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Mesolithic South West Scotland, Lithic Raw Materials and Regional Settlement Structure

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ABSTRACT

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Regional approaches to the investigation of prehistoric settlement tend to be difficult in areas devoid of either economic, structural or stylistic evidence for the sequential use of the landscape. This is particularly the case in western Scotland where acid soils have contributed to the destruction of most 'soft' archaeological debris. Conversely however, evidence for the manufacture and maintenance of lithic artefacts is abundant in the form of extensive knapping waste. These tend to be spatially discrete however, located on the three island hot-spots of archaeological visibility, namely Rhum, Arran, and the Southern Hebrides archipelago of Islay, Jura and Colonsay. On all three, visibility is probably a function of access to fine grained lithic raw materials.

On the basis of the heterogeneous distribution of these, this thesis takes a regional approach to the Mesolithic settlement of western Scotland. By tracing the movement and differential use of lithic raw materials from Arran to Skye, a model of regional scale integration, but with lower levels of sub-regional mobility is proposed.

This research contributes to the Mesolithic of western Scotland in two substantive ways. Firstly, the regional beach survey has clarified the nature and distribution of beach pebbles as a viable source of flint. Although the beaches have long been recognised as the primary source of flint, their distribution throughout the region, and density at the island scale remained unclear. Survey undertaken at both these scales highlighted the spatial and temporal heterogeneity of the deposits. This has significant implications for archaeological visibility in the region, differential raw material use, and the temporal dimension of the beaches as flint sources. Secondly, an approach is developed which makes use of the consistent relationship between volume and surface area in spherical beach pebble raw materials. This provides a useful means for investigating assemblage structure in terms of the nature of raw materials being used. The consistent relationship between proportions of debitage types provides a means for comparing assemblages against an experimental template for which raw material starting conditions are known.

Contents

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CHAPTER 1

Introduction

1.1. Introduction

The aim of this thesis is two-fold: Firstly to develop a model of regional settlement and mobility along the west coast of Scotland during the Later Mesolithic, achieved through the sourcing of lithic raw materials. Secondly, to investigate ways in which raw materials were being used and how people were provisioning themselves and their landscape.

1.2. The case for a regional perspective

The need for a regional approach to the earliest Prehistoric settlement of Scotland is self evident if we are to avoid as Woodman warns, proceeding along a narrow research base by focusing on only a few large sites (1989:5). Examples of this type of approach include Mercer's research on Jura (1974, 1980), although in fairness at that time there were few other sites with which to compare his assemblages apart from those further south. More recently Mellars' excavations on Oronsay (1987) have contributed much to our understanding of the economic attributes of the Obanian shell middens. However, little attempt was made in the report to situate Oronsay more widely within the region, particular in relation to sites on nearby Jura. Similarly, although the excavations on Rhum (Wickham-Jones 1990) provided considerable evidence for Mesolithic presence on the island, only a limited attempt was made to place this activity more widely within the region.

Recently however, the stated aims of Mithen's work on Islay and Colonsay represented a departure from this traditional site based approach by focusing on the islands of the southern Hebrides. The project attempts to link together the four islands of Islay, Jura, Colonsay and Oronsay. However, although focused on the archipelago, it still covers only a small proportion of the region, and one arguably less extensive than could conceivably have been encompassed in either a seasonal or annual round of Mesolithic activity. What is therefore needed is an inclusive study taking in the whole of the region, which in this case is defined as extending from Aran in the south to Skye in the north.

There are a number of reasons why I feel it is now time to attempt a broader regional perspective on the Mesolithic of western Scotland

1) There are a sufficiently large number of sites to provide the all important spatial component. In particular, those on Rhum and Arran have extended our knowledge of occupation along the coast, while those on Islay, Colonsay and Jura have considerably increased the density of sites in the central zone. As a result western Scotland now has sufficient numbers of Mesolithic sites with reasonable contextual information to make a regional approach worthwhile. Although Rhum and Arran do not necessarily represent the extent of Mesolithic activity, they do provide a sufficiently large section of the coast to consider issues such as seasonal and annual settlement patterns. One possible problem with taking a regional perspective at present are the lack of sites on some of the other islands in the chain, for instance Mull and Skye. This is also the case on the mainland along the lowland coastal strip as well as the adjacent uplands. Whether or not the apparent absence is real or just a lack of visibility remains to be seen.

2) It is clear that we have as yet few methodological tools at our disposal with which to integrate the sites of the region as individual units of analysis. This lack of interpretative framework leaves us with artefact catalogues but little potential for more illuminating interpretation. I would argue that the only way in which we are going to move beyond the simply descriptive, is to change our focus and consider the region as a whole. By avoiding the difficult and unanswerable questions concerning the sites themselves, regional approaches have the potential to enable us to develop stronger models of settlement and mobility. In turn this top down approach may also better equip us to look again at sites and to make some sense of their complexity.

3) Extensive mobility is likely to have played a significant role in Prehistoric economic strategies within the region. To concentrate on specific sites, islands or even archipelagos, is therefore to ignore this much more expansive use of space in overall subsistence and settlement strategies. Taking a regional approach allows us to integrate a greater sample of sites from an arguably more representative range of ecotones.

1.3. The trouble with regional approaches in Scotland

The risk with regionally based projects is that without some clearly defined linking methodology, they end up as site based analyses, just with many more sites. By linking methodology I mean some means to demonstrate that sites functioned as part of an integrated system. The following are some of the limitations which have I believe have up to now restricted the potential of regional approaches in western Scotland.

Faunal and floral evidence for seasonality: Rowley-Conwy's comments concerning the viability of regional research in areas devoid of faunal assemblages are particularly applicable to sites in Scotland (1987, 1993). Acid soils have meant that little if any economic evidence has survived, apart from the regions shell middens. Whether these can be interpreted as alternative economic strategies, as argued by Bonsall (1996), is in my opinion still unproved despite the broadly contemporary nature of the material. An additional problem concerns our inability to predict the ranges of species which may have been present in the region. Although this is not uncommon for the Mesolithic in general, it is argued that on small islands such as Islay, the lack of faunal evidence may suggest that animals were either not present or at such low densities that they were not being regularly hunted. Although herbivores could swim to Jura and then across to Islay, this implies a precarious balance between viable populations and the pressures of hunting. This may have been particularly the case on the more distant islands such as Colonsay or Rhum where animals would have needed to have swum ten or more kilometres. There is the possibility of deliberate introduction during the Mesolithic (Grigson and Mellars 1987:246; Woodman 1978), however there is at present no obvious evidence for this. If it was the case then it implies considerable complexity of both landscape and social organisation.

Plant remains may have some potential for providing a seasonal perspective on settlement, but once again poor preservation limits their use in western Scotland. The ubiquitous carbonised hazel nut suggests an autumn presence, but they can be stored and easily transported, particularly after roasting. There may be some scope for inferring an autumn occupation at Staosnaig on Colonsay, where hazel nut appears to have been collected and processed. Moreover evidence for the use of other plants at the site has been forthcoming, in particular the Lesser Celandine (*Ranunculus ficaria*) and Pignut (*Conopodium majus*), (Lake pers com) both of which are summer perennials. However this does not mean that the site was unoccupied for the rest of the year, particularly since the large pit and stone lined structures at the site may suggest the roasting and possible storage of large quantities of hazel nut.

The lithic assemblages: The use of typology and site structure is also unlikely to advance our understanding of activity within the region. As yet we have no clear methodology with which to approach the question of microlith function, although as suggested by Clarke (1976) and Finlayson (1990), there may be a case for a considering a greater range of uses than simply projectiles. However, so far there has been little attempt to consider assemblages along these lines. There may be some scope for considering aspects such as differential patination on microliths in terms of hafting strategies (Finlay pers com). However, without some means of objectifying patination, this may simply reflect the effects of internal colour and textural variability within the flint rather than shielding.

There may be scope for specialised versus generalised type approaches (Straus 1987), however little comparative work has been done so far on the non-microlith artefacts or edge damaged components within the assemblages. The approach followed by Mellars (1976) in his attempt to categorise Mesolithic sites in terms of lithic assemblages, may be argued as not particularly useful in the Scottish situation (Wickham-Jones 1990:166). With the larger assemblages on Islay, Colonsay and Rhum, there is the complication of closeness to raw material sources, which may have biased the assemblages towards what was being manufactured, rather than the plant and animal resources which may have been collected.

Settlement evidence: The lack of habitation features limit the extent to which models of seasonal settlement can be proposed. Even with slightly warmer conditions than today (Mellars 1987:20), undertaking fieldwork on Colonsay and Islay during January suggests that winters would have been a considerable challenge. With few obvious structural features, no comparisons can be made between sites in terms of seasonal occupation. Whether the lack of more substantial structures indicates a movement away from the islands during winter or simply a lack of survival is unclear.

At first sight the options for developing conventional regional approaches might therefore seem limited.

1.4. How the thesis proposes to develop a regional perspective

It was with these points in mind that I became involved with Dr Steven Mithen's Southern Hebrides Mesolithic Project in 1994. Previously I had taken part as an undergraduate volunteer, during which time it became clear that there were no easy solutions to the dilemma of these sites. Few structural, faunal and floral remains and virtually no spatial patterning (Thomas 1995) suggested that along with our lack of interpretative framework for the lithic assemblages, we could say little about what was going on either on the sites themselves. This begged the question of how to move beyond simply considering them in their own right. In particular, how could we move beyond the concept of site to get to grips with the region as a functioning unit, as it must undoubtedly have been.

One thing that was clear from assemblages on the Rhinns of Islay in particular was that significant flint working was being undertaken. By contrast, this suggested that elsewhere in the region for instance on the islands of Mull and Skye or even the mainland, that the relative lack of archaeological visibility may reflect the absence of raw materials, and therefore a lack of manufacturing activity.

This was the beginning of my interest in the geological sourcing of raw materials within the region, particularly the flint. The work of Wickham-Jones and Collins (1978) in particular had suggested that flint could be collected along many of the region's beaches. If this was the case, then the use of its movement as an index for mobility during the Mesolithic would be limited. However, if not then the potential for a study based on the sourcing and tracing of this material throughout the region would be considerable. It also represented the begging on my interest in experimental studies, and in particular the relationship between raw materials and their associated debitage assemblages. As such these represent the two potential methodologies employed in the study to investigate both assemblage variability and differential raw material use. How these were applied and the structure of the thesis is outlined as follows:

1.5. Scope and structure of the thesis

This thesis represents a processual approach to the question of Mesolithic mobility and raw material use for the west coast of Scotland. Spatially it extends from Arran in the south to Skye in the north, while it is chronologically limited to the Mesolithic, although excluding the Obanian type sites. It aims in particular to consider both the nature and scale of mobility within the region, through the analysis of the movement and differential use of cryptocrystaline lithic raw materials.

Chapter two begins with a brief introduction to the region and its archaeology. It begins with a description of the earliest evidence for occupation, and the debate concerning the non-geometric assemblages. The later Mesolithic is introduced by using the theme of occupation at the interface between land and water. Contrary to Finlayson (1990), I argue that location was orientated less towards the use of aquatic resources, than to the open conditions present at these interface zones.

Chapter three introduces a number of theoretical concepts concerning mobility and economic strategies among hunters and gatherers, and as such provides the essential underpinning to the interpretative chapters which follow.

Chapter four provides a brief introduction to lithic raw materials in the region. It then proceeds to outline in detail the results of the regional and island scale flint sourcing undertaken as part of this research.

Chapter five takes a regional look at the use of alternative raw material types, by focusing on the transport and differential use of bloodstone, quartz, flint and pitchstone. The discussion focuses in particular on the proportions of each type within assemblages from Skye to Arran. It also considers the types of artefacts being produced from each, in the context of mobile provisioning strategies.

Chapter six focuses down from the previous analysis, by looking in detail at a series of fieldwalked assemblages from Islay, the aim of which is twofold. Firstly, to investigate whether Mesolithic sites could be considered as isolated knapping events, or alternatively as integrated within the organised and structured use of the island. Secondly, to investigate provisioning strategies and small scale mobility patterns through the analysis of raw material distance decay models. Techniques applied include linear regression, mean proportions and dimensional analysis of platform cores, primary flakes and pebbles.

Chapter seven focuses again in detail by considering only excavated assemblages, again from Islay. In this case however, an additional component of the analysis includes the use of an experimentally generated comparative debitage assemblage. This is used as a template for the complete pebble to abandoned core reduction trajectory, against which the archaeological assemblages are compared. As with chapter six, they are assessed as produced either as unrelated knapping events, or the structured and organised use of the island. In addition, conclusions are drawn as to the nature of raw materials being introduced into the sites and subsequent knapping strategies.

Chapter eight integrates the previous six, with conclusions drawn as to the structure of Mesolithic settlement and mobility within the region.

CHAPTER 2

The region, its geography, geology and archaeology

2.1. Introduction

The chapter begins with a brief outline to the study region, its geography and geology. It then proceeds to discuss the earliest tentative evidence for human occupation in the form of tanged points and dates from northern Scotland. The possible broad blade assemblages are introduced in terms of their value as indicators of both early settlement and the survival of the tradition in Scotland. This is followed by a discussion of the extensive evidence for later Mesolithic presence, which takes as its theme the apparent bias towards occupation of the interface between land and water. It is argued that rather than aquatic resources, preferential location reflects the terrestrial benefits of settlement along the lower woodland margin.

2.2. The study area

The study area covers the western seaboard of Scotland and includes the islands of the Inner Hebrides. To the south the region is bounded by the Mull of Kintyre and the Isle of Arran, and to the north by Loch Alsh and the Isle of Skye, a strip approximately 270km long by 80km wide. A total of nine Inner Hebridean islands were incorporated, including Skye, Rhum, Mull, Iona, Colonsay, Oronsay, Jura, Islay, and Arran, as shown in figure 2.1. below.

The region is characterised by a diversity of topographic environments. Bounded in the east by the Grampian highlands, the coastal strip runs from the southern tip of the Mull of Kintyre up to Loch Alsh. To the west the region is bounded by the islands of the Inner Hebrides. These comprise a range topographic environments, from land below 200m as across most of Islay, to the volcanic peaks of Skye and Arran. The coastline is extensively variable, ranging from the exposed Atlantic cliffs and large sandy bays on the Inner Hebrides, to the mainland low level fjord type coast along the Mull of Kintyre, in the Oban area, Morvern and Ardnamurchan and up to Loch Alsh. Many of these coastal lochs penetrate far inland, for example Loch Linnhe and Loch Fyne both over 50km, and Loch Sunart almost 40km.

The present vegetational character of the region is equally varied although much of the patchwork of stunted forest, bog, open grassland, plantation and pastoral farmland represents the accumulated impact of long term human activity and increased oceanicity particularly from the early sixth millennium bp (Mellars 1987:74). A greater proportion of the region was probably covered with hazel-birch scrub from the mid tenth millennium bp (*ibid*:72), although the affects of storms and salt spray may have reduced the cover along the western edges of the Inner Hebridean islands in particular (McVean and Ratcliffe 1962).

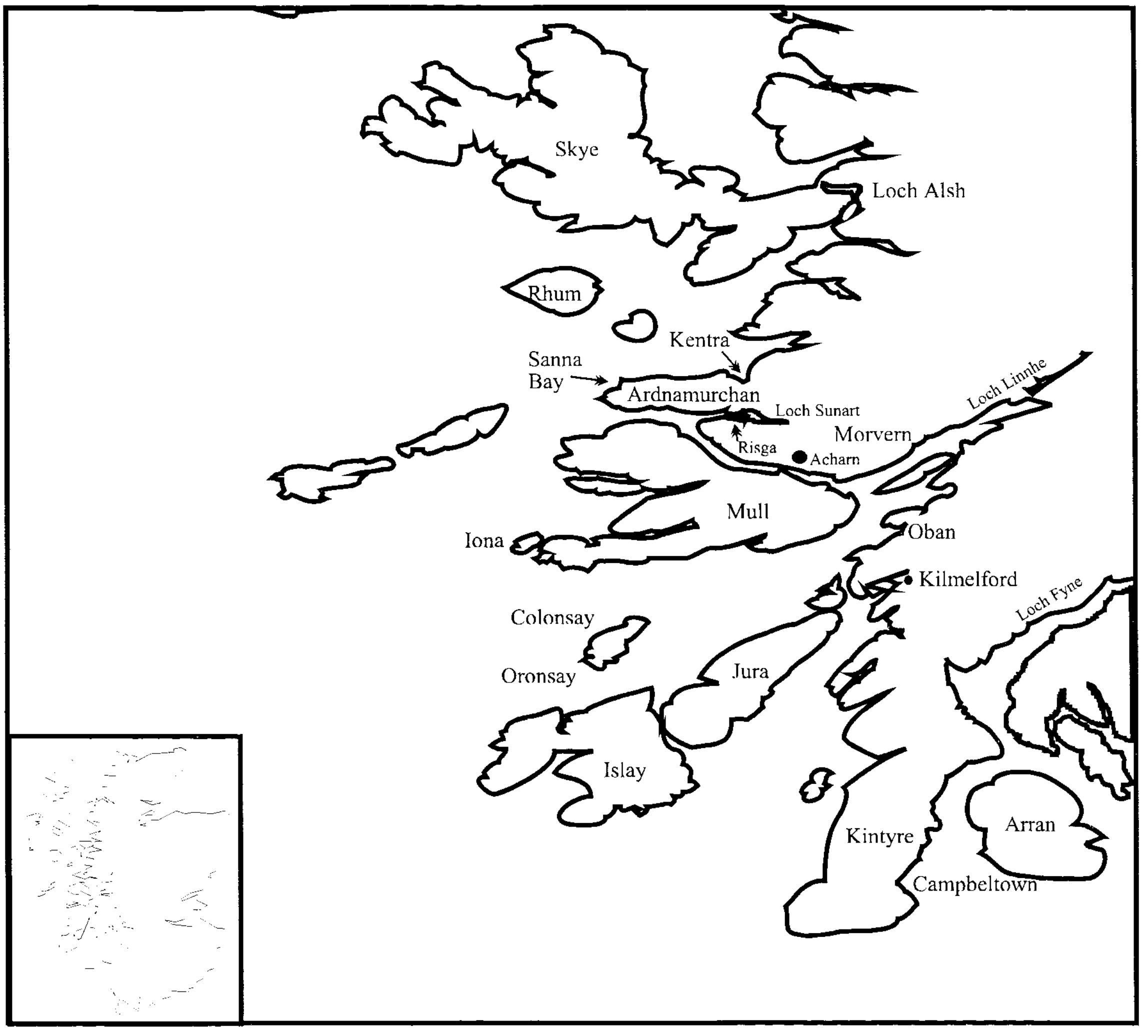

Figure 2.1. Map of the study region from Skye in the north down to Aran in the south (Plate Carree projection).

It is likely that the present scrub along sections of the south coast of Mull (Jermy and Crabbe 1978), eastern Colonsay (Mellars 1987) and eastern Jura is similar to that which probably covered much of the region during the Mesolithic.

2.3. Geological development of the region

An understanding of the geology of the area is necessary for this study which seeks to identify the importance of raw materials in the Mesolithic. The discussion begins with a brief overview of the late Cretaceous and Tertiary succession. This is followed by an outline of the Devensian glaciations and associated sea level change. A brief introduction to lithic types in the region is given, and the section concludes with a general discussion of the implications for Mesolithic settlement.

2.3.1. The late Cretaceous and early Tertiary

Uplift during the Late Cretaceous led to extensive erosion of earlier Cretaceous and even underlying Jurassic deposits (Hallam 1983). Continental movement during the early Tertiary and in particular the late Palaeocene to early Eocene around 66 to 50 million years ago created a spreading centre between Greenland and north-west Europe (Upton 1988). This resulted in extensive vulcanism at around 63 million years ago (Fyfe *et al.* 1993). This ended 52 million years ago, but with a peak towards the end of the Palaeocene at 59 million years (Musset *et al.* 1988). Sub-areal eruption of basaltic lavas from fissure systems and vents in Scotland (Emeleus 1991) and Antrim (Preston 1981) led to the capping of remnant Mesozoic deposits. Surviving onshore examples of these include the Skye-Canna region, up to 600m thick (Anderson and Dunham 1966). The Mull region with up to 1800m of deposit, which extend east to Morvern, north to Ardnamurchan, west to Coll, and south to the Firth of Lorne (Emeleus 1991; Fyfe *et al.* 1993). The final and best known region is Antrim which has a basalt capping of up to 800m (Fyfe *et al.* 1993). Continuing uplift during the late Eocene and early Oligocene around 37 million years ago resulted in the erosion of many of these earlier deposits, including both the Tertiary volcanics and Cretaceous chalks beneath. Subsidence during the late Oligocene around 27 million years ago, led to the accumulation of much of these terrestrial sediments in offshore basins (Fyfe *et al.* 1993). At the Eocene-Oligocene boundary, ice caps in the mid latitudes of North America and Europe had begun to develop, culminating in the rhythmic 100,000 year growth and decay cycles of the last 750 thousand years (Boulton *et al.* 1991).

2.3.2. The Devensian

The last of these cycles began approximately 120,000 years ago, within which there were two major cold phases, the first during the early Devensian at approximately 70,000 years ago, and the final more severe phase at 18,000 bp. The extent of Scottish ice cover during the early phase is unclear as ice margins were destroyed during the later more extensive phase (Dawson *et al.* 1988), but Scotland was essentially ice free by the mid Devensian. However, by 25,000 years ago the caps were again well established. Most reconstruction's (Boulton *et al.* 1991) suggest the Inner Hebrides were completely covered during the final glaciation. However this may not have been the case on Islay, where the Rhinns peninsular probably remained unglaciated (Dawson *et al.* 1988; Sissons 1981). By 13,000 years ago, milder conditions prevailed during the Windemere interstadial as the oceanic polar front migrated northwards, allowing the waters of the north

Atlantic Drift to once again reach the coast of western Scotland (Peacock and Harkness 1990; Ruddiman and McIntyre 1973). Temperatures rose close to those of the present day while plant communities developed towards closed vegetation cover in the lowlands and highland valleys (Walker 1984). As a result of isostatic rebound, relative sea level fell in those areas most effected by previous ice loading, to within a few meters of that of today (Boulton *et al.*1991; Jardine 1975). Cooler conditions returned however during the Loch Lomond stadial around 11,000 years ago, with temperatures between 7° and 9° Celsius lower than those of today (Bishop and Coope 1977). This lasted approximately 1,000 years with deglaciation finally complete by approximately 10,000 years ago. Limited isostatic rebound or at least stable conditions, combined with rising sea levels as a result of world-wide ice melting led to levels of the order of 1.5m above those of today.

During the Flandrian, temperatures ameliorated rapidly as a result of North Atlantic Drift waters once again reaching the coast of Scotland. From 8,500 years ago world-wide climatic improvement and the melting of the North American and Eurasian ice sheets led to increasing sea levels culminating in the main Holocene shoreline at between 6,500 and 5,500 years ago (Boulton *et al.*1991; Dawson 1984; Mellars 1987:25). The position of this varied in western Scotland according to the degree of isostatic rebound. At Oban for instance it stood at 14m above present sea level, declining in altitude to the west, south west and north west (Dawson 1984). On Oronsay it stood at approximately 7m above present sea level (Mellars 1987), on Jura it reached approximately 4.5 m, and on western Islay it lay at approximately 3.5m (Firth pers com). Isostatic rebound continued to operate particularly in areas close to the centre of previous maximum glacial depression. In the Malin-Hebrides sea area for instance, uplift continues at a rate of roughly 1.8mm per year (Fyfe *et al.*1993; Shennan 1989).

2.3.3. Implications for Mesolithic settlement

This brief introduction to the region's geology and glacial history highlighted a number of aspects of relevance to the early settlement of the study area. First of all, extensive erosion during the Late Cretaceous and Early Tertiary has removed much of the former chalk and flints. Only in a few specific locations was it preserved beneath a capping of basalt extruded during the Tertiary. This suggests that flint as a primary raw material exploited during the Mesolithic would have been spatially restricted. In addition, previous work in region has demonstrated the heterogeneous distribution of Tertiary chalcedonies and volcanics, in particular bloodstone (Wickham-Jones 1990) and pitchstone (Thorpe and Thorpe 1984) primarily from Rhum and Arran respectively.

The region would appear to have been ice free by around 13,000 bp, and the whole of Scotland by 10,000 bp, suggesting that the west coast in particular would have been potentially available for human colonisation prior to the Holocene. There is growing evidence that the western coastal strip of Norway was occupied by the early tenth millennium bp, and settled within a very short space of time, of the order of between 200 and 300 years (Bjerck 1995:138). The lack of a similar early presence in Scotland is curious (Woodman 1989:20). One reason for this may be to do with sea level rise. Early sites may have been located along the coasts, as suggested by the continued use of this interface during the later Mesolithic and Obanian. This would have led to the destruction of earlier sites (*ibid*:19), for instance around Oban with sea levels up to 14m above those of today during the main Holocene transgression.

2.4. The earliest evidence for settlement

Wasting of the Scottish ice cap after approximately 13,500 years ago, and in particular after the Loch Lomond stadial between 11,000 bp and 10,000 bp, provided the environmental context for the initial human colonisation of Scotland. The earliest evidence is contentious, none more so than the hand-axe from Islay (Wickham-Jones 1994). This appears to have been recovered from dunes along the west coast of the Rhinns at Machir Bay (Mithen pers com), suggestive of ballast dumping or wrecking. Dates of 10.080±70 bp (SRR-1788) from a dump of approximately 900 shed reindeer antler from Inchnadamph were thought by some to be associated with human collection and caching (Lawson and Bonsall 1986a, 1986b; Morrison and Bonsall 1989:136). The cave was excavated in 1926 (Callander *et al.* 1927), but unfortunately most of the deposit was discarded, however no stone artefacts were noted. This suggests that the site is more likely to represent a natural accumulation of shed antler (Wickham-Jones 1994).

Tentative evidence for a late glacial or very early post-glacial occupation of the west coast is present in the form of artefacts typologically defined as Ahrensburgian (Morrison and Bonsall 1989). Examples have been found on Tiree and Stronsay (Livens 1956), Jura (Mercer 1980) and Islay (Mithen forthcoming). However, none has so far been found in securely dated early contexts. The Islay point was recovered during fieldwalking on the eastern half of the island. Perhaps significantly it is unpatinated. The often extreme patination on artefacts from Later Mesolithic assemblages on Islay may suggest the piece as younger, an example of what Woodman refers to as "sports" (Woodman 1989:20). In addition, he highlights the danger of association by typology, particularly in the light of the two tanged points found at Cass Ny Hawin on the Isle of Man from within Mesolithic horizons dated to 7,700 bp (Woodman 1987).

In sum the evidence for a late glacial or early Holocene occupation of the region remains tentative at best. The hand axes are probably no more than curiosities, the Inchnadamph antlers most likely natural, while the tanged points are only suggestive (Woodman 1986) of a possible early presence.

2.5. The first real evidence for occupation

Prior to the advent of radiocarbon dating, there was a general consensus that the English Mesolithic could be subdivided into two typologically distinct phases (Clark 1932). With the subsequent accumulation of dated assemblages, it became clear that the period did in fact chronologically subdivide into two distinct phases (Jacobi 1973, 1976; Mellars 1974). In England, the earlier phase appears to have begun during the late 11th millennium bp, continuing until the mid ninth millennium bp, and characterised by a restricted range of large retouched artefacts. These included obliquely blunted points, trapezoids and isosceles triangles (Myers 1988), referred to as non-geometric (Clark 1932) or broad-blade after the descriptions of Francis Buckley (Radley and Mellars 1964). From the mid ninth millennium bp, artefacts reduced in size with assemblages increasingly dominated by small scalene triangles, rhomboids, rectangles and rods. These were referred to as geometric (Clark 1932) or narrow-blade, again after Francis Buckley (Radley and Mellars1964). This phase lasted until the beginning of the Neolithic around the mid sixth millennium bp (Jacobi 1976; Myers 1988:23).

This scheme has been used in Scotland to suggest an early presence, as well as the survival of broad blade traditions after their disappearance in England. However its applicability to the Scottish material remains in doubt (Wickham-Jones 1990:169; Woodman 1989).

2.5.1. The broad blade assemblages

Possible broad blade assemblages have been recovered from the from the east coast site of Morton (Coles 1971), the island of Jura (e.g. Mercer 1974, 1980), and from the mainland at Kilmelford Cave just south of Oban (Coles 1983) and the derived coastal site of Shewalton, Ayrshire (Lacaille 1930). The east coast site of Lussa Bay on Jura, contained an assemblage of possible broad blade affinity was recovered from the present intertidal zone (Mercer 1970). On the basis of illustrations, it does appear to contain a significant non geometric component, in particular the large triangles and trapezes (*ibid*:10 and fig 6). The assemblage also contained what Mercer described as "laterally-compressed leaning cones" (*ibid*:8, fig 4), and a number of regular steeply retouched end scrapers (*ibid*:12, fig 7).

Approximately 600m upstream from Lussa Bay, Lussa Wood 1 produced dates of 8194±350 bp (SRR-160) and 7963±200 bp (SRR-159) from charcoal within a series of three stone rings (Mercer 1980:7). Association with this feature, the lower excavated horizon produced a number of geometric and non-geometric artefacts, including a possible tanged point (*ibid*:11). A comparable assemblage was found at Glenbatric Waterhole on the southern edge of Loch Tarbert (Mercer 1974). Area G1 produced a series of steeply retouched non geometric triangles, trapezes, large scalene triangles and rhomboids (*ibid*:20, fig 10), along with a selection of cores and end scrapers similar to those from Lussa Bay (*ibid*:19, fig 9 and 26, fig 12). A few possible non-geometric artefacts have been recovered on Islay at Bolsay Farm (Mithen forthcoming) and Kindrochid 4 (Marshall forthcoming), and on the mainland at Kilmelford Cave just south of Oban (Coles 1983) and Shewalton (Lacaille 1930). However, these were isolated finds from assemblages dominated by geometric facies.

The extent to which the presence of a non-geometric element in Scotland reflects pre-ninth millennium bp occupation is unclear (Woodman 1989:9), since at Mount Sandel and the Isle of Man, they have been found within securely dated geometric assemblages (Woodman 1985, 1987). This is supported by Woodman's analysis of the non-geometric component of the Jura assemblages which suggest that the presence of trapezes is no indication of chronology as they occur on all sites (1989:13). However he does conclude that both Glenbatric Waterhole and Lussa Bay produced relatively greater numbers of isosceles and short scalene triangles, suggesting a possible early chronology (Jacobi 1982; Woodman 1989:13). Unfortunately, both sites are undated, although Bonsall has suggested that Lussa Bay was occupied sometime between the early and mid Holocene transgression, after 9000 bp but before 8000 bp (1988).

2.5.2. The survival of broad blade traditions in Scotland?

With the east coast site of Morton dated to 6100±255 bc (NZ-1191), and 4350±150 bc (Gak-2404), Lussa Wood 1 was taken to indicate the survival of a non-geometric tradition in Scotland (Coles 1971; Mellars 1974; Woodman 1978; but see Woodman 1989). However, with the secure mid ninth millennium dates from the geometric assemblage on Rhum (Wickham-Jones 1990), the hypothesis is no longer tenable. Similarly, occupation at Morton is more likely to represent two phases of occupation (Myers 1988). The earliest as yet undated, associated with the non-geometric artefacts, while a later geometric occupation probably dates to between 7,000 and 6,000 bp (Bonsall 1988; Myers 1988). Equally, Mercer's (1980) supposed non-geometric assemblage at Lussa Wood 1 may have been incorrectly associated with the dates from within the circular stone structures (Bonsall 1988; Woodman 1989). The transition from non-geometric to geometric forms, if in fact it did occur in Scotland, must have taken place sometime prior to the mid 9th millennium, broadly contemporary with the shift in England. The developed nature of narrow blade traditions on Rhum implies that earlier horizons should exist elsewhere, probably to the south. Whether these include Glenbatric Waterhole or Lussa Bay is open to question.

2.5.3. Reasons for the shift to narrow blade toolkits

Myers (1989) argued that the adoption of narrow blade artefacts reflected the changing relationship between the scheduling of technology and subsistence activities. This was in response to changes in environmental structure, particularly the migratory behaviour of herbivores. Climatic amelioration (Pitts and Jacobi 1979; Evans 1975) reduced the seasonal nature of the environment and thus the spatial and temporal predictability of species such as red deer. This changed relationship between hunter and prey led to increased time constraints on the scheduling of activities, as well as greater variety in mobility strategies, and consequently the range of lithic resources encountered (Myers 1989:88).

Conversely, Finlayson argues that the development of temperate woodland and less seasonal environments resulted in greater diversity in plants and smaller animals, in turn encouraging the use of wider ranges of smaller microliths (1990). His substantive objections to Myers' position would appear to be firstly that microwear analysis suggests a greater range of resources exploited than implied by microlith use as projectiles only. Secondly, he considers deer migration as of less importance in Scotland, particularly in the Inner Hebrides. He argues that location along the coast, around lochs and along river banks strongly suggests the use of aquatic resources (*ibid*:51). The bias towards sites in these locations is undeniable in western Scotland, however this does not necessarily mean that they were being positioned to take advantage of aquatic resources. Although their use is not denied, I argue that it was the terrestrial resources associated with the interface between water and land which encouraged occupation. These included ease of access and thus settlement along these natural pathways (Tilley 1994:86), made easier by only having to memorise and communicate spatial information in single rather than multi-dimensional space. Chase has noted that aboriginal populations of the Cape York peninsular in northern Australia (1984:112) who live along the coasts, had a much more accurate mental map of estate boundaries compared to those living further inland, where prominent spatial markers are absent. Moreover, the more open conditions along the waters edge would have attracted browsing animals and birds, encouraged the growth of plants such as hazel and soft fruits, while also providing some relief from the Scottish midge.

In the rest of the chapter, the region's sites are introduced and discussed in terms of location, and in particular the strong bias towards location along the regions coasts and rivers, and around it's lochs. The discussion suggests that occupation along the waters edge reflects settlement at the interface between woodland and the more open grassland strip typical of the coasts, or the wetter soils around inland bodies of water, rather than the use of aquatic resources.

2.6. The archaeology of the region, the narrow and possible broad blade sites

The following discussion introduces sites from the region by taking as its theme location at the waters edge. It starts with the mainland before providing a brief summary of each of the principal islands.

2.6.1. The mainland

The evidence for Mesolithic presence on the mainland is extremely poor. Whether this is due to a lack of occupation or simply a lack of visibility is as yet unclear, although as argued in Chapter 4 and 5, the latter explanation is considered more likely. Along the north coast of Ardnamurchan, a number of possible Mesolithic assemblages have been found eroding from dunes at Kentra (Lacaille 1954). In addition, Sanna Bay on the western tip of the peninsular produced a probable beaker cremation burial and shell mound, with an assemblage of rough flint artefacts, of which a few were of possible later Mesolithic facies (*Ibid*). At Acharn on Morvern, two Mesolithic scatters were surface collected adjacent to Loch Arienass (Ritchie *et al.*1975). Approximately 17km to the south of Oban, a small cave within Kilmelford Pass produced a flint and quartz assemblage of narrow blade character, with an additional possible broad blade component (Coles 1983). The cave is unlikely to have been located at the woodland edge, nevertheless it would have been within easy reach of the coast. At Campbeltown on the south east coast of the Mull of Kintyre, a collection of derived artefacts was recovered from within raised beach deposits at Millknowe, Dalaruan, and Albyn Distillery (Breuil 1922; Gray 1894; McCallien and Lacaille1941). Much of the assemblage appeared mixed although it did include a possible Mesolithic component. Although the record of sites from the mainland is particularly poor, all appear to have been located close to the coast or adjacent to rivers or lochs.

2.6.2. The Isle of Arran

The archaeological significance of Arran has long been recognised (Man 1918; Smith 1895), particularly in the context of the use of local pitchstone (Ritchie 1968; Thorpe and Thorpe 1984). The site of Auchareoch at 160m O.D., and 4km from the south coast of the island is dated to between 7300±90 bp (OxA-159) and 8060±90 bp (OxA-160), (Affleck *et al.*1988). Although not located directly overlooking water, a number of smaller tributaries of the Kilmory Water flow south approximately 300m to the west and 100m to the east of the site. In addition, a small basin to the south of the site may suggest that it previously overlooked an area of bog or even standing water.

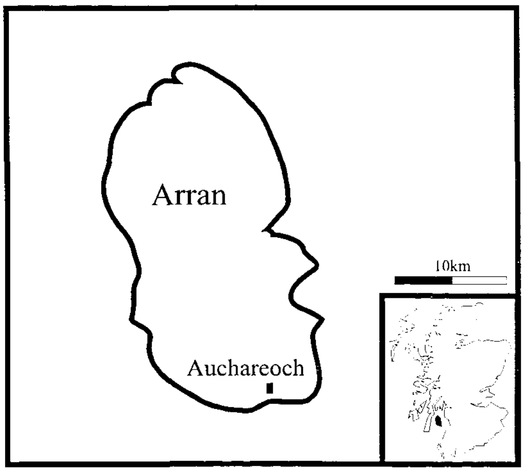

Figure 2.2. The Isle of Arran showing the location of the site of Auchareoch.

2.6.3. The island of Risga

Recent results of work on the island of Risga are suggestive of occupation prior to the Obanian, with a range of geometric artefacts of flint, quartz and bloodstone (Pollard *et al.* 1996:176). The island is small, of the order of 600m by 400m, with the site located on the eastern edge close to the water. The results of this work should provide more evidence as to the nature of the site and in particular the relationship between the narrow blade assemblage and shell midden. Interestingly, the island is located on what would have been the most efficient crossing point between Morvern and Ardnamurchan. Located adjacent to Loch Teacuis, down the valley from which lies Loch Arienas and the two Mesolithic scatters at Acharn, activity on the island may be suggestive of movement via this central Morvern access route.

2.6.4. The island of Jura

In considering the Jura assemblages it is important to keep Mercer's chronology in mind (after Mercer 1972; Woodman 1989).

Phase 1A: Late glacial occupation distinguished by tanged points at **Lussa Wood 1** (Mercer 1980).
Phase 1B: **Lussa Wood 1** dated by association with stone circles to 8194±350 bp (SRR-160) and 7963±200 bp (SRR-159), (Mercer 1980). **Lussa Bay** derived material, predating marine transgression (1970), and **Glenbatric Waterhole** floor G1 (Mercer 1974).
Phase 2: **Lealt Bay** (Mercer 1968), **Carn Southern Raised Beach** (Searight 1990), and **North Carn** dated to 7414±80 bp (SRR-161), (Mercer 1972). Also **Glenbatric Waterhole** floor G2 (Mercer 1974), and late occupation at **Glengarrisdale** layer 3b (Mercer and Searight 1986)
Phase 3: **Lussa River** dated to 2670±140 bc (BM-556) and 2250±100 bc (BM-555), (Mercer 1971) and **Glengarrisdale** layer 3a (Mercer and Searight 1986).

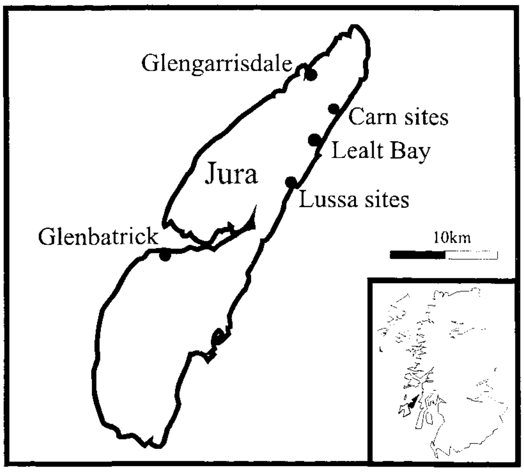

Figure 2.3. The island of Jura showing the location of Mesolithic sites along the west and east coasts

Lealt Bay: Produced an assemblage of 50,000 pieces of worked flint (Mercer 1968). From their position within maximum transgression deposits, they must have been manufactured prior to approximately 6,000 bp. The assemblage was assigned to a phase 2, mid 8th millennium bp occupation of the island (*ibid*:23). Located at approximately 15m O.D., 100m to the north west of Lealt Bay and flanked by low cliffs, the site would have provided an ideal landing and launching site for small boat crossings of the sound of Jura.

Lussa River: Located along the west bank of the Lussa River approximately 550m upstream from Lussa Bay and the village of Lussagiven, the assemblage contained a significant quartz component and, as with Lealt, large numbers of bipolar cores (Mercer 1971:25). With dates of 2670±140 bc (BM-556) and 2250±100 bc (BM-555), the assemblage appeared to represent a late development on Jura (*ibid*:5). However these probably correspond to later Neolithic activity at the site (Woodman 1989:16). On the basis of radiocarbon evidence, bipolar cores and the extensive use of quartz and quartzite, Mercer assigned Lussa River to his phase 3, mid fifth millennium bp occupation, and suggested a link between the assemblage and the Obanian middens of Oronsay (1971:24). Located less than 100m from the river, suggests that the site may have been placed at the interface between wooded and wetter more open ground. The river is presently flanked by a strip of damp grassland, along which the road to Lussagiven runs. Mercer noted that the strip was usually water-logged for part of the year (*ibid*:27).

North Carn: Dated to 7414±80 bp (SRR-161), the site produced an assemblage similar to that from Lealt Bay (Mercer 1972:4), which was assigned to a phase 2, mid 8th millennium bp occupation (*ibid*:18). Located along the northern edge of the Carn Burn, approximately 60m north west of North Carn Bay, the site is presently at 13m O.D., facing down towards the sea. Flanked by bedrock, the small bay would have provided an ideal launching and landing site for crossings of the sound of Jura to the mainland.

Carn Southern Raised Beach: Located 300m south of North Carn, the site produced a small assemblage of flint an quartz, which was attributed to a phase 2, mid 8th millennium bp occupation (Searight 1990:14). The site is located along the southern edge of a small plateau between 18m and 21m O.D., less than 100m to the north east of a possible launching and landing site within the small bay at Bogh a' Chuirn (*ibid*:8).

Glengarrisdale: Located on the north west coast of Jura, the site produced an assemblage attributed to a phase 2, mid 8th millennium bp presence. There was a subsequent late phase 3, mid to late fifth millennium bp occupation, along with an additional earlier rolled component (Mercer and Searight 1986:54). The site is presently at 11m O.D., approximately 300m south of Glengarrisdale Bay (*ibid*:42, ills1). Facing north, it would offered an ideal sheltered launching and landing site for small boat crossings, possibly to Colonsay.

Lussa Bay: Collected from within the bay, the assemblage consists of 4424 stained flints. Mercer suggested the assemblage was deposited either immediately before or after the last maximum transgression (1970). By contrast, Bonsall considers the site was occupied during the early Holocene, after 9000 bp but before 8000 bp (1988). No chronology was assigned to Lussa Bay, however following Mercer's scheme it would appear to represent a phase 1B, late 9th millennium bp occupation comparable to Glenbatric Waterhole Area G1 (1974) and aspects of Lussa Wood 1 (Mercer 1980). As derived material, little can be said about the location of the site. However, the recovery of the assemblage from within the bay may suggest that a component may have been washed down the Lussa River, suggesting a riverside location for the site.

Lussa Wood 1: Located 600m upstream from Lussa Bay and adjacent to the Lussa River, the site produced a series of three stone rings from within a shallow scoop, dated by charcoal to 8194±350 bp (SRR-160) and 7963±200 bp (SRR-159), (Mercer 1980:7). An early phase 1A occupation was proposed on the basis of the possible tanged point, and a phase 1B late 9th millennium presence for the rest of the assemblage (*ibid*:22). The site is similarly positioned to Lussa River although slightly higher up the gravel bank at approximately 16m O.D., facing down the valley towards Lussa Bay (*ibid*:3). As with Lussa River, this suggests that the site may have been located adjacent to the river, possibly at the woodland edge.

Glenbatric Waterhole: Located along the southern edge of Loch Tarbert, the site produced two lithic concentrations, areas G1 and G2 (Mercer 1974). Area G1 was assigned to a phase 1B, late 9th millennium occupation, while G2 was tentatively ascribed to phase 2, mid 8th millennium bp (*ibid*:13). The site is currently at 18m O.D., to the rear of a small bay facing due north. Flanked by exposed cliffs, the site would have provided an ideal sheltered landing and launching location for small boats, perhaps for crossings to the northern tip of Islay.

2.6.5. The island of Colonsay

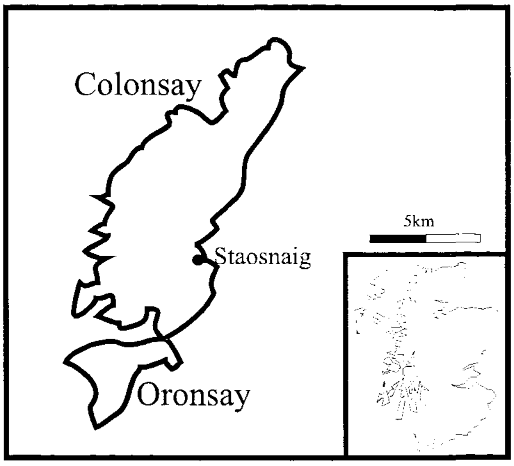

Figure 2.4. The island of Colonsay showing the location of the site of Staosnaig

Substantial evidence for activity on Oronsay, albeit later Obanian (Mellars 1987), suggested that similar or related sites would be found on the adjoining island of Colonsay (Mithen 1989; Mithen *et al.* 1991). Early discoveries of worked flint have included a selection of later Prehistoric artefacts from dunes along the north coast of the island (Lacaille 1954). Recent investigation has included fieldwalking, test pitting (Marshall forthcoming; Mithen forthcoming), excavation (Mithen 1989; Finlay forthcoming), and geophysical survey (Marshall forthcoming). A concentration of Mesolithic debris was located at the head of Loch Staosnaig, at approximately 20m O.D., while the small sheltered bay would have provided an ideal launching and landing site for small boats. The position of the site along the upper lip of late glacial beach deposits, again suggests occupation at the woodland edge.

2.6.6. Mull

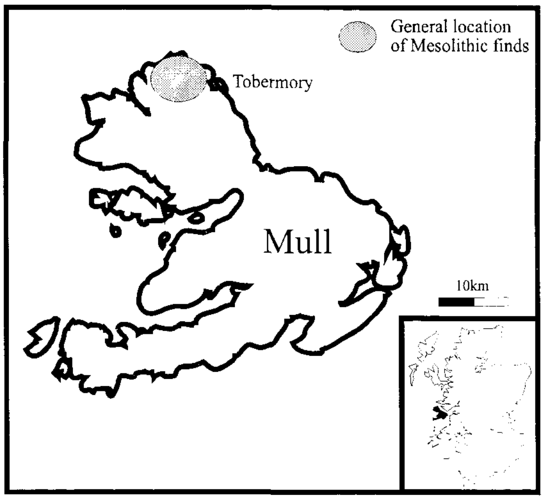

Figure 2.5. The island of Mull showing approximate location of Mesolithic find spots from the north coast of the island.

Evidence for Mesolithic activity on Mull is meagre, however, a small display in the local museum in Tobermory contains a number of platform cores. These appear to have been recovered during forestry work on the northern half of the island, although exact find-spots are unclear.

2.6.7. Rhum

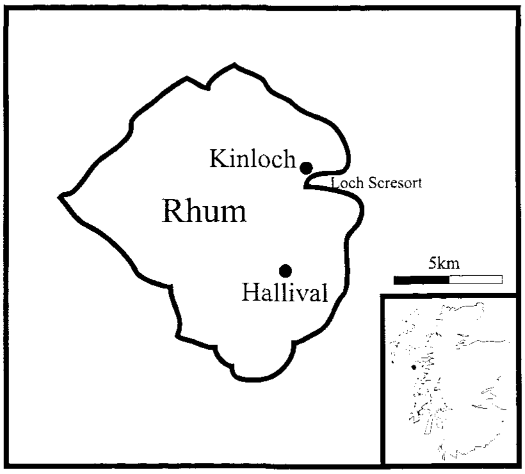

Figure 2.6. The island of Rhum showing location of Kinloch and Hallival

Excavations at the head of Loch Scresort produced a geometric assemblage which was dated to 8590±95 bp (GU-1873), and 8515±190 bp (GU-1874), both beyond calibration limits (Wickham-Jones 1990:135). The main lithic concentration was located at approximately 12m O.D., 150m north of Loch Scresort and approximately 30m south of a watercourse running from north west to south east across trenches BB and BC (*ibid*:29,30,43).

Fieldwalking across the rest of the island located a number of lithic scatters, suggesting activity around the island, particularly along the north and east coasts, although the chronology of these is unclear (*ibid*:149, 150). The only inland find was at Hallival, which consisted of a single barb and tang arrowhead of bloodstone (*ibid*:150). The presence of bloodstone at Kinloch indicates either that the coast was being traversed from Kinloch to Bloodstone Hill in the west, or more likely that the interior of the island was being crossed.

2.6.8. Islay

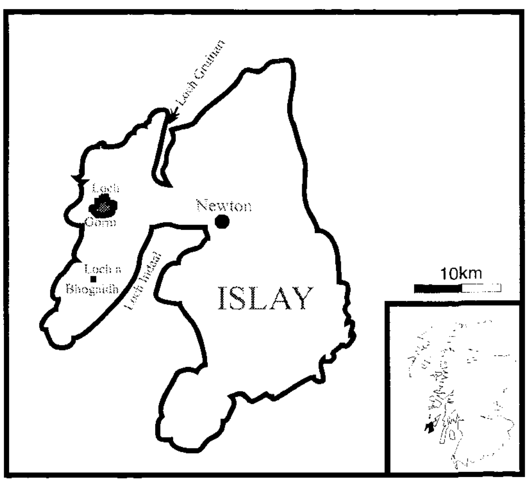

Figure 2.7. The Isle of Islay showing location of Newton and the Loch Gorm and Loch a' Bhogaidh basins.

For a more detailed discussion of fieldwalked and excavated assemblages from the island, see Chapters 6 and 7. The following discussion focuses initially on the site of Newton, it proceeds by outlining those located around the Loch Gorm and Loch a Bhogaidh basins, both fieldwalked and excavated, before briefly discussing a selection of fieldwalked collections from the rest of the island.

Newton: Located at approximately 20m O.D., the site contained evidence for both Mesolithic and later Prehistoric activity (McCullagh 1991). The assemblage from the lower end of trench 2 was of typical Mesolithic geometric facies, dated to 5855±90 bc (GU-1954) and 5815±225 bc

(GU-1953). The pollen evidence from the site suggests that it was located adjacent to fresh water in a wooded environment (*ibid*:47). Although the closest standing water is presently 700m to the north of the site at Loch Skerrols, a depression at the base of the slope immediately adjacent to the Mesolithic horizons in Area 2, noted during a visit to the site, may suggest the presence of standing water or at least wet ground prior to drainage.

The Loch Gorm sites: Located at 30m O.D., sites around Loch Gorm on the northern half of the Rhinns peninsular may suggest similar positioning as in the case of Newton. These include the sites of Kindrochid 4, Coulererach and Rockside, and the fieldwalked collections from Loch Gorm 3, 10, 11, 12, and 13 (Mithen forthcoming). All eight were located along the 30m contour, suggestive of positioning around the lower woodland edge. At Kindrochid 4, the presence of leached sterile sands at the lower end of trench 1, points to location at the edge of the local water table. In addition, boggy ground within a small basin to the east of the main debris concentration suggests that the site may have been located next to an area of fen.

The Loch a Bhogaidh sites: The location of the sites of Bolsay Farm and Gleann Mór (Mithen *et al.* 1992) both at 70m O.D., around the now empty Loch a Bhogaidh basin may reflect similar site placement, perhaps at the lower woodland edge. This may be complicated by the presence of seepage at Bolsay, and the small stream at Gleann Mór, however the similar altitude of both sites may suggest that the lower woodland edge was restricted to the 70m contour around the basin.

Other sites: The fieldwalked and test pitted site at Bowmore 10 (Mithen forthcoming) overlooks the Loch Indaal from a small spur approximately 50m south east of the Loch Indaal and at an altitude of between 20m and 30m O.D. Again this suggests the site as located at the edge of coastal woodland. Moreover, positioned immediately adjacent to a series of sand flats at the head of the Loch Indaal, it may suggest the landing and launching of small boats (Bjerk 1995:140) for crossings of the Loch. The fieldwalked sites of Gruinart 7 and 13 on the west coast of Loch Gruinart, at between 20m and 40m O.D., may suggest similar deliberate location, possibly at the woodland edge. As with Bowmore 10, both would have had extensive views over the Loch.
The fieldwalked sites of Bowmore 9 and 12 are located along the northern and southern edges of the Laggan River respectively. With higher sea levels, the former is likely to have been much closer to the sea than its present 2km. Bowmore 12 is located at approximately 30m O.D. immediately to the south of the river. The placement of both sites is suggestive of repeated location at the waters edge.

2.7. Discussion

The primary aim of this chapter has been to introduce the study area and its sites within a regional context. Since the aim of the thesis is to investigate regional settlement within the broad and narrow blade Mesolithic, only those sites containing artefacts typically associated with these periods are discussed. Although recent dates may suggest a chronological overlap between narrow blade contexts and a number of Obanian type sites, for instance Ulva Cave and Druimvargie, I would suggest that the relationship is still unclear. To incorporate them at this stage would, I believe, only serve to further complete an already patchy picture.

The outline of the geological succession and vegetational character of the region, followed by the discussion of sites in terms of location, highlighted four substantive questions concerning the Mesolithic of the study area. These are discussed here, but will be followed in more detail through the thesis. The first concerns the geological development of the region and suggests that the distribution of cryptocrystaline lithic raw materials would have been markedly heterogeneous. Secondly, the apparent bias towards site placement at the waters edge suggests consistent regional scale settlement structure. Thirdly, sites placed at coastal nodes and along inland pathways suggest structured regional scale mobility through open water travel. Finally, there is a marked heterogeneity in the visibility of specific locations, particularly the islands of the Inner Hebrides, which suggests either more intensive exploitation, or alternatively some other factor exaggerating their visibility.

2.7.1. Knappable quality raw materials, a patchy resource

The introduction to the regions geological succession highlighted that all of western Scotland would have formed part of a large depositional basin during the Late Cretaceous, however extensive uplift and erosion during the subsequent Tertiary removed much of this material. Only in a few places does this remain preserved under cappings of basalt. The principle outliers include those in Antrim, and the deposits on Morvern and Mull. This suggests in terms of in-situ flint, a markedly heterogeneous distribution. The presence of the Morvern deposits in particular, have been argued as exploited from the site of Risga (Lacaille 1954; Morrison 1980; Pollard *et al.* 1996).

In addition to these few in-situ outliers, extensive erosion during the Tertiary suggests that derived flint deposits should exist throughout the region. In the context of coastal processes this explains the suggestion that flint should be found on the beaches throughout the region (Wickham-Jones and Collins 1978:7). As with the in-situ deposits, this point has been picked up on by other authors when discussing regional beach flint use (Wickham-Jones 1990:51; Woodman 1989:6). In both cases however, these inferences appear to have been made on the basis of publish geological reports, rather than actual investigation of the viability of the resources or the validity of assuming region wide distribution (but see Mercer 1974:16 concerning flint from Malcolm's point, Mull). These interpretations particularly concerning the presence of beach pebble flint remain questionable, and are discussed further in Chapter 4. For the moment however, what I wish to highlight is that cryptocrystaline raw materials had a heterogeneous distribution, including Rhum bloodstone (Wickham-Jones 1990) and Arran pitchstone (Thorpe and Thorpe 1984). This suggests that considerable scope exists for considering their movement and differential use during the Mesolithic as a means for investigating regional mobility. This is used as the starting point for the discussion in Chapters 4, 5, 6 and 7.

2.7.2. Life at the water's edge, Mesolithic regional settlement integration

Finlayson presents what he refers to as an integrated model of subsistence and settlement for the region, with the suggestion that the shift towards smaller geometric toolkits enhanced access to the greater range of resources, including aquatic (Finlayson 1990:51). Two lines of evidence are used to support his case. The first is the apparent bias towards sites located along the coasts, lochs or rivers, while the second is the presence within Obanian contexts along the west coast, of shellfish, fish and seal (*ibid*). This latter point rests on the demonstration of a chronological overlap between Obanian type fossils and the earlier geometric assemblages, for instance at Druimvargie and Ulva (Bonsall and Smith 1993; Russel *et al.*1995). However I would argue that the Obanian as an additional aspect of generalised Mesolithic subsistence is still open to question. To simply extrapolate from Obanian site placement to infer a similar emphasis on aquatic resources in the narrow blade sites may not be justified. There are other factors besides the extraction of aquatic resources which may have encouraged settlement at the waters edge. While this does not rule out the use of aquatic resources, I would argue that occupation along coasts and rivers, and around lochs, was primarily to take advantage of the terrestrial resources attracted and encourage by the less wooded nature of these interfaces.

It is likely that much of the region would have been significantly more wooded during the Mesolithic than it is at present (Birks 1977; Mellars 1987), although McVean and Ratcliffe (1962) suggest that the western fringes of the islands of the Inner Hebrides and the mainland may have supported less extensive growth. Although the upper woodland limit may be difficult to define, its lower edge would be have been determined along the coasts by active beaches and salt spray, and around lochs and along rivers by waterlogging. The strip between the water, whether marine or fresh, and the woodland edge would have been dominated by grass and sedge. The more open conditions would have encouraged light sensitive species such as hazel, which is also tolerant of waterlogging (Rackham 1980:207, 210). Soft fruits also tend to be more productive along the open interface, for instance blackberry are common along the south coast of Mull. Moreover, the open grasslands would have attracted grazing animals and birds, both aquatic and terrestrial, which could be hunted either through encounter or intercept strategies. An additional advantage of the water to woodland interface would have been the speed and ease with which the landscape could be traversed. By following these natural pathways (Tilley 1994:86), the difficulties of navigating through woodland would be avoided, by reducing the need to locate places in two dimensional space. In fact by using the interface, the landscape need only be remembered and communicated in one dimension, for instance the walking time from a prominent point. The considerable advantages of the open conditions at the water to woodland interface are likely to have encouraged settlement, although this does not mean that aquatic resources were being ignored, or even that sites were being positioned for the same reasons throughout the region. It does suggest however, that more labour intensive and inherently risky aquatic based strategies may have been of less importance than terrestrial ones available at the waters edge.

By focusing on site location, the above discussion has arguably side-stepped the issue of the shift towards narrow blade traditions, if in fact it did occur in Scotland. I agree with Finlayson (1990) and Myers (1989), that it suggests an adaptive response to changes in environmental structure. Although as discussed above, Myers' model may be less applicable on islands, while I find Finlayson's integrated hypothesis and in particular the focus on aquatic resources, less convincing.

2.7.3. Nodes and pathways, interregional mobility

Site placement along the coasts of the region strongly suggest the launching and landing of boats for crossings between the islands, and between the islands and the mainland. These generally require sheltered shelving sandy beaches, although not extensive mudflats (Bjerk 1995:140). Much of the coastline of the region is characterised by cliffs and rocky foreshores, for instance along the east coast of Jura, Islay or Mull. The location of the east coast sites on Jura (e.g. Mercer 1968, 1970), suggest that crossings to the mainland, approximately 6km to the east were being regularly undertaken. The west coast sites of Glenbatric Waterhole (Mercer 1974) and Glengarrisdale (Mercer and Searight 1986) may suggest crossings to Islay and Colonsay respectively. Similarly, on Islay the site of Bowmore 10 within the Loch Indaal may suggest crossings of the loch to the Rhinns peninsular (see Chapter 6). East coast sites including Staosnaig on Colonsay and Kinloch on Rhum suggest crossings from other islands to the east, while the location of the site of Risga within Loch Sunart suggests a staging point along the optimal crossing route from Morvern to the Ardnamurchan peninsular. At the regional scale coastal sites can be incorporated within a model of extensive interregnal mobility through the use of boats. This point is picked up on further in Chapters 5, 6 and 7.

