Reassessing Marine Fishery Intensification in Southeast Queensland

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A review of the archaeological evidence underlying a model by Walters of late Holocene Aboriginal marine fishery intensification in southeast Queensland is undertaken. The results of a regional review of the available fish bone neither support an argument for a general pattern of increase in fish discard at coastal sites nor the claim for an exponential increase through time in the number of sites exhibiting fish remains. Major taphonomic issues and research biases are considered to have played a role in structuring the archaeological database of the region.

Introduction

Since the mid-1980s, Walters (1986, 1988, 1989, 1992a, 1992b, 1992c, 2001) has developed and defended a model of late Holocene fishery intensification for Moreton Bay and southeast Queensland generally. His model represents one of several recent syntheses of late Holocene culture change in southeast Queensland which feature marine resources (especially fish) (e.g. Hall 1982, 1987, 1990, 1999, 2000; Hall and Hiscock 1988; McNiven 1990a, 1991a, 1992a, 1999; Morwood 1986, 1987). As one of a few available wide-ranging regional explanatory models, Walters' view of late Holocene change has become an important referential framework for other studies. Sporadic debate centred on his model has variously focussed on the antiquity of marine fishing (Frankland 1990; Walters 1992c), taphonomic issues (McNiven 1991a), recovery methods (Ross and Coghill 2000; Ross and Duffy 2000) and the concept of intensification itself (Arnold 1993:84-85). Paradoxically, despite energetic debates about the role and relative importance of marine fish in the late Holocene archaeological record of southeast Queensland, no systematic review and evaluation of the basic archaeological evidence for fishing has been undertaken. This paper represents such an evaluation of the region's archaeological record as a means of assessing the indices of intensified marine fishing employed by Walters. Archaeological fish remains from 23 sites are systematically reviewed prior to a synthesis of the evidence for marine fishing and a discussion of the main taphonomic issues and research biases that have played a role in structuring the region's archaeological database.

Walters' Model

Walters (1986, 1988, 1989, 1992a, 1992b, 1992c, 2001) developed an explanatory model linking increased discard of marine fish remains in the late Holocene to intensifying regional social networks. He attributed a time-lag of some 4,000 years between mid-Holocene sea level stabilisation and human occupation of the coast to the marginality of the coastal landscape prior to late Holocene increases in marine productivity induced by anthropogenic changes in fluvial sedimentation. In the absence of significant terrestrial resources, the development of specialised production systems predicated on marine fish is argued to have been necessary for permanent occupation of the coastal lowlands. Furthermore, the adoption of specialised marine fishing was viewed by Walters as requiring a transition from mobile hunting and gathering of terrestrial resources to more sedentary marine resource-based production involving radical restructuring of existing social structures and ideological systems, accompanied by significant population growth.

Walters derived archaeological evidence for the development of the fishery from eight coastal shell middens in a variety of ecological settings around Moreton Bay: Sandstone Point; St Helena Island; Toulkerrie; Wallen Wallen Creek; Minner Dint; NRS 7; NRS 8; and NRS 10 (Figure 1). On the basis of these analyses, Walters (1989:220; also 1986:318-320, 1992a) identified three main indicators of intensifying marine fishing activities: (i) the establishment of new fishing territories by eastward expansion of people to the islands of Moreton Bay; (ii) an exponential increase through time in the number of sites containing marine fish remains; and, (iii) increased intensity of fish remain discard through time. The last two of these indicators are examined in this paper.

The Archaeological Evidence for Fishing

Over the past 40 years, archaeological investigations in southeast Queensland have focussed almost exclusively on the coastal strip (but see, for example, Smith and Hall 1996). Although little of the region has been systematically surveyed, over 1,500 coastal midden sites have been documented (Aiken *et al.* 1992), 62 of which have been excavated (Table 1). Of these 62 sites, 27 are said to contain fish remains, although only 23 have been reported with even basic details and only 21 have been radiometrically dated (Table 1). In order to assess the archaeological evidence for chronological change in marine fish production, each of these 21 sites, plus the undated NRS 7 and NRS 10 sites which are used by Walters to derive his model, are systematically reviewed.

At the outset it was intended to synthesise the archaeological evidence for marine fishing by integrating results from analyses of fish bone assemblages into a single database. On reviewing the evidence, however, it became clear that the lack of comparability between excavations and analyses precluded any meaningful quantitative treatment of the data and presented problems for building a regional understanding of the use of fish resources. Consequently, a qualitative site-by-site review of evidence for fishing was considered more appropriate. The following sections briefly describe investigations at each dated site containing fish (plus NRS 7 and NRS 10), focussing on recovery strategies, the abundance and chronology of fish remains and potential interpretation problems.

Table 1. Summary of shell midden excavations conducted on the southeast Queensland coast.

Site	Year	Excavator/s	Site Area (m^2)	Area Excavated (m^2)	Sieve Size (mm)	Site Reported	Fish Remains Present	^{14}C Dated
Aranarawai Beach Ridge II	–	R. Neal	–	–	–	N	–	Y
Aranarawai Creek	–	R. Neal	–	–	–	N	–	N
Bell's Creek	1972	L. Haglund	1000	0.75	–	Y	–	N
Booral Homestead Midden	1989	I. McNiven	–	0.25	5/2	N	–	Y
Booral Shell Mound	1989	I. McNiven	120	0.5	5/2	Y	Y	Y
Bribie Island 9	1992	J. Hall	500000	0.75	6/3	Y	Y	Y
Bribie Island 67	1993	J. Hall	300000	1	6/3	N	Y	N
Broadbeach Burial Ground	1965-8	L. Haglund	285	228	–	Y	Y	Y
Brown's Road	1980-1	M. Strong	5000	8.25	6/3	N	N	Y
Bundall	1968	L. Haglund	2500	75	–	Y	N	N
Caloundra I	1965	D. Tugby	5000	1.9	–	Y	N	N
Cameron Creek Site 134	1988	I. McNiven	312	16	3	Y	N	N
Cameron Point Site 62	1988	I. McNiven	–	0.75	3	Y	Y	Y
Canalpin Creek	–	R. Neal	–	–	–	–	–	N
Cascade Gardens	1970	L. Haglund	700	50	–	Y	Y	N
Cooloola Sand Patch 102	1988	I. McNiven	3000	10	3	Y	N	N
Double Island Point Site 1	1988	I. McNiven	20000	11.5	3	Y	Y	Y
First Ridge 19A	1980	R. Robins	4	0.75	6/3	Y	N	N
First Ridge 19B	1980	R. Robins	4	0.25	6/3	Y	Y	Y
Freshwater Creek Site	1988	I. McNiven	64	1.75	3	Y	N	N
Hope Island	1986	I. Walters	–	1.25	3	Y	N	Y
Kabali Site	1988	I. McNiven	–	1.75	3	Y	N	Y
King's Bore Sandblow 97	1988	I. McNiven	10000	121	3	Y	Y	Y
Lake Coombabah	1999	G. Alfredson	–	–	–	Y	N	Y
Lazaret Midden	1995 1998	A. Ross Quandamooka	– –	1 –	6/3/1 6/3/1	Y Y	Y Y	Y Y
Leisha Track Site 93	1988	I. McNiven	150	21	3	Y	N	N
Little Sandhills	1980	R. Robins	90	90	6/3	Y	Y	Y
Madonna	–	R. Neal	–	–	–	N	–	N
Maroochy River 2	1988	I. McNiven	2000	0.25	3	Y	N	Y
Maroochy River 4	1988	I. McNiven	4400	1	3	Y	N	Y
Minner Dint	1978	J. Hall	–	4	3	Y	Y	Y
New Brisbane Airport	1984 1987 1988 1989	J. Hall J. Hall J. Hall J. Hall	– – – –	0.25 1 – –	6/3 6/3 6/3 6/3	Y Y N N	N Y Y Y	Y Y Y –

Table 1. Summary of shell midden excavations conducted on the southeast Queensland coast (cont.).

