrove valuation intended to provide policy makers with better information to compare development alternatives for the mangroves, has been conducted actively over the last decade by universities and donor agencies. While it is impossible to stop mangrove degradation in the foreseeable future, there are many opportunities for bringing it under control and minimizing its negative impacts. Alternatives include the protection and management of remaining forests, the promotion of mangrove ecotourism and mangrove-friendly aquaculture, the rehabilitation of degraded areas with active involvement of local communities, the implementation of ICZM, and the enhancement of regional cooperation.

タイ湾の海況の季節的変動

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本稿においては、タイ湾の海況の季節的変動に関する二つの研究を紹介する。

一つは水温・塩分観測データの解析結果である。1995年9月および1996年の4月～5月にSEAFDEC（東南アジア漁業開発センター）がタイ湾西部とマレー半島の東部海岸海域81点において詳細な水温・塩分観測を行った。データ解析の結果、タイ湾の成層度合いの水平的分布は主として潮流混合と水深に依存していて、成層が9月よりも4～5月に発達するのは海面温度の上昇によることがわかった。またタイ湾と南シナ海の海水交換が最も大きくなるのは4～5月で、それは河口循環流の強化と南西モンスーンによる鉛直循環流の組み合わせによるためであることもわかった。

もうひとつは、タイ湾奥北東部バンパコン河口域の河口循環流の季節変動に関する数値実験である。1995年9月11、12日と1996年4月19日にタイ政府港湾局が行った、バンパコン河口域の水温・塩分観測データを用いて、診断モデル計算を行った。塩分垂直分布の季節変動から、バンパコン河口域が雨季（9月）には塩水くさび河口型に、乾季（4月）には軽度成層河口型に分類されるということがわかった。数値実験結果から、雨季には河口循環流が強化され、雨季、乾季ともに河口近くでは鉛直混合がよく起こっていることが明らかとなった。河口循環流は陸から負荷されたリンや窒素を沖合いに移流させるだけでなく、バンパコン河口域の栄養物質を海底層から有光層に押し上げる役割も果たしている。

SEASONAL VARIATION OF OCEANIC CONDITION IN THE GULF OF THAILAND

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Two studies on the seasonal variation of oceanic condition in the Gulf of Thailand are presented in this paper.

One is the analysis of intensive hydrographic data obtained in the western part of the Gulf of Thailand and the east coastal sea of Peninsula Malaysia during September 1995 and April-May 1996 by SEAFDEC (Southeast Asia Fisheries Development Center). Horizontal distribution of the degree of stratification is governed mainly by the tidal mixing and the water depth and the stratification is more developed in April-May than in September due to larger sea surface heating. Water exchange between the Gulf of Thailand and the South China Sea is increased in April-May due to the coupling effect of intensified estuarine circulation and vertical circulation due to the southwest monsoon.

Another is the diagnostic numerical experiment

on the seasonal variation of estuarine circulation in the Bangpakong Estuary at the northeastern part of the head of the Gulf of Thailand. Hydrographic data in the Bangpakong Estuary obtained on 11-12 September 1995 and 19 April 1996 by Harbor Department of Thailand are used in this study. Vertical distribution of salinity suggests that the Bangpakong Estuary can be categorized as the salt wedge estuarine type in wet season (September), and the slightly stratified one in dry season (April). Results of numerical experiments show that stronger estuarine circulation can be found in wet season, and vertically well mixing occurs near the river mouth in both seasons. Estuarine circulation not only advects the loaded phosphorus and nitrogen from land to the offshore area but also upwells the nutrient from the bottom layer to the euphotic layer in the Bangpakong Estuary.

南シナ海の資源の減少は回復可能か？ 持続可能な管理へのアプローチ

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南シナ海は世界最大の周辺海の一つであり、東にフィリピン、北に中国、西にベトナムといった、世界で有数の沿岸部人口増加率の高い国々に囲まれている。これらの国々にはかなりの数の漁業船団が存在し、この準閉鎖海域の漁業資源を収奪している。フィリピンでは商業的生産の25%以上がその西側の海で捕獲されたものであり、この漁業への圧力はまだ続くものと思われる。中国では、南東部における沿岸地域の急激な人口増加により、ますます漁業への依存が高まっており、それは香港の海洋保護地域

への違法な漁業者の侵入や海南省政府の漁業振興策などを見ても明らかである。南シナ海の真中に散らばる小さな群島や浅瀬は周辺諸国の本土から離れていて、また特にスプラトリー諸島やパラセル諸島周辺の領土をめぐる紛争により、担当する管理当局および法の執行機関はこの地域の大部分における漁業活動の適切な規制ができなかったし、やりたがらなかったのである。その結果、行き過ぎた非合法で破壊的な漁業が、例外ではなく、一般的におこなわれている。このような持続不可能な収奪的漁業がおこ



IS THE DEGRADATION OF RESOURCES IN THE SOUTH CHINA SEA REVERSIBLE? : APPROACHES TO SUSTAINABLE MANAGEMENT

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The South China Sea, one of the largest marginal seas of the world, is surrounded by countries with the highest population growth in their coastal zones, including the Philippines to the east, China to the north, and Viet Nam to the west. All these countries have substantial fishing fleets that exploit this semi-enclosed sea. For the Philippines, more than 25% of its commercial production comes from its western seas and this fishing pressure is expected to continue. For China, the rapidly growing coastal population on its southeastern sector is becoming more and more

dependent on fisheries production, as evidenced by illegal fishers invading the marine reserves of Hong Kong and the decision of Hainan province to increase its fishing efforts in a significant manner. Due to the distance of the small island groups and shoals in the middle of the South China Sea from the mainland of the bordering states and because of the disputes about the territorial boundaries particularly around the Spratlys and the Paracels, management authorities and law enforcers have been unable or unwilling to properly regulate the fishing efforts in much of the

なわれていることを考慮すると、沿岸生態系の置かれている状況は継続的に悪化し、資源は枯渇の一途をたどっている。現在の領有紛争の状態は、海洋生物資源とそれが依存する生態系にとって悪い前兆である。それゆえ、持続可能な管理措置が緊急に必要なになっている。ほとんどの国家は、紛争を引き起こすことなく、本国の沿岸を管理する措置をすぐにとることができる。より深刻なのは、対立する諸国が南シナ海の真ん中にある漁業資源、特にアジア大陸から離れた礁、群島、諸島周辺の漁業資源の管理のための計画を共同でおこなわなければならないということである。本稿はこれを実現するさまざまなアプローチを概説するものである。



region. As a consequence, excessive, illegal, and destructive fishing are often the norm rather than the exception. In the light of such unsustainable extractive activities, coastal ecosystems are continually being degraded and the resources being depleted. The status of the present territorial disputes bodes ill for the marine living resources and the ecosystems on which they depend. Hence, sustainable management measures are urgently needed. Most nations can take immediate steps to manage their mainland coasts as this can be done without disputes breaking out. More seriously, the contesting nations must plan together the management of the fishery resources in the middle of the South China Sea, particularly those around the reefs, shoals and islands some distance from the Asian continent. The paper outlines various approaches on how this might be approached.

沿岸域のダイナミックな環境の監視と分析におけるRSとGIS技術の利用

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リモートセンシング (RS) と地理情報システム (GIS) 技術の到来および急速な発展のおかげで、過去20年の沿岸海洋環境の監視と分析はかなり進歩した。本稿では東・南シナ海および北西太平洋におけるRSとGIS使用の結果を提示する。第一に、高性能高分解能ラジオメーター (AVHRR) から得られたデータによる海面温度イメージがジオサット高度計のデータから得られた潮位変異性マップと共に用いられて、前線、渦、湧昇といった、東・南シナ海における中規模の要素分析に用いられている。陸棚前線、熱塩前線、河口域前線、潮流前線、湧昇前線の5つのタイプの前線が確認されている。これらの前線の特性と形成が分析され、3つの中規模の渦の

データが得られ、これらの原因と発達を分析する。良く知られている浙江沿岸の湧昇の特筆すべき特徴はAVHRRとジオサット高度計の両方で観察される。沿岸の湧昇と潮位の変化の関係について議論される。次に、TOPEX高度計により6年間おこなわれた極めて正確で継続的な風と波のデータを用いて、GISに基づいた分析と東・南シナ海の予測システムが開発される。10年、50年、100年周期の海上風速と波浪高が推測される。地上観察を通じた妥当性検証は、高度計によって得られた強度の風と波の計測不確実性はそれぞれ10%と5%であり、現在の質と継続性をもってすれば、衛星高度計データは沿岸海洋環境の理解と予測に極めて有効であると言える。

USE OF RS AND GIS TECHNOLOGY IN THE MONITORING AND ANALYSIS OF COASTAL DYNAMIC ENVIRONMENT

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Substantial progress has been made in the monitoring and analysis of coastal marine environment during the past two decades, thanks to the advent and rapid development of remote sensing (RS) and geographical information system (GIS) technologies. In this paper, results of RS and GIS applications in the China Seas and Northwest Pacific Ocean are presented. First, sea surface temperature images derived from Advanced Very High Resolution Radiometer (AVHRR) data, in conjunction with sea level variability maps derived from Geosat altimeter data, are used to investigate mesoscale features, including fronts, eddies and upwelling, in the China Seas. Five types of fronts are identified, namely, shelf-break front, thermohaline front, estuarine front, tidal front and upwelling front. The characteristics and formations of these fronts are analysed. Three mesoscale eddies have been captured, their causes and evolution

are examined. Remarkable signatures of the well-known Zhejiang coastal upwelling are observed by both AVHRR and Geosat altimeter. The possible relationship between coastal upwelling and sea level changes is discussed. Second, using six years of TOPEX altimeter wind and wave data with unprecedented accuracy and continuity, a GIS-based analysis and prediction system is developed for the China Seas. The 10-, 50- and 100-year return values of sea surface wind speed and significant wave height are estimated. Validation against in situ observations indicates that the uncertainties of altimeter-derived extreme winds and waves are at the levels of 10% and 5%, respectively, suggesting that satellite altimeter data, with present quality and duration, are already very useful in understanding and prediction of coastal marine environment.

タイ湾における汚染問題

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富栄養化は今日のタイ湾内部で最も深刻な問題である。富栄養化の原因は大都市から河口域に流れ込む有機排水の流入である。湾の外部では、魚の水銀濃度が天然ガス生産プラットフォームの近海で上昇していることが判明した。この地域の5- 10%の魚がFAOの設定した許容限界基準（ぬれたときの体重の0.5ug/g）よりも多い水銀に汚染されていた。この金属の監視プログラムはそれゆえ不可欠である。海洋汚染問題の軽減は以下に述べる重要な要素を含む、包括的プログラムによっておこなうことができ

よう。

1. ベースラインと監視
2. 水質基準の設置
3. 汚染物質の汚染源、経路、量の確認
4. 汚染の管理、解消、自然の復元

現在のところ、タイは20年にわたってこのようなプログラムを実施しているが、いくつかの要素を強調しておかなければならない。



POLLUTION PROBLEMS IN THE GULF OF THAILAND

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Eutrophication is the most serious problem of the inner gulf of Thailand nowadays. Eutrophication is caused by the discharge of organic wastewaters from big cities into the river estuaries. In the outer gulf, mercury concentrations in fishes were found to elevate in the vicinities of natural gas production platforms. About 5 - 10% of fishes in these vicinities had mercury concentrations higher than the standard acceptable limit set by the FAO (0.5 ug/g wet weight). Monitoring program on this metal is therefore essential. The problems of marine pollution could be alleviated through a comprehensive program which includes these

important components : 1. Baseline and monitoring ; 2. Water quality criteria establishment ; 3. Identification of sources, pathways, and quantity of pollutants ; and 4. Pollution control, abatement, and rehabilitation. So far Thailand has implemented such a program for more than two decades, but certain components are needed to be emphasized.

沿岸生態系の保護における法的要件およびその含意 中国の事例

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中国の急速な国民経済の発展、特に沿岸地域における発展に伴ない、沿岸域生態系はますます深刻な環境に対する圧力にさらされている。沿岸域生態系の保全および保護と経済開発とのバランスをどのようとり、持続可能な発展を図るかということが中国の中央政府と地方政府の重要な課題となっている。本稿の目的は以下に述べる3点である。

(1) 沿岸地域における急速な経済開発にかんがみ、

中国の沿岸生態系の現状の背景をなす情報を提供する

(2) 法的側面に焦点を当て、沿岸域生態系の管理の不完全さを分析する

(3) 沿岸域生態系保護の分野における中国の現在の諸政策に関して論評する

結論として言えることは、生態系管理のために、特に政策・法規・管理手法の観点から、次に何をすべきかということが強調されるであろうということである。



LEGAL REQUIREMENTS AND IMPLICATIONS ON THE PROTECTION OF COASTAL ECOSYSTEMS - A CASE IN CHINA

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Along with the rapid development of national economy in China, and particularly in coastal areas, the coastal ecosystem is confronted with increasingly serious environmental pressure. How to balance economic development with the preservation and protection of the coastal ecosystem for sustainable development has become an important challenge to the Chinese government, both central and local. This paper aims at : (i) providing background information on the current status in coastal ecosystem in China in the context of rapid economic development in the coastal

areas ; (ii) analyzing the deficiency in the management of coastal ecosystem, with focus on the legal aspect ; (iii) commenting on the current efforts in China in the field of coastal ecosystem protection. In the conclusion, emphasis will be laid on what is required next in the ecosystem management, especially in terms of policies, legislation, and management approaches.

韓国の沿岸域環境における有機スズの影響

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韓国は世界でも有数の造船国であるにもかかわらず、TBTを基に作られたよごれ止めペイントが2000年3月から使用禁止となった。この研究の主たる目的は、韓国沿岸の海生生物へのブチル及びフェニルスズ化合物の影響を調査し、海生生物に対するこれらの化合物の毒性を研究することである。ブチルスズ化合物 (BTs) は、韓国沿岸の67箇所から採集されたイガイ (貽貝) および牡蠣のサンプルから検出された。一方、フェニルスズ化合物 (PTs) の値は67箇所のうち26箇所において検出限界を下回ってい

た。トリブチルスズ (TBT) とトリフェニルスズ (TPT) の濃度はそれぞれ48~2,800ng/gと<3~1,820ng/gであった。二枚貝のTBT平均濃度はTPTの平均濃度の3.5倍であった。韓国沿岸の26箇所から採取され分析されたヒトデ (*Asteria pectinifera*) のサンプルには、検出可能な量のBTsとPTsが含まれていた。ヒトデのTBTとTPTの全体的な濃度は<3~323ng/gと8~835ng/gであった。ヒトデにおけるモノブチルスズ (MBT)、ジブチルスズ (DBT) およびTBTの平均的組成は86%>8%>6%と減少す

EFFECTS OF ORGANOTINS IN THE COASTAL ENVIRONMENT OF KOREA

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TBT-based antifouling paints were banned since March 2000 in Korea, although Korea is one of the leading shipbuilding countries in the world. The major objectives of this work are to assess the exposure of marine organisms to butyl- and phenyltin compounds on the coast of Korea and to study on the toxic effects of these compounds on marine organisms. Butyltin compounds (BTs) were detected from the mussel and oyster samples collected from 67 sites on the coast of Korea, whereas phenyltin compounds (PTs) were below detection limits at 26 out of 67 sites. Overall range of tributyltin (TBT) and triphenyltin

(TPT) concentrations were 48 to 2800 ng/g and <3 to 1820 ng/g, respectively. The mean TBT concentration in bivalves was 3.5 times higher than that of TPT. The starfish (*Asteria pectinifera*) samples analyzed from 26 sites in the coast of Korea contained detectable amount of BTs and PTs. Overall ranges of TBT and TPT concentrations in starfish were <3 to 323 ng/g and 8 to 835 ng/g, respectively. Mean compositions of monobutyltin (MBT), dibutyltin (DBT) and TBT in starfish were in decreasing order of 86 % > 8 % > 6 %, whereas TPT, diphenyltin (DPT) and monophenyltin (MPT) were in order of 75 % > 17 %

るが、TPT、ジフェニルスズ（DPT）、モノフェニルスズ（MPT）の減少は75%>17%>8%の順であった。アキ貝科のイボニシ（*Thais clavigera*）のインポセックスの頻度は2つの基準地では0%であったが、61箇所のうち47箇所でインポセックス発生率は100%を記録している。港湾や造船所の付近におけるインポセックス発生率は比較的高かった。イボニシのTBTとTPTの濃度は、それぞれ5~508ng/gと3~2,460ng/gであった。インポセックスと有機スズとの間に有意の肯定的関係が得られた一方で、オスとメスの性比率とインポセックス発生率との関係は否定的なものであった。人の手のついていない水域に生息していたイボニシを港に移した際に、TBTとTPTがイボニシに蓄積され、インポセックスを誘発したのである。この事実は、この種をTBTとTPTによる汚染の悪影響を示すバイオインジケータとして用いる可能性が十分にあることを示している。



> 8%. Frequency of imposex in rock shell, *Thais clavigera*, was 0% at two reference sites, but at 47 out of 61 sites, frequency of imposex was recorded as 100%. The degree of imposex was relatively high at the sites near a harbor and a shipyard. TBT and TPT concentrations in *T. clavigera* ranged from 5 to 508 ng/g and from 3 to 2,460 ng/g, respectively. A significant positive relationship was found between degree of imposex and organotin concentration, whereas a significant negative relationship was obtained between female to male sex ratio and the degree of imposex. During a field transplantation of *T. clavigera* from a pristine area to a port, TBT and TPT were accumulated in *T. clavigera*, and imposex was induced. This species shows considerable potential as a bioindicator species of the adverse effects of TBT and TPT contamination.

Fong Ching Wai, Terence

SEAMCAT : 東アジア海洋沿岸生態系の保全と管理支援のための メタデータカタログ

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東南アジアSTART地域センター (SEA START RC) は、1996年に「START開設のためのSEA地域委員会」によって設立され、バンコクのチュラロンコン大学に本拠を置いています。また、このセンターは学際的地域センターのグローバルネットワークの一部を構成し、科学的資源を動員して、政策の発展を支援する科学的評価実施のための枠組みの構築に貢献するものであります。このセンターの関心は、グローバルな変動データの統合およびモデルの提供ならびに、グローバルな転換をおこなうための

政策の発展および情報を提供するためのセンターとして働くことにあります。

情報活動の一環として、センターはウェブでアクセスできるメタデータのカタログを作成しています。メタデータ、すなわちデータの概説とその位置確認は生態系、特に海洋沿岸生態系の管理に極めて重要なツールであります。

長い時間をかけて、東アジア地域のデータが収集されましたが、ほとんどのデータの存在箇所およびその質は知られていませんでした。データ収集には



SEAMCAT : A METADATA CATALOGUE TO ASSIST THE CONSERVATION AND MANAGEMENT OF EAST ASIAN MARINE COASTAL ECOSYSTEMS

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South East Asia START Regional Centre (SEA START RC) is an NGO, created in 1996 by SEA Regional Committee for START (SARCS) and is located at Chulalongkorn University in Bangkok. It is part of a global network of multidisciplinary regional centres that mobilise scientific resources to help provide the framework to make scientific assessments to support policy development. Its focus is to provide synthesis and modelling of global change data, and act as a centre for global change policy development, and information.

As part of its information role, it has created a web accessible metadata catalogue. Metadata, the description and location of data, is an extremely important tool in the management of ecosystems especially marine coastal systems.

Over time a lot of data have been collected in the East Asia region, the location and often the quality of most of the data is unknown. There is a major investment in data collection and this investment must be managed.

SEAMCAT is addressing this need. It is a project

非常に大きな投資がおこなわれており、この投資は管理しなければなりません。

SEAMCATはこの要請に応えています。SEAMCATはGEF, UNDPおよびUNEPによって資金提供を受けたプロジェクトであり、DIFフォーマットのNASAのグローバル・チェンジ・メタデータ・ディレクトリーに基づいたものであります。これは人々が参加をし、メタデータを共有するプロセスの一部となっております。これは参加者が自分の持つデータの存在を広報し、自らの組織のもつ科学的見識に対する認知を受け、国際的なレベルでは、国際条約および合意を支援する場でもあります。これらが参加者が得ることができるメリットであります。SEAMCATを東アジアにおいてなくてはならない資源にするためには、皆様の参加が必要なのです。



sponsored by GEF, UNDP and UNEP and is based on the NASA Global Change Metadata Directory in DIF format. It is part of a process in which people need to participate, to share their metadata. It is a venue where participants can advertise the existence of their data, gain recognition for their organisation's scientific expertise and, at an international level, support internal agreements and conventions. These are among the benefits participants can gain. To make SEAMCAT an invaluable resource in East Asia we need your participation.

沿岸域および海洋環境におけるASEANの国際協力

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ASEANによる環境問題での国際協力は、1977年に第一次ASEAN下位地域環境プログラムを実施したことから始まる。ASEANの環境協力では、沿岸域・海洋環境問題が優先課題として取り上げられた。

『ASEANビジョン2020』は、2020年までに「地域の環境、天然資源の持続性、人々の高い生活水準を確保するための持続可能な発展のメカニズムを確立した、きれいで緑豊かなASEAN」の構築を目指している。この点に関して、ASEANは「ハノイ行動計画」および「環境に関する戦略行動計画1999-2004」を採択した。これらの文書は沿岸域・海洋環境の統合的保護・管理のためのアクションプランおよび地域的な枠組みを発展させる目標を設定している。

ASEANが明らかにした協力枠組みの7つの優先課題は次のとおりである。

- a) サンゴ礁、海藻、マングローブ
- b) タンクからの原油スラッジとバラスト水
- c) 固体・液体廃棄物管理
- d) クリーン技術
- e) 沿岸域侵食
- f) エコ・ツーリズム
- g) 保護された海洋領域を含む沿岸域湿地帯

ASEANは戦略的に自らを、他の機関や組織と協力・調整をおこない、アジア諸海域の沿岸および海洋資源の保護の効率性と費用効果の向上を図る機関であると位置づけている。

ASEAN COOPERATION ON COASTAL AND MARINE ENVIRONMENT.

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ASEAN Cooperation on the Environment started in 1977 with the implementation of the first ASEAN Subregional Environment Programme. Coastal and marine environmental issues have received high priority in the ASEAN environmental cooperation. The ASEAN Vision 2020 envisioned "a clean and green ASEAN with fully established mechanisms for sustainable development to ensure the protection of the region's environment, the sustainability of its natural resources, and the high quality of life of its peoples" by the year 2020. In this regard, ASEAN adopted the Hanoi Plan of Action and the Strategic Plan of Action on the Environment, 1999-2004, outlining objectives to

develop regional framework and action plan for integrated protection and management of coastal and marine environment. ASEAN has identified seven priority areas in its cooperation framework including : a) coral reef, sea grasses, mangrove ; b) oil sludge from tanks and ballast water ; c) solid and liquid waste management ; d) clean technology ; e) coastal erosion ; f) eco-tourism ; and g) coastal wetlands including protected marine areas. ASEAN has strategically positioned itself to collaborate and coordinate with other agencies and organizations to increase efficiency and cost effectiveness in protecting coastal and marine resources in the Asian seas.



パネル討論 Panel Discussion



〔熊本氏〕

では、ここで会場の皆様と討論をおこないたいと思います。パネリストに対してコメントや質問がありましたら、またこれまでの発言や基調講演に関しご意見がありましたら、ここでお願いします。

〔質問者 1：マレーシア政府関係者〕

ありがとうございます。科学者と管理者の役割に関してですが、科学者と政策形成者との間の橋渡しがきちんとなされていないということに私は同意します。多分、これは管理者が補わなければいけない部分なのだろうと思いますが、往々にして管理者自身にその能力がないことがあります。これは本当に問題であると思います。この橋渡しをするということ、科学を政策形成者にわかりやすく解説するもう一つの技能について、集中的に考えて行かなければならないと思います。また、法的な問題に関しては、私の経験上、上司に従っていくつかの交渉に臨んだ

ことがあります。自分が外交や交渉の技能を全く持っていないことに気が付きました。ですから、これも科学者が身に付けるべきもう一つの技能のように思います。このような場合、この問題に対処するには、最後に目標を達成するために多くの技能を身に付けなければならないと考えます。これが第一点です。

第二点は、諸国間の調整の欠如という問題です。これは本当のことだと思います。私はあなた方がおっしゃったことに完全に同意します。しかし、時折気がつくのは、協力を渉るというよりは、どの省庁が、またどの機関がこうした国際協力の窓口になるのかということに関して全く知識がないことがあるということでもあります。例えば、国連環境計画の活動を例にとると、マレーシアにおける国連環境計画の活動は、通常、環境省が窓口になっており、そこに焦点が当てられています。ですから、国連環境計画の活動に関する情報は全て我々の役所に届き、我々が



〔Prof. Kumamoto〕

I suppose it is time to open discussion to the floor. So, if you have any comment or question to the panellists or you want to state all you views on previous statements or keynote speeches, please do so right now.

〔Q1〕

Thank you very much. Regarding with the role of scientists and the role of the managers, sometimes I agree that there is a missing bridge between scientists and policy-makers. Perhaps this is the one that manager should do, but then sometimes also manager itself doesn't have any capability. That is really a problem. I guess this is the bridge that one what we have to concentrate on thinking about another skill to interpret

the science to policy-makers. Also, in terms of legal issues, I have just followed my supervisor to couple of negotiations, and I realised that I don't have any skill to do in the way of diplomacy and negotiations. So, I guess, this is another skill. In this case, I think, in order to coop this problem, a lot of skills we need in order to reach the goal at the end. That is one.

The second one is regarding with the lack of coordination between countries. That's true. I agree fully with what you said. But sometimes also there is a kind of, not reluctant, but there no knowledge about which ministry and which institutions supposed to be the gate for one of the activities, for example UNEP. The UNEP activities in Malaysia usually will be taken by the Ministry of Environment that should be the one who is the gate or national focal point.

広報活動をおこない、委員会を創設したりします。もちろん、これは常にうまくいくとは限りません。我が国では、他の諸機関も様々な会議に参加していることがあるのを知っていますが、彼らがどの会議に出席しているかという情報が入手できていないのです。また彼らの方も我々から情報を得てはいません。このような状況ですので、我々は国内外において、我々の活動に対する認識を高め、どの省庁がある活動の窓口になっているかということを理解できるようにした方がよいと思います。ありがとうございました。

[熊本氏]

今挙げられた二点を要約しますと、第一は監督機関がどこになるかという問題ですね。これは大変重要な問題で、私共も長い間議論をしてきました。第二は、調整の欠如ですね。これはさまざまな組織の間の関係についての問題です。ベックマン博士、それぞれについてコメントを頂けますでしょうか。大和田博士にはその後にお話を続けて頂きたいと思

います。

[ベックマン氏]

どちらの問題に対するコメントになるか分かりませんが、問題の原因の一部は縦割り行政にあると思います。我々はすでに環境を悪化させる汚染の大きな原因は、森林伐採、未処理下水、農薬や肥料にあることを知っています。しかし、いつも思うのですが、以下のようなことが何ヶ国で起こっているのでしょうか。農業省の人たちが自分たちの活動が環境に与える影響を本当に理解していない。会議に出席して、汚染の問題について学習しているのは国連環境計画の人たちだけで、農業省の人たちは会議に全く招待されていない。林業は土砂堆積の主要原因であるが、林業担当の役人は自分たちの活動が海洋環境に与える影響について助言を受けているのでしょうか。ほとんどの国で、そんなことは行われていないでしょう。伝えたいメッセージが伝わらず、関係者の理解が得られないのです。林業省の役人は、木材の伐採量が増えると昇進し昇給するのです。誰一人として



So any information related to the UNEP activities get to our office and we are the one who will make dissemination or we might establish committee as necessary. Of course this is not always perfectly working, but sometimes I know that in my country many of other agencies also attending other meetings. We thought giving us that they are invited this and that. They are also not getting any information from us because they don't give us any information. In this case, perhaps we need within country a kind of awareness, but also from outside world, we have to see which channel, which focal point (should be the gate) for one of activities. Thank you.

[Prof. Kumamoto]

To narrate on two points. First, which among concerned organisations. That is quite important problem and we've discussed long long time. The other point was the lack of coordination. That is under the aspect

of relations among organisations. Dr. Beckman, would you like to make some comment on each?

[Dr. Beckman]

I am not sure which it will do, but a part of problem is the sectoral divisions. We all know that the large amount of pollution that degrades environment is from logging, from raw sewage, from agricultural pesticides and fertilisers. But I wonder how many countries would do as follows. People in agricultural ministries actually do not understand the impact of their activities on environment. It is only the focal point for UNEP that is attending the meetings and learning about the pollution, but agricultural ministry would never be invited to those meetings. The forestry is causing a great deal of sedimentation problem, but have the forestry official been advised on the impact of their activities on marine environment? In most countries, probably not. The message is not getting

彼らの活動が、環境全体や海洋環境に対してどんな破壊的な影響を与えているかを問いただしたりはしないのです。ですから、誰かが彼らを教育しなければならないのです。

どのように彼らを教育すべきかは私には分かりません。しかし、乗り越えなければならない課題がいくつかあると考えています。その一つが縦割り行政です。私はその役割を担うのがNGOか科学者だと思っています。誰かが担当窓口より向こうに情報を伝えなければならないのです。私は何年前、ある会議に出席したことがあります。そこでは船舶が廃棄したごみによる汚染の取り扱いについて議論していました。その会議は国連環境計画か、どこかの機関の主催で開催されていたため、担当窓口になった省庁は環境関連省庁だったと思います。ですから、諸国の政府は環境省の人間を会議に出席させていました。しかし、ほとんどの人が船の側に近づいたこともなく、またその汚染水域を見たこともない人たちでした。しかし、彼らはその会議で船舶からの汚染を規制する話し合いをしていたのです。そういっ

た人たちを会議に出席させ、自分達が国内で権限をもたないものについて議論やトレーニングをおこなうことは皆様の税金の無駄遣いです。なぜ運輸省はその会議に招かれなかったのでしょうか。それは運輸省が担当省庁ではなかったからです。ですから、誰かが何とかしてこの縦割り行政を打破して行かなければならないのです。他の国々では、おそらくマレーシアでは、天然資源は州が独占的に管理しています。しかし州政府の役人はそうした会議に招かれませんが、国の役人も招かれませんが。我々は適切な人材と関係省庁を探す方法を考えなければならないのです。我々は誰が実際に力を持っていて、状況を変えることができるかを明らかにしなければならないのです。問題に関して権限を持たない人たちに話すのではなく、このような人たちと話をしなければならないのです。

[熊本氏]

バックマン博士は主に政府のさまざまな機能の間の関係と、省庁間の関係等についてお話くださいま

out and people don't understand. The forestry department officials will be promoted or got a raise if they increase the amount of logs cut. No one is asking them what a detrimental effect of the activities are on the environment as a whole and marine environment. So somebody has to educate them.

I am not sure how it should be done, but I think these are some of the problems that I see there has to be overcome. It is the sectorial division. I could see that that maybe it's the NGOs or maybe it's scientists. Somebody has to reach out beyond the focal point. I've been to a meeting couple years ago and we were talking about handling pollution from dumping from the ships. Because it was sponsored by UNEP or somebody, so the focal point was sure the UNEP and environment ministries. So governments sent people from Ministry of Environment. Mostly people have never been near a ship. They've never been near the water. They were there to talk about how to control

pollution from ships. That wasted everyone's money to bring those officials to the meeting to be trained about things that they have no power to change within their own countries. Why wasn't the Ministry of Transport invited? Because they were not the focal point. So somebody has to overcome this sort of sectoral divisions. In other countries, maybe in Malaysia, the natural resources are exclusively in state control, but state official has never been invited to these meetings so as national officials. I think we have to find a way to bring the right people in. We have to identify who are the movers and shakers that can actually change things. Let's try to talk to them, rather than talk to the people that can't do anything for the problem.

[Prof. Kumamoto]

Dr. Beckman mentioned mainly about the relationship between government functions and between departments

した。もう一つの重要な問題は科学者と政府関係者との間の橋渡しです。大和田博士、これらについてお話し頂けますでしょうか。

[大和田氏]

科学者とさまざまな組織の橋渡しをするのは大変重要だと思います。また協力の必要もあると思います。東シナ海のような国際的な活動舞台においては、多くの国が参加していますが、東京湾のようなところでも、どのように協力すべきかという点で、いつも激論を戦わせています。異なる省庁から多くの人がやってきて、それぞれの方法による東京湾の利用を主張しており、科学者も常に異議を申し立てますし、地元は地元で違った構想を描いているのです。私共はいつも協力をおこなうための情報の共有がまだできていないと感じています。ですから、このような場合には、ジャナミ博士の見解である、地元の人たちも含めて議論をしようという見解に賛成します。それこそが、おそらく、将来の解決策になり、この問題の解決につながるものと希望しています。

[質問者2：タイからの参加者]

私はこの問題に対して解決法や解答があるとは思いません、と申しますのは、自然システムの悪化の原因となる問題は、長年にわたって存在しているからです。多くの人にこの問題を理解してもらおうとする際には十分注意しなければなりません。自然のシステムを自国民の利益のために保全するのは、彼らが果たすべき役割であるからです。科学者は多くの場合、意思決定者に解答を提供しません。なぜなら、科学者は常に確証がなければ何も話さないからです。ですから、科学者は、意思決定者に対して、少なくともその内容に関する手がかりを与えるために、所有する情報を提供する方法を身に付けなければならないのです。私は頂点に立つ意思決定者、例えば大臣や政界の人物が、環境問題で何が起きているかを理解できないとは思いません。海洋において問題が起きていることは、ある面では、理解しているのです。しかし彼らは常にもっと重要なものがあると考えているのです。ですから、このような場合、自然のシステムが国民の幸福にとって

and so forth. The other aspect which we are keen to mention is the bridge between scientists and government officers. So Dr. Ohwada would you mention about those?

[Dr. Ohwada]

I agree it is very important to bridge between scientists and organisations, and the needs of collaboration. In such international fields such as East China Sea, there are many countries come together, but even in the Tokyo Bay, we always have big discussions how to do that. Many people from different ministries will have their own ways to utilise the area, and scientists also dispute, and society think different. We always think that we still have a lack of information to share together for collaboration. So in such case, I agree that in such discussion, the local people will attend together. That is probably a future solution, and I hope it will be the solution to the problem.

[Q2]

I think we cannot find one solution or answer to this problem because the problems of causing degradation to natural systems that have been going on years after years. But we have to be very careful of trying to get people to realise that. It's their role to play in order to conserve the natural system for their own benefit of their people. Scientists most of the time cannot give the answer to decision-makers because scientists always have to be certain before saying something. So scientists have to learn also to supply information on what they have for decision-makers so that at least they get something to think. I don't believe that top decision-maker like ministers or big guys will not understand what's going on. I think they realise the problem happen in the ocean in certain aspect. But they always think that something is more important. So in this case, I think we have to work harder in order to make them realise that this system

非常に重要なシステムであることを、理解させるように努力をしなければならないと考えています。しかし、残念なことながら、我々科学者はそれをなしていないのであります。また、我々は他の組織、例えばNGO、に常に依存することはできません。なぜならNGOは時としてさまざまな問題に否定的見解を持っているからであります。彼らは常に反対ばかりしている集団であるからです。ですから、関係者全員を一同に集めることが重要です。それは簡単なことではありません。我々がそれに対処する方法を見つけられるとは思いません。しかし、我々は少なくとも情報を提供し、どんな努力をおこなうことができるかを提示することはできます。我々は常に協力をして行かなければなりません。ですから、一つの解決策を目指すのではなく、少なくとも、彼らにこの地球の生態系が人々の幸福にとって極めて不可欠なものであることを理解させるべきだと思っています。

〔質問者3：タイ水産省・国際海洋研究所〕

議長、ありがとうございます。タイ水産省のチョー・サップ・フィルと申します。またタイの国際海洋研究所にも所属しております。先ほどカークマン博士が政府諸機関の間の調整が欠けているというお話をされました。この点に関しては異論を唱える方はいないと思います。しかし、私自身の例を述べさせていただきますと、現在40歳であり、政府の役人としてのキャリアは半分を過ぎたところでございます。私は政府諸機関の間の調整がそれほど欠如していたとは思いません。私は水産省に入省して以来ずっと、タイ北東部の熱帯雨林プロジェクトにおいて、農業省のいくつかの部局で仕事をしてまいりました。私はそこで、いくつかの部局が調整をおこない、共同で事業をおこなう例を見てきました。しかし、難しい面は実際にあります、と言うのは我々はみんな所属する省庁が違い、持っている知識も異なるということであります。我々は自分達の知識をそれぞれの分野で生かそうとします。例えば、私は漁業分野で、林業省の役人は林業の分野で自らの知識を生か

is one of the system which is very important to the national well-being which we, scientists, cannot do that as yet. And also we cannot depend on other groups, for example, we cannot depend on NGO all the time because sometime NGO do have negative view of looking at things they always say no to everything. So the reason is very important in order to have everybody together. It is not easy. I don't think we could find the solution to coop with that. But at least we should try to bring the information out, trying to show them what's the effort which can happen. We have to try to work together at all time, so I don't think we should look for one solution, at least make them realise that this ecosystem is very vital to their well-being of the people.

[Q3]

Thank you Mr. Chairman. I am from Department of Fisheries in Thailand, and also from International

Ocean Institute of Thailand. Dr. Kirkman has mentioned about the lack of coordination between government agencies. I think that nobody refuse your claim in this aspect. However if I put myself as a case study, I am 40 years of age and I am half way through my working career as a government official. I think the coordination among government agencies was not too bad in the past. I have been involved since the beginning when I started my career with the Department of Fisheries; I had to work with several departments in the Ministry of Agriculture on the rain forest project in the North East of Thailand. I found that the coordination among several departments. However, I think the difficulty do exist because we are on different crowns, we have different knowledge. We were trying to frame on our knowledge on each areas, for example, I will frame myself in fisheries and forestry officers frame themselves in forestry. We don't really know integration among different subjects. I think once we become

します。しかし、我々にはこれらの異なる分野をどうやって統合するかという方法が分からないのであります。もっと重要なポストについたら、我々はより協力を緊密にして行かなければなりません。しかし、20年も同じ部署にいるとはっきりと自分の分野が決まってしまうので、調整をおこなうことはますます難しくなるでしょう。しかし、この会議に出席されている方々は、自分たちの知識が無駄になったとお考えになり、解決法を探してこの会議に参加していらっしゃるのではないかと考えております。

過去二年間、私はカナダのハリファックスで行われた、カナダの国際海洋研究所が主催する国連海洋法アジェンダ21というトレーニングプログラムに参加いたしました。このプログラムは省庁間の協調を達成する一つの方法になるだろうと思っています。国際的なプログラムで、世界中から集まった80人の人たちが参加していました。私はアジアから出席した一人で、このトレーニングプログラムのクラス代表でした。そこで分かったことは、皆の意見が異なるだけでなく、知識も異なるということでした。キャ

リアが異なるだけでなく、政府機関から派遣された人も多く、一部にはNGOや大学から派遣された人もいました。プログラム初日から共にさまざまなことを学びました。

我々は海洋学、水産学、港湾管理、水上交通などについて学びました。また、海洋管理に関するあらゆる事柄を学びました。政策に関しても、交渉のシミュレーションを学びました。また、共同管理などについても学びました。このようなプログラムに参加したのはこの時が初めてでした。今では、どのようにすれば人々の専門の分野が分かるかも分かるようになりましたし、今やそのことを知るべき時代になっています。異なる分野を統合するためには、我々は他の人たちが何をやっているかを理解する必要があります。なぜ沿岸警備隊が人を救助するために常に準備をおこなうのか、原油流出が養殖に対してどのような影響を与えるのか、ということを理解する必要があります。ですから、これが我々の考えるべき方向なのではないかと思います。また、私は人材開発のための投資が最も重要だと思っています。



senior officer, we have to integrate more, but we become far away from coordination because we will have really clear frame after 20 years for myself. But I think the people in this forum have been wasted a lot in their knowledge so that they are here together trying to find a solution.

Last two years, I attended the training programme in Halifax, Canada, so-called United Nations Convention on the Law of Sea: Agenda 21, organised by International Ocean Institute of Canada. I found that the organisation is perhaps a way to achieve the coordination. Because of its international basis, we have 80 people from around the world participating in the training programme. I was the one from Asia and I was the representative of the class in the training programme. I found that we have different opinions, not only in opinion, but also in knowledge. We were from different career, many people from government agencies, some people from NGO, some people from

university. We have learned things together since the beginning. We learned Oceanography, Fishery, port management, transportation. We learned everything on ocean management. Even for policy, we learned how to simulate the negotiation. We learned about joint government and so on. I never attended this type of thing before. Now we became realised that we can see how people frame themselves in this world, and it is time to know that. In order to integrate, we really need to understand other people what are they doing, why the coastguard need to prepare all the time to go to help people, what would be the effect of the oil spill to aquaculture. So perhaps this is the way that we should think about. And I think the human resources investment is the most important. You have to start to educate people from early work career, for example, in the International Ocean Institute (IOI), they already provide training for 20 years, and the most successful person is the Prime Minister of

キャリアについた早い時期から若い人たちを教育して行かなければなりません。例えば、国際海洋研究所（IOI）では20年にわたってこのようなトレーニングを提供していますが、卒業生の中で最も成功した人物はタンザニアの首相になっています。私もトレーニングを終えて2年後に国際海洋研究所のタイ・オペレーショナル・センターの所長になりました。私は来年からすぐこの仕事に取り掛かるつもりです。我々は10年、20年単位の長期計画を立てており、その時にはさまざまな省庁からの若い職員があふれることになるだろうと思っています。我々は次の10年から20年の間に、政府機関の職員だけでなく、様々な職業の人たちも集める努力をおこないたいと思っています。このシンポジウムにおきましても、このようなトレーニングについて考慮して頂ければと考えております。ありがとうございました。

[熊本氏]

このようなトレーニングが2年間カナダでおこなわれたということを理解するのはかなり重要なこと

だと思います。また、所属する省庁の違いにもかかわらず、このトレーニングにより、若い職員達が共通の知識を持ち、最終的に環境の悪化についてある共通の理解ができるようになるというのも大切なことだと思います。そういうご趣旨の発言でございましたね。それはまったく大切なことだと思います。

第二質問者のポータストラポン博士は、唯一の解決法などない、とおっしゃいました。確かにそのとおりだと思います。しかし、一つ博士に質問がございます。私は25年前にタイにやって来たのですが、20年、30年前の状況を考えると、私の質問は異なる価値に対する共通理解というようなものとは違うものになるうかと思っています。30年前、我々はこのような問題について議論することなどありませんでしたが、現在ではそれができるようになっています。ですから、もし25年前のタイにおける異なった価値に対する共通の理解に関して、何かご存知のことや気づかれたことがございましたら、お話し願えないでしょうか。

Tanzania who is one of the alumni of this training programme. And for myself after two years I finish training programme, I became IOI director of Thailand operational centre. I think I am going to start my work right away next year. We plan for long term future, for example, 10 to 20 years that we will be filled by young people from several departments. From now, we hope that next 10 or 20 years we will get strong effort of people in difference occupations, not only in government agencies. I think perhaps this symposium has to think about this kind of training. Thank you.

[Prof. Kumamoto]

I suppose it is quite important to understand such kind of training is a course for two years in Canada and to share the common knowledge among young officers even they belong to different departments, and finally we may come to some common understanding

of environment degradation. That is your point. I suppose that's quite important.

Q2 person mentioned that there is no one solution. I agree with you. But I have one question to you. Comparing such kind of problem twenty, thirty years ago when I came year 25 years ago in Thailand, but my question today is entirely different from such kind of common understanding of different values. 30 years ago, we didn't discuss this matter at all, but now we can do that. So if you have some knowledge or impression of such kind of common understanding of different values 25 years ago in Thailand, if you have some comment about that, we really appreciate it.

[Q2]

25 years ago, our resources were still very abandoned, so people did not care. Everybody was trying to get them. As I mentioned in other block, the greediness of the people is one of the crucial

〔質問者2〕

25年前、我々の資源は放置されており、人々も全く気にかけていませんでした。皆がその資源を使おうとしていました。他の分科会で申し上げましたように、人々の貪欲さが決定的な要因でした。私はある会議、国家レベルでの会議、に参加していましたが、そこでは違法なクローリングボードの合法化が議論されていました。その会議に参加していた全員が、特に教育機関からの出席者が、「我々はそんなことはできない。なぜならもうすでに大量の違反者がいるからだ」と言っていました。しかし、その日の終わりには、それが合法化されてしまいました。何故だか分かりますか。その理由は、当時の副首相がヒップスがたくさんあるところの出身であったからです。そうです、彼はその機会を最大限に利用したのです。こういうわけで先ほど我々はこのような決定を下す人たちを説得しなければならないと主張したのです。このようなことをやりたい放題にさせることはできないのです。ありがとうございました。

〔質問者4〕

私は、ベックマン博士に質問させて頂きたいとします。私たちはこのシンポジウムで、法の執行力の決定的な欠如という話を聞きました。環境保護に関する法令、法律、協定などはほとんどの国にあります。しかし、重要なのはその執行です。法の執行は単に法律家の仕事ではありません。その点にはご同意いただけるかと思います。地域社会—科学者、社会経済学者、教育者、地元の地域共同体の人々—はその執行に対してどのような役割を果たしうるのでしょうか。

〔ベックマン氏〕

我々が環境関連法やMPAの保護などを見ると、執行力がまったくないとは思いません。しかし、より近代的な表現を使えば、規制の応諾の促進という言葉になるかと思います。私の考えでは、西洋のやり方—「命令と規制」と呼ばれているもの—例えば恒久的免許制度、逮捕、罰金などをその要件とするもの—には時として危険が伴うということです。ア

point. Everyone in the room, particularly from education institutions, they said "no, we cannot do that because now we have too many of them already". But at the end of the day, the decision was made that we have to legalise them. You know why? Because the Deputy Minister at that time was from the area all those were. So he wanted to get most. This is why we have to try to convince more people that such a kind of decision, we cannot let them do as easy as it was. Thank you.

〔Q4〕

I'll give Dr. Beckman a question. We heard during this symposium, there is very strong lack of enforcement. There are legislation, laws and acts in almost all countries relating to the environment protection. But the enforcement is the clue. The enforcement is not only the duty of lawyers, you may agree with me, what kind of role the other

community may have for enforcement, such as scientist, and also other part of people like social-economists, like a local community.

〔Dr. Beckman〕

I would like to comment before excusing myself. If we look at environmental laws, protection of MPA, and so on, I don't think there is no enforcement, but the modern words would be to promote compliance with the rules. I think one of the danger is that we try to take sometimes the Western methods — what we call "command and control" — which requires permanent licence, arrest fines and so on. My observation after so many years in Asia, that doesn't really work here to have system-based licensing, and inspections and fines will result in insulting people. Sometimes the result is in favour for the new middle class and inspectors and so on because white envelopes are passed. This corruption problem, I think, has to

ジアで長年にわたり観察をしてまいりますと、このようなシステム化された免許制度や査察や罰金というものは結果的に人々を侮辱し、うまく機能しないということがわかります。時には、そのような措置が新興中産階級や査察官の利益になることがあります。なぜなら袖の下が渡されるからです。この腐敗という問題は、真剣に取り組んで行かなければならない問題です。また考えなければならないのは、このような罰金や罰則や免許制度を設けずに、いかにして規制の応諾を推進するかという問題であります。そしてそれには、地元共同体との協力や奨励金制度などを考えなくてはなりません。こうすることによって、規制に従うことが経済的利益をもたらすので、人々が関心を持つようになるのです。「命令と規制」の手法を続けようとしても、それはただうまくいかないことが多くの国で証明されています。

〔質問者5：ミャンマーからの参加者〕

政治問題と沿岸海洋生態系を含む環境管理との関連について議論したいと思います。通常政治的な問

題、特に政治体制の違いが環境管理や環境問題において、特定の国を支援する可否かの口実にされてきました。生態系の保護と管理において、政治的問題や政治体制の違いを議論に含めようとすれば、モラル的側面をそれに適用しなければなりません。これはアジアだけでなく、世界中で起こっていることです。例えば、ミャンマーは超大国が政治力で生み出した副産物によって大変苦しめられています。その結果、環境管理の進展のようなものがまったく見られないのです。このような政治的理由が、沿岸海洋生態系を含む環境の管理や保護に対する援助をおこなわない口実として述べられてきました。ですから、私の質問は、このような政治的な問題が環境管理において正当性を有するものかどうか、ということであります。我々はこの問題を真剣に考えなければなりません。これは単にミャンマーの問題であるばかりでなく、他の国々の問題でもあるのです。他にも超大国の政策に必ずしも同調しない国はあるわけですから。ありがとうございました。

seriously be addressed. And what we should be looking at is what are the methods you can promote compliance without these fines and punishment and licence by involving local community, and by providing economic incentives, so that it becomes the interest of the people to comply with the rules because of the benefit of economy by complying. I think if you follow the "command and control", it is simply proved that in many countries, it does not work.

〔Q5〕

What I would like to discuss is the political issues and connection at management of environment including costal and marine ecosystems. Usually political issues especially the political differences always have been the excuses for supporting or not supporting any countries for environmental management or environmental problems. The moral aspect should be applied if you want to include political issues or differences in protection

and management of ecosystems. It is usually happened around the world, and it is not just in Asia. For example, in Myanmar itself has been suffered seriously by political by-product made by superpowers. As a result, there is no such development in environmental management. Such political reasons have been given as excuses not to offer or lender any support or assistance in management or protection of environment, including coastal and marine ecosystems. So the question is whether the political issues are valid in managing environment. We should look at it very seriously. It's not just Myanmar the case, but also other countries, I believe. There are many countries which are not always be in line with other superpower's policy. Thank you.

〔Q6〕

Mr. Chairman. I am little bit uneasy and I try to formulate what it is. The emphasis on this meeting is

〔質問者6：サンゴ礁の専門家〕

議長、私はこのシンポジウムに居心地の悪さを感じており、その理由を説明したいと思います。この会議は「保護」という概念を強調しています。私はサンゴ礁に取り組んで26年になりますが、現在までに、ほとんどのサンゴ礁は危機に瀕しています。ますます悪化しているのです。過去にその保護を試みたことがありますが、今している話は昨年のもので、特にサンゴ礁に関するものです。これはゆゆしき問題ではありますが、もう時効が過ぎています。我々にはパラダイムの転換が必要なのです。我々は「保護」から、私に言わせてもらえば、現存する環境の「緊急救助」という考え方に移行して行かなければなりません。我々はまだ保護について語っていますが、サンゴ礁を保護することはできないし、保護できなかった、ということを知っています。この会議では、ハーグにおける温暖化ガス排出管理の交渉が失敗したことについて触れられることが余りありませんでしたが、これもその原因の一つです。地球温暖化は続いているのです。これは確認された科学的な事実

です。もし我々が温暖化ガスを排出しつづけ、それを抑制できなければ、我々は保護などできないし、これがサンゴ礁のかかっている病気の第一の原因なのです。地球温暖化は大きな脅威です。ですから、保護の問題はもはや中心的課題ではなく、現存するものをどうやって救い出すか、我々に何ができるかを考えなければなりません。これに関しては誰も知らないと思います。私は将来の会議のテーマとして、この問題を中心的問題として取り上げることを提案します。もうすでに保護の段階ではありません。なぜなら我々は特にこれらの資源を保護することに失敗したからです。また正直に申し上げれば、ここからどうやって進んでよいか分からないということも告白したいと思います。ありがとうございました。

〔熊本氏〕

将来の会議のテーマに関する重要な提案をありがとうございました。私もあなたに同意します。



"protection". I work for 26 years on reefs. All the reefs are hardening so far. We tried in those days protection. I think we are talking about yesteryear, especially with respect of coral reefs. It's problematic which is not valid any longer. I think we need a paradigm shift. We have to go from "protection" to perhaps something which I might call "emergency rescue" of what we have. We are talking still about protection, but we know that you cannot protect, and we failed to protect coral reefs. There was a very little talk in this conference about the failure of the negotiation in the Hague on the emission control. So this is part of it. Global warming continues. It's an established scientific fact. If we continue the greenhouse emissions, and if there is not containment, we will fail to protect and these are the prime reasons for the coral reef diseases and so on. Global warming is the main threat. So I think the question of protection is no longer the centre but it should be an effort to

rescue what we have and how do we go about it. I think nobody knows that. I would suggest that perhaps in the future meetings, we make it as a central issue. Not protection any longer, because we failed protecting especially these resources. And we don't know how to proceed from here if we are honest. Thank you.

〔Prof. Kumamoto〕

Thank you mister for very important suggestion for our future conference. I agree with you. Anybody want to comment or answer?

〔Dr. Kirkman〕

I wanted to give you an example that has to do with what Dr. Suraphol told us when he was talking about it earlier.

In Australia, 28 years ago, nobody knew what sea grasses were. There were two scientists in the whole of Australia working on sea grasses. I was

[カークマン氏]

オーストラリアでは28年前、海藻について知っている人は誰もいませんでした。オーストラリア全体で、海藻を研究している科学者は2人しかいなかったのです。私はその当時、海藻の研究はまったくしておりませんでした。ある湾で底引き網を使って若いえびを調査していました。そこで私は海藻の表面に100倍もの数の若い海老がいることを発見しましたが、海藻のことは誰も知りませんでした。そこで私がオーストラリアで海藻を研究する3番目の科学者になったのです。私の言いたいのは、その9年後、我々はオーストラリア全国海藻シンポジウムを開催したということです。そこには108人の研究者が集まり、28年後、西オーストラリアでは、海洋環境について議論をする際に海藻のことについて言及しない政治家はいなくなりました。そんなことはもう見られず、海洋環境について議論するとき、どこかで必ず海藻のことを話すのです。それはちょうどヨーロッパにおいて、鯨やタツノオトシゴの話をするのと同じようなものです。しかし、南オーストラ

リアでは、政治家はいつも海藻のことについて話すのです。我々はオーストラリアのこの現状を誇りに思っています。なぜなら我々はメディアを使ったからです。我々は別に嘘をついたわけではありません。そんなことをしてはいけないからです。すぐに見破られます。しかし我々は、時として特定の発見を強調し、「この地域の大部分にはこのような海老がいて、それはそこにこれだけの海藻があるからだ」と訴えてきたからです。しかし、やがて徐々に政治家や学校の先生、科学者達が海藻に取り組み、地域全体を発展させて行ったのであります。これは単に海藻のことだけにとどまりません。これが私のオーストラリアでの経験です。ありがとうございました。

[熊本氏]

カークマン博士、ありがとうございました。議論に関してコメントなどがないようでしたら、カークマン博士に昨日と本日のセッションの議論の総括をして頂きたいと思います。



not working on it at all, but I was told to troll in a bay looking for juvenile shrimps, and we found that 100 time more juvenile shrimps on sea grasses which nobody knew anything about. So I was then the third scientist to work on sea grasses in Australia. My point is that 9 years later, we had national sea grass symposium. There were 108 people at that meeting. 28 years later, in Western Australia, there is no politician to stand up and talk about marine environment without mentioning sea grass. This does not happen. Every time they talk about marine environment, they mention sea grass in somewhere, much in the same way that people in Europe would mention whales or sea horses. But in southern part of Australia, politicians always talk about sea grasses.

We are very proud of that in Australia because we used the media. We didn't exactly tell lies because that's not a way to do. You'll get caught out. But we sometimes exaggerate the particular findings we

found and said "much of the area has these prawns is where in fact more". But gradually, slowly, politicians, school teachers, scientists began to develop a whole region working on sea grasses. Now, this doesn't only apply to sea grasses. This is my experience in Australia. Thank you.

[Prof. Kumamoto]

Thank you, Dr. Kirkman. If we don't have any comment on the discussion, I would like to ask Dr. Kirkman to summarise all the discussions of the sessions of today and yesterday.

[Dr. Kirkman]

First of all, you've heard the summarisation of these sessions. The first session was about the social-economic part of the proceedings. We talked about regional and central government with policy of integrated coastal sea management and legislation with protected

〔カークマン氏〕

まず最初に、皆様はすでにこの2つのセッションの要約を聞いておられます。第一のセッションでは、議事のうち社会経済的部分を取り扱いました。我々は沿岸海洋管理の政策に関して地方政府と中央政府について論じ、保護された海域に対する法制について議論をしました。そして、我々は資源、資源の利用、資源の枯渇を表す小さな図を使って議論しました。そして、我々が責任を負っている様々な活動をその図に当てはめ、資源と枯渇について議論しました。

ファン博士が報告した第二のセッションでは、地域における沿岸管理の法的要件について議論しました。ここでは、我々は能力が目標であるということを議論しました。このグループは能力開発、立法化の取り組み、政策形成について、最下層、政治家、政策形成者や科学者を含むユーザーや利害関係者の持つあらゆる側面から、議論をおこないました。

第三のセッションでは、ウェイ氏から科学に関する報告を聞きました。現在の環境悪化の状況につい

てがテーマでした。いくつかの事例では原因が分からないため、その地域では汚染源を特定する作業が続いているという話をしました。ここでも公共教育の必要性が確認されましたが、他の場でもこの点は強調されています。地域間調整を強化するための推奨策として、我々は新しい技術をできるだけ使っています。アメリカのGPS信号のスクランブルが解除されたおかげで、新しい人工衛星が次々打ち上げられ、我々は非常に有利な立場にあります。海洋保護水域では、人工のサンゴ礁などについても警戒をしなければならないことが指摘されました。しかし、これは閉鎖された人工のサンゴ礁に関する話の一つでした。我々はまた絶滅の危機に瀕した種を養殖する技術の開発についても経験しました。

私の会議の総括は、この地域の基盤に関するものです。この地域における問題は極めて似通っております。国によって若干の違いがあるとはいえ、我々は類似した熱帯生態系を取り扱っており、かなりの類似性が、地域の抱える問題、その原因、そして我々ができることに見られます。タイは別として、こ



area. And there was nice little diagram with very small one which showed resources, use of various resources, and depletion. And they joined them up in various activities that we are responsible for resources and depleted them.

The second session which Dr. Huang reported on was the legal requirements of the region for the management of the coast. In that, we talked about the capacity is the goal. The group talked about capacity building, working on the legislation, and policy-making from all aspects of the users or stakeholders from the bottom, from the politicians, from policy-makers, and from scientists.

In the third session, we heard from Mr. Wei about science. What is the current situation of degradation? We don't know in some cases, so the identification of pollution is going on in the region. The fact again is that we require public education, and this was emphasised in another talks as well. For the recommendation

with strengthening coordination, we use new technology as much as we can. The new satellites are going up all the time with the unscrambling of the GPS, we've got a big advantages there now. In the marine protected areas, it was pointed out that how careful we have to be with artificial reefs. But this was one of the talks on contained section of artificial reefs. We also experienced some development of technology for culturing threatened species.

My summary of the meeting has to do with the regional basis. The problems here in this region are very similar. There are slight differences from one country to another, but we are dealing with tropical ecosystems, and there is considerable amount of similarities both in the problems, the causes, and what we can do about it. Some of these problems, apart from Thailand, are due to the enclosed sea or partly enclosed sea. This was one of the reasons that this meeting was sponsored by EMECS. EMECS would

これらの問題の一部は閉鎖性・準閉鎖性海域によって引き起こされている問題であります。これがこの会議が財団法人国際エメックスセンターの主催で開催されている理由でもあります。財団法人国際エメックスセンターはこの地域が大きなエメックス会議をサポートできるかどうかを検証し、それが可能かどうかを試していました。私は科学的見地から言っても、疑うことなく、財団法人国際エメックスセンターはこの地域にこれらの問題に取り組む科学者が存在することを認めたと確信しています。ですから、この地域での科学の発展はすでに大きなシンポジウムを開催できる段階に至っているのです。

それから我々はパネルディスカッションを行いました。どうやら私がパネルディスカッションを総括しなければならないようですので、その総括を総括し、会議を終了したいと思います。ですから、すばやくパネルディスカッションを総括したいと思います。

我々は海洋保護水域とその水域の計画段階について議論をしました。秩序だった制度と法制を作らな

ければならず、他国から借りてきて、自分たちのものにしたものであっても、法制に関して、人々が何を利用できるか分かるようにしなければなりません。地域協力、いくつかの問題に対しての条約や協定の必要性についても議論をしました。大和田博士は様々な形態の汚染について論じ、同じく「自己汚染」の概念を提示しました。それは大変よい問題提起であったと思います。そして問題解決には知識が鍵となると発言しました。我々は知識を持っはいるが、その知識を慎重に使わなければならない、と論じました。それから誰かがいくつかの組織について議論をし、それらにいかにかまとまりがないか、ということ論じました。また地域における科学者の役割についても議論がおこなわれました。それから我々はパネルディスカッションにはいりました。これは私がこの会議で得たものの総括としては十分だと思います。どうもありがとうございました。

investigate whether this area could support a large EMECS meeting and whether it was in fact eligible. I am sure scientifically without any doubt at all that EMECS would agree that this area certainly has the scientists to come at the problems. So the scientific development is at the stage to hold a large symposium.

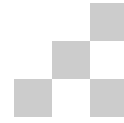
And we had the panel discussion. I suppose you want me to summarise the panel discussions, and summarise my summary, and close the meeting. So very quickly I summarise the panel discussions.

We talked about the marine protected areas and planning stages of marine protected areas. Ordered institutions and legislations should be made so that people know what is available as far as using legislation even from other countries, and bringing them into their own. We spoke regional cooperation and the necessity of convention or agreement in the region for some of the problems. Dr. Ohwada mentioned

pollution in its many forms and referred early to the "self-pollution" similarly. I think it was a good one. And the key are the knowledge to solving the problem. So we do have that knowledge, but we have to use it in a very careful way. Then someone else spoke about couple of institutions and how they weren't very well organised. Also the role of scientists in the region was discussed. We then went into a discussion with panel. I think we had enough of me on that. So thank you very much. I think that is reasonable summary of what I obtain from this meeting. Thank you.



閉会式 Closing



〔熊本氏〕

二日間にわたる、この特別なシンポジウムのすべてのセッションをととても上手にまとめて頂きありがとうございました。これより閉会式に入りたいと思います。

皆様、我々はこれで「沿岸・海洋生態系の保護と管理に関する国際シンポジウム」の全てのスケジュールを終了いたしました。それではこのシンポジウムを閉会するに当たって、メナスヴェタ博士とカークマン博士に短い閉会のスピーチを頂きたいと思います。メナスヴェタ博士、お願い致します。

〔メナスヴェタ氏〕

「沿岸・海洋生態系の保護と管理に関する国際シンポジウム」が終了しました。組織委員会の一員として、私はこのシンポジウムの成果に大変満足しております。このシンポジウムは国家の適切な保護を通じて、沿岸資源の合理的利用と持続可能な開発を目指す最初の重要な一歩であります。これらのセッションにおける討議と議論は、極めて素晴らしい着想、専門知識、情報の交換の場となりましたが、これにより将来の実りある地域協力が生み出されるものと信じております。我々は昨日の朝、副首相がお帰りになる際お会いして、お話をしました。その際副首相から沿岸海洋生態系の悪化に対して非常な懸念を抱いており、より一層の地域協力を進めたい、とのお話を伺いました。私はこのシンポジウムが彼の願いを幾分か果たしたのではないかと考えております。このシンポジウムの成功は、2003年にタイで開かれることが予定されている第6回エメックス会議への道を切り拓くものと考えております。今回の会議を主催した諸機関が、次の第6回エメックス会議も全面的に支援して下さいを願っています。その一方で、この場をお借りしまして、来年11月に神戸で開かれることになった第5回エメックス会議のメンバーとして、この会議に皆さんをご招待したいと存じます。ありがとうございました。

〔カークマン氏〕

皆様、私の話は十分に聞かれたことと存じます。熊本教授、メナスヴェタ博士、そして会場の皆様。

〔Prof. Kumamoto〕

Thank you very much for very nice summarisation of the all sessions of this special symposium of two days. I would like to proceed to closing session.

Now ladies and gentlemen. We finished all of our schedule of this International Symposium of protection and management of coastal marine ecosystems. It's the time to close our symposium with short closing remarks by Dr. Menasveta and Dr. Kirkman. Dr. Menasveta please.

〔Dr. Menasveta〕

The International Symposium on protection and management for coastal and marine ecosystem is now came to a conclusion. As a member of organising committee, I am very pleased with the outcome of this symposium. This symposium is the first and important step toward the rational use of coastal resources and sustainable development through proper national protection. Deliberations and discussions in these sessions have resulted in a very good exchange of ideas, expertises and information which could lead to a fruitful regional cooperation in the future. We contacted the Deputy Prime Minister before he left this meeting yesterday morning, and he expressed his concern about degradation of coastal marine ecosystems and wished to see more regional cooperation on this matter. I think this meeting has more or less fulfilled his wish. The success of symposium can also clear a way for the 6th EMECS conference which is now considered to be held in Thailand in 2003. I hope that the present sponsoring agencies will have full support for this 6th EMECS conference. Nevertheless, as a member of the 5th EMECS conference which came to be held in Kobe next November, I would like to take this opportunity to invite all of you to attend this conference. Thank you.

〔Dr. Kirkman〕

I am sure you heard enough from me. Prof. Kumamoto, Dr. Menasveta, ladies and gentlemen. I

皆様は今回の会議が大変な成功であったことに同意してくださるものと思います。私はまず各セッションの報告者の方々に心から感謝申し上げたいと存じます。それぞれのセッションの議長も大変上手に議事を進めていただき、感謝いたしております。また、今日の午後にそれぞれのセッションの要約と概略を報告してくださったりポスターの皆様、大変な量の仕事だったと思いますが、ご苦労様でした。今日の午後の議長を務められたスラポール博士、またこのセッションの議長を務められた熊本教授、大変感謝しております。ありがとうございました。

我々はすべての問題に関して、皆様の着想、新しい研究、視点を聞かせていただきました。今回の会議の主催者である財団法人国際エメックスセンターも満足されたことと思います。この地域の大学関係者にも参加していただいたことは明らかです。三つの大学から多くの学生が参加してくれました。とても素晴らしいことです。彼らは最も重要であるセッションの部分に積極的に参加してくれました。我々と財団法人国際エメックスセンターは、こうした若い人たちをこのような会議に呼ぶことは大変重要なことであると思っています。我々は彼らの参加にとっても満足しています。国連環境計画および財団法人国際エメックスセンターを代表して、エメックスの次の神戸での会議の成功を祈りたいと思います。これをもちまして閉会の言葉とさせていただきます。ありがとうございました。

[熊本氏]

シンポジウムを終える前に、少しお礼の言葉を述べさせていただきますと存じます。まず全ての参加者と関係諸機関の皆様に感謝申し上げます。このようなご支援がなければ、この重要なシンポジウムをタイで開催するという目標の達成は不可能であったことでしょう。この点から、私は国連環境計画東アジア海域地域調整機構、タイ政府科学技術環境省環境政策計画局、東南アジア海洋法・政策・管理プログラム、チュラロンコン大学に感謝したいと存じます。加えて、私の個人的な感謝の気持ちを、ここバンコクでシンポジウムを開催するのにご尽力いただきましたカークマン博士、フアン博士、メナスヴェタ博士に捧げたいと思います。最後に皆様方を来る2001年11月に神戸で開催される第5回会議にご招待したいと思います。皆様とは神戸で、あるいは2003年にここバンコクでお会いできることを期待しております。本当にありがとうございました。

am sure you all agree that the meeting has been most successful and I must thank most sincerely the speakers at each of sessions. The chairmen of each session ran them very well, I must thank them too. And the rapporteurs of each sessions whom we heard earlier this afternoon, giving use the summary and overview of each session did considerable amount of work. I must thank them for their great deal of work. This afternoon's chairman, Dr. Suraphol, I am very grateful for you too, and Professor Kumamoto for this session as well. Thank you.

We heard your ideas, new research, and angles on all the problems. We have satisfied EMECS in their sponsoring of this meeting. It was very clear that universities in this region came to our meeting, and there were many students here from three universities. I am very pleased to see them. I must say they listened to the most important part of the meeting which were the sessions. We and EMECS felt bringing these young people into a meeting like this is the most important. We are very pleased with their attendance. I would like to wish, on behalf of UNEP, EMECS for all the best in the next big meeting in Kobe. With that I would like to close. Thank you.

[Prof. Kumamoto]

Before close this symposium, let me allow to express in a few words to our participation. Appreciation to all the participants and concerned organisations. Without such support we could not achieve our goal to organise this important symposium here in Thailand. From this point, I would like to express our appreciation to United Nations Environment Programme/East Asian Seas Regional Coordinating Unit, Office of Environment Policy and Planning, South East Asian Programme in Ocean Laws, and Chulalongkorn University. In addition, I would like to express my personal appreciation to Dr. Kirkman, Dr. Huang, Dr. Menasveta who substantially promoted to organise symposium here in Bangkok. Finally, I would like to invite all of you to the 5th conference in Kobe in coming November 2001. I also would like to see you in Kobe or here in Bangkok in 2003. Thank you very much indeed. Thank you.

OBJECTIVES OF ADB5712REG COASTAL AND MARINE ENVIRONMENTAL MANAGEMENT IN THE SOUTH CHINA SEAS, PHASE II - CAMBODIA COMPONENT

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This paper summarizes the activities conducted in the Kingdom of Cambodia (Cambodia) under ADB 5712-REG Coastal and Marine Environmental Management in the South China Sea, Phase 2. Designed to implement a number of the important recommendations made in the first Phase of this regional technical assistance (ADB 5552-REG, Coastal and Marine Environmental Management in the South China Sea, February 1994 to June 1996), the objectives of this regional technical assistance were to :

- 1) Promote the sustainable use of coastal and marine resources in the western portion of the South China Sea ;
- 2) Promote regional cooperation in the protection and management of coastal and marine environmental resources ; and
- 3) Increase the capacity of countries participating in the regional technical assistance to manage their coastal and marine environmental resources on a sustainable basis.

Implementation and Outputs of ADB 5712-REG Activities in Cambodia

The Cambodia Ministry of Environment (MoE) was the Executing Agency in Cambodia for ADB 5712-REG. It was supported by technical assistance from GEC Global Environmental Consultants Ltd., in association with the World Wide Fund for Nature - International and Wetlands International - Asia Pacific according to the overall Terms of Reference for ADB 5712-REG. This technical assistance provided for 32.5 person-months of and 14.5 person-months of national and international consultant support, respectively, for Cambodia from February 1999 to March 2000. Draft plans were submitted to the Bank and to Cambodia in October 1999 and provincial and national workshops were held in December 1999 to review the draft plans. The draft plans were also reviewed at a regional workshop on coastal and marine environmental management held in Sanya City in March 2000, after which this final report was prepared.

The major outputs of ADB 5712-REG in Cambodia were a national strategic plan for coastal and marine environmental management and a national coastal and marine protected area plan as one component of the overall strategic plan. The preparation of these plans was supported by : a coastal community survey ; the compilation of a coastal and marine environmental management database for Cambodia ; and a demonstration project in Preah Sihanouk National Park to test some of the key approaches recommended in the strategic and protected area plans.

Strategic Coastal and Marine Environmental Management Plan for Cambodia

The coastal and marine sector is extremely important to Cambodia's economic development. For example :

- 1) 75% of the households in the four coastal provinces/municipalities rely on the primary sector, agriculture, fishing, and forestry, as the main source of employment and income. Coastal and marine biodiversity resources are important to these households ;
- 2) Coastal and marine biodiversity provides substantial benefits to local communities and the country of about US \$12 million in benefits per year for the major coastal and marine ecosystems of Cambodia. This translates to about US \$162 per household per year for all residents living in the coastal districts in which these ecosystems occur. Coastal and marine biodiversity generates significant flows of benefits to local households and communities ;
- 3) Sihanoukville has been designated as one of three priority economic development areas of the country (along with Phnom Penh and Siem Reap) ;
- 4) Sihanoukville port is the major national marine port of the country ; and
- 5) Coastal areas are often the focus of tourism and Cambodia is no exception. The Ministry of Tourism's national tourism plan delineates eight areas as tourism development priorities ; three of Cambodia's four coastal provinces/municipalities are included in these areas : Sihanoukville, Kep, and the coastal area of Kampot Province. These areas also include the offshore islands of these provinces/municipalities.

Unlike its most of its southeastern Asian neighbors, Cambodia's relatively low population, still abundant productive natural resources, and current development situation are all advantages in its economic development. If it wishes, Cambodia can use these advantages to learn from the experiences of its neighbors how to build institutions, develop and implement policies and laws, and appropriately design and deliver investments and technical assistance for the coastal and marine environment sector. A good foundation has already been laid by Cambodian institutions, supported by donors, in setting up the first pieces of the legal framework for environment, as well as in capacity building, community participation, and protected areas.

Yet, there is much to be done in the area of coastal and marine environmental management in Cambodia :

- 1) The data and information base is extremely weak and lacks any spatial or temporal continuity on which planning and management decisions can be made ;
- 2) Cambodia's coastal residents, relying almost exclusively on productive natural resources, are extremely poor and lack much of the basics required for daily living : adequate food and water ; employment ; health care, education ; transportation ; and environmental sanitation ;
- 3) While civil society is beginning to return to many parts of coastal Cambodia, resource extraction remains under the influence of powerful people and organizations ;
- 4) Despite the lack of quantitative information, there are signs that the health and integrity of productive natural resources - forests ; wetlands ; and fisheries - in coastal and marine Cambodia are beginning to become adversely affected by human activities ;
- 5) The fiscal and budgetary realities of present-day Cambodia make it unlikely that solutions to these issues will come entirely from the government ; and
- 6) Lack of especially skilled and experienced human resources in the field of coastal and marine environmental and natural resources management and conservation.

The Strategic Plan for Coastal and Marine Environmental Management in Cambodia presented in this report sets out a proposal for removing these constraints so that Cambodia's current advantages can be realized.

The overall goal of the Cambodia Strategic Plan for Coastal and Marine Environmental Management is :

Achieve poverty alleviation and economic development in the coastal provinces of Cambodia

The Strategic Plan contains six major components, each with a specific set of objectives :

Component 1 : Legal, Policy, and Institutional Framework	Objective 1.1	Strengthen and Rationalize the Institutional, Legal, and Policy Framework for Natural Resource and Environmental Management
	Objective 1.2	Strengthen the National Coastal Steering Committee and Set Up Cambodia Coastal and Marine Resources Fund
Component 2 : Data and Information Management	Objective 2.1	Strengthening the Capacity for Basic Environmental and Natural Resources Management
	Objective 2.2	National Coastal and Marine Biodiversity Assessment
	Objective 2.3	Coastal and Marine Information Management System
Component 3 : Integrated Coastal and Marine Management Plans for Coastal Provinces	Objective 3.1	Prepare Coastal and Marine Functional Zoning Plans
	Objective 3.2	Implement, Monitor, and Revise Plans
Component 4 : Community Development and Livelihood Improvement	Objective 4.1	Initial Community Level Infrastructure Rehabilitation
	Objective 4.2	Community Development and Livelihood Improvement
	Objective 4.3	Protected Area Community Development and Livelihood Improvement (linked to Component 6 : Coastal and Marine Protected Areas)
Component 5 : Community-Based Coastal and Nearshore Fisheries Management	Objective 5.1	Fisheries and Aquaculture Licensing System
	Objective 5.2	Enforcement
	Objective 5.3	Establishment of Coastal Fishery Reserve System
	Objective 5.4	Coastal and Nearshore Fisheries Infrastructure Support
Component 6 : Coastal and Marine Protected Areas	Objective 6.1	Implement Investment Program for Coastal and Marine Protected Areas
	Objective 6.2	Strengthen Legal, Policy, Institutional Framework for Protected Areas

Coastal and Marine Environmental Management Plan

The overall aim of the Cambodia Coastal and Marine Protected Area Plan is to alleviate poverty in the coastal provinces of Cambodia by formalizing and strengthening Cambodia's coastal and marine protected area system and simultaneously providing opportunities for coastal rural household and community economic development. To achieve this aim, the following must be met :

- 1) Enhancement of existing physical, biodiversity, land use, and socioeconomic information in the coastal and marine areas of Cambodia to enable formal planning and management of the entire coastal and marine protected area system ;
- 2) Formalization of a coastal and marine protected areas system for Cambodia through establishing a system of six reserves currently estimated to cover a total of 388,700 ha ;
- 3) Identification and, if appropriate, establishment of additional marine reserves in the most important sites within the EEZ of Cambodia to complete the marine protected areas system ;
- 4) Extensive and comprehensive upgrading of all marine and coastal protected area sites presently identified with respect to biological and socioeconomic assessments, management plans, zoning, boundary demarcation, infrastructure and other facilities ;
- 5) Local community participation in all aspects of protected areas management including livelihood support, and community development programs for approximately 24,000 households and 120 villages, respectively ;
- 6) Development of a cadre of approximately 360 sufficiently and appropriately trained management, administrative and technical staff in the system of six reserves ;
- 7) Elaboration of the legal, institutional, and policy framework for protected area management in Cambodia. This includes institutional arrangements for protected areas management and consistent organizational arrangements within protected area management boards that are based on functional requirements for reserve management ;
- 8) Effective ongoing biological and socioeconomic monitoring.

The Plan has three objectives as defined in the overall Strategic Plan for Coastal and Marine Environmental Management :

- 1) National coastal and marine biodiversity assessment (This is an objective of Component 2 : Coastal and Marine Data and Information Management under the Strategic Plan for Coastal and Marine Environmental Management. It would need to be completed as a first part of implementing the overall Coastal and Marine Protected Area Plan and is therefore included here.
- 2) Investments for the six currently identified coastal and marine protected area reserves to initiate or upgrade management and protection of biodiversity, plus concomitant investments in community development and economic livelihood support for communities using the natural resources of the existing protected areas ; and
- 3) Strengthening the legal and institutional framework for protected area planning and management.

Based on the lessons learned from the experience with other natural resource management projects in the region, support for the protection agency is necessary but not sufficient to ensure effective implementation of a plan for protected areas. The need to effectively improve the income status of the adjoining communities, particularly the more vulnerable (poorer) ones, requires a combination of extension, credit and social support tied in with environmental promotion, and legal, policy and contractual measures to ensure that incentives exist for joint protection. To this end, it is proposed that investments in protected areas and in community development and economic livelihood support would be secured with the development of joint agreements between communities, protected area management boards, and governments for protecting biodiversity resources within designated protected areas.

