HOLOCENE MANGROVES AND MIDDENS IN NORTHERN AUSTRALIA AND SOUTHEAST ASIA

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INTRODUCTION

In a recent paper in Nature announcing the presence of extensive mangrove swamp in northern Australia between c.7000 and 6000 BP, Woodroffe et al. (1985c:713) argue that the mangroves were succeeded by open floodplains with tidal river channels by c.5500 BP. Evidence from archaeological sites in the Alligator Rivers area of northern Australia suggest that mangrove swamps were an important source of food for Aborigines in the region until c.3000 BP. Changes in the location and content of middens after that date are in accord with the geomorphological evidence for the replacement of mangrove swamps away from the tidal river channels by open saline flats (Fig. 1).

Geomorphological and archaeological studies in southeast Asia indicate that mangroves and associated middens were widespread during mid-Holocene times. These southeast Asian middens show similarities with the north Australian archaeological evidence. At least until c.5000 BP, the Aborigines of northern Australia shared in a general, if diverse, southeast Asian pattern of economy and technology.

HOLOCENE MANGROVES IN NORTH AUSTRALIA

Since 1969, evidence for Holocene environmental change on the coastal plains of northern Australia has strengthened, although detailed knowledge and direct dating have only recently become available.

Williams (in Story et al. 1969:74-5) noted that the coastal plains of the Alligator Rivers region

> ...consist mainly of exposed estuarine sediments laid down in drowned river valleys. ...buried mangrove layers are known to occur sporadically. Throughout the plains, several feet of freshwater clays have been deposited over the gleyed estuarine or coastal muds and clays, and each year the plains are flooded to depths of up to 6ft for up to 6 or 8 months.

Borings on a bare tidal salt flat in the Fitzroy Estuary of northwestern Australia indicated a much wider extent of mangrove swamps at about 6000 BP than at present. Jennings (1975:252) suggested that a significantly longer and heavier rainy season than now would be required to support this mangrove growth.

