Appendix 1

Turner Farm Midden Analysis

Statistics presented in Table A1.1 below compare the shell and nonshell components of the midden by occupation. Estimates of excavated volumes of both shell-free and shell-rich lenses (Total) were made from stratigraphic profiles on a section-by-section, stratum-by-stratum basis, and totaled for each stratigraphic unit except the plow zone.

Shell weight was determined from column samples using a two-step procedure. Large shell fragments were separated from nonshell and small shell fragments by screening (.4 cm mesh) and hand sorting. The fraction that passed through the screen was weighed and soaked overnight in an HCl solution to dissolve all small shell fragments. It was then dried, and weighed again and the weight loss was then added to shell weight. The ratio of shell (kg) to total volume (S/T), which was calculated only for shell-rich strata, indicates the weight of shell per cubic meter of midden. Note that it decreased through time. The significance of this trend is enhanced by the taphonomic loss of shell density through time. The weight of the nonshell fraction (N.S.) was calculated using the following formula:

$$\text{N.S.} = \text{wt of residue/vol of residue} \times \text{vol of stratum}$$

The ratios of nonshell volume to shell volume (NSV/SV) were established by screening and hand sorting a separate set of column samples—three per stratigraphic unit per section. They are not directly comparable, however, because of differential crushing of the shell fraction. Note also that the nonshell fraction has little impact on overall midden volume until it saturates the interstitial voids in the shell fraction.

Table A1.1. Turner Farm Midden Analysis

Stratum[a]	Total (m^3)	Shell (kg)	S/T[b]	N.S.[c]	NSV/SV[d]
Occupation 1	.3	190			
Occupation 2					
Shell-free	15.1	779			
Shell-rich	25.5	12,747	500	45.8	.23
Occupation 3					
Shell-free	14.7	812			
Shell-rich	19.9	11,424	574	340.1	.34
B2GF					
Shell-free	1.4	14			
Shell-rich	8.9	5,097	573		.34
2GF	17.6	908			
CCS					
Shell-free	.2	8			
Shell-rich	42.7	22,292	522	72.2	.13
1GF	19.2	999			
MCS					
Shell-free	.1	2			
Shell-rich	12.1	7,929	655	9.6	.13
NGF	.7	42			
FCS	64.7	52,435	810	.7	
Sod[e]	24.5				

[a]B2GF, below the second gravel floor; 2GF, second gravel floor; CCS, coarsely crushed shell; 1GF, first gravel floor; MCS, moderately crushed shell; NGF, new gravel floor; FCS, finely crushed shell, or plow zone.
[b]Ratio of shell (kg) to total volume (m^3) midden.
[c]Nonshell fraction.
[d]Ratio of nonshell volume to shell volume.
[e]No breakdown or shell analysis done.

Appendix 2

Radiocarbon Dates

The following is a comprehensive list of all radiocarbon dates from the Turner Farm site. Dates from different occupations are discussed and listed separately in relevant chapters.

Dates	Stratum/ Occupation	Section	Sample number	Feature number	Material	Association	Lab number
115 ± 65	1GF	W35S90	147C		Charcoal		SI 4246
175 ± 70	MCS	W55S90	7C		Charcoal		SI 4239
875 ± 70	1GF	W60S85	4C		Charcoal		SI 4238
1200 ± 100	CCS	W55S110	197C		Charcoal		GX 2465
1955 ± 50	2GF	E20S75	37C	19-1973	Charcoal	Pipe	S1 4240
2105 ± 75	2GF	E15S75	120C		Charcoal		SI 4245
2275 ± 130	B2GF	W55S105	195C		Charcoal		GX 2463
2530 ± 65	B2GF	W55S105	44C		Sea urchin	Points and pottery	S1 2407
2575 ± 75	B2GF	W55S105	43C		*Mya*	Points and pottery	S1 2398
2660 ± 100	OCC3	W15S70-75	4362	39-1974	Human bone	Bundle burial	GX 14968
2705 ± 60	OCC2	W40S90		12-1972	Antler	Hearth	SI 1926a
2895 ± 170	2GF	W65S115	30C		Charcoal		GX 20369
2970 ± 65	OCC2	E0S75	62C	14-1974	Swordfish	Pit in subsoil	SI 2402
3080 ± 160	2GF	W25S115	48C		Charcoal		GX 20370
3105 ± 75	OCC3	W25S70	64C	30-1974	Human bone	Primary inhumation	SI 2399
3115 ± 65	OCC2	W40S90		12-1972	Antler	Hearth	S1 1926b
3185 ± 65	B2GF	E40S65	81C	21-1974	Charcoal		SI 4244
3205 ± 75	OCC3	W15S70-75	66C	39-1974	Human bone	Secondary inhumation	SI 2400
3270 ± 75	OCC3	W25S70	63C	30-1974	*Mya*	Primary inhumation	S1 2397
3280 ± 50	B2GF	E20S80	78C	12-1974	Charcoal		S1 4243
3280 ± 180	OCC3	W30S65		18-1975	Human bone	Primary inhumation	GX 15744-A
3445 ± 70	OCC2	E40S65-70	72C		Swordfish	Subsoil surface	SI 2401

(Continued)

Dates	Stratum/ Occupation	Section	Sample number	Feature number	Material	Association	Lab number
3450 ± 75	OCC3	E0S65-70	60C	28-1974	*Mya*	Pit in subsoil	SI 2396
3470 ± 60	OCC3	W10S50	124C	9-1975	Charcoal	Primary inhumation	GX 19997-AMS
3480 ± 90	OCC2	E10S80	57C	22-1973	Charcoal	Cache	B 6031
3480 ± 75	OCC3	W30S65	153C	18-1975	Charcoal	Cremation	SI 4248
3490 ± 235	OCC3	W10S50		9-1975	Human bone	Primary inhumation	GX 15745-A
3515 ± 80	OCC3	W15S105	194C	3-1973	Soil sample	House floor	SI 1924
3610 ± 90	OCC3	W15S70-75	65C	39-1974	Charcoal	Secondary inhumation	SI 2404
3630 ± 85	OCC3	W35S90-95	14C	7-1972	Charcoal	Pit	SI 1919
3650 ± 75	OCC3	W20S100	31C	19-1972	Charcoal	Hearth	SI 1922
3662 ± 59	OCC3	W10S50		9-1975	Bone	Primary inhumation	GX 15745-G-AMS
3665 ± 55	OCC2	W25S105	42C		*Mercenaria*	Basal midden level	SI 2403
3700 ± 220	OCC3	W30S70	148C	6-1975	Charcoal	Primary inhumation	GX 14806
3700 ± 85	OCC3	W30S65	152C	18-1975	Charcoal	Primary inhumation	SI 4247
3710 ± 80	OCC3	W5-10S70	68C	24-1974	Charcoal	House floor	SI 2390
3710 ± 60	OCC2	E5S85	63C	15-1973	*Mya*	Pit (top)	SI 4242
3745 ± 75	OCC2	W25S95	37C	15-1972	*Mya*	Pit (needle)	SI 2406
3770 ± 260	OCC3	W10S50		9-1975	Human bone	Primary inhumation	GX 15745-G
3785 ± 75	OCC2	E5S85	41C		*Mya*	Layer above Feature 15	SI 2408
3825 ± 65	OCC3	W30S65	154C	18-1975	Charcoal	Primary inhumation	SI 4249
3825 ± 76	OCC3	W30S65		18-1975	Bone	Primary inhumation	GX 15744-G-AMS
3855 ± 75	OCC3	W10S55	70C	41-1974	Charcoal	Cremation	SI 2405
3870 ± 115	OCC3	W30S70	6657	6-1975	Human bone	Primary inhumation	GX 14807
3920 ± 25	OCC2	E15S80			Ivory	Walrus tusk	OS 1832-AMS
3945 ± 230	OCC3	W30S65		18-1975	Human bone	Primary inhumation	GX 15744-G
4005 ± 55	OCC2	E5S85	44C	15-1973	Charcoal	Pit (upper)	SI 4241
4020 ± 80	OCC3	W10S55	71C	42-1974	Charcoal	Cremation	SI 2393
4050 ± 220	OCC2?	W60S90	196C		Charcoal	Midden base	GX 2464
4135 ± 85	OCC2	E0S70-75	69C	24a-1974	*Mya*	Foreshaft	SI 2395
4310 ± 140		Marsh			Peat	Base of marsh	SI 2216
4390 ± 55	OCC2	E10S80	53C	24-1973	Charcoal	Dog burial	SI 1921
4410 ± 80	OCC2	W25S105	2051		Swordfish		SI 1920
4555 ± 95	OCC1	E5S85	54C	15-1973	Charcoal	Pit	SI 1923
4970 ± 85	OCC1	E40S65	65C	22-1974	Charcoal	Pit (biface)	SI 2392
5210 ± 70	OCC1	W35S105	13C	5-1972	Charcoal	Pit	SI 2394
5290 ± 95	OCC1	E5S85	39C	15-1973	Charcoal	Pit (biface)	SI 1925
Too small	OCC2	E0S75	61C	24a-1974	Charcoal	Foreshaft	SI 2391

Appendix 3

Summary of Occupation 3 Burial Features

Feature number	Burial style[a]	Number of individuals[b]	Lithics[c]	Bone artifacts	Vegetable remains	Bone counts
30-1974	I	1 sa		—	—	—
34-1974	I	1 a♀	2 St points			1 Aves
			1 TSB, Ocher			
38-1974	C	1 a♂	1 Preform	1 Awl	1 Beechnut	2 Deer
		1 a♀	1 MI blades	Tool frags:		1 Fox
		1 a?	1 Boats blade	2 Engraved		1 Mustelid
		1 sa	10 TSBs	1 Notched		14 Phocid
			5 St points	1 Perf.		6 Mammal
			1 Cn point	7 Antler frags		26 Aves
			2 Drills			
			1 Small biface			
			2 Adzes			
			2 Gravers			
39-1974	B	1 a♂	1 Boats blade	—	—	
		1 a♂?	1 Blade frag, ocher			
		1 a♀?				
		1 a?				
		1 sa				
41a-1974	C	1 a♂	3 Preforms	—	—	1 Med Aves
		3 a?	4 TSBs			6 Deer
		6 sa	13 St points			1 *Mustela macrodon*
			≥4 Drills			1 Mustelid
Fea. 41a or b:			2 Biface frags			44 Lg mammal
						1 Fish
41b-1974			1 Preform	1 Painted turtle scute		
			1 TSB	1 Worked bone		
			2 St points			
			1 Drill			
			1 Biface frag			
			1 Gouge			

42-1974	C	2 a? 5 sa	8 Preforms 4 TSBs 15 St points 5 Drills 1 Adz 3 Gouges 1 Beveled cobble	1 Box turtle carapace	2 Beechnuts	7 Deer 5 Dog 71 Lg mammal 1 Phocid 1 Lg Aves 1 Med Aves
6-1975	I	1 a♀ 2 sa	2 Drills	—	—	1 Mammal
7-1975	C	1 a 4 sa	1 TSB 3 St points	—	1 Beechnut	⩾1 Deer 1 *Felis* sp. 1 Goose
9-1975	I C	1 a♀ 5 sa	2 Preforms 1 MI blade 2 Boats blades 6 TSBs 6 St points ⩾2 Drills 1 Adz 1 Gouge 1 Grooved axe 1 Beveled cobble 6 Pebbles, ocher	4 Toggling harpoons 4 Awls 1 Antler harpoon 1 Bodkin 1 Gouge 1 Painted turtle plastron 1 Wolf maxilla Many worked bone frags 16 Antler frags	2 Beechnuts	36 Deer 9 Dog 30 Mammal 1 Goose 7 Aves
12-1975	C	1 a♂ 1 a 3 sa	3 Preforms 2 MI blades 2 Boats blades 1 TSB 7 St points 2 Cn points 3 Drills 1 Adz 1 Gouge 3 Pendants 18 Pebbles 10 Copper beads, limonite frag	1 Awl 1 Harpoon 1 Box turtle scute 1 Painted turtle scute 15 Antler frags	1 Beechnut	2 Raptor talons

(Continued)

Feature number	Burial style[a]	Number of individuals[b]	Lithics[c]	Bone artifacts	Vegetable remains	Bone counts
18-1975	I	1 a♂	7 Boats blades	10 Gaming pieces	≥2 Plum pits	
			5 St points	27 Antler frags		
19-1975	C	4 a?	6 Preforms	4 Gouges	—	155 Deer
		5 sa	6 MI blades	1 Barbed bone spear		1 Moose
			5 TSBs	1 Needle		1 Bear
			39 St points	1 Bead		1 *Mustela macrodon*
			6 Cn points	1 Porcupine incisor		38 Mammal
			≥4 Drills	Many worked bone frags		1 Lg mammal
			1 Grooved axe	26 Antler frags		1 Turtle
			1 Beveled cobble			
			1 Grooved abrader			
			4 Limonite nodules			
24-1975	C	1 a?	10 Preforms	2 Barbed spear frags	—	1 Moose
		1 sa	23 MI blades	1 Toggling harpoon		4 Deer
			3 Boats blades	5 Gouges		17 Beaver
			5 TSBs	1 Needle		3 Dog
			21 St points	2 Beads		1 Porcupine
			≥3 Drills	1 Engraved bone		452 Mammal
			3 Gravers	Several worked bone frags		379 Lg mammal
			1 Wedge (?)	46 Antler frags		6 Aves
			5 Gouges			
			5 Adzes			
			3 Whetstones			
			3 Beveled cobbles			
			1 Notched cobble			
			1 Anvil stone			
			1 Rod			
24a-1975	C	—	1 Boats blade	—	—	
			2 TSBs			
			6 Biface frags			

28a-1975	C	1 a? 2 sa	1 St point 2 Drills 3 Biface frags 1 Stone rod frag	1 Bone gouge 18 Antler frags	—	7 Lg mammal
Fea. 28a or b			1 TSB 1 Drill 1 Tip	—		
28b-1975			4 St. points 1 Drill 3 Biface frags	1 Worked frag	—	—
30-1975	I	1 a♀	—	—	—	1 Dog 28 Mammal
33-1975	I	1 sa				
34-1975	I	1 a♀ 1 sa	2 St. points 1 Util. flake	—	—	2 Aves
35-1975	I?	?	5 Preforms 4 MI blades	—	2 Beechnuts	—

[a]Burial style: B, bundle; C, cremation; I, inhumation.
[b]Number of individuals: a, adult; sa, subadult; in, infant.
[c]Lithics: St point, stemmed point; TSB, tapered-stem blade; MI blade, Mansion Inn blade; cn point, corner-notched point.

Appendix 4

Charcoal Identification

Dosia M. Laeyendecker

Twenty-eight charcoal samples were selected from a larger set submitted between 1978 and 1980 (Table A4.1). Some were single pieces, while others included multiple fragments. All were collected by hand during excavation from contexts ranging from about 5000 B.P. to 500 B.P. All told, they are remarkable for the diversity of species represented. In fact, one sample produced charcoal of two species.

METHOD

For identification the charcoal fragment is broken by hand along transverse, tangential, and radial sections. These surfaces are studied with a reflective light microscope under 50 to 300 power magnification. Wood and wood-slide collections from the Smithsonian Institution Department of Botany were used for comparisons. The wood structure is remarkably well preserved in charcoal, but even so, it can usually be identified only to genus or family. Identification to species level may be dependent on species diversity in the area of investigation. For instance, there is only one native species of beech in North America, thus *Fagus* sp. may reasonably be identified as *Fagus grandifolia*. The condition and the size of the charcoal fragment are important factors for identification and the fragments from the Turner Farm site were satisfactory in this respect. Other reference materials include photographs and descriptions (see, e.g., Core, Coté, and Day 1979; Panshin and de Zeeuw 1970; Schweingruber 1978).

DISCUSSION

The charcoal fragments from the Turner Farm site provide some information about paleoenvironments during the site's occupation. However, this material is not suitable for

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Table A4.1. Charcoal Samples

Catalog number	Occupation	Section	Feature	Species[a]	Comment[b]	Date
62c	1	E5 s85		*Pinus strobus*		
135c		W30s75		*Ostrya virginiana*	1	
168c	2	W95s80		*Tsuga canadensis*		
55c	2	W5s95		*Fagus grandifolia*		
56c	2/3	E20s75	21-1973	*Fagus grandifolia*		
95c	3	W10-10s70	38-1974	*Fagus grandifolia*		
104c	3	W10s55	41-1974	*Acer* sp.		
105c	3	W10s55	42-1974	*Franxinus* sp.		
24c	3	W35s100		*Fragus grandifolia*		
12c	3	W20s100		*Platanus occidentalis* or *Fagus grandifolia*	3	
1c	B2GF	W60s95		*Abies balsamea*		
43c	B2GF	W5s80		*Betula* sp.		
78c	B2GF	E20s80		Hardwood, maybe *Betula* sp., and softwood, probably *Abies* sp.		3820 ± 50 (SI 4243)
40c	2GF	W25s115		*Betula* sp.		
116c	2GF	E15s70-75		Hardwood		
35c	2GF	W15s90		*Ostrya virginiana*	1	
11c	2GF	W55s85		*Pinus strobus*		
48c	2GF	W25s115		*Fraxinus* sp.		
114c	CCS	E35s70		Hardwood, *Platanus occidentalis* or *Fagus grandifolia*		
60c	CCS	W15s95		Hardwood, *Platanus occidentalis* or *Fagus occidentalis*	2	
74c	CCS	E40s70		Hardwood, probably *Betula* sp.		
119c	CCS	E75s50		Hardwood, *Platanus occidentalis* or *Fagus grandifolia*	2	
130c	1GF	W30s85		*Fagus grandifolia*		
23c	1GF	W40s95		*Quercus* sp., oak		
142c	1GF	W15s55		*Fagus grandifolia*		
147c	1GF	W35s90		*Pinus strobus* and probably *Fagus grandifolia*		115 ± 65 (SI 4246)
6c	MCS	W55s85		*Fagus grandifolia*		

[a]*Pinus strobus*, white pine; *Ostrya virginiana*, eastern hophornbeam; *Tsuga canadensis*, eastern hemlock; *Fagus grandifolia*, American beech; *Acer* sp., maple; *Franxinus* sp., ash; *Platanus occidentalis*, sycamore; *Abies balsamea*, balsam fir; *Betula* sp., birch; *Quercus* sp., oak.

[b]1. Tentative identification; occurs in Maine today, but is more common to the south. 2. Sycamore occurs today in Maine, but is more common to the south; its similiarity to beech raises doubt about this identification.

analysis of quantitative trends in forest composition or environmental change through time (Smart and Hoffman 1988:191–192).

The vegetational history of the period covered by the Turner Farm site—about 5000 to 500 B.P.—can be reconstructed roughly with the help of pollen analysis. In northeastern North America in postglacial times, between 12,000 and 10,000 years ago, tundra and spruce woodland were replaced by pine forests (*Pinus strobus* mostly) mixed with oak and birch. Hemlock (*Tsuga canadensis*) spread into New England between 10,000 and 8,000 years ago and continued to become more abundant until around 6000 B.P., when beech populations expanded within the forests of the Northeast. Thus the modern hemlock-beech-birch forests of the East were formed during the mid-Holocene, largely replacing the white pine-dominated forests of earlier times (Jacobson et al. 1987:282). Pollen diagrams from Moulton Pond, Maine, register closed forest in the area from about 7,000 years ago. Around 5,000 years ago hemlock reached its maximum pollen values in these diagrams. Pine, birch, and oak were also important and at the same time there are indications of an increase in diversity of the forest. A major decline in conifers, especially of hemlock, is found around 4,700 years ago and this was followed by a maxima of hardwoods, mainly beech, maple (*Acer* sp.), and ash (*Fraxinus* sp.) at around 3,500 years ago. Hemlock reached a second maximum in the diagrams before decreasing again (together with the temperate hardwoods) around 2,000 years ago, when the diagrams indicate that spruce was on the increase, which suggests more severe environmental conditions (edaphic and/or climatic and/or anthropogenic; Davis et al. 1975:435, 453–455).

CONCLUSION

The wood types identified in the charcoal samples from the Turner Farm site all derive from mixed hardwood-dominated forests. This agrees with the data from pollen diagrams from the area. The regional change from conifer-dominated forests to hardwood-dominated forests around 4,700 years ago would presumably have taken place during Occupation 1. The sample from that time period is identified as pine. The samples from Occupations 2 and 3 and later strata represent hardwoods that were available in the area. The fact that no spruce shows up in the latter strata does not mean that is was not there. Archaeologically deposited charcoal is in itself an unnatural assemblage. Firewood was not collected at random nor in proportion to the species in the natural environment (Ford 1979:301). We can say, however, that the charcoal samples from the Turner Farm site indicate a great variety of available firewood for the people to choose from, and the availability of a variety of conifer and hardwood species with different characteristics for cultural use.

This diversity stands in contrast to the spruce-dominated growth that covers wooded areas of the Penobscot Bay islands today. This dichotomy was caused mainly by extensive deforestation during the late eighteenth and early nineteenth centuries and the mid-nineteenth century when virtually all wooded areas of the Maine coast were being cleared for agriculture and sheep raising. As sheep herds shrank during the early twentieth century, dense growths of spruce spread over old pastures. Today, older stands are increasing in species diversity.

Appendix 5

Geoarchaeology in Central Coastal Maine

DANIEL F. BELKNAP

INTRODUCTION

Archaeological sites along the coast of Maine demonstrate marine adaptation by the people who constructed them. Geology properties of the sites and their environs are important influences on the nature of the sites, the cultural record within them, and their preservation potential. This appendix is concerned primarily with the geologic setting and paleogeographic evolution of two Maine coastal sites as determined from remote sensing and cores, and the use of these examples to develop a model of preservation potential on the Maine coast.

A primary control of coastal change, particularly in Maine, is relative sea-level change. Sea-level rise of approximately 60 m (Belknap, Anderson, et al. 1987) over the past 10–11 thousand years (Kelley et al. 1992) has resulted in coastal retreat in Maine and created a transgressive stratigraphy (Belknap, Shipp, Kelley et al. 1989). This setting results in shoreline destruction of a majority of sedimentary facies, along with any record of human occupation. Only a fraction of the record of sedimentary environments (and, potentially, the archaeological record) may be preserved in specialized settings.

Masters and Flemming (1983) summarized marine geoarchaeology, and Pearson et al. (1986) discuss specific examples of site preservation in the nearshore realm. Kraft et al. (1983) presented a particular model of site preservation potential in transgressive coastal settings. They emphasized that the depth of burial, composition and size of the site, and energy (depth of shoreface erosion) are critical variables. These general examples can be applied to the Maine coast.

Bourque (1976, 1983), Goldthwait (1935), Kellogg (1982, 1991), Myers (1965), Sanger (1975, 1981, 1988a, 1988b), Sanger and Belknap (1987, 1991), Sanger and Sanger (1986), Yesner (1980), and others have examined the geoarchaeology of Maine coastal sites. Oldale

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(1985), Kellogg (1988), Sanger and Kellogg (1983), and Snow (1972) have discussed sea-level change in regard to regional archaeology. Kellogg (1982) developed a model of site distribution based on intertidal energy environments within Maine's embayments, finding the majority of sites in protected mid- to upper-estuarine settings with southern exposures, beaches, moderate slopes, and access to food resources and travel routes. These sites represent human choices within the context of geologic environments and biological resources. Shipp et al. (1985, 1987), Belknap, Shipp et al. (1986), and Kelley (1987) developed this zonal concept geologically, demonstrating that Maine embayments have a high-energy outer zone of erosion, an intermediate zone of bluff erosion and sediment transfer, and an inner zone of sediment accumulation, with mudflats and marshes. Belknap (1986) and Belknap, Kellogg et al. (1986) discussed applications of the geologic model in archaeological sites. Recently, Young (1990), Young et al. (1992), and Davies (1992) have applied the specific preservation potential model of Kraft et al. (1983) and Belknap and Kraft (1985) in Pemaquid Beach and Damariscotta River geoarchaeological studies.

This appendix presents two case studies of archaeological sites and the geologic environments in which they are imbedded—at Turner Farm on North Haven Island, and Lazygut Island, off Deer Isle, both in central coastal Maine. The context of cultural and faunal remains is intimately related to this setting, and in particular reflects changes in coastal environments over time. The sites represent two extremes of preservation. Lazygut Island is completely eroded, and is represented by isolated dredge and scuba retrievals. Turner Farm is a deeply stratified site, with a record, stretching back over 5,000 years, that has been intensively studied by traditional archaeological techniques (Bourque, this volume). Its remains reflect coastal changes, climate change, rising sea level, and changes in human culture. It is presently undergoing erosion at a gravel beach and bluff front. A primary goal of this study is the evaluation of preservation potential for these two examples, and a prediction of preservation potential and optimal exploration schemes. Preservation potential in eroding coastal sites is very low, while discovery potential for hypothetical buried, protected sites may be equally low.

GEOLOGIC AND ARCHAEOLOGICAL SETTING

Maine's complex coastline results from drowning by the sea of a crystalline bedrock framework. These rocks were eroded by rivers and glaciers into hills and valleys because of their differential resistance. This topography was modified by glacial and glacial-marine deposits draped over the bedrock during retreat of the Wisconsin-age Laurentide ice sheet margin 14 to 12 ka (thousand years ago). Major glacial deposits include till and outwash. The glacial-marine Presumpscot Formation is a blue-gray mud containing ice-rafted dropstones. Modern sedimentary environments are predominantly found within the peninsulas and embayments of the coast, such as tidal flats, marshes, and pocket beaches flanking bedrock ledges and bluffs of Quaternary sediment. Sandy barrier beaches are found predominantly in the southwestern part of the state.

The distribution of sedimentary environments is intimately linked with geomorphology of the coast. The Maine coast comprises four major coastal compartments (Kelley 1987; Shipp et al. 1985). They reflect primarily bedrock structure and composition, but also abundance of glacial sediment sources for modern littoral systems. The two study areas are located in the east-central compartment, typified by large islands and bays (Figure A5.1).

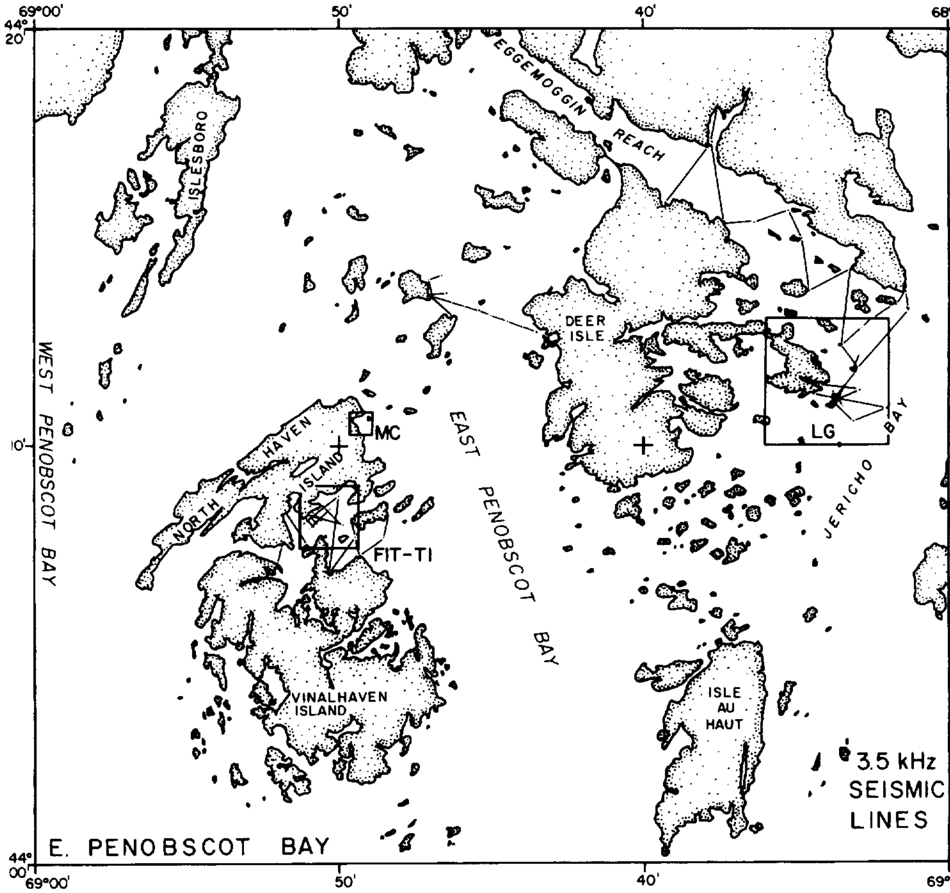


Figure A5.1. Location map of central coastal Maine, East Penobscot Bay, and Jericho Bay. Boxes refer to Marsh Cove (MC) and to detailed location maps of Turner Farm (FIT-TI) and Lazygut Island (LG).

Within the coastal compartments, Shipp et al. (1985, 1987), Belknap et al. (1986b), and Kelley (1987) have identified a three-zone embayment model of geomorphology and sedimentary environments. This model extends Kellogg's (1982) shoreline model to a fuller evaluation of embayment sedimentary lithosomes and establishes an evolutionary model, tested with quantitative sedimentary analyses (Duffy et al. 1989; Hay 1988; Kelley et al. 1988; R. Smith 1990; Walsh 1988; Whalen 1989; Wood 1991; Wood et al. 1989). The inner zone accumulates sediments temporarily. The middle zone contains eroding bluffs, and involves active transfer of sediment from a Pleistocene source to temporary storage in the inner zone or loss offshore. The outer zone is stripped of sediments except for small, coarse-grained pocket beaches in the intertidal level, and has smaller volumes of sediments preserved in the subtidal level. This geographic arrangement of zones reflects a geologic history of transgression. As shorelines move landward, transgression exposes more of the embayment to greater wave energy and increased tidal current activity, while at the same time bluff and subtidal sources of sediment are depleted. The zones of protection, transition, and stripping translate landward, with variable preservation of the transgressive record.

Within the embayments salt marshes and mudflats are important biological habitats. *Mya arenaria* (soft-shell clam) and *Mytilus edulis* (blue mussel) are abundant here today. Between 6 and 1.5 ka, *Crassostrea virginica* (eastern oyster) was abundant in the estuaries. Various anadromous fish migrate through the estuaries, while abundant fish and crustaceans are found in the productive Gulf of Maine offshore. All these resources are represented in shell middens in various proportions (although crustacean shells do not preserve well). Shellfish are particularly important to geoarchaeology because they are preserved both in geologic facies and the middens, and are indicators of the contemporary environmental conditions. Their importance in diet and culture is a separate issue, of course.

Processes that influence these sedimentary environments include sea-level change, wave activity, tidal currents, and slumping. Sea-level change is a long-term and slow process, but it has profound effects on coastal stratigraphy and evolution.

Postglacial sea-level changes have been complex, a result of global eustatic sea-level rise and local glacioisostatic effects. The Presumpscot Formation was laid down during a local submergence between 14 and 11 ka, when the coast was rebounding from profound glacioisostatic depression. Rebound caused emergence and local sea-level lowstand (Belknap, Andersen et al. 1987; Schnitker 1974; Shipp et al. 1989, 1991) about 60 m below present at 10–11 ka (Kelley et al. 1992). During this emergence the recently deposited sediments were eroded, with deep valleys continuing seaward of the present coast (Kelley et al. 1986). Sea level rose rapidly to −20 m between 9 and 8 ka, reached −15 m by 6.3 ka, and then rose at a decreasing rate over the past 5 ka until historic times, when a further acceleration appears to have begun (Belknap, Shipp, Stuckenrath et al. 1989; Figure A5.2).

Affecting productivity, tides are important in mixing of the Gulf of Maine and its coastal embayments (Schnitker 1975). Tidal range has changed through the late Holocene, increasing from about 1 m 6 ka to present variable ranges as sea-level rise changed tidal resonance within the Gulf of Maine-Bay of Fundy system (Grant 1970; Scott and Greenberg 1983). Variations in tidal mixing and regional climatic changes were responsible for a lower productivity but warmer Gulf of Maine prior to 6 ka, and cooling with higher productivity since that time, as determined from fossils of foraminifera and diatoms preserved in offshore cores (Schnitker 1975; Schnitker and Jorgensen 1990).

Most of the Maine coast has a low river input of water or sediment, with the result that the embayments are neutral embayments (Johnson 1925) rather than estuaries. Most have nearly normal marine salinity and are well mixed (Fefer and Schettig 1980). Only the Kennebec-Androscoggin and Saco rivers differ in transporting sand at their mouths, while they and the Penobscot have sufficient flow to have major freshwater dilution in their lower reaches. The Penobscot Bay region containing the present study areas has open-marine conditions.

Wave activity is controlled by fetch and coastal orientation. Outer portions of embayments are exposed to high wave energy, particularly during winter storms. Elsewhere, wave energy is fetch limited. Tides in eastern Penobscot Bay average 3.0 m mean range, 3.5 m spring range (NOAA-NOS 1992a). Tidal currents are effective where constricted in channels, and can reach 1 m/sec or greater, sufficient to move gravel, resulting in effective scour. Tidal currents in Fox Islands Thorofare, off Burnt Island 5 km east of the Turner Farm site,

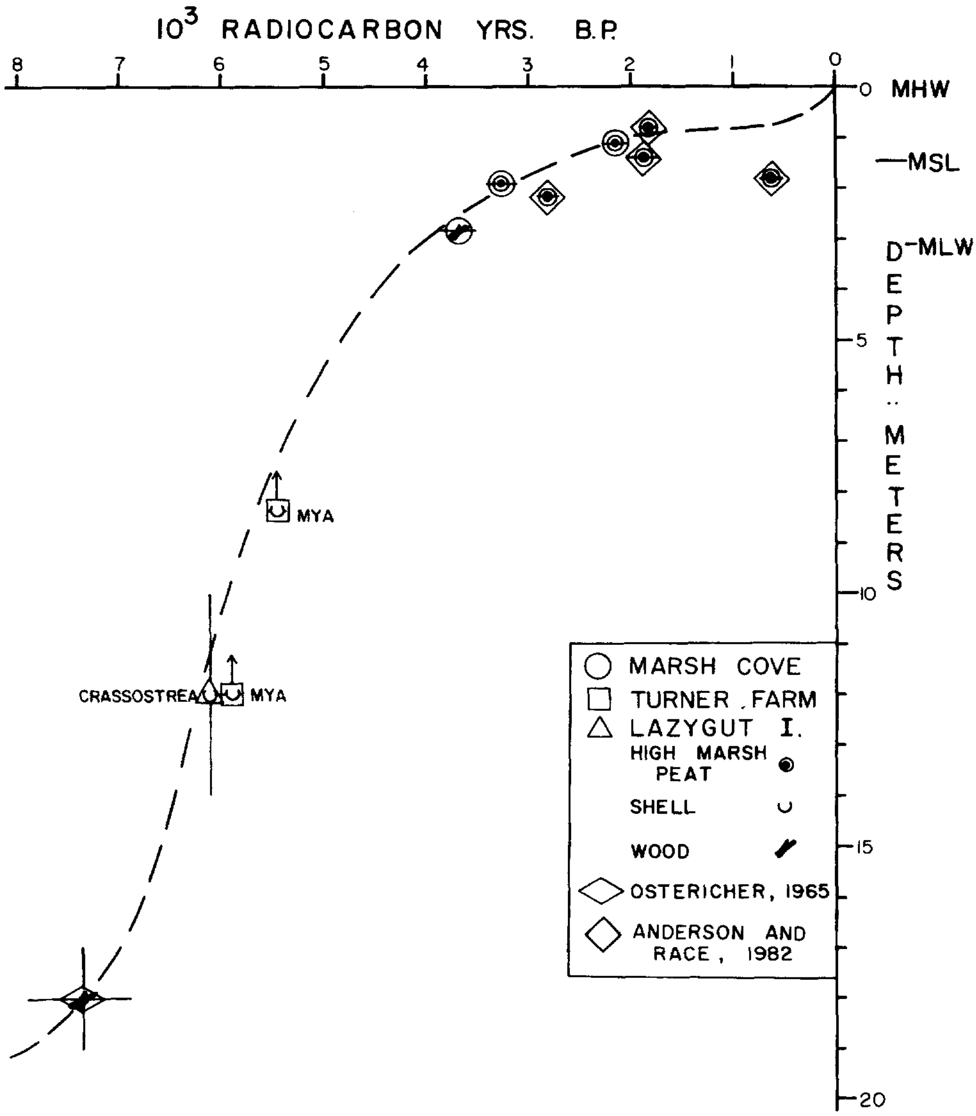


Figure A5.2. Sea-level curve for Penobscot Bay, Maine. Data are shown in Table A5.1. Sea-level trend is generalized from Kelley et al. (1992) and Belknap et al. (1989b).

reach 0.7 m/sec (NOAA-NOS 1992b). Currents off Lazygut are less constricted, and thus have lower velocity (0.15 m/sec). Ice is an effective mover of sediment, but also can act to dampen waves during the winter. Mass movements, especially slumps on bluffs of glacial-marine sediment, are important in destabilizing supratidal (and subtidal) sediments, emplacing them in areas where they can be redistributed by waves and tides (Kelley and Hay 1986; R. Smith 1990).

An increasingly important coastal geologic process is human intervention. Coastal development and larger-scale engineering threaten many shorelines (e.g., Kelley et al. 1989). Recent attention to geologic preservation (e.g., Maine Sand Dunes Regulations) and laws protecting archaeological sites are an important control, but private efforts are critical as well. For example, Maine Historic Preservation has recently protected sites on donated land on Dodge Point in the Damariscotta River, while the Glidden Midden in Damariscotta is protected by a private landowner.

Human occupation of the coast is not new, however. The archaeological record of coastal adaptation is at least 5,000 years in extent, and it is possible that there is a record between 10 and 5 ka submerged on the present inner shelf. Kellogg (1982, 1991) showed that site distribution is predictable, following a logic of access and utilization of resources, but also probably reflecting preservation potential. The majority of sites are found within the mid-inner zone of embayments. Middens record occupation and utilization of local resources, but require specialized analysis of stratigraphy (e.g., Bourque 1976; Sanger 1981; Skinas 1987).

METHODS

Submerged coastal environments were examined using two remote sensing techniques: seismic reflection profiling and side-scan sonar. These techniques have been discussed in detail by Belknap and colleagues (Kellogg et al. 1986; Kelley et al. 1987; Shipp, Kelley et al. 1989) and Kelley and Belknap (1988, 1989). The Raytheon RTT1000A high-resolution 3.5-kHz system can penetrate 50 m of Quaternary sediments and has a vertical resolution of 25 cm. We also used an ORE Geopulse "boomer" 1.5-kHz sonar at 125 joules to penetrate sediments as much as 150 m thick. This device has vertical resolution of about 0.5 m. Seismic reflection data were used to construct cross sections and maps of depth to reflector surfaces. The side-scan sonar, an EG&G SMS 260, is digital, providing rectified, dimensionally correct surficial images of the seafloor typically in 200-m-wide swaths. Depending on the scale, pixels of 0.5 m horizontal scale can be resolved.