2.7.4. Archaeological visibility, intensive occupation or site formation process

Evidence for Mesolithic occupation of the islands of the Inner Hebrides, particularly the Southern Hebrides archipelago, Rhum and to some extent Arran, is far more pronounced than elsewhere in the region. This may reflect a relative lack of research elsewhere in the region, particularly along the coastal lowland strip, and the uplands. Compared to the broadly comparable Norwegian situation, the lack of visibility in Scotland away from the islands of the Inner Hebrides is curious (Woodman 1989:27). Along the south western coastal strip of Norway, occupation was coastally focused (Indrelid 1978:169), while there appears to have been only a minimal presence in the highlands between the major fjords (Bang-Andersen 1989:339). However there was evidence for contemporary sites located within the interior uplands (*ibid*:340; Bang-Andersen 1995), most of which were located along lakes and rivers, suggesting logistically organised reindeer hunting (Mikkelsen 1978). The presence of flint in the uplands points to connections with the coast, suggesting seasonal use (Bang-Andersen 1989; 1996). One point emphasised by the upland sites is the small size of the assemblages, in which retouched artefacts are particularly rare. Around the lakes of Ovre Storvatnet and Gyvatnet in central southern Norway, artefact densities ranged from just over 100 pieces per square meter at locality 145, to just 0.8 at locality 148 (Bang-Andersen 1989:344, table 2). This may suggest that upland sites in Scotland, if they do exist, are going to be difficult to find. However there is also the possibility that the use of the Norwegian analogy may be misleading. More extreme seasonality and fragmentary landscapes may have encouraged relatively greater levels of seasonal mobility. The larger islands of the Scottish west coast would probably have been less seasonal, and may therefore have been able to support more continuos and stable occupation without recourse to upland resources. Clearly this is a question which needs to be addressed through new survey on the islands of the Inner Hebrides, and on both the lowland coastal strip and uplands of the mainland.

The alternative explanation for the lack of visibility away from the three hotspots of the Southern Hebrides archipelago, Rhum and Arran may be to do with site formation processes, particularly access to lithic raw materials. This is supported by the density of residues on the latter two islands, from which bloodstone and pitchstone respectively can be collected. The suggestion is that a similar situation may have resulted in the extreme visibility of Islay, Colonsay and Jura. This point is discussed further in Chapters 4 and 5 in particular.

CHAPTER 3

Models and concepts in the study of raw materials and lithic technologies

3.1. Introduction

The purpose of this chapter is to provide a theoretical framework for investigating the regional and site data from the Mesolithic of Western Scotland.

3.2. Chapter structure

The chapter is organised around three broad themes, looking in particular at strategies adopted by hunters and gatherers to cope with both spatial and temporal heterogeneity in the distribution in energy. The first introduces the concept of **settlement and mobility strategies**, and in particular looks at the collector forager continuum and associated site or scatter based signatures. It proceeds by considering effective temperature as a measure of seasonality, and the concepts of time stress and risk. The second theme focuses on **lithic raw material strategies**, and includes a discussion of the mechanical and functional imperatives behind differential selection and use. It proceeds by considering the effects of mobility on the degree to which raw material collection could be incorporated within daily or seasonal behaviour, while also assessing the potentials for research offered by the tracing of lithic transfers. The third theme shifts the focus from raw materials to **artefact strategies** by considering aspects such as design, portability and provisioning. These are discussed in terms of site or scatter based archaeological signatures, and as with settlement and mobility, in relation to the concepts of time stress and risk.

3.3. Settlement and mobility strategies

The framework followed here examines mobility along the collector-forager continuum as initially proposed by Binford (1980), and recently thoroughly examined by Kelly (1992, 1995).

3.3.1. The collector-forager continuum

Effective Temperature, or E.T., provides a measure of the degree of seasonality, reflected primarily in terms of primary plant biomass production (Bailey 1960). Although high primary biomass is not a reflection of the amount available for human consumption, E.T. provides a measure of the degree to which resources are seasonally available. High E.T. values correspond to less seasonal environments in which resources are regularly distributed both spatially and temporally. However they tend to be dispersed, solitary and difficult to get at. Low E.T. values are found in highly seasonal plant poor environments such as the Arctic, where plant biomass is minimal. In this case, animals both aquatic and terrestrial provide the bulk of the resources. As a result of extreme seasonality, these tend to be available for limited periods of time at predictable locations, for instance along the migratory routes of herbivores. Alternatively, they can be dispersed and unpredictable, such as seals at sea ice breathing holes.

These variations in the spatial and temporal distributions of energy are dealt with in varying ways by hunters and gatherers, primarily through the organisation of mobility. In an influential model, Binford (1980) proposed that the essential difference between groups living in regions at each end of the E.T. continuum, is that foragers move consumers to resources while collectors move resources to consumers. Foragers move between locations where they locate as a group in order to exploit an area, and are referred to as residentially mobile. Collectors on the other hand send out logistically organised groups in order to collect resources and to transport them back to the residential base. Rather than an encounter strategy as practised by foragers, collectors intercept resources at specific locations. To illustrate this dichotomy, Binford (1980) used two groups living in very different environments.

3.3.1.1. Residentially organised foragers

The !Kung of the central Kalahari (Lee 1979), were taken as archetypal residentially mobile foragers. Camps are positioned within short distances of a patch of resources, which are then generally exploited on a daily basis. Resources acquired tend to be utilised soon after collection, in other words a system in which immediate returns on energy invested predominates (Woodburn 1980:97). Resources are exploited until no longer productive, at which stage the individual or group moves on. Typical of this mode of subsistence is the value placed on both freedom of movement and an avoidance of property accumulation. This lack of investment in belongings tends to result in an ephemeral distribution of debris, while spatial redundancy results in a diffuse but at the same time fine grained (Binford 1980), and off-site (Foley 1981) archaeological signature. Fine grained signatures are created typically by the foraging end of the continuum where place is of less importance than the patch as a whole. Although clumped to some extent, the distribution of resources within each patch are sufficiently random so as not to result in deliberate and repeated use of specific locations. Activity is spread across the whole of the landscape, and thus the archaeological correlation between activity and debris tends to be less repetitive but more immediate.

3.3.1.2. Logistically organised collectors

At the opposite extreme, the Nunamiut of central Alaska provision themselves through logistically organised intercept hunting, often far from the residential hub (Binford 1978). These tend to be located close to critical resources such as fuel and shelter. Hunters range out for longer periods of time, collecting resources from repeatedly occupied locations along the caribou annual migration route. Spatial and temporal heterogeneity of both landscape and resources, as well as the often extreme distances involved, dictate that materials collected are only utilised at some time after collection. Delayed returns (Woodburn 1980:98) are therefore a result of both distance and the very brief windows of abundance typical of highly seasonal environments. These brief although abundant periods tend to be spatially predicable, resulting in the repeated use of strategic locations, and produce a coarse grained site based archaeological signature (Binford 1980; Foley 1981).

3.3.1.3 Serial specialists

Although presented as an illustrative dichotomy, a number of groups living in highly seasonal environments with low E.T. values are noted as practising levels of residential mobility higher than expected, and therefore difficult to fit within the collector model (Binford 1980:17). These include Arctic groups such as the Copper (Damas 1972), Netsilik (Balikci 1968), and Baffinland Inuit (Hantzch 1977), and equestrian bison hunters such as the crow (Ewers 1955). These groups could be included within what Binford (1980:17) referred to as serial specialists. As foragers in more temperate environments, residential mobility allows these groups to position themselves with respect to food resources. However, unlike other seasonal environments in which resources tend to be dispersed but clumped both spatially and temporally as in the case of the Nunamiut, those available to the Netsilik, Copper and Baffinland Inuit tend to be dispersed and solitary (Kelly 1995:129). Seal hunting by the Copper Inuit requires frequent movement of the order of 16km (Damas 1969: Kelly 1995:129). Since the animals tend to return to the same breathing hole, once taken, they would be of little use and the group would have to move on. The Netsilik move 14 time a year covering an area of 6,000km^2, with an average distance per move of 16.8km (Kelly 1995:112). During midwinter and spring, they hunt seal at breathing holes, while during summer and autumn they move inland, subsisting on fishing and the opportunistic hunting of solitary caribou (Balikci 1968:79; Damas 1972:13; Kelly 1995:129). The Baffinland Inuit cover an annual range of 25,000km^2 through 60 residential moves each of an average of 12km (kelly 1995:112). In terms of mobility strategies then, the three groups from highly seasonal environments outlined here appear to be organising themselves along similar lines as residentially mobile foragers. Plains bison hunters such as the Crow were extensively mobile through the use of horses (kelly 1995:129), and moved 38 times a year with an average distance per move of 19.2km, covering a total annual area of

61,880km^2 (Kelly 1995:113). Although bison are gregarious, the herd is less spatially constrained and therefore once hunting was initiated, the numbers within settlement catchments would decline as the animals were killed and scared off, forcing the group to move on. As with the Inuit groups discussed above, the Crow who live in a highly seasonal environment operate a residentially organised foraging mode of subsistence.

3.3.2. Time stress and risk

Although Binford's (1980) model draws a valid dichotomy, it must be said that much of the difference noted between these two extremes reflects the scale and degree of risk in failing to meet dietary requirements (Torrence 1989a:60). The unforgiving nature of high latitude environments requires foresight and planning if the brief windows of opportunity are not to be missed. By scheduling activities, conflicting demands on time during critical periods is avoided (Smith 1979:53; Torrence 1983). The main difference between the two groups highlighted in Binford's study is the way in which larger animals were hunted. The predictability of these in terms of numbers, movement and aggregation is structured by the degree of seasonality which an environment experiences. A useful measure of seasonality is effective temperature (E.T.), a measure of both the amount and duration of solar radiation (Binford 1980; Kelly 1995).

3.4. Lithic raw material strategies

3.4.1. Mechanics and morphology

Fracture consistency provides a key measure of the degree of control which can be applied during blank manufacture (Dibble and Whitaker 1981; Whitaker 1994). Formal artefacts requiring standardised blank forms are best produced on materials which are homogenous, and which fracture conchoidally on impact. Examples of these include amongst others, chert, cryptocrystaline silicates, obsidian and fine grained volcanics (Whitaker 1994). Chert tends to be the toughest, although considerable variability exists within the group. Homogenous obsidians, silicates and volcanics are easier to work although slightly more brittle and thus more likely to snap during manufacture and use. Macro-crystalline materials such as quartz crystal are harder and therefore more brittle than chert, and consequently fractures more frequently. For other more expedient artefact forms, such as choppers, anvils and hammers, coarse grained volcanic and metamorphic lithologies are suitable.

The differential use of raw materials of varying quality has been noted in a number of French assemblages. At Marillac (Meignen 1988), notches and denticulates tend to be manufactured of lower quality materials, while the small size of raw materials at Pech de L'Aze, Orgnac, Combe Grenal and Corbiac, results in smaller dimension levallois flakes (Dibble 1983:62, 1985).

3.4.2. Distance to sources and procurement strategies

Distances over which raw materials were moved can provide an index as to the size of exploitation ranges (Feblot-Augustins 1993:212; Gamble 1986:331; Geneste 1988; Kuhn 1991, 1995:27; Rensink 1993:105; Roebroeks *et al.*1988). The work of Geneste in particular, identified a series of significant shifts in assemblage structure with increasing distance. These included the local zone within a 5km radius from which 85% to 95% of all lithic material was collected. An intermediate zone between 5km and 20km, from which 5% to 20% was sourced, and a distant zone from 20km onwards, from which only 2% of lithic raw material was generally collected (Feblot-Augustines 1993:215; Geneste 1988:63). Materials coming from more than 20 km were invariably introduced as retouched tools or ready-made blanks.

Patterns of mobility determine the extent to which collection of lithic materials can be embedded (Binford 1979) or nested within the collection of other resources. High residential mobility increases the potential numbers of resources encountered, while at the same time limiting the predictability of being able to collected from a specific location. Bamforth (1986:40) argues that technological organisation is structured by the spatial distribution of lithic raw materials, and that curation or artefact maintenance in particular was closely related to scarcity. Maintenance and recycling were dependant on the availability and accessibility of replacements, which were in turn structured by mobility patterns which either limited or enhanced access. Bamforth's case studies demonstrate that changing patterns of mobility resulted in differing levels of access, which in turn led to changes in the level of maintenance and recycling (see also Jeske 1989:34). A clear relationship existed between the distribution of raw materials and both the scale and intensity of mobility. Similarly, in the Italian west central coastal Mousterian sites of Grotta Guattari and Grotta di Saint' Agostino, lithic assemblages were structured by access to raw materials and changes in the subsistence settlement system (Kuhn 1991, 1995). In both cases, the degree to which settlement was residentially or logistically organised, determined the extent to which alternative lithic sources were encountered and used.

Changes in accessibility can result from longer term alterations of climate. Rolland and Dibble (1990) argue that climatic deterioration influenced Middle Palaeolithic tool morphology by affecting the availability of raw material, while sea level change on the island of Jersey is suggested as having limited access to stone outcrops at La Cotte (Callow 1981; McBurney and Callow 1971).

3.5. Artefact strategies, form and design

Technology represents a primary adaptive response to the organisation and maintenance of energy, and as such its primary role is the reduction of risk (Oswalt 1973, 1976; Smith 1979; Torrence 1983, 1989a, 1989b). This view of technology resulted from the move away from the culturally deterministic type fossils of the first half of this century. In particular, it had its roots in processual approaches of the 1960's, which emphasised the notion of artefact strategy as problem solving process (Gamble 1986:13, 38; Nelson 1991:58). On a practical level, this paradigm shift led to renewed interest in the function of artefacts (Binford 1973; Binford and Binford 1966, 1969; Dibble 1983, 1984; Mellars 1969, 1970; Rolland 1977, 1981), as well as other aspects of the archaeological record, for instance animal residues (Behrensmeyer and Hill 1980; Brain 1981; Hill 1983, 1984; Stiner 1991), and site and assemblage formation processes (Foley 1981; Schiffer 1972, 1976). At a theoretical level, the shift led to considerable debate as to how to interpret the archaeological record (Binford 1981, 1989; Binford and Stone 1985; Bordes 1973; Bordes and de Sonneville-Bordes 1970; Freeman 1973, 1981, 1983; Gould 1978, 1980, 1985; Gould and Watson 1982; Gould and Saggers 1985; Sackett 1973).

In this section a number of theoretical concepts concerning artefacts are introduced, beginning with the principle of portability, and leading on to a discussion of Binford's (1977, 1978, 1979) technology states, and Kuhn's (1994) provisioning model. It then outlines the value of considering technology within the concepts of risk (Torrence 1989b) and artefact design (Bleed 1986).

3.5.1. Portability

One obvious factor to examine is the extent to which choices about artefacts are conditioned by the need to carry them. Increased portability through size reduction would be advantageous for mobile hunters and gatherers, since reducing the weight carried in the form of technology increases the quantity of other resources which can be carried (Ebert 1979; Gould 1969; Nelson 1991). The potential for size reductions in terms of technology is substantial, either through the use of smaller standardised elements (Kuhn 1994), or more versatile tool-kits (Kelly 1988; Shott 1986). The energetics of transportation can be considered in terms of cost benefit relationships, which suggest that transportation costs are primarily a function of mass and the type of terrain traversed (Brannan 1991). Since the latter cannot be controlled for, limiting transport costs are best achieved through mass reduction. The use of lightweight alternatives to stone, smaller more highly stressed composite artefacts, multifunctional tools, transported cores, and the caching of critical elements represent some of the ways in which this can be achieved.

The transport of cores and prepared blanks is used by Kuhn (1994) to model the utility of alternate raw material strategies. The results of his study suggest cores as the most efficient single artefact to carry, although if the use of more than a single tool was envisaged, then the best overall strategy would be to carry a selection of smaller blanks and retouched pieces (Kuhn 1994:435).

An important aspect of the principle of portability lies in its affect on how much of technology could be carried before negatively effecting the transport of other resources. Although clearly not the only determinant, effective weight reduction balanced against minimal loss of efficiency would be an advantage, for instance in terms of cutting edge (Kelly 1988; Kuhn 1994:437; Gould 1969:76; Shott 1986). As argued above, this can be achieved through standardisation, multifunction tools or the use of light weight alternatives.

3.5.2. Artefact states

In a series of influential papers concerning the Nunamiut Eskimo, Binford outlined a number of ways in which technology is organised in order to maximise returns for a given weight carried (1977, 1978, 1979). In these three papers he presents a tripartite division of technology, **active gear** (Binford 1979:261), **passive gear** (*ibid*:256), and **insurance gear** (Binford 1977:31, 1979:257).

Active gear

Active gear comprises that in use and includes **personal gear** (Binford 1979:262) carried regularly by the individual, **site furniture** (Binford 1978:329, 1979:263), and **co-opted situational gear** (Binford 1979:264). Personal gear is essentially anticipatory in character and consists of artefacts regularly carried by the individual. In particular they include those directly associated with specific tasks, the well being of the individual, and emergency gear (*ibid*:262). Site furniture includes artefacts associated with the functioning of specific places and include items such as hearth stones, hearths and anvils (*ibid*:264). These remain as fixed features to be used and reused during subsequent visits. Situational gear comprises artefacts co-opted whatever is to hand, in response to contingencies (*ibid*). Once used, they are either dismantled or simply discarded.

Passive gear

Passive gear includes seasonally specific gear in storage (Binford 1979:257).

Insurance gear

As opposed to seasonal passive gear, insurance gear provisions the landscape with what may be needed in the future (Binford 1979:257). It may take the form of site furniture not in use, or small caches at prominent points in the landscape.

3.5.3. Provisioning of people, provisioning of places

A similar approach to the organisation of technology has recently been presented by Kuhn, in which he suggests a dichotomy between the **provisioning of people**, and the **provisioning of places** (1995:22). Provisioning of people involves equipping individuals with what Binford refers to as personal gear (Binford 1979). On the other hand, provisioning of places involves gearing up of strategic locations in the landscape with either the means of production, raw materials, or finished artefacts, or both (Kuhn 1995:23). As he points out, the balance between the two strategies will depend on the extent to which artefacts and raw materials can be carried, and the predictability of being able to access resources through technology, as they become available (*ibid*). The technological signatures of the alternate strategies may be expected to differ. Mobile toolkits need to optimise the potential of individual artefacts in relation to carrying costs (*ibid*:25), resulting in more extensive maintenance (Kelly 1983, 1988; Shott 1989), particularly in the context of raw material scarcity. Places on the other hand would be expected to be characterised by a maximisation of versatility, while relatively increased availability of raw materials would tend to result in less intensive maintenance (Kuhn 1995:24).

3.5.4. Technology, time and risk

The extent to which time scheduling and risk management in particular provides a selective hone on technology has been extensively studied by Torrence (1983, 1989a, 1989b). In seasonal environments, time scheduling provides an effective means of avoiding temporal conflicts in terms of resources available for only short periods (Binford 1978; Jochim 1976). The Copper Eskimo of Banks and Victoria Islands, northern Canada spend four weeks during late November and early December repairing clothing and tents while living off stored foods, after which a move is made to sea ice for seal hunting (Damas 1972:13). This period of enforced down-time provides the context for essential maintenance and repair of technology. In terms of Oswalt's (1973, 1976) typology of tool types, the increased risks involved in not accessing these resources suggests that technology would tend to be more complex, comprising relatively greater numbers serial technounits and parallel subsistants. The degree to which tool-kit specialisation would be adopted can therefore be related to ecological productivity, in turn dependant on latitude (Gamble 1986:38).

3.5.5. Artefact design, reliable and maintainable

In an influential paper, Bleed has argued that technology can be considered within the context of the principles of engineering design (1986), as either **reliable** or **maintainable** . Reliable systems operate come-what-may, with over-designed strong components, and parallel subsystems as backups. Parts are well made and maintained by specialists using a generalised repair kit at specific intervals. Maintainable systems on the other hand are light and portable with elements arranged in series. Repair kits tends to be specialised, consisting either of ready to use elements, or the means for their production, for instance blanks or cores. The artefacts are maintained by the operator as they fail.

To illustrate the contrast, Bleed compared the !Kung San and the Amazonian Yanomamo, with the Nunamiut and the Copper Eskimo (*ibid*:743). The toolkits of the !Kung bear all the hallmarks of a maintainable system with light and portable systems of few critical parts, mostly arranged in series. Repair is primarily through the replacement of elements with pre-prepared components, for instance arrowheads or link shafts (Lee 1979:135). Conversely, in the case of the Nunamiut and Copper Eskimo, the majority of tools are reliable, over-designed and under-stressed, with numerous parallel sub-systems. For instance, Nunamiut hunters usually carry from 2 to 4 rifles (Binford 1978:25), as well as keeping track of large amounts of cached insurance gear distributed around their hunting territories (Binford 1979:256). Gearing-up takes place during slack times well before the artefacts are required. The Copper Eskimo prepare their tools well in advance of the movement onto the ice for seal hunting. Their tools are over-designed and under-stressed, with numerous parallel sub-systems, such as breathing-hole probes, harpoon rests and drag lines (Damas 1972:14).

This suggests that reliable systems are relatively more common in less seasonal environments, while maintainable strategies would be common in more extremely seasonal zones. However the use of alternate strategies is not universal, and does depend on tasks at hand. Summer caribou hunting by the Copper Eskimo was undertaken using less maintainable technologies, consisting of a single bow and three or four arrows in various stages of completeness (Bleed 1986:743). This emphasis on reliable technologies in this case reflects the less critical nature of caribou hunting, compared to sea ice seal hunting (Damas 1972:13).

CHAPTER 4

Lithic raw materials in western Scotland

4.1. Introduction

Previous discussion as to the availability of lithic raw materials and in particular flint have alluded to its presence along many of the regions coasts (Ritchie 1981; Wickham-Jones 1986; Wickham-Jones and Collins 1978). However, little attempt has been made to either locate or quantify these observations within a regional context. One reason for this may have been the perception that no patterning would be found since the range of possible depositional mechanisms were too haphazard. The default assumption was therefore that flint would be found throughout the region. However, the significantly higher densities of this material within Mesolithic horizons on Islay compared to other islands in the chain or the mainland, suggested that the distribution was not homogenous.

In this chapter, I attempt to fill this lacuna in our knowledge of both the location and nature of flint raw materials, and in particular beach pebbles, in western Scotland. The chapter begins with an introduction to the four main cryptocrystaline raw material types used during the Mesolithic and later prehistory. It proceeds by focusing in on the flint deposits, and in particular some models which may account for its distribution in the area. This is followed by a description of the results of a regional scale survey project in which flint producing beaches were identified and described from Kintyre in the south to Loch Alsh and Skye in the north. The second part of the chapter focuses on a series of beaches along the west coast of Islay which were identified as particularly rich during the regional survey. These are discussed in terms of flint productivity and sustainability, and in terms of their potential for sourcing on the basis of pebble morphological characteristics. I then discuss the validity of using the modern beaches as analogous for those of the Mesolithic, and on the basis of this, a model of Prehistoric flint availability for the region is proposed.

4.2. Scottish lithic raw materials

The following four lithic raw materials types were intensively exploited and extensively used during the Mesolithic and later prehistory. Some working of other materials was present, for instance agate and silicified limestone, but only at very low frequencies.

Bloodstone: A crypotocrystaline silica deposited from hydrothermal solutions within tertiary lavas along the west coast of the island of Rhum (Wickham-Jones 1990:51). Although outcrops of bloodstone are known to exist elsewhere in Scotland, the scarcity and poor quality of these suggests that Rhum was the major source exploited during prehistory (Wickham-Jones 1990:51). Fresh nodules can be collected from outcrops along the top of bloodstone hill, however an easier method is to gather from derived frost shattered talus or as naturally tested beach rolled pebbles at the base of the cliffs (*ibid*:52). During experimentation, bloodstone was found to be workable, with many of the same concoidal fracture characteristics as flint. In fact, some of the more homogenous nodules were easier to work than flint, particularly when using hard hammer direct percussion. Less force was needed to remove blades, resulting in reduced incidence of platform perimeter crushing. The only difference noted was that bloodstone tended to be slightly more brittle, leading to relatively greater proportions of blades and flakes snapping during removal and retouch.

Quartz: Milky white and clear, quartz is present throughout the region, although no detailed study of its distribution was made. The former occur as veins within bedrock and along some of the regions beaches as pebbles, while crystals are found as isolated clusters (Mercer 1971). Vein quartz was of poor internal quality and difficult to work, although beach pebbles of milky white quartz were of better quality and could be worked as either rough platform or bipolar cores. Mercer (1968:20) noted a number of in-situ sources of clear and amethyst crystal along the east coast of Jura. Although these were not found during survey, a number of crystals were collected along the western slopes of the Paps of Jura. Most were small although a few workable pieces of between two and three centimetres were found. They were of good internal quality and easily worked using the bipolar technique, enabling the removal of small thin flakes. These could be fashioned into triangular and cressentic microliths through gentle edge crushing.

Pitchstone: A natural volcanic glass which can be found as minor intrusions and lava flows within the British Tertiary Volcanic Provence of western Scotland and Ireland (Thorpe and Thorpe 1984:1). The primary sources exploited during the Mesolithic and later Prehistoric appear to have been located on Arran, particularly at Corrygills and Tormore along the east and west coasts respectively (*ibid*:21). From here it can be collected either in-situ from narrow dykes along the coasts or as derived cobbles and pebbles. During survey in the vicinity of Corregills and Tormore, the only material found was extensively porphyritic or crystalline and almost impossible to work. Removals tended to be brittle, with almost all breaking along the large crystal inclusions during removal or retouch. Although better quality sources may have been missed, this points to pitchstone as a relatively poor quality raw material, particularly for blade working.

Flint: Occurs both in-situ and as beach pebbles, the former are known from Arran, Mull, central Morvern and Eigg (Bailey *et al.* 1924; Harker 1908; Lee and Bailey 1925; Peach *et al.* 1909; Richey and Thomas 1930; Wickham-Jones and Collins 1978; Wickham-Jones 1986). However most of these are ephemeral and of poor quality. The remnant deposits on Arran (Gunn *et al.* 1903) were not located during survey despite considerable time spent searching, suggesting that they can probably be ignored as a viable resource. Unfortunately access to the central Morvern in-situ deposits below Beinn Iadin (Lee and Bailey 1925) was not possible. However, down-slope riverbeds and road cuttings were investigated but no flint was found. The deposits at Malcolm's point on the south coast of Mull were sampled along with the adjacent beaches. Flint nodules eroding from this small remnant deposit were found along beaches for only approximately 50m either side, although considerable quantities could be collected from the remnant itself. Most were small and highly fractured although a number of workable pieces were collected. They ranged in colour from grey to yellow, and internally from fine to coarse grain. Most had a fractured and crushed cortex, suggestive of having been rolled prior to capping. Although variable in quality, pebbles were successfully used to produce a range of flakes, blades and small platform cores. The appearance of much of this material was distinctive, including possible heat induced fracturing and staining.

4.3. The origins of the flint

4.3.1. Previous models

The in-situ deposits of flint represent the remnants of the originally more extensive Upper Cretaceous depositional basin which covered the region. The best known of these remnants include those from Antrim, Morvern and Mull. However there appears to be little relationship between any of these and the more extensive deposits of beach pebble flint in the region. Since the in-situ deposits in Scotland are ephemeral, its presence on beaches and in archaeological assemblages has generated considerable debate since the early discoveries at Campbeltown (Gray 1893). Gray considered the most likely origin for the flint to have been human transport "...by the canoe load." (1893:273), a point which McCallien and Lacaille concurred with during their later excavations at Campbeltown (1941:61). During my own investigation of the currently active beaches, no flint was found. Whatever the process which led to original deposition at the Albyn Distillery, it now appears to have ceased.

During survey of the region, seaweed with pebble anchors attached, in particular oarweed (Laminaria digitata), and sea belt (Laminaria saccharina), was often encountered. These attach themselves to anything solid, but are then dislodged during storms, floating to the surface to drift with prevailing currents. This may suggest that some of the flint was carried from sea floor deposits, possibly from Antrim (Piggott and Powell 1949; Smith 1895; Wickham-Jones and Collins 1978). However, as Gray noted in 1893, this could only have accounted for the movement of moderately sized pebbles and certainly not the larger 5kg cobbles found at Campbeltown. Similarly, the smallest fractions present on the region's beaches are equally unlikely to have derived from anchor drift as they could not have supported initial growth to begin with.

Wickham-Jones and Collins (1978:7) suggest that a portion of the flint may have derived from ships ballast, either deliberately dumped or spilled during the considerable number of wreckings along the regions coasts (Blackburn 1986, see also Gray 1893). Some support for this suggestion was found during my survey of the small harbour at Portnahaven on the southern tip of the Rhinns peninsular of Islay, where a number of large coarse grained nodules were found. But even if this was the case the obvious point to make is that since flint was definitely being used during the Mesolithic, modern ballast spillage or dumping may only represent an additional and probably insignificant component. Also, the significant small fraction component in the assemblages strongly suggests a natural origin for the majority of the flint.

4.3.2. A glacial model of flint origin

This discussion builds on the results of the regional survey discussed in section 4.4. Childe argued that the flint had been carried to Campbeltown by ice (1935:13). However, all the evidence points to an east to west direction of glacial travel during the Devensian. Since no in-situ chalk and flint is present to the east of Kintyre, McCallien and Lacaille (1941:61) rejected Childe's hypothesis in relation to the nodules at Campbeltown. However, recent discoveries by Benn and Dawson of unrolled chalk and flint within glacio-marine deposits along the west coast of Islay, strongly supports the glacial scenario (1987). According to them, this material was incorporated to the east of the Rhinns of Islay within ice travelling broadly north east to south west. As the ice rafted out beyond the west coast of the Rhinns, the included sediments were sub-glacially deposited. Since the closest Mesozoic deposits are located within the Loch Indaal Basin (Fyfe *et al.* 1993) to the east of the Rhinns, they suggested this as the most likely origin of the flint on western Islay (Dawson and Dawson 1994). As discussed in chapter 2, since the Rhinns was probably not ice covered during the last glacial maximum (Dawson *et al.* 1988), this suggests that deposition occurred earlier during the Devensian. This is supported by a Optically Stimulated Luminescence date from the chalk and flint containing glacio-marine sediments on the Rhinns peninsular of approximately 70,000 bp (Mithen pers com).

However, Dawson and Dawson's (1994) conclusions concerning the Loch Indaal as primary source raise a number of interesting points. They considered the flint as derived from Mesozoic deposits within the Loch, however this cannot explain the presence of similar deposits on

Colonsay and Iona, which were located during my raw material survey. Even more difficult to explain are the flint deposits on the Mull of Oa to the east of the Loch Indaal, and therefore inexplicable in terms of east to west glacial travel, figure 4.1.

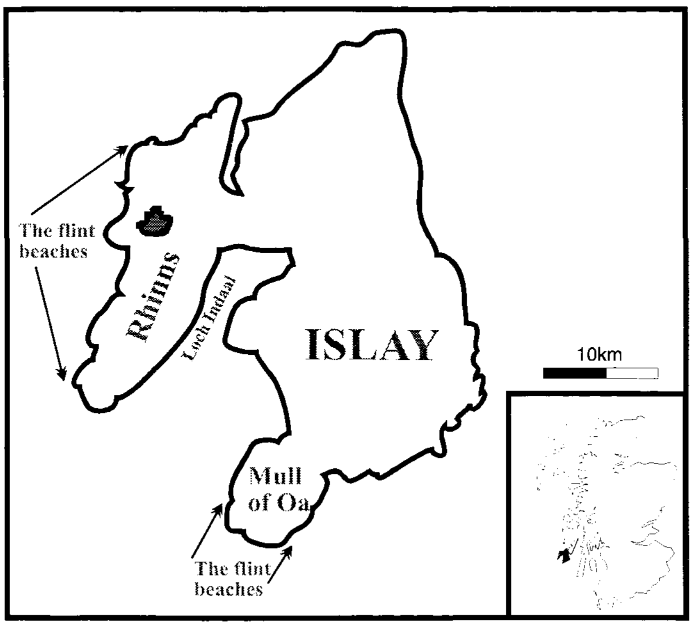

Figure 4.1. Locations of flint producing beaches on Islay.

Moreover, if the Loch Indaal was the original source of chalk and flint, then similar deposits of unrolled material should be found on the Rhinns itself. Apart from archaeological scatters, none was recovered during fieldwalking. Where then did the chalk and flint originate, and how did it end up within glacially derived deposits along the west coast of Islay?

A glacial model which may better explain the observed distribution of chalk and flint within the region, needs to consider ice travelling from south to north rather than east to west. The presence of chalk and flint along the Atlantic seaboards of Islay, Colonsay and Iona suggests deposition along a broad swathe from Islay northwards as suggested by the decline in density of nodules on Colonsay and Iona. Since the Scottish ice travelled from east to west, this south to north movement may suggest deposition from beneath ice derived from an alternative flow. A possible candidate may be the Midlandian extension of Irish ice across Antrim noted by Stephens, Creighton and Hannon (1975:10). Chalk and flint may have been incorporated along the Antrim coast and immediately out to sea in the Rathlin area. As ice calved from the snout of the glacier, icebergs would be free to float northwards under the influence of prevailing currents, which presently flow northwards. Basal melting may have led to the dropping of included sediments in a broad swathe along the western seaboard of the islands of the Southern Hebrides. This material would have been reworked by the sea and accumulated on the islands, so possibly explaining the presence of the chalk and flint. In addition, this process may have led to the disposition of some chalk and flint on the Mull of Kintyre, for which support is present in the form of small pebbles along the south west coast.

4.3.3. Summary

It is likely that a small proportion of the flint found within the study area was derived from the winnowing of Upper Cretaceous deposits, sea weed anchor drift, and human transport during prehistory and more recently as ballast. However these processes are unlikely to have been responsible for the significant quantities of flint found along the west coasts of the Southern Hebrides. The recovery of unrolled land based chalk and flint nodules point to a glacial origin, however the lack of suitable sources to the east may suggest an Irish origin. Whatever the original source, exposure to prevailing Atlantic seas, led to the its reworking and concentration along the western coastlines of Islay, Colonsay and Iona in particular.

4.4. Flint sourcing and characterisation: survey at the regional scale

4.4.1. Aims and method

The primary aim of the regional raw material survey was to locate and describe sources of beach pebble flint along the mainland and islands of the Inner Hebrides from Arran and the Mull of Kintyre to Skye and Loch Alsh, figure 4.2. Survey was undertaken through continuous walking and sampling of most of the regions coastlines. Flint pebbles found were described and measured. An assessment was made of the productive potential of each beach in terms of the numbers of pebbles available for collection and in particular their viability for the manufacture of platform cores. The second aim was to identify a series of deposits for more intensive study of raw material dimensions and productivity. This was undertaken in the second half of the chapter in which the focus shifts from the region to the island scale of analysis. The survey area extended from the southern tip of the Mull of Kintyre and the island of Arran to Loch Alsh and Skye, a straight line distance of approximately 270km. Inner Hebridean islands surveyed included Islay, Jura, Colonsay, Oronsay, Mull, Iona, Rhum and Skye, with additional investigation of the south coast of Arran. Stretches of the mainland coast were walked in the vicinities of Campbeltown, western Kintyre, Oban, Morvern, Ardnamurchan, Arisaig and Loch Alsh.

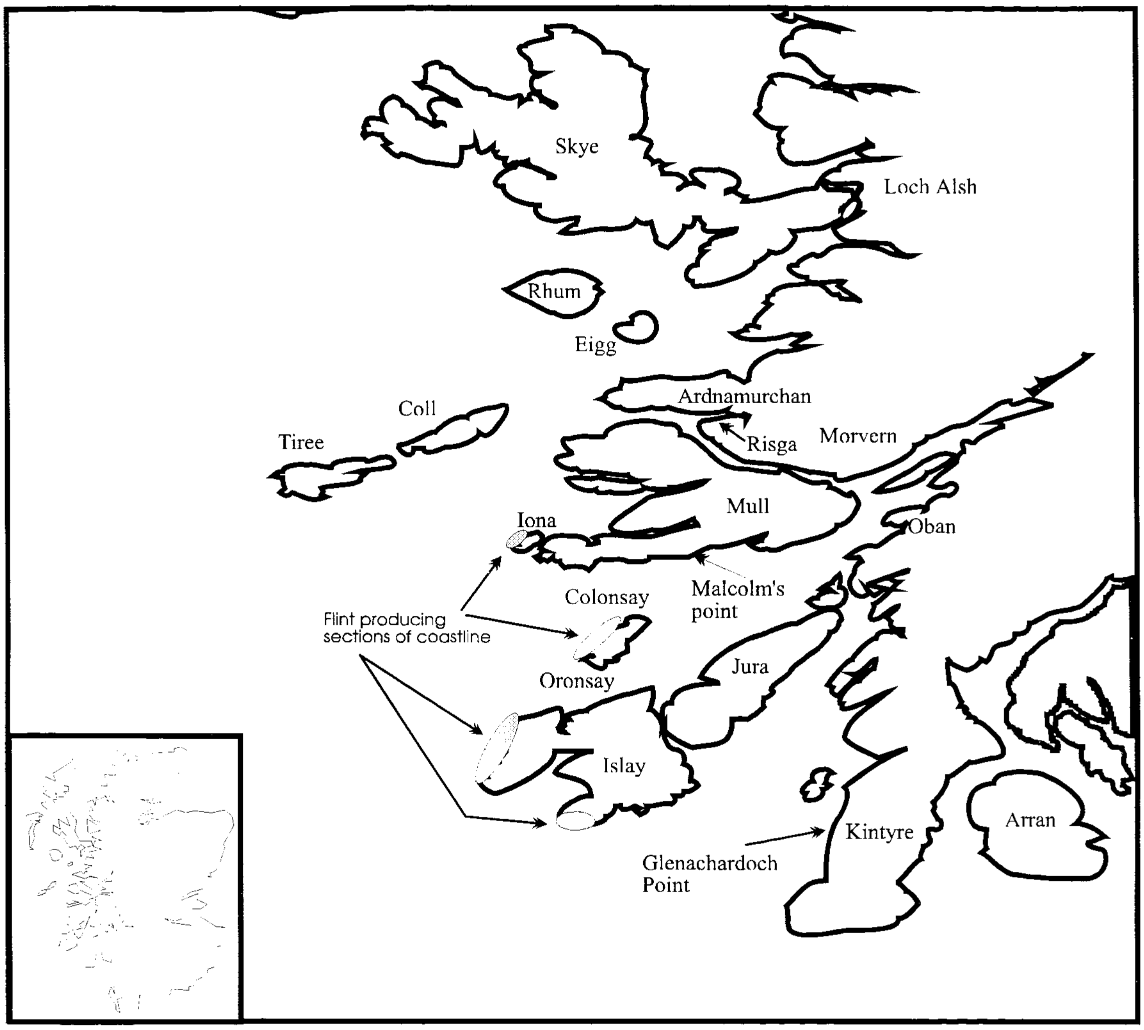

Figure 4.2. Raw material survey region showing principle islands and sections of the mainland discussed in the text. The flint producing beaches of the Mull of Oa, the Rhinns peninsular of the Isle of Islay, the island of Colonsay, and Iona are highlighted (Plate Carree projection).

4.4.2. Results

What follows is a brief description of the results of the flint survey along the coasts of the islands and along the mainland.

Arran: Beaches along the west, south and east coasts were investigated but very few pebbles were found. King's Cave, Largymore, and Whiting Bay produced a total of only nine pebbles weighing a total of 595g, figure 4.3. Individual pebbles ranged from 10g to 160g, with a mean of 66g. The north coast of the island was not surveyed.

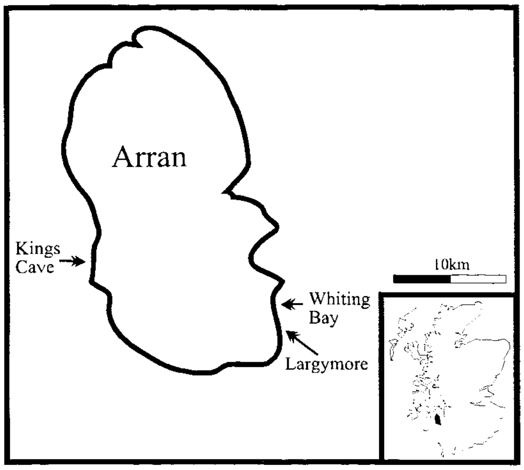

Figure 4.3. The island of Arran showing flint producing beaches.

Mainland coast from the Mull of Kintyre to Loch Alsh: Small numbers of pebbles were found along the west coast, from the southern tip of the Mull of Kintyre north to Glenachardoch point, see figure 4.2. These were small and angular, with polished and chalky cortex. North of Glenachardoch they were absent along the rest of Kintyre, Morvern and Ardnamurchan until Loch Alsh where survey ceased. Access to the central Morvern chalk deposits was not possible however stream beds, road cuttings and the adjacent coast was investigated, including beaches adjacent to the island of Risga, but no flint was found.

Jura: A small assemblage of flint beach pebbles was collected from five locations along the west coast of the island, figure 4.4. They were rare, small and highly polished, weighing between 4g and 226g, with a mean of just 46g. Flint was almost completely absent along the east coast.

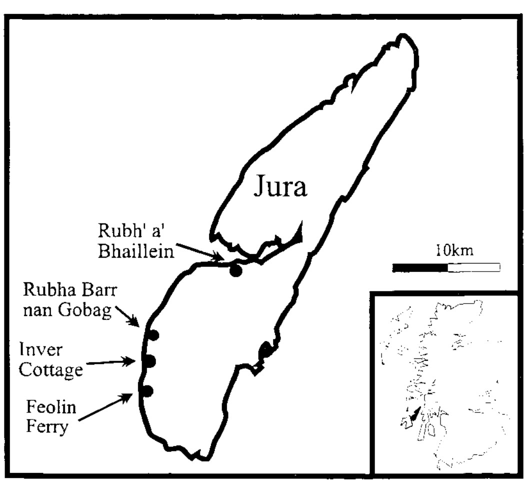

Figure 4.4. The island of Jura showing flint producing beaches.

Islay: Flint was present along most of the island's beaches, although densities were low along all except those of the Rhinns peninsular. These latter were particularly rich in both number and quality. In addition, two beaches on the Mull of Oa produced large numbers of pebbles, figure 4.5. Port Asiubus on the south east coast produced an assemblage of angular pebbles with the appearance of having been worked. None was diagnostic, and the location of the beach at the base of an inaccessible gully suggests that the assemblage is natural. The second deposit on the Oa was located within a small cave to the rear of Eileanan Mora on the south west coast. This material appears to have been deliberately cached although there is no evidence for working beyond the removal of a few flakes. One of the nodules was the largest so far found on Islay at over 4kg. There was no indication of the antiquity of the cave although its floor was composed of beach sand and limpet shells suggesting a post maximum transgression date. The Islay flint sources are discussed further in section 4.5.

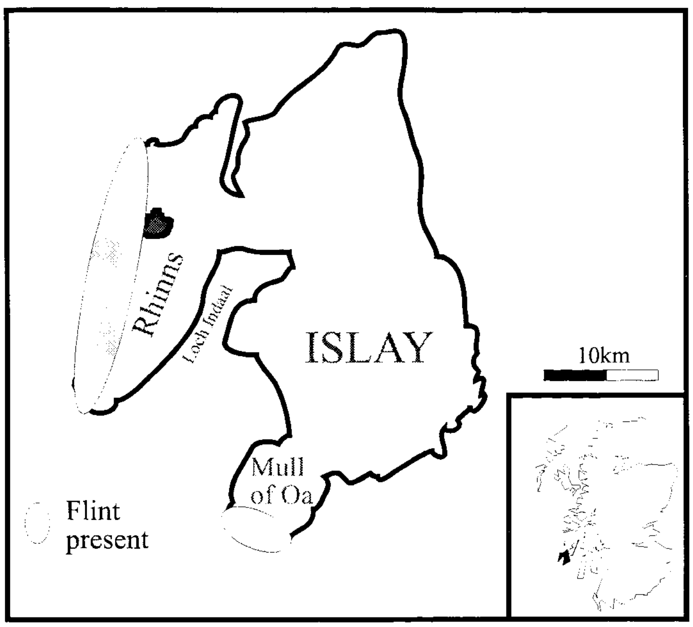

Figure 4.5. Location of flint producing beaches on the Rhinns of Islay and Mull of Oa

Oronsay: The assemblage was very small despite a considerable time spent surveying. Four small polished chalky white pebbles were found at grid reference (354 872) on the south east coast of the island, and six at Port na Luinge in the west. They ranged in weight from 4g to 150g with a mean of 63g, while the complete assemblage weighed 602g. Considering the presence of flint on Islay to the south and Colonsay to the north, the extreme scarcity of flint on Oronsay is surprising. It may be that the shelving nature of the west coast (Mellars 1987: fig15.1) has limited the extent to which pebbles are driven up against the island.

Colonsay: Pebbles were present in large quantities along the west coast of the island from the northern tip at Eilean Dubh, down to Port Lobh. A total of eight beaches and sections of coastline were found to be productive, figure 4.6. Pebbles ranged from 2g to 659g with a mean of 64g, however compared to Islay, they were slightly less common and generally smaller.

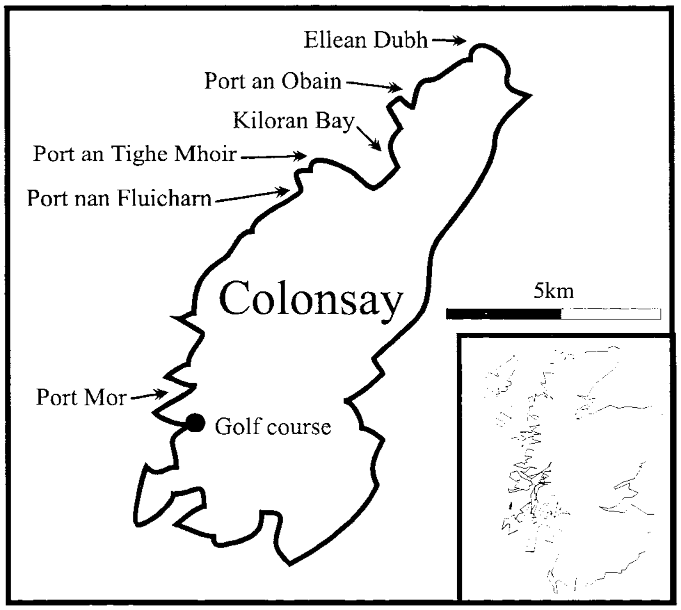

Figure 4.6.The island of Colonsay showing location of flint producing beaches.

Mull: Apart from some limited derived material below the in-situ deposits at Malcolm's point no other flint was found on the beaches of the island, see figure 4.2.

Iona: Flint was found within active and raised beach deposits along the south west coast adjacent to the golf course. Although there were considerable quantities present, pebbles were less common than on either Colonsay or Islay to the south, ranging in weight 10g to 354g, with a mean of 59g.

Rhum: Despite considerable time spent surveying, only a single small pebble weighing 5g was found. It came from the north western edge of Loch Scresort, figure 4.7. Nodules superficially similar to flint were collected below Bloodstone Hill on the west coast of the island, however these are probably variants of the local Tertiary chalcedonies.

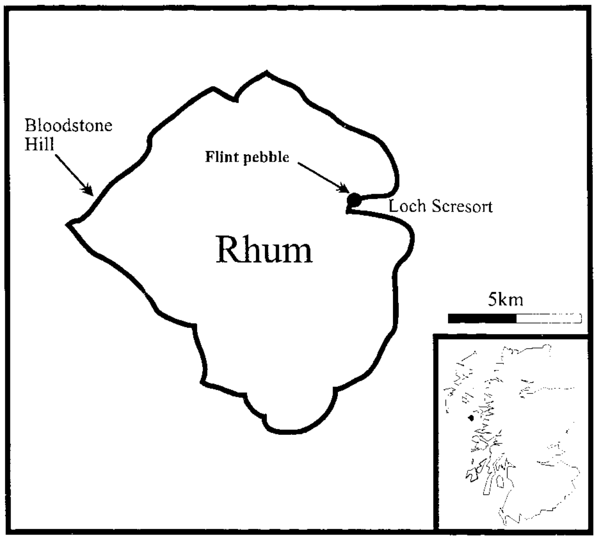

Figure 4.7. The island of Rhum showing location of one and only flint beach pebble found, and the source of bloodstone on the west coast.

Skye: Flint pebbles were found eroding from raised beach deposits at Staffin Bay, figure 4.8. They ranged from 7g to 900g in weight, were slightly rolled and had extensive chalky cortex. Some appeared worked, including a possible large bipolar core. The fact that similar deposits were not found elsewhere on Skye, the absence of smaller fractions, and the worked nature of the assemblage, all suggest that this material was brought onto the island, possibly associated with the use of the nearby An Corran rock-shelter (Saville and Miket 1994). Interestingly, the unrolled chalky nature of much of this material suggests that it was not sourced from beach deposits.

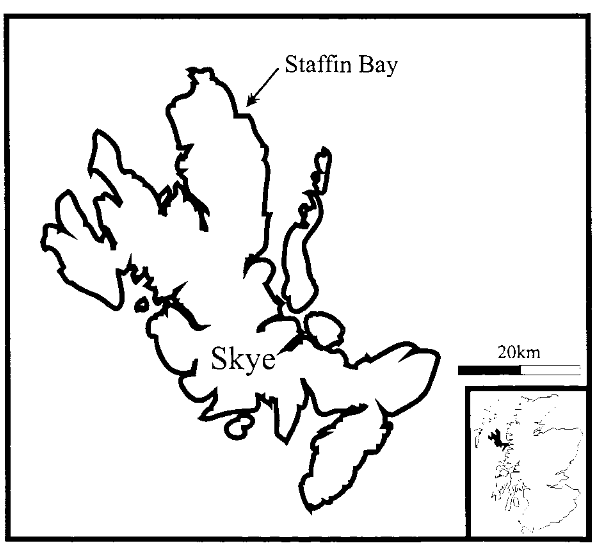

Figure 4.8. The Isle of Skye, showing beach flint collection location at Staffin Bay.

4.4.3. Summary

Flint beach pebbles were found throughout the region but in most cases at extremely low densities. The exceptions to this were the islands of Islay, Colonsay and Iona, where significant numbers of good quality rolled nodules could be collected. In addition, there was a distinctive west coast bias in the distribution of viable quantities of flint on these three islands. Moreover, pebbles could only be collected from specific sections of coastline either within bays, inlets or up against headlands. Of all three islands, Islay was the richest and therefore was designated for further more intensive survey.

4.5. Flint sourcing and characterisation, the Islay survey

The Islay survey begins with a brief outline of the aims and methods applied. It describes the beaches surveyed and assemblages generated, highlighting in particular the presence of a substantial small fraction component. In order to use the assemblages more effectively in the analysis, it develops a method of defining a lower sub-sampling cut-off, by removing those pebbles too small to have been of technological use during the Mesolithic. The following section uses this minimum, and discusses beaches in terms of relative size fraction composition, seasonal variability, predicted relative productivity and sustainability. In the next section, the pebble assemblages are discussed in terms of morphology, and the potential of exterior pebble characteristics as a means for sourcing of material found archaeologically in the interior of the island.

4.5.1. Aims and method

The aim of the Islay survey was firstly to generate a relative measure of flint productivity for individual beaches, expressed in terms of usefulness and sustainability during the Mesolithic. Secondly, it was to investigate whether beach specific morphological characteristics of the pebbles could be used to source material recovered archaeologically from the interior of the island.

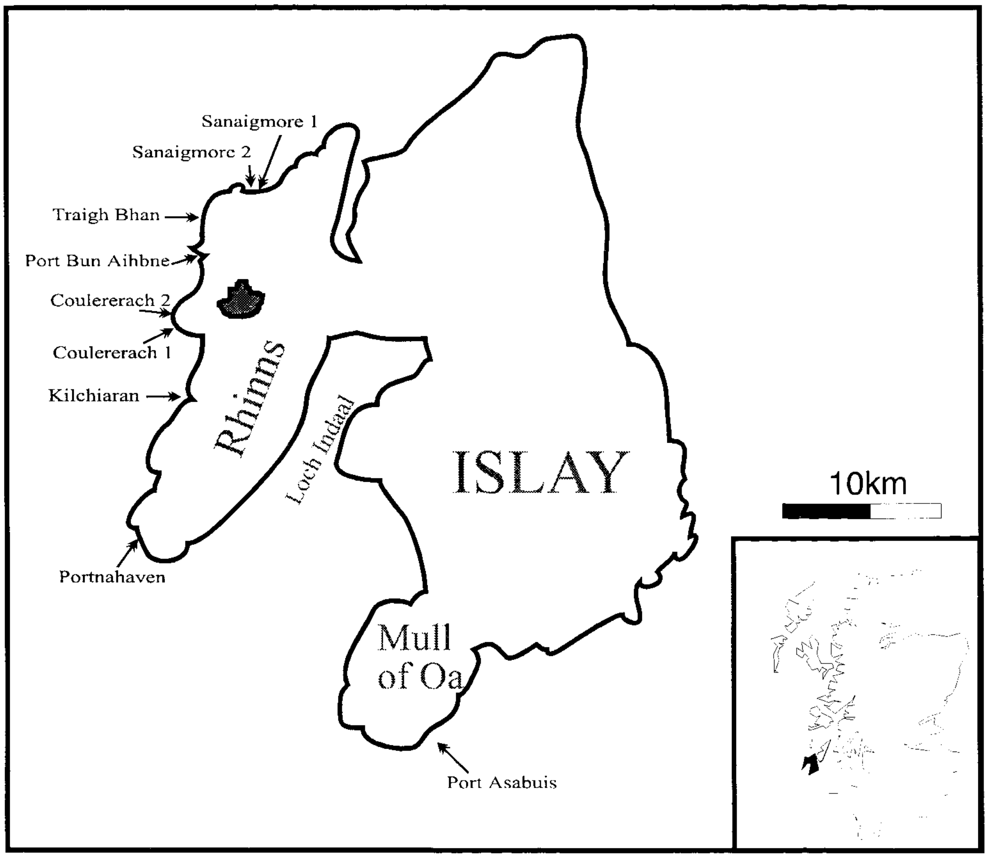

Figure 4.9. Location of beaches surveyed in detail on the Rhinns of Islay and Mull of Oa.

Intensive survey was undertaken along the west coast of the Rhinns during February, March and July of 1994, with a single sampling episode on the Mull of Oa at Port Asabuis in July, figure 4.9., table 4.1. In order to ensure quantifiable and repeatable coverage, collection was undertaken within a series of consecutive two meter wide strips running from a fixed baseline along the high water mark down to the low tide level. All flint was collected irrespective of size. The time taken to clear each row was noted and all pebbles measured and described.

Table 4.1. Description of beaches surveyed on Islay.

Beach (grid ref)	Location	Estimated beach size (area)	Survey size (% coverage)	Description
Portnahaven (164 525)	Rhinns of Islay	23m by 20m ($460m^2$)	240 m^2 (52%)	Southern tip of Rhinns peninsular facing West. Steep profile, 30° to 35°, levelling off at upper lip. Part of extended beach system. Flint from 2g to 1595g, extremely rounded and battered, many larger examples retaining chalky cortex. Sand fractions absent.
Kilchiaran (200 598)	Rhinns of Islay	77m by 38m (2926 m^2)	532 m^2 (18%)	Facing slightly North West within large bay. Shallow profile with sand across lower half. Flint rounded and battered with little remnant chalky cortex, from 1g to 1506g. Additional angular slightly rolled component present, as well as number of worked pieces including struck flakes and platform cores.
Coulererach 1 (190 643)	Rhinns of Islay	15m by 31m (465 m^2)	372 m^2 (80%)	Facing due West, steep profile of 25°. Flint rounded and battered with little chalky cortex, from 1g to 1150g.
Coulererach 2 (192 651)	Rhinns of Islay	8m by 17m (136 m^2)	136 m^2 (100%)	Small beach facing slightly North West, 50m to the rear of narrow channel. Moderately steep, approximately 15°. Flint from 1g to 3045g, battered and rolled with little chalky cortex. Sand fractions absent.
Port Bun Aihbne (207 683)	Rhinns of Islay	62m by 37m (2294 m^2)	444 m^2 (19%)	Northern extent of beach system, facing West. Steep profile of 30°, with pronounced upper lip. Flint rounded and battered with little chalky cortex, from 1g to 978g. Sand fractions absent.
Traigh Bhan (213 700)	Rhinns of Islay	97m by 60m (5820 m^2)	1500 m^2(26%)	Rear of extended channel, composed largely of sand, with additional pebble and boulder component. Shallow slope along southern half becoming steeper and less sandy to the north. Open to sea via two channels. Flint from 1g to 2032g, rounded and battered, but with larger examples retaining chalky cortex.
Sanaigmore 2 (236 710)	Rhinns of Islay	29m by 32m (928 m^2)	320 m^2 (35%)	South western corner of Sanaigmore Bay, facing North East. Composed of sand and pebbles, shallow slope with access to sea via small channel. Protected on all sides by rock outcrops. Flint from 1g to 783g.
Sanaigmore 1 (239 710)	Rhinns of Islay	57m by 33m (1881 m^2)	594 m^2 (32%)	South east corner of Sanaigmore bay, facing North West. Composed of pebbles grading down to pea sized fractions at low water level. Steep profile of 25° with distinct upper lip. Flint rounded and battered from 1g to 702g.
Port Asabuis (317 411)	Mull of Oa, Islay	30m by 10m (300 m^2)	120 m^2 (40%)	Bottom of steep gully, facing South East. Shallow profile strewn with large boulders, pebbles and sand. Flint angular and unrolled, from 1g to 726g.

4.5.2. Beach survey results, the complete assemblage

The collection from all nine beaches numbered 4015 pebbles weighing 257.2kg, with a mean of 64.1g. Port Asabuis on the Mull of Oa was sampled once due to access difficulties, and removed from subsequent analysis due to the apparent worked nature of much of the assemblage. This limited the sample to eight beaches from along the west coast of the Rhinns peninsular. The reduced assemblage numbered 3642 pebbles weighing a total of 238kg, with a mean weight of 65.4g. The majority of the assemblage (93.4%, n=3403) consisted of pieces less than 200g in weight, figure 4.10.

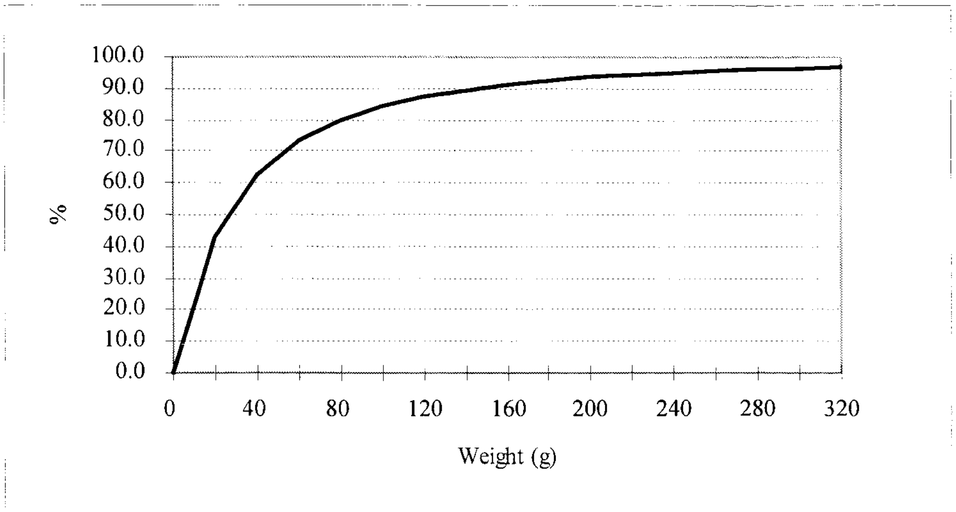

Figure 4.10. Pebble weight cumulative curve for the complete Rhinns collection (n=3642).

All beaches were dominated by large proportions of small pebbles, figure 4.11. However, the more exposed beaches at Portnahaven and Port Bun Aihbne produced proportionally less small fractions than sheltered ones at Sanaigmore or Kilchiaran. The more exposed higher energy beaches tended to be steeper and dominated by larger pebbles, with finer fractions winnowed down through the profile and consequently less common.

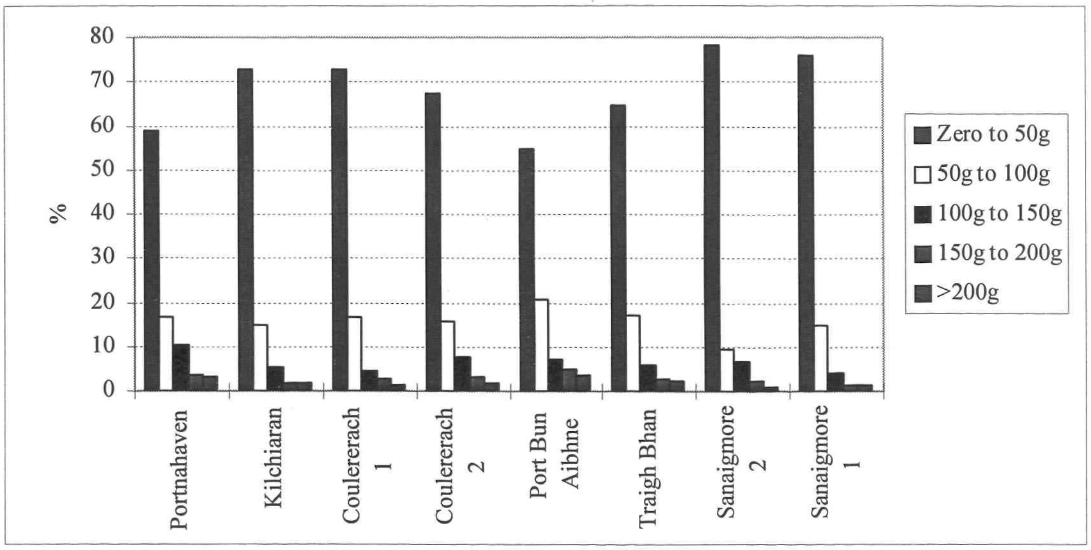

Figure 4.11. Pebble weight frequency histogram for beaches along the Rhinns peninsular, the complete collection (n=3642).

