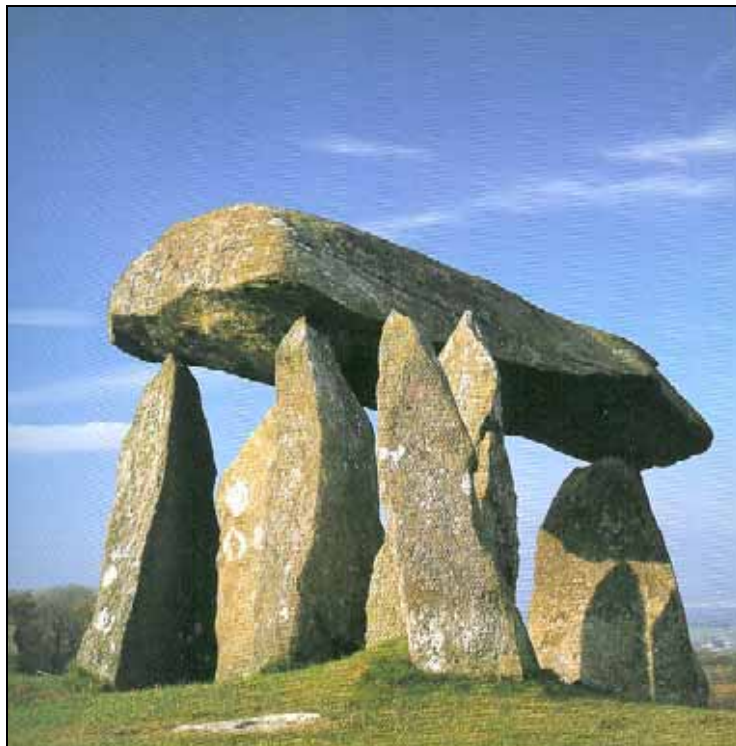




**The scope of Strategic Environmental
Assessment of Irish Sea Area SEA6 in regard
to prehistoric archaeological remains**



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Cover picture: Pentre Ifan, Dyfed Wales, entrance to chambered tomb, 4000-5000 BP.
 (John Manley, 1989)

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Executive Summary

The SEA6 area comprises the UK sector of the Irish Sea, that is the bulk of the Irish Sea itself, and part of the coastal waters of Northern Ireland. In order to understand and prioritise the nature of prehistoric archaeological sites which might occur on the sea floor this report considers the context of all the adjacent land masses, including the Irish Republic, and to the south the Celtic Sea and western Channel. Prehistoric submarine archaeological remains back to a date of about 225,000 years ago, Palaeolithic, Mesolithic and Neolithic, could occur with low probability in many parts of the SEA6 area.

Palaeolithic archaeological sites as old as 225,000 years Before Present (BP) occur at locations on the Welsh coast, with a great density of sites from the later Mesolithic and Neolithic. Some sites therefore pre-date the last interglacial high sea level, and although they were covered by the Devensian ice sheet, material inside caves survived.

The penultimate glaciation, the Anglian covered the whole Irish Sea, and southern Wales and Ireland, but the last one the Devensian, left the southern Irish Sea exposed, and also left southern Wales and the southern rim of Ireland exposed. The deep channel known as the Celtic Trough is the cumulative effect of over-deepened scour by ice sheets and meltwater tunnelling, partially infilled by glacial and marine sediments. It is deepest at the northern end. Occupied caves co-existing with the last ice sheet have been found in southern Wales, but not in southern Ireland. Particular attention is given in this report to Oxygen Isotope Stage 3, 64,000-22,000 years before present, for which sophisticated reconstructions of the climate and vegetation of western Europe have recently been made.

There are also Palaeolithic sites in southern England, the Channel Islands, and Brittany. At the time of the maximum glaciation of the Devensian, people were probably living on the floor of the English Channel and the exposed plains of the Celtic Sea, as well as in Cornwall, and on the ice edge in southern Wales itself. Submerged prehistoric sites have been found in the English Channel. The re-occupation of Wales and Ireland could have been as much from the south, as from the east, when the ice retreated. This could explain some of the highly developed Mesolithic sites in Ireland which seem to pre-date the equivalent structures on the British mainland. The rising sea level separated Ireland from the rest of Britain at about 12,000 years BP, although brief land contact may have been re-established around 10.5-9.5 ka BP due to isostatic uplift.

Evidence from the northern North Sea and the Russian Arctic suggests that some prehistoric peoples occupied the exposed shelf area during late glacial periods utilising Inuit-style survival methods, and butchering marine mammals. If this proves to be the case, there may be unexpected occurrence of early prehistoric sites, Late Palaeolithic, on the Atlantic shelf, and in the southern Irish Sea, where people could have been hunting marine mammals. Pipe entrenching is the process in the oil and gas industry which is most likely to disturb prehistoric archaeological deposits. Commercial site investigation using acoustics and coring could provide beneficial new archaeological data. Re-interpretation of existing acoustic data should be carried out whenever possible in order to reveal the Pleistocene low sea level landscape and drainage. The paper concludes with tentative suggestions for discussion of protocols and a reporting regime.

1. Overview of the legislation and agreements (English, Welsh, Scottish, Northern Irish, UK, EU & international) that apply to UK marine and maritime prehistoric archaeological remains in SEA6

1.1 UN Conventions, European laws and directives, UK legislation

SEA6 includes parts the seabed which come under the jurisdiction of England, Wales, Scotland, Northern Ireland, and the Isle of Man, all of which have slightly different administrative arrangements for the supervision of archaeology. This chapter first discusses the UN and European agreements and directives, then UK, and finally the different administrative arrangements which exist for marine archaeology in England, Wales, Scotland, Northern Ireland, and Isle of Man. 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 (except Manx National Heritage) (Flemming, 2004, p. 119).

1.2 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). 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 human beings and early hominids previously lived or hunted on terrain which was at that time dry land, or where they exploited fish and shellfish on the coast which is now submerged. Sites discussed are all older than 2,000 years, and mostly older than 4,000 years. It must not be assumed that the comments made or conclusions reached in this paper would apply in exactly the same way to shipwrecks on the sea bed. A separate report on the status of submerged shipwreck archaeology in the Irish Sea SEA6 sector is being prepared by Wessex Archaeology (SEA6 Marine Archaeology, 2005).

1.3 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. When reporting the status of legislative documents which may or may not have been signed on behalf of the UK Government or UK agencies I will not comment 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" etc., will be deemed to have equivalent meaning. Nothing stated in the following discussion 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.

1.4 The United Nations Convention on the Law of the Sea (UNCLOS) was negotiated continuously from 1968 through to 1982 when the Convention document itself was agreed. The Convention became recognised international law when it had been ratified at national level by 65 states, and was ratified by 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.

1.5 The Articles of UNCLOS directly concerned with marine archaeology are 149 and 303 (See Annexe 1). Article 149 applies only to archaeology in the International Area outside national jurisdiction. Since, by definition, SEA6 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 SEA6 which is periodically licensed for the exploitation of hydrocarbons, aggregates, or windfarms, it follows that Article 303 applies in a general sense to SEA6.

1.6 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, but has not 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.

1.7 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 in terms of the "going rate" for the levels of national regulatory control which the 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.

1.8 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 SEA6 and to this Report. Underwater cultural heritage is defined, as in most other documents, as traces of human existence which have been partially or totally underwater for at least 100 years. UCPUCH is designed to be compatible with UNCLOS (UCPUCH, Article 3).

1.9 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.

1.10 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 completely 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.

1.11 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 erosion, since only a few sites need to be excavated, and it is sufficient in most cases to document the type of site for research purposes. To date no submerged prehistoric sites with archaeological strata *in situ* below low tide level have been reported in the SEA6 area, and those scattered items which have been found are in very sheltered shallow coastal waters, and so no immediate evidence is available on rates of erosion. Drowned forests are exposed from time to time by storms in Caernarfon Bay, and at several other locations along the Welsh coast (Steers 1948), but there is no evidence that they are being eroded away. However, submerged Mesolithic sites in the Solent (Momber, 2004) are eroding substantially each year, and archaeological information, in the absence of repeated surveys, would be lost. 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 Kolfschoten and Laban, 1995; Post *et al.*, 2001; Glimmerveen *et al.*, 2004; van Kolfschoten and van Essen 2004). Some of the bones have been adapted as tools by humans (Louwe Kooijmans, 1970-71; Post, personal communication 2002; Verhart, 2004). The flow of material recovered by fishermen in Scottish Waters is likely to be 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 the disturbed and recovered material should be monitored by palaeontologists and archaeologists than simply lost. The combination of erosion and disturbance by trawling needs to be assessed fully before deciding that an archaeological site can be safely left *in situ*. Most of the remaining Rules refer to the planning and conduct of projects conducted by specialist archaeologists to study or excavate sites of underwater cultural heritage.

1.12 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. Most of the Articles concern archaeology on land, control of the trade in antiquities and the prevention of looting. The Valetta Convention (VC) applies "underwater" (Article 2.ii). 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, p.119). The status of implementation in Territorial Waters and throughout the continental shelf within each authority will be discussed below.

1.13 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.

1.14 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 SEA6. 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;"

1.15 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). In practice there is only a small quantity of aggregate dredging in SEA6. 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 bordering the Irish Sea 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-WIDE

1.16 Three components of UK law apply directly to marine archaeology in all parts of SEA6: 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.

1.17 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 5 vessels in international waters would be designated as Protected Places. The purpose of this safeguard is not primarily archaeological, but MoD liaise closely with DCMS and the heritage agencies in the process of site designation.

1.18 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.

1.19 Within the SEA6 sector each of the Home Country Heritage Agencies has direct jurisdiction over the seabed within the 12-mile limit, and Manx National Heritage also has authority over a 12-mile territorial sea around the Isle of Man. The Home Country Heritage Agencies have expressed a concern to protect the cultural heritage beyond the 12-mile limit, but 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 SEA6 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.

1.20 The following paragraphs summarise the situation in each of the regimes which apply in the Irish Sea.

ENGLAND

1.21 English Heritage was allocated the responsibility for maritime archaeology by the National Heritage Act (2002). This gives the agency responsibility for all aspects of offshore submerged archaeological sites and submerged landscape out to the 12-mile limit. A Head of Maritime Archaeology has been appointed, and is based at Fort Cumberland, Eastney. Ian Oxley outlines the policy of English Heritage for conservation of maritime archaeology in English waters (Oxley, 2004, p. 95-98). This statement endorses the central role of the National Monuments Record, the need to establish continuity between land and marine research, and the policy to employ professional maritime archaeologists with the appropriate skills and training to manage the regime for the maritime archaeological resource. Several prehistoric submerged sites have been discovered and studied in English waters, and are known to English Heritage. The situation has been previously reported in the archaeological document for SEA2/3 (Flemming 2002).

WALES

1.22 Cadw is the agency in Wales responsible for the protection and conservation of the built heritage. It is the historic environment agency within the Welsh Assembly Government. Cadw was established in 1984 and is responsible for the preservation of ancient monuments and buildings, and manages directly some 127 ancient monuments which are in State care. The range of monuments included within the definition of historic buildings includes caves, standing stones, dolmens, and prehistoric sites. Cadw implements the Protection of Wrecks Act (1973) and VC within the 12-mile limit, but takes a pragmatic interest in submarine archaeology beyond the Welsh 12-mile limit within the continental shelf, as required by VC. Cadw grant aids the NAS in Wales, and several training courses for divers in archaeological techniques are held each year in different venues in Wales.

1.23 There are four regional archaeological trusts in Wales, for Gwynedd, Clwyd-Powys, Dyfed, and Glamorgan-Gwent. They have an advisory role in respect to Cadw. The trusts receive funding from Cadw and the Royal Commission on Ancient and Historical Monuments of Wales (RCAHMW). Most of the concern regarding archaeological remains below low tide level has been for shipwrecks, and to date no submarine prehistoric site has been brought to the notice of Cadw or the regional trusts. Cadw is however fully aware of the significance of drowned landscapes and is particularly concerned about the possible impact of planned offshore windfarms. Cable-laying for connection from offshore wind turbines to the inshore infrastructure will cross sensitive areas where buried Mesolithic littoral settlements might be expected. There is need for further study of possible site occurrence, and the development for recommendations for mitigation. There is aggregate dredging in the Welsh sector of SEA6 and Cadw gives advice to applicants for licenses, to Crown Estates, and to the Welsh Assembly Government. The guidance given by Cadw incorporates the Guidance Notes of BMAPA/EH, and the

Joint Nautical Archaeology Policy Committee (JNAPC) Code of Practice, which is under revision. The person responsible for marine archaeology in Cadw is Sian Rees.

SCOTLAND

1.24 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." This clearly includes submerged prehistoric sites inundated by rising post-glacial sea level. The legally stated limit at present is out to the 12-mile limit of Territorial Waters, but serious research concern is applied to the problems of marine archaeology in deeper water out to the median line. The Ancient Monuments and Archaeological Areas Act 1979 gives powers to schedule monuments within the Territorial Seas. 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. However, HS takes a pragmatic interest in submarine archaeology throughout the continental shelf area, as would be required by the Valetta Convention.

1.25 The Royal Commission for Ancient and Historical Monuments for Scotland (RCHAMS) maintains an archival record service documenting all archaeological sites, and this is accessible to the public and scholars through an internet search system known as CANMORE and CANMAP. 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. (Unpublished paper issued by MP of NMRS, 2002). The University of St Andrews has created a data base and GIS system analysing all coastal archaeological sites which are, or could be, threatened by coastal erosion.

NORTHERN IRELAND

1.26 I am indebted to Wes Forsythe of the Centre for Maritime Archaeology at the University of Ulster for the following notes which I have edited slightly.

1. The Historic Monuments & Archaeological Objects (NI) Order 1995

Monuments in territorial waters 38

(1) A monument situated in, on or under the sea bed within the seaward limits of United Kingdom territorial waters adjacent to the coast of Northern Ireland (referred to in this Article as a monument in territorial waters) may be included in the Schedule under Article 3(1) and the remaining provisions of this Part shall apply accordingly to any such monument which is a scheduled monument (but, subject to paragraph (5), not otherwise).

(2) In relation to any monument in territorial waters which is under the ownership or guardianship of the Department [of Environment and Heritage], references in this Part to land associated with the monument (or to associated land) include references to any part of the sea bed occupied by the Department for any such purpose relating to the monument as is mentioned in Article 18(1).

(3) Without prejudice to any jurisdiction exercisable apart from this paragraph, proceedings for any offence under this Part committed in United Kingdom territorial waters adjacent to the coast of Northern Ireland may be taken, and the offence may for all incidental purposes be treated as having been committed, in any place in Northern Ireland.

(4) It is hereby declared that, notwithstanding that by virtue of this Article this Part may affect individuals or bodies corporate outside the United Kingdom, it applies to any individual whether or not he is a British subject, and to any body corporate whether or not incorporated under the law of any part of the United Kingdom.

(5) The powers conferred by Article 24 shall be exercisable in relation to any land forming part of the sea bed within the seaward limits of United Kingdom territorial waters adjacent to the coast of Northern Ireland.

(6) References in this Article to the sea bed are references to land permanently covered by the sea.

2. The Valletta Convention 1992 was ratified by the UK Government on 21st September 2000 and came into force on 21st March 2001. The above Order (1995) ensured that Northern Ireland was already satisfying and, in fact, surpassing its requirements. Various officers in Environment and Heritage Service have responsibilities for enforcing compliance with this Order. For example:
 - a. consulting on Planning Applications and monitoring compliance with conditions set;
 - b. scheduling sites and monuments, issuing consents to works on protected sites and monitoring compliance with conditions set;
 - c. licensing excavations and monitoring compliance with conditions set;
 - d. reporting on and processing cases of treasure finds;
 - e. acting as agent in Northern Ireland for the DCMS and Receiver of Wreck.
3. As the closest points between Northern Ireland and the Isle of Man is around 28 nautical miles, and the territorial waters only extend from each for 12 nautical miles, the 'working boundaries' do not intersect on a domestic level. For international considerations, the UK Government takes responsibility for both and, therefore, there would be no obvious conflict.
4. Northern Ireland has had a few large-scale applications with regard to 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, however this 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. Outfalls and interconnector pipes with Britain are a more common development. Again mitigation has been recommended for submerged and coastal sites. Some special difficulties have occurred due to deep water conditions between Ireland and Scotland, as well as dealing with dangers such as the old munitions dumps in the Beaufort Dyke.

1.27 Experience in NI of attempting to protect archaeology at sea has generally been good, with developers working to understand our concerns. A few however will inevitably try to cut corners (and standards). Practical difficulties include the fact that many dredging rigs are not well suited for conducting archaeological monitoring and in such situations we have had to do the best we can. Given the likely subtlety of submerged prehistoric sites this is a particular concern.

ISLE OF MAN

1.28 The Isle of Man is not part of the UK. Isle of Man Manx Government has jurisdiction over the seabed and the superjacent waters out to the 12-mile limit, defined in the usual way as if Isle of Man were an independent country. This situation was created by the UK Act of Parliament, The Territorial Seas Act 1987, and the subsequent Manx Act, Territorial Seas (Consequent Provisions) Act 1991. These Acts had the effect of transferring rights over the seabed from the Crown Estates Commission to the Manx Department of Highways, Ports, and Properties.

1.29 All material connected with shipwrecks within the Isle of Man 12-mile limit is the responsibility of the Receiver of Wreck, Isle of Man. The Receiver of Wreck does not have any responsibility for submerged terrestrial sites or artefacts. The Isle of Man does not hold jurisdiction over any of the seabed beyond the 12-mile limit, and therefore all the area of the Irish Sea SEA6 sector outside this limit constitutes part of the UK continental shelf, and the archaeology in this area is the responsibility of one or other of UK Home Country Heritage Agencies.

1.30 Manx National Heritage is aware of the possible occurrence of submerged prehistoric sites within the 12-mile limit, but has not so far published regulations or directives concerning the institutional responsibility for protecting such sites, or the responsibilities of offshore operators to avoid damage to them.

1.31 The previous paragraphs have reviewed a range of international and national documents which pertain to UK Territorial Sea and Continental Shelf. The SEA6 area abuts on the median line with the continental shelf of the Republic of Ireland. The prehistoric archaeology of the Irish Sea can only be logically studied by including the known sites on all coastal areas adjacent to the sea, and the climate, environmental, and archaeological indicators of the whole submerged landscape from Ireland to the UK coast. The Republic of Ireland has its own legislation on these matters, and has signed and ratified the same international documents signed by the UK. Thus research into the prehistoric occupation of the floor of the Irish Sea within the SEA6 area should in principle include consultation with, and possibly collaboration with, the equivalent agencies and research bodies in the Republic.

