A review of 1970s and 1980s archaeological studies showed there were numerous interpretations and explanations for dramatic changes in habitation and artefact indices in several regions of eastern Australia (Chapter 2). In this chapter, these explanations and interpretations are compared with the archaeological evidence on which they were based (presented in Chapter 7 and Appendix 4). This comparison shows that in many instances the explanations and interpretations cannot be sustained. Equally, it shows that a wide range of interpretations and explanations are possible, but that simplistic relationships between numbers of sites/artefacts and numbers of people, or between numbers of artefacts and the introduction of the ‘Small Tool Tradition’ or Bondaian assemblages, are unlikely to describe the full complexity of a region’s prehistory.

Population-change explanations

Assumptions underlying the population-change explanations
Most behavioural-change explanations are based on the assumption that quantitative changes in the habitation and artefact indices were produced by a change in the number of artefacts manufactured and habitations used by each person. That is, there were changes in the ratio of habitations to people and in the ratio of artefacts to people. Population-change explanations tend to assume (or imply) that those ratios were relatively constant throughout time and thus a change in the number of habitations and/or artefacts is evidence of a change in population size.

Many researchers of the 1970s and 1980s perceived or assumed that the long-term direction of the quantitative changes in the archaeological records of eastern Australia was only towards ‘increase’, or assumed that decreases in the most recent millennium BP were not significant. On this basis, they proposed that the quantitative changes indicated a trend towards increasing population size, which continued until European contact. The population increases were usually seen as part of a general continent-wide phenomenon, though local shifts in population from one environmental zone or geographic area to another, or shifts from one type of habitation to another without the inference of a general population increase, were also proposed.
Very few advocates of the population-change explanations were explicit about the assumptions on which they based their conclusions; authors who were explicit include Beaton (1985), Ferguson (1985), Ross (1985) and Morwood (1986: 117, 1987: 343; see also O’Connell and Allen 1995: 857).

Beaton (1985: 16) stated that ‘Archaeological sites ultimately mean people, and questions about the presence or absence of sites may just as well be phrased in terms of the presence or absence of people’. Beaton’s (1985: 17–18) discussions about the relationship between trends indicated by ‘a histogram of sites occupied per thousand year period’ and population-growth models show that he accepted changes in population size were reflected in that index.

Ross (1984: 234; 1985: 87) believed an increase in the number of sites to be ‘the most suitable indicator’ of population increase, ‘where it can be demonstrated that behavioural change and archaeological visibility have not biased the archaeological record’. She qualified this by citing one of three conditions which Bailey (1983b: 163) stipulated should be established if one is to accept an increase in site density as evidence of population increase: that is, that the average number of inhabitants per site remained unchanged. Ross concluded:

In other words, it must be possible to demonstrate that a greater number of sites in the landscape was not a function of purely behavioural change. (Ross 1985: 87)

Ross argued further:

The only behavioural change which could produce more occupation sites in an area, and a concomitant expansion of people into previously unoccupied or rarely occupied regions, without involving an increased number of people, would be a change involving the same number of people spending shorter periods of time at more sites. The obvious expression of this would be **more sites, but with each site containing sparser occupation debris**. (1985: 87) (my emphasis)

Ross then stated, ‘This is clearly not the case in the middle to late Holocene in south-eastern Australia.’ However, this is exactly the evidence that is documented in the Upper Mangrove Creek catchment for the first millennium BP — more sites, but with many containing ‘sparser occupation debris’. The evidence presented in the previous chapter suggests this may also be the case in other regions in eastern Australia. Ross’ statements assume that the ultimate measure of the number of people inhabiting either individual sites or specific areas of land is the total amount of habitation debris accumulated. In addition, Ross’ statement does not allow for the possibility that two behavioural changes may have occurred at the same time; for example, people may have begun to move more frequently at the same time as they began to make more artefacts per head of population.

Ferguson (1985: 11–12) analysed artefact distributions in the late-Pleistocene through mid-Holocene levels at several sites in south-western Western Australia to test the assumption that ‘since artefacts are products of human activity, the frequency of artefact finds can be seen to indicate the intensity of that activity’. He (1985: 492) stated that it is unlikely that the evidence from individual sites in his study area suggests only a change in local settlement pattern or that some other raw material could have been substituted for stone. He (1985: 491–2) argued that the artefacts were ‘essential components of the prehistoric society’s cultural core’ and that there was sufficient continuity in the stone-working process to legitimise comparison of the relevant late-Pleistocene through to mid-Holocene levels. Ferguson (1985: 492–3) concluded, as a result of his analyses, that ‘the drop in artefacts suggests a corresponding drop in the amount of human activity’, and that ‘the region-wide drop in artefact finds during the mid-Holocene suggests a comparable region-wide drop in human
population’. However, he (1985: 12) expressed reservations about whether comparable statements could be made about the increase in the artefact accumulation rate in the late-Holocene levels of sites since new stone-reduction techniques and artefact types occurred in this period.

Morwood (1987) argued that archaeological criteria for population increases could include increases in the rate of site formation processes and in occupational intensity at sites, as well as more intensive economic exploitation as indicated by the use of new habitats, resource types, extractive technologies and management strategies. Following Ross (1985) and Hughes and Lampert (1982), Morwood said that in south-eastern Queensland ‘The growth of site numbers over time … provides a general measure of population increase’ (1987: 343).

