



**The scope of Strategic Environmental Assessment of North Sea Area SEA7 with regard to prehistoric and early historic archaeological remains**



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cover picture: diving for prehistoric remains associated with the Mesolithic site at Kinloch, Rùm (CR Wickham-Jones).

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## Contents

### Executive summary

1. Overview of the legislation and agreements that apply to UK marine and maritime prehistoric and early historic archaeological remains in the SEA7 area.
2. Background to sea-level change and the human settlement record of Sea7.
3. A brief history of the human occupation of the western seabord of Scotland, and N. Ireland.
4. Known and likely submerged sites in the SEA7 area.
5. Consideration of the potential impacts of oil field operations on submarine prehistoric and historic archaeological remains within SEA7.
6. Consideration of the opportunities presented by oil and gas operations for site/artefact identification.
7. Summary of existing activity regarding the reporting, investigation and protection of prehistoric and archaeological remains.
8. Recommended measures to prevent damage to prehistoric and archaeological remains from oil and gas activities.
9. Acknowledgements
10. Bibliography
11. Annex 1: Articles 149 and 303 of UNCLOS
12. Annex 2: Acronyms

## List of figures

- 1.1 Simplified bathymetry of the North Atlantic, showing the area of the Storegga Slide between Iceland and Norway
- 2.1 Reconstruction of palaeogeography during the Late Devensian glacial maximum
- 2.2 Reconstruction of the limit of the Late Devensian ice sheet maximum
- 2.3 Condensed summary of factors affecting the human occupation of Britain in the last 0.7 million years. Sea levels, ice ages, island/peninsula, fossils, archaeological tool industries, and key sites. (Stringer 2004, AHOB website, [http://www.nhm.ac.uk/hosted\\_sites/ahob/overview\\_time\\_chart.gif](http://www.nhm.ac.uk/hosted_sites/ahob/overview_time_chart.gif)).
- 2.4 Schematic palaeogeographic reconstruction showing the inferred extent of the late Devensian ice sheet at, or shortly after, the glacial maximum
- 2.5 Shoreline uplift isobases (m OD) for the Main Lateglacial Shoreline
- 2.6 GIS reconstruction of dry land areas around Scotland's west coast that would have existed at the start of the Holocene interglacial
- 2.7 GIS reconstruction of dry land areas around the Outer Hebrides that would have existed at the start of the Holocene interglacial
- 2.8 Modelled surfaces for various Holocene Shorelines for the Scottish mainland
- 2.9. Palaeogeographic reconstructions of Northwest Europe
- 2.10 Relative sea level graphs around western Scotland
- 2.11 Bathymetry of the west coast of Scotland to 80 m depths
- 3.1 Location of the principal excavated Mesolithic sites in the SEA7 area.
- 3.2 Typical stone flakes from the Mesolithic site at Kinloch, Rùm.
- 3.3 Excavation taking place at Kinloch, Rùm – the darker discolorations provide evidence for the pits and post holes that once existed on site.
- 3.4 Hypothetical reconstruction of the site at Kinloch, Rùm, based on the excavated evidence (drawing, Pipeline)
- 3.5 Excavation taking place at the rockshelter of Sand, Applecross (photo, SFS).
- 3.6 Dense limpet midden under excavation at Sand (photo, SFS).
- 3.7 N. Uist, Location of Early Prehistoric sites (Neolithic and Bronze Age) recorded in the National Monuments Record for Scotland. © Crown copyright 2003. All rights reserved. Licence number WL8691.
- 3.8 N. Uist, Location of Late Prehistoric sites (Iron Age) recorded in the National Monuments Record for Scotland. © Crown copyright 2003. All rights reserved. Licence number WL8691.
- 3.9 N. Uist, Location of Medieval sites recorded in the National Monuments Record for Scotland. © Crown copyright 2003. All rights reserved. Licence number WL8691.
- 3.10 Baleshare, N. Uist, location of coastal sites recorded as part of the SCAPE coastal survey. © Crown copyright 2005. All rights reserved. Licence number WL8691. With thanks to SCAPE, the Centre for Field Archaeology and Historic Scotland.
- 3.11 Baleshare, N Uist, recent storm surges (A. Dawson).
- 3.12 Archaeological sites recorded by Scotland's First Settlers during fieldwork 1999-2004. Numbers refer to the SFS recording numbers (Hardy & Wickham-Jones forthcoming) (SFS).
- 3.13 Wood visible in the inter-tidal zone at Clachan Old Harbour, Raasay (photo SFS).

- 3.14 Divers preparing for an archaeological examination of the underwater landscape of Loch Scresort, Rùm.
- 3.15 Rathlin Island and the Irish coast looking SE and showing the effects of the Holocene Lowstand, ie a 30m drop in sea level, the emergence of a sheltered landscape (now submerged) is clear. (R Quinn)
- 4.1 The North Sea Flint – location and illustration.
- 4.2 Clachan Old Harbour (Sue Dawson & SFS).
- 4.3 Location of the site at Clachan Old Harbour (Sue Dawson & SFS).

### **List of Tables**

- 3.1 Key sites relating to the earliest human occupation of the SEA7 area.
- 3.2 Estimate of entries for archaeological sites of all periods in the National Monuments Record for Scotland by island group. NB: some sites have more than one entry.

NB: there is a discrepancy between the use of dates by the natural sciences, who mainly use uncalibrated radio-carbon years BP (Before Present) and the use of dates by archaeologists who tend to use calibrated years BC (Before Christ). In order to simplify matters the dates in this report are given in uncalibrated radiocarbon years BP except where they are directly quoted from an archaeological report in which case they are given in calibrated years BC. All dates are clearly marked as to whether they are BP or BC. See Calib radiocarbon calibration program.

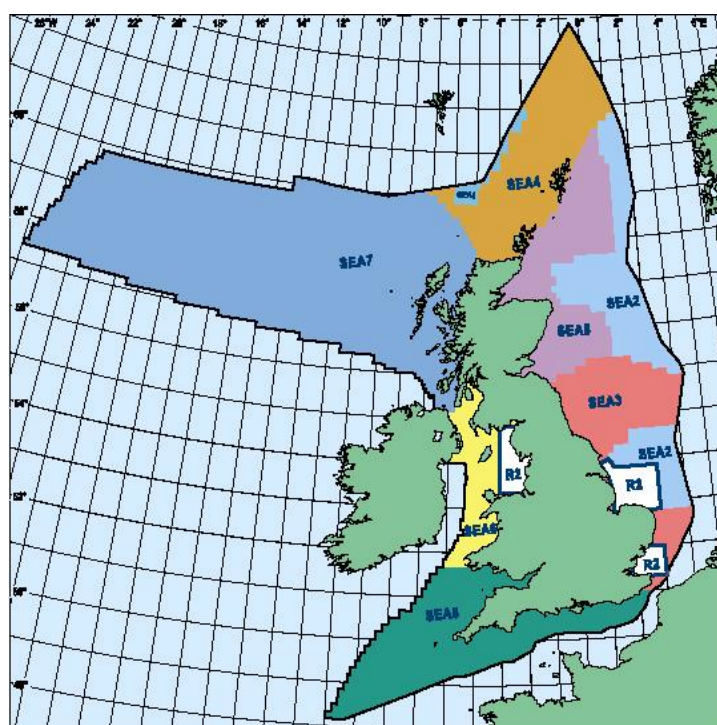
<http://calib.qub.ac.uk/calib/>

## Executive Summary

There is a high likelihood of surviving prehistoric archaeology (10,000 – 5000 years old) in certain areas of SEA7, most notably to the west of the Outer Hebrides for a distance of some 10km, to a depth of -20m, and in and among the islands elsewhere (particularly around Islay, Jura, Mull and the Small Isles) along the coast and between S Scotland and N Ireland. The reasons comprise a complex interplay of changing sea level and the rebound of the land once freed from the compression of ice at the end of the last Ice Age. The net result of these physical effects is that 10,000 years ago relative sea level has been up to 45m lower along much of the coast and this corresponds with the period of early human settlement in the area. In places this means that considerable areas of submerged land exist. An investigation of bathymetric, sedimentary and tidal data for the area suggests that the prehistoric land surface, including archaeological remains, may survive in many places.

Any archaeological remains that might be found would be highly significant because early remains are so far rare on the islands. Elsewhere in Scotland, archaeological material from this time indicates the importance of the coast suggesting that it is along those submerged coastlands that one might expect to find indications of early settlement, and thus, incidentally, providing one reason why so few remains have been found among the outer islands and coast of SEA7.

Cooperation between existing extraction companies and renewable industries and archaeologists elsewhere in Britain shows how the recording and investigation of archaeological material could be beneficial to both parties should work take place in SEA7. The final sections provide a preliminary examination of how matters might be taken forward to safeguard the archaeological knowledgebase without prejudicing commercial interests.



# 1. Overview of legislation and agreements (UK, EU and international) that apply to UK marine and maritime prehistoric and archaeological remains in the SEA7 area.

## UN Conventions, European laws and directives

1.1 In general terms each of the UK Home Country Heritage Agencies (English Heritage, Cadw of the Welsh Assembly Government, Historic Scotland for Scottish Ministers, Department of Environment Northern Ireland, Environment and Heritage Service, and Manx National Heritage) has formal responsibility for marine archaeology out to the 12 mile limit off their respective coasts. In practice these agencies take an interest in the marine archaeological potential of the UK continental shelf beyond the 12-mile limit of the Territorial Waters (Flemming, 2004, 119). SEA7 comprises seabed which comes under the jurisdiction of Scotland, a small area under the jurisdiction of Northern Ireland, as well as seabed outside the Territorial limit (of 12 nautical miles) which is under UK jurisdiction, though where Historic Scotland is now extending its interest. Each of these has slightly different administrative arrangements for the supervision of archaeology. This section first discusses the UN and European agreements and directives, then UK, and finally the different administrative arrangements which exist for marine archaeology in Scotland and Northern Ireland.

1.2 Much of SEA7 comprises seabed below 200m deep (fig 1.1) which is too deep to hold prehistoric archaeology. Relative sea level change has not exposed land below 200m deep within the period of human occupation of Britain. This area can thus be excluded from the present report



Figure 1.1 Simplified bathymetry of the North Atlantic, showing the area of the Storegga Slide between Iceland and Norway

1.3 Included within SEA7 is the outcrop of Rockall around which the Rockall Bank comprises a small area of shallower water that is of potential for submerged archaeology. It is thus included in the present study. Lower relative sea levels would have exposed the Rockall Bank and although it has always been isolated from the main landmass of Scotland it did have potential to offer to an earlier human population, particularly one that relied on the resources of sea ice, skerries, and islands for survival (section 3).



1.4 In this report there will be no analysis or discussion of the state of shipwreck archaeology. There are an estimated 26,500 historic losses over 100 years old and 13,500 wrecks in UK Territorial Waters (English Heritage 2002, para. 4.3). In Scottish waters the Protection of Wrecks Act (1973) is administered by Historic Scotland (English Heritage, nd, 15). There are many more wrecks in deeper water further offshore. Many of the same international legislative documents apply to all types of marine archaeology, whether of shipwrecks, abandoned single artefacts, or submerged sites of previous human occupation. However, the emphasis of the present report is entirely on the subject of submerged sites where humans and early hominins previously lived or hunted on terrain which was at that time dry land, or where they exploited fish and shellfish along a coast which is now submerged. In practice, the geomorphological history of the area (see below) means that the sites discussed are all likely to be older than 2,000 years, and mostly older than 4,000 years. It should not be assumed that the conclusions of this paper apply to shipwrecks on the sea bed. A separate report on submerged shipwreck archaeology in the SEA7 sector is being prepared by Wessex Archaeology (SEA7 Maritime Archaeology).

1.5 Legal regimes will be reviewed from the global and UN level successively downwards in scale to the regional and local, and non-statutory agreements or codes. No comment is offered when reporting the status of legislative documents which may or may not have been signed on behalf of the UK Government or UK agencies as to the reasons, nor as to likely changes in policy. All terms such as "underwater cultural heritage", "maritime archaeology", "marine archaeology", "submarine archaeology", "nautical archaeology" "submerged archaeology or prehistory" etc., will be deemed to have equivalent meaning. Nothing stated in the report should be interpreted as an attempt to define strict legal obligations. It is an attempt to show by analogy, and in plain language, how prudent anticipation of future events leads to a consistent view of the responsibilities of regulatory authorities and operators.

1.6 The United Nations Convention on the Law of the Sea (UNCLOS) was negotiated from 1968 and finally agreed in 1982. The Convention became recognised international law with ratification at national level by 65 states, and was ratified by the UK on 25 July 1997. Although UNCLOS entitles the coastal state to declare an Exclusive Economic Zone out to about 200 nm from a coastal baseline, and to declare an extra 12 nm Contiguous Zone outside the traditional 12 mile Territorial Sea, the UK has decided not to opt for either of these legal rights.

1.7 The Articles of UNCLOS directly concerned with marine archaeology are 149 and 303 (Annexe 1). Article 149 applies only to archaeology in the International Area outside national jurisdiction. Since, by definition, SEA7 defines a part of the UK Continental Shelf these circumstances do not apply. Article 303(1) stipulates that all states have the duty and right to protect archaeological resources found at sea "and shall co-operate for this purpose". This Article is completely open-ended, with no geographical boundaries or distinctions between different economic or jurisdictional zones. Since the UK has signed UNCLOS, and has a designated Continental Shelf which includes SEA7 which is periodically licensed for the exploitation of hydrocarbons, aggregates, or windfarms, it follows that Article 303 applies in a general sense to SEA7.

1.8 The UNESCO Convention on the Protection of the Underwater Cultural Heritage (UCPUCH) (General Conference, 31C, 2001) is an international and globally applicable document which has been passed by UNESCO General Conference. It furthers the idea of protection for "objects of an archaeological and historical nature" codified under Articles 149 and 303, 1 of UNCLOS through a comprehensive set of provisions, that cover both finds and geography. It has not, however, been ratified by sufficient countries to become international law. It has not been ratified by the UK. It is probable that the necessary number of signatories to make the Convention into agreed International law may never be obtained. This means that there is no comprehensive international regulatory framework for the marine historic environment situated beyond the territorial limits of sovereign States (Burlington House Declaration 2005, <http://www.sal.org.uk/downloads/unesco/Burlington-House-Declaration.doc>). The Convention is generally recognised as an important way forward for the protection of underwater cultural heritage, and the UK government has been urged to re-consider its position regarding ratification.

1.9 There is considerable tradition, at least in the field of international legal conventions concerning the sea, for complex documents to be discussed for many years, and for those draft clauses or principles which have consensus acceptance to become the guidelines by which people act, while other principles are neglected, ignored, or rejected, long before agreement or ratification of the final



document. Thus the UNESCO Convention should prudently be considered as the guiding principal for best practice regarding the levels of national regulatory control which the UK as a coastal state might be obliged to assert on its Continental Shelf, and similarly for the obligations of operators exploiting or utilising the resources of the Continental Shelf (Burlington House Declaration 2005).

1.10 The Preamble to UCPUCH states that UNESCO is conscious "of the need to respond appropriately to the possible negative impact on underwater cultural heritage of legitimate activities that may incidentally affect it". This is the situation which applies to SEA7 and to this Report. Underwater cultural heritage is defined, as in most other documents, as "all traces of human existence having a cultural, historical or archaeological character"...which have been partially or totally underwater for at least 100 years (UCPUCH, Article 1). UCPUCH is designed to be compatible with UNCLOS (UCPUCH, Article 3).

1.11 UCPUCH (Article 4) states that underwater cultural heritage shall not be subject to the law of salvage, unless this is authorised by the competent authorities, and the cultural heritage materials have maximum protection. UK Salvage Law only applies to shipwreck, including articles associated with shipwreck, and so salvage law does not apply to prehistoric material on the UK Continental Shelf whether outside or inside Territorial Waters, even if the raised material is landed at a British port.

1.12 UCPUCH (Article 5) states that signatories should use the "best practicable means" to prevent or mitigate adverse effects to underwater cultural heritage caused by legitimate activities under their jurisdiction. Again, although UK has not signed, the general indication of this Article is clear. A point of uncertainty and ambiguity regarding this clause is the extent to which it is open-ended, requiring apparently unlimited commitment to ensure that no damage is done, and to what extent a common-sense judgement should be applied regarding the chances of an unknown site lying in the path of some legitimate commercial activity. This obligation is dealt with more specifically in UCPUCH (Article 10.4) which applies directly to the Continental Shelf.

1.13 The UNESCO Convention concludes with a set of Rules Concerning Activities Directed at Underwater Cultural Heritage. The preferred means of protecting cultural heritage sites is protection *in situ*. For prehistoric sites this is sensible, provided there is no likelihood of on-going erosion. Excavation itself is a destructive process, only a few sites need to be excavated in order to obtain material for study. Furthermore, the constant development of improved archaeological techniques means that good practice is always to leave material for future investigation, where possible. In most cases it is sufficient to document the type of site for research purposes. The likely elements of the SEA7 archaeological resource to which these apply are discussed below in sections 1.12 – 1.14. Most of the remaining rules of UCPUCH refer to the planning and conduct of projects conducted by specialist archaeologists to study or excavate sites of underwater cultural heritage and as such they follow carefully drawn up international professional standards.

1.14 Inter-tidal peats and preserved timbers have been recorded in SEA7 (section 4.) and there are anecdotal records of drowned forests in slightly deeper waters, especially off the western coastlands. These support the results of geomorphological work which indicate that, in general, the land surface to the west is slowly subsiding, though the history of relative sea level change in the area is complex (section 2). This means that there is considerable potential for archaeological sites to have been drowned as sea level rose. Although no submerged archaeological sites have yet been found to the west of the Hebrides, this has to be largely a consequence of the relatively recent realisation that they might occur – there has been no targeted research on the archaeological potential of this area.

1.15 To date, there are no recorded submerged archaeological sites with material *in situ* below low tide level in the SEA7 area. Isolated finds are likely to have come from deliberate or accidental losses at sea (section 4). The recovery of worked stone from the inter-tidal zone at Clachan Old Harbour, Raasay (section 4) does highlight the possibility of submerged sites, but finds to date relate to sheltered and shallow coastal waters, so that there is no immediate evidence as to the condition and rates of erosion of any submerged cultural material.

1.16 In the southern and central North Sea the volume of Pleistocene terrestrial mammal bones recovered by bottom trawlers is sufficient to support a modest trade in sorting and dispersing the bones to museums, research groups, collectors and fossil shops (Post and Kompanje, 1995; van Kolfshoten and Laban, 1995; Post *et al*, 2001; Glimmerveen *et al*, 2004; van Kolfshoten and van Essen 2004). Some of the bones have been humanly modified to be used as tools (Louwe Kooijmans, 1970-71;

Verhart, 2004). The flow of material recovered by fishermen in Scottish Waters is much smaller, but not zero. Since the bones and fossils are inevitably disturbed by bottom trawls (van Kolfschoten and Laban, 1995) it is better that they be recovered and then monitored by palaeontologists and archaeologists rather than simply lost. In order to leave a potential archaeological site *in situ* the threat from erosion and disturbance by trawling needs to be assessed fully.

1.17 The European Convention on the Protection of the Archaeological Heritage (Revised) (The Valetta Convention) was agreed by the Member States of the Council of Europe in 1992, and became law on 20 March 1992. It has been ratified by the UK. The Home Country Heritage Agencies are responsible for implementation of the Valetta Convention each within their area of authority, in Scotland the lead body is Historic Scotland. Most of the Articles concern archaeology on land, control of the trade in antiquities and the prevention of looting. The Valetta Convention (VC) does apply "underwater" (Article 2.ii). Historic Scotland implements VC, and has programmes for coastal archaeology, analysis of erosion and its impact on archaeology (Historic Scotland Archaeological Procedure, Paper 4, 1996) and offshore submarine archaeology, which is covered by the Policy Paper "Conserving the Underwater Heritage" (Historic Scotland, 1999). This is discussed in more detail below. HS takes a pragmatic interest in submarine archaeology throughout the continental shelf area, as would be required by the Valetta Convention. A discussion meeting on submarine prehistoric archaeology hosted by English Heritage in May 2003 concluded that the Home Country Heritage Agencies should be encouraged to accept responsibility for the care of the submarine landscape out to the limit of the UK Continental Shelf (Flemming, 2004, 119).

1.18 In VC the archaeological cultural heritage is also linked with the concept of "historical and scientific study" (Article 1.1) and "research into mankind and the related environment" (Article 1.2.i). This suggests an analogy with the many Articles of UNCLOS relating to scientific research. Article 1.3 of VC states that it applies whether on land or under water.

1.19 VC (Article 2) provides for "archaeological reserves" on land or under water. VC (Article 5) spells out at length the consultation which should take place between planning authorities and developers to avoid damage to archaeological remains. The implications are relevant, by analogy, to procedures which may be recommended on the UK Continental Shelf in SEA7. DTI implements European Directives on protection of the environment, and notes that EU does require that operations on the continental shelf include submarine archaeology and prehistoric remains in the environmental assessment (EU 2001). In the context of submarine prehistoric preservation DTI has drawn the attention of operators and archaeologists to the Pipeline Act 1999, Schedule 1. Also, to the European regulations (EU 2001) from which the following is an extract (Annex 1, para. (f)) requiring an assessment to consider, *inter alia*:

"the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;"

1.20 The terms of reference for the present report require consistence and compatibility with the Guidance Notes on protecting the offshore heritage produced by BMAPA and RCHME (Wessex Archaeology, 2001) and BMAPA and English Heritage (2003) and with the Protocol for reporting finds of archaeological interest produced for BMAPA and English Heritage by Wessex Archaeology (2005). In practice there is no aggregate dredging in SEA7 and the authority of RCHME does not apply in Scotland. Nevertheless, it is reasonable that the principles established in those documents should be taken into account, as, equally, the policy statement of English Heritage in response to its formal appointment as the body responsible for implementing the Valetta Convention in England (EH, 2002, Taking to the Water). In practice the Home Country Heritage Agencies indicate that they take a similar and adaptable view to the need to apply prudent conservation standards both within and beyond the 12-mile Territorial Limit.

#### **UK Law**

1.21 Three components of UK law apply directly to marine archaeology in all parts of SEA7 (English Heritage, nd): The Ancient Monuments and Archaeological Areas Act 1979; the authority of the Receiver of Wrecks, which applies only to shipwreck (Coastguard and Maritime Agency, Department of Trade, Merchant Shipping Act (1995)); and the Protection of Wrecks Act (1973) administered by the respective Heritage Agencies.

1.22 The Protection of Military Remains Act (1986) has the principal concern to protect the sanctity of vessels and aircraft that are military maritime graves. In 2001 the Secretary of State for Defence announced that 16 vessels within UK jurisdiction would be designated as Controlled Sites, and five vessels in international waters would be designated as Protected Places. The purpose of this safeguard is not primarily archaeological, but MoD liaises closely with DCMS and the heritage agencies in the process of site designation.

1.23 During 2004 the consultation report "Protecting our Marine Historic Environment: Making the System work better" was published jointly by the Department of Culture Media and Sport (DCMS) the Welsh Assembly Government, Historic Scotland for Scottish Ministers, and the Department of the Environment Heritage Service of Northern Ireland. It seeks to establish the common UK view including that of English Heritage, which is not a Government body but an agency reporting to DCMS, and the other Heritage Agencies which are within Government Departments. The submerged prehistoric landscape is referred to in paragraphs 13, 16, and 41, but is generally treated only very briefly in comparison with the discussion of shipwrecks. The intention of this consultation is to create a more consistent UK-wide set of standards, detailed definitions, codes of practice, and principles for the management of the offshore submerged cultural heritage in all its forms. Also during 2004 extensive workshops and consultation meetings were held by the Crown Estates Commission and the Institute of Field Archaeologists to increase awareness of the objectives and problems in managing and regulating the submerged cultural heritage (and see Oxley & O'Regan, 2001).

1.24 Within the SEA7 sector direct jurisdiction over the seabed within the 12-mile limit is primarily the responsibility of Historic Scotland, though the Department of the Environment Heritage Service of Northern Ireland has responsibility for the seabed relating to the stretch of their coastlands in the south. Both organisations have expressed a concern to protect the cultural heritage beyond the 12-mile limit, but they do not have legislative obligation to do so. No formal agreement has been considered to establish the boundaries between the areas of responsibility of the different agencies in the SEA7 sector beyond the 12-mile limit, and they collaborate at a technical level to resolve regulation of sites which appear to be close to the approximate boundaries of two agencies.