Vibracores using an aluminum tube 7 cm in diameter and up to 10 m in length were taken using a cement-settler vibrator. We have modified the standard Lanesky et al. (1979) and Hoyt and Demarest (1981) technique for underwater work using a scuba diver and three-point mooring on our research vessels (Belknap, Kellogg et al. 1986). Core sites were chosen based on seismic data to sample representative facies and explore potential sites. Cores were continuous and penetrated all Holocene marine sediments easily, and up to a meter into the Pleistocene Presumpscot Formation. Cores were split and described for sediments and fossils. Subsamples were collected for radiocarbon dates. Dated samples from all sites are listed in Table A5.1.

The seismic, side-scan, core, and available bathymetric data were integrated into maps of depth to particular reflectors (structure contour) and thickness of sedimentary lithosomes (isopach). The most important map is a structure contour on the top of the Pleistocene and/or bedrock. This easily identifiable pre-Holocene reflector represents the upland erosional surface before transgression (the *basal unconformity*), modified in some cases by shoreface erosional processes (the *ravinement unconformity*; Belknap and Kraft 1985). The local relative sea-level curve (Belknap, Kelley et al. 1987; Belknap, Shipp,

Table A5.1. Radiocarbon Dates below Eastern Penobscot Bay

Lab number	Core number	Material[a]	Depth below MHW (m)	Corrected age (years B.P.)	$\delta^{13}C$
Upper Penobscot Bay (Ostericher 1965)					
W-1306	211	W	20 ± 1	7390 ± 500[b]	
Holt Pond Marsh, Stonington (Anderson and Race 1982)					
SI-4596	HD-1	BM(?)	0.83–0.89	1825 ± 55	
SI-4595	HC-3	BM(?)	1.37–1.43	1880 ± 150	
SI-4767	HB-3	BM(?)	1.84–1.94	655 ± 75	
SI-4768	HA-3	BM(?)	2.94–2.29	2835 ± 70	
Fox Island Thorofare (Belknap, Kellogg et al. 1986)					
GX-11004	TF-VC-2	S–MA	11.96	5880 ± 105	2.0
GX-11005	TF-VC-3	S–MA	8.31	5430 ± 100	1.6
Marsh Cove, North Haven (Belknap, Kellogg et al. 1986)					
GX-11006	MC-VC-4	HM	1.12	2145 ± 125	−19.0
GX-11007	MC-VC-4	HM	1.87	3255 ± 150	−27.7
GX-11008	MC-VC-4	W	2.83	3700 ± 200	−26.3
Lazygut Island (Belknap, Kellogg et al., 1986)					
SI-4650	Dredge	S–CV	8–11	6100 ± 65	

[a]HM, high marsh (*Spartina patens*, *Juncus gerardi*); BM, basal marsh (± terrestrial and humic compounds); S, shells: MA, *Mya arenaria*, CV, *Crassostrea virginica*; W, wood.
[b]Date is uncorrected, raw age.

Stuckenrath et al. 1989; Kelley et al. 1992) was then used to guide construction of paleogeographic maps, by intersecting sea level and the pre-Holocene surface. Geologic experience resulted in modifications to this simplistic intersection, by restoring former coastal environments and accounting for losses at the shoreface ravinement. Thus, the paleogeographic reconstructions are somewhat subjective models.

Finally, this framework was used to constrain an interdisciplinary geoarchaeological interpretation of the two regions. Cultural and faunal remains in middens indicate human selection from available environments, and relate to natural fossils in cores. For example, the contemporary coexistence of *Mya arenaria* (soft-shell clam) in the Turner Farm midden and in situ in nearby vibracores suggests a local food source for the midden builders. The present environment does not provide immediately available *Mya*, because it is an open gravel beach. This suggests a more protected mudflat environment 5 ka.

TURNER FARM SITE

The Turner Farm site is in a protected location facing Fox Islands Thorofare (Figure A5.3). The site is on a terrace and eroding bluff at the northern end of a small gravel barrier beach between Fish Point and Kent Cove. Modern environments include a fresh-to-brackish back-barrier marsh, sand and gravel barrier, and eroding bluffs of glacial sediment sitting on a bedrock ledge. Tidal flats containing *Mya arenaria* exist within 1–2 km NW and N of the site today, but the immediate intertidal area is a relatively steep, coarse-grained beachface.

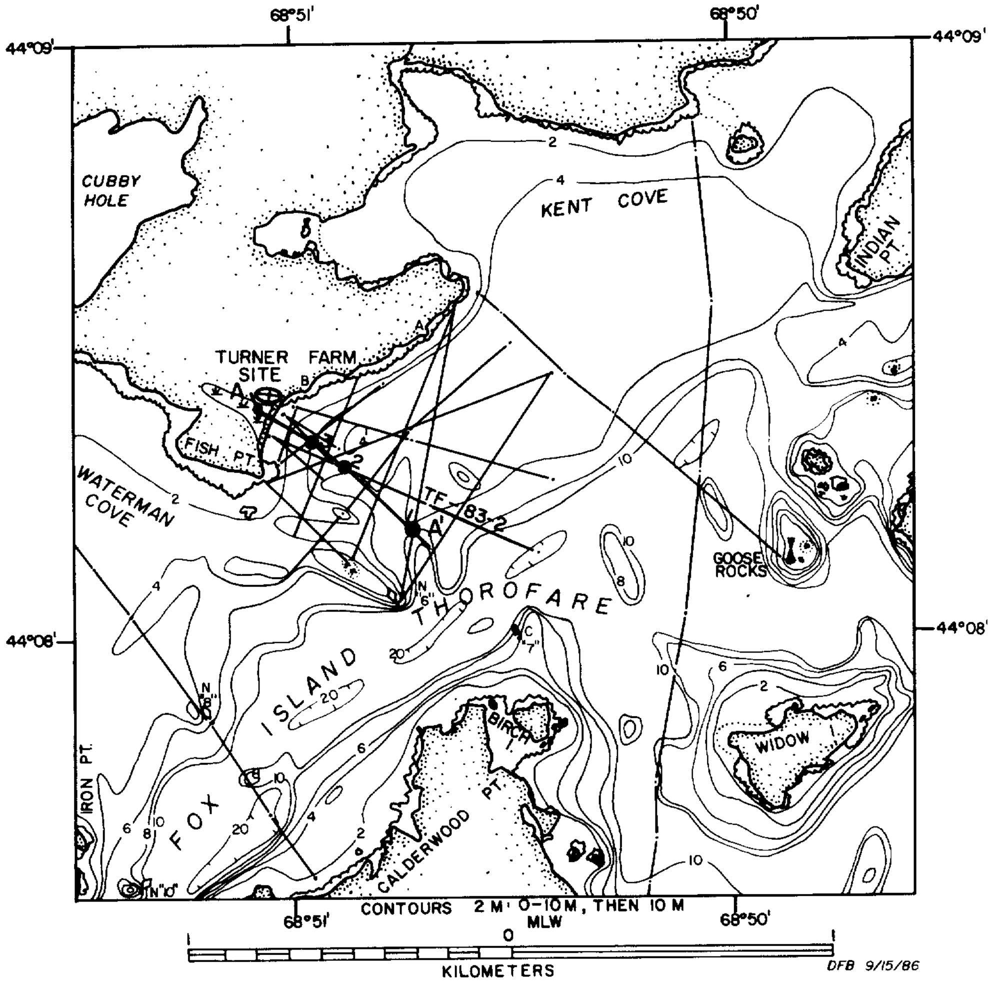


Figure A5.3. Turner Farm site, detailed location map. Seismic reflection tracklines are shown by dot-long-dash lines, while cores are shown by filled dots.

Results

Seismic profiles using the 3.5-kHz profiler were run in 1984. A total of 12 km was profiled (Figure A5.3) for general stratigraphy in the adjacent Fox Islands Thorofare, with a grid of closely spaced lines immediately offshore of the site. Seismic data reveal facies interpreted as bedrock, uppermost Pleistocene Presumpscot Formation, Holocene mud, and littoral sand and gravel units. Within the mud are pockets of natural gas that obscure deeper reflectors. These seismic facies and techniques of interpretation are described in detail by Belknap et al. (1989a) and Belknap and Shipp (1991). Seismic profile TF-83-2 (Figure A5.4) crosses a broad subtidal flat with more than 6 m of Holocene mud overlying Presumpscot Formation and bedrock. A strong gas signature suggests organic-rich mud at

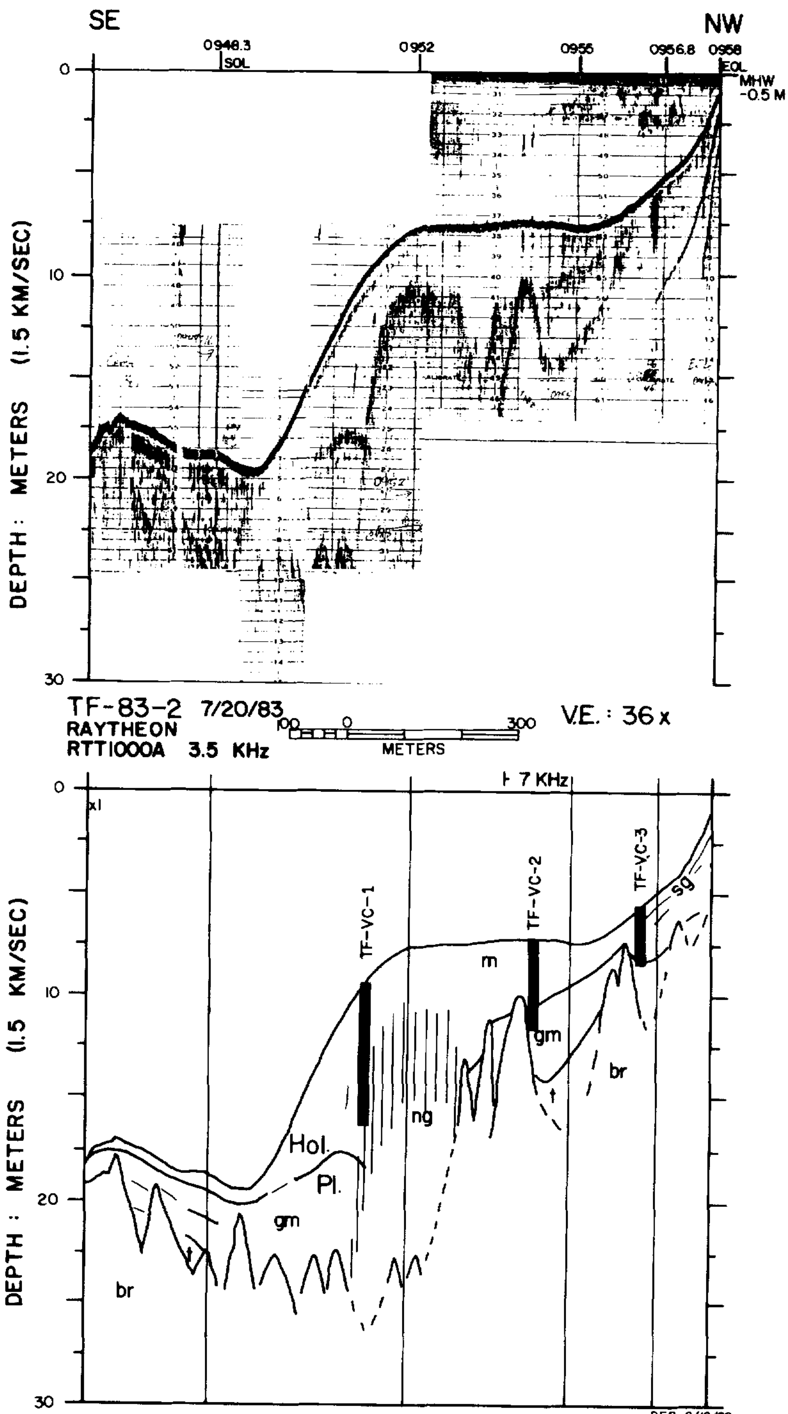


Figure A5.4. Example of 3.5-kHz data, raw and interpreted, along line TF-83-2 (see Figure A5.3 for location). Underwater vibracores (solid bars) are projected up to 100 m laterally to this line. Hol., Holocene; Pl., Pleistocene; m, mud; ng, natural gas; sg, sand and gravel; gm, glaciomarine mud; t, till; br, bedrock.

the base of the Holocene sediments. This profile runs normal to the barrier, and is the site of the three vibracores taken in this area. Spiky bedrock (including Fish Point Ledge) is evident, overlain by Presumpscot Formation and a landward-thinning wedge of Holocene estuarine mud. Coarse beachface sediments are not clearly resolved on profile TF-83-2 because of shallowness of the water, but visual observations confirm the coarse surficial sediments in depths less than 5 m on the profile.

Based on the seismic data, cores were sited in a shore-normal transect along TF-83-10, in a paleovalley thought to connect with the present back-barrier marsh. This protected environment was hypothesized to be a likely region of human occupation or resource supply. Three underwater vibracores (Figure A5.3) were taken in 5, 8, and 10 m depths below mean high water (MHW), and one hand auger (Dutch core) was taken in the back-barrier marsh. These cores and seismic profile were used to construct the cross section in Figure A5.5. Core TF-VC-1, farthest offshore, is subtidal embayment mud, containing fine sand lenses and fossils of *Macoma balthica* and *Yoldia* sp. Cores TF-VC-2 and TF-VC-3 are remarkably alike, with a thin upper unit of subtidal estuarine mud grading to intertidal embayment mud with scattered pebbles and sand, and fossils of *Mya arenaria*. Each core penetrates a distinct erosional unconformity on the Presumpscot Formation. At this contact, in situ *Mya arenaria* are found in growth position, burrowing into the underlying stiff Pleistocene mud. These shells provide a minimum estimate of sea level (Figure A5.2) at 5880 ± 105 and 5430 ± 100 B.P., respectively. There is no evidence for a barrier at that time. After 5000 B.P., as rate of sea-level rise slowed (Belknap et al. 1989b), a barrier formed across

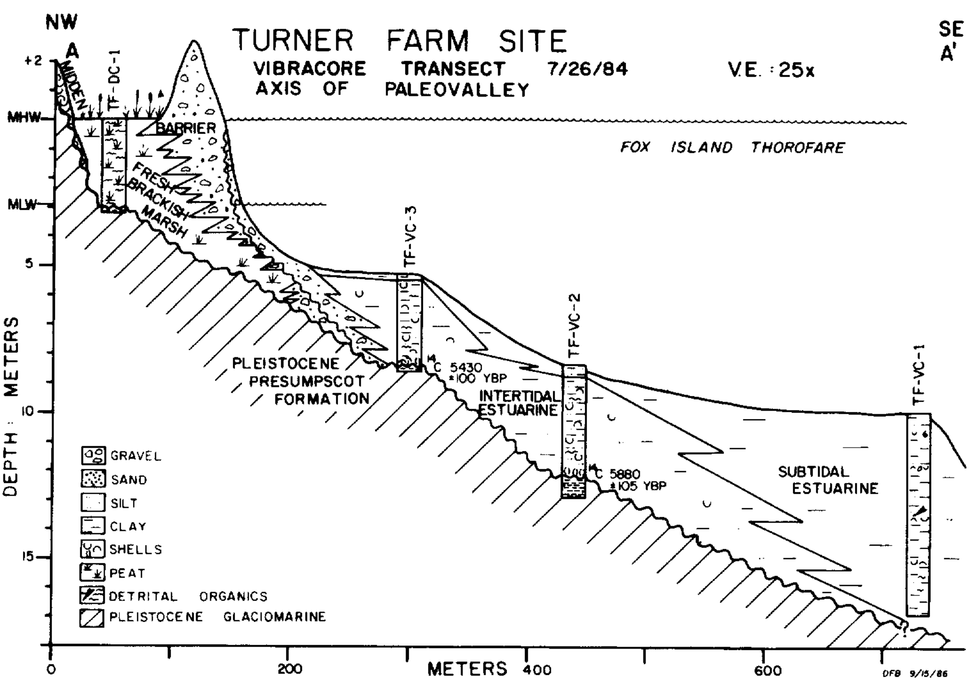


Figure A5.5. Geologic cross section A–A′ (see Figure A5.3 for location).

the upper reaches of the Fish Point paleovalley, enclosing a back-barrier marsh. This marsh is now 3 m thick, but its offshore extent and precise time of initial formation is unknown. Formation of the barrier may also be related to interception of new coarse-grained sediment sources, and increasing fetch as Fox Islands Thorofare widened with sea-level rise.

In Marsh Cove, 4.5 km to the northeast (Figure A5.1), more saline back-barrier marsh deposits were cored to aid in constructing the local sea-level curve. The stratigraphy of the Marsh Cove barrier/back-barrier demonstrates transgression, as at the Fish Point barrier, but contains back-barrier lagoonal muds and salt marsh peat.

Seismic data and absolute core control were used to devise structure contour maps of the area. The most useful (Figure A5.6) maps the base of the Holocene section (top of the

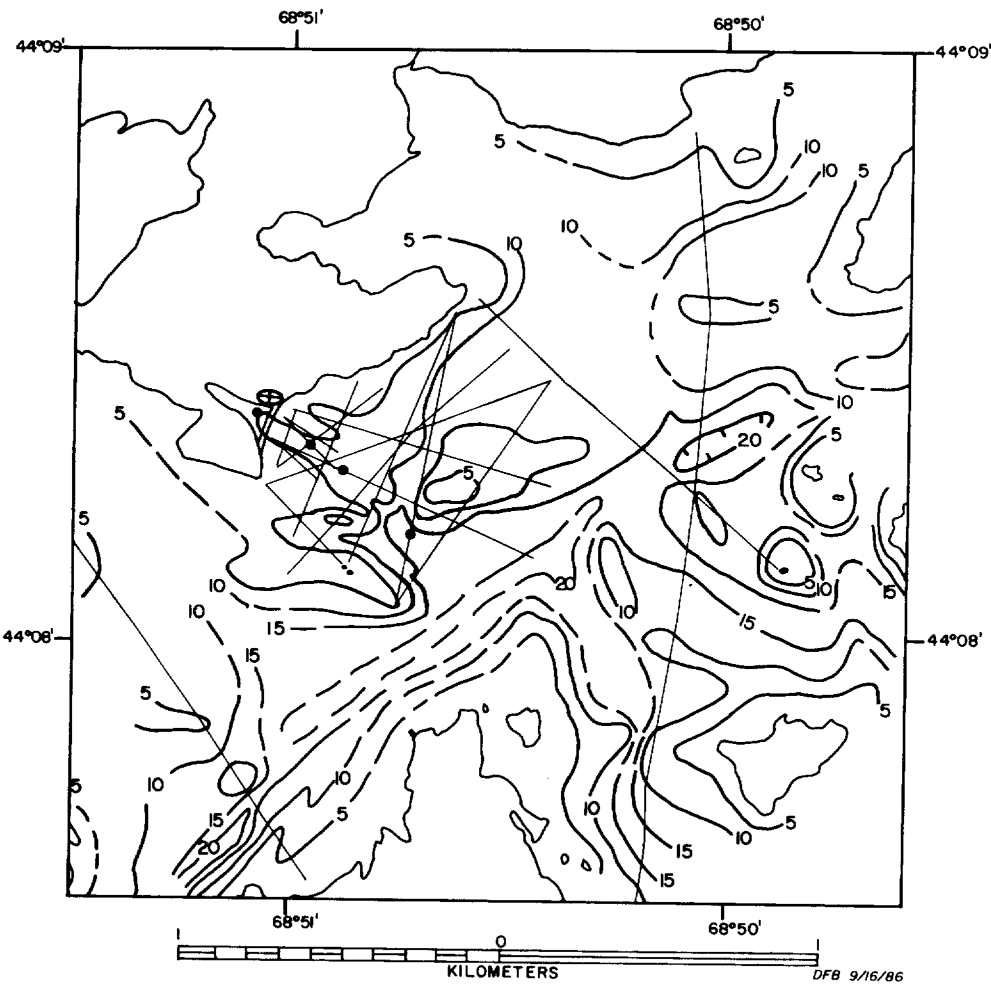


Figure A5.6. Structure contour map of central Fox Island Thoroughfare, off Turner Farm Site, base of Holocene.

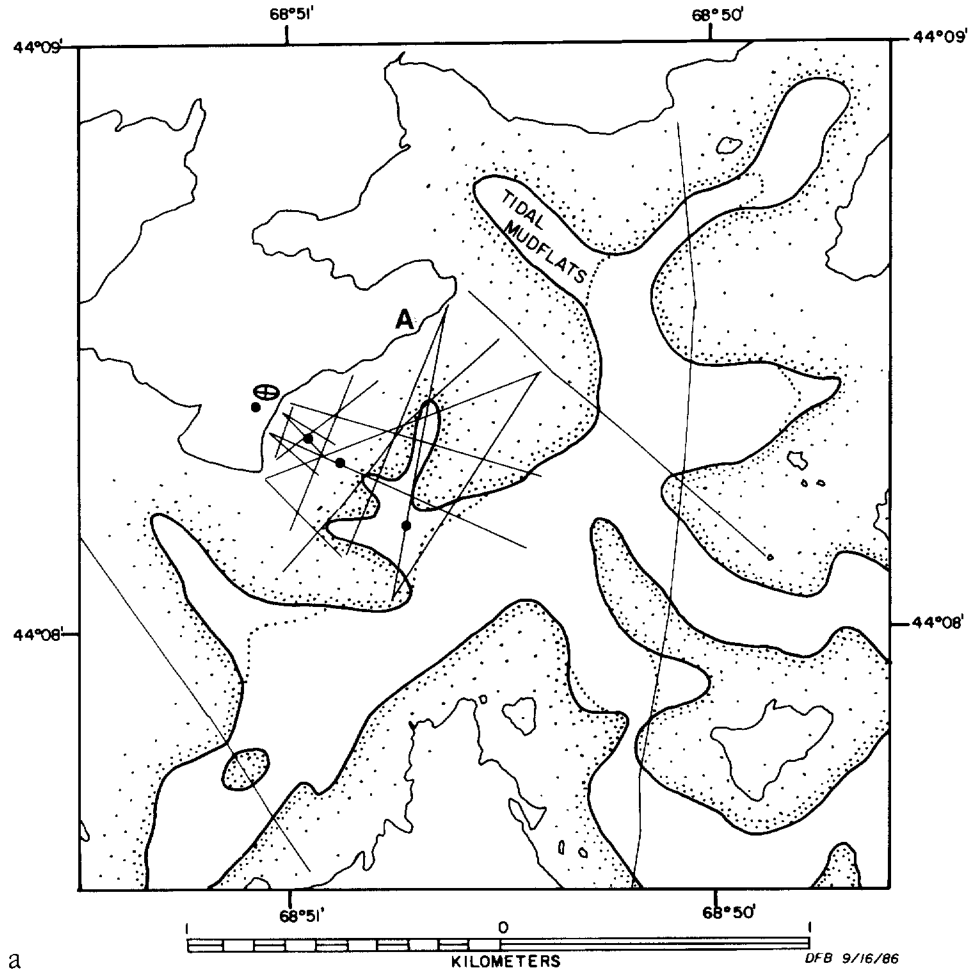
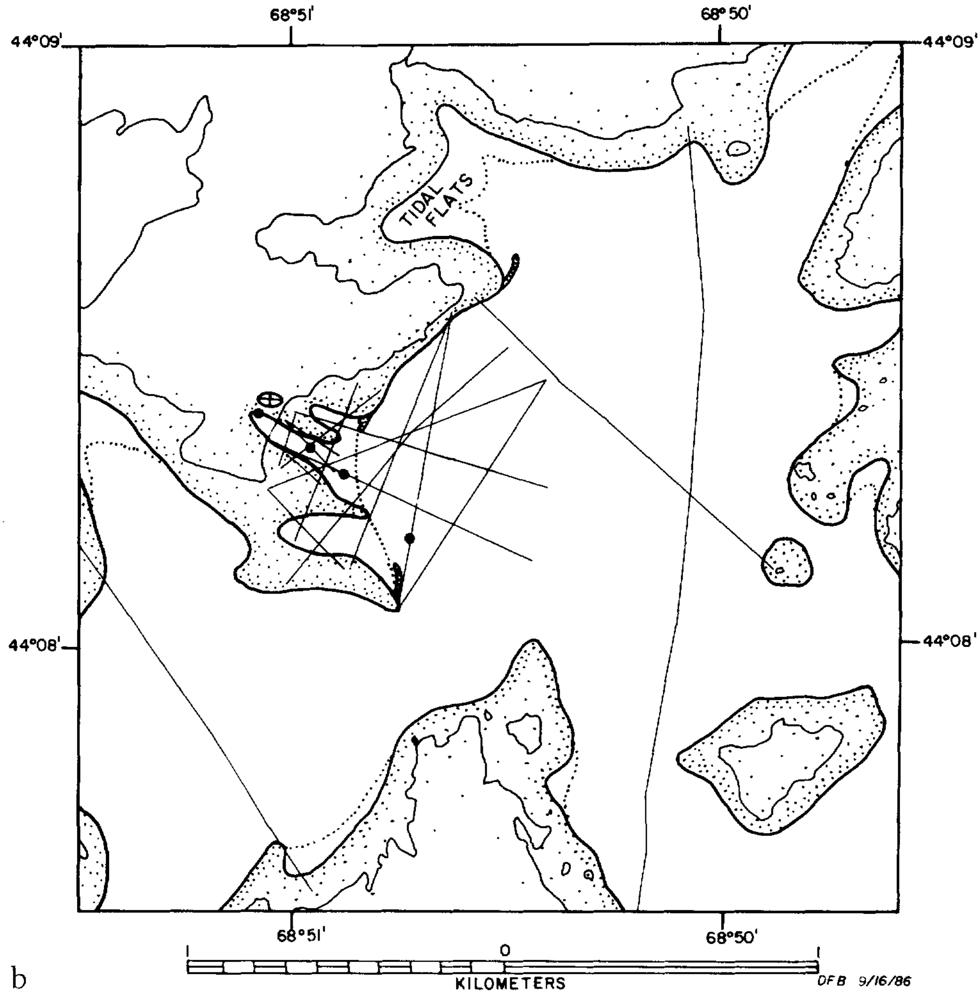


Figure A5.7. Paleogeographic reconstruction of the Turner Farm site region. (a) Sea level −10 m, approximately 6000 B.P. (b) Sea level −5 m, approximately 4500 B.P.

pre-Holocene, including bedrock, till, and Presumpscot Formation). The pattern of structure contours identifies a major bedrock-controlled paleochannel in the location of the present axis of Fox Islands Thorofare, with tributary paleovalleys into Kent Cove and the Turner Farm back-barrier marsh. A similar paleovalley probably exists in Waterman Cove as well. The surficial bathymetric expression does not always correspond to these paleovalley trends, as is seen in the smaller tributaries, indicating a thick Holocene valley fill. Another important feature is the broad flat between 10- and 5-m depth, located east of the site off point "A" in Figures A5.3 and A5.7a. Seismic profiles record thick Holocene mud with gas wipe-out, suggesting a relatively flat pre-Holocene surface and a possible former intertidal flat. Whether this flat was produced subsequent to retreat of an eroding bluff, or by



b

Figure A5.7. (*Continued*)

relatively passive flooding of a previously existing flat area, cannot be determined from the seismic data alone.

Discussion

Structure contour maps of the pre-Holocene surface and core and seismic information concerning facies distributions are combined to create paleogeographic reconstructions, which are more subjective interpretations of the whole data set. Figure A5.7a and b illustrates two reconstructions for the area, at sea levels of 10 and 5 m below present, respectively. These levels correspond to approximately 6000 and 4500 B.P., based on the

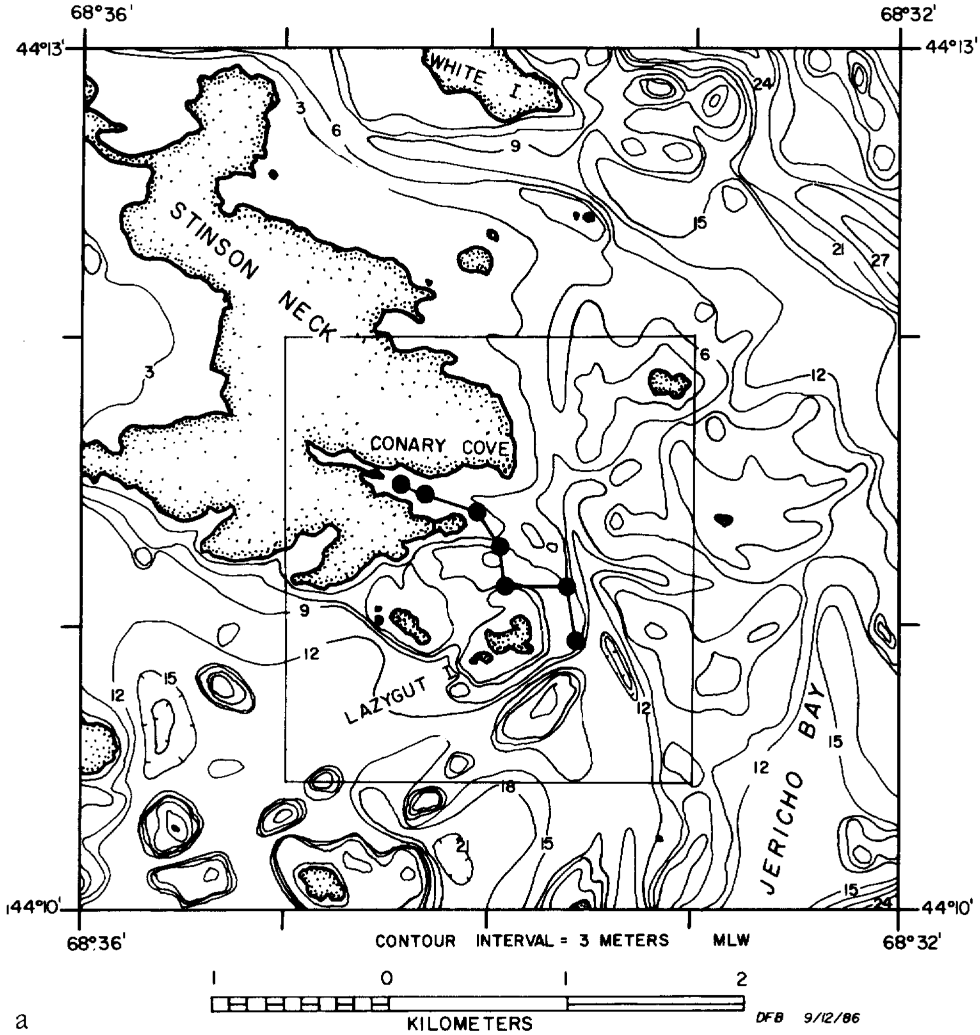
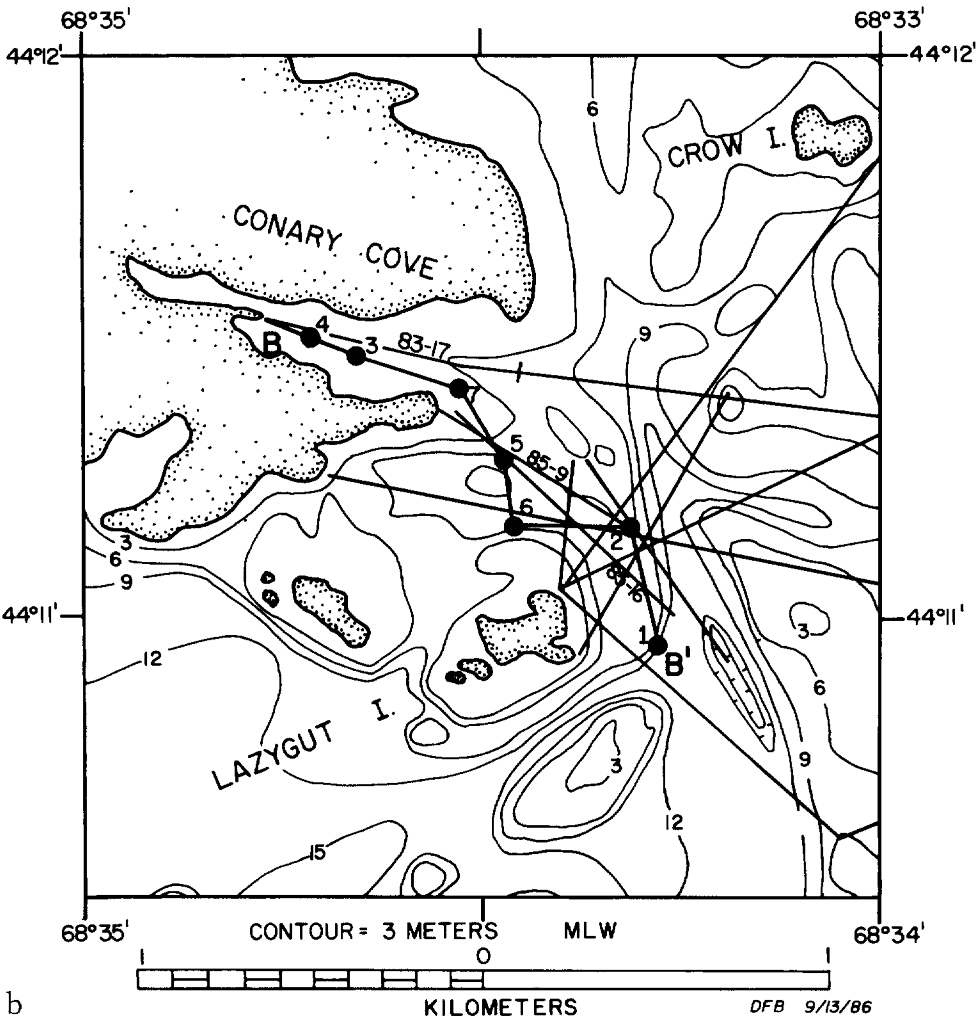


Figure A5.8. Location maps of Lazygut Island. (a) Regional map, box encloses detail of 8b. (b) Lazygut Island and Conary Cove, with tracklines (solid line) and underwater vibracores (filled dots). Thick line connecting vibracores is a synthetic cross section (Figure A5.11). Vibracore 2 is in the artifact producing area.

sea-level curve (Figure A5.2). At 6000 B.P. (Figure A5.7a) sea-level rise overtopped the narrow margins of the Fox Islands paleochannel, flooding the Fish Point paleovalley. A much broader area became available for development of tidal mudflats, including colonization by *Mya arenaria*. This was also the end of the hypsithermal in the Gulf of Maine (Schnitker 1975). Swordfish remains in Maine middens suggest deep-sea swordfish hunting, from bases such as Turner Farm. The protected channel with the natural harbor of Fish Point paleovalley makes this a logical site for human occupation. In situ *Mya* in cores TF-VC-2 and TF-VC-3 clearly demonstrate an abundant mudflat resource between 5800 and



b

Figure A5.8. *(Continued)*

5300 B.P. By 4500 B.P. (Figure A5.7b), rising sea level and coastal retreat allowed intrusion of intertidal water to the present back-barrier of Turner Farm. Mudflat resources may have begun to wane immediately in front of the site, but northwestern Kent Cove and Waterman Cove may have been alternative sources of *Mya*. Barriers may have formed as fetch increased within Fox Island Thorofare, and then migrated landward to become the present beach.

It is difficult to reconstruct the original size of shell midden sites when affected by modern coastal erosion (e.g., Skinas 1987; Kellogg 1991; Young et al. 1992). Turner Farm is the oldest (5290 ± 95 B.P.) deeply stratified site on the Maine coast. Sea level rose from at least 8 m below the present over this period of occupation, suggesting either protection from erosion, or unusual placement with respect to the eroding coastline. The coastal evolution suggested in Figure A5.7 allows for a narrow tributary embayment very different from the modern setting, evolving to a barrier with back-barrier marsh. Present coastal erosion is thus attacking the *side* (SE), rather than the *front* (SW) of the site. Turner Farm presently represents zone 2 of the embayment sedimentary evolution model, with eroding bluffs and sediment redistribution. It has evolved from a more protected zone 1 setting within the past 5,000 years.

LAZYGUT ISLAND

The Lazygut Island site has yielded a set of isolated artifacts found near a bedrock knob submerged at 10-m depth 500 m NE of Lazygut Island at the intersection of Eggemoggin Reach and Jerico Bay (Figure A5.8a). This site is open embayment, stripped of intertidal sediment and exposed to normal and storm wave conditions from the Gulf of Maine.

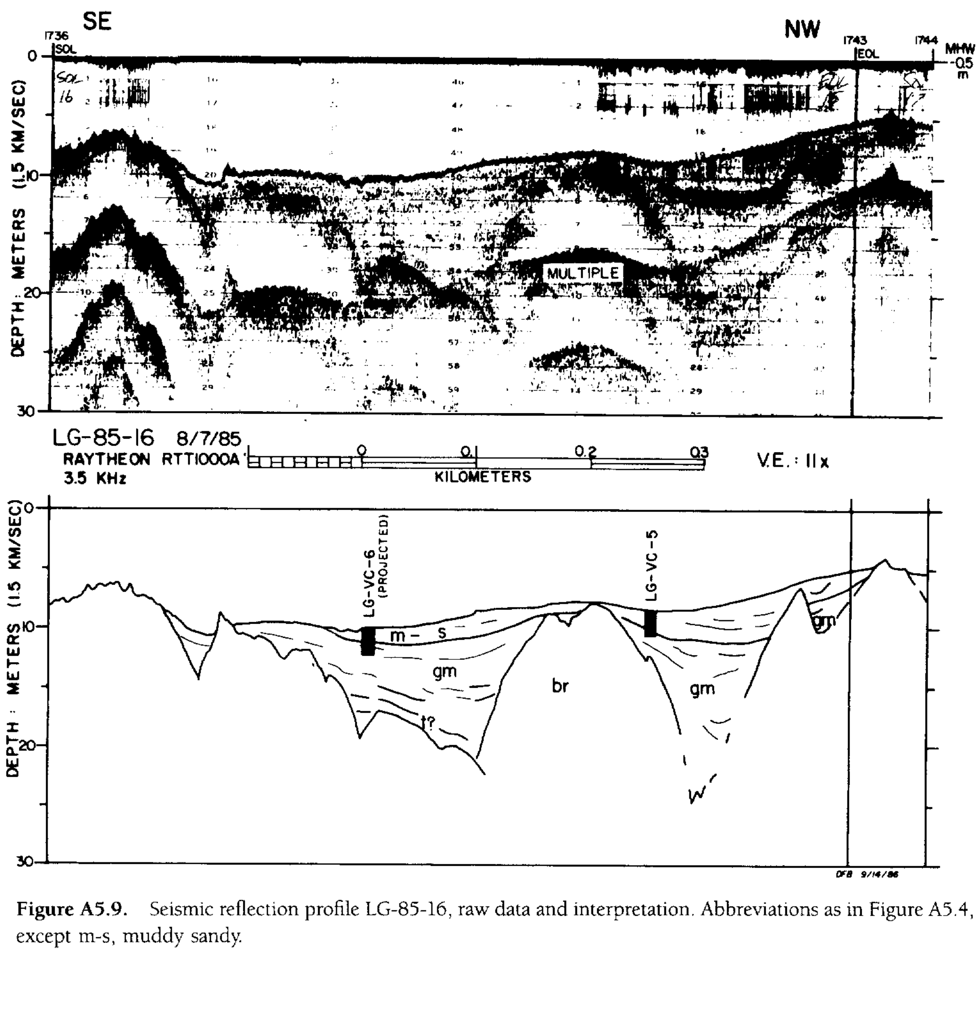


Figure A5.9. Seismic reflection profile LG-85-16, raw data and interpretation. Abbreviations as in Figure A5.4, except m-s, muddy sandy.