1.32 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 which may be disturbed. Consultation may take place through scholarly organisations such as the Council for British Archaeology (CBA), or the Nautical Archaeology Society. For example the consultation phase of the Mineral Planning Guidance for On-Shore Oil and Gas and Coalbed Methane Development included circulation of the relevant archaeological paragraphs to the CBA in 1999-2000. Discussion of the draft specifically referred to the importance of wetland and intertidal archaeology, and the importance of Mesolithic activity on the Dogger Bank. The British Marine Aggregate Producers Association (BMAPA) collaborated with the Royal Commission on the Historical Monuments of England (RCHME) to produce a Consultation Document (Wessex Archaeology, 2001).

1.33 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. By analogy, broadly equivalent principles may be applied to monitoring and managing the archaeological impact of the offshore Oil and Gas Industry. There is reference to prehistoric sites from Palaeolithic to Mesolithic. Pre-dredge surveys and evaluation may be needed. Dredging 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 appear 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 a background paper on Palaeolithic and Mesolithic archaeology and marine aggregate dredging by Wenban-Smith (2002).

1.34 Summary of legal situation and the prudent practices to adopt in the Irish Sea Waters of the UK sector

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 English Heritage, Cadw of the Welsh Assembly Government, Historic Scotland for Scottish Ministers, the Environment and Heritage Service of Northern Ireland and the Manx National Heritage for the Isle of Man. Each of these agencies (with the exception of Manx National Heritage) has indicated informally that they are 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.

1.35 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. The following extract from the proceedings edited by Flemming (2004, p.119) indicates the direction in which agency responsibilities may evolve. The wording has presumably been discussed with the other Heritage Agencies.

"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. Overview of known and likely areas with prehistoric archaeological remains, with mapped indications of relative likelihood of the presence of remains (sensitivity mapping) and with hotspots identified

2.1 During the last million years the British landmass has been connected by dry land to the mainland of Europe for far more time than it has been separated by sea, and the Irish Sea was dry land or blocked by ice sheets for much of this period (Fig. 1). The earliest occupation of the British mainland by hominids, *Homo heidelbergensis*, occurred about 500,000 years Before Present (BP) (Pitts and Roberts, 1997), and recent evidence suggests that it could be as early as 700,000 years BP. In Wales three stages of human occupation can be identified, with early Neanderthals at Pontnewydd Cave near Llandudno dating to about 225 ka (thousand years) BP, Coygan Cave with classic Neanderthal at about 50 ka BP near Tenby, and Paviland Cave with modern humans at about 26 ka BP, on the Gower peninsula. Of these sites Coygan and Paviland are very close to the present shore, while Pontnewydd is 8km inland. In addition, Kendrick's Cave, on the Great Orme peninsula near Llandudno, has revealed Late Upper Palaeolithic materials dated to 10 ka BP. Lynch *et al.* (2000, p.9, Fig. 1.4) map 28 major Palaeolithic sites in Wales, of which approximately half are either on or very close to the coast.

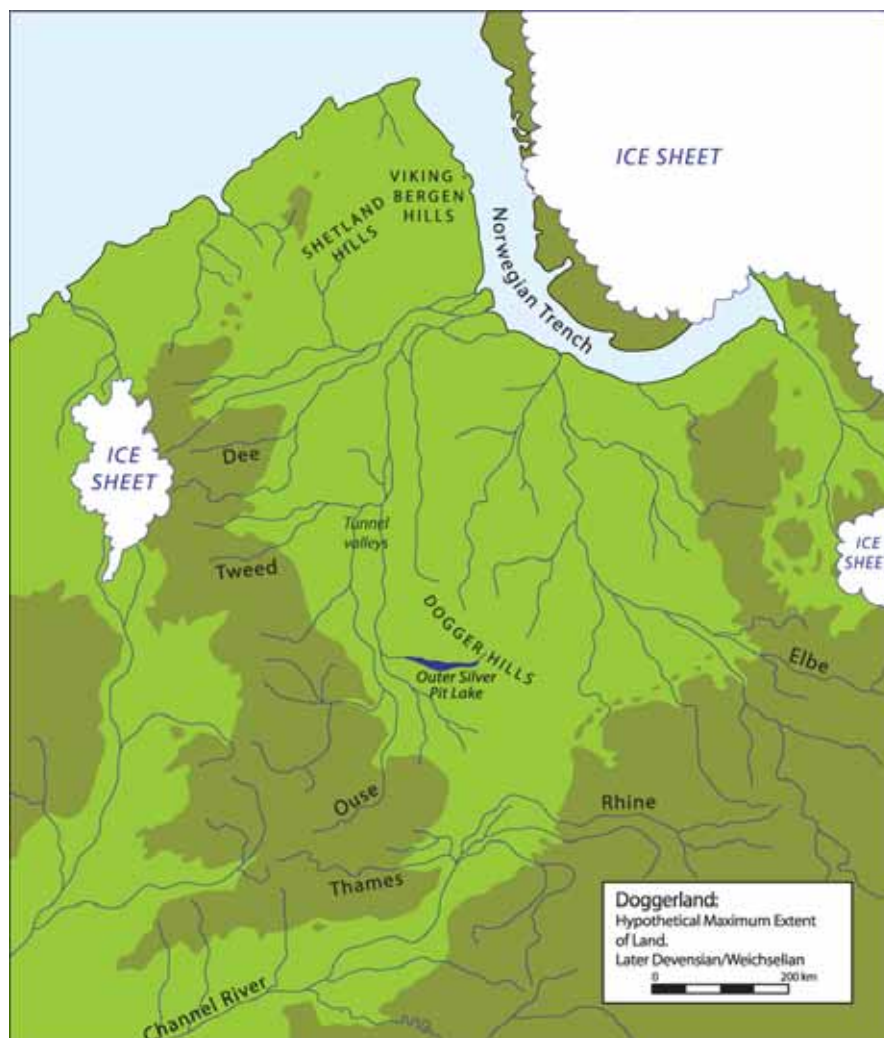


Figure 1 This map is a speculative reconstruction of the river courses across the North Sea floor, the Channel, and the Irish Sea at the Late Glacial cold stadial when the area of dry land was a maximum. Map devised by B.J. Coles and S.E. Rouillard, Copyright permission granted.

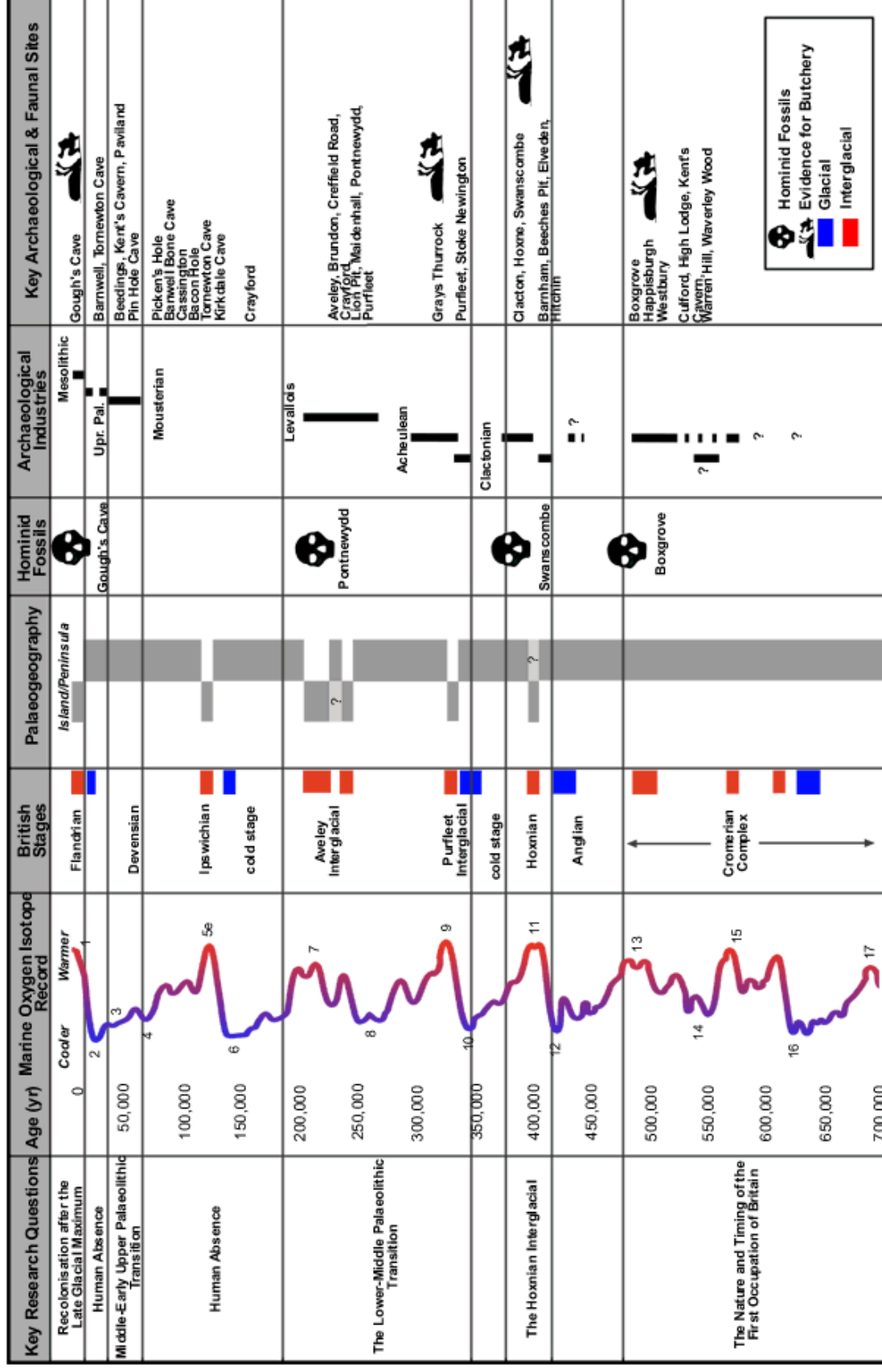


Figure 2 Condensed summary of factors defining the human occupation of Britain in the last 0.7 million years. Sea levels, ice ages, island/peninsula, fossils, archaeological tool industries, and key sites. From: Chris Stringer (2004) , web site for AHOB, Ancient Human Occupation of Britain.

The proximity of occupied Palaeolithic caves so close to the shore suggests that sites of similar age might be found on the continental shelf. In principle human and proto-human artefacts may therefore have been deposited in sediments or caves on the continental shelf at any time in the last half million years whenever the glacial control of world sea level caused the floor of the Irish Sea to be exposed. However, the facts that the ice sheets of the last two glaciations both scoured the floor of the Irish Sea, and that great thickness of infill and sediments has accumulated in some areas since the last glaciation, make the survival and discovery of sites problematic.

2.2 The Ancient Human Occupation of Britain (AHOB) project led by Chris Stringer at the Natural History Museum has analysed the various phases during which hominids could cross into the British isles, and when they were either isolated, or absent (Fig. 2.). From this figure it can be seen that Britain was cut off from the mainland of Europe only briefly for about 10 ka at the last interglacial 125 ka BP, and again for longer at about 200-230 ka BP, and briefly at 330 ka and 400 ka. At all other times in the last half million years you could walk across the English Channel, or live there. At the same time, large parts of Scandinavia and northern Britain were covered in ice sheets, which sometimes extended as far south as the Thames, and covered almost the whole of Wales and Ireland (Figs.3, 4). Thus the favourability for hominids living on the British Isles was determined as much by the proximity of the ice sheet as the contact with France or the Netherlands. Human sites do not exist at all on the British Isles between the dates 21-13 ka BP. The occupation of the English Channel, Ireland and the floor of the Celtic Sea at this time is possible, and people would then migrate back to Ireland and the floor of the Irish Sea when the ice melted, since people were certainly driven out of these areas completely when the ice expanded to its maximum. On the other hand, if people were living on the floor of the Celtic Sea, or on the Atlantic margins, the migration routes may have been more complex. In Stringer's analysis, Pontnewydd appears as the type site for the last interglacial, stressing the importance of this region for the whole of the British Isles.

2.3. Van Andel and Davies (2003) have published a multi-disciplinary analysis of the climatic fluctuations during Oxygen Isotope Stage 3, approximately 60-24 ka BP, and the consequent effects on the distribution of Neanderthal and anatomically modern humans (AMH). The study consists of a concatenated sequence of models describing the temporal and regional variation of temperature, precipitation, seasonal variability and extremes, snow cover, wind speed, vegetation, fauna, wind-chill factor, and habitability for hominids. During OIS-3 the Greenland ice core data GISP2, (Meese *et al.*, 1997; Johnsen *et al.*, 2001) show rapid fluctuations of temperature of the order of 5-10°C every few thousand years, the so-called Dansgaard/Oeschger oscillations. The models are run on a 60 x 60km grid resolution (Van Andel and Davies, 2003, p.58) and this necessarily limits the accuracy, as well as there being some uncertainties as to how one model output relates causally to the next model. Nevertheless, the sequence of calculations and plotted maps, correlated with summaries of known major archaeological sites, provides a thought-provoking analysis. The maps and calculations should be used in future as a starting point in studies which attempt to understand where people would have been living on the sea floor at times of low sea level. Unfortunately Van Andel and Davies (2003) do not take into account any archaeological data from the seabed, or any of the known occurrences of fossil fauna or human occupation sites on the sea floor of North West Europe.

2.4 The ice sheet of the penultimate glaciation, the Anglian, covered the whole of Ireland and Wales, and the floor of the Irish Sea (Fig. 3). The Anglian glacial maximum was at about 300-350 ka BP. The last glaciation, the Devensian, with a maximum at 20 ka BP, was slightly smaller in extent, and the ice sheet stopped just short of the southern coasts of Wales and Ireland, leaving small strips of the present coastal lands free of ice (Fig. 4). The great majority of Palaeolithic sites in Wales are on Carboniferous Limestones, suggesting that they survive in caves. Most open sites would have been destroyed by later ice movements. Also, rather curiously, some of the southern Welsh Palaeolithic sites were very close to the ice margin, suggesting that AMH, who arrived in central and northern Europe about 30 ka BP, could adapt efficiently to living in very cold conditions.

2.5 The possibility or probability that humans were living in the northern borders of England and around the fringes of Scotland before 10,000 BP is being investigated at the University of Newcastle by Dr Penny Spikins through a project entitled "Submerged Archaeological Landscape Team" (SALT). A post-graduate dissertation by Miriam Cantley entitled "Is there a convincing argument for late-glacial occupation of Northern Britain?" (University of Newcastle, web-site, 2004) is directly relevant to the present assessment. This work is not yet complete. The question of pre-glacial maximum occupation of Scotland was discussed in the reports on SEA4 and 5 by Flemming (2003, 2004).



Figure 3 Palaeogeographic map showing features at the southern margins of the Anglian and Wolstonian ice sheets (based on Gibbard 1988, with permission from the British Geological Survey 2000)(Woodcock; in: Woodcock and Strachan 2000).

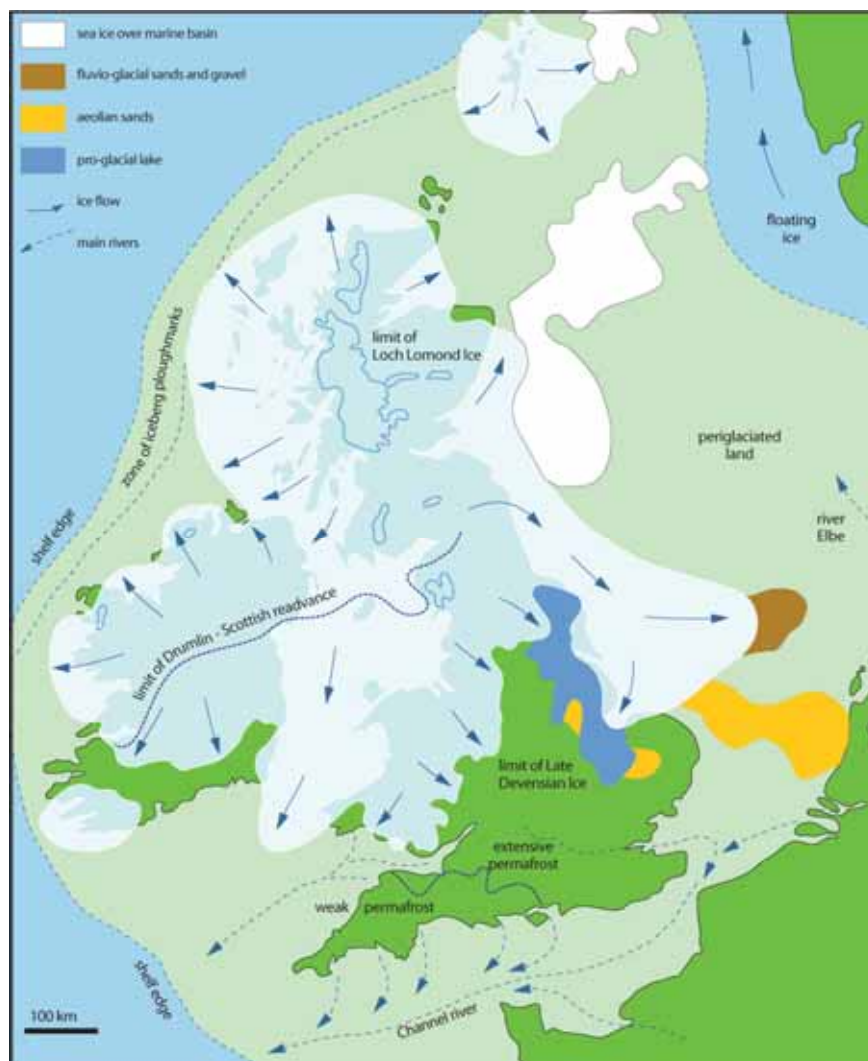


Figure 4 Palaeogeography during the Devensian glaciation (After Woodcock and Strachan 2000)

2.6 The Mesolithic period, starting about 10,000 years BP, introduces the technologies of hut construction, more sophisticated tools, microliths, sophisticated hunting techniques, recoverable canoes, and more evidence of fishing and the use of coastal resources. Forests were spreading over the British Isles, with birch, juniper, and pine progressively giving way to larger deciduous trees, and finally the landscape was dominated by oak, elm, lime, ash and alder by 7,000 years BP. Mesolithic peoples used fire to clear forest and improve the scope for hunting. Because the sea level was still rising, sites which are now situated on the coast would actually have been several miles inland, and hunters were probably roaming the coast plains which are now submerged (Lynch *et al.*, 2000, p. 28). The presence of drowned forests and submerged freshwater peats at several locations on the Welsh coast confirms the preservation, at least in part, of this drowned terrestrial landscape (Steers, 1948, p.125, 140, 144-5).

