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Prehistoric stone artefacts from Enga and the implication of links between the highlands, lowlands and islands for early agriculture in Papua New Guinea

by

Pamela SWADLING*, Polly WIESSNER** and Akii TUMU***

ABSTRACT

Two of the unanswered questions of Papua New Guinea prehistory are: (1) whether agriculture was present in the mid-Holocene not only in the highlands but also in the lowlands and Bismarck Archipelago and (2) whether the presence of agriculture might have been influenced by interaction between these regions. This paper addresses these questions through an analysis of prehistoric stone mortars, pestles and figures, which hold information on both style and function.

KEYWORDS: Papua New Guinea, Enga Province, Pacific archaeology, early agriculture, Sepik-Ramu inland sea, networks, social interaction, mortar and pestle, stone figure

RÉSUMÉ

Cet article traite deux des questions sans réponse de la préhistoire de la Papouasie Nouvelle-Guinée : (1) l'agriculture était-elle présente dans le mi-Holocène non seulement dans les hautes terres mais également dans les basses terres et l'archipel Bismarck et (2) la présence de l'agriculture pourrait-elle avoir été influencée par l'existence de relations entre ces deux régions. Cet article aborde ces questions en analysant des mortiers, des pilons et des figures en pierre préhistoriques, qui livrent des informations sur leur style et leur fonction.

MOTS-CLÉS : Papouasie Nouvelle-Guinée, province Enga, archéologie du Pacifique, début de l'agriculture, mer intérieure du Sepik-Ramu, réseaux, interaction sociale, mortier et pilon, figure en pierre

Stone mortars, pestles and figures are important archaeological finds that offer information about the prehistory of Papua New Guinea that is not available from other sources. They are used in this paper to address the questions (1) whether agriculture was also present in the lowlands and

Bismarck Archipelago as well as the highlands in the mid-Holocene and (2) whether the presence of agriculture was influenced by the social interaction that linked these regions. In the highlands they have been dated to the period 8,000 to 3,000 cal. years ago. In the lowlands and

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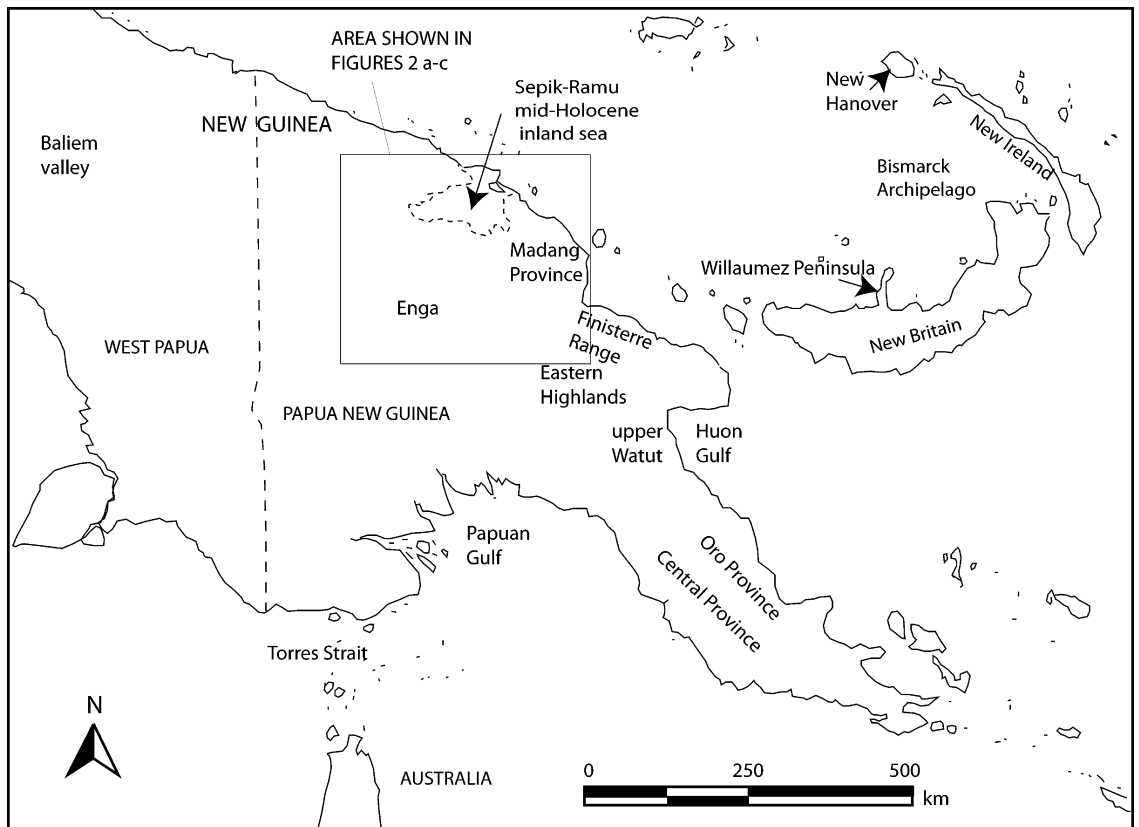


FIGURE 1. – General location map

islands mortars and pestles have not been recovered in archaeological excavations, but can be dated by association and relative chronology. They do occur in association with the mid-Holocene shoreline of the former inland sea in the Sepik-Ramu (figures 2a and c), but are absent from the floodplain that formed after 4,000 cal. BP. A relative chronology is provided in the islands by their absence from Lapita assemblages (Chappell, 2005; Swadling and Hide, 2005; Torrence and Swadling, 2008).

Neuhaus (1911: 140) was the first to propose that the prehistoric stone mortars and pestles found in Papua New Guinea were used to produce pounded taro puddings. Looking at their distribution throughout Papua New Guinea mortars and pestles generally occur in those areas where taro (rather than bananas, yams or sago) is the staple or could have been in the past (Swadling and Hide, 2005; Swadling, 2005). They are rarely found in rock shelters, most come from land suitable for gardening and building houses. Many have been found during the construction of airstrips. Taro cultivation has declined in many parts of PNG due to taro blight, beetle damage and the introduction of higher yielding crops. The distribution of these artifacts is used in this paper as a proxy for the location of

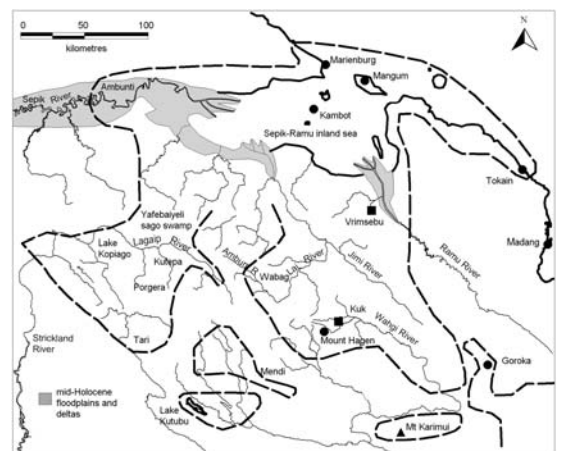


FIGURE 2a. – The mid-Holocene Sepik-Ramu inland sea (shoreline based on Chappell, 2005)

taro cultivation and human occupation in Enga and elsewhere in Papua New Guinea during the mid-Holocene.

While the distribution of these artifacts provides us with a broad overview of where people were living and their subsistence, the different styles of mortars and pestles and their distribution give us information about social networks. The elaborate forms of mortars and pestles found in Enga are comparable to finds from

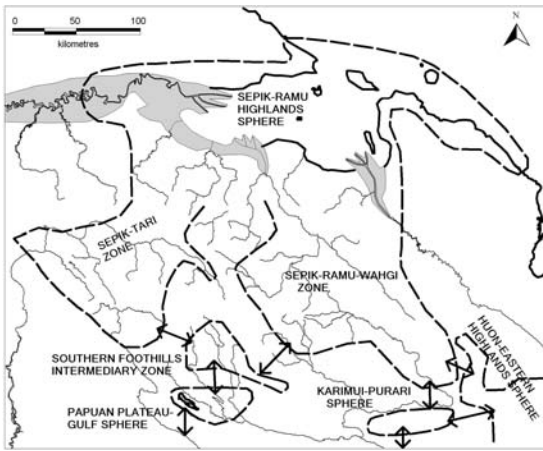


Figure 2b. – Schematic representation of the interaction spheres and zones proposed in the text

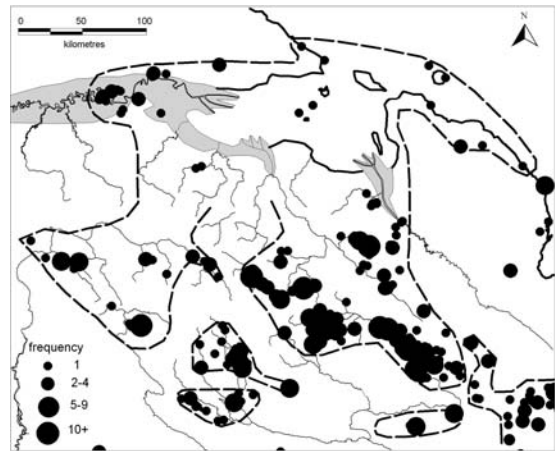


FIGURE 2c. – Mortar and pestle distribution and frequency (based on database under construction by Swadling)

other provinces. Many of these have coastal affinities. This distribution pattern demonstrates that mid-Holocene communities in Enga, as elsewhere in the highlands (see Swadling and Hide, 2005; Swadling, 2005), were linked with the coast, in this case the Sepik-Ramu inland sea until it ceased to exist after 4,000 cal. years ago (Chappell, 2005). Following the infilling of the inland sea the interaction distance between coastal and highlands communities increased and the continuation of coastal to highlands interaction became dependent on communities that occupied the riverbanks of the southern tributaries that crossed the Sepik-Ramu floodplain (Swadling, n.d.).

From an overall perspective coastal links rather than trans-highlands social networks seem more important in explaining the distribution of mortar, pestle and figure finds in the New Guinea highlands. Highlanders participated in a number of interaction spheres that extended inland from the coast. The four largest coastal to highlands interaction spheres extended inland from (1) the Sepik-Ramu inland sea into the central highlands, see figure 2b, (2) from the Huon Gulf into the eastern highlands, (3) from the Huon Gulf into the upper Watut and (4) from the Oro coast into the highland valleys of Oro and Central provinces (Swadling and Hide, 2005; Swadling, 2005; Torrence and Swadling, 2008). The nature of these spheres largely explains the regional variability found in the distribution of stone mortars, pestles and figures in the New Guinea highlands, including the general absence of these artifacts in the Baliem valley of West Papua. Despite this being the case, some mortar styles are clearly local innovations within the central highlands.

