Three Aboriginal shell mounds at Hope Inlet: Evidence for coastal, not maritime Late Holocene economies on the Beagle Gulf mainland, northern Australia

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Abstract

Many hundreds of Aboriginal shell mounds exist on the northern coasts of Australia. Though these archaeological features increasingly figure in broad constructions of past coastal hunter-gatherer economies, few have been analysed in any detail. This paper describes the excavation and analysis of three *Anadara*-dominated shell mounds situated in adjacent microenvironments at Hope Inlet, Shoal Bay near Darwin on the Northern Territory coast. These stratified deposits, formed over some 15 centuries between about 2000 and 500 years B.P., provide a relatively fine-grained record of subsistence and settlement strategies of hunter-gatherer peoples during this Late Holocene period. This study finds that these North Australian coastal groups practiced not a specialised marine or maritime subsistence economy focused on offshore resources, but a generalised and flexible coastal subsistence economy tied to the land.

Introduction

Many hundreds of Aboriginal shell mounds exist on Australia's northern coasts. Though these archaeological features increasingly figure in broad constructions of past coastal hunter-gatherer economies, relatively few have been excavated and analysed in fine detail. This paper describes the excavation and analysis of three shell mounds at Hope Inlet, Shoal Bay on the Northern Territory coast near Darwin, undertaken in 1996 with the permission and help of traditional owners, the Larrakia community. The excavated sites are three of hundreds of mounds dominated by *Anadara granosa* shell, recorded during surveys for a PhD project undertaken in the late 1990s at Northern Territory (now Charles Darwin) University (Bourke 2000; Burns 1999).

As this was one of the first systematic archaeological investigations for this region, the initial research aimed to address general questions on subsistence and settlement strategies of past Indigenous societies on this section of the North Australian coast. This study finds that during the Late Holocene, people practiced not a specialised marine or maritime economy adapted to exploiting offshore resources, but a generalised and flexible coastal subsistence economy tied to the land (cf. Hallam 1987). The distinction between coastal economies that focus on coastal margins and hinterland and marine or maritime economies that focus primarily on the shore and offshore resources, as defined by Gaughwin and Fullagar (1995), is an important one. Distinguishing between the two avoids the tendency, sometimes apparent in the archaeological literature, to an *a priori* view that the presence of shell mounds indicates increasingly complex and specialized marine economies in the Late Holocene.

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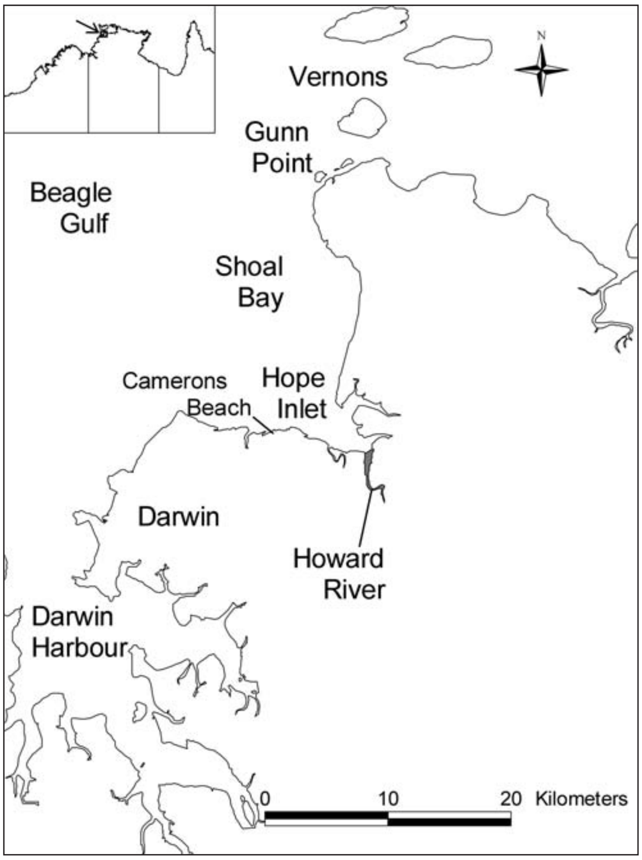

Figure 1 Location of Hope Inlet on the North Australian coast, showing places mentioned in the text. Map data courtesy of Northern Territory Department of Infrastructure, Planning and Environment. Copyright Northern Territory of Australia.

Environmental context of the Hope Inlet mounds

Hope Inlet is a small, nearly infilled estuary facing the Beagle Gulf at the south-eastern end of Shoal Bay, about 25 km north-east of Darwin (12° 20′ S, 131° 02′ E) (Fig. 1). The landscape is one dominated by chenier plains, fringed by mangrove forests hundreds of metres wide. This depositional landscape is shown by geomorphic studies at Camerons Beach, Shoal Bay, to have formed within the last 2500 years (Woodroffe and Grime 1999). Within the Hope Inlet coastal plains area of less than 100 km^2 are some 200 Aboriginal shell middens, earth mounds and shell and stone artefact scatters (Bourke 2000, 2002; Burns 1999). The three excavated mounds – designated HI81, HI83 and HI80 - are located a few kilometres inland of the present shoreline within a kilometre radius. They are situated on one of a series of uplands headlands and associated saltflats areas. Each headland is separated by broad drainage channels with mangroves, brackish to freshwater swamps and tidal channels (Fig. 2).

HI81 is a circular (14 x 15 m) mound situated on a laterite ridge that borders the headland margins and

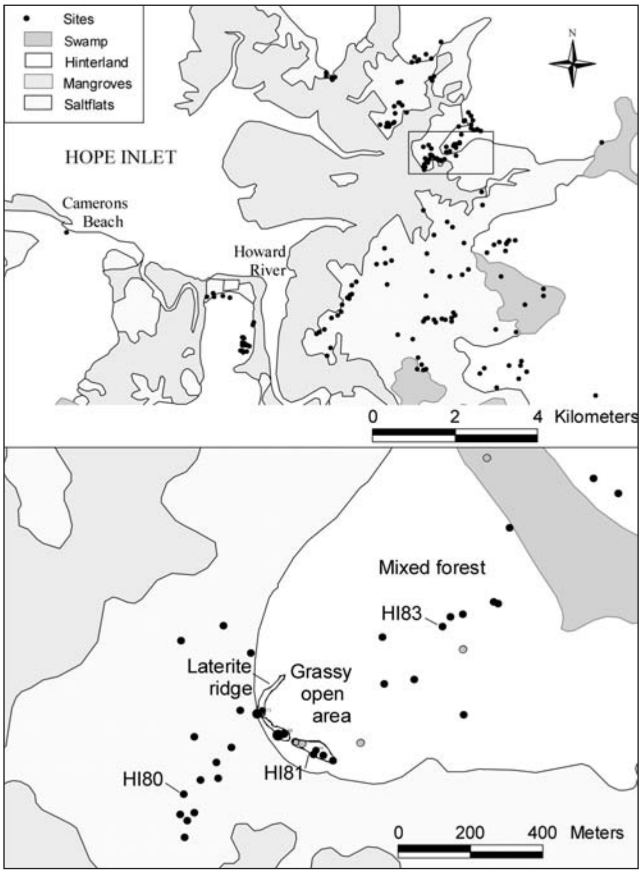

Figure 2 Map showing A) Distribution and environmental context of Hope Inlet sites and B) Detailed location plan of excavated sites. Map data courtesy of Northern Territory Department of Infrastructure, Planning and Environment. Copyright Northern Territory of Australia.