What was clear from the size distributions described above was that the majority of pebbles collected during the survey would have been of little technological use. Beaches rich in these small size fractions would have been correspondingly less attractive as raw material sources. Therefore to continue to analyse the complete assemblage of 3642 pebbles would have been of little use since the small fraction component would obscure any variability in the larger more useful size fractions.

4.5.3. Defining a minimum useful pebble size

Some means of defining an objective lower cut-off point was therefore needed. Two methods were employed to determine an appropriate sub-sampling threshold. The first through the experimental replication studies reported on more fully in Chapter 7, and the second, the analysis of worked, unworked and partially worked pebbles from excavated and fieldwalked contexts across Islay.

4.5.3.1. Experiments

Experimental replication was undertaken using a range of flint pebbles and quartzite hammers collected from beaches along the west coast of the Rhinns peninsular, primarily Portnahaven and Kilchiaran Bay. The aim of these experiments was to produce platform cores and blades. Successful pebble working was found to be dependant initially on minimum pebble dimension which, if less than approximately 40mm, meant that the split pebble was difficult to hold particularly during the initial stages of core blank preparation. It therefore appeared as though 40mm represented a minimum below which the potential returns in terms of successful core working declined considerably. Using the fitted power regression line, a 40mm minimum dimension equated to a weight of 211.2g, figure 4.12.

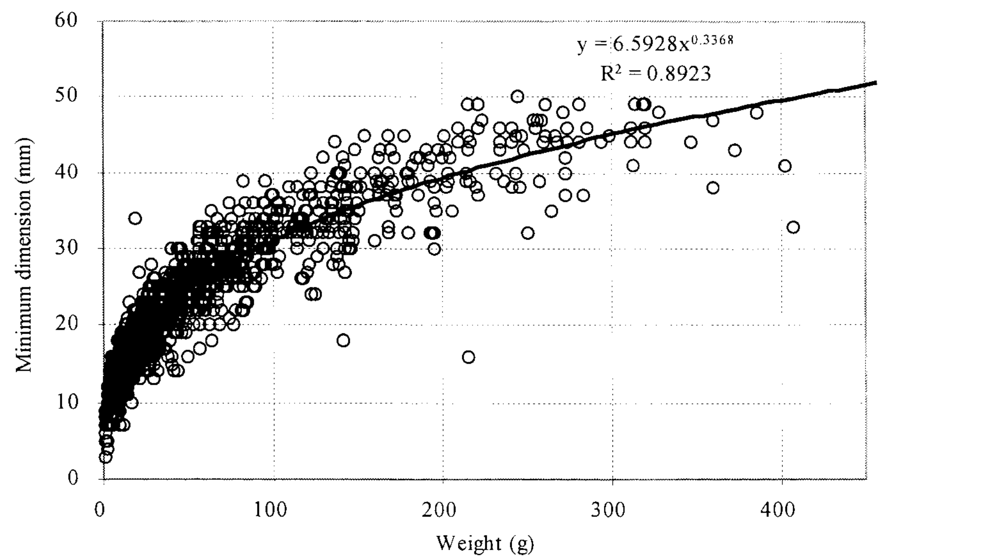

Figure 4.12. Flint beach pebble minimum dimensions plotted against weight for the complete Rhinns collection (n=3642).

4.5.3.2. Unworked pebbles from archaeological contexts

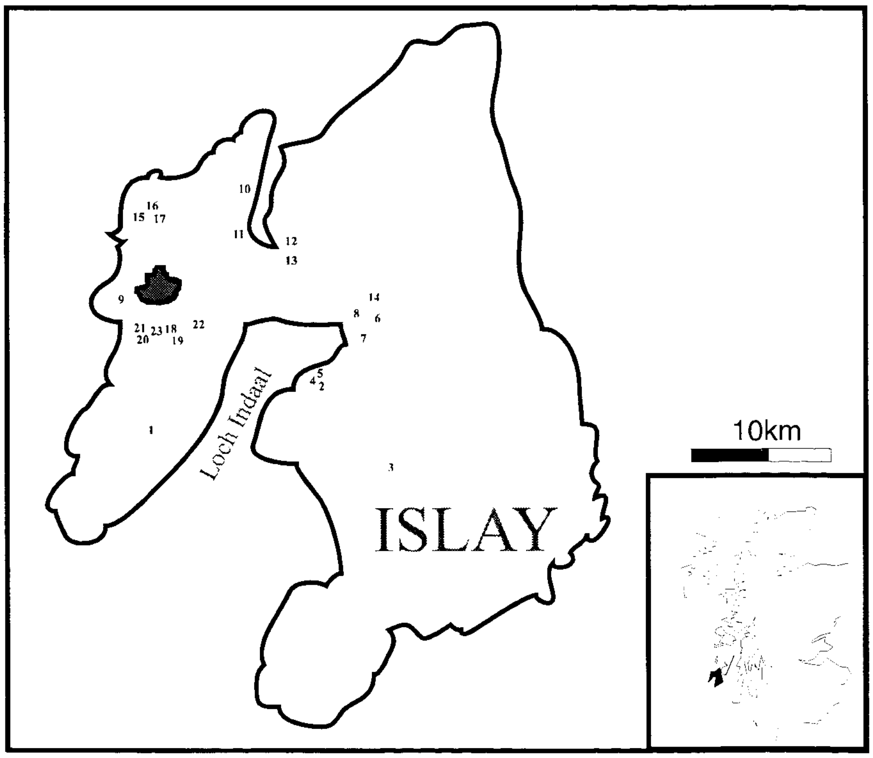

Figure 4.13. Location of fieldwalked and excavated assemblages containing flint beach pebbles from Islay.

A collection of 272 worked, partially worked and unworked pebbles were weighed and measured from 23 excavated and fieldwalked contexts across Islay, figure 4.13. and table 4.2.

Table 4.2. Map reference and numbers of pebbles from fieldwalked and excavated assemblages from Islay.

Site	Map reference	Number of pebbles
Bolsay Farm	1	1
Bowmore 10	2	9
Bowmore 12	3	2
Bowmore 16	4	14
Bowmore 18	5	4
Bridgend 13	6	1
Bridgend 14	7	1
Bridgend 15	8	1
Coulererach	9	15
Gruinart 13	10	23
Gruinart 7	11	1
Gruinart 8	12	2
Gruinart 9	13	1
Scarrabus	14	4
Kindrochid 3	15	38
Kindrochid ditch	16	30
Kindrochid 4	17	37
Loch Gorm 3	18	1
Loch Gorm 10	19	3
Loch Gorm 5	20	7
Loch Gorm 6	21	13
Loch Gorm 9	22	2
Rockside	23	3

Of these, 78.3% (n=213) were unworked. The rest were defined as either slightly worked, with one removal, or worked if with more than one. In all cases pebbles were only included if an accurate estimate of original dimensions was possible. The numbers of pebbles heavier than approximately 215g declined significantly, figure 4.16. suggesting that larger fractions were being worked relatively more often.

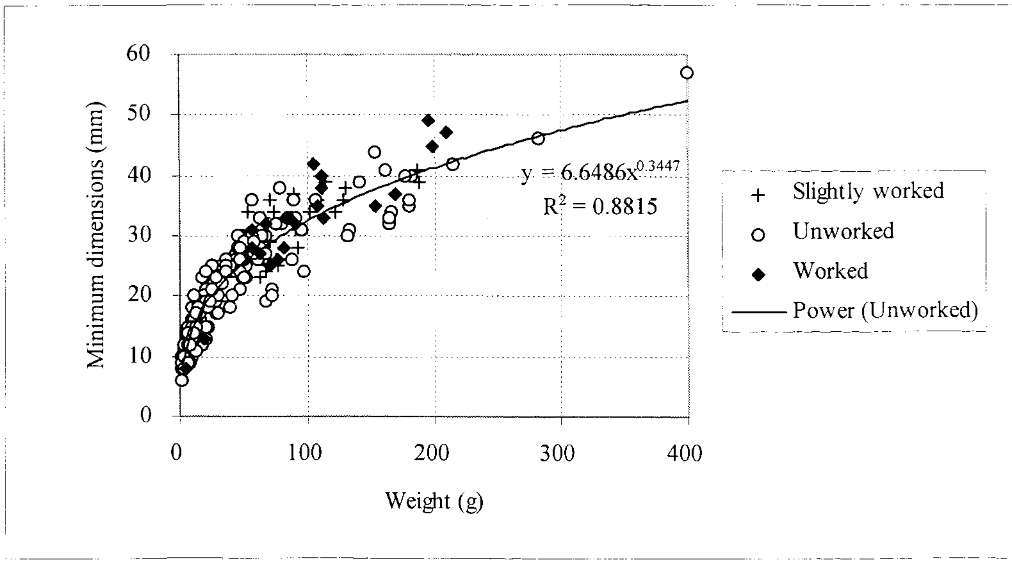

Figure 4.14. Unworked, partially worked and worked flint beach pebbles from fieldwalked and excavated assemblages from Islay.

Although a range of different sized pebbles were being transported across the island, this analysis suggested that those greater than 215g being worked more often and were thus being removed from the assemblages. According to the fitted power regression equation, $y=6.5928x^{0.3368}$, see figure 4.14., pebbles of 215g corresponded to a minimum dimension of 42.3mm.

4.5.3.3. Summary

The experimental studies and pebbles from archaeological contexts suggested 200g or 40mm as a minimum dimension for pebble utility. This does not mean that smaller pebbles were not being collected and used, but rather that beaches relatively rich in pebbles less than 200g would have been correspondingly less attractive as raw material sources.

4.5.4. The large fraction assemblage, pebbles over 200g

4.5.4.1. Variability between beaches

Ignoring pebbles less than 200g reduced the assemblage from 3642 to only 239 pieces, while mean pebble weight increased to 445.7g. Portnahaven produced relatively greater proportions of pebbles over 400g, figure 4.15. and table 4.3. However, no significant differences were noted between the eight beaches.

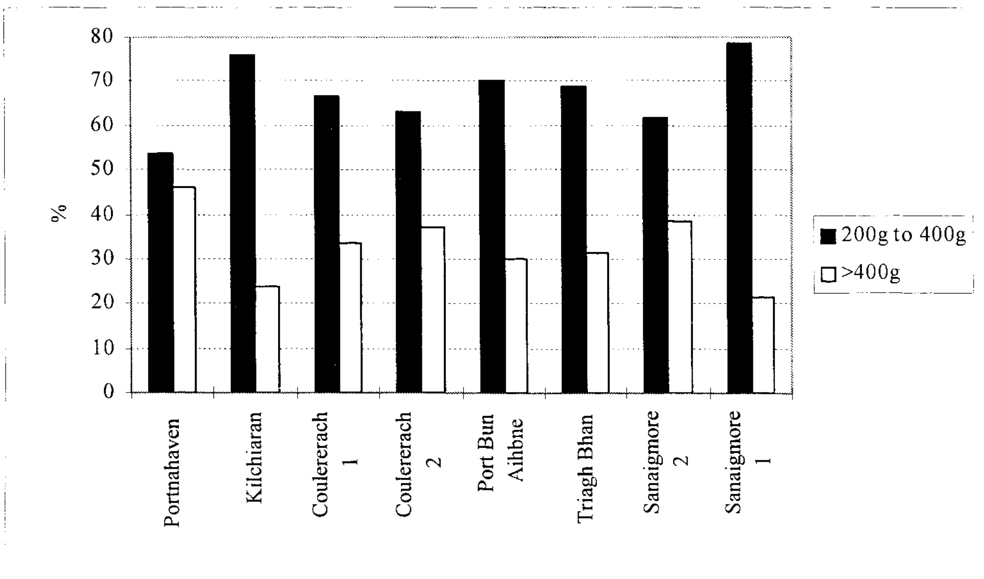

Figure 4.15. Proportions of pebbles greater than 200g and 400g from the Rhinns collection,(n=239).

Table 4.3. Numbers of pebbles greater than 200g and 400g from beaches along the Rhinns peninsular.

Beaches	Pebbles < 400g	Pebbles > 400g
Portnahaven	21	18
Kilchiaran	16	5
Coulererach 1	12	6
Coulererach 2	29	17
Port Bun Aihbne	26	11
Traigh Bhan	35	16
Sanaigmore 2	8	5
Sanaigmore 1	11	3

4.5.4.2. Seasonal variability

During the survey the only seasonal constraints to collection were snow and seaweed. Even so I did not observe any consistent decline in recovery rate between winter and summer. Storm frequency is more likely to have played a part in the redistribution and incorporation of new flint nodules but this could not be verified.

4.5.4.3. Predicted relative productivity of the beaches

The previous section suggested that all beaches were broadly similar in terms of size fractions present. However differences were noted between the densities of pebbles present and therefore the relative productivity of each beach per unit area and collection time. Coulererach 2 was removed at this stage of the analysis because collection intensity was greater than on the other seven beaches. It is discussed separately below.

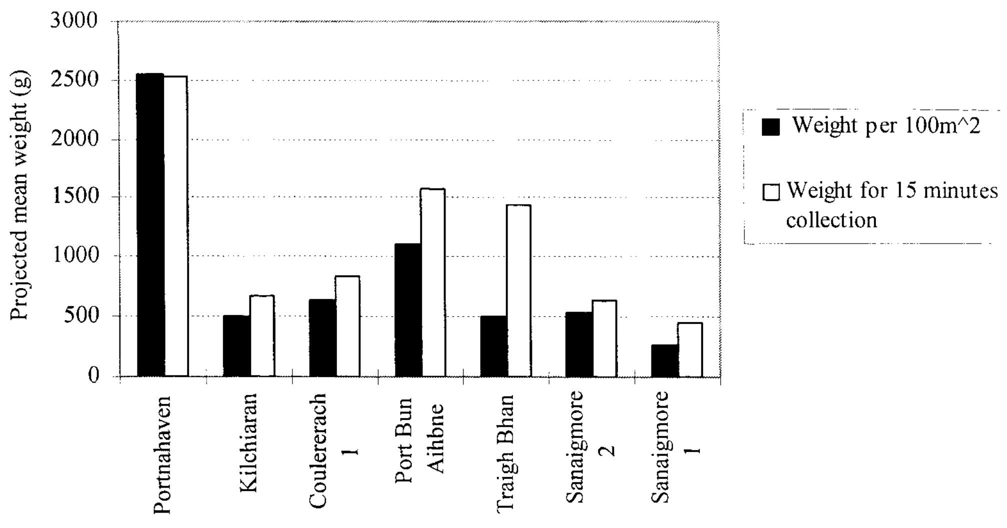

Figure 4.16. Projected mean weight of pebbles greater than 200g per $100m^2$ of beach surface area, and 15 minutes of collection by one person (Coulererach 2 removed).

For the purposes of the survey the unit area for collection was taken as $100m^2$, while unit time involved one person collecting for 15 minutes. In terms of unit collection rates, Portnahaven was the most productive beach followed by Port Bun Aihbne, figure 4.16. Both were similarly exposed to prevailing Atlantic breakers, steep and lacking smaller fractions. The winnowing of these down through the profile led to relatively greater large fraction collection rates.

4.5.4.4. Sustainability

Limiting the analysis to pebbles over 200g considerably reduced the number of larger pebbles on individual beaches, suggesting that repeated collection would have rapidly led to a reduction in numbers. Part of the rational behind the strip survey was to enable this issue to be investigated. However, it was found to be unsuitable since wave action and surface movement of pebbles across the beaches led to redistribution between strips. In the light of this, the small beach at Coulererach 2 was selected for more detailed survey, where flint was collected from the whole of the surface.

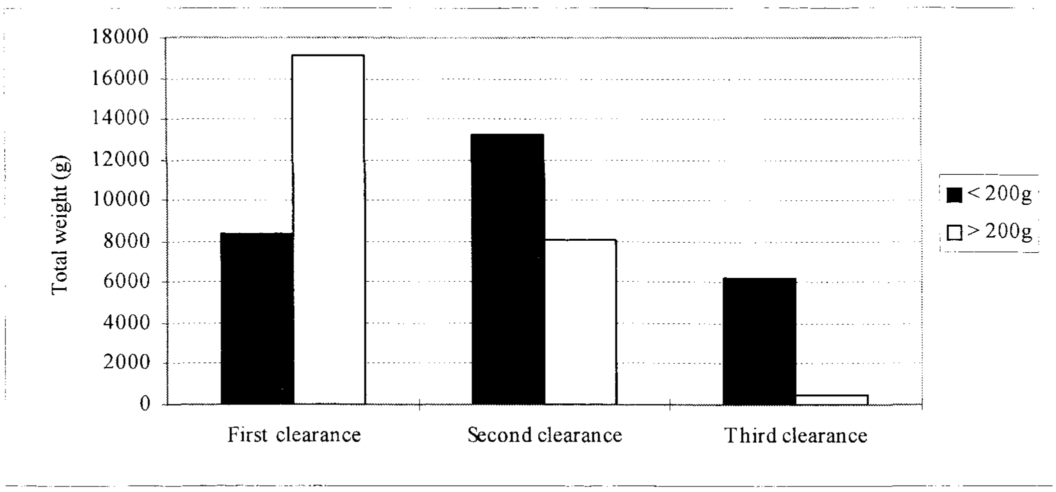

Figure 4.17. Total weight of pebbles less than 200g, and greater than 200g from the small beach at Coulererach 2, complete surface collection during March and twice during July
(χ^2=32.7, df = 2, p<0.001).

Table 4.4. Numbers of pebbles less than 200g, and greater than 200g from the small beach at Coulererach 2, complete surface collection during March and twice during July.

	Pebbles<200g	Pebbles>200g
First clearance (March)	164	29
Second clearance (July)	301	15
Third clearance (July, one week later)	242	2

The beach was cleared during March, and then subsequently twice during July 1994, figure 4.17. and table 4.4. A significant decline in the proportions of pebbles over 200g was apparent from 29 in March, to 15 during the first clearance in July, and to just two during the second, a week later. Intensive collection had led to a significant decline in recovery rates, particularly of the larger fractions, although with only three samples available for comparison, little can be said in detail about the rate. But since only a week elapsed between the two July collections, the decline from 15 to only two pebbles heavier than 200g suggests extreme sensitivity. The significant increase in recovery of fractions less than 200g during July compared to March was due to weed cover in the latter. In addition, storms during July had reincorporated much of the upper matrix of the beach, so adding further pebbles.

5.5.4.5. Other assemblage characteristics

The second aim of the Islay survey was to investigate whether any distinctive pebble characteristics could be attributed to specific beaches or stretches of coastline. If this was the case, then they could be used as a means for beach specific sourcing of material from archaeological contexts. The characteristics investigated included colour, proportions of chalky cortex, surface texture, and roundness and sphericity. The analysis made use of the complete Rhinns assemblage of 3642 pebbles. It would have been preferable to consider only those of sufficient size to be technologically useful, but the limited numbers of larger pebbles within many of the assemblages, for instance Sanaigmore 1 with only 14 greater than 200g, meant that this was impossible

Colour: Was assessed from the cortex and pebbles grouped as black, yellow or grey. No obvious colour variation was noted between beaches, figure 4.18., with all dominated by grey flint.

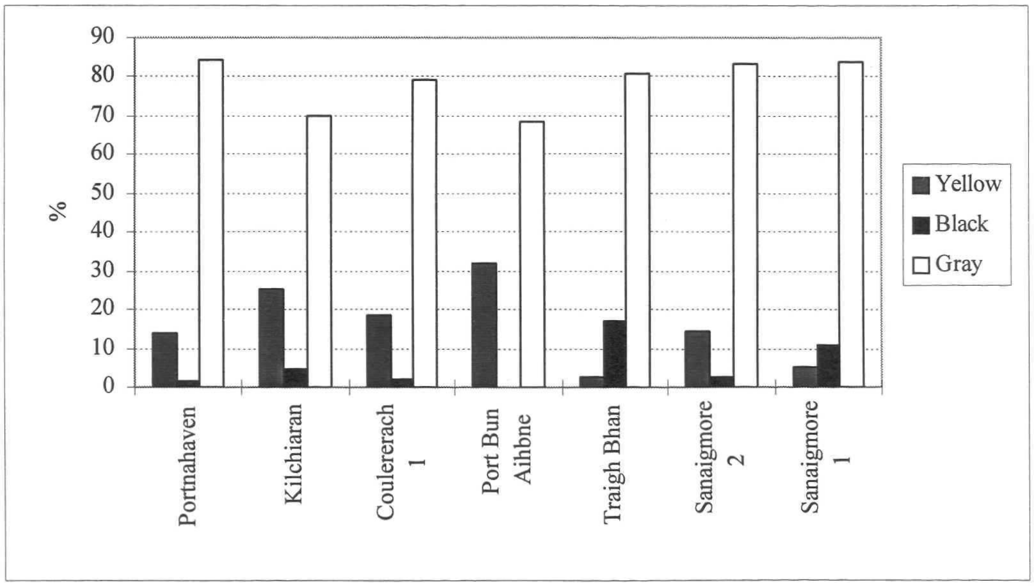

Figure 4.18. Proportions of yellow, black or grey flint beach pebbles from the Rhinns collection (n=3642), beaches arranged from south to north.

Chalk cortex: Was defined as extreme if it covered more than 50% of the pebble surface, moderate if around 50%, and slight if less than 50%. Most pebbles were slightly chalky, figure 4.19., particularly on the higher energy beaches at Portnahaven, Kilchiaran, Coulererach 1 and Port Bun Aihbne.

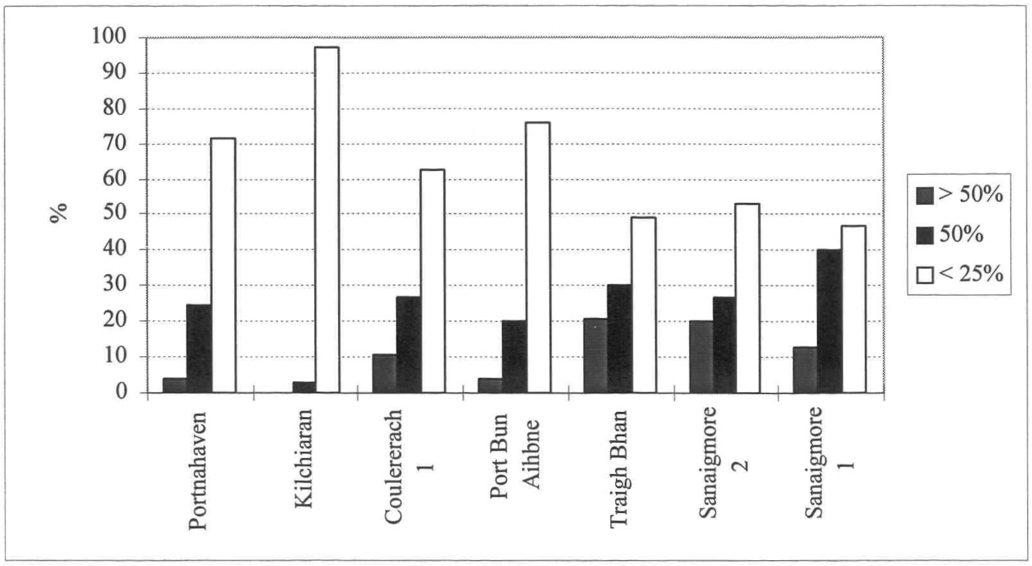

Figure 4.19. Proportions of chalky cortex remaining on flint beach pebbles from the Rhinns collection (n=3642), beaches arranged from south to north.

Surface texture: Was defined as extreme if 75% to 100% of the pebble surface was battered and crushed, moderate if 25% to 75%, and slight if 0 to 25%. Extreme battering was more common on the exposed beaches of Port Bun Aihbne and Portnahaven, figure 4.20.

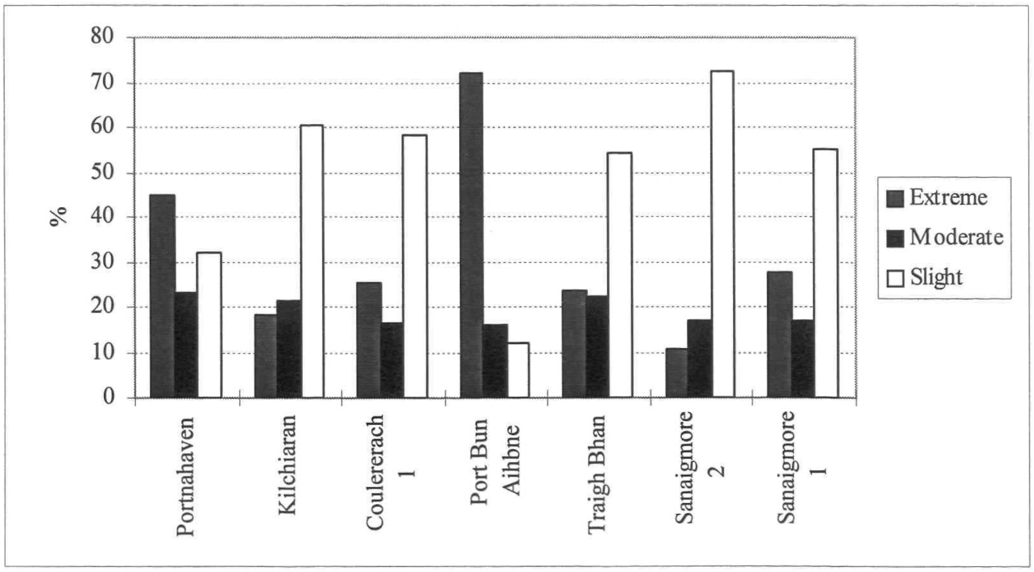

Figure 4.20. Proportions of extreme, moderate and slight surface fracturing on flint beach pebbles from the Rhinns collection (n=3642), beaches arranged from south to north.

Roundness and sphericity: Was assessed according to figure 4.21. (after Maclain 1995). The exposed beaches at Portnahaven, Port Bun Aibhne and Coulererach 1 produced greater proportions of well rounded pebbles, figure 4.22., while the sandier sheltered beaches at Traigh

Bhan and Sanaigmore 2 produced a more angular assemblage. The presence of a large angular component at Kilchiaran was probably due to the glacio-marine deposits to the rear of the beach from which unrolled nodules may have been eroded relatively recently.

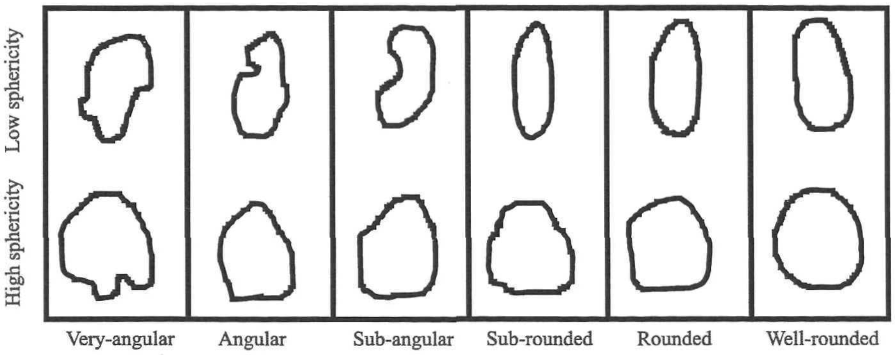

Figure 4.21. Chart for assessing roundness and sphericity (after Maclain 1995).

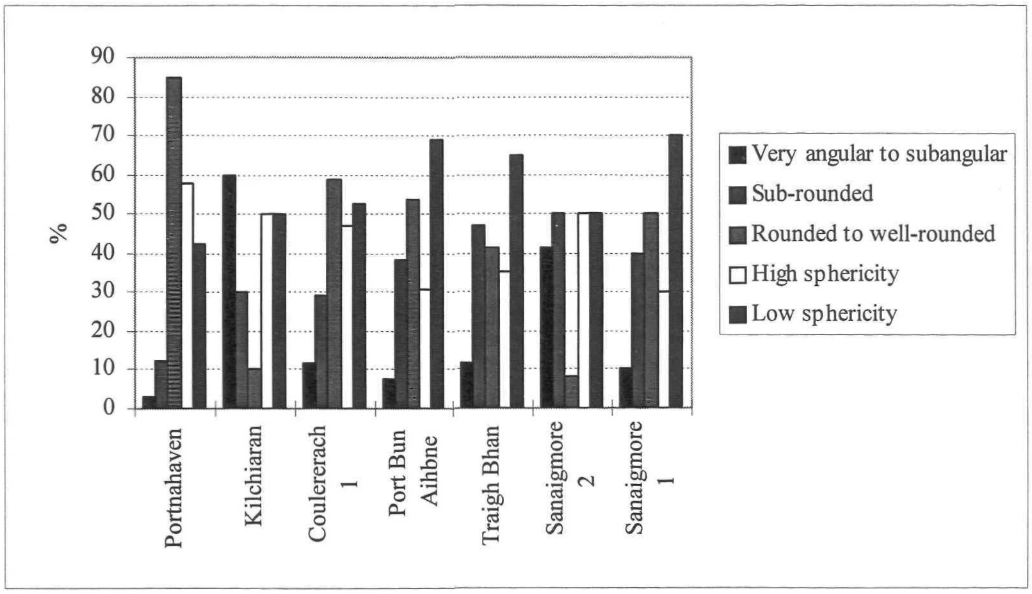

Figure 4.22. Proportions of pebble roundness and sphericity on flint beach pebbles from the Rhinns collection (n=3642), beaches arranged from south to north.

5.5.4.5.1. Summary

Neither colour, cortex, surface texture nor shape provided a robust means for differentiating between beaches. Although there was some limited association between the higher energy beaches and less cortex, rougher surfaces and roundness, all contained at least a component of pebbles with similar morphologies. This suggests that surface characteristics are unlikely to be able to provide detailed sourcing information to the level of beaches. However they are distinctive in terms of the types of environment in which pebbles are found, for instance as in-situ nodules, or as derived pebbles in riverine or coastal situations. Surface fracturing in particular provides a means for assessing where nodules were sourced. Those collected from beaches tend to be highly fractured and crushed with numerous small surface cone fractures, while those from rivers are generally smoother and less angular. As discussed previously in this chapter, the collection of pebbles recovered from Staffin Bay on Skye appeared to have derived from a riverine or sheltered coastal situation rather than exposed Atlantic beaches. This suggests the exploitation of alternative and as yet unlocated raw material sources in the north of the region.

4.6. Summary of the results of the island scale survey

All beaches were dominated by significant numbers of smaller flint pebbles, the majority of which would have been of little use for the production of platform cores in particular. In fact over 90% of all assemblages consisted of pebbles less than 200g in weight. The significance of 200g was highlighted during experimental replication using pebbles from the Rhinns, and an analysis of archaeological pebble assemblages from across Islay. This suggested that fractions below 200g and in particular with minimum dimensions less than 40mm would have been of little use, at least during the Mesolithic. Using this as a sub-sampling limit, the assemblages declined considerably in size, highlighting the fact that although the deposits on Islay were the richest in the whole of western Scotland, they could very easily have been exploited to extinction. This was emphasised by the study at Coulererach 2 where collection declined from 29 pebbles greater than 200g, to only two a week later. This suggests that in addition to spatial heterogeneity, there would have been an additional temporal dimension to the availability of flint in the region. This raises the possibility that continual exploitation during the Mesolithic may have denuded the larger pebble fractions in particular. Moreover, declining sea levels after the maximum transgression would have exacerbated the problem since no new nodules would have been incorporated from within land based glacio-marine deposits. It is interesting to note that the later Prehistoric appears to correspond with a shift towards greater use of the bipolar technique, better suited to the use of smaller pebbles.

The investigation of the larger pebble fractions suggested that although all beaches produced similar ranges of nodules, the more exposed Atlantic facing coasts were relatively more productive. The lack of smaller fractions and sand in particular reduced the area which needed to be covered to collect similar quantities of larger more useful pebbles. This pointed to beaches at Portnahaven, Kilchiaran, Coulererach and Port Bun Aihbne as the most productive, compared to sandier sheltered beaches at Sanaigmore and Traigh Bhan. Archaeologically there may be some support for this in terms of significant evidence for the transport and initial working of flint at Gleann Mór and Bolsay Farm, most probably sourced at Kilchiaran Bay. At Coulererach significant quantities of flint appear to have been carried to the site and initially worked. The same may be true for Kindrochid 4, located only 2.5km from the rich deposits at Port Bun Aihbne, while the substantial flint deposits at Portnahaven may suggest the southern portion of the Rhinns as a useful area in which to undertake further investigation.

Sourcing of pebbles to individual beaches on the basis of morphology proved unsuccessful, primarily since all beaches produced a range of pebble types. However the study did highlight that there may be some potential at the regional scale for comparing surface characteristics in terms of possible sources.

4.7. Using the modern distribution of beach flint as an analogy for the early Holocene

The previous discussion highlighted the heterogeneous distribution of flint beach pebbles within the region. This represents the modern situation and the extent to which it reflects the viability of these same coastlines and beaches during the Mesolithic may be open to question. The following section argues that at both the regional and island scales, the modern distribution of flint beach pebbles provides a valid analogy for inferring the location of those of the Mesolithic.

4.7.1. The regional scale

My survey highlighted that the flint producing beaches are concentrated along the west facing coasts of the Rhinns of Islay, Colonsay and Iona. Small deposits were found elsewhere in the region but viable quantities were essentially restricted to these three islands. Since the mid Holocene when sea levels reached their present level there is no other process which could have resulted in the presence and absence of raw material that I have described at this regional level. Intensive collection away from these three islands is unlikely to have been so successful at removing all fractions, even the very smallest, and therefore beaches presently lacking flint were probably similarly unproductive during the Mesolithic. Similarly, on the flint rich islands, although some material may have been transported in, the presence of a significant fine fraction component strongly suggests a natural origin for the bulk of the deposits. Archaeologically there may be some support for this interpretation in terms of the apparent correlation between intensive Mesolithic activity and sources of flint particularly on Islay. If we assume that the visibility of these sites was a function of raw material accessibility, then the lack of similarly rich assemblages away from the Southern Hebrides may suggest a relative absent of similar raw materials elsewhere. The present western focus on the Southern Hebrides in particular is therefore a good analogy for predicting where similar materials could have been collected during the Mesolithic.

4.7.2. The island scale

Significant differences in flint productivity were noted between the west and east facing coats of the three flint producing islands. At the island scale, the absence of smaller fractions unlikely to have been removed, suggests that the presence of an east to west imbalance was similarly so during the Mesolithic. In addition to the west to east bias, pebble deposits tend to be found at specific locations. In particular these are found within bays and inlets and up against headlands. The location of these are unlikely to have changed significantly since the early Holocene, even in the context of significant sea level change. The significant Mesolithic assemblages recovered from the western half of the Rhinns of Islay close to the sources of flint pebbles provide some support for this interpretation. The fact that on Islay at least, only a few small assemblages have so far been found along the east coast suggests the present west coast bias as a strong analogy for the location of those of the Mesolithic. The modern pebble beaches are therefore likely to be located in much the same places as those of the Mesolithic. This is supported by significant raised beach deposits to the rear of many of the presently active beaches on Islay, for instance Portnahaven and Port Bun Aihbne. In addition, rolled Mesolithic artefacts, specifically platform cores and blades were recovered during the survey at Kilchiaran Bay. This suggests that flint was being collected and worked from these same areas during the Mesolithic. The modern location of beaches therefore provides a strong analogy for the location of those producing raw materials during the early Holocene.

4.7.3. Limits of the analogy at both the regional and island scales

The previous discussion presented evidence for the validity of using the modern location of flint beach pebbles for inferring those of the past, however, this does not imply that the assemblages would have been similarly structured. Continuous collection from the Mesolithic up until the production of lighter flints during the 1940's (Finlay pers com), suggests that significant changes were taking place within the assemblages. Combined with this were the effects of rising sea levels during the late Mesolithic and early Neolithic, followed by its fall. This would have led to a relative increase and then decrease in flint incorporated from eroded land based glacio-marine deposits. In view of these processes, extending the locational analogy to include size fractions which might have been potentially available would be unwise, but as a comparative measure of productivity throughout the region, the modern beaches do provide a useful guide.

4.8. The survey within the context of Mesolithic settlement in the region

Flint along the west coasts of Islay, Colonsay and Iona would have proved attractive to Mesolithic hunters and gatherers. Significant evidence for the working of flint to the almost total exclusion of any other materials on Islay suggests that the islands resources were being intensively collected and worked. This suggests that re-tooling may have been an important factor behind the occupation of the island. To what extent other resources were being exploited is unclear although the presence of hazel nuts, microliths and a few bone fragments are suggestive of the range of possible other activities. Although flint deposits on all three islands are rich in comparison with those from the rest of the region, the low proportions of larger fractions suggests that as long-term sources of raw material during the Mesolithic, they would have been sensitive to over-exploitation. This would have been compounded by falling sea levels from around 6000 bp with no new nodules incorporated from within the land based glacio-marine deposits on Islay, Colonsay and Iona. The Islay survey highlighted in particular the small size of the majority of pebbles available for collection. This would have had an effect on the types of artefacts which could be produced. For instance, few of the pebbles recovered during the survey would have been sufficiently large to produce larger artefact types, for instance axes. Small raw materials are strongly correlated with small core and blade based tool assemblages.

CHAPTER 5

Regional raw material use

5.1. Introduction

The development of regionally based models of Mesolithic settlement in western Scotland are dependant on the understanding of the location and nature of knappable quality raw materials. For the region as specified in Chapter 2, these include the four types, bloodstone, quartz, flint and pitchstone. In this chapter I look at differential use of raw materials and the distances over which they were travelling in the context of the results of the survey discussed in the previous chapter.

5.2. Aims

This study has four principle aims:

1) To investigate the maximum spatial scale over which people were moving during the Mesolithic.

2) To investigate spatial and temporal lithic provisioning strategies.

3) To investigate rates of mobility.

4) To consider the nature of archaeological visibility, sites or scatters and their relevance to interpreting occupation intensity.

5.3. Method

A dataset of thirteen sites were compared in terms of raw material proportions and straight line distances from each site to the closest probable source or sources of raw materials. Only large Mesolithic assemblages with blade based artefact components were considered, restricting the analysis to later and possibly earlier Mesolithic horizons. Analysis was therefore restricted to the island hotspots of Rhum, the Southern Hebrides, including Jura, Islay and Arran, with an additional site on the mainland at Morvern.

5.4. The study area and its lithic resources

As previously discussed, the study region covers the western mainland coastal strip and islands of the Inner Hebrides. In the analysis presented here, the region extends Rhum in the north, to Arran in the south, a straight distance of approximately 185km. For a more detailed discussion of the four main cryptocrystaline lithic types see Chapter 4, these are:

Bloodstone: A hydrothermal chalcedony found in-situ within tertiary lavas on the west coast of Rhum (Wickham-Jones 1990)

Flint: Occurring primarily as beach pebbles, which can be collected along the west coasts of Islay, Colonsay and Iona.

Quartz: Milky white and crystalline, both clear and amethyst, can be collected throughout the region as in-situ deposits and beach pebbles.

Pitchstone: A volcanic glass present mainly on the island of Arran (Thorpe and Thorpe 1984), but with smaller deposits of coarse material known from Craignish on the mainland to the north east of Jura, on Eigg and in Ireland.

5.5. The assemblages

5.5.1. Rhum

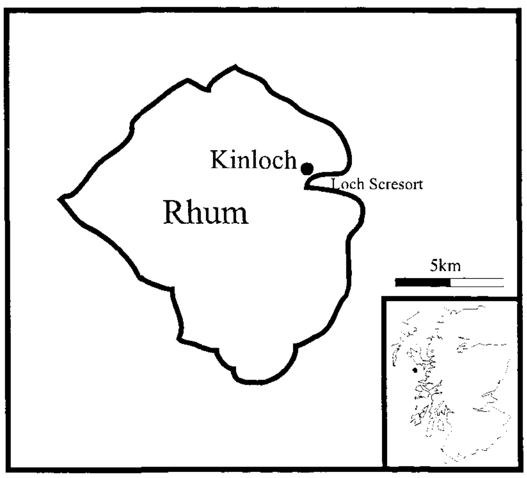

Figure 5.1. The location of the site of Kinloch, Rhum.

Kinloch: Located at the head of Loch Scresort, figure 5.1., the assemblage contained a substantial quantity of flint and bloodstone (99.3%, n=137037), (Wickham-Jones 1990:60, table 2). Unfortunately due to classification difficulties, pitchstone and flint were jointly grouped as chalcedony (*ibid*:57). Limited use was made of quartz (0.5%, n=668) and agate (0.2%, n=262), both available along the west coast of the island. In addition a few pieces of silicified limestone (0.05%, n=69) and pitchstone (0.004%, n=6) were found (*ibid*:60, table 2), both present on the nearby island of Eigg (*ibid*:52). This strongly suggests that all lithic raw materials present at Kinloch, apart from flint were collected within a 15km radius of the site.

In order to assess the relative proportions of flint and bloodstone in the assemblage, the following discussion uses the counts from the sample from Trench AD in which flint and bloodstone were separated (*ibid*:71, ill36). Of the sampled assemblage of 743 pieces from the Mesolithic horizon, 61% (n=453) were of bloodstone, while the remaining 39% (n=290) were of flint. Inner flint comprised approximately 83.5% (n=268), and secondary 16.5% (n=53). Sites on Islay to the south and close to abundant sources of flint raw materials (see Chapters 4 and 6), had inner proportions of the order of between 58% and 65%. This suggests that proportionally more of the flint introduced at Kinloch was being carried onto the island in a more extensively worked state. Compared to flint, relatively high non-cortical bloodstone proportions (93.3%, n=375) were present at Kinloch suggesting that nodules were being worked at source (*ibid*:78). Retouched artefacts, and microliths in particular were noted as having been produced from both bloodstone and flint (*ibid*:99), although no breakdown of proportions was given. However it was noted that flint was more frequently used (*ibid*:102).

The mixed Mesolithic/Neolithic horizons from Trench AD, dated to 3890±65 bp (GU-2042), and 4080±60 bp (GU-2148), consisted of 479 pieces, of which 370 (77.3%) were of bloodstone, and 109 (22.7%) of flint (*ibid*:80, ill45). Compared to the earlier Mesolithic horizons, this suggests increasing use of locally occurring bloodstone during later prehistory, figure 5.2.

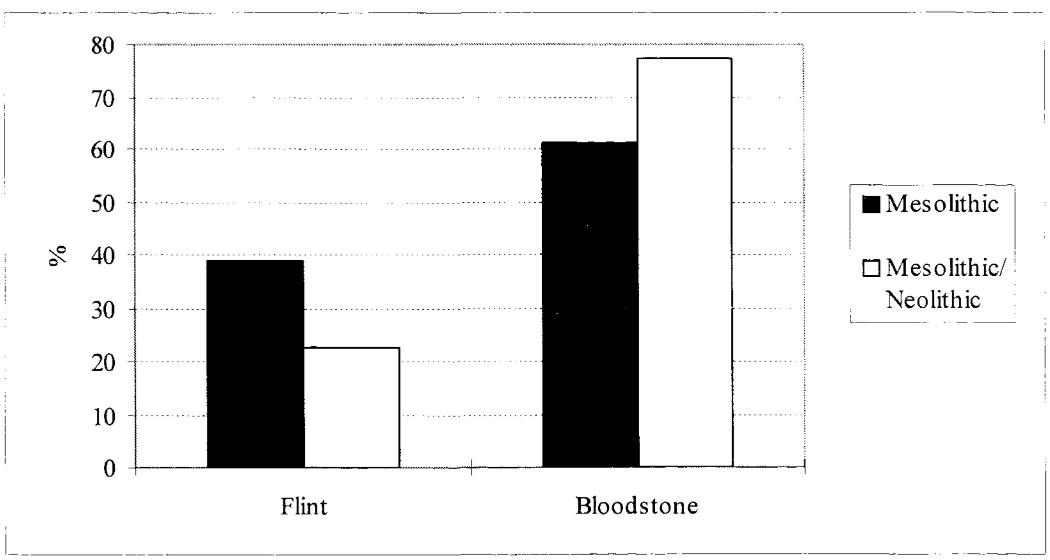

Figure 5.2. Proportions of flint and bloodstone in Mesolithic and mixed Mesolithic/Neolithic horizons from Kinloch, Trench AD (After Wickham-Jones 1990:71, ill 36, & 80, ill 45).

Of the total flint assemblage, secondary pieces accounted for 32% (n=35), and inner 68% (n=74), (*ibid*:80, ill45). Compared to the earlier Mesolithic horizons this suggests increase use of fresher more cortical flint pebbles during later Prehistory, figure 5.3. This may be supported by the similarity between inner proportions in the mixed horizon at Kinloch, and those from Islay to the south where inner flint comprised between 58% and 65% of the assemblages. Interestingly, secondary and inner bloodstone proportions remain the same in both the Mesolithic (93.3%, n=375) and later Prehistoric (93.2%, n=345) horizons.

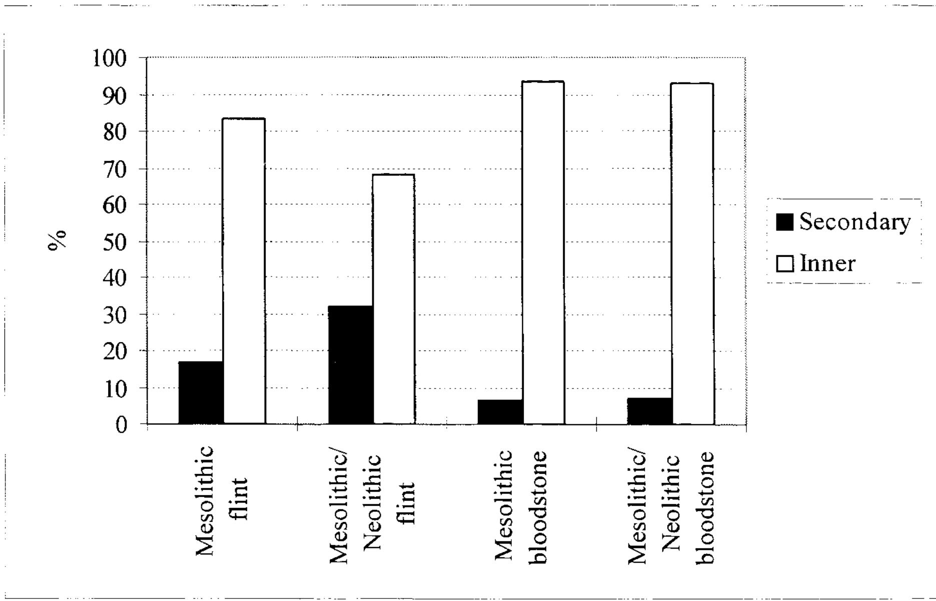

Figure 5.3. Proportions of secondary and inner flint and bloodstone in Mesolithic and mixed Mesolithic/Neolithic horizons from Kinloch, Trench AD (After Wickham-Jones 1990:71, 80).

This suggests similar bloodstone use during both the Mesolithic and later Prehistoric, probably since raw materials were close to hand. However there appears to have been a temporal shift in the use of flint, both in terms of quantity as well as the way in which nodules were being introduced onto the island.

The primary raw materials used at Kinloch were bloodstone and flint, the former available for collection along the west coast of the island at bloodstone hill, 10km to the west. Flint on the other hand is unlikely to have been available in any quantity. On the basis of regional beach survey (see Chapter 4), the most likely source of this material would have been Islay or Colonsay, 130km and 100km to the south respectively.

5.5.2. Morvern

Acharn: Two surface collected Mesolithic assemblages from central Morvern, figure 5.4. Scatter A consisted of 96.7% (n=632) flint, while the remaining 3.3% (n=22) was composed of quartz, mudstone, quartzite, chert, bloodstone and granite (Ritchie *et al.* 1975:28). The flint assemblage consisted of 42 (6.7%) worked pieces including microliths and microburins (*ibid*:29, no's 1-5,7), and 86 (13.6%) cores and chunks, including one bipolar core of bloodstone. Pieces of flint with cortex accounted for 26.6% (n=168) of the assemblage.

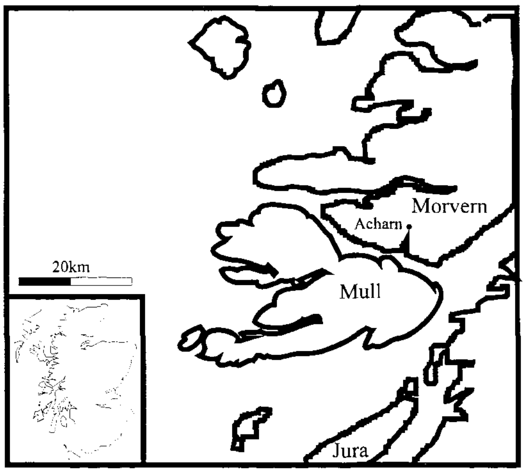

Figure 5.4. Location of the Mesolithic scatter at Acharan, Morvern

Scatter B consisted of 97.4% (n=227) flint, the remaining 2.6% (n=6) comprising quartz, quartzite, mudstone and pitchstone. The flint assemblage consisted of 10 (4.4%) worked pieces including a microlith (*ibid*:29, no8), and nine (3.9%) cores and chunks. Pieces of flint with cortex accounted for 25.7% (n=59) of the assemblage, significantly similar to scatter A at 26.6%. Both assemblages contained a reduced secondary component compared to sites on Islay to the south, where cortical flint comprised between 35% and 42% (see Chapter 6).

The significant flint component suggests contact with Islay 90km to the south, while the lower secondary proportions suggest that it was being introduced at later working stages. Interestingly, cortex proportions at Acharn lay between those present on Islay to the south, and Rhum to the north. Since the site is located close to an in-situ deposit of flint on Beinn Iadain (see Chapter 4), this may suggest the use of locally derived flint rather than beach pebbles from Islay or Colonsay. Unfortunately no cortex descriptions were given in the report (*ibid*), and therefore whether or not these deposits were exploited remains unclear. The very low levels of bloodstone suggest that very little was being transported off the island of Rhum 60km to the north west.

5.5.3. Jura

Lealt Bay: Produced an assemblage of 17.7kg of flint, 5.4kg of milky quartz, an "ounce or two" of pitchstone and clear quartz crystal, and a pebble of "siliceous vein material" (Mercer 1968:20), possibly bloodstone. The pitchstone collection comprised a total of 43 pieces, of which two were cores, one an awl and one probable later Prehistoric flake scaled point base. Seventeen flint pebbles suggest that the majority were beach collected. Milky quartz can be collected locally on Jura, although specific sources were not been located during survey of the island. Flint is unlikely to have been present on the island, the closest substantial source being Colonsay or Islay at 30km and 45km to the west respectively.

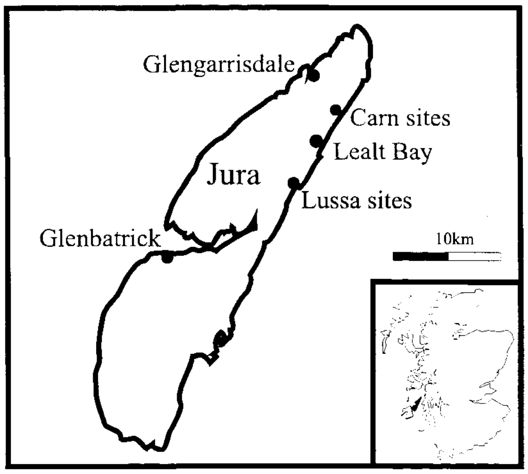

Figure 5.5. Location of Mesolithic sites from the west and east coasts of Jura.

The presence of pitchstone, if from Arran suggests movement over a distance of approximately 75km. However as noted by Mercer (1968:45), andesitic pitchstone can be collected at the head of Loch Craignish 25km due east suggesting the possibility of direct collection or material derived as glacial erratics. However, considering the generally poor quality of pitchstone away from Arran (Thorpe and Thorpe 1984), it is likely that the Craignish material would have been of little use.

Lussa River: Produced an assemblage of milky quartz and flint weighing 32.7kg and 4kg respectively, as well as five flakes and a core of pitchstone, and 40 pieces of quartz crystal (Mercer 1970:10). Significant use was being made of local quartz, although primarily for bipolar working (*ibid*). The site was dated to 2670±140 bc (BM-556), and 2250±100 bc (BM-555), both uncallibrated (*ibid*:5), however these dates probably relate to Neolithic activity at the site (Woodman 1989:16). The presence of a large quartz component within the assemblage suggests that local raw materials played in significant part in overall lithic provisioning at the site. Flint implies transport over 45km from Islay, or 30km from Colonsay, while the pitchstone if from Arran points to transport over 75km. The shift towards the greater use of these locally available raw materials may suggest a decrease in mobility scales and therefore a relative lack of access to flint on Islay or Colonsay, in turn reflected in greater use of local although less tractable raw materials. Alternatively it may reflect a shift in emphasis towards flake artefacts, for which local quartz provided a suitable raw material.

North Carn: The assemblage consisted of 7.3kg flint, 2.7kg milky quartz, 16 pieces of colourless quartz crystal, and a single pitchstone flake (Mercer 1972:9). Of this only 0.9kg, mostly flint, was recovered from the in-situ land surface dated to 7414±80 bp (SRR-161). The remaining 9.1kg coming from mixed gravels and occupational debris above, which is dated to 3584±65 bp (SRR-162), (*ibid*:5). Although quartz was present at the site, minimal use appears to have been made of it, with only two microliths (0.3% of total 713), and four scrapers (4.2% of total 96), although greater proportions of scalar cores were being produced of quartz (22.6%, n=7). As with the other Jura sites, the presence of flint implies movement over 50km from Islay, and 32km from Colonsay. The single piece of pitchstone suggests movement of approximately 75km from Arran, although at such low densities glacially derived nodules from Craignish cannot be ruled out.

Glenbatric Waterhole: Produced 10.8kg of flint, 762g of milky quartz, 56g of crystal quartz, and two flakes of pitchstone (Mercer 1974:16). An area of burning in area G2 was dated to 4225±230 bp (GX-2563), and 5045±215 bp (GX-2564) from a shallow trough in the artefact free zone between areas G1 and G2 (*ibid*:13,16). However, these dates are more likely to reflect later Prehistoric activity. At approximately 18m O.D. the site could have been occupied at any time after the early transgression (Woodman 1989:13). Unfortunately, no breakdown of the flint and quartz proportions were given for areas G1 and G2, although the two flakes of pitchstone were noted as having come from the former (*ibid*:16). On the basis of the trench numbering scheme (*ibid*:18), it would appear as though the collection of flint beach pebbles were recovered from area G1.
Interestingly, Mercer noted the presence of more than one type of flint, typical beach pebbles and a "mediocre grey cherty" material, which he considered to have come from Malcolm's point on the south coast of Mull (*ibid*:18). If flint was being collected from Mull, this would imply transport over a distance of 39km. The presence of beach pebble flint implies transport over a distance of 50km from Islay, or 30km from Colonsay, while the pitchstone may suggests transport over 80km from Arran. Although at such low densities glacially derived nodules from Craignish cannot be ruled out.

Lussa Wood 1: The deposits were divided into three horizons, lower middle and upper, in which flint decreased while quartz increased, table 5.1., and figure 5.6.

Table 5.1 Total weight of flint and quartz from the lower, middle and upper horizons at Lussa Wood 1 (after Mercer 1980:8,11).

Horizon	Flint	Quartz
Upper	24kg	8.4kg
Middle	6.8kg	454g
Lower	4.6kg	280g

Compared to flint, locally available quartz was being more extensively used during later phases. In addition, crystal increased from 14 pieces in the lower horizon, to 20 pieces in the middle, and 99 in the upper, while pitchstone increased from 3 pieces in the lower horizon, to 4 in the middle, and 64 in the upper (*ibid*:8).

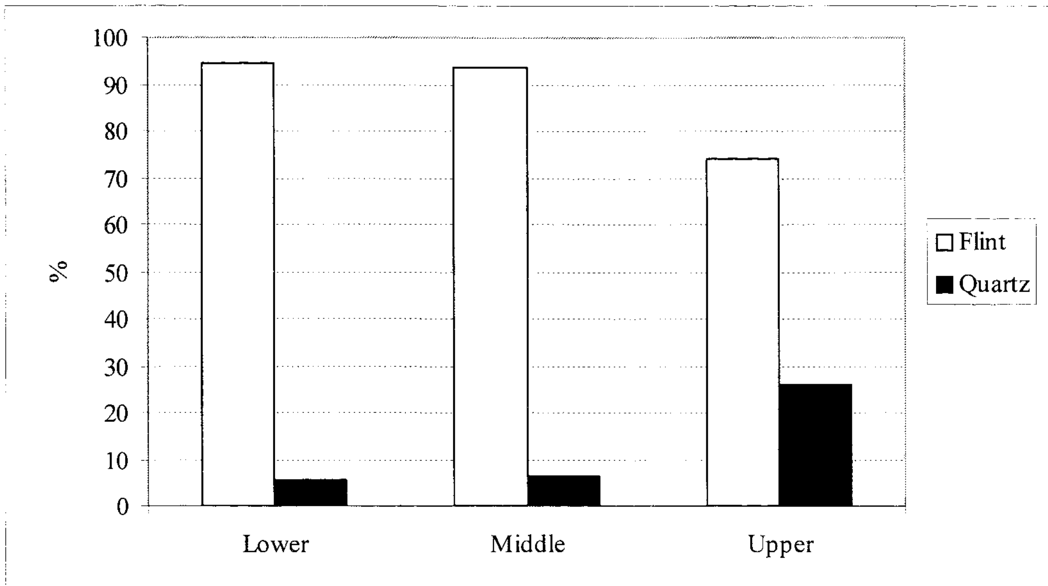

Figure 5.6. Flint and quartz proportions from the lower, middle and upper horizons at Lussa Wood 1, the Isle of Jura (after Mercer 1980:11).

In addition, three porcelanite axe fragments from Antrim were recovered in the upper horizon (*ibid*:8). The increasing diversity of raw material types on the one hand, along with increasing use of local quartz may initially appear contradictory. Increasing diversity of raw materials suggests greater levels of mobility within the region, while at the same time, increasing use of local less tractable materials points to the opposite. This may suggest that the upper horizon shift towards local quartz was conditioned not by changes in mobility structure, but by increasing use of flake and scalar core technologies for which poorer quality raw materials are suitable. Éclat écaille increased from 0.1% (n=1) in the lower horizon, 1.7% (n=23) in the middle, and 4.5% (n=227) in the upper, while the number produced from quartz increased from none in the lower horizon, to 4.3% (n=1) in the middle, and 15.4% (n=35) in the upper (*ibid*:21). As with the other Jura sites, the presence of flint implies transport over a distance of 50km from Islay, or 30km from Colonsay, while the presence of pitchstone suggests movement over 80km from Arran. Porcelanite sourced to either Tievebulliagh or Rathlin island indicates movement over a distance of 85km.

Glengarrisdale: The assemblage consisted of 17.5kg of flint, 23.9kg of milky quartz, 104 pieces of quartz crystal, and seven pieces of pitchstone (Mercer and Searight 1986:47). From the central excavation trenches, two possible intact horizons were identified, layer 3a and 3b. The upper layer 3a produced 1.94kg of flint, and 5.03kg of quartz, while 3b produced 5.48kg of flint, and 2.61kg of quartz (*ibid*:47, table 2), figure 5.7.

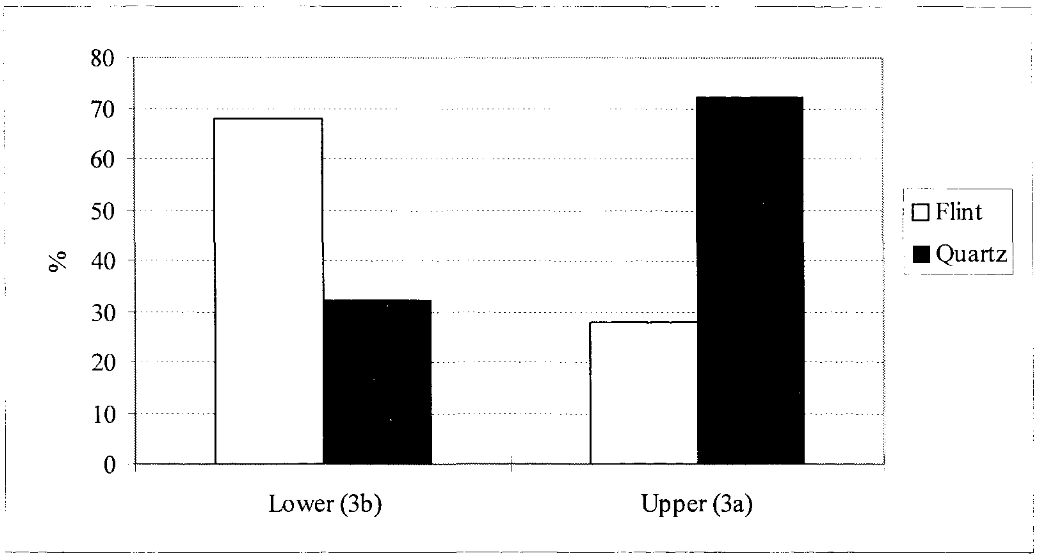

Figure 5.7. Proportions of flint and quartz from the lower (3b) and upper (3a) horizon at the site of Glengarrisdale, western Jura.