Enga province was chosen as the highlands case study in this paper for two reasons. Firstly it is located south of the former Sepik-Ramu inland sea (figures 2a and 3). Secondly differences in style distributions indicate that two zones of social networks extended from the former shoreline of the inland sea into what is now Enga province. One set was aligned by way of the lower Lagaip to the large agricultural populations living in the Tari basin, whereas the other served the Wahgi and its associated valleys, such as the Lai. Smaller networks extended to the south coast (figure 2b). These different networks indicate that there were multiple entry routes for exchanging tangible and intangible products between coast and highlands in the mid-Holocene. In other words the highlands were not isolated from the coast, nor were coastal inhabitants isolated from the highlands at this time. Crops, plumes, ritual practices, songs, decorations, etc. could have been shared and transferred from coast to highlands or vice-versa by these routes.

Agricultural history in the highlands

Unlike in the lowlands and islands agriculture is documented as being present in the highlands since the early Holocene. During the Holocene palaeoenvironmental records document increasing deforestation in the highlands valleys. Although burning occurred in the highlands in the Pleistocene, it is only in the Holocene that it is associated with sediment build-up in low-lying areas. These sediments were produced by slope wash following clearing and gardening activities. By 7,000 to 6,000 years ago the lower parts of all the major highland valleys in PNG were domina-

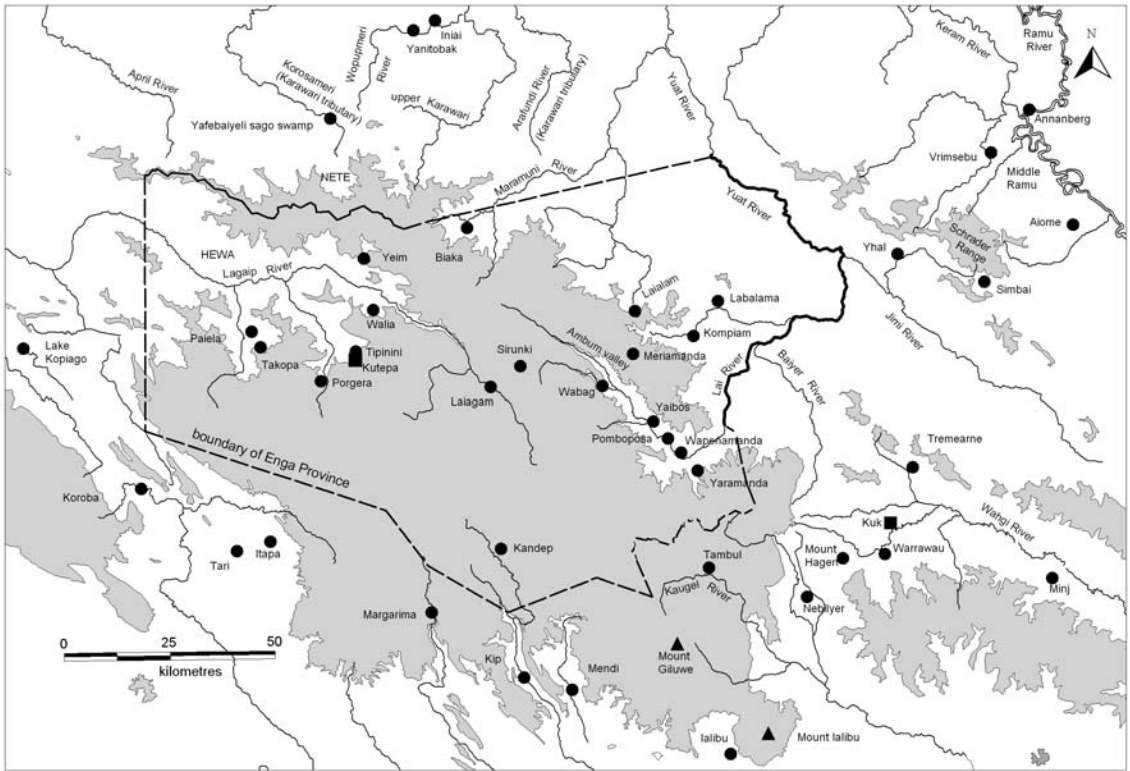


FIGURE 3. – Location map for Enga and nearby areas (shaded area above 2100 m)

ted by anthropogenic grassland. By the mid or late Holocene this is also the case for lower montane sites and isolated valleys (Hope and Haberle, 2005: 547).

The oldest site with evidence for the cultivation of plants in Papua New Guinea is Kuk in the Western Highlands (figures 2a and 3). Taro and bananas were being planted in gardens at Kuk from 10,000 years ago (Denham *et al.*, 2003). The initial garden evidence, which only survives in a wetland context, consists of taro starch and banana phytoliths, as well as evidence for other crops and features such as garden stake holes. The deposition of sediments in low-lying areas indicates that similar gardening activities were taking place on valley slopes, but features from these gardens have not survived. By about 7,000 years ago garden mounds in which crops are planted were being made. The oldest gardening tool is a woman’s digging stick found near Tambul. It dates to about 4,500-4,000 years ago (Golson, 1996: 145). Shortly before 4,000 years ago the first rectangular field systems, consisting of networks of garden ditches, are in use (Denham, 2006).

Frequency of mortar and pestle finds in Enga

The Enga sample consists of 99 mortars and 34 pestles. Table 1 gives a general appraisal of the types of mortars and pestles recorded in Swadling’s database. For both mortars and pestles elaborate types are less frequent than undecorated ones.

TABLE 1. – Number of mortars and pestles in the Engan sample

mortars	
mortars of unknown shape	3
plain bowls in boulders	19
plain bowls with shaped exterior	42
bowls with elaborate decoration or pedestal bases	<u>35</u>
	99
pestles	
pestles of unknown shape	4
plain pestles	25
pestles with elaborate decoration	<u>5</u>
	34

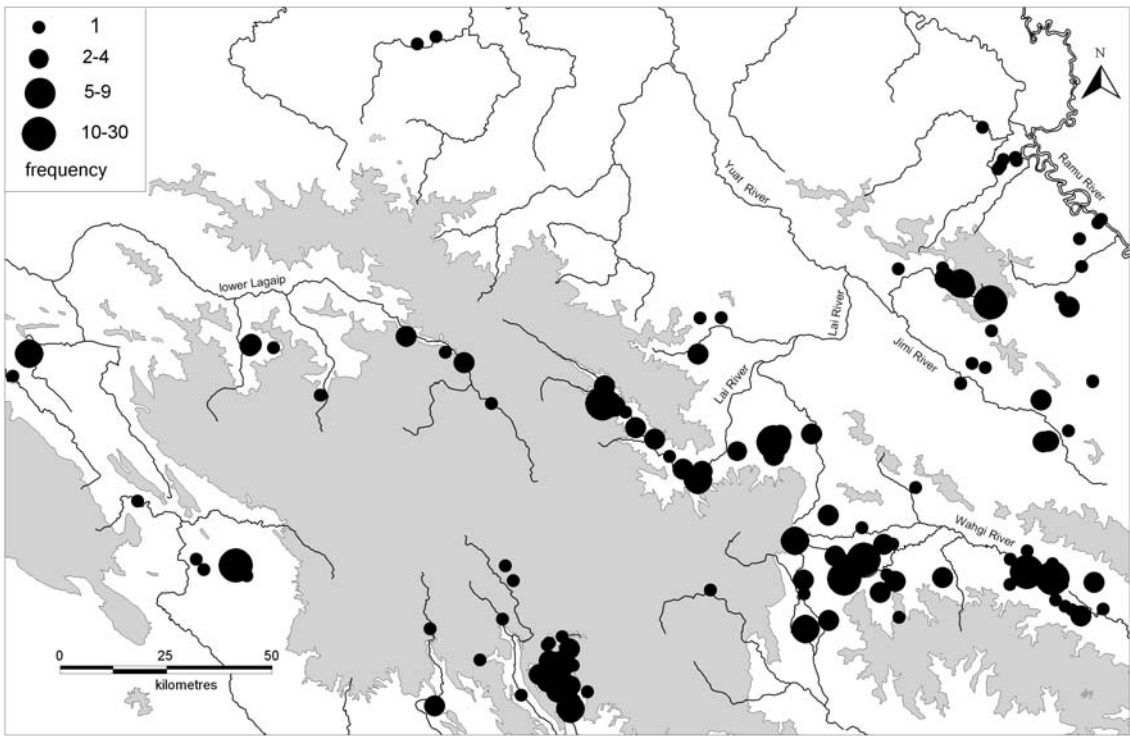


FIGURE 4. – Distribution and frequency of mortars and pestles in relation to altitude (shaded area above 2100 m)

Distribution of mortar and pestle finds in Enga

The main clusters of mortars and pestles found in Enga are in the valleys of the Lai and its tributaries in the east and the valleys of the lower Lagaip and its tributaries in the west (figure 4). Their original use is unknown. Historical traditions stretching back some 350 years and eyewitness accounts report the discovery of these artefacts while building houses and gardens, their interpretation as stones or bones of the ancestors, and use in rituals of fertility. Originally they were probably made and used for food preparation, feasting and gardening rituals by small sized horticultural communities living in dispersed hamlets adjacent to their gardens. The distribution of these artefacts in modern times probably approximates the prehistoric one as Wiessner was told that clans did not take their sacred stones with them when they migrated to distant areas after being roused by warfare or in pursuit of new and better land. Migrants sought oddly shaped stones and interpreted them as ancestral stones for their new areas of residence.

Few mortar and pestle finds have been reported from above 2,100 metres (figure 4). All the finds come from areas suitable for taro cultivation (figure 5). Clarke’s (1977) study of taro

gardening at all elevations where cultivation now occurs concluded that people could have supported themselves growing taro in high altitude areas where gardeners now cultivate sweet potato, but would have had to cope with slower maturation rates and lower yields. When Wiessner made a survey of ritual sites in the high altitude area of the upper Lagaip she found that mortars and pestles do not feature there as ritual stones. This low frequency and lack of elaborate mortars and pestles from high altitude areas confirms Wiessner and Tumu’s (1998: 33) findings, based on oral histories, that such areas were formerly inhabited by mobile ‘hunter-gatherer’ groups and have only been densely settled by agriculturalists since the introduction of the sweet potato. The latter was introduced some 250-400 years ago (Wiessner, 2005: 124).