Figure 4 Shell mound HI83 in mixed forest. Photo: Trish Bourke.

Figure 5 Shell mound HI80 on open saltflats. Photo: Trish Bourke.

Figure 3 Shell mound HI81, showing excavation square overlooking saltflats. Photo: Trish Bourke.

overlooks the saltflats (Fig. 3). It is one of five shell mounds of a "composite mound site" (Cribb 1996:160) amassed along the 300 m long ridge, the largest of which rises seven metres high. An open low-lying grass-covered area extends inland from the ridge to the edge of mixed forest, within which a few hundred metres to the northeast is mound HI83 (Fig. 2). This circular (16 x 14m) mound (Fig. 4), is one of a dozen circular and doughnut-shaped middens clustered 50-100 m apart along the centre of the narrow headland. Mound HI80 lies within view, seaward of the large mound, on bare saltflats close to mangroves (Fig. 2). During king tides and after wet season rains, this elongated mound (Fig. 5) appears as a small, low island in a flat sea of water. Auguring showed it widens under the saltflats surface, with only the tip (11 m^3) of the total volume (73 m^3) showing. Many of another 28 small shell middens on this saltflats section may also be larger than their visible parts, and more may be completely buried (cf. Woodroffe et al. 1988).

Methods

Samples were taken from 1 x 1 m test pits in each of the three shell mounds, generally following guidelines by Johnson (1980). Each 1 x 0.5 m half of the excavation squares, designated Sections A and B, was excavated so it could be analysed separately. Samples were removed in small increments of 3 cm spits and all material from Section A was wet sieved through 6.4 and 3.2 mm sieves, dried and analysed.

These samples, of approximately 0.8 m^3, 0.5 m^3 and 0.6 m^3 from mounds HI81 (91 m^3), HI83 (57 m^3) and HI80 (73 m^3), represent about 1% of total mound volumes, so may be limited in how representative they are, given that shell mounds may be heterogeneous, as discussed by Bowdler (1983) and others (eg. Waselkov 1987:143). However, a mitigating factor in this study looking at vertical patterns of material distribution and shell fragmentation, is that the patterns are replicated in each mound, when the test pits are dug in various locations with respect to the mound centres,

Site	Material	Depth (cm)	Lab Code	$\delta^{13}C$	Age (b.p.)	Calibrated age (midpoint cal B.P.)
H181	*Anadara*	5	Wk6524	-1.6	1900±70	1553(1399)1273
H181	*Anadara*	140	Wk6523	-2.4	2220±70	1932(1788)1601
H183	*Anadara*	67	Wk6526	-2.3	1910±70	1564(1406)1279
H183	Charcoal	67	Wk6527	-25.3	1850±70	1946(1817)1574
H183	*Anadara*	16	Wk8252	3.2±.2	2020±90	1761(1531)1330
H180*	*Anadara*	3	OZC956	0#	980±75	652(532)446
H180*	Charcoal	3	OZC957	-25#	590±110	727(607)463
H180*	*Anadara*	40	OZC959	-25#	860±75	9631(751)662
H180*	Charcoal	40	OZC959	-25#	860±75	931(751)662
H180*	*Andara*	48	OZC960	0#	1090±90	766(633)497
H180*	Charcoal	48	OZC961	-25#	1010±90	1167(930)731

* = AMS analysis; # = assumed $\delta^{13}C$ values; calibrated ages 2-sigma.

Table 1 Radiocarbon age estimates on whole *Anadara* shells and charcoal pieces collected during excavation of sites HI81, HI83 and HI80 with the CALIB REV 4.3 Univ. of Washington Program, using the atmospheric decadal dataset 2 for charcoal samples and marine dataset with a DR correction value of 58 ± 40 for shell samples (after Reimer and Reimer 2000; Stuiver et al. 1998). These are revised estimates of those in my PhD thesis (Bourke 2000), determined using the previous version, the 1993 CALIB REV 3.0.3 model.

which implies a certain consistency to their internal structures. The main concern is that rare or clustered features may not be recovered, so Section B was cursorily examined for unusual features.

In this analysis, shell was measured by both weight, to allow for comparison with other components, and by minimum numbers of individuals (MNI) to compare the relative contribution of different shellfish species to subsistence. MNI counts are less affected by differential weight loss between species of shells that differ in robustness, as durable parts such as hinges and flanges may be counted, and reduce bias in interpretations by underestimates of actual flesh content provided by lighter shells (Coleman 1966:37, cited in Bowdler 1983:140 and see Meehan 1982:141-2).

Most of the vertebrate faunal remains (over 80% in each) was recovered from the 3.2 mm sieve, highlighting the importance of analysing this smaller material (see James 1997; Shaffer and Sanchez 1994). Moreover, the burnt, very fragmented state of all bone meant it was not feasible or appropriate, given the uncertain representative nature of the assemblage due to pre and post-depositional processes, to estimate the dietary contribution of fish or other animals using NISP or MNI counts (cf. Horton 1984; Ringrose 1993), so these are simply tabled as present to the identifiable taxa level.

Dating

Radiocarbon age estimates on *Anadara* shell and charcoal samples from the mounds, of between 2000 and 500 years BP (Table 1) have been calibrated and corrected for marine reservoir effect. However, the dates are considered minimum ages, due to evidence suggesting a smaller correction factor may be more appropriate for this region (Woodroffe and Mulrennan 1993:40-1; Woodroffe et al. 1988:98; paper in prep).

Shell Fragmentation

Shell fragmentation is used here as a sensitive measure of variation in the history and formation of midden deposits. In this analysis, *Anadara* shells less than half whole are classed as fragmented. Studies have found that initial deposition robust bivalves such as these results in minimal fragmentation, so highly fragmented shell is likely to be caused by activities that take place after initial discard (Muckle 1985:50-63, 68,77 and see Claassen 1998:58,114-5). Hiscock (1985:89-90) demonstrates an inverse relationship between breakage of stone artefacts and rate of sediment accumulation, which also applies to shell middens. When the rate of shell deposition slows or stops, fragmentation is higher, as shell and other material exposed on the midden surface for long periods are subject to weathering, disturbance by humans and other animals such as goannas, and taphonomic decay (see Bourke 2000:117-9; Claassen 1998:58,114-5;).