Éclat écaille increased in proportion from 3b to 3a, from 39% (n=127), to 73.1% (n=128), of the retouched assemblage including platform cores respectively. Of these, a greater proportion of those from the upper horizon 3a were of quartz (42.2%, n=54), compared 3b (34.6%, n=44), (*ibid*). The increase in quartz use, as well as its application for bipolar cores suggests that later activity saw greater use of local raw materials. The presence of flint implies transport over a distance of approximately 50km from Islay, or 30km from Colonsay, while the presence of pitchstone suggests movement from Arran, over 80km away.

5.5.4. Islay

Kindrochid 4: The following discussion is based on catalogues generated as part of my research. Two small unretouched flakes of pitchstone were present within a Mesolithic assemblage numbering 10343 retouched and unretouched pieces of flint greater than 10mm. The largest piece measured 10mm square, retained some cortex and was fine grained and dark green in colour. The second chip was about 5mm square, had no cortex, was fine grained and olive green in colour. There were two chips of quartz crystal present, although they were probably natural, along with two flakes of milky quartz, one obviously struck from a platform core and measuring 22mm by 18mm.

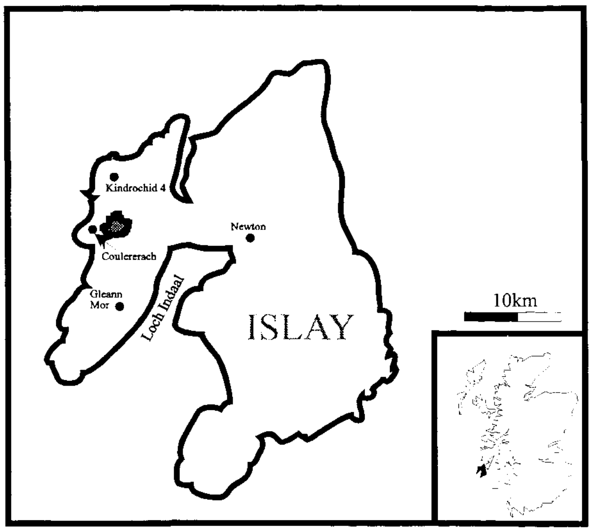

Figure 5.8. Location of the sites of Kindrochid 4, Gleann Mór, Coulererach and Newton on Islay.

Flint raw materials at the site would have been collected from the beaches of the Rhinns just over two kilometres to the west, along with quartz, figure 5.8., while the pitchstone suggests transport over approximately 85km from Arran. For a more detailed discussion of Kindrochid 4 see Chapters 6, 7.

Gleann Mór: Based on the use of the assemblage database compiled by the Southern Hebrides Mesolithic Project. From a collection of 13738 retouched and unretouched pieces greater than 10mm, a single possible pitchstone chunk, and 1132 pieces of quartz were recovered. Of the quartz assemblage, 32 (2.8%) were cores, four bipolar and 28 platform, while one piece (0.09%) may have been retouched, a possible scraper. Quartz is locally available on Islay as in-situ outcrops or beach pebbles, suggesting that at least a component of the assemblage could be natural. The presence of flint implies collection from just under three kilometres to the west, figure 5.8., while the single possible piece of pitchstone suggests transport over approximately 85km from Arran. For a more detailed discussion of the Gleann Mór assemblage and the site, see Chapters 6 and 7.

Newton: Approximately 1km to the north east of the village of Bridgend, figure 5.8. Newton produced a Mesolithic assemblage consisting entirely of flint, while a single flake of pitchstone was recovered from later Prehistoric contexts further up the terrace (McCullagh 1991:34). The presence of flint implies that pebbles were being carried across Islay over a distance of approximately 14km, while pitchstone if from Arran, suggests transport over 70km. For a more detailed discussion of the Newton assemblage see Chapter 6.

Coulererach: Produced an assemblage of 879 retouched and unretouched pieces of flint greater than 10mm. This implies transport over a distance of just over 1km, figure 5.8. For a more detailed discussion of the assemblage and site see chapter 6 and 7.

5.5.5. Arran

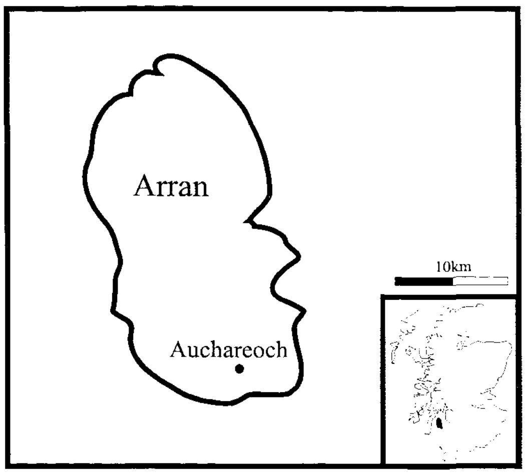

Figure 5.9. Location of the site of Auchareoch, Isle of Arran.

Auchareoch: Located 4km inland from the south coast of the island, figure 5.9., at approximately 165m O.D., the assemblage consisted of flint and pitchstone numbering 4567 pieces. There appears to be a discrepancy in numbers in the report which lists only 4417 pieces. This is due to the exclusion of 150 pitchstone chunks (see Affleck *et al.* 1988:47). Although locally available, pitchstone was poorly represented within the assemblage (12.4%, n=568), compared to flint (87.2%, n=3983). There was an additional small quartz, agate and mudstone component (0.4%, n=16). The presence of greater proportions of primary flakes of pitchstone 4% (n=16) than flint 1.06% (n=39) suggests that pitchstone was being worked on site as raw nodules more commonly than flint. In addition, greater proportions of cores and chunks of pitchstone were being abandoned on site 28.5% (n=162), as opposed to only 2.7% (n=107) for flint, suggesting less efficient more expedient use of the former. This is supported by only 7 (1.2% of complete pitchstone assemblage) pitchstone microliths, but 133 (3.3% of complete flint assemblage) of flint (*ibid*). The presence of flint at Auchareoch suggests collection approximately 85km away on Islay, although flint is present along the coast from Ardrossan to the Rhinns of Galloway, and on the island itself in small quantities, see Chapter 4.

5.6. Discussion

5.6.1. Settlement and mobility strategies

Along the collector forage continuum as proposed by Binford (1980), where would the Mesolithic of south west Scotland have fallen? As suggested in Chapter 2, seasonality may provide a means for inferring rates and extent of mobility. In order to investigate this I estimated E.T. or effective temperature for the region based on mean temperature from the island of Colonsay. Effective temperature is calculated as follows, where W and C are the average temperatures of the warmest and coldest months (after Kelly 1995:66).

$$\mathbf{ET = \frac{18W - 10C}{(W\text{-}C) + 8}}$$

The E.T. for Colonsay is therefore 11.7 with an average warmest temperature for August of 13.6° C, while the coldest was 4°C (Mellars 1987:17, fig 2.9). In Kelly's table this places western Scotland just below the Ainu of Hokkaido (E.T. = 12), a coastal group benefiting from warm sea currents, and just above inland North American Great Basin groups such as the Ute and Assiniboine (both with E.T. = 11.7) (Kelly 1995:67, table 3.1). The Ainu, an example of a collector system, are reported as having 2 residential moves per year within a total area of 171 km^2 (Kelly 1995:112, table 4.1). No figures exist for the interior groups mentioned above however the Crow Indians from the Great Plains (E.T. = 13) move their residential base 38 times per year and cover a total area of 61.880 km^2 (*ibid*:113, table 4.1). These extremes in area and mobility illustrate the difficulty of predicting settlement systems from environmental data. However the area covered by the Crow equates to a settlement radius of 140km, which is broadly comparable with the distances implied for movement along the Scottish west coast, in particular with reference to flint on Rhum, implying a distance from Islay of approximately 130km. In terms of overall scale, this may suggest that the Mesolithic of south west Scotland involved a residentially mobile forager mode of subsistence, the expected archaeological signature of which is off-site and fine grained (Binford 1980; Foley 1981). However, the archaeological record of the region appears to have been quite the opposite. Repeated use of sites along the coasts and rivers and around inland lochs as suggested in Chapter 2, produced palimpsests of coarse grained debris, pointing rather towards logistically organised collector strategies. This point is further discussed in Chapter 8.

5.6.2. Scales of mobility

The presence of flint within Mesolithic horizons throughout the region, particularly in those areas from where it is unlikely to have been available for collection, indicates its transport. Although other smaller sources may have been exploited, for instance the in-situ deposits on Mull or Morvern, or the island of Iona, the density and character of artefacts and debitage on Rhum suggests that much of the material would have come from Islay or Colonsay, approximately 120km to the south. Mesolithic waste and artefact assemblages on Jura are unlikely to have been sourced on the island itself, with the closest flint source located to the west on Islay and Colonsay between 15km and 20km away. Although close, direct or embedded collection would have taken time, and at least one water crossing. It does suggest that the islands of the Southern Hebrides were being simultaneously exploited. The presence of substantial flint deposits on Islay is no surprise, given there closeness to the Atlantic coast flint sources. Straight line distances of up to 17km are implied by the presence of flint on the east coast of the island, although the largest assemblages on the Rhinns peninsular were all less than 5km from prospective sources. The presence of flint on Arran is more difficult to interpret, since although flint tends to be rare on the island itself, substantial till deposits exist to the south east in Galloway.

5.6.3. Provisioning strategies

This discussion makes use of the approach to the organisation of technology recently introduced by Kuhn (1995), in which he argued for a bipartite division of artefacts geared on the one hand towards provisioning of the individual, and on the other towards place.

5.6.3.1. Provisioned people

It was argued in the proceeding section that since flint was present on those islands where it cannot be naturally collected, it must have been humanly transported. The presence of pebbles on Rhum suggests that at least a proportion of this material was carried in its raw state, however without actually looking at the material, it has not been possible to verify the source. They may have come from Islay or alternatively could have been fortuitous finds of single pebbles on any of the region's beaches. The presence of some debitage with cortical platforms suggests earlier working, although determining what proportion of the full reduction trajectory (Raab *et al.* 1979:177; Jefferies 1982) was present is more difficult. However there was some suggestion that flint on Rhum was being introduced at a later stage, see figure 5.10. The first three assemblages were collected from between 1km and 5km from the raw material sources along the west coast of the Rhinns of Islay, while Kinloch is located over 130km on the island of Rhum. Arranged at increasing distance from the flint sources on Islay. An increasing proportion of inner versus cortical debitage was noted, significantly so at Kinloch.

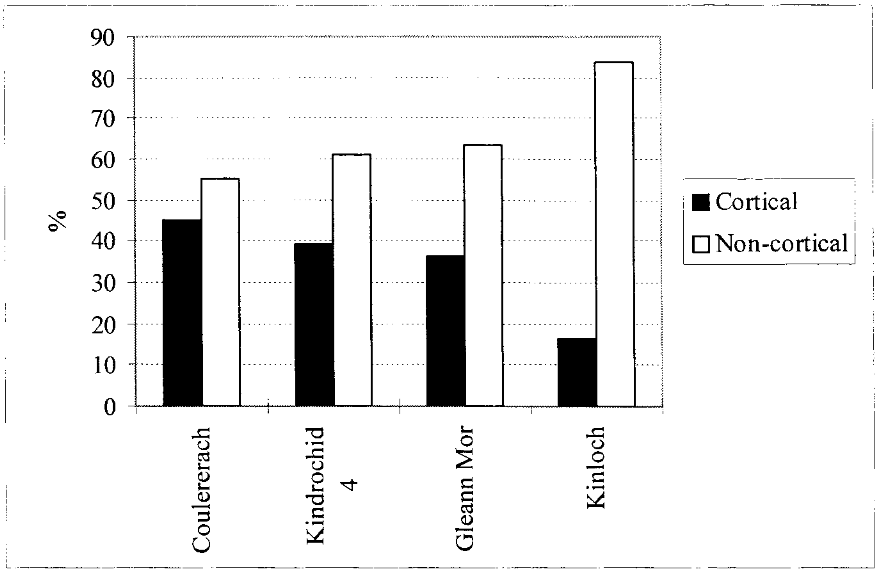

Figure 5.10. Secondary and inner debitage proportions from the Islay sites of Coulererach, Kindrochid 4 and Gleann Mór, and Kinloch from Rhum, arranged at increasing distance from the west coast flint sources on Islay.

This suggests that although some pebbles were being introduced, raw materials being carried onto the island were predominately in the form of partly worked cores. There are significant advantages in terms of transporting small tested and partly prepared blade cores (Finlayson 1990:48). Once the core has been set-up, removal of blades is a relatively efficient and easy process. In addition, platform cores provide a compact and easily transported source of blades and flakes.

This suggests that small platform cores provided the technological bridge for operations between the island hotspots of Rhum and the Southern Hebrides. By technological bridge I refer to the means by which artefacts are maintained and manufactured in areas devoid of suitable raw materials. In other words, the means of artefact manufacture carried by the individual.

5.6.3.2. Provisioned places

Although flint would appear to have functioned as the bridging technology throughout the region, use was being made of local less tractable lithic types on Rhum, Jura and Arran. On Rhum, the use of locally occurring bloodstone augmented flint which was being brought onto the island. The Mesolithic horizon from Trench AD contained 61% bloodstone, and 39% flint (Wickham-Jones 1990:71). This suggests that although flint was being carried as part of the individuals mobile toolkit, the absence of flint from the beaches of Rhum led to a relative scarcity, which encouraged the use of local bloodstone. However, flint appears to have remained in use, particularly for more formal artefacts such as microliths where its use outweighed bloodstone. The use of bloodstone increased into the later Prehistoric, where it comprised almost 76% of Trench AD mixed Mesolithic and Neolithic horizon, compared to 61% in the previous Mesolithic contexts.

On Jura non-local flint was augmented by locally available but less tractable quartz. These were used for a range of artefact types, although they tended more often to be used for informal types. Milky quartz and quartz crystal can be collected along the beaches of Jura as well as in-situ, although it was not possible to determine which of these sources was being used. The use of quartz ranged from between approximately 7% at Glenbatric Waterhole, to almost 90% at Lussa River, figure 5.11.

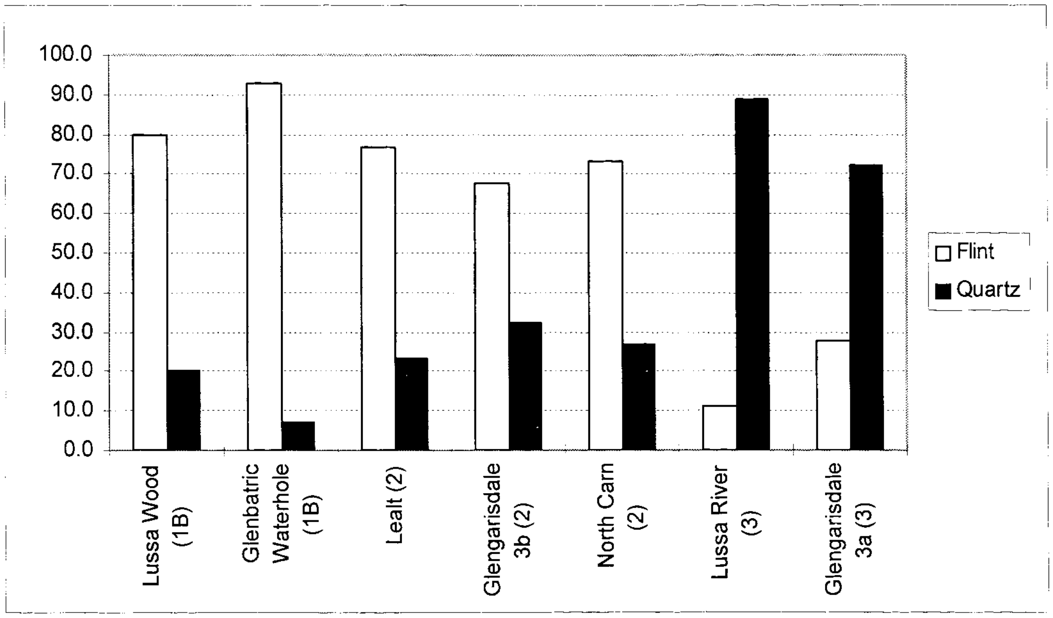

Figure 5.11. Flint and quartz proportions from the Jura assemblages, arranged from left to right according to Mercer's chronology (phase in brackets).

It is clear that there was considerable temporal variability in the proportions of quartz used on Jura. This scheme could be further refined by separating the Lussa Wood 1 assemblage into its lower, middle and upper horizons, see figure 5.6. Quartz proportions in the lower and middle horizons suggest early phase 1B activity, and the upper mixed horizons, phase 2. The use of local quartz appears to have increased considerably through time on Jura, suggesting either that access to the raw material sources on nearby Islay and Colonsay was restricted, or alternatively that flint declined as a critical raw material.

On Islay there was less use made of local raw materials other than beach pebble flint, although this is unsurprising given the quality and quantity of resources along the Atlantic coast. All of the flaked material from the Newton Mesolithic horizon dated to the eighth Millennium bp was of flint (McCullagh 1991:32). The Mesolithic horizon at the eastern end of Trench 1 at Kindrochid 4 produced two deliberately struck but unretouched flakes of milky quartz, and one split pebble, from which they probably originated (Marshall forthcoming). At Coulererach there appears to have been little use made of local quartz or any other raw material besides flint beach pebbles. The assemblages at Gleann Mór and Bolsay Farm produced a larger quartz component, although the extent to which much of this material may be natural is at present unclear. Continued study of these assemblages in the context of The Southern Hebrides Mesolithic Project will hopefully clarify the picture further. However, of the 1108 pieces of quartz greater than 10mm at Gleann Mór, 28 possible cores were recovered of which 14 were bipolar, with an additional possible retouched scraper. This relatively low level of utilisation may suggest that a large component of the quartz assemblage may be natural or possibly later Prehistoric.

On Arran, flint was being augmented by the use of local pitchstone, where at Auchareoch it comprised 12.4% of the assemblage. The greater proportions of chunks and cores of pitchstone abandoned on site suggests more expedient use. Only 1.2% of the pitchstone assemblage consisted of microliths, compared to 3.3% of flint (Affleck *et al.* 1988:47). Cortex was present on only 12% of the flint assemblage, low compared to sites on Islay or even Rhum in the north. This may suggest that cores were being introduced at a much later reduction stage. Flint beach pebbles were probably unlikely to have been available in any quantity on Arran, and therefore were probably transported onto the island, either from Islay to the north west, or Galloway drift deposits to the south.

On Rhum, Jura, Arran and to some extent Islay as well, flint based technologies were being augmented by locally occurring less tractable raw materials. Although some use was being made of the latter for the production of retouched pieces, their main use would appear to have been for more expedient artefacts. Although these were being used on their source islands along with the imported flint, they would appear not to have left the islands in any quantity, during the Mesolithic at least. Although this will be discussed in more detail in the next section concerning rates of mobility, what is clear is that these other raw materials were primarily being used on the islands on which they had been collected. This suggests that in contrast to flint which was being used to provision individuals, local raw materials were being used to provision places (Kuhn 1995). Provisioning of places is not strictly used in the way which Kuhn proposed. Rather than the site as cache of raw materials, the use of local stone is undertaken at the island scale. These do not appear to move off their source islands in any quantity, suggesting that although they were being extensively utilised, they were not being incorporated within mobile individual provisioning strategies. Rather, they were being used on their source islands, perhaps carried in larger volume from source to site, in effect lithifying (Webb 1993:108) what could otherwise be considered a chalcedony free landscape.

5.6.4. Rates of mobility

As introduced above, although local raw materials were being utilised on the islands of Rhum, Jura and Arran, little of this material was moving off the islands either as raw materials, or as retouched artefacts. A single bipolar core of bloodstone was recovered at Acharn, Morvern, however as a ploughsoil deposit, its chronological affinity is unclear. At Lussa Wood 1, a single éclat écaille and possible graver of pitchstone were recovered from the upper horizon (Mercer 1978:10), while at Lealt Bay an assemblage of 43 pieces of pitchstone consisted of two cores and an awl. The presence of milky and crystalline quartz in the region limits the extent to which interpretation of use beyond Jura can be made. Crystal at Staosnaig on Colonsay may have been transported from Jura or it may have been locally collected. On Islay no microlithic component of either milky or crystalline quartz has so far been found. Apart from these few retouched non-flint exotics away from their source islands, nothing else has so far been found. At such low densities no process besides low level use or fortuitous introduction need be implied, for instance there is no need to invoke gift exchange (Jacobi 1978:304). An hour or so of knapping usually results in more chips and small flakes in pockets, shoes and tool-bags, than the number of Pitchstone pieces collectively recovered at Kindrochid 4, Gleann Mór and Newton.

The presence of flint in all the regions assemblages points to extensive movement between the islands and the islands and the mainland, with retouched artefacts and raw materials being carried as part of the overall technological system. However, although similarly retouched artefacts were being produced from local raw materials, these appear not to have been moved as extensively. As argued above, this suggests that flint was being used as the primary bridging technology between the island hotspots. The fact that non-flint retouched artefacts were not moving any distance may suggest that they were present at such low densities as to be virtually invisible away from their source islands. Alternatively, with flint operating as the bridging technology, particularly in the form of small platform cores, non flint elements replaced as part of overall maintenance and repair, would have relatively enhanced the rate at which they were flushing from the system. The fact that these local raw materials are not present away from their source islands in any quantity as raw materials or retouched artefacts (Gramley 1983), suggests either that the rate of artefact replacement was very rapid, or alternatively, that island or archipelago scale mobility was more gradual. In effect distance between sources and artefacts accumulated gradually, allowing for the flushing of non-flint exotics before the individual had travelled very far.

5.6.5. Sites or scatters

The pattern of sites within the region is one of marked heterogeneity in the distribution and density of knapping debris. To some extent this may reflect a lack of fieldwork in some areas, for instance on the islands of Mull or Skye, or along the mainland coastal strip from Kintyre to Ardnamurchan, or even the uplands to the east. However for the moment the pattern does appear to be one of intensive occupation of the islands of the Southern Hebrides, Rhum and to some extent Arran. To what extent is this likely to reflect actual occupation intensity during the Mesolithic?

A presence on the intervening islands and mainland between the Southern Hebrides and Rhum and Arran is implied by the movement of flint from the former to both the latter. However, the visibility of this is particularly low, suggesting one of two things. Either occupation was primarily focused on the Southern Hebrides, Rhum and Arran, and therefore the lack of evidence from the rest of the region indicates a lack of presence. Alternatively, the islands may simply be more archaeologically visible. It would be difficult to explain why the Southern Hebrides and Rhum would be the primary foci of Mesolithic settlement in the region in purely economic terms. Constrained and relatively small, the islands would have supported limited population densities. Using Mithen's (1990:118) red deer population density estimates, with a resulting mean of approximately two animals per square kilometre, the population on the Rhinns peninsular would have been approximately 450 animals. Although not entirely isolated, crossing onto Islay from Jura would have entailed a swim of just less than 1km across the extremely tidal sound of Islay. Whether such low levels of inferred red deer populations could have been sustained is unclear, particularly in the context of significant circumstantial evidence for hunting is unclear. In any event, red deer populations are likely to have been larger on the adjacent mainland of Kintyre, why then is comparable hunting evidence conspicuous in its absence? It was argued earlier that individual provisioning with flint platform cores provided the bridging mechanism for operations between the sources of raw materials. This suggests that once off these islands, assemblages would be far smaller since the amount of waste generated would have been reduced by pre-preparation of the cores. In addition, raw materials would be expected to be less wastefully utilised. In effect, once off the Southern Hebrides or Rhum, assemblages would be expected to comprise only isolated artefacts and limited quantities of waste. However, at the origin of these lithic materials, much more substantial assemblages would be expected to be present in view of the extent to which pebbles had to be prepared through splitting and removal of cortical flakes. A large proportion of the mass of each core would be expected to have been left in close proximity to where the pebble as raw material had been collected.

In effect, the high visibility of the southern Hebrides and Rhum, and to some extent Arran are probably a function of their status as primary raw material source locations. The strong correlation between site location and water, whether marine, loch or riverine may suggest on Islay at least, that other tasks were being undertaken. If lithic raw materials were the only reason for visiting the islands, then sites would be expected to be strongly correlated with the coast. Instead they appear to have been located along the coasts of Jura, the Lochs of the Rhinns and the rivers of the main body of Islay. This suggests that an important criteria was to locate on the interface between woodland and more open environments, coastal, grassland or riverine. That these locations were attractive is indicated by the large palimpsests which accumulated during repeated visits, obviously to collect raw materials, but also to gather and hunt. However it is unclear whether the flint or some other resource was the primary reason for visiting the island. The extreme archaeological visibility of the southern Hebrides and Rhum, and in particular the site rather than scatter based archaeological signatures (Foley 1981) is therefore probably a function of intensive core working at locations which provided a range of opportunities for shelter, hunting and gathering.

5.6.6. Summary

Flint acted as the basic lithic currency throughout the region during the Mesolithic, which was collected primarily from the beaches of either Islay or Colonsay. For instance, along the Atlantic coast of Islay, Pebbles were being collected and worked at Coulererach and Kindrochid 4. Platform cores, flakes and blades, were being produced, from which microliths were fashioned. It would appear as thought pebbles, possibly whole, but definitely as partially worked platform cores were being carried off the island by individuals as part of their mobile toolkit. Eventually a component of these ended up on the island of Rhum in the far north, implying straight line distances covered of approximately 130km, although it is unlikely that such a route was followed. As part of the individuals mobile toolkit, cores were continuously reduced on route, thus generally getting smaller and retaining less cortex. The lack of archaeological visibility on the islands and mainland between the hotspots of Mesolithic activity on the southern Hebrides and Rhum, was not due to a lack of presence, but rather a reduced emphasis on primary manufacturing. The presence in these interim locations was sustained by transported flint cores, the archaeological residues of which would be expected to be essentially invisible.

Once away from the flint source islands, local raw materials were drafted into use, although flint appears to have remained important for the manufacture of microliths. Local less tractable raw materials such as bloodstone, quartz and pitchstone tended to be used as scrapers, borers and bipolar cores. This trend towards increasing use of local raw materials increases throughout the Mesolithic and into the Neolithic and Bronze Ages.

The reasons for this may be as follows. During the Mesolithic, mobility scales reduced, so limiting the extent to which collection along the Atlantic coasts could be embedded. Alternatively it may reflect a shift in technological strategies away from blade based artefacts. An alternative explanation may be that continuous exploitation of the flint deposits on Islay, Colonsay and Iona had depleted, see Chapter 4. Changes in mobility are unlikely to have resulted in the shift towards greater use of local raw materials. The later Mesolithic contexts on Jura for instance contain greater proportions of exotic materials such as Pitchstone and even porcelanite. These suggest that if anything, mobility had increased during the upper Mesolithic horizons and later Prehistoric. The second scenario is considered unlikely as well, since microliths continued to be made of these less suitable raw materials. If a shift towards less demanding technologies had encouraged the greater use of local raw materials, then this should also be reflected in the decline of microlithic forms. The third scenario is considered a possibility, continuous collection of flint led to a relative decline in viability of the beaches as sources, so encouraging the greater use of local less tractable raw materials. Some support for this may be found on Colonsay at the site of Staosnaig. Although deposits of flint comparable to those on Islay are presently available for collection along the islands Atlantic coast, there was significant use being made of very small pebbles during the Mesolithic. This may suggest that as opposed to the present availability of flint, progressively smaller and smaller fractions were being collected to extinction on Colonsay. As pebbles available for collection declined in dimension, greater use was made of smaller and smaller fractions. It is interesting to note the considerable emphasis on bipolar working at Staosnaig, for which small pebbles are well suited.

Although artefacts were being produced of both flint and local raw materials, these less tractable types were not leaving the islands in any quantity. In fact, few Mesolithic artefacts of either bloodstone, quartz or pitchstone have so far been found away from their respective source islands. This may suggest their use at such low densities that they are unlikely to be found at all. Alternatively it may indicate that with flint as the mobile source of raw material, within the context of repair and replacement of artefacts or composite elements, non-flint raw materials were being preferentially flushed from the system. This may suggest either rapid rates of artefact renewal, or as considered more likely, lower levels of regional mobility.

CHAPTER 6

The archaeology of Islay, the fieldwalked assemblages

6.1. Introduction

The question posed many times previously in this thesis continues to provide the research theme, and that is, what would be an appropriate scale at which to view occupation of the western Scottish seaboard? In the previous chapter, the discussion looked at the whole of the region from Arran to Skye. But how about intermediary spatial scales, for instance the larger islands of Mull, Islay or Skye. Could these have sustained permanent or semi-permanent occupation? Alternatively, were people moving rapidly over long distances across and along the extensive water highways linking the islands, and the islands to the mainland. The aim of this chapter is to consider this point, by shifting in detail from the previous regional scale approach, to one in which the island functions as the analytical unit. In particular, a series of fieldwalked assemblages from across Islay are investigated in relation to variability in composition and artefact morphology, and distance to raw materials.

6.2. Chapter structure

The chapter is divided into four main sections. The first begins by looking at proportional composition for each of the individual fieldwalked collections, before telescoping out to consider collated mean proportions for the island as divided along the Loch Indaal to Loch Gruinart axis. It proceeds in the third section by focusing in on platform cores, primary flakes and pebbles, looking in particular at dimensional and morphological changes across the island. In the final study, individual assemblages across both halves of the island are investigated in terms of core dimensions and morphology, and the effect of distance to raw materials on both.

6.3. Aims

The fieldwalked assemblages provide a spatially extensive sample of debitage and artefacts for comparison in terms of distance to raw material sources on the Isle of Islay. The aim of this study was to identify whether assemblage variability could be interpreted either in terms of assemblage size or alternatively as related to distance from raw materials. It is argued that this provides an index as to the extent to which sites across the island can be interpreted as interrelated and therefore part of structured use of the landscape, or alternatively the results of essentially unrelated knapping episodes. The second aim was to investigate whether morphological changes in components of the debitage assemblage could be used as a key to interpreting mobility strategies on the island.

6.4. Method

Regression analysis: The analysis was initially undertaken on a series of 84 fieldwalked assemblages collected by line walking from across Islay. The complete collection consisted of 8445 pieces of flint. Although many of the assemblages recovered contained a substantial Mesolithic component, some means was needed by which those resulting from later Prehistoric activity could be removed from the analysis. Due to generally poor recovery of smaller fractions, retouched pieces as an indicator of period were considered unreliable. However, one artefact readily identifiable and commonly recovered in the region were platform cores. These were taken as defining those assemblage dominated, or at least containing a Mesolithic component. On the basis of this, the collection was reduced from 84 to 31 assemblages. Of these, Bowmore 4 and Loch Gorm 6 were unusable due to discrepancies in counts. Although they were not used during the initial analysis of basic assemblage parameters, they were incorporated during the core study. In addition to the removal of assemblages without platform cores, a series of closely spaced collections were amalgamated at Bridgend 11, Gruinart 13 and Gruinart 7. This reduced the number of assemblages to 25, containing a total 6490 pieces of flint.

Collated mean proportions: Using the same 25 assemblages as above, mean proportions for all assemblage components were collated to the western and eastern halves of the island, separated by the Loch Indaal to Loch Gruinart axis.

Dimensional analysis: The dimensional analysis of platform cores, primary flakes and pebbles was initially undertaken by collating means from each half of the island. In the second study this was extended by focusing on those assemblages containing ten or more cores, with means again calculated. Primary flakes and pebbles were not included in this second study.

6.5. Results, the 25 assemblage analysis using linear regression

The 25 assemblages were field collected from across Islay, figure 6.1. The two main debitage groups included flakes, blades, chunks and platform cores, and primary, secondary and inner, table 6.1.

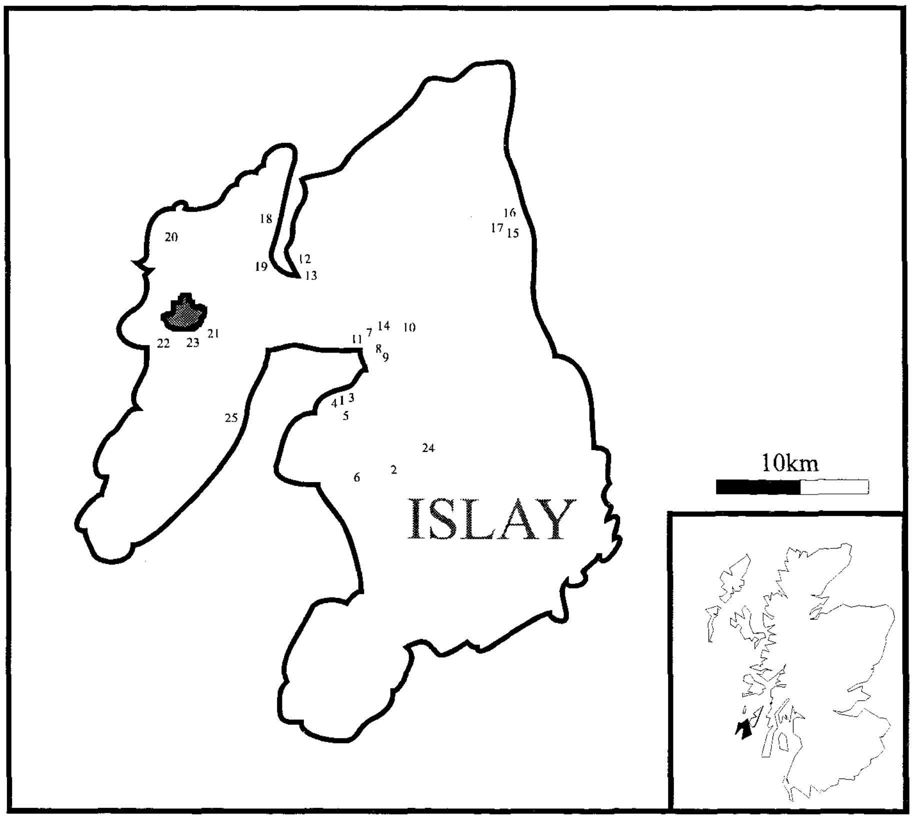

Figure 6.1. Approximate location and map reference number for the 25 fieldwalked collections from Islay.

Table 6.1. Counts of flakes, blades, chunks and platform cores, and primary, secondary and inner, and retouched, for 25 fieldwalked collections from Islay.

Site	Map number	Total	Flakes	Blades	Chunks	Platform cores	Primary	Secondary	Inner	Retouch
Bowmore 10	1	237	154	25	16	42	12	166	59	27
Bowmore 12	2	34	33	0	0	1	0	14	19	0
Bowmore 16	3	10	8	0	1	1	0	8	2	0
Bowmore 18	4	51	43	3	1	4	3	26	22	2
Bowmore 19	5	7	5	1	0	1	0	3	4	1
Bowmore 9	6	309	238	21	40	10	4	167	138	19
Bridgend 11	7	498	416	35	13	34	11	187	300	24
Bridgend 12	8	75	63	4	4	4	1	24	50	4
Bridgend 13	9	32	25	0	1	6	0	14	18	2
Bridgend 14	10	82	63	3	7	9	10	25	47	6
Bridgend 15	11	21	20	0	0	1	0	10	11	0
Gruinart 8	12	20	9	0	9	2	2	9	9	1
Gruinart 9	13	33	28	1	2	2	0	14	19	4
Scarrabus	14	394	342	15	12	25	18	182	194	32
Kiells 1	15	59	49	5	3	2	5	20	34	4
Kiells 2	16	38	32	3	1	2	1	16	21	5
Kiells 4	17	9	6	1	1	1	0	4	5	3
Gruinart 13	18	400	365	8	19	8	20	185	195	21
Gruinart 7	19	431	337	29	16	49	11	233	187	8
Kindrochid 4	20	3353	2404	244	494	211	125	1893	1335	130
Loch Gorm 1	21	134	108	8	5	13	10	86	38	13

Loch Gorm 5	22	172	128	18	17	9	15	88	69	5
Loch Gorm 9	23	33	22	3	7	1	0	17	16	1
Mulindry 10	24	23	20	0	2	1	0	10	13	6
Port Charlotte 1	25	36	20	4	10	2	0	28	8	4

6.5.1. Primary, secondary and inner proportions against assemblage size

Primary, secondary and inner debitage proportions were plotted against assemblage size, and linear regression lines fitted for each, figure 6.2. The large assemblage at Kindrochid 4 was removed due to its biasing effect on the distribution. The resulting R^2 values were low at 2.5%, 6E-06% and 0.2% for primary, secondary and inner respectively.

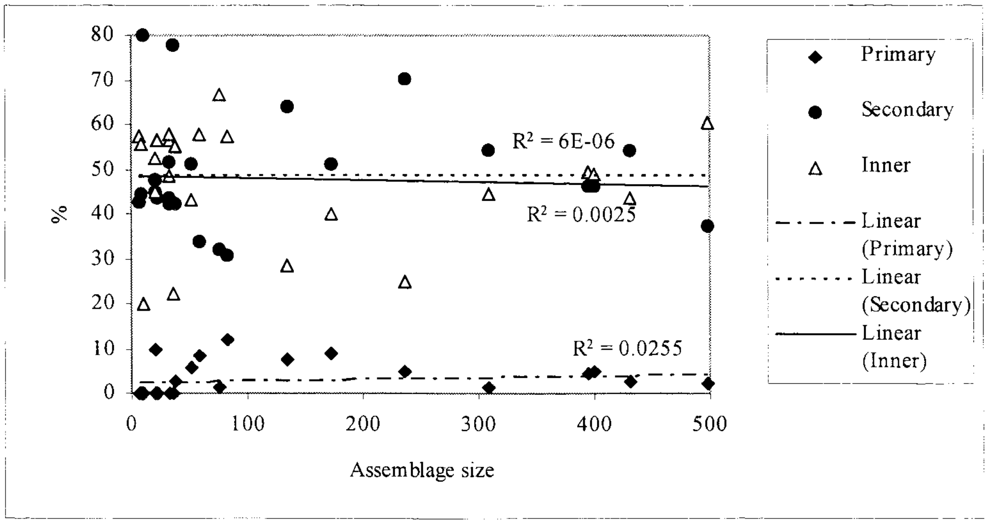

Figure 6.2. Primary, secondary and inner debitage proportions plotted against assemblage size (excluding Kindrochid 4).

6.5.2. Primary, secondary and inner proportions against distance

Distance accounted for little of the variability present in the proportions of primary, secondary and inner debitage, with R^2 values of 3.8%, 16.2% and 21.5% respectively, figure 6.3. However although low, they were considerably higher than those achieved plotting against assemblage size. This may suggest that distance played a more significant role in structuring the 25 assemblages than total assemblage size.

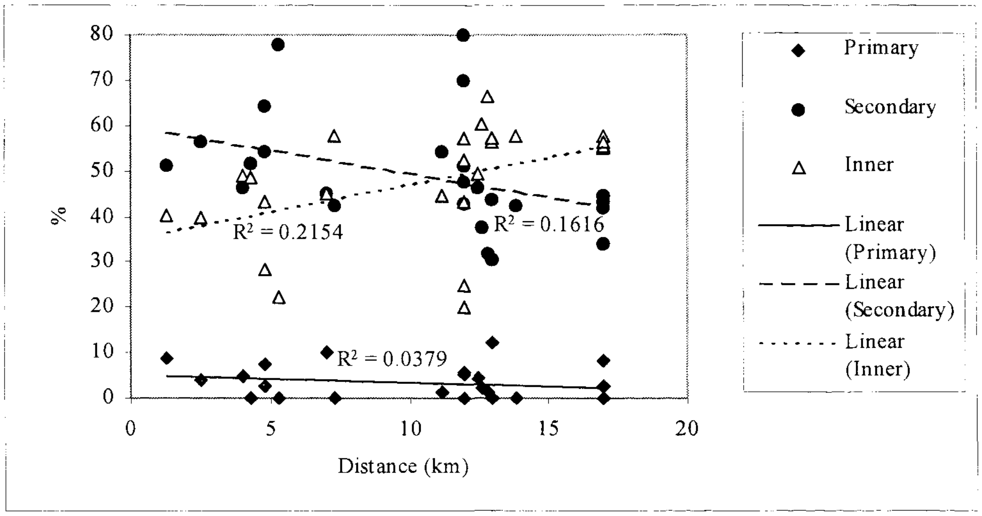

Figure 6.3. Primary, secondary and inner debitage proportions for all 25 assemblages plotted against distance (km).

6.5.3. Flake, blade, chunk and platform core proportions against assemblage size

Proportions of flakes, blades, chunks and platform cores were plotted against assemblage size for all 31 apart from Kindrochid 4, figure 6.4. However, R^2 values were low at 3.4%, 0.7%, 4.7% and 0.7% respectively.

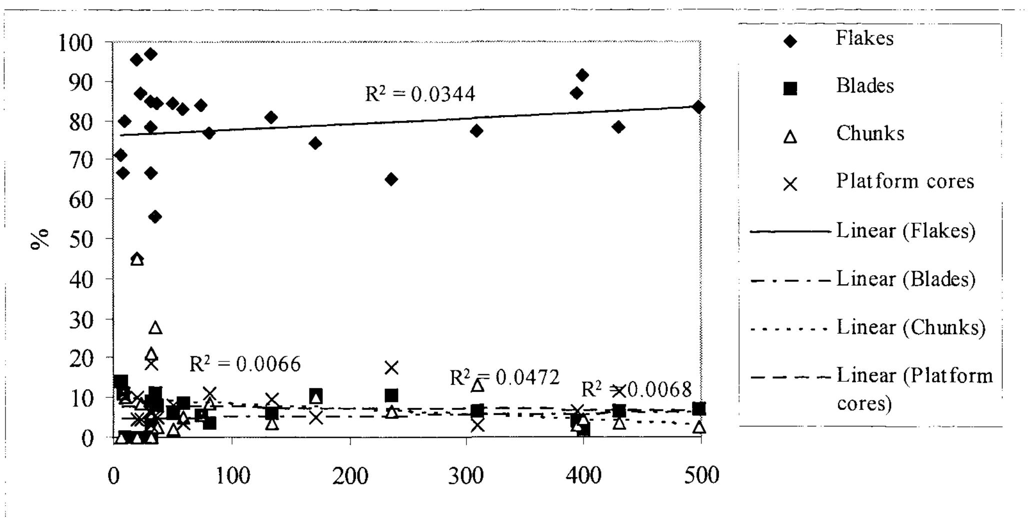

Figure 6.4. Flake, blade, chunk and platform core proportions plotted against assemblage size (excluding Kindrochid 4).

6.5.4. Flake, blade, chunk and platform core proportions against distance

Proportions of flakes, blades, chunks and platform cores for all 31 collections were plotted against distance, figure 6.5. Again very little of the variability in proportions was accounted for, with R^2 values of 9.9%, 1.8%, 13.6%, and 1.5% respectively.

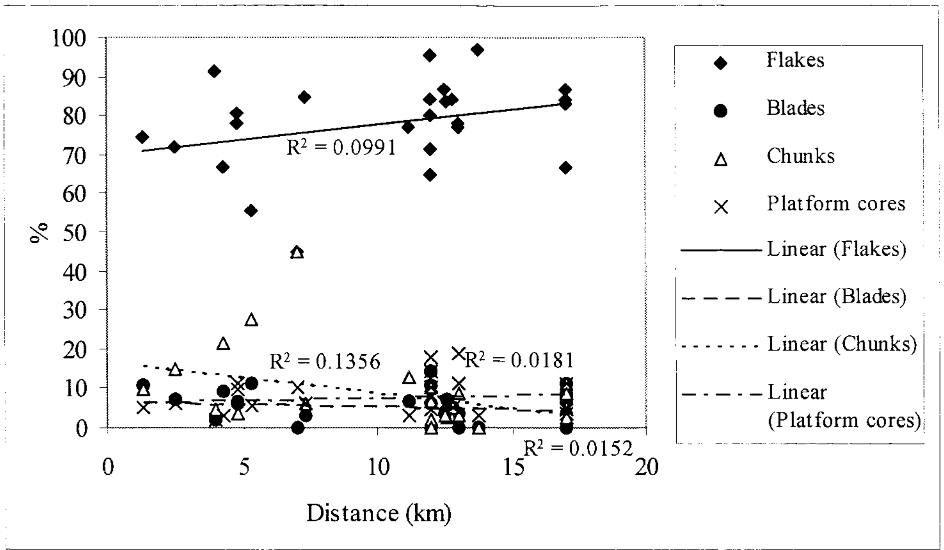

Figure 6.5. Flake, blade chunk and platform core proportions for all 25 collections plotted against distance (km).

6.5.5. Retouch against assemblage size

Retouch proportions plotted against assemblage size produced an R^2 of 5.6% with Kindrochid 4 removed, suggesting little in the way of a significant relationship between the two, figure 6.6.

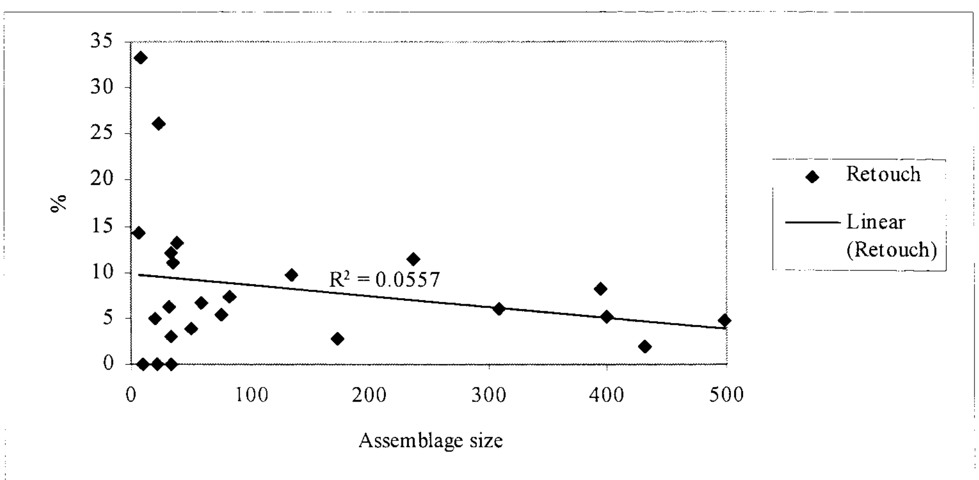

Figure 6.6. Retouch proportions plotted against assemblage size (excluding Kindrochid 4).

6.5.6. Retouch against distance

Plotting all 31 assemblages against distance, produced an R^2 value of 18.1%, figure 6.7. Although weak, this may suggest more of the variability in retouch proportions as accounted for by distance than assemblage size.

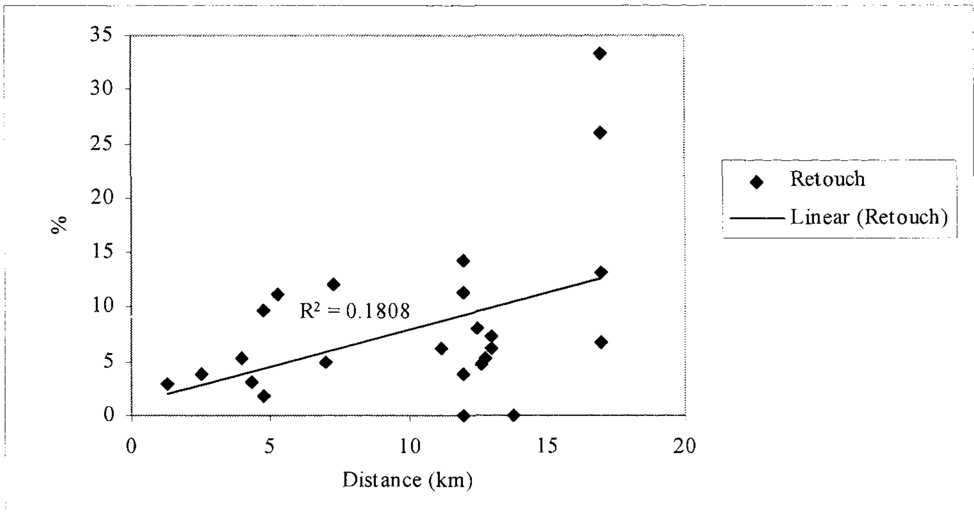

Figure 6.7. Retouch proportions plotted against distance (km).

6.5.7. Summary

Linear regression analysis was disappointing with very low R^2 values in all cases. The reasons for this may be firstly that the fieldwalked data is of insufficient resolution to identify patterns which exists within the assemblages, related either to their size or distance from raw material sources. Secondly, no patterning may exist at all, and thirdly in the case of distance, relating all sites to a single distance trajectory may be ignoring the possibility that each assemblage may have been generated through its own source to site route. In other words, fall-off patterns across the island may have varied from source to source, and between routes across the island. However, the results of the analysis were suggestive of a stronger relationship between debitage proportions and distance than between assemblage size. However, the significance of this is severely limited by the universally poor R^2 values present in all cases.

6.6. Assemblage means collated to the western and eastern halves of the island

Assemblage size was a continual problem during the previous analysis. For instance, 61% (n=19) of the field collections contained fewer than 5 blades, while 48% (n=15) produced less than 5 retouched pieces.

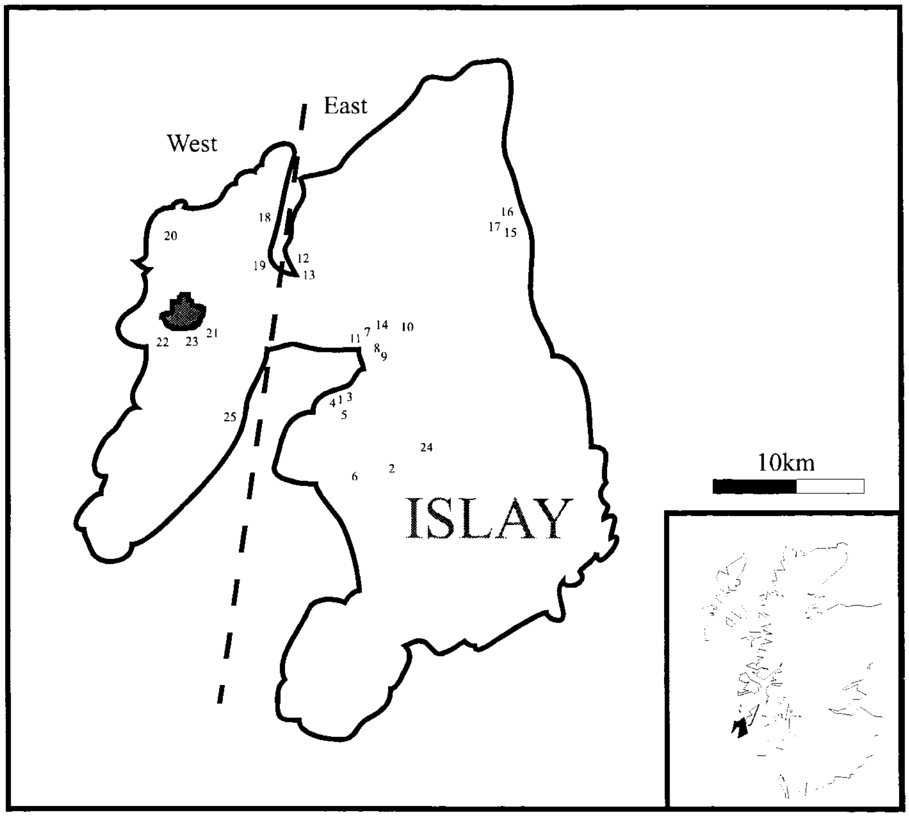

Figure 6.8. Division of Islay into the western and eastern zones along the Loch Indaal to Loch Gruinart axis.

Table 6.2. Fieldwalked sites from the western and eastern halves of the island.

West (n=7)	Map number	East (n=18)	Map number
Gruinart13	18	Bowmore 10	1
Gruinart7	19	Bowmore 12	2
Kindrochid 4	20	Bowmore 16	3
Loch Gorm 1	21	Bowmore 18	4
Loch Gorm 5	22	Bowmore 19	5
Loch Gorm9	23	Bowmore 9	6
Port Charlotte 1	25	Bridgend 11	7
		Bridgend 12	8
		Bridgend 13	9
		Bridgend 14	10
		Bridgend 15	11
		Bridgend 8	12
		Bridgend 9	13
		Scarrabus	14
		Kiells 1	15
		Kiells 2	16
		Kiells 4	17
		Mulindry 10	24

In an attempt to account for this variability, the 25 collections were grouped to within the western and eastern halves of the island, figure 6.8., and table 6.2, and the results presented as mean proportions for each debitage category. It is likely that the Loch Indaal to Loch Gruinart axis was more pronounced during the Mesolithic, with generally higher sea levels, suggesting that the island may have been more extensively separated.

6.6.1. Primary, secondary and inner

Mean primary and secondary proportions declined from west to east, while inner pieces increased, figure 6.9., table 6.3.

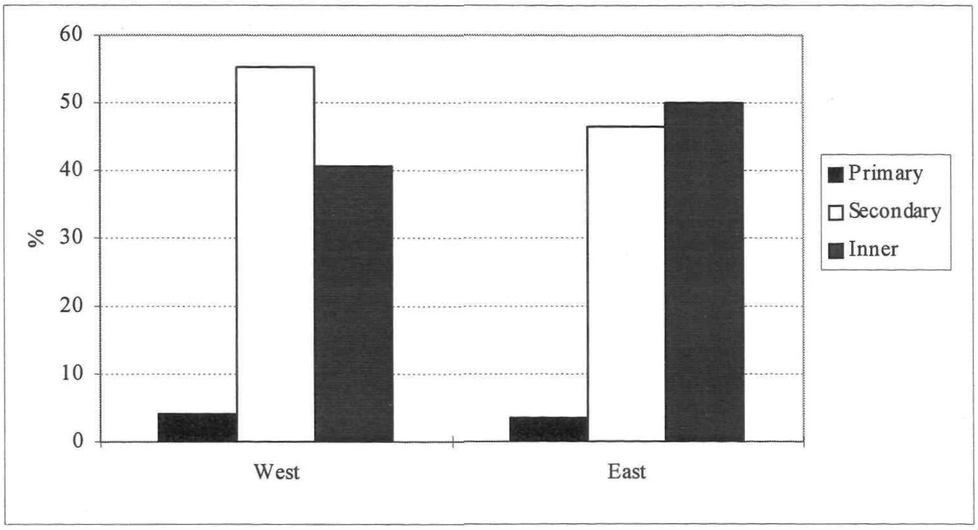

Figure 6.9. Mean proportions of primary, secondary and inner debitage from the western and eastern halves of Islay.

Table 6.3. Numbers of primary, secondary and inner debitage from the western and eastern halves of the island.

	West	East
Primary	181	67
Secondary	2540	889
Inner	1861	952

This suggests a distance related transition from early stage pebble working to the use of more reduced pebbles and cores on the eastern half of the island.

6.6.2. Flakes, blades, chunks, platform cores and retouch

Mean flake proportions increased with distance, as did platform cores, figure 6.10., and table 6.4, while blades and chunks declined.

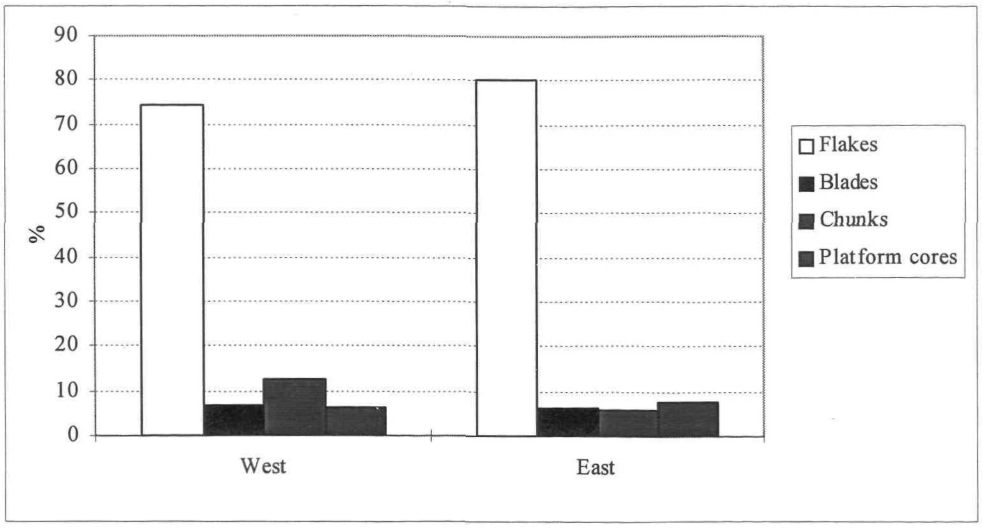

Figure 6.10. Mean proportions of flakes, blades, chunks and platform cores from the western and eastern halves of Islay.

Table 6.4. Numbers of flakes, blades, chunks and platform cores from the western and eastern halves of the island.

	West	East
Flakes	3404	1533
Blades	314	117
Chunks	570	111
Platform cores	294	147

This decline in chunks suggests an increase in the proportions of formal prepared cores with distance, less likely to produce chunks either through working or maintenance.

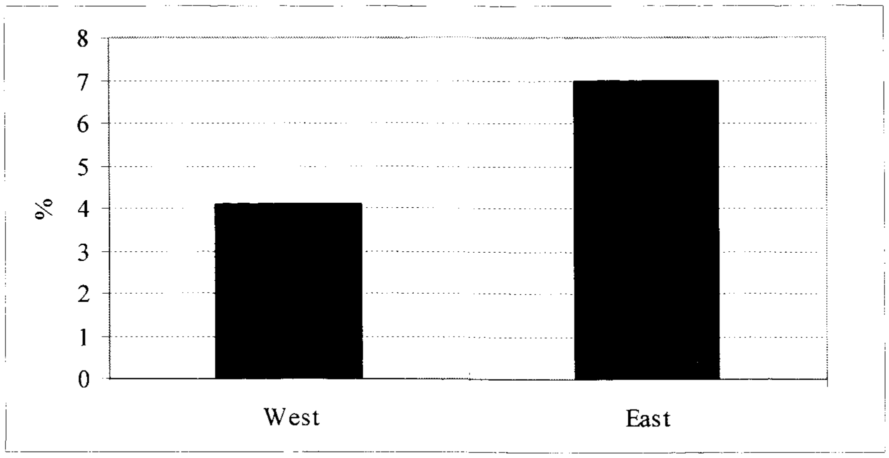

Figure 6.11. Mean retouch proportions from the western and eastern halves of the island.

The decline in mean blade proportions may suggest that blades were being more effectively used as distance to raw materials increased. This was supported by greater mean retouch proportions in assemblages further from the west coast, figure 6.11. Although types of retouch were not available for comparison, this does suggest a relative increase in distance induced raw material stress on the eastern half of the island.

6.6.3. Summary

Collated mean proportions supported the interpretation of a consistent relationship between assemblage structure and distance to raw material sources. In the case of primary, secondary and inner debitage, both of the former declined across the island, while the latter increased. As suggested earlier, this reflects the gradual removal of cortex as cores were progressively worked while being moved across the island. That this change took place over such a short distance, of the order of only 10km, suggests intensive sub-island scale raw material use.

Flakes and platform cores increased in proportion across the island with increasing distance to raw materials, while blades and chunks declined. The increase in cores suggests longer use life and therefore greater rates of abandonment as cores became too small to work. In addition, the decline in chunks suggests a reduction in the proportions of amorphous cores and partly worked pebbles with distance. The increase in flakes and corresponding decrease in blades may reflect relative success of the latter with distance. As cores were moved across the island, increasing blade productivity through the progressive removal of cortex, resulted in a relative increase in good quality blades produced. The fact that blade proportions decreased with distance, suggests that this increase blade removal success rate resulted in greater numbers being used for the production of retouched artefacts, thus removing them from the dataset. This is supported by the increase in retouch proportions from west to east, from 4% to 7%.

