4 Radiocarbon and Cultural Chronologies in Southeast Queensland Prehistory

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Abstract. In this paper we present an overview of the radiocarbon chronology of pre-European Aboriginal occupation of southeast Queensland. Analysis of these data provides the basis for evaluating cultural chronologies proposed for southeast Queensland which emphasise time-lags between sea-level stabilisation and permanent occupation of the coast and late prehistoric structural change in settlement and subsistence strategies linked to intensifying regional social alliance networks. This synthesis of the radiocarbon chronology demonstrates that significant increases in the number of occupied sites and the rate of site establishment does not occur until after 1,200 cal BP, and is restricted to the coastal strip. While sea-level change may have significantly influenced the representation of earlier sites, the pattern over the last 1,000 years cannot be explained solely in terms of differential preservation due to geomorphological processes. While these results indicate significant structural change in the archaeological record of southeast Queensland in the late Holocene, the nature of that change requires closer examination through further detailed studies of local and regional patterns.

Introduction

Archaeological evidence from southeast Queensland comprises one of the largest regional archaeological data sets documented in Australia, incorporating some 58 dated sites (Ulm 1995; Ulm *et al.* 1995; Figure 1). Patterning in the archaeological record of the region, including apparent increases in site establishment and changes in resource use, has often been cited as an exemplar of pancontinental processes involving structural change in production and productivity in Aboriginal societies in the late Holocene (e.g. David 1994; Lourandos 1993; Lourandos and Ross 1994; Morwood 1987; Walters 1989, 1992a).

In southeast Queensland, three main indices have been employed in arguments for late Holocene cultural change towards more intensive production and productivity: 1) increases in the rate of site establishment and use (David 1994; Hall 1996; Lourandos 1993; Lourandos and Ross 1994; Morwood 1986, 1987; Walters 1989, 1992a); 2) initial occupation of a marginal environment (Walters 1989, 1992a); and 3) intensified marine resource exploitation (Morwood 1986, 1987; Walters 1989, 1992a). These indicators of change have received widespread application in similar regional Australian studies (e.g. Barker 1995; Bowdler 1981; David 1994; Lourandos 1983; Ross 1984; Williams 1988).

This paper focuses on the first of these indices through an examination of the radiocarbon chronology of Aboriginal occupation of southeast Queensland, concluding that significant change in the regional archaeological record, as reflected in the radiocarbon chronology, occurs after 1,200 BP and not at 2,000 to 4,500 BP as argued by some.

Modelling Chronology in Southeast Queensland

Over the last 10 years, general syntheses of regional archaeological patterns in southeast Queensland have emerged which emphasise significant increases in site numbers and use since the mid-Holocene, especially in the coastal region (Hall 1987, 1996; Hall and Hiscock 1988; McNiven 1990, 1991a; Morwood 1986, 1987; Walters 1987, 1989). These syntheses are based largely on the results of numerous archaeological studies conducted under the auspices of the Moreton Region Archaeological Project (MRAP) (e.g. Alfredson 1984; Bonica 1992; Bowen 1989; Crooks 1982; Hall 1980a, 1982, 1984, 1986, 1987; Hiscock 1988; McNiven 1990; Nolan 1986; Robins 1983; Walters 1987). This large regional data set has provided the basis for contesting various archaeological interpretative frameworks.

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Interpretations of regional cultural change in southeast Queensland have essentially polarised around two views: one emphasising that coastal landscapes and resources have only recently emerged as a focus for settlement and the other holding that people were always on the coast.

In various publications Walters (1987, 1989, 1992a, 1992b) developed an explanatory model linking increased discard of fish remains in the late Holocene (post-2,000 BP) to intensifying regional social networks. He argued for a time-lag of some 4,000 years between mid-Holocene sea-level stabilisation and human occupation of the coast. This time-lag is attributed to the marginality of the coastal landscape prior to late Holocene (post-3,000 BP) increases in marine productivity induced by anthropogenic changes in fluvial sedimentation. Walters argued that the post-2,000 BP adoption of specialised marine fishing required 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.

The cultural chronology suggested by Morwood (1986, 1987) similarly emphasises that the apparent elaboration of social complexity in the late Holocene was related to the development of the marine fishery (see Walters 1992b:29). He explained Holocene cultural changes in terms of increasing social complexity which developed as a response to the post-transgressive configuration of key regional resources (particularly marine fish and bunya nuts). Morwood (1987) contended that before 6,000 BP populations were highly mobile and of low density, reflecting the generally low productivity of regional environments prior to sea-level stabilisation. Although Morwood (1987:343) conceded that "there may have been human exploitation of coastal resources" before the mid-Holocene, he argued that "conditions during times of fluctuating sea levels do not appear to have been conducive to high, littoral productivity". After 6,000 BP, however, the formation of Moreton Bay brought about a dramatic increase in marine resource productivity which "provided scope for an accelerating increase in population in the region, especially after 4000 BP" (Morwood 1987:343). Morwood (1987:343) suggested that:

> The growth of site numbers over time from 4500 bp (5000 BP) appears to be of logarithmic rather than linear type, and provides a general measure of population increase ... This increase occurs in all major environmental zones and post-dates the stabilization of sea level by 1500 years. Certainly, the evidence does not suggest that a sizable population of coastal dwellers was 'pushed back' to the present coastline by the last marine transgression.

Although Morwood (1987:346) noted evidence for marine resource exploitation around the mid-Holocene, he maintained that "intensive and specialized use of marine foods did not occur until much later".

In a similar argument, Hall (1982, 1987, 1990, in prep.; see also Hall and Bowen 1989; Hall and Hiscock 1988; Hall and Lilley 1987; Hall and Robins 1984) has related more intensive use of marine resources in the late Holocene to changes in marine productivity caused by mud flat progradation. Contrary to Walters and Morwood, however, Hall posits that people were always resident on the coast and simply followed the transgressing coastline, subsequently annexing new or previously little-used subcoastal areas. He suggests that prior to 6,000 BP populations in the region were of lower densities and only peripherally used subcoastal regions. Between 6,000 and 2,500 BP changes in regional demography are argued to have occurred in response to stabilising sea-levels and subsequent lags in marine productivity, with the abandonment of some islands and annexation of inland areas, with people occupying most of the coastal zone by 2,500 BP. After 2,500 BP people appear to expand out to the Bay islands as other areas are already occupied. This pattern was completed by around 1,000 BP resulting in an increase in the number of discrete socio-political groups and overall population densities in the region and he suggests that this may have been the basis of further cultural differentiation.

McNiven adopted a similar explanatory framework for the northern coast of the study region, arguing that the evidence for first occupation of Cooloola at c.5,500 BP is associated with sea-level stabilisation and suggesting that this represented:

> a localized adaptation of an extant marine-terrestrial settlement-subsistence system which had slowly been moving westwards across much of the present continental shelf with the transgressing coastline (McNiven 1990:376).

McNiven (in prep.) argues for major socio-demographic changes in Aboriginal populations in the region in the last 2,000 years as evidenced in apparent localisation of resource use (including, for example, shellfish and stone resources).

