Early Holocene backed artefacts from Australia

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Abstract

Many archaeologists have argued that backed artefacts, or backed 'blades', were used in Australia only during the last 4500 years. We show that those arguments are theoretically flawed and present case studies which demonstrate the manufacture of backed artefacts in the early Holocene. Implications of early Holocene backed artefacts are explored.

Today most archaeologists seem to believe that backed artefacts, once called backed blades or microliths (see Hiscock and Attenbrow 1996), were made in Australia only since 4500 years BP. Forceful arguments to the effect that backed artefacts appear suddenly at that time have been made in several studies (eg. Bowdler 1981; Bowdler and O'Connor 1991; Johnson 1979; Morwood 1979, 1984; White and O'Connell 1982:120). This argument, which we call the 'sudden appearance model', additionally advocates that from their introduction at 4500 years BP backed artefacts were found in large numbers in sites throughout southern and eastern Australia. In the late 1970s adoption of this model was encouraged by fieldwork providing sequences in which backed artefacts were restricted to levels younger than 4500 years BP. For example, Johnson (1979) and Morwood (1979, 1981) undertook detailed excavations and claimed that the lowest backed artefacts in their sites were dated accurately. Arguing that those dated specimens indicate the 'true' introduction of backed artefacts, Johnson (1979) rejected situations where backed artefacts are quoted as being older than 4500 years BP. Many archaeologists have accepted this argument and employed the sudden appearance model in interpreting the archaeological record.

More than fifteen years on, the logic of these arguments is not compelling. For example, we do not see why backed artefacts should first appear everywhere at the same date. Nor can we see a reason to negate all early Holocene dates for backed artefacts. In this paper we describe flaws in the sudden appearance model for the introduction of backed artefacts, and demonstrate that in the Sydney region backed artefacts were manufactured in the early Holocene.

An outline of the sudden appearance model

As Bowdler and O'Connor (1991) have described, the late 1970s saw an alteration in the views of archaeologists about the antiquity of backed artefacts in Australia. Since that time the consensus has been that backed artefacts, and other implement types considered to belong to the 'Small Tool Tradition', are no older than 4500 years. This view is staunchly defended by its adherents (eg. Bowdler and O'Connor 1991; White and O'Connell 1982), but is nowhere developed in more detail than by Ian Johnson, who in 1979 presented a model in which backed implements became archaeologically visible after 4500 years BP; although he claimed that in the southeast of New South Wales they do not appear until after 3500 years BP (Johnson 1979:136). To arrive at such a conclusion Johnson dismissed all associations of backed artefacts and dates older than 4500 years BP, and developed criteria to assess the validity of associations between radiocarbon samples and backed artefacts at any site. He concluded that associations would be more reliable where:

1. Dates were on material either from a narrow stratum and/or from a concentration of artefacts which can be taken to represent a short-term occupation (Johnson 1979:116–117). In situations where excavation units are deep, and/or where dated samples and artefacts are spatially distant, radiocarbon determinations from a spit do not necessarily date artefacts in that spit.

2. Vertical movement of artefacts within a deposit is minimal. Deposits in which vertical movement is restricted are often those with high sedimentation rates and a matrix that gives protection from vertical movement of artefacts (Johnson 1979:116–117). Where vertical movement has taken place as a result of human or animal disturbances the downward migration of smaller artefacts will be indicated in the artefactual sequence (Johnson 1979:117–118).

On the basis of these criteria Johnson concluded that the best sites for dating backed artefacts were those in which single occupations were visible and/or sites where the deposit had built up rapidly. In both these cases the researcher needs a knowledge of the vertical movement of artefacts before dated samples and artefacts which are presently physically associated can be inferred to originally have been laid down at the same time (Johnson 1979:117). As sound taphonomic principles we agree with these notions.

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These principles alone, however, do not refute all dates over 4500 years BP (cf. Johnson 1979:124–130). For example, the principles do not deny the age of backed artefacts disputed by Johnson: at Fromms Landing Shelter 2 at 4850±100 years BP (R 456/1), Bobadeen at 7750±120 years BP (ANU 124), Swansea Channel at 7530±140 years BP (SUA 421) or Graman at 5450±100 years BP (GAK 806). Johnson therefore advocated a number of secondary conditions which also must be met before associations between backed artefacts and radiocarbon samples are accepted. As it is these conditions with which we disagree they are described in some detail.

Johnson (1979:118) suggested that the appearance of backed artefacts should be dated on a regional basis. He argued that the 'Small Tool Tradition' is a 'coherent phenomenon' (Johnson 1979:115), that several independent inventions are unlikely to account for the occurrence of backed artefacts (Johnson 1979:115), and that backed artefacts are essentially a 'stylistic' type (Johnson 1979:142). As a result of these premises Johnson argued that a date should be accepted only if it corresponds to dates for backed artefacts in other sites in the same region (Johnson 1979:118). By presuming that in any one area backed artefacts should first appear in all sites simultaneously, this principle allowed him to eliminate what he believed to be artefacts vertically displaced through post-depositional disturbance. This argument will obviously maintain the *status quo* by ensuring that dated backed artefacts which do not fit the sudden appearance model are rejected.

