II. ASSESSMENT SURVEYS

5 ASSESSMENT SURVEY: SHETLAND

GRAEME WILSON

Introduction

Coastal zone assessment surveys have been undertaken in Shetland over four seasons by EASE Archaeology. Surveys have been undertaken on Mainland, Westside, Northmavine, Lunna, South Mainland and on the islands of Whalsay, East Burra, West Burra and Trondra (Figure 5.1) (Moore & Wilson 1998a; 1998b; 1999). The areas surveyed were chosen in consultation with the Shetland archaeologist, Val Turner, and the projects were entirely funded by Historic Scotland. The surveys were carried out in accordance with guidelines provided by Historic Scotland (see Ashmore 1994; Historic Scotland 1996). As it is difficult to condense the large body of information generated by these surveys within the space available, this discussion is unavoidably brief.

In general, the Shetland landscape can be characterised as rugged and hilly with small well-defined areas of good land. Within the survey area, the nature of the landscape varies greatly. South Mainland contains much of the richest, low-lying land surveyed and Northmavine much of the poorest, yet each has pockets of land representing all types encountered.

At present, much of the land is given over to sheep. Very little arable was encountered during the course of survey, even in those areas where it was deemed likely that crops could be grown. It was quite common to encounter land which had apparently been cultivated in the recent past but which was now poorly tended and waterlogged and declining into moorland (Stapf in Moore & Wilson 1998a). Habitations have either contracted towards the towns or moved inland towards the modern roads. There are numerous reasons for these recent changes in land use. However, the effect is that the landscape is for the most part deserted and free of modern 'clutter'. This, together with the history of past land use, makes Shetland an ideal place to carry out this kind of fast audit survey.

Previous Work

Previous work in the survey areas, as in Shetland as a whole, has been very limited. South Mainland has perhaps had relatively more attention than Westside and Northmavine has seen the least previous work. Shetland has, perhaps, suffered from its extreme geographical location in relation to the centres of archaeological enquiry further south. Archaeological activity has been intermittent and has had varying aims, from academic enquiry to rescue excavation. It is no surprise, however, that the little work that has been done should have such relevance for the whole of Scotland. The multi-phase settlement site at Jarlshof in South Mainland (outwith the survey area) remains one of the most important type sites in addressing settlement change through time in Atlantic Scotland. Clickhimin (Hamilton 1968) and Scalloway (Sharples 1998) brochs are two of the very few which have been completely excavated and published.

One of the earliest and most important large-scale bodies of work is the Royal Commission Inventory (RCAHMS 1946) which covered the whole of Shetland and has provided a basic data set, against which all subsequent survey can be compared. The next significant phase of activity was carried out by C S T Calder during the 1950s and 1960s. Calder recognised that the 1946 survey was incomplete and attempted to correct this through a combination of excavation and further survey, much of which took place either within the area of this survey or nearby (see Calder 1958; 1963).

Calder's work demonstrated the huge potential of Shetland archaeology, particularly for the study of very early settlement. However, there has, with only one exception (Whittle 1986), been no attempt to expand upon this. The most recent work has tended to be rescue orientated and has, with few exceptions (eg Hedges 1986), lain outwith the area of this survey. The results, however, have informed this work.

Analysis

Introduction

In all, some 846 'sites' were encountered during survey. This does not include the figures for East Burra, West Burra and Trondra (report in preparation). Analysis of this information is not straightforward, partly due to the sheer scale of the information but also because of the nature of the resource and the problems of summarising an extremely heterogeneous data set within tight parameters. The survey results presented here encompass five different areas, each of which, as noted above, has its own character. There are some very interesting trends which will be discussed below after the following provisos.

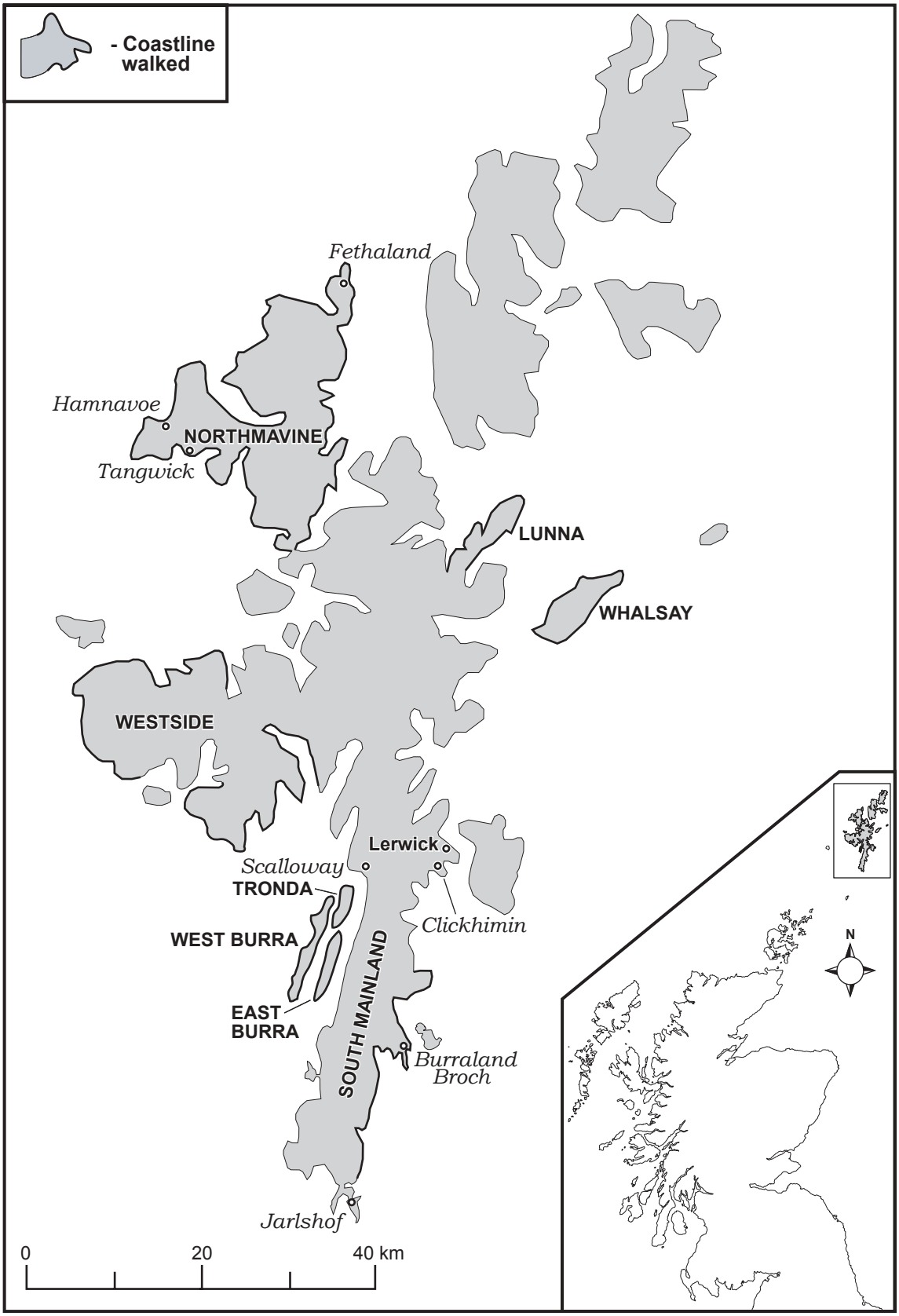

Figure 5.1. Location map showing the areas of survey and places mentioned in the text.

It should be noted that the aims of the fieldwork were to characterise the archaeological resource within the coastal zone. This was achieved by systematic survey and presented in a map-based format. There was no clear requirement to reduce the information to statistics of the kind presented here. Also, although the survey was systematic, it was also subjective, since it reflects the opinions and experience of the fieldworkers. In many cases a site formed the focus for much argument regarding its identity and significance; some interpretations were also changed in the light of new fieldwork, and others will undoubtedly be changed after future investigations. The histograms presented here, then, will give an unjustly objective impression to the casual observer and will be, if anything, more subjective than the survey since sites with long organic development over time must be 'shoe horned' into what are in essence (but unavoidably) arbitrary and modern categories of period and type.

One of the most basic problems encountered during survey was how to define a 'site'. At one level this is simple: a site is any residue of human activity either visible or previously recorded within the survey area. It becomes more troublesome when dealing with large complex sites which span large areas of land and which functioned over a long period of time. It was commonplace to encounter isolated fragments of what were most likely to be much larger residues of past activity. An example of this might be a ruinous dyke, or an outbuilding which functioned only as part of a field system, or a croft lying away from the survey area. Each fragment of dyke or outbuilding would have been recorded as an individual site. Where these elements could be seen to be related to others then the whole was given one site number. In this way, when an abandoned croft could be seen to be related to outbuildings, field systems, etc, then all was counted as a single site and its location and extent recorded.

Where practical, sites of widely different date have been separated, such as where a 19th-century sheep crue clearly overlies a prehistoric house. This was the only practical way that the survey could progress without becoming bogged down, but it has no doubt meant that certain phases of multi-period sites are under-represented. Nevertheless, even taking account of the provisos outlined here, the histograms are useful: they paint a broad picture of the scale of the resource, its strengths and its weaknesses.

Sites by date

The histogram showing sites by date is interesting for several reasons (Figure 5.2). Firstly it highlights the huge number of sites of early prehistoric date (4th–3rd millennium BC and 3rd–1st millennium BC) which are visible in the Shetland landscape. Most of these sites are interpreted as houses, which are more often than not associated with field systems. These structures are not a homogenous group; they survive in such good condition that it is possible to discern several sub-groups of types which can be found in each survey area and throughout Shetland. It is not clear whether they reflect changes through time or differences in function (Figure 5.3). In several cases, groups of houses of varying type were found surviving together in the same location.

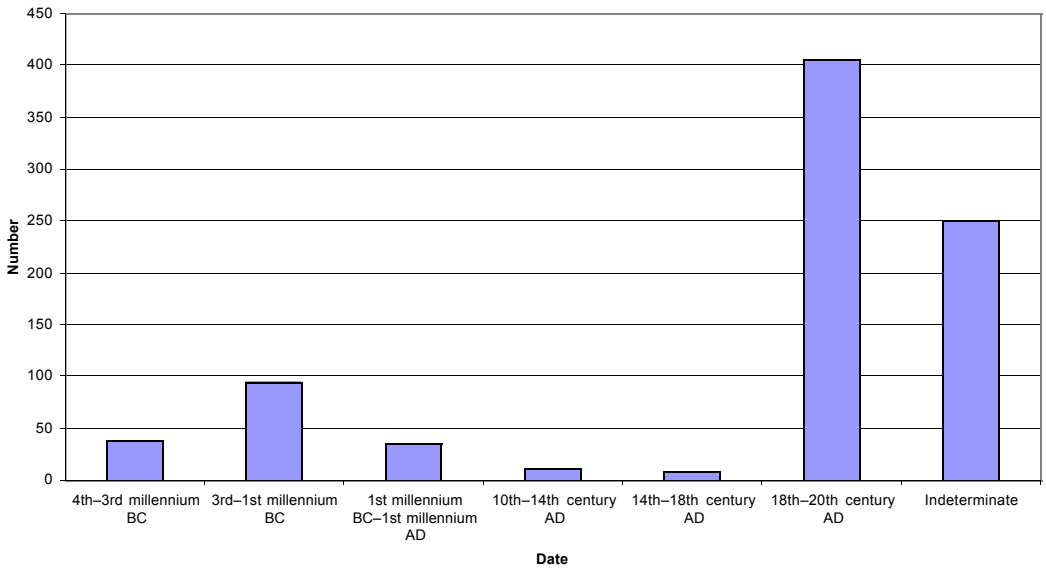

Figure 5.2. Graph showing the total number of sites located, grouped by date.

Figure 5.3. A prehistoric house at Lunna.

The 1st millennium BC – 1st millennium AD category comprises for the most part brochs, together with post-broch settlement, but also includes defended promontories, early church sites, and putative early Christian monastic stack sites. It is more than likely that the large broch mounds conceal other earlier settlement remains (see Carter *et al* 1995). It would not be possible, however, to confirm this without recourse to excavation.

The categories 10th – 14th century AD or 14th – 18th century AD were chosen in order to attempt to define the remaining archaeological resource during an interesting period in Shetland history. It was hoped to detect Norse and then Scottish influence on settlement patterns. In the event this did not prove possible. Very few sites could be confidently assigned to either category. The great majority of sites placed within these date ranges are in fact churches. There are several possible reasons for this gap in the record, some of which are general points applicable to all periods. These include:

- Problems with site recognition – sites of this period may be present but have been attributed to the wrong date range. Sites which are apparently of 18th–20th-century AD date are the most likely candidates here, as well as a percentage of the sites of indeterminate date.
- The nature of settlement, and its economy, may have changed during this period of time and entailed a shift away from the coast and out of the survey area. This would be an attractive theory if some earlier settlement types could be shown to exist within the survey area: Norse influence might then be assumed to be restricted to the outlying, less desirable land. Unfortunately, although there is some evidence in the form of a few putative early Norse structures encountered by the surveyors inland, outside the survey area this does not seem to be the case.
- Earlier sites may be obscured beneath later foundations. In a few cases, such as at Fethaland (Figure 5.4), abandoned structures known to date to the 19th century could be seen to overlie earlier buildings of similar plan. Without recourse to excavation, it is not possible to say more.

Figure 5.4. Fethaland fishing station.

Perhaps the most likely explanation is that the 10th–14th and 14th–18th century date ranges are artificial – historical – constructs which should not have been applied to the archaeological evidence. They were designed to discern patterns in the architecture of settlement which may never have existed beyond a shift from cellular house forms in the later Iron Age towards more rectilinear forms which persist into the present day. It may be that the only way to positively identify sites of this period is via excavation.

Sites by type

The sites have been further divided under eight headings in an attempt to characterise the resource further (Figure 5.5). As some sites come under more than one heading, there would appear to be more sites here than in Figure 5.2: fishing stations, for example, are considered to be both maritime and industrial; a croft and field system is both domestic and agricultural.

There are some interesting points that may be drawn from Figure 5.5. Relatively few of the sites are of indeterminate type. This is due to the excellent preservation of remains in the Shetland landscape where it is easy to identify a field system or a scrap of walling eroding from a section, but less easy to date it since it could conceivably date from any time from the Neolithic onwards.

Sites of every type are represented within the coastal zone, including some which occur nowhere else – noosts, otter traps, fishing stations. Settlement will have been attracted to the coast for ease of transport and access to marine resources. Also, in Shetland, the hinterland is generally hilly and the land of poorer quality than that near the sea. The overriding

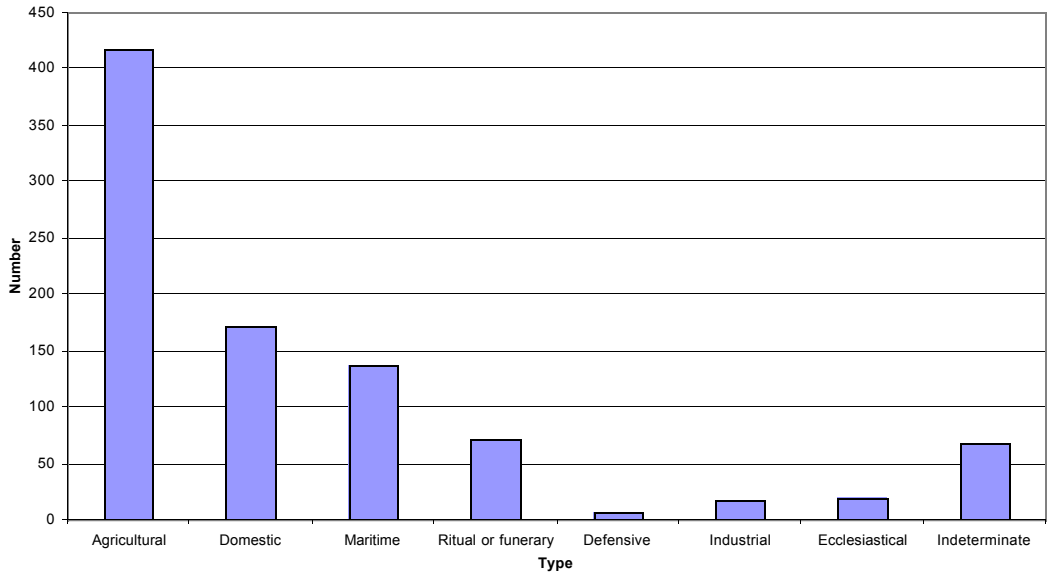

Figure 5.5. Graph showing the number of sites located, grouped by type.

impression gained from carrying out this work has been that the coastal zone contains the greatest variety and highest potential.

Some of the categories contain very few different types of site; 'defensive' sites are entirely defended promontories, for example. Other categories contain a very wide range of sites: click mills, field systems, clearance cairns, sheep crues, and outbuildings all fall within 'agricultural'; the 'maritime' category includes noosts, fishing stations, whaling stations, wrecks and hulks, yet there seems little gain in creating categories purely for mills or for noosts. Some categories contain sites of widely different date: 'domestic' contains both prehistoric houses and 19th-century crofts, while others, for example 'defensive', contain sites of similar date.

Comparison of site type with site date shows some interesting trends and adds more depth to the picture. It can be seen that certain date ranges are dominated by certain site types. The 1st millennium BC – 1st millennium AD range, for example, is dominated by brochs. The 4th – 3rd millennium BC range is dominated by houses and cairns. The 18th – 20th century category, however, contains a very wide variety of sites. There are several possible explanations for this. On the face of it, it could be expected that there would simply be less variation in the archaeology of the earliest settlers in Shetland. Their society might be expected to have been less complex than modern society and give rise to less variation in the record. This is not, however, borne out by a closer examination of the facts. Brochs, for example, are monumental structures easily identified in the landscape. There have been several excavations of these sites and their date range is not in any serious doubt. It is only when we question the location of the structures which are not brochs that it becomes clear that there may be a bias in the data. The figure of 36 sites in the 1st millennium BC – 1st millennium AD date range does not tell us the whole story.

A similar case holds true for the early prehistoric period, which is dominated by houses and cairns. The cairns are very visible monuments which are relatively difficult to destroy, thus they have survived the passage of time very well and are represented disproportionately in most surveys. The houses are only identified as a result of previous excavation, before which their true age was in doubt.

It is therefore far more likely that this apparent increase in site diversity through time reflects our lack of knowledge concerning early settlement and that our inability to identify site variation is due to a lack of data concerning the true nature of the structures identified by survey. This situation is especially frustrating in Shetland where site preservation is excellent. A limited programme of trial excavation would answer many questions.

As outlined above, the surveys took place over eight separate parts of Shetland and although this is not always illustrated by the histograms, the results would seem to point towards certain patterns. There are, for example, more brochs but fewer prehistoric houses in South Mainland. Fishing stations were found only in Northmavine. Westside contains many more defended promontories than any other area as well as some small square cairns not identified anywhere else.

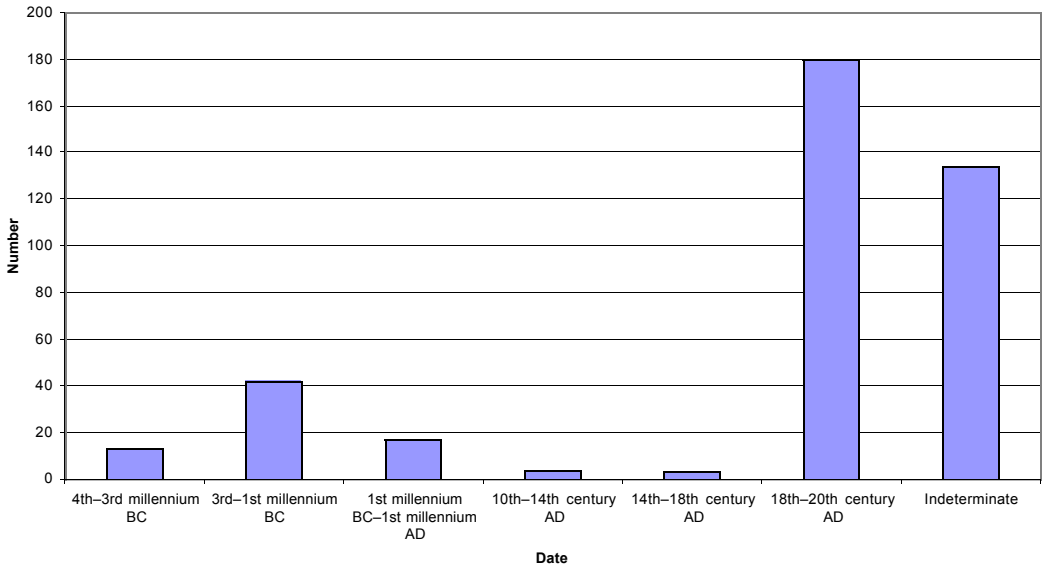

Figure 5.6. Graph showing the number of vulnerable sites, grouped by date.