1.25 The legal position of artefacts on the seabed around the UK currently presents something of an anomaly. Where artefacts are found on land there are clear legal procedures that cover reporting and ownership, these differ slightly between the home countries. Artefacts from submerged sites (below the low tide mark), are not currently subject to similar regulations, however. In the event that finds can be shown to have come from a wreck (even as part of the cargo of a dug out canoe) then they would certainly be covered by the Merchant Shipping Act 1995. However, the main thrust of this report is towards finds from submerged sites and at present there is no strict obligation to report lithics or other material from submerged sites, whether settlement, burial, or other, should they be found on the seabed. Good practice would dictate that they be reported to the Receiver who could then alert the relevant Agency. This anomaly should be resolved as part of an ongoing review of the future of marine heritage protection. It is likely that the use of the Receiver to channel heritage information such as this will be formalised in order to simplify procedures.

1.26 The following paragraphs summarise the situation in the two regimes which apply to SEA7.

#### **Scotland**

1.27 Historic Scotland implements VC, and has programmes for coastal archaeology, analysis of erosion and its impact on archaeology (Historic Scotland Archaeological Procedure, Paper 4, 1996) and offshore submarine archaeology, which is covered by the Policy Paper "Conserving the Underwater Heritage" (Historic Scotland, 1999). The latter paper mentions "...remains of structures which were originally built wholly or partly underwater, such as fishtraps and crannogs and also the remains of human activity which originally took place on dry or marshy land which has since been inundated, either by water levels rising relative to land or by marine or fluvial erosion" (ibid, 1). This clearly includes submerged prehistoric sites inundated by rising post-glacial sea level, as well as historic material. In addition, it is noted that non-archaeological material may be of considerable archaeological value such as for example finds of organic remains in stratified sediments that may be analysed. The legally stated limit covered by Historic Scotland's remit at present is out to the 12 mile limit of Territorial Waters (ibid, 2), but serious research concern is now applied to the problems of marine archaeology in deeper water out to the shelf edge.

1.28 The Ancient Monuments and Archaeological Areas Act 1979 (AMAA 1979) gives powers to schedule monuments within the Territorial Seas. In practice this act was designed to protect “structural remains” rather than deposits of artefacts. This is important for any consideration of the traces of early settlement for these are less likely to comprise identifiable structures, though the Act does cover material in caves, another likely type-site for early settlement. There have been some moves to remedy this weakness, but in practice few artefact deposits (eg: typically a scatter of stone tools) have been considered for scheduling, whether on land or underwater. To date the only application of AMAA 1979 underwater in Scotland has been to wrecks: the scheduling of seven vessels from the German High Fleet that lie in Scapa Flow, and the protection of eight fishing vessels in Aberlady Bay. AMAA 1979 is a tool for the protection of submerged prehistory that has still to be used. A full discussion on AMAA 1979 in relation to the underwater heritage is given in the report of English Heritage’s Marine Legislation Project (nd).

1.29 The Protection of Wrecks Act (1973) is administered in Scotland by Historic Scotland for Scottish Ministers, and this applies out to the 12-mile limit. Discussion of this act is relevant to maritime archaeology rather than to the type of archaeological site and landscape considered here.

1.30 It is important to note that HS takes a pragmatic interest in submarine archaeology throughout the continental shelf area, as would be required by the Valetta Convention.

1.31 The Royal Commission on the Ancient and Historical Monuments for Scotland (RCHAMS) maintains an archive that holds records of all known archaeological sites in Scotland, and this is freely accessible to the public and scholars through an internet search system known as CANMORE and CANMAP (<http://www.rcahms.gov.uk/>). RCAHMS runs a Maritime Project of the National Monuments Record of Scotland (NMRS) which seeks to document maritime sites, defined as ships, boats, and crashed aircraft, but not built structures or prehistoric sites (RCAHMS, 2003).

### **Northern Ireland**

1.32 The Historic Monuments & Archaeological Objects (NI) Order 1995 covers monuments in territorial waters, which are defined as those monuments situated in, on or under the sea bed within the seaward limits of United Kingdom territorial waters adjacent to the coast of Northern Ireland. Where the monument is under the ownership or guardianship of the Department of Environment and Heritage, references to land associated with the monument include any part of the sea bed occupied by the Department.

1.33 The above Order (1995) ensured that Northern Ireland was already satisfying and, in fact, surpassing the requirements of the VC. Various officers in Environment and Heritage Service have responsibilities for enforcing compliance with this Order.

1.34 In practice, Northern Ireland has had a few large-scale applications for off-shore wind farms and aggregate extraction. With regard to the largest wind farm, archaeological mitigation was recommended to deal with all the submerged sites affected, though the application has now stalled. It was the view of the Northern Ireland government that aggregate extraction would be too detrimental to the marine environment and no licenses have been granted. Where developments such as outfalls and inter-connector pipes with Britain occur mitigation has been recommended for submerged and coastal sites.

### **Non-statutory Measures**

1.35 It is good practice for government agencies, planning authorities, and industry representatives to develop non-statutory guidance, recommendations, or codes of practice for the protection of archaeological sites. Consultation may take place through scholarly organisations such the Council for British Archaeology (CBA), or the Nautical Archaeology Society and through professional organisations such as the Institute of Field Archaeologists (IFA).

1.36 The Scottish Coastal Archaeology and the Problem of Erosion (SCAPE) trust based at the University of St Andrews has created a data base and GIS system to record and analyse all coastal archaeological sites which are, or could be, threatened by coastal erosion ([www.scapetrust.org](http://www.scapetrust.org)). The contents of this data base with reference to the SEA7 area have been reviewed (section 3 & 4).

1.37 The Marine Archaeological Resource (Oxley & O’Regan, 2001) is a comprehensive paper commissioned by the Institute of Field Archaeologists and designed to introduce the importance of the

marine resource (defined to include submerged landscapes and prehistoric and historic sites, as well as maritime heritage such as shipwrecks), as well as to provide guidance to ensure the well-being of the resource.

1.38 The British Marine Aggregate Producers Association (BMAPA) has collaborated with the Royal Commission on the Historical Monuments of England (RCHME) to produce a Consultation Document (Wessex Archaeology, 2001) and Protocol (Wessex Archaeology 2005) for the reporting of finds of archaeological interest. The BMAPA/RCHME code discusses Environmental Impact Assessment (EIA) which should include a description of the measures envisaged in order to avoid, reduce, and if possible remedy significant adverse effects on the historic environment. Although there have been, as yet, no licences for aggregate dredging in Scotland the Protocol is relevant here because by analogy, broadly equivalent principles may be applied to monitoring and managing the archaeological impact of the offshore Oil and Gas Industry. It includes reference to prehistoric sites, and notes the necessity in some cases for pre-dredge surveys and evaluation. Exclusion zones can be implemented around areas where the presence of prehistoric assemblages has been confirmed. Although it may be possible for a suitably experienced archaeologist to visit onshore screening plants periodically to carry out a visual search for stone tools and other human artefacts, such procedures are unlikely to be productive. Copies of reports on any sites located and the measures taken should be lodged with the appropriate Curators and the NMR and NMRS as appropriate. A Guidance Note on marine aggregate dredging and the historic environment has been published by BMAPA, EH, and Wessex Archaeology (BMAPA and English Heritage 2003), and initial reports in England include a background paper on Palaeolithic and Mesolithic archaeology and marine aggregate dredging by Wenban-Smith (2002).

#### **Summary of legal situation and the prudent practices to adopt in Scottish Waters of the UK sector**

1.39 No Government agency in the UK has been formally allocated the responsibility to monitor, manage, or protect the prehistoric cultural heritage on the UK Continental Shelf outside Territorial Waters. Within Territorial Waters the responsibility rests with Historic Scotland in Scottish Waters, and the Environment and Heritage Service of Northern Ireland. Each of these agencies is concerned to protect the cultural heritage beyond that limit in their respective adjacent areas of the UK Continental Shelf. Through signing UNCLOS, the UK is duty bound to observe the stipulations of UNCLOS Article 303, while the draft UNESCO Convention indicates the responsibilities which are, by general consensus, deemed to be reasonable in regard to prehistoric cultural heritage on the Continental Shelf. The principles of the Valetta Convention, broadly interpreted, might apply on the Continental Shelf since it does apply underwater, but no UK agency has been statutorily designated to implement it outside Territorial Limits. It is therefore prudent, though not legally binding, for all parties, government agencies, regulatory authorities, commercial operators, and voluntary bodies to act as if their standards of conduct were to be judged, in broad measure, by the standards of those documents.

1.40 During 2003 an international meeting of prehistoric archaeologists from countries bordering the North Sea was held under the auspices of English Heritage. Senior representatives of English Heritage were present, and recommendations agreed at the end of the meeting were circulated in writing to obtain confirmation from all concerned. With regard to the SEA7 area, these recommendations are important as an indication of "best practice". The following extract from the proceedings (Flemming 2004, 119) indicates the direction in which agency responsibilities may evolve.

#### **"Recommendations to English Heritage**

- (i) English Heritage, in co-operation with the other appropriate UK Home Country heritage agencies, should be encouraged to accept the responsibility to undertake the care of the submarine landscape out to the edge of the UK Continental Shelf, and should consider the necessary legal and administrative steps to do this.
- (ii) English Heritage, in co-operation with the other appropriate UK Home Country heritage agencies, should continue to co-operate with other UK government regulatory bodies to ensure the protection of submarine prehistoric sites and the submerged prehistoric landscape, including consultation with DTI, DEFRA, CEFAS, and BGS.
- (iii) English Heritage in co-operation with the other appropriate UK Home Country heritage agencies, should act as the expert bodies of reference in regard to the DTI

and offshore oil and gas, European Directives, and other industrial liaison including advising other agencies regarding mitigation required to limit damage caused by offshore aggregate extraction, windfarm installations, pipelines, coastal engineering, and fisheries to the submarine prehistoric heritage."

## 2. Background to the archaeology and overview of sea level changes

### Background

2.1 During the last million years lower relative sea levels have meant that the British landmass has been connected by dry land to the mainland of Europe for long periods. This has affected the early settlement history of Britain, in that it has to be considered as a continuation of the NW European plain. Figure 2.1 illustrates the Late Devensian (c.22,000 yrs BP) ice maximum palaeogeography for the British Isles. This process has also meant that considerable amounts of dry land existed to the west of Scotland, beyond the Outer Hebrides. All of this, now submerged, land was once available for human settlement. Archaeological evidence from the land suggests that the archaeological potential of this sea bed area should be taken seriously, and this is supported by finds of artefacts (sparse) as well as of animal bone (more frequent) (see below, section 3). This document is designed to look at the background and potential of the sea bed in the area known as SEA7.

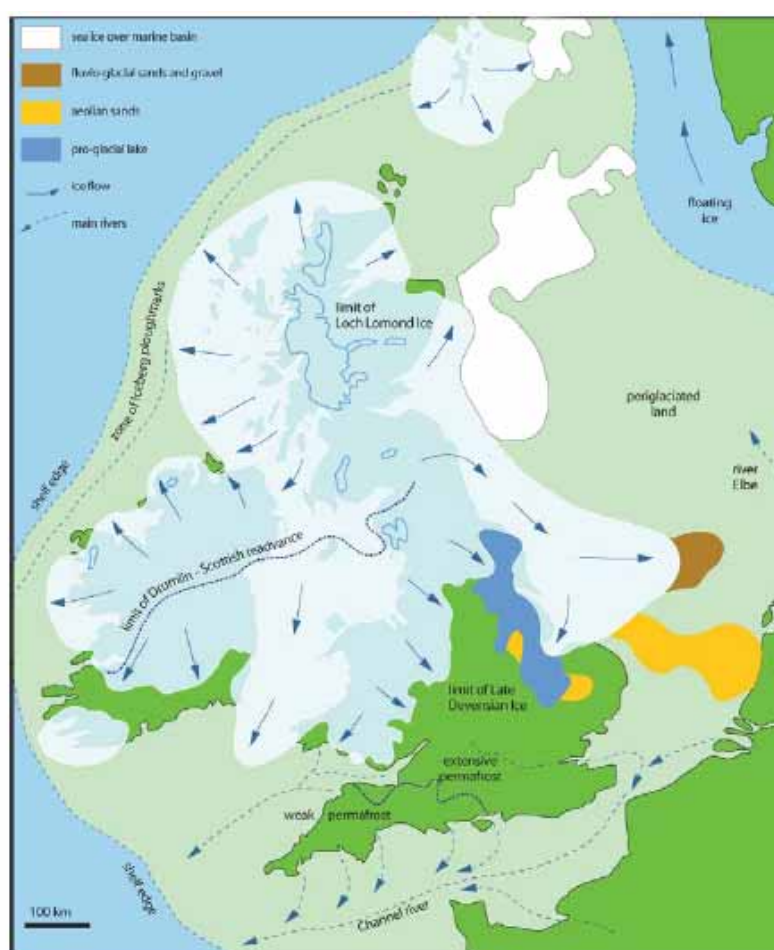


Fig 2.1 Reconstruction of palaeogeography during the Late Devensian glacial maximum (after Woodcock and Strachan, 2002).

2.2 The earliest occupation of the British mainland by hominins, *Homo heidelbergensis*, occurred about 500,000 years Before Present (BP) (Stringer & Andrews, 2005), and recent evidence suggests that it could be as early as 700,000 years BP (Parfitt, 2006). Sites from this period comprise both open air camp sites and cave sites, though they are relatively rare. Finds comprise flaked stone tools, sometimes of considerable size, along with animal bone that may show signs of butchery or modification for use as tools (Pitts & Roberts, 1997). It is thus possible that evidence for various stages of the early occupation of Britain may survive in sediments or submerged caves on the continental shelf. Life throughout this period was based on hunting and foraging, with increased reliance into more



recent times on coastal and marine resources. Reconstructions of the North Sea terrain as dry land (known as “Doggerland”, Coles, 1998) suggest that it would have had much to offer these early hunters (Fischer, 1995). Although ice cover must have had a considerable impact on any local inhabitants for much of the time, work on existing sites, and the study of northern coastal hunting cultures today, suggest that the coastal margins in proximity to ice are often of particular value for settlement, offering a range of resources and the means to harvest them. Sea ice and off shore skerries, for example, play an important role in the traditional Inuit lifestyle (Ehrlich, 2003), and there is evidence for human occupation in arctic Norway from around the 9<sup>th</sup> millennium BC (Bjerck, 1995). The (now submerged) continental coastlands of Scotland are likely to have played an important role in attracting and supporting early settlement.

2.3 In practice, most of the Scottish UK continental shelf has been covered at various times by successive ice sheets, which have served to both scour the land surface and deposit sediment, thus reducing the chances that early settlement remains might survive and suggesting that, where they have, they may well be buried under glacial material. Early archaeological deposits are thus unlikely, though there are cases on land where early archaeological deposits have survived over-running by ice sheets (eg: High Lodge, Mildenhall; Ashton & Cook, 1990) permitting palaeoecological studies and artefact retrieval. It is also possible that the more sheltered environment within a cave might serve to preserve early deposits. Submarine caves are thus of considerable importance, though caves are not without their own internal complexities (eg Creag nan Uamh, Murray *et al*, 1993).

2.4 The Ancient Human Occupation of Britain (AHOB) project led by Chris Stringer at the Natural History Museum ([http://www.nhm.ac.uk/hosted\\_sites/ahob/index\\_2.html](http://www.nhm.ac.uk/hosted_sites/ahob/index_2.html)) has analysed the various phases during which hominins could cross into the British Isles, and when they were either isolated, or absent (Fig. 2.3). From this figure it can be seen that in (relatively) recent times Britain was cut off from mainland Europe only briefly for about 10,000 years, at the last interglacial 125,000 BP. For most of the period since the earliest human occupation 700,000 years ago, Britain has been a part of continental Europe, though for much of this time northern Europe has been subject to cooler, even glacial, periods. As a rough correlation the periods when Britain has existed as an island relate to the warmer, inter-glacial periods. The study of the development of settlement in Britain from its earliest beginnings is very much on-going. Each new find can alter the picture. The AHOB project is designed to apply the most up-to-date techniques and bring together a wide spectrum of evidence, though it has not so far focused on Scotland.

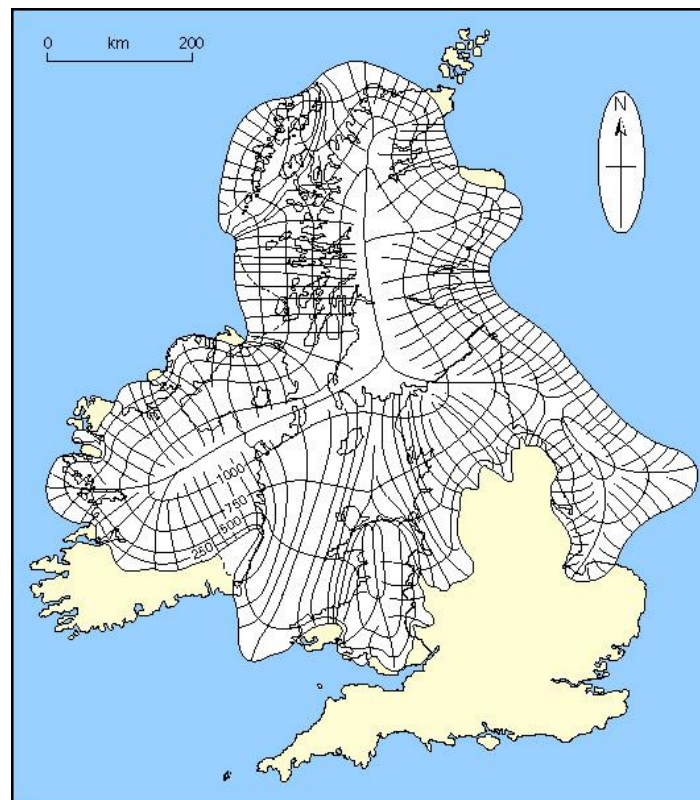


Figure 2.2 Reconstruction of the limit of the Late Devensian ice sheet maximum over the British Isles.

2.5 In practice, evidence for human settlement in Scotland is lacking for the period prior to the end of the last Ice Age some 11,000 years ago. Given the existence of people further south in Britain it is notable that Scotland was completely covered by ice during the last glaciation (Late Devensian) (Fig. 2.2) and it seems likely that a population did exist here prior to that, but that any evidence for this has either been destroyed or buried beneath glacial deposits. Isolated finds of stone tools that might indicate earlier (Palaeolithic) settlement are generally considered to be unreliably contexted (Saville, 1997) and thus do not provide hard evidence for a Scottish Palaeolithic. Conditions in Scotland were certainly suitable for settlement at earlier periods as shown by the reindeer assemblages from Creag nan Uamh (Murray et al, 1993), and this is supported by other environmental work that goes back into earlier periods (eg Van Andel and Davies, 2003).

2.6 The generally accepted earliest date for archaeological evidence relating to the human occupation in Scotland relates to the 11<sup>th</sup> millennium BP (Ashmore, 2004), after the last glaciation. This relates to the period known archaeologically as the Mesolithic (Wickham-Jones, 1994). The Mesolithic population of Scotland comprised nomadic hunter-fisher-gatherers; the evidence is ephemeral (scatters of stone tools and discolorations in the soil may provide the only clues as to a Mesolithic site; Warren, 2005), and new sites often mean that the date of the earliest settlement can be pushed back slightly further. Nevertheless, the ice cover across Scotland at the height of the last glaciation provides a useful blank slate for research into recent settlement history.

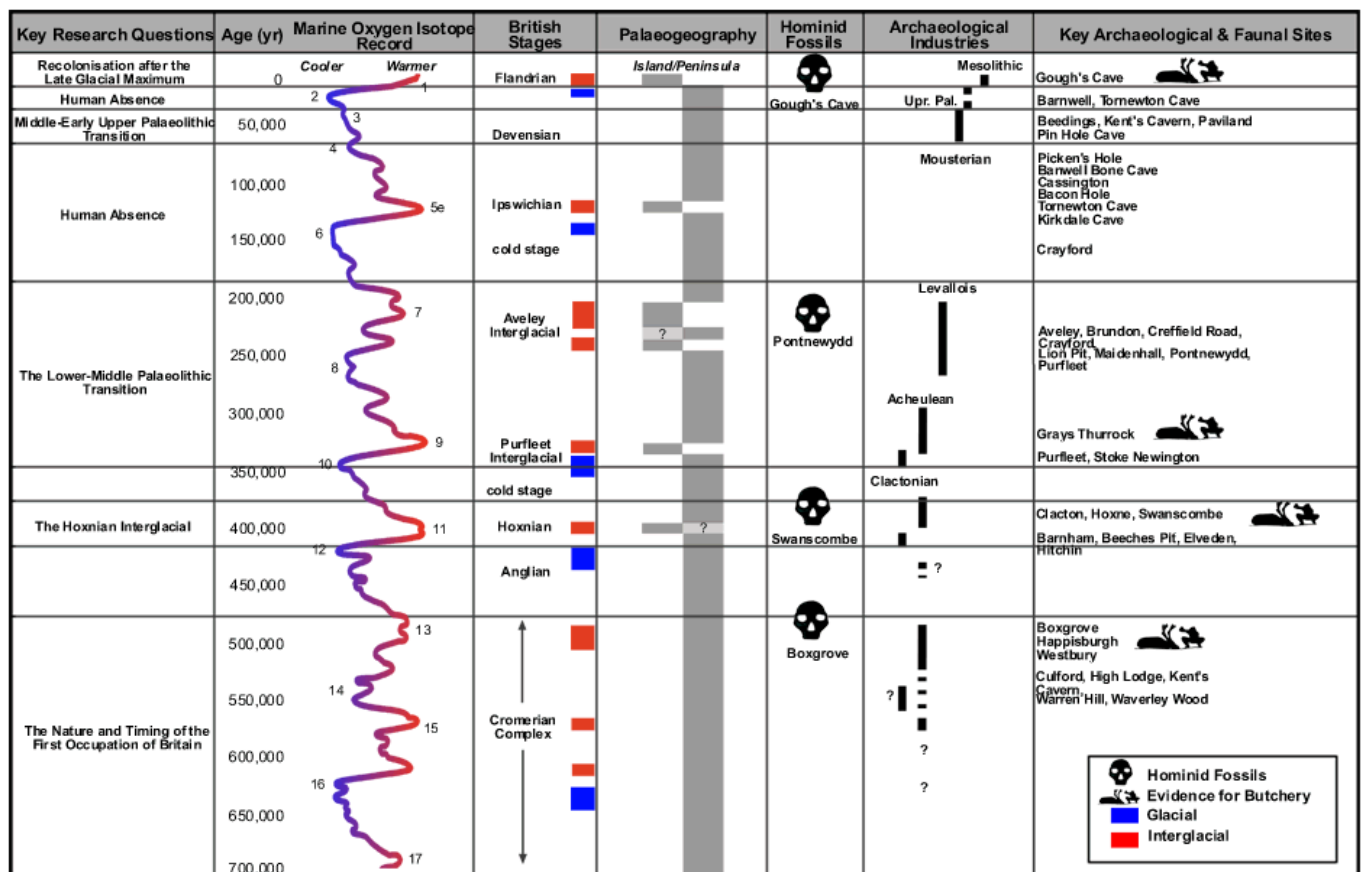


Figure 2.3 Condensed summary of factors affecting the human occupation of Britain in the last 0.7 million years. Sea levels, ice ages, island/peninsula, fossils, archaeological tool industries, and key sites. (Stringer 2004, AHOB website, [http://www.nhm.ac.uk/hosted\\_sites/ahob/overview\\_time\\_chart.gif](http://www.nhm.ac.uk/hosted_sites/ahob/overview_time_chart.gif)).

2.7 Some 5000 years ago Mesolithic Scotland gave way to the Neolithic, with the introduction of farming and considerable changes to other aspects of life (see below section 3). From this period onwards archaeological sites are both more common and comprised of larger, more obvious, remains that were often stone built. The history of relative sea level change is such that in some areas even relatively recent sites may have been submerged. On-going coastal erosion, a product of adverse weather as well as of rising sea levels, also means that sites are being destroyed and some finds making their way onto the sea bed.

