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Part II

The Boduna Island (FEA) Lapita Site

JIM SPECHT[1]* AND GLENN SUMMERHAYES[2]

[1] Senior Fellow, Anthropology, Australian Museum, Sydney NSW 2010, and

Honorary Associate, School of Philosophical and Historical Inquiry,
University of Sydney NSW 2006, Australia
jspecht@bigpond.com

[2] Department of Anthropology, University of Otago, PO Box 56, Dunedin, New Zealand
glenn.summerhayes@stonebow.otago.ac.nz

ABSTRACT. The FEA Lapita pottery site on Boduna Island, West New Britain, is one of the most important Lapita sites of the Talasea region. Archaeological investigations in 1980 and 1985 concluded that the site has been disturbed and its stratigraphic integrity is insecure. Fieldwork in 1989 targeted this issue, and further work in 2001 examined the island's geological history. This paper describes the 1989 study, and concludes from the pottery from the various excavations and surface collections that there is residual evidence for stylistic change through time. Use of the island began c. 3340–3000 cal. BP, but no firm date can be suggested for the end of pottery use on the island. The island seems too small to have supported permanent occupation without importation of food or use of land elsewhere for gardening, and might have been used only intermittently by local residents or visiting groups, perhaps for special social or ritual activities similar to the use suggested by Kirch for zone C at ECA/B in the Mussau group.

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The FEA Lapita site on Boduna Island near Talasea is one of many pottery find-spots on Willaumez Peninsula in West New Britain, Papua New Guinea (Fig. 1; Specht *et al*., 1991; Swadling *et al*., 1992; Anderson *et al*., 2001). Archaeologists have visited the site many times since 1974, and carried out four separate studies in 1980, 1985, 1989 and 2001. Those of 1985 and 2001 have been published in summary form (Ambrose & Gosden, 1991; White *et al*., 2002), and here we report on the work conducted in 1980 and 1989 (Specht *et al*., 1989: 13–16), with observations on the other two studies and on various surface collections made from 1974 onwards.

The FEA pottery has been compared with that of the "Far Western" and "Western" stages of Lapita in the Bismarck Archipelago (Ambrose & Gosden, 1991: 187; White *et al*.,

* author for correspondence

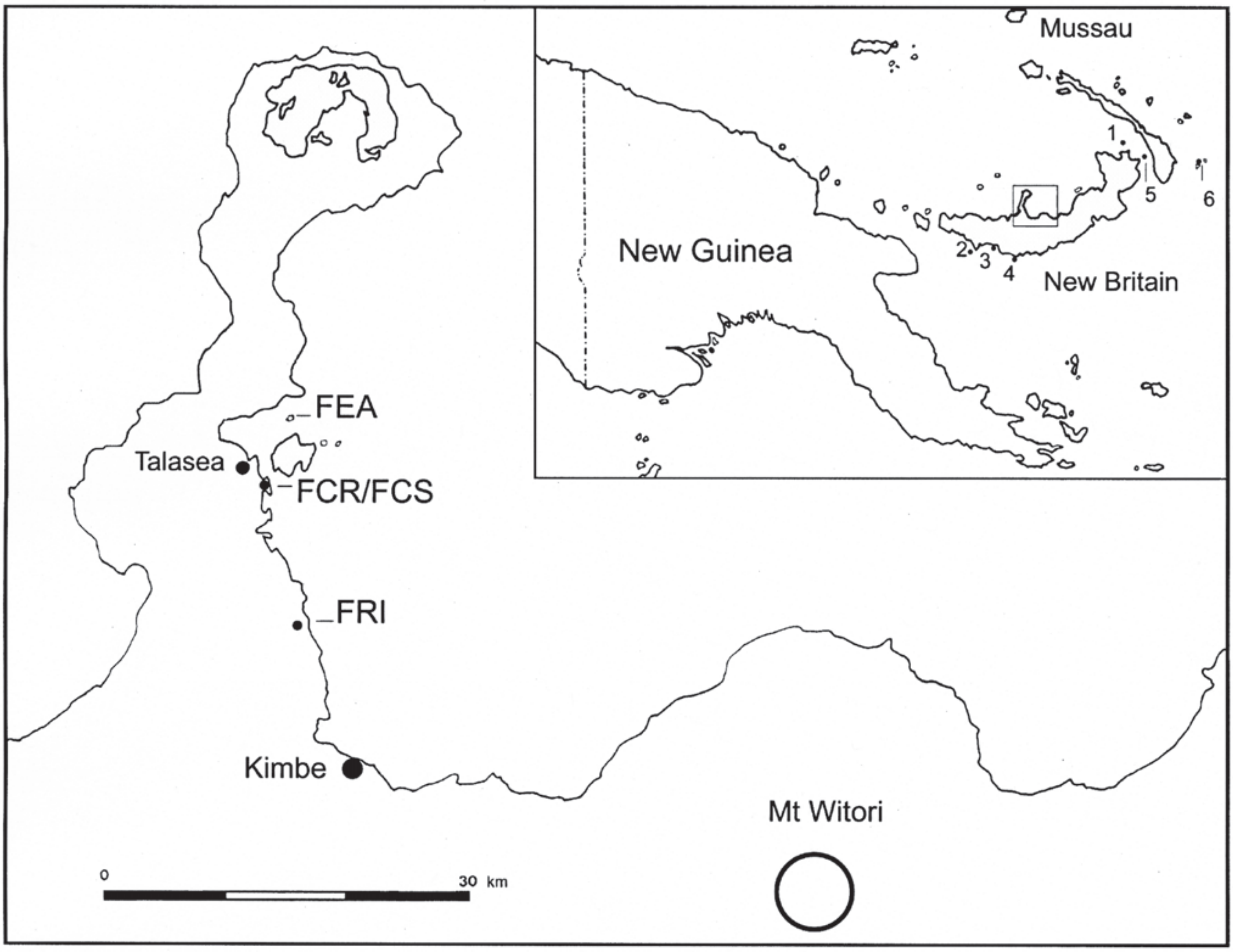

Fig. 1. Location of Willaumez Peninsula, West New Britain Province, Papua New Guinea, with some of the main sites mentioned in the text. The locations numbered in the inset box are: 1—Watom Island; 2—Arawe Islands; 3—Kreslo; 4—Kandrian; 5—Duke of York Islands; 6—Anir Islands.

2002: 106). These stages equate with the "Early" (3500 to 3000–2900 cal. BP) and "Middle" stages (2900 to 2700–2600 cal. BP) of the revised Lapita terminology (Summerhayes, 2001a, 2001b, 2004: table 2). This is supported by calibrated radiocarbon dates of about 3300 to 2700 BP for the basal level of FEA (White *et al*., 2002: table 2).

All four studies on FEA have concluded that natural and human agencies have extensively disturbed the archaeological deposits since the Lapita period. As Kirch and Hunt (1988: 28) have pointed out, however, in coastal locations in the Pacific, "post-depositional alterations that move things among strata must be accepted as commonplace—the rule, rather than the exception." This applies particularly to sites with Lapita pottery (Green, 1979: 31). In the case of FEA, despite these "post-depositional alterations" the site still has much to offer to an understanding of human history in this region. FEA is arguably the richest surviving early Lapita site in the Talasea area, with both dry land and underwater components. Here we examine the degree of displacement of cultural materials in the land component of the site, review options for the original context of deposition of the Lapita period materials, and the possibility that there were several phases of pottery deposition. A best estimate for the start of dentate-stamped pottery on the island is 3340–3000 cal. BP.

Comparisons between finds from the land excavations and those from inter-tidal and underwater contexts reveal several differences that could reflect time or spatial differentiation in discard patterns or activity areas (cf. Torrence & White, 2001: 136). As Boduna Island appears too small for permanent occupation without substantial importing of food and other supplies, the FEA site may represent a special function location for non-domestic purposes.

Boduna Island—site FEA

Boduna Island (Observation Island on topographical maps, at 150°04.3'E 5°16.6'S) lies between Garua Island and Pangalu village at the northeastern approach to Garua Harbour on the eastern side of Willaumez Peninsula, West New Britain, Papua New Guinea (Fig. 2, Plates 1, 2). Boduna is one of the smallest of nine islands in Garua Harbour (Plate 3). The small township of Talasea is located on the south side of the Harbour.

The Willaumez Peninsula was formed by Quaternary volcanism, and the Talasea area is dominated by volcanic cones, flows of pyroclastic material and lava, *in situ* and reworked tephras, and active geothermal areas (Heming & Smith, 1969; Lowder & Carmichael, 1970; Ryburn, 1975).

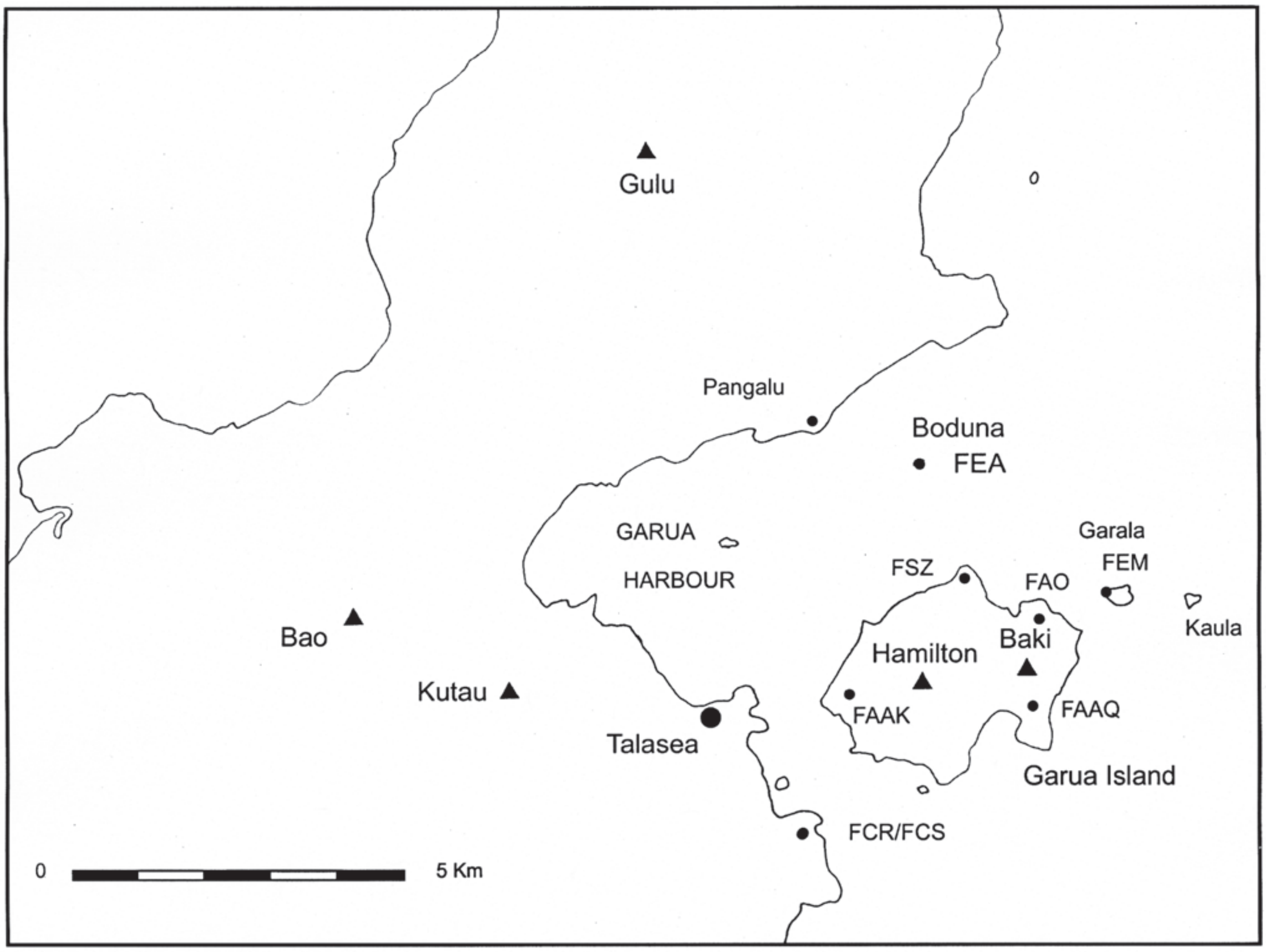

Fig. 2. Garua Harbour and Boduna Island, West New Britain, showing the main archaeological sites and obsidian source volcanoes (solid triangles) of the Talasea area mentioned in the text.

Uplifted coral reef platforms of mid-Holocene age and later are present on the mainland and some islands, within the Harbour and along the east coast of the Peninsula. One such uplifted reef forms Boduna Island, standing about 1 m above present sea level and capped by about 1–1.5 m of sand and tephra-derived sediments. The island is about 120 m long and up to 100 m wide, and is surrounded by fringing reef with a gap on the southwest side that creates a small, sandy-bottomed lagoon (Plate 3; White *et al*., 2002: 101, fig. 2). This gap provides safe access for canoes and small boats, but landings are possible all round the island during calm seas and at high tide. Apart from a grassy area on the southwest side, the island has a cover of low, scrubby vegetation with few trees of any size (Plate 4). Geothermal areas occur at several points on the north and south sides of the island (White *et al*., 2002: fig. 2). Today, villagers and expatriates use Boduna as a fishing and picnic venue, and the traditional owners in Pangalu village on the north side of Garua Harbour occasionally use the island for small gardens.

The FEA site covers the entire land surface and extends on to the fringing reef and into the lagoon, indicating a site area of about 11,000–12,000 m^2. This estimate differs from published figures of 6,000 m^2 and 10,000 m^2 (Anderson *et al*., 2001: table 1; White *et al*., 2002), which cover only the land component. The total land area excavated during the various investigations since 1974 probably amounts to about 10 m^2. Allowing for about 10% of the island's surface being formed by exposed coral, and therefore unsuitable for excavation, less than 0.02% of the island has been excavated.

Archaeological investigations

Initial investigations 1974–1980. In 1966, an agricultural officer at Talasea showed Specht sherds found on Boduna, but in the absence of dentate-stamped decoration they did not appear to belong to the Lapita ceramic series, as it was understood at that time. J. Rhoads and L. Sutherland visited the island in 1974 and found undoubted Lapita dentate-stamped sherds and obsidian flakes in beach sand and in a light grey, cemented deposit at and below the high tide level. In 1980, Specht and staff of the provincial Cultural Centre dug several spade pits to 80–100 cm below surface on the southwest beach and near the centre of the island. From the highly abraded nature of the pottery and obsidian finds, their distribution throughout the deposit and the absence of clear stratigraphy, the excavators concluded that the site was extensively disturbed.

The Lapita Homeland Project 1985. As part of the Lapita Homeland Project of 1985, Ambrose and Gosden (1991: fig. 2, 187) excavated two spade pits on the western side of the island and two 1 m^2 trenches near its highest point. They described the stratigraphy as having a "dark root zone" at the surface covering reworked airfall tephras down to 60–70 cm below surface. Under these reworked tephras were "beach sands" and "some evidence of a buried soil" down to the base of the trenches at about 100 cm below ground surface. This buried soil overlay a substrate composed of hardened sand on the coral basement, with the buried soil continuing to the edges of the island where it underlay an indurated beach rock at high tide level (Plate 4). Ambrose and Gosden confirmed the disturbed nature of the archaeological deposit, but suggested that the basal level, described as a "Lapita-period soil", might warrant further examination.

Subsequent studies 1989 and 2001. In 1989, Specht led a team specifically to assess the condition of the basal level, and this work is reported below. In 2001, White *et al*. (2002) studied the island's geological history, and examined the lagoon floor where many sherds had been collected over several decades. They concluded that the island formed in the middle-to-late Holocene as "an inter-tidal or exposed sandy cay" similar to those forming in and around Garua Harbour today (White *et al*., 2002: 106). Following human settlement about 3000 years ago, tectonic activity raised the island, which then experienced an earthquake and a tsunami. Around 1400–1000 years ago the island was blanketed by tephra from the Dk eruption of Dakataua volcano at the northern end of Willaumez Peninsula. When the geothermal activity began is not clear, but by about 655–430 cal. BP megapodes were laying eggs on the island, some of which became cemented into the beach deposits. The exact sequence and dates of the earthquake and tsunami, and when the basal deposits became cemented, are not known.

Surface collections 1974–2001. In the course of these examinations and other visits, the various archaeologists made surface collections of sherds and obsidian items. These are held at the West New Britain provincial Cultural Centre in Kimbe, and the Papua New Guinea National Museum and Art Gallery and the Archaeology Laboratory of the University of Papua New Guinea in Waigani, National Capital District, Papua New Guinea. Staff members of the Cultural Centre and Walindi Plantation Resort (between Kimbe and Talasea) have also made surface collections, which are held at the Cultural Centre and Resort. John Ray of Kimbe has collected about 400 sherds, many from the lagoon floor (Torrence & White, 2001; White *et al*., 2002: 103). The total number of sherds in these various surface collections exceeds 600.

These collections came from the island's land surface, beaches and inter-tidal zone, and from underwater contexts on the sandy floor of small lagoons on the northern and southwestern sides of the island. The inter-tidal zone on the southwestern side of the island is partly formed by "indurated beach rock" (Ambrose & Gosden, 1991: 187) that incorporates sherds and obsidian pieces (Plate 4; cf. White *et al*., 2002: fig. 2). White *et al*. (2002: 103) suggest that sherds found in the southwestern lagoon derived from the beach rock, as "rounded chunks " of beach rock that did not contain sherds "were found in the lagoon some 6 m from the current shoreline." Samples of this beach rock collected in 1974 and 1989 show that the sherds contained in it are uniformly heavily abraded and do not retain their original surfaces. In contrast, the condition of sherds from the southwestern lagoon varies from fresh to heavily abraded. While the heavily abraded sherds may have eroded from the beach rock, this is unlikely for the fresh sherds. These are more likely to have been originally deposited on the lagoon floor, where they were covered with sand and are now being exposed by wave action.

The 1989 excavation

The 1989 trench was located close to the highest point of the island near the western end, adjacent to one of the 1985 test trenches (Ambrose & Gosden, 1991: fig. 2). Initially the trench was 2 m^2 in area, but was reduced to 1 m^2 at 30 cm depth and only the northern half of the trench was fully excavated. The sediments were dry-sieved through 4 mm mesh, and the sieve residues were bagged for later sorting and recording at the University of Papua New Guinea with the assistance of archaeology students organized by Jean Kennedy. The excavation revealed five layers and ended at 90–100 cm below ground surface (Fig. 3a). An unpublished profile of the 1985 excavation provided by Chris Gosden shows the same layer sequence and depth (Fig. 3b). The basic stratigraphy is as follows:

1. Black, humic topsoil of reworked tephra and calcareous sand penetrated by roots and crab holes, with charcoal and charred nutshells (excavated volume approximately 0.14 m^3).
2. Fine-grained buff to yellow tephra penetrated by roots and crab holes. This tephra was absent from the southern end of the trench (0.42 m^3).
3. Coarse, reddish-brown reworked tephra and possibly calcareous sand. This was excavated in four spits with a total thickness of 40–45 cm. Roots penetrated to the top of spit 4 (0.54 m^3).
4. Grey-brown reworked tephra and beach sand with possible soil development in its upper part. This layer was excavated in two spits and ended on the surface of layer 5. It was more compact than layer 3, and towards the base was weakly cemented as a result of geothermal heat, which reaches 50°C (Ambrose & Gosden 1991: 187; cf. White *et al*. 2002: 104) (0.23 m^3).
5. The base of the trench was an off-white to light grey, cemented sediment presumably resting on the coral limestone platform. This layer was too hard to excavate with the tools available in 1989 (the 1985 profile drawing suggests that Ambrose and Gosden penetrated several centimetres into the layer). The surface of layer 5, which showed a slight declination to the south, contained small molluscs and possibly charcoal, but no pottery or obsidian. It is not clear how this layer relates to the beach rock containing sherds and obsidian that is exposed on the southwest beach.

Layer 2 had a sharp boundary with layer 1, but its boundary with layer 3 could be defined only over the northern part of the trench. The boundary between layers 3 and 4

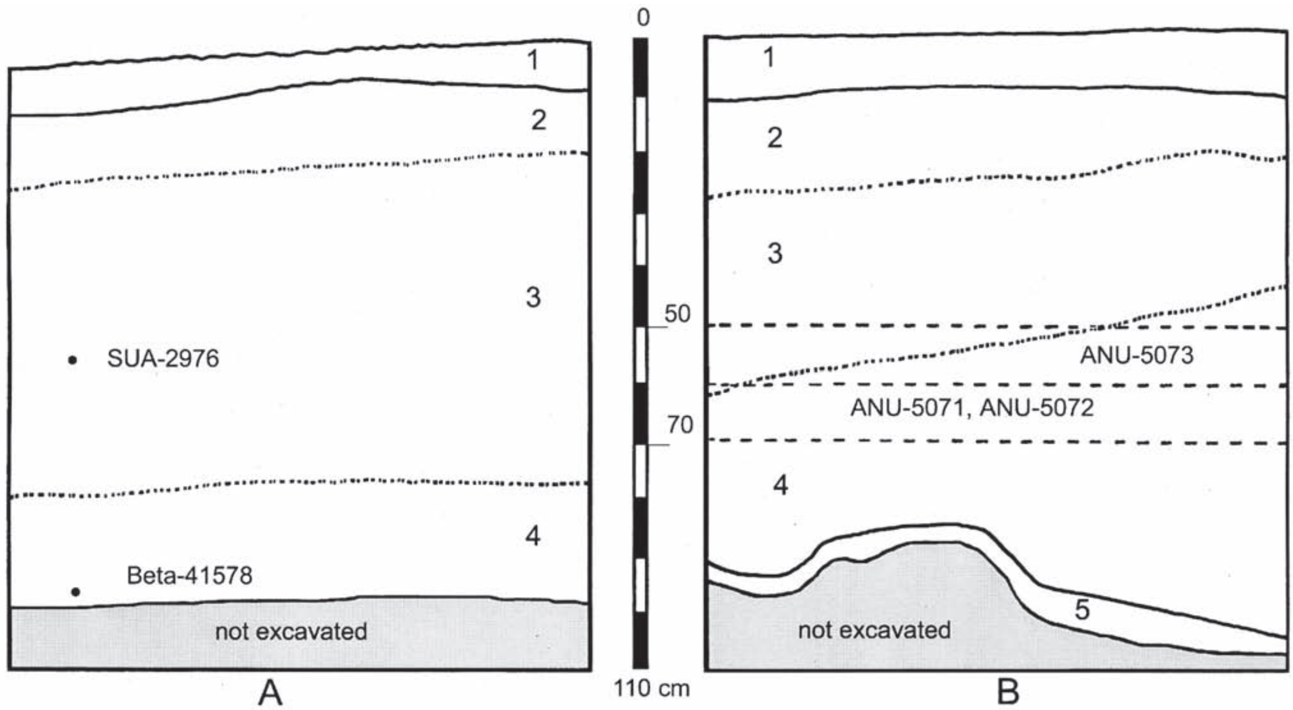

Fig. 3. Schematic drawings of profiles at FEA, Boduna Island, showing the positions of radiocarbon dating samples. (*A*) Profile of West face of the 1989 trench; for the layer descriptions, see text. (*B*) Profile (face not indicated) of 1985 trench based on the dating submission forms used by Ambrose and Gosden (1991), which describe the stratigraphy as: layer 1—black humic root zone; layer 2—brown, drier ash layer; layer 3—yellow-brown ash layer with predominantly rolled material; layer 4—brown, shelly layer with less rolled finds and much shell; layer 5—grey compact shelly layer.

was also recorded in 1985, though in 1989 lenses of layer 4 noted in layer 3 indicate sediment mixing. The "beach sands" observed in 1985 were not specifically identified in 1989. Pottery and obsidian were found throughout layers 1 to 4, but none were found on or in the surface of layer 5.

A transect of eleven auger holes was drilled at 10 m intervals on a N–S line from beach to beach across the island, aligned with the western side of the 1989 trench. On the south side and near the centre of the island each auger hole ended on the cemented surface of layer 5, but this was missing on the north side where the auger holes reached the coral limestone platform. The maximum depth of c. 100 cm was adjacent to the 1989 excavation near the centre of the island. The sediment sequence in the auger holes reflects that of the excavation, with layer 2 locally missing and sediments comparable with layers 3 and 4 present in all holes except those closest to the sea, where beach sands occurred. Shells, sherds and obsidian were found in all auger holes.