Although people have long had an impact on the Engan landscape, the population density remained low until sometime between 1795 and 1825 (Wiessner and Tumu, 1998: 33). On the basis of historical traditions it is estimated that 10,000 to 20,000 people inhabited the major Engan valleys prior to the introduction of the sweet potato (Wiessner and Tumu, 1998: Appendix 2). By the time of the 1980 census the population was 150,000 (Wiessner and Tumu, 1998: 56).

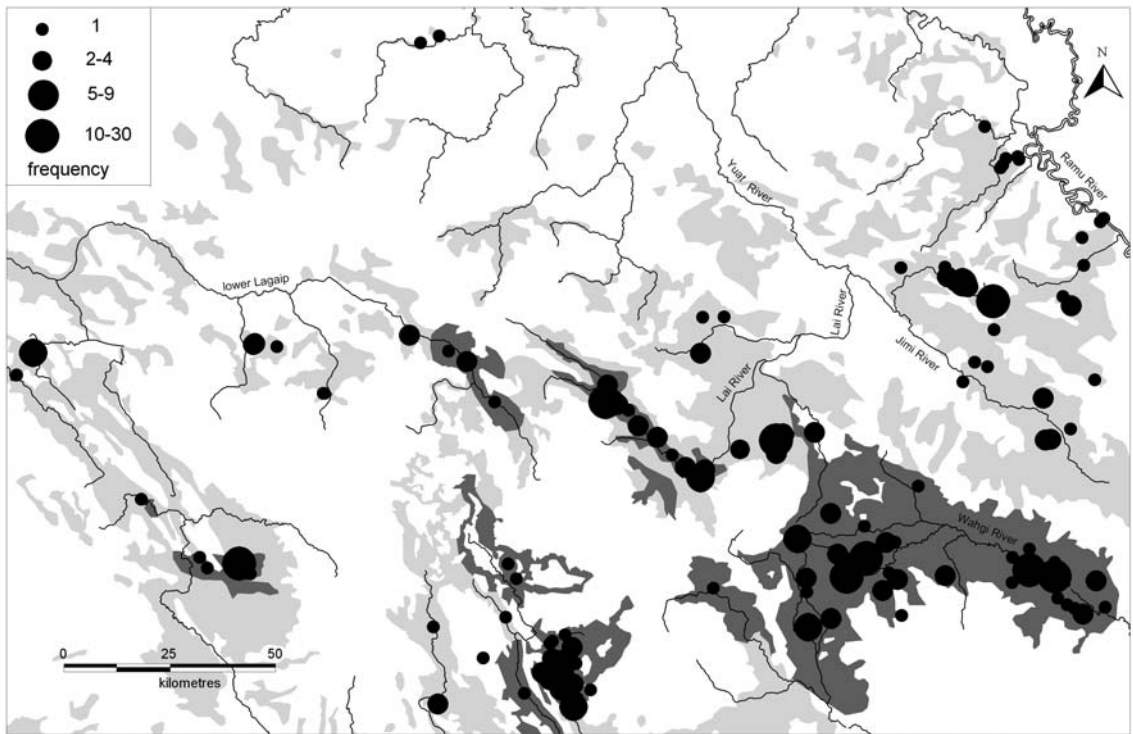


FIGURE 5. – Distribution of mortars and pestles in relation to cultivated land. All shading is cultivated land (following Saunders, 1993). This consists of 75 % to 10 % anthropogenic vegetation with 20 % to <1 % in current use. Darker shading indicates modern high population density (above 50 persons per sq km)

The Sepik-Ramu to highlands interaction sphere

As mentioned above, Enga was chosen as the highlands study area for this paper as the two most important interaction zones that extended into the highlands from the shores of the Sepik-Ramu inland sea are represented in Enga. The Lai valley was the western extension of the Sepik/Ramu-Wahgi zone and the lower Lagaip was the highlands link within the Sepik-Tari zone (figure 2b). Enga myths for the ‘original’ dispersal of tribes mirror the Sepik/Ramu-Wahgi and Sepik-Tari division. Tribes of Eastern Enga describe a feast on the slopes of Mt. Giluwe for which a mythical ancestor named Maragomoye gathered people from all corners of the world and distributed the food at daybreak so that people could disperse. Why he did this is not told. After the distribution people set off for surrounding regions, Mendi, Ialibu, Mt. Hagen, and others. A man named Kiualumaita and his sister traveled to the west to found tribes of the Kaugel Valley, Tambul and the Saka valley of eastern Enga. Western Enga tell quite a different myth, one of incest and cannibalism that triggered the dispersal of the four sons of Hela to found groups of the Papuan Plateau who the

Enga call Duguba, the Duna, the Huli and the western Enga (Wiessner and Tumu, 1998: 23-24).

Within the Wahgi and its associated valleys clusters of finds suggest that there were a number of sub-centres. The populations living in the Lai River valleys were the most western sub-centre of the Sepik/Ramu-Wahgi zone. Access from the inland sea to this particular sub-centre would have been via the Arafundi (a Karawari tributary), and the tributaries of the Yuat, namely the Maramuni and Lai rivers. Other sub-centres had different routes, for example the eastern Wahgi would have been linked with the inland sea via the Schrader Range and Jimi valley (figures 2a and 3).

The Tari basin was the main focus for the other interaction zone. It would have been accessed from the shores of the inland sea by way of the Karawari and Korosameri river valleys and the intermediary highlands valley of the lower Lagaip (figures 2a and 3). Forest clearance in this basin seems to lag behind the Wahgi valley, occurring about 5,000 cal. BP (Haberle, 2003: 155).

Distance may have been a factor causing variation in the transfer of ideas within the two zones. The distance between the coast and the

large agricultural valleys was greater for the Sepik-Tari zone than was the case with the Sepik/Ramu-Wahgi zone. However, stylistic features on stone mortars, pestles and figures indicate that there was some trans highlands contact between these zones via the southern foothills intermediary zone (figure 2b).

In addition to being alignments to the north coast, both the Sepik/Ramu-Wahgi and Sepik-Tari zones were part of major social networks that extended north-south across New Guinea (figure 2b). These north-south linkages continued at a reduced rate after the formation of the Sepik-Ramu floodplain until they were directly or indirectly disrupted by European trade activities in the early twentieth century.

The north-south trade axis that extended north from the Tari basin to the lower Lagaip and south to the Papuan Plateau was prior to the arrival of Europeans the most important trade alignment for the Tari (Ballard, 1994: 140-141). The Sepik component of this trade to Tari had probably declined after 1905 when conflict between the Iatmul and Chambri disrupted trade. The replacement of stone tools by metal in the middle Sepik probably played a major part in instigating this conflict. This disruption would have terminated the trade alignment from the north coast across the middle Sepik floodplain to the Karawari river system and thence to the lower Lagaip valley in the highlands (Swadling, n.d.).

Another important north-south trade axis extended from the Middle Sepik through the western Wahgi to Torres Strait. Pearl shell gathered in Torres Strait reached the Sepik by means of this route. In 1932 Margaret Mead observed pearl shell crescents being traded down the Yuat River, a Sepik tributary. These trade goods had come from the Wahgi valley, having taken the following route from the south coast. This was upriver to the Papuan Plateau, on to the foothills west and south of Mts Giluwe and Ialibu (Mendi to Ialibu), from these foothills to the Kaugel and Nebilyer valleys and thence to the Wahgi valley. The pearl shell crescents Mead observed in the middle Sepik in 1932 would have travelled such a route. A year later Europeans were flying pearl shells into the Hagen area as they found that the people in the Hagen area valued this product. Strathern (1971: 203) suggests that prior to 1933 partnerships of big men in the Mount Hagen

area were probably 'predominantly aligned along a north-south axis.' Certainly the men of the lower Nebilyer, with their contacts with Kaugel and Ialibu, had control over the flow of pearl shells into Hagen. This north-south trade axis has a long history as pearl shell fragments have been found in deposits dating to 3,000 to 2,000 years ago in the Ritamauda rock shelter in the Yuat gorge (Swadling, 1994: 135, 141-146).

It is interesting, by way of contrast with the Wahgi, to note that pearl shells were not common in most parts of Enga and the Tari basin in 1938. Bill Adamson observed on a major patrol made that year that the Huli seem to have little shell, but are keen to acquire it (Bird, 2003: 273).

Historical differences within Enga

There are considerable geographic differences between the Lai and lower Lagaip valleys (figure 3). The differing livelihood potential of the valley systems of the Lai and lower Lagaip as well as the Engan high country, together with their different spheres of interaction, has probably long influenced the nature of ritual behaviour in these areas.

Early historical traditions describe the pre-sweet potato life styles of the people living at an altitude of 1,500-1,900 metres in the main and tributary valleys of the Lai River as sedentary horticulturalists. They cultivated taro, yams and other crops on the flat river terraces, let their pigs forage on the mid valley slopes, and hunted and gathered in the high forest. Horticulturalists also resided from 1,900 to 2,100 metres in areas such as the Ambum valley of the upper Lai, but they were more serious hunters having access to high country rich in game. Above 2,100 metres scattered relatively mobile groups planted some taro but were mainly dependent on hunting and gathering (Wiessner, 2005: 121).

Prior to the introduction of the sweet potato the horticulturalists living in the lower Lagaip valley frequently faced famines. They had traditions of supplementing their diet with food obtained by trade, especially sago¹ starch and *Pangium edule* from groups such as the Nete on the upper Korosomeri (Wiessner and Tumu, 1998: 68-69). Living at 1,200 to 1,500 metres, the Nete obtained their sago from stands located below 800 metres in altitude. One Nete clan in

1. Sago macro-fossils have been recovered from swamp deposits dating to 39,630± 810 BP near Annenberg in the middle Ramu (Chappell 1993). Although this find is not associated with human activity it does demonstrate that sago was present during the Pleistocene. The age of such sago stands as Yafebaiyeli is of considerable interest in terms of social interaction between the lowlands and the highlands as Yen (1995: 836-837) considers all stands above 300 metres in altitude to have been planted.

the 1960s had rights to a section of the Yafebaiyeli sago swamp, 10 square acres in size, located at an altitude of 600 metres in Gadio territory. The sago flour was carried upslope after being manufactured into balls weighing up to 30 kilograms (Dornstreich, 1974: 217).