Each of these researchers was assuming that changes in the numbers of habitations and/or artefacts are evidence of changes in the number of people across the land or in sites. There are many problems in accepting this assumption — apart from the fact that valid alternative explanations to population change can be proposed for these quantitative changes (as acknowledged by Ferguson for the late-Holocene). For example, it has not been established that changes in the number of people inhabiting a site or region or the amount of time spent (e.g., person-days) in a site or region are the only mechanisms that produced changes in the habitation establishment rate, the number of habitations used or the rate of artefact accumulation. It has not been demonstrated yet, nor can it yet be assumed, that (a) knapping was such a constant part of the activities in a habitation that the debris from this activity can act as a measure of the whole range of activities undertaken at a site, and/or time spent at a site, and/or number of people who used a habitation (Bettinger 1981; M. C. Hall 1981; Hiscock 1981: 31–2, 1984: 133–5; Smith 1982: 114–15; see also Chapter 2, Increases in the archaeological record, Population change); (b) there was a direct relationship between artefact use and discard behaviour (Binford 1973; Foley 1981a: 16, 1981b: 165, 1981c: 197); or (c) the rates of use and discard of stone artefacts are known (Foley 1981b: 175).

**Implications of population-change premises**

If it is ESTABLISHED or researchers CONTINUE TO ASSUME that changes in the habitation indices and the artefact accumulation rates were produced by changes in population size, the decreases in the indices that are presently documented for the latter half of the Holocene throw doubt on explanations which propose that the population continued to increase throughout Australian prehistory.

Many researchers tended to accept that changes in the habitation indices and artefact accumulation rates acted in concert; that is, they followed the same trends in timing and direction. This was not necessarily the case in all areas. In the Upper Mangrove Creek catchment, changes in the habitation indices and the local artefact accumulation rate did not coincide in time or direction, and this was also the case with the habitation indices and artefact accumulation rates for individual habitations in other eastern Australian regions.

If the documented changes in both the habitation and artefact indices for the eastern Australian regions were EACH produced by a change in population size, then various scenarios can be constructed. For example, assuming a three-phase sequence with group size and the magnitude of changes in each index remaining the same, only if there was an increase in both the habitation indices and the artefact accumulation rates in the most recent period could the trends be taken as an indication that population continued to increase until contact. If there was a decrease in one index and an increase in the other, it would suggest population size remained the same in the final phase as in the second phase; a decrease in both habitation and artefact indices would suggest a decrease in the population size in the final phase.
Following from this, if the regional trends based on the habitation indices and artefact indices for other regions in eastern Australia have any validity, then one can speculate as to likely changes that occurred in the population size in each region in the first millennium BP. If only the habitation indices are measures of population change, then there was an increase in population size in the majority of regions in the last 1000 years: in the NSW south coast-Sydney region, in south-eastern Queensland, NSW southern uplands-tablelands, southern Victorian Mallee, as well as the Upper Mangrove Creek catchment. In two regions there was no change in the size of the population (central Queensland highlands and the northern Victorian Mallee), and in the NSW Hunter Valley there was a decrease in population in one area and an increase in another.

In the case of the artefact accumulation rates, rates for individual habitation sites in these regions did not always follow the same direction in the last 1000 years or so, and for none of the regions (except the Upper Mangrove Creek catchment) has a local artefact accumulation rate been calculated. So, if it is assumed that where more than 50% of the sites have decreased rates in the final phase the local artefact accumulation rate decreased, and if only the local artefact accumulation rates are indicators of population change, then there was a decline in population in most regions in the last 1000 years: in the central Queensland highlands, south-eastern Queensland, NSW Hunter Valley, NSW Blue Mountains, South Australian lower Murray Valley, as well as the Upper Mangrove Creek catchment. Only two regions had stable populations: the NSW south coast-Sydney and south-western Victoria.

If the habitation indices and local artefact accumulation rates are both measures of population change, then in most regions the population was either stable (south-eastern Queensland, Upper Mangrove Creek catchment) or had declined (central Queensland highlands and NSW Hunter Valley); in only one region did the population increase in the last 1000 years (NSW south coast-Sydney).

Based on the above, the minimum implication is that in the first millennium BP the population did not increase, or did not continue to increase in all regions. Such simplistic interpretations of the data are, of course, not tenable. However, they were presented to show the type of conclusions that can be reached with the type of data currently available, IF the population-change premise is adopted.

Although the above scenarios are presented in terms of general population change, under the population-change premise, the presently documented trends could also be explained as:

1. local shifts in population from one geographic or topographic zone to another for a variety of reasons (e.g., as in Moore 1970; Luebbers 1978, 1981; Beaton 1985; Lourandos 1985a; Ferguson 1985); or,

2. in some regions, particularly country where rockshelters exist, a shift in preference from inhabiting one type of location for another, that is, rockshelters versus open deposits (e.g., as in Stockton 1970a; Stockton and Holland 1974), in regions such as the Upper Mangrove Creek catchment, central Queensland highlands, NSW south coast-Sydney; or preference for one habitation over another, but of the same type, because of changed local environmental conditions (Smith 1982) or a change in the cultural ‘status’ of the location (Morwood 1986).

Under the population-change premise, only if one assumes that the gaps in the archaeological record contain a different trend from that already documented (i.e., that the present studies are biased or unrepresentative of the locality or region itself or of the continental trends) can one avoid the conclusion that the presently documented trends indicate that in some regions of eastern Australia there were periods of decreasing population, and that in the last 1000 or 2000 years, the population was less than that of the preceding millennia.
Growth rates

Some researchers associated dramatic increases in habitation indices and/or artefact accumulation rates with dramatic increases in their growth rates (e.g., Hughes and Lampert 1982; Ross 1984).

If ever it is demonstrated that the relationship between numbers of habitations and people, as well as between stone artefacts and people, was such that the ratio between these variables remained constant over time, then it could be assumed that the growth rates in the indices represent the growth rates in the human population. This would allow changes in relative population size to be proposed, but would not relate to actual population size (for which the actual ratio between people and habitations and/or artefacts is required). Average annual growth rates were calculated for the habitation and artefact indices (Chapters 6 and 7, Appendix 4) so that comparisons could be made with the rates which are normally cited by demographers in discussions on population growth.