How disturbed is the FEA site?

Our 1989 study aimed to assess the extent of disturbance and the suggestion of Ambrose and Gosden (1991: 187) that the layer 4 was the original Lapita deposition surface, a view supported by White *et al*. (2002: 105). Ambrose and Gosden (1991: 187) recorded sherds throughout their excavations, but observed that those in the lowest level appeared to be less weathered and larger than those higher up. White *et al*. (2002: 106) made similar observations, adding that the presence of sherds in the layer 2 tephra is clear evidence for reworking of the deposit. Whereas these two reports discussed the issue of disturbance in general terms, here we examine it more closely through the radiocarbon dates, and the frequency, distribution and size of finds, and observations relating to the position of sherds.

Radiocarbon dates. There are eight radiocarbon dates from 1985, 1989 and 2001 (Table 1). As no plant-derived material was recovered from layer 4, the three samples for this level consisted of marine shells. A fourth shell sample from the cemented southwest beach deposit was also dated (White *et al*., 2002: 105). The dates were calibrated by CALIB 5.0.1 (Stuiver & Reimer, 1993 [version 5]) and are cited within the text as age ranges at 2σ rounded to 10-year intervals. The charcoal and megapode eggshell samples were calibrated with the Intcal04.14c curve using a 10-year moving average for the sample growth span (Reimer *et al*., 2004), whereas the marine shell samples were calibrated using the Marine04.14c curve (Hughen *et al*., 2004). For the marine shell samples we used $\Delta R = 0 \pm 0$, as there is no measured value for the Talasea area. This is a serious impediment, as measured ΔR values for other localities in the Bismarck Archipelago region vary widely and depend on location and mollusc species dated (Petchey *et al*., 2004: table 1). This problem should be kept in mind in the discussion of the FEA dates.

The charcoal sample (SUA-2976) from layer 3 spit 3 yielded an essentially modern result (Specht & Gosden, 1997: 178). This sample was collected at the same depth (50–60 cm) as ANU-5073, which gave a much older result of 3160–2730 cal. BP. This inconsistency is further highlighted by ANU-5071, which is about a thousand years younger than ANU-5072 although both came from 60–70 cm below ground surface. The 1985 radiocarbon sample submission forms, made available to us by Chris Gosden, identified sample contexts by spit and depth, and not by reference to the layers on the 1985 profile drawing, which shows that the

Table 1. Conventional and calibrated radiocarbon dates for FEA, Boduna Island, derived from Ambrose & Gosden, 1991: 187; Specht & Gosden, 1997: tables 1 and 2; White *et al*., 2002: table 2, 105. Calibrations are by Calib 5.0.1 (Stuiver & Reimer, 1993 [version 5]), with the calibrated ranges cited at 2σ.

	year	material	layer	depth	lab. no.	CRA	cal. BP	prob.
1	2001	megapode shell	*n.a.*	*n.a.*	Wk-9935	570±56	655–516	1.000
2	2001	megapode shell	*n.a.*	*n.a.*	Wk-10235	485±65	649–583	0.177
							568–428	0.759
							376–324	0.065
3	1989	charcoal	3 spit 3	50–60	SUA-2976	80±160	452–446	0.005
							441–350	0.089
							335–0	0.907
4	1985	marine shell	4 top/3 base	60–70	ANU-5071	2050±90	1834–1399	1.000
5	1985	marine shell	4 mid-top	60–70	ANU-5072	3090±80	3085–2712	1.000
6	1985	marine shell	4 top	50–60	ANU-5073	3130±90	3164–2729	1.000
7	1989	*Chama* sp. shell	4 base	90–100	Beta 41578	3330±60	3341–3004	1.000
8	Samples 5–6	marine shell	4 mid-top	*n.a.*	pooled mean	3108±60	3053–2746	1.000
9	Samples 5–7	marine shell	4	*n.a.*	pooled mean	3218±42	3180–2890	1.000
10	2001	*Anadara* sp. shell	*n.a.*	*n.a.*	Wk-9936	3210±50	3182–2807	1.000

excavation units at 50–70 cm cut across the sloping interface of layers 3 and 4 (Fig. 3b). Sample ANU-5071, therefore, could have come from the lower part of layer 3 or the upper part of layer 4. If the former, there is a discrepancy of over 1500 years between SUA-2976 and ANU-5071 that can only be attributed to extensive sediment disturbance. This disturbance raises doubts that ANU-5071 indicates the continuation of pottery until around 1820–1400 cal. BP, as White *et al*. (2002: 105) have suggested.

Table 1 shows that the results of the three shell samples (ANU-5072, ANU-5073, Beta-41578) for layer 4 are very consistent, with the lowest sample (Beta-41578) having a slightly older age range than the other two. Using the test for sample significance supplied with the CALIB 5.0.1 program, samples ANU-5072 and ANU-5073, and ANU-5073 and Beta-41578 are statistically the same. Samples ANU-5072 and Beta-41578, however, are statistically significantly different. The pooled mean of ANU-5072 and ANU-5073 (3050–2750 cal. BP) overlaps by only 50 years with Beta-41578 (3340–3000 cal. BP), and the two results are statistically significantly different. For the rest of this paper, we use Beta-41578 as the best estimate for the appearance of dentate-stamped pottery at FEA.

The relationship of the shell sample from the southwest beach (Wk-9936) to the three shell samples from layer 4 is uncertain. Its position could be stratigraphically equivalent to layer 4 (White *et al*., 2002: 105), as its result (3180–2810 cal. BP) overlaps with those of layer 4.

Tephra analyses. Professor Hiroshi Machida (Tokyo Metropolitan University) inspected the layer 2 tephra in the field and assigned it to the Dk event of about 1400–1000 years ago (Machida, 1991). Subsequently samples from layers 2–3–4 were analysed by John Webb and Peter Jackson (La Trobe University) by electron microprobe. They identified the major elements of the tephra glasses and compared the Fe/Ca ratios of each as these discriminate between the Holocene tephras of central New Britain (Torrence *et al*., 2000: fig. 3). Using the terminology of Machida *et al*. (1996) for the region's Holocene tephra sequence, the results were as follows:

- Layer 2: Dk, W-K4, W-K3, W-K2
- Layer 3: W-K4, W-K3, W-K2
- Layer 4: Dk, W-K4.

The Dk and W-K4 tephras, dated to about 1500–1000 years ago, occur throughout (Machida *et al*., 1996: table 1; Torrence *et al*., 2000: table 3). The presence of these tephras in layer 4 contrasts markedly with the pooled mean date for this layer, which is older than both tephra events by more than two millennia. The presence in layers 2 and 3 of W-K2 tephra, which is dated c. 3480–3190 cal. BP (Petrie & Torrence, in prep.), but its absence from layer 4 is surprising. An obvious explanation for the inconsistency of the results is that all three layers have been extensively reworked, but there is also the possibility of anomalous results due to alteration of the surface chemistry of the individual shards of volcanic glass (Hanslip, 2001), though such alteration was not observed during the analyses. This issue is further discussed below in connection with the obsidian characterization study.

Conjoins and position of finds. We now turn to the obsidian and pottery (Table 2). The prevalence of abraded obsidian pieces and sherds meant that no conjoins could be effected either within or between excavation units. The position of finds in the lower levels was examined in the expectation that if they were relatively undisturbed, flat objects should lie more or less parallel to the former ground surface. The small size of most finds hindered this exercise, and relatively few were actually on layer surfaces. Several of the largest sherds within layer 4 were lying approximately horizontal, but others that were at an angle that could not be their normal position of rest are interpreted as evidence for post-discard disturbance.

Distribution of obsidian. The obsidian pieces recovered in 1989 were counted and weighed, mean weights per excavation unit were calculated, and frequencies were standardized to 1 m^3 of deposit (Table 3). The total weight of modified and unmodified obsidian recovered was 1.54 kg. As some unmodified pieces of low quality fragmented during transport from the field, it is impossible to calculate

Table 2. Distribution of finds at FEA by raw counts and weights (g). Only weight is given for "Unmodified obsidian" as many pieces fragmented during transport from the field.

layer	volume (cu.m.)	bone wgt	shell wgt	coral wgt	modified obsidian no.	modified obsidian wgt	unmodified obsidian wgt	all obsidian wgt	stone axe frag.	pottery no.	pottery wgt
1	0.14	0	0	0	9	4.6	0	4.6	0	75	362
2	0.42	0	5.3	0	249	329.5	19.3	348.8	0	1,929	5,790
3 spit 1	0.15	0	2.6	29.8	157	250.1	5	255.1	0	605	2,485
3 spit 2	0.13	0	0	0	166	172.7	36.6	209.3	0	965	3,268
3 spit 3	0.15	0	3.1	0	199	224.8	43.3	268.1	0	1,003	3,667
3 spit 4	0.11	0	0	0	87	79.1	5.9	85	0	637	2,395
4 spit 1	0.11	0	55.7	28.4	119	125	23.1	148.1	14.3	1,026	3,668
4 spit 2	0.12	0.24	155.5	32.9	58	135.8	83.5	219.3	0	784	3,904
totals	1.33	0.24	222.2	91.1	1,044	1,321.6	216.7	1,538.3	14.3	7,024	25,539

the original numbers. The 1044 modified pieces weigh 1.32 kg. The weight distribution for all obsidian is bimodal, with peaks in layer 4 and layer 3 spits 1–3 (Table 2). A similar bimodal distribution is suggested by the number and mean weight of modified obsidian pieces, with peaks in layer 4 spit 2 and layer 3 spit 1 (Table 3). These distributions could indicate vertical displacement or different phases of obsidian use on the island. The mean weight of modified obsidian pieces from layer 4 spit 2 is the heaviest (2.3 g) for all excavation units, and more than twice the mean weight of most other levels. The mean weight of modified obsidian for the whole trench is 1.3 g, substantially lower than the 3.5 g obtained by Goulding (1987: table 25) for the 1985 finds. This discrepancy probably reflects the exclusion of unmodified pieces from calculations for the 1989 finds, and the recovery of more small pieces through laboratory sorting of sieve residues in 1989.

Distribution of pottery. The 1989 excavation yielded 7,024 sherds weighing 25.5kg (Table 2). Quantification of pottery for each excavation unit included sherd counts and size expressed as weights and areas, with areas measured on graph paper to the nearest square centimetre. Here, sherd size is treated as a proxy for the degree of breakage as a result of post-depositional disturbance (cf. Calder, 1972). The counts, weights and areas were standardized to 1 m^3 of deposit, and means calculated for each excavation unit (Table 3). With the exception of layer 1, the largest sherds by both area and weight are in layer 4 spit 2 and the smallest in layer 2. The standardized values show that most sherds occur in layer 4, which contains 35–38% of sherds by count, area and weight. The frequencies decline in layer 3 spit 4, but increase again in spits 2 and 3. This roughly matches the bimodal distribution of obsidian noted above.

Tables 4 and 5 show the percentage frequency of sherd size groups based on counts and area in square centimetres (the distribution of size groups by weight is similar to that for sherd areas). Sherds less than 6 cm^2 in area make up 80–91% by count and 50–71% by area in each excavation unit. There are very few sherds of 16 cm^2 or more in area, but in layer 4 spit 2 they contribute 25% of the total sherd area. The largest sherd (128 cm^2) came from the base of layer 4 spit 2, which has over 60% of all large sherds. In summary, very small sherds (<6 cm^2) dominate throughout, but large sherds tend to be in the lower levels. There are no comparable data for the excavated pottery from the 1985 or 2001 investigations, though White *et al*. (2002: table 1) give size group frequencies for 288 sherds recovered from transect holes on the lagoon floor. They found that 40% were less than 4 cm^2 in area and only 19% exceeded 16 cm^2. These size distributions broadly agree with those of the 1989 excavated samples, though the latter have more very small sherds. This probably reflects differences in recovery techniques, a greater degree of disturbance of the land deposits, or both.

The mean sizes of the excavated sherds can be compared with those for the SAC and SAD Lapita sites on Watom Island

Table 3. Distribution and mean weights (g) of modified obsidian and pottery at FEA standardized for one cubic metre of deposit.

layer	modified obsidian mean wgt	modified obsidian n/cu.m	modified obsidian wgt/cu.m	pottery mean wgt	pottery mean area	pottery n/cu.m	pottery area/cu.m	pottery wgt/cu.m
1	0.51	64	33	4.83	3.8	536	1,987	2,586
2	1.32	593	785	3.00	2.5	4,593	11,199	13,786
3 spit 1	1.59	1,047	1,667	4.12	3.0	4,033	11,704	16,567
3 spit 2	1.04	1,277	1,328	3.39	3.1	7,423	22,667	25,138
3 spit 3	1.13	1,327	1,497	3.66	2.8	6,667	18,461	24,447
3 spit 4	0.91	791	719	3.76	3.2	5,791	19,035	21,773
4 spit 1	1.05	1,082	1,136	3.58	2.9	9,327	27,799	33,345
4 spit 2	2.30	483	1,132	4.98	3.5	6,533	22,164	32,533
totals	1.3			3.64	2.9			

Table 4. Percentage distributions of sherd size groups (cm²) at FEA by count.

layer	0.5–1.9	2.0–5.9	6.0–10.9	11.0–15.9	16.0–20.9	21.0–25.9	>26.0
1	25	55	12	4	1.4	1.4	0
2	52	38	7	1.5	0.25	0.25	0.15
3 spit 1	34	55	10	0.4	0.4	0	0.8
3 spit 2	41	44	12	2	0.5	0.3	0
3 spit 3	38	53	6	1.5	0.8	0	0.1
3 spit 4	38	48	10	2.5	1	0.3	0.3
4 spit 1	42	46	8	2.5	0.7	0.5	0.2
4 spit 2	35	51	10	1	1	1.3	0.6

Table 5. Percentage distribution of sherd size groups (cm²) at FEA by area.

layer	0.5–1.9	2.0–5.9	6.0–10.9	11.0–15.9	16.0–20.9	21.0–25.9	>26.0
1	7	44	23	13	6	8	0
2	21	44	21	7	2	2	2
3 spit 1	11	52	26	2	3	0	6
3 spit 2	13	44	28	9	3	3	0
3 spit 3	14	56	17	6	5	0	1
3 spit 4	12	45	24	10	6	2	1
4 spit 1	14	45	21	11	3	3	2
4 spit 2	10	40	21	4	6	8	11

(Specht, 2003: tables 2 and 3), where the deposits of both localities display various degrees of reworking (Specht, 1968, 2003; Green & Anson, 2000). The mean areas of sherds at FEA are smaller than those from SAC, but are similar to those at SAD. In terms of mean weight, the SAD sherds are generally lighter than those of FEA, perhaps reflecting small differences of thickness. Allowing for the slightly different sherd size group intervals between FEA and Watom, the frequencies for FEA sherds less than 6 cm² in area (50–71%) compare well with those less than 5.1 cm² at SAC (62.5–73.6%), but most of the excavation units in the SAD trenches have more smaller sherds than FEA (Specht, 2003: table 5). These figures suggest that FEA may have experienced a similar degree of disturbance as SAC, but possibly not as much as SAD.

In summary, the FEA sherds might have been deposited in or on layers 3 and/or 4. If layer 4 was the original context of discard, then over 60% of its original pottery content has been displaced upwards. If the original discard of pottery was associated with layer 3, then about one-third of the sherds have been displaced downwards. The latter possibility seems unlikely in view of the radiocarbon dates for both layers and the sherd size groups discussed above. The possibility of two phases of deposition cannot be discounted.

Discussion. The above discussions of the stratigraphy, distribution of finds, tephra analyses, and obsidian and sherd frequencies and size distributions support the view that the FEA site has experienced considerable disturbance and displacement of its archaeological materials. The Lapita period materials could have been deposited during the formation of layer 4 or on its surface, as Ambrose and Gosden (1991: 187) suggested. This is supported by the consistency of three dates on shells from layer 4, which suggest that many or all of the artefacts in layer 4 belong to this level, and place the initial Lapita use of the island at between 3340–3000 and 3050–2750 cal. BP. Later reworking of layer 4 could have displaced many sherds and probably much obsidian into higher contexts. If this were so, the finds from this layer represent less than half of its original content, though some large sherds, pieces of obsidian and marine shell remained in layer 4. On the other hand, if the original level of discard was on the surface of layer 3, then about one-third of the sherds have been displaced downwards. An alternative interpretation is that some of the obsidian and pottery in layer 3 represents continued artefact deposition, possibly lasting until around 1830–1400 cal. BP (ANU-5071), though the essentially "modern" result for spit 3 of this layer throws doubt on the relevance of this date. On balance, deposition of the Lapita period materials on layer 4 seems more likely.

The non-pottery finds

Table 2 shows the distribution of finds. The low quantities of bones, shells and coral pieces reflect the acidic nature of the tephra-derived sediments, high ambient and ground temperatures, and the area's mean annual rainfall of >4100 mm (McAlpine *et al*., 1983: 181, Talasea). In such conditions, organic materials disappear rapidly from the archaeological record. In light of the evidence for vertical displacement of sherds discussed above, other items could have been similarly displaced. This is discussed further in the section on obsidian.

Bone. Specht *et al*. (1991: 289) refer to "several" pieces of bone from the 1989 excavation, but further examination indicates only one definite piece. This was recovered in layer 4 spit 2 and is an abraded fish vertebra that is not identifiable to species or genus.

Shell. Shells (222.2 g) were present from layer 2 down, mostly at the base of layer 4 and on the surface of layer 5 (155.5 g), where they are very degraded and incomplete. The identified taxa include Tridacnidae (possibly *Hippopus hippopus*), Cypreidae, Strombidae, Trochidae, Muricidae, possibly Cymatiidae and Lambidae, *Chama* sp., and Ostraeidae. In addition, possible Neritidae and *Hyotissa* sp. were found in the auger holes, and White *et al*. (2002: 105) report *Anadara* sp. No worked shell was noted.

Coral. Twenty-two small pieces of coral (91.1 g) occurred from layer 3 down, mostly from layer 4. All are too degraded to judge whether any were used as tools.

Obsidian. The evidence for disturbance discussed above suggests that an unknown proportion of the obsidian pieces recovered in 1989 is out of context. With the possible exception of three stemmed obsidian tools, discussed below, we are unable to control for this likelihood.

Because of the island's geological origin, all obsidian found on Boduna must have been imported from one or more of the four source areas known in the Talasea area (Torrence *et al*., 1992; Bird *et al*., 1997). On the basis of hand specimen observation, some obsidian pieces were assigned to the Hamilton source on Garua Island; 46% by weight of these "Hamilton" pieces came from layer 4. We submitted 28 other pieces from layers 3 and 4 for PIXE-PIGME analysis at the ANSTO facility, Lucas Heights, NSW. The initial results allocated 15 pieces to the Kutau/Bao source and one (a tiny chip from sherd FEA/I/311) to the Gulu source (Plate 2), and 12 pieces were not assigned because of aberrant results possibly caused by geothermal alteration of their surfaces (Summerhayes *et al*., 1993: 63; cf. Hanslip, 2001: 160–162). When 27 pieces were later re-analysed with each prepared to provide a fresh target surface, all were allocated to the Kutau/Bao source (Summerhayes *et al*., 1998: table 6.5). The chip taken from a sherd was not re-analysed as it was too small to prepare a fresh target surface. Two small, stemmed tools from layers 2 and 3 spit 1 were later analysed separately and both were attributed to the Kutau/Bao source (P. Rath, pers. comm.).

About 86% of all pieces by weight show signs of human modification, including nearly one-quarter of the "Hamilton" obsidian. This obsidian is rated in quality as "low" and generally "not viable" for making flaked artefacts because its fracture patterns are irregular and unpredictable (Torrence *et al*., 1992: 88, table 1). Almost half of the "unmodified" obsidian belongs to the "Hamilton" category, which has the highest mean weight per piece (17.4 g), perhaps because its poor quality caused the stone workers to discard these pieces early in the reduction process. The presence of this low-grade obsidian raises the question: why was it selected instead of better quality obsidian? One possible answer is that it was not brought to Boduna for flaked tool production.

Table 6 presents basic data about the modified obsidian. Non-cortical pieces dominate (94%), and of these, flakes are the most common technological type. There are nine cores, all small (weight range 6.6–19.7 g) and with one to three platforms for the removal of small flakes. Goulding (1987: table 25) reports only four cores in the 1985 sample, with a mean weight of 10.5 g. Four of the 1989 cores are on thick flakes, one of which retains a small amount of cortex. Retouch is rare, with only 16 examples identified. The most important of these are the three small, stemmed tools made on flakes found in layers 2 and 3 (Table 7, Figs 4a–c). The tool from layer 2 has a pointed, bifacially flaked stem, with a hinge fracture at the distal end. The tool from layer 3 spit 1 also has a bifacially flaked stem and retains part of the platform at the proximal end. The third tool, from layer 3 spit 2, has two side notches forming the stem.

Table 6. Basic descriptive data of obsidian excavated at FEA.

layer	CORTEX other	CORTEX flake	CORTEX core	CORTEX retouched other	CORTEX retouched flake	NO CORTEX other	NO CORTEX flake	NO CORTEX core	NO CORTEX retouched other	NO CORTEX retouched flake	NO CORTEX stemmed tool	total
1	1	1	0	0	0	2	5	0	0	0	0	9
2	2	11	0	0	0	11	219	1	1	3	1	249
3 spit 1	3	4	1	0	1	9	135	2	0	1	1	157
3 spit 2	2	7	0	0	0	6	148	1	0	1	1	166
3 spit 3	2	8	0	0	1	8	177	2	0	1	0	199
3 spit 4	0	7	0	0	0	2	77	1	0	0	0	87
4 spit 1	4	0	0	0	0	5	108	1	0	0	0	119
4 spit 2	2	2	0	1	0	3	48	0	1	2	0	58
totals	16	40	1	1	2	46	917	8	2	8	3	1044

Table 7. Size (mm) of stemmed obsidian tools recovered from FEA.

layer	L	W	TH	stem L	stem TH	weight
2	53	27	10	36.5	10	8.34
3 spit 1	38	26	12	22.5	12	8.75
3 spit 2	27	21	5.5	19	5.5	2.14

Two main kinds of stemmed obsidian tools occur on Willaumez Peninsula, its neighbouring islands and in the Mopir obsidian source region (Torrence *et al*., 1990: 460–461; Fullagar *et al*., 1991: 111; Araho *et al*., 2002). Both types occur widely in pre-Lapita, pre-W-K2 tephra contexts (> 3600 cal. BP) in the Talasea area (Araho *et al*., 2002; Torrence *et al*., 2000). Type 1 forms are long, prismatic blades with bifacially flaked stems. Type 2 forms are more variable, but larger examples are made on *kombewa* flakes, with bifacially flaked stems and usually a sharp, rounded edge formed by the intersection of two flake surfaces. The FEA finds are identical to small Type 2 tools (Kealhofer *et al*., 1999: fig. 3 FAO 359; Torrence *et al*., 2000: 235; Araho *et al*., 2002: 66–67; Torrence, 2002: 185–186, fig. 12.1).

Two other stemmed obsidian tools have been found on Boduna. Ambrose and Gosden (1991: 187, fig. 7) found the stem of a Type 1 tool in the top spit of their Square II, and in 1980 Ian Lilley, John Normu and Andrew Marenge found a Type 2 tool on the surface (Fig. 4d; now in the West New Britain Cultural Centre, Kimbe). A second item with side notches found by Lilley, Normu and Marenge could be an accidental product (Fig. 4e).

The presence of stemmed obsidian tools on Boduna Island raises the issue whether they indicate pre-Lapita use of the island or their production continued after the W-K2 eruption. White *et al*. (2002: 106) question the 1985 find as evidence for pre-Lapita activity on Boduna, particularly as their reconstruction of the island's history suggests that it was probably "an inter-tidal or exposed sandy cay from about 3000 years ago or a little more." This dating has no firm foundation, however, and there is no evidence to show that Boduna was not available for human use in pre-Lapita times. The stemmed tools might have been brought to the island at that time, but subsequently became incorporated into later stratigraphic contexts. Alternatively, the tools could have been brought to the island after the W-K2 event, perhaps during Lapita times, as items scavenged from older contexts on Garua Island or the mainland. While this is possible, it is hard to understand why small items such as those found in 1989 were selected, as they are too small for use as cores and have not been re-worked. Finally, small tools could have been produced in the Talasea area after the W-K2 event, as Torrence (2002: 186) reports a small Type 2 item in a post-W-K2 context on Garua Island. On present evidence, we are unable to choose between these three options.