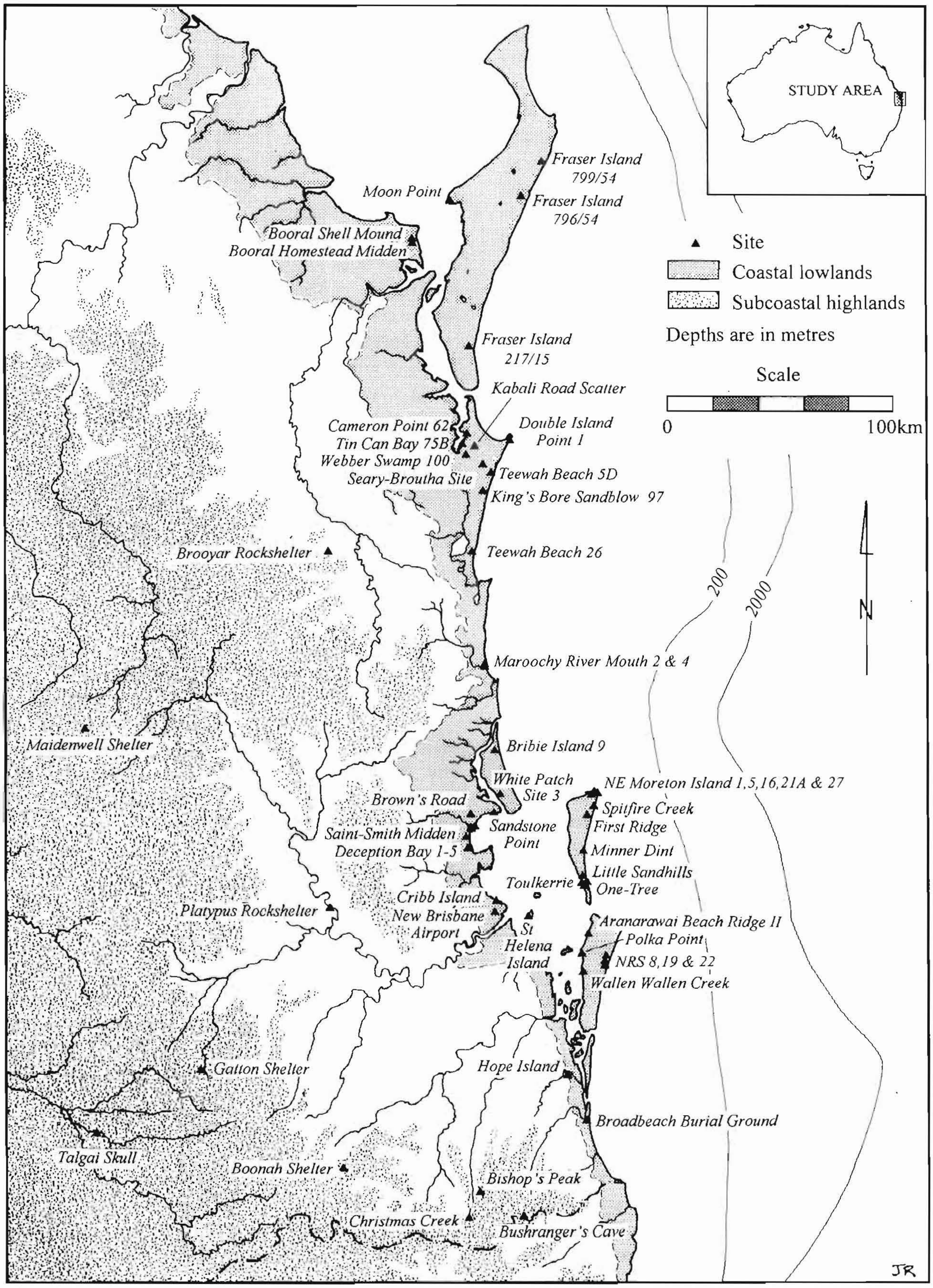

Figure 1. Southeast Queensland, showing radiocarbon dated archaeological sites (n=58).

Radiocarbon dates form the basis for all of the cultural chronologies proposed for southeast Queensland outlined above. Given variations in the timing of major changes in models of culture change we felt that an updated synthesis of available ^{14}C data may provide one avenue for investigating issues of change in the region. This synthesis is broadly similar to other recent studies of chronological frameworks based on large regional suites of ^{14}C dates such as Bird and Frankel (1991) for western Victoria and southeast South Australia, Holdaway and Porch (1995) for southwest Tasmania and Boot (this volume) for southeast New South Wales.

The Radiocarbon Record

The radiocarbon date sample employed in this analysis was constructed through a thorough survey of published and unpublished sources which report research in the study region. This search located 149 dates from 58 sites, including several dates which are not previously reported (Appendix 1; Figure 1). We estimate that this sample represents as much as 90% of determinations made on archaeological materials in southeast Queensland.

Appendix 1 lists the radiocarbon data used in this analysis and includes the site name (as reported), mean and standard deviation of conventional ^{14}C ages, laboratory code, sample material, citation and calibrated age/s. Where it was not possible to cite a published source, unpublished theses, reports and personal communications are acknowledged. ^{14}C ages in the second column are as reported without correction for marine reservoir effect or other error, with the exception of three dates from the Broadbeach Burial Ground, which are listed with a correction estimate for isotopic fractionation (Stuiver and Reimer 1993). Five dates in the sample (from Deception Bay sites 1-5) were initially undertaken as part of geomorphological research and later identified to be from cultural deposits (see Nolan 1986).

Although various 'chronometric hygiene' criteria have been implemented in archaeological studies based on radiocarbon dates (e.g. Meltzer and Mead 1985; Spriggs and Anderson 1993), we have chosen to only exclude determinations which are clearly problematic on the basis of their archaeological associations. In total, 13 determinations were omitted from the sample. The 10 determinations for the Talgai Skull listed in Appendix 1 were obtained on soils and carbonate nodules reportedly associated with the find spot of the human cranial remains (Hendy *et al.* 1973; Smith and Sharp 1993). There is no firm evidence for directly relating these determinations with the actual antiquity of the remains. Because of the equivocal nature of these dates, they have been excluded from the analysis. The three dates from Boonah Shelter are inverted, although Morwood (Department of Archaeology and Palaeoanthropology, University of New England, pers. comm., 1995) suggests that the age of 3,240 ± 50 BP (Beta-25204) is accurate and that the other two determinations (Beta-21276 and Beta-25205) were undertaken on intrusive organic material and should be discarded. We have chosen to follow Morwood's recommendation in excluding these two determinations. A single determination in the Wallen Wallen Creek sequence (SUA-2344R) is clearly anomalous and is thought to have been caused by ground water contamination (Neal and Stock 1986:620).

All conventional radiocarbon ages were calibrated from radiocarbon years to calendar (sidereal) years using the CALIB (Version 3.03c) computer program (Stuiver and Reimer 1993). Only calibrated dates are used in our analysis to ensure comparability of the time scale used in assessing temporal changes in patterns of human occupation (see Ward 1994 for discussion). Only one determination (SUA-2341) from southeast Queensland is presently beyond the limits of available calibration data.

Studies of marine reservoir effect have not been undertaken in the immediate study area (see Gillespie and Polach 1979). Researchers have generally corrected radiocarbon determinations obtained on marine shell by simply subtracting 450 years (e.g. Alfredson 1984) and some have then calibrated determinations into calendar years using the bi-decal atmospheric calibration curve (e.g. McNiven 1989). Applying this standard correction value, however, does not take into account the fact that oceanic reservoir ages are not constant, but rather fluctuate through time with changes in reservoir parameters such as "input and output fluxes and exchange with the atmosphere" (Stuiver *et al.* 1986:980). We have applied the global marine calibration model with a generalised regional correction value ($\Delta R = -5 \pm 35$) suggested by Stuiver and Braziunas (1993) for marine determinations. This ΔR value is the weighted mean of the difference between the known historical age and the conventional ^{14}C age for marine shell samples from the east coast of Australia based on results presented by Gillespie and Polach (1979; see Stuiver *et al.* 1986: Table 1).

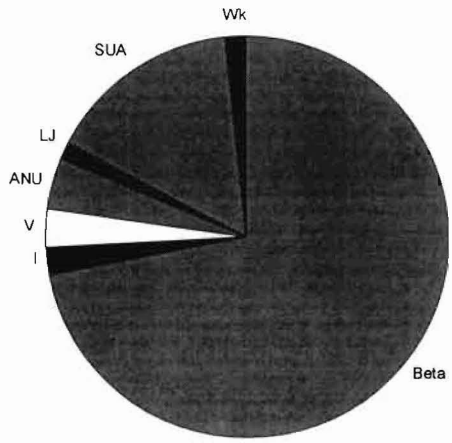

Figure 2. Distribution of dates by laboratory. Key to abbreviations: Beta=Beta Analytic; I=Teledyne Isotopes; V=Victoria Radiocarbon Laboratory; ANU=Australian National University; LJ=University of California; SUA=Sydney University; Wk= Waikato.

