

# Scotland's intertidal prehistory: Lub Dubh Aird, a raw material and knapping site in Upper Loch Torridon

Karen Hardy,\* Jonathan Benjamin,† Andrew Bicket,‡  
John McCarthy† and Torben Ballin§

## ABSTRACT

*Sea-level rise and coastal change have impacted on the visibility of early to mid-Holocene sites worldwide. Due to the combination of eustatic and isostatic effects, modern coastal landscapes rarely reflect those occupied and exploited by prehistoric people. This suggests that intertidal and marine archaeology is set to become increasingly important in future studies of the coastal populations of prehistoric Britain. Though Scotland's west coast is renowned for its abundance of evidence for the Mesolithic, the potential for intertidal sites has barely been investigated. We report on a newly discovered raw material source and primary knapping location on the beach and across the intertidal zone at Lub Dubh Aird, Upper Loch Torridon. Our results suggest that a multi-disciplinary approach to investigation into early prehistoric human occupation of the west Scottish coastline – that incorporates survey of intertidal zones together with the upper beach and nearby areas – is essential to fully appreciate the range of sites present and to allow these to be integrated into a better understanding of coastal landscape use at this time.*

## INTRODUCTION

Scotland has almost 12,000km of coastline and hundreds of islands, many of which lie along the Atlantic coast. This Atlantic façade is well known for its abundant Mesolithic remains, which comprise both shell middens and open air sites (Lacaille 1954; Mercer 1969, 1972, 1974, 1978, 1980; Mercer & Searight 1986; Mellars 1987; Pollard 1990; Wickham-Jones 1990; Connock et al 1992; Searight 1993; Bonsall et al 1994, 2009; Mithen 2000; Hardy & Wickham-Jones 2002, 2003, 2004, 2009; Saville 2004; Wickham-Jones & Hardy 2004; Saville et al 2012; Hardy 2013, 2016). Most known sites occur near the current coastline, although this may be due in part to better visibility and more archaeological work in these areas.

The tidal range is generally between 4m and 5m in western Scotland. The evidence from many coastal sites, which often includes shellfish from the intertidal zone, highlights its importance in coastal life throughout historic and prehistoric periods (Hardy 2013; Verdún et al 2013). However, there has been little archaeological focus on the intertidal zone of Scotland to date and only a very small number of sites have been recorded (Bailey et al in press). The lack of research in the intertidal zones may have resulted in a negative bias within the existing record (Benjamin et al 2014) in comparison to other areas of Britain, where greater attention has been paid to the study of submerged and intertidal evidence for Mesolithic hunter-gatherers (eg Bell 2007), and Neolithic early agriculturalists (eg Sidell & Haughey 2007). An understanding

\* ICREA, Pg. Lluís Companys 23, 08010 Barcelona, Catalonia, Spain

\* Departament de Prehistòria, Facultat de Filosofia i Lletres, Universitat Autònoma de Barcelona 08193 Bellaterra  
Barcelona, Spain

† Archaeology Department, Flinders University, GPO BOX 2100, Adelaide, SA 5001, Australia

‡ Wessex Archaeology, 7–9 N St David Street, Edinburgh EH2 1AW

§ Lithic Research/Research Fellow, University of Bradford, Banknock Cottage, Denny FK6 5NA

of the nature of coastline fluctuation is essential in order to fully appreciate the potential for archaeological sites to be found, and to address the complexity of the record for early occupation from west coast Scotland and the Mesolithic in Britain in general.

Early prehistoric sites have been found below the current high water mark in coastal environments in many places throughout the world (Benjamin et al 2011; Evans et al 2014). Global sea-level rose around 120m after the last glacial maximum (Fairbanks et al 1989) and continued to rise through the end of the Pleistocene and the early–mid-Holocene. This would have had a profound impact on landscapes and people throughout the Mesolithic in Scotland (approximately 10,000–5,000 years ago).

The sea-level was fluctuating at the time of the earliest known evidence for human habitation in Scotland, which currently stands at around 14,000 years ago (Ballin et al 2010a). It did not stabilise until between 6,000–4,000 years ago. Despite this, and while inferences have been made about the general situation (Ballantyne 2004), sea-level curves for this region remain ill-defined. Our understanding of the complex isostatic situation is based on models which are only useful at a coarse scale (Shennan & Horton 2002; Shennan et al 2006; Smith et al 2006; Bradley et al 2011; Shennan et al 2012), or very localised curves (eg Jordan et al 2010), which are currently too few to extrapolate in terms of a wider geography or time-scale.

However, understanding the relative sea-level during this period in Scotland is complex beyond the matter of rising seas. Substantial variation in relative sea-level (RSL) was influenced by wide ranging patterns of isostasy across western Scotland and this is clearly visible in the collated models underpinning national sea-level models (Bradley et al 2011). In some areas of Scotland, isostatic activity has created recognisable raised beaches (eg Ballantyne 2004: 34). In the Outer Hebrides, relatively little isostatic adjustment is thought to have taken place, although local-scale influence cannot be discounted (Jordan et al 2010) as there is a paucity of diagnostic data – such as sea-level index (eg Ritchie 1985; Jordan

et al 2010; Benjamin et al 2014). A further limitation is the effectiveness of RSL models in the field, especially where no local model has been compiled. The distribution of intertidal and submerged prehistoric potential linked to early to mid-Holocene RSL fluctuations is variable across western Scotland (Smith et al 2006; Jordan et al 2010; Rennie & Hansom 2011), and while RSL models can be used for guidance, these should not override physical archaeological prospection. Indeed, in situ archaeological material and palaeoenvironmental deposits of archaeological interest serve as important resources to test and enhance such models.

The complexity of the RSL in north Britain, together with a lack of focused resources, means the Mesolithic of this region has not yet had the considerable impact from archaeological investigation of submerged sites that has occurred in other regions. These include the southern North Sea (Peeters 2011; Tizzard et al 2011, 2014; Weerts et al 2012), the south-west Baltic (Fischer 1995; Andersen 2011; Luebke et al 2011) and the eastern Mediterranean (Galili & Rosen 2011). The tidal regime in parts of Britain can be as much as 13.7m in the Severn Estuary, where coastal and intertidal Mesolithic and later prehistoric sites have been the focus of study (eg Bell 2007). Elsewhere in the Solent, the fully submerged site of Bouldnor Cliff confirms the presence of submerged prehistory in Britain as England's only fully submerged Mesolithic site to have been investigated in detail by archaeologists (Momber et al 2011). But the physical environment and coastal prehistories in Wales and the south of England are probably not the best *comparanda* with the west of Scotland. The nearest comparison in geographic terms comes from the north coast of Ireland. Here, intertidal and fully submerged palaeosols containing in situ worked flint have recently been recovered at the site of Eleven Ballyboes (Westley 2013), and test excavations were successful in producing further results in the submarine environment. This is Ireland's first in situ Mesolithic deposit to have been discovered and recorded from a fully submerged

environment. Eleven Ballyboes is significant to the Scottish context and this discussion, as it is both geographically near in relative British and European terms, and because the site was found to have been created and preserved in a location where deglaciation and resulting isostatic activity is comparable to that which occurred in western Scotland.