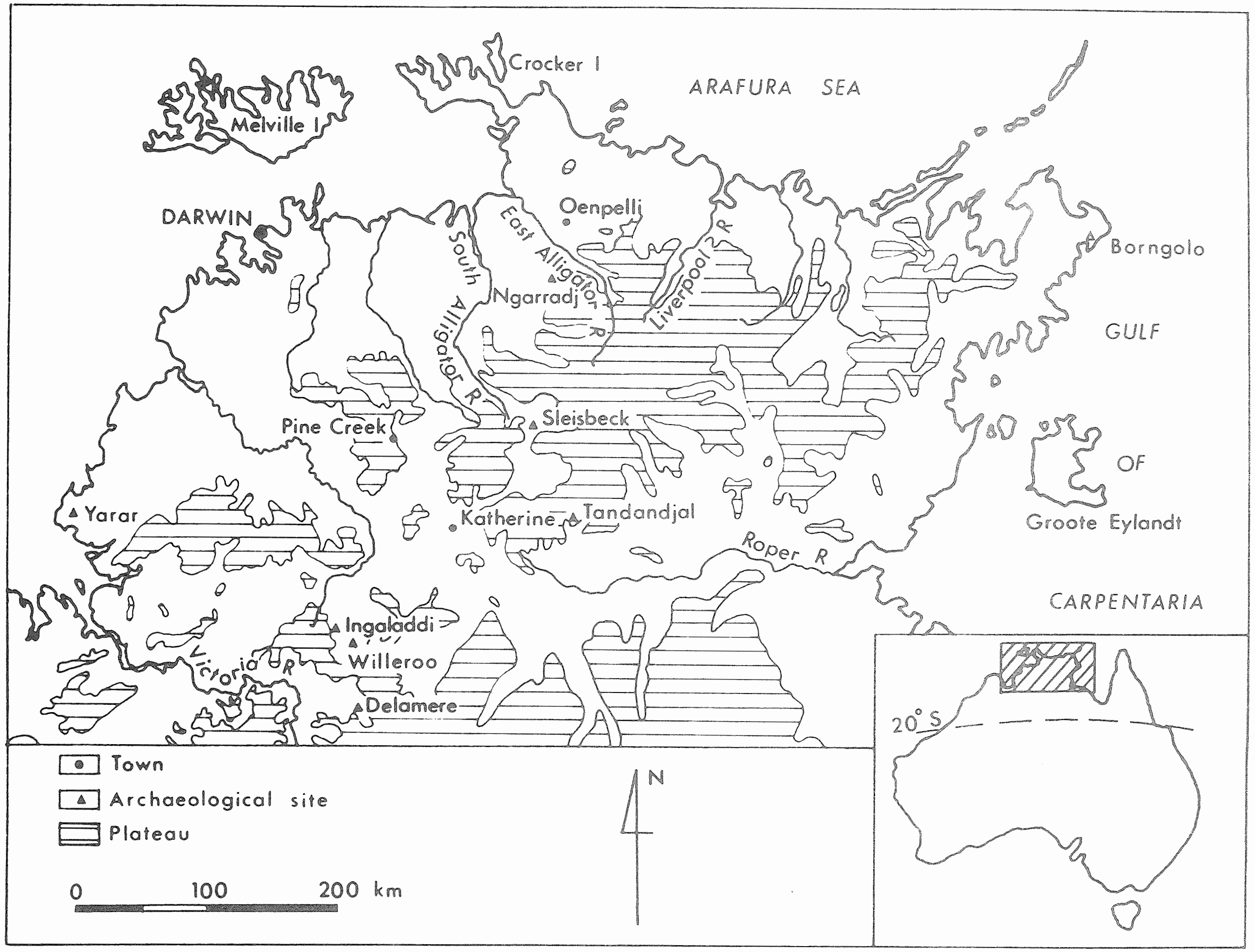


Figure 2. Archaeological sites in the north of the Northern Territory, Australia.