Conary Cove (Figure A5.8b), 800 m to the northwest, is contiguous with this site but contains more protected flats environments. Artifacts were recovered by fishermen in 1982, and systematic scuba exploration was performed in 1983. Only isolated flakes were found, and no coherent site was recognized on the seafloor.

Results

Seismic profiles totaling 13 km were run using the same techniques as off Turner Farm. Bedrock and glaciomarine mud are clearly identifiable (Figure A5.9) at the base of the section. Overlying the pre-Holocene erosional unconformity is a thin (< 2 m) section of

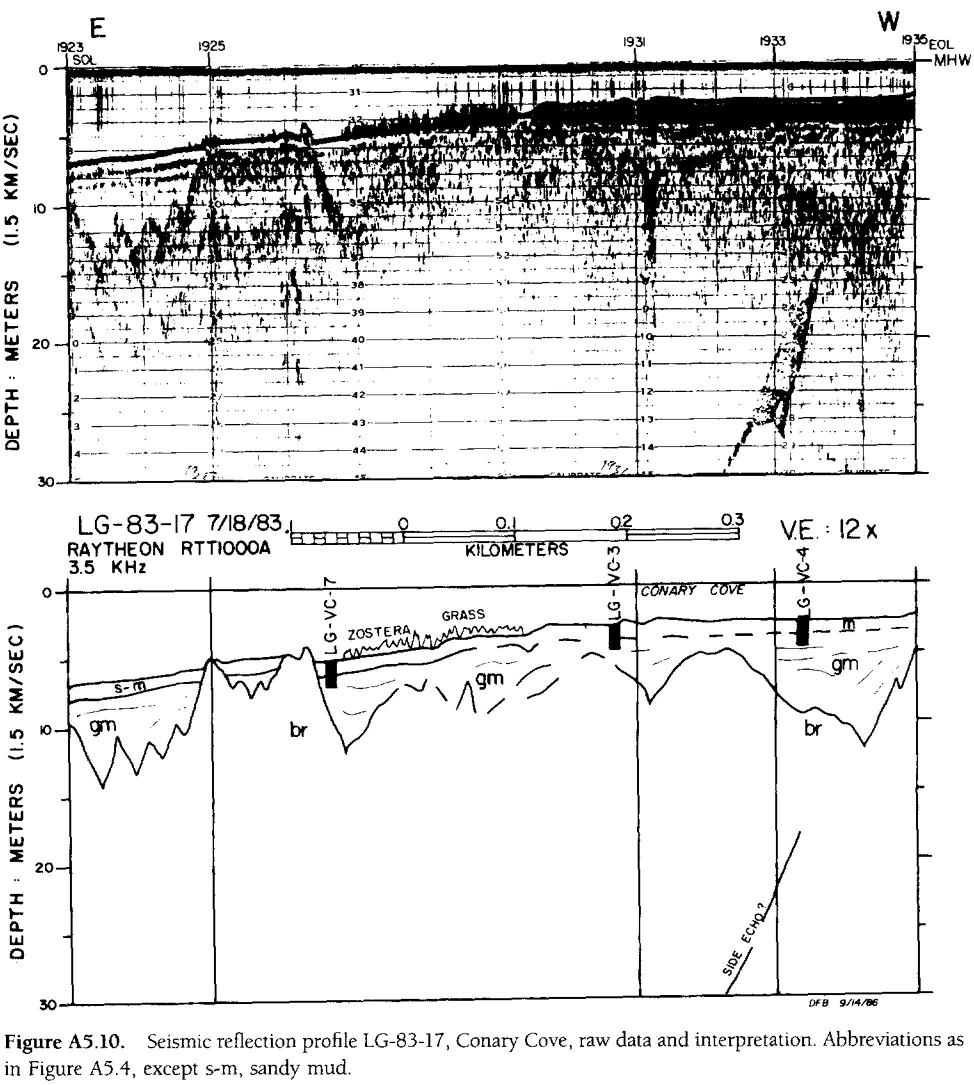


Figure A5.10. Seismic reflection profile LG-83-17, Conary Cove, raw data and interpretation. Abbreviations as in Figure A5.4, except s-m, sandy mud.

embayment mud. This is overlain in turn by an erosional ravinement surface, representing the present higher-energy open embayment, with a thin (< 0.5 m), coarse surficial lag. In Conary Cove, section LG-83-17 (Figure A5.10) shows thicker mud and no ravinement unconformity or coarse surficial lag. Profile LG-85-16 (Figure A5.9) runs over the flake discovery site and was used to site four vibracores.

Side-scan sonar mapping provided an alternative view of distribution of the site. There is an isolated granite knob at the site of the flake discovery, while the surrounding seafloor is relatively uniform, with a dark return typical of coarse surficial lag. There is no suggestion of an anomaly that might indicate a midden.

Cores were sited roughly along a SE–NW transect at approximately 2-m-depth intervals. Cores are arranged in a synthetic cross section (Figure A5.11) including Conary Cove. Cores LG-VC-1,2,6,5, and 7 contain a consistent stratigraphy of muddy, shelly gravel representing high-energy open embayment, overlying an erosional ravinement surface cut into subtidal embayment mud, gradually evolving from a shallower, lower-energy embayment or mud flats. The upper unit contains *Modiolus modiolus* (horse mussel), *Crepidula fornicata* (slipper shell), barnacles, and fragments of many other (probably reworked) shells. *Crassostrea virginica* were dredged up in this vicinity from this surface lag by fishermen. The deeper embayment is interpreted from fossils of *Modiolus* and articulated *Arctica islandica* (black quahog) in growth position, while the shallower embayment is interpreted from detrital organics, *Ilyanassa obsoleta* (periwinkle), *Argopecten irradians* (bay scallop), and *Mya arenaria*. The base of the Holocene is an erosional surface with burrows into the Pleistocene Presumpscot Formation. Articulated *Mya* were abundant, as at Turner Farm. Cores LG-VC-3

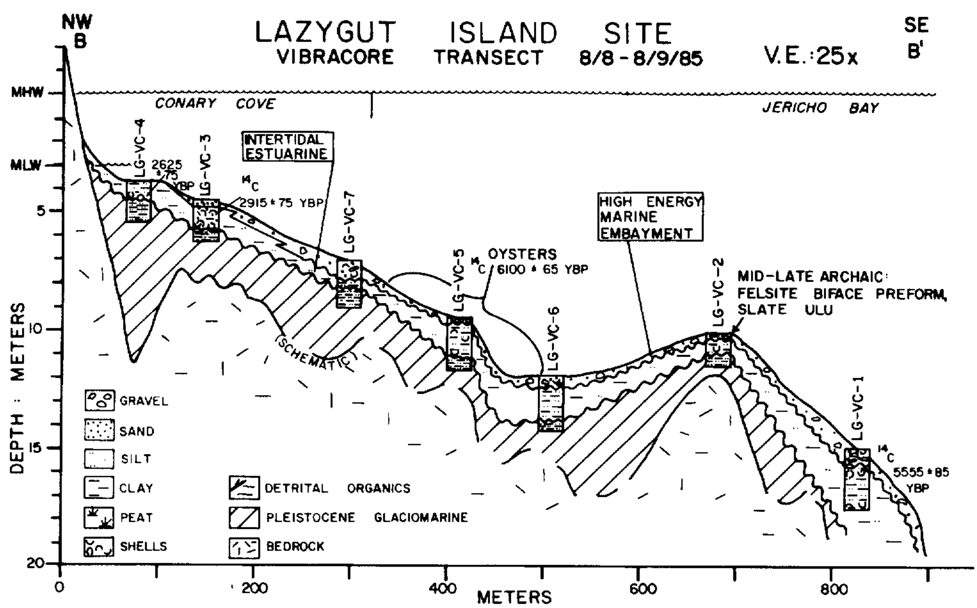


Figure A5.11. Geologic cross section B–B′ (see Figure A5.8 for location).

and 4 were within the more protected Conary Cove mudflats environments. Core 3 is similar to the outer cores, while core 4 contains a continuous Holocene mudflat section with no ravinement surface. *Mya* provide rough sea-level indicators for 2625 ± 75 and 2915 ± 75 B.P. in cores LG-VC-3 and 4, respectively. Radiocarbon dated *Arctica* in core LG-VC-1 are deeper-water shells, and can only provide a minimum sea level at −16 m 5555 ± 85 B.P.

Discussion

Seismic and core data were combined to construct a structure contour map of the pre-Holocene surface. As might be expected from the cores, the structure contour map parallels the present bathymetry closely. Paleogeographic reconstructions of the Lazygut Island area at −10 m and −5 m (Figures A5.12a and A5.12b) reveal a gradual isolation of the region into separate bedrock islands. The embayment presently framed by Stinson Neck and Lazygut Island was a likely site of a broad mudflat environment c. 5000 B.P. Continued transgression exposed the region to shoreline erosion and increasing wave energy. Any hypothetical coherent site at the bedrock knob would have been destroyed by littoral actions, redistributing sediments, shells, and artifacts into the surficial lag, from which a few scattered remnants have been recovered. Lazygut Island is a prime example of zone 3 of the embayment sedimentary evolution model (Belknap, Kellogg et al. 1986), with stripped shorelines and eroding subtidal zones.

Discovery of archaeological materials at this location was serendipitous, but hindsight allows an understanding of why this site was viable. The direct access to open Gulf of Maine environments is obvious, and would have changed little throughout the history of the location. Abundant *Mya* in nearby flats would have provided another resource. If a shell midden existed at this site, it was completely removed, due to lack of sheltering from open marine wave conditions.

CONCLUSION

Central Coastal Maine Sites

Two archaeological sites in central coastal Maine were investigated with seismic reflection profiling and coring to reconstruct paleogeography and sedimentary environments. Geologic data allow modeling of the geomorphology and geologic environments of the landscape at times of lower sea level, specifically −10 m (c. 6000 B.P.) and −5 m (c. 4500 B.P.). At Turner Farm, a stratified midden on North Haven Island, a restricted interisland channel gradually widened, and broad tidal flats developed nearby, containing abundant soft-shell clams. A paleovalley leading to the present site was gradually filled and cut off by changing shorelines. The present coastline configuration is steeper, with shellfish resources more than 1 km away. Lazygut Island is not a coherent site, simply scattered artifacts found on the seafloor. Reconstruction of paleoenvironments reveals a headland-embayment setting with protected tidal flat and abundant clams c. 5000 B.P. This evolved into the open high-energy embayment environments of the present, erasing much of the stratigraphic record. These two sites illustrate an evolutionary model of coastal sites, and provide evidence for a model of preservation potential.

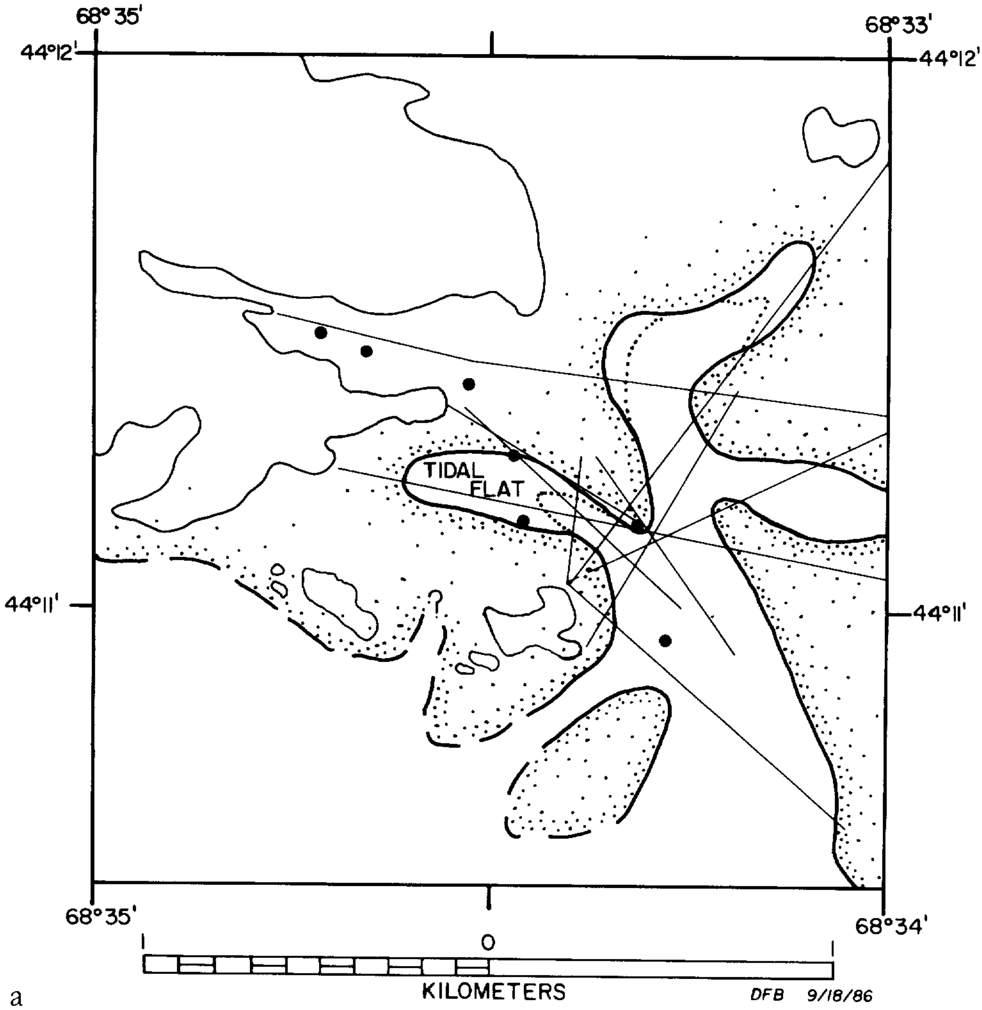


Figure A5.12. Paleogeographic reconstruction at Lazygut Island. (a) Sea level −10 m, approximately 6000 B.P. (b) Sea level −5 m, approximately 4500 B.P.

Archaeological Preservation Potential

Kraft et al. (1983) discussed a model of preservation potential that emphasized the importance of depth of shoreface erosion versus depth of burial of back-barrier or estuarine sites during transgression. This concept can be applied to the Maine coast as well.

Exposed coastal sites typically stand on bluffs with eroding faces. The face may be simply the thickness of the midden itself, directly on top of Pleistocene sediments. Depth of erosion from a few meters to more than 10 removes the entire stratigraphic column, resulting in complete destruction of the site as a coherent, stratified unit. Scattered lithic artifacts might conceivably survive such a transgression. This model describes the Lazygut

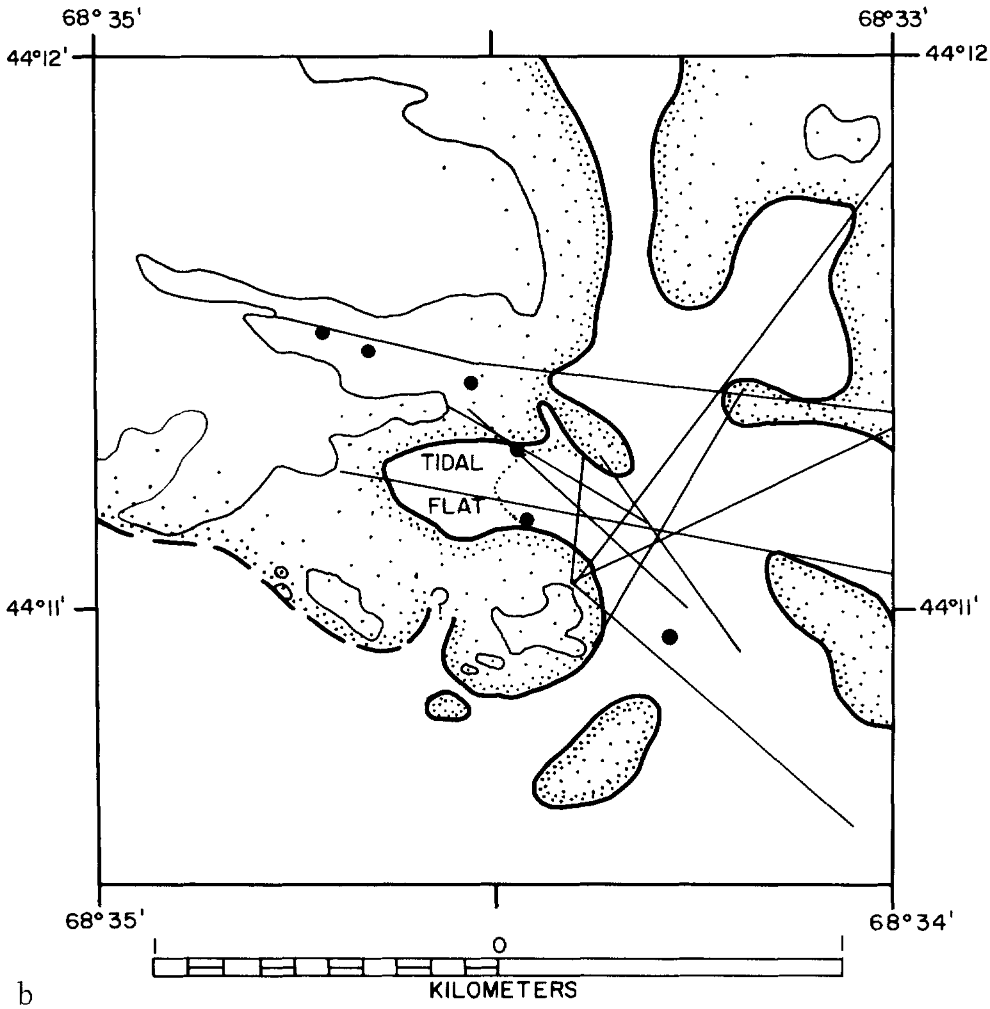


Figure A5.12. *(Continued)*

Island finds, and probably the majority of pre-Ceramic sites that may have existed on the now submerged inner shelf.

In contrast, sites that were situated in a tributary embayment, back-barrier, or similar sheltered setting have the potential to be preserved by delayed erosion, or by deep burial before the arrival of the eroding littoral zone. The Turner Farm site displays the delayed erosion model of preservation. The site buried in the Fish Point paleovalley has thus been partially preserved below the shoreface ravinement surface. Discovery potential of such sites is low, however, with present remote sensing devices. However, Shipp (1989) and Davies (1992) discuss discovery of buried natural shell bioherms (natural oyster mounds) within the Damariscotta River, a potential model for a buried midden. Chance sampling by vibracoring is the most likely mechanism for discovery potential at present. The likelihood of discovery is undoubtedly small, but modeling of most probable site locations increases this potential.

For the present, the most likely locations for preserved sites on the inner shelf are best modeled using archaeological and geoarchaeological criteria. Following Kellogg (1982, 1991), potential sites would be S or SE facing, near a headland, with access to a beach for landing boats and mudflats for food resources. Enhanced preservation potential occurs on the flank of a paleovalley, perhaps in a back-barrier setting. Shelter from open gulf marine conditions lessens the depth of shoreface erosion. A systematic search in the expanding database of seismic reflection profiles from the Maine coast could result in identification of such potential sites. Kellogg (1991) has in fact accomplished the goal in Muscongus Bay. Recent advances in Geographic Information System technology may make this task cost effective.

Acknowledgments

Several University of Maine students and other professionals aided in gathering the information for this study. Dr. Bruce Bourque, Maine State Museum, was the principal investigator who requested geologic assistance. R. Craig Shipp and Stephanie Staples were primary field assistants for coring and seismic work at both localities. Robert Lewis, Maine State Museum, helped in the field. The University of Maine, Darling Marine Center and Center for Marine Studies provided equipment.

Appendix 6

Analysis of Lithic Artifacts

The Identification, Petrologic Description, and Statistical Analysis of the Lithic Artifacts Recovered from the Turner Farm Site

ROBERT G. DOYLE

INTRODUCTION

The study of artifact lithology at the Turner Farm site began in the mid-1970s as a cooperative field project between the Maine State Museum and the Maine Geological Survey. Extensive bedrock mapping in Penobscot Bay (Figure A6.1) during the 1970s provided excellent geologic information that helped locate many nearby Turner Farm lithic source areas. In fact, one of the two most commonly used materials at the site—a banded-spherulitic rhyolite (BSR)—was located on the north end of Vinalhaven Island (Figure A6.1) by the author using data published in a 1968 report (Dow, 1965). This lithic represents at least 15 percent of all the artifacts found at the site. This discovery (Bourque et al. 1984; Doyle 1978) stimulated the systematic petrologic analysis of the entire Turner Farm artifact collection. A total of 1,920 artifacts, plus several hundred flakes and chips, were examined over a three-year period.

The results of this initial work were summarized in an internal memorandum to Bourque in 1978, and in two later unpublished reports. Two other lithic artifact source studies undertaken subsequent to the initial Turner Farm lithic research contributed greatly to an understanding of coastal Maine lithic materials.

OBJECTIVES

The objectives of the Turner Farm lithic study are threefold: (1) to identify and describe all the lithic artifact materials, (2) to locate the lithic source area for each lithic type, and

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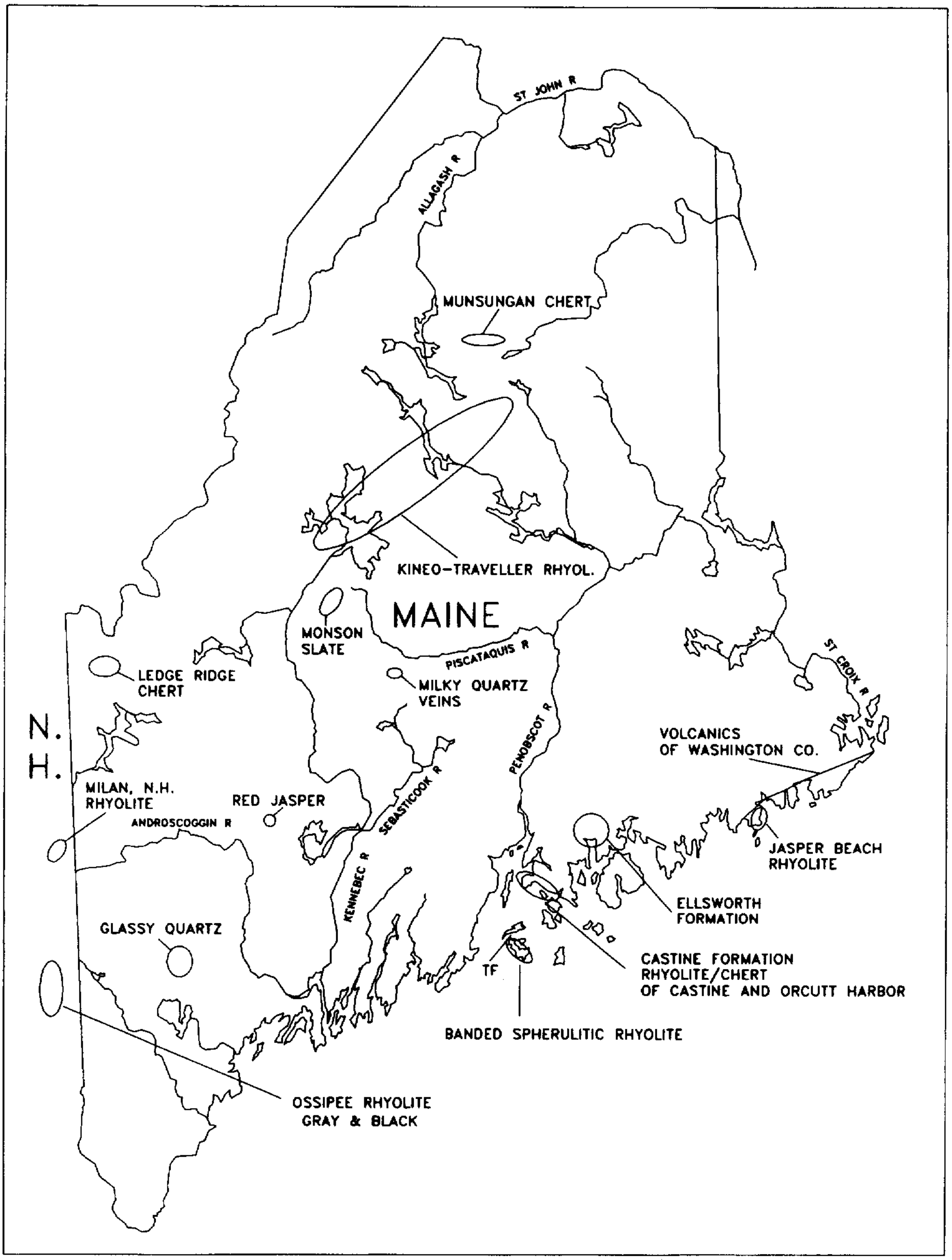

Figure A6.1. Location of principal lithic source areas in Maine and New Hampshire.

(3) to present these data in a way that would compare lithic preference through archaeological time. There are four sections in this study:

1. Research methods.
2. Petrologic description, provenience, and geologic setting of lithic materials.
3. Presentation of statistical data for the lithic materials.
4. Summary and conclusions.

METHODS

Petrologic Analysis

Artifacts were examined individually and their lithology described. Most were made from readily identifiable rock types with a confirmed source provenience. This allowed for rapid lithic identification. Certain exotic lithologies, highly weathered rocks, and undistinguished volcanic rocks received more careful petrologic examination. Identification, however, was mostly limited to hand-specimen and binocular analysis. Thin-section petroscopy was rarely employed. It is an expensive procedure, and for this project, not a critical consideration. There are a few instances, such as the Munsungan chert or banded-spherulitic rhyolite, where already-published petrographic analyses (see, e.g., Billings 1965; Pollock 1986) were useful.

Mineral composition, grain size, texture and fabric, color, luster, and hardness were the primary identifying parameters. Some lithologies were difficult to identify. These included very fine grained, dense, highly silicious rocks; strongly metamorphosed quartz-feldspathic layered rocks; and weathered rocks, particularly with the fine-grained silicious volcanics. The weathering process frequently masks the identity of certain rock types, although some lithologies such as the Castine volcanics, Kineo-Traveler volcanics, Trap rock, and the black variety of the Orcutt Harbor volcanics had diagnostic weathering characteristics. For other fine-grained silicious rocks, however, there was no easy identification, except to assume that they were probably volcanic. It is nearly impossible, by hand-specimen analysis, to differentiate between highly weathered cherty rocks and very fine grained volcanic rocks. Fortunately, the Turner Farm collection contained few cherty lithologies. About 30 artifacts of unique or rarely seen lithologies required special consideration. Some have been source provenienced, at least to a geographic region; others have not. The more common exotics were (1) white to buff-colored opaque cherts, usually mottled, spotted, or swirled in red, yellow, or brown; (2) a dense, slightly lustrous, and highly silicious massive rock (possibly mylonite, a resilicified fault gouge); (3) complex volcanic pyroclastic rocks, which occurred in spatter cones, volcanic breccias, and finely bedded, rippled, flow-banded ash beds; and (4) highly silicious rocks, with no genetic telltales, that appear to have been subjected to multiphase metamorphism. These are possibly from the Canadian Shield.

ARTIFACT AND LITHIC GROUPING

The artifacts themselves are separated into three topologies: bifaces, scrapers, and ground and pecked tools. Bifaces include all flaked tools that were formed as projectile points, blades, and large bifacial scrapers; scrapers include all end scrapers and smaller bifacial scrapers; ground and pecked tools include all tools—gouges, adzes, and plummets—that were fashioned by grinding or pecking stones.

About 30 individual lithologies were identified from lithic studies conducted during the 1980s on over 200 central coastal Maine artifact collections. Artifacts from the Turner Farm represent 18 of these 30 lithologies. These 18 lithic types were separated into five major lithic groups:

1. Rhyolites (lavas, tuffs, ash, and pyroclastics).
2. Other volcanic rocks (local andesite plus rhyolite varieties from eastern Washington County).
3. Quartz, plus five chert varieties.
4. Plutonic rocks (granite, gabbro, diabase, basalt, trap).
5. Metasedimentary and metavolcanic rocks of moderate to high metamorphic grade. These include Ellsworth Formation rocks, quartzite, and slate.

These data are summarized in four tables, presented and discussed in a later section. They offer a wide variety of statistical information that attempts to define lithic materials use, tool applications, and changes in lithic preference through time at the site.

LITHIC SOURCE AREAS

Lithic source areas are narrowly defined geographic areas where a specific lithology was present and available to prehistoric people. They occur as proximal sources, such as bedrock outcrops, from which fragments of the rock were extracted, or as distal sources, as cobbles or rock fragments in glacial drift or the bed load of streams and rivers. Munsungan chert is an example of a proximal source area. The Kineo-Traveler Mountain rhyolite is primarily a distal source area, because it is so common in the glacial drift.

The 30 specific lithic types that I have identified can be traced to individual source areas in the Northeast. They are distributed throughout New England, the Champlain Valley and eastern New York, the mid-Atlantic States, and the southern Canadian Maritimes. Ramah chert of coastal Labrador and possible Canadian Shield rocks are also included (Figure A6.2). These source areas contain either single lithologies, such as the banded-spherulitic rhyolite of Vinalhaven, or a petrologic group, such as "quartzite," which embraces all types of quartzite, defined by color and grain size. Unique and important lithologies within such groups, such as the Cheshire quartzite, are noted as a source-area subset.

The lithic data are organized in two formats. The first is a simple listing, by cultural period, of each artifact by its site number, tool type, and lithology. Though not published here, this large folio of artifact listings is available at the Maine State Museum. The second format is a series of biaxial matrices that match tool type against lithology for each cultural period. For the Turner Farm site this is a 40-page document.

PETROLOGIC DESCRIPTION AND PROVENIENCE OF THE LITHIC MATERIALS

This section presents a petrologic description of each of the 18 lithologies found at the Turner Farm site, and the geologic and geographic setting of each source lithology.

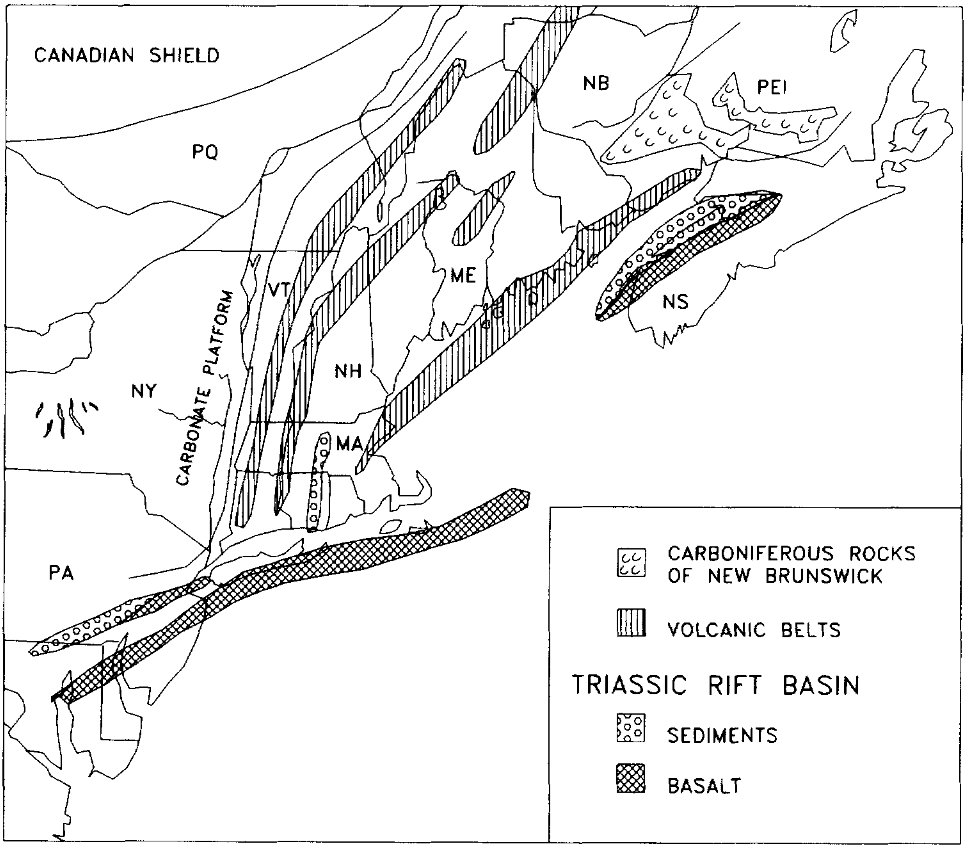

Figure A6.2. Generalized geologic map of the northeastern United States and adjacent Canada.

Regional Geology

It is important to present a brief picture of the geologic setting of the region within which the lithic materials were found. The region extends from Virginia to the eastern Maritime Provinces, westward to the Champlain Valley, and includes the rocks of the Canadian Shield and Labrador (Figure A6.2). It embraces a wide variety of regionally metamorphosed rocks, a multicomponent stratigraphy, and complex geologic structures, all of which have contributed to generation of a large number of lithic artifact materials.

The geology is characterized by a series of northeast-trending rock belts containing a variety of rock suites. They range in age from the Late Precambrian to Mid-Mesozoic, and are intruded by large masses of plutonic rocks, mostly granite, gabbro, and a number of extrusive basalt flows and related trap dikes. This rock sequence forms the Appalachian Geologic Province, about 350 miles wide and extending from the Maritimes to Georgia (Figure A6.2). It is bounded on the west by the weakly folded Paleozoic Carbonate Platform west of the Champlain Valley in New York and Ontario. These rocks contain many of the chert lithics found at the Turner Farm site. On the east the province is bounded by the Gulf of Maine and occasional exposures of younger cover rocks of Mesozoic and Tertiary age. This region is the very large hunting ground for lithics used by the Maine peoples.

Metamorphosed Rocks. Within the region there are four clearly defined metavolcanic belts separated by metasedimentary rocks; they contain most of the rock types used for Maine coastal artifacts. The two eastern belts contain the largest number and greatest variety of source materials. Metasedimentary rock belts consist of two lithologic types. There is a weakly metamorphosed, fine-grained, platy, and brittle type (slate, metasiltstone, and phyllite) and a more strongly altered type that consists of granular, usually coarse-grained schist and gneiss. Much softer and not amenable to flaking, these were mostly used for ground and pecked tools. The most important source areas of slaty rocks used for ground stone tools are the northern and central Maine Clastic Basins, the western Maine-New Hampshire Clastic Basins, and the Vermont Slate Belt (Figure A6.2).

Quartzite, a metamorphosed sandstone, becomes tougher with increased metamorphism and is often used for flaked tools. It occurs in a great variety of localities, but flaking-quality quartzite is rarely found in Maine rocks.

Sedimentary Rocks. The eastern side of the Paleozoic Carbonate Platform (Figure A6.2) contains several thousand feet of gently folded layers of limestone/dolomite, shale, and coarse to fine argillaceous sandstone. Beds and nodular layers of chert are scattered throughout this sequence, which extends from Niagara Falls and Ontario, eastward to Albany, where it bends south down into Virginia.

Igneous Rocks. The Mesozoic rocks of the Minas Rift Basin of central New Brunswick are composed of terrestrial Red Bed sediments and a large, elongate mass of basalt—the North Mountain basalt. The basalt contains two varieties of chalcedonic material: bedded, nodular, and fracture-filling chalcedony, and agate/petrified wood. Both varieties are found at the Turner Farm site. The basalt also contains native copper, which was probably the source of copper bead specimens found at coastal Maine sites.

It is possible that a small amount of finer-grained, tough, hornfelsed argillites may be present in the Red Bed sequence and found its way to the Maine coast. However, such rock types were not of the excellent-quality argillite—the dark gray, very hard, compact, and silicious hornfels—that is present throughout northeastern collections. Those come from rift basin rocks of the eastern rift basin terrane (Figure A6.2), where the siltstone layers were contact metamorphosed by intruding basalts.

Petrologic Descriptions

The 1,920 artifacts from the Turner Farm represent, as noted above, 18 lithic types, separated into five major petrologic groups: rhyolites, varietal volcanics, quartz/chert, plutonic rocks, and metasediments/volcanics.

Rhyolite Group

This group contains four distinct rhyolitic lithologies.

1. Banded-spherulitic rhyolite from Vinalhaven.

2. Rhyolite lithologies from the Cape Rosier/Castine portion of the Castine Formation.
3. Orcutt Harbor dark-colored Castine Formation varieties from Brooksville.
4. Kineo-Traveler Mountain porphyry.

Banded-spherulitic rhyolite (BSR) is a finely banded rhyolite flow composed of quartz and plagioclase feldspar. In fresh rock, there are light-colored (light gray to lavender) bands of microcrystaline quartz and feldspar, and dark-colored (dark brown to black) bands of intergrown smoky quartz (Billings 1965). The bands occur in two distinct habits, and both are found in artifacts. In one, the bands are nearly flat, planar features; in the other, the bands are contorted into whorls, spherules, or wavy streamers. Surface weathering changes the color of the bands to buff and very dark gray, with occasional patches of deep rose red. Heat treating will also develop this red coloration.

BSR is exposed on the northern end of Vinalhaven in a one-half-mile-wide band from Perry Cove to Crockett Cove (Figure A6.1), with the layered BSR variety best exposed in Perry Cove, and the spherulitic variety on Crockett Point. (Thin-banded, often spherulitic rhyolite is fairly common in felsic volcanic environments of the northern Appalachians, but the BSR of the Crockett Cove member is a very unique lithology). There are two other nearby exposure areas of the Vinalhaven Formation that include banded rhyolite (Figure A6.1). Mapped by Stewart and Wones (1974) and Dow (1965), one is on the southwest side of Isle au Haut, and the other on Great Spruce Island, but these are lithologically quite distinct from the BSR. Two other banded rhyolite localities are found in New England. They are the rhyolite vein fillings at Milan, New Hampshire, and the banded rhyolite in the Blue Hills south of Boston (Figure A6.2). These two are common lithic materials in the Northeast, but distinctive from the BSR.