Johnson further argued that not only should backed artefacts appear simultaneously at all sites, but all levels within a site occupied after their appearance should contain backed artefacts (Johnson 1979:118). He states:

When looking for the first appearance of backed implements in an area we should therefore be looking not so much for the earliest assemblage containing backed implements but for the latest assemblage without them. (Johnson 1979:118).

In this statement there is no acknowledgment of functional variation between sites, and its archaeological expression in the composition of artefact assemblages. Similarly, changes through time in site function, and hence assemblage content, are not considered. Moreover, this argument is symptomatic not only of negating functional variations between sites, but also indicates the strong desire to divide the past into neat phases based on such *fossile directeurs*.

An expectation of a rapid and regionally ubiquitous appearance of backed artefacts has further implications for the sudden appearance model. Following Mulvaney's (1985) argument, Johnson predicted that the archaeological manifestation of the sudden appearance model could be seen in the temporal distribution of the earliest backed artefacts at sites, across the continent or in each region.

I would argue that numerous dates associated with backed implements would be younger than or as old as their

introduction, whilst a small scatter of dates would lie in the millennia preceding their *true date* of introduction. (Johnson 1979:119, our emphasis).

In this statement Johnson is advocating a model that explained away this 'small scatter' of early dates as being displaced specimens now in a false association with dated samples. However, alternative explanations have been offered for such a pattern. For example, Hughes and Djohadze (1980) noted that such a pattern could be explained by low discard rates for backed artefacts in the early Holocene and high rates in the mid-late Holocene. To avoid such an alternative Johnson invoked disturbance to explain what he considered to be 'anomalous' associations between early dates and backed artefacts. In this way the sudden appearance model implies that if an apparently early backed artefact could have been disturbed, then it was!

Problems with the sudden appearance model

As summarised above, the sudden appearance model for Australian backed artefacts is complex and involves several sub-arguments that have not been widely discussed. A detailed examination of the model reveals several methodological problems. We have selected the more problematic premises for examination below:

1. Identification of backed artefacts. One of the basic tenets of researchers who have used the sudden appearance model is that backed artefacts are consistently and accurately recognised by researchers. This premise is necessary to allow for the region-wide comparison of assemblages required by the model. However, universally accurate identification of this implement type has never been demonstrated and is suspect in view of Johnson's own comments (Johnson 1979:114 — footnote). Indeed, examples of backed artefact mis-identification have been reported in the literature, and include confusing ridge-straightening/redirection flakes with backed artefacts (eg. Hiscock 1986, 1993a). In addition there may be quite varied opinions about which specimens should be classed as backed artefacts. For example, there has been debate as to whether the 'elouera' and/or 'Juan knife' should be regarded as backed artefacts or as separate implement types (eg. Glover 1969; Lamb 1996; McBryde 1977; Mulvaney 1975:231; Stockton 1977; Turner 1931; White and O'Connell 1982:106).

2. Uniformity of site function. As described above, the sudden appearance model contains the expectation that backed artefacts will always be present in sites after the introduction of that implement form. In fact, variation in the proportions, and even presence, of an implement type may relate to its function and use-life as well as to the activities carried out at each site (eg. Ammerman and Feldman 1974; Binford 1977; Schiffer 1976). For example, at single function sites a particular implement type, such as backed artefacts, might be absent even though that type of implement was used and discarded at contemporary sites in the same region. In addition, the aver-

age life-span of different implement types determines the rate at which they are replaced and discarded, and thus the relative abundance of each type in an assemblage. Consequently, chronological change in the average life-span of a type, such as backed artefacts, might result in them being rare or common at different levels in a site. A third example of a process that could produce vertical changes in abundance of backed artefacts, documented at rockshelters, is chronological change in the degree to which maintenance and discard of such artefacts took place at open sites rather than at rockshelters. While studies of these processes have not been undertaken in Australia, the possibility that these mechanisms were at work makes it difficult to determine whether the absence of backed artefacts in a site, and/or level within a site, is due merely to the rarity of that implement type or the infrequency of its discard, or its absence from the prehistoric tool-kit. Consequently, there is no reason to assume that when backed artefacts were in use, they would necessarily be discarded in all sites, and all levels within those sites.

3. Culture area assumption. The sudden appearance model contains the argument that dates should be accepted only if they correspond to other dates for backed artefacts in the region. This reasoning is based on the expectation that in any region backed artefacts result from a sudden diffusion with no backed artefacts used before but always and ubiquitously used afterwards. Given this assertion the only question can be: 'when does this diffusion occur?' This phrasing prevents an examination of the rate of change by ensuring sudden change will be perceived. Hence a circular argument occurs. By rejecting all early Holocene dates, because they do not correspond to the major period of backed artefact discard, the argument guarantees that 4500 years BP will be seen as the date of introduction. The solution to this difficulty is to disentangle two events:

- the introduction of backed artefacts, and
- major phase of backed artefact discard.

If backed artefacts did appear suddenly the two events may have been contemporaneous. However, we query whether these events were coincident and believe each should be investigated separately.

