



NEW ZEALAND JOURNAL OF ARCHAEOLOGY



This document is made available by The New Zealand Archaeological Association under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

To view a copy of this license, visit
<http://creativecommons.org/licenses/by-nc-sa/4.0/>.

Prehistoric Ecology and Economy in the Port Moresby Region

Susan Bulmer

Anthropology Department, University of Auckland

ABSTRACT

Three prehistoric communities in the Port Moresby area have been found to have unspecialised hunting, fishing, gardening and collecting economies from 2,000 years ago until the 16th century A.D. They are compared to Motupore, a settlement on an offshore island, thought to have had a specialised trading economy from A.D. 1100 until the 17th century. Archaeological evidence for prehistoric trade and economic change is questioned. Changes in settlement distribution following the 16th century suggest that an increased dependence on trade may relate to this later period. Possible reasons why specialised trading may have been a local development, rather than an introduction, are discussed.

Keywords PAPUA-NEW GUINEA, PORT MORESBY, PREHISTORIC, PROTOHISTORIC, ENVIRONMENT, UNSPECIALISED ECONOMIES, TRADING, ECONOMIC CHANGE.

INTRODUCTION

The Port Moresby region offers its human inhabitants a distinctive ecological situation in Melanesia, a countryside of savannah and grassland together with a relatively low and highly seasonal rainfall. Thus it resembles parts of northern Australia more than it does most of lowland tropical Papua New Guinea. There were a number of other savannah regions in lowland Papua New Guinea and elsewhere in the Pacific. The question can be raised as to what the resources were in these zones and what use was made of them in prehistoric times. People of different prehistoric¹ periods may have had different cultural preferences and technologies, and these must be taken into account.

In Papua New Guinea, during the recent past, such savannah areas have characteristically been occupied by specialised trading people, such as the Motu of Port Moresby and the Sio of the Madang Province. Such traders could make use of areas with relatively poor agricultural potential by manufacturing pottery and other goods for exchange for food, and by acting as middlemen trading in other commodities. Another characteristic ecological position of such "commercial" traders in Papua New Guinea is on small off-shore islands lacking garden land; such groups typically made shell ornaments (Lewis 1929:15) or pottery to exchange for food and other mainland supplies.

This paper discusses new archaeological evidence from the Port Moresby region in order to consider the ecological conditions of the ceramic-using communities of the region over the past 2,000 years, and to search for the origins of the specialised economy of the proto-historic residents of the area. Previous discussions (Bulmer 1971, 1975; Allen 1976, 1977a, 1977b) were based only on preliminary information from the archaeological excavations, and therefore the issues can now be re-examined.

LANDSCAPE AND CLIMATE

The area considered in this paper consists of about 700 km² of low altitude coastal plains, abutting at only about 30 m a.s.l. the foothills of the Owen Stanley Ranges. This is the domain of the Western Motu and Koita language groups, well known in ethnographic literature (e.g. Seligman 1910; Groves 1954, 1960, 1972). The area is bordered on the north by the Laloki River and extensive river swamps and plains. It contains only one large expanse of open fresh water, the Waigani Swamp, the remaining swampland being shallow water or seasonally inundated up to 1-2 m a.s.l. There are no other perennial

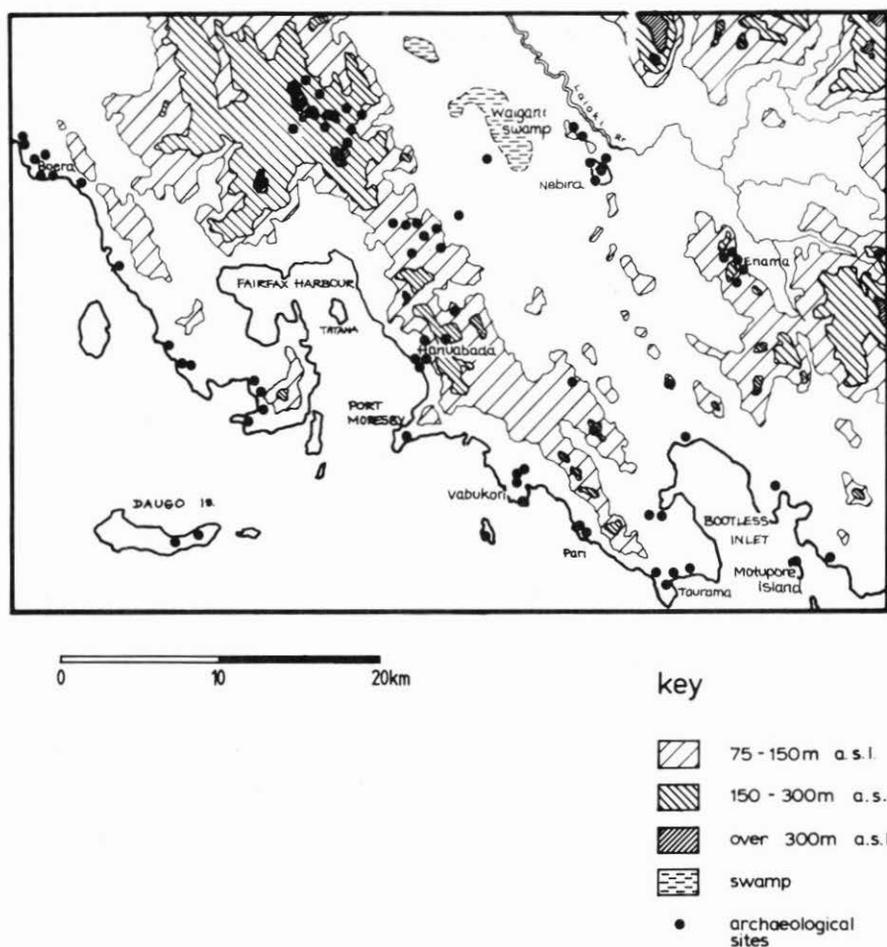


Figure 1 Distribution of archaeological sites in the Port Moresby area.

water courses in the area, other than the Laloki, and permanent water supplies are likely to have been important to prehistoric communities, with only small springs in the coastal hills and near the beaches at certain localities.

The Port Moresby region (Figure 1) includes a series of parallel ridges, the highest of which forms a coastal range of hills up to 400 m high. The ridges were important in their contribution to the local climate, running parallel to prevailing northwest-southeast winds, and allowing much of the moisture-rich winds and clouds to pass the Port Moresby area by (Fitzpatrick 1965:84). Certain peaks in the range and of lower ridges next to the river plains, at Nabira and Eriama, were used as prehistoric settlement sites. This according to oral histories was for defensive reasons.

The annual rainfall varies from about 80 cm in the southwest, near Fairfax Harbour, from 100-125 cm in the plains and ridges, and up to 150 cm in the foothills to the north and east. Most of this rain falls during the northwest monsoon season, when warmer humid conditions prevail between November and mid-April. With brief "doldrum" periods of transition between, a cooler dryer period prevails from about April to November or December. In some months less than 2.5 cm of rain falls, and there is

considerable variation in the seasonal patterns from year to year. Temperatures range generally from about 18-35°C and humidity from about 74 to 82%. With the variation in rainfall there are sometimes conditions of drought on the coast and plains, offering relatively unfavourable conditions for plant growth.

FOREST AND GRASSLAND

The character of the vegetation of the Port Moresby area (Heyligers 1965, Mabbutt 1965) is related not only to the local climate, but also to the effects of human activity, particularly fire. The vegetation has been divided into six main types by Mabbutt (1965:17): mixed herbaceous vegetation, grassland, savannah, palm and pandanus vegetation, scrub and thicket, and forest.

In the coastal hills the low rainfall and mainly shallow or fine textured droughty soils are responsible for the presence of savannah vegetation, semi-deciduous thicket, and strongly deciduous forest. Hill tops are in many cases covered by *Themeda* grassland, while steeper slopes and valleys characteristically have *Eucalyptus-Themeda* savannah with some remnant forest and thicket indicating that the savannah and grassland are the result of human activity, and that much if not all of the area was formerly forested (Eden 1974:108).

The littoral plains also reflect low rainfall and droughty soils, with semi-deciduous thicket on sandy beach ridges. Mid-height and low evergreen forests occur on flats with tidal inundation. The permanent swamps have, apart from the one area of open water mentioned, vegetation ranging from mixed herbaceous vegetation to tall grasslands (*Phragmites-Saccharum robustum*). Seasonal swamps largely bear mid-height evergreen thicket.

The fluvial plains in the Port Moresby area bear *Eucalyptus-Themeda* savannah in areas that presumably carried mainly semi-deciduous forest formerly, and *Imperata* grasslands in the more moist low-lying areas. Although the savannah and grassland vegetation are thought to be predominantly anthropogenic, there may have been some natural savannah and grassland when human interference began in this area. However, the former extent of these vegetation zones is not known. At the rate of expansion recorded in the recent past (Eden 1974), the present savannah and grasslands could plausibly have been created in the two thousand years during the occupation of the region by pottery-using people.

On the other hand, some of this vegetation could be a result of much earlier human intervention, not in clearing for gardens, but in maintaining grasslands as hunting territory. During the generally colder and dryer climate of the glacial periods, the savannah and grassland vegetation is thought to have been much more extensive, and, on the basis of animal distributions, at some period was continuous all around the coast of Papua (J. I. Menzies: pers.comm.). At the end of the Pleistocene the area of this vegetation would have reduced as a result of rising temperatures and increasing precipitation, as well as the rising sea levels (Peterson and Hope 1972, Mabbutt *et al.* 1965). If hunters were already in the habit of burning grass as a hunting technique, this could have maintained grasslands in areas that would otherwise have regenerated into other vegetation.

