9

Ironbark Site Complex

Introduction

This chapter describes archaeological investigations of a major stone quarry/shell midden complex in the approximate centre of the southern Curtis Coast study region. In addition to an extensive, low density linear midden common to the archaeological record of the region, the Ironbark Site Complex features evidence for major stone quarrying and reduction activities. The site has yielded evidence for Aboriginal use from around 1,500 years ago into the post-contact period. Survey and excavation methods are outlined and the results of excavations are presented. Analyses demonstrate that activities at the site were focussed on the reduction of rhyolitic tuff, with edge-ground hatchets one of the key manufacturing products. Geochemical and archaeological studies indicate that the quarry was a major raw material source in the region, with artefacts from nearby sites and beyond found to be geochemically indistinguishable from rock available at the Ironbark Site Complex.

Site description and setting

The Ironbark Site Complex is a large multiple-component stone quarry/shell midden site complex located on the lower southern bank of Middle Creek (Latitude: 24°07′45″S; Longitude: 151°46′30″E) (Fig. 9.1). The site has three broad components: an exposed concentration of flaked rhyolitic tuff covering an area of c.1,000m^2 along a section of narrow beach separating the mangrove fringe from an eroding frontal ridge; a discontinuous exposure of shell and stone artefacts which covers at least 150,000m^2 across low transgressive dune ridges adjacent to the creek; and small isolated exposures of shell, flaked bottle glass and a large baler shell artefact associated with a stand of cycads (*Cycas megacarpa*) on an elevated ridge immediately inland of the quarry (Fig. 9.2). Artefact densities vary across the quarry from 9,500 to less than 10 artefacts/m^2. The entire site is estimated to contain more than one million stone artefacts. Stone artefacts and shell occur discontinuously both in section and along the base of a low erosion bank bordering the creek, stretching some 1,373m between the two elevated headlands from the Queensland Parks and Wildlife Service (QPWS) camping area in the east, to the western tip of the embayment c.100m west of the quarry and in the adjacent intertidal zone in the mangrove fringe (Fig. 9.2). Large dead trees in growth position on the fringing beach and the presence of many dead trees indicate significant bank recession across the deposits adjacent to the creek margin. Tidal action and storm-surge are probably responsible for much of the bank erosion, although recent cattle grazing has exacerbated the problem as evidenced by cattle faeces close to the bank. Driftwood has also been washed into piles along the fringing beach by tidal action with several piles pushed up against the base of the erosion bank, particularly in the area of the quarry. Driftwood deposition suggests that most, if not all, of the exposed quarried material is occasionally impacted by large tides and/or storm-surge activity. Occasional scatters of shell and flaked stone were also observed on four wheel drive tracks up to 1km south of the site complex, although it is unclear whether these exposures are associated with those visible in the erosion bank and close to the creek margin or part of the low density background scatter across the region.

Rhyolitic tuff outcrops on the headlands at either end of the embayment. Exposures in the area of the QPWS camping area in the east do not appear to have been quarried. The western headland, however, exhibits evidence for stone reduction, with rhyolite boulders (both modified and unmodified) on the beach fringe extending for 100m before the beach continues. This exposed rock is divided roughly in two by a group of large boulders which originates in the main elevated hill to the south and continues down to and below the water's edge, creating a break in the mangrove fringe (Fig. 9.3). The eastern half of the quarry and adjacent bank are protected from the direct impact of wave and wind action by a low intertidal sand bank covered with mangroves which runs parallel to the mainland for about 500m (Figs 9.2, 9.7). The western half of the quarry is close to the northwestern extent of this sand bank and is exposed to a much higher energy tidal environment, as evidenced by the presence of coarser angular sands in the intertidal zone and heavier weathering of exposed rock (Fig. 9.7). The less weathered material on the eastern half of the quarry appears to have been targetted for reduction. Densities of modified stone decrease markedly to the west. The southern margin of the quarry exposure adjacent to the bank exhibits many large boulders. Flaked artefacts are evident on the surface of and in crevices between these boulders, and it is conjectured that the artefacts may have deflated from erosion bank deposits receding to the south with sediment, shell, lighter artefacts and other cultural materials removed by tidal action. As part of this process some smaller artefacts may have become lodged in the interstices between rocks and other artefacts on the gentle slope towards the creek, partly explaining the abundance of smaller material on the parts of the quarry closest to the creek.

Large modified and apparently unmodified blocks of rhyolitic tuff (some individual blocks weighing over 50kg) occur between the rocky headlands both along the narrow sandy beach separating the low erosion bank from the mangrove fringe, and on the muddy substrate in the intertidal zone of the mangrove fringe itself. The location of these artefacts away from the natural rock occurrence is thought to be the result of a combination of deliberate transport and progressive recession of bank deposits containing cultural material, leaving lag deposits of heavier material in the intertidal zone. There is no higher ground from which cobbles could have rolled down, and the low energy estuary does not appear to have sufficient energy to move large (>5kg) stones under normal conditions.

Vegetation over the Ironbark Site Complex is distinctively zoned by substrate. Elevated land on the western headland is covered by open woodland dominated by eucalypts (*Eucalyptus intermedia*, *E. acmenioides*, *E. umbra*), with black she-oak (*Allocasuarina littoralis*) on the fringes of the zone closest to the creek margin. The understorey includes native grasses, grass trees (*Xanthorrhoea* sp.) and cycads (*C. megacarpa*). The low sandy ridges and swales between the western and eastern headlands support open forests of melaleucas (*Melaleuca quinquenervia*), eucalypts (*E. tereticornis*) and swamp box (*Lophostemon suaveolens*), with cloudy teatree (*M. dealbata*) and weeping cabbage palm

(*Livistonia decipiens*) dominating the base of swales. A small area of closed, dry rainforest occurs on the southeastern half of the dune system, and includes many traditional Aboriginal food sources such as burdekin plum (*Pleiogynium timorense*), bumpy ash (*Flindersia schottiana*), brown pine (*Podocarpus elatus*) and native cherry (*Exocarpus latifolius*). The more exposed eastern headland supports eucalypts (*E. tessalaris*), burdekin plum and wattle (*Acacia aulacocarpa*). Mangrove vegetation adjacent to the site comprises a dense fringe of spotted mangroves (*Rhizophora stylosa*), with grey mangroves (*Avicennia marina*) dominating the low sand bank in the creek parallel to the mainland (Olsen 1980a:18). Extensive sandy to muddy intertidal flats adjoin the site, supporting populations of hercules club whelk (*Pyrazus ebininus*), telescope mud whelk (*Telescopium telescopium*), and oyster (*Saccostrea glomerata*) attached to mangroves. No oysters were observed on the rhyolitic tuff of the quarry exposure, which has both intertidal and subtidal components, suggesting that the rock is not a preferred substrate for these shellfish.

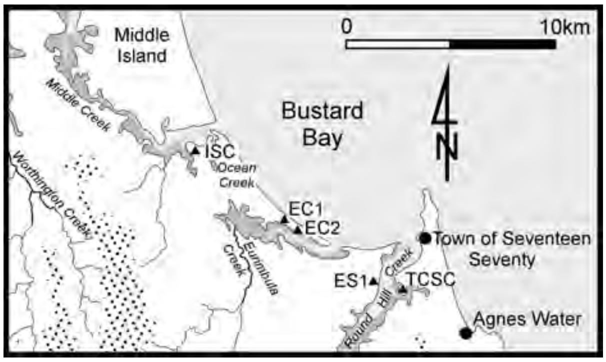

Figure 9.1 The Middle Creek catchment area showing the location of the Ironbark Site Complex (ISC) and nearby excavated sites (EC1=Eurimbula Creek 1; EC2=Eurimbula Creek 2; ES1=Eurimbula Site 1; TCSC=Tom's Creek Site Complex). Dark grey shading indicates the general extent of mangrove, saltflats and claypans. Dotted shading indicates land above 200m. Solid dots indicate local population centres.

Evidence for European use of the immediate area is limited. Although the Bustard Head Lightstation 11km to the north had a permanent presence from 1867, it was not until 1907 that cattle were farmed on Middle Island, across the creek from the Ironbark Site Complex, with Katherine Bowton officially taking up the 3,432ha Red Hill grazing lease in 1917 (Buchanan 1999:64). Anecdotal evidence reported by Buchanan (1994) suggests that the Bowton family, resident on Middle Island from 1907 to 1977, regularly interacted with local Aboriginal people. The Bowton homestead was located close to the northern bank of Middle Creek, just 3km upstream of the Ironbark Site Complex. During a visit to the homestead in the mid-1970s, Buchanan (1994:102) was shown a collection of 'Aboriginal grinding stones, stone cutting implements and woven baskets'. The site area is likely to have been logged in the late nineteenth century, with a sawmill and loading jetty in operation near the mouth of nearby Eurimbula Creek, 8km to the southeast, by 1867 (Buchanan 1999:33; Growcott and Taylor 1996:65–6). Eurimbula Creek Station was established in the area of the sawmill in 1868 (QDEH 1994:79), although the Eurimbula run was not officially surveyed and leased until 1878 (Growcott and Taylor 1996:65).

The Ironbark Site Complex area is situated on a Special Purposes Reserve jointly controlled by the Queensland Environmental Protection Agency (EPA) and Department of Natural Resources, Mines and Energy. Middle Creek is a popular recreational fishing area, with access from a designated QPWS camping area with an unofficial boat ramp which cuts through midden deposits at the eastern end of the site complex (Fig. 9.2). Surveys confirmed that material culture associated with these contemporary fishing and camping activities is largely confined to the eastern end of the site complex and along a narrow 4WD access track which runs along the inland margin of visible surface midden materials before turning south. Occasional recent human defecation sites are located to the west of the camping area and along the margins of the 4WD track. Except for occasional flotsam washed onto the fringing beach through the mangroves, the only other object found during the present project was a 20 gallon 'BP' brand oil drum placed upright next to a large teatree at the western edge of the teatree swamp, just inland of Squares L–M.

The site was first recorded in September 1996 by the author during systematic pedestrian surveys focussing on open beaches and the lower reaches of major creeks in the area, conducted as

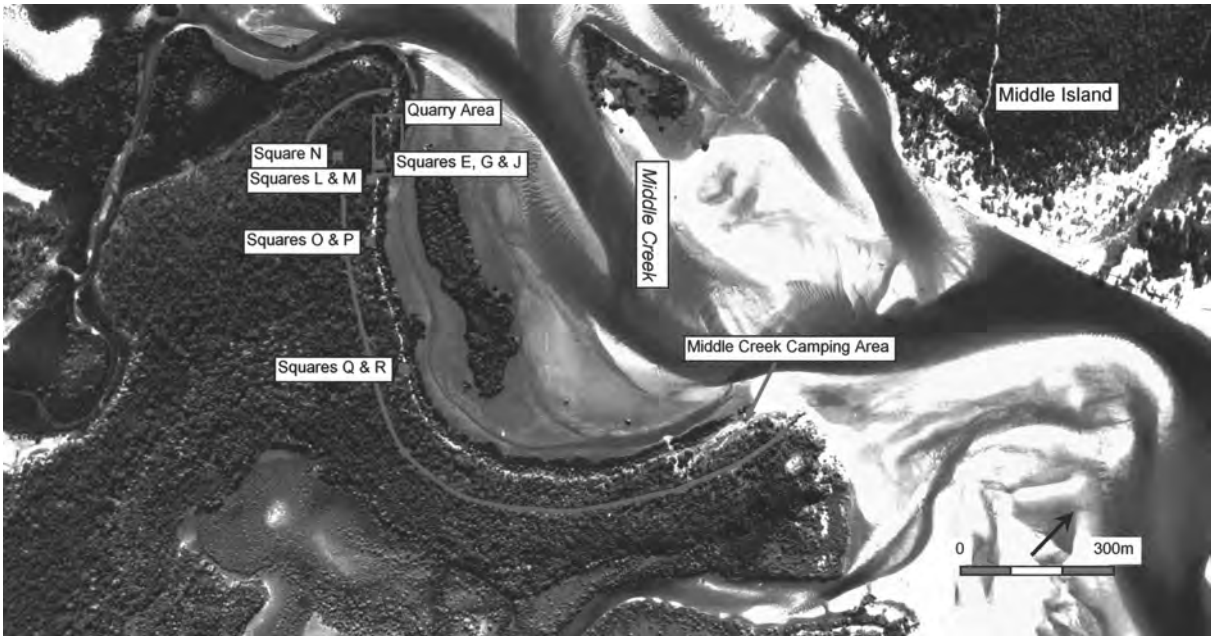

Figure 9.2 Aerial view of the Ironbark Site Complex, showing the maximum extent from the creek of shell and stone exposed at the surface (heavy line) and the general location of excavation squares (after BPA Run 15D/79, 30 July 1996). Based on data provided by the Department of Natural Resources and Mines, Queensland 2006, which gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

part of the Gooreng Gooreng Cultural Heritage Project (GGCHP) (see Lilley et al. 1997). Adopting an encounter-and-record strategy, the site was originally described and recorded as five separate sites corresponding to major concentrations of midden and flaked stone encountered along the creek margin from east to west (originally designated the GGCHP Site Numbers CC26, CC27, CC28, CC29 and CC41; see Lilley et al. 1997). Subsequent and more intensive survey of the area confirmed earlier speculation that these separate 'sites' were in fact different exposures of a single, large, multiple-component site complex. The site is registered on the EPA's Indigenous Sites Database as KE:B07–KE:B10 and KE:B22 (corresponding to the original five separate recordings above) and as Queensland Museum Scientific Collection Number S863.