Type 2 artefacts form a diverse group in both form and size, and were probably multi-function tools (Torrence, 1992, 2002: 185), though Araho *et al*. (2002: 68–70) and Torrence (2004: 168–170; cf. Rath & Torrence, 2003) have proposed that particularly fine, large examples might have served as a form of early valuable. The three FEA specimens recovered in 1989 are so much smaller than most Type 2 tools that they must have served other functions. Nina Kononenko has examined them for use-wear evidence and concludes that they were probably used in activities involving plants such as tubers and soft wood (Kononenko & Specht, in prep.). Similarly, a small example from FAO on Garua Island was also probably used with plants (Kealhofer *et al*., 1999: fig. 3, FAO 359, table 4).

During excavation 55 pieces of obsidian were bagged for use-wear and residue studies by Richard Fullagar, who divided the pieces into two groups, "Lapita" (layer 4, n = 37) and "post Lapita" (layers 2–3, n = 18). Fullagar (1992: 137–138, fig. 2) recorded both plant and animal uses, but most pieces displayed severe surface weathering that prevented more detailed study (cf. Hanslip, 2001: 160 on the generally poor condition of archaeological obsidian artefacts in western Pacific sites).

Other stone. Only one non-obsidian stone artefact was excavated, in layer 4 spit 1. This is part of the cutting-edge of a ground axe or adze blade (14.3 g) made from grey tuff or quartzite. In 1980 a fragment of a ground grey-green quartzite tool (62.7 g) was found on the southern beach. This could be part of an axe or adze blade, though no blades in this kind of rock type have been found in the Talasea area. In 2001, White's team recovered the cutting edge of another ground stone axe blade from a surface context. This is made from rhyolite, with a flattened lenticular to plano-convex cross-section, with many small chips removed from the rounded, medial cutting-edge as a result of use. This is probably of local origin, as rhyolite rocks are a feature of the Kimbe Volcanics of Willaumez Peninsula (Smith & Johnson, 1981; Ryburn, 1975).

Many tiny (<1 cm) angular fragments of rock were found in all layers, some probably derived from the tephras that form the deposits. There were also pieces of white to off-white chalcedony-like rock, one piece of calcite crystal, and a possible piece of quartz. All of these are 1 cm or less in length. Their tiny size and the absence of large pieces make it unlikely that they were artefacts. These and several chips of volcanic rock possibly from heat-retaining stones are not tabulated.

Pottery

This section covers the sherds excavated in 1980 and 1989, and about 260 sherds from the various surface collections. The surface collections were made over many years by different people, and are clearly biased towards large items (cf. White *et al*., 2002: 104). Many sherds in the Walindi and Ray collections came from the inter-tidal zone and southwest lagoon floor, but others cannot be assigned to a specific collection area. In the following discussions, we treat the surface collections as a single group. We have examined those in the provincial Cultural Centre (126) and at Walindi (23), one sherd collected by Sarah Jarman (Plate 5), one found by Philip Munday (Plate 6), and 24 sherds in the Ray collection. We have also had access to some sherds recovered in 2001 (White *et al*., 2002: figs 3–4), but have not re-studied those found in 1985 (Ambrose & Gosden, 1991: figs 3–6).

Selected sherds are shown in Figs 5–22. The illustrations of sherds in the Cultural Centre, Walindi, and Jarman items are based on sketches made by Specht from the actual sherds. Drawings of the Ray collection are based on photographs provided by J.P. White; with these, it is often difficult to identify vessel part or design details. Even with drawings made by direct observation of the sherds, the weathered surfaces occasionally introduce uncertainty about the decorative technique employed and the nature of the design. Figures 5–22, therefore, should be treated as interpretations that might vary between observers, particularly with regard to the orientation of some sherds, which could be rims or pedestal bases, shoulders or flat bases. In Appendix 1, "WNB-CC" refers to sherds in the West New Britain Cultural Centre, Kimbe; "Walindi" to sherds held at Walindi Plantation Resort. The "Ray collection" items are mostly held in Kimbe; the modelled heads are in the National Museum and Art Gallery, Waigani (Torrence & White, 2001). The current locations of the Jarman and Munday sherds (Plates 5–6) are not known.

Compositional studies. Boduna's geological origin means that the pottery was made elsewhere or the raw materials were brought to the island. Obsidian inclusions in the pottery offer a clue to the possible location of the clay or temper sources, or pottery production centres. At least 12 excavated and surface sherds contained tiny chips of obsidian, eight of which were removed for PIXE-PIGME analysis. Only the one from incised body sherd FEA/I/311 (layer 3 spit 3; Fig. 6m) could be mounted for analysis, and this was allocated to the Gulu source (Specht *et al.*, 1991: 288; Summerhayes *et al.*, 1993: 63). Similar inclusions in sherds at the FSZ and FAO sites on Garua Island have also been assigned to the Gulu source (Torrence & Summerhayes, 1997: 80; Summerhayes, 2000: 170). The seemingly regular occurrence of Gulu obsidian in sherds at FEA and on Garua Island raises the question whether the pieces occurred naturally in temper sands or were accidentally incorporated in the temper sand as a result of human obsidian reduction processes. Alternatively, they might have been deliberately added to the clay. If pots were made on Boduna, the obsidian could have been brought to the island specifically for adding to the clay, and this might explain the presence in the 1989 excavation of low quality obsidian, which we have compared with that from the "Hamilton" source. We note that Dickinson (1997: table 149–1) recorded "grains of pumiceous volcanic glass" of undetermined origin in two sherds from FSZ, but not in the two FEA sherds that he examined.

There have been four studies of the composition of FEA pottery. Julian Hollis examined sherds recovered in 1974 and 1980 in hand specimens and by petrographic thin section, together with sherds from other pottery sites in the Talasea area (Hollis, 1983; cf. Summerhayes, 2000: 167–168). Hollis suggested that "while some minor differences exist between sherds from different sites, their temper inclusions clearly originated from the same geological province." He concluded that the sherds were all of local manufacture, a finding consistent with that of Anson (1983) and Lohu (1983) for sherds from the FCR/FCS site on the mainland of Willaumez Peninsula opposite Garua Island. Dickinson (1997, 2000: 172) reached a similar conclusion for sherds from FEA and FSZ, adding that their andesitic minerals supported a possible mainland origin.

Summerhayes (2000: 145–149, 170, tables 9.8 and 11.3) analysed 307 sherds from spits 2 to 7 of Ambrose and Gosden's trench II. He identified four mineral inclusion groups: "light (feldspars)," "pyroxene = light" (equal quantities of feldspars and pyroxenes), "calcareous" and "inclusion free." Sherds with "light (feldspars)" represented 75% of the sample, those in the "pyroxene = light" group 20%, and the "calcareous" and "inclusion free" groups only 4% (Summerhayes, 2000: table 9.8). Nine sherds from the "light (feldspars)" group showed mainly plagioclase feldspars, with some amphiboles, oxides and quartz (Summerhayes, 2000: table 11.3). The dominance of "light (feldspars)" is consistent with the composition of beach sands from nearby Garua Island and the Talasea area in general (Summerhayes, 2000: 168, 203). The "pyroxene = light" group declined from 25% of sherds in spit 7 to 14% in spit 2.

In the fourth study, Summerhayes compared a sample of the 1989 sherds with the 1985 collection and sherds from Garua Island; the results are reported here for the first time (Table 8). This sample consisted of 203 of the 2447 sherds found in layers 4 and 3 spit 4, and included all rim, shoulder and decorated sherds, and some plain body sherds. Summerhayes identified four mineral groups, with a fifth residual group of unassigned sherds. Two sherds in the "light (feldspars)" group have flecks of mica; these are not tabulated separately. The "light (feldspars)" and "pyroxene = light" groups match those of the 1985 sample. In both samples these groups account for more than 90% of sherds examined (Table 8; Summerhayes, 2000: table 9.8). The new groups are "magnetite" and "pyroxene", but neither is common (<1% and 6.4% respectively). The "calcareous" and "inclusion free" categories are not represented in the 1989 sample, but this is not surprising as they were rare (<4%) in the 1985 sample, and Dickinson (1997) did not identify a calcareous fraction in his FEA sample. The low frequency of the "calcareous" group in the 1985 sample, and its absence from that of 1989 might reflect post-depositional dissolution of calcareous grains, as Dickinson (2000: 166) has noted for Watom Island pottery. This possibility seems unlikely, as the excavated sherds at FEA have smooth surfaces, whereas those from Watom that have lost calcareous grains have pitted surfaces with vacuoles marking the position of the lost grains. The scarcity of calcareous tempered sherds,

Table 8. Pottery fabric groups at FEA in the 1989 excavated sample.

layer	pyroxenes	pyr = light	light	magnetite	?	totals
3 spit 4	3	3	41	1	3	51
(%)	(6)	(6)	(80)	(2)	(6)	
4 spit 1	2	11	60	1	0	74
(%)	(3)	(15)	(81)	(1)	(0)	
4 spit 2	8	28	41	0	1	78
(%)	(10)	(36)	(53)	(0)	(1)	
totals	13	42	142	2	4	203

then, probably reflects the rarity of this temper in the Boduna assemblages.

The results of the analysis of the 1989 sample generally support those of the earlier study. There are two main and four minor fabric groups at FEA, which could indicate that the pots came from several production centres. The obsidian inclusion assigned to Gulu suggests that one of these was probably located on the north side of Garua Harbour.

Given the evidence for disturbance of FEA, a random distribution of the fabric groups might be expected, but the distribution appears to be patterned. The frequencies of sherds in the two main groups change between layer 4 spit 2 and layer 3 spit 4, with the "light (feldspars)" group increasing from 53% to 80%, and the "pyroxene = light" group decreasing from 36% to 6%. The distributions of the "pyroxene" and "magnetite" groups are uninformative, as both are rare. These frequency changes are in line with the results for the 1985 sherds, which showed an increase of "light (feldspars)" and decrease in "pyroxene-light" between spits 7 and 2 (Summerhayes, 2000: table 9.8). The changes in the 1989 sample do not seem to be related to increased breakage of sherds between layer 4 spit 2 and layer 3 spit 4, as the three levels show similar size ranges: 96% of sherds in each are less than 11 cm^2 and 86–88% are smaller than 6 cm^2. Support for a change in fabrics through time at FEA comes from the FSZ site on Garua Island, which on stylistic and dating grounds is probably later than FEA (Summerhayes, 2004: table 2). Only the "light" fabric is present at FSZ, and in the chemical analyses FSZ sherds grouped with the "light (feldspars)" sherds of FEA (Summerhayes, 2000: 145, 202). While further work is clearly needed, the apparent shift in the nature of the sand temper might be related to more than one phase of pottery deposition on Boduna.

The prominence of the "pyroxene = light" fabric in layer 4 at FEA contrasts with its scarcity at the FCR/FCS site on the mainland near Talasea, where Lohu (1983: 260) noted that the dominant grain type was plagioclase feldspars (the "light (feldspars)" group of Summerhayes). Quartz and volcanic lithics were also fairly common, but clinopyroxene and hornblendes were absent or present only as minor components. This is surprising, as Hollis (1983) considered that amphiboles and pyroxenes comprise about 60% of present-day beach sands in the Talasea area, with alkali feldspars and other plagioclase making up most of the balance. An explanation for this discrepancy might lie in the nature of the present-day beach sands, which are derived from several tephra events preceding and post-dating Lapita pottery in this area. Alternatively, there could have been several contemporary pottery production centres using different temper sands during the Lapita period, or the locus of production shifted through time. If the obsidian inclusions in the FEA, FAO and FSZ sherds did originate from the Gulu source, then there might have been production centres on the northern and southern sides of Garua Harbour using mineralogically related but distinct beach sands. On the other hand, the apparent shift in the nature of temper sands in the 1985 and 1989 sherd samples discussed above could reflect temporal rather than spatial differences between production centres. Finally, we note the use of two clay mixes to make a pot at the RF-2 site in the SE Solomon Islands (Clough, 1992: 189). A similar situation might have existed at FEA, but the question why potters employed special construction procedures requiring the use of two clay mixes for the same vessel remains to be answered. There is, however, no evidence of the use of more than one clay-temper mix in any of the FEA sherds we have inspected. Clearly, there is need for more detailed studies of both sherds and beach sands, as well as confirmation of the source of the obsidian inclusions.

The two "magnetite" sherds at FEA are unusual, as this mineral has not been reported in sherds from other north coast Lapita sites. It occurs, however, at sites in the Arawe Islands and near Kandrian on the south side of New Britain (Summerhayes, 2000: 172–175), where the source of the magnetite could be river beds to the west of Kandrian (Summerhayes, 2000: 168, table 11.1). The "pyroxene" group, represented by 13 sherds at FEA, are probably of local origin, but might also have come from the south coast, as Hollis noted that while pyroxenes occur in the Talasea area, they are always in association with light minerals that do not occur in the FEA sherds. The presence of a similar fabric group on the south coast of New Britain around the Arawe Islands, where pyroxenes occur in local river sands, may indicate that FEA pyroxene group was imported from the south coast. Most of the FEA sherds, however, are clearly of local origin.

In summary, the results of the analysis of the 1989 sample generally support those of the earlier studies. Together, they show two main and four minor fabric groups at FEA, which probably indicate several production centres. The "magnetite" group probably represents imports from the south coast of New Britain, and the "pyroxene" group might also have come from that area, but the other four groups are consistent with an origin in the Talasea area. The obsidian inclusion assigned to Gulu suggests that one of the production centres or raw material sources was located on the north side of Garua Harbour.

Vessel production and forms. Most sherds are too small or poorly preserved to determine how the vessels were made. A few have smooth indentations on their interior surfaces that suggest the use of the paddle-and-anvil technique. Others indicate an additive construction process such as "slab-building" (cf. Tonga—Poulsen, 1987: 136, fig. 61; New Caledonia—Sand *et al*., 1996: fig. 32, 1999a: 22; Wickler, 2001: fig. 4.10). This is particularly visible on thick shoulders, flat bases and rims; one flat base sherd from layer 4 spit 2 was made from three pieces of clay (Fig. 10c). For some vessel shapes, such as flat-based bowls and large vessels of complex form with several inflection points, the only way to achieve the desired form was probably to prepare the vessel in several parts and then join them. This technique would have an added advantage for large vessels of complex forms, as it would strengthen the shoulders to support the weight of the upper body of the unfired pot. Some rims have an additional band of clay added to produce a channelled or grooved lip (Figs 12h, 15d).

Whereas the excavated sherds are frequently soft and friable, the surface sherds are hard and those from the intertidal zone and lagoon floor seem unaffected by extended immersion in seawater. Nearly all of the excavated sherds have a red-brown core and surfaces, but many surface sherds have dark grey to black cores. As the surface finds are frequently very thick (see below), this difference in colour of the core is probably the result of incomplete oxidation of the clay during firing.

Table 9. Distribution of vessel parts at FEA.

layer	rim	shoulder round	shoulder carinated	base round	base flat	vessel stands	body/neck dec.	body/neck plain
1	5	1	1	0	0	0	3	65
2	34	4	5	1	?1	2	42	1841
3 spit 1	10	3	3	2	1	0	25	561
3 spit 2	23	3	5	0	0	0	23	911
3 spit 3	21	1	4	1	0	2	31	943
3 spit 4	11	0	7	0	0	0	16	603
4 spit 1	14	0	10	2	0	0	19	981
4 spit 2	24	0	7	4	0	0	26	723
totals	142	12	42	10	1 (2)	4	185	6628

The excavated sherds and surface collections (Figs 5–22) include all of the eight vessel forms identified in the Arawe Islands: unrestricted open bowls and cups (I, II and III), restricted jars (IV, V), globular pots (VI) flasks and incurving bowls (VII), and vessel stands (VIII) comprising both pot stands and pedestal bases (Summerhayes, 2000: 33–34, figs 4.1–4.3).

Table 9 shows the frequencies of excavated rim, shoulder, base and vessel stand sherds. The orientations of three-quarters of the rim forms are indeterminate, but most of the remainder are vertical or everted while a few have inwardly curving profiles. Neck sherds include the "outcurving" and "everted" forms identified by Summerhayes (2000: fig. 4.4) in the Arawe assemblages, where they define forms IV–V and form VI respectively. As most sherds are small, vessel mouth diameters could often be estimated only as a range, and the results are not tabulated. Most mouth diameters measured range between 160–180 mm to 280–320 mm; the smallest diameter is about 80 mm (Fig. 5f).

Many lips are too damaged or weathered to allocate them to a profile category, but flat lips are more common than rounded ones. A distinctive form of lip has a shallow, rounded groove. This occurs on rims of both constant and expanded thickness (Figs 8a, 12f), with the latter grading into the channelled or grooved form made by adding a band of clay (Figs 12h, 15d). Grooved rims with or without an added clay band occur in the Arawes (Summerhayes, 2000: figs 5.1, 5.6), at ECA (Egloff, 1975: figs 9.13, 9.14) and the Duke of York Islands (White, 2007: figs 10, 13), and Tonga (Poulsen, 1987: fig. 54). Birks (1973: fig. 37) records a pot stand with a grooved lip at Sigatoka in Fiji. The grooved rim with an added band of clay may be related to the composite or flanged rims of Buka (Wickler, 2001: fig. 4.2), New Caledonia (Sand *et al*., 1996: fig. 108) and Tonga (Poulsen, 1987: figs 52.24, 53.1). Sand (2000: 23; Sand *et al*., 1996: fig. 157) suggests that in New Caledonia the composite rims were associated with lids, but the lid form has not been specifically identified in the FEA or Arawes assemblages.

Ten round bases were identified in the excavated sample. There are definite flat bases in layer 3 spit 1 (Fig. 6b) and 4 spit 2 (Fig. 10c), with another possible one in layer 2 (shown as a shoulder in Fig. 5o). Flat bases also occur in the surface collections (Figs 13b–e) and the 1985 excavated sample (Ambrose & Gosden, 1991: fig. 4.1), but appear to be relatively uncommon. Two surface finds have base diameters of about 260 mm and 160–180 mm (Figs 13d–e). Anson (1986: 161) did not record flat-based bowls in his Talasea sample. Two pedestal stand bases in the surface collections are about 300–320 mm in diameter, and a third one is 280 mm (Figs 16b, c, e).

Carinated shoulders are nearly four times more frequent than rounded shoulders in the excavated sample, though it is difficult to recognize rounded shoulders as they often lack distinctive features. Carinated shoulders show both convex and concave upper bodies. Two surface finds have a sharply carinated shoulder with a horizontal or sloping "ledge" above the angle of the carination (Figs 15u, 18i). Another surface sherd classed as a flat base could be a similar shoulder (Fig. 13e). This kind of shoulder is present at the FOH site in the Arawe Islands (Summerhayes, 2000: fig. 5.3, sherd 979), and resembles shoulders at SEE in the Duke of York Islands (White, 2007: fig. 16) and WKO013A in New Caledonia (Sand *et al*., 1998: figs 3–6; 1999b: 36–41). One FEA example is clearly dentate-stamped (Fig. 17i); the other (Fig. 14u) is too heavily weathered to identify if it was once decorated.

Two dentate-stamped sherds, from layer 4 spit 1 (Fig. 9g) and in the Walindi collection (Fig. 17c), have two horizontal relief bands similar to those on the cylinder stand from zone C at ECA/B on Eloaua Island (Kirch, 1997: fig. 5.5). Best (2002: 81–82, fig. 23.IIb, fig. 25, appendix B) draws attention to similar sherds in FOH/G in the Arawe islands (cf. Summerhayes, 2000: fig. 6.2), possibly on Watom Island (cf. Specht, 1968: plate 3a), in EAQ on Ambitle Island in the Anir Group of New Ireland (cf. Bellwood, 1978: fig. 9.13d), and in the RF-2 site of the SE Solomons (cf. Parker, 1981: plate 6). Fragments are also reported from the Teouma site in Vanuatu (Anon., 2005; Shing *et al*., 2005; Bedford *et al*., 2006). At ECA/B, the cylinder stand is dated to about the same period as the basal level of FEA (Kirch, 2001a: 103). Two other FEA surface sherds with a single relief band could also be from cylinder stands (Figs 17b, d).

One rim sherd in the Cultural Centre collection is from a pot stand of form VIII, and has a rounded-triangular projection (Fig. 16a) similar to those on pot stands in Fiji (Birks, 1973: fig. 34, plates 26, 29) and Tonga (Poulsen, 1987: fig. 60.2). At FEA, pedestal stand bases are represented by a sherd from layer 3 spit 3 (Fig. 7c), one from spit 7 of test pit II excavated in 1985 (Ambrose & Gosden, 1991: fig. 6.1, where the caption should be switched with that for fig. 5), and four in the surface collections (Figs 16b–e). Two of these are dentate-stamped, and the third has gouge-incision. Several other sherds classed as rims could in fact be from similar bases (e.g., Figs 10b, d, e from layer 4 spit 2). The

Table 10. Distribution of decorated sherds excavated at FEA.

layer	notch lip	scallop lip	D/S	D/S & incised	D/S & circle	D/S & flange	D/S, circle & flange	incised or plain stamp	incised & circle stamp	circle stamp	circle & exc. Δ	shell imp.?	exc. Δ	gouged & exc. Δ	gouged	?	total
1	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	1	6
2	14	0	14	1	2	0	0	28	1	0	1	0	1	0	0	4	66
3 spit 1	6	1	3	0	1	0	0	22	1	0	0	0	0	0	0	1	35
3 spit 2	12	0	10	3	0	0	0	15	0	0	0	1?	0	1	1	0	43
3 spit 3	9	1	7	1	2	0	0	22	1	1	0	0	0	0	0	3	47
3 spit 4	2	1	9	0	0	0	0	10	0	0	0	0	0	0	0	0	22
4 spit 1	5	0	10	0	0	1	1	17	0	0	0	0	0	0	0	0	34
4 spit 2	9	2	20	1	0	0	0	13	0	0	0	0	0	0	0	0	45
totals	59	5	74	6	5	1	1	129	3	1	1	1?	1	1	1	9	298

form is known from other Lapita sites in the Bismarck Archipelago, such as ECA in the Mussau group (Egloff, 1975: figs 12, 14a–b; Kirch, 1997: plates 5.1, 5.2); FNT (Kreslo) between the Arawes and Kandrian (Specht, 1991: fig. 8); the Arawe Islands (Summerhayes, 2000: figs 5.16, 5.31–33, 6.8, 8.7–8); at SEE in the Duke of York Islands (White, 2007: fig. 15); and at ERA (Kamgot) in the Anir group (Summerhayes' excavation). Further afield, it also occurs in New Caledonia (Sand, 2000: fig. 3; Sand *et al*., 1996: fig. 157), Fiji (Birks, 1973: fig. 37, plates 24, 25, 33A), and possibly Tonga (Poulsen, 1987: plate 43.6). Although Parker (1981) did not record this form in the SE Solomons sites, several sherds at RF-2 illustrated as rims could be re-interpreted as pedestal bases (Parker, 1981: fig. 30, plate 8). It is difficult to determine whether these fragments are from freestanding supports for vessels, or are the bases of bowls-on-stands.

A sherd in the Cultural Centre has an unusual profile and curvature that suggests it might have been part of a bowl-on-stand, with possible dentate-stamped design on the shoulder/base angle (Fig. 11i). This form, not previously reported in the Talasea area, has also been tentatively identified at sites FCR/FCS and FEM in the Talasea area (Specht, 2007; Specht & Torrence, 2007). Further afield, it occurs in Lapita contexts at the ECA site (Kirch, 1996: fig. 6), in New Caledonia (Sand *et al*., 1996: figs 34, 62; 1999a: 20; 1999b: 46; Sand, 2000: fig. 3; Chiu, 2003: 287–288, fig. 7.1), and in Fiji (Birks, 1973: fig. 33, where it is described as a "cover"). Egloff (1979: fig. 19, plate 8, 70) recorded similar vessels in Collingwood Bay and the Trobriand Islands of Papua New Guinea, though an excavated example in his Mound C is dated later than Lapita at c. 640–970 cal. BP (Egloff, 1979: 29). Best (2002: 72–73, figs 23, IIg–j) introduces comparisons with 19TH century pottery and wooden vessels in Fiji as possible later parallels for the bowl-on-stand form. May and Tuckson (1982: 9.39) illustrate a recent bowl-on-stand from the East Sepik Province of Papua New Guinea, as well as other modelled clay items that could produce base sherds similar to those found in Lapita contexts (May & Tuckson, 1982: figs 9.45, 9.63).