Site	Year	Excavator/s	Site Area (m^2)	Area Excavated (m^2)	Sieve Size (mm)	Site Reported	Fish Remains Present	^{14}C Dated
NE Moreton Island 1	1987	I. Lilley	–	0.5	6/3	Y	N	Y
NRS 5	1983	R. Neal	182	1	3	N	–	N
NRS 7	1983	R. Neal	754	0.75	3	Y	Y	N
NRS 8	1983	R. Neal	149450	6.75	3	Y	Y	Y
NRS 10	1983	R. Neal	5280	0.25	3	Y	Y	N
NRS 12	1983	R. Neal	2000	0.5	3	N	–	N
NRS 14	1983	R. Neal	1800	1	3	N	–	N
NRS 17	1983	R. Neal	500	2	3	N	–	N
NRS 19	1983	R. Neal	18050	0.25	3	N	–	Y
One-Tree	1980	J. Hall	700	–	6/3	N	–	Y
Polka Point	1961-4 –	D. Tugby R. Neal	– –	– –	– –	N N	– –	Y Y
Saint-Smith Midden	1994	J. Hall	60000	0.75	6/3	Y	Y	Y
Sandstone Point	1972 1984 1985	L. Haglund I. Walters J. Hall	25000 25000 25000	6.0 0.5 9.5	– 3 3	Y Y Y	Y Y Y	Y Y Y
Seary-Broutha Site	1988	I. McNiven	600	0.5	3	Y	N	Y
St Helena Island	1983	G. Alfredson	180	0.5	2	Y	Y	Y
Teewah Beach 5D	1988	I. McNiven	–	7.5	3	Y	N	Y
Teewah Beach 18	1988	I. McNiven	–	0.75	3	Y	N	N
Teewah Beach 26	1988	I. McNiven	100	1.5	3	Y	Y	Y
Teewah Creek 112	1988	I. McNiven	140	0.5	3	Y	N	N
Tin Can Bay 75B	1988	I. McNiven	–	0.5	3	Y	Y	Y
Toulkerrie	1978 1985 1989	J. Hall I. Walters J. Hall	– – –	3.5 2.5 1.75	6/3/1 3 3	Y Y Y	Y Y Y	Y N Y
Waddy Point 1	2001	I. McNiven	36	0.75	3	Y	Y	Y
Wallen Wallen Creek	1985	R. Neal	–	4	–	Y	Y	Y
Webber Swamp 100	1988	I. McNiven	–	0.5	3	Y	N	Y
White Cliffs Sandblow 98	1988	I. McNiven	600	10	3	Y	N	N
White Patch Site 1	1973	L. Haglund	–	3	–	Y	Y	N
White Patch Site 2	1973	L. Haglund	–	3	–	Y	Y	N
White Patch Site 3	1973	L. Haglund	35	4.5	–	Y	Y	Y
White Patch Site 4	1973	L. Haglund	–	2	–	Y	N	N
White Patch Site 5	1973	L. Haglund	–	9	–	Y	N	N

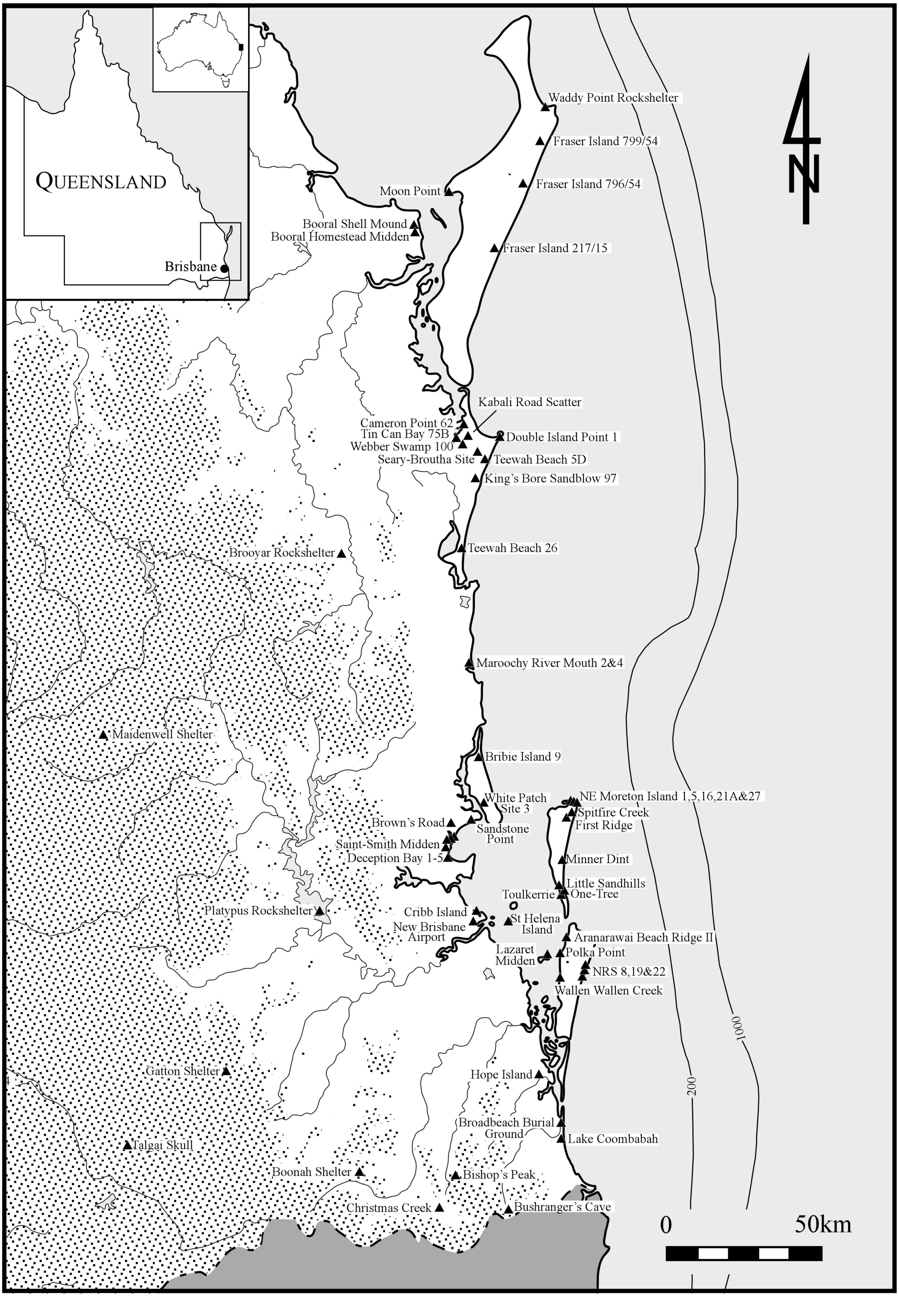

Figure 1. Southeast Queensland, showing dated archaeological sites.

Booral Shell Mound

The Booral Shell Mound is part of an extensive midden-fishtrap site complex on the western shores of Great Sandy Strait (Frankland 1990; see also Bowen 1998). A 50cm x 100cm trench was excavated at the highest point of the mound as contiguous 50cm x 50cm pits. The site was excavated in 25L arbitrary units within stratigraphic units and sediments sieved through nested 5mm and 2mm screens. Results are available for one of the pits (Square A). The site was occupied shortly before 2,950 ± 60 BP (Beta-32046, charcoal)[1]. Frankland (1990) identified a total of 1,470 NISP (number of identified specimens) of fish bone and an MNI (minimum number of individuals) of 36. Although large numbers of fish remains from a variety of species are evident from the base of the deposit, rates of fish bone discard clearly decrease through time (Figure 2).

Bribie Island 9

Bribie Island 9 is a large (c.500,000m^2) midden complex on the northern end of Bribie Island (Hall 1991, 1999; Smith 1992; cf. Hall [1999:174] who cites area as 10,000m^2). Few details about the excavation have been published. According to Hall (1999:174; see also Hall 1991), the site contains 'fish and other vertebrate bone' although further abundance details are not presented. Although the site is dated to 3,280 ± 80 BP (Beta-56566, charcoal), fish remains only occur in the top of the deposit dated to 200 ± 80 BP (Beta-56565, charcoal) (J. Hall, School of Social Science, University of Queensland, pers. comm., 2002).

Broadbeach Burial Ground

The Broadbeach site is a large burial complex near the Nerang River on the Gold Coast. Haglund (1976) excavated a total of 228m^2 at the site. Eight radiocarbon dates bracket use of the site from 1,390 ± 100 BP (ANU-68/2, charcoal) to 50 ± 86 BP (V-161, charcoal) (Ulm and Reid 2000). As the excavation was focussed on obtaining Aboriginal skeletal material for comparative anatomical studies (e.g. Murphy 1991), little attention was given to the recovery and analysis of associated cultural materials. Some faunal material was identified by Bartholomai (1976). Fish remains were apparently recovered from throughout the deposit and all diagnostic elements were identified as belonging to the Family Sparidae. Only 34 individual fish bone elements were identified, consisting mainly of vertebrae.

Cameron Point Site 62

This large shell midden was exposed in an erosion face on the eastern shores of Tin Can Bay (McNiven 1990a:200-209, 1991b). Three 50cm x 50cm pits were excavated immediately behind the eroding section, one of which (Square B) has been reported. There is a marked vertical discontinuity in the distribution of cultural material, with faunal remains restricted to the top 17cm of the deposit and the last 190 ± 50 (Beta-34400, charcoal) years. All stone artefacts lie below this upper level. A total of 0.15g of fish bone was recovered from the upper level (XU2, 4 and 5). An otolith (0.10g) from a summer whiting (*Sillago ciliata*) was the only specimen identified. McNiven (1990a:206) cautioned that the fish may have been deposited by dingoes as 'dingo faeces exhibiting fish bones have been observed on the surface adjacent to the site'.