4. High chronological resolution. Arguments in favour of the sudden appearance model have tended to dismiss observations with low chronological resolution. Quite rightly, Johnson (1979:117) states that data with higher resolution are better than those with lower resolution for many purposes. However, different levels of chronological resolution are appropriate to different hypotheses. As the sudden appearance model predicted that backed artefacts were not used before 4500 years BP, the resolution of data necessary to test this model could be extremely low and yet still be sufficient to refute it. For example, a deposit representing a single occupational event dated between 7000 years BP and 10,000 years BP which contained a backed artefact would falsify the model.

5. Proof by suspicion. A major argument used in

rejecting early Holocene dates for backed artefacts has been to say that if the artefact could have been displaced, it was. For example, Johnson (1979:131) describes the early dates associated with backed artefacts at Graman 1 as 'anomalies', and writes,

The most economical explanation of the anomalies observed may lie in animal or human disturbance bringing older charcoal closer to the surface in the fairly shallow, loose, dry and sandy deposits of the rock shelter...

This argument is not, however, as economical as admitting that the dates and associations are in fact *not* anomalous. Johnson made the same argument in rejecting association between dates and backed artefacts at a number of sites such as Bobadeen (Johnson 1979:129) and Burrill Lake (Johnson 1979:128).

We have two objections to this somewhat quizzical argument. Firstly, this argument is only applied to specimens in early Holocene levels, whereas the validity of associations in more recent levels is rarely queried. It could be equally argued that backed artefacts associated with radiocarbon estimates less than 4500 years BP are no more precisely dated than are earlier specimens. Secondly, and more importantly, although it will lead to the rejection of erroneous associations of older dated material with younger backed artefacts, this argument also eliminates any association that conflicts with the sudden appearance model, including those which may actually be correct. As a result of this reasoning much of the published debate does not adequately test the sudden appearance model. What would falsify the sudden appearance model is the identification of assemblages containing backed artefacts in early Holocene contexts in which processes of disturbance can be recognised and controlled.

It is now clear that the principles used to assess the existence of backed artefacts older than 4500 years BP are not adequate. Indeed, they reinforce the expectation of a sudden appearance in many sites of numerous backed artefacts only after that time. To avoid this circularity the principles used to assess the validity of associations between early Holocene dates and backed artefacts must not be such that they pre-determine the outcome of testing the model. If the question to be pursued is 'at what dates do backed artefacts occur?', then we suggest the following research guidelines:

1. Develop an increased understanding of backed artefact identification, manufacture, use and discard.
2. Carry out detailed research into each site's formational processes. A separate evaluation of the validity of each association (of date and backed artefact) will have to be done. In assessing whether 'displacement' has occurred, the pattern of dates from surrounding sites cannot be considered.
3. Select only assemblages from contexts with appropriate chronological resolution as tests of the model.

Investigations of these issues should be pursued in detail and these steps will need to be done separately for each site and for each level within a site. While a comprehensive re-assessment along these lines, of data relat-

Figure 1. Upper Mangrove Creek catchment

ing to associations previously rejected in the sudden appearance model, is outside the scope of this paper we would like to discuss new evidence bearing upon the question of whether backed artefacts existed prior to 4500 years BP.

Evidence from Upper Mangrove Creek

Mangrove Creek is a southerly flowing creek which drains into the Hawkesbury River. The Upper Mangrove Creek catchment is approximately 30 km west of the present coastal centre of Wyong on the NSW central coast (Figure 1). The catchment is within the Sydney Basin and is part of the Hornsby Plateau which is heavily dissected sandstone country with clifflines and small rock outcrops on the ridges and along most of the creeks. Ridge tops and upper sections of the ridge sides are composed of Hawkesbury sandstone, whilst the valley bottoms and lower ridge sides are within the Narrabeen Group of sandstones and shales. Rocks suitable for artefact manufacture can be locally obtained from pebbles that derive

from these sandstones. Valley bottoms and lower slopes are generally covered with tall open forest and open forest, and the ridge tops and upper slopes with open forest and woodland. Rainforest species occur along the banks of creeks in some of the less open and more steeply sided valleys and gullies (Attenbrow 1981:29–31).

Hundreds of sites occur within Upper Mangrove Creek catchment, of which 56 have been excavated (Attenbrow 1980, 1981, 1982a, 1982b, 1987; Bonhomme 1985; Macintosh 1965; Vinnicombe 1980). In this paper we concentrate on the two rock shelters with the longest stratified sequence of human occupation: Loggers Shelter (NSW NPWS site 45–3–776) and Mussel Shelter (45–3–804). Both sites are in the valley bottom, less than 20 m above the creek line. These shelters are formed in outcrops of sandstone through cavernous weathering and block fall. Deposits in these shelters accumulated to a depth of about two metres during the Holocene. Excavations at both sites retrieved large assemblages of artefacts forming well-dated cultural sequences (Attenbrow 1981). Consequently both sites provide suitable information to test the sudden appearance model.

Figure 2 (above). Floor plan of Mussel Shelter showing analysed squares.

Figure 3 (below). Stratigraphic section from squares A and B in Mussel Shelter.

Mussel Shelter.