Justification of the Plans

INTERNATIONAL OBLIGATIONS

Cambodia has endorsed several international conventions and as such is obliged to fulfill its commitments to these conventions ; three are of relevance to the implementation of these Plans :

United Nations Convention on the Law of the Sea Cambodia is a signatory to this Convention. These Plans will enable Cambodia to adhere to a number of the articles of UNCLOS, specifically those pertaining to : conservation and preservation of the marine

environment (Part XII Section 1 Articles 192, 197, 199, and 200) ; monitoring and environmental assessment (Article 4) ; prevention, reduction, and control of pollution (Articles 207 to 208) ; and sustainable exploitation of marine resources (Article 62)

The International Convention on Biodiversity Conservation This convention calls on all countries to develop and implement national plans for biological diversity conservation and set forth and implement a plan of action for aspects for priority attention. Cambodia acceded to this Convention on 9 February 1995. These Plans include a review of marine and coastal biodiversity resources in the country to assure adequate coverage of these resources is incorporated into Cambodia's system of protected areas and also provide for establishing sustainable management of Cambodia marine fisheries resources

Convention on Wetlands of International Importance This Convention came into force for Cambodia on 23 October 1999. The Convention calls on all countries to set aside and manage those areas that are important to migratory waterfowl and waders. The coastal and marine protected area plan includes the Peam Krasop Wildlife Sanctuary that contains the Koh Kapik Ramsar Site.

THE NATIONAL ENVIRONMENTAL ACTION PLAN FOR CAMBODIA (1998-2002)

The NEAP proposed an ambitious short-term action program that for a number of reasons has fallen behind in implementation. Nevertheless, recommendations in the NEAP are a further endorsement of the strategies and actions developed in these Plans for natural resources and environmental management in coastal and marine Cambodia. Coastal Fisheries Management and Biodiversity and Protected Areas are two of the six thematic areas in the NEAP ; NEAP recommendations for these thematic areas are :

Coastal Fisheries Management

- Updating fisheries regulations on the entry of domestic and foreign commercial boat operators into the fisheries.
- Protect critical marine and coastal areas.
- Strengthen the capacity of the DoF to manage the fisheries.
- Provide non-fishing economic opportunities in coastal communities as a way to reduce fishing pressure.

Biodiversity and Protected Areas

- Preparation and enactment of legislation on the operational aspects of protected area management.
- Train the staff of the MoE and other agencies involved in biodiversity conservation within and outside protected areas.
- Establish a trust fund or endowment to provide long-term financing for conservation programs.
- Prepare and implement management plans for priority areas of high biodiversity conservation significance.
- Special mention was given to Preah Sihanouk and Bokor National Parks, and the Koh Kapik Ramsar site in Peam Krasop Wildlife Sanctuary.

These Plans provide detailed direction and guidance for meeting these recommendations contained in the Cambodia NEAP, through Component 5, Community-Based Coastal and Nearshore Fisheries Management and Component 6 : Coastal and Marine Protected Areas of the national Strategic Plan.

CONTRIBUTION TO SUBREGIONAL BIODIVERSITY CONSERVATION

Allowing for the fact that data is somewhat out of date for some of these ecosystems and incomplete for others, the overall level of protection afforded to the known area of ecosystems is very high ; 50% of the known area of major coastal and marine ecosystem in Cambodia are protected under the current protected area system. In addition, Cambodia's overall coastal and marine ecosystem protection^{xlvii} is greater than that proposed across the entire subregion for mangroves and other coastal wetlands. Even without extension of the existing coastal and marine protected area system, Cambodia's protection of its mangrove and other coastal wetland resources would be higher than the average level of protection throughout the Subregion that would be achieved with the implementation of all four plans in the subregion.

NATURAL RESOURCE SECTOR

Cambodia's coastal and marine resources will improve as a result of implementing these two Plans :

Improvement of Coastal and Marine Natural Resources with Coastal and Marine Protected Area System

- Enhancement of existing physical, biodiversity, land use, and socioeconomic information in the coastal and marine areas of Cambodia to enable formal planning and management of the entire coastal and marine protected area system ;
- Formalization of a coastal and marine protected areas system for Cambodia through establishing a system of six reserves currently estimated to cover a total of 388,700 ha ;
- Identification and, if appropriate, establishment of additional marine reserves in the most important sites within the EEZ of Cambodia to complete the marine protected areas system ;
- Extensive and comprehensive upgrading of all marine and coastal protected area sites presently identified with respect to biological and socioeconomic assessments, management plans, zoning, boundary demarcation, infrastructure and other facilities ;
- Elaboration of the legal, institutional, and policy framework for protected area management in Cambodia. This includes institutional arrangements for protected areas management and consistent organizational arrangements within protected area management boards that are based on functional requirements for reserve management.

Improvement of Coastal and Marine Natural Resources with Community-Based Coastal and Nearshore Fisheries Management

- Detailed fisheries resource assessments in fisheries and aquaculture zones
- Improved licensing system for both capture fishers and aquaculture operations based on long term sustainable yield estimates for fishing and aquaculture zones
- Fishing communities organized into self-regulating associations for monitoring, surveillance and patrol
- Basic surveys for identification of fisheries of habitats, fishery reserves in the coastal and marine areas
- Surveys, data collection, and identification of reserve boundaries for conservation of fishery resources and fishery resource conservation for these reserves.

Poverty Alleviation and Economic Development

It is understood and accepted that providing increased economic opportunities to the rural poor is a necessary prerequisite to achieving sustainable management of Cambodia's productive coastal and marine resources and the protection of Cambodia's important coastal and marine ecosystems. A number of components of these Plans are directed towards poverty alleviation and economic development :

1) The Plans would provide livelihood support to approximately 200 villages in coastal Cambodia, representing approximately 25% of the total population of the coastal provinces and municipalities. About 50% of this would be achieved through the Coastal and Marine

^{xlvii} as a proportion of known existing ecosystem area

Protected Area Plan, targeting villages and households living within or adjacent to the six designated protected areas. The remainder would be achieved through poverty alleviation programs in villages that would be identified as priorities for assistance in coastal Cambodia ;

- 2) Improvement in basic rural infrastructure throughout coastal Cambodia : roads ; markets ; health centers ; schools ; and water supply ; and
- 3) Investments in appropriate and modest value added activities in the fisheries sector to increase the benefits accruing to fishing households.

EMPLOYMENT

Employment in coastal and marine areas of Cambodia would benefit from these Plans in six ways :

- 1) The community development and poverty alleviation activities (Component 4 of National Strategic Plan) would use local labor resources, labor-intensive methods to help absorb under-employment and demobilizing military ;
- 2) The extensive training and capacity building built into the Plans would increase the employability of beneficiaries ;
- 3) The coastal and marine protected area plan would increase direct employment in protected area management and employ a cadre of sufficiently and appropriately trained management, administrative, and technical staff in the system of six reserves ;
- 4) Properly implemented, the Plans will ensure the creation of an enabling environment for private sector and public participation in coastal and marine resource management, thereby increasing private sector employment in the coastal and marine sector ;
- 5) Indirect and induced employment would undoubtedly increase as a result of investment in the coastal and marine areas of Cambodia ; and
- 6) Natural resource sector-dependent employment would increase with increasing health of Cambodia's coastal and marine biodiversity resources.

PUBLIC PARTICIPATION AND COMMUNITY DEVELOPMENT

The Plans will ensure full local community participation in all aspects of coastal and marine environmental management, including livelihood and community development programs, and this will be strengthened in the legal, policy, and institutional framework of the province. Specific programs would have a positive impact on coastal communities living in surrounding areas in a number of ways. In addition, public awareness and appreciation for the conservation values of Cambodia's coastal and marine areas would increase, and environmental and educational opportunities for the public and youth in particular would improve.

Additional Benefits

Additional expected benefits to these Plans are :

- 1) Coastal and marine functional zoning will improve the likelihood that economic development can proceed in the study area in a rational, and sustainable manner ;
- 2) Improved data and information on productive natural resources and important ecosystems in the provinces will enable ongoing improved resource management decisions to be made ;
- 3) Increased local responsibility for and control over the management and protection of productive natural resources of coastal and marine Cambodia ;
- 4) Improved capacity of local institutions for coastal and marine environmental planning and management ;
- 5) Beneficiary involvement in implementation of the Plans and training of beneficiaries in stewardship of coastal and marine resources ;
- 6) Recognition that sustainability requires support of communities ;
- 7) Assigning priority to coastal and marine biodiversity conservation as a necessary requirement for economic development ; and
- 8) Increased capacity in and strengthened linkages among key local institutions.

ECONOMIC JUSTIFICATION OF COASTAL AND MARINE PROTECTED AREA PLAN

Preliminary analyses indicate that the coastal and marine protected area plan is modestly economically feasible. At a 12% discount rate, the economic Net Present Value is = \$1.01 million. At this rate, for every \$1 of cost, there will be \$1.06 of benefit ; the economic rate of return (EIRR) is estimated at 13%. This is an acceptable rate of return, given the fact that it does not include all the direct benefits to beneficiaries that would be derived from the poverty alleviation activities that are a part of the coastal and marine protected area plan.

Assuring Sustainability

The long-term sustainability of these Plans will be enhanced by :

- 1) Concomitant institutional, policy, and legal strengthening of overall framework for coastal and marine environmental management
- 2) Development of institutional and human resource capacity to implement the activities required for biodiversity protection ;
- 3) Development of ownership and commitment at the local level to the objectives of the Plans ; and
- 4) Promotion of alternative livelihood opportunities for communities to reduce pressure on key coastal and marine biodiversity resources.

Key to the success of the above would be participatory planning, collaboration among key stakeholders ; community empowerment would result from information sharing, consultation, and collaboration.

Implementation of the Plans will have significant positive environmental impacts to Cambodia's environment. There may be some environmental impacts caused by some of the civil works and facilities construction, but these are expected to be local and either insignificant or mitigable. It is expected that environmental guidelines of Cambodia would be followed through the construction and operation of the civil works and facilities.

Modest resettlement is currently assumed for the Coastal and Marine Protected Area Plan. If more detailed design studies confirm the need for resettlement of any magnitude whatsoever, leaving households where they are and developing livelihood alternatives and community development programs should be considered as an alternative. Failing that, a Resettlement Action Plan would need to be prepared, and this plan would require and environmental and social assessment, including assessment of impacts at the receiving sites, would need to be conducted as part of detailed design.

There is potential in the Coastal and Marine Protected Area Plan for negative impacts caused by possible increased levels of human activity within the protected areas, particularly those which are coastal tourism destinations. The recommendations are to :

- Ensure that environmental assessments of all types of human activities contemplated for protected area are conducted as part of

- preparation of protected area management plans ; and
- Ensure the coastal and marine protected area management plans include limits for human activities for activities such as tourism within the protected area and that these limits are strictly enforced.

Implementation and Future Activities

PARTNERSHIPS AND CO-MANAGEMENT : THE GUIDING PRINCIPLE

The Government of Cambodia alone will not be able to implement these Plans in a way that provides the maximum benefits to its coastal residents and to the country as a whole. The multi-sectoral nature of the Plans almost guarantees this, and yet this is exacerbated by severe constraints of capacity ; reach of civil government to local levels, and availability of financial resources.

Partnerships among the various stakeholders offer a way to overcome these constraints. The list of stakeholders includes :

- 1) The government sovereignty over land and resources and setting the basic legal, policy, and regulatory framework within which the other stakeholders operate ;
- 2) Local communities whose livelihood depends on the availability of productive natural resources and who have to live with the consequences of investment and resource allocation decisions ;
- 3) ILIs providing the initial investments that will be required ;
- 4) Donors providing technical assistance support ;
- 5) The private sector as sources of funds, influence, and expertise - particularly true in the case of coastal Cambodia for tourism, fisheries products, and perhaps even small scale sustainable enterprises ; and
- 6) NGOs as a conveyors of public information ; technical advice ; providing linkages among stakeholders ; and monitoring.

Experience has shown elsewhere that all stakeholders are necessary ; they will all be necessary for coastal and marine environmental management in Cambodia. Wherever possible, incentives should be created for all stakeholders to remain involved and to bring their best talents and skills to the tasks at hand.

RECOMMENDED NEXT STEPS

The National Strategic Plan for Coastal and Marine Environmental Management and the National Coastal and Marine Protected Area Plan should be viewed as important steps in an ongoing process of : examination of environmental issues ; priority setting ; project definition ; and evaluation for Cambodia's coastal and marine area. The challenge is to ensure that this process is maintained.

Like elsewhere, coastal and marine environmental problems in Cambodia are multi-sectoral, involve numerous constituencies ; involve policy and legal issues ; and involve great uncertainty with respect to the adequacy of scientific information. A number of initial development activities have taken place in coastal Cambodia. These have made and continue to make important impacts on certain parts of the overall situation, such as capacity and local awareness. The results of these initiatives have made it possible to produce these Plans. Now, the RGC and donors will need to commit to longer projects and initiatives according to these Plans. These Plans set out the environmental priorities for coastal Cambodia. It is therefore appropriate to use the document as a basis for planning and coordinating activities in the coastal and marine environment sector in Cambodia.

It is recommended that the NCSC and the Ministry of Environment could conduct the following activities upon receiving this report :

- 1) Translate and improve the Khmer version of the reports and produce versions of these reports that are more useful for ongoing consultation and implementation in Cambodia (actual international consultant reports are generally not appropriate for this work and the format needs to be modified to suit Cambodia conditions) ;
- 2) Provide ongoing support to MoE for the preparation of program documents for input to the second Five Year National Development Plan ;
- 3) Preparation of program documents for submission to the Council of Ministers for formal national government approval of the RETA outputs. This would require inter-ministerial meetings and revision of the program documents to address the comments made in these meetings ; and
- 4) Consultations between MoE the Council of Ministers and Ministry of Planning with respect to second Five-Year National Development Plan and approval of the RETA outputs.

Subsequent steps could consist of :

- 1) Applying to national, provincial, and international organizations for project establishment and required funding ;
- 2) Implementing activities using the expertise gained in doing technical assistance through both ADB 5712-REG and the results of the first phase, ADB 5552-REG ;
- 3) Establish demonstration projects for initial implementation of the plans ; and
- 4) Conduct a campaign to promote the involvement of major stakeholders in coastal and marine environmental management.

Complementary to this would be regular review of progress being made on the action items identified in the Plans as a part of the regular planning and coordination activities of the country.

THE ROLE OF MYANMAR'S ENVIRONMENT RELATED LAWS AND REGULATIONS IN PROTECTION AND MANAGEMENT OF COASTAL MARINE ECOSYSTEMS : ISSUES AND NEEDS

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Myanmar is in the process of forming Ministry level Environment body while National Commission for Environmental Affairs (NCEA) serves as a national focal point and coordinating agency for environmental matters. Although environmental protection law is yet to be promulgated, currently, there are several sectoral laws and regulations that contain portions on environmental protection. These existing laws are partially equipped with vision of sustainable management of marine resources especially in the area of prevention and management of coastal and marine ecosystems. Localized uni-sectoral development activities across nation's coastal areas are not always in line even with environmental regulations defined in sectoral laws. In addition, local socio-economic activities, transboundary trade and border area rehabilitation programmes are not less in contributing overall environmental degradation to the ecosystems. Whilst the issues need to be addressed properly in order to achieve harmony between socio-economic development and protection and management of coastal marine ecosystems, various obstacles still remain. Therefore, the role of currently available environment related laws have become vital in protection of the ecosystems. However, in practice the effectiveness in implementation and enforcement of those laws are largely reduced by limitations. Financial support and human resources, administrative enforcement and integrated appropriate mechanism in laws appear as major deficiencies. If enforcement of the laws and management of coastal zones become ineffective, the future of the Bay of Bengal and the Andaman Sea ecosystems are at high risk. This paper discusses related major issues and constraints, and provides with possible management strategy to deal with current problems.

1. Introduction

Coastal and marine areas of Myanmar have very diverse ecosystems composed of evergreen forests, wetlands, mangroves, coral reefs, seagrass beds and sandy beaches. These ecosystems are distributed within approximately 12 million hectares of coastal areas of six states and divisions of Myanmar.

Similar to some of the South East Asian countries, Myanmar coastal environment of today is faced with variety of serious threats and problems. Degradation of coastal and marine environment has resulted from wide range of pollution sources such as sewage, nutrient runoffs, synthetic organic compound, sediments, litter and plastic, and oil/hydrocarbons (DOLF, 1998). In addition, conversion of coastal mangroves and wetlands to other purposes such as agriculture, aquaculture, settlement and infrastructure development poses serious danger to the coastal and marine ecosystem. Non-sustainable localised uni-sectoral development activities in coastal areas are also worsening the already deteriorating situation of coastal marine ecosystems.

Most needed integrated multi-disciplinary approach and stakeholder coordination as well as cooperation in major issues such as land use planning, resources utilization and management, coastal zone management and sustainable development are yet available. Therefore, there is an urgent need to manipulate those issues before the situation reach to ecosystem boiling point.

Myanmar, in the post-Rio period, like many other countries in the Asia Pacific region, has responded to the emerging challenges of achieving sustainable development by reshaping environmental governance to make it more suited to integrating the environmental and development concerns of the country. The coastal and marine environmental issues, which are mentioned previously, are regarded as part of the country's whole environmental problems. In order to coordinate with related agencies, a national environment body, National Commission for Environmental Affairs (NCEA) has emerged in 1990.

Environment management, which plays vital role in sustainable development mechanism, is fairly new in Myanmar. However, environmental law is not totally strange to Myanmar, as the nation's sectoral laws have either in parts or segment on environmental protection. The environmental management pattern in Myanmar is largely sectoral with existing laws relating to environmental management being formulated and administered by the ministries and departments concerned. For instance, the Ministry of Forestry is responsible for forest management including wild life conservation, while Ministry of Industry Controls and regulates industrial activities and pollution. The Ministry of Health is responsible for environmentally related issues. Conservation of marine and freshwater fishery resources is carried out by the Ministry of Livestock and Fisheries whilst the Ministry of Labour controls the pollution of environment from factories (NCEA, 1999).

The environmental protection and management part is either weak or unavailable in most sectoral laws, except the forest law of 1992. For example, laws under the Ministry of Livestock and Fisheries emphasize in capture fisheries by regulating fishing. None of the portion of the fisheries laws covers conservation, management and research sector regarding the protection and management of coastal and marine ecosystems.

Implementation of laws, especially enforcement of standards and environmental quality, is critical for the success of any environmental protection regime. Supplementary legislation on sectoral aspects of environmental management is necessary to bridge the gaps in the framework laws and to provide practical guidelines and criteria to the enforcement agencies. In addition, Myanmar Agenda-21 has stated that there is a need for new laws and mechanisms for enforcement and implementation in order to harmonize current environmental trends and conditions. Accordingly, in line with Myanmar Agenda 21, the environmental protection law was drafted by NCEA in coordination with the UN-ESCAP and UNEP and soon to be approved by the cabinet.

Most countries in the region have laws to cover sector-specific environmental problems and issues (ESCAP, 2000). Institutional mechanisms for achieving this integration are, therefore, of paramount importance. Formulation and implementation of appropriate policies and programmes, enactment of laws, rules and standards for enforcement of policies and creation of delivery mechanisms for implementation of plans and enforcement by institutions provide credibility and stability to the environmental regime.

In this paper, environmental related sectoral laws are described from the environmental protection viewpoint and some development activities that contradict environmental sustainability are mentioned. It also highlights the role of environmental related sectoral laws in protection and management of coastal and marine ecosystems in Myanmar.

2.Environment Related Laws and Regulations : Is Coastal Marine Ecosystems Prioritized?

Environmental Institutions

Aware of the fact that environment and development are non-separable, Myanmar government pays more attention on environmental affairs. As a result, NCEA has emerged as a coordinating agency collaborating closely with government ministries and departments in matter relating to the environment. It also acts as the national focal point for environmental matters vis-a-vis other countries and international organizations, coordinates the work of various relevant ministries and departments and reports directly to the Cabinet. The NCEA was established with the following objectives :

- (i)To develop sound environmental policies in order to safeguard the environment and prevent its degradation;
- (ii)To set environmental standards, rules and regulations for pollution control;
- (iii)To formulate environment plans, programmes and strategies; and
- (iv)To promote environmental awareness and public participation in environmental activities.

There is neither a specific protection and management body or coordination unit that has multidisciplinary approach for coastal and marine ecosystems. However, separate indirect responsibility on protection and management of marine environment scattered amongst different ministries.

At the ministry level, the ministry of Science and Technology is empowered to designate its directorate to carry out environmental research activities while the ministry of Forestry oversee the conservation and management of forest, biodiversity and wildlife. Protection, conservation and management of coastal and marine areas are under the responsibility of fisheries department of the Ministry of Livestock and Fisheries.

Under the Ministry of Education, Marine Science Department of the University of Maw-la-myne is one and the only educational institution in the country relating to coastal and marine activities. The department carries out research and development activities of the marine ecosystems.

Policy Formulation

Environment policy of a country shows its vision on environment and political will to achieve any set objectives of the country; thus is an initial important part of environmental governance.

The National Environment Policy of Myanmar formulated by the NCEA has been proclaimed through the Gazette in accordance with Notification No. 26/94 dated 5 December 1994, issued by the Government of the Union of Myanmar. The Policy Statement reads as follows :

To establish sound environmental policies utilization of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy : -

"The Wealth of a nation is its people, its cultural heritage, its environment and its natural resources. The objective Myanmar's environment policy is aimed at achieving harmony and balance between these through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilize its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interest of present and future generations. Environmental protection should always be the primary objective in seeding development."

The policy clearly shows the sustainable development vision in its statement and its reflection is seen in Myanmar Forest Policy, which was notified in 1996. It was issued in view of the importance of the Myanmar Forestry Sector in enhancing national socio-economic development, and formulated with the overall context of ecological balance and environmental stability, taking full cognizance of the forestry principles adopted at the United Nations Conference and Development (UNCED) in 1992. The Policy has identified six imperatives : (1) protection of soil, water, wildlife, biodiversity and environment; (2) sustainability of forest resources for the present and future generations; (3) basic needs of the people; (4) efficiency to harness, in the socio - environmentally friendly; (5) participation of the people in the conservation and utilisation of the forests; and (6) public awareness about the vital role of the forests in the well being and socio-economic development of the nation (MOF, 1996).

The Government ministries including the Ministry of Energy and the Ministry of Health, have also issued policies in which some provisions for protection of environment have been included.

Environmental Related Laws

Since environmental law is not yet available in Myanmar, sectoral laws relating to environment are regarded as environmental protection laws. However as mention previously, these laws, in general, do not possess holistic vision on environmental management there by only emphasizing on specific issues of related sector. Therefore, the affect of those laws on environmental protection is of indirect. For example, the City of Yangon Development Law (1990), the City of Yangon Municipal Act (1992) and the Development Committee Law (1993) contains provisions relating to water pollution (Lwin, 2000). As the City of Yangon is located in coastal zone, prevention of pollution from the city is quite important for the sustainability of coastal marine ecosystems.

In addition, the Yangon Port Act (1905), the Canal Act (1905), the Embankment Act (1909) and the Ports Act (1908) provides cleanness of inland waterways, hence, it prevent from increasing pollution level in the estuary and marine areas. Prevention of mangrove deforestation can also be seen in the Salt Enterprise Law, which prohibits production of salt by means of wood fire or charcoal and permits only solar salt.

Similarly, the Factories Act, 1951 has provisions whereby effective arrangement is required to be made in every factory for the disposal of wastes and effluence. Measures for the proper disposal of waste and effluence, and in particular, treatment of waste water from the textile and chemical plants have resolved much of the environmental pollution problem that would have adverse impact on the coastal marine ecosystems.

Provisions of these environmental related laws control the land based pollution sources, thereby protect coastal and marine ecosystems indirectly. However, it is clear that some of the laws were promulgated before the WWII and are no longer comprehensive enough to encounter environmental problems of today. These laws are seriously needed to amend in line with current environmental situations. As well, new laws and mechanisms for enforcement with sustainable development vision are also necessary to create.

Laws Related to Coastal and Marine Ecosystem Protection

Laws related to coastal and marine environments are described in different sectoral laws under two ministries : the Ministry of Livestock and Fisheries, and the Ministry of Forestry. For instance, the Marine Fisheries Law (1990), the Freshwater Fisheries Law (1991), the Fish-

ing Rights of Foreign Fishing Vessels Law (1989), and the Aquaculture Law (1989) prohibit causing water pollution, harassing fishes and other marine organism and using explosive substances, poison chemicals and dangerous material in fishing. In addition, the Territorial Sea and Maritime Zone Law (1977) provides measures for protection of marine environment, prevention and control of marine pollution. It also endorses conducting scientific research and management of the marine environment. The Pesticide Law (1990) prohibits the use of pesticides to catch or kill land or aquatic animals. The Pearl Law of 1995 protects and conserves water area of oyster fishing grounds from destruction and oyster from extinction.

The Forest Law of 1992 and the Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law (1994) cover protection and management of mangrove forests in the coastal zones.

In fisheries sector, while some of directives and regulations emphasize in assuring fisheries revenue, others prevent overfishing by declaring closed season and territories, restriction of fishing gear etc. However, those laws and regulations are weak in conservation measures including protection of aquatic resources habitat. Apart from the laws mentioned above, there are also several directives from the ministry in protection of marine resources however, those are more of ad hoc basis.

Appropriate law promulgated to protect some of coastal resources is the Forest Law of 1992 and the Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law (1994). These laws are considered quite comprehensive in protection and management of mangrove forests as well as wildlife in Myanmar. However, Ministry of Forestry declared Lapi Islands as Marine National Park under those laws although the island ecosystem has coral reef ecosystem domination. Logically, it should be under the Ministry of Livestock and Fisheries however; the ministry has no administrative power to manage the park. In addition, there is no regulation or coordination mechanism to allow collaboration between the two ministries in this case and hence, such mechanism is necessary to set up. Moreover, in any of the fisheries laws, protection and management of other coastal marine ecosystems such as coral reefs, seagrass beds, and sand beaches are not prioritized. Therefore, there is an urgent need to introduce new fisheries law that would ensure the protection, management and sustainable utilization of coastal marine resources.

Latt (1998) stated that aquaculture can affect land, water bodies, seed quality and availability but in general, the level of impact depends upon type of aquaculture system and level of intensification. Therefore, regulating aquaculture is also important for coastal and marine environment. In this case, the Aquaculture Law of 1989 prohibits obstruction of waterways and prevents water pollution from the aquaculture activities. The directives of the Directorate of Fisheries have more specific regulation on pollution control as aquaculture effluent can produce negative impact on the water environment. One of the regulations also prohibits clearance of mangroves for aquaculture. However, currently no specific regulation prohibits mass collection of natural fish seedlings. Wild shrimp seedling (post larvae of shrimp) that supply to almost entire traditional shrimp farms in Rakhine State were collected from estuary areas since shrimp hatcheries in Rakhine State have very low production capacity. The Directorate of Fisheries is trying to regulate the collection of wild seeds with limited success (Latt, 1999a).

3.Socio-economic and Development Activities vs. Legal Issues

Regarding the coastal and marine ecosystems, chapter sixteen of the Myanmar Agenda-21 has described three programme areas, namely : strengthen sustainable use of coastal and marine living resources; promote environmental conservation and integrated management of coastal resources and areas; and promote effective management of island ecosystems. Under each programme area, specific objectives were set up and programme activities were outlined however, there is a need for appropriate national policies, legislation, infrastructure and capability to manage, protect and sustainably use the coastal marine resources (NCEA, 1999).

In reality, effective implementation of the three programme areas is very difficult and unable to perform. As mentioned previously, in general, there are five prominent laws under the Ministry of Life Stock and Fisheries enacted to ensure sustainable use of marine resources and to promote aquaculture systematically. However, effective enforcement of those laws has been much limited by poor infrastructure, insufficient skilled manpower and financial support. Until today, major tasks in protecting living marine resources are just chasing of illegal poaching vessels and checking prohibited fishing gears. Protection of seagrass beds and coral reefs are almost non-existence apart from declaration of Lampi Island National Marine Park and its surroundings as protected area. In protecting those area, illegal blast fishing, illegal charcoal production and logging in island ecosystems has been continuously halted by armed patrol units under the Defense Ministry however, again limited resources and uncontrollable transboundary illegal trade undermine the effective enforcement.

Further more, in reality, the present scenario of coastal and marine environment of Myanmar is astonishing. Continued population growth, fishery and agricultural development and human induced changes in the country are adding human impacts and increasing the potential for marine pollution thorough direct discharge to estuaries and coastal areas. Degradation of coastal environment is mostly the result of a wide range of activities on land and at sea (Aung, et. al., 1999).

Non Sustainable Development Activities

The present scenario of development activities within the coastal and marine environment is further described here to highlight how some of those activities contradict with environmental related laws of Myanmar.

Marine Fishery

One of the localized uni-sectoral development activities that contradict with Myanmar Agenda-21 in coastal areas is capture fishery. For example, in the past few years, the Divisional Economic Development Committee has increased issuance of fishing license in order to achieve local economic development and to obtain more foreign exchange in Tanintharyi coastal region while studies reveal that there is a clear decline in overall fishery resources in the area. Recent re-estimation of MSY by the Department of Fisheries clearly stated over fishing in Tanintharyi coastal areas and has recommended revoking demersal fishery awarded to foreign fishing fleets but to allow expansion of local fisheries that has small individual fishing capacity (DOLF, 1999). However in Rakhine coastal region, DoF has recommended to increase capture fishery production by allowing over 80% more fishing vessels based only on MSY obtained through official fish landing. If capacities of illegal poaching by foreign fleets were considered, it would clearly see the current production far more exceeding the MSY. Although volume of illegal poaching is hard to estimate, already there is a clear indication of decline in fishery resources, according to unpublished data of seafood processing industry. In hot pursuit of economic development, sustainable marine resources management becomes paralyzed in the absence of proper infrastructure, sufficient resources and effective management control mechanism that enhanced by multi-sectoral coordination.

Moreover, fishing live marine organisms by artisanal fishery poses great threat to marine and coastal biodiversity as well as coral reefs, apart from the industrialized commercial fishing. Mud crab fishery and life fish export of Coral fish, Grouper and Black Tiger Shrimp breeders would be a prominent example to this issue. According to Tropical Ecosystem Research Project survey reports of DANCED (1998-2000), between 80 and 100 tons of life mud crab of both small and large sizes are being exported every month as Tanintharyi mangroves

serves as major mud crab seed source for soft shell crab farmings of a neighbouring country. Similarly in Rakhine State, 3,948 tons of mud crabs have been exported in 1998-99 budget year alone through border trade (Latt, 1999b). Moreover, unconfirmed source reported approximately 50 per cent of shrimp breeders used in hatcheries of Thailand comes from Myanmar. All those activities, although being operated by most artisanal fishermen, have been affecting greatly to the stability of coastal marine ecosystems. Dynamiting coral fish, trampling and boat anchoring by those fishermen have contributed greatly to damage coral reefs apart from upland deforestation, littering and domestic sewage. Although the extent of coral reef destruction in the whole Taninthayi Division is not yet estimated, it is evident that large area of coral reefs within the Lampi Island Marine National Park boundary has been seriously damaged.

Mangrove Forests

Threat to mangrove ecosystems of different coastal zones of Myanmar is another major issue in the country. Agricultural expansion, insufficient alternative energy supply, traditional shrimp culture and lack of environmental awareness have been prime causes of mangrove deforestation. The country's total mangrove areas were estimated differently as 385,993 ha (Oo, 1998), and 1,660,000 ha (Mackinnon, 1996 as quoted by Brunner, 1998) in the early 1900. Nevertheless, those mangrove areas shrunk to a much smaller size, reported by Hamlington et al., (1984), and Than Htay & Saw Han (1984) as 652,000 ha and 570,070 ha respectively. In the 1990s, the total area again reduced to 177,256 ha (Oo, 1998), 381,000 ha (Myint, 1995) and 420,000 ha (Mackinnon, 1996 as quoted by Brunner, 1998) in the 1990s.

Prime cause of mangrove deforestation is also different in different coastal zones and changes by period of time. In the early 1990s, main cause of mangrove deforestation in Ayeyawady deltaic coastal zone was due to charcoal production and agriculture expansion. Inadequate alternative source of energy supply in the country especially in major cities makes people to choose biomass fuel for cooking. Tremendous amount of charcoal and fuelwood supplies to Yangon, Bago and Ayeyawady Divisions comes from Ayeyawady mangroves while approximately 80% of households utilize biomass fuel in the country (Han, 1995).

In this case, the Forest Law of 1992 has great positive impact on the rehabilitation of forests including mangroves in Ayeyawady Division. In a country where majority of people is solely dependent upon natural resources, the role of such comprehensive law plays paramount role. The law that recognizes needs of people and its participation in resources management is vital and now proven successful at least in Ayeyawady Division due to collaborative efforts amongst stakeholders of both local, governmental and international origin. Such successful projects need to be highlighted and should implement in other area as well.

However, contrast scenario can be seen in Rakhine coastal zone where mangroves were heavily cut for developing traditional shrimp culture especially in the 1990s. Over 7,000 ha of traditional shrimp ponds were developed in 1998-99 budget year alone, and almost all of them were converted from mangroves (Latt, 1999b). Much higher figure of mangrove deforestation rate exists in reality. (Department of Marine Science, University of Maw-la-myne, personal communication, 2000). The root of mangrove destruction in Rakhine coastal zone is forced repatriation of refugees in the late 1980s and early 1990s. They introduced non-sustainable traditional trap and hold shrimp culture brought from neighbouring country to Rakhine State where there was almost non-existence of such farming practice previously. In recent years, the lucrative income of shrimp farming attracted indigenous people to adopt the non-sustainable farming practice resulted in destruction of mangroves. Although the Directorate of Fisheries is aware of the problem, local fisheries authorities stranded in deadlock situation as repatriated refugees are operating the majority of farming area fearing that such corrective measure would result in international criticism. Such situation prevents enforcement of the Forest Law of 1992 that protects and conserves mangroves.

Some international agencies also could not be spared from taking responsibility in mangrove destruction. Aung et al., (1999) stated that the World Bank's Paddy Project launched in the Ayeyawady delta in 1983 has caused serious negative consequences in the estuarine ecosystems. The other, CDRT project of the UNDP that has aquaculture micro income project activities passed out wrong message of non-sustainable and ecologically damaging aquaculture practices to people in the remote townships of Rakhine State. This was mainly due to irregularities in implementation of such project component (Latt, 1999b).

Coral reefs, Seagrass beds and Island ecosystems

There were no comprehensive surveys on species composition, population and situation of coral reefs in Myanmar. However, earlier reports (UNDP/FAO 1982, FAO 1983) described a diverse and well-preserved system of coral reefs, with some of the most spectacular reef formations in Southeast Asia. A more recent (1986) survey confirmed this impression (Fischer, 1997). In 1985, a study described 61 species and 31 genera of Hermatypic corals and four species in the genera of Ahermatypes from sites in the Mergui Archipelago. Again in 1996, Wildlife Conservation Society (Myanmar) and University of California; USA has conducted survey on coral reefs in Tanintharyi coastal zone especially within the Myeik Archipelagoes. The field studies reveal serious destruction of coral reefs in some islands including Lampi Island Marine National Park due to non-sustainable fishing practices, upland deforestation and domestic waste (Fischer, 1997). During the last 15 years, many reefs south of latitude 11°N has suffered much destruction. Especially within the island ecosystems of Tanintharyi coastal zone, coral reefs, mangroves and fisheries resources are heavily exploited due mainly to its economic nature that has direct impact from neighbouring country. As mention above, stringent rules and strict enforcement is not sufficient in controlling the resources of Taninthayi coastal and marine areas since the coast is about 1,200 km long. In addition, huge area of approximately 34,340 square kilometres covering Myeik Archipelago that consist of about 800 islands make any administration and law enforcement to work almost impossible under the present situation. Another potential threat to coral reef ecosystems in Tanintharyi coastal zone is impact from oil, gas and mineral exploration. The development of natural gas production and mineral deposits in watershed areas and in offshore could have a significant impact in coming years (Oo, 1998). No effective measures and sustainable management of coastal marine resources by concerned agencies exists to date apart from declaring ban on non sustainable fishing practices such as use of explosive by the Department of Fisheries.

The Department of Marine Science of the University of Mawlamyine also conducted seagrass inventory survey. Some of the seagrass ecosystems are considered serious threat, as there is an extensive mangrove as well as up land deforestation in various coastal zones of Myanmar. However, protection of the said ecosystem is not yet available since there is no specific law relating to this.

Another development activity that is considered major threats to coastal marine ecosystems and standing against the Forest Law and the Wild Life Law is expansion of agriculture plantation. Those plantation projects do not possess proper coordinating mechanism amongst related departments and institutions as well as multi-disciplinary approach in implementation. Especially Tanintharyi Division, where such projects are being developed, is sensitive to such large-scale development of socio-economic activities due to geographical characteristic of its own. However those projects were approved without EIA and environmental impact mitigation measures although the division has diversified and fragile ecosystems of both terrestrial and marine. In fact, the Forest Law of 1992 requires reforestation of deforested area and prohibits any act that has threat to environment and biodiversity. Meanwhile, ministry of agriculture has a right to award large-scale plantation as part of national plan. In such situation where a country does not require EIA for such case, project development methodology and implementation strategy are vital to the environment. Otherwise, even land clearing would cause severe damage to adjacent coastal and marine ecosystems as Taninthayi Division has over 5,000 mm of average annual rainfall. Such incidence reveals needs in reviewing

existing laws and appropriate amendments accordingly.

Main cause of island ecosystem destruction in Tanintharyi coastal zone has been logging in up land and mangrove areas and charcoal production but recently shrimp culture emerges as potential threat to mangroves despite the forest and fisheries laws that prohibit mangrove destruction and conversion to aquaculture. Poverty and lack of environmental awareness amongst indigenous and migrated people have been easily exploited by small and medium scale investors of neighboring country to harvest coastal marine resources in non-sustainable manner. Raw material for all timber sawmills along the Thai coast adjacent to Tanintharyi Division totally relies on resources from Myanmar as Thailand has total ban on its forest resources. Despite the stringent rules (by the local administrative authority) and harsh penalties, illegal logging is continued to thrive in the island ecosystems and estuary mangroves along the border. Therefore, like in the Ayeyawady mangrove case, there is an urgent need to have change in resources management strategy as well as environmental protection law in order to have sustainable resources utilization and management in the Division.

Judicial System

In present Myanmar Judicial system, there are three levels of Courts; the Supreme Court, the State Court or Divisional Courts (including District Courts) and the Township Courts. Most of forest offences are tried initially by the Forest Laws in Township Courts and for cases, which are beyond the jurisdiction of the Township Courts, are tried by the State or Divisional Courts. The Supreme Court of the Union of Myanmar, established under Section 3 of the Judiciary Law 1998, is the highest Court of Appeal and exercises both appellate and revisional powers. It also has original jurisdiction and it is the one and only Court in Myanmar which can try the Maritime cases (Toe, 1999).

Special Courts are separately constituted by the Supreme Court to achieve speedy and effective trial and they have power to establish Environmental Courts or Tribunals if it is required. However, even the Township Courts could play a very important role in implementing environmental related laws by cooperating with various administrative institutions where administrative actions are recognized under some laws.

Regarding criminal offences relating to environment, one must bring a case to one the Courts to prosecute. For example, public or a designated person such as police or officer of either Forest Department or Fishery Department or any agency relating to environment should inform the court for legal offences so that necessary action can be taken against those who violate the laws. In this case, limited infra structure and resources availability further reduces the capability and efficiency of concerned authority who are enforcing laws. Moreover, it is rather impossible neither to monitor negative environmental consequences resulted from development projects such as large-scale agriculture plantation nor taking action against violators of environment related laws with present status.

In addition, just passing punishment to violators alone would not solve the problems. Educating people and provision of alternative income generation would help them to abandon destructive exploitation of the coastal marine resources. Furthermore, international cooperation especially transboundary cooperation at both local and government levels in protection and management of coastal marine ecosystems is of great importance and necessary.

4.Needs and Constraints : Effects on Local and Regional Marine Ecosystem

Present status of major development and legal issues on protection and management of coastal and marine environment is thoroughly explained in the previous sections. And achieving good governance in coastal and marine sector would be certainly difficult not just only for Myanmar but also for other countries as it involves wide range and variety of scope and multi-sectoral in character. Programmes to protect coastal and marine environments are inherently difficult to implement because they tend to be compressive in scope and multisectoral in character. Because of the multiple uses of coastal and marine resources, policies must ensure a balance among various sectoral objectives (NCEA, 1999). There have been several efforts in promoting coastal and marine environmental protection in Myanmar, never the less, apart from some achievements several limitations still prevent from achieving such good governance.

There is some evidence of positive impact that resulted from present environmental related laws. For instance, since the promulgation of new forest law in 1992, the Forest Policy Statement of 1995 stipulated to increase the reserved forest to 30% of the country's total land area from the present status of about 15% and the Protected Areas System to 5% in the short term and 10% in the long term from the present status about 2% so as to ensure the security of forest resources. Mangroves are included in afforestation programme at a rate of 20,000 ha per year. Regarding international cooperation in the area of coastal zone, the Government, with the help of UNDP and FAO has been making great effort in mangrove reforestation in the Ayeyarwady coastal areas. The Community Development of Ayeyarwady Mangroves Project (UNDP/FAO/MYA 93/026) was a unique example that focuses on mangrove forest rehabilitation using community participatory approach. Moreover, the UNDP's Community Development for Remote Township Project (MYA 096/009) has Environment Sub Project component that focuses on upstream environmental conservation and coastal aquatic ecosystem enhancement. These outcomes clearly state the importance of close cooperation and coordination amongst local and international stakeholders.

Further more, the role of the Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law (1994) has been tremendous. A total of twenty-two wildlife sanctuaries and national parks have been declared by the government in accordance with the law (Gyi, et al., 1995). Amongst the twenty-two wildlife sanctuaries and national parks, the five, namely, Mainmahla Island Wildlife Sanctuary, Thameehla island Marine Sanctuary, Moscos Islands Marine Sanctuary and Lampi Island Marine National Park is situated within the coastal and marine area.

Despite some achievements mentioned above, some constraints remain still. First, weak legal, coordination and institutional mechanisms and unavailability of environmental protection laws that cover all aspects of coastal and marine ecosystems appear as important limitation. In addition, lack of policy measure and effective mechanism in the whole fishery sector leads to decline in marine resources. Similarly, although the Science and Technology Development Law encourages to promote research and development on environmental conservation, again there is no proper mechanism to implement it.

Second, insufficient resources : financial, skilled manpower etc. stand prominently amongst the limitations. In fact, protection and management can be carried out at certain level if sufficient financial resource is available even with present environmental related laws. Both in forestry and fishery sector, only few-trained personals are available and therefore, it is difficult to perform effectively even extension services in the field.

Lack of appropriate infrastructure and awareness appear as another limitation. Poor infrastructure causes ineffectiveness in most sectors. Although there are some extension activities by government and international agencies, it is still insufficient at this stage thus, resulted in lower level of awareness amongst stakeholders.

Last but not least is coordination and close operation amongst local and international stakeholders in promotion of sustainable coastal and marine resources management and implementation of good governance programmes. The role and positive out comes of local and international stakeholders' cooperation in protection and management of coastal marine ecosystems has been mentioned in previous paragraphs.

And, as it has complex ecosystems and multi-sectoral issues with inseparable boundaries, the role of cross-sectoral coordination and cooperation in both local and international level is vital.

The stated issues are to be tackled properly and act accordingly before time runs out. What, if the coastal and marine ecosystems of Myanmar is not well conserved and managed! The answer is well predictable; there will be regional catastrophe in marine environment as Myanmar's coastal zone composed significant portion of Bay of Bengal marine ecosystem and later on to the Indian Ocean environment.

Although there are many uncertainties about the Bay's ecological functioning, and lack of comprehensive, reliable data, continuous harmful incidences in the Bay of Bengal derived from land and sea based sources is mounting pressure on to the health of marine environment. For instance, in the port of Chittagong in Bangladesh, an estimated 6,000 tons of crude oil is spilled annually, while crude oil residue and wastewater effluent from land based refineries amount to about 50,000 tons per year (Khan, 1993 as quoted by ESCAP, 1995). In addition, increased use of pesticides is leading to the transport of an estimated 1,800 tonnes of pesticides in to the Bay of Bengal where they reappear as toxic residues in finfish and shellfish (Holmgren, 1994 as quoted by ESCAP, 1995). Nutrient pollution from agriculture is also another major problems in the area. High sedimentation in estuary area is of great threat to marine ecosystems as well. The Ayayarwady deltaic coastal zone has annual discharge rate of 250 million tonnes and the coast is building seawards at 5 kilometer per 100 year (Thwin, 1998). If the total sedimentation rate of Bay of Bengal were considered, there would be clear evidence that enormous threat being made to marine environment.

Apart from those mentioned above, there are several other problems being faced in the Bay of Bengal, including over-exploitation, unauthorized incursions by foreign fleets and reduction in catcher per unit of effort and habitat degradation. As the Bay of Bengal is characterized by a number of critically important areas of biological diversity, at least six of which have been identified as having regional priority, it is indeed worth conserving the marine ecosystem by preventive measures. Since the Myanmar marine ecosystem is part of the Bay of Bengal greater ecosystem, it deserves due attention.

5.Recommendations

Usually, it is easier to provide suggestion than taking action accordingly. Recommendations should be applicable and in line with present needs. Based on the present scenario described above and aiming to have overall achievement in pursuance of sustainable utilization and management of coastal marine resources in Myanmar, the following suggestions and management strategy are recommended. Needs and recommended management strategy are described separately.

First of all, management infrastructure, which deserve first priority is necessary however, some of recommended management strategies could be utilized while the needs are being fulfilled. Development of national land use planing that considered multi-sectoral aspect and sustainable development vision in its concept is to start with. At the same time, more appropriate and workable institutional mechanism that describes detailed responsibility for various sectors should be created. In addition, development of integrated coastal zone management (ICZM) body and speedy implementation in cooperation with related sectors of local and international agencies should also be done.

In case of Myanmar, development of human resources appears as one of the most important factor in management strategy. Such resources in protection and management of coastal marine ecosystems could be acquired by collaborating with NGOs and institutions of both local and international. Using the skilled human resources, wide range of environmental education activities shall be promoted whilst sustainable development extension services are provided in collaboration with all stakeholders. It should be bare in mind that sustainable management of coastal marine resources is neither an easy task nor effort of one party/country, and previous success stories from Myanmar and other countries prove that local and international stakeholder cooperation is vital and necessary. Only after promotion of environmental awareness, further steps such as sustainable utilization, protection and management can properly be taken.

Moreover, as most coastal and marine boundaries are inseparable, transboundary collaborative efforts in research, development and enforcement activities are necessary at both local and national levels. Appropriate guidelines and mechanism should be laid down by concerned governments to allow more simple and easier activities at local/micro level of transboundary nature so that most needy and urgent issues can be properly addressed and tackled by the stakeholders.

In pursuing such constructive efforts to protect coastal and marine ecosystems, political differences amongst all stakeholders should be dropped with broader vision.

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MARINE POLLUTION PROBLEMS IN THAI WATERS

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Abstract

Eutrophication is the most serious problem of the inner gulf of Thailand nowadays. Eutrophication is caused by the discharge of organic wastewaters from big cities into the river estuaries. In the outer gulf, mercury concentrations in fishes were found to elevate in the vicinities of natural gas production platforms. About 5-10% of fishes in these vicinities had mercury concentrations higher than the standard acceptable limit set by the FAO (0.5 ug/g wet weight). Monitoring program on this metal is therefore essential. The problems of marine pollution could be alleviated through a comprehensive program which includes these important components : 1. baseline and monitoring, 2. water quality criteria establishment, 3. identification of sources, pathways, and quantity of pollutants, and 4. pollution control, abatement, and rehabilitation. So far Thailand has implemented such a program for sometime, but certain components are needed to be emphasized.

INTRODUCTION

Thailand has two coasts. One curves around the scooped-out shore of the Gulf of Thailand and has a length of 1870 km. The other lies along the shore of the Andaman Sea of the Indian Ocean and has a length of 800 km extending northwards from the Malaysian boarder to the Burmese boarder.

The Gulf of Thailand (Fig. 1) is roughly triangular and may be divided into two sections ; the "inner gulf" and the "outer gulf". The inner gulf is the apex of the Gulf of Thailand and is roughly square-shaped. It has an average depth of 20 metres and a slope of about 0.2 m per km. The surface area is about 10,360 km² ; along its shores, aquaculture farms and fisheries abound. The runoff from Thailand's four principal rivers ends into the Gulf.

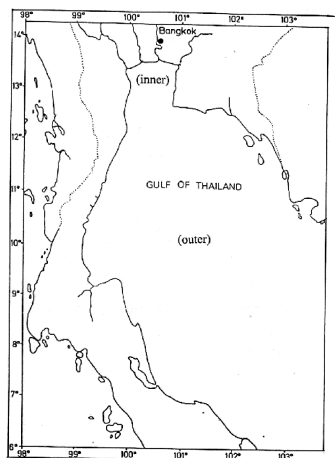


Fig.1 The Gulf of Thailand

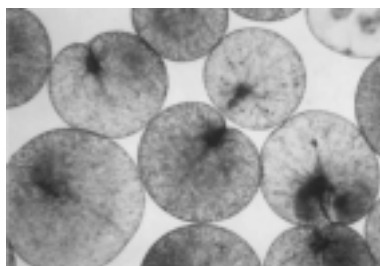


Fig.2 *Noctiluca*, the plankton which frequently bloom in the inner gulf as a result of eutrophication.

The industrial development, in and nearby the cities, is a major cause of migration of people from rural areas to the cities. The sharp increase of population in the cities, coupled with inadequate industrial wastewater treatment system, has resulted in water pollution problems in the inner gulf.

Water pollution problems in the gulf are generally caused by two groups of activities, i.e. land based and sea based. Land based activities include coastal urbanization, industrial development, agriculture, drainage basin modification, and tourism. Sea based activities include seabed exploration and exploitation and the risk of petroleum and other toxic chemical transportation. This paper will address two current problems, i.e. eutrophication in the inner gulf, and the contamination of mercury in the middle of the outer gulf.

EUTROPHICATION PROBLEM

Among the four rivers draining to the inner gulf, the Chao Phraya is the most polluted, particularly in the river estuary area, due to the urban and industrial expansion. The Ta chin is becoming increasingly polluted due to accelerated industrial and agricultural development, as well as urban expansion from the Bangkok area. The Mae Klong used to be subjected to severe water pollution problem in the past, but now the problems are being remedied by a proper management system. The Bang Pakong used to be the least affected by pollution. However, the installation of the thermal power plant at the lower reach may have altered the ecosystem of the estuarine area.

The major pollutants of the rivers are degradable organic wastes. The common effects are increased oxygen demand, input of pathogens, increased turbidity, and enrichment of nutrients or in another word "eutrophication". Since the inner gulf is a semi-enclosed. The wastes drained from the mentioned rivers tend to retain and accumulate. Decomposition the wastes results in the problem of eutrophication. Eutrophication can cause explosive bloom of algae sometime it is called "red tides".

Noctiluca scintillans (Fig. 2) and *Trichodesmium erythraeum* were the two species of planktons which frequently bloom in the inner gulf (Suvapepant, 1995). *Noctiluca* usually changed the apparent color of water into dark green. This kind of plankton is not toxic fish and shellfish but the dense bloom can result in the anoxic condition. Besides the decomposition of the dead cells will release large amount of ammonia into the water and affect the livelihood of marine animals nearby. The bloom of *Trichodesmium* will change the apparent color of seawater into yellow-green color and later change into red-brown. Similar to *Noctiluca*, only the anoxic condition will occur (Suvapepant, 1995).

Blooming of diatoms could occur as a result of eutrophication. These diatoms were recorded for blooming in the inner gulf, e.g. *WCosinodiscus Rhizosolenia*, *Hemidiscus*, *Chetoceros*, and *Ceratium*. In January 2000, *Ceratium furca* blooming in the Chao Phraya river estuary covered a vast area and changed the apparent color of seawater into red.

According to Suvapepant (1995), 43 major red-tides were recorded during 1988-1995. Twenty-one red-tides were caused by *Trichodesmium*, 17 were caused by *Noctiluca* and the rest by diatoms. It was fortunate that most of red-tides are associated with anoxic condition. There was only one incidence of toxic condition. In May 1983, paralytic shellfish poisoning (PSP), after consuming the contaminated mussels in the red-tide area of Pranburi river estuary was reported. Sixty-three people were ill and one died because of this incidence. Nevertheless, the specific plankton which was the causative agent of this PSP could not be confirmed.

The anoxic condition of algal bloom could cause a massive fish killed. In August 1991, there was a mass fish killed in the coastal

area of Choburi. This incidence was due to a vast blooming of *Noctiluca*, covering the area from Bangsan district to Pattaya (Fig. 3).

MERCURY CONTAMINATION

Total mercury in seawater and sediment of the Gulf of Thailand is shown in Table 1. Considering the data obtained from several surveys, it can be found that the mercury concentration of seawater during the period from 1974-1980 is comparable to the natural level as suggested by Kothny (1973), i.e. in the range of 0.01-0.38 ppb. High mercury concentrations (44.7-847 ppb) nevertheless were reported during 1983-1987. The levels were even higher than those detected in Minamata Bay, Japan (1.6-3.6 ppb). Whether these reported data are valid, there is a need for further clarification during sample collection and analysis. Most mercury concentrations in the sediments were still within the acceptable limit of 0.3 ppm (Ministry of Transport, Japan, 1976), except certain locations such as the Chao Phraya River estuary and the east coast of the Gulf. Higher mercury concentrations in such areas might be due to the contamination from urban and industrial areas.

Total mercury concentration in biota of the Gulf of Thailand are shown in Table 2. In the coastal area, almost all mercury concentration in fishes were lower than 0.2 $\mu\text{g/g}$ wet. These concentrations could be regarded as a natural background of mercury in fish in general. Nevertheless fishes in the off shore



Fig.3 Apparent color of seawater caused by the blooming of *Noctiluca*, Choburi coast, 19th August 1991.

Table 1 Total mercury in seawater and sediment of the Gulf of Thailand

Study period	Location	Total mercury in		Reference
		Seawater ($\mu\text{g/l}$)	Sediment ($\mu\text{g/g wet}$)	
1974	Bang Pra Coast	0.015-0.019	0.003-0.069	Menasveta (1976).
1975 - 1976	Inner Gulf	0.01-0.11		Sidhikasem (1978)
1977	Inner Gulf	0.02-2.00		Sidhikasem (1978)
1975 - 1976	Inner Gulf	0.467		Piyakarnchana et al. (1977)
1976	Chao Phraya Estuary	0.216+0.280	0.012-0.264	Menasveta (1978).
1979 - 1980	Estuarine areas	0.24-0.38	0.007-0.017	Sidhichaisakem and Chernbamrung (1983)
1980	Estuarine areas - Mae Klong - Ta Chin - Chao Phraya - Bang Prakong		0.23+0.1 0.67+0.1 2.80+0.4 0.52+0.2	Menasveta and Cheevaparanapiwat(1981)
1983 - 1984	Bang Prakong Estuary	44.7	0.14	Bamrungrachirun et al. (1987a)
1983 - 1987	East coast of the Inner Gulf	847.0	2.26	Bamrungrachirun et al. (1987b)
1983 - 1987	Inner Gulf	0.2-203.0		Jarach (1987a)
1984 - 1986	West coast of the Inner Gulf	0.1-88.7		Jarach (1987b)

area, in the vicinity of natural gas platforms, exhibited higher mercury concentrations. These fishes were caught and analyzed recently (ARRI, 1998). Between 5 - 10% of fishes at Erawan and Funan platforms had mercury concentrations higher than 0.5 $\mu\text{g/g}$. This concentration is the maximum permissible concentration in fish set by the FAO. The biological magnification of mercury was detected by several reports. Fish of higher trophic levels bore higher residue than those in the lower trophic levels. This suggested that mercury might be concentrated in the same manner as organic compounds such as organochlorine compounds, i.e. passed through and amplified by the food chain.

A positive linear relation between size and mercury content of fish is well documented. However, for low levels of mercury in fish (below 0.2 $\mu\text{g/g}$) no increase, or a very moderate increase in mercury content was found to occur as fish weight increased. As the level of mercury increased, the mercury level in relation to the weight increased noticeably. At extremely high levels of mercury, caused by manifest contamination, no relation to age or weight was found. This indicates that there is a threshold level of mercury in the environment, above which fish cannot eliminate mercury from their muscular tissues faster than it is incorporated and accumulation thus occurs. This relationship also indicate that fish are adapted to a mercury concentration of less than 0.2 $\mu\text{g/g}$. All past data indicated that the maximum natural concentration in fish is 0.2 $\mu\text{g/g}$ or less. It should be noted that 23.3% of fishes caught in the vicinity of the natural gas platforms in the Gulf of Thailand had mercury above 0.2 $\mu\text{g/g}$.

In order to prove that mercury contamination in the middle of the outer gulf was due to natural gas production, an investigation was made by comparing mercury in fish caught from the natural gas production area and the coastal area, including from the Andaman Sea. It was found that mercury in cobia (*Rachycentron canadus*) in the area of the natural gas production was significantly higher than the concentrations detected in cobia of the coastal areas and the Andaman Sea (Pongplutong, 1999).

CONCLUDING REMARKS

There are several marine pollution problems in Thai waters, but the most notable ones that receive much attention now are the problems of eutrophication in the inner gulf and the contamination of mercury in the area of natural gas production of the outer gulf.

Thailand has implemented a program on marine pollution control during the past three decades. Such as program includes basically four components, i.e. 1. baseline and monitoring studies, 2. water quality criteria establishment, 3. identification of sources, pathways and quantity of pollutants, and 4. pollution control, abatement, rehabilitation. Nevertheless, the last two components need more emphasis.

Table 2 Total mercury in biota of the Gulf of Thailand

Study period	Location	Kind of biota	Total mercury($\mu\text{g/g wet}$)	Reference
1974	Bang Pra Coast	3 rd trophic level fishes	0.003-0.010	Menasveta(1976).
		4 th trophic level fishes	0.002-0.057	
1976	Chao Phraya Estuary	Fishes and shellfish	0.009-0.205	Menasveta(1978)
1977 -1980	Inner Gulf	Fishes and shellfish	0.002-0.206	Sivarak et al. (1981)
1978 - 1979	River estuaries	Bivalves	0.013-0.120	Menasveta and Cheevaparanapiwat(1982)
1976 - 1977	Inner Gulf	3 rd trophic level fishes	0.002-0.130	Cheevaparanapiwat and Menasveta(1979)
		4 th trophic level fishes	0.010-0.650	
1979 - 1981	Inner Gulf	Fishes and shellfish	0.012-0.051	Sidhichaikasem and Chernbamrung (1983)
1980	Estuarine areas			Menasveta and Cheevaparanapiwat(1981)
	- Mae Klong	Mulletts	0.04+0.03	
	- Ta Chin	Mulletts	0.07+0.04	
	- Chao Phraya	Mulletts	0.15+0.06	
	- Bang Prakong	Mulletts	0.08+0.03	Menasveta and Cheevaparanapiwat(1981)
1980	Estuarine areas			
	- Mae Klong	Green mussels	0.07+0.04	
	- Ta Chin	Green mussels	0.09+0.03	
	- Chao Phraya	Green mussels	0.21+0.06	
	- Bang Prakon	Green mussels	0.09+0.04	
	- Hua Hin	Green mussels	0.04+0.03	
1982 - 1983	Inner Gulf	Bivalves	0.001-0.041	Sivarak et al. (1984)
1982 - 1986	Inner Gulf	Bivalves	0.001-0.153	Boonyachotmongkol et al. (1987)
1990	Sichang Island	Fishes	0.012-0.032	Menasveta (1990)
	Mab Tapud	Fishes	0.013-0.049	
	off-shore (Erawan)	Fishes	0.055-0.324	ARRI (1998)
1997	Outer Gulf of Thailand	Demersal Fishes	0.003-0.93	

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THE STATUS OF CAMBODIA'S COASTAL AND MARINE ENVIRONMENT : " EMERGING POLICIES AND MANAGEMENT STRATEGIES".

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Abstract

This paper presents the major current coastal and marine environmental problems in Cambodia and highlights the present lack of policy, and legal and institutional capacity to properly manage coastal and marine resources in the face of increasing development pressures and touches on the policy response being developed by the government to address these problems. The paper looks at the elements involved in the coastal policies and management strategies in Cambodia, which are still to be formulated, and the beginning of a coastal zone management framework, which is emerging.

INTRODUCTION

During the past two decades was the complete destruction of institutions responsible for capable of managing the country's coastal and marine resources. These include trained personnel, appreciate laws and regulations, enforcement capacity, and government structures for the development of coastal and marine environmental policies and needed co-ordination for their implementation.

Cambodia does not yet have a compliment of coastal and marine environmental policies. By nature, policy development is a protracted affair, which requires extensive dialogue within governments. It is a process that entails the development of legislation and the creation of institutions and supporting structures. Cambodia is just at the start of the process. As a consequence the content of coastal and marine issues and problems for instance logging, over exploitation of natural resources, administrative and management issues, infrastructure issues, is for meantime less critical than developing the process by which the issues and problems can be managed. However, there is little room for complacency as the development pressures are mounting rapidly. Any advantage that Cambodia currently enjoys will be rapidly lost unless safeguards are put in place to allow inevitable economic development while ensuring the sustained quality of coastal and marine environment and resources based.

This paper is divided into three sections. The first provides an overview of the major coastal and marine environmental issues. Second identifies the existing legal, policy and institutional framework issues for managing and protecting coastal and marine ecosystem. The third section addresses the elements involved in the coastal and marine policies and management strategies in Cambodia are still the beginnings of a coastal zone management framework are emerging.

1.OVERVIEW OF COASTAL AND MARINE ISSUES

Cambodia is situated in Southeast Asia between 10o and 15o latitude North and 102o and 108o longitude east. The country occupies about 181,035 km² and has population 11.2 million persons. Cambodia shares a land border with Thailand on the Northwest, Lao PDR on the Northeast and Viet Nam on the east and south.

The coastline of Cambodia extends 435-km along the Northeast shore of the shallow Gulf of Thailand between the Vietnamese and Thai borders. The coastal zone consists of estuaries and bays and 64 islands of various dimensions, including three offshore islands of Tang, Pring, and Polowai. Administrative boundaries of the coastal zone include Koh Kong province, Sihanoukville Municipality, Kampot province and Kep Municipality. The total area of the claimed Exclusive Economic Zone is about 500,000 km² as was declared on 6 February 1970 (SEAPOL, 1991).

The coastal climate of Cambodia is tropical monsoon, which is typically hot and humid. The average annual temperature is around 27oC with maximum average of 35oC in April and a minimum average of 19oC in December. Average annual precipitation varies from 2,000 to 4,000 mm. The season is from about June to October.

The coastal provinces and municipalities of Cambodia, Koh Kong, Sihanoukville, Kampot, and Kep, are no exceptions to the current economic development situation of the country. The large town on the coast is Sihanoukville, which is being developed as a deep seaport and considered as one of the economic growth centres of the country.

1.1 Population Pressures

Statistic from the 1998 National Census indicate that 31% of the coastal population had their previous residence outside the place of remuneration and of these, full 56% came from some other province or municipality in which they are currently living. Three percent of the population of Kampot province moved there from another province or municipality in Cambodia, while 45% of the residents of Koh Kong are from another province. Furthermore, 84% of the respondents stated that they moved to their current place residence for economic or security reasons. Coastal Cambodia, therefore is populated by great many inhabitants who may not have experience in the economic activities of the coastal zone.

1.2 Coastal Economic development

The Royal Government's goals for Sihanoukville municipality originally planned for economic development in Cambodia through the rebuilding of urban growth, tourism, port expansion and industry.

• Urbanisation

Investment in Sihanoukville municipality will lead to increased urban growth, as population from the rural areas move to tourism and associated services for increased economic opportunities. The Urban environment infrastructure is current insufficient to meet the requirement of even the current urban population. Without appropriate investments, the environmental quality of this town will degrade.

- **Tourism development**

Coastal Sihanoukville is a matter of great importance to the future of Cambodia, both in term of economical and environmental considerations. This development is expected to lead the way for Sihanoukville to develop as commercial centre, which would substantially increase its population. The impact from this development may be affected to coastal inland resources, coastal water resources.

The number of tourists in the three coastal provinces has been estimated at 10,206. An approximately 9% growth in tourism arrivals in Cambodia is Japanese, Taiwan, and Chinese. This indicated that the positive growth in the potential tourism development sector in the country.

- **Port development**

Coastal Sihanoukville port expansion development can make a contribution to the economy as a main hub for growth of maritime transport, which should, in turn, attract manufacturing entries, but may also have an adverse impact on the surrounding environment. These effects of new expansion port can be focused upon location, port construction and port operation. These lead to impacts on water quality, coastal hydrology, bottom contamination, marine ecology, air noise, waste management and visual quality.

- **Industrial development**

The industrial development zone was established in Sihanoukville called " Stung Hav-Sihanoukville Industrial Zone". This industrial zone include petrochemical production, to exploit recently confirmed oil and gas reserves in the gulf of Thailand, food processing based on the local fisheries in the area, timber processing, and re-manufacturing. However, these industries pose potential damage to the environment.

1.3 Coastal Poverty Issues

Villagers in 75% of coastal villages met food shortages. The mainly attribute this to natural disasters such as insects, storms, high winds, and a dry season that lasted longer in recent years. On the other hand, coastal communities are also lack of infrastructure as many of them lack such facilities as schools, hospitals, and paths in the village, and lack of electricity. The shortage of drinking waters along the coast is related to this problem of inadequate rural infrastructure.

Many households in Cambodia's coastal villages are lack of regular and stable income. Many fishers are unable to fish more than 10-15 days/month because of the lack of security at sea and the incidence of natural disasters such as storm.

Many villages indicated the lack of stable prices and markets for products because of a lack of access for many coastal households to markets beyond their local village. Involved in marine harvesting the people keep little of the marine catch for domestic consumption and most of their catch is sold to local traders who then transport the products for sale at markets outside the villages.

1.4 Coastal Environmental Issues

- **Pollution**

Sihanoukville urban locality of coastal city, solid and liquid wastes are discharged into the river and carried into the sea directly. In addition, many agriculture and agro-industrial plants in the suburbs of the coastal city discharge organic residues into the coastal waterways that runs into the sea. These substances are toxic to the marine plants and hazardous to fisheries.

Facilities to provide water, electricity, and sewage treatment have not kept pace with the increase in population in the coastal region. Therefore, the sea has been used for untreated sewage disposal. This practice has resulted in water bodies becoming a potential hazard to human health and marine life.

Coastal waters have been polluted by agricultural activities. The main causes are the release of pesticides and insecticides into the water. Increases in agriculture yields have been accompanied by the increase in the use of artificial fertilisers and a variety of pesticides and insecticides. This has resulted in surface and ground water contamination in this region and during periods of rainfall result in direct run-off into the inland and coastal waters.

Pollution of coastal area from the industrial sector is relatively small in scale and magnitude compared to the problems of neighbouring nations. Most of the small-scale industries and handiwork are usually found situated along the shoreline of Tumnob Rolok Sihanoukville and along streams. The direct disposal of industrial waste, particularly liquid waste from Sihanoukville's brewery, into the coastal environment is viewed as a serious issue that needs to be addressed.

- **Degradation of natural resources**

Fisheries : the fish stocks inshore waters may be over-exploited. Fish stock depletion is indirectly evidenced by fishermen selling their vessels, which were shown that it is no longer economically viable to earn a living from fishing in inshore areas.

Another reason for stock depletion is likely related to the fishermen using gear, such as push nets and drag nets, in sea grass areas which depletes the stocks of juvenile fish and destroys the sea grass ecosystem which is so vital to the existence of many fish species.

The degradation of juvenile fish stocks has a direct impact both on the future inshore and offshore mature stocks.

Use of harmful traditional methods : the use of harmful traditional methods for fishing, such as dynamite, fish poisons or intoxicants, has also affected fisheries production. The uses of these methods in the inshore areas have resulted in the destruction of coral, mangrove, and wetland areas. These methods can destroy the important breeding grounds for the fish as well as the entire ecosystem needed to support the entire life cycle.

Mangroves : the total mangrove forest covers approximately 83,700 hectares in the coastal areas. Current studies indicate that through habitat degradation, the mangrove forests have been reduced by roughly 35-40% in Sihanoukville area. These mangrove forests are now still being depleted due to uncontrolled exploitation for firewood and charcoal and reclamation for rice fields.

The main causes of degradation are driven by local economic activities. Some of the factors contributing to destruction of mangrove forests are related to agriculture activities where people are clearing land by using the burning method. In addition to this mangroves are cut for wood and charcoal production.

Beach and shoreline erosion occurs as a result of mining or removal of sand (silica sand) and this aggravates the effects of natural processes related to wind, currents and waves. The removal of sand and the resulting beach erosion is remarkable in the Tuk Sap (20 km, ESE of Sihanoukville), O Tres (15 km of SSE of Sihanoukville), and O Chru (East of Tuk Sap) regions.

Wildlife : wildlife habitats have also been destroyed by the war by the filling of mangrove areas for housing accommodation, by pollution of marine environment and by some fishing and hunting activities. A large wildlife market exists including clouded leopard, sun bears,

and species of primates, deer, snakes, and turtles taken from the parks.

Destructive fishing practices, collection of corals for trade, declining water quality due to unsustainable logging practices, and domestic and industrial waste disposal under threaten Cambodia's coral reefs.

Seagrasses : seagrasses are under threatened by destructive fishing practices including motorised push nets, shallow water trawling, and weighted bottom nets which rip up and destroy seagrass meadows.

The depletion of natural resources such as forests, fish, mangroves, and wildlife, coral reef, seagrass, which are the main coastal and marine resources within the coastal area, has led to an overall decrease in socio-economic conditions.

1.5 Coastal and marine protected areas

The present system of coastal and marine protected areas in Cambodia comprises six reserves such national park, wildlife sanctuaries, protected landscapes, multiple use areas. However, the major issues with respect to these protected areas are degradation of biodiversity resources ; lack of facilities and absent of infrastructure ; no regulations specifying the process of protected area boundary determination and delineation, and demarcation ; and the current system has not developed from a consistent physical, biological, and socio-economic information base with an objective of ensuring representative ecosystem coverage.

2.ADMINISTRATIVE AND MANAGEMENT ISSUES

2.1 Enforcement of existing laws

The environmental protection and natural resources management law is not adequately enforced. This is largely because of lack of human and financial resources. The fisheries law has many good provisions for the protection of marine habitats and fisheries resources. For instance, dynamite fishing, trawling in coastal water, pushing netting and cutting mangrove occurs daily, but are rarely prosecuted.

2.2 Decision-making processes

The decision-making process relating the development in the coastal zone is poorly defined, vague and ambiguous. It appears that, whatever the official mechanisms are high-ranking individuals can make decisions without consultation and participation. On the other hand, it appears to be conflict between provincial and national decision-makers with plans and policies developed independently by the two levels of government.

2.3 Legal framework

A legal framework does exist for management of the coastal zone. There are laws on protected areas, fishing, industrial development, land use, forestry, environmental protection and natural resources management, environmental impact assessment, water pollution control, and other important coastal zone issues. All governors and departments in all provinces and municipalities identified the lack of a legal and policy framework for coastal zone management and administrative structure to implement it as a major constraint on coastal zone management in Cambodia.

2.4 Lack of coastal zone planning

All provinces and municipalities are required to prepare Master plans. Planning has not occurred in the coastal zone. However, the plan prepared by provincial authorities specifies industrial, tourism, and residential zones but does not suggest any guidelines for development, standards or further plans.

Unplanned and uncoordinated development is occurring all along the coast, but is not yet viewed as a major problem because the rate of development is slow. However, it is envisaged that this lack of planning result in haphazard development and will be a source of serious conflicts in the near future.

2.5 Lack of information about distribution and status of natural resources

Information on marine habitats such as coral reefs, seagrasses and endangered species are still limited. The distribution of such these information and data both national and provincial levels are limited. Without information about what people are catching, it is not possible to estimate where the fisheries are overfishing.

2.6 Lack of public awareness and participation and capacity

Many problems related to public and participation could be addresses. And actions to these should strengthen laws, raising public awareness and doing research. Associated with this concern is a serious lack of technical capacity among government staff and minimal resources to prepare and disseminate information. Participation is still low priority for most government officials, may be reflecting the historical lack of community participation in decision-making in Cambodia. The lack of participatory planning and management has meant that some solutions to environmental problems are unsatisfactory.

3.CAMBODIA'S EMERGING COASTAL POLICY FRAMEWORK

The basic emphasis the Cambodian government at present is to attempt to clarify the lines of responsibility for activities that currently transcend local, regional and national interests the intent is to manage and co-ordinate government actions, to clarify ministry attributions, and to ensure administrative effectiveness and propriety. The existing restructuring of administrative tasks is directed reshaping the civil service, reforming the organisational framework for effective management, and reforming the regulatory mechanisms. The effectiveness and efficiency of organising and managing planned coastal development and resources use is depending upon this successful re-structuring of the state (reformed administration).

3.1 Legal, Policy and Administrative Frameworks

The Royal Government of Cambodia is being emerging to develop Cambodia become a state with a functional legal and administrative system. Many Royal decrees, laws, sub-decrees and other legal instruments have been issued and are being developed. At the present, a process of making policy and law are done by a combination of national and international experts. These are law on Environmental Protection and Natural Resources Management, land law, Royal decree on the Creation and Designation of Protected Areas, Sub-decree on Environmental Impact Assessment and Water control Pollution, Fisheries and Forestry laws, and Law on Land Management, Urbanization and construction. On the other hand, Cambodia became a member of the Coordinating Body of the Seas of East Asia (1995), Association

of South East Asian Nation (1999), MARPOL (1994), Biodiversity convention (1994), CITES convention (1997), Ramsar convention (1999) and Climate Change convention (1995).

3.2 Institutional Frameworks

The numerous institutions with statutory power or interests in coastal and marine areas give rise to the problems of overlap, gaps in responsibilities and lack of co-ordination. The government has set up some organisational institutions in order to ensure overall co-ordination and co-operation of the different policies and measures taken by ministry levels of administration. Apart from the existing coastal and marine co-ordination consists of the Ministry of Environment, Ministry of Agriculture, Forestry and Fisheries Coastal Co-ordinating Unit and the National Coastal Steering Committee.

The Ministry of Environment (MoE) was established in 1993 to address issues of environmental management in the country, hold a number of responsibilities with respect to the coastal zone, the most obvious being the general protection of the environment in the coastal zone. More specific duties include the planning and management of the protected area system in the coastal zone. And its strategy is based on the execution of sole and joint responsibilities in conjunction with other ministries concerned with specific aspects of natural resources and infrastructure management.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) is the main ministry responsible for managing Cambodia's forests, including inundated forests mangrove, as well as wildlife and fisheries. Two departments of MAFF are directly relevant to biodiversity management and protection in Cambodia. It is clear from the responsibilities of MAFF and MoE that close co-ordination between the ministries and departments involved in nature conservation is essential to avoid conflicts and promote complementary activities towards implementing the coastal protected area plans.

National Coastal Steering Committee (NCSC) is an attempt to deal with the multi-sectoral natural of coastal resource issues. This committee was established in 1997 and meet on a quarterly basis. Members of this Committee include the Minister of Environment (Chairman), Under Secretaries of State from Ministry of Agricultural Forestry and Fisheries (vice Chair), Ministry of Tourism ; Industry, Mines and Energy ; Public Works and Transport, Rural Development, Women's Affairs, Planning, Council of Development for Cambodia, Governors of coastal provinces and others donors, NGOs and related coastal projects are observers. The NCSC is responsible for the overall direction of coastal projects and activities. All members are asked to ensure the co-operation of their line ministries and provincial authorities. The committee assisted by secretariat calls Coastal Co-ordinating Unit (CCU) was created 1996 in the Ministry of Environment and is responsible for co-ordination of activities by international organisations, governmental agencies, and the private sectors in the coastal area in Cambodia. Provincial working groups have been formed at the provinces and municipalities, these working groups are supported by Danida coastal zone project in its ongoing technical assistance activities in the coastal zone.

3.3 Coastal zone management Cambodia-Danida project (2000-2002)

The Danish International development Assistance (Danida) under the Environmental and Disaster Relief (EDRF) initiated its support to the Project environmental Management in the Coastal Zone.

Phase 1 was started in May 1997 and its outputs were trained provincial staff, initiated the development of information base in support of management, conducted socio-economic studies and issue-specific case studies in the coastal zone and considered longer term Danida support to coastal zone management.

Phase 2 was started in March 2000 and focused on three components : policy, legal and institutional framework ; planning and environmental management ; and pilot project on community based resources management. These three components are ongoing to prepare laws and regulations source book in the coastal zone, user's manual guide to the source book and coastal policy recommendations. Planning and environmental management component is under producing physical framework plan and environmental profile for provinces and municipalities. There are 8 pilot projects will implement to Cambodia's coast. Two have been testing with communities along the coastal zone, one is in Ream National Park at Sihanoukville municipality and other in Peam Kraop Wildlife Sanctuary in Koh Kong province, they are both based on natural resources management and alternative livelihood activities.

CONCLUSION

The Royal Government's goals directly place the major priority on the coastal areas for economic development. The new plans for economic development through the rebuilding of infrastructure, tourism, industrial development and expansion of port, and oil and gas explorations and exploitations. The impact of development conflicts will become evident, given the existing and potential planned coastal economic activities due to the lack of development policy and legal framework guidelines, the lack of coastal zone planning, the lack of law enforcement, poor decision-making process, the lack of information and participation and capacity.

In order to start the coastal resources management process moving in sustainable direction in Cambodia, firm political and institutional commitment at national, provincial and local levels will be important to the development of integrated coastal resources management policy and management planning to focus on sustainable resources use. On the other hand, Cambodia has to maintain basic human needs, and provide the possibility to satisfy the aspirations of its people for a better life ; should ensure economic growth and development are possible, without causing adverse changes to coastal and marine ecosystems.

Cambodian should design integrated coastal management approach is the key to promote sustainable use of its resources, it is the key to sustain critically important coastal ecological processes, and the overall quality of the marine environment ; it is the key to preserve Cambodia's biological diversity and ensure the quality of life for its people of present and future generations.