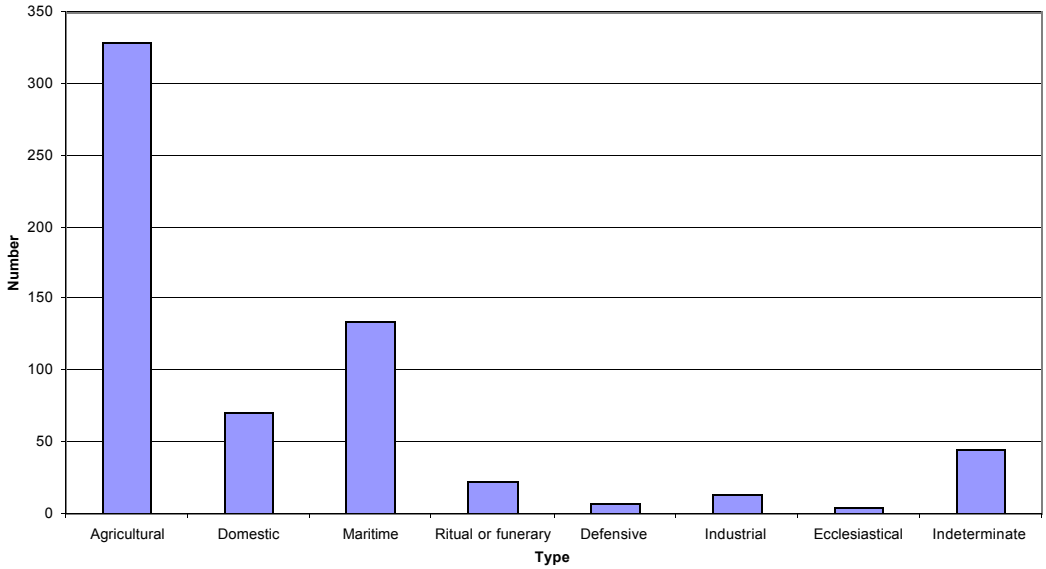

Figure 5.7. Graph showing the number of vulnerable sites, grouped by type.

Vulnerable sites

Figures 5.6 and 5.7 show that all categories of date or type contain some examples which are vulnerable, but there is some variation in the percentages of type which are at risk.

A high proportion of certain types of site are vulnerable due to their nature, since their preferred location would always have been close to the shore. Most 'maritime' sites, for example, lie close to the shore. An obvious example of a vulnerable site type within the maritime category is the boat noost. These will always have been placed above the highest expected tideline to ensure safety during stormy weather, yet not so far that dragging the boat to the sea would have involved a disproportionate effort relative to risk. This is a type of site, incidentally, which is probably one of, if not the most numerous recorded. However, to this author's knowledge, none of the Shetland examples have ever been excavated and they could conceivably be of almost any date.

Many brochs within the coastal zone are vulnerable since they have been sited upon headlands or promontories which appear easy to defend but are also more vulnerable to erosion (Figure 5.8).

Figure 5.8. Burraland Broch, South Mainland.

Geology and erosion

The survey areas were dispersed widely over Shetland, which possesses a very varied geology. Consequently, given the limited space available, it is only possible to summarise very briefly the geology and erosion classes found.

In much of Shetland, the underlying geology is generally 'hard', ie the rock types are igneous or metamorphic. There are some (softer) sandstones in the south and west, but these mostly lie outwith the survey areas. Coast edges are more often than not over 5 m high. The combination of these two factors might be expected to result in less erosion and less vulnerable archaeology, and, as Figure 5.9 illustrates, up to 50 per cent of the coast-edge was classified as stable. Unfortunately, however, the archaeology tends to be found in the lower lying areas, which are more susceptible to the effects of coastal erosion.

Even archaeology situated on a high coastal edge is not always protected. In many places, such as on the west coast of Northmavine, the coast is exposed to the full force of the sea and vegetation can be stripped for hundreds of metres due to wind forcing sea water inland, even over high cliffs.

Erosion was found to be not just a result of rising sea levels and increased storminess, but of a combination of factors. Current land management practices, for example, have a great effect on the stability of the coast-edge. Overgrazing by sheep is common and cattle trampling the ground can easily destabilise fragile deposits. Rabbit infestation is common on archaeological sites since the presence of walls and stonework makes the ground higher and consequently much drier than the surrounding, often poorly drained, landscape.

It is difficult to judge the speed of erosion in most of the areas surveyed since there is no previous information against which to compare the recent findings. Old maps and aerial photographs have been consulted as part of the post-survey analysis, but without much success; there is no substitute for repeated site visits together with basic recording of exposed sections.

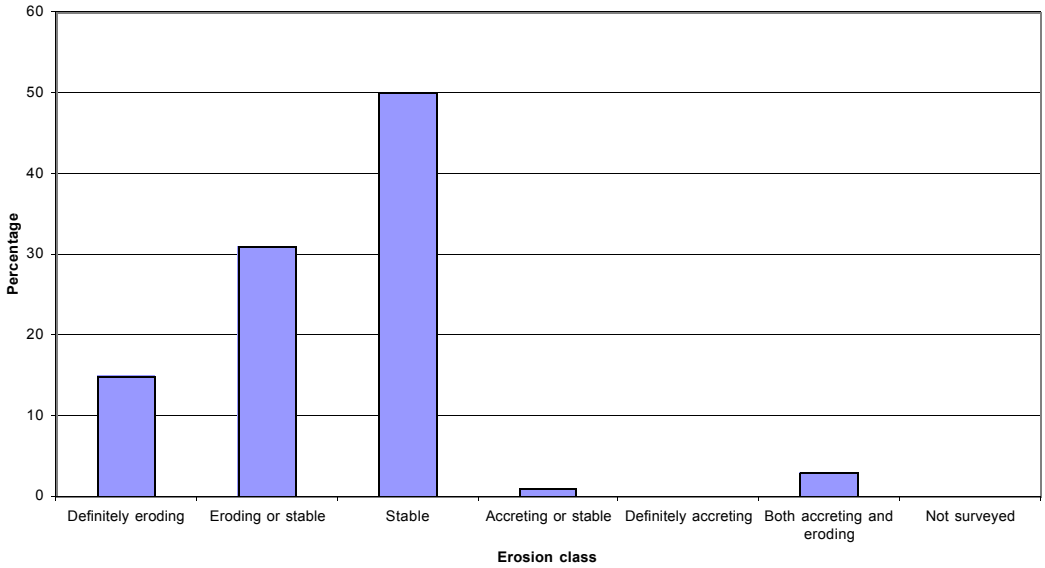

Figure 5.9. Graph showing erosion classes for the coastline surveyed.

Discussion and Recommendations

The surveys have demonstrated the richness of archaeology in Shetland. Sites of all periods survive in abundance, are well preserved and easily detected by survey. The nature of the Shetland landscape, however, means that there is a concentration of sites within the coastal zone and, consequently, a huge proportion of these sites are under direct threat. The implication of this distribution pattern is that if the resource is damaged without any record being made, there will be no second chance: there is no large body of sites lying in the hinterland which may still be present when the coastal sites are lost.

Many of the sites in the coastal zone are specialised and can tell us a great deal about certain facets of past ways of life. This does not mean that they are of limited relevance to wider studies. Nineteenth-century fishing stations, which are still well preserved in Northmavine, are part of a wider phenomenon occurring all around the North Sea. The development of prehistoric settlement in Shetland is of interest in its own right, and it can be seen that there were a great many local adaptations of more widespread house types, yet Shetland is also part of Atlantic Scotland. The large-scale survival in Shetland of prehistoric remains, including entire field systems, makes it one of the best places to study continuity and change through time.

As well as illustrating the potential of the resource within the coastal zone, the surveys have pointed towards gaps in the data and indicated areas which would benefit from further work. There is a great threat to the archaeology of Shetland from coastal erosion, and it goes without saying that the threat is increasing. The onset of global warming, linked with rising sea levels, is set to exacerbate the problem in the short to medium term. There is a need to further define and understand the resource since one of the problems that has been frequently encountered is our basic lack of understanding. In order to formulate strategies to manage the threat, we must have more information. This can only be gained by more fieldwork.

One intriguing type of deposit identified by these surveys is submerged peat. The recognition of old ground surfaces extending offshore opens up the possibility that terrestrial archaeological sites survive under the sea. The existence of such remains and their condition remains uncertain, but is probable. Recent excavations of a burnt mound at Tangwick in Northmavine (Moore & Wilson 2000) recovered the well-preserved remains of a Bronze Age structure together with associated ground surfaces from beneath a storm beach, showing that archaeology can survive in quite unexpected locations.

It is recommended that coastal surveys be repeated, after a suitable interval. This is important in order to gather information on rates of erosion, to record new sites not previously seen, and to reconsider past interpretations in the light of work elsewhere. In the interim, very vulnerable sites should be recorded, others should be monitored, and work should be undertaken to gauge the potential of the many sites which could not be characterised by survey alone.

References

Ashmore, P J 1994 *Archaeology and the Coastal Zone: Towards a Historic Scotland Policy* Historic Scotland, Edinburgh.

Calder, C S T 1958 'Stone Age house – sites in Shetland' *Proc Soc Antiq Scot* 89 (1955–56), 340–97.

Calder, C S T 1963 'Cairns, Neolithic houses and burnt mounds in Shetland' *Proc Soc Antiq Scot* 96 (1962–63), 37–86.

Carter, S P, McCullagh, R P J & MacSween, A 1995 'The Iron Age in Shetland: excavations at five sites threatened by coastal erosion' *Proc Soc Antiq Scot* 125 (1995) 429–82.

Hamilton, J R C 1968 *Excavations at Clickhimin, Shetland* HMSO, Edinburgh.

Hedges, J W 1986 'Bronze Age structures at Tougs, Burra Isle Shetland', *Glasgow Archaeol J* 13 (1986), 1–43.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Historic Scotland Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Moore, H & Wilson, G 1998a *Report on a coastal zone assessment survey of Northmavine, Shetland* Historic Scotland archive report.

Moore, H & Wilson, G 1998b *Report on a coastal zone assessment survey of Westside, Shetland* Historic Scotland archive report.

Moore, H & Wilson, G 1999 *Shetland Coastal Survey 1998: Whalsay, Lunnasting, South Mainland* Historic Scotland archive report.

Moore, H & Wilson, G 2000 'Food for thought: a survey of burnt mounds of Shetland and excavations at Tangwick' *Proc Soc Antiq Scot* 129 (1999), 203–37.

RCAHMS 1946 *Inventory of the Ancient Monuments of Orkney and Shetland* vol 2 HMSO, Edinburgh

Sharples, N 1998 *Scalloway: A Broch, Late Iron Age Settlement and Medieval Cemetery in Shetland* Oxbow Monograph 82, Oxford.

Whittle, A (ed) 1986 *Scord of Brouster: an early agricultural settlement on Shetland* Oxford University Committee for Archaeology Monograph 9, Oxford.

6 ASSESSMENT SURVEY: ORKNEY

GRAEME WILSON

Introduction

EASE Archaeology were commissioned by the Orkney Archaeological Trust to carry out three separate seasons of coastal zone assessment survey (Moore & Wilson 1998; 1999; 2000). This work was funded by Historic Scotland and was carried out from 1997 to 1999. In consultation with Julie Gibson, the Orkney Archaeologist, ten areas were chosen for survey. The areas examined were the islands of Graemsay, Burray (including Hunda), Flotta, South Ronaldsay, part of Hoy, North Ronaldsay, Sanday, Westray, Papa Westray (including the Holm of Papa Westray) and part of West Mainland from Waulkmill Bay to Bu Point (Figure 6.1). Fieldwork and the preparation of the reports was carried out in accordance with Historic Scotland guidelines (1996).

As might be expected, the ten areas surveyed vary greatly both in landscape and in archaeological potential. The surveys also generated an enormous body of information. For these reasons it is difficult to summarise the findings in the limited space available and still do justice to the particular riches each area possesses. Much of this discussion revolves around the facts as they are displayed in the form of histograms. These histograms are useful summaries, but do tend to gloss over those sites which are remarkable or unusual. Although necessary for this level of discussion, the histograms are not a substitute for the individual survey reports.

The landscape of Orkney may be generalised as low-lying and fertile. Much of the land within the survey area was fenced up to within a few metres of the coast-edge, and was mostly given over to cattle at the time of survey, although there was some variation: barley was cultivated over much of the south end of South Ronaldsay (surveyed during 1997) and it could be seen that almost all fields had been cultivated in the past. The coastal strip between field and coast-edge was usually left untouched and in consequence was often very overgrown. The combination of flat ploughed fields and overgrown coast-edge undoubtedly adversely affected the results, but it is difficult to see how this could be remedied without recourse to more invasive prospective methods such as trial trenching or large-scale geophysical survey. Both are impractical on the scale of these surveys but have their place within more targeted studies (see Moore, this volume).

Despite the problems encountered, a very large number of sites were detected by this survey – some 843, in fact. Many of these sites are multi-period and the impression gained is of settlement becoming focused, and therefore becoming more detectable, in certain locations, perhaps in an effort to maximise use of the fertile landscape.

Previous Work

An enormous body of previous archaeological work has been carried out in the survey area. A basic survey was carried out over all of Orkney during the 1930s (RCAHMS 1946) which was followed by reassessment in the 1980s (eg Lamb 1983). It should not be surprising that new sites continue to be found in previously surveyed areas. Each survey reflects the differing aims and expectations of the fieldworkers, each successive survey is carried out at different times of the year, and sites are revealed or concealed according to the vagaries of, for example, weather and erosion.

Previous excavations within the survey area include some of the most important in Scotland for the study of prehistory. A few have genuine relevance beyond Scotland and to the whole of north-west Europe. They serve to confirm Orkney's importance as a place where the quality and ubiquity of prehistoric remains is such that they may serve as a 'test bed' for wider theories concerned with prehistory. The sites include Knap of Howar Neolithic farmstead (Ritchie 1983), Isbister chambered tomb (Hedges 1983), Quoyness chambered tomb (Davidson & Henshall 1989), Holm of Papa Westray North (Ritchie 1995) and Holm of Papa Westray South (Davidson & Henshall 1989) chambered tombs, Pool Neolithic and Iron Age settlement (Hunter 1990), Tofts Ness Bronze Age settlement (Hunter & Dockrill 1990), and the Scar boat burial (Owen & Dalland 1999). Most of these excavations took place as a result of the threat from coastal erosion; all lie within the coastal zone.

If there is one drawback to previous work, it is that it has been reactive and site-specific. Excavation has tended to address specific management problems existing at specific locations, but without looking further afield. There has been no attempt to undertake an in-depth landscape study of an *area*, backed up by survey and excavation, and this is reflected in the

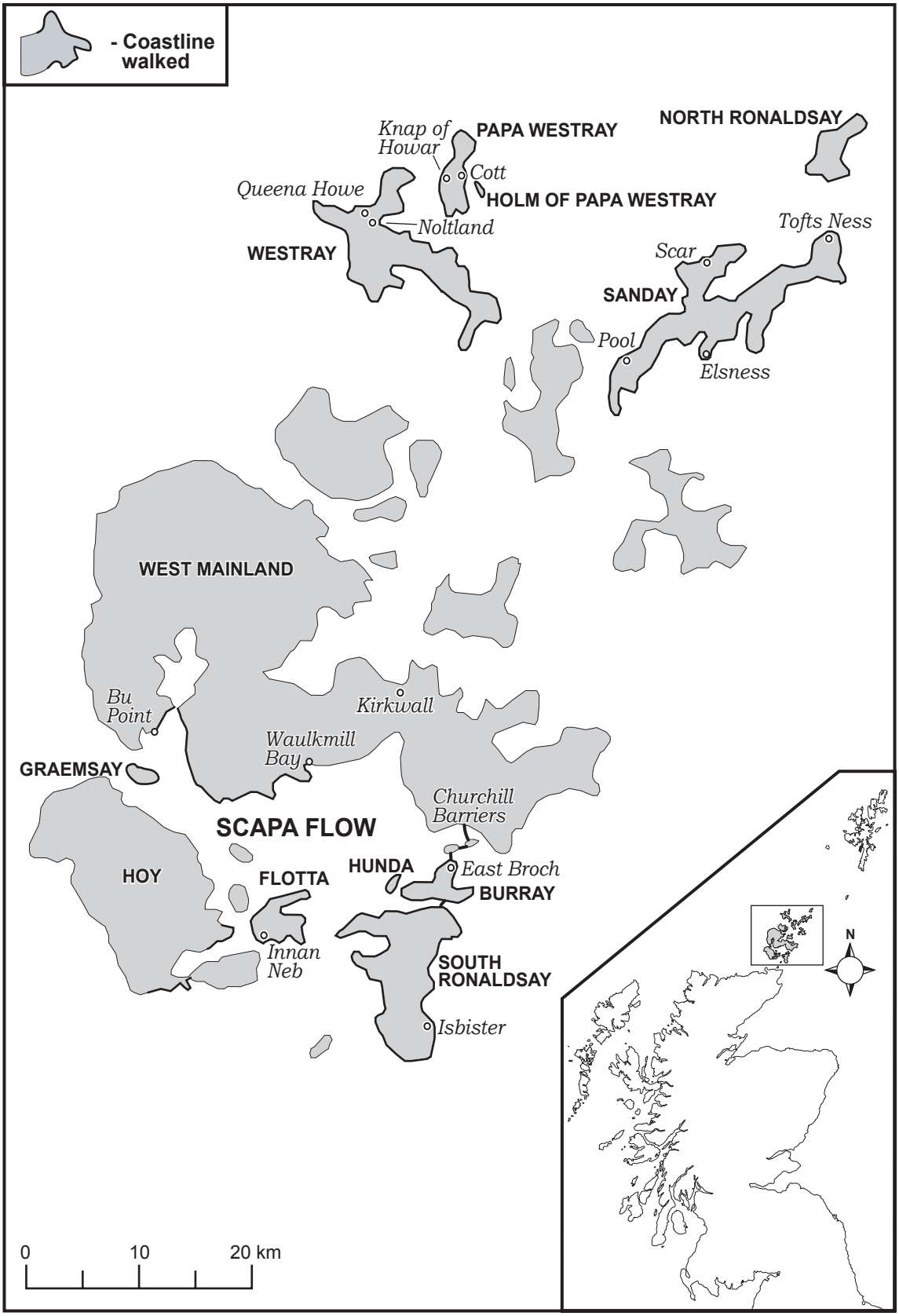

Figure 6.1. Location map showing the areas of survey and places mentioned in the text.

results of the excavations to date where it has not been possible to place the sites into their local context.

Analysis

Introduction

As mentioned above, histograms have been chosen as the method of summarising the survey results. It is worth going into some detail concerning how these results have been generated. Firstly, there are problems concerning the definition of what constitutes a 'site'. For the purposes of the survey a site was usually a geographical concentration of the remains of any past human activity. This was further subdivided by date so that, for example, where a World War II coastal battery overlay a broch (eg sites B15, B34, Moore & Wilson 1998), the two were presented as separate entries. Sites of different type but lying close together were also often distinguished, for example a church was distinguished from a prehistoric settlement (eg sites G24, G36, Moore & Wilson 1998) or kelp workings. In this way, some detail could be kept concerning sites presently regarded as unrelated, but it was not always practical to do this. An example of a site recorded as a singular entity even though it contains many different elements is Elsness on Sanday (site SY66, Moore & Wilson 2000). Here, a promontory of land contains a concentration of burial monuments conceivably spanning the Neolithic and Bronze Age.

It was intended to present the results of the surveys primarily in map form (though there was some experimentation with analysis using histograms), therefore it was adequate to represent the 'sites' for the most part as geographical locations containing features of archaeological interest. The accompanying descriptions gave more information on the nature of the site.

There were then, complications when attempts were made to break down every 'site' by type and by date, even where the widely different elements had already been separated. One reason for this is that many sites cannot be easily characterised by just one type (Figure 6.2). Kelp workings, for example, may be maritime, but they are also industrial. Crofts are both domestic and agricultural. Noosts are maritime, but are very likely related to crofts.

The problems of quantification are compounded by the occurrence of very large sites comprising a great number of disparate elements spread over a very wide area. At one end of the scale are the wartime remains which lie around Scapa Flow: these were all built within a very short period of time, with the singular aim of defending the harbourage of the British Home Fleet from attack (Figure 6.3).

Figure 6.2. Eroding Settlement at Cott, island of Papa Westray.

Figure 6.3. One of the Churchill Barriers blocking entry to Scapa Flow.

There is a case for regarding all of these remains as one site. This was not done (common sense prevailing); instead the separate batteries were identified where possible (sometimes using documentary information) and counted as units since each had its own history and its own purpose (anti-torpedo boat or anti-aircraft for example). Even so, the defensive category is swamped by World War I and World War II ammunition lockers, anti-submarine netting, blockships, gun positions, Churchill Barriers, decoy airfields, telegraph sheds, listening posts, machine gun positions, military bench marks, engine sheds, searchlight positions, camps, and so on (Figure 6.4).

The overall figure of 843 sites is a minimum number since any one site can include many different elements. Boat noosts often occur together in sheltered parts of the coast, but it was not considered practical to count each noost as a separate site, although they are individually described in the survey reports. Multi-period prehistoric sites were frequently encountered, but it would not be possible to chart their development through time without recourse to excavation (Figure 6.5).

Figure 6.4. Memorial to Squadron Commander Dunning, West Mainland.

Figure 6.5. Queena Howe prehistoric settlement, island of Westray.

Another complication which the histograms gloss over is the variation between islands. Important examples of this include:

- World War I and World War II defensive remains are located almost entirely around Scapa Flow, with only limited remains elsewhere.
- Eighteenth- and nineteenth-century kelp workings are more common in the north isles than around Scapa Flow.
- Very large settlement mounds (also known as 'farm mounds') are concentrated in some of the north isles, particularly Sanday.

The variation in the archaeology sometimes reflects differences in geology or geography. It was relatively difficult to detect new sites on Sanday, for example, probably because the large deposits of sand on the island will have obscured many sites. The sand is also one of the factors giving rise to the large settlement mounds mentioned above. The defensive remains around Scapa Flow are there because of the suitability of that body of water as a sheltered anchorage.

Built heritage

The histograms are useful in many ways, even taking account of the provisos noted above (see Wilson, this volume, for similar problems in quantifying Shetland sites). The data has been broken down into seven date ranges, each intended to illuminate one more or less distinct period (Figure 6.6). Where possible, the sites have also been characterised by type (Figure 6.7). The totals for Figures 6.6 and 6.7 are very different. This is because a single site of any one period may be classed as more than one type: blockships are both defensive and maritime; kelp working areas are both maritime and industrial.