6.7. Dimensional analysis from the two halves of the island

6.7.1. Platform cores

As opposed to the previous discussion in which the 25 fieldwalked assemblages were considered individually and as collated means, the dimensional analysis of platform cores comprised 27 collections, listed below in table 6.5., and shown in figure 6.12. The extra two assemblages came from Bowmore 4 and Loch Gorm 6, which were excluded in the previous analyses due to discrepancies in counts.

Table 6.5. Fieldwalked assemblages from the western and eastern halves of Islay, containing platform cores.

West (n=8)	Map number	East (n=19)	Map number
Gruinart13	18	Bowmore 10	1
Gruinart7	19	Bowmore 12	2
Kindrochid 4	20	Bowmore 16	3
Loch Gorm 1	21	Bowmore 18	4
Loch Gorm 5	22	Bowmore 19	5
Loch Gorm9	23	Bowmore 9	6
Port Charlotte 1	25	Bridgend 11	7
Loch Gorm 6	**26**	Bridgend 12	8
		Bridgend 13	9
		Bridgend 14	10
		Bridgend 15	11
		Bridgend 8	12
		Bridgend 9	13
		Scarrabus	14
		Kiells 1	15
		Kiells 2	16
		Kiells 4	17
		Mulindry 10	24
		Bowmore 4	**27**

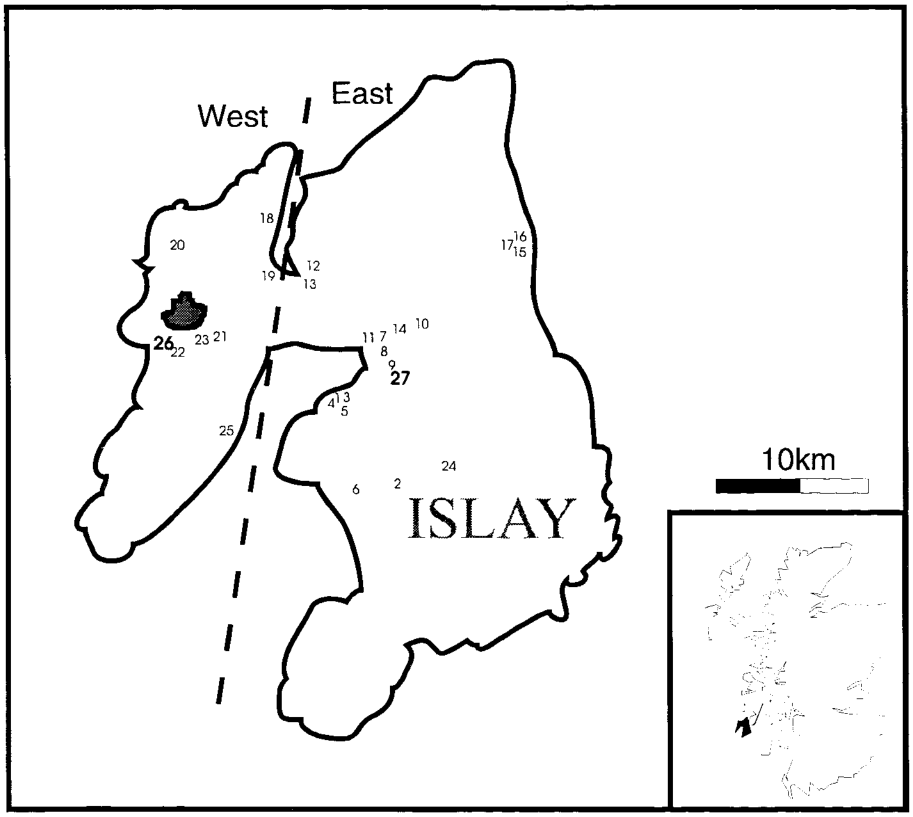

Figure 6.12. Location and map numbers of fieldwalked assemblages containing platform cores.

The 27 assemblages produced a total of 453 platform cores. These were grouped within the western (n=296) and eastern halves (n=157) of the island. Basic parameters of the complete assemblage are presented below in table 6.6. Length was measured perpendicularly from the primary platform to the base of the core, expressed to the closest millimetre. Mean platform diameter was calculated by summing the broadest and narrowest axis across the primary platform and dividing by two, again expressed to the closest millimetre.

Table 6.6. Summary of mean core dimensions from the 27 fieldwalked assemblages (n=453 cores).

	Weight (g)	length (mm)	Mean platform diameter (mm)
Mean (SD)	21.4g (11.3)	26.8 (5.9)	23.1 (5.7)
Maximum	90.6	48	44.5
Minimum	2.5	11	9.5

6.7.1.1. Core dimensions

Cores declined slightly in mean dimensions from west to east, figure 6.13.

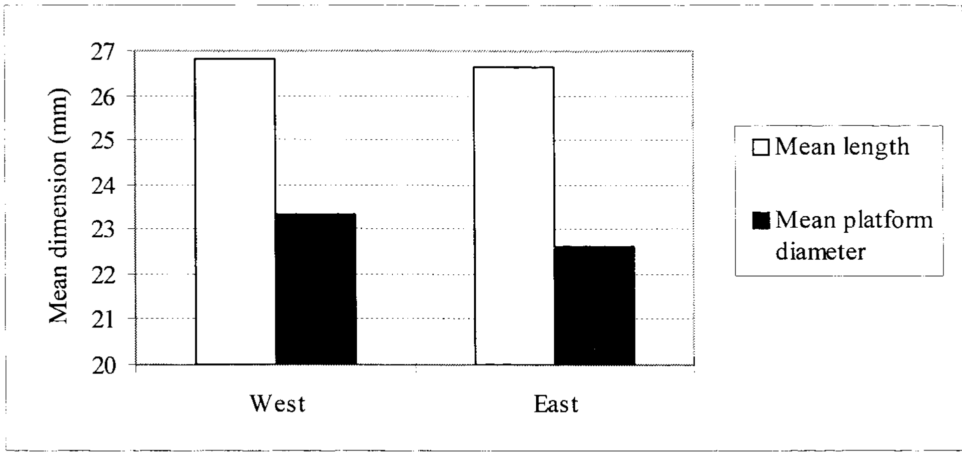

Figure 6.13. Mean core length and platform diameter for the western and eastern halves of Islay.

This suggest slightly more extensive working at greater distances from raw materials, probably reflecting longer use lives. However, the scale of this decline needs to be kept in perspective with both mean lengths and platform diameters declining by less than 1mm.

6.7.1.2. Platform perimeter working

Platform perimeter working was expressed as a measure of the proportion of the primary platform from which flakes and blades had been removed. Mean proportions increased from 60% in the west, to almost 64% in the east, figure 6.14.

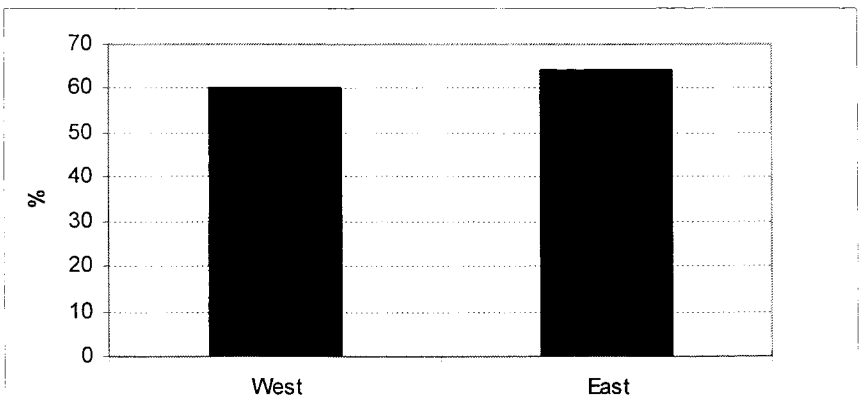

Figure 6.14. Mean proportions of platform perimeters worked from the western and eastern halves of Islay.

This suggests similar intensity of core use across the island, although with a slight increase of just over 6%. This may reflect raw material scarcity or more likely, simply longer use lives. Conversely however, slightly greater proportions of cores in the western region had been worked around their complete perimeters, 11.8% (n=35) and 9.6% (n=15) respectively. This suggests that although platforms were tending to be more extensively worked in the east, cores completely worked tended to be discarded closer to sources of replacement raw materials (*sensu* Gramley 1983). In addition, completely worked cores from the western region tended to be smaller than those in the east, figure 6.15. This may suggest differing use and abandonment criteria being applied across the island, particularly in terms of the most intensively worked cores. Assuming that extensive perimeter working reflects greater emphasis on the maintenance of core use life, then this suggests core use across Islay may have operated at two levels. In the first, production of a full range of blank forms was undertaken through the use of a range of core types. Abandonment was related primarily to distance from replacement raw materials, either in an absolute sense or in terms of use life. Alternatively, more extensively worked cores discarded close to viable replacements, are suggestive of individual provisioning as the mobile means of artefact production. Carried with the individual and more extensively maintained, these tend to be abandoned closer to the raw material sources.

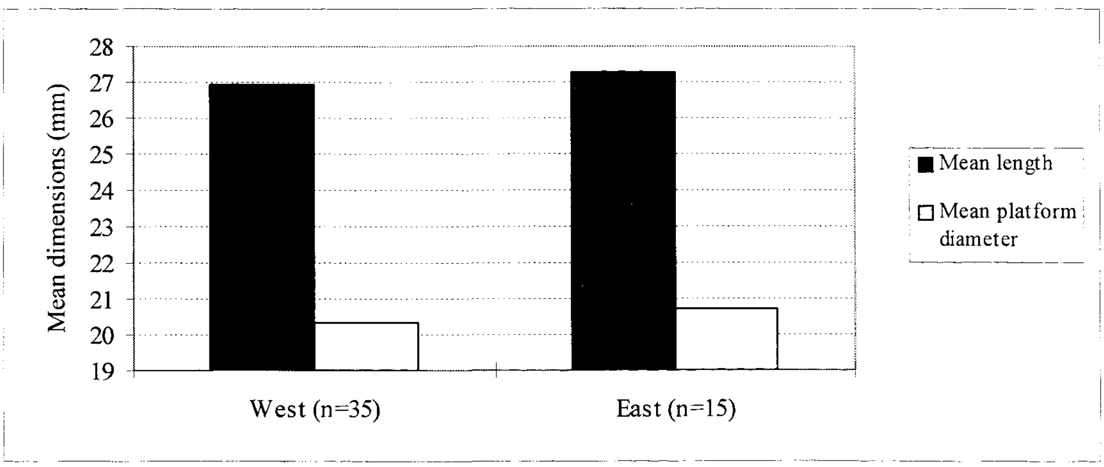

Figure 6.15. Mean dimensions of cores with complete perimeter working from the western and eastern halves of Islay.

6.7.1.3. Cortex

Proportions of cortex remaining were assessed visually and cores grouped as having none, greater than zero but less than 50%, and between 50% and 100%. Those with zero cortex increased from west to east while conversely those with greater than 50% declined. There was little change in the proportions of those with less than 50% but greater than zero, figure 6.16., table 6.7. This suggests more extensive working on the eastern half of the island, probably as a results of longer use life.

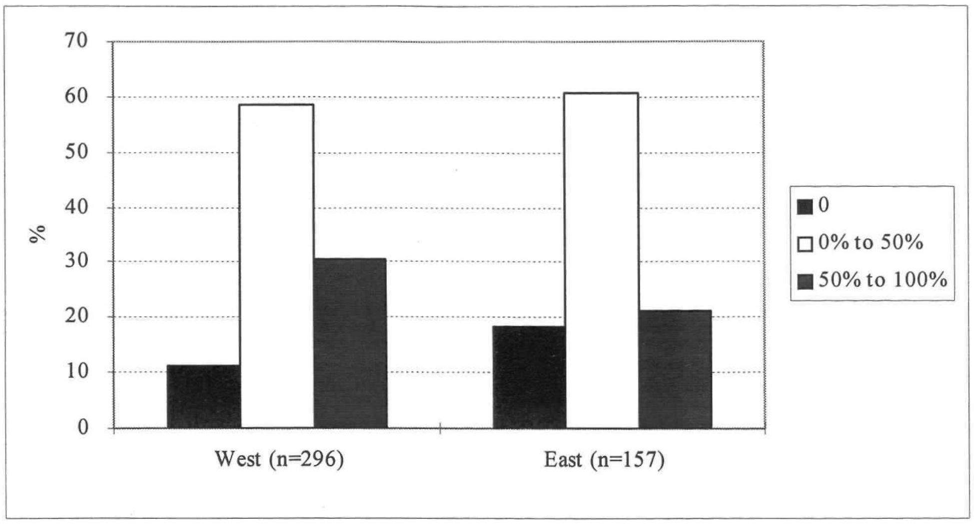

Figure 6.16. Mean cortex proportions from platform cores from the western and eastern halves of Islay.

Table 6.7. Numbers of cores with zero, zero to 50%, and 50% to 100% from the western and eastern halves of Islay.

Cortex	West	East
0	33	29
Zero to 50%	173	95
50% to 100%	90	33

6.7.1.4. Platform numbers

There was no significant change in the proportions of cores with one, two and more than two platforms across the island, figure 6.17., and table 6.8., suggesting that the incorporation of new platforms was not an efficient means of extending core life. The effective maintenance of a single platform probably represented a more efficient means of maintaining and perpetuating the life of small platform cores, at least in latter stage of life.

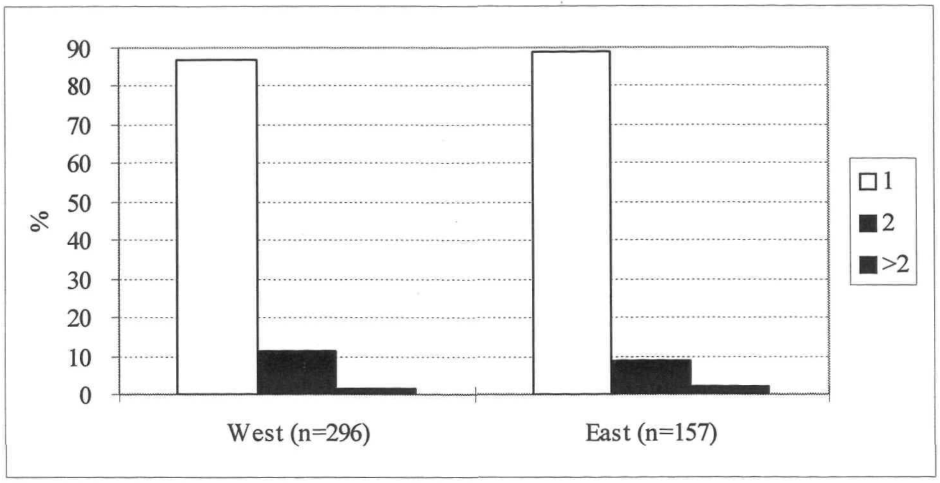

Figure 6.17. Proportions of cores with one, two, and more than two platforms from the western and eastern halves of Islay.

Table 6.8. Numbers of cores with one, two, and greater than two platforms from the western and eastern halves of Islay.

Platforms	West	East
1	258	140
2	34	14
>2	4	3

6.7.1.5. Core shape

Cores were grouped into four shape categories as follows:

Pyramidal: Obviously tapering from primary platform to base.
Wedge: Platforms two or more times as wide as they were broad (similar to Mercer's "laterally compressed leaning cones" (e.g. 1980:9, fig5, no's 5,9).
Block: Maximum primary platform two or more times as wide or broad as maximum length from platform to base.
Irregular: Platform cores but with no obvious formal shape.

Formal shapes, in particular pyramidal and wedge increased in proportion from west to east. Correspondingly, informal block shapes declined, figure 6.18., table 6.9. There was little change in the proportions of irregular cores.

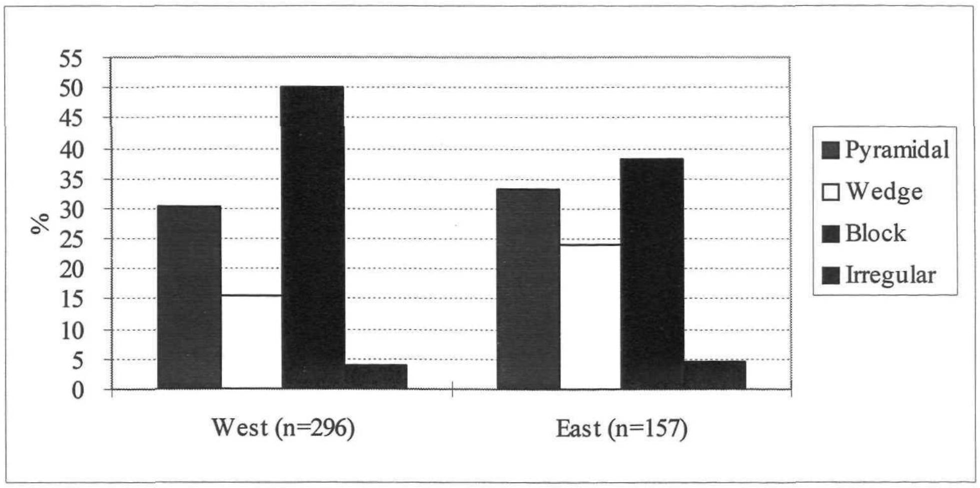

Figure 6.18. Proportions of core shape from the western and eastern halves of Islay.

Table 6.9. Core shapes, numbers from the western and eastern halves of Islay.

Shape	West	East
Pyramidal	90	52
Wedge	46	38
Block	148	60
Irregular	12	7

The increase in formal types suggests longer use lives with distance from the west coast raw material sources, and the winnowing of less productive and reliable informal types.

6.7.1.6. Abandonment

Cores were grouped on the basis of the most probable reasons for discard as follows:

Size: No absolute limit was defined, however, cores were considered as too small to work when they could no longer be effectively held either to work or rejuvenate.
Hinge and step fractures: Again no absolute number could be defined, however cores were considered as abandoned on the basis of hinge or step fractures when they were considered to have either been unworkable due to these, or unable to have been rejuvenated due to their extent and depth.
Unclear: When no obvious reason for abandonment could be proposed either for continued working, or for rejuvenation.
Other: This included all factors to do with the flint itself, for instance inclusions, fractures, or irregular platform or flaking surfaces.

Greater proportions of cores were being abandoned due to size on the eastern half of the island, while little change was apparent in those discarded due to hinges and other, figure 6.19., table 6.10. This suggests that although hinge and step fractures, inclusions and irregular surfaces could be removed through rejuvenation, there was little which could be done about declining dimensions. Cores for which no obvious reason for abandonment could be determined, declined from west to east. This suggests greater use life on the eastern half of the island, and an increasing reluctance on the part of the knapper to discard to the core prior to its exhaustion.

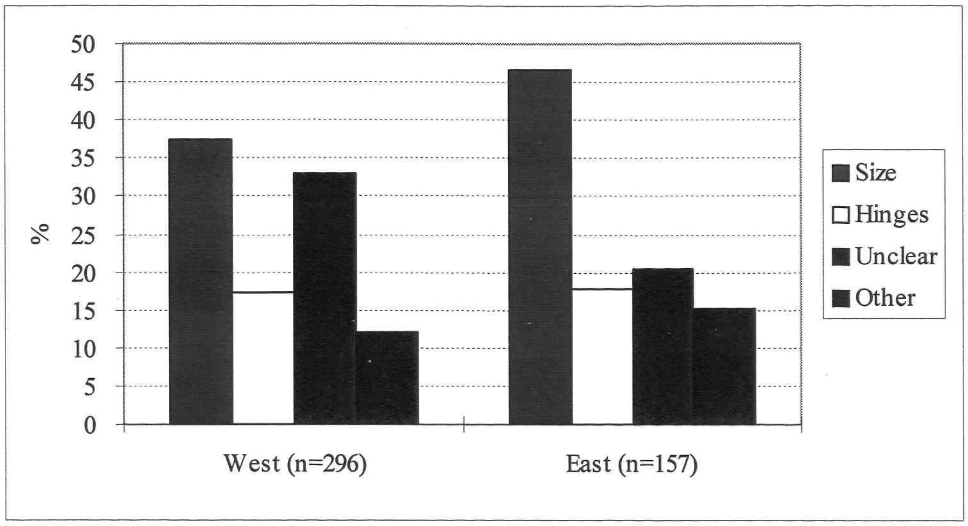

Figure 6.19. Proportions of cores abandoned due to size, hinges, no apparent, or other reasons from the western and eastern halves of Islay.

Table 6.10. Proportions of cores abandoned due to size, hinges, no apparent, or other reasons from the western and eastern halve of Islay.

Abandon reasons	West	East
Size	111	73
Hinges	51	28
Unclear	98	32
Other	36	24

6.7.2. Primary flakes

A total of 194 primary flakes were studied from 19 of the 27 fieldwalked assemblages, table 6.11., see figure 6.12. All pieces with evidence of having been removed through a blow to the cortical surface were included. They were measured along their longest and shortest axis parallel to the ventral surface, and from the thickest section of the dorsal to ventral surface. The number of ventral surfaces were also counted. Primary flakes declined in dimension across the island, figure 6.20., suggesting removals from progressively smaller pebbles and partially worked cores. As primary flakes were defined on the basis of clear evidence for removal through cortical impact, increases in the number of ventral surfaces with distance suggested greater proportions struck from partially worked pebbles or core blanks in the east, figure 6.21.

Table 6.11. Primary flakes from Islay, number of pieces and map reference numbers, refers to figure 6.12.

Site	Map number	Zone	Number
Bowmore 10	1	East	8
Bowmore 18	4	East	6
Bowmore 9	6	East	5
Bridgend 11	7	East	5
Bridgend 12	8	East	1
Bridgend 13	19	East	1
Bridgend 14	10	East	5
Scarrabus	14	East	13
Gruinart 8	12	East	1
Kiells 1	15	East	3
Kiells 2	16	East	1
Gruinart 13	18	West	11
Gruinart 7	19	West	12
Kindrochid 4	20	West	94
Loch Gorm 1	21	West	15
Loch Gorm 5	22	West	5
Loch Gorm 9	23	West	1
Loch Gorm 6	26	West	4
Bowmore 4	27	East	3

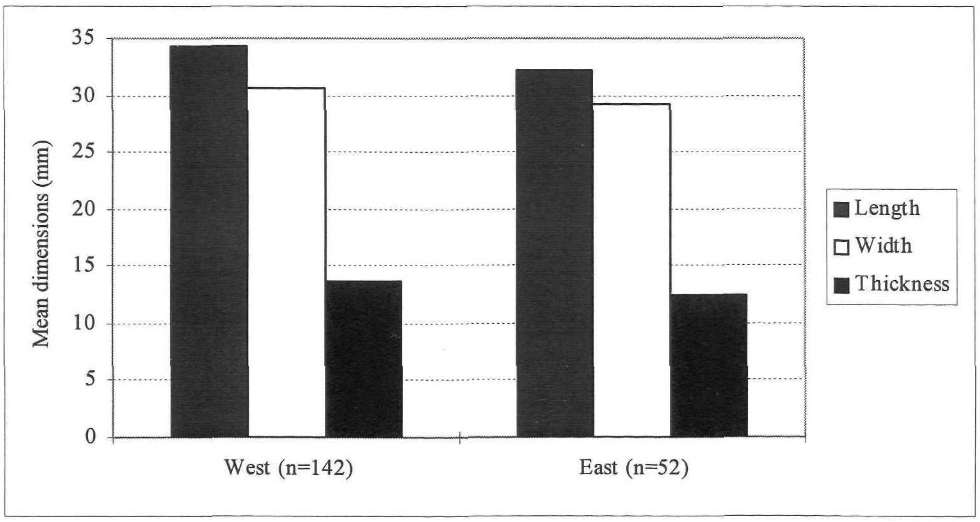

Figure 6.20. Primary flake mean dimensions from the western and eastern halves of Islay.

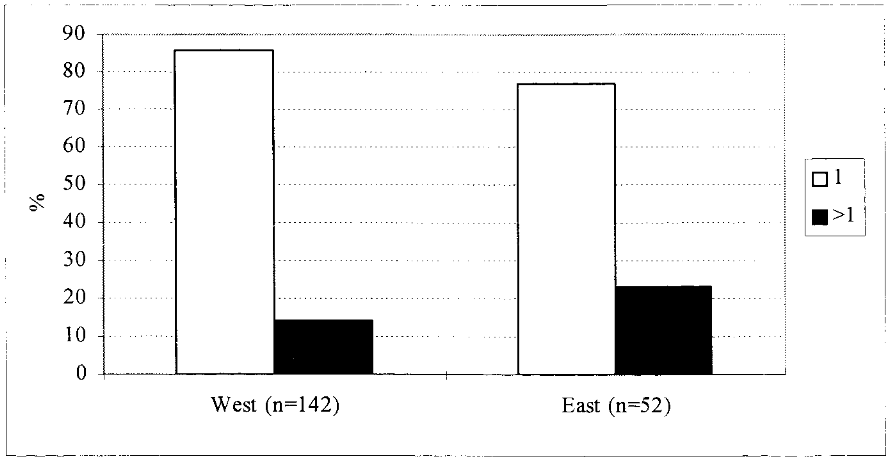

Figure 6.21. Primary flakes, number of ventral surfaces from the western and eastern halves of Islay.

Table 6.12. Number of ventral surfaces on primary flakes from the western and eastern halves of Islay.

Number of ventral surfaces	West	East
1	122	40
> 1	20	12

6.7.3. Pebbles

Flint pebbles were measure along their longest axis, and then perpendicular to this, measured in the remaining two plains. The assemblage consisted of 134 pebbles from 18 of the 27 fieldwalked collections, figure 6.22., table 6.13. Map numbers correspond to those in figure 6.12. Mean pebble dimensions declined progressively across the island, however there was little change in the proportions tested, figure 6.23., and table 6.14. The decline in dimensions suggests the progressive winnowing of larger fractions with distance. The majority of the pebble assemblage would have been of little use during the Mesolithic. It was suggested in Chapter 4 that 200g represents a lower usefulness limit for the production of platform cores in particular. Of the fieldwalked assemblage only 2% (n=3) pebbles were greater than 200g in weight, suggesting that the bulk of the assemblage would have been of little use. As field collected assemblages, the possibility of mixed Mesolithic and later Prehistoric horizons must be born in mind. Two of the three pebbles over 200g came from the Kindrochid 4 fieldwalked assemblage. However during excavation of the Mesolithic horizons, complete pebbles were very rare. This suggests that the larger fractions collected during fieldwalking may have derived from later Prehistoric activity at the site.

Table 6.13. Pebbles from Islay, number of pieces and map reference number, refers to figure 6.12.

Site	Map number	Zone	Number of pebbles
Bowmore 10	1	East	5
Bowmore 12	2	East	2
Bowmore 16	3	East	14
Bowmore 18	4	East	4
Bridgend 15	11	East	1
Scarrabus	14	East	6
Gruinart 8	12	East	2
Bridgend 11	7	East	2
Bridgend 13	9	East	1
Bridgend 14	10	East	1
Gruinart 9	13	East	1
Gruinart 13	18	West	24
Gruinart 7	19	West	3
Kindrochid 4	20	West	44
Loch Gorm 9	23	West	1
Loch Gorm 5	22	West	7
Loch Gorm 6	26	West	15
Bowmore 4	27	East	1

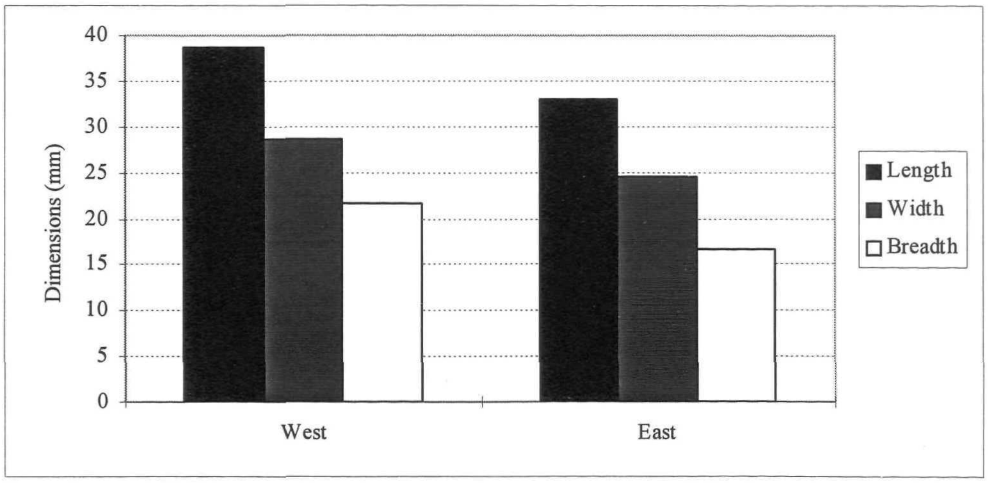

Figure 6.22. Mean pebble dimensions for pebbles collected during fieldwalking from the western and eastern halves of the island.

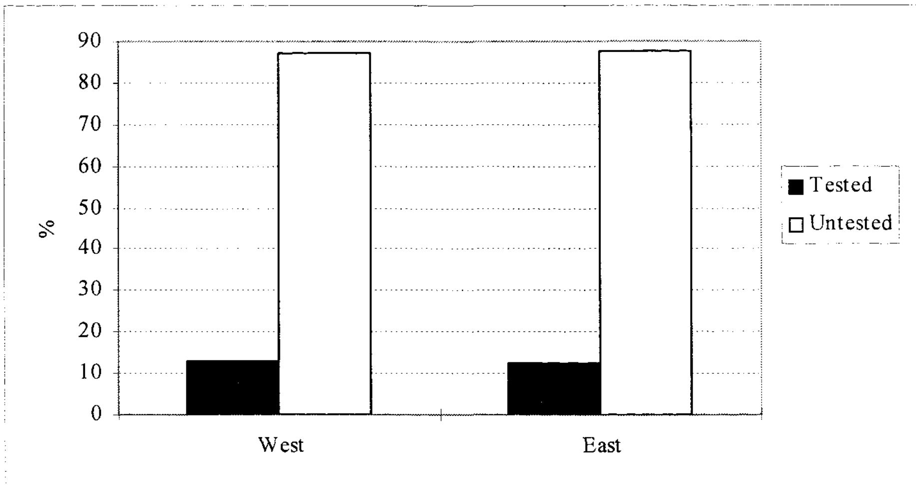

Figure 6.23. Mean proportions of pebbles tested and untested from the western and eastern halves of the island.

Table 6.14. Numbers of pebbles tested and untested from the western and eastern halves of the island.

	West	East
Tested	12	5
Untested	82	35

6.8. Site based analysis of platform cores

During the previous analysis, cores were grouped to the western and eastern halves of the island, and dimensional and morphological means compared. Although both halves of the island are accessible today, the situation may have been different during the Mesolithic, particularly in the context of higher sea levels. It is likely that the Loch Indaal to Loch Gruinart axis was more pronounced, therefore suggesting a much greater degree of isolation for the Rhinns and the main body of the island. This raises the possibility that if raw material and technological strategies across each half were similar, then by comparing collated means, the results would look essentially the same. The significant similarity between dimensions suggests that this was in fact the case. In order to investigate this possibility, the analysis shifts in detail by focusing on a series of sites located at differing distances from the west coasts on both halves of the island. Only those assemblages with ten or more cores were included in this study. These were measured and described as in the previous analysis, with means calculated for each assemblage. Analysis of the results of this study highlighted a number of consistent changes in cores profiles, which supported the point raised above, that similar raw material and technological profiles were present across each half of the island.

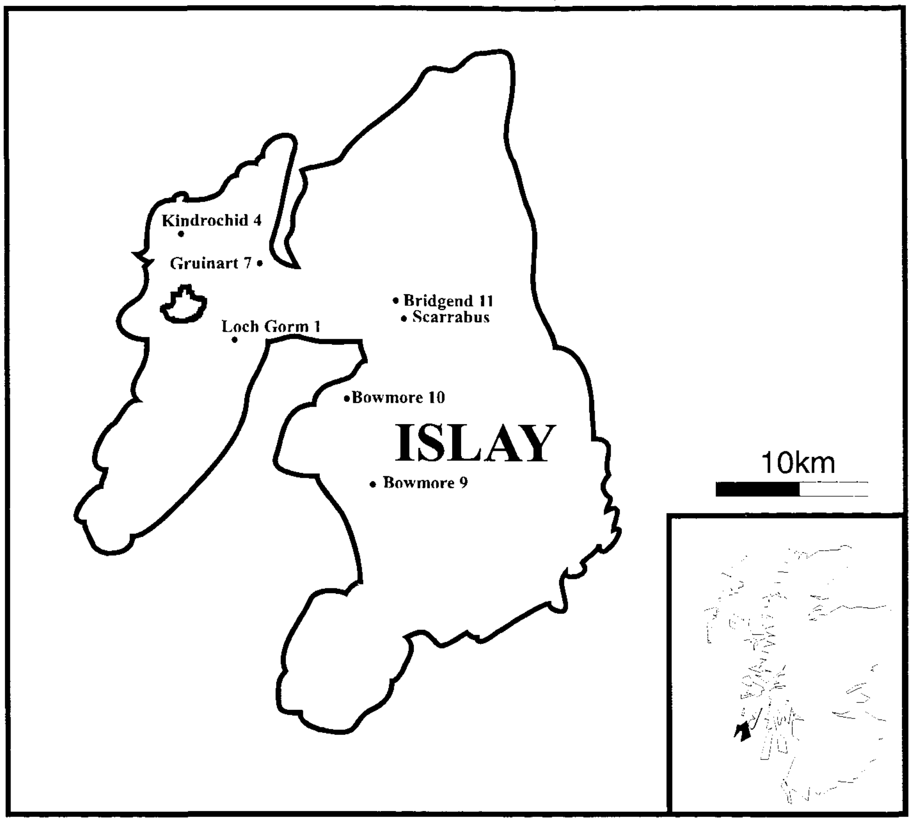

Figure 6.24. Location of assemblages on Islay containing ten or more platform cores.

Limiting analysis to assemblages with ten or more cores reduced the number of sites from 27 to only seven, from which a total of 384 platform cores were measured and described, figure 6.24., table 6.15. Means were calculated for each assemblage and plotted as bar graphs at increasing distance from the west coast.

Table 6.15. Islay sites containing more than 10 platform cores, numbers and straight line distance to the west coast raw material sources.

Site	Number of cores	Zone	Straight line distance to the west coast of the Rhinns peninsular (km)
Kindrochid 4	211	West	2.5
Gruinart 7	49	West	4.8
Loch Gorm 1	13	West	4.8
Bowmore 9	10	East	11.2
Bowmore 10	42	East	12
Scarrabus	25	East	12.5
Bridgend 11	34	East	13

6.8.1. Mean core dimensions

Cores declined in both mean length and platform diameter from Kindrochid 4 to Bowmore 9 on the east coast of the Loch Indaal. They increasing at Bowmore 10 to levels similar to those at Kindrochid 4 on the west coast of the Rhinns, before declining again with distance at Scarrabus and Bridgend 11, figure 6.25.

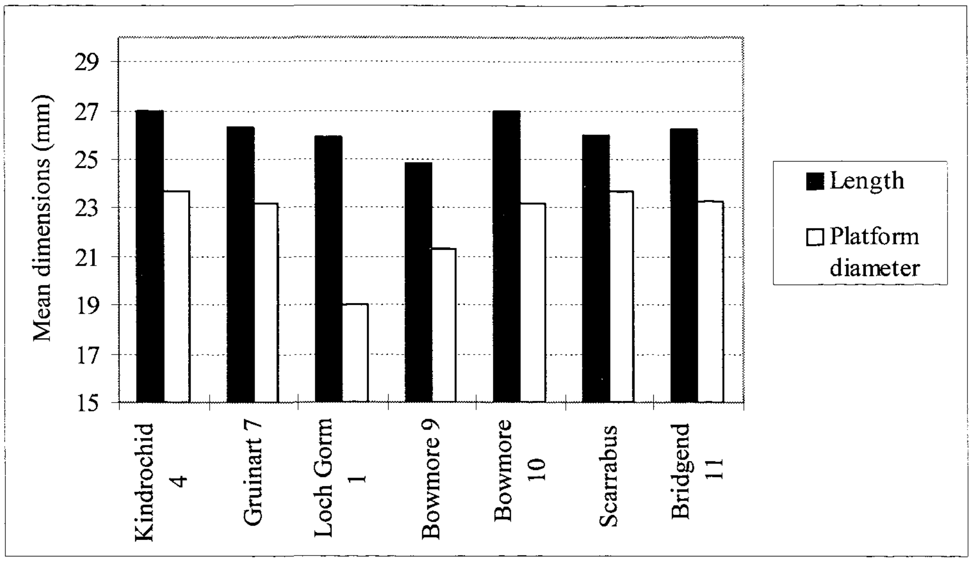

Figure 6.25. Platform core mean length and platform diameter from the seven Islay sites with 10 or more cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

This suggests similar declines from initially larger dimensions within assemblages along the west coasts of both halves of the island, supporting the point made earlier that by collating means, essential differences across each half would be obscured. The Loch Indaal to Loch Gruinart axis appears to have corresponded with a reversal in the trend towards declining core dimensions with distance. In fact, mean dimension at Bowmore 10, located 12km from the sources of raw materials along the west coast were very similar to those found at Kindrochid 4 at only 2.5km from the same beaches. Similarities between assemblages at differing distances across both halves of the island can be seen in the previous series of length frequency histograms. In particular the similar ranges of lengths present at Bowmore 10 and Kindrochid 4, in contrast to Gruinart 7 and Bridgend 11, themselves significantly similar, figure 6.26. Longer cores tended to be rare in the Gruinart 7 and Bridgend 11 collections, particularly those longer than 32mm. This suggests similar declines in dimensions away from the west coasts of both the Rhinns and the eastern half of the island. Since raw materials are unlikely to have been available in the vicinity of Bowmore 10, see Chapter 4, this suggests that broadly the same range of cores were being abandoned as at the west coast site of Kindrochid 4.

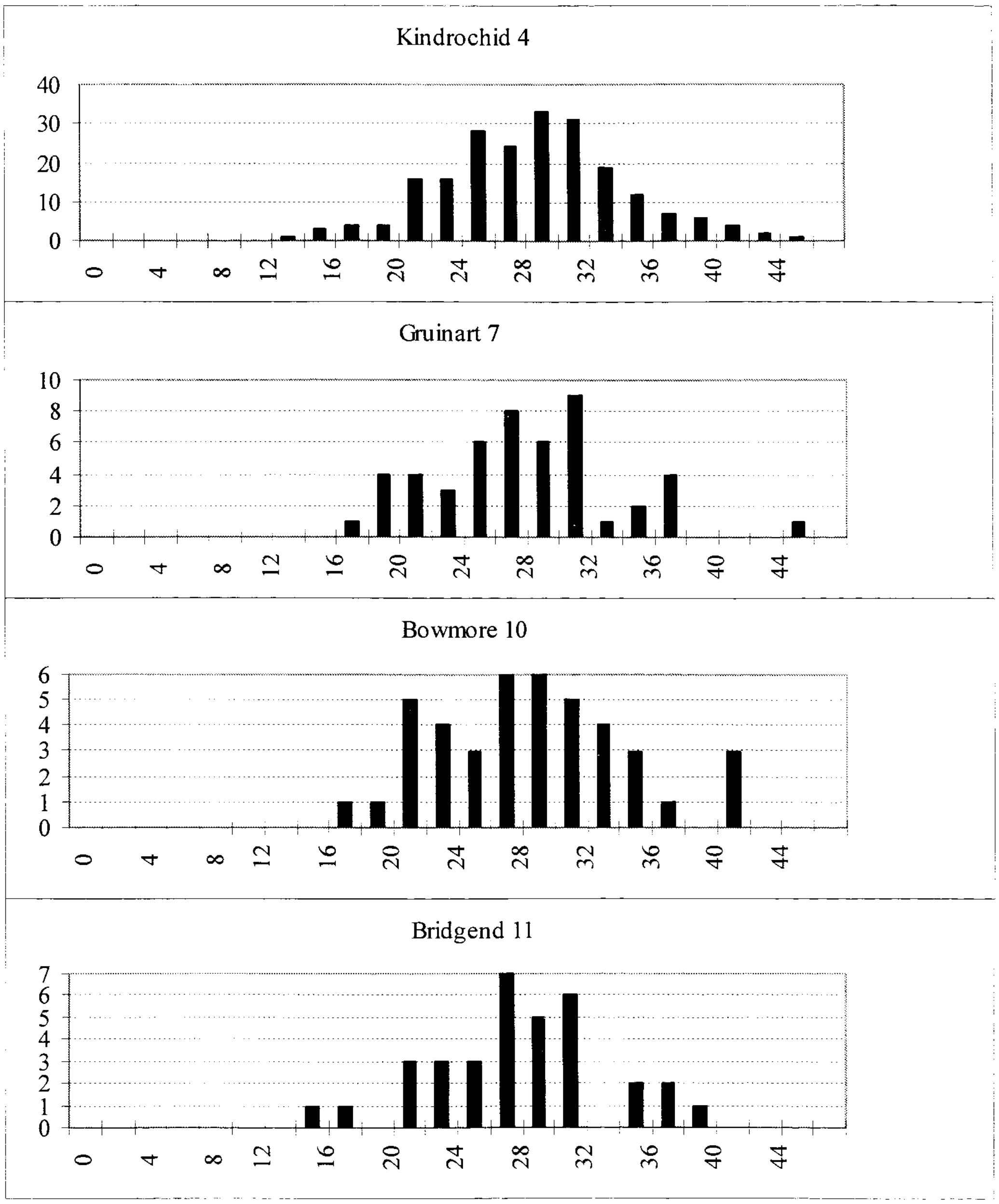

Figure 6.26. Core length frequency histograms for collections from the west (Kindrochid 4, Gruinart 7) and east halves of the island (Bowmore 10, Bridgend 11), arranged at increasing distance from the west coast raw material sources.

This is curious since in terms of walking distance from the west coast, Bowmore 10 is approximately 15km distant. An interesting aspects of Bowmore 10 is its placement adjacent to a small spur of land along the north eastern edge of the Loch Indaal, immediately adjacent to the extensive Bridgend mudflats. One reason for the placement of this site may therefore have been to do with launching and landing of small boats. Bowmore 10 may have therefore served as a nodal point for crossings of the Loch Indaal. Although the mudflats may have been situated further inland with the relatively higher sea levels during the Mesolithic, general low lying land around Bridgend immediately to the north of the site suggests that similar inter-tidal deposits may have been present. For the purposes of launching and landing of small craft, shallow sand banks pose considerable difficulties (Bjerk 1995:140), and therefore the placement of the site at the edge of these may support an interpretation of repeated occupation in the context of water travel. This may explain the apparent similarities in terms of raw material use and technology at Bowmore 10 and Kindrochid 4. The ability of water travel to collapse space may have resulted in grater proportions of cores in particular being introduced at an earlier stage in the reduction sequence.

6.8.2. Platform working

Platform perimeter working varied considerably across the island, with higher levels of between 50% and 100% relatively more common on the eastern half, figure 6.27., table 6.16. The high proportions of apparently low intensity platform use at Loch Gorm 1 reflects the presence of greater numbers of wedge shaped cores. As described in the previous section these were defined on the basis of platforms two or more times as wide as broad. Whether or not they represent a specific class of core, they emphasise the working through, rather than around the platform perimeter, so tending towards lens shaped rather than circular platforms. During experimentation, it was found that blade removals from these cores tend to be wider than examples produced when working around the platform. Wedge shaped cores present at Lussa Bay (Mercer 1970:6, fig 4, no's 1 to 4), Lussa Wood 1 (Mercer 1980:9, fig 5, no's 5 & 9), and Glenbatric Waterhole (Mercer 1974:19, fig 9, no's 7 & 9 to 11) were referred to by Mercer as "laterally flattened leaning cones" (*ibid*). Whether they reflect an earlier chronology as may be suggested by the Jura assemblages is unclear.
The presence of increasing proportions perimeter working suggests that although fresher cores were being introduced onto the eastern half of the island, possibly via Bowmore 10, they were being used for longer than equivalent examples closer to the raw material sources on the Rhinns. The Loch Indaal to Loch Gruinart axis appears to correspond with a significant increase in the degree to which platforms were being utilised prior to discard.

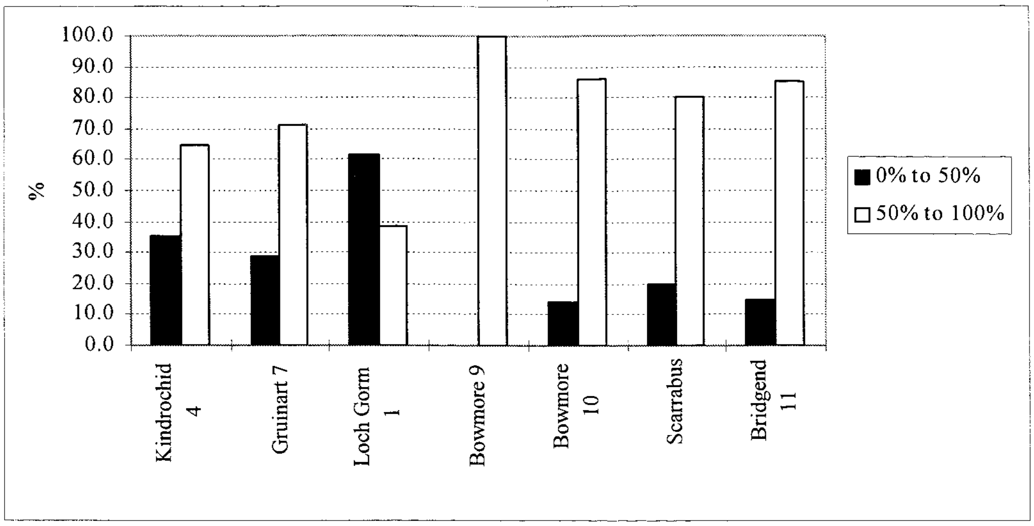

Figure 6.27. Platform perimeter working from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.16. Numbers of cores worked between zero and 50%, and 50% to 100% from the Islay fieldwalked assemblages with ten or more cores.

Site	0 to 50%	50% to 100%
Kindrochid 4	75	136
Gruinart 7	14	35
Loch Gorm 1	8	5
Bowmore 9	0	10
Bowmore 10	6	36
Scarrabus	5	20
Bridgend 11	5	29

6.8.3. Cortex

Cores were grouped on the basis of either the presence or absence of cortex. Those retaining cortex increased slightly in mean proportion across the Rhinns from Kindrochid 4 until Bowmore 9. Again this may reflect the relatively greater numbers of wedge shaped cores at Loch Gorm 1. Cores lacking cortex then increased across the eastern half of the island from Bowmore 10 through to Bridgend 11, figure 6.28., table 6.17. Again this suggests an increase in core utilisation particularly beyond the Loch Indaal to Loch Gruinart axis.

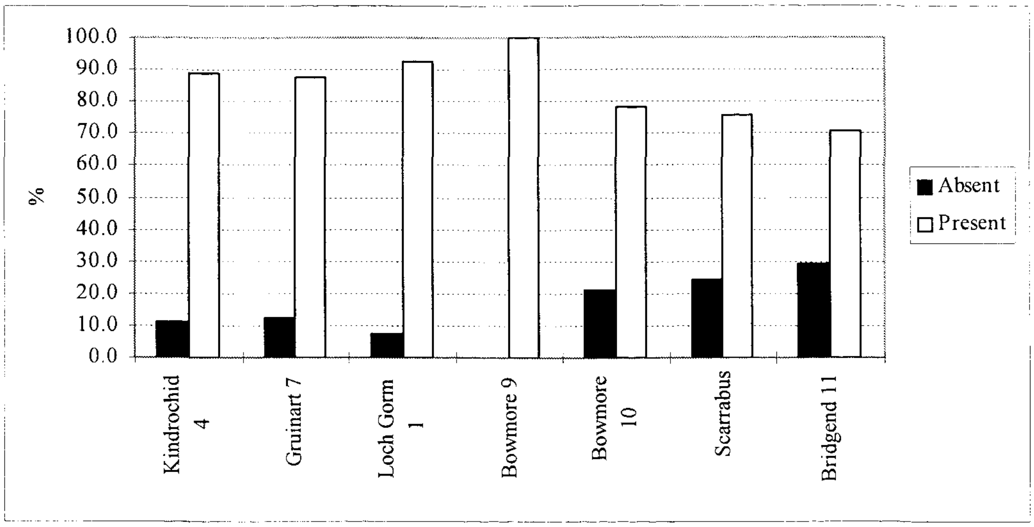

Figure 6.28. Platform core mean cortex proportions from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.17. Numbers of cores with or without cortex from Islay fieldwalked assemblages with more than 10 cores.

Site	Absent	Present
Kindrochid 4	24	187
Gruinart 7	6	43
Loch Gorm 1	1	12
Bowmore 9	0	10
Bowmore 10	9	33
Scarrabus	6	19
Bridgend 11	10	24

6.8.4. Numbers of platforms

Mean proportions of cores with single platforms appeared to increase across both halves of the island, from Kindrochid 4 on the Rhinns and Bowmore 10 on the eastern half of the island, figure 6.29., table 6.18. Again this suggests that the use of multiple platforms did not represent an efficient means of extending core life. The Loch Indaal to Loch Gruinart axis appears to correspond with a slight increase in multi-platform cores. Greater proportions of these cores at Kindrochid 4 suggests their presence in the context of easier access to raw materials. The significantly similar proportions present at Bowmore 10 suggests similar rates of access were possible at the later site despite being located at over 12km away.

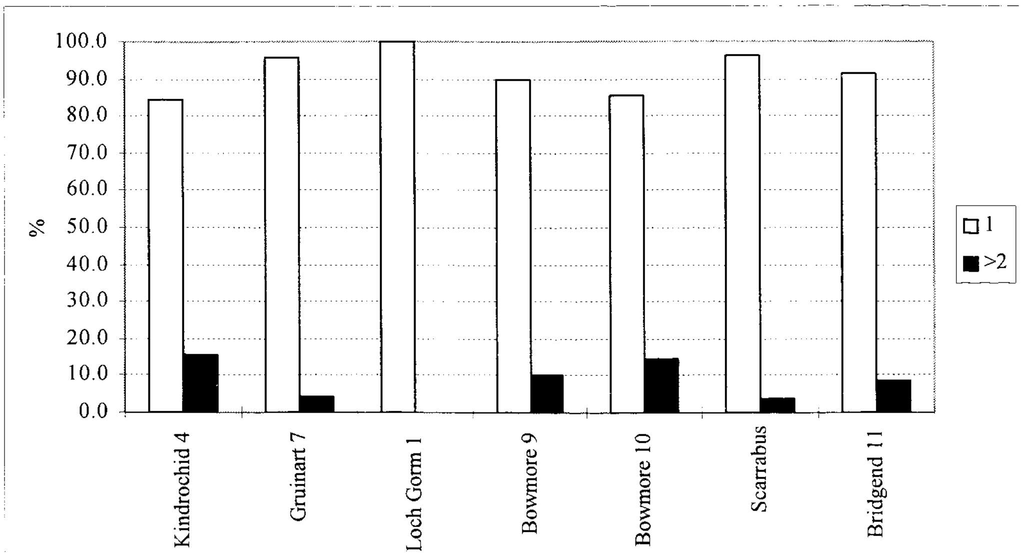

Figure 6.29. Proportions of platform cores with one and more than one platform from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.18. Numbers of cores with one and more than one platform from the seven Islay fieldwalked assemblages with more than 10 cores.

Site	One platform	Two or more platforms
Kindrochid 4	178	33
Gruinart 7	47	2
Loch Gorm 1	13	0
Bowmore 9	9	1
Bowmore 10	36	6
Scarrabus	24	1
Bridgend 11	31	3

6.8.5. Core shape

Cores were defined on the basis of shape as follows:

Pyramidal: Obviously tapering from primary platform to base.
Wedge: Platforms two or more times as wide as they were broad (similar to Mercer's "laterally compressed leaning cones" (e.g. 1980:9, fig5, no's 5,9).
Informal: Maximum primary platform two or more times as wide or broad as maximum length from platform to base, and cores with no obvious formal shape.

Wedge shaped cores increased in mean proportion progressively across both halves of the island with the Loch Indaal to Loch Gruinart axis corresponding to a shift in proportions. Pyramidal forms were less clear, although they appeared to remain broadly constant, apart from Loch Gorm 1 and Bowmore 9. Conversely, informal types declined regularly across both halves of the island, again

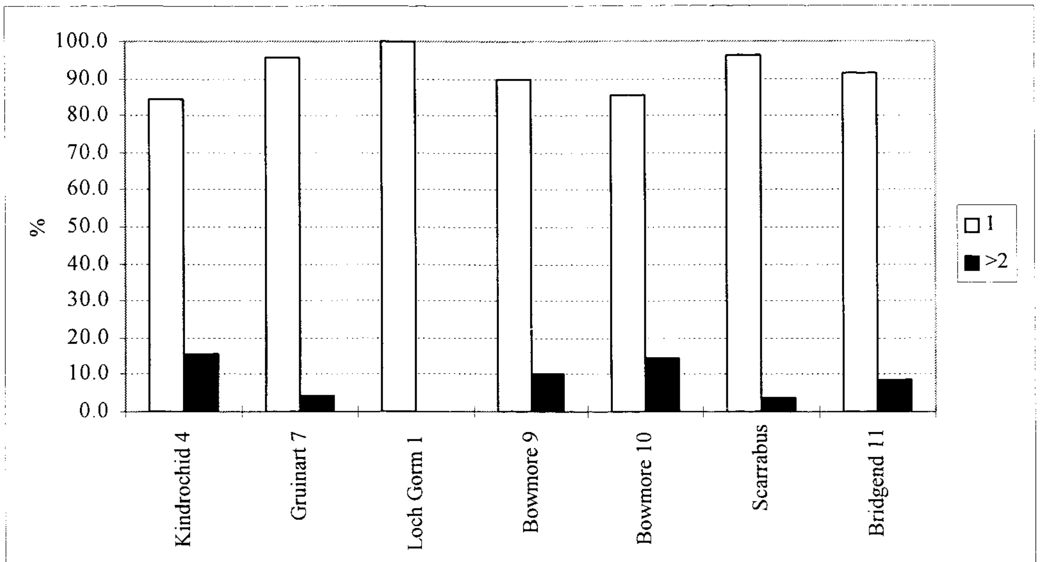

Figure 6.29. Proportions of platform cores with one and more than one platform from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

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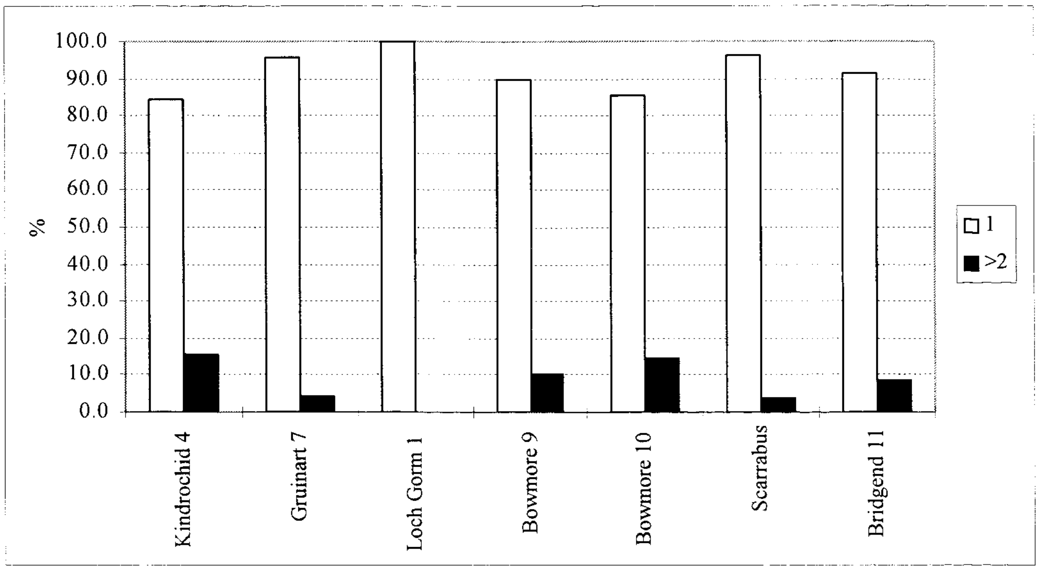

Figure 6.29. Proportions of platform cores with one and more than one platform from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.18. Numbers of cores with one and more than one platform from the seven Islay fieldwalked assemblages with more than 10 cores.

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Wedge: Platforms two or more times as wide as they were broad (similar to Mercer's "laterally compressed leaning cones" (e.g. 1980:9, fig5, no's 5,9).
Informal: Maximum primary platform two or more times as wide or broad as maximum length from platform to base, and cores with no obvious formal shape.

Wedge shaped cores increased in mean proportion progressively across both halves of the island with the Loch Indaal to Loch Gruinart axis corresponding to a shift in proportions. Pyramidal forms were less clear, although they appeared to remain broadly constant, apart from Loch Gorm 1 and Bowmore 9. Conversely, informal types declined regularly across both halves of the island, again

with the Loch Indaal to Loch Gruinart axis corresponding with a shift in proportions, figure 6.30., table 6.19.

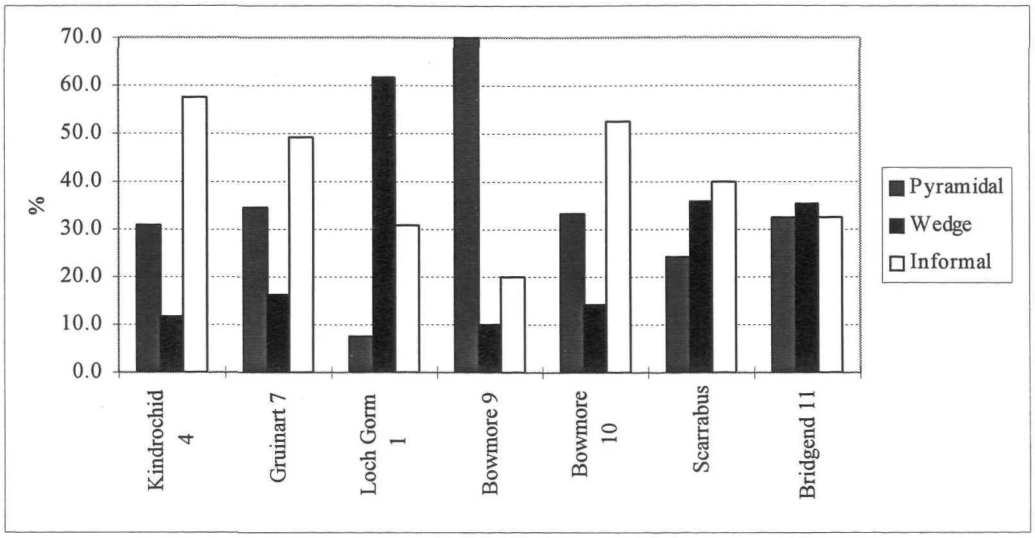

Figure 6.30. Proportions of pyramidal, wedge and informal (block and irregular) platform cores from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.19. Numbers of pyramidal, wedge and informal (block and irregular) platform cores from the seven Islay fieldwalked assemblages with more than 10 cores.

Site	Pyramidal	Wedge	Informal
Kindrochid 4	65	25	121
Gruinart 7	17	8	24
Loch Gorm 1	1	8	4
Bowmore 9	7	1	2
Bowmore 10	14	6	22
Scarrabus	6	9	10
Bridgend 11	11	12	11

This suggests longer use life with distance corresponding to greater proportions of formal shapes. The proportion of informal types highlighted significant similarity between Kindrochid 4 and Bowmore 10 (χ^2=0.35, df=1, p=0.554), which may suggest similar rates of early stage core blank working at both sites.

6.8.6. Hinge and step fractures

Cores with two or less hinge or step fractures increased in proportion across both halves of the island, figure 6.31., table 6.20. Again the Indaal-Gruinart axis appeared to correspond to a shift in proportions, particularly beyond Bowmore 10. This decline in intensity of hinging and stepping was surprising. The expectation was of increased fracture numbers with distance and use life. Since this was apparently not the case, it may suggest relatively greater levels of rejuvenation with distance. Rather than simply abandoning the core, access to raw materials encouraged greater intensity of maintenance. This is supported in the following discussion concerning probable reasons for discard, in which hinges and steps as a contributory factor decline across both halves of the island.