2.8 A brief consideration of the environmental evidence shows that at the time that the first inhabitants were settling down in Scotland after the last Ice Age so the landscape was recovering. The world of Mesolithic Scotland was one of open woodland (Edwards, 2004; Tipping, 2004) with birch, hazel, oak and pine dominating in various parts of the country. The woodlands provided a useful resource to the Mesolithic inhabitants of Scotland and examples of tree stumps in both peat and intertidal deposits throughout SEA7 bear mute testimony to this. Peat growth in Scotland generally took off in more recent times, some 3000 years ago, but there are many examples of peat deposits at, or near to, present sea level, that show that some peat had started to grow well before this, particularly in poorly drained coastal areas, and in situations where sea level was relatively lower. Drowned woodlands and submerged peats are useful indicators for the archaeologist of the potential of the submerged landscape to hold archaeological information, though there is only one example in SEA7 where artifacts have been recorded from such deposits (Clachan Old Harbour, Raasay, Hardy & Wickham-Jones, forthcoming). Elsewhere in Britain footprints preserved in soft muds along inter-tidal flats have been dated to the Mesolithic (Bell *et al*, 2000).

#### **Relative Sea level changes – Lateglacial, Loch Lomond Stadial (Younger Dryas) and early Holocene**

2.9 According to most authorities, the western extent of the Late Devensian ice sheet reached as far as the continental shelf (Figs. 2.4). During the maximum extent of glaciation regional sea level was ca. 120 m lower than present (Fairbanks, 1989). This was caused, not by the growth of the last British ice sheet, but by the growth and expansion of ice sheets worldwide. However, owing to the loading of the last British ice sheet on the underlying lithosphere (crust), the position of relative sea level during the last glacial maximum around the former ice sheet was much higher. This was due to the glacio-isostatic depression of the crust beneath the ice, the amount of depression increasing towards the western Highlands where the ice was thickest. During the last glacial maximum, the sea floor beyond the maximum limit of the ice and across a belt several hundred km in width was raised vertically. This was due to a compensatory radial outward movement of subcrustal material from beneath the lithosphere underneath the ice sheet (Peltier, 1998). In such areas during the glacial maximum, therefore, the sea level was lowered on the one hand but on the other the crust beneath the seafloor was raised – causing a regional shallowing. Figure 2.4 shows a schematic palaeogeography off western Scotland. Areas of glacio-marine sedimentation, possible land areas and over-deepened basins are noted. The position of the shelf break is seen to the north west of the Outer Hebrides.

2.10 As the ice sheet started to melt regional sea level started to rise as a result of the melting of ice sheets worldwide. At the same time, as the British ice sheet started to retreat and thin, the land underneath the ice sheet started to rise. The rate of vertical rise of the land surface beneath the ice varied regionally with the greatest rates of rise in areas where the ice was formerly thinnest. By contrast, smaller amounts of vertical rebound took place towards the edge of the ice sheet where the ice thicknesses were thinner. Beyond the ice margin, these processes were accompanied by quite different vertical land movements. Here, as subcrustal material started to migrate back into areas underneath the lithosphere underlying the ice sheet, the areas of ocean floor started to sink (Lambeck *et al*, 1996).

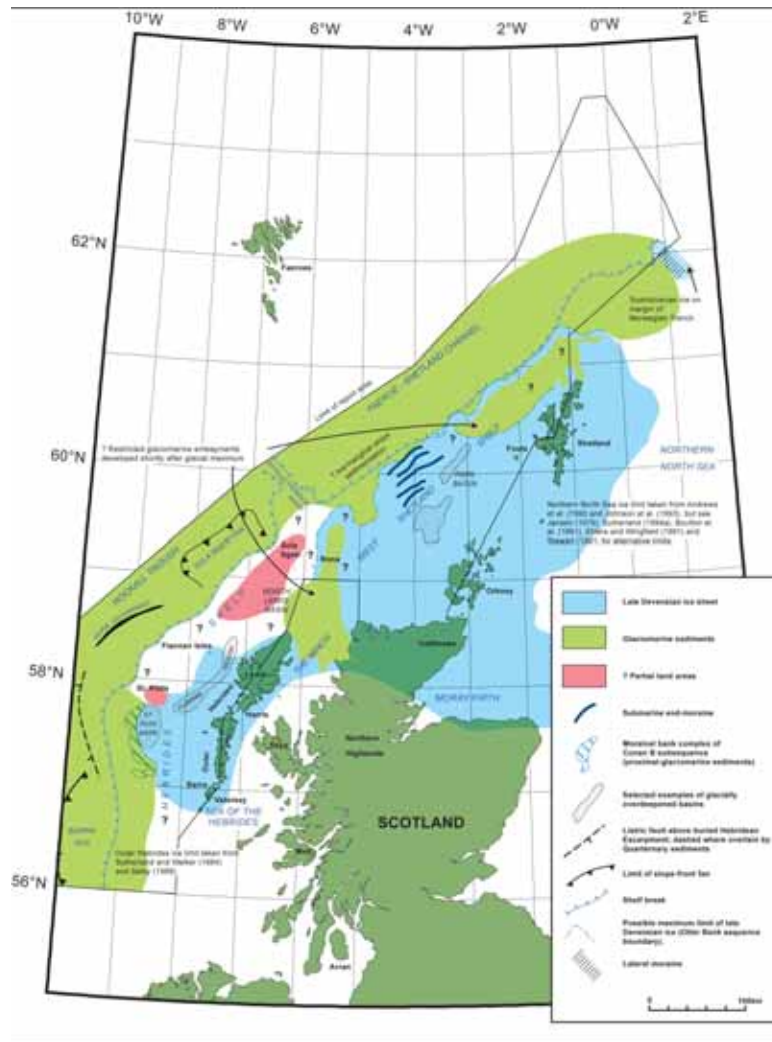


Figure 2.4 Schematic palaeogeographic reconstruction showing the inferred extent of the late Devensian ice sheet at, or shortly after, the glacial maximum. (After Stoker *et al*, 1993). Note the shelf break to the west of the Outer Hebrides. (IPR/40-3C British Geological Survey. ©NERC. All rights reserved)

2.11 Accompanying the eastward retreat and thinning of the ice sheet was a rapid rise in regional sea level. For the most part the early stages of ice sheet decay (deglaciation) were characterised by a rate of rise of (glacio-eustatic) sea level (ie. an increase in the global volume of ocean water caused by melting ice sheets worldwide) that took place at a faster rate than the rate of crustal rebound around the edge of the ice sheet. Thus, one might imagine that as the ice sheet retreated eastwards towards the present Scottish mainland the rapidly rising sea level was immediately flooding into land areas exposed by the melting ice. Thus, during the early stages of regional deglaciation there were no new land areas exposed for possible Palaeolithic habitation.

2.12 This complex interplay between the global eustatic component of sea level rise and the rebounding of the land with the removal of the ice sheets leads to a variable pattern of relative sea level changes around the Scottish coast. For Scotland, this trend of rising sea level outpacing the rate of rise of the land surface, continued until the end of the Younger Dryas (Loch Lomond Stadial. C.11-10,000 radiocarbon years BP) period. For archaeology, the end of the Younger Dryas is highly significant since it is at this stage that parts of the Scottish coastline close to the centre of glacio-isostatic rebound in the western Highlands start to experience a rate of crustal rebound that is faster than the rate of rise in regional sea level (ie. increase in the global volume of ocean water). It is for this reason that the curves of relative sea level changes for Arisaig and Islay, Figure 2.10, shows this trend clearly. Farther west and north (i.e. towards the periphery of the UK landmass) however, (throughout the western Isles and Orkney and Shetland) the rate of crustal rebound remained insufficient to

exceed the rate of rise in sea level caused by an increasing global ocean volume of seawater. Such areas, therefore, continued to experience net submergence.

### Late Glacial Shoreline isobase map

2.13 The relative sea level history of Scotland during the Holocene (last 10,000 years) is complex. This is due to the overburden of ice when the last Scottish ice sheet covered the region. Ice cover was concentrated in the western Highlands with thinner areas of cover towards the peripheries of Scotland. Thus, the area around Oban in the west had greater thickness of ice than areas of the Outer Hebrides, the North coast and the Northern Isles. This leads to varying amounts of isostatic rebound and therefore, the position in the landscape where we see relict Shorelines today. For the Oban area, this translates to visible shorelines dated to c.10ka years up to 10 metres OD. However, the same Lateglacial Shoreline is well below present sea level in the areas of Coll and Tiree, Islay and the Solway Firth coastline. Predicted shorelines for the Outer Hebrides and the Orkney Isles suggest they are located between 20-30 metres below present.

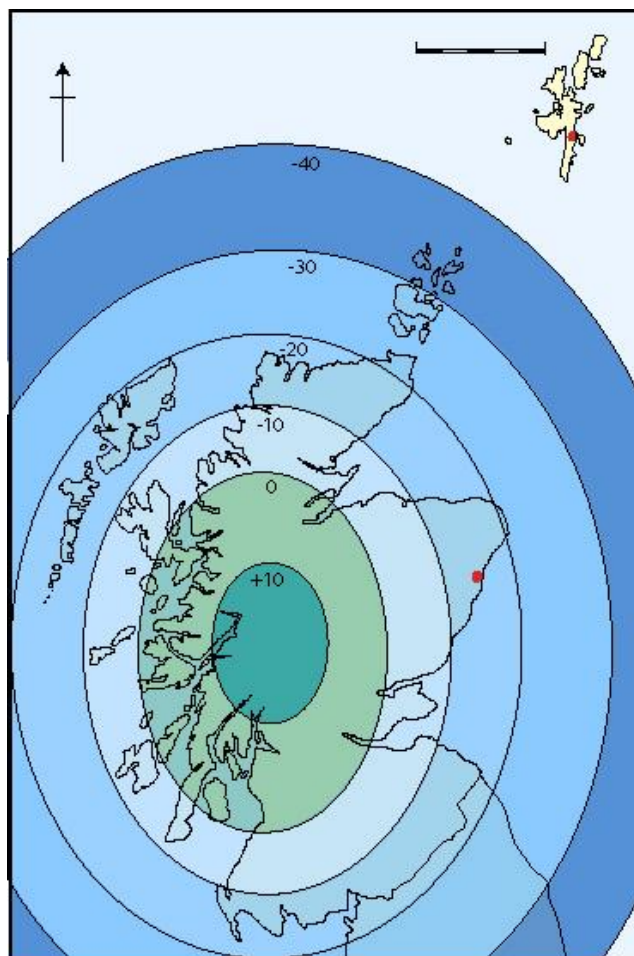


Figure 2.5 Shoreline uplift isobases (m OD) for the Main Lateglacial Shoreline. NB: Areas shaded green are above present sea level, all blue shading is below sea level.

2.14 Shoreline uplift isobases (in metres Ordnance Datum (OD)) for Main Lateglacial Shoreline of Younger Dryas age have been extrapolated to -40m water depth (below OD) based on various sources (Figure 2.5). The best estimate of regional eustatic sea level for the Younger Dryas is between -40m and -45m OD. Thus, the shoreline isobases are plotted to -40m but no further. The coastal areas shown inside (and above) the 0m shoreline contour indicate those areas where any coastal settlement archaeology of early Holocene age would be preserved at or above present day sea level. Outside of the 0m isobase contour, any existing Mesolithic coastal settlement archaeology could occur below sea level across those areas of seabed shallower than the contours indicated.



2.15 Fig. 2.6 and Fig. 2.7 shows a GIS reconstruction of a) dry land areas around Scotland's west coast that would have existed at the start of the Holocene interglacial. The reconstruction is based on the intersection of shoreline uplift isobases (in metres Ordnance Datum (OD)) of Main Lateglacial Shoreline of Younger Dryas age extrapolated to -40m water depth (below OD) (based on various sources) with bathymetric data. The best estimate of regional eustatic sea level for the Younger Dryas is between -40m and -45m OD. Thus the shoreline isobases are plotted to -40m water depth but no further. The reconstruction thus depicts those now submerged land areas where Mesolithic settlements could have existed. b) early Mesolithic palaeogeography of South Uist, Benbecula and North Uist. Note that the reconstruction does not include any component of former vertical land movement due to tectonic subsidence.

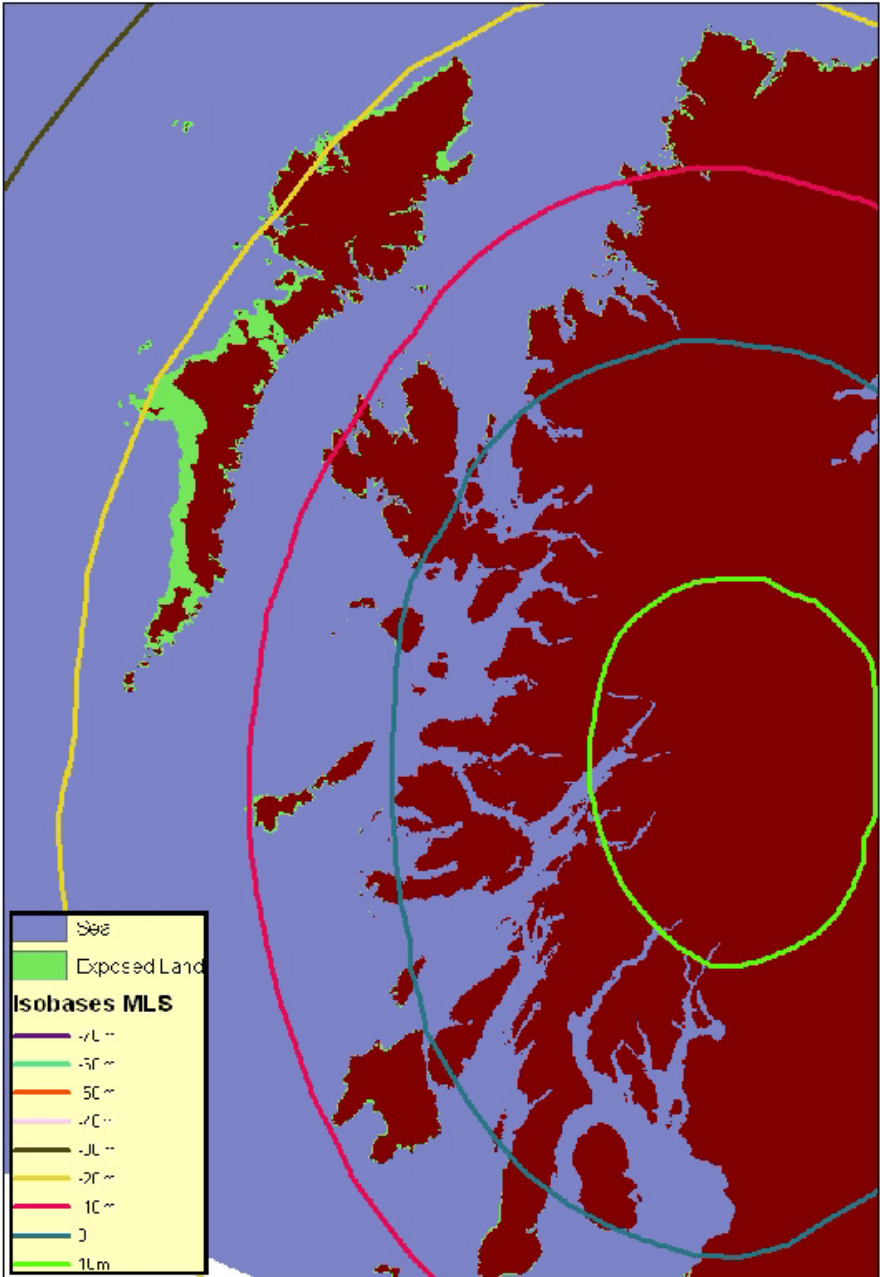


Figure 2.6 GIS reconstruction of dry land areas around Scotland's west coast that would have existed at the start of the Holocene interglacial (GIS courtesy of Richard Bates, University of St Andrews).

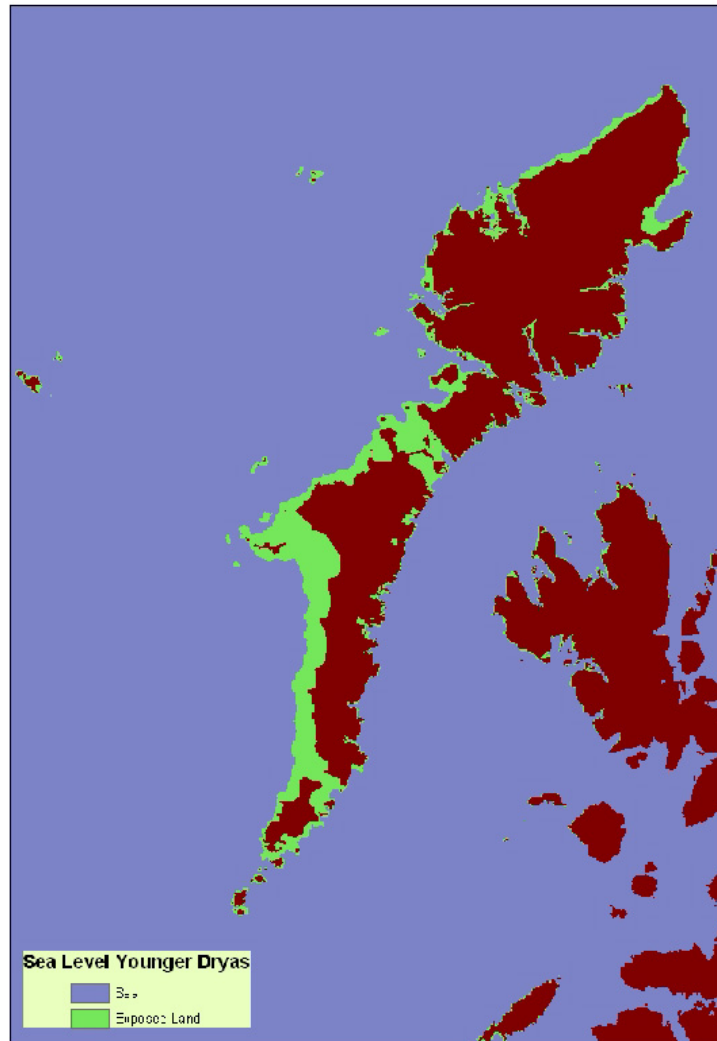


Figure 2.7 GIS reconstruction of dry land areas around the Outer Hebrides that would have existed at the start of the Holocene interglacial (GIS courtesy of Richard Bates, University of St Andrews).

### Holocene Relative Sea Level Changes

2.16 Smith et al. (2006) (Fig 2.8) show the most recent analysis of Shorelines around the Scottish coast with the production of empirical models, based upon shoreline altitude data (Firth *et al*, 1993). The isobase maps show the sequences of Holocene shorelines reflecting variations in the relationship between isostatic movements and sea-surface change with increasing distance from the centre of the Late Devensian ice sheet. Thus, towards the heads of estuaries (such as the Forth, Tay, Clyde) close to the centre of uplift, the evidence is of high visible shorelines. Towards the periphery of Scotland the evidence for relative sea level change is contained in buried sequences below present sea level. The SEA7 area includes areas around the Scottish coast of high relative sea level change



(up to 10m at Oban and areas far to the west, on the periphery of the Scottish uplift centre (Outer Hebrides) where the evidence for Holocene relative sea level changes are buried below present coastal sediments. Areas of the sea floor may have been dry land 10-12,000 years BP; flooded by the continuing rising sea (due to ice-melt) around 7000 years BP; and then exposed again a few thousand years later by the isostatic uplift of the land. Figure 2.10 shows a range of relative sea level curves produced from observational data to illustrate the variability along the Scottish Atlantic coastline.

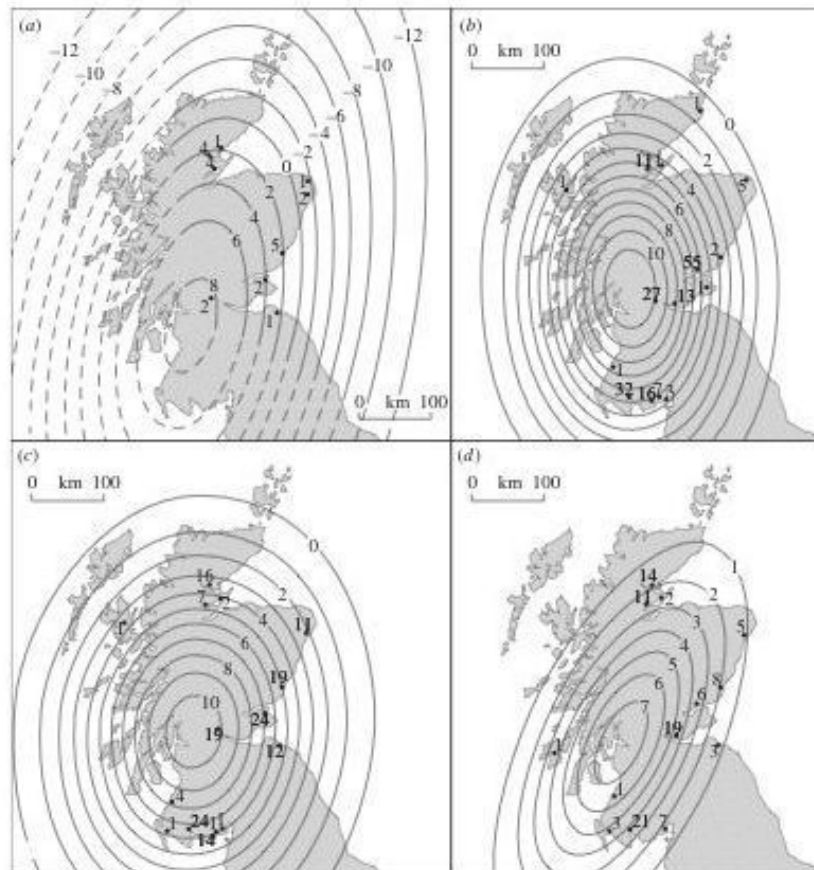


Figure 2.8 Modelled surfaces for various Holocene Shorelines for the Scottish mainland (after Smith *et al.*, 2006)

### Models of Postglacial isostatic adjustment

2.17 Rheological models, glacio-hydro-isostatic rebound models, based upon geophysical data and modelled to the available sea level data have been developed by Lambeck (1993, 1995) and Peltier *et al.* (1998, 2002). British ice sheet models since the Last Glacial Maximum have also been developed (Fig 2.9, Shennan *et al.*, 2002). The model ICE-4G (VM2) is the model used to constrain, and gives the best fit to the observational data, for the relative sea level data for the British Isles (Peltier *et al.*, 2002). Nevertheless, there are discrepancies between model predictions and the observational data sets for some areas of Scotland (e.g. Orkney and the North of Scotland (Wick). Models of glacio-hydro-isostatic sea level change have also been developed for the Irish Sea Basin as the original British Isles models failed to represent the changes observed along the Irish Sea margins since deglaciation. (Lambeck and Purcell, 2001).

2.18 Fig.2.9 (Shennan *et al.*, 2000) shows the sequence of changing coastline and the impact of rising sea level on the British Isles, including the northern islands. At 22,000 BP Scotland and the western Isles are covered by the ice sheet, with Orkney just on the edge, and small ice sheet on Shetland (Woodcock and Strachan, 2000). By 14,000 the ice cap has retreated almost completely to the modern coastline of Scotland, and by 12,000 BP the ice has entirely melted, although there is a brief period of renewed ice cover, the Loch Lomond stadial, around 10,000 BP.