2.7. Anatomically modern humans (AMH) were present in Ireland by about 10 ka BP in the early Mesolithic, and the transition to Neolithic farming only took place in 6000 BP, the last agricultural revolution in Europe apart from northern Scandinavia ((Malone, p.11). The population density during the Mesolithic was extremely low, about 1 person per km², with variation from 5/km² in the densest areas, and 1/20km² in the lowest densities (Malone, p.18). Before the peak of the last glaciation the fauna of Ireland included woolly mammoth, brown bear, arctic fox, the Irish giant deer, and reindeer. Archaeologists have made extensive searches to discover signs of human occupation before the glacial maximum, but nothing definite has been found. Harbison (1988, p.17) describes some interesting flints which were supposed at various dates to be Palaeolithic, but concludes that none of them were both genuinely Palaeolithic and *in situ*. Curiously, a Palaeolithic worked flint found at Mell, near Drogheda, was probably "...dislodged from a layer perhaps a quarter of a million years old. Mitchell's interpretation was that it was a piece of Palaeolithic hunter's waste which had probably been deposited somewhere in the base of the Irish Sea before being brought {inland} by ice-movement..." (Harbison, 1988, p.17). The analysis so far establishes the broad picture that there was pre-glacial maximum occupation of Wales, with archaeological material surviving close to the coast, while artefacts identified beyond doubt as *in situ* only establish AMH occupation of Scotland and Ireland after the Last Glacial Maximum (LGM).

2.8 Figures 5 and 6 (Lambeck, 1995, Shennan *et al.*, 2000b) show the sequence of ice sheet limits, coastline, and the impact of rising sea level on the British Isles, including Ireland, for the melting of the Devensian ice cap. Lambeck (1995) and Shennan *et al.* (2000a, 2000b) have produced models which combine the compensation for the addition and removal of the weight of ice (Glacial isostatic correction) and for the removal and addition of weight of water (Hydro-isostatic correction) during the rising sea level (see Figs 5 and 6). In Figures 5(a)-5(d) we see the north British ice cap melting rapidly from 22,000 to 14,000 years ago. As the weight of ice is removed the land rises faster than the global sea level, so that the area of dry land increases throughout this period, both northwards and south-westwards. By 12,000 years BP the sea is beginning to overflow the land (Fig. 5(e)) and, although a small ice cap forms briefly around 10,000 years BP, the sea continues to rise faster than the land, forming deep bays and gulfs penetrating into the North Sea, isolating Dogger Bank, and separating the Straits of Dover about 7,000 years BP (Fig. 5(h)). In the Irish Sea by 18,000 BP the Celtic Trough appears as an over-deepened basin filling with meltwater from the north, as a periglacial lake (Fig. 5(b)). This situation continues to 14,000 BP with an extensive land-mass to the south linking Ireland, Wales, Cornwall, the Celtic Sea basin, the English Channel and Brittany.

2.9 By 12 ka BP a channel of sea water breaks through at north and south, and Ireland is separated from Britain and the European mainland. The Isle of Man remains connected to the mainland until 10,000 BP. A variation of this scenario is provided by Tappin *et al.* (1994, p.87, Fig. 65), with the initial breakthrough earlier at about 16,000 BP, followed by the isostatic uplift of the land overtaking the sea level rise from 10,500 to 9,500 years BP producing land connections from Cornwall to Waterford in Ireland, and then from Bardsey Island in Wales to Wicklow Head in Ireland. This sequence is derived from the analysis of sediment deposits on the floor of the Irish Sea, rather than the generalised eustatic+isostatic model for the whole north-west shelf.

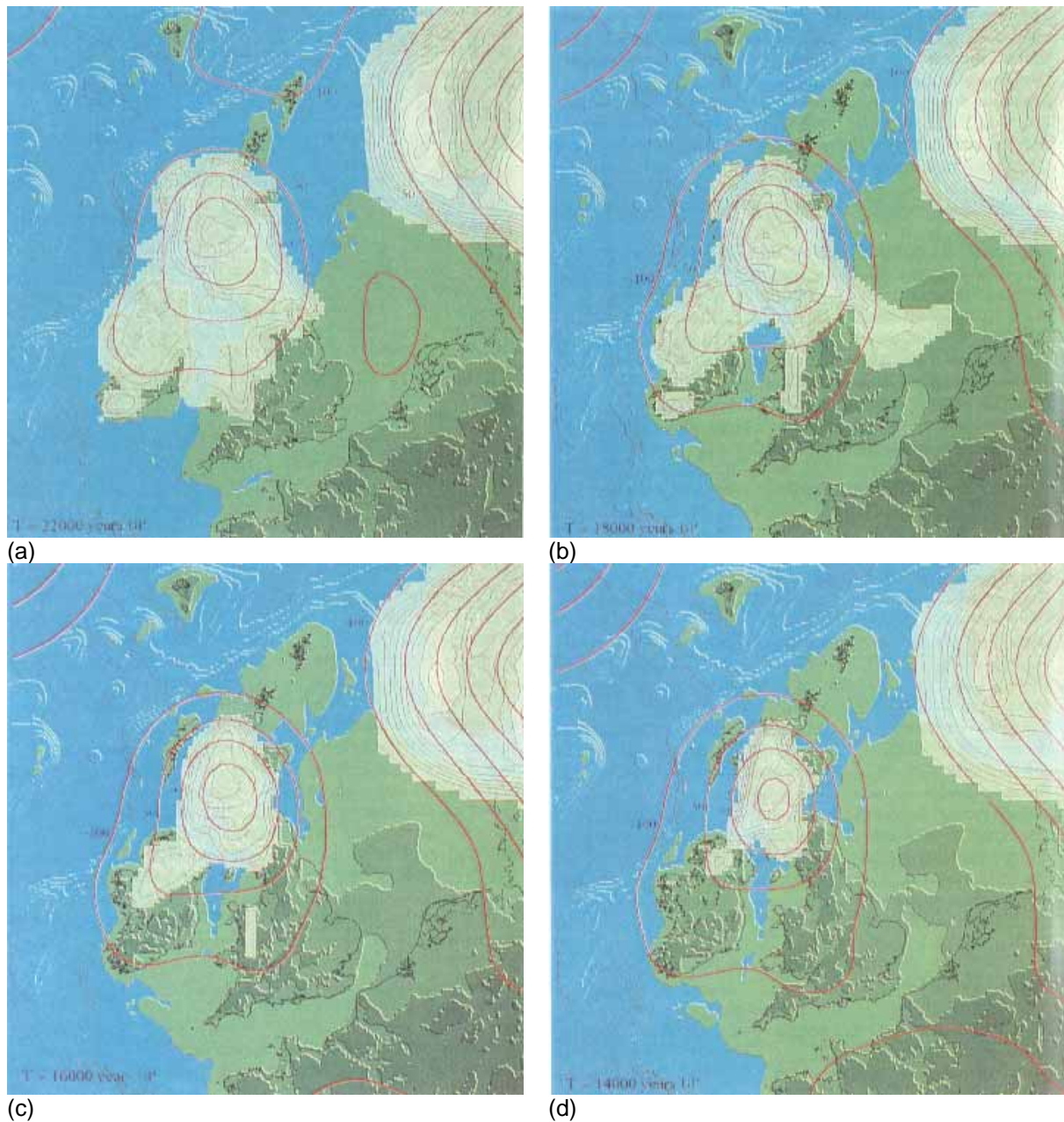


Figure 5 *Isobase maps of predicted shorelines, shoreline locations and ice sheet limits for selected epochs. (a) 22,000 years BP corresponding to the adopted time of maximum glaciation over the British Isles, (b) 18,000 years BP corresponding to the time of the onset of deglaciation of the large ice sheets, (c) 16,000 years BP, (d) 14,000 years BP.*

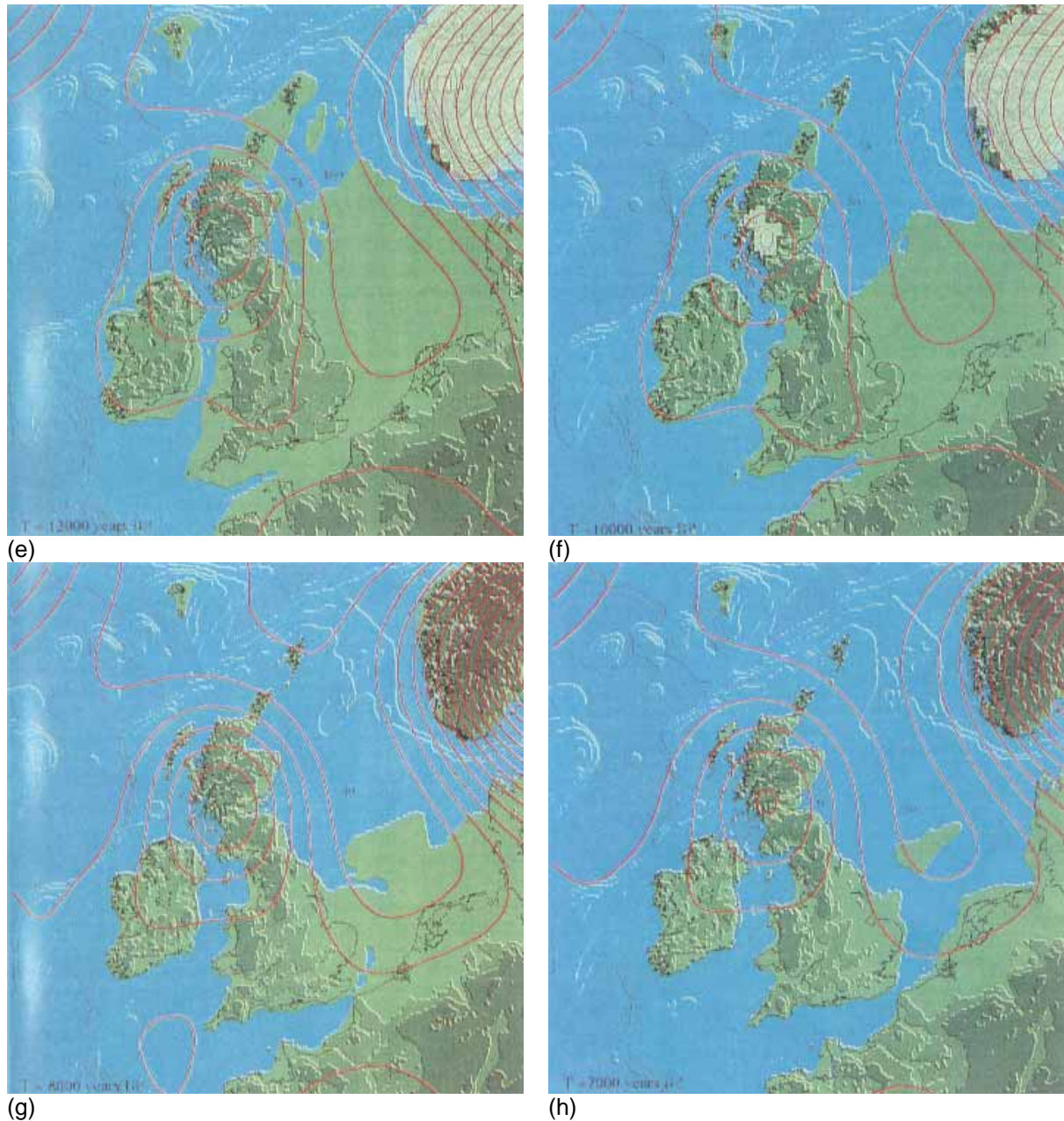


Figure 5 continued (e) 12,000 years BP, (f) 10,000 years BP, (g) 8,000 years BP, (h) 7,000 years BP. The maximum ice heights for these epochs are: 1,500m at the time of the glacial maximum at 22,000 years BP, 1,400m at 18,000 years BP, 1,300m at 16,000 years BP, 1,000m at 14,000 years BP and 400m at 10,000 years BP. Palaeowater depths are also indicated with contours at 50, 100, 150 and 200m. Isobase contour intervals are 50m for (a) to (d), 25m for (e) and (f) and 10m for (g) and (h). (After Lambeck, 1995).

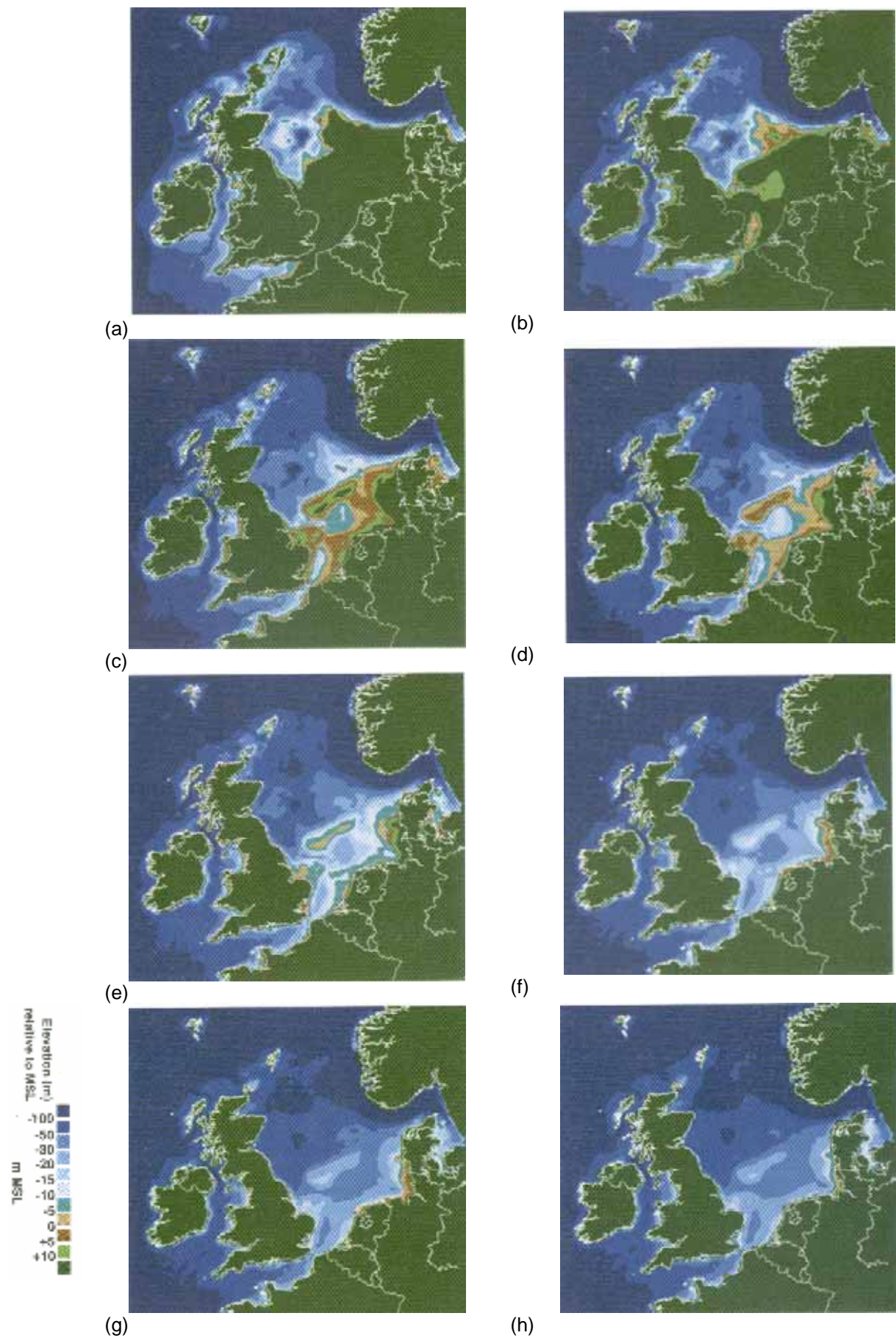


Figure 6 Palaeogeographic reconstructions of Northwest Europe (a) 10,000 years BP, (b) 9,000 years BP, (c) 8,000 years BP, (d) 7,500 years BP, (e) 7,000 years BP, (f) 6,000 years BP, (g) 5,000 years BP, (h) 4,000 years BP. Elevations (metres) relative to MSL, depths below MSL are given as negative. (After Shennan et al., 2000b).

2.10 Fitzhugh (2002) sets out the strong evidence for early human exploitation of the food resources of the circum-polar zone, using life-strategies similar to modern Inuit or Eskimos. Zhokhov Island, north of Siberia, in the Laptev Sea, is the northernmost Arctic site occupied at 8400 years BP (Pitulko, 2001). Excavations at the Mamontovaya Kurya site on the Usa River, inside the Arctic circle, revealed stone tools and carved mammoth tusks nearly 40,000 years BP (Pavlov *et al.*, 2001). The exploitation of marine mammals, especially seals, walruses, and cetaceans must be considered for peoples living in circum-polar conditions. Anyone who has seen a walrus haul-out will know how clumsy the animals are on the beach. They would have been the most attractive prey for any peoples who chose to live on the northern or north-west margins of Europe during peak glaciation, or as early as, say, 12-14,000 years BP. The reported recovery by Dutch fishermen of walrus bones showing signs of cut-marks and butchery from 56° North in the central North Sea (Klaas Post, personal communication) strongly suggests this possibility. This type of culture may correlate with the otherwise curious retrieval of a lithic artefact off the Viking Bank from a depth of 145m (Long *et al.*, 1986). Wickham-Jones has pointed out (2003, personal communication) that the availability of large quantities of fat from marine mammals is an important component of a glacial climate diet, since the hunter-gatherer diet inland tends to be too lean to support human survival in extreme cold.

2.11 Pitulko *et al.* (2004) show that modern humans were living in the Russian Arctic at 72° North on the delta of the Yana River about 30,000 years BP. Tools of stone and bone were found. The area was never covered by thick ice, and remained suitable for large herbivores throughout the last glaciation. This site and others of similar age (Pavlov *et al.*, 2001) show that people were living in the high Arctic before the last glacial maximum. In the region of Scandinavia, in the areas where the ice cap and glaciers were presumably similar to present conditions at the last interglacial, any population would have been forced to migrate outwards as the ice thickened and grew in extent. While humans may have exploited floating sea ice and the peri-glacial tundra for terrestrial and marine mammals, they cannot have existed very close to the ice cap itself, or in the land areas actually covered by ice. This argument applies equally to any population of Scotland after the last interglacial, if any. Thus determination of the limit of the ice sheet at different dates is critical to understanding where people might have lived, exploiting an Inuit-style of life on the outer margins of the continental shelf during the glacial maximum. The failure to find pre-Devensian sites in most of the northern UK, other than a few cave sites, is in marked contrast to the Russian experience. Professor Ole Gron (personal communication, 2005) has expressed the view that this failure may be due the earlier archaeological materials being buried beneath a thick sterile layer below the post-Devensian occupation site. In Russian excavations it is not uncommon to excavate through a post-glacial site, then several metres of deposits with no anthropogenic signs, and then to find a deeper pre-glacial archaeological site below that. Such persistence is not common in western Europe.

2.12 In northern peri-glacial conditions the availability of protein for prehistoric peoples close to the shore was higher than in the hinterland (Momber, 2000, 2001; Fischer, 1995). At glacial maximum when the sea did not penetrate into the Irish Sea or North Sea area any inhabitants would have depended on large mammals such as mammoth and reindeer. Typical maps and discussions of the food base tend to emphasise the availability of terrestrial mammals on the continental shelf (e.g. Barton, 1997, p.134). Fischer (1995, 2002) has added the importance of coastal fish and shellfish. Later, Mesolithic peoples would have benefited from the resources of wetlands and estuaries. Flemming (1996) summarises the reasons for prehistoric peoples being attracted to the coast, and estimates that, as sea level fell, vegetation and fauna would colonise the exposed land close to the shoreline within a few decades. Bailey (2003) has recently summarised the strong case for coastal dwelling during prehistoric times.