Apart from the north coast of Ireland, there are other Northern European contexts that provide good case studies for the feasibility and significance of the intertidal and sub-tidal zones to local and regional early prehistory. Geologically, the rocky, glacially scoured coastal setting of southern Norway offers perhaps the best comparison with the north-west Scottish coastal and offshore environments (and certainly more similar than the shallow basins of the southern North Sea and south-

west Baltic Sea). Like Scotland, the post-glacial shoreline displacement varies significantly and is not always predictable. Yet areas do exist where sea-level rise outpaces isostatic land rebound. In the 1990s, the oldest dated human skeletal remains from Norway, which date to between 7100–7500 bc, were found at the site of *Hummervikholmen* in shallow water in a small inlet (Nymoen & Skar 2011: Figs 4.1, 4.5). While recent survey work in the Bay of Firth, Orkney, has failed to detect any intertidal or submerged early prehistoric material (Bates et al 2013), Scotland's rugged north-west coastline of sea lochs (fjord systems) and islands, which is comparable to some Norwegian coastlines, suggest that some submerged and intertidal landscapes in Scotland may benefit from more intensive investigations in the intertidal and shallow underwater environments.



ILLUS 1 Location map, Inner Sound and Loch Torridon. Contains Ordnance Survey data © Crown copyright and database right 2015 (A Bicket)



## THE INNER SOUND

The Inner Sound is a north-facing U-shaped area of sea between the mainland and the east coast of the Isle of Skye (illus 1). It incorporates several islands, including Rona, Raasay, the Crowlin Islands, Pabay and Longay. Numerous Mesolithic and early prehistoric sites have been recorded here, both on the main coastlines and on the islands (Hardy & Wickham-Jones 2009; Saville et al 2012). Two large sea lochs on the mainland coast of the Inner Sound – Loch Carron in the south and Loch Torridon in the north – also contain evidence for early prehistoric settlement. However, the local sea-level models are complex. Earlier iterations of the Applecross RSL model (eg Shennan et al 2006: Fig 7, model 9), which focuses on the eastern coastline of the Inner Sound, is an example of the complexity involved in understanding sea-level fluctuation. Depending upon which ice model parameters are applied (eg Bradley et al 2011, illustrated in Sturt et al 2013), the possible fluctuations in sea-level

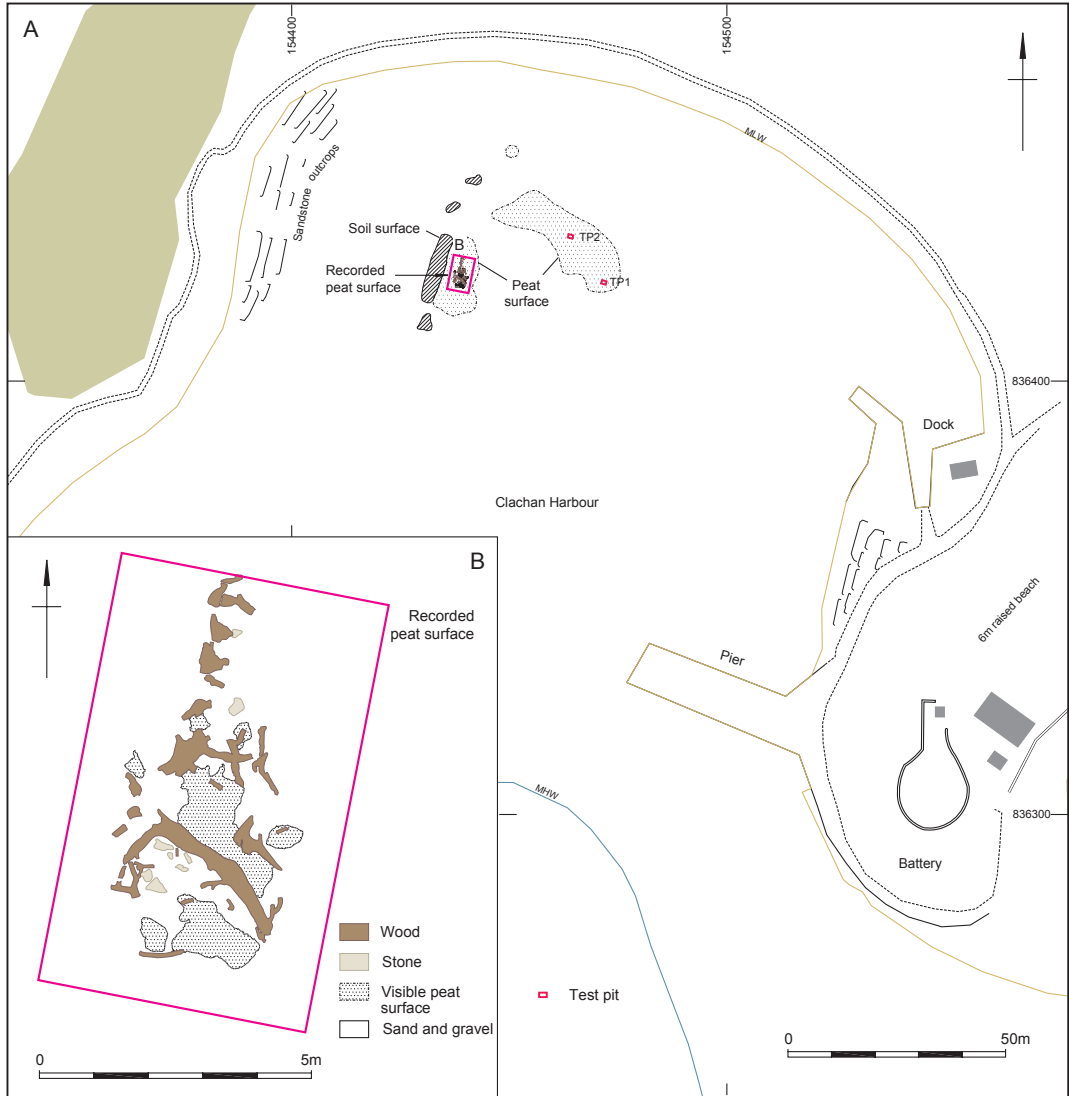
(the GIA [glacial isostatic adjustment] model curve) suggest either potential *or* no potential for early Holocene submerged prehistory, with no control points covering the Mesolithic. The modeled RSL scenario for the Isle of Skye (Bradley 2011: model 8) is positioned on post-glacial isobase reconstructions (eg Dawson 2009). The exact relationship of relative sea-level in this area is unclear but early and pre-Mesolithic potential is suggested; certainly sediments and organic deposits suitable for rationalising the palaeogeography of the landscape during the Holocene and late Pleistocene are noted, for example, around Upper Loch Torridon (Bicket & Shaw 2012).