As our purpose is to examine models for Holocene change in southeast Queensland, only calibrated ages less than 10,000 years are considered. The exclusion of older dates does not significantly alter the sample structure as only eight unequivocal determinations from two sites (Bushranger's Cave and Wallen Wallen Creek) exceed 10,000 cal BP. The exclusion of problematic determinations (10 from the Talgai Skull, two from Boonah Shelter, and one from Wallen Wallen Creek) and the eight determinations which exceed 10,000 cal BP reduces the sample used in this analysis to 128 radiocarbon dates from 57 sites.

Sample Structure

The comparability and reliability of the radiocarbon data set used in this analysis is enhanced by two features. Firstly, the majority of determinations (71.88%, n=92) were made at a single laboratory, thereby minimising the effects of inter-laboratory variability in sample preparation and counting procedures (Figure 2). Secondly, only a small proportion of determinations in the sample (n=37) were made on marine shell, with more than 70% made on charcoal (n=91). This bias is important in confined areas such as Moreton Bay where there is the possibility of older terrestrial carbon from fluvial activity being incorporated into shell structures (see Little 1993).

For the purposes of this analysis we have divided dated archaeological deposits in the study region into two broad types: 1) coastal sites, and 2) subcoastal sites (Figure 3a). This division conforms with the major physiographic zones of the region defined by Coaldrake (1961) as the coastal lowlands (or 'wallum'), and subcoastal highlands (Figure 1). With the exception of two sites (the Broadbeach Burial Ground and King's Bore Sandblow Site 100), all coastal sites (96%) comprise shell-bearing deposits with lesser quantities of other faunal material and stone artefacts. The Broadbeach Burial Ground is the only dated cemetery site in the region (see Haglund 1976) while King's Bore Sandblow Site 100 is essentially an open artefact scatter in structure (see McNiven 1992) although since first use both sites have always been in close proximity to the ocean. All subcoastal sites are rockshelter deposits located between 40km and 160km inland from the current shoreline. Although other site forms (such as unstratified artefact scatters, earthen circles, fish traps and rock art sites) are found in southeast Queensland none has been successfully dated with radiometric techniques (see Hall and Hiscock 1988).

As is clear from Figure 3a, coastal sites dominate the sample, comprising more than 86% of dated sites and more than 80% of radiocarbon determinations. Dates from subcoastal sites account for less than 20% of the sample, although there are marginally more radiocarbon dates per site than from coastal deposits. The dominance of coastal deposits in the sample reflects the general coastal orientation of archaeological research in the region rather than the abundance of archaeological materials.

More than 55% of sites have only a single date and over 77% of sites have fewer than three dates (Figure 3b). This is a significant problem both in establishing occupational chronologies for individual sites and in assessing the reliability of age determinations (cf. Smith and Sharp 1993; Webb 1996). In this analysis, sites with single determinations are considered to be accurate, in the absence of other data to assess reliability (see Bird and Frankel 1991:13).

Methods

Three main techniques have been employed in Australia in the generation of regional chronologies based on radiocarbon dates: 1) estimates of the number of sites occupied in specified periods (e.g. Bird and Frankel 1991; Lourandos 1993; Lourandos and Ross 1994), 2) counts of radiocarbon dates over time using a moving average (e.g. Allen and Holdaway 1995; Bird and Frankel 1991; Holdaway and Porch 1995), and 3) rates of establishment of new sites (e.g. Attenbrow 1982; Flood *et al.* 1987; Hughes

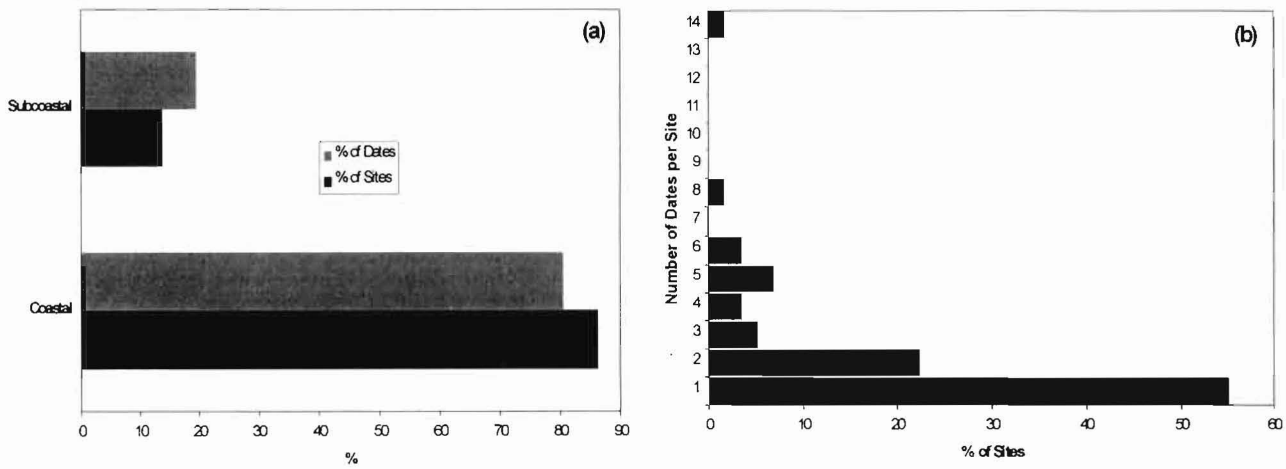

Figure 3. (**a**) Frequency of major site types and proportion of dates for each major site type; and (**b**) frequency of sites with different numbers of radiocarbon dates.

and Lampert 1982; Lourandos 1983; Williams 1988).

The first technique is simply an estimate of the number of sites occupied in 500-year (or other specified) periods based on linear interpolations between radiocarbon determinations. Because of the dearth of sites with termination dates, an assumption is made that sites were occupied to the present if there are no major stratigraphic disconformities to suggest otherwise. This tends to inflate the number of recently-occupied sites, but given the coarse scale of analyses, this bias probably has little effect on broad trends.

The second method, developed by Rick (1987), involves the calculation of a moving average of the number of radiocarbon dates in sliding 600-year intervals measured every 200 years. Bird and Frankel (1991) used this technique in analysing the radiocarbon chronology from western Victoria and southeast South Australia, and variants of the method have recently been adopted by several other Australian investigators (Allen and Holdaway 1995; Holdaway and Porch 1995; Smith and Sharp 1993). Rick's (1987) method is based on the premise "that the number of dates is *related* to the magnitude of occupation" (Rick 1987:55, original emphasis) and that "all things being equal, more occupation produces more carbon dates" (Rick 1987:56). Implicitly, this method assumes that radiocarbon samples are selected at random from an unbiased archaeological record.

As Holdaway and Porch (1995:74) note, several of the assumptions of the method are difficult to sustain as, in reality, dates are not selected randomly and the availability of charcoal for dating is structured by taphonomic factors affecting the representation both of sites and of charcoal within deposits, as well as sampling and research biases.

The usefulness of this method is, therefore, dependent on an understanding of the complex biases structuring the archaeological date sample. In his examination of the Peruvian preceramic radiocarbon record, Rick (1987) provided a consideration of the effects of research design and taphonomic processes on the sample of radiocarbon dates. Bird and Frankel (1991) provide only a superficial discussion of the biases inherent in their date sample and justify the use of the technique on the basis that it is a "finer scale of counting" and "suggests greater or more complex variability" (Bird and Frankel 1991:4). Bird and Frankel (1991:10) interpret the results of this method to support their argument for "short-term adjustments in settlement pattern in response to local conditions" rather than "cumulative directional change". This seems a strange conclusion given that the original aim of the technique was to smooth the curve and broaden the temporal influence of each date (Rick 1987:61).