Mussel Shelter is a sandstone overhang 12.5 m long, 1.75 m wide and 1.7 m high. A total of 2.25 m² of the shelter floor was excavated: 1.75 m² inside the shelter and 0.5 m² outside (Figure 2). Details of the excavations are described elsewhere (Attenbrow 1981). Analyses in this paper relate to two 1 m² squares called A and B. Spits varied in depth, averaging 5.9 cm thick, but with most less than 5 cm. Where stratigraphic boundaries occurred care was taken to ensure that the deposit from different strata was removed as separate spits. Six radiocarbon dates were obtained on charcoal fragments retrieved from sieves on the site (Table 1).

Spit	Layer	Average depth (cm)	C14 date	Lab. number
6	Upper (base)	25.6–31.1	1150±90	SUA 1504
12	Middle	56.9–62.9	2230±80	SUA 1503
16	Middle (base)	76.2–80.9	3150±100	SUA 1505
20 (square B)	Lower	96.2–104.4	5370±60	SUA 2411
24–25	Lower	120.5–130.5	8460±120	SUA 1506
31	Lower (base)	164.3–176.0	8730±70	SUA 2410

Table 1. Radiocarbon age-estimates from Mussel Shelter.

Four main strata have been identified in the deposit (Figure 3). Each of these strata is briefly described below:

Sediment in the Upper Layer is characterised by a well-stratified series of grey-brown to brown lenses of silty clayey fine sand. In this layer there is a very low content of fine rubble. Organic matter is also low (2–6% by weight). This layer has an average thickness of 31 cm and was excavated in six spits (1–6).

The Middle Layer consists of brownish grey to dark brown ashy sediments with textures ranging from clayey silty very fine sand through to clayey silty medium sand. These sediments have a very low content of fine rubble and are rich in organic matter (6–10% by weight). Two 10 cm thick charcoal-rich lenses are located towards the rear of the shelter. This layer has an average thickness of 50 cm and was excavated in 10 spits (7–16).

Sediments in the Lower Layer are moderately dull brown to pink silty clayey medium to fine sand. Throughout the layer sediments are compacted and very hard. The upper 10–15 cm of this stratum has abundant shale rubble, concentrated towards the rear of the shelter in square A. Organic matter is extremely low (<3% by weight). This layer has an average thickness of 92.5 cm and was excavated in 15 spits (17–31).

An archaeologically sterile basal layer consists of pink to reddish-yellow indurated clayey silty sand.

Cultural material was recovered throughout the 1.8 metres depth of deposit in the upper three layers (Table 2).

Artefact densities vary considerably. In the Middle Layer all spits, except the uppermost spit 7, have more than 650 artefacts, with some containing thousands of artefacts. In contrast spits in the Upper and Lower Layers all have fewer than 350 artefacts, and many have far fewer. A variety of raw materials and retouched forms were found in all layers.

Spit	Layer	Average depth (cm)	Backed artefacts	Total artefacts
1–6	Upper	0–31.1	0	178
7	Middle	31.1–36.5	1	167
8	Middle	36.5–41.1	0	698
9	Middle	41.5–46.6	4	684
10	Middle	46.6–51.4	0	907
11	Middle	51.4–56.9	3	1982
12	Middle	56.9–62.9	11	1392
13	Middle	62.9–67.4	33	3366
14	Middle	67.4–71.6	21	2691
15	Middle	71.6–76.2	66	3658
16	Middle	76.2–80.9	35	2583
17	Lower	80.9–84.9	3	266
18	Lower	84.9–90.1	4	339
19	Lower	90.1–95.0	0	111
20	Lower	95.0–104.5	0	74
21–22	Lower	104.5–114.6	0	42
23	Lower	114.6–120.5	2	38
24	Lower	120.5–125.5	0	22
25	Lower	125.5–130.5	0	13
26	Lower	130.5–131.3	0	24
27	Lower	131.3–138.9	0	29
28	Lower	138.9–145.8	0	11
29	Lower	145.8–158.6	0	15
30	Lower	158.6–164.3	0	1
31	Lower	164.3–176.0	0	3
TOTAL			183	19,294

Table 2. Vertical distribution of backed artefacts and other artefacts within square A, Mussel Shelter.

Hundreds of backed artefacts were recovered from excavations in squares A and B. For example, in square A alone 183 backed artefacts were retrieved between spits 7 and 23 (Table 2). Most of these specimens came from the Middle Layer (spits 7–16). In the Lower Layer, below spit 16, nine backed artefacts were recovered from spits 17, 18 and 23. In the adjacent square B an additional three backed artefacts are present in the Lower Layer (ie. spits 19 and 20).

We contend that the backed artefacts in the Lower Layer, and particularly the specimens in spit 23, do not derive from substantially higher levels through post-depositional movement and are therefore older than those recovered from the Middle Layer. From analyses carried out so far there is no reason to suspect such movements. Several reasons lead us to this conclusion:

1. Distinctive raw materials, on which some backed artefacts are made, have a restricted vertical distribution. For example, in spit 19 and below there are distinctive light grey cherts readily differentiated from the chert artefacts recovered from higher spits. These light grey cherts display marked patination not found above spit 19. A number of small flakes made on this material are consistent with debris removed during backing retouch. One of the backed artefacts in spit 20, square B, is made on this grey chert. It is thus unlikely that the backed artefact made on this material derived from higher levels through downward displacement. A charcoal sample from the same spit as this grey chert backed artefact yielded a date of 5370 ± 60 years BP (SUA 2411).