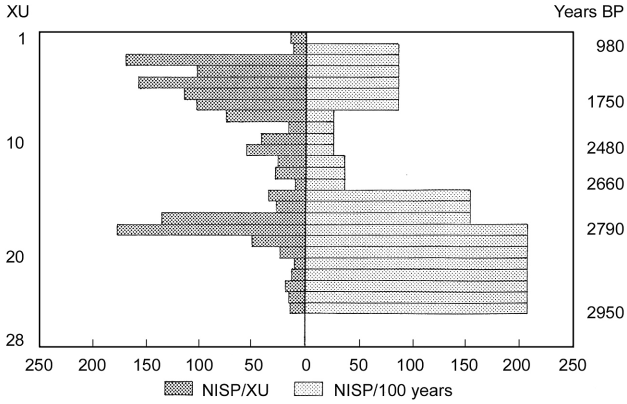

Figure 2. Number of identified specimens (NISP) of fish remains by excavation unit and 100 year interval, Booral Shell Mound, Square A (Frankland 1990:58).

Double Island Point Site 1

Double Island Point Site 1 is a large shell and stone artefact scatter in an active sandblow 500m south of Double Island Point (McNiven 1990a:130-141, 1991c). An excavation covering 11.5m^2 was undertaken to exhume two Aboriginal burials. Fish remains accounted for 0.31g of the faunal assemblage, including a single MNI of tarwhine (*Rhabdosargus sarba*). The site is dated to 160 ± 90 BP (Beta-34059, charcoal).

First Ridge 19B

This site is one of a number of small discrete shell heaps occurring in northeast Moreton Island (Robins 1983, 1984). A 50cm x 50cm pit was excavated at one of these sites (19B) in two 10cm-deep excavation units. All sediment was sieved through 6mm and 3mm screens. Recoveries consisted almost entirely of pipi (*Donax deltoides*), with some charcoal and a single whiting otolith. A date of 1,150 ± 70 BP (Beta-1946) was obtained on a shell sample.

King's Bore Sandblow 97

King's Bore is an extensive stone artefact scatter covering some 10,000m^2 within a large active sandblow about 250m inland from Teewah Beach (McNiven 1985, 1990a, 1992a). A total area of 111m^2 was excavated to a depth of 5cm, yielding 5,265g of stone artefacts and 1.22g of shellfish and fish remains with some fragments identified as pipi (*Donax deltoides*) and summer whiting (*Sillago ciliata*). A further 10m^2 was subjected to controlled excavation to investigate *in situ* deposits, resulting in the recovery of a further 1.38g of pipi fragments and unidentified fish bone and scale fragments from the surface and 138g of stone artefacts. Although a date of 3,560 ± 100 (Beta-25510, charcoal) was obtained from the *in situ* deposit, all of the recovered faunal remains are argued to be derived from modern carnivore activity on the basis of their good preservation and the presence of flesh on some shell and bone fragments (McNiven 1990a, 1990b, 1992a). Fish bone was also noted as a component of a desegregating dingo scat on the site.

Lazaret Midden

The Lazaret Midden is located on the northeast margin of Peel Island in southern Moreton Bay (Ross 2001; Ross and

Coghill 2000; Ross and Duffy 2000). Four 50cm x 50cm pits have been excavated, two of which have been analysed and await full publication. Material was sieved through 6mm, 3mm and 1mm mesh. The age of the midden ranges from c.1,200 BP at the base to modern at the top. Ross and Coghill (2000:81) report that there 'is abundant fish bone in the site at all levels, particularly in the 1 mm fraction'. Ross and Duffy (2000:37) report that 0.1–0.5% of each 100g sample of the 1mm sieve residue consists of bone, 'particularly fragmented fish spines' and that 50g of fish bone was recovered from the 1mm sieve from a single square. On the basis of extrapolation, Ross and Duffy (2000:38) suggest that the total fish bone in this square is in excess of 150g and that this 'is more than twice the weight of fish bone excavated from any other Moreton Bay site.' Recently, Ross (2001) reported that 'fish bone found in the Lazaret Midden represents almost 60,000 NISP (weighing almost 250g) from just one 50cm x 50cm pit.' A major problem here is the fact that most of the 60,000 NISP reported are not actually *identified* specimens or elements, but rather 'fragmented fish spines' (Ross and Duffy 2000:37) yielded by the 'use of a 1mm sieve for fish bone recovery' (Ross 2001). In the absence of other relative abundance measures (e.g. MNI) it is difficult to evaluate the significance of this site for understanding regional fishing patterns.

Little Sandhills

Little Sandhills is an extensive shell midden and stone artefact scatter located in active sand dunes on southern Moreton Island (Robins 1983, 1984). Excavations were conducted over the entire surface of the site, some 90m^2, to a depth of 5cm. Excavations included the total recovery of 10 small piles of shell. Excavated sediment was sieved through 6mm and 3mm screens. The combined assemblage consisted of shellfish remains (mostly *Donax deltoides*) and stone artefacts, as well as small amounts of fish bone and other bone fragments tentatively identified as dugong (*Dugong dugon*). Fish remains included 18 diagnostic skeletal elements from Sparidae and whiting with some mullet scales. A radiocarbon date obtained on shell returned a result of 102.1 ± 7% BP modern (Beta-1945), indicating probable post-contact occupation.

Minner Dint

Minner Dint is a discontinuous shell midden exposed in a truncated foredune on the east coast of Moreton Island (Hall 1980). Two 1m x 2m trenches (A and B) were excavated, yielding a near-basal age of 520 ± 75 BP (I-11095, charcoal) from Trench B. Excavation followed natural stratification and all sediment was sieved through 1/8 inch (3.175mm) mesh (Hall 1980:100), not only 1/4 inch (6.35mm) mesh as Walters (1979:37) stated. The deposit was dominated by pipi (*Donax deltoides*), which comprised over 99% by weight of the entire faunal assemblage. Small amounts of fish, marine snail (*Conuber* sp.) and cockle (*Anadara* sp.) remains were also found. Table 2 is a corrected version of Hall's (1980:105) Table 2, which used the weight of pipi fragments rather than total pipi weight from his Table 5 (Hall 1980:106). Walters (1986:180) also used the erroneous version. The vertebrate faunal assemblage consisted entirely of fish remains, representing eight identified species. A total of 190 fish NISP were counted. All 22g of identified fish bone from Trench B occurred in Spit 3, 10–15cm below the surface (Walters 1979:40). Despite the small quantity of fish remains recovered and their restriction to a small area of the excavated deposit, Hall (1999:176, my emphasis) interprets the site 'as a camp relating to *fishing* and shellfish gathering which was repeatedly visited for short periods of time'.

Table 2. Weights and percentages of faunal categories from Minner Dint (Hall 1980:105-106).

Category	Trench A Weight (g)	%	Trench B Weight (g)	%
Fish Bone	1.55	<0.01	22	0.02
Pipi	67757	99.99	110107	99.91
Snail	8.26	0.01	69.5	0.06
Cockle	–	–	2.3	<0.01

New Brisbane Airport

The New Brisbane Airport site is located on a palaeo-shoreline in a prograded section of the Brisbane River delta, some 5km from the modern shoreline (Hall and Lilley 1987). The site was excavated on four separate occasions, yielding evidence for human occupation before 4,830 ± 110 BP (Beta-33342, charcoal; Ulm and Hall 1996). Hall reported 'significant' (1990:180) and 'fragmentary fish bone' (1999:174) dating to the mid-Holocene encased in the ironstone conglomerate matrix of the lower excavation units, although quantification of the remains has not been attempted. Walters (1992c:35) noted that only a few fragments of fish bone were recovered and argues that these have not been demonstrated to be cultural. Stratigraphic and other details published to date do not provide a clear cultural context for the fish remains.

NRS 7, 8 and 10

These three sites are located on the central east coast of North Stradbroke Island and form part of the Blue Lake Creek site complex (Neal 1984). 'NRS' is an acronym for 'Norma Richardson Site' (Neal 1984:29).

NRS 7 covers an estimated area of 754m^2 and is located on a high frontal dune 225m south of Blue Lake Creek and 50m west of Eighteen Mile Swamp. Neal (1984) excavated three contiguous 50cm x 50cm pits at the site. Although culturally-sterile deposits were not reached, the upper units appear to contain the densest cultural material. Pipi (*Donax deltoides*) comprised over 99% by weight of the total assemblage. The remainder included occasional other shells such as oyster (*Saccostrea glomerata*), whelk (*Pyrazus ebeninus*) and hairy mussel (*Trichomya hirsuta*) with smaller amounts of stone artefacts and bone. A total NISP of 126 for fish remains from the site was counted by Walters (1986:233), although it is unclear whether these remains derive from only one or from all three pits excavated (Figure 3).