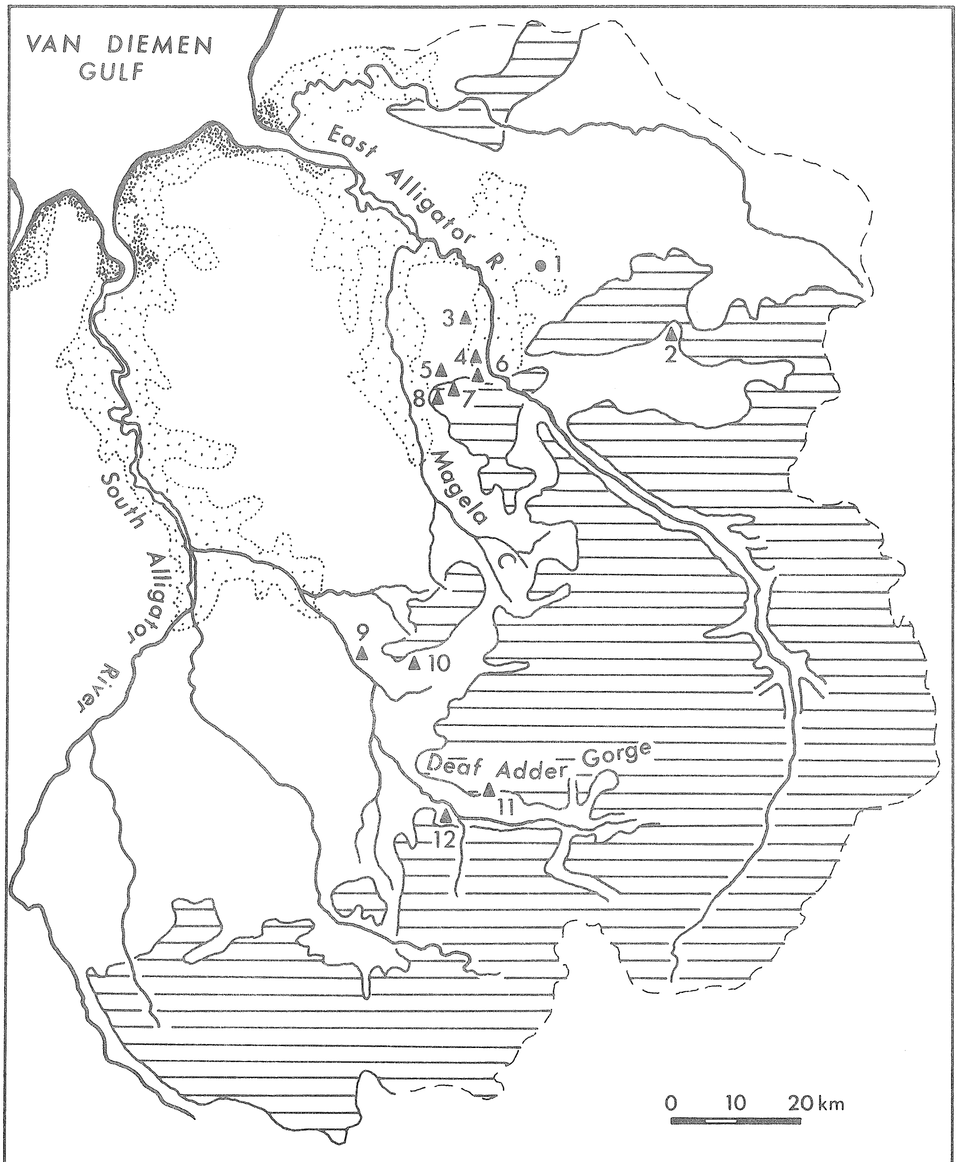


Figure 2. Archaeological sites and environmental sub-regions, western Arnhem Land.

Thom *et al*. (1975) found that large areas of the Ord River estuary in the Cambridge Gulf had been covered with mangroves between 6-7000 years BP prior to their replacement by bare mud-cracked high-tidal flats at about 5000 BP. They explained the change in mangrove distribution in terms of slightly higher sea levels and coastal progradation (Thom *et al*. 1975:228).

Geomorphological work by Woodroffe *et al*. (1985a and b) and Hope *et al*. (1985) on the South Alligator River has conclusively demonstrated that a series of local changes in the landscape and ecology of the South Alligator plains (Fig. 2), involving the distribution of mangroves, has taken place since the early Holocene. It is argued that extensive areas of the coastal plains of northern Australia were previously covered with mangrove forest. This forest was most widespread in the South Alligator system between 5500 and 6800 years BP (Woodroffe *et al*. 1985b). They present 42 C14 dates to support their case!

Combining data from Woodroffe *et al*. (1985b) and Hope *et al*. (1985) it is possible to distinguish three phases in the recent environmental history of the South Alligator floodplain ending with the conditions present there today (Table 1).

AGE YR BP	RIVER CHANNELS	FLOODPLAIN
0 - 1500	mangroves absent or rare, levees built up	seasonally flooded wetlands and/or grasslands
2500-4000	mangroves on point bars and meanders	bare salt flats and grasslands
4500-7000	mangrove swamp phase	extensive mangrove forests

Table 1: Environmental changes in the South Alligator floodplain 7000 - 0 BP.

Once rising sea levels drowned the pre-existing valley system, it is argued, the embayments silted up rapidly and were colonised by extensive areas of mangroves. This big mangrove swamp phase terminated abruptly when sedimentation choked the mangroves out leaving them restricted to the marginal riparian forests (Woodroffe *et al*. 1985b: 27-9). Around 3000 BP, the floodplain behind this mangrove fringe consisted of saline plains. By about 1400 BP, however, further siltation and the creation of levee banks along the river allowed non-saline grassland to invade the floodplain. Fresh-water wetlands and black-soil plains then built up in the upstream areas (Hope *et al*. 1985:237).

Various explanations for these changes in sedimentation rates and local ecology have been put forward, including a fall in sea level, changes in climate and river discharge, an increase in Aboriginal burning, and coastal progradation. In this context the ultimate causes of these changes are less important than their effects on Aboriginal settlement and subsistence patterns.

ARCHAEOLOGICAL SHELL MIDDENS IN THE ALLIGATOR RIVERS AREA

Shell middens in western Arnhem Land dated to the mid-Holocene period occur in small rockshelters which cluster around the inland margin of the East Alligator - Magela Creek floodplain. They occur at Arguluk Hill near Oenpelli township, Nawamoyn, Malangangerr, Paribari, Ngarradj Warde Djobkeng, and Malakunanja II (see Fig. 2).

A feature of the shell middens at these sites is the predominance of mangrove/mudflat shellfish species found in them. The major midden species are listed in Table 2.