The Excavations

Site HI81

Excavation toward the mound centre, revealed a 110 cm thick layer of whole *Anadara* shells packed loosely together, with interstitial spaces filled with fine dark brown grey ashy matrix, interspersed with organic ash and silt lenses. This is overlain by a 5 cm thick compact surface cap of soil and fragmented shell (50%), probably due to post-depositional disturbance by human or animal activity on the mound surface and/or weathering processes. The upper shell mound layer sits on a more consolidated dark brown red gravelly soil lateritic ridge with less, more weathered (chalky white) shell, and medium brown sandy sediment at the base of the pit.

During excavation, charcoal pieces were noted falling through spaces between the shells to the next spit, resulting in higher charcoal density on the ridge surface, where the denser matrix acts as a barrier. This observed vertical displacement throws doubt on assumptions of stratigraphic integrity in this type of tropical mound, compared with more sediment-rich south-eastern middens (cf. Beaton 1985; Knuckey 1999:7). Loose shell began falling inwards from the walls after removing the bonding surface cap, and a box-frame used to rectify this made it difficult to see small-scale stratigraphic features. On its removal a cave in revealed a stratigraphic profile of the exposed wall (Fig. 6) and a stone hearth, comprising fifteen soot-covered, fist-sized lateritic rocks (Fig. 7), which resembles a stone oven used by the Arnhem Land "Fish Creek" group for cooking kangaroo (McCarthy and McArthur 1960:169, Plate 3A).

Analysis of the excavated material

The 933 kg of material from section A, HI81 comprises predominantly shell (536,669g, 72%), with much smaller quantities of bone (50g, <0.1%), 28 fish otoliths (5.5g), crustacean (9.5g, <0.1%), laterite rocks > 6 mm (56,928g, 7.6%) and stone artefacts, manuports (6.9g, <0.1%), ochre (286.3g, <0.1%) and charcoal (67g, <0.1%) (Table 2) and the remainder (20%) shell grit, sediment and plant remains.

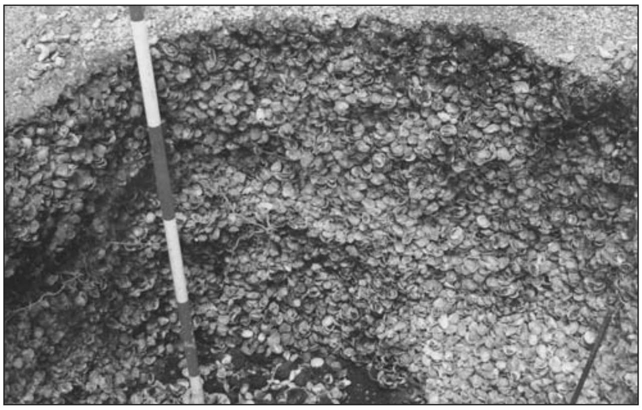

Figure 6 Mound HI81, profile of exposed wall after cave-in, with stone hearth at base. Photo: Trish Bourke.

Figure 7 Close-up of soot-covered stone hearth at base of mound HI81 on ridge. Photo: Trish Bourke.

Invertebrate Fauna

Of twenty-one mollusc species identified, the open mudflat bivalve *Anadara granosa* is dominant, representing 97% by MNI (Table 3) and 99% by weight of the shell assemblage. This edible species is rare around Darwin today. The second most numerous shell species, the oyster *Saccostrea echinata*, only comprises 0.2%, concentrated in the lower ridge layer (Fig. 8) and are large specimens (av. wt. 7 g); much larger than those recovered from mounds HI83 and HI80 (av. wt. 2 g). Other species that are common today in mangroves around Darwin, including the gastropods *Cassidula angulata*, *Nerita* spp. *Terebralia semistriata Telescopium telescopium*, *Ellobium aurisjudae* and *Chicoreus capucinus*, occur in frequencies of 0.1% or less, mainly in the upper levels of both the shell mound, and the laterite ridge (Fig. 8).

Vertebrate Fauna

Of fragmented bone recovered (Table 2) at least 25% by weight was identified as fish, and includes the vertebrae of small, unidentified fish species. *Arius* sp. (Fork-tailed catfish) dominates, with 26 otoliths, skull fragments, vertebrae and pectoral spines identified. Two otoliths of *Protonibea tiacanthus* (Black jewfish) were recovered from the middle layers and a proximal metatarsal (0.8 g) of Antilopine kangaroo from 20 cm below the surface. Fragments of mammal, reptile and one piece of bird bone, crustacean exoskeleton and claws identified as Mud crab, and mangrove worm tubes, were recovered mainly from the lower laterite ridge.

Stone Artefacts

A total of 33 stone artefacts recovered (Table 4) are

Spits	To Depth	Spit wt	Shell		charcoal		Bone	Otoliths	Crab	Stone artefacts		Ochre	Rocks
	cm	kg	g	% frag	g	g	n	g	g	n	g	g	g
1-2	6	37	29768	35	0.1	4.7	1	0.3		3	0.3	0.2	390
3-4	11	32	28679	16	0.6	6.6	7	0.8		4	0.2		50
5-6	19	31	29341	5	0.3	1.5	1	0.1		3	0.4		92
7-8	26	29	28111	4	1.3	1				1	0.1		113
9-10	31	28	26748	2	0.2	0.3	1	0.1					5
11-12	37	26	25465	3	1.3	1	1	0.1		1	0.1		28
13-14	44	30	28231	2	3	1.1	3	0.8	0.3	1	0.3	0.1	52
15-16	51	31	29542	2	1.8	1.3						44	
17-18	57	29	28215	3	2.9	1.1			0.2				7
19-20	64	30	28061	3	1.7	1					1.2	35	
21-22	70	30	27999	2	2.4	0.6	2	0.5				0.1	12
23-24	77	31	27609	4	2.7	1.4	2	0.3					7
25-26	85	32	28305	3	1.5	1				2	0.1	0.1	3
27-28	91	32	29756	1	1.2	4.4							6
29-30	99	31	29464	1	1.5	0.2							41
31-32	107	31	28916	4	6	1.3			3.2			13.4	306
33-34	116	44	29943	12	16	12.6	6	1.7	2.3			1.6	1592
35-36	124	55	19218	12	10.1	5.1	2	0.5	1.1	1	0.1	1	4563
37-38	130	62	15967	10	3.2	1				2	0.1	159.2	8235
39-40	135	64	10004	16	4.1	0.9	1	0.1	2	5	3.8	11.7	10789
41-42	142	63	4741	23	2.6	0.6			0.4	3	0.4	96.1	14955
43-44	149	62	1830	37	1.6	0.9	1	0.2		3	0.5	0.9	10010
45-47	160	94	766	56	0.6	0.5				4	0.5	0.7	5593
Totals		933	536669		66.7	50.1	28	5.5	9.5	33	6.9	286.3	53928

Table 2 Quantitative data, Section A, mound HI81. All artefacts are quartz except three chert flakes in spits 39 and 41.