Oral traditions tell that the pre-sweet potato cults of the agriculturalists living in the main and tributary valleys of the Lai River were in the hands of the elders and involved feasting with the ancestors to elicit their cooperation and goodwill. In the lower Lagaip cults were in the hands of ritual experts who had specialised knowledge and could perform spells and other procedures. Rituals were performed for both ancestors and other supernatural beings. They were permeated with mystery, fear and goals of appeasement. The agriculturalists living in both the Lai and lower Lagaip valleys did not have initiation ceremonies that introduced young men to the secrets of ritual life. However, these ceremonies were practised until the mid-xxth century by groups living in high-altitude areas who claim a pre-sweet potato history as hunter-gatherers (Wiessner and Tumu, 1998: 194-195; Wiessner, 2004).

Links between the highlands, lowlands and islands

The following discussion of different types of artifacts looks first at finds from Enga and asso-

ciated parts of the highlands, then considers the evidence for links with the shore of the former inland sea, and east along the north coast to West New Britain and other parts of the New Guinea mainland.

From the nature of stone mortars, pestles and figures it seems likely that there were differences in ritual practices in the Lai, lower Lagaip and the high altitude areas of Enga in the mid-Holocene, just as there were in the xixth and early xxth centuries. There are marked differences between the stone figures, elaborate mortars and pestles from the Sepik-Tari zone and the Sepik/Ramu-Wahgi zone, see Table 2. In addition to the varied agricultural potential between the lower Lagaip and Lai valley described above, other factors may have contributed to these differences. Firstly, access to these areas from the shores of the former Sepik-Ramu inland sea would have been achieved by different sets of rivers. Secondly, as mentioned above the distance was greater between the shores of the former Sepik-Ramu inland sea and the large populations resident in the agricultural centre at Tari, than was the case with the agriculturalists in the Wahgi and associated valleys such as the Lai. There were also inputs into the Wahgi and associated valleys originating from the Keram/middle Ramu area, which was one of the major populations centres on the shores of the inland sea. All these factors may have led to the observed differences.

artifact /technique	Sepik-Tari zone	Sepik/Ramu-Wahgi zone
stone figures	marsupial/bird forms: lack lower limbs, a raised decorative band is common	provenanced finds of marsupial figures come from high altitude areas legs are present on full body forms heads have either a long snout with prominent nostrils or a short snout with little or no nostril depiction
elaborate bird pestles	lack wings	have wings
elaborate mortars	low frequency of pedestal mortars	high frequency of pedestal mortars
decorative technique	bossed mortars are rare, but alternative techniques are used to produce the effect of a ring of bosses on mortars	common use of a ring of bosses as a decorative technique on mortars

TABLE 2. – Main differences in mid-Holocene elaborate artifact finds between the two interaction zones

Stone figures

The marsupial or bird figures from the two zones fall into two groups (figures 6-7). Those from the lower Lagaip, the Nete area to the north, and the Tari and Mendi areas to the south

lack lower limbs and often have a raised band in the area of the abdomen (figure 6). A raised band is also used as a form of decoration on mortars in the Tari area.

By contrast legs are represented on full body carvings on the figures from the upper Lai and

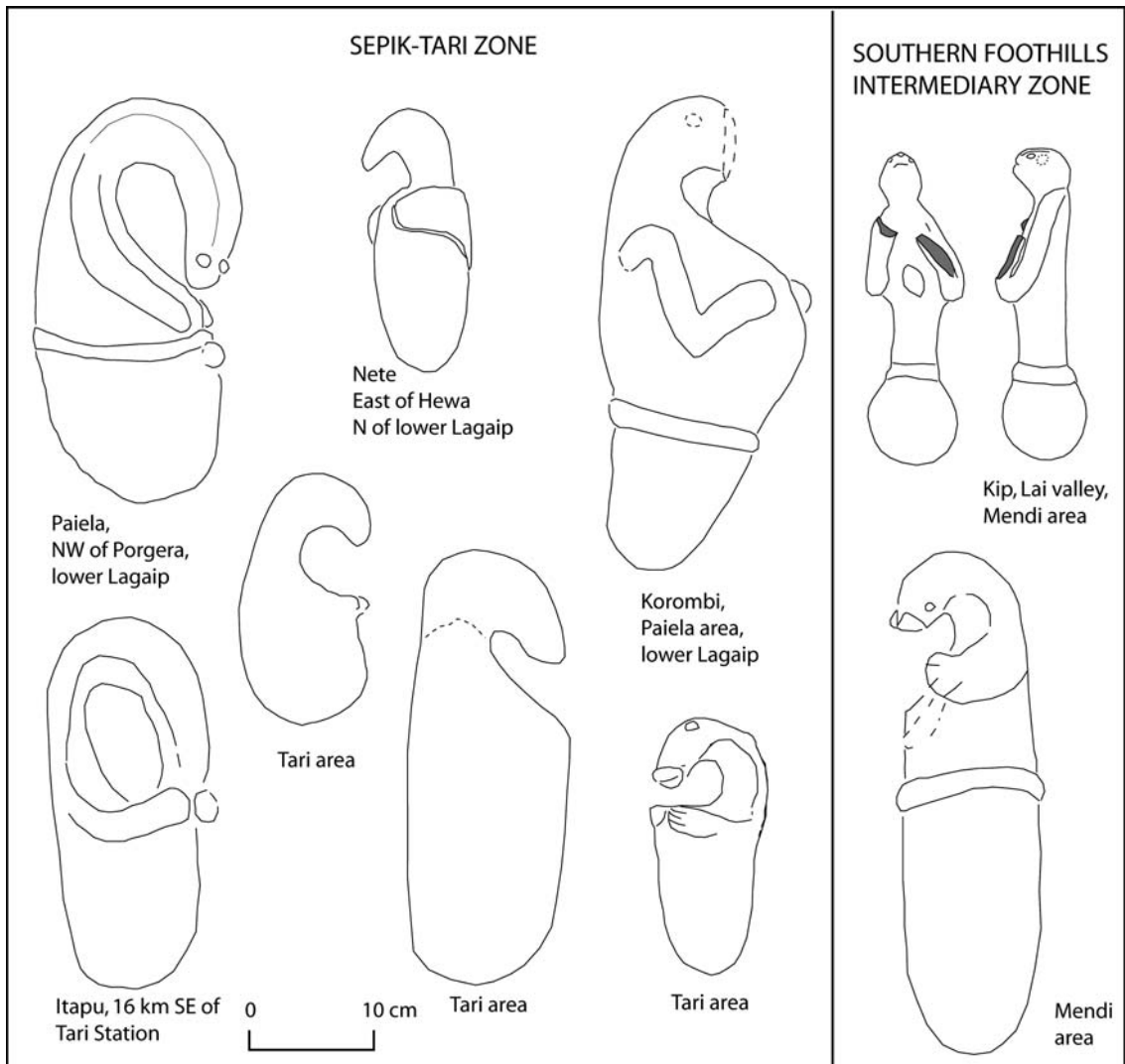


FIGURE 6. – Marsupial and bird figures plus a related pestle. These artifacts lack lower limbs and often feature a raised decorative ring. They are from the Sepik-Tari zone and foothills west and south of Mts. Giluwe and Ialibu. Until this study the Nete figure has been considered to be a pestle. (Based on Newton 1979 and database under construction by Swadling.)

Maramuni rivers. As well as legs, two head styles are also present. One has a longer snout with elaborate nostrils whereas the other has a shorter snout with little or no nostril depiction (figure 7). All the figures with specific provenances come from high altitude areas (for locations see figure 3), the two without specific provenances were obtained on the one hand during road construction in an unknown part of Enga and on the other bought on the Baiyer river roadside. One of the figures with elaborate nostril depiction from Ambum has been dated using micro-rootlets found in a micro-crack during conservation work. These rootlets provided the material for an AMS radiocarbon date for when the artifact was lost or discarded. The result is a date of about 3500 cal. years ago (Tworek-Matuszkiewicz, 2002a, 2002b).

What is striking about the distribution of the western group is that they were found along the important north-south trade axis that extended from the Sepik watershed south to the Tari basin, apart from one figure and a related pestle coming from the eastern trade axis (or southern foothills intermediary zone) running from Tari to the Mendi area (figures 2b and 3).

Zoomorphic/anthropomorphic figures with some resemblance to the Engan finds have been found in the lower Sepik, middle and upper Ramu, Gumine in Simbu and near the Girua River on the slopes of Mount Lamington in Oro. Despite the geographic spread of these figures, an unusual stylistic feature suggests that these resemblances may be based on a common iconography. The specific feature is the presence of a ridge that joins the shoulders on the back of many figures. It is found for example on the