POTAMIDIDAE	:	*Cerithidea anticipata* *Telescopium telescopium*
ELLOBIIDAE	:	*Cassidula angulifera* *Cassidula rugata* *Ellobium aurisjudae*
NERITIDAE	:	*Neritina crepidularia*
GELOINIDAE	:	*Geloina coaxans*

Table 2: Mangrove/mudflat shellfish species from western Arnhem Land sites (from Schrire 1982:51).

The small climbing snail *Cerithidea anticipata* and the bivalve *Geloina coaxans* form up to 95% of the shellfish in these middens. Another common midden component is the claws of small crabs (cf. *Sesarma sp.*). The known ecological requirements of these shellfish and crab species indicate that the Aboriginal occupants of these sites were collecting from the landward fringe of an estuarine mangrove/mudflat swamp subject to tidal inundation.

C14 dates from the lower levels of these middens suggest that shellfish collecting from mangrove swamps commenced at about the same time as sea levels reached approximately their present height by about 7000 BP (Table 3).

SITE	DATE	LAB. NO.
Nawamoyn	7110 ± 130	ANU-53
Malangangerr	5980 ± 140	GaK-627
Malakunanja II (charcoal)	6355 ± 250	SUA-264
Malakunanja II (shell)	6360 ± 100	SUA-264/S1

Table 3: C14 dates from the lower midden levels at western Arnhem Land sites.

Dates from recent, intrusive charcoal from the surface layers of these sites have been interpreted as evidence that mangrove/mudflat shellfish collection persisted in the area until c.500 BP. However, a new series of dates on the shellfish themselves, plus charcoal dates from within the upper midden layers, indicates that the collection of such shellfish had ceased by c.3000 BP (Table 4).

SITE	DATE	LAB. NO.
Paribari (charcoal)	3210 ± 100	ANU-17
Ngarradj Warde Djobkeng (shell)	3760 ± 70	SUA-2246
Ngarradj Warde Djobkeng (shell)	3980 ± 50	SUA-2295
Ngarradj Warde Djobkeng (shell)	3600 ± 60	SUA-2409
Ngarradj Warde Djobkeng (charcoal)	3990 ± 195	SUA-225
Malakunanja II (shell)	4050 ± 50	SUA-2264
Malakunanja II (shell)	4680 ± 110	SUA-263/S1

Table 4: C14 dates for the upper levels of mangrove/mudflat shell middens at western Arnhem Land sites.

There appears to be a high level of correlation between the archaeological evidence for the collection of mangrove/mudflat shellfish and crabs between 7000 and 3000 BP and the geomorphological evidence for the local widespread occurrence of mangroves. After 3000 BP, sites such as Nawamoyn, Malangangerr, Ngarradj Warde

Djobkeng and Malakunanja II were no longer used as base camps and shellfish dumps.

Shell midden sites dated younger than 3000 BP are located on the coastal plains themselves rather than around the fringes of the floodplains. Such middens occur on the South Alligator River floodplain at Bullocky Point (M. Smith, pers. comm.), at Point Stuart and Sampan Creek on the Mary River coastal plain (Baker 1981), and further afield on the Blyth River plains in central Arnhem Land (Meehan 1983). While mangrove or estuarine shellfish occur in these middens, particularly *Geloina sp.*, and *Telescopium telescopium*, the climbing snail *Cerithidea anticipata* is either entirely absent or present only in tiny numbers. The different location and composition of shellfish middens younger than 3000 BP, compared with the older middens around the fringes of the floodplains, is consistent with a marked reduction in the extent of mangrove cover in the region since that date. The middens document recent changes in Aboriginal subsistence patterns and seasonal movements.

MID-HOLOCENE MANGROVES AND MIDDENS IN SOUTHEAST ASIA

Woodroffe *et al.* (1985b-24-9) explain the sequence of geomorphological changes in the South Alligator floodplain by reference to progradational processes. Similar changes documented elsewhere in southeast Asia have been used as evidence of higher Holocene sea levels.

Studies on the Holocene stratigraphy of the Longhai floodplain near Zhangzhou, southern Fujian, document a sequence of terminal Pleistocene terrestrial deposits lying beneath dark-grey marine muds dating from 8000-2500 BP. Wood within the marine mud layer was dated to 5660 ± 90 BP. The last 2500 years have seen the build up of 1 to 2 m of alluvial clay on top of these marine muds with smaller rivers flowing in former tidal channels and freshwater peats developing in the ancient bays and lagoons (Baolin *et al.* 1983:405-6).