Eden (1974) argued that the savannah and grassland in the Port Moresby area are the direct result of forest clearance for cultivation, with regeneration of forest prevented by grass burning together with low rainfall. Over two-thirds of the savannah and grassland of southern Papua lies in the zone of less than 150 cm of rainfall. The process of forest clearance can still be observed in the area, with cultivators preferring the richer soils formed under forest cover and the protection of tall vegetation against over-exposure of crops to wind and sun in open areas. Eden also argued that in the Port Moresby area there is no evidence that grass burning, in the absence of tree clearance for cultivation, has in

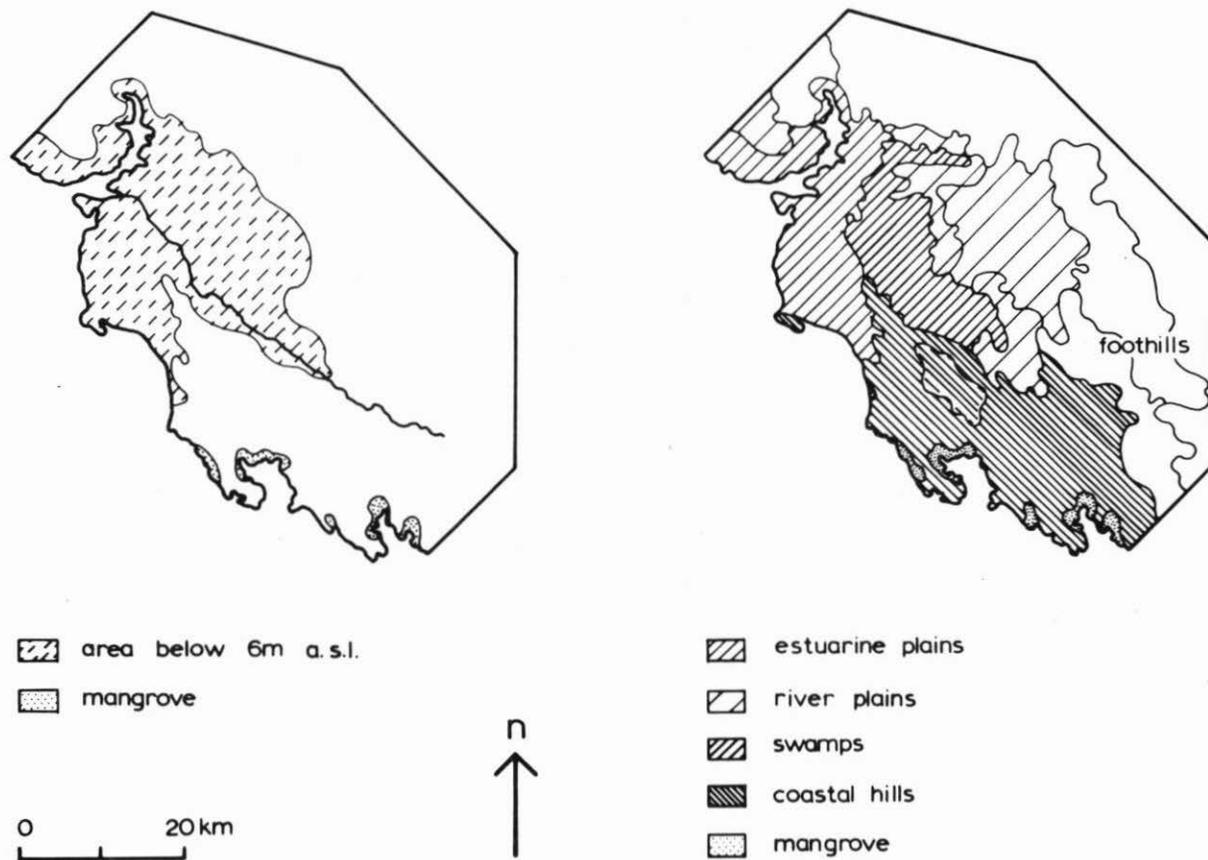


Figure 2 Ecological zones and estimated post-glacial shoreline in the Port Moresby area.

itself expanded the extent of the grasslands. However, it is possible to clear forest with fire for hunting purposes, as the Tasmanian aborigines did (Jones 1969), so the southern Papuan grasslands need not all originally have been created as a result of gardening.

Tropical vegetation is still present on the plains to the north and south of the Port Moresby area, and it is recorded in late 19th century accounts (e.g. Chalmers and Gill 1885:315) that there was a dense belt of tropical vegetation on the banks of the Laloki a hundred years ago. This and other accounts, such as references in oral histories to stands of sago near Barune and Taurama, and the presence of a sago tree and good gardens on the plains between the coast and the Laloki (Chalmers and Gill 1885:314) indicate that there has been some vegetation change in recent centuries. The former presence of sago may have consisted of natural stands, the regeneration or recultivation of which would have been discouraged by the local climate (Pajmans 1976:43).

FAUNA

The lowland forest, savannah and grassland contain an impressive quality and variety of animals and birds, in addition to the abundant animal life of the sea, beaches and freshwater swamps (George 1973, Laurie and Hill 1954). A detailed discussion of lowland fauna is beyond the scope of this paper, but a summary for archaeological purposes was given in Bulmer (1978:23-32). However, the recent archaeological literature has argued for the "impoverishment" of Papua New Guinea hunting in general (e.g. Allen 1977c:173-4). Although a number of larger animal species were lost to the hunting scene through extinction at the end of the Pleistocene, with only the pig and cassowary remaining as land game of large size, nevertheless an abundance of animal life was hunted. Meat may have comprised only a relatively small proportion of the diet, but was nonetheless of economic importance.

Early visitors to Port Moresby give an impression of the abundance of land game. The Laloki River area abounded in such animals as the scrub fowl (*Megapodius freycinet*), brush turkey (*Talegalla fuscirostris*), goura pigeon (*Goura scheepmakeri*), pig (*Sus scrofa*), and crocodile (*Crocodylus porosus* and *C. novaeguineae*) (Chalmers and Gill 1885:315-7). Romilly (1889:164-5) described the number of ducks and wild fowl on the lagoons about the river, the scrub fowl, brush turkey, parrots, and quail in the grass and garden fallow on the coastal plains, and the pigeons that roosted by the hundreds on small islands near the mainland. Romilly also found the inland grassland to be swarming with wild pig and wallaby.

There were also a wide range of smaller less conspicuous animals in the savannah and grasslands, such as described by Menzies (1972) for the Eriama area. These are not likely to have been of much economic importance, even if hunted from time to time. However, the Koita people ate a wide range of animals (Turner 1878:482), even if the coastal Motu ate mainly wallaby supplied by the Koita (Lawes 1879:373), in addition to the produce of the sea.

Marine animal life was of particular importance to the Motu, as with other coastal groups. The most spectacular sea game was the large mammal *Dugong dugon*, taken inside the reef with nets. Other animals of importance were turtles, which laid eggs on offshore islands such as Motupore, as well as a wide variety of reef and school fish, all taken with nets.

ECOLOGICAL ZONES

In terms of contrasts in land forms, vegetation and animal life, the Port Moresby area can be divided into five ecological zones (Fig. 2). On present evidence prehistoric settlements were located in four of these: rocky coast, estuarine plains, coastal hills, and inland river plains. The swamps are a fifth major resource zone. Evidence from site surveys up to the end of 1972 indicated that there were no settlements in the swamps, but of course such evidence is likely to be elusive. A thorough search of raised ground in the swamps and

adjacent to them is needed; up to 1973 only the vicinity of the Waigani swamp had been covered at all thoroughly.

Rocky coast. The Port Moresby coast between Boera and Bootless Inlet has about 45 km of rocky shore and embayments. This zone offers a variety of animal resources, principally fish, shellfish, sea mammals, and pigeons (on offshore islands). As well as a barrier reef up to 16-24 km wide, the coastline has fringing reefs rich in shellfish and numerous bays with sandy beaches or mangrove swamps, the latter also being a source of shellfish. This stretch of coastline is notable particularly for its concentration of shellfish beds (Swadling 1977), contrasting with the coasts to the east and west, which have much narrower fringing reefs or sandy beaches with little by way of edible shellfish. One major bay, Fairfax Harbour, was the locality of a large population concentration in the proto-historic period, which may be primarily due to its protected waters and settlement sites.

Two vegetation zones are adjacent to this coastline; savannah and grassland on the coastal hills, which were probably formerly forested, and mangrove swamps in embayments and on some stretches of coast. Other resources important to coastal settlements are clay deposits used for pottery, the known sources used in prehistoric times being on or near the coast, freshwater springs already mentioned, and chert in the coastal hills, used for artefacts.

Estuarine plains. The other major subdivision of the coastline is the estuary around Galley Reach, at the mouths of the Vanapa and Laloki Rivers. The inlet provides fishing and open water access to the foothills, now about 5 km from the coast. Shellfish are found along the muddy shoreline, including the gregarious species used for trade. Mangrove and sago stands provide uncultivated food supplies, and access by boat made it possible for gardens to be maintained on elevated land inland and also facilitated trade with inland groups.