The geologically distinctive rhyolitic tuff that has been quarried at this site is restricted in distribution to coastal headlands and near-coastal outcrops in a 40km long coastal zone between Wreck Rock in the south and Middle Creek in the north, on which the Ironbark Site Complex is situated. The Ironbark quarry is located within an outcrop of rhyolitic tuff with ignimbrite flows that infilled a palaeotopographic low with undifferentiated and heavily weathered granites of Permian to Triassic age (Ellis and Whitaker 1976). Stephen Cotter (Cooperative Research Centre for Landscape Evolution and Mineral Exploration, University of Canberra, pers. comm., 2000) suggested that this rhyolitic tuff is Triassic in age. The rocks are aphyric, containing minor sanidine and/or quartz micro-phenocrysts, and dark green, partly devitrified glass. Lithic fragments of trachyte and rhyolite are noticeably absent from this suite of flow units compared to other outcrops of Agnes Water Volcanics along the coastline, with a greater proportion of glassy material (Stephen Cotter, Cooperative Research Centre for Landscape Evolution and Mineral Exploration, University of Canberra, pers. comm., 2000; for further details see Ulm et al. 2005). Despite systematic examination of virtually all coastal occurrences of rhyolitic tuff, the Ironbark Site Complex is the only location where evidence for significant Aboriginal procurement has been documented, even though virtually every site recorded in the region exhibits artefacts manufactured on this material.

Reid (1998) analysed a sample of the lithic assemblage excavated from the Ironbark Site Complex quarry (Square E) and adjacent middens (Square M), demonstrating a level of standardisation of the reduction sequence on several technological and descriptive indices. On this basis, Reid (1998) suggested that the quarry was primarily a place of manufacture of edge-ground hatchets. The Ironbark quarry was not used exclusively for the production of hatchets, however, as numerous flaked pieces, cores and flakes sourced to the quarry have been recovered from sites throughout the region, making it difficult to separate quarried hatchet blanks from stone reduced for other end-products (Dickson 1981:34). Significantly, nine bifacially flaked edge-ground hatchets from various locations in central Queensland and manufactured from rhyolitic tuff like that found at the Ironbark Site Complex have been located in museum collections and during field surveys. One hatchet was found at the Ironbark site during surveys c.100m east of the quarry exposure (Fig. 9.12). Five hatchets held by the local Miriam Vale Shire Historical Society Museum in Agnes Water were collected from Lowmead (45km from the Ironbark Site Complex), Kalpowar (79km), Moondoondah (25km), Miriam Vale (30km) and Bororen (31km). Further south, hatchets held by the Queensland Museum were collected from Bundaberg (100km), Gin Gin (97km) and Sharon (96km). Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) was used in an attempt to provenance the hatchets to particular outcrops of rhyolitic tuff on the basis of trace element geochemistry. Preliminary results confirm that all hatchets identified as rhyolitic tuff exhibit a similar geochemical signature. Moreover, this geochemistry can be correlated with the background samples from the Ironbark Site Complex, the only major rhyolite quarry known in the region (for further details see Ulm et al. 2005).

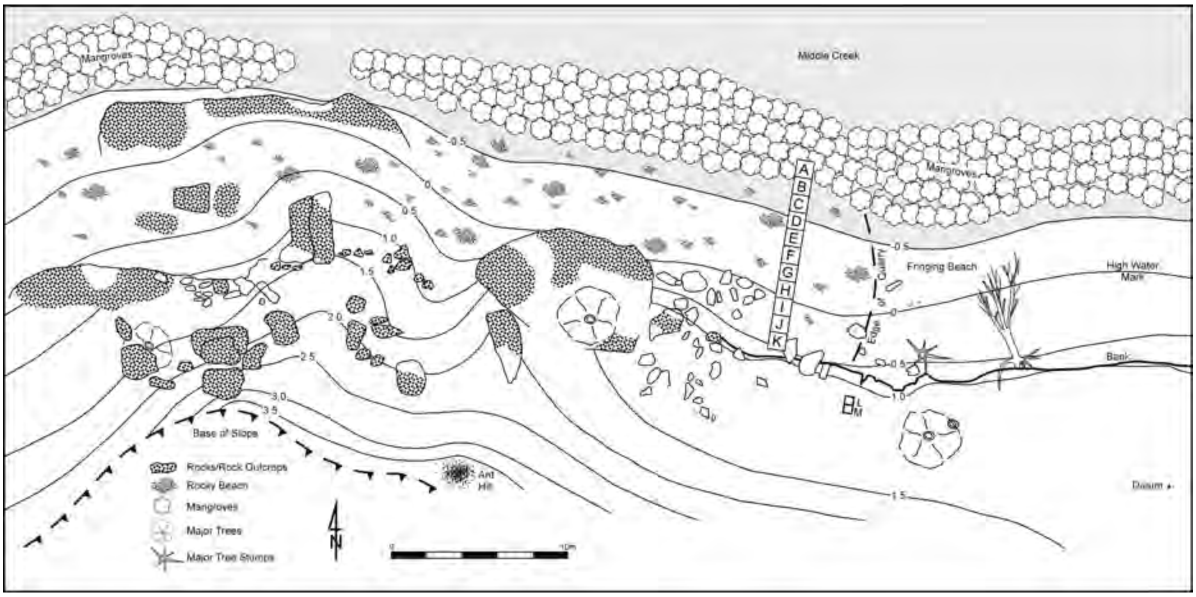

Figure 9.3 Site plan of Ironbark Site Complex, showing area of Squares A–M. Contours are in 0.5m intervals. Rock outcrops and low density artefactual material continue for a further c.50m southwest of the limits of this plan.

Excavation methods

Owing to the extent of the site and resource constraints prohibiting large open area excavation, a strategy was adopted whereby a broad area could be characterised through a program of limited excavations. In total, 4.75m^2 was excavated. Three 1m × 1m squares (E, G and J) were excavated along a north-south transect on the quarry to obtain a sample of material to characterise onsite reduction. A further 1m × 50cm trench excavated as contiguous 50cm × 50cm squares (L–M) was located on the bank adjacent to the quarry in an attempt to recover organic materials to date the initiation of quarrying and increase the sample of flaked stone artefacts (Fig. 9.3). Two 1m × 50cm trenches excavated as contiguous 50cm × 50cm squares (O–P and Q–R) were excavated into the midden east of the quarry (Figs 9.5–9.6) to sample areas not immediately associated with it. A single 50cm × 50cm square (N) was excavated on the ridge inland of the quarry (Fig. 9.4) to sample

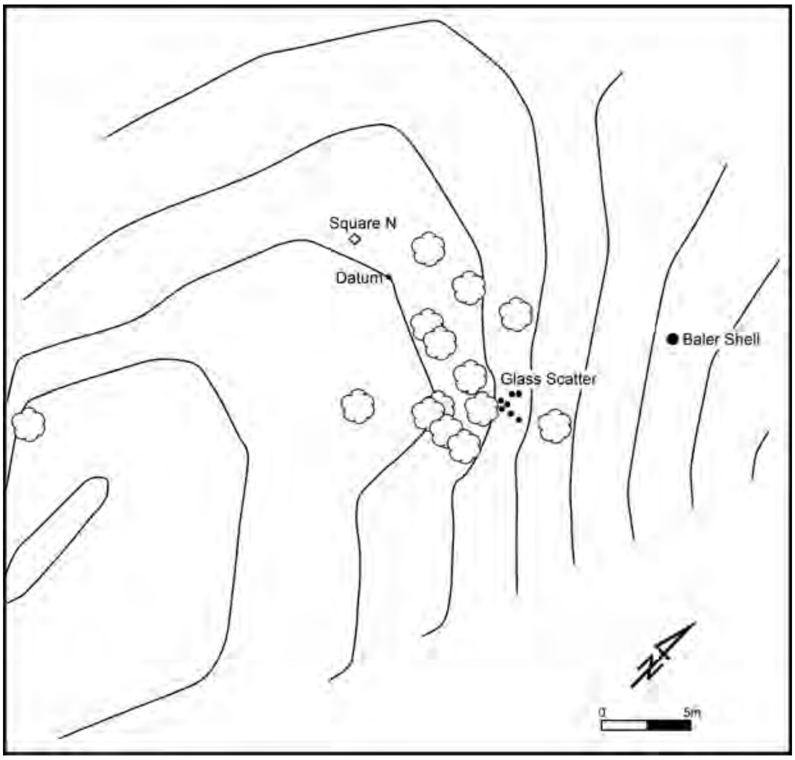

Figure 9.4 Site plan of Ironbark Site Complex, showing area of Square N. Contours are in 0.5m intervals. Only cycads over 50cm in trunk height are shown.

shell associated with the cycad grove and glass artefacts. Over 1,225.4kg of sediment was excavated at the site (this figure excludes material removed from Squares E, G and J on the exposed quarry, see below). Excavations were conducted between 12 January and 13 February 1998. Excavation areas were mapped in detail. The large area over which cultural material is distributed prohibited detailed mapping of the entire site. All sections were photographed, drawn and described except Squares E, G and J on the quarry, which were only photographed and described.

To sample quarry materials, an excavation grid was established as an 11m long and 1m wide transect extending from the mangrove fringe (Square A) to the erosion bank (Square K) (Fig. 9.3). Three squares (E, G and J) were excavated. This approach was adopted to sample an apparent separation of larger material located further upslope on the quarry exposure and smaller material downslope towards the creek. The excavation aimed to test if these observations represented discard of smaller materials downslope and/or post-depositional sorting of the assemblage by periodic tidal inundation. A portable wooden frame comprising eleven 1m × 1m squares was constructed to facilitate excavation of the quarry (Fig. 9.8). This was necessary as the lower part of the excavation grid adjacent to Middle Creek was periodically inundated by the tide. Traditional string lines were not practicable because chain arrows could not penetrate the rocky substrate and string lines moved with tidal action. A sealant was applied to the wooden frame to minimise warping caused by exposure.

Conventional excavation methods using trowel and brush could not be used to remove the first stratigraphic unit of Squares E, G and J as it comprised of layered stone with no intervening sediment (Fig. 9.8). Rather than imprecisely drawing the thousands of pieces of stone onto excavation forms, they were recorded photographically to expedite recovery. The method involved using a large colour photograph of each excavation unit of each square taken in plan, or close to plan, view. All material larger than 30mm was plotted three-dimensionally, assigned unique field specimen (FS) and object numbers and bagged individually. Individual object numbers were written directly onto the photographic print using a 0.3mm waterproof marker (Fig. 9.8). Given the uneven nature of sections formed solely of rock, a general protocol was adopted to remove artefacts and rocks that were more than half-way into the square. Artefactual and non-artefactual material smaller than 30mm was removed with tweezers. This material was bagged according to excavation unit, assigned a field specimen number and weighed.

Conventional excavation methods were generally followed once the sediments underlying the rock were encountered (see Chapter 3 for a detailed discussion of the standard excavation methods employed at all sites). Excavated sediments were wet-sieved through 3mm mesh in the

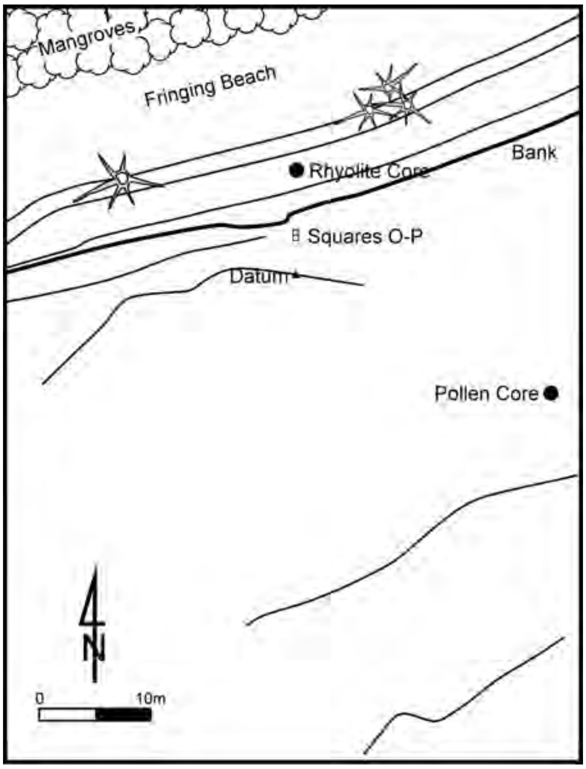

Figure 9.5 Site plan of Ironbark Site Complex, showing area of Squares O–P. Contours are in 0.5m intervals. Tree stumps are shown on the fringing beach.