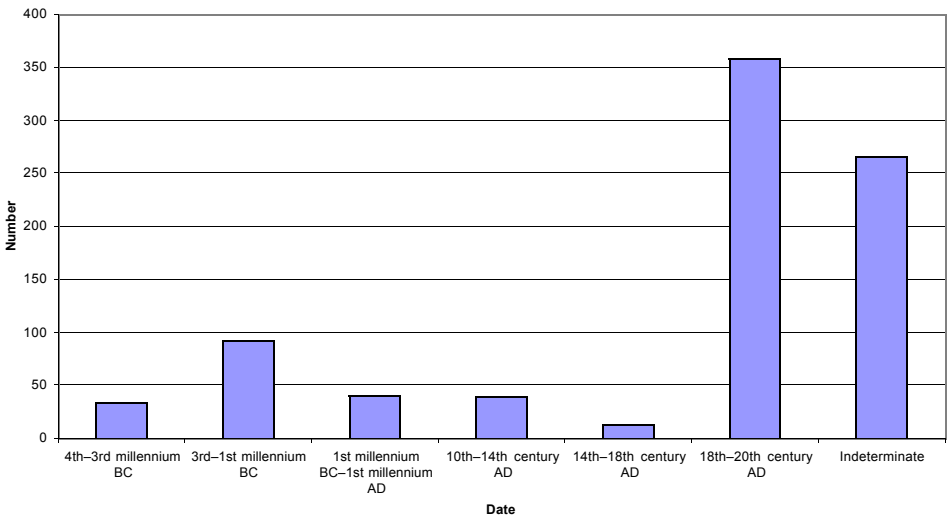

Figure 6.6. Graph showing the total number of sites located, grouped by date.

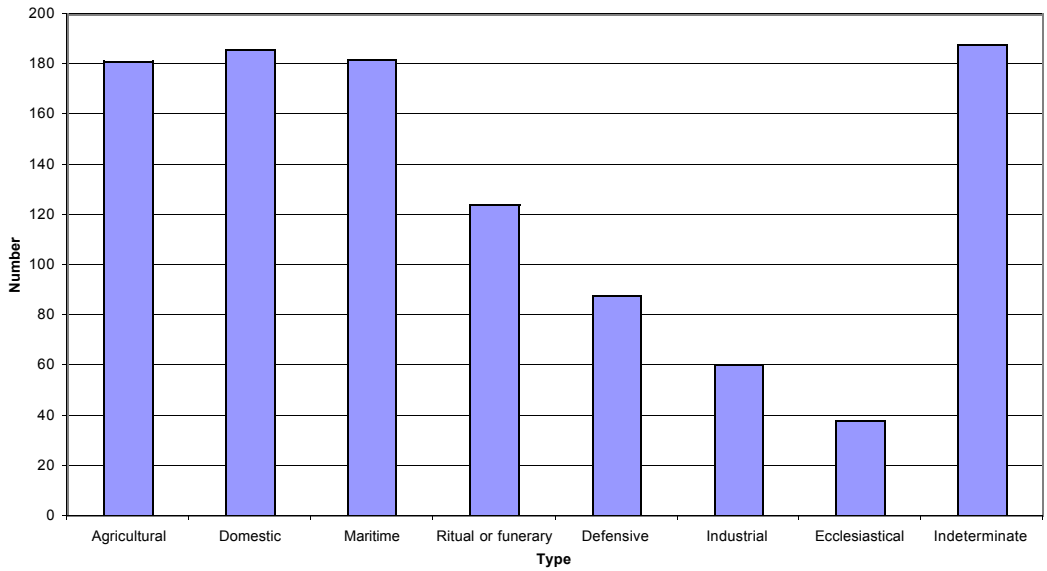

Figure 6.7. Graph showing the number of sites located, grouped by type.

The 4th–3rd millennium BC date range contains 34 entries, the majority of which represent sites categorised as ritual/funerary, ie chambered cairns. The exceptions to this are sites such as the Knap of Howar and Pool, proven by excavation to belong within this date range. There are only a few cases where a site which was neither a cairn nor without previous excavation was assigned this date; usually where distinctive artefacts such as struck flints were recovered from an eroding section.

The fact that so few types of site can be assigned to the 4th–3rd millennium BC date range without excavation highlights a general point applicable to most date ranges. Most periods are represented only by a limited range of very distinctive, readily identifiable types: chambered cairns in the Neolithic, burial mounds and burnt mounds in the Bronze Age, brochs in the Iron Age, and so on. In part, this reflects the history of archaeology, where antiquarian interest has been attracted towards the larger and more monumental sites. In Orkney, where the preservation of the remains is such that Neolithic houses may stand to roof height, it is difficult to assign a date to a scrap of wall seen eroding from a section. On mainland Scotland, it is most likely that the wall would be medieval or later; in Orkney, it could represent settlement of any date from the Neolithic onwards.

The 3rd–1st millennium date range contains 92 sites. These are almost entirely burial mounds together with a few burnt mounds. The single exception is a settlement site investigated by excavation at Tofts Ness (see site SY193, Moore & Wilson 2000) on Sanday. The number of burial mounds is in fact an underestimate. One of the patterns of distribution of these monuments is the way in which they cluster at what may have been liminal places in the landscape, on promontories and peninsulas. These groups of monuments have been recorded as site complexes since it is difficult to define the resource accurately without recourse to more intensive survey, and additionally they often extend far outwith the survey area.

The identification of any mound as a burial monument belonging to the 3rd–1st millennium BC is fraught with difficulty. Usually, identification is based on a combination of factors: size and shape; whether they occur singly or in groups; association with other monument types; and location within the landscape. Sometimes distinctive elements such as cist burials will be exposed in the body of the mound. Mounds often cluster around very large chambered cairns, and it might be assumed that they post-date the chambered cairn, but this is not necessarily the case. In the first place, recent excavations elsewhere in Orkney have shown how small chambered cairns can appear to be Bronze Age prior to excavation (Downs 1999). Also the sequence of large Neolithic chambered cairn followed by Later Bronze Age burial mounds is perhaps in doubt following the results of excavations at Knowth in Ireland. There, the satellite mounds have turned out to be earlier than the central cairn and the suggestion is that a special central space was surrounded by smaller cairns before a final formalisation/monumentalisation of the space through the construction of the central passage grave (Whittle 1996). This may be a viable model for Orkney.

The 1st millennium BC – 1st millennium AD date range is occupied mostly by brochs together with their associated settlements (Figure 6.8). There are no obvious contenders for non-broch settlement sites

except for where they have been uncovered by excavation, as at Pool, Sanday (Hunter 1990; site SY117, Moore & Wilson 2000). Also included within this date range are various structures situated on isolated promontories or stacks. These may be early Christian eremitic sites.

Figure 6.8. East broch of Burray, island of Burray.

The 10th–14th century AD and 14th–18th century AD date ranges are problematic because they are relatively recent yet contain fewer sites than the prehistoric date ranges (a total of 52 sites). This might partly be expected because the prehistoric date ranges encompass a huge period of time – some 4000 years. However, the 10th–18th century AD date range should include better preserved sites, including many for which there is documentary evidence. In effect, church sites make up the majority for this period and these have been dated by reference to documentary evidence. There was no definite sign of domestic settlement belonging to this period (though see Moore, this volume). It is likely that a great deal of the domestic settlement is hidden by modern settlement and some may have been misattributed to a later date range. Almost nothing is known about the nature of settlement between the 10th and 18th centuries AD, particularly towards the end of this date range, and all that can be said is that there is a real need for more work in this area.

The 18th–20th century AD date range contains a large number of sites. Not only are these sites in general better preserved, but they also display a greater spread of site type. It is also relatively easy to characterise a site within this date range from the surface remains alone, although we should not be complacent. The enormous range of defensive sites within the survey area has been mentioned above and this reflects the national importance of Scapa Flow for the study of military remains. Although these remains were abandoned only a very short time ago, it was difficult to characterise them without recourse to documentary information and, despite this, there are sites of which little more could be said than that they are probably related to the defence of Scapa Flow and are of 20th-century date. Most of these sites are in poor condition and deteriorating rapidly: they were built in a hurry and from materials which will not necessarily stand the test of time. Many were purposely built very close to the coast-edge and are now being actively eroded.

Vulnerable sites

The histograms illustrating vulnerable sites by date and by type (Figures 6.9 and 6.10) show how large a proportion of sites belonging to the modern period are vulnerable. In part, this is probably due to a proliferation of sites linked to the exploitation of marine resources – 172 vulnerable sites are maritime in nature. Most of these are of 18th–20th century date and include kelping remains, piers, jetties, noosts and sheds. Not all are maritime in nature, however. The majority of the agricultural sites deemed to be vulnerable are also of 18th–20th century date. The

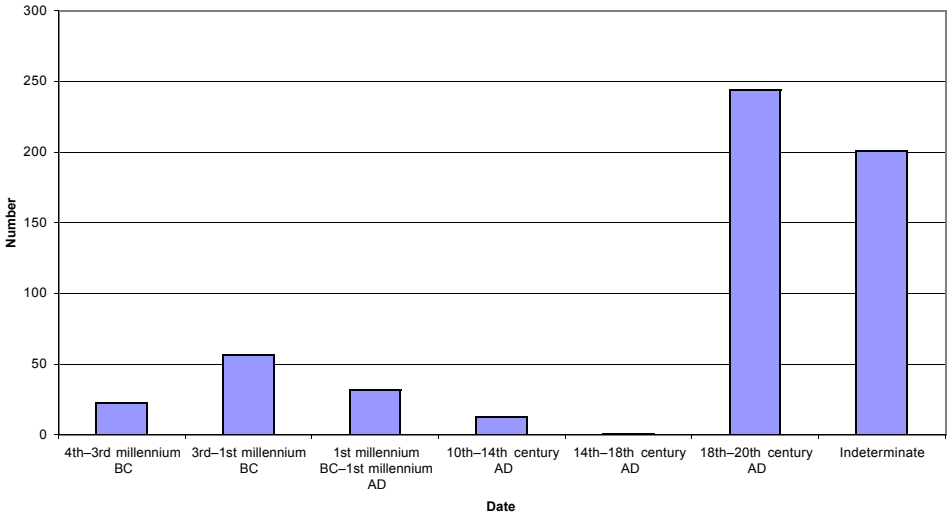

Figure 6.9. Graph showing the number of vulnerable sites, grouped by date.

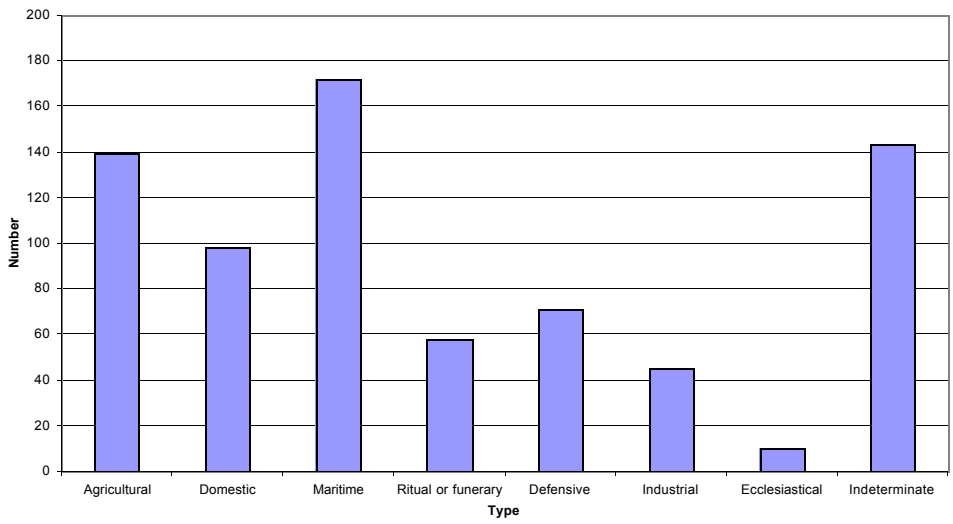

Figure 6.10. Graph showing the number of vulnerable sites, grouped by type.

relatively large number of vulnerable sites assigned a 3rd–1st millennium BC date reflects the occurrence of groups of burial monuments in vulnerable locations such as promontories. A very large proportion of defensive sites, of all dates, were deemed vulnerable. This is because the purpose for which they were built tended to determine that they were located in vulnerable areas, ie to provide good views over stretches of water in the case of World War II remains, or to provide a defensible location in the case of brochs or promontory forts.

Geology and Erosion Within the Survey Area

The underlying geology of the survey area is composed almost entirely of Old Red Sandstone. The topography of the survey areas appears generally low-lying and rolling. In part, this is due to the relatively soft sandstones, but it is also due to the deposition of till during the last ice age. The till is, however, generally no more than 1 m thick. In addition, the topography of a large part of the survey area, in particular the islands of Sanday, North Ronaldsay and parts of Westray, is affected by deep deposits of wind-blown sand.

All of the factors mentioned above are relatively vulnerable to erosion (Figure 6.11). Erosion in the survey area has a variety of causes. Marine erosion by a variety of different wave actions is the major cause, but there is also sub-aerial erosion by wind, rain and water. Chemical erosion by salt spray is also a factor. In addition, there are contributing factors which affect rates of erosion.

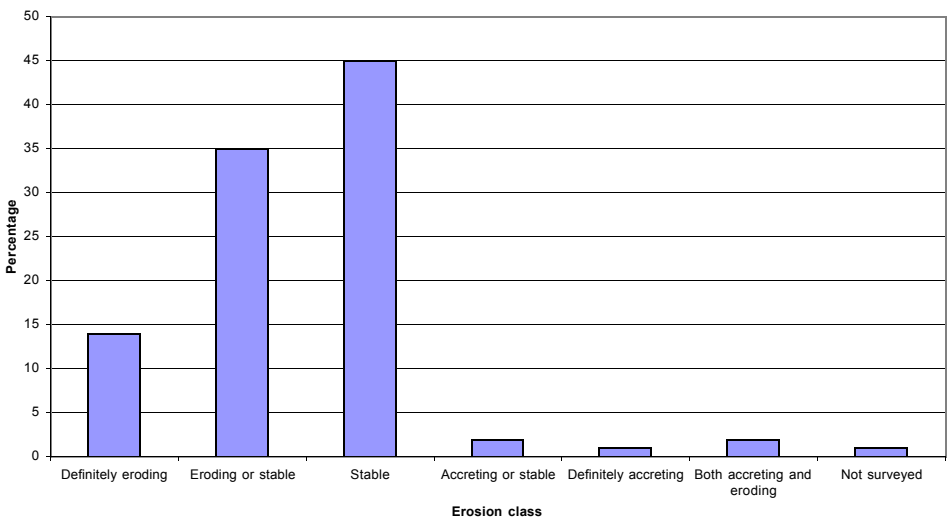

Figure 6.11. Graph showing erosion classes for the coastline surveyed.

Farming practices have a direct effect on the susceptibility of the coastal zone to erosion. Overstocking, for example, can damage already vulnerable turf, making it easier for wave action to remove soil. Within the survey area there was, however, only limited evidence for an adverse effect on erosion from land management practices. The single exception to this was on the island of North Ronaldsay, where a large population of sheep, kept on the foreshore, appears to be having a detrimental effect on the vegetation.

The greatest contributing factor affecting erosion is the sinking of the islands, together with changes in sea level since the last glaciation. Already much land has been lost, and this trend is set to continue if predictions of rising sea levels due to global warming are correct.

Discussion and Recommendations

The impression gained during these surveys is of a coastal zone which is extraordinarily rich in monuments of all periods. Any deficiencies in the record – a lack of medieval settlement or non-broch settlement for example – is likely to be due to a combination of factors. These include the difficulty of assigning dates to sites or characterising them without recourse to excavation. Also, the hinterland of much of the area surveyed had been repeatedly cultivated in the past and was in consequence featureless. This does not mean that the 'missing' sites have been destroyed or that they were never located within the coastal zone. It is to be expected that prospective excavation would rapidly fill any gaps in our knowledge.

One important factor which was brought home to the surveyors again and again was that the group of sites identified is in effect a self-selecting one. This is because identification relies on preconceptions of what the various monuments should look like. It is doubtful, for example, that a Bronze Age burial mound would be correctly identified if it was too big or too small to fit within the expected size range, or if it were in an unexpected location. These surveys thus have the effect of creating an *average* impression of the archaeological potential of the coastal zone. Unusual sites, or site types not previously identified through some other means such as excavation, are in fact less likely to be identified since they fall outwith the 'known universe' of site variation. This tendency is exacerbated when attempts are made to summarise the data. There is a pressure to fit sites into neat categories, which derive from, for example, the results of previous excavation work. These sites, in turn have often been chosen for study due to what it is anticipated will be found during excavation rather than because of the site's unknown potential. It is interesting to note that some of the most informative and useful work has been from rescue excavations where there were no previous expectations or where the expectations were confounded by the results. Pool, Sanday (site SY117, Moore & Wilson 2000) and Knap of Howar, Papa Westray (site PWT1, Moore & Wilson 1999) are two good examples of this.

The areas surveyed consisted of a series of separate islands, each of which varied in the nature of its archaeological potential, as mentioned above. It should be remembered that all of the areas surveyed have suffered greatly through rising sea levels. Distribution maps which use the present-day coastline will be misleading unless they purport to show only modern settlement patterns. The Neolithic landmass of Orkney was very different, to the point where several of the islands surveyed were in all probability joined. This will have obvious implications for interpretation and for predictive modelling of site location. Westray, Papa Westray and the Holm of Papa Westray were probably one island (Ritchie 1985, illus 8). The Holm of Papa Westray is dominated by Neolithic funerary monuments – this may appear an odd place for such monuments but it may have in fact been a promontory or ness of land and as such sits quite happily with other similar locations used for burial during this period. The ways in which the coastlines of Orkney have changed, from the last ice age to the present-day, is an important topic for future research.

Some important recommendations arise from these surveys:

- It is clear that there are a great many sites whose true potential is at present uncertain. Further work is needed to assess these sites in more detail. This information is essential if both local and national priorities are to be formulated, and it is desirable that further work is carried out as soon as possible.
- There is a lack of data concerning the potential of the landscape between the monuments. In Orkney, sites often appear as massive anomalies in what is otherwise a relatively bland landscape. There has been some previous work which has shown that entire prehistoric landscapes can survive buried beneath wind-blown sand (eg Links of Noltland, Westray, and Tofts Ness, Sanday) and more work is needed to investigate the relation Orkney sites have with their hinterland.
- Regardless of any long-term management strategies which may be put in place, there is a large group of sites of all periods which have been identified through these surveys as worthy of further work now (see Recommendations, Moore & Wilson 1998; 1999; 2000). This does not necessarily mean full-scale excavation in every case but a range of options including monitoring and survey.

- These surveys should be repeated after a suitable interval of time, perhaps ten years, in order to assess rates of erosion, for which there is at present very little information. It is not necessary that all the areas are resurveyed; it may be equally useful to sample those stretches of coastline deemed most at risk.

References

Ashmore, P J 1994 *Archaeology and the Coastal Zone: Towards a Historic Scotland Policy* Historic Scotland, Edinburgh.

Davidson, J L & Henshall, A S 1989 *The Chambered Cairns of Orkney* Edinburgh University Press, Edinburgh.

Downes, J 1999 'Survey and excavation of Neolithic cairns' *DES* 1998, 69.

Hedges, J W 1983 *Isbister*: *A Chambered Cairn in Orkney* British Archaeological Report 115, Oxford.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Historic Scotland Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Hunter, J R 1990 'Pool, Sanday: a Case Study for the Late Iron Age and Viking Periods' in Armit, I (ed) 1990 *Beyond the Brochs: Changing Perspectives on the Atlantic Scottish Iron Age* Edinburgh University Press, Edinburgh, 175–93.

Hunter, J R & Dockrill, S J 1990 'Recent research into burnt mounds on Fair Isle, Shetland and Sanday, Orkney' in Buckley, V (ed) 1990 *Burnt Offerings: International Contributions to Burnt Mound Archaeology* Wordwell, Dublin, 62–8.

Lamb, R G 1983 *The Archaeological Sites and Monuments of Scotland 19: Papa Westray and Westray (with adjacent small islands)* RCAHMS, Edinburgh.

Moore, H & Wilson, G 1998 *Report on a Coastal Zone Assessment of Orkney: Burray, Flotta, Graemsay, Hoy and South Ronaldsay* Historic Scotland archive report.

Moore, H & Wilson, G 1999 *Orkney Coastal Zone Assessment Survey 1998: Westray, Papa Westray, Holm of Papa Westray, West Mainland* Historic Scotland archive report.

Moore, H & Wilson, G 2000 *Orkney Coastal Survey 1999: Sanday and North Ronaldsay* Historic Scotland archive report.

Owen, O & Dalland, M 1999 *Scar*: *A Viking Boat Burial on Sanday, Orkney* Historic Scotland, Edinburgh.

RCAHMS 1946 *Inventory of the Ancient Monuments of Orkney and Shetland* vol 2, RCAHMS, Edinburgh.

Ritchie, A 1983 'Excavation of a Neolithic farmstead at Knap of Howar, Papa Westray, Orkney' *Proc Soc Antiq Scot* 113 (1983), 40–121.

Ritchie, A 1995 *Prehistoric Orkney* Historic Scotland, Edinburgh.

Whittle, A 1996 *Europe in the Neolithic: the creation of new worlds* Cambridge University Press, Cambridge.

7 ASSESSMENT SURVEY: LEWIS

MIKE CHURCH AND CHRIS BURGESS

Introduction

During the months of June, July and August 1996, a team from the Department of Archaeology at the University of Edinburgh undertook an assessment of the erosion of the archaeology and built heritage within the coastal zone of the west, north-west and north-east of Lewis. The results of this 441-km linear survey detail 1825 individual cultural heritage sites, 15 palaeo-environmental sites and 319 geomorphic and erosion cells. Historic Scotland and the Department of Archaeology, University of Edinburgh, sponsored the study.