2.13 Human remains in south Wales have been found a few km from the ice front (Woodcock, 2000, p.404; Lynch *et al.*, 2000, p.8), so cold itself was not a deterrent. Palaeolithic hunters required fresh water, food supplies, a supply of flints, bone and wood to make weapons and tools, some timber for fires, shelter, skins for clothing, and a secure position which might have to be defended, with good routes of access, and the option to move or migrate with the seasons, or with changing supplies of fish, shellfish, or mammals. Mesolithic settlements with constructed dwellings were often positioned so as to be convenient to fish traps and fish weirs on the coast. Knowledge of these requirements has been used with great success by archaeologists in the UK and Denmark to predict and interpret submerged Mesolithic sites (Andersen, 1980; Pedersen *et al.*, 1997; Momber, 2001; Coles 1998, 1999, 2000; Fischer, 2004; Skaarup and Gron, 2004). Hunting kill sites, flint quarries, flint-knapping sites, settlements, camps, shell middens, charcoal from fires, and shelters, tend to cluster round shorelines, estuaries, lagoons, headlands and promontories.

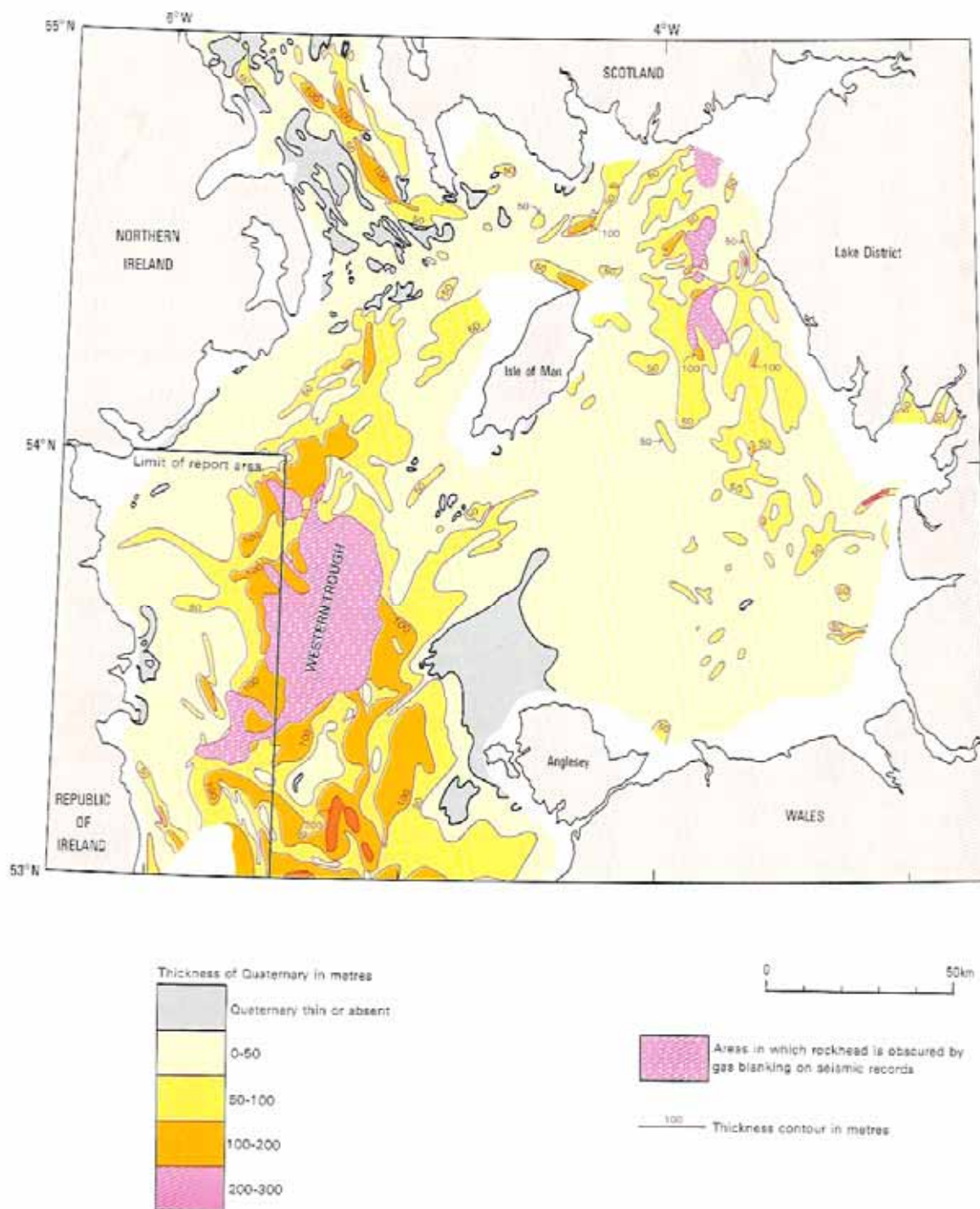


Figure 7 Thickness of Quaternary sediments in the Irish Sea in the northern part of the SEA6 area. From Jackson et al. (1995, p.86, Fig. 65). (Copyright permission to be arranged)

2.14 This places a premium on identifying accurately the ice limits, shorelines and rivers at each date, and especially those shorelines where the sea level was locally constant for hundreds or thousands of years, relative to the local land. Under these conditions rivers would tend to create stable estuaries, and perhaps barrier bars or lagoons and wetlands, waves would erode substantial rock terraces, cliffs, and caves, and shallow water sediments or peat could accumulate. Because of the doming of central Scotland the previous shorelines with terraces and caves have been uplifted in many areas, and several occupied caves are known on raised terraces around Oban (Wickham-Jones, 1994 p.71-73). The shorelines of Northern Ireland and Scotland on both sides of the North Channel are still uplifting as part of the outer fringe of the Scottish post-glacial isostatic rebound.

2.15 Taphonomy is the study of the changes which occur to deposits after primary burial. Archaeological materials may be covered by metres of sediments which protect them indefinitely, or eroded by ice, eroded by rivers, eroded and scattered by surf action on a beach, eroded by bottom action of storm waves in shallow water, eroded by tidal currents, chemically altered, or disturbed by trawling, dredging, entrenching, or drilling. There is insufficient space in this report to discuss all the processes, conditions, and topography which are most favourable in every combination of circumstances for the survival of an archaeological artefact *in situ* which is submerged for at least part of its existence. The typical conditions for the survival of known submerged archaeological prehistoric sites are presented in a table by Flemming (1983, p.161-163) classified as Ria, Lagoon, Estuary, Sheltered alluvial coast, Exposed accumulating beach, Submerged sea caves, Karstic caves, and Islands and archipelagos. Each site is classified in terms of depth, age, tidal range, current, wind fetch, and estimated wave action. Peat and submerged forests are important indicators, and Figs 19 and 20, in Louwe Kooijmans (1970/1), illustrate the widespread occurrence of peat on the floor of the North Sea.

2.16 The topography, seabed geology, and unconsolidated sediments of the Irish Sea are described by O'Cofaigh and Evans (2001), Tappin *et al.* (1994) and Jackson *et al.* (1995). See also Holmes and Tappin (2005) in the SEA6 technical report series, especially Figures 7 and 13. The detailed analysis of the regional sediments, with the probability of finding submerged prehistoric sites, will be discussed in Section 2.27. In broad terms the Quaternary sediments are less than 50m thick over most of the SEA6 area, with the exception of the central axis of the Celtic Trough, where they can be as much as 300m thick (Fig. 7). The Celtic Trough is flanked on the west by the Irish Platform, and on the east by the Eastern and Welsh Platforms, where the water depth is usually less than 60m, and the Quaternary deposits are partially absent, especially around Anglesey. The Celtic Trough itself, and scattered elongated depressions on the shelves, are interpreted as of glacial origin, with three successive generations of incisions (Jackson *et al.*, 1995, p.85). The Quaternary deposits consist of glacial tills, clay, pebbles, mud, and some interglacial and arctic-like glaciomarine beds. Detailed cross-sections are shown by Jackson *et al.* (1995, p.90-92) and Tappin *et al.* (1994, p.80-81). Because of the relatively shallow water, and the strong tidal current regime, much of the seafloor is covered in active, mobile, modern marine bedforms (Fig. 8), gravel furrows, gravel waves, sand ribbons, and sand waves. North of 53° N the seabed shows relict bedforms from terrestrial periglacial conditions (Fig. 9) including polygonal periglacial patterned ground and roches moutonnée.

2.17 Tappin *et al.* (1994, p. 86-91) describe the relict seabed features and modern marine sediments south of 53° N. Within the SEA6 sector there are Pleistocene glacial deposits forming seabed outcrops, fault scarps, infilled channels, and the so-called "sarns". In Cardigan Bay there are three low ridges of cobbles and boulders stretching out to sea hundreds of metres perpendicular to the coast. In legend these have been supposed to be the remains of ancient buildings. North (1957) showed comprehensively that these features are natural glacial features. Tappin *et al.* (1994, p.86) describes them as clast-supported clayey diamictons, covered by gravel, cobbles, and boulders. Garrard and Dobson (1974) conclude that they are late glacial median moraines formed by the glaciers descending from the Cambrian Mountains. Tappin *et al.* (1995, p.86) comment that the sarn ridges overlie deep incisions, and are similar to the so-called St Patrick's Causeway on the south coast of County Wexford leading to the Saltees Islands. The origin of these ridges, while undoubtedly glacial, may be a complex result of ice-rafting, flooding, and moraine material.

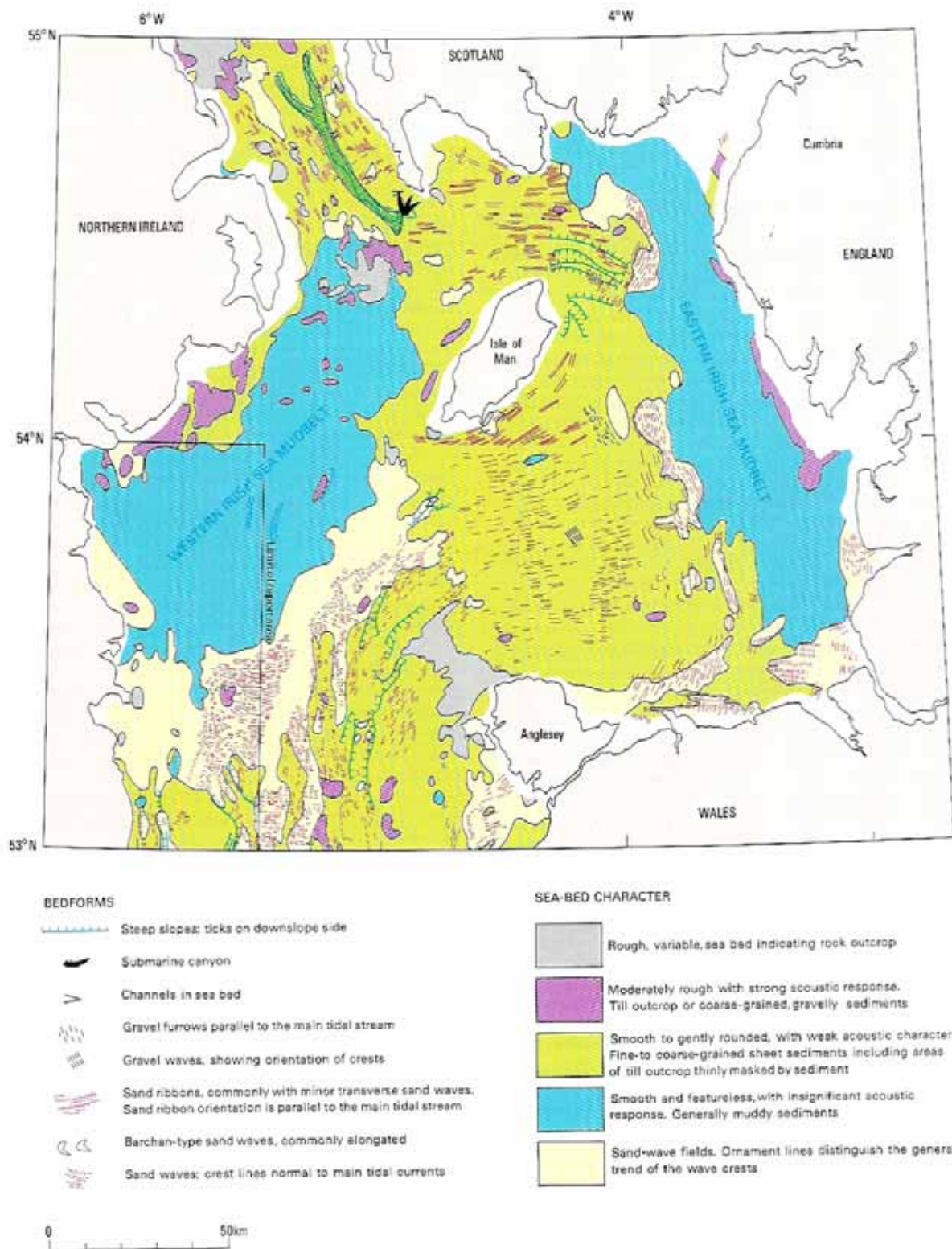


Figure 8 Modern active sedimentary bedforms in the Irish Sea in the northern part of the SEA6 area. From Jackson et al. (1995, p.97, Fig. 73). (Copyright permission to be arranged)

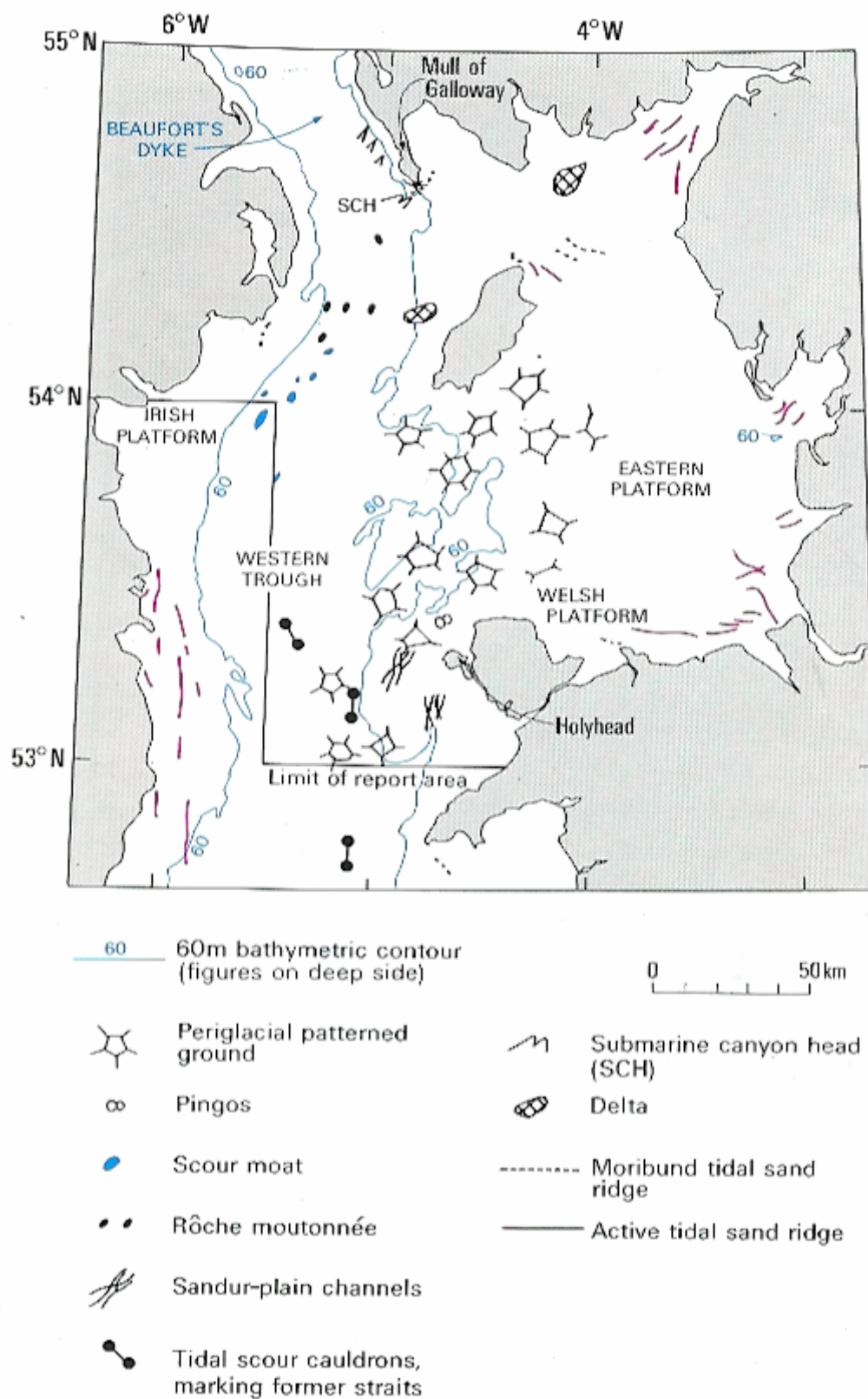


Figure 9 *Periglacial terrestrial relict landforms in the Irish Sea*

2.18 In view of the work of Pitulko *et al.* (2004) it is important to consider the effect of sea water rising over archaeological deposits in permafrost, which would indicate the possibility of good preservation of artefacts. Although other factors also apply, for example ice scour, glacial erosion, frost shattering, and normal subaerial erosion processes, the critical period for survival of an archaeological deposit is the time when the surf zone starts to impact on the site, and the ensuing few hundred years as the sea level rises over the site, and coastal shallow water waves are breaking over the site, or washing into a cave mouth. Favourable factors for survival in the deposit area include:

- ❑ Very low beach gradient 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. Drowned forests and peat are good indicator environments.
- ❑ 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.

2.19 This brief analysis demonstrates that 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. Generalised coarse resolution maps tend to omit the details which show the necessary local topographic clues. The BGS 1/250,000 maps, although they are primarily designed to present sediment data, provide a much more accurate representation of topography, with isobaths at 10m intervals, than the Admiralty Charts. Additional high resolution swath bathymetry would be enormously valuable in detecting probable sites. It is no coincidence that the most prolific area of proven submerged Mesolithic sites is between the islands of the Danish archipelago, where many hundreds of sites have been mapped and sampled by the National Museum Maritime Archaeological Institute, and the National Forest and Nature Agency, assisted by amateur divers (e.g. Skaarup and Gron, 2004). Further submerged Baltic sites have been discovered in sheltered waters off the coast of northern Germany (Lubke, 2001, 2002). The Bouldnor Cliff site in the lee of the Isle of Wight on the Solent is protected in the same way. Off Gibraltar a hook-shaped submerged promontory contains caves facing inwards towards the land which would be protected from waves while the sea level rose (Flemming, 1963; 1972), and similarly protected sea caves have been found in the Bay of Villefranche (Flemming, 1972). The ability to reconstruct the conditions under which Irish Sea archaeological sites were formed and buried has recently been improved by the sophisticated analysis techniques of Praeg (2003) and Gaffney (2004). Praeg (*op. cit.*) has used seismic imaging to detect buried glacial tunnels under modern sediments. Gaffney (*op. cit.*) has 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 draining northwards from the north-east flank of the Dogger Bank in the North Sea, and is being tested on other parts of the UK shelf.