The Walindi collection includes a body sherd with two rectangular cut-out sections (Fig. 17e). This may be part of a pedestal base, as examples of such bases with triangular cut-outs and with dentate-stamped designs are reported from the Arawe Islands (Summerhayes, 2000: 82, fig. 5.33; 101, fig. 6.8; 131–135, figs 8.7, 8.8), the ECA site on Eloaua (Kirch, 1997: plates 5.1 and 5.2), and in the Anir group at the EAQ (AM collection, Sydney) and ERA sites (Summerhayes' excavations). Sand (2000: 23) specifically notes that only one example is known from New Caledonia. Cut-outs are also found on bowls-on-stands in the Collingwood Bay area of Papua New Guinea, dated to between c. 640–970 cal. BP (Egloff, 1979: plate 8, 29, 70), and in nineteenth century pottery and wooden vessels from Fiji (Best, 2002: 72–73, figs 23, IIg–j).

A plain rim in the Cultural Centre has additional strips of clay applied to the interior and exterior to form a triple rim (Fig. 15p). This composite form recalls double rim sherds found at Kreslo (Specht, 1991: fig. 3i), the Amulut site in the Arawe Islands (Specht, personal observation), and the Buka-Nissan-Sohano sites (Wickler, 2001: 80).

Ambrose and Gosden (1991: fig. 6.9) illustrate what might be a small strap handle; nothing similar was found in the 1989 excavation or the surface collections. This handle, the composite rim, flat-based bowls, pot stand and pedestal bases, possible bowl-on-stand and cylinder stand extend the range of forms recorded for the Talasea area in the FCR/FCS collection (Anson, 1983: 35).

Decoration. Only 298 excavated sherds (4.3% of all excavated sherds) show surface modification that can be classed as "decoration", though weathering has almost certainly obliterated decoration on some sherds. This weathering also makes it difficult to identify the technique employed on some decorated sherds; these are listed as "?" on Table 10. The frequency of decorated to plain sherds ranges from 3.3% to 5.7% between excavation units. Ten techniques are definitely present in the 1989 excavated sample: dentate-stamping, linear incision, plain stamp impressions, gouging (very wide incision), circle impressions, arc or half-circle impressions, excised triangles, relief applied as a continuous horizontal band or flange, lip notching and scalloped lips. A sherd excavated in 1985 adds a rocker stamp to this list (Ambrose & Gosden, 1991: fig. 3.3). Elsewhere in the Talasea area this rocker technique occurs only on a surface find at FSZ on Garua Island (Specht & Torrence, 2007). One sherd from layer 2 and one surface find are classed as dentate-stamped, but might be shell-impressed. In view of uncertainty raised by the weathered condition of these sherds, the sherd from layer 2 is not listed separately on Table 10. In the Talasea area, definite shell-edge impressions are confined to FAO, FSZ, FAAK and FAAQ on Garua Island (Summerhayes, 2000: fig. 9.2; Specht & Torrence, 2007). It also occurs in the Arawe Islands at FOJ and FNY (Summerhayes; 2000: tables 7.3, 8.3, 9.7, fig. 9.2). Some exterior surfaces and occasionally rim interiors have a red to red-brown slip, but there is no definite evidence for lime-infilling of designs.

To this list of decorative techniques, the surface collections add cut-outs, applied relief knobs and short bands, punctations and perforations. The Ray collection includes three modelled human-like heads with dentate-stamping resembling tattoo marks that were probably attached to the side of pots (Torrence & White, 2001: 136). Similar heads have been reported from Kamgot (ERA) in the Anir group, New Ireland (Summerhayes, 1998), at Boirra (NKM001) in New Caledonia (Sand *et al*., 1996: fig. 162), and Naigani (VL21/5) in Fiji (Torrence & White, 2001: 138). Possibly related bird heads are reported from SZ–8 in the SE Solomons (Donovan, 1973a: fig. 8; Green, 1979: fig. 2.6) and the Teouma site in Vanuatu (Clausen, 2005: 122; Bedford *et al*., in review). Further afield, Bellwood (1997: fig. 7.13) illustrates a modelled human head from the Kalumpang site on Sulawesi that resembles the Lapita examples.

Three carinated shoulder sherds at FEA have a prominent relief knob just above the shoulder angle (Figs 18f,g,h). In each case the knob is evenly rounded and does not represent a head. Another sherd recovered from a 1980 spade pit has a short vertical strip together with dentate-stamping and impressed circles (Fig. 18e).

No fingernail impressions or brushed surfaces (Green & Anson, 2000: figs 13h–j) were recorded in either the excavated or surface collections.

The quality of dentate-stamping ranges from very fine, closely spaced, needlepoint impressions to large, square impressions, though only one or the other is present on each sherd. The number of impressions per 10 mm was counted for a sample of sherds in an attempt to distinguish between these extremes. While the result was not successful largely due to difficulty in counting faint impressions on weathered sherds, the number of impressions ranges from 5 to 13 per 10 mm, with most around 7 to 8 per 10 mm. Some paired dentate-stamped lines and arcs are so close and regular that they might have been made by a double-rowed tool, or possibly by two tools held together. This is particularly noticeable with groups of straight lines joined at each end by a short, half-circle impression. The distinction between the very fine and larger dentate-stamping is matched by the way they are applied: the very fine dentate-stamped lines are closely placed, whereas the larger ones tend to be more widely spaced. Because the small size and weathered surfaces of most sherds restrict the number of examples of dentate-stamping that could be measured, we have not plotted the vertical distribution of the frequency of impressions.

Among the rim sherds are 59 with single or double notched lips and five examples of a wavy, scalloped lip modification where the rim/lip is wavy like the edge of a bivalve mollusc. All these rims are otherwise plain. Notching is almost always on flat lips, with single notching usually on the inner edge or top of the lip. Double notching is located on the outer and inner edges of the lip. A dentate-stamped rim from layer 3 spit 3 has rounded to triangular excised notch on the exterior edge of the lip (Fig. 7a). Six other rim sherds have alternating apex-to-base excised triangles on the lip (layer 2: Figs 5a,b; surface: Figs 12f, 12h, 14a, 15d). These include three grooved or channelled rims (Figs 12f, 12h, 15d), one of which (Fig. 12f) has rectilinear dentate-stamping that probably represents a Type 2 face.

Most sherds have only one decorative technique and combinations are rare, though this may reflect the small size of most sherds. Linear incision is present on more than half of all decorated sherds, though some heavily weathered sherds classed as incised might have originally been dentate-stamped or plain line impressed. Plain line impressions of arcs and straight lines commonly occur with designs that were also produced by dentate stamping, and in some cases the plain line stamping could be mis-identification of faint dentate-stamping. The two examples of punctations are a horizontal rim with punctations inside concentric incised arcs and a body sherd with incised lines below a row of punctations (Figs 14b, 19i). The rim shown in Figure 14b is unlike any other known in the Lapita ceramic series, but recalls the decoration on a rim of different form at the KAM site near Finschhafen on Huon Peninsula, where it was found on the surface with Type X sherds.

The dentate-stamped designs include a range of horizontal bands or panels of repeated elements. The most common design element is a band of overlapping arcs or short alternating diagonal straight lines that create the "rope" design (Specht, 1968: 129). This is Anson's (1983: table XII) motif 35. Best (2002: 46–49) attributes this decoration to a "roulette" tool. Several very small sherds from layer 4 have very regular bands of this design that might have been made by such a roulette, but most were clearly made by separate, consecutive tool impressions. It is often impossible to determine the kind of tool used when the lines are close together, but both dentate and plain tools were used. No attempt is made in the drawings to identify precisely the type of tool used, except where it is clearly not dentate.

Mead (1975: 24, fig. 2.12) identifies these bands as restricted zone markers. At FEA, they are used both as zone markers between design zones and as integral parts of larger designs, especially faces.

In his discussion of representations of dentate-stamped triangles, Anson (1983: 58–64; cf. 1990) noted consistent differences between those in the Watom collections and those of ECA, EAQ and FCR/FCS. These involve the angle of the apex, the number of infill radial lines and their "elaboration" or combination with other design elements. The latter three sites rarely have apex angles exceeding 36° or more than two infill radial lines, and about one-quarter of the triangles are elaborated in some manner. At FEA triangles occur on ten sherds: four dentate-stamped sherds excavated in 1989 (layer 2: Fig. 5s, layer 4: Figs 9g, 10d, 11b), five in the surface collections (incised: Fig. 17a, dentate-stamped: Figs 12g, 13a, 16b, 17c), and one excavated in 1985 (Ambrose & Gosden, 1991: fig. 3.5). One surface find (Fig. 13a) has three sets of triangles, making a total of eleven representations. The four examples for which the apex angle was measured are about or below 30°, in line with Anson's 16–25° for two FCR/FCS sherds (Anson, 1983: table I; 1990: table 1). Three triangles have one infill radial line, four have two lines, two have three lines, one has parallel diagonal lines, and one consists of three nested triangles. Two triangles are elaborated with circle impressions and plain or dentate-stamped arcs (Plate 5; Figs 12g, 13a; compare with motifs 207, and 214 and 217 in Anson, 1983: table XII). Similar triangles with one to three infill lines occur at FCR/FCS and FRI in the Talasea area, at FOH/D-E-F and FLF in the Arawes (Summerhayes, 2000: figs 5.31, 9.1), and at SEE in the Duke of York Islands (White, 2007: figs 4, 10, 12, 14, 16).

Curvilinear and rectilinear face designs are well represented in the surface collections, with at least fourteen examples (Plate 6; Figs 12c, 12d, 12f, 16f, 19d–h; White *et al*., 2002: fig. 3). Most cannot be assigned to a definite Spriggs type, but Types 1A, IB, IC, ID, 2A, 2C, or 2E may be represented (Spriggs, 1990, 1993). In contrast, there are no definite faces in the much larger excavated collection, though two sherds could be fragments of curvilinear faces (Figs 7h, 7p). At least three surface sherds have designs that Spriggs (1990: fig. 32, 3A) has classed as "earplugs" (Fig. 19h; White *et al*., 2002: fig. 3b). Other possible "earplugs" might be present, but as a related design on a flat-based bowl at ECA/B separates panels of repeated elements that do not constitute a face design (Kirch, 1987: fig. 3), this is uncertain. Both FEA collections have sherds with interlocking rectilinear designs (the "labyrinth" of Siorat, 1990: 62) that might have served as space fillers between faces (cf. Kirch, 1987: fig. 3; Spriggs, 1990: fig. 8). These are more common in the surface collections (10, including one incised sherd) (Figs 12a–b, 13a, 13c, 14g, 20c–e, 20g–h) than in the excavated sample (2) (Fig. 8e; Ambrose & Gosden, 1991: fig. 6.2, where the caption for figure 5 applies).

There are 45 motifs that can be related definitely or possibly to Anson's (1983: table XII) list. These are distributed as follows:

- 12 in the excavated sample only: M18, cf. M84, M206, M231, M436, cf. M437, M441, M443; and possibly M161, M314, M435, M496.
- 25 in the surface collections only: M3, cf. M16, M27, M38, M40, M43 or M50, M73, M120, cf. M132, cf. M157, M169, M175 or M176, M185 or M208, M217, M273, M275, M311, M417, M474, cf. M467; and possibly M214, M298, M330, M347, M391.
- 8 in both collections: M1, M35, M37, cf. M100, M167, M207, M421 or M427, M430.

More than half of these motifs occur only in the surface collections, and only 18% (8 out of 45) are shared between the two collections. These include two basic motifs (M1 and M35) that act as zone or boundary markers.

The sherd with cut-outs in the Walindi collection has very fine dentate-stamping in groups of four short, straight lines closed at each end by a small, half-circle or arc impression (M120; Fig. 16e). Similar groupings are common at other Lapita sites in the Bismarck Archipelago: FCR/FCS on the south side of Garua Harbour (Specht, 2007: figs 5p, 7f–h); FOH/D-E-F and FNY in the Arawe Islands (including vessel form VIII, where they also occur with cut-out elements) (Summerhayes, 2000: figs 5.17, 5.30, 5.33, 5.35, 8.3); SEE in the Duke of York Islands (White, 2007: fig. 15); ECA on Eloaua (Egloff, 1975: fig. 13h); and EAQ on Ambitle Island (White & Specht, 1971: plate 1a).

Linear incision or plain line impressions are sometimes combined with dentate-stamping to create some designs, but the most common incised designs are groups of rectilinear and/or curved lines forming triangles, diamonds, ovals and circles, paired parallel lines, criss-cross diagonal groups and alternating panels of diagonals (Figs 6–11, 14, 19, 22, 22; cf. Ambrose & Gosden, 1991: figs 3.1, 3.7, 3.10, 4.3, 6.5; White *et al*., 2002: fig. 4). The sherds are too small to identify complete designs, but most have parallels in other Lapita sites in the Bismarck Archipelago: FCR/FCS on Willaumez Peninsula (Anson, 1983: fig. VII), the Arawe Islands (Summerhayes, 2000: figs 5.24, 6.3, 7.6), Kreslo (Specht, 1991: figs 2, 3), Watom Island (Garanger, 1971: figs 12.1–4; Anson, 1983: fig. V; Green & Anson, 2000: figs 15B and D), Duke of York Islands (Lilley, 1991: figs 2B and C; Thomson, 1998: samples 18–20, 29; White, 2007: figs 4, 8), Eloaua (Kirch, 1987: fig. 5f, 1988: fig. 5), Lamau on New Ireland (Gorecki *et al*., 1991: fig. 2), Ambitle (White & Specht, 1971: plate IIF and G; Anson, 1983: fig. VI). Further south, comparable incised designs occur in Buka-Nissan-Sohano (Wickler, 2001: plates 5.2, 5.3), New Georgia (Sheppard *et al*., 1999: figs 2, 3; Felgate, 2001: figs 3 and 4, 2003: figs 10–13, 50, 60–71), the SE Solomon Islands (Donovan, 1973b: fig. 3, 54–55; Green, 1976: fig. 79; Parker, 1981: fig. 12B), Vanuatu (Bedford & Clark, 2001: fig. 1), New Caledonia (Sand, 2000: fig. 6; Sand *et al*., 1996: figs 42, 43, 69, 90, 126; Sand, *et al*., 1999b: 45, 56), Fiji (Kay, 1984: figs 163, 183, 185; Best, 2002: figs 18, 19), and Tonga (Poulsen, 1987: plate 46.22–24). An incised sherd from site SZ–8 in the SE Solomons shows that some incised designs are stylized faces similar to Spriggs Type 2 (Donovan, 1973b: fig. 3 sherd 79/I). Similar sherds occur at FEA and can be matched to parts of the SZ–8 face, while others have curvilinear designs that recall Type 1 faces (Figs 7, 13, 21; White *et al*., 2002: fig. 4a). Incised lines occasionally act as borders (the "bounded" forms of Wickler [2001: 112]), but it is impossible to say whether the presence or absence of such borders is significant.

Table 11. Change through time in frequencies of selected aspects of form and decoration at FEA.

layer	plain rims	D/S rims	all D/S	incised only	plain carin. shoulders	plain round shoulders	all carin. shoulders	all dec. shoulders	all D/S
3 spits 1–2	90.1%	6.3%	22.1%	47.4%	35.7%	35.7%	14.3%	7.1%	19.5%
3 spits 3–4	78.1%	18.8%	27.5%	46.4%	50.0%	8.3%	19.6%	8.9%	21.9%
4	72.2%	19.4%	41.8%	38.0%	52.6%	0.0%	33.9%	16.1%	37.9%

Several sherds have much broader and more rounded incised lines than normal incision, and might be better termed gouged (Figs 12c–d; 16c). This technique is present at the FOH site in the Arawes (Summerhayes, 2000: figs 5.19, 5.31) and the ECA site in the Mussau group (Kirch, 1988: fig. 4; 1997: plate 5.1), where they are presented as parts of pedestal bases. Two FEA examples (Figs 12c–d) are shown here as rims, and in this position the designs resemble Type 1 faces. This gouged line technique may be related to the carving of the vessel surface without penetrating the vessel body reported at EAQ on Ambitle (White & Specht, 1971: fig. 3), at SEE in the Duke of York Islands (White, 2007: figs 10, 15) and in the Arawe Islands (Summerhayes, 2000: fig. 5.32).

Stylistic change at FEA?

Here we return to the possibility for a change in the FEA pottery through time suggested by the bimodal distribution of sherds (and obsidian) identified in the section discussing the degree of disturbance of the FEA site, and the apparent shift in the nature of temper materials. Assessing distinctions in the distributions of fine and coarse dentate-stamping proved impossible, because the abraded surface and small size of most sherds meant that counting the number of tooth impressions per 10 mm was possible on too few sherds to examine possible stratigraphic patterning.

Form and decoration. Table 11 summarises the distributions of selected aspects of form and decoration of the excavated pottery. As the totals for the individual excavation units are too small for meaningful percentage calculations, the Table combines the excavation units in pairs. Layers 1 and 2 are omitted, as the pottery in these levels is clearly not in context. "Plain rims" include those with lip modifications but no other decoration. The columns show percentages by layer or layer division, except for " "All carinated shoulders", "All decorated shoulders" and "All D/S." These give percentages for the trench as a whole, but do not total 100% because layers 1 and 2 are not shown. Accepting that the percentages are often based on very low frequencies, and that the use of sherd counts may be misleading, each column shows change through time. Dentate-stamped rims as a percentage of all rims and all dentate-stamped sherds decline from layer 4 to layer 3 spits 1–2, and sherds with incised decoration increase slightly. Expressed as a percentage of all dentate-stamped sherds in the trench, dentate-stamping decreases by half between layer 4 and layer 3 spits 1–2. While plain rims (with or without lip modifications) are common (72.2%) in layer 4, they are even more common (90.1%) in layer 3 spits 1–2. Plain carinated shoulders decrease from 52.6% to 35.7%, but are counter-balanced by an increase in plain round shoulders from 0% to 35.7%. Most decorated shoulders are in layer 4 (16.1%), and fewest in layer 3 spits 1–2 (7.1%). Carinated shoulders as a percentage of all shoulders decrease from 33.9% to 14.3%.

There is, thus, a shift from dentate-stamping to more incised decoration, shoulders become more rounded and fewer are decorated, and plain rims are more common. These patterns provide reasonable grounds for arguing that, despite the evidence for extensive disturbance, this part of the FEA site displays systematic changes in forms and decoration through the layers. It is not clear whether these changes were associated with changes in the frequencies of the various fabric groups.

We now turn to the surface collections from FEA and their relationship to the 1989 excavated sample. The excavated and surface samples share most aspects of form, including the possible cylinder stands, pot stands, pedestal bases and flat bases. The only examples of thick, "ledged" shoulders are in the surface collections. Perhaps the most striking difference between the samples is the much higher frequency of decorated sherds in the surface sample, though this probably reflects collector bias (White *et al*., 2002: 104). These sherds include decorative techniques that are not present in the excavated sample, including knobbed relief decoration, modelled heads and cut-outs. There is a marked contrast between the collections in terms of motifs matched with the Anson list: only 18% occur in both collections. Furthermore, sherds with parts of faces and their associated "earplugs" and space fillers are common in the surface collections, but are rare in the excavated sample.

Some surface sherds have very fine, tightly spaced dentate-stamping similar to that reported from FCR/FCS and the Eloaua, Arawe and Anir sites, where the technique is assigned to the early stage of Lapita in the Bismarck Archipelago (cf. Kirch, 2001a: figs 4.30, 4.39). In the excavated sample this very fine dentate-stamping seems less common. On the other hand, the FEA surface collections have only one example of groups of closely spaced straight lines with the ends closed by plain arc impressions that are common at FRC/FCS and in the Arawe sites. Other FEA surface sherds have larger but carefully executed dentate-stamping similar to some of the excavated sherds.

Thickness. Visual inspection suggested that the surface sherds were thicker than those recovered from the 1989 excavation. We tested this by comparing the maximum and minimum thickness of the two groups. The excavated sample (n = 640) covered all rims, shoulders, necks, bases, decorated body and some plain body sherds. The surface collections (n = 185) covered the same categories. Each sample, therefore, is biased towards "significant" sherds. Only sherds with both original surfaces preserved were measured. Measurements for body thickness avoided lips and inflection or corner points such as necks, shoulders and base angles, where the

Table 12. Descriptive statistics for maximum thickness (mm) of body sherds excavated at FEA in 1989.

layer	count	mean	variance	SD	min.	max.	range
1 and 2	176	8.176	19.704	2.25	3.3	15.4	12.1
3 spit 1	26	8.219	6.106	2.471	4.5	14.6	10.1
3 spit 2	72	8.282	4.062	2.015	4.9	17.2	12.3
3 spit 3	67	8.391	5.678	2.383	4.5	16.1	11.6
3 spit 4	50	9.412	4.331	2.081	5.1	14.1	9
4 spit 1	73	9.204	9.804	3.131	3.4	19.2	15.8
4 spit 2	70	9.156	9.736	3.12	3.2	19.3	16.1

thickness might be greater or less than the body. Shoulders were recorded separately at the point of maximum thickness. The pairs of measurements were compared by the Student's *t*-test (two-tail).

The first step involved the body thickness of the excavated sample to check whether there are differences between excavation units. Tables 12 and 13 present the descriptive statistics for each level, with layers 1 and 2 combined. The means of minimum thickness for all sherds vary by less than 1 mm and those of the maximum thickness by less than 1.3 mm, with the two spits of layer 4 showing the largest ranges. Layer 4 spits 1 and 2 were compared with Layer 3 spits 2 to 4. While there is no statistically significant difference between the four pairs in minimum thickness (P = >0.05), the differences in maximum thickness between Layer 4 spits 1 and 2 and Layer 3 spit 2 could be significant (P = 0.037 and 0.049). In real terms, however, the difference is only about 1 mm and this may be due to sample bias or measurement error. The small number of decorated sherds per excavation unit prevents comparisons between the units, but overall, there is no significant difference between the excavated incised and dentate-stamped sherds.

We compared the maximum thickness of 3690 plain body sherds from the six excavation units of layers 3 and 4. The results of two comparisons (Layer 4 spit 2 against Layer 3 spit 1; Layer 4 spit 2 against Layer 3 spit 3) are statistically significant (P = <0.01), but are not archaeologically meaningful as the means (6.3–7 mm) and standard deviations (1.6–1.8 mm) vary by less than 1 mm. These results confirm that there is no major change in mean sherd thickness between the excavation units. In each excavation unit, however, the plain body sherds are 1.6–2.5 mm thinner than the decorated sherds and those showing vessel form used in the above analysis, and these differences are statistically significant (P = <0.01). What this means in cultural terms is unclear. Some plain body sherds must come from decorated vessels, but the thickness differences could indicate two sets of vessels (thin = plain, thick = decorated) that had different functions.

We then compared the excavated and surface collections in terms of minimum and maximum thickness for all sherds, dentate-stamped sherds, incised sherds, and maximum shoulder thickness (Table 14). For both maximum and minimum body thickness the differences for all sherds are highly significant (P = <0.01), with the surface sherds thicker than those excavated. Similarly, the excavated shoulders are thinner than the surface finds by more than 2 mm, and this difference is highly significant (P = 0.0018). Comparisons between dentate-stamped and incised sherds showed that the differences between them are also highly significant (P = <0.01).

The impression that the surface finds are thicker than those excavated is thus seemingly supported. The key to explaining this may lie in the nature of the vessels being compared. If we are correct in suggesting that large vessels require thick walls and shoulders to support the weight of the vessel, particularly before firing, then the excavated and surface samples probably reflect different sets and/or sizes of vessels. A similar situation has been noted at the Goro site in New Caledonia (Sand *et al*., 2001: 98). Other contrasts between the two FEA samples include the apparent restriction to the surface finds of cut-outs on a probable pedestal base, deeply incised or gouged rim sherds with Type 1 faces, "ledged" shoulders, and short applied relief strips and knobs, the tattooed heads, and the presence of very fine needle-point dentate-stamping. In each case of difference, however, the examples are few, so their absence from one collection or the other could reflect sample bias.