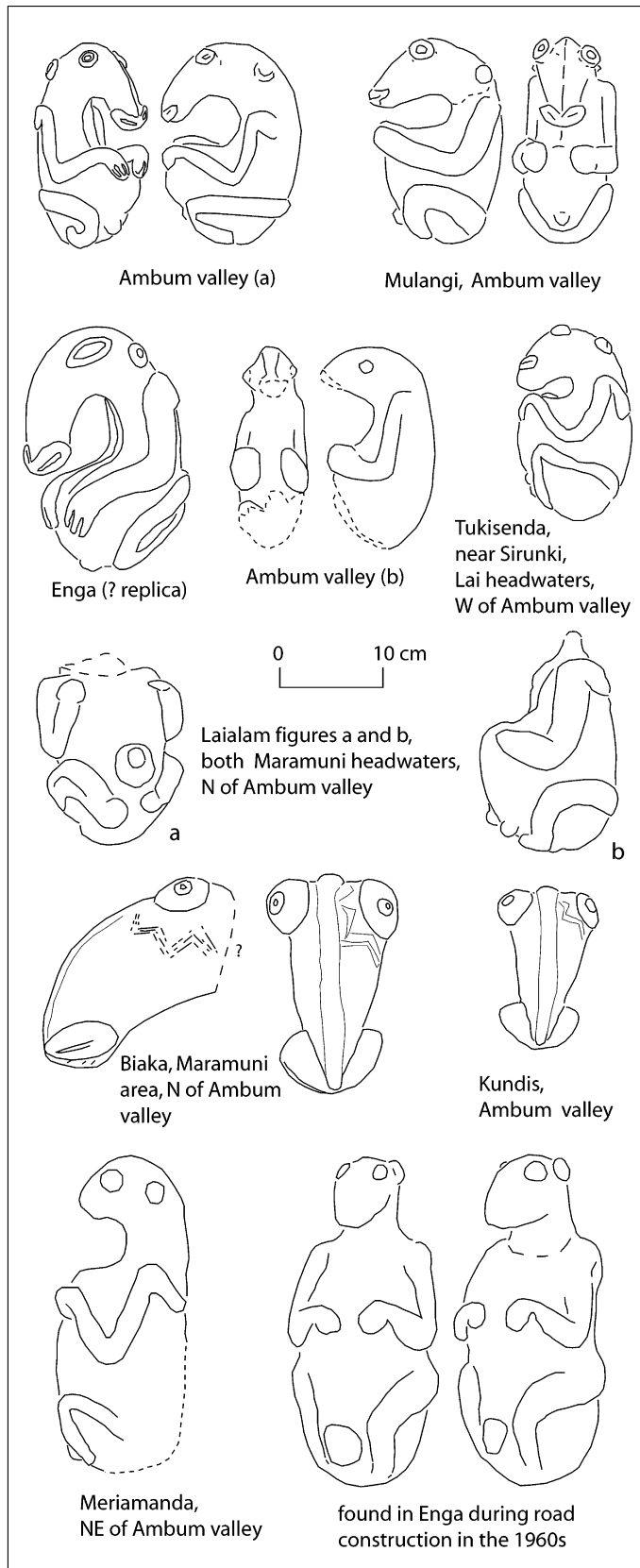


FIGURE 7. – Marsupial figures associated with high altitude areas in the western part of the Sepik/Ramu-Wahgi zone. Two head styles are present, namely a long snout with elaborate nostrils and a short snout with little or no nostril depiction. The Laialam figure (a) has no scale and the bottom right of the Meriamanda figure is estimated as it was not shown in the available photograph. (Based on Newton 1979 and database under construction by Swadling.)

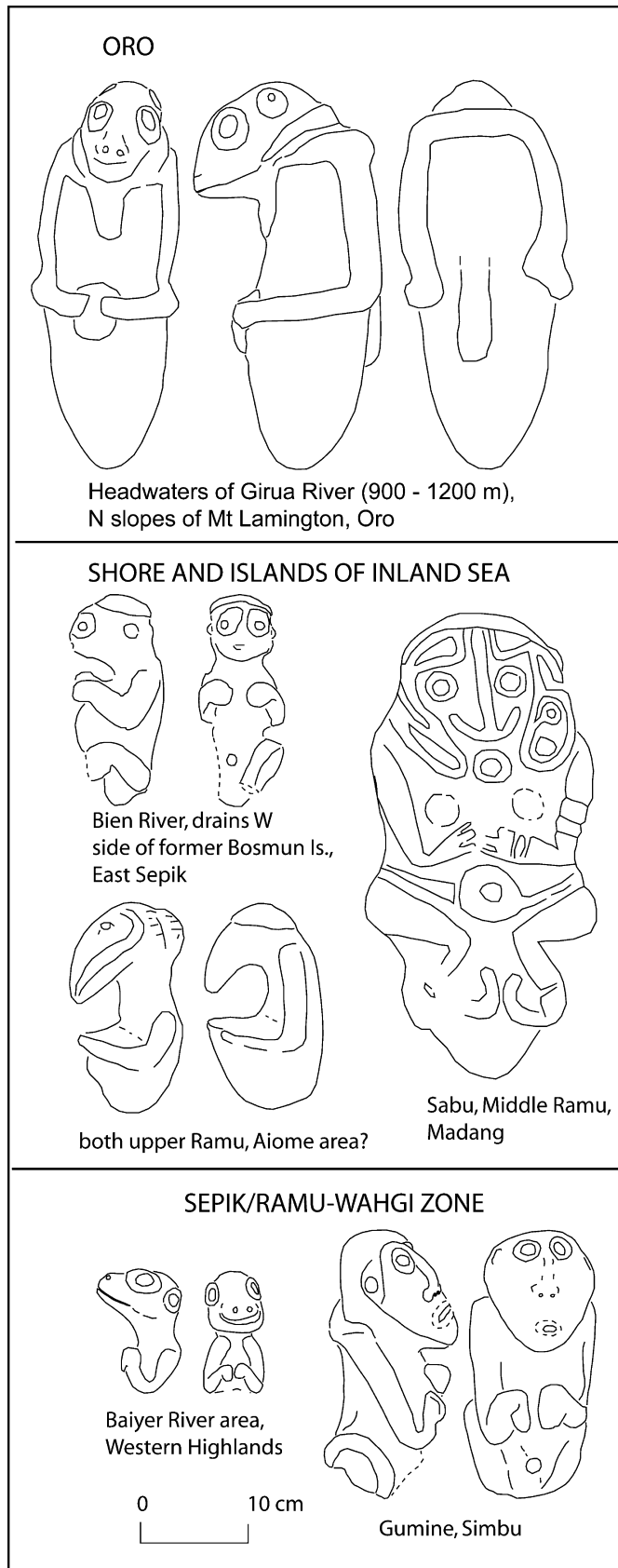


FIGURE 8. – Figures from outside Enga. The extent of the upper Ramu is problematic as it can refer to the Aiome area (Madang Province) or the Eastern Highlands. The Gumine side view is drawn from a photo whereas the front view of the figure is from a clay replica. (Based on Newton 1979 and database under construction by Swadling.)

Ambum figure from Enga, and also features on the figures from Gumine in Simbu and Girua in Oro (figure 8).

Bird pestles

The only representations of actual species in the central highlands, namely a cassowary and hornbill, come from the Sepik-Tari zone (figure 9). Just as figures lack legs in the lower Lagaip, bird pestles from the Tari-Sepik zone lack wings. Bird pestles with wings are present in the Lai valley system, mainly in the middle Lai and are also a major marker of the Sepik/Ramu-Wahgi zone. Finds from Yhal in the Kaironk valley, the area between the Lai and Baiyer rivers, the Lai valley up to Wabag, and the many finds in the Western Highlands and Simbu show a clear orientation to the Sepik-Ramu. The find from the Mendi area is the only find of a winged bird pestle from the Southern Highlands in the database. It is probably significant that it was found along the important N-S trade alignment through the southern foothills intermediary zone mentioned above (figure 2b).

Finds of bird pestles from Tokain on the Madang coast and from Marienberg in the lower Sepik, where a white sand beach existed in the mid-Holocene, as well as others from the Willaumez Peninsula in New Britain, Aikora in Oro and Wonia in Western Province indicate a wide coastal distribution of the bird imagery and ritual that gave rise to these artifacts.

Bossed mortars

Bossed mortars with rounded bases are common in the Sepik/Ramu-Wahgi zone, but curiously are absent from the Sepik-Tari zone (figure 10). Bühler (1946-1949: 579) and Riesenfeld (1955: 58) recognised that mortars with rounded bases and bosses are only found in eastern New Guinea and in West New Britain. Within eastern New Guinea they occur in parts of Enga, Western Highlands, parts of Southern Highlands, Simbu, Eastern Highlands, in the Schrader Range of Madang, as well as in coastal Oro and in the Oro/Central province highlands, the upper Watut river system in Morobe and in New Britain east as far as the Willaumez Peninsula. They appear to be absent from East New Britain, New Ireland, Manus, Bougainville, Sandaun, Milne Bay and Gulf provinces, as well as West Papua.

Pedestal mortars

Another major difference in the stone mortars from the Sepik-Tari zone compared to those from the main and tributary valleys of the Lai river is the low frequency of pedestal mortars in the former and high frequency in the latter. Only one plain pedestal mortar comes from the lower Lagaip and its tributaries whereas 24 plain and decorated pedestal forms come from the Lai and its tributaries. In the Sepik/Ramu-Wahgi sphere pedestal mortars are commonly decorated with an encircling ring of bosses, in much the same way as the simple bowl mortars mentioned above (figures 10 and 11). There are only two elaborately decorated pedestal mortars from the Tari area in the database. One of these is decorated in an alternative way so that the end result resembles a ring of bosses (figure 11a). This is done by the use of an undulating raised band.

Pedestal mortars with bosses are found in the main Lai valley and examples occur in the Sepik. They are found in most cases in the eastern parts of the Southern Highlands, the Western Highlands, the Schrader Range in Madang, Simbu and mainly in the southwestern part of the Eastern Highlands. They are characterised by an encircling row of bosses on the upper body above the waist. The base is usually flared wider than the waist.

Outside of the Sepik/Ramu-Wahgi sphere plain pedestal mortars are only known from the Oro/Central province highlands. As the Sepik finds are the only pedestal mortars decorated with a ring of bosses above the waist from a lowland or coastal area, it is likely that this style is a highlands innovation.

Anthropomorphic face mortars

Mortars decorated with anthropomorphic faces are not common in eastern New Guinea, but finds from diverse regions seem to share stylistic features. This is achieved in a somewhat unconventional way in the case of the Takopa find from the lower Lagaip.