2.20 The factors in the previous paragraphs are those which promote survival of the original deposit *in situ*. However, if an archaeological deposit is buried under 5-10m of mud or sand it will not be discovered, except in very unusual circumstances. Thus the final requirements for survival and discovery are:-

- ❑ Low net modern sediment accumulation rate so that the artefacts are not buried too deeply.
- ❑ No fields of sand waves or megaripples over the site.
- ❑ Ideally, a slight change in oceanographic conditions so that the site is being gently eroded to expose deposits when visited by archaeologists. (This factor is sufficiently common in known sites to be a serious factor, and should not be regarded as an unlikely fluke).

2.21 Potential discovery "hot-spots" in the SEA6 cannot be listed exhaustively at this stage. The steps needed to create high resolution local sensitivity maps can be identified, and are discussed later in this section. In principle the key factors are:-

- ❑ "Fossil" estuaries and river valleys.
- ❑ The flanks of banks and ridges which have been proven to have peat layers, or which are likely to have peat layers.
- ❑ 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, fossil erosional shorelines, submerged rocky shores protected by other islands, or in archipelagos.
- ❑ Deposits of sediments formed within, or washed into rocky gullies and depressions.
- ❑ "Fossil" coastal sites comparable by analogy to modern Inuit migratory sites, adjacent to sea ice, giving access to marine mammals as a food resource.
- ❑ Areas of permafrost containing archaeological deposits which were then inundated, and protected by other factors listed above.

2.22 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.

2.23 Waves

For a general analysis of the hydrography of the Irish Sea see Howarth (2005). Seasonal wave heights for the Irish Sea are given by Draper (1991). Wave heights for the Irish Sea are given by Draper (1991). The Autumn and Winter wave patterns are very similar, and the winter data are shown in Fig. 10. The northern half of SEA6 is the most sheltered area of open water on the north-west European shelf. Equivalent areas of shelter are found in the Thames estuary and the Severn estuary, but almost nowhere else. The whole area from Caernarvon northwards to the Mull of Kintyre is so screened from the open Atlantic, and restricted in wind fetch, that the highest waves which only occur for 10% of the time in winter (H_s exceeded for 10%) are less than 4.0m, and for much of the area are less than 3.0m. Close inshore on the Northern Irish coast around Belfast Lough, and along the north coast of Wales, the 10% exceedance significant wave height is less than 1.0m. In the southern half of SEA6 the H_s winter waves exceed 4.0m for only 10% of the time.

At lower sea levels the seabed and coast would have been even more sheltered and protected from wave action.

In terms of the present effects of wave action, fine material has been winnowed out of many of the sediments, and has accumulated in the central trough, or remained as shallow water deposits close to the estuaries of the Mersey and Dee rivers. Areas of exposed bedrock, or thin layers of marine sands, indicate that the combined effect of waves and currents has limited the accumulation of sediments very substantially. Most of the active bedforms appear to be controlled by current action rather than waves, except in shallow water (see below).

The implication of this analysis is that prehistoric sites, or organic coastal deposits and landforms, if they ever existed, have suffered less erosion by waves than on other parts of the UK continental shelf and coast.

2.24 Currents

The tidal currents of the Irish Sea have been modelled using high resolution 3D hydrodynamic models (Proctor and James, 1995; Holt and James, 2001; Holt *et al.* 2001; Holt *et al.* 2003). Simplified maps of the currents are provided by Jackson *et al.* (1995, p.101). Surface tidal streams exceed 2.0m/sec in the North Channel, and exceed 1.0m/sec around the Isle of Man, in the approaches to the major estuaries, Solway Bay, Morecambe Bay, and Liverpool Bay, and around Anglesey. South of Anglesey the peak currents exceed 1.0m/sec throughout the SEA6 area, and exceed 1.5m/sec close to the Irish coast. A useful presentation of a typical current field is given by Holt *et al.* (2003, p.488). (Fig. 11). The relatively high current velocities result in a highly mobile seabed for modern marine

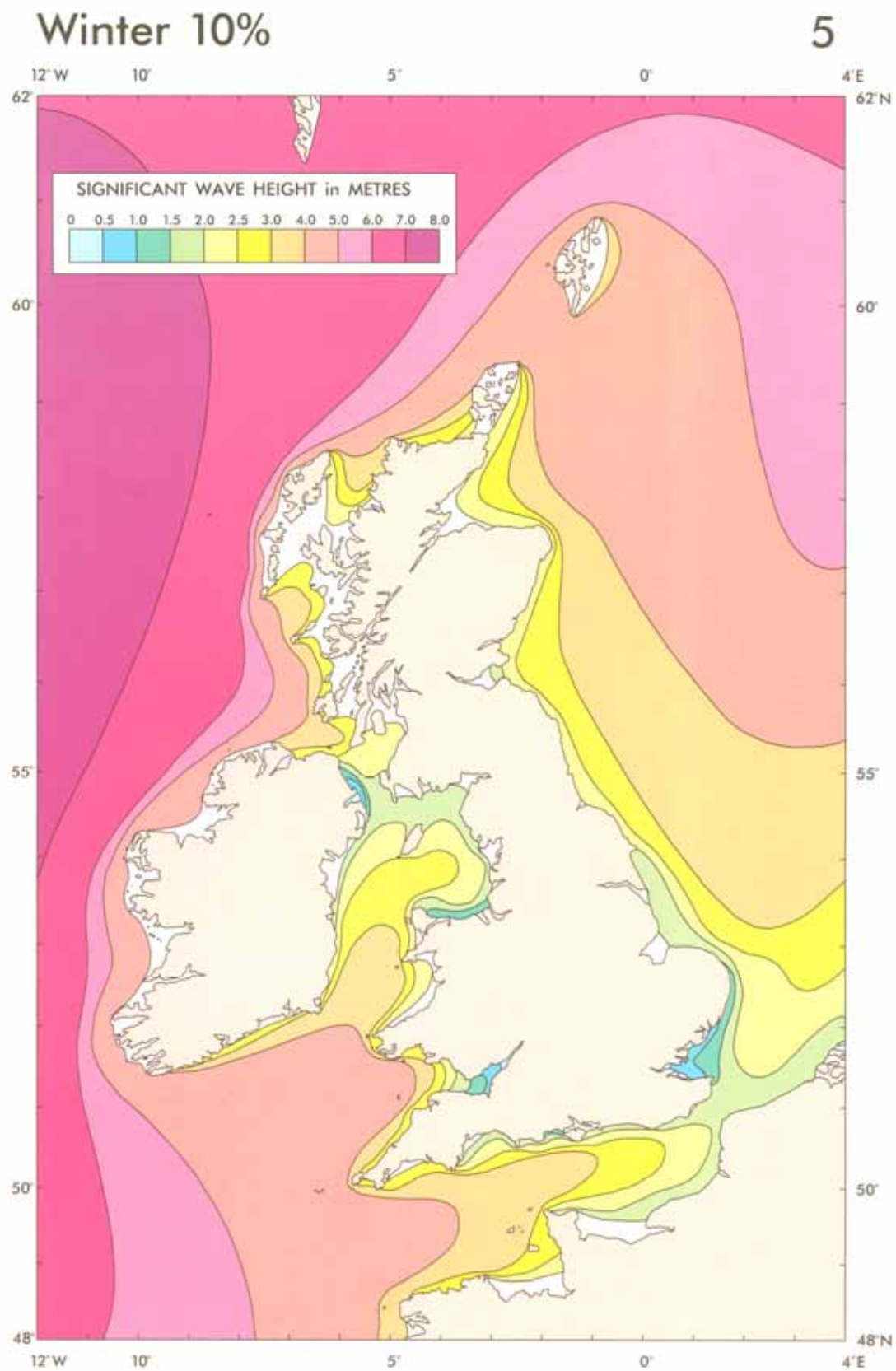


Figure 10 Significant wave height in metres exceeded for 10% of the winter (Draper 1991).

sediments, but the low level of sediment input from rivers means that much of the material in transport derives from erosion and winnowing of previous deposits. Stride (1982) traced the sediment transport paths, and showed that there are bed-load partings in the North Channel, and at 53°N. Mud accumulates in the zones of low velocity between the Isle of Man and St Bees Head to the east, and off Dundalk Bay to the west. Where Holocene or Quaternary terrestrial deposits have been eroded, the heaviest archaeological materials such as flint tools are likely to remain as lag deposits. The areas of recent mud accumulation will tend to result in deeply buried sites.

2.25 Interpretation of archaeological prospectivity depends on separating modern bedforms and banks of mobile sand and sand waves from earlier Devensian gravel, clay, moraines, drumlins, or peat, eliminating areas of bare rock or extremely thin modern marine sediments over bedrock, and identifying erosional features associated with fossil cliffs and caves. Since the earliest inhabitants of the continental shelf may have been living in a culture similar to that of the Inuit peoples of Greenland and northern Canada and Alaska, we also need to search for the traces of sheltered sea bays and gulfs which may have been covered by sea ice. In these environments marine mammals would have prospered.

Seabed sediments

2.26 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 potential preservation of sites.

2.27 List of BGS sheets and their significance

The following sheets of the BGS Bottom Sediments series are wholly within the SEA6 area, or overlap it.

Isle of Man: 54°- 55°N, 4°- 6°W. BGS 1985

The North Channel is more than 100m deep for most of its width, and more than 140m deep on the deepest axis, known as the Beaufort Dyke. This area has been used for disposal of surplus munitions. The crossings from Mull of Kintyre to Fair Head, or from Stranraer peninsula to Belfast Lough provide the shortest sea routes, only 10 nautical miles, which might have been used in the Mesolithic. Although this Channel presents the narrowest sea crossing, the coasts of Scotland and Northern Ireland are both still uplifting as a result of the isostatic recovery from deglaciation. The coasts were therefore lower in the water 5000 years ago. Prehistoric archaeological sites are unlikely to be preserved on the exposed Stranraer shore and the Mull of Galloway, but have a high probability of preservation in Belfast Lough on the Northern Irish coast, and in Luce Bay in the lee of the Mull of Galloway.

The seabed for most of the Channel between Stranraer and the Belfast-Bangor coast of Northern Ireland is covered in various mixtures proportionally of gravel and sand, with small admixture of mud. The bedrock is covered in a layer of Quaternary drift and till, with occasional pockets 50-100m thick. A sheet of sand ribbons overlies part of the area, obscuring part of the drowned landscape. Some glacial features outcrop in the form of roche moutonnée and crag and tail, indicating the direction of movement of the ice sheet,

The south-west part of the map, between the Isle of Man and Dundrum Bay defines the northern end of the great mud expanse filling the Western Trough. Cross-sections show the Trough eroded into pre-Quaternary beds to a depth of 200m below present sea level, and infilled with about 100m of

glacial till and marine muds. This environment provides very poor prospects for finding prehistoric settlements or signs of occupation. The Northern Irish coast and the Isle of Man coast out to a depth of 40-50 m both show a seabed of sandy gravel and gravelly sand. A river delta spans the 60m isobath west of the Isle of Man. The east side of the sheet depicts a seabed of sand and gravel, mostly shallower than 40m. South-east of the Isle of Man the sandy gravel exhibits extensive polygonal features which are detected on sidescan sonar. These are interpreted as periglacial ice-wedge polygons up to 80m in diameter. North-east of the Isle of Man and south of Burrow Head is another submerged river delta at a depth of 40-50m.

In the area covered by this BGS sheet there are several favourable zones for the possible occurrence and preservation of prehistoric sites. The existence of *roche moutonnée*, periglacial polygonal features and river deltas indicates that the Pleistocene landscape has been preserved, at least partially. Luce Bay and Belfast Lough appear to be good preservation sites in shallow water, and the area around the Isle of Man, especially to the south east.

Lake District, 54° - 55°N, 3° - 4° W. BGS 1983

The surface deposits in this area are mostly marine sediments of muddy sand and sandy mud, with some gravel close to the shore. Cross-sections show buried valleys incised 40-140m deep into pre-Quaternary bedrock, draining off the mainland. The valleys may be glacier deepened. The thick sediment infill suggests poor prospectivity for prehistoric archaeology, except close inshore.

Liverpool Bay, 53° - 54° N, 3° - 4° W. BGS 1984.

The area mapped by this sheet is mostly covered in sand, gravelly sand, and muddy sand. The western half of the Bay is very flat, with slopes averaging less than 1°, and extensive fields of sand waves. The shallows of the north coast of Wales close inshore are adjacent to numerous important prehistoric sites on land, and there may be some sites in shallow water. Most of the offshore area is Devensian glacial till covered in tens of metres of marine deposits. This does not appear to be a prospective area for archaeological sites on the surface, though there may be buried sites.

Anglesey, 53°-54° N, 4° - 6°30' W. BGS 1990.

The western half of this sheet extends over the Celtic Trough and a mudbelt of minimal archaeological potential on the surface. The northern part of the Trough is pure mud, with more sand and gravel to the south. The eastern half of the sheet covers the coast of Anglesey itself and Caernarvon Bay. North and north-west of Anglesey there are periglacial polygon patterns on the sea floor, detected by sidescan sonar. This suggests a very thin cover of marine sediments. North-west and west of Anglesey are extensive areas of bare rock and pre-Quaternary outcrops. Such Quaternary terrestrial deposits as remain on the sea floor are likely to be lag deposits, and these could contain prehistoric artefacts. Given the significant number of Palaeolithic cave sites in North Wales, and the large number of coastal Mesolithic sites in Anglesey and Caernarvon, this is a strongly prospective area. A search could be made for submerged cliffs and caves.

Cardigan Bay, 52° - 53° N, 3°50' - 6°30' W. BGS 1988

Quaternary deposits are 50m thick over most of this area on the Irish and Welsh platforms, with a thickness of 200m or more in the central Celtic Trough- St George's Channel Trough. The deep incision is over 300m in places, but largely infilled. There are relict bedforms from periglacial terrestrial exposure, including moraines, networks of infilled channels, braided rivers, and periglacial polygons 15-80m in diameter. Active modern bedforms include sand ribbons and sand waves. The areas of exposed periglacial features are moderately prospective for prehistoric archaeology.

2.28 Summary of Section 2

At first sight the SEA6 area is a rather poor prospect for the conservation of submarine prehistoric remains, but this is partly because of the complexity of its late Pleistocene history, and the spatial variability. All the adjacent land masses have dense distribution of prehistoric sites close to and on the shore, and there must have been periods when the ice extent did not cover the Irish Sea floor completely, and people were living and hunting there. Because the whole sea floor was glaciated during the last two glaciations, any artefacts which remain must have either have survived the ice moving over the site, or must have been formed close to the ice edge as the ice cap retreated.

3. A brief history of the known/inferred human prehistoric movements and uses of SEA6 including a brief chronology

3.1 Palaeolithic, Mesolithic, and Neolithic sites occur scattered across the mainland of Wales, northern England, and Scotland, with many sites on or close to the west coast. Earth circles and causewayed enclosures from the Neolithic occur in Anglesey and the Isle of Man (Casteldon, 2003, p.117). The Isle of Man was certainly occupied by 7000 BP (Davey 1999, p.46) when it was already an island. The earliest occupation of Ireland for which there is any evidence is about 10,000 BP, although in theory, on the basis of ice-free land (Fig. 5) people could have moved north from the area of the English Channel and the Channel Islands as early as 16,000 BP. If the earliest occupation is genuinely 10,000 BP the incomers must have travelled by boat, as the Irish Sea flooded by 12,000 BP. On the other hand, Tappin *et al.* (1994, p.87) calculate that isostatic uplift created a brief land-bridge from Skokholm Island to Waterford from 10.5 to 9.5 ka BP.

3.2 The structure of this Chapter will be to consider the major prehistoric sites close to the modern coast in each land area, working from the Palaeolithic forwards in time, and trying to deduce from this what significant role may have been played by human occupation of the floor of the Irish Sea, if it occurred. The variety and quantity of archaeological deposits in land-based coastal sites are extremely rich, and it is worth reviewing these in order to show what, at least potentially, might exist in the adjacent coastal waters. Greater detail of minor sites will exist in national monument records (NMR) but I have restricted the present review to major sites listed in published books which could be obtained in most libraries. Before working systematically through the evidence from the adjacent coastal lands, I will consider the more general implications of the intensive multi-author study edited by Van Andel and Davies (2003) which sets out to work through the physical and bio-geographical processes which influenced the archaeology of Europe preceding the last glacial maximum.

3.3 Van Andel and Davies (2003) analyse the climate changes during the last glaciation, concentrating on the period of Oxygen Isotope Stage 3 (OIS3) from 60 ka BP to 24 ka BP. During this period of time the prevailing Neanderthal inhabitants of Europe, extending from the Mediterranean coast to Bulgaria, the Ukraine, Germany, and southern Britain were progressively replaced by anatomically modern humans (AMH). Since Neanderthal and AMH lived on the borders of the Irish Sea, and since the climate changes which occurred during OIS3 are in the middle phase of the Devensian glaciation, the type of analysis conducted by Van Andel and Davies (2003) is potentially useful as a model. In a series of maps (Van Andel and Davies, 2003, Figs 4.3(a-d)) they present maps at intervals of approximately 10k years showing the distribution of known Neanderthal/Mousterian settlements. The sampling of sites may not be complete, but the summary of trends (Van Andel and Davies, p. 39) shows a migration of sites in response to worsening or ameliorating climate, and a final thinning out.

3.4 In contrast, the AMH population expands slowly after 47 ka BP, and accelerates to reach a steady level at about 30ka BP. (Van Andel and Davies, 2003, Figs. 4.5(a-c)). Subsequent chapters reconstruct the palaeoclimate and conditions under which Neanderthals and AMH would have been living through the various warm and cold phases preceding the glacial maximum. While the methodology is interesting, the resolution of the models in time and space, and the detail of the input data, do not provide local information which would be applicable to understanding the sequence of events in the Irish Sea. Nevertheless, the book is essential reading, and may lead to more detailed studies, both in terms of the fine scale of input data, and the rigour of the models.

3.5 The Bathymetry of the Irish Sea is shown in Figure.11 Subsequent maps of the archaeology on land should be related to the topography shown for the sea basin in this figure. In the following sections on the different regions I will add notes on the archaeology of the Republic of Ireland where appropriate, as supplements in square brackets thus: [...].