CONSERVATION AND RESTORATION OF COASTAL ENVIRONMENTAL RESOURCES IN THE SETO INLAND SEA PLANNING AND POLICY PERSPECTIVES

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Abstract

The Seto Inland Sea, which is one of most typical and large scale of enclosed sea in Japan, shows considerable improvement of water quality, but has environmentally deteriorated condition of ecosystem or biological resources. Various types of coastal developments, even when they are practiced with environmental consideration, have caused remarkably changed beaches, sandy beds and other peculiar shorelines with fauna, flora and natural scenic beauty. The conservation policies have been implemented since enactment of The Seto Inland Sea Conservation Law (1973, 1978), and the basic conservation plan of The Seto Inland Sea based on the Conservation Law, have the role of guiding wastewater emission regulations, controlling shoreside land reclamations, and fostering environmental learning movements. This paper characterizes functional targets, expected performances and gained results of conservation measures described in subsequent phases of basic plan, and refers to new policy perspectives and emphasizes coastal environmental resources restoration in the 2000 amendment of the Seto Inland Sea Conservation Plan, especially from the view points of sustainable coastal management.

Keywords : environmental resources management, restoration, the Seto Inland Sea, planning perspective, socio-economic valuation.

1. ENVIRONMENTAL CHANGES IN THE SETO INLAND SEA

Past decade shows improved water quality but deteriorated coastal environmental resources in terms of quantity and quality of most biologically productive areas such as seaweed beds or tidal flats due to land development in the Seto Inland Sea.

1.1 Water quality improved

In order to improve water quality in the Seto Inland Sea, pollutants emissions have been reduced by means of regulation-compliance system concerning installation and operation of specified plants with end-of-pipe equipments, total mass flow control of COD matters in watersheds, and administrative guiding for nitrogen and phosphorous reduction in all point and non-point sources sectors.

Attributable to these measures, the COD pollutant loads from industrial sectors have been reduced to less than half of the amount recorded when the Seto Inland Sea Environmental Conservation Act first went into effect, as shown in Fig.1. Progress in sewerage construction and other pollution prevention practices have also caused a steady reduction in the amount of domestic sewage loadings.

"Red tides" are also down to 40% of the average yearly number of occurrences compared to when these occurred frequently across the entire Seto Inland Sea. Consequently, water environment is judged to be turned into the relatively improved from severely polluted crisis situation.

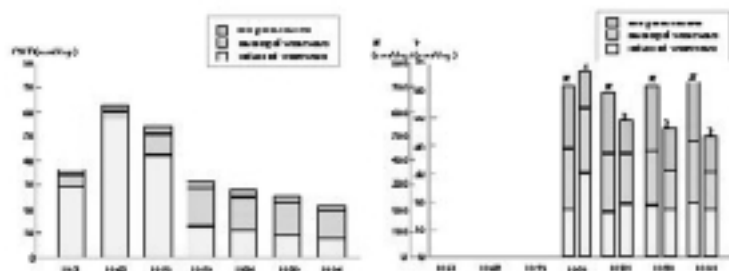


Figure 1 Decreasing Pollutants Loading in the Seto Inland Sea

However, eutrophication in the Seto Inland Sea results both from organic pollutants inflowing to the sea and from the so-called "internal production," i.e., phytoplankton propagation due to increased loading of nitrogen and phosphorous. As a result, there has been little change in recent years in either the level of achievement in environmental goals of COD or occurrences of red tides each year, and so the water quality in the Seto Inland Sea does not show satisfactory level. Moreover, oxygen-depleted masses occur on a seasonal basis in some areas.

1.2 Seaweed beds and tidal flats being disappearing

The basic indicators of the Seto Inland Sea, the Osaka Bay area most developed in the Seto Inland Sea, and the whole shoreline in Japan are compared with each other in table 1. The ratio of natural coastal line over total coastal line implies the degree of coastal development.

The Conservation Act contributes to preserve, to the considerable extent possible, the seaweed beds and tidal flats that are important for conserving marine biological resources and fostering migratory birds in habitation space. As shown Fig.2, lands reclaimed in the Seto Inland Sea area accounts for more than 280 since 1965, and 448 since 1898. The NGOs for environmental conservation pay attention to the average reclamation land volume more than 5 per year throughout the modern age. Although the rate at which seaweed beds and tidal flats are disappearing has slowed since the Seto Inland Sea Conservation Act went into effect, approximately 1,300 hectares of seaweed beds (amounting to 21% of the loss nationwide) and approximately 800 hectares of tidal flats (21% of the loss nationwide) have disappeared from the Seto Inland Sea during the 13 years between 1978 and 1991.

Of these, 40% of the seaweed beds and 70% of the tidal flats were lost due to changes brought about by anthropological activities in the form of land development, or dredging for industrial or port/harbor development.

There were only approximately 17,500 hectares of seaweed beds and approximately 11,700 hectares of tidal flats in the Seto Inland Sea coastal regions in 1999, amounting to 9% and 22% of the total in Japan.

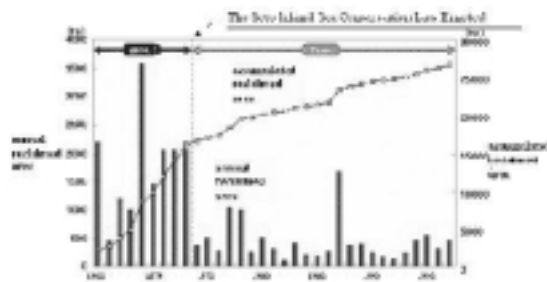
2. NEW TRENDS IN ENVIRONMENTAL POLICY

In Japan, in 1993 the new Basic Environment Law was established in place of the Basic Pollution Control Law to indicate nationwide fundamental philosophy on environmental management, the role of various economic sectors, principal policies and means for promotion. In 1994, a Basic Environmental Plan based on this law was established.

The Basic Environment Law calls for actions to reduce the burden on the environ-

Table 1 Change of Coastal Environmental Resources in the Seto Inland Sea Area

	Tokyo Bay area	Osaka Bay area	Seto Inland Sea area	Total area in Japan
• Sea area	1,380	1,529	21,827	-
• Adjacent land area	13,279	18,585	67,223	377,837
• Land area population (million)	32.5	18.3	35.3	125.6
• Population density (capita/)	2,453	933	524	332
• Logistics in adjacent prefectures (million ton/year)	1,563	993	2,342	6,738
• Fishery production (thousand ton/year)	-	35	594	7,250
• Water quality goal achievement level (%)	63	67	78	81
• Red tide (event/year)	51	19	89	-
• Coastal line (km)	801	442	6,912	-
• Natural coastal line ratio (%)	12.9	16.5	53.5	-
• Shallow sea less 10m in depth	360	117	2,527	-
• Shallow sea ratio (%)	26.1	7.7	11.6	-
• Seaweed beds ratio (%)	1.27	0.30	1.14	-
• Tidal flats ratio (%)	1.41	0.01	0.51	-

**Figure 2 Lands Reclaimed in the Seto Inland Sea Area under Special Permits**

with nature in recreation, eco-tours or environment-conscious actions.

The policy orientation based on public needs identified first in the Basic Environmental Law is to achieve environmental goal of water quality in terms of COP, N, P and furthermore to minimize red tide events, which occurred in recent years.

The red tide as excessive propagation of phytoplankton in eutrophicated conditions of receiving water is judged to be unstable change out of range of autonomous ecosystem variation. The less the assimilation capacity of sensitive tidal flats or seaweed beds, the more the red tide seems to happen frequently. The remediation or restoration of ecosystems in sandy beaches, silty tidal flats or seaweed beds becomes a prioritized option of measures in the Seto Inland Sea area.

The basic Environmental Law emphasizes the citizens participation in voluntary conservation movement, one example of which is shown in Picture 1 to illustrate clean-up action by a NPO. The activities of bird watching on these beaches or shore sides, fishing festival or biological monitoring survey are highly appraised for environmental conservation in the Seto Inland Sea area.

The Basic Environmental Plan identifies four long-term management policy ends as in loop-closing in material flow and metabolism, ecologically symbiotic coexistence, public and business sector participation in equal partnership towards joint environmental action, international environmental sustainability aids, and shows policy guides and measures designed to achieve these objectives.

The desired water environment are interpreted by comprehensive characteristics in terms of clean water quality, adequate water quantity, conserved aquatic life, well-managed waterfronts for sustainable use. The shorelines in urban areas are suffered from rapid change of land use patterns for industrial or business uses. As shown in Fig.3, for example, industrial and business activities in the Osaka Bay area have required additional coastal land development in shoresides.

Judging from scarcity of natural shorelines, the new environmental policy emphasizes that sandy beaches with ecological value should be conserved, and that deteriorated waterfronts are expected to be recovered by means of ecological restoration practices. In addition to protecting the safety of water environment from bacterial pollution or natural disaster damage, the law stresses the need to promote comprehensive measures to reduce the load discharging in each stage of water usage, and preserve the aquatic ecosystem in water environment.

3. MEASURES TO RESTORE ENVIRONMENT DAMAGED IN PAST DECADES

There have been trial practices to restore the seaweed beds, tidal flats and other precious ecological spaces. Furthermore, natural sandy beaches, fishing spots and other places for contact with nature that had been lost, have been restored and sometimes re-developed on environment-conscious design principles. These activities must be based on the following basic guides for full consideration approach.

ment caused by socio-economic activities with the voluntary or compliance-based responsibilities equally shared by all economic sectors, in order to develop communities, regions and societies with environmental and socio-economic sustainability.

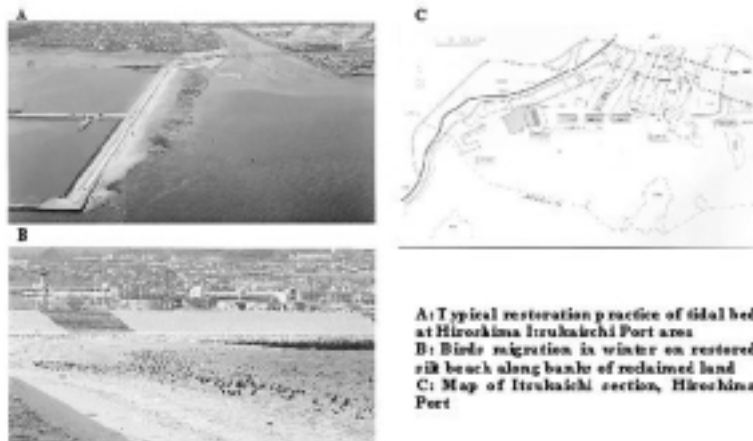
The new law extends ultimate environmental management goals much further than the previous concepts of preventing pollution and protecting nature. Regarding environmental management concept, the law identifies the public need to :

- (1) ensure the air, water, soil, biosphere and natural medium of human environment being maintained in satisfactory quality, level and condition.
- (2) ensure biodiversity of fauna and flora and preserve many types of characteristic natural environment systematically in accordance with the natural and societal conditions of the region, and
- (3) provide accessible opportunities for people to come in contact friendly

**Picture 1 Voluntary Clean-up Activities (Kansai Clean-up Office)**



Figure 3 Land Reclaimed in the Osaka Bay Area



Picture 2 Tidal Flat Practice at Hiroshima Itsukaichi Port Area



Picture 3 Yagura Green Park with Tidal Pool and Pedestrian Way

3.1 Identifying appropriately target regions

From the standpoint of restoring deteriorated environment, these policies initiatives should focus on areas where natural environment has been remarkably deteriorated due to industrial or port/harbor development. For example, Picture 2 shows the typical practice of tidal flat restoration at the Hiroshima Itsukaichi Port area. This artificial tidal flats 17.4 ha was supplied by the port authority in 1991, for the purpose of birds victims compensation against large scale of land reclamation for port and industrial uses more than 150 ha, which enforced the original tidal flat with 7.1 ha to disappear. Recently the restored silty beach affords citizens pleasures of watching so many migrated birds in winter as in the original tidal flat.

3.2 Strengthening governmental leadership or initiatives in organizational aspects

The ocean regions in the Seto Inland Sea are publicly owned, and up to now environmental management efforts have been conducted mainly by the national government and local governments. While the national government and local governments should continue to play a leading role in restoring the environments that have been damaged in past, it is important for them to coordinate these efforts with voluntary actions of citizens and private business sectors.

The industrial activities in the 20th century in the Yagura area, which locates in the north west part of Osaka City, have transformed completely rural or agricultural land originally reclaimed by the farm development leader Mr. Yagura in 1778. The shore sides have been occupied by industrial wastes derived from the great scale of production of steel-related, chemicals and machinery manufactures.

Picture 3 shows the pedestrian way, the man-made small tidal pool and the scene of Yagura green park in the front of densely-inhabited area. In this environmental restoration practice, corresponding to the private sectors' efforts of information disclosure related to chemicals safety for public, the public sector's initiatives of park construction are expected to be followed by collaboration of preparing opportunity of accessibility to shoresides through passage and voluntary greening activities by private sectors.

3.3 Implementing actions on well-structured integrated planning scheme

It is important to connect the past efforts having beneficial impacts and adverse effects with required actions towards target environment in the future. As environmental restoration of seaweed beds, tidal flats etc. will take time up to its completion, these restoration actions must be done on a planned basis from a long-term perspective.

The environmental restoration, which covers whole processes of planning, designing, execution and appraisal, should be supported by fundamental planning scheme of both of the economic/physical development agency side and the environmental protection agency side. For example, port and harbor authority has a function of formulating environmental conservation and greening port management vision (see Table 4), and implementing the individual tidal flat mitigation project, in consort with general guiding of the Seto Inland Sea environmental conservation plan by Japan Environment Agency, and also with more detailed policy orientation in the local environmental plan of the related prefectural environmental agency.

3.4 Choosing appropriate technologies

Appropriate technologies must be selected based on land and ocean characteristics: topography, resources use patterns, water quality, tidal currents, the biological habitats in the area in the process of choosing measures. Achievement level of technologies development of environmental remediation and restoration engineering works should be considered in this evaluation process from the viewpoint of environmental performance and socio-economic feasibility. Also promising is the study of design and construction technologies from new perspectives and the confirmation of their effectiveness through demonstration tests or pilot practices. In such cases, sufficient study should

be conducted to ensure that the tests are done at an appropriate time and in a location where they will not give adverse effects to the environment.

In the case of the Tokushima airport extension project, extended airport facilities could not be constructed without destruction of the sandy beach where citizens have enjoyed water-related recreations. For the adequate practice of mitigation approach, the south side beach is planned to be restored by means of laying sand on the deteriorated beach.

The hydro-dynamical condition have sensitive effects of probable recession of front line of sandy beach due to violent wave force in storms. The waterbreak was usually constructed for the purpose of protecting sandy beach from violent waves. The construction of the conventional waterbreak are liable to limit the exchange of the inside sea water with the outside water, and to accompany obstacles in the open ocean view. In the examination of strategic environmental assessment of this project. The submerged structure of waterbreak is judged to be preferable to the conventional one, because it make water easily flow in and out of the waterbreak as illustrated in Picture 4.



Picture 4 Submerged Breakwater Planned in Tokushima Airport Project



Fig.4 Transplantation of Local Peculiar Vegetations for Mitigation Practice

3.5 Preparing reasonable and effective follow-up actions and maintenance for sustainable management

The natural environment that has been restored or partially developed in the comprehensive conservation practices must be appropriately maintained so that the environment continues to fully recover from the deterioration. In addition, as hydro-dynamical and ecological potential effects of artificially recovering natural environment are not yet understood on the scientific base, the effects and impacts of restoring environment must be studied through appropriate monitoring, for the purpose of developing, improving and accumulating knowledge of environmentally sound technologies for sustainable coastal management.

In the case of the Tokushima airport extension project as shown in Fig.4, the locally scarce plants named as Kohbou lawn, Kohbou wheat and others which are typical species on sand slope are enforced to face to endangered situation. Therefore, it is requested to transplant them and foster them in the considerably long period before the construction practices starting time. Field survey and experiments on biomass, biodiversity and ecological vulnerability have been performed, in order to gain adequate informations of biological mitigation practices. Environmentally sound technologies of maintenance, improvement and recovery would be much more developed for sustainable city management.

4. EVALUATING BENEFITS OF ENVIRONMENTAL RESTORATION

Environmental restoration projects require the sufficient monetary funding and financial support. Who pay these costs? The decision-making on mitigation site, project size, engineering options and others holds efficiency and equity or not?

4.1 Economic efficiency of environmental restoration

Public projects are recently evaluated by means of cost benefit analysis or it's derivative application methods. The benefit of the target project are quantified in terms of money, by using increased production amount, saved expenditure cost or other econometrical substitutes in the comparison with those in the baseline condition.

Furthermore, the environmental benefit due to environmental restoration project is quantified by other complicated methods including the travel cost method (TCM) for recreational uses of restored environmental resources, the hedonic price method for amenity services of environmental resources, and the contingent valuation method (CVM) for non-use, bequest, or altruistic benefits attributable to restored ecological quality.

Public decision-making on regional development projects is expected to indicate not only monetary direct benefits and costs but also external environmental damage costs or restored environmental benefits which are not directly tradable on the observable conventional market.

For example, Table 2 shows the typical comparison sheet of alternatives of a waterfront development project. The alternative

Table 2 Illustrative Alternative Comparison

Alternatives	Benefits		Costs		Benefit/Cost ratio	
	Direct monetary	Indirect non monetary	Direct monetary	Indirect non monetary	Internal only	Including external
1	200	+30	100	0	2.0	2.3
2	200	0	95	0	$\frac{200}{95}$	$\frac{200}{95}$
3	200	0	90	10	$\frac{100}{90}$	2.0
4	250	0	120	20	$\frac{250}{120}$	$\frac{250}{140}$

*base line for reference

1 which has the reasonable degree

of monetary direct benefits associated with additional mitigation costs and non-monetary environmental benefits, is judged to be superior to other alternatives 2, 3 and 4. The alternative 4 having the maximum monetary benefit and relatively high value of the internal cost-benefit ratio, had been chosen in the economic growth first society.

4.2 Valuating ecological resources of tidal flats

The reclamation projects of tidal flats or sandy beaches become topics of regional social concerns in the Seto Inland Sea area and other coastal areas. The disappearance of tidal flats due to solid waste landfill or urban development is acceptable or not? The operation of solid waste landfill supports industrial and urban activities to discharge solid waste. Are there other alternatives of waste management such as prevention, reducing, reuse, recycle and/or another landfill operation in inland areas?

The value of ecological resources of tidal flats has been measured in terms of willingness-to-pay price in environmental economy in the growing stream of environmental awareness and raised public concerns on bio-diversity and scarcity of local species. In Japan, a good deal of discussion on pros and cons of land reclamation in shoresides have been observed in Isahaya (Saga), Wajiro (Fukuoka), Fujimae (Nagoya, Aichi), Sanbanse (Tokyo, Chiba) and other tidal flats. In the case of the Fujimae tidal flats, the ecological value of tidal flats is estimated to be more than 2000 million US \$ by a researcher. Because the contingent valuation method or any of other valuation methods

has week points of quantification bias, the decision-making process is requested to improve direct evaluation of environmental resources in cost-benefit analysis, strategic environmental assessment, and post-audit practice.

Table 3 shows examples of evaluating the tidal flat and other seashore areas in the east Mikawa bay, and represents that the total use value for recreational activities remains smaller than the level of the non-use value of ecological bequest or the existence value of natural dignity itself in the traditional local community.

Table 3 Examples of Valuation of Tidal Flats

Flats or beaches	Location	Researchers	Measured value	Estimated resource value	Methodology
Fujimae tidal flats	Nagoya City	Kuriyama et.al. (1998)	6,555- \12,060 /person/year	296 billion yen/year (national) 9.0 bil.yen/year (Nagoya City)	CVM for existence value
Shiokawa tidal flats	Toyohashi City, Aichi Pref.	Morioka et.al. (1998)	\11,160 /person/year (WTP:EV)	3.9 billion yen/year (Toyohashi City)	CVM for existence value
Mikawa green coastal park	Toyohashi City, Aichi Pref.	Morioka et.al. (1998)	\4,800 /person/year	1.7 billion yen/year (Toyohashi City)	CVM for user's value
Tsukimigaok beach	Tokushima Pref.	Morioka et.al. (1996)	\1,200(TCM) \2,590(CVM) /person/year	12 billion yen/year	TCM and CVM for user's value

5. NEW POLICIES OF THE SETO INLAND SEA BASIC CONSERVATION PLAN AND THE SETO INLAND SEA PORT AND HARBOR ENVIRONMENTAL PLAN

In 2000, Japan Environment Agency (2001, Ministry of Environment) and Japan Bureau of Port and Harbor, Ministry of Transport (2001 Ministry of Land and Transport) established the new environmental plans related to the Seto Inland Sea. First, Japan Environment Agency amended the Seto Inland Sea Basic Conservation Plan, which consists of dual aims as water quality conservation and natural scenic landscape conservation, and indicates categorized nineteen policies.

Table 4 shows that shallow shore beds and natural beaches are expected to be conserved in article 3, and that the avoidance, reducing impacts, and mitigation practice should be examined in environmental impact assessment of land reclamation in article 5, and furthermore that lost or damaged environmental resources once served as valuable amenity assets are requested to be recovered or restored in article 8 in the Basic Conservation Plan.

Table 4 Aims and Basic Policies of the Seto Inland Sea Basic Conservation Plan and the Seto Inland Sea Port and Harbor Environmental Plan

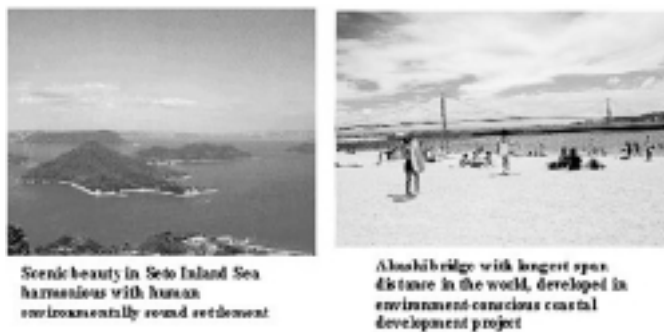
Title of plan	the Seto Inland Sea Basic Conservation Plan	the Seto Inland Sea Port and Harbor Environment Plan
Background of in-agency initiative	Basic Environment Plan Report of Seto Inland Sea Conservation Council	Principal Guide of Eco-port Report of Port Council
Basic concept	Future generation must inherit sound environment Lost environmental resources should be recovered	Future generation must inherit sound environment Sustainable development in the Seto Inland Sea area
Aims characterized	Good water quality Conserved scenic beauty	Formulating coastal area where human activities harmonious with natural environment Region-wide collaboration among ports and harbors in the Seto Inland Sea area
Major policies characterized	Water pollution control Scenic landscape conservation Shallow shore beds conserved Marine sand extraction control Land reclamation with environmental consideration Waste landfill with environmental consideration Sound water cycle in basin management Restoration of lost environmental resources Environmental protection in islets Sewerage construction Harmful bottom sediment removal Water quality monitoring Research development initiatives Citizens involvement Environmental learning initiatives Information disclosure Area-wide collaboration International collaboration Financial aid	Water and sediment purification Conservation and restoration of biological environment and niche Clean marine surface Landscape conservation Protecting historic heritage Public accessibility improvement Emission reduction in regional environment Sound waste landfill management Treatment of left boats Scientific research promotion Technology development for conservation Information disclosure and communication

5.1 Promoting scenic beauty recovery and coastal redevelopment with environmentally upgraded assets

The Seto Inland Sea area is designated as area-wide beautiful National Park. For example, the left in Picture 5 shows typical landscape of human settlement in harmony with small green islands. Regional development requires physical infrastructures of roads, ports, industrial estates and others as shown in the scene of Akashi great bridge. The sandy beach which was recovered in an associated coastal redevelopment project (1998), gives comfortable recreation and sport services seen brilliantly against the blue sky and the bridge.

5.2 Enhancing environmental restoration practices

The nearly 2% of total sea area of about 23 thousands km² have been reclaimed, and at the same time more than 45% of coastal



Picture 5 Scenic Beauty in Regional Development

lines have been occupied by industrial or residential uses. In order to ensure tidal flats and seaweeds beds on the principle of the total net zero loss, more numbers of ecological restoration projects are desired for biological habitat improvement in each coastal zone in Japan. Several experiences of geological and hydraulic engineering works have brought about taking root of seaweeds or florae, immigration of benthos and other meso organisms, and inhabitation of birds or fishes.

The illustrated examples in pictures, shows remarkable increase of observed species or sure evidence of settlement of endangered species : 91 species of birds and an Asari clam in Kasai Seashore Park, 230 species of birds in Osaka South Port Bird Garden, a scarce lizard-like goby in prepared tidal flat of Gushikawa, and thickly grown seaweeds on gentle banks of Kansai Airport.

5.3 Strict applications of environmental impact assessment

The strictly applicable process of environmental impact assessment (EIA) has exerted favorable effects on effective performance of environmental conservation. The EIA practice is much more emphasized as one of available effective policies in conservation of ecological systems.

Five typical examples of performances of EIA or other related policy implementation in coastal development in Table 5, imply that the evolutionary process of environmental conservation policies should include wide range of avoidance, reducing impacts and so-called mitigation.

5.4 Capacity building of voluntary environ

Environmental conservation should be promoted by not only governmental regulation and management but also citizens and business sectors voluntary initiatives. Environmental learning is a key issue of widely covered environmental movement. In recent 20 years, public and societal concerns on marine environment have been raised and become tied with voluntary actions. In 1974, the severe event of oil spill due to a petroleum tank breakage happened in Seto Inland Sea, and again in 1997 the Japan Sea shore area faced to oil spill contamination due to a Russian tanker accident. The former gave damages of more than 15,000 million yen including one of fish-raising industries, and the latter did 35,000 million yen. The scenes of emergency actions differ in personal characters of rescue parties and relieved targets. The latter includes that voluntary citizens actions aid damaged waterfowls and plants in Picture 7.

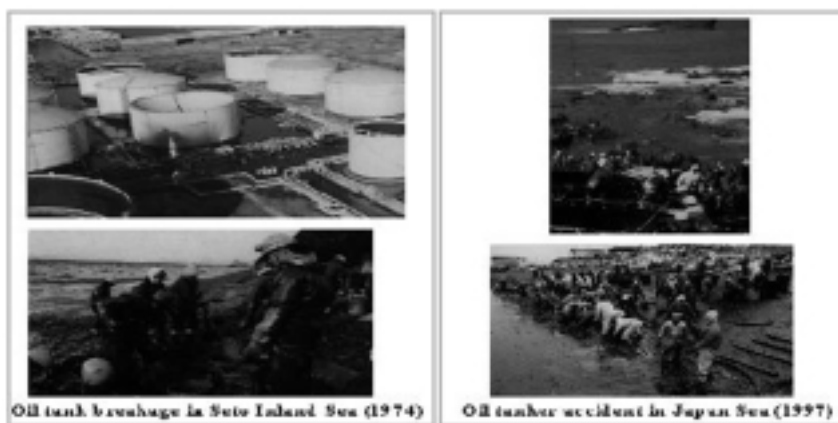
In the Seto Inland area, various types of environmental learning programs are put into practice. For example, Picture 8 shows the scene of plankton sampling and microscope examination in young generation eco-club initiative. Voluntary action are expected to be supported by information disclosure and communication support system. Concerning the Seto Inland Sea issues, the Setouchi Net is available by anyone. The Setouchi Net includes topics in what is new, answers to probable questions, provide environmental information, communication plaza, research data base, interface and address, home page links. The ecological restoration and environmental recovery actions are subject to be stimulated by raised environmental literacy capacity of citizens and business sectors.



Picture 6 Biological Restoration Projects

Table 5 Minimizing Environmental Impacts Attributable to Formal EIA or Formal EA's Advice in Development Councils

	Development plan	Possible damage	Performance of EIA or others
Tsukinoura bay, Ikuno Island, Hiroshima (1979)	38ha of reclamation by coal ash landfill	Seaweeds and tidal flats should be lost	Plan cancelled
Tomita section, Imabari Port (1987)	34ha of reclamation for port and urban redevelopment	Natural beach of 560m in Odagahama should be lost	Shifting location of reclamation work by 200m far
Itsukaichi section, Hiroshima Port (1986)	154ha of reclamation for port, industrial estate, urban renovation and park	Tidal flats of 7.1ha should be lost	Prepared 17.4ha of tidal flats for mitigation
Dejima section, Hiroshima Port (1996)	129ha of reclamation for port, business use and park	2.2ha of seaweed beds and 0.5ha of tidal flat should be lost	Same area of tidal flats and 2.9ha of seaweed bed were prepared
Industrial zone, Wakayama (1997)	Coal power plant sited and operation plan, instead of neighboring steel industry relocation permitted in past	Disappeared seashore and forecasted impacts reduction due to steel industry relocation	Prepared lagoon, biotope, artificial seaweed beds and other 24 relevant countermeasures



Picture 7 Who Have Concerns on Monetary and Ecological Damages in Two Oil Spill Events?



Picture 8 Young Generations Participation Initiative

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TOWARDS THE SUSTAINABLE MANAGEMENT OF COASTAL AREAS IN KOREA

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Development-oriented coastal utilization has resulted in deterioration of marine ecosystem, loss of tidal mudflat, occurrence of large-scale and long-standing red-tides, etc. To deal with such problems and other maritime related affairs more efficiently, integrated coastal management (ICM) system has been incorporated into national planning regime since the mid 1990s. The Korean government also created the Ministry of Maritime Affairs and Fisheries in 1996 for comprehensive handling of marine issues.

To adequately respond to various coastal issues, the Ministry carried out coastal assessment projects from 1996 to 1998, and enacted the Coastal Management Act in early 1999. Coastal Management Act functions as a framework act that provides fundamental and comprehensive guidelines on rational use of coastal resources and space. Main components of the Act include geographical scope of coastal areas, relationship to other laws, contents and establishing process of ICM plan at national and local levels, coastal improvement projects, and periodic evaluation.

The National ICM plan based on this Act was established in September 2000. Concomitant actions to the National ICM plan implementation are being executed, e.g., cancellation of major coastal development projects, establishment of local ICM plans, comprehensive assessment for tidal wetland protected areas, designation and management of Coastal Environmental Management Areas (CEMA), establishment of Ocean Korea 21 (the national framework plan for the sustainable development of ocean), etc. In addition to the above actions, public awareness on sustainable use of marine resources has been enhanced and stakeholders including local governments have paid serious attention to ICM implementation. Thus, it can be expected that the ICM regime inclusive of Coastal Management Act will be a window of opportunity for sustainable use of coastal areas in Korea.

I. INTRODUCTION

The current management regime for ocean and coastal areas incorporates integration coastal management to enhance the efficiency and the effectiveness of coastal resources and space utilization. The concept of integration coastal management (ICM) has emerged from the Agenda 21 of 1992, which became the normative guideline for coastal states to utilize their resources. Since the Agenda 21 of 1992, international agencies such as UNEP, UNDP, IMO, World Bank, FAO, IAEA, etc. have applied ICM to their policies. ICM also has been supplemented by the Biodiversity Convention of 1993; the Global Program of Action for the Protection of the Marine Environment from Land-based Activities; and the United Nations Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks of 1995.

In addition, coastal states have prepared various measures to implement ICM. Sorensen (1997) reported that 180 ICM efforts had been initiated by approximately 90 coastal nations and semi-sovereign states and these efforts were relatively even distributed around the world except Africa region. Coastal states in East-Asian region also have given concerted efforts to establish and implement ICM since 1992. Coastal nations in East-Asian region have been challenged by various coastal management issues, such as coastal erosion, over-exploitation of natural resources, natural habitat loss, marine ecosystem degradation, and user conflicts. However, they have difficulties in formulating appropriate institutional mechanisms, which enable integrated management to be workable.

The Republic of Korea is a leading country in incorporating ICM concept into national planning regime and establishing integrated coastal management system (Hong & Chang, 1997, Cicin-Sain and Knecht, 1998, Lee, 1998). ICM concept was introduced in the mid 1980s by oceanographers and marine policy researchers. The Korean Government prepared management arrangements and policies to apply the ICM to various fields on coastal utilization; enactment of the Marine Development Basic Act of 1987, preparation of National Agenda 21, formulation of the New Marine Policy Direction toward the 21st Century, and the creation of the Ministry of Maritime Affairs and Fisheries (MOMAF) in 1996.

The establishing ICM was accelerated by the creation of MOMAF, which carried out national coastal assessment projects from 1996 to 1998. Based on the assessment results, Korean government enacted 'the Coastal Management Act' in 1998. To successfully implement the Coastal Management Act, National Plan on Integrated Coastal Management was established in September 2000 through being reviewed by National Commission on Natural Environment Conservation. Although coastal-related affairs of ten governmental agencies were integrated into MOMAF by implementing the Coastal Management Act and the National ICM plan, for the successful implementation of ICM regime, Korea needs to enhance its planning and management capacity at national and local levels and to build public awareness among NGOs, residents, fishermen, and industries.

This paper is written to illustrate ICM mechanism development mechanism, of Korea and major components of the Coastal Act and the National ICM Plan. In addition, purpose of the paper includes sharing Korean experiences for establishment of ICM regime with other countries.

II. ICM MECHANISM DEVELOPMENT IN KOREA

Introduction of ICM concept and needs for ICM

For past two decades, the first major goal of Korea was to establish a self-reliant industrial nation and transform itself from an agricultural backwater into a modern industrial economy to provide a decent way of life for its people. Such exploitation-rather than development-oriented economic policy, however, brought a lot of adverse impacts on coastal resources and space, such as coastal environment degradation, tidal wetlands loss, common occurrence of large-scaled and long-standing red-tides, increase of eutrophication, and decrease of fishery production. Especially, loss of tidal wetlands by indiscernible reclamation became a pending issue associated with sustainable development of coastal areas (Table 1).

Table 1 Loss of tidal wetlands during past one decade in Korea

Year	1987 (A)	1998 (B)	B - A	Portion of loss
Area	2,815 km ²	2,393 km ²	- 422 km ²	15%

As degradation of coastal environment and resources became one of main policy issues to be urgently dealt with, Korea slowly drew lessons from the developed countries and realized that, when undertaking economic development, great attention must be paid to the environmental protection (Hong and Lee, 1995). This change of coastal utilization policy can be attributed to introduction of the ICM concept and the policy recommendations by oceanographers and marine policy researchers. The paradigm of coastal zone management was novel one to Korean government in that coastal zone included both land and marine components, that coastal management concerned with both development and conservation, and that coastal management involved various sectors and disciplines. However Lee (2000) assessed that Korean government was not ready to experiment with such innovative management framework and did not implement the policy recommendations made by academia until the early 1990s.

Agenda 21 and incorporation of ICM into national planning regime

What drove establishment of the integrated coastal management? The Agenda 21 of 1992 contributed to increasing the interest of Korean government on applying the ICM concept to national planning regime, and enhancing public awareness on sustainable utilization of coastal resources. Since the Agenda 21 played a key role in introduction of ICM concept into their coastal management framework (Cicin-sain, 1993; Hong and Lee, 1995; Miles, 1999), Korean government also could not be free from the international mega trends. The fact that the ICM paradigm received international recognition in explicit way gave credibility and reliability on the paradigm for Korean government to formulate a policy arrangements such as 'New Marine Policy Direction toward the 21st Century' in 1995 and 'the Marine Development Basic Plan' in 1996, and to address the national need for establishing institutional mechanisms of ICM (Lee, 2000). Thus the needs for establishing ICM were emerged from as follows;

- Development-oriented national policy causing the concentration of population and industrial activities on coastal zone
- Appearance of problems such as degradation of coastal water quality, loss of marine habitat, and multiple use conflicts
- Setoral and somewhat fragmented governance system that can not effectively address those issues since coastal zone is governed by nine ministries based on about 50 laws
- Increase of the need for improving coastal governance system since the Rio Declaration of 1992, and
- Recommendation of establishing national ICM mechanism by international community based on Chapter 17 of Agenda 21.

Korean government created the Ministry of Maritime Affairs and Fisheries to comprehensively cope with various marine issues emerged from adverse impacts due to past development-oriented policies, and to adequately address the above coastal management issues. ICM establishment can be defined as a core part of integrated affairs carried out by the newly created ministry. To effectively implement the national plan of developing integrated coastal management system, MOMAF also took over the authority of coastal management from the Ministry of Construction and Transportation in March 1997, and established Division of Coastal Zone Management in May 1997.

III. ESTABLISHMENT OF NATIONAL ICM REGIME

- Coastal Management Act and National ICM Plan - Coastal Assessment and Enactment of the Coastal Management Act

Korean government carried out coastal assessment projects from 1996 to 1998. In the first phase of the assessments of 1996, coastal zone assessment was made on the West Coast regarding coastal ecosystem, resources, uses, human impacts, and natural hazards. Comparative analysis was also made on existing institutional arrangements of coastal management. In the second phase of 1998, coastal zone assessment was carried out on the South and East Coast. The assessment results include as follows :

- Korea has a relatively long coastline measuring 11,542 km, due to its indented coastal shape on the west and south coast (Table 2),
- Presently coastal zone in Korea accommodates 45 ports, 415 fishing ports, 25 coastal cities, 22 industrial complexes, and about 33 percent of total Korean population, and
- Provided that Korea keeps pursuing ocean-oriented development policy, it is projected that by the year of 2005, more than 40 % of total population and 50% of total GDP will occupy the coastal zone.

Based on the assessment results on coastal areas, the draft of the Coastal Management Act was prepared by the MOMAF through consultation with stakeholders including relevant ministries, experts from various fields, non-profitable organizations and other interest groups. Korean government enacted 'Coastal Management Act' in February of 1999, which functions as a national mechanism for implementing the concept and the principles of integrated coastal management. The Act has entered into force since September 1999.

The main components of the Act include :

- National policy of coastal management
- Coastal management boundary
- National ICM plan, its major components and establishment process
- Local ICM plan and establishment process
- Coastal improvement project
- Coastal management council at national and local levels
- Periodic inspection and evaluation

National Policy of Coastal Management

Korean government emphasizes that the Act has to contribute to ensuring sustainable development on coastal areas through integration of several dimensions (Cicin-sain, 1993; Cicin-sain and Knecht, 1998) :

- Integration among coastal uses (e.g., port development, fisheries, coastal tourism, marine ecosystem protection, industrial activities on coastal land, agriculture etc.)
- Integration between the land and the sea sides
- Integration between various institutional arrangements relevant to coastal uses
- Integration of governance system
- Integration among nations, and
- Integration between disciplines (interdisciplinary approach)

Incorporation of integration concept into coastal management will lead to improve current institutional mechanism and implementation capacity as integration is not just centralization of authority (Imperial, 1999). Integration is a mechanism to lead to :

- Maximizing management capacity in cooperation with user groups, national and local authority,
- Achieving goals and objectives for sustainable development,
- Forming a more complete, harmonious, and coordinated entity, and

Table 2 Characteristics of coastal areas in Korea

Natural characteristics	Coastline (km)	Total Land side Islands	11,542 6,228 5,314
	Area (km ²)	National Land Coastal city & county Tidal wetlands EEZ	99,393 31,870 2,393 286,543
	West and South coast	Depth Geographic feature Geological feature	Shallow Deeply indented coast Tidal mudflat
	East coast	Depth Geographic feature Geological feature	Deep Simple-lined coast Sandy beach
	Islands (number)	Resided Is. Non-resided Is.	479 2,691
Socio-economic characteristics	Population (1,000 indiv.)	National Coastal city & county	45,830 12,466 * 27% of national population
	Employees	27.3% of national employees	
	Industrial complex	National complex Local complex	75% of total national 37% of total local
	Ports & harbors	Commercial ports Fishing harbors	50 2,239
	Power plants (number)	40 (50% of total power plants)	

- Establishing science-based management system.

As the integration gives an emphasis on coordination and harmonization between components of coastal systems, the Coastal Management Act functions as a framework mechanism on institutional arrangements pertinent to coastal management. Korean government anticipates to achieve goals for sustainable development of coastal areas through the above integrated management system. In this regard, the purpose of the Act is to preserve the coastal environment, ensuring sustainable development, and promote various values of coastal resources.

Coastal Management Boundary

Coastal management boundary on the Coastal Management Act is determined, based on a basic concept that the coastal boundary incorporating landward and seaward components. In this regard, the coastal area includes coastal water and coastal land. Coastal water embraces from shoreline to the outer limit of national territorial water (12 nautical miles), and coastal land basically covers uninhabited islands and 500 meters inland from shoreline. In the case of fishing harbors, ports, industrial complexes and coastal cities, coverage of the coastal land extends to 1,000 meters inland from shoreline. For more effective management of coastal areas, coastal management boundary needs to include coastal watershed for addressing adverse impacts on coastal areas originated from socio-economic activities within the watershed. By applying the integrated approach to defining coastal boundary, holistic and comprehensive management can be pursued. In this regard, Lee (2000) pointed out that Coastal Management Act has been successful only in a limited fashion in incorporating both natural subsystems and the socio-economic subsystems within its management boundary.

Integrated Coastal Management Plan at National and Local Levels

Integrated coastal management plan at national level (hereinafter National ICM plan) is formulated by the Ministry of Maritime Affairs and Fisheries through the deliberation of the National Coastal Management Council (chaired by the Vice-Minister of MOMAF) and the approval of the Environmental Conservation Committee (chaired by the Prime Minister). The draft of the National ICM plan is required to have consultation with various governmental agencies, local governments, non-profitable and profitable organizations, experts and coastal residents before official deliberation of the National Council. Main components of the National ICM plan should include as follows :

- Coastal land boundary
- Planning area
- Basic policy statement of coastal management
- Strategies for coastal conservation, sustainable use and development
- Restriction on coastal use activities, and support for coastal community according to other laws
- Coordination and harmonization of individual policies or initiatives made by other governmental agencies or local governments, and
- Basic policy direction on coastal improvement project

The newly established National ICM plan led to change towards integrated management system from traditional management. In the case of designation of coastal protected areas, 128 coastal areas have been designated as various types of coastal protected areas including nine coastal wetlands, 64 specially protected islands, 18 natural habitats, and 47 environmental ecosystem areas. In addition, coastal development projects having caused coastal problems were cancelled or coordinated under the Plan. Especially, 61 coastal reclamation projects have been cancelled, and 26 coastal development projects also have been cancelled including construction of industrial complexes and large-scaled coastal tourism complexes. In addition, to adequately address coastal deterioration and to improve quality of marine environment, Korean government has designated four Marine Protected Areas (MPA) and five Special Management Areas (SMA). With regard to MPA and SMA, Marine Pollution Prevention Act was amended in February this year and management plans on the areas is being prepared by MOMAF.

The Plan has required establishing ICM plan at local level on ten coastal areas with strong user conflicts. According to this management policy, local governments or related governmental agencies should formulate the Local ICM plan through deliberation of Coastal Management Council at both national and local levels when they pursue new or previously designed development projects on the areas (Table 3).

Coastal Improvement Projects and Periodic Inspection

For improving quality of life on coastal areas through support of coastal communities, the National ICM plan includes basic policy direction of coastal improvement project that is categorized as three types of projects : protection of coastline from natural hazards, improve-

Table 3 National and local plans of ICM in Korea

	National Plan	Local Plan
Type of plan	Overarching guidelines	Action plan of national plans
Planning area	Coastal boundary on the Act	Coastal management areas at local level
Formulation	Minister of Maritime Affairs and Fisheries	Head of local governments
Approval	National Coastal Management Council Environment Conservation Council	Local Coastal Management Council National Coastal Management Council
Main components	• Coastal land boundary • Planning area • Vision and strategies for sustainable management • Restriction on coastal use activities, and support for coastal community according to other laws • Coordination and harmonization of coastal activities • Basic policy direction on coastal improvement project	• Re-designation of local planning boundary • Vision and strategies for sustainable management at local levels • Management arrangements for implementing national plan on local area • Detailed restriction on coastal use activities, and support for coastal community according to other laws • Coordination and harmonization of coastal activities
Enforcement	Since September 2000	Under preparation of plans

ent and restoration of deteriorated coastal environment, and development of environment-friendly waterfronts for enhancing public access to coast. According to the Coastal Management Act of Korea, Minister of Maritime Affairs and Fisheries establishes Coastal Improvement Plan through deliberation of National Coastal Management Council every ten years. MOMAF formulated Coastal Improvement Plan in September 2000 and will enter into force in 2001. Funding from MOMAF can be made available to local governments when they implement coastal improvement projects on the Coastal Improvement Plan.

The improvement projects will contribute to enhancing quality of life on coastal areas by directly and visibly supporting coastal communities at low income as the basic objective of ICM is to maximize long-term economic and social benefits (Burbridge, 1997). Coastal residents will be included in important constituency for settling ICM regime.

Korean government has pursued the principle of adaptive management to successfully implement the National Coastal Management Plan and Coastal Improvement Plan. The principle was incorporated into the Act in the form of 'periodic inspection of coast and assessment of performance'. Many experts pointed out that evaluating ICM efforts and programs is effective tool for ensure adaptive management in managing coastal resources (Olsen, 1993; GESAMP, 1996; CRC, 1997). As Sorensen (1993) noted that ICM should be a program and not one-time project, the newly established ICM regime of Korea is expected to 'sustainable mechanism' by performing 'periodic inspection'. To meet the objectives of the inspection, Korean government needs to juxtapose detailed guideline to the periodic evaluation and to develop evaluation indicators in various fields (Vandermeulen, 1998), which enable public officials to understand and carry out their jobs relevant to ICM regime. By doing so, the advanced evaluation system should be incorporated into ICM system of Korea.

Concomitant actions to establishment of ICM regime

Harmonization and collaboration between coastal authorities is one of integral elements for evolving newly established ICM mechanism (Sorensen, 1997; Chua, 1999; Imperial, 1999). As the National ICM plan of Korea functions as basic guidelines for sustainable development through wise use of coastal resources, relevant institutional arrangements should also be incorporated into the ICM mechanism at operational level. Amendments of each laws and development of efficient management tools should be ensued by relevant governmental agencies as well as by private sector inclusive of NGOs, coastal community and profitable societies. Policies change in some fields pertinent to coastal management occurred in parallel with establishment of National ICM regime, including cancellation of large-scaled coastal reclamation projects, revision of coastal development projects, comprehensive assessment of tidal-mud flats, and survey on marine debris.

Cancellation of the reclamation projects is an important indicator showing a shift in attitude and philosophy for managing coastal areas. Coastal waters of 2,622 km² equivalent to area of existing tidal wetlands have been reclaimed to meet the need for farming lands and industrial complexes. Although the reclamation of coastal areas provided spaces for agricultural, industrial, and urban activities, it resulted in a lot of adverse environmental impacts including the loss of valuable tidal-mud flats, the destruction of natural habitat and mariculture grounds, and the coastal pollution. Implementation of the large-scaled reclamation is partially originated from strong competition to use coastal space, but mainly lack of awareness on unique values of coastal resources.

In addition, Korean government and other stakeholders recognized that national institutional mechanism should be formulated to preserve tidal-mud flats especially located in west coast of Korean Peninsula. In 1999, Wetlands Conservation Act was prepared and has entered into force since February 2000. Comprehensive assessment of tidal wetlands has been carried out since 1999, and based on the assessment results, Korean Government will establish strategies and prepare management plans, for using and managing the wetlands in sustainable manner.

One of major concomitant actions to establishment of National ICM regime is amendment of Marine Pollution Prevention Act in 1999. The past Prevention Act coped in very limited fashion with coastal pollution problems including algal blooming, decrease of fisheries resources, eutrophication, pollutants discharge from coastal land, and increase of heavily polluted sites. To effectively address the above problems, watershed management approach was introduced into the amended Prevention Act. According to the Act, nine areas were designated as Coastal Environment Management Areas (CEMA) inclusive of five Special Management Areas (SMA) and four Marine Protected Areas (MPA). The definitions of MPA and SMA are as follows that :

- MPA is coastal waters in relatively pristine and good ecological conditions which need to be preserved and protected continuously, and
- SMA is coastal waters which do not meet water quality standards, impose significant risks or potential risks to human health, ecosystem integrity and coastal uses, and thus need special management measures for restoration.

To improve marine environment and protect ecosystem of coastal areas, Korean government prepared 'Strategic Plan for CEMA' in April 2000 that functions as management principles and strategies for coastal environment. Action Plans for managing two pilot areas of CEMA will be formulated and implemented next year through consultation with governmental agencies, local governments, and user groups

within those areas. To enhance implementability of the action plans and achieve objectives of the Strategic Plan, intensive investment will be executed in the fields of constructing treatment facilities construction, raising public awareness, monitoring and research for measuring carrying-capacity, cleaning mariculture grounds etc.

Establishment of ICM regime has been also supported by recently formulated 'Ocean Korea 21', as the national framework plan for the sustainable development of ocean. As successful implementation of ICM is essentially required to achieve sustainable development of marine and coastal resources, ICM implementation is one of strategic actions for Ocean Korea 21. ICM mechanism of Korea will be moreover strengthened by implementation of Comprehensive Plan for Marine Environment Preservation that is being prepared by MOMAF. The Comprehensive Plan will enter into force in 2001.

In the case of public participation and awareness enhancement, Agenda 21 of 1992 asserted that public involvement in resources management would have a pivotal role in ensuring the sustainable world, through Chapter 23 to Chapter 28. In Korea, public awareness on ICM has been rapidly raised since the mid 1990s in the recognition of the fact that coastal resources including wetlands could provide present generation as well as future generation with various opportunities for sustainable development. With regard to NGOs' activities, most of them paid a strong attention to preservation and protection of natural ecosystem on inland areas before the mid 1990s. NGOs have made concerted efforts, however, to protect the wetlands from various development-oriented coastal activities since the mid 1990s as 33% of valuable wetlands in Korea have disappeared by reclamation projects during the past decade (MOMAF, 1998). For interactive networking between coastal NGOs, the Network for Coastal Conservation as a coordinating body has been recently established to exchange information on marine environment conservation and to enhance their capacity for achieving sustainable development. In addition, they operate education program to their members and coastal citizens, and perform periodic monitoring to marine debris through support of MOMAF. Although their participation in ICM planning and implementation still remains relatively minimal, they are expected to play a major role in establishing sustainable ICM mechanism.

The science-policy interaction as one of unique feature of ICM components has been applied to ICM mechanism of Korea. Integration between science and policy is considered to be a basic principle for guiding the wise use of coastal resources. As Cicin-sain and Knecht (1998) stated that one of the strengths of ICM process is its reliance on accurate information and data, building science and information base is highly associated with leading to rational decision-making on coastal management (Olsen, 1993; GESAMP, 1996; Chua, 1999). For building knowledge-base of ICM, Korea government carried out comprehensive assessment on coastal areas in the field of natural sciences and social sciences, and established coastal geographic information systems (GIS) inclusive of various coastal information by putting assessment results into the system. To improve the pre-existing GIS system, the basic plan for establishment of coastal GIS system was formulated by MOMAF in 1999. The coastal GIS system includes basic maps on coastal areas, socio-economic activities, natural environments etc, and will continuously add results of coastal assessment and monitoring to the GIS system. In addition, as more efficient GIS system for decision-making on ICM needs to be developed, Korean Government is paying attention to establishment of decision-making support system which enable to enhance coastal management capacity of policy-makers and to build a knowledge base for ICM in Korea (Mumby et al., 1995; Cicin-sain and Knecht, 1998; Fabbri, 1998).

IV. Conclusion

It can be said that ICM regime of Korea has been established through continuous efforts at National level since the mid 1980s and that the ICM concept is appreciably being incorporated into planning regime at national level. It also can be stated that coastal management of Korea has undergone some positive changes in terms of institutional arrangements and substantive policies.

Under these changes, Korean Government has successfully enacted the Coastal Management Act, and established the National ICM Plan based on the Act. In addition, some concomitant actions have been taken to form ICM regime of Korea. Local governments and other stakeholders are paying attention to implementation of National ICM plan and establishment of Local ICM plan. Thus, it can be expected that the newly established ICM regime will be a window of opportunity for sustainable use of coastal areas in Korea.

More concerted efforts, however, should be given to successful implementation of the National ICM plan and formation of fully integrated management system. Implementation of management plans is very substantial part of ICM as Sorensen (1993) noted plans that are not implemented are for the most part a waste of money. In this regard, Korean Government are facing new challenge to successful ICM implementation through more explicit integration of institutional arrangements, building of management capacity, setting priority for resources allocation, and application of adaptive management.

Firstly, the integration in limited fashion is originated from unique social and political environment. Although MOMAF is a responsible agency dealing with ICM, main authorities of other governmental agencies has not been fully integrated and coordinated into National ICM regime. The agencies still maintain major responsibilities for coastal land management.

Secondly, lack of management capacity at local levels is due to the fact that Korean Government applied the top-down comprehensive model to establishing of ICM regime. Application of the top-down model might be considered to be very efficient approach in centralized political system. Actually the top-down model played a key role in integrating institutional arrangements at national level in Korea. Institutional integration at local level and participation in establishing National of local governments, however, were very minimal. Thus it needs to prepare detailed guidelines for planning and management at local level, and to operate education and training programs for local public officials.

Thirdly, Lee (1999) pointed out that the resolution of analysis for priority setting for resources allocation had to be sacrificed although guidelines for the setting was developed through the process of planning based on the Coastal Management Act. The tool for the priority setting has to be developed through stronger coordination of related authorities, development of technology for optimal resources utilization, and valuation of coastal resources.

Finally, the adaptive management is an integral part of evolving ICM regime. Korean Government has applied the adaptive approach to implementation of ICM plans at national and local levels. Current ICM regime is lack of indicators for evaluation, guidelines of performance monitoring by public officials, and feedback process for improving ICM regime.

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EFFECTS OF ORGANOTINS IN THE COASTAL ENVIRONMENT OF KOREA

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Abstract

TBT-based antifouling paints were banned since March 2000 in Korea, although Korea is one of the leading ship-building countries in the world. The major objectives of this work are to assess the exposure of marine organisms to butyl- and phenyltin compounds on the coast of Korea and to study on the toxic effects of these compounds on marine organisms. Butyltin compounds (BTs) were detected from the mussel and oyster samples collected from 67 sites on the coast of Korea, whereas phenyltin compounds (PTs) were below detection limits at 26 out of 67 sites. Overall range of tributyltin (TBT) and triphenyltin (TPT) concentrations were 48 to 2800 ng/g and <3 to 1820 ng/g, respectively. The mean TBT concentration in bivalves was 3.5 times higher than that of TPT. Frequency of imposex in rock shell, *Thais clavigera*, was 0% at two reference sites, but at 47 out of 61 sites, frequency of imposex was recorded as 100%. The degree of imposex was relatively high at the sites near a harbor and a shipyard. TBT and TPT concentrations in *T. clavigera* ranged from 5 to 508 ng/g and from 3 to 2,460 ng/g, respectively. A significant positive relationship was found between degree of imposex and organotin concentration, whereas a significant negative relationship was obtained between female to male sex ratio and the degree of imposex. During a field transplantation of *T. clavigera* from a pristine area to a port, TBT and TPT were accumulated in *T. clavigera*, and imposex was induced. This species shows considerable potential as a bioindicator species of the adverse effects of TBT and TPT contamination.

1. INTRODUCTION

Contamination of organotins has been monitored in many countries since the early 1980s. Biomonitoring techniques are applied for organotins monitoring due to their high bioconcentration characteristics. Organotin concentrations in biota are thousands of times higher than those in ambient water and also reflect the integrated information of exposure more than several months long. Bivalve organisms such as mussels and oysters have been used as monitoring organisms due to their ability of accumulation of organotins, sessile characteristics and wide distribution. Bivalves have been used to determine temporal and spatial variations of butyl- and phenyltin concentrations (Short and Sharp, 1989; Wade *et al.*, 1988; Page and Widdows, 1991; Fent and Hunn, 1991). Thus, analysis of organotin concentrations in bivalves around coastal waters should provide information that could assess the extent of organotin contamination.

Due to induction of imposex (imposition of male sexual organ on female) in gastropod species, TBT and TPT are classified as endocrine disruptors (Oehlmann *et al.*, 1996; Horiguchi *et al.*, 1997). Because imposex is mainly caused by TBT, it is widely used as a biomarker. Many previous studies have shown positive dose-response relationship between TBT concentrations and degree of imposex in several neogastropod species (Gibbs *et al.*, 1987; Stroben *et al.*, 1992). An increasing androgen level mediated the induction mechanism (Bettin *et al.*, 1996). However, other compounds, for example acetic acid or copper-based antifouling paint, also induce imposex in *Lepsiella vinosa* in a laboratory exposure experiment (Nias *et al.*, 1993). Furthermore, the relationship between TPT, as well as TBT, and degree of imposex has not yet been evaluated with field samples.

In this study, butyltin- and phenyltin residues in bivalves collected from the coasts of Korea were quantitatively determined to reveal the extent of organotins contamination. We also determined the extent of imposex caused by organotin contamination of *T. clavigera* found in the coastal waters of the Korean peninsula. The relationship between TBT and TPT concentration and the degree of imposex was investigated to evaluate use of this species as a specific biomarker for effect-based monitoring of both compounds. The relationship between degree of imposex and sex ratio was also investigated to determine how the female population was affected by TBT and TPT compounds.

2. MATERIALS AND METHODS

STUDY AREA

In order to monitor nationwide organotin contamination, biota samples were collected from along the coast of Korea (Fig. 1). Most of major harbors and shipyards in Korea were included in the sampling sites. Several wharves for fishing boats were also included in sampling sites. In addition, there were subjected more extensive survey for bivalves in Chinhae Bay, Kamak Bay and Kwangyang Bay (Fig. 1).

SAMPLE COLLECTION

Two different kinds of target organisms were used to monitor organotin contamination in the marine environment of Korea. Bivalves were used as a sentinel species for basic monitoring. The target species depended on species dwelling on the sampling sites. The sampling date, species, and sites were summarized in Table 1. In case of bivalves, *Mytilus coruscus* and *Mytilus edulis* were selected on the East Coast. On the South and the West coasts, *Crassostrea gigas* were used as target species. Bivalve samples were collected at 67 sites from January 1995 to October 1998 (Fig. 1). More than 20 individuals were sampled at a site during low tide, immediately frozen in dry ice and transferred to laboratory. They were kept in freezer at -20 before analysis.

Thais clavigera (Neogastropoda: Muricidae) was selected to investigate imposex, because the organism is widespread and abundant in Korea. The 61 sampling sites are shown in Figure 2. Information of samples were shown in Table 2. They were sampled from January 1995 to May 1997. Sites 1 and 59,

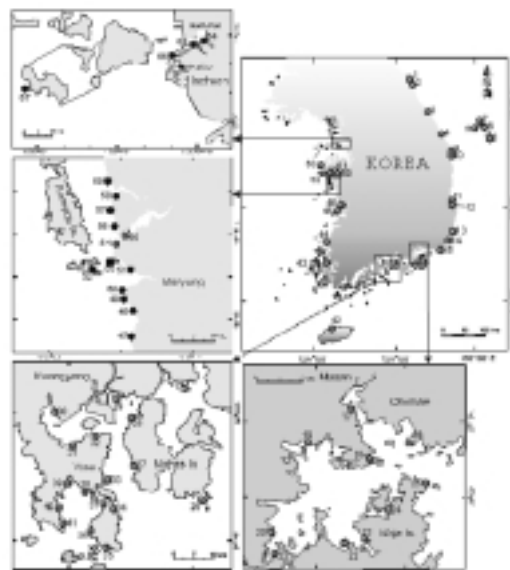


Figure 1 Location of Bivalve Sampling Sites on the Coast of Korea

Table 1 Summary of Bivalve Sampling Sites Along the Coast of Korea

Site	Name	Date	Species	Remark
East coast				
1	Breakwater of Sokcho Harbor	01/96	<i>Mytilus corsus</i>	h ^a
2	Yongumjung, Sokcho	01/96	<i>M. corsus</i>	
3	Breakwater of Mukho Harbor	01/97	<i>M.corsus</i>	h
4	Breakwater of Chukbyun Harbor	02/97	<i>M.corsus</i>	h
5	Todong, Ulleung Island	07/96	<i>M.corsus</i>	h
6	Cheodong, Ulleung Island	07/96	<i>Mytilus edulis</i>	h
7	Hyunpo, Ulleung Island	07/96	<i>M.edulis</i>	
8	Dok Island	07/96	<i>M.edulis</i>	
9	Inside of breakwater, Uljin	01/96	<i>M.edulis</i>	h
10	Outside of breakwater, Uljin	01/96	<i>M.edulis</i>	
11	Inside of breakwater, Pohang	01/96	<i>M.edulis</i>	h
12	Outside of breakwater, Pohang	01/96	<i>M.edulis</i>	
13	Changsangpo, Ulsan	02/97	<i>M.edulis</i>	h, s ^b
14	Breakwater of Onsan Harbor	01/96	<i>M.edulis</i>	h
South coast				
15	Cho Island, Pusan	01/96	<i>M.edulis</i>	h
16	Haengam, Chinhae	06/97	<i>Crassostrea gigas</i>	h
17	Kapo, Masan Bay	06/97	<i>C.gigas</i>	
18	Shimri, Masan Bay	06/97	<i>C.gigas</i>	h
19	Chindong, Chindong Bay	06/97	<i>C.gigas</i>	
20	Bumugae, Wonmunpo Bay	06/97	<i>C.gigas</i>	
21	Shinri, Wonmunpo Bay	06/97	<i>C.gigas</i>	
22	Sagok, Kohyonsong Bay	06/97	<i>C.gigas</i>	
23	Obi, Kohyonsong Bay	06/97	<i>C.gigas</i>	s
24	Silchun, Chilchung waterway	06/97	<i>C.gigas</i>	
25	Uhor, Kadok waterway	06/97	<i>C.gigas</i>	
26	Keumpo, Namhae Island	08/95	<i>C.gigas</i>	h
27	Namsang, Namhae Island	08/95	<i>C.gigas</i>	
28	Kalwha, Namhae Island	08/95	<i>C.gigas</i>	
29	Kalsa, Kwangyang	08/95	<i>C.gigas</i>	
30	Yumpo, Kwagyang	08/95	<i>C.gigas</i>	
31	Yochun industrial complex	08/95	<i>C.gigas</i>	
32	Myodo, Yochun	08/95	<i>C.gigas</i>	h
33	Breakwater of Yosu	06/97	<i>C.gigas</i>	
34	Muslmok, Yosu	08/95	<i>C.gigas</i>	
35	Chakeum, Kamak Bay	06/98	<i>C.gigas</i>	
36	Hyangdae, Kamak Bay	06/98	<i>C.gigas</i>	
37	Chinmo, Kamak Bay	06/98	<i>C.gigas</i>	h
38	Kukdong, Kamak Bay	06/98	<i>C.gigas</i>	h
39	Soho, Kamak Bay	06/98	<i>C.gigas</i>	
40	Sepo, Kamak Bay	06/98	<i>C.gigas</i>	
41	Kulkuchi, Kamak Bay	06/98	<i>C.gigas</i>	
42	Breakwater of Cheju Harbor	07/97	<i>C.gigas</i>	h
West coast				
43	Koha Island, Mokpo	06/97	<i>C.gigas</i>	h
44	Youngkwang	06/97	<i>C.gigas</i>	
45	Kunsan	06/97	<i>C.gigas</i>	h
46	Changhang	06/97	<i>C.gigas</i>	
47	Muchangpo	08/98	<i>C.gigas</i>	
48	Chukdo	08/98	<i>C.gigas</i>	
49	Daechon	07/98	<i>C.gigas</i>	
50	Kunip	08/98	<i>C.gigas</i>	
51	Songhak	08/98	<i>C.gigas</i>	
52	Wonsan Island	07/98	<i>C.gigas</i>	
53	Songdo, Chunsu Bay	08/98	<i>C.gigas</i>	
54	Kasungkuchi, Chunsu Bay	08/98	<i>C.gigas</i>	
55	Namgok, Chunsu Bay	08/98	<i>C.gigas</i>	
56	Yuldo, Chunsu Bay	10/98	<i>C.gigas</i>	
57	Sahori, Chunsu Bay	10/98	<i>C.gigas</i>	
58	Tumangdong, Chunsu Bay	10/98	<i>C.gigas</i>	
59	Namdang, Chunsu Bay	07/98	<i>C.gigas</i>	
60	Chunsu dam	07/98	<i>C.gigas</i>	
61	Chunsu strait	07/98	<i>C.gigas</i>	
62	Chunsu bridge	07/98	<i>C.gigas</i>	
63	Manripo	06/97	<i>C.gigas</i>	
64	Inchon North Port	05/98	<i>C.gigas</i>	h
65	Mansuk wharf	05/98	<i>C.gigas</i>	h
66	Mouth of North Port	05/98	<i>C.gigas</i>	h
67	Youngy Island	05/98	<i>C.gigas</i>	

^ah : harbor ^bs : shipyard

Table 2 Summary of imposex measurement and organotin concentrations in *Thais clavigera* at total of 61 sites on the coast of Korea. See Figure 1 for sites. Remark : h, harbor area ; s : shipyard area ; hs : harbor and shipyard area.

Site No.	Number of Samples	% Female	MFPL ^a	MMPL ^b	% Female with imposex	RPL Index ^c (%)	TBT (ng/g)	TPhT (ng/g)	REMARK
1	30	50	0.0	9.6	0	0	24	3	
2	24	67	5.8	9.4	100	62	94	28	h
3	30	50	10.8	13.5	100	80	198	210	h
4	28	68	1.3	4.9	84	26	12	15	
5	25	48	1.5	7.6	17	20	27	21	
6	30	33	5.1	10.1	70	51	44	91	
7	23	26	8.4	11.2	100	75	174	8	
8	28	57	0.5	6.0	6	7	12	11	
9	24	42	0.9	15.4	50	6	29	11	
10	26	31	10.0	15.5	100	64	336	67	h
11	26	19	10.1	14.6	100	69	250	118	h
12	25	60	4.0	13.5	87	30	8	21	
13	25	40	1.0	6.0	40	17	5	8	
14	24	33	8.2	13.2	88	62	33	19	
15	25	20	11.3	13.8	100	82	34	9	
16	24	21	6.1	9.6	100	63	75	17	
17	25	48	2.0	11.3	58	18	13	10	
18	26	62	0.9	12.8	25	7	13	16	
19	25	24	6.0	10.8	100	56	57	173	
20	24	25	7.2	8.2	100	88	205	244	
21	24	42	12.0	11.5	100	105	508	1860	hs
22	25	56	8.1	10.8	100	75	60	234	
23	25	40	9.3	11.1	100	84	197	373	h
24	25	24	7.1	9.9	100	72	130	220	
25	25	80	4.1	8.7	100	47	44	109	
26	24	42	5.2	12.7	100	41	86	146	
27	23	39	6.8	8.2	100	83	100	218	
28	26	35	4.8	8.3	96	58	94	221	
29	24	50	3.4	11.3	100	30	27	176	
30	24	67	2.3	6.4	88	36	28	217	
31	25	64	6.5	11.7	100	55	45	312	
32	25	28	8.2	8.9	100	93	78	723	h
33	20	30	7.7	10.6	100	72	59	238	h
34	24	13	9.8	10.5	100	94	142	395	h
35	27	30	8.9	10.0	100	89	86	491	h
36	20	35	10.0	9.5	100	105	131	387	h
37	20	30	7.7	9.1	100	84	62	266	
38	20	35	8.8	10.9	100	81	45	142	
39	21	33	7.4	8.3	100	89	48	116	
40	22	32	7.4	8.8	100	84	129	358	
41	17	29	7.5	7.7	100	97	56	785	
42	20	10	8.0	9.1	100	88	55	380	
43	10	0	- ^d	11.0	-	-	82	502	
44	20	30	6.7	8.9	100	76	95	170	
45	19	11	10.1	9.8	100	104	414	244	
46	25	20	11.5	12.6	100	91	269	259	s
47	25	24	11.5	10.6	100	108	178	358	
48	20	25	9.4	11.0	100	85	186	281	
49	22	36	6.4	9.7	100	67	23	46	
50	24	8	9.0	9.9	100	91	322	77	s
51	26	23	10.6	10.6	100	100	354	269	s
52	28	11	9.4	11.3	100	83	439	220	s
53	27	19	9.1	9.7	100	94	261	159	s
54	35	37	7.3	11.5	100	63	81	49	
55	58	34	10.1	10.3	100	98	145	73	hs
56	27	11	9.7	10.5	100	93	415	824	h
57	26	15	12.8	12.0	100	107	326	193	h
58	26	8	12.0	18.3	100	66	140	380	h
59	30	90	0.0	5.8	0	0	38	42	
60	25	32	27.9	28.0	100	100	394	2460	h
61	25	64	16.9	26.2	100	64	165	191	h

^aMFPL : Mean female penis length ^cRPL (relative penis length) index (%) = MFPL / MMPL x 100^bMMPL : Mean male penis length ^dNo females



Figure 2 Location of *T. clavigera* Sampling Sites on the Coast of Korea

remote from harbor and ship traffic, are reference sites. The samples were collected by forceps during low tide, stored in a Ziploc[®] bag, and then frozen with dry ice.

Analytical procedure

The analytical procedure is a modification of method suggested by Stallard *et al.* (1989) and Shim *et al.* (1998). Only a brief overview of these procedures is presented here. The soft tissues removed from biota samples were combined in amber bottles. The combined wet tissues were homogenized with a Tekmar tissuemizer and weighed to about 5 g in 50 ml polypropylene centrifuge tubes. Triphenyltin chloride was added to samples as a surrogate standard. For digestion, the samples were mixed with 6 N HCl and allowed to stand for 30 min. The digested samples were extracted by shaking for 3 h with 20 ml dichloromethane with tropolone (0.1%). After 10 min centrifugation (4000 rpm), 2 ml of organic extracts were transferred to 15 ml glass test tubes and concentrated to about 25 μ l under a gentle stream of nitrogen. The concentrated extracts were re-suspended in 2 ml n-hexane and derivatized with 250 μ l of 2 M propylmagnesium bromide for 20 min. The remaining Grignard reagent was destroyed with 4 ml of 0.4 N sulfuric acid. The derivatized extracts were recovered by centrifugation and cleaned up on 1 g of activated florisil. During the florisil clean-up, the organotin compounds were eluted twice with 2 ml of n-hexane. The cleaned extracts were concentrated again and spiked with tetrabutyltin as an internal standard, and then analyzed by GC/FPD.

The whole analytical procedure was validated by analyzing reference materials (NIES11 : sea bass, *Lateolabrax japonicus*) from the National Institute for Environmental Studies of Japan.

INSTRUMENTAL ANALYSIS

The GC (HP5890 Series II) was equipped with a capillary column (SPB-1, 30 m $\times$ 0.25 mm i.d. $\times$ 0.25 μ m film thickness) and a flame photometric detector. The interference filter (Dietrich Optical) mounted on the detector ranged from 600 to 2000 nm. Under splitless injection mode, 2 μ l of sample was injected.

The oven temperature was programmed from 50 (2 min holding time) and heated to 150 (10 min holding time) at a rate of 10/min, and then heated again to final temperature of 240 (5min holding time) at 30/min. The injector and detector temperature were 225 and 250, respectively. The carrier and make-up gas were helium. The hydrogen-rich flame consisted of hydrogen (170 ml/min) and air (100 ml/min). Column head pressure was adjusted to 28 psi.

Recoveries of organotin compounds from spiked (0.3 μ g Sn/g) in *C. gigas* samples ranged from 71 to 98% for butyl- and phenyltin compounds. The method detection limits of the whole analytical procedure for *C. gigas* ranged from 1 to 3 ng/g.

Measurement of imposex

A sample size of 10 to 58 *Thais clavigera* from each site was used to measure frequency and degree of imposex. Shell length was measured with Vernier calipers. The shells were cracked open with a titanium tool and the animals were removed. *T. clavigera* were sexed by appearance of a prominent female sperm-ingesting gland (Horiguchi *et al.*, 1994). The penis of both female and male were cut, and penis length was measured to the nearest 0.1 mm using Vernier calipers. The frequency of imposex females was expressed as a percentage. Whereas the degree of imposex was expressed by index of relative penis length (RPL) : [(mean length of female penis)/(mean length of male penis) (100)] (Bryan *et al.*, 1986).

3.RESULTS

Butyl- and phenyltin residues in mussels and oysters ('95-'98 surveys)

The concentrations of butyl- and phenyltins in bivalves collected from 1995 to 1998 are summarized in Table 3. All the mussel and oyster samples analyzed contained detectable amount of butyltin compounds (BTs), whereas phenyltin compounds (PTs) were below detection limits at 26 out of 67 sites. Overall ranges of TBT and TPT concentrations were 48 to 2800 ng/g (mean $\pm$ se, 566 $\pm$ 573 ng/g) and < 3 to 1820 ng/g (161 $\pm$ 325 ng/g), respectively. The mean TBT concentration in bivalves was 3.5 times higher than that of TPT. Overall concentrations of dibutyltin (DBT) and monobutyltin (MBT) compounds, degradation products of TBT, ranged from < 2 to 1950 and from < 3 to 1270 ng/g, respectively. Concentrations of diphenyltin (DPT) and monophenyltin (MPT), degradation products of TPT, ranged from < 4 to 96 and from < 5 to 73, respectively. Total BT and PT concentrations (sum of tri-, di- and monoorganotins) ranged from 39 to 6020 ng/g and from nd to 2039 ng/g, respectively. Mean compositions of BTs was in order of TBT (71%) > DBT (18%) > MBT (11%). TPT concentration also accounted for most of total PT concentration in bivalves. The spatial distributions of BTs are shown in Figures 3 through 7.

In comparison of BTs at three coasts of Korea, mean TBT level at the south coast was higher than those at the east and the west coasts (Fig. 12). However, the mean total BT concentration was the highest at the East Coast. All the three BT concentrations were low in oysters from the West Coast. The mean TBT and total BT concentrations in oysters from the West Coast are less than half of those from the east and the south coasts. In case of PTs, both TPT and total PT concentrations at the south coast were higher than that at the east and the west coasts (Fig. 12).

The overall TBT levels in bivalves were relatively high at sites near harbors and shipyards. DBT and MBT in bivalves showed similar distribution patterns to that of TBT. TBT and DBT concentrations were highly correlated ($r^2 = 0.68$; $p < 0.01$) as were DBT and MBT ($r^2 = 0.87$; $P < 0.01$), respectively (Table 4). These correlations among butyltins demonstrate DBT and MBT are degradation products of TBT. Phenyltins in bivalves, however, showed different distribution patterns from that of TBT. Although significant correlation was also obtained between TPT and DPT, the correlation coefficients among PTs ($0.02 < r^2 < 0.33$) were much lower than those among BTs ($0.66 < r^2 < 0.87$). Furthermore, no significant correlation ($p > 0.05$) was obtained between TBT and TPT.

FREQUENCY AND DEGREE OF IMPOSEX

Frequency and degree of imposex in *T. clavigera* from 61 sites on the coast of Korea are shown in Table 2. The frequency of imposed females was greater than 80% at 51 sites. Only the two reference sites (Sites 1 and 59) had no females with imposex. With the exception of the reference site (Site 1), the samples from 18 sites (Fig. 2a, Sites 1 through 18) on the west and southwest coast of

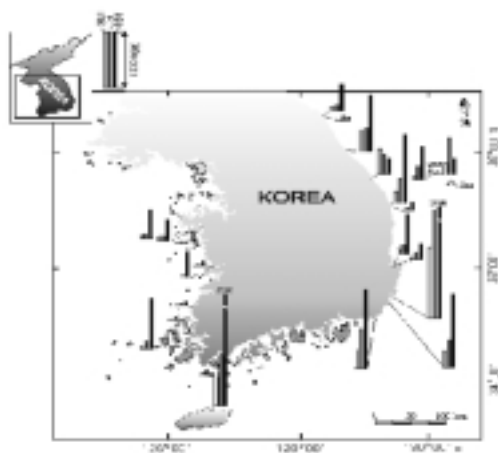


Figure 3 Concentrations of Monobutyltin (MBT), Dibutyltin (DBT) and Tributyltin (TBT) in Bivalves Along the Coast of Korea

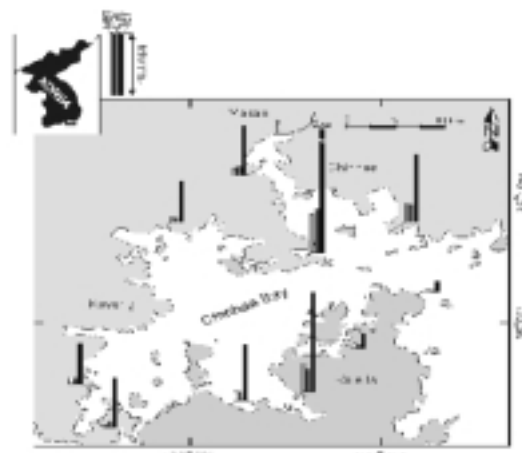


Figure 4 Concentrations of Monobutyltin (MBT), Dibutyltin (DBT) and Tributyltin (TBT) in Bivalve from Chinhae Bay



Figure 5 Concentrations of Monobutyltin (MBT), Dibutyltin (DBT) and Tributyltin (TBT) in Bivalve from Kwangyang and Kamak Bays.



Figure 6 Concentrations of monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT) in bivalve from Chunsu Bay

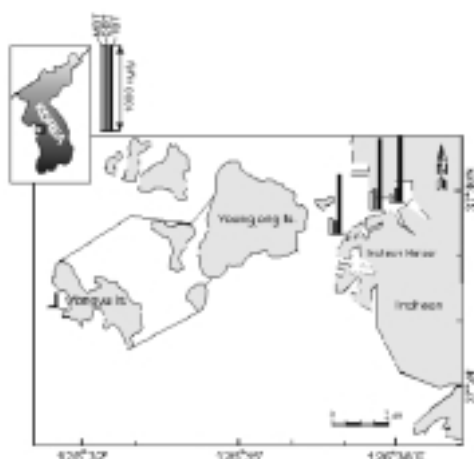


Figure 7 Concentrations of Monobutyltin (MBT), Dibutyltin (DBT) and Tributyltin (TBT) in Bivalve from Incheon North Port and Yongyu Island

Korea showed a frequency of imposex ranging from 6 to 100% and RPL indices from 7 to 82% (Table 2). The overall frequency and degree of imposex in this region are relatively low compared to the other sites and only Sites 3, 10, and 11 are located near harbors. Samples from the 6 sites located on the East Coast of Korea (Fig. 2a) each had an imposex frequency of 100% (Sites 56, 57, 58, 59, 60, and 61) and RPL indices were higher than 60%, except for Site 59. Site 59 is a reference site that is far from boating activities, whereas the other five sites are near harbors.