The Inner Sound has abundant evidence for an early prehistoric human presence (Hardy & Wickham-Jones 2009). This stretches across the whole region from north Skye to Loch Torridon, and includes the islands of Raasay, Rona, the Crowlin Islands and Pabay. An Ahrensburgian point was found at Loch Shildaig, in Upper Loch Torridon (NGR: NG 8161 5231) (Ballin



ILLUS 2 Aerial photograph of Clachan Harbour, Raasay, looking north north-east (photo: J Benjamin; © Wessex Archaeology 2012)





ILLUS 3 Plan of peat and tree deposits, Clachan Harbour (M Wildgoose, E James)

& Saville 2003). Though no secure date can be ascribed to this find, the Ahrensburgian was a Late Upper Palaeolithic culture present at the end of the Younger Dryas (represented in Scotland by the Loch Lomond re-advance) in the terminal Pleistocene. It was present across the north-west European plain, while Ahrensburgian-like artefacts have been found in a broader geographical region that also encompasses southern Scandinavia. This artefact, and a similar

one found in Tiree, represent some of the earliest evidence for humans in Scotland (Ballin & Saville 2003).

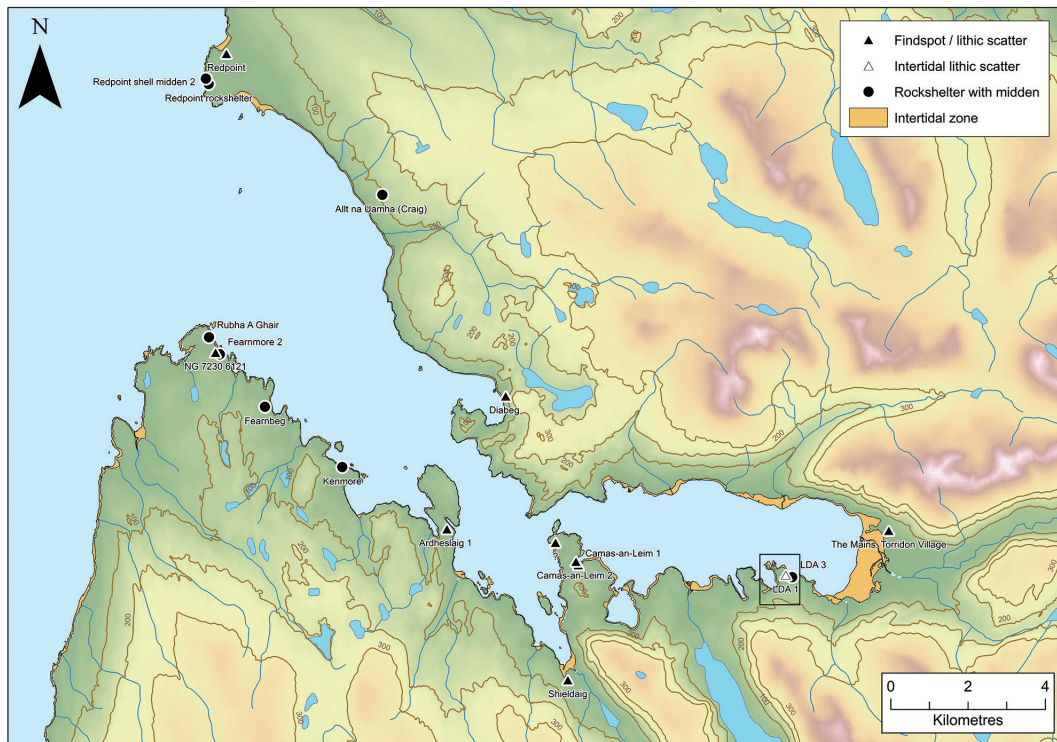
One intertidal site is known, this lies on the south-west corner of Raasay at Clachan Harbour (NGR: NG 54465 36404). It is an area of fallen tree trunks and peat containing embedded lithics. It was first identified during the Scotland's First Settlers project (Hardy & Wickham-Jones 2009) (illus 2, illus 3).

A paleoenvironmental monolith core taken as part of this project (Dawson 2009) revealed that the diatom and pollen assemblages indicate a fall then a subsequent rise in sea-level in the early–mid-Holocene (Cressey et al 2007). As part of a new pier development, two trenches were excavated in the intertidal and upper beach zone; 27 lithic artefacts, a canid tooth, charcoal, hazelnut shell and a bevel-ended stone tool were discovered, embedded in the peat deposit or in the underlying clay deposit (Ballin et al 2010b). The deposits appeared to stretch underneath the storm beach at the head of the bay (Cressey et al 2007). Two radiocarbon dates on Birch (*Betula*) tree trunks from the intertidal zone, above the layer where most of the lithics were found, fall between 7598–7084 cal BC and provide a *Terminus ante quem* for the lithic assemblage, which has been characterised as Early Mesolithic or possibly earlier (Ballin

et al 2010b). Though the raw material was initially identified as ‘tuff’ (Ballin et al 2010b), confirmation of this must wait until the several sources described have been identified and samples collected as several artefacts have the characteristic appearance of baked mudstone from An Corran. More recently, shovel pitting was extended further below the intertidal zone; however, no further peat or fallen tree trunks were detected (McCarthy et al 2014).

Several mesolithic sites are known around Loch Torridon, including an extensive site near Shieldaig in Upper Loch Torridon (Walker 1973; Ballin 2001, 2002; Birch 2013) and a further 14 sites containing early prehistoric lithic material, including rockshelters with shell middens, lithic scatters and findspots (Hardy & Wickham-Jones 2009; Hardy 2013, 2015) (illus 4).

Lub Dubh Aird (NGR: NG 8723 5505) is a low-lying bedrock promontory approximately



ILLUS 4 Early prehistoric and Mesolithic sites, Upper Loch Torridon. Contains Ordnance Survey data © Crown copyright and database right 2015 (A Bicket)



ILLUS 5 Photogrammetry model from aerial photographs of Lub Dubh-Aird, Upper Loch Torridon, looking west (photos: J Benjamin 2012; A Bicket, created using Autodesk 123D Catch, illustrated K Foster, E James). The main implementiferous cove is in the centre right next to the end of the road

700m long × 300m wide at its maximum extent (illus 5) on the south shore of Upper Loch Torridon and lying in a north-west direction. A fault-line which runs roughly E/W at the base of the promontory creates a sharply stepped bedrock topography. The east-facing coastline has three bays, which consist of a mixture of sand and small gravel overlain by small to large angular rocks and outcropping basal rock. The third bay is near the tip of the peninsula, faces north-east and is extensively covered in beach pebbles. The promontory is covered in shallow blanket peat overlying the bedrock and is today heavily vegetated, with a combination of rhododendrons, conifers and heather/bracken scrub.