Examination of the average annual growth rates for the habitation indices (Tables 7.6 and 7.7) suggests that in some regions lower growth rates prevailed in the first millennium BP than in earlier millennia. In two regions — NSW southern uplands-tablelands and south-eastern Queensland — late-Holocene growth rates continued increasing into the first millennium BP, though in the latter region the rates did not return to the high values of the fifth and sixth millennia BP.

Average annual growth rates for artefact accumulation rates in the first millennium BP in individual habitations varied within each region (Tables A4/17 to A4/42). Growth rates for local artefact accumulation rates could not be calculated for each region, as they were for the catchment (Table 6.6). The large number of regions with numerous habitations with decreasing growth rates in the first millennium BP, however, may indicate decreasing or stable populations existed in many regions in this period, or, if there was an increase in population size, the actual rate of population growth may have declined or remained relatively stable (stationary).

Hughes and Lampert (1982: 20) stated that there was a two- to threefold increase in site numbers and a six- to tenfold increase in ‘the intensity of occupation’ (i.e., rate of implement accumulation) after 5000 BP. Ross (1984: 198–9) stated that there was a tenfold increase in site numbers after 4000 BP. Although these authors concluded that the most likely explanation for the increases was population increase, none claimed that the population growth rate was the same as that for the habitations and/or artefacts. Hughes and Lampert made no comment about the difference in the growth rates that they calculated for habitation and implement numbers. If the increase in the growth rate for human populations was not the same as that for habitations and/or artefacts, this implies that the ratio between numbers of people and numbers of habitations and/or artefacts changed at the same time as the growth rates for the habitations and artefacts changed. If so, the relationship between changes in population size and changes in material behaviour and habitation patterns is obviously more complex than implied by many of the explanations reviewed here.

The increases in the growth rates referred to by Hughes and Lampert and Ross took place over several millennia — that is, over 2000 years for the artefacts and 5000 years for habitations on the NSW south coast, and over 4000 years for habitations in the Victorian Mallee. The growth rates are very much lower when standardised as millennial or average annual growth rates. For Hughes and Lampert’s 1982 data, the average annual growth rates for south coast habitations are between ×1.0001 and ×1.0002 (+0.01% and +0.02%), and for the implements ×1.0009 and ×1.0012 (between +0.09% and +0.12%); for the southern Mallee the average annual growth rate based on Ross’ figures is ×1.0006 (0.06%).
The average annual growth rates for the eastern Australian regions (including the NSW south coast-Sydney using my recalculated figures, and the Victorian Mallee) can be summarised as follows:

**Habitation indices** (i.e., numbers of habitations used and rates of known-habitation use) (Table 7.7):

The average annual growth rates were all less than +0.11% p.a., with positive values ranging from +0.01% to +0.11%; only one region had a value >0.1%. Only two regions had negative growth rates (a decrease) in one period — central Queensland highlands with a growth rate of −0.03% in the ninth millennium BP, and NSW Hunter Valley (MANS), with −0.19% in the most recent phase.

**Artefact accumulation rates** (Tables A4/17 to A4/42):

Most average annual growth rates with positive values ranged between +0.01% and +0.94%, with the highest being +3.45%. Most negative values ranged from 0.003% to -0.66%, with the lowest being -1.98%. Four habitations with sterile layers had values of -100%. Most habitations had one or more levels in which the growth rate was +0.1% or greater; seven had levels with positive values greater than +0.5%. Two habitations had negative values greater than −0.5%.

The average annual growth rates for the habitation indices are the average for a period of one millennium. The growth rates for the artefact accumulation rates are the average for the estimated length of time over which a single spit or level accumulated, which is usually less than 1000 years.

There is much temporal and regional variation in the growth rates. As a rule, the highest growth rates in the indices occur within the last 5000 years, but high growth rates are not restricted to this period. If these indices indicate population growth rates, then there was also much temporal and regional variation in population growth, and all major population increases were not restricted to the last 5000 years.

The percentage figures that constitute significant growth rates in demographic and social terms for hunter-gatherer populations have been discussed by Ammerman et al. (1976), Weiss (1978: 774), Hassan (1981, 1982) and Gray (1983). Hassan (1981: 143) calculated the average annual rate of world population growth during the Pleistocene at well below 0.01% (a figure he says is ‘exceedingly low’). He (1981: 208; 1982: 244–5, Table 3.2) said that during the Lower Palaeolithic it was 0.00007%, during the Middle Palaeolithic 0.005% and during the Upper Palaeolithic 0.01%. The acceleration in rates from Lower to Upper Palaeolithic, he said, perhaps reflects greater evolutionary adaptability and biological development from Homo erectus to H. sapiens. Hassan (1981: 140, 201, 221) argued that the maximum rate of growth for hunter-gatherers should be placed at about 0.5% p.a. with an average of 0.1% p.a. He considered that a growth rate of 0.1% is well below the explosive rates of today, which often exceed 1% and 2% p.a. in many nations. A rate of 0.5%, however, is sufficiently rapid to alter demographic conditions in a short time (Hassan 1981: 221). He (1981: 140, 221, 259) pointed out that prehistoric populations were not incapable of rapid rates of population increase — at a rate of 0.5% p.a., the doubling time would be ca 130 years or about seven generations; at a rate of 0.1%, doubling would take about 35 generations (ca 650 years). Birdsell (1957 in Hassan 1981: 203) proposed an annual growth rate for waves of immigrants sweeping over newly discovered territory in Australia of 3.6% (the equivalent to doubling every generation), but Hassan (1982: 257) said this figure is unrealistically high and that the rate could not have been higher than between 0.5% and 1%. Hassan (1981: 142, 260; 1982: 245) emphasised that the above figures are average rates and small populations would have been subject to stochastic fluctuations in size, and changes in mortality and fertility rates could have led to population increase or decline if no other mechanisms dampened the effect of such fluctuations.
Gray (a demographer) said the apparent population changes referred to by Lourandos (1983a, 1984) and Hughes and Lampert (1982) imply a near-stationary state, and that a tenfold population increase over 2000 years, as suggested by the recent archaeological evidence in south-eastern Australia, implies an average annual growth rate of only 0.1% p.a. This, Gray (1985: 23) pointed out, was hardly a population explosion, and local occurrences of growth or decline at this rate actually support the ‘near-stationarity’ hypothesis. He commented further that a tenfold population increase over a much shorter period (say 500 years) would be needed to signify a considerable departure from ‘near-stationarity’; such an increase represents a growth rate of 0.5% p.a. Gray (1985: 26) concluded that over time we should expect to find very considerable changes (increases) in the sizes of Aboriginal populations (local and continental), but that such changes over very long periods of time are relatively insignificant and do not contradict the hypothesis of long-term ‘stationarity’.