The Takopa mortar from the Paiela area has the usual long nose with the upper part extended to make an encircling frame for the face, but instead of raised bosses extending around the circumference of the bowl from behind the upper face, it has a row of depressions. It has cheek 'dimples' like finds from elsewhere, but as with the bosses the Takopa dimples are depressed rather than raised, and the mouth is clearly defined. No other anthropomorphic face mortar

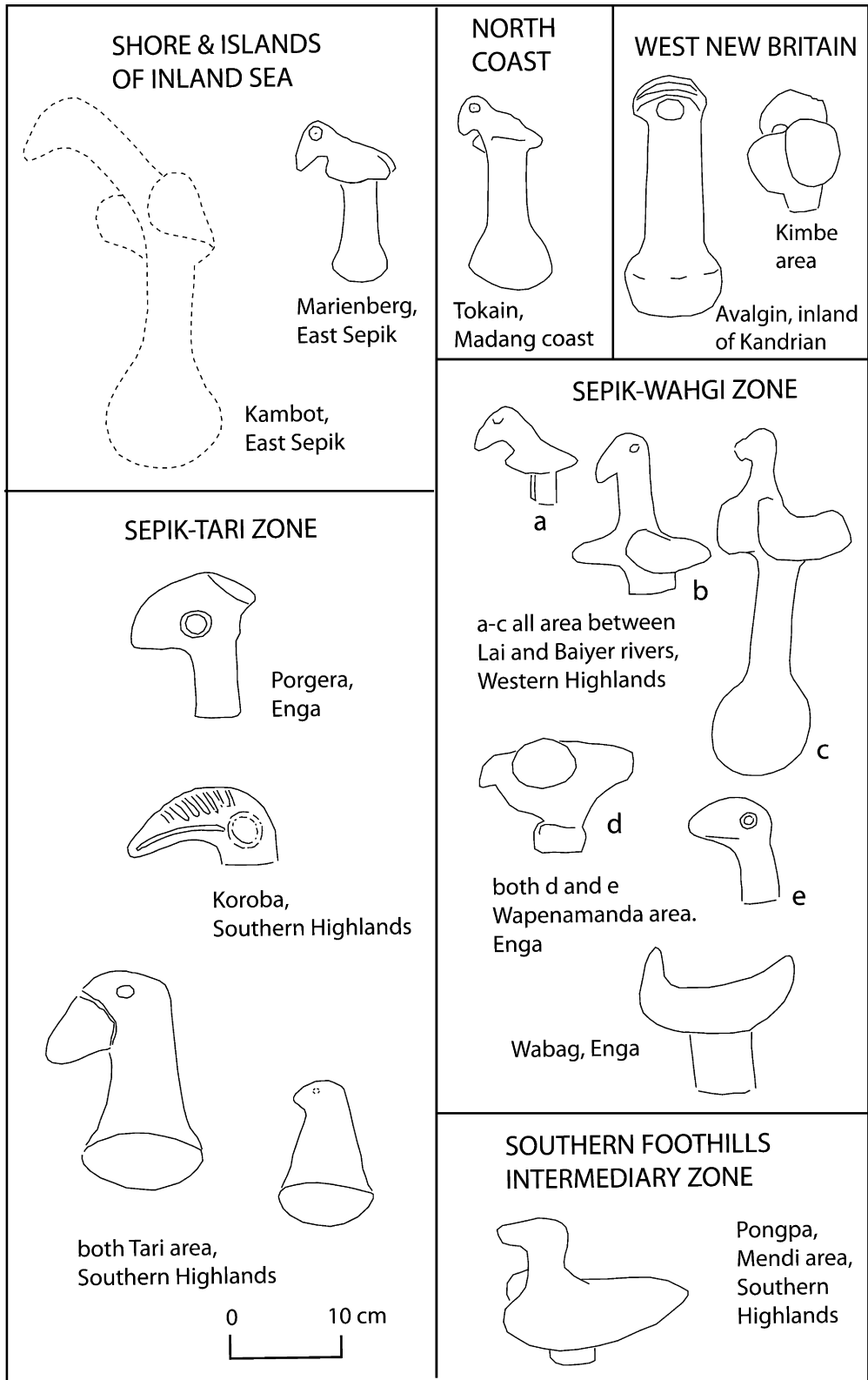


FIGURE 9. – Bird pestles

The Kambot pestle is reconstructed from measurements (see Swadling and Hide, 2005: 300). (Based on Newton, 1979 and database under construction by Swadling.)

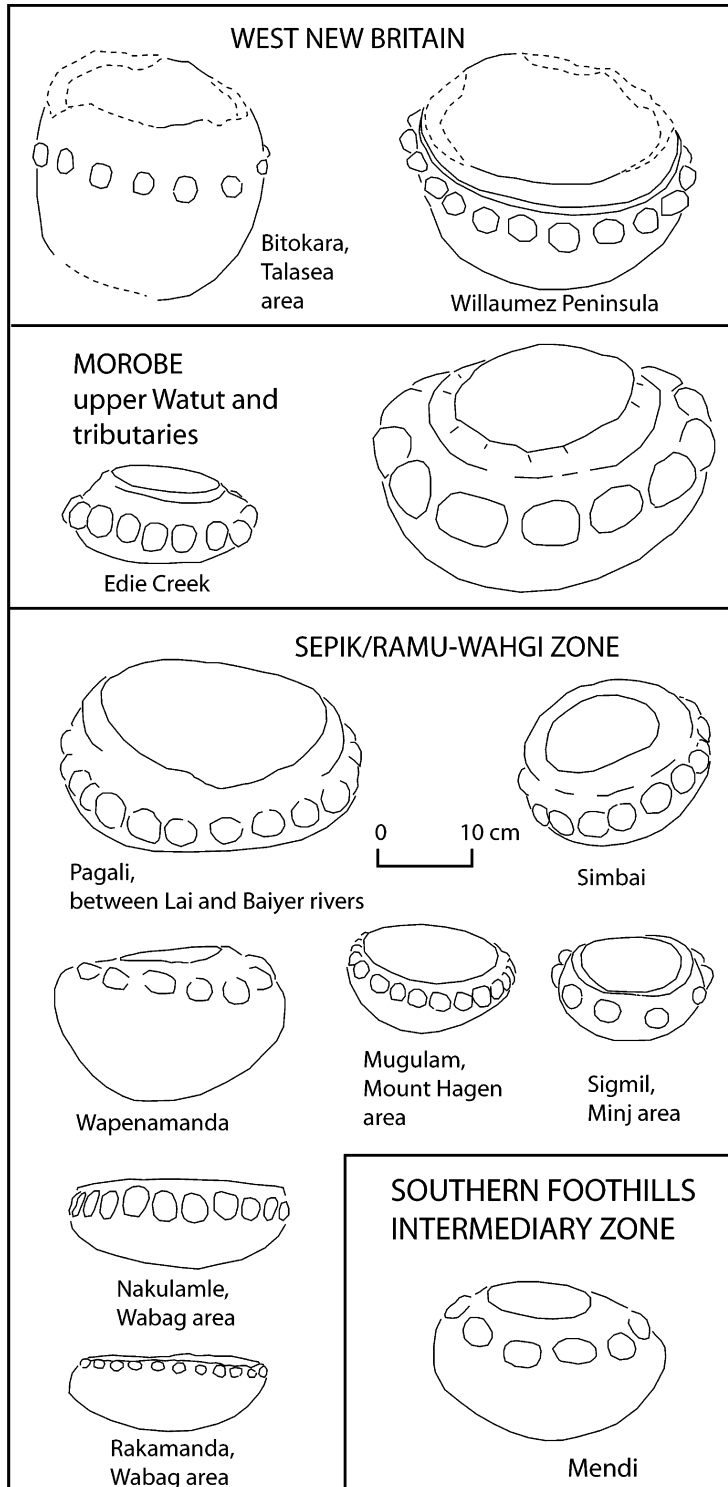


FIGURE 10. – Bossed bowls with rounded base. (Based on Newton, 1979 and database under construction by Swadling.)

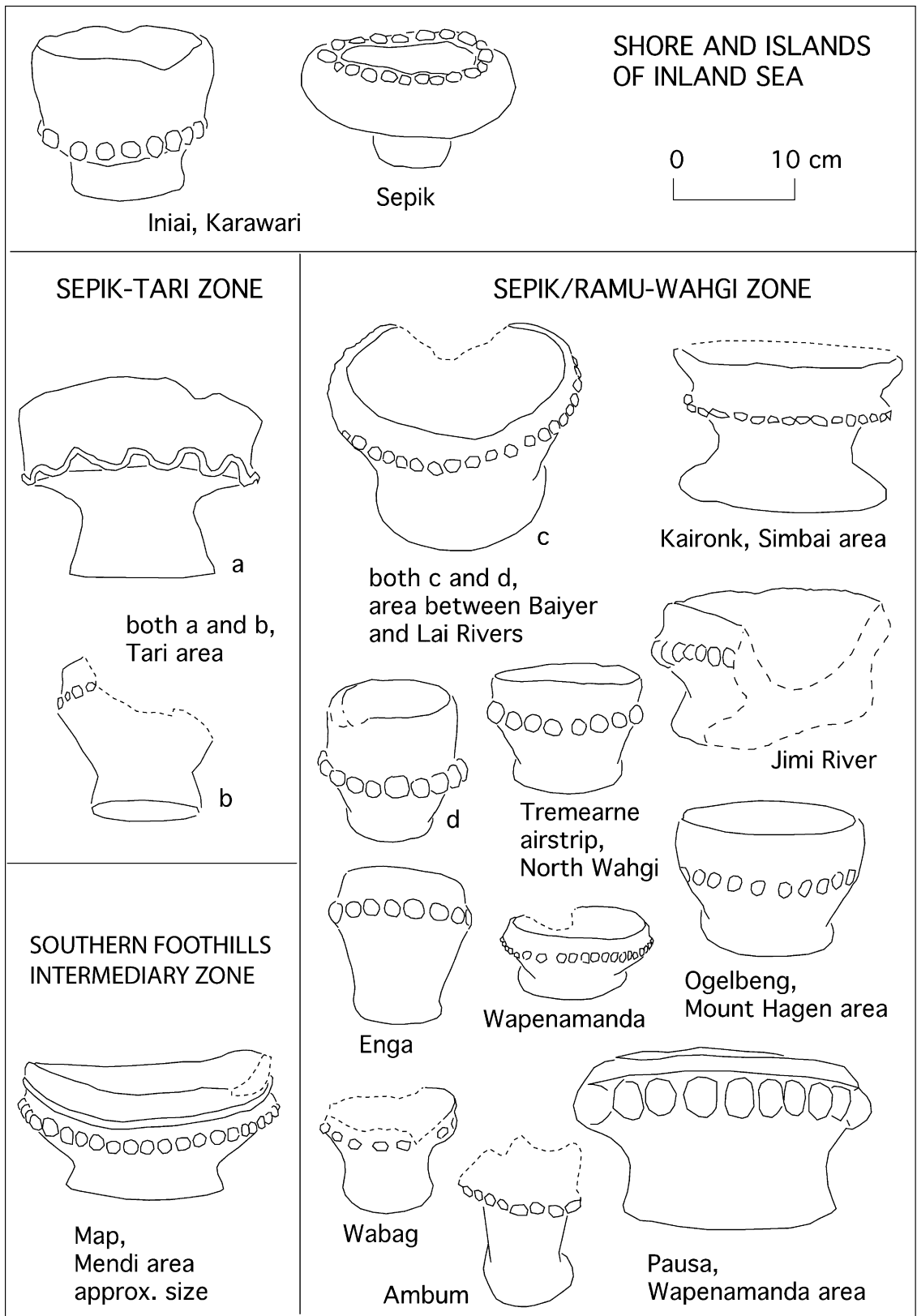


FIGURE 11. – Decorated pedestal mortars. (Based on Newton, 1979 and database under construction by Swadling.)