The rivers have contributed considerably to the progradation of the coastline through the deposition of sediments. More important are the effects of the post-glacial maximum transgression, which formed cliffed slopes and inner beaches several kilometres inland (Mabbutt 1965:109). In the Galley Reach area a series of beaches marks coastal progradation of almost 4.8 km. The post-glacial higher sea level, while only about 3-4 m in height, would have put the shoreline of Galley Reach much further inland, and there is no indication of local raising or lowering of land level itself during the past 5,000 years that could account for the changes in shoreline. Figure 2 shows the approximate position of the 6 m a.s.l. contour, which indicates the probable extent of the former river plains zone. This may have been fringed by a much smaller swamp zone than at present, taking into consideration the amount of sedimentation that is likely to have occurred in recent times. There is, as far as I am aware, no precise dating yet of the post-glacial higher sea level in the Port Moresby area.²

Coastal hills. The series of parallel lines of hills, with intervening valleys, between the coast and the river plains, provides a contrasting ecological zone. This was covered almost entirely in savannah woodland and grasslands, before the development of the present city, but was probably formerly forested, as discussed above. Some land in the coastal hills supports gardens, but re-cultivation is inhibited by grass burning, which maintains the savannah and grassland vegetation and prevents garden fallow cycles. Hunting in this zone was prolific, particularly of pig and wallaby, but also of a wide range of other animals and birds.

Collecting of uncultivated plants and materials was important in the proto-historic period, and some wild plant foods were of particular importance as famine foods (Oram 1977:83-4). Gardening was seriously limited by the low and highly seasonal rainfall in this zone.

River plains. Extensive level river plains to the north of the survey area offered navigable rivers from the sea to the foothills. They would have been important as a forest

hunting and gardening zone for people resident in the adjacent deforested coastal hill zone. The environs of the Laloki River and the plains to the north were covered with medium to tall evergreen forest, with some deciduous forest on the northeastern plains, near the Vanapa River. This zone is more conducive to bush fallow gardening, due to its higher rainfall than the coastal hills, but some of it was deforested through human activity. The fluvial plains contain clays that could in the past have been used for pottery, and a deposit of red ochre is known to have been used.

Swamp. This zone supports abundant fishing and hunting, as well as providing access to sago collecting. The margins of the inland swamps support good gardens, and natural vegetation ranges from tall grassland to evergreen thicket and medium-height evergreen forest. The only open swamp water is the Waigani Swamp, an important resource area.

The foothills themselves probably provided an additional important resource zone for people on the plains. The foothill forests and gardens could have supplied products to people on the plains through trade, even if they may not have obtained them directly.

Although the Port Moresby region offered serious limitations to the Motu and Koita people of the proto-historic period, it will be argued below that this should perhaps be seen more as a product of their own specialization and population density and concentration on the coast and in the coastal hills, than as a necessary limitation on all human habitation in this area. Clearly the Port Moresby environment offered a wide range of resources for hunting and collection, and could have offered a comfortable context for hunting and collecting people. As well, good all-season garden land was available near Bootless Inlet to the east, in the foothills, and on the inland river plains to the north, and agricultural groups resident in these areas or moving seasonally to them could have been well-accommodated in terms of vegetable food supplies. A more detailed discussion of these issues was presented in Bulmer (1978:11-34); only the more important of these will be touched on here.

Allen (1977a:36) and Swadling *et al* (1977:53) have argued that the southern Papuan coastal plains were not extensively inhabited before the coming of the pottery-using communities about 2,000 years ago. These writers assume the earlier settlement was sparse and impermanent owing to the restricted resources of the savannah coastal plains and point to the absence of early sites in this region as significant. Swadling and her co-authors cite not only the absence of pottery sites but the absence of pestles and mortars as supporting evidence. The point that they imply is that other parts of Melanesia had pottery-using occupants over 1,000 years earlier, but they do not take account of non-ceramic settlement.

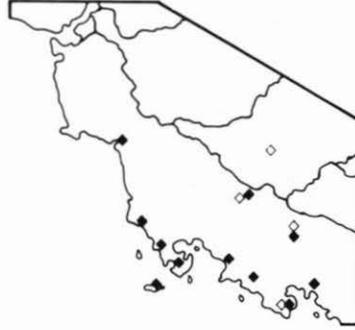
Although there has been a relatively intensive survey in the Port Moresby area, few other areas of southern coastal Papua have been thoroughly searched for archaeological evidence. Surely the use, at this stage of research, of such negative evidence is hazardous; at best we can say that we are convinced that earlier inhabitants did not use pottery and did not make use of such rock shelters and caves as we have discovered. However, the Port Moresby landscape consists of heavily weathered and unstable sedimentaries and archaeological evidence of only 2,000 years ago has been found to nearly two metres deep under sediments on one site (Bulmer 1978:200) so it seems probable that earlier occupation evidence similarly lies deep under the river valley sediments.

DISTRIBUTION OF PREHISTORIC SETTLEMENT

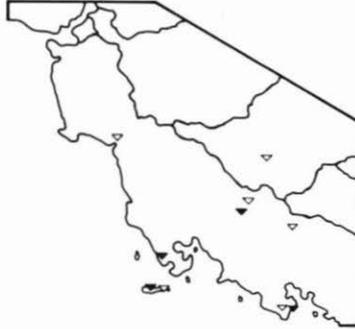
The prehistoric sites of the area have been divided into three chronological periods based on pottery style changes (Bulmer 1978:337-341). These are an Early period (50 B.C. to A.D. 1000), a Middle period (A.D. 1000 to A.D. 1500) and a Late period (A.D. 1500 to A.D. 1870). (These dates are derived from radiocarbon dates.) Figure 3 shows the distribution of 84 archaeological sites by ceramic period, and Figure 4 shows the percentage of sites by ecological zone in the three ceramic periods. In all three periods the majority of sites were coastal, with the Early period having the highest percentage of

early period sites

- ◇ — 50 BC
- ◆ 50BC - AD750

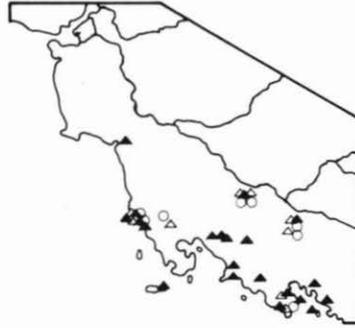


- ▽ AD 750-850
- ▼ AD 850-1000



middle period sites

- site of style II
- △ site of style III
- ▲ site of style IV



late period sites

- site of style V
- site of style VI

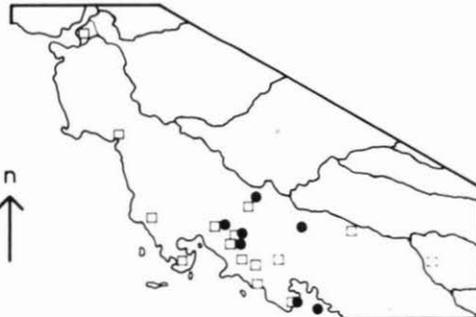


Figure 3 Distribution of archaeological sites by period in the Port Moresby area.

coastal sites. The coastal hill zone appears not to have been occupied by pottery-using people in the Early period and was first settled in the Middle period, with an increased number of sites in the Later period. The proportion of sites on the river plains was similar in the first two periods but decreased in the Late period.

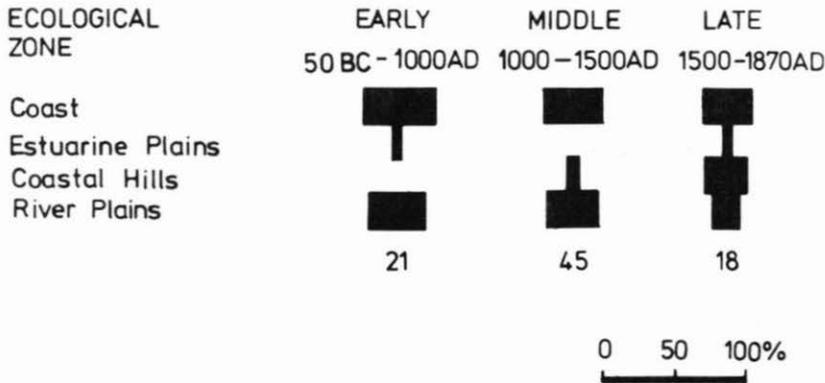


Figure 4 Percentage of sites by period of occupation and ecological zone.

This generally fits with the oral histories of the Port Moresby area (Oram 1977). The two language groups, the Motu and Koita, have traditions of different origins. The Motu, people of the sea and trade, and the Koita, people of the land, explained their economic symbiosis in historical terms (Seligman 1910:41-50). The Koita had moved down from the mountains and across the plains to the coast, while the Motu arrived by sea to dwell with them. Genealogies suggest this may have occurred only within the past 400-500 years. By the 19th century there were eight western Motu villages spread at approximately 15 km intervals along the coast and the Koita settlements on the hills above the coast, on the coast or adjacent to the Motu villages. At this time none of the Koita settlements were on the river plains, and it appears from the archaeological evidence that the abandonment of the Koita river plain settlements may date to the period since A.D. 1500.