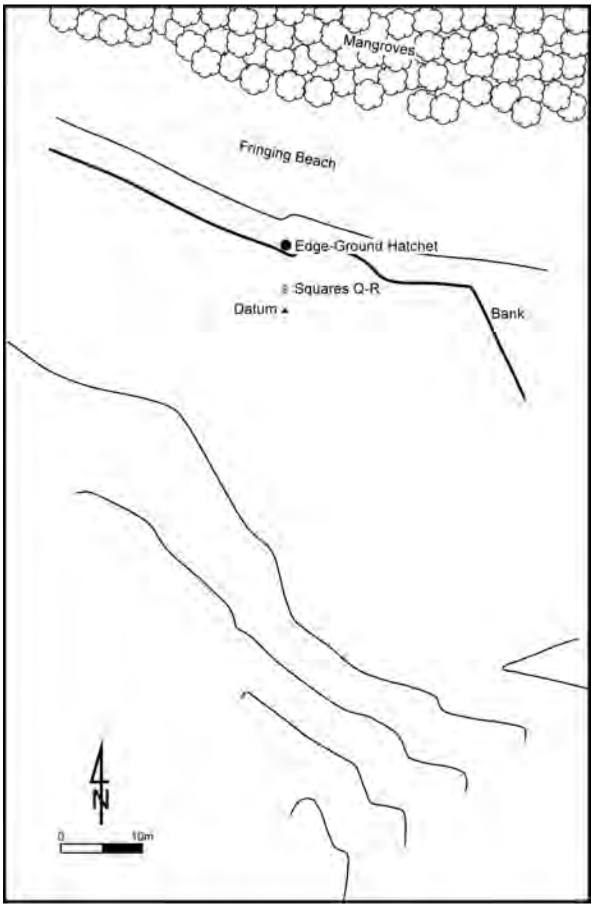

Figure 9.6 Site plan of Ironbark Site Complex, showing area of Squares Q–R. Contours are in 0.5m intervals.

adjacent estuary, because the moisture content of the matrix prevented effective dry-sieving. Sediment samples (c.200g) were taken for each excavation unit from the material that passed through the 3mm sieve prior to wet sieving. Large boulders encountered towards the base of Squares E, G and J were checked for modification before being plotted, removed, weighed and eventually returned as backfill (see below). Excavation of Square E ceased at a maximum depth of c.50cm below surface, when artefactual material was no longer recovered. Stone (n=1,754) and shell (n=4) objects encountered *in situ* during excavation were plotted three-dimensionally. Squares L–R were excavated conventionally.

Squares L–M were situated on the low bank immediately adjacent to the quarry (Fig. 9.3). In this area, *in situ* stone artefacts were visible as a concentrated layer c.30cm below ground surface in the erosion bank, with flaked rhyolitic tuff and a single oyster valve on the surface. The excavation trench was oriented at right angles to the erosion bank and situated 50cm south of the edge of the bank (Fig. 9.3). The erosion bank in this area is oriented east-west and undercut by wave action to a depth of c.30cm, preventing excavation closer to the eroding section. Recent bank recession in this area is evidenced by a large dead tree in growth position 2m from the current erosion section (Fig. 9.3). Excavation proceeded in shallow, arbitrary excavation units averaging 4.55cm in depth and 10.18kg in weight. Excavation ceased at a maximum depth of 68.24cm below ground surface after unmodified boulders of rhyolitic tuff covered the entire base of the excavation area (Fig. 9.11). A total of 30 XUs was removed, distributed as follows: Square L (13 XUs), Square M (17 XUs). A total of 305.3kg of sediment was excavated. Excavated sediments were gently dry-sieved through 3mm screens onto a plastic tarpaulin located 10m southeast of the excavation to prevent contamination to underlying strata. Stone (n=180), pumice (n=17), charcoal (n=5) and shell (n=1) specimens encountered *in situ* during excavation were plotted three-dimensionally.

Square N was located 100m southwest of Squares L–M (Fig. 9.2). Archaeological materials in this area are focussed on a relatively flat ridge located c.100m inland of the quarry (Fig. 9.4). The ridge trends northeast-southwest, is approximately 20m in elevation, and contains two isolated exposures of shell (dominated by oyster), a scatter of bottle glass and a large baler shell artefact associated with a cluster of over 80 cycads (*C. megacarpa*). This cycad species is restricted in distribution to a small area of central Queensland centred on Miriam Vale and including the Bustard Bay area (Hill 1992). Some cycad plants in the group suggest considerable antiquity, with trunk heights of up to 3m. A 50cm × 50cm square was located over one of the shell exposures. Excavation proceeded in shallow, arbitrary excavation units averaging 3.46cm in depth and 8.8kg in weight. Excavation ceased at a maximum depth of 27.7cm below ground surface after culturally-sterile sediments had been reached. A total of 8 XUs was removed comprising 70.6kg of sediment. Excavated sediments were gently dry-sieved through 3mm screens onto a plastic tarpaulin located 10m west of the excavation. Stone (n=112) and shell (n=51) specimens encountered *in situ* during excavation were plotted three-dimensionally. Glass was collected using tweezers wrapped in plastic cling wrap, which was changed between samples to avoid cross-contamination of any residues. Samples of near-surface sediments were taken from the location of the glass scatter to allow analysis of background starch and cellulose.

Squares O–P were located 150m southeast of Squares L–M (Fig. 9.2). A layer of oyster shell was exposed in the low erosion section in this area adjacent to a large block of rhyolite (with flaking evident around its top margin) on the fringing beach. Immediately inland of the frontal dune is an oblong-shaped teatree swamp c.30m wide (north-south). The land rises gently to the south of the swamp, where shell material is visible on the surface in disturbed areas around the base of trees and in crab burrow spoil, indicating a probable subsurface origin. There is evidence for extensive erosion of the deposits fronting the creek, with the stumps of several large trees in growth position located on the fringing beach several metres away from the current erosion face (Fig. 9.5). The excavation trench was situated 50cm south of the edge of the erosion bank. Excavation proceeded in shallow, arbitrary excavation units averaging 3.7cm in depth and 12.94kg in weight. Excavation ceased at a maximum depth of 65.7cm below ground surface after several units of unambiguously culturally-sterile sediments had been removed. A total of 32 XUs was removed, distributed as follows: Square O (13 XUs), Square P (19 XUs). A total of 414kg of sediment was excavated. Excavated sediments were gently dry-sieved through 3mm screens onto a plastic tarpaulin located 10m south of the excavation. Shell (n=85), charcoal (n=12), crustacean carapace (n=9), stone (n=9) and pumice (n=2) specimens encountered *in situ* during excavation were plotted three-dimensionally.

Squares Q–R were located 250m southeast of Squares O–P (Fig. 9.2) and adjacent to the location of an edge-ground hatchet which was recorded in the erosion section in October 1996 during the original recording of the site complex (Fig. 9.12). By January 1998 the hatchet had eroded out of the bank onto the fringing beach. The erosion bank in this area has slumped and is slightly rounded so the 1m x 0.5m excavation grid was located on the top of a low ridge c.3m south of and at right angles to the erosion bank (Fig. 9.6). Excavation proceeded in shallow, arbitrary excavation units averaging 3.6cm in depth and 11.77kg in weight. Excavation ceased at a maximum depth of 67.06cm below ground surface after several units of culturally-sterile sediments had been removed. A total of 37 XUs was removed, distributed as follows: Square Q (17 XUs), Square R (20 XUs). A total of 435.5kg of sediment was excavated. Excavated sediments were gently dry-sieved through 3mm screens onto a plastic tarpaulin located 10m west of the excavation. Shell (n=41), charcoal (n=16) and stone (n=5) specimens encountered *in situ* during excavation were plotted three-dimensionally.

At the completion of the excavations a layer of plastic sample bags was placed over the bases of Squares L–M, N, O–P and Q–R, which were then backfilled with sediments which had passed through the 3mm sieve, and culturally-sterile yellow sands from the beach fringing Middle Creek. Large dead tree branches were placed over the top to discourage goanna burrowing in the backfill. Squares E, G and J were backfilled with the large non-artefactual boulders which had been removed during the course of excavation.

Cultural deposit and stratigraphy

Excavation revealed a highly variable distribution of cultural material across the site (Table 9.1). While large quantities of stone artefacts and minimal shell were recovered from the quarry and adjacent bank, excavations to the east of the quarry revealed a low density sequence of shell with only occasional small stone artefacts.

Squares E, G and J consisted almost entirely of flaked stone, with occasional shell and crab remains assumed to be of recent origin given the presence of colouration and/or flesh still attached to many specimens. The deposit can be divided into three major stratigraphic units (SUs) (Table 9.2). The surface (SUI) is dominated by large pieces of stone with abundant smaller stone material directly underneath (Fig. 9.8). Many of the smaller pieces of stone were oriented vertically along their longitudinal margin, suggesting an origin higher in the deposit. This pattern may be the result of size-sorting of the deposit by wave action, resulting in smaller material working its way down in the rock matrix. Alternatively, it could represent functional differences in the use of space for different reduction activities (see below). Lower excavation units contained abundant flaked material under 30mm in maximum dimension which is not visible on the present quarry surface. The base of the exposed quarry deposit comprised large boulders embedded in coarse sands (SUII). The boulders appeared to have been flaked *in situ*: although flaked material was recovered around their margins, no material was found directly beneath them on removal. Basal deposits also contained small, rounded gravels presumably derived

Figure 9.7 General view of the western side of the quarry sloping into Middle Creek, showing a massive core in centre foreground. Middle Island in background. Facing north.

Figure 9.8 Surface of Square E, XU1, showing photographic recording method. Facing north.

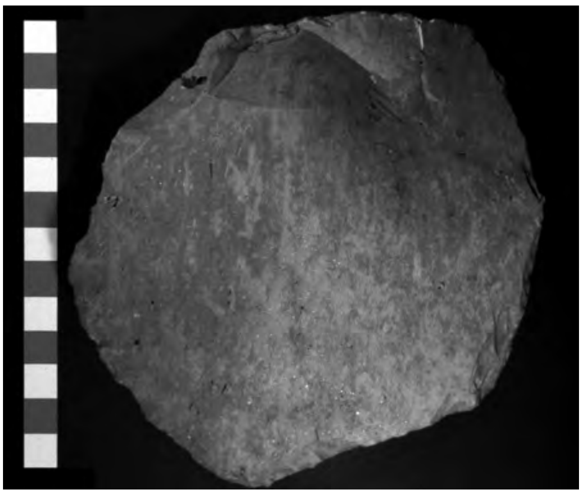

Figure 9.9 Large flake (FS54) manufactured on non-local banded rhyolite recovered from the surface of Square G on the quarry. Note the heavy edge-damage along the distal margin. Scale=1cm (Photograph: Paul Aurisch).

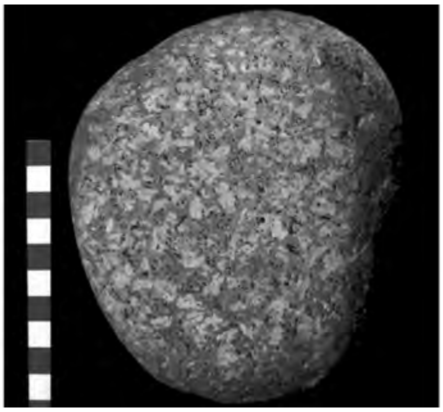

Figure 9.10 Water-rounded microgranite hammerstone (FS88) exhibiting impact-pitting recovered from the surface of Square J on the quarry. Several similar artefacts were noted eroding from adjacent midden deposits. Bustard Head, some 11km to the north is the nearest source of this raw material. Scale=1cm (Photograph: Paul Aurisch).

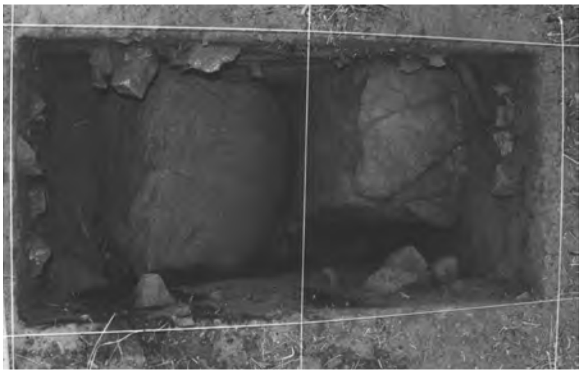

Figure 9.11 General view of completed excavation, Squares L–M. Facing southeast.

Figure 9.12 Close-up view of edge-ground hatchet (FS2747) (Photograph: Paul Aurisch).

from long-term tidal deposition of sediments. In Square E, the closest excavation square to the creek, the coarse, infilling sands gave way to dark grey mangrove muds and clays with depth (SUIII). This pattern suggests that the original rock outcrop consisted of rounded boulders stacked on top of one another with an infilling of sands and gravels in the interstices between rocks in all but the upper 30cm of deposit.