Aims

The primary aims of the project were to fulfil the requirements of the ongoing programme of coastal erosion assessment defined in Historic Scotland's *Archaeology Procedure Paper 4: Coastal Zone Assessment Survey* (1996). In addition, the results also contributed to ongoing research interests of the wider Calanais Archaeological Research Programme (CARP; Harding 2000). These included:

- the development of computer-aided survey using the software package PenMap (Strata 1996), initiated during previous research projects in Lewis
- provision of a linear survey control along the coasts for the various area survey projects undertaken within the study area
- examination of the coastal strip for potential sites for rescue excavation and selective sampling

The Study Area

This survey comprised the intertidal zone and a 50–200 m strip inland from the Mean High Water Spring (where possible). The survey was executed along a linear transect running from Aird Drollageo in the south-west via the Butt of Lewis to Ranish in the south-east of the study area (Figure 7.1). A wide diversity of coastal forms was covered by this transect, including high cliffs and low rock platform, stretches of raised beach, areas of extended sand dunes and machair, intertidal saltings and isolated areas where alluvial deposition is prevalent.

Lewis is the largest land body in the bow-shaped chain of islands which makes up the Western Isles. The almost exclusive coverage of basement rock of hard metamorphic Lewisian Gneiss is amongst the oldest in Britain, with some formations dating back to 2800 million years. However, the Butt of Lewis and an area north and east of Stornoway are underlain by softer Metasediments and Triassic sediments that affect the long-term erosion of their respective coastlines in relation to the rest of Lewis.

The present Holocene landscape can be broadly separated into two main areas: the 'blacklands' and the coastal strip. The 'blacklands' cover most of the island interior and consist of a treeless subdued topography covered in blanket peat, dotted with hundreds of lochs of varying size and bare outcrops of Lewisian Gneiss. Stretches of the coastal strip consist of land that is agriculturally more viable and on which most of the island's settlement is concentrated. Its form is a function of the development of machair through natural processes (Ritchie 1979; 1985) and anthropogenic intervention (Pankhurst & Mullin 1994; Boyd & Boyd 1990). Pollen diagrams within the survey area indicate that tree cover was greatly reduced by the 1st millennium BC (Bohncke 1988; Birks 1994; Lomax & Edwards 2000).

During the second half of the Holocene the increasingly marginal and forbidding interior has concentrated settlement within the coastal zone. The resulting archaeological remains cover all periods from Neolithic ceremonial remains, through Bronze Age landscapes in both machair and blanket peat, the monumental drystone architecture of later prehistory, medieval ecclesiastical complexes and expanses of abandoned post-medieval settlement. The concentration of this varied and diverse settlement within the coastal zone, coupled with the unique preservation systems of peat and machair and limited intensive agriculture, has created an archaeological resource of great importance.

Previous Work

More than 20 excavations of archaeological sites have taken place within the survey area. These are outlined by Burgess and Church (1997, 29–31). There has also been important research into Quaternary environments and geomorphology, concentrating on Uig Sands and a stretch of relic coastline in the north-west (Sutherland 1993).

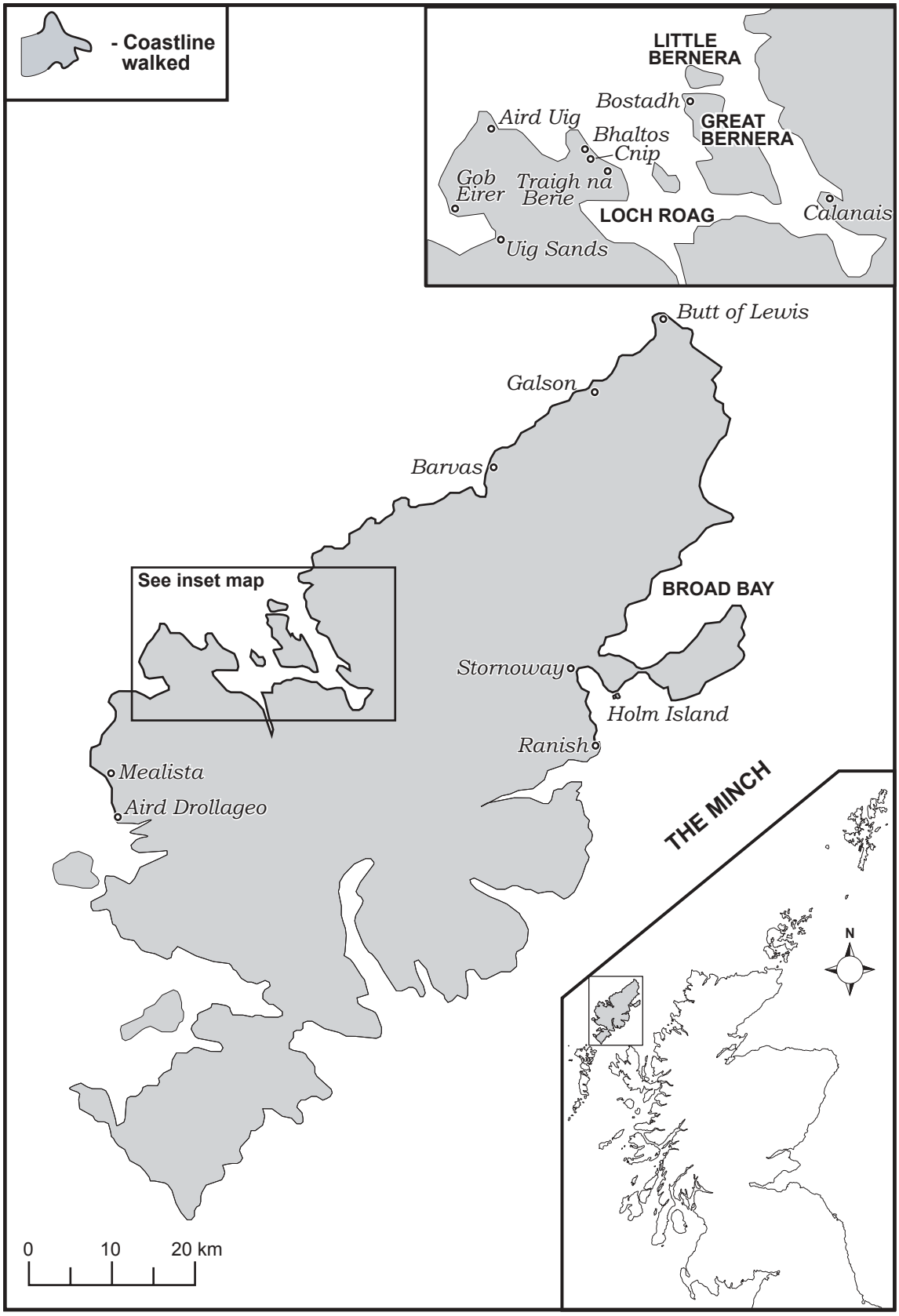

Figure 7.1. Location map showing the area of survey and places mentioned in the text.

Prior to 1985 the main projects were the RCAHMS survey published in 1928 and the coastal erosion assessment undertaken by the National Museums of Scotland (Cowie 1994). The latter involved a detailed survey and site description of selected strips of coastline rich in prehistoric remains.

The initial research of CARP, following the acquisition of Calanais Farm in 1985 (Harding 2000) concentrated on the later prehistoric settlement on the Bhaltos Peninsula. Field survey (Armit 1994) was followed by the excavation of a wheelhouse and cellular complex at Cnip (Harding & Armit 1990), an island dun at Loch Bharabhat (Harding & Dixon 2000), and a broch at Loch na Beirgh (Harding & Gilmour 2000). The island dun and broch have now both been classified as complex Atlantic roundhouses.

In 1993 the West of Lewis Landscape Project (WLLP) started a programme of field survey concentrated around the Loch Roag complex in the west of Lewis (Burgess 2001). Initial work concentrated on the chronology and nature of human settlement from the Neolithic to the post-medieval within an area 4 km by 10 km, stretching from Calanais on the coast into the 'blackland' interior (Coles & Burgess 1995). Further fieldwork within the survey area, investigating the remains of early prehistoric field systems under the peat near the Calanais stones, has been completed recently (Flitcroft *et al* 2000).

The Garenin Landscape Survey (GLS) was set up in 1994 to investigate the late medieval and post-medieval settlement of Garenin through intensive field survey and limited excavation. This led to the trial excavations of features of all periods including blackhouses, illicit stills, a corn kiln, and a promontory enclosure (Burgess & Gilmour 1996; Burgess & Johnson 1999).

The Uig Landscape Survey (ULS) was initiated to investigate the human settlement of Aird Uig, the headland adjacent to the Bhaltos Peninsula. This area was chosen to provide a western comparison for the study of the Loch Roag complex (Burgess 2001). An intensive field survey in the initial season (Burgess & Church 1996a) was followed by selective excavation of certain settlement types in the following seasons (eg Church & Gilmour 1999; Bronk Ramsey *et al* 2000). A component of the initial field survey was a coastal erosion assessment of the archaeology in the 50 m strip around Uig sands (Burgess & Church 1996b) and a reassessment of the coastal erosion sites examined by Armit in the Bhaltos Peninsula (1994).

The survey of the Loch Roag area was completed in 1996 with the detailed survey of the Islands of Great and Little Bernera. Covering an area of more than 900 ha, these two islands lie at the centre of the Loch Roag complex between East and West Loch Roag. The opportunity to study these islands provided a perfect opportunity for linking the surveys on the east (GLS and WLLP) and the west sides (ULS) of the Loch Roag complex (Burgess 2001). Sites of all periods were examined at the same time as the detailed excavation of the late prehistoric and Norse settlement at Bostadh Beach (Neighbour & Burgess 1997).

Methods

The survey adopted a three-phase approach following the standard pattern of linear and area surveys and Historic Scotland's *Archaeology Procedure Paper 4* (1996).

Phase 1: Desk-based assessment

Archaeological, geological and geomorphic material was consulted from the following sources:

- Ordnance Survey record cards, map sheets and the National Monuments Record of Scotland (NMRS) database through the Artemis GIS system – the Artemis data was generated on the basis of a search set to note all sites within 500 m of a centre line path based on the Ordnance Survey 1:25000 survey of the coastline of Lewis
- a selected sample of aerial photographs from the Aerial Photographic Unit at the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS)
- the Historic Scotland Map Room for all relevant Scheduled Ancient Monuments
- the National Map Library for copies of the First Edition 6" Ordnance Survey

Phase 2: Fieldwork

Three field teams, each comprising two people, examined stretches of the coastline divided into arbitrary administrative parcels. Each team covered 5–10 km per day. Each team was equipped with a pen-based portable computer (Compaq Concerto 486SL 33 MHz, 12 Mb RAM) into which details of all cultural heritage, palaeo-environment features and erosion and geomorphology were recorded. PenMap software was used to record the data onto scaled background maps using a GIS system to manage the data. Record forms were programmed for the project by the authors and altered and refined on the basis of the first week's experience in the field. Sites were located to an accuracy of 20 m (a radius of 10 m) by means of either compass resection or hand-held navigational GPS.

The coverage by linear transect included the intertidal zone (where it was deemed safe to examine it) and a

50–200 m strip inland from the Mean High Water Spring. Extensions to the survey strip were made when areas subject to erosion processes directly related to the coastal erosion regime were noted, eg Barvas machair, NGR NB 346 514. Only offshore islands safe to reach by foot were visited, for example Holm Island, NGR NB 450 304. Some stretches of coast were inaccessible due to the presence of crofts running to the foreshore.

Phase 3: Reporting

The use of computers in the field greatly increased the efficiency of transfer, manipulation and analysis of the survey data. A 440-page archive report was lodged with the NMRS (Burgess & Church 1997) and a summary note published in *Discovery and Excavation in Scotland* (Burgess *et al* 1997).

Analysis

Archaeological sites

One thousand eight hundred and twenty-five sites were recorded with a monument density of (on average) more than four sites per kilometre (Table 7.1 and Figure 7.2). This density varies spatially, with areas such as Great Bernera having a high density, and, conversely, some of the more inaccessible cliffs, such as the stretch in the north-east of the survey, having a much lower density. The density from this survey is greater than those of the other surveys completed to date under the wider national strategy being implemented by Historic Scotland. However, rather than simply signifying a higher density of archaeological sites, this may be due to the chronological range of this survey, which included a vast number of post-medieval sites. Also, this may be due to the identification of single 'site elements' in addition to the 'settlement complexes' that are commonly recorded in the other surveys.

Period (field recording)	General period	Number of sites	Percentage of total sites
Prehistoric	Prehistoric	178	9.75
Neolithic	Prehistoric	8	0.44
Bronze Age	Prehistoric	7	0.38
Iron Age	Prehistoric	17	0.93
Pictish	Prehistoric	1	0.05
Norse	Norse/Medieval	4	0.22
Medieval	Norse/Medieval	31	1.70
Pre-clearance	Norse/Medieval	211	11.56
Post-medieval	Post-medieval/Modern	592	32.44
Crofting	Post-medieval/Modern	101	5.53
Modern	Post-medieval/Modern	133	7.29
Multi-period	Prehistoric	1	0.05
Unknown	Unknown	541	29.64
Totals		1825	100.00

Table 7.1. Breakdown of sites by period.

It must be stressed that though some sites can be attributed with confidence to a period, for example complex Atlantic roundhouses are thought to be exclusively Iron Age, many of the period identifications for the sites should be interpreted as 'possible' rather than 'probable' dates. This is

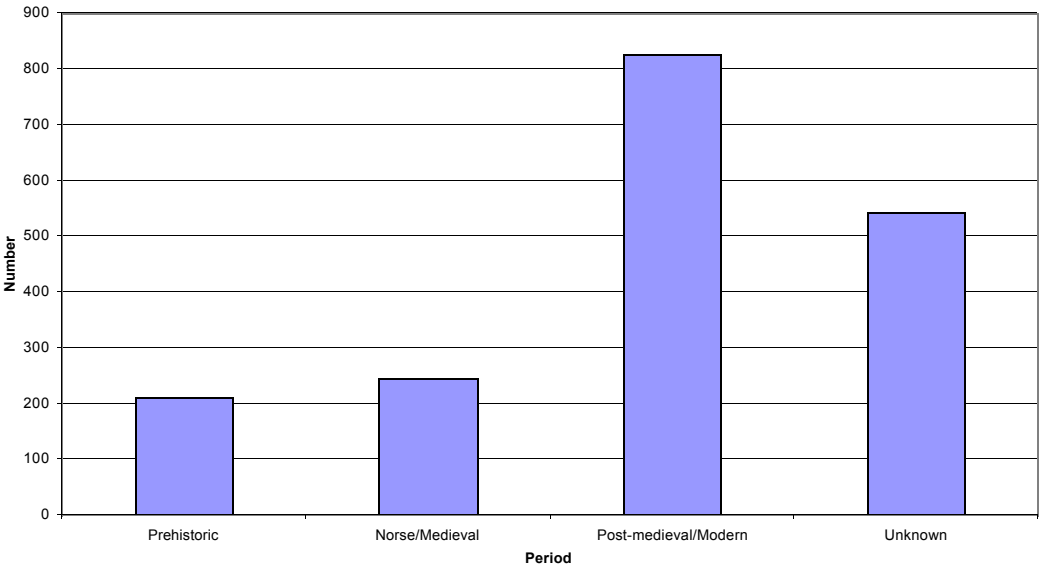

Figure 7.2. Graph showing the total number of sites recorded, grouped by period.

especially true of the Norse/Medieval bracket which may include many post-medieval buildings and field systems which were identified in the field as earlier due to variations in the overall form of the rectilinear structures and rigging. Also, many sites, for example Galson (see below), cover more than one period. Past research has shown the dangers of constructing chronologies by survey alone (cf Armit 1996), especially as many Lewisian sites appear as piles of stones obscured by peat and turf. Five hundred and forty-one of the sites (approximately 30 per cent of the total) have therefore been assigned to the 'Unknown' category.

Vulnerable sites

The erosion status of sites by period can be seen in Figure 7.3. This shows that almost 50 per cent of the prehistoric sites are definitely eroding, with a further 15 per cent eroding/stable and only 36 per cent stable. Conversely, the later sites are predominantly stable (66 per cent for Norse/Medieval and 77 per cent for Post-medieval/Modern) and the 'Unknown' sites are subject to slightly more erosion. Clearly, the prehistoric sites are much more likely to be eroding than any other period grouping, primarily as a result of their location and their archaeological visibility within the machair and sand zones. This again has implications for the monitoring and management of the machair zone as many of these sites are considered to be important site types within the Western Isles and beyond.

Erosion cells and geomorphology

The results below were obtained through analysis of the 319 erosion cells, the total length approximately 441 km. The results are presented in three basic groups of data:

- the overall survey (Figure 7.4)
- comparison of the east and west coast data sets (Figure 7.5)

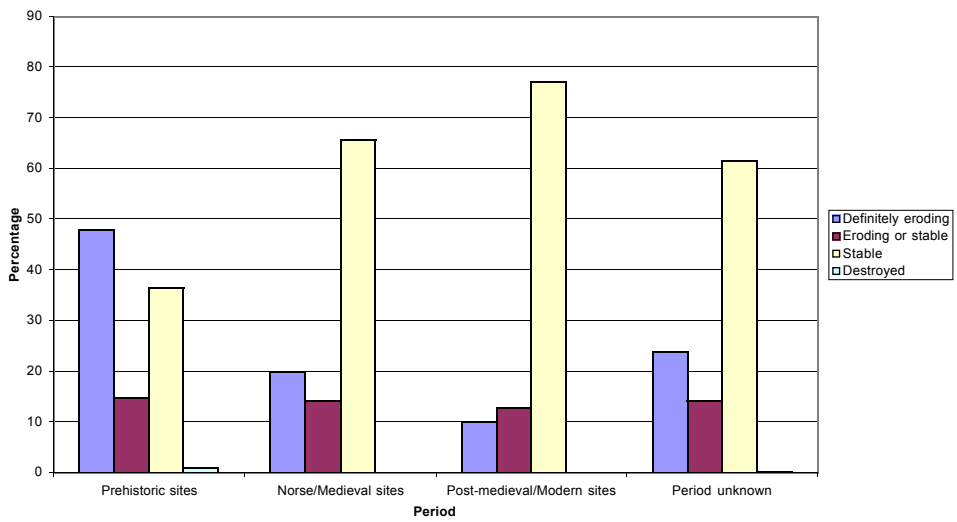

Figure 7.3. Graph showing the erosion state of sites from each period.

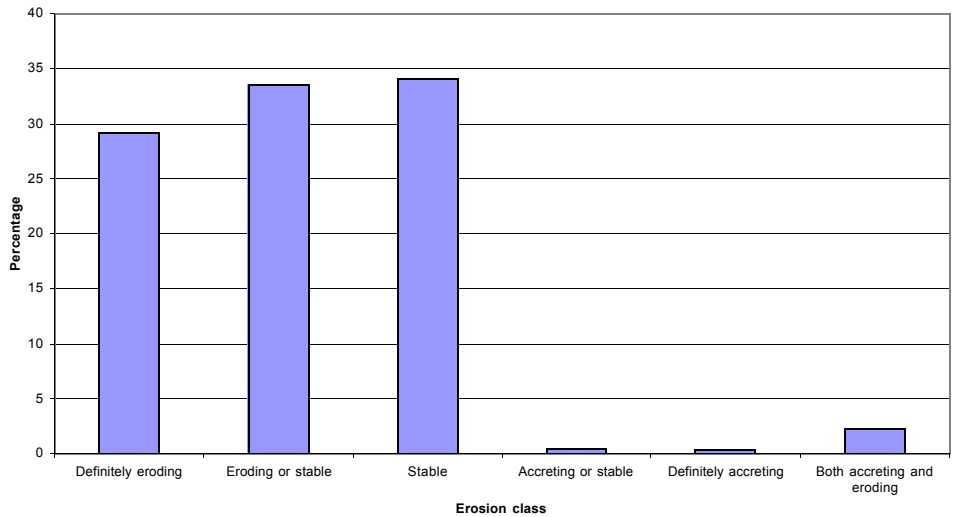

Figure 7.4. Graph showing erosion classes for the coastline surveyed.

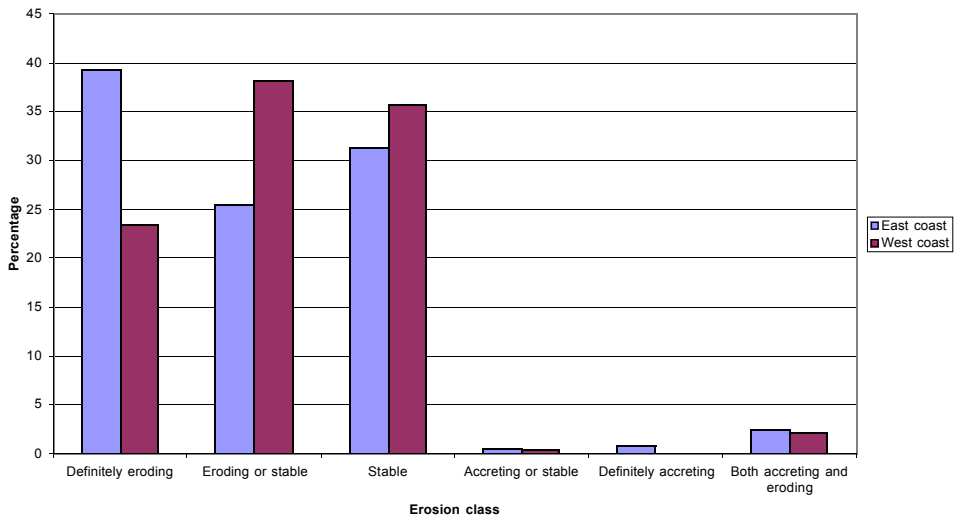

Figure 7.5. Graph comparing erosion classes for the east and west coasts.