NRS 8 is an extensive midden (149,450m^2) located in a large swale behind high dunes to the south of Blue Lake

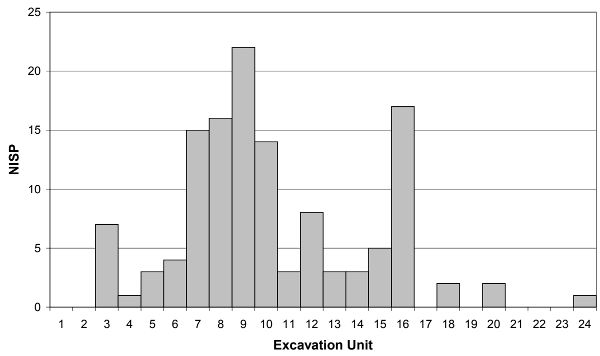

Figure 3. Number of identified specimens (NISP) of fish remains by excavation unit, NRS 7 (after Walters 1986:341).

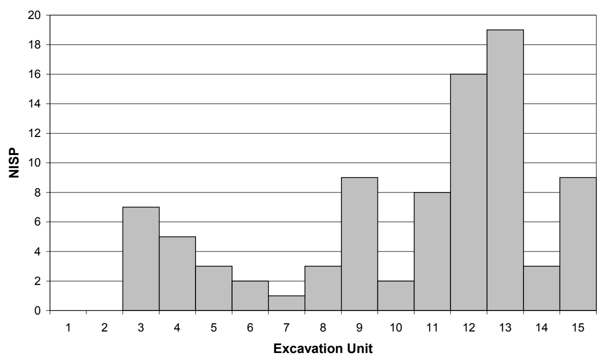

Figure 4. Number of identified specimens (NISP) of fish remains by excavation unit, NRS 10 (after Walters 1986:342; cf. 1986:349).

Creek (Richardson 1984:28-29). Neal (1984) excavated some 6.75m^2 at the site in a series of 50cm squares. Walters (1986:233) reported a total NISP of 61 for fish remains derived from four of these excavated pits (i.e. an average of c.15 NISP per 50cm x 50cm pit). Data on the vertical distribution of fish remains are not reported. Richardson (1984) obtained a date of 470 ± 60 BP (ANU-3336, marine shell) from an auger sample at this site.

NRS 10 covers an area of some 5,280m^2 to the north of the confluence of Blue Lake Creek and Eighteen Mile Swamp (Richardson 1984:28-29). A single 50cm x 50cm pit was excavated. The gross composition of the deposit is similar to other NRS sites, with pipi (*Donax deltoides*) dominating the faunal remains. Walters (1986:233) identified a total of 87 fish NISP (but note there is an unexplained discrepancy of four fish NISP between the total of 87 presented in Table A4 [Walters 1986:342] and the 91 in Table A11 [Walters 1986:349]; see Figure 4).

Excavated material from all three sites was sieved through 3mm mesh. Although no dates are available for the controlled excavation pits, Walters (1989, 1992a) stated that they are of a similar antiquity to marine shell from auger samples taken in this general area which indicate that the entire site complex dates to the last 200 years (see Richardson 1984).

Saint-Smith Midden

The Saint-Smith site is an extensive shell midden deposit on the shores of Deception Bay near the mouth of the Caboolture River (Hall 1995). In addition to an extensive program of auguring to define the subsurface extent of the deposit, three 50cm x 50cm test pits were excavated in 10L units and sediment was sieved through 6mm and 3mm screens. Hall (1995:13) noted significant disturbance in one of these pits (TP1), and excluded it from analysis. Occupation spans the last 1,000 years, with a near-basal date of 930 ± 60 BP (Wk-3423, charcoal). The cultural assemblage was dominated by shellfish remains with lesser quantities of stone artefacts and bone. Fish remains were recovered from all pits and are associated with shell material. A total of 7.5g of fish bone was recovered from TP2 and 33g from TP3, although no data are presented for the vertical distribution of fish remains in the deposit.

Sandstone Point

Sandstone Point is an extensive midden complex covering an area of some 25,000m^2 on a series of beach-ridges on the foreshore of Deception Bay. The site was originally excavated by Haglund (1974; see also Crooks 1982) who recovered a variety of shellfish remains with some terrestrial and marine mammal bone and fish remains. Charcoal samples returned radiocarbon ages of 620 ± 95 BP (SUA-478) and 780 ± 95 BP (SUA-479; Crooks 1982:37). Walters (1986:202-209) excavated a further two contiguous 50cm x 50cm pits at the site (SSP 1-A and 1-B) adjacent to 'the most promising looking exposure' (Walters 1986:204). Two charcoal samples from close to the middle and base of this deposit returned radiocarbon values of 500 ± 50 BP (SUA-2358) and 740 ± 50 BP (SUA-2357) respectively (Walters 1986:204). Owing to time constraints, only the first four excavation units (out of 37) of one of the pits (SSP 1-A) were analysed in Walters' (1986) original study. Despite this small sample size, however, Walters (1986:209, 233) extrapolated the NISP data to give a figure of some 46,000 NISP/m^3. Contrary to Frankland's (1990:62) assertion, full NISP data for SSP 1-A are presented by Nolan (1986:85) who reports a total of 35,883 NISP or 101,796 NISP/m^3 (Figure 5).

Hall (see Nolan 1986) excavated a further 38 (50cm x 50cm) pits at the site in 1985. Unlike previous excavations, which were all on the frontal dune, these were distributed over the entire site complex. Analysis of assemblages from four of these by Nolan (1986) revealed marked intra-site variability in the distribution and age of cultural material, particularly fish bone (Figure 6).

St Helena Island

The St Helena Island site is an extensive midden (c.900m^3) in the southwest of St Helena Island in Moreton Bay located approximately 6km east of the mouth of the Brisbane River (Alfredson 1983, 1984a, 1984b). Two 50cm x 50cm pits were excavated. Only one of the pits has been analysed. About 75% of the excavated material was sieved through 2mm mesh, while the remainder was mechanically dry-sieved in nested Endicott sieves ranging from 125μm to 16mm mesh. Of the sieve residue, only about 75% of material smaller than 4mm was sorted owing to the limitations of time and identifiability. Two shell samples returned radiocarbon ages of 1,370 ± 60 BP (Beta-6140) for XU9 and a non-basal 2,240 ± 70 BP (Beta-6141) for XU13. Alfredson (1984a:74) used a depth-age curve to extrapolate a basal age for the site of about 2,700 BP.

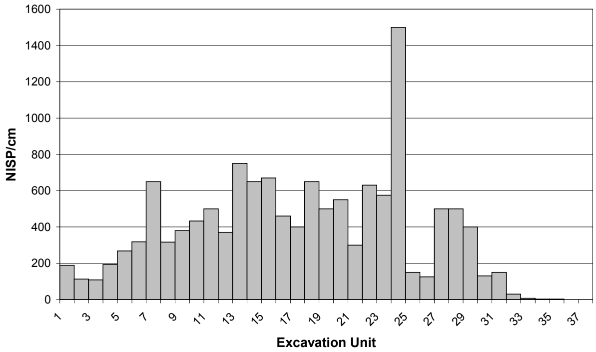

Figure 5. Number of identified specimens (NISP) of fish remains by vertical centimetre of deposit by excavation unit, Sandstone Point 1-A (after Nolan 1986:85).

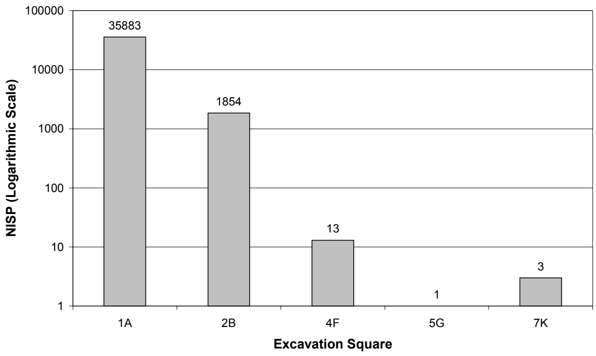

Figure 6. Comparison of abundance of fish remains at Sandstone Point where NISP data available (Nolan 1986:85-88).