Sediments at Squares L–M were similar to those encountered at Square N, but quite different from those excavated at Squares O–P and Q–R. The Squares L–M deposit can be divided into four major SUs on the basis of sediment colour and texture (Table 9.3, Fig. 9.13). The matrix is basically brown throughout, with SUs differentiated largely on the basis of texture, and markedly different levels of consolidation throughout the deposit. Large quantities of stone artefacts were recovered from SUII, with occasional stone artefacts recovered to the base of excavations, when large boulders were exposed across the basal units. pH values are slightly acidic (6.0) to acidic (5.5) throughout, which may partially account for the absence of shell and bone material in this part of the deposit. The location of Squares L–M at the base of a steep hill suggests that local sediments derive primarily from eroding soils on the surface of the rhyolitic debris flow which forms the substrate of the elevated ground (Fig. 9.3). This pattern contrasts with the excavations to the east, which encountered the quartz-dominated sandy sediments of the low transgressive dunes.

Angular rhyolitic gravels were encountered in Square N c.10cm below the surface and excavations ceased at 27.7cm (Table 9.4, Fig. 9.14). Most of the cultural material was recovered from the thin layer of soil overlying the rock, with occasional shell pieces located in the interstices of the lower rocky unit. Cultural materials were dominated by oyster (*S. glomerata*), with some crustacean carapace, nerite (*Nerita balteata*) and stone artefacts. The shallow and limited distribution of cultural materials suggests that all material is likely to be contemporaneous. The pH values range from 7.5 at the top of the sequence to 6.0 in the basal sterile sediments.

Limited quantities of shell, dominated by oyster, were recovered from the shallow bank deposits east of the quarry exposure in Squares O–P and Q–R consistent with the low density shell observed in the erosion bank. Most shell was recovered from 20–30cm below ground surface. Occasional small shell fragments were recovered to the base of excavations and are thought to have been displaced by crab burrowing (see above). All sediments comprise brown to yellowish-brown sands. The pH values are generally slightly acidic (6.0), but range from neutral (7.0) to highly acidic (4.0). Despite being separated by 250m, Squares O–P and Q–R share a similar stratigraphic sequence. These deposits can be divided into six major SUs (Tables 9.5–9.6, Figs 9.15–9.16). The upper units are dominated by humic material and numerous roots. Squares O–P yielded a greater range of cultural materials than Squares Q–R, including fish otoliths and crustacean carapace fragments.

Table 9.1 Ironbark Site Complex, Squares E–R: summary excavation data and dominant materials.

SQUARE	XUs (#)	DEPTH (cm)	WEIGHT (kg)	SHELL (g)	BONE (g)	CHARCOAL (g)	ARTEFACTS (g)	STONE (g)	ORGANIC (g)
E	11	16.02	NA	NA	0	0	143359.2[a]	NA	0
L	13	68.24	142.95	3.92	0	33.12	3058.45	2538.88	965.84
M	17	68.10	162.30	0	0	21.87	8941.10	1672.87	606.88
N	8	27.70	70.60	940.79	0.02	8.81	5.99	52177.60	1193.50
O	13	52.72	179.50	345.64	0.63	54.42	3.31	195.91	988.60
P	19	65.66	234.50	334.37	0.24	78.91	51.29	275.86	1119.44
Q	17	67.06	213.60	173.00	0	21.14	216.17	80.39	2738.80
R	20	66.24	221.90	46.53	0	24.34	1.21	29.25	1310.20
Total	107	–	1225.35	1844.25	0.89	242.61	155636.72	56970.76	8923.26

a Only includes artefacts over 30mm in maximum dimension (n=869).

Table 9.2 Stratigraphic Unit descriptions, Ironbark Site Complex, Square E.

SU	DESCRIPTION
I	Exposed rhyolitic tuff rock matrix consisting of both artefactual and non-artefactual stone. Approximately 96% of this material is artefactual. SU depth varies across the square owing to the uneven nature of the large rock matrix. No sediments are present in this SU.
II	Extends across the entire square to a depth of c.19cm. A rocky matrix with moist, dark yellowish-brown (10YR-4/4) coarse sands. Approximately 50% of the rock is artefactual. pH values are alkaline (8.5).
III	Extends across the entire square to a depth of at least 40cm below the surface of the quarry. Compact dark grey (1N-6/6) clay matrix containing largely non-artefactual gravels and boulders. The few artefacts recovered from the unit are positioned vertically along the longitudinal margin in the cracks between larger rocks. Mangrove roots are visible in the underlying unexcavated matrix. pH values remain alkaline (8.5).

Table 9.3 Stratigraphic Unit descriptions, Ironbark Site Complex, Squares L–M.

SU	DESCRIPTION
I	Extends across the entire trench with an average depth of c.10cm and a maximum depth of 17cm below the surface. The unit comprises humic, loosely consolidated, dark greyish brown (10YR-4/2) sediments which are poorly-sorted, fine and subrounded. It contains many fine fibrous and some larger roots. Small pieces of pumice are present. pH values are slightly acidic (6.0).
II	Extends across the entire trench with a maximum thickness of 20cm and a maximum depth of 35cm below ground surface. More consolidated than SUI, with visible clumping of sediments. Matrix remains fine and sandy with dark greyish brown (10YR-4/3) sediments. Several large roots encountered, with fewer fine rootlets. This SU contains the majority of stone artefacts recovered from the deposit. Small pieces of pumice are present. pH values are slightly acidic (6.0).
III	Extends across the entire trench with the exception of an area of Square M where a large rhyolitic boulder encountered at the base of SUII interrupts the unit. The SU has a maximum thickness of 17cm and a maximum depth of 48cm below ground surface. It consists of fine sandy brown (10YR-5/3) sediments mottling in places to yellowish brown (10YR-5/4). Some large roots present. Less pumice present than SUII. pH values are slightly acidic to acidic (5.5–6.0).
IV	Extends across the entire trench, except where interrupted by boulders, with a base defined by rhyolitic boulders. The unit has a minimum thickness of 33cm and a minimum depth of 72cm where it infills crevices between boulders. The SU may extend further in depth in the continuing thin interstices between boulders where it was not possible to excavate. The unit exhibits moist, well-sorted, fine subrounded sandy brown (10YR-4/3) sediments mottling in places to dark yellowish brown (10YR-4/4) sediments. The unit is less consolidated than SUIII. No pumice is present. Few fine rootlets are present. pH values remain slightly acidic (6.0).

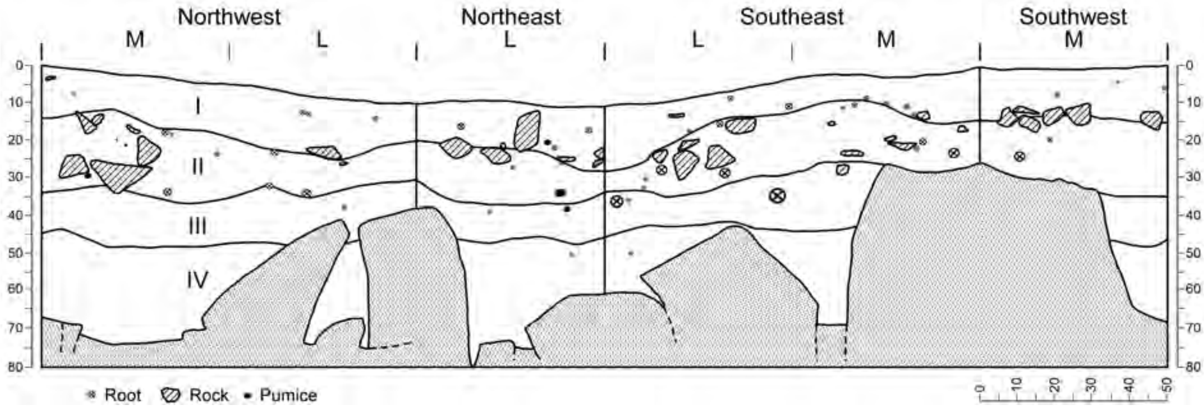

Figure 9.13 Stratigraphic section, Ironbark Site Complex, Squares L–M.

Table 9.4 Stratigraphic Unit descriptions, Ironbark Site Complex, Square N.

SU	DESCRIPTION
I	Extends across the entire pit with an average depth of 3cm and a maximum depth of 6cm below the ground surface. The unit comprises a thin, loosely consolidated matrix capped by a dark organic humic layer containing many fibrous roots. Occasional tufts of grass penetrate the surface with numerous small fibrous roots. Sediments are dark greyish brown in colour (10YR-4/2) and are poorly-sorted, coarse and subangular. Includes some shell (dominated by oyster) which appears to be concentrated on the surface, roots up to 1cm in diameter and rhyolitic tuff gravels. pH values are slightly alkaline (7.5).
II	Extends across the entire pit with a maximum thickness of 8cm and a maximum depth of 13cm below the surface. The loosely consolidated sediments continue to be dark greyish brown (10YR-4/2) although the matrix is slightly finer with poorly-sorted medium and subangular sediments predominating. Some larger roots are present in this unit (up to 2cm in diameter), although there is less organic material in general than in SUI. Shell material is common at the top of this unit, but decreases in abundance with depth. Occasional small stone artefacts and pieces of blocky charcoal also occur. Most of the cultural material (including shell, crustacean carapace and stone artefacts) recovered from the square was located at the interface of SUI/II. pH values are neutral (7.0).
III	Extends across the entire pit with a maximum thickness of 11cm and a maximum depth of 18cm below the surface. Non-artefactual rocks make up the majority of this unit. Sediment colour and texture remains consistent with SUII: dark greyish brown and loosely consolidated. Only very small shell and charcoal fragments were recovered with large quantities of small subangular gravels. There are few roots and the sediment is extremely dry and dusty. pH values are slightly acidic (6.0).
IV	Unit extends across the entire trench with a minimum thickness of 16cm and a minimum depth of at least 30cm below the surface. The base of this unit was not reached. As in SUIII, non-artefactual coarse gravels make up the majority of the unit. Sediments are poorly consolidated and lighter than previous SUs grading from brown (10YR-5/3) to pale brown (10YR-6/3). The matrix continues to be poorly-sorted, medium and subangular. There is evidence for minor bioturbation in this unit in the form of ant burrowing. There are few roots present and only minute fragments of oyster and charcoal were recovered. pH values remain slightly acidic (6.0).

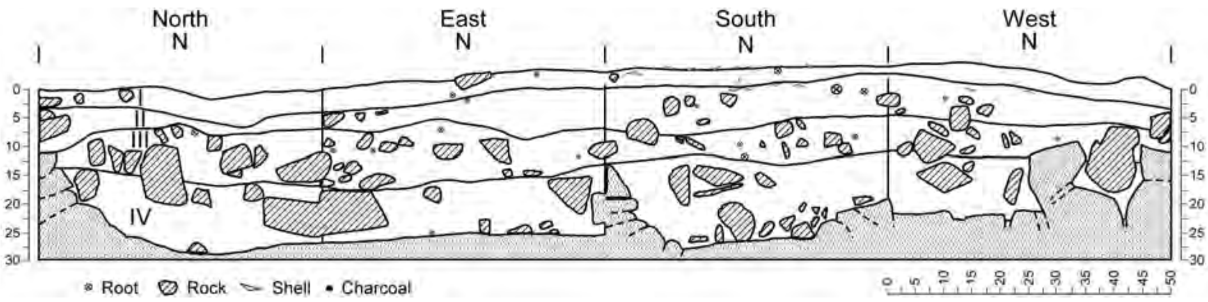

Figure 9.14 Stratigraphic section, Ironbark Site Complex, Square N.

Table 9.5 Stratigraphic Unit descriptions, Ironbark Site Complex, Squares O–P.