- inspection of the erosion cells within the coastline of sand and machair in more detail (Figure 7.6)

Figure 7.4 shows that the overall regime is characterised by erosion of the coastline, with approximately 29 per cent of the coastline actively eroding and a further 36 per cent of the coast showing some signs of erosion. Only 34 per cent of the coastline was stable and less than 1 per cent of its length displayed a predominantly depositing regime.

Comparison of erosion to the east and west coasts

The hypothesis that the west coast was undergoing more erosion than the east coast was formulated during fieldwork. This was thought to be because the west coast is in the direct line of the severe storms and marine action from the Atlantic whereas the east coast that faces on to The Minch is relatively sheltered. This was an important distinction as approximately 78 per cent of the archaeological sites were located on the west coast. However, when the two data sets are compared (Figure 7.5), it can be seen that the east coast was experiencing the greater erosion, with over 39 per cent of the coast definitely eroding and a further 26 per cent eroding/stable compared to the west coast where 23 per cent was definitely eroding and 38 per cent was eroding/stable.

This apparent negation of the initial hypothesis can be explained through more detailed examination of the geomorphic profiles of the two coasts. For example, though there are large stretches of generally stable high cliff on the east coast, there are also long stretches of eroding sand beaches and machair that are different in character to the generally smaller pocket beaches of the west coast. Also, on the east coast there are long stretches of softer New Red Sandstone cliffs to the north and east of Stornoway. These were generally showing signs of active erosion. Conversely, most of the underlying geology of the west coast is harder Lewisian Gneiss, a sizeable proportion of which consists of stable low rock platforms and cliff within the more sheltered sea lochs of East, West and Little Loch Roag.

Erosion within sand and machair zones

During the fieldwork it was obvious that many of the sand and machair systems encountered were more dynamic in their erosion regimes than the other systems observed. Also, the machair areas have acted as a focus for human settlement from prehistory to the modern day, resulting in numerous rich archaeological sites being recorded. Many of these have been shown through excavation to be unrivalled for their preservation of structural remains, bone and shell, for example Cnip wheelhouse complex (Harding & Armit 1990; Armit 1996) and Bostadh Beach (Neighbour & Burgess 1997).

Previous archaeological and environmental surveys (Ritchie & Mather 1970; Cowie 1994; Ramsay & Brampton 1995; Burgess & Church 1996b) have been biased towards these areas though none has presented comparative data to justify this concentration of research and assessment. All the erosion cells from sandy beaches and machair (approximately 33 km) are presented in Figure 7.6. Fifty per cent was definitely eroding, 26 per cent was eroding/stable and only 4 per cent was stable. This shows that within the wider framework of the generally eroding regime, the sand and machair coastlines act as erosion foci. The low level of stability was particularly marked when compared to the overall stable proportion of the entire study area (approximately 34 per cent). Sand and machair systems also act as deposition foci, with almost 7 per cent depositing and a further 13 per cent showing signs of erosion and deposition.

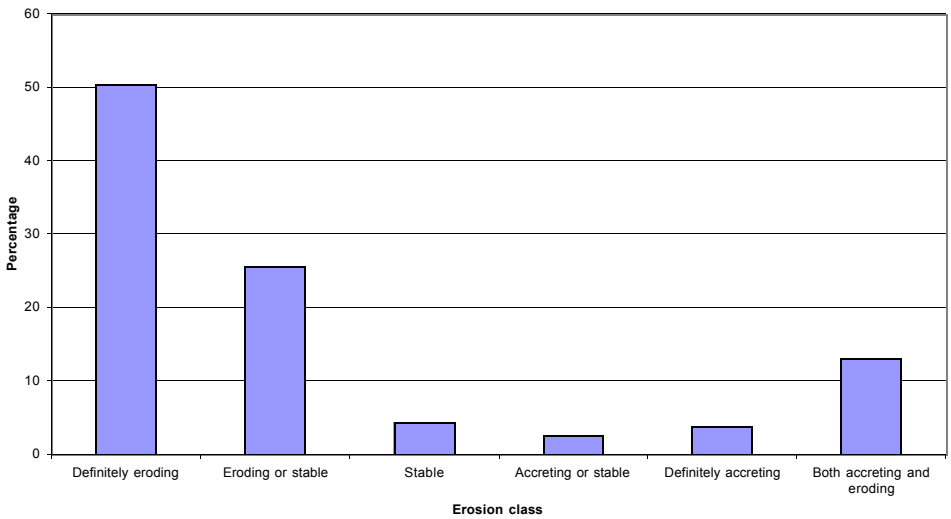

Figure 7.6. Graph showing erosion classes for sand and machair zones.

The threat to the archaeology within the machair zone is twofold: predominantly from erosion of the archaeological remains but also from the changing 'archaeological visibility' that occurs within the system. For example, the potentially unique Mesolithic stone artefact scatter located by Lacaille at Traigh na Berie (Lacaille 1937) has never been relocated following sand accretion and so has been lost to archaeological research up to this point. The eroding middens within the same zone will also soon be lost forever.

The ease of transport by water and wind action, coupled with the inherent high levels of erodibility of the matrix (Summerfield 1991), mean that machair systems are extremely dynamic, suggesting that the observed results may change from season to season. The results presented here only relate to the erosion regime occurring at the time of fieldwork. Therefore, medium- to long-term predictions for a particular area can only be gained through comparison with further periodic surveys, using a similar methodology. It is obvious, highlighted by all previous surveys and assessments, that the machair should be one of the priority areas for any coordinated and regular monitoring scheme in the future.

Discussion and Recommendations

A more detailed discussion on the types of sites comprising the study is provided in the full archive report (Burgess & Church 1997). The large number of sites and their wide diversity in form and date make it impossible to discuss the archaeological results in any depth within this paper. However, the main threats and erosion foci for the archaeology can be summarised into three general classes which apply for both the west and east coasts within the study area:

- erosion of sites (such as promontory enclosures) located on incised cliffs
- sites of various types and ages within the dynamic erosion/deposition system of machair
- a small number of sites threatened within alluvial systems

Sites on incised cliffs

Sites of this class are typified by promontory enclosures, of which over 60 individual examples have been identified (Burgess 2000). These promontory enclosures are almost exclusively located on incised cliff lines and stacks, and include Gob Eirer (Figure 7.7; Church *et al* 1999). The cliffs are eroding through continuous small-scale slumping and erosion of the soil matrix coupled with low-frequency, high-magnitude cliff slip events which could destroy large portions of a promontory enclosure. Some of these events have reduced many promontory sites to little more than stacks of less than a few metres across.

Figure 7.7. The Late Bronze Age / Early Iron Age promontory enclosure of Gob Eirer.

The actual rate of erosion seems to vary depending on the underlying geology and the depth of substrate on which a site sits. Sites located on the cliffs of Lewisian Gneiss, for example, are generally stable; the threat of erosion increases when sites are situated on deep soft substrates such as glacially-derived sands and gravel. Conversely, sites on the 'till cliffs' overlying Metasediments around north-west Lewis and the conglomerate cliffs of New Red Sandstone on the east coast are at a much greater risk as these areas are experiencing much higher rates of erosion of the relatively soft underlying geology.

Sites within machair zones

Sand and machair zones are experiencing severe erosion and rapid deposition that impacts on the archaeological sites within these dynamic systems. The erosion mechanisms stem from marine, aeolian, livestock and human activity. Marine erosion results in wave undercutting of the sand sections. This can vary in size from the small-scale, as seen in the eroding middens on Cnip headland, to the large continuous eroding sections of up to 5 m in height at Galson. Marine erosion is particularly marked at high spring tides and during high-magnitude, low-frequency storm events such as the storm which revealed archaeological remains at Bostadh during the winter of 1993/4 (Neighbour & Burgess 1997).

Aeolian erosion results in blow-outs and erosion scars which are sometimes very extensive, as at Barvas machair. These basic erosion mechanisms and resulting geomorphic features are exacerbated by animal and livestock grazing. Animals cause direct erosion through their tracks, especially up dune sides, and through extensive burrowing (eg at Mealista, Traigh na Berie and Barvas). Animal activity also impacts on the ability of the machair system to resist erosion by thinning or removing the vegetation that binds the unstable matrix together. Human activity further destabilises the delicate balance between the erosion faces and the erodibility of the machair. This can be the direct impact of human exploitation of the zone, for example through sand extraction and cultivation at Barvas machair, or the more widespread impact of recreational activity. All these erosion mechanisms create material that is consequently deposited further inland by aeolian activity, unless constrained by topography.

Both the erosion and deposition within these zones can be very local and the general regime of an erosion cell may hide the fact that an important site is being eroded or covered up. Also, the dynamic erosion regime that exists in many of these zones can switch from erosion to deposition in a season. Therefore, the high concentration of important prehistoric sites within this zone needs a rigorous monitoring and management scheme.

Sites affected by alluvial action

This class is limited to the points along the coastline where rivers and streams enter the sea or within wider areas of alluvial erosion and deposition, for example at Broad Bay. Generally, the erosion is not too severe because most of the bodies of water are not of the size to cause extensive damage. Along certain stretches of incised coastline, streams are providing a further erosive mechanism at points of weakness that may directly impact upon sites located there. Alluvial action is also one of the few observed mechanisms for deposition within the coastal zone. This is particularly marked at Broad Bay where a number of sites, including a probable Norse settlement, are being both eroded and covered over by sand and mud.

Project evaluation

Further fieldwork, under the wider CARP, has been undertaken on a selection of coastal erosion sites highlighted by the survey. These include a hearth complex of presumed Late Neolithic/Bronze Age date under 1.5 m of eroding peat near Aird Calanais (Figure 7.8; Flitcroft & Heald 1998); a more detailed assessment of the promontory enclosures identified during the coastal erosion assessment of Lewis (Burgess 2000); and work on the multi-period later prehistoric/early historic settlement and cist complex at Galson (Neighbour & Church 2000).

Figure 7.8. Eroding section at Aird Calanais. The hearth complex is eroding from the basal layers of the section and the site is representative of those sites eroding on the low rock platforms of the sea lochs.

At Galson (Figure 7.9), the machair edge has been eroding for decades and has revealed a succession of archaeological remains. These can be broken down into two main groups associated with two major levels in the eroding section. The lower group consists of a number of Iron Age burial cists from an old ground

surface that sporadically appear approximately halfway up the section. These were revealed by the progressive erosion of the section (Stevenson 1954; Ponting & Bruce 1990; Neighbour *et al* in press) and form part of an Iron Age cemetery, with the grave goods and radiocarbon dates pointing to the period of burial within a single horizon or old ground surface relating to the first half of the 1st millennium AD. The higher group consists of domestic dwellings with associated palaeosols and middens. This level is less easy to define chronologically, with many finds of Late Iron Age, Norse and medieval date reputedly recovered from the upper horizons. Early excavations (Edwards 1924; Baden-Powell & Elton 1937) identified this upper level as one continuous midden, with the implicit assumption of single-period deposition. However, it is clear from the range of structural forms and artefacts recovered from this layer, which is up to 4 m thick in some areas, that it represents hundreds of years of accumulation.

The Iron Age cemetery is very important archaeologically, not only because of the alkaline properties of the machair that allow excellent preservation of skeletal material, but also due to the rarity of Iron Age burials within Atlantic Scotland and beyond. The archaeological remains within the upper level are also very important as they contain the transitional period from the relatively well-represented Late Iron Age to the Norse and early medieval periods about which very little is known archaeologically within Lewis.

Figure 7.9. Sampling a Late Iron Age structure at Galson.

A programme of monitoring has been underway since 1997 (Church & Neighbour 1998; Neighbour & Church forthcoming). Photographic composites for computer rectification and detailed drawings of the eroding section have been produced at regular intervals. Baseline EDM surveys of the eroding edge have been complemented by geophysical survey in the area immediately behind the erosion face. This has revealed a range of high-resistance anomalies, probably reflecting the presence of buried walls up to 30 m beyond the eroding face. The shapes of the anomalies confirm the presence of both Iron Age cellular structures and Norse or medieval buildings. This research has led to the establishment of a stratigraphic relationship of at least six structures for the upper level, at the time of recording. From initial observation of the pottery, these range in date from Iron Age polycellular forms to rectilinear Norse and medieval structures. Detailed sampling for palaeo-economic data and radiocarbon dating has also been undertaken, establishing the taphonomic pathways for the carbonised material to be used in the dating programme (Peters *et al* 2000). The various classes of environmental remains (plant macrofossils, marine and terrestrial bones and shell) have been incorporated into ongoing PhD research by researchers at the University of Edinburgh.

The initial results of this monitoring have shown that a strip at least 1 m wide has eroded at certain points of the site since 1997. Hence, detailed recording of this type provides a snapshot of the archaeological profile that can change radically over one season, with the concomitant development in interpretation that may occur from the evolving identification of the structural forms of the site. It is hoped that the analysis of the data from the survey and sampling will allow insights into the transitional period between the Late Iron Age and Norse periods. However, it has been argued in the past that a full appreciation of this and other important aspects of such sites is only possible through extensive excavation, as the recording of successive eroding sections can be misleading (O Owen pers comm).

The threat that coastal erosion poses to the archaeological resource in the study area has only been summarised briefly in the space available. The archaeology within the Western Isles in general is of international importance, with a significant proportion of the sites concentrated within the 1 km coastal strip. Many of these sites, especially the prehistoric remains, are actively eroding and some are likely to be lost within the next 10 years.

The three erosion foci outlined above should form the starting point for any monitoring scheme to be developed in the future. Schemes such as Shorewatch, utilising local enthusiasm that is apparent across Lewis,

would be the obvious first step. This could be complemented by establishing baseline surveys and detailed and regular monitoring by professionals of especially complex areas such as Galson. Survey and monitoring can be made more effective by backing them up with targeted excavation of sites identified as being of particular importance that would otherwise be lost, unrecorded, to the sea.

Acknowledgements

We would like to thank all those who gave assistance in the field, especially Nevenka Vesligaj and Dr Mary MacLeod for supervising survey teams and undertaking desk-based assessment and copy-editing. We would like to thank Professor Harding, Dr Geraint Coles, Dr Simon Gilmour and Tim Neighbour for advice throughout the various stages of the project. We are also very grateful to the landowners, factors and crofters for their kind permission and cooperation in conducting this survey. Thanks are also due to the residents of Lewis who have actively involved themselves in the work, including Noreen MacIver, Carol Knott, Sue Hothersal, David and Rosie Roberts and Jim Crawford. Finally, we thank Mr Patrick Ashmore for his encouragement in overseeing the project on behalf of Historic Scotland.

References

Armit, I 1994 'Archaeological field survey of the Bhaltos Peninsula, Lewis' *Proc Soc Antiq Scot* 124 (1994), 67–94.

Armit, I 1996 *The Archaeology of Skye and the Western Isles* Edinburgh University Press, Edinburgh.

Baden-Powell, D & Elton, C 1937 'On the relation between a raised beach and an Iron Age midden on the Island of Lewis, Outer Hebrides' *Proc Soc Antiq Scot* 71 (1936–7), 347–65.

Birks, H J B 1994 'Floristic and vegetational history of the Outer Hebrides' in Pankhurst, R J & Mullin, J M *Flora of the Outer Hebrides* HMSO, London, 32–8.

Bohncke, S J P 1988 'Vegetation and habitation history of the Callanish area, Isle of Lewis, Scotland' in Birks, Birks, Kaland & Moe (eds) *The Cultural Landscape: Past, Present and Future* Cambridge University Press, Cambridge.

Boyd, J M & Boyd, I L 1990 *The Hebrides: a natural history* Collins, London.

Bronk Ramsey, C, Pettitt, P B, Hedges, R E M, Hodgins, G W L & Owen, D C 2000 'Radiocarbon dates from the Oxford AMS system: Archaeometry Datelist 30' *Archaeometry* Vol 42 No 2 (2000), 459–79.

Burgess, C G P 2000 'Promontory Enclosures on the Isle of Lewis, The Western Isles, Scotland' in Frodsham, P, Topping, P & Cowley, D (eds) '*We were always chasing time', papers presented to Keith Blood* NAG Vo17/18, (1999).

Burgess, C G P 2001 *Lewis, Mesolithic to Modern. A study of site and settlement distribution in the Western Isles of Scotland* Unpublished PhD Thesis submitted September 2000, University of Edinburgh.

Burgess, C G P & Church, M 1996a 'Uig Sands to Aird Uig, Isle of Lewis (Uig Parish)' *Discovery and Excavation in Scotland* (1995), 96.

Burgess, C G P & Church, M 1996b *Uig Landscape Survey: First Interim Repor*t Dept of Archaeology, University of Edinburgh, unpublished Technical Report.

Burgess, C G P & Gilmour, S 1996 'Garenin Landscape Survey (Uig Parish)' *Discovery and Excavation in Scotland* (1995), 112–13.

Burgess, C G P & Church, M 1997 *Coastal Erosion Assessment, Lewis (CEAL)* Dept of Archaeology, University of Edinburgh, unpublished Technical Report submitted to Historic Scotland.

Burgess, C G P, Church, M & Gilmour, S 1997 'Isle of Lewis Coastal Erosion Survey' *Discovery and Excavation in Scotland* (1996), 112.

Burgess, C G P & Johnson, M 1999 'Excavations at Garenin (Uig Parish)' *Discovery and Excavation in Scotland* (1998), 100.

Church, M & Neighbour, T 1998 *Archaeological Evaluation of Two Subterranean, Drystone Dwellings Exposed by Coastal Erosion at Galson, Isle of Lewis; November 1997 and August 1998* Centre for Field Archaeology Technical Report No 407.

Church, M & Gilmour S 1999 'Guinnerso (Uig Parish)' *Discovery and Excavation in Scotland* (1998), 106.

Church, M, Gilmour, S & Flitcroft, C 1999 'Gob Eirer (Uig Parish)' *Discovery and Excavation in Scotland* (1998), 106.

Coles, G & Burgess, C G P 1995 'Calanais Environs Survey (Uig Parish)' *Discovery and Excavation in Scotland* (1994), 96.

Cowie, T 1994 *Coastal Erosion and Archaeology in Lewis and Harris* Dept of Archaeology, National Museums of Scotland, unpublished Technical Report submitted to Historic Scotland.

Edwards, A J H 1924 'Report on the excavation of an earth-house at Galson, Borve, Lewis' *Proc Soc Antiq Scot* 58 (1923–4), 185–203.

Flitcroft, C & Heald, A 1998 'Aird Calanais (Uig Parish)' *Discovery and Excavation in Scotland* (1997), 85.

Flitcroft, C, Johnson, M & Coles, G 2000 'Calanais Fields (Uig Parish)' *Discovery and Excavation in Scotland* (2000), 102–3.

Harding, D W 2000 *The Hebridean Iron Age: twenty years' research* Dept of Archaeology, University of Edinburgh, Occasional Paper Series No 20.

Harding, D W & Armit, I 1990 'Survey and excavation in West Lewis' in Armit, I (ed) *Beyond the Brochs: changing perspectives on the Later Iron Age in Atlantic Scotland* Edinburgh University Press, Edinburgh, 71–107.

Harding, D W & Dixon, T N 2000 *Dun Bharabhat, Cnip, an Iron Age settlement in West Lewis: Volume 1 – The structures and material culture* Dept of Archaeology, University of Edinburgh, Calanais Research Series No 2.

Harding, D W & Gilmour, S M D 2000 *The Iron Age settlement at Beirgh, Riof, Isle of Lewis: Excavations, 1985-1995 – Volume 1: The structures and stratigraphy* Dept of Archaeology, University of Edinburgh, Calanais Research Series No 1.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Lacaille, A D 1937 'A stone industry, pot sherds and a bronze pin from Valtos, Uig, Lewis' *Proc Soc Antiq Scot* 71, 279–96.

Lomax, T M & Edwards, K J 2000 'Pollen and related studies of human impact at Loch Bharabhat' in Harding, D W & Dixon, T N *Dun Bharabhat, Cnip, an Iron Age settlement in West Lewis: Volume 1 – The structures and material culture* Dept of Archaeology, University of Edinburgh, Calanais Research Series No 2, 110–13.

Neighbour, T & Burgess, C G P 1997 'Bostadh (Uig Parish)' *Discovery and Excavation in Scotland* (1996), 113-4.

Neighbour, T & Church, M 2000 'Galson multi-phase settlement' *Discovery and Excavation in Scotland* (2000), 94.

Neighbour, T, Knott, C, Bruce, M & Kerr, N W in press 'Excavation of two burials at Galson, Isle of Lewis' *Proc Soc Antiq Scot*.

Pankhurst, R J & Mullin, J M 1994 *Flora of the Outer Hebrides* HMSO, London.

Peters, C, Church, M J & Coles, G M 2000 'Mineral magnetism and Archaeology at Galson on the Isle of Lewis, Scotland' *Physics and Chemistry of the Earth (A)*, Vol 25 No 5 (2000), 455–60.

Ponting, M R & Bruce, M 1990 'Two Iron Age cists from Galson, Isle of Lewis' *Proc Soc Antiq Scot* 119 (1989), 91–100.

Ramsay, D & Brampton, A 1995 *Survey of Coastal Erosion in the Western Isles* H R Wallingford, unpublished Technical Report submitted to Historic Scotland.

Ritchie, W 1979 'Machair development and chronology in the Uists and the adjacent islands' *Proceedings of the Royal Society of Edinburgh* 77B, 107–22.

Ritchie, W 1985 'Inter-tidal and sub-tidal organic deposits and sea level changes in the Uists, Outer Hebrides' *Scottish Journal of Geology* 21/2 (1985), 161–76.