Ammerman et al. (1976: 29) stated that it was unreasonable to expect a regional population to continue growing at a rate of 1% to 3% a year over a period as long as 1000 years. However, he believed that even an apparently low rate of growth such as 0.1% a year would lead to major changes in population size and probably to socioeconomic changes as well, if it was maintained over periods in the order of 2000 years.

Thus, the significance that can be assigned to a particular growth rate depends as much on the length of time over which it was maintained, as on the actual growth rate itself.

Population-change conclusions
If the regional changes in the number of habitations and/or artefacts over time are assumed to indicate changes in population size, and if it is accepted that either a 0.1% p.a. growth rate over 2000 years or a 0.5% p.a. growth rate over 500 years may have brought about significant demographic, social or economic changes, what conclusions can be drawn from the archaeological evidence? Did growth rates of either 0.1% p.a. over 2000 years or 0.5% p.a. over 500 years occur in many or any regions in eastern Australia? Conclusions that can be drawn depend on which set of evidence is taken as the indicator of population change — the habitation indices or the artefact accumulation rates.

• If the habitation indices (number of habitations used and rate of known-habitation use) are taken as the indicators, then the calculated growth rates suggest significant change did not occur in any region. All average annual growth rates were less than +0.11% p.a. (Table 7.7). The growth rates for 500-year periods have not been calculated, but the raw data do not appear to indicate growth rates of greater than 0.5% p.a. were maintained for periods of more than 500 years.

• If the artefact accumulation rates are taken as the indicators, then although average annual growth rates greater than +0.1% occurred at many times, it is not often that they were maintained for periods of 2000 years or more (i.e., Bass Point for ca 2150 years and Devon Downs for ca 1900 years). Growth rates of +0.5% p.a. or greater occurred less frequently and at only one site were they maintained for a period greater than 500 years (Sandy Hollow for ca 510 years) (Appendix 4, Tables A4/17 to A4/42). At other sites, growth rates of +0.5% or greater were all associated with periods of less than 220 years (Native Wells 2 and Gatton). Three sites had negative values of −0.1% or less which were maintained over 2000 years: at Kenniff Cave between ca 16,200 BP and ca 13,700 BP (ca 2500 years), at Native Well 2 between ca 2300 BP and ca 100 BP (ca 2200 years), and Fromms Landing 6 between ca 2950 BP and ca 100 BP (ca 2850 years). No sites indicate growth rates of -0.5% or less for periods of 500 years or more.

The evidence from individual sites is, however, likely to represent only the changes in each particular site and may not be representative of the changes within a locality or region as
a whole. In addition, the length of time over which a growth rate appears to have been sustained (e.g., as at Bass Point and Devon Downs) is a function of the temporal units into which the site’s deposits were divided for other analytical purposes. Reanalysis of the data grouped according to other units may show other trends.

The above conclusions suggest that the ‘dramatic’ increases in the archaeological record which are documented in the previous chapters may not necessarily indicate that demographically or socially significant changes occurred in the population growth rates at certain points in time. Claims for dramatic increases in population growth rates during specific periods of time in the late-Holocene may be unfounded. However, even though a growth rate may not change over time, the size of the increase in a population after a long period of time could become relatively substantial (Gray 1985: 26). Thus if a prevailing system or systems (e.g., social, economic or technological) could not operate effectively beyond a certain population size, then a steady increase in the size of a population over the long-term eventually may have brought about social, economic and/or material changes. Although I argue elsewhere in this monograph that quantitative changes in the archaeological record may not be produced by population change, there is no doubt that the population increased in size from the time of initial colonisation to the time of British colonisation in 1788. In addition, over this time, the increasing size of the population would have resulted in larger amounts of cultural debris being created and larger numbers of sites being inhabited. However, populations no doubt also declined in many regions and perhaps continent-wide at various times, and some arid and semi-arid regions may have been abandoned in some periods, for example, during the Last Glacial Maximum (Davidson 1990: 53–5; and recent studies, see below). In addition, growth rates associated with these increases and decreases in population need not have been uniform in direction, magnitude or timing in different areas across the continent.

If changes in the habitation and artefact indices are evidence of population change, then the ‘population changes’ were principally small in scale, that is, <0.1% p.a., and where they reached >0.5% p.a. they were not sustained over long periods of time, that is, for periods exceeding 500 years. The growth rates do not indicate any periods which were above ‘near stationarity’ — that is, the archaeological evidence does not support dramatic increases or decreases in population sizes during particular periods in time. Investigating theoretical issues associated with the identification of archaeological indices that measure population growth and decline (see discussion in Beaton 1990: 32) was beyond the scope of this study. However, these issues need to be addressed, as well as the nature and size of samples of sites on which the trends are based, in order to identify archaeological measures of population change in hunter-gatherer communities. Associated with these concerns is the identification of factors or processes that would have brought about changes in the growth rate and perhaps resulted in ‘rapid’ population changes (Hassan 1982: 263).