ORGANOTIN CONCENTRATIONS IN THAIS CLAVIGERA

All the *T.clavigera* samples contained detectable TBT and TPT compounds (Table 2). The concentrations of TBT and TPT in *T. clavigera* range from 5 to 508 ng/g and from 3 to 2,460 ng/g, respectively. TBT and TPT concentrations in the two reference sites were 24 and 3 ng/g (Site 1) and 38 and 42 ng/g (Site 59), respectively. The mean concentration of TBT (mean $\pm$ S.E. = 136 ± 126 ng/g) was about half that of TPT (267 ± 398 ng/g). There was a low correlation coefficient ($r^2 = 0.27$) between TBT and TPT concentrations in *T.clavigera*. The TBT concentrations were higher than 200 ng/g near harbors and shipyards (remarked in Table 2). Exceptionally elevated TPT concentrations were also found at the sites near a harbor (Site 60; 2,460 ng/g) and a shipyard (Site 21; 1,860 ng/g). However, the

Table 3 Summary of organotin concentrations in bivalves from the coast of Korea. See text for abbreviations.

Concentration(ng Sn/g dw)	MBT	DBT	TBT	MPT	DPT	TPT
Min - Max	nd-1270	27-1950	48-2800	nd-73	nd-96	nd-1820
Mean (mean±sd)	122±197	170±290	566±573	10±57	22±38	161±325
Composition (%) (mean±sd)	11±11	18±11	71±16	1±6	16±18	83±19

Table 4 Regression coefficient (R2) between concentration of each organotin compounds in bivalves.

Organotins	MBT	DBT	TBT	MPT	DPT
DBT	0.87**a				
TBT	0.66**	0.68**			
MPT	0.14	0.36	0.10		
DPT	0.00	0.01	0.00	0.02	
TPT	0.10	0.15	0.17	0.02	0.33**

a**99% confidence limit

bnot enough data

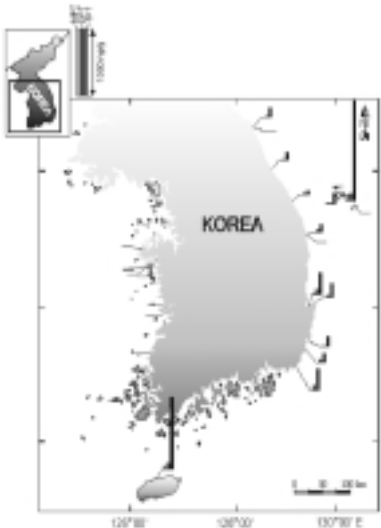


Figure 8 Concentrations of monophenyltin (MPT), diphenyltin (DPT) and triphenyltin (TPT) in bivalve along the coast of Korea

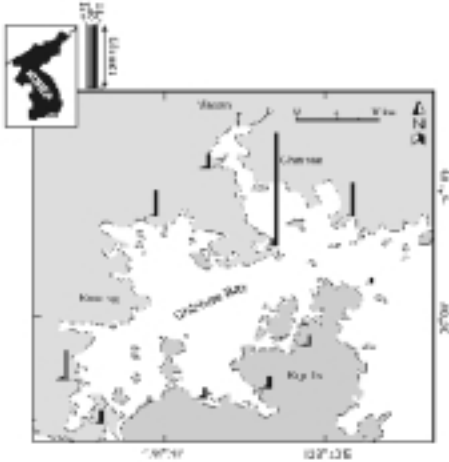


Figure 9 Concentrations of monophenyltin (MPT), diphenyltin (DPT) and triphenyltin (TPT) in bivalve from Chinhae Bay



Figure 10 Concentrations of monophenyltin (MPT), diphenyltin (DPT) and triphenyltin (TPT) in bivalve from Kwangyang and Kamak bays

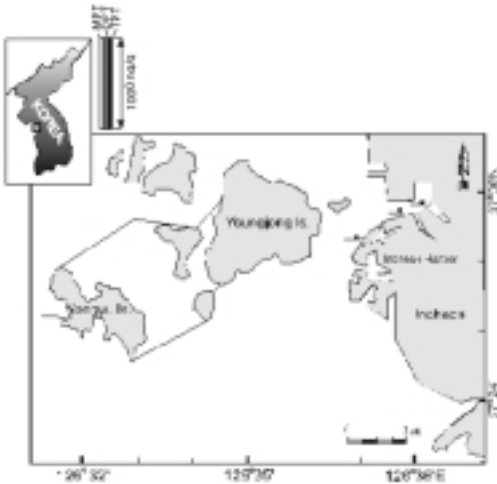


Figure 11 Concentrations of monophenyltin (MPT), diphenyltin (DPT) and triphenyltin (TPT) in bivalve from Incheon North Port and Yongyu Island

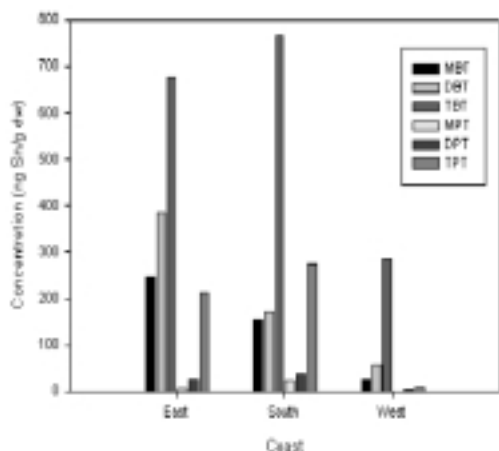


Figure 12 Mean concentrations of tributyltin (TBT), triphenyltin (TPT) and their degradation products on the three coasts of Korea

and sum of TBT and TPT that caused half of RPL_{MAX}, estimated from the models, were 35, 23, and 99 ng/g, respectively.

The percentage of females in the *T. clavigera* population at a site is apparently reduced as the concentrations of TBT and TPT increase in tissues (Fig. 14a and b). The sex ratio shows stronger relationship with TBT ($r^2 = 0.32$; $p < 0.001$) than with TPT ($r^2 = 0.17$; $p < 0.05$). The RPL index shows stronger relationship ($r^2 = 0.44$; $p < 0.001$) with percentage of females (Fig. 14c) than with the TBT and TPT concentrations. With a respect to the percentage of female *T. clavigera*, the sample groups divided by 10% interval of RPL index were compared to the reference group which showed less than 10% of RPL using student t-test (e.g. <10% RPL vs 10-20% RPL). The percent female of each sample group of 80-90% and >90% RPL index was significantly different from that of the group of <10% RPL in 99.9% confidence limit. The groups of 60-70% and 70-80% RPL showed significant difference with the group of <10% RPL in 95% confidence limit, respectively. The percentage of female between the group of 50-60% RPL and the group of 10% RPL was significantly different in 85% confidence limit. However, the other groups (10-20, 20-30, 30-40 and 40-50% RPL) showed no significant difference in 85% confidence limit.

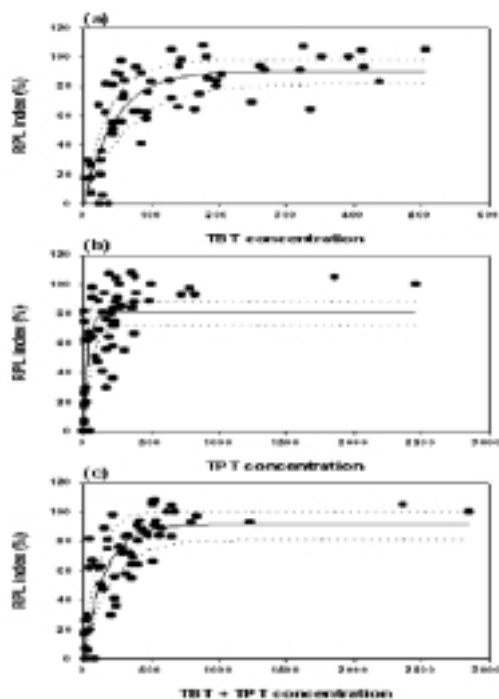


Figure 13 Plots of relative penis length (RPL) index as a function of tributyltin (TBT) (a), triphenyltin (TPT) (b) and sum of tributyltin and triphenyltin (c) concentrations in *Thais clavigera*

distribution pattern of TPT concentration was not closely related to the locations of the harbor (e.g. Site 10) and shipyard (e.g. Site 50). The overall TBT and TPT concentrations in *T. clavigera* were relatively low at Sites 1 to 18 except for Sites 3, 10, and 11 which are located near a harbor on the southwest coast of Korea (Table 2 and Fig. 2a). TBT concentrations were relatively higher than those of TPT in samples from the West Coast, but TPT concentrations were higher in samples from the South and the East coasts.

RELATIONSHIP BETWEEN DEGREE OF IMPOSEX AND ORGANOTIN BODY RESIDUES

Relationships between RPL indices and triorganotin concentrations in *T. clavigera* are shown in Figure 13. These data provide supporting evidence for the dose-response relationship of TBT and TPT in the induction of imposex in *T. clavigera*. A curve of exponential rise to maximum ($y = RPL_{MAX} \times (1 - e^{-\alpha X})$) fitted the best in the case (Fig. 13a, b and c). As both TBT and TPT were detected at all the sites surveyed, it is difficult to determine which compound was the major component inducing imposex in *T. clavigera*. The TBT ($r^2 = 0.63$; $p < 0.001$) relationship with degree of imposex is stronger than that of TPT ($r^2 = 0.51$; $p < 0.001$) (Fig. 13a and b). The highest regression correlation coefficient ($r^2 = 0.69$; $p < 0.001$) was obtained between RPL index and sum of TBT and TPT concentrations in *T. clavigera* (Fig. 13c). In addition, the concentrations of TBT, TPT

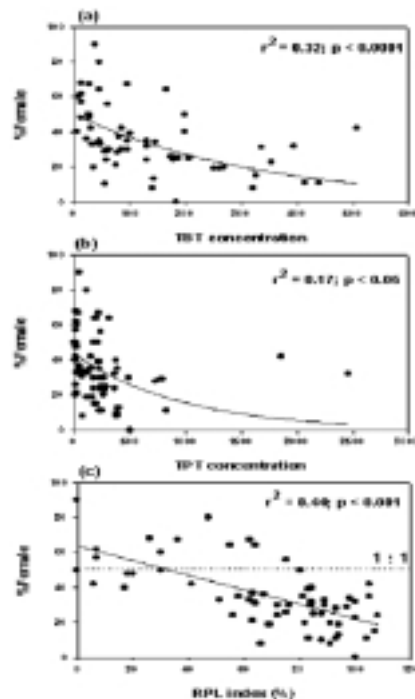


Figure 14 Percentage of female *Thais clavigera* (% female) and as a function of tributyltin (TBT) (a), triphenyltin (TPT) (b), and relative penis length (RPL) index (c)

4. DISCUSSIONS

Status of organotin contamination in Korea

This study is the first report of TPT contamination as well as TBT in the marine environment of Korea except for the Chinhae Bay System (Shim *et al.*, 1998 ; Shim *et al.*, 1999). TBT and TPT concentrations in the coastal environment of Korea are comparable to those in developed countries when the concentrations were converted to tin basis (Table 5). However, BTs concentrations in mussels and oysters from coastal waters in Korea were much higher than that in other Asian countries (Japan, Hong Kong, Thailand and Malaysia). TPT concentration in mussels from Tokyo Bay, Japan was higher than the results in this study. TBT concentrations in bivalve was relatively high at the innermost site of the enclosed bays where harbors or shipyards were located. Therefore, the primary source of TBT in the marine environment of Korea is believed to be antifouling agent leached from ship hulls.

The frequency of imposex was 100% at 46 out of 61 sampling sites, which was comparable to the results of Horiguchi *et al.* (1994) in Japan. This high frequency of imposex and its wide distribution indicate that organotin contamination is widespread in Korea. The degree of imposex appears to be closely related to boating and dry-docking activities, suggesting that antifouling paint applied to ship hulls was a major source of organotin contamination. In addition, many scattered small wharves and the fishing vessel traffic may also be sources leading to the wide distribution of imposex to the remote places from harbors and shipyards. The low degree of imposex as well as low organotin concentration in *T. clavigera* on the west and southwest coast of Korea could be explained by high flushing efficiency. The tidal range of the region exceeds about 3 meters compared to less than 1 m on the east and southeast coast of Korea (NORI, 1999).

In this study, a higher correlation coefficient was obtained between the RPL index and TBT than between the RPL index and TPT in *T. clavigera*. However, it is difficult to conclude that TBT more strongly influences imposex in *T. clavigera* than TPT does. Even though TBT and TPT concentrations in *T. clavigera* were not significantly ($r^2 = 0.09$; $p > 0.05$) correlated, both compounds showed positive relationships with the RPL index. Sites 1 through 18 at which both TBT and TPT concentrations were low showed less intensive imposex either. Several sites in Kwangyang Bay and Chinhae Bay (e.g. Sites 32 and 41), where low TBT and high TPT concentrations were found, showed relatively high RPL indices. These results support the hypothesis that TPT has an effect on imposex induction of *T. clavigera*.

Although high degrees of imposex were measured in *T. clavigera* collected near a harbor (e.g. Site 35) and a shipyard (e.g. Site 45), some sites remote from large harbor and shipyard also showed comparable frequency and degree of imposex (e.g. Site 49). Furthermore, although imposex was observed in *T. clavigera* samples whose TBT concentrations were less than 20 ng/g (Sites 4, 8, 12, 13, 17, and 18), but two reference sites whose TBT concentrations were 24 and 38 ng/g, respectively, showed no imposex female. These results indicate that TBT and TPhT were not the only compounds to cause imposex in *T. clavigera*.

Female *T. clavigera* are masculinized, sterilized, and then died when their oviducts were fully blocked by abnormal male sexual organs (Horiguchi *et al.*, 1994). These irreversible masculinizations and selective mortalities may cause an unbalanced female to male sex ratio. In this study, the female to male ratio was significantly reduced as TBT and TPT concentrations increased and degree of imposex increased (Figs. 14a-c). *T. clavigera* could be recruited to a contaminated area from other pristine areas, because *T. clavigera* has a planktonic stage as a veliger larva. However, the apparent decline of the female *T. clavigera* population observed in this study as a function of organotin concentration indicates that organotin pollution may cause local extinction of this organism.

The TPT concentrations in this study are slightly higher than the results reported elsewhere, although there are little TPT concentration

Table 5 Concentrations of butyltins and triphenyltin compounds in bivalve molluscs collected worldwide (ng/g wet wt)

Organism	Location	Concentration				References
		MBT	DBT	TBT	TPT	
CRASSOSTREA VIRGINICA	Gulf of Mexico, 1989-1991	<5-145	<5-380	<5-1450	na	Garcia-Romeo <i>et al.</i> , 1993 ^{ab}
	Chesapeake Bay, USA	na ^c	nd ^c	<10-5600	na	Espourteille <i>et al.</i> , 1993
	Coastal estuaries, USA	<5-120	<5-270	<5-660	na	Wade <i>et al.</i> , 1988 ^{ab}
Crassostrea gigas	Coastal estuaries, UK, 1986-1989	na	na	80-6350	na	Waite <i>et al.</i> , 1991
	Chinhae Bay, Korea 1995	19-119	53-559	250-1350	188-678	Shim, 1996 ^{ab}
	South and West Coast, Korea, 1995-1998	<3-533	<2-707	16-2370	<3-1820	This study ^{ab}
Mytilus edulis	Pacific coast, USA 1986-1987	na	na	<5-1080	na	Short and Sharp, 1989
	Tokyo Bay, Japan, 1989	20-120	40-540	20-240	28-5930	Higashiyama <i>et al.</i> , 1991
	Lynher River, 1987-1989	1989	nd	340-1000	540-2320	Page and Widdows, 1991 ^a
	British Columbia, Canada, 1990	8.2-49	6.8-80	52-314	na	Stewart and Thompson, 1994 ^a
	Coastal estuaries, USA	<5-1240	<5-1280	<5-1560	na	Wade <i>et al.</i> , 1988 ^{ab}
	Eastern Scheldt, Netherland, 1988	<1-410	<1-340	<1-2300	na	Ritsema <i>et al.</i> , 1991
	Mediterranean, 1988	na	12-2450	220-2600	<2-1005	Tolosa <i>et al.</i> , 1992 ^a
Mytilus corsus	East Coast, Korea, 1996-1997	<3-1270	27-1950	48-2800	<3-1520	This study ^{ab}
Dreissena polymorpha	Freshwater, Netherland, 1992	<6-860	<4-1740	6-11500	28-3200	Stab <i>et al.</i> , 1995 ^{ab}
Perna viridis	Coast of Hong Kong, 1989	na	na	64-115	na	Chiu <i>et al.</i> , 1991
	Coast of Malaysia, 1992	na	na	14.2-23.5	na	Tong <i>et al.</i> , 1996
	Coast of Thailand, 1994-1995	<3-45	1-80	3-680	na	Kan-atiyeklap <i>et al.</i> , 1997

^aDry weight basis ^bExpressed in tin base ^cna ; not analyzed, nd ; no data shown

data for gastropods in the literature (Fent and Hunn, 1991 ; Tolosa *et al.*, 1992). Interestingly, TPT concentrations exceeded TBT at 40 out of 61 sites, indicating that the coastal waters of Korean peninsula are highly contaminated by the TPT compound. High TPT to TBT concentration ratios suggest that *T.clavigera* is the suitable species to use for monitoring TPT as well as TBT.

In summary, bivalves in coastal waters of Korea is widely contaminated with butyl- and phenyltin compounds. TBT concentrations in bivalve were comparable to those in other countries. Spatial distribution of TBT and TPT concentrations biota was related to location of harbors and shipyard. Widespread and high intensity of imposex in *T.clavigera* along the coast of Korea indicated that organotin contamination apparently affect marine organisms. The female to male sex ratios showed a negative correlation with organotin concentrations and the degree of imposex. The obviously reduced female to male sex ratio in population of *T.clavigera* implied that local extinction of this species may happen at the place highly polluted with organotins. A positive relationship was obtained between the degree of imposex and TBT and TPT concentrations in this organism. This species accumulated both TPT and TBT to high concentrations, but even at concentrations of these compounds of less than 10 ng/g, imposex was present. This species is also widely distributed and abundant along the coast of Korea. Therefore, *T.clavigera* could be used as a target organism in an effect-based monitoring regime for both TBT and TPT compounds in marine environment of Korea.

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GOVERNMENTS OF DEVELOPING COUNTRIES GROSSLY UNDERVALUE THEIR MANGROVES?

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Abstract

In the tropics, mangroves fringe a large percentage (e.g. close to 50% in Malaysia) of the coastline. This gives the impression that the mangrove ecosystem is very common. In reality (measured as a percentage of land area), even in a region where they are most abundant like South & Southeast Asia and Australia (where some 50% of the world's mangroves occur), mangroves constitute a mere 0.4% of the land area of this region. Thus mangrove ecosystems are rare. This, combined with their numerous economic (e.g. forestry and fisheries resources) and ecologic (e.g. carbon sink and coastal protection) roles, should make mangroves a highly valued commodity.

Historically, mangroves have been considered as bad swamp land full of mosquitoes and other vermin and so is best reclaimed for other uses. Although this concept is no longer in vogue, mangroves are still very much undervalued, especially by governments of developing countries. In much of the world, mangroves are not considered to be a valuable asset by governments. Yet in the few developed countries where mangroves occur, they are completely protected by law (e.g. Australia and the U.S.A.).

Why is it that only the developed countries recognise this value? And why are some newly rich like Singapore and Hong Kong prepared to spend millions to restore their mangroves that have been destroyed? Is it too late for the developing countries' governments to wake up to this? Governments is the operative word because the whole exercise requires strong political will. Much more so than ecology and economics, though they may be the fundamental reasons that mangroves are considered important.

Alternatively, international and non-governmental organisations could strengthen existing international conventions like the biodiversity convention of UNCED or even institute a new one to specifically protect the world's dwindling mangrove ecosystems.

INTRODUCTION

In the tropics, mangroves fringe a large percentage (e.g. close to 50% in Malaysia) of the coastline. This gives the impression that the mangrove ecosystem is very common. In a region where they are most abundant like South & Southeast Asia and Australia (where some 50% of the world's mangroves occur), mangroves constitute a mere 0.4% of the land area of this region (Table 1). Even in the four countries (Brazil, Bangladesh, Indonesia & Nigeria) where some 40% of the world's mangroves are to be found, mangroves constitute only 0.63% of these countries' land area. There are only some 181,000 km² of mangroves in the world (Spalding et al., 1997) which is equivalent to a mere 0.037% of the world's surface area or 0.12% of the world's total land area. Thus, in reality, mangrove ecosystems are in the rare category, as far as ecosystems go. They should thus be considered valuable, based on their rarity alone.

Apart from being rare (and thus valuable) the mangrove ecosystem also plays many other important roles. These include : maintenance of channel depth, sediment accretion and coastal protection, fish from mangrove water ways, natural cockle (*Anadara granosa*) and oyster beds, bird sanctuary / migratory stops, fish nursery grounds and their support of adjacent coastal fisheries and the sequestration of atmospheric carbon dioxide (e.g. Ong, 1993 & Ong, 1995).

Table 1 Comparing mangroves, population density, population growth, and per capita gross domestic product of selected " countries"

"Country"	Mangroves [,000km ²]	(%World)	Land [,000km ²]	(%Land)	Pop ⁿ . Dens. [No./km ²]	Pop ⁿ . Gwth. [%]	Per Capita GDP (PPP*) [US\$]
WORLD	181	(100)	148,000	(0.122)	40	-	-
Indonesia	42.6	(23.5)	1,905	(2.24)	117	1.6	2,685
Bangladesh	5.8	(3.2)	144	(4.03)	897	2.2	1,410
Nigeria	10.5	(5.8)	924	(1.14)	134	2.9	930
Brazil	13.4	(7.4)	8,512	(0.16)	20	1.9	6,418
Sub-total	72.7	(40.4)	11,485	(0.63)	-	-	-
Australia	11.5	(6.35)	7,713	(0.15)	3	1.2	23,145
Japan	0.005	(0.003)	378	(0.001)	335	0.3	23,780
USA	1.99	(1.1)	9,373	(0.021)	29	1.0	33,872
Sub-total	13.5	(7.5)	18,084	(0.075)	-	-	-
Singapore	0.006	(0.003)	0.62	(0.97)	6,407	0.7	25,353
Hong Kong	0.003	(0.0015)	1.04	(0.29)	6,250	2.3	20,485
Malaysia	6.4	(3.5)	330	(1.94)	67	2.4	8,513
Indonesia	42.6	(23.5)	1,905	(2.24)	117	1.6	2,685

* Purchase-Power Parity (based on World Bank ratios)

Data mainly from Spalding et al. (1997) and Asiaweek 26 (45).

Thus their scarcity, combined with their numerous economic and ecologic roles, should make mangroves a highly valued commodity.

Historically, mangroves have been considered as bad swamp land full of mosquitoes and other vermin and so is best reclaimed for other uses. Although this concept is no longer in vogue, mangroves are still very much undervalued, especially by governments of developing countries. In much of the world, mangroves are not considered to be a valuable asset by governments. Yet in the few developed

countries where mangroves occur, they are completely protected by law (e.g. Australia and the U.S.A.).

In this paper we address the question as to why mangroves are still not generally recognised for their real worth and what could possibly be done to overcome this.

THE VALUE OF MANGROVES

Is it possible to realistically put a value to any ecosystem? One can value ecosystems from the goods and services they produce. There are many different goods and services produced by different ecosystems (Ewel et al., 1998) but not all the goods (and even less so the services) have tangible market values. Still, we could first list the goods that a particular mangrove or ecosystem provides and then proceed to assign a value to each of these goods. Amongst the goods produced by mangrove ecosystems are timber (for use as firewood or conversion to charcoal or rayon), fish (like fin fish, cockles, crabs and prawns caught within the mangrove ecosystem), harvested forest products like nipah (*Nypa fruticans*) fronds and sap (for sugar and subsequent alcohol and vinegar production). The list is short. Timber is the most obvious goods derived from mangroves but, even so, not all mangroves can sustainably produce timber on a commercial basis. Still, it is possible to put an economic value to mangrove timber (as timber or after conversion to value added products like charcoal or rayon). One vital question is which value should be used: the value from mangrove wood chips or the value of rayon, the finished product? It is also possible to put values to fish caught within the mangrove ecosystem but those harvested for local sustenance (which may be substantial in certain systems) will not have market value.

Even with goods, the valuation is not straight forward but with services the problem is even more complex. Mangroves provide many services. These include: an ecological buffer zone between land and sea, resting sites for migratory birds, fish nursery to both marine and freshwater fish, nutrients to fish in adjacent coastal waters, carbon sequestration sites, storm protection, estuarine channel depth maintenance (Wolanski et al., 1992) and sites for aquaculture. The list is long but all of these do not have any market value. Many attempts have been made to put values to these services but more often than not these values are contentious.

How does one put a value to nutrients provided by mangroves to the fisheries of its adjacent coastal fisheries when it is not even known how much of the adjacent coastal fisheries is dependent on this outwelled mangrove nutrients, and for that matter, how much nutrients are outwelled from mangroves to its adjacent coastal systems (e.g. Simpson et al., 1997)?

We may be able to put some reasonable estimates of value in terms of the use of mangroves for ecotourism (it is possible to determine how much is spent by eco-tourists) but how does one put a rational figure on the value of mangroves as a resting site for migratory birds? If the migratory birds are lost, it may be taken as potential loss in terms of fewer eco-tourists but do we also factor in the other side of the coin; that migratory birds may carry infectious diseases (and the cost of eradicating and treating these diseases)?

With goods, if the price is contentious, market forces will ensure that the correct value will eventually surface. With services, there is no market forces at play so the values will remain contentious and will not be resolved. Still, it is obvious that mangroves have great value (both market and non-market) but it is only the exact quantum is contentious.

GOVERNMENTS PERCEPTION OF THE VALUE OF MANGROVES - SOME SCENARIOS

The Developed

Since most of the world's developed countries are in Europe and Europe has no mangroves, there are very few developed countries with mangroves. Australia, Japan and the U.S.A. are amongst the few developed countries who have mangroves (although the 5 km² mangroves or 0.00013% of the land area in Japan is almost insignificant).

Australia has huge areas from the tropics to the temperate (presently, mangroves make up about 0.15% of the total land area) and although some of these mangroves were cleared during early European settlement (e.g. converted to grow sugar cane), mangroves are now well protected by the government. Commercial fishing is not permitted within mangrove areas and should any mangroves need to be converted to alternate uses, equivalent areas need to be rehabilitated or established.

In Japan, the mangroves are in the Okinawa prefecture and although they were used for tannin until about the middle of the twentieth century, they are now well protected. We were told that on Iriomote Island all the trees are tagged and being monitored by numerous research groups.

In the U.S.A. most of the mangroves are in Florida (0.02% of the total land area is mangroves). There was significant loss of mangroves through reclamation for agricultural and other uses until the 1970s and 1980s. Since then all mangroves (and salt marshes - the temperate equivalent) are close to totally protected whether they grow in National Parks (like the Everglades National Park) or in some private compound. Even the pruning of mangroves requires special permission from the relevant authorities (Note: some species of mangroves like *Rhizophora* will die if their tops are lopped off!).

What we see in all these developed countries is the realisation that mangroves are very valuable natural assets that require special government protection.

The Newly Developed

Some 13% of Singapore (around the early nineteenth century) were covered in mangroves. In 1990, there were some 6 km² (or just under 1%) left (Spalding et al., 1997). Efforts are now being made to establish new mangroves.

Most of the mangroves in Hong Kong have been converted to other use and there is now less than 3 km² (or less than 0.3% of the total land area) of mangroves left (Tham & Wong, 2000). The only significant area of mangroves left is the Mai Po mangroves. The mangroves are rather depauperate yet millions of dollars are being spent in management and rehabilitation. The newly developed like Singapore and Hong Kong have also realised the value of mangroves and have given them the necessary attention.

The Almost Developed

Malaysia is a nation with a relatively low population and substantial natural resources. She aspires to join the ranks of the developed nations by the year 2020. There are some 6,400 km² (or just under 2% of the total land area) of mangroves. We estimate that this represents less than half of what originally (in the late eighteenth century) existed. Malaysia stands proud at having the Matang Mangroves - a rare example of a sustainably managed tropical ecosystem for timber production. There were also less than successful exploits like the massive mangrove wood chips (for rayon production in Japan) extraction in Sabah and Sarawak (e.g. see Ong 1982). The Federal Government has realised the importance and value of mangroves and has recently advised all State Governments (in Malaysia's federal system, land matter comes under the jurisdiction of the individual states) to refrain from using mangroves for other uses. Since there is yet no legislation in place, there is still no strong legal protection.

The Developing

Most of the mangroves in the world are in the developing countries. In many of these countries, the population pressures are so great that many of the mangroves have been destroyed or devastated. There are however still vast areas of pristine excellent mangroves left in Indonesia (despite its huge population of over 200 million) and even Bangladesh (human population of around 130 million) with the world's largest continuous area of mangroves in the Sunderbans (some 4% of its total area of land is still under mangroves). Indonesia has almost a quarter of the world's mangroves or 2.2% of its total land area. In highly populated areas like the island of Java, population pressures (including the building of aquaculture ponds of 'tambaks') have decimated the areas of mangroves but the single most major threat is now the concessions given to the harvesting of huge areas of pristine luxuriant mangroves for wood chips (for the Japanese rayon industry). It must be noted that Indonesia has done quite a creditable job in having a relatively large number of national parks for a developing country but the fact remains that much of Indonesia's mangroves remain legally unprotected and are highly susceptible to the very low returns from the mangrove wood chips industry.

DISCUSSION

Essentially many mangroves can provide a few very valuable goods such as timber (which is often converted to higher value charcoal or to even higher value rayon) and fish. These are goods with market values that are determined by market forces. Mangroves also provide a vast host of services ranging from fish nursery, migratory bird stops, storm protection, nutrients for adjacent coastal fisheries to carbon sinks for mitigating the world's increasing atmospheric carbon dioxide. Many of these services are difficult or impossible to uncontentiously value as they cannot be transacted. Nonetheless they are still very valuable and their values can only be realised with governmental intervention. Whilst it is generally accepted that market forces should be left to dictate the values of most things, it is also accepted that there are certain values that cannot be left to market forces and where market failures occur, responsible governments should intervene.

Somehow it seems that governments in developed and newly developed countries have realised that the non-market values provided by the mangrove ecosystem are considerable (although their values may not be direct but one or two steps removed) and merits protection.

They have thus expended funds to rehabilitate or even recreate the system or have legislated to afford the mangrove ecosystem good protection. They have realised that this aspect of the value of mangroves cannot be left to market forces.

The governments of developing countries on the other hand have continued to undervalue their mangroves by leaving the economics entirely to market forces. Even for a almost developed country, like Malaysia (who at the same time has the enlightened belief that market forces cannot be allowed to rule completely), there still appears a reluctance to intervene.

There seems to be a dilemma. The developing countries have a much greater stake to protect their mangroves since these are valuable natural assets, yet little is being done. Why is this so? A lack of understanding?

First, it can be argued that most of the tropical developing countries have more mangroves (as a percentage of the total country area) than those of the developed countries. Mangroves are not as scarce in these countries so they are consequently less valued. Perhaps it would help if these countries take a more global view?

Second, most of these countries may perceive that there is little or no immediate benefit in protecting their mangroves. In fact, they may perceive a loss of control and loss of right to use these mangroves. This may also be because of the misconception that protection means the loss of use but in actual fact sustainable use is very much part of the concept of protection.

In the case of Malaysia, it may be political baggage : the problem of land being a state matter in a federal system. But surely, the State Governments must also be aware of the value of mangroves (they have been informed by the Federal Government, if no one else).

Why this lack of political will at the State level? Protection of certain sectors that tend to profit? Whatever, the source of this problem of the lack of protection of mangroves in Malaysia comes down to the state governments continuing to grossly undervalue mangroves.

For the developing countries the solution is also to get the governments (whether federal or state) to intervene with legislation and to follow up by strictly enforcing the new laws. There has been enough done by various UN organisations as well as non-governmental organisations in the past 20 or so years, all over the world to inform governments about the value of mangroves so there is no longer any excuse to plead ignorance. What is now needed is the political will for governments to intervene and save the mangroves so that the services provided by this unique ecosystem benefits the masses for generations to come rather than just a few in the present generation.

This is very much in line with the sustainable development concept in a number of recent international conventions that most governments are now signatory to.

The alternative is for a more global approach : for an international convention to protect mangroves. One mechanism is to strengthen the biodiversity umbrella of UNCED so that the mangrove ecosystems worldwide are given adequate protection by governments. At the same time, there is also a need to ensure that governments that protect their mangroves are given adequate compensation by the international community in recognition of their contribution to the health of the overall global environment. For this to happen, international organisations (like UNEP and FAO) and non-governmental organisations (like World Wide Fund for Nature and Wetlands International) would have to take the initiative.

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ASEAN COOPERATION ON COASTAL AND MARINE ENVIRONMENT

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ASEAN

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 to cooperate in securing the region's peace, stability and development. The current members of the Association are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. The ASEAN Secretariat office is based in Jakarta, Indonesia.

ASEAN has evolved from the initially small machinery in 1967 into the large and diversified organization. ASEAN cooperation now ranges from trade, industry, service, finance, economic and functional cooperation. Environmental protection and sustainable development is among the priority areas of cooperation. ASEAN's core cooperation approach in tackling problems and undertaking initiatives is through consultation and consensus. ASEAN members have also become more active in putting collaborative efforts in addressing problems and issues faced by the region.

ASEAN Cooperation on the Environment

ASEAN Cooperation on the Environment started in 1977 when the ASEAN Sub-Regional Environment Programme I was prepared and implemented by the ASEAN Experts Group on the Environment (AEGE) under the purview of the ASEAN Committee on Science and Technology. The First ASEAN Ministerial Meeting was held in 1981. The cooperation was further strengthened when the status of AEGE was upgraded to the ASEAN Senior Officials on the Environment (ASOEN) in 1989. Since then the organizational structure of the ASEAN cooperation in the field of environment consists of the ASOEN and its subsidiary bodies, the Meeting of the ASEAN Environment Ministers and the ASEAN Secretariat (through its Environment Unit of the Economic and Functional Cooperation Bureau).

To carry out its function, ASOEN established three Working Groups namely : Nature Conservation and Biodiversity, Coastal and Marine Environment and Multilateral Environmental Agreement represented by concerned agencies from the member countries. The Working Groups meet at least annually to discuss and plan collaborative programmes and activities. An organizational structure of ASEAN Environmental Cooperation appears as annex 1.

Environmental priorities

At the 2nd ASEAN Informal Summit held in Kuala Lumpur in 1997, the ASEAN Heads of Government adopted the ASEAN Vision 2020 which envisioned, among others, "a clean and green ASEAN with fully established mechanisms for sustainable development to ensure the protection of the region's environment, the sustainability of its natural resources, and the high quality of life of its peoples" by the year 2020.

At the ASEAN Summit held in Hanoi in December 1998, the ASEAN Leaders also adopted the Hanoi Plan of Action (HPA) as the first six-year plan of action towards the ASEAN Vision 2020. Fifteen points of action are related to environment, which appears as annex 2. In this regard, the ASEAN Senior Officials on the Environment (ASOEN) developed an ASEAN Strategic Plan of Action on the Environment (SPAEE), 1999-2004, in support of the objectives stipulated in the HPA.

The activities in the SPAEE are grouped into the following five main areas : (a) Land / Forest Fires and Haze

- (b) Nature Conservation and Biodiversity
- (c) Coastal and Marine Environment
- (d) International Environment Issues
- (e) Other Environment Activities

COOPERATION ON COASTAL AND MARINE ENVIRONMENT

The coastal and marine environment of Southeast Asian countries is of vast mangroves, coral reefs and sea grasses, which are hatching grounds and nurseries for many species of marine organisms. These habitats provide, among others, food, employment and economic welfare to people and serve as coastal barriers and pollution filters. Mangroves, sea grasses and coral reefs are now threatened by pollution, exploitation and over-development of coastal areas in the region. Coastal and marine pollution caused by land and sea-based activities are increasing in an alarming rate.

For ASEAN, the main challenge is how to maintain an optimal balance between development and conservation of natural resources in the regional for present and future generations.

Followings are some of the various planned and on-going activities undertaken under the purview of the ASOEN and other relevant ASEAN bodies.

ASEAN Senior Officials of the Environment (ASOEN)

The Strategic Plan of Action on the Environment, 1999-2004 outlines two key objectives :

- Develop a framework and improve regional coordination for the integrated protection and management of coastal zones by the year 2001
- Develop a Regional Action Plan for the Protection of the Marine Environment from Land-based and Sea-based Activities by the year 2004

The ASEAN Working Group on Coastal and Marine Environment (AWGCME), chaired by Thailand, has been tasked to coordinate regional cooperation in addressing coastal and marine environmental issues. AWGCME has identified seven priority areas in its cooperation

framework for the integrated protection and management of coastal zones, including :

- coral reef, sea grasses, mangrove
- oil sludge from tanks and ballast water
- solid and liquid waste management
- clean technology
- coastal erosion
- eco-tourism; and
- coastal wetlands including protected marine areas.

To achieve the objectives stipulated in the SPAE, the Working Group has formulated regional strategies and implemented various planned and on-going activities as follows.

- a) Information exchange/networking
The Internet-based information system is being developed to facilitate the exchange of information and experiences among the ASEAN member countries especially on the identified seven priority subject areas
- b) Standard format on coral monitoring
ASEAN is considering the possibility to adopt the Data Acquisition Form developed by Thailand in coral reef and sea grasses monitoring at the regional level.
- c) Harmonization of criteria for identifying coastal and marine pollution "hotspots"
Several guidelines are being considered to be used as the criteria for ASEAN, including the one developed by the Global International Water Assessment (GIWA) and the other by Thailand using its coastal water quality standards.
- d) Develop the marine water quality standards for the ASEAN region
- e) Develop criteria aimed at designating areas to protect critical marine habitats and resources
- f) Develop guidelines for management and conservation plans for marine resources including community-based coastal surveillance for clean coastal environment
- g) Develop a regional mechanism to enhance surveillance and follow-up action against illegal discharge including tanker de-sludging activities at sea.

Committee on Science and Technology (COST)

The Sub-Committee on Marine Science under COST has implemented several regional programmes on coastal zone management including :

- The ASEAN-Australia Economic Cooperation Programme (AAECP) on Marine Science (1994-1998)
The project was built in three phases, focused on Coastal Living Resources, on Regional Ocean Dynamics, Marine Science and Technology Management, and on Coastal Zone Environmental Resource Management.
Among the outputs were : the successful establishment of National Environment and Resource Information Centres (NERICs) in participating member countries (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam). The Centres are responsible for collecting and managing data on coastal zones; the establishment of linkages between the NERICs and agencies responsible for the management of the nation's coastline; and the development of Directories on Coastal and Marine Data Metadata bases.
- The ASEAN-Canada Cooperative Programme on Marine Science (1991-1999)
The project was originally focused on the establishment of environmental criteria for the protection of marine resources on certain enterprises, including capture fisheries, aquaculture, tourism and recreation.
The succeeding phase, entitled Establishment of Environmental Criteria for Development and Management of Living Marine Resources & Human Health Protection, focused on the development of safe standards for the marine environment. A "Marine Water Quality Criteria" for 18 parameters^{xi} using local tropical species as test organisms have been formulated and being considered for adoption by the ASEAN Senior Officials on the Environment (ASOEN)
- The ASEAN-EU Cooperation Project entitled "Interdisciplinary Scientific Methodologies for the Sustainable Use and Management of Coastal Resource System (1995-1999)
A "SimCoast Software" was developed. SimCoast is an expert system containing a set of rules and interdisciplinary protocols for integrated coastal zone planning/decision-making facilitating cross-section and transect analysis. SimCoast was designed for use by coastal zone managers, researchers, planners and policy makers protocols for integrated coastal zone planning/decision-making.

ASEAN Senior Officials Meeting on Agriculture and Forestry

The ASEAN Sectoral Working Group on Fisheries has implemented various activities in addressing fish and marine resources management.

- Promotion of Mangrove-friendly Aquaculture in Southeast Asian Countries
A series of workshop and training were conducted to discuss the status of utilization of the region's mangrove areas for aquaculture and problems encountered as well as recommendations for sustainable aquaculture in mangrove areas. A Second series of workshop focusing on the effects of shrimp culture on mangroves has been planned.
- Conservation and Management of Sea Turtles in Southeast Asian Countries
One of the major activities of the project is to test the suitability and acceptability to the region of various types of turtle excluding devices^{xii}. The suitability criteria tested included the device's efficiency in excluding sea turtles from the catch as well as ease in installation, transportation and storage.
Two additional activities have been planned for the coming years until December 2002, namely (i) Sea Turtle Hatchery Management Study and (ii) Sea Turtle Statistics Management. The first activity aims at understanding the nesting ecology and incubation biology of eggs and hatching sex ration from natural beach and artificial environment; evaluating management of hatchling production in the study area; and formulating specific recommendation to help improve existing conservation practices. The second activity will involve the establishment of a regional network on sea turtle and a regional GIS database.
- Fish Trade and Environment
As results of the Preparatory meeting on Issues of International Fish Trade and Environment held in November 1999, ASEAN and SEAFDEC have agreed to assist FAO in the in-dept analysis on whether fishery subsidies contribute to over-fishing or over-

^{xi} The 18 parameters include: ammonia, arsenic, bacteria, cadmium, chromium, copper, cyanide, dissolved oxygen, lead, mercury, nitrate/nitrite, oil and grease, phenol, phosphate, temperature, suspended solids, tributyltin and zinc.

^{xii} Three US's (Anthony Weedless, Super Shooter and Bent Pipe) and two Mexico's (Georgia Jumper and Mexican) were tested in comparison to the ones designed by SEAFDEC.

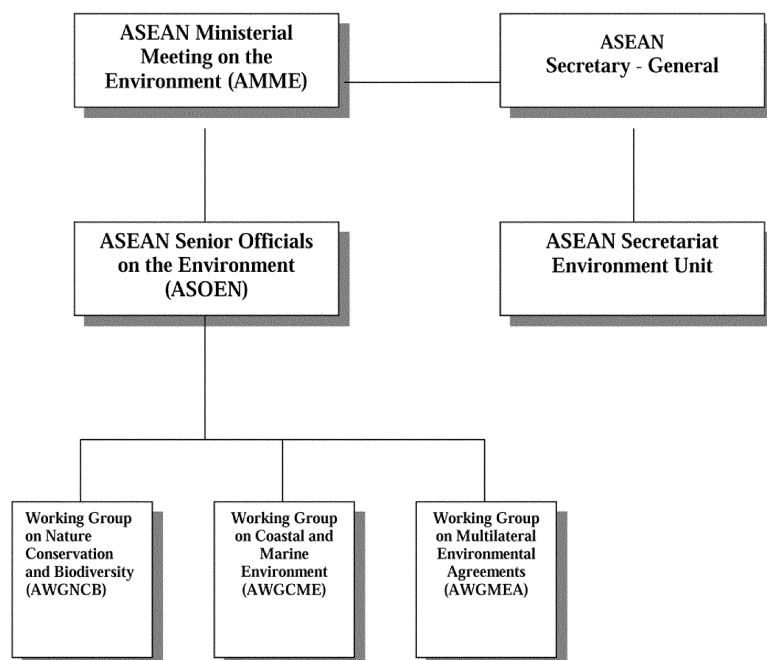
capacity fisheries. It is also agreed to support SEAFDEC's to organize a regional meeting to discuss Sanitary and Phyto-sanitary and other trade issues that are being formulated by WTO for the next multilateral trade negotiations.

Conclusion

The coastal and marine environment has received high attention in the ASEAN cooperation development agenda. ASEAN has also progressed in developing and implementing regional strategies and activities to protect these valuable resources and to cope with the challenge of balancing environmental concerns with the imperatives of development. Considering that there are several initiatives planned and implemented by regional and international agencies and organizations for sustainable development of Asian seas, ASEAN has strategically positioned itself to collaborate and coordinate with those existing initiatives to increase efficiency and cost-effectiveness. ASEAN's comparative advantage would be to mobilize strong commitments of its member countries for regional cooperation and good attention of the highest bodies. ASEAN would also welcome further consultations with other partner agencies in this regard.

ANNEX 1

Organizational Structure of ASEAN Environmental Cooperation



ANNEX 2

Hanoi Plan of Action for Environmental Protection and Sustainable Development

1. Carry out the ASEAN Cooperation Plan on Transboundary Pollution with emphasis on the Regional Haze Action Plan by the year 2001.
2. Strengthen the ASEAN Specialized Meteorological Centre with emphasis on its ability to monitor forest and land fires and provide early warning of transboundary haze by the year 2001.
3. Establish the ASEAN Regional Research and Training Centre for Land and Forest Fire Management by the year 2004.
4. Strengthen the ASEAN Regional Centre for Biodiversity Conservation by setting up networks of relevant institutions and carry out collaborative training and research by the year 2001.
5. Promote regional coordination to protect the ASEAN Heritage Parks and reserves.
6. Develop a framework and improve regional coordination for the integrated protection and management of coastal zones by the year 2001.
7. Strengthen institutional and legal capacities to carry out Agenda 21 and other international environmental agreements by the year 2001.
8. Harmonise the environmental databases of member countries by the year 2001.
9. Carry out a regional water conservation programme by the year 2001.
10. Establish a regional centre or network to promote environmentally sound technologies by the year 2004.
11. Draw up and adopt an ASEAN Protocol on access to genetic resources by the year 2004.
12. Develop a regional Action Plan for the Protection of the Marine Environment from Land-based and Sea-based Activities by the year 2004.
13. Carry out the Framework to Achieve the Long-term Environmental Goals for Ambient Air and River Water Qualities for ASEAN countries.
14. Enhance regional efforts in dealing with climatic change.
15. Enhance public information and awareness of and participation in issues on the environment and sustainable development.

MANAGEMENT OF BIOLOGICAL RESOURCES IN TAMGIANG LAGOON FROM A SOCIO-ECONOMIC CULTURAL VIEWPOINT

TON THAT PHAP

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Introduction

Tam Giang lagoon, which runs along the coast of Thua Thien Hue Province, Viet Nam, has an area of 22,000 ha and a length of more than 60 km. On its eastern side, the lagoon is separated from the sea by sandy dunes with 2 openings : Thuan An and Tu Hien. On the western side of the lagoon are rice fields and river estuaries. The area is unique in terms of landscape and biological resources. Communities settled there to exploit the lagoon's biological resources and farm on the sandy land at the edge of the lagoon.

At present, because of population pressure and a decrease in aquatic resources, government officials consider aquaculture as an alternative means of improving villagers' income and reducing exploitation pressure on the lagoon. As a result, aquaculture has recently developed so rapidly that it is having strong impact on attempts to promote a sustainable system of aquaculture production in the lagoon area.

The lagoon dweller communities and their fishing activities

According to published statistics, the lagoon dweller community has a population of 220,000, including 100,000 sampan dwellers and 116,786 dwellers on land, which therefore can be divided into the two major groups : dwellers on land and dwellers on sampans.

1. The group of dwellers on land may be divided into Westbank and Eastbank groups. In terms of livelihood, Eastbank dwellers include 3 subgroups :

- Sea-fishing people.
- Lagoon-fishing people.
- Farming people.

Similar Westbank dwellers consist of 2 subgroups :

- Farming people.
- Lagoon-fishing people.

2. The groups of dwellers on sampans are fishers who live on their sampan on the lagoon and who have no land to build a house. They live together, forming small communities, based on their blood and occupation relations. Their communities are called "van". A leader of the "van" and a representative board are elected to manage community activities, such as organizing rituals or ceremonies, protecting rights for "van" people. The poor households earn living by mobile-gear fishing (gill net, push-net, hook... which is called minor-fishing requiring small capital and investment. So the communities with this type of livelihood are called "minor-fishers community" (van tieu nghe).

On the other hand, the fishers with fixed-gears such as fish corral, bottom nets form major-fishing communities (van dai nghe) with larger capital and investment.

Both major and minor-fishing communities live together on the water near the lagoon banks. All these people are called sampan people.

Not accepted by villagers on the main land as village members, sampan people had to gather on boats. Due to their origins, sampan people were considered as people with "no land to live on and no land for graves". Vietnamese language has some contemptuous words (Nooc, ke nooc). This distinction between land and water people has existed for many centuries and still exists now though it is less serious.

During the time of feudalism, the lagoon belonged to the state and communes around the lagoon managed it. All the fishing activities carried out by sampan dwellers were put under a strict supervision of those communes' authorities, who set taxes on various types of fishing. As for fixed-gear fishing, the communes' authorities held auctions for allocating water surface use-right to fishers. The bidding rules used to give priorities to those who were using the water, that is, the previous bidwinner. Therefore, the bidwinners used to use the water for a long time and it was often transferred from one to another generation. The fishing area allocated for fixed-gear fishing belongs to households, which is considered as a type of private ownership. Mobile gear fisher (no money to win the auction) fished the waterspace outside of the fixed gear grounds. They were not limited within their commune boundaries but could fish throughout the lagoon. They share the fishing ground with some farmers who live around the lagoon. This can be seen as a form of open access. All activities were remained stable thanks to the control by a management mechanism in which farming villages in charge of the "van" had close ties with fisher organization in their work of management.

After the April 1975, the lagoon became state-owned. The old institution was dissolved, the government abandoned the old administrative structure, integrated Van of fishers into land based villages, the sampan dweller communities were added to agriculture cooperatives on land and were considered as sections specializing in fishery of agriculture cooperatives. All the fishing activities were brought under the control and management of commune authorities. From now on the model of fishing were designed according to the pattern applied for farming, which resulted in the formation of groups and big groups of fishing. In general, this form of resource management proves to be less effective.

For its favorable conditions such as large area, aquatic resource abundance and the closeness the lagoon has attracted a great population of fishers who have come and settled down.

The life related to the environment and ecological resources of the lagoon has enriched the fishers' knowledge of the characteristics of this ecosystem like tide regime, aquatic organism behaviors. Besides, the common background, each group of fishers also has a deeper knowledge of ecological features of the aqua-life they are fishing. In other words, the lagoon fisher community has specialized, to some extent, in their fishing activities with their specific gears and fishing techniques suitable for each trade. It is this specialization that has resulted in the division of the two groups, which share the dwelling places and fishing areas under the control and management of the local government, which keeps the production activity in stability. There are currently 13 kinds of gears corresponding to 13 trades. For the last 5 years the number of gears has kept increasing sharply and the resources were degraded strongly. The production before 1970 was about 3,000 tons/year. Since 1980, the yield has been reduced to 2,000 ton/year while the number of the labours engaged has increased 60,000 in 1980 up to 90,000 in 1993. High fishing intensity has resulted in the depletion of the lagoon resources and increased the

difficulties of fisherfolk.

Present management system and the overexploitation of resources in Tam Giang lagoon :

According to the regulation on Protection of aquatic resources, dated April 25 1989 by the Socialist Republic of Viet Nam, the national government is the highest management body that administrates the protection and development of aquatic resources through a system of policies, strategies, socio-economic plans, technical applications and documents. The national government issues decree, resolutions, articles and decisions regarding the protection and development of resources. Province and district governments issue decisions and announcements appropriate to the local situation for enforcement based on national government documents (Ha Ky, 1994).

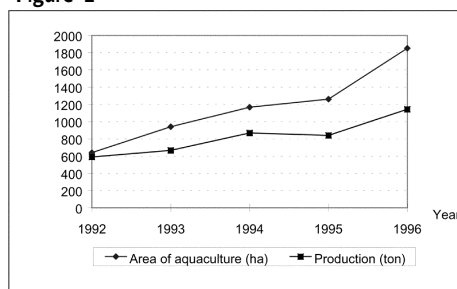
At present, Tam Giang aquatic resources are managed by a system of administrative and functioning bodies, with key roles played by provincial People's Committee (PC), district PC, Commune PC, Department of Fisheries, Division of Protection of aquatic resources, and District bureaus of Agriculture or Fisheries. In general, regulations issued by local administration are few compared to those promulgated by the national government. Local enforcement of national policies was not given much attention by local governments. A good working relationship coordination among the above mentioned government institutions in the management and protection of aquatic resources of the lagoon is insufficient. Therefore, violations and conflicts in fishing activities are not resolved satisfactorily, thoroughly and promptly and overfishing occurred.

In the present management, government has emphasized the role of people in management system. The notion that "people are the root" is often emphasised by the government. Vietnamese government is promoting the role of people involved in management according to the principle "people know, people discuss, people do and people supervised". Especially in recent years the government has encouraged the development of democracy at grassroot level, commune and villages, aiming at upholding the role of people in management. Although the government has talked about the local roles in management of fishery, in reality, there is often a top-down management approach used. This is one of the reasons why fishers pay little attention to implementing regulations on protection of the aquatic resources issued by the national and local governments.

Aquaculture as a solution to the depletion of the biological resources

The year of 1978 marked the beginning of the aquatic culture in the lagoon. The first species to be cultured was *Glacilaria*. Afterwards, the shrimp was put into testing culture. The first companies to come were state-run and foreign ones. The popular culture models are monoculture and semi-intensive culture with two principal species *Gracilaria* and tiger shrimp.

Figure 2



Present aquaculture methods are mainly ponds, net enclosures and cages. Ponds are more common for the following systems : extensive, improved extensive and semi-intensive. The area of production in the lagoon in 1996 are presented in figure 2.

Aquaculture is regarded as a pilot scheme, investigating the economic activity for fisheries development in Thua Thien Hue. The Department of Fisheries in Thua Thien Hue promotes semi-intensive culture in which villagers include aquaculture as part of their livelihood portfolio and state-run companies supply seed and technical support. This is the official strategy for aquaculture development in Thua Thien Hue province.

In the past 5 years basic aquaculture techniques, acquired from training courses held at the Fishery Extension Centre (Phu Tan), have enabled the lagoon fishers to experiment and learn from other experienced aquaculturists. Step by step, they are developing their own aquaculture practices that are characterised by low stocking density and polyculture. Polyculture seems to be more sustainable than monoculture as this reduces the risk of losing the whole crop due to disease. Common polyculture

patterns include : shrimp (*Penaeus monodon*)/ crab (*Scylla serata*) / fish (*Siganus guttatus*) / seaweed (*Gracilaria tenuispinata*) ; shrimp/seaweed and shrimp/crab/fish. Grass carp (*Ctenopharyngodon idella*) and groupers and are cultured in cages.

This flexible approach is more appropriate to the environmental conditions of Tam Giang ecosystem and to the management and investment capacities of local people. This runs counter to previous aquaculture development (semi-intensive and monoculture) that was previously applied by state-run companies. Low intensity polyculture has resulted in increased economic benefits because investments for seed and feed are low, no improved techniques are required, product quality is good and the price obtained for the product is higher than in high-density culture.

Meanwhile, aquaculture companies that relied on more intensive cultivation methods have had to abandon their ponds or rent them to fisherfolk ; these companies are no longer involved in aquaculture development in Tam Giang lagoon. However, aquaculture production in the lagoon is still regards as unstable and further research is required to address the associated problems.

Around the lagoon are larger communities of farmers, who had a habit of looking down on the sampan dwellers, and therefore ignored the fishing. Also, the fishing by itself, could not guarantee the fishers' life at that time. That is why most sampan dweller wished they could settle down on land and earn their living by doing another occupation. This behaviours and thinking made the farmers unwilling to considered the fishing as an important livelihood as their farming - basic requirement for forming farming - fishing households. This is why there exist two nearly separated communities of farmers and of fishers. The farmers have their livelihood linked with the farming activities while the fishers earn their living by exploiting the lagoon resources. This is understand easily that, when fishing ground have reached a limit in their capacity for exploiters, the fishers who the first ones be attracted by aquaculture - an activity which could help them to improved their lives.

The major-fishing households are the richest in the sampan dwellers' communities. They are also very sensitive to the demands of the market to change their fishing for creating new ways and forms of aquaculture for a better life. They are, therefore in the lagoon fishing community, the first to be attracted by aquaculture. With their capital accumulated during their time of fishing, their understanding of the lagoon environment and aquafire they easily took up to the new activity and have proved to be successful. The lagoon aquaculture was born with the former fishers as the pioneers. And now they still play the most important part in the lagoon aquaculture activities.

Aquaculture were developed successfully, partly supported by some other policies such as : fishery extension policy :

The fishery extension program of Thua Thien - Hue was founded in 1992 in order to assist the people in the development of the aquaculture in the province. The program has held many training courses on aquaculture techniques, and supplied capitals to poor households, as well as encouraged and assisted local seed and fry production. Besides, the government has invested billions of VN doings in the construction of dikes and the planning of shrimp-rearing areas. It is generally accepted that the fishery extension program has contributed its positive part to the success of the aquaculture in the lagoon.

Policy on resettlement of shampam people :

Since the hurricane of 1985, which caused serious damage to the lagoon communities in terms of materials as well as human lives. The local authorities have carried out the policy of resettlement on land for some of the sampan dwellers such as providing land, construction materials and money to build houses. They have also been helped to have a livelihood in aquaculture.

Policy on allocation the land use right to farmers :

After 1988 the government issued some changes. The 64 CP. Decree allocates the land to farmers. The farmers have the right to use an area for farming in a period 20 years. In that time, transferring exchanging, renting, inheriting or pawning the right are acceptable. Based on this decree, central and local government wrote strict stipulation on aquaculture area. All fishers and farmers living around the lagoon have the right to use an area for aquaculture. The policy on granting aquaculture area has promoted people to make efforts to develop aquaculture to contribute towards improving fishers' lives.

In brief, it can be concluded that the declining of the resources, the good fishery market has led the fishers to the aquaculture. And the local government has played the part of the initiator, guide and assistant to the local fishers in the breaking through a completely new activity of aquaproduction, aquaculture, in which they have hardly any experience.

Aquaculture development- a signal of the instability in fishing activity :

It is too soon to understand or to see early how aquaculture development would impact the environment and the natural resources. What is immediately apparent to the aquaculture is that their lives are improving from the income they earn by doing aquaculture. Besides, a process of privatization of the fishing ground has also begun- the transfer of community property rights to family or group ownership and the exclusion of mobile fishers from the traditional fishing grounds. It is not difficult to understand why the situation has spawned conflicts in the area, particularly between mobile fisher and aquacultures, both from the same villages. For the mobile gear fate has taken a turn for the worse, the traditional fishingground have been steadily narrowed.

The development of the big van (of fixed gear fishers) and the small van (mobile gear fishers) in the lagoon has increased the gap between the powerful and the powerless. The local commune budget has been dependent on the taxes of the fixed gear fishers. There fore, all policies and regulations of fishing development have been so designed to cater to the need of the fixed gear fishers. In the process, the mobile gear fishers have been grossly neglected. The development of the aquaculture followed the old ways make fishing activity become more complex.

Some suggestions for making strategies for management of biological resources in tamgiang lagoon :

Thanks to the unique topography, in terms of salinity, the lagoon is divided into 3 distinctive areas : oligohaline, mesohaline and euryhaline This creates a typically brackish water environment with valuable resources and a high potential for aquaculture.

Aquaculture has developed with its production continuously increasing, the fishers' techniques and skills improved. With only two species - the shrimp and the crab, aquaculture activity has changed the situation and position of the fishing in the lagoon. Its production shares a proportion nearly as large as that of the fishing in some area of the lagoon. Therefor, the economic values of the lagoon must be evaluated based on the value of water for aquaculture as well as for fishing.

Besides, under pressure of aquaculture, the natural ecosystem is being converted to artificial ecosystem, which is requires additional energy to maintain its stability. And apparently, this artificial ecosystem is prone to become more insatiable due to the frequent instability of the lagoon mouth in some recent years. As can be seen in practice, the aquatic resources are becoming poorer ; in 1979 alone, when the Tu Hien inlet was filled up, several rearing ponds were neglected due to a decrease in the salinity. The flood of 1999 reopened the inlet and created another one has made the salinity become suitable for resuming the aquatic culture in Cau Hai area, while in other areas the aquaculture operation was challenged with the fluctuations of salinity.

Aquaculture in the Tamgiang lagoon are exposing its instability of its environment under the impacts of insatiable inlets.

The following matters should be focused on while a policy for the lagoon resources management is outlined.

The management system of the lagoon requires highly applicable measures. So subecosystems and their stability should be identified. Policies and strategies for aquatic fishing and culture should be based on the natural environment features of subecosystems to obtain a higher adaptiveness as the successful management of all the subsystems means the success in the management of the whole system.

Pollnac said : "It will be easiest in communities characterised by occupational multiplicity, that is communities where individuals practice several strategies to gain a living" "The greatest difficulties will arise among those who are strictly fishermen, with little or no contact with agricultural". However, fishing communities in Tamgiang lagoon shows that a strict fishers community are able to earn the living from aquaculture, the pioneers approaching aquaculture succeed in doing aquaculture.

It can be say that the government strategy of development of aquaculture shows its important role in influence the conversion of capture activities to aquaculture ones.

The agriculture management forms should not applied to the aquaculture for the distinctive future of this kind of production. The fishers must have their important role in the management of the lagoon resources. There should be certain share of authority and responsibility between the commune and the community. In other word, an application of the community-based management to subecosystems of interest would upgrade the effectiveness and adaptiveness of management.

Though Tamgiang lagoon has great potential for aquaculture development which bring better incomes for producers, it should be understood that this lagoon has natural resources which have created the livelihood of a large community over many generations. If a reasonable balance between aquaculture and fishing can not be maintained, and encroachment of lagoon water for aquaculture development continues, degradation or even destruction of this ecosystem is unavoidable.

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ENHANCEMENT OF INTEGRATED COASTAL ZONE MANAGEMENT IN THAILAND : INSTITUTIONAL ASPECTS

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Abstract

The concept of integrated coastal zone management (ICZM) is a specific management program that combines the idea of coastal area management with coastal resource management. It refers to the geographic area defined by the enabling legislation for coastal management. Also, it applies the concept of sustainable development and considers the interaction and relationship among socioeconomic issues, environmental well-being and operational feasibility, as key components in a system. It is important for coastal countries to employ ICZM into their planning process for development, including Thailand, one leading coastal country in this region.

Institution is one major and initial key factor in a management program, it is also important for implementing integrated coastal zone management. As the ICZM concept lies on a defined geographic area, institutional framework of that particular area becomes very substantial and requires adjustment to suit ICZM. By using Thailand as a case study, this study was an attempt to raise the importance of institution in implementing ICZM in a country and to propose an institutional arrangement to run ICZM programme. The methods employed to conduct this study were secondary data review and institutional analysis.

Introduction

Importance of coastal areas has been recognized by all coastal countries. Especially, in tropical regions where coastal resources, such as fisheries, mangrove forests and reefs are abundant and diverse. These areas are significant for aquatic and terrestrial living organisms in terms of food, shelters and habitats. For human beings, the uses of these particular areas and their resources are expansive for various development activities : local and national economic growth, recreational purposes, industrial production and social development. Depletion and deterioration of coastal areas and resources can occur when they are overused and conflicts over uses can also be created if uses are unplanned.

Thailand has an extensive coastline on both sides that are opened to Thai Gulf on the east and the Andaman Sea on the west, covering area of 513,115 km² within 24 provinces. (Sudara, 1998) These areas are important to the country in terms of economy and human settlement. Major heavy industries such as steel, oil refinery and petrol chemical are located along coastline especially on the east coast. Agricultural activities and tourism are also major economic activities in coastal areas that contribute large amount of income at both local and national scales. Rapid economic growth and economic promotion of Thailand during the last 20 years have stimulated establishment of economic activities and led these areas into intense pressure of area deterioration and resource depletion.

The government institutional framework, as a major component involving management program and practice, is a critical factor affecting the development process, including resource use patterns. Many studies and research had been done in coastal resource management and scientific experiment of coastal resource. This study emphasized the recognition and the importance of institutions as one major element in analyzing integrated coastal zone management and as one powerful mechanism in planning and management in facilitating coordination among levels of government and their bureaucracies relevant to define specific resource conservation and economic development activities.

Objectives and Methodology

The issues related to Integrated Coastal Zone Management in Thailand have appeared in form of resource management and activity management e.g. mangrove management and tourism management. In order to enhance more practices of integrated coastal zone management in Thailand, the study was aimed at 1) indicating and reviewing importance of institutional arrangement and 2) strengthening the roles and duties of local governmental agencies in managing natural resources in their own area context, which is recognized as a zone management.

The study employed two major research methods : secondary data review and informal discussion with key informants, and one technical analytical tool that is institutional analysis (Ostrom, 1993) of the existing institutional framework in Thailand. The secondary data included existing policies and plans relevant to coastal resource management and technical books on institutions and integrated coastal zone management. The interviewees for discussion were government officials of policy making and implementing levels. The institutional analysis focused on the identification of rules, actors and actions actively involved in management.

Finally, this study used a case study of Ranong Province, which was based on the finding of the author's master thesis, to define as a zone for management. The information and data gained from discussion and results of the analysis were used as basis for supporting recommendation and conclusion of the study.

Results and Discussion

In the process of management, objectives and goals of the plans and programs are defined, plans are implemented and the monitoring and assessment are processed under number of considerations depending on the overall country context; social background, regulations, policies and institutional framework. Specifically to integrated concept, there is no perfect single pattern or agent for resolution. Proper management body will be arranged differently based on problems, needs and physical context.

Importance of Institutions in Integrated Coastal Zone Management

Hoozemans (1995) stated that the coastal area is considered as an interacting system of economic activities, physical processes, chemical

reactions and biological activity. Planning is considered to be an essential task in developing a balance of the system and institutional arrangements for implementation of proposed measures is recognized as one major element in analysis for integrated coastal zone management. (Hoozemans, 1995)

The nature and operation of institutions and their mode of decision making will have significant implications for the implementation of any strategies or plans. Good and specific institutions for any particular management context can create benefits, reduce conflicts and reflect needs of their people. They direct uses of resources that respond to the local conditions. For ICZM, key institutions are required to generate, adapt and disseminate knowledge and technologies that are conducive to local conditions. Besides, good institutional arrangement will issue effective policies that can represent local interests and reflect benefits. (Srisakulchairak, 1999)

Institutional Analysis of the Government Institution Framework in Thailand : Specifically related to Integrated Coastal Zone Management

Institutional analysis is a useful tool to understand how the community manages resources and how improvements can be made to encourage the sustainable uses of resources. Institutions are dynamic and diverse by physical and country context. Thailand has the administrative system that combines the concept of centralization, decentralization, and deconcentration. (Chayabutr, 1998) It has aggregated its authority in the central government agencies in a structure of ministries and offices. Also, the country has the local government, based on decentralization, that allows people to participate in local administration under laws and regulations. Finally, Thailand also employs the concept of deconcentration to deconcentrate some administrative authority such as decision making to the provincial level of administration. The study divided the government administrative body into three levels : national, provincial and local. And, divided the duties and roles into planning, implementation and coordination.

Ranong province was used as the study area for this study. The province is compact and dynamic in terms of economic activities related to coastal resources and area. Mangrove forests and fisheries are outstanding coastal resources that contribute income to the province and to the country. Dugong Dugong, an endangered species is found along coastlines of the province. Major threats to the existence of those resources are tin mining, overfishing by outsiders and by using destructive fishing gears, and conversion of on-going concessions for mining along coastlines in concession areas into intensive shrimp ponds.

The study identified of the existing institutional framework by rules that govern, actors who have authority or been entitled to govern, and actions that are implemented. By using Ranong as the study case. The table 1 summarized the existing framework of how government institutions at different levels work in Ranong.

Rules :

- The central government in general issues rules, regulations and policies in relation to resource management. Most of the 'rules' stated under the central level in the table 1 are to be applied by relevant agencies of any level. The duration of the application is at least five years. They act as guidelines to be conducted and to be followed by all agencies so that the development trend of the country will go to the same direction.
- The Provincial and Tambon five-year plans are issued accordingly to those from the central level. These plans are guidelines for initiation of annual action plans for approval and budgets.

Actors :

- The actors at the central level have influence over planning and policies and decision making. They have authority in making decision on activities and budgets.
- The provincial administrative system is a combination of deconcentration and decentralization. Provincial administration offices, where ministries at the central level have their representative offices, represent deconcentration of central power at certain extent. However, there is a provincial council where representatives are elected to perform the legislative function and advisory role to provincial board. The decentralization is not obvious though the province has its own income.
- The Tambon Council and Administrative Organization represent local government administration system. They have income, manage their own budget, initiate their own plans and projects, prepare their own projects and implement their own programmes.

In Ranong, mangrove forests are very biologically abundant and physically expansive. It is recognized by UNESCO as a mangrove biosphere reserve. Consequently, active actors include one mangrove research centre and three mangrove management units Royal Forestry Department in the province. Also, there is fishery research station which aims to maintain and increase numbers of mud crab species in the mangrove forest. This kind of agency, by regulations, does not depend on provincial or tambon administrative organization or their plans. They are assigned directly by the ministry or department at the central level. But by courtesy, they work in consistance with provincial and local agencies.

Actions :

- The actions in the central level are still guidelines for 1) ministries and relevant agencies as national focal points of development and 2) provincial and local administrative levels in issuing their master and annual plans.
- Provinces and tambons have their master plans that are consistent with policies or actions created in the central level. The priority can be categorized and proposed through their annual plans for approval and budgets, in case that their budget or capacity is insufficient.

Discussion

Roles and duties of agencies at each level is guided by national law and regulations. Their actions are created accordingly by national policies. Planning and implementation are major focus of management practices, while coordination and cooperation are a mobilizing tool for catalyzing planning and implementation process as well as budgeting system.

The figure 1 illustrated the major tasks of actors in different levels. From the figure, Thailand has two approaches of planning and implementation for planning : top-down and bottom-up. But they are not well integrated. The left side showed government agencies at three levels : central, provincial and local and their tasks were stated on the right side.

- The central level agencies mostly do decision and policy making roles. They deliberate sectoral, provincial and local objectives and then initiate relevant plans and policies. In case of emergency, they set up cross-sectoral committees to examine and resolve the issues. However, policies mostly are not in time for solving problems or do not respond to local needs and really concern local conditions and benefits.

Table 1 Identification of Existing Institutional Framework in Ranong Province

Administrative Level	Rules	Actors	Actions
Central	- The Constitution Law - The Enhancement and Conservation of National Environmental Quality Act 1992 - The Forestry Act - The Cabinet Resolution on mangroves - National Economic and Social Development Plans - Thailand's Policy and Prospective for Enhancement and Conservation of National Environmental Quality 1997-2016 - Policies, Measures and Action Plans on National Coastal Environment and Resources	- Office of National Environmental Board - National Mangrove Committee - Ministry of Science, Technology and Environment - Ministry of Agriculture and Cooperatives - Ministry of Interior	The National Environmental Quality Management Plan 1999-2007
Provincial	Provincial Master Plans (5-year plan)	- Provincial Council - Provincial Administration Office : - Policies and Planning Section - Provincial Forestry Office - Provincial Fisheries Office - Provincial Industrial Office - Research Centre - Aquaculture Research Centre - Mangrove Forest Management Unit	- Provincial Plans (annual action plan) - Mangrove rehabilitation program - Cease of mining and mangrove concessions - Non-destructive and traditional fishing gears demonstration programs
Local	Tambon 5-year Plan	- Tambon Administration Organization - Tambon Council - Villages	- Tambon Plans (annual action plan) - Pier construction - Canal excavation - Ecotourism promotion

Source : adapted from Srisakulchairak, 1999

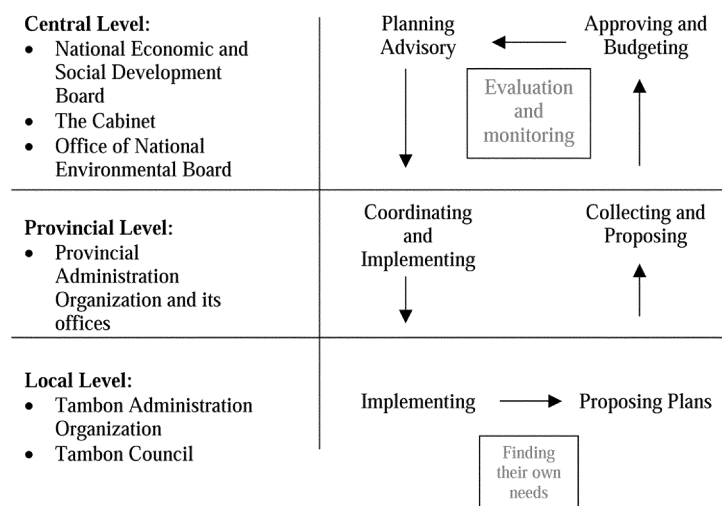
- The provincial level agencies perform coordinating role between central and local governments. They also act responsively to their policies in controlling activities into the same direction, as well. In a way, the Provincial Council, as a legislative body, proposes its own plans and issues its own policies while Provincial Administrative Organization acting as executive body will perform under policies made by Provincial Council. This ensures that policies will reflect local conditions and benefits because members of Provincial Council are elected by local people.
- The local level is based on decentralization concept of administration. They administrate themselves under small and limited budget. They still financially rely on provincial and central governments through 1) proposing their plans additionally to provincial annual plans and 2) directly requesting from concerned agencies. Though they have capacity to manage their resources and plan their land use, limited capacity in terms of finance, technical knowledge and technology is a major constraint for them to fully operate integrated planning and management.

Summary and Recommendation

Integrated Coastal Zone Management is a time-consuming process. It is an inter-disciplinary approach to consider, coordinate and integrate the interests of all appropriate economic sectors. The overall goal is to ensure optimum sustainable use of coastal natural resources, perpetual maintenance of high levels of biodiversity, and real conservation of critical habitats. And the main objective is to coordinate the initiatives of the various sectors toward long-term optimal socio-economic outcomes, including resolution of conflicts between sectors and arranging trade-offs.

This paper studied importance of institutional arrangement for integrated coastal zone management. Along with the finding from institutional analysis, the informal interviews and discussions were conducted with government officials, especially at the provincial level. Their opinions support the summary of the study that provincial level of administration can enhance integrated coastal zone management. Summaries and key issues that support the idea can be concluded as follows :

- It is recognized that there is no single pattern or single unit to operate integrated coastal zone management. (Clark, 1992)
- There are several suggestions for structure of institution to deal with coastal zone issues, recommended by Lowry (1989); to establish a

Figure 1 The Existing Institutional Framework and their inter-relation


new agency, to develop a lead agency and to rely on an inter-agency commission or council of equals or near-equals.

Consequently, the recommendation of this study is to strengthen the government agencies at provincial level as the institutional arrangement framework for ICZM. As mentioned, the provincial administrative bodies consist of representative offices from the central government level as well as local people in the Provincial Council. The following are motives and potentials that identify the provincial government as institutional framework to run ICZM :

- They know the local conditions and understand current situation in their provinces.
- They have their own income via tax collection and can request more through annual plans.
- Their current roles of coordination and cooperation of integrated works have to be strengthened and more practical to facilitate the management.
- Their administrative system is combination between deconcentration and decentralization that link local government and central government.
- It helps enhancing public participation and community management, also providing chances for local government in exercising making their plans and policies.
- More integrated plans and policies can be magnified and inconsistency of policies can be minimized.
- Finally, network among themselves can be created and increased to facilitate works in the future.

Conclusion

Coastal resources are precious to all countries. The importance of integrated planning and management is considered an effective tool to both prevent and cure any possible adverse impacts. Along with the concept of sustainability, integrated coastal zone management should be encouraged in order to protect coastal environment, to improve quality of people's lives, and to promote coordination and cooperation among government and private agencies.

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STATUS AND PERSPECTIVE OF MARINE PROTECTED AREAS IN VIET NAM

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Viet Nam has long history of protected areas with the first reserve - Cuc Phuong National Park established in 1962. Marine protected areas, however, have not been paid attention for a long time. The sea is more important with every passing day. The threats to marine resources have become higher in parallel. Actually, marine biodiversity, living resources have degraded widely and the natural based economic activities (fishing, aquaculture, and tourism) have been impacted. Viet Nam government is aware the importance of MPA and promoting actions for marine conservation. This paper is to review the existing status, plans and perspective of MPA system in Viet Nam.

1. History and existing status

Protected areas was considered as a tool to conserve coastal and marine ecosystems in Viet Nam in 1986 when some reserves dominant by mangroves such as Ca Mau cape, Bac Lieu were established. In the same year, the 15,043 ha Cat Ba National Park was approved which included some 5,400ha of coastal waters making it the first protected area in the country with an approved marine component. Further marine surveys conducted by the Oceanographic Institute in Haiphong have recommended an expanded marine component for this park but this still waits formal approval.

Working together with the WWF-Viet Nam Program, the Institute of Oceanography in Nha Trang conducted surveys to plan similar extensions of the important marine component of the Con Dao Islands National Park. This has been approved in principle and a tentative zoning plan has been proposed for the park, which includes the marine environment.

Halong Bay was approved in 1994 as an UNESCO World Heritage Site comprising a thousand islands, it was proposed and established for its landscape qualities. The area of this famous site reaches up 43,700ha including mainly marine environment.

Xuan Thuy wetland was approved as Nature Reserve by Viet Nam government and the recognized as Ramsar site in 1995. This area is very famous in term of mangroves and migrant birds. The recent designation proposed to expand marine component about 1400ha but not approved yet.

Can Gio mangrove forest was destroyed thoroughly during the war. It is considered, however, one of the best mangroves in Viet Nam now by the trial to rehabilitate for more than 20 years. This area was recognized as Nature Reserve in 1990 by Viet Nam government and then as Biosphere Reserve on 21 January 2000 by UNESCO.

At present time, there are 22 existing protected areas considered relatively as coastal and marine protected areas with the purpose to conserve coastal forest, mangroves, seagrass beds and wetlands. Beside Cat Ba and Con Dao National Parks and Halong Bay World Heritage, the others have not included marine areas. Marine components of former terrestrial reserves such as Cat Ba and Con Dao National Parks have only recently been recognized as integral components of these protected areas, and even so must undergo further expansion to cover critical marine habitats. At the present time, only a nominal proportion of Viet Nam's coastal and marine resources are included in the existing protected areas system.