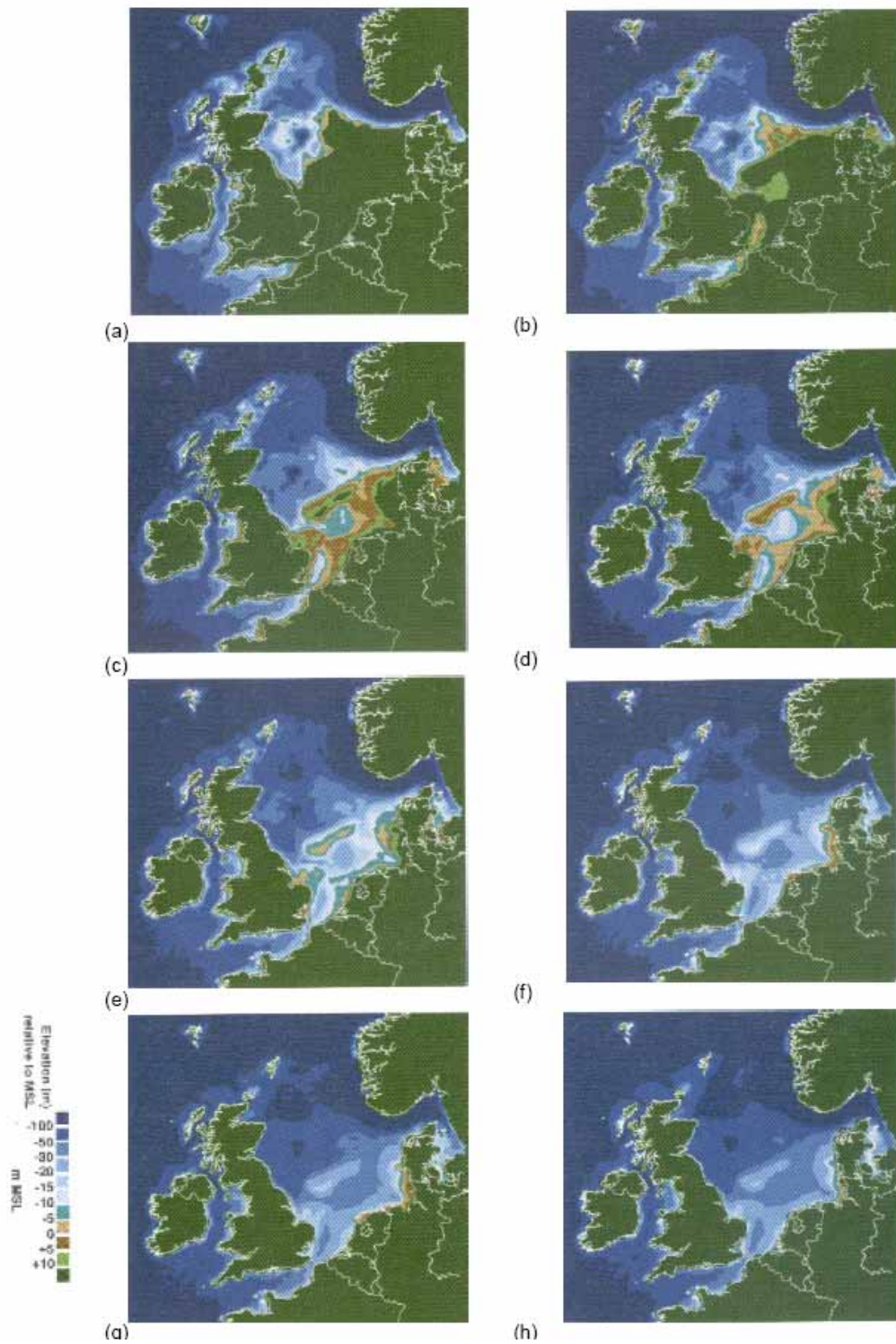


Figure 2.9. Palaeogeographic reconstructions of Northwest Europe a) 10,000 yrs BP, b) 9,000 yrs BP, c) 8,000 yrs BP, d) 7,500 yrs BP, e) 7,000 yrs BP, f) 6,000 yrs BP, g) 5,000 yrs BP, h) 4,000 yrs BP. Elevations (m) relative to Mean Sea Level (MSL), depths below MSL are negative. (After Shennan *et al.* 2000).

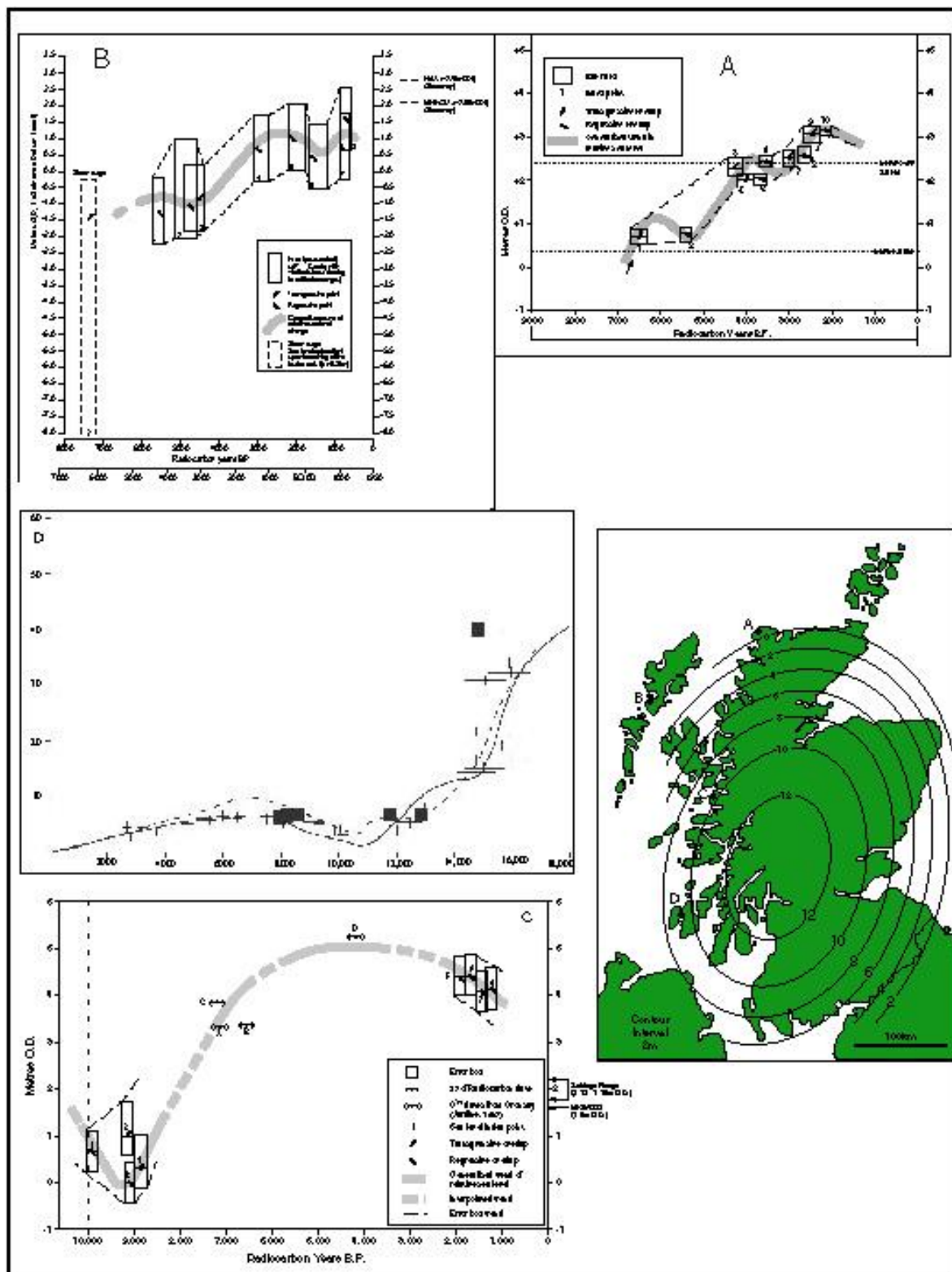


Figure 2.10 Relative sea level graphs around western Scotland (A after Dawson, 1999; B after Jordan, 2004; C after Dawson *et al.* 2001, and D after Shennan *et al.*, 2005).

## Relative Sea Level Changes

### 2.19 Rockall

The Rockall Plateau is an extensive shallow water area to the west of the British Isles (Fig. 2.4) and separated from the Scottish mainland by the 3000 metre deep Rockall trough. The trough is a SW trending basin which lies between the mainland and the Rockall Plateau. Rockall Island is the only area to appear sub-aerially on the Plateau. A possible wave-cut platform around the island exists at c.110m. Beyond the island a break of slope at c. 180m depth and dredged beach material suggest sub-aerial erosion during a Holocene sea level stance (Roberts, 1975). The continental margin northwest and west of the British Isles consists of a broad continental shelf, a narrow continental slope and a broader continental rise. Between latitudes 55° and 60°N, an inner and outer shelf are separated by the Outer Hebrides. A shallow basin separating the islands of Rona, Flannan and St Kilda from the Outer Hebrides is the only area of relief on the outer shelf.

### 2.20 St Kilda

The St Kilda archipelago (57°49'N, 08°35'W) lies 64km to the west of the Outer Hebrides towards the edge of the western Scottish continental shelf. The shelf slopes gently westward from the Outer Hebrides to a depth of 120-140m around St Kilda over a distance of c.100 km. There is little sediment deposition on the shelf, mainly erosional landforms. Near-vertical and cliff-like, the marginal slope exhibits a pronounced break of slope with the western margin fronted by near-level surface at c. 120m depth (Sutherland, 1984). The cliffed coastline of the islands and stacks that comprise the archipelago plunge to depths of -40m. This shallows at -120 to -80 m and then to -40 around the base of the clifflines around the islands. This upper erosional surface culminates in clear marine erosional platform at c. -40 m. Planation of the bedrock surfaces and cliff formation must have occurred during periods of sea-level stability. It is suggested that during the peak of the late Devensian ice sheet, sea levels around St Kilda were around 120 m lower than present. The marine planation surfaces that occur between -70 and -40 m are thought to have been formed during the last period of N Hemisphere glaciation; the Loch Lomond Stadial (Younger Dryas, 11,000-10,000 BP) when local relative sea level may have stood around -40 m (Sutherland, 1984). The subsequent 40 m rise of sea level is attributed to the mild conditions of the Holocene when marine erosion has been less effective.

### 2.21 Outer Hebrides

The sedimentary evidence for Holocene relative sea level fluctuations in the Outer Hebrides is somewhat limited. Radiocarbon dating of intertidal peats can be indirectly related to a sea level at least as low as the occurrence of the peat/organic deposits. Thus, a date of c.5,700 <sup>14</sup>C years BP was obtained for intertidal deposits in Benbecula (Ritchie, 1998) which allude to a sea level at least 5 m lower than the present. Recent work on the Isles of Lewis and Harris by Jordan (2004) shows that the mid-late Holocene relative sea level record can be summarised into two main events occurring between 5500±60 <sup>14</sup>C years BP and 4500±100 <sup>14</sup>C years BP, and between 3000±80 <sup>14</sup>C years BP and 820±50 <sup>14</sup>C years BP. Figure 2.6 shows the sea level curve for the sites studied with the two periods clearly identified. The index points 1 to 3 indicate the first mid Holocene regression/transgression period, which is then followed by the index points 4 to 8 which show late Holocene fluctuations as identified from other peripheral glacio-isostatic areas of Scotland (Dawson and Smith, 1997). Rising sea levels throughout the Holocene controlled the onshore movement of vast amounts of sediment from the extensive and fairly shallow coastal shelf to the west, which in turn has developed into the modern beach and dune systems and the machair grassland that fringes the western Atlantic seaboard of the whole island chain. The sea level index points identified by Jordan (2004) are thought to be representative of coastal barrier formation as opposed to direct shoreline development. However, as barrier formation is closely related to the relative movement of the sea it is believed that both the Main Postglacial Transgression and the later Blairdrummond Shoreline (Smith *et al.*, 2000) are recorded in the sediments. One site in particular, Northton on the Isle of Harris, has also recorded an early/mid Holocene (7370±80 <sup>14</sup>C years BP) storm surge event that was imprinted upon the rising relative sea level tendency for the area. Sediments from this event have a similar sedimentological signature to storm deposits from the storm surge that occurred in January 2004 across the southern areas of the Outer Isles.

### 2.22 NW Scotland mainland

The NW of Scotland has been subject to extensive study of relative sea level change during the last twenty years (Peacock, 1970; Shennan *et al.*, 1994; 1995; 1999; 2000; 2005). Peacock (1970) defined the local marine limit around Arisaig at c.41 m OD from terraces and banks of shingle and sand

interpreted as raised beaches at Sunisletter. Figure 2.6 shows Sea level changes at Arisaig since 16 000 cal yr BP. The marine limit occurs between Upper LochDubh (sill elevation 36.48 m OD) and Cnoc Pheadir (sill elevation 42.5 m OD) Rapid RSL fall continues until at least 14 000 cal yr BP. The relative sea level then rose and reached no higher than c. 10 m during the Holocene.

### **BGS sea bed sediments and Quaternary sheets 1:250,000**

2.23. The British Geological Survey (BGS) collaborated with its opposite numbers in Netherlands and Norway during the 1980s and 90s to produce a series of seabed sediment maps for the UK Continental Shelf at a scale of 1:250,000. These maps, and the associated cores, are an essential tool for assessing the archaeological potential and sensitivity of areas of the sea floor, providing classification of surface sediments by grain size, thickness of active marine sediments, thickness of Holocene deposits, standard cross-sections, information on tidal currents, sand waves and sand ripples, carbonate percentage, and other items of information which vary from sheet to sheet. Some sheets, but not all, include copious technical notes, sections, core profiles, and analysis of sources, references, and comments on the various facies. All sheets show positions of platforms and pipelines at date of publication. Notes on some of the most relevant sheets follow (from north to south). This analysis refers only to the geological, sedimentary, and taphonomic conditions relevant to primary occupation in the area, and the preservation of sites. Many of the sheets also contain islands where archaeological remains are known on shore, or in the intertidal zone, and these features, where relevant, are described in Section 3.

### **Taphonomy**

2.24 Taphonomy is the study of those changes which occur to material once it has been buried (either deliberately or accidentally). Archaeological deposits may subsequently be covered by deep sediments which protect them, or eroded by ice, rivers, beach waves, storm waves, or tidal currents. They may be chemically altered or disturbed by trawling, dredging, entrenching, or drilling. The survival of an archaeological artefact or site is a complex process, and there are obviously more factors to be considered where a site is subsequently submerged.

2.25 At the peak of the last glaciation, enough water was locked up in ice sheets to cause sea level to fall by c.125m (see section 2.9). This fall was enough to make substantial areas of the sea-bed west of mainland Scotland towards the Outer Hebrides, dry land. Much of the sea-bed sediments are not of marine origin but are submerged terrestrial deposits and deposits due to the erosion and re-deposition of material by glaciers and ice-sheets. The presence of sands, gravels, silts, clays and organic-rich deposits are referred to as Marine Aggregate Deposits (MAD) (Wenban-Smith, 2002). The potential for preservation of archaeological remains within these sediments depends upon the depositional and post-depositional processes on the off-shore landscape prior to inundation due to marine transgression. Many areas will have been subject to repeated glaciations and marine inundation since the peak of the ice sheet at c.22,000 yrs BP. material will have been transported, remixed and reworked. Rising water levels may favour the preservation of associated intercalated organic deposits. Once buried by fine-grained material, these may be more resistant to the effects of aerial exposure during marine regression (Wenban-Smith, 2002). Evidence offshore for estuarine clays and silts, littoral and estuarine peats and silt-rich floodplain deposits are likely to provide good preservation potential for archaeological material (e.g. Clachan harbour, Raasay, Inner Sound).

2.26 In a glaciated area such as the submerged landscape of SEA7 specialised conditions such as ice scour, glacial erosion, frost shattering, and normal sub-aerial erosion processes have all to be taken into account when considering the survival of archaeology. In view of the work of Pitulko *et al* (2004) it is also important to consider the effect of sea water rising over archaeological deposits in permafrost, which can result in the good preservation of artefacts.

2.27 With regard to submerged archaeological deposits, the critical period for survival is the time when the surf zone starts to impact on the site, and the ensuing few hundred years as sea level rises, and coastal shallow waves are breaking over the remains, or washing into a cave mouth (Flemming 1983, p.161-163). The survival or destruction of an archaeological deposit, whether originally inland or on the coast, depends acutely upon the local topography within a few hundred metres or a few km of the site. Favourable factors for survival of archaeological material include:



- Very low beach and offshore gradient so that wave action is attenuated and is constructional in the surf zone.
- Minimum fetch so that wave amplitude is minimum, wavelength is short, and wave action on the seabed is minimum.
- Original deposit to be embedded in peat or packed lagoonal deposits to give resistance and cohesion during marine transgression.
- Where deposits are in a cave or rock shelter, roof falls, accumulated debris, concretions, breccia, conglomerate formation, indurated wind-blown sand, all help to secure the archaeological strata.
- Local topography contains indentations, re-entrants, bays, estuaries, beach-bars, lagoons, near-shore islands, or other localised shelter from dominant wind fetch and currents at the time of transgression of the surf zone.
- Frozen ground or permafrost enclosing archaeological deposit at time of inundation.

2.28 Many sites are likely to be deeply buried. The ability to reconstruct the conditions under which submerged archaeological sites may have been formed and buried, and their re-discovery, has recently been improved by sophisticated analysis techniques (eg: Praeg, 2003; Fitch *et al*, 2005). Praeg (*op cit*) has used seismic imaging to detect buried glacial tunnels under modern sediments. Fitch and his colleagues (*op.cit.*) have re-interpreted extensive sub-bottom seismic records to detect the changes in sediment characteristics indicating buried river valleys. This technique has exposed a wide meandering river system draining northwards from the north-east flank of the Dogger Bank in the North Sea, and it is now being tested on other parts of the UK shelf, though it has yet to be extended to SEA7. Detailed reconstruction of the prehistoric topography of the submerged shelf is important as it may then be "populated" using modelling based on the known locations of prehistoric sites in similar landscapes (Lake *et al*, 1998). This allows construction of a "hypothetical" settlement pattern that may be tested, eg through diving, coring and remote sensing as relevant. In this way a more accurate map of potential sites can be drawn up.

2.29 Potential discovery "hot-spots" in the SEA7 cannot be listed exhaustively at this stage because of the lack of research in the area, but see section 4 for a preliminary discussion of some areas. The steps needed to create high resolution local sensitivity maps can however be identified. In principle the key factors that increase the potential for both early human settlement, and archaeological survival, are:-

- "Fossil" estuaries and river valleys.
- Valleys, depressions, or basins with wetland or marsh deposits.
- Nearshore creeks, mudflats, and peat deposits.
- "Fossil" archipelago topographies where sites would have been sheltered by low-lying islands as the sea level rose.
- Niche environments in present coastal zones, wetlands, intertidal mudflats, lochs, and estuaries.
- Caves and rock shelters in re-entrant bays.
- Deposits of sediments formed within, or washed into rocky gullies and depressions.

### **Bathymetry**

2.30 Bathymetry data for the SEA7 area is indicated on the individual BGS sheets at 1:250,000 scale (see section 2.33-2.41). Figure 2.11 shows the bathymetry of the west coast of Scotland based on various sources. A detailed bathymetry for the SEA7 area can be seen in SEA7 Geology ([www.offshore-sea.org.uk](http://www.offshore-sea.org.uk)). The areas beyond c. >-200m are thought to be of low prospect in terms of archaeological preservation, although a varied topography would allow for sedimentation to be retained in bedrock hollows. Potential areas close to the coast and around the many offshore islands and archipelagos are evident from arrange of depths below present, especially in the Outer Hebrides, Islands of Islay, Jura, Mull and the Small Isles.

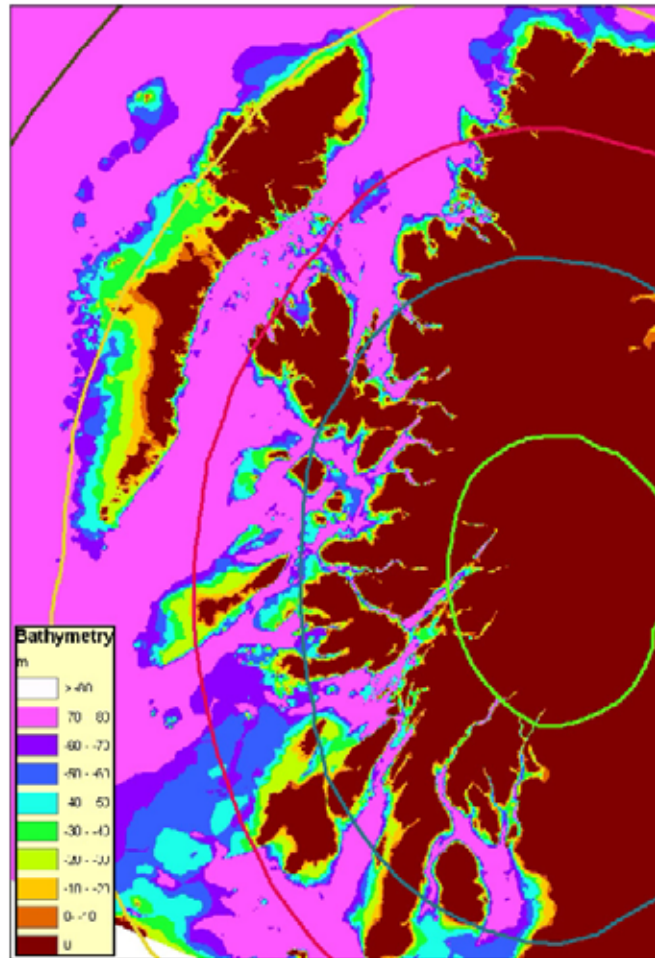


Figure 2.11 Bathymetry of the west coast of Scotland to 80 m depths. Contours are shown every 10 metres.

### Waves

2.31 The changes in and survival of an archaeological site, and the chances of discovery, depend on the present conditions of winds, waves, and currents in the area, and the water movements on the seabed. The waves that are most likely to destroy and scatter a submerged site, either during the marine transgression, or under the present conditions, are the winter storms combined with heavy swell from the open Atlantic. Areas of SEA7 are more protected from such extreme wave exposure than other SEA areas especially within the Inner and Outer Hebrides. A recent report for Scottish Natural Heritage (SNH) looked at wind, wave and tidal data along the coastline between Cape Wrath and the Mull of Kintyre on the west coast of Scotland (Ramsey and Brampton, 2000). The tides around Scotland result in significant tidal currents, even in areas of low tidal range (e.g. around Islay). Within tidal inlets and estuaries the effects of currents can dominate the sedimentary regime of the area. Tidal information is summarised for each individual BGS sheet (see section 2.25). Wave activity, in the form of wind-generated waves, is often the major process influencing the littoral regime around the Scottish coast. Within the eastern Minch area waves generated from the Atlantic and local conditions will be dominant. Significant offshore wave height predictions around Lochinver (NW Scotland) of c.8m; around Arnamurchan, c.12m and off Islay heights of 11-16m are predicted. Nearshore wave conditions are variable, in part due to the indented nature of the coastline, shelter provided by islands, and the nature of the sea floor topography and are likely to be reduced due to dissipation of the waves (Ramsey and Brampton, 2000). Possible severe wave conditions which could be generated in the Atlantic will have limited influence on the west coast mainland and east-facing coastlines due to the protection from the islands of Islay, Jura, Mull, Skye and many smaller islands within the inner and Outer Hebrides.



### **BGS monographs**

2.32 Two BGS monographs summarise the Quaternary geology, sea-bed sediments and bathymetry of the SEA7 area. 1) The geology of the Malin-Hebrides sea area. (Fyfe, *et al.*, 1993) and 2) The geology of the Hebrides and West Shetland shelves, and adjacent deep-water areas, (Stoker *et al.*, 1993): The Malin-Hebrides area has a varied offshore topography. Deep water occurs in the Inner Sound, east of Raasay, at 316 m, the deepest recorded on the UK continental shelf. The topography of the sea floor has been altered by Quaternary ice sheets which have eroded the weaker sedimentary rock rather than the igneous and metamorphic rocks, which has led to the over-deepening of the sedimentary basins. These basins have been infilled with Quaternary sediments of considerable thicknesses. The presence of sea bed sediments is related to the strength of the tidal streams which have swept and eroded much material. The geology of the Hebrides and West Shetland shelves summarises the Quaternary sediments, sea bed sediments and bathymetry to the west of the Outer Hebrides. The coastal geomorphology is of a drowned landscape due to the interaction of euastatic processes and isostatic changes in sea level since deglaciation. Below sea level there is a northward increase in the gradient of the coastal slope. West of the Uists (Outer Hebrides) the 20m isobath occurs up to 10km offshore and no well defined break of slope. The shelf edge and slope comprise a marked break of slope at the Geikie Escarpment with a descent into the Rockall Trough at c -700m. The areas are well summarised in the individual BGS sheets described in section 2.33 to 2.41.