Castine volcanics (CAS) underlie a very large part of eastern Penobscot Bay. They are rhyolitic rocks of the Siluro-Devonian age Castine Formation (Brookins, Berdan, and Stewart 1973). The Formation is broken into segments by plutons and the waters of the Bay (Figure A6.1), but the segments are all of the same geologic age and petrology. Two distinct lithologies were used for Turner Farm artifacts: (1) the typical Castine Formation gray-green rhyolite that underlies the Cape Rosier and Castine peninsulas (CAS), and (2) the Orcutt Harbor varieties, dark gray to black-colored rhyolite found at Orcutt Harbor (OHB). The lithology of the typical CAS is first described, followed by the description of the OHB varieties.

There are three kinds of CAS used for artifacts:

1. A dark gray, slightly lustrous, fine-grained, tough rock, occasionally micro-porphyritic in texture. It appears chalky to buff-colored when weathered. It is the most common variety of CAS.
2. A slightly vitreous gray-green tuff (?), with occasional pyrite crystals present. It commonly has a wavy mottled texture. When weathered, it has a dull gray color and powdery surface texture.
3. A gray to gray-green, slightly granular pyroclastic (?) rock that weathers to a chalky surface texture.

The Orcutt Harbor varieties occur in the south corner of Brooksville Township in central Hancock County (Figure A6.1) as scattered exposures all around the Harbor. There are four varieties used for artifacts:

1. OHB, a dark gray, vitreous to slightly dull rock, very fine-grained to nearly aphanitic. It contains ± 15 percent submillimeter, glassy, white feldspar phenocrysts.

Larger (up to 1.0 mm) feldspar phenocrysts are also seen. It has a very dark gray to black chertlike lithology, but its volcanic texture and the presence of phenocrysts define its volcanic origin.

2. OHW, a dark gray to black rhyolite that contains irregularly shaped, subrounded spots and mottles of gray to white feldspar that appears to have undergone chemical alteration before induration. Artifacts of this material vary from very slightly spotted to a nearly all white.
3. OHM is a mottled and wavy-textured rhyolite, dark gray to gray-brown and brick red in color. It is slightly coarser grained and moderately vitreous.
4. OHC, a very dark gray to black chert, with moderate to dull luster, and excellent conchoidal fracture. Some specimens have a very slightly granular, "flinty" texture.

The Orcutt Harbor varieties do not develop a strong weathering patina. For the Turner Farm study, these four varieties are included under the name *Orcutt Harbor Black* (OHB).

Kineo-Traveler Mountain Porphyry (KTM) is the most common rock type used in artifacts in coastal and southern Maine sites. At the Turner Farm it represents 25 percent of all artifacts. The type KTM is commonly a green-gray, glassy, porphyritic rhyolite containing rectangular phenocrysts of feldspar, tiny glass beads of quartz, plus several accessory minerals. Its source area is the Traveler Mountain-Kineo Mountain rhyolite belt, described by Rankin (1968) as the Piscatiquis Volcanic Belt. It is a belt of caldera centers that extends for over 100 miles from Flagstaff Lake northeast to Grand Lake Matagamon (Figure A6.1). Three calderas—Traveler Mountain, Big Spencer Mountain, and Kineo Mountain—were the major contributors of artifact material. Each center has its peculiar petrologic character, and artifacts may commonly be tied back to an individual caldera.

The Traveler Mountain center is composed of a dark-colored, quite glassy, welded ash flow tuff containing phenocrysts of clear quartz and white to buff (plagioclase) feldspar. Quartz is rare, but does occur both in euhedral grains and in clear glass beads. Magnetite and hornblende phenocrysts are present in the upper part of the volcanic mass. The Big Spencer caldera rhyolite has a dark green to blue-green, quite glassy groundmass that contains phenocrysts of prismatic-shaped feldspar (occasionally cross-twinned), clear quartz glass beads, almandite (red) garnet, plus occasional pink apatite. The Kineo Mountain rhyolite is lighter colored than that from the other centers, with a gray-green to light green and wavy-banded gray-green color and texture. Feldspar phenocrysts are much larger, and quartz glass beads and garnet are very common. Rankin (1968) provides an excellent petrologic description of all varieties of KTM. KTM lithologies have, for a long time, been identified in the archaeological literature as Kineo felsite, presumably because of the presence of a large prehistoric quarry waste dump at the base of the mountain (see, e.g., Moorehead 1922:215–219). However, in lithic samples from coastal sites there does not seem to be a statistically greater number of artifacts from the Kineo caldera. Although not inappropriate, the name Kineo felsite or rhyolite should not be used to identify all KTM lithics. It should be used only for material from the Kineo caldera.

Volcanic Varieties Group—Andesite (AND)

There are two source areas of andesite used for artifacts at the Turner Farm. One is an outcrop exposure located a few hundred yards west of the site. The other is a series of random exposures of andesitic rocks intercalated with the Washington County portion of the Coastal Volcanic Belt.

Andesite (AND). The artifact lithics from both sources are fine-grained, silicious, and similar to those in the rhyolite group. They are separated from that group on the basis of either an andesitic composition or because they have petrologic characteristics that tie them to the Washington County Volcanics. They are also present at some other small outcrop areas along the Washington County coast. Turner Farm is one of the few coastal sites that contains a significant number of andesite specimens (89, or 6 percent of the total artifacts). The other coastal sites examined contained less than one-half percent andesite specimens. This is probably due to the proximity of andesite exposures. It was acceptable as a local source, but perhaps not fine enough or in sufficient quantity for export. Artifacts are dark gray-green or rose-violet to dull gray in color, moderately to slightly vitreous, with a swirled and mottled, flow-banded texture. Specimens are usually coarser grained than the average rhyolitic artifact.

Washington County Volcanics (WCV)

A large section of the Washington County coast and part of New Brunswick is underlain by weakly metamorphosed volcanic and associated sedimentary rocks—the *Washington County volcanics* (WCV). The sequence was very carefully mapped by Gates (1978), and much of the descriptive petrology and locality information comes from his work.

WCV source rocks range from a silicious mudstone to fine-grained, vitreous rhyolite lava flows. They contain significant amounts of the richly textured and brightly colored felsic volcanic lithologies found in many coastal collections. Pyroclastic rocks, commonly from explosive volcanic activity, are a common petrology of WCV lithics. They include tuff, tuff breccia, autobreccia, and lapilli piles. Lava fountain spatter-cone-textured rocks are also present in both outcrop and artifact. Mixtures of tuff, ash beds, and shallow-water mud deposits provide a mottled, swirly bedded, multicolored silicious mudstone lithology. Silicious mudstone is fairly common in this terrain, where the intermixing of pyroclastic particles and sea-bottom mud generated a very fine, tough silicious rock with an almost cherty texture. Jasper Beach, a small cove in Machiasport (Figure A6.1), contains large numbers of brick red, purple, brown, and pink cobbles of silicious mudstone. It has a dull luster, and colors often have a faded hue. Jasper Beach cobbles were commonly used for artifacts at coastal Maine sites. Another silicious mudstone source area is the pelagic sediment portion of the various chert facies of the Munsungan Formation at Munsungan Lake in northern Piscatiquis County.

The rhyolite and volcanic varieties groups together comprise the more silicious (felsic to intermediate) volcanic lithic suite at the Turner Farm site. They form more than three quarters of the total number of artifacts, and most of the bifacial tools.

Quartz/Chert Group

The quartz/chert group includes all the pure silica (SiO_2) lithologies found at the site. It contains the mineral quartz class and four classes of chert—one from Maine, one from Nova Scotia, and two from New York. *Quartz* (QZ) occurs randomly in the glacial drift, and in veins and cavities in bedrock. It has such a ubiquitous distribution that a single source area attribution is impossible. However, one Maine bedrock source of quartz crystal and one of milky quartz are well known and may have been lithic source areas. These are the extensive milky quartz fracture filling (in places up to two feet wide) that occurs in the Vassalboro Formation near Albion in central Maine, and pegmatitic glassy quartz from Sagadahoc and Oxford counties, Maine. Several kinds of quartz appear in the collection, including glassy crystal, rose, smoky, milky, and dull, massive, gray bull quartz. Small stemmed points were commonly made from glassy or milky quartz; small end scrapers of fairly glassy varietal and rose quartz are also common.

The four chert classes are Munsungan chert, Nova Scotia chalcedony, eastern New York chert, and varietal chert, which includes varicolored jasper, gray-brown chert, and exotic chert, much of which may have a Canadian Shield provenience.

Munsungan chert (MUN) is a commonly occurring lithology at many coastal sites, with the largest number found in Ceramic-age collections. There are statistically fewer MUN chert specimens found at the Turner Farm site (about 3.5 percent of the total artifacts) than at many coastal sites. The Goddard site a few miles to the east has about 10 percent Munsungan material.

The chert occurs as interbeds in the Munsungan Lake Formation, a dacitic (intermediate composition) submarine volcanic and volcanoclastic rock of Ordovician age (Figure A6.1) located in northwestern Maine (Hall 1970; Pollock 1986). The dacite flows, and accompanying pyroclastics, appear to have been deposited in repetitive cycles with the chert beds near the top of each cycle. The chert beds range in thickness from a few centimeters to tens of meters, thus providing good quarrying ground. Bonnichsen et al. (1980) reported extensive quarry and debitage evidence in the area. The geologic environment for the chert deposits at Ledge Ridge, in northern Oxford County (Figure A6.1), is similar to the Munsungan chert; however, the "host" rock at Ledge Ridge is a basalt.

In artifacts, MUN chert occurs in a variety of colors, with deep wine red, dark green, and mottled red and green the most popular. Gray, dark gray, and occasional black specimens are also present. The gray shades are the most commonly occurring in outcrop. It is a moderately fine-grained, massive textured chert, weakly translucent on thin edges, with excellent conchoidal fracture. Stress fractures are nearly absent. Most artifact specimens contain up to 15 percent dark gray diatom spheres. Pyrite has not been seen in outcrop or artifact specimens. Munsungan chert cobbles have not been reported in the glacial debris deposits along the coast, nor to any extent down the glacial travelway as is the case with ubiquitous KTM material. Even around the shore of adjacent Munsungan Lake, there is not a large amount of MUN chert cobbles. Early people must have obtained MUN chert from its proximal outcrop source.

The *Nova Scotia chalcedony* (NSC) lithic class is composed of varicolored and textured chalcedony and agate. Both varieties were deposited from slow-cooling, late magmatic stage, silicious exhalates that filled veins, fractures, and cavities in a Triassic-age rift basalt. Artifact-quality masses of chalcedony and agate are present throughout much of the length of the flow—a steep-sided, 300-foot-high ridge (North Mountain) that forms the southern shore of the Minas Basin from Digby Cove to Parrsboro, Nova Scotia (Figure A6.3). Native copper is also present in small veinlets, often in close association with chalcedony.

Both in outcrop and artifact the chalcedony/agate specimens are brightly colored, translucent to transparent, generally have a glassy luster, and show both a brittle and weakly

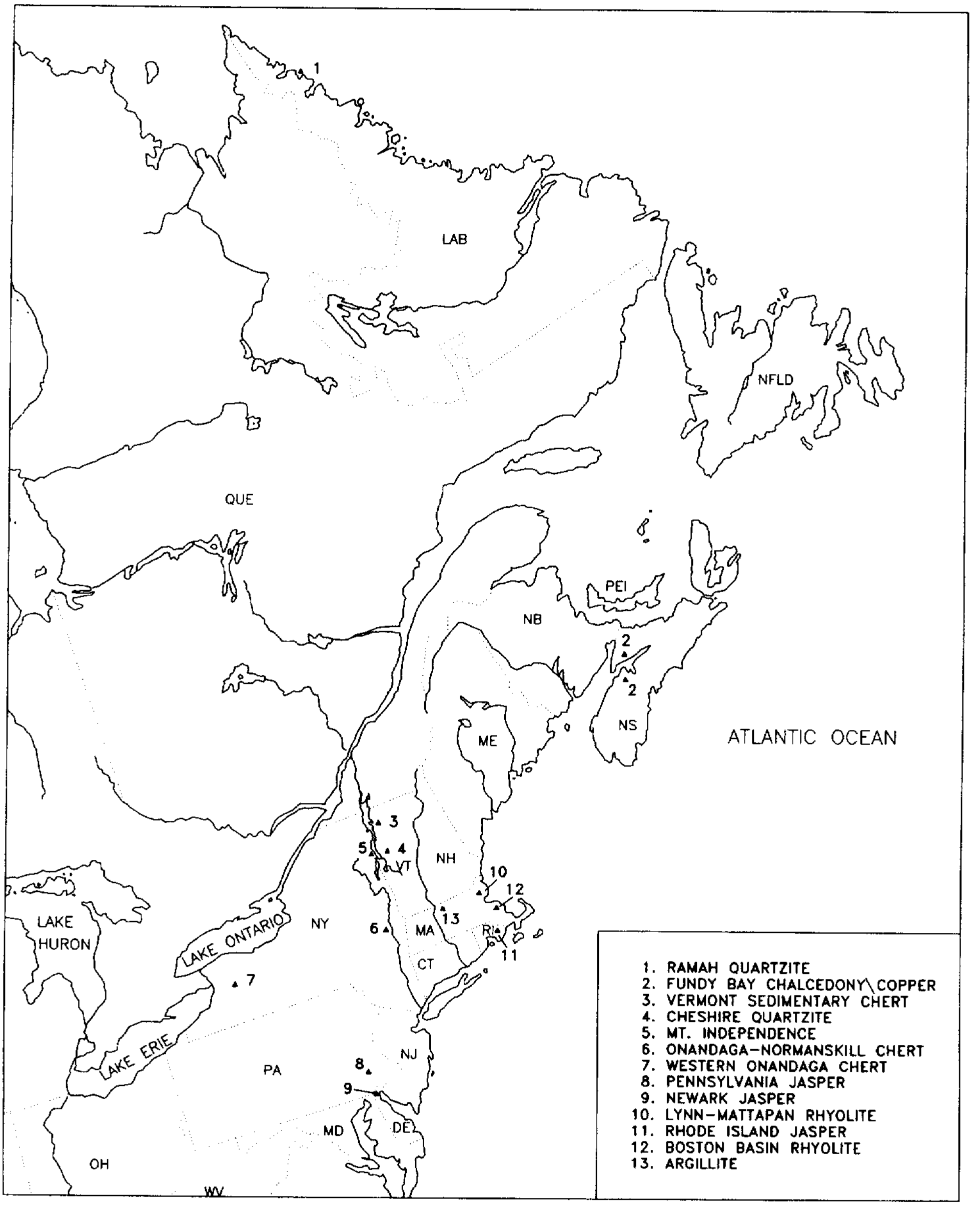

Figure A6.3. Location of lithic source areas in the northeastern United States and Canada, exclusive of Maine and New Hampshire.

conchoidal fracture pattern. The glassy varieties occur in a wide range of colors: pink, rose, deep wine red, light and dark purple, as well as red-brown and dark red-brown. Textural habits include wavy banded, swirled, mottled, spotted, and layered. The chalcedony of Blomidon Point is different from the rest of the localities along the mountain. It has a dull luster, is opaque, and is often massive textured. Colors include pale pink, rose, and buff-violet. It looks more like a porcelainite than a chalcedony, but was quite popular as an artifact material, perhaps because it occurs in thicker beds and is quite accessible, with a lot of material in one place.

The mottled, swirled, dark wine red and purple, glassy chalcedony is quite common near and northeast of Digby. A yellow to pale orange-yellow moss agate was found on Moose Island, just east of Parrsboro.

There is also a weakly banded, dull to bright red to purple variety found in a few coastal artifacts that has been traced to Scotts Cove, a small fish-hook-shaped cove across the Bay from Parrsboro. The base of the basalt flow at this locality is in contact with a thin limestone bed deposited as lacustrine limy mud at the margin of a large lake that formed sometime after the basalt was extruded and chilled. Thompson (1974) postulates that the chalcedony occurs as silica replacement of organic material (such as tree trunks and limbs), and of clay nodules and thin silty beds in the limestone. Some of the tree trunk chalcedony masses have amethyst tube cores.

Genetically equivalent Triassic basalt flows are also present on Grand Manan Island about 50 miles to the southwest (Figure A6.2). However, only a few fracture-filling patches of dull white chalcedony have been observed. It was of very poor quality and size for artifacts, and is not seen in the Turner Farm collection.

New York cherts (NYC) include a variety of bedded and nodular deposits contained within the carbonate and clastic sedimentary rocks of the Carbonate Platform west and northwest of the Appalachian folded belt (Figure A6.2). They have been a major lithic source for the prehistoric peoples of New England.

These Carbonate Platform cherts are not common at coastal Maine sites, but even the Turner Farm site contained at least 30 Platform chert artifacts. Most of the NYC artifacts are light- to dark-colored, dull gray, sometimes gray-brown or pale green, mottled cherts, of varying grain size and texture. There are three specimens of the gray-brown, mottled Onandaga chert and four of the lustrous, diatom-rich green Normanskill chert, plus a dull gray, massive chert artifact of presumed Helderberg provenience.

Varietal chert (VAR CHE) is represented by a number of chert artifacts that may have a New York source area, but no provenience can be determined. These include common vitreous and dull-luster gray and black chert, and a red jasper of possible central Maine provenience. There are also six "exotic" varieties with no recognizable provenience. Varietal chert was much more commonly used during the Ceramic period.

Plutonic Group

The Plutonic group includes three major igneous rock types: granite, gabbro and diabase, and basalt and trap rock. Though of different genesis and petrology, they form a common lithic material for many of the ground and pecked artifacts. A few flaked artifacts of trap rock and basalt are present. Most of the plutonic lithics in the Turner Farm collection can be found in outcrop or in drift cobbles on the Island.

Granite (GRA) is composed of orthoclase (K-feldspar) and some sodic plagioclase feldspar, quartz (± 5 percent), micas, and accessory minerals such as garnet and tourmaline. Such rocks are coarse grained, fairly soft, with a texture that is easily pecked. They are light colored, often with rich color patterns, which may have led to their use as ornamental pecking stones or plummets. Locally available granite is red, pink, whitish, light green, or gray colored.

Grabbo and *diabase* (GAB/DIA) are the darker-colored, more iron-rich equivalents of granite. They are usually green-gray, dark green, or almost black. Gabbro is composed of calcic plagioclase, hornblende, biotite, and olivine. There is a small gabbro body exposed at the north end of North Haven Island that may have been a local source. Some artifacts were presumably derived from beach cobbles. Diabase is the porphyritic variety of gabbro, found throughout Maine, but more commonly along the eastern coast. Like common gabbro, it is composed of dark gray to black, fine- to medium-grained mafic minerals, but it also contains fairly large (1.0–3.0 mm) laths of white to buff Ca-rich plagioclase that give the rock a spotted appearance. It is rarely found in artifacts, usually as poorly formed bifaces and occasional hammerstones.

Basalt and *trap* (BAS/TRA) rock types are the extrusive (lava flow) equivalents of gabbro. Both are found in outcrop and in the beach drift on North Haven. Basalt is very fine grained, almost aphanitic, massive, and rarely textured. Colors range from dark greenish black to black and very dark gray. Disseminated pyrite is fairly common. Many basalt flows on the East Coast occur in Triassic rift basins such as the Palisades in New Jersey and North Mountain in Nova Scotia.

An older basalt flow that crops out conveniently to the Turner Farm at Mullins Head on North Haven (Figure A6.1) may have been a source rock. Its primary use was for ground and pecked tools, but some varieties are sufficiently tough and brittle for making bifacial tools.

Trap rock is an ultra fine-grained variety of basalt that occurs in dike and sill swarms, part of the Triassic lava intrusions associated with Atlantic rifting. The fine texture is caused by very rapid cooling (quenching) as lava came in contact with the cold country rock it invaded. It is very dark gray to black in color, very brittle, with fair conchoidal fracture, and has a characteristic orange to orange-yellow weathering rime. Trap was used for bifaces and scrapers. Dikes and sills of trap rock are quite common along the coast, and on islands in Penobscot Bay.

Metamorphic Group

The metamorphic group includes rocks of both low- and high-grade metamorphism. Low-intensity metamorphism, such as that which alters shale to slate or devitrifies glass particles in volcanic rocks, had little impact on, or sometimes improved, the flaking quality of a rock. High-intensity metamorphism, however, completely alters the fabric, grain size, and composition of rocks, often rendering them nearly useless for flaked artifacts. Quartzite is an exception; its flaking properties were often improved by intense metamorphism. Four individual lithologies are included here: metamorphosed sediments and volcanics, Ellsworth Formation lithologies, quartzite, and slate.

Metamorphosed sediments and volcanics (MSV) includes phyllite, schist, gneiss, granulitic rocks, and magmatite. They are usually coarse, granular, soft, and contain much mica.

Phyllite is a micaceous, often chlorite-rich metamorphic rock with a shiny, platy texture, often rippled in appearance. It is soft and easily scraped into shape, with colors of green to dark gray to black. Phyllite was used for ornaments or plummets. Ellsworth Formation phyllite was commonly used for that purpose.

Schist, gneiss, and granulite are varieties of coarsely recrystallized, granular rocks composed of quartz-feldspar-biotite + muscovite + calcareous minerals. They have a banded to massive texture and tend to be coarse-grained. Source areas for these lithologies were probably from the Kearsarge-Central Maine Synclinorium of central Maine (Osberg et al. 1985). Cobbles of these lithologies are common in the drift on North Haven, which provided a plentiful local supply. The granulite and schist/gneiss cobbles are occasionally found on North Haven, but gabbro and granite are more common.

The *Ellsworth Formation* (ELS) crops out from Castine to Gouldsboro, concentrated around Ellsworth Falls (Figure A6.1). It consists of a number of strongly metamorphosed igneous and sedimentary rocks of early Paleozoic age (?). The rocks are characterized by a green to dark green color, intense shearing and microfolding (often with a chevron pattern), and the presence of large amounts of chlorite. Nearly every central coastal site contains ELS artifacts. The rock is quite soft, and weathers quickly. It is not often found in the drift, and thus outcrop quarrying was probable. Ellsworth Formation rock occurs in four characteristic lithologies:

1. Green- and gray-banded schist with chlorite > hornblende green bands and feldspar > mica > quartz gray bands. Band thickness is variable, but averages 0.5 cm.
2. Folded and strongly foliated green chlorite-rich phyllite, often containing thin lenses of "greenstone."
3. Massive, highly sheared and foliated greenstone, composed of chlorite, calcic feldspar, hornblende, and mica.
4. Fine-grained gabbro, usually dark gray-green in color.

Their distribution is random, although the banded schist is more common at the northern boundary of the Ellsworth Formation. Bright green, subglassy crystalline chlorite was used for finely carved and ornamented plummets.

Only 2 of the 16 *quartzite* (QZT) artifacts have a confirmed source provenience. These are from the Cheshire Quartzite of northwestern Vermont. The remaining 14 are from unknown source areas, although the Canadian Shield, eastern New Brunswick, and possibly far northwestern Maine are suspected source areas. Many of the other 15 specimens are fine-grained, massive, weakly lustrous to glassy, with good conchoidal fracture. Magnetite and tourmaline impurities are common. Color ranges from black to blue-gray to gray and brown. The flaking quality varied from excellent to moderate, with the Cheshire Quartzite having the best quality. Ramah chert from Labrador, another high-quality material, was not found at the Turner Farm site, though it is present in many coastal Maine sites. Cheshire Quartzite is a Paleozoic rock unit that occurs in a narrow, arcuate outcrop band in northern and western Vermont (Doll et al. 1961; Figure A6.3). It is medium brown to honey brown in color, with occasional faint gray mottling, very fine grained, and with a subglassy luster. Most pieces are translucent on thin edges. It displays a strong mineral grain lineation and a slight "nubbly" grain texture. These characteristics and its particular brown color are diagnostic. One confirmed source of high-quality Cheshire Quartzite is a series of outcrops near Otter Creek, a few miles east of Vergennes, Vermont.

Slate (SLT) is a very common rock type in the Appalachian folded belt, occurring in nearly every geologic terrain. With rare exceptions, slate did not survive glacial drift transport. I suspect that it is a proximal source area that required direct quarrying. Slate is the product of strong compression (at fairly low temperature) of shale that formed a tough, strongly cleaved rock. Slaty cleavage allows it to be split into very thin plates. Slate with a high percentage of adulterating minerals is classed petrologically as a metasiltstone. It too is found at the site and has a variety of source areas, largely in the mid-Maine sedimentary basin. The few ground stone tools from the Turner Farm were made from slate or, less commonly, from metasiltstone. Those of highest quality are almost surely made from Monson slate, a thin lens of highest-quality slate from a still-operating quarry in Monson, northern Franklin County, Maine (Figure A6.1).

STATISTICAL DATA ON THE LITHIC MATERIALS

This section summarizes the lithic identification data of artifacts from the Turner Farm site according to their lithic class, tool type, and cultural period. The data are presented in four tables.

There were 1,920 lithic artifacts in the collection analyzed, comprising 1,242 bifaces, 388 scrapers, and 290 pecked and ground tools (Table A6.1). These recoveries are about normal for coastal Maine sites. Bifaces represent 65 percent of the total, with nearly 90 percent of them made from two of the three silicious lithologic groups—rhyolite, volcanic varieties, and quartz/chert. Most of the other bifaces were of basalt, trap, and quartzite. Scrapers represent about 22 percent of the tools, and, like the bifaces, were made mostly (+90 percent) from the silicious lithologic groups. Local Penobscot Bay sources and distant sources are about equally represented, with about 4 percent each. The percentage of KTM scrapers (8.39 percent), as usual, was twice that of local or distant sources. This is also a common statistic in coastal Maine. The largest percentage of pecked and ground tools were made from KTM, CAS, and EPB, mostly from beach drift cobbles.

There were 1,292 rhyolite group artifacts recovered, representing 67 percent of the total tools. This is the most common lithologic group used. When we add the 166 tools of the volcanic varieties group, they together total 1,458 artifacts—about three-fourths (76 percent) of all tools studied. The silicious volcanic lithologies are, by a wide margin, the most commonly used rock type at the Turner Farm site. Except for WCV, their source areas are local, within 25 miles of the site. I have included cobble-derived KTM as a locally derived, distal-source lithic. This decision is based on extensive coastal beach surveying where up to 15 percent of the beach cobbles are of KTM.

The quartz/chert group contains 224 tools (12 percent of all tools), most of them bifaces. There were 84 scrapers (4.38 percent of the total), mostly QTZ, MUN and NSC, consistent with other coastal sites. The absence of NYC scrapers is due in part to a cautious identification of chert lithologies. It is possible that some scrapers (and some bifaces as well) may well have a Hudson Valley provenience. There were nine pecked and ground tools, most of them probably reused cores, or irregular chunks of quartz.

Plutonic Group lithologies include granite (GRA), basalt (BAS) and trap (TRA), and gabbro (GAB) and diabase (DIA). All these rock types except diabase are common to Penobscot Bay, both in outcrop and glacial drift. There were 144 tools in this group. Of

Table A6.1. Artifact Summary by Tool Type

	Tool type						Total tools	
	Bifaces		Scrapers		Ground and pecked			
Lithology[a]	Number of tools	Percent of tools	Number of tools	Percent of tools	Number of tools	Percent of tools	Total number	Total percent
Rhyolite group								
BSR	414	21.43	24	1.25	8	0.42	446	23.25
CAS	59	3.08	56	2.92	35	1.82	150	7.82
OHB	160	8.36	22	1.15	25	1.29	207	10.79
KTM	261	13.74	161	8.39	67	3.52	489	25.49
Total rhyolite	894	46.61	263	13.75	135	7.05	1,292	67.36
Volcanic varieties group								
AND	73	3.81	5	0.26	11	0.57	89	4.64
WCV	57	2.97	13	0.68	7	0.36	77	4.01
Total volcanic varieties	130	6.78	18	0.94	18	0.93	166	8.65
Quartz/Chert group								
QZ	27	1.41	14	0.74	4	0.21	45	2.35
MUN	26	1.36	37	1.93	0	0	63	3.28
NSC	10	0.52	12	0.63	0	0	22	1.14
NYC	7	0.36	1	0.05	0	0	8	0.42
VAR CHE	61	3.18	20	1.04	5	0.26	86	4.48
Total Quartz/Chert	131	6.83	84	4.38	9	0.47	224	11.68
Plutonic group								
GRA	0	0	0	0	11	0.57	11	0.58
BAS/TRA	58	3.02	14	0.73	10	0.79	82	4.27
GAB/DIA	3	0.16	2	0.10	46	2.36	51	2.66
Total plutonic	61	3.18	16	0.83	67	3.49	144	7.51
Metamorphic group								
MSV	12	0.62	5	0.26	41	2.13	58	3.02
ELS	0	0	0	0	12	0.63	12	0.63
QZT	12	0.62	2	0.10	2	0.11	16	0.83
SLT	0	0	0	0	3	0.15	6	0.31
Total metamorphic	24	1.25	7	0.36	61	3.18	92	4.80
All totals	1,240	64.65	388	20.23	290	15.12	1,918	100.0

[a]Reader is referred to text for definitions of abbreviations.

these, 72 bifaces and scrapers were made from trap or basalt. There were three weathered, flaked tools made with unusually tough gabbro and diabase. There were 57 ground and pecked tools of coarse-grained plutonic rocks, plus 10 made from basalt.

Metamorphic group lithologies include 92 artifacts, two-thirds of them ground and pecked. The bifaces and scrapers are made with a fine-grained granulite lithology, a possible Bangor-area source rock that may have come from the beach drift. In the quartzite class there were 14 flaked artifacts and 2 pecking stones. Twelve ELS artifacts were identified, mostly formed into plummets. Quartzite artifacts are not as common in the collection as at other coastal sites, but there is considerable evidence from chip recovery that quartzite was probably commonly used at Turner Farm, although identifiable artifacts are rare. Unlike most other of the metamorphic class lithics, quartzite has no local provenience. Drift cobbles of possible Canadian Shield quartzite were a potential source. Only six slate ground-stone tools were found, although I had noted considerable slate debris from the screenings. Slate tools at the Turner Farm did not seem to survive well.

Summarizing the data from Table A6.1, there is evidence of heavy dependence on two very local materials—BSR and the nearby outcrops of AND. Their rate of use was at least twice the average of most other central coastal sites, some of which were not very distant from these source areas. The rhyolite group, as expected, represents the most numerous lithologic type for all tools. WCV, MUN, and varietal chert are next most numerous of the silicious lithologies. There is the usual correlation with the metamorphic and plutonic lithic groups as the commonly used lithology for pecked and ground tools. The use of KTM for these nonflaked tools is slightly above average for coastal sites. The chert lithologies have the highest percentage of use for scrapers, with MUN the most commonly used chert. The few GRA tools probably represent a poorly selected sample; I identified many of the granite pecking stones as noncultural cobbles. In general, the pattern of use for each tool type and lithology follows the pattern for most coastal Maine sites.

The Archaic period is represented by 974 tools and the Ceramic by 944 (Table A6.2). The rhyolite group was the most common lithic group in both periods, with 75 percent and 57 percent, respectively, for the Archaic and Ceramic. The preferential use of fairly local silicious volcanic material remained fairly constant between Archaic and Ceramic times, with a slight lessening of the percentage of use of rhyolitic tools by the Late Ceramic period. Quartz/chert group lithologies were more common in the Ceramic than the Archaic by a more than 2 to 1 margin, the largest difference being the high scraper use of MUN and NSC in the Ceramic. The lithologies in this group generally have distal source areas, indicating the possibility of more extensive travel and outside contact by Ceramic period people. The use percentage for plutonic group lithologies in the Ceramic period was somewhat greater than that for the Archaic, although the use pattern for each lithology in the plutonic group did not change much over time. There was merely a slightly increased use percentage of plutonic lithologies in the Ceramic. Metamorphic group lithics, as a group, show a marked decline in use percentage and total numbers from Archaic to Ceramic. There were 92 artifacts, in all, representing about 5 percent of all tools at the site. Of these, 41 were from the Archaic. The 12 ELS artifacts were recovered from both Moorehead and Susquehanna deposits.

There were 16 QZT artifacts found, largely from the Archaic. Two Cheshire Quartzite bifaces, however, were from Late Ceramic features. Although the quartzites are generally

Table A6.2. Artifact Summary by Culture

Lithology[a]	Archaic: Number of tools	Archaic: Percent of tools	Ceramic: Number of tools	Ceramic: Percent of tools	Total tools: Number of tools	Total tools: Percent of tools
Rhyolite group						
BSR	295	30.28	151	16.50	446	23.25
CAS	99	10.16	51	5.40	150	7.82
OHB	108	11.09	99	10.49	207	10.79
KTM	232	25.82	257	27.22	489	25.48
Total rhyolite	734	75.36	558	59.11	1,292	67.36
Volcanic varieties group						
AND	34	3.49	55	5.83	89	4.64
WCV	16	1.64	61	6.46	77	4.01
Total volcanic varieties	50	5.37	116	12.29	166	8.65
Quartz/Chert group						
QZ	18	1.84	27	2.86	45	2.35
MUN	5	0.51	58	6.14	63	3.28
NSC	1	0.10	21	2.22	22	1.14
NYC	3	0.31	5	0.53	8	0.42
VAR CHE	41	4.21	45	4.77	86	4.48
Total quartz/chert	68	6.98	156	16.53	224	11.68
Plutonic group						
GRA	5	0.51	6	0.63	11	0.58
BAS/TRA	43	4.41	39	4.13	82	4.27
GAB/DIA	33	3.37	18	1.91	51	2.66
Total plutonic	81	8.32	63	6.67	144	7.51
Metamorphic group						
MSV	26	2.67	32	3.39	58	3.02
ELS	12	1.23	0	0	12	0.63
QZT	0	0	16	1.69	16	0.83
SLT	3	0.32	3	0.31	6	0.31
Total metamorphic	41	4.21	51	5.70	92	4.80
All totals	974	100.00	944	100.00	1,918	100.00

[a]Reader is referred to text for definitions of abbreviations.

considered to have distant source areas, the tough nature of this rock allows for its survival in the glacial drift train. Except for the known source area of the Cheshire material, the quartzites are not a good indicator of a wider area of contact.

Summarizing the data from Table A6.2, there is an increase in the use of more distantly sourced lithics by Ceramic period people. The percentage of use of locally derived lithologies—like the rhyolite group, AND, and plutonic rock cobble material—stays roughly equal in both major cultural periods. However, most distant source area lithologies like the WCV and the quartz/chert group show an increase from Archaic to Ceramic times.

The distribution of nearby and distantly derived lithologies is shown in Table A6.3, a comparative listing of many of the 18 rock types by source distance and number of artifacts for each lithology and cultural period. Nearby source areas are defined as within a few miles of the site. Distant source areas are more than 25 miles away. Because of its extensive distribution pattern in the coastal drift, the KTM numbers are arbitrarily divided in half; for

Table A6.3. Preferential Use of Nearby versus Distant Sources of Lithic Materials

Nearby			Distant		
Lithic type[a]	Archaic	Ceramic	Lithic type[a]	Archaic	Ceramic
BSR	295	151	KTM(½)	116	129
CAS	99	51	WCV	16	61
OHB	108	99	MUN	5	58
KTM(½)	116	128	NSC	1	21
AND	34	55	NYC	3	5
QZ(¾)	13	20	VAR CHE	41	45
BAS/TRA	43	39	QZT	0	16
GAB/DIA	33	18	SLT	3	3
MSV(¾)	21	24	QZ(¼)	5	7
ELS	12	0	MSV(¼)	6	8
Totals	774	585		206	353
All totals	1,359			559	

[a]Reader is referred to text for definitions of abbreviations.

the same reason, quartz (QZ) and MSV have been split 3:1, for nearby and distant sources, respectively.

Nearby lithologies were used far more than distant sources, and much more extensively in the Archaic than in the Ceramic. It appears that these Archaic people preferred not to travel for distant lithologies as much as those who lived later on. The largest percentage increases between the Ceramic and Archaic in use of distantly sourced lithics were for WCV (16 to 61), MUN (5 to 58), and NSC (1 to 21). There was a marked decrease in use of the BSR from Archaic to Ceramic. It appears that Ceramic period people developed a preference for distantly sourced cherts, more exotic rhyolite, and quartzite, thus reducing their use of the excellent BSR source only one mile away.

CONCLUSIONS

The conclusions of this study are largely defined in Table A6.4, a summary of the distribution of lithic materials through the five major cultural traditions uncovered at the site. Table A6.4 is a summary document. It presents, in both tabular and graphic form, the complete range of numbers of lithic artifacts used in turn by each of the five major cultural levels, thus indicating how use preference changed through time. The stratigraphic units are those used elsewhere in this volume (see Chapters 4–8).

Table A6.4 is quite straightforward, although two numbers bear emphasis. They are the very high frequency of BSR in Occupation 3 and its high frequency in the late Ceramic. Other traditions certainly knew BSR was nearby, but seemed to prefer other materials for their tools. Occupation 2 stone workers definitely preferred KTM to BSR. There appears to have been no Archaic period quartzite artifacts identified. Likewise, ELS artifacts are not present in the Ceramic period recoveries. These anomalies have been checked and seem valid. There are no lithic source data that would explain this strange relationship.

Table A6.4. Distribution of Lithic Materials

	Culture						
	Archaic				Ceramic		
Lithic materials[a]	Occupation 1	Occupation 2	Occupation 3	Total Archaic	Early Ceramic	Late Ceramic	Total Ceramic
BSR	3	27	265	295	38	113	151
CAS	0	28	71	99	15	36	51
OHB	0	42	66	108	9	90	99
KTM	11	133	88	232	74	183	257
AND	1	12	21	34	12	43	55
WCV	3	7	6	16	11	50	61
QZ	10	6	2	18	4	23	27
MUN	0	2	3	5	6	52	58
NSC	0	1	0	1	5	16	21
NYC	0	0	3	3	3	2	5
VAR CHE	2	29	10	41	6	39	45
GRA	0	3	2	5	5	1	6
BAS/TRA	5	13	25	43	0	39	39
GAB/DIA	0	25	8	33	0	18	18
MSV	0	14	12	26	11	21	32
ELS	0	7	5	12	0	0	0
QZT	0	1	1	2	3	13	16
SLT	0	0	3	3	1	2	3
Total	35	349	590	974	203	741	944

[a]Reader is referred to text for definitions of abbreviations.

The scant recoveries from Occupation 1 suggest an almost complete dependence on nearby source areas. With the exception of two fairly well confirmed brown and gray cherts, all the other tools could have been recovered right on the Islands. I still have the impression that there was probably a much larger use of granite and slate for hand tools, but the fragile nature and fire cracking of these rock types have lost many tools in the ground.

In a general way, however, the pattern of lithic preference is quite typical of the Maritime cultural evidence I have examined during the past decade. Archaic populations seem to have stayed close to home and used native material. Later traditions began to expand their travel and distant contacts, culminating in the greatly expanded use of "exotic" cherts and other distant silicious lithologies during the Late Ceramic. This pattern, as noted, is common to the majority of Maritime occupations. It is interesting to observe that when we add the lithic preferences of the Paleoindian tradition to the Archaic and Ceramic, we see an expansive trade and travel style in the oldest people, a drawing in during the middle period, and another expansion in the later traditions.