Although there is a larger number of sites known for the Middle period, there is a similar increase from the Early to the Middle period in number of sites on the river plains and on the coast. This could possibly be due to a larger number of sites having been settled at the same time, but alternatively could relate to the inevitably greater destruction of earlier sites due to exposure and to later habitation at the same sites, or to more frequent changes in settlement location. In the absence of more detailed evidence on site size and the duration of occupation, an hypothesis of population increase in the Middle period (Allen 1976: 441) cannot at present be supported on archaeological data. Allen posited a marked build up of population in the vicinity of Bootless Inlet (Allen 1977b: 400), about A.D. 1000. Up to 1972 there were only three sites with pottery comparable to that at Motupore on the Bootless Inlet coast, other than the Taurama sites, none of which is from a large deposit. Further site survey data may now be available but has not been presented yet by Allen to support his interpretation.

There is new settlement on the coast in the Middle period, two new substantial settlements are established at Motupore and at Boera. Archaeological excavations at a Boera site, Ava Garau, Site AMH, by Pamela Swadling, have shown that the community here began about A.D. 1250 (Swadling: pers.comm. 1976). Boera is on the edge of the swampy river plains, so the people may have been making use primarily of sago. Their oral traditions indicate the settlement was established 10 generations ago (Oram 1977:85). Williams (1932) recorded traditions in the Gulf that trading voyages from there to the Port Moresby coast were begun a very long time ago. If these people came from the west and originated the trade with the Gulf of Papua, they may have depended on imported food supplies from at least this period. On grounds of settlement size, Boera is the largest of the prehistoric villages in the Port Moresby region.

A final consideration in respect to the ecology of prehistoric settlement is the question of seasonality, and whether the sites were occupied only seasonally, in response to the local climate. Certainly it should be expected that the local people made use of more than one ecological zone, and indeed the archaeological evidence supports this. People could have been living on the coast for part of the year and on the inland plains at other times. It seems likely, in fact, that for much of prehistory the local population lived mainly on the river plains.

Sites on the coast may then have been seasonal garden sites, or fishing and shellfish-collecting or salt-making camps, lived at temporarily by inland people. This could explain the presence of small amounts of inland-style pottery at coastal sites.

PREHISTORIC VILLAGE ECONOMIES

Five excavations in the Port Moresby area provide information about three mainland communities, and one community on an offshore island, Motupore (Bulmer 1975). The mainland communities include one coastal village (Taurama) and two settlements on the inland river plains (Nebira and Eriama). The archaeological evidence shows that each community had a different economic emphasis, although all but Motupore would be considered within the modern range of unspecialised Melanesian village economies.

The two river plains communities are represented by three excavations, two open settlement sites at Nebira and a rock shelter camp/burial site at Eriama. Nebira is a 180 m high hill on the plains next to the Laloki River, with settlement refuse all around its upper slopes, in the saddle at about 140 m a.s.l. between two peaks (Site ACJ) and at the base of the hill to the northeast (Site ACL). Site ACL was occupied from about A.D. 100 to A.D. 1000. Some occupation during this period was also present at Site ACJ, but the remains of this were subsequently disturbed by occupation and burials made between about A.D. 1000 to 1600. Eriama is on a ridge 5 km upriver. A rockshelter there (Site ACV) was used as a cooking/camp site from about 40 B.C. to about A.D. 1500, and subsequently used for secondary disposal of the bones of the dead.

The village at the coast at Taurama was similarly long-occupied, with evidence possibly dating from about 50 B.C. to some time later than A.D. 1350. This site, according to oral history was colonised by people from Motupore island in about the 16th century and was finally abandoned early in the 18th century because of warfare. The island of Motupore was the site of a village from about A.D. 1100 to probably some time in the 17th century.

The data from the excavations will be discussed under four headings: the use of shellfish, other fauna, trade, and the locational and other indirect evidence of cultivations and other plant foods. The archaeological data will be compared where relevant with information from oral history and ethnographic accounts of the historic people of the Port Moresby area.

Use of shellfish

The people who lived at Taurama ate a very large number of shellfish species, which is to be expected because of the position of this settlement on the beach in front of shellfish beds. On the other hand, the two inland communities at Eriama and Nebira also ate a wide range of shellfish, particularly considering the smaller sample of shells available for identification from these sites. Evidence of technological use of shell is available so far only from Taurama. The collections from Nebira were too fragmentary and weathered for it to be possible to obtain technological information from them, and the shells from Eriama consisted only of food refuse and of finished artefacts, with no manufacturing refuse included in the collections.³

Detailed data about shellfish found at Nebira Site ACL were not given in the published report (Allen 1972), so only limited comparisons can be made with the shellfish data from other sites, and no shellfish data are yet available from Motupore.

There were 283 fragments of shell identified from the Nebira Site ACJ collections, but the shell at this site was very weathered and fragmented. The main shell-dumping area was apparently outside the excavations, probably downhill where a large amount of shell is found. Only a total of 6.2 kg was excavated, mostly on the north and northeastern side of the excavations, possibly derived from residences higher up the slope, and stratigraphically later than the layers containing the burials (Bulmer 1978:169).

Twenty shellfish species were identified in the Nebira collections. Nearly all were coral reef and rocky shore species, and only 5-10% of the shells identified from all layers came from mudflat or mangrove areas (Bulmer 1978: Table 6.11). The commonest species were the gregarious *Strombus luhuanus* (the blood-mouth conch) and *Anadara antiquata* (an ark shell). No freshwater species or land snails were present. Four species (*Spondylus*, *Trochus*, *Pinctada* and *Conus*) were the material used in ornaments associated with the Nebira burials, but in the absence of any indication of manufacturing at the site it is not known if any were made there. Drill points and grindstones were found at Nebira that could have been used for shell manufacturing, but also could have been used to work bone or other organic materials. Four non-ornamental shell artefacts were found with burials as well, possibly as burial goods: these were two *Cypraea* shells that may have been scrapers, and two perforated *Anadara* shell weights. There were also two definite cases of shells having been placed in graves with the dead, presumably as food for the deceased. In another six burials, shells were present in the grave, but could have been accidentally included as midden material already present in the soil.

Allen (1972:119-20) found 39 species of molluscs at Site ACL, Nebira, including 36 marine, two freshwater species and a land snail. From the relatively smaller proportion of shellfish in the later layers he concluded that the importance of molluscs as a food item diminished throughout the occupation of Site ACL. This, together with a sharp decline in the representation of fish in the total faunal remains from the site, seems to be the basis of Allen's interpretation of this site as indicating "gradual adaptation" to inland environments by the early ceramic-using settlement (Allen 1977b:393). This is a less cautious repetition of an earlier discussion where he stressed (1972:122) the possible bias of the small sample on which these conclusions were based.

The shellfish species lists were not published, but it was reported that the marine molluscs came from reef, mangrove, or reef flat environments. *Chama* sp. and *Strombus* spp. (*S. labiatus*, *S. luhuanus*, *S. gibberulus gibbosus* and *S. canarium*) were the commonest shellfish throughout the deposit, accounting for 68% and 13% of the total shell weight respectively. No changes in habits of exploitation of different species were indicated from this sample. Freshwater species identified included *Melania* sp. and *Velesunio* sp. These represented only 1% of the total weight of molluscs each, and could have come from the Laloki River or the nearby Waigani Swamp. Allen commented (1972:119) on the very high proportion of shell to meat in the *Chama* sp. which presumably should not have been favoured by a community that had to transport its

shellfish some distance inland. On the other hand, perhaps it was favoured for the reason that it did have a robust shell, that could be used as raw material for artefacts or for lime-making. *Chama pacifica* is the shell used for making small shell discs in the southern Milne Bay area (Seligman 1910:514).

Fifty-one shell artefacts were excavated at Site ACL. Detailed stratigraphic data were not given in the published report, but the artefacts included 33 small shell discs (13 of *Spondylus* sp. and the rest of unidentified grey-white shell), 10 *Conus* arm rings (mainly from Level 11 down), and eight perforated shells. Because of the presence of drill points in the stone industry, it was concluded that shell discs were manufactured by this community, but no manufacturing waste was described.

At Eriama Site ACV, 281 shells of 33 species were identified (Bulmer 1978:Table 7.5). The proportions of shellfish species contrasted with those at nearby Nebira. The inhabitants of this site made use of a variety of saltwater species, but they also made a much greater use of muddy shore and mangrove species, with between one-third and half of shells identified in all layers being from this environment. There was also a greater use of freshwater species and landsnails than at Nebira. The variations between layers in proportion of marine shellfish showed no clear patterns of change in use from different sources. This shell was food refuse and not remains of manufacturing of shell artefacts; there was no manufacturing waste present and the distribution of shell on the site was similar to other habitation refuse and contrasted with the distribution of burials and burial goods.

The most numerous species, the muddy shore species of Melaniidae, Thiariidae, *Saccostrea exhumata* and *Geloina coaxans* are all gregarious species such as are commonly traded in the modern context, but this does not prove they were obtained by trade. The people of Eriama could have journeyed to the shellfish beds themselves to collect shellfish.

Another contrast in the use of shellfish between Nebira and Eriama, is that coral reef and rocky shore species at Eriama do not show a predominance of a small number of gregarious species, but are more evenly divided between a larger number of species. This would seem to indicate a lack of direct access to the beds of gregarious rocky shore and reef species, which were perhaps obtained in smaller numbers through trade.

The community at Taurama used a wide range of shellfish species, some of which were obtained from in front of the site, and others of which were found in nearby areas (Swadling 1977). The people apparently did not have much interest in muddy shore shellfish; only four species from this environment were identified in the collections, while 50 species of rocky shore and reef shellfish were present.