SU	DESCRIPTION
I	Only extends across the southern half of Square P to a depth of approximately 3cm below ground surface. The unit comprises a dense mat of humic material including rootlets, bark, leaves and small fragments of charcoal. Sediments are dark greyish brown (10YR-4/2) and are well-sorted, fine and subrounded. This sediment matrix was found to be consistent with that of the lower SUs. pH values are neutral (7.0).
II	Extends across the entire trench with a maximum thickness of 8cm and a maximum depth of 13cm. In Square O and the northern half of Square P this unit extends from the surface. It consists of loosely consolidated brown (10YR-5/3) sandy sediments. Numerous small rootlets and a small number of larger roots (up to 3cm in diameter) are present as well as some humic matter, especially towards the upper margin of the SU. Shell (dominated by oyster), charcoal and pumice are present, particularly towards the base of the unit. pH values are slightly acidic (6.0).
III	Extends across the entire trench with a maximum thickness of 11cm and a maximum depth of 22cm. Brown (10YR-5/3) to greyish brown (10YR-5/2) sediments with numerous roots ranging from <1–3cm in diameter. Occasional shell encountered throughout. pH values are slightly acidic (6.0–6.5).
IVa	Extends across the entire trench, with the exception of a small area in the northeast section (see SUIVb), with a maximum thickness of 17cm and a maximum depth of 32cm. Sediments comprise a loosely consolidated yellowish brown (10YR-5/4) sand. Shell is most abundant in this SU, especially in Square P. Small roots and fine hair rootlets are numerous. pH values are neutral to slightly acidic (6.5–7.0).
IVb	Well-defined dark greyish brown (10YR-4/2) sandy matrix with numerous minute charcoal fragment inclusions and occasional shell restricted to the northeast corner of Square O. The unit has a maximum thickness of 17cm and a maximum depth of 33cm below the surface. The matrix is poorly consolidated, but otherwise similar to SUIVa. pH values are slightly acidic (6.5).
Va	Extends across the entire trench with a maximum thickness of 12cm and a maximum depth of 42cm. Very similar to SUIV but graded to a slightly lighter yellowish brown (10YR-5/4) with more roots. This SU contains small quantities of shell and occasional pumice and charcoal. pH is slightly acidic (6.5).
Vb	Extends across the entire trench. Although the base of this SU was not reached in Square O it is assumed to have a maximum thickness of c.20cm and a minimum depth of c.60cm. Comprises light yellowish brown (10YR-6/4) loosely consolidated sediments including a small number of roots. Contains occasional artefacts, non-artefactual stone and pumice. pH values are slightly acidic (6.0–6.5).
VI	Extending across the entire base of Square P with a minimum thickness of 12cm and a maximum depth of at least 67cm below the surface. The base of this unit was not reached and was only encountered in Square P owing to deeper excavation, but it is assumed to continue across the base of Square O. Sediments comprise loosely consolidated very pale brown (10YR-7/4) sands and appear to be culturally-sterile with occasional non-artefactual stone, pumice and charcoal fragments. Few roots occur in this unit. pH values are slightly acidic (6.5).

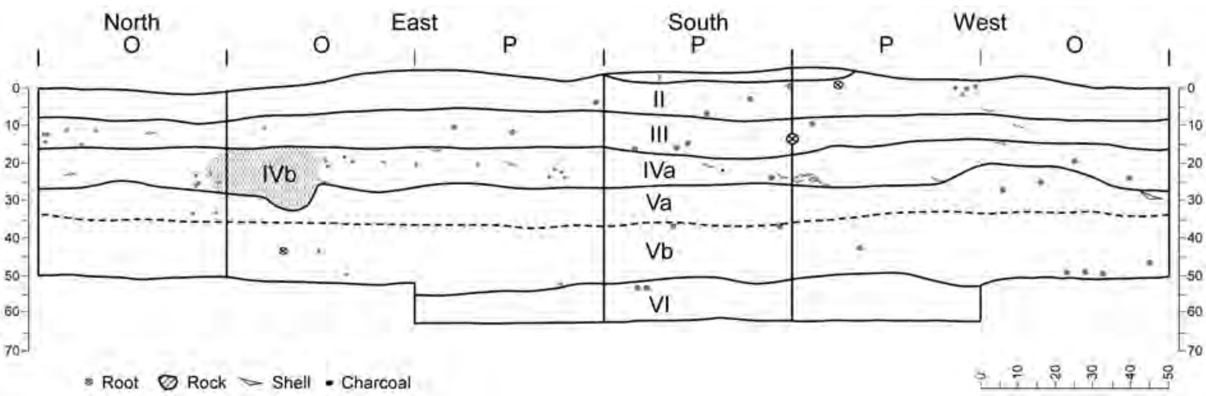

Figure 9.15 Stratigraphic section, Ironbark Site Complex, Squares O–P.

Table 9.6 Stratigraphic Unit descriptions, Ironbark Site Complex, Squares Q–R.

SU	DESCRIPTION
I	Extends across the entire trench with an average depth of 3cm and a maximum depth of 5cm below the surface. Thin unit of fibrous, humic material and roots in a poorly-sorted, fine, subrounded matrix mottling from brown (10YR-5/3) to dark yellowish brown (10YR-4/3). pH values are slightly acidic (6.0).
II	Extends across the entire trench with a maximum thickness of 15cm and a maximum depth of 18cm. It comprises loosely consolidated yellowish brown (10YR-5/4) sediments with some fibrous roots and occasional large roots. Contains occasional shell (dominated by oyster), artefacts, charcoal and pumice. pH values are slightly acidic (6.0–6.5).
III	Extends across the entire trench with a maximum thickness of 14cm and a maximum depth of 28cm. Sediments are very loosely consolidated and brown (10YR-5/3) to pale brown (10YR-6/3). pH values are slightly acidic (6.5).
IV	Extends across the entire trench with a maximum thickness of 24cm and a maximum depth of 52cm. Comprises brown (10YR-5/3) sediments. More consolidated and fewer roots than SUIII. Includes occasional stone artefacts, pumice, charcoal and minute shell fragments. pH values range from slightly acidic to acidic (5.0–6.0).
V	Extends across the entire trench with a maximum thickness of 20cm and a maximum depth of 62cm. Unit comprises loosely consolidated yellowish brown (10YR-5/4) sediments with few roots. Includes some minute stone artefacts and shell fragments, with pumice nodules and small charcoal fragments common throughout the unit. pH values are slightly acidic (6.0–6.5).
VI	Extends across the entire base of the trench with a minimum thickness of 14cm and a minimum depth of at least 70cm below the surface. The base of this unit was not reached. Comprises loosely consolidated pale brown (10YR-6/3) to very pale brown (10YR-7/4) sediments with few roots. This unit appears to be culturally-sterile with pumice nodules and occasional fragments of charcoal common. pH values are slightly acidic (6.0–6.5).

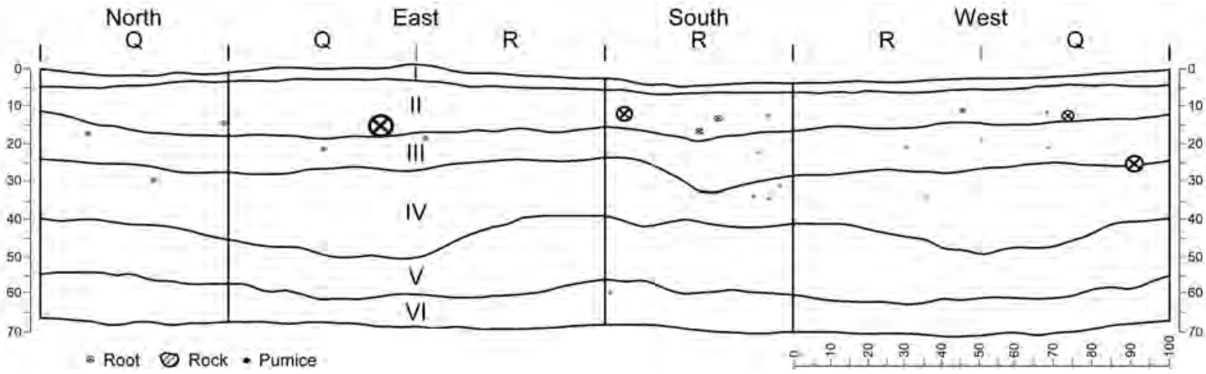

Figure 9.16 Stratigraphic section, Ironbark Site Complex, Squares Q–R.

Radiocarbon dating and chronology

Eight radiocarbon dates were obtained from the site (Table 9.7). Five conventional radiocarbon dates were obtained on charcoal and two on *Anadara trapezia* valves. In addition, a single accelerator mass spectrometry (AMS) date was obtained on organic material from a pollen core from the teatree swamp adjacent to Squares O–P. A single shell/charcoal paired sample (Wk-8558/Wk-8557) was obtained from Square P to investigate local marine reservoir conditions (see Chapter 4 for details). The samples consisted of whole *A. trapezia* valves and charcoal fragments collected from the 3mm sieve residue. Although the shell/charcoal pair returned an apparent age difference of 390 ^{14}C years, a ΔR value could not be calculated because the charcoal age is modern at one sigma. This places the determination in a recent segment of the radiocarbon calibration time-scale where significant uncertainties in ^{14}C activity are introduced by large-scale fossil fuel combustion beginning in the late nineteenth century. In the absence of a determined estuarine ΔR value for Middle Creek, the local open water value of ΔR= +10±7 is adopted as the default value for the calibration calculations presented in Table 9.7.

In the absence of datable organic material on the quarry, three radiocarbon dates were obtained for Squares L–M on the adjacent bank, where stratified deposits containing both flaked stone artefacts and charcoal occurred. The date of 1,519 cal BP (Wk-6361) is associated with the lowest artefactual material in Square M and provides a date for initiation of use of the bank adjacent to the quarry as a discard area, and by implication, provides a minimum age for quarrying at the site. The date for these activities, however, is not necessarily synchronous with initiation of reduction at the quarry itself. The two other dates of c.600 cal BP (Wk-6359) and 1,288 cal BP (Wk-6360) correspond to synchronous peaks in the abundance of charcoal and stone artefacts in Square M. The simple age-depth relationship indicates at least two major phases of deposition. The apparently rapid sedimentation evident in the bottom two-thirds of the deposit is exaggerated by the small volume of sediment excavated between the large basal boulders and corresponds with very low rates of stone artefact discard. The determination of 1,288 cal BP (Wk-6360) dates the first major peak in artefact density and is at a depth where sediments have infilled the underlying crevices between major boulders to form a relatively flat surface. From this date onwards this bank area appears to have been regularly used for stone artefact discard. Dates from Squares O–P and R suggest that the bank deposits adjacent to the quarry largely date to the last 500 years. Evidence for older deposits in this area may have been removed by erosion.

Indirect age estimates for quarrying can also be derived by establishing the presence of Ironbark Site Complex quarrying products in other dated sequences in the region. Although rhyolitic tuff does not appear regularly in regional stone artefact assemblages until the last 1,500 years (see Chapter 14), stone artefacts manufactured from rhyolitic tuff geochemically consistent with the Ironbark Site Complex raw material have been recovered from the basal levels of Square E2 at Eurimbula Site 1, located some 11km to the southeast, dating to 3,020±70 BP (Wk-3945), raising the possibility that the quarry was in use at a much earlier date (Ulm et al. 1999a).

Table 9.7 Radiocarbon dates from the Ironbark Site Complex (see Appendix 1 for full radiometric data for each determination). * = assumed value only.

SQUARE	XU	DEPTH (cm)	LAB. NO.	SAMPLE	$\delta^{13}C$ (‰)	^{14}C AGE	CALIBRATED AGE/S
M	4	5.4–10.5	Wk-6359	charcoal	−26.9±0.2	650±60	669(626,600,560)517
M	9	22.9–28.1	Wk-6360	charcoal	−25.7±0.2	1400±60	1351(1288)1173
M	17	60–69.3	Wk-6361	charcoal	−26.2±0.2	1640±150	1865(1519)1260
O	9a	27.4	Wk-8556	*A. trapezia*	−0.5±0.2	910±55	608(509)442
P	7	16.3	Wk-8557	charcoal	−26±0.2	200±140	508(271,210, 197,194,146,15,3)0*
P	7	17.6	Wk-8558	*A. trapezia*	−0.3±0.2	590±60	317(254)0*
R	9	17.5–20.4	Wk-10964	charcoal	−26.8±0.2	290±89	506(297)0*
Core	–	25-30	OZD-756	organics	−25*	215±55	310(275,174,149,10,4)0*

In addition to the radiocarbon assays, an assemblage of bottle glass associated with Aboriginal activities also provides evidence for the chronology of site use. Only one (FS186) of the seven pieces of glass could be confidently dated. The bottle fragment has the base mark of the Australian Glass Manufacturers. Bottles with this base mark were manufactured between AD 1900 and AD 1915 (Boow 1991:180; Errol Beutel, Queensland Museum, pers. comm., 1999). Another glass specimen (FS182) is dated to between AD 1820 and AD 1870 on the basis of the absence of a mould seam and the presence of a deep push-up with ridges made by the pontil (Boow 1991:26). A more precise date for manufacture cannot be assigned to this bottle, although its close association with the base confidently dated to AD 1900–AD 1915 suggests that the entire assemblage dates to the early twentieth century.

A low-lying ephemeral swamp dominated by weeping cabbage palm (*L. decipiens*) and melaleuca (*M. quinquenervia*) occurs in the base of a swale immediately inland of the frontal dune in the area of Squares O–P, running parallel to the creek bank. The basin sediments of this feature were sampled using a simple method of pile-driving a 3m length of 50mm diameter aluminium pipe into the approximate centre of the swamp, c.30m southeast of Squares O–P, to obtain a sample of the organic deposits. The core penetrated to a depth of 1.26m below ground surface and revealed a band of rich organic sands to c.30cm, underlain by sterile beach sands. The determination of 215±55 BP (OZD-756) dates the base of the organic layer and provides a minimum age for swamp formation, suggesting that this feature is of very recent origin.