The presence of mangrove wood and roots, dating between 4000 and 6600 BP, situated on top of Pleistocene terrestrial deposits near Port Dickson in the Straits of Malacca, has been interpreted as documenting the post-glacial rise in sea level during the mid-Holocene (Geyh *et al.* 1979:441-3).

A site with mangrove/mudflat shellfish 22 km from the present-day coastline occurs at Khok Phanom Di, in eastern Thailand (Pornchai 1984:1-13). Shellfish from this site, particularly *Anadara nodifera*, *Cerithidea obtusa*, and *Geloina ceylonica*, and also mangrove crabs *Scylla serrata* have been dated to 3530 ± 280 BP (RL-1202) (Pornchai 1984:1-13). Higham *et al.* suggest that Khok Phanom Di was initially occupied from between 7000-6000 BP until 3000 yr BP, after which there was a decline in sea level and mangroves disappeared from the vicinity of the site.

Hoabinhian shellmounds with mangrove/mudflat shellfish (cf. Bellwood 1985:174 re. misidentified shellfish species) located between 15 and 20 km inland have been recorded in Sumatra, Malaysia, and Vietnam (Bellwood 1985:162-74, Dunn 1975:124, Gorman 1971:310, Heekeren 1972:86-88). Bellwood estimates that these sites date between 10,000 and 3000 BP. One Hoabinhian shellmound at Sukajadi Pasar in North Sumatra returned a date of 7340 ± 360 BP (SUA-1107) from the lower 1/3 of the deposit (Bronson and Glover 1984:43). Most of these large shellmounds have now been quarried away for lime burning.

Finally, Glover (1986:40-43) reports an increase in mangrove molluscs from about 5500 to 4500 years ago in East Timor middens, and also reports small numbers of the mangrove species _Anadara sp._, _Geloina sp._, and _Telescopium telescopium_ at Ulu Leang in South Sulawesi between 3500 and 7000 BP. These indicate the existence of mangrove swamps within reach of this now-inland site.

The point of bringing these scattered geomorphological and archaeological references together is to draw attention to the fact that river valleys which adjoin low-energy coasts in monsoon south-east Asia appear to have experienced changes similar to those documented by Woodroffe _et al_. (1985a,b, and c) for northern Australia. This sequence suggests that river valleys flooded by the post-Pleistocene rise in sea levels were subject to rapid siltation, followed by a period of tidal conditions when the muds in these infilled valleys were covered with mangrove forests. Finally, there was a buildup of alluvial or terrestrial deposits which lifted these floodplains above the tidal limit and freshwater swamps developed.

Woodroffe _et al_. (1985c:711-13) see the growth of the mangrove forests as a result of the interaction of sea level changes and river sedimentation. They interpret the subsequent development of floodplains and tidal river channels as a response to sedimentary infill rather than reflecting changes in rainfall, river flow or sea levels.

ARCHAEOLOGICAL DISCUSSION

Schrire (1982:73) argues that the faunal contents of the western Arnhem Land midden sites point

> ...to prehistoric human foraging in mudflats..., freshwater streams and lagoons, ...marshes and swamps..., woodlands, ... and monsoon forest thickets... .

Making allowance for the different land mammals existing in Australia, Aboriginal subsistence patterns in the north of the continent between 7000 and 3000 BP as described by Schrire would appear to conform with the model of broad spectrum hunting, fishing and gathering put forward by Gorman to explain Hoabinhian patterns of coastal exploitation in southeast Asia. In this model, several environmental niches were exploited from a single base camp (Gorman 1971:315).

Gorman stresses that the Hoabinhians were acquainted with many plant species either tended or domesticated in present-day southeast Asia (Gorman 1971:316). This is also true of Arnhem Land and Cape York Aborigines. Golson's analyses (1971:209) have shown that:

> ...not only a notable component of the food genera [used by the Aborigines] of Arnhem Land and Cape York...[contains] species that are cultivated in Malaysia, but also...these genera [show] a much higher degree of similar use between Australia and Malaysia than is exhibited by their shared food genera taken as a whole.