Over a period of several years, people have been collecting flaked lithics from Lub Dubh Aird. Three small beaches and a rockshelter which lies 100m to the east of the peninsula have all been identified as areas where lithics have been recovered, though most artefacts have been collected from one small south-east facing bay at Lub Dubh Aird (illus 5). A project was therefore set up in collaboration with the local collectors

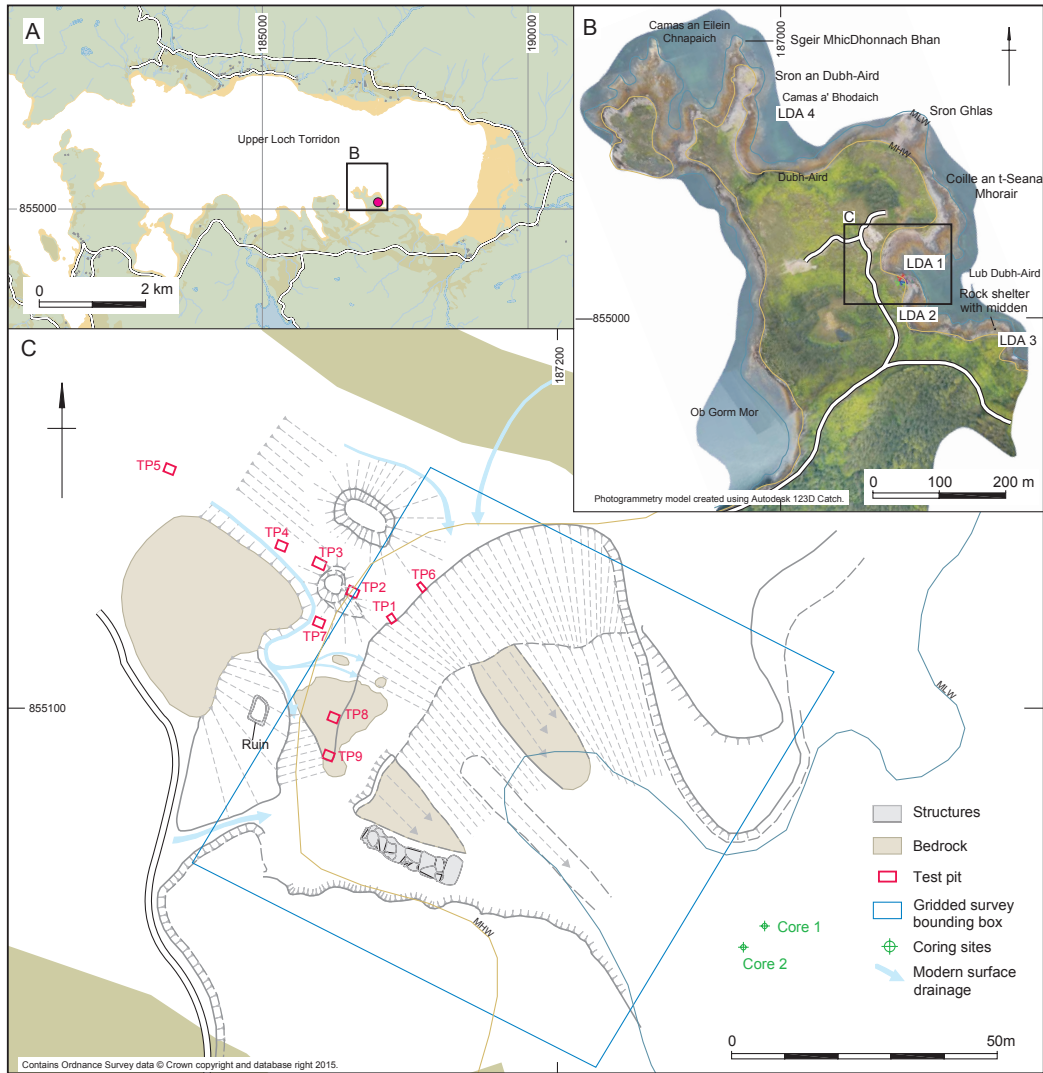
in an attempt to identify the source of the lithic artefacts through a programme of survey and test pitting (illus 6).

## METHODS

The main lithic producing beach (NGR: NG 8723 5505) was given the identifier LDA 1. The geomorphology of the beach was investigated, three survey methods were implemented and the results were then combined.

Two locations were augured to assess the accumulation of sediments in a short transect moving from a mid-point on the beach to low tide. A walkover survey of the entire beach was conducted on the day of the lowest tide of the year (7 April 2012) to ensure maximum exposure. A 5m × 5m grid was marked out across the beach (total extent 55m × 50m) and a controlled collection was carried out. A scuba and snorkel survey was also undertaken to 100m from the low water mark; however no surface artefacts were identified on the seabed, which is composed of pebbles and medium grain sand.





ILLUS 6 Surveyed locations on Lub Dubh-Aird, Upper Loch Torridon (A Bicket, created using Autodesk 123D Catch, illustrated by K Foster, E James)

Nine test pits (1m × 0.5m) were laid out above the beach LDA 1 (illus 6). All material from the test pits was passed through a 2mm sieve, which permitted the recovery of the lithic material that was present. Walkover surveys were also conducted in the other two small bays. LDA 2 (NGR: NG 87198 55028) is adjacent to LDA 1 and is covered by densely packed rocks, which mask the visibility of the gravelly sand beach surface. LDA 4 (NGR: NG 8692 55257)

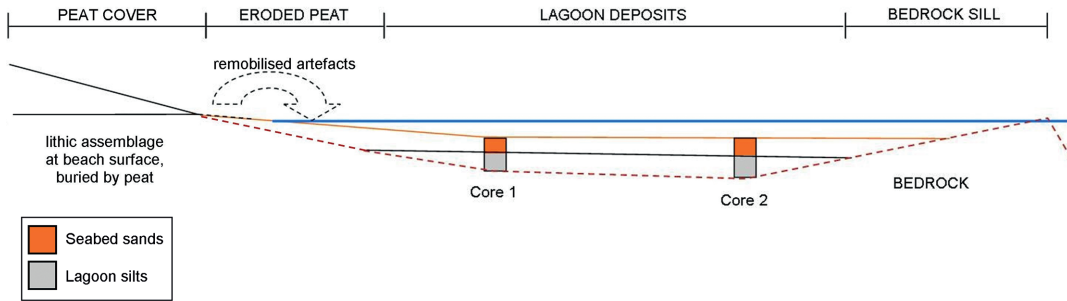
lies to the north west of LDA 1. It is largely covered in pebbles, and these mask the visibility of the beach surface. The rockshelter (LDA 3, NGR: NG 87350 54981), which is in fact a large void with a vast slab of rock covering it, is formed out of an extensive rock tumble that lies on a rock platform which is around 2m above high water. It measures 1.6m deep × 2m wide × 1.5m high. The date of this collapse is unknown (illus 7).



ILLUS 7a Rock platform with boulders showing collapse. The rockshelter is on the left of the platform on a small flat boulder beneath the solitary tree. Above this, and now covered in vegetation, is a rock cliff

ILLUS 7b Rockshelter (photos: K Hardy)





ILLUS 8 Schematic cross-section of Lub Dubh-Aird cove indicating marine lagoon environment in place prior to the formation of the current beach. Lithics may be eroding from back beach onto foreshore. Fine-grained silts of around 0.3m thickness were encountered in the mouth of the embayment, suggesting a lagoon or very low energy waterlain depositional environment; the silts were overlain by around 0.3m of modern, mobile seabed sands (A Bicket)

## RESULTS

### LDA 1

#### *Geomorphology*

The upper beach at LDA 1 consists of a shallow layer of gravelly sand lying on stepped sandstone, heavily covered by seaweed and mollusc populations in places, and constrained between two rocky promontories. Towards the back of the beach, bedrock was sometimes exposed. Sorting was well developed on the beach with sediments and shells sorted by size and density up the beach profile. As the beach descends towards the water, the depth of shelly sand thickens while the exposed areas of bedrock are covered in a thick bed of seaweed (illus 8). Interdigitated peat is eroding from the back of the beach.