**Behavioural change: qualitative changes in stone artefact assemblages**

Explanations and interpretations relating to behavioural change are based on the assumption that during the Holocene the population size remained stable or fluctuated within only a narrow range. Most of these explanations assume that there were changes in the ratio of habitations to people and in the ratio of artefacts to people; that is, the average number of habitations used or artefacts manufactured by individual people altered.

Typological, technological and raw material changes are the focus of interpretations and explanations involving qualitative changes in the stone artefact assemblages. Many
researchers associated dramatic increases in the habitation indices with the introduction of artefacts diagnostic of the Bondaian assemblages or ‘Small Tool Tradition’ (Lampert and Hughes 1974: 233; Bowdler 1981: 108, 1983: 12–13; Morwood 1981, 1984; Hughes and Lampert 1982: 26; Rowland 1983: 73; Ross 1984: 200). However, the causal relationships proposed between these events were often indirect; for example, the qualitative changes in the stone artefact assemblages resulted in larger numbers of artefacts which in turn made the archaeological deposits more visible. Other explanations, which suggest direct relationships between qualitative changes in the stone artefact assemblages and quantitative changes in the archaeological record, concern only the dramatic changes in artefact accumulation rates.

Qualitative changes in the stone artefact assemblages have been proposed as explanations for both the dramatic increases in the artefact accumulation rates in the last 5000 or 4000 years BP and for the decreases in the artefact accumulation rates in the last 1000 years or so. Some of the explanations were discussed during presentation of the evidence from the Upper Mangrove Creek catchment (Chapter 6), and are apparent in the review of quantitative changes in eastern Australia (Chapter 7, Appendix 4). Examples quoted below demonstrate that qualitative changes in the stone artefact assemblages cannot be used as a universal explanation for the quantitative changes in the archaeological record.

**Increases in the artefact accumulation rates in the last 5000 or 4000 years BP**

Qualitative changes in the stone artefact assemblages in south-eastern Australia that researchers have related to increases in artefact accumulation rates were said to occur at the beginning of the ‘Small Tool Tradition’ or Bondaian Phase of the Eastern Regional Sequence (i.e., Phase 2 in the Upper Mangrove Creek catchment), as well as at the transition from the Middle to Late Bondaian Phase (referred to as Bondaian and post-Bondaian Phases by some researchers [Table 3.7], and as Phases 3 and 4 in the Upper Mangrove Creek catchment).

**Introduction of Bondaian assemblages/‘Small Tool Tradition’**

Increased artefact accumulation rates were said to coincide with or be associated with the introduction of the ‘Small Tool Tradition’ (e.g., Lampert and Hughes 1974: 233; Bowdler 1981: 108, 1983: 12–13; Morwood 1981, 1984; Hughes and Lampert 1982: 26). Introduction of the ‘Small Tool Tradition’/Bondaian assemblages has been identified by the appearance (addition) of new implements into the assemblages — a typological change; a change in technology; and a change in raw materials.

While some of the new implements can be interpreted as innovations, the changes in technology and raw materials do not represent the introduction of new technology or new raw materials. They are simply a change in the frequency (number of times) that a technique or raw material was used.

1. **Typological change** — the addition of new implements into the assemblages. New implements which are said to appear in eastern Australia with the ‘Small Tool Tradition’ include backed artefacts such as Bondi points and geometric microliths (but see Hiscock and Attenbrow 1998). Ground-edged artefacts appear for the first time in south-eastern Australia; in Queensland, South Australia and western NSW, unifacial (pirri) points also appear.

Increases in the artefact accumulation rates are usually related to changes in the flaked artefacts and not the ground-edged artefacts. However, the appearance and then subsequent increase in the use of ground-edged artefacts probably also impacted on many aspects of Aboriginal life, which may be reflected in the amount of stone artefact manufacturing debris accumulated at sites. McBryde (1977: 234–6) associated an increase in ground-edged implements with a decline in the representation of macropodids and a rise in that of phalangeridae in the food refuse at sites in the New England region. An association
between the increase in ground-edged implements and the increase in total numbers of artefacts has not been raised by other researchers and is not discussed here.

Hughes and Lampert (1982: 25) and Ross (1984: 200) stated that the new stone implements introduced with the ‘Small Tool Tradition’ expanded the existing range of stone implements and did not just replace existing types. Ross as well as Hughes and Lampert argued against the suggestion that these additions resulted in an increase in the number of artefacts discarded per head of population at a site, not only because of the increased range of implements per person but also as a result of the greater quantity of manufacturing debris created. Hughes and Lampert (1982: 25) argued that the curves ‘for only maintenance tools (flake scrapers, core tools and elouera)’ at Burrill Lake and Currarong 1 (both on the NSW south coast) showed no appreciable divergence from those for ‘all implements’ and thus the addition of the ‘new tool types’ did not affect the trends.

In addition, the evidence from other regions indicates that the appearance of new implement types (e.g., backed artefacts, unifacial points) did not always coincide in time with a ‘dramatic’ increase in the artefact accumulation rates in all sites and/or regions; for example, not at Sandy Hollow in the NSW Hunter Valley (Fig. 7.11; Table A4/22), Native Well 1 and 2 in the central Queensland highlands (Figs 7.24 and 7.25; Tables A4/37 and A4/38) or Maidenwell in south-eastern Queensland (Fig. 7.28; Table A4/41).

In contrast, at Devon Downs, while the disappearance of points in the upper two spits coincides with a dramatic decrease in the artefact accumulation rate (and may be due to the smaller sample size in these units, Smith 1982: 110–11), there was a more substantial earlier decrease in the number of unifacial points which appears to coincide in time with a substantial increase in the artefact accumulation rate (in spit 4). At Native Well 1, pirri points disappeared from the assemblage in the same level (4) as the most dramatic increase in the artefact accumulation rate (though it was not the period with the highest growth rate). Thus dramatic increases in artefact accumulation rates were associated in one site with the disappearance of an implement type, and at the other with a reduced frequency of an implement type.