2. In the upper 1.3 m of deposit in square A a strong positive correlation occurs between the number of backed artefacts and the total number of artefacts in each spit ($r=0.881$ $n=19$ $p<0.001$). We take this to reflect a sampling phenomenon, in which the absence of backed artefacts in some spits could be explained by the small assemblage recovered (eg. spits 19, 20, 21–22). This interpretation is supported by the observation that two backed artefacts have been recovered from spit 20 in the adjacent square B. The implication of these data is that small numbers of backed artefacts in these lower spits are explicable in terms of the assemblage size rather than vertical displacement (see Hiscock 1993b; Gorecki *et al.* 1997 for similar arguments).

3. Within the Lower Layer there is no evidence for size-sorting of the assemblages. While the assemblages in the Lower Layer show average specimen weights greater than those in the Middle Layer, there is no consistent vertical change in artefact size within spits 17–31. Size-sorting, as smaller artefacts move downward at a different rate to larger artefacts, is one archaeological signature of vertical displacement (see Schiffer 1987:267–269). Absence of such a pattern in the Lower Layer is consistent with an absence of wholesale vertical movement of artefacts.

4. Backed artefacts are proportionately more common in spit 23 than in any higher level in the deposit (Figure 4). Downward vertical movement cannot account for this pattern because there is no reason to believe that backed artefacts are displaced more frequently than other artefact types. Migration of a representative sample of an assemblage with backed artefacts into a similar sized assemblage without backed artefacts would produce a composite assemblage with a low proportion of backed artefacts. This is not the situation. Consequently, the generally high proportions of backed artefacts in the lower spits are inconsistent with downward movement of artefacts.

Figure 4. Vertical changes in the ratio of backed artefacts to other artefacts in square A, Mussel Shelter.

5. Rubble rich sediments at the top of the Lower Layer (spit 17) would have impeded the downward movement of stone artefacts from the Middle Layer. This rubble is vertically restricted. It is implausible that backed artefacts would migrate through such a rubble rich deposit without large quantities of rubble fragments also moving downward to lower levels.

These data combine to indicate that vertical displacement is an unlikely explanation of the distribution of backed artefacts in the Lower Layer. Within the Lower Layer the presence of these backed artefacts in small assemblages, and in the same proportions within those assemblages, supports the interpretation that backed artefacts were in use at the time these assemblages were discarded.

Radiocarbon dates indicate that some of the backed artefacts in the Lower Layer must be substantially older than 4500 years BP. From square B two specimens have been obtained from spit 20, in association with charcoal yielding a date of 5370 ± 60 years BP (SUA 2411). A further 10–16 cm down in the deposit two specimens were recovered from spit 23 in square A. These backed artefacts are effectively bracketed between dates of 5370 years BP and 8460 years BP (Table 1), suggesting that these specimens are 5500–8000 years old. By extrapolating from a depth/age curve the best estimate for the age of these specimens is 7500 years BP. To be less than 4500 years old, backed artefacts in spit 23 would have had to move from at least spit 19, a vertical distance of 20 cm. As we have described above there is no large reservoir of backed artefacts immediately above spit 23 from which artefacts could derive, and there is no evidence for vertical movement of that magnitude.

Figure 5. Floor plan for Loggers Shelter showing analysed squares.

Loggers Shelter.

Loggers Shelter has formed in a sandstone cliff overlooking Mangrove Creek. On the back wall is a small panel with drawings. These drawings are in black, white and red pigment, and include depictions of macropods, fish, dolphins and eel-like figures. The shelter has a floor measuring 7 m by 2.5 m, and a high ceiling up to 6 m above the floor. Deposit extends 2 m beyond the shelter overhang, where sediment has been trapped by a massive slab of sandstone roof-fall.

Artefacts included in this analysis come from two adjoining squares, each 1 m², positioned on the flat floor immediately outside the dripline (Figure 5). Because of the abundance of large rocks and rubble, these squares, called E and F, were dug in 10 cm spits. Six radiocarbon dates were obtained on charcoal fragments retrieved from sieves on the site (Table 3).

Throughout the two metre deep deposit the only visible changes are in colour, dark greyish-brown to pale-

brown, and probably result from post-depositional loss of organic matter with increasing depth. Sediment consists of silty sand with high amounts of fine and coarse rubble (15–50% by weight). Large boulders are found throughout the deposit, and are more numerous below 50 cm from the surface.

Stone artefacts are present throughout the two metres of deposit. Table 4 presents the vertical distribution of backed artefacts and total artefact assemblage in the top 1.2 m of the deposit. This portion of the deposit spans the same period of time as the deposits in Mussel Shelter discussed above. In contrast to the sequence at Mussel Shelter, there is less vertical variation in artefact densities, and spits 5–13 each contained several hundred artefacts. A total of 14 backed artefacts was recovered from the deposit (Table 4). Of particular interest are the lowest backed artefacts that were recovered, one each from spit 7 and spit 9.