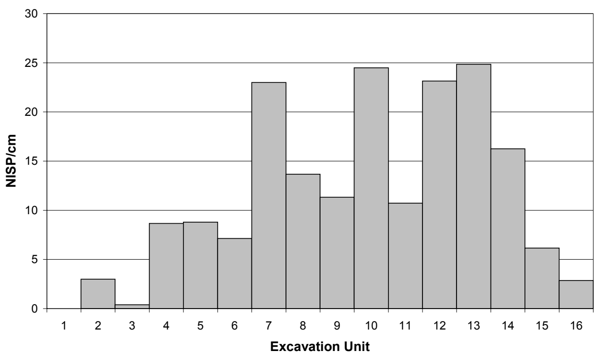

Figure 7. Number of identified specimens (NISP) of fish remains per vertical centimetre of deposit by excavation unit, St Helena Island, Test Pit 1 (after Walters 1986:343; cf. Alfredson 1984a:63).

The faunal assemblage was volumetrically dominated by rock oyster (*Saccostrea glomerata*), hairy mussel (*Trichomya hirsuta*) and mud whelk (*Pyrazus ebeninus*). Fruit bat (*Pteropus poliocephalus*) was present throughout, as were fish (Figure 7), with seven species identified. Walters (1986:350) calculated a total of 576 NISP. Smaller amounts of mud crab (*Scylla serrata*) shell and dugong (*Dugong dugon*), turtle and lizard bone were also recovered. Both fish and fruit bat bone constituted a much greater proportion of the faunal assemblage in the lower half of the deposit, although no attempt was made to quantify the bat bone owing to extensive fragmentation (Alfredson 1984b:4).

Alfredson (1984a:73) interpreted material from Excavation Units 2 to 5 as disturbed nineteenth century quarry spoil. Even if one disregards this material, there is a general trend towards the diminution of the quantity of fish remains towards the surface of the deposit, a fact which Walters (1986:244) could not attribute to diagenetic bone loss. As there are only two radiocarbon dates from the sequence it is difficult to construct temporal analytical units for this site (see Frankland 1990).

Teewah Beach Site 26

Teewah Beach Site 26 is a large midden site 8km north of the Noosa River (McNiven 1990a:96-109). A 1.5m^2 pit was excavated using arbitrary 5cm units within stratigraphic units. All sediments were sieved through 3mm mesh. Five radiocarbon dates were obtained on charcoal, ranging from 4,780 ± 80 BP (Beta-25512) to 340 ± 70 BP (Beta-30401). The combined assemblage was dominated by shellfish remains (and *Donax deltoides* in particular) with lesser amounts of stone artefacts, charcoal and some fish bones. A total of 1.73g of fish bone yielded an MNI of one. Four posterior molars identified as tarwhine (*Rhabdosargus sarba*) were the only diagnostic fragments. All fish remains were associated with the upper shell deposit which dates to the last 1,000 years.

Tin Can Bay Site 75B

This site is exposed in an erosion face on the west coast of Tin Can Bay. McNiven (1990a:191-200, 1991b) excavated two contiguous 50cm x 50cm pits. The base of the midden is dated on shell at 700 ± 70 BP (Beta-19421), producing a calibrated age of 309 cal BP (probably mid-seventeenth century and not modern as McNiven [1990a:194] inferred). Cultural material consisted primarily of shellfish remains, stone artefacts and a minute quantity of fish bone (0.01g of unburnt bone). McNiven suggested again that dingos and not humans were responsible for deposition of the fish material.

Toulkerrie

Toulkerrie is an extensive midden complex situated on low sand ridges on the southwest coast of Moreton Island. The site was initially investigated by Hall (1984) in six 50cm x 50cm pits and a 2m x 1m trench, some of which were later extended. Excavation was conducted in 5cm units and material wet sieved through nested 6mm, 3mm and 1mm screens (J. Hall, School of Social Science, University of Queensland, pers. comm., 1995; due to a typographical error, Hall [1984:64] incorrectly reported 8mm mesh as the larger of the two grades used for sieving, and Walters [1986:181] restated this erroneous figure despite reporting the correct one in a previous work [Walters 1979:38]). A single radiocarbon determination on charcoal obtained close to the base of the cultural deposit returned an age of 370 ± 75 BP (I-11096). Fish remains were found to dominate the vertebrate faunal assemblage (95% by weight), with a minimum of 204 individuals from 10 species identified from the coarse screen fraction alone from Trenches 4 and 6 (Hall 1984). Bream (*Acanthopagrus australis*), tarwhine (*Rhabdosargus sarba*) and mullet (*Mugil cephalus*) were the dominant taxa.

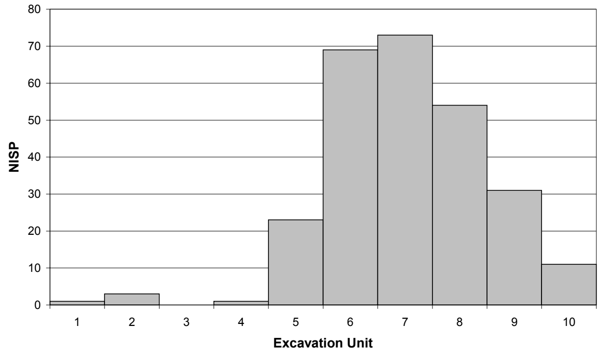

Figure 8. Number of identified specimens (NISP) of fish remains by excavation unit, Toulkerrie W9A (after Walters 1986:339).

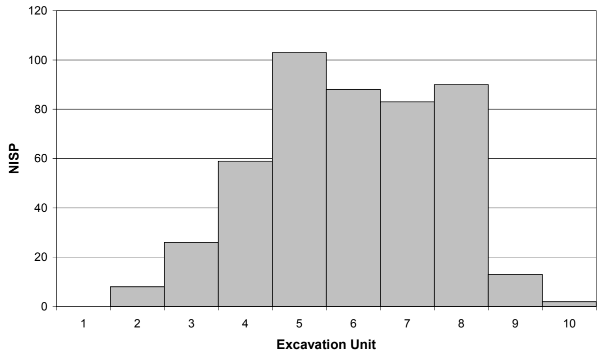

Figure 9. Number of identified specimens (NISP) of fish remains by excavation unit, Toulkerrie W9B (after Walters 1986:340).

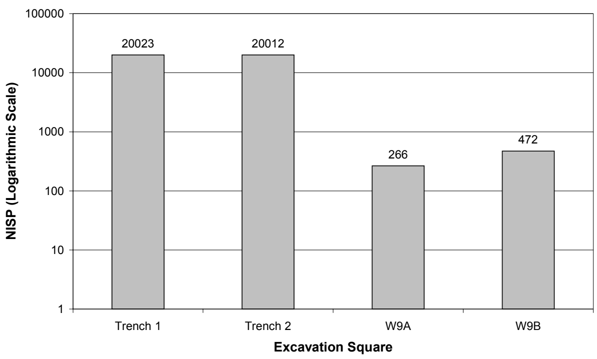

Figure 10. Comparison of abundance of fish remains at Toulkerrie where NISP data available (after Hall and Bowen 1989; Walters 1986).

As part of his doctoral research, Walters (1986:189-193) excavated 10 more 50cm x 50cm pits adjacent to Hall's Trench 6 in order to expand the fish sample. All the deposit was wet sieved through 3mm mesh. While no radiocarbon determinations were obtained, Walters assumed contemporaneity of his deposit with the nearby pits excavated by Hall (1984). This chronological assumption is problematic because Walters' excavations were at least 20m away from the pit that yielded the 370 ± 75 BP date. The only other indication of the antiquity of his deposits is a number of European artefacts in the top 5cm of Trench 6 (Hall 1984:68). Walters (1986:339-340) only presents NISP fish data for two pits – W9A and W9B (Figures 8, 9). Walters identified a total 57 MNI of fish for both trenches.

Hall and Bowen (1989; see also Bowen 1989) excavated a further seven 50cm x 50cm pits about 100m south of the original excavation. Sediment was wet sieved through 3mm screens. Only three of these pits have been analysed and reported. Fish dominate the vertebrate faunal assemblage with four species identified in the preliminary analysis: bream (*Acanthopagrus australis*), tarwhine (*Rhabdosargus sarba*), snapper *(Chrysophrys auratus*) and whiting (*Sillago* sp.). Significantly, low rates of fish bone deposition are evident from the earliest use of the site some time before 2,290 ± 80 BP (Beta-32047, charcoal), although the highest concentrations of fish remains are located in the upper unit which also contains abundant shellfish remains. Hall and Bowen (1989) calculated 20,023 NISP for Trench 1 and 20,012 NISP for Trench 2 (Figure 10).

Figure 10 clearly illustrates significant variation in the density of fish remains across the Toulkerrie site. This intra-site variation has not been taken into account in interpreting fish remains abundance at the site and should act as a caution against extrapolating from small test pits to entire sites (cf. Hall and Bowen 1989:14-15).