The dependence of this technique on sample structure is clearly illustrated by an example from the present study. In southeast Queensland the majority of research has been conducted in geologically-recent landforms to resolve questions of localised resource use (e.g. Nolan 1986). Excavations undertaken at Sandstone Point, for example, were located entirely on a late Holocene beach-ridge system (Cotter this volume). Sites located on this ridge could therefore be no older than late Holocene in age. Fourteen radiocarbon determinations were obtained at this site to investigate intra-site variability. These 14 dates represent 11% of the entire date set. Clearly, the nature of research strategies can radically affect the structure of radiocarbon date samples.

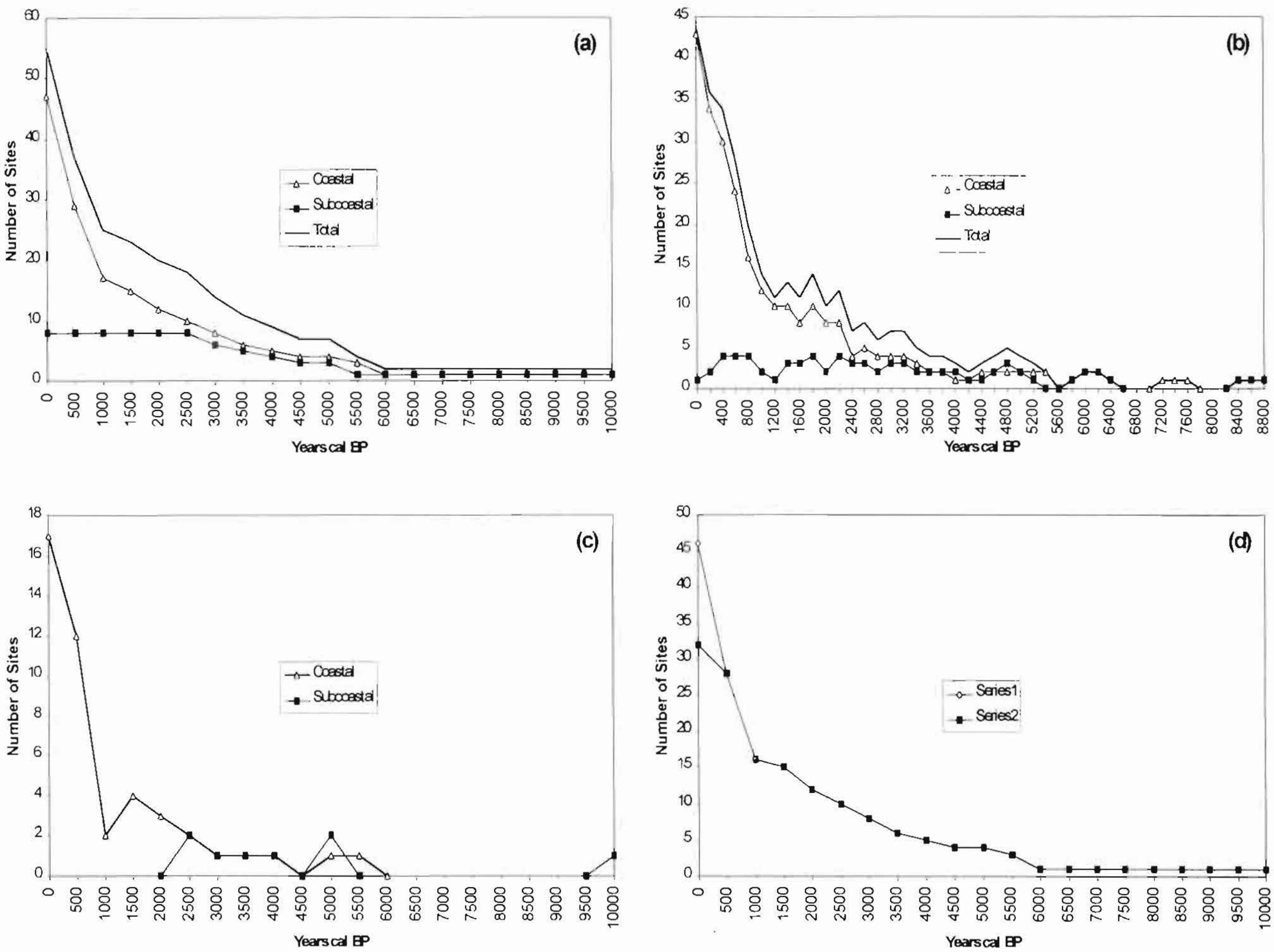

Figure 4. (**a**) Estimated number of dated sites occupied in each 500-year period; (**b**) number of sites with central radiocarbon dates falling in each 600-year period, measured at 200-year intervals; (**c**) number of new sites established in each 500-year period using earliest dates; and (**d**) Estimated number of dated coastal sites occupied in each 500-year period. Series 2 excludes sites first occupied in the last 200 years.

The third technique involves the use of basal dates which have commonly been used in regional syntheses to represent the establishment of new sites through time. This technique is useful for examining patterns of land-use by focusing on site *creation* rather than *occupation* and use of sites. Bird and Frankel (1991:4) have criticised this method for, among other things, "assuming continuity of occupation after first use, and lumping together dates from sequences and short-term occupations", thereby denying "the possibility of demonstrating discontinuity or the reuse of sites after a significant gap in occupation". These criticisms are difficult to sustain, however, as the method does not assume continuity of site use since the technique is explicitly based on site establishment, requiring the use of initial dates for site occupation (and, in a variation of this technique, reoccupation after long breaks in occupation, see Smith and Sharp 1993).

Despite limitations inherent in all three methods reviewed above, they are useful devices to characterise broad, long-term patterns in the distribution of radiocarbon dates.

Application of Methods to the Southeast Queensland Database

In the present analysis we have chosen to present the regional ^{14}C data set using all three techniques. The first is an estimate of the number of dated sites occupied in 500-year periods (Figure 4a), the second utilises Rick's (1987) method of counting the number of dates in 600-year periods measured at 200-year intervals (Figure 4b) and, finally, the dates are expressed as the number of new sites established through time (Figure 4c).

From 6,000 BP the estimated number of dated sites occupied in each 500-year period increases. Although the relatively coarse-grained temporal framework used here may mask short-term variability in the use of particular sites, at 1,000 BP there is an apparent increase in the rate of site occupation, although this may, in part, be a product of analytical methods in that sites without a termination date are assumed to have been occupied until the last 500 years; this has the cumulative effect of exaggerating the number of sites in the most recent period.

The dramatic increase in the number of coastal sites established and occupied in the last 1,000 years is exaggerated by the inclusion of 14 sites which were first occupied only within the last 200 years (Figure 4d): Double Island Point Site 1, Kabali Road Scatter, Little Sandhills, Northeastern (NE) Moreton Island 1, 5, 16, 21A and 27, NRS 7, 8 and 10, Seary-Broutha Site, Teewah Beach 5D and Webber Swamp 100 all fall into this category. As first occupation of all of these sites is confined to the post-contact period, they cannot be assumed to represent pre-European settlement and subsistence strategies. Despite this, however, removal of these sites from the data set does not significantly alter the apparent trend toward more coastal sites occupied through time (Figure 4d).