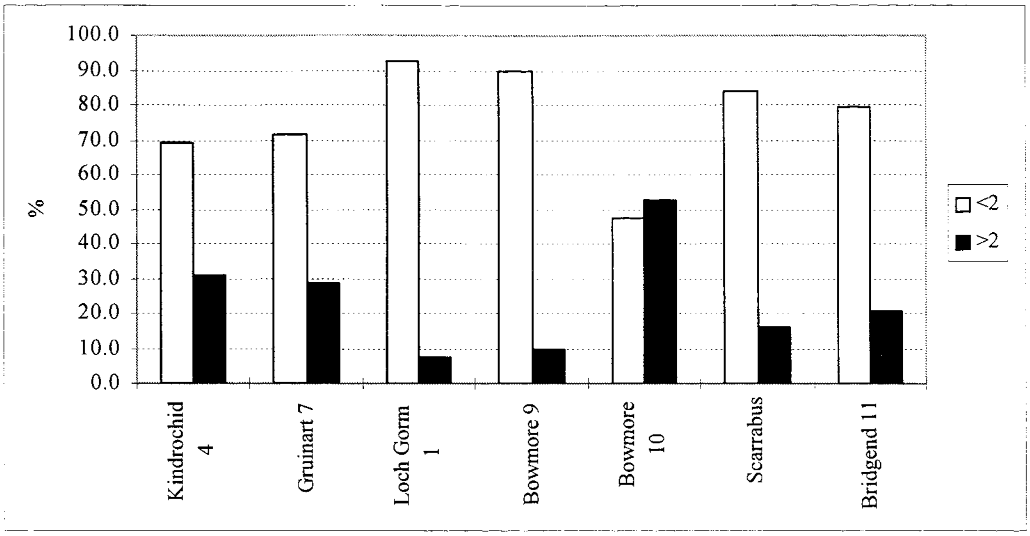

Figure 6.31. Proportions of platform cores with less than two, and greater than two hinge or step fractures from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.20. Numbers of cores with less than two, and greater than two hinge or step fractures from the seven Islay fieldwalked assemblages with more than 10 cores.

Site	< 2 hinges	> 2 hinges
Kindrochid 4	145	65
Gruinart 7	35	14
Loch Gorm 1	12	1
Bowmore 9	9	1
Bowmore 10	20	22
Scarrabus	21	4
Bridgend 11	27	7

6.8.7. Core abandonment

Cores were grouped on the basis of the most probable reasons for discard as follows:

Size: No absolute limit was defined, however, cores were considered as too small to work when they could no longer be effectively held either to work or rejuvenate.

Hinge and step fractures: Again no absolute number could be defined, however cores were considered as abandoned on the basis of hinge or step fractures when they were considered to have either been unworkable due to these, or unable to have been rejuvenated due to their extent and depth.

Unclear: When no obvious reason for abandonment could be proposed either for continued working, or for rejuvenation.

Other: This included all factors to do with the flint itself, for instance inclusions, fractures, or irregular platform or flaking surfaces.

Discard due to size increased across both halves of the island from Kindrochid 4 in the west and generally from Bowmore 10 in the east, figure 6.32., table 6.21. Hinge and step fractures and cores discarded while still viable declined across both halves of the island. Again the Loch Indaal to Loch Gruinart axis appears to correspond with a shift in proportions, particularly beyond Bowmore 10.

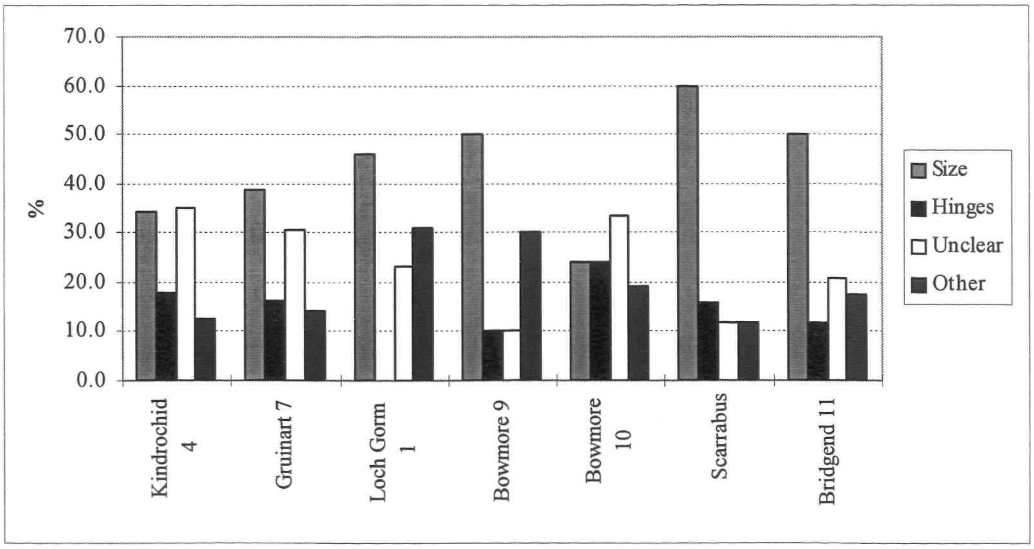

Figure 6.32. Proportions of platform cores abandoned on the basis of size, hinge and step fractures, no apparent reason, and other (inclusions and flaws, and irregular flaking or platform surfaces) from the seven Islay sites with more than 10 cores each, arranged at increasing distance from the west coast raw material sources. Loch Indaal to Loch Gruinart axis located between Loch Gorm 1 and Bowmore 9.

Table 6.21. Numbers of cores abandoned due to size, hinge and step fractures, no apparent reason, and other (inclusions and flaws, and irregular flaking or platform surfaces) from the seven Islay fieldwalked assemblages with more than 10 cores.

Site	Size	Hinges	Unclear	Other
Kindrochid 4	72	38	74	27
Gruinart 7	19	8	15	7
Loch Gorm 1	6	0	3	4
Bowmore 9	5	1	1	3
Bowmore 10	10	10	14	8
Scarrabus	15	4	3	3
Bridgend 11	17	4	7	6

Similarly high levels of mean proportions abandoned for no reason at Kindrochid 4 and Bowmore 10 suggests similar levels of access to raw materials at both sites.

6.9. Summary of the aims and results of chapter 6

The aim of chapter 6, was to investigate two aspects of the Islay archaeological record. Firstly whether activity on the island could be interpreted as structured, or alternatively the result of independent and unrelated knapping episodes. This has a bearing on whether we interpret settlement and mobility from the region as either island specific, or regionally organised. The second aim was to use assemblages from across the island to interpret patterns of movement of raw materials, and by implication the mobility of people. Initially this was approached through comparative analysis of basic assemblage structure, and the relationship between either assemblage size or distance from raw materials. Secondly it was investigated through comparative dimensional and descriptive analysis of three artefact classes, platform cores, primary flakes and pebbles.

6.9.1. Linear regression analysis

Considering the very low R^2 values in all cases, the value of linear regression analysis is questionable. As discussed in Section 6.5.7., this may be due to three factors. Either the integrity of the field collected data was insufficient to identify patterning which exists across the island. Considering the variability in recovery success generally associated with fieldwalking, this may be a distinct possibility. Alternatively, no patterning at all may exist as highlighted by the low R^2 values. The third alternative may be to do with the existence of more than one route between source and sites across the island, and therefore to relate each assemblage to a single straight line distance is unrealistic. This could be tested by considering assemblages from possible individual access routes, for instance river valleys. However with the dataset so far, the sample per route would be too small for a viable application of linear regression analysis.

However, as outlined in Section 6.5.7., although the results of linear regression analysis were generally inconclusive, they may be suggestive of patterning across the island as structured by distance rather than assemblage size.

Primary, secondary and inner: Low correlation coefficients were identified between the proportions of primary, secondary and inner debitage when plotted against either assemblage size or straight line distance. However in the case of the latter, they tended to be higher, suggesting that slightly greater amounts of variability across the island could be accounted for by distance than assemblage size. In the context of localised raw materials along the west coast, this is suggestive of distance related sequential knapping.

Flakes, blades, chunks and platform cores: Correlation coefficients for flakes, blades, chunks and platform cores were low when plotted against both assemblage size and distance. As with primary, secondary and inner, distance accounted for a significantly greater proportion of overall variability than assemblage size. This may suggest a stronger distance based relationship between formal debitage categories pointing towards the progressive reduction of cores.

Retouch: Variability in retouch proportions was weakly correlated with both assemblage size and distance although the latter was stronger, possible suggesting an increase with distance from raw material sources.

6.9.2. Collated means

Although the correlations summarised above were suggestive of distance based changes in assemblage profile, they were arguably less than convincing. This suggested that taking an island wide perspective, would provide a more robust picture of patterns of raw material and artefact use. Assemblages were collated from either side of the Loch Indaal to Loch Gruinart axis and mean proportions for each half of the island.

Primary, secondary and inner: Collated mean proportions identified an expected decline in primary and secondary debitage with a corresponding increase in inner at accumulative distance from the west coast of the Rhinns peninsular. As distance increased, proportions of cortex on transported cores declined progressively, suggesting structured use of the island.

Flakes, blades, chunks and platform cores: Mean proportions of blades and chunks declined with distance while flakes and cores increased. The decline in chunks suggests the winnowing of less formal cores with distance, supported by a slight increase in mean core proportions suggestive of relatively greater levels of abandonment of worn out pieces with distance. Changes in blades and flake proportions are more difficult to interpret however. The slight decline in blades with distance may reflect, rather than any deliberate attempt to produce less, increasing success in their production. As cores were worked and continuously maintained, the proportions of successful inner blade removals would be expected to increase, and thus be proportionally more likely to be utilised further. Some support for this was present in the form of relatively greater proportions of retouched artefacts with distance. Increasing proportions of flakes with distance may simply reflect the relative decline in the other debitage categories.

Retouch: Mean retouch proportions increased with distance by a factor of just under two. To what extent this indicates greater incidence of retouch with increasing distance is unclear, however it probably reflects the relative decline in other debitage categories particularly core preparation waste further from the raw material sources.

6.9.3. Dimensional and morphological analysis

6.9.3.1. Platform cores, primary flakes and pebbles, collated means from the two halves of the island

Collated to the two halves of the island, mean core parameters were broadly similar, however there was some suggestion of either more intensive use in the east or simply longer use lives. Mean core lengths and platform widths declined by only 0.7% and 3%, suggesting only slight increases in the extent of use with distance. To some extent this may reflect similar abandonment criteria being applied irrespective of distance to raw materials, particularly in terms of minimum size. There was some evidence present for more intensive use of cores in the form of platform perimeter working, which increased from west to east by 6.7%. This is supported by the almost doubling of the number of cores lacking perimeter cortex in the east, again suggesting in the context of similar dimensions on discard, that they were being relatively more intensively worked. Longer lives and more extensive use are suggested by the relative abundance of formal shapes on the eastern half of the island along with greater proportions of cores abandoned due to size, compared to hinge fractures and those discarded for no obvious reasons.

Primary flakes declined in mean dimension across the island, while the numbers of ventral surfaces increased. The former suggests removal from progressively smaller pebbles, while the latter points towards greater numbers of primary debitage produced through removals from partly worked pebbles or core blanks.

Pebbles declined in mean dimension across the island, although the numbers tested remained broadly constant. The former suggests the progressive removal of larger more technological useful fractions as distance increased, while the latter points to similar intensity of working and a lack of caching. This suggests that raw materials were not being moved across the island in order to provision places, but rather that they were carried and discarded by individuals. Of the total assemblage of 134 pebbles, only three were considered to have been of any technological use for Mesolithic blade core manufacture.

6.9.3.2. Platform cores, site based analysis

The island wide collated means identified a number of consistent although slight shifts in core reduction strategies across the island. However, by comparing collated means, essential differences in core profiles across each half of the island may have been obscured. In order to test whether this was the case, parameters were collated from each assemblage with ten or more cores and proportions arranged at increasing straight line distance from the west coast of the Rhinns.

Mean core dimension declined across both the Rhinns peninsular and the eastern half of the island. The Loch Indaal to Loch Gruinart axis appeared to correspond to a reversal in the trend towards declining mean sizes. In fact cores from the site of Bowmore 10 at approximately 12km from the sources of raw materials were significantly similar to those from Kindrochid 4 at 2.5km. Beyond both these sites, mean dimensions declined with increasing distance towards the east. This suggests that similar ranges of cores were being abandoned at both Kindrochid 4 and Bowmore 10, which points to similar rates of access to raw materials irrespective of absolute distance. The extent of platform perimeter working and proportions of cores lacking cortex increased particularly beyond the Loch Indaal to Loch Gruinart axis suggesting as with collated mean dimensions that cores were being used for longer and more extensively on the eastern half of the island. Although slight, the mean proportions of cores with single platforms appeared to increase across both halves of the island. The Loch Indaal to Loch Gruinart axis corresponding with a slight reversal in the trend towards increasing proportions particularly at Bowmore 10. Similar mean proportions at Kindrochid 4 and Bowmore 10 suggest comparable rates of raw material access irrespective of absolute distance. Mean proportions of informal core shapes declined across both halves of the island from Kindrochid 4 in the west and Bowmore 10 in the east. Correspondingly, pyramidal and wedge shaped pieces increased, suggesting a similar distance related shift towards formal shapes. Again the Loch Indaal to Loch Gruinart axis appears to have corresponded with a shift in core morphology. Mean proportions of cores with less than two hinge or step fractures increased across both halves of the island, again with a shift apparent at the Loch Indaal to Loch Gruinart axis. Assuming that the higher proportions of cores with more than two fractures at Kindrochid 4 reflect absolute proximity to raw materials, then the similarly high levels at Bowmore 10 may suggest a similar degree of access. Mean proportions of cores abandoned due to size increased across both halves while those discarded due to hinges and for no obvious reason declined. Again the Loch Indaal to Loch Gruinart axis appears to have corresponded with the shift in proportions. Assuming that cores abandoned for no apparent reason at Kindrochid 4 reflect absolute proximity to raw materials, then similar proportions at Bowmore 10 in particular may suggest similar levels of access.

The patterning summarised above supported the proposition made above in Section 6.931., that similar shifts in core strategies would be apparent across each half of the island, and that collating assemblages from each was obscuring this variability.

CHAPTER 7

The experimental and excavated assemblages

7.1. Introduction

In chapter 6, linear regression analysis was used to investigate a series of fieldwalked assemblages from across Islay. This suggested the presence of a relationship between assemblage variability and increasing distance from raw materials. In addition, it pointed towards artefact strategies across the island as having operated at a number of spatial scales, from the island as a whole, it's two component halves, and to within Loch basins and river valleys. The aim of Chapter 7 was to move beyond the use of the fieldwalked collections to examine in particular, at which stage of the reduction sequence raw materials were being introduced into the sites, and what this could tell us about sequential or otherwise use of the island. In effect the questions being asked were similar to those presented in Chapter 6. To what extent each of the collections differ, and how this can be used to provide us with an index for investigating the degree of spatial and temporal integration. One way in which this could have been achieved would have been to simply compare the assemblages against each other. However, this would provide only a relative measure of the extent to which sites differed. What was needed was a means of generating a model or template of how an assemblage would appear if all components of the reduction sequence were present.

7.2. Aim

The aim of Chapter 7 was similar to that outlined previously for the fieldwalked assemblages. In this case though, assemblages were not only compared against each other, but also against an experimental template. This provided a means for comparatively assessing how raw materials were being introduced into the sites. On the basis of inferred similarities or differences in raw material starting configurations, the use of the landscape could be proposed as either sequential or intermittent.

7.3. Method

The study consisted of two main components.

Generation of a comparative experimental template: A selection of pebbles were knapped using hard and soft hammer percussion, the primary aim of which was to produce small blade blanks suitable for the manufacture of microliths. All debitage fractions were collected, counted and measured.

Proportional and dimensional analysis of all five assemblages: The experimental assemblage, and those recovered through excavation at Kindrochid 4, Gleann Mór, Coulererach, and Newton were firstly collated in terms of basic assemblage parameters, including proportions of unretouched primary, secondary and inner debitage, and flakes, blades, chunks and platform cores. The proportions of these are referred to as **The comparative assemblage** and are presented for the experimental assemblage and each of the four archaeological sites in turn.

Secondly, a sample of unretouched blades and flakes from each the former four assemblages were dimensionally studied. Newton was excluded from this analysis as access to the material was not possible in the context of this research. This analysis was restricted to those pieces retaining platforms, the rational for which was twofold. Firstly, the presence of platforms strongly suggests removal from platform cores. This avoided the inclusion of other types of waste, for instance those generated through bipolar techniques. Secondly it allowed for the exclusion of probable incomplete pieces snapped either during manufacture or subsequently on site. The results of this analysis are referred to as **The platform assemblage.** Mean dimensions are presented for each of the four assemblages, which follow on directly from the tabulated results of the previous comparative assemblages for each site.

An introduction to the archaeological sites and their assemblages is given, which forms the basis for a brief discussion as to possible function of each. The comparative assemblage was generated from published reports, data generated as part of this research at Kindrochid 4, and by the Southern Hebrides Mesolithic Project.

7.4. The assemblages

7.4.1. The experimental assemblage

The aim of the experiments was to model the relationship between raw materials and the structure of debitage assemblages. It was argued that if pebbles were knapped in consistent ways, then irrespective of pebble size, a consistent relationship would exist between categories of waste produced. If validated by the results of the experimental analysis, then the template generated could be used to compare a series of unknown archaeological assemblages along a similar hypothetical reduction trajectory. In other words, by comparing the replicated and archaeological assemblages, the latter could be positioned along the reduction continuum or trajectory, so enabling the reduction 'distance' of each from raw materials to be determined.

The section begins with an introduction to the experimental methods and results in terms of distinctive artefact categories produced. Linear regression analysis is then used to test whether a consistent relationship was in fact present between waste categories irrespective on raw material starting conditions.

7.4.1.1. Method

The experiments were undertaken over a two month period, during which a series of pebbles collected from the beaches of western Islay were knapped. The primary objective in all cases was the optimisation of blade production, through the use of platform cores. As opposed to bipolar and disc forms, the association with these and dated Mesolithic horizons of the region is well documented. Although there may be some association between platform cores and later Prehistoric horizons (McCullagh 1991; Wickham-Jones 1990), the association is still far from clear.

Debitage categories were collated in two ways. Firstly, the collection was separated to the level of primary, secondary, inner, flakes, blades, chunks and platform cores, as well as debitage less than 10mm but greater than 3mm. Secondly, flakes and blades retaining platforms were described and measured. As argued earlier, the presence of platforms strongly suggest removal from platform cores.

The raw materials: The experiments were undertaken using 24 flint beach pebbles collected from active deposits at Kilchiaran and Portnahaven, both of which located along the west coast of the Rhinns of Islay. They ranged from 62g to 136g in weight, and 62mm to 136mm in length, table 7.1. All were typical of flint pebbles available along the west coast of Islay, Colonsay and Iona today, see Chapter 4, and therefore probably broadly comparable with those available during the Mesolithic. They ranged in colour from translucent black, through grey, to yellow, and were of generally of good internal quality and easily workable.

Table 7.1. Mean weight and dimensions of flint pebbles used in the experimental replication study.

	Weight (g)	Length (mm)	Width (mm)	Breadth (mm)
Mean (SD)	555.1 (246)	91.9 (15.7)	70.7 (11.1)	54.6 (9.1)
Maximum	1333.6	136	94	73
Minimum	209.9	62	44	41

The hammers: A selection of ovoid quartzite hammers were collected from the same beaches from which the raw materials had been derived, namely Kilchiaran Bay and Portnahaven, the only exception being a Père David's deer antler base. Two types of stone hammers were found to be of use, those with which the flint pebbles were initially split, and those with which cores were prepared and blades and flakes removed. The former group ranged in maximum dimensions from between 85mm and 92mm. Core working generally required smaller hammers, the most useful being flattened ovoids of quartzite, measuring around 70mm. Although absent from Islay, broadly similar examples have been recovered from Lussa Wood on Jura (Mercer 1980:9, fig5, no 3), and at

Kinloch on Rhum (Wickham-Jones 1990:119, ill 78, no's 1 & 3). The Père David's deer antler base measured 150mm in length.

7.4.1.2. How close were the experimental assemblages to those of the Scottish later Mesolithic?

The success with which the experiments were able to reproduce an assemblage comparable to those of the Mesolithic is assessed in two ways. Firstly though mean core dimensions, and secondly mean inner blade dimensions.

The experimental platform cores: The experiments produced a range of platform cores comparable to those recovered from Mesolithic horizons across Islay. These are compared below in terms of length from platform to base, and mean platform diameter, figure 7.1. The Mesolithic assemblages compared were from the sites of Gleann Mór, Coulererach and Kindrochid 4 on the Rhinns peninsular, see figure 7.12., and a fieldwalked collection of 453 platform cores from across the island, see Chapter 6 for a discussion of these.

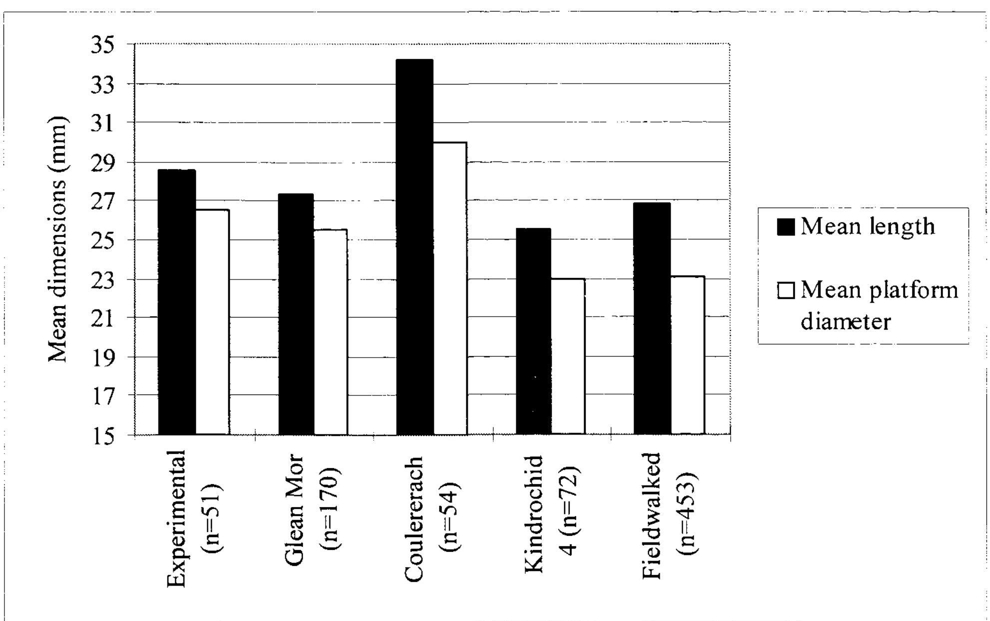

Figure 7.1. Mean length and diameter of platform cores produced experimentally, compared to those from the Mesolithic sites of Gleann Mór, Coulererach and Kindrochid 4 from the Rhinns of Islay, and those generated through fieldwalking across the island.

The experimental blades: Experimentally produced inner blades with platforms were comparable to those recovered from excavated Mesolithic sites across Islay, including Gleann Mór, Coulererach and Kindrochid 4, figure 7.2. The fieldwalked assemblages were excluded as the numbers of inner blades recovered were very small. This may not be an entirely true comparison, since much of the inner blade component of the Mesolithic assemblages would have been removed and reworked. However, it does suggests that both the experimental and archaeological collections were at least aiming towards the production of a comparable range of blank types, particularly in terms of blade dorsal to ventral thickness.

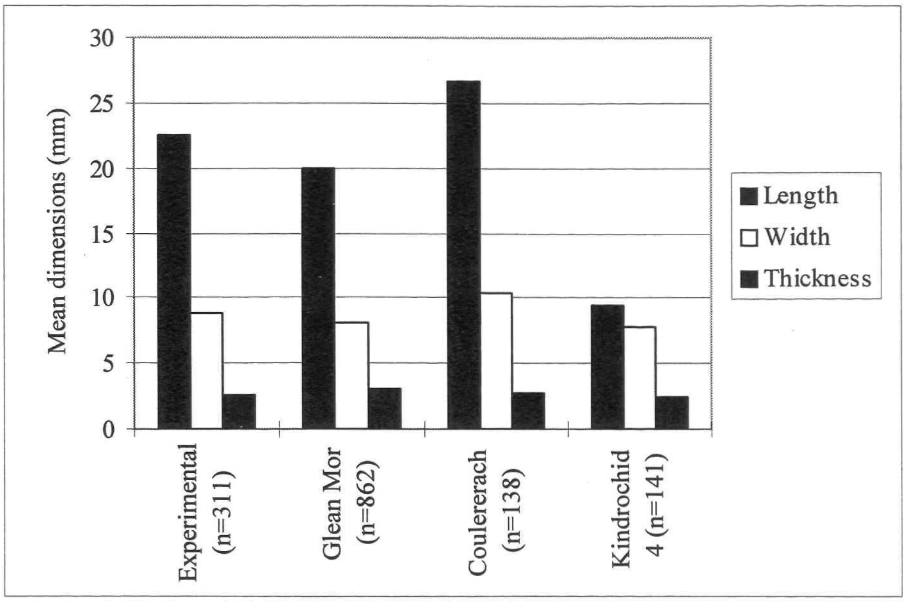

Figure 7.2. Mean length, width and breadth of inner blades produced experimentally, compared to those from the Mesolithic sites of Gleann Mór, Coulererach and Kindrochid 4, from the Rhinns of Islay.

7.4.1.3. Summary

The replication experiments were successfully able to replicate an assemblage of blades and platform cores morphologically comparable to those recovered archaeologically. This similarity extends to the use of the same pebble raw materials, beach sources, and hammer configurations, as those likely to have been used during the Mesolithic.

7.4.1.4. Pebble parameters, the presence of a consistent relationship between debitage categories?

The previous discussion highlighted similarities between morphological attributes of aspects of the experimental assemblage and those recovered from Islay. However as outlined earlier, the primary aim of the experiments was to generate a comparative debitage template. By template I mean the relationship between the proportions of specific debitage categories, for instance, flakes, blades and platform cores. The advantage when considering the use of raw materials which tend towards spheres in shape, is that irrespective of original dimensions, the tendency is also towards a constant although exponential relationship between volume and surface area, of the form:

$$A=(3V)^{2/3}$$

Where A is pebble surface area, and V equals volume.

For instance, by splitting pebbles in the same way, using each of the segments produced as core blanks, and then removing cortex and inner blades and flakes, a broadly constant relationship between pieces with cortex and those without is expected. In the following section, the experimental assemblages are investigated using linear regression analysis in order to verify whether or not this is the case.

7.4.1.4.1. Primary, secondary and inner

Numbers of primary and secondary debitage plotted against inner, highlighted a significant linear relationship between the latter two, with an R^2 of 88.3%, figure 7.3. However, very little of the variability amongst primary debitage was accounted for by inner, with R^2 at only 0.08%.

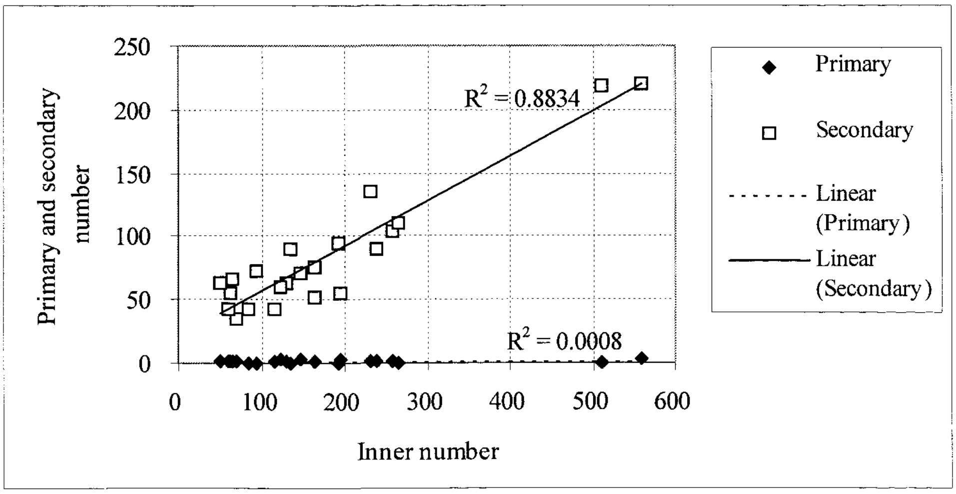

Figure 7.3. Numbers of primary and secondary debitage plotted against inner numbers for the complete experimental assemblage.

The presence of the two large assemblages at the upper end of the scattergram suggested that the distribution was being excessively weighted. They were therefore removed and the linear regression re-run. In this case, R^2 for secondary and inner declined to 57.7%, highlighting the considerable effect these two assemblages were having on the strength of the association, figure 7.4. However, a correlation coefficient of 58% implies the presence of a relationship between the numbers of secondary and inner waste irrespective of pebble size.

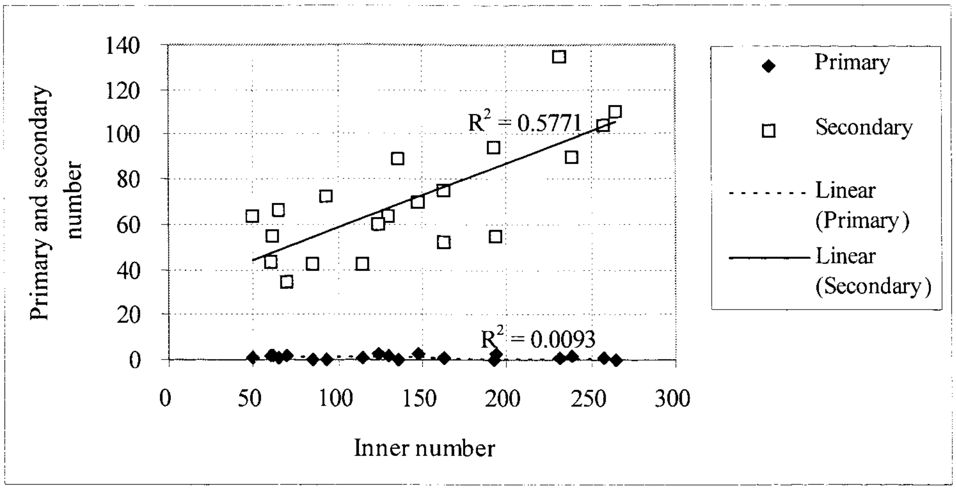

Figure 7.4. Numbers of primary and secondary debitage plotted against inner numbers for the experimental assemblage, (excluding the two largest assemblages greater than 300 pieces).

This was further emphasised by plotting the proportions of primary, secondary and inner debitage against assemblage size. Each collection was constrained within broad limits, figure 7.5, although there tended to be greater overlap in proportions in the smaller assemblages. Primary flakes consisted of between zero and 2% of the assemblage, although as seen above there was little correlation between number of inner debitage.

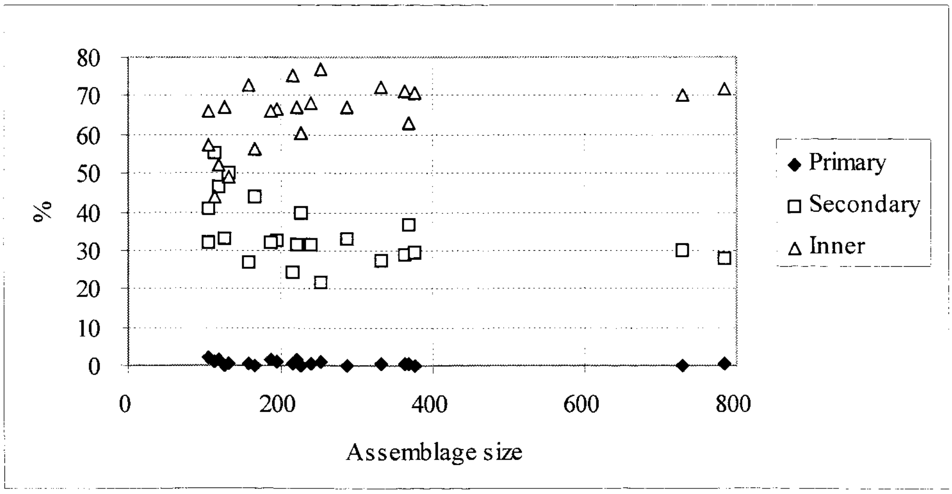

Figure 7.5. Proportions of primary, secondary and inner plotted against assemblage size for the complete experimental assemblage.

Of the 22 assemblages, 17 consisted of secondary proportions between 20% and 40%, the five exceptions being small assemblages of less than around 200 pieces in total. Correspondingly, 17 out of 22 inner collections comprised between 60% and 80% of the assemblages, again the exceptions being those generated by smaller pebbles. This suggest that for a complete assemblage produced by the knapping of pebbles to abandoned cores, more than 60% of the assemblage would lack cortex, while on between 20% and 40% of pieces, it would be present.

7.4.1.4.2. Flakes, blades and platform cores

Blade and platform core numbers plotted against flakes, produced and R^2 value of 63.9% and 28.1% respectively, figure 7.6. In other words, almost 64% of the variability in blade numbers was accounted for by flakes, irrespective of pebble size.

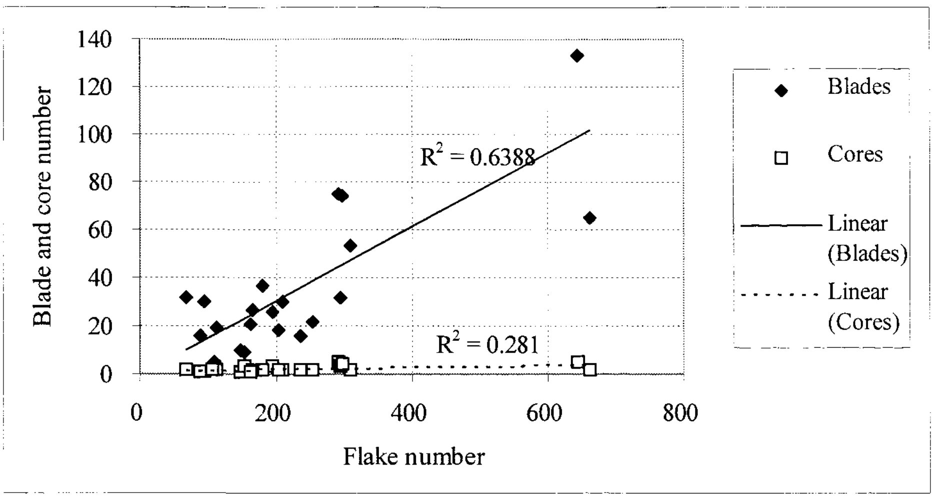

Figure 7.6. Numbers of blades and platform cores plotted against flake numbers for the complete experimental assemblage.

As expected, core numbers were more erratic, tending towards an absolute minimum rather than any definite number related to pebble size. The position of the two largest assemblages to the right of the scattergram suggested that they might be weighting the relationship, as in the case of secondary and inner. Removing them reduced R^2 for blades to 42.1%, while cores increased to 36.6%, figure 7.7. Once again, the relationship declined in strength, although still broadly indicating that a relationship was present irrespective of pebble size.

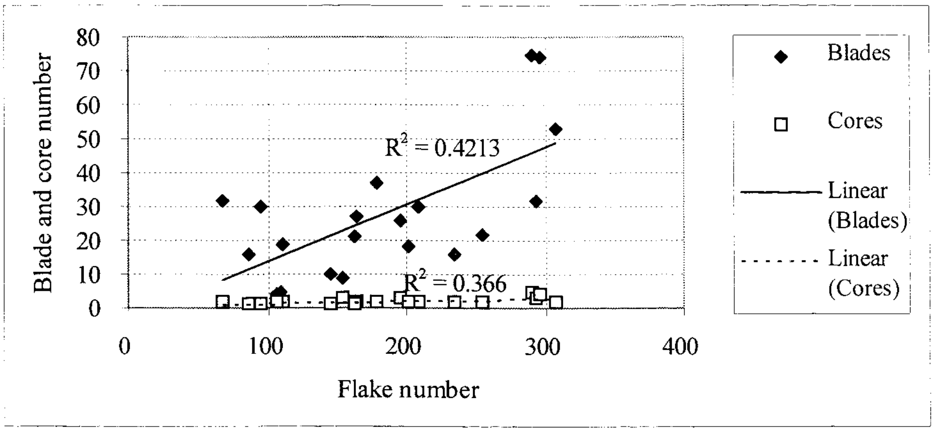

Figure 7.7. Numbers of blades and platform cores plotted against flake numbers for the experimental assemblage excluding the two largest assemblages greater than 400 pieces.

That any relationship at all was present between flake and blade numbers was considered significant, bearing in mind the number of factors conspiring against consistent blade production. As with primary, secondary and inner, plotting the proportions of blades, flakes and platform cores highlighted their consistently limited range of proportions. Of the 22 flake collections, 20 lay between 78% and 94%, while correspondingly, 20 out of the 22 of the blade collections lay between 4% and 24%, figure 7.8. As with primary, secondary and inner proportions, the outliers were all from the smallest assemblages. Cores were restricted between zero and 2% of each assemblage.

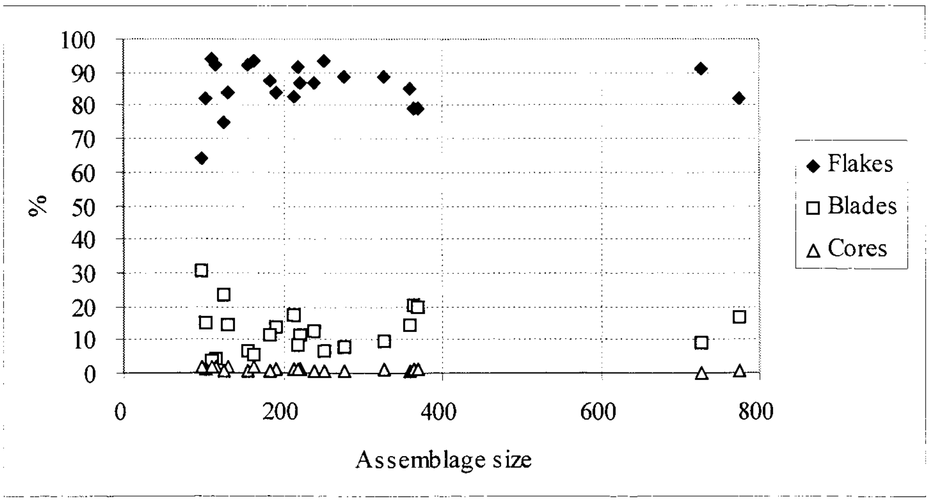

Figure 7.8. Proportions of flakes, blades and platform cores plotted against assemblage size for the complete experimental assemblage.

7.4.1.4.3. Small debitage

Plotting the numbers of debitage greater than 3mm but less than 10mm for each pebble, against the total number of pieces greater than 10mm identified a highly significant relationship (R^2 of 93.5%), between the two, figure 7.9.

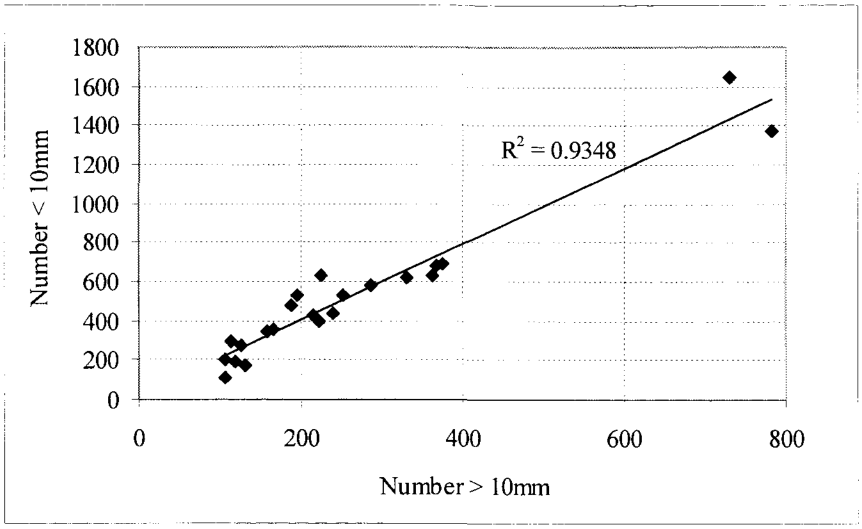

Figure 7.9. Small debitage numbers less than 10mm but greater than 3mm, plotted against number greater than 10mm for the complete experimental assemblage.

Again, the position of the two largest assemblages suggested that the distribution was being excessively weighted. Once removed, R^2 declined to 83.2%, still a highly significant relationship, figure 7.10.

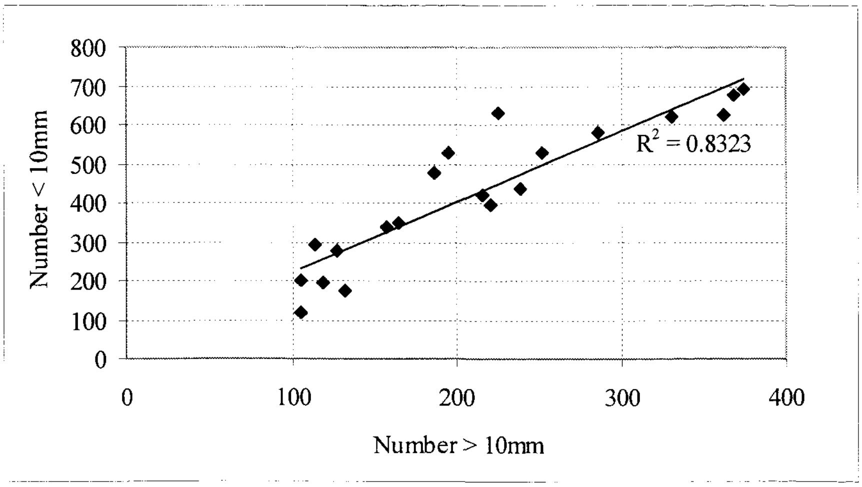

Figure 7.10. Small debitage numbers less than 10mm but greater than 3mm, plotted against number greater than 10mm for the experimental assemblage (excluding the two largest greater than 400 pieces).

In other words, just over 83% of the variability in small fraction numbers was accounted for by large debitage numbers irrespective of pebble size. Plotting small fraction proportions against total assemblage size highlighted as with the other debitage types, that proportions of pieces less than 10mm but greater than 3mm were limited to within a restricted range, figure 7.11. Of the 22 collections, 20 produced small fraction proportions of between 60% and 75% of the complete assemblage. The two exceptions being the two smallest collections.

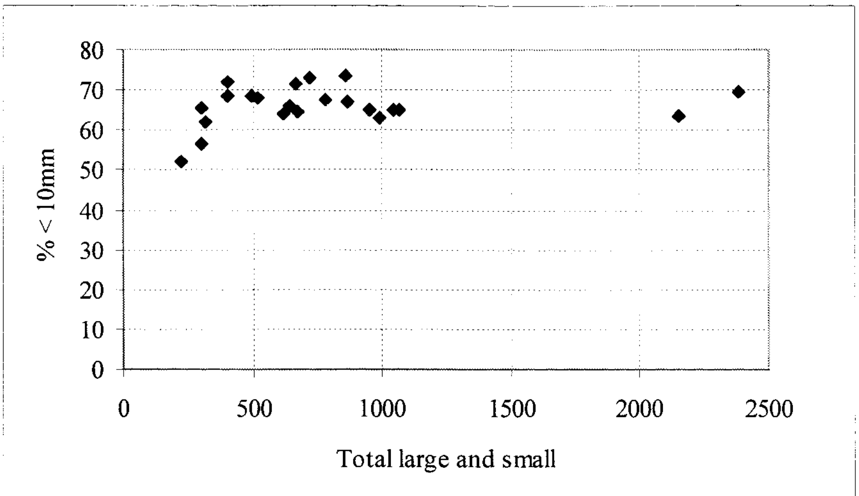

Figure 7.11. Proportions of small debitage less than 10mm but greater than 3mm, plotted against the complete assemblage.

7.4.1.4.4. Conclusions, the presence of a consistent relationship

The experiments successfully reproduced an assemblage of flakes, blades and cores, comparable to those recovered archaeologically from Mesolithic narrow blade horizons in the region. It was suggested that when using pebble raw materials and a similar reduction techniques, a regular relationship would be found to exist between debitage components produced. The results of the experiments supported this, with a regular relationship found between numbers of inner and secondary debitage, and flakes and blades. This relationship was present irrespective of pebble size, which suggested that the experimentally produced assemblages could be used as a benchmark against which to asses the archaeological collections in terms of their position along the reduction trajectory. In the next section, the insights gained in this analysis are used to investigate a series of archaeological assemblages from Islay. These are discussed in terms of the proportions of the complete reduction trajectory present.

7.4.1.5. The comparative experimental assemblage

Basic structure

The experimental assemblage consisted of 17380 pieces greater than 3mm, table 7.2.

Table 7.2. The comparative experimental assemblage, basic debitage counts.

Type	Number
Total > 10mm	5797
Total < 10mm	11583
Flakes	4971
Blades	754
Platform cores	51
Chunks	21
Primary	29
Secondary	1862
Inner	3906

Mean proportions were calculated for all 22 assemblages, table 7.3.

Table 7.3. The experimental comparative assemblage, basic debitage proportions.

	Mean (SD)	Maximum	Minimum
Total > 10mm	34% (5)	47.8%	26.3%
Total < 10mm > 3mm	66% (5)	73.8%	52.3%
Flakes	85.6% (7.2)	93.9%	63.8%
Blades	12.8% (6.8)	30.5%	3.5%
Platform cores	1% (0.5)	1.9%	0.3%
Primary	0.7% (0.7)	1.9%	0%
Secondary	34.3% (8.5)	55.3%	21.8%
Inner	65.1% (8.6)	77%	43.9%

The platform assemblage

Flakes and blades with platforms numbered 1292 individual pieces. Of these, only secondary and inner flakes, and inner blades are presented below, table 7.4. Secondary blades were excluded due to small sample size.

Table 7.4. The experimental comparative assemblage, platform debitage mean dimensions.

Secondary flakes (n=221, 17.1%)	Length	Width	Thickness	Platform width
Mean	27.2	21.9	7	10
SD	10.8	8.8	3.8	5.7
Maximum	60	63	21	33
Min	4	7	1	0
Inner flakes (n=703, 55.4%)	Length	Width	Thickness	Platform width
Mean	16.4	12.6	3.2	5.8
SD	7.3	4.9	2.2	4.1
Maximum	59	37	18	27
Min	2	5	0.7	0
Inner blades (n=311, 24.1%)	Length	Width	Thickness	Platform width
Mean	22.6	8.9	2.6	4.1
SD	8.5	2.5	1.7	2.8
Maximum	56	23	12	17
Min	10	2	0.7	0

7.4.2. Kindrochid 4

7.4.2.1. The site in its landscape

Kindrochid 4 is located 450m west of the River Leoig at approximately 30m O.D, and 2.5km from the west coast of the Rhinns, figure 7.12. To the north of the site lie the open grasslands of Sanaigmore Bay and to the south the Loch Gorm basin. The River Leoig, or rather a small stream a meter or so in width flows within the broad valley to the east of the site. However prior to deepening and straightening earlier this century (Eric Bignall pers com), it is more likely to have been an area of damp fen rather than a flowing stream. Along the opposite bank of the river the valley is bounded by a series of low cliffs while within it lie a series of small rocky outcrops.

7.4.2.2. Excavation aim and method

The site was investigated through fieldwalking, test pitting and a series of 1m wide slot trenches. The aim of the latter was twofold. Firstly to provide a comparative lithic assemblage close to the west coast raw material sources, and secondly to investigate whether or not when investigating Mesolithic sites of this type, structural features are more likely to be found away from areas of substantial lithic debris, possibly dumps.

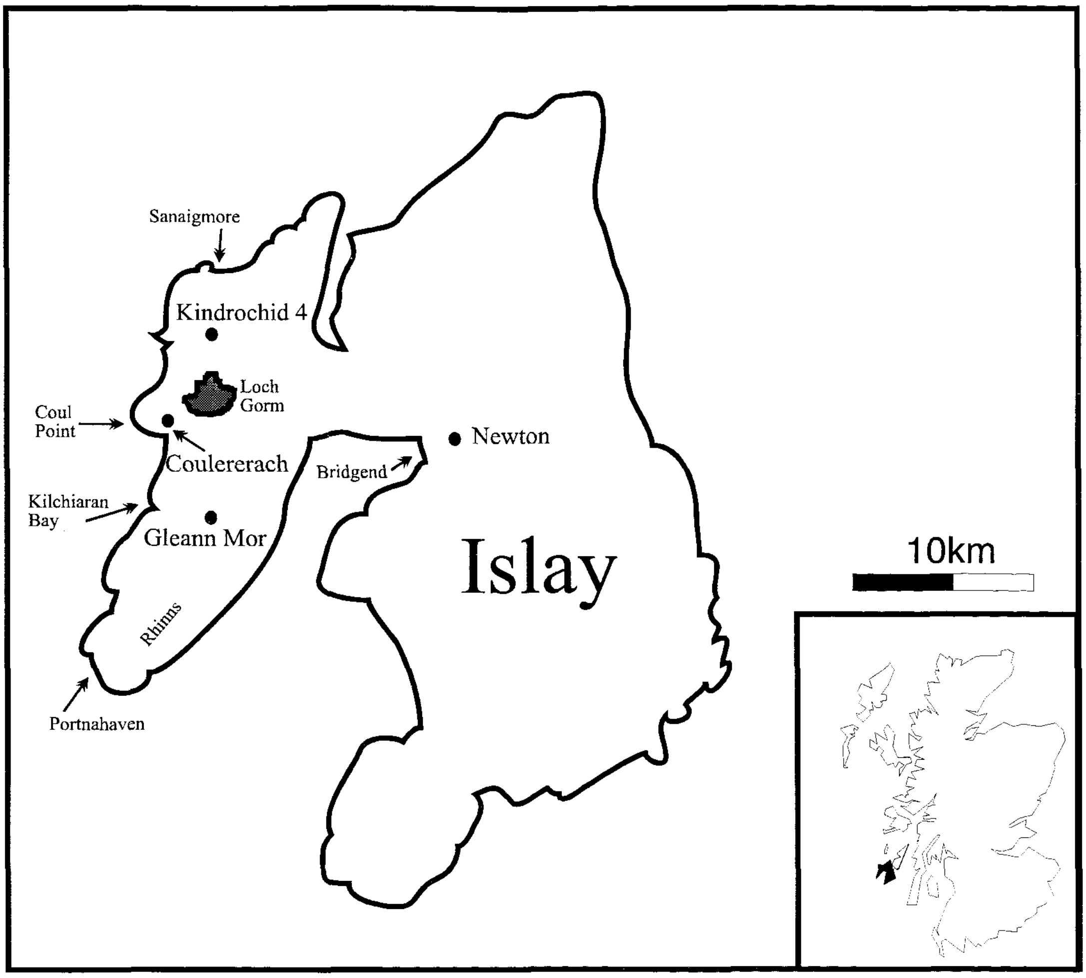

Figure 7.12. Location of the sites of Kindrochid 4, Coulererach, Gleann Mór and Newton, the Isle of Islay.

7.4.2.3. The lithic assemblage

Table 7.5. Complete retouched and unretouched flint assemblage, Kindrochid 4, Trench 1, Area 2, Contexts 3 and 4.

Unretouched flint	**Number (n=20739)**
Debitage < 10mm >3mm	11244 (54.2%)
Debitage > 10mm	9495 (45.8%)
Flakes	7774 (81.9%)
Blades	849 (8.9%)
Chunks	786 (8.3%)
Cores	83 (0.9%)
Pebbles	3 (0.03%)

Counts for primary, secondary and inner include all debitage categories.

Unretouched flint	**Number (n=9495)**
Primary	41 (0.4%)
Secondary	3678 (38.7%)
Inner	5776 (60.8%)

Table 7.5. continued.

Retouched artefacts	Number (n= 847, 8.2% of total retouched and unretouched assemblage > 10mm, n = 10342)
Microliths	110 (13%)
Microlith fragments	380 (44.9%)
Microburins & Lamella a Cran	309 (36.5%)
Scrapers	26 (3.1%)
Other	22 (2.6%)

7.4.2.4. Site function

Activity at Kindrochid 4 was concentrated in two main areas, 1 and 2. Area 1 included a series of pits, stake holes, patches of burning and a stone lined slab covered chamber. Very little lithic material was recovered from within or associated with these features and so far no dates have been obtained. The majority of the assemblage was undiagnostic although a few platform cores and microliths were recovered, the presence of which may suggest the features as Mesolithic. However the possibility of incorporation of earlier debris within later features must be born in mind. Until dates are obtained, the chronology and therefore significance of Area 1 remains uncertain. However, Area 2 produced an assemblage of typical Mesolithic facies from what would appear to be a midden deposit.

Of the total lithic assemblage excluding unretouched debitage less than 10mm from Area 2, just over 8% (n=847) was retouched, compared with 5% (n=654) at Gleann Mór, 2.9% (n=283) at Newton and 1.7% (n=35) at Coulererach. The presence of substantial numbers of microliths (n=110, 13%) and in particular microlith fragments (n=380, 44.9%), along with large numbers of microburins and lamelle à cran (36.5%, n=309) suggest an emphasis on the manufacture of blade based artefacts. Conversely, scrapers were poorly represented at only 3.1% (n=26), compared with 7.7% (n=50) at Gleann Mór, 5.3% (n=15) at Newton, and 8.6% (n=3) at Coulererach. Complete microliths were relatively rare at Kindrochid 4, at 13% (n=110), compared with 33.5% (n=219) at Gleann Mór, 55.8% (n=158) at Newton, and 25.7% (n=9) at Coulererach.

Activity at Kindrochid 4 during the Mesolithic would on the basis of the substantial proportions of microburins, lamelle à cran and broken microliths, appear to have been dominated by the manufacture and repair of blade based artefacts. Lower proportions of scrapers and other amorphous forms suggests a restricted range of activities undertaken. The lithic inventory and location of the site suggests the manufacture and repair of composite artefacts and perhaps the monitoring of animal movements between Loch Gorm and Sanaigmore Bay. In addition, the site was well placed to exploit the richest source of lithic raw materials in the whole of western Scotland, see chapter 4.

7.4.2.5. The comparative assemblage

Basic structure

The counts below, table 7.6, are slightly different to those presented above for the complete assemblage, table 7.5. A number of debitage categories were removed in order to allow comparison between the other three collections, which were in some cases catalogued slightly differently. For instance, cores were not described in terms of cortex at Gleann Mór while at Newton, chunks were similarly undefined. In addition since complete pebbles were deliberately absent from the experimental assemblage they were also excluded. Small debitage remained as counted for the whole of the assemblage. Unretouched debitage larger than 10mm included only flakes, blades, platform cores and chunks, while primary, secondary and inner comprised only blades and flakes.

Table 7.6. Kindrochid 4, Area 2, Trench 1, Contexts 3 and 4, the unretouched comparative debitage assemblage.

Unretouched debitage	**Number (19946)**
Total < 10mm	11244 (56.4%)
Total > 10mm	8702 (43.5%)
Flakes, blades and platform cores	**Number (8702)**
Flakes	7774 (89.3%)
Blades	849 (9.8%)
Platform cores	79 (0.9%)
Primary, secondary and inner	**Number (8623)**
Primary flakes	40 (0.5%)
Secondary flakes and blades	3091 (35.8%)
Inner flakes and blades	5492 (63.7%)

The platform assemblage

Random sampling of approximately 33% of bagged sieve residue was sorted for all debitage fractions with platforms, table 7.7. As in the case of the experimental assemblage, secondary blades were excluded from the analysis as were the additional dimensional and descriptive categories.

Table 7.7. Kindrochid 4, Area 2, Trench 1, Contexts 3 and 4, the unretouched comparative platform debitage assemblage, mean dimensions.

Secondary flakes (n=200, 29.1%)	Length	Width	Thickness	Platform width
Mean	18.6	16.1	5.4	7.6
SD	7	5.8	3.1	4.5
Maximum	41	46	19	21
Min	7	5	1.5	0
Inner flakes (n=325, 47.2%)	Length	Width	Thickness	Platform width
Mean	14.6	10.8	2.6	4.2
SD	4.6	2.9	1.4	2.6
Maximum	35.2	22	17.8	13
Min	6.4	5.4	0.7	0
Inner blades (n=141, 20.5%)	Length	Width	Thickness	Platform width
Mean	19.4	7.7	2.4	2.7
SD	6.6	2.6	0.9	1.9
Maximum	39.4	17.5	5	9
Min	10	3.8	0.7	0

7.4.3. Gleann Mór

7.4.3.1. The site in its landscape

Gleann Mór is located approximately 9.5km to the south of Kindrochid 4, slightly further from the west coast at just under 3km from Kilchiaran Bay, see figure 7.12. The site is located at approximately 65m O.D. on the east bank of a small stream draining northwards into the valley of the Gleann Mór river, which runs south east from Loch Gearach, and into the sea at the village of Port Charlotte. The Gleann Mór river drains an area of approximately 23 km^2, bounded to the south by Beinn Tart a Mhill, and to the north by the arc of mountains including Turnaichaidh, Cnoc Dubh and Cnoc Breac. The presence of flint eroding from the eastern edge of a small disused quarry immediately to the south of the Port Charlotte to Kilchiaran Bay road was first noted by Newell (Mithen pers com). Test pitting during 1988 by the Southern Hebrides Mesolithic Project, highlighted the presence of a concentration of Mesolithic artefacts. On the basis of these initial results, the site was suggested as the residue of a single occupation short term hunting camp.

7.4.3.2. Excavation aim and method

To test this interpretation, excavations were undertaken during 1989, the primary aim of which was firstly to generate a lithic assemblage with which to characterise the site and to investigate any spatial patterning present. The second aim was to acquire material for C^{14} and TL dating. A trench of 4m^2 was opened over the main lithic scatter and the upper peat removed. This was followed by controlled excavation of a series of sixteen 1m^2 squares, A through P. The presence of the upper peat horizon and waterlogged nature of the soils beneath suggested a lack of agricultural activity at the site and therefore the possibility that an undisturbed Mesolithic horizon would be encountered.

7.4.3.3. The lithic assemblage

The flint assemblage totalled 26318 pieces, table 7.8, with an additional collection of possibly worked quartz and other materials of 2295 (8%) pieces.

Table 7.8. Complete retouched and unretouched flint assemblage, Gleann Mór, Trench II.

Unretouched flint	**Number (n=23626)**
Debitage <10mm>3mm	11188 (47.3%)
Debitage >10mm	12438 (52.7%)
Flakes	10318 (83%)
Blades	1031 (8.3%)
Chunks	862 (6.9%)
Cores	221 (1.8%)
Pebbles	6 (0.05%)

The following counts for primary, secondary and inner exclude cores and pebbles due to both not described in terms of cortex. The discrepancy between totals for flakes, blades and chunks of 12211 compared to the sum of primary, secondary and inner of 12207, was due to four chunks unclassified in terms of cortex.

Unretouched flint	**Number (n=12207)**
Primary	501 (4.1%)
Secondary	3955 (32.4%)
Inner	7751 (63.5%)
Retouched artefacts	**Number (n=654, 5% of total retouched and unretouched assemblage >10mm, n = 13092)**
Microburins	9 (1.4%)
Microliths	219 (33.5%)
Microlith fragments	75 (11.5%)
Scrapers	50 (7.7%)
Other	301 (46%)

7.4.3.4. Site function

The location of the site on a small spur overlooking the valley of the Gleann Mór river may suggest monitoring of movement along the main access route between the Loch Indaal and Kilchiaran Bay approximately 3km to the west. Kilchiaran represents the most significant source of raw materials from Coul point south to Portnahaven, a distance of approximately 12km, figure 7.12. The presence of large proportions of small debitage less than 10mm (47.3%, n=11188), suggests knapping on site. Low microburin proportions (1.3%, n=9), compared to 36.5% (n=309) at Kindrochid 4, suggests only limited production of microliths. This was supported by lower proportions of microlith fragments (11.5%, n=75), compared to 44.9% (n=380) at Kindrochid 4. Complete microliths were more common at 33.5% (n=219), compared to only 13% (n=110) at Kindrochid 4. Scrapers were also more common at 7.7% (n=50), as were amorphous retouched forms (46%, n=301), compared to 3.1% (n=26) and 2.6% (n=22) at Kindrochid 4 respectively. Greater proportions of complete microliths, scrapers and amorphous forms and a correspondingly small number of microlith fragments and microburins may suggest relatively less emphasis on blade based manufacture. The larger proportions of complete microliths is difficult to explain in terms of manufacture or repair. Located some distance from the west coast, primary raw material processing is unlikely to represent a significant component of activity at the site. With only limited views down towards the valley of the Gleann Mór river, the use of the site as a intercept local would have been limited. However there is the possibility that some animal movement through the small valley adjacent to the site between the Gleann Mór river valley and the Loch a' Bhogaidh basin.