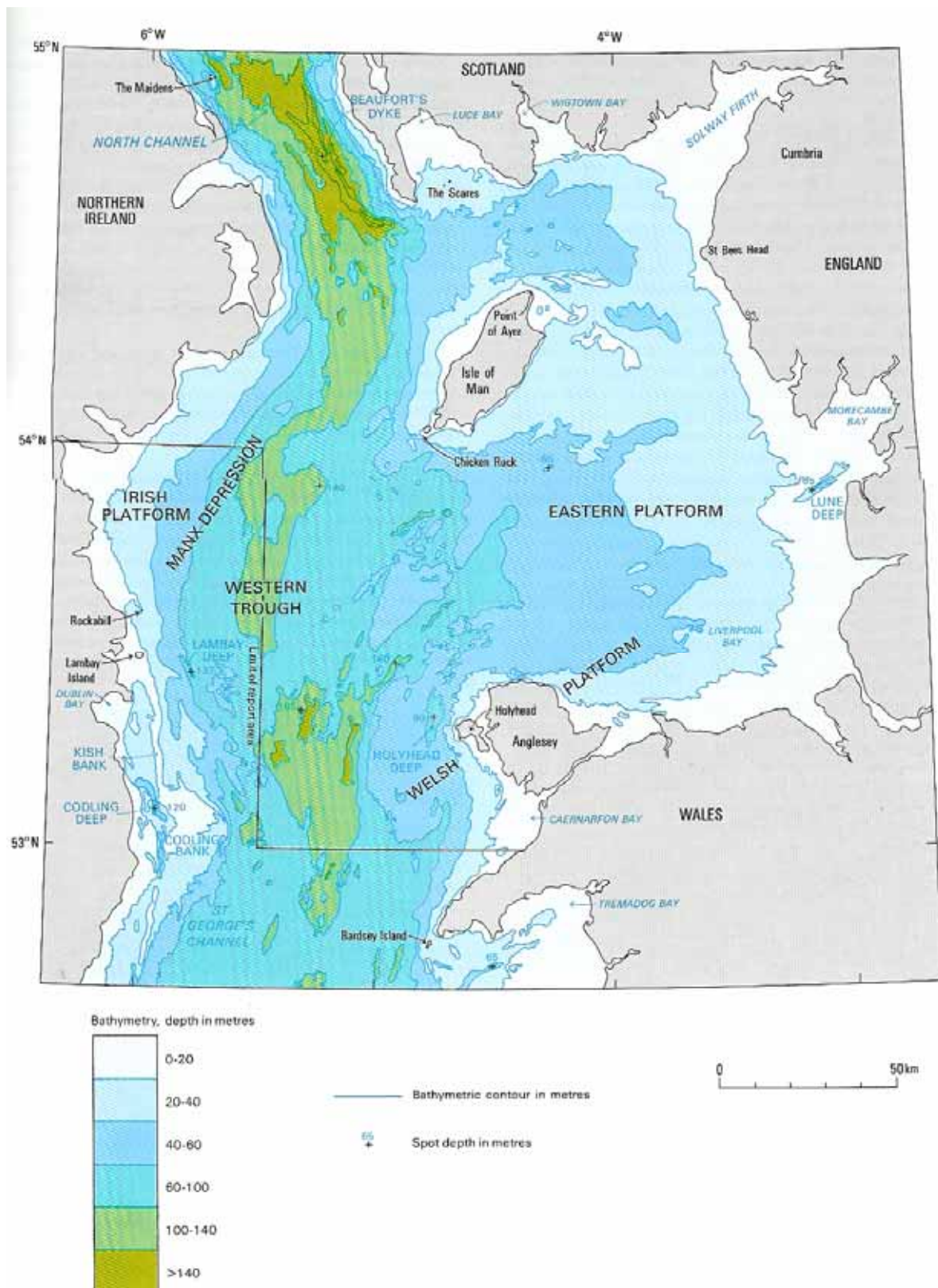


Figure 11 Bathymetry of the Irish Sea showing the principal topographic features of the sea floor. Source:.....? Note the useful map from the Irish Sea Pilot, Joint Nature Conservation Committee.

PALAEOLITHIC: Older than 10,000 years BP

3.6 England

Late Palaeolithic sites near the English coast of the Irish Sea include the cave at Kirkhead, and an open site near Blackpool (Manley, 1989, p.19). On this timescale it is important to consider the sites further south which relate to possible occupation of the Celtic Sea. The archaeology of the Channel Islands (Johnston, 1986) provides a convenient summary of the situation when the islands were joined both to the mainland of Normandy and across the floor of the English Channel to the UK and Ireland. Many Palaeolithic handaxes have been found on the beaches of Jersey (Johnston, 1986, p.5). The two major Palaeolithic cave sites are La Cotte de St Brelade and La Cotte a la Chevre. Callow (p.7-25, in Johnston 1986) describes the topography of the caves, relevant climate changes, sea level changes, and stone industries. He concludes that Jersey was occupied during the Palaeolithic during periods when the sea level was 20m or more lower than at present, but not during glacial maxima due to the cold climate. Barton (1997, p.84) identifies La Cotte de St Brelade, Jersey, as one of the most significant British Lower Palaeolithic sites. Recently a submerged Palaeolithic worked flint from the Upper Palaeolithic, about 12 ka BP, has been found near Guernsey between the islets of Crevichon and Jethou (Sebire, 2004; Conneller, *et al.*, forthcoming). Nearby, off the Normandy peninsula, Scuvée and Verague (1988) describe a Palaeolithic site at a depth of 20m. These two discoveries suggest that further research may begin to fill in the picture of submerged Palaeolithic archaeology of the western Channel and Celtic Sea.

3.7 Wales

Figure 12 shows the distribution of major Palaeolithic sites in Wales. The concentration of sites on the present coastline is manifest, for example, Coygan Cave (17 on Fig. 12). Since the sea level was lower for most of the last 100,000 years this does not mean that the sites were originally on the shore, and the periods of occupation need to be correlated carefully with dates, proximity to ice sheet, climate, and sea level. At Coygan Cave around 50 ka BP some artefacts have survived from classical Neanderthal occupation, together with assemblages of bones of carnivores and herbivores. These include mammoth, woolly rhinoceros, horse, and spotted hyena (Lynch *et al.*, 2000, p.8).

3.8 Pontnewydd Cave (4 on Fig. 12) has revealed twenty Pleistocene human remains from the bodies of at least three individuals. The bones were mixed up with stratified layers containing bones of other animals, including hibernating bears. Occupation of the cave is dated to about 225 ka BP. Kendrick's cave (1 on Fig. 12) contained the only example of portable carved Palaeolithic art found in Wales. A Late Upper Palaeolithic horse jawbone was carved with zig-zag lines. Also found were perforated teeth of wild cattle and deer, with incised decorations.

3.9 Paviland Cave (19 on Fig. 12) contained a skeleton of a 24 year old male, apparently formally buried, and stained with red ochre. Near the bones were pierced sea shells and small ivory rods, probably from bracelets. The bones have been dated to 25,840 \pm 280 BP (OxA-8025) (Lynch *et al.*, 2000, p.19). It is remarkable that the region was inhabited so close to the glacial maximum. The Gower peninsula would have been visible across the Bristol Channel as a prominent hill, but it would not have been a comfortable place to live.

3.10 Scotland

No Palaeolithic sites are known in western or south western Scotland.

3.11 Northern Ireland

No Palaeolithic sites are known in Northern Ireland. [This does not mean that they could not exist on the south coast of the Irish Republic, but only the southern rim of the present land mass was free of ice at the last glacial maximum. Since caves were occupied, or at least used for rituals, in close proximity to the ice in southern Wales, it is not impossible that Palaeolithic materials could exist off the southern coast of Ireland].

Note: The absence of identified Palaeolithic sites in Ireland is curious. Harbison and O'Brien (1996, p.10) confirm this status, and searches in libraries and on the web repeat the position. As pointed out by one American web-page, this means that human beings seem to have settled in North America before they settled in Ireland. It is doubly curious in view of the long record of occupation in southern England, in northern France, and in northern Wales.

3.12 Isle of Man

No Palaeolithic sites are known in the Isle of Man

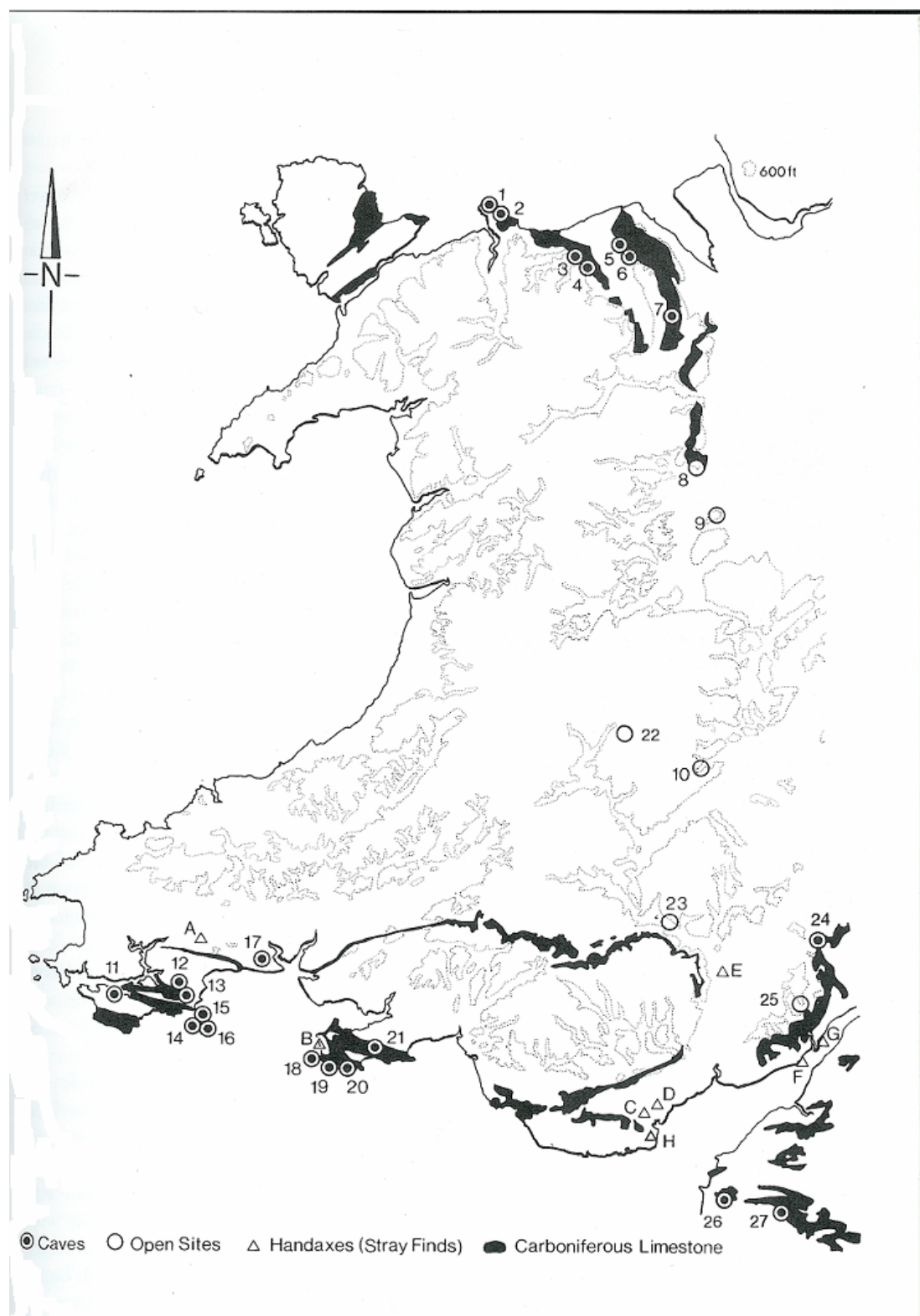


Figure 12 *Principal Palaeolithic sites in Wales (reproduced from Lynch et al., 2000, Fig. 1.4, p.9, National Museum of Wales).*

1. Kendrick's Cave; 2 Ogof Tan-y-Bryn; 3 Cefn Cave; 4 Pontnewydd; 5 Cae Gwyn; 6 Ffynnon Beuno; 7 Lynx Cave; 8 Porth-y-Waen; 9 Breiddin; 10 Arrow Court; 11 Priory Farm Cave; 12 Hoyle's Mouth; 13 Little Hoyle; 14 Potter's Cave; 15 Nanna's Cave; 16 Ogof-y-Ychen; 17 Coygan; 18 Worm's Head Cave; 19 Hound's Hole and Goat's Hole Caves, Paviland; 20 Long Hole; 21 Cathole; 22 New Radnor; 23 Gwernvale; 24 King Arthur's Cave; 25 Ty-llwyd, Llanishen; 26 Uphill caves; 27 Gough's Cave.

MESOLITHIC: After 10,000 years BP

3.13 England

By about 10 ka BP the post glacial climate had ameliorated, pine and birch woods were spreading, and the wildlife increased in variety. Numerous freshwater lakes were left by the retreating ice. The development of constructed settlements, centred round caves or groups of huts, is the defining characteristic of the Mesolithic. Food acquisition was still by hunting, fishing, and gathering, not by cultivation. Tools were made of stone, not metal, and there was no pottery. Near the Irish Sea coast Bewley (1994, p.34) depicts two key Mesolithic settlements, at Eskmeals and Poulton-le-Fylde. There are undoubtedly many more small sites.

3.14 Wales

Figure 13 shows the distribution of major Mesolithic settlements in Wales. Again, the concentration close to the present coast is apparent. Given the mountainous nature of the present Welsh landscape above sea level, and the low relief of the floor of the Irish Sea, it is possible that there were concentrations of settlements in the foothills of the mountains overlooking an extensive coastal plain, now submerged. Since the highlands were densely forested by this date, the areas most suitable for hunting wild game would have been the coastal plain. Lynch *et al.* (2000, p. 27-28) discuss the Mesolithic diet, and changes in hunting patterns in response to change in climate and vegetation. Exploitation of fish and shellfish was active, with probable hunting of seals in the autumn months when the females come ashore with pups.

3.15 Sian Rees (personal communication, 2005) states that there is a strong likelihood of submerged land surfaces occurring offshore along the Welsh coasts. The North coast, Liverpool Bay, is well known for deep deposits of flint from the Mesolithic and Neolithic periods which occur on the coastal strip and foreshore. These deposits undoubtedly extend offshore. Steers (1948) describes the so-called submerged forests which occur on several parts of the Welsh coast, and which are usually deposits of peat, soil, and tree remains. The main submerged forests described include that at Criccieth near Portmadoc (*ibid*, p.125); Llanaber (*ibid*, p.140-141); Borth and Barmouth (*ibid*, p.144-145); and at Ynyslas (*ibid*, p.145). The peat at Barmouth was revealed at a depth of 55ft (= 17m) below High Water Springs Ordinary Spring Tide during construction of a railway bridge. At Llanaber peat and rootlets of land plants including alder occur in deposits which are covered at high tide. All these deposits appear to be post-glacial coastal lagoon and estuary peats which have been flooded by the rising sea level. Their seaward extension might be associated with signs of contemporaneous human activity. Cecil Jones (2000, p.21) describes the discovery of tree-stumps in the inter-tidal zone just south of Gwddw Llanddwyn, with an oak stump giving an uncalibrated radiocarbon date of 6295+/-90 years BP.

3.16 Scotland

Fig. 14 shows the distribution of principal prehistoric sites in Scotland. Wickham-Jones (1994, p.54) has suggested that the re-occupation of the northern shelf during the melting of the Devensian ice sheet was by a combination of migratory movements up the west coast from England and Ireland, up the east coast from England and mainland Europe, including from the occupied areas in the central North Sea, and from the east or north-east, where people may have been living on the ice edge, or had recently re-occupied the margins of Norway and Denmark below present sea level. By the time of the Mesolithic and Neolithic cultures the people of Shetland and Orkney had developed architectural sophistication to rival anything else in the whole of Europe. In south west Scotland Mesolithic sites have been found on the islands of Rhum, Risga and Oronsay, and in the cliffs around Oban.

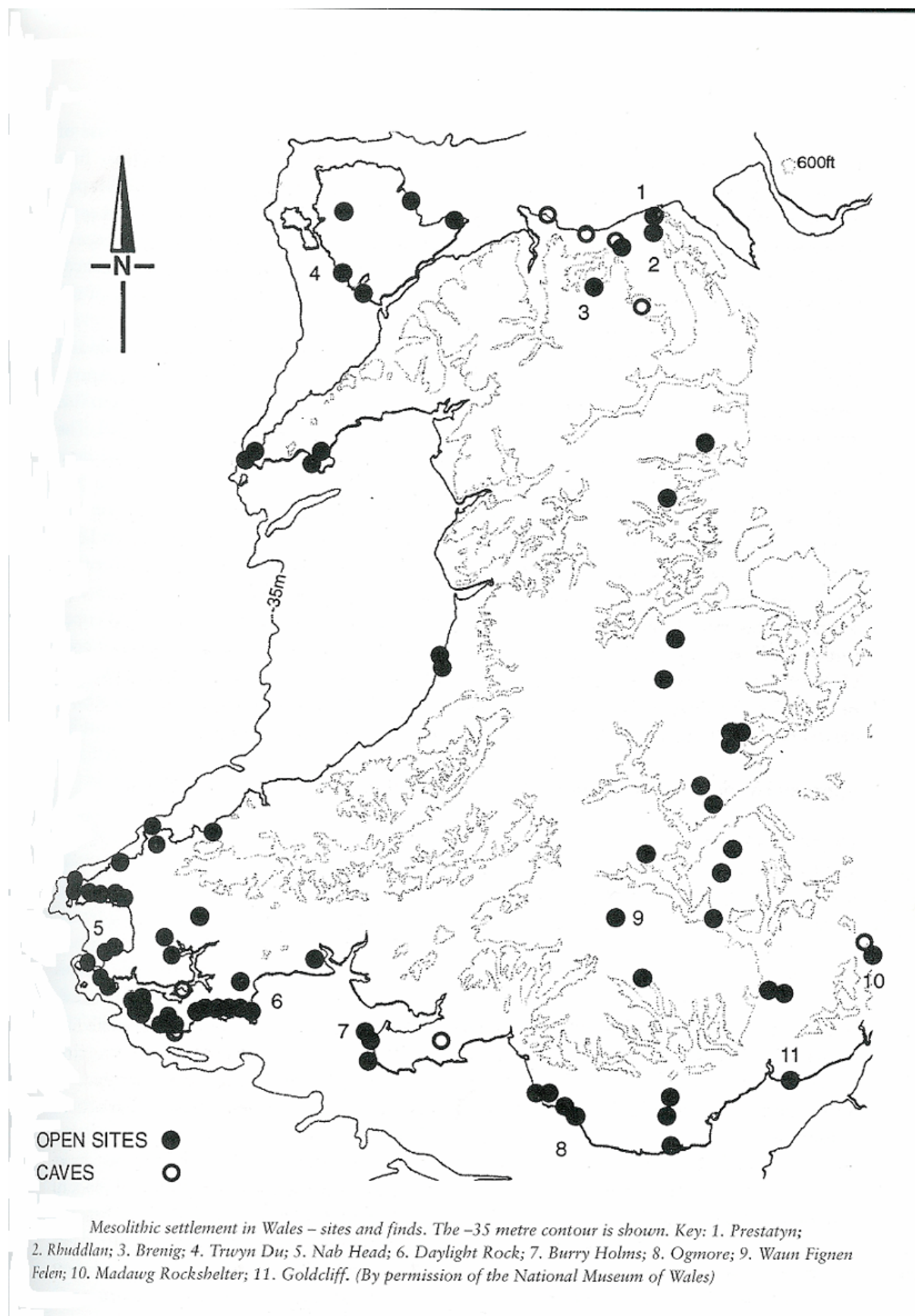


Figure 13 Distribution of Mesolithic settlements in Wales. (Reproduced from Lynch et al, 2000, Fig. 1.7, p.25. National Museum of Wales).