Subcoastal deposits account for only eight (14%) of the total number of dated sites. Only one rockshelter, Bushranger's Cave, is dated to before 5,500 BP. An increase in the number of dated subcoastal sites occupied is evident between 5,500 and 2,500 BP, from one to eight dated sites. However, because of the small sample size, the significance of this change is difficult to assess, particularly as there is no further increase after 2,500 BP. Contrary to arguments made by Lourandos (1993) and David (1994: 325), accelerating patterns of coastal site occupation and use evident in the radiocarbon record of the late Holocene are not reflected in the independent data set provided by subcoastal rockshelters in the region. In fact, all dated subcoastal sites are occupied before 2,500 BP and over half of them are occupied before 4,000 BP (Figure 4a). The apparent divergence in patterns of site occupation between coastal and subcoastal sites in the late Holocene may simply be a product of inadequate sampling. In most of the dated subcoastal sites only dates from single 50cm x 50cm pits were obtained and several of these are non-basal, such as at Brooyar Rockshelter (McNiven 1988) and Boonah Shelter (Dr M. Morwood, Department of Archaeology and Palaeoanthropology, University of New England, pers. comm., 1995).

Discussion

Three important patterns emerge from our analysis of the radiocarbon chronology of the region. First, coastal occupation pre-dates the close of the last marine transgression around 6,000 BP. Archaeological evidence from Wallen Wallen Creek (Neal and Stock 1986), Teewah Beach Site 26 (McNiven 1991a), Hope Island (Walters *et al.* 1987) and the New Brisbane Airport site (Hall and Lilley 1987) indicate that people were on the coast around the time of sea-level stabilisation. The occupation of the coastal lowlands throughout the mid-to-late Holocene (and arguably the early Holocene, as evidenced by the Wallen Wallen Creek assemblage) is demonstrated by the continuous record of radiocarbon dated sites. Although there is no simple relationship between number of sites and number of people (e.g. Ross 1985), the general increase in the number of dated sites or locations on the landscape through time suggests an expansion in the *general magnitude* of occupation in the region.

Second, the number of coastal sites increases gradually, but consistently, from 6,000 BP to around 1,200 BP after which a dramatic acceleration in site creation and use is apparent. Significantly, increases in the estimated number of sites in the last 1,000 years coincide with increased rates of site establishment, possibly indicating a reordering of land-use involving more locations on the landscape. Third, few coastal or subcoastal sites dating to the early and mid-Holocene are recorded in southeast Queensland.

The evidence does not support arguments proposed by Walters and Morwood that periods of greater sedimentation around 3,000 BP were related to increases in marine productivity and increases in Aboriginal occupation of the coast. If this enrichment of marine resources did occur, it does not coincide with any changes in the available radiocarbon record of Aboriginal occupation from this time. Significant increases in the number of occupied sites, the rate of site establishment and the number of sites with central radiocarbon dates falling in each 600-year period do not occur until after 1,200 cal BP, some 2,000 years after the proposed enrichment of Moreton Bay (Figures 4a to 4c). Similarly, the distribution of occupied sites and the rate of site establishment does not support Morwood's (1987) argument for a dramatic increase in site numbers around 4,500 BP (see also Hall and Hiscock 1988).

The apparently abrupt commencement of the increasing trend in the number of occupied sites at

6,000 BP is suggestive of the potential role of the marine transgression in structuring the archaeological sample by inundating previous coastal sites. This truncation of the archaeological record creates a bias towards the representation of post-transgressive occupation (Head 1986). The later change after 1,200 BP, however, is more difficult to ascribe to taphonomic factors and may instead signal some kind of change in the use of regional coastal landscapes. Whether this pattern is related to changes in marine resource use is yet to be demonstrated (Ulm 1995).

The overwhelming concentration of sites established in the late Holocene may be partly explicable in terms of the operation of geomorphological processes, such as erosion and progradation, working to differentially destroy and bury sites. In a recent paper, Hall (in prep.) discussed the possible impact of sea-level rise on the archaeological record of southeast Queensland based on geomorphological studies of changing Holocene sea-levels and coastlines. He suggested that many pre-6,000 BP coastal sites have been destroyed by inundation and erosion associated with transgressive processes.

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 1983, 1986, 1987; Rowland 1983, 1989). In the study region, approximately 20,000km^2 of land has been submerged by transgressing seas over the last 18,000 years (see -200m contour on Figure 1; Ulm 1995). 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.

Thus, the paucity of sites before 6,000 BP may simply be an artefact of rising sea-levels. However, given the relative stability of sea-levels and coastal landforms since about 3,000 BP, it is difficult to explain the dramatic increase in the number of occupied sites which occurs after 1,200 BP in terms of differential preservation. Visibility of these earlier sites is also problematic. Cotter's (this volume) detailed palaeogeographical study of the Deception Bay area has demonstrated that patterns of sedimentation would rapidly obscure sites by deposition of aeolian and dunal sands.

After reviewing evidence for Pleistocene archaeological sites on the Australian continent, Smith and Sharp (1993:49) noted the "presence of sites on or near the Pleistocene coast, wherever the continental shelf is steep enough to allow their preservation". All known Pleistocene and early Holocene sites in Australia which exhibit use of coastal resources are located in rockshelters situated near palaeoshorelines (e.g. Barker 1991, 1995; Morse 1988, 1993; Veth 1993). Thus, in southeast Queensland where the continental shelf is relatively wide, has a gentle slope and no near-coastal rock formations conducive to shelter formation, it is perhaps not surprising that archaeological evidence is lacking for coastal occupation prior to mid-Holocene sea-level stabilisation. This evidence does not demonstrate that people did not occupy the coast prior to this time, as Walters has implied. Evidence of Pleistocene occupation of the region from Wallen Wallen Creek, Bushranger's Cave, and possibly the Talgai Skull site, combined with evidence of coastal occupation synchronous with sea-level stabilisation at Teewah Beach 26, New Brisbane Airport, Hope Island and Wallen Wallen Creek, provides compelling evidence for the presence of populations following the transgressive coastline westwards (see Hall 1996; Hall and Hiscock 1988; McNiven 1991a).

The simplest explanation for the near-absence of evidence for coastal occupation before the mid-Holocene is that known coastal sites were formed in landscapes which only date to this period. Detailed geomorphological studies from the entire region are now required to establish a framework for evaluating the structure of this archaeological evidence.

Interestingly, all six coastal sites in the region which date to before 3,000 BP (Booral Shell Mound, Teewah Beach Site 26, Bribie Island Site 9, Polka Point, Wallen Wallen Creek, New Brisbane Airport, King's Bore Sandblow Site 97) also contain more recent cultural deposits dating to the late Holocene. Perhaps further and more thorough excavation and systematic dating of basal deposits at apparently recent sites may result in the identification of further mid-Holocene deposits (see Breschini and Haversat [1991] for a similar phenomenon in coastal California). Excavations at several coastal sites in the region have ceased before reaching culturally-sterile deposits. Post-excavation analysis of material from both Toulkerrie (Bowen 1989; Hall and Bowen 1989) and NRS 8 (Neal 1984) revealed that cultural material was still being recovered in basal excavation units. There is also the possibility that evidence of earlier occupation is separated from more recent assemblages by sterile deposits such as at Wallen Wallen Creek (Neal and Stock 1986).

The evidence presented in this paper is not only consistent with models of continuing coastal occupation throughout the marine transgression (such as those proposed by Hall 1987; Hall and Hiscock 1988; McNiven 1991a) but suggests the late Holocene increases in occupation may be related to the operation of existing coastally-oriented social systems.

Significantly, the evidence presented here for subcoastal occupation demonstrates that the number of occupied rockshelter sites does not change during the last 2,500 years, and that the pattern of initial occupation of subcoastal sites is not synchronous with changes in rates of coastal site establishment, which does not alter greatly until after 2,000 BP (cf. Lourandos 1993). Although most subcoastal sites were first occupied between 6,000 and 3,000 BP, all eight were occupied up until the present.