7.4.3.5. Comparative assemblage analysis

Basic structure

Table 7.9. Gleann Mór, Trench II, the unretouched comparative debitage assemblage.

Unretouched debitage	**Number (n=22709)**
Debitage > 10mm	11521 (50.7%)
Debitage < 10mm	11188 (49.3%)
Flakes, blades and platform cores	**Number (n=11521)**
Flakes	10318 (89.6%)
Blades	1031 (9%)
Platform cores	172 (1.5%)
Primary, secondary and inner flakes and blades totalled 11341 pieces, the discrepancy between the above count for flakes and blades of 11349 was due to eight flakes unclassified in terms of cortex.	
Primary, secondary and inner	**Number (n=11341)**
Primary flakes	450 (4%)
Secondary flakes and blades	3515 (31%)
Inner flakes and blades	7376 (65.1%)

The platform assemblage

An assemblage of 329 flakes and blades with platforms, table 7.10., was sampled from Trench II, square E, which consisted of a total of 908 inner and secondary flakes and blades. In retrospect, this was too small a sample, however this was not possible due to time constraints and others using the assemblage as part of current Southern Hebrides Mesolithic project analysis. As with the previous two platform assemblage analyses, secondary blades were excluded.

Table 7.10. Gleann Mór, the unretouched comparative platform debitage assemblage, mean dimensions, Trench II, Square E.

Secondary flakes (n=86, 6.1%)	Length	Width	Thickness	Platform width
Mean	20.4	17.3	5.6	7.6
SD	7.7	6	3.1	4.8
Maximum	42	4.2	18	23
Min	7	8	1	0
Inner flakes (n=195, 59.3%)	Length	Width	Thickness	Platform width
Mean	15.3	12.5	3.4	4.9
SD	6	4.8	2.4	4
Maximum	38	32	18	22
Min	5.5	5.5	0.6	0
Inner blades (n=41, 12.5%)	Length	Width	Thickness	Platform width
Mean	21.8	9.5	3.2	3
SD	7	3.4	1.7	1.9
Maximum	36	17	8	8.7
Min	9	3	0.5	0

7.4.4. Coulererach

7.4.4.1. The site in its landscape

Discovered during drainage work to the north of the main farm buildings, see figure 7.12, the site lies on ground sloping gently to the east at approximately 30m O.D. It has extensive views across the whole of the Loch Gorm basin from An Carnan in the north, to Glacan Daraich in the east, and the hills of Turnaichaidh, Cnoc Dubh and Cnoc Breac to the south, an area of approximately 19km^2.

7.4.4.2. Excavation method and aims

Excavation at Coulererach involved test pitting and a 1m wide by 70m long slot trench. The lithic assemblage discussed here was recovered from on top of the lower glacial gravel horizon immediately below the extensive peat deposits with comprise the field. These were over a meter deep in places.

7.4.4.3. The lithic assemblage

The lithic assemblage discussed here, table 7.11, was recovered from Trench 1 lower horizon.

Table 7.11. Complete retouched and unretouched flint assemblage, Coulererach, Trench 1.

Unretouched flint	**Number** (n=2827)
Total <10mm>3mm	844 (29.9%)
Total >10mm	1983 (70.1%)
Flakes	1602 (80.8%)
Blades	254 (12.8%)
Chunks	45 (2.3%)
Cores	54 (2.7%)
Pebbles	28 (1.4%)
Primary, secondary and inner counts included all debitage classes.	
Unretouched flint	**Number (n=1983)**
Primary	121 (6.1%)
Secondary	767 (38.7%)
Inner	1095 (55.2%)
Retouched artefacts	**Number (35, 1.7% of total retouched and unretouched assemblage >10mm, n = 2018)**
Microburins	5 (14.3%)
Microliths	9 (25.7%)
Microlith fragments	1 (2.9%)
Scrapers	3 (8.6%)
Other	17 (48.6%)

7.4.4.4. Site function

Small debitage less than 10mm (29.8%, n=844) suggests that knapping was taking place at Coulererach. However this was significantly less than at Kindrochid 4 and Gleann Mór where it comprised 54.2% (n=11244) and 47.3% (n=11188) respectively. One reason for this discrepancy may be to do with the location of the site on the edge of Loch Gorm. The position of the majority of artefacts immediately above the lower sandy clay horizon and within the highly organic sedge and peat deposit which made up the rest of the profile suggests that the artefacts may have sunk slowly onto this surface. This may account for the relative lack of small fractions. Significant primary reduction debitage suggests an emphasis on pebble working at the site while at the same time significant evidence was present for blade production. Coulererach produced the highest proportion of blades (12.8%, n=254), compared to 8.9% (n=849) at Kindrochid 4, 8.3% (n=1031) at Gleann

Mór, and 5.4% (n=512) at Newton. This may suggest blade production as the end of the working continuum at Coulererach as there appears to have been little emphasis placed on retouch. Only 1.7% (n=35) of the assemblage was retouched, compared with 8.2% (n=847) at Kindrochid 4, 5% (n=654) at Gleann Mór, and 2.9% (n=283) at Newton. Unfortunately the size of the retouched assemblage at only 35 pieces limits what can be said about types. Cores accounted for 2.7% (n=54) of the Coulererach assemblage, compared to 1.8% (n=221) at Gleann Mór, 1.7% (n=157) at Newton, and 0.9% (n=83) at Kindrochid 4, suggesting relatively more expedient use of raw materials. As to why this was being undertaken at approximately 1km from the coast is unclear although shelter from prevailing winds and unrestricted views over the Loch Gorm basin may have been a contributory factor. The considerable depth from which the assemblage was recovered, over 1m in places, combined with a higher loch level during the Mesolithic, suggests that the site was much closer to the waters edge than its present 1km. An alternative reason for the location of the site may therefore include the extraction of aquatic resources.

7.4.4.5. The comparative assemblage

Basic structure, table 7.12.

Table 7.12. Coulererach, the unretouched comparative debitage assemblage.

Unretouched debitage	**Number (n=2758)**
Total < 10mm	848 (30.7%)
Total > 10mm	1910 (69.3%)
Flakes, blades and platform cores	**Number (n=1910)**
Flakes	1602 (83.9%)
Blades	254 (13.3%)
Platform cores	54 (2.9%)
Primary, secondary and inner	**Number (n=1856)**
Primary flakes	111 (6%)
Secondary flakes and blades	675 (36.4%)
Inner flakes and blades	1070 (57.7%)

The platform assemblage

An assemblage of 671 flakes and blades retaining platforms was collated from the complete trench 1 assemblage, table 7.13. As with the previous three platform assemblage analyses, secondary blades were excluded.

Table 7.13. Coulererach, the unretouched comparative platform debitage assemblage, mean dimensions.

Secondary flakes (n=218, 32.5%)	Length	Width	Thickness	Platform width
Mean	28	22.8	7.6	9.9
SD	13.3	10	5.1	7.1
Maximum	68.5	60	32	36.5
Min	3.5	6.3	1.4	0
Inner flakes (n=258, 38.5%)	Length	Width	Thickness	Platform width
Mean	16.9	13.7	3.2	4.9
SD	7.4	5.5	3	4.3
Maximum	41	53	35	30
Min	3	5.3	0.5	0
Inner blades (n=134, 20%)	Length	Width	Thickness	Platform width
Mean	27	10.3	2.8	3.5
SD	9.7	3.4	1.4	2.4
Maximum	60	20	7	10.5
Min	10	4	0.5	0

7.4.5. Newton

The following description of the site and its assemblage is based entirely on the published report (McCullagh 1991).

7.4.5.1. The site in its landscape

Newton was excavated during the late 1980's prior to destruction of a series of cropmarks just under a kilometre east of the village of Bridgend, see figure 7.12. Features included annular and penannular, sub-circular and other amorphous marks extending 180m across a west facing terrace at approximately 22m O.D., (McCullagh 1991:23).

7.4.5.2. Excavation aim and method

Excavations were concentrated in two areas, the first on the upper terrace at approximately 22m O.D., and the second along the southern edge of the main A846 from Bridgend to Port Askaig. This consisted of a two meter wide slot trench extending from approximately 20mm O.D., 75m down to 15m O.D. The aim of the excavations was to establish the nature of the cropmarks before destruction by the road and to uncover any features not located by aerial photography (McCullagh 1991:23).

7.4.5.3. The lithic assemblage

Table 7.14. Complete retouched and unretouched flint assemblage, Newton, Area 2 (after McCullagh 1991:34).

Unretouched flint	**Number (n=10625)**
Debitage <10mm>3mm	1181 (11.1%)
Debitage >10mm	9444 (88.9%)
Flakes	8534 (90.4%)
Blades	512 (5.4%)
Chunks	230 (2.4%)
Cores	157 (1.7%)
Pebbles	11 (0.1%)

Primary, secondary and inner counts include flakes, blades and cores. The discrepancy between primary, secondary and inner of 9200, compared to the sum of flakes, blades and cores of 9203, due to three of the 157 cores not defined in terms of cortex (see McCullagh 1991:34, table 2.1 & 2.2).

Unretouched flint	**Number (n=9200)**
Primary	98 (1.1%)
Secondary	1425 (15.5%)
Inner	7677 (83.5%)

Retouched artefacts	**Number (n=283, 2.9% of total retouched and unretouched assemblage >10mm, n = 9727)**
Microburins	20 (7.1%)
Microliths	158 (55.8%)
Microlith fragments	42 (14.8%)
Scrapers	15 (5.3%)
Other retouched	48 (17%)

7.4.5.4. Site function

Area 1: Produced a series of superimposed fence lines and two pits dated to 3015±25 bc (GU-1952) and 2930±60 bc (GU-1951), (McCullagh 1991:48). The former was interpreted as a hearth containing early Neolithic Grimston/Lyles Hill pottery while the latter produced a pollen profile indicative of both arable and pastoral farming (McCullagh 1991:37). The pollen profile pointed to woodland clearance around the late sixth millennium bp, but with a gradual increase in heathland soon after, suggesting a decline in the quality of grassland. This suggests that Newton was briefly occupied during the early Neolithic but abandoned as the soil deteriorated with grassland replaced by heath. Some time after this a series of rectangular pits were dug suggesting a burial function however no skeletons or grave goods were found (McCullagh 1991:48). No dating was possible besides being inferred as later than the truncated Neolithic pit dated to 2930±60 bc (GU-1951). The pollen evidence pointed towards arable agriculture in the vicinity while the presence of the possible burial structures may suggest a Christian Irish presence (McCullagh 1991:49).

The lithic assemblage consisted of 440 pieces of worked flint of which the majority were flakes and chunks. A total of 54 blades were present along with 13 platform cores, one with subsequent bipolar working (McCullagh 1991:34). Of the 20 retouched artefacts, a single microlith was recovered along with a series of edge and end retouched pieces. Wet sieving failed to produce any substantial small debitage component suggesting a lack of in-situ knapping on the upper terraces (McCullagh 1991:36).

Area 2: Produced the earliest evidence for activity at Newton in the form of a series of features including hearths and a sizeable midden deposit. Dates of 5855±90 bc (GU-1954), and 5815±225 bc (GU-1953) indicated a Mesolithic presence while the pollen profile pointed to mixed but open woodland, possibly bordering on a fresh water loch (McCullagh 1991:47). This may suggest Newton as similarly located to Kindrochid 4 and Coulererach, both adjacent to water. The lack of any significant depressions next to the site suggests that it may have been located next to an area of wetness. This is supported by the presence of a depression at the base of the slope immediately adjacent to the midden deposits although drainage has led to the drying out of this area. Substantial quantities of well preserved hazel nut shell within the Mesolithic horizons suggests that the collection and processing of these may have been undertaken. However, the possibility for storage and transport must be kept in mind.

A lithic assemblage of 9728 pieces of flint was recovered from the south western end of the slot trench, context F35, table 7.14., above. Limited proportions of small debitage (11.1%, n=1181) less than 10mm, suggests less intensive on-site working at Newton, compared to Gleann Mór where they accounted for 47.3% (n=11188), or at Kindrochid 4 where they comprised 54.2% (n=11244) of unretouched debitage. However, the comparative value of this small fraction component is limited. Although reference was made to a 9% sieve sample (McCullagh 1991:32), it is unclear whether this relates the proportion of the complete lithic assemblage recovered through sieving or of excavated soils processed (Mithen pers com).

Microburins were poorly represented at 7.1% of the retouched assemblage compared with 14.3% (n=5) at Coulererach, and 36.5% (n=309) at Kindrochid 4. This may suggest less emphasis on blade based artefact manufacture. However, complete microliths were relatively common at 55.8% (n=158), compared with 13% (n=110) at Kindrochid 4, 25.7% (n=9) at Coulererach, and 33.5% (n=219) at Gleann Mór. Scraper proportions were broadly comparable at 5.3% (n=15), compared to 3.1% (n=26) at Kindrochid 4, 7.7% (n=50) at Gleann Mór, and 8.6% (n=3) at Coulererach. Other retouched types accounted for 17% (n=48) of the retouched assemblage, compared to 2.6% (n=22) at Kindrochid 4, 46% (n=301) at Gleann Mór, and 48.6% (n=17) at Coulererach.

7.4.5.6. The comparative assemblage

Basic structure, table 7.15.

Table 7.15. Newton, the unretouched comparative debitage assemblage from Area 2.

Unretouched debitage	**Number (n=10348)**
Debitage <10mm>3mm	1181 (11.4%)
Debitage >10mm	9203 (88.6%)
Flakes, blades and platform cores	**Number (n=9203)**
Flakes	8534 (92.7%)
Blades	512 (5.6%)
Platform cores	157 (1.7%)
Primary, secondary and inner	**Number (n=9046)**
Primary flakes	98 (1.1%)
Secondary flakes and blades	1308 (14.5%)
Inner flakes and blades	7640 (84.5%)

7.5. Comparative analysis of basic assemblage structure, primary, secondary and inner, and flakes, blades, platform cores and small debitage.

The proportions of debitage are presented firstly by type and then compared by site using Chi-Squared significance tests.

7.5.1. Basic assemblage structure

Primary, secondary and inner, and flakes, blades and platform core numbers and proportions were plotted at increasing distance from the west coast of the Rhinns, and compared using Chi-square significance tests. The aim was to investigate the extent to which the four Mesolithic assemblages differed from one another as well as the experimentally generated template. A summary of the basic structure of all five assemblages is presented below in table 7.16.

Table 7.16. Summary of basic assemblage structure from the experimental assemblage, and those from the archaeological sites of Coulererach, Kindrochid 4, Gleann Mór and Newton.

	Experimental	Coulererach	Kindrochid 4	Gleann Mór	Newton
Primary%	0.7	6	0.5	4	1.1
Secondary%	34.3	36.4	35.8	31	14.5
Inner%	65.1	57.7	63.7	65.1	84.5
Flakes%	85.6	83.9	89.3	89.6	92.7
Blades%	12.8	13.3	9.8	9	5.6
Platform cores%	1	2.9	0.9	1.5	1.7

7.5.1.1. Mean proportions of primary, secondary and inner debitage

7.5.1.1.1. Primary debitage

Mean proportions of primary debitage at Kindrochid 4 (0.5%) and Newton (1.1%) were within one standard deviation (0.7%) of the experimental mean of 0.7%, figure 7.13. Significant proportions of primary material were present at Coulererach (6%), and at Gleann Mór (4%), suggesting a relative abundance of earlier stage working compared to either the experimental assemblage or those from Kindrochid 4 or Newton.

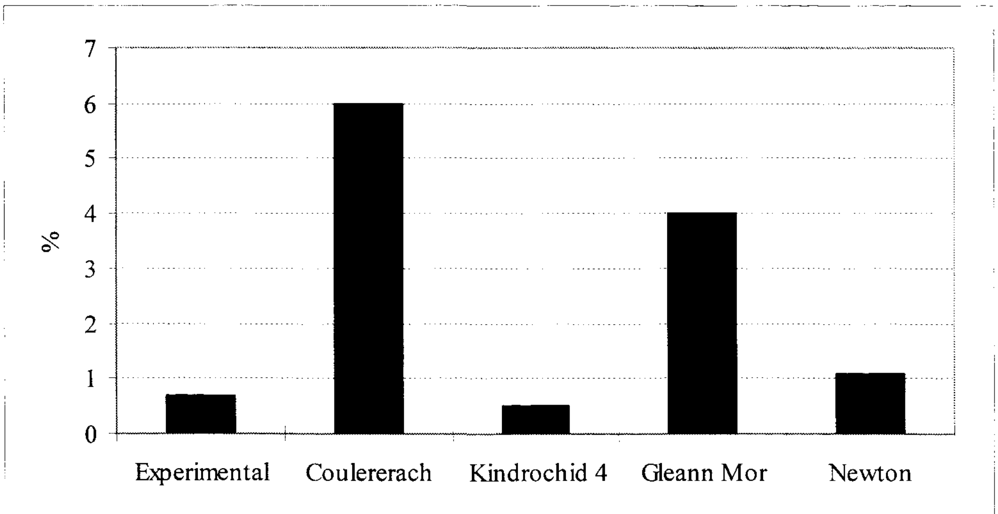

Figure 7.13. Primary debitage proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

This was expected at Coulererach since the site is located only 1km from a rich source of raw materials along the west coast. However it was less expected for Gleann Mór at just over 3km from the coast. The site of Newton at over 13km produced more than twice the mean proportion of primary flakes at Kindrochid 4 at just over 2km. This may suggest differential dispersal of raw materials not solely related to distance from sources. The higher than expected proportions of primary material at Gleann Mór may suggest Kilchiaran Bay to Port Charlotte as a potential axis for the movement of earlier stage core blanks and pebbles, whether to the site of Bolsay Farm, or across the Rhinns peninsular. Similarly at Newton it may suggest the introduction of partially worked pebbles, possibly via the site of Bowmore 10 on the eastern edge of the Loch Indaal. Although sampled by fieldwalking, the assemblage contained 12 (5%) primary flakes.

7.5.1.1.2. Secondary debitage

Mean secondary proportions were all apart from Newton (14.5%), within one standard deviation (8.5%) of the experimentally predicted mean (34.3%), figure 7.14. Coulererach (36.4%) and Kindrochid 4 (35.8%), produced slightly higher than expected proportions, while Gleann Mór (31%) and Newton (14.5%) were lower.

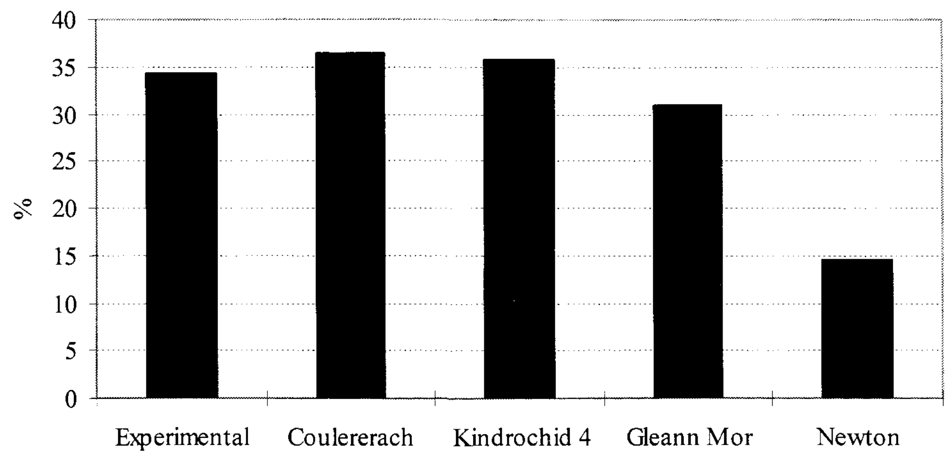

Figure 7.14. Secondary debitage proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

Mean secondary proportions declined regularly with distance from the west coast, figure 7.14, suggestive of sequential core reduction across the island.

7.5.1.1.3. Inner debitage

Mean proportions of inner debitage were all within one standard deviation (8.6%) of the experimental mean (65.1%), apart from Newton at 84.5%, figure 7.15.

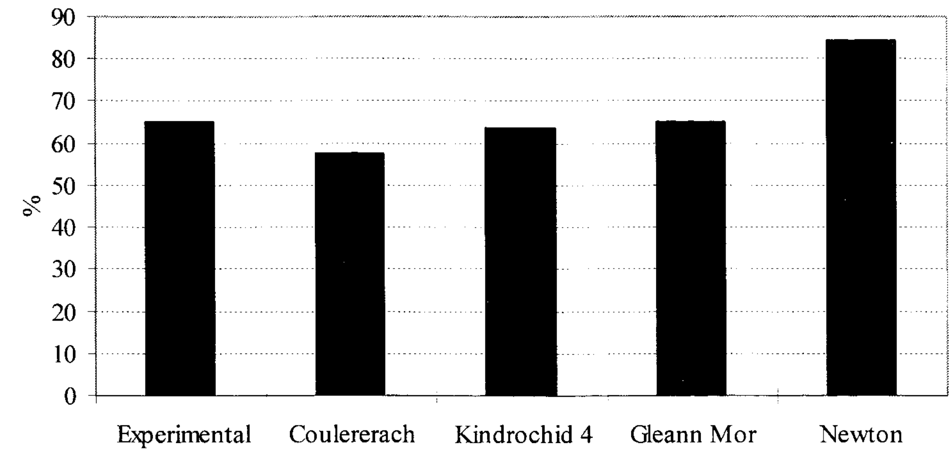

Figure 7.15. Inner debitage proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

Coulererach produced the lowest proportions (57.7%), followed by Kindrochid 4 (63.7%), Gleann Mór (65.1%) and then Newton. Inner proportions increased with distance, suggesting progressive removal of cortex as cores were moved across the island.

7.5.1.2. Significance test results for primary, secondary and inner debitage

To test the statistical significance of these differences, a series of one-sample chi-square tests were undertaken on each assemblage. Observed counts were compared against those predicted by the experimental model.

7.5.1.2.1. Coulererach

Observed and expected counts were significantly (χ^2=633, df=2, p<<.001) different, table 7.17, although the majority of this was accounted for by the difference between observed and expected primary counts (χ^2=614.4). Over seven times as many were observed as were expected.

Table 7.17. Chi-squared significant tests for primary, secondary and inner proportions at Coulererach, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Primary	111	0.008	15	96	614.4
Secondary	675	0.341	633	42	2.8
Inner	1070	0.651	1208	-138	15.8
Σ	1856	1	1856		633

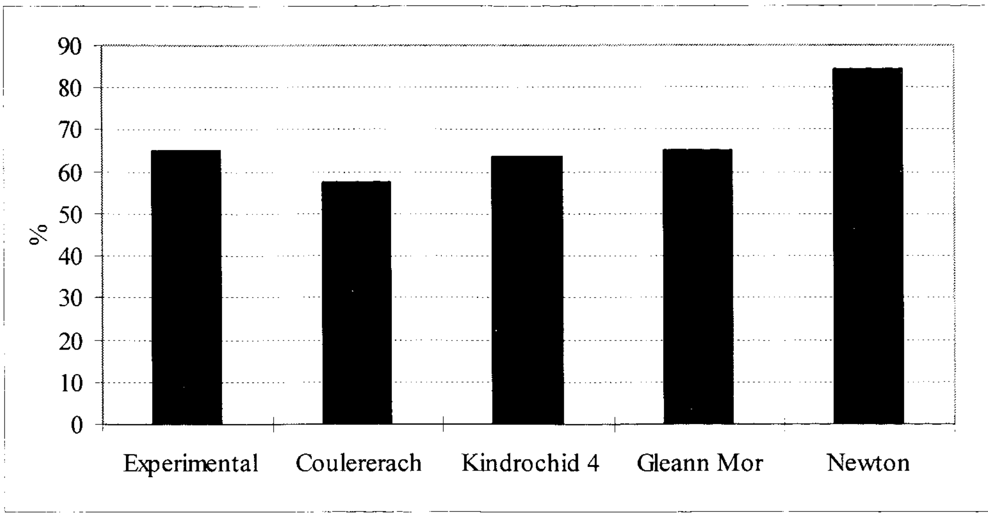

Figure 7.15. Inner debitage proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

Coulererach produced the lowest proportions (57.7%), followed by Kindrochid 4 (63.7%), Gleann Mór (65.1%) and then Newton. Inner proportions increased with distance, suggesting progressive removal of cortex as cores were moved across the island.

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7.5.1.2.1. Coulererach

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Secondary	675	0.341	633	42	2.8
Inner	1070	0.651	1208	-138	15.8
Σ	1856	1	1856		633

Little difference was noted between observed and expected secondary (χ^2=2.8), however a significant difference was identified between observed and expected inner counts (χ^2=15.8). The greatly inflated numbers of primary, and the lower than expected inner counts suggest Coulererach as a primary pebble and core blank processing local.

7.5.1.2.2. Kindrochid 4

A significant difference was identified between observed and expected numbers of primary, secondary and inner debitage at Kindrochid 4 (χ^2=22.6, df=2, p<.001), table 7.18., of which the majority was accounted for by primary (χ^2=12.2), and secondary (χ^2=7.8). Fewer primary flakes were observed than were expected, while greater numbers of secondary flakes were observed than were predicted. The difference between observed and expected inner numbers was less extreme (χ^2=2.7). This may suggest relatively greater emphasis on the working of partly prepared core blanks.

Table 7.18. Chi-squared significant tests for primary, secondary and inner debitage proportions at Kindrochid 4, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Primary	40	0.008	69	-29	12.2
Secondary	3091	0.341	2940	151	7.8
Inner	5492	0.651	5614	-122	2.7
Σ	8623	1	8623		22.6

7.5.1.2.3. Gleann Mór

A significant difference was identified between observed and expected numbers of primary, secondary and inner debitage (χ^2=1448.3, df=2, p<<.001), table 7.19., with most accounted for by primary (χ^2=1416). A total of 450 were observed while only 91 were expected, an underestimation by a factor of approximately five.

Table 7.19. Chi-squared significant tests for primary, secondary and inner debitage proportions at Gleann Mór, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Primary	450	0.008	91	359	1416.3
Secondary	3515	0.341	3867	-352	32
Inner	7376	0.651	7383	-7	0.007
Σ	11341	1	11341		1448.3

The difference between observed and expected numbers of secondary debitage was significant (χ^2=32), however there was little difference between inner pieces (χ^2=0.007). More primary pieces at Gleann Mór suggests a relative emphasis on earlier stage working, while minimal differences between observed and expected amongst inner debitage suggest an additional component of later stage working of partly prepared cores.

7.5.1.2.4. Newton

A significant difference between observed and expected numbers of primary, secondary and inner debitage was identified (χ^2=1553.6, df=2, $p<<.001$), table 7.20. The majority accounted for by differences between observed and expected numbers of secondary debitage (χ^2=1023.6), although inner (χ^2=520.6) and primary (χ^2=9.4) were both significantly different. Primary flake numbers observed were slightly greater than expected, the presence of which at over 13km from the west coast raw material sources, implies transport of pebbles and core blanks over significant distances.

Table 7.20. Chi-squared significant tests for primary, secondary and inner debitage proportions at Newton, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Primary	98	0.008	72	26	9.4
Secondary	1308	0.341	3085	-1777	1023.6
Inner	7640	0.651	5889	1751	520.6
Σ	9046	1	9046		1553.6

Substantial numbers of inner debitage, with almost 1.3 times as many as expected, suggests an additional emphasis on the working of prepared cores, supported by almost 2.4 times as many secondary pieces expected than observed.

7.5.1.3. Mean proportions of flakes, blades, platform cores and small debitage

7.5.1.3.1. Flakes

Mean flake proportions in each of the four Mesolithic assemblages were broadly comparable with those produced experimentally, figure 7.16, and all within one standard deviation (7.2%) of the replicated mean (85.6%). All apart from Coulererach (83.9%) produced proportions greater than the experimental assemblage, while Kindrochid 4 and Gleann Mór were similar at 89.3% and 89.6% respectively.

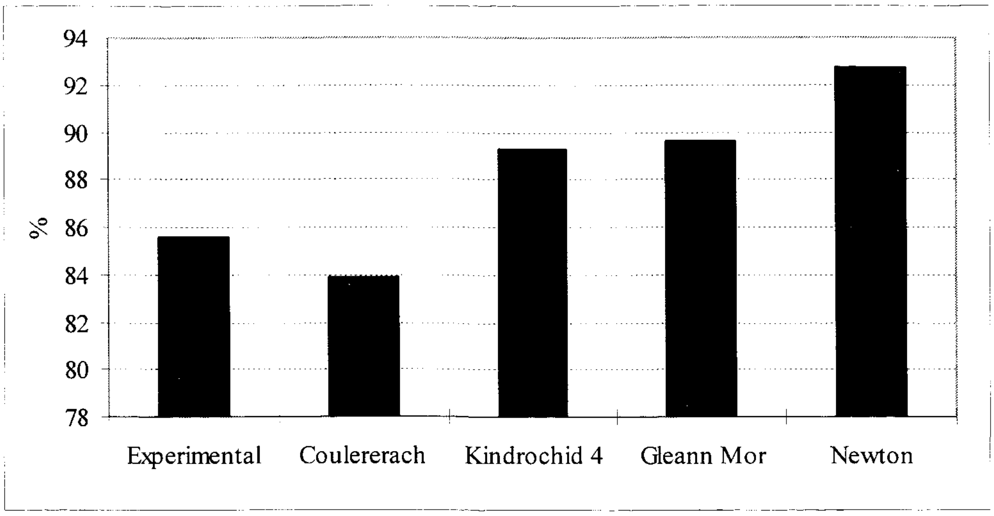

Figure 7.16. Flake proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

Newton produced the highest proportion of flakes at 92.7%. Although there appears to have been significant early stage knapping at Coulererach, mean proportions of flakes were generally lower than the other four assemblages. In all assemblages, flakes increased in proportion with distance.

7.5.1.3.2. Blades

Blades were mostly within one standard deviation (6.8%) of mean experimental proportions (12.8%), the exception being Newton at 5.6%, figure 7.17. Mean blade proportions were highest at Coulererach (13.3%), while Kindrochid 4 and Gleann Mór were similar at 9.8% and 9% respectively. Higher than predicted mean proportions of blades at Coulererach suggested an emphasis on their production, surprising in the light of an emphasis on early stage pebble and core blank preparation. However, relatively low levels of retouch at Coulererach (1.7%, n=35), may suggest that blades produced either deliberately or as part of the core preparation sequence were not being worked. Blades declined regularly in proportion with increasing distance.

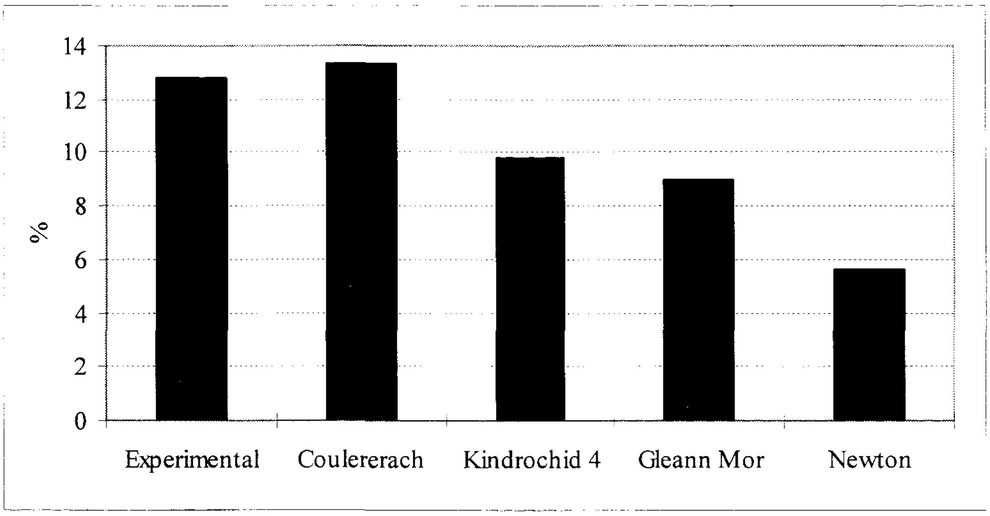

Figure 7.17. Blade proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

7.5.1.3.3. Platform cores

Of the four Mesolithic assemblages, Kindrochid 4 (0.9%) and Gleann Mór (1.5%) were within one standard deviation (0.5%) of the mean experimentally predicted proportion (1.1%), figure 7.18.

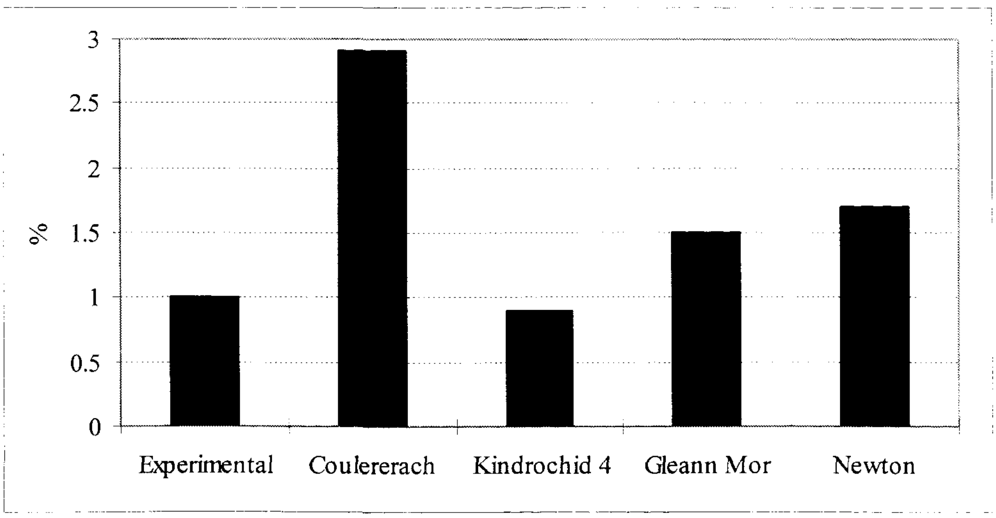

Figure 7.18. Platform core proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

Significantly greater proportions of cores were present at Coulererach (2.8%), and slightly more at Newton (1.7%). Higher than predicted mean proportions at Coulererach suggest an emphasis on early stage core preparation. The progressive increase in core proportions from Kindrochid 4 suggests increasing rates of abandonment with distance. This may reflect more extensive use at greater distances from raw materials, longer use life or alternatively a relative decline in preparation waste.

7.5.1.3.4. Small debitage

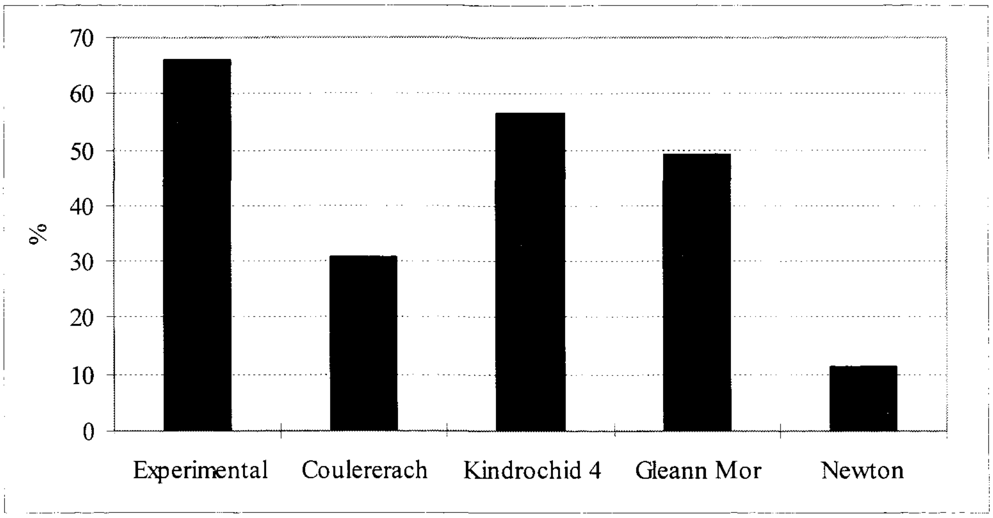

Figure 7.19. Small debitage < 10mm proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

The experimental assemblage produced consistently greater proportions of small debitage than the four Mesolithic collections, figure 7.19. This may reflect genuine differences in knapping intensities at each site. For instance, Kindrochid 4 produced large numbers of retouched artefacts, while conversely Coulererach and Newton produced relatively fewer. Alternatively, site formation processes may have influenced small fraction proportions present. Both Kindrochid 4 and Gleann Mór appear to represent in-situ knapping deposits, whereas Coulererach was less clearly so. This does not explain the low small fraction component at Newton however, which McCullagh described as an accumulating midden deposit (1991:47). Coulererach it was suggested may have formed at the edge of Loch Gorm. Size sorting would have occurred as the assemblage settled at the edge of the Loch, resulting in the reduced small fraction presence. Differences in recovery technique may have influenced the proportions within the assemblages. All were sieve processed, however there is some question as to how much of the Newton assemblage was processed as such (Mithen pers. com). Clearly, a number of factors effected small fraction recovery rates at Coulererach, Kindrochid 4, Gleann Mór and Newton. All four produced less than the experimentally predicted mean, however the two most likely in-situ deposits at Kindrochid 4 and Gleann Mór were also closest in terms of small fractions present.

7.5.1.4. Significance test results for flakes, blades and platform cores

7.5.1.4.1. Coulererach

A significant difference was identified between observed and expected counts of flakes, blades and platform cores (χ^2=65.6, df=2, p<<.001).

Table 7.21. Chi-squared significant tests for flake, blade, chunk and core proportions at Coulererach, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Flakes	1602	0.86	1643	-41	1
Blades	254	0.13	248	6	0.2
Cores	54	0.01	19	35	64.5
Σ	1910	1	1910		65.7

Much of this was accounted for by the difference between observed and expected numbers of cores (χ^2=64.5), table 7.21. Little significant difference was identified between observed and expected flakes (χ^2=1) and blades (χ^2=0.2). Slightly fewer flakes were present and six more blades than predicted. The presence of a significant blade component may suggest an emphasis on their manufacture, however in the context of a relative lack of blade based retouch, a more probable explanation is that blades were a by-product of core preparation at Coulererach.

7.5.1.4.2. Kindrochid 4

A significant difference was identified between flake, blade and platform core numbers (χ^2=82.3, df=2, p<<0.001), with most accounted for by flakes (χ^2=11.2) and blades in particular (χ^2=70.3).

Table 7.22. Chi-Squared significant tests for flake, blade, chunk and core proportions at Kindrochid 4, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Flakes	7774	0.86	7484	290	11.2
Blades	849	0.13	1131	-282	70.3
Cores	79	0.01	87	-8	0.7
Σ	8702	1	8702		82.3

Considerably fewer blades were present than were predicted, table 7.22, while flakes were more abundant. Little difference was noted between observed and expected numbers of platform cores (χ^2=0.74). Summing blade, microburin and Lamelles a cran counts to produce a better estimate of original blade proportions, Kindrochid 4 appeared significantly similar to the experimental assemblage, figure 7.20.

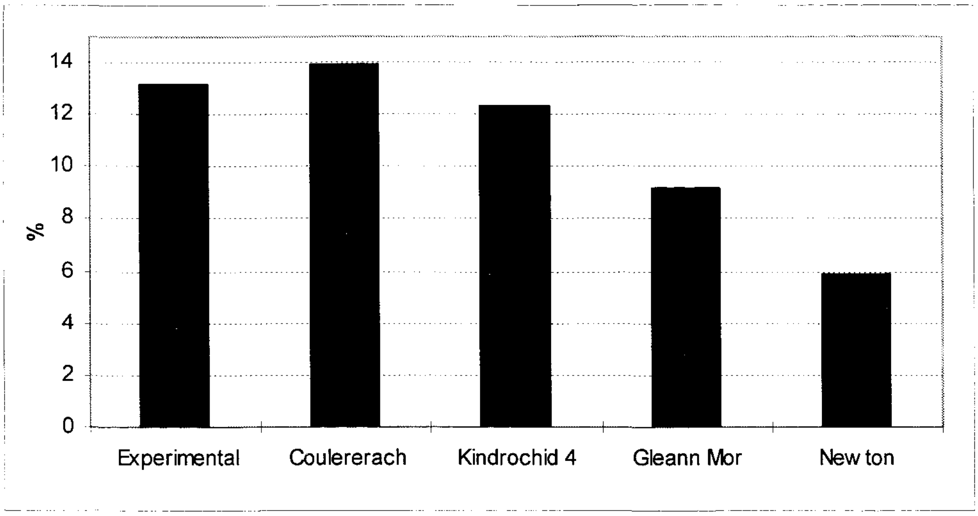

Figure 7.20. Combined blade and microburin proportions in the experimental assemblage, and from the sites of Coulererach, Kindrochid 4, Gleann Mór and Newton, arranged at increasing distance from the west coast of the Rhinns of Islay.

7.5.1.4.3. Gleann Mór

The difference between observed and expected numbers of flakes, blades and platform cores was significant (χ^2=190.8, df=2, p<<0.001).

Table 7.23. Chi-squared significant test for flake, blade and core proportions at Gleann Mór, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Flakes	10318	0.86	9908	410	17
Blades	1031	0.13	1498	-467	145.6
Cores	172	0.01	115	57	28.3
Σ	11521	1	11521		190.8

The majority accounted for by the difference between observed and expected numbers of blades (χ^2=145.6), although flakes (χ^2=17) and platform cores (χ^2=28.3) were significantly different as well, table 7.23. Blades were under-represented, while flakes and platform cores were more abundant than predicted. This may suggest less emphasis at Gleann Mór on blade working, although as above with Kindrochid 4, it may reflect greater use being made of blades for the production of artefacts. Retouch levels were relatively high at 5% of the complete assemblage, however there were few microburins (n=9, 14%). Even when summing blades and microburins, proportions remained low, suggesting a relative lack of blade working compared to either the experimental assemblage or Kindrochid 4.

7.5.1.4.4. Newton

The difference between observed and expected numbers of flakes, blades and platform cores was significant (χ^2=485.5, df=2, p<<0.001).

Table 7.24. Chi-square significant test for flake, blade and core proportions at Newton, Isle of Islay.

	Number observed	Experimental proportions	Number expected	(O -E)	χ^2
Flakes	8534	0.86	7915	619	48.4
Blades	512	0.13	1196	-684	391.2
Cores	157	0.01	92	65	45.9
Σ	9203		9203		485.5

Most was accounted for by the difference between observed and expected numbers of blades (χ^2=391.2), while flakes (χ^2=48.4) and cores (χ^2=45.9) were also significant, table 7.24. As with Gleann Mór, blades were under-represented while flakes and platform cores were more abundant, suggesting a relative lack of emphasis on blade production. Summing blades and microburins as a rough guide to original blade proportions supported this interpretation, figure 7.20 above.

7.5.1.5. Summary

Mean proportions of primary, secondary, inner, and flakes, blades and platform cores were comparable with the experimentally predicted means, with most (75%, n=18) lying within one standard deviation. Notable exceptions to this were platform cores from Coulererach and Newton, primary pieces at Coulererach and Gleann Mór, and secondary and inner from Newton. Notable similarities included blade proportions from Coulererach, platform core and primary proportions at Kindrochid 4, and inner at Gleann Mór.

7.5.1.5.1. Coulererach

Significantly large proportions of primary debitage at Coulererach suggest a relative emphasis on the working of pebbles and core blanks, unsurprising given that the site is located only 1km from the richest source of raw materials in the whole of western Scotland. Pebbles which on the basis of a lack of large hammer-stones on site, would appear to have been introduced already split, were being partially prepared on site. The higher primary and secondary debitage proportions, but reduced inner, compared to the experimental assemblage suggest a relatively greater emphasis on early stage working of blanks. Cores set-up at Coulererach were probably being removed from the site, for use elsewhere on the island and beyond. The presence of a range of core shapes, reflect extensive variability in preparation success. These are likely to have resulted from the stochastic nature of early stage core working. The higher than expected proportions of cores suggests that greater numbers were being abandoned at Coulererach, which probably reflects deliberate choice on the part of the knappers in the preferential removal of better core blanks, as well as possibly the abandonment of worn out pieces at sources of fresher replacements (Gramley 1983). The larger than expected blade component may suggest an emphasis on their production as blanks for the manufacture of other retouched artefacts. However, the preparation of core blanks involves not only the removal of cortical material, but also the preparation of the flaking surface through the setting up of parallel ridges. During my own experiments reported on earlier in this chapter, this stage of initial core preparation often resulted in the removal of large blades. This suggests that with the apparent limited emphasis on retouch at Coulererach, greater proportions of these would have remained unworked and thus intact. Some blade working was taking place, as suggested by the presence of microliths and microburins, however these were rare, comprising only 0.5%, and 0.3% of the complete assemblage greater than 10mm respectively, see table 7.11. This suggests that the significant blade component is not necessarily indicative of an emphasis on their production, but in this case a relative lack of secondary use.

The predominance of early stage core working debitage, suggests that the primary function of Coulererach was the setting up of platform cores blanks, from where they were distributed across the island and beyond. Raw materials were probably being introduced as split pebbles, or core blanks, which would then be prepared through cortex removal. The relative lack of an inner debitage component compared to the experimental assemblage points to prepared cores being removed from the site, rather than worked in-situ.

7.5.1.5.2. Kindrochid 4

The assemblage approximated closest with that generated experimentally, particularly in terms of primary, secondary and inner. This suggests that as in the experimental assemblage, the full range of debitage types were present, in turn suggesting that complete pebbles or at least split core blanks were being introduced and worked. Support for this may be present in the similarity between core proportions in both assemblages. Blades were relatively less common, while flakes were correspondingly more common. However, summing blades and microburins as an index of original proportions, suggested that as with cores, the experimental assemblage and that from Kindrochid 4 would have been similar.

As with Coulererach, this suggests the introduction of unworked core blanks at Kindrochid 4. The difference in inner proportions however suggests that unlike the former, cores were being more extensively worked at Kindrochid 4.

7.5.1.5.3. Gleann Mór

Although further from the west coast than Kindrochid 4, Gleann Mór produced considerably greater proportions of primary material than predicted by the experimental assemblage, suggesting the introduction and working of greater numbers of unworked pebbles or core blanks. The lower than expected secondary proportions, and correspondingly greater inner component, suggests an additional emphasis on the working of more extensively worked cores. This points to a decline in cortex proportions as distance increased from the raw material sources, as pebbles were moved along the Gleann Mór River. However, increased primary debitage proportions suggests the transport of an additional pebble and core blank component. Situated within a significant west to east funnelling valley from Kilchiaran Bay on the west coast of the Rhinns, to the west coast of the Loch Indaal, greater primary proportions may suggest the movement of raw materials along this corridor. These may either have been introduction at sites such as Bolsay Farm, or alternatively have been moved across the Rhinns peninsular, and introduced onto sites on the eastern half of the island, possibly through boat crossings of the Loch Indaal from Port Charlotte to sites such as Bowmore 10, see Chapter 6. The importance of Kilchiaran Bay as a raw material source is supported by the large numbers of rolled artefacts currently eroding from former raised deposits, see Chapter 4. Although located within the southern half of the Rhinns peninsular, absolute distances between it and sites on the eastern half of the island, such as Bowmore 10 and Newton are similar to those from the coast of the northern half of the peninsular. If water distances across the Loch Indaal are removed, then in terms of land needing to be traversed, Kilchiaran would have been the closest source of raw materials for the eastern half of the island.

Compared to the experimental assemblage, blade proportions were lower at Gleann Mór, while flakes and cores were higher. This suggests progressive working of cores with distance, and longer use lives leading to increased rates of abandonment, while the more extensively worked and maintained cores would have led to increased inner blade removal success, resulting in fewer being abandoned on site and therefore their lower overall visibility.

7.5.1.5.4. Newton

Movement of raw materials onto the eastern half of the island either across the Loch Indaal or via its northern edge is suggested by slightly higher than expected proportions of primary flakes at Newton. In fact, they were over twice as common as at Kindrochid 4. Conversely, secondary debitage proportions were lower than predicted by the experimental assemblage, while inner was more common. As with Gleann Mór, this suggests a distance decay relationship between cores retaining cortex. However, slightly greater proportions of primary flakes at Newton suggest that an additional component of pebbles or core blanks were being transported across the island. Higher than expected proportions of cores abandoned at Newton, suggests longer use lives while as at

Gleann Mór, declining blade proportions points towards increasing inner blade removal rates and thus relatively fewer discarded without being retouched.

7.6. Platform debitage assemblage analysis

The previous discussion focused on the basic debitage proportions from each of the five assemblages. With the following analysis, only flakes and blades retaining platforms were measured and described. The aim was to dimensionally assess debitage components for each assemblage against one another, as well as the experimentally generated collection. The aim was again to investigate how raw materials were being introduced into the sites. As with the consistent relationship demonstrated previously in terms of mean proportions of basic debitage categories irrespective of pebble dimensions, it is argued that the range of dimensions present in each assemblage, provides a key to investigating what proportion of the reduction sequence is present. Early stage core work is typified by larger blades and flakes, while extensively worked cores tend to be smaller flakes and blades. The proportions of large and small components within an assemblage may therefore provide and indication of the dimensions of cores being introduced and worked. The rational for only including blades and flakes with platforms in this analysis, was firstly that they were definitely produced through platform core working, rather than for instance bipolar, and secondly that they are probably more complete. Mean dimensions and cumulative frequency histograms are presented for each of the four assemblages, experimental, Coulererach, Kindrochid 4, and Gleann Mór. As outlined earlier, Newton was excluded from the platform debitage analysis. For each debitage type, a Kolmogorov-Smirnov significance test was undertaken.

7.6.1. Secondary flakes

7.6.1.1. Mean dimensions

There was significant similarity between Coulererach and the experimental assemblage, and additionally between Kindrochid 4 and Gleann Mór, figure 7.21. This may suggest that as in the experimental assemblage, a large proportion of the complete reduction trajectory was present at Coulererach. Slightly larger means may suggest a relatively greater emphasis on earlier stage working at the latter. Gleann Mór and Kindrochid 4 produced similar secondary flake means, although those from the former were consistently slightly larger, suggesting a greater relative emphasis on the working of slightly larger cores. Although Gleann Mór was located further from the west coast than Kindrochid 4, relatively greater proportions of larger cores being introduced and worked.

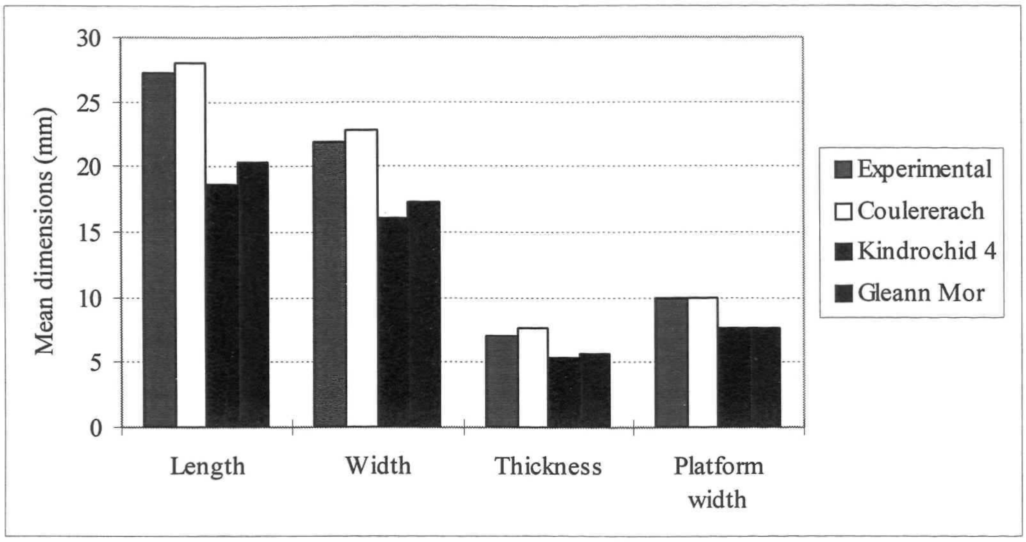

Figure 7.21. Secondary flake mean dimensions for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

7.6.1.2. Length

The cumulative curve supported the conclusions drawn on the basis of the mean lengths, figure 7.22, table 7.25. Coulererach and the experimental assemblage were significantly similar, while both differed from Kindrochid 4 and Gleann Mór. Small secondary flakes were initially more common at Coulererach where for instance 20% of the assemblage measured less than 14mm compared to 17mm in the experimental collection. Beyond 20mm however, longer flakes became relatively more common at Coulererach where 70% of the assemblage measured less than 34mm, compared to 31mm in the experimental collection. Flakes longer than 59mm were absent from the experimental assemblage but present at Coulererach, suggesting the working of larger cores at the latter. Secondary flakes at Gleann Mór tended to be slightly longer than those from Kindrochid 4, with 70% less than 23mm in the former and 20mm in the latter. This suggests a relatively greater proportion of longer cores being introduced and worked at Gleann Mór than at Kindrochid 4, although the former is located further from the coast.

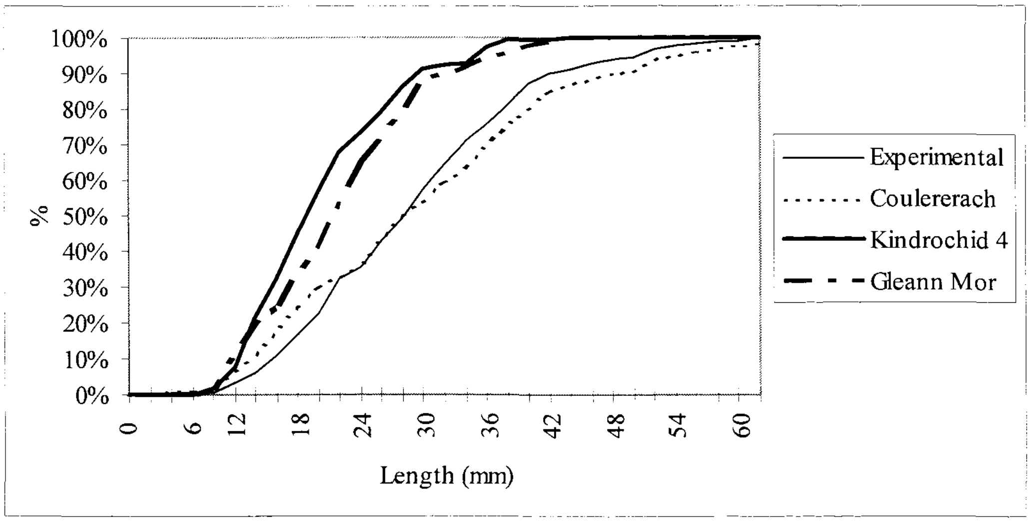

Figure 7.22. Secondary flake length cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.25. Kolmogorov-Smirnov significance test results for secondary flake lengths. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=221) (n=218)	**0.08**	**0.13**
Experimental-Gleann Mór (n=221) (n=86)	0.31	0.12
Experimental-Kindrochid 4 (n=221) (n=200)	0.38	0.13
Coulererach-Kindrochid 4 (n=218) (n=200)	0.38	0.13
Coulererach-Gleann Mór (n=218) (n=86)	0.30	0.17
Gleann Mór-Kindrochid 4 (n=86) (n=200)	**0.16**	**0.17**

7.6.1.3. Width

As with mean dimensions, the cumulative curve and significance test suggested a similar range of dimensions in the experimental assemblage and that from Coulererach, and additionally between Gleann Mór and Kindrochid 4, figure 7.23, and table 7.26. Greater proportions of narrow secondary flakes were initially more common at Coulererach than in the experimental assemblage, particularly those less than 17mm. Beyond this, wider pieces were more common in the former. For instance, 70% of the experimental assemblage measured less than 24mm, but less than 27mm at Coulererach. This suggests relatively greater proportions of larger diameter cores were being worked at Coulererach. Greater proportions of secondary flakes at both Kindrochid 4 and Gleann Mór were significantly narrower than those from either Coulererach or in the experimental assemblage, suggesting the working of proportionally greater numbers of smaller diameter cores at both sites, particularly Kindrochid 4.

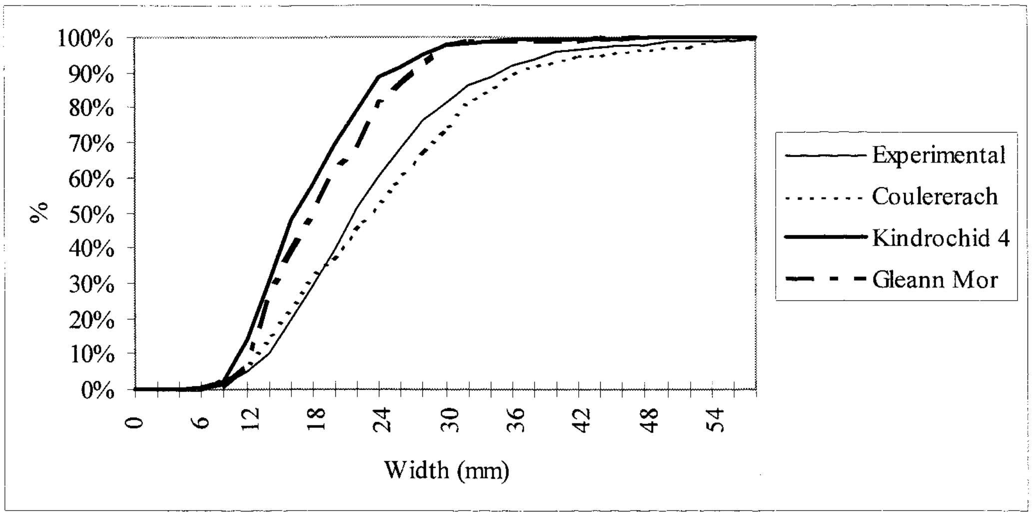

Figure 7.23. Secondary flake width cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.26. Kolmogorov-Smirnov significance test results for secondary flake widths. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=221) (n=218)	**0.01**	**0.13**
Experimental-Gleann Mór (n=221) (n=86)	0.23	0.12
Experimental-Kindrochid 4 (n=221) (n=200)	0.30	0.13
Coulererach-Kindrochid 4 (n=218) (n=200)	0.37	0.13
Coulererach-Gleann Mór (n=218) (n=86)	0.30	0.17
Gleann Mór-Kindrochid 4 (n=86) (n=200)	**0.10**	**0.17**

7.6.1.4. Thickness

As with mean thickness', the cumulative curve again pointed to significant similarity between the experimental assemblage and that from Coulererach, and additionally between Gleann Mór and Kindrochid 4, figure 7.24, table 7.27. The experimental assemblage and that from Coulererach were similar up to 5mm. Beyond this, thicker pieces were more common at Coulererach. For instance, 70% of the experimental assemblage measured less than 7.5mm, but less than 9mm at Coulererach. Again this suggests greater proportions of larger diameter cores worked at Coulererach. A greater proportion of secondary flakes at both Kindrochid 4 and Gleann Mór were significantly thinner than at Coulererach and in the experimental assemblage. Again this suggests the working of smaller diameter cores at both sites, particularly Kindrochid 4.

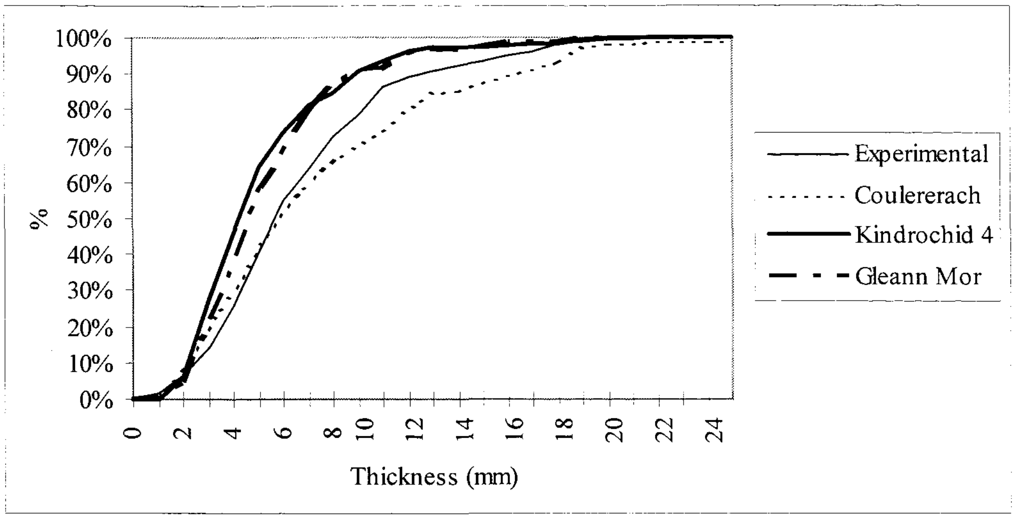

Figure 7.24. Secondary flake thickness cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.27. Kolmogorov-Smirnov significance test results for secondary flake thickness. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=221) (n=218)	**0.12**	**0.13**
Experimental-Gleann Mór (n=221) (n=86)	0.17	0.12
Experimental-Kindrochid 4 (n=221) (n=200)	0.23	0.13
Coulererach-Kindrochid 4 (n=218) (n=200)	0.22	0.13
Coulererach-Gleann Mór (n=218) (n=86)	0.22	0.17
Gleann Mór-Kindrochid 4 (n=86) (n=200)	**0.09**	**0.17**

7.6.1.5. Platform width

As with mean platform widths, the cumulative curve suggested a similarity between the experimental assemblage and that from Coulererach, and additionally between Kindrochid 4 and Gleann Mór, figure 7.25, table 2.28. In addition, no significant difference was noted between Coulererach and Gleann Mór. Slightly greater proportions of platforms were initially narrower at Coulererach, however beyond 10mm, the assemblage contained significantly greater proportions of wider flakes. Again this suggests the working of larger diameter cores at Coulererach. Platform widths at Kindrochid 4 and Gleann Mór suggest similar ranges of smaller diameter cores being introduced and worked at both sites.