### **BGS sea bed sediments and Quaternary sheets 1:250,000**

2.33 The British Geological Survey (BGS) collaborated with its opposite numbers in Netherlands and Norway during the 1980s and 90s to produce a series of seabed sediment maps for the UK Continental Shelf at a scale of 1:250,000. These maps, and the associated cores, are an essential tool for assessing the archaeological potential and sensitivity of areas of the sea floor, providing classification of surface sediments by grain size, thickness of active marine sediments, thickness of Holocene deposits, standard cross-sections, information on tidal currents, sand waves and sand ripples, carbonate percentage, and other items of information which vary from sheet to sheet. Some sheets, but not all, include copious technical notes, sections, core profiles, and analysis of sources, references, and comments on the various facies. All sheets show positions of platforms and pipelines at date of publication. Notes on some of the most relevant sheets follow (from north to south). This analysis refers only to the geological, sedimentary, and taphonomic conditions relevant to primary occupation in the area, and the preservation of sites. Many of the sheets also contain islands where archaeological remains are known on shore, or in the intertidal zone, and these features, where relevant, are described in Section 3.

Each BGS sheet covers an area 2° of longitude and 1° of latitude. Within the SEA 7 area 10 sheets are reviewed below in north-south sequence.

#### **2.34 Sutherland: BGS, 1989. 58° N – 06° W**

Quaternary deposits occur over much of this sheet and are thickest in the central part of the Minch Basin (+80 m) and to the NW of Lewis (+100 m). The underlying geology throughout the area is predominantly Permo-Triassic and Jurassic with some Lewisian. Mesoscale bedforms (iceberg ploughmarks) are extensive in the N Minch Basin between the Outer Hebrides and the North of Skye and mainland Scotland. They occur in a belt running SSW to NNE from 8-10° N to 6° W. The zone of ploughmarks follows the trend of the 200 m isobath. The surface sea bed sediments are sand/and gravely sand in the Minch with muds and sandy muds throughout the southern areas of the sheet. The bathymetry of the area comprises steep immediately offshore to c. -100 m with more gentle undulations between -100 to -140 m in the Minch. Tidal currents are generally 0.75m<sup>s</sup> to 1.0m<sup>s</sup> and increase to 1.5m<sup>-2</sup> around the Butt of Lewis.

#### **2.35 Lewis: BGS, 1989. 58 ° N – 08 ° W**

The sheet is predominantly composed of Quaternary glaciomarine sediments which are up to 300 m thick in places and underlain by Lewisian gneiss and Mesozoic sediments. Sea bed sediments are clean sands and gravels which are muddy sands in the NW and in the Minch off Stornaway. The fine-grained sediments in the Minch area have been deposited since Late Glacial times. Bedrock is exposed to the west of Harris. A pronounced break of slope at -160 m marks the edge of the Geikie escarpment which steepens deeply after -640 m depth. The bathymetry for the western edge of the

Outer Hebrides shows a gradual slope from -20 to -80 m over c.10km offshore, whereas on the Minch shoreline the surface drops to c. -130m at the coast and undulates to -200m throughout the Minch. The extreme NW area of the sheet descends to c.-1200m to the North Rockall Trough. Tidal speeds average  $0.5 - 1.0 \text{ m}^{-2}$  but reach  $1.5 \text{ m}^{-2}$  around the Butt of Lewis.

### **2.36 Geike : BGS, 1989. 58° N – 10° W**

The Quaternary geology of the area is composed of undifferentiated Holocene- Pleistocene sediments and Plio-Pleistocene sediments. Large areas of the sheet are composed of Quaternary glacio-marine sediments. Sea bed sediments are gravelly sands with sandy muds towards the Geike Escarpment. The majority of the sheet is deeper than the 200m isobath with a descent into the Rockall Trough to depths of -1800m. The Geike area is unique on the UK Shelf, with a wide gently sloping outer shelf beyond the -200m break of slope to the Geikie Escarpment at c.-700m. The steep slope of the escarpment has been attributed to erosion during the lowered sea level in the mid-Oligocene (Jones *et al*, 1986). The slope is free of sediment.

### **2.37 St Kilda: BGS, 1992. 57° N – 10° W**

50-100m thicknesses of Late Devensian sediments occur throughout the sheet. The Holocene sediments are discontinuous and are less than 1m thick. Muds are prevalent in areas deeper than 900m. Less than 1 m of mud has been deposited since the Late Glacial maximum. Slides and sediment slumps characterise the sea bed from the steep scarp descending to the Rockall Trough. Large areas of lateglacial muds occur to the south of St Kilda. Some mud occurs on the escarpment between -400m and 2000m with sand and gravelly sand between 120 and 150m depths. The sea bed is steep to the south and west of St Kilda. There are large areas of sediment starved undulating surfaces at c.100-300m depths and exposed bedrock to the east of the sheet. Submerged platform surfaces have been identified at -120m and -40m (Sutherland, 1984a).

### **2.38 Little Minch: BGS, 1988. 57° N – 08° W (including part of Great Glen: 57° N – 06° W)**

The area to the west of the Outer Hebrides is predominantly bedrock with sediment accumulations within the bedrock depressions providing a veneer of clean sandy sediments. East of the Outer Hebrides the pattern of sedimentation is related to the bathymetry. Muddy sediments occur in deeper water (e.g. the Inner Sound) and many sheltered and many sheltered sea lochs (e.g. Loch Snizort, Skye), whilst gravels tend to accumulate in the shallower areas. The Quaternary sediments are unevenly distributed and wide areas have little or no cover. To the west of the Outer Hebrides the irregular Lewisian sea bed allows sediment infilling with thicknesses less than 10m. In the Little Minch there is a little Quaternary cover over the Mesozoic bedrock. In the Sound of Sleat and Inner Sound sequences partly infill deeply incised channels up to 140m thick. The whole sheet is shallower than 200m depth, whilst the east coast of Skye has steep slopes to c.100m; the slopes are shallow off the west coast of the Outer Hebrides with the 40m isobath located c. 10km offshore. Tidal data suggests  $1.5 \text{ m}^{-5}$  between Harris and South Uist with an overall rate of  $1.0 \text{ m}^{-5}$  to the western edge of the Outer Hebridean island chain. The greatest tides occur around SE Skye with  $2.0 \text{ m}^{-5}$  towards the Kyle of Lochalsh. The area holds good prospect for archaeological preservation in SEA7 in areas within/between islands with highly indented coastlines.

### **2.39 Peach: BGS, 1992. 56° N – 010° W**

The sheet is divided by the shelf break. To the east is underlain by glaciogenic sequences of Quaternary origin, whilst the west slope descends to over 200m into the Rockall Trough. The Barra Fan is an accumulation of late Tertiary and Quaternary muds and sandy mud which forms a lobe on the shelf slope and has a dip of 50-7 degrees. A borehole at the foot of the fan at c.1750m depth has an upper 2m of sedimentation of glacial Late Devensian, Younger Dryas (LLS) and Holocene age. The outer shelf at c. 140 m depth is predominantly gravels and sand. The shelf break marks the limit between muds and coarser sediments of the outer shelf. Tidal currents are generally low throughout the area at  $0.2 \text{ m}^{-5}$ .

### **2.40 Tiree: BGS, 1988. 56° N – 08° W (including part of Argyll: 56° N – 06° W)**

Large areas of exposed bedrock occur around Coll and Tiree and to the west of Mull; Colonsay and N Jura. 200m thicknesses of Quaternary formation (Jura) occur to the west of Colonsay. Glaciomarine sediments are widespread in the Sea of the Hebrides. The sea bed sediments here are muddy between -140 and -180m. Sands and gravel are present to the south and west of Mull and Islay. The majority of the area is within the 200m isobath with deep indented sea lochs around Mull.

#### **2.41 Malin: BGS, 1989. 55° N – 08° W**

The sea bed sediments are mainly composed of sandy gravel. To the east the sediment pattern is controlled by tidal currents which have swept the North Channel leaving gravel and sand ribbons. To the SE of Islay muddy sediments are preserved away from the influence of strong tidal currents. Tides reach 1.5m<sup>s</sup> off Islay and are locally 2.0m<sup>s</sup> around Rathlin Island. The bathymetry of the sheet is varied with deep, steep slopes to the north and east of Rathlin Island reaching -200m and shallower slopes off the Rhinns of Islay, with the 40m isobath at c.5km offshore.

#### **2.42 Summary of Section 2**

Initial study of the SEA7 area suggests good prospects for the conservation of submarine prehistoric remains. The area is likely to have been settled from earliest times though evidence for Palaeolithic occupation on land has been affected by ice action during the late Devensian glaciation which ended c. 14,000 years ago. A complex history of relative sea level change, however, means that parts of the sea bed have been exposed as dry land during and since this period. These areas were suitable for human settlement from early on and may well preserve the record of that settlement. Some of these submerged areas remain exposed well into recent times (5000 BP) and are thus likely to have been settled through the Mesolithic and into the Neolithic. Indeed the lack of Mesolithic sites in the Western Isles is notable and probably to be explained by this history of sea level change. This dearth of sites means that any archaeological sites to be found on the submerged landscape of the SEA7 area would be particularly important. Nevertheless not all archaeological sites will survive submergence by the sea. Taphonomic factors affecting site survival are addressed, though a lack of detailed research in the SEA7 area means that hotspots cannot at present be mapped.

### 3. A brief history of the human occupation of the western seaboard of Scotland, and N. Ireland.

This section will look first at the general history of human settlement throughout the SEA7 area, and then in particular at each specific area through time.

3.1 The earliest recorded settlement in the SEA7 area comes from the islands, it dates back to the ninth millennium BC and relates to the Mesolithic, or Stone Age hunters who settled in Scotland after the end of the last Ice Age. Several of Scotland's earliest dated archaeological sites come from this area. This undoubtedly reflects an element of bias in that archaeologists have long been attracted to the wealth of archaeological material surviving here, but it also reflects the importance of the area to an early population who were reliant upon water based transport and who were attracted to the rich resources of the west coast lands and islands. Not only did the coast offer food in terms of fish, shellfish, seabirds, mammals, nuts, roots and berries, it also had other advantages such as the shelter afforded by the many rockshelters and caves, and easy access to water based transport (Hardy & Wickham-Jones, 2004).

3.2 There are many sites with Mesolithic remains in the area, some of which will be covered in more detail later (see below), but key sites are listed in table 3.1.

Site Name	Location	Date	Type of Site	Reference
<b>Mount Sandel</b>	Northern Ireland	9 <sup>th</sup> millennium BC	House site	Woodman, 1985
<b>Newferry</b>	Northern Ireland	5 <sup>th</sup> - 7 <sup>th</sup> millennium BC	Stone tool scatter	Woodman, 1977
<b>Newton</b>	Islay	7 <sup>th</sup> millennium BC	Possible house remains	McCullough, 1989
<b>Glean Mor</b>	Islay	6 <sup>th</sup> - 7 <sup>th</sup> millennium BC	Stone tool scatter	Mithen, 2000
<b>Bolsay Farm</b>	Islay	6 <sup>th</sup> - 7 <sup>th</sup> millennium BC	Stone tool scatter	Mithen, 2000
<b>Jura - various sites</b>	Jura		Stone tool scatter	Mercer, 1970; 1971; 1974; 1980
<b>Ulva</b>	Mull	5 <sup>th</sup> - 7 <sup>th</sup> millennium BC	Cave with midden	Bonsall <i>et al</i> , 1994
<b>Staosnaig</b>	Colonsay	6 <sup>th</sup> - 7 <sup>th</sup> millennium BC	House site	Mithen, 2000
<b>Oronsay middens</b>	Oronsay	5 <sup>th</sup> - 7 <sup>th</sup> millennium BC	Midden	Mellars, 1987
<b>Kinloch</b>	Rùm	7 <sup>th</sup> -8 <sup>th</sup> millennium BC	House site	Wickham-Jones, 1990
<b>Camas Daraich</b>	Skye	7 <sup>th</sup> millennium BC	Stone tool scatter	Wickham-Jones & Hardy 2004
<b>An Corran</b>	Skye	6 <sup>th</sup> - 7 <sup>th</sup> millennium BC	Midden	Hardy <i>et al</i> , forthcoming
<b>Northton</b>	Harris	7 <sup>th</sup> millennium BC	Anthropogenic soil	Gregory, 2002
<b>Oban caves</b>	Oban	6 <sup>th</sup> - 8 <sup>th</sup> millennium BC	Midden	Pollard, 1990
<b>Risga</b>	Ardnamurchan	5 <sup>th</sup> - 6 <sup>th</sup> millennium BC	Midden	Pollard <i>et al</i> , 1996
<b>Sand</b>	Applecross	6 <sup>th</sup> - 8 <sup>th</sup> millennium BC	Midden	Hardy & Wickham-Jones, forthcoming

Table 3.1: Key sites relating to the earliest human occupation of the SEA7 area, in common with archaeological convention dates provided in calibrated years BC/AD.

3.3 Although there is a considerable record of earlier (Palaeolithic) settlement further south in Britain going back some 700,000 years (Parfitt, 2006; AHOB nd), there is, to date, no secure evidence from the Palaeolithic in Scotland. The presence of Palaeolithic hunters to the south suggests that Scotland was inhabited in earlier times, at least periodically, and it is likely that the remains of this period have been masked by later geomorphological processes. The last glaciation covered Scotland in its entirety and led to dynamic changes in the landscape which mean that earlier archaeological material is likely to have been scraped up and destroyed, or buried under more recent deposits. In this respect the potential of west facing caves to hold pre-glacial human remains in Scotland has been noted by Dawson (pers com), in light of the fact that the general trend of glacial movement ran from east to west. West facing caves would be sheltered from glacial scour and thus tend to preserve interior deposits. This is as true for submerged caves on old coastlines, as for those above sea level, and it has important implications for submerged archaeology. Nevertheless, though Palaeolithic material has been recovered from glaciated areas elsewhere (eg in Wales, Lynch *et al*, 2000), none has so far come to light in Scotland.

3.4 In this context it is also relevant to consider the success of hunting cultures along the margins of ice and sea, both today and in the relatively recent past (Blankholm, 2004; Elias & Brigham-Grette, 1997). This is precisely the type of environment that would have been available at times within the SEA7 area. The proximity of an ice front is not always a deterrent to human settlement and it means that there is a high likelihood of, one day, finding traces of Palaeolithic settlement here.

3.5 It is thus likely that Scotland was inhabited during the Palaeolithic and that the current absence of evidence cannot be regarded as evidence of absence. There have been occasional finds of Palaeolithic handaxes and other stone tools in Scotland, but sadly none come from reliably contexted find spots (Saville, 1997). This places particular importance on the submerged archaeological record because it is here that the record of Palaeolithic settlement in the north might survive. Lower relative sea levels during parts of the Palaeolithic mean that the area of land available for settlement has been at times greater than that today, and the vagaries of seabed archaeology mean that in places the prehistoric landscape is likely to survive (section 2). The submerged landscape of the Scottish Shelf is thus the most likely location for the preservation of traces of early settlement. Such traces would be particularly important as an indication of the true extent of Palaeolithic settlement in Britain.



Fig 3.1 Location of the principal excavated Mesolithic sites in the SEA7 area. Key: 1 – Mount Sandel; 2 – Newferry; 3 – Newton; 4 – Gleann More; 5 – Bolsay Farm; 6 – Jura (various sites); 7 – Ulva Cave; 8 – Staosnaig; 9 – Oronsay middens; 10 – Kinloch; 11 – Camas Daraich; 12 – An Corran; 13 – Northton; 14 – Oban Caves; 15 – Risga; 16 – Sand.

3.6 Many sites now provide evidence for Mesolithic settlement along the western seaboard of Scotland (fig 3.1). Most comprise scatters of characteristic stone tools (fig 3.2) together with the burnt remains of hearths and sometimes formations of post and stake holes that may be interpreted as shelters (eg Kinloch in Rùm, figs 3.3 & 3.4). A few sites lie in caves and rockshelters (eg: Ellary Boulder Cave, Argyll; or Sand, Applecross, fig 3.5), and some are midden sites where organic material including both marine shells and animal bone have been preserved (eg the Oronsay middens; fig 3.6). The dates for these sites run from the 9<sup>th</sup> millennium BC into the 4<sup>th</sup> millennium BC (table 3.1). The Mesolithic lifestyle was essentially mobile, as people moved around the landscape to make the most of different resources at different times of the year. In general Mesolithic remains are ephemeral and they can be hard to spot.



Fig 3.2 Typical stone flakes from the Mesolithic site at Kinloch, Rùm



Fig 3.3: Excavation taking place at Kinloch, Rùm – the darker discolorations provide evidence for the pits and post holes that once existed on site.



Fig 3.4: Hypothetical reconstruction of the site at Kinloch, Rùm, based on the excavated evidence (drawing, Pipeline)

3.7 The available evidence suggests that the island locations of the west coast Mesolithic were cut off from the mainland of Scotland by the time that they were inhabited (section 2). People were skilled seafarers. Although no direct evidence of boats has yet been found (there is some evidence for boats at this time from elsewhere in Europe, see Warren, 1997 for a general discussion), waterways, whether open sea, sea lochs, or inland, provided many advantages for travel. Not only is water transport more efficient than movement on foot, especially for carrying household goods and small children, it also provided ready made routeways and sight-lines, especially in a forested environment. It is easy to get lost when walking through virgin forest. It is likely that individual communities travelled from island to island, to the mainland and into the interior in different seasons. Territories are likely to have comprised varied areas of coast and islands, and perhaps to have fluctuated at different times of the year. It was a fluid and sophisticated use of the landscape.

3.8 The modern topography of west coast Scotland means that no site is far from the sea. This would have been so in the past, even with a lowered sea level, no site is likely to have been more than 50km from the coast and most were much nearer. Indeed the coast is likely to have been of especial



importance for the early settlers as it could offer varied and relatively stable resources that in themselves offered some advantages over many of the resources of the interior. Whale and seal blubber, for example, was not just an important source of fat for the lean winter months; it also provided a good source of vitamins for people whose diet might not always be rich in vegetable matter. This is backed up by recent isotope studies on surviving human bone from the Mesolithic which demonstrate the dominance of marine foods in the diet (Schulting & Richards 2002).



Fig 3.5: Excavation taking place at the rockshelter of Sand, Applecross (photo, SFS).



Fig 3.6: Dense limpet midden under excavation at Sand (photo, SFS).

3.9 The concentration of sites around the coasts means that early settlement was particularly vulnerable to sea level rise. The relative changes in sea level since the early Mesolithic mean that many sites are likely to have been submerged particularly along the western fringes of the Hebrides. If one also takes into account the fact that settlements tended to be located in more sheltered spots so as to minimise the destructive effects of tidal range, tidal currents, and oceanic storm waves, there is a clear potential for some sites to be preserved even after submergence. There is thus considerable potential for submerged Mesolithic archaeology in the SEA7 area.

3.10 Some 5000 years ago there was a shift in the basis of the economy across Scotland with the adoption of farming. This heralded the period known by archaeologists as the Neolithic. The introduction of cultivation and domestic animals was only one of many changes that took place, though most archaeologists today consider these changes to have taken place within a local population rather than to have included an influx of people from the outside. A few sites with Mesolithic-type remains, but later dates (eg at Carding Mill Bay, a midden site outside Oban; Connock *et al*, 1992), indicate that some people continued to live as coastal foragers for part of the year at any rate.

3.11 With the advent of the Neolithic there is also a marked change in the type of site that survives. Settlement sites continue to be characterized by poor preservation, but other types of site, such as stone built tombs, are found for the first time. Stone circles and settings are also found. Although the SEA7 area may be perceived as marginal today, it was not so to a people accustomed to water transport, and the success of the Neolithic way of life here is demonstrated by the quality of some of the sites. Many elaborate and well built tombs are to be found (eg Unival; Henshall, 1972, 529) and the area incorporates several of Scotland's best known stone circles and settings eg Callanish in Lewes (Ashmore, 1995) and Ardnacross in Mull (Wickham-Jones, 2001, 181-3).

3.12 Isotope studies on human bone from the period indicate the increasing importance of terrestrial proteins over marine resources, but the nature of the land means that few sites are far from the sea. The coastal fringe offered fertile farmlands. In this respect the history of sea level change is once again important as it means that there is considerable potential for submerged Neolithic sites in the shallower waters between and to the west of the islands. Some sites such as Eilean an Tighe (Scott, 1951), are currently monitored because of the degree of active coastal erosion that is now taking place. Although in this case the erosion is a destructive process, in other cases submergence may well have been protective.

3.13 The advent of metal around 4000 BC heralded the archaeological period known as the Bronze Age. The introduction of metal was accompanied by other changes to the lifestyle such as new pottery and styles of arrowheads. The Bronze Age in Scotland was a time of many changes such as the rise in importance of the individual with concomitant changes in burial and ceremony. As population grew, so the focus of occupied land spread to include hill lands, although the topography meant that coastal locations were still important, such as the Udal in North Uist (Crawford, 1996), Rosinish in Benbecula (Shepherd & Tuckwell, 1979), and Alt Chrysal in Barra (Branigan & Foster, 1995, 49-160). Later in the period a general downturn in climate led to the abandonment of many hill farms, the remains of which are often visible today as low circular footings, or hut circles, scattered across the uplands. The start of the growth of inland peat deposits has been recorded at this time (Whittington & Edwards, 1997)

3.14 As might be expected in an area as conducive to communication as west coast Scotland there are indications that metallurgy filtered into the local communities from early on, as at Northton in Harris where there are hints of bronze working (Gregory, 2002). To the south, the site of Kilellan in Islay (Ritchie, 2005) suggests a thriving Bronze Age community and there are many other Bronze Age sites, including both settlements and tombs, around the islands.

3.15 Nevertheless, metal was not common in the early Bronze Age. By the 1<sup>st</sup> millennium BC, however, finds of metal tools and weapons were more frequent including both objects that were apparently lost or discarded and deliberate depositions of hoards. The latter reflect both the collection and re-use of metal goods by traveling smiths, and ritual deposits of valuable objects made to curry favour or appease the gods. They include so many bronze swords that a distinct regional tradition, known as “Minch” swords, has been identified. The increasing popularity of weapons was a reflection of changes to society and by the late 1<sup>st</sup> millennium BC this was also reflected in the popularity of defended settlement sites. The advent of iron introduced a new and more durable raw material, and this period is known as the Iron Age.

3.16 A variety of Iron Age settlements exists in the area, most are circular or sub-circular and they are collectively known as Atlantic roundhouses. They include single storey structures, but perhaps the best known are the brochs, many of which comprised multi-storey stone towers that reached well over 10m in height (Turner *et al*, 2005). Dun Carloway, in Lewis, is one of the best known in Scotland. The brochs were built to combine elements of defence and ostentation. Iron Age Scotland was a time of local unrest, and many of the settlements of the time reflect this. Crannogs, built on artificial or enhanced islands, and other islet settlements were common as were wheelhouses. Relatively recent excavations of wheelhouse sites have taken place at Sollas, in North Uist (Campbell, 1992), and Cnip in Lewis (Harding & Dixon, 2000), from which much has been learned about settlement and economy at the time. Although the need for defence meant that some settlements moved into the interior, the fertile lands, and easy access combined with rocky outcrops meant that the coast was still important.

3.17 With the advent of the 1<sup>st</sup> millennium AD, documentary sources start to complement the archaeological evidence for the later Iron Age. To the south, the Roman Empire spread its tentacles and even though they did not directly conquer west coast Scotland, the influence of the Roman neighbours is apparent. Roman artefacts have been found at some sites, as at Bhaltois in Lewis (Armit, 1994), and Dun Ardtreck in Skye (Mackie, 2000) and though it is likely that some Roman goods made their way into the area indirectly, other goods suggest direct importation, at Dun Fiadhairt in Skye a terracotta model of a bale of fleece was found (Curle, 1932, 289), while a group of Roman coins were recovered in Benbecula in the 19<sup>th</sup> century (Robertson, 1970). The evidence suggests that trade flourished, and west coast society prospered in the late Iron Age.