The details of existing coastal and marine protected areas and their management effectiveness are shown on Table 1. Based on

Table 1 Existing Coastal and Marine Protected Areas in Viet Nam and Management Issues

Area Name	Year	Size (Ha)	Designate	Protection Requirement	Management Effectiveness
Ha Long Bay	1994	43,400	World Heritage Site	High	Medium
Ba Mun	1977	2,153	Nature Reserve	Medium	Low
North Hai Van	1993	14,498	Landscape PA	Medium	Low
South Hai Van	1992	10,519	Landscape PA	Medium	Low
Son Tra Peninsular	1977	4,439	Nature Reserve	High	Low
Deo Ca - Hon Nua	1986	8,876	Landscape PA	Medium	Low
Ca Mau cape	1986	4,453	Nature Reserve	High	Medium
Bac Lieu	1986	125	Managed Nature Reserve	High	Medium
Ong Trang	1993	1,540	Managed Nature Reserve	High	Medium
Dam Doi	1986	272	Managed Nature Reserve	High	Medium
Cat Ba	1986	20,700	National Park	High	Medium
Xuan Thuy	1995	7,686	Nature Reserve	High	Medium
Cu Lao Cham	1986	1,544	Nature Reserve	High	Low
Binh Chau- Phuoc Buu	1986	11,293	Nature Reserve	High	Medium
Con Dao	1984	19,998	National Park	High	High
Vo Doi	1986	3,757	Nature Reserve	High	Medium
Phu Quoc	1986	14,957	Nature Reserve	High	Low
Can Gio	1990	42,630	Managed Nature Reserve	High	High
Tien Hai	1995	12,500	Nature Reserve	High	Low
U Minh	1993	9,794	Nature Reserve	High	Medium
Thai Thuy	1998	13,697	Nature Reserve	High	Low
Thanh Phu	1994	8,823	Nature Reserve	High	Medium

the criteria of the project of reef at risk in southeast asia, only two areas (con dao national park and can gio biosphere reserve) are considered being good management and 13 ones belong to medium level of management effectiveness. Meanwhile, almost areas (18/22) have needed high protection requirement. Be aware that all existing areas have been mainly designed for terrestrial biodiversity conservation. In term of institutional arrangement, all existing protected areas of the country have been managed by forest protection department (fpd) of ministry of agriculture and rural development (mard). The staff were mainly trained for terrestrial conservation. Up to present, there has not been any agency responsible to marine conservation. It means that management effectiveness for marine environment is lower than that showed in above figure.

2. The Plans for Future

The project ADB 5712-REG (phase 2) has proposed the national system including 30 coastal and marine protected areas in which there are 6 existing ones of priority for only strengthened management, 8 existing ones of priority for expansion and strengthened management, and new establishment of 6 protected areas. With this plan, the areas of marine ecosystems will be increased significantly (Table 2). The objectives and details of the plan were summarized by Vo Si Tuan et al. (in print). The report can be available from Viet Nam MOSTE or WWF Indochina at Ha Noi.

Recently, Viet Nam Government authorized Ministry of Fisheries (MoFi) to develop National Plan for Marine Protected Areas. The results of the project ADB 5712-REG have been used for a part of this plan. MoFi plan has emphasized the areas (15 areas listed) with dominance of marine components and supported mainly to coral reefs and seagrass beds. The plan included also a marine protected area in Spratly archipelago. The plan is on the way to be approved by the government and then the problem of institutional vacuum will be solved in near future. It means that Viet Nam will have two systems responsible to manage PA systems in forthcoming time. FPD of MARD continues to do management of terrestrial PAs including mangroves, coastal forest ecosystem. MoFi will be responsible to the PAs on the sea with the objectives to conserve mainly coral reefs, seagrass beds, island ecosystems and marine living resources. Some of them are being managed by FPD at present time.

3. Opportunities

SIGNIFICANCE OF COASTAL AND MARINE BIODIVERSITY RESOURCES Many of Viet Nam's coastal and marine reserves contain biodiversity values which have high value for national conservation. The BAP (Government of Viet Nam and GEF, 1995) indicated four marine reserves have high biodiversity significance and are worthy of priority attention for management: Con Dao, Cat Ba, Phu Quoc, and Vo Doi. A portion of Cat Ba National Park forms part of the Ha Long Bay UNESCO World Heritage Site and is thus already of high international importance. The recommended expansion of the reserve to include the biodiversity-rich outer islands in the bay will further emphasize the importance of the park to the region and to international conservation as a whole. Additionally the Tam Giang-Cau Hai Reserve is being proposed as the country's second Ramsar Site as a sister to Xuan Thuy, a Ramsar Site since 1995. Implementation of effective management in the above sites will rank all these protected areas as the most important coastal and marine sites in the country and key sites for regional conservation in the South China Sea.

Table 2 Increase in coastal and marine ecosystem protection that would be achieved with Plan for Coastal and Marine PAs^{xxxiv} by project ADB 5712-REG (phase 2)

Ecosystem	Total Area (ha)	Existing Protection		Proposed Protection	
		Area (ha)	% Total	Area (ha)	% Total
Mangrove	110,670	43,115	39	43,185	39
Coral Reef	7,532	1,000	13	4,500	60
Seagrass	4,578	0	-	2,660	58
Island	184,440	39,093	21	75,303	41
Other Coastal Wetlands ^{xxxv}	108,530	11,227	10	50,598	47
Total	415,750	94,435	23	176,246	42

COMMUNITY AWARENESS AND PARTICIPATION The coastal surveys^{xxxvi} indicate a high community awareness of the major issues affecting the decline in marine resources that impact their lives and perpetuate the poverty of coastal communities in Viet Nam. This awareness will be an important asset in securing support of conservation initiatives in the coastal and marine protected areas that indeed require community support. At the same time, however, those interviewed in these community surveys indicated that their important concerns, not at all surprisingly, relate to infrastructure, credit, marketing issues, rural poverty, and environmental sanitation. Only a few of approximately 20 issues raised by the coastal communities are related to biodiversity conservation and these were relatively low priority. These results indicate that, to be successful in the long term, any protected area investment must address the basic socioeconomic needs of rural coastal communities. Without this, these communities will continue to use the resources of designated protected areas for their own economic purposes.

TOURISM There are five priority coastal tourism zones in the coastal area of Viet Nam comprised of some 12 coastal provinces^{xxxvii}. 24 of the 39 existing and proposed coastal and marine Protected areas occur in these priority provinces, which indicates a close relationship between the locations of these protected areas and the country's overall tourism development plans. The total international tourism visits^{xxxviii} in Viet Nam in 1993 were some 1.3 million people, increasing to over 2.7 million in 1998. Of these, international visits to coastal provinces numbered some 970,000 people for 1993 and almost 1.7 million people in 1998, an increase of about 12% per year over this period. The equivalent figures for domestic tourist visits^{xxxix} are 6.5 million for 1993 and 13.6 million in 1998. Domestic visitors to coastal provinces increased from about 4 million people in 1993 to 7.7 million people in 1998, an increase of about 14% per

^{xxxiv} These estimates are made using best available coastal and marine ecosystem data available at the time this Plan was prepared; data are found in GEC Ltd., WWF, and WIAP, 1999. ADB 5712-REG Phase 2. Socialist Republic of Viet Nam: Technical Annex 2: Viet Nam Coastal And Marine Environmental Management Database. Report prepared for Asian Development Bank. 67 pp.

^{xxxv} lagoons, estuaries, tidal mudflats, Melaleuca forest

^{xxxvi} Technical Annex 1, op. cit.

^{xxxvii} The National Tourism Master Plan designates the following 12 provinces in the National Tourism Zones: CTZ 1 Quang Ninh, Hai Phong, Thai Binh; CTZ 2 Thua Thien, Quang Nam, Da Nang; CTZ 3 Khanh Hoa, Ninh Thuan, Binh Thuan; CTZ 4 HCM City, Ba Ria Vung Tau; and CTZ 5 Kien Giang.

^{xxxviii} International tourist coastal province and total Viet Nam international visits are based on the total number of international tourist arrivals in all coastal province destinations and in all Viet Nam destinations combined, respectively. International tourists who visit more than one province are counted in each province. International tourists who visit more than one destination in a province are counted at each destination.

^{xxxix} Domestic tourist coastal province and total Viet Nam domestic visits are based on the total number of domestic tourist arrivals in all coastal province destinations and in all Viet Nam destinations combined, respectively. Domestic tourists who visit more than one province are counted in each province. Domestic tourists who visit more than one destination in a province are counted at each destination.

year over this period.

Many of the protected areas ranked and selected as priority sites for development assistance by this project occur in priority provinces in the National Tourism Master Plan and are already targeted for tourism development. These protected areas will play a significant role as tourism continues to develop and expand in the country. Environment is an important part of the tourism product that the country has to offer. Successful tourism will therefore attempt to maximize profits while preserving the natural environment. The favorable locations of protected areas will be an economic advantage to the private sector involved in the tourism industry. Preservation of the seascapes and biodiversity values in the coastal and marine zone should be an important priority to government planners who recognize the significance of their natural heritage to a successful tourism (visitor-oriented) economy.

INTERAGENCY COOPERATION AT THE LOCAL LEVEL There are some examples of successful protected area management at the local level. For instance, joint agreements by local institutions to cooperate in management and protection to look after all institutional needs already exist at Con Dao National Park. In this protected area there is a good deal of cooperation between the District People's Committee, the Fisheries Department, the National Park, the Navy, fishermen and other citizens. Improvement in the planning and management of coastal and marine protected areas will require that local levels of organization - districts, communes, and villages - need to be involved and to be allocated more responsibility for these activities. Joint institutional agreements and collaboration at the local level can utilize scarce physical resources as well as ensure that at least one professional on the island is adequately trained in a required field, such as environmental monitoring and management. Con Dao has a rudimentary cooperation structure in place around specific activities. This foundation of collaboration can hopefully be extended and expanded to identify those areas of marine environmental management that need strengthening, with the ultimate goal being the conservation of the island resources and environment.

TRAINING Training opportunities for guards, rangers, area managers, technicians, and scientists have been made available through GEF/UNDP projects and other projects implemented by the WWF, but these have thus far largely been focused on personnel assigned to forest reserves, with little attention to management staff in marine reserves. Under the GEF/UNDP/WWF project, three training facilities have been established at Cuc Phuong, Cat Tien, and Bach Ma, and thus far some 2,000 guard level staff of forest reserves have benefited from six week in-country short courses and another 12 Ms.level degree studies have been provided to senior level managers in Forestry. Recently, six staff from Con Dao were sent to the Philippines for SCUBA training but as yet a similar training program and facilities for staff in other marine reserves is required to mirror the good of the facilities and work in the forestry sector. Existing facilities in these areas combined with practical field training in Cat Ba or Con Dao or both using their facilities can be used to offer at least part of the needed training for staff of marine reserves. Trainers conducting training programs presently being offered by the Great Barrier Reef Marine Protection Authority (GBRMPA), Australian Institute of Marine Science (AIMS), and the Coastal Zone Environmental and Resource Management Project (CZERMP) in Viet Nam would have already developed course materials and manuals.

CONCLUSION

The establishment and management of marine protected area system become an urgent requirement for biodiversity conservation and sustainable development of coastal zone of Viet Nam. The government has invested a number projects concerning with scientific baseline and institutional arrangement of MPAs. There are also strong supports from international organizations. WB and DANIDA selected Hon Mun area (Nha Trang) to be a pilot site of marine protected areas. Danish Environment Assistance program for Viet Nam has prepared some other projects to develop MPAs in framework of Integrated Coastal Management. More supports are appreciated to formulate MPA system of Viet Nam in near future.

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PRELIMINARY STUDY ON THE EFFECT OF DYNAMICAL PROCESSES OF THE MAXIMUM TURBIDITY ZONE ON PLANKTON ECOLOGY IN THE PEARL RIVER ESTUARY

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Abstract

This paper preliminarily studied the effect of dynamical processes of the maximum turbidity zone on plankton ecology in the Pearl River estuary using the method of analyzing historical investigation data. The result indicated that the dynamic processes of turbulence mixing, gravitational circulation, re-suspension and front have obvious influence on plankton ecology within the maximum turbidity zone in the Pearl River estuary. The concentration of chlorophyll *a*, primary productivity, the amount of phytoplankton and zooplankton is 1.87mg/m³, 609mg/m².d, 1055 (104cell/m³ and 319ind/m³ respectively in winter; 1.98mg/m³, 86mg/m².d, 84 (10cell/m³ and 129ind/m³ respectively in summer. The concentration of chlorophyll *a*, primary productivity, the amount of phytoplankton and zooplankton in maximum turbidity zone are higher than in the near sea area. The plankton ecology within the maximum turbidity zone in the Pearl River estuary is mainly controlled by dynamic factor. This aspect of research is one of the basic research of ecosystem dynamical processes and ecosystem model of estuary, and it is worthwhile to study deeply.

INTRODUCTION

Since 1990s, a new international cooperated research plan ----Global ocean ecosystem dynamics (GLOBEC) has being formed under the promotion of a few the international organizations (Wan, 1998; Wu et al., 1998; Zeng, 1998). The research field of GLOBEC mainly is focused on the physical processes effect on plankton, and the interactions between physical processes and biological processes (Wan, 1998). Estuary is the area of frequent human activities, complex dynamical processes and frail ecology. The research of estuarine has been gradually recognized since the research plan of LOICZ was put forward by IGBP (Liu et al., 1996). Estuary ecosystem is similar to marine ecosystem in many aspects. However, because the abiological condition and transport processes are different, the structure of biological population and spatial variation are also different, a special ecosystem is formed in the estuary. The special horizontal transport caused by the interaction between the dynamics of river and ocean, front, stratification, tuburlance mixing are the important dynamical processes. The functions of these processes in estuarine ecosystem have not been understood well, and they can't meet the necessities to establish estuarine ecosystem model yet.

The maximum turbidity zone is one of the special dynamic phenomenon in tidal estuary. It is the cloudy waters in which the concentration of suspended particular matter is higher than in the upper river and down sea area, and it often moves upper and down regularly in a certain range. Maximum turbidity zone can been found in every tidal estuary in every climate condition in the world, specially it develops very well in part mixing estuary and full mixing estuary (Sheng, 1995). The initial stage research of maximum turbidity zone has been focused on deposition dynamics in estuary, then on the characteristic and regular pattern of geochemistry. In recent years, the research has been focused on biogeochemistry, ecology and environment. The results indicated that: the maximum turbidity zone has the function of enriching heavy metals and other pollutants (Alan et al., 1996; Fishes, 1991; Seylen et al., 1990). The pollutants can be absorbed by plankton, and then affects the whole estuary ecosystem by food chain. In other way, the maximum turbidity zone is the area for fish spawning and growing, and that fish resource is abundant in the maximum turbidity (John, 1993; Julian, et al., 1989). Therefore, it is a very important work to study more deeply on plankton ecology within the maximum turbidity. Simultaneously, a few research results indicated that the dynamic processes of turbulence mixing (Irihion et al., 1997; Cloern, 1987; Alpine et al., 1996; Ficher, et al., 1992; Grobbelaar, 1985; Cole et al., 1984; Wofsy, 1983; Grobbelaar, 1990;), gravitational circulation (Ficher, et al., 1992; Tremblay, et al., 1997), re-suspension (Wofsy, 1983) and front (John, 1993; Flemming, 1993; Frank, 1992; Fever, 1986; Mann, 1988; Arthur, 1979; Ball et al., 1979) have obvious influence on plankton ecology within the maximum turbidity zone. The Pearl River Estuary is one of the largest one in China, in which the maximum turbidity zone develops very well, and its moving range is large. In this paper, the effect of dynamical processes of the maximum turbidity zone on plankton ecology in the estuary of Pearl River will be preliminarily discussed based on historical data.

1. THE DYNAMICAL CHARIRESTICS OF MAXIMUM TURBIDITY IN THE PEARL RIVER ESTUAREY

The Pearl River is the third largest river in China and the largest river system flowing into the South China Sea. The Pearl River estuary lies in southern Guangdong Province. The estuary is located in a subtropical area, with annual rainfall ranging from 1600 to 2300 mm. The annual water flow rate of the river is about 11,100m³/s. The main Pearl River estuary (also called Lingdingyang) is a N-S bell-shape area, with a N-S distance averaging about 49km and the E-W width varying from 4 to 58km(see Fig1). The whole estuary area is within the sub-tidal zone with strong fresh water and marine water interactions and circulation current along the west coast. The estuary is complex in environmental and hydro-dynamical conditions, and the ecosystem is very frail.

The economy along the estuary has developed rapidly in the past two decades. The developed city Hong Kong and Macau are located in the eastern and western side of the estuary respectively. The action of mankind has put tremendous pressure on the local environment. It is very important to propose measure for strategic environmental control and management in the Pearl River delta region for the next century. Plankton is the basic biology in the estuarine ecosystem, and it is also the main source of substance and energy for ecosystem. So the research on dynamical processes of plankton ecosystem in the Pearl River estuary has great significance for practice and theory.

Many research results indicated (Sheng, 1995; Tian, 1986; Pang et al., 1999; Uncles et al., 1993): gravitational circulation, flocculation deposition of silt, re-suspension caused by eroding of tidal current are the three main causes for the forming of maximum turbidity zone. The research on maximum turbidity zone in the Pearl River estuary (Tian, 1986) showed that: during full tidal period, the total positive pressure points to down river, and the inclined pressure always points to upper river, a zero point of pressure gradient exists in bottom water during full tidal period. The average inclined pressure is less than the positive pressure during full tidal period in the surface water, and that the average inclined pressure is larger than the positive pressure in the full tidal period in the bottom water from the zero point to down river. Therefore a net gravitational circulation forms, which the surface water flows to down river, and the bottom water flow to upper river, under the co-operation of inclined pressure and the positive pressure. The sediment substance is main silt with high

content of water in bottom of Pearl River estuary. Especially in the upper layer sediment of 1-2cm, the inter-space of silt is high to 0.586. Silt will enter water and became suspended status again when the tidal current is larger than critical value of sandy moving. The re-suspend sandy will be conveyed and assembled by gravitational circulation in the bottom water, and will form maximum turbidity zone. The clay in the estuary is easy to flocculate when the salinity is above 4, and salinity variation range of maximum turbidity zone in the estuary is 4-22. The content of fine grain is very high in the range of maximum turbidity zone, and this has a good relationship to flocculation of silt.

2. THE TERRITORY OF MAXIMUM TURBIDITY ZONE IN THE PEARL RIVER ESTUARY

From 1980s to 1990s, two large-scale multidisciplinary investigation of resource in the Pearl River estuary were carried out, they are "Multidisciplinary Investigation of Coastal Resources of Guangdong" and "Multidisciplinary Investigation of Island Resource of Guangdong". The content of the two multidisciplinary investigations included hydrology, chemistry, environment, climate, geology and biology. The characteristics of tidal dynamics, mixing between fresh water and marine water, transportation of silt were analyzed in the reports of the two investigations (GCRI, 1986; GIRIG, 1993). In recent years, several investigations of hydrology and water quality were also carried out in the Pearl River estuary by Hong Kong government for the environmental impact assessment of some large coastal projects. The above investigation data was also helpful to understand the hydro-dynamics and environment condition furthermore.

In these results, there were few researches on maximum turbidity zone directly. According to the classification standard for estuary, the main estuary (Lingdingyang) belongs to partially mixing estuary during flood season, and fully mixing estuary during dry season (Tian 1986). During flood season, the salt water first enters into the estuary like a wedge from Urmston Road (see Fig.1), then enters into the estuary from Lantau Channel after an hour. The maximum turbidity zone changes gradually with the variation of tidal period. The maximum turbidity zone moves to the upper estuary in flood tidal period, and moves to the down estuary in ebb tidal period. This moving distance is about 2-5km. In other way, the maximum turbidity zone is also affected by the variation of runoff from river, the maximum turbidity zone moves to down estuary in flood season, and moves to upper estuary in dry season. The moving distance is about 8-13km. The territory of maximum turbidity zone is mainly at the central area of the estuary. In addition, the concentration of suspended particular matter is also affected by tide period and season. Generally, the concentration in flood tide is higher than in ebb tide, and the concentration in flood season is also higher than in dry season.

The territory of maximum turbidity zone illustrated above is only one the research results. Concerning the close relationship between maximum turbidity zone and estuary front, the territory of maximum turbidity zone is possible different to the above result. In fact, the later research results showed that (Ying, 1994; Ying, 1995) two kinds of density front exist in the main estuary (Lingdingyang). One is the front between the fresh water and the fresh-marine mixing water; the other is the front between the fresh-marine water and marine water. The first kind front exists at the area between West Shoal and West Channel. The fresh water from Jiao Men, Hongqi Men and Heng Men (the salinity is less than 2) run across the West Shoal, and encounter the fresh-marine water from Hu Men (the salinity is 2-30). The front, which is also called estuary shoal front, is formed by velocity shear and density gradient. This front starts from the area near Humen, and stretches to the area near Zhuhai. The second kind front exists at the area between Neilingding Island and Lantau Island. The forming mechanism of front is that: in the initial stages of flood tide, the high salinity water (the salinity is higher than 30) enters into the estuary from Urmston Road and Lantau Channel successively, and encounters the fresh-marine water which restores near the north side of Lantau Island. According to the latest result (Sheng, 1995), the main mechanism is silt source from land and salinity. Therefore, territory of fresh-marine front is similar to the territory of maximum turbidity zone. In summary, the territory of maximum turbidity zone is from the area near Hu Men to the north side of Lantau Island.

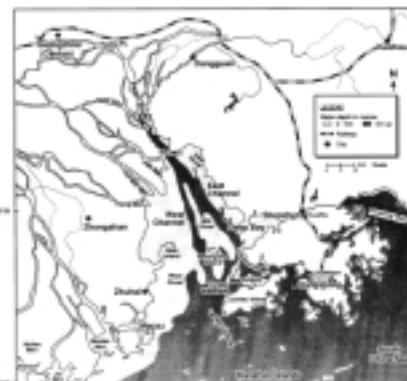


Fig.1 The location of the Pearl River estuary

3. THE EFFECT OF DYNAMICAL PROCESSES OF THE MAXIMUM TURBIDITY ZONE ON PLANKTON IN THE PEARL RIVER ESTUARY

The early research result about plankton in Pearl River estuary was mainly focused on the quantity, species, distribution and variation, and there were few researches on the relationship between plankton and environment condition, much less came down to plankton ecology dynamics. In recent years, there were several researches focus on the structure and function of plankton ecology system, the relationship between primary productivity and secondary productivity, the relationship between ecological characteristics of plankton and environment condition (Huang et al. 1995; Huang, et al., 1995; Huang et al. 1997).

In later 1990s, several investigations on plankton ecology were carried out in the Pearl River estuary and adjacent waters, these data are used in this paper to analyze the dynamical effects of maximum turbidity zone on plankton ecology. The main results are illustrated in Tab.1. The transparency in inner estuary (Hu Men to Lantau Island, also the territory of maximum turbidity zone) is 0.6m and 0.8m in summer and winter respectively, the transparency in outer estuary is 3.5m and 5.3m in summer and winter respectively, and the transparency in Dapeng Bay is 9.0m and 3.9m in summer and winter respectively. In spite of the transparency in the sea area of inside estuary is less than outer estuary and Dapeng Bay, the concentration of chlorophyll a, primary productivity, the amount of phytoplankton and zooplankton in maximum turbidity zone are higher than in the adjacent waters. The concentration of chlorophyll a, primary productivity, the amount of phytoplankton and zooplankton in maximum turbidity zone is 11.87mg/m³, 609mg/m².d, 1055 (10⁴cell/m³) and 319ind/m³ respectively in winter; 1.98mg/m³, 86mg/m².d, 84 (10cell/m³) and 129ind/m³ respectively in summer. Therefore, the plankton ecology within the maximum turbidity zone in the Pearl River estuary is mainly controlled by hydro-dynamical factor.

Table 1 Biomass and environment parameters in the Pearl River estuary and adjacent waters

Season	Area	Sal.	Tran. (m)	Chl-a (mg/m ³)	Primary Productivity (mg/ m ² .d)	Phytoplankton Abundance (×10 ⁴ cell/m ³)	Zooplankton Abundance (ind/m ³)
Summer	Inner Sea	16	0.6	1.98	86	84	129
	Outer Sea	32	5.3	0.95	343		222
	Dapeng Bay	24	9.0	0.32	104	275	430
Winter	Inner Sea	26	0.8	11.87	609	1055	319
	Outer Sea	33	3.5	0.78	175		
	Dapeng Bay	32	3.9	0.66	169	50	276

4.CONCLUSION

It will be helpful for protecting estuarine ecosystem to develop ecosystem model. In recent years, ecosystem dynamics has been recognized as an important factor affecting marine ecosystem. Maximum turbidity zone is one of special dynamic phenomenon in tidal estuary, and plankton ecology dynamic process in estuarine maximum turbidity zone is an important process in the research on estuarine ecosystem dynamics. This paper preliminarily studied the effect of dynamical processes of the maximum turbidity zone on plankton ecology in the Pearl River estuary using the method of analyzing historical investigating data. It is showed that the dynamic processes of turbulence mixing, gravitational circulation, resuspension and front have obvious influence on plankton ecology within the maximum turbidity zone in the Pearl River estuary. The concentration of chlorophyll a, primary productivity, the amount of phytoplankton and zooplankton in maximum turbidity zone are higher than in the adjacent waters. The plankton ecology within the maximum turbidity zone in the Pearl River estuary is controlled by dynamic factor. This aspect of research is one of the basis of research of ecosystem dynamic processes and model of estuary, and it is worthwhile to study deeply.

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Seasonal Variation of Stratification in the Gulf of Thailand

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Intensive hydrographic observations were carried out in the western part of the Gulf of Thailand and the east coastal sea of Peninsular Malaysia in September 1995 and April–May 1996. The characteristics of seasonal variation of oceanic condition in that area are discussed basis of an analysis of observed water temperature, salinity and density distributions in these cruises and NAGA cruises (Yanagi and Takao, 1998a). Stratification is most developed in March–May mainly due to large sea surface heating and weak sea surface wind, which weakened until September–October, vanishing in December–January. The horizontal distribution of bottom cold, saline and heavy water masses, which are found during the stratified season, is governed by the tidal mixing and the water depth. Water exchange between the Gulf of Thailand and the South China Sea becomes large in March–May due to a coupled effect of the intensified estuarine circulation and the Ekman transport by the southwest monsoon.

Keywords:

· Stratification,
· seasonal variation,
· Gulf of Thailand,
· SEAFDEC.

1. Introduction

No systematic and intensive field observation had been conducted in the Gulf of Thailand after the Joint Thailand-Vietnam-US NAGA Expedition of 1959–1961 (Wyrtki, 1961). Therefore, the detailed characteristics of seasonal variation of the oceanic condition in the whole area of the Gulf of Thailand have not yet been clarified.

SEAFDEC (South East Asian Fisheries Development Center) carried out two intensive field observation campaigns in the western part of the Gulf of Thailand and the east coastal sea of Peninsular Malaysia in September 1995 and April–May 1996. The raw data have already been published (Saadon *et al.*, 1999).

We analyzed the water temperature and salinity data obtained by these cruises in this paper in order to clarify the detailed characteristics of seasonal variation of oceanic conditions in the western part of the Gulf of Thailand and the east coastal sea of Peninsular Malaysia.

2. Observations

Intensive hydrographic observations were carried out from 5 to 28 September 1995 and from 24 April to 17

May 1996 by M.V.SEAFFDEC at 81 stations in the western part of the Gulf of Thailand and the east coastal sea of Peninsular Malaysia (Fig. 1). A CTD (Conductivity, Temperature and Depth profiler) cast was made at each observation station in order to obtain the vertical profiles of water temperature and salinity. Density (σ_t) is calculated from water temperature and salinity using the usual state equation.

The spatial resolution of these observations was finer than that of NAGA Expedition since the NAGA cruises covered 36 to 47 stations whereas the SEAFDEC cruises used 81 stations.

3. Results

Horizontal distributions of sea surface water temperature, salinity and density (σ_t) in September 1995 and April–May 1996 are shown in Fig. 2. The sea surface water temperature in April–May 1996 was higher by about 1°C than in September 1995. The sea surface salinity in the western part of the Gulf of Thailand and east coastal sea of Peninsular Malaysia in April–May 1996 was lower than in September 1995. Salinity in the offshore area east of Peninsular Malaysia in April–May 1996 was higher than in September 1995. The density in the western part of the Gulf of Thailand and east coastal sea of Peninsular Malaysia in April–May 1996 was lower than in September

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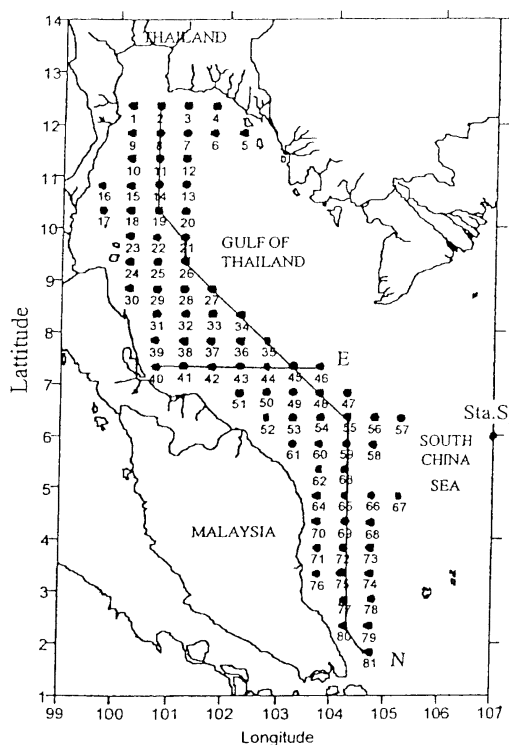


Fig. 1. Locations of 81 sampling stations during both cruises. Vertical distributions of water temperature, salinity and density along the E and N sections are shown in Figs. 3 and 4, respectively.

ber 1995. Density in the offshore area east of Peninsular Malaysia in April–May 1996 was higher than in September 1995.

Vertical distributions of water temperature, salinity and density across the west-east observation section from Sta. 40 to Sta. 46 (Line E in Fig. 1) are shown in Fig. 3. Low water temperature, high salinity and high density water mass existed in the bottom layer around Sta. 42 in September 1995. Low water temperature and high density water mass existed in the bottom layer around Sta. 43 in April–May 1996 with a volume larger than in September 1995. In the surface and middle layers, water temperature, salinity and density were vertically well-mixed in September 1995 but stratified in April–May 1996. Low salinity surface water spread from Peninsular Malaysia to the east during April–May 1996. Density distributions in both seasons were affected by both temperature and salinity ones.

Vertical distributions of water temperature, salinity and density across the north-south observation section from Sta. 2 to Sta. 81 (Line N in Fig. 1) are shown in Fig. 4. Low water temperature, high salinity and high density water masses existed in the bottom layer around Stas. 21

and 63 in September 1995. In April–May 1996, thermocline, halocline and pycnocline developed from the bottom around Sta. 21 to the sea surface around Sta. 34 or Sta. 72. A surface water temperature front existed around Sta. 72 but a salinity one around Sta. 34. Sea surface density fronts existed around Stas. 34 and 72 corresponding to salinity and temperature fronts, respectively.

Vertical profiles of water temperature, salinity and density at the central part, Sta. 35, are shown in the lower panel of Fig. 5. Stratification developed in April–May 1996. Seasonal variations of vertical profiles of water temperature, salinity and density at nearly the same station during NAGA cruises are shown in the upper panel of Fig. 5 (Yanagi and Takao, 1998a). The seasonal variation of vertical profiles of temperature, salinity and density in NAGA cruises is very similar to that found in SEAFDEC cruises, that is, stratification was most developed in March–April 1960, weakened in October 1959 and vertical mixing was dominant in December 1959–January 1960. This suggests that the seasonal variations of water temperature, salinity and density observed in SEAFDEC cruises were not unique phenomena in 1995 and 1996 but typical ones in this area.

4. Discussion

4.1 Seasonal variation of stratification

Sea surface water temperature and salinity in April–May 1996 were higher and lower, respectively, than values recorded in September 1995, as Figs. 2 and 5 show. Such a water temperature increase in the surface layer is mainly due to large sea surface heating and weak sea surface wind in April–May. The seasonal variation of the heat flux through the sea surface and the sea surface wind in the Gulf of Thailand are shown in Figs. 6 and 7 (Stansfield and Garrett, 1997). Sea surface heating is larger and sea surface wind is weaker in April–May than in September. Large sea surface heating and weak sea surface wind result in the development of stratification in April–May, which is clearly shown in Fig. 5. Quantitatively, surface water temperature depends not only on the sea surface heat flux and wind stirring but also on horizontal heat transport. We shall therefore have to carry out a quantitative study in the near future in order to clarify the detailed mechanism of seasonal variation of water temperature in this region.

The maximum river discharge into the Gulf of Thailand is recorded in October, as shown in Fig. 8 (Snidvongs, 1998). Though the river discharge in April–May is lower than in September, sea surface salinity becomes lower in April–May than in September due to the development of stratification, as shown in Fig. 5. However, vertically averaged salinity in September is lower than that in April–May due to larger river discharge.

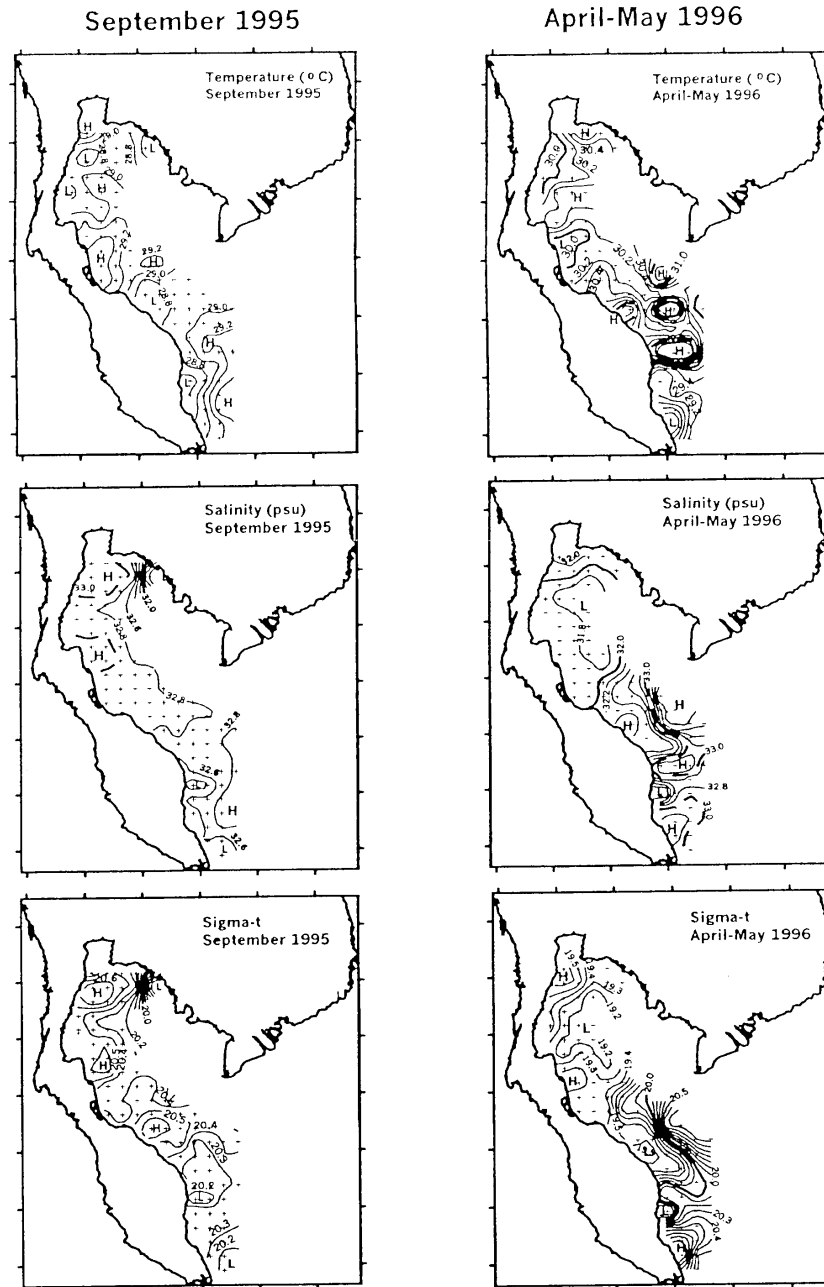


Fig. 2. Horizontal distributions of water temperature, salinity and density (sigma-t) at the sea surface in September 1995 and April-May 1996.

From Figs. 5, 6, 7 and 8, we can understand the characteristic of seasonal variation of stratification in the Gulf of Thailand and the east coastal sea of Peninsular Malaysia. Stratification is most developed in March-May due to large sea surface heating and weak sea surface wind, weakened until September-October and it vanishes in

December-January due to sea surface cooling and strong northeast monsoon.

The effect of river discharge on the stratification is expected to become large from September to December due to the large discharge volume (Fig. 8), but the stratification is weakened in October, vanishing in December,

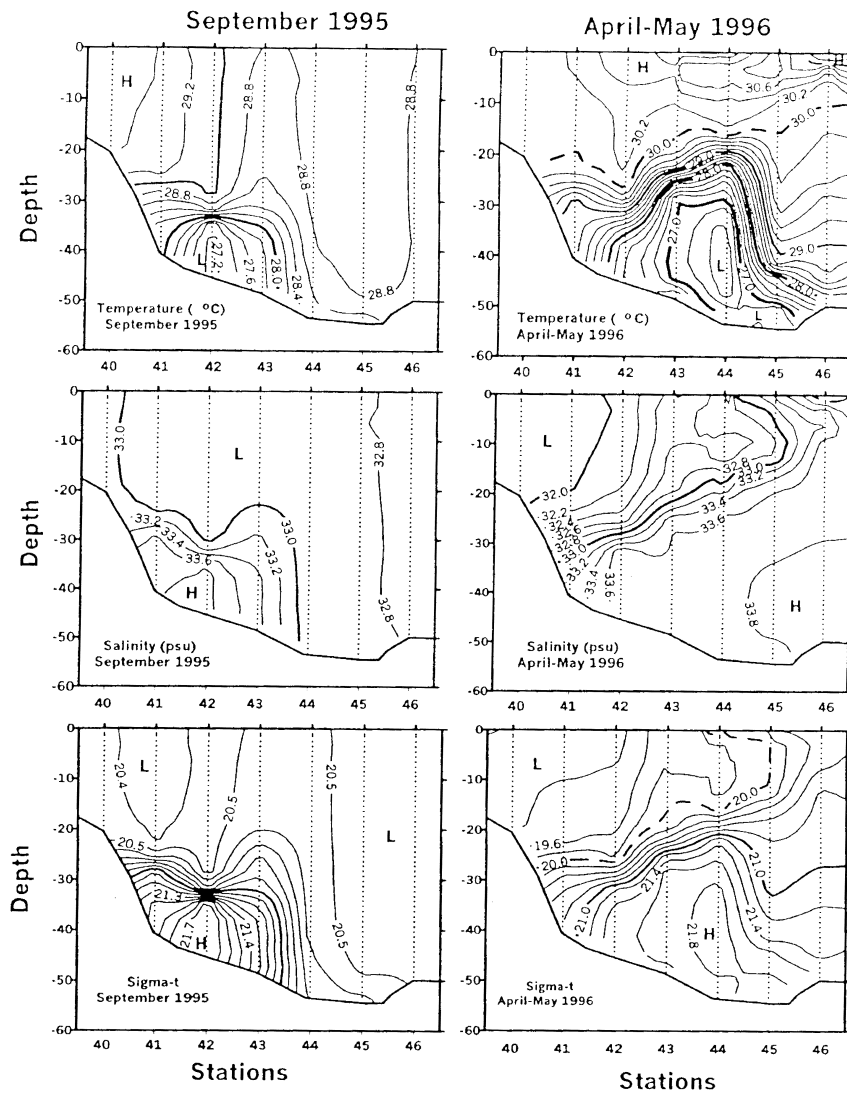


Fig. 3. Vertical distributions of water temperature, salinity and density along the E section from Sta. 40 to Sta. 46 in September 1995 and April-May 1996.

as shown in Fig. 5. These facts suggest that the seasonal variation of stratification in the Gulf of Thailand is mainly controlled by sea surface heat flux and sea surface wind. The effects of sea surface heating (B_h) and fresh water discharge (B_f) to the stratification are estimated by the following equation (Yanagi and Takahashi, 1988):

$$B_h = \alpha Q / c_p, B_f = \beta SR / A, \quad (1)$$

where α denotes thermal expansion coefficient ($2.3 \times 10^{-4} \text{ } ^\circ\text{C}^{-1}$), Q sea surface heat flux, c_p a specific heat ($0.95 \text{ cal g}^{-1} \text{ } ^\circ\text{C}^{-1}$), β salinity contraction to density (10^{-3}

$\text{g cm}^{-3} \text{psu}^{-1}$), S salinity, R river discharge and A surface area under the effects of river discharge ($3 \times 10^5 \text{ km}^2$, Simpson and Snidvongs, 1998). When we substitute $Q = 80 \text{ W m}^{-2}$ ($=19.2 \text{ cal m}^{-2} \text{sec}^{-1}$), $S = 31.8 \text{ psu}$, $R = 500 \text{ m}^3 \text{sec}^{-1}$ in April and $Q = 20 \text{ W m}^{-2}$ ($=4.8 \text{ cal m}^{-2} \text{sec}^{-1}$), $S = 32.8 \text{ psu}$, $R = 3000 \text{ m}^3 \text{sec}^{-1}$ in September from Figs. 2, 6 and 8 into Eq. (1), we obtain Table 1. The effect of fresh water discharge on the stratification in the Gulf of Thailand is smaller by 1 order of magnitude than that of sea surface heat flux in April. Both have nearly the same values in September, when the fresh water discharge is largest, but the sum of B_h and B_f in September is smaller

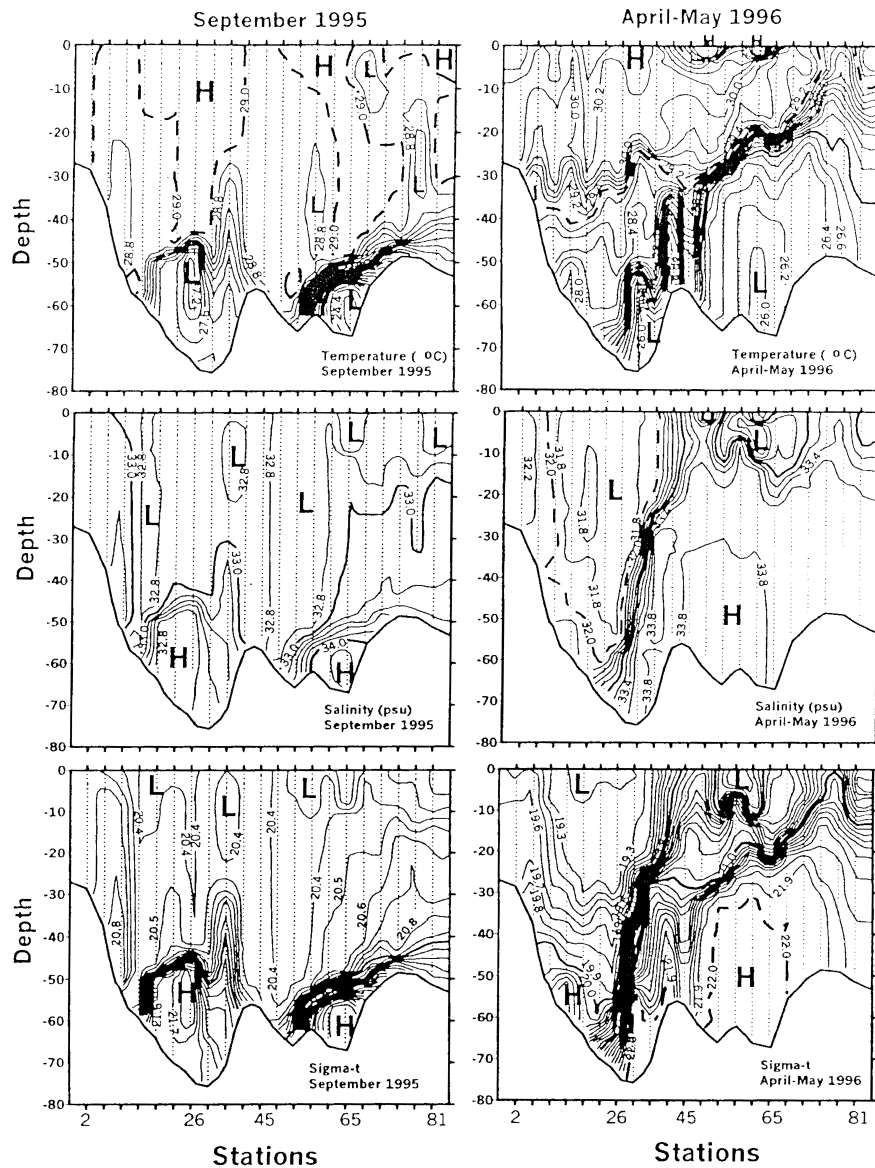


Fig. 4. Same as Fig. 3 except the N section from Sta. 2 to Sta. 81.

than B_h in April. If we include the effect of the Mekong River (largest river discharge in September is $45 \times 10^3 \text{ m}^3 \text{ sec}^{-1}$; Simpson and Snidvongs, 1998), B_f increases by one order of magnitude in September. However, we have no quantitative information on the ratio of Mekong River water to the fresh water volume in the Gulf of Thailand. The observed results on the seasonal variation in stratification shown in Fig. 5 suggest that the fresh water discharge effect cannot maintain the stratification in December–January when the strong northeast monsoon blows. A detailed analysis will be necessary in the future.

4.2 Seasonal variation of density-driven current

A T-S diagram for both cruises is shown in Fig. 9. The temperature and salinity of light surface water (upper left part of Fig. 9) in April–May 1996 were higher by about 1.0°C and lower by about 0.5 psu , respectively, than in September 1995, except for the values with about 28.5°C and 31.2 psu , that were obtained in the northeastern part of the Gulf of Thailand under the influence of local river discharge. The reason for such a seasonal variation of surface water temperature and salinity was explained in Subsection 4.1.

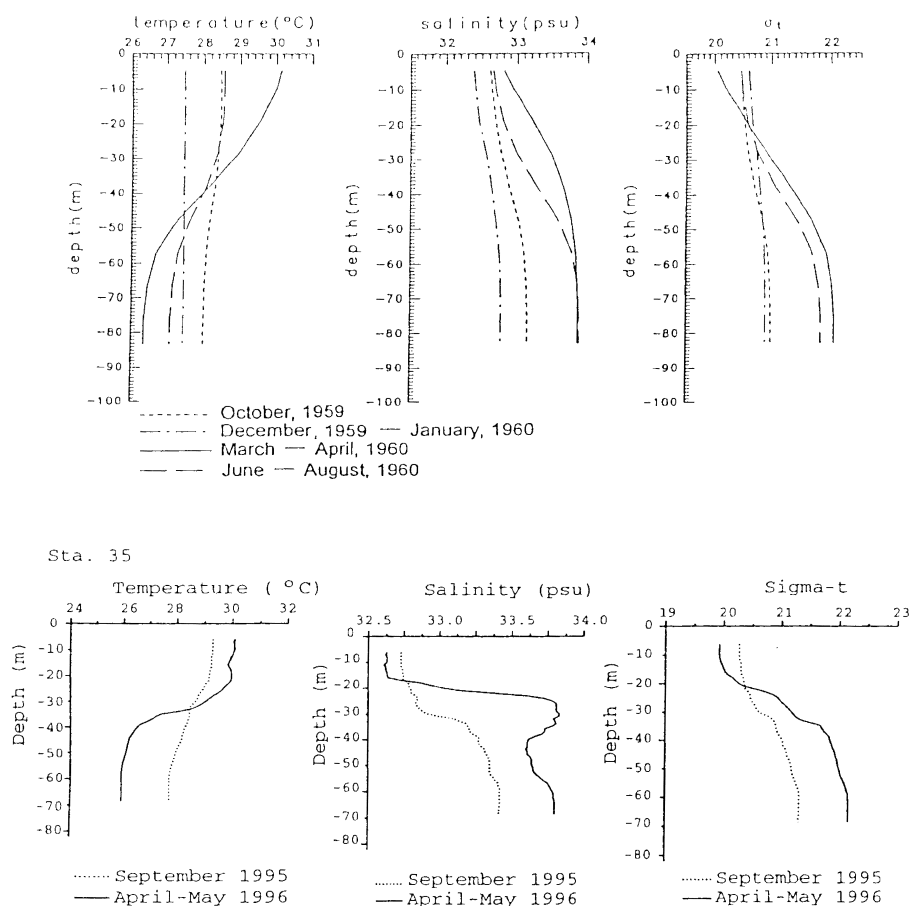


Fig. 5. Seasonal variations of vertical profiles of water temperature, salinity and density at the mouth of the Gulf of Thailand during NAGA cruises (upper; Yanagi and Takao, 1998a) and SEAFDEC cruises (lower).

By contrast, the temperature and salinity of heavy bottom water (lower right part of Fig. 9) in September 1995 were lower by about 0.5°C and higher by about 0.3 psu, respectively, than in April–May 1996. Such low water temperature and high salinity were observed in the bottom cold, salty and heavy water mass around Sta. 63, as shown in Fig. 4. This suggests that the temperature and salinity of the bottom cold, salty water mass, which was generated by the development of stratification in April–May, decreases and increases, respectively, until September. In other words, the cold and salty water is supplied from the South China Sea to the bottom cold and salty water mass in the Gulf of Thailand and the east coastal sea of Peninsular Malaysia. Climatological mean water temperature and salinity 100 m below the sea surface at Sta. S (see Fig. 1) above the shelf break of the South China Sea in April and September are also shown in Fig. 9 (National Oceanographic Data Center, 1998). Water temperature and salinity 100 m below the sea sur-

face at the shelf break are lower and higher, respectively, than those of the bottom cold and salty water mass in the east coastal sea of Peninsular Malaysia. These facts suggest that the development of the density-driven current, which is induced by the horizontal density difference between the head of the Gulf of Thailand and the South China Sea and flows offshore in the upper layer and on-shore in the lower layer, during the stratified season from March to October. From Fig. 4, the density difference 20 m below the sea surface between the upper Gulf of Thailand and the tip of Peninsula Malaysia is nearly 0 sigma-t in September but about 2.0 sigma-t in April–May. This means that the density-driven current, driven by the density difference between the head of the Gulf and outside of the Gulf, is intensified in April–May. This also suggests that the water exchange between the Gulf of Thailand and the South China Sea is intensified in March–May when the stratification is developed.

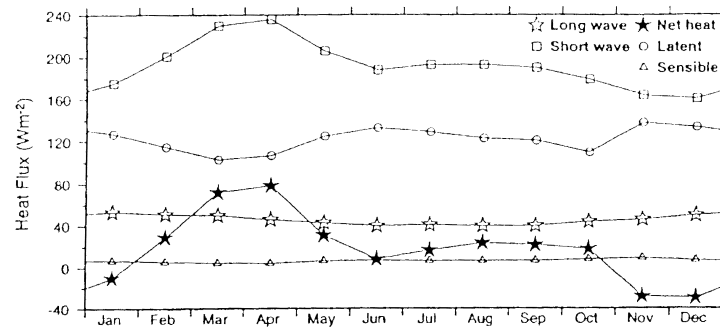


Fig. 6. Average annual cycle of the individual heat flux components and the net heat flux (W m^{-2}) over the Gulf of Thailand from the $1^\circ \times 1^\circ$ monthly climatology data of the University of Wisconsin-Milwaukee/Comprehensive Ocean Atmosphere Data Set (UWM/COADS) (Stansfield and Garrett, 1997).

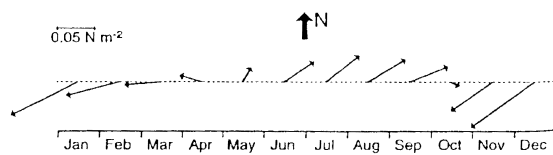


Fig. 7. Annual cycle of monthly wind stress (N m^{-2}) at the mouth of the Gulf of Thailand from $1^\circ \times 1^\circ$ UWM/COADS data (Stansfield and Garrett, 1997).

Table 1. Effects of sea surface heating and fresh water discharge on stratification.

	April	September
B_h ($\text{g cm}^{-2} \text{sec}^{-1}$)	4.6×10^{-7}	1.2×10^{-7}
B_f ($\text{g cm}^{-2} \text{sec}^{-1}$)	5.3×10^{-8}	3.3×10^{-7}

4.3 Bottom cold, salty and heavy water mass

Bottom cold, salty and heavy water masses exist around Stas. 26, 42 and 63 in April–May and September, as shown in Figs. 3 and 4. The seasonal variation of density difference between the bottom and surface layers is shown in Fig. 10. Horizontal distributions of large and small density difference areas in both seasons are nearly the same as the seasonal variation of its degree. The density difference is relatively small (vertically well-mixed) near the head of the Gulf of Thailand and the central part of the observational area, but relatively large (stratified) in the central part of the Gulf of Thailand and the southern part of the observational area. Figure 10 suggests that the horizontal distribution of bottom cold water masses is not governed by the sea surface heating and the sea surface wind, but mainly by the tidal mixing.

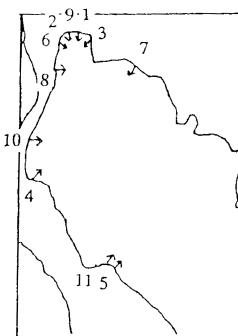
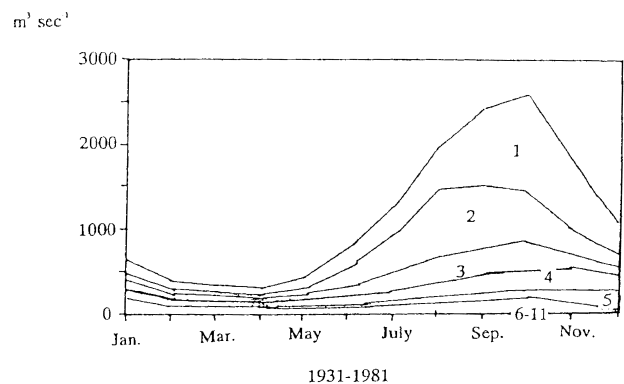
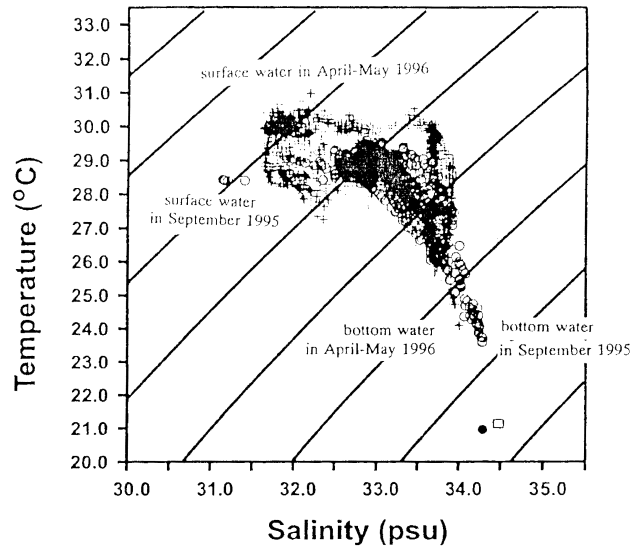


Fig. 8. Average freshwater discharges by months into the Gulf of Thailand by 11 rivers and streams on the basis of data from Thailand Irrigation Department (Snidvongs, 1998).

As semi-diurnal and diurnal tidal currents have nearly the same amplitude in the Gulf of Thailand (Yanagi and Takao, 1998b), the horizontal distribution of $\log(H/U^3)$, where H is the water depth in meter and U is $(M_2 + K_1)$ tidal current amplitude in meter per second (Simpson and Hunter, 1974), has been calculated and the result is shown



T-S diagram in the Gulf of Thailand T-S diagram at 100 m in South China Sea
 ○ : September 1995 ● : September
 + : April-May 1996 □ : April

Fig. 9. T-S diagrams for the cruises in September 1995 (open circle) and April–May 1996 (cross).

in Fig. 11(c). $\log(H/U^3)$ is small (vertically well-mixed) in the head of the Gulf of Thailand and offshore area of Peninsular Malaysia and large (stratified) in the central part of the Gulf of Thailand and east coastal sea of Peninsular Malaysia. The horizontal distribution of $\log(H/U^3)$ shown in Fig. 11 roughly corresponds to that of degree of stratification shown in Fig. 10.

The rate of change in potential energy of a water column (dV/dt) due to sea surface heat flux, fresh water discharge, tidal mixing and wind stirring is given by the following equation (Yanagi and Takahashi, 1988; Yanagi and Tamaru, 1990):

$$dV/dt = -\alpha g QH/2c_p - \beta g SHR/2A + 4\epsilon k_b \rho U^3/3\pi + \delta k_s \rho_a W^3 \quad (2)$$

where g denotes the acceleration due to gravity (980 cm sec^{-2}), ϵ and δ the efficiency of conversion from the turbulent energy to potential energy ($\epsilon = 0.015$, $\delta = 0.039$), k_b the bottom drag coefficient (0.0026), k_s the sea surface drag coefficient (6.4×10^{-5}), ρ the density of sea water (1.020 g cm^{-3}) and ρ_a the density of air ($1.25 \times 10^{-3} \text{ g cm}^{-3}$). When we assume $H = 30 \text{ m}$, the summation of first and second terms in the right hand side of Eq. (2) becomes -0.75 g sec^{-3} in April and -0.67 g sec^{-3} in September. When we assume $U = 30 \text{ cm sec}^{-1}$ and $W = 5 \text{ m sec}^{-1}$, the summation of third (0.35) and fourth (0.39)

terms in the right hand side of Eq. (2) becomes 0.74 g sec^{-3} . This suggests that tidal mixing with an amplitude of 30 cm sec^{-1} and wind stirring with a speed of 5 m sec^{-1} cannot destroy the stratification at the place with a depth of 30 m in April but they may destroy the stratification at the same place in September. In December–January, when the northeast monsoon blows stronger than 5 m sec^{-1} , the combined effect of wind stirring and tidal mixing may destroy the stratification in the deeper part of the Gulf of Thailand.

4.4 Biochemical processes related to bottom cold and salty water mass

The dissolved oxygen concentration deeper than 40 m at Sta. 42, where the bottom cold and salty water mass existed as shown in Fig. 3, in April–May 1996 was between $4.0\text{--}4.5 \text{ ml l}^{-1}$ but it was $3.0\text{--}3.5 \text{ ml l}^{-1}$ in September 1995 (Rojana-anawat and Snidvongs, 1999). This suggests that the sinking organic matter is decomposed in the bottom cold water mass and dissolved oxygen is consumed during the stratified season from March to September. Nutrients must be stored in this bottom cold and salty water mass, although there are no direct observational data for this. A local maximum of chl. *a* concentration was observed 30 m below the sea surface just above this bottom cold water mass at Sta. 43 in September 1995 (Snidvongs and Rochana-anawat, 1995).

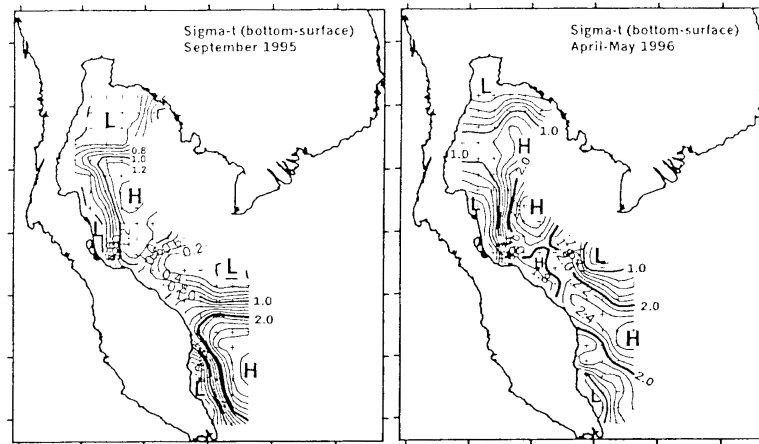


Fig. 10. Horizontal distribution of density difference between the bottom and surface layers in September 1995 (left) and that in April-May 1996 (right).

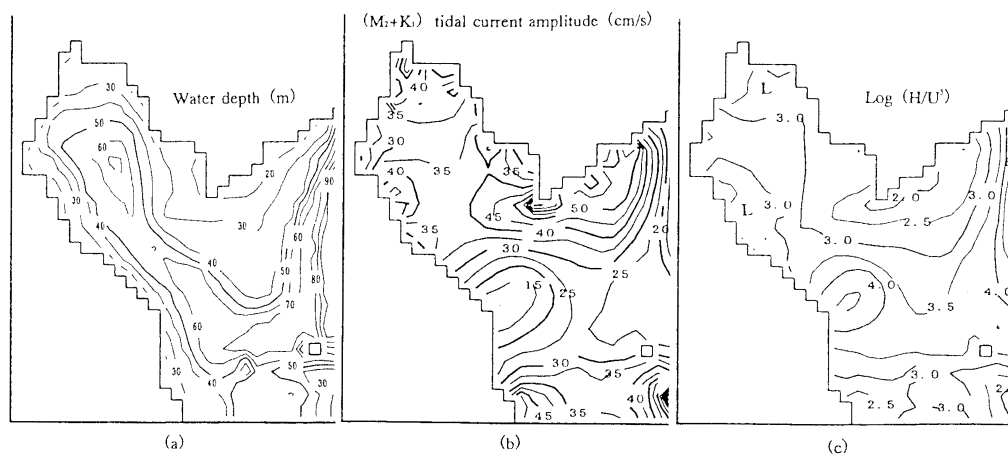


Fig. 11. Horizontal distributions of water depth in meter (a), $(M_2 + K_1)$ tidal current amplitude in cm s^{-1} (b) and $\log(H/U^3)$ (c) (Yanagi and Takao, 1998b).

5. Conclusions

Seasonal variations in sea surface wind, heat flux through the sea surface, river discharge, degree of stratification, density-driven current and wind-driven current are schematically summarized in Fig. 12. A strong north-east monsoon blows, the sea surface is cooled, a vertically well-mixed condition is developed in the Gulf of Thailand in January and the inverse estuarine circulation is generated by the northeast monsoon. On the other hand, large sea surface heating and weak southwest monsoon develop the stratification and the estuarine circulation is developed in April. Estuarine circulation is intensified by the surface Ekman transport due to the southwest monsoon. The largest water exchange between the Gulf

of Thailand and the South China Sea is expected during this season. Large river discharge, moderate sea surface heating and moderate southwest monsoon generate moderate stratification in September.

A bottom cold water mass exists in the central part of the Gulf of Thailand, where the amplitude of the tidal current is low and the water depth is large, and a great deal of nutrient must be stored in this bottom cold water mass.

We shall develop a three-dimensional numerical ecosystem model coupled with a hydrodynamical model to clarify quantitatively the mechanism of seasonal variation of physical and biochemical processes in the Gulf of Thailand.

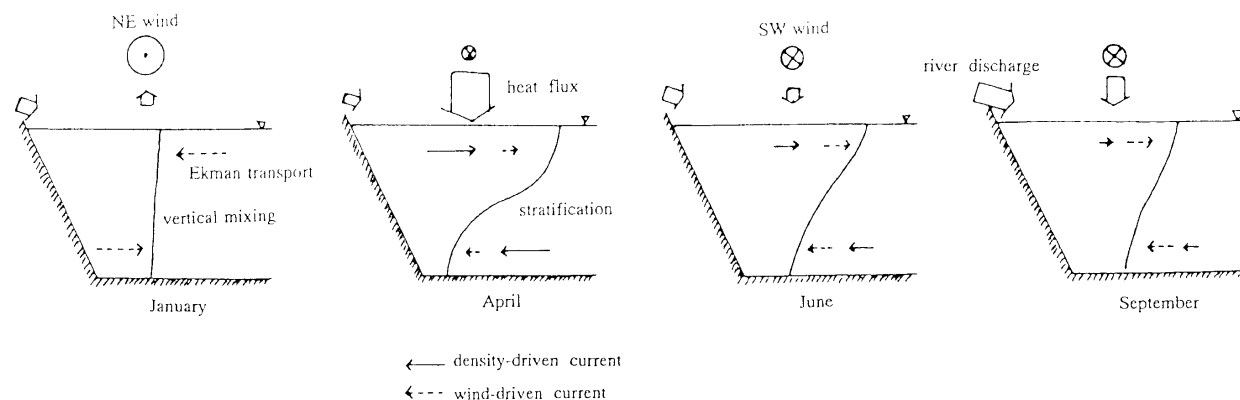


Fig. 12. Schematic representation of seasonal variations in wind, heat flux through the sea surface, river discharge, stratification, density-driven current and wind-driven current in the Gulf of Thailand.

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LEGAL INSTRUMENTS FOR COASTAL BIO-CONSERVATION IN CHINA

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Abstract

This paper introduces the basic facts about marine flora and fauna in China and reviews the development of bio-conservation policies in the past decades. The bulk part of the paper reviews the legal instruments for coastal bio-conservation in China and introduces the progress of ICM and MPAs in China as they are two powerful tools for bio-conservation.

Basic Facts about Marine Flora and Fauna in China

Situated at the boundary of the Western Northern Pacific, the coastal waters of China is composed of the Bohai Sea, the Huanghai Sea, the Donghai Sea and the Nanhai Sea. Extending from the temperate zone to the tropical zone, the Chinese waters houses abundant marine ecosystems and rich species.

China has 18 000 km of continental coastline and 14 000 km of island coastline. Along the coastline there are more than 1800 estuaries in various forms and of various sizes. Of them, there are about 60 estuaries at the mouth of a river of more than 100 km long and 16 sea-inputting rivers have each a drainage area of over 3000 km².

Chinese coastal wetland is composed of intertidal zone and estuarine swamps, with a total area of 2,000,000 ha, of which the slity tidal flat and swamps is about 1 670 000 ha and the rest is rocky tidal zone and coral reefs. The sandy and muddy tidal zone is made of silty mud where abundant benthos live, especially shellfishes. The sandy and muddy zone acts as important spawning nursery and feeding grounds for commercial species. The rocky tidal zone, narrow and steep, consists of mainly rocks, has abundant benthic algae and shellfishes, as well as endemic fishes. The coral reef tidal zone is distributed mainly in the waters off Guangdong, Guangxi, Hainan and Taiwan. The silty tidal zone is mainly distributed in and around the estuaries or sheltered bays. In North China, the estuarine wetland is distributed with large stretches of reeds and other herbal plants. In South China, the estuarine wetland is distributed with mangroves. The wetland with rich plant communities has especially rich invertebrates and birds.

China has more than 5 000 islands, majorly rocky islands and minorly silty and coral reef islands. More than 90% of islands are close to the continent with strong interaction of coastal waters and oceanic waters, resulting in good habitats. Some islands are distributed with rare vegetation, birds, snakes and other higher organisms.

Chinese waters has complex ecosystems and rich species, taxa and communities (Tables 1 and 2). Based on the studies in the past 70 years, there has recorded in Chinese waters 20 278 species in 44 families and 5 kingdoms, of which animalia has most species (12 794 species) and monera has least species (229 species).

Table 1 Number of marine species recorded in China

Kingdom & family	Number of species	Kingdom & family	Number of species
MONERA	229	ANIMALIA	12,794
Bacteria	79	Porifera	106
Actinobacteria	18	Coelenterata	989
Cyanomycete	131	Ctenophora	9
Oxybacteria	1	Platyhelminthea	574
		Nemertea	52
PROTISTA	4,596	Kinorhyncha	10
Bacillariophyta	1,395	Nematoda	122
Pyrrophyta	255	Acanthocephala	32
Chrysophyta	14	Rotifera	17
Xanthophyta	3	Priapulida	2
Cryptophyta	1	Annellida	979
Ciliophora	291	Sipuncula	39
Sarcomastigophora	2,997	Echiurqa	9
		Mollusca	2,554
FUNGI	188	Arthropoda	2,971
Yeast	61	Bryozoa	488
Other fungi	127	Entoprocta	9
Mycophycophyta	1	Brachiopoda	8
		Phoronida	4
PLANTAE	1,203	Chaetognatha	37
Rhodophyta	443	Echinodermata	471
Phacophyta	153	Hemichordata	6
Chlorophyta	11	Urochorda	125
Pteridophyta	3	Chordata	3,181
Gymnosperae	399		
Angiospermae			

Among 24 families of animalia, three families such as Arthropoda, Chordata and Mollusca have each over 2500 species, and eight families such as Coelenterata, Annelida, Platyhelminthea, Bryozoa, Echinodermata, Urochorda, Nematoda and Portifera each have more than 100 species. The rest families each have less ten species.

The 6 families in plantae are composed of vascular plants and aglae. In the three families of algae, 794 species have been recorded. Among 413 species of vascular plants recorded in the three families, only 40 species of mangroves and 13 species of seaweeds are true vascular plants, while others are saline plants or coastal plants distributing in the beaches.

Not much has been carried out on the studies of fungi and it is difficult to give a complete picture of marine fungi in China as only yeasts in the Bohai Sea and fungi on the rotten wood in Hong Kong were studied.

Only 5 000 species in 7 families in Protista are recorded. Of which, the studies on unicellular algae is more intensive, especially on diatoms. With 1395 species have been recorded in Bacillariophyta, a complete picture of diatoms in different habitats has been obtained. In the family of Pyrrophyta, 255 species have been recorded, among them some are HAB species. Both foraminifera and radiolaria in the family Sarcomastigophora have received more intensive studies as 2606 species distributing from ancient to modern times.

Table 2 Number of species of some taxa recorded in China's seas

Sea area/ taxa	China seas	Huanghai and Bohai seas	Donghai Sea	Nanghai Sea
Pyrrophyta	255	74(16)	117(33)	182(50)
Rhodophyta	443	112(49)	217(94)	264(166)
Hydromedusae	435	101(25)	288(73)	307(106)
Reef-builders	195	0	27(0)	193(160)
Snails	1,115	130(57)	565(142)	686(279)
Opisthobranchia	450	108(36)	228(58)	343(179)
Cephalopoda	101	14(2)	76(14)	82(24)
Copepoda	523	125(23)	317(25)	458(172)
Shrimps	476	49(4)	138(20)	316(212)
Crabs	734	90(23)	305(75)	578(349)
Echinoderm	474	57(30)	139(44)	379(291)
Fish	3,032	280(48)	1,750(573)	1,825(687)
Total	8,133	1,140(313)	4,167(1151)	5,613(2675)

Note: number in () refers to number of endemic species recorded in the sea area.

The studies of horizontal distribution of marine species in China show that the number of species increases from north to south. Among 8133 species of 12 taxa in Table 2, some are distributed only in one sea area while others are found in all the Chinese waters. The endemic species recorded are 313 species in the Huanghai Sea, 1151 species in the Donghai Sea and 2675 species in the Nanghai Sea.

The Chinese waters act as the northern boundary of tropical species in the Indo-Pacific Oceans and the southern boundary of the warm species in the Northern Pacific and some of the cold water species. As indicated in Table 2, only 27 species of 195 species of reef-building coral survive in the coastal water off Fujian, all fail to build reefs. The northern boundary for reef builders is the waters around Hainan and south to Taiwan Island. This is true also for mangroves. Sea (Phoca largha) has 7 breeding grounds in the Northwestern Pacific, with the southernmost one in the Liaodong Bay. Both herring (*Clupea pallasii*) and cod (*Gadus macrocephalus*) might not be found in the Donghai Sea although they form fishing seasons in winter in northern Huanghai Sea. Furthermore, cold temperate species such as *Ophiura sarsi* and *Oregonia gracillis* can only be found in the deep waters under the control of old waters masses in northern Huanghai Sea.

Marine species in China is composed mainly of warm water species (tropical and subtropical species) followed by wide distributing and warm water species and less of cold water species.

Brief History of Biological Conservation in China

Biological conservation in China started in 1956 when some congressmen proposed to "designate closed area for natural forest in order to conserve natural vegetation for meeting the needs of scientific research. The motive was accepted and the Regulations Concerning the Management of Hunting and the Regulations for Designating Closed Areas (Nature Reserve) of Natural Forest were drafted by the Ministry of Forest in October of 1956. In the same year, the National Program of Science and Technology listed the establishment of and studies on nature conservation and nature reserves as one of the basic research areas.

The State Council called for in its Directives to Positively Protect and Rational Use of Wildlife Resources in 1962 setting up nature reserves for protecting rare and rare wildlife. In 1964, the State Council endorsed the Regulations Concerning the Conservation of Aquatic Resources (Draft). The Regulation calls for the listing and protection of rare and commercial aquatic flora and fauna. In addition, the Regulation proposes to set up fishery close areas and protection of aquatic environments. In 1979, the Regulation was promulgated. In 1979, the Environmental Protection Law (Trial) was made public. In 1982, the Regulations Concerning Soil Conservation and the Marine Environmental Protection Law were published. In 1984, the Water Pollution Control Law and the Forest Law were promulgated. In 1985, the Grassland Law was published. In 1986 the Mineral Resource Law and the Law Concerning Land Management were made public. In the same year, the Program for Nature Conservation was published after three years of hard work. Among 10 major targets for conservation, three have direct relation with marine biological conservation, namely the conservation of species, the conservation of swamps and coastal intertidal flats and, the protection of seas. The Program has set guidelines and policies in China for nature and biodiversity conservation.

Legal Instruments for Marine Biological Conservation in China

The legal instruments for marine biological conservation in China may be analyzed from two aspects, policies and programs and laws and regulations.

1. Policies and programs for marine biological conservation

China has made environmental protection and sustainable development as the basic state policy. As stated in The Development of China's Marine Programs (State Council, 1998), China adopts the policy of "simultaneously planning and implementing the development of marine resources and the protection of the marine environment. China will work out a program for the coordinated development of marine resources and the protection of marine eco-environment and, in line with the principles of 'putting prevention first, combining prevention with control' and 'making the causer of pollution responsible for treating it', improve the monitoring, surveillance, law enforcement and management of marine environment. Stress will be laid on strengthening the control of land-based pollutants and implementing the system for controlling the total quantity of pollutants, in order to prevent the marine environment degenerating." The introduction of the

following three documents may give a picture how the basic state policy is implemented in China as regards with marine biological conservation.

National Program for Nature Conservation (Committee for Program for National Conservation, 1987) lays down the general policy for marine biological conservation. The Program advocates to "set up specialized agency to plan marine development and management in an integrated way and from the long-term interests and to supervise the enforcement of marine laws and regulations." The Program calls for rehabilitation of fisheries resources by protecting spawning grounds and setting up protected areas of larval fishes and adopting measures such as closed season and closed area. The Program urges governments at all levels and the relevant administration agencies to channel the funds for protected areas into the master plan for social and economic development. In its Chapter of the Protection of Seas, the Program describes the present state of environment and resources, analyzes the existing major issues and recommends the major countermeasures to be taken. The countermeasures include 1) the overall planning and management of marine development; 2) the promotion of studies on marine environment and resources; 3) the development with all efforts of coastal aquaculture and protection of coastal fishery resources and gradual development of offshore fisheries; 4) the strengthening of marine environmental protection and prevention of marine pollution; and 5) development of studies on island ecology in a planned way.

China's Oceanic Agenda 21(SOA, 1996) takes the conservation of ocean living resources for sustainable utilization as one of its basic policies. The Agenda determines to 1) establish marine protected areas of coral reefs, mangrove, grass bed and island and protected areas in coastal spawning and nursery areas of commercial species in order to protect biological species and ecosystem; 2) control resource breakdown from wanton fishing by managing properly coastal artisan fisheries; 3) manage well the mariculture in the tidal flats and shallow waters for the rational development and utilization of waters suitable for mariculture and develop clean mariculture technology for the avoidance of self-pollution induced by mariculture; 4) improve methods and technologies in commercial fisheries and control the development of fishery economic at a moderate speed so as to maintain their production and the sustainable utilization of commercial fishery resources for the coming generations; 5) develop ocean ranching technologies for artificial enhancement of high quality fishery resources; 6) strengthen rational resource development and utilization and management in the exclusive economic zone. The Agenda makes the conservation of marine biodiversity as one of the program areas, with the following activities. 1) Make clear the basic conditions of China's marine biodiversity and develop the assessment standards for marine biodiversity. Compile the list of China's marine organisms and carry out survey and systematic studies on the present state, habitat, distribution, quantity, variation patterns and the cause of being endangered of the endangered species. On the basis of these surveys and studies, draw up the assessment standards and conservation norms for China's marine biodiversity. 2) Strengthen the conservation of ecosystem and species outside the marine protected areas. Develop the Regulations for the Management of China's Marine Biodiversity Conservation. Conserve the rare marine species in China and in the world, and the mangrove and coral reef ecosystem. 3) Set up information systems and monitoring systems for marine biodiversity. Carry out long-term dynamic monitoring of the species resources of marine ecosystems and develop gradually the monitoring system of marine ecosystem. Establish national information system of marine biodiversity conservation and realize its networking with the correlative information systems in the world. 4) Positively carry out international and regional cooperation in the conservation of marine biodiversity. Strengthen exchange and cooperation in the fields of management, scientific research, technical development and transfer and personnel training of marine biodiversity, including the cooperation and exchange between the transnational non-governmental organizations. 5) Carry out various forms of demonstration projects for the conservation and utilization of marine biodiversity. Conduct education in the conservation of marine biodiversity through activities of tourism, mariculture, integrated utilization and intensive processing of the living resources. Designate the tourist activities. Positively enhance both quantity and quality of conservation activities in order to obtain improvement of both biological conservation and development and to reach the unity of ecological, economic and social benefits. Promote popularization among the public the sense of conscientious conservation.

China developed its Marine Biodiversity Action Plan (SOA, 1995) in 1995. The Action Plan describes the present state of marine biodiversity and its conservation and assesses the present state of marine biodiversity conservation, proposes the targets and tasks for marine biodiversity conservation and formulates the measures for implementing the Action Plan. The objectives of marine biodiversity conservation are to maintain the richness of marine biodiversity, protect a variety of typical marine ecosystems, reserve and increase the stock of endangered and rare species, promote the sustainable development of marine biotic resources and others, create better environmental conditions for various types of marine natural ecosystems and landscape and ensure the sustainable development of marine economy and raise the living standards of the people in the coastal areas. For meeting these objectives 7 strategies are being taken. 1) Strengthen publicity and education for marine biodiversity conservation by mobilizing all social forces. 2) Increase the total financial input for marine natural conservation; 3) Strengthen and perfect existing marine protected areas; 4) Build a series of new conservation zones for particular marine ecosystems and for rare and endangered species; 5) Strengthen national coordination for marine protection and improve and upgrade policy, regulations and economic measures; 6) Strengthen basic research on marine biodiversity; 7) Strengthen information collection, processing and service.