Appendix 7

The Human Burials from the Turner Farm Site

LENORE T. BARBIAN AND ANN L. MAGENNIS

INTRODUCTION

The rise of the population-based approach to skeletal analyses is a landmark event in the field of skeletal biology. Not only did this approach greatly contribute to our understanding of skeletal pathology (Buikstra and Cook 1980), it provided the framework with which to address issues of wider anthropological interest. Skeletal analysis need no longer be viewed solely in a typological perspective. Now skeletally derived data (including age, sex, and pathology) can be used to address questions of social complexity, social organization, and population adaptational success. While this approach has proven useful in the analysis of a wide number of temporally and spatially distinct prehistoric populations (see Cohen and Armelagos 1984), its application has been largely lacking in the Northeast. The blame for this situation cannot be placed entirely on the research interests of past scholars. New England generally lacks the large, homogeneous skeletal series that is essential for population-based studies. As a way around this problem, Schindler and coworkers (1981) have advocated a regional approach to questions of biocultural adaptation and suggest ways in which data generated from small samples can be combined to address questions of larger regional concern. It is precisely this suggestion for using small samples that guided Shaw's (1988) study of the Late Archaic Moorehead phase skeletal series from the Nevin site. Given the current issue of reburial and the uncertainty regarding the continued availability of skeletal material, it is essential that we continue to integrate analyses of these small samples into studies of larger regional interest.

It is in the light of these concerns that the analysis of the Turner Farm Late Archaic skeletal series was undertaken. The purpose of the study presented here is to characterize the size and demographic composition of the sample and to present detailed descriptions of

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both the unburned and cremated interments that will focus on the age, sex, and pathologies associated with each interment feature. Although the process of cremation results in the destruction of most aging, sexing, and pathology indicators that are crucial for studies of biocultural adaptation, the analysis of burned bone can provide important information on the condition of the corpse at the time of incineration. Bodies can be burned soon after death, curated for a period, or dismembered and/or defleshed prior to burning. Since this information is an important component of biocultural studies, we will present descriptions of the burning patterns associated with each cremation feature. More detailed discussion of the mortuary activities associated with the cremation features is available elsewhere (Barbian and Magennis 1994). The information presented here is an attempt to contribute to the regional database, which can be used by other researchers to address a variety of questions concerning prehistoric biocultural adaptation. More synthetic summaries of the Turner Farm skeletal series are available elsewhere (Barbian and Magennis 1994; Magennis and Barbian 1995).

METHODS

Minimum Number of Individuals

The first step in generating a profile of the Turner Farm series is to determine the minimum number of individuals (MNI) present. This was fairly straightforward for the primary inhumation features. All features were inventoried, and no duplication of body parts was noted that would suggest the presence of another individual (Table A7.1).

Table A7.1. Minimum Number of Individuals by Feature

Feature type	Feature number	MNI[a]
Primary unburned inhumations	6-1975	3
	9-1975	1
	18-1975	1
	30-1974	1
	34-1974	1
Secondary unburned inhumations	30-1975	2
	39-1974	5
Cremations	7-1975	5
	9-1975	6
	12-1975	5
	19-1975	9
	24-1975	2
	28-1975	3
	30-1975	2
	34-1975	2
	38-1975	5
	41-1974	10
	42-1974	7
Total		70

[a]MNI, minimum number of individuals.

MNI counts for the secondarily deposited features were determined by sorting the skeletal remains by bone type and size and counting the most commonly represented feature or element (Table A7.1). Subadults were identified by lack of epiphyseal closure on the long bones or presence of deciduous dentition. All individuals given the designation subadult represent individuals most likely less than 18 years of age at the time of death. However, it should be noted that many skeletal elements achieve developmental maturity before the age of 18, including the vertebrae, temporal, and the bones of the hands and feet. It is possible, therefore, that at least some of the subadult elements are included in the adult category. This is unlikely to inflate the MNI counts artificially since we adopted a conservative approach to determining the number of individuals. If the bony landmark used to establish the MNI count was not diagnostic of either adult or subadult status, the number of subadults, based on identifiable immature elements, was subtracted from this MNI estimate in order to determine the number of adults present.

Sex Determination

Accurate assessment of the sex of a skeleton is important to the development of reliable measures of sex-specific rates of mortality or morbidity. Such measures can prove to be useful tools for the investigation of environmental or cultural factors that influence the adaptive success of prehistoric populations. Two factors influence the accuracy of the sex determination of skeletal material: (1) age at death and (2) completeness of the skeleton. In general, the skeleton shows a marked lack of sexual dimorphism until puberty, at which time the structural constraints associated with childbirth for females and the bony landmarks associated with the increased muscle mass of adult males begin to be manifest. However, dental (Ditch and Rose 1972; Hunt and Gleiser 1955) and osseous (Boucher 1955; Hunt and Gleiser 1955; Reynolds 1945) observations and measures have been developed in order to sex prepubescent skeletons. While the success of these studies has varied, they all require a large sample of complete individuals. Since the Turner Farm site does not meet this criterion, none of the subadult material was assigned a sex.

Even though assessment of subadult sex remains problematical, sexing of adult skeletons is well established and known to have a high degree of accuracy (e.g., Bass 1971; Brothwell 1981; Krogman 1962; Ubelaker 1978; Workshop of European Anthropologists 1980). The two bony elements used most often to assign sex are the pelvis and the cranium. In general, sex is determined based on a set of visual criteria, although metric measures do exist. When utilizing visual inspection of the pelvis and cranium together to determine sex, accurate determination has been reported in 98 percent (Krogman 1962) and 97 percent (Meindl et al. 1985) of the cases studied. Using solely the pelvis, researchers have reported 96 percent (Meindl et al. 1985; Phenice 1969) and 95 percent (Krogman 1962) accuracy. Investigations of the accuracy of sex determination based solely on cranial morphology have reported 92 percent (Meindl et al. 1985) and 90 percent (Krogman 1962) success rates. Metric measures of the cranium and/or mandible have been developed to determine sex (Giles 1964, 1970; Giles and Elliot 1963), but the question of population-specific differences in the male–female dividing point has limited their application. In a recent study, Meindl and coworkers (1985) found that cranial metric determinations of sex are less accurate than subjective sex assessments. They attribute the failure of metric techniques to accurately determine sex to the age-related increase in dimensions experienced by the cranium.

While most studies to determine the accuracy of sexing techniques rely on complete pelves and crania, archaeologically derived skeletal series are often characterized by a fair to high degree of fragmentation. In a study in which only the pubis was available for the assessment, a lower but still substantial accuracy (83 percent) in sex determination was reported (Lovell 1989). In addition, techniques have been developed to estimate sex for those remains that lack either pelvic or cranial elements. Although less reliable than visual cranial or pelvic inspection, the diameter of the humeral or femoral head and circumference of the femoral midshaft have been used to metrically determine sex (Black 1978; DiBennardo and Taylor 1979; Krogman 1962; MacLaughlin and Bruce 1985). While caution needs to be used when applying these methods to small samples since sex-related size differences tend to be population specific, DiBennardo and Taylor (1979) suggest that femoral circumference may represent a fairly plastic measure perhaps due to functional demands associated with bipedalism. They have reported a substantial degree of accuracy (82 percent) in their study of modern autopsy specimens utilizing the regression techniques developed by Black (1978).

The sexing of the primary inhumations at the Turner Farm site was fairly straightforward, and visual observation of the pelvis and cranium was utilized. However, sex determination of the secondarily deposited inhumations and cremations was made more difficult by the lack of complete skeletons and the differential representation of the bony elements used in determining sex. Feature 39-1974 and all the cremations represented features in which a large degree of comingling of individuals' body parts occurred. While the most accurate assessments of sex are based on both the cranium and pelvis, this was not possible for these features. However, Feature 30-1975 appears to represent a fairly discrete bundle based on field notes and photographs, and we were, therefore, able to assign cranial and pelvic elements to this individual.

Accurate sexing of the cremated material is further complicated by the fragmentation bone experiences when burned. It should be noted that the fragment size of the cremated material at Turner Farm was generally small, resulting in the destruction of most of the bony landmarks used to establish sex. Even where adequate portions of the cranium or pelvis were present, the burning process can further complicate accurate sex determination. First, it should be remembered that sex determination based on a single landmark appears to have accuracy rates similar to those associated with metric techniques. Second, the twisting, warping, and shrinkage bone experiences when burned may confound both visual observation of sex characteristics as well as metric techniques. Studies investigating the effects of burning upon bone reduction have found bone shrinkage rates to be variable and highly dependent on the temperature at which the bones were burned (Buikstra and Swegle 1989; Burns 1987; Herrmann 1977; Shipman et al. 1984). Shipman and colleagues (1984) suggest that a sliding-scale correction factor can be applied to control for bone shrinkage if the temperature at which the bones were incinerated can be independently determined. Until such independent techniques are forthcoming, metric determinations of the sex of cremated osseous material appear unwise.

The sex determination of the secondary interments was based on a variety of criteria. Visual observation of any available complete or partial pelvis, cranium, or mandible was used to determine the sex of the individuals. In addition, femoral midshaft circumference was used to aid in the determination of the sex of the individuals in the comingled secondary unburned inhumation. Due to the problems of bone shrinkage already discussed, metric analyses were not used for the cremation features. It should be noted that it was not possible to distinguish individuals due to the comingling of the remains of the secondary interments. In addition, many of the adult individuals contained within the cremation features could not be assigned a sex due to the lack of appropriate skeletal elements. The sex, and criteria used to establish sex, of the adult interments are presented in the feature descriptions below.

Age Determination

Adult Age at Death

Numerous criteria exist for establishing adult age at death, including degenerative changes of the symphyseal face of the pubis, cranial suture closure, dental wear, and long-bone microstructure. While often one indicator (usually the pubic symphysis) is used, Lovejoy, Meindl, Mensforth, and Barton (1985) advocate a multifactorial approach to determining age at death. Their rigorous approach includes seriation of the sample based on five different age indicators: pubic symphysis and auricular surface metamorphosis, dental wear, cranial suture closure, and trabecular involution of the proximal femur. Although Lovejoy and coworkers present a convincing argument for such a multifactorial approach, constraints exist that may limit its applicability to archaeologically derived populations. Most notable are skeletal completeness and amount of time available for the analysis. While it was not possible to employ all the age indicators advocated by Lovejoy and colleagues, we did attempt to incorporate as many as possible. Seriation was used to reduce observer error and, where possible, two or more aging criteria were employed to determine adult age at death.

Perhaps the most commonly used and widely studied indicator of adult age at death is the metamorphosis of the pubic symphyseal face. One result of this intensive scrutiny has been the development of several different aging standards (see Gilbert and McKern 1973; Katz and Suchey 1986; McKern and Stewart 1957; Todd 1920, 1921). While the availability of so many aging standards may make the choice difficult, Meindl and colleagues (1985), in a blind test of three aging standards, found that the Todd (1920, 1921) 10-phase system yielded the most reliable estimates, although all methods tended to underage the oldest individuals.

A less utilized, though potentially more accurate (see Lovejoy 1985), means of aging skeletal material is dental attrition. Although dental wear is highly variable between populations due to differences in diet, food preparation techniques, and nondietary tooth use, Lovejoy (1985) argues that it is the most reliable indicator for establishing age at death for archeological skeletal series and is useful even in studies of contemporary skeletal populations. Since rates of tooth wear are population specific, a universal standard cannot be applied. Rather, attrition rates must be developed for each population in question based on functional wear gradients (see Brothwell 1981; Lovejoy 1985; Miles 1963, 1978).

For small skeletal samples such as Turner Farm, establishing attrition rates is often difficult, since a series of both subadults and adults of all ages is needed. Due to the paucity of individuals in the 6- to 18-year age range, functional wear gradients could not be constructed for the Turner Farm series. However, since dental attrition represented the only criterion available for aging some individuals, the Turner Farm dentitions were seriated by degree of wear. The dentitions were then grouped into 10-year age intervals based on the dentitions of individuals whose age was determined by other methods.

Aging criteria used in our assessment of the Turner Farm adult sample included Todd's (1920, 1921) stages of the pubic symphysis as modified by Meindl and colleagues (1985), dental wear, and auricular surface metamorphosis (Lovejoy, Meindl, Mensforth, and Barton 1985). Cranial suture closure was not recorded due to the extreme age of many of the adult skeletons, as well as the presence of artificial cranial deformation (Features 6-1975 and 18-1975) and severe craniofacial pathology (Feature 30-1975).

For the primary unburned inhumations and Feature 34-1975, we assessed the skeletons for as many of the above criteria as possible. Due to the comingling of Feature 39-1974, crania and pelves were aged independently. The size of the fragments associated with the secondary cremation features resulted in the preservation of few aging criteria. In instances where the dentitions or the appropriate pelvic elements were preserved, the standard aging techniques were used.

Subadult Age at Death

Unlike sex, age determination of subadult remains can be firmly established by several developmental standards using both osseous and dental remains. Age estimates based on the dentition can use either dental developmental standards of the deciduous and permanent dentition (Moorrees et al. 1963a, 1963b) or dental eruption rates (Schour and Massler 1941; Ubelaker 1978). The maturation of the skeleton involves the fusion of the epiphyses on the long bones and vertebrae. Since maturation does not occur uniformly across the skeleton, the pattern of epiphyseal closure can be used to determine age at death within a fairly narrow range (Brothwell 1981; Goss 1977; Krogman 1962; McKern and Stewart 1957; Modi 1957; Ubelaker 1978). Standards also exist that utilize long-bone length to determine subadult age at death (Johnston 1962; Merchant and Ubelaker 1977; Ubelaker 1978). Similarly, a series of regression equations can be used to estimate fetal age based on the length and width of fetal bones (Fazekas and Kosa 1978).

All subadult aging standards are based on the developmental and maturation rates of the skeleton. It is known that both development and maturation are influenced by a wide variety of factors, including but not limited to nutrition, genetics, and sex. Aging standards that utilize long-bone length appear to be particularly sensitive to population differences since adult stature is known to be determined by both environmental and genetic factors. On the other hand, dental development appears to yield the most accurate estimate of subadult skeletal age. However, due to the burning of the majority of the subadults, few teeth are available for analysis. Due to the paucity of other aging criteria, the long-bone length standards presented by Ubelaker (1978) were often utilized to determine subadult age at death.

In the determination of age for the Turner Farm subadults, multiple indicators were used where possible. Where dentitions were preserved, the dental development standards of Moorrees and colleagues (1963a, 1963b) were assumed to offer the most accurate estimate of age. Since discrete individuals were lacking in the cremation features, the appropriate bony elements were aged by the relevant standards and the results were compared and pooled to determine the ages of the subadults in each feature. Often epiphyses remained the sole indicator of the presence of subadults in the cremation features. In these cases, the epiphyses were seriated according to size and the subadults were placed into large age categories (less than 1, 1–10, 10–18) based on the size of the epiphysis. Table A7.2 presents the age distribution of the Turner Farm unburned and cremated interment features.

Incineration of Bone

Patterns of fractures of cremated bone can be analyzed for information regarding whether the body was burned fresh or curated for a period of time prior to incineration. Burning of fresh individuals may not always signify a lack of preincineration manipulation of the corpse since individuals or parts of individuals can be "green" when burned. Green-bone burning refers to the incineration of recently defleshed but still fresh bones. Bones in which much of the organic component has been allowed to decompose are referred to as dry. When attempting to distinguish between in-flesh, green-, or dry-bone burning, it is also necessary to control for the degree of incineration. Bones can be completely incinerated (calcined), incompletely incinerated (smoked), or unburned. The degree to which a bone is burned obviously depends on a wide variety of factors, including length of the burning, type of wood burned, and proximity of the bone to the center of the fire. All these factors can affect the nature and fracturing pattern of cremated bone (Thurman and Willmore 1980).

Due to the large number of variables that contribute to the fracture patterns of cremated bone, it is not surprising that contradictory and conflicting results have been found by researchers. In general, it is easier to distinguish dry-bone burning, while the distinction between fleshed and green specimens is more difficult. Calcined bone fragments that demonstrated no warpage, deep longitudinal or vertical fractures, and superficial checking most likely represent bone that was dry at the time of incineration (Baby 1954; Binford 1972; Buikstra and Swegle n.d.). Calcined fragments characterized by diagonal fracturing, deep checking, warping, and cracks extending nearly the length of the bone may be indicative of either fleshed or green-bone burning (Baby 1954; Binford 1972; Buikstra and Swegle n.d.; Thurman and Willmore 1980–81). While Thurman and Willmore (1980–81) were able to distinguish those bones which were green from those which were fleshed at the time of burning, their criterion is primarily one of degree of warping and checking. Buikstra and Swegle (1989) were unable to duplicate their results and, in fact, suggest that the only feature distinctive of in-flesh burning of calcined material is a pattern of concentric curved cracks in the popliteal region of the femur.

Buikstra and Swegle (1989) were able to distinguish dry, green, and fleshed bone in smoked specimens. Bones that exhibit a uniform smoked appearance are indicative of green-bone burning. Bones that were dry at the time of incineration fail to achieve a uniform black color and retain areas of unburned bone. Those areas that fail to burn apparently reflect the lack of organic material within the bone for combustion. In fleshed burning, some areas calcined before others became smoked. It has been suggested that this characteristic of in-flesh cremation—variation in the degree of burning due to differential protection of the bone by the surrounding soft tissue—is the best means to distinguish in-flesh from green-bone burning (Buikstra and Goldstein 1973). However, care must be exercised when evaluating these characteristics since a similar pattern can result from dismemberment prior to burning or may reflect the position of the bone in the fire.

Table A7.2. Age Distribution of the Inhumation Features

Burial type	Feature number	Subadult age category				Adult age category					
		<1	1–10	10–18	Subadult	Adult	18–25	25–35	35–45	45–55	55+
Unburned inhumations	6-1975	1	1								1
	9-1975										1
	18-1975								1		
	30-1974			1							
	30-1975					1					1
	34-1974							1			
	39-1974		1					3	1		
Cremations	7-1975	1	1	2		1					
	9-1975	2	2	1					1		
	12-1975	2	1			2					
	19-1975	2	1		2	4					
	24-1975				1	1					
	28-1975		2			1					
	30-1975			1		1					
	34-1975		1			1					
	38-1974		1			1		1	1	1	
	41-1974	1	4	1		2		1	1		
	42-1974	1	3	1		1			1		
Totals		10	18	7	3	16	0	6	6	1	3

FEATURE DESCRIPTIONS

Primary Unburned Inhumations

Four of the primary unburned inhumations recovered at Turner Farm represent the interment of single individuals (Features 9-1975, 18-1975, 30-1974, and 34-1974). In addition, Feature 6-1975 represents the inhumation of three individuals: an adult female, a newborn or infant less than 0.5 years of age, and an infant aged 1–1.5 years. While the adult female clearly represents a primary inhumation, it is not clear whether the subadults associated with her were intact or partially decomposed at the time of their burial. Although body part representation can be an indictor of secondary interment, it is not possible to determine the degree of body part loss due to vagaries of preservation. Age, sex, and the criteria used to establish them, as well as the pathologies associated with each of the primary unburned inhumations, are detailed in Table A7.3.

Secondary Unburned Inhumations

Feature 30-1975

A complete but disarticulated skeleton of a female aged 55+ years was recovered in this feature. The degree of disarticulation and position of the remains suggest that there was little or no soft tissue remaining on the bones at the time this individual was buried. At least one more individual was identified on the basis of an additional patella and a fragment of a femoral condyle. Detailed descriptions of these individuals are included in Table A7.3.

Feature 39-1974

A minimum of five individuals were interred in Feature 39-1974 based on left zygomatic processes. At least one of these individuals was a subadult based on the presence of a mandible with deciduous dentition as well as immature long-bone, innominate, scapula, vertebral, and sacral elements. Based on the degree of epiphyseal union/nonunion (Modi 1957; McKern and Stewart 1957; Ubelaker 1978) and dental formation of a first mandibular molar and a mandibular canine (Moorrees 1963b), this individual was between 8 and 10 years of age at the time of his or her death. The remaining four individuals were classified as adults based on the complete union of all long-bone epiphyses. Based on the morphology of four reconstructed skulls and two partial innominates, one adult is male, one is a probable male, one is a probable female, and the other is of indeterminate sex. Only a modest amount of osseous material was recovered from this feature, suggesting that complete individuals were not buried.

Based on the metamorphosis of the pubic symphysis (Meindl et al. 1985; Todd 1920, 1921) and auricular surfaces (Lovejoy, Meindl, Pryzbec, & Mensforth 1985) of the two male os coxae, one individual is 35–40 years of age and the other is 20–26 years of age. This correlates well with the age ranges generated from the degree of dental wear. The two male skulls were aged at 20–30 years and 30–40 years. The cranium of indeterminate sex was aged at 20–30 years, and the female cranium was 25–35 years of age. Therefore, Feature 39-1974 contains the remains of an 8- to 10-year-old subadult, a male aged 30–40 years,

Table A7.3. Skeletal Inventories and Descriptions of the Unburned Inhumations

Feature	Sex[a]	Age (years)[b]	Skeletal completeness	Pathology
6-1975 Sk 1	F (C)	50+ (AS)	Incomplete: mandible missing, all maxillary teeth lost antemortem, right radius missing, pelves incomplete.	Porotic hyperostosis on occipital and both parietals; remodeled periostitis on left femur, right and left tibia; unremodeled periostitis on left tibia; osteoarthritis of glenoid fossa of right scapula, sternal articular surfaces of right and left clavicles, and cervical, thoracic, and lumbar vertebrae. Note: cranial deformation with parietal flattening, entire vault compressed superior/inferior resulting extreme parietal bossing; occiput rounded and protrudes posteriorly; frontal flattened and slopes posteriorly.
6-1975 Sk 2	S	1–1.5 (DE, LBL)	Fragmentary and incomplete: incomplete cranium; sternum, left clavicle, right ulna, innominates, and most of the bones of the hands and feet missing; left femur and the vertebrae very fragmentary.	Slight, active periotic hyperostosis over frontal, occipital, both parietals, and temporals; slight, active periostitis on right femur and right tibia; hypocalcification, hypoplasias, and circular caries on maxillary and mandibular deciduous dentition.
6-1975 Sk 3	S	0–0.5 (LBL)	Incomplete: few cranial fragments, right scapula, both humeri, right ulna, right ischium and pubis, both femurs, tibiae, fibulae, some ribs, and thoracic vertebrae present.	All bones show moderate to severe, active periostitis; medullary cavities of all long bones are restricted in width.
9-1975	F (C)	55+ (AS, DA)	Nearly complete but fragmentary: cranium, hands, and feet incompletely represented.	Slight, remodeled periostitis on left tibia; osteoarthritis on distal articular surface of right fibula, both patellar articular surfaces, and cervical, lumbar and S1 vertebral fragments; a mid-thoracic vertebral body collapsing; all long-bone cortices are very thin suggesting advanced osteoporosis.

18-1975	M (C, P)	35–40 (PS, AS)	Basically complete	Slight remodeled porotic hyperostosis on frontal and both parietals; osteoarthritis on L5. Note: cranial deformation.
30-1974	S	10–12 (EU, DE, DF)	Incomplete: right and left femurs, right innominate, sternum, sacrum, and bones of both hands and the right foot missing.	Slight, remodeled porotic hyperostosis in both orbits and on parietals and occipital; slight, remodeled periostitis on right tibia, root of I^1 is resorbing; healed fracture of the trochlea of the right humerus resulting in the formation of a pseudo-facets on the radius and ulna; healed fracture of the left 1st and 2nd metatarsals.
30-1975 Sk 1	F (C, P)	55+ (AS, PS)	Fragmentary and incomplete: both scapulae, right radius, left clavicle, left humerus, and both hands missing; vertebrae, ribs, and both feet poorly represented.	Slight, remodeled porotic hyperostosis in right orbit and on parietals, temporals, and the occipital; osteoarthritis on right distal femur and proximal tibia, left femur fovea, cervical, lumbar, and sacral vertebrae; internal sagittal sulcus does not run along the midline but from the frontal runs right of midline; mandible has large abscess at midline; the body of the left mandible appears foreshortened in the ventral-dorsal aspect.
30-1975 Sk 2	?	?	Incomplete: one patella and one fragment of a femoral condyle.	None.
34-1974	F? (C)	25–35 (AS, DA, EU)	Incomplete: both femurs, both patellae, left tibia, left innominate, sacrum, and coccyx missing; remaining bones are fragmentary and incompletely represented.	Slight, remodeled porotic hyperostosis on frontal, parietals, and occipital; highly porotic olecranon process of right ulna, lesser sigmoid cavity appears abnormally small; anconeus attachment is pronounced and brachialis attachment area is porotic; insertion for subscapularis on right humerus is porotic.

[a]C, Cranial morphology; P, Pelvic morphology.

[b]AS, auricular surface (Lovejoy et al. 1985); DA, dental attrition (Lovejoy 1985; Miles 1963, 1978); DE, dental eruption (Schour and Massler 1941; Ubelaker 1978); DF, dental formation (Moorrees et al. 1963a, 1963b); EU, epiphyseal union (Brothwell 1981; Goss 1977; Krogman 1962; McKern and Stewart 1957; Modi 1957; Ubelaker 1978); LBL, long-bone length (Johnston 1962; Merchant and Ubelaker 1977; Ubelaker 1978); PS, pubic symphysis (Meindl et al. 1985; Todd 1920, 1921).

a probable male 20–30 years of age, a probable female 25–35 years of age, and an adult of indeterminate sex aged 20–30 years.

The pathologies associated with the adult individuals interred in Feature 39-1974 are minor. A well-healed fracture occurred on one left clavicle. A fracture to a right vertebral arch resulted in the formation of a pseudo-arthrosis on L4. Osteophytosis is present on the vertebrae of at least two individuals, on the glenoid fossa of one left scapula, and four right and three left ribs.

Cremations

Feature 7-1975

There is a minimum of five individuals represented in this feature, each very poorly represented. This is especially evident in the paucity of recovered cranial fragments and in the lack of symmetrical representation of body parts. With the possible exception of ulnar shafts, none of the five individuals is represented by both a left and a right side of the same bone or element. Long-bone fragments are overrepresented in comparison to the total amount of bone in the feature.

Of the five individuals, four are subadults and one is an adult. The youngest individual is aged at birth to 6 months based on the degree of development of the basioccipital (Redfield 1970) and the size of the ilium. The second subadult is approximately 2–6 years of age based on crown development of an incomplete mandibular first molar (Moorrees et al. 1963b). The third subadult is at least 6 but less than 15 years of age. This rough age determination is based on bone size and the degree of epiphyseal union/nonunion of the distal humerus, distal radius, and the acromion and coracoid processes of the scapula (Brothwell 1981; Krogman 1962; McKern and Stewart 1957; Modi 1957; Ubelaker 1978). The fourth subadult is approximately 14–18 years of age based on the degree of epiphyseal union/nonunion of the proximal humerus (Brothwell 1981; Krogman 1962; McKern and Stewart 1957; Modi 1957; Ubelaker 1978). Adult age estimation for the fifth individual is based on the complete epiphyseal union of a proximal tibia fragment. Sex of the adult could not be determined.

The majority of the bone in this feature is calcined, but some fragments are only smoked. There is evidence of some red-ocher staining, and it is most apparent on the subadult remains. The majority of the bones show color and cracking patterns indicative of dry-bone burning. A number of fragments, however, suggest they were burned when the bones were fairly fresh. This is especially evident on the vertebrae and the large limb bone fragments. Overall, it appears that both fresh and dry bones were burned.

Feature 9-1975

The minimum number of individuals represented in this feature is six, of which one is an adult and the remaining five are subadults. At least two newborns are represented by temporal, sphenoid, and long-bone fragments. Age is estimated on the basis of length of the tibiae (Johnston 1962; Merchant and Ubelaker 1977; Ubelaker 1978). A subadult is represented by a right-mandibular permanent second molar, proximal humeral epiphysis, and scapula fragments. Development of the molar crown suggests an approximate age of 5 years (Moorrees et al. 1963b). A subadult of 5–10 years of age is represented by the proximal humeral epiphysis and scapula fragments. This age estimate is based on the relative size of this individual compared to individual number three. A 16- to 20-year-old subadult is represented by a radius and humerus. The age estimate is based on the recent fusion of the distal radial epiphysis and initial union of the proximal humeral epiphysis (McKern and Stewart 1957; Modi 1957; Ubelaker 1978). Based on morphology of an incomplete pubic symphysis (Meindl et al. 1985; Todd 1920, 1921), an adult 30–40 years of age is present in this feature. Sex could not be determined for this individual. The counts of adult elements suggest that at least two adults are contained in this feature. However, it is likely that the individual aged 16–20 years was included in those adult categories. While it is possible that there is at least one additional adult in this feature, this individual would be represented by only two cuneiforms and a fifth metatarsal.

Nearly all of the bones in this feature are completely calcined. Only a few fragments exhibit evidence of being both smoked and calcined. The color of the calcined fragments ranges from white to gray to buff, but gray predominates. It would appear that both fresh and dry bones were burned. At least one individual was burned green. Characteristics of green-bone burning (twisting, extreme warping and cracking, as well as checking) are most evident on those bones representing the 16- to 20-year-old individual. Further, cranial fragments representing one of the younger subadults (excluding either of the newborns) appear to have been burned green. The adult appears to have been burned dry.

Feature 12-1975

The minimum number of individuals represented in this feature is five: two adults and three subadults. The minimum number of adults was determined on the basis of maxilla, mandible, and petrous portions of the temporal fragments. Of these two adults, at least one is a male as determined on the basis of pubic bone morphology. It was not possible to determine the sex of the other adult, and age could not be estimated. Despite the fact that portions of a pubis were preserved, symphyseal morphology was sufficiently distorted due to burning such that no age estimate could be made with confidence.

There are at least three subadults of distinctly different ages represented in this feature. One is a fetus, approximately 6 to 7 lunar months of age based on the breadth of a distal humerus and the length of the petrous temporal (Fazekas and Kosa 1978). The second subadult is aged at newborn to 1 year based on the long-bone size and the lack of fusion of the vertebral arches to the bodies (Goss 1977; Ubelaker 1978). The third subadult is estimated as older than the other two (4–7 years of age), primarily on the basis of tooth crown formation of the unerupted permanent canine, premolar, and first molar (Moorrees et al. 1963b). These three teeth survived the cremation episode due to the protection offered by the surrounding bone of the maxilla.

Although there were at least five individuals represented in this feature, the total quantity of bone was relatively small. This suggests that complete bodies were likely not included. In general, all skeletal elements were poorly represented, but this is particularly striking with regard to the cranium, of which only a few vault fragments were recovered. It should be noted that one cranial fragment from this feature conjoined with a cranial fragment from Feature 19.

The majority of the bone in this feature was calcined, indicating rather complete burning for an extended period. Fragment size was very small, suggesting that the bones were subject to significant amounts of manipulation, perhaps either by stirring during the burning process or due to some unknown postburning treatment.

Based on patterns of cracking, checking, and amount of warping, it appears that a continuum of dry- to green-bone burning is represented among these individuals. Neither the fetus nor newborn provided clear evidence of bone state at the time of burning. The vault and long-bone fragments of the 4- to 7-year-old subadult appear to have been more green than dry. At least one of the adults appears to represent dry-bone burning. The other adult was too poorly represented to determine whether the bone was green or dry.

Feature 19-1975

At least nine individuals are represented in this feature. This MNI is based upon eight left temporals and eight proximal right ulnae as well as one tibia of a newborn that is not represented by either of the other two elements. Among the five subadults, there is at least one aged at birth to 6 months based on the size of the tibia (Johnston 1962; Ubelaker 1978), and one aged at 6 months to 1 year based on deciduous canine crown development (Moorrees et al. 1963a). Based on the eruption of the maxillary deciduous dentition (Schour and Massler 1941) and the formation of a permanent central incisor crown (Moorrees et al. 1963b), a third individual is aged at 2–5 years. Reasonable age estimates could not be made for the other two subadults since they were represented only by femoral epiphyses. Due to differences in their size, however, it is clear that they are of distinctly different ages, ranging from 2 to 15 years. In addition, there are four adults, based on the mandibular third molar sockets and complete epiphyseal union of the long bones.

In general, the skeletal elements of these nine individuals are not evenly represented in this feature. In particular, cranial fragments are relatively overrepresented, while postcranial elements are greatly underrepresented, despite the fact that there were at least eight proximal ulnae recovered. Long bones were particularly poorly represented. Cranial fragments from this feature conjoined with one of those included in Feature 12.

The majority of the bones in this feature are completely calcined. There is a fair amount of smoked bone represented as well, however. Burning, warping, cracking, and checking suggests that the burning was largely of dry bone. Differential burning patterns on internal and external portions of some of the cranial fragments suggest that bones were fragmented prior to burning or that the fragmentation occurred soon after the burning started and portions of the skull(s) were scattered and turned. In some cases, the outer table was calcined and the inner table only smoked, while the exact opposite pattern was evident on an immediately adjacent vault fragment.

Feature 24-1975

There are two individuals represented in this feature: one adult and one subadult. Mature adult status is determined on the basis of bone size and complete epiphyseal union. The subadult is represented only by a distal femoral epiphysis fragment and a few cranial vault fragments. The adult is nearly as poorly represented as the subadult. There are only about 15 cranial fragments, a few fragments of the femur, tibia, and fibula all from the area of the knees, five vertebrae fragments, nine rib fragments, a small number of foot bones, and a number of unidentifiable long-bone fragments. By far, the majority of bone recovered from this feature is animal, there being at least eight times as much faunal bone as human bone. There were fragments that could not easily be assigned to the human or faunal category and were kept separate for analytical purposes.

The human bones in this feature largely were smoked, although a few fragments were calcined. The animal bone was both smoked and calcined. There is no evidence to suggest that the human and animal bone were not burned simultaneously, despite the fact the human bone appears to be burned to a slightly lesser degree than the animal bone. It is quite clear that a large quantity of faunal remains were burned with the scanty remains of these two individuals. In fact, the human remains are so poorly represented as to be potentially interpretable as an incidental inclusion.

Feature 28-1975

There are at least three individuals represented in this feature: one adult and two subadults. The adult is represented only by the left patella and a few fragments of a femur. The subadults are not well represented either. The most common elements from the subadults are vertebrae. Age estimates for these two subadults were based on the degree of vertebral development and union of the arches with the bodies (Goss 1977). The older subadult is likely between the ages of 6 and 12. The other subadult is approximately 3–8 years of age.

While degree of burning in this feature ranges from calcined to unburned, it stands in contrast to the others by virtue of the large quantity of bone that is not burned. While the remains of the adult are smoked or calcined, the subadults are incompletely burned or unburned. The older of the two subadults appears to be represented by unburned remains (at least vertebrae), while the bones of the younger individual are smoked. It appears that the fire was not especially hot or of long duration because so many bones were not burned.

Feature 30-1975

There are at least two individuals represented in this feature: one adult and one subadult. The subadult is approximately 12–16 years of age based on initial union of the first metacarpal epiphysis (Modi 1957; Ubelaker 1978). A precise age estimate of the adult is not possible. This small amount of cremated bone was recovered in association with Feature 30-1975, an unburned inhumation. Observations recorded in the field suggest that this feature may extend into an unexcavated area. Therefore, the remains reported here may only represent a small portion of the entire feature.

These two individuals are very poorly represented. There are about 30 adult and subadult cranial vault fragments. The adult is also represented by a few fragments of the ilium, ribs, vertebrae, feet, and long bones. The subadult is represented by fragments of ribs, innominate, first metacarpal, vertebrae, and ulna. There is also a distal tibia epiphysis and the neck and trochanter areas of both right and left femora demonstrating lack of epiphyseal union. Bone size and lack of epiphyseal union suggest that this subadult is between the ages of 5 and 15. It is quite possible that the subadult fragments represent two individuals of different ages. The distal tibia epiphysis is much larger relative to the size of the proximal femora. The first metacarpal showing initial union of the epiphysis also does not appear to represent the same individual as that of the femora. The cranial vault fragments are quite thin and are not in keeping with a subadult near the age of 12–15. None of the individuals is well represented and the total number of fragments is quite small.

All of the bone fragments in this feature are completely calcined white with the exception of two fragments that are smoked. The morphology of the smoked fragments suggests that they likely are animal bone. Warping and splitting of some of the cranial fragments suggests that they were burned fresh.

Feature 34-1975

There are two individuals represented in this feature: one adult and one subadult. The subadult identification is based on the presence of fragments of the mandible, ulna, cranial vault, and ribs. Based on crown formation of the mandibular left permanent canine and first premolar (unerupted), age is estimated to be 4–6 years (Moorrees et al. 1963b). The adult is represented only by a fragment of the atlas and at least two long-bone fragments. A precise adult age estimate could not be obtained. Overall, neither of these individuals is well represented.

The degree of burning observed on the bone from this feature varies from smoked to calcined. Approximately half of the fragments are completely calcined, while the rest are both smoked and calcined. It appears that two of the fragments are unburned. Whether the bones were burned when they were still fresh or dry is not clear.

Feature 38-1974

There are at least five individuals represented in this feature: four adults and one subadult. The subadult is represented by only a few elements, including a fragment of the temporal, occipital, distal humerus, axis, a fragment of the ischium, and a thoracic vertebra centrum. That the centrum was not fused to the vertebral arch suggests this individual is probably less than 6 years of age (Goss 1977). Although five adults are indicated by the temporal, mandible, and scapula, those portions on which the MNI was based are not readily distinguished on the basis of age. Therefore, the count for these three elements may include bones that are, in fact, the subadult.

Among the adults, relatively well-preserved portions of the innominate allowed broad age estimates for three of the four individuals. Two adults of indeterminate sex are 20–30 and 40–50 years of age based on pubic symphysis morphology (Meindl et al. 1985; Todd 1920, 1921). The third adult is 35–45 years of age based on characteristics of the auricular surface (Lovejoy, Meindl, Pryzbec, and Mensforth 1985). Age could not be estimated for the fourth adult. Of these four individuals, at least one is female and one is male. Sex of the female was determined on the basis of morphology of the pubis. There is at least one very large, robust male included in this feature who is represented by a number of elements including femora, innominate, and fragments of the face.

This feature was distinct from the rest of those at the site in several regards. First, the bone fragments are relatively large. Second, representation of body parts is quite even, suggesting that complete, or nearly complete, individuals (except the subadult) were cremated. Third, the relative representation of calcined bone is slightly less than in other features. It appears that these five individuals were relatively complete and represent a single burning event followed by interment in the pit. This feature is also notable since it appears that the bones of at least some of the individuals were stained with red ocher prior to burning.

Feature 41-1974

There are at least 10 individuals represented in this feature. Six are subadults under the age of 18. The age of one subadult is between birth and 1 year based on dental crown formation (Moorrees et al. 1963a) and the development of the bassi-occipital (Redfield 1970). Age of three of the subadults is between 3 and 10 years. This broad age estimate is based on the maximum diameter of the proximal femoral epiphysis. While there are no standards in print that show the age-related size differences of subadult long-bone epiphyses, these age assignments are based on measurements of maximum diameter of a small sample of subadult epiphyses of known age. Obviously, a large margin of error was placed around those measures we obtained. The fifth subadult is between 3 and 10 years of age based on vertebral development (Goss 1977). The sixth subadult is 14–18 years old based on degree of metacarpal epiphyseal union (Ubelaker 1978). Among the four adults, one is a 35- to 45-year-old male as judged by the pubic symphysis (Meindl et al. 1985; Todd 1920, 1921). Another of the adults is young (20–35) based on lack of alveolar recession exhibited on the maxilla. More precise age estimates for the other two adults could not be determined.