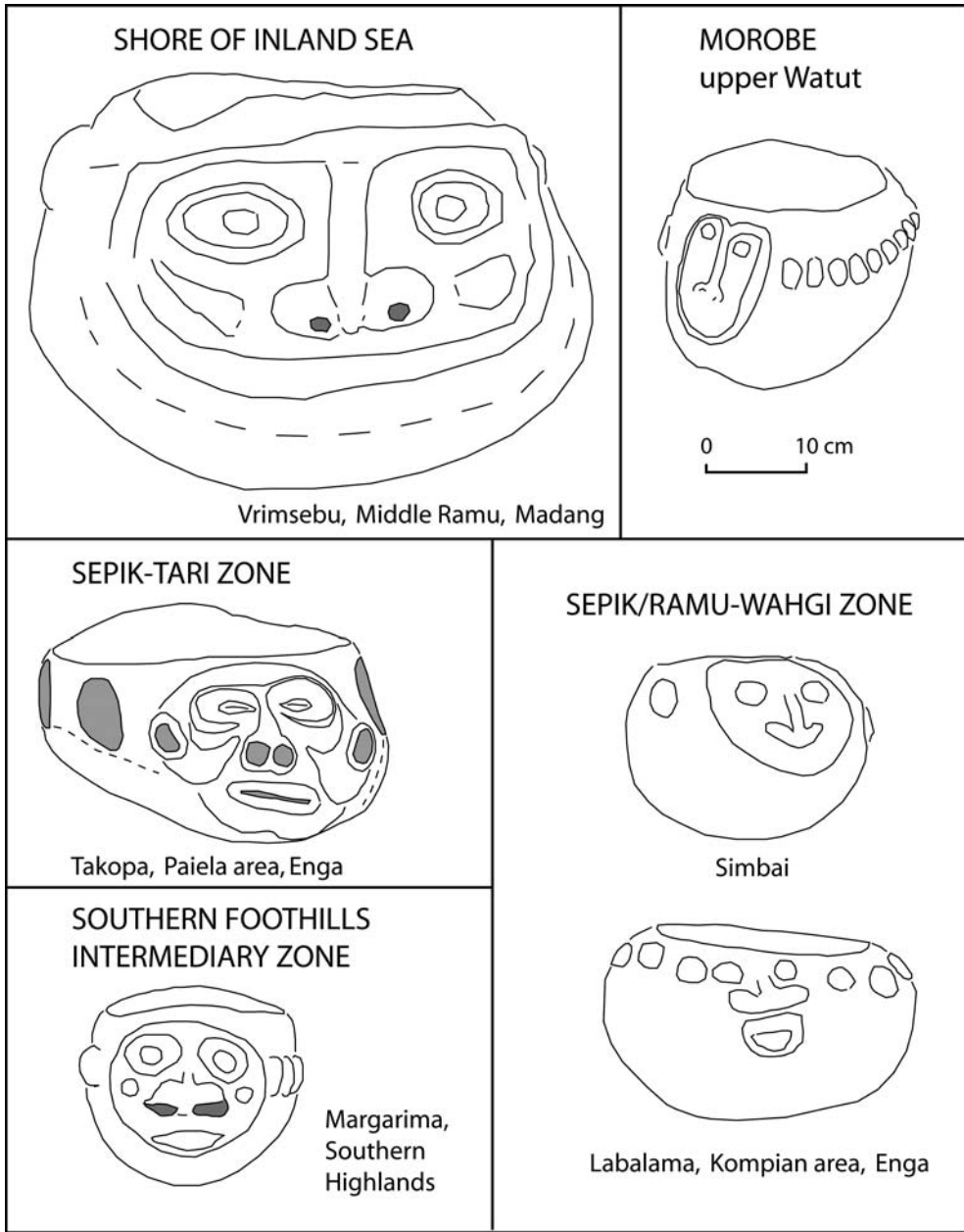


FIGURE 12. – Anthropomorphic face mortars. (Based on Newton, 1979 and database under construction by Swadling.)

with depressed bosses and dimples is in the database. In this respect the Takopa mortar, like the hornbill and cassowary bird pestles from the same area, could be seen as being unconventional.

The heavily weathered anthropomorphic mortar from Labalama in the Kompian area in eastern Enga is very simplified in comparison with the Takopa find. Whereas the face mortar from Margarima, which is located about midway between Tari and Mendi in the southern foothills intermediary zone (figure 2b), has more features

in common with the Takopa mortar and finds from outside the highlands (figure 12).

Both the Takopa and Margarima mortars are very similar to the most elaborate anthropomorphic face mortar known from PNG that was found at Vrimsebu in the Middle Ramu, Madang Province (figure 12). Another mortar with similar stylistic features is known from the upper Watut in Morobe Province. A coastal rather than a trans highlands link seems to be the most likely explanation for this widely spread distribution.



FIGURE 13. – Anthropomorphic head pestles. All have sunken eyes except the raised eyes on the heads from Tari and Yaramanda. (Based on Newton, 1979 and database under construction by Swadling.)

Anthropomorphic heads on pestles

Like anthropomorphic face mortars, pestles decorated with anthropomorphic features are not common and mainly occur in two areas of eastern New Guinea. These are the central highlands and the Huon Peninsula.

The most elaborately decorated pestle with an anthropomorphic head known from PNG was found at Cape Arkona on the Huon Peninsula (figure 13). Another with similar features namely inset eyes, long nose with inset nostrils, mouth, jutting chin and clearly defined ears was found at Sialum on the Huon Peninsula.

Two comparable pestles to those found on the Huon Peninsula and a number of related exam-

ples are known from the highlands. The two comparable finds come from Pomboposa in the Lai valley in the Sepik/Ramu-Wahgi zone and the other comes from Lake Kopiago in the Sepik-Tari zone. What may be related finds are known from Tari in the Southern Highlands, Repikama and Yaramanda (both located in the area between the Lai and Baiyer rivers) and the Kundiawa area in Simbu (figure 13). Two other possibly related finds come from the eastern highlands and the Irowat-Surprise Creek junction of the upper Watut in Morobe province (both are illustrated in Swadling, 2005: 6, figure 8).

In view of the links with the Huon Peninsula it is interesting that trochus armbands have been excavated from mid-Holocene deposits at the Kutepa rock shelter near Tipinini in the lower Lagaip valley (pers. comm. Jo Mangi 1988; see figures 2a and 3 for location). Trochus is not a common shellfish on the Sepik coast, but is common on the rocky shores of the Huon Peninsula and offshore islands.

Before discussing the distribution patterns of mortars and pestles further, it is necessary to consider how the distribution of these artifacts may be related to the distribution of speakers of the Trans New Guinea language family.

Mortars and pestles, agriculture and the Trans New Guinea language family

Pawley (2007) has proposed that the widespread distribution of the Trans New Guinea language family is linked to the spread of agriculture. An antiquity of 7,000 to 12,000 years is proposed for this family, on the basis that it has more lexicostatistical diversity than either the Indo-European or Austronesian language families. The languages in the Trans New Guinea family are spoken in all the inhabited highlands valleys from the neck of the Bird’s Head to southeast Papua, much of the southern lowlands of West Papua, as well as in the lowland and mountainous areas to the northeast and south of New Guinea (figure 14). The largest and most diverse subgroups within this family occur in the lowland and mountainous areas to the northeast of New Guinea; there are about 100 languages in the Madang group and about 70 in the adjacent Finisterre-Huon group. After Madang and the Finisterre-Huon subgroups the greatest diversity is found in the highland valleys between the Strickland River and the Eastern Highlands province. Pawley (2007: 47-52) proposes that the timing of early agriculture at Kuk in the Western Highlands and the movement of agricultural communities out from this area some 7,000 to

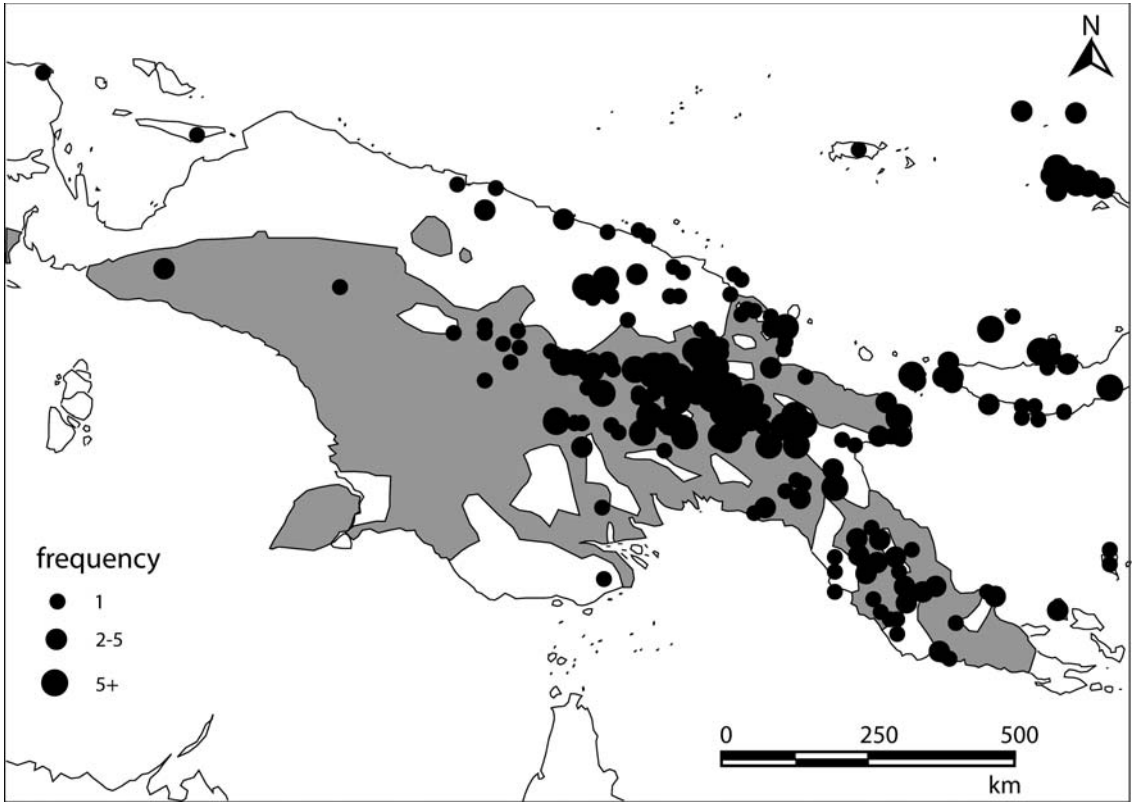


FIGURE 14. – Map showing the main clusters of mortars and pestles and the Trans New Guinea language family (shaded area). Language distribution is from Pawley (2007) and mortar and pestle distribution is from the database under construction by Swadling

10,000 years ago provides the best explanation as to how this language family came to be so widely distributed in New Guinea.