A charcoal sample from spit 7 gave a radiocarbon date of 7950±80 years BP (SUA 2412). While this age-esti-

mate may accurately date the specimen in spit 7, we make no claim that this backed artefact *must* be older than 4500 years BP. There is no indication of the antiquity of material in spit 6. While an age-depth curve yields an estimate for spit 6 of 5000–6900 years BP it is possible that slower sediment accumulation occurred, and that the spit contains material younger than 4500 years BP. If this were the case downward movement of 10–15 cm could have brought a far younger backed artefact into apparent association with the charcoal in spit 7. Hence the specimen from spit 7 cannot be taken as indisputable evidence for backed artefacts older than 4500 years BP. However, we have no such doubts about the antiquity of the backed artefact in spit 9.

Spit	Average depth (cm)	C14 date	Lab. number
2	9–18	530±90	SUA 1124
4	27–38	2480±60	SUA 2165
7	55–65	7950±80	SUA 2412
9	73–82	8380±120	SUA 1125
13	109–120	9450±120	SUA 1206
20–21	179–206	11050±135	SUA 931

Table 3. Radiocarbon age-estimates from Loggers Shelter.

Spit	Average depth (cm)	Backed artefacts	Total artefacts
1	0–9	0	678
2	9–18	4	690
3	18–27	3	429
4	27–38	2	432
5	38–45	3	211
6	45–55	0	262
7	55–65	1	193
8	65–73	0	184
9	73–82	1	206
10	82–91	0	278
11	91–103	0	325
12	103–109	0	358
13	109–120	0	333
TOTAL		14	4579

Table 4. Vertical distribution of backed artefacts and other artefacts through the upper 1.2 metres of deposit within squares E and F, Loggers Shelter.

The lowest backed artefact was recovered from spit 9, at a depth of 73–82 cm below the surface. A charcoal sample submitted from this spit yielded a radiocarbon date of 8380±20 years BP (SUA 1125). We take this radiocarbon date to be an unequivocal indicator of the antiquity of this specimen for the following reasons:

1. The antiquity of spit 9 is reinforced by radiocarbon dates from higher and lower in the deposit. Material in spit 9 is bracketed between dates of 8000 years BP and 9500 years BP, from charcoal samples recovered in spits 7 and 13 respectively (Table 3).

2. Using radiocarbon dates from spits 7, 9 and 13 it is clear that the deposit formed extremely quickly during the early Holocene. For the period between 9500 years BP and 8000 years BP the sediment accumulated at an average rate of 4.3 cm/100 years. The result of this rapid sedimentation is that by 8000 years BP there had been a build up of almost 20 cm of deposit above the top of spit 9. Deposit of this thickness would have impeded downward displacement of artefacts from levels less than 8000 years BP.

3. Rapid sedimentation during the period 8000–9500 years BP partly reflects increased rates of roof-fall at that time. One measure of the roof-fall rate is the abundance of rocks within the deposit. As noted above, rubble was particularly frequent in the deposit below 50 cm. In the upper portion of the deposit (spits 1–5) the rubble represented 10.7% by weight; whereas below spit 5 rubble formed 22% of the deposit by weight. Furthermore, with gravel-sized fragments added to the larger rubble, rocks form 35–50% of the deposit by weight below spit 5. These large quantities of densely packed rock must have acted as an effective barrier to the downward migration of artefacts. We consider it extremely unlikely that the specimen in spit 9 has descended as much as 17–20 cm through a rubble-rich deposit of this kind.

4. As can be seen from the vertical distribution of backed artefacts listed in Table 4, there was no 'reservoir' of specimens immediately above spit 9 from which the artefact could have descended. No backed artefacts occur in spits 6 and 8, and only a single specimen in spit 7. Given that there are so few backed artefacts in spit 5, far above the sample dated to 8000 years BP, it is unlikely that a specimen would travel downwards through spits 6, 7 and 8 to lodge in spit 9.

5. Distinctive raw materials are vertically restricted. With the exception of one specimen in spit 7, the assemblage from spit 8 and below contains a recognisable yellow mudstone which is absent in the mid- and late-Holocene levels in the deposit. In addition, there are several kinds of chert, including a light grey variety, which are restricted to the upper seven spits. While the backed artefacts in spits 7 and 9 are not made on any of these materials, the dramatic change in raw materials between spits 7 and 8 is indicative of minimal vertical movement of artefacts at this depth in the deposit.

For these reasons the backed artefact in spit 9 in Loggers Shelter is likely to be older than 8000 years BP. Sedimentary and radiometric information indicate

that the presence of the specimen in early Holocene levels cannot easily be explained as a result of downward displacement. This conclusion is supported by the lack of a reservoir of backed artefacts and the restricted vertical distribution of certain raw materials within the deposit.

Conclusion

We have presented two examples of stratified sites in which backed artefacts are associated with dates older than 4500 years BP. In both sites there are a number of reasons for discounting downward vertical movement as the mechanism producing this association. Sedimentological, radiocarbon and archaeological observations combine to indicate that these specimens are early Holocene in age.