Ritchie, W & Mather, A S 1970 *The Beaches of Lewis and Harris* Dept of Geography, University of Aberdeen, Technical Report for Countryside Commission of Scotland.

Stevenson, R B K 1954 'Long cist burials, particularly those at Galson (Lewis) and Garioch (Wester Ross), with a symbol stone at Garioch' *Proc Soc Antiq Scot* 86 (1951–2), 106–8.

Summerfield, M A 1991 *Global Geomorphology* Longman Scientific & Technical, London.

Sutherland, D G 1993 'The Outer Hebrides' in Gordon & Sutherland (eds) *Quaternary in Scotland* The Geological Conservation Review Series No 6, 411–14.

8 ASSESSMENT SURVEY: ISLE OF BARRA

KEITH BRANIGAN

Introduction

Barra is a roughly square island (Figure 8.1), about 8 km north–south and 7 km east–west, with a peninsula (Eoligarry) projecting some 4 km to the north, and projecting headlands in the north-east (Bruernish) and the south-west (Tangaval). The geology is dominated by heavily glaciated gneiss which on some of the high ground is exposed and bare. The highest point of the island is the peak of Heaval at 383 m, and the centre of the island is dominated by peaks at around 200 m. Unlike the Uists, the west coast is not a continuous belt of flat, low-lying land but features a series of steep hillsides and cliff faces, punctuated by small areas of machair. The only extensive area of machair is on the Eoligarry peninsula. The east coast is rocky and generally bleak, but has three deep inlets at the north-east providing harbourage. The interior of the island is dominated by peat bog and moorland covered by heather. Apart from the limited pockets of machair, the only lowland pasture areas are the Borve valley and the area east of Allasdale, both on the west side of the island.

Barra was archaeologically unexplored territory when SEARCH (Sheffield Environmental And Research Campaign in the Hebrides) began work there in 1988. Apart from the excavations by Young (1952; 1955) and the catalogue of 22 sites in the RCAHMS volume (1928), there were no published accounts of the island's archaeology. Between 1988 and 1999 the entire island was surveyed, archaeological survey running in tandem with a survey of coastal erosion.

The survey of coastal erosion was carried out by a team of two, Prof. D Gilbertson and Dr J Grattan, using a modification of the method described by Grainger and Kalaugher (1990). The survey procedure particularly emphasised:

- whether or not a section of shoreline was experiencing negligible erosion in terms of the time frame of the survey
- the character of the sum of the lithologies of the present bedrocks or the superficial deposits and their geomorphic relationships in order to assess their propensity to loss by one or other mechanism
- the nature of the wide range of erosional activities which are active in this geoarchaeological context

The archaeological and erosion surveys were conducted in a zone 50 m from the High Water Mark; where precipitous cliff slopes were encountered, the zone was extended to 100 m. The archaeological survey was conducted by six walkers, a supervisor and a director. The walkers were divided into two teams, each with its own maps and equipment. The zones were walked at approximately 8 m intervals, with the two senior team members walking behind checking results. The coastal zone was surveyed in good weather in late May/early June over a four-year period and visibility was generally excellent. Some sites, however, surely remain unexposed beneath the machair.

Survey Results and Analysis

Two hundred and twenty sites and monuments were recorded in the survey of the 50 m coastal zone on Barra. Sites and monuments judged to be built after 1900, and walls, banks or other linear boundaries the greater part of which extended beyond the coastal zone were excluded from the survey. Of the 220 sites and monuments recorded, 27 were not identified to a functional type (and in some cases were not ascribed to one of our four broad chronological categories). The sites are catalogued and described, and in some cases illustrated, in Branigan and Grattan 1998, where the coastal corridor is divided into five zones with a combined length of 61.7 km.

Ascribing even broad chronological periods to an unexcavated site or monument is particularly difficult in the Western Isles, where some structures, for example the small circular hut, have been in use with little known variation for millennia. In the case of Barra, however, over 30 carefully selected excavations have enabled us to acquire some dating evidence for a wide variety of structures and also to compare in detail structures of broadly the same type but different date. We believe that we can ascribe most sites to one of four broad chronological periods – earlier prehistoric (4th–2nd millennium BC); later prehistoric (1st millennium BC – 8th century AD); medieval (9th–15th century AD); and modern (16th–19th century AD). The least certain of our ascriptions are shieling huts (separating medieval from modern is often difficult), although these are rare or unknown in the coastal zone. The chronological breakdown of the 193 sites to which we have ascribed a date is shown in Table 8.1 and Figure 8.2.

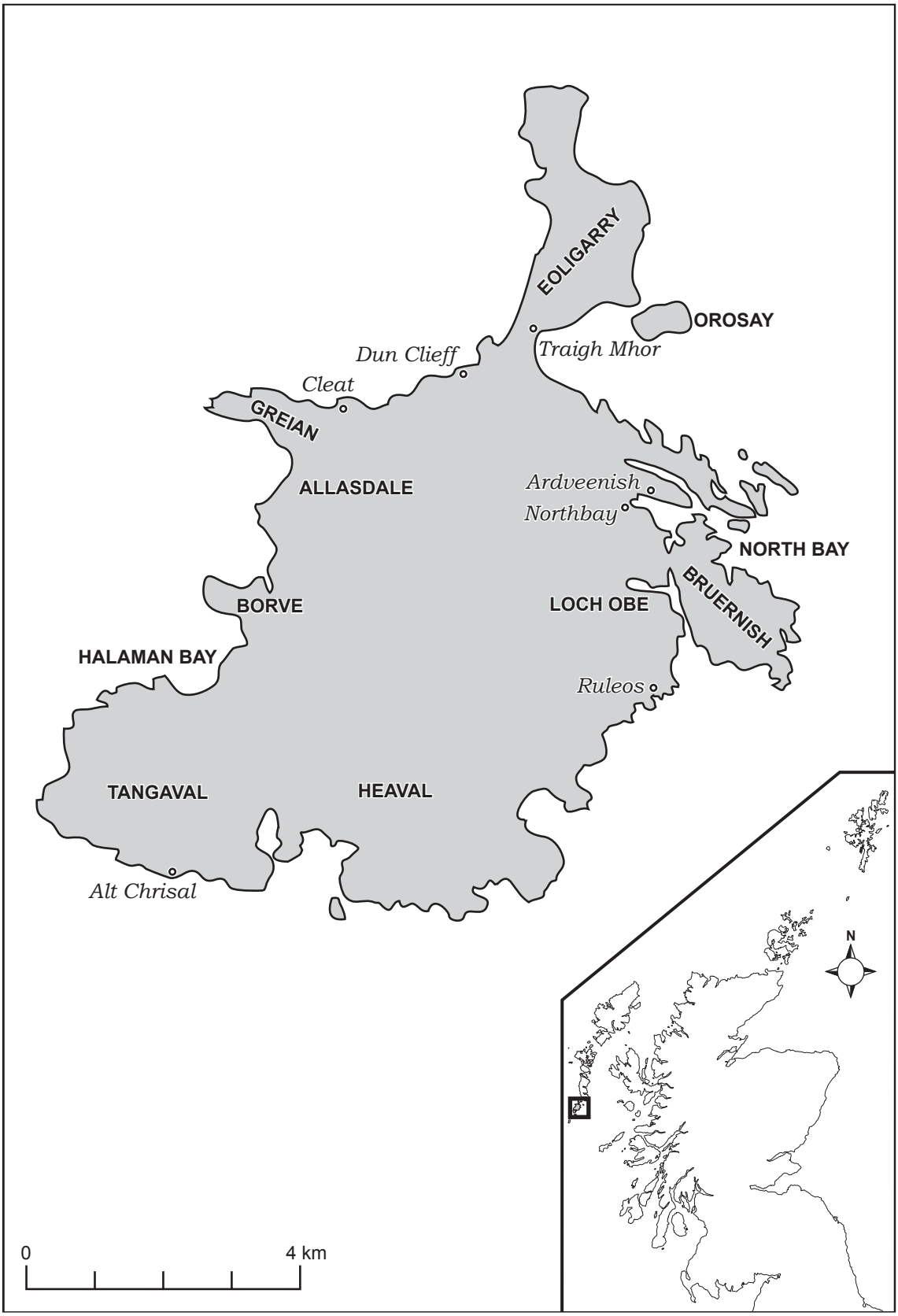

Figure 8.1. Location map showing the places mentioned in the text. Note, the entire coastline of Barra was surveyed.

Period	Number of sites	% of total number of sites
Earlier prehistoric	8	4
Later prehistoric	18	9.5
Medieval	4	2
Modern	163	84.5

Table 8.1. Chronological breakdown of sites.

The dominance of modern period sites is to be expected, as is the small number of medieval sites since these are at present the least diagnostic group of monuments. The earlier prehistoric sites include both Neolithic and Early Bronze Age monuments; most of the later prehistoric sites belong in the Middle Iron Age, but there are a few Late Bronze Age/Early Iron Age examples.

The functional or typological categorisation of sites initially identified no less than 24 types, but for this analysis the number has been reduced to just four. These are: permanent occupation sites (including houses and outbuildings); seasonal, agricultural and 'industrial' activity sites (including shielings, clearance cairns, kelp ovens, etc); burial monuments; and ritual monuments. The breakdown of the 193 classified sites by these functional groups is shown in Table 8.2 and Figure 8.3.

Functional group	Number of sites	% of total number of sites
Permanent occupation sites	103	53.5
Activity sites	83	43
Burial monuments	6	3
Ritual monuments	1	0.5

Table 8.2. Functional breakdown of sites.

The two dominant groups are again not unexpected, since houses/outbuildings and activity sites are far more common in the Hebridean landscape as a whole than burial and ritual monuments (of which see more below). Although the group sizes are small, there may be some significance in the different concentration levels of permanent occupation sites found in the coastal zone in earlier and later prehistory. Only one (12.5 per cent) of the earlier prehistoric sites in the coastal zone is a permanent occupation site, whilst eight (45 per cent) of the later prehistoric sites fall within this category. In contrast, five (83 per cent) of all the burial monuments found within the zone are earlier prehistoric. We will be able to understand better the significance of these variations when we compare the distribution of site types within the coastal zone to their distribution in the island as a whole, in the following section.

Sites have been judged to be 'vulnerable' when they are on either an eroding or an eroding and accreting coastline. The latter category comprises mainly areas of machair and dune systems where material is eroded and may be deposited elsewhere. Given the unpredictability of such erosion and accretion, all sites in such a stretch of coastline must be considered vulnerable to erosion. The breakdown of vulnerable sites by period is shown in Table 8.3, where the number of vulnerable sites is given as a percentage of the total number of sites of that period found within the coastal zone, (see also Figure 8.4).

Period	Number of sites	% of total number of sites for period
Earlier prehistoric	6	75
Later prehistoric	14	78
Medieval	0	0
Modern	96	59

Table 8.3. Breakdown of vulnerable sites by period.

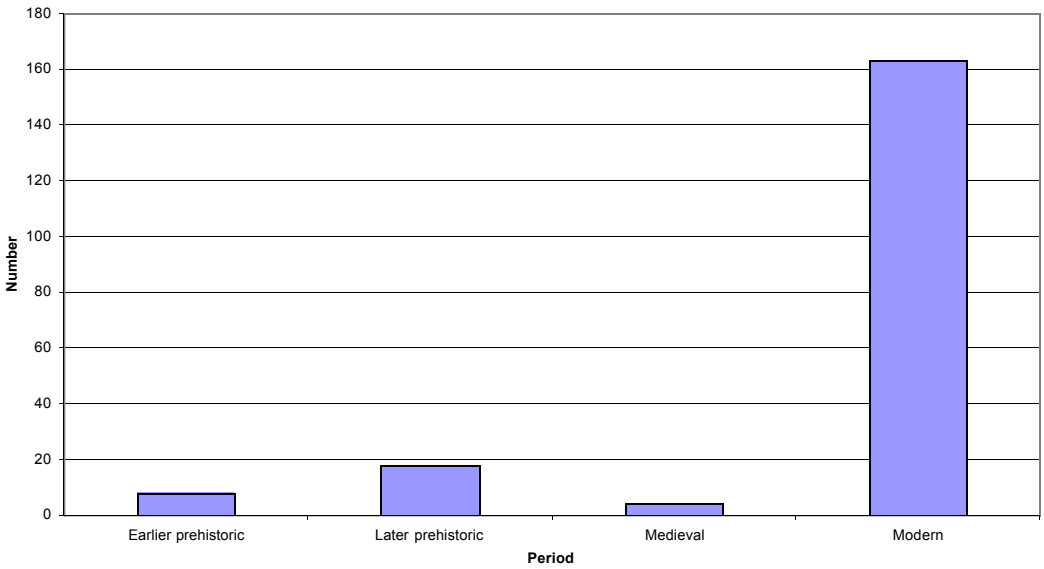

Figure 8.2. Graph showing the number of sites for which a date was ascribed, grouped by period.

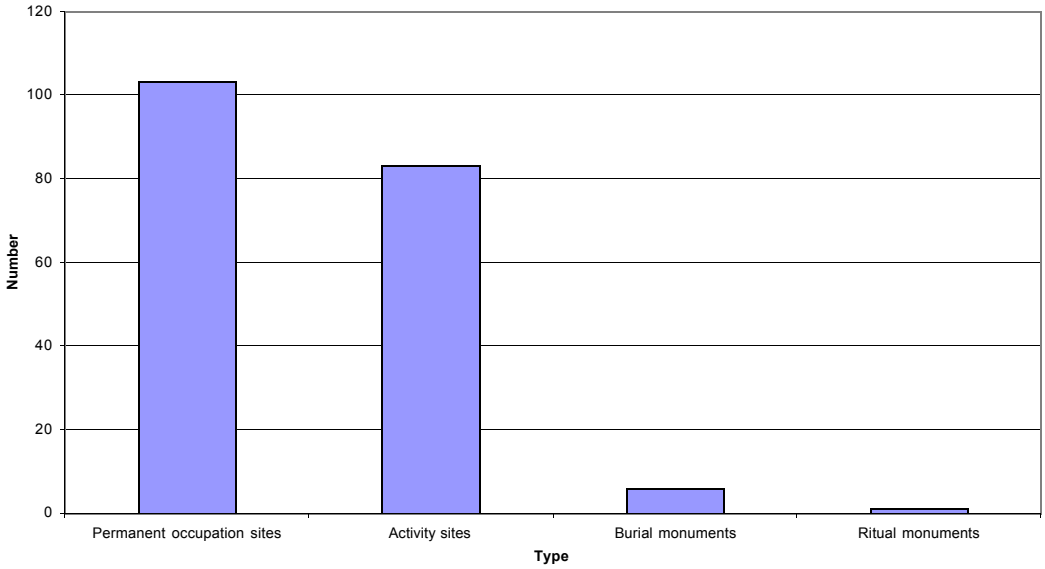

Figure 8.3. Graph showing the number of sites for which a function was ascribed, grouped by site type.

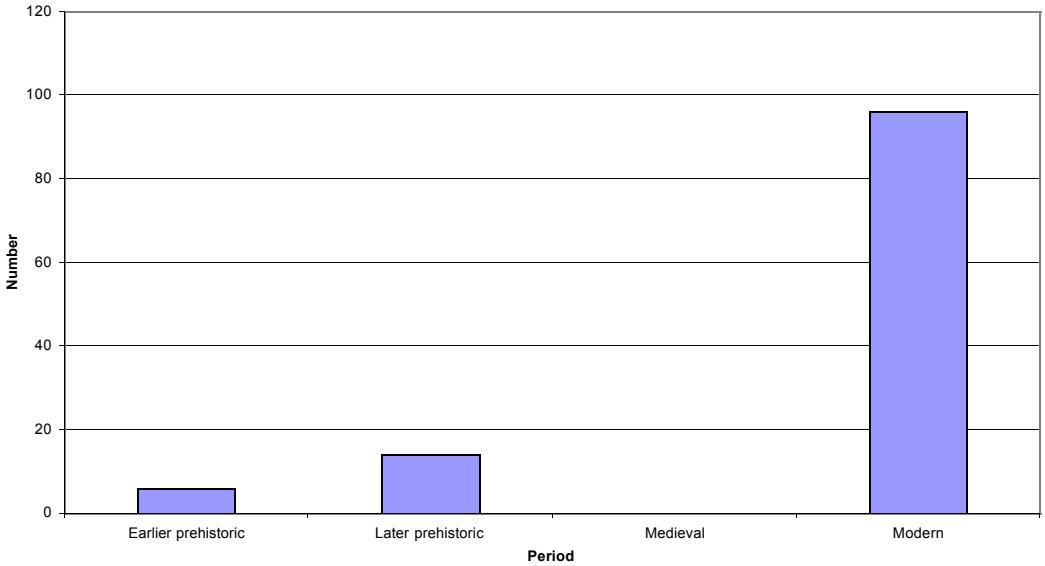

Figure 8.4. Graph showing the number of vulnerable sites, grouped by period.

Prehistoric sites seem to be the most vulnerable, and since they are few in number this must be a matter of concern. However, the threat to each site has to be assessed individually (as was done in the full report, Branigan & Grattan 1998) since highly localised factors often constitute greater risk or offer greater protection to a site than the general state of the coastline suggests.

The breakdown of vulnerable sites by site type or function (Table 8.4 and Figure 8.5) shows that burial monuments and activity sites are the most threatened and since there are so few burial monuments within the coastal zone, they again must be regarded as a cause for concern. The same caveat concerning very localised factors must be borne in mind however.

Function group	Number of sites	% of total number of sites for function group
Permanent occupation sites	53	51
Activity sites	61	73.5
Burial monuments	5	83
Ritual monuments	0	0

Table 8.4. Breakdown of vulnerable sites by function.

An assessment of the overall level of erosion around the coasts of Barra is complicated by the areas of sand and machair where there is both accretion and erosion,

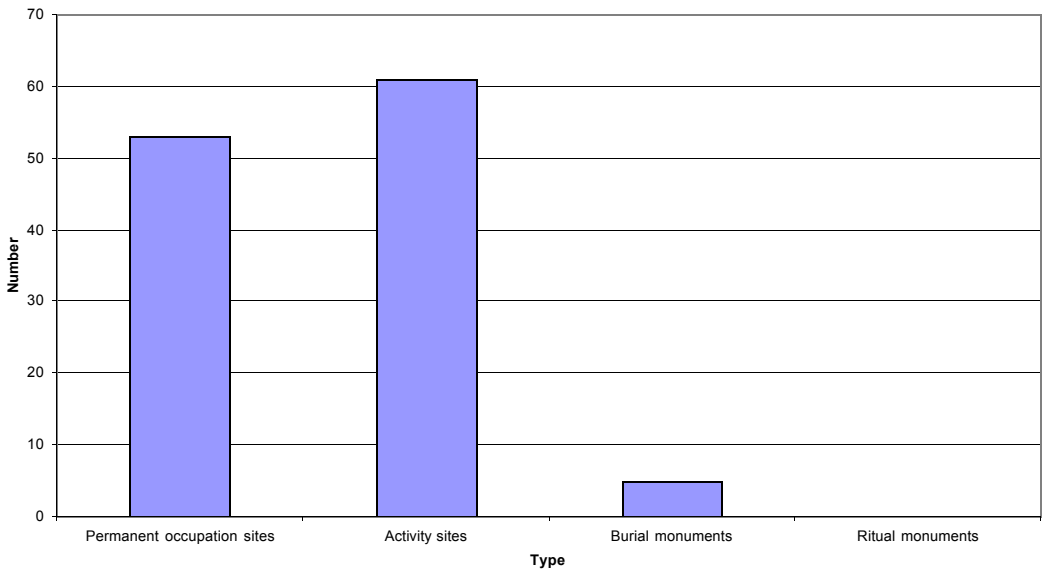

Figure 8.5. Graph showing the number of vulnerable sites, grouped by site type.

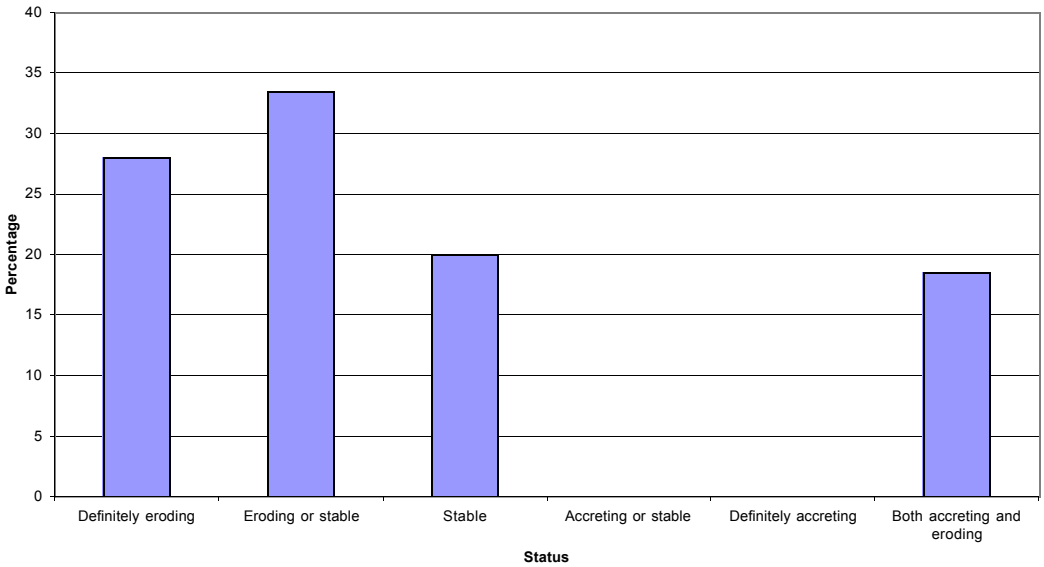

Figure 8.6. Graph showing erosion classes for the coastline surveyed.

but the essentially erosive character of the coastal environment is clear from Table 8.5 and Figure 8.6.