The lack of simultaneity in the appearance of new artefact types and substantial changes in the artefact accumulation rates is also seen in sites outside eastern Australia. For example, at Nauwalabila I (the Lindner Site), Arnhem Land, the main concentration of bifacial points occurred in units with the highest number of artefacts per kilo of sediment (units 17 to 9), but they first appeared (a single occurrence) in a much earlier level (unit 27) (Jones and Johnson 1985a: Tables 9.4 and 9.6; Jones 1985: 296). The first appearance of adze/chisel slugs occurred at the beginning of an upward trend in the concentration figures (unit 19) though a substantial increase in the concentrations and the highest concentration figures occurred later (units 17 to 9). The adze/chisel slugs remained in the assemblage throughout the sequence and did not decline in number or disappear with the decrease in artefact concentrations in the upper eight units.

2. Technological changes

The appearance of Bondaian assemblages are described as being characterised by the increased control in flaking, and changes in the preparation of cores and retouched flakes (Stockton 1977a: 216; Johnson 1979: 95, 110–11; Kohen et al. 1984: 66–7; Hiscock 1986: 42–4).

At Sandy Hollow in the Hunter Valley, Hiscock (1986: 44) said technological changes accompanied each of three phases which he called Pre-Bondaian, Phase I Bondaian and Phase II Bondaian. The technological features include faceted platforms (which were introduced and were present only in the Phase I Bondaian spits) and overhang removal. The latter was present throughout the sequence, but the percentage of flakes with overhang removal increased in Phase II Bondaian spits. Pre-Bondaian spits have a virtual absence of platform preparation (Hiscock 1986: 42–4, Table 6). However, although these technological and typological features are present in the spits with the highest artefact accumulation rates, their appearance did not
coincide with the most dramatic increase in the artefact accumulation rate (Fig. 7.11, Table A4/22). There was a marked increase in the artefact accumulation rates at the beginning of Phase I Bondaan, but it was not as dramatic as that which occurred within the pre-Bondaan phase or midway through Phase I Bondaan.

At Devon Downs, the technological change was described as a change in the ‘reduction processes from flake technology to an opportunistic mode of stone working’ (Smith 1982: 114). Smith concluded, however, that this change was not correlated with changes in the ‘amount of stone in the deposit’ (Fig. 7.23, Table A4/34).

The evidence from Sandy Hollow and Devon Downs suggests that the appearance of a technological change and a dramatic change in the artefact accumulation rates did not always coincide in time. Artefact accumulation rates also increased at times when technological change was not identified.

3. Raw material change. The increased relative frequency of fine-grained materials such as silcrete, chert and indurated mudstone/tuff, which are usually associated with the introduction of the Bondaan assemblages and ‘Small Tool Tradition’, was not suggested as a reason for the increased accumulation rates. Smith (1982: 110–11) suggested that ‘the availability of suitable stone’ may be a reason for quantitative changes, but at Devon Downs he argued that there were no obvious changes in the types of raw materials utilised and thus this type of change did not explain the observed variation.

Transition from Middle to Late Bondaan (Bondaan to post-Bondaan)

The disappearance of or a decline in backed artefacts, as well as an increase in the percentage frequency of ground-edged artefacts, bipolar artefacts and quartz as a raw material have been documented at the transition from Middle to Late Bondaan (from Bondaan to post-Bondaan; from Phase 3 to 4 in the Upper Mangrove Creek catchment). The increase in bipolar artefacts represents an increase in bipolar working.

The increase in bipolar artefacts (a ‘typological’ change), due to an increase in bipolar working (a technological change) is usually associated with an increase in the percentage frequency of quartz (a change in raw material usage). Bipolar working is seen more often on quartz material than on other types of raw material (e.g., silcrete, chert, indurated mudstone/tuff), and increased at the expense of hand-held percussion.

Assemblages in the uppermost levels at many sites in south-eastern Australia (referred to as Late Bondaan, post-Bondaan, Late Small Tool Phase or ‘Recent’) are quartz-dominant (McCarthy 1948: 22; Lampert 1971a: 16, 44–7, Table 5; Flood 1980: 250, 329; Attenbrow 1981: 45–52). The increased percentage frequency of quartz artefacts in ‘recent assemblages’ was used by some to explain the continuing increase in rates of artefact accumulation at some sites. For example, Williams (1985) suggested that significant increases in the rates of sedimentation and artefact discard did not occur until after 2000 BP on the NSW south coast and that:

Perhaps these changes were associated with shifts in technology ... where backed blades tended to drop out of assemblages and were replaced by quartz artefacts, which are mostly unretouched. (Williams 1985: 327–8)

Hiscock (1982b: 43) considered that quartz domination may have been due to the fact that quartz was more highly reduced than other stone types and therefore may reflect only changes in knapping behaviour. An increase in the use of quartz and bipolar technology may result in a greater quantity of debitage being produced per unit time. Individual sites in the Upper Mangrove Creek catchment (Chapter 6) and several other sites in eastern Australia (e.g., Currarong 1 [Lampert 1971a: 67]; Sassafras [Flood 1980: 328]; Shaws Creek K2 [Kohen
et al. 1984: Fig. 6]) have quartz-dominant assemblages with decreased rates of artefact accumulation in the upper levels. This shows that increases in the percentage frequency of quartz artefacts at individual sites were not always associated with increases in the artefact accumulation rates.

**Conclusion relating to increases in the artefact accumulation rate**

It is clear that typological, technological and/or raw material changes, which have been used to identify the introduction of the Bondaian assemblages or the ‘Small Tool Tradition’ and the transition from middle to late Bondaian (Bondaian to post-Bondaian), did not always coincide in time with the onset of dramatic changes and/or continuing increases in the artefact accumulation rates. Quantitative changes occurred at some sites at the same time as typological, technological or raw material changes, but as a general rule it cannot be said that quantitative changes occurred in all sites or all regions at the same time as the appearance of the Bondaian assemblages/‘Small Tool Tradition’.