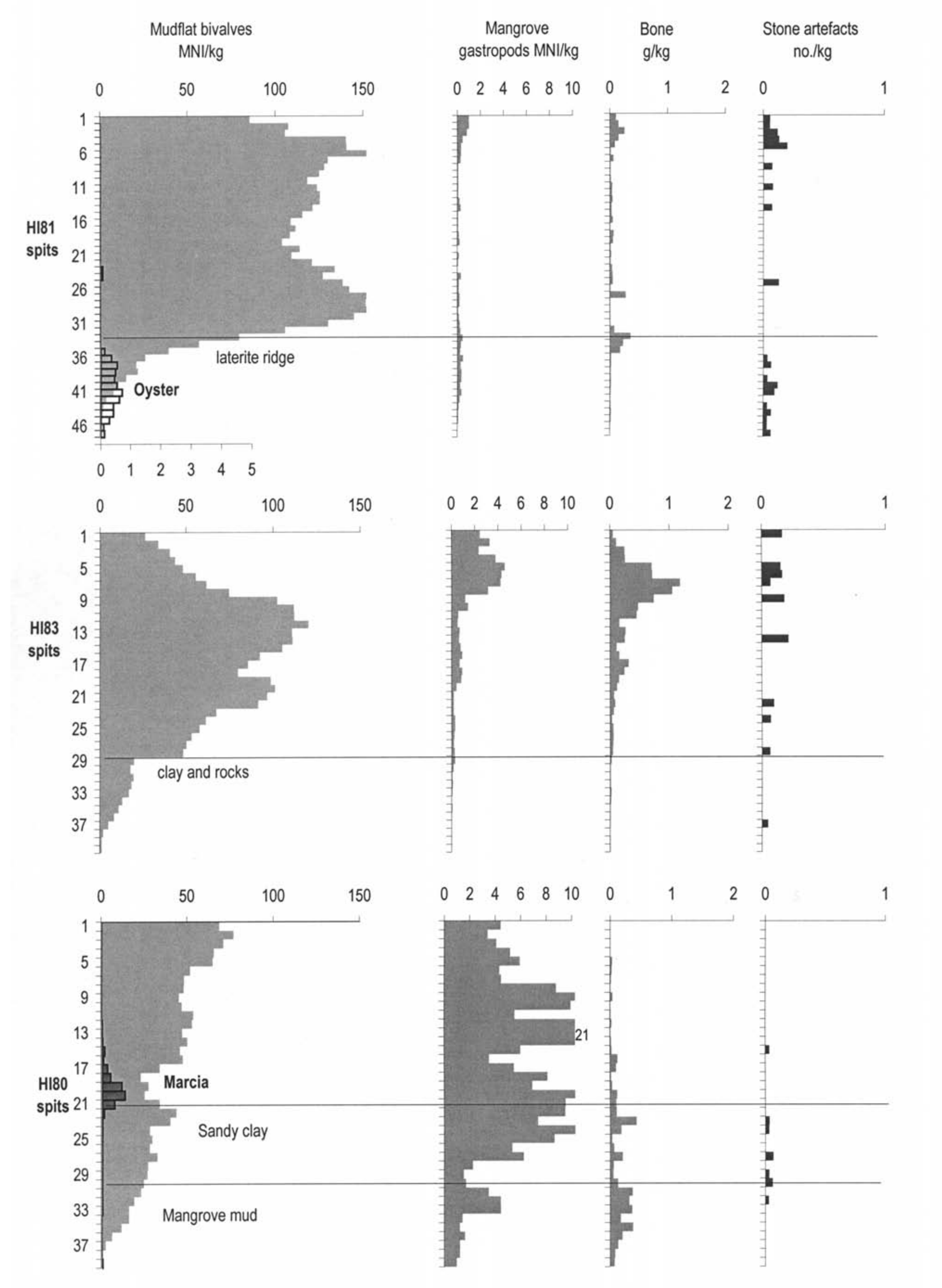

Figure 8 Graphs showing differences within and between shell mounds HI81, HI83 and HI80, in relative frequencies of mudflat bivalves (predominantly *Anadara*) and other faunal remains such as the common suite of mangrove gastropods (*Cassidula angulata*, *Nerita* spp. *Terebralia semistriata Telescopium telescopium*, *Ellobium aurisjudae* and *Chicoreus capucinus*) the oyster (*Saccostrea*) in HI81, and vertebrate bone of fish and terrestrial animals, and stone artefacts.

Mollusc species	Habitat	HI81		HI83		HI80	
		MNI	%	MNI	%	MNI	%
Anadara granosa	Om	68592	97%	28641	92%	31464	72%
Juvenile *Anadara*	Om	1685	2.4%	1953	6.2%	3217	7.3%
Marcia hiantina	Osm			28	0.1%	1132	2.6%
Saccostrea echinata (oyster)	M/r	162	0.2%	9	0.0%	25	0.1%
Cassidula angulata	M	54	0.1%	273	0.9%	3346	7.6%
Nerita spp.	M	66	0.1%	103	0.3%	1013	2.3%
Terebralia semistriata	M	41	0.1%	60	0.2%	858	2.0%
Telescopium telescopium	M	31	#	11	#	109	0.2%
Ellobium aurisjudae	M	7	#	12	#	619	1.4%
Chicoreus capucinus	M	28	#	35	0.1%	29	0.1%
Placamen calophyllum	sm	46	0.1%	2	0.0%	60	0.1%
Xanthomelon sp.	T	20	#	77	0.2%	20	0.0%
Volema cochlidium	sm/M	13	#	10	#	39	0.1%
Geloina coaxans	M	10	#	4	#	17	#
Cerithidea sp.	s	10	#	1	#	382	0.9%
Melo amphora	sm	1	#	3	#	6	#
Cymbiola flavicans	sm	3	#	3	#		
Placuna sp.	sm	2	#			13	#
Melina ephippium	M	1	#				
A. inequivalvia	s					20	#
Arca sp.	r					16	#
*Cerithium coralium**		106	0.1%	24	0.1%	85	0.2%
Nassarius sp.*		9	#	1	#	40	0.1%
Littoraria sp.*		2	#			60	0.1%
Pseudonachis sp.*		1	#			3	#
Juvenile *Ellobium**						404	0.9%
Juvenile *Cassidula**						302	0.7%
Iravadia sp.*						266	0.6%
Corbula sp.*						133	0.3%
Juvenile *Telescopium**						64	0.1%
Salinator sp.*						42	0.1%
Notospisula sp.*						35	0.1%
Dentalium sp.*						3	#
Total MNI		70890		31250		43822	

* Chenier shell, # < 0.1%, Om = open mudflats, M = mangroves, s = sandy, m = mud, r = rock, T = terrestrial.

Table 3 Relative proportions by MNI of mollusc species within and between mounds HI81, HI83 and HI80.