Future dating efforts could make use of cosmogenic radionuclide dating (10B and 26Al) to provide a chronological framework for when the rhyolitic tuff present at the quarry was exposed and thus became available for Aboriginal utilisation. A large, worked boulder (see Fig. 9.7) provides a good candidate for dating the exposure time for the upper surfaces. The assumption is that the boulder, like the rest of the outcrop at the quarry, was transported to its present position by a rock debris flow, and that during that transport the rock was split, exposing fresh surfaces. It is this fresh face which has been knapped. The age determination obtained for the timing of the exposure of this fresh face would provide indications, firstly, of the probable timing of the debris flow and indirectly the timing at which the surface became available for Aboriginal resource procurement. Large nodules of sea-rafted pumice recovered from stratified bank deposits (especially Squares L–M) may also be suitable for indirect dating using geochemical source characterisation (see Ward and Little 2000).

In summary, radiocarbon determinations from the frontal dune excavations indicate that cultural deposits began accumulating by 1,640±150 BP (Wk-6361) with indirect evidence for site use by 3,020±70 BP (Wk-3945). Bottle glass dated to AD 1900–AD 1915, assigned an Aboriginal behavioural origin (see below), establishes a *terminus post quem* for use of the site.

Stratigraphic integrity and disturbance

Several lines of evidence suggest that the stratified deposits generally exhibit good stratigraphic integrity. Although stone on the quarry has been displaced to an unknown degree by tidal action, cultural materials from the adjacent bank deposits are consistent with the pattern of distribution observed in section in the erosion bank. This pattern suggests that the extant bank deposits exhibit integrity, although of major concern is the differential representation of cultural deposits caused by bank recession. The presence of large tree stumps in growth position on the mangrove fringe indicates significant recent erosion, while the presence of large artefacts in the intertidal mangrove fringe up to 15m from the present erosion section suggests an erosional regime of some antiquity. Interpretation of aerial photographs from the late 1940s is currently underway in an attempt to quantify the rate of recent erosion. Anecdotal evidence from local crabbers suggests that there has been a major restructuring of the creek mouth over the last 30 years.

Conjoin analysis of the *A. trapezia* assemblage was limited by the small number of valves present in excavations and their generally poor preservation. Twelve measured intact and broken valves were considered in the conjoin analysis, distributed as follows: Square O (10 valves); Square P (2 valves). Methods proceeded as described in Chapter 5. A single conjoin was identified. The conjoining valves both came from the shell concentration encountered in Square O, XU9, located c.30cm below ground surface. The close vertical proximity of these valves suggests that material in this zone of the deposit has experienced limited post-depositional movement.

After tidal erosion and root penetration, ghost crab (*Ocypode cordimanus*) and goanna (*Varanus punctatus*) burrowing appear to be the major source of post-depositional disturbance across the site. Although no voids or other unambiguous evidence for burrowing were encountered during excavation, ghost crabs and goannas are common in the area. A goanna was observed burrowing into the backfill of Squares L–M on several occasions. Goannas are known to have caused significant disturbance to shell deposits elsewhere (see Roberts 1991).

Laboratory methods

Owing to the large quantity of excavated materials from the quarry, detailed analysis of Square E only has been completed to date. Field observations and preliminary processing of Squares G and J indicate a broad homogeneity in the composition of all three pits, although Square E yielded the most artefactual material. All other excavated squares (Squares L–R) were analysed to maximise the available sample (see Chapter 3 for a detailed discussion of the standard laboratory methods employed at all sites). Results from all squares are summarised below, although only selected data are illustrated in Figures 9.17–9.24. Further summary results for all excavated squares are available in Appendix 4. Stone artefacts from Squares E and M were analysed in detail by Reid (1998) who used 22 attributes to investigate the reduction sequence at the quarry. These attributes were designed to identify the primary stages of reduction, focussing, for example, on the presence of cortex. These attributes were applied to all of the artefacts larger than 30mm from Squares E and M (Reid 1998). For further details on methods, see Reid (1998). Use-wear and residue analyses were conducted on the bottle glass assemblage in the Archaeological Sciences Laboratory, University of Queensland, using standard procedures outlined by Loy (1994).

Cultural materials

Invertebrate remains

Nineteen taxa of shellfish weighing 1,844.3g were recovered from Squares L–R, consisting of nine marine bivalves, eight marine gastropods and two terrestrial gastropods (Table 9.8). The shell is dominated by rock oyster (*S. glomerata*), comprising 74.4% by weight (Figs 9.19–9.20), followed by scallop (*Pinctada albina sugillata*) (8.9%) and mud ark (*A. trapezia*) (8.5%). The remaining 16 taxa are relatively rare, each contributing less than 3% by weight. The assemblage exhibits relatively high diversity with a calculated Shannon-Weaver Function (H') of 1.633 and Simpson's Index of Diversity (1–D) of 0.65. With the exception of a single piece of oyster found on the surface of Square L, no shell was recovered from the 305.3kg of deposit excavated from Squares L–M adjacent to the quarry. Square N yielded the most shell despite the small volume of the excavation, with 940.8g, consisting of 886.9g of oyster. The range of shellfish taxa recovered indicates gathering focussed on the intertidal zone and creek margins adjacent to the site. Although shell sizing was undertaken, the small sample makes results unreliable and they are not discussed further.

Some 23.8g of mud crab (*Scylla serrata*) carapace are present in Squares N and O–P. Virtually all of this material was recovered from Square O, XU4, approximately 10cm below ground surface. The assemblage was dominated by the hard, decay-resistant claw tips, providing another indication that acidic soil preservation conditions may have adversely affected the representation of other crustacean carapace components.

Table 9.8 Presence/absence of shellfish identified in the Ironbark Site Complex, Squares L–R.

FAMILY	TAXON	L	M	N	O	P	Q	R	TOTAL (g)
				MARINE BIVALVIA					
Arcidae	*Anadara trapezia*			X	X	X		X	156.1525
Chamidae	*Chama fibula*					X			0.6770
Donacidae	*Donax deltoides*					X			2.1302
Mytilidae	*Trichomya hirsutus*			X	X	X			23.0983
Ostreidae	*Saccostrea glomerata*	X		X	X	X	X	X	1372.7084
Pteriidae	*Pinctada albina sugillata*			X	X	X	X		164.7145
Veneridae	*Gafrarium australe*				X				2.7673
Veneridae	*Placamen* sp.					X			32.7395
Veneridae	*Venerid* sp.				X				0.1644
				MARINE GASTROPODA					
Batillariidae	*Pyrazus ebininus*				X	X			6.8144
Lottiidae	*Acmaeid* sp.			X					0.2285
Littorinidae	*Bembicium nanum*			X					1.9586
Littorinidae	*Littoraria* sp.				X				0.0187
Muricidae	*Bedeva paivae*				X				0.1294
Muricidae	*Morula marginalba*				X				0.8771
Neritidae	*Nerita balteata*			X					48.6466
Planaxidae	*Planaxis sulcatus*			X					0.0553
				TERRESTRIAL GASTROPODA					
Camaenidae	*Trachiopsis mucosa*			X	X	X	X	X	29.8380
Subulinidae	*Eremopeas tuckeri*			X		X	X	X	0.5263

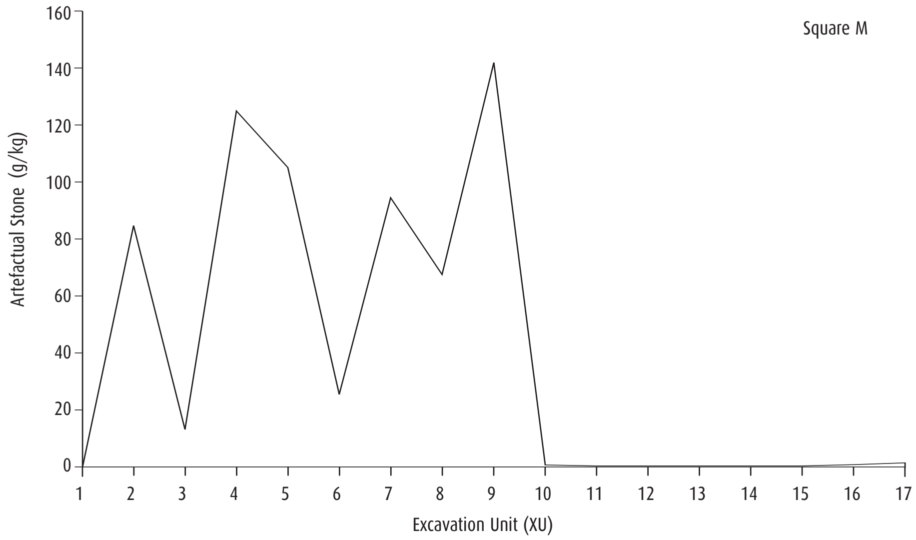

Figure 9.17 Abundance of artefactual stone.

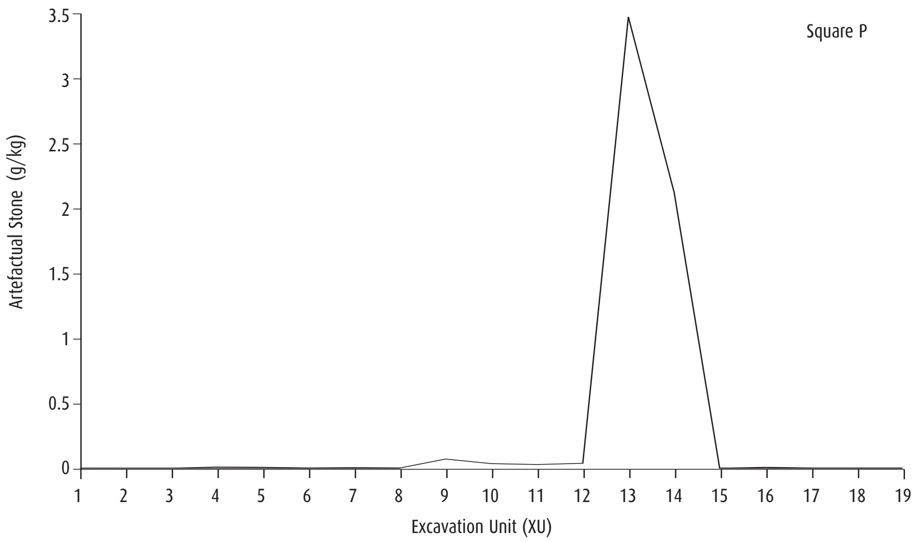

Figure 9.18 Abundance of artefactual stone.

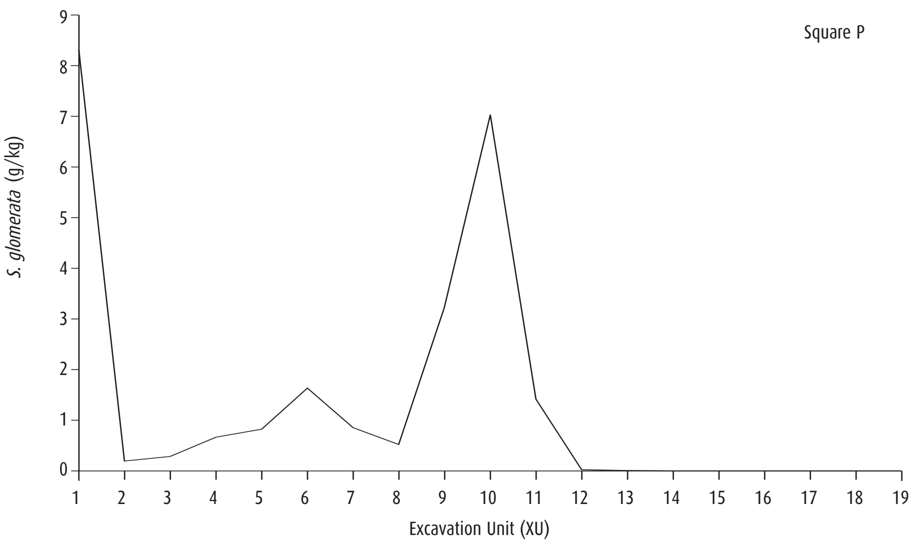

Figure 9.19 Abundance of oyster (*S. glomerata*).