A major limitation in interpretations of coastal occupation in southeast Queensland stems from a poor understanding of the relationships between coastal and subcoastal sites. In part, this has resulted from patterns of research focused on shell-bearing archaeological sites in close proximity to the present shoreline. The distribution of excavated sites either on the extreme coastal fringe or in subcoastal rockshelters may have seriously biased our knowledge of variability in site structure and thus representations of the variability of resource use and settlement patterns in the area.

Open subcoastal sites, consisting almost exclusively of stone artefacts, account for more than 99% of recorded non-coastal sites in the study region. Unfortunately, these sites generally form unstratified deposits and are rarely associated with material suitable for radiometric dating. Attempts to establish a relative dating system based on artefact morphology and correlation with dated rockshelter assemblages may provide an avenue for resolution of this problem (see Hiscock 1988), although recent attempts to implement this system have met with limited success owing to problems of obtaining large sample sizes of complete and unretouched flakes (Smith and Hall 1996).

Towards an Alternative Interpretation

On the basis of the chronological data presented, we argue that a model of permanent occupation of the coastal lowlands throughout the Holocene is more appropriate than Walters' (1992b:35) argument for 'transient or itinerant' occupation of the coast prior to 2,000 BP (see also Morwood 1987).

While the relationship between the spread of radiocarbon dates for a region and *actual* patterns of land-use are complex and heavily dependent on the adequacy of sampling and other factors, in large regional data sets such as that available from southeast Queensland it provides a coarse-grained overview of general patterns and broad long-term trends in the archaeological record. Studies of site use and discard patterns in the region demonstrate that the apparent change identified in the radiocarbon record at 1,000-1,200 BP towards increased site creation and use is also reflected in structural changes in the regional archaeological record (Hall 1996; McNiven 1990, in prep.; Ulm 1995). Most significant is the apparent explosion of shellfish remains as evidenced by the dramatic increase in coastal shell middens, a site type which only appears in the mid-Holocene.

Mid-to-late Holocene settlement strategies in southeast Queensland are characterised by increasingly localised use of resources in the coastal zone (see McNiven in prep.) and possibly also in subcoastal areas (Morwood 1986, 1987). This pattern is evident both in the content and distribution of sites. The dramatic increase in the number of occupied sites in the very late Holocene is synchronous with changes in site structure. Excavations of numerous sites in the region have demonstrated repeated late Holocene patterns suggesting qualitatively different patterns of occupation to those which obtained in the mid-Holocene (David 1994:77). New site types emerge in the late Holocene evincing repeated occupation and associated increases in the use of local resources such as stone, shellfish and plant foods requiring specialised processing. The apparent introduction of widespread shellfishing at c.2,000 BP may signal a structural change in the way in which people were utilising coastal landscapes in the region (McNiven in prep.). The magnitude and broad synchrony of these changes in the structure of the coastal archaeological record may also signal the emergence of sedentary-based mobility strategies and altered social arrangements akin to those observed in the ethnohistoric literature.

This general scenario is consistent with the model offered by Hall and Hiscock (1988) which has slowly-rising post-Pleistocene populations making socio-demographic adjustments by fissioning and exploiting little-used territory (ie. subcoastal highlands and then islands) until such time as they have difficulty in responding in this manner, the available land space becoming essentially filled with respect to traditional socio-economic organisation. Thus, by the late Holocene, those populations living on the coast had already experienced a fissioning process resulting in migration to the offshore islands and, being restricted in territorial expansion by neighbors to the west, had little choice in traditional economic terms but to expand their spectrum of targeted food resources. The dramatic increase in shell midden deposits after 1,200 BP could very well represent the beginning of such an intensification process, as could the purported increase in both the discard and the range of fish taxa posited by Walters (1989, 1992a). The concurrent increase in the numbers of bevelled pounders, stone artefacts almost certainly used in the processing of fernroot (Hall *et al.* 1989), would also bolster an argument in favour of the instenification of production.

In this connection we note that the only two Aboriginal cemeteries excavated in the study region date to this time period. The Broadbeach Burial Ground has been radiometrically dated from about 1,200 BP (Haglund 1976) and the Double Island Point site (McNiven 1991b) is speculated to date to within the last 900 years. Following Pardoe's work (1988, 1995) we are willing to posit that such cemeteries represent relatively sedentary populations who, although maintaining social ties with other such groups, practice societal exclusion rather than inclusion (see Pardoe 1995:709), in much the same patterns as witnessed at European contact in this region.

Conclusion

A re-examination of the chronology of pre-European Aboriginal occupation in southeast Queensland is critical because changes in site occupation and use modelled by researchers in the region are viewed as part of wider processes of alterations in subsistence and settlement strategies in many areas of Australia in the late Holocene (e.g. Lourandos and Ross 1994). Interpretations of the archaeological record of southeast Queensland have assumed an important role in academic discourse on late Holocene cultural change in Australia. Both proponents of intensification arguments (e.g. David 1994; Lourandos 1993; Lourandos and Ross 1994) and their opponents (e.g. Bird and Frankel 1991; Hall and Hiscock 1988) have cited archaeological evidence from southeast Queensland to support quite different interpretations of prehistoric cultural change.

The radiocarbon chronology presented in this chapter provides evidence for Aboriginal presence in the coastal lowlands throughout the Holocene. The number of occupied sites increase throughout the region over the last 6,000 years. An accelerated rate of coastal occupation is evident in the last 1,200 years, although this trend may be exaggerated by the analytical techniques employed it may also signal emerging intensification processes and broad-spectrum resource targeting.

In this paper we have deliberately focused on trends and patterns in quantitative data at the regional (macro-) level. Equally significant are qualitative changes in site use at a smaller (micro-) scale. Techniques employed in the construction of regional chronologies from radiocarbon dates play a significant role in defining archaeological trends concerning prehistoric human behaviour. To delineate changes in prehistoric social and economic strategies we must effectively discriminate between long- and short-term processes (see Bird and Frankel 1991; Lourandos 1993, this volume).

In closing we wish to emphasise that analyses of the type presented here which attempt to correlate dates, numbers of sites and initial occupation dates in order to define archaeological trends, are not ends in themselves. They represent but one aspect of an attempt at explaining the archaeological record, and a coarse-grained one at that. In short, while such results permit us to build quite rational scenarios about past human behavioural change, they can – and have – resulted in quite polarised interpretations, none of which are a great deal better than the others at satisfying the requirements of a knowledge claim. Because such polarity of view can never be resolved at this level of analysis and discourse, dynamic ethnograghically-based models need to be developed which may be archaeologically tested through carefully-constructed research designs. For our part, we are currently developing a socio-economic model for the southeast Queensland study area.

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Appendix 1. Radiocarbon dates (n=149) from archaeological sites (n=58) in southeast Queensland.