Erosion class	Length in km	% of length of coastline surveyed
Eroding	17.3	28
Eroding or stable	20.6	33.5
Stable	12.5	20
Accreting or stable	0	0
Accreting	0	0
Accreting or eroding	11.3	18.5

Table 8.5. The erosional status of Barra's coastline.

About 20 per cent of Barra's coastline can be said to be stable. These stretches lie mainly in the sheltered sea lochs. The surface lithology and the bedrock erode at very different rates, however, and this is reflected in significant differences in the threat posed to monuments at different points in the coastal zone.

Discussion

What is particularly interesting about the coastal erosion survey of Barra is that the sites and monuments found within the coastal zone can be compared to those on the island as a whole because the entire island has been surveyed. The gazetteer of sites and monuments on Barra (Branigan & Foster 2000, 2–41) lists 960 locations (plus 23 on the offshore islands of Fuday and Fiuay, which are not included here). The coastal zone surveyed represents approximately 4.2 per cent of the total area of the island.

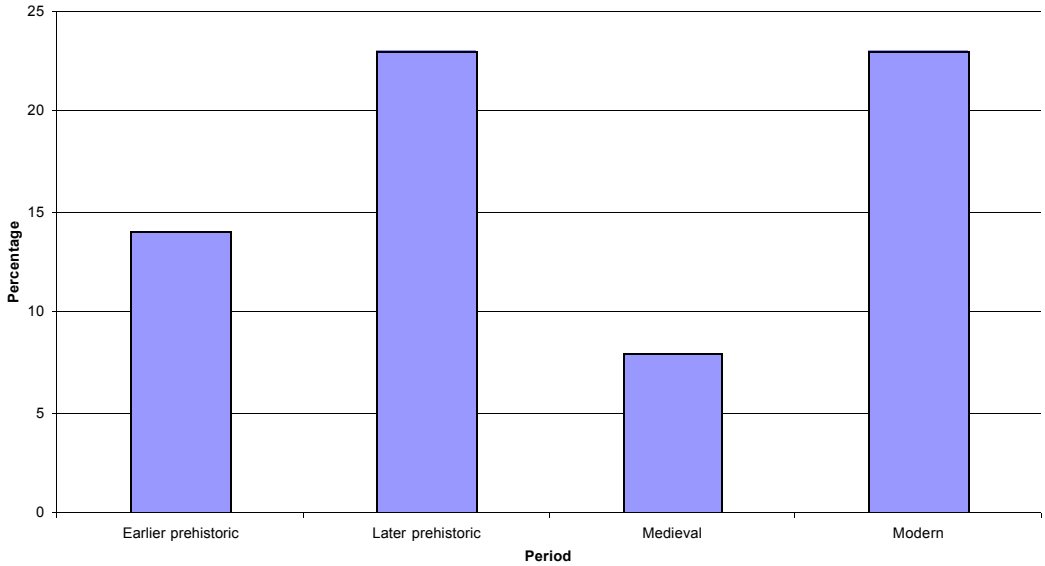

Figure 8.7. Graph showing the number of sites found in the coastal zone as a percentage of the total number located on Barra, grouped by period.

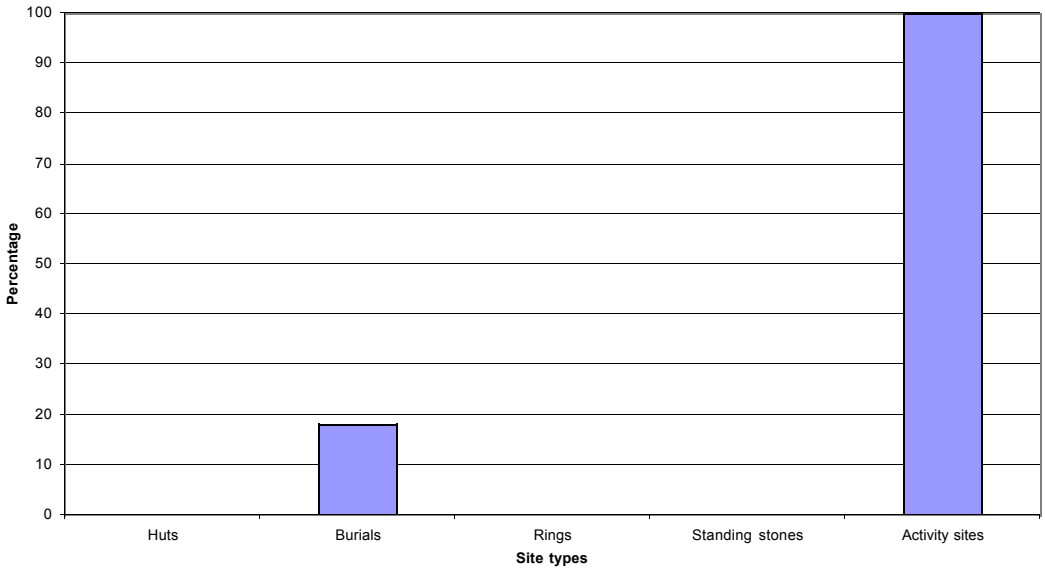

Figure 8.8. Graph showing the number of Neolithic–Late Bronze Age site types found in the coastal zone as a percentage of the total number found on Barra.

In contrast, the 220 sites and monuments recorded in the coastal zone represent 23 per cent of the total number recorded from the entire island. It is true of course that the coastal zone has been surveyed more intensively (the average spacing of surveyors here was 8–10 m, whilst in the interior it was usually 15–30 m). However, given the nature of most sites and monuments on Barra which, except on the machair, are represented by upstanding structural elements, we believe that few sites that are in any way visible on the surface have been missed. Even if we allowed for a 15 per cent rate of omission due to failure to discover inland sites, the number of sites and monuments in the coastal zone would still represent 20 per cent of the total for the entire island. It is reasonable to conclude, therefore, that the coastal zone is archaeologically rich and was a preferred zone for at least some types of human activity in some periods in the past. To clarify this further we can compare the density of sites in the coastal zone at different periods (Figure 8.7).

It can be seen that sites are relatively more frequent in the coastal zone than in the island as a whole during all four of our broad periods of time, and particularly during later prehistory and the modern era. We have to apply a caveat concerning the medieval period, because it is particularly difficult to ascribe unexcavated sites to this period. This is partly because the coastal zone has only a few monuments, such as castles and early churches, which obviously belong to that period and partly because we have tended to ascribe the vast

majority of the ubiquitous shielings and shepherds' shelters to the modern period. It does seem to us, however, that taking into account the length of time occupied by each period, the Iron Age and the modern era have been periods of relatively high population on Barra. This may explain the relative density of sites and monuments in the coastal zone in these periods.

However, to better understand the variations in density through time and space we should also compare the density of different types of monuments in the coastal and inland zones.

Figure 8.8 shows the number of each of the five different types of Neolithic–Late Bronze Age monuments found in the coastal zone as a percentage of the total number found on the island as a whole.

It will be seen that although the sample numbers are small, none of the house sites (11), standing stones (5), or stone rings (6) are found within 50 m of the coast. The Neolithic–Late Bronze Age monuments in the coastal zone are burials (6 Early Bronze Age–Late Bronze Age cairns) and 'activity sites' (Figure 8.9). The 'activity sites' comprise three small sub-circular enclosures marked out by stones (eg see Branigan 1995, 170–6) and two midden areas apparently unassociated with structural remains. They seem to be associated in some way with exploitation of marine resources; the middens almost certainly with the cockles from the beaches at the north end of the island.

When we turn to the Iron Age, we have only various settlement sites to look at, but these provide some interesting contrasts (Figure 8.10).

Figure 8.9. Site E11, an oval 'activity enclosure' of possible Late Bronze Age date on the north coast of Barra. The soil has been eroded from the rock up to the edge of the enclosure, which was partially excavated in 1994.

We have identified four different types of roundhouses in Iron Age Barra: small round or oval houses up to 6 m maximum; large roundhouses over 8 m (and up to 12 m) diameter; and large roundhouses with substantial amounts of internal stone debris and evidence for piers or lintels – aisled houses. In addition, there are the brochs and duns, or Atlantic Round Houses. Whilst none of the 23 examples of small roundhouses are found in the coastal zone, 14 per cent of large roundhouses and 9 per cent of aisled houses are found here. Most significantly, no less than 58 per cent of the Atlantic Round Houses (mostly brochs but some variant thick-walled structures usually called duns) are located in the narrow coastal zone.

These are significant variations in distribution, the interpretation of which is complicated and must depend to some extent on our general interpretation of the

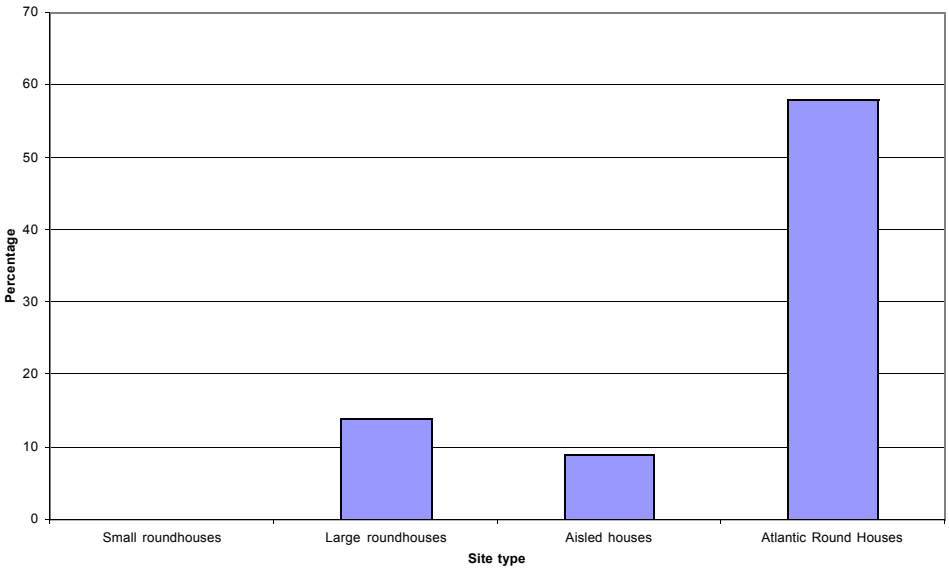

Figure 8.10. Graph showing the number of Iron Age settlements found in the coastal zone as a percentage of the total number found on Barra

social and chronological relationships between the various types of structure. Excavations at two sites on Barra have demonstrated that the small roundhouse appears no later than the Early Iron Age, and that the aisled house in at least one instance replaces a large roundhouse on the same site (Branigan & Foster 2000, 150, 224).

We also note that we have loose clusters which include on the one hand small and large roundhouses, and on the other small, large and aisled roundhouses (Branigan & Foster 2000, 344). It is tempting to suggest that large and small roundhouses were contemporaries in the Early Iron Age, possibly occupied by family groups of either different size or status, and that the larger houses were replaced during the Middle Iron Age by the aisled house. The aisled house is a far more complex structure architecturally, and possibly socially (Parker Pearson & Sharples 1998, 16–21) than the plain roundhouse. The same is true of the Atlantic Round House, which required an even greater input of time and labour to construct, and which seems to be broadly contemporaneous with the aisled house though appearing somewhat earlier in the Middle Iron Age. It appears that it is the larger and probably higher status buildings that appear in the coastal zone during the Iron Age, and that the most complex and prestigious of all, the Atlantic Round House, dominates the Iron Age settlement of the coastal zone for much of the Middle Iron Age.

Having said that, it is notable that the aisled house, found on the machair on the Uists, is found at inland sites on Barra, in some cases at well over 200 m above sea level. These locations require a different construction technique to those on the machair, with thick-walled, free-standing houses like Allasdale and Alt Chrisal replacing the single-skin, lined subterranean structures of the Uist machair.

Figure 8.11. Site L7, a blackhouse on the east coast of Barra. The southern wall has been breached by the scouring effect of the tide.

The dominant site type amongst the 163 modern sites and monuments found in the coastal zone is the blackhouse (64 examples; Figure 8.11). In fact the coastal zone provides 40 per cent of all the blackhouses recorded on Barra. Various interpretations could be offered for this heavy concentration of blackhouses in just 4 per cent of the island's land area. It might suggest that the 18th–19th-century population of Barra was heavily dependent on fishing and kelping for their subsistence and to enable them to pay the rent for their crofts. We know that kelping was certainly a very significant economic activity on Barra from c 1770 to 1835 (Bumsted forthcoming).

But a closer look at the distribution of the 64 blackhouses within the coastal strip on Barra suggests another explanation for this concentration. In fact, 57 (90 per cent) of the coastal blackhouses are found in north-east Barra, which represents just 30 per cent of the entire coastal strip. This area includes the bleak Bruernish peninsula, North Bay and Ardveenish, and Loch Obe and Ruleos. These are areas to which we know crofters and cottars were cleared, initially in small numbers, by General Roderick Macneil around 1830, and then in larger numbers by Colonel Gordon of Cluny in 1848–50. Macneil may well have wanted a landless population clustered around his new 'chemical factory' at Northbay, where many would have been employed in processing the made kelp Macneil imported from the Clanranald estate (Bumsted forthcoming). Gordon shifted people from the machair of Eoligarry, Cleat/Greian and Borve to the east coast, where census data for 1851 demonstrates that the new population there were now fishermen and boat-builders. They replaced the crofters recorded in the 1841 census, who were shipped off to Ontario. In other words, the concentration of blackhouses in the coastal strip of north-east Barra can be directly related to the social and economic disruptions of the period c1830–50.

Recommendations

Six sites were identified to be the subject of a watching brief in our original report (Branigan & Grattan 1998, 92–4). These include features associated with the broch on Borve Headland, which are actively eroding into the sea, and the later prehistoric monument at Dun Clieff, which sits on a small tidal islet and is exposed to Atlantic storms (Figure 8.12). In addition, there is one site (on the tidal islet of Orosay at the north end of Traigh Mhor) for which we have repeatedly urged an assessment excavation. This is an extensive midden with traces of stone structures which forms an eroding mound about 35 m in diameter. It may be Iron Age, but six small and very fragile sherds found in the eroding face have their nearest parallels in the fabric of Beaker

Figure 8.12. Site G9, Dun Clieff, on the west coast of Barra. Exposed to the full force of Atlantic storms, this tidal islet has been stripped of all soil except on the summit, where the walls of a late prehistoric structure cling to an increasingly precarious existence.

sherds from Alt Chrisal on the south coast of the island. This site should be investigated and assessed.

In more general terms, the dune systems at Eoligarry, Allasdale and Halaman Bay should be monitored regularly to identify any exposed archaeology. Eoligarry certainly has several sites currently visible within the dunes, and material has been recorded but is no longer visible at Allasdale. Apart from possible threats of mechanical cockle extraction or airfield runway works at Traigh Mhor, there are no foreseeable threats from human impact on the coastal archaeology at present. In a longer time frame, with the continued subsidence of the west coast of Scotland and the threat of rising sea levels posed by global warming, many of the sites identified in our coastal survey must be threatened with damage or total destruction.

Conclusions

The coastal erosion survey of Barra has revealed that there are areas of rapid erosion and areas of archaeological richness. Fortunately, they rarely coincide. The principal threats to monuments are on the west coast. The particular value of the Barra survey is that it was undertaken alongside a survey of the entire island. It therefore provides an opportunity to arrive at a better understanding of the relationship between the archaeology of the coastal corridor and its hinterland.

References

Branigan, K 1995 'Sampling excavations on the Tangaval Peninsula' in Branigan, K & Foster, *P Barra: Archaeological Research on the Tangaval Peninsula* Sheffield Academic Press, Sheffield, 170–6.

Branigan, K & Foster, P 2000 *From Barra to Berneray* Sheffield Academic Press, Sheffield.

Branigan, K & Grattan, J 1998 *Coastal Assessment Survey. Barra and Vatersay* Historic Scotland archive report.

Bumsted, J M forthcoming 'The rise and fall of the kelping industry in the Highlands of Scotland' in Branigan, K forthcoming *Historical Archaeology in the Western Isles* Sheffield Academic Press, Sheffield.

Grainger, P & Kalaugher, P 1990 'Factors influencing the coastal landslips hazard zonation of parts of north and south Devon' *Proc Usher Society* 7, 295–8.

Parker Pearson, M & Sharples, N 1999 *Between Land and Sea. Excavations at Dun Vulan, South Uist* Sheffield Academic Press, Sheffield.

RCAHMS 1928 *The Outer Hebrides, Skye and the Small Islands* HMSO, Edinburgh.

Young, A 1952 'An aisled farmhouse at the Allasdale, Isle of Barra' *Proc Soc Antiq Scot* 87, 80–106.

Young, A 1955 'Excavations at Dun Cueir, Isle of Barra, Outer Hebrides' *Proc Soc Antiq Scot* 89, 290–328.

9 ASSESSMENT SURVEY: NORTH SUTHERLAND (KYLE OF DURNESS TO TORRISDALE BAY)

KEVIN BRADY AND CHRISTOPHER D MORRIS WITH DEREK J MCGLASHAN

Introduction

The study area for this survey (Figure 9.1), conducted in autumn 1997, extended from the Cape Wrath peninsula to Torrisdale Bay (approximately 125 km). The mainland coastal strip was limited to the 50–100 m 'corridor' alongside the shoreline, together with the High Water Mark, and – where feasible – the intertidal zone. The difficulties of measuring any given length of coastline are considerable, and have been discussed elsewhere (see Ashmore 1994, 25–7). There is very little doubt that, given the highly indented and fractal coastline involved, the overall distance for the purposes of survey and fieldwork on the ground was considerably greater than that estimated at the desktop stage.

Previous Work

The northern Scottish counties were early recognised as having a rich archaeological and built heritage, as evidenced by the second and third reports of the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) being devoted to the 'Inventory of Monuments and Constructions' in this area (RCAHMS 1911a; 1911b). This was the first systematic ordering and account of the archaeology of this area 'from the earliest times up to 1707' (RCAHMS 1911a, v). These accounts have formed the basis for all subsequent work.

Additions to the record have been largely dependent upon individuals supplying information to the Ordnance Survey (OS), the local Sites and Monuments Record, or RCAHMS either directly to the National Monuments Record of Scotland (NMRS) or through entries in *Discovery and Excavation in Scotland*. Various OS surveyors had been active in the area in 1957, 1959, 1960, 1964, 1971, 1977, 1978, 1980, 1981 and 1983. There have been a number of overview papers (Henshall 1982; Reid *et al* 1982; Omand & Talbot 1982) and a guidebook for the county of Sutherland (Close-Brooks 1986/1995). Understandably, some of the more obvious prehistoric

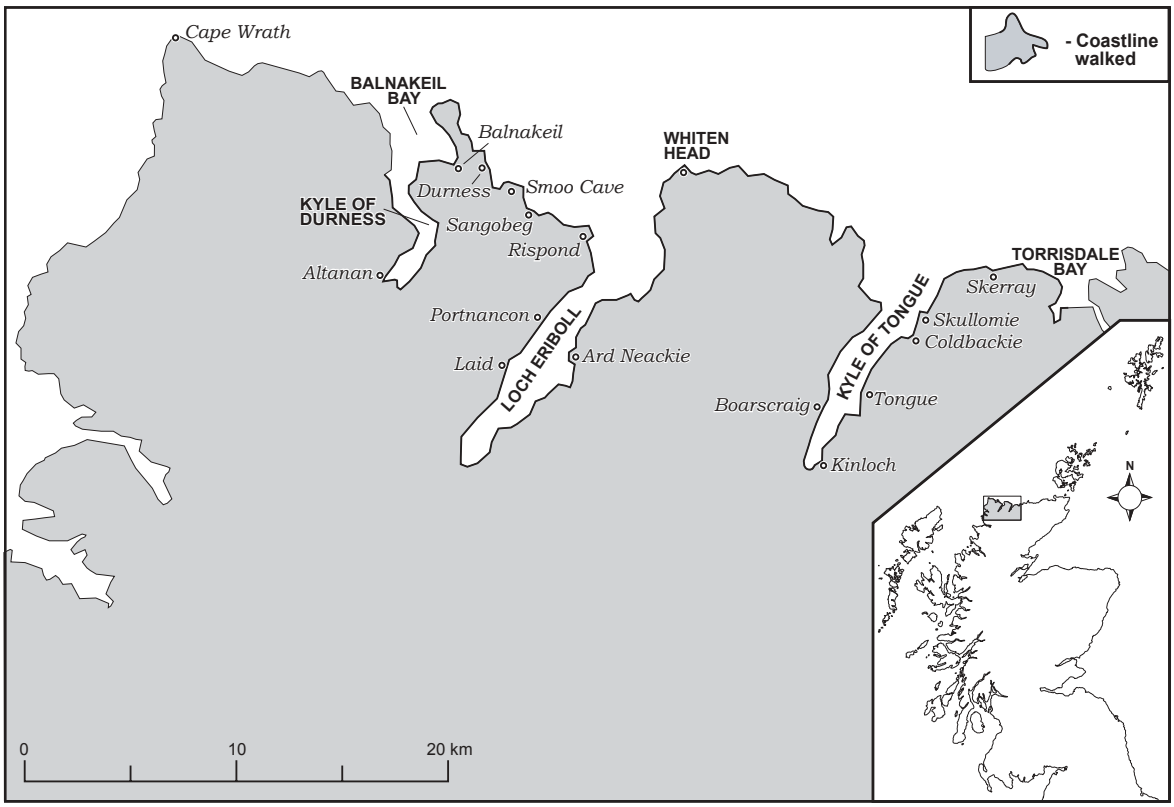

Figure 9.1. Location map showing the area of survey and places mentioned in the text.

monument types have generated specialist studies (eg Armit 1990; MacKie 1994; Henshall & Ritchie 1995). There has been some general interest in the Viking impact on the area (eg Small 1982; Batey 1993, 155–8; Cox 1994; Morris *et al* 1994, 152–3; Fraser 1995; Waugh 2000). Medieval or Later Rural Settlement (or MOLRS) studies have stemmed directly from the pioneering work of Horace Fairhurst (Fairhurst 1964; 1968; Fairhurst & Petrie 1964), and the follow-up to Fairhurst's approach in Strathnaver can be seen in more modern publications (Morrison 1987). Professor John Hume provided a pioneering study of industrial archaeology (1977), and Elizabeth Beaton considered some aspects of the building types and traditions in the area (1987; 1995).