With a cooperative effort by the Ministry of Forestry and WWF commenced in 1989, A Biodiversity Review of China was published (Carey, 1996). The publication reviews the state of China's biodiversity and the efforts both in place and planned to protect it. The Review is divided into four parts. The first details the objectives and methods of the review, including a summary of the main aspects of biogeography theory that were relevant to its preparation and the principles behind protected area system design. Part two provides an analysis of the characteristics of China's biodiversity and the threats that face it. The bulk of the Review consists of part three which provides a detailed province-by-province analysis of China. Part four has five chapters on special issues, including issues of marine protection. These issues are considered of particular biodiversity significance and must be considered in terms of the whole country or large areas of the country, rather than individual provinces. In its chapter of marine protection, a number of recommendations are made. 1) Island population should be kept under strict control and incorporated into the protection and tourism development. Tourism should be regulated by issuing restricted numbers of permits and licenses, and all tourist activities should be away from core zones and minimized during the breeding seasons of critical species. Strict control of tourist-related pollution is required. The provision of tourist accommodation within protected areas is generally not recommended. Tax or surcharges may be drawn from tourist agencies involved to raise finance for the operational costs of the reserve. Where tourism development is already underway, the only method of reducing negative impacts on the environment is to restrict tourist activities to less sensitive areas like sandy beaches. Sewage treatment plants are essential for safeguarding water quality on which both marine life and tourism depend. 2) Better conservation of reefs requires reserve border marking, strengthening of protection law enforcement (through training, publicity and the provision of necessary equipment), arousing public awareness and the carrying out of baseline ecological studies necessary for drawing up sound management plans. Coral mining should also be controlled at the market end and officials of the Oceanic, Industrial Commerce and Public Security Departments should stop trading of corals and coral products. 3) A healthy, colorful coral reef will have much higher potential in attracting up-market and more profitable activities like diving and glass-bottom boat tourism. At reef sites, permanent buoys should be installed to prevent anchor damage and guards are needed to prevent damage while education officers promote environmental awareness to the public. 4) Elite tourism, involving water sports and diving, if

managed well, should help generate sufficient incentive to keep the marine environment in a prime state. Unfortunately, in most areas there is still a long way to go before the marine conditions can recover sufficiently for such tourism to be established. 5) In addition to coral transplantation, which has been tried at a number of places, another less sophisticated method of coral reef recovery is the introduction of artificial reefs. Different objects, including old cars, boats, tyres, cement, PVC and pulverized fuel ash blocks have been used as artificial reefs in various countries. Piled-up cement or PFA blocks have been shown to be best for coral settlement. It may therefore be useful to lay down a series of artificial reefs, preferably of cement blocks, in certain reserves, especially on sandy or sandy-muddy bottoms just below the existing coral zone so as to widen the shallow water band necessary for shallow water coral reef species and at the same time attract marine life. The total surface area provided, substratum irregularity and orientation all play a role in affecting the success of coral settlement. 6) As far as seaweed reserves are concerned, action should be guided by the present situation of each reef ecosystem. In general, cooperative management fueled by economic returns and local support should be strengthened, which in turn, will generate a positive feedback cycle for conservation and continuous exploitation to enhance each other. Studies on the general ecology of the algae-carrying reef and a monitoring program to determine the effects of continuous seaweed harvesting on the reef ecosystems are needed to draw up management strategies for conservation and sustainable exploitation. It has been shown that rational harvesting practices involving replanting of young material and cutting of the oldest would generate higher carrageenan yield per unit weight of seaweed.

2. Laws and regulations for marine biological conservation

The National Constitution revised in 1982 regulates in its Article 9 that: "the State protects the rational use of natural resources and rare flora and fauna and forbids any organizations and any individual to seize or damage natural resources by any means."

Under the umbrella of National Constitution, various laws and regulations have been promulgated to conserve biological resources (Table 3). Among them, the Marine Environmental Protection Law, the Fisheries Law, the Wildlife Conservation Law the Regulations Concerning Nature Reserves and Regulations Concerning the Management of Marine Nature Reserve are more important instruments for marine biological conservation.

Table 3 National Laws and regulations related to marine biological conservation

Laws and Regulations	Promulgated by
Regulations Concerning the Protection of Reproduction of Aquatic Resources	State Council in 1979
Environmental Protection Law (Trial)	National People's Congress in 1979
Marine Environmental Protection Law	National People's Congress in 1982 and revised in 1999
Regulations Concerning Environmental Protection in Offshore Oil Exploration and Exploitation	State Council in 1983
Regulations Concerning the Prevention of Pollution of Sea Areas by Vessels	State Council in 1983
Regulations Concerning the Dumping of Wastes at Sea	State Council in 1985
Fisheries Law	National People's Congress in 1986 and revised in 2000
Mineral Resources Law	National People's Congress in 1986
Regulations for the Implementation of the Fisheries Law	Ministry of Agriculture, Animal Husbandry and Fisheries in 1987
Regulations Concerning Prevention of Environmental Pollution by Ship-breaking	State Council in 1988
Regulations Concerning Prevention of Pollution Damage to the Marine Environment by Coastal Construction Projects	State Council in 1990
Regulations Concerning Prevention of Pollution Damage to the Marine Environment by Land-based Pollutants	State Council in 1990
Wildlife Conservation Law	National People's Congress in 1988
Regulations Concerning Sea Area Use Management	Ministry of Finance and State Oceanic Administration in 1992
Regulations Concerning the Implementation of the Wildlife Conservation Law	State Council in 1993
Regulations Concerning Nature Reserve	State Council in 1994
Regulations Concerning the Management of Marine Nature Reserve	State Science and Technology Commission in 1995

Marine Environmental Protection Law is enacted to protect and improve the marine environment, conserve marine resources, prevent pollution damages, maintain ecological balance, safeguard human health and promote sustainable economic and social development. In its revision in 2000, a new chapter, the chapter for marine ecological conservation was added. With eight articles, the chapter regulates the range and measures for marine ecological conservation, including the conditions for setting up marine protected areas and the issues need special attention in marine development. Article 20 of the law states that "the State Council and local People's Governments at the Provincial level shall adopt effective measures to protect such typical and representative marine ecosystems as mangroves, coral reefs, seaside wetlands, islands, bays, mouths of rivers that empty into the sea, important fishery waters, etc.; sea areas where rare and endangered marine organisms are naturally and densely distributed; marine organisms existence areas with important economic value and marine natural historic remains and natural landscapes of great scientific and cultural significance. For marine ecosystems with important economic and social values that have been damaged, efforts shall be made to renovate and recover them." The Law requires in article 24 that the "exploration and exploitation of marine resources shall be rationally distributed in accordance with marine functional zonation scheme and shall not bring about damages to marine ecological environment." The Law in its article 25 regulates the introduction of alien species by stating, "the introduction of marine animal and plant species shall conduct scientific argumentation to avoid damages to marine ecosystems." The Law declares in article 28 that "the State shall encourage the development of ecological fisheries, popularize multiform ecological fisheries production methods and improve marine ecological conditions."

Fisheries Law was revised in 2000 (China Ocean News, 2000). The most important changes are three new articles, articles 16, 17

and 29 and the revision of original article 27. Article 16 states that " the import and export of aquaculture seedlings should be subject to the approval by the fisheries administrative department of the State Council or of the people's governments of provinces, autonomous region or municipalities directly under the State Council." Article 17 states that " the import and export of aquaculture seedling should pass a quarantine to prevent spreading of pests into and out of China. The introduction of genetic-transferred aquaculture seedlings should pass a safety assessment procedure." The original article 27 states, " protection shall be provided to rare aquatic animals whose capture is banned by the state. In case there is a special need to catch them, the matter should be handled in accordance with the relevant laws and regulations." This article has been revised and turned into article 37 in the new version of the Law. It reads that " the state exercises conservation as a higher priority of rare and endangered species such as Chinese river dolphin (*Lipotes vexillifer*) for preventing their extinction. The killing and hurt of wild aquatic animals under prior protection of the state is banned. In case that a wild aquatic animal under prior protection of the state should be fished for scientific research, acclimation for culture, exhibition or other needs should be handled in accordance with the Wildlife Conservation Law of the People's Republic of China."

Wildlife Conservation Law, as the first national law for resource conservation, indicates a new development in the legislation of wildlife conservation. According to the Law, the forestry administrative department of the State Council is responsible for the management of land wild animals in China and the fishery administrative department of the State Council is responsible for the management of aquatic wild animals in China. The Law regulates the classification and name listing of wild animals under protection (Table 4). Accordingly, the wild animals under state protection are classified into three types, namely rare and endangered species, beneficial wild animals and wild animals with important economic value and scientific value. The Law states four major responsibilities of governments at various levels: 1) the responsibility of planning and formulation of conservation measures; 2) the responsibility to establish nature reserves; 3) the responsibility to save wild animals when they subject to the threats of natural disasters; 4) the obligation of compensation for economic losses caused by wild animals; and 5) the responsibility to prevent from damages by wild animals.

Table 4 Name List of Key Wild Animals under State Protection

Name of species	Level of protection	Name of species	Level of protection
Pinnipedia	II	<i>Chelonia mydas</i>	II
Sirenia	II	<i>Eretmochetys imbricata</i>	II
Dugong dugong	I	<i>Bahaba flavolabiata</i>	II
Cetacea	II	<i>Trachidermis fasciatus</i>	II
<i>Sousa chinensis</i>	I	<i>Hippocampus kelloggi</i>	II
Cetacea	II	<i>Acipenser sinensis</i>	I
<i>Diomedea albatrus</i>	I	<i>Acipenser dabryanus</i>	I
<i>Pelecanus</i> spp.	II	<i>Psiphurus gladius</i>	II
<i>Sula</i> spp.	II	<i>Branchiostoma belcheri</i>	I
<i>Phalacrocorax pelagicus</i>	II	<i>Glossobalanus palybanchioporos</i>	II
<i>Phalacrocorax niger</i>	II	<i>Saccoglossus hwangiauiensis</i>	II
<i>Fregula undrewsi</i>	II	<i>Cypraea tigris</i>	II
<i>Ciconia ciconia</i>	I	<i>Cassis cornutab</i>	II
<i>Ciconia nigra</i>	I	<i>Pinctada maxima</i>	II
<i>Haliaeetus leucorhynchus</i>	I	<i>Tridacna cookiana</i>	II
<i>Haliaeetus albicilla</i>	I	<i>Nautilus pompilius</i>	I
<i>Caretta caretta</i>	II	<i>Corallum</i> spp.	I

Regulations Concerning Nature Reserves is a concrete step that China takes to implement the CBD in 1994. According to the Regulations, the state adopts a management system of nature reserve combining integral management and sector management. The environmental protection administrative department of the State Council is responsible for the integral management of nature reserves in China and the sector administrative department of the State Council such as forestry, agriculture, geology, minerals, water conservancy and ocean affairs are responsible for nature reserves within its own responsibilities. The Regulation states that the state will take economic and technical policies and measures favorable for the development of nature reserves and channel the development plan of nature reserves into national economic and social development plan.

Regulations Concerning the Management of Marine Nature Reserve consists of 23 articles covering all administrative and technical aspects for the establishment and management of marine nature reserves. Its article 5 states, " the state administrative department of marine affairs is responsible for studying and developing national plan of marine nature reserves, examining the schemes and reports for establishing state-level marine nature reserves, approving the general development plan of state-level marine nature reserves and managing exclusively the work on marine nature reserve in China." Its article 6 states " in an area that possesses one of the following characteristics, a marine nature reserve may be set up: 1) Typical marine physiographic areas, representative natural ecosystem areas, as well as areas within which natural ecosystems have been damaged to some extent, but may be recovered through efforts of protection; 2) Areas with highly rich marine organism species, or areas where rare and endangered marine organism species are naturally and densely distributed; 3) Sea areas, seashores, islands, seaside wetlands, mouths of rivers that empty into the sea and bays, etc. with special protection values; 4) Areas where marine natural remains of great scientific and cultural values are located, and 5) Other areas which call for special protection.

The above policies and laws and regulations indicate that China has set up its legal framework for coastal bio-conservation. However, just as the case before 1992 when the CBD was adopted, there is no a national framework law for bio-diversity conservation although various sector laws and regulations are dealing with some aspects of biodiversity conservation. The issue here is should China develop a national framework law for bio-diversity conservation like the CBD.

ICM and Marine Nature Reserves in China

At the first meeting of the Conference of Parties, held in the Bahamas in November-December 1994, it was decided that priority attention should be given to coastal and marine ecosystems, given their dominant contribution to global biodiversity. The second Conference of Parties, held in Jakarta, Indonesia, on November 6-17, 1995, gave further attention to issues related to coastal and marine

diversity (de Fontaubert, Downes, and Agardy, 1996) Although the convention itself does not make specific reference to ICM, a principle outcome of the second Conference of Parties was Decision II/10, on "Conservation and Sustainable Use of Marine and Coastal Biological Diversity." Among other recommendations, this statement, now called the Jakarta Mandate, encourage the use of integrated marine and coastal area management as the most suitable framework for addressing human impacts on marine and coastal biological diversity and for promoting conservation and sustainable use of this biodiversity (and) encourages Parties to establish and /or strengthen, where appropriate, institutional, administrative, and legislative arrangements for the development of integrated management of marine and coastal areas, and their integration within national development plans.(UNEP, 1995).

As the Conference of Parties and the Subsidiary Bodies of the CBD continue their implementation of the convention, ICM is being seen as an important tool in protecting coastal and marine diversity. For example, a group of experts met in Jakarta in March 1997 to discuss, among other things, the formulation of guidelines for protecting coastal and ocean biodiversity within the framework of ICM. It has become increasingly clear that biodiversity per se cannot be protected by specialized measures taken in isolation; rather, biodiversity protection will need to be built into a broader, comprehensive management framework, such as that provided by ICM, for a successful outcome(Biliana. Cicin-Sain and Robert W. Knecht, 1998)

Since 1994, China has been cooperating with UNDP for capacity building in ICM. The Xiamen Demonstration Site in the Regional Program for Marine Pollution Control and Management in the East Asian Seas has achieved good results and praised by international organizations for providing experiences for China and other countries to draw on for the work in this regard. In 1997, China cooperated again with UNDP in implementing the project of Capacity Building for ICM in Northern South China Sea. The Project designated three demonstration sites in Hailing Bay of Guangdong, Fangchenggang Port of Guangxi and Qinglan Bay of Hainan. The Hailing Bay Demo Site focuses on the application of ICM for sustainable fisheries development and develops the management framework to ensure that the bay conditions remain conducive for aquaculture and fisheries development by preventing or reducing the harmful effects of illegal fishing, pollution and habitat destruction. Fangchenggang City acts as the Great Sea Pathway of the Southeast China and port development is of high priority. The Project focuses on environmental management in Port, attempting to minimize environmental pollution arising from port construction and operation, and habitat destruction due to reclamation of tidal swamps. At Qinglan Bay, the demo site aims at addressing multiple resource-use conflicts, especially focusing on the conflicts of tourism, industrial development and conservation of coral and mangrove resources. Overall the project is highly successful and the prospects for activities being sustained are good.

In addition ICM, the development of nature reserves or protected areas have been regarded as another powerful tools for marine bio-conservation as it has been demonstrated successful for bio-conservation for several decades..

According to Bulletin of Marine Environmental Quality in China at the End of 20th Century (SOA, 2000), up to 2000, China has set up 73 MPAs of various types in coastal waters, covering a total area of 140 000 ha. Of them, 18 MPAs are under the management of oceanic administration departments. The past experiences have indicated that the establishment of MPAs has not only generated significant and positive impacts on improving marine environmental quality, conservation of marine biological resources and biodiversity and fastening rehabilitation, but also provided important bases for the development of science and culture, eco-tourism, eco-education and international cooperation.

Table 5 Marine Protection Areas in Coastal China

Location	Number of MPAs		
	Total	State-level	Local-level
Liaoning	9	4	5
Hebei	2	1	1
Tianjin	1	1	
Shandong	7	1	6
Jiangsu	2	2	
Shanghai	2		2
Zhejiang	2	1	1
Fujian	9	1	8
Guangdong	13	3	10
Guangxi	5	3	2
Hainan	21	3	18
Total	73	20	53

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INSTITUTIONAL FRAMEWORK FOR MARINE ECOSYSTEM PROTECTION IN KOREA

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1. Physical Characteristics and Management System of Marine Ecosystem in Korea

Korea has territorial waters of 447,000 km², which is 4.5 times greater than the area of national land. In the west and south coasts, wide area of coastal shelves (345,000 km²) has been developed, providing productive fishing ground and mineral resources. The coastal extension of Korea marks up to 11,542 km including the coastline of more than three thousands islands.

Korean Peninsula borders Yellow Sea on the west coast, the East Sea on east coast and the Korean strait on the south coast. The west coast is characterized by the wide and long-stretches of tidal mud flat under strong influence of tidal flow. Yellow Sea is semi-enclosed sea, with the average depth of 44m, bordering China on the west. With the rapid development of industry along Korean coast and Chinese coast, Yellow Sea has been recognized as one of the most vulnerable large marine ecosystem in the world.

The southern coastal waters are characterized by the presence of various semi-enclosed bays and islands. This unique physical setting of southern coast allowed the development of various kinds of coastal use activities such as aquaculture, fishing, port and coastal industries at different levels of intensity.

The east coast is characterized by the narrow development of coastal shelf along the coast and the development of sandy beaches and lagoons under strong influence of waves.

Korean coastal waters are classified into three classes according to water quality criteria such as pH, COD, DO, SS, fecal coliform, Total-N, Total-P, oil and heavy metals (Table 1). The 1st class standard implies that coastal water is suitable for fisheries and mariculture. The 2nd class standard sets for swimming and other recreational purposes. And the 3rd class standard sets for the use of industries and port activities.

Table 1 Seawater quality standards

Category	PH	COD (mg/l)	DO (saturation %)	SS (mg/l)	E.coli (MPN 100ml)	Normal Hexane Extracts (mg/l)	TP (mg/l)	TN mg/l)
I	7.8-8.3	<1	>95	<10	<200	ND	<0.05	<0.007
II	6.5-8.5	<2	>85	<25	<1000	ND	<0.1	<0.015
III	6.5-8.5	<4	>80	-	-	-	<0.2	<0.03
All Areas (Hazardous Substances)	Cd<0.01mg/l, As, Cr ⁺ 6 <0.05mg/l, Zn, Pb<0.1, Cu<0.02, CN, Hg, Organic phosphorous, PCB< Detection limit							

According to the COD monitoring results of 1998, most of Korean coastal waters in west and south coast can be classified as the second class waters which are not suitable for fishing or aquaculture activities (MOMAF & Office of Prime Minister, 1999).

The degradation of coastal water quality have been caused by combined factors including increasing pollution load from land-based activities, increasing oil-spills from shipping accidents, pollution load from aquaculture activities and the reduction of natural purification capacity due to the loss of coastal wetland.

Since 1970s, there has been a rapid increase in land-based pollution due to the increase and concentration of human population and industrial activities in a few coastal cities. The population growth rate in coastal cities marked three times higher than the national average rate. As consequences, BOD loading to Korean coastal waters have increased about 40% during last decade, aggravating coastal eutrophication and increasing the occurrences of red-tides in terms of aerial expansion and frequency.

Due to the increase in shipping activities, Korea has also observed the increase of oil-spill accidents. For example, annual accidents in 1970s marked the average of 100 cases, while the rate has increased up to 600 cases in late 1990s. Coastal waters for aquaculture ground have been also degraded due to intensive culture activities above the carrying capacity. Presently, about 8000 licenses are issued for aquaculture activities for the coastal waters of 113,000 ha.

Korea has a wealth of tidal mud-flat on the west and south coasts (2,393 km²), which is a home to important fish species and migratory birds. The coastal wetland has also served the function of purifying the incoming polluted waters from rivers and streams. This national treasure has been threatened due to large-scale coastal development projects such as coastal reclamation and infilling, port development and tourism development. The loss of coastal wetland would affect the fisheries resources as well as the carrying capacity of coastal waters.

2. Challenges for Managing Marine Ecosystem in Korea

2.1 Lack of Effective Management Measures responding to Increasing Pollutants Load

The sewage discharge to Korean coastal waters has been increased from 12,323,000m³/day in 1990 to 14,632,000m³/day in 1995, and expected to mark 17,870,000m³/day in 2001. The BOD loading is expected to increase up to 7,184ton/day in 2001 from 6,030ton/day in 1995. Despite of the continuous increase of land-based pollutants loading, wastewater treatment facilities along the coastal area are still inadequate. At national level the sewage treatment facilities are provided at average rate of 66% in 1998, while the average facility rate in coastal area is only 39%, which is mostly at primary treatment level.

It has been observed that increasing the wastewater treatment facilities in quantity only have limited success in reducing land-based pollution. Thus, considering the aggravating problems of coastal eutrophication, a pressing needs are identified to apply effective treatment

measures for nitrogen and phosphorous. In addition, urgent attention should be paid in applying effective treatment measures for non-point source pollution and combined sewage overflows during heavy rain.

In terms of monitoring and survey, it has been addressed that systematic survey of pollution sources and monitoring of marine pollution are still insufficient. Coordination among various types of marine survey or monitoring activities conducted by different agencies according to various legislation is in critical need. Lack of effective data quality assurance programme and an integrated information management system of monitoring data has reduced the utility of monitoring and survey results for management purposes.

2.2 Lack of Integrated Management System of Effectively Addressing Land-Sea Interface Issues

Existing management measures for land-based pollutants do not take due consideration on the risks to marine ecosystem. Thus, there is a need to expand and develop wastewater treatment facilities and technologies which are sensitive to the ecosystem characteristics and carrying capacity of receiving coastal waters.

In addition, despite of emerging problems of new pollutants in coastal waters, such as POPs and endocrine-disruptors, countermeasures are still inadequate in terms of technology and institutional capacity. Effective management strategies are needed to tackle the environmental problems caused by endocrine-disruptors and Persistent Organic Pollutants (POPs).

In the respect of institutional capacity, more efforts should be made for effective implementation of integrated management. Although various agencies for marine environment, fisheries, and maritime affairs are consolidated under Ministry of Maritime Affairs and Fisheries (MOMAF), sectoral responsibilities are still carried out under MOMAF separately through various departments and divisions. Such separate work duties need to be more effectively coordinated and integrated at operational level. Integration for marine environment management should extend to cover ship-based pollution such as oil-spills, implementation of International Conventions (e.g. IMO), environmental management of aquaculture ground, port environment management, and marine ecosystem management, etc.

2.3 Lack of Knowledge-Base for Marine Environment Conservation

Despite the fact that the degradation of marine environment is taking place at rapid pace, there are not sufficient education institutions for training marine environment experts. Marine environment management in Korea has been mostly the responsibility of government. Thus, participation or investment of private sectors in marine environment has been very limited. To maximize the effectiveness of utilizing existing resources, partnership should be built among relevant scientific agencies especially at local level. There is also a need to support and promote local training centers and to build cooperative system among research agencies.

The existing scientific and technical capacity in Korea is insufficient to accurately determine conditions of marine environment. This is partly due to the lack of investment in developing technologies for marine environmental management and improvement. Existing environment improvement measures still relies heavily on primary level of technology such as collection of solid wastes and dredging of contaminated sediments.

The participation of civil society groups in marine environment management is still limited and the level of public awareness is still low. Conflict resolution relying on regulation and compensation has proven to be not effective. There are insufficient civil society organizations which have sound and genuine goals in conserving marine environment, and the supporting mechanism to promote and maintain such organizations is not adequately institutionalized.

3. Legal Framework for Marine Ecosystem Protection

The legislation relevant to marine environment management can be grouped into three categories (Bang, 1999). First category includes the legislation which is oriented to preventing pollution. Main example of this category is Marine Pollution Prevention Act (wholly amended 1999). This Act is under the umbrella of Environment Policy Act. Relevant Acts in this category include Water Quality Conservation Act, Waste Management Act on Disposal and Treatment of Sewage and Animal Wastes, Environment Impact Assessment Act, and Act on Damage Compensation of Oil-Spills.

The Marine Pollution Prevention Act provides regulations to prevent marine pollution from various sources including sea-based activities and land-based activities. This Act provides the mechanism of designating and managing coastal environment management areas, which include marine protected areas and special management areas. The definitions of marine protected areas and special management areas are provided in later part of this paper. This Act also provides the framework of marine pollution monitoring and water quality standards.

Second category includes the legislation oriented to ecosystem protection. Main example is Wetland Conservation Act (1999). This Act is under the umbrella of Nature Environment Conservation Act. The main objectives of the Wetland Conservation Act are to protect wetland, to protect livelihood of residents in wetland conservation area, and to enhance scientific understanding of wetland. Thus, the Act provides the framework of conducting national survey on wetland ecosystem, and socio-economic characteristics. It also establishes the mechanism of designating 'Wetland Conservation Area', and formulating and implementing 'Management Plan of Wetland Conservation Area'.

Third category includes the legislation oriented to regulating spatial uses of coastal land and water. Main example of this category is Coastal Management Act (1999). This Act is under the umbrella of National Land Comprehensive Development Act, and relevant Acts under this category include National Land Use Management Act, Public Waters Management Act, and Public Waters Reclamation Act. Coastal Management Act was enacted to reduce multiple use conflicts related to coastal space uses, to restore the degraded coastal ecosystem and to prevent natural hazards. It provides the mechanism of integrated coastal management planning at both national and local levels, conducting coastal zone improvement projects, and operating 'Coastal Management Council' at both national and local levels.

4. Policy Framework for Marine Ecosystem Protection - Strategic Plan for Coastal Environment Management Areas

4.1 Framework of the Plan

4.1.1 Objective

The objective of this Plan is to formulate systematic and comprehensive management guidelines to improve marine environment and to protect ecosystem of coastal areas designated for 'Coastal Environment Management Areas (CEMA)' including 'Marine Protected Areas (MPA)' and 'Special Management Areas (SMA)' (MOMAF, 2000).

4.1.2 Legal background

The Marine Pollution Prevention Act provides the legal authority of this Plan. The Act also establishes the basic management framework for 'Marine Protected Areas' and 'Special Management Areas'.

4.1.3 Characteristics of the Plan

This Plan is National Plan to be established by the Minister of the Maritime Affairs and Fisheries. This Plan is to serve as the

implementation Plan of 'Ocean Korea 21', which is the national framework plan for the sustainable development of oceans toward 21st century as well as the implementation Plan of 'Five-year Marine Pollution Prevention Plan'.

4.1.4 Legal Process of Plan Formulation, Implementation, and Revision

Through consultation with heads of national agencies, provincial and local governments, the Minister of Maritime Affairs and Fisheries formulates and implements the Plan every 5 years in close relation to 'Five-year Marine Pollution Prevention Plan'. The Plan should maintain the adaptability for unforeseen changes and new scientific understandings and subject to revision in every 2-year period.

4.2 Coastal Environment Management Areas (CEMA)

4.2.1 Definition

CEMA is defined according to Article 4, para. 4 of Marine Pollution Prevention Act and consists of 'Marine Protected Areas' and 'Special Management Areas'.

Marine Protected Areas (MPA) is defined as coastal waters in relatively pristine and good ecological conditions, which need to be preserved and protected continuously. Four bays on the west and south coast have been designated as MPA in February 2000, such as Hampyeong Bay, Wando-Doam Bay, Deuk-Ryang Bay, and Kamak Bay.

Special Management Areas (SMA) is defined as coastal waters which do not meet water quality standards, impose significant risks or potential risks to human health, ecosystem integrity and coastal uses, and thus need special management measures for restoration. Five bays on the west and south coast have been designated as SMA in February 2000, such as Sihwa-Incheon Coastal Area, Kwang-Yang Bay, Masan Bay, Pusan Coastal Area, and Wool-San Coastal Area.

4.2.2 Criteria for Designation of CEMA

The designation of MPA and SMA is conducted considering various environmental and socio-economic criteria such as water quality standards, biological diversity and resources, coastal land utilization, pollutants loading, sea-use activities, etc.

4.2.3 Management Boundary of CEMA

In terms of physical and spatial Boundary, CEMA includes semi-enclosed bay waters and adjacent watershed areas where pollutants directly influence coastal environment.

The scope of management actions covers environmental (water quality, sediment quality) management measures, resources (living resources, space utilization) management measures, and institutional measures (human resources, organizational and financial resources).

4.3 Management Principles of Special Management Areas

4.3.1 Principle of Sustainable Development

This plan adopts the principle of conserving the functions and structures of ecosystem for the long-term and equal benefits of both present and future generations in terms of environmental, socio-economic and cultural values.

4.3.2 Principle of Ecosystem Management

This plan adopts the principle of formulating and implementing management strategies taking due consideration of ecosystem diversity and processes.

4.3.3 Principle of Precautionary Approach

This plan adopts the principle of applying appropriate management measures to prevent potential risks based on limited available knowledge and information on the impacts on coastal water and ecosystem.

4.3.4 Principle of Integrated Management

This plan adopts the principle of establishing integrated management system by addressing land-sea interface issues, coordinating among relevant agencies, and involving stakeholders.

4.3.5 Principle of Building Partnerships

This plan adopts the principle of safeguarding common vision and interest, and ensuring transparency and accountability of policy making process by building effective partnership among stakeholders.

4.4 Vision and Strategies

4.4.1 Vision

This Plan envisions Korean coastal waters to serve as sustainable resource base for ecologically responsible and economically viable marine and fisheries activities, and to serve as high-quality amenity space by developing coastal waterfront in environmentally-friendly and aesthetically-sound manner.

4.4.2 Strategies

This Plan adopted following strategies for managing Korean coastal waters and ecosystem. According to following strategies, specific action plan has been developed and implemented.

4.4.2.1 Strengthening the knowledge-base for coastal environment management

- Establish integrated monitoring system for the effective management of marine environment and resources
- Establish integrated information management system
- Establish continuous monitoring system for pollutants of high risk

4.4.2.2 Establishment of comprehensive system of managing marine pollution sources

- Secure wastewater treatment facilities and environmental infrastructures which are sensitive to marine ecosystem
- Apply total quantity management system of pollutants loading
- Develop effective management system for non-point pollution sources
- Develop effective measures for managing pollution driven by aquaculture activities

4.4.2.3 Establishment of Optimal Environment Restoration Model considering Specific Characteristics of Coastal Ecosystems

- Develop standard management model and approaches for coastal restoration
- Apply integrated management of environment restoration related projects including both coastal water and watershed

4.4.2.4 Protection of Marine biodiversity

- Establish the limit on allowable resources utilization for each coastal ecosystem
- Designate habitat protection area (No-Take Zone)

4.4.2.5 Establishment of partnership among stakeholders at local level

- Promote public and private environmental investments which have positive economic impacts on local economy
- Establish and operate cooperative decision-making system involving government, academia, industry, and civil society groups
- Develop public awareness and participation programs

4.4.2.6 Establishment of Systematic Planning and Management System

- Standardize the planning and management process in Coastal Environment Management Waters
- Apply effective evaluation system at multiple levels
- Develop appropriate economic techniques and methodology for the valuation of environmental resources
- 4.4.2.7 Selection of a Pilot Management Areas and Focus Management Efforts
 - Resources to raise Cost-Effectiveness and Transferability
 - Select pilot management areas considering the feasibility and applicability of management measures
 - Secure the implementability of management measures by developing strategic action plans and applying priority actions
 - Develop regional cooperative management programs with relevant regional programs and international donors

5. Summary and Conclusion

This paper described the status of marine environment in general and addressed the main management issues with special respect to marine ecosystem protection at land-sea water interface. The author explained the legal framework of marine ecosystem protection, by grouping the relevant legislation into three categories: legislation oriented to marine pollution prevention, legislation oriented to ecosystem protection, and legislation oriented to spatial use regulation. More specific explanation has been given to important legislation such as Marine Pollution Prevention Act, Wetland Conservation Act and Coastal Management Act. All these Acts have been wholly amended or enacted recently under the strong initiatives of MOMAF in integrating marine environment management measures.

Since the creation of integrated ocean governance, Ministry of Maritime Affairs and Fisheries in 1996, major efforts have been successfully initiated to establish integrated institutional framework for marine environment management. It seems that newly developed framework provides more effective mechanism of integrated planning, especially in addressing the land-sea water interface issues. However, more efforts remain to be made for integrating among different sectors, facilitating the participation of private sectors, and enhancing the local capacity in marine environment management. In addition, more innovative efforts are needed to develop optimal model of marine ecosystem protection and restoration, considering Korea's unique characteristics of coastal uses.

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USE OF REMOTE SENSING AND GIS TECHNOLOGY IN THE MONITORING AND ANALYSIS OF COASTAL DYNAMIC ENVIRONMENT

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Abstract

Substantial progress has been made in the monitoring and analysis of coastal marine environment during the past two decades, thanks to the advent and rapid development of remote sensing (RS) and geographical information system (GIS) technologies. In this paper, results of RS and GIS applications in the China Seas and Northwest Pacific Ocean are presented. First, sea surface temperature (SST) images derived from Advanced Very High Resolution Radiometer (AVHRR) data, in conjunction with sea level variability maps derived from Geosat altimeter data, are used to investigate mesoscale features, including fronts, eddies and upwelling, in the China Seas. Five types of fronts are identified, namely, shelf-break front, thermohaline front, estuarine front, tidal front and upwelling front. The characteristics and formations of these fronts are analysed. Two mesoscale eddies have been captured, their causes and evolution are examined. Remarkable signatures of the well-known Zhejiang coastal upwelling are observed by both AVHRR and Geosat altimeter. Second, using six years of TOPEX altimeter wind and wave data with unprecedented accuracy and continuity, a GIS-based analysis and prediction system is developed for the Northwest Pacific Ocean. The 10-, 50- and 100-year return values of sea surface wind speed and significant wave height (SWH) are estimated. Validation against in situ observations indicates that the uncertainties of altimeter-derived extreme winds and waves are at the levels of 10% and 5%, respectively, suggesting that satellite altimeter data, with present quality and duration, are already very useful in understanding and prediction of coastal marine environment.

1.Introduction

In the past few decades, there has been a growing recognition of the important role that mesoscale oceanic events, such as fronts, eddies and upwellings, play in ocean circulation and marine aquaculture. Meanwhile, it is also becoming more evident that efficient investigation of these phenomena would almost be impossible without the technique of satellite remote sensing. It is understood that satellite SST images have the capability of revealing the surface thermal structure of the ocean while satellite altimetry has the power of disclosing its dynamic features such as wind, wave and sea level variation. Therefore, joint analysis of both data sources provides an effective way for studying coastal and marine environment. The China Seas and the Northwest Pacific Ocean are particularly attractive for such studies because of the coexistence of several types of fronts, eddies and upwellings within a relatively small area, which is likely attributed to their unique geographical locations and hydrologic conditions.

Knowledge of extreme wind and wave climate of the global ocean is of increasing demand for a number of reasons. Oceanographers and meteorologists need it to better understand and more precisely predict many environmental phenomena and processes related to global change. It is of great concern by government officials for decision-makings with regard to the prevention and reduction of ocean disasters, as well as sea-going rescue activities. Coastal and marine industry is another community to which wind and wave information is extremely important. Therefore, it is clear that understanding of the extreme conditions of wind and wave climate is of interest not only scientifically to the research circle, but also economically to the government and industry.

2.Mesoscale Dynamic Features in the China Seas

2.1 Fronts

Front is a very common feature in both open oceans and coastal seas. The following types of fronts usually exist in the coastal and continental regions : Shelf-break front, thermohaline front, estuarine front, tidal front, and upwelling front. Almost all types of fronts exist in the China Seas. Based on the analysis of both scientific literature and satellite SST images, eight frontal zones in the Yellow Sea and East China Sea are identified and indicated in Figure 1 (numbers in Figure 1 correspond to those in the following text), their major characteristics are summarised below.

1) Kuroshio frontal zone (Figure 2), which belongs to shelf-break front located on the continental slope of the East China Sea. It is a large vertical frontal zone meandering around the 200 m isobath with its maximum and minimum intensities in summer and in winter, respectively.

2) Zhejiang coastal frontal zone (Figure 3), which exists throughout the year but has different causes between



Figure 1. Schematic chart showing the bathymetry and circulation system (winter pattern) of the eastern China Seas.

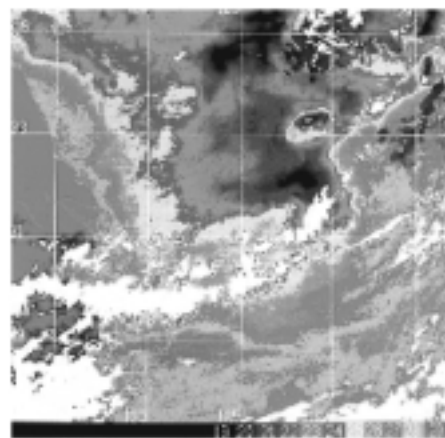


Figure 2. SST (in °C) image of 6:13UTC 29 August 1986 derived from AVHRR data showing a front-eddy coupling structure in the East China Sea.

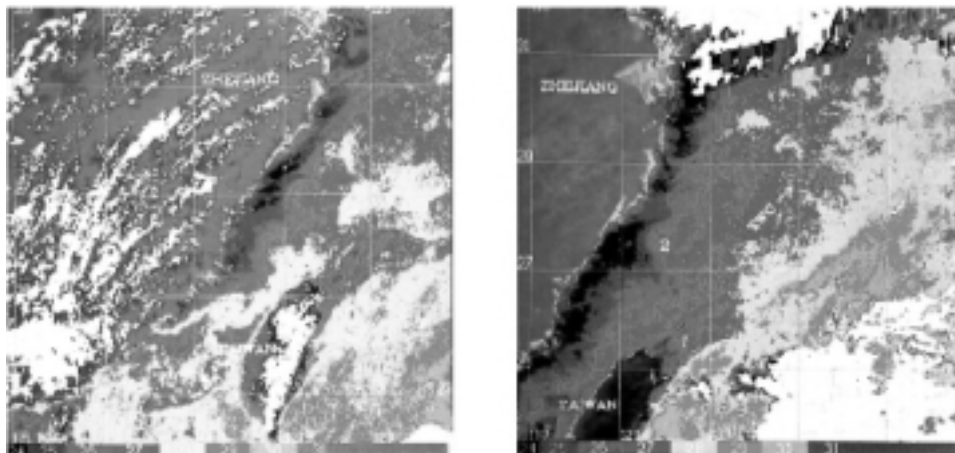


Figure 3. (a) SST (in $^{\circ}\text{C}$) image of 6 : 18UTC 22 July 1986 derived from AVHRR data showing Zhejiang coastal upwelling and its frontal zone, as well as a cyclonic warm eddy in the Taiwan Strait ;
(b) SST (in $^{\circ}\text{C}$) image of 5 : 47UTC 25 July 1986 derived from AVHRR data showing Zhejiang coastal upwelling and its frontal zone.

the YSWC.

4) Frontal zone on the northeast boundary of the YSWC where warm water from the YSWC merges with cold water from the southwest branch of the West Korea Cold Current (WKCC) (Figure 4). This front, oriented almost latitudinally, can sometimes approach to the central part of the southern Yellow Sea and frequently displays vigorous transfrontal exchanges in forms of warm and cold jets and small eddy-like structures.

5) Frontal zone in the Tsushima Strait between the Tsushima Current (TC) and the southeast branch of the WKCC (Figure 4). It is a meandering thermohaline front throughout the year. Its dramatically variable SST patterns can be mainly ascribed to the high annual variabilities of the two currents involved.

6) Shandong coastal frontal zone located around the east tip of the peninsula (Figure 4). The cause of this front also varies from winter to summer. In winter, it is generated by the interaction between warm flow from the YSWC and the cold coastal flow from the Bohai Sea. In summer, however, it is likely to be produced by strong tidal mixing when the coastal current diminishes. This frontal zone has its sharpest SST gradient in the east of the peninsula, then becomes divergent towards the south, eventually disappears in the southern Yellow Sea.

7) The Changjiang River discharge front formed near its estuary (Figure 1). Basically this is a salinity front whose intensity largely depends on the river runoff (Beardsley et al., 1983). In addition, the variations of the YSWC and YSCC also have certain impacts on it.

8) Tidal mixing front which occurs at the boundary of the tidally well mixed shallow water and the vertically stratified deeper water. In the China Seas, tidal fronts mostly appear near the Jiangsu coast (Lie, 1989) and the west coast of Korea peninsula (Figures 1 and 4). These fronts are easily recognisable in both infrared and visible satellite images because of their remarkable SST gradient and high turbidity of mixed coastal waters.

2.2 Eddies

A mesoscale eddy is defined as a rotational movement of a temperature-anomalous water mass with a horizontal scale of 100(300) km. Since eddy plays a significant part in the exchanges of energy and substance between ocean circulation systems and adjacent waters, it is one of the major foci in modern oceanography.

In Figure 2, a cyclonic eddy with a spatial scale of about 150 km centered at (126 $^{\circ}\text{E}$, 32 $^{\circ}\text{N}$) in the northern East China Sea, whose central temperature is 5°C lower than the surrounding water, can be clearly identified. It is thought that the following two reasons may contribute to the formation of this eddy : i) The shear effect of local current system, and ii) the southward extension of the Yellow Sea Cold Water Mass (YSCWM).

It is worth to note that, in summer, when both the shear effect of the current system and the southward extension of the YSCWM reach their maximum intensities, the heavy surface spreading of the upwelled cold bottom water might, for a certain period, prevent the northwest branch of the Kuroshio from penetrating into the Yellow Sea. Meanwhile, to the east of the eddy, an intense shelf-break front with a SST gradient of 5°C per latitude/longitude grid is formed over the 200 m isobath. Thus, a distinct seasonal front-eddy coupling structure can be reasonably created on the edge of the continental shelf in the northern East China Sea due to the combined effects of current system, water mass and bottom topography (Figure 2). When autumn comes, however, the impact of the eddy can no longer reach the surface, the YSWC will return to the Yellow Sea as usual. This region is again back to its normal state of current confluence.

In Figure 5, a star-like anti-clockwise eddy with a diameter of nearly 150 km located between 123 $^{\circ}\text{E}$ ~124 $^{\circ}\text{E}$, 38 $^{\circ}\text{N}$ ~39 $^{\circ}\text{N}$ is evident. The central temperature of this eddy is below 8°C , 4°C lower than the surrounding waters. Time series of SST images prove the continuing existence of this cold water patch from the end of October

winter and summer. In winter, it is an interface between the Zhejiang coastal water diluted from the Changjiang River and the warm saline water of the Taiwan Warm Current (TWC). In summer, the enhancement of the local upwelling interacts with the permanent TWC, giving rise to a visible surface manifestation of this front.

3) Frontal zone between the Yellow Sea Cold Current (YSCC) and the southwest boundary of the Yellow Sea Warm Current (YSWC) (Figure 4). This is an unstable thermohaline frontal zone whose characteristics, such as shape, length and orientation largely depend on specific hydrometeorological situation, particularly the annual and inter-annual variabilities of

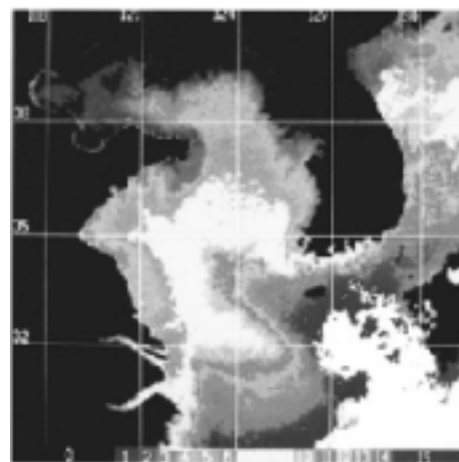


Figure 4. SST (in $^{\circ}\text{C}$) image of 5 : 51UTC 28 January 1987 derived from AVHRR data showing thermohaline frontal zones in the eastern China Seas.

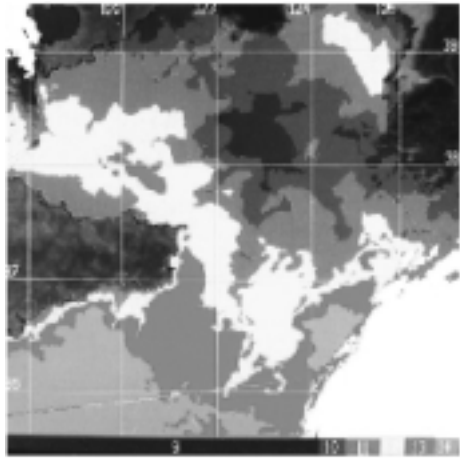


Figure 5. SST (in $^{\circ}\text{C}$) image of 11:19UTC 17 November 1987 derived from AVHRR data showing a cyclonic cold eddy in the northern Yellow Sea.

to the end of November in 1987. The formation of this eddy seems to be closely related to local bottom topography, since the water depth at the eddy center is about 10 m deeper than the adjacent area. When the air temperature begins to drop in autumn, the vertical mixing of the sea water enhances and the thermocline structure starts to disappear, the bottom temperature distribution of this area is then reflected at the surface in forms of a cold water core above the small basin.

2.3 Upwelling

Upwelling is known as a continuous upward motion of ocean water. Although the velocity of the flow is very small compared with horizontal current, it does play an important role in the equilibrium of ocean circulation as well as in marine aquaculture.

The most important upwelling in the China Seas is the Zhejiang coastal upwelling (Figure 3). Since summer thermocline prevails in the China Seas, the presence of a sustainable cold water patch serves as a good indicator of the existence of this upwelling. In Figure 3 we can see that the prominent upwelling zone is located between $25^{\circ}\sim 30^{\circ}\text{N}$. The upwelled surface water is 5°C lower than the SST of the TWC. Tracing the SST features of the two images (Figure 3(a) and (b)) separated by three days, the surface off-shore spreading of the upwelled cold water is obviously visible. Coincidentally, on our sea level variability maps derived from Geosat altimetry (Figure 6), a group of contour rings with high value in its center appears in the upwelling area. Moreover, we find that the location of the variability maximum moves one degree southward along the coast from the first year (November 1986 to November 1987) to the second (December 1987 to November 1988).

3. Extreme Wind and Wave Climate in the Northwest Pacific Ocean

Our analysis process is composed of six practical steps. The TOPEX wind and wave data are first sorted into $1^{\circ}\times 1^{\circ}$ grid cells, resulting in approximately 10^4 samples within each cell. In the following two steps, the probability density function (PDF) and the cumulative probability density function (CPDF) of each grid are obtained by generating the corresponding histogram and cumulative histogram, respectively. In step four, the extremes of the CPDFs are fitted with a theoretical probability function. Next, the return values of extreme wind and wave for a given duration can be calculated for each grid. Finally, regional maps of the return values can be constructed through an optimal interpolation.

Figures 7 and 8 present the spatial distributions of the 10-, 50- and 100-year return wind speeds and SWHs of the Northwest Pacific Ocean, respectively. The general pattern of all maps in these figures is dominated by regional structures with a clear trend of northward increase. Maximum return values are found in the northeast part of the study area for the wind speed. A major portion of the East China Sea also exhibits large extremes. Minimum return values are found in the tropical areas between $120^{\circ}\sim 130^{\circ}\text{E}$. Striking regional features can be identified in the South China Sea where the Asian monsoon prevails. The difference between extreme wind speed and SWH of the Northwest Pacific Ocean in terms of spatial distribution is somewhat surprising (see Figures 7 and 8). Two well-defined maxima of SWH appear in the area south of Japan and in the East China Sea, respectively (Figure 8). Low extreme SWHs are found in the tropical ocean as well as in the Bohai Sea.

4. Concluding Remarks

Based on SST images derived from NOAA AVHRR data and sea level variability maps derived from Geosat altimeter data, a number of mesoscale oceanic features, including fronts, eddies and upwelling, have been observed and analysed. Some results, such as the cyclonic cold eddy in the northern East China Sea, are in good agreement with in situ measurements; Some are discovered for the first time, for example, a cyclonic cold eddy in the northern Yellow Sea. The necessity and advantage of using multi-satellite data in the

investigation of mesoscale activities are also demonstrated in this research. Further development of remote sensing technology will no doubt lead to a better description and understanding of the mesoscale dynamic processes in the China Seas.

Using six years of TOPEX altimeter data with unprecedented accuracy and continuity, the extreme values of wind speed and SWH are estimated for the Northwest Pacific Ocean. The unique contribution of this study is perhaps the presentation of a spatial pattern of extreme wind and wave climate for this region. Specific results include the 10-, 50- and 100-year return values of sea surface wind speed and significant wave height. Validation against site measurements suggests that the uncertainties of the TOPEX-derived extreme values are at the level of 10% for wind speed and 5% for SWH. As a result, it is time that satellite altimeter data be of practical and even operational

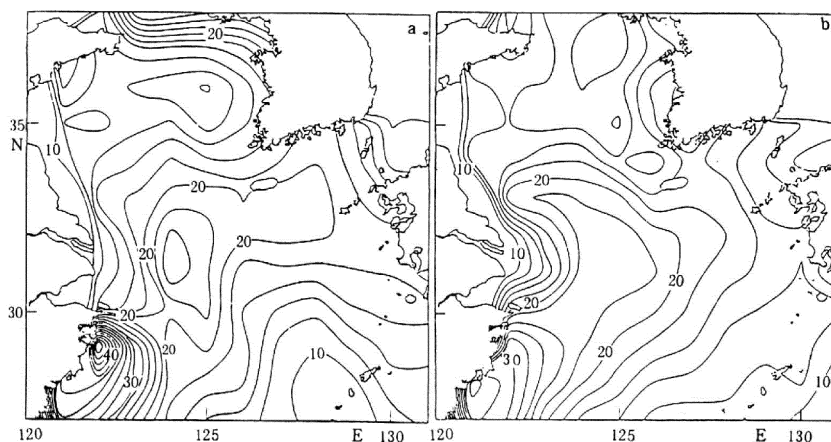


Figure 6. Sea level variability maps (in cm with an interval of 2 cm) of the eastern China Seas derived from Geosat altimetry during (a) November 1986 and November 1987, and (b) December 1987 and November 1988.

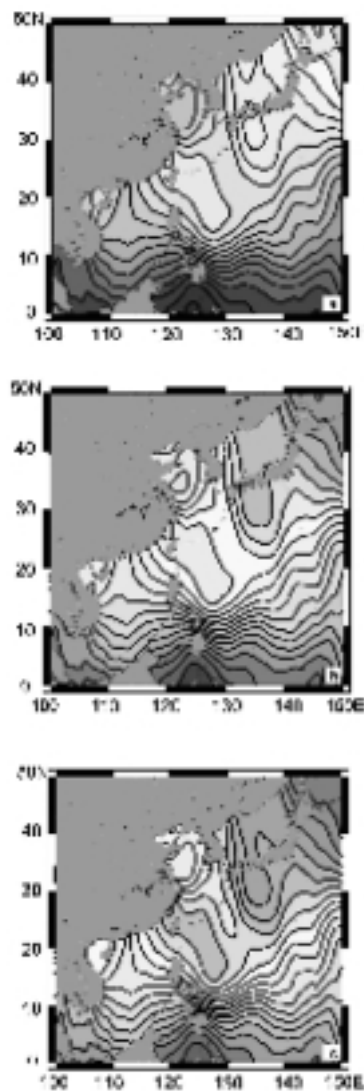


Figure 7. Return wind speeds of the Northwest Pacific Ocean derived from six years (1993-1998) of TOPEX altimeter data for a period of (a) 10 years, (b) 50 years, and (c) 100 years.

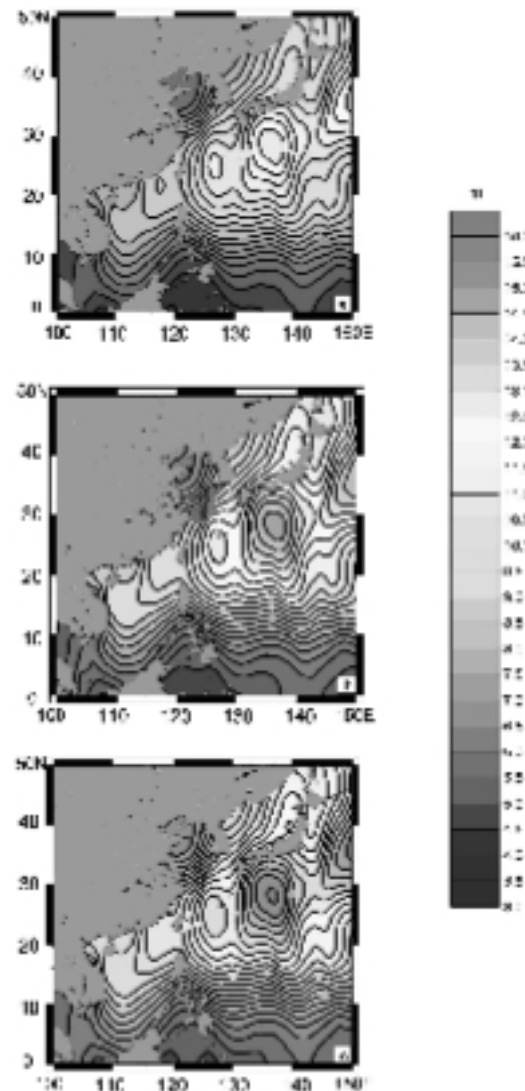


Figure 8. Return SWHs of the Northwest Pacific Ocean derived from six years (1993-1998) of TOPEX altimeter data for a period of (a) 10 years, (b) 50 years, and (c) 100 years.

use in coastal and marine engineering.

Acknowledgements

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HOW AND WHAT SOLUTIONS FOR SUSTAINABLE MANAGEMENT OF THE MANGROVES IN MEKONG RIVER ESTUARIES?

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1.Mangrove changed status on Time-lines Mekong River Delta - Viet Nam

Major time as year	Current areas in Hectare	Dominant species of plant	Typical Forest structure and quality	Main pressures and impacts on Mangrove
1940	250,000	Avicennia Rhizophora Bruguiera Ceriops	Dense natural forest Rich biodiversity and big wood trees natural habitat of wild life	6 persons/1 km2 Natural primary Mangrove
1960	149,000	as above	as above	11 persons/1 Km2 in Mangrove area - Fire-wood an - Charcoal
1975	15,000	Avicennia Excoecaria Thespesia Phoenix Acanthus	Scattered wood trees, opened-land and shrubs	To be destroyed by chemical agents during war time and other weapons
1985	85,000	Avicennia Rhizophora Bruguiera Sonneratia Lumnitzera	Reforestation by Rhizophora Medium style	Reforestation and Shrimp pond system have been realized parallelly ecological unbalance
1995	58,000	as above	as above	More serious logging and destruction of mangroves for expansion of shrimp ponds and Coastal new economic
Zones				
1999	87,000	Rhizophora concentrated Avicennia Sonneratia	Man - made Mangrove reach the optimum ecosystem	Application of much more reason able and new policies for Land use and sustainable management of the mangrove and coastal zones.

2.Ecological function of mangrove Forests

- Mangrove forests are known to fulfill important ecological functions in the coastal zone and all estuaries - focused areas as Mekong river nine river mouths - preventing erosion and salty intrusion, supporting enrichment of the biodiversity and silted alluvium.
- Mangrove areas offer a habitat or shelter to other plants and animals as optimum ecosystem for coastal flora and fauna. This abundant food source is consumed by fish, prawns, crabs, molluscs, amphibians, reptiles, mammals using feeding strategies. Besides, the mangroves are used as nursery sites for juvenile fish species. The leaf litter produced by the mangroves provides the basis of their nursery value. Many commercially important fishes, crabs, prawns, various kinds of molluscs use mangroves as nursery grounds and shelter during their juvenile stages.
- Mangroves play an important role in regulatory by controlling water quality. They control water quality by attenuation of peaks in nutrient discharge and sediments, neutralization of potential sulfuric acids by frequent flooding and maintenance of ground water level and prevention of salt water intrusion. The anaerobic mangrove sediments also have the ability to trap heavy metals and pesticides without harm to the trees. As a result, mangroves can incorporate, trap or immobilize inorganic nutrients, heavy metals or pesticides that would otherwise flow towards the sea.

Coastal zone protection

Mangroves also play an important role in protecting the coastal communities from cyclones and storms. The waves and the currents are weakened by mangrove roots and trees break up wave energy and the degree of wave reduction is proportional to the width and density of the forest the soil is not easily washed away or erode, placing large amounts of sediments in suspension and thereby increasing water turbidity.

In Viet Nam, mangroves' trees were planted to protect sea - dykes from erosion which are more effective and successful. So far the planting and rehabilitation of mangroves for protection of coastal zones and estuaries in general and sea dykes in particular have only achieved initial results.

Mangrove destruction and involved unbalances of ecosystem in Coastal areas

Mangroves were destroyed seriously by chemical agents during war time, almost in Mekong River delta.

Mangroves have been logging for timber, charcoal and other housing materials etc..

Mangroves were exploited fast for occupation of agricultural land and aquaculture. The large scale of mangrove areas in Mekong delta were heavily destroyed due to over- exploitation productions for timber, charcoal, domestic consumption, export and coastal aqua culture development (based on immediate benefits and short-term planning, unstable implementation).

1980 Reforestation of mangrove as 22,222 Ha. but replacement of natural mangrove for new agricultural land as 24,000 Ha.

1983 Reforestation of mangrove as 4000 Ha but clearing of natural mangrove as 21,000 Ha for new shrimp-ponds.

1987 Reforestation of mangrove as 6,000 Ha but continued exploitation of land and natural mangrove as 23,400 Ha for shrimp - ponds.

1992 Over 45,000 Ha of mangroves in Mekong delta, almost locations on estuaries and coastal sites, were replaced by shrimp - ponds and short - term cultivation.

1995 Initial success of mangrove rehabilitation and protection by :

- Major option reforestation programme
- Long-term sustainable planning for coastal optimum ecosystem establishment
- Serious regulation of mangrove conservation.

3.How and what solutions of mangrove sustainable development and management

- Based on new official policies in the renovation strategy, the collaboration among major sectors (inter ministries) in the National sustainable development programme of coastal zones in Viet Nam, as :
 - * Long-term biodiversity conservation action plans;
 - * Natural disaster control in coastal zones;
 - * Keeping the stable balance between Ecological statement and Economic development;
 - * Effective implementation of the Law on Forest resource Protection and Development, parallel actions on promotion of agro - forestry and aquaculture - forestry;
 - * Land - allocation for local households, state support local communities (by fund, technique, long-term planning making) on implemented plans of reforestation;
 - * Agro - forestry and Aquacultural extension services development, based on sustain able Eco - Eco Models (Mangrove forest habitat, pond and irrigation, adapted crops);
 - * Limited and control the spontaneous immigrants to the mangrove areas.
 - * The mangrove forest management activities are promoted as local community participatory with state functional institutions, which follow reasonable regulation of "Benefits and Responsibilities" Mangrove forests are leased out to households under clearly spelled out benefit and responsibility sharing mechanisms for planting, management, protection and harvesting of productives.
 - * A directive on the technical procedure for the establishment and maintenance of mangrove forests was issued since 1984. In addition, in order to achieve these environmental objectives, regarding the rational use of natural resources and environmental protection in coastal zone, was enacted.
 - * In 1995, the Government promulgated a policy for the sustainable use of wetland areas in Mekong delta, almost focused estuarine and coastal mangrove areas, as protected and reserved areas which are core - sites of coastal biosphere conservation. There are 8 sites of mangrove reserve areas around Mekong delta peninsula, which will become the core zones of coastal biodiversity protected action stations. Especially the unique mangrove forest of Can Gio district (Suburb of biggest city in Viet Nam as Ho Chi Minh city) has just certified an International Biosphere Reserve by UNESCO in Nov 2000, its surface as 30,000 Ha.
 - * The mangroves adjoining the river estuaries and along the coast are important green belts and serve to protect human life, properly and fields against coastal and river bank erosion, strong monsoons and storm floods. The government has therefore declared strict regulations to protect these forests. Apart from this, establishment of new plantations are encouraged and supported.
 - * The responsibility for coastal development and environmental protection in Viet Nam is delegated to the local administration and other involved sectors. They have formulated together a number of decisions, regulations, instructions and guide looks to protect, and limit the irrational utilization of mangroves in Mekong delta.

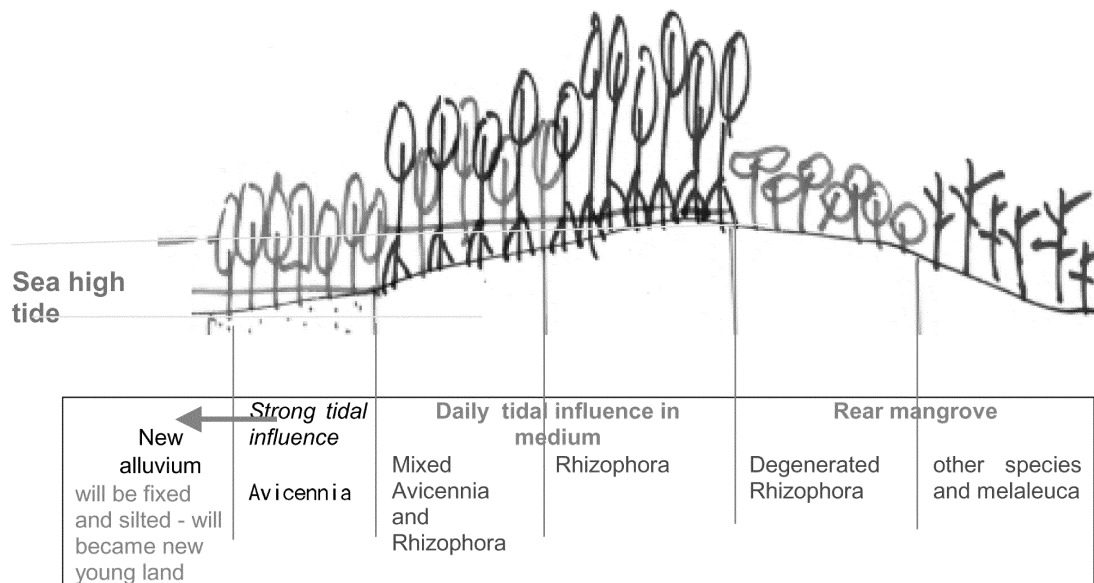
Nevertheless, shrimp raising for export has been very profitable and the conservation of mangrove forests to shrimp ponds continued to increase rapidly as on models classified : protected forest, forestry - fishery, fixed cultivation land with mangrove bands. The existing statement of mangrove development and management in Mekong delta has been pushing up successful environmental protection in coastal zones and livelihood increasing for local communities.

- For example as the action plan for local communities, management in Ca Mau province (Main coastal province in Mekong delta peninsula) from 1995 to 2005) :

Long-term planning characteristics	Mangrove forest type and landuse	Planned data of Areas Hectare	Management styles
TOTAL OF MANGROVE AREAS - Rich forest - Poor forest must be cared to Rich level - Reforestation	Whole province - Natural forest - Man-made forest	51,492 4,195 35,907 11,373	* State forestry station and local community Joint management * Main power as house holds
Main objectives of functional role forests on planning	- Nature reserve - Protection - Production on Models	3,850 12,747 34,895	* State Forestry stations and local communities, households * Interministries.
- Indicated planning for production areas	* Mangrove outside Aquaculture * Mangrove inside Aquacultural areas	27,044 24,448	- House holds - Aquacultural farms
None forest - lands in 1995 and towards 2005 on planning	* Reforestation * Settlement and resettlement * Agro-Forestry and Aquaculture * Restore	61,899 13,783 2,177 38,684 7,236	- Private farms - House holds - State enterprises - Local planning department - Local communes

4.Conclusion

- Continued programme of enhancing capacity management for state institutions and local communities on mangrove forest system. To be pushing up strong by the awareness of mangrove environmental functions and ecological benefits for all different social levels who involve the coastal areas, and human activities in there for live hood.
- Expansion of land allocation for mangrove - reforestation and Forest farms development.



- Reforestation continuing. Reserved areas Agro-Forestry and Aquaculture on model styles
- Long-term planning for sustainable development in coastal zones and focused estuaries.
- Local community joint management with interministries and cross - sectors collaboration in coastal areas as on
- Protection of ecosystems
- Biodiversity conservation
- Natural resources and land use reasonable utilization
- Stable keeping balance between Economy and Ecology
- Save stability of natural habitat and optimum biosphere for human life.
 - International cooperation and Intergovernment control the coastal zone and marine resources management, study and education for sustainable development of coastal and marine region.

COASTAL MANAGEMENT SYSTEM AND ECOLOGICAL PRESERVATION IN JAPAN

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Introduction

In 1999, the Diet passed the Coast act Amendment, and in February 2000, National Land Agency made "the Guideline for the Integrated Coastal Management Plan" which covers all coastal area in Japan. They reveal new coastal management system in Japan. I would like to introduce the coastal management system, especially legal system in Japan. And I will present new ideas of legal system. I will point out three major points. The first is historical and fundamental issues, the second is the Acts and legal doctrines before 1999 and the third is new system.

The first point is historical and fundamental issues, e.g. who is an owner of coastal lands, who has responsibility of maintain coastal lands, how the agency maintain coastal lands?

The second is the Acts and legal doctrines before 1999 and environmental problems in coastal area. We did not have integrated coastal management act, but have four management laws, the Coast act, the Harbor Act, the Fishery Port Act and the River Act, though these four acts apply the limited coastal area. There is extensive coastal area where four acts did not apply. We think that Ministry of Construction or Governor of Prefectures maintain that area for the public use on the basis of "Kobutsu-ho" doctrine.

We have many environmental Laws. This time I introduce our experience of the Law Concerning Special Measures For Conservation of the Environment of the Seto Inland Sea of 1978.

The third is new coastal management system. The Coast act Amendment adopts "public coast" system. So all coastal area is regulated and maintained by four acts. National Land Agency makes "the Guideline for the Integrated Coastal Management Plan" which covers all coastal area in Japan. So integrated coastal management conferences will be established in order to make integrated coastal management plans in a few years.

In my conclusion, I will point out some merits and demerits of Japanese experiences and propose some ideas to new coastal management system.

1. Some Problems in Coastal Area

Japan is an island country located in East Asia in the northwest Pacific Ocean. Japan's size is about 380,000 square kilometers. Japan is made up of many islands, including 4 large islands : Hokkaido, Honshu, Shikoku, and Kyushu. The country has diverse natural environments due to the variety of climates found there. Four fifths of the land area is mountainous, with mountain ranges running from the north to the south. There are also a few spacious plains. On the whole, Japan's rivers are short and rapidly flowing streams. Therefore the nation is often troubled with water shortage in spite of an abundance of precipitation, and with flood. Many peninsulas and capes complicate the coastlines and form diverse scenery.

There are many problem of coastal management in Japan. The first is protection of coastal area from disaster. Much of coastal area has been eroded by wave and wind. We have much strong wave from typhoon and rainstorm in winter. And the construction of dams in many rivers makes lack of sand supply, coastal erosion happens many areas. The Coast Act provides the Coastal Protection Zone where Minister of Construction made and maintained breakwater. And we have also flooded near the mouth of rivers. So coastal area near the mouth of rivers are often designated to the Coastal Protection Zone. About half of Coastal line is designated for the Coastal Protection Zone. See Table 1.

We had been made windbreak forests. Japanese traditional coastal seine "Hakusha-Seisho"(white sand and green pine at the beach) was often a seine of windbreak forest at the beach.

The second is environmental problems. Water pollution and destroy of wetland and happened many coastal areas. Especially we have special acts for water pollution ; the Water Pollution Control Act, the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea and the Lake Environment Conservation Act.

The third is the reclamation. In 100 years we had many big development projects and destroyed much coastal wetland area. Especially after 1960s, many big industrial development projects have been operated at coastal area.

2. Coastal Management System before 1999

Before speaking about the new Coastal Management System in Japan, I would like speak about Japanese legal system. First, who is an owner of coastal lands? Second is Japanese traditional legal system.

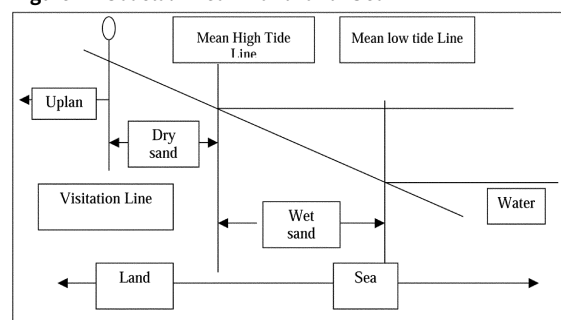
2.1 Who is an owner of coastal land?

In Japanese legal system, mean high tide line (high tide line on Vernal Equinox Day and Autumnal Equinox Day) divide "the land" and "the sea". Private ownership does not settle in the sea. The land from the mean high tide line to the mean low tide line(dry sand area) is generally owned by national government. Of course, upland area owned by private person generally. See Figure 1.

2.2 Coastal Management by special acts

Generally speaking, our coastal legal system is simple, but not integrated. Coastal area regulated by special acts, the Coast act, the River Act, the

Figure 1 Coastal Area Land and Sea



Harbor Act and the Fishery Port Act. But there is wide no regulated area. See table 1.

Table 1 Coastal Line in Japan

	Acts	Coastal Protection Zone Line (include undesignated Line) (Km)	Other Lines (Natural Coast Line) (Km)	Total(Km)
Ministry of Construction	Coast act	5,874(37.1%)	10,458(9,012)	16,273(47.0%)
Ministry of Agriculture, Forestry and Fisheries	Harbor Act & Coast act	5,272(33.3%)	2,955(1,635)	8,091(23.4%)
Agricultural Structure Improvement Bureau	Land Improvement Act & Coast act	1,830(11.5%)	-	1,796(5.2%)
Fishery Agency	Fishery Port Act	3,442(21.7%)	2,955(1,635)	6,295(18.2%)
Ministry of Transportation	Harbor Act & Coast act	4,460(28.2%)	-	8,661(25.0%)
Co-jurisdiction of Ministry of Construction and Agricultural Structure Improvement Bureau	Land Improvement Act & Coast act	237(1.5%)		228(0.6%)
others		-(0.0%)	1,369(-)	1,369(4.0%)
total		15,843(100.0%)	19,164(12,306)	34,662(100.0%)
		45.8%	55.4%(35.5%)	

(Japan River Association, RIVER HANDBOOK 1998,246-247(Japan River Association, 1998)

The "kobutsu" doctrine

The "Kobutsu" means the properties, institutions and facilities for public use, and constructs and maintains by Pubic Authorities. For examples, "kobutsu" includes road, urban park, public hall that are man-made and river, national park, coastal area that are natural goods.

Generally speaking, Government or public authorities control Kobutsu on the basis of the regulatory acts (e.g. the Road Act, the River Act), and also government or public authorities control unregulated Kobutsu on the basis of "Kobutsu" doctrine. Government and other public authorities maintain the "Kobutsu" for public use, and Government and other public authorities have a liability for proper maintenance. Although people are able to use the "Kobutsu" freely, people do not have the right to use. People don't have a standing to sue the decision of maintain by Government or public authorities. Government and public authorities have wide discretion to keep "Kobutsu."

The Coast act (before 1999)

The purpose of the Coast act is the protection of coastal Area from disaster. The Act applies all coastal area, but only regulates the Coastal Protection Zone. Director of coastal area is the Minister of Construction, or Governor of Prefecture.

The River Act (before 1997)

The purposes of the River Act are flood control and irrigation. Many rivers in Japan have fast flowing stream. So riverside field, especially the mouth of river area, is often flooded. Director of River area is the Minister of Construction, or Governor of Prefecture.

The Harbor Act (before 2000) and the Fishery Port Act

The purposes of the Harbor Act are ① making the Plan of Harbor System and Construction and maintenance of Harbors, and ② establishment and maintenance of Steamship Routes. Director of the Harbor is the Port Authority or Local Government.

The purposes of the Fishery Port Act are the making the Plan of Fishery Port System and Construction and maintenance of Fishery Ports. Director of the Fishery Port Act is Local Government.

3.Environmental Problems and Law

3.1 Environmental Laws

There are many environmental laws in Japan. Japan's environmental administration had been based on two laws : the Basic Pollution Prevention Law enacted in 1967 and the Law for the Preservation of the Natural Environment enacted in 1972. Up until 1993, the administration has played a fixed role in preventing pollution and preserving the natural environment. Nevertheless, the framework of these laws, which concentrated on restrictions, was no longer adequate to deal with the increasing scope of the domains that require environmental measures and, in particular, to devise appropriate measures to deal with atmospheric pollution from nitrous oxides in major cities, pollution of the water in enclosed coastal seas, etc. caused by household sewage, and global environmental problems such as the ever-increasing quantities of wastes, global warming and the destruction of the ozone layer. What was needed was a reconsideration of our socioeconomic system and the type of action that should be taken, through measures involving all entities -- the national government, local public organizations and private companies, as well as autonomous efforts on the part of private citizens -- and the use of a variety of techniques in an appropriate manner.

The Basic Environmental Law of 1993 is designed to provide the major foundation for developing a comprehensive new set of environmental countermeasures more suited to the age of global environmental concerns. The Basic Environmental Law first establishes three basic principles for environmental preservation : enjoyment and inheritance of the bounties of the environment, creation of a society capable of sustainable use that reduces the burden on the environment, and making active efforts to preserve the global environment through international cooperation. It also identifies the duties of the national government, local public organizations, companies and citizens as regards environmental preservation. Secondly, with regard to environmental preservation policy, the law identifies guidelines for the establishment and implementation of measures and specifies that a Basic Environmental Plan should be prepared and brought before the general public as the major policy framework. It also specifies such basic measures as environmental standards and pollution control plans

; consideration for the environment in national and other measures ; evaluations of environmental impact ; disposition of restrictions to eliminate obstacles to environmental preservation and economic assistance or subsidies for the elimination of obstacles to environmental preservation ; the construction of facilities relating to environmental preservation and the promotion of similar projects ; encouraging the use of products, etc. that help ease the burden on the environment ; promotion of environmental education and autonomous activities on the part of the general public ; support for science and technology ; and international cooperation, subsidies and financial measures with respect to global environmental preservation efforts and the like. Thirdly, the law prescribes the establishment of Environmental Councils within the Environment Agency and at the prefectural level.

Major Environmental Laws relating coastal area are follows : the Basic Environmental Law of 1993, the Water Pollution Control Act of 1978, the Law Concerning Special Measures For Conservation of the Environment of the Seto Inland Sea of 1978, the Environmental Impact Assessment Law of 1997, the Natural Park Act of 1957, the Law for the Preservation of the Natural Environment of 1972, the Law Concerning Special Measures for the Preservation of Lake Water Quality of 1984, the Law Relating to the Prevention of Marine Pollution of 1970.

In recent years not only have COD or BOD not been improving rapidly, particularly in narrow bays, inland seas, lakes serving as reservoirs, and rivers in urban areas, but also chemical pollution problems have worsened. Therefore, the Law Concerning Special Measures for Conservation of Lake Water Quality was established in 1984 and a revision of the Water Pollution Control Law was passed in 1989 to prevent underground water pollution by toxic substances. As for the sea area, the Environment Agency has developed EQS and uniform effluent standards for nitrogen and phosphorus to prevent eutrophication of coastal seas. In addition, in 1996, the Water Pollution Control Law was amended, with incorporating purification of polluted groundwater, and in 1997, EQS for groundwater were established. See table 2 & figure 2

3.2 The Law Concerning Special Measures For Conservation of the Environment of the Seto Inland Sea(hereinafter "Seto I. S. L.")

We have some experience of coastal zone regulation by the Law Concerning Special Measures For Conservation of the Environment of the Seto Inland Sea (hereinafter "Seto I. S. L."). The Seto I. S. L. is a special act for Seto Inland Sea Area and a kind of special the Water Pollution Control Act. Seto I. S. L. takes five major methods for ensure the purposes of the act. The first is making Plan for Conservation of Environment of Seto Inland Sea (National Basic Plan (1981, Amendment 1994, and now under making New Amendment) and each Prefectural Plan). The second is the adoption of permission system for Installation of specified Facilities. The third is the ensuring Reduction of Total Amount of Pollution. The forth is the making Guideline for Reduction of Specified Substances. The fifth is the countermeasures for Natural Seashore Conservation. The prefectures concerned designate the area as Natural Seashore Conservation Area by ordinance. 91 areas are designated at the end of December in 1997. The sixth is Special Consideration to Reclamation. In considering the license for reclamation taken in the Seto Inland Sea, the governor of the prefecture concerned should take into account the peculiarities of the Seto Inland Sea. The basic policy for reclamation proposed by the Seto Inland Sea Conservation Council in May 1974, should be applied. Reclamation of the Seto Inland Sea should be strictly controlled, and if it is authorized for an unavoidable reason it should be conducted in accordance with three region policies.

I would like to check the efficiency of the Seto I.S.L., because National Basic plan and each Prefectural plan make a kind of comprehensive environmental coastal zone regulation plan (not integrated zone management plan). I would like to focus to reclamation problem, because reclamation in Seto Inland Sea was a symbol of urbanization, industrialization and water pollution in Seto Inland Sea Area. After enactment of the Seto I.S.L., though the basic policy for reclamation strictly control of reclamation, number of reclamation permission was decreasing, but total reclamation area was increasing. See table 3 & figure 3.

4.New Coastal Management System --- New legal System in Japan

Recently, the Diet enacted the River Act Amendment of 1997, the Coast act Amendment of 1999 and the Harbor Act Amendment of 2000 and will enact the Fishery Port Act Amendment next year. In February 2000, the National Land Agency made "the Guideline for the Integrated Coastal Management Plan" which covers all coastal area in Japan. Japanese Coastal System has been changed by these Amendments and the Guideline.

Figure 2

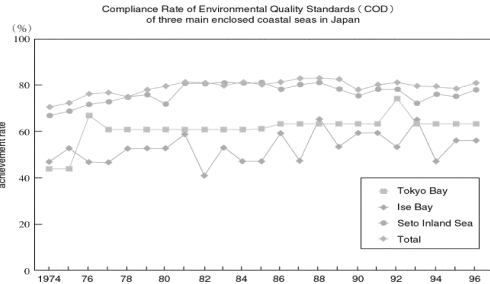


Table 2

State of Water Pollution in Lakes and Bays (FY96)



Table 3 Reclamation in Seto Inland Sea

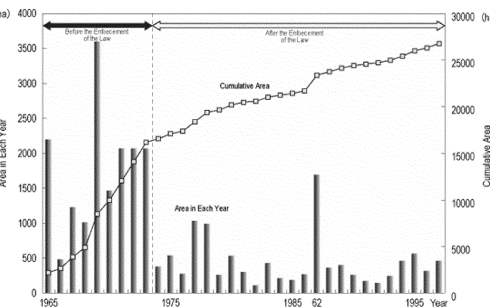


Figure 3 History of the Reclamation in Osaka Bay



4.1 The Coast Act Amendment of 1999 and other Acts

The Coast Act Amendment of 1999 put the conservation of coast environment newly in addition to a conventional purpose. Being putting the conservation of river environment to a conventional purpose even the River Act Amendment of 1997 this modification is the same content in this sense. And also this Amendment introduced the public coastal zone system in addition to the coastal protection zone. The Coast Act applies all coastal area. The public coastal area has been managed for environmental conservation and public use, although management was hardly done conventionally.