Our earlier discussion has revealed flaws and circularity in the sudden appearance model so readily adopted by many researchers (eg. Beaton 1982; Bowdler 1981; Bowdler and O'Connor 1991; Johnson 1979; Morwood 1979, 1981; White and O'Connell 1982). The logic of arguments purporting to examine evidence of backed artefact chronology has made it easy to dismiss backed artefacts in early contexts, by assuming that specimens found in levels older than 4500 years BP could not be *in situ* and must therefore be displaced from more recent contexts. In light of the case studies presented here, we conclude that the sudden appearance model cannot be sustained at a pan-continental scale. In Upper Mangrove Creek backed artefacts were present in the early Holocene, and we have no reason to think that this is the only region in which they would have been employed at that time. This conclusion suggests that other sites with specimens in early levels should be re-examined. However, as we have already discussed, each site must be examined independently. The demonstration of early Holocene backed artefacts at Upper Mangrove Creek reveals nothing about formation processes in sites in other regions, and hence does not in itself give credibility to those examples previously dismissed. Nor should there be an expectation that similar archaeological patterns will necessarily be repeated in other regions, since we must accept the potential for the history of occupation to differ regionally.

One of the unreconciled contradictions in arguments advanced by Johnson (1979), and accepted by others (eg. White and O'Connell 1982:117), is the difference between the alleged date for the introduction of backed artefacts in southeast New South Wales and the date identified in sites elsewhere in Australia. Johnson (1979:136) concluded that backed artefacts were introduced only 3500 years ago in the Capertee Valley of southeast New South Wales, and yet accepted evidence for an introduction of backed artefacts up to 4500 years ago in other regions (Johnson 1979:139). Acceptance of these variations in chronology is a tacit admission of regional differences in timing of backed artefact use, of

the kind that is inconsistent with the proposition of a continent-wide sudden appearance of that type. Regional variation of this magnitude must suggest the possibility that not only do some regions have initial use of backed artefacts far less than 4500 years ago, but also that in other regions people employed backed artefacts well before that time.

Refutation of the sudden appearance model, as outlined in this paper, suggests an alternative depiction of these regional differences. Our interpretation of the archaeological evidence from Upper Mangrove Creek is that backed artefacts were initially used as a minor element in the tool kit of early Holocene hunter-gatherers, and only during the mid-Holocene became a major component of the implement suite. We have already argued that previous discussions of backed artefact chronology have failed to sufficiently differentiate between the first appearance of backed artefacts and the major phase of their discard. At Mussel Shelter the vertical change in backed artefact abundance displays a classic battleship curve, beginning in the early Holocene and with the peak of popularity in a level dating to c.3000 years BP (Figure 6). The earliest portion of the curve is highly visible at this site because of the large sample of backed artefacts (141/m³ in square A). This pattern suggests at least two mechanisms by which the archaeological expression of backed artefact chronology may appear to differ between regions. Firstly, regional differences in the oldest dateable backed artefacts may simply reflect differences in the archaeological visibility of early Holocene backed artefacts if they were infrequently used (Hughes and Djohadze 1980). In those locations at which early Holocene backed artefacts are not readily archaeologically apparent it is the phase of increased discard at 3500–4500 years BP that may be seen erroneously as the introduction of backed artefacts. Secondly, backed artefacts may have been used in some regions during the early Holocene but not other regions. As argued above, the unequivocal demonstration of early Holocene backed artefacts in Upper Mangrove Creek does not imply their use in all other regions. Hence, the differences observed by people such as Johnson (1979) and Morwood (1981) may be accounted for either by regional variations in the timing of peak popularity of backed artefact use, or by differences in the timing of backed artefact introduction.

Revision of backed artefact chronology in this way has ramifications for interpretations of the nature and rate of change in Holocene Australia. Depictions of change within the Holocene that depend on the presence of backed artefacts as *fossile directeurs* to indicate assemblage antiquity must be re-evaluated. For example, studies where the age of sites has been estimated from the presence or absence of backed artefacts have typically assumed that sites containing backed artefacts are younger than 4500 years BP (eg. Ross 1981, 1984; Godwin 1983). Demonstration of early Holocene backed artefacts means that in future such arguments must be carefully constructed.

Figure 6. Vertical changes in backed artefact numbers in square A, Mussel Shelter.

Perhaps the most dramatic implication of our arguments is for interpretations based on the tenet that the distinctive implement types found in the Holocene are properly grouped together using the concept of the 'Small Tool Tradition' (eg. Beaton 1982; Bowdler and O'Connor 1991; Gould 1973, 1980; Morwood 1984). The perceived sudden appearance of backed artefacts, points, tulas and other forms has been taken to imply that these are a suite of related implements, possibly introduced from outside Australia. Beaton (1982) and Bowdler (1981) have expanded this notion by including a range of other technological and social traits in the introduced suite. All of these assertions rely on the supposed similarity in the antiquity of each of the components of the 'Small Tool Tradition'. The presence of early- or mid-Holocene backed artefacts at Upper Mangrove Creek is inconsistent with the claims that this type of artefact was introduced at only 3500–4500 years BP, along with the dingo, de-toxifying technologies and other phenomena. Uncertainty about the antiquity of components of the 'Small Tool Tradition', such as tulas (Hiscock and Veth 1991) and points (Jones and Johnson 1985; Bowdler and O'Connor 1991), as well as backed artefacts, renders dubious claims that these types form a coherent package introduced in the mid-Holocene. The dramatic increase in the abundance of backed artefacts 4000–4500 years BP must now be explained in terms other than the initial introduction of that type as part of a package of introduced technologies (Hiscock 1994). We therefore advocate that

Australian archaeologists cease to employ the concept of a pan-continental 'Small Tool Tradition' which hides regional and chronological variation in archaeological assemblages and masks the complexity of change in Holocene Australia. Instead research should focus on revealing the development of adaptive systems in different parts of the continent without presupposing that those systems necessarily emerge at the same time or from a common origin.