Table 13. Descriptive statistics for minimum thickness (mm) of body sherds excavated at FEA in 1989.

layer	count	mean	variance	SD	min.	max.	range
1 and 2	123	7.613	3.908	1.977	3.7	14.7	11
3 spit 1	26	7.746	4.383	2.094	4	12.9	8.9
3 spit 2	72	7.233	3.517	1.875	4.4	16.9	12.5
3 spit 3	67	7.346	4.486	2.118	3.6	14.6	11
3 spit 4	50	6.862	2.94	1.715	3.9	10.8	6.9
4 spit 1	73	6.875	5.472	2.339	1.5	14.7	13.2
4 spit 2	70	7.289	6.703	2.589	2.7	15	12.3

Table 14. Comparisons of sherd thickness (mm) between FEA excavated sherds and surface collections.

	count	mean	SD	min.	max.	range	*t*	df	P
all sherds—minimum									
excavated	639	7.5	2.2	1.5	16.9	15.4			
surface	184	8.1	2.5	4	16	12	-3.2	821	0.0014
all sherds—maximum									
excavated	640	8.5	2.4	3.3	19.2	15.9			
surface	185	9.7	2.8	4	17	13	-5.98	823	<0.0001
dentate—minimum									
excavated	45	7.5	2.5	1.5	13.6	12.1			
surface	33	10.2	2.8	6	16	10	-4.52	76	<0.0001
dentate—maximum									
excavated	45	8.7	2.6	4	15.6	11.6			
surface	33	11.5	2.6	7	17	10	-4.77	76	<0.0001
incised—minimum									
excavated	84	7.3	2.5	2.7	16.9	14.2			
surface	35	9.3	2.2	5.5	14.4	8.9	-4.16	117	0.0001
incised—maximum									
excavated	85	8.1	2.7	3.2	17.2	14			
surface	35	10.8	2.3	7	15.5	8.5	-5.19	118	<0.0001
shoulder—maximum									
excavated	54	10.4	2.5	6.1	17.8	11.7			
surface	24	13.0	4.4	6	24.7	18.7	-3.24	76	0.0018

Discussion

The presence on Boduna of stemmed obsidian tools that are typically older than the W-K2 eruption in the Talasea area indicates the possibility of pre-Lapita use of the island. Alternatively, they could be items scavenged from older deposits elsewhere, or perhaps were produced during or after the Lapita period.

Notwithstanding the uncertainties about the stratigraphic integrity of FEA, analysis of the 1989 excavated finds has shown vestiges of a stylistic sequence and the site may not be as worthless as suggested by White *et al*. (2002: 106). The initial use of pottery began during the “Early” (or “Far Western”) Lapita period, as indicated by Beta-41578 (3340–3000 cal. BP) for the basal level of FEA. This date range agrees comfortably with that indicated by comparisons between the FEA surface collections and pottery from zone C at ECA/B on Eloaua Island that falls in the same time frame (ca 3250–3150 cal. BP; Kirch, 2001b: 206). The lack of a local ΔR value for Garua Harbour, however, needs to be addressed. There is as yet no evidence for earlier activity contemporary with that on the palaeobeach terrace of ECA/A (3530–3260 cal. BP at 1σ; Kirch, 2001b: 205) and at ECB (3470–3250 cal. BP at 1σ; Kirch, 2001b: 214), though this might be implied by the presence of Willaumez Peninsula obsidian at ECA and ECB (Kirch, 1990: 124). This obsidian, however, could have been in circulation on New Ireland prior to Lapita arrival in the Mussau group.

The relationship at FEA between the excavated and surface sherds is ambiguous. The differences between the two collections might indicate slightly different dates. Alternatively, they might have been contemporary, with the apparent differences in their vessel forms and decoration reflecting that different activities were conducted in each area. There is no physical evidence for a stilt structure over the lagoon floor, like those in the Arawe and Mussau Islands (Kirch, 1988, 2001a: fig. 4.45; Gosden & Webb, 1994), but this cannot be ruled out.

Use of the island continued until about 2900 to 2700–2600 cal. BP, with discard both on land and in the sea. This is reflected in the shift in layers 4 and 3 towards fewer dentate-stamped sherds and more incised ones, and towards more rounded, plain shoulders and plain rims with or without lip notching. Whether these changes were related to the shift in the pottery temper groups remains to be seen. The changes more or less match the shift at ECA in the Mussau group to almost exclusively incised decoration, which was completed by about 2850–2750 cal. BP (Kirch, 2001b: 213).

Pottery use on Boduna probably ceased at this point or soon after, as pottery typical of the “Late” Lapita and “Post-Lapita Transition” phases in the Bismarck Archipelago (Green, 2003: fig. 3) is not present at FEA. These phases are represented on Garua Island, where thin, globular pots with everted rims are common; these are sometimes plain or with only lip notching, or decorated with shell and fingernail impressions, and punctate and incised designs (Summerhayes, 2000: figs 9.2–9.4; Specht & Torrence, 2007). There are no fingernail impressions at FEA, and only two sherds with punctate designs. Furthermore, we reject the result of sample ANU-5071, now assigned to layer 3, as indicating continuation of pottery use on Boduna until 1830–1400 cal. BP (White *et al*., 2002: 106). The FEA sherd (Fig. 14b) similar to one found at KAM near Finschhafen on Huon Peninsula with Type X sherds may indicate casual use of pottery on Boduna within the last millennium, as Type X is now dated to about 1000–500 cal. BP (Lilley & Specht, 2007).

Most of the pottery at FEA was produced locally around Talasea, with the obsidian chip from the Gulu source in one sherd perhaps indicating that there was a production centre on the north side of Garua Harbour. The change in temper sands noted in the 1985 and 1989 samples could indicate a shift in the location of production through time, or perhaps there were several centres operating concurrently. The presence of probable Gulu obsidian in sherds at the later sites FSZ and FAO suggests that the centre on the north side of Garua Harbour might have continued through to this period.

A few FEA sherds have mineral sands that point to a probable south coast New Britain origin. The presence of several Lapita sherds in the Arawe Islands and at Kandrian that could have originated on Willaumez Peninsula is consistent with this (Summerhayes, 2000: fig. 11.36). This is not surprising, as some form of interaction between the two areas is indicated by the presence of Willaumez Peninsula obsidian in the Arawe sites (Summerhayes *et al*., 1998: table 6.5).

These extra-areal links are reinforced by the close similarity of FEA vessel forms and decoration with Lapita pottery throughout its distribution (e.g., Green, 1978, 1979; Anson, 1986; Kirch, 1997; Summerhayes, 2000). This, of course, is to be expected, in view of the widespread occurrence of Willaumez Peninsula obsidian at many of these sites (Green, 1987; Specht, 2002; Summerhayes, 2004). Of particular interest here is the sharing of incised designs, as well as dentate-stamped designs, across the Lapita distribution within the Bismarck Archipelago and beyond. Linear incision (including plain line stamping) does not appear at FEA on the small sample of sherds with very fine, closely spaced needlepoint dentate-stamping, but does occur on sherds with the larger, more widely spaced dentate-stamping. This echoes the situation in the Mussau group, where linear incision begins towards the end of fine dentate-stamping and increases with, and continues after, the development of "coarse dentate-stamping" (Kirch, 2001a: figs 4.30, 4.39; 2001b: 213).

Boduna is probably too small to have supported permanent settlement at any time, unless it was a small community that primarily depended for subsistence on access to land on Garua and the mainland, or on imported resources. The island might have been used only intermittently by local residents on Garua or the mainland, or by groups visiting the Talasea area (cf. Gosden & Pavlides, 1994: 169 for possible intermittent Lapita use of the Arawe Islands). The FEA surface collection of pottery is currently unparalleled in the Talasea area, and raises the possibility that it reflects use of the island for special social or ritual events in which the island's comparative isolation and sea-bound position made it a desirable, perhaps necessary, location for such activities. A similar special function has been proposed for the stilt building in zone C of ECA/B, which was associated with a rich aggregation of exceptional finds (Kirch, 2001a: 103). On a related theme, Terrell and Welsch (1997: 568) have suggested that "Lapita pots were culture elements in the material paraphernalia …of some kind of cult, dance complex or social ritual." While we would not assign all decorated Lapita vessels to such a context and would allow some to have had a role in the secular domain, we hypothesise that FEA might have been a locality where activities of a religious or ritual nature were conducted (cf. Best, 2002).

Conclusion

The FEA site is important because of its position near the beginning of the Lapita sequence in the Bismarck Archipelago and its rich and diverse pottery assemblage. There are, however, several challenges for future work at the site. Much of the deposit has been severely disturbed by human and natural activities that have extensively displaced the cultural materials, though those in layer 4 might be less disturbed. The range of finds is very limited, as the acidic sediments derived from tephras have destroyed most items of organic origin. In pottery terms, the richest part of the site appears to be permanently underwater on the lagoon floor, but the 2001 investigation of this location offers little hope that further underwater studies will reveal an archaeological deposit susceptible to controlled excavation. Nevertheless, in view of the generally poor state of preservation of beach-level Lapita sites in the Garua Harbour area (White *et al*., 2002: 106), continued monitoring of finds from Boduna's lagoon and perhaps further excavation would be justified.

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Appendix 1

Details of sherds from FEA illustrated in Figures 5–22. This Appendix provides basic provenance data and a brief description for each sherd illustrated in Figs 5–22. "WNB-CC" indicates sherds in the West New Britain Provincial Cultural Centre, Kimbe.

Figure 5. Pottery excavated from FEA layer 2 in 1989.

(*a*) FEA/I/70: rim, form I, dentate-stamped, excised triangle, circle impressed.
(*b*) FEA/I/I/69: rim, form I, dentate-stamped, excised triangles, single notched lip.
(*c*) FEA/I/17: rim, form I, incised or dentate-stamped.
(*d*) FEA/I/26: rim, form I, dentate-stamped.
(*e*) FEA/I/71: rim, form I, dentate-stamped.
(*f*) FEA/I/78: rim (damaged lip), form V, mouth diameter 80 mm, dentate-stamped.
(*g*) FEA/I/11: rim, form I, plain.
(*h*) FEA/I/71: rim, form uncertain, incised.
(*i*) FEA/I/15: rim, form uncertain, plain.
(*j*) FEA/I/56: rim, form uncertain, double notched lip.
(*k*) FEA/I/12: rim, form V, plain.
(*l*) FEA/I/55: rim, form uncertain, double notched lip.
(*m*) FEA/I/57: rim, form V, single notched lip.
(*n*) FEA/I/14: rim, form uncertain, plain.
(*o*) FEA/I/81: shoulder, dentate stamped or plain stamp.
(*p*) FEA/I/130: body, incised, circle impressed.
(*q*) FEA/I/79: shoulder, red slip, dentate-stamped.
(*r*) FEA/I/109: body, incised.
(*s*) FEA/I/107: body, dentate-stamped.

Figure 6. Pottery excavated from FEA layer 3 spits 1 (*a–i*) and 2 (*j–t*) in 1989

(*a*) FEA/I/229: spit 1, rim, form I, dentate-stamped.
(*b*) FEA/I/155: spit 1, flat base, incised, plain arc impressed.
(*c*) FEA/I/179+193 (recent break): spit 1, body, dentate-stamped.
(*d*) FEA/I/173: spit 1, body, dentate-stamped, circle impressed.
(*e*) FEA/I/156: spit 1, shoulder, incised.
(*f*) FEA/I/175+192 (recent break): spit 1, body, incised.
(*g*) FEA/I/171: spit 1, body, incised.
(*h*) FEA/I/168: spit 1, body, incised.
(*i*) FEA/I/600: spit 1, body, incised.

(*j*) FEA/I/236: spit 2, rim, form I, incised lip.
(*k*) FEA/I/526: spit 2, rim, form uncertain, single notched lip.
(*l*) FEA/I/241: spit 2, shoulder, dentate-stamped, lime infill.
(*m*) FEA/I/242: spit 2, body, dentate-stamped, excised triangles.
(*n*) FEA/I/245: spit 2, shoulder, incised, plain arc impressed.
(*o*) FEA/I/240: spit 2, shoulder, incised.
(*p*) FEA/I/243: spit 2, shoulder, incised.
(*q*) FEA/I/267: spit 2, rebated shoulder, incised, plain arc impressed.
(*r*) FEA/I/239: spit 2, body, incised.
(*s*) FEA/I/256: spit 2, body, incised.
(*t*) FEA/I/253: spit 2, body, incised.

Figure 7. Pottery excavated from FEA layer 3 spit 3 in 1989
(*a*) FEA/I/305: rim, form I, excised triangles on lip exterior, dentate-stamped.
(*b*) FEA/I/325: rim (damaged lip), form uncertain, incised or dentate-stamped, plain stamp.
(*c*) FEA/I/285: pedestal stand base, form VIII, dentate-stamped, obsidian inclusion.
(*d*) FEA/I/292: rim, form II or VII, red-brown slip, single notched lip, slash incision.
(*e*) FEA/I/287: rim, possibly form V, double notched lip.
(*f*) FEA/I/288: rim, form uncertain, red slip, single notched lip.
(*g*) FEA/I/296: rebated shoulder, circle impressed.
(*h*) FEA/I/321: body, dentate-stamped, circle impressed.
(*i*) FEA/I/267: shoulder, traces of dentate-stamped arcs.
(*j*) FEA/I/314: shoulder, dentate-stamped, plain arc impressed.
(*k*) FEA/I/552: body, dentate-stamped.
(*l*) FEA/I/316: body, dentate-stamped, incised.
(*m*) FEA/I/311: body, incised, obsidian inclusion.
(*n*) FEA/I/323: body or slightly rebated shoulder, incised.
(*o*) FEA/I/319: body, incised.
(*p*) FEA/I/313: body, incised, plain arc impressed.
(*q*) FEA/I/327: body, incised.
(*r*) FEA/I/309: body, incised.
(*s*) FEA/I/315: body, incised.
(*t*) FEA/I/310: body, incised.

Figure 8. Pottery excavated from FEA layer 3 spit 4 in 1989
(*a*) FEA/I/361: rim, form I, dentate-stamped.
(*b*) FEA/I/360: rim, form I, dentate-stamped.
(*c*) FEA/I/332: rim, form uncertain, plain.
(*d*) FEA/I/377: body, dentate-stamped.
(*e*) FEA/I/378: body, dentate-stamped.
(*f*) FEA/I/363: body, incised.
(*g*) FEA/I/365: body, incised.
(*h*) FEA/I/379: body, incised.
(*i*) FEA/I/366: body, incised.

Figure 9. Pottery excavated from FEA layer 4 spit 1 in 1989
(*a*) FEA/I/414: rim, form I, dentate-stamped.
(*b*) FEA/I/413: rim, form I, incised.
(*c*) FEA/I/418: rim, possibly form V, double notched lip.
(*d*) FEA/I/405: rim, form II or VII, plain.
(*e*) FEA/I/422: rebated shoulder, dentate-stamped, circle impressed.
(*f*) FEA/I/433: body, dentate-stamped.
(*g*) FEA/I/424: possible cylinder stand, dentate-stamped, circle impressed.
(*h*) FEA/I/436: body, dentate-stamped, design uncertain.
(*i*) FEA/I/423: shoulder or flat base angle, incised.
(*j*) FEA/I/427: body, incised.
(*k*) FEA/I/425: shoulder, incised.
(*l*) FEA/I/428: body, incised.
(*m*) FEA/I/437: body, incised.
(*n*) FEA/I/438: body, incised.
(*o*) FEA/I/430: body, incised.

Figure 10. Pottery excavated from FEA layer 4 spit 2 in 1989

(*a*) FEA/I/477: rim, form I, mouth diameter 280–320 mm, dentate-stamped, incised, plain stamp.
(*b*) FEA/I/479: rim, form I, or possibly base of a stand, form VIII, dentate-stamped.
(*c*) FEA/I/480: flat base of form I bowl, or shoulder, dentate-stamped.
(*d*) FEA/I/529: rim, form I, or possibly base of a stand, form VIII, dentate-stamped.
(*e*) FEA/I/530: rim, form I, plain.
(*f*) FEA/I/468: rim, form uncertain, double notched lip
(*g*) FEA/I/450: shoulder, possibly form VI, plain.
(*h*) FEA/I/453: shoulder, possibly form VI, plain.
(*i*) FEA/I/450a: shoulder, possibly form VI, plain.

Figure 11. Pottery excavated from FEA layer 4 spit 2 (*a–h*) in 1989, and surface finds (*i–k*)

(*a*) FEA/I/481: shoulder, dentate-stamped (design uncertain).
(*b*) FEA/I/485: shoulder, dentate-stamped.
(*c*) FEA/I/512: body, dentate-stamped.
(*d*) FEA/I/493: body, dentate-stamped.
(*e*) FEA/I/490: body, dentate-stamped.
(*f*) FEA/I/486: body, dentate-stamped.
(*g*) FEA/I/487: body, dentate-stamped.
(*h*) FEA/I/484: body, dentate-stamped.
(*i*) WNB-CC: bowl on stand, traces of dentate-stamped design on the exterior base angle.
(*j*) Ray collection: body, dentate-stamped, plain stamp (drawn from photo).
(*k*) WNB-CC: shoulder, possibly form V, dentate-stamped, circle impressed, plain stamp.

Figure 12. Sherds from various surface collections at FEA

(*a*) WNB-CC: rim, form I, dentate-stamped, incised.
(*b*) WNB-CC: rim, form I, dentate-stamped.
(*c*) WNB-CC: rim, form I, dentate-stamped, gouged, excised triangle.
(*d*) Ray collection: rim, probably form I, dentate-stamped, gouged, plain stamp or incised (drawn from photo).
(*e*) Walindi: rim, form I, exterior dentate-stamped, incised; interior dentate-stamped.
(*f*) FEA/A/22: rim, form I, dentate-stamped, excised triangles, face Type 2.
(*g*) WNB-CC: rim, dentate-stamped, circle impressed, plain stamp.
(*h*) FEA/A/6: rim, form I, mouth diameter 220–240 mm, excised triangles.
(*i*) White *et al*. 2001: rim, form I, dentate-stamped, plain stamp.
(*j*) FEA/A/4: rim, form I, dentate-stamped, circle impressed.
(*k*) WNB-CC: rim, form I, dentate-stamped, incised, plain stamp.
(*l*) Ray collection: rim, probably form I, dentate-stamped, plain stamp (drawn from photo).

Figure 13. Sherds from various surface collections at FEA

(*a*) Jarman collection: rim, form I, mouth diameter 280–300 mm, dentate-stamped, circle impressed.
(*b*) FEA/1990/A: complete profile of flat based bowl, form I, dentate-stamped, circle impressed.
(*c*) FEA/1990/D: flat base, form I, dentate-stamped, plain stamp, incised.
(*d*) FEA/23: flat base, form I, base diameter 260 mm, plain.
(*e*) FEA/A/5: flat base, form I, base diameter 160–180 mm, grooved.

Figure 14. Sherds from various surface collections at FEA

(*a*) WNB-CC: rim, form I, incised, excised triangles.
(*b*) FEA/SW beach/1: rim, form I or IV, incised, punctate.
(*c*) FEA/14: rim, possible form IV, incised.
(*d*) FEA/18: rim, form I, incised.
(*e*) Walindi: rim, possible form V, incised.
(*f*) FEA: rim, form uncertain, incised, single notched lip.
(*g*) FEA/2: rim, possible form V or VII, incised (Anson, 1983: fig. VII.2).

Figure 15. Sherds from various surface collections at FEA

(*a*) FEA/25: rim, form I, mouth diameter 300 mm, plain.
(*b*) FEA/26: rim, form I, plain.
(*c*) FEA/12: rim, form I, plain.
(*d*) WNB-CC: rim, form I, excised triangles.
(*e*) WNB-CC: rim, possibly form IV, plain.
(*f*) WNB-CC: rim, form V, single notched lip.
(*g*) FEA/53: rim, form V, plain.
(*h*) FEA/40: rim, form V, mouth diameter 200 mm, plain.
(*i*) WNB-CC: rim, form VI, plain.
(*j*) FEA/A/18: rim, form uncertain, plain.
(*k*) White *et al*. 2001: rim, form uncertain, single notched lip.
(*l*) WNB-CC: rim, possibly form IV, plain.
(*m*) FEA/SW beach/5: rim, form III or IV, mouth diameter 200 mm, plain.
(*n*) WNB-CC: rim, form uncertain, plain.
(*o*) FEA/1990/C: rim, form uncertain, plain.
(*p*) WNB-CC: multiple rim, form VI, plain.
(*q*) FEA/A: shoulder, plain.
(*r*) FEA/31: shoulder, plain.
(*s*) FEA/2: shoulder, plain.
(*t*) FEA/SW beach/9: shoulder, plain.
(*u*) FEA/15: base or shoulder, plain.

Figure 16. Sherds from various surface collections at FEA

(*a*) WNB-CC: probable pot stand, form VIII, plain.
(*b*) FEA/SW beach/7: base of pedestal stand, form VIII, base diameter 300–320 mm, dentate-stamped, plain arc impressed.
(*c*) FEA/10: base of pedestal stand, form VIII, base diameter 300–320 mm, gouged incision.
(*d*) FEA/A/17: base of pedestal or pot stand, form VIII, plain.
(*e*) FEA/A/7: base of pedestal stand, form VIII, base diameter 280 mm, dentate-stamped.
(*f*) Ray collection: possible base of pedestal stand, form VIII, or rim of form I bowl, dentate-stamped (drawn from photo).

Figure 17: Sherds from various surface collections at FEA

(*a*) Walindi: shoulder, dentate-stamped, incised.
(*b*) White *et al*. 2001: body, applied relief band, dentate-stamped, circle impressed.
(*c*) Walindi: body, possible cylinder stand, two applied relief bands, dentate-stamped.
(*d*) WNB-CC: body, applied relief band, dentate-stamped.
(*e*) Walindi: possible pedestal stand, form VIII, cut-outs, dentate-stamped, plain arc impressed.

Figure 18. Sherds from various surface collections at FEA

(*a*) Walindi: shoulder, dentate-stamped.
(*b*) WNB-CC: shoulder, dentate-stamped.
(*c*) FEA/A/20: shoulder, dentate-stamped, possibly punctate.
(*d*) WNB-CC: shoulder, dentate-stamped, circle impressed.
(*e*) FEA/TT(1)/4 [1980]: shoulder, double applied relief knob, dentate-stamped, circle impressed.
(*f*) WNB-CC: shoulder, applied relief knob.
(*g*) White *et al*. 2001: shoulder, applied relief knob.
(*h*) FEA/A/16: body, applied relief knob.
(*i*) FEA/I/590: shoulder, diameter about 340 mm, dentate-stamped.

Figure 19. Sherds from various surface collections at FEA

(*a*) WNB-CC: body, dentate-stamped, circle impressed.
(*b*) FEA/1990/B: body, dentate-stamped, incised.
(*c*) FEA/SW beach/12: body, dentate-stamped.
(*d*) WNB-CC: body, dentate-stamped, incised, gouged.
(*e*) WNB-CC: body, dentate-stamped, plain arc impressed.
(*f*) Ray collection: body, dentate-stamped (drawn from photo).
(*g*) WNB-CC: body, dentate-stamped.
(*h*) Ray collection: body, dentate-stamped, circle impressed (drawn from photo).
(*i*) WNB-CC: body, incised, punctate.

Figure 20. Sherds from various surface collections at FEA

(*a*) Ray collection: possibly rim or body, dentate-stamped (drawn from photo).
(*b*) Walindi: body, dentate-stamped.
(*c*) WNB-CC: body, dentate-stamped.
(*d*) Walindi: body or shoulder, dentate-stamped.
(*e*) WNB-CC: body, dentate-stamped.
(*f*) Walindi: body, dentate-stamped.
(*g*) FEA/3: shoulder, dentate-stamped.
(*h*) Walindi: body, dentate-stamped, circle impressed.