#### *Survey and test pitting*

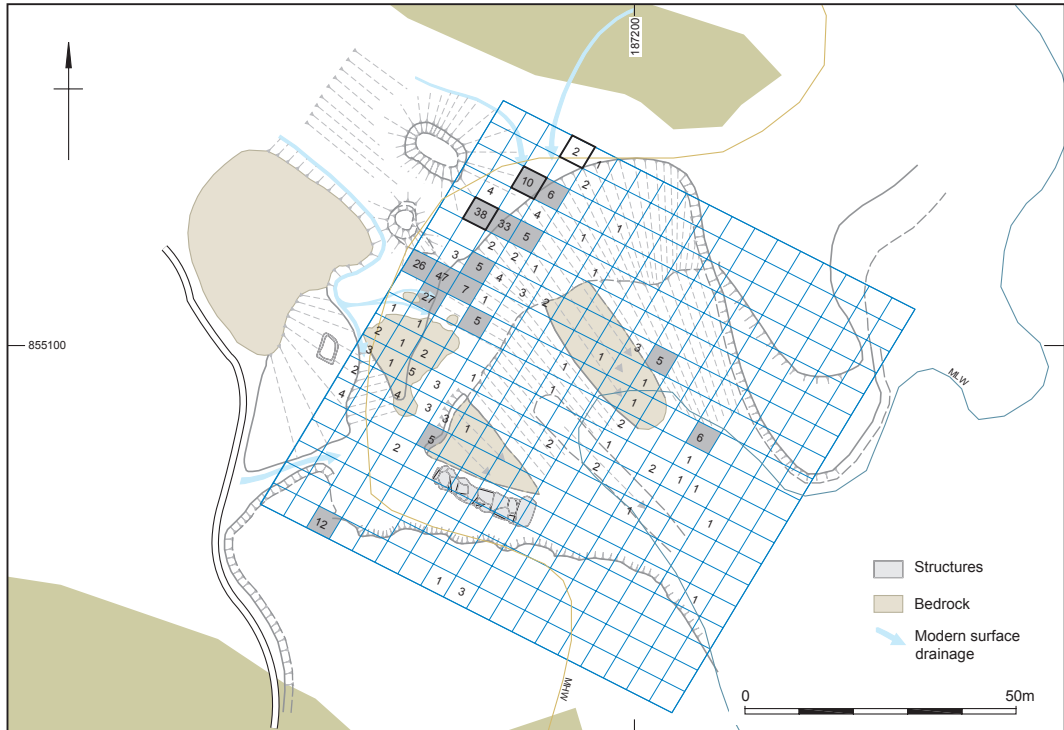
417 pieces of flaked lithic, including material in flint and quartz/quartzite were collected in the walkover survey at LDA 1. The artefacts, including a number of fire-cracked or crazed pieces, were distributed over a wide area; however, they were particularly concentrated in an area of the upper beach roughly in the middle of the bay. No material was found in the south part of the bay (Table 1). All the artefacts were recovered from the gravelly sand context that covers much of the beach and extends below the peat at the head of the beach (illus 9). In some

places on the beach this gravelly sand context is covered by angular rocks and lithic material and a large number of small flint nodules were also recovered from beneath the angular rocks in the same gravelly sand context.

Nine test pits were excavated in the peat above the beach. Test pits 1, 6 and 7 were laid in the peat abutting the edge of the beach while the other test pits 2, 3, 4, 5, 8 and 9 were placed further up the slope and away from the beach. Test pit 1 was placed directly above the location where the highest concentration of beach lithics was found, test pits 2 and 3 were located a short distance to the south, also abutting onto the beach. One hundred lithics were recovered from test pit 1. The lithic material was all recovered from the same gravelly sand layer which lies across much of the beach and continues below the peat. A further 12 lithic artefacts were found in test pits 2 and 3 (Table 1). No artefactual material was found in the peat or in any of the other test pits.

A small amount of lithic material was also found at LDA 2 (12 pieces) and LDA 4 (eight pieces). Two pieces were found by the track above the bay. A test pit (0.60m×0.50m) was opened in the middle of the rockshelter (LDA 3). The surface layer consisted of a mixture of limpet and periwinkle shells and 13 lithic artefacts. Although there was evidence for otters in the rockshelter, no evidence of animal burrowing that could indicate animal disturbance was found.





ILLUS 9 LDA 1; Distribution of flint artefacts (see Fig 6 for location of grid) (illustrated by K Foster, E James). Grid units with 5–10 flints are coloured light grey, whereas grid units with more than 10 flints are in a darker grey shade. Grids with thick black rims yielded fire-crazed flints. Flint pebbles are not included, and it was also decided not to include finds in quartz/quartzite as their anthropogenic status is less certain. The greatest density of lithic material corresponds directly with the back beach contour of the current high tide

The surface limpet and periwinkle layer with lithics (Context 1) continued to 0.2m. Below this, a layer of dark soil mixed with largely broken shells continued for around 10 cm (Context 2). Context 3 was a layer of looser grey soils around 12cm deep with oyster and some limpet shells, principally unbroken. Context 4 was around 8–12cm deep and consisted of dark soil, mixed with small angular stones and a mixture of broken and unbroken limpet shells. Below this, voids opened up between large angular rocks. Four lithic artefacts were also found amongst rocks in front of the rockshelter.

### THE LITHIC ASSEMBLAGE

A total of 2,229 lithic artefacts have been recorded altogether. These include the artefacts

from LDA 1 that were collected previously by locally based collectors. While the previously collected pieces do not form part of the gridded collection and are therefore not included in the analysis of distribution, they do form part of the raw material characterisation (Table 1).

### RAW MATERIAL

With a small number of exceptions, the artefacts are attributable to two main groups of raw materials, namely flint and quartz/quartzite. The flint represents a wide variety of different colours, patterns, textures and inclusions, and they correspond to what (in the archaeological literature) is usually referred to as poor quality flint. This was determined through microscopic examination of the artefacts ( $\times 8$  magnifications)