3.18 The first local groups to be clearly identified in documents are the Picts and the Scots and this does not happen until the second half of the 1<sup>st</sup> millennium AD. Their story is traditionally one of enmity, and this is supported by the archaeological evidence such as it is. The Scots kingdom of Dalraida was based in Argyll and the southern islands, possibly centred on the fort at Dunadd in Argyll (Lane & Campbell, 2000), while Pictish influence to the north is reflected in occasional finds of Pictish symbol stones such as that at Raasay House in Raasay (Fischer, 2001, 103). In the 9<sup>th</sup> century, the term *Alba* appears, suggesting the rise of a Scottish identity into which Pictish culture had been subsumed. Although the kingdom of Dalraida disappeared, it was the Scottish language and much of their culture which apparently dominated the new political and cultural scene. At the same time, however there was a new power in the west: in AD 795 Viking raiders attacked the monastery of Iona.

The west coast and its islands must have appeared very attractive to the Norsemen as they sailed past for by AD 870 the process of Viking colonization in the area was well underway.

3.19 Several Viking sites exist in west coast Scotland including both settlement sites and burials, and the evidence for Norse culture is backed up by finds of stray artefacts, such as an armlet from Jura (Graham-Campbell, 1983) and the two boat stems from Eigg (McGrail, 1987, 101, 124-5) as well as numerous place names. Perhaps the best known Viking find comprises the Lewis chessmen, found in the sands of Uig Bay in 1831 (Taylor, 1978). Viking society was based around trade and seafaring and west coast Scotland was well suited to this because it lay along a major communications route between Scandinavia and Ireland. Generally, the evidence suggests prosperity in the Isles at this time.

3.20 Although Viking influence continued in the north into the 13<sup>th</sup> century AD, the 12<sup>th</sup> century AD saw the rise of the Lords of the Isles in Argyll and the islands. Many medieval and post-medieval sites have been recorded from west coast Scotland, but there has been little detailed study of this period. In Islay the Finlaggan project has centred on the important site of Finlaggan, the capital of the MacDonald Lords (Caldwell, 1998). Gradually, the political influence of mainland Scotland began to penetrate deeper into society and the Lordship of the Isles was finally forfeit to the Scottish Crown in AD1493. Ruined house sites, small fortified castles and towers, local churches and fine carvings, all date from the historic record of west coast Scotland and show a rural society of largely self-sufficient smallholdings with a strata of wealthier tacksmen who acted to collect the rents and carry out administration for the local clan chiefs, some of whom held considerable wealth and power. This system slowly collapsed until in the 19<sup>th</sup> century AD, the advent of a new "industrial" British aristocracy meant that in many cases power shifted away from those with a historical link to the land. Mass evictions and movement, for a variety of reasons, both political and economic, reduced the population and created the historic landscape as it is seen today. Only in the 20<sup>th</sup> century AD did the role of the sea as a means of communication begin to wane, though the centralization of political power in lowland Scotland meant that the "perceived" marginalization of the western seaboard started long before that.

3.21 **St Kilda** St Kilda lies 64km west of Harris in the outer Hebrides. The 100m isobath almost joins it to the Hebrides, so that it is likely to have been linked to mainland Scotland at times and continuous with the Devensian ice sheet at the peak of the last glaciation. Current interpretations suggest that St Kilda became a separate island, or group of islands, shortly before 12,000 years ago. Submarine caves occur around St Kilda, with several west facing caves that should be regarded as potential sites for the preservation of early archaeology. The archipelago is subject to wind and waves from all directions, though predominantly from the south and south-west. St Kilda has been the focus of much archaeological work in recent years. Finds of stone tools suggest that the island group has been inhabited since the Neolithic, some 5000 years ago (Fleming, 2005). St Kilda is visible on the horizon from the Hebrides in clear conditions, so it is not surprising to find that local seafarers made the trip out, though earlier archaeological work had concentrated on later material. Fleming argues that St Kilda occupied a central role within Hebridean culture well into recent times (ibid) and remains from all major periods have now been recorded here. The steep mountainous topography of St Kilda meant that settlement was relatively confined, and the people had to look to coastal and marine resources for survival right up to the evacuation of the island in the early 20<sup>th</sup> century AD. The recent designation of St Kilda as a World Heritage Site is in recognition of the quality of both the archaeological remains and the natural heritage, both on land and underwater.

3.22 To the west of St Kilda the sea bed plunges to the Rockall Trench which drops to a depth of as much as -3000m. Although this lies within SEA7 the depth is well below that to which relative sea level has dropped within the human history of settlement in Britain and there is thus no potential for preserved archaeology here. To the west, however, lies Rockall, sitting on the Rockall plateau, where there is some, albeit limited, archaeological potential.

3.23 **Rockall.** Rockall comprises a rocky stack that rises abruptly from the sea some 500km from the Scottish mainland. It is a volcanic plug of aegirine granite. Throughout the 20<sup>th</sup> century it has attracted many expeditions to climb it, plant flags, and even sleep overnight. There is no evidence that it was ever inhabited, though it is possible that the bird life has, at times, been harvested in the same way that the Lewismen harvest the gannets of Sula Sgeir (Beatty, 1992) or the men of St Kilda once harvested their local cliff birds. The archaeological potential of Rockall lies in the seabed around

it, where a platform rises from the oceanic depths. Most of this is still well below -200m deep and would never have breached the surface even at times of relatively low Pleistocene sea levels. Nevertheless, a small area, some 10km by 10km lies above the -200m contour and would have been dry land at times, eg during the last glacial maximum, including the circular arcuate ridges and reefs of Helen's Reef (Binns, 1972; Roberts, 1975). Although this would still have been separated from the main landmass of Britain by the deep waters of the Rockall Trench, it does offer limited archaeological potential. The exposed land is likely to have been colonised by salt-tolerant vegetation, with seeds transported by birds. However, the distance from the mainland of Scotland or Ireland, and exposure only at the glacial maximum 20,000 years ago, make permanent human occupation extremely unlikely. By the time that Mesolithic settlers were well established in west coast Scotland relative sea levels had once more risen to inundate all but a remote rocky islet.

**3.24 The Outer Hebrides: Lewis to Barra.** Archaeological material from Northton, Harris, has been dated to the Mesolithic, 7<sup>th</sup> millennium BC (Gregory, 2002). An early presence in the islands is also indicated by the analysis of pollen from deep peat cores at several sites which shows anthropogenic alterations to the vegetation (Edwards, 1996), but other archaeological sites from this time are so far lacking, probably because of the amount of land that has been lost to sea level rise, particularly on the west coast. The attractions of the coast for the Mesolithic population have been noted above, and any scatters of Mesolithic stone tools inland may well lie under the deep peat deposits that blanket much of the land. The seabed to the west drops gradually down to -100m over a distance of some 50km offering considerable potential for a submerged landscape from earlier prehistory and several instances of inter-tidal peat deposits and buried tree stumps have been recorded along the western shores particularly around North Uist (Armit & Sharples pers com; Armit, 2003). From the Neolithic onwards archaeological sites are frequent (figs 3.7-9) and the density of sites on land provides some idea of the potential of the submerged landscape, especially for the earlier periods. The low gradient of the submerged land surface along these western shores means that coastal sites are likely to have been subject to strong winds and storm waves. In addition to their impact on settlement, these will have had an adverse erosive effect during submergence so that the survival of any individual site is very dependent on small scale local topography such as the protective presence of dune ridges, rock outcrops, or sandbars. The bathymetry of the seabed is recognized to be an unreliable indicator of pre-submergence topography with the result that a detailed study of sediments using remote sensing and analysis in the ways advocated by Praeg (2003) and Fitch *et al* (2005) would be necessary to identify potential hotspots for archaeological survival. Nevertheless, it is important to remember that the gentle gradient also means that a relatively small (vertical) change in sea level would have a big impact in (horizontal) terms of land available to the island inhabitants. As a general rule of thumb the sheltered areas between and around the islands are likely to have high archaeological potential. The density of sites on land, and active exploitation of the better drained lowlands highlighted by the distribution maps of archaeological sites (below) would support this conclusion.

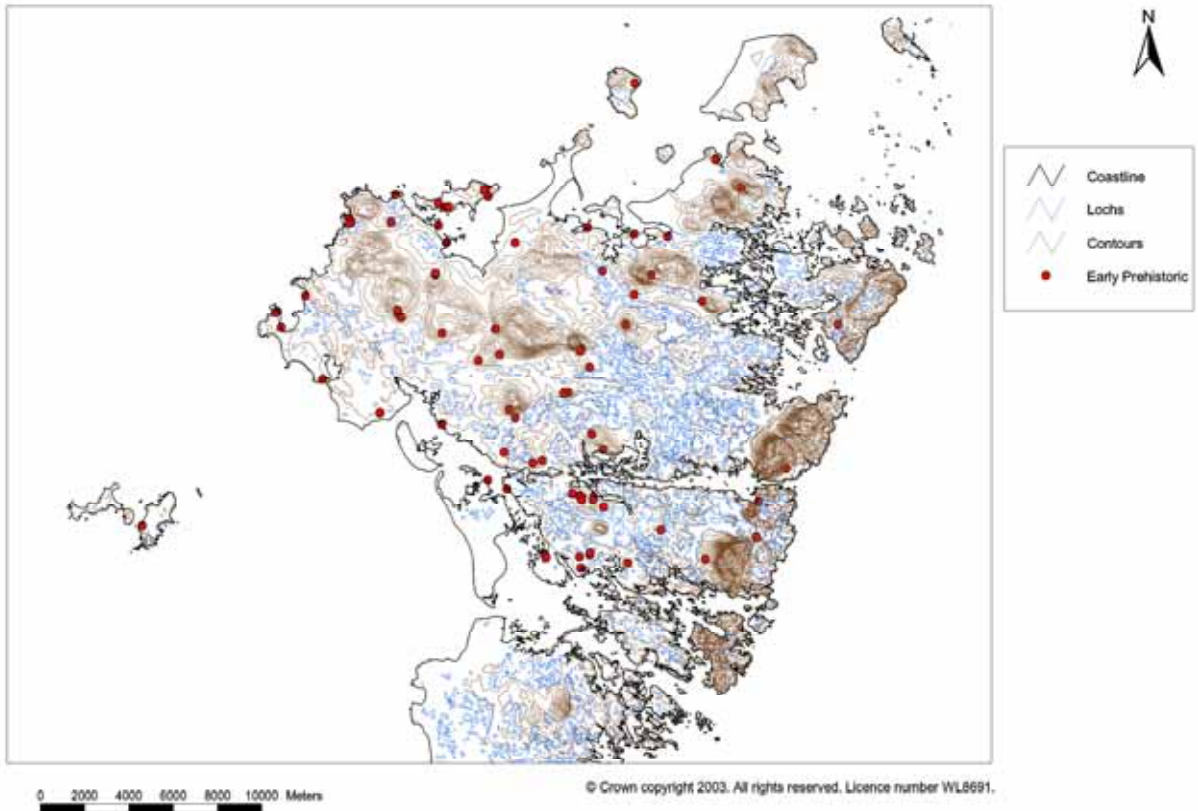


Fig 3.7: N. Uist, Location of Early Prehistoric sites (Neolithic and Bronze Age) recorded in the National Monuments Record for Scotland. © Crown copyright 2003. All rights reserved. Licence number WL8691.

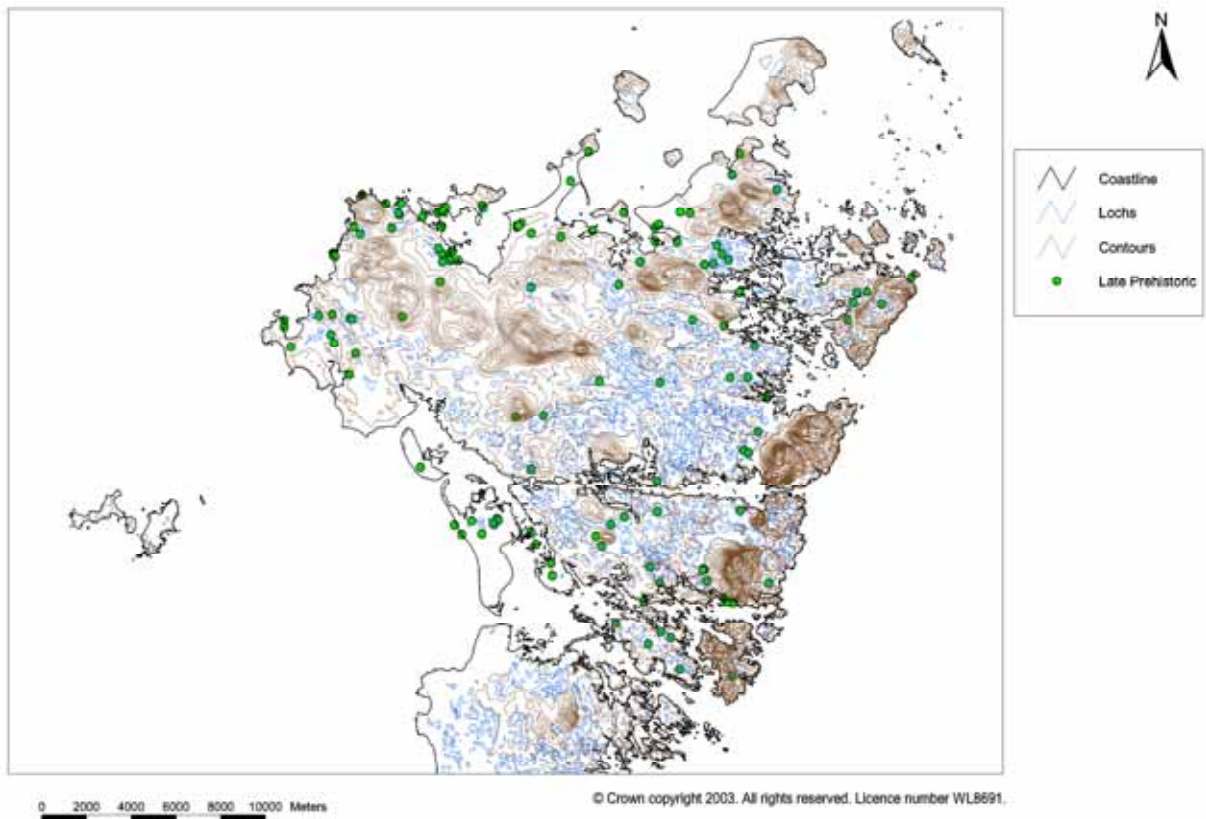


Fig 3.8: N. Uist, Location of Late Prehistoric sites (Iron Age) recorded in the National Monuments Record for Scotland. © Crown copyright 2003. All rights reserved. Licence number WL8691.



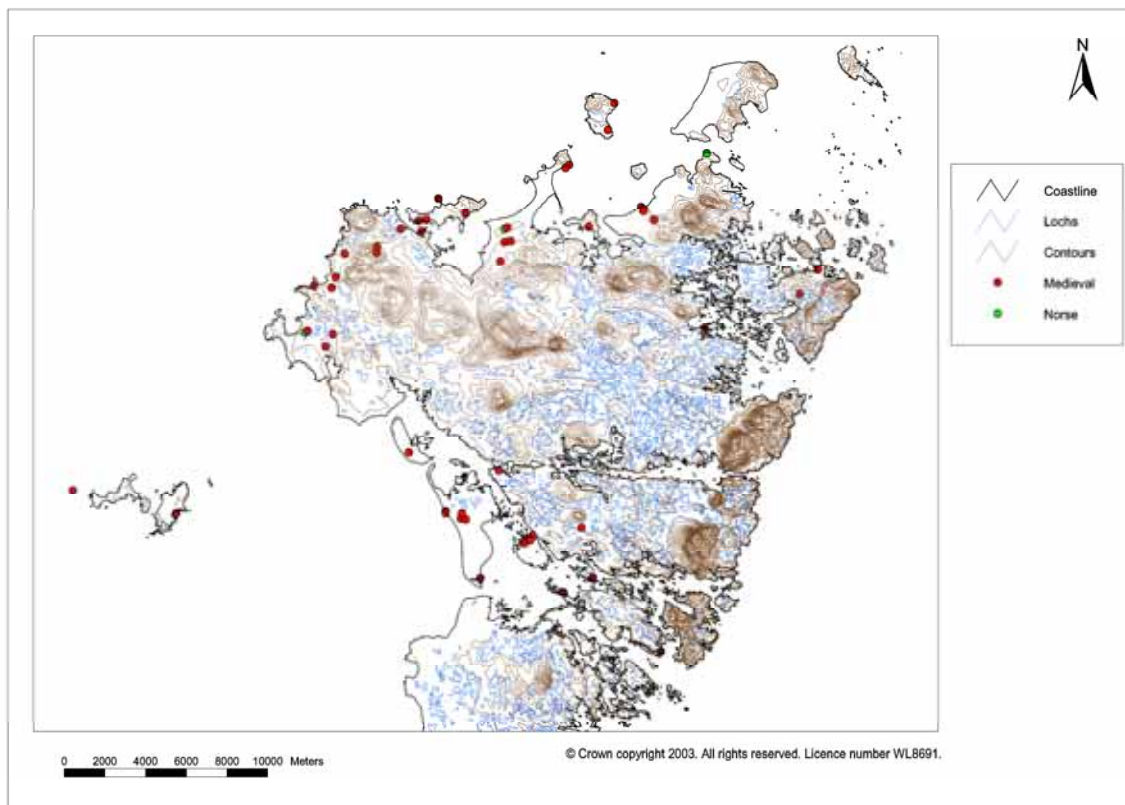


Fig 3.9: N. Uist, Location of Medieval sites recorded in the National Monuments Record for Scotland.  
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3.25 One location that might be singled out as indicative of archaeological potential is Baleshare a small tidal island off the west coast of North Uist. Many sites have been recorded here, particularly along the coast, and many of these are actively eroding. This is a good example both of the problems of coastal erosion and of the archaeological potential of the intertidal zone as shown by a recent map of over 100 sites recorded along this stretch of coastline produced by SCAPE (fig 3.10). Alastair Dawson has identified three major wave surges across the island in recent times that have left their mark in the sediments (fig 3.11). In 2006 it was noted that storms had newly exposed a thick layer of intertidal peat on the foreshore (T Dawson pers com). It will not be long before Baleshare joins the repertoire of submerged archaeology, though some of the sites are particularly important. Abundant prehistoric remains have been recovered here from various excavations including finds of pottery and stone tools as well as a variety of structural remains, and activity seems to have taken place, if intermittently from the Neolithic onwards (eg James & Duffy, 2003, 43 - 71).



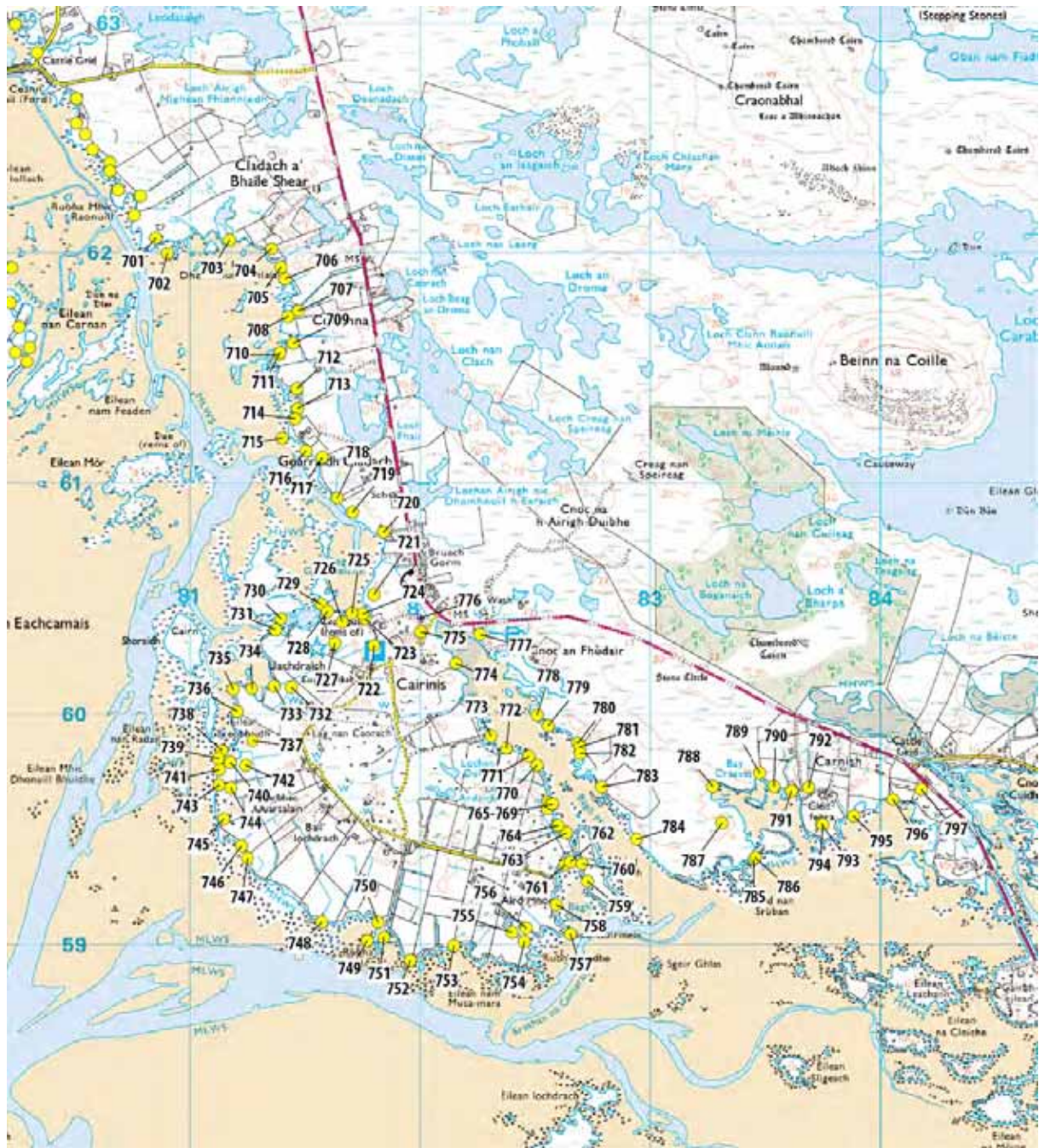


Fig 3.10: Baleshare, N. Uist, location of coastal sites recorded as part of the SCAPE coastal survey. Numbers refer to SCAPE registration numbers. © Crown copyright 2005. All rights reserved. Licence number WL8691. With thanks to SCAPE, the Centre for Field Archaeology and Historic Scotland.

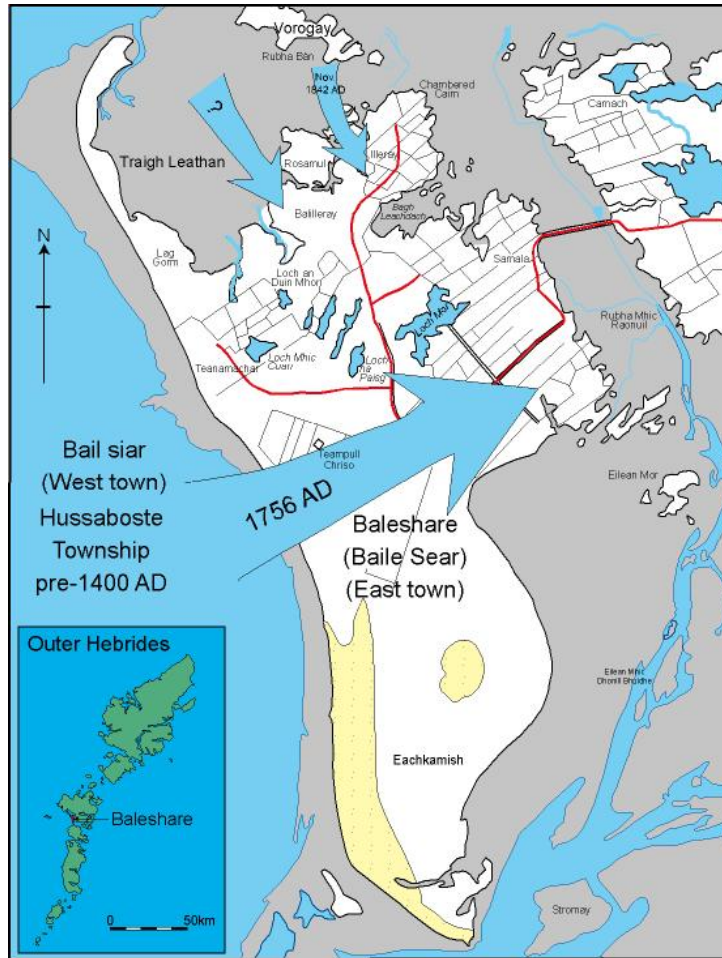


Fig 3.11: Baleshare, N Uist, recent storm surges (A. Dawson).