Figure 21. Sherds from various surface collections at FEA

(*a*) WNB-CC: shoulder, incised.
(*b*) Walindi: shoulder, incised.
(*c*) FEA: shoulder, incised, perforation on top margin.
(*d*) Walindi: body/neck, incised.
(*e*) Walindi: body/neck, incised.
(*f*) FEA/SW beach/10: body, incised.
(*g*) FEA/5: body, incised.
(*h*) FEA/13: body, incised.
(*i*) FEA/B/(b): body, incised.
(*j*) FEA/7: body, incised.
(*k*) FEA/50: body, incised.
(*l*) WNB-CC: body, broad incised.
(*m*) WNB-CC: body, incised.
(*n*) FEA/17: body, incised.
(*o*) FEA/A/11: body, incised.
(*p*) WNB-CC: body, incised.

Figure 22. Sherds from various surface collections at FEA

(*a*) FEA/A/8: body, incised.
(*b*) Walindi: body, incised.
(*c*) WNB-CC: body, incised.
(*d*) WNB-CC: body, incised.
(*e*) FEA/A/12: body, incised.
(*f*) WNB-CC: body, incised.
(*g*) Walindi: body, incised.
(*h*) WNB-CC: body, incised.
(*i*) Ray collection: body, incised.
(*j*) Ray collection: body, incised.
(*k*) Ray collection: body, incised.
(*l*) Ray collection: body, incised.
(*m*) Ray collection: body, incised.
(*n*) Ray collection: body, incised.
(*o*) Ray collection: body, incised.
(*p*) Ray collection: body, incised.

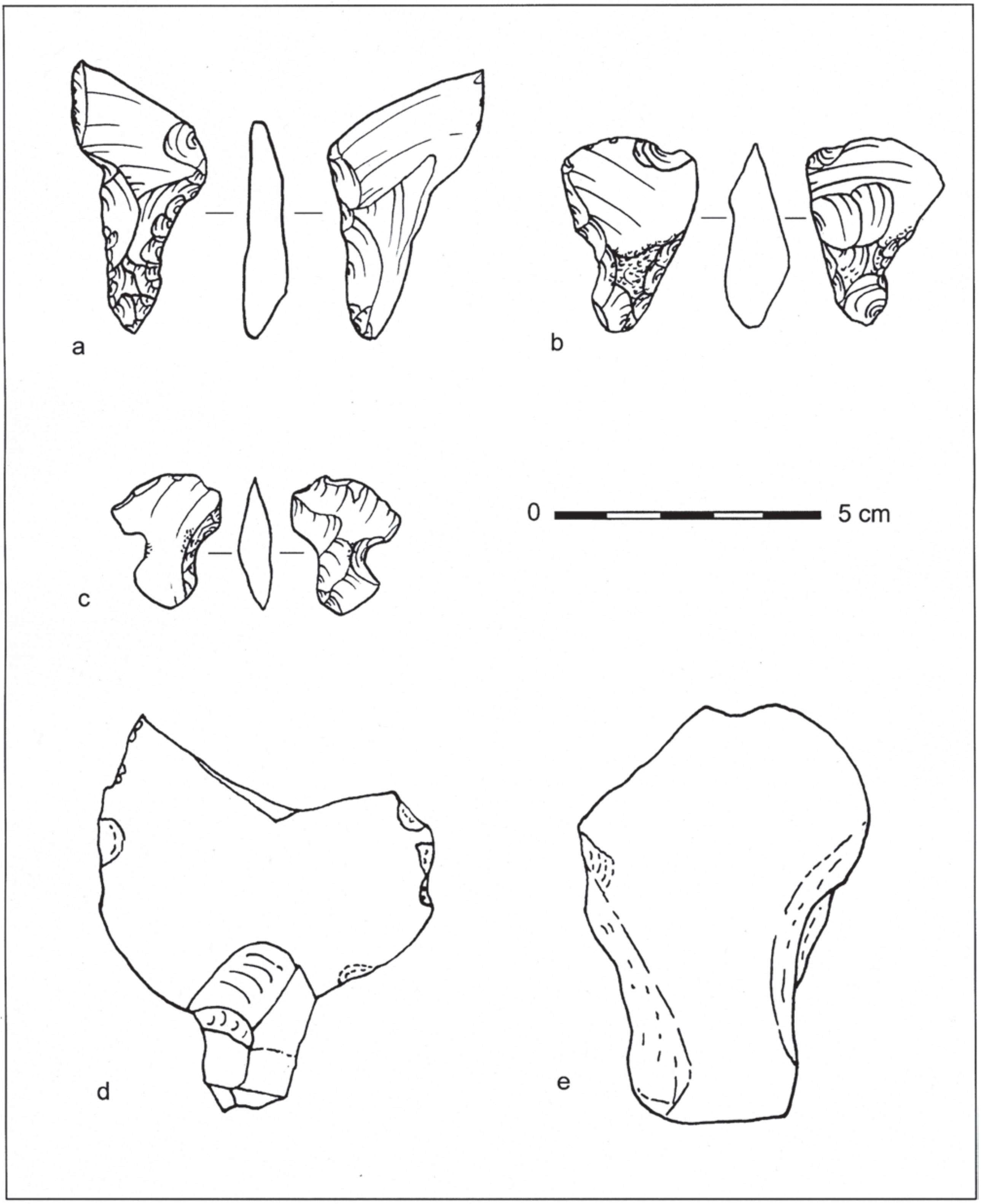

Fig. 4. Stemmed obsidian tools from FEA, Boduna Island. Items (*a–c*) were drawn by Nina Kononenko. The drawings of items (*d*) and (*e*), which were collected in 1980 by I. Lilley, J. Normu and A. Marenge, are based on sketches by Specht in the West New Britain Cultural Centre, Kimbe. (*a*) 1989, layer 2; (*b*) 1989, layer 3 spit 1; (*c*) 1989, layer 3 spit 2; (*d*) 1980, surface, Type 2; (*e*) 1980, surface (possibly not a stemmed form).

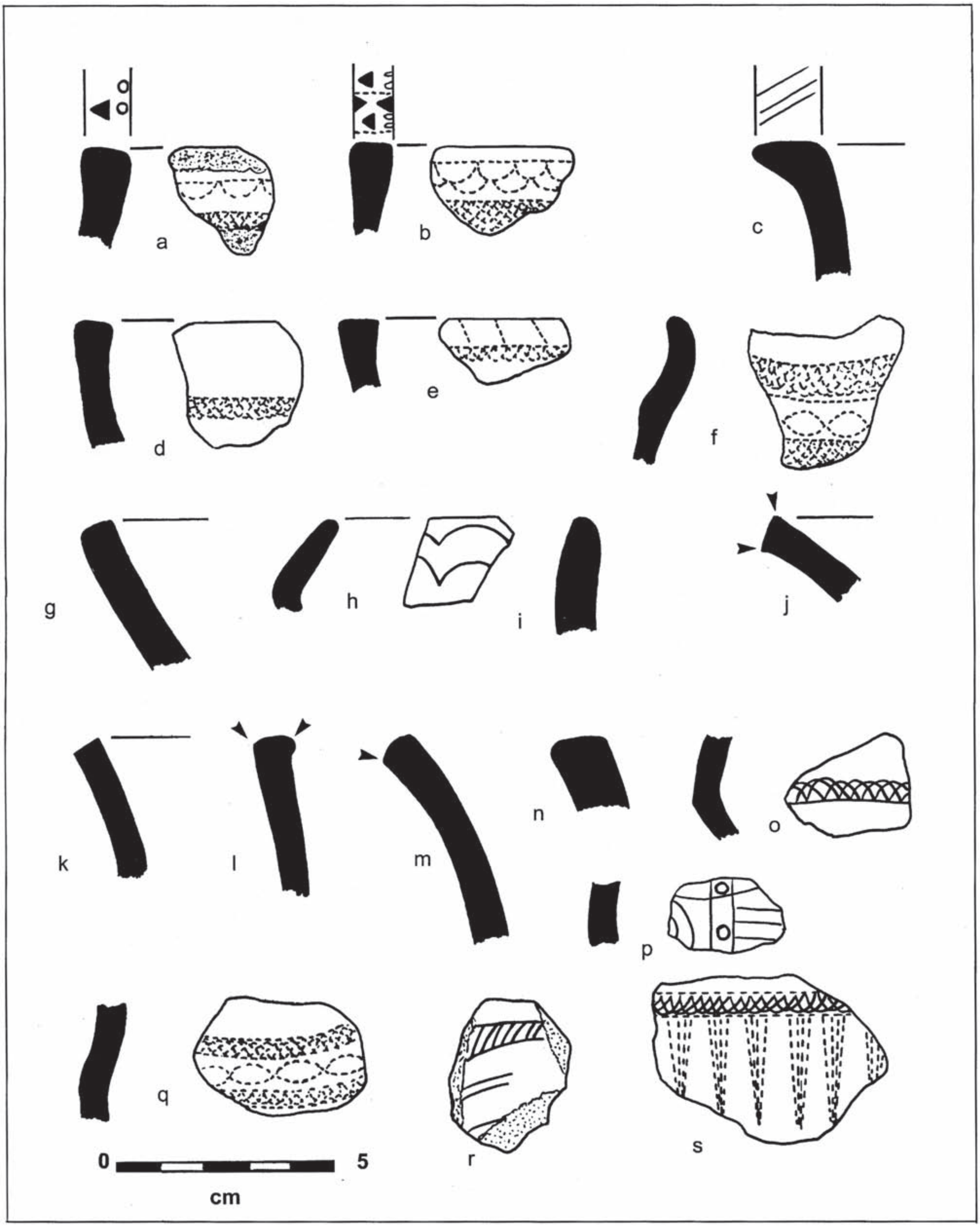

Fig. 5. FEA, Boduna Island, pottery excavated from layer 2 in 1989 (for details, see Appendix 1).

Fig. 6. FEA, Boduna Island, pottery excavated from layer 3 spits 1 (a–i) and 2 (j–t) in 1989 (for details, see Appendix 1).

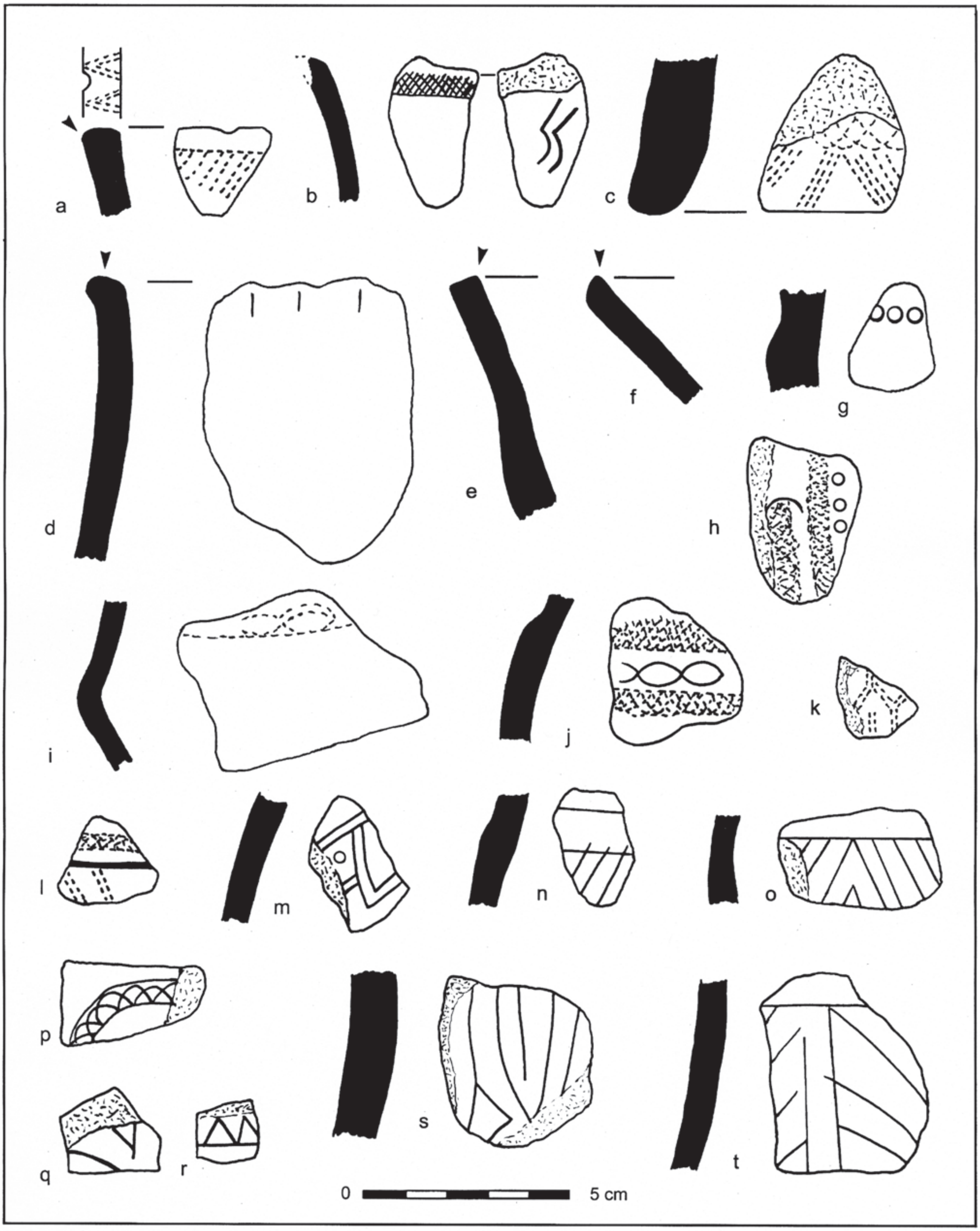

Fig. 7. FEA, Boduna Island, pottery excavated from layer 3 spit 3 in 1989 (for details, see Appendix 1).

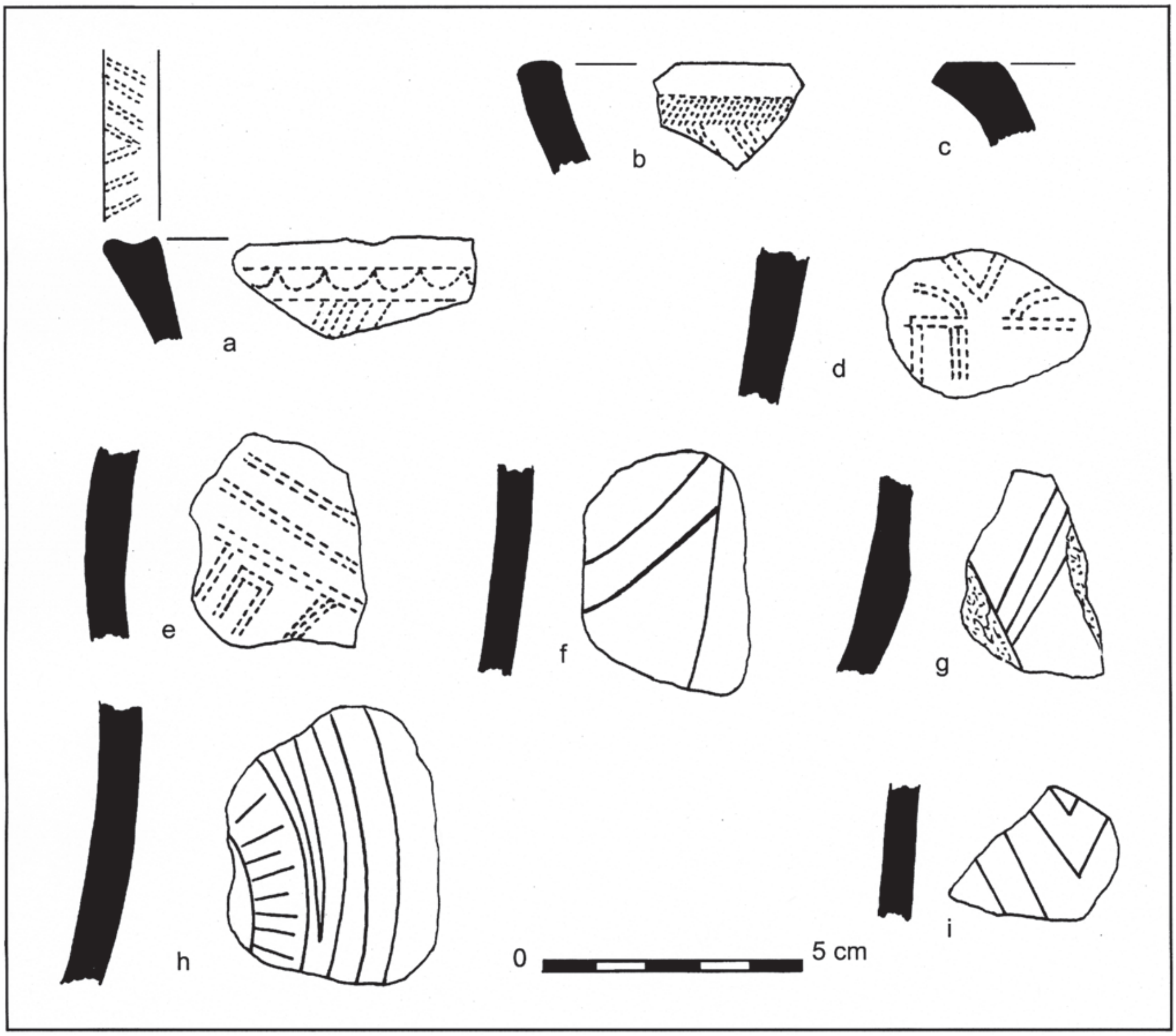

Fig. 8. FEA, Boduna Island, pottery excavated from layer 3 spit 4 in 1989 (for details, see Appendix 1).

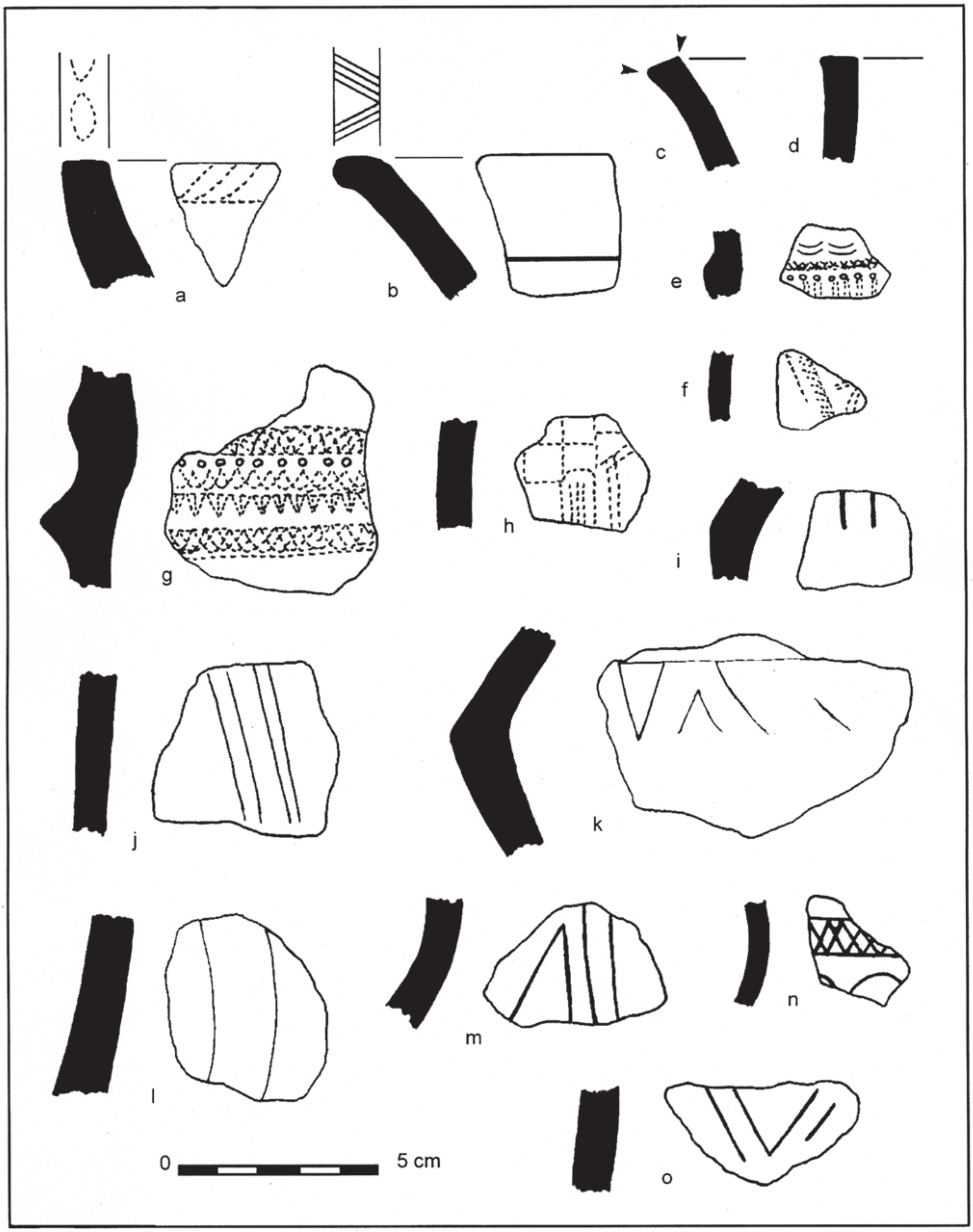

Fig. 9. FEA, Boduna Island, pottery excavated from layer 4 spit 1 in 1989 (for details, see Appendix 1).

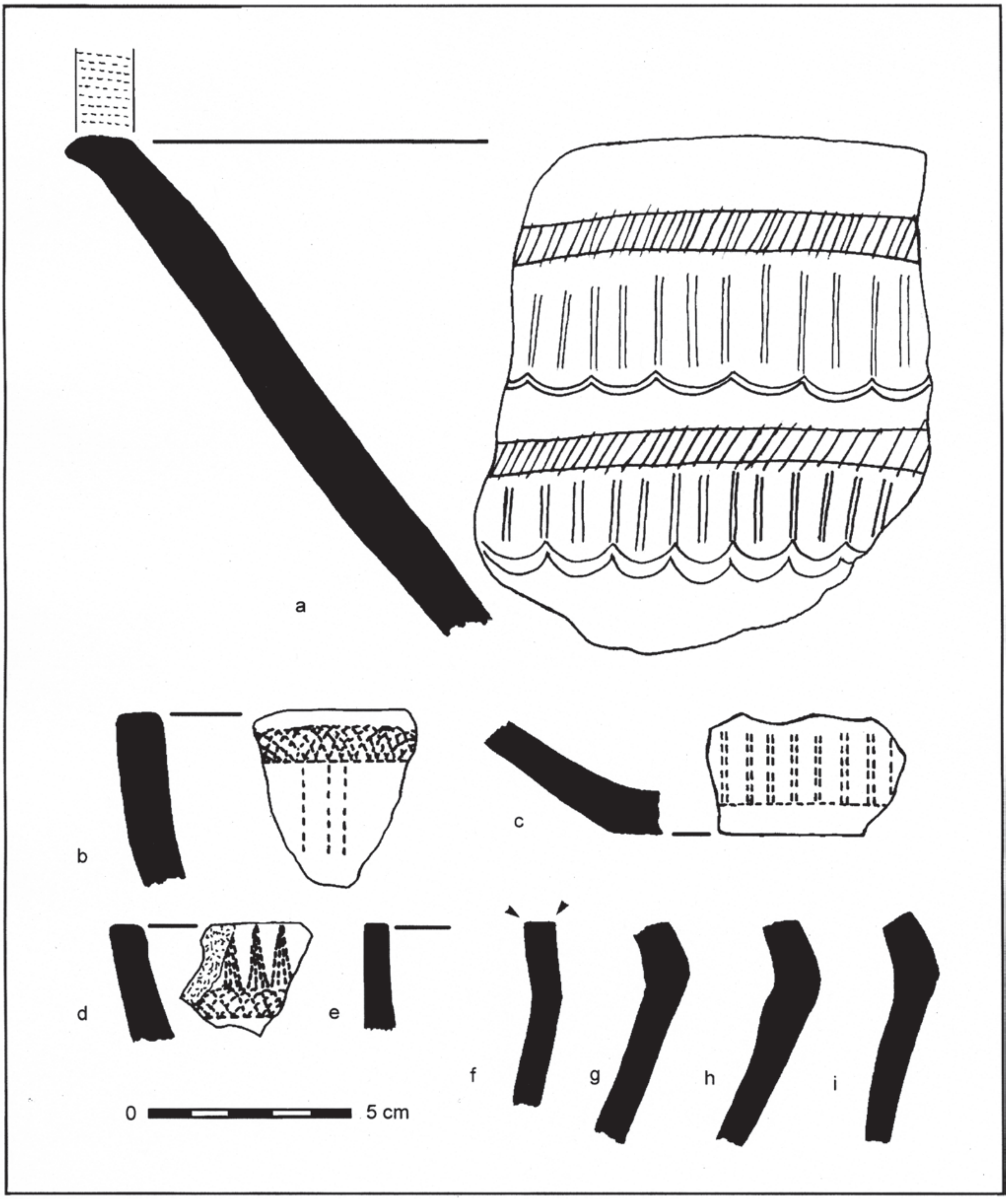

Fig. 10. FEA, Boduna Island, pottery excavated from layer 4 spit 2 in 1989 (for details, see Appendix 1).