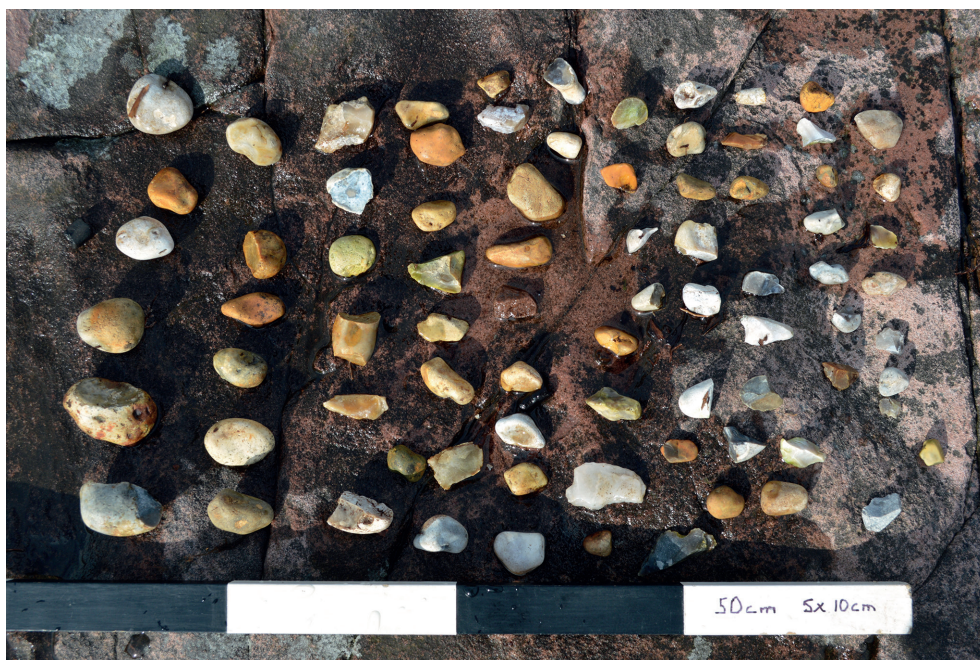
TABLE 1  
Site location and lithic artefact summary

<i>Site name</i>	<i>Grid reference</i>	<i>Number of lithic artefacts</i>
LDA 1, main bay, previously collected	NG 8723 5505	1,661
LDA 1, main bay, gridded collection	NG 8723 5505	417
LDA 2, small bay between LDA 1–LDA 3	NG 87198 55028	12
LDA 3 rockshelter	NG 87350 54981	17
LDA 4, larger bay at north end of peninsula	NG 8692 55257	8
Upper beach test pits		112
Path above bay		2
Total		2,229

which revealed that most pieces contain characteristic fossils.

The provenance of the flint is uncertain, but the presence on the shores of Lubh Dubh Aird of the large numbers and very small size of the flint pebbles (illus 10) suggest that they may be local to Upper Loch Torridon. Due to the ‘U-bend

shaped’ bottle-neck in the middle of Loch Torridon, they are unlikely to have been washed in with the tide. Likewise, the large number of very small pebbles suggests they were probably not collected elsewhere and brought here. They may derive from the southern outliers of the Durness Limestone (east of Loch Torridon), and



ILLUS 10 A selection of lithic artefacts and raw material from the intertidal zone, LDA 1 (photo: K Hardy)

then reach Loch Torridon by being washed down streams (Tilley 1951; Hoersch 1981; Johnstone & Mykura 1989). As the Durness Limestone dates to the Cambrian/Ordovician, rather than the Cretaceous period, this would make the material chert, rather than flint, but as their source remains to be confirmed, they will be referred to as flint to avoid confusion.

Quartzes and quartzites have been placed in one category as it is sometimes difficult to distinguish between the two groups (Ballin 2008). The basal quartzite in the region is visibly similar to what is referred to as saccharoidal (or fine-grained) quartz in other parts of Scotland. Some purple 'quartzite-like' pieces are probably Torridonian sandstone. However, while their exact sources are not known, all the sources are local (Johnstone & Mykura 1989).

A small number of other raw materials were also found. Two weathered/rolled pieces from LDA 1 were identified as probably baked mudstone from An Corran, Skye (Hardy & Wickham-Jones 2009; Saville et al 2012), but some attributes – including small 'air pockets' in one of the pieces which may be from escaping gas – suggest that these heavily abraded/water-rolled objects could be in igneous rock, possibly deriving from one of the many igneous dykes cutting the local country rock in the general Loch Torridon area (Woodland 1979), or possibly tuff (hardened volcanic ash). One piece of Rum bloodstone was recovered from the path above the Bay; this piece is characterised by its dark-green colour and easily identifiable globules. In western Scotland, bloodstone is only known from the Island of Rum, to the south-west of Skye (Emeleus & Bell 2005: 68). It was exchanged widely in the region, predominantly in the Mesolithic period (Wickham-Jones 1990; Wickham-Jones & Hardy 2004).

#### THE LITHIC ARTEFACTS

The definitions of the main lithic categories are as follows (Ballin 2000):

*Chips:* All flakes and indeterminate pieces the greatest dimension (GD) of which is  $\leq 10\text{mm}$ .

*Flakes:* All lithic artefacts with one identifiable ventral (positive or convex) surface,  $\text{GD} > 10\text{mm}$  and  $L < 2W$  ( $L$  = length;  $W$  = width).

*Indeterminate pieces:* Lithic artefacts which cannot be unequivocally identified as either flakes or cores. Generally the problem of identification is due to irregular breaks, frost-shattering, fire-crazing or water-rolling.

*Blades and microblades:* Flakes where  $L \geq 2W$ . In the case of blades  $W > 8\text{mm}$ , in the case of microblades  $W \leq 8\text{mm}$ .

*Cores:* Artefacts with only dorsal (negative or concave) surfaces – if three or more flakes have been detached, the piece is a core, if fewer than three flakes have been detached, the piece is a split or flaked pebble.

*Tools:* Artefacts with secondary retouch (modification).

#### LDA 1

The finds from LDA 1 (1,661 pieces) comprise those collected by local collectors, as well as finds collected in a grid system that covered the beach and intertidal zone. A small number of additional finds were retrieved from test pits on the shore and other nearby locations. Table 2 comprises all material collected by local collectors.

The main lithic raw materials are flint (1,586 pieces) and quartz/quartzite (72 pieces), with three pieces in other raw materials. In addition to 115 chips, 232 indeterminate pieces and one detached platform-edge, the flint debitage includes 1,096 flakes. Sixty-three of those are hard percussion flakes, whereas 443 are bipolar flakes and 590 are indeterminate flakes. The 103 cores are dominated by bipolar material (43 split pebbles and 49 bipolar cores), supplemented by nine irregular cores and two combined platform/bipolar cores. Thirty-nine flint flakes with retouch or use-wear were also recovered. One piece has an oblique truncation, whereas one may have been used as a burin (although it is not a *formal* burin).



TABLE 2  
LDA 1: Local collectors' assemblage

Flint: chips	115
Flint: hard percussion flakes	63
Flint: bipolar flakes	443
Flint: indeterminate flakes	590
Flint: indeterminate pieces	232
Flint: platform-edges	1
Flint: irregular cores	9
Flint: combined platform/bipolar cores	2
Flint: split pebbles (early-stage bipolar cores)	43
Flint: bipolar cores	49
Flint: flakes – retouch or use-wear	39
Quartz/quartzite: hard percussion flakes	5
Quartz/quartzite: bipolar flakes	2
Quartz/quartzite: indeterminate flakes	57
Quartz/quartzite: indeterminate pieces	7
Quartz/quartzite: irregular cores	1
Baked mudstone or igneous rock: hard percussion flakes	2
Unknown rock type: indeterminate flakes	1
TOTAL	1,661

Most of the quartz/quartzite pieces are flakes (five hard percussion flakes, two bipolar flakes, 57 indeterminate flakes), supplemented by small numbers of indeterminate pieces. Five flakes are in a 'greasy' quartz also found at the Shieldaig settlement site (Walker 1973; Ballin 2001, 2002). The quartz/quartzite category only includes one core, namely an irregular core in quartzite.