Waddy Point 1 Rockshelter

Waddy Point 1 Rockshelter is a small shelter on the southern end of the Waddy Point headland on Fraser Island. A 1.5m x 0.5m trench was excavated as contiguous 50cm x 50cm squares to a maximum depth of 182cm (McNiven *et al.* 2002). Sediments were dry sieved through 3mm mesh. Preliminary results are only available for Square A, the one least disturbed by animal burrowing. Recovered material includes charcoal (808.8g), shell (10,304.1g), bone (148.5g) and stone artefacts (17.2g). The distribution of bone in Square A is presented in Figure 11. Note that although the bone data are dominated by fish, they also include some bird and mammal bone. A few larger mammal bones occur, including the mandible of a northern brown bandicoot, suggesting that the proportion of fish bone in the total weight reported is relatively low. The base of the shell deposit containing the recovered fish bone is dated to 1,050 ± 50 (OZF-556; charcoal), although stone artefacts continue to the base of the excavation indicating that basal cultural deposits were not reached.

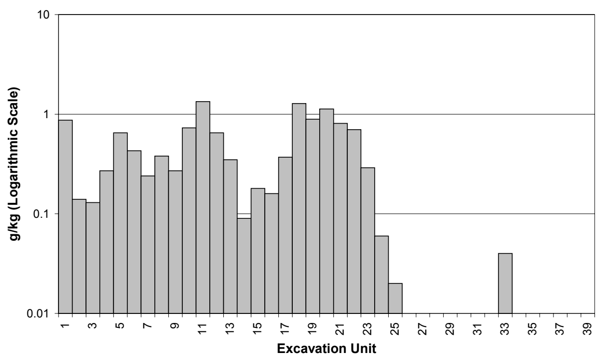

Figure 11. Comparison of abundance of all bone by excavation unit, Waddy Point 1 Rockshelter, Square A (after McNiven *et al.* 2002).

Wallen Wallen Creek

Wallen Wallen Creek is an open midden site located about 400m inland from the present west coast of North Stradbroke Island (Neal and Stock 1986). The site represents the earliest evidence for human occupation in southeast Queensland, with 20 radiocarbon dates spanning from 21,800 ± 400 BP (OxA-806, charcoal) to 1,070 ± 50 BP (SUA-2461, marine shell) (Gowlett *et al.* 1987; Neal and Stock 1986:619). Faunal remains are restricted to the upper deposit, which is dated to the last c.4,000 years (cf. Ross and Duffy [2000:22] who claim the site 'demonstrates that marine exploitation … has been the dominant subsistence activity at the site from 20,000 B.P. to the present' – at the glacial maximum the site was located 30–40km inland of the coast and is therefore unlikely to have been close to abundant marine and littoral resources). A total of four 1m squares were excavated, although results from only two of these (WWC-X/Z and WWC-M28-B) have been reported (Neal and Stock 1986; Walters 1986). Details of fish remains are only available for square WWC-M28-B (Walters 1986).

Although radiocarbon dates are not available for WWC-M28-B, dates reported for adjacent squares are 1,520 ± 70 BP (SUA-2236) on shell from 49–56cm depth, 9,810 ± 130 BP (SUA-2251) on charcoal from 136–141cm depth, and 17,500 +900/-800 BP (SUA-2235) on charcoal from 189–200cm depth. Neither Neal and Stock (1986) nor Walters (1986) related the excavation units to measurements of depth, although Neal (Queensland Environmental Protection Agency, pers. comm., 1995) indicated that fish remains in this sequence are restricted to the last 3,000 years. Significantly, Walters' (1986) own analysis revealed decreasing rather than increasing fish discard at the site though time, a fact he could not attribute to diagenetic bone loss (Walters 1986:244; Figure 12).

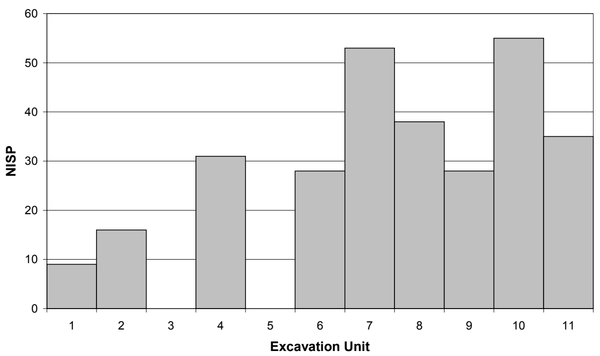

Figure 12. Number of identified specimens (NISP) of fish remains by excavation unit, Wallen Wallen Creek, M28-B (after Walters 1986:246).

White Patch Site 3

This site is one of a number excavated by Haglund (see Crooks 1982:60-74) on the southwest coast of Bribie Island. Haglund excavated an area of c.4.5m^2 at Site 3 which yielded a large faunal assemblage dominated by whelk (*Pyrazus ebeninus*), cockle (*Anadara* sp.), oyster (*Saccostrea glomerata*) and mussel (*Trichomya hirsuta*). Although many of the fish remains were not speciated owing to fragmentation, 35 skeletal elements were identified to species level, these being mainly bream (*Acanthopagrus australis*) and tarwhine (*Rhabdosargus sarba*), but including a single element of the fork-tailed catfish (*Arius* sp.). Crooks (1982:64) noted a concentration of fish bone in Square B52 representing about 14 bream, 10–15cm below the surface. Two dates of 450 ± 95 BP (SUA-480) and 670 ± 95 BP (SUA-481) were obtained on charcoal samples from Square C50.

Summary

The regional data relating to the representation of fish remains in coastal sites are summarised in Table 3. Clearly, fish remains are a rare component in southeast Queensland faunal assemblages. Only five sites contain more than 300 NISP, the minimum limit suggested by Amorosi *et al.* (1996) for assemblages to be used in inter-site comparisons. The overall picture presented by these 23 sites is one of considerable variability and the absence of any general directional trend towards intensifying marine fish production. Of the eight sites originally used by Walters', three (NRS 7, 8 and 10) probably date to the post-contact period and should not necessarily be considered as representative of pre-European Aboriginal lifeways, two (Wallen Wallen Creek and St Helena Island) actually exhibit decreases in the rate of fish discard over the last 1,000 years which Walters (1986) himself could not attribute to taphonomic factors, and one site (Minner Dint) has virtually all recovered fish remains from a single excavation unit. Only two sites (Sandstone Point and Toulkerrie) appear to support the model, demonstrating significant deposition of fish remains over the last thousand years. Of the sites investigated since Walters' original study, only the Booral Shell Mound could be said to have evidence for *significant* fish discard, but even here the trend is towards decreasing discard through time (Figure 2). The significance of fish remains recovered from the Lazaret Midden and Waddy Point 1 Rockshelter sites is difficult to evaluate. Many of those contributing to the high NISP reported at the Lazaret Midden are actually highly fragmented fish spines from the 1mm sieve and may not represent many individual fish, while at Waddy Point 1 Rockshelter actual fish bone data are not available and basal deposits were not reached. Although fish bone is present at other sites, at four of them its cultural status has been called into question (Cameron Point Site 62, King's Bore Sandblow 97, New Brisbane Airport, Tin Can Bay Site 75B), at two sites fish production may be associated with mortuary practices rather than subsistence (Broadbeach Burial Ground, Double Island Point), and at the remaining sites the evidence for fishing is confined to a few elements, potentially representing a single individual fish. At many sites no data are presented for the vertical distribution of fish remains in the deposit (Broadbeach Burial Ground, Lazaret Midden, New Brisbane Airport, NRS 8, Saint-Smith Midden), making assessments of change in discard patterns through time difficult. In sum, this overview indicates that it is difficult to characterise the distribution of fish remains in archaeological sites in southeast Queensland as a single consistent pattern.

Discussion

This review reveals three major impediments to accepting the Walters model of late Holocene fishery development.

Table 3. Summary of southeast Queensland regional fish bone data.