	HI81		HI83		HI80	
	n	wt	n	wt	n	wt
Quartz	29	3.1	15	5.8	3	6.1
Quartzite			1	8.7	3	64.1
Dolerite			1	1.1	2	0.2
Chert	4	3.8				
Tuff			2	0.3		
Other					1	0.2
Total artefacts	33	6.9	19	15.9	9	70.6
3.2mm Proportion (%)	91		83		44	
Av. wt (g)		0.1		0.1		1.0

Table 4 Raw materials, total number and average weight of stone artefacts, and proportion from 3.2mm sieve in each sample. (Anomalously large artefacts are excluded from average weight estimates).

made from quartz (88% numerically and 51% by weight), except for a large (30 x 20 mm) reddish/orange retouched chert flake and three much smaller flakes, probably off the same piece, from the laterite ridge. Artefact types are mostly flakes and flaked pieces from the 3.2 mm sieve, of average weight 0.1 g (Table 4). This small-sized lithic debitage (MacDonald 1991:12) is concentrated in the upper levels of both the shell mound, and the laterite ridge (Fig. 8). Ochre is mostly red, but one yellow piece was also recovered.

Site HI83

Excavation toward the southeast edge of the deposit, revealed an upper 65 cm thick layer of whole *Anadara granosa* shells in a sparse matrix of dark brown, greyish, charcoal and ash rich silt, and lenses of thin, fine ash. The exposed surface is capped by a 5-10 cm thick compacted soil-rich layer of highly fragmented shell (80%), probably due to recent trampling by cattle, given this mound's low topography in an area where livestock were run (Christian and Stewart 1953:116; Pietsch 1985:1; cf. Mowat 1994:207). A frame used to stop falling loose shell prevented observation of stratigraphy. The midden merges into a lower light brown clay and rocks layer, to a compacted hard clay base.

Analysis of the excavated material

The 588 kg of material from square A, HI83 comprises

Spits	To Depth	Spit wt	Shell		Charcoal	Bone	Otoliths		Crab	Stone artefacts		Ochre	Rocks
	cm	kg	g	% frag	g	g	n	g	g	n	g	g	g
1-2	5	25	16052	74	1	1.6				4	4.7	2	202
3-4	9	21	13817	63	2.9	5.1	1	0.3		1	0.1		542
5-6	14	25	16875	51	8.5	17.8	4	0.8	2.1	4	1.4	0.5	162
7-8	18	28	19570	31	13.5	31.2	1	0.2	0.8	1	0.1	0.6	53
9-10	23	22	17814	12	9.4	13.1				2	0.3		20
11-12	30	20	17244	8	4.9	6.2							100
13-14	36	21	17710	7	5.1	5.3				2	0.1		332
15-16	41	23	18903	9	3.5	3.2			1.8				265
17-18	45	23	17402	8	4.7	6.5			0.4				393
19-20	49	21	15517	7	2.4	2.9						0.3	826
21-22	53	21	13901	4	2.5	1.6			0.3	1	8.7	0.3	871
23-24	57	30	13498	4	1.9	1.4	1	0.6		2	0.1		3559
25-26	63	34	15806	11	4.4	1.9						0.9	4183
27-28	67	31	13506	7	2.7	1.5				1	0.2		2696
29-30	71	36	8452	7	2.1	0.5							5840
31-32	75	40	5595	5	1.6	0.3							7986
33-34	79	38	5215	6	1.9	0.7							7084
35-36	85	41	3744	8	1.2	0.2							7998
37-38	91	43	2152	11	1.1	0.1				1	0.2		9475
39-40	98	46	516	17	0.6	0.2							13049
Totals		588	253290		75.9	101.3	7	1.9	5.4	19	15.9	4.6	65636

Table 5 Quantitative data, Section A, mound HI83. All artefacts are quartz except for dolerite in spit 5, tuff in spits 24 and 37 and large quartzite flake in spit 22.

Spits	To Depth	Spit wt	Shell		Charcoal	Bone	Otoliths		Crab	Stone artefacts		Ochre	Rocks
	cm	kg	g	% frag	g	g	n	g	g	n	g	g	g
1-2	4	28	17231	30	3		1	0.6					4
3-4	7	28	14403	23	12.8								12
5-6	12	29	14812	29	15.3	0.8			0.2				5
7-8	16	32	17446	26	7.2	0.3							2
9-10	21	31	15548	28	9.6	0.7						1	0
11-12	25	46	21151	29	21.7	0.8	2	0.3	0.7				23
13-14	31	48	22907	37	13.7	0.6	1	0.2					149
15-16	39	51	24960	21	5.2	3.3	1	0.3	0.3	1	0.4		245
17-18	43	46	16577	29	14.2	2.5	1	0.4	0.5				1055
19-20	49	49	21286	34	25.1	3.6	1	0.2	0.1			0.1	456
21-22	55	52	23137	33	7.1	5.3	7	3.8	0.2				631
23-24	62	61	24680	45	18.1	18.3	11	3.9	1	2	0.4		581
25-26	69	70	28058	42	9.9	3.3	3	2.6	1.7				839
27-28	76	63	23443	30	8.6	8	1	0.3	7.5	2	5.7		546
29-30	82	65	20587	18	33.6	5.8	2	0.9	1.6	3	64		1007
31-32	90	70	22162	35	21.2	23.6	14	7.5	5.1	1	0.1		2102
33-34	98	66	13446	23	21.9	17.4	2	1.2	1				194
35-36	107	66	7740	20	63.5	19.1	7	2.2	1.9				28
37-39	119	85	1967	39	74.5	8.2	3	2.3	0.3				18
Totals		986	351541		386.2	121.6	57	26.7	22.1	9	70.6	1.1	7896

Table 6 Quantitative data, Section A, mound HI80. Quartz in spits 15,27 and 29, dolerite pieces in spits 27 and 32 and large quartzite manuport in spit 30.

predominantly shell (253,290g, 61%), with small quantities of bone (101g, <0.1%), seven fish otoliths (1.9g), crustacean (7.5g, <0.1%), laterite rocks > 6 mm (65,636g, 16%) and stone artefacts, manuports (15.9g, <0.1%), ochre (4.6g, <0.1%) and charcoal (76g, <0.1%) (Table 5) and the remainder (22%) shell grit, sediment and plant remains.

Invertebrate Fauna

Fifteen species from the HI83 sample are dominated by *Anadara granosa*, representing 92% by MNI (Table 3) and 99% by weight of the shell assemblage. Other mangrove gastropods such as *Cassidula angulata*, *Chicoreus capucinus*, *Nerita* spp. and *Terebralia semistriata*, occur in frequencies less than 1%, mostly in the upper 20 cm of the deposit (Fig. 8).

Vertebrate Fauna

Of recovered bone (Table 5), a few macropod and possum teeth and some fragmented mammal, fish, rodent and bird bone were identified. Two, 27 and 34 mm long incisors, from medium to large macropods recovered from 30 cm depth, are broken at the tip, similar to a wallaby incisor Schrire (1982:93-4) excavated at Malangangerr rockshelter in Arnhem Land and interpreted by her as broken engraving tools. An Antilopine kangaroo metatarsal bone was also noted in Section B just below the surface.