Two hard percussion flakes may be in baked mudstone. The larger of the two pieces seems to be a broad blade which is unintentionally widened at the distal end.

The lithics collected from the gridded survey of the beach and the tidal zone comprise 196

pieces of possible quartz/quartzite artefacts, but as many of these pieces are heavily abraded and/or covered by algae it is almost impossible to characterise them more precisely. A total of 417 pieces of worked flint was recovered during this survey, and they are summarised in Table 3.

The flints from the gridded survey of LDA 1 include 30 chips, one hard percussion blade, 315 flakes, 38 indeterminate pieces, 15 cores, and 18 pieces with retouch or use-wear. The flakes embrace six hard percussion flakes, 96 bipolar flakes, and 213 indeterminate flakes. The cores are dominated by 12 bipolar specimens, supplemented by one small single-platform core (illus 11), and two irregular cores.

TABLE 3  
LDA 1. Flint artefacts from the gridded survey

Chips	30
Hard percussion blades	1
Hard percussion flakes	6
Bipolar flakes	96
Indeterminate flakes	213
Indeterminate pieces	38
Single-platform cores	1
Irregular cores	2
Bipolar cores	12
Pieces with retouch/use-wear	18
TOTAL	417

The gridded flints from LDA 1 were distributed across the shore/tidal zone as shown in illus 9. The concentration of worked flint is heaviest in the north part of the beach, and below test pit 1. The small amount of burnt flint was recovered from this area also. The finds from the test pits are summarised in Table 4.

In total, the three test pits yielded 112 lithic artefacts, 59 of which are in flint. The flint artefacts are dominated by flakes, with one being a hard percussion flake, seven are bipolar flakes, and 36 are indeterminate flakes. In addition, 11 chips were found, as well as one indeterminate piece, one bipolar core, and two pieces with retouch/use-wear. One of the latter (from TP 1) is a small thumbnail scraper.

Taken together, the material from the local collectors, the gridded survey and the test pits, the assemblage is dominated by flint. The reduction technology is indicated by the composition of the flakes and the cores. The flakes include 5% hard percussion flakes, 38% bipolar flakes, and 57% indeterminate flakes. Various attributes (such as the character of the ventral ripples) suggest that most of the indeterminate flakes and flake fragments may also have been based on the bipolar technique. The ratio of certain hard percussion:bipolar flakes is *c* 12:88. This ratio is mirrored by the split pebbles/bipolar cores (with split pebbles being early stage bipolar cores) which have the exact same ratio.

The LDA 1 assemblage only includes three more accomplished (formal) tools, with most modified flints being pieces with expedient retouch or use-wear comprising: one thumbnail scraper, one side-scraper and one truncated piece.

TABLE 4  
LDA 1. Test pits

	<i>TP 1</i>	<i>TP 6</i>	<i>TP 7</i>	<i>Total</i>
Flint: chips	10	1		11
Flint: hard percussion flakes	1			1
Flint: bipolar flakes	7			7
Flint: indeterminate flakes	33	3		36
Flint: indeterminate pieces		1		1
Flint: bipolar cores	1			1
Flint: pieces – retouch/use-wear	1	1		2
Quartz/quartzite: possibly worked	47	2	4	53
TOTAL	100	8	4	112



ILLUS 11 (a) Broad blade artefacts, LDA 1; (11b) Bipolar flake with retouch, LDA 1; (11c) Single platform core, LDA 1; (11d) Thumbnail scraper, LDA 1; (11e) Scraper, LDA 2; (11f) Flakes, LDA 1 (photos: 11a, K. Hardy, b-f, Daniel O'Donnell)

None of these is diagnostic, although the general size, shape and execution of the small scraper is consistent with a Mesolithic date.

#### LDA 2

The assemblage from LDA 2 comprises 12 flint artefacts: three bipolar flakes, three indeterminate flakes, two bipolar cores, two combined platform/bipolar cores and two scrapers. In addition, four pieces of possibly worked quartz or quartzite were

recovered. Most of the flints are toffee-coloured, but it is possible that this is post-depositional staining. The two scrapers are both based on bipolar flakes (greatest dimensions c 30–40mm), and they both have a straight distal working-edge. The larger of the two has additional lateral blunting retouch. Although these objects are generally slightly larger than the artefacts from LDA 1, they are technologically identical. This assemblage does not contain any diagnostic artefacts.



*LDA 3 (rockshelter)*

The focus of this location is a collapsed rockshelter (immediately west of LDA 2). The assemblage includes two pieces of possibly worked quartz/quartzite and one piece of possibly worked 'other' rock. However, the assemblage is dominated by flints, including: one hard percussion flake, four bipolar flakes, six indeterminate flakes, two indeterminate pieces and one irregular core. Four of the flint flakes are burnt, and in conjunction with the presence of shell and bone, this suggests domestic settlement. The assemblage does not contain any diagnostic artefacts.

*LDA 4*

This location, which is situated in the bay immediately north of LDA 1, yielded a small assemblage of eight lithic artefacts. In addition to two pieces of possibly worked quartz/quartzite, the following flint artefacts were recovered: one bipolar flake, one indeterminate flake, two indeterminate pieces, one irregular core and one bipolar core. In terms of typo-technological attributes, this assemblage corresponds to that of LDA 1. No diagnostic finds were made.

## DISCUSSION

## GEOGRAPHY AND MOBILITY IN LOCH TORRIDON

The assemblage from Lub Dubh Aird adds another location and dimension to the already busy early prehistoric landscape of Loch Torridon (illus 4). Although the LDA assemblage is not strongly associated with chronological indicators, the presence of two hard percussion blanks, including one broad blade in baked mudstone/igneous rock, suggests the application of broad blade platform technology similar to that found in the lowest, early or pre-Mesolithic deposits from beneath the shell midden at An Corran (Saville et al 2012) and the finds from Clachan Harbour, Raasay (Ballin et al 2010b).

The context of the flint assemblage at LDA 1, found consistently within a layer of small pebbles overlain in places with larger angular stones and which extends below the peat at the

top of the beach, is consistent with an early date. Although few retouched pieces were recovered at LDA, the solitary and relatively plain thumbnail scraper (in contrast to the well-executed Bronze Age thumbnail scrapers) is indicative of an early prehistoric, most likely Mesolithic, date (see, for example, the assemblage from Killellan Farm, Islay, which includes Mesolithic as well as Early Bronze Age type scrapers (Saville 2005)). The almost complete absence of blades/microblades and formal tools at LDA is intriguing, and supports the notion that the bay was a raw material source rather than a domestic location. The widespread distribution of the lithic scatter and the flint pebbles is found across both the upper beach and the intertidal zone with a concentration of artefacts in the upper beach adjacent to TP1, which also produced 100 flaked lithic pieces. The distribution of both pebbles and the small amount of flaked pieces across both the upper beach and intertidal zones suggests that the whole beach in its broadest sense was used to collect the flint nodules and conduct primary processing.