The anomalous aspect of this feature is that a right and left femur and ischium most likely representing one individual (likely a male based on the large size and robustness of the bones) are largely unburned or smoked. One other proximal right femur of an adult is also largely unburned or smoked. For a minimum of 10 individuals included in this feature, they are poorly represented across body parts. Only three of the subadults and three of the adults are consistently represented.

The vast majority of the bones in this feature are calcined with some showing calcined cortex and smoked trabeculae. Further, most of the bones appear to be burned dry. At least one subadult, however, and likely one adult appear to have been fairly fresh at the time of burning.

Feature 42-1974

There are at least seven individuals represented in this feature. Of these, five are subadults ranging in age from a late-term fetus/newborn to approximately 2–14 years of age. The late-term fetus/newborn was identified on the basis of humerus length (Johnston 1962; Ubelaker 1978). The measure is approximate because the humerus is quite warped due to burning. This individual is represented at least by a tibia, an ilium, and two femur fragments. One subadult is approximately 10–14 years of age based on the recent eruption of the second mandibular molar (Schour and Massler 1941). The remaining three subadults, based on counts of the glenoid fossa of the scapula, are younger than this individual, and are aged from 2 to 10 years. This assertion is based on size of the bones of these individuals relative to the 10- to 14-year-old. There are also at least two adults represented. A portion of an adult left maxilla with second premolar through third molar was preserved. Those teeth present exhibited wear to at least the middle third of the crowns, while the first molar showed wear to the root on the lingual surface. This degree of dental attrition suggests that this individual was at least 40 years of age. No elements indicative of sex were sufficiently well preserved to allow sex determination. The minimum individual counts for the frontal, temporal, occipital, zygomatic, and maxilla would indicate that there are more than two adults represented here. The elevated counts on these bones can be explained as an inability to distinguish between subadults and adults based on size and developmental characteristics of these elements.

Most of the bones in this feature are completely calcined, although a few are both smoked and calcined. Further, the majority of the fragments, especially those that are obviously adult, appear to be burned dry. There are a few fragments (one cranial fragment and a few long-bone fragments likely representing a single subadult) that exhibit characteristics indicative of fresh-bone burning. Whether this individual was articulated or disarticulated at the time of burning could not be determined.

Like that demonstrated in all other features with the exception of Feature 38-1974, the distribution of fragments across elements indicates that complete individuals are not represented in this feature, and cranial and long-bone fragments are especially underrepresented.

CONCLUSIONS

A minimum of 70 individuals was recovered from Turner Farm, including subadults and adults of both sexes. Of the 38 subadults recovered, there is at least one fetus, nine individuals less than 1 year of age, 20 infants and children between the ages of 1 and 10, and eight subadults greater than 10 but less than 18 years of age. Similar to the broad age distribution of the subadults, each decade of the adult life span is represented in this series. Of the 32 adults, six are less than 35 years of age. Of these six, at least two females and one male are present. Ten adults are greater than 35 years of age with at least three females and two males represented. The remaining 16 adults were too fragmentary to further estimate age at death.

The Turner Farm skeletal series represents one of the largest skeletal samples yet recovered in the Northeast. However, the size of total burial population at Turner Farm is unknown. It seems likely that many more individuals were interred at Turner Farm since only a portion of the mortuary component was excavated (Bourque, Chapter 6 this volume). In addition, complete features were not consistently excavated at Turner Farm. For these features, at least, the true number of individuals interred is unknowable. On the other hand, there is evidence suggesting that some individuals may have been interred in more than one cremation feature for, as mentioned above, a cranial fragment from Feature 12-1975 was found to fit a partially reconstructed calvarium from Feature 19-1975. If this phenomenon was a common occurrence, the MNI counts associated with the cremation features may be inflated.

In absolute terms, the 70 individuals are a small sample, and care must be exercised not to overinterpret the results reported here. Rather, this report should be viewed as a contribution to the regional database that is needed to test hypotheses regarding prehistoric mortuary activity as well as human adaptive dynamics in the Northeast. The challenge remains for other investigators to add to this important database. The publication of both recently excavated and museum-curated inhumations and cremations will greatly contribute to our understanding of regional prehistory. Until then our understanding of northeastern Late Archaic cultural strategies and their biological consequences will remain as fragmentary and incomplete as the skeletal series associated with it.

Appendix 8

Features and Activity Areas

The Spatial Analysis of Faunal Remains

ARTHUR E. SPIESS AND ROBERT A. LEWIS

INTRODUCTION

Bourque's excavation at the Turner Farm site is certainly the largest contiguous excavation using modern techniques of recovery and recording in a complex stratified shell midden in the Northeast. It may, in fact, be the largest area excavated in a shell midden in the Northeast since before World War II, when excavation comprised a rapid "turning over" of midden matrix for artifacts (Spiess 1985). Despite earlier basal dates on some middens in the Hudson Valley (Brennan 1977; Claassen 1991), the Turner Farm site also contains the longest and most detailed stratified series of separate occupations, beginning c. 5200 B.P. and ending with the Contact period.

These attributes of largest and longest, coupled with an intensive faunal analysis by the authors, allow two related lines of research that can be better addressed at this site than at others. First, Turner Farm provides a record of changes in hunting and fishing focus and seasonality across five millennia. The details of this chronological record, along with the faunal analysis techniques used to develop the data, are presented elsewhere (Spiess and Lewis 1993), although the techniques used are summarized in this appendix and the results are summarized in the main body of the book.

This appendix primarily addresses the faunal content of features, and the horizontal distribution of faunal remains within each occupation. The horizontal distribution of faunal remains is markedly nonrandom. Data from horizontal groups of features are scrutinized in an attempt to characterize the feature "association." Particularly in Occupation 3, fauna from the evident association of house floors, hearths, and pits contain significant behavioral data on seasonal length of occupation, and on faunal processing and disposal. Faunal remains recovered from contexts outside defined features were also nonrandomly distributed horizontally within a given occupation level. Often, concentrations of faunal remains

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from outside the physical boundaries of the features seem to be associated with feature complexes. Coupled with information on feature distribution and form, we have detected several discrete activity areas across the site, especially within the Moorehead phase (Occupation 2) and Susquehanna tradition (Occupation 3). There is a repetitive sequence of Moorehead phase activity areas along what is now the seaward edge of the site, which for the first time gives some evidence for the size of Moorehead phase domestic activity areas. We think we have detected "dog yards" behind the human focus of habitation. The faunal content of pit and hearth features, in particular a detailed season-of-death analysis and minimum-numbers-of-individuals counts, provides information about whether the feature was used for one short season or multiple seasons. In particular, a complex of domestic features from Occupation 3 seems to provide support for a hypothesis of year-round, or nearly year-round, occupation of the site during the Susquehanna tradition. Also for the Susquehanna tradition, faunal contents of grave features provide additional information on how the deceased were treated.

The Turner Farm faunal analysis is not the only modern faunal analysis of a shell midden in New England and the Maritime Provinces; we do, however, believe that it is the most detailed, and may eventually form a comparative basis for regional reconstructions. Although much shell midden faunal analysis has been done recently, relatively little of it has been published in detail. The reader is referred to Barber 1982, Bernstein 1993, Spiess and Hedden 1983, Sanger 1987, and Stewart 1986, as well as to Spiess and Lewis (1993) for a more complete review of unpublished work.

METHODS: RECOVERY AND STATISTICS

The faunal sample from each feature at the Turner Farm site was saved and processed as a unit. In several cases, stratigraphic divisions were recognized within features, and the faunal remains were recovered and processed separately for each division. For example, some of the Occupation 3 grave pits contained a different quality of fill in their uppermost levels than lower in the pit. The upper pit fill contained mostly "noncalcined" bone, while the lower pit fill was characterized by a high percentage of calcined human and animal bone. The upper pit fill may represent midden material washed or moved into the depression from the surrounding matrix; so, in such cases the faunal remains are reported as separate samples from the two kinds of pit fill. Unless such stratigraphic evidence indicated reason for separation, we assume that the fill of each pit is an "association" reflecting a single depositional event, or deposition over limited time.

The faunal data from the features are searched for several types of patterns. Species counts (and for some species, body parts counts) are compared with the suite of faunal data from the rest of the (relevant) occupation in a search for significant differences (Spiess and Lewis 1993). Different types of features (e.g., hearths or pits) are compared for significant faunal differences. Finally, the seasonality data are carefully scrutinized to test the hypothesis that all fauna associated with a given feature may be of limited seasonality (the null hypothesis) versus the alternative that the features accumulated faunal material from animals killed during many seasons. The provenience unit for faunal remains from outside of individual, defined features was either a 5 × 5 foot section (and appropriate stratum), or a balk between squares.

An extensive literature has developed around the statistical search for horizontal distribution patterning in archaeological samples (Berry et al. 1980; Dacey 1973; Hietala and Stevens 1977; Whallon 1973, 1974). This literature was reviewed for potential applicability to this study. The variance–mean ratio test was considered for use in detection of spatial patterning, but its use was rejected as being too insensitive to some types of nonrandom patterning (Hietala and Stevens 1977). Hietala and Stevens's recommendation of a "balance between induction and deduction" characterizes the Turner Farm study. We have relied on scanning by the human eye to detect patterning, backed by contingency table analysis (chi square), and Fisher's exact test where borderline statistical significance is suspected.

One crucial step in this visual analysis was deciding on the categories of bone to plot on a site plan. Various categories of deer bone were plotted to test for differential distribution of deer skeletal parts. Distal metapodial, proximal metapodial, metapodial diaphysis, astragalus, and first phalange were plotted separately in a search for skeletal parts reduction patterns similar to those reported by Binford (1978). Codfish vertebrae were plotted separately from codfish skull parts. Visual comparisons were made between seal distribution and deer, *Mustela* and deer, and so on. Only a few such comparisons produced visually differentiable (significant) patterns, although in Occupation 2 the total faunal sample shows evident nonrandom patterning.

METHODS: FAUNAL ANALYSIS

Faunal analysis techniques used in the Turner Farm study were chosen or developed to produce a variety of information on taxonomic identification, age (in years) or sex identification, and season of death. We paid relatively less attention to bone breakage patterns and bone cut marks, which form the focus of some faunal studies. This section summarizes the types of methods used. A complete and detailed description of methods can be found in Chapter 2 of Spiess and Lewis (1993). Some specific techniques and modern comparative data samples have been published elsewhere already: tooth sectioning, mounting, and grinding (Bourque, Morris, and Spiess 1978), seasonal change in Maine white-tailed deer tooth cementum layer thickness (Spiess 1990), measurement schemes for deer and seal skeletons (Spiess and Hedden 1983:188–199), and some modern comparative samples for clam (*Mya*) growth layer seasonality analysis (Spiess and Hedden 1983:203–206).

Identifications, especially of small mammals, birds, and fish, were made whenever possible with comparative skeletal collections—especially those at the Maine State Museum; Maine Historic Preservation Commission; Department of Anthropology, University of Maine—Orono; and the Museum of Comparative Zoology, Harvard University. The senior author had extensive experience with large mammal identifications from northeastern North America before the project began, but specific elements were often checked against comparative collections. Taxonomic identifications were recorded to the lowest possible taxonomic level, making certain assumptions about species distributions. For example, we assumed only one species of the deer genus *Odocoileus*—*O. virginianus*, the white-tailed deer—was present, and did not attempt to differentiate bone fragments between *O. virginianus* and *O. hemionus*. Sometimes taxonomic differentiation was possible only to the genus level (reported by just the genus name), or to a higher taxonomic level—for example, "seal." In the case of ducks we found that we could sort certain postcrania by size only, and one bone element by several morphological and size groupings, although each grouping may be multigeneric.

Various bone length and width measurements were recorded during the study, bone sizes being useful for a variety of analyses. In specific cases they can be used to separate closely related taxa—for example, harbor seal versus gray seal for some postcrania, or deer versus moose. Jaw measurements particularly were used to separate sea mink (*Mustela macrodon*) from common mink (*M. vison*). Some species, such as gray seal and *Mustela*, are sexually dimorphic, and bone measurements could differentiate some males from some females. Given a large enough sample (such as with deer bone at this site), we used bone widths to track the change in average size of deer over time. A decrease in the frequency of the very largest deer toward the present indicates either (deer) environmental degradation or intensification of hunting pressure and the decreasing frequency of very old age in the population. Finally, bone size measurements for a large sample of modern white-tailed deer were used to produce a pair-wise regression analysis and confidence limits of one bone fragment coming from the same (sized) deer as another bone fragment.

Bone length, coupled with epiphyseal union state, is a useful age determinant in many species. For example, in seals (genus *Phoca*), a humerus with unfused epiphyses with a length measurement below a certain value is indicative of a fetal or newborn seal. This is also true for deer. In some cases, these attributes convey season-of-death information. In many cases, epiphyseal fusion states can be used to construct age demographies by arbitrarily established age groupings, which provide some information on human hunting techniques.

Tooth wear and eruption states provided both age and season-of-death information. A tooth wear scheme for deer, developed by wildlife biologists, provided an adequate age demography. The eruption of some deer teeth are seasonal markers. Tooth eruption in seals, where the deciduous teeth are replaced shortly after birth, provides another age and seasonality tool.

In an attempt to detect season of death and, secondarily, age at death, tooth sectioning and observation of optical layers in dentin and cementum was attempted on many mammal species. The state and width of the last growth year was recorded and measured if applicable, and compared with the state and width of preceding growth layers. It was particularly successful on deer and seal species, especially after we corrected the deer data for deceleration of the growth rate throughout the growth season (Spiess 1990). A similar technique was used on soft-shell clam (*Mya arenaria*) hinges (chondrophores), although there is a high frequency of irregular layers in this species. Some fish otoliths (ear ossicles) were sectioned to determine season of death, and we made regular observations on the status of the last growth layer on the vertebral centrum. This vertebral centrum layer, however, can be misleading in certain fish species.

Some bird species are in themselves season-of death indicators. For example, the red-throated loon is a common fall migrant, absent most of the year. Other species, such as the common loon and Canada goose, tend to nest much more frequently on fresh water than along the marine coast. The vast majority of the population is resident along the coast only during the nonbreeding season. Thus, large numbers of these species are indicative of nonbreeding season hunting. Moreover, we examined fragmentary bird long bones that could be identified to species for the presence of medullary bone, a calcium reserve deposit inside the bone cavity in female birds just before nesting. Not only did the presence of medullary bone in certain species indicate season of death, but it also indicates the nearness of a breeding colony (rookery) in certain species.

Most of the raw data were recorded on an NISP (number of identified specimens) basis, as simple bone counts, and were manipulated as such for basic statistical tests. Only in rare circumstances were we interested in MNI (minimum numbers of individuals), most often during the analysis of the contents of features from which all feature fill had been recovered. The types of age, sex, and size information mentioned above were used occasionally to identify more individuals in feature fill samples than would have been identified by a simple right–left element comparison. For example, a 3- to 4-year-old deer molar and a deer metapodial with a fused distal epiphysis cannot come from the same deer, ergo MNI = 2. Thus, when we attempted an MNI analysis, it was a "maximal" MNI, using all sources of information available to differentiate individuals.

Now we proceed to an examination of the faunal content of features, and the horizontal distribution of faunal remains within each occupation.

OCCUPATION 1

A single feature, designated "Feature 5 and 6-1972," contains uncontaminated Occupation 1 faunal material. This shell- and soil-filled pit has yielded swordfish, cod (*Gadus*), deer, and *M. macrodon* (Table A8.1). Swordfish presence probably indicates summertime hunting. The deer-swordfish-codfish orientation presages a similar subsistence in Occupation 2, but because of the small sample there is little more we can say about Occupation 1.

OCCUPATION 2

Features

Three kinds of features occur in Occupation 2: hearths, pits, and dog burials (Tables A8.2–A8.4). Faunal samples from the hearths are too small to be informative. Faunal suites associated with the dog burials are small, but they are unusual. Feature 22-1973, which is a cache pit associated with a dog burial, contains two cervid distal tarsal bones (naviculocuboid), one each from a deer and a moose, as well as a *Mustela macrodon* skull. Moose are rare in Occupation 2, and inclusion of the same moose skeletal element with one of deer, the only cervid bones in the feature, is odd. The *Mustela macrodon* cranium is much more complete than those from the rest of the midden, adding to the impression that these bones

Table A8.1. Occupation 1 Faunal Remains

Odocoileus. 1 bone. Right P_2, 5–7 years of age by wear pattern.
Swordfish. 21 bone fragments. Postcranial.
Cod. 56 bones. Dentary, atlas, 24 caudal vertebrae, 29 precaudal vertebrae, basioccipital, parasphenoid. MNI = 4 based upon vertebrae exhibiting 5, 6, 7, and 8 annuli.
Duck, species indeterminate. Tibiotarsus diaphysis.
Flounder, species indeterminate. 10 caudal vertebrae.
Mustela macrodon. 1 right radius.

Table A8.2. Faunal Contents of Occupation 2 Hearths

Feature 3-1972. W50S90. Cooking pit.
Odocoileus. 1 bone. Phalange 1, epiphysis fused. Heavy muscle markings.
Castor. 1 bone. Upper-right molar, root open.
Feature 9-1972. W30S90. Hearth (possible mixture of bone from Occupation 3).
Odocoileus. 9 bones, MNI = 2. Skull fragments, pelvis fragment, 3 scapula fragments, calcaneus.
Duck. 1 bone.
Feature 27-1972. W15S90. Hearth, brown soil floor.
Odocoileus. 1 bone. Right scapula.
Feature 12-1972. W40S90. Hearth in low pit.
Odocoileus. Antler basal fragment, shed. Large individual.

were placed especially in the cache. Feature 26-1974 evidently included a whole vertebral column from a sculpin possibly caught in late summer or fall.

The Occupation 2 pits (Table A8.4) contain relatively small identifiable bone samples. Feature 15-1972 and Feature 32-1975 contain both winter and "warm-season" catch remains. If these pits contain fill generated by one occupancy (rather than, say, material accumulated over a few years, swept up and dumped in one episode), then there is good evidence for multiseasonal use of the Turner Farm within each annual cycle during Occupation 2.

There are three feature associations for Occupation 2 that can be made on the basis of horizontal proximity. One association consists of Feature 15-1972, Feature 16-1972, and Feature 20-1972 (all pits), and possibly Feature 9-1972. There is no striking idiosyncracy of the faunal assemblage within these four features. A minimum of four deer are represented: a fetus or newborn, a calf, and two adults. The other two associations—Feature 3-1972 (hearth/pit) with Feature 12-1972 (hearth), and Feature 27-1975 with Feature 32-1975 (both pits)—are without idiosyncracies in faunal representation.

Table A8.5 compares bone counts in the pits (excluding dog burials) and hearths with

Table A8.3. Faunal Contents of Occupation 2 Cache Pit Near Dog Burial

Odocoileus. 1 bone. Distal tarsal bone, left.
Alces. 1 bone. Distal tarsal bone, right.
Mustela macrodon. Anterior cranium with incisors and premolars, plus two probably associated canines. Sectioned canine showed very thin, light line forming; seasonality late winter or early spring.
Birds. Two vertebrae of large duck and/or other bird.

Note. Interesting inclusion of skeletal element in this feature from one deer and one moose. Moose are rare in Occupation 2. Inclusion of almost complete cranium of *M. macrodon* is also rare, since this is the most complete cranium in the whole site. It is possible that each bone represents economically valuable prey of the associated dog.

Feature 26-1974. E0S70. Dog burial.
Sculpin, short-horn. 9 vertebrae, probably one individual. 3-years-old, summer or fall catch.
Ducks. 5 bones, MNI = 2. All forearm limb bones.
Small alcid. 1 bone.

Table A8.4. Faunal Contents of Occupation 2

Feature 15-1972. W25S95. Pit.
Odocoileus. 9 bones, MNI = 3.
DM_3 with moderate wear—November to March kill, calf.
Diastema and symphysis, term fetus or newborn, March to July kill.
Adult: 2 metatarsal fragments, phalange, calcaneus, astragalus, axis vertebra, distal tibia; measurements indicate possibly one individual of modest size.
Duck. 4 bones, MNI = 1. One identified as scaup, which are a winter duck in Maine.
Alcid, small. 1 bone.
Note. Could be a "two season" feature with winter and early spring kills represented.
Feature 16-1972. W20S95. Pit.
Odocoileus. 6 bones, MNI = 3.
DM_3 with moderate wear—November to March kill.
2 adults represented by humerus and 4 tarsal bones.
Swordfish. Bone fragment.
Castor. Incisor fragment.
Note. Swordfish probably indicates summer fishing, so this feature contains summer and winter garbage.
Feature 20-1972. W20S90. Pit in floor.
Odocoileus. 1 bone. Mandible fragment.
Feature 20-1975. W35S80/W40S80. Larger shell-filled pit.
Odocoileus. 1 bone. Proximal radius.
Feature 28-1974. W5S70. Pit.
Mustela macrodon. Right mandible, female.
Feature 27-1975. W40S70. Pit, filled with rock and brown soil.
Odocoileus. 1 bone. Very large astragalus.
Swordfish. Blade fragments.
Feature 32-1975. W45S65. Whole-clam filled pit.
Odocoileus. 3 bones, MNI = 1. Metatarsal fragments; calcaneus, deciduous M_2 with modest wear: November to March kills.
Sturgeon. 2 scute fragments.
Note. Sturgeon have been interpreted as warm-season fishing evidence, the deer as a winter kill.
Feature 5-1975. W30S80. Pit, filled with dark soil and crushed shell.
Odocoileus. 3 bones, MNI = 1. Condyle fragment, left $M_{1/2}$ 3–4 years, distal phalange 1.

the nonfeature (i.e., midden) bone count from Occupation 2. There are no striking inclusions or exclusions of any particular taxon. There is only one detectable difference—a significantly different distribution of deer axial (e.g., skull, vertebra, pelvis, ribs) versus appendicular (e.g., limb) elements. Hearths contain 11 axial and two appendicular deer skeleton fragments, while the pits contain eight axial and 16 appendicular elements, respectively. By Fisher's exact test, the probability of this distribution being drawn from identical original samples by chance alone is 0.0035. Thus, although neither appendicular nor axial body parts are exclusively distributed in either category, axial body parts tend to be found in hearth debris, while pit debris tends to contain more appendicular elements. Material deposited in hearths may have been the "first discard" from the use of a carcass, while the pits accumulated refuse processed further, or curated longer.

Table A8.5. Occupation 2 Bone Frequencies in Pits and Hearths

Taxon	Pits	Hearths	Rest of Occupation 2
Odocoileus	24	12	1,031
Alces	0	0	7
Castor	1	1	39
M. macrodon	1	0	87
Duck	4	1	41
Small alcid	1	0	4
Other bird	0	0	109
Swordfish	2	0	218
Sturgeon	2	0	12
Sculpin	0	0	14
Totals	35	14	1,562

Horizontal Distribution

The search for horizontal patterning within Occupation 2 began by indicating the number of bone elements appearing in each 5 × 5 foot section for several taxa, and various skeletal parts from some taxa (Table A8.6). These distributions were analyzed for patterning on three scales. First, bone concentrations of less than 5 × 5 dimension—very high concentrations of one taxon confined within one section—define small-scale patterning. Second, bone distribution patterns were scanned on a "whole-site" basis. Third, a compilation of feature location data and bone concentration data allowed the definition of three separate activity areas within Occupation 2.

Within Occupation 2 there is a stratigraphic dichotomy between the shell layer (soil containing shell) and dark shell-free soil (essentially the darkly stained subsoil upon which much of Occupation 2 lies directly). In all cases examined, the bone distributions of the two stratigraphic layers were congruent. This fact strengthens the hypothesis that material in the shell-free horizon was "trodden" into it, or otherwise closely mirrors the material still contained in the overlying shell-and-soil-deposition layer. For the rest of the analysis we have ignored this apparently "derived" stratigraphic subdivision.

Small-Scale Patterning

In the case of two taxonomic groups there is patterning on a scale smaller than the 5 × 5 section provenience unit. This patterning is evidenced by high concentrations of bone totally contained in one square, with much lower or no distribution outside that section. A high number of duck and "Aves: species indeterminant" (which is probably mostly duck) bones occur in two sections: W30S105 (30 bones), and W10S100 (27 bones). The W30S105 concentration contains eider, scaup, and black duck-sized *Anas* axial and appendicular skeletal parts, as well as bones of a few other bird species. The W10S100 bird bones cannot be identified beyond "duck" and some species larger than duck. No seasonality inferences can be made. Two sections contain high concentrations of codfish vertebra: W35S100 contains 7 vertebrae, and W25S105 contains 68. The codfish in W25S105 come

Table A8.6. Occupation 2 Taxa and Skeletal Body Parts Investigated for Horizontal Distribution Patterns

Deer: Metapodial shaft, metapodial proximal end, vertebrae, scapula, isolated teeth, skull parts, astragalus, distal tibia, first phalange, second phalange.
Bird: Bird, not further identified; duck; cormorants; loon; alcid, small and medium; geese; great auk.
Other taxa: Swordfish, sword; swordfish, other (includes postcrania); mink, skull, teeth and jaws; mink, postcrania; cod, skull fragments; cod, vertebra; seals, all elements.

from at least three individuals of ages 6, 7, and 8 years. These concentrations may represent highly localized processing or discard events, such as dumping the contents of a soup pot.

Whole Site Features

Search for distributional patterns on a "whole-site" basis consisted of comparing mapped representations of the number of bones per section for various taxonomic and skeletal parts categories. The distributions are highly nonrandom, as best exemplified in the distribution of a common bone type, isolated deer teeth (Figure A8.1). The teeth are grouped in three concentrations, one in the northeast corner of the main excavation, one in the northwest corner, and one in the south central portion of the excavation. Comparison of the deer teeth distribution with other taxa showed that the same concentrations appeared on all other bone maps (Figure A8.2). Thus, on the whole-site level there was a nonrandom bone distribution into three activity areas (areas 1, 2, and 3 on Figure A8.3), but all taxa and

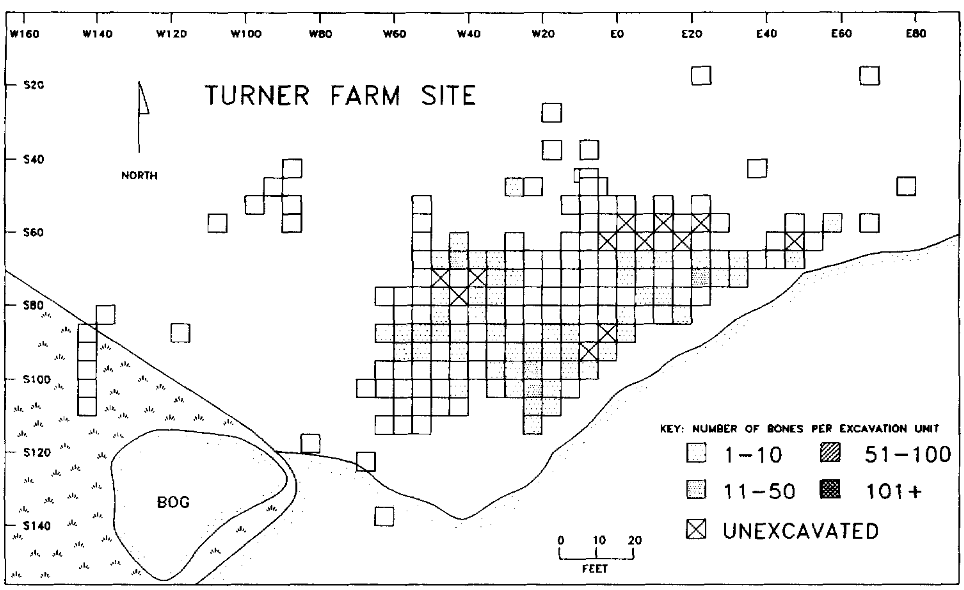

Figure A8.1. Occupation 2 deer tooth distribution.

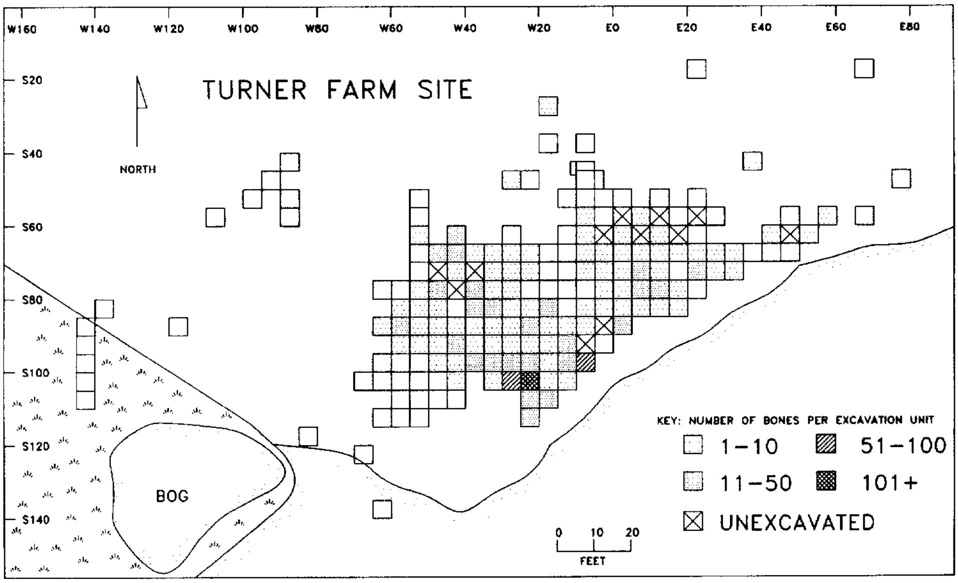

Figure A8.2. Occupation 2 bone refuse density.

body parts follow the same tripartite distribution pattern. A fourth area inland from Area 3 was defined in Chapter 5 (pp. 80–85), on the basis of artifact distribution.

The three sharply defined concentrations become clearer when all bone is considered on one map, and when the bone densities are mapped with hearth and pit features (Figure A8.3). Discrete groups of features correspond with the three faunal concentrations. The congruence of feature groups with bone concentrations, and the low density of bone between each concentration, allowed definition of three activity areas.

Activity Areas

Area 1 consists of a dense group of features (including hearths) associated with a dense bone scatter on the south central portion of the site. The highest bone density is immediately shoreward (south) of the features, suggesting a refuse dumping area peripheral to the hearth activity area. Area 2 consists of a group of pits roughly congruent with a moderately dense scatter of bone. Area 2 is immediately adjacent to Area 1, but further inland. Area 3 consists of a group of features (including hearths) and a moderate density of faunal remains among the features. If there is an area of high bone density adjacent to and associated with Area 3, it exists in the unexcavated portion of the site shoreward, and may be mostly eroded away.

Faunal remains were tabulated by activity area (Table A8.7). In many cases the distribution was found to be nonrandom. Swordfish sword, commonly used as a raw material for tool manufacturing, is more common relative to other swordfish bone in Area 3 than it is in Area 1. Conversely, swordfish bone that would have been attached to meaty

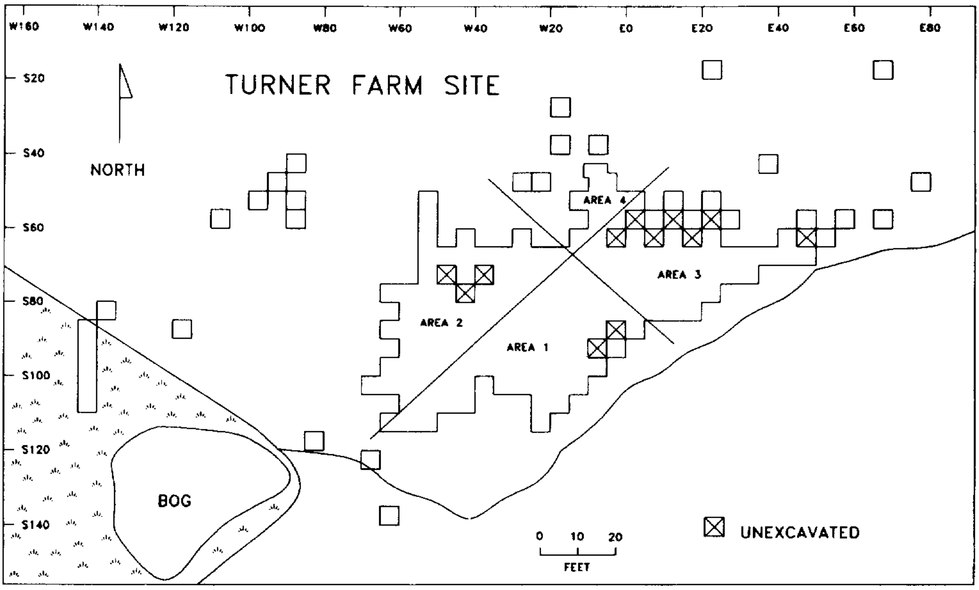

Figure A8.3. Occupation 2 activity areas.

swordfish parts is more common in Area 1. This distribution is statistically significant (chi-square = 10.4, *DF* = 2, *p* less than 0.01). There is a higher proportion of mink postcrania to teeth and jaw fragments in Areas 1 and 3 than in Area 2. However, the distribution is not significantly different than chance (p = 0.25). The relative frequency of codfish bone, compared with all plotted bone, is lower in Area 2 (4 percent) compared with Areas 1 and 3 (15 to 16 percent). The differential distribution of cod vertebrae versus cod skull parts is marginally significant ($p \approx 0.10$). Note that the high cod vertebra count is caused in part by the location of the two concentrations of cod vertebra that are smaller than a 5 × 5 section in dimension. Seal bone is infrequent in Occupation 2, but that which is present is not randomly distributed. Seal bones are most relatively common compared with other bone in Area 2 (5.5 percent), more than twice as common as in the samples from Areas 1 and 2 (2.0 percent and 1.5 percent, respectively). Bird bone, as a proportion of total bone, is 4 to 5 times greater in Areas 1 and 3 (18 to 19 percent) than in Area 2 (4 percent).

Table A8.7 also examines the counts of deer skeletal parts that were horizontally plotted. Isolated teeth are relatively most common in Area 2. However, aside from the teeth, deer bone elements do not appear to be differentially sorted between these three concentrations. Even the appendicular and axial bone counts (other than teeth) exhibit the same pattern of relative proportion between activity areas.

Thus, except for the proportion of swordfish sword to other bone, the attributes of Areas 1 and 3 appear similar (Table A8.8), exhibiting hearth presence, high codfish count, low seal bone count, high bird bone count, and low isolated deer tooth count. Differences between the activity areas do not appear to be related to differential processing of deer carcasses, the primary terrestrial meat source in Occupation 2. Thus, we cannot easily

Table A8.7. Faunal Distribution in Occupation 2 Activity Areas[a]

	Activity area		
	1	2	3
Total bone count plotted	562	283	245
Swordfish: sword	15	16	26
Swordfish: other bone	28	19	14
Mink: teeth, jaw, skull	16	6	6
Mink: postcrania	25	5	18
Cod: skull fragments	13	3	10
Cod: vertebrae	87	8	23
Seals: cranial	8	8	2
Seals: postcranial	3	7	1
Seals (total elements)	11	15	3
Birds: all species, elements	101	11	36
Deer: skull elements	22	20	10
Deer: scapula	23	12	13
Deer: vertebrae	25	6	3
Deer: isolated teeth	69	84	43
Deer (total axial)	139	122	69
Deer (total axial less teeth)	70	38	26
Deer: metapodial shaft	15	13	6
Deer: metapodial, proximal	28	23	8
Deer: astragalus	23	16	5
Deer: tibia, distal	30	13	7
Deer: 1st and 2nd phalanges	31	13	14
Deer (total appendicular)	127	78	40
Deer (total elements)	266	200	109

[a]Note that some of the data are subtotals.

Table A8.8. Occupation 2 Activity Area Relative Attributes

Area 1	Area 2	Area 3
Hearths and pits	Pits	Pits and hearths
Adjacent, shoreward, high density bone concentration	Moderate bone density congruent with features	Moderate bone density congruent with features
High swordfish "meat" bone	Intermediate	High swordfish sword
High codfish proportion, especially high vertebra count	Low codfish proportion	High codfish proportion
Low seal bone	High seal bone, and high postcranial count	Low seal bone
High bird bone	Low bird bone	High bird bone
Low isolated deer tooth count	High deer teeth, isolated	Low isolated deer tooth count

account for these distributions in terms of Nunamuit-style cervid carcass processing activities (Binford 1978).

We have already commented on the multiseasonal content of some Occupation 2 features. Deer and seal tooth sectioning and eruption provides the following specific seasonality associated with Area 1: January–February, February–March, March–April, March–July, October–January. Thus, Area 1 contains multiseasonal data. The other two areas have smaller, and therefore less complete, seasonal indicator samples, but each exhibits multiple seasonality as well.

We hypothesize that the hearth and feature portion of Area 1 represents a focus of domestic activity (centered on the hearths), and that the heavy bone concentration extending seaward represents a "dump" that was "in front" of the domestic area. Some sort of structure associated with the hearth–feature complex is implied, although the only evidence for one is the boundedness of the rear of the bone distribution.

Area 2 clearly contrasts with Area 1: lack of hearths, a scatter of pits, no definite bone concentration, low codfish and bird bone proportion, high seal bone count (especially postcrania), and high count of isolated deer teeth. Area 2 lies "behind" Area 1 and is clearly not associated with hearth-focused activities. The Occupation 2 people made much of their dogs, according them special treatment upon death. In arctic and subarctic cultures that use "working" dogs, the dogs are often tied up adjacent to human living quarters. There is no hearth or other focus of obvious human activity in Area 2. The pits tend to be shallow and irregularly spaced. The suite of bones from Area 2 suggests some human selection of what was deposited in the area: low proportion of fish bone and bird bone and high proportion of seal bone, especially postcrania. While whole fish can be fed to dogs, other evidence suggests that human dependence on codfish was high, and that what was left after human use was discarded, often in discrete piles, in the dump of Area 1. Fish bone, especially the size of codfish bone (and bird bone as well), are notorious for choking dogs. Most owners of working dogs would avoid feeding them fish bone (defleshed fish "racks") or bird carcasses. In the arctic, pinniped meat is often used preferentially to cervid meat for dog food, because it has a lower human preference value. Since seals were not killed often during Occupation 2, it is even more likely that such (strange?) meat "went to the dogs." Moreover, many of the seal bones from this site exhibit ragged epiphyseal ends, a classic mark of dog chewing. We would expect seal skull fragments to end up in the dump of Area 1, and most of the postcrania to end up as dog food, as the data indicate. The high proportion of isolated deer teeth in Area 2 possibly results from human discard of the jaws, followed by canid chewing, which destroys the bone holding the teeth, freeing the isolated teeth for deposition into archaeological context. It is, therefore, possible that Areas 1 (human) and 2 (dog) represent a human–dog occupation unit of some kind.