Only a small quantity of fish bone was identifiable to species level, predominantly *Arius* sp. (Fork-tailed catfish), mainly on the basis of six otoliths recovered, and one broken otolith of *Protonibea tiacanthus* (Black jewfish), and a *Wrasse* sp (wrasse) tooth. Also present are vertebrae of unidentified small fish species. Due to fragmentation, it was only possible to identify *Scylla serrata* (Mud crab) on the basis of claw morphology, and a few barnacles. Only one piece of bird bone was identified in spit 9.

Stone Artefacts

Four varieties of raw material – quartz, quartzite, dolerite and tuff are represented in 19 stone artefacts recovered (Table 4). Quartz dominates numerically (79%), but only makes up 37% by weight, as one large quartzite flake weighs 8.7 g. However, the majority are small-sized lithic debitage, comprising flakes and flaked pieces mostly from the 3.2 mm sieve (83%), with an average weight of 0.1 g and a maximum dimension between 2-10 mm. Red ochre, and one yellow piece, was also recovered.

Site HI80

Four stratigraphic layers were observed during the excavation slightly northwest of the mound centre:a 40 cm thick upper layer of mainly *Anadara* shells in a dark greyish black sticky muddy matrix, a thin layer (5-10 cm) of mainly *Marcia* and *Anadara* shells in a light-medium brown sandy matrix, and a 30 cm thick medium brown sandy clay layer, with fewer, mainly *Anadara* shell, overlying blue-grey mangrove mud with a few shells extending to the base at 120 cm depth. A large mangrove buttress root was observed *insitu* at the base of the west wall (Fig. 9) and the water table was reached at around 70 cm.

Analysis of the excavated material

The 986 kg of material from square A, HI80 comprises mainly shell (351,541g, 96%), with small quantities of bone (122g, <0.1%), 57 fish otoliths (26.7g, <0.1%) crab (22g, <0.1%), barnacles (161g, <0.1%), laterite rocks (7,896g, 2%) and stone artefacts, manuports (70.6g, <0.1%), ochre (1.1g, <0.1%) and charcoal (386g, 0.1%) (Table 6) and the remainder (2%) shell grit, mud sediment and plant remains.

Invertebrate Fauna

In the mound HI80 sample, *Anadara granosa* comprises 72% by MNI and 86% by weight - a reduction of 20% MNI (and 13% weight) compared with mounds HI83 and HI81 (Table 3). MNI counts show a much larger proportion of mangrove gastropods, particularly *Cassidula angulata*. This thin-walled shell is well represented at 8% by MNI (but only 1% weight, due to survival of mostly only the flange). Other mangrove gastropods including *Nerita* spp. (2.3%) and *Terebralia semistriata* (2%) are also in higher proportions. The shell is relatively well preserved, and some whole *Nerita* even retain their colour patterns, though this is apparently common in Neritid fossils (Claassen 1998:70). A notable decrease in density of *Anadara* in spits 17 to 21 is replaced by two other bivalves – *Marcia hiantina* and *Anadara inaequivalvis* - in this layer only (Fig. 8).

Although 27 shellfish species were identified, only 18 are of a size usually thought suitable for human consumption. The remainder of small-sized and juvenile chenier shells from the 3.2 mm sieve, (3% by MNI, < 0.1% by weight), derive mainly from the basal sandy clay that probably represents the chenier plains surface on which shell was first deposited, and lower mangrove mud layers. Unidentified shell pieces comprise 6% of shell content.

Figure 9 West wall, excavation pit HI80, showing mangrove buttress root at base. Photo: Trish Bourke.

Vertebrate Fauna

Vertebrate fauna found concentrated in the lower layers of this mound (Table 6; Fig. 8), comprises generally larger, well-preserved pieces of bone and crustacean remains, possibly due to an anaerobic mud matrix that would slow decomposition processes (Stein 1992:201). At least 30% was positively identified as fish bone and includes numerous vertebrae of small, unidentified fish species. Five fish were identified to species level, mostly on the basis of otoliths and skull fragments, including 37 otoliths of the ubiquitous *Arius* sp. (Fork-tailed catfish) from throughout the mound and 20 of *Protonibea tiacanthus* (Black jewfish) from the lower half only. Jaw fragments of *Acanthopagrus* sp. (Bream), an hyperostotic bone of *Polynemus sheridani* (Threadfin salmon), and *Lates calcarifer* (Barramundi) vertebrae and two large (1.3 and 1.7 g) macropod vertebra were also noted in Section B, a reminder that rare features may not be recovered from one column sample. Small fragments of reptile vertebrae, mammal and one piece of bird bone, as well as mammal teeth and a 13 mm long incisor (0.5 g) broken at the tip, from a medium to small macropod, were recovered from spits 12-35 of Section A.

A relatively large quantity (161g) of barnacles recovered, often attach to mangrove roots, crabs and *Anadara* mollusc shells (Broom 1985:11), and may be incidental additions. A few whole specimens however, are large enough (12-20 mm) to have been eaten, as assumed to be in some New South Wales middens (eg. Colley 1997). Crustacean claws in this sample differ morphologically from mud crab, being less curved and more robust, and are probably *Thalassina* sp. (mud lobster), common in mangroves (Murray and Hanley 1986). This lobster has little meat and Southeast Asian indigenous groups used it mainly as medicine against asthma and as bait (Holthuis 1991). Small quantities of mangrove worm tubes, sea urchin, cuttlefish, annelid worm tubes, tusk shells, coral, pumice and shell grit in the lower layers are probably incidental additions from chenier muds (see Healy and Coates 1997; O'Connor and Sullivan 1994:23).

Stone Artefacts

Nine stone artefacts recovered mainly from the lower levels comprise quartz flakes and small pieces of dolerite and red ochre (Table 4). Average artefact size of 1 g is larger than at the other two sites. Two blue/grey quartzite manuports (63.9 g), which probably derive from a sole outcrop of this material on the saltflats 7 km to the south, make up most of the artefact weight. Burnt fractured fine siliceous hearth material was also noted in Section B.

Chronology and formation of mounds HI81, HI83 and HI80

Mound HI81 began to form on a sandy laterite ridge at the headland edge soon after a major phase of mudflat build-out around 2300 years ago at Shoal Bay (see Woodroffe and Grime 1999). Radiocarbon dates from the laterite ridge and mound surface, calibrated to around 1800 and 1400 cal BP respectively (Table 1), are minimum ages, and suggest an averaged accumulation period over a few centuries for this mound. However, closer dating is required before we can conclude that the upper and lower layers accumulated at the same rate. Other evidence, such as differences between the shell and laterite ridge layers in shell fragmentation and changes in resources exploited (such as *Saccostrea* only in the lower ridge), suggests the possibility of temporally separate occupation periods and different resources targeted at different times. In the lower laterite ridge, high levels of shell fragmentation (increasing with depth from 10 to 80%) are consistent with slow deposition of *Anadara* shell, intensive human activity, and decay processes. For the upper shell mound, low levels of shell fragmentation (2-3%) support the interpretation of rapid deposition of mainly *Anadara* shell around 1400 cal BP.