Food species such as Dioscorea sp. and Colocasia sp. figure prominently in these food lists.

In addition to wooden spear shafts and points, spear throwers, pipes, and fragments of string, mats and baskets, the following food plants were recovered from midden deposits at Paribari in western Arnhem Land (Schrire 1982:58-65):

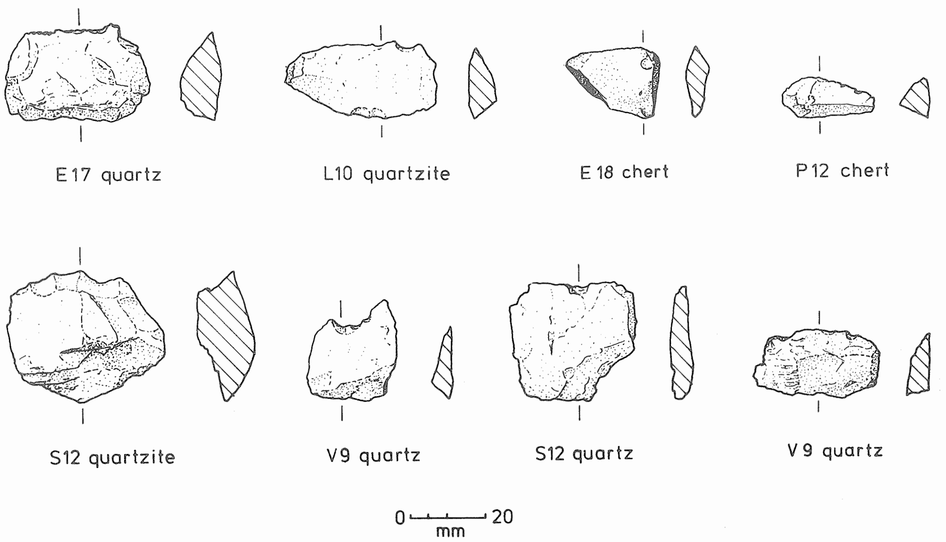
Livistona humilis
Eleocharis dulcis
Nelumbo nucifera
Cycas media
Terminalia ferdinandiana
?Triglochin sp.

However, it is not known whether use of the plants listed above, which belong to genera present in the Malaysian region, goes back as far as 3000 BP.

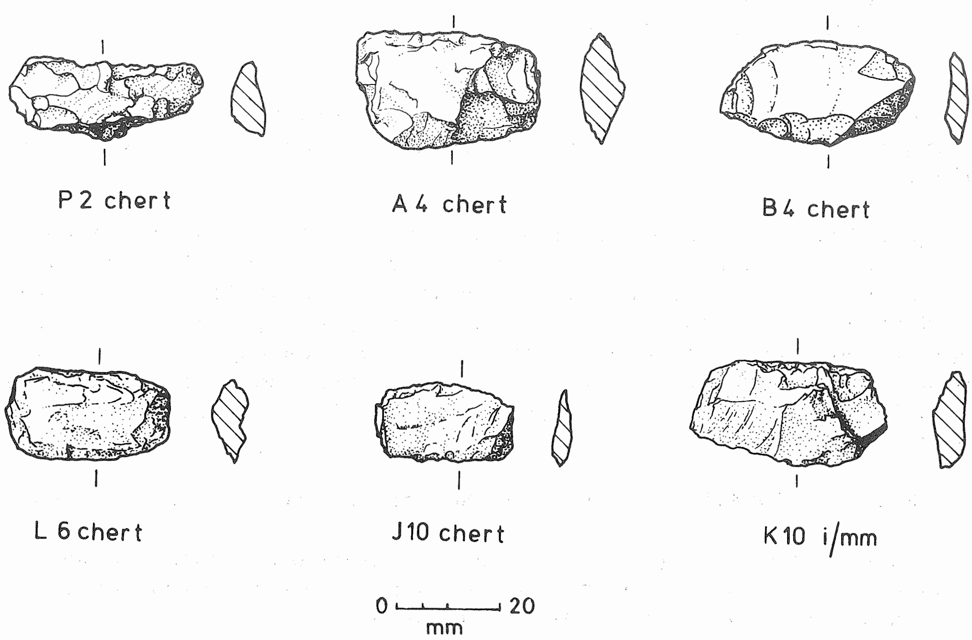
The lower layers of mangrove/mudflat shell middens in western Arnhem Land contain chert and quartz cores and simple flakes (Fig. 3), in association with small bone points and spatulas, shell scrapers, grinding and pounding stones, ground ochre pieces, and small lenticular edge-ground axes. The same elements occur in the upper midden levels dated 5000-3000 BP, but there they are accompanied by small unifacial and bifacial stone projectile points and rectangular scrapers (Figs. 4 and 5).