While some of the highest densities of mortar and pestle finds occur where the greatest lexicostatistical diversity is found within the Trans New Guinea language family, namely Madang, Morobe and the central highlands, the low frequency of finds where related languages are found in West Papua suggests that some factor other than language led to the observed distribution of these artifacts.

Distribution of mortars and pestles on the mainland and islands of New Guinea

Figure 14 demonstrates that mortars and pestles do not have a uniform distribution in New Guinea, very few have been found in West Papua and the south coast of Papua New Guinea. Most are found in the highlands valleys located in the spine of New Guinea (extending from the Southern Highlands as far east as Oro and Central provinces), the coastal lowlands (including the coastal areas of the former Sepik-Ramu inland sea), and east to the islands of New Bri-

tain and New Ireland. Few are found west of the Sepik coast. Most are from eastern New Guinea, New Britain and New Ireland.

Commonality in elaborate styles is higher within eastern New Guinea. Mainland style influences extend east to the Willaumez Peninsula of West New Britain, but are not apparent beyond the Willaumez Peninsula of West New Britain. This suggests that any linkage between eastern New Guinea and New Ireland was indirect through New Britain. It should also be noted that links between the mainland and New Britain demonstrates some maritime prowess, as it involves a voyage across the difficult waters of the Vitiaz Strait, between the Huon Peninsula and West New Britain.

Shared iconography

Table 3 provides a crude plot of the widespread geographic distribution of the elaborate styles of mortars, pestles and figures discussed in this paper. Disregarding local variants of stone figures, it is probably significant that all styles of mortars, pestles and figures listed occur in the Sepik/Ramu-Wahgi zone. It also has the densest

	Bird pestle	Bossed bowl mortars	Stone figure	Face mortar	Anthropomorphic head pestle	Pedestal plain	Pedestal bossed
Sepik-Tari zone	x		x	x	x		x
Sepik/Ramu-Wahgi zone	x	x	x	x	x	x	x
Coast and islands of inland sea	x	x	x	x		x	x
N coast – Huon Peninsula	x	x			x		
Huon Gulf-Eastern Highlands	x	x		x	x		x
Huon Gulf-Upper Watut, Morobe	x	x		x	x		
Oro coast-Oro/Central province highlands	x	x	x			x	
West New Britain	x	x					

Table 3. – The geographic distribution of the elaborate styles of mortars, pestles and figures discussed in this paper

distribution of mortars and pestles (figure 14). This should not be a surprise as the Wahgi and its associated valleys have historically been the most densely settled part of the highlands and it is likely that this has long been the case. For the last ten thousand years the Wahgi has been a centre of agricultural innovation and development (Denham *et al.*, 2003 ; Golson, 1989). It is therefore to be expected that ideas and products would have been transferred via the multiple access routes that linked the inhabitants of the Wahgi and its associated valleys with the people living on the shore of the inland sea. Visits from canoes carrying people with links to distant areas, such as the Huon Peninsula and West New Britain, would have also led to the exchanging of intangible (such as dances, hunting and gardening rituals) and material items, such as crop varieties and shell decorations. It is not known how far individual mortars, pestles and figures were traded, as little work has been done on sourcing.

Some of the proposed mid-Holocene iconographic links are independently verified by the presence of another artifact made in the mid-Holocene moving in the opposite direction. The mid-Holocene introduction of bird pestles and bossed bowl mortars from east New Guinea into West New Britain seems more plausible when it is known that obsidian stemmed tools, made in the mid-Holocene on the Willaumez Peninsula of West New Britain from local sources, have been found on the shore and islands of the Sepik-Ramu inland sea. The production of obsidian stemmed tools on the Willaumez Peninsula

dates from before 6,000 to 3,600 years ago (Araho *et al.*, 2002: 62). Four obsidian stemmed tools come from the Sepik and three have been sourced to the Kutau/Bao source on West New Britain. Two of the stemmed tools come from Mangum on the large mid-Holocene island at the mouth of the inland sea. A third comes from the Bien River area. The Bien drains the western side of the same mid-Holocene island. The fourth find is from the Sepik but has no specific provenance (Swadling and Hide, 2005: 307).

Mortars, pestles and agriculture in the highlands, lowlands and islands of Papua New Guinea

Social contact between the coast and the highlands is the best explanation for the widespread distribution of elaborate types of mortars, pestles and figures in eastern New Guinea and east to West New Britain. The low frequency of elaborate forms west of the Strickland and a general absence of them in the Baliem valley, despite evidence of forest clearing in the latter from 7,800 cal. BP (Haberle, 2003: 153), indicates that their use and distribution was not primarily driven by trans highlands social networks.

Although it has been recognised for some time that mortars and pestles occur in both New Guinea and the Bismarck Archipelago (Bühler, 1946-1949; Bulmer and Bulmer, 1964: 72; Chowning, 1977: 19; Riesenfeld, 1950) few models have been proposed to explain this distribution. One factor behind the reluctance to accept a

comparable use for mortars and pestles in New Guinea and the Bismarck Archipelago relates to perceptions about the history of agriculture in lowlands and island Melanesia.

Spriggs (1993) raised the possibility that there was agriculture in the Pacific in the Pleistocene, but subsequently (Spriggs, 1997: 84-89) proposed that it was not widespread in the Bismarck Archipelago until the late Holocene. The current archaeological signature for agriculture in the lowlands and islands is the appearance of nucleated settlements in a degrading landscape characterised by decreasing forest cover and higher rates of erosion (Spriggs, 1997: 84-89). Where the problem arises is in applying this model. At present there are no Pleistocene pollen histories for any part of the Bismarck Archipelago. Apart from one site dating back to the mid-Holocene on Manus, all other archipelago pollen cores just cover the late Holocene (Specht, 2005: 262). In other words, this model cannot demonstrate when agriculture occurred in the lowlands and islands.

The preliminary dating of the rectilinear earth mounds at Lavongai on New Hanover, New Ireland, to 3,000-4,000 BP (Leavesley and Troitzsch, 2007) raises the likelihood of pre-Lapita agriculture in this region.

Stone mortars and pestles provide another line of inquiry. The presence of stylistically similar mortars and pestles (bird pestles and bossed bowl mortars) in the highlands, on the coast of the Sepik-Ramu inland sea and in West New Britain indicate that ideas and products (including taro) were being exchanged by the social networks that linked these regions. Moreover the presence of stemmed obsidian artifacts in the Sepik-Ramu, which were imported from the Willaumez Peninsula in West New Britain, where they were made in the mid-Holocene (Araho *et al.*, 2002: 62) demonstrates that maritime links existed between these areas at this time.

Conclusion

In Papua New Guinea the archaeological record reveals that the early-mid Holocene, compared to the Pleistocene, was a period of rapid cultural change. This has been found to be the case not only in the New Guinea highlands, but also in the lowlands and islands. The unanswered question has been the extent to which these changes were the product of independent developments or social interaction (Kirch, 2000: 78).

This study has shown that Enga and other parts of the highlands of Papua New Guinea

were not cut off from the social interaction that linked the coast, other parts of New Guinea and the Bismarck Archipelago in the mid-Holocene. During this time, and even earlier, the existence of a large inland sea placed the large intermontane valleys of the highlands closer to the coast. The presence of stylistically similar stone mortars and pestles in the highlands, the Sepik-Ramu, the Madang-Morobe coastline and West New Britain indicate that ideas and products, such as crops, were being exchanged by the social contact that linked these regions. In addition, the association of stone mortars and pestles with taro growing areas makes a strong case for taro cultivation being present in the mid-Holocene not only in the highlands (from where we now have taro starch dating to the early Holocene), but also in the lowlands and Bismarck Archipelago.

Acknowledgements

Without the assistance of villagers, travellers, museum staff, researchers from many disciplines, government officers and collectors, a study of this nature is not possible.

We also wish to acknowledge the foundation work on these artifacts by the late Graeme Pretty and the late Douglas Newton. Thanks are due to the following individuals who assisted in various ways: Chris Ballard, Paul Brugman, Susan Bulmer, John Burton, Barry Craig, Helen Dennett, Brian Egloff, Jack Golson, Crispin Howarth, Ottmar Maier, Marion Melk-Koch, Robin Hide, Jim Specht, and Robin Torrence. Any errors are our responsibility.

Artifacts stolen from the Papua New Guinea National Museum and Art Gallery in 2003

The following artifacts mentioned and illustrated in this paper were stolen from the PNG National Museum and Art Gallery on 19 May 2003. If anyone comes across them could they please assist in arranging their return.

1. Bird figure, height 21.5 cm from Nete, east of Hewa, north of lower Lagaip (figure 5).
2. Bird pestle, height 21 cm from Avalgin, inland of Kandrian, West New Britain (figure 9).
3. Bird pestle head, height 9.5 cm, from Pausa, Wapenamanda area (figure 9).
4. Marsupial/anthropomorphic figure, height 24 cm, from Kip, Lai valley, Mendi area (figure 6).

Note on provenance corrections

During this study some previously published artifact provenances were found to be incorrect. The first error arose due to wrongly assigning Pausa/Yaramanda to the Porgera area rather than locations near Wapenamanda. This was the case with two bird pestles (see Swadling and Hide, 2005: 304, figure 8). The second error is a publishing gremlin. According to the National Gallery of Australia catalogue, a pestle (Cat. No. 87.1556) comes from either the PNG mainland or New Britain, but is published in Meyer (1995: 311, plate 347) as coming from Ambum in Enga. The third error is the case of incorrect information being provided to a collector. A mortar illustrated in Friede (2005: 30, plate 4) does not come from the Eastern Highlands, but from Takopa in the Porgera area in Enga; as both the late Graeme Pretty and Wiessner obtained photos and information giving its provenance as Takopa.

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