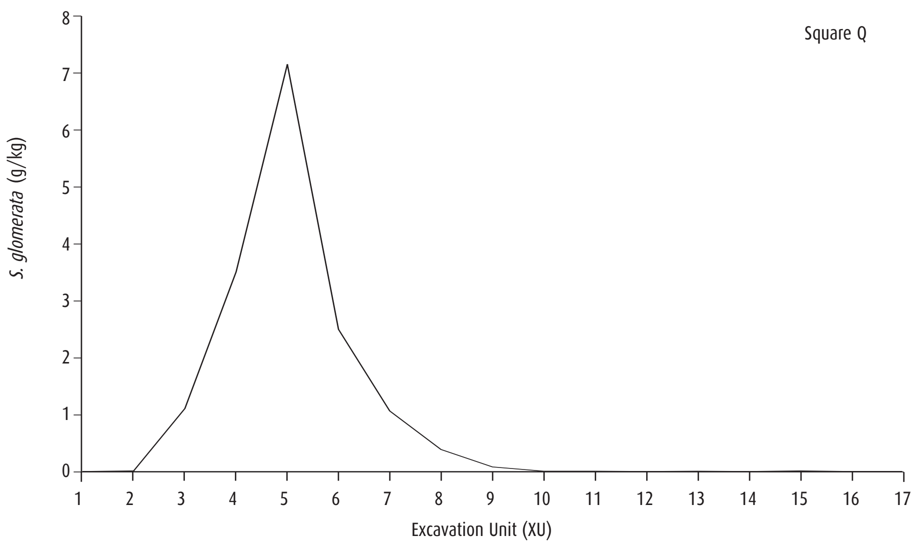

Figure 9.20 Abundance of oyster (*S. glomerata*).

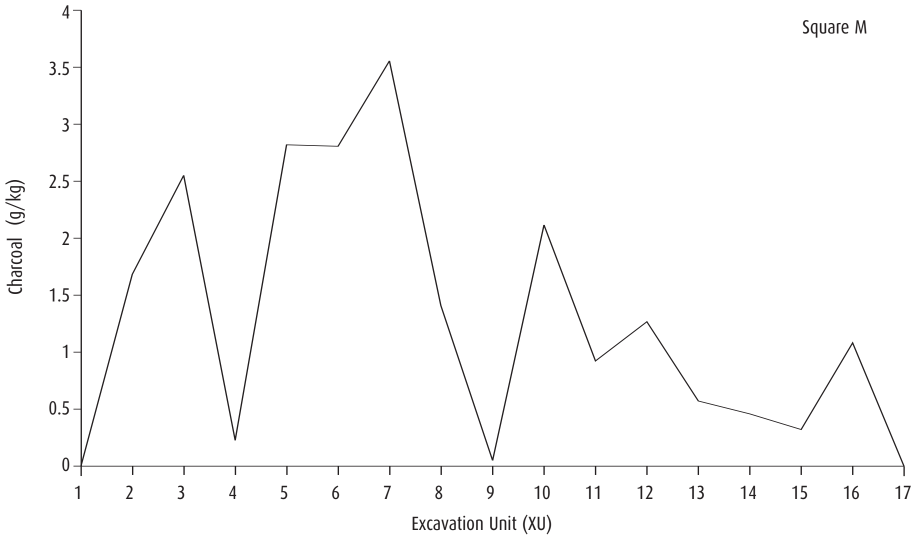

Figure 9.21 Abundance of charcoal.

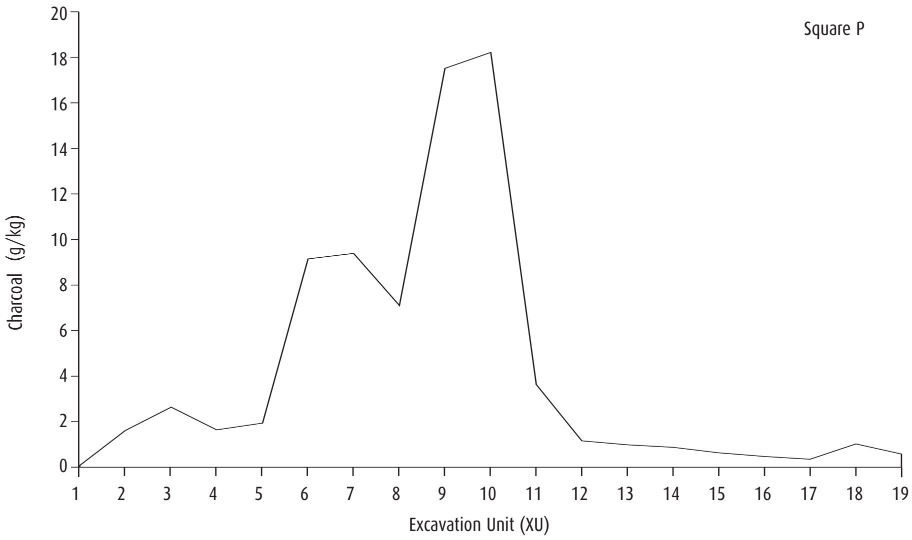

Figure 9.22 Abundance of charcoal.

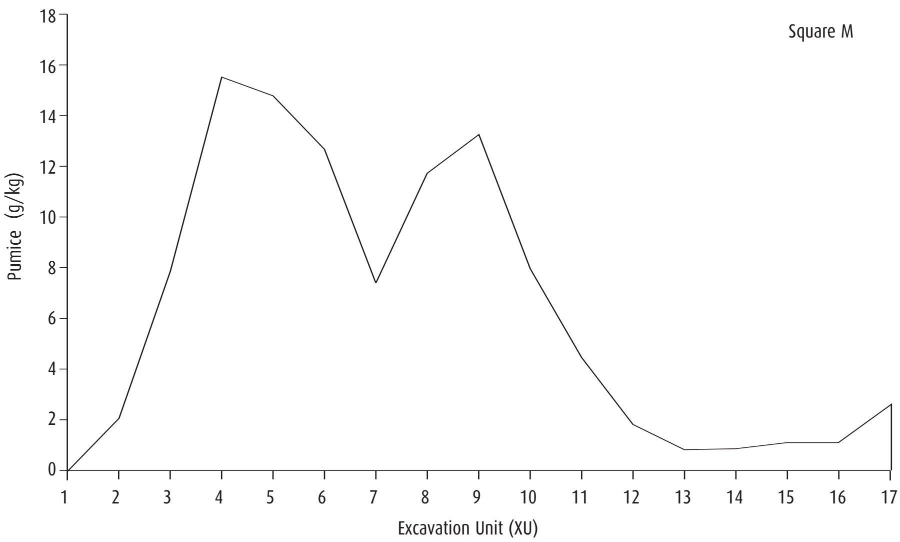

Figure 9.23 Abundance of pumice.

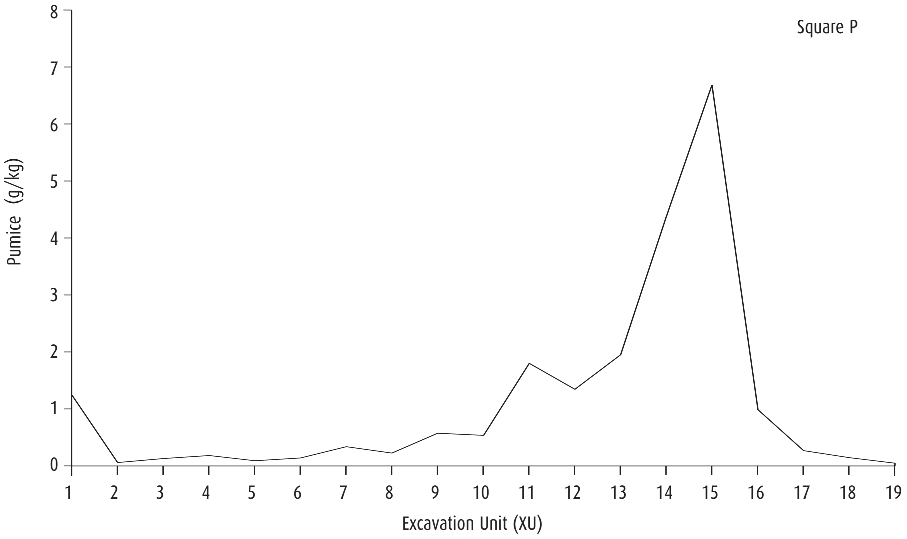

Figure 9.24 Abundance of pumice.

Baler shell artefact

The baler shell (*Melo amphora*) artefact recovered near the cycad grove in the vicinity of Square N is the first of its type found in the region. Although badly deteriorated, the shell exhibits evidence for intentional modification. An ovulate area approximately 10cm long and 5cm wide appears to have been removed from the ventral surface of the final whorl. Fragments of shell have been removed from the ventral margin, either intentionally or during use, to form a jagged edge. Despite intensive survey of the area where the artefact was recovered, no other fragments of baler shell were located, suggesting that shell working took place elsewhere. Roth (1904:29) describes three major forms of modification of *Melo* sp. shells as 'water-carriers' in Queensland: on the east coast north of Bowen *Melo* sp. shells have the ventral surface of the last whorl, the spire and columella completely removed to form an open basin; in the Whitsunday Island region an area of the ventral surface of the final whorl is removed to allow insertion of the hand to hold the columella as a handle; and along the Gulf of Carpentaria the last whorl of the shell is pierced for insertion of the thumb during transport. The present example is similar to the form described by Roth for the Whitsunday Island region. Similar examples are held by the Queensland Museum indicating a general distribution of this form throughout central Queensland.

Vertebrate remains

Bone is extremely rare in all sampled deposits at the Ironbark Site Complex owing to the acidic sediments. Five pieces of bone were identified as fish, weighing 0.8895g, with a NISP of three. A total MNI of three was calculated. The three pieces of bone identified in Squares O–P were all lefthand otoliths identified as Sparidae. These otoliths range in size from 9.9–11.8mm in length which equate to modern comparative collection fish lengths of c.305–365mm. The weight of bone identified to taxon was 0.8738g, giving an identification rate of 98.23% (Table 9.9) (see Vale 2004 for further details).

Table 9.9 Fish bone abundance, Ironbark Site Complex, Squares N, O and P.

SQUARE	XU	NUMBER SPECIMENS	TOTAL WEIGHT (g)	NISP	WEIGHT NISP (g)	MNI	% IDENTIFIED BY WEIGHT
N	5	2	0.0157	0	0	0	0
O	6	1	0.2948	1	0.2948	1	100
O	8	1	0.3395	1	0.3395	1	100
P	6	1	0.2395	1	0.2395	1	100
Total	–	5	0.8895	3	0.8738	3	98.23

Stone artefacts

Stone artefacts were recovered from all excavated squares (Table 9.10). Large quantities of stone artefacts were recovered from Square E, with 869 artefacts above 30mm in maximum dimension weighing 143.4kg. Only three of these artefacts were not rhyolitic tuff, comprising one basalt and two silcrete artefacts. All of the rhyolitic tuff is assumed to derive from the Ironbark exposure itself. The predominance of rhyolitic tuff is not surprising given the proximity of the raw material source. Few formal artefacts were identified in the assemblage. The low silica content and presence of large inclusions in the raw material greatly diminish the predictability of flaking the material. Since virtually all of the excavated stone is rhyolitic tuff, with a similar specific gravity, weight is a useful proxy for artefact size. A plot of weight of artefacts more than 30mm versus depth shows a clear pattern of size-sorting in Square E deposit (Fig. 9.25). Heavier artefacts are located at the top of the deposit while the abundance of lighter material increases with depth. This pattern is likely the result of tidal action transporting smaller material into interstices in the deposit.

Elsewhere at the quarry, a large flake (FS54) manufactured on banded rhyolite was recovered from the surface of Square G (Fig. 9.9). This artefact was found between two large boulders with its platform facing upwards, suggesting that the object was intentionally cached. Heavy edge-damage and polish are evident along the distal margin. Banded rhyolite is not available locally and no likely sources of this material have been identified during geological reconnaissance of the wider region (Stephen Cotter, Cooperative Research Centre for Landscape Evolution and Mineral Exploration, University of Canberra, pers. comm., 2000). In Square J a water-rounded microgranite hammerstone (FS88) exhibiting impact-pitting on the margins was recovered from the surface (Fig. 9.10). Similar artefacts were noted eroding from adjacent midden deposits. Bustard Head, 11km to the north, is the nearest source of this raw material.

A total of 4,178 stone artefacts weighing 12,277.5g was recovered from the bank deposits of Squares L–R (Table 9.10). The assemblage is manufactured only on rhyolitic tuff (n=4,165) and quartz (n=13). The assemblage is overwhelmingly dominated by small flaked pieces, with occasional flakes, broken flakes and cores only identified in Squares L–M. Most artefacts are extremely small, with an average weight of 2.9g. Size-classing of artefacts less than 30mm in maximum dimension from Squares E and M was undertaken by Reid (1998:70–2). Results show that <30mm material is dominated by very small (<10mm) artefacts identified as flaking by-products in experimental studies. Furthermore, Reid (1998:74–5) found that c.60% of artefacts recovered from Square E and c.50% of artefacts recovered from Square M exhibited either primary or secondary cortex, indicating initial stages of reduction consistent with quarrying activities. These data are consistent with a pattern of initial reduction on the exposed quarry itself, with later stages of artefact production undertaken on the adjacent bank. The large volume of very small flakes as the by-product of these activities support this conclusion (for further details see Reid 1998).

Lamb (2003) examined one large artefact (FS3166) for organic residues which was collected from the erosion bank c.20m west of Squares O–P. This artefact is manufactured on rhyolitic tuff and exhibits a roughly triangular cross-section and distinct bevelling along one margin. Lamb (2003) found starch grains and plant fibres concentrated on the bevelled edge of the tool including cooked, partially cooked and otherwise damaged starch grains indicating probable processing of both cooked and raw plants.