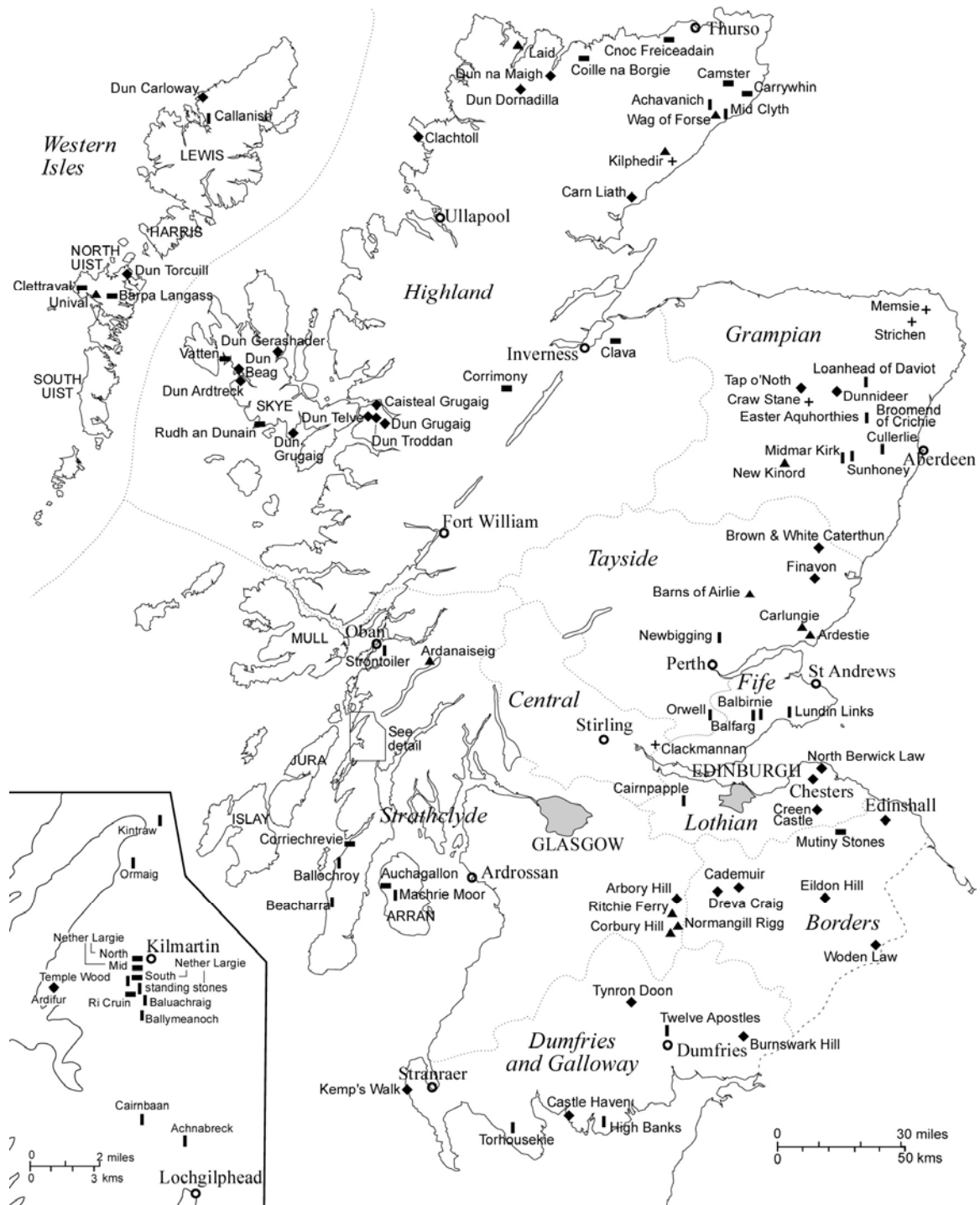


Figure 14 These maps show in very general terms the distribution of the major prehistoric sites in Scotland. Databases quoted in the text indicate that there are many more small sites, often concentrated very close to the modern shoreline. (From MacSween and Sharp, 1989).

3.17 Northern Ireland [and the Republic of Ireland]

The sea routes from Iberia through Brittany to Ireland seem to have been known to sailors in prehistoric times. Nevertheless, the first demonstrable occupation of Ireland is consistent with arrival by land, the earliest probable date for human presence in Ireland at present is about 9500 years BP at Woodpark, in County Sligo (Harbison, 1988, p. 19). By 9 ka BP sophisticated round huts about 6m in diameter were being built. It is odd that no earlier signs of occupation are found, since Ireland was almost completely deglaciated by 14 ka BP, and migration could, in principle, have taken place from the south after this date. A series of comments by Harbison (1988, p.24) are highly relevant:

"...we can no longer afford to envisage Ireland's earliest Mesolithic families as having come only to northeastern Ireland. The Lough Boora excavation and.... Mesolithic flintwork in the valley of the Munster Blackwater, should prompt us to envisage Mesolithic people crossing what is now the Irish Sea by a number of land-bridges, which were still in existence at various points in the provinces of Ulster and Leinster, where some of their earliest settlements may have been submerged by the subsequent rise of sea level".

3.18 The Centre for Maritime Archaeology at the University of Ulster has conducted a wide range of studies onshore and offshore to evaluate the archaeological potential of the coast of Northern Ireland (Quinn *et al.*, 2000). Wes Forsythe (personal communication, 2005) reports as follows: "With regard to submerged prehistoric sites we have the remains of Early Mesolithic forests in the form of peats, roots, and branches on the foreshore. These occur in Strangford Lough, Co. Down and at Portrush, Co. Antrim". McErlean *et al.* (2002) plot the distribution of Mesolithic sites around the shores of Strangford Lough (*ibid*, p.40) and Neolithic sites (*ibid*, p.49) but no prehistoric sites are described as being intertidal or submerged. Discussion of sea level change and dated wood fragments shows that the whole of the Lough floor was probably forested dry land at approximately 9 ka BP (*ibid*, p.43). The distribution of submerged forests and peat is discussed (*ibid*, p.127-131), but with no correlation with worked materials or prehistoric settlement sites. Because the area was within the Devensian ice cap the land itself was depressed by the isostatic loading, and was depressed below the contemporaneous sea level at the glacial maximum. The land rose rapidly after 20 ka BP, so that the relative local sea level was 30m lower than at present about 10 ka BP. The rising sea then flooded the Lough progressively, reaching a highest relative level at about + 5m at 5 ka BP, and then dropped back as the land continued to rise slowly to the present day (McErlean *et al.* 2005, p.31). By the Late Mesolithic the Lough was a rich source of shellfish, and many shell middens have been found which probably date from this period.

3.19 Isle of Man

Lamplugh (1903) observed water-worn flints in the storm beaches at the Point of Ayre. Recent research shows that the lithic material is of late Mesolithic type (Davey, 1999). Archaeological material on the island extends back at least as far as 8 ka BP, and it is in eroding coastal sections that the stratigraphy is most clearly seen. Manley (1989, p.31) names three Mesolithic sites on the Isle of Man, at Port St Mary, Cass ny-Hawin, and Glen Wyllan.

NEOLITHIC: After 5600 years BP

3.20 England

Maps included in Manley (1989) show axe factories in Cumbria, and numerous cairns and barrows. They are not close to the coast.

3.21 Wales

Figure 15 shows the distribution of Megalithic tombs and stone axeheads in Wales, and can be taken as a proxy for Neolithic activity. Farming, more complex settlement structures, trade, and pottery define the characteristics of the Neolithic. The prolific distribution of monumental structures, dolmens, standing stones, stone circles, and other forms of tombs testifies to a considerable population (Lynch *et al.*, 2000, p.46-48). Many Neolithic structures are close to the coast, but the sea level was close to modern sea level, and we would not expect to find many structures flooded to a depth of more than a few metres. Exchange of trade goods with Ireland was frequent (Lynch *et al.*, 2000, p.54) and sea trade was probably common along the coast, as well as across the Irish Sea. The most easily identified trade goods are typical polished stone axes which were manufactured at a limited number of "factories" which provided the best materials.

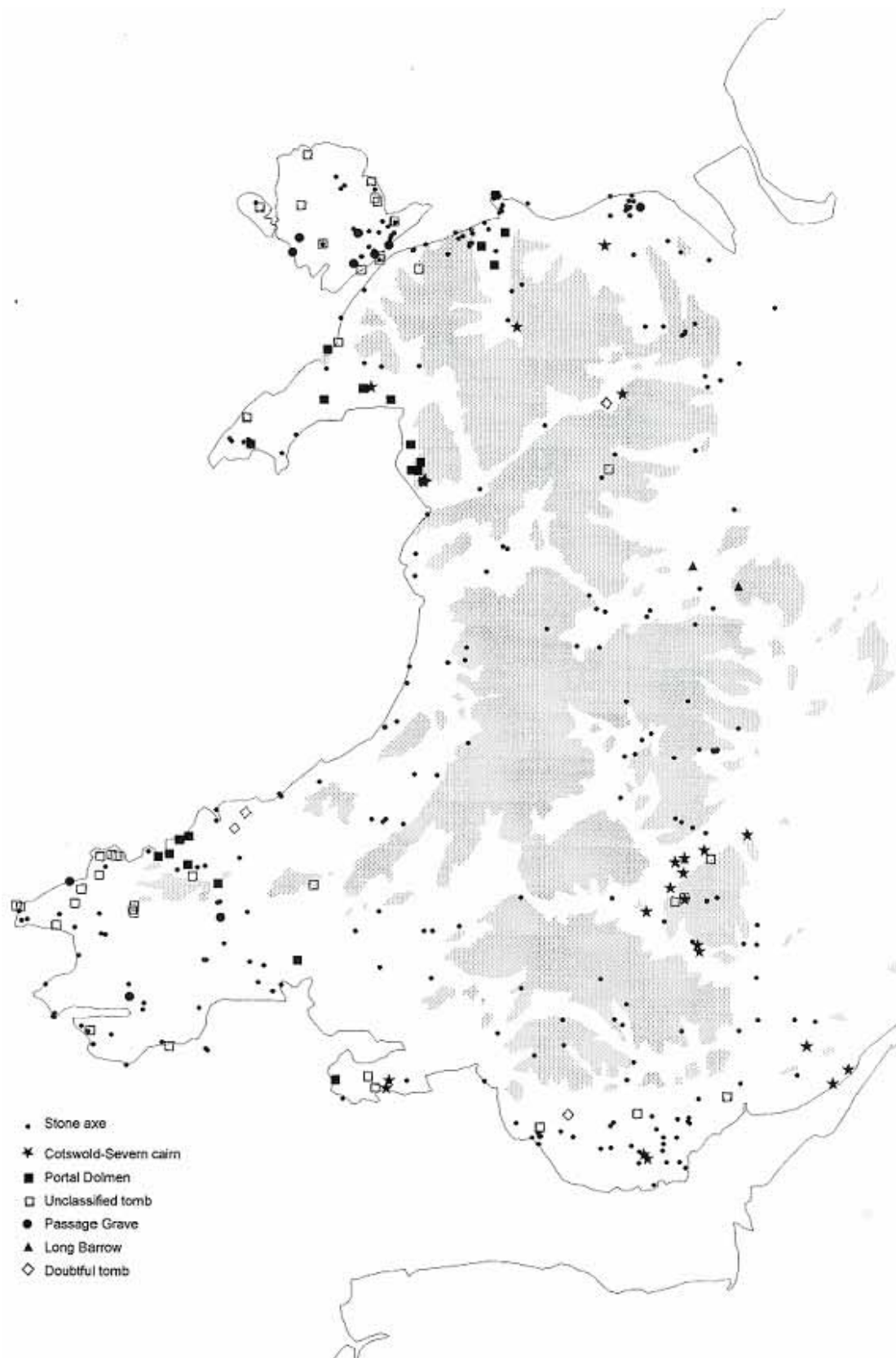


Figure 15 *Distribution of megalithic tombs and stone axeheads in Wales. (Reproduced from Lynch et al, 2000, Fig. 2.1., p.47).*

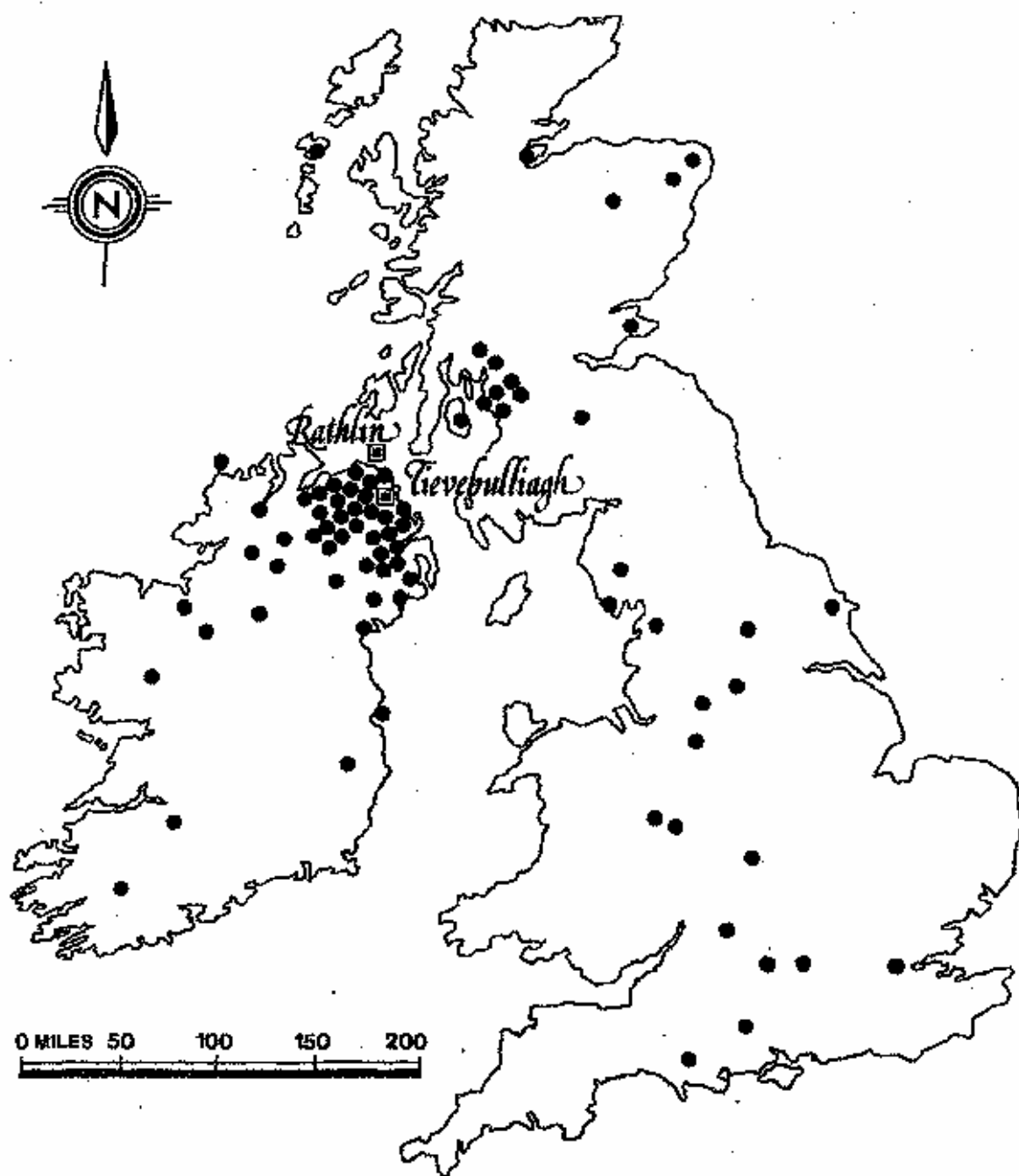


Figure 16 *Distribution of axeheads from Tievebullagh and Rathlin. (From Harbison, 1988, p.32)*

3.22 Scotland

Manley (1989) shows Neolithic occupation sites and an axe factory on the Isle of Arran, occupation sites in Galloway, and a high concentration of barrows and cairns in Galloway and the Stranraer peninsula, including a wedge tomb which appears to be very close to the shore.

3.23 Northern Ireland [and Republic of Ireland]

Neolithic farming techniques reached Ireland after 6000 BP, and during this phase of occupation we find Megaliths, dolmens, passage graves, and tomb mounds. There is a substantial concentration of early megalithic Court Tombs in the North. Contact by sea with Scotland is certain at this period, and Neolithic stone axes from Tievebullagh and Rathlin are found all over the UK, with a concentration in the nearby coastal regions of Scotland (Harbison, 1988, p.32) (Fig. 16). McErlean *et al.* (2002, p.404) describe the recovery of a Neolithic logboat from the foreshore at Greyabbey Bay in Strangford Lough dating to 3499-3032 cal. BC (GrN-25435), that is, about 5265 +/- 233 years BP. See Wessex (2005, SEA6 Marine Archaeology) for a discussion of shipwreck archaeology.

3.24 Isle of Man

Davey (1999, p.48) reports that the Neolithic of the island has recently been studied intensively. Since 1959 the eroding cliffs of Phurt have produced a range of artefacts from the Middle and Late Neolithic. Many of the finds have been made by private collectors, but the majority of finds are now in the curation of the Manx Museum. The finds include pottery with 106 rim sherds and carinated or decorated body sherds. The lithics have not yet been fully studied. Davey (1999, p.50) summarises the work of several authors who have analysed the formation of the Flandrian cliff-line, and the succession of Mesolithic, Neolithic and Bronze Age settlement. There is no discussion of possible extension of the occupation area underwater. Since the island is just within the zone of deglacial isostatic uplift it is possible that the relative sea level changes in the area during the last few millennia preclude submerged sites in shallow water.