Diet also amended the Harbor Act for environmental conservation and will amend the Fishery Port Act for environmental conservation.

4.2 The Guidelines for Integrated Coastal Zone Management Plans

The National Land Agency makes "the Guideline for the Integrated Coastal Management Plan" in March 2000. The guideline is the guidance of case that local government (Prefecture or City) sets the integrated coastal zone management plan, there is a big meaning in that introduced the new concept called the coastal zone management plan.

(1)Necessity for and basic concepts on Integrated Coastal Zone Management

Coastal areas are in sensitive natural balance, where land, water and air interface while varied coastal land and water uses often compete and conflict : such as industries, traffics, amenity, cultural activities and other uses for human needs. With a recent rise in the public awareness of the importance of the global environment, it has become one of the today's critical issues to preserve or enhance the function of natural reproduction cycles and the diversity of nature in coastal areas. Not only from the perspective of the development of safe, variously functioned coastal areas, but also from the viewpoint of restoration and creation of esthetic, sound coastal environments, Integrated Coastal Zone Management (ICZM) has become vital in order to solve, balance conflicting demands from various concerned agencies, groups and individuals.

Also there are some needs for adoption of integrated coastal zone management. The first is needs for "integrated" system. As I mentioned, we had special acts for management specific area and wide no regulated area, but didn't have integrated system. But the law reform from the viewpoint of environmental conservation is demanding the coastal management system of integration.

(2)Basic concepts on ICZM

Basic concepts on ICZM are the following : Create or restore aesthetic, safe, sound coastal areas for this and succeeding generations.

Balance competing demands of environments, safety, and various land and water uses in coastal areas. Foster partnerships among various concerned local governments, agencies, groups and individuals.

(3)ICZM plans

An Identification of the boundaries of the coastal zone

The boundaries of the coastal zone subject to an ICZM plan will be identified to treat an entire encompassed area as a natural system unit, strongly influenced by each other in light of geographical shapes, water and soil movements. The zone encompasses a certain part of coastal areas, extending in two directions, [A] a coastline direction and [B] an inland/seaward direction. Local authorities will make clear these two directions boundaries : a coastline direction boundary is expected to be based on the 48 portions of the whole country coastline which the guidelines show ; an inland/seaward direction boundary extends in accordance with the characteristics of local areas and planning elements.

Viewpoints for planning

a.Participation and cooperation

To encourage participation and cooperation of various concerned groups such as the national government, local administrations, private sectors, Non-Profit Organization (NPO), fishermen, local communities.

b.Wide overview

To provide wide overviewed implementation, giving full consideration to the whole of bays, inland seas and river.

c.Long-term view

To provide long-term viewed implementation, setting a future vision of coastal areas under an analysis of natural cycles.

d.Continuing implementation

To provide a continuing implementation based on the results of continuous monitor and analysis of the execution of an ICZM plans.

(4)Building ICZM plans

Findings as to study of the coastal area

Defining problems of coastal areas by making a detailed study of the features of coastal areas, including the characteristics of the nature, disasters, social, economic interests, culture and history in coastal areas.

Planning elements

An ICZM plan is expected to include the following elements :

- a.The boundaries of a coastal zone (to be indicated clearly on map)
- b.Period of reauthorization of the plan (approximately every 10 years)
- c.Basic policy (basic policies for projects and activities in the coastal zone in light of the future visions)
- d.Definitions of issues and basic directions of comprehensive management programs for solving, managing the issues.
- e.Organizations for the implementation of an ICZM plan and measures to evaluate the execution of the ongoing plan

(5)Organizations for the decision-making and implementation of ICZM plans

Integrated Coastal Zone Management Commission

Integrated Coastal Zone Management Commission shall be created, consisting of representatives of each of the prefecture governments

and cities in the coastal zone as its main members and representatives of each of concerned groups or individuals, such as the national government, agencies, NPO, the residents, the enterprises and any other groups in the coastal zone. The Commission is responsible for building or developing an ICZM plan, reviewing the execution of the ongoing plan and providing the information of the plan to the public. Even the case the national government or agency are not included as a member of the Commission, it may be appointed with an approval of the Commission, especially when a coastal zone extends two or more than two prefectures' jurisdictions or when the Commission requests the participation of the national government or agencies (including branch offices).

Certification organization

The governors, mayors and administrators of the members of the Commission may certify the ICZM plan, addressing a full support for the implementation of the plan when the plan is considered to be relevant and appropriate.

Organization relating Integrated Coastal Zone Management Commission

Integrated Coastal Zone Management Commission may, if necessary, appoint the following organizations to assist and advise the Commission in carrying out its decision-making and other functions on the plan.

a. Coastal Zone Committee

To encourage the participation and coordination of various concerned groups and individuals in various areas.

b. Technical committee

To provide technical, special evaluations and inspections on planning goals or execution of ongoing plans.

c. Administrative Coordination Committee

To encourage the coordination and cooperation with local, prefecture, national agencies.

(6) Things to consider

Character of ICZM plans

Although ICZM plans don't have legal enforcement policy, they are expected to be master plans based on consensus of various concerned groups and individuals, making the policies of plans more effective and enforceable. Coordination with related plans and policies.

ICZM plans are encouraged to be consistent with various related plans, policies and other projects in coastal zones by the national government and local authorities.

Features of coastal zones especially expected to be planned

The features of coastal zones urgently expected to be planned are the followings :

- a. Having bays where diverse land and water uses are or are likely to compete and conflict
- b. Having superior landscapes or historical, cultural resources.
- c. Having a scheduled project supposed to make considerable impacts on local economy or natural environment.

Enhancement of the public awareness and dissemination of the information.

Prefecture, local governments are encouraged to enhance the public awareness of the basic idea and the need of ICZM, and to disseminate information about the contents of ICZM plans to the public.

(7) Next Steps

The National Land Agency is scheduled to enhance understanding of ICZM and the guidelines of ICZM, and to assist local authorities to develop a model of ICZM plans by modeling coastal zones where coordination and corporation among multi-prefecture governments are needed, such as bays.

5. Conclusions---Some problems to build New System

5.1 Coastal Zone Management System

I speak about Japanese Coastal Zone Management System. We will have the Integrated Coastal Management System in a few years as I introduced. But I think we have five problems to build the Integrated Coastal Management System. First is coastal zone and zoning. We know the urban zoning system and already use the system over 30 years. And we have limited experiences coastal area management in Seto Inland Sea Area. But the Seto I.S.L. has good effects to decrease number of reclamation permission, but not good for recovering natural environment. And some big projects, for example, Kansai Airport Project, The Hon-shi Bridge Project that make three big bridges between Honshu and Sikoku Island, had been carried out and there are many new projects which are under planning. Second is effect of coastal plan. New Coastal Zone Management plan has not legal effect, because the Plan has no statutory basis as same as other administrative plans. Third is to ensure public participation and/or partnership. We have much the experience to make the law that has public participation prescription. However, it is not always succeeding in the effective enforcement. Forth is to make "integrated" plan. We have many administrative plans, but it is difficult for us to make "integrated" plan. And if we make integrated plans, it is not always succeeding in the effective enforcement. Fifth is check system for Integrated plans. People who use coastal area for swimming, sailing and fishing don't have standing to sue reclamation permission. Governor or agencies have wide discretion to manage coastal area on the basis of "Kobutsu" doctrine. The resident lawsuit that the resident in local body can make to sue is almost the sole lawsuit means.

5.2 Reform of Administrative System

After restructuring of government departments and agencies, new system will begin on 1 Jan., 2001. And the Local Government Act Amendment and other relative acts had effect on 1, April 2000. These reform are the biggest change after World War II and it is difficult for us to understand the effectiveness of the Reform now. It is important for us that the directors of Coastal area (except Fishery Port area) are Minister of Land and Transportation in national level. Formerly, the Minister of Construction, the Minister of Transportation and Minister of Agriculture, Forestry and Fisheries has authority and also there are wide non-regulated areas, the integrated management is more expected.

Now new system is beginning. It is difficult for me to assess the system now.

PROBLEMS AND PROSPECTS OF SEAGRASS CONSERVATION AND MANAGEMENT IN HONG KONG AND CHINA

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There are eighteen, eight and four species of seagrass have been recorded in Mainland China, Taiwan and Hong Kong respectively. All Hong Kong seagrasses (Japanese eelgrass *Zostera japonica*, Spoon grass *Halophila ovata* and *Halophila beccarii* and Widgeon grass *Ruppia maritima*) share the characteristic of co-occurring with mangroves in the low to mid- intertidal region of sand and mud flat areas. Rapid coastal development, in recent years, has caused a decline in seagrass populations in China. The lower level of concern awarded to seagrass is mainly due to lack of knowledge of the plants themselves. The confused nomenclature and similar Chinese pronunciation, combined with inadequate knowledge, leads readily to the confusion of seagrass and algae in China. Seagrasses have been little studied in China and the ecology of Chinese species is poorly known, the limited studies upon seagrasses are only concerned with their classification and distribution. The lack of biological and ecological information on the seagrasses increases the difficulty of their conservation and management.

Seagrass, Mangrove and Coral Reef

Seagrass beds are one of the most important coastal habitats in the world, though they attract less concern than many others. Their significance is comparable to such well-known important coastal habitats as mangroves and coral reefs. However, unlike mangroves and coral reefs, which are restricted to tropical or occasionally sub-tropical areas, seagrasses are widely distributed in both the tropical and temperate zones. Mangrove and coral reef are rarely, if ever, found in close proximity because of their divergent physio-chemical requirements, but seagrasses freely intermingle with both communities. Seagrasses also often form extensive meadows that bridge the distances between coral reefs and mangroves.

Seagrass - Neglected Resource in China

The lower level of concern awarded to seagrass is mainly due to lack of knowledge of the plants themselves. People constantly confuse seagrass, seaweed and algae. "Seaweed" and "algae" originally had the same meaning, and even now are only slightly distinguished. Both are completely different from seagrass, however. 'Alga' is the Latin name for seaweed, defined as the group of primitive photosynthetic plants without true leaves, stems and roots. Seaweed is defined as marine macro-algae (i.e. large algae that grow in the sea). Seaweed is often used in the medicinal and food industries, and seaweeds such as *Porphyra*, *Laminaria*, *Eucheuma* and *Sargassum* species are used as a source of food. Seaweed is composed of a recognizable blade, stem-like stipe and root-like simple rhizoids or more complex holdfasts. Seagrasses, however, are flowering plants specializing in soft-bottomed nearshore marine environments. They are believed to have evolved from land plants that adapted to life in the marine environment. Seagrasses possess erect leaves and shoots and creeping stems or rhizomes, while the more primitive algae do not. The flowering structure of seagrass varies in different species. The entire reproductive cycle of seagrasses, including flowering, pollination and development of fruits and seeds, takes place underwater. Seagrass dispersal occurs by two means, vegetative and reproductive. Vegetative propagation only allows plants to colonize adjacent unvegetated areas, while seed reproduction allows seagrass to disperse farther.

The Chinese pronunciation of the words for seagrass (Cantonese "hoi cho", Mandarin "hai cao") and algae/ seaweed (Mandarin "hai zao", Cantonese "hoi zho") are very similar, adding further to the confusion. In Chinese taxonomic classification, most seagrass species, particularly the family Potamogetonaceae which includes the genus *Ruppia*, *Zostera* and *Phyllospadix*, use the word "zao"/"zho" (algae) rather than "cao"/"cho" in their Chinese species name (Table 1). This nomenclature, combined with inadequate knowledge, leads readily to the confusion of seagrass and algae and hence under-estimate the fragility and value of seagrasses. As a result, Chinese people always misunderstand the seagrass bed is a kind of wasteland without any conservation necessity.

Value of Seagrasses

Seagrass meadows occur in most shallow, sheltered, soft-bottomed marine coastlines and estuaries of the world. Globally, approximately 70 species are recognized. The small number of species does not, however, reflect either the abundance or the economic and ecological importance of the group. The high primary production rate of seagrasses has been well documented and acknowledged as the basis for their importance to the coastal zone (McRoy & McMillan 1977 ; Zieman & Wetzel 1980 ; Hillman *et al.* 1989). Considerable amounts of seagrass primary production have been shown to be exported (Bach *et al.* 1986) and to either washed ashore on distant coasts or deposited on the deep sea floor (Wolff 1976 ; 1980). Seagrasses have been identified as an important resource for higher trophic levels many kilometres away from the site of production, and where

Table 1 Seagrass species in China

Seagrass species in China	Nomenclature used "zao"/"zho" (algae)
ZOSTERA MARINA	✓
ZZOSTERA CAESPITOSA	✓
Zostera caulescens	✓
Zostera asiatica	✓
Zostera japonica (1) (2)	✓
PHYLLOSPADIX JAPONICA	✓
Phyllospadix iwataensis	✓
POSIDONIA AUSTRALIS	×
Halodule uninervis (2)	✓
Halodule pinifolia (2)	✓
Syringodium isoetifolium	✓
Cymodocea rotundata	✓
Enhalus acoroides	×
Thalassia hemperichii (2)	✓
Halophila ovalis (2)	×
Halophila minor (H. ovata) (1) (2)	×
Halophila beccarii (1) (2)	×
Ruppia maritima (1) (2)	✓

Note : (1) The species has also been recorded in Hong Kong
(2) The species has also been recorded in Taiwan

they appear to have made major contributions to other ecosystems (Thresher *et al.* 1992). Live seagrass is apparently a minor source of food to its communities. Some sea-urchins, crustaceans and fishes may eat seagrasses, but they also need other sources of nutrition (Klump *et al.* 1989). Seagrasses form a major component of the diet of dugongs and green turtles (Lanyon *et al.* 1989).

The spatial complexity of the seagrass canopy plays a potentially important role in structuring the associated faunal community (Orth *et al.* 1984 ; Stoner & Lewis 1985 ; Lee *et al.* in press). Spatial complexity in the form of dense seagrass canopy provides a large number of microhabitats and, thus, increased protection from predators. A dense canopy can, therefore, support a high abundance and biomass of epifauna (Fong 1998 ; Lee, in press). Hydrodynamic features such as water current reduction and shear stress at the canopy are correlated positively with seagrass abundance (Gambi *et al.* 1990). Seagrass can modify water flow and reduce currents and waves to result in the increased trapping of organic detritus. The standing crop of detritus was significantly higher in the seagrass bed than in the adjacent unvegetated area and was directly proportional to plant biomass (Fong 1998).

The increased amounts of accumulated detritus enhance the overall faunal abundance. The major food resources utilized by consumers in a Hong Kong seagrass bed are detritus and algae but not the living plant. No local organisms have been observed to feed on living plants directly. Organisms utilize the seagrass organic matter only after decay. Detritus is usually the major food web base in seagrass habitats (Zimmerman *et al.* 1979 ; Stoner *et al.* 1995). Detritivores and deposit-feeders dominate the trophic categories of the associated faunal components of the local seagrass beds, both in terms of abundance and species numbers. This indicates that the detrital pathway is an important means by which energy and matter is transferred to higher trophic levels in local seagrass beds. The origin of the energy source is, however, mainly allochthonous. Detritus derived from seagrass and algae, mainly supplied in winter (Fong 1998), comprised only a small portion of the total accumulated detrital biomass. Detritus from these two sources is, however, of high quality and hence probably more digestible. Local seagrass beds, therefore, not only provide a primary source of detritus, but also act as a trap retaining external organic matter for the resident consumers.

Seagrasses provide shelter and feeding grounds for a diverse assemblage of organisms. As seagrasses provide shelter and food during the early life history stages of animals when individuals are susceptible to predation, they are also important nursery areas, especially for fish (Pollard 1984). Seagrasses are, therefore, important habitats for fisheries (Bell & Pollard 1989). Seagrass beds generally support more fish than bare substrata (Heck *et al.* 1989). Significantly greater abundance of fishes were also collected from artificial seagrass beds than from bare sand (Bell *et al.* 1987). Seagrass faunal communities also usually contain penaeid prawns (Heck *et al.* 1989 ; Coles *et al.* 1993). Juvenile horseshoe crabs, *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*, are commonly found and feeding inside *Halophila beccarii* bed in Deep Bay and *Zostera japonica*/*Halophila ovata* beds at Tung Chung. Seagrass beds are an important spawning and nursery ground of horseshoe crabs (Chiu and Morton 1999).

Current Situation and Problems of Seagrass Conservation

The status of HK seagrasses

There are eighteen, eight and four species of seagrass have been recorded in Mainland China, Taiwan and Hong Kong respectively (Sun 1992 ; Fong, 1998 ; Lam, 2000). Three of these (Japanese eelgrass *Zostera japonica*, Spoon grass *Halophila minor* or *H. ovata* and *Halophila beccarii*) and one monocotyledonous angiosperm (Widgeon grass *Ruppia maritima*) are found in Hong Kong. It is known that these, including the four Hong Kong species, have fairly wide geographic ranges along the Chinese coast (Huang *et al.* 1994). All Hong Kong seagrasses share the characteristic of co-occurring with mangroves in the low to mid-intertidal region of sand and mud flat areas.

Halophila beccarii, the Spoon grass, has an oval shaped leaves without cross vein. It is widely distributed in the South China Sea and the Bay of Bengal (Den Hartog 1970 ; Phillips & Menez 1988). In Hong Kong, the plant was first recorded from Tsim Bei Tsui as dense mats amongst pioneer mangroves (Hodgkiss and Morton 1978a). The recent distribution of *H. beccarii* suggests that the plant is extending its range on the intertidal mud flat along the southern fringe of Deep Bay, from Sha Kiu Tsuen to Ha Pak Nai (Fong 1998). The largest bed of *H. beccarii*, also the largest seagrass bed in Hong Kong, was recorded at Ha Pak Nai and occupies a total area of ~4 hectares. Besides Deep Bay, *H. beccarii* can also be found in Tai Ho in Lantau and occasionally in Starling Inlet, especially Luk Keng.

The other Spoon Grass *Halophila minor* has similar morphology as *Halophila beccarii*, the obvious difference is the leaves of *Halophila minor* showing cross vein. This species has a wide distribution. The centre of its geographical range is the South China Sea and the seas of the Sunda shelf, near Indonesia (Den Hartog 1970). Its northernmost occurrence is in Hong Kong. It used to be widely distributed on the sheltered flats at Tai Tam, Three Fathoms Cove and Hoi Sing Wan in Tolo Harbour and in Deep Bay (Morton & Morton 1983). *H. minor* is now recorded from three locations in Hong Kong, namely, San Tau in Lantau, Sheung Sze Wan in Sai Kung and Lai Chi Wo in Crooked Harbour (Fong, 1998).

The genus *Halophila*, particularly the species *Halophila minor*, is short-lived pioneer annual plant that can colonize some areas in a short time and disappear quickly under unfavourable condition, i.e., typhoon or strong water current. The population of the intertidal *H. minor* at San Tau, Sheung Sze Wan and Lai Chi Wo has been found to extend in large areas, however, disappeared completely in a very short period of time. The cycle repeats again in every year.

Unlike the genus *Halophila*, *Zostera japonica* is perennial in Hong Kong. *Zostera japonica*, the Eelgrass, has elongated leaves and occurs from Sakhalin and Kamchatka (north of Japan) to Vietnam in East Asia, and along the Pacific coasts of North America (Den Hartog 1970 ; Phillips & Menez 1988). *Z. japonica* was first reported as *Z. nana* Roth. from Lai Chi Wo, Hong Kong, by Hodgkiss and Morton (1978b). *Z. nana* Roth. is a junior synonym of *Z. japonica* (Phillips & Menez 1988) and the identity of the local *Z. japonica* was confirmed by Lee (1997). *Zostera japonica* has been recorded from five locations in Hong Kong, namely, Sheung Sze Wan in Sai Kung, San Tau in Lantau Island, Lai Chi Wo, So Lo Pun and Pak Kok Wan in Crooked Harbour and Sam A Chung in Double Haven, north-east New Territories, Hong Kong (Fong 1998). The first record as well as the largest *Zostera* bed was from Lai Chi Wo, part of the Yan Chau Tong Marine Park established at 1996. The populations of *Z. japonica* at So Lo Pun, Pak Kok Wan and Sam A Chung are small and are probably pioneer populations. *Z. japonica* at So Lo Pun, Pak Kok Wan and Sam A Chung may have originated from the population at Lai Chi Wo in view of the proximity of the three locations. The small population of *Z. japonica* at Sheung Sze Wan may also be originated from the population at Lai Chi Wo even they are quite far away.

Ruppia maritima, the Widgeon grass, is not a true 'seagrass', but it is a grass with high salinity tolerance. It was once recorded from Shek O Lagoon and has been recently reported from shallow brackish water 'gei wai' (shrimp ponds) at the Mai Po Marshes Nature Reserve (Dunn & Tutchter 1912 ; Melville & Chan 1992). *R. maritima* usually grows in gei wai channels at between 0.6 to 1.2m depth. Widgeon grass is an extremely important food source for waterfowl in North America. Their leaves are expanded at the base and arise alternately from the sheath and taper to long pointed tips.

Natural Stresses of Seagrasses : A Case Study in Hong Kong

Both abiotic and biotic factors appear to locally influence the growth of seagrasses although temperature seems to be the major abiotic factor influencing their life cycle (Fong, 1998). A combination of high air temperature with low spring tides occurring in the summer mid

afternoon, results in strong desiccation and heat stresses which can greatly impact the intertidal seagrasses. The typhoon in summer, however, impose a minor effect on the seagrasses. Growth was retarded during this time and resulted in nearly zero seagrass, particularly Japanese eelgrass *Zostera japonica*, bed area expansion. In winter, a return of a more favourable temperature regime ($<20^{\circ}\text{C}$) promotes the growth of Japanese eelgrass, resulting in significant increases in percentage cover and bed area.

Flowering and seed germination of local seagrasses are also influenced by temperature. In Hong Kong, the temperate species Japanese eelgrass *Zostera japonica* starts to flower in March when temperature begins to rise from low winter values (Fong, 1998). Their flowering period extends for nearly five months, with a peak in May, and finish before August, a time that is associated with peak heat and desiccation stresses in summer. The tropical species Spoon grasses, however, prefer to flower during hot summer. Seeds of local seagrasses were found in the sediment throughout the year but mostly in late spring and summer (May to September), following the flowering peak.

Macro-algal blooms are common during the winter in Hong Kong and it may influence the growth and survival of *Zostera japonica* (Fong 1998 ; 1999 ; Fong *et al.*, 2000). The macroalgae and epiphytic algae may reduce light availability for photosynthesis and limit the rate of gaseous exchange by *Z.japonica*. Such algal growth may result in large reductions in seagrass biomass and production through suffocation. Heavy epiphytic growth can increase the chance of sloughing weakened leaves through wave surge, as strong wave action is common during winter. This threat can, however, be relieved by the presence of *Clithon* spp., the major grazer of local *Z.japonica* beds. The suppression of epiphyte biomass by a grazing epifauna is an important factor in the maintenance of growth and productivity by seagrasses. Macro-algal blooms, therefore, caused limited impacts on the performance of *Z.japonica*. The mature algae disappear during summer, as they cannot withstand such high temperatures. Only microalgae and the spores of macroalgae are still found on the leaves of *Z.japonica* during summer, and these have little impact during this period.

Anthropogenic impacts of seagrasses

Rapid coastal development, in recent years, has caused a decline in seagrass populations in China including Hong Kong. Shatin, Tai Po and Plover Cove in Hong Kong had large areas of mangroves and are believed to have had large seagrass beds in the past. Following reclamation for new town development and reservoir construction, all these coastal shores including those possible mangroves and seagrasses were destroyed. In addition, many small bays were dammed to form fishponds for aquaculture and which may also have limited the abundance and distribution of seagrasses. The largest Japanese eelgrass *Zostera japonica* bed in Hong Kong (Lai Chi Wo) is located beside such a fishpond. *Halophila minor* was previously recorded in many location of Hong Kong, including Deep Bay, Tai Tam and Starfish Bay, but is now gone. The damage due to development can also be expected along the coastline of China.

Few studies of and publications on seagrasses have been made in China, most being concerned with their classification and distribution in early eighties (Yang & Wu 1981 ; Yang 1982 ; Yang & Li 1983). The degree of damage of seagrasses in Hong Kong, as well as in China, can not be estimated due to the lack of baseline information. There are, however, some evidences showing that seagrasses in China are under stress and threatened :

CASE 1 : DEVELOPMENT OF CHEK LAP KOK INTERNATIONAL AIRPORT IN HONG KONG

The development of the Hong Kong Chek Lap Kok new international airport has threatened the survival of seagrasses. Reclamation and construction works there increased the sediment loading of the seawater and hence threatened the populations of *Zostera japonica* and *Halophila minor* at San Tau, Lantau, Hong Kong (Lee 1994 ; 1997). *Z.japonica* and *H.minor*, fortunately, are still surviving at this site, but most plants died during the peak period of reclamation. The population of *Z.japonica* recovered gradually after the completion of the Chek Lap Kok international airport (Fong 1999). According to June 1999 survey, however, the native *Z. japonica* at San Tau is nearly total disappeared, only several small colonies with total area less than 0.04 m^2 left. Only one of the five transplanted patches of *Z.japonica* (from Lai Chi Wo) remains and enlarged from 0.06 m^2 to 15 m^2 . Under the highly turbid water, the health of the perennial plant *Z. japonica* was very weak and it may use up the food reserve to support their life. Once the construction completed the water quality getting better, *Z.japonica* can undergo photosynthesis and recover after certain period of time. Heavy algal blooms occurred every year since the completion of airport, however, further hazard the weakened *Z.japonica*. Heavy epiphytic growth seriously affects the above-ground component of *Z.japonica* by increase the chance of sloughing weakened leaves through wave surge (Fong 1998). Apart from removing the upper portion of the plant, the shading effect of algal blooms causing *Z.japonica* further depleted the food reserve and eventually died. The good health of transplanted patches has more reserve so that some of them can survive and expand. As *Halophila minor* is an annual and opportunistic plant, it recolonized San Tau and extended to Tung Chung Bay after a short period of time. Unlike *Zostera japonica*, *H. minor* can survive under low light intensity and usually found in lower intertidal zone. San Tau and Tung Chung are suitable habitats of *H.minor*, as the anthropogenic stresses reduced, many patches ranged from 3 m to 10 m diameter were found along the coasts. Further development and reclamation in Tung Chung would impose further hazards on the seagrasses. Most of the coastlines in Tung Chung Bay will be reclaimed to form homogenous concrete wall and no more suitable habitats can be provided for seagrasses. In addition, the increasing human population at Tung Chung New Town, close to San Tau, may further threaten the seagrass populations through sewage discharges and increased disturbance. The elevated nutrient loading of seawater resulting from increasing housing development is a common cause of seagrass decline (Short *et al.* 1996). Algal blooms should occur continuously that may cause *Z.japonica* further decline in San Tau. Further development and reclamation may also change the hydrology of Tung Chung Bay with a result of coastal erosion. The increased erosion will wash out the sediments and change the substratum of seagrass bed. Therefore seagrasses will no longer survive in San Tau even the area was designated as SSSI.

CASE 2 : BRIDGE JOINING SHEKOU, SHENZHEN TO SHEUNG PAK NAI, HONG KONG

In order to improve vehicular transportation, the Governments of the Hong Kong Special Administrative Region and the People's Republic of China will build a bridge joining Shekou to Sheung Pak Nai and the cross-link is expected to be completed by 2005 at the earliest. The construction of the bridge, like the development of the new airport, may seriously jeopardize the survival of seagrass, *Halophila beccarii*, which inhabits the southern coastline of Deep Bay. Deep Bay is already heavily polluted and conditions may worsen as the populations of the northwest New Territories of Hong Kong and the Shenzhen Special Economic Zone increase further. Reclamation and dredging will form a major component of the bridge construction programme and intertidal mud/sand flats may also be destroyed by the construction of the associated transportation network. Such development work in conjunction with pollution will probably severely impact the survival of *H.beccarii*. The *H.beccarii* beds in Deep Bay are well known nursery ground of horseshoe crab. Some sand patches and freshwater streams along the shoreline of Deep Bay are the breeding and spawning sites of horseshoe crab *Carcinoscorpius rotundicauda* and *Tachypleus tridentatus* (Chiu & Morton 1999). Such bridge construction seems cannot be omitted due to the economical needs and the involvement of mainland government. Even the turbidity of seawater in Deep Bay are naturally high, *H.beccarii* still cannot immune from the additional sedimentation effect. To minimize the influences on seagrass beds, the sedimentation caused by the associated constructions should be controlled. The construction of the transportation network should also build inland, not close to the shore. And the most

important is to preserve and protect coastal shores, otherwise all the habitats suitable for seagrass and horseshoe crab will be destroyed.

CASE 3 : CONSTRUCTION OF ARTIFICIAL CORAL POOL AT SANYA, HAINAN, CHINA

The tourist industry in Hainan is growing quickly which in turn deteriorating the coastal habitats particularly coral reef and seagrass bed. Since coral reef is important scenery to attract tourists, some resorts considered constructing artificial coral pool in their adjacent natural beaches. The largest patch of seagrass in Dadonghai Bay, Sanya were destroyed to construct the artificial coral pool.

CASE 4 : SEAWEED AQUACULTURE IN HAINAN, CHINA

The culture of seaweed *Eucheuma serra* is very common in Hainan, China. The seaweed culture rafts are usually set up in coastal soft bottom shore where seagrass inhabited. The seaweed culture practice not only disturb the seagrass habitats, the fast growing seaweed also compete nutrients with seagrass in turn retarding their growth. The large numbers of seaweed culture in Hainan, therefore, restrict the distribution and abundance of seagrasses.

Conclusion

If the seagrass bed being destroyed, it may not be recovered after a long time. The fast economic growth of coastal cities in China is unavoidably deteriorating and destroying the seagrass habitat. Chinese people are still not aware the importance of seagrass conservation. Action should be taken now to conserve seagrasses in China lest they become extirpated when people aware their vulnerability. The most pressing requirement for the seagrass conservation is to preserve the existing beds. Education is the most challenging and urgent element to make the conservation and preservation of the threatened seagrass habitat success. The lack of seagrass baseline information including their extent and condition, however, increase the difficulties of seagrass conservation and education. Seagrass mapping involving remote sensing and particular researches, such as the relationships of seagrass and fisheries and their vulnerability in China, are necessary to conduct immediately so as to reflect the current situation and the urgency of seagrass conservation in China. Seagrass monitoring program, conservation and management plan is therefore necessary to develop protecting their long-term survival in the foreseeable rapid development of all local inshore environments. A preliminary monitoring and conservation plan under the urban Hong Kong condition (Fong, 1999) can act as a reference for all coastal areas of China.

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IS THE DEGRADATION OF RESOURCES IN THE SOUTH CHINA SEA REVERSIBLE? : APPROACHES TO SUSTAINABLE MANAGEMENT

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Abstract

The South China Sea, one of the largest marginal seas of the world, is surrounded by countries with the highest population growth in their coastal zones, including the Philippines to the east, China to the north, and Vietnam to the west. All these countries have substantial fishing fleets that exploit this semi-enclosed sea. For the Philippines, more than one-fourth of its commercial production comes from its western seas and this fishing pressure is expected to continue. For China, the rapidly growing coastal population on its southeastern sector is becoming more and more dependent on fisheries production, as evidenced by illegal fishers invading the marine reserves of Hong Kong and the decision of Hainan province to continually increase its fishing efforts. Due to the distance of the small island groups and shoals in the middle of the South China Sea from the mainland of the bordering states, and because of the disputes about the territorial boundaries particularly around the Spratlys and the Paracels, management authorities and law enforcers have been unable or unwilling to properly regulate the fishing efforts in much of the region. As a consequence, excessive, illegal, and destructive fishing are often the norm rather than the exception. In the light of such unsustainable extractive activities, coastal ecosystems are continually being degraded and the resources being depleted. The status of the present territorial disputes bodes ill for the marine living resources and the ecosystems on which they depend. Hence, sustainable management measures are urgently needed. Most nations can take immediate steps to manage their mainland coasts as this can be done without disputes breaking out. More seriously, the contesting nations must plan together the management of the fishery resources in the middle of the South China Sea, particularly those around the reefs, shoals and islands some distance from the Asian continent.

INTRODUCTION

A paper on the large marginal sea that is variously referred to as the South China Sea, the East Sea, or the western Philippine seas, depending on one's perspective, has to start somewhere. I choose to start about 35 million years ago (Ma) in the Early Oligocene when the Philippine island of Mindoro, now located southwest of the main island of Luzon, was located approximately where Pratas Island is today, in an extensive body of water that was just the western tropical Pacific, referred to by geologists as the Proto-South China Sea. Luzon itself was then about where the bird's beak of New Guinea is today, and there was no significant land mass to define a marginal sea. The semi-enclosed basin that is the focus of this conference did not exist then, so we can conclude that there were no problems, environmental, social, or political. A cynic would say, well, that is because man had not yet arrived at the scene.

One might say that the origin of our interests started to come about 5 million years later, when a rift on the sea floor opened up, pushing Mindoro, the Calamianes island group, and Palawan to the south. This rift was the opening of what is now the South China Sea. Not to belabor the geological history, I wish to briefly mention that about the same period, Luzon began its northward migration, followed at some distance by the chain of eastern Philippine islands that eventually caught up about 10 Ma, although the present juxtaposition of the Philippine archipelago and Borneo to define the eastern boundaries of the South China Sea did not take place until the end of the Miocene, 5 Ma (Hall 1996).

My concern as a marine biologist here is not about geological resources which are at the bottom of the present day political issues, but about the biological resources, more specifically the marine living resources of the South China Sea. In spite of the interest in the fisheries of the basin, our knowledge of the environment and resources therein is limited. Marine scientific research in the area is slowly, slowly advancing and is the topic of another paper (Gomez, in press).

MARINE LIVING RESOURCES AND FISHING PRACTICES

Characteristics of the fisheries

Marine production in the South China Seas (SCS) contributes 12% to total marine global production (Table 1). Culture fisheries, on the other hand constituted more than half (54%) of worldwide culture production in 1995. While capture fisheries amount to almost 7 Mt/yr which is 8.2% of the 1995 world (Talaue-McManus 2000).

The potential for increased production from the capture fisheries in the South China Seas may be estimated by looking at the basin level instead of territorial boundaries. In a work by Pauly and Christensen (1993), habitat and bathymetric subdivisions of the South China Sea were used to appraise its capture fisheries potential (Table 2). It showed that of all the subdivisions, coral reefs (10 - 50m) are fully exploited and the Vietnam/Chinese and Bornean shelves have a possibility to increase production but these may have been realized by now. Untapped areas are the deep shelf (50-200m) and the open ocean (200-4000m) which have an additional 841,000 t/yr potential, if its large pelagics and cephalopods are exploited (Pauly and Christensen 1993). Expansions into these areas are constrained by economics and the current state of technology.

Focusing on small pelagic fisheries, these straddling stocks shared among the states in the SCS were studied over a period of 15 years (1978 - 1993) by Yanagawa (1997). After 1987, most of the small pelagic fisheries reached full levels of exploitation. The rapid increase from 1976 to 1983 which was accompanied by a shift on major species, appears to indicate a huge fishing selection pressure (Yanagawa 1997 in Talaue-McManus 2000). The larger pelagic fisheries are also of concern in spite of the highly migratory nature of their catch, such as tuna and sharks.

When combined, the tuna catch of Taiwan, Indonesia, the Philippines, and Thailand comprise 23% of the global landed catch over a period of 6 years (1988 - 1993). Three of these countries (Thailand, Philippines and Indonesia) make up 72% of world tuna export market during 1990 - 1993 (Talaue-McManus 2000). A stabilized catch of ~ 725,200t in the South China Sea may indicate a state of full exploitation (Peckham 1995 in Talaue-McManus 2000). Exports in the region account for 91 - 96% of total production. On the other hand, Japan, Western Europe, and the US used 83 - 90% of their tuna production for domestic consumption. This shows that the SCS

is a net exporter to these countries, even as fish becomes a scarce commodity. Another pelagic fishery of concern is that of sharks and shark products. Sharks migrate throughout the SCS. They are taken as by-catch as well. The demand for shark products is high and growing in Southeast Asia as these products are used for exotic food, medicinal and ornamental purposes.

Worldwide, total global production of fish reached a record level of 109.6 M tons in 1994. Most of the 7% increase from the previous year was due to an increase in marine capture fisheries (FAO 1997a). In 1995, although there was still an increase in total world production, there was a decline in harvest from marine capture fisheries, which was offset by the increase in aquaculture (Table 3/ Figure 1). In 1994, eleven of the 20 countries which produced over 1.1 Mt per year were Asian. These Asian countries are also the main contributors in the global capture and marine aquaculture fishery. Total production from marine waters appears to have stabilized at around 80 Mt. Asia has also continued to have the highest rates of increase in marine production over the last two decades (Figure 2) while the other continents' contributions have remained static (De Silva 1996).

The Central West Pacific, which include the South China Sea, are areas rich in demersal resources, including penaeid shrimps and small pelagic resources (FAO 1997b). Fisheries in the region are strongly influenced by global market trends as fishery developments are geared towards the export market. The higher prices fetched by these fishery products fuel the expansion of their export. Domestic markets are also growing rapidly in response to rising populations. Taken together, these factors increase the fishing pressure in the region.

As a result, more and more people are coming to rely on the same number of resources (Gomez 1998).

It is estimated that by 2010, fish supplies will need to increase by 6 Mt to merely maintain current per caput consumption levels. However, marine fisheries are fully exploited and offer few other opportunities for regional countries to increase domestic protein supplies.

Most pelagic fish, crustaceans and demersal species in the coastal fishing grounds of the Gulf of Thailand, Tonkin Bay, and other parts of the SCS are fully exploited or already depleted. And moderately exploited anchovies, smaller tuna and cephalopods are unlikely to meet the future demand in marine fish production (FAO 1997a).

Philippine fisheries

With fish and fish products second only to rice as the dominant food group consumed in the Filipino diet, local populations are heavily dependent on fish as its main source of protein (White and Cruz-Trinidad 1998). Economically, fisheries contribute 3.8% to total gross domestic product (GDP), the industry employs some 990,000 persons, and fishery exports are valued at roughly US\$550M (BFAR 1997). All things considered, it is understandable that fishing pressure in the entire archipelago remains high. And as the western seas provide more than 25% of the commercial fisheries production for the Philippines, this particular region within the South China Sea plays a significant role in the sustenance of the fishery industry as a whole. Estimates of the Kalayaan reefs indicate that they may potentially provide income in the range of US\$ 86-165M annually, with pristine reef fisheries showing a high potential production yields of 78-105 t/sq.km/yr (Alino et al. 1998). This further underlines the importance of this region.

Trends in the general fishery industry of the country show that production is on the increase, mainly due to an increase in aquaculture that has almost doubled in the last 10 years. Both municipal and commercial fisheries have, on the other hand, gone down in production over the same period (Figure 3). Catch per unit effort has also seen a decline (Figure 4) perhaps indicative of the overfished state of the resource (White and Cruz-Trinidad 1998).

Hong Kong and Hainan Province

The local fishing fleet of Hong Kong amounts to some 4460 vessels, a third of which are trawlers, long-liners and gill-netters that engage in distant water fishing. It is this offshore fishing fleet that is most affected by the Chinese government's summer ban on fishing in the SCS as well as a year round ban on trawling in its territorial waters down to a depth of 40m (Morton 2000). This raises potential problems for the smaller trawling component of the Hong Kong fleet as their larger counterparts may come to compete with them for the fish inshore. And as Hong Kong waters are already acknowledged to be over fished, this ban also appears to raise more concerns about increasing fishing instead of remedying it. Half of the fishing fleet is made up of P4 sampans, which were originally developed for use in mariculture. Nowadays, these boats work the coastline of Hong Kong, fishing out anything that is of value, and at times doing so with destructive methods such as dynamiting or poisoning (Morton 2000).

Of the administrative regions of China, Hainan has the greatest responsibility for the South China Sea, resulting mainly from the definition of its boundaries when it was upgraded from an administrative region of Guangdong into a separate province. A full treatment of its role in the SCS development is hampered by a lack of access to English references. The maritime nature of the province is brought to the fore when the examination of the incidents between the Philippines and China hark back to the fact that virtually all the fishing vessels apprehended by Philippine authorities hail from Hainan. The fishing efforts of the province continue to increase in an effort to boost its local economic development.

Destructive fishing

The fishing pressure being exerted on the South China Sea is, by itself, intense enough to have a negative effect on quantitative condition of the living resources. Add to that the destructive nature of some of the fishing practices, and the picture is even more grim for the future of the resources. The use of dynamite or other explosives as well as the application of poisons to capture both ornamental and edible species (Gomez 1998) are just two examples of the destructive fishing being practiced.

Another destructive technique is called "muro-ami." The destruction it causes is mainly due to the rock-weighted scare line used to drive the fish into the net. Concern has been raised as to the damage this practice does to the coral community. An alternative to this is the "Pa-aling" method. The rock-weighted scare line of muro-ami is replaced with a series of plastic hoses carrying compressed air from the fishing vessel, which forms a wall of bubbles used to drive the fish into the set-net. An assessment of this gear shows a highly efficient fish catching ability that inflicts minimal damage to the coral community. However, this high efficiency in catch ability necessitates regulation, if overfishing is to be avoided (Miclat et al. 1991).

Endangered species

More and more species of marine organisms today are being threatened principally from overexploitation and habitat degradation. Since a full treatment of this topic would unduly extend this presentation, I will only deal with marine turtles as an example. Virtually all species of these reptiles are threatened or endangered worldwide and all the species that occur in the South China Sea are. It is also generally known that many fishermen from the surrounding states catch sea turtles, whether for personal consumption or for commerce.

In the past decade when Philippine authorities apprehended Chinese fishing vessels illegally operating in western Philippine waters, invariably these carried turtle carapace and live sea turtles (Gomez 1996). The fishery for turtles that are known to breed on the islets of the Spratlys has been known for some time (Cheng 1996). The net effect of this unregulated, illegal harvesting of these threatened species is a continuing decline in the populations. In eastern Malaysia where data are available for protected rookeries, the decline in the

nesting of several species over the period of a decade (1984-1993) became evident as early as 1990 (Ibrahim 1994 in Talaue-McManus 2000). At the end of the period of monitoring data, the number of nesting turtles declined from the average to a low number for three of four species as follows : hawksbill 41 to 38, olive Ridley 269 to 98, and leatherback 374 to only 63. Only the green turtle was able to maintain significant numbers of nesting individuals during that same period.

MANAGEMENT STATUS

Bilateral considerations

The situations involving the Philippines and China in fisheries disputes are those more familiar to me, although there have been occasional incidents between Philippine and Malaysian fishers and authorities. The establishment of the joint cross-border Marine Turtle Sanctuary between the Philippines and Malaysia is a sign of willingness to cooperate between these two members of ASEAN, regardless of differences in position about various other issues.

Whether it is a question of the stereotype of a "big guy versus a small neighbor" or one of a misperception of the need to regain "lost" hegemony, the initial attempts for China and the Philippines to address management issues in the western Philippine seas have not made much progress. The past decade witnessed a number of incidents, before and after the infamous Mischief Reef occupation by China in 1995, involving the apprehension of illegal fishers by Philippine authorities. Setting aside political or territorial arguments, virtually all apprehended fishing vessels have yielded either illegal fishing apparatus such as dynamite and cyanide or illegally collected endangered species, as mentioned above.

One or two bilateral meetings among government officials have been held to address fisheries management issues in the South China Sea. The fisheries authorities last met in the Philippines last year, but there was an impasse resulting from China's proposing joint exploratory fishing in an area that covered not only the Spratlys but also Palawan island! This was perceived as unacceptable by Philippine authorities as it was also unconstitutional.

The late 1990's saw a proclamation or two by the Chinese government to close fishing in the South China Sea for two months in the summer, presumably to give the fish stocks a bit of reprieve or time to recover. While many fishers heeded these management measures, a fair number ignored them. It was during the 1999 "closed season" that a covey of fishing vessels was chased by Philippine authorities for illegal activities near the Scarborough Shoals, resulting in the capsizing of at least one of them. Needless to say, this resulted in a protest by Beijing which drew a comment by a Philippine legislator to the effect that even by Chinese government laws, they were fishing illegally and should not have been fishing where they were discovered. When far from apparent surveillance, fishers everywhere are wont to ignore even the laws of their home country.

The recent negotiations for the endorsement of the GEF proposal for the South China Sea Biodiversity stalled for a long time due to objections by China about the inclusion of fishery resource studies in the Spratlys and other central regions. Rational management must be based on sound knowledge. Without the latter, we can only have "political" management which will not ensure the sustainability of resources.

Territorial disputes

The territorial issues of the South China Sea region are interesting and even exciting, but too complex to be treated at length in this paper. Many sources exist for those interested to read up on them, including a broad range of papers presented last June in Oslo during the conference on "Human and Regional Security around the South China Sea." While no formal proceedings will be published for the conference, many of the papers are now in press in various journals. For those interested in these, the conference organizer, Prof. Stein Tonnesson of the University of Oslo should be contacted. Speaking of which, he has recently published a paper entitled "China and the South China Sea : A Peace Proposal" which offers a European's perspective on the issues (Tonnesson 2000).

The point I wish to raise here is that the territorial disputes in the Paracels and Spratlys, among others, are making management of marine living resources difficult to address in a rational fashion. Virtually all the littoral states with the probable exception of China are ready and willing to address the issues, as manifested in the initiative brokered by Indonesia and referred to as the informal workshop series "Managing Potential Conflicts in the South China Sea" (see Stormont 1994 for an early description).

In the meantime, ASEAN has proposed a Code of Conduct for the South China Sea claimant states to defuse the tensions arising from the political disputes. If this is adopted, there may be a chance to give not only the political animals but also the marine living resources of the South China Sea some respite through negotiated, fair, and sustainable management measures.

MANAGEMENT NEEDS

Coastal

Individual countries surrounding the SCS should be conscious of the need to better manage their coastal zones. While some began this process even before the Earth Summit in 1992, the recognition for the need for integrated coastal management is enshrined in Chapter 17 of Agenda 21. A review of the practices in the region, however, would indicate a wide variation of effort, even within countries. It may take another few decades before the entire coastline of the SCS will have been subjected to ICM or similar sustainable management, or is this just a pipe dream?

Whether ICM or any of its variants is adopted or not, there are two management tools worth mentioning that should be considered for the enhancement of the coastal environment and which can contribute to the sustainability of marine living resources. The first of these is the proper installation of artificial reefs or the broader effort of restoration techniques, including coral transplantation and reintroductions of species. I am careful to state that the installation of artificial reefs should be "proper" because the whole concept of their use has occasioned some controversies. This is not the place to discuss these, but suffice it to say that there can be a proper method that will have a net positive effect on the coastal communities. The question of transplantation and reintroduction also elicits debates. At the 9th International Coral Reef Symposium held in Bali in October 2000, there were a significant number of papers presented to indicate that some progress is being made in this direction, at least as far as coral reefs are concerned. Needless to say, economics will be an important factor which may translate to some countries or municipalities being able to take some significant actions while others will not. The second intervention is the establishment of marine protected areas (MPA's), which may be marine reserves, marine parks, sanctuaries, replenishment areas, or the like. It is now recognized that it is very difficult to adequately patrol wide expanses of coastline and prevent desperate fishers and collectors from taking illegal catch. Without abandoning the practice of monitoring, surveillance, and control, many countries now find it useful to set aside marine areas for stricter protection. The areas so delineated are generally non-fishing and non-collecting zones where fish, invertebrates and seaweeds will have a respite from human exploitation and serve as sources of propagules to repopulate open areas. Details on location and size of such MPA's need to be determined very precisely for maximum benefit. Again,

this is an area of rapid advance in marine conservation that SCS littorals need to take on board.

Offshore

MPA's for the islets, shoals, and reefs of the SCS have been proposed (McManus 1994 and Gomez 1994). While this proposal seems rational to many people, political considerations have, to date, shot it down. As an example, the proposal from a Philippine NGO at the Second World Conservation Congress held in Amman, Jordan on 4-11 October 2000 for the establishment of a Spratly Islands Sanctuary met with opposition from the Chinese delegation, apparently from purely political considerations.

Much as management measures are needed in the central region of the SCS, the challenges are enormous, as we shall see in the following section.

Regional fisheries cooperation

The number of reported fisheries incidents or conflicts between countries in the South China Sea may be diminishing of late. If this is an indication of a reduction in illegal and destructive fishing activities, this is a good sign. However, incidents of repeated violations of the Cape d'Aguilar Marine Reserve in Hong Kong by mainland Chinese fishermen (Morton 2000) are an indication of the intractance and desperation of hungry fishers. In the same editorial, Prof. Morton recognizes "the need to develop a South China Sea-wide policy on sustainable fisheries development." Sadly, in the next paragraph he goes on to state "that no international agreement on fishing could ever be implemented, even if formulated. The South China Sea is a resource firecracker just waiting to be ignited and this will, surely, happen unless something is done about resolving how its resources are to be managed."

Paralleling this concern is the need to manage the growing live trade in wild groupers and wrasses. Bentley (1999) summarizes the situation in Southeast Asia and flags the need to develop sustainable management systems in view of the gradual overexploitation of stocks.

The article states that "As the waters around Hong Kong and China became depleted of wild stocks, fishing vessels targeted the coral reefs of the Philippines, Malaysia and Indonesia." It is also recognized that the with the growing affluence of consumers in China and some countries around the South China Sea, the demand for live reef fish continues to grow and presents a real concern, as I had flagged in 1998 with respect to exotic marine products in a short article entitled "Fragile coasts."

Marine scientific research

In a paper that I read in a conference on the South China Sea in Oslo last June and which is now in press, I outlined the role of marine scientific research in the region. To pick out the salient point for this conference, if the management of living resources is to move positively, there must be solid data on which it will be anchored. This can be achieved in part by the individual efforts of the littoral states, but there will be a need to integrate the information. Too, some attributes of the marine ecosystems of the SCS can only be adequately appreciated by joint studies, such as those that can be undertaken on oceanographic expeditions involving two or more countries, if only to guarantee the safe passage of the research vessels through disputed waters. Are all parties willing to consider this?

Certainly the members of ASEAN have been willing for a long time.

Improved statistics

Besides the new data that could be gathered through scientific research, there is also a need to improve the gathering of fisheries statistics for the region. As an example, Lau and Parry Jones (1999) recommend the fine tuning of Hong Kong's fisheries monitoring to segregate the live fish statistics from the rest of the marine fish imports. This is for the sake of providing feedback to the supplying countries that "should establish quotas to ensure the long-term sustainability of their fisheries." In addition to the existing FAO and other statistics gathering systems, there may be a need for special agreements for providing more precise information about particularly threatened species such as marine turtles.

CONCLUSIONS

Given the above, am I optimistic or pessimistic in reply to my own question in the title? In the short term I will be pessimistic, but in the long term I would like to be a bit optimistic. I say, "a bit" because delayed, positive management action may be too late for some resources. If a species becomes extinct in the short term, there is no way to bring it back into existence. For living resources that are severely depleted, the recovery process may be possible but slow, even with positive human action, such as restoration and transplantation. My own work to restore giant clam populations in the Philippines has taken more than a decade, but we are now restocking many reefs, including some in the South China Sea.

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STRATEGY ON PROTECTION AND MANAGEMENT OF COASTAL ECOSYSTEMS IN CHINA

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Abstract

This paper describes the variety of marine biotic resources in China, deals mostly with some problems relating to protection and management of coastal marine ecosystems. Authors presented the background relating to international coastal marine ecosystem researching, and situation on marine biodiversity and bioresources utilization, as well as environmental status in coastal region. The efforts of the Chinese Government in conservation of the coastal bioresources are reviewed. Protection regulations and management steps of coastal ecosystems in China are described.

Key words : Coastal ecosystems, protection, management, China

The seas and oceans are the treasure house of living resources that are the important sources of protein for human beings. It is known that there are more than 200 thousand species of organisms in the world oceans, of which, about 19 thousand species are fishes and about 20 thousand crustaceans. Many marine organisms are of value for the development and utilization and provide human beings with rich food and resources for many other purposes such as extraction of medicines. The marine living resources contribute annually 22 percent of animal protein for the world. Coastal communities in the world rely on marine living resources for protein and cash income. The world ocean fishery were caught lands annually about 80-90 million tons of fishes and shellfishes, of which 95 per cent comes from the water under national jurisdiction, namely the 200 nautical miles exclusive economic zone and the waters over the continental shelf (SOA, China Ocean Agenda 21, 1996, China Ocean Press, Beijing). Human activities including fishery production are carried out mostly in the coastal waters. It is estimated that 25% of biological productivity and 90% of activities for fishes and other bioresources in the world are exploited in the coastal waters. Marine ecological damages due to overfishing and environmental pollution have resulted in decreasing biodiversity, declining commercial fishery resources and lower capacity for sustainable social and economic development. Population boom, resource depletion and environmental pollution have been exercising, more and more impacts on the seas and oceans, especially in the coastal waters.

Aquatic resources are generally under a state of crisis in the world as estimated by FAO since (Elliott, 1993). More than 45% of fisheries resources in the world seas and oceans are being overfished or at a stage of recovery from overfishing. Furthermore, harmful algal bloom events have increased in the past decades, bringing significant impacts not only on the ecosystems but also human health. This implies the development of new strategies to adapt production and consumption patterns to ensuring harmonization with the environment and to develop ecosystem-based management approaches are important, "Agenda 21" developed in the World Summit in 1992 calls on the coastal states to develop integrated coastal zone management. In the past decades, the scientific community in the world has made positive response to these challenges. Observations of coastal ecosystems and study of marine bioresources have become hotspots worldwide. Many international programs and projects including OSLR, LME, GLOBEC, LOICZ, JGOFS have been launched to address coastal ecosystems and bioresources.

Since the 1970's, the COMAR has promoted the research and the administration on coral reef, mangrove, coastal lagoon, estuary, seagrass bed and beach, especially the researches in the coastal shallow waters all over the world (Elliott, 1993). The project aims at making rational use of coastal resource and improving coastal management. Through the COMAR, the UNESCO and other international agencies have founded some regional inter-regional and international cooperation networks on coastal research (Elliott, 1993). In Asia scientists from twenty countries cooperated in the study and management of mangroves and set up the "International society for mangrove ecosystem" (Huang, 1998). In the Antilles area, ten island countries have developed a united program of coastal management, especially of coastal erosion with the technical support by Puerto Rico University. In South America, Argentina, Brazil, Chile, Peru and Uruguay an integrated management project developed the researches of the coastal ecosystem in the Temperate Zone (Elliott, 1993).

As a large developing coastal country, it is necessary to take the exploitation and protection of oceans as a longterm strategic task. In 1996, the Chinese government developed its sustainable ocean development strategy in China's Ocean Agenda 21(SOA, 1996). The contents include sustainable development the ocean and coastal areas, sustainable development of islands, conservation and sustainable utilization of marine living resources, integrated management of coastal areas and national jurisdictional waters, marine environmental protection and others.

1. Marine biodiversity and bioresources utilization

It is estimated that the number of species of life on the earth varies from five million to thirty million. Of these, 1.4 million species have been recorded up to present (Shen et al, 1990). About 200 thousand species are founded in the oceans, less than that on land. It is well known that diversity at higher taxonomic levels (Phyla and Classes) is much greater in the sea than on land or in freshwater : 34 Phyla and 73 classes in the marine environment compared with 15 Phyla and 33 classes on land (Briggs, 1994). In addition, many biological taxa are only found in marine ecosystems. Changes of marine biodiversity vary are obviously with regions, showing two geographical features and distribution steps : (1) Except Asteroidea (starfish) and Macrocystis, many marine organisms groups such as seagrass, coral, shellfish, shrimp, crab and fish, have counterparts on land. The species diversity in tropical zone is much higher than that in colder zones. For example, species in South China Sea is much richer than that in East China Sea, Yellow Sea and Bohai Sea. (2) In the tropical zone, species diversity of many organisms in the India-West Pacific Ocean, especially in the waters among the Philippines, Indonesia and east Australia (including the southern waters of South China Sea), may be with the highest value (Elliott, 1993).

By following the "The Convention of Biological Diversity" which was developed in the UNCED in 1992. China developed in 1994 by cooperation with UNDP "The Action Plan for Protecting Biodiversity in China" in more than two years of development (CWGE, 1994). A series of conservation objectives, measurements and action plans have been developed in this plan, which has become a soft law in China for taking actions to conserve biological diversity on land and in the sea. A committee of biodiversity conservation in China came

into exists in 1994. Forty-eight Conservation waters of marine species are designed and with the total area of 3,260,000 ha. One of them has been designated a member of the International Biosphere Protective Web under the Human and Biosphere Program of UNESCO. Of these, 15 Conservation Regions are protected at national level with the area of 3,100,000 (Chen, 1998). In the other hand, 'Fishery Law' and "The laws for aquatic Resources Propagation" have been decreed by the Chinese Government, by which sanctuary zones and closed season, as well regulations controlling fishing gear were formulated for relevant waters and fishing grounds. For example, the inlet of Daya Bay prohibited for shrimp fishing, and closed seasons from March to September are enforced to promote shrimp propagation. Another example is the establishment of a closed season for the fish, *Pseusdaena polyactis*, from June to September in the Yellow Sea from March to May in the South China Sea.

In the area of international cooperation, China has signed agreements with Japan and Australia for the protection of migrating birds and their habitats. In 9 bird banding stations along the Chinese coast 62,775 birds of 186 species have been banded and more than 400 birds, with longest flying distance of nearly 10 thousand km, have been recovered. Recently, UNDP, WB and NOAA have help China formulate such plans as "Plan for Biodiversity Protection in China" and "Action Plan for Protection of Large Marine Ecosystems in the Yellow Sea".

China is a big coastal nation located along the west Pacific Ocean, with 12 provinces and cities along the coast. There are Bohai Sea, Yellow Sea, East China Sea and South China Sea. Marine ecosystems in China are diverse and rich in living resources. However, there still exists a contradiction between population and resources, environment and development. China has taken many measures, with results, for the conservation of marine living resources. Covering warm temperature, subtropical and tropical zones, China's seas cross 38 divisions of latitude. Three million km³ of sea area, including a broad continental shelf and complex currents, such as the Kuroshi and the currents along the coast, are under the administration of China. China has 18,000km of coastline with more than 1,500 rivers such as the Changjiang and the Pearl River. Comprehensive biotopes and ecosystems support habitable conditions for species diversity (Huang, 1993). In China, 820 thousand km² fishing ground have be exploited. The area of shallow waters and intertidal zone is about 13 million-hectare (ha). According to science level at present, the waters of 2.6 million ha are used for mariculture, of them 938 thousand ha have be exploited (Huang, 2000). Coastal and shallow sea resources in some coastal provinces and cities in China are given in Table 1. China's seas also have some typical regional species as well as a great number of temperate and warm water species. The number of species increases from the north to the south. The South China Sea is the biggest sea in China, and with the richest biological species. For instance, of more than 2,500 fishes so far identified, there are only 300 species in the Yellow Sea, 1,000 in the East China Sea, but more than 1,500 in the South China Sea (Huang, 1994a). It is also one of important large marine ecosystems in the world. More than 20 thousand species are recorded in China Seas. Of them, 13.86 thousand species are founded in the South China Sea (Table 2) (Huang, 1994), some belonging to special groups. It was estimated that about 4.9 million tons of fish production could be landed from the South China Sea. The total capture production in three provinces along South China is more than 3 million tons at present (Table 3), and the mariculture production up to 2 million tons (Table 4), accounting for 30% of the total fishery production in China (Table 5). The coast of China is

Table 1 Coastal and shallow sea resources of the provinces and cities along the China coast

Province	Length of mainland line (km)	Area of shallow sea(km ²)	Area of tidal zone (km ²)
Liaoning	1,971.5	7,723.6	1,974.2
Hebei	421.0	2,610.0	1,167.9
Tianjin	153.0	1,593.3	370.3
Shandong	3,122.0	8,219.4	3,223.6
Jiangshu	953.0	10,121.6	5,090.4
Shanghai	172.0	5,453.5	904.2
Zhejiang	1,840.0	7,598.3	2,444.0
Fujian	3,051.0	3,970.0	2,069.0
Guangdong	3,368.1	10,586.2	2,041.9
Guangxi	1,083.0	2,596.6	1,005.3
Hainan	1,617.8	2,177.5	488.5

Table 2 The number of marine organisms recorded from South China Sea

Kingdon			Phylum	Species	Kindom	Phyla	Species	
Monera			Bacteria	46	Animalia	Porifera**	71	
			Actinobacteria	17		Coelenterata**	679	
			Cyanobacteria	106		Ctenophora*	6	
			Chloroxybacteria	1		Platyhelminthes	247	
Protista			Bacillariophyta	1,290		Nemertea**	33	
			Chrysophyta	14		Nematoda	9	
			Xanthophyta	2		Annelida	584	
			Pyrrophyta	185		Sipuncula*	33	
			Ciliophora	94		Mollusca	2,002	
			Sarcomastigophora	2,067		Arthropoda	2,380	
			Fungi	109		Bryozoa**	348	
Plantae	Algae		Rhodophyta	271			Entoprocta**	7
			Phaeophyta	84			Chaetognatha*	30
			Chlorophyta	142			Echinodermata*	380
	Tracheo-phyta		Pteridophyta	11			Urochordata	110
			Gymnospermae	2			Chordata	2,171
			Angiospermae	314			Others	13
Total			3,860					

Table 3 Changes of total capture fishery production in Guangdong, Guangxi and Hainan provinces in China

Unit : ten thousand tons

Year	Capture fishery production	Year	Capture fishery production
1989	147.24	1994	260.09
1990	161.47	1995	237.74
1991	178.80	1996	318.24
1992	206.79		

Table 4 Mariculture area and production in Guangdong, Guangxi and Hainan

Year	Production (ton)			Area (ha)		
	Guangdong	Guangxi	Hainan	Guangdong	Guangxi	Hainan
1989	121,487	2,081	3,628	89,471	5,173	3,706
1990	137,919	3,348	4,204	92,351	5,433	3,713
1991	159,207	11,919	5,199	92,750	8,690	3,790
1992	175,664	23,725	7,371	93,290	14,560	3,990
1994	242,224	75,364	16,474	105,710	29,900	5,790
1995	357,950	147,514	14,773	116,150	41,000	6,930
1996	1,345,590	531,331	22,050	138,523	48,436	7,594

Table 5 Comparison of marine capture and culture production in China

Year	Capture production	Culture production	Total
1990	551	162	713
1992	691	242	933
1993	767	309	1,076
1994	896	346	1,242
1995	1,027	412	1,439
1998	1,497	860	2,357
2000*	860	650	1,510

Unit : ten thousand tons. *The data in 2000 is estimated.

also a way-station for more than 200 species of migrants (Huang, 1994a), The living resources of China are an important component of marine source of food, industry and medicine.

The major problems in the marine fishery activities include the artificial alteration of resource structure of offshore commercial fishes due to overfishing and the decrease of fishery commercial value, this is the most significant cause of the decline in marine living resources. For example, the fishes *Pseudosiaena crocea*, *P. Polyactis*, *Trichurus huamela* and the squid *Speiella maindroni* were for a long time important catches for the Chinese fishing industry. Because of overfishing, such resources have declined since 1970's. The valuable *P. crocea* is no longer a fishery (Chu et al, 1997). In recent years, more than 7,000,000 ha of beaches and mudflats in China have been enclosed for land or cultivation. In contrast to the existing 20,000 ha of mangroves, it is estimated that more than 50,000 ha were growing in the 1950's. For coral reefs 80% have been destroyed along the 400km coastline of Hainan Island (Huang, 1993). The deterioration of water quality due to pollution and offshore movement of larval and spawning grounds and the alteration of population structure in some important mariculture areas and coastal and estuarine spawning grounds. The serious damages to typical marine ecosystems due to construction for marine and coastal engineering such as land reclamation and urbanization and the reduction of biodiversity have caused effects at different degrees on human health. The problems existing in marine living resources and marine ecosystems have affected the sustainable ocean development. The Chinese government has attached great attention to the conservation of marine biological resources. Series of measures such as pollution discharge control and closed fishing seasons and areas were adopted to enhance the protection and management of the coastal ecological environment and bio-resources.

In order to prevent the degradation of marine ecosystems and to maintain the sustainable utilization of the resources, it is imperative to reinforce the protection of the biological species and ecological environments. To establish marine protected areas and conservation zone of certain scale and quantity for the formation of regional and international networks of marine protected areas in a planned way and to protect marine biodiversity by taking proper measures ; to improve and perfect various effective technical measures of development and utilization for the rational utilization of commercial fishes ; to improve the legal systems for the conservation of marine living resources and for the reinforcement of the management in biological resource development and utilization ; to reinforce the regional and international cooperation for the maintenance of the marine ecosystems in a favorable state so as to form the international cooperation mechanisms for the conservation, research and management of the marine ecosystems.

2.Environment status in coastal sea

The monitored results showed that the change of inorganic nitrogen level was obvious in various sea areas (Qi et al., 2000). The highest values occurred in the East China Sea, with average of $1000 \mu\text{g} \cdot \text{L}^{-1}$, followed by the South China Sea, with an average of $300 \mu\text{g} \cdot \text{L}^{-1}$. The lowest appeared in the Bohai Sea and Yellow Sea, with an average level of $200 \mu\text{g} \cdot \text{L}^{-1}$. Compared the nutrient level in some representative estuaries and bays, the highest values occurred in Changjiang estuary and Hangzhou Bay. The values in Laizhou Bay and the coastal waters along western Guangdong Province were lower (below $200 \mu\text{g} \cdot \text{L}^{-1}$). The highest level of inorganic phosphorus occurred in Bohai Sea, the higher was in East China Sea, and the lowest in South China Sea. The results indicated that phosphate value in Hangzhou Bay was much higher than in other bays and estuaries. The lowest was in Daya Bay and Xiamen Bay (below $10 \mu\text{g} \cdot \text{L}^{-1}$). Which showed that the water quality conditions in South China Sea (including Daya Bay) is better than others.

Based on data monitored at past 10 years, nutrient quality indexes were calculated with the eutrophication equation (Qi et al., 2000). The results indicated that the nutrient quality indexes (NQI) and phosphate quality indexes (PQI) for some areas along China seas in 90's

Table 6 Nutrient quality index (NQI) of most areas along the China seas in 90's

Year	Liaodong Bay	Bohai Bay	Jiao-zhou Bay	Chang-jian Estuary	Hang-zhou Bay	Coastal area along Guangdong province	Pearl River Estuary	Beibu Bay	Coastal sea along Hainan Island
1990	2.25	2.49	3.82	1.82	2.89		3.72		1.66
1991	2.63	2.33	2.54	4.50	6.11	0.73	7.35		2.68
1992	2.87		2.84	3.73	4.72		3.17		
1993	2.38		2.96	3.59	5.21		3.65	2.09	
1994	2.58	1.71	3.08	3.88	5.07	2.43	3.96	1.42	1.69
1995	2.81	1.71	3.51	4.15	5.37	2.23	3.82	1.30	1.39
1996	2.77	2.86	2.00	5.35	5.37		3.09		
1997	2.83	4.40	3.15	5.41	5.54	1.88	3.87		
1998	2.81	3.12	3.13	4.53	5.13	1.83	4.51	1.49	1.65
Mean	2.71	2.66	3.00	4.11	5.05	1.82	4.13	1.58	1.81

Table 7 Phosphate quality index (PQI) in most areas along the China seas in 90's

Year	Liao-dong Bay	Bohai Bay	Jiaozhou Bay	Changjian Estuary	Hang-zhou Bay	Coastal area along Guangdong province	Pearl River Estuary	Beibu Bay	Coastal sea along Hainan Island
1990	0.52	0.40	3.78	1.19	3.15		1.32		0.65
1991	0.98	1.03	2.00	1.80	5.48		1.40		1.10
1992	2.00		1.70	1.40	1.93		1.05		
1993	1.10		1.70	1.40	2.48		1.20	0.50	
1994	1.40	.75	1.52	1.50	2.74	0.74	1.27	0.32	0.78
1995	1.07	0.66	2.08	1.77	2.67	0.50	1.84	0.24	0.37
1996	1.00	0.89	0.84	1.55	2.60	0.34	0.69		
1997	2.29	4.18	1.86	2.04	2.81	0.57	1.39		
1998	1.80	0.93	1.33	2.60	3.33	0.53	1.60	0.40	0.53
Mean	1.35	1.26	1.87	1.69	3.02	0.54	1.31	0.37	0.69

were different from one to another (Table 6-7). Nutrient index in Hangzhou Bay, Changjiang estuary and Zhujiang (Pearl River) estuary were higher than in other sea regions, and up to eutrophication level. Meanwhile, there is a trend of annual increase. Much attention should be paid to environmental problems.

More and more attention has been paid to the ecosystems and biological resources in the estuaries in the world (Konx, 1986 ; Chu, 1995 ; Zhang, 1997, 1998). Phytoplankton, especially the red tide species and its bloom has become an important part of research in the estuarine ecosystem and biological resources. The Pearl River is one of the three big rivers of China, its dilution flow quantity through estuary into South China Sea reaches about $3 \times 10^9 \text{ m}^3$ (Han et al.1991 ; Huang et al., 1997). There are metropolises such as Hong Kong, Macao, Shenzhen and Zhuhai locating along both sides of Pearl River estuary, Guangzhou and other cities to its north. Rapid economic growth and multiple human activities tend to increase pressure on the environment in the Pearl River estuary. In the past 20 years, environmental conditions, ecosystems and biological resources of the Pearl River estuary were broadly investigated for exploitation and protection. Many research results showed that the chlorophyll-a values varying with season and area, having a negative correlation with phosphorus. Besides, biodiversity and production in the estuary decreased with environmental changes from human impacts (Chan et al. 1987, Huang et al. 1995, 1997, Wang 1989). The variation of successions of population structure in different seasons were obvious because of changes of fresh-water quantity inflow that affects dilution, temperature, salinity and nutrient in the estuarine region. But the dominant population of phytoplankton in the same season was a little different to its annual variation (such as summer). In the Changjiang estuary where species composition of phytoplankton belonging to estuarine ecological types (Gu et al. 1995), low salinity species from coastal waters become the main part of communities. Phytoplankton biomass in the rainy seasons was far higher than that in the dry seasons. They considered that seasonal and yearly changes of the Changjiang's dilution were more important factors in determining changes of phytoplankton abundance. Similar features of phytoplankton composition, dominant species and change trend were found in the Pearl River estuary. Phytoplankton were mainly dominated by *Skeletonema costatum* and *Nitzschia pungens* in both estuarine zones in summer. Though the composition of dominant phytoplankton species in the Pearl River estuary varied with different years, the red tide organism *Skeletonema costatum* was always dominant and with the highest abundance, and became more and more the most dominant species (Table 8). This trend means that there are higher risks of red tide events and calls for higher attention. According to records, red tides occurred 20 times in the 1970's, but 300 times in the 1990's. It is obvious that various reasons can induce a red tide event, but more and more red tide events nowadays has revealed its close relationship to human activities such as irrational aquaculture development and higher pollution input. Red tides problem in the coastal waters in China has received wide concern and a large numbers of researches have been carried out. Why the red tide events due to *Skeletonema costatum* have outburst more and more frequently? What factors stimulate a red tidal bloom? What are the relationships to other biological species? These questions need to be answered through researches as soon as possible.

Main zooplankton dominant species of Pearl River estuary in summer were *Acartia spinicauda*, *Paracalanus crassirostris*, *Oithona rigida* and *Paracalanus aculeatus*. The results indicated that zooplankton abundance was correlated with phytoplankton. The variation trend of zooplankton gut pigment contents was coincided with chlorophyll a level in the water column (Tan et al., 2000). It provide insight on problems such as the red tide mechanism.

Of the phytoplankton samples collected in the cruise of summer 1999, 41 species of red tide organisms were found. Based on data reported, there were 472 times of red tide recorded in Hong Kong waters from 1975-1996, of these 38 times were brought about by *Skeletonema costatum*. The species usually dominated in the waters according to the previous survey, with maximum reaching 6.5×10^5

Table 8 Annual variations in phytoplankton composition and abundance in the Pearl River estuary in summer

Year	Total species	Average amount (cells/L ⁻¹)	Main dominant species
1981	132	2.1×10^4	Chaetoceros pseudocurvisetus Chaet. lorenzianus Chaet. affinis Skeletonema costatum
1987		1.6×10^5	Chaetoceros affinis Skeletonema costatum Nitzschia pungens
1996	116	1.1×10^5	Nitzschia delicatissima Skeletonema costatum Chaet. Pseudocurvisetus
1999	130	6.3×10^5	Skeletonema costatum Nitzschia pungens Nitz. delicatissima Asterionella japonica

cells/L and accounting for 97.6% of the total amount, especially in Victoria Harbor of Hong Kong during summer 1996 (Huang, 1997). The results investigated in the cruise indicated that dominant species was *Skeletonema costatum*, with an average of 2.8×10^5 cells/L and accounting for 45.0% of the total amount. It is a euryhaline and eurythermal species, and can quickly grow under eutrophic conditions. Most of other dominant species were also red tidal organisms. This is an environmental problem that should receive attention for the protection of the Pearl River estuary and Hong Kong waters.

3. Species conservation and monitoring network

Sanctuary zones and closed seasons as well regulations controlling fishing gear were formulated for relevant waters and fishing ground. Since 1979, 24 sites for artificial fish reefs have been identified in the coastal waters of China and 28,000 reefs and 99,137 m³ rocks have been laid out. The construction of fish reefs has attracted fishes and improved the ecological environment. More than 20 species of marine organisms are designated to be protected species such as *Cypraea*(*Cypraea*) *tigris*, *Cassis cornuta*, *Tridacna* (*Dinodacna*) *cookiana*, *Pin. maxima*, *Haliotis gigantea* *discus*, *Panulirus* spp., *Tachypleus tridentatus*, *Thelotrema ananas*, *Macrura reevesii*, *Pagrosomus major*, *Epinephelus subsp.*, *Chelonia mydas*, *Phoca canina*, Chinese Polphin, *Coilia ectenes*, *Bahaba flavolabiata* and *Chlamys farreri*. From the beginning of 70's, much attention has been paid to marine environmental monitoring in China to develop monitoring system of water, air and biological communities. About 20 annals of environmental quality about Chinese coastal waters and 40 annals of sea regions were published by the government and relevant agencies during recent 30 years. More than 60 marine environment and marine pollution monitoring stations have been set up (Huang, 1993; Xu, 1989). Such as Jiaozhou Bay Station, Daya Bay Station and Sanya Station established for the ecological observation by the Chinese Academy Sciences, in addition to many hydrological observation stations established by State Oceanic Administration. The network of monitoring stations has provided powerful service to strengthen marine environmental development, management and protection. Besides, about 20 natural protection zones have been established by the Chinese government, mainly in the representative coral reef waters and mangrove swamps (Table 9).

Table 9 A part of natural conservation regions in South China Sea

Name of protect region	Locate position	Area (km ²)	Main protect target
Neilingding Island-Futian	Shenzhen, Guangdong	870	Mangrove, Rhesus monkey, bird
Gangkou Huidong turtle	Huidong, Guangdong	800	Turtle and their space of reproduction
Shankou mangrove ecology	Hepu, Guangxi	4,000	Mangrove ecosystem
Sanya coral reef	Sanya and Wanning, Hainan	6,000	Coral reef ecosystem
Dazhou Island marine ecology	Wanning, Hainan	7,000	Esculent swift and island ecosystem
Dongzaigang	Qionghsan, Hainan	2,500	Mangrove and their habitat
Weizhou Island coral reef and coastal landscape	Beihai, Guangx	8,000	Coral reef ecosystem and varied marine bioresources
Dongsha Islands coral reef ecosystem	Dongsha Islands	10,000	Coral reef ecosystem

4. Coral reef ecosystem

It is well known that the ecosystems of coral reef and mangrove are of high productivity and high biodiversity (Zou et al., 1996; Huang, 1998), and of high value in housing commercial species and sightseeing. These ecosystems are of significant importance for aquaculture and biodiversity conservation as breeding place for various organisms. It is worldwide phenomena that coral reef bleached by greenhouse effect recently. More and more damages from human activities on coral reef have been recorded. The coral reef and mangrove ecosystem had played important roles in local fishery and economic development. Decay of the coral reef was found by human activities and overuse e.g. the area of coral reef around Hainan, Xisha and Nansha islands, the area of mangrove in South China coast were reduced and ecosystems suffered from destroy. Consequentially, a tendency of coastal environment degenerating, marine resources declining took place, and coastline erosion accelerates.

Coral reef is an important ecosystem among the global marine ecosystems (Clive, 2000). Productive capacity in the coral reef area is much higher than the open sea. In the reef area, with a great number of reef-building organisms (corals, crustacean, mollusk, echinoderm, fishes, algae, etc.), coral reefs contribute to maintaining higher level of biodiversity. Corel reef is listed as a higher priority ecosystem for protection in 1980 in the World Conservation Strategy. At present, the "Global Coral Reef Monitoring Network" is playing an active role in reef monitoring and protection all over the world. In China, the central government has considered the coral reef research as a priority in the "9th Five Year Science and Technology Plan" and "China's Ocean Agenda 21" (Munoz-Chagin, 1997; Tracy, 1997). Coral reef in China is mostly distributed in the South China Sea. It is located at the northernmost part of the Indo-Pacific reef area and represents an important part of this area. In 1990, the central government of China approved the setting up of Sanya National Coral Reef Reserve; the reef resources and marine biodiversity in the Reserve have been protected successfully since then. The revised version of the "Marine

Environment Protection Law" stresses on the conservation of coral reefs. At the provincial level, Hainan's authorities approved the "Regulations Concerning the Conservation of Coral Reefs in Hainan" in 1998(Yu et al, 1996). The laws and regulations have laid down a strong base for reef protection in the area. Nowadays, great attention is paid and great need is felt for building up an integrated marine environmental information system, to enhance efficiently in the coastal conservation and management, and in assessing, exchanging and disseminating actual information on the coral reef environment in Southern China.