Glass artefacts

Seven bottle glass fragments were recovered from the surface near the cycads on the ridge south of the quarry near Square N. The glass assemblage consists of three bottle bases and four small body sherds, one of which conjoins to a base. The recovery of glass at a long-term Aboriginal site some distance from known early European population centres supports the inference that it was discarded by Aboriginal people. This inference is strengthened by the fact that only incomplete

Table 9.10 Stone artefacts from the Ironbark Site Complex, Squares E, L–R.

	RHYOLITIC TUFF								QUARTZ		TOTAL	
	FLAKE		FLAKED PIECE		CORE		OTHER[a]		FLAKED PIECE			
SQUARE	#	(g)	#	(g)	#	(g)	#	(g)	#	(g)	#	(g)
E[b]	7	1078.1	867	112720.9	22	29438.7	1	121.3	0	0	869	143359.0
L	7	407.8	1347	1950.7	7	691.3	2	8.3	2	0.50	1365	3058.5
M	1	257.8	2640	7138.3	2	1313.4	1	233.7	0	0	2644	8943.2
N	0	0	8	3.9	0	0	0	0	2	2.1	10	6.0
O	0	0	59	3.3	0	0	0	0	1	<0.1	60	3.3
P	0	0	49	50.5	0	0	0	0	4	0.7	53	51.2
Q	0	0	26	216.4	0	0	0	0	2	0.1	28	216.5
R	0	0	16	1.1	0	0	0	0	2	0.1	18	1.2
Total	15	1743.7	5012	122085.1	31	31443.4	4	363.3	13	3.6	5047	155638.9

a Includes broken flakes and hammerstones.

b Only includes artefacts over 30mm in maximum dimension.

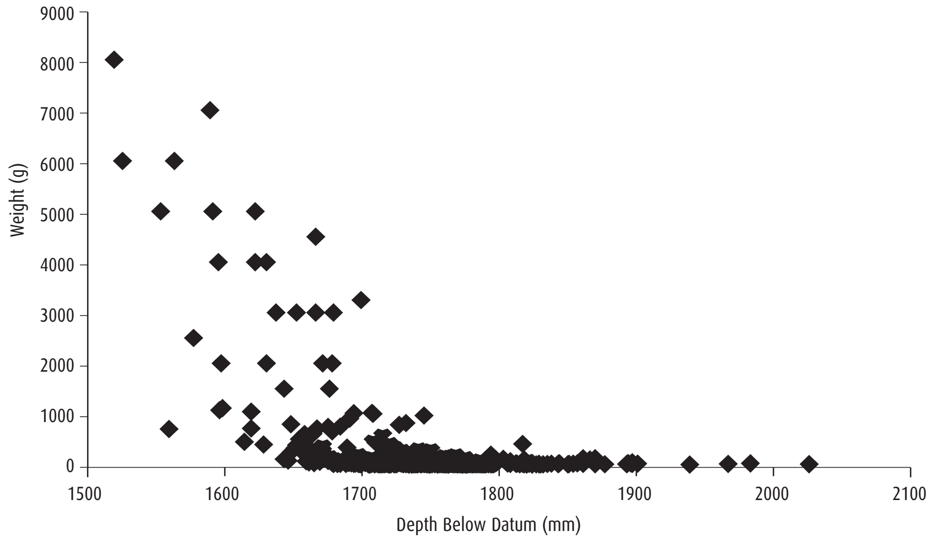

Figure 9.25 Weight-depth distribution of individually provenanced artefacts greater than 30mm in maximum dimension, Square E (n=784).

bottles were recovered. The presence of three bases in the assemblage suggests intentional selection and transport of the thicker bottle bases to the site. This pattern has been documented elsewhere in Australia, where thick bottle bases were targetted for acquisition while thinner neck, shoulder and body sherds were frequently discarded (Allen and Jones 1980; Freeman 1993). In the absence of unambiguous signs of intentional modification of the glass, the assemblage was inspected for use-wear and residues.

All seven glass objects were initially examined for use-wear and residues using an Olympus® metallurgical incident-light microscope under low level (<500×) magnification (see Loy 1994 for a discussion of techniques). Although starch grains were observed on the surface of all seven glass objects, only two sherds (FS181 and FS187) exhibited quantities of starch and use-wear features suggestive of systematic use in plant processing. Masses of large starch grains (>20μm) are present on the surface of FS187 directly behind the working edge. The other sherd (FS181) has starchy, soft plant tissue and fibres as well as deep scoring on the ventral surface. Both artefacts exhibit starch grains of greater average size and in much greater densities than occur in the surface and near-surface sediments at the site (for further details see Ulm et al. 1999b).

In a further study, Vernon (1999) intensively examined three of the glass objects (FS183, 184, 187) for use-wear and residues. All three artefacts were found to be covered in starch and an opalised, latex, frosted film, with a gritty, textured appearance. Residues were found set back from the cutting edge, and comprise large quantities of starch grains and cellulose. Structural elements include bark and insect casings, seeds and micro-hyphae colonised by cyanobacteria. Sections of xylem (secondary parenchymal wall thickening) were also found, which are common to all angiosperms (flowering plants). These elements are consistent with use of the artefacts on cycad seeds, tubers or mangroves (David Doley, Department of Botany, University of Queensland, pers. comm., 1999). The growth of fungi and microscopic plants on the surface of the glass artefacts had been promoted by the large quantities of starch residues. Using reference specimens, cycad (*C. megacarpa*) starch and sheets of tissue with large storage cells were identified in cross-section. Other residue elements found on the glass artefacts, such as bark, sap and starch with storage tissue, are consistent with tubers, indicating that the glass artefacts were used for a variety of plant processing activities.

Other remains

Scattered fragments of charcoal were recovered from all excavations (except Squares E, G and J on the quarry), with occasional large pieces of blocky charcoal totalling 242.6g (Figs 9.21–9.22). Pumice totalling 3,248.1g occurs throughout the bank deposits but is most abundant in the basal units of Squares L–M, which appear to have been more exposed to storm-surges than other investigated deposits. The quantity of pumice recovered from the bank excavations decreases from west to east (Figs 9.23–9.24). This pattern may be related to the greater protection afforded to these eastern deposits by the low sand bank located just offshore, although the antiquity of this feature is currently unknown (Fig. 9.7). Although pumice is known to have been used as an abrasive (Rowland 1994:121) the assemblage from the Ironbark Site Complex exhibits no obvious signs of use and is thought to have entered the site through a combination of wind and sea-rafting without causing major stratigraphic disturbance, evidenced in the consistent age-depth relationship of the radiocarbon dates for Squares L–M.

Discussion

Excavation revealed a highly variable distribution of cultural material across the site area. Analyses indicate that although the cultural deposits at the Ironbark Site Complex are generally low density, the extent and recent chronology of the majority of the deposits demonstrate that a large quantity of cultural material was discarded over a relatively short period of time. The volume of excavated stone artefacts manufactured on rhyolitic tuff indicates that stone extraction and reduction was the main activity undertaken throughout the period of site occupation, with the exception of the post-contact phase of occupation associated with the use of glass. Fishing, shellfishing and toxic (cycad) plant processing are also documented at the site. Although the Ironbark Site Complex was first used for raw material extraction before 1,500 years ago, intensive site use predominantly occured in the last 1,000 years. The presence of rhyolitic tuff (geochemically identical to the Ironbark quarry raw material) in the Eurimbula Site 1 assemblage by 3,000 cal BP suggests that the quarry was at least occasionally used prior to the last 1,500 years, although available data indicate that earlier phases of use were ephemeral. Systematic use of the quarry as an extraction and reduction site is clearly evidenced within the last 1,500 years although it is also possible that older deposits may have been removed by coastal erosion.

No shell or other food refuse was recovered adjacent to the quarry (Squares L–M). Although stone artefacts are visible in the erosion section in this area no shell was observed. The pH of soils in this area is relatively low (6.0), but shell is preserved in other parts of the site of a similar antiquity with similarly slightly acidic soils. There may be a functional explanation for the absence of food refuse in the immediate area of the raw material outcrop. This difference between midden and non-midden remains may represent a separation of activity areas. The initial stages of stone reduction centred on the raw material exposure and the adjacent bank (the area of Squares L–M) containing no shell remains. Domestic activities involving fish and shellfish use spread along the low, crescentic bank to the east (Squares O–P and Q–R) and west. Ross et al. (2003) observed a similar pattern on Moreton Island. They noted that the abundance of stone declines with distance from the Cape Moreton quarries with a concomitant increase in the density of shell, 'suggesting that close to the source of lithic material, site use was principally associated with tool manufacture, while further away from the quarries the focus of site use was subsistence activities' (Ross et al. 2003:78).

A key issue in situating the use of the Ironbark Site Complex within the broader context of the cultural chronology of the southern Curtis Coast is determining when the resource was first regularly incorporated into local land-use strategies. The great antiquity of the geological events which created the rhyolitic tuff debris flow pre-dates Aboriginal colonisation of the continent by at least several hundred million years, indicating that resource availability was not the determining factor in the initiation of exploitation or subsequent patterns of use. Use of the quarry is therefore more productively viewed as embedded within broader regional mobility patterns, as evidenced by the presence of contemporary sites exhibiting quarrying products. Geochemical sourcing to the Ironbark quarry of edge-ground hatchets distributed over a wide area of central Queensland, and the presence at the site of artefacts manufactured on non-local raw materials including banded rhyolite and microgranite, indicate that raw materials flowed both into and out of the site. The fact that artefacts manufactured on rhyolitic tuff sourced to the quarry are pervasive in excavated assemblages from local sites indicates that the quarry was a significant resource in local land-use strategies and an important node for regional exchange networks of Aboriginal groups along the southern Curtis Coast and adjacent hinterland. The commencement of systematic use of the quarry over the last 1,000 years is contemporaneous with periods of increased site use documented at other sites in the immediate area. The sourcing of numerous artefacts throughout the region to the quarry indicates a refocussing of land-use strategies on local raw materials, or localisation, which may be related to reduced patterns of mobility. These contentions are further developed in Chapter 14.

The presence of flaked bottle glass associated with evidence for continuity of pre-contact subsistence behaviours in the Middle Creek area is significant as it demonstrates continuities in Aboriginal occupation which is otherwise absent from the documentary record. This finding accords with Aboriginal oral historical data (Clarkson et al. n.d.). These data are consistent with McNiven's (1993, 1998; Courtney and McNiven 1998) findings on Fraser Island to the southeast, where clay pipes and flaked bottle glass artefacts have been recovered from the surface of 10 shell middens on the east coast of the island. The evidence from the Ironbark Site Complex also conforms to the evidence from other sites in southeast Queensland suggesting continuing Aboriginal use of places and landscapes into the post-contact period (see Lilley and Hall 1988; Neal 1984). Identification of starch grains adhering to the surface of glass artefacts also illustrates the potential of residue techniques in the study of contact period materials.

Cycads appear to have been widely used throughout central Queensland as a source of carbohydrate in the late Holocene (Beaton 1982; Beck 1985), with a variety of processing techniques adopted to remove toxins before consumption. Processing techniques typically take up to three to five days (Beck 1985). The identification of cycad processing at the Ironbark Site Complex in the early twentieth century indicates that complex food preparation was still undertaken well after a permanent European presence was established in the region. Logically, this evidence suggests that occupation of the site during this period was not ephemeral, but comprised a range of activities including shellfish gathering, artefact manufacture and use, and plant food processing.

The continuing use of occupation sites into the post-contact period may also contribute to our understanding of regional land-use trajectories. Whereas some sites such as the Seven Mile Creek Mound and the Mort Creek Site Complex were abandoned in the remote past, occupation at other sites was first initiated in the last two millennia and then maintained into the post-contact period, indicating historical continuities in the use of, and transmission of knowledge about, culturally important places. This suggestion is supported by findings at the Tom's Creek Site Complex (see Chapter 13) and is further discussed in Chapter 14.

Summary

The Ironbark Site Complex is unique in the regional archaeological record, being the only major lithic reduction site recorded for the coastal area between Elliot Heads near Bundaberg 100km to the south and South Molle Island in the Northumberland Island Group 530km to the north. The site was used for raw material extraction for the last 3,000 years, with evidence for regular use dating from 1,500 years ago, and shows continuity of traditional hunter-gatherer occupational strategies into the early post-contact period. Radiocarbon dates from the extensive midden deposits adjacent to the quarry indicate that the most intensive period of use of the site is probably archaeologically very recent, dating to within the last 1,000 years or so. However, it is likely that older deposits have been removed by coastal erosion. The ubiquity of stone artefacts manufactured on rhyolitic tuff at other sites in the region dating to the last 1,500 years suggests that the Ironbark Site Complex played a key role in provisioning local stone. As a major resource extraction site, changes in the use of the Ironbark Site Complex are important for understanding changes in Aboriginal settlement and subsistence patterns in the broader coastal region.