Around this same period mound HI83 also built up rapidly some 300 m inland on the same headland. This is shown by low levels of shell breakage (5-7%) in the middle spits, and calibrated radiocarbon estimates bracketing this mound, of around 1550 and 1400 cal BP from the surface and basal levels respectively (Table 1). Close correspondence between the uncorrected radiocarbon age of 1910 ± 70 BP on the basal shell and 1800 cal BP on a large chunk (5 g) of charcoal found in secure stratigraphic association (cemented together in the clay base), provides more evidence for a smaller standard marine reservoir correction for this region. The condition of surface shells was distinctively less weathered in appearance than the whiter, chalkier shells from the base of the mound, which leads me to argue with confidence that the dated surface shell sample had not been moved up from the lower levels. Moreover, the uncorrected radiocarbon ages of these shell dates (Table 1) are statistically indistinguishable at the 95% level (Alan Hogg, personal communication 2000).

Many centuries after HI83 and HI81 ceased accumulating, mound HI80 was formed on nearby saltflats between 900 and 500 cal BP (Table 1), following another major phase of mudflat build-out and chenier building around 900-1000 BP at Shoal Bay (Woodroffe and Grime 1999). Signs of diverse, intensive human activity during formation of mound HI80 include relatively high shell fragmentation (20-40%) through the mound consistent with periodic reworking of discarded shell, some 18 shellfish species and a dozen other species, of fish, crab, mud lobster, barnacles, bird, reptiles and mammals, and charcoal. As well, over 1700 imported rocks in the 0.6 m^3 sample is estimated to represent some 1400 rocks per year being carried some distance across the saltflats to this mound for use as hearth stones.

Around 700 cal BP in HI80 there appears to have been a short-term local increase in *Marcia hiantina* and *Anadara inaequivalvis* that thrive in coarser, more sandy substrates than the finer silty muddy substrates preferred by *Anadara granosa* (Lim 1966, cited in Broom 1985:5). This may reflect a more favourable habitat for *Marcia* - a culturally favoured resource - resulting from changes in relative quantities of sand, mud, river and sea currents and the location of sand banks, as observed on the Arnhem Land coast during the 1970s (Meehan 1982:62,70, 78, 142). Longer-term environmental change in the last 700 years, of mudflat build-out and local mangrove expansion (Michie 1988; Woodroffe and Grime 1999 and see Hiscock 1997), is reflected in the decreased quantities of the mudflat bivalve *Anadara* in HI80 compared with HI81 and HI83, and correlating increase in proportion of mangrove gastropods (Table 3).

Discussion: What the shell mounds represent

There is no doubt that the large shell mounds at Hope Inlet represent a focus on the collection of *Anadara granosa* (HI81 - 97%; HI83 - 92%; HI80 - 72%). But a closer look helps to avoid any tendency other researchers have noted (eg. Bailey 1999; Bailey et al. 1994; Bird and Frankel 1991; Cribb 1986; Rowland 1999; cf. Beaton 1985, 1986), to interpret these highly visible, well-preserved large volume deposits, as representing a large proportion of a past economy. A rough estimate of 12,000 m^3 for the total

Fauna	Optimal Season	HI81	HI83	HI80
MARINE / ESTUARINE				
Fork-tailed catfish (*Arius* sp.)	Dec-Jan	*	*	*
Black jewfish (*Protonibea tiacanthus*)		*	*	*
Threadfin salmon (*Polynemus sheridani*)	Oct-Dec, Mar-May			*
Barramundi (*Lates calcarifer*)	Oct-Dec, Mar-May			*
Wrasse (*Wrasse* sp.)	March-May		*	
Bream (*Acanthopagrus*)	March-May			*
Small unidentified fish sp.	Dec-Jan	*	*	*
Crab (*Scylla serrata*) and others	May-July	*	*	*
Mud lobster				*
Barnacles			*	*
Mangrove worm	Dec-Jan	*		*
Annelid worm				*
Sepia cuttlefish				*
TERRESTRIAL				
Macropod	July-Oct	*	*	*
Possum			*	*
Rodent		*	*	*
Reptile	July-Oct			*
BIRD (prob. Waterbirds)	June-March	*	*	*

Table 7 Non-mollusc fauna present in sites and optimal season for harvesting (after Davis 1985; Thomson 1939; Russel-Smith et al. 1997).

volume of shell deposited at Hope Inlet over 1500 years, from 2000 to 500 BP, is 8 m^3 per year – a quantity collected over one year in the 1970s by the 40-strong Anbarra group in Arnhem Land (Meehan 1982:166). A few hundred people could have accumulated the combined volume of about 220 m^3 for the three excavated mounds over just a few years.

Episodic mound use for diverse activities

What people were doing at these mounds is revealed not only by the bulk of shells showing a focus on a specific resource, but also by the mound's internal structure, micro-environmental location and more minor contents indicating diverse activities. Noticeable in the internal structure of the Hope Inlet mounds are layers of whole *Anadara* shell with little matrix, alternating with ashy humic layers of more fragmented *Anadara* shell and increased densities of other faunal remains and stone artefacts. These patterns were also noted in *Anadara* mounds on Cape York, and as Bailey et al. (1994:76) and Beaton (1985) suggest, may represent alternating periods, of rapid deposition of the dominant *Anadara* shell, and when shell deposition slowed or stopped while other activities continued.

Major shellfish gathering and mound building periods

The periods of rapid *Anadara* shell deposition around 1500-1400 years ago of the upper part of the large mound HI81, and of HI83 (91 m^3 and 57 m^3 respectively) may represent increases in harvesting *Anadara* when abundant and "fat" due to seasonal spawning glycogen and carbohydrate build-up (see Broom 1985:24-5; Meehan 1982:80,142), which Bailey (1975b:59) noted gave oysters their "appeal to the palate". Large harvests may have fed people gathered on the coast for ceremony in the mid-late dry as observed ethnographically (Meehan 1982:89; Warner 1969:463). The presence of exotic stone such as dolerite and tuff in HI83 and HI80 and in surface scatters at Hope Inlet, which is an area almost devoid of stone, also supports the idea of a ceremonial aspect to the mounds, but this requires more detailed discussion beyond the scope of this paper and will be the subject of another paper (Bourke in press).

Diverse subsistence activities between major shellfish gathering periods

Though the data suggest that these mounds were places where large quantities of *Anadara* are processed and discarded rapidly, this is clearly not their sole use. The distribution of sites at micro-environmental intersections - in the most advantageous positions to exploit a variety of resources from the surrounding mangroves, tidal flats, creeks, rivers, swamps, monsoon jungle and mixed forest patches, and more open coastal eucalypt woodland - is a well-known characteristic of hunter-gatherers with a generalized foraging strategy and broad resource base.