Although most sites in Loch Torridon comprise assemblages that are too small to be used for comparative purposes, the site which lay beside the Shieldaig–Kenmore road (NGR: NG 8161 5231) (Ballin 2001, 2002, 2013; Birch 2013), and is located approximately 6.5 miles by sea from LDA (illus 4, Shieldaig), contained thousands of artefacts, principally on quartz, with small assemblages of flint and bloodstone. The source of the flint from this site was originally considered to be a local beach, due to the high quantity of cortical pieces found and the small size and heavily rolled nature of the pebbles (Ballin 2002). The high proportion of bipolar cores in the LDA assemblage (n=12; 80% of the total number of cores), is similar to the large Shieldaig site (n = 21; 63% of the total number of cores including flint and bloodstone), while the difference between the relatively high proportion of retouched pieces at the Shieldaig site (13.5%), by comparison with the very low proportion of retouched pieces (4.3%) and the large amount of primary flakes at LDA, is notable. Despite intensive walkovers over several years, covering all the beaches in the region, no other beach in

the area has been found to contain either the nodules or flaked material that is present at LDA. A more direct connection between the two places is suggested by the presence at LDA 1 of the five flakes on the 'greasy' quartz, which is also found at the Shildaig settlement site, as well as a small bloodstone presence at both sites. Taken together, all the evidence suggests a link between the two sites, with LDA most likely representing a raw material source for the Shildaig site.

The perspective of Shildaig as a living area and LDA as a raw material source is enhanced by the numerous burnt lithics at Shildaig, which suggests a number of hearths (Birch 2013). Only three burnt lithics were found at LDA, and currently no evidence for a domestic site has been detected – 'day-time' cooking events can occur outwith living areas and the presence of these burnt lithics cannot be used in isolation as an indicator of a living area. In this respect it is interesting to note that a much higher proportion (four out of 11) of artefacts found at LDA 3 (rockshelter) was burnt, though its low height would appear to preclude it from being a useful place for extended habitation. However, the fact that lithic artefacts were found in four different locations at LDA suggests movement across the area, and offers a perspective of a small-scale prehistoric landscape rather than a 'site'.

Further afield, many of the sites identified around the Inner Sound, including Sand, contain material described as chalcedonic silica (Wickham-Jones 2009); however, Birch (2013) suggests that there is a superficial similarity between this and flint, and in certain cases, much of the raw material may in fact be flint. A new evaluation of the raw materials from the other Loch Torridon sites, and more widely in the Inner Sound, may well extend the distribution of the LDA flint pebble raw material source and suggests a potential network of sites in the region, all connected by the pebble raw materials source at LDA.

The presence of a small number of Rum bloodstone artefacts around Loch Torridon adds another piece to the developing picture of connectivity over a broader geographical area from Rum (Wickham-Jones 1990), to south Skye, at Camas Daraich, Point of Sleat, (Wickham-

Jones & Hardy 2004; Hardy et al 2010), Sand, Applecross and the other early prehistoric and Mesolithic sites in the Inner Sound to the Mesolithic sites and baked mudstone source of An Corran in north-east Skye (Hardy & Wickham-Jones 2009; Saville et al 2012) and Upper Loch Torridon. Taken together, these sites suggest a complex mixture of local and more distant mobility patterns in early prehistoric periods.

#### WHY BIPOLAR?

All known Upper Palaeolithic, Mesolithic and Neolithic industries in western Scotland include an element of blade production; the almost complete absence of 'proper' blades or microblades (that is, elongated soft percussion blanks with parallel lateral sides and dorsal arrises) at Lub Dubh Aird, as well as the reliance on bipolar technique for the production of elongated blanks, makes this assemblage, at first glance, highly unusual.

However, throughout the Hebridean area, the bipolar technique was used at times for the reduction of all lithic raw materials, including flint, chert, quartz, bloodstone and baked mudstone. Bipolar material has been found at several other sites around the Inner Sound, including scatters on Scalpay (Hardy & Wickham-Jones 2009), An Corran (Saville et al 2012), Shildaig (Ballin & Saville, 2003) and Sand (Wickham-Jones 2009) and use of this technique is also common in the Southern Hebrides (Wicks et al 2014).

Small pebbles are ill-suited for platform technique (eg Callahan 1987: 63; Finlayson 2000: 105) as they do not contain sufficient mass to allow the necessary decortication and preparation of platforms, flaking-fronts and platform-edges; due to their small size and curved exterior, primary blows tend to glance off these pebbles and small pebbles have so little mass that a blow tends to move the hand and pebble, rather than detach a flake. The evidence suggests that on the whole, the bipolar approach was used for initial quartering of large pebbles, cobbles or blocks, general reduction of small pebbles and final reduction of small platform cores which, due to their low mass, could not be reduced any further by the application of free-hand percussion (Ballin 2008: 69).

At Lub Dubh Aird, no large pebbles, cobbles or blocks of lithic raw material were available and the pebbles are all extremely small. These pebbles would not have been suitable for platform reduction and it is most likely that the predominant use of the bipolar technique found at LDA was a functional necessity determined by the small size of the raw material pebbles.

#### PREHISTORIC PEOPLE IN LOCH TORRIDON

Loch Torridon is likely to have been a desirable place to live during the Mesolithic. Today, it is used for shellfish farming and fishing, while wild molluscs are still very abundant. Upper Loch Torridon, in particular, offers a relatively sheltered marine environment and the many sites around the coastlines suggest a high degree of mobility, and a well-established population. The early prehistoric site of Allt na Uamha (also known as Craig, NGR: NG 7679 6490) lies on the south-facing coast of Loch Torridon, at 85m above sea-level and has outstanding visibility across the north part of the Inner Sound. This site, which also has a shell midden, is evocative as the route up from the shore is steep and relatively challenging and its location appears to have little to do with practicalities of marine exploitation. It may have acted as a stepping stone into upland areas or it could have had another purpose that had little to do with resource exploitation, such as long distance communication. However, this site, and the early prehistoric occupation of Loch Torridon in general, require further investigation to enable a clearer understanding of the Mesolithic and, more generally, the early prehistoric use of this area and of the people who inhabited it at this time.

A collaborative, multidisciplinary approach to the study of coastal landscapes in Scotland, inclusive of the intertidal and sub-tidal zones, is essential to obtain a better understanding of their prehistoric occupation. The dynamic nature of the west coast of Scotland during the early to mid-Holocene, which includes sea-level fluctuations, isostatic recovery and its accompanying localised earthquakes and rock falls, makes it highly recommendable to combine landscape perspectives, including

geography, geomorphology and the study of intertidal and submerged areas, with land-based archaeological survey and excavation. From the smallest daily scale to the largest regional scale, the Mesolithic people of the Scottish west coast lived in a landscape where the integrated use of raw materials and local resources was combined with their use of the sea for travel, long distance visibility and resource collection.

Examining the whole available landscape, including those areas that are difficult to access or that are uninhabitable today due to changes in sea-level, is set to develop a more realistic and clearer perception of site distribution, landscape use and small scale movement of coastal Mesolithic populations in West Scotland.

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