3.26 Several archaeological projects have taken place in the islands such as the joint project between the universities of Cardiff and Sheffield in South Uist (Parker Pearson *et al*, 2004), or Edinburgh University's project around Callanish in Lewis (Harding, 1996), and many important sites have been recorded and excavated. To the east of the islands the seabed drops abruptly into the Sound of Shiant which reaches -160m deep in places, suggesting that they were separated from their eastern neighbours early in prehistory. A surprise find from the Sound of Shiant comprises a gold torc, dating to the Bronze Age and recovered during fishing (Cowie, 1994). It is assumed to have resulted from a loss at sea.

3.27 **Skye.** Although mountainous, Skye is also known for its fertile glens and bays, and in recent history it supported a considerable population who lived by farming and fishing. The waters round Skye are generally deep, dropping to -120m or more over a distance of around 10km in many places, though to the west there is a more sheltered seabed plateau, around 80m deep for some 30km. At its closest point Skye lies less than a kilometre from the Scottish mainland, but this stretch of water, known as the Sound of Sleat is notorious for its strong current. Several sites attest to Mesolithic occupation in Skye going back to the 7<sup>th</sup> millennium BC (eg Camas Daraich, Wickham-Jones & Hardy, 2004; An Corran, Hardy *et al*, forthcoming). There is then a continuous record of sites through time to the present day, though the population has fluctuated. Skye has attracted several archaeological projects in recent years; on-going work at High Pasture Cave is currently investigating a high-status site from the Iron Age with evidence of both burial and metalworking (Birch, nd). In historic times Dunvegan was a centre of considerable importance and today Skye attracts many visitors, especially those with ancestral links to the island.

3.28 **The Inner Sound.** The Inner Sound comprises the area of sea between north-east Skye and the Scottish mainland, including adjoining coastlands and islands such as Raasay. It has been included separately because it has recently formed the basis of an archaeological project to record and study midden sites and scatters of stone tools around the coast (Hardy & Wickham-Jones



forthcoming). The Scotland's First Settlers project took place from 1999 – 2004 and recorded 198 sites around the Inner Sound (fig 3.12), 129 of which were previously unknown. Although it was not possible to date every site, remains from the early Mesolithic (Sand) into historic times (the sea cave at Crowlin 1) were recorded, and there was one inter-tidal site at Clachan Old Harbour, in Raasay (fig 3.13). The project has clearly demonstrated the value of detailed survey work and the potential of the coastal archaeological record even in an area that might be regarded as peripheral by 20<sup>th</sup> century standards. With regard to submerged archaeology, the Inner Sound has a complex history of relative sea level change that means that while some places, such as the southern coast of Raasay, hold potential for submerged or inter-tidal sites, other parts are likely to have less archaeological value (Shennan *et al*, 2000). In addition, it is known for strong currents and wave action, and drops abruptly to depths of as much as -200m over very short distances such as 5km. There may well, however, be potential for submerged west facing caves along the Applecross coastline, and the west coasts of Raasay and Rona.

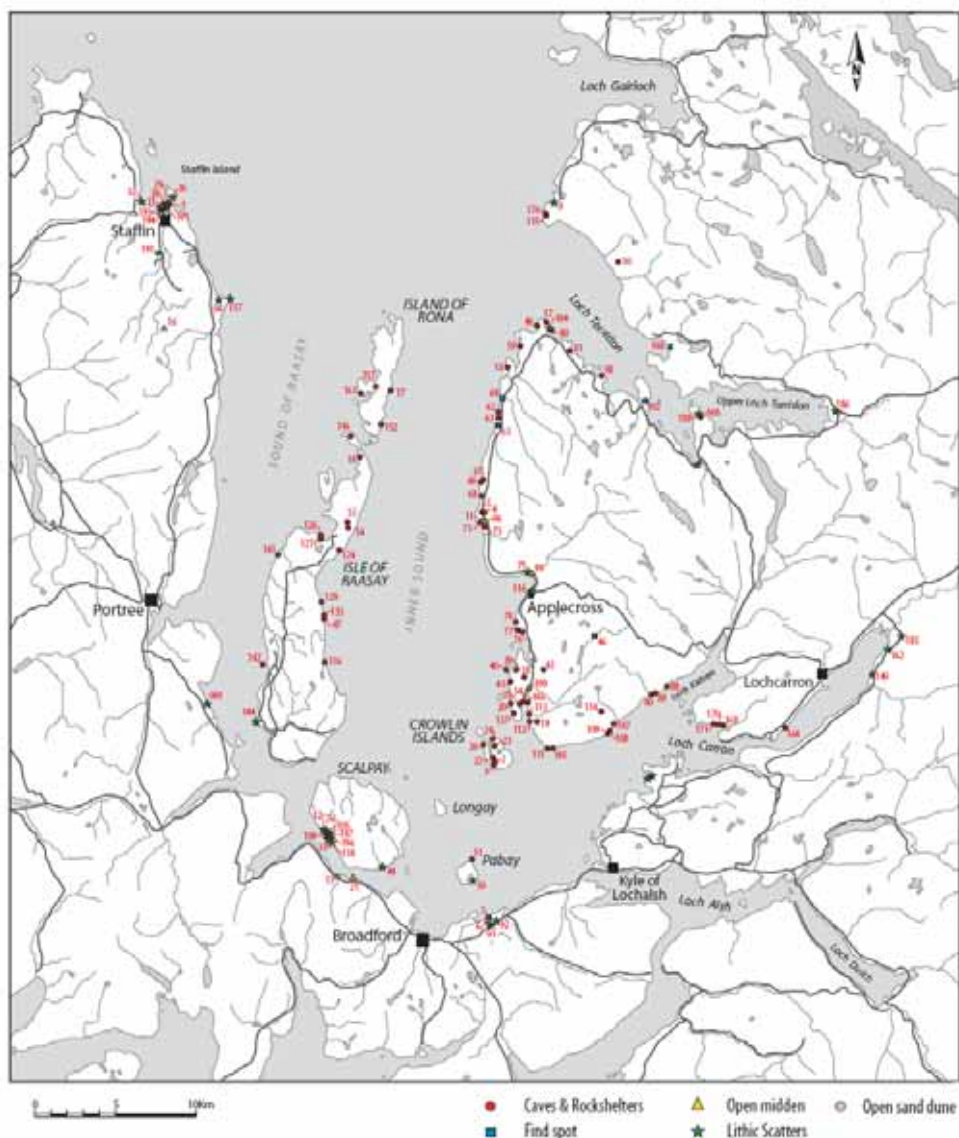


Fig 3.12: Archaeological sites recorded by Scotland's First Settlers during fieldwork 1999-2004. Numbers refer to the SFS recording numbers (Hardy & Wickham-Jones forthcoming) (SFS).



Fig 3.13: Wood visible in the inter-tidal zone at Clachan Old Harbour, Raasay (photo SFS).

3.29 **The Small Isles: Eigg, Muck, Rùm and Canna.** The available evidence suggests that the Small Isles were already individual islands by the beginning of the Holocene, and even with some relative sea level change they would never have been large landmasses. Between the islands the water drops to -80m. The site at Kinloch on Rùm is still one of the earliest indications of the Mesolithic settlement of Scotland (Wickham-Jones, 1990, Ashmore, 2004). Other Mesolithic sites are lacking from these islands, but this may well be a reflection of the general lack of archaeological work here. Neolithic and Bronze Age sites do exist though they are scarce, and though scatters of stone tools have been found, few have been studied in detail. In principal the islands, though small, offer varied resources, including fertile land and it is unlikely that they lay uninhabited. In the early Christian period there is evidence that Canna, in particular, was important (RCAHMS, 1999) and there are several Viking finds from the islands. Rùm is of especial value with regard to its historical archaeological remains which have survived with little deterioration since the island population was cleared in the early 19<sup>th</sup> century. Not only does Rùm contain a well preserved record of historic settlement, it also contains a unique and well preserved (sometimes eccentric) suite of archaeological sites relating to the varied attempts of 19<sup>th</sup> century landowners to wrest a living from the land (Love, 2001). A brief examination of the underwater landscape in Loch Scresort, Rùm, carried out in 1987 did not reveal any early sites (fig 3.14).



Fig 3.14: Divers preparing for an archaeological examination of the underwater landscape of Loch Scresort, Rùm.

**3.30 Mull, Tiree and Coll.** To the north-east Mull is separated from mainland Scotland by less than 1 km of water, and the waters between Mull and islands of Tiree and Coll to the north west are generally less than 80m deep. Although many archaeological sites have been recorded here, including some fine Neolithic stone settings, there has been a general lack of detailed archaeological work until the recent inception of the Inner Hebrides Archaeological Project by the University of Reading (Mithen *et al*, 2006) which has uncovered several stone tool scatters and other sites providing evidence for activity from the Mesolithic into more recent periods. An intertidal organic deposit on Coll has recently been studied by Dawson who dated it to a relative low stand of sea level around 8000 radiocarbon years ago (Dawson *et al*, 2001).

**3.31 Islay and Jura.** Together with Colonsay and Oronsay, Islay and Jura form a close-knit island group which is separated from the mainland by the Sound of Jura, which drops to some 80m deep. These islands contain many archaeological sites, the importance of which has stimulated much archaeological work in the second half of the 20<sup>th</sup> century. The evidence for Mesolithic activity has been the focus of several projects (Mercer, 1970, 1971, 1974, 1980; Mithen (ed) 2000; Ritchie, 2005); on Oronsay it is especially important because of the particularly good preservation there (Mellars, 1987), and on Jura there is the suggestion that settlement may be particularly early, perhaps even related to a lower period of relative sea level, though this has yet to be verified (Mercer, 1971, 1980). The waters round the islands are relatively shallow, rarely reaching more than -40m, and given the quantity of evidence for early settlement the sea bed between the islands must be regarded as of particular potential with regard to early archaeological remains. To the west the seabed slopes gradually over a distance of 75km to a depth of -80m and though of great potential for early settlement remains, it is very exposed which would also have brought problems in terms of wind and waves as the sea level rose. Later sites are no less important. The site at Kilellan in Islay included Bronze Age and Early Christian remains as well as the early material (Ritchie, 2005), Oronsay was home to an acclaimed Medieval priory and school of sculpture (Fischer, 2001), and Finlaggan in Islay, the centre of power for the Lords of the Isles has been the focus of recent study by the National Museums of Scotland (Caldwell, 1998).

**3.32 W Coast Scotland: Kintyre to Cape Wrath.** In general the seas off the west coast of the Scottish mainland drop quickly to depths of as much as -120m and in the north they are exposed to considerable wind and wave action, but there are areas of shallower water and protected bays and inlets, particularly to the south, where favorable conditions combine to offer the potential for submerged prehistoric sites. Along this coastline there is evidence for human settlement from the earliest times, the concentration of sites in the south being merely a reflection of the greater amounts of work carried out there. Historically the areas round Oban and Campbeltown were important for their Mesolithic remains (Wickham-Jones, 1994), but recent work has identified sites in Kintyre (Tolan Smith, 2001), Ardnamurchan (Pollard, *et al* 1996), and Applecross (Hardy & Wickham-Jones, forthcoming). Neolithic and Bronze Age sites occur along the coast with fine settings of standing stones around Oban and Kilmartin (Ritchie & Harman, 1996). The Iron Age is represented by numerous duns, forts, brochs and crannog sites, and various early church foundations provide evidence for the early Historic period. In historic times the population rose to near, or just over, the carrying capacity of the land, since when migration and eviction have led to the current situation where the Highlands as a whole contain only 4% of the population of Scotland. As with the islands, the west coast has only been deemed remote in recent centuries; in the Medieval period the lordship of the Isles provided a thriving political identity for her inhabitants and their neighbours.

**3.33 N Ireland (Portrush to Ballycastle) and Rathlin Island.** To the north of Rathlin Island the sea drops abruptly to -200m, beyond that, however, the Laconia Bank and shallower waters lead to the Southern Hebrides. To the south, between Rathlin and the Irish mainland lies a narrow strait that never reaches more than -50m deep (fig 3.15). Preserved inter tidal peat deposits are common along this stretch of coast, some recorded at depths of up to -25m (Cooper *et al*, 2002). This stretch of the N. Irish coastline has provided abundant archaeological evidence from the Mesolithic to the present day. The early Mesolithic site of Mount Sandel, outside Coleraine is particularly important for our understanding of the early settlement of Ireland (Woodman, 1985) and more recent projects have looked at Mesolithic material in both Rathlin Island (McCartan, 2000) and at the mouths of the Antrim Glens (Woodman, 1992). The work of Cooper *et al* suggests, however, that much of the record of Mesolithic settlement in the area may now be submerged (2002). Cooper *et al (ibid)* also point out that although the Scottish islands have seen very different uplift to the N. Irish coast in the period

immediately after the Ice Age one effect of the Holocene lowstand would have been the emergence of a series of islands and skerries between the two within a generally low energy coastal strait (ibid, 385). This is potentially of great importance as it would have facilitated the movement of people, in this case Mesolithic settlers, along the coast; it is also important today as an indicator of a potential hotspot for submerged archaeology. An on-going project to run a power cable between Ballycastle in Antrim and Church Bay in Rathlin, has been subject to route surveys carried out by Metoc Ltd (<http://www.metoc.co.uk/pressreleases/rathlin.pdf>) including remote sensing. The potential significance of archaeology here is a matter of concern and the data will be reviewed by the Environment and Heritage Service (Archaeology and Natural Environment sections) as part of the EIA process. The Neolithic and Bronze Age sites of the area are particularly interesting because of the outcrops of porcellanite on Rathlin and at Tievebulliagh, both of which were exploited to produce stone axes that were later distributed to the mainland of Britain. There are other indications of links through time with west coast Scotland, the islands and peninsulas of which are clearly visible in fine weather.

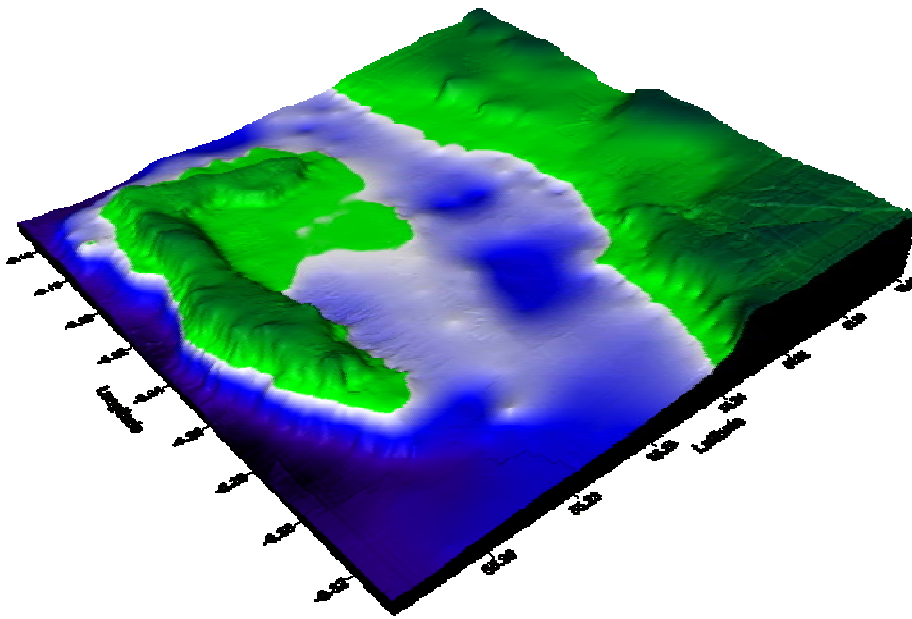


Fig 3.15: Rathlin Island and the Irish coast looking SE and showing the effects of the Holocene Lowstand, ie a 30m drop in sea level, the emergence of a sheltered landscape (now submerged) is clear. (R Quinn)

### 3.34 Summary

West coast Scotland and the outlying islands have been occupied from some 10,000 years ago by people well used to making a living from the land and surrounding seas. Coastal resources have always been important, particularly in early times before the advent of farming, but their role in later times should not be underplayed. In some areas it is likely that relatively lower sea levels at the start of this period exposed areas of land that would have been suitable for settlement, and it is reasonable to assume that settlement covered such zones, particularly given the importance of coastal resources noted above. It is also quite possible that evidence for settlement at even earlier times survives underwater, a relict of even lower relative sea levels. As archaeology has only just started to take these possibilities seriously, there has been no research on this to date in this area. Nevertheless, the richness of the archaeological record on land gives some idea as to the potential of the submerged landscape (table 3.2). In addition, recent surveys of much of the coastline in the SEA7 area carried out on behalf of the Scottish Coastal Archaeology and the Problem of Erosion (SCAPE) Trust demonstrate the great number of sites that lie along the present coasts, many at great danger from erosion and submergence (<http://www.scapetrust.org/>).



Island name	Number of Entries in NMRS
St Kilda	83
Lewis and Harris	5393
North Uist	656
Benbecula	26
South Uist	518
Barra	140
Skye	1794
Small Isles	730
Coll and Tiree	397
Mull	1060
Colonsay and Oronsay	313
Jura	200
Islay	891

Table 3.2 Estimate of entries for archaeological sites of all periods in the National Monuments Record for Scotland by island group. NB: some sites have more than one entry.

## 4. Known and likely submerged sites in the SEA7 area.

### Introduction

4.1 Work elsewhere has demonstrated considerable potential for submerged prehistoric remains to survive on the seabed in the right conditions. There is, for example, a long history of the investigation of submerged sites in Denmark and other parts of the North Sea with impressive results (Flemming (ed), 2004). In addition, large quantities of fossilized animal bone have been recovered from various locations across the North Sea (van Kolfschoten & van Essen, 2004). Most of these come from the Brown Ridge area but some have been recorded from further north, in particular two areas to the west of northern Scotland and also a smaller area southeast of Shetland (Flemming, pers com). Sadly, these specimens are mostly recovered in trawl nets so that information on their original context is lacking. They may well be redeposited from eroded submerged or coastal sites, though it is likely that some are *in situ* and they still provide a good idea of the potential of the area for early human settlement. Dated material is confined to those find spots further south and ranges from early Pleistocene material (some 1.8 million years ago) to early Holocene material (prior to 8000 years ago) (van Kolfschoten & van Essen 2004). Although some species, such as large carnivores, are by and large, lacking and this has yet to be explained, these finds are important because they start to fill in the picture of conditions across this largely unexplored territory.

4.2 In the north the fossils are spread more thinly and are more fragmentary than those from the Brown Ridge area. The species of mammal recorded from the Scottish North Sea are (in order of abundance of fossils) reindeer, *Rangifer tarandus*, bison, *Bison* sp., musk-ox, *Ovibos moschatus*, woolly mammoth, *Mammuthus primigenius*, red deer, *Cervus elaphus*, and some woolly rhino, *Coelodonta antiquitatis* (Flemming, 2003).

4.3 Artefacts, as opposed to unworked animal bone, from the North Sea are mainly to be found in the southern reaches, from the Brown Ridge area (Loewe Kooijmans, 1970-71; Verhart, 2004). With regard to Scotland finds of this kind are limited to a single worked flint from vibrocore number 60+01/46 obtained as part of a BGS programme in the UK shelf some 150km north-east of Lerwick, near Viking bank, in a water depth of 143m (fig 4.1; Long *et al*, 1986). While it is possible that this find came from an area of dry land and is thus to be regarded as a submerged indication of prehistoric settlement, it is equally possible that it is the result of a loss at sea, either in ancient or recent times. Further work in the area is needed to assess the context of the find.

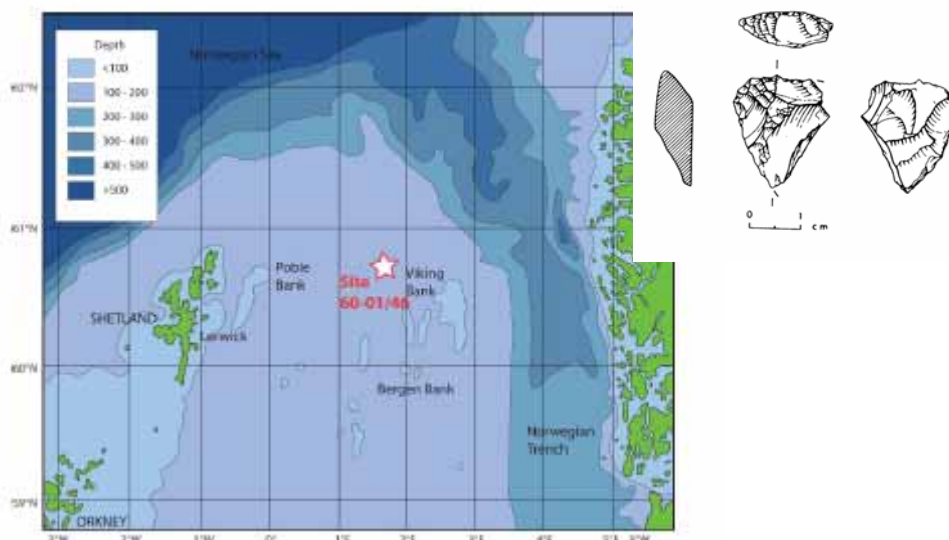


Fig 4.1: The North Sea Flint – location and illustration.

### Submerged finds from SEA7

4.4 Many intertidal peat deposits and examples of submerged woodland have been noted along the western coastal stretches of the Hebrides, though few have been accurately recorded or studied. The result is an impressive body of evidence, albeit largely anecdotal, for submergence in the last few thousand years. Recent storm activity in the Outer Hebrides has uncovered many new exposures of intertidal peats and on-going studies include those on Coll (Dawson *et al*, 2001), and Raasay (Dawson in Hardy & Wickham-Jones, forthcoming). These provide evidence of a slowly rising relative sea level with still stands of sufficient length to permit the growth of woodland. Conditions like this would have permitted the local Mesolithic inhabitants to settle in the vicinity of the (now submerged) coastline.



Fig 4.2: Clachan Old Harbour (Sue Dawson & SFS).

4.5 At Clachan Old Harbour on the S. coast of Raasay (fig 4.2), there is a deposit of submerged peat and tree roots (fig 3.8; fig 4.3). Much of this has been destroyed by recent digging for fuel, though this has now stopped. There is anecdotal evidence for the removal of stone tools here and when the site was visited by archaeologists in the summer of 2001, a single stone flake was recovered. This is certainly indicative of human activity in the vicinity, but it was not possible to carry out any excavation of the site, and flakes have not been observed on subsequent visits (Hardy & Wickham-Jones forthcoming; Dawson forthcoming). Dawson's work has dated this material to pre 8800 BC and shown that it relates to a slightly lower still stand in relative sea level that lasted long enough for the growth of woodland at the site, probably between 500 and 1000 years (*ibid*). The importance of this site is that it confirms the possibility that the spread of evidence for early prehistoric settlement is not primarily related to current sea level. More sites, and dates, are needed.

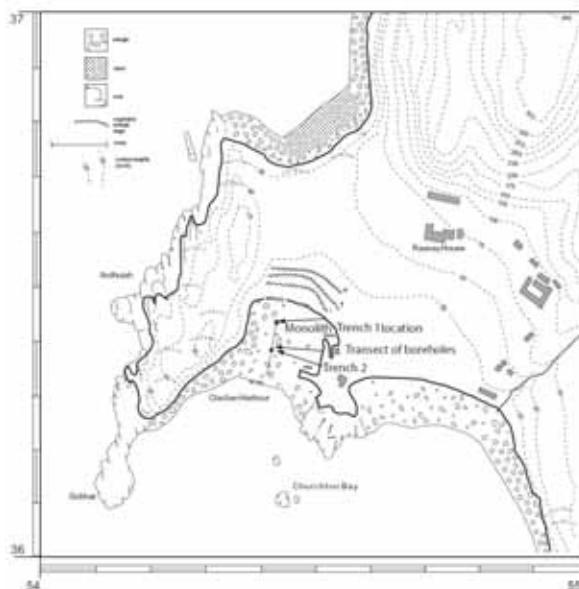


Fig 4.3: Location of the site at Clachan Old Harbour (Sue Dawson & SFS).