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Appendix 1. description of backed artefacts

MS/Be/20 — Mussel Shelter, square B, spit 20 (Fig. 7a)

Definite backed artefact made on a pale grey chert. Distal portion of a retouched flake that has been heat shattered. As a result of exposure to heat the proximal end has been shattered and is missing, while the remaining surface of the specimen displays crazing. The heat shattered surface truncates retouched scars on the backed surface, indicating that the breakage is not related to manufacture but occurred after the specimen was complete. The cross-section of the original was triangular, as indicated by a remnant of the dorsal ridge, but has been modified by extensive backing. At the distal tip the backing is bidirectional (i.e. from both dorsal and ventral surfaces), while along the preserved proximal portion retouch scars derive from the ventral surface. The retouched surface is uniformly steep, with an angle to the ventral face of more than 85°. It is likely that this artefact was backed using bipolar techniques. The backed surface curves gradually to meet the straight unretouched margin, giving the specimen the typical form of a Bondi Point.

Maximum length = 21.3 mm. Chord length = 21.3 mm. Thickness of retouched surface = 3.0 mm.

MS/Be/20 — Mussel Shelter, square B, spit 20

Definite backed artefact made on quartz. The distal end has been broken transversely and is missing. Bidirectional backing is found along most of the retouched margin. The backed surface converges sharply on the distal end.

Maximum length = 8.8 mm. Chord length = 8.4 mm. Thickness of retouched surface = 2.8 mm.

Figure 7. Definite backed artefacts from: (a) Mussel Shelter, square B, spit 20. (b) Mussel Shelter, square A, spit 23. (c) Loggers Shelter, square F, spit 7. (d) Loggers Shelter, square F, spit 9. This specimen is associated with a radiocarbon date of 8380 ± 120 (SUA 1125). Scale has 1 mm divisions. Colour photographs are available at <http://artalpha.anu.edu.au/web/arc/resources/paa/ba/photo.htm>

MS/Ac/23 — Mussel Shelter, square A, spit 23

Definite retouched flake made on quartzite. Possible backed artefact. This specimen is the proximal end of a retouched flake, from which the distal portion has been broken transversely. Retouch scars deriving from the ventral surface occur at the proximal end and along one margin. These scars have an angle of about 50° to the ventral surface, and cannot unambiguously be classified as backing, although it is consistent with the early stage of backing retouch.

Maximum length = 8.9 mm. Chord length = 7.6 mm. Thickness of retouched surface = 3.7 mm.

MS/Ad/23 — Mussel Shelter, square A, spit 23 (Fig. 7b)

Definite backed artefact made on quartzite. This specimen is the medial fragment of a retouched flake, from which the distal and proximal portions have been broken transversely. At the distal end of this fragment retouch scars derive only from the ventral surface, whereas at the proximal end there is bidirectional backing. These scars have an angle of over 85° to the ventral surface.

Maximum length = 19.6 mm. Chord length = 13.7 mm. Thickness of retouched surface = 4.9 mm.

LS/F/7 — Loggers Shelter, square F, spit 7 (Fig. 7c)

Definite backed artefact made on a fine grained sedimentary rock. The specimen is complete, with retouch positioned at the distal end, forming an oblique backed surface giving the specimen an asymmetrical plan shape. Backing scars derive mainly from the ventral surface, although small scars and crushing on the dorsal ridge reveal that the flake was placed on an anvil for backing.

The unretouched platform is 3.2 mm wide. Maximum length = 28.0 mm. Chord length = 26.6 mm. Thickness of retouched surface = 4.3 mm.

LS/F/9 — Loggers Shelter, square F, spit 9 (Fig. 7d)

Definite backed artefact made on rhyolite that has weathered to a pale grey colour. The specimen is a proximal fragment. The distal portion is missing, the specimen terminating in a single transverse snapped surface. This broken surface truncates backing scars and reveals

that the break occurred after the completion of the specimen. Retouch scars deriving from the dorsal surface have removed the platform. Originally the flake had a triangular cross section, which has been modified by retouching on one lateral margin. Backing occurs along the entire length of the retouched edge. At the distal end of the specimen the backing is bidirectional. Towards the proximal end of the specimen backing retouch is unidirectional, with scars deriving from the ventral surface. The unretouched margin is straight, while from mid-way along the length of the specimen the backed surface angles toward the opposite margin, giving a classic asymmetric form.

Maximum length = 19.0 mm. Chord length = 16.0 mm. Thickness of retouched surface = 2.0 mm.

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