4. Nature of the remains known and likely to be encountered from the different periods and uses of SEA6

4.1 Submerged prehistoric sites of various ages have been discovered in all the adjacent seas of the British isles during the last few decades, with the exception of the Irish Sea. The rate of discovery elsewhere continues unabated (e.g. Skaarup and Gron, 2004), which makes the lack of discoveries in the SEA6 area increasingly difficult to explain. As explained in Chapter 2 of this report, the Pleistocene sequence of events in the Irish Sea, and modern conditions, do not make it a highly prospective area, but there would seem to be pocket environments within which archaeological sites of the last 12,000 years could have survived, even if only in scattered form.

4.2 The scope for increasingly sophisticated detection methods, mapping, and excavation is now such that an extra focus should perhaps be given to this important sea area. Examples from the Baltic (e.g. Fischer, 1991, 1995, 1997) are impressive, and habitations have been found off the coast of Denmark as early as 12 ka BP. 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, and at a depth of 12m, in the Solent. Quinn *et al.*, (2000) describe the sophisticated application of acoustic techniques in coastal waters, and these could be supplemented by analysis of previously obtained offshore oil and gas prospecting records.

4.3 The most prospective areas of SEA6 are in the shallows along the north coast of Wales, around Anglesey, south east off the Isle of Man, in the sheltered waters around the Stranraer peninsula, and the loughs of Northern Ireland. Submerged caves may exist in the exposed bedrock offshore Anglesey. Areas of submerged deltas and superficial periglacial polygons may also preserve indicators of human activity. As shown in Chapter 2, Pleistocene periglacial features have been preserved on the floor of the Irish Sea, and we know that people could live close to the ice sheet, and that they could and did exploit sea mammals for food. It therefore seems highly probable that people were living on the floor of the Celtic Sea to the south, and near or in the southern Irish Sea during or close to the time of maximum glacial extent. As the ice retreated, people would have moved slowly northwards. By the Mesolithic period boats were in frequent use, and the crossing from Scotland to northern Ireland would have been a place of intensive activity.

4.4 These ideas are admittedly speculative at the present time, but based on a logic which has been found applicable in other sea areas around UK and northern Europe. It is to be hoped that the increased use of acoustic techniques, combined with an increased vigilance for minor indicators of human activity will produce positive and possibly exciting results.

5. Consideration of the potential impacts of oil field operations on submarine prehistoric archaeological remains

5.1 SEA6 is as yet an almost unknown quantity as far as submarine prehistoric remains are concerned. On the one hand we know that there is a very long history of prehistoric occupation in Wales with many sites close to the coast during the last 120 thousand years, and a strong Mesolithic culture on both sides of the Irish Sea. On the other hand, no *in situ* prehistoric sites have been found below the low tide level, apart from those in the sheltered waters of Strangford Lough. In spite of the extensive glacial scour during the Devensian glaciation, and the potential destruction of earlier archaeological materials, there are many suggestive factors indicating that there could be some highly significant preserved sites. Periglacial and sub-glacial geomorphological features survive on the seabed, and there is only a thin veneer of modern active marine sands in many places. The numerous submerged forests and peat beds on the coast indicate a well-preserved drowned landscape. In the areas of exposed bedrock there is a reasonable prospect that there could be caves, or artefacts preserved in gullies.

5.2 Both offshore windfarms and oil and gas exploitation disturb the seafloor in ways which could damage submerged archaeological sites. Offshore hydrocarbon prospecting and exploitation have several phases of activity which could impact on submarine prehistoric archaeology. Gas production platforms and pipelines are already installed and operational in Morecambe Bay, but the amount of new work disturbing the seabed is now minimal. The following types of activity in principle cause disturbance which could damage or destroy archaeological materials:

- i) Coring of seabed to investigate pipe routes and foundation engineering for platforms.
- ii) Emplacement of platforms, concrete gravity, jacket or jack-up. Consider the total footprint of the platform, and 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.

5.2 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 tens or hundreds of km of burial. All shallow sediment cores sampling the top 1-10m of sediment in sensitive areas should be checked routinely for prehistoric materials.

5.3 The excavated sediment from pipe entrenching machines is not brought to the surface, but is ploughed or jetted to the side of the trench, there is thus no chance at present to investigate the occurrence of prehistoric artefacts in the sediments. Consideration should be given to some way of monitoring this process, either by recovering sediment, or close video inspection by ROV. Prehistoric artefacts have been retrieved from 50m depth by ROV and clamshell grab (Josenhans *et al.*, 1997) off British Columbia.

5.4 Trawling and dredging both disturb the upper 0.5-1.0 metre of sediments over large areas, but are outwith this report. The offshore aggregate industry already has a very healthy collaborative relationship with the academic archaeological community, and indeed funds from the industry provide support for some very important excavations. Many land excavations have been started by good observations from industry workers. Louwe Kooijmans has shown that fishermen also can become prolific sources of information and assistance in retrieving subsea archaeological materials. The Solent fishery demonstrates the same point, with some of the local fishermen having collections of flint tools which are catalogued by the County archaeologist, but left in the possession of the finders.

6. Consideration of the opportunities presented by oil and gas operations in an area for site/artefact identification, e.g. seismic survey, sub-bottom profiling, coring, ROV

6.1 The previous discussion shows that, given sensible preparation, briefing, and mutual understanding offshore industries can actually serve the archaeological community. A workshop sponsored by English Heritage (Flemming, 2004) outlines the various ways in which positive collaboration between the offshore industries and submarine prehistoric archaeology can be fostered. It is not within the terms of the present report to make specific proposals of this nature, especially since the cost implications and time lost (if any) are not immediately apparent. However, on the assumption that some staff time, funds, and assistance might be available, the following paragraphs show that activities of the offshore oil and gas industry could be positively helpful, with appropriate monitoring.

6.2 Acoustics

Acoustic surveys of various kinds can contribute to the discovery of submarine prehistoric sites, but, to date, only through circumstantial identification of likely topographic and stratigraphic conditions. No acoustic system has yet been used successfully to demonstrate that a particular structure or surface feature contains worked flints, shell midden deposits, charcoal, carved wood, or bones. Swath bathymetry, side-scan sonar, and conventional shallow sub-bottom profiling can identify a drowned beach ridge or river valley, or similar features of archaeological relevance beneath a few metres of modern sediments. Recent data analysis by Gaffney (2004) at the University of Birmingham has shown that river valleys and beaches can be revealed in 3 dimensions beneath overlying sediment, permitting subsequent visualisation. This technique should be applied whenever possible to review the possible locations of prehistoric settlements on rivers, estuaries, and in sheltered bays.

6.3 Chirp technology can show fine-scale stratification which gives strong clues, but physical sampling by core, grab, or diving, or ROV has always proved essential to establish existence of a submerged prehistoric site. No cross-correlation check has been carried out using high frequency, high resolution acoustics over known submarine prehistoric sites to test signatures of anthropogenic materials. The Danish experience, where acoustics are used routinely to select optimal diving sites on the basis of topography suggests that no such direct signature yet exists. Ongoing work in Norway and Denmark indicates that some data on this problem will soon be available, at least regarding large features such as wooden posts. 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 could not distinguish shapes at the level required to identify worked flints. Medical type acoustics at 4 MHz has a penetration of only 20-30cm.

6.4 Coring, grab samples, and site investigation

Coring and sampling of seabed sediments can identify sedimentary facies, and detect material such as peat, beach gravels, clay, deltaic muds, and organic materials indicating age, and pollen indicating vegetation, temperature, and shells indicating salinity. BGS cores and commercial cores which have been archived provide a massive body of data which has not been exploited archaeologically. In future, any planned core or grab sample investigation by offshore operators should be checked against the list of archaeologically sensitive areas, and in the high-probability archaeological zones the cores must be examined for archaeological signals.

6.5 Dredging and pipe entrenching

Bulk movement of seabed sediments has the potential to damage prehistoric sites in the SEA6 area very seriously. Paradoxically, in the SEA6 area, this may be a way that archaeologists could discover sites in water more than a few tens of metres deep. As mentioned in para. 5.3 such operations should be monitored or sampled at intervals to check for artefacts or designated indicators.

6.6 Avoidance

Acoustic systems and seabed sampling create the potential to gain advance warning of the probable presence of prehistoric sites, and hence to plan avoidance of intervention. Avoidance would usually

increase costs for the operator. Repeated instructions to avoid newly indicated potential sites would complicate logistics and add more to costs. Over-sensitive thresholds for site avoidance would ensure that no artefacts were recovered, and no sites discovered for archaeological research. It follows that avoidance criteria should 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 and the sediments disturbed on a 100% basis, rather than avoid the site.

6.7 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, but discovery and research does involve disturbance, unless the artefact is on the surface. The objective is to balance over time the sum total of acquired and published knowledge and the sum total of preserved artefacts left *in situ* for future generations. Research excavation underwater increases knowledge but destroys sites. Undiscovered sites represent future knowledge, but present ignorance. The marine environment in SEA6 is low wave energy, but with strong tidal currents close to the coast

This combination of forces, combined with a low sediment input compared with the North Sea, has resulted in a thin layer of active marine sands in most of the sector, covering the Pleistocene landscape, with the latter actually exposed in some areas. Thick marine deposits occur in the Central Trough, and in Morecambe Bay, close to the English coast. No submerged prehistoric sites have been found other than in the coastal Loughs, but there is strong evidence on both coasts that they should exist. If sites do exist, there is a powerful argument to discover and excavate a few, monitored under academic supervision. This approach differs from the management protocols of the Danish archipelago, where hundreds of submerged sites are known, and the great majority are preserved *in situ*.

6.8 Conclusion to section 6

Offshore oil and gas operations, and the sub-contracted services, present a good opportunity to discover and record submarine prehistoric sites in SEA6, outside Territorial Limits. 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 practices regarding the reporting, investigations and protection of prehistoric and archaeological remains

7.1 The Outer Continental Shelf legislation in the USA 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, and no prehistoric artefacts had ever been found on the outer shelf, and no academic search was being conducted for remains. During the same period American marine archaeologists working on minuscule budgets, and usually assisted by large teams of volunteers, were studying palaeo-indian prehistoric sites in water depths up to 10-20m at many locations on all sides of the USA (e.g. Stright, 1990; Cockrell and Murphy, 1978; Ruppé, 1981). 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. For the SEA6 area outside the coastal Loughs and estuaries, this assumption is not valid. 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, and to monitor the archaeological impact. When the existence of a site is certain, then academic resources should be deployed to monitor, and, if suitable, excavate.

7.3 BMAPA and English Heritage (2003) have developed a detailed protocol for the management of archaeological sites impacted by aggregate dredging, and the principles developed in that document could be adapted to the offshore sector. Notwithstanding the fact that aggregate dredging is not a major industry in SEA6, this document still provides a valid basis for assessing obligations offshore. Expert groups such as the ADU, the Hants and Wight Trust for Maritime Archaeology, and the Nautical Archaeology Society, or the Maritime Archaeology Centre at the University of Ulster should be consulted. Sites need to be reported and studied whenever possible. Procedures could be recommended consistent with BMAPA and RCHME schemes in England to encourage and promote the reporting of sites with a minimum interference with work schedules. Notice of intention to carry out operations or to disturb the surface sediments in key areas is the major step. Within Scottish Waters the recording of sites would presumably become part of the NMRS managed by RCHAMS, In Wales sites should be reported to Cadw and the relevant regional Archaeology Trust.

7.4 The work of Louwe Kooijmans and van der Sluis produced hundreds of palaeontological finds, and some prehistoric artefacts, in less than 10 years by collecting materials reported by Dutch fishermen who were fishing on the UK side of the median line (See the SEA3 Report, Flemming, 2002). Post (personal communication) has confirmed that many tons of Pleistocene terrestrial mammal bones are landed by Dutch fishermen each year. Further documentation of the palaeontological finds from the southern North Sea are provided by Glimmerveen *et al.* (2004). A few finds (Dogger, 1832, Leman/Ower 1932) were also reported by UK fishermen. But the failure of UK fishermen to retrieve palaeontological material is not really explicable. There must be material in many other areas, such as the Irish Sea, even allowing for the different geology and sedimentary regime. Preliminary enquiries suggest that Scottish fishermen are retrieving small quantities of palaeontological items, and this line of analysis should be followed up so as to identify the areas which may have supported *in situ* mammal populations, and where bones have been transported into areas by glacial transport or post-glacial run-off. If an *in situ* fauna can be identified, this would be an 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 prehistoric archaeology as a whole.

8. Recommended mitigation measures to prevent damage to prehistoric and archaeological remains from oil and gas activities. These should draw on, and where appropriate be concordant with, draft guidance produced by BMAPA and RCHME

8.1 The objective is to achieve a constructive and positively beneficial relationship between the offshore oil and gas activities in sector SEA6, and the archaeological research community, and associated legislation, both national and international. As already pointed out, the marine aggregates industry is minor in the Irish Sea. Nevertheless, the obligations and procedures worked out by BMAPA and RCHME do exist, and DTI has instructed in the terms of reference of this report that the recommended procedures for the offshore oil and gas industry should be consistent, both in terms of contiguous geography and as between different industries.

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 SEA6 should, on the present evidence, be restricted in such a way that offshore hydrocarbon activity of any kind should be curtailed or banned. Since the Home Country Heritage Agencies and Manx National Heritage already have the responsibility to manage and protect sites out to the 12 mile limit, this discussion will only apply to the sea bed beyond that limit. Notwithstanding possible legal arguments which could suggest that such pre-emptive restrictions might be desirable, we need to consider the practical effects for archaeology, in addition to the economic and industrial impacts. The experience with the OCS legislation on archaeology in the USA shows that when such regulations are rigidly enforced, large sums of company money are spent in pre-disturbance and avoidance surveys, and no archaeological artefacts are ever discovered. Meanwhile cash-strapped archaeological teams struggle to recover deposits of prehistoric artefacts found in the coastal zone, usually assisted by sports divers. Since so many known artefacts have been retrieved in European waters by commercial activities from at least three major industries (Fishing, aggregate dredging, and port engineering), an overly restrictive policy would be self-defeating for archaeology, as well as expensive for industry.

8.4 The legal point of view might be that commercial exploitation of resources will disturb unknown archaeological sites, and may do damage before work is halted or diverted. Therefore exploitation should be restricted, or subject to exhaustive pre-disturbance surveys. While this may prevent commercial damage to sites, it also ensures that no sites will ever be discovered by archaeologists, while natural wave and current erosion will progressively destroy deposits anyway. In the low energy environment of the Irish Sea the risk of destruction by erosion is perhaps not as high as in other parts of the UK, but it is not zero.

8.5 It is therefore in the interests of long term preservation of the archaeological sites, and in the interests of acquisition of archaeological knowledge, that we use industrial and commercial activities as a means of identifying archaeological prehistoric sites in the offshore area. On the coast and in shallow water and sites discovered will usually be known to the local authorities, and in most cases documented by RCHAMS, Cadw, NI Heritage Service and HS. The approach suggested here of encouraging and then monitoring industrial activity would only apply further offshore, perhaps outside Territorial Waters. There should be a logical continuity of the protocols at the Territorial Limit.

8.6 The ideal structure would require or encourage the industry and its sub-contractors to check whether their activities are in archaeological prospective zones, and to identify, and report, when their activities positively detect prehistoric artefacts, or, in the case of acoustic surveys, provide very strong evidence. If this can be achieved at minimal or acceptable cost/delay to industry, then there is a positive advantage in allowing operators to start activities in zones of archaeological potential, while avoiding positively identified sites, if any. The recent development of methods for reconstructing the Quaternary drainage pattern and landscape under modern sediments from existing archived seismic penetration surveys (Gaffney, 2004) suggests that this method should be used in those cases where there is any probability of seabed disturbance impacting prehistoric sites.

8.7 It may sound heretical to encourage industrial activity in all cases, but the conditions and circumstance in the SEA6 area need to be treated realistically. There is no comparison with the Danish situation where complex and relatively undisturbed sites, each with thousands of artefacts, are known to occur with a spacing of the order of 1-5km. This report has shown that SEA6 has only a moderate potential for the preservation of submerged prehistoric sites. Periods of occupation were bracketed in narrow time zones between retreat of the ice and successive periods of inundation and post-glacial isostatic uplift. Even if there were originally quite a dense scatter of artefacts in the SEA6 seabed there are no means now for finding sites in the complex topographic conditions of low hills, moraines, rocky outcrops, gullies and depressions by surface observation. High resolution acoustics, both swath bathymetry and sub-bottom profiling would be useful, but some form of disturbance, dragging, dredging, coring or excavation is essential if we are to find anything at this stage. In coming years, if and when we know much more, this situation may alter, and limited areas could be strictly protected for future controlled research.

8.8 The guidance notes for the aggregates industry have been formally published (BMAPA and English Heritage, 2003) in a booklet prepared by Wessex Archaeology, and illustrated with a number of excellent graphics showing types of prehistoric materials that have been found in the sea, and relating these to date and sea level. The guidance notes cover legislation, statutory controls, possible effects of aggregate extraction, obtaining archaeological advice, application procedures, assessment, evaluation, archaeological investigation, mitigation, and monitoring. An equivalent guide could be produced for the offshore oil and gas industry and its contractors.

8.9 In the SEA6 open waters it would be difficult to mount a major excavation with strict site stratigraphy, and it is probable that, in the near future, academic activity would be limited to analysis of finds by commercial operators, and occasional dives to check for surface finds. There is a very competent and active group of marine archaeologists in Northern Ireland who could take the lead in this. When more sites are located and understood, excavation might become advisable, especially if a site revealed a major item such as a bog body in peat.

8.10 The success of this approach depends upon many more people in the commercial sector being aware that prehistoric artefacts could (admittedly with low probability) be present in almost any sediment recovered from the seabed in SEA6, and learning to recognise artefacts of flint, bone, and antler. It has been suggested that stone tools are so obscure that non-experts would never learn to recognise them. I doubt if this is true, and recognition kits or guidance notes could be distributed or posted as notices at very little cost. Since the older tools tend to be larger, there is a greater chance of recognising those artefacts which are the least likely to be found.

8.11 Excavation procedure: The responsibility for excavation of offshore sites rests with the archaeological authorities and the university research community. Any plans for excavation or submarine survey for archaeological purposes would be conducted in accordance with the standards of safety normal for offshore operations, and diving would be conducted in accordance with HSE regulations. This paper cannot comment on funding in regard to offshore archaeological projects.

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In May 2003 English Heritage organised a Workshop entitled "Submarine Prehistoric Archaeology of the North Sea", and the proceedings have been published in 2004 by the Council for British Archaeology. The papers presented at that Workshop have prompted me to think speculatively, but I hope responsibly, about the complex of events controlling human cultures in the Irish Sea during and since the last glacial maximum. Some of the ideas presented in this report are based on those papers, which I have cited with credit to the authors. Any distortion or misinterpretation of their writing is my fault.

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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
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)
RCAHMW	Royal Commission on Ancient and Historical Monuments of Wales
RCHME	Royal Commission on the Historical Monuments of England
RCHAMS	Royal Commission on Historic and Ancient Monuments for 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