4.6 In 1991 a scallop boat dredged a gold torc from the seabed near the Shiant Isles (Cowie 1994). This artefact is Bronze Age in date and assumed to relate to loss at sea, whether deliberate or accidental. During the Bronze Age the deliberate deposition of high class objects in association with water was a common phenomenon. The characteristics of the Sound of Shiant mean that this artefact could have travelled here from some distance, but the find is also an indication that similar prehistoric material might occur elsewhere on the seabed.

4.7 In 1981 a group of divers recovered a gold arm-ring from the sea bed near to Ruadh Sgeir at the north end of the Sound of Jura (Graham-Campbell, 1983). This artefact has been dated to the Viking period, probably 10<sup>th</sup> century AD, and is assumed to have resulted from a loss at sea. Again it signifies the potential of the seabed for prehistoric remains that relate perhaps to the wider aspects of life rather than to direct settlement.

#### **Potential finds and hotspots on the seabed.**

4.8 There is great likelihood of finds relating to the Mesolithic (10,000BP – 6,000BP) and Neolithic (6,000BP – 4,000BP) periods on the shallower parts of the Scottish Shelf (down to c.-45m) in the SEA7 area, in areas where the conditions for site preservation (see above section 2) can be met. There is also a high possibility of finds relating to the Palaeolithic period, prior to the Mesolithic, especially on lower stretches of the Scottish shelf, though it is difficult to pinpoint hotspots for this.

4.9 Potential locations for the survival of archaeological material on the sea bed include the shelf to the west of the Hebrides; the Hawes Bank and sea bed around Coll and Tiree; and between and around Islay, Jura, Colonsay and Oronsay. Smaller locations include parts of the Rum and Canna coastline, sheltered inlets and reaches to the east of the Hebrides, and sheltered inlets around Skye. Recent research at the University of Ulster, Coleraine has highlighted the previous existence of a low energy strait with various islands between the N Irish coast and the S Hebrides in the early Holocene (Cooper *et al*, 2002) thus confirming the importance of this area as a potential archaeological hotspot.

4.10 The development of increasingly sophisticated detection methods, mapping, and underwater excavation means that the recovery of archaeological information from SEA7 is increasingly likely. There is now work on this in all parts of Britain and Europe except Scotland. Examples from the Baltic (e.g. Fischer, 1995) are impressive, and include surprisingly early material; Momber and Campbell (2005) report on a Mesolithic cooking area, complete with hearth, oven pit, burnt stones, and nearby branches and timbers dating from about 9000 BP, at a depth of 12m, in the Solent; Quinn *et al*, (2000) describe on-going work in Northern Ireland; and Fitch *et al* (2005) publish the reconstruction of Mesolithic topographies in the Dogger Bank area or the North Sea. Some networks have already been set up (eg the Submerged Landscapes Archaeological Network <http://www.science.ulster.ac.uk/cma/slan/>) and there is considerable scope for Scotland to benefit from the experience of those already working in the field.

## 5. Consideration of the potential impacts of oil field operations on submarine prehistoric and historic archaeological remains within SEA7

5.1 At present SEA7 is an unknown quantity as far as submarine archaeology is concerned, but it is likely that a considerable resource of prehistoric material has been preserved in the area. Prehistoric remains on land attest a long history of occupation and the known attractions of coastal areas for early settlers mean that areas now submerged are likely to have been well used in the past. It is worth noting that the remains of earlier occupation, such as Mesolithic sites, are often ephemeral and can be hard to spot even on land. It is essential that careful consideration be given to liaison with relevant specialists so that those who are working underwater know exactly what to look for.

5.2 The numerous submerged peat beds and timbers along the coast indicate a well-preserved drowned landscape in many places especially along the western and southern reaches. Although there has undoubtedly been much scour and erosion, there are many areas where preservation is likely to be better (section 4.8 – 4.10). In the areas of exposed bedrock there is a reasonable prospect that there could be caves, or artefacts preserved in gullies.

5.3 Oil field operations include many activities which could damage submerged archaeological sites. Some of these are common to offshore windfarms, gas exploitation, and hydrocarbon prospecting, indeed to any activity which will disturb the seafloor. The following types of activity in principle cause disturbance which could damage or destroy archaeological remains:

- i) Coring of the seabed to investigate pipe routes and foundation engineering for platforms.
- ii) Emplacement of platforms, concrete gravity, jacket or jack-up. It is important to consider here the total footprint of the platform, including that of any associated support systems.
- iii) Permanent anchors for semi-submersible platforms.
- iv) Pile driving.
- v) Drilling and running casing.
- vi) Pipe entrenching.
- vii) Coastal entrenching, terminals, docks, shoreside structures, jetties.
- viii) Movement (including dumping) of sediment, gravels or rock.

5.4 The total area of sea floor disturbed, excavated, or drilled in the course of these activities is small compared with bottom trawling, aggregate dredging or beach replenishment, but there is always a chance that a single core may penetrate a prehistoric site, as in the case of the Viking Bank core (Long *et al*, 1986), or that a trench for a pipeline will intersect one or more prehistoric sites over the extreme length of burial. All shallow sediment cores sampling the top 1-10m of sediment in sensitive areas should be checked routinely for prehistoric materials. In addition it is worth noting that such cores may well hold data of use to those undertaking the reconstruction of past sea bed topography who seek to examine structures below the surface sediments. There is a lot to be gained from liaison between those studying the seabed and those exploiting it (section 6).

5.5 At present the excavated sediment from pipe entrenching machines is not brought to the surface, but is ploughed or jettied to the side of the trench, meaning that there is no chance to investigate the sediments for prehistoric material. Furthermore, the sediment dumps could mask archaeological sites. Consideration should be given to monitoring extracted sediment, either by hand, or by close video inspection using ROV. Prehistoric artefacts have been retrieved from 50m depth off British Columbia by ROV and clamshell grab (Josenhans *et al.*, 1997).

5.6 Other activities include trawling and dredging which both disturb the upper 0.5-1.0m of sediments over large areas, but are outwith this report. The offshore aggregate industry has a healthy collaborative relationship with the academic archaeological community, indeed funds from the industry provide support for valuable offshore work (outwith of Scottish waters). On land, many excavations have been started by the good observation of untrained workers in industry and the same interest would be a valuable asset offshore. Fishermen can also act as prolific sources of information and assistance in retrieving subsea archaeological materials, as demonstrated in the Solent where observation by local fishermen and divers has led to some important discoveries (Momber, 2004). Whatever the impacts of oil field and other operations, close liaison between archaeologists and operators serves to mitigate them.

## **6. Consideration of the opportunities presented by oil and gas operations for site/artefact identification.**

6.1 Close co-operation between archaeologists and the offshore industries serves to benefit both communities (section 5). With sensible preparation, briefing, and mutual understanding the two can work together to increase archaeological knowledge. It is worth noting that this includes not only the recovery of archaeological material, but also of information relating to topics such as sea level rise and climate change. A workshop sponsored by English Heritage provides a useful example of some of the ways in which positive collaboration between the offshore industries and submarine prehistoric archaeology might be taken forward (Flemming, 2004). It is not within the terms of the present report to make specific proposals relating to this, but it is worthwhile looking at the opportunities presented by oil and gas operations in general. This assumes that some staff time, funds, and assistance might be available.

### **Techniques**

#### **Remote surveys**

6.2 An accurate understanding of submarine prehistory is dependent on a good understanding of the topography of the submerged land surface. Simple bathymetric information is not adequate to provide this as it relates to the present topography of the seabed which may have been subject to both sedimentation and erosion since inundation. Remote sensing of various types is integral to this work because it can provide information relating to the makeup of the upper layers of the seabed which in turn relate to time slices through its history. In this way Gaffney and his colleagues have used 3D seismic data to reconstruct the positioning of incised tunnel valleys in the southern North Sea ([http://www.iaa.bham.ac.uk/research/fieldwork\\_research\\_themes/projects/North\\_Sea\\_Palaeolandscapes/project\\_outline/03\\_method\\_statement.htm#3.1](http://www.iaa.bham.ac.uk/research/fieldwork_research_themes/projects/North_Sea_Palaeolandscapes/project_outline/03_method_statement.htm#3.1); Fitch *et al*, 2005). This work is potentially very important with regard to the identification of archaeological sites on the North Sea bed.

6.3 Acoustic survey has still to be refined to the extent that it can identify submerged structures or features that might contain worked flints, shell midden deposits, charcoal, worked wood, or bone. Nevertheless, remote sensing techniques such as swath bathymetry, side-scan sonar, and conventional shallow sub-bottom profiling are all useful tools for the analysis of submerged landscape features in the manner identified above (section 6.2). Consideration should be given to the application and development of these techniques in relation to archaeology alongside and during more conventional industrial applications.

6.4 While Chirp technology can show fine-scale stratification which gives strong clues as to the presence of archaeological materials, physical sampling by core, grab, diving, or examination by ROV has always proved essential to establish the existence of a submerged prehistoric site. As yet there have been no cross-correlation checks using high frequency, high resolution acoustics over known submarine prehistoric sites to test for the signatures of anthropogenic materials, though the Danish experience, where acoustics are used routinely to select optimal diving sites on the basis of topography suggests that no direct signatures exist as yet. This is also the subject of ongoing work in Norway and Denmark, particularly for large features such as wooden posts (Flemming pers com). With regard to smaller objects such as worked flints, a consideration of the wavelength of high frequency sound, which is of the order of 4-15 mm in the frequency range 400-100 kHz, suggests that the resolution would not be able to distinguish shapes at the level required for their identification. It is worth noting that medical type acoustics at 4 MHz, though dealing with finer subject matter, have a penetration of only 20-30cm.

#### **Coring, grab samples, and site investigation**

6.5 Coring and sampling of seabed sediments can identify sedimentary facies, and are important in the detection of material such as peat, beach gravels, clay, deltaic muds, and organic materials. These can be used to indicate surface conditions, as well as age, vegetation cover (pollen), sea level change (diatoms), temperature and salinity (shells). In addition coring has, on one occasion, yielded an artefact – the North Sea flint (Long *et al*, 1986). There is a large body of existing BGS and commercial cores which provide a massive body of data that has not, to date, been exploited archaeologically. In the light of the North Sea flint a brief examination of this would be a worth while task, and in future, any planned core or grab sample investigation should include examination for



archaeological material. This does not require great archaeological knowledge – it is relatively easy to spot potential archaeological artefacts which usually stand out by virtue of their contrast to the background material. Simple identification charts could be provided for the use of non-archaeological operators in conjunction with liaison with local archaeologists to provide a check-up service. Procedures for examining and recording archaeological finds from marine aggregate samples have been carefully drawn up and published (including identification guidelines, albeit not illustrated), in the BMAPA/English Heritage Protocol (2005) and could be used to form the basis of a relevant procedure here. Once a reliable network of archaeologically sensitive areas has been drawn up this should be used to target cores and samples for examination.

### **Dredging and pipe entrenching**

6.6 As seen in section 5, the bulk movement of seabed sediments has great potential to damage and mask prehistoric sites. These operations should be monitored or sampled to check for artefacts or designated indicators either by hand or with ROV.

### **Conclusion to Section 6**

6.7 Offshore oil and gas operations, and the sub-contracted services, present a good opportunity to discover, examine and record submarine prehistoric sites. Regulations and Avoidance criteria should be set a level such that acoustic surveys and sampling systems have the maximum chance of physically proving the existence of archaeological sites.

## 7. Summary of existing activity regarding the reporting, investigation and protection of prehistoric and archaeological remains.

7.1 In the USA, the Outer Continental Shelf legislation requires offshore operators to conduct extensive pre-disturbance and avoidance surveys before starting operations, so as to protect prehistoric archaeological sites, as well as shipwrecks. By the early 1980s the situation was attracting severe criticism because hundreds of millions of dollars had been spent, no prehistoric artefacts had ever been found on the outer shelf, and the work lacked academic input. During the same period American marine archaeologists struggled to study known submerged palaeo-indian prehistoric sites in water depths up to 10-20m at many locations around the USA (e.g. Stright, 1990; Cockrell and Murphy, 1978; Ruppé, 1981), in general they were working with limited budgets, and relied on volunteers. Flemming (1981) wrote to comment on the absurdity of this position. UK regulations should avoid repeating this mistake.

7.2 The assumption behind a strict code of *in situ* preservation is that academic institutions or statutory regulatory bodies will both discover, classify, and excavate sites, and have sufficient funds to prove or disprove the existence of artefacts in high-potential areas. In practice, this assumption is not valid. The statutory regulatory bodies relevant to SEA7, such as Historic Scotland do not have the resources for this type of input and their support for any archaeological project is more commonly part of a complex package that includes academic bodies, other grant agencies, and sometimes commercial contractors. Academic institutions and grant giving bodies are also working with all too limited resources. Only commercial companies can justify the cost of seabed work in open sea conditions. It is therefore preferable to allow commercial companies to proceed in the manner which is technically and economically the most efficient for them, to encourage liaison with archaeologists, and to monitor all archaeological impact. When the existence of a site is confirmed, then academic and other resources can be deployed to monitor, record, and, if suitable, excavate.

7.3 BMAPA and English Heritage (2003 & 2005) have developed a detailed protocol for the management of archaeological sites impacted by aggregate dredging, and the principles developed in these documents could be adapted to the offshore sector. Although aggregate dredging does not take place in SEA7, this document provides a useful and valid basis for assessing obligations offshore. Expert groups such as the ADU, the IFA, the Hants and Wight Trust for Maritime Archaeology, the Nautical Archaeology Society, and the Maritime Archaeology Centre at the University of Ulster should also be consulted. The study and understanding of submerged landscapes and archaeological sites is still in its infancy and it is important that sites be reported and studied when found. The BMAPA protocol provides a useful mechanism to encourage the reporting of sites with minimum interference to commercial work schedules. Advance notice to the relevant state agency (Historic Scotland or DOENI) of any intention to carry out operations or disturb the surface sediments in key areas is crucial. Within Scottish Waters the recording of sites would presumably become part of the NMRS managed by RCHAMS, for Irish Waters there is the Northern Ireland Sites and Monuments Database, managed by the Environment and Heritage Service for the Department of the Environment, Northern Ireland.

7.4 In the North Sea, the work of Louwe Kooijmans and van der Sluis recorded hundreds of palaeontological finds and some prehistoric artefacts in less than 10 years using the reports of Dutch fishermen who were fishing on the UK side of the median line (Flemming, 2002). In addition, many tons of Pleistocene terrestrial mammal bones are landed by Dutch fishermen each year (Glimmerveen *et al*, 2004). A few finds have been reported by UK fishermen, notably from the Dogger and Leman and Ower Banks (Burkitt, 1932). But the failure of UK fishermen to retrieve palaeontological material is remarkable. There must be material in other areas, even allowing for different geology and sedimentary regimes. Preliminary enquiries suggest that Scottish fishermen do retrieve small quantities of palaeontological items (Flemming pers com), and consideration should be given to means whereby further finds might be encouraged. In this way, areas which may have supported mammal populations could be identified, together with those places into which bones have been transported by glacial transport or post-glacial run-off. If an *in situ* fauna can be identified, this would be a most useful indicator towards the possibility of human occupation. In this sense, all industries offshore which have the potential to impact or disturb prehistoric archaeological materials may provide data which impact on the management of offshore prehistory and archaeology as a whole.

7.5 The pros and cons of disturbing and excavating archaeological materials should they be discovered have been discussed above and are discussed in more detail below (section 8.10). Although preservation *in situ* is an oft quoted archaeological goal, in practice, the information to be gained from examination of material is currently such that at present the balance of favour must tip towards examination. Given the constraints of commercial activity this is likely to accord with the needs of those offshore industries affected by finds of archaeological material. Any excavation or examination must take place in full co-operation with relevant archaeological bodies, with full regard to health and safety, and following all archaeological professional guidelines regarding the well-being of the material (Oxley & O'Regan 2001). It is also important that finds be published to as wide an audience as possible.

## **8. Recommended measures to prevent damage to prehistoric and archaeological remains from oil and gas activities.**

8.1 The objective is to achieve a constructive and positively beneficial relationship between the offshore oil and gas activities in sector SEA7, and the archaeological research community, with regard to the relevant legislation, both national and international. Although the marine aggregates industry does not operate in section SEA7, the DTI has instructed that the procedures recommended by this report be concordant with the BMAPA Protocol (Wessex Archaeology 2005).

8.2 The following comments are intended to suggest the areas of discussion which might promote and maintain such a relationship. None of these comments should be regarded as assuming any particular outcome of that discussion process.

8.3 The first question to consider is whether any known areas within SEA7 should, on the present evidence, be restricted in such a way that offshore industrial activity of any kind should be curtailed or banned. Since the Home Country Heritage Agencies already have the responsibility to manage and protect sites out to the 12 mile limit, this discussion only applies to the sea bed beyond that limit. Notwithstanding possible legal arguments which might suggest that such pre-emptive restrictions be desirable, the practical effects for archaeology (in terms of potential loss of properly recorded evidence) in addition to the economic and industrial impacts mean that they are not, at present recommended. Furthermore, the experience with the OCS legislation on archaeology in the USA shows that the rigid enforcement of such regulations can be counter-productive.

8.4 Industrial and commercial activity should thus be regarded as a means to identify archaeological sites in the offshore area. In this respect it is important to marry the interests of the acquisition of archaeological knowledge with those of the long term preservation of the archaeological resource. Following the procedures for land-based archaeology, it is assumed that coastal and shallow water sites are usually notified to the relevant authorities and documented by RCHAMS, NI Heritage Service and HS. The following discussion is thus concerned with industrial activity further offshore, perhaps outside Territorial Waters. There should be a logical continuity of the protocols at the Territorial Limit.

8.5 The recent development of methods for reconstructing the Quaternary drainage pattern and landscape under modern sediments from existing archived seismic penetration surveys (Fitch *et al*, 2005), if combined with predictive modelling of site location provide methods to check for the probability of prehistoric sites. It should, however, be remembered that these techniques are as yet untested with regard to the actual location of sites, and also that constant monitoring and checking of actual site locations is necessary to refine any predictive modelling.

8.6 An ideal structure would require or encourage the industry and its sub-contractors to check for prospective archaeological zones and to identify and report when prehistoric artefacts are found or indicated by remote sensing such as acoustic surveys. This should entail minimal or acceptable cost and delay to industry and provides a positive advantage to allowing operators to work in zones of archaeological potential.

8.7 Potential action in the event of the location of archaeological material may be divided into three: avoidance; examination; preservation *in situ*. Whatever course is followed it is vital that there be close co-operation between commercial operators and archaeologists. Once archaeological or palaeontological sites are found then relevant specialists should be brought in.

8.8 Avoidance: in the long run, the use of acoustic systems and seabed sampling by both commercial operators and archaeologists create the potential to gain advance warning of the likely presence of prehistoric sites, and hence to plan mitigation procedures. One option would be to avoid activity in specific areas. Avoidance, however, usually increases costs for the operator, while repeated instructions to avoid potential sites can also complicate logistics. In addition, over-sensitive thresholds for site avoidance mean that artefacts are not recovered, and there is thus a lack of archaeological information. This is to be avoided at this early stage of the discipline of submerged prehistory when sites are needed not only to test the accuracy of techniques for pinpointing potential

hotspots, but also to provide data on the occupants of the submerged land surfaces. Avoidance criteria should thus be set at a coarse, non-sensitive level. Mandatory instructions to divert or delay operations should only be considered after human artefacts or mammal bones have been recovered. Even then it is possible that the decision would be to monitor operations during disturbance of the sediments, rather than to avoid the site.

8.9 Examination: excavation increases knowledge but destroys sites, and this is as true underwater as it is on land. On land one professional archaeological tenet would be to preserve a portion of any site for examination in future by those with better techniques, but this is not always possible and may be less viable when dealing with submerged sites discovered in the course of industrial exploitation. Excavation/examination should be undertaken with a view to health and safety, careful recording, maximising information recovery, artefact conservation, and publication or dissemination of the findings. Detailed excavation is less likely to be a viable option on deeper sites, though information recovery through sampling may still be well worthwhile. The excavation of underwater sites, both prehistoric and historic, has been the subject of much archaeological consideration (Oxley & O'Regan 2001) and professional guidelines should be strictly adhered to. It is important to give consideration to the costs of excavation which need to include conservation of any artefacts and ecofacts, as well as specialist analysis and publication of the findings.

8.10 Preservation *in situ*: the legally preferred method of preserving submarine archaeological sites is *in situ* (see Section 1.11). Strictly speaking this means no disturbance at all (and thus avoidance by the operator), but in practice the very actions of discovery and research are likely to involve disturbance, unless the prehistoric material is clearly visible on the surface of the seabed. The objective is thus to balance the sum total of acquired and published knowledge together with the sum total of artefacts left *in situ* for examination by future generations.

8.11 The lack of existing sites within sector SEA7, coupled with the strong likelihood of submerged prehistory means that should archaeological material be recovered a powerful argument exists for the examination of initial sites, in order to better understand, and thus manage, the resource. Once there is a body of data and sites then an approach more akin to the management protocols of the Danish archipelago, where hundreds of submerged sites are known and the great majority are preserved *in situ*, should be considered.

8.12 The BMAPA protocol and other guidance provide useful notes for commercial operators in SEA7. Nevertheless, it is recommended that an equivalent guide/s be produced for the offshore industries and their contractors.

8.13 The success of this approach depends upon the number of people in the commercial sector who are aware that prehistoric artefacts could be present in almost any sediment recovered from the seabed in SEA7. Education and communication is vital. Simple measures that can be taken include talks to relevant staff at all levels, and the production of identification charts for material such as stone and bone tools. It is important that effort be made to ensure that the importance of potential finds is stressed to all those who work offshore. Many people have an interest in their past though few have considered the possibility that evidence might lie deep underwater. It is time to redress the balance.

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## **Annexe 1 - Articles 149 and 303 of UNCLOS**

### **Article 149. Archaeological and historical objects**

All objects of an archaeological and historical nature found in the Area shall be preserved or disposed of for the benefit of mankind as a whole, particular regard being paid to the preferential rights of the State or country of origin, or the State of cultural origin, or the State of historical and archaeological origin.

### **Article 303. Archaeological and historical objects found at sea**

1. States have the duty to protect objects of an archaeological and historical nature found at sea and shall co-operate for this purpose.
2. In order to control traffic in such objects, the coastal State may, in applying article 33, presume that their removal from the sea-bed in the zone referred to in that article without its approval would result in an infringement within its territory or territorial sea of the laws and regulations referred to in that article.
3. Nothing in this article affects the rights of identifiable owners, the law of salvage or other rules of admiralty, or laws and practices with respect to cultural exchanges.
4. This article is without prejudice to other international agreements and rules of international law regarding the protection of objects of an archaeological and historical nature.

## Annexe 2 - Acronyms

AHOB	"Ancient Human Occupation of Britain" project
BMAPA	British Marine Aggregates Producers Association
BGS	British Geological Survey
CBA	Council for British Archaeology
DCMS	Department of Culture, Media, and Sport
DTI	Department of Trade and Industry
DTLR	Department of Transport, Local Government, and the Regions
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
HS	Historic Scotland
IFA	Institute of Field Archaeologists
ka	Thousand years.
MoD	Ministry of Defence
NAS	Nautical Archaeology Society
NI	Northern Ireland
NHA	National Heritage Act 2002
NMR	National Monuments Record
OCS	Outer Continental Shelf, (legislation, USA)
RCHME	Royal Commission on the Historical Monuments of England
RCHAMS	Royal Commission on the Historic and Ancient Monuments of Scotland.
ROV	Remote Operated Vehicle
TttW	"Taking to the Water". Policy statement of English Heritage, 2002
UCPUCH	UNESCO Convention on Preservation of the Underwater Cultural Heritage
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea 1982
UNESCO	United Nations Educational, Scientific and Cultural Organisation.
VC	Valetta Convention, European Convention on the Protection of the Archaeological Heritage (Revised) 1992