On the basis of breakage attributable to culinary use, the Taurama people ate every species of shellfish present in the identified collections. All species show breakage, such as damage to the edge of the lips and holes broken through the backs or whorl, with no necessary additional wear, that would have come from the extraction of the animal from the shell. Swadling (1976:161-2, 1977) studied the growth patterns of two species, *Strombus luhuanus* and *Anadara antiquata*, to learn about the history of exploitation of these populations. After an initial period of heavy exploitation, there was a continuous use of the populations without substantial interruption. This supports the continuous occupation of the general area of Taurama, for if people did not continue to live at the particular site, they continued in occupation of other sites close enough to continue to use the shellfish beds.

At least eight species of shell were used not only for food but also for artefact manufacturing at Taurama. These include *Tridacna* sp., *Pinctada maxima*, *Trochus* sp., *Conus litteratus*, *C. marmoreus*, *Anadara antiquata*, *Spondylus* sp., and an unidentified bivalve. These species all show additional breakage to the shells which can be attributable to artefact manufacture or use, in addition to the breakage due to use for food. The only unfinished artefacts or artefacts broken in the process of manufacture are *Trochus*

arm rings and medium-size *Conus* top discs. Artefacts that were made from shells broken from food use include *Cypraea* scrapers and *Trochus* scrapers. Additional shell artefacts that could have been made at Taurama, considering the manufacturing waste, are *Tridacna* and *Conus* arm rings, medium shell discs, similar to *Spondylus* discs at other sites but made of white (possibly *Tridacna*) shell, small bivalve and other shell pendants, and small *Cypraea* beads.

Other fauna

Animal bones and teeth are more difficult to interpret than shells, in terms of minimum numbers of animals, their representativeness and their origins. There are more variations in the disposal of animal bone in archaeological sites in Melanesia. In addition to their technological use as raw material for ornaments and artefacts, unworked bones are used as hunting trophies. Some animal remains, for example dogs, are not necessarily disposed of as food refuse. In addition, bones may not survive due to their consumption as food by free-ranging dogs and pigs. Many of the land species are normally found in more than one ecological zone, hunters often travel long distances to hunt, and animal carcasses are traded as meat, so it may not be simple to reconstruct the environment of the site or the hunting territory from the animals identified.

While the majority of birds and animals are strictly or predominantly forest creatures, the natural savannah woodland has a distinct dominant fauna. This includes, particularly, *Isoodon macrourus*, *Macropus agilis*, *Rattus sordidus*, and a particular suite of birds. When the animals can be identified to species level, it might be possible to recognise this assemblage in the archaeological record. Other animals that may supply clues to human ecology are *Echymipera kalubu*, the bandicoot that prefers the forest edge and human-disturbed vegetation, and the pig, which prefers the same niche in the wild. An interesting species that was possibly originally restricted to the natural savannah woodland, but spread throughout the secondary forest in the wake of human disturbance is *Tachyglossus*, the smaller Echidna. Although the spread of this animal may have occurred at a much earlier time than that of the archaeological sites discussed here, it may nevertheless be a useful indicator if taken in conjunction with the distribution of other creatures with distinct habitat.

On the basis of the very limited amount of animal remains⁴ excavated at the Taurama site (573 fragments from nine or more species totalling only 556 g) only a minimum number of 16 individuals can be established (Bulmer 1978:Table 8.9b). (Minimum numbers were based on the presence of mutually exclusive cranial bones or other diagnostic bones or teeth. If this was not possible, only a single individual animal was attributed to each animal group, which means that minimum numbers are very likely to be larger than indicated, considering the time span and stratigraphic distributions involved.) There were two or more species of wallaby (seven or more individuals), dugong, crab, fish, a small reptile, a small bird, sea urchin, pig (one tooth only), and dog (a puppy burial in a small pit in the deepest habitation layer, which, on grounds of pottery styles, probably dates to about 2,000 years ago).

This restricted evidence does not support any change in use of faunal resources at Taurama. The most numerous animals, wallabies, were present throughout the sequence, and their further division into two or more species and the time span involved, precludes any suggestion of specialised hunting such as Allen (1976) has made for Motupore. On the other hand, it does seem that the people of Taurama made use of a wider range of marine animals than did the inland communities; crab and sea urchin were not found at Nebira or Eriama.

One interesting fact about the Taurama bone collections is that their distribution and condition seems to indicate free-ranging dogs or pigs at the site. The tiny bone fragments were well-distributed throughout the deposits and more numerous in the deeper layers. Their rarity thus is not due to weathering, and indeed they are mostly in an unweathered

condition, and their distribution around the living area as well as the midden dump, in contrast to the shells concentrated in the dump, suggests the bones were thrown out for the animals to consume, only tiny fragments being lost in the sand or rubbish. This disposal of bone is typical of modern villages that do not pen or tether their pigs or dogs.

Bone was rare at Nebira Site ACJ as well, but there were some large fragments and no indication of disturbance of the burials by pigs or dogs. Thus the scarcity of bone at this site must be due to its disposal normally elsewhere, probably downhill from the living area, as was found in respect to shells as well. The pigs and dogs at these sites may have been feral ones caught in the forest or grasslands; with close access to hunting territory there may have been little need to keep domestic animals.

Of the 1,000 fragments of bone excavated at Nebira, weighing only 1 kg, 119 fragments have been identified. A total of more than 50 animals is represented in the collections, including at least 13 species (Bulmer 1978:Table 6.20). There are two species of bandicoot (one large and one small): the larger common species around Port Moresby is *Isodon macrourus*, but three other species might have been taken by local hunters — *Echymipera kalubu*, *E. rufescens*, and *Peroryctes broadbenti*. There is also a cuscus species (three species, *Phalanger maculatus*, *P. orientalis* and *P. gymnotis*, are common in lowland forest), a large rat (probably *Uromys* sp.), a large bat (*Pteropus* or *Dobsonia*), a small and a medium-sized bird (possibly scrub fowl or brush turkey), and two species of wallaby (one probably *Macropus agilis* and the other one of the smaller forest wallabies, *Thylogale bruijini* or *Dorcopsis veterum*). There were also a dugong tooth and mandible, dog, pig, a goat tooth, a small quantity of fishbone, and possibly turtle bone. The goat tooth is in a layer indicating it is prehistoric, in the sense of being earlier than local European colonisation, but probably later than southern Papuan contact with European voyagers, which began in the 17th century. Goat is early prehistoric in Indonesia, and so could have been introduced by Indonesian voyagers or traders.

In general, the animal bone from Nebira shows that the inhabitants made use of a wide range of animals from forest, grassland, and sea. The fish could be river fish from below the site, but shellfish and dugong from the coast were also eaten. The range of animals represented suggest hunting in both grassland and forest.

Faunal remains from Site ACL below the hill showed the commonest animals were pig, wallaby (nearly all *Macropus agilis*) and fish (Allen 1972:116-7). Bones from bandicoot, bird, turtle, rat, dog, and dugong and crab remains were also identified but minimum numbers were not attempted because of their fragmentary condition. Four main families of fish were in the 565 fish bones identified, 85% of which were catfish (Tachysuridae: *Hexanumatichthys latirostris*). This fish can now be caught in the river in front of the site, but Allen (1972) did not suggest a riverine orientation of the settlement, but emphasised rather the resources brought from the coast.

The *Eriama* animal bone collections and other animal remains included 1,316 fragments (1,644g), of which 162 identified pieces indicated more than 61 individual animals (Bulmer 1978:238-42). These represented at least 19 species, and had a similar distribution at the site to that of human bone. Because of this, and the positive association of wallaby, goat and dog remains with the burials, much of the bone at this site should be interpreted as food for the dead or for mourners.

The animals identified included three species of small reptile, a large and a small species of rat, two or more kinds of wallaby, pig, dog, goat, two species of *Pseudocheirus* (ring tail possum), a species of *Phalanger* (cuscus), a large and a small bat, a large and a small bandicoot, a medium-sized bird (possibly brush turkey or scrub fowl) and a small bird, fish, and possibly dugong.

The most remarkable animal is goat, although probably only one individual is represented in the collections. The bones of this animal were put into three or more burials as grave goods, one burial being dated to A.D.1620 ± 70 (GaK 2671, Bulmer 1978:213), earlier than European settlement in southern Papua, although not earlier than contact with European voyagers elsewhere on the coast.

Allen (1976) suggests that one indication that the people of Motupore were maritime specialists trading with people on the mainland is the specialised faunal remains at Motupore. A relatively narrow range of food animals is present in the collections, consisting mostly of fish. These are almost entirely shallow reef and harbour species, and the thousands of perforated shell net weights and the absence of fishhooks suggests their fishing techniques were similar to those of the Motu fishermen of proto-historic times. There was a relatively small amount of pig bone at Motupore, and no dog bones. Aside from one rodent and one lizard, all other animals identified are *Macropus agilis*, including 158 individual animals in the sample studied.

Trade

There is thus archaeological evidence that inland communities made use of animal food from the coast, and that people living on the coast and offshore islands made substantial use of land animals. The land animals could have been obtained by the coastal people journeying inland, as the historic Koita did (Williams 1939:18), going for weeks on hunting expeditions to the vicinity of the Laloki River. Similarly inland groups could have journeyed to the coast by water transport or on foot, as oral histories indicate they did. Thus it would have been possible to obtain fish, shellfish and dugong flesh directly, although alternatively they could have been obtained by trade with coastal communities. The relatively high proportion of gregarious muddy shore shellfish at Eriama similarly is consistent with local trade but does not prove it, as these could have been obtained directly.