**Decreases in the artefact accumulation rates in the last 1000 years**

Decreases in the artefact accumulation rates were explained in terms of typological, technological and raw material changes. Some explanations incorporate a change from stone to another type of raw material, rather than the exchange of one stone type for another (i.e., simple raw material change, as discussed in the previous section).

**Typological change**

The decrease or disappearance of backed or other artefacts has not been advocated as a reason for decreased artefact accumulation rates — possibly because the latter went unrecognised or was considered unimportant. However, the following examples indicate that it was unlikely there is any association between the two events.

At Maidenwell, the loss of/decrease in backed artefacts coincided in time with a substantial decrease in the artefact accumulation rate at the beginning of the Recent Period, when there was also the greatest decline in the growth rate (Fig. 7.28; Table A4/41). (Morwood 1986: 98, believes the backed artefact in the uppermost excavation unit was ‘scuffed up’ from earlier levels.) At Native Well 1 and Native Well 2, backed artefacts and pirri points respectively disappear from the assemblages subsequent to dramatic decreases (Figs 7.24 and 7.25, Tables A4/37 and A4/38). In contrast, in the Upper Mangrove Creek catchment, the decline in backed artefacts began before the dramatic decrease in the artefact accumulation rate (Chapter 6).

**Technological change**

Again, as with the other qualitative changes, whether or not there was a correlation between changes in technology and decreases in artefact accumulation rates varied from site to site. Technological change was investigated by Smith (1982: 111, 114–15) as a cause for the quantitative changes at Devon Downs: a ‘change from a well-developed flake technology, including unifacial points, to a more casual approach to stone working in units 1 to 3’. He concluded that the decrease in the artefact accumulation rate was not correlated with the technological change (Fig. 7.23, Table A4/34).

At Sandy Hollow, reanalysis of the artefact distribution patterns by Hiscock (1986: 44, Fig. 3) and myself (Chapter 7, Appendix 4) show that the beginning of the Phase II Bondaian coincided with a substantial decrease in the artefact accumulation rate and the greatest decline in the growth rate (Fig. 7.11, Table A4/22).
**Raw material change**

Smith (1982: 110–11) proposed that changes in the ‘availability of stone’ were likely to affect the amount of stone in a site. However, for the sequence at Devon Downs, he (1982: 111–12) concluded that the lack of variation in the index used to measure this aspect indicated that changes in the availability of stone did not explain the observed variations in either the decrease or the increase in the artefact accumulation rate.

A change in the nature of the raw materials used was also proposed as an explanation for decreased amounts of stone in the recent levels of archaeological deposits, i.e., the replacement of stone by another raw material but one which has not survived (Mulvaney 1975: 243), or one which was not left behind (Schrire 1972: 664–6). Both of these explanations are essentially the same (changes in preferred raw materials) except that the new raw materials differ and the reason for the change from the original raw material differs. Although Mulvaney’s explanation may partially explain a change in technology (i.e., the ‘degeneration’ in stone-working), the fact that all archaeological deposits in the area do not have a decline in the artefact accumulation rates in the upper levels make it appear less plausible. It remains a difficult hypothesis to test, unless sites are found which have long histories of habitation and excellent preservation of organic materials throughout.

**Conclusions concerning qualitative changes in the stone artefact assemblages**

There are some instances where temporal correlations between quantitative and qualitative changes in the artefact assemblages are documented. However, as a general rule, the dramatic quantitative changes in the artefact accumulation rates in the latter half of the Holocene did not occur at the same time (i.e., in the same spit or level in a site) as the appearance or disappearance of backed artefacts, the increased use of bipolar working, an increased use of quartz or changes in other raw materials, or changes in technology. The quantitative changes did not always coincide in time with the appearance of the Bondaian assemblages / ‘Small Tool Tradition’ or the transition from the Middle to Late Bondaian (Bondaian to post-Bondaian).

Such a conclusion implies that

1. if dramatic changes in the artefact accumulation rates are indicative of changes in the population size, then the increase in population was not necessarily associated with the introduction of the ‘Small Tool Tradition’ or Bondaian assemblages, or any of the other qualitative changes examined above (see also Williams 1985: 5, 327–9).

2. Bowdler’s (1981) hypothesis that the association of increases in archaeological phenomena with the appearance of the ‘Small Tool Tradition’ in the eastern Australian highlands is an indicator that ceremonial activities were associated with the first successful occupation of the highlands is not supported. In addition, the evidence presented in previous chapters indicates that dramatic increases in the habitation establishment rates, the numbers of habitations used and the artefact accumulation rates were not geographically restricted and occurred over a much wider area and diversity of environments than the eastern Australian highlands.

Dramatic increases in the habitation establishment rates, the numbers of habitations used and the artefact accumulation rates may be said to be associated with Bondaian assemblages and the ‘Small Tool Tradition’ in so far as they often occur within the period in which these assemblages have been identified. However, the dramatic changes in the artefact accumulation rates cannot necessarily be explained by typological, technological or raw material changes in the stone artefact assemblages (or at least those aspects examined above). The appearance of Bondaian assemblages / the ‘Small Tool Tradition’ and the qualitative changes in the stone artefact assemblages examined above cannot be used as universal explanations for the quantitative changes in the archaeological record.
Conclusions and post-1980s studies

During the past 22 years, many other studies have been carried out which incorporate some of the explanations and interpretations addressed in this and earlier chapters. These more recent regional studies reinforce the results of 1970s and 1980s studies in documenting increasing numbers of habitations established and used during the Holocene, and also the fact that artefact accumulation rates increased in the upper levels of some sites and decreased in others within the same region. Many explanatory models for these quantitative changes still include intensification and increasing social complexity (Lourandos 1997: 240–3), though such processes are often said to begin much later than originally proposed by Lourandos. For example, Ulm and Hall (1996: 54–5) put forward intensification of resource use associated with changes in land-use as late as 1200 BP to explain the increase in shell middens and bevelled pounders that occurred in south-eastern Queensland at that time. Sociodemographic models have also been proposed (Lourandos 1997: 243, 318–21, 327–30; David and Lourandos 1997).