Soejono (1984:56-7) describes Hoabinhian sites as containing

> ...crude stone scrapers and cleavers, grinding stones, as well as objects of wood and bamboo. The upper strata include axes with ground edges and cord-marked pottery.



<u>Figure 3</u>. Utilised flakes, layers IV-VI, Ngarradj Warde Djobkeng.



<u>Figure 4</u>. Rectangular scrapers, layers I-III, Ngarradj Warde Djobkeng.

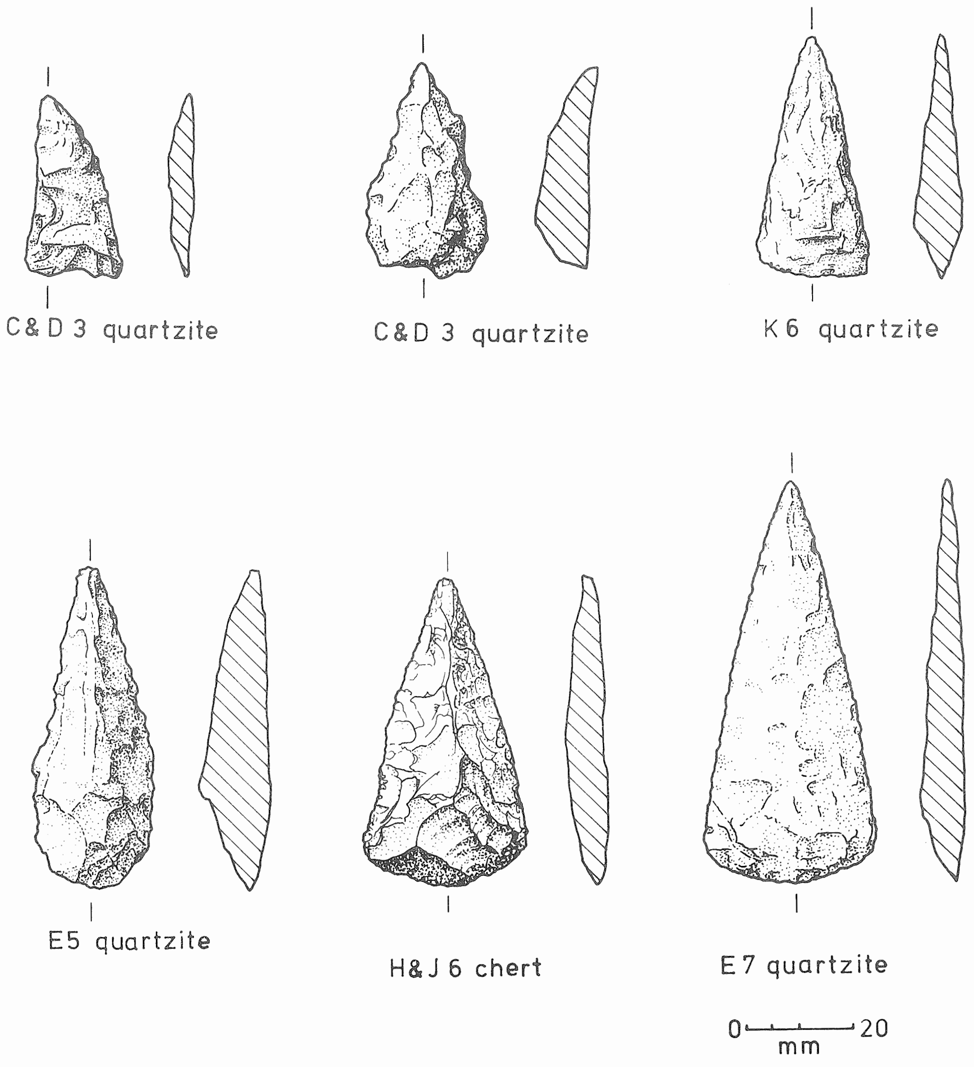


Figure 5. Points, Layers I-II, Ngarradj Warde Djobkeng.