Site	Date First Fishing (cal BP)[1]	NISP	MNI	Weight (g)	Comments
Booral Shell Mound	>3076	1470	36	–	major fish discard; fish discard before 3000 BP; decreasing discard
Bribie Island 9	<173	–	–	–	minimal
Broadbeach Burial Ground	<1290	34	–	–	production possibly associated with non-subsistence activities; no data for vertical distribution; minimal
Cameron Point Site 62	<147	–	1	0.15	possible non-cultural origin; minimal
Double Island Point	<219	–	1	0.31	production possibly associated with non-subsistence activities; minimal
First Ridge 19B	<673	1	1	–	minimal
King's Bore Sandblow	modern	–	–	<2.59	probable non-cultural origin; minimal
Lazaret Midden	<1222	60000	–	250	highly fragmented; no data for vertical distribution
Little Sandhills	modern	18	–	–	modern; minimal
Minner Dint	<523	190	10	23.55	22g in one 5cm-deep unit
New Brisbane Airport	>5586	few elements	–	–	fish bone present by 5000 BP; possible non-cultural origin; no data for vertical distribution; minimal
NRS 7	modern	126	–	–	modern; minimal
NRS 8	<55	61	–	–	modern; no data for vertical distribution; minimal
NRS 10	modern	87	–	–	modern; minimal
Saint-Smith Midden	>816	–	–	40.5	major fish discard; confined last 1000 years; no data for vertical distribution
Sandstone Point	<2328	37754	–	–	major fish discard
St Helena Island	>1826	576	–	–	decreasing discard
Teewah Beach Site 26	<861	–	1	1.73	minimal
Tin Can Bay Site 75B	<309	–	1	0.01	possible non-cultural origin; minimal
Toulkerrie	<2328	40773	–	–	major fish discard
Waddy Point 1 Rockshelter	<930	–	–	–	actual fish remains not quantified
Wallen Wallen Creek	<3000	296	–	–	analysed assemblage not dated; decreasing discard
White Patch Site 3	<649	–	–	–	minimal

First, some of its basic predictions are simply not supported by the quantitative data. Numerous sites in the region dating to the late Holocene contain *no evidence at all* for fishing (Figure 13). Of the five sites which exhibit major fish discard, three (the Booral Shell Mound, Wallen Wallen Creek and St Helena Island) actually demonstrate *decreasing* rather than increasing rates of fish bone discard through time (Table 3). Second, the small samples employed by Walters raise critical problems for the examination of regional production strategies over time. Small sample sizes combined with the effect of variable recovery procedures considerably reduces confidence in the cited data and thus the reliability of the model (see below). Third, because half of the faunal assemblages analysed in Walters' original study are undated, any estimate of discard rates through time is problematic. Only two sites (Toulkerrie and Sandstone Point), therefore, appear to support the model, demonstrating trends towards significant deposition of fish remains over the last 1,000 years, but even at those sites major problems remain to be addressed.

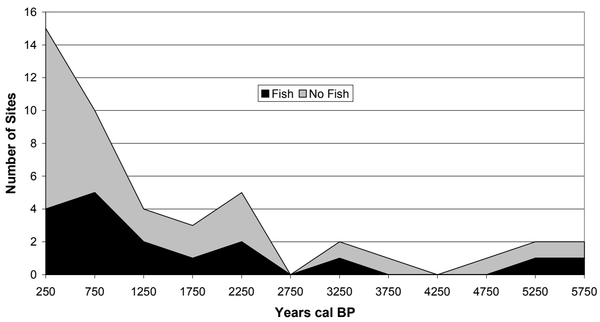

Figure 13. Number of new sites established through time using earliest dates showing sites with fish bone versus sites without fish bone.

At Toulkerrie, the sample excavated and analysed by Walters was not dated. Walters' assumption of contemporaneity with nearby occupation dated by Hall (1984) to about 400 BP needs to be treated with caution as later research conducted by Hall and Bowen (1989) revealed significant differences in the timing of initial occupation across the site. Recent excavations at the site have revealed an occupational sequence spanning the last 2,300 years, indicating that people occupied this locality for some time (see Bowen 1989; Hall and Bowen 1989).

The Sandstone Point site is clearly not typical of coastal archaeological deposits in southeast Queensland. Three main factors set the foredune deposits at Sandstone Point apart. First, the cultural deposits on the foredune accumulated over a relatively short period of time. Second, there appear to be relatively low rates of mechanical damage to bone elements compared to other sites in the region (Walters 1986:248). Third, the abundance of fish scales recovered from the excavation suggest favourable preservation conditions (Walters 1986:235). Historical literature characterises the Toorbul Point area (where Sandstone Point is situated) as an important Aboriginal inter-group gathering site, at least in the contact period (Nolan 1986). Thus, major marine fishery production at this site, at least in the more recent past, may have taken place within a very specific inter-group production context. However, ongoing analysis of the Sandstone Point material by Walters (see Hiscock and Walters 1994) may clarify the apparently anomalous status of the site.

Although the *actual archaeological evidence* for marine fishery intensification (i.e. fish bones) is meagre, a number of factors may have influenced the representation of fish remains in the southeast Queensland archaeological record. These include differential site preservation, site-specific taphonomic factors, excavation strategies, recovery techniques and quantitative methods. Each of these factors is briefly discussed below.

Geomorphology

Geomorphic processes (especially the impact of sea level change and erosion on the representation of archaeological material) have featured prominently in discussions of the southeast Queensland coastal archaeological record (e.g. David and Chant 1995; Hall and Lilley 1987). The problem is particularly acute in this region because the absence of major rock formations close to the coast and the dominance of sandy sediments have resulted in complex patterns of coastal sedimentation and landscape development operating over both short and long time spans (e.g. Cotter 1996). As David and Chant (1995:429) note, in southeast Queensland 'the influence of changing sea levels on site survival has to be considered before occupational trends can be inferred from the archaeological record'.

Sea level fluctuations, coastal erosion, cyclonic and storm-surge activity and coastal progradation have resulted in differential destruction of the coastal archaeological record (e.g. Bird 1992; Head 1987; Rowland 1989). In the study region, approximately 20,000km^2 of land has been submerged by transgressing seas over the last 18,000 years. This fact has obvious implications for the representation of coastal archaeological sites pre-dating the close of the transgression (c.6,000 BP). Thus, the archaeological record is expected to be truncated and biased towards later Holocene adaptations. The simplest explanation for the near-absence of fish remains and sites before 3,000 BP is that known coastal sites were formed in landscapes which only date to the late Holocene. Detailed geomorphological studies from the entire region are now required to establish a framework for evaluating the structure of this archaeological evidence. In sum, as all the assemblages used by Walters were derived from geomorphological contexts of late Holocene age, it is perhaps not surprising that their components only date to the late Holocene.

Taphonomic Factors

A further complication is the potential role of taphonomic factors in structuring archaeological assemblages in the region. Walters (1986:256) has repeatedly argued that the 'methodological controls' employed in his investigations 'imply that the patterns of distribution and abundance … adequately reflected composition of the prehistoric catches'. The only archaeological marine fish bone samples currently available, however, are from shell midden contexts. This is unlikely to represent the range of fish production and consumption activities recorded in the ethnohistoric literature. For example, several accounts note the immediate consumption of fish at the site of capture on the beach probably below tidal range (McNiven 1992b).

Like all faunal remains, fish bone is susceptible to a wide variety of possible post-depositional modification (see Lyman 1994a). Colley (1990:215), for example, noted that fish are 'particularly vulnerable to the effects of differential preservation because some fish bones are extremely fragile while others are robust'. Despite publishing a paper on the role of dogs in the representation of faunal remains in the archaeological record (Walters 1984), Walters does not consider the potential role of domestic dogs in modifying fish bone accumulations in his southeast Queensland study. His own and other ethnoarchaeological research has established that the remains of small-bodied animals such as fish are especially vulnerable to modification by dogs, with documented losses of up to 97% of skeletal elements (e.g. Hudson 1993; Jones 1986; Kent 1981, 1993; Lyon 1970; Walters 1984, 1985).

Early historic accounts document the presence of numerous dogs at Aboriginal camp sites; Flinders (1814) for example notes such on Coochie Mudlo Island. There is evidence for scavenging by dogs in the study region by c.4,000 BP (see Novello 1989:73) and recent studies of dingo scavenging behaviour in the area demonstrate that fish comprise a significant part of the diet (Twyford 1994, 1995). It may well be that the apparent abundance of fish remains in excavated island sites (Lazaret Midden, St Helena Island) is related to lower numbers of dogs relative to mainland areas. Thus, domestic dogs may have been a significant agent in structuring the representation of fish remains in archaeological assemblages.

Other taphonomic factors influencing the survival of fish bone include burning and post-depositional diagenesis. In fact, the two may be related in that the high proportions of burnt bone recovered in the region (Walters 1986:240) could indicate the loss of unburnt bone. It is unlikely that chemical attrition alone could account for the distribution of fish remains since the majority of excavated sites are fairly alkaline (pH = 7.0 to 8.0). Two sites, Cameron Point Site 62 and Tin Can Bay Site 75B, have recorded pH levels as low as 4.0 and 4.5 respectively, which would not be conducive to survival of fish bone, although at both these sites other faunal remains (such as shellfish) did not appear to be adversely affected by these conditions (see McNiven 1990a). Further studies are required to define the various taphonomic processes affecting fish representation in the archaeological record of the region as a basis for undertaking valid inter-site comparisons of faunal assemblages (Amorosi *et al.* 1996).