Much efforts of management have been exercised by the Chinese government to protect the coastal ecosystems. First, laws and regulations have been promulgated to keep coral reefs and mangroves from being destroyed by enhancing public awareness on the importance of these typical ecosystems to sustainable development ; secondly, more financial resources are used for scientific research on coral reefs and mangroves. In the mean time, much attention has been paid to biodiversity research and marine resource information collection. It is a long-term scientific research to restore the coral reefs and mangrove ecosystems. A lot of experiments have been done for different objectives such as for fisheries, power station pollution, in case of coastline erosion, over development, sightseeing construction and even on thorny starfish that feeds on corals.

4. Estuarine ecosystem

There are three big rivers in China, including Yellow River, Changjiang and Zhijiang (Pearl River). The Pearl River estuary is typical large subtropical estuary in China ; it is reported that significant changes with the characteristic listed as follows have taken place on the environment, ecology and community composition. (1) Due to 8 branches influx to the Pearl River Estuary and its natural topography, the estuary can be divided into several kinds of ecosystems such as river mouth, island and islets, mangrove and intertidal, frontal ecosystems. The biodiversity in these ecosystems have a common tendency of decline. (2) The changed environment and overfishing caused by natural impacts and anthropologic activities have over-taken or reduced the fish production, particularly the catch rate of the commercial species in the Wanshan fishing ground, the largest fishing ground in the estuary. The fishes landed tend to be younger and smaller than the past. Most of the fishes landed are of shorter food chain species. The species-richness of *Penaeus orientalis* has diminished. The quantity of some commercial species of fish larva decreased. (3) Affected by the organic matter deposited in the sediment and influx of sea water, the seasonal low DO zone were determined in some parts of the estuary, especially in the bottom along the two side of the estuary. (4) The habitat of Chinese White Dolphin moved from South China coastal waters to only the waters around in the Nei Lingding in the Pearl River Estuary and with the tendency of number decline. The Chinese Dolphin is listed as the highest priority on the list of mammals under state protection (Huang and Liu, 2000). Several cooperative researches on Chinese White Dolphin between Guangdong Ocean and Fishery Department and Hong Kong had been carried out. The region from the west of Lantau Islands to Nei Lingding has designated t as a conservation area for protecting Chinese White Dolphin. (5) With increasing population boom and industry development, the disposal of municipal sewage, industrial effluents and agricultural runoff has increased. Eutrophication caused by nitrogen and phosphorus loading in the Pearl River estuary, and the re-suspension of trace metals from the sediments have induced frequent algal blooms and red tide events in South China coastal waters, with occasional massive fish kills due to severe dissolved oxygen (DO) depletion or toxic red tides (Hodgkiss, 1995 ; Qi et al., 2000 ; Yin et al., 1999). For example, the red tide event occurred through March to April in 1998 extended from the coastal waters from the east of Pearl River Estuary-Hong Kong water area, Dapeng Bay, Guishan Islands to Yangjiang. The economic losses amounted to hundreds of million of RMB (Guangzhou Daily, 1998). Research on the environment and organism resources in the Pearl River Estuary has a significant importance either for the objectives of geology, estuarine type or economy. We should put much emphasis on the ecosystem and marine resources researches in the Pearl River Estuary to maintain its biodiversity and the sustainable utilization of resources.

5. Protection regulations and management measures

In order to protect and manage coastal ecosystems in an effective way, a series of marine environmental protection policies or laws and regulations have been established based on "Environment Protection Law of China", "Fishery Law of China", "Wildlifes Protection Law of China", "Aquatic Product Breed Protection Statute", "The laws for aquatic Resources Propagation" and "Fishery Water Quality Standard". The regulations related to oceans are listed mostly as follows :

- a. "National Marine Environmental Protection Law of P. R. China", Revised in Dec.1999
- b. "Regulations Concerning the Management of Marine Standardization", Jan. 1997
- c. "Regulations Concerning the Management of Marine Natural Protection Zone", May 1995
- d. "Provisional Regulations Concerning the Management of Sea Area Use ", May 1993
- e. "Regulations Concerning the Dumping of Waste at Sea of P. R. China", Sept.1990
- f. "Regulations Concerning Environmental Protection in Offshore Oil Exploration and Exploitation of P. R. China". Sept.1990

Relevant water quality and discharge standards have also been established. Monitoring protocols, standard methods, intercalibration samples, quality control and quality assurance systems and EIA system for marine environment and ecology have been established and perfected, which has reached international level. Monitoring instruments have been improved. Human resources for high quality monitoring have been developed. All these assure environmental monitoring quality.

The measures to protect coastal ecosystems are as following :

- (1) A series environment protection laws and regulations and rules have been established and put into effect. Development of management system and human resources. Central government and local governments coordinate in the management system. Enhancement of public awareness for environment protection and ecological conservation.
- (2) Increasing national financial input to marine science and technology researches, and promoting the development of marine sciences and technology. Improving monitoring technique of marine environment and ecology. Developing auto-monitoring technique of coastal environment and ecology, ocean buoy technique, under water detecting technique, aviation and remote sensing technique. To realize 3-dimensional monitoring system of marine environment and ecology.
- (3) Scientific planning, and development of marine functional zonation scheme. The study of environmental capacity in different regions, and the control of total pollutants discharge and load. Control and manage the discharge of land-based pollutants according to marine environmental capacity.
- (4) Rectifying monitoring scheme more reasonably by giving more attention to f monitoring residual toxins in marine organisms and geology monitoring, and attach importance to the research of new organic pollutants in medium.
- (5) Modernizing marine environment monitor, information transportation and management system. Establishing and perfecting the three systems such as information transformation, environmental quality information management and marine pollution source as soon as possible.
- (6) In the view of the international character of marine environment, expanding international cooperation and communion actively.

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THE JAKARTA MANDATE OF THE CONVENTION ON BIOLOGICAL DIVERSITY AND ITS IMPLEMENTATION FOR THE EAST ASIAN SEAS REGION^{xlii}

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Abstract

The Jakarta Mandate on Marine and Coastal Biological Diversity is a global consensus on the importance of marine and coastal biological diversity and is a part of the Ministerial Declaration on the implementation of the Convention on Biological Diversity, as adopted by the Conference of the Parties (COP) at its second meeting held in Jakarta in November 1995. The programme of the Jakarta Mandate covering the five themes namely Integrated Marine and Coastal Area Management (IMCAM), Marine and Coastal Living Resources (MCLR), Marine and Coastal Protected Areas (MCPA), Mariculture, and Alien Species, are developed to assist in mitigating the problem faced by marine and coastal ecosystem. The paper outlines the importance of marine and coastal biological diversity and status of the marine and coastal resources in the region. The programme of work for the Jakarta Mandate as adopted during the fourth meeting of COP as well as the recent programme adopted at COP 5 will be elaborated.

I. INTRODUCTION

The conservation and sustainable use of marine and coastal biological diversity (biodiversity) are among today's most important environmental issues, including in the East Asian regions. However, conservation-related research on the sea is still lacking compared to similar research on terrestrial ecosystems. For example, papers published in Conservation Biology Journal was only 5% focused on marine ecosystems and species, compared with 9 % freshwater and 67% terrestrial in their subject matter (Murphy and Duffus, 1996). This negligence to marine and coastal biological diversity is unfortunate situation considering the seas's richness, their importance to humankind, and the immediate threats to them.

The Convention on Biological Diversity (CBD or Convention) is a legally binding instrument committing governments to protecting the earth's biological resources. It was opened for signature in June 1992, at the Earth Summit in Rio de Janeiro. As of early December 2000, 178 States and one regional economic integration organization have ratified the Convention.

The Convention defines biological diversity as "the variability among living organisms from all sources including, *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."

The three objectives of the CBD are (a) the conservation of biological diversity, (b) the sustainable use of its components and (c) the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The CBD is unique in the sense that it is the only multilateral, legally binding instrument that covers the entire world's ecosystems, thereby taking a comprehensive rather than a sectoral approach. The Convention describes an ecosystem as "the dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit."

This document was prepared with the objective to provide information on the Conservation and Sustainable use of Marine and Coastal Biological Diversity under the Convention as well as its implementation under the Jakarta Mandate programme of work. Section II will describe the importance of marine and coastal biodiversity. Section III covers the threats to the marine and coastal biodiversity. Cooperation with other organization and future work are summarized in Section IV.

II. IMPORTANCE OF MARINE AND COASTAL BIOLOGICAL DIVERSITY

Marine and coastal ecosystems that contain high biological diversity hold significant physical, economical, social and cultural values, not only for the local communities, which is using the resources but also for humankind as a whole. Marine and coastal biodiversity can be important because it supplies us with food (fishing, hunting), direct enjoyment (scenic values, whale watching), or ecosystem services (recycling of nutrients), (Ehrlich and Ehrlich, 1992). Marine and coastal biodiversity may be broadly divided into direct economic and indirect economic values.

The East Asia Seas that stretch between Asia and Australia, and between the Pacific and the Indian ocean covers 8.94 million km² or about 2.5 percent of the world's ocean surface (Soegiarto, 1985). Coral reefs, seagrass beds and mangroves of these regions are the most diverse and productive ecosystem in the world. Mangrove resource consists of 20 - 25 species of shrubs and trees, and has a total area of 2 million or 12% of the world total of mangrove forest (Talaue-McManus, 2000). The products direct economic use of mangroves include the mud itself used as fertilizer in Goa (India), potash manufactured in Nbotany Bay (Australia), pulp for paper, matches and charcoal.

Marine plant and animal resources have direct economic values as a source of food, livestock feeds, medicine, building materials and other natural and industrial products. For example, fishes and shellfishes provide source of protein. Products made from various parts of sharks and sea horses are popular as ingredients in Asian medicines. Similarly, seaweeds are used in the health food industry.

Coastal resources can also have a direct value without being harvested and consumed. They provide services as recreation areas, education sites and tourist attractions. With annual growth rate of 5.5 percent, tourism is one of the world fastest growing economic sectors and plays a vital role in the economy of many islands and coastal regions (van de Heijden and van Zwol, 2000).

Moreover, coastal ecosystems provide indirect economic values. Ecosystems, i.e., mangrove forests, coral reefs and seagrass beds, provide services as spawning, nursing and feeding area for vertebrate and invertebrate organisms, and at the final process will provide source of income for coastal communities. These ecosystems and their organisms also play a significant role in stabilizing the biosphere and regulating the climate. For example, mangrove forest provides protection against erosion, cyclones, and produces particulate and dissolved organic matter that contributes to fisheries in the coastal waters. Marine algae and phytoplankton remove a great part of the primary greenhouse gases (CO₂) from the atmosphere, and produce 30-50 percent of the global oxygen supply.

Similarly, seagrass beds that cover large areas of coastal waters perform a wide spectrum of biological and physical functions in the marine environment. They stabilize the substrate, produce sediments, serve as habitats, nurseries, and as a primary food source for fish and many invertebrates. The beds also provide shelter and area of refuge for various species of fishes and endangered species such as,

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Dugong and turtles.

Above all, marine and coastal biological diversity may prove to have future direct values through technological advancements in food production, medical research and other industrial development. Genes present in the wild stocks of fish, shrimp, and seaweed species that are used at present in mariculture, will play important role in breeding programme aims at improvement in growth, reproduction, disease resistance, and other characteristics. In addition, marine and coastal biological diversity and the ecosystems they compose, hold cultural and aesthetic values for humankind.

III. THREATS TO MARINE AND COASTAL BIOLOGICAL DIVERSITY

The earth's biological resources are vital to humanity's economic and social development. As a result, there is growing recognition that biological diversity is a global asset of tremendous value to present and future generations. At the same time, approximately 66 percent of the human population, or close to four billion, now live within 80 kilometers of the coast, with figure expected to increase to 75 percent by 2020. This dense coastal population exerts in increasing pressures on marine and coastal biodiversity.

There are at least five major threats to marine and coastal biodiversity, i.e., overexploitation, pollution, habitat destruction, alien species and global climate change. In most East Asian countries (China, South Korea, Thailand, Viet Nam, Cambodia, Philippines, Malaysia and Indonesia), overexploitation of resources is the general rule and is largely because of population pressure and the low-income status of the coastal communities.

Coastal development and conversion of mangrove ecosystems to brackish water ponds (tambaks) are being undertaken at an extremely rapid pace. For example, at present 'tambaks' cover almost all the northern coast of Java and along the west coast of South-Celebes. The rate of degradation is rapid. Estimated rate of loss of mangrove forest in each country of bordering the East Asia seas ranges from around 0.5 - 3.5% of the total area per annum.

Similarly, high diversity of seagrass whereabouts 20 out of 50 species of seagrass in the world is found in the East Asia Seas (Fortes, 1995). Seagrass beds provide a valuable nursery for commercially crustaceans and fishes. However, recent studies by ASEAN-Australia Living Aquatic Project suggest that up to 50 % of seagrass beds are damaged by destructive fishing practices, land-based pollution and sedimentation (Table 1).

Table 1 Number of Seagrass species, number of associated fish species with seagrass beds and cause of degradation of seagrass beds in some East Asian countries

Country	Species	Associated fish species	Immediate causes of degradation
Cambodia	6	-	Fishing, transportation and navigation
China	4	8	Land reclamation
Indonesia	12	165	Sedimentation, industrial wastes
Malaysia	10	15	Coastal reclamation, oil spills, land-based pollution
Philippines	16	172	Industrial development, ports and recreation
Singapore	11	-	Land reclamation, dredging and shipping
Thailand	10	67	Waste disposal from domestic use, aquaculture, land reclamation and development
Viet Nam	14	-	Fertilizer production, animal feed production, land reclamation for agriculture and aquaculture.

Source : Chia and Kirkman (2000), Talaue-McManus (2000)

Coral reefs are also among the richest in species diversity and productive fishery areas. In Southeast Asia contains 30% of the world's coral reef (Gray, 1997). For example, Indonesia reefs contain approximately 450 species of coral reefs. Unfortunately up to 60 % of the reefs reported have been lost due to the increased of sedimentation, overexploitation by dynamite and chemical fishing as well as land-based pollution. The result of the ASEAN-Australia Living Coastal Resources Project 1984-1994 reported that about 35 % of coral reefs are listed in the poor category with live coral cover less than 25%, only 27 % considered as good with coral cover above 50% (Table 2).

Table 2 Status of Coral Reef Ecosystem in Southeast Asia. Condition values refer to percentage of transects (at depth of 3 m and 10 m) with coral cover of poor < 25%, fair 25 - < 50 %, good 50 - < 75% and excellent > 75%.

Country	Number of transect (n)	Excellent %	Good %	Fair %	Poor %
Indonesia	190	2.6	24.2	31.6	41.6
	324 ^{a)}	6.5	22.5	28.4	42.6
Malaysia	193	11.4	52.8	27.5	8.3
Philippines	238	1.3	7.5	49.2	42.0
Singapore	142	2.8	9.2	20.4	67.6
Thailand	178	16.9	42.1	34.8	6.2

Source : Chou (1998), a) Nontji (2000)

Toxic materials entering marine environment are either naturally occurring substances in elevated concentrations or synthetic compounds from industrial processes. Marine and coastal resources in contaminated ecosystems generally have reduced species diversity, as more sensitive species die out and pollution-tolerant species proliferate. The effects of toxic pollution on marine biodiversity is very clear that exposure to pollutant can cause immune system impairment, reduce reproductive success and developmental aberrations.

Alien species, also known biological invasions, biological pollution or exotic are organisms that have been transported by human activity, intentionally or accidentally, into regions where they have not historically occurred (Norse, 1993). Alien species are a great threat

to the integrity of natural communities of plants and animals and to the preservation of endangered species (Carlton and Geller, 1993). The magnitudes that are caused by marine biological invasion may lead to profound ecological changes in the ocean.

Studies on alien species were mostly done in North America (Table 3) and there is lack of research on invasion species in developing countries.^{xiv} There is sensible evidence in support of the hypothesis that shipping serves as a vector for the introduction of foreign organisms from continent to continent.

Table 3 Invasions probably mediated by ballast water

Higher taxon	Species	Native Distribution	Introduced to	First recognized
Dinoflagellata	<i>Alexandrium catenella</i>	Japan	Australia	1986
Cnidaria Scyphozoa	<i>Phyllorhiza punctata</i>	Indo-Pacific	California	1981
Annelida Oligochaeta	<i>Teneridrilus mastix</i>	China	California	1984
Crustacea Mysidacea	<i>Neomysis japonica</i>	Japan	Australia	1977
Copepoda	<i>Pseudodiaptomus inopinus</i>	Asia	Columbia River	1990
	<i>P. marinus</i>	Japan	California	1986
	<i>P. forbesi</i>	China	California	1987
Caridea	<i>Exopalemon styliferus</i>	Indonesia	Irak, Kuwait	1983
Mollusca				
Bivalvia	<i>Potamocorbula amurensis</i>	Asia	California	1986
	<i>Theora fragilis</i>	Asia	California	1982
	<i>Dreissena polymorpha</i>	Euroasia	Great Lakes	1987
	<i>Perna viridis</i> ^{a)}	Java	Ambon	1995
Pisces	<i>Butis coilomatodon</i>	Indo-west Pacific	Nigeria, Cameroon	1983
	<i>Mugiligobius</i> sp.	Philippines	Hawaii	1987
	<i>Parablennius thysanius</i>	Philippines	Hawaii	1971

Source : Carlton and Geller (1993), a) green mussel may be introduced during mariculture program or transported by ballast water.

Global climatic change is not only a terrestrial issue, but it also concerns for sustainability of marine biological diversity. Human activities including the burning of fossil fuels, destruction of forests and the release of CFCs cause to increase in average temperature of 1 to 3 °C during the next century (Intergovernmental Panel on Climate Change). Because many tropical marine species live at temperature close to their upper lethal limits, an increase of a few degrees could kill them entirely. For example, the phenomenon of coral 'bleaching' is one possible impact of rising seawater temperature. Marine biologists began observing widespread bleaching of reef corals across the tropical Pacific Ocean in the early 1980s.

Bleaching has also been linked to stress from high visible light and UV levels, low salinity, parasitic infection and pollution; coral appear more vulnerable to these as temperature stress increases (Norse, 1993). Global warming will probably reduce the capacity of reefs to act as breakwaters and provide sand and rock as building materials. Furthermore, fish and shellfish populations will probably be less abundance as there will be reduced structural complexity to shelter juveniles and small species.

IV. THE JAKARTA MANDATE ON MARINE AND COASTAL BIODIVERSITY AND ITS IMPLEMENTATION

In view of common concern regarding marine and coastal biodiversity, and recognizing the significant differences between marine and terrestrial biodiversity, at the second meeting of the Conference of the Parties, COP (November 1995, Jakarta, Indonesia), the Parties to the CBD agreed on a programme of action for implementing the Convention with respect to marine and coastal biodiversity. The programme demonstrates that the CBD is an important tool for promoting the conservation and sustainable use of marine and coastal ecosystems and their natural resources.

This programme is referred to in the Ministerial Statement, adopted at the same meeting, as "the Jakarta Mandate on Marine and Coastal Biodiversity". The Ministerial Statement reaffirms that there is a critical need for the COP to address the conservation and sustainable use of marine and coastal biological diversity, and urges Parties to initiate immediate action to implement the decisions adopted on this issue. Furthermore, the Ministerial Statement welcomes the commitment of the Government of Indonesia to play a major role in facilitating the implementation at the global and regional level.

The Jakarta Mandate has five thematic issues i.e. integrated marine and coastal area management, marine and coastal living resources, marine and coastal protected areas, mariculture, and alien species. In fact, these thematic issues are not a new one, but the adoption by the Parties of the Jakarta Mandate provides the opportunity for the Convention to play a coordinating role in facilitating and promoting the conservation and sustainable use of marine and coastal biological diversity.

In carrying its programme of work, the Convention should support and guide national, regional and global activities, drawing not only upon its roster of experts, but also upon the wide range of existing activities worldwide, and by initiating new efforts and by actively engaging the support of all relevant institutions in the implementation of the Jakarta Mandate.

Decision II/10 of the COP invites international and regional bodies responsible for legal instruments, agreements and programmes which address activities relevant to conservation and sustainable use of marine and coastal biodiversity with a view to improving existing measures and developing new actions in light of the recommendation adopted by COP. Those institutions were invited to cooperate in the planning and implementing of the programmes affecting marine and coastal biodiversity.

The multi-year programme of work for the Jakarta Mandate on marine and coastal biological diversity was adopted by the Parties to the Convention at the fourth meeting of the Conference of Parties (Bratislava, May 1998), which is contained in the annex to decision IV/5 of the meeting (see www.biodiv.org/jm.html).

The aims of the programme of work is to assist the implementation of the Jakarta Mandate on marine and coastal biological diversity at the national, regional and global levels. It identifies key operational objectives and priority activities within the five key programme elements. In addition, the programme of work also provides a general element to encompass the coordination role of the Secretariat, the collaborative linkages required, and the effective use of experts, in particular in relation to promote and strengthen taxonomy expertise.

^{xiv} It looks as if all alien species comes from developing countries to industrialized countries. Thus, research on the opposite travelling ships will help to understand how severely the introduction species from countries to countries or from continent to continent

The programme elements and their operational objectives are summarized as follows :

1.Implementation of integrated Marine and Coastal Area Management (IMCAM)

- 1.1 To review the existing instruments relevant to IMCAM and their implication for the implementation of the Convention;
- 1.2 To promote the development and implementation of IMCAM at the local, national and regional level;
- 1.3 To develop guidelines for ecosystem evaluation and assessment, paying attention to the need to identify and select indicators.

2.Marine and coastal living resources (MCLR)

- 2.1 To promote ecosystem approaches to sustainable use of marine and coastal living resources;
- 2.2 To make available to the Parties information on marine and coastal genetic resources, including bioprospecting.

3.Marine and coastal protected areas (MCPA)

- 3.1 To facilitate research and monitoring activities related to the values and the effects of marine and coastal protected areas or similar restricted management areas on sustainable use of marine and coastal living resources;
- 3.2 To develop criteria for establishment of, and for management aspect of, marine and coastal protected areas.

4.Mariculture

To assess the consequences of mariculture for marine and coastal biological diversity and promote technique that minimizes adverse impact.

5.Alien species and genotypes

- 5.1 To achieve better understanding of the causes of the introduction of alien species and genotypes and the impact of such introductions on biological diversity;
- 5.2 To identify gaps in existing or proposed legal instruments, guidelines and procedures to counteract the introduction of and adverse effect exerted by alien species and genotypes; and to collect information on national and international actions to address these problems
- 5.3 To establish and incident list on introductions of alien species and genotypes through the national reporting process or any other appropriate means.

Six basic principles identified in decision IV/5 for the implementation of the Jakarta Mandate programme of work. These basic principles are ecosystem approach; precautionary approach; importance of science; roster of experts; involvement of local and indigenous communities; and three level of implementation (national, regional and global).

Decision IV/5 also provides guidance regarding tools for implementation of the work programme. The tools were identified by COP to assist the Secretariat, partner organizations, Parties and other Government during execution of the activities. The tools includes inter alia (a) Roster of experts on marine and coastal biological diversity; (b) Database of initiatives on programme elements, with special emphasis on integrated marine and coastal area management; (c) Memoranda of cooperation; (d) Ad hoc Technical Expert Groups; and (e) The Jakarta Mandate website; and (f) Clearing house mechanism.

The fifth meeting of the Conference of the Parties (Nairobi, May 2000) reviewed the progress of implementation of the programme of work. In addition to complete the programme of work as adopted through decision IV/5, COP at the same meeting (COP V) adopted decision V/3 which provides additional guidance in the implementation of the Jakarta Mandate programme of work.

In decision V/3, paragraph 3, the COP decided on the integration of coral reefs issues into the programme element of the Jakarta Mandate, noting that it would have a minimum three-year time schedule (paragraph 1). A proposal for how coral reefs may be integrated into the programme element is being prepared and will be presented in the sixth meeting of Subsidiary Body on Scientific Technical and Technological Advice, (SBSTTA) in March 2001 in Montreal, taking into consideration the input from a liaison group meeting on coral reef held in October 2000 in Bali.

Under programme element IMCAM, COP 6 adopted further work on development guidelines for coastal areas, taking into account ecosystem approach. The work on ecosystem evaluation and assessment, inter alia through guidelines on evaluation and indicators, will continue.

With regard to marine and coastal living resources, information on approaches to management of marine and coastal living resources in relation to those used by local and indigenous communities will be gathered and scientific, technical and technological matters related to issue of marine and coastal genetic resources to be analyzed by SBSTTA.

IV.COOPERATION WITH OTHER ORGANISATIONS AND FUTURE WORK

The function of the Secretariat of Convention on Biological Diversity is to promote the implementation of specific activities of the programme of work, and in the same time perform an overall coordination role of their implementation by Parties and relevant bodies.

Activities associated with the programme of work should be cost-effective and efficient. Duplication of efforts should be avoided, and harmonization of respective programmes of work will be pursued through strong coordination between the Convention and other relevant bodies, with a particular view to the list of partner organizations mentioned in decision II/10, paragraph 13, and the Convention on Wetlands. Furthermore, particular in relation to coral reefs work, organization listed in decision V/3, paragraph 4, will be invited to collaborate with the Secretariat of CBD in the implementation the Jakarta Mandate programme.

The COP through decision V/3 requested the Executive Secretary of the Secretariat of the CBD to coordinate with the secretariats of regional seas conventions and action plans with a view to exploring the possibility of further collaboration, including the development of joint work programmes, in the implementation of the Jakarta Mandate on Marine and Coastal Biological Diversity, paying particular attention to the identification of priorities for action at the regional level, the development of joint implementation strategies and identification of joint activities and the use of regional networks, and to report to the COP at its sixth meeting on collaboration with the regional seas conventions and action plans.

The Secretariat of CBD has established cooperation with relevant bodies, UN and non-UN organizations in the implementing the Jakarta Mandate on marine and coastal biological diversity. Memorandum of Cooperation has been established with East Pacific Permanent Secretariat (EPPS), Barcelona Convention Secretariat as well as other non UN organizations such as Ramsar Convention Secretariat and International Ocean Institute (IOI). The progress of implementation of the Jakarta Mandate Programme of Work (as of June 2000) through partnership with other organizations and bodies is described in Annex 2 of present document.

In carrying its programme of work, the Convention supports and guides national, regional and global activities, drawing not only upon its roster of experts, but also upon the wide range of existing activities worldwide, and by initiating new efforts and by actively engaging the support of all relevant institutions in the implementation of the Jakarta Mandate.

The success of the programme will depend on the participation and contribution from the Parties, countries, international and regional organisations, and non-governmental organisations as well as relevant stakeholders.

To this end, the Secretariat of the East Asian Regional Seas Action Plan (UNEP EAS/RCU) may wish to consider establishing a partnership with the Secretariat of the Convention in view of implementation of the Jakarta Mandate programme of Work on the basis of decisions IV/5 and V/3 as well as relevant provisions of the Convention.

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ANNEX 1

Decision V/3. Progress Report on the Implementation of the Programme of Work on Marine and Coastal Biological Diversity (implementation of decision IV/5)

The Conference of the Parties,

Recalling the need to implement the programme of work on marine and coastal biological diversity in a holistic manner, taking into account river basin issues, the effects of land-based activities (including pollution) and tourism plans,

Noting the relevance for the future implementation of the programme of work of the joint work plan 2000-2001 of the Convention on Biological Diversity and Ramsar Convention on Wetlands,

Stressing the importance of regional approaches to the implementation of the programme of work and therefore of cooperation with regional bodies,

1. Takes note of the tools that have been used for the implementation of the programme of work on the conservation and sustainable use of marine and coastal biological diversity, as set out in the note by the Executive Secretary on the subject prepared for the fifth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (UNEP/CBD/SBSTTA/5/7, annex I), requests the Executive Secretary to report to future meetings of the Subsidiary Body on Scientific, Technical and Technological Advice on the application of these tools, encourages the Secretariat and the Subsidiary Body to complete, as soon as possible, the implementation of decision IV/5 on the programme of work on marine and coastal biodiversity as adopted by the Conference of Parties at its fourth meeting, and notes that the work element on coral reefs was enabled at the fifth meeting of the Conference of the Parties, and will have a minimum three year time schedule;

1. CORAL REEFS

2. Endorses the results of the Expert Consultation on Coral Bleaching, held in Manila from 11 to 13 October 1999, as contained in the annex to the present decision;

3. Decides to integrate coral reefs into programme element 2 (Marine and coastal living resources) of the programme of work;

4. Requests the Executive Secretary to integrate fully the issue of coral bleaching in the programme of work on the conservation and sustainable use of marine and coastal biological diversity and to develop and implement a specific work plan on coral bleaching, taking into account the recommendations set out in the annex to the present decision, as appropriate, and in cooperation with the United Nations Framework Convention on Climate Change, and invites Parties, other Governments and relevant bodies to contribute to its implementation. In conducting his work on coral bleaching, the Executive Secretary will also liaise with, inter alia, the Convention on Wetlands, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the United Nations Educational, Scientific and Cultural Organization (including the World Heritage Convention), the Food and Agriculture Organization of the United Nations, regional fisheries organizations, the Intergovernmental Panel on Climate Change and the Global International Waters Assessment and will formally liaise with the Global Coral Reef Monitoring Network and the International Coral Reef Initiative;

5. Notes that there is significant evidence that climate change is a primary cause of the recent and severe extensive coral bleaching, and that this evidence is sufficient to warrant remedial measures being taken in line with the precautionary approach, transmits that view to the United Nations Framework Convention on Climate Change and urges the United Nations Framework Convention on Climate Change to take all possible actions to reduce the effect of climate change on water temperatures and to address the socio-economic impacts on the countries and communities most affected by coral bleaching;

6. Urges Parties, other Governments and relevant bodies to implement response measures to the phenomenon of coral bleaching by :

- (a) Identifying and instituting additional and alternative measures for securing the livelihoods of people who directly depend on coral reef services;
 - (b) Encouraging and supporting multidisciplinary approaches to action relating to coral-reef management, research and monitoring, including the use of early-warning systems for coral bleaching, and collaborating with the International Coral Reef Initiative and the Global Coral Reef Monitoring Network;
 - (c) Building stakeholder partnerships, community participation programmes and public education campaigns and information products that address the causes and consequences of coral bleaching;
 - (d) Using appropriate policy frameworks to implement integrated marine and coastal area management plans and programmes that supplement marine and coastal protected areas and the multiple conservation measures outlined in the Renewed Call to Action of the International Coral Reef Initiative;
 - (e) Supporting capacity-building measures, including training of and career opportunities for marine taxonomists, ecologists and members of other relevant disciplines, particularly at the national level;
 - (f) Implementing and coordinating targeted research programmes, including predictive modelling, in the context, as appropriate, of the ongoing activities referred to in paragraph 4 of the present decision;
7. Invites Parties, other Governments and relevant bodies to submit case-studies on the coral-bleaching phenomenon to the Executive Secretary, for dissemination through the clearing-house mechanism;
8. Agrees that physical degradation and destruction of coral reefs also pose a significant threat to the biological diversity of coral-reef ecosystems, and therefore decides to expand its request to the Subsidiary Body on Scientific, Technical and Technological Advice, as contained in section II, paragraph 1, of decision IV/5, so as to include the effects of such factors;

II. INTEGRATED MARINE AND COASTAL AREA MANAGEMENT

9. Endorses further work on developing guidelines for coastal areas, taking into account decision V/6, on the ecosystem approach;

10. Encourages the Subsidiary Body on Scientific, Technical and Technological Advice, with the assistance of the Executive Secretary, to continue work on ecosystem evaluation and assessment, inter alia, through guidelines on evaluation and indicators;

III. MARINE AND COASTAL LIVING RESOURCES

11. Requests the Executive Secretary to gather information on approaches to management of marine and coastal living resources in relation to those used by local and indigenous communities and to make the information available through the clearing-house mechanism;
12. Takes note of the work of the Executive Secretary on marine and coastal genetic resources, including bioprospecting, and requests the Subsidiary Body on Scientific, Technical and Technological Advice to analyse, and provide advice on scientific, technical and technological matters related to the issue of marine and coastal genetic resources;
13. Suggests that the Subsidiary Body on Scientific, Technical and Technological Advice consider the following issues and prioritize them as appropriate : the use of unsustainable fishing practices, including the effects on marine and coastal biological diversity of the discard of by-catch; the lack of use of marine and coastal protected areas in the context of management of marine and coastal living resources; and the economic value of marine and coastal resources, including sea grasses, mangroves and other coastal ecosystems; as well as capacity-building for undertaking stock assessments and for economic evaluations;

IV. ALIEN SPECIES AND GENOTYPES

14. Requests the Executive Secretary to make use of existing information, expertise and best practices on alien species in the marine environment in the implementation of the work programme on alien species under decision IV/1 C;

V. GENERAL

15. Approves the terms of reference and the duration of work specified for the ad hoc technical expert groups on marine and coastal protected areas and mariculture, as contained in annex II to recommendation V/14 of the Subsidiary Body on Scientific, Technical and Technological Advice, with the addition of "Identification of best practices" for mariculture;
16. Requests the Executive Secretary to make further use of the roster of experts for peer-review and preparation of background documents ;

VI. COOPERATION

17. Invites the United Nations Educational, Scientific and Cultural Organization to continue its strong involvement in the implementation of the programme of work, and requests the Executive Secretary to further strengthen cooperation with other global organizations;
18. Requests the Executive Secretary to coordinate with the secretariats of regional seas conventions and action plans with a view to exploring the possibility of further collaboration, including the development of joint work programmes, in the implementation of the Jakarta Mandate on Marine and Coastal Biological Diversity, paying particular attention to the identification of priorities for action at the regional level, the development of joint implementation strategies and identification of joint activities and the use of regional networks, and to report to the Conference of the Parties at its sixth meeting on collaboration with the regional seas conventions and action plans.

Annex (to decision V/3)

PRIORITY AREAS FOR ACTION ON CORAL BLEACHING

A. Information-gathering

Issue : Our ability to adequately project, and thus mitigate, the impacts of global warming on coral-reef ecosystems and the human communities which depend upon coral-reef services is limited by the paucity of information on :

- (a) The taxonomic, genetic, physiological, spatial, and temporal factors governing the response of corals, zooxanthellae, the coral-zooxanthellae system, and other coral-reef-associated species to increases in sea-surface temperature;
- (b) The role of coral reefs as critical habitat for marine species and natural resources for human communities;
- (c) The current status of coral-reef health and threats to coral reefs; and
- (d) The potential capacity of recovery 1/ of corals and resilience of the ecosystem after mass mortality.

Response :

- (a) Implement and coordinate targeted research programmes, including predictive modelling, that investigate : (1) the tolerance limits and

adaptation capacity of coral-reef species to acute and chronic increases in sea-surface temperature;(2)the relationship among large-scale coral-bleaching events, global warming, and the more localized threats that already place reefs at risk; and(3)the frequency and extent of coral-bleaching and mortality events, as well as their impacts on ecological, social and economic systems;

- (b)Implement and coordinate baseline assessments, long-term monitoring, and rapid response teams to measure the biological and meteorological variables relevant to coral bleaching, mortality and recovery, as well as the socio-economic parameters associated with coral-reef services. To this end, support and expand the Global Coral Reef Monitoring Network and regional networks, and data-repository and dissemination systems including Reef Base - the Global Coral Reef Database.Also, the current combined Sida-SAREC and World Bank programme on coral-reef degradation in the Indian Ocean, as a response to the 1998 coral-bleaching event, could be used as an example;
- (c)Develop a rapid response capability to document coral bleaching and mortality in developing countries and remote areas.This would involve the establishment of training programmes, survey protocols, availability of expert advice, and the establishment of a contingency fund or rapid release of special project funding;
- (d)Encourage and support countries in the development and dissemination of status-of-the-reefs reports and case studies on the occurrence and impacts of coral bleaching.

Issue : The remoteness of many coral reefs and the paucity of funding and personnel to support on-site assessments of coral reefs require that remote-sensing technologies are developed and applied in the evaluation of coral-bleaching events.

Response : Extend the use of early-warning systems for coral bleaching by :

- (a)Enhancing current NOAA AVHRR Hot Spot mapping by increasing resolution in targeted areas and carry out ground-truth validation exercises;
- (b)Encouraging space agencies and private entities to maintain deployment of relevant sensors and to initiate design and deployment of specialized technology for shallow-oceans monitoring;
- (c)Making the products of remote sensing readily accessible to coral reef scientists and managers worldwide with a view to those scientists and managers that are based in developing countries.

B.Capacity-building

Issue : There is a substantial lack of trained personnel to investigate the causes and consequences of coral bleaching events.

Response : Support the training of and career opportunities for marine taxonomists, ecologists, and members of other relevant disciplines, particularly at the national and regional level.

Issue : Coral bleaching is a complex phenomenon.Understanding the causes and consequences of coral bleaching events requires the knowledge, skills, and technologies of a wide variety of disciplines.Any action aimed at addressing the issue should bear in mind the ecosystem approach, incorporating both the ecological and societal aspects of the problem.

Response : Encourage and support multidisciplinary approaches to coral-reef research, monitoring, socio-economics and management.

Issue : Public awareness and education are required to build support for effective research, monitoring, and management programmes, as well as policy measures.

Response : Build stakeholder partnerships, community participation programmes, and public education campaigns and information products that address the causes and consequences of coral bleaching.

C.Policy development/implementation

Issue : Nearly 60 per cent of the world's coral reefs are threatened by localized, human activities that have the potential to exacerbate the impacts of coral-bleaching events.Evaluations of the 1998 coral-bleaching events suggest that marine protected areas alone may not provide adequate protection for at least some corals and other reef-associated species as sea-surface temperatures rise.

Response : Use existing policy frameworks to implement the multiple conservation measures outlined in the Renewed Call to Action of the International Coral Reef Initiative, and develop and implement comprehensive local-to-national-scale integrated marine and coastal area management plans that supplement marine protected areas.

Issue : Most coral reefs are located in developing countries, and the majority of the people living near coral reefs are often extremely poor. Thus, even minor declines in the productivity of coral-reef ecosystems as a result of coral bleaching events could have dramatic socio-economic consequences for local people who depend on coral-reef services.

Response : Identify and institute additional and alternative measures for securing the livelihoods of people who directly depend on coral-reef services.

Issue : Coral bleaching is relevant not only to the Convention on Biological Diversity but also the United Nations Framework Convention on Climate Change and the Convention on Wetlands.The ultimate objective of the United Nations Framework Convention on Climate Change is to reduce emissions in a manner that "allows ecosystems to adapt naturally to climate change".The United Nations Framework Convention on Climate Change calls upon Parties to take action in relation to funding, insurance, and technology transfer to address the adverse effects of climate change.The Convention on Wetlands provides guidance on the conservation and wise use of wetlands, including coral reefs.

Response : Initiate efforts to develop joint actions among the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, and the Convention on Wetlands to :

- (a)Develop approaches for assessing the vulnerability of coral-reef species to global warming;
- (b)Build capacity for predicting and monitoring the impacts of coral bleaching;
- (c)Identify approaches for developing response measures to coral bleaching;
- (d)Provide guidance to financial institutions, including the Global Environment Facility, to support such activities.

Issue : Coral bleaching has the potential to impact local fisheries, as well as certain high-value commercial pelagic fisheries and coastal ecosystems.

Response : Encourage the Food and Agriculture Organization of the United Nations and regional fisheries organizations to develop and implement measures to assess and mitigate the impacts of sea-surface temperature rise on fisheries.

Issue : Coral-bleaching events are a warning of even more severe impacts to marine systems.If anomalous sea-water temperatures continue to rise, become more frequent, or are prolonged, the physiological thresholds of other organisms will be surpassed.Not only will local fisheries be impacted, but certain high-value commercial pelagic fisheries and coastal ecosystems will be affected as well.

Response : Emphasize that coral bleaching can be monitored as an early warning of the impacts of global warming on marine ecosystems and that the collapse of coral-reef ecosystems could impact ecological processes of the larger marine system of which coral reefs are a part.

Issue : The observations of the 1998 coral-bleaching events suggest that coral-reef conservation can no longer be achieved without consideration of the global climate system and that it requires efforts to mitigate accelerated global climate change.

Response : Emphasize the interdependencies and uncertainties in the relationships among marine, terrestrial, and climatic systems.

D.Financing

Issue : Because the issue of climate change is global and long-term in scale, Governments around the world need to work together to make funds available to implement initiatives to address the causes and consequences of coral bleaching.

Response : Mobilize international programmes and mechanisms for financial and technical development assistance, such as the World Bank, the United Nations Development Programme, regional development banks, as well as national and private sources to support implementation of these priority actions.

1 / Recovery is the return of a coral colony to a state of health, including a symbiotic relationship with zooxanthellae, after the health and/or symbiotic relationship has been disrupted by a stress or perturbation. Recovery may involve a change in the genetic composition of species of the zooxanthellae. Resilience is the return of a coral-reef ecosystem to a state in which living, reef-building corals play a prominent functional role, after this role has been disrupted by a stress or perturbation. A shift toward high dominance by frondose algae accompanied by a reduction in the functional role of coral would indicate a situation of low resilience.

Annex 2

Indicative List of Partner Conventions, Organizations and Bodies in the Areas of Marine and Coastal and Outcome of Cooperation with the CBD Secretariat (SCBD) ^{xlvj/}

NAME OF CONVENTION, ORGANIZATION OR BODY	RESULTS EMERGING OR EXPECTED FROM COOPERATION
Secretariat of the Permanent Commission for the South-East Pacific (CPPS) (providing the secretariat of the Convention for the Protection of the Marine Environment and the Coastal Zone of the South East Pacific - the Lima Convention - and the Regional Coordinating Unit of the Plan of Action for the South-East Pacific).	- Regular exchange of views and information and mutual participation of the representatives in respective relevant meetings. - Provision of technical assistance and working documents by SCBD. - CPPS-CBD Meeting of Experts to Analyze the Ecological Impacts of Alien Species (Vina de Mar, September 1998). The report was submitted to SBSTTA 4 as information document UNEP/CBD/SBSTTA/4/INF/5. - Workshop on the Effect of Mariculture to Adjacent Marine and Coastal Environment in the South-East Pacific (Puerto Mont, October 1999). - Third Meeting of Ad Hoc Technical Expert Group on Marine Protected Areas in the South-East Pacific (Punta Arenas, December 1999).
Regional Coordinating Unit to the Caribbean Environment Programme (CAR/RCU) (providing the secretariat of the Convention on the Protection and Development of the Marine Environment of the Wider Caribbean Region - the Cartagena Convention - and its Protocol on Specially Protected Areas and Wildlife)	Contribution of CAR/RCU to SCBD on relevant issues e.g. provision of Regional Guidelines for Integrated Planning and Management of Coastal and Marine Areas in the Wider Caribbean Region and of Common Guidelines and Criteria for Protected Areas in the Wider Caribbean Region, as well as database of wider Caribbean Marine Protected Area (CAMPAM Database)
Regional Coordinating Unit for Mediterranean Action Plan (providing the secretariat of the Convention for the Protection of the Marine Environment and the Coastal Regions of the Mediterranean - the Barcelona Convention) and Regional Activity Centre for Specially Protected Areas	Inclusion of CBD provisions relating to marine and coastal biological diversity in the activities for the implementation of the Protocol
Secretariat of the Regional Organization for the Protection of the Marine Environment (ROPME) (providing the Secretariat of the Kuwait Convention) and Secretariat of the Red Sea and Gulf of Aden Environment Programme (PERSGA) (providing the Secretariat of the Jeddah Convention)	Technical assistance to ROPME and PERSGA in the development of protocols concerning biological diversity and establishment of protected areas in the PERSGA and ROPME Regions
Helsinki Commission (HELCOM) (secretariat of the Convention on the Protection of the Marine Environment of the Baltic Sea)	- Adoption of proposal for identified co-operative linkages in marine and coastal biodiversity between CBD and this convention. - Regular exchange of views, information and materials and considerations of CBD provision by the HELCOM.
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)	Exchange of information and consideration of CBD provisions by the OSPAR Commission
Secretariat of Convention on Wetlands (Ramsar)	- Support of the Ramsar Secretariat to the CBD Expert Consultation on Coral Bleaching. - Joint work plan 1998-1999 and 2000-2001
United Nations Educational, Cultural and Scientific Organization (UNESCO) and its Intergovernmental Oceanographic Commission (IOC), Man and Biosphere Programme (MAB) and the World Heritage Centre (WHC)	- Exchange of information and material, particularly on integrated marine and coastal area management and marine and coastal protected areas - Support to the Global Taxonomy Initiative through the UNESCO-IOC Register of Marine Organisms - Identification of appropriate education and public awareness activities in the context of the CBD-UNESCO Global Initiative on Public Education and Awareness
United Nations Environment Programme (UNEP)	- Harmonization of programmes and activities of SCBD and the secretariats of the UNEP Regional Conventions and Action Plans - Provision of technical assistance to the clearing-house of the Global Plan of Action for the Protection of the Marine Environment from Land-Based Activities
Food and Agriculture Organization of the United Nations (FAO)	- Exchange of information with regard to marine and coastal living resources, including genetic resources - Provision of assistance by FAO in conducting a study on the effects of stock enhancement on marine and coastal biological diversity (with ICLARM)
United Nations Division of Ocean Affairs and the Law of the Sea (UNDOALOS)	Joint study of the relationship between CBD and the United Nations Convention on the Law of the Sea with regard to the conservation and sustainable use of genetic resources on the deep seabed
International Maritime Organization (IMO)	Exchange of information, particularly in the area of marine and coastal alien species and genotypes and specially sensitive areas
International Ocean Institute (IOI)	- Exchange of relevant information and material - SCBD contribution to the IOI summer training courses for developing country young professionals (yearly) - Cooperation in the IOI-Jamaica Leadership Seminar (Ocho Rios, August 1999) on resources other than metallic in the "Area" - IOI contribution to the Expert Consultation on Coral Bleaching
Global International Water Assessment (GIWA)	Elaboration of a methodology protocol for the assessment of transboundary water bodies, including their biological diversity
International Center for Living Aquatic Resources Management (ICLARM)	- ICLARM hosted the Expert Consultation on Coral Bleaching - Exchange of information and material
International Coral Reef Initiative (ICRI)	- Cooperation in promoting the conservation of coral reefs and its related ecosystems. - SCBD is member of Coordinating and Planning Committee of ICRI. - ICRI support in the organization of the Expert Consultation on Coral Bleaching (October 1999). - ICRI CPC resolution on coral bleaching and climate change to CBD (October 1999) was distributed in SBSTTA V as part of document UNEP/CBD/SBSTTA/V/INF/5.
The World Conservation Union (IUCN)	- Support in the organization of the Expert Consultation on Coral Bleaching - Cooperation in relation to the identification and selection of criteria for MCPA establishment and management

^{xlvj} The following organizations have also expressed their interest to cooperate with the CBD Secretariat in the area of marine and coastal biological diversity: the Commonwealth Secretariat, the International Council for the Exploration of the Sea (ICES), The World Bank, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Arctic Council and its Working Group on Conservation of Arctic Fauna and Flora (CAFF), the Association of Southeast Asian Nations (ASEAN) Secretariat, and the Caribbean Community Secretariat - CARICOM. Modalities for cooperation with these institutions are presently under consideration.

PEAM KRASAOP WILDLIFE SANCTUARY : INSIGHTS INTO LIFE IN THE MANGROVES

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MAP OF CAMBODIA



Koh Kong is one of four coastal provinces in Cambodia, and has the country's biggest area of mangrove forest. Mangrove forests are fertile, diverse saltwater ecosystems found in the coastal zone, and ensure inhabitants with food and shelter. These productive natural environments provide breeding habitat for a variety of birds, reptiles, mammals and insects. Similarly, mangroves also provide habitat to a variety of fish species, crustaceans and shellfish. New plant tissue is constantly being broken down within these forests, thereby contributing to the life support system for vast numbers of animal consumers including humans. Human dwellers further find a primary source of income, fuel, medicine and other basic necessity for their livelihood within mangrove forests.

Within Koh Kong province, Peam Krasaop Wildlife Sanctuary (PKWS), one of Cambodia's Protected Areas, boasts a unique mangrove ecosystem consisting of 23,750 hectares and spans over parts of three districts, and has around 10 000 people living within its borders. This area is influenced by inter-tidal levels and water from highland areas. Indeed, the estuarine areas are the intersection between freshwater and saltwater, especially during the rainy season. Within the same area, Koh Kapik and associated islands have been nominated as a Wetland of International Importance under the Ramsar Convention.

PKWS provides favorable conditions for fishery and other resources. Many people have resided on and done various occupations for their livelihoods and are dependent upon the natural resources in this area. PKWS and Koh Kapik Ramsar Site in Koh Kong have some of the best remaining examples of mangrove forests in the Gulf of Thailand, as many other areas have been cleared for intensive shrimp aquaculture, large-scale charcoal production, and other purposes.

Although the coastline, particularly Koh Kong Province, is relatively unpopulated there has been a rapid increase in migration into the province, especially, in PKWS due to improved security and short-term economic opportunities. Population pressures and marketing opportunities place greater pressure on the mangroves and aquatic resources within and surrounding PKWS.

PMMR

In 1998 the Participatory Management of Mangrove Resources (PMMR) began working with local communities to better understand livelihood and management issues in PKWS. The team, funded by Canada's International Development Research Centre (IDRC), is composed of government staff, at the national and provincial levels, from various technical departments. The lead institution is the Ministry of Environment (MoE); the provincial team is interdisciplinary. PMMR team members come from the Department of Environment, the Department of Fisheries, the Department of Rural Development and the Department of Women's Affairs. This project supports a strategy of community-based coastal resource management (CBCRM) and the focal point of PMMR's work in PKWS is five coastal villages.

The PMMR project has worked hard to establish good relationships and co-operation with all governmental levels : the PMMR team facilitates between the national level government and local people. The importance of this type of co-operation cannot be undervalued, and in Cambodia is imperative if government policies and laws are to be implemented in a successful manner. In the capacity building of provincial and local authorities, the PMMR team has held many training courses and sent provincial and local leaders to participate in training courses on mangrove forest management in Thailand and local villagers on study tours to other areas in Cambodia working on community-based resource management. Research includes a focus on understanding resource use patterns, marketing influences, livelihood issues, management issues and the socio-economic realities that community members face. This micro-level work provides useful insights that can be applied to other villages within PKWS and in Koh Kong province.

LIFE IN PKWS

After Cambodia's liberation from the Khmer Rouge (KR) in 1979, Cambodians were able, again, to live individually as family units, to own private property and, importantly, to establish businesses to earn their livelihood^{xxviii}. Koh Kong was quite unpopulated, and national government policy encouraged people to live in Koh Kong. There has been a net influx of people since 1979; in fact, it is estimated that the average annual growth rate in Koh Kong is 16 %. Unfortunately, over time the increase in population has put pressure on mangrove resources.

During the late 1980's and into the 1990s, Koh Kong town and province have developed rapidly, partially in response to market pressures from Thailand and to in-migration. Many residents in the mangrove forests of PKWS are economic migrants and internally displaced persons from inland areas of the country, and are therefore without traditional ties to the landscape or experience in its management. This movement of peoples in response to the post-conflict dimension of Cambodian reality is an essential element in the analysis and promotion of social and political stability in the country.

In PKWS, there have been significant changes in resource abundance over time. Most villagers, even those that have lived in the area for only a few years, are able to discuss the changes in resources and suggest possible reasons.

"Prior we could catch more fish at the night time with small fishing gear : the mangrove forest was not destroyed, low population, fishing used traditional method and all activities in this area were strong controlled by government and government has providing program to local people every months for mangrove protection and mangrove replanting (1960s). At the present (1990s), fish production has dramatically declined due to the use of modern equipment, influx migration, illegal fishing, mangrove destruction

^{xxviii} The end of the catastrophic KR regime resulted in many internally displaced Khmer. At this point, villages had been destroyed and KR guerilla activities continued in parts of Cambodia ; therefore, some people could not return to their villages and instead sought to make their livelihood elsewhere.

and poor management. Fishers ensure that they also concern about the decline of fish production because there are now no proper management and responsibility over natural resources (Koh Sralao group meeting, March 1999)."

Where villagers are not always able to make a link is between the cutting of mangrove trees for charcoal and the decline in fisheries resources (some do and some do not)^{xxix}.

Villagers remain highly dependent upon their environment : aquatic resources are used for subsistence and income generating purposes, mangroves provide breeding grounds and protection for aquatic resources, other wildlife and a source of fuel wood. People are poor - resources are declining, houses leak during the rainy season, there is not an adequate water supply in most villages, there are few schools and those that are open only offer grades one and two, and there are few clinics in any of the villages. Life in PKWS is dynamic : weather, foreign markets, illness and availability of resources all have an influence on village life.

LIVELIHOOD ACTIVITIES^{xxx}

FISHING ACTIVITIES

Fishing methods and seasons have changed over time. Traditionally, gear was not overly efficient, thus helping to ensure that resources were not over-exploited. Prior to the KR, there were specific seasons for fishing, and laws ensuring that people did not fish during spawning were enforced. The PKWS area was firmly managed by Department of Forestry, Fisheries and Hunting officials who worked with Village Chiefs to disseminate and enforce laws with local fishers and farmers. At that time, mangroves species were quite abundant and there was little destructive action or clearance of mangrove forest for shrimp farming.

As the population has increased, so too has the number of fishers in the PKWS area. Especially since 1990 when the Thai market has opened up and more efficient fishing gear was introduced (often illegal i.e. cyanide fishing or illegal trawling), villagers have noticed a gradual decline in resources. Most people in PKWS no longer fish merely for subsistence purposes, and while some people continue to crab trap, other fishing gear is also used. Fishers now use nylon nets; trawlers use polysynthetic nets. Push netting and trawling in shallow waters is illegal, as is dynamite and cyanide fishing; however, illegal fishing is quite popular.

General, the following small-scale types of fishing gear are found in PKWS :

- CRAB TRAP : Used to catch mangrove mud crabs and swimming crabs. Fishers use a rowboat with fixed oars or long tern boats with a 5 Hp engine. Families may have anything between 50 to more than 100 traps, with one or two members crab trapping;
- CRAB NET : Used to catch swimming crab. People use a long stern boat with a 5 Hp engine. Two people operate the crab traps. Each family has between 1-3 Units of net (1Unit = 10 Hands, 1 Hand = 25 m);
- FISH NET : People use different sizes of fish nets to catch fish in sites near the coastline and in the sea. People use a long stern boat with engines of different horsepower.

There are two types of fish processing, described as follows :

- Small-scale or subsistence processing : dried salt fish, salt fish, fish sauce, mollusk fermentation etc;
- Large-scale or market processing : shelling of crab for pure meat, small shrimp fermentation, jellyfish processing, fish freezing etc. These products are exported to Thailand and sold to local markets.

The following species are the most frequently caught by fishers : mangrove mud crab, swimming crab, shrimp, prawn, grouper, green mullet, red snapper, and sea-bass because such species can be sold in high price. Other species are also sold in low price to the market.

Life as a fisher is difficult, both in terms of labor and the amount of effort it takes per catch. Resources are affected by population increases, mangrove cutting, the use of modern fishing gear and illegal fishing activities within PKWS. Some people can easily survive from fishing resources, especially if they have access to large boats or illegal gear; however, many fishers do not have enough money to support their livelihood, subsequently becoming in-debt to the middle-person.

Fishers sell their fish production to a local middle-person, not directly to the market since transportation is expensive and time-consuming and the small-scale fisher often does not have enough product to sell themselves directly to the market. Fishers who borrow money or need support from the middle-person, in return, have to sell their product back. Other fishers, who do not owe money to the middle-person, can sell their product to any middle-person or, if they have a large boat, to the market directly.

CHARCOAL PRODUCTION

Families have always undertaken charcoal production in PKWS. Prior to the KR, a few families produced enough charcoal used as cooking fuel for entire villages. There were ten areas that were used selectively for charcoal production^{xxxi}.

Charcoal production increased dramatically in the 1990's : the potential for easy profit through the Thai market lured many Khmer's into this area. Too much pressure was placed upon the mangroves, and some of the best mangrove stands were decimated. Even though charcoal production is illegal, it has been really difficult, until recently, for the Department of Environment to curb such activities. The government started to destroy charcoal kilns. As more kilns were destroyed, some former charcoal producers became middlemen while poor people fled deeper into the mangroves to avoid detection. Because of a lack of budget for monitoring and enforcement, the government had difficulty in stopping these illegal activities. However, the Department has been trying consistently to stop charcoal production for the past few years and, with the help of the 1999 ban on illegal logging activities, charcoal production has dramatically decreased.

Those that now make charcoal are poor : the profit that they get from their jobs is not enough for living. Few middle-persons are willing to support charcoal production (many middle-persons are now involved in fisheries activities). Far fewer people are coming into PKWS to make charcoal, and those that do find it difficult to live. The days of large charcoal kilns and profits are gone; indeed, life has become extremely difficult and risky for charcoal producers.

Year	Price per kg in Thai Baht	Price per kg in \$ US
1997	2.15 Baht	\$ 0.05
1998	2.4 Baht	\$ 0.05
1999	2.55 Baht	\$ 0.06
2000	4.16 Baht	\$ 0.1

Source : PMMR team observations

THE AVERAGE MARKET PRICE FOR CHARCOAL

As less charcoal is produced in PKWS, the profit for charcoal production has increased. While charcoal production activities do continue, it is seen as too risky for most people to be involved in unless absolutely desperate. Charcoal production is no longer seen as a

^{xxix} For further information on changes in resources usage over time, see Appendix A.

^{xxx} For further information on livelihood options / activities found in PKWS, see 2000. Mangrove Meanderings : learning about life in PKWS. PMMR - IDRC Technical Report. Phnom Penh.

^{xxxi} For more information about charcoal production, see PMMR's case study Smashed Livelihoods ; life as a charcoal producer in PKWS.

profitable business in spite of the lure from the Thai market. From the middle of 2000 mangrove charcoal was no longer sold to Thailand; small-scale production was sold locally. It is illegal for people to use mangrove wood to make charcoal; instead, people now use upland wood to make charcoal. How this is effecting upland species requires further investigation.

FARMING

In PKWS area, there is not enough farmland for local people, except in Toul Korki commune. Farmers are found in Toul Korki commune. In this commune, this land area is more than enough for agriculture or upland farming. Rice production in this commune is produced for local consumption. Villagers make their money from upland farming, small-scale fishing activities, animal husbandry and other livelihood enhancement opportunities.

AQUACULTURE

To date, aquaculture in PKWS has included extensive, semi-intensive and intensive shrimp pond culture, crab farms, green mussel culture and limited fish cage culture.

Perhaps shrimp culture began in a limited manner in the early 1980's. By the early 1990's, investors from Thailand became interested in the Cambodian market. Apparently, Thai investors had World Bank money and needed to spend it so they picked the Cambodian market, even though experts warned of potential problems. The soils are too peaty and no matter how much lime one adds to compensate, the pH remains too acidic. By 1997, there were 23 shrimp farms that covered over 800 ha. However, since early 1998 most of the shrimp farms have stopped operations.

GREEN MUSSEL CULTURE

Green mussel culture began near Koh Kang village, PKWS in 1994. Initially, green mussels were cultured as feed for the shrimp farms (between 1994 - 1997). However, when shrimp farms collapsed in 1998 people were forced to find alternative markets for their product. The market price in Thailand was high, and people began exporting green mussels and in 1999 the number of people growing green mussels increased.

FISH CULTURE

Grouper and snapper culture were tried, unsuccessfully, with one villager near Koh Sralao. Grouper culture began in January 1999, and was followed by snapper culture in February 1999. Although the project was begun enthusiastically, the villager, eventually, lost interest. Grouper culture and snapper culture were not successful because:

1. SITING - the cages were placed too close to the house, for security reasons, with low tides of less than 1 m;
2. UPLAND RUNOFF - in the upland areas, one of the yellow creepers are processed into a powder that is then exported to Vietnam to be used in some medicine. When processing this plant, sulfuric acid and chloridic acid are used;
3. CYANIDE FISHING - these wastes are harmful to the fish; the grouper did not appear healthy;
4. MARKET CONSTRAINTS - the Thai market was unstable i.e. buying and selling price the same; therefore, no profit;
5. COSTS - it is difficult to find trash fish for feed. Snapper especially like to eat a lot;
6. FRESHWATER - since one can only raise saltwater fish for a six month period until the rains begin, this is not a suitable time period to raise fish for the market.

OTHER LIVELIHOOD ACTIVITIES

Besides the jobs are mentioned above, villagers of PKWS are engaged in a series of subsistence and market activities including: wine making, water selling, goods selling, boat taxi, hunting, fix machine and hiring labor.

Issues in PKWS

GENERAL KNOWLEDGE

Because so many people are newcomers, local environmental knowledge is difficult to access and, therefore, to pass on. Many people in the villages have had little access to formal education and many are illiterate. The Chief of Koh Sralao suggested that 66 % of the villagers either had minimal education or were illiterate and perhaps 34 % held a medium education level (grade 2, 3 or 4). Unfortunately, people did not have access to education during the Lon Nol (1970 - 1975) and Khmer Rouge (1975 - 1979) period. For children coming into PKWS, unless young, there is no chance to go to school.

SECURITY

Security in Koh Kong has improved recently. Before, there were many places that the team could not visit and it was necessary to inform the proper authorities of field visits. This all took time to organize. Now the team can travel throughout PKWS to visit various sites and villages without any problems. Villagers can now travel freely between Koh Kong town and their villages. In Cambodia, the military navy is very influential along the coastline. For example, in Koh Kong they control all islands in the sea, including Koh Kong Island, and the open sea. Therefore, the Department of Fisheries, who are legally in charge of off shore fisheries, cannot control the number of boats and equipment used in the open sea. The Navy reaps a benefit from fishery resources while small-scale fishers find their yields declining. Before some police in the PKWS area were supporting small-scale illegal activities i.e. charcoal production and logging. This is changing: some police are working with Provincial Department of Environment Checkpoint staff to protect resources in PKWS.

Recently, a new governor was appointed to Koh Kong who is quite supportive of the work of the PMMR team and is interested in resource protection and conservation of PKWS.

MANAGEMENT CONSTRAINTS

The protection and conservation of natural resources in PKWS falls under the jurisdiction of the MoE, specifically the Department of Natural Conservation and Protection. There is a need for close cooperation between Ministries at the national level, especially between MoE and the Ministry of Agriculture (MoA). Techniques and experiences need to be shared more often. For example, until 1993 the MoA was responsible for the Wildlife Sanctuary (MoE was only created in 1993 and Cambodia's twenty-three protected areas fall under state property of the MoE^{xxxii}). Although the provincial level created a committee to prevent and mitigate

^{xxxii} Cambodia's constitution was passed by the National Assembly on the 22nd of September, 1993. Article 59 of the Constitution states that:
The state shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rocks and sand, gems, forests and forestial products, wildlife, fish and aquatic resources.

This article established the framework for environmental protection in Cambodia.

anarchical activities on mangrove resources, it is still difficult to implement resource protection measures for the following reasons :

- Lack of human resources among public servants and local people, especially those who will perform the tasks of protection and conservation of the natural resources;
- Lack of appropriate employment and creativity used in finding new occupations that will not destroy the environment;
- Lack of means i.e. equipment, funding and materials to control fishery abuses, mangrove deforestation and hunting;
- Lack of cooperation to avoid duplication of work between responsible authorities; for instance, armed forces could control illegal fishery and forest activities for the relevant authority;
- Lack of participation in resource management initiatives by local people;
- No official committee or mechanisms that enables people to formally participate in community based management initiatives (PMMR is working on this); and
- Poverty.

It is difficult to manage resources in PKWS because technical officials do not have any real power to manage the resources. That is, the police and navy military are involved in resource extraction activities, and are more powerful than technical officials from the environment department. It is difficult for departments to manage or enforce resource protection given limited budgets and funding. Poverty limits both village-level and technical department officials options. Although national level policy exists both in the realm of community development and environmental protection such policy, drafted in Phnom Penh, is unrealistic in isolated places such as PKWS.

There needs to be closer collaboration between Department of Environment staff and Department of Fisheries staff in Koh Kong to encourage that appropriate policy be both developed and enforced regarding aquatic resources. In fact, the Department of Environment could learn a lot from the Fisheries department. Illegal fishing activities are barely controlled in PKWS - hence, extensive grenade and other forms of illegal fishing exist. Most importantly, more local people need to be involved in resource management and protection.

LEGISLATION

Many new laws and sub-decrees are pending that will affect Protected Areas management. These include the following : Land Law (just finished translation in Rome); Fisheries Law (draft, provisions for community co-management); Forest Law (draft - community management and transparent concession allocation); Sub-decree on Systematic First Registration (outlines a process for land title which the MoE would have to also follow should it decide to implement land title (since PA's are state land, land title might not be legal); Sub-decree on Establishment on Community Forestry (sitting with the Council of Ministers, contains provisions for community forestry in PA's) ; Sub-decree on PA Management (just submitted to the Council of Ministers)xxxxiii.

The Law on Environmental Protection and Natural Resource Management came into effect in 1996. This law establishes the basis for environmental legislation in Cambodia, and there are a number of important purposes to this law including :

- To protect and promote environmental quality and public health through prevention, reduction, and control of pollution;
- To encourage public participation in environmental protection and natural resource management; and,
- To ensure the sustainable conservation, development, management and use of resources.

Although many laws are in draft form or under review, there is enough of a legal base to support resource management initiatives and, more specifically, community based management initiatives.

Participatory Coastal Resource Management in PKWS

During the time of PMMR project implementation (1998 to 2000), through extensive facilitation and training opportunities, both local people and authority figures became interested in participatory management and protection of coastal resources. Government authorities now believe that collaboration among stakeholders is very important in environmental protection and conservation, and it can better solve existing problems. Moreover, there is an economic incentive for villagers to be involved in CBCRM initiatives - government does not have the money to protect resources without local involvement.

Participatory coastal resource management is beginning in PKWS : villagers and provincial officers are working together to find solutions to pressing management issues. Most villagers are expressing a greater interest in learning about resource protection and conservation and in exploring the idea of co-management. Government authorities are recognizing the importance of local resource management initiatives, and are lending support to the PMMR team and to local initiatives. Considering that the team began its work in Koh Kong when resource extraction activities by most government officials were rife, this is no small feat.

A process of 'community organizing' is now being undertaken in each of the villages. Villagers are drafting their own resource management plans, according to how they would like to manage resources in the areas surrounding the village. Once a series of village level plans have been drafted, PMMR will facilitate a process between technical institutions and villagers to begin finding solutions. Since PMMR is a research project, it is hoped that these experiences will lend themselves to informing community fisheries and other policy initiatives.

Facilitation between different players or stakeholders has been integral to the work of PMMR. It takes time to build relationships and an understanding of resource conservation issues. There are no easy solutions to be presented; however, when players begin to listen to each other and to understand local realities, possible solutions can be worked towards. Importantly, since this project has been largely driven by the PMMR team, a PR process that works in Cambodia has emerged. Ultimately, the research, planning and analytical skills can be applied by each PMMR team member in whatever job they do in the future. The PMMR team must continue facilitating a process that works towards village ownership of resources. Then, the real resource protection work can begin!

APPENDIX A : CHANGES IN NATURAL RESOURCES USAGE IN PKWS

Time Period	Activities or Occurrence
1953 to 1970	○ Low population, subsistence fishing (traditional gear used) ; ○ Market for production in Singapore (boat came to buy fish) ; ○ Families worked fishing boats together ; abundant supply of fish ; ○ Better 'management' by the Department of Fishing, Forestry and Hunting (DFFH) ; villagers took part in mangrove replanting ; ○ DFFH controlled charcoal production (limited to specific sites) ;
1970 to 1975	○ Similar to 1953 - 1970 time frame ; ○ Government management systems began to break down with the war ; ○ Some people fled the area because of fear and the disruption caused by the war ;
1975 to 1979	○ No people live in PKWS (only Pol Pot 's Navy) ;
1979 to 1989	○ Abundant supply of fish (could easily catch 100 kg / family / night) ; number of fishers increased ; ○ Mangrove wood burned for charcoal ; in the late 1980's there was a significant increase in charcoal production ; ○ The area was controlled by the Department of Agriculture ; ○ Provincial authority controlled the number of in-migrants into the area ;
1990 to 1993	○ Fish catch began to decline as population increased ; ○ Mangrove destruction activities increased ; ○ Shrimp farming began ; ○ Fishing gear became more efficient (and illegal as with trawling or dynamite fishing) ○ Poor management due to political crisis ; net in-flux of people ; ○ Opening up of export markets i.e. Thailand ;
1994 to 1997	○ Illegal fishing gear used ; family catch / night / family is 12 kg ; ○ Nearly 800 ha of the mangrove forest cleared for shrimp farms ; ○ Large market for charcoal exports ; ○ Large net in-migration, little 'management' in the area ; ○ Declared a wildlife sanctuary in 1993, MoE took charge ; ○ Strong military, police and navy activities in the area ; un-controllable illegal activities causing serious mangrove degradation ;
1997 to 1999	○ Shrimp farms proved unsuccessful (diseased each other out because of poor siting) so less and less land was cleared for shrimp ponds ; ○ Continuing decline in resources i.e. fish and mangrove ○ Fewer people have access to fishing modern fishing gear i.e. trawlers, some resort to cyanide fishing, crab trapping or green mussel culture ; ○ Charcoal exportation activities continue, perhaps somewhat reduced at times ; ○ Given tighter control of the area, some migrants returned to their birth provinces ; ○ 1998 elections proved to be a resource extraction bonanza, since then activities are far more controlled.

SEAMCAT : A METADA CATALOGUE TO ASSIST THE CONSERVATION AND MANAGEMENT OF EAST ASIAN MARINE COASTAL ECOSYSTEMS DATA

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Abstract

South East Asia START Regional Centre (SEA START RC) is an NGO located at Chulalongkorn University in Bangkok. It is part of a global network to help provide the framework to make scientific assessments to support policy development. Its focus is to provide synthesis and modelling of global change data, and act as a centre for global change policy development, and information. As part of its information role, it has created a web-accessible metadata catalogue. Metadata, the description and location of data, is an extremely important tool in the management of ecosystems especially marine coastal system data. Over time much data have been collected in the Southeast Asian region, the location and often the quality of most of the data is unknown. There is a major investment in data collection and this investment must be managed. SEAMCAT is addressing this need. It is a project sponsored by GEF, UNDP and UNEP and is based on the NASA Global Change Metadata Directory in DIF format. It is part of a process in which people need to participate, to share their metadata. It is a venue where participants can advertise the existence of their data, gain recognition for their organisation's scientific expertise and, at an international level, support internal agreements and conventions. Metadata is about past and present data for the future.

INTRODUCTION

The Southeast Asian region comprises some of the most rapidly developing countries in the world today. Entire societies are being transformed putting pressures on the environment. These pressures have to be quantified and understood in the short and long term. The scientific community in each of the countries in the region has set for itself an agenda of strengthening the infrastructure required to support research on global environmental change at local and international levels.

The Southeast Asia START Regional Centre (SEA START RC) was created in 1996 by the SEA Regional Committee for START (SARCS) and is located at the Environmental Research Institute, Chulalongkorn University, in Bangkok Thailand, facilitated by the National Research Council of Thailand (NRCT).

The SEA START RC is part of a global network of multidisciplinary regional centres that mobilise scientific resources and help provide the framework to make scientific assessments to support policy development. The other members of the START network are in South Asia, Temperate East Asia, Pan-Africa, Mediterranean, and Oceania.

Its role in the region is to act as an information centre which provides facilities to store and manage the data of regional and global changes, provide data access, exchange and updates to the region and to link with other regional centres. It is also a regional co-ordinating centre for the SARCS Secretariat and research activities of the International Geosphere Biosphere Program. Synthesis and modelling of data on Greenhouse Gas (GHG) flux, Land Use Cover Change (LUCC) are among its products as is validation and calibration of climate models and application of GHG-induced climatic change models. Further, it is a centre for policy development to establish linkages with relevant government ministries in the region, to provide estimations and predictions and recommend policies on land use and other activities that relate to GHG and responses based on GHG induced climatic change models.

As part of its role as an information centre, SEA START RC has set-up a metadata catalogue to assist global change scientists working within Southeast Asia to identify and locate the data sets they require

WHAT ARE METADA

Consider the purchase of a packet of biscuits from the supermarket. When you see the packet, you know that there are biscuits inside the box. But, often you want or need to know more about the biscuits. You want to know about the quality or maybe the history of the packet or what the biscuits are made from. This information is usually listed on the box giving information about when they were made, who made them, where were they made, who imported them, how heavy is the packet, how many biscuits are inside, when should they be used by and what is the composition of each biscuit. A map has a legend, containing a description of location, the scale and when it was made. These are both examples of metadata. They are descriptions that will help you decide whether the item is what you want or not. Global change metadata describes where global change data are, their quality and when and by whom they were collected. It is not the data itself or summary data.

Metadata are "Descriptive information that characterizes a set of quantitative and/or qualitative measurements and distinguishes that set from other similar measurement sets". (Lola Olsen, Global Change Master Directory, [http : //gcmd.gsfc.nasa.gov/about_us/mission.html](http://gcmd.gsfc.nasa.gov/about_us/mission.html))

WHAT ARE DATA

The type of data SEA START RC has been locating includes raw quantitative and qualitative data sets, remotely sensed data, aerial photographs, maps, original documents and video. The list is not definitive and can include other data on a case by case basis. We are currently not considering data to consist of tables from reports, journals or proceedings. Often the data from these sources are summary data and contain no information as to their quality. In proceedings and reports the source of the data may be acknowledged but is often not the primary data source and the resolution of the initial data has been lost during successive summaries.

WHY ARE DATA IMPORTANT

In Southeast Asia, socio-economical and environmental changes are occurring at a very rapid pace. These changes create national and international impacts. Data are resources that enable scientists and policy makers to make decisions on how to manage changes. Change is traced by comparing historical with current data. Often historical data are not catalogued and sometimes almost forgotten. Historical data sets cannot be duplicated and are unique assets. Data when collected is about time and place and no data set can be collected again.

Data collection is usually the most expensive part of any research program. This means that organisations with data have a major investment in a unique resource. Unfortunately, in many organisations this is not recognised and data collected for one project may never be reused. In today's economic climate, the funding available for further data collection is getting scarcer. This is especially true with developing countries within South East Asia. There are many aid organisations and non-government organisations which have funded once-up data collection programs and more often than not the data is never reused or given to the host country for custodianship.

Metadata collection is about the management of data. It is an integral part of the management process, a process that is lacking in many organisations. Often data sets are located on different computers, on different floors and different departments. Even within one organisation, researchers will not know what data the other departments hold. There is sometimes a person who will know where data are located and information about the collection method and quality but when that person retires, changes job or the contract is finished the information about the data sets disappears.

In the region, there are many networks of scientists, usually each following their specific discipline. They meet at conferences, seminars and workshops and may have some familiarity with what data their colleges may have. There is an increasing trend towards multidisciplinary research especially in the area of global change. To locate data outside of ones discipline is difficult and time consuming. A substantial metadata base will solve this problem.

The quality of some data held in the region is also unknown. To improve the quality of data, metadata must be recorded. This will allow the users of data to determine which data sets are of sufficient quality for the purpose of use.

Regional metadata catalogues also allow countries to find data in neighbouring counties to determine the extent or future existence of transboundary impacts.

WHAT IS SEAMCAT

The aim of SEAMCAT is to create a catalogue of metadata of data on global change that is free and can be accessed easily over the Internet. Developed from NASA's Global Change Master Directory (GCMD) format, it will provide descriptions of data collected and stored in the Southeast Asian region.

GCMD created the original Data Interchange Format (DIF) that is compatible with the U.S. federally mandated Federal Geographic Data Committee's (FGDC) Content Standard on Digital Geospatial Metadata.

DIF is a de-facto standard used to create directory entries that describe a group of data. A DIF consists of a collection of fields, which detail specific information about the data. At least four fields are required in the DIF, while the other fields expand upon and clarify the information. Some of the fields are text fields, others require the use of valid or pre-defined values.

The DIF allows data users to understand the contents of a data set. The DIF contains those fields that are necessary for users to decide whether a particular data set would be useful for their needs.

The Southeast Asia START Regional Centre created "skinny DIF", called SEA START DIF, which consists of four required DIF fields. After a filing process, "skinny DIFs" are put into a directory to alert users of the existence of a particular data set, and may be modified at a later time to provide additional information. The SEA START DIF can be accessible at [http : //dif.start.or.th/dif/](http://dif.start.or.th/dif/)

BENEFITS AT AN ORGANISATINAL LEVEL

A data inventory will allow better data management practices so that the extent of data holdings are known.

Reducing duplication of data collection can save money. The data you require may have been collected by another department within your organisation or by another organisation. This other organisation may have an on-going data collection program in which you may be able to participate. Savings can be spent on data interpretation and synthesis rather than data collection.

A data set is expensive to collect and may be useful to others. Data can be given away, money recouped on a cost recovery basis or sold for profit. In any case, if people know of the existence of data, this knowledge may lead to external funding or technical assistance for data interpretation. In the case of a planned project, co-operative partners may be found.

A metadata catalogue not only advertises the existence of data but also signals an organisation's ability and expertise in data collection and analysis.

BENEFITS AT A NATIONAL LEVEL

- Organisations will have access to multidisciplinary data allowing a broader perspective for decision making.
- Savings can be made through collaborating on data collection rather than collecting similar data sets.
- Time can be saved in searching for national and international global change data.

BENEFITS AT AN INTERNATIONAL LEVEL

- Access to the location of global change data from neighbouring countries.
- International recognition of your participation in a project enabling a greater understanding and management of global change impacts.
- Support for international agreements and conventions will.

SEAMCAT IS INTERESTED IN METADATA FROM :

Agriculture
Agriculture and food security
Atmosphere
Attitudes, preferences, behavior
Biosphere
Boundaries

Cryosphere
Disasters
Economic activity
Energy
Environmental chemistry
Environmental information
Environmental law
Environmental management
Environmental monitoring
Environmental protection
Freshwater
Human and environmental health
Human dimensions
Human health
Human settlements
Hydrosphere
Industry
Industry and energy
Land and freshwater resources
Land surface
Lithosphere
Marine environments
Oceans
Paleoclimate
Policy and institutions
Pollution
Population dynamics
Radiance or imagery
Solar physics
Solid earth
Subject disciplines
Terrestrial ecosystems
Transportation
Urban Habitat

CONCLUSION

In the region, there are many issues relating to global change data. Access to data is at times denied for various reasons. This is the prerogative of the data owner, but over time attitudes change, governments change and the data withheld today may be accessible at sometime in the future. If there is not a concerted effort to locate and describe the data today an important asset will be lost. The quality of data is sometimes in question, this can also be addressed by correct data management techniques. There must be a raising of awareness at all levels that data collected yesterday and today for whatever purpose can and will be used to make decisions in the future.