Site	^{14}C Age	Lab. No.	Sample	Reference	Calibrated Age/s[a]
Aranarawai Beach Ridge II	1880 ± 80	Beta-24538	charcoal	Neal 1989	1939(1735)1551
Bishop's Peak	1420 ± 60	Beta-16298	charcoal	Edmonds 1986	1380(1290)1174
	2620 ± 90	Beta-16299	charcoal	Edmonds 1986	2852(2742)2357
Boonah Shelter	1300 ± 60[b]	Beta-25205	charcoal	Morwood pers comm	1291(1174)1005
	1960 ± 110[b]	Beta-21276	charcoal	Morwood 1987	2124(1866)1568
	3240 ± 50	Beta-25204	charcoal	Morwood pers comm	3540(3392)3276
Booral Homestead Midden	2400 ± 110	Beta-38414	charcoal	Frankland 1990	2743(2348)2122
	2420 ± 80	Beta-32045	charcoal	Frankland 1990	2723(2352)2157
Booral Shell Mound	980 ± 60	Beta-37394	charcoal	Frankland 1990	954(904,853,835,806,797)720
	1750 ± 60	Beta-36303	charcoal	Frankland 1990	1730(1603,1590,1576)1503
	2480 ± 60	Beta-36304	charcoal	Frankland 1990	2736(2460,2384,2377)2341
	2660 ± 60	Beta-38415	charcoal	Frankland 1990	2844(2750)2507
	2790 ± 80	Beta-38242	charcoal	Frankland 1990	3063(2846,2819)2744
	2950 ± 60	Beta-32046	charcoal	Frankland 1990	3216(3061,3050,3013)2865
Bribie Island 9	200 ± 80	Beta-56565	charcoal	Smith 1992	421(267,205,143,17,0*)0*
	3280 ± 80	Beta-56566	charcoal	Smith 1992	3634(3462)3270
Broadbeach Burial Ground	26 ± 86[c]	V-161	charcoal	Haglund 1976	278(0*)0*
	450 ± 70	ANU-67	charcoal	Haglund 1976	543(488)299
	1086 ± 91[c]	V-157	charcoal	Haglund 1976	1221(969)786
	1156 ± 110[c]	V-162	charcoal	Haglund 1976	1290(1061)796
	1290 ± 70	ANU-68	charcoal	Haglund 1976	1294(1171)982
Brooyar Rockshelter	2650 ± 60	Beta-23344	charcoal	McNiven 1988	2794(2748)2496
Brown's Road	2030 ± 70	Beta-3077	charcoal	Kelly 1982	2116(1931)1747
Bushranger's Cave	700 ± 60	Beta-42843	charcoal	Hall pers. comm.	681(648)539
	1980 ± 70	Beta-42844	charcoal	Hall pers. comm.	2009(1874)1710
	2090 ± 90	Beta-18897	charcoal	Hall & Hiscock 1988	2307(1989)1814
	3460 ± 80	Beta-44134	charcoal	Hall pers. comm.	3865(3683,3670,3638)2467
	4720 ± 100	Beta-4851	charcoal	Hall & Hiscock 1988	5607(5447,5404,5328)5050
	5540 ± 100	Beta-4852	charcoal	Hall & Hiscock 1988	6481(6294)6036
	5820 ± 110	Beta-42845	charcoal	Hall pers. comm.	6855(6624,6590,6566)6313
	8090 ± 110	Beta-42846	charcoal	Hall pers. comm.	9252(8979)8551
	9270 ± 100[d]	Beta-42847	charcoal	Hall pers. comm.	10435(10278,10261,10195)9984
Cameron Point Site 62	190 ± 50	Beta-34400	charcoal	McNiven 1991c	293(264,212,141,21,0*)0*
	950 ± 60	Beta-34401	charcoal	McNiven 1991c	937(788)675
Christmas Creek	1000 ± 70	Beta-54588	charcoal	Bonica 1992	978(913)720
	1990 ± 90	Beta-54589	charcoal	Bonica 1992	2116(1878)1635
	3270 ± 60	Beta-44841	charcoal	Bonica 1992	3577(3460)3345
Cribb Island	390 ± 50	Beta-3227	shell	Ward & Hacker 1981	modern
	1300 ± 90	Beta-3226	shell	Ward & Hacker 1981	1035(857)654
Deception Bay 1	1000 ± 140	LJ-949	shell	Kelly 1982	833(563)322
Deception Bay 2	760 ± 140	LJ-952	shell	Kelly 1982	627(420)0
Deception Bay 3	995 ± 70	SUA-1257	shell	Nolan 1986	683(558)472
Deception Bay 4	650 ± 130	SUA-1256	shell	Nolan 1986	517(280)0
Deception Bay 5	755 ± 135	SUA-1255	shell	Flood 1981	619(410)0
Double Island Point 1	160 ± 90	Beta-34059	charcoal	McNiven 1990	309(248,232,131,90,33,0*)0*
First Ridge	1150 ± 70	Beta-1946	shell	Kelly 1982	869(680)557
Fraser Island 217/15	1960 ± 110	Beta-1698	shell	Kelly 1982	1788(1510)1274
Fraser Island 796/54	1835 ± 85	Beta-1701	shell	Kelly 1982	1562(1356)1214
	1965 ± 100	Beta-1700	shell	Kelly 1982	1767(1513)1287
Fraser Island 799/54	1270 ± 80	Beta-1699	shell	Kelly 1982	970(797)649
Gatton Shelter	1090 ± 70	Beta-5897	charcoal	Morwood 1986	1070(945)788
	3030 ± 90	Beta-5898	charcoal	Morwood 1986	3375(3203,3192,3162)2876
	3820 ± 120	Beta-15811	charcoal	Morwood 1986	4508(4142,4104,4097)3831
Hope Island	1500 ± 80	Beta-20800	charcoal	Walters *et al.* 1987	1524(1331)1256
	2600 ± 70	Beta-20797	charcoal	Walters *et al.* 1987	2778(2734)2362
	3720 ± 70	Beta-20798	charcoal	Walters *et al.* 1987	4228(3984)3780
	4350 ± 220	Beta-20799	charcoal	Walters *et al.* 1987	5566(4860)4277
Kabali Road Scatter	70 ± 70	Beta-19424	shell	McNiven 1990	modern
King's Bore Site 97	2290 ± 80	Beta-30402	charcoal	McNiven 1992	2359(2314,2224,2213)2016
	3560 ± 100	Beta-25510	charcoal	McNiven 1992	4082(3824,3785,3749,3734)3488