Excavation Strategies

Any estimation of the value of the Walters model as an heuristic device must be tempered by recognition of his extremely small sample size. Walters provides no rationale or discussion of sampling adequacy other than a rather vague statement that all shore types were represented (Walters 1986:209). In the 1986 study, he conducted independent excavations at only two sites, Sandstone Point and Toulkerrie whereas all other supporting evidence is derived from excavations conducted by other investigators. In the main, the research designs used by these other researchers were directed at resolving issues of chronology and gross assemblage composition and not at characterising broad changes in fish production strategies. Of the eight sites employed in his original study (Walters 1986), five (St Helena Island, Wallen Wallen Creek, NRS 7, NRS 10 and Minner Dint) fall into this category.

A simple comparison of the area excavated and the total site area (see Table 1) demonstrates that the excavated fraction of archaeological deposits is much less than 0.5% for most of the sites reviewed, with the Broadbeach Burial Ground providing the exception. The high degree of spatial heterogeneity evident at the two middens which have been subjected to larger-scale excavation, Sandstone Point (Figure 6) and Toulkerrie (Figure 10), should serve as a caution against accepting results from small samples as representative of entire sites (see O'Neil 1993).

Given the small sample of excavated sites and of recovered fish remains from them, the total range of prehistoric fishing activities in southeast Queensland is unlikely to be adequately represented. Contrary to Walters' assertion, his sample cannot be expected to encompass the full range of intra-site variability, let alone provide sufficient data to enable meaningful inter-site comparisons and insights into regional processes (see Anderson 1973; Plog and Hegman 1993). To date, the types of sampling procedures employed in the excavation of shell midden deposits in southeast Queensland have been unsuited to characterising the internal diversity and composition of sites at any but the coarsest level.

Recovery Techniques

Another important sampling consideration is the efficacy of recovery techniques to yield data to evaluate fishing. Various screening experiments have demonstrated that mesh sizes create significant biases in faunal recovery (e.g. O'Neil 1993; Shaffer 1992; Shaffer and Sanchez 1994). Experiments which have included fish bones indicate that mesh sizes between 0.5mm and 2mm are required for maximum representative recovery (Casteel 1970, 1972, 1976a; Colley 1990; Gordon 1993). Indeed, Casteel (1976a, 1976b) has argued that column- or core-sampling is the only reliable method for representative recovery of fish remains. With the exception of the Lazaret Midden, where 1mm screens were used, and the two Booral sites and St Helena Island where 2mm screens were employed, 3mm mesh is almost universally the smallest screen size used in excavations in the area (Table 1). This factor may have had a significant impact on the fish representation in samples.

In an earlier study, Walters (1979) found that as much as 80% of fish remains passed through 3mm mesh (based on analysis of a single 661.6g bulk sample from Toulkerrie). Given this result it is somewhat surprising that he placed so much credence in the fish bone assemblages used for his later study which were derived almost exclusively from 3mm sieve residues. Walters' study also demonstrated that the use of larger mesh sizes biased recovery against some fish taxa with small diagnostic skeletal elements, such as mullet and whiting (see also Hall 1980:105-106). Also, the use of different sieve sizes makes it difficult to compare the representation of fish remains between sites. For example, both Frankland (1990) and Ross (2001) have attempted to directly compare the abundance of fish remains recovered with 2mm and 1mm screens respectively, with those derived from sites around Moreton Bay where 3mm screens were used.

Analytical Methods
A variety of abundance measures has been employed in the analysis of fish remains from archaeological sites in the region. For example, Walters (1986) used number of identified specimens (NISP), McNiven (1990a) used both weight and minimum number of individuals (MNI) and Frankland (1990) used MNI and NISP. These abundance measures are not necessarily comparable (e.g. Grayson 1979, 1984). Figure 14 reveals major discrepancies between patterns revealed by NISP and those given by MNI in the abundance of fish remains from the Booral Shell Mound.

NISP is particularly prone to problems of inter-site comparability, given the potential effects of taphonomic factors and differences in the way that different investigators calculate the measure. Lyman (1994b:38) defines NISP as 'the number of identified specimens per taxon … The taxon can be a subspecies, genus, family, or higher taxonomic category'. Although there is some disagreement over whether the term 'specimen' can be equated with 'element' or 'fragment', there appears to be consensus on the meaning of 'taxon'. All investigators who have used NISP as a measure of fish abundance in southeast Queensland have adopted the highest taxonomic category possible – Pisces.

The use of NISP also raises significant problems in Walters' application of the measure to calculate the abundance of fish remains discarded in various time intervals. The sites in his sample are not necessarily comparable even at a basic level. Direct inter-site comparison of these data is based on an assumption that all fish remains were subject to identical preparation, discard and post-depositional alteration and that the remains of all fish taxa respond to these factors in the same way (see Brian 1994). Walters (1986:248; cf. 1992c:35) has already demonstrated that even in his small sample there were significant differences between fish bone assemblages in patterns of mechanical damage.

Another problem in Walters' analysis is the equation of excavation units with temporal units in presenting discard patterns at particular sites. In this form of analysis there is an explicit assumption that each excavation unit represents an equivalent (and therefore comparable) period of time (Frankel 1988) and a constant rate of accumulation of both cultural materials and natural sediments. As Bird and Frankel (1991:181) note, these arbitrary analytical units 'combine material from an unknown number of activities or episodes of occupation into longer-term archaeological units'. Although excavation units are useful as a descriptive framework for defining assemblage composition and variability, they are inappropriate for addressing questions of change through time.

These chronological limitations are exacerbated when inter-site comparisons are attempted. At the Booral Shell Mound site, for example, a series of five radiocarbon dates from a single 50cm x 50cm pit provided Frankland (1990) with a well-dated sequence from which to calculate rates of discard of cultural material in 100-year intervals. This analysis demonstrated that in terms of NISP, the most intensive period of fish discard at the site occurred between 2,950 and 2,790 BP (see Figure 2). This form of analysis is not possible for most other coastal sites because of poor chronological resolution.

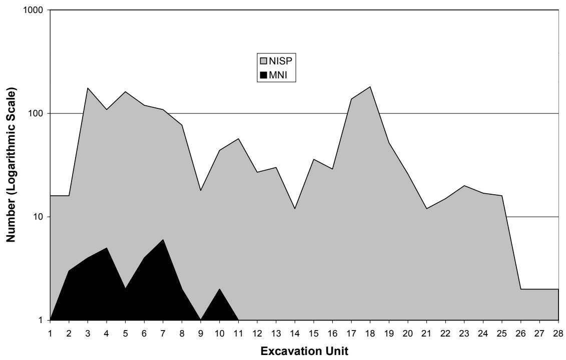

Figure 14. Abundance of fish remains calculated using both NISP and MNI methods, Booral Shell Mound, Square A (after Frankland 1990:59, 60). A logarithmic scale is employed so that small MNI figures are visible.

Conclusion

> All I have tried to show, here and elsewhere since the late 1980s, is that *on the evidence we have*, the interpretation I have given is the most parsimonious one that adheres to the data (Walters 1992c:37, original emphasis).

The review of the evidence for marine fishing in southeast Queensland demonstrates that the spatial and temporal distribution of fish remains in coastal sites is highly variable and is not simply characterised by increasing discard of fish remains through time. In fact, most coastal sites dating to the late Holocene do not contain fish remains at all, while at others fish abundance actually decreases through time. However, it is difficult to confidently define regional patterns in the fish evidence at this stage as a combination of factors, such as discard behaviour, taphonomic factors, recovery procedures and quantification techniques, may have a significant impact on the comparability of assemblages and the validity of inter-site comparisons. In sum, I do not deny that (a) marine fish may have been a significant component of Aboriginal subsistence in the past, nor that (b) an intensification of marine fishing occurred in Moreton Bay in the late Holocene. I simply point out that *there is no current archaeological evidence available* to support a claim for intensifying marine fishing in southeast Queensland.

Notes

[1] Radiocarbon ages in this paper are reported as conventional radiocarbon ages (Stuiver and Polach 1977). That is, they are corrected for isotopic fractionation and not corrected for marine reservoir effect or any other correction. Where not otherwise stated, the sample material used to determine each date is supplied with the laboratory number in the text. Where calibrated ages are reported, conventional radiocarbon ages were calibrated using the CALIB (v4.3) computer program (Stuiver and Reimer 1993) using the datasets of Stuiver *et al.* (1998) with no laboratory error multiplier. For shell dates, the central Queensland ΔR of 10 ± 7 recommended by Ulm (2002a, 2002b) is adopted. For charcoal dates, 24 years were subtracted before calibration to correct for ^{14}C variation between northern and southern hemispheres (after Stuiver and Reimer 1993). Calibrated ages for other conventional radiocarbon ages may be found in Ulm and Reid (2000). For a discussion of regional marine reservoir issues see Ulm (2002a, 2002b).

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