As mentioned above, Allen thought that the predominance of wallaby bone and the absence of most other land species at Motupore may indicate trade with mainland hunters. He argued (1977b:394) that if the people of Motupore were hunting for themselves they would have been likely to obtain a wider range of species. On the other hand, they may have preferred wallaby for other reasons, such as ritual or technological uses, so this does not prove the other animals were not caught. Other animals could have been eaten on the mainland, with only wallabies brought to the island. Vanderwal (1973:233-4) similarly found a predominance of wallaby at Oposisi on Yule Island, and suggested it might reflect trade with the mainland.

The only direct archaeological evidence of trade so far found in the Port Moresby area is the presence of foreign stone. Some of this could, of course, have been obtained directly by journeying to the sources. On the other hand, the presence of obsidian that had its origins on Fergusson Island in the Milne Bay Province 550 km to the east (Allen 1972:109, Ambrose 1976) makes long-distance indirect trade plausible. Allen (1972) found "small quantities of obsidian . . . from the earliest to the most recent levels" at Nebira, Site ACL.

Small flakes of obsidian have also been found in the excavations at Eriama, Nebira Site ACJ, and Taurama, although only a single weathered "antique" flake was found at Motupore. Only two flakes of obsidian were found at Eriama Site ACV, out of a total of 360 flakes and cores (Bulmer 1978:246-7), one in Layer F (A.D.1319 ± 125, GX 3334, Bulmer 1978:213) and one in Layer D (later than F and earlier than a date of A.D.1490 ± 120 [GaK 2668, Bulmer 1978:213] in Layer B). Fourteen flakes of obsidian were excavated at Nebira, out of a total flake and core assemblage of nearly 16,000 pieces. Ten of these come from Layer B (bracketed by two dates of A.D.1276 ± 150 (GaK 2672) and A.D.1579 ± 80 (GaK 2673, Bulmer 1978). One flake comes from each of Layers D and E and one from each of two early burial pits (Bulmer 1978:Table 6.14). These deposits are thought probably to date to between about the 11th and 14th centuries A.D. At Taurama, out of a total of over 21,000 flakes and cores, 17 flakes of obsidian were excavated, some in each layer (Bulmer 1978:Table 8.10), an occupation thought to span a period from about 50 B.C. to about A.D. 1100. A separate excavation in another part of Taurama, dated by two radiocarbon samples to A.D.1196 ± 85 (I 6887B, Bulmer 1978:275) and A.D.1357 ± 85 (I 6862, Bulmer 1978:275), i.e. about A.D.1100-1390 (Bulmer 1978:274-6), contained no obsidian flakes among 1,217 flakes and cores.

No sites have yet been found in the Port Moresby area that contain large quantities or larger flakes of obsidian such as occur in the Mailu area (Irwin 1977), so it seems on present evidence that the people of Port Moresby may never have obtained obsidian in any quantity. The flakes that remain in the Port Moresby sites must be the result of reflaking until the remaining flakes were too small to be used.

Allen (1977b:393, 411, Footnote 5) argued that there was obsidian trade to the Port Moresby area up until about A.D. 1000, the cessation of which coincided with the introduction of a new pottery style to the area. Because the Motupore site did not contain obsidian he concluded that the trade had discontinued, and he supported this with the statement that none of the Port Moresby surface sites known to relate to the period after A.D. 1000 had produced obsidian.

As the result of the study of ceramic style changes (Bulmer 1978), it is possible to date 30 sites to the period between A.D. 1 and A.D. 1000 and 62 sites to periods after A.D. 1000. Unfortunately none of the sites have produced any obsidian at all, other than in the five excavations, so the argument of change in obsidian trade on the basis of surface collections is unsupported.

Allen (1977b:411) also argued that in the three excavations at sites of post-A.D. 1000 age all contain earlier material from previous occupations in secondary position. While it is possible that the obsidian flakes are derived from earlier occupations, it is equally possible that they have been introduced into stratigraphically deeper layers through postholes and burials or other disturbances.

In contrast to obsidian, trade in other stone artefacts seems to have been complex and important, but its history is not yet archaeologically well-documented, because so few stone artefacts, other than flake tools, have come from stratigraphically-controlled excavations. However, surface collections include a large number of stone artefacts, most of which are made of rock foreign to their area. Sourcing of stone artefacts has begun with a study of surface collections from Taurama. This indicates a variety of sources were probably used, including one in the Milne Bay Province (C. Pigram: pers.comm., 1978). Ethnographic accounts indicate axe-adzes came from inland (Seligman 1910:115) and the Milne Bay Province (Seligman 1910:24), club heads from inland also (Stone 1876:57), and drill fly-wheels from Elema (Stone 1876:47). Allen (1977c:443-4) found "green diorite" axe-adzes at Motupore, which he considered came from inland in the Owen Stanley ranges. Other less conspicuous stone artefacts in the collections include possible sling stones, oven stones, files, grindstones, possible agricultural tools, pounders, and nutcrackers. These are all made of stone foreign to the immediate Port Moresby area, and therefore were probably obtained through trade, although this is not to my knowledge reported in the published accounts.

Shell ornaments were probably traded in prehistoric times in the Port Moresby area, but as yet there is no direct evidence of this. There are three sites where it is known or suspected shell ornaments were made. Shell manufacturing refuse at Port Moresby indicates *Conus* top discs and *Trochus* arm rings were made there and probably a variety of other ornaments as well. Allen (1977c:443) found similar evidence of shell disc manufacture at Motupore, and the presence of a large proportion of *Chama* shell at Nebira Site ACL may indicate shell disc manufacture there as well. No positive evidence of shell ornament manufacture was found at Nebira Site ACJ or Eriama, but for particular reasons neither of these cases of negative evidence is convincing. Vanderwal (1973:179) thought the presence of *Trochus* arm rings at Yule Island, in the absence of manufacturing waste, might indicate trade with the mainland.

Two of the proto-historic and historic period communities in the Port Moresby area specialised in the manufacture of shell ornaments for trade. These were Vabukori, a village settled as long as oral histories record, i.e. it was already occupied when Taurama was first colonised from Motupore (Oram 1977:78), and Tatana, a village later settled from Hanuabada. These villages made *Spondylus* shell discs for trade with local Motu pottery-making villages, as well as with more distant communities in the *hiri* trade. On

archaeological evidence the local manufacture of this ornament may be relatively recent; at Taurama manufacturing waste of *Spondylus* shell was present only in the surface deposits of Square 7X, dated on the basis of pottery style to about A.D. 1100. Shell discs were manufactured at Motupore throughout the sequence (Allen 1977c:443), but the species used have not yet been reported. Only the burials at Eriama, dated to A.D. 1623 ± 70 (GaK 2671, Bulmer 1978:213), contain the full range of Motu ornaments (Seligman 1910:514-5).

Pottery is the other major trade commodity. Only a very limited amount of archaeological evidence of local trade in the Port Moresby area exists. Allen (1972:99) reported that the mica inclusions in the clay used in the pottery at Nebira Site ACL, and the misfired sherds, i.e. rejects from the firing process, found in the excavations indicated that pottery was made at Nebira. Late period sherds at two sites in the Owen Stanley mountains and sherds at sites in the coastal hills may have been obtained from coastal communities, such as was the case in the recent past with the Motu and Koita.

One major problem is the lack of evidence for pottery manufacture *per se*, such as firing areas. What are possibly misfired sherds have been found at other Port Moresby sites (Bulmer 1978:183-5), but these are rare and difficult to interpret. Contrasts in frequencies of decorative styles of pottery at Middle period sites, and the continuity of decorative style at Nebira have also been put forward as possible evidence of trade (Bulmer 1978:185), but this evidence is as nebulous as that for shell ornament trade. The study of clays, such as carried out by Irwin at Mailu (Irwin 1977) and the study of tempers has only so far been attempted on Motupore material, but this has considerable potential in the study of local trade.

Trade over long distances into areas where pottery is not manufactured, such as the *hiri* trade to the Gulf, should be archaeologically testable, but this has not yet been done.

Allen's hypothesis (1977b:393f) that trade was not evident to any appreciable extent in the Early period, that in the Middle and Late periods there was on the Southern Papuan coast a growth of localised and more specialised economies, and that trading "escalated" to complex levels only within the last 500-800 years seems to be without archaeological support. There is little evidence for trade of any kind, let alone for complex trading.

Motupore does indeed stand apart in terms of its archaeological remains as a candidate for the role of a specialist trading community, but there is no direct evidence as yet for trading as such. This community could have maintained gardens on the mainland, as many offshore island-dwellers do in Melanesia, and could have been making pottery and shell ornaments for its own consumption.

Cultivated and uncultivated plant foods

Although no archaeological evidence as yet exists for the plant foods or raw materials used by the prehistoric inhabitants of the Port Moresby settlements, there is indirect evidence in the location of the sites for their involvement in cultivating. All four communities had direct access to good, all-season, garden land, and they probably lived there for this reason. Eriama is next to the foothills in a small fertile stream valley, Nebira is next to the fertile river terraces, and Taurama and Motupore are both opposite excellent garden land (Oram 1977:86).

This contrasts with the situation of the proto-historic and historic Motu, whose condition was precarious in terms of agriculture. Oral histories indicate they moved, possibly within the last 400-500 years, from Bootless Inlet to the west, into an ecologically less favourable position, motivated primarily by pressure of warfare with settlements to the east. Subsequently villages moved westward from Hanuabada in search of ecologically better, or perhaps more diverse, locations.