Elsewhere in Indonesia, Glover (1973:61) notes that various flake and blade industries developed there in isolation until about 5000 BP when

> ...new elements such as pottery, more specialised tool forms, domesticated and imported animals appear in the deposits, signalling perhaps either immigration or widespread diffusion of new cultural orientations.

Amongst the specialised stone implement forms referred to, he includes Maros points from South Sulawesi, which first appear in deposits dated between 6000 and 5500 BP (Presland 1980:39), tanged points in East Timor by 5000 BP (Glover 1977:275), and the undated hollow-based points from central Java.

These specialised tool forms in Indonesia, and the small unifacial and bifacial points in northern Australia, appear at about the same time - c.5000-6000 BP. While these artifacts can all be classified as 'projectile points', they represent quite dissimilar artifact forms. Furthermore, their archaeological contexts vary. Pottery, fishhooks, shell adzes and domesticated animals are present in Timor at the same time that wild plant foods and animals continued to be collected in parts of South Sulawesi, and in northern Australia (Glover 1977:275-80, 285-6).

While there is no direct historical evidence for contact between these areas, Glover (1977:280) interprets the changes in Timor as reflecting

> ...the arrival in the island about 3000 b.c. of agricultural immigrants from the west or north, bringing Timor into a closer relationship with neighbouring islands.

Bellwood regards the expansion of Austronesian-speaking peoples throughout the region between 3000 and 1000 BC as being responsible for the major biological, linguistic and cultural changes in the prehistory of the archipelago (Bellwood 1985:320).

However, a degree of economic and cultural differentiation was already present in the southeast Asian region prior to 5000 BP. Higham et al.(1986) suggest that the people at Khok Phanom Di, near the Gulf of Thailand, possessed cord-marked pottery, fish hooks and nets, buried their dead with grave goods, imported stone adzes, exchanged shell beads, and probably possessed rice agriculture between 6000 and 5000 BP. Furthermore, agriculture appears to have developed independently in Papua New Guinea and may also have been part of later Hoabinhian adaptations in Malaysia and Indonesia.

The distinctiveness of northern Australian Aboriginal social institutions and of their hunting and gathering economy is usually explained as the outcome of tens of thousands of years of adaptation in isolation to the Australian environment. The evidence from western Arnhem Land increasingly suggests that the Aborigines of northern Australia shared in a general, if diverse, southeast Asian pattern of economy and technology until about c.5000 BP.

After c.5000 yr BP, historical changes associated with the expansion of Austronesian-speaking peoples altered the pre-existing regional economic and social patterns, thereby accentuating the distinctiveness of the north Australia Aboriginal way of life.

Although the northern Australian Aborigines continued as hunter -gatherers after this time, Aboriginal culture did not remain static. In addition to influences from central Australia, the Aborigines in northern Australia, like other hunting and gathering peoples in inland, mountainous or isolated island locations in southeast Asia, shared in some of the innovations which were transforming the region: the domestic dog, outrigger canoes, and fishhooks, among other things which were introduced after 5000 BP (Jones 1980:138-43, White 1971: 192).

Changes in the environment, subsistence patterns, and social institutions of western Arnhem Land continued after 3000 BP (Jones ed. 1985:291-4). Social and economic change may have accelerated when Makassan and Bugis sailors established regular contact with northern Australia sometime in the past 500 years.

Like the non-Austronesian speaking peoples of Papua New Guinea, the Aborigines of northern Australia were affected by these changes, but they were not culturally overwhelmed by them. The items of material culture and cultural practices borrowed from southeast Asia were largely incorporated within existing economic and social patterns (Berndt and Berndt 1947-8:311).

The archaeological evidence for the period 10,000-3000 BP remains sketchy on both sides of Wallace's Line. It deserves greater attention than it is presently receiving as it is a period that is crucial for the understanding of subsequent historical developments in southeast Asia and Australia, up to and including those of the present day.

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