Site	^{14}C Age	Lab. No.	Sample	Reference	Calibrated Age/s[a]
Little Sandhills	102.1 ± 0.7%	Beta-1947	shell	Robins 1983	0*(0*)0*
Maidenwell Shelter	1210 ± 100	SUA-1915	charcoal	Morwood 1986	1288(1064)918
	4300 ± 70	Beta-6924	charcoal	Morwood 1986	4980(4835)4571
Maroochy River 2	610 ± 70	Beta-27085	shell	McNiven 1989	423(260)0
Maroochy River 4	170 ± 60	Beta-27087	shell	McNiven 1989	modern
	840 ± 60	Beta-27086	shell	McNiven 1989	550(474)313
Minner Dint	520 ± 75	I-11095	charcoal	Hall 1980b	641(514)319
Moon Point	1470 ± 80	Beta-2609	shell	Kelly 1982	1206(995)841
New Brisbane Airport	1120 ± 60	SUA-2179	charcoal	Hall & Lilley 1987	1080(966)913
	3910 ± 80	Beta-23345	charcoal	Hall & Lilley 1987	4513(4277)3994
	4830 ± 110	Beta-33342	charcoal	Hall pers. comm.	5738(5577,5511,5493)5296
NE Moreton Is. 1	430 ± 60	Beta-24473	shell	Lilley & Hall 1988	modern
NE Moreton Is. 5	380 ± 60	Beta-24470	shell	Lilley & Hall 1988	modern
NE Moreton Is. 16	400 ± 60	Beta-24471	shell	Lilley & Hall 1988	modern
NE Moreton Is. 21A	320 ± 50	Beta-24472	shell	Lilley & Hall 1988	modern
NE Moreton Is. 27	440 ± 60	Beta-24474	shell	Lilley & Hall 1988	modern
NRS Site 8	470 ± 60	ANU-3336	shell	Richardson 1984	264(70,10)0
NRS Site 19	450 ± 60	ANU-3337	shell	Richardson 1984	modern
NRS Site 22	410 ± 50	ANU-3338	shell	Richardson 1984	modern
One-Tree	1620 ± 60	Beta-3073	charcoal	Hall 1982	1570(1491,1472,1440,1419)1328
Platypus Rockshelter	560 ± 60	Beta-3076	charcoal	Kelly 1982	643(529)476
	2420 ± 90	I-11094	charcoal	Kelly 1982	2736(2352)2151
	2480 ± 70	Beta-3075	charcoal	Kelly 1982	2743(2460,2384,2377)2334
	3850 ± 170	SUA-1502	charcoal	Kelly 1982	4809(4221,4207,4153)3698
	4540 ± 80	Beta-3074	charcoal	Hall & Hiscock 1988	5444(5246,5186,5122,5056)4867
Polka Point	765 ± 45	V-22	charcoal	Bermingham 1966	719(663)567
	1560 ± 80	Beta-28487	shell	Neal 1989	1279(1107)924
	1750 ± 90	Beta-28488	charcoal	Neal 1989	1826(1603,1590,1576)1402
	3020 ± 100	Beta-24540	charcoal	Neal 1989	3380(3200,3197,3154)2860
Saint-Smith Midden	260 ± 60	Wk-3424	charcoal	Hall 1995	430(284)0*
	960 ± 60	Wk-3423	charcoal	Hall 1995	940(886,875,823,817,791)693
Sandstone Point	103 ± 0.8%	Beta-15808	charcoal	Nolan 1986	modern
	320 ± 50	Beta-15806/A	charcoal	Nolan 1986	469(303)0*
	340 ± 50	Beta-15806/B	charcoal	Nolan 1986	479(309)0*
	500 ± 50	SUA-2358	charcoal	Walters 1987	546(509)334
	620 ± 95	SUA-478	charcoal	Kelly 1982	674(550)472
	740 ± 50	SUA-2357	charcoal	Walters 1987	705(657)554
	740 ± 80	Beta-15809	charcoal	Nolan 1986	737(657)539
	780 ± 95	SUA-479	charcoal	Hall 1982	899(666)542
	810 ± 80	Beta-16837	charcoal	Nolan 1986	899(672)557
	1190 ± 100	Beta-15805	charcoal	Nolan 1986	1283(1059)800
	1500 ± 110	Beta-15807	charcoal	Nolan 1986	1554(1331)1167
	1600 ± 80	Beta-16838	charcoal	Nolan 1986	1611(1412)1296
	1990 ± 60	Beta-15810/A	charcoal	Nolan 1986	2000(1878)1726
	2290 ± 100	Beta-15810/B	charcoal	Nolan 1986	2469(2314,2224,2213)1990
Seary-Broutha Site	100.5 ± 0.9%	Beta-19423	shell	McNiven 1990	modern
Spitfire Creek	450 ± 70	SUA-2082	shell	Neal 1984	modern
	560 ± 70	SUA-2081	shell	Neal 1984	331(230)0
St Helena Island	1370 ± 60	Beta-6140	shell	Alfredson 1984	1050(916)754
	2240 ± 70	Beta-6141	shell	Alfredson 1984	2008(1834)1647
Talgai Skull	4560 ± 70	R2526/13	soil	Hendy *et al.* 1973	5444(5258,5176,5135,5075)4875
	4730 ± 40	R2040/4	carbonate	Hendy *et al.* 1973	5573(5450,5373,5330)5307
	7890 ± 110	R2526/17	soil	Hendy *et al.* 1973	8985(8560)8377
	8300 ± 115	R2526/21	soil	Hendy *et al.* 1973	9480(9242)8955
	9160 ± 85	R2618/1	carbonate	Hendy *et al.* 1973	10298(10037)9936
	9530 ± 335	R2526/25	soil	Hendy *et al.* 1973	11896(10534,10519,10479)9867
	9590 ± 490	R2526/33	soil	Hendy *et al.* 1973	12463(10794,10758,10560)9494
	9790 ± 60	R2040/5	carbonate	Hendy *et al.* 1973	11005(10967)10682
	11650 ± 100	R2618/2	carbonate	Hendy *et al.* 1973	13851(13538)13285
	12400 ± 300	R2526/29	soil	Hendy *et al.* 1973	15406(14450)13681
Teewah Beach 5D	100.1 ± 0.9%	Beta-19422	shell	McNiven 1990	modern
Teewah Beach 26	340 ± 70	Beta-30401	charcoal	McNiven 1991a	504(309)0*
	950 ± 100	Beta-25511	charcoal	McNiven 1991a	984(788)659

Site	^{14}C Age	Lab. No.	Sample	Reference	Calibrated Age/s[a]
Teewah Beach 26	1070 ± 70	Beta-30399	charcoal	McNiven 1991a	1065(936)782
	3140 ± 100	Beta-30400	charcoal	McNiven 1991a	3540(3341,3281,3278)2994
	4780 ± 80	Beta-25512	charcoal	McNiven 1991a	5642(5562,5549,5468)5299
Tin Can Bay 75B	700 ± 70	Beta-19421	shell	McNiven 1991c	485(313)158
Toulkerrie	310 ± 80	Beta-32049	charcoal	Hall & Bowen 1989	502(299)0*
	350 ± 80	Beta-32796	charcoal	Hall & Bowen 1989	512(312)0*
	370 ± 75	I-11096	charcoal	Hall 1982	515(425,392,319)0*
	2150 ± 80	Beta-32048	charcoal	Hall & Bowen 1989	2323(2063)1878
	2290 ± 80	Beta-32047	charcoal	Hall & Bowen 1989	2359(2314,2224,2213)2016
Wallen Wallen Creek	1070 ± 50	SUA-2461	shell	Neal & Stock 1986	719(637)530
	1230 ± 50	SUA-2465	shell	Neal & Stock 1986	906(755)654
	1520 ± 70	SUA-2236	shell	Neal & Stock 1986	1241(1058)911
	2120 ± 70	SUA-2462	charcoal	Neal & Stock 1986	2303(2007)1874
	4290 ± 90	SUA-2466	charcoal	Neal & Stock 1986	5027(4833)4531
	6950 ± 80	SUA-2343	charcoal	Neal & Stock 1986	7693(7673)7656
	9760 ± 140[d]	SUA-2467	charcoal	Neal & Stock 1986	11319(10957)10390
	9810 ± 130[d]	SUA-2251	charcoal	Neal & Stock 1986	11488(10977)10480
	11990 ± 70[b]	SUA-2344R	charcoal	Neal & Stock 1986	14233(13931)13672
	13040 ± 220[d]	SUA-2463	charcoal	Neal & Stock 1986	16113(15437)14661
	13650 ± 240[d]	SUA-2342	charcoal	Neal & Stock 1986	16925(16307)15609
	16420 ± 260[d]	SUA-2464	charcoal	Neal & Stock 1986	20044(19279)18712
	17500 ± 900[d]	SUA-2235	charcoal	Neal & Stock 1986	18549(20770)0*
	20560 ± 250[d]	SUA-2341	charcoal	Neal & Stock 1986	no calibration possible
Webber Swamp 100	101.1 ± 0.8%	Beta-19425	shell	McNiven 1990	modern
White Patch Site 3[e]	450 ± 90	SUA-480	charcoal	Crooks 1982	553(488)287
	670 ± 95	SUA-481	charcoal	Crooks 1982	721(640,597,565)504

Notes

a Dates were calibrated using the following procedure (after Stuiver and Reimer 1993):

1. Conventional radiocarbon ages were calibrated using the CALIB (Version 3.03c) computer program (Stuiver and Reimer 1993).
2. Atmospheric samples were calibrated using the bi-decal atmospheric calibration curve with no laboratory error multiplier. 40 years was subtracted from atmospheric samples to correct for ^{14}C variations between northern and southern hemispheres.
3. Marine samples were calibrated using the marine calibration model with a ΔR regional correction value of -5.0 ± 35.0 (Stuiver and Braziunas 1993).
4. The calibrated ages reported span the 2 sigma calibrated age range.

b Excluded from analysis. See text.

c These dates were corrected for isotopic fractionation using a correction estimate of -24 ± 2, as recommended by Stuiver and Reimer (1993).

d Excluded from analysis – calibrated age/s over 10,000 BP. See text.

e Also referred to in the literature as Bribie Island Site 3.

0* Represents a 'negative' or 'modern' age BP.