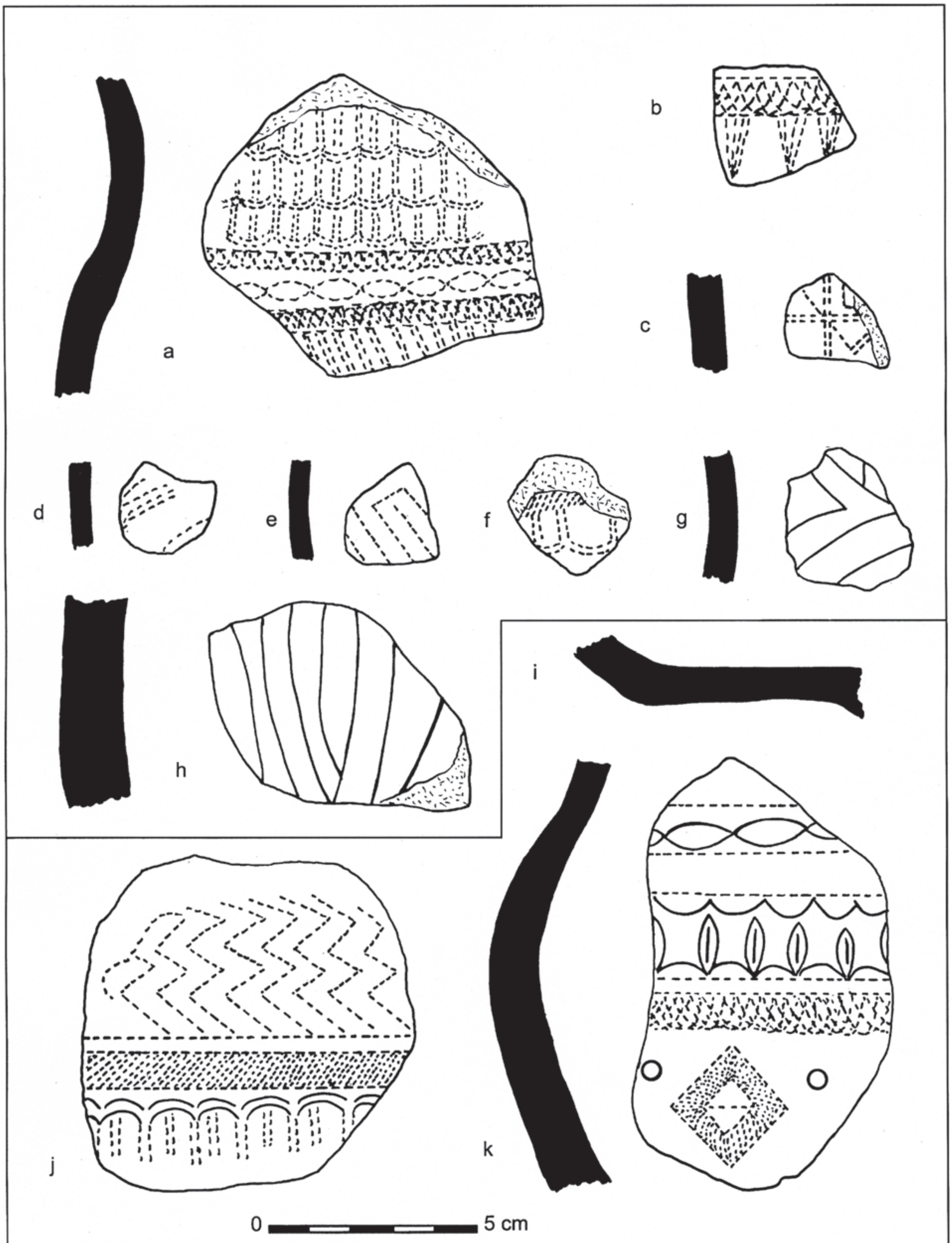

Fig. 11. FEA, Boduna Island, pottery excavated from layer 4 spit 2 (a–h) in 1989, and surface finds (i–k) (for details, see Appendix 1).