Conditions in the Port Moresby area were often severe, with seasonal droughts, floods and famines (Groves 1960), so that villagers were forced to leave the area or to plunder

their more fortunate neighbours. This is the traditional explanation of the genesis of the long-distance trade voyages, the *hiri*, during which the people of Port Moresby sailed to the Gulf of Papua to sell pots and shell ornaments and other items in order to obtain canoe hulls for their trading voyages and sago on which they depended for most of the year. As already mentioned oral traditions in the Port Moresby area (Oram 1977:85) indicate that the *hiri* was begun by immigrants to Boera village, 10 generations ago, and traditions in the Gulf suggest trading voyages from the Gulf to the Port Moresby coast were begun a very long time ago.

However, Oram (1977) argued that earlier accounts of the Motu have not sufficiently emphasised the extent of their reliance upon their gardens. They spent considerable energy to make gardens in spite of the fact that they only provided sufficient food for three or four months of the year (Groves 1960). The main problem with gardens in Port Moresby is the highly seasonable rainfall, and only yams and bananas grow at all well. Coconuts do well only in some villages. Groves (1960:7) wrote that the yam harvest frequently failed entirely, when the elements were hostile, and in any case stored yams begin to rot in November or December in the middle of the wet season. Thus famine was endemic in Port Moresby.

The savannah, grassland, mangrove, and deciduous forest all offered a range of edible and useful plants used prehistorically which continue to be used at present by the people of the Port Moresby area, and were especially used as famine foods in recent times. Their use has not yet been described in detail in publication, but Oram (1977:83-4) emphasised the importance of wild plant food and compiled a list of 35 edible wild plants in the Port Moresby area. These include the fruit of the mangrove (*gavera*), *Elaeocarpus* nuts, breadfruit, *Pandanus* fruits, *Cordyline* root, banana stems, the nut of *Terminalia complanata* (*hodava*), a large aroid *Amorphophallus complanatus* (*hatoa*), and a wide range of other wild tubers, including a wild yam (*taitu kava*).

Adding to this the wide range of plants used as raw materials for artefacts, construction, firewood, and clothing, it is clear that the uncultivated vegetation zones of the Port Moresby area were of considerable economic importance to the local villages, even when extensive use was made of imported food. Ohtsuka (1977) described the dependence on collected fruits and leaves of a community on the Oriomo plateau. This is located in an area 60 m and over above sea level, with a rather similar climate. The rainfall is similarly highly seasonal, a factor that probably encourages a dependence upon collecting or the use of storable vegetable staples.

CONCLUSIONS

Oral histories and records of the conditions in the last century indicate that the Port Moresby area was, for a period of 400-500 years, occupied by two groups with contrasting economies. The Motu were maritime traders and the Koita gardeners and hunters, and both depended on imported food for much of the year. The Motu traders came by sea to settle on the coast, while the Koita moved from the inland river plains to the coast and coastal hills. Archaeological evidence generally supports this picture, but shows that prior to this, from about 50 B.C. until A.D. 1500, the inland river plains and coast were occupied by pottery-using settlements with unspecialised gardening, hunting, and collecting economies.

A closer examination of the various ecological zones of the Port Moresby area indicates that this countryside had ample resources for human life. Previous archaeologists have exaggerated the lack of resources of the savannah and grassland coastal plains and its extremes of climate, and have argued that this is the reason for the absence of earlier archaeological evidence. There is an abundance of animal life, a variety of uncultivated plant resources, and prehistoric populations could as well have won a comfortable living from the soil of the inland river plains, the foothills, and the area to the east of Bootless

Inlet. They may have been normally resident in these areas, or could have moved their settlement sites seasonally to take advantage of resources in different areas.

During the Early period, from about 50 B.C. to A.D. 1000, there were at least one coastal and two inland settlements of substantial size, in addition to other settlements along the coast of unknown size. The three large communities all had unspecialised economies, although the people at Taurama, on the coast, made rather more use of marine food than did the two inland, river-plains communities at Nebira and Eriama. On the basis of animal bone in the sites, these people hunted in forest as well as grassland, and kept or hunted pigs and probably kept dogs. By virtue of their location near the best garden land in the region it can be expected that they were cultivators as well as fishermen, hunters and collectors.

During the Middle period of settlement two new substantial settlements were established on the coast, one at Motupore at about A.D. 1100 and another at Boera at about A.D. 1250. The archaeological data from these sites are not yet available, so it is not yet known if these people were culturally similar to the established local communities. Motupore is an offshore island, but it is close to good garden land on the mainland, so its inhabitants may have been cultivators. Boera is situated near the swampy river plains, and could have been established there to take advantage of sago stands. The three earlier communities, at Taurama, Nebira and Eriama, appear to have continued their unspecialised existence.

It is only during the Late period, in the 16th-19th centuries A.D. that there is archaeological evidence for changes in settlement patterns and culture. The settlements at Nebira and Eriama were abandoned in the 16th century, which agrees with Koita oral histories of having moved from the inland plains toward the coast, and the settlement at Motupore was abandoned in the 17th century, which fits with Motu oral histories of Taurama having been settled by people from Motupore, although genealogies place it in the 16th century. However, the historic condition of the Motu and Koita, with the Motu spread westwards into eight villages, and the Koita established in the coastal hills and on the coast, was only achieved in the 19th century, according to oral histories.

Allen (1976, 1977a, 1977b, 1977c) has argued that there was a marked change in economy and settlement in southern coastal Papua at about A.D. 1000, when previous settlements and the earliest ceramic style were abandoned, and specialist traders, who had a different ceramic style, arrived from outside the area. A sudden increase in population in the Port Moresby area put already-strained, local resources under greater stress, leading to the establishment of a complex system of long-distance trade. This interpretation was based both on the apparent similarity of the culture and economy of the Motu and of the Motupore settlement, and the abandonment of the Nebira Site ACL and its ceramic tradition at about the same time that the Motupore site was first occupied.

It has been argued in this paper that Nebira was not abandoned in A.D. 1000, but rather the settlement was moved to the top of the hill. The early pottery style was not discontinued, but at least at Taurama (and also at Boera, P. Swadling: pers.comm.) appears to have developed into the style of pottery present at Motupore. It has also been argued above that there is no direct evidence that the people of Motupore were specialist traders; their island home, although lacking in garden land, was close to good garden land on the mainland, so they could have been cultivators. The only evidence for trade at Motupore is the presence of non-local stone axes, which could have come from the inland mountains. Otherwise the people could have made pottery and shell ornaments for their own use and hunted wallabies on the mainland.

The other three communities contemporary with Motupore (other than Boera for which no information is available) were unspecialised in their economies and show no signs of economic change around A.D. 1000. The alleged change in obsidian trade, based on the absence of obsidian at Motupore, is not supported by archaeological evidence from other sites where obsidian flakes are present in later periods. In any case, it appears that obsidian trade was never important.

If marked change occurred, it was probably during the Late period, possibly as recent as the 18th and 19th centuries, following the abandonment of Taurama and the movement westwards along the coast, and from the inland river plains toward the coast. This was a movement away from the best garden land, and it seems likely it was related to an increasing dependence upon imported food. The reasons given in oral tradition for these changes in settlement location involve warfare. Pressure was exerted on the Koita by groups in the foothills, and on the Motu by groups to the east, the ancestors of the Eastern Motu. There were probably other causes for this change in settlement pattern, such as epidemics depleting certain communities (Dutton 1969:33). Seen in ecological terms, the pressure of warfare jeopardized access to good all-season garden land on the river plains and in the Bootless Inlet area. Even without population increases this could have encouraged the more intensive use of the land between the coast and river plains, both for gardens and for hunting and collecting. Hunting by fire in garden fallow and grasslands would have contributed to the deterioration of the land for gardening. There is no indication that pottery-using people were dwelling on the plains between the coast and the inland river plains. The small quantities of Middle and Late period pottery seem to indicate a change in the use of this zone, and it is worth considering whether the clearing of the forest may relate mainly to the very recent past.

Whether the change in settlement patterns was a product of population increase or of segmentation into smaller, more widely spaced settlements, is not clear. Oram (1977) found that oral histories said that the movement west from the present city area was explicitly a search for a better environmental situation.

The origins of the *hiri* long-distance trading remain a matter of speculation. If it is argued, as oral history does, that the trading is a response to the insufficient and unpredictable local cultivations, then it can only have occurred when the local population was located on or near the coast. If they had remained on the river plains or to the east there presumably would have been no shortage of food. Therefore, on archaeological grounds, it should be argued that the *hiri* probably dates only to the Late period. Oral histories of Boera village suggest the *hiri* was established only ten generations ago, about the 16th century A.D., and on archaeological grounds this is plausible.

On the other hand, Allen (1976:449) argued that the people of Motupore were already specialist traders when they arrived in the Port Moresby area, and that the *hiri* developed in response to the increase in population and the cultural change they introduced. The general lack of evidence for trade both at Motupore and at the other sites makes it impossible to answer this question. The apparent unimportance of the obsidian trade, and the small quantity of other non-local stone artefacts mean that the only direct evidence for trade so far is inconclusive.

This paper has argued that the evidence for local continuity of settlement and ceramic style up to the 16th century argues against the introduction of marked economic change at A.D. 1000. Instead, the most plausible explanation, based on archaeological evidence and oral histories, is that the *hiri* is a local institution. Its origins may lie in the movement, primarily for military reasons, into a zone unfavourable to gardening. Rather than adapting to the greater use of uncultivated, local, plant foods, the local people obtained these through trade, probably elaborating a less formal coastal trading system already in existence.