Area 3 is similar in all respects to Area 1 except for its high proportion of swordfish bill to other swordfish bone. Inspection of the distribution of swordfish bone within Area 1 reveals a dichotomy between the sections in the feature area (S95 and northward) and the dump. In the Area 1 dump, other swordfish bone outnumbers swordfish sword 22:4, while the ratio of other bone to sword is 6:7 in and around the features. If Area 3 (as excavated) is associated with an unexcavated dump area rich in nonsword swordfish bone, then the faunal assemblages from Areas 1 and 3 would resemble each other very closely. We hypothesize that Area 3 is an incompletely excavated domestic activity area, and that a "dump" area that may be partially eroded remains unexcavated to shoreward.

OCCUPATION 3

Features

Three types of features that contain bone are found in Occupation 3: pits, cobble hearths and floors, and graves. The hearths tend to be extensive cobble or boulder structures that merge with cobble pavements to form hearth–floor complexes. The graves contain cremated, noncremated secondary burial, and noncremated articulated human remains. In many cases the grave pits contain cremated (calcined) animal bone, and some fresh animal bone. In some graves a stratigraphic division was clearly visible, separating a cremation from deposition of noncremated material. Such cases will be noted. The human remains from these graves are described in Appendix 7.

Hearths, Floors, and Pits

By far the largest faunal collection comes from Feature 19-1972, a hearth complex (Table A8.9). Deer bone from a minimum of eight individuals dominates the collection. The feature contains faunal remains taken during all seasons of the year, with the possible exception of March-April-May. Swordfish bone is included in the sample. Its presence is attributed to some mixture from underlying Occupation 2.

Table A8.9. Occupation 3 Faunal Remains from Hearth–Floor Complex Feature 19-1972 (W25S100)

Odocoileus. 113 bones, MNI = 8; 2 calves (less than 1 year), 1 at 2 years, 3 at 3–4 years, 1 at 5–7 years, 2 at 8+ years.
Skeletal parts: 34 teeth and jaw parts, 3 skull fragments, 6 scapula, 2 pelvis, 2 vertebrae, 7 tibia, 4 radius, 6 phalanges, 6 auxiliary/dewclaw parts, 23 carpals/tarsals/sesamoids, 6 metapodials, proximal, 10 metapodials, distal, 1 metapodial, shaft fragment, whole circumference but broken transversely.
Note on body parts: All sections of body represented. One striking difference from Occupation 3 body parts distribution is lack of broken metapodial shaft fragments.

Phocid. 4 bones. Canine, humerus, metacarpal/tarsal, acetabulum fragment; MNI = 1.

Mustela sp. 2 bones, MNI = 1. A tibia and vertebra.

Castor. 5 upper postcanines, MNI = 1.

Canis. 6 bones, MNI = 1.

Bird. 2 bones. 1 black guillemot coracoid, one unidentified bird skull fragment.

Swordfish. 21 bones, including vertebral fragments, and mandible fragment, MNI = 1.

Codfish. 2 vertebrae, MNI = 2.

Seasonality of the above sample:

a. *Odocoileus*, parietal with shed antler. January to June kill.
b. *Odocoileus*, left lower M_1 and M_2: M_1 erupted, M_2 3/4 erupted, 6–8 months of age. December to February kill.
c. *Odocoileus*, right lower DM_3 and M_1; wear on DM_3 indicates 5–9 months of age. November to March kill.
d. *Odocoileus*, right lower DM_2, DM_3 and M_1; wear and eruption pattern: 5–9 months of age. November to March kill.
e. *Odocoileus*, right M_1; 3–4 years of age, sectioning indicates 1/4 thickness width of growth layer. August to September kill.
f. *Phoca*, canine; rest (translucent) layer forming. June to July kill.

Summary: Deer hunting during summer (August–September) and winter (December–February) confirmed. Fall and spring possibly represented. Seal hunting during hauling-out period confirmed (June–July). Overall confirmed seasonality: June–July, August–September, December–February. Springtime is also possible.

Table A8.10. Occupation 3 Faunal Remains from Hearth–Floor Complex Feature 24-1974 (W20S70)

Odocoileus. 37 bones, MNI = 5. One ≤ 2 years, two 3–4 years, one 5–7 years, one 8+ years.
Left $M_{1/2}$, 2–4 years of age; 3 isolated teeth 3–4 years; right and left mandibles 3–4 years of age; lower molar 5–7 years, upper molar 8+ years.
Mustela. 5 bones, MNI = 2. 3 mandibles (2r, one 1l), talus, lumbar vertebra.
Castor. 6 bones. 2 incisors, 1 molar, 2 metacarpal/metatarsals, ulna.
Phocid. Bulla and phalange.
Halichoerus. Postcanine tooth.
Ursus. Phalange.
Great auk. Humerus, femur.
Ducks. 1 bone each: scaup (probable winter kill); *Anas*, coracoid.
Cod. 3 bones. Caudal vertebra, articular, precaudal vertebra with 4 annuli.

Note: Scaup confirms winter, probably cod, indicates fall use of this living floor.

Feature 24-1974 (Table A8.10) is another hearth–floor complex, again dominated by deer, but containing a diversity of other species and of multiple seasonality. The collections from the smaller hearths (Table A8.11) are dominated by deer but contain a diversity of species. The inclusion of swordfish again (Feature 3-1973) is probably caused by upward mixture by excavation for the houses.

The collections from Occupation 3 pits (Table A8.12) are generally small and unremarkable. Feature 35-1974, a pit with shell in the fill, contains a variety of furbearers, a seal, and probably one tomcod, which is a late fall or winter catch. Feature 19-1975 is a stratigraphically distinct collection of uncalcined bone associated with a cremation feature; its faunal contents should probably be considered equivalent to other pit fill.

Two major associations between groups of hearths and pits can be postulated on the basis of contiguity or proximity. Association 1 consists of Feature 24-1974 (hearth and floor), Feature 19-1972 (hearth complex), Feature 2-1973 (hearth), Feature 3-1973 (hearth), and Feature 25-1972 (hearth). Together these features form a functional complex exhibiting multiple faunal seasonality, greatly strengthening the hypothesis that year-round or near year-round use of the site occurred during Occupation 3. The alternative hypothesis—a series of short occupations at random with respect to season—is seemingly contradicted by the association of these features into one activity complex.

Association 2 consists of Feature 12-1974 (hearth), Feature 7-1974 (pit), Feature 27-1974 (pit), and Feature 19-1974 (pit). Feature 12-1974 contains a few bones from at least two deer individuals: a calf killed in October-November, and an adult. The pits add cod and *Phoca* to the list of fauna in this association, without providing more seasonality data.

Burial Features

Collections of nonhuman faunal remains from Susquehanna burials are dominated by calcined bone fragments (Table A8.13). Unburned bone is also included within these features, as is some burned (black, but not calcined white) bone. Burned (black) bone has been in a fire, but not heated enough (600 °C) for calcination. The presence of a few pieces of burned (black, not calcined) faunal bone does indicate incomplete or partial combustion of some faunal inclusions. Since the human bone in Susquehanna burials included calcined,

Table A8.11. Faunal Remains from Occupation 3 Hearths

Feature 18-1972. W30S100. Hearth?
 Odocoileus. Proximal radius
Feature 1-1973. W10S90. Hearth.
 Odocoileus. Phalange/proximal.
 Flounder. 1 bone
Feature 2-1973. W15S100. Hearth.
 Odocoileus. 6 bones. Left $M_{1/2}$ 2 years, carpus radial, metapodial fragment, 2 phalanges, scapula fragment.
 Mustela. Right pelvis.
Feature 3-1973. W15S105. Hearth.
 Odocoileus. 4 bones. Antler tine, proximal radius, astragalus (charred), phalange.
 Mustela macrodon. Female. Right mandible.
 Castor. Incisor and 6 molars.
 Ursus americanus. Canine.
 Swordfish. 23 blade fragments (upward mixture Occupation 2).
 Duck. Ulna.
 Ardeid (heron), large Carpometacarpal.
 Bird, unidentified. Tibiotarsus.
 Note: Heron indicates warm-season occupation.
Feature 12-1974. E20S80. Hearth.
 Odocoileus. 10 bones, MNI = 2. Left lower mandible with M_1 3/4 erupted (October–November), 3 phalanges, astragalus, 2 right calcaneus, 2 vertebrae, distal tibia epiphysis closed.
Feature 25-1972. W15S90. Hearth or shallow pit.
 Odocoileus. 2 bones. 2 metapodial fragments.
 Eider. Coracoid.

burned, and unburned bone, we assume that faunal material (as food for the deceased perhaps) might also include all three types of bone.

Unfortunately, however, some unburned bone could have been mixed with the feature fill as grave pits were dug in preexisting midden matrix. Therefore, we can only state with certainty that the calcined and burned faunal material was included in the grave fill with the human interment. Unburned bone may or may not be deliberate inclusions in the grave fill.

Primarily looking at data derived from the calcined bone inclusions, therefore, there are some patterns that emerge. The volume of calcined faunal bone in these features varies tremendously, from nil in several cases to approximately 800 fragments and 1-kg mass in the case of Feature 24-1975. The large volume is primarily dependent on the amount of large mammal bone (probable deer) and identified deer bone in the feature.

There is no "standard" set of faunal inclusions—that is, no evidence of a "deer cult," "bear cult," or similar pattern. However, the faunal sample from each feature may be dominated by the bones of one taxon, and usually the minimum number of individuals represented by that taxon is one or two. The most common "dominant" species inclusion is deer (*Odocoileus*). In several cases deer antler and jaw fragments are present along with postcrania, so that we can reasonably conclude that whole deer were cremated. In Feature 24-1975 beaver bone is dominant. Based on an examination of epiphyseal fusion states, it is likely that only one beaver was cremated. In cases where deer (or moose) bone is not the dominant inclusion in a cremation, the deer or moose are represented most often by

Table A8.12. Faunal Remains from Occupation 3 Pits

Feature 13-1975. W35S90. Hearth or pit.
  Odocoileus. 1 bone. Upper left premolar, 3–4 years.
Feature 2-1971. W55S80. Pit with black soil and some shell.
  Odocoileus. 2 bones. Phalange I and mandible symphysis.
Feature 32-1974 and 33-1974. W15S65. Shell- and dark-soil-filled pit.
  Odocoileus. 1 bone. Carpus intermedial cuneiform.
Feature 32-1974. W15S65. Shell-filled pit.
  Cod. Caudal vertebra.
Feature 7-1974. E25S75. Pit.
  Cod. 2 skull bones.
Feature 27-1974. E15S70. Pit.
  Odocoileus. 5 bones. 3 phalanges, cervical vertebra, antler tip.
  Phoca. 2 bones. Canine and scapula.
Feature 19-1974. E15S75. Pit, dark soil and shell fill.
  Odocoileus. 1 bone. Phalange II.
Feature 35-1974. W20S70. Pit with shell.
  Lutra. 1 bone. Ulna distal.
  Castor. Incisor.
  Phocid. Tibia, right, proximal fragment.
  Mustela macrodon. Left proximal femur.
  Tomcod. 8 vertebrae, MNI = 1. 2 annuli, all exhibit full growth layer. Late fall or winter.
Feature 26-1975. W30S70. Pit.
  Odocoileus. 5 bones, MNI = 2. 3 teeth: 2 upper molars, 3–4 years of age, upper molar, 2 years of age; distal metapodial, male parietal with shed antler (January to May kill).
  M. macrodon. Lower right M_2.
  Phoca. Canine.
Feature 19-1975. W5S55. (Part of Feature 11-1975.) Uncalcined bone stratigraphically separated from cremation feature.
  Odocoileus. 3 bones. Lower right mandible, 3–4 years, ulna fragment, sesamoid.
  Phoca vitulina. Bulla.
  Branta canadensis. Right humerus, proximal.
Feature 16-1975. W15S55. Pit filled with brown soil and shell.
  Cod. Premaxillary bone.
  Mustela macrodon. Ulna.
Feature 7-1972. W35S95. Shell-filled pit.
  Odocoileus. Right proximal radius.
Feature 26-1972. W20S75. Pit.
  Odocoileus. 2 bones. Astragalus, parietal with mature antler still attached (September to January kill).

metapodials or other leg bones. These may represent marrow bones (metapodials with no meat on them) or small "packages" of meat.

In addition to whole deer and beaver, or deer and/or moose parts, there are other common inclusions. Canids, sometimes identifiable by size as probable domestic dogs, are commonly represented by skull parts (five cremations), although postcranial canid parts are present in two of these cremations. The most commonly identifiable bird inclusions are wing bones of large geese, presumably Canada goose. Furbearers, such as bobcat, mink (species indeterminant), and fox are represented by a few bones, as are one or more seal species.

Table A8.13. Detailed Bone Identifications of Occupation 3 Cremation Burial Features

Feature 6-1975. W30S70.

Tomcod. 2 individuals, one 2 years of age, one 4 years; late fall to early winter catch.

Mustela macrodon. 1 bone. Left mandible, probably male.

*Mammal bone fragment, unidentified.

Note. This feature contained a flexed human adult female and infant burial, with some red ocher present.

Feature 7-1975. W15S55.

**Felis* sp. (probably bobcat). Left maxilla without preserved teeth.

**Odocoileus*. Right proximal radius fragment, epiphysis fused.

*Canada goose. Proximal right humerus.

*39 unidentified mammal bone fragments.

4 unidentified mammal bone fragments.

Feature 9-1975. W10S45 and W10S50.

*Large mammal (probably *Odocoileus*), 36 long-bone fragments.

*Aves, medium-sized. One long-bone fragment.

Uncalcined tomcod. One 2-year-old individual; spring catch.

*Canada goose. Proximal left humerus.

*Aves, unidentified. 6 fragments.

*Mammal, unidentified. 30 fragments.

*Dog. 8 skull fragments including zygomatic, occipital, sagittal crest and maxilla, and one rib fragment.

Note: Feature includes burial of an uncalcined human skeleton with cremated material placed on the gut cavity.

Feature 18-1975. W30S65. (Uncalcined burial of an adult male.)

Odocoileus. 2 bones, MNI = 2. An upper left molar exhibiting wear in 5–7 year range, and distal metapodial fragment, unfused epiphysis. Both uncalcined.

Feature 12-1975. W10S50.

*Large mammal. 41 small long-bone fragments.

**Odocoileus*. Distal metapodial condyle, epiphysis unfused.

*Aves, large. 28 long-bone fragments.

*American eel. Caudal vertebra.

*Fish, very small. Jaw fragment, 2 spines or fin rays.

*Aves, large. 4 phalanges.

*Aves, large. Proximal carpometacarpus fragment.

*Canada goose. 2 humerus fragments, a right proximal and a right distal, which may or may not be from the same bone.

**Odocoileus*. Right astragalus fragment.

*Mammal, unidentified. 88 fragments.

*Small mammal. Tooth root, probably incisor or canine.

**Odocoileus*. 9 antler fragments.

*Seal, probably gray seal. Phalange fragment.

*Dog. Maxilla with incisors and two premolars, left and right zygomatic arches.

*Moose. Proximal left metatarsal fragment.

*Turtle, probably a box turtle. 3 marginal scute fragments.

*Turtle, unidentified. 1 scute fragment.

*Beaver. Anterior mandible fragment.

Odocoileus. MNI = 2. Lower right M_1 and M_2.

Odocoileus. Upper left deciduous molar with moderate–heavy wear.

Odocoileus. Proximal metacarpal.

Odocoileus. Two metapodial diaphysis fragments.

Odocoileus. Phalange I, distal.

Duck. Left femur, distal.

(Continued)

Table A8.13. (*Continued*)

Loon. Right tarsometatarsus.
Codfish. Precaudal vertebra, 8 years, L_5 growth state (late fall catch).
Castor. Molar.
Note: There are multiple layers of deposition of cremated material in Feature 12. It is possible that the uncalcined material was accidentally in the feature fill during feature construction.

Feature 19-1975 (and Feature 11). W10S50.
*Large mammal long-bone fragments, all deer-sized. 16 large fragments, 133 small fragments.
**Odocoileus*. Auxiliary second phalange, epiphysis unfused, calf.
Odocoileus. Phalange II, distal fragment.
Odocoileus. Phalange I, epiphysis fused, uncharred. Length of phalange indicates a modest buck or large doe.
Odocoileus. Left lower $P_{3/4}$. 2 years of age, uncharred.
Odocoileus. Left astragalus, complete, size matches Phalange I length individual.
Odocoileus. Antler and parietal, fused, uncharred.
Odocoileus. Phalange III.
**Odocoileus*. Astragalus fragment.
**Odocoileus*. 4 fragments radius shaft.
Odocoileus. 40 long-bone diaphysis fragments.
Odocoileus. Metatarsal fragment.
M. macrodon. Right humerus shaft, uncharred.
**M. macrodon*. Right humerus shaft, charred (second individual).
Alces. Proximal end of auxiliary metacarpal, head fusing, charred.
*Bear. Right ulna, fragment of semi-lunar notch.
*Turtle, painted (?). Marginal scute.
*Mammal, unidentified. 37 fragments.
Fish. Vertebral fragment, perforated and slightlly ground.
Longhorn sculpin. Preoperculum.
Note: Two right humeri from two *M. macrodon* present poor probability of chance occurrence. Assemblage is dominated by deer, which does not exhibit evidence of more than one individual being involved. If one individual, it is a 2-year-old buck in the 200-pound weight range, killed between September and March or April.

Feature 24-1975. W10S40.
*Large mammal (could be *Odocoileus*). 37 large and small calcined long-bone fragments.
**Odocoileus*. Distal metapodial condyle fragment.
**Odocoileus*. 4th carpus.
**Odocoileus*. 3 anterior metacarpal diaphysis fragments.
**Odocoileus*. Metatarsal, right, proximal fragment.
**Moose*. Femoral head fragment.
*Mammal, small or medium. 425 fragments.
*Aves, medium size. Edge of sternum fragment.
**Castor*. Scapula, distal 1/3.
**Castor*. Pelvis, acetabulum.
**Castor*. Incisor fragment.
**Castor*. Left and right femoral heads with epiphyses fusing; three lumbar/sacral vertebrae with unfused epiphyses.
**Castor*. 3 tibial diaphysis fragments.
**Castor*. Caudal vertebra, epiphyses unfused.
**Castor*. Proximal left scapula fragment.
**Castor*. Third metacarpal.
**Castor*. Left radius, distal fragment, epiphyses unfused.
**Castor*. Clavicle, one proximal and one distal fragment.

(*Continued*)

Table A8.13. (*Continued*)

**Castor*. Acetabulum of pelvis, left, fragment.
*Canid, probable dog. 2 skull fragments. Maxilla and squamous temporal portion.
*Canid, probable dog. Metatarsal or metacarpal, proximal fragment.
*Porcupine. Fragment of right mandible.
*Aves, unidentified. 5 long-bone fragments.
Fish. 3 vertebrae identified as longhorn sculpin, tomcod, and American eel. May or may not be part of feature fill.
Note: The assemblage is dominated by what appears to be the recognizable components of one complete beaver.

Feature 28. W20S40.
*Large mammal. 7 unidentified bone fragments.

Feature 30-1975. W15S55.
*Mammal, unidentified. 26 bone fragments.
*Canid, possible dog. Right maxillary fragment with alveolus for P^2/P^3.
**Odocoileus*. 13 antler fragments.
**Odocoileus*. One first phalange distal fragment.
Mammal. 3 longbone diaphysis fragments.

Feature 34. W11.5S46.
*Aves. Two long-bone fragments.

Feature 38-1975. W10S70-75.
**Odocoileus*. 2 metacarpal fragments.
*Large mammal. 5 small long-bone fragments.
*Fox (species?). Fragments of left maxilla, no teeth preserved.
*Small mammal. Rib fragment (could be fox).
Phoca. Left pelvis, acetabulum area.
**Phoca*. 14 rib fragments.
*Aves, medium-sized. A distal radius and humerus shaft.
*Aves, 84 long-bone fragments.
**Odocoileus*, tooth fragment, probable lower P^2.
**Odocoileus*, 2 antler fragments.
**Mustela* sp., possible *M. macrodon*. Right pelvis, acetabulum, rim fragment.
Note: This sample is "dominated" by a medium-sized bird, possibly a duck. Portions of a fox and seal also were included, as were portions of at least one leg bone of a deer.

Feature 41-1974 (Feature 3 and Feature 14). W10S55
*Large mammal (*Odocoileus*?). 20 large and 24 small long-bone fragments.
**Odocoileus*. Left jaw symphysis.
**Odocoileus*. Metatarsal shaft fragment, distal, epiphysis fusing.
**Odocoileus*. 2 metapodial distal condyles, fused to shaft.
**Mustela macrodon*. Right mandible.
*Small mustelid. Right humerus shaft (could be *M. macrodon*).
*Aves, medium-sized. A distal radius and humerus shaft.
*Aves, medium-sized. 7 long-bone fragments.
*Fish, Flounder (?). Opercular fragments.
Note: Feature 41 is dominated by deer, with at least two individuals represented by lower leg bones.

Feature 42-1974 (and Feature 22). W10S55.
*Large mammal. 71 fragments.
**Odocoileus*. Metapodial, distal condyle fragment.
**Odocoileus*. Metatarsal, 5 diaphysis fragments.
**Odocoileus*. Metacarpal diaphysis fragment.
**Odocoileus*. Left mandible alveoli from M_2 and M_3.

(*Continued*)

Table A8.13. (*Continued*)

*Canid, possible dog. 4 fragments of right zygomatic bone, and one maxilla fragment with M^1 alveolus.
*Aves. Medium phalange.
Large mammal. Bone fragment, charred, not completely burnt.
Canid. Tibia, left, proximal end, epiphysis fused, unburnt.
Odocoileus. Vertebra, anterior articular process.
Cod. Right premaxilla.
*Phocid. Maxillary fragment.
*Aves. Large (goose-sized), long-bone diaphysis fragment.
*Aves. 36 long-bone diaphysis fragments, mostly from medium-sized species, some from large species.

*Denotes calcined bone.

Horizontal Distribution

Here we consider the distribution of bone outside of the features discussed above. The methodology is analogous to that used on Occupation 2. A substantial amount of horizontal patterning of Occupation 3 faunal remains exists at a scale below the size of the 5 × 5 foot excavation unit. This scale of patterning manifests itself as sections with high bone concentration adjacent to sections almost devoid of bone. For example, E25S70 contains 36 bones, only one adjacent section contains more than 5 bones. In this square, most of the bone is deer and nondeer mammal. Section W35S100 contains 54 bones, 35 of which are bird (ducks and unidentified medium-sized birds) and 10 of which are flounder. Thus, even apart from recognized features, there are faunal-deposition episodes that covered very small areas of the site.

The features of Occupation 3 are distributed as shown in Figure A8.4. A plot of total bone counts is superimposed on the features in Figure A8.5. We began to differentiate activity areas by arbitrarily blocking off the cremation and burial area as Area 1. Bone outside of feature fill in this area is uncommon. A tier of sections nearer the shore, adjacent to Area 1, is characterized by modest bone concentrations associated with pits, post holes, and a depression. The depression itself is nearly devoid of faunal remains. This area is designated Activity Area 2.

East of Area 2 we have designated Area 3a and Area 3b, while south of Area 2 is Area 4. The bone concentration in Area 4 is partially congruent with a distribution of hearths and cobble floors, although the southernmost sections contain a heavy bone concentration and lack features. Area 3a may be another partially excavated hearth–cobble floor series along its inland margin. Area 3b is not demonstrably associated with hearth–cobble floor features, but it may be an inland satellite activity area analogous to 3b, with the hearths unexcavated (eroded from the front of the site?). Area 5 appears to stand by itself as a separate bone concentration, associated with few features. Area 6 is a diffuse scatter of bone that may or may not be associated with a concentration in section W45S110 (see Figure A8.6, all taxa).

Table A8.14 presents comparisons of these areas divided among major faunal components. (Note: this comparison is only for bones outside of the features examined above.) The following attributes for these activity areas can be observed from the figures and Table A8.14:

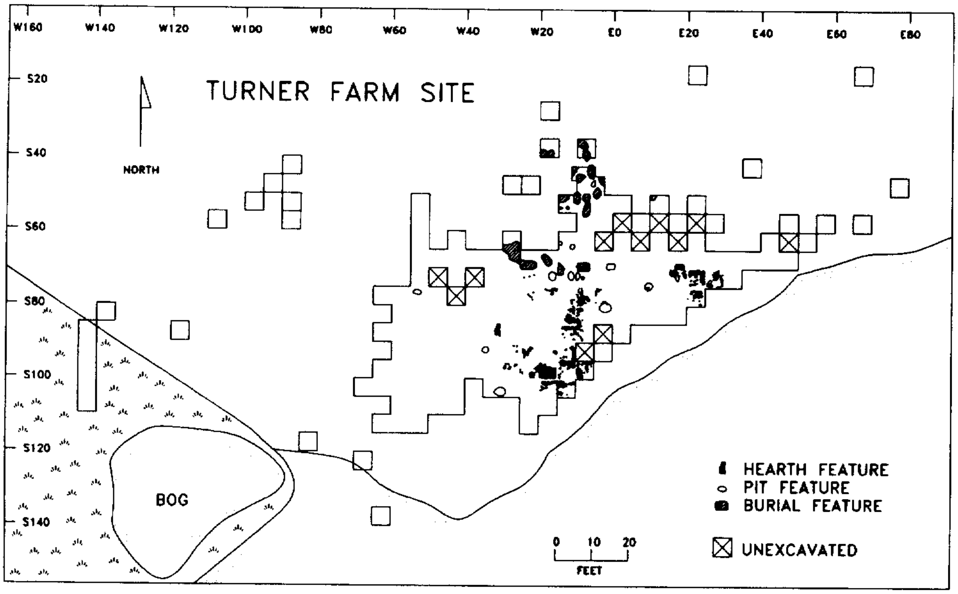

Figure A8.4. Occupation 3 features.

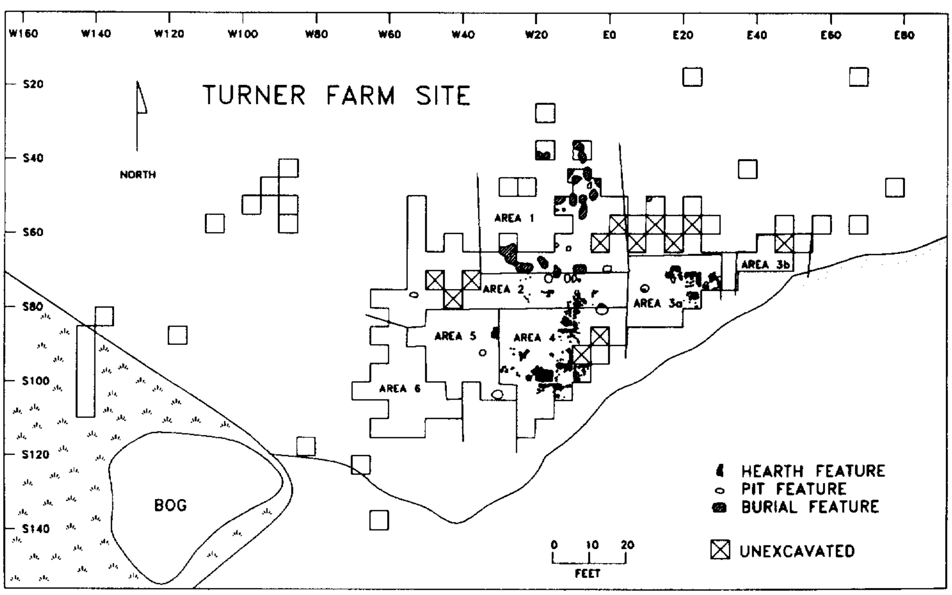

Figure A8.5. Occupation 3 faunal activity areas.

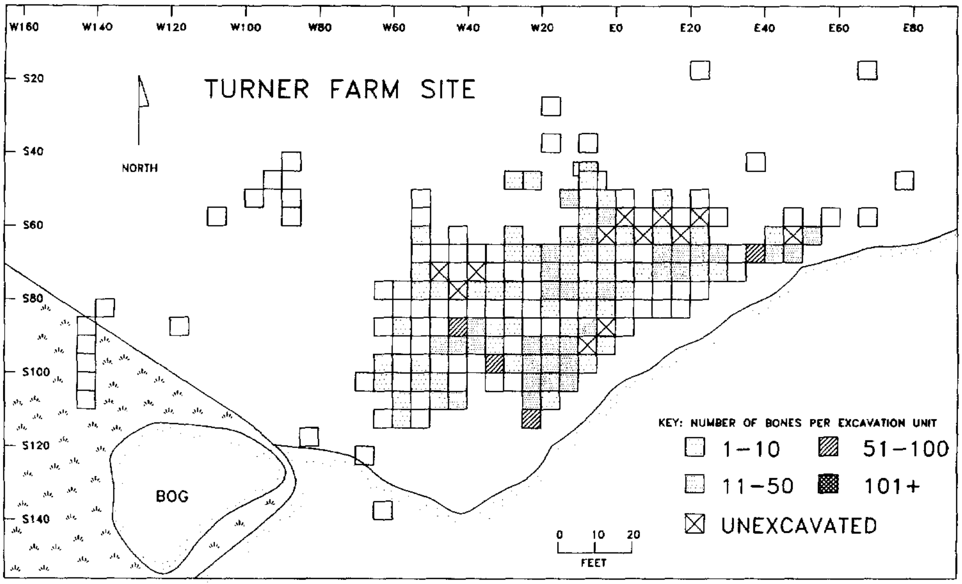

Figure A8.6. Occupation 3 bone refuse density.

Area 1—Cremation feature area.
  a. Moderate bone concentration and frequency.
  b. Distinguished only by high fishbone frequency due to a concentration of 11 codfish bones in W15S55. Other fish species do not exhibit higher concentrations.
  c. Overall, the suite of fauna from outside the features is "average."

Area 2—Concentration of pits, and a large depression, immediately shoreward of Area 1.
  a. Moderate bone concentration and frequency.
  b. Distinguished only by an especially low fishbone frequency.

Area 3a—A concentration of extrafeature bones to the inland and west of an area of hearths and pits.
  a. A dense concentration of bone.
  b. Characterized only by a moderately low fishbone frequency.

Table A8.14. Faunal Remains of Occupation 3 Activity Areas[a]

	Area 1	Area 2	Area 3a	Area 3b	Area 4	Area 5	Area 6
Deer	62	57	116	79	125	32	12
Other mammal	22 (0.35)	23 (0.40)	55 (0.47)	18 (0.23)	76 (0.62)	40 (1.25)	22 (1.83)
Fish	29 (0.47)	5 (0.09)	19 (0.16)	6 (0.08)	35 (0.26)	34 (1.05)	22 (0.29)
Bird	7 (0.11)	5 (0.09)	15 (0.13)	9 (0.11)	139 (0.11)	71 (2.22)	33 (0.29)
Total identified bone	120	90	205	112	392	160	70

[a]Numbers in parentheses denote frequencies relative to deer bone.

Area 3b—A dense bone concentration, seemingly distinct horizontally from Area 3a and perhaps only partially excavated. Same characteristics as Area 3a. These data suggest that Area 3b is adjacent to an unexcavated hearth–pit area (shoreward).

Area 4—A dense concentration of hearth and cobble floor–hearth complexes. Extrafeature bone distribution overlaps the feature distribution, although the greatest bone concentration lies shoreward (south and west) of the feature-filled area. Characterized by:

a. A distinctly bounded, heavy concentration of bone, which may have extended shoreward of the excavated area.
b. Low in deer bone frequency, since all other taxa are relatively high in frequency.
c. There is an especially noteworthy concentration of bird bone in the most shoreward extension of this area.

Area 5—A definitively bounded, dense concentration of bone contiguous on the west of the hearth complex distribution in Area 4. Reflecting a pattern similar to Area 4, deer parts are underrepresented; all others overrepresented (in particular nondeer mammal and fish).

Area 6—A diffuse, light scatter of bone, except for a concentration of bone in W45S110. Overall this area is characterized by a very low concentration of fishbone and a high concentration of nondeer mammal. Except for W45S110, bird bone concentration is low. There are no hearths or pits in the area. The relatively high nondeer mammal count is caused principally by a concentration of mink postcranial bones, and a relative paucity of deer bone. Perhaps Area 6 can best be characterized as low in deer and exceptionally low in fishbone frequency.

A sample of deer cranial, axial, and appendicular skeletal parts was selected for distributional analysis within the seven activity areas (Table A8.15). Surprisingly, there is no evident patterning of deer skeletal parts among these activity areas despite the evident patterning of the other taxa described above. Thus, whatever were the processing patterns of deer body parts, that processing was not correlated with the activities that deposited differing proportions of fish, bird, and nondeer mammal bone across Occupation 3.

Table A8.15. Deer Postcranial Bone in Occupation 3 Activity Areas[a]

	Area 1	Area 2	Area 3a	Area 3b	Area 4	Area 5	Area 6
Teeth	15 (0.26)	22 (0.42)	46 (0.42)	25 (0.40)	49 (0.45)	12 (0.41)	1 (0.20)
Scapula	5 (0.07)	5 (0.10)	16 (0.15)	9 (0.14)	11 (0.10)	1 (0.03)	2 (0.40)
Tibia	2 (0.03)	1 (0.02)	1 (0.01)	0	4 (0.04)	0	0
Astragalus	4 (0.07)	7 (0.13)	4 (0.04)	6 (0.10)	3 (0.03)	5 (0.17)	1 (0.20)
Metapodial, proximal	8 (0.14)	4 (0.08)	14 (0.13)	3 (0.05)	7 (0.06)	5 (0.17)	0
Metapodial shaft fragment	4 (0.07)	5 (0.10)	8 (0.07)	7 (0.11)	9 (0.08)	2 (0.07)	1 (0.20)
Metapodial, distal	8 (0.14)	1 (0.02)	8 (0.07)	4 (0.06)	4 (0.04)	2 (0.07)	0
Phalanges 1 and 2	12 (0.21)	7 (0.13)	21 (0.19)	8 (0.13)	22 (0.20)	2 (0.07)	0
Totals	58	52	109	62	109	29	5

[a]Numbers in parentheses denote frequencies relative to column totals.

OCCUPATION 4

Occupation 4 is subdivided into six stratigraphic levels, from uppermost to lowermost as follows: New Gravel Floor, Moderately Crushed Shell, First Gravel Floor, Coarsely Crushed Shell, Second Gravel Floor, and Below Second Gravel Floor. All these subdivisions are represented over a wide area of the site, except for the New Gravel Floor, which is localized in the eastern end of the main excavation. In keeping with the chronological ordering of data from earliest to latest, this discussion begins at the bottom of the list.

Below Second Gravel Floor

It is possible that up to five activity areas are represented by the faunal remains (Table A8.16, Figure A8.7), although each was sampled by only one or two excavated sections each. Most taxa and all deer element categories appear to be distributed at random with respect to the rest of the bone sample. Exceptions are duck bone, unidentified bird bone, and flounder. Ducks and unidentified bird bone represent 10 to 21 percent of the bone sample in some squares, but are absent from others. Swordfish are represented by three bones, coming from the areas of densest bone concentration. They probably represent upward mixture from an Occupation 2 swordfish bone concentration.

Second Gravel Floor

The Second Gravel Floor exhibits a concentration of features at the eastern end of the excavated area, with only a single feature (Feature 1-1972) west of E0S100. Four of these features, including Feature 1-1972, have yielded identifiable faunal samples (Table A8.17). The collection from Feature 16-1974 is notable by its all-cervid composition—two adult deer and parts of a moose. Also notable is the house floor, Feature 8-1973, which contained a proximal rib end of a large whale, probably *Eubalaena* (right whale).

Our inspection of bone distribution failed to detect any significant horizontal distribution shifts among deer body part categories. The map of deer postcranial elements (Figure A8.8) is, therefore, representative of all deer skeletal part distribution (including teeth and cranial parts), and can be used for comparison with other taxa. Deer bone distribution within the main excavation area is divided into northeastern (Area 1) and southwestern (Area 2) distributions. The distribution patterns of several other mammal taxa mimic the deer bone distribution: moose, beaver, phocids (with gray and harbor seal being evidently inseparable).

Table A8.16. Faunal Distribution from Occupation 4 Below Second Gravel Floor Activity Areas

	Area 1	Area 2	Area 3	Area 4	Area 5
Total bones	15	43	71	29	195
Ducks and unidentified birds	0	0	8	3	41
Flounder, cod, sculpin, swordfish[a]	0	11	0	11	26

[a]Regarded as displaced from Occupation 2.

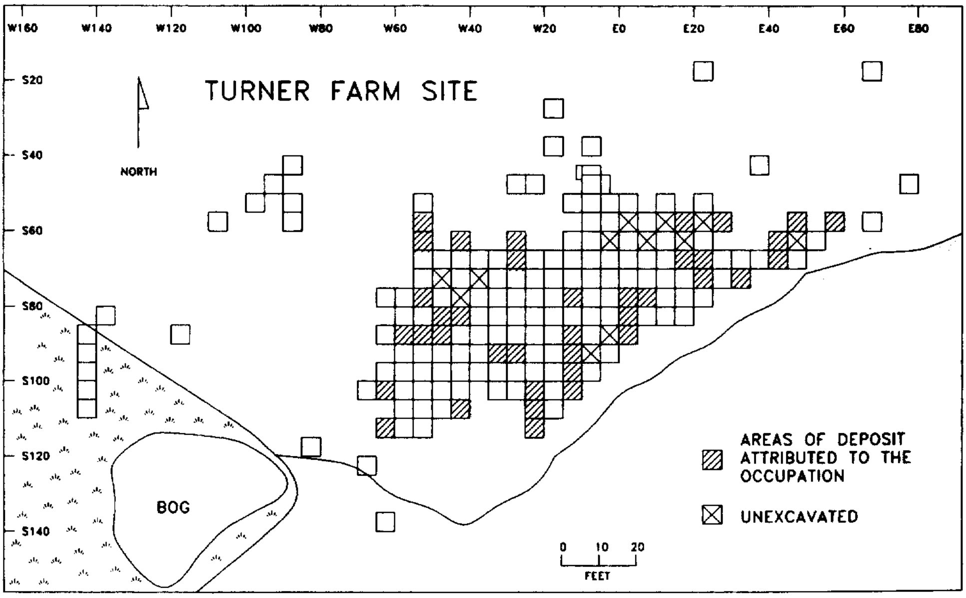

Figure A8.7. Occupation 4, Below Second Gravel Floor, areas of occurrence.