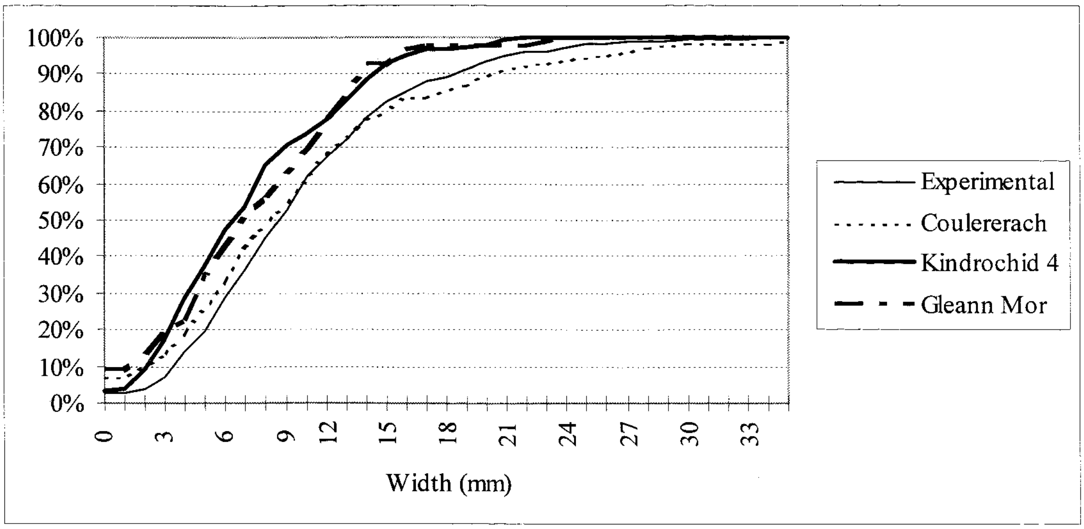

Figure 7.25. Secondary flake platform width cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.28. Kolmogorov-Smirnov significance test results for secondary flake platform widths. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=221) (n=218)	**0.06**	**0.13**
Experimental-Gleann Mór (n=221) (n=86)	0.15	0.12
Experimental-Kindrochid 4 (n=221) (n=200)	0.20	0.13
Coulererach-Kindrochid 4 (n=218) (n=200)	0.16	0.13
Coulererach-Gleann Mór (n=218) (n=86)	**0.16**	**0.17**
Gleann Mór-Kindrochid 4 (n=86) (n=200)	**0.09**	**0.17**

7.6.2. Inner flakes

7.6.2.1. Mean dimensions

There was a significant degree of similarity between mean inner flake dimensions in the experimental assemblage and that from Coulererach, although slightly longer and wider flakes in the latter suggest the working of a range larger cores, figure 7.26. Shorter and narrower mean dimensions at Kindrochid 4 and Gleann Mór suggest the working of smaller cores, particularly at the former. The similarity between mean flake thickness in all assemblages suggests similar emphasis being placed on thinner removals, particularly at Kindrochid 4. Thickness can be reduced through the use of soft hammers in particular, however length and width is more dependant on core dimensions. Similar mean widths at both Coulererach and Gleann Mór suggest the working of larger diameter cores although still with thickness being controlled for.

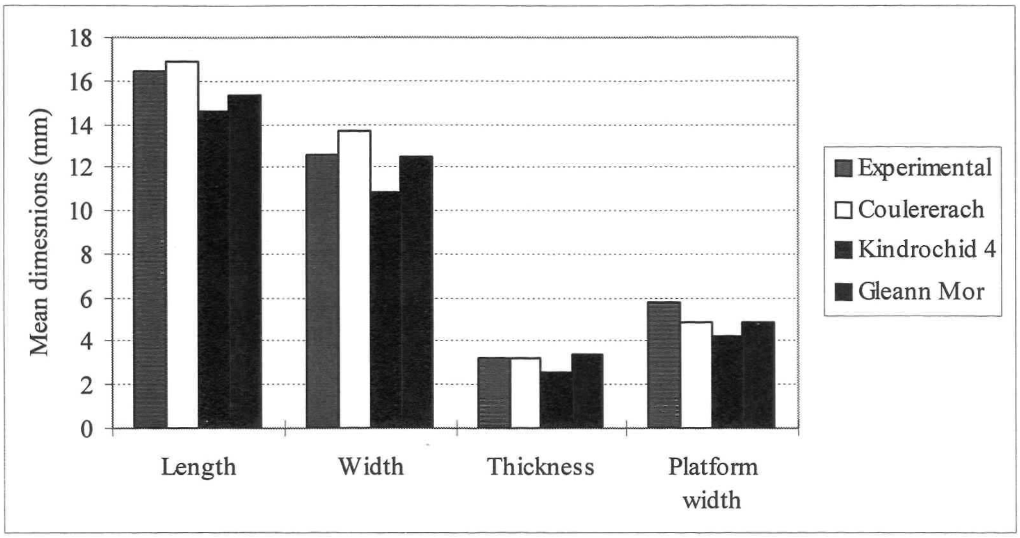

Figure 7.26. Inner flake mean dimensions for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

7.6.2.2. Length

The cumulative curve indicated a significant similarity between Coulererach and the experimental assemblage, between the experimental assemblage and Gleann Mór, and between Glean Mór and Kindrochid 4, figure 7.27, table 7.29. For flakes over 14mm in particular, Coulererach produced greater proportions of longer pieces, suggesting the working of greater proportions of longer cores. Inner flakes at Kindrochid 4 were consistently shorter, suggesting the working of smaller cores, while greater proportions of longer flakes at Gleann Mór suggests the working of a component of larger cores.

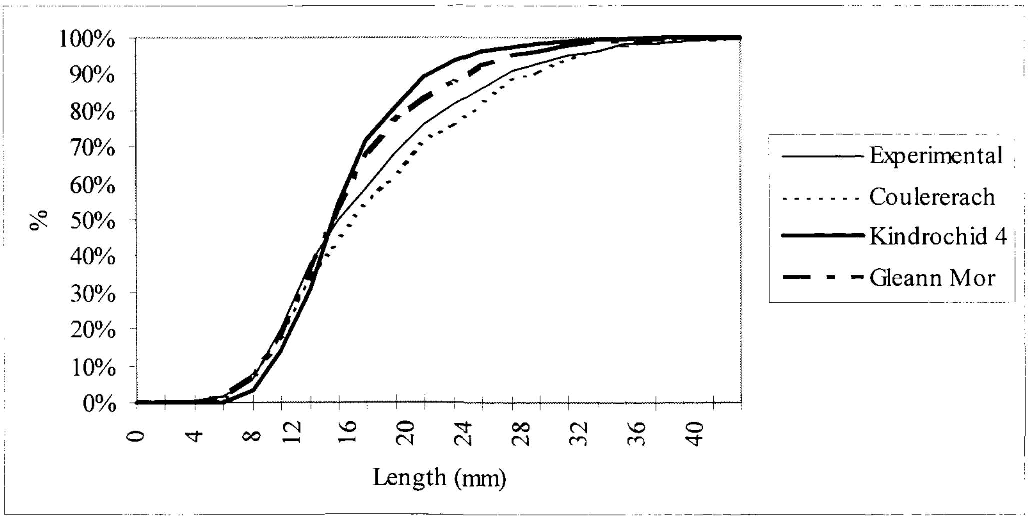

Figure 7.27. Inner flake length cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.29. Kolmogorov-Smirnov significance test results for inner flake length. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=703) (n=258)	**0.06**	**0.10**
Experimental-Gleann Mór (n=703) (n=195)	**0.10**	**0.11**
Experimental-Kindrochid 4 (n=703) (n=325)	0.13	0.09
Coulererach-Kindrochid 4 (n=258) (n=325)	0.19	0.11
Coulererach-Gleann Mór (n=258) (n=195)	0.16	0.13
Gleann Mór-Kindrochid 4 (n=195) (n=325)	**0.06**	**0.12**

7.6.2.3. Width

As with mean dimensions, the cumulative curve indicated a significant similarity between the experimental assemblage and that from Gleann Mór, figure 7.28, table 7.30. This suggests as in the former, the full range of inner flake fractions present and therefore points towards the working of a larger range of core sizes. Coulererach produced greater proportions of wider flakes than those from the other three assemblage, suggesting the working of larger diameter cores. Those from Kindrochid 4 tended to be significantly narrower, suggesting the use of smaller diameter cores.

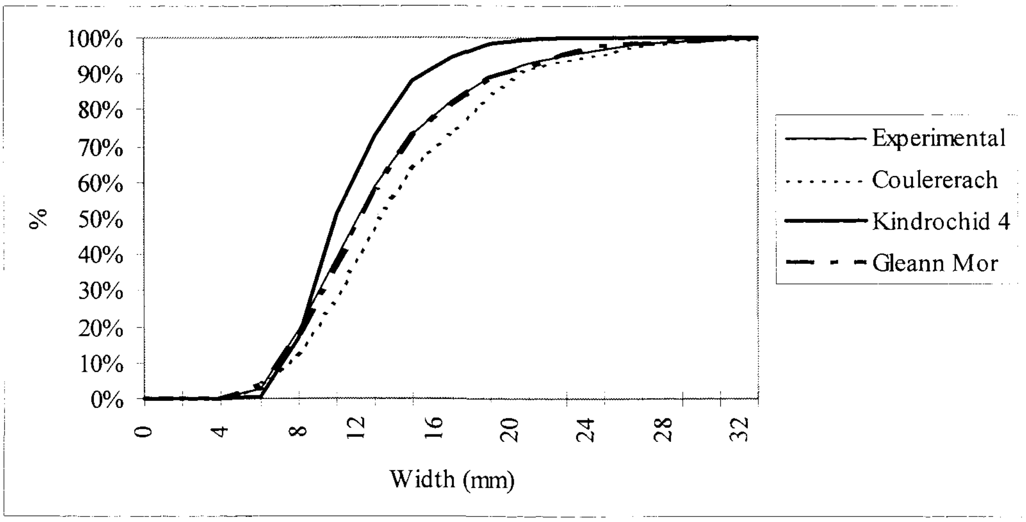

Figure 7.28. Inner flake width cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.30. Kolmogorov-Smirnov significance test results for inner flake width. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=703) (n=258)	0.12	0.10
Experimental-Gleann Mór (n=703) (n=195)	**0.02**	**0.11**
Experimental-Kindrochid 4 (n=703) (n=325)	0.15	0.09
Coulererach-Kindrochid 4 (n=258) (n=325)	0.25	0.11
Coulererach-Gleann Mór (n=258) (n=195)	**0.10**	**0.13**
Gleann Mór-Kindrochid 4 (n=195) (n=325)	0.15	0.12

7.6.2.4. Thickness

As with mean dimensions, the cumulative curve identified a significant similarity between Coulererach and the experimental assemblage, and between Coulererach and Gleann Mór, figure 7.29, table 7.31. As argued for mean thickness, this suggests similar thickness minimising strategies being applied in all assemblages. This suggests that inner flakes were being deliberately removed as blanks or as failed blade removals. The apparent emphasis on the minimisation of thickness at Kindrochid 4 may suggest the working of smaller cores, but probably also a relatively greater emphasis on minimisation of thickness.

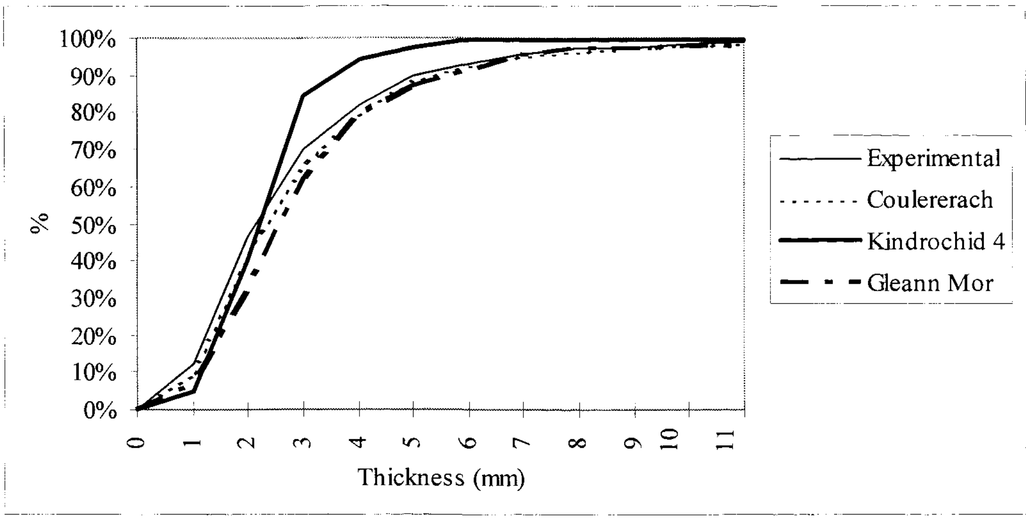

Figure 7.29. Inner flake thickness cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.31. Kolmogorov-Smirnov significance test results for inner flake thickness. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=703) (n=258)	**0.05**	**0.10**
Experimental-Gleann Mór (n=703) (n=195)	0.14	0.11
Experimental-Kindrochid 4 (n=703) (n=325)	0.15	0.09
Coulererach-Kindrochid 4 (n=258) (n=325)	0.20	0.11
Coulererach-Gleann Mór (n=258) (n=195)	**0.09**	**0.13**
Gleann Mór-Kindrochid 4 (n=195) (n=325)	0.25	0.12

7.6.2.5. Platform Width

As with mean dimensions, the cumulative curve identified a significant similarity between Coulererach, Gleann Mór and Kindrochid 4 for platform widths less than 5mm, figure 7.30, table 7.32. Platform widths for the experimental assemblage and those from Gleann Mór and Coulererach merged after approximately 8mm, suggesting the production of a similar ranges of large platform flakes. However, Kindrochid 4 produced consistently fewer wide platform flakes, particularly beyond approximately 5mm. As with flake thickness, this suggests the use of smaller diameter cores and the minimisation of width and thickness.

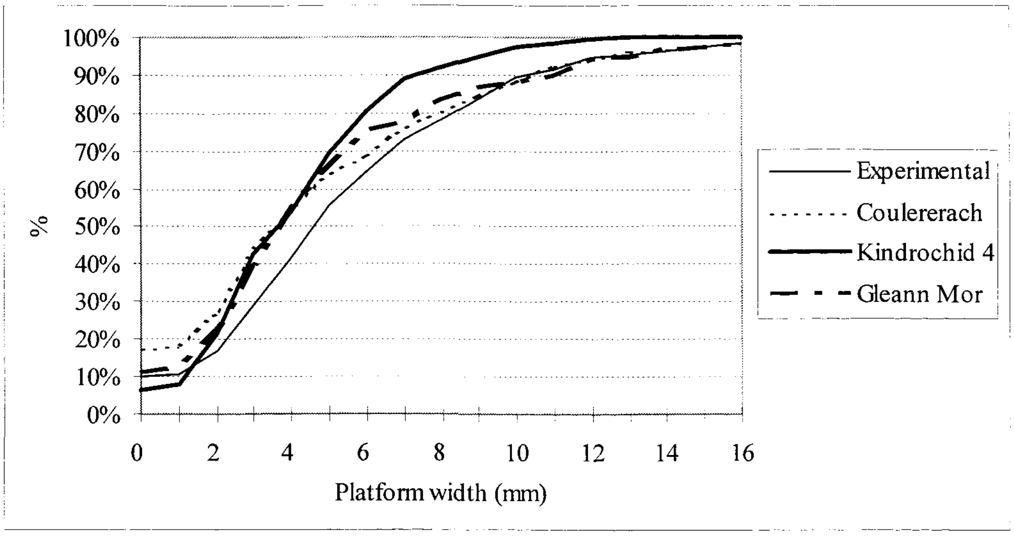

Figure 7.30. Inner flake platform width cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.32. Kolmogorov-Smirnov significance test results for inner flake platform width. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=703) (n=258)	0.15	0.10
Experimental-Gleann Mór (n=703) (n=195)	0.13	0.11
Experimental-Kindrochid 4 (n=703) (n=325)	0.16	0.09
Coulererach-Kindrochid 4 (n=258) (n=325)	0.13	0.11
Coulererach-Gleann Mór (n=258) (n=195)	**0.07**	**0.13**
Gleann Mór-Kindrochid 4 (n=195) (n=325)	**0.11**	**0.12**

7.6.3. Inner blades

7.6.3.1. Mean dimensions

Mean lengths and widths were both greater at Coulererach than any of the other assemblages, figure 7.31. This suggests the working of larger proportions of longer and larger diameter cores. Gleann Mór and the experimental assemblage had similar mean lengths and widths, suggesting the working of a similar range of cores. Smaller mean length and width from Kindrochid 4 suggest the working of a larger component of smaller cores. There was a considerable degree of similarity noted between mean thickness, suggesting similar thickness minimising strategies being applied in all assemblages. This appears particularly to have been the case at Kindrochid 4, supported by mean platform width which suggests the greater use or smaller diameter cores along with greater effort in minimising blade thickness.

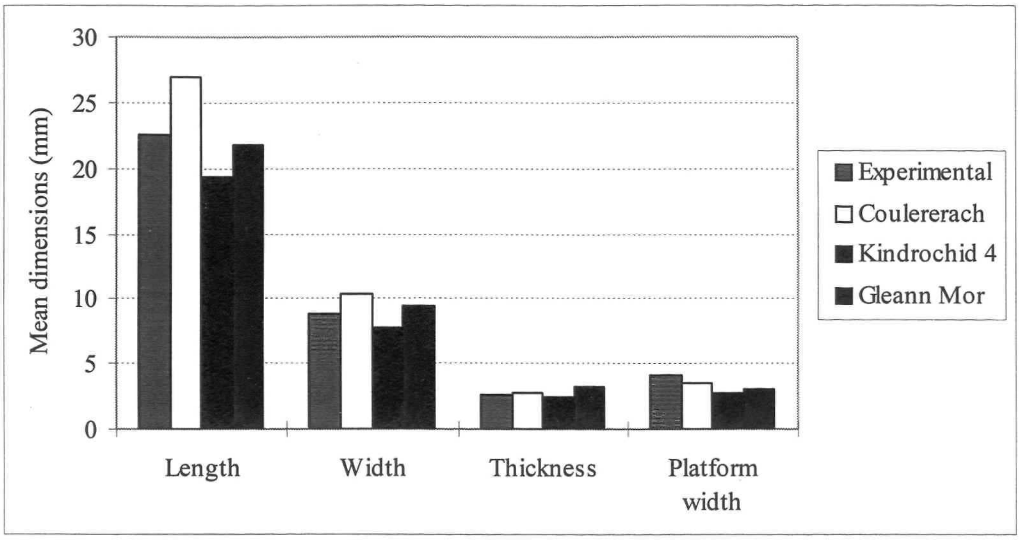

Figure 7.31. Inner blade mean dimensions for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

7.6.3.2. Length

The cumulative curve supported the interpretation of a significant similarity between the experimental assemblage and that from Gleann Mór, and between Coulererach, Gleann Mór and Kindrochid 4, figure 7.32, table 7.33. Kindrochid 4 produced consistently shorter blades while those from Coulererach were longest. As with the other debitage classes, this suggests the working of a greater proportion of longer cores at Coulererach, a range of core lengths at Gleann Mór comparable to those in the experimental assemblage, and at Kindrochid 4 of a disproportionate number of shorter examples.

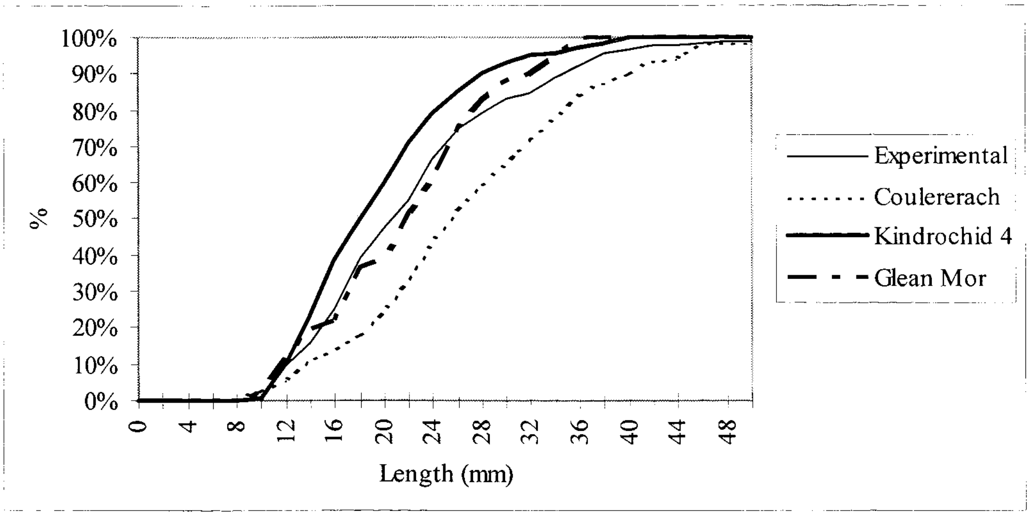

Figure 7.32. Inner blades length cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.33. Kolmogorov-Smirnov significance test results for inner blade length. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=311) (n=134)	0.24	0.14
Experimental-Gleann Mór (n=311) (n=41)	**0.09**	**0.26**
Experimental-Kindrochid 4 (n=311) (n=141)	0.16	0.14
Coulererach-Kindrochid 4 (n=134) (n=141)	0.38	0.16
Coulererach-Gleann Mór (n=134) (n=41)	**0.23**	**0.24**
Gleann Mór-Kindrochid 4 (n=41) (n=141)	**0.21**	**0.24**

7.6.3.3. Width

The cumulative curve indicated a significant similarity between Gleann Mór and Coulererach, and between the experimental assemblage and Gleann Mór, figure 7.33, table 7.34. Both produced a greater proportion of wider blades than the experimental assemblage and particularly Kindrochid 4. Again this suggests the working of a greater proportions of smaller diameter cores at Kindrochid 4, with an emphasis on the minimisation of width.

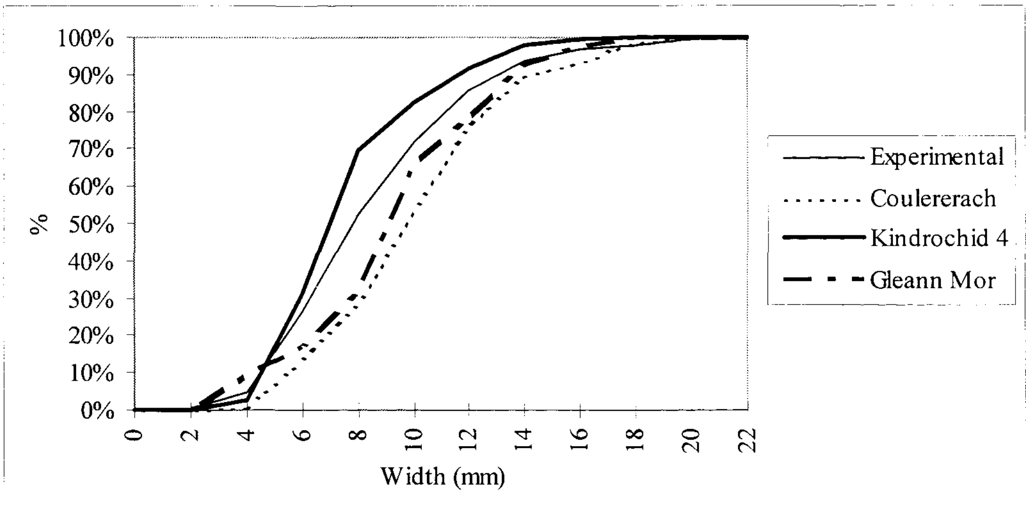

Figure 7.33. Inner blade width cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.34. Kolmogorov-Smirnov significance test results for inner blade width. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=311) (n=134)	0.17	0.14
Experimental-Gleann Mór (n=311) (n=41)	**0.21**	**0.26**
Experimental-Kindrochid 4 (n=311) (n=141)	0.17	0.14
Coulererach-Kindrochid 4 (n=134) (n=141)	0.24	0.16
Coulererach-Gleann Mór (n=134) (n=41)	**0.13**	**0.24**
Gleann Mór-Kindrochid 4 (n=41) (n=141)	0.38	0.24

7.6.3.4. Thickness

The cumulative curves indicated the presence of a significant similarity between Gleann Mór and the experimental assemblage, between Coulererach, Kindrochid 4 and Gleann Mór. There were greater proportions of thicker blades at Gleann Mór, suggesting the working of longer and larger diameter cores, or possibly more likely, less emphasis on the minimisation of blade thickness, figure 7.34, table 7.35. There was considerable similarity between the experimental assemblage and Kindrochid 4, particularly around 3mm, suggesting a similar degree of emphasis was being placed on the minimisation of blade thickness.

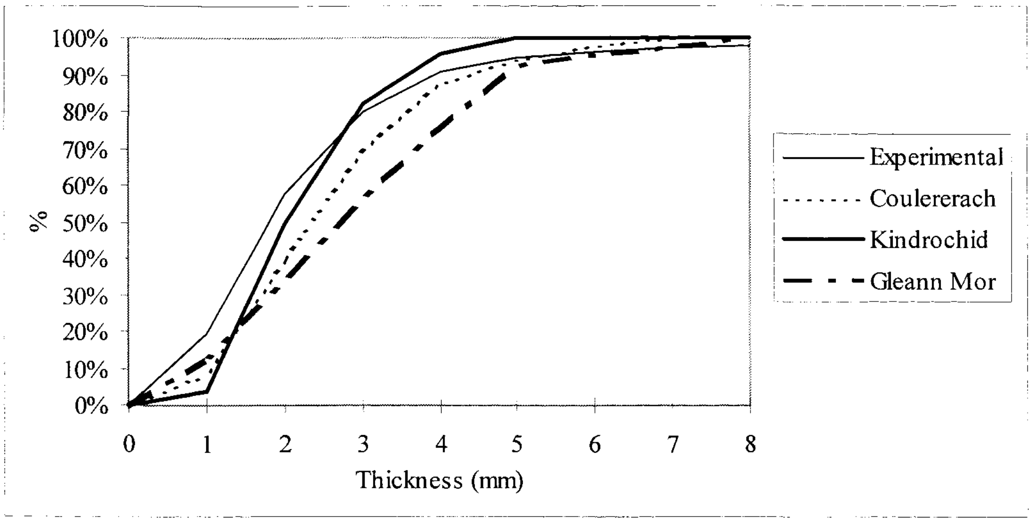

Figure 7.34. Inner blade thickness cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.35. Kolmogorov-Smirnov significance test results for inner blade thickness. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=311) (n=134)	0.16	0.14
Experimental-Gleann Mór (n=311) (n=41)	**0.24**	**0.26**
Experimental-Kindrochid 4 (n=311) (n=141)	0.16	0.14
Coulererach-Kindrochid 4 (n=134) (n=141)	**0.13**	**0.16**
Coulererach-Gleann Mór (n=134) (n=41)	**0.13**	**0.24**
Gleann Mór-Kindrochid 4 (n=41) (n=141)	0.26	0.24

7.6.3.5. Platform width

The cumulative curve supported the mean widths although to some extent contradicted both the mean and cumulative thickness' which suggested an emphasis on the minimisation of blade dimensions particularly in the experimental assemblage, figure 7.35, table 7.36. A greater proportion of platforms amongst the latter were wider than the three Mesolithic collections. This may reflect relatively less success in minimising platform dimension during the experiments, although this appears unlikely since both width and thickness were low compared to the other assemblages. It may be that proportionally greater effort was being expended on minimising proximal shoulder width prior to blade removal at Kindrochid 4 and Gleann Mór, but less so at Coulererach and in the experimental assemblage.

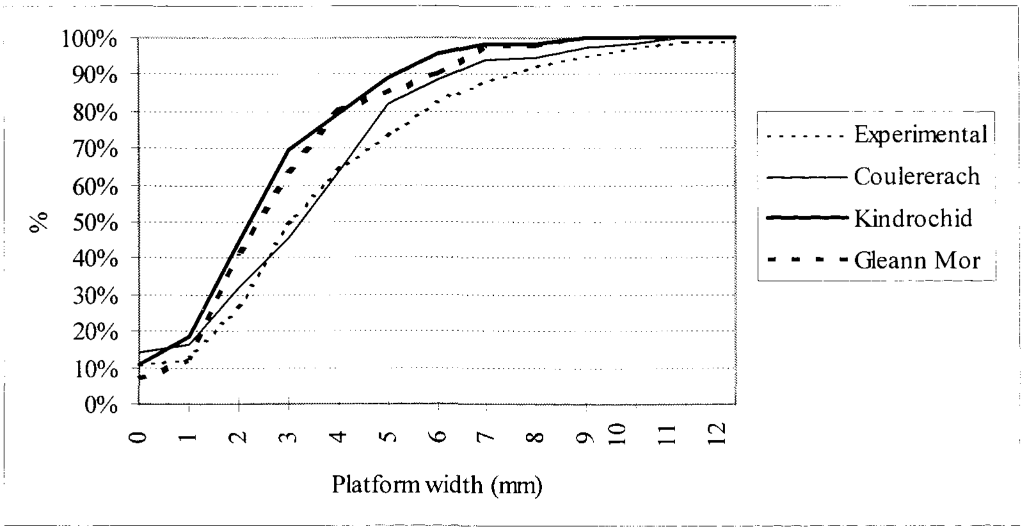

Figure 7.35. Inner blade platform width cumulative frequency histogram for the experimental assemblage and those from the archaeological sites of Coulererach, Kindrochid 4 and Gleann Mór.

Table 7.36. Kolmogorov-Smirnov significance test results for inner blade platform width. (Assemblages not significantly different at the 0.05 level highlighted).

Assemblages compared	$Dmax_{obs}$	$Dmax_{.05}$
Experimental-Coulererach (n=311) (n=134)	**0.09**	**0.14**
Experimental-Gleann Mór (n=311) (n=41)	**0.16**	**0.26**
Experimental-Kindrochid 4 (n=311) (n=141)	0.20	0.14
Coulererach-Kindrochid 4 (n=134) (n=141)	0.24	0.16
Coulererach-Gleann Mór (n=134) (n=41)	**0.18**	**0.24**
Gleann Mór-Kindrochid 4 (n=41) (n=141)	**0.06**	**0.24**

7.6.4. Summary

7.6.4.1. Secondary flakes

There was considerable similarity between mean and cumulative dimensions for Coulererach and the experimental assemblage. This suggests that as in the latter, Coulererach contained a more complete range of early core working debitage fractions, particularly those associated with the deliberate removal of cortex during blank preparation. Kindrochid 4 and Gleann Mór produced a comparable range of secondary flakes although those from the latter tended to be slightly larger. In contrast to the experimental assemblage, this suggests the working of smaller cores at both sites and

Kindrochid 4 in particular. Since it was previously argued that Kindrochid 4 contained most of the pebble to core debitage sequence, then this may suggest that pebbles being introduced at Kindrochid 4 tended to be smaller than those at Coulererach. Smaller cores at Gleann Mór were suggested previously in terms of lower mean secondary proportions, pointing to a distance based relationship between proportions of cortex, and by implication size.

7.6.4.2. Inner flakes

Larger inner flakes suggested the working of a greater proportion of longer and larger diameter cores at Coulererach compared to the experimental assemblage or those from Kindrochid 4 or Gleann Mór. This suggests an emphasis on the working of early core blanks. Smaller dimensions overall for Kindrochid 4 may suggest an emphasis on blade production. As argued previously, it would appear as though the complete reduction sequence was present at Kindrochid 4, suggesting that pebbles being worked may have been smaller than those introduced at Coulererach. In all assemblages there appears to have been an emphasis on the reduction of thickness, particularly at Kindrochid 4. This suggests that as with blades, flakes were being produced as thinly as possible, and therefore that flakes were secondary to the production of blades.

7.6.4.3. Inner blades

Inner blades at Coulererach were considerably longer and wider than from the other three assemblages, suggesting an emphasis on the working of larger cores. However as with inner flakes, thickness appears to have been minimised in all collections. Inner blades from Kindrochid 4 were the shortest and narrowest suggesting an emphasis on the reduction of overall dimensions, or probably more likely the use of a greater proportion of smaller cores.

7.7. Discussion

How did the analysis presented in this chapter help to further elaborate on the use of flint beach pebbles across Islay? Unfortunately, the small number of assemblages, and the lack of the all important spatial component, particularly in the platform assemblage analysis, limited the value of the analysis. However, there were some interesting methodological approaches developed, and points raised concerning the nature of the archaeology on Islay. First of all, the experimental assemblage provided a comparative template for assessing platform core assemblages produced using pebble raw materials. As in the analysis presented here, it provides a useful tool for comparing assemblages not just against each other, but with a more objective comparative measure for which initial parameters are known.

Secondly, the analysis suggested, as was outlined in Chapter 6 and the fieldwalked assemblage analysis, that activity across Islay was organised at a number of spatial scales. These will be discussed further in the next chapter. However, in terms of the comparative analysis presented here, the few sites considered suggested that the Loch Gorm and the now extinct Loch a' Bhogaidh basins, and the river valleys of the Laggan and Sorn on the eastern half of the island, represented important occupational foci. In the context of extensive use of the island's raw materials, and boat crossings of the Loch Indaal, settlement and mobility appears to have funnelled down from the Rhinns peninsular, across towards the eastern half of the island. This suggests the movement of individuals from the Loch basins of the Rhinns, up the river valleys of the eastern half of the island, and then presumably across to Jura.

CHAPTER 8
Conclusions

In the introduction it was stated that the primary aim of this thesis was to develop a regional model of settlement and mobility during the Mesolithic, based primarily on the sourcing and tracing of lithic raw materials. This is now discussed in the light of evidence presented, and organised as follows:

The spatial and temporal distribution of lithic raw materials: Heterogeneity in lithic raw materials, both spatial and temporal is emphasised, and the value of this discussed in terms of generating regional models.
Integration at the island and regional scales, pattern recognition: The exploitation, transportation and differential use of lithic raw materials is emphasised as a means for investigation regional settlement structure. It focuses in particular on the value of comparing and contrasting alternative spatial scales as a key to pattern recognition. A number of seasonal models are presented for Islay and regional; scale mobility is discussed in terms of the collector versus forager model discussed in section 3.3.
Contribution of the thesis to Prehistoric studies in western Scotland, and some suggestions for the future direction of research: The chapter is rounded off with a brief discussion of the potential contribution of this research to present interpretations and future research in Scotland.

8.1. The spatial and temporal distribution of lithic raw materials in western Scotland

Finlayson has recently argued that the potential for studies based on sourcing of lithic raw materials in Scotland is considerable (1990:44), the reasons for which he cites as twofold. Firstly, the range of potentially workable types are visually distinct, and can be identified without recourse to 'hard' science, both costly and time consuming. Secondly, as shown in Chapter 4, the sources of these materials tend to be spatially discrete and located at considerable distance from one another. To this could also be added that they are all markedly different in terms of internal and morphological characteristics, and therefore their potential value for artefact production.
The four main lithic types in use during the Mesolithic were Rhum bloodstone, Arran pitchstone, quartz and flint pebbles. The first two can be collected from in-situ deposits on their source islands, while quartz and flint are available both in-situ and as beach pebbles. Characterisation work undertaken on pitchstone (Thorpe and Thorpe 1984) and bloodstone (Wickham-Jones

1990) strongly suggests that these materials were being collected on their respective islands during prehistory. Locating the sources of quartz is more problematical since it tends to be widely distributed and probably available for collection throughout the region.

The in-situ flint deposits from the region are well known from geological reports, although there appear to have been few attempts made to investigate these on the basis of their potential as raw material sources during the Mesolithic. A number of the in-situ deposits were investigated as part of this research, in particular those on central Arran, Morvern and Mull. This results of this strongly suggested that only the latter would have provided a viable source of raw materials. However the rugged and inaccessible nature of the coastline may have deterred its use, particularly in the context of higher sea levels. Although the ephemeral nature of the in-situ deposits suggests that they were not being extensively exploited, the clear dominance of rolled flint in Mesolithic assemblages from the region indicates that it was from the beaches that the bulk of the raw materials were being collected. The regional survey highlighted that flint beach pebbles can only be collected in any quantity along the west facing coasts Islay, Colonsay and Iona. At the island scale, the nature of the coastline strongly suggests that collection would only have been feasible from a limited number of specific points. As with the point specific deposits of Rhum bloodstone and Arran pitchstone, flint would have had an equally restricted spatial distribution during prehistory.

Detailed investigation of the beaches of Islay as discussed in Chapter 4, suggested that not only was the flint spatially restricted, but there would also probably have been a considerable temporal dimension to its availability. It was shown that although the beaches of Islay provide the richest source of flint in whole of the western Scotland, they were extremely sensitive to over-exploitation. Even with moderate rates of flint collection, for instance once a week, productivity declined significantly, particularly in terms of the larger more useful fractions. Similar temporality in raw material accessibility has been suggested by Care (1982), Jacobi (1979), and Pitts and Jacobi (1979) concerning flint use during the Mesolithic in southern England.

Archaeologically there may be some support for a decline in the potential of the Scottish west coast flint beach pebble raw material sources. At the site of Staosnaig on Colonsay, significant numbers of very small pebbles were being carried into the site, with examples of 15mm in diameter. Since large flint pebbles are currently available for collection along the west coast of the island, this apparent emphasis on the use of smaller technologically less useful fractions is curious. Although any number of more colourful but ultimately untestable scenarios may be proposed, one explanation may be that the beaches of Colonsay had simply been overexploited. This is supported by the apparent shift towards greater use of the bipolar technique at the site, which can make use of pebbles too small for platform core use. Additional support for this decline in productivity may be seen in later Prehistoric assemblages from the region, which suggest that beach pebbles declined in importance. As discussed in Chapter 5, there was an apparent shift on the island of Jura towards greater use of local less tractable raw materials in the upper Mesolithic horizons. This is unlikely to have resulted from a lack of access to the flint beaches of Islay or Colonsay to the west, since the implication of increased use of Arran pitchstone is of greater levels of regional mobility. This may suggest that the use of local lithic types suitable for the production of rough flakes was acceptable in the context of changing technological strategies with an emphasis on expediency. Alternatively it may indicate the decline in the raw material sources on Islay and Colonsay, encouraging the greater use of local lithic types. As reported in Chapter 4, beach survey on the island of Skye located a small assemblage of large unrolled, and therefore probably non-beach collected flint nodules. The location of these suggests an association with the nearby An Corran shelter (Saville and Miket 1994). On the island of Arran, the Gallery Grave at Monamore dated to the late sixth millennium bp, produced a broken knife of 5.5cm in length (Mackie 1975:27), while on the island of Bute, the mid-Neolithic 'domestic' site at Auchategan contained a large knife of 10cm (Marshall 1978:44). The size of the latter in particular strongly suggests the use of sources other than those from either Islay, Colonsay or Iona, where pebbles potentially large enough to have produced these artefacts are extremely rare.

Once again, an explanation for the apparent shift away from beach pebble flint may have been a relative lack of access to those on Islay, Colonsay or Iona. However, this is not supported by the evidence, admittedly ephemeral, which points to a later Prehistoric presence on the islands. Additional support for the decline in importance of the beaches of Islay or Colonsay as sources is suggested by the apparent later Prehistoric shift towards the use of yellow and brown flint. This tends to be rare on both islands, generally comprising between 3% and 33% of the beach assemblages, see Chapter 4. Moreover, very few of the larger more useful fractions were of these colours.

8.2. Integration at the island and regional scales, pattern recognition

As discussed in Chapter 1, regional approaches are difficult in areas devoid of economic debris, mutually exclusive evidence for the use of alternate ecotones, or structural features with which to infer seasonal presence. Some other means of investigating regional settlement patterns is required.

It was suggested that lithic raw material transfers and differential use provides the best means at present for developing regional models. As discussed in Chapter 4 and above, they are variably distributed in space, and are likely to have been similarly so during the Mesolithic. Raw material transfers over distances of greater than 100km along the west coast suggests considerable spatial integration. The presence of flint on Rhum strongly suggest collection from further south, while its presence on Arran may suggest a similar degree of spatial interaction. Since this material would needed to have been transported, it is likely that an important consideration would have been portability. This suggests that the most efficient means of carrying raw materials would have been in the form of small flint cores, or possibly as unworked pebbles. The presence of primary debitage on the island of Rhum may suggests that at least a component of individual provisioning would have been in the latter form. Unfortunately, the report does not specify what proportion of primary debitage was cortex struck, and therefore absolute comparisons are difficult. Although less efficient in terms of the quantities of material which may be carried for a given proportion of useful edge, the relative cost benefit relationship of this strategy may have to some extent been reduced by water travel. In effect allowing raw materials to be shipped rather than carried. This suggests the provisioning of people (Kuhn 1995) with personal gear (Binford 1979), particularly of flint.

However, this was not a two way process. There is very little evidence for similar transportation of other lithic raw material types. For instance, there is very little evidence for the movement of bloodstone off the island of Rhum, particularly as retouched artefacts or cores. Clearly, its use on the island itself was extensive, its lack of visibility on other islands or the mainland is therefore curious. The same could be said for Arran pitchstone which occurs in such low densities away from the island that no processes beside chance introduction need be proposed. Since it was being used, albeit less intensively than flint or bloodstone on Rhum, suggests that some other criteria was being applied when it came to individual raw material provisioning choices. Raw material selection was not based purely on availability. In fact it could be argued that flint beach pebbles represent a less spatially and temporally predictable resource than either bloodstone or pitchstone, both of which can be collected from in-situ deposits. Flint beach pebbles on the other hand were restricted to only a few beaches, and as discussed in Chapter 4 were particularly sensitive to over-exploitation. Despite this, flint appears to have been repeatedly selected as the preferred raw material carried by the individual, in effect acting as the bridging technology for operations within a region which for the most part was devoid of good quality raw materials.

The use of raw materials besides flint, appears to have been island specific. Although not strictly provisioning of places in the sense of Kuhn's (1995) argument, island specific use suggests that local raw materials were only used to augment transported flint. Although they were being used to produce blade based artefacts, there was an emphasis on more expedient use. Why does flint turn up on Rhum while bloodstone is essentially absent in assemblages away from Rhum?

Differential and preferential use: Preferential use of flint would have meant that greater proportions of flint elements would be expected in composite artefacts, at least while cores remained viable. The longer an individual operated away from the sources of flint, the greater the proportion of elements composed of other lithic types. Clearly this was taking place on Rhum, where artefacts and in particular microliths, were being produced from bloodstone. Why there is virtually no bloodstone present throughout the rest of the region, or for that matter Arran pitchstone, is curious. It was proposed earlier that flint operated as the mobile bridging technology. This meant that once the islands had been abandoned, toolkits would have been dominated by flint, particularly in the form of the means of production, platform cores. Although some composite elements of local raw materials would be present, when lost or damaged, their replacements would have been of flint. This suggests relatively more rapid rates of replacement for non-flint elements once the islands had been abandoned. Although it is not possible to determine artefact attrition rates, the extreme lack of visibility away from the source islands may suggest that absolute distances were being covered only relatively slowly, allowing for the flushing of non flint elements over short distances, but possibly longer time scales, from the system. Rather than rapid inter-regional island hopping facilitated by boat travel, this suggests that activities were considerable more spatially focused, perhaps on a seasonal or annual scale.

It was suggested above that regional integration was probably accomplished through extensive although gradual rates of mobility rather than rapid island hopping. But does the evidence from Islay support this interpretation? It was stated in Chapters 6 and 7, that one way in which island scale integration could be measured, would be through the degree to which assemblages were different structurally. In other words, variability provides the index to raw material configurations, and therefore the degree of interaction between assemblages. Distance based changes in assemblage structure across Islay were suggestive of integrated use of the island. This was apparent at three spatial scales, the whole of the island, its two halves, and around a series of basins and river valleys. This suggested that occupation of the island could be viewed at three spatial scales.

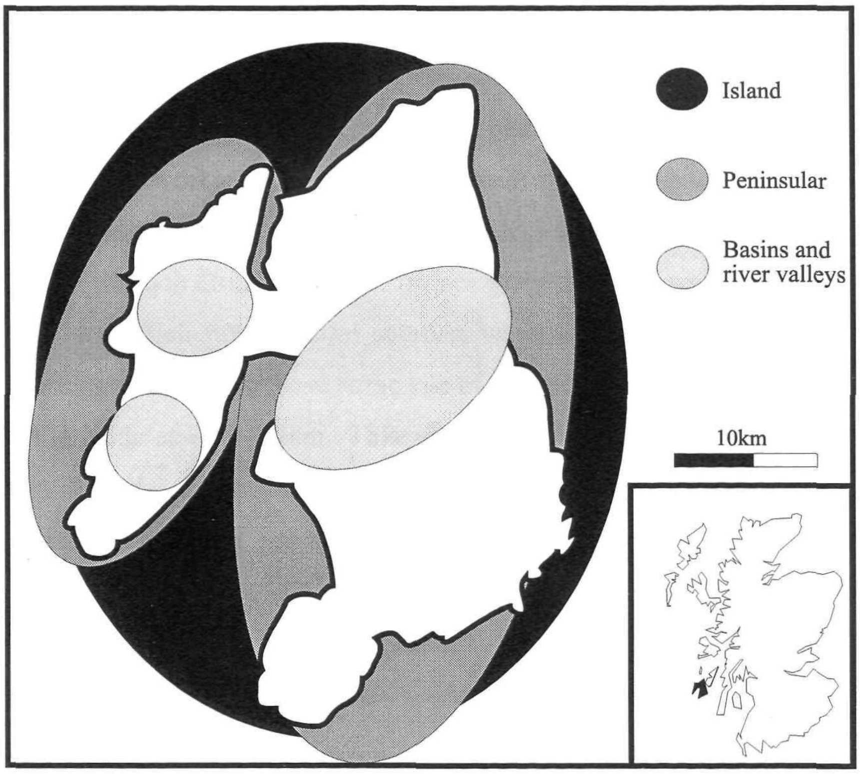

Figure 8.1. The three spatial scales of Mesolithic occupation, Isle of Islay:

The island scale: Across the whole of the island, linear regression analysis of fieldwalked collections suggested that a distance based relationship existed between the proportions of specific debitage types in each assemblage. In other words, as distance increased, the proportions of for instance, primary, secondary and inner debitage changed accordingly. As at the regional scale this suggests that raw materials in the form of cores were being moved from the west coast raw material sources on the island. All assemblages differed, suggesting sequential use of the landscape rather than unrelated knapping events. Similarly, in terms of core dimensions and characteristics, there was an apparent although only very slight increase in the extent to which working increased as distance to raw materials accumulated. In particular there was only very minimal changes in mean core dimensions across the island. This suggested that variability in artefact and raw material strategies may have operated at a lower level of integration, perhaps across the Rhinns peninsular and the eastern half of the island.

The peninsular scale: At this scale, the evidence suggested that the Rhinns peninsular and the eastern half of the island operated largely independently of one another. This is supported by the interpretation of the island as having been physically split into two along the Loch Gruinart to Loch Indaal axis, although the gap is unlikely to have been particularly wide, and certainly not of the scale of the Oronsay strand. However, when comparing platform cores from individual sites across both halves of the island, a progressive but broadly comparable increase in the extent of core working was noted. On the Rhinns, there was a correlation present between distance from the west coast raw material sources and extent to which cores had been worked. Mean core dimensions declined, as did cortex and platform perimeters remaining unworked. However, this intensity of working appears to have ceased at the shores of Loch Gruinart. On the eastern half of the island, this increase in intensity of working appeared not to have transferred across the Loch Indaal to Loch Gruinart divide. In fact cores from the west coast site of Kindrochid 4 just over 2km from rich raw material sources, were significantly similar in terms of any measures of working intensity, to those at the site of Bowmore 10 on the western shores of the eastern half of the island, at over 12km. This suggests that the use of space across the island was more significantly structured at the peninsular scale, than the island as a whole. The similarities between west coast sites close to raw materials and those at greater distances may suggest that open water crossing of the Loch Indaal had served to collapse space, however, not simply in terms of removing water distance. Cores on the west coast of the eastern half of the island tended to be larger and less extensively worked than those immediately across the water on the Rhinns. Bowmore 10 in particular appears to have played an important part in this bipartite use of Islay. Its lithic assemblage points to the introduction of raw materials at an earlier stage of reduction, while its position at the edge of the Bridgend mudflats suggests launching and landing of small boats. Significantly, it represents the optimal embarkation point for journeys across to the Rhinns. Ignoring water distance, the closest beach pebble raw material source for those embarking from Bowmore 10 would have been via the Loch Indaal to Port Charlotte, and then along the Gleann Mór river to Kilchiaran Bay. This suggests an additional scale of spatial organisation, focused on large loch basins and river valleys. Some support for the movement of fresher raw materials along this access route was seen at the site of Gleann Mór, as discussed in Chapters 6 and 7.

Basins and river valleys: As discussed previously, occupation across the island appears to have been organised across its two halves. However, differences in distance based relations, and site location similarities suggest a third and final scale of organisation, focused in particular on the basins of Loch Gorm and Loch a Bhoighi. Similarly, on the eastern half of the island, the main axis of activity would appear to have been focused primarily along the Sorn and Laggan river valleys from Bridgend and Bowmore to Port Askaig. In effect, activity appears to have funnelled down across the island from west to east, probably to a large extent a function of topography on the eastern half, tending to focus activity along the two rivers in particular. Coming back to the point raised previously concerning movement of raw materials via the Gleann Mór river valley and across the Loch Indaal. The site of Gleann Mór produced a relatively greater component of larger fresher raw materials than Kindrochid 4, despite being almost twice as far from the coastal raw material sources. This suggests the Gleann Mór river may have acted as a conduit for the transfer of raw materials across the Rhinns, and possibly the whole island.

Regional mobility, foragers, collectors or serial specialists

As discussed in Chapter 3, the use of Effective Temperature (E.T.) and ethnographic analogy for inferring mobility patterns was less than successful when attempting to predict mobility patterns for Mesolithic western Scotland. Calculated E.T. for Colonsay was 11.7 (see section 5.6.1.), which when compared with those presented by Kelly (1995:128), indicates that groups living in comparably seasonal environments were as mobile as the Crow of the Great Plains who moved 38 times per year albeit by horse, and covered an area of almost 70,000km^2. Alternatively, the Ainu of Hokkaido with similar E.T. levels move only twice a year, covering an area of just 171km^2 (*ibid*:113). This demonstrates that E.T. is only suggestive of the ways in which groups organised themselves in differing environments, particularly extremely seasonal ones. However this still leaves us with few clues as to how mobility was organised during the Mesolithic of Western Scotland. Bang-Andersen (1996:437) proposes that the Mesolithic of Southern Norway was logistically organised, with movement between permanently occupied coastal lowlands, and the seasonally exploited mountainous interior. His model includes a primary residential basecamp on the coast with satellite special purpose and extraction sites, with further extraction sites in the mountainous interior, and transitory camps in the intervening area (*ibid*:439). The most likely scenario appears to be late summer to early autumn hunting of reindeer and elk in the interior, with fishing in the intermediate zones. Occupation along the coast may have been continuous, providing a refuge for the group as a whole during winter (*ibid*:440). This model relies crucially on the demonstration that flint was being carried inland from the coastal sources, however as of yet, evidence for similar interaction in Scotland remains conspicuous in its absence. Rather than across, present evidence suggests that mobility was concentrated along the coastal strip. Where then does this leave mobility models for the west coast of Scotland?

Table 8.1. below lists a number of ethnographically generated characteristics of foragers, collectors and serial specialists (see section 3.3.). Effective Temperature for Colonsay was calculated as 11.7 (see section 5.6.1.), suggesting a moderately seasonal environment. Archaeological grain of resolution (*sensu* Binford 1980) is coarse with sites consisting of palimpsest accumulations. Archaeological signatures (*sensu* Foley 1980) are site based, with specific locations repeatedly occupied. Technology is maintainable with elements arranged in series (*sensu* Bleed 1986), while the maintenance of this technology is undertaken through the provisioning of individuals (*sensu* Kuhn 1995) with small platform cores of flint. Distance per move was probably low as suggested by the low rate of movement of bloodstone and pitchstone off the islands of Rhum and Arran respectively. The movement of flint from Islay to Rhum, a

distance of approximately 130km, suggests that the area covered on the annual scale along the 80km wide coastal strip, was of the order of at least 10,400km^2.

Table 8.1. Characteristics of foragers, collectors and serial specialists (After Binford 1980; Bleed 1986; Foley 1980; Kelly 1995; Kuhn 1995).

	Foragers	**Collectors**	**Serial specialists**	**Mesolithic western Scotland**
Seasonality	Low	High	High	Moderate
Mobility	Residential	Logistic	Residential	**Unknown**
Archaeological grain	Fine	Coarse	Fine	Coarse
Archaeological signature	Off-site	Sites	Off-site	Sites
Technology	Maintainable	Reliable	Reliable and maintainable	Maintainable
Provisioning	People	People and places	People	People
Number of moves	High	Low	High	**Unknown**
Distance moved	low	High	Low	Low
Area covered	Low	High	High	High

As shown in table 8.1., the material record of the region contains aspects common to foragers, collectors and serial specialists, suggesting that categorising mobility strategies on the basis of our present understanding of it's archaeological signature would be difficult. However, a number of aspects, in particular to do with the sites themselves, may be suggestive of organisational structures. Specific locations appear to have been revisited on a regular basis, which in terms of the characteristics defined by Binford (1980) and Foley (1980), suggests that larger sites such as those on eastern Jura, Islay, Colonsay or Rhum, were components of a collector system. Repeated visits with limited ranges of activities carried out, led to the accumulation of large coarse grained palimpsests of limited internal diversity. Although the size of these sites may suggest a basecamp function, the limited range of activities carried out as indicated by the lack of diversity within the artefact assemblages suggests that the general purpose basecamps have not as yet been found. Rather than repeated use, the visibility of the larger sites within the region is probably a function of access to raw materials. Collection and working led to the creation of large palimpsests of knapping waste, generally absent from the rest of the region.

Serial foraging (Binford 1980) is probably unlikely to have been undertaken. Although seasonal resources were gathered, for instance hazel nuts, these were probably not spatially differentiated to the extent that specific areas could be exploited sequentially. Serial foragers as discussed by Binford (1980) were constrained by the types of resources available, for instance seals at breathing holes or solitary caribou or moose. The lack of spatial predictability in these resources necessitated a foraging mode of subsistence, which allowed dispersed resources to be exploited as they became sequentially available. Being less seasonal than the Arctic, serial foraging in Scotland is probably not a viable strategy.

An alternative scenario may be tethered foragers. Dense scrub woodland and limited well drained soils would have encouraged repeated occupation of specific locations. As argued in Chapter 2, this is most likely to have taken place at the lower woodland edge, around freshwater lochs and river courses. Repeated visits to these locations, particularly in the context of early stage raw material processing, would have led to the accumulation of substantial knapping debris. The presence of smaller concentrations as revealed through fieldwalking is suggestive of short term foraging around these larger centres.

The picture at present is ambiguous. However, on the basis of the dataset available, the scenario considered most likely is of groups of foragers repeatedly occupying nodal points within the landscape. These were typically on well drained soils with extensive fields of view along the coast and larger inland watercourses. From these locations, encounter foraging was undertaken with the collection of plants and hunting of animals both terrestrial and aquatic.

8.2.1. Summary

The regional and island scale evidence suggests extensive spatial coverage, but also local scale stability. The differential use of lithic raw materials in particular points to mobility as involving only minimal amounts of island hopping. This suggests that people were traversing large distances within the region, probably via the extensive water highways, but then remaining for longer periods of time either on specific islands or the adjacent mainland. This may reflect year round occupation of the coastal strip, or alternatively seasonal shifts in settlement focus. For instance, summer expansion along the coast, but with contraction southwards during late autumn and winter, or alternatively expansion westwards onto the islands, with a late Autumn shift back to the mainland. The few seasonal indicators present suggest at least a summer and autumn presence, for instance perennial tubers at Staosnaig on Colonsay, and the extensive hazel component on most sites. However although these are suggestive of summer and autumn presence, they do not rule out winter occupation. The perception of declining climatic conditions when moving west belies the truth. In fact, the climate of the islands of the inner Hebrides is comparatively mild compared to areas further inland. For instance on the island of Colonsay, annual temperature ranges are of the order of 9° C compared to between 12° C and 13°C for parts of inland and eastern England (Mellars 1987:18). Rainfall is less extensive, while snowfall is insignificant. The island of Tiree has the highest incidence of bright sunshine for Scotland as a whole (*ibid)*, suggesting that in terms of winter occupation, west was not worse. In fact it may have been considerably more pleasant to over-winter on the islands than the interior mainland or the adjacent uplands.

At the regional, island and sub island scales, sites appear to have been placed at coastal nodes and along Lochs and rivers, suggesting repeated and organised use of the landscape. As discussed above, defining this use of the landscape as characterising foragers, collectors or serial specialists is difficult. However, on the basis of the present evidence, tethered foraging is considered the most likely strategy. This may have involved short term foraging from central bases on both the islands and the mainland. Connecting sites on the islands and mainland, those along the coast suggest launching and landing points for inter-regional travel. Those on the east coast of Jura suggest crossings to the mainland, where similar locations are likely to be present, in particular along the west coast of the Mull of Kintyre. Sheltered launching and landing sites on Western Jura are suggestive of boat crossing to Colonsay and Islay, while Staosnaig would have provided an ideal sheltered cove upon which to beach small boats. Sites around the coast of Ardnamurchan, although ephemeral, suggest crossings to Eigg and Rhum. The site of Risga within Loch Sunart suggests a staging post along the shortest crossing from Morvern to Ardnamurchan. Being so small the island is unlikely to have been much use for anything else. To the south of Risga, the site of Acharn in central Morvern suggests placement along a pathway leading from the island of Mull, up via Risga and Ardnamurchan and across to Rhum.

8.3. Contribution of the thesis to Prehistoric research in western Scotland

Spatial variability in flint beach pebble raw materials: Regionally focused raw material survey highlighted the spatially discrete distribution of flint beach pebbles. In doing so it provided an answer to the long standing question as to whether its distribution throughout the region could be considered as ubiquitous, and as such has provided a foundation for future research into relationships between raw materials and patterns of settlement and mobility.

Temporal variability in flint beach pebble raw materials: It highlighted the temporal dimension to the availability of flint beach pebbles, which may provide a useful entering wedge for research looking at the nature of the Mesolithic to later Prehistoric transition. In particular the apparent shift towards greater emphasis on alternative raw material sources and the incorporation of bipolar knapping techniques

Raw materials and archaeological visibility: The markedly heterogeneous distribution of flint beach pebbles strongly suggests a correlation between sources of raw materials and extreme archaeological visibility. As such it provides a template for where and where not to expect to find archaeological sites.

The value of experimental studies: The experimentally generated template provides a useful means for assessing assemblages from the region in terms of how raw materials were being introduced into the sites.

Regional and island scale mobility, the utility of spatial contrasts in pattern recognition: Contrasting the regional and island scales provided the all important spatial element required in regional approaches. By looking at both scales, decisions made on the islands can be better understood in terms of regionally organised use the landscape.

Excavated versus fieldwalked: In terms of regional and island scale raw material pattern recognition, the fieldwalked data provided the most useful dataset, primarily due to spatial coverage. The cheapness of the approach makes it an ideal tool for accumulating spatial data on the scale required to make regional approaches worthwhile. Large scale excavation on the other hand, although providing significantly large comparative assemblages, has arguably not contributed much to our understanding of the sites themselves. This is not to say that fieldwalking could provide a site based narrative, however in terms of the all important pattern recognition required at the regional scale, fieldwalking probably provides the best compromise.

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