ACKNOWLEDGEMENTS

The fieldwork on which this paper is based was partly supported by grants from the Myer Foundation and the University of Papua New Guinea. I am grateful to Janet Davidson, Ralph Bulmer and Geoffrey Irwin for helpfully commenting on an earlier draft of the paper.

Notes

1. "Prehistoric" in this paper refers to the period before 1870, i.e. before the eye-witness accounts of early administrators and missionaries were written down, and "historic" refers to the period after this. "Proto-historic" is used to refer to the final period of prehistoric times to which local oral histories pertain, a period of up to 17 generations, or perhaps 500 years ago (Oram 1969, 1975).
2. Archaeological data may possibly be of assistance in this question, as it has in Western Polynesia, where settlements associated with a raised beach level and Polynesian Plain Ware pottery are dated to between the 4th century B.C. and the 3rd century A.D. (Green 1975). The earliest settlement at Taurama, dated so far only on grounds of comparative ceramic styles, is similarly located on a clean sandy beach level slightly higher than the present high water line. Similar pottery in the Yule Island sites is dated to before 50 B.C. and at Nebira Site ACL to earlier than 200 A.D. This suggests the local high sea level could have occurred in the same period as the similar level in the eastern Pacific. An additional point is that Lapita pottery is thought to have been ancestral to both this early southern Papuan ceramic style (Bulmer 1978:370-1) and Polynesian Plain Ware (Green 1975:311). Perhaps the reason we have not yet found Lapita sites in southern Papua is that, as with Western Samoa, they are located on a beach line now below sea level.
3. Identifications of all shell from the excavation in the midden area of Taurama Site AJA, Square 7X, and unworked shell from Sites ACJ and AJA were made by Pamela Swadling. Ornaments, other artefacts and shell manufacturing waste were identified by the author, using a reference collection of Southern Papua shell made by G. Irwin, to whom I am very grateful.
4. Bone identifications from the 1968 excavations at Nebira were made by J. Menzies. Bones from subsequent work at Nebira and from Eriama and Taurama were identified by myself with the use of Menzies' identified specimens for reference. Unfortunately a lack of reference collections in Auckland makes it difficult to take many identifications to species level.

REFERENCES

- Allen, J. 1972. Nebira 4: an early Austronesian site in Central Papua. *Archaeology and Physical Anthropology in Oceania* 7:92-124.
- Allen J. 1976. Fishing for wallabies: trade as a mechanism of social interaction, integration and elaboration on the Papuan south coast. In Rowlands, M. and Friedman, J. (Eds), *The evolution of social systems*:419-455. Duckworth, London.
- Allen J. 1977a. Resource management in coastal Papuan prehistory. In Winslow, J. (Ed.), *Man and environment in Melanesia*:35-44. Australian National University Press, Canberra.
- Allen, J. 1977b. Sea traffic, trade and expanding horizons. In Allen, J., Golson, J. and Jones, R. (Eds), *Sunda and Sahul. Prehistoric Studies in Southeast Asia, Melanesia and Australia*:387-418. Academic Press, London.
- Allen, J. 1977c. The hunting Neolithic: adaptations to the food quest in prehistoric Papua New Guinea. In Megaw, J. V. S. (Ed.), *Hunters, gatherers and first farmers beyond Europe*:167-188. Leicester University Press.
- Ambrose, W. R. 1976. Obsidian and its prehistoric distribution in Melanesia. In Barnard, N. (Ed.), *Ancient Chinese bronzes and Southeast Asian metal and other archaeological artefacts*:341-378. National Gallery of Victoria, Melbourne.
- Bulmer, Susan. 1971. Prehistoric settlement patterns and pottery types in the Port Moresby area: a preliminary review. *Journal of the Papua New Guinea Society* 5:28-91.
- Bulmer, Susan. 1975. Settlement and economy in prehistoric Papua New Guinea: a review of the archaeological evidence. *Journal de la Société des Océanistes* 31:7-75.
- Bulmer, Susan. 1978. Prehistoric culture change in the Port Moresby region. Ph.D. Thesis, University of Papua New Guinea.

- Chalmers, James and Gill, W. Wyatt. 1885. *Work and adventure in New Guinea 1877-85*. The Religious Tract Society, London.
- Dutton, T. E. 1969. The peopling of Central Papua. *Pacific Linguistics, Series B – Monograph No. 9*. Australian National University, Canberra.
- Eden, Michael J. 1974. The origin and status of savanna and grassland in southern Papua. *Transactions of the Institute of British Geographers* 63:97-110.
- Fitzpatrick, E. A. 1965. Climate of the Port Moresby-Kairuku area. In Mabbutt *et al.* 1965:83-97.
- George, Graeme G. 1973. Land mammal fauna. *Australian Natural History* 17:420-6.
- Green, R. C. 1975. Lapita pottery and a lower sea level in Western Samoa. *Pacific Science* 29:309-15.
- Groves, M. C. 1954. Dancing in Poreporena. *Journal of the Royal Anthropological Institute* 84:75-90.
- Groves, M. C. 1960. Motu pottery. *Journal of the Polynesian Society* 69:3-22.
- Groves, M. C. 1972. Hiri. Motu. In Ryan, Peter (Ed.), *Encyclopaedia of Papua New Guinea*:523-527 and 802-805. Melbourne University Press and the University of Papua New Guinea, Melbourne.
- Heyligers, P. C. 1965. Vegetation and ecology of the Port Moresby-Kairuku area. In Mabbutt *et al.* 1965:146-173.
- Irwin, Geoffrey. 1977. The emergence of Mailu as a central place in the prehistory of coastal Papua. Ph.D. Thesis, Australian National University.
- Jones, Rhys. 1969. Firestick farming. *Australian Natural History* 16:224-8.
- Laurie, Eleanor M. O. and Hill, J. E. 1954. *List of land mammals of New Guinea, Celebes, and adjacent islands, 1758-1952*. British Museum (Natural History), London.
- Lawes, W. G. 1879. Ethnological notes on the Motu, Koitapu and Koiari tribes of New Guinea. *Journal of the Anthropological Institute* 8:369-76.
- Lewis, A. B. 1929. Melanesian shell money. *Field Museum of Natural History Publication, Anthropological Series* 19:1-36.
- Mabbutt, J. A. 1965. Summary description of the Port Moresby area. Geomorphology of the Port Moresby-Kairuku area. In Mabbutt *et al.* 1965:12-18 and 106-129.
- Mabbutt, J. A., Heyligers, P. C., Scott, R. M., Speight, J. G., Fitzpatrick, E. A., McAlpine, J. R. and Pullen, R. 1965. *Lands of the Port Moresby-Kairuku area*. Land research series No. 14, Commonwealth Scientific and Industrial Research Organisation, Melbourne.
- Menzies, J. I. 1972. The relative abundance of *Planigale novaeguineae* and other small mammals in the south Papuan savannas. *Mammalia* 36:400-5.
- Ohtsuka, R. 1977. Time-space use of the Papuans depending on sago and game. In Hitoshi Watanabe (Ed.), *Human activity system. Its spatiotemporal structure*:231. University of Tokyo Press, Tokyo.
- Oram, Nigel. 1969. Taurama: oral sources for a study of recent Motu prehistory. In Inglis, K. S. (Ed.), *The history of Melanesia*:423-442. University of Papua New Guinea and Australian National University.

Oram, Nigel. 1977. Environment, migration and site selection in the Port Moresby coastal area. In Winslow, J. (Ed.), *Man and environment in Melanesia*:74-99. Australian National University Press, Canberra.

Paijmans, K. (Ed.). 1976. *New Guinea vegetation*. Commonwealth Scientific and Industrial Research Organisation and Australian National University Press, Canberra.

Peterson, J. A. and Hope, G. S. 1972. The lower limit and maximum age for the last major advance of the Carstensen glaciers, West Irian. *Nature* 240:36-7.

Romilly, H. H. 1889. *From my verandah in New Guinea: sketches and traditions*. David Nutt, London.

Seligman, C. G. 1910. *The Melanesians of British New Guinea*. Cambridge University Press, Cambridge.

Stone, Octavius C. 1876. Description of the country and natives of Port Moresby and neighbourhood, New Guinea. *Proceedings of the Royal Geographical Society, London* 20:92-109.

Swadling, Pamela. 1976. Changes induced by human exploitation in prehistoric shellfish populations. *Mankind* 10:156-62.

Swadling, Pamela. 1977. Central Province shellfish resources and their utilization in the prehistoric past of Papua New Guinea. *Veliger* 19:293-302.

Swadling, P., Aitsi, L., Trompf, G. and Kari, M. 1977. Beyond the early oral traditions of the Austronesian people of the Gulf and Western Central Provinces. *Oral History* 5:50-80.

Turner, W. Y. 1877-8. The ethnology of the Motu. *Journal of the Anthropological Institute* 7:470-97.

Vanderwal, R. L. 1973. Prehistoric studies in central coastal Papua. Ph.D. Thesis, Australian National University.

Williams, F. E. 1932. Trading voyages from the Gulf of Papua. *Oceania* 3:139-66.

Williams, F. E. 1939. The reminiscences of Ahuia Ova. *Journal of the Royal Anthropological Institute* 69:11-45.

Received 16 November 1978