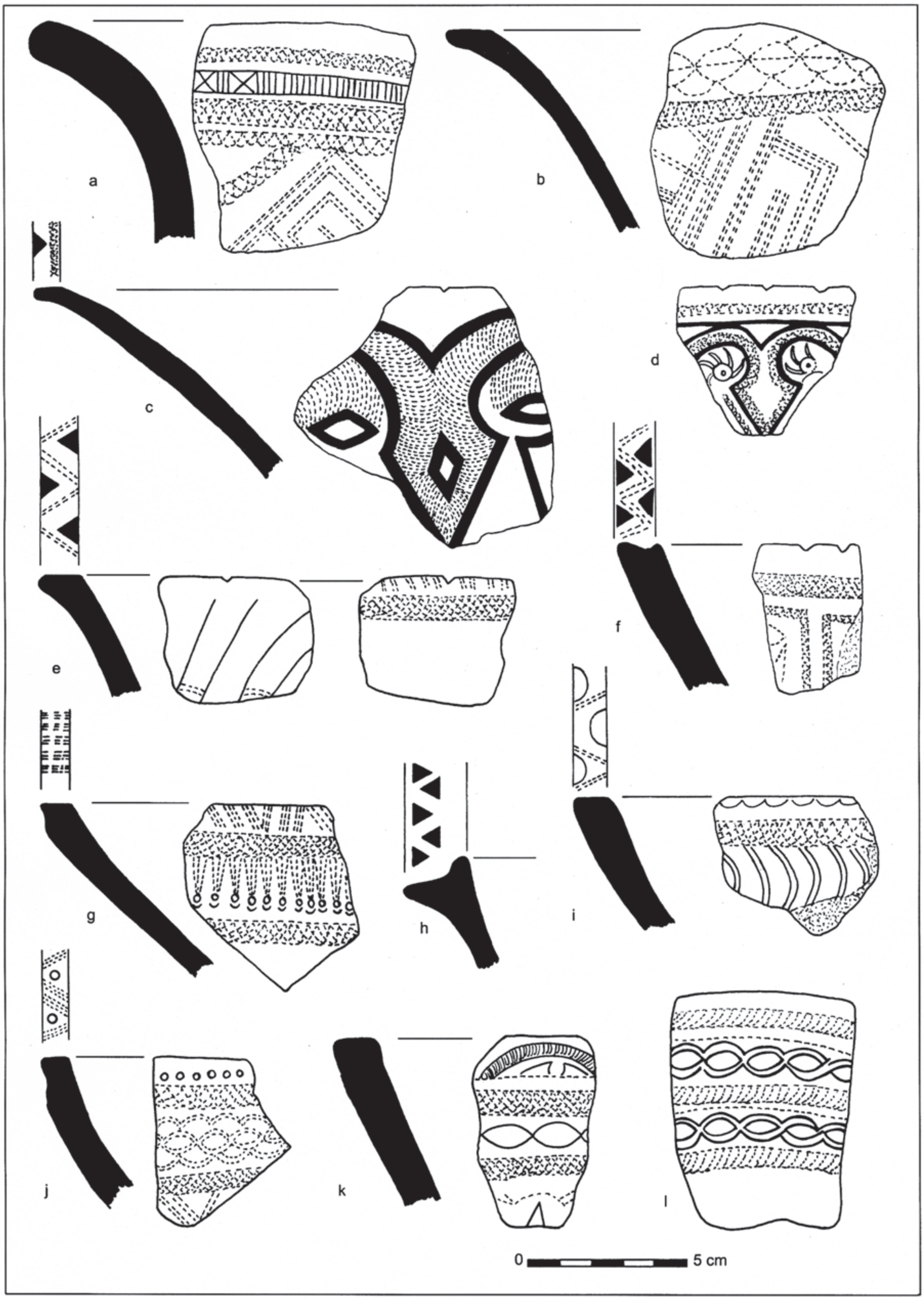

Fig. 12. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

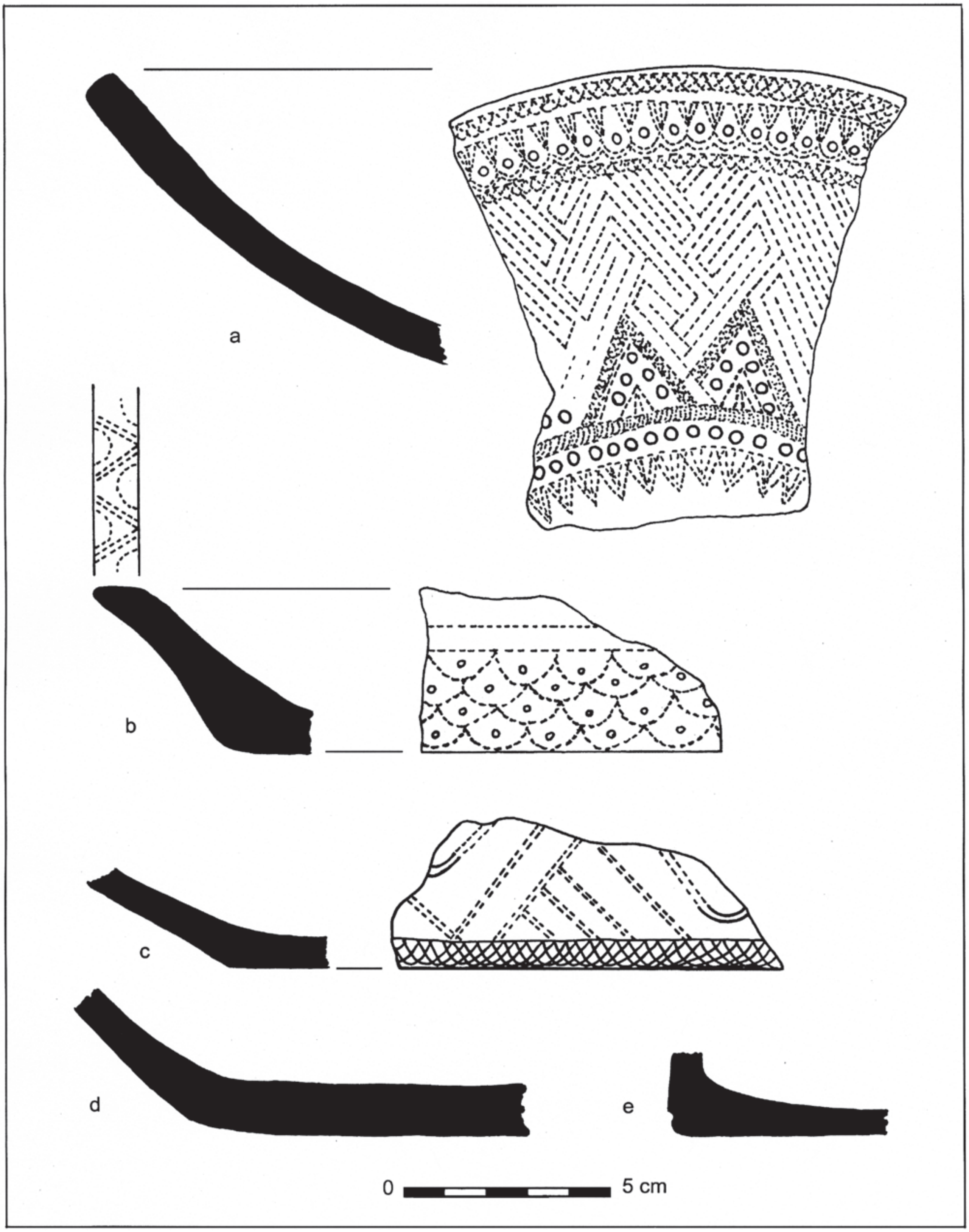

Fig. 13. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

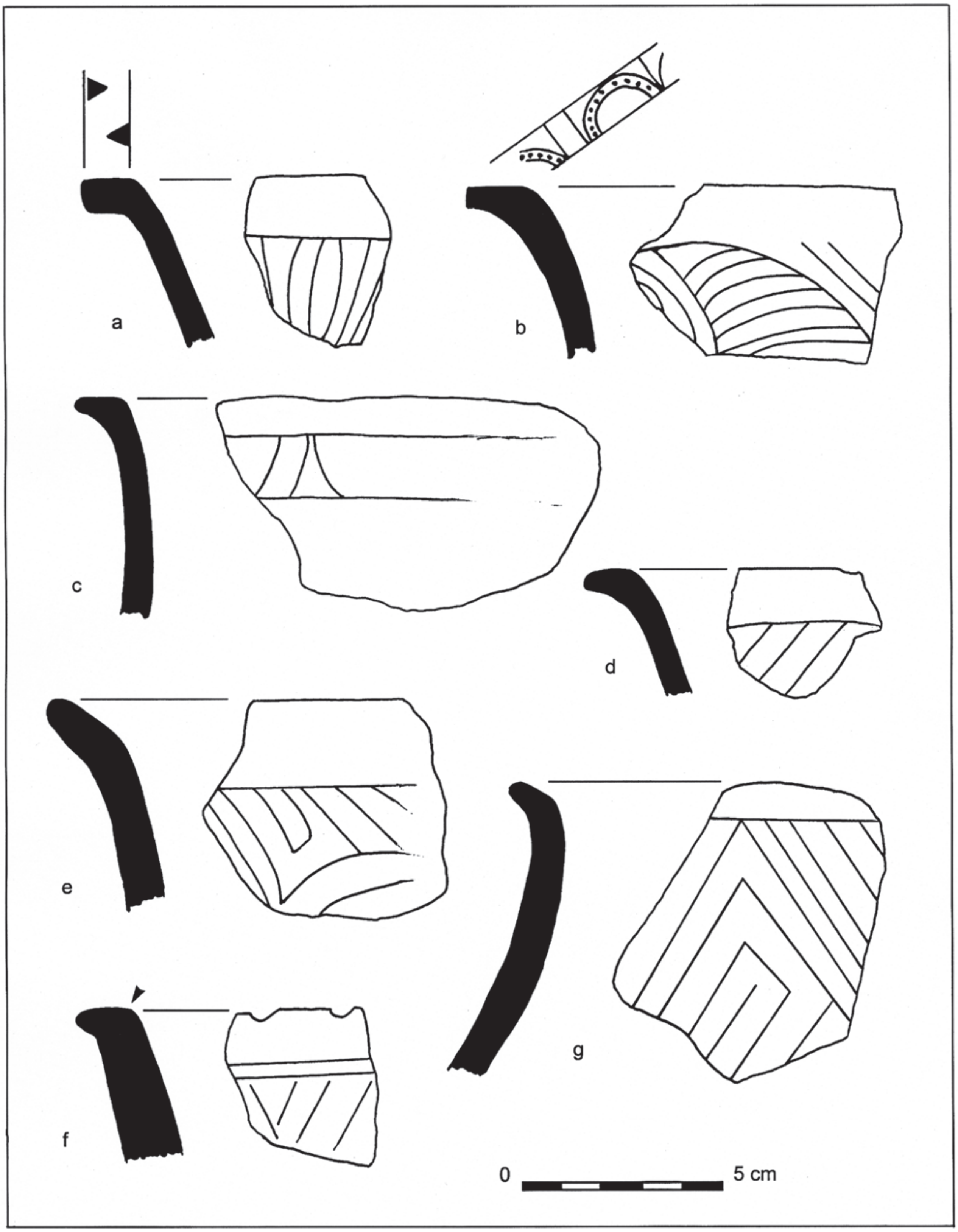

Fig. 14. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

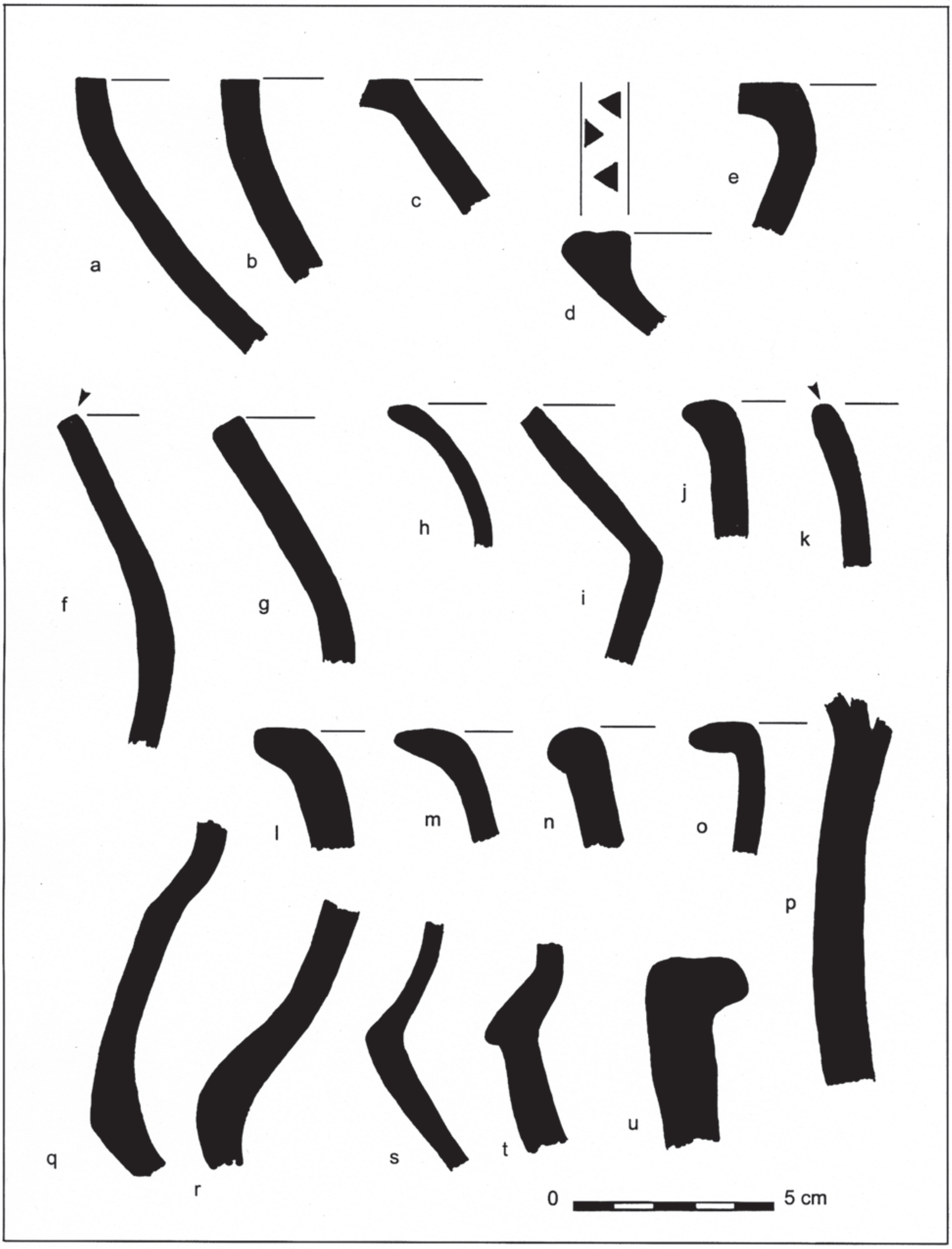

Fig. 15. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

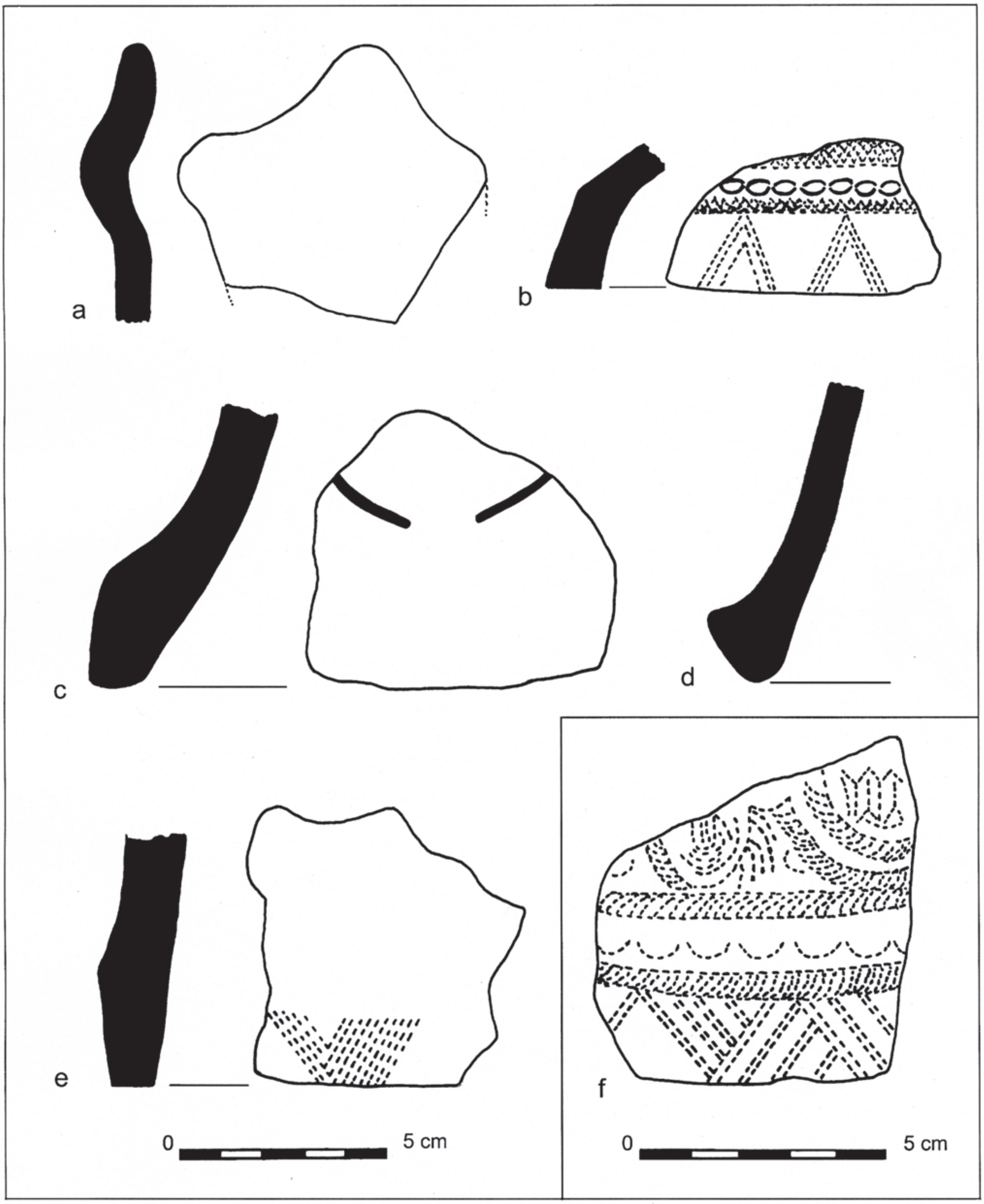

Fig. 16. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

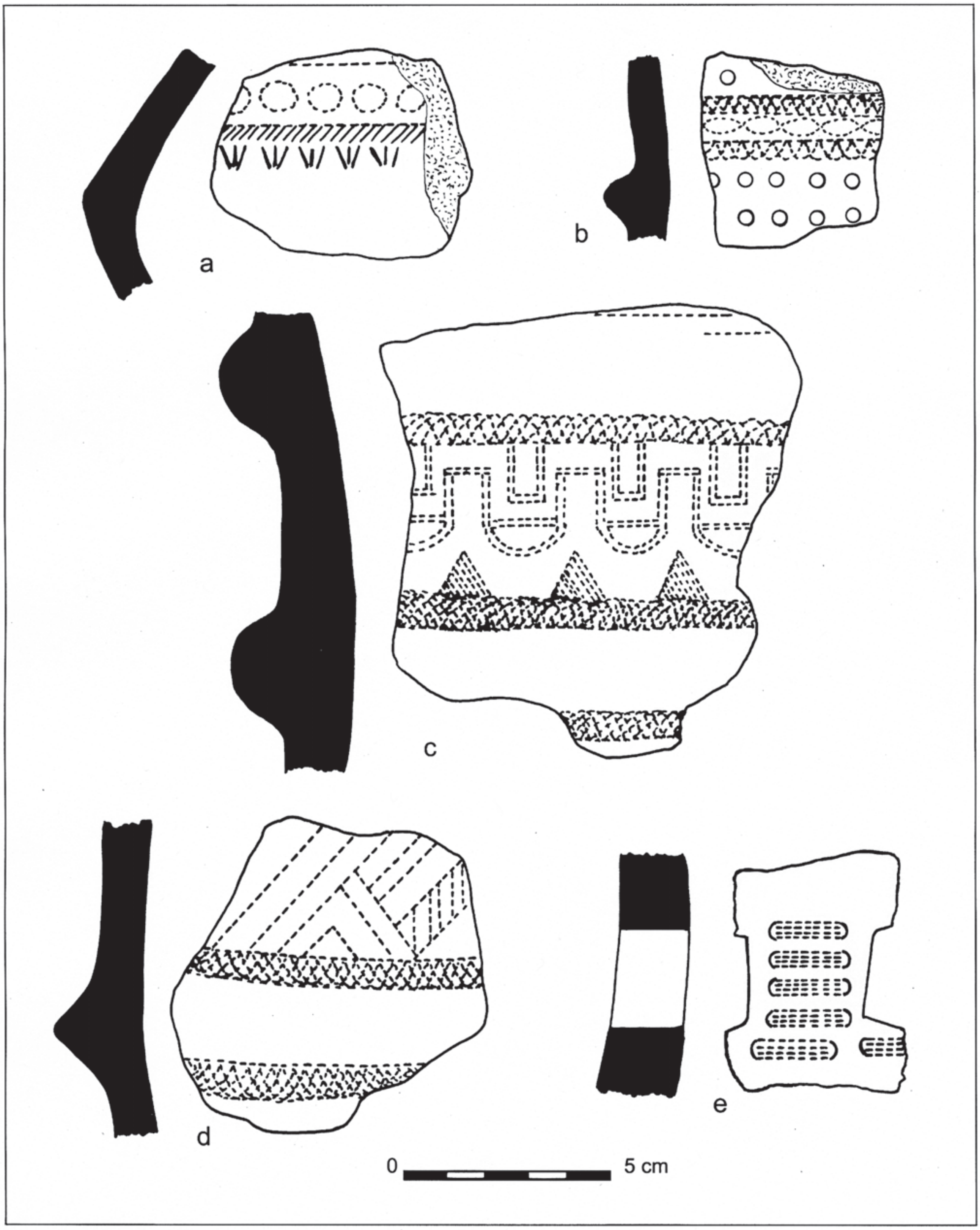

Fig. 17. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

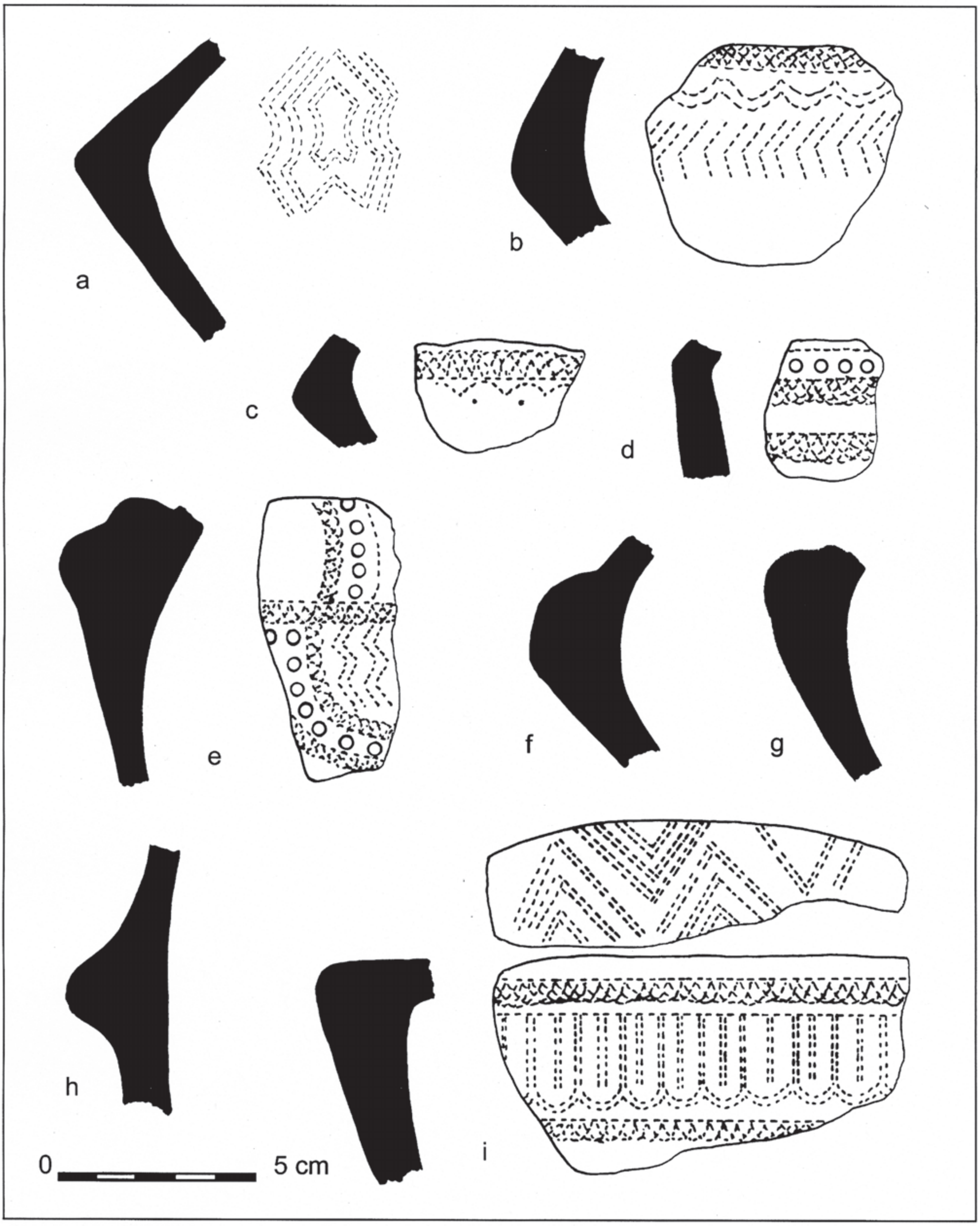

Fig. 18. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

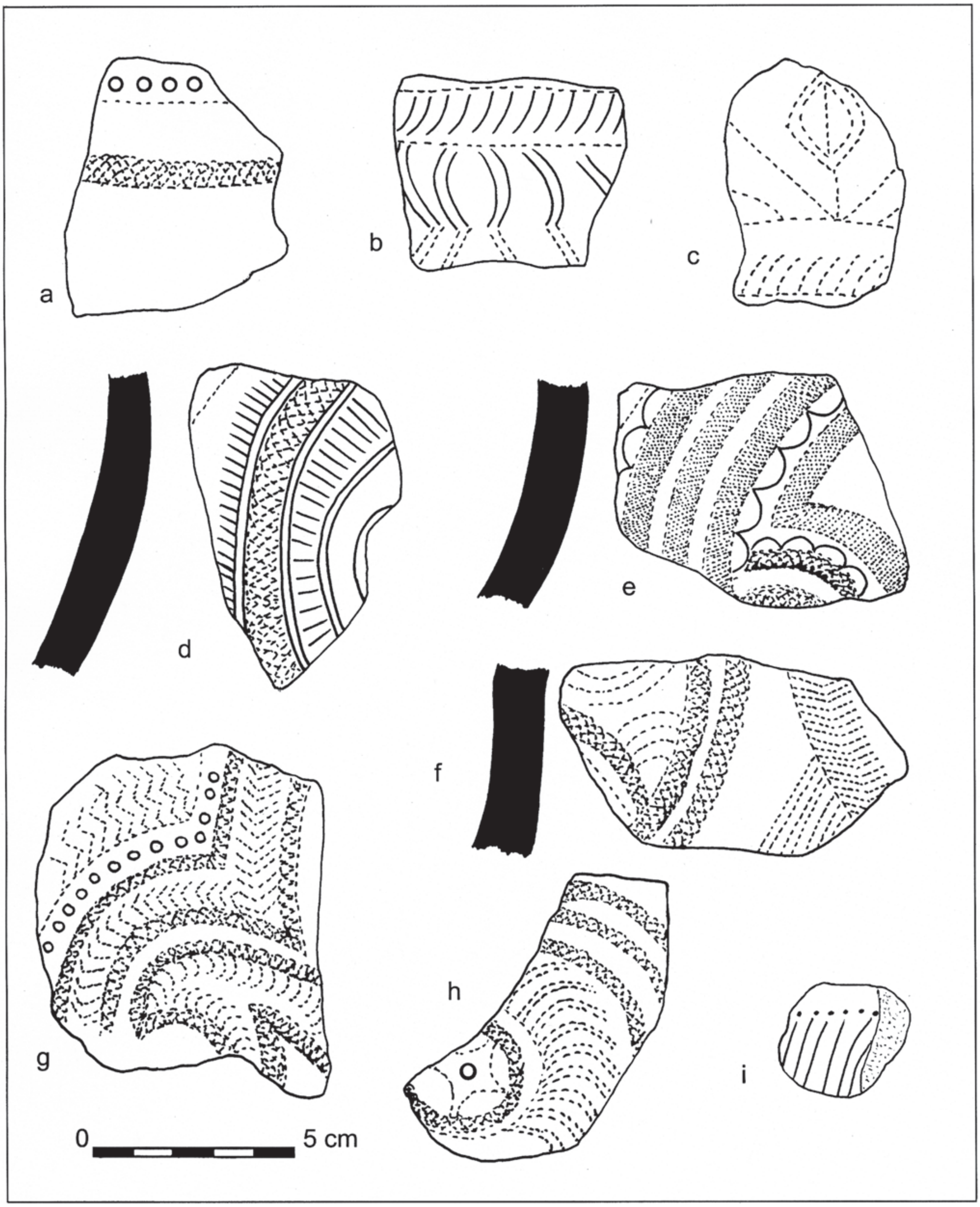

Fig. 19. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

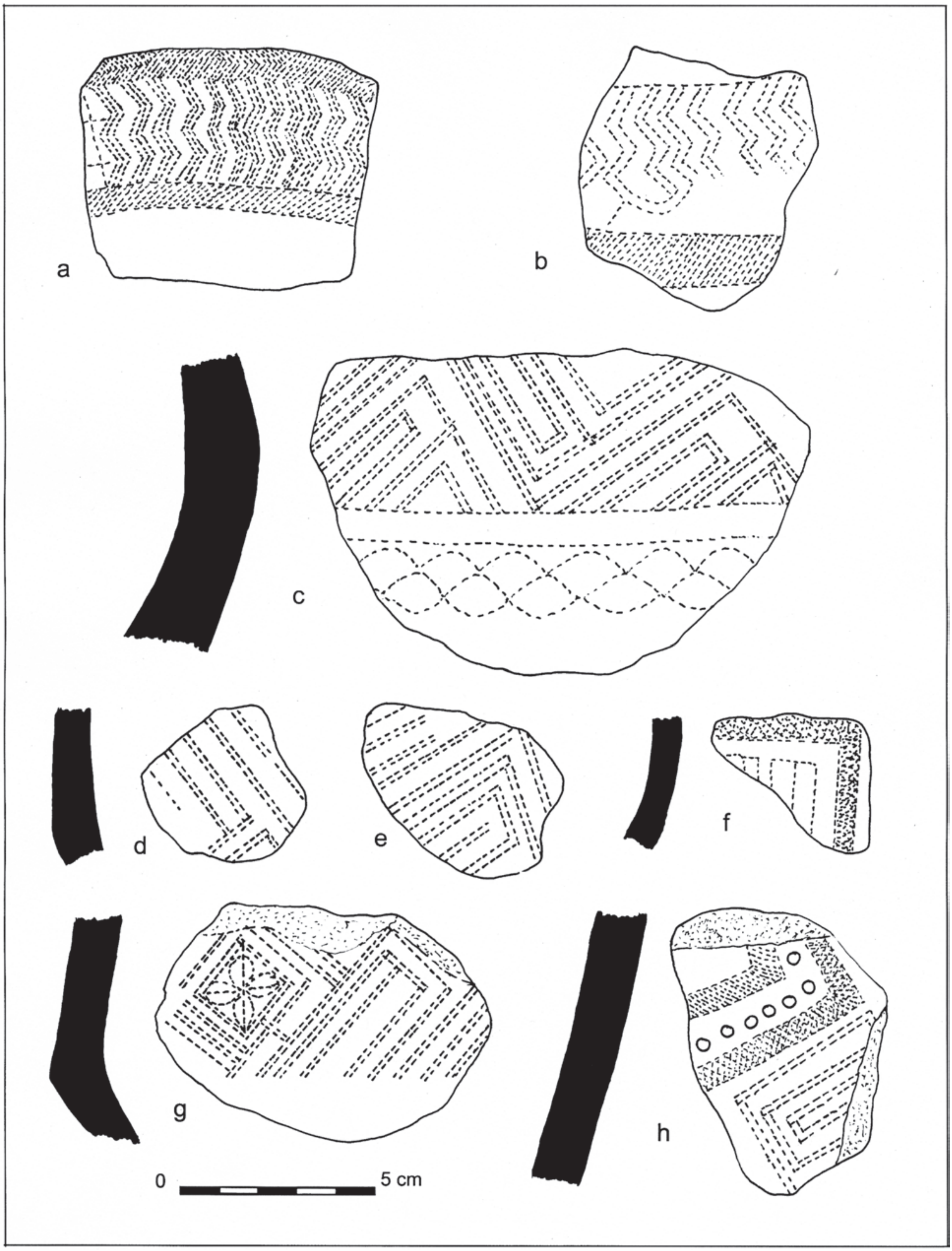

Fig. 20. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

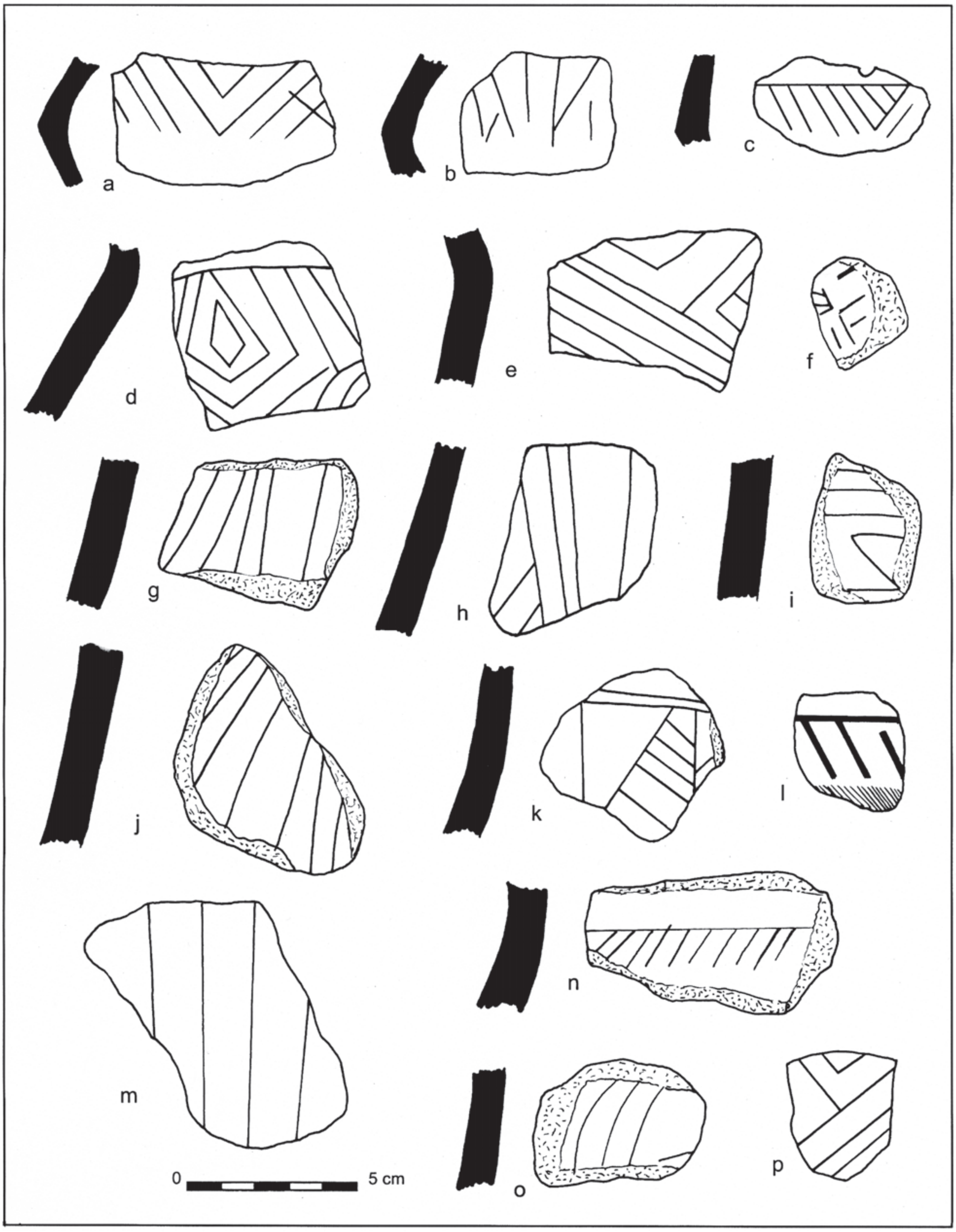

Fig. 21. FEA, Boduna Island, surface sherds (for details, see Appendix 1).

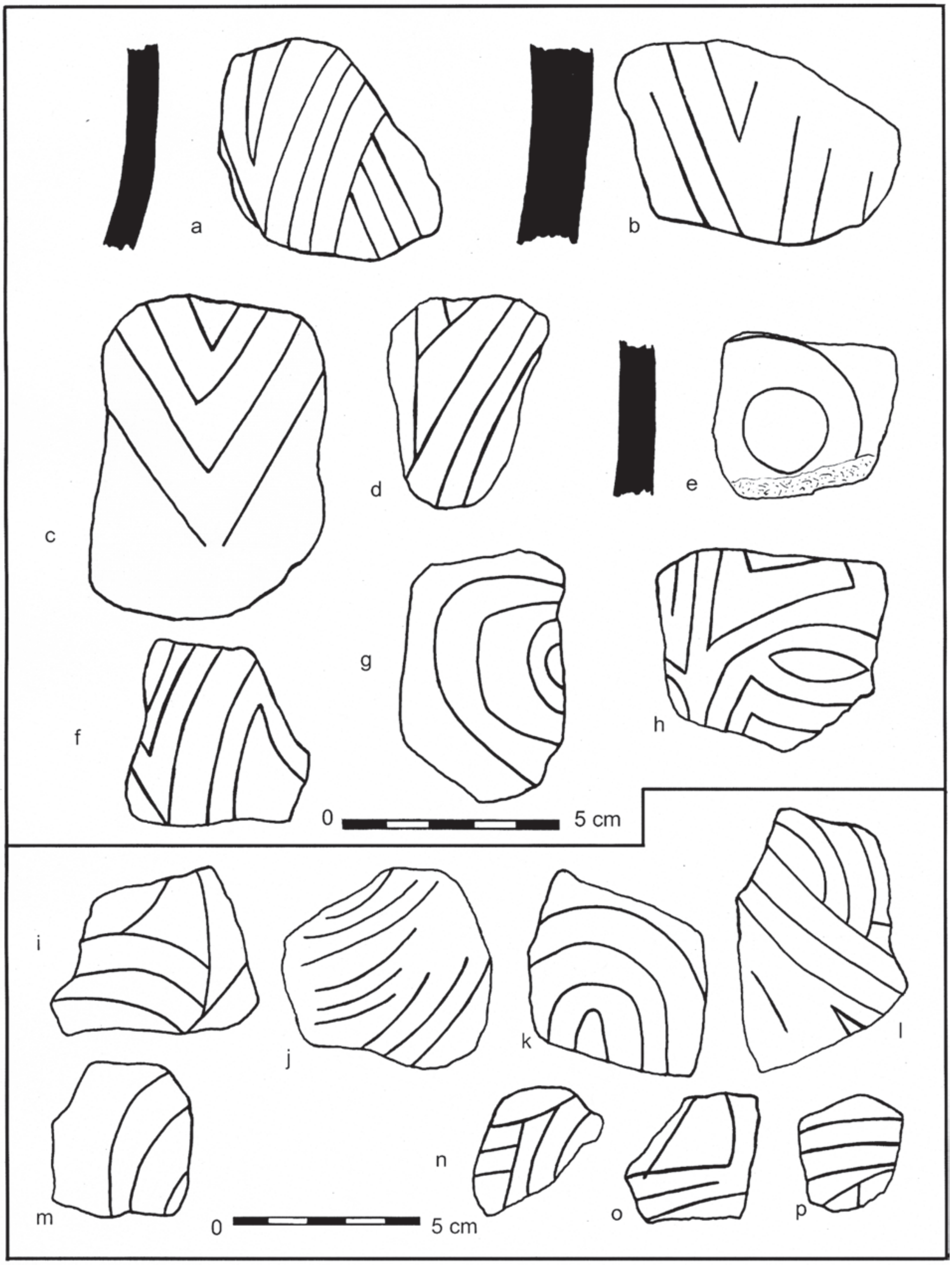

Fig. 22. FEA, Boduna Island, surface sherds (for details, see Appendix 1). Ray collection items drawn from photographs at slightly less than natural size.

Plate 1. General aerial view of Garua Harbour, Willaumez Peninsula, West New Britain, Papua New Guinea. Garua Island is in the foreground, with the mainland of Willaumez Peninsula behind it. Boduna Island lies between Garua Island and the mainland on the right hand side. The FCR/FCS site is at beach level on the mainland on the left hand margin of the photo. Photo: S. Wale, published with permission of Kimbe Bay Shipping Agencies.

Plate 2. Aerial view of Boduna Island (site FEA) looking eastwards. Photo: J. Specht, 1989.

Plate 3. Aerial view from above Boduna Island looking westwards across Willaumez Peninsula. Pangalu village is at beach level in the right foreground. The bare land near the centre is an extensive area of hot springs. Mt Gulu, one of the obsidian source volcanoes of Willaumez Peninsula, forms the highest point (515 m) in the right background. Photo: J. Specht, 1989.

Plate 4. View of the southwest beach of Boduna Island, with Neville Baker (left), François Wadra (centre) and Stephen, a worker from Garua Plantation. Baker is standing on the light grey beach rock that contains sherds and obsidian flakes (White *et al*., 2002). Behind Wadra and Stephen is Garua Island, with Lapita site FAO on the long ridge sloping to the left. Mount Baki is in the distance behind this ridge, and the dark brown scar on the extreme right of the photo is a scoria quarry pit, above which is located Lapita site FSZ. Garala Island is on the left of the photo, with Lapita site FEM at beach level facing Boduna. On the horizon are volcanoes to the south of Cape Hoskins, where Mount Witori (source of the WK tephras) is located. Photo: J. Specht, 1989.

Plate 5. Rim sherd of a form I bowl with dentate-stamping and circle impressions found on Boduna Island by Sarah Jarman in 1988 (see Fig. 13a). Photo: R. Bolzan, Australian Museum.

Plate 6. Dentate-stamped sherd found on Boduna in 1990 by Philip Munday, who provided the photograph. The sherd is shown with what appears to be a notched rim at the top, though the orientation is uncertain. The curvilinear design is probably part of a Spriggs (1990) Type 1 face (cf. Fig. 19g).