The data suggest that when *Anadara* shell discard slowed down or ceased, the mounds were used for other activities, including cooking other resources, such as the suite of gastropods from the mangroves (*Cassidula angulata*, *Nerita* spp. *Terebralia semistriata Telescopium telescopium*, *Ellobium aurisjudae* and *Chicoreus capucinus*) that are common to each mound (Table 3 and Fig. 8). Laterite rocks congregated in each mound are a typical feature of tropical shell mounds, probably used as hearthstones (cf. Veitch 1994). Small sized lithic debitage indicates working of stone artefacts took place on each of these mounds. A range of less archaeologically visible faunal remains of fish, crab and barnacles, macropods, possum, reptiles and bird in the mounds indicate harvest of these resources during these periods (Table 7). These, and 60% and 30% respectively of thin-shelled *Cassidula* and *Nerita* shells (usually only the flange) would not have been recovered without analysis of the 3.2 mm sieve.

The range of faunal remains in each site shows hunting on the land was taking place along with gathering molluscs from the mudflats and mangroves, with variation in relative frequency of estuarine resources and terrestrial game according to seasonal availability and the micro-environmental location of each site (cf. Bailey 1975a:VII:40-1 and Meehan 1982:114-6). For example, fish and crab occur together with terrestrial game in the more inland mound HI83, albeit in smaller quantities than in mound HI80. In HI80, where mollusc gathering and fishing appear to have been major activities, macropods captured on the hinterland were carried out to this saltflats mound for cooking.

Fishing at Hope Inlet appears to have been an important subsistence activity as for other north Australian coastal economies (cf. Bailey 1975b Barker 1999:124). Based on the optimal season for species represented, when abundant and "fat" (Davis 1985; Thomson 1939; Russel-Smith et al. 1997), the mounds were used for fishing for much of the year, from the mid-late dry (July-Nov), through the wet (Dec-Jan) to the early dry (March to May) and for crabbing and hunting macropods in the dry season (Table 7). All of the fish species in these deposits could have been procured from the estuarine Howard River, and Hope Inlet tidal flats, creeks, swamps or nearshore waters. Fork-tailed Catfish, the most common species identified, may be caught using traps across the mouths of creek estuaries, where they are found in abundance (Larson 1988; Larson and Martin 1989). The numerous small vertebrae may represent large hauls of small fish procured from the tidal flats or tidal channels/creeks. A variety of techniques employing spears, nets, poison, or traps may have been used, as described by ethnographies of fishing technology in Northern Territory waters (Basedow 1907:23; Foelsche 1882; Hugo 1983:54-104; Thomson 1939). These include groups of men and women capturing fish by pushing matted grass barriers across pools of shallow water on the saltflats, or using portable woven fish nets, mangrove brushwood and grass or more permanent hardwood fence traps, placed across tidal channels and flats as traps utilising the big tides of the late dry or wet season flood water run-off from coastal flats, or using poisons to stun fish in the late dry season when water levels are low in lagoons and waterways. Wrasse may have been speared around the 2400-year-old coral reefs fringing Gunn Point and Vernon Islands off Shoal Bay (Michie 1984; 1988). Large fish such as the Barramundi and Threadfin Salmon, are easy to spear when they move in large numbers to creek mouths and onto saltpans flooded by late dry/early wet season king tides (Davis 1985:303), as they still do at Hope Inlet today.

Subsistence tied to the land

Of particular interest at the Hope Inlet sites is the lack of remains of offshore resources such as large sea-turtles or dugong. The fish remains are consistent with quantitative late 20th century ethnographic reports of coastal Arnhem Land community diets, which indicate that fish taken from the estuarine system and shallow seas of the near-shore, rather than marine deep-sea fish, contributed a relatively high proportion of the diet (Jones 1980:116-7, 123, 125, 131-2; McCarthy and McArthur 1960; Peterson 1973:182). The focus on land and near-shore resources signifies Late Holocene foraging strategies clearly different from the predominant image of 19th and early 20th century ethno-historical accounts from the Darwin region, which feature the hunting of large marine creatures such as dugong and saltwater turtles, using metal harpoons and sea-going dugout canoes (eg. Basedow 1907:25, Earl 1846:249; Searcy 1909).

Technology such as harpoons or watercraft are not essential to procure dugong, which may be trapped by groups of people when they enter creeks at high tide, or stranded marine turtles may be taken from reef holes at low tide (Akerman 1975), so it is notable that the remains of these marine creatures is also lacking in Late Holocene mound sites on other parts of the north Australian coast, in the Kimberleys and at Cape York (Bailey 1977, 1999; Veitch 1996). At Cobourg Peninsula in Arnhem Land, Mitchell (1996) found that sea-turtle and dugong remains occur almost exclusively in more recent middens, that post-date Macassan contact. Although practices of cutting up dugong meat and cooking it close to the beach would not necessarily lead to bone remains intruding into middens (Kim Akerman 2004), dugong consumption sites that have been recorded near middens at Princess Charlotte Bay contain glass and metal, indicating that these are also less than 200 years old (Cribb and Minnegal 1989:2). At Hope Inlet, intensive surveys found no remains of dugong or turtle at all, either on or near middens, though the discovery of dugong sites may depend on erosion of mudflat areas where they are buried (cf. Cribb and Minnegal 1989). On the available data to date it does seem that a significant increase in capture of these large marine animals occurred within the last few hundred years with adoption of dugout canoes and metal harpoons, as posited by Mitchell (1996). The data support Mitchell's hypothesis (1994, 1995, 1996) that these changes in resource focus, along with expansion of the ceremonial exchange system, were part of major economic changes across north Australia ensuing from Macassan contact (and see Berndt 1951; Thomson 1949).

The lack of offshore resources in Late Holocene midden sites on the north Australian coast contrasts with excavated sites from this period on the east coast of Australia, which contain sea-turtle and dugong remains (eg. Barker 1991, 1999; Beaton 1985). This contrast is noteworthy, given that the diet of the Late Holocene Northern Territory coastal groups as represented in the shell mounds, is consistent with stable isotope analysis for bone collagen from Late Holocene people of the southeast Queensland coast, indicating more of a reliance on land-based resources and less on marine foods than suggested by the ethnographic data (Collier and Hobson 1987).

Concluding remarks

Examination of the content, internal structure and chronology of the Hope Inlet mounds reveals variation in human behaviour in space and time and the lack of direct correlation between quantity of material deposited (mound size) and intensity of human activity. At least two Hope Inlet sites on one headland cluster appear to be contemporary, and may represent the remains of activities during gatherings between neighbouring groups. These activities may have been part of small-scale regional socio-economic systems of alliance and exchange that existed just prior to their expansion following Macassan contact (see Allen 1997; Mitchell 1994, 1995).

However, also subsumed within the mounds is evidence of mound use for a variety of activities during periods when *Anadara* was not being deposited in large quantities. These data reveal the Late Holocene people who built the large Hope Inlet mounds did not have a specialised or intensified marine economy focused on off-shore resources and large sea creatures. In contrast, it was a generalised and flexible subsistence coastal economy as defined by Gaughwin and Fullagar (1995:39), utilising the resources of the nearshore, estuarine river systems and coastal plains and hinterland.

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