Table A8.17. Faunal Remains from Occupation 4 Second Gravel Floor Features

Feature 16-1974. E45S70. Hearth or floor.
- *Odocoileus*. 25 bones, MNI = 2.
  - 7 teeth and fragments, 5–7 years of age (Individual 1?).
  - 2 teeth, 3–4 years of age (Individual 2?).
  - 3 phalanges, distal humerus, 2 scapula fragments, 2 carpals, atlas and axis vertebra fragments, left femoral head, 2 mandible fragments, 4 metatarsal shaft fragments, all adult when possible to age.
    - *Note*: Very strong impression from measurements and complementary bone elements that only two fully adult deer are represented.
- *Alces*. 2 bones. Lumbar vertebra fragment and 3rd phalange fragment.
  - *Note*: This feature is unusual in containing 100 percent cervid remains. No concrete seasonality indicators.

Feature 11-1973. E5S75. Hearth, in shell-free floor.
- *Odocoileus*. 1 bone. Right 1st or 2nd molar, 2 or 3 years.
- Sculpin. 1 bone. Cheek spine.
- Striped bass. 1 bone. Caudal vertebra.
- Birds. 2 bones.
  - *Note*: Striped bass indicates summer fishing.

Feature 8-1973. E5S85. House floor in N 1/2 of section.
- *Odocoileus*. 1 bone. Metapodial shaft fragment.
- *Gavia immer* (loon). Coracoid.
- Whale of Balaenid family, possibly *Eubalaena*. Proximal end of rib.
  - *Note*: Inclusion of rare whalebone on house floor notable.

Feature 1-1972. W50S95. Hearth?
- *Odocoileus*. 3 bones, MNI = 1. Scapula, ulna, distal humerus fragment.
- *Mustela marodon*. 2 bones, MNI = 1. Right proximal femur, right proximal humerus, both epiphyses fused.

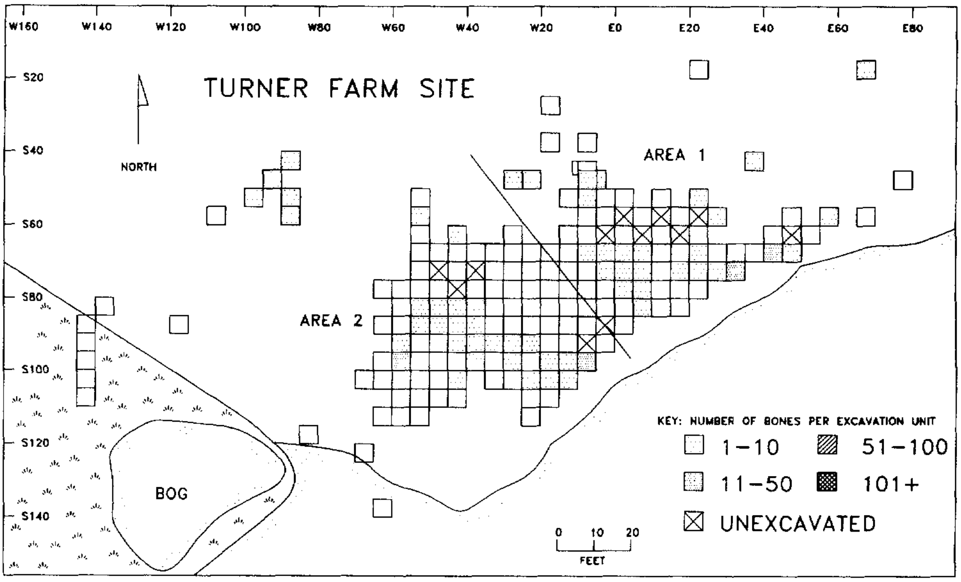

Figure A8.8. Occupation 4, Second Gravel Floor, distribution of deer postcranial.

Distributions of two mammal taxa (mink and bear) seem heavily weighted toward Area 2. In the case of mink, both cranial and postcranial fragments are involved. The skewed distribution favoring Area 2 is even more marked in the birds and fishes. The distribution of all bird taxa, as exemplified by the ducks, is almost exclusively in Area 2. (One partial exception is *Gavia immer* [common loon], with 4 of 31 bones in Area 1. The 4 loon bones from Area 1 are appendicular long-bone elements from a minimum of one individual.) Moreover, three bird species exhibit localized distributions within Area 2. Six cormorant bones are found in the western half, while 7 goose and 10 great auk bones are in the eastern half of Area 2. In the case of all three species, the minimum number of individuals is two, so the distributions are not caused by the localized spread of the carcass of a single individual. Fishbone exhibits almost exclusive distribution in Area 2 as well. Flounder occurs in two localized patches within Area 2, a pattern congruent with sculpin and swordfish. Sturgeon, however, occur only in one patch in Area 2.

The most obvious hypothesis to test is that Areas 1 and 2 represent different seasons of habitation (Table A8.18). Area 2, which essentially lacks features and has a great diversity of fauna, contains evidence of multiple seasonal use. Area 1 is full of features, but contains almost solely deer, moose, bear, and seal bones. Unfortunately, there is no tooth sectioning or tooth eruption data nor any immature seal bones that might indicate seasonality of Area 1. So we lack comparative seasonality data from these two areas to test the hypothesis.

Coarsely Crushed Shell

The coarsely crushed shell (CCS) layer essentially covers the entire excavated area of the Turner Farm. There are four features found in the CCS layer, of which two are

Table A8.18. Seasonality Data from Occupation 4 Second Gravel Floor, Area 2

1. *Halichoerus* (B572). W35S95. Mid-February through May kill.
2. *Ursus*. No sectioned teeth from Second Gravel Floor, but all bear kills of known seasonality at the site are late fall or winter kill.
3. *Mustela* (mink). No sectioned teeth from Second Gravel Floor, but all *Mustela* kills of known seasonality are winter or early spring kills.
4. Duck. A tibiotarsus with medullary bone deposits, indicating a spring kill before/during egg laying.
5. Loon. Tibiotarsus with medullary bone deposits, indicating a spring kill before/during April.
6. Ducks. Identification of scaup bone in duck sample indicates hunting between October and April.
7. *Gavia stellata*. A fall migrant.
8. Flounder vertebrae exhibit the following growth states: annulus (one individual), 1/4 or 1/2 growth (three individuals), 3/4 growth (two individuals), full growth (one individual).
9. Swordfish and striped bass confirm warm-season fishing as well.
10. Deer (E1776). Tooth section, June through December possible kill based upon growth layer of unknown width.

disturbances of uncertain origin truncated by the plow zone. Three of the four have yielded identifiable faunal samples (Table A8.19). Feature 11-1972, a hearth located toward the shoreline/midpoint of the site, contains bone from a deer killed sometime during December through February. Feature 10-1974, located toward the northeast end of the excavation, is a hearth or pit containing bone from a variety of bird species and from at least three deer. One of the deer was killed in late summer or fall. The suite of birds, especially the merganser and loon, are much more common along the coast during cold weather, suggesting winter seasonality as well.

The distribution of deer postcranial remains is widespread in the CCS level (Figure A8.9). The largest concentration occurs in five sections, W20S70 to E0S70, which are located between Feature 4-1974 and Feature 10-1974. Deer cranial bones and deer teeth

Table A8.19. Occupation 4 Coarsely Crushed Shell Feature Faunal Contents

Feature 4-1975. W30S70. Pit, contains fire-burned cobbles.

Odocoileus. 3 bones, MNI = 2. Phalange III, auxiliary metacarpal, adult; distal metapodial, epiphyses unfused.

Feature 11-1972. W25S95 and W20S95. Hearth.

Odocoileus. 1 bone. Left mandible with P_4, M_1, M_2; 3–4 years of age by tooth wear. M_2 successfully sectioned: 2nd full thickness growth layer formed. Killed in December–January–February.

Feature 10-1974. E15S75 (NW) and E10S75 (NE). Pit.

Odocoileus. 16 bones, MNI = 3. Left $M_{1/2}$ 5–7 years of age; upper molar 3–4 years of age. Left DM_1, DM_2, DM_3, very light wear (August through November kill).

13 postcrania: 2 left condyles, 3 carpal/tarsals, 2 scapula fragments, femoral head unfused, 5 metapodial fragments (proximal, shaft, and distal).

Phoca. Cervical vertebra fragment.

Bird, unidentified. 2 bones.

Duck, unidentified. 2 bones. Coracoid and humerus. (probably winter kill).

Merganser. Coracoid.

Gavia immer (loon). Humerus fragment (probably winter kill).

Branta canadensis (goose). Scapula.

Note: Definite late-summer or fall deer kill. Suite of birds suggests cold-season hunting of birds.

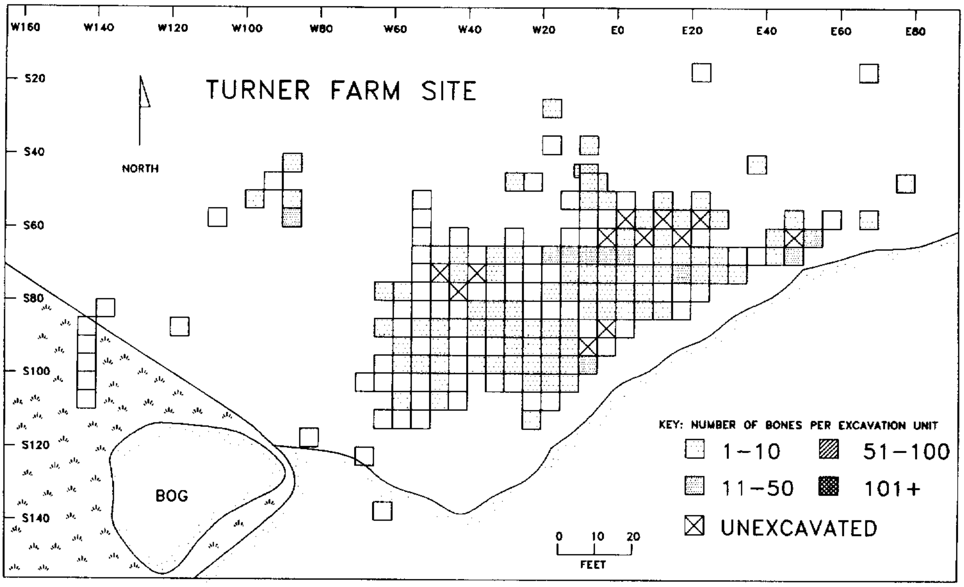

Figure A8.9. Occupation 4, Coarsely Crushed Shell, distribution of deer postcranial.

show very similar distributions, but without quite such a concentration of bone in W20S70 to E0S70. Beaver and phocid bone also show a nonfocused pattern. In contrast, the distribution of bear, moose, and mink (both postcranial [Figure A8.10] and cranial fragments) shows a concentration on the south-central and southwestern portions of the excavation. All bird species bones, as exemplified by the ducks (Figure A8.11), are concentrated in the south-central and southwestern portions of the site. Flounder also concentrate in the south-central and southwestern portions of the site with the notable addition of about 160 bones, including 136 vertebra, in W45S85. The general flounder–bird distribution pattern is similar to the swordfish, codfish, and sculpin bone distribution. Two fish species, striped bass and sturgeon, exhibit localized distributions of their own. Curiously, the most striking parallel in horizontal distribution patterns exists between mink bone distribution (Figure A8.10) and flounder distribution (Figure A8.12), even in such details as the W35S85 concentration, and a diffuse scatter of bone in the northeast corner of the site.

It is impossible to delimit activity areas of internally uniform faunal content larger than a few contiguous squares in this palimpsest of overlapping patterns. However, as in the Second Gravel Floor, there is an area of the site in the northeast corner that contains primarily deer and seal bone, while those taxa are joined by the majority of bird and fishbone in the south-central and southwestern portions of the site. A comparison of season of deer death (from tooth sectioning and tooth eruption data) with horizontal location within the coarsely crushed shell showed that there is no apparent seasonal difference in the deer bone reflected in the horizontal distribution pattern.

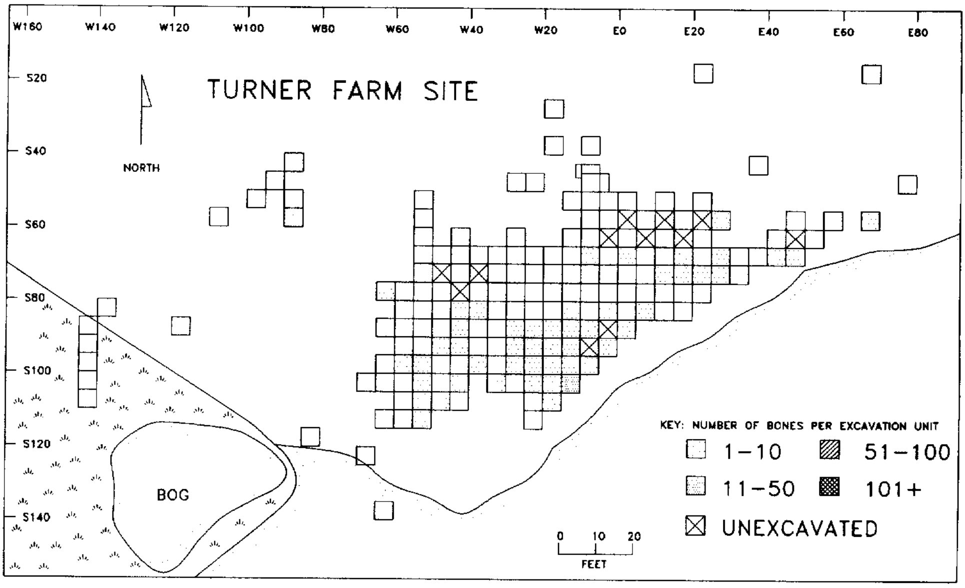

Figure A8.10. Occupation 4, Coarsely Crushed Shell, distribution of mink postcranial.

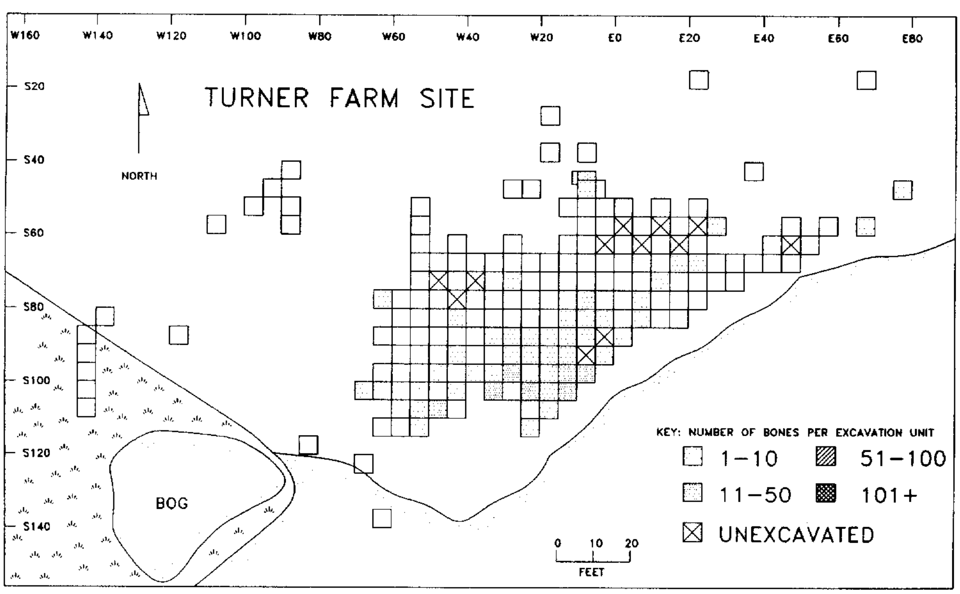

Figure A8.11. Occupation 4, Coarsely Crushed Shell, distribution of duck.

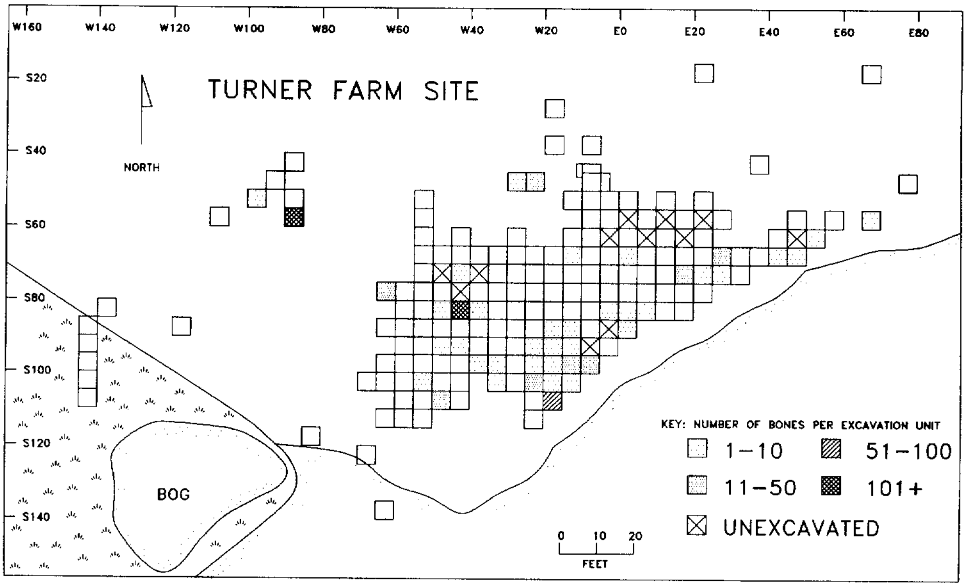

Figure A8.12. Occupation 4, Coarsely Crushed Shell, distribution of flounder.

First Gravel Floor

As with the underlying levels, deposits assigned to the First Gravel Floor are widespread. Two features associated with the First Gravel Floor have yielded identifiable faunal remains (Table A8.20). Both contain a variety of taxa. Feature 2-1975 is of at least summer seasonality, while Feature 3-1974 is of at least summer and early fall seasonality.

Deer postcrania (Figure A8.13) and deer tooth distribution is again widespread, and is closely paralleled by phocid, moose, and beaver distributions. As in antecedent ceramic levels, bear bones and mink crania and postcrania concentrate in the south-central–southwest areas of the main excavation.

Most fishbone is concentrated at the western edge of the excavation: flounder (Figure A8.14), sturgeon, and sculpin. There is an additional concentration of 100 flounder bones in W20S100. Two fish species, striped bass and swordfish, show distributions independent of this pattern. Bird bones, best represented by ducks (Figure A8.15), concentrate in the south-central and southwestern portions of the excavation. Again, we cannot explain these differential species distributions with concrete season-of-death information.

Moderately Crushed Shell

Deposits assignable to the Moderately Crushed Shell (MCS) level are widespread across the site, but with large lacunae. Feature 12-1973, a dense scatter of fire-cracked rock, has yielded a diversity of fauna (Table A8.21). Deer postcrania are essentially distributed evenly over the areas where MCS deposits have been identified (Figure A8.16). For the first time, however, there is a disparity between the distribution of deer teeth/cranial parts and

Table A8.20. Occupation 4 First Gravel Floor Fauna

Feature 2-1975. E5S60. Cluster of fire-burned rock resting on or in fire-burned floor.

Odocoileus. 5 bones, MNI = 2, one adult, one less than 3 years. 2 phalanges, one metatarsal distal condyle fragment, upper molar 3–4 years of age, left radius, distal epiphysis unfused.

Alces. 1 bone. Proximal metacarpal fragment.

Phocid. 1 phalange. One *Phoca* radius proximal end (2 bones).

Mustela macrodon. Left mandible, male.

Flounder. 2 bones, MNI = 1. 2 vertebrae, both with 3 annuli. Last layer forming L_3 (growth 1/4 formed). Late spring–early summer.

Note: At least summer seasonality, possibly more. Lack of evidence.

Feature 3-1974. E10S75. Hearth.

Odocoileus. 6 bones, MNI = 1. Femur, metapodial shaft fragment, phalange, 2 calcaneus fragments, incisor.

Castor. 1 bone. Incisor fragment.

Mustela sp. Canine.

Bird, smaller than duck. 1 bone.

Sculpin. 11 bones, MNI = 8. 2 vertebra, one L_3 (1/4 growth layer), one L_4 (1/2 growth layer). Late spring and summer.

Flounder. 22 vertebrae, MNI = 3. 3 exhibit L_6 (fully formed). Summer and fall flounder fishing.

Note: At a minimum, summer and early fall seasonality, probably late spring, summer, and early fall seasonality represented by fish remains.

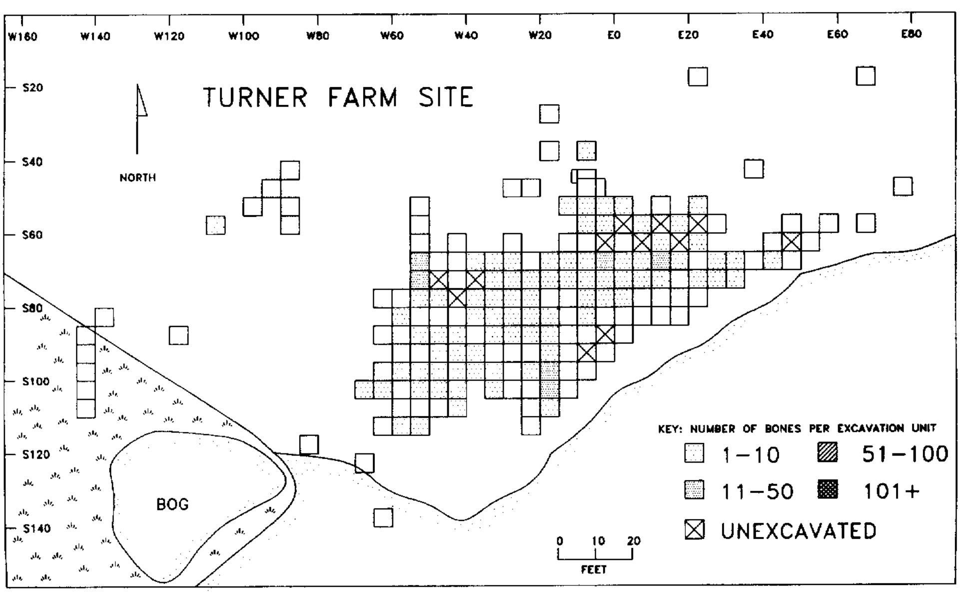

Figure A8.13. Occupation 4, First Gravel Floor, distribution of deer postcranial.

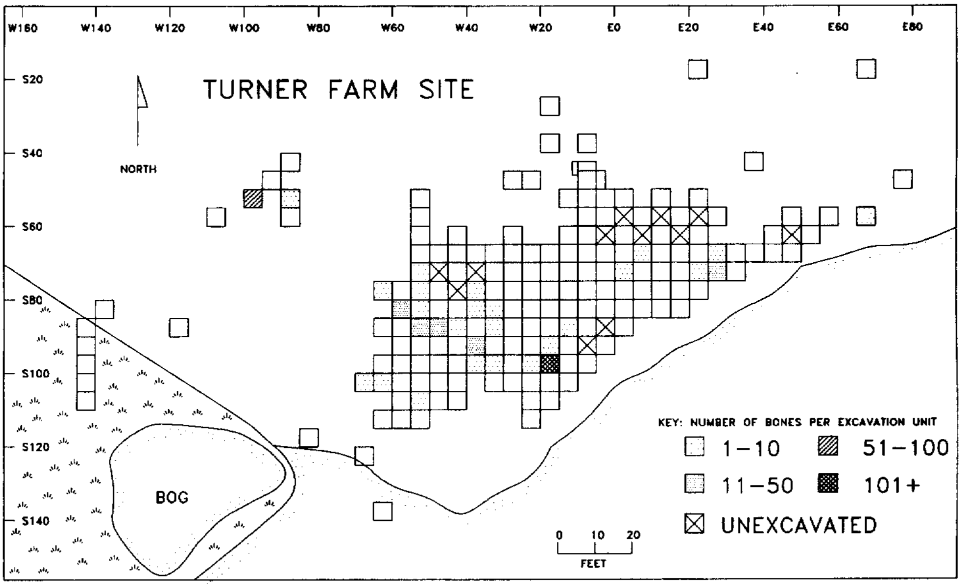

Figure A8.14. Occupation 4, First Gravel Floor, distribution of flounder.

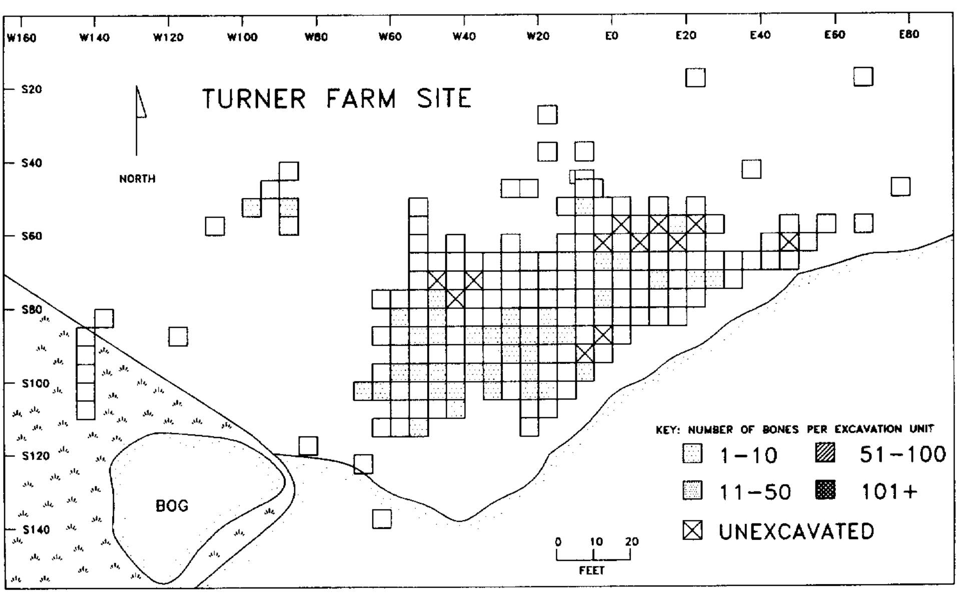

Figure A8.15. Occupation 4, First Gravel Floor, distribution of duck.

Table A8.21. Occupation 4 Moderately Crushed Shell Feature Fauna

Feature 12/1973. W10S100. Dense scatter of fire-cracked rock.
Castor. Incisor.
Mustela and *M. macrodon*. 12 bones, MNI = 3. 4 mandible, 2 maxilla fragments, cervical vertebra, pelvis, 2 ulna, 2 radius.
Flounder. 7 bones, MNI = 2. 1 American dab, 1 winter flounder.
Cod. Dentary.
Black guillemot. Humerus.
Alcid, medium-sized. Ulna.
Great auk. Tibiotarsus.
Duck. 7 bones, MNI= 2.
Bird, unidentified. 23 bones.

deer postcrania: deer teeth are much less frequent in the western and southern areas of the excavation (Figure A8.17). Moose, seal, and beaver distribution patterns follow that of deer postcrania. For the first time, there is a recognizable contrast between the distributions of mink crania and postcrania. The cranial parts concentrate in the north and south-central corners of the excavation (Figure A8.18), while the postcrania concentrate in the south-central and southwest corners (Figure A8.19). Bird bones concentrate in the northeast and south-central areas of the excavation, but are virtually absent from the western edges. All other bird taxa follow this pattern. Flounder bones (Figure A8.20) concentrate in the northeast corner of the excavation, with a small concentration at section W50S80. Cod,

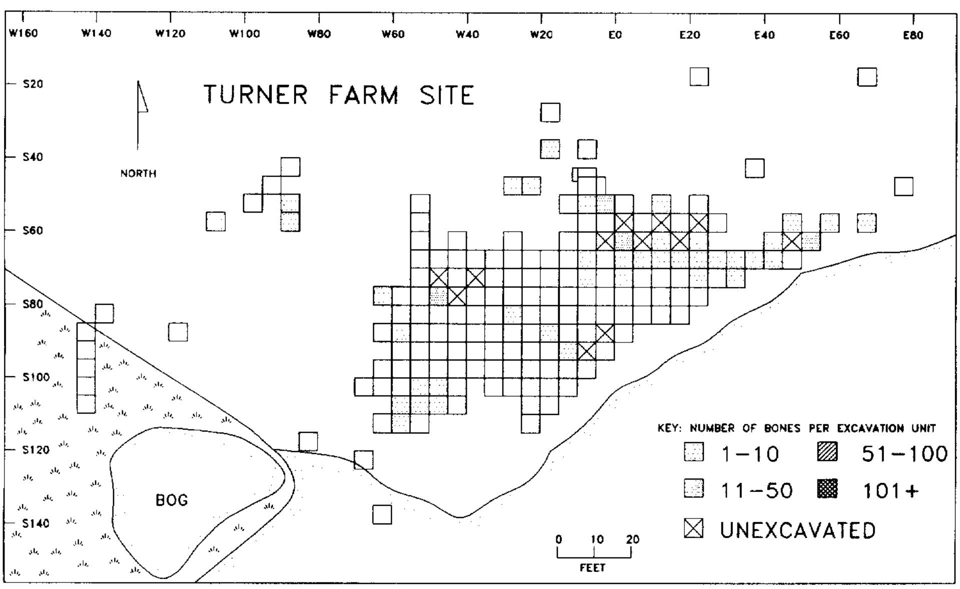

Figure A8.16. Occupation 4, Moderately Crushed Shell, distribution of deer postcranial.

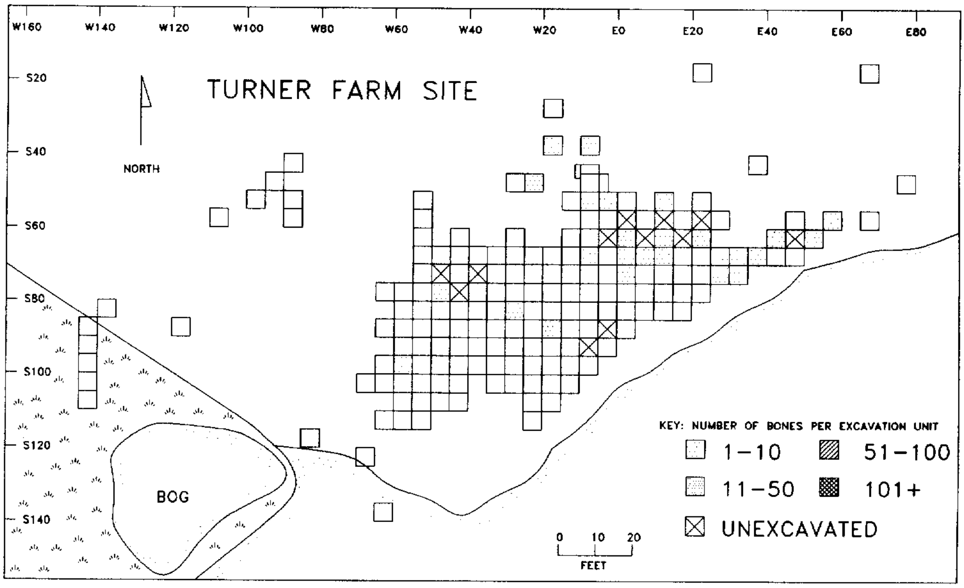

Figure A8.17. Occupation 4, Moderately Crushed Shell, distribution of deer teeth.

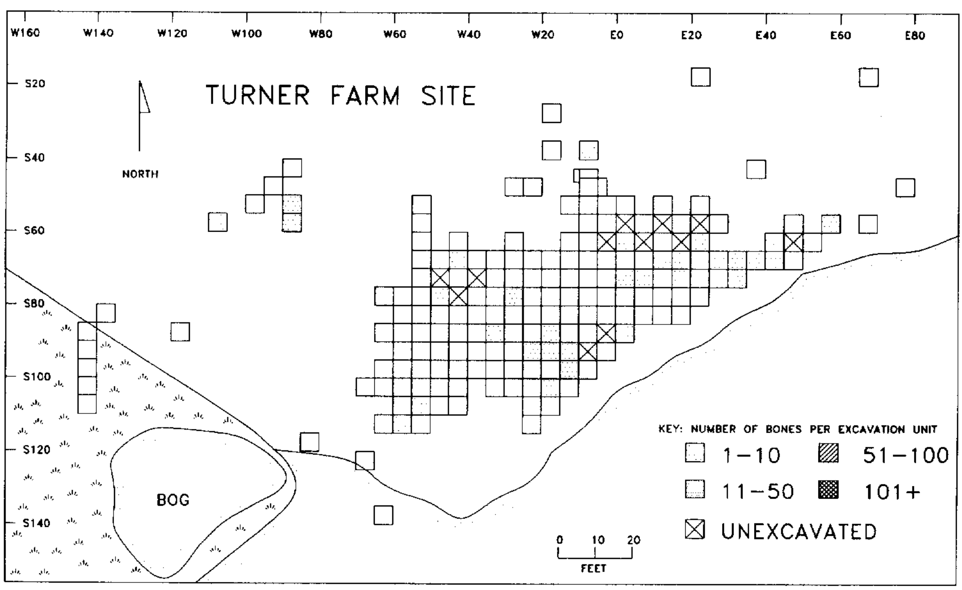

Figure A8.18. Occupation 4, Moderately Crushed Shell, distribution of mink cranial.

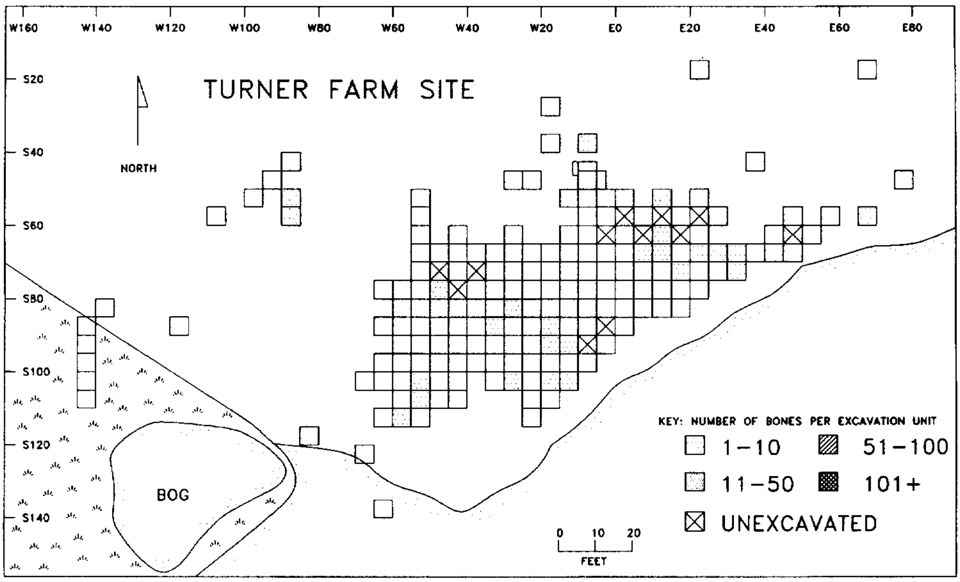

Figure A8.19. Occupation 4, Moderately Crushed Shell, distribution of mink postcranial.

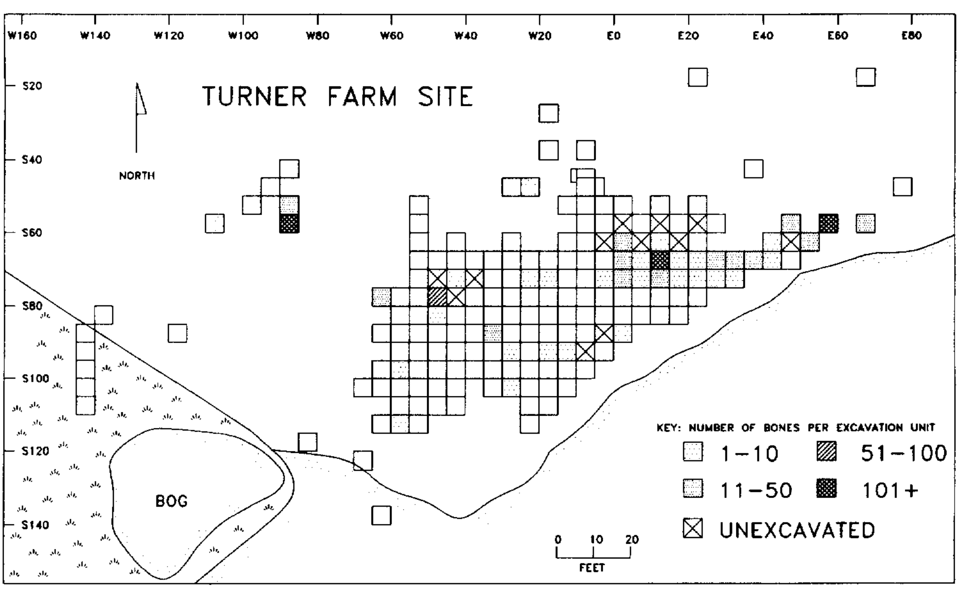

Figure A8.20. Occupation 4, Moderately Crushed Shell, distribution of flounder.

sturgeon, sculpin, and striped bass follow this pattern. Again, we are at a loss to explain these very large scale distribution patterns.

New Gravel Floor

Deposits assignable to the New Gravel Floor are concentrated in the northeast corner of the excavation. Because of the small bone sample size, and limited horizontal distribution, little can be said about horizontal distribution within the New Gravel Floor.

CONCLUSION

The dog burials in Occupation 2 and the human burials in Occupation 3 include "special" faunal inclusions that had meaning to the deceased or their survivors. The cache pit (Feature 22-1973) probably associated with dog burial Feature 24-1973 in Occupation 2 included, among several unusual artifacts, the same hoof element from a deer and a moose, the latter being rare at the time. There is no standard set of faunal inclusions in the human interments—no "bear cult," for example. Usually a limited number of species and specimens were included in a burial, such as one beaver in one feature. Dogs were evidently buried with humans during Occupation 3. Some bone assemblages, such as the hind limb of a deer, represent probable food stores added to the graves. Whether some of the species, such as furbearers, represented resources for the deceased, or whether they had special meaning beyond simple resources, is difficult to discern without further comparative data from other sites.

The horizontal distribution of bone and features is easily divided into three activity areas in Occupation 2. The addition of artifacts to the analysis defines an additional area—Area 4 (see pp. 80–85). Two seem to be human occupations near the shore, the easternmost one eroded. A possible dog yard has been identified behind the human occupation area. In Occupation 3, there are more evident activity areas, some associated with fire hearth and rock pavement complexes that must represent domestic structures. The scale of horizontal faunal patterning seems to change between the Archaic occupations (2 and 3) and subsequent Ceramic period levels. Part of the difficulty in interpreting these patterns may be the paucity of Ceramic period features with which to associate the faunal distributions. However, the whole site seems to be differentiated into only two or three major faunal deposition areas in each of the Ceramic period occupations. While it seems most likely that we are looking at major seasonal differences in use of the large area involved, we cannot prove that hypothesis despite the plethora of seasonality data available. At least we can say that the nature of occupation and deposition at the site changed significantly between the Archaic and Ceramic occupations.

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