Continent-wide demographic changes are still proposed (e.g., Beaton 1990; Dodson et al. 1992: 119–23; O’Connor et al. 1993: 96, 102; Flood 1995: 248–9), though regional changes, sometimes involving local shifts of population, have been proposed more frequently (e.g., McNiven 1992a; David and Chant 1995: 514; Morwood 1995: 39; Morwood and Hobbs 1995a: 180–2; Morwood and L’Oste-Brown 1995: 175; Ulm and Hall 1996: 55). Researchers still base conclusions on the assumption that changing numbers of sites or artefacts provide a general measure of population increase, for example: O’Connor et al. (1993: 101) state that:

when the magnitude and direction of change in discard rates are internally consistent at the regional level, this must signal fundamental changes in the regional system … we explicitly assume that regional changes in discard rates of a large order of magnitude do reflect population change (cf. Ferguson 1985).

Changes in site use, that is, in the ‘intensity of site use’, also remains a common theme (Barker 1991; Lourandos 1993: 74; Boot 1996b: 77–8; David 1991; Morwood and Jung 1995: 97–9; Morwood and Hobbs 1995a: 180–1), as well as periods of abandonment (Morwood, Hobbs and Price 1995: 81, 85). A change from the preferential use of rockshelters to open locations within the same locality was still proposed (McDonald 1994: 74–8, 80, 348–9); and human taphonomic processes (treadage) were investigated to account for changes in artefact accumulation rates (Jung 1992; Morwood and Jung 1995: 99; Morwood and Hobbs 1995a: 181; Lamb 1996b). Natural processes, including the rising sea-level and coastal erosion were still advocated to explain the documented increases in site numbers (e.g., Bird and Frankel 1991a: 3, 5–6, 1991b: 187–8; Dodson et al. 1992: 119–23; Ulm and Hall 1996: 52–3).

Researchers have begun increasingly to undertake detailed investigations which assess changes in site numbers and artefact numbers in individual sites, as well as the abundance and paucity of particular artefact types and stages of reduction at a regional level, in terms of responses to changing risk factors (e.g., Hiscock 1994, 2002; Lamb 1996a; Thorley 1999: 67; Clarkson 2001: 67–8), mobility patterns (e.g., McNiven 1992b, 1994; Hiscock 1996; Barton 2000: 38–9; Thorley 2001), and tool manufacturing and maintenance behaviour (Barton 2000: 38–40). Hiscock (1993: 65, 75) described the transition from pre-Bondaian to Bondaian as representing ‘an increase in the regularity and precision of knapping related to raw material conservation’. Many recent consulting reports involving Aboriginal sites on the Cumberland Plain (Sydney region) and in the NSW Hunter Valley incorporate discussions about site function, land-use and mobility patterns. They were among the themes White (2001) explored in addressing reasons why changes in a rockshelter assemblage occurred over time. However, most
consulting reports deal with stone artefact assemblages in open contexts and their explanations for assemblage variation in different parts of their study area (e.g., according to stream order) do not address temporal change (e.g., Craib et al. 1999: 138–42; Kuskie and Kamminga 2000; AMBS 2002a, 2002b, 2002c, 2000d, 2003).

Studies have increasingly used more than one ‘measure of intensity of site use’ (e.g., stone artefacts, faunal remains, ochre, sediment) (e.g., Barker 1991: 105–7; David and Chant 1995: 514; Morwood and Hobbs 1995b; Morwood and Jung 1995; Mulvaney and Kamminga 1999: 272). Some studies have included regional and temporal variations in engraved and pigment images to identify long-term social and demographic changes including changes to territorial boundaries (e.g., David and Chant 1995: 514; Morwood and Hobbs 1995a, 1995b; Morwood and Jung 1995).

At a more continental scale, decreased artefact accumulation rates and sterile layers/disconformities at and about the time of the Last Glacial Maximum have been interpreted as periods of site or regional abandonment or lower population densities (i.e., local shifts in population) and contraction in the size of territories due to increased aridity, particularly in arid and semi-arid regions in northern Australia (e.g., Hiscock 1988b; Ross et al. 1992: 109; Smith 1989; Veth 1989, 1993: 103–14; Allen 1990: 300; O’Connor et al. 1993; Thorley 1999: 66–7; O’Connor 1999: 48–9, 121–2) and Cape York (e.g., Morwood and Hobbs 1995a: 180), as well as after the Last Glacial Maximum in south-west Tasmania (Cosgrove et al. 1990; Cosgrove 1995).

On the other hand, evidence from many regions indicates a richness, complexity and variability in the archaeological record of the late-Pleistocene prior to the Late Glacial Maximum comparable with that documented in many late-Holocene sites in, for example, south-west Tasmania (e.g., Cosgrove et al. 1990; McNiven et al. 1993; McNiven 1994; Cosgrove 1995; Holdaway and Porch 1995); the Kimberley and north-west Western Australia (O’Connor 1999: 199, 122; Balme 2000; Veth et al. 2000: 56); northern Queensland (David 1991; Hiscock 1984; Lamb 1996b); and the NSW south coast (Boot 1996b: 77–8); though David and Chant (1995: 423–4) present an opposing view. The archaeological evidence for the late-Pleistocene and early-Holocene periods of ‘intensification’ in eastern mainland Australia as speculated by O’Connor (1999: 119, 122) for the Kimberley needs more detailed examination. However, discussions in the final chapters concentrate on explanations for the quantitative changes in the Holocene archaeological record of the Upper Mangrove Creek catchment.