Excavations and intensive survey have been few and far between (for example see Reid *et al* 1967; Pollard 1992; Morrison 2000; Low et al 2000).

Methods

The procedures adopted were standard for this type of survey. A background study complying with the methodology specified in the Historic Scotland *Archaeological Procedure Paper 4* (1996) was conducted, essentially to gather the primary information required prior to undertaking the fieldwork. The fieldwork procedure involved walking parallel transects along the coast, paying particular attention to the High Water Mark and the intertidal zone and the first break of slope inland from, and above, the High Water Mark. During the walk-over phase, the erosion class of the coastline was noted on the maps. The geomorphological information was gathered on-site during the archaeological survey by Derek J McGlashan or in the post-survey phase of the work using secondary sources.

The primary concern of the surveyors was to characterise each site accurately without engaging in elaborate surveying techniques. Essential measurements for dimensions, etc, were taken. Where the sites had been previously characterised, the emphasis was upon checking the earlier records. Within the overall site dimensions, significant details were checked and this was followed up with a brief description of the remains and their current condition. Usually, a sketch plan was added to the recording sheets, and a photographic record made where feasible. The sites were then added to the relevant map sheet copy.

A distinction was made between discrete sites within the coastal zone and broader cultural landscapes which extended beyond the coastal zone. In general, record sheets were completed for both sites and landscapes, although some of the features of the latter were marked upon the 1:10,000 (or 1:10,560) map sheets, and only the dimensions within the coastal zone were measured and recorded.

Analysis

Built heritage

Four hundred and eighty-five sites were recorded by the field survey. Of these, 107 (22 per cent) were already catalogued in the NMRS (September 1997). The remaining 378 sites (78 per cent) are newly recorded.

Twenty-two of the sites recorded fall into more than one period category, firstly, because of demonstrable reuse of an earlier monument, and secondly, because

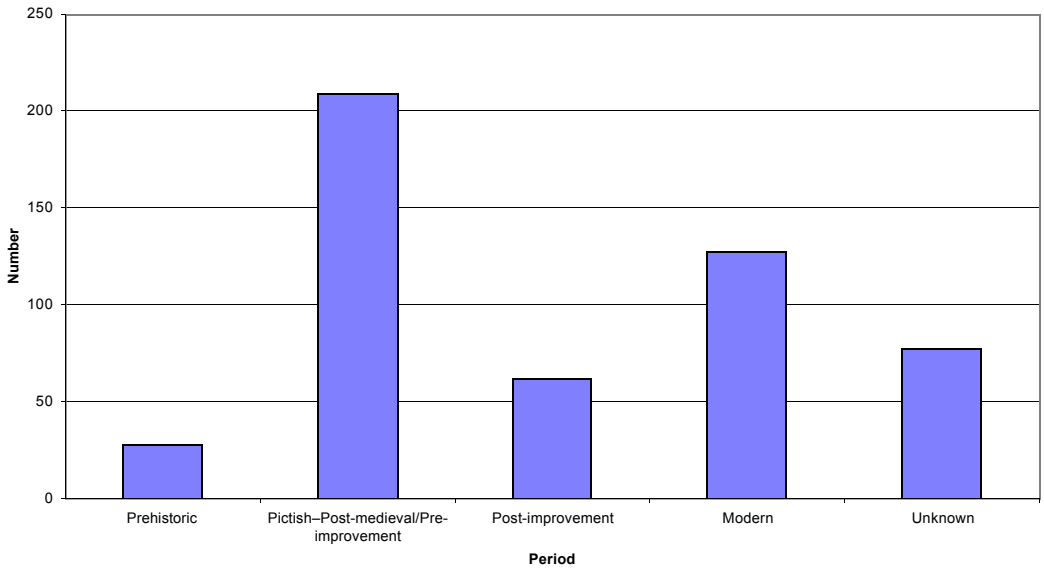

Figure 9.2. Graph showing the total number of sites located, grouped by period.

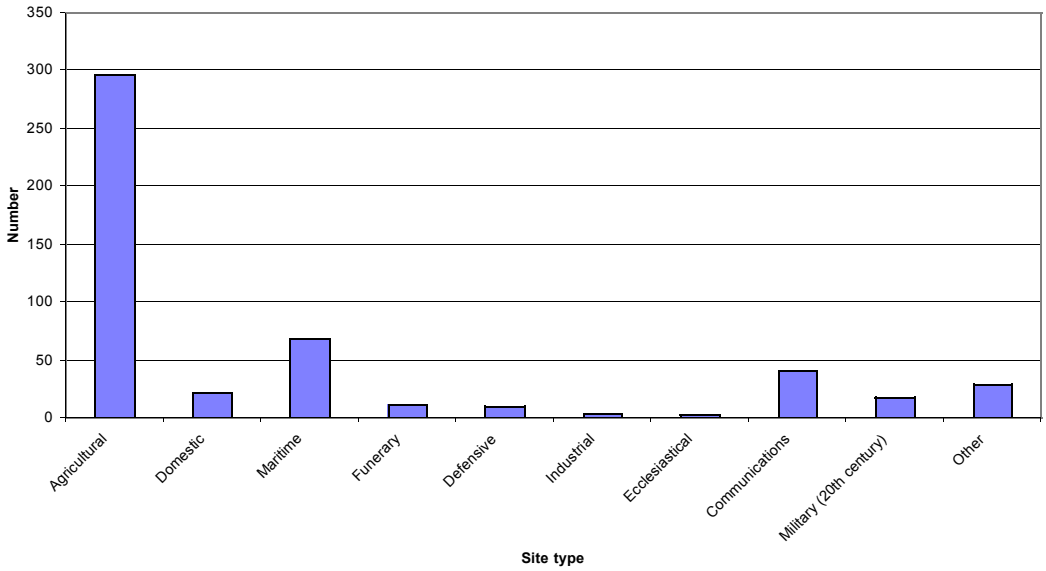

Figure 9.3. Graph showing the number of sites located, grouped by type.

some sites fit comfortably into widely divergent periods of time. In the statistical breakdown, these sites have retained a presence in each period category in which they have appeared. This gives a revised total of 507 sites. All subsequent percentages are taken from this total.

The following categories have been used to separate the sites into a broad temporal framework (Figure 9.2):

- *Prehistoric sites*. The majority of these sites were identified and classified prior to this survey. The term 'Prehistoric' is used to cover a period from the 5th millennium BC to c AD 600 (ie with the historically-attested advent of Christianity in the later Pictish period). Twenty-eight were so categorised (5.6 per cent of the total site population).
- *Pictish, Norse, Medieval and Post-medieval/Pre-improvement sites*. This category covers all sites from c AD 600 to the late 18th century. This is, in effect, most of the medieval period and the post-medieval sites up to, but not including, those sites of a clearly improved nature (see Crawford 1967). Two hundred and nine sites were categorised as consisting of elements considered to be within this broad period (41.6 per cent of the total site population). It is possible that this figure may be misleadingly high: many of the sites recorded in this category may be of later date, but with no characteristically post-improvement elements.
- *Post-improvement sites*. This category catalogues those sites which are 18th–19th century in date and clearly result from the changing practices of land-management brought in as 'improvements' by the Sutherland estate. Sixty-two sites were recorded in this category (12.3 per cent of the total site population).
- *Modern sites*. This category encompasses all 20th-century sites, many of which are at least partially still in use. Special attention was paid to the increasingly ephemeral military sites remaining from World Wars I and II. One hundred and twenty-seven sites were recorded in this category (25.2 per cent of the total site population).
- *Sites of Unknown Date*. Seventy-seven sites which could not be securely fixed to any of the above categories, or that were in any way ambiguous, were not categorised as to period (15.3 per cent of the total site population).

For consistency with other papers in this volume, Figure 9.3 attempts to categorise all sites recorded by type. Whilst certain categories such as 'funerary' are clearly definable, many others are not. There is a considerable degree of overlap between the categories presented here. The largest category is 'agricultural' representing some 59 per cent of the total. 'Domestic' represents only 4.4 per cent of the total. This creates a somewhat confusing picture as many of the elements grouped in the general 'agricultural' category, had domestic elements. Similarly, many of the sites recorded in the 'agricultural' category, for example hollow-ways and possible drove roads, could just as easily have fitted into the 'communications' type. Visibility and clarity of site definition have been a problem for almost all the researchers engaged on these coastal surveys. However, the authors felt that far more intensive fieldwork would be required to examine the use of the landscape through the millennia and thus safely begin to break down those elements into a more

Figure 9.4. Causeway across the Kyle of Tongue.

detailed pattern. As argued in the conclusion to this paper, more concentrated survey outwith the 50–100 m parameter set for this exercise is required in order to understand fully the component parts of the wider agricultural landscapes encountered. The high number within this category simply reflects the fact that the survey was conducted in a rural area (as further evidenced by only 0.8 per cent of the total site population being considered 'industrial') and close to the sea (the second largest category being 'maritime' at 13.5 per cent, representing everything from wrecks to landing places to fishing stations).

Vulnerable sites

The sites most threatened with destruction by coastal erosion processes are the 53 sites (10.5 per cent of the total site population) located either partially or wholly within the intertidal zone, or the 64 sites (12.7 per cent of the total site population) located at the High Water Mark.

Many of the 53 sites within the intertidal zone were built to be within the zone and, as such, their presence there is not taken as a consequence of erosion. However, many of them are seriously deteriorating. The monumental pier at Skullomie provides a graphic illustration of such a site being destroyed by wave and storm action. Many of the sites associated with the, now redundant, ferry-crossing at Tongue are also being destroyed, possibly by the change in tidal pattern brought on by the construction of the vehicular causeway (Figure 9.4). These sites present their own particular problems in that their very nature demanded they be built where they were, yet their location is ultimately leading to their destruction, although not necessarily in an area with a general erosional problem. Other sites located in the intertidal zone clearly signify an area where land has recently been lost to the sea. This is marked along the west shore of Loch Eriboll where dykes are now partially below the High Water Mark. Whether grazing pressure has depleted foreshore vegetation and allowed the sea to break further back on the hinterland at places like Laid is a matter of conjecture and longer-term analysis is required.

Many of the 64 sites located partially or wholly at the High Water Mark are nearer the sea now than when they were constructed and are clearly under threat of at least partial destruction. The potentially very important Late Norse site at Sangobeg is close to total destruction from both marine incursion and hinterland riverine action (Figure 9.5).

The dykes and field-system associated with Boarscaig are now at the High Water Mark and the erosion-scars appear fresh. Whether this is due to saltmarsh depletion brought on by overgrazing is unclear. Again, the construction of the vehicular causeway across the Kyle may have altered the rate at which the sea flows out of the south half of the Kyle of Tongue, thus leading to increased pressures on the shoreline. A long-term study of the effects of the causeway on both tidal patterns and sediment distribution is required and, indeed, eagerly sought by many local residents. The

Figure 9.5. Eroding Norse site at Sangobeg.

patterns of erosion in Loch Eriboll and the Kyle of Tongue are mirrored in the Kyle of Durness where sites like Altanan are now at the High Water Mark and erosion-scars are fresh.

Only 0.8 per cent of sites deemed vulnerable fall within the prehistoric category (Figure 9.6). This probably reflects the low overall percentage of prehistoric sites. Past climatic and coastal changes may be responsible for this low density. Factors such as fluctuating sea levels may have destroyed settlement evidence which had survived in sheltered areas, such as at Smoo Cave. The Pictish through to post-medieval/pre-improvement category has the highest percentage of vulnerable sites (36.8 per cent). Many of these sites represent isolated elements of the general agricultural landscape (eg dykes). Other sites are potentially extremely important. The possible Late Norse midden and structural elements recorded at Sangobeg Sands had badly eroded at the time of the survey and are not expected to last many more winters. Large numbers of the post-improvement and modern category sites (22.2 per cent and 24.8 per cent respectively of the total number of vulnerable sites) are deemed to be in danger from erosion. This may reflect the greater use made of the sea in these periods, with more structures being built at the High Water Mark and in the intertidal zone.

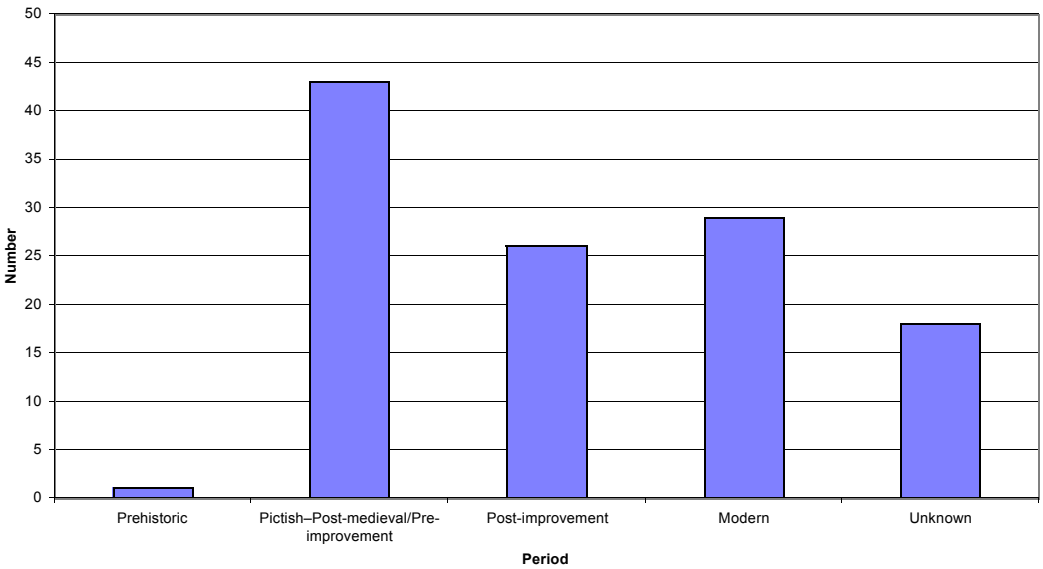

Figure 9.6. Graph showing the number of vulnerable sites, grouped by period.

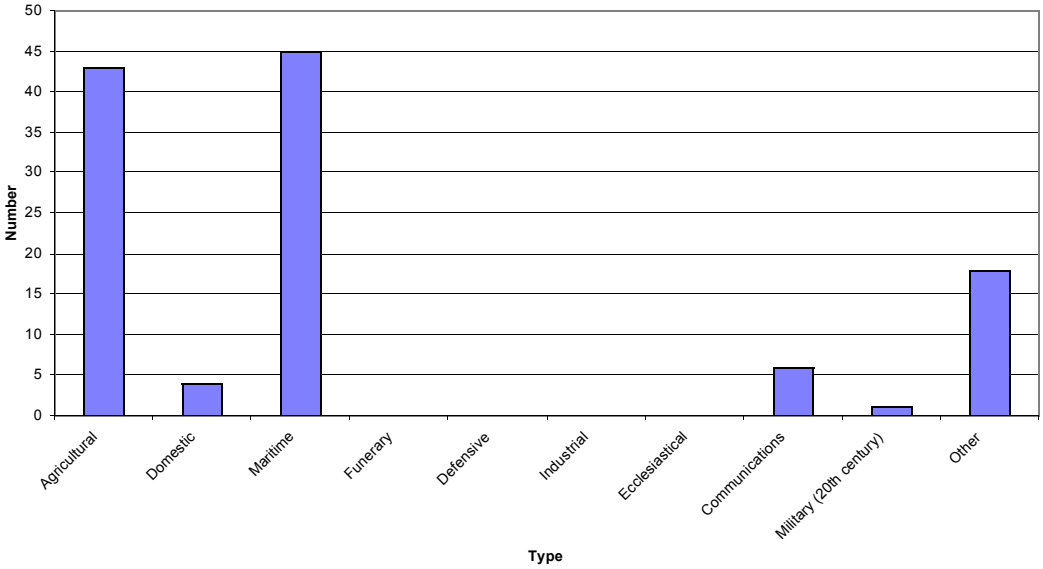

Figure 9.7. Graph showing the number of vulnerable sites, grouped by type.

The vulnerable sites by type category (Figure 9.7) is dominated by maritime sites (38.5 per cent of the total). This is hardly surprising given that such sites are built at the High Water Mark or even within the intertidal zone. However, there is some evidence that modern factors are exacerbating the erosional problem at places such as the Kyle of Tongue (Figure 9.8 and see below). The grandiose estate buildings at the fishing station of Rispond are also deteriorating due to lack of use as the harbour and sea-defences are not maintained sufficiently to stop storm inundation. Again, the agricultural category provides a large number of threatened sites (36.8 per cent of the total). The heterogeneous nature of this category has been explained above and this is reflected in the different elements threatened: limekilns, mills, fields, and indeterminate structures.

Figure 9.8. Eroding foreshore at the west side of the Kyle of Tongue.

Geological and Geomorphological Context of the Northern Sutherland Survey Area

Derek J McGlashan

The North Sutherland area is at the extreme north-west section of the British mainland and has an interesting and varied geology. The different rock types have varying resistance to erosion, and react in different ways to particular processes. In general, the sedimentary rocks suffer more from erosion than the metamorphic rocks. Especially spectacular forms occur in the Durness Limestone, with Smoo Cave being a classic example of a well-developed cave-system. The Durness Limestone also lends itself to the formation of geos, which are common along this coast (Steers 1973). Sandy bays are often found where different rock types meet, one type being more easily eroded than the other: Coldbackie is a classic example of this. The study area crosses the Moine Thrust, an impressive geological feature of Late Ordovician – Mid Silurian age which runs south-south-west from Whiten Head, separating the Hebridean (Foreland) Terrane from the Northern Highlands Terrane. The Hebridean (Foreland) Terrane has a basement of Archean and Early Proterozoic rock which is unconformably overlain by generally undeformed fluvial and lacustrine sediments of mid–late Proterozoic age, again overlain unconformably by early Cambrian-Llanvirn quartz arenites and carbonates. The Northern Highlands Terrane is described as exhibiting 'complex polyphase deformation and metamorphism' in the early Proterozoic (1600–2500 Ma) fluvial-shelf Moine sediments. The Moine Thrust closed orthogonally and had a displacement in excess of 100 km (Dr K Ingham pers comm).

The landscape in this area is dominated by the spectacular scenery inherited from the last (Devensian) glaciation. The result of this is a landscape characterised by glacial overdeepening and watershed breaching (Sutherland 1994). Contrary to popular belief, the mountains of the north-west Highlands were not covered by ice during this period (McCarrol *et al* 1995). In general, for this study area, the movement of ice was in a northerly direction (Sutherland 1994) and exhibits a landscape of glacial scour, creating 'knock and lochan topography' (Linton 1963; Rea & Evans 1996). The current coast was at that stage covered by ice, with the coast during the glacial maximum being many miles to the north (Price 1983; Dawson 1992). The height of relative sea level has fluctuated considerably since the Devensian (Shennan *et al* 1996; Dawson & Smith 1997), which is due to the extent, thickness and form of the ice (Evans 1991). In many areas of the United Kingdom, the land is still reacting to the removal of the last ice-sheet. The mountains of the north-west Highlands, for example, are, in general, rising (relative to the level of the sea), while other areas are sinking, for example, southern England and the Outer Hebrides. Sutherland is outwith the zone of falling sea levels, as depicted in Carter (1988), therefore relative sea level in the study area may be stable, or rising slightly. As yet, there is no accurate data relative to current sea level fluctuations, as the data has not been collected for long enough in an area close enough to yield accurate results.

Erosion

Much of this coast consists of hard rock cliffs, and so is not liable to be eroding at a rapid rate (Figure 9.9). However, a number of areas have a more dynamic nature, for example Balnakeil Bay. These areas require more accurate studies to determine longer-term trends affecting their stability. In general, most of the 'softer' coast exhibited some evidence of erosion, which may either be due to a recent storm event or be part of a longer-term trend. There were few areas where major changes could be identified as readily as at Coldbackie. The changes there are very interesting, and highlight questions regarding sediment movement and the causeway at Tongue. Again, this requires (and deserves) further study. The majority of the sand dunes had areas of recent vegetation colonisation, and some had embryo dunes evident (eg Coldbackie). This would suggest a recent influx of sediment, which again could be due to recent weather conditions as opposed to a longer-term trend in sediment availability. In many areas, erosion appears to be caused, or exaggerated by, grazing or trampling by tourists, and at Skerray the sea wall protection could well be a factor causing, or increasing, the erosion elsewhere in the bay. The results of the field observations of the erosional state of the coastal zone within the survey area are presented in the Figure 9.9.

This was a small, short-term study. More detailed analysis could only be achieved with a longer-term, more accurate study. What must be remembered is that this is an assessment of the coastal stability, it is not an environmental assessment or a rehabilitation guidance note. If further work is to be done at the coast involving protection structures, or the removal or destruction of features, a more detailed assessment and management prescription is likely to be required.

Discussion

The principal aim of this survey was to document the built heritage and archaeology of the coastal zone and to assess the impact of erosional processes upon the cultural heritage. This involved a visual inspection and rapid recording of a coastal strip 50–100 m wide above the High Water Mark and the intertidal zone below. Four hundred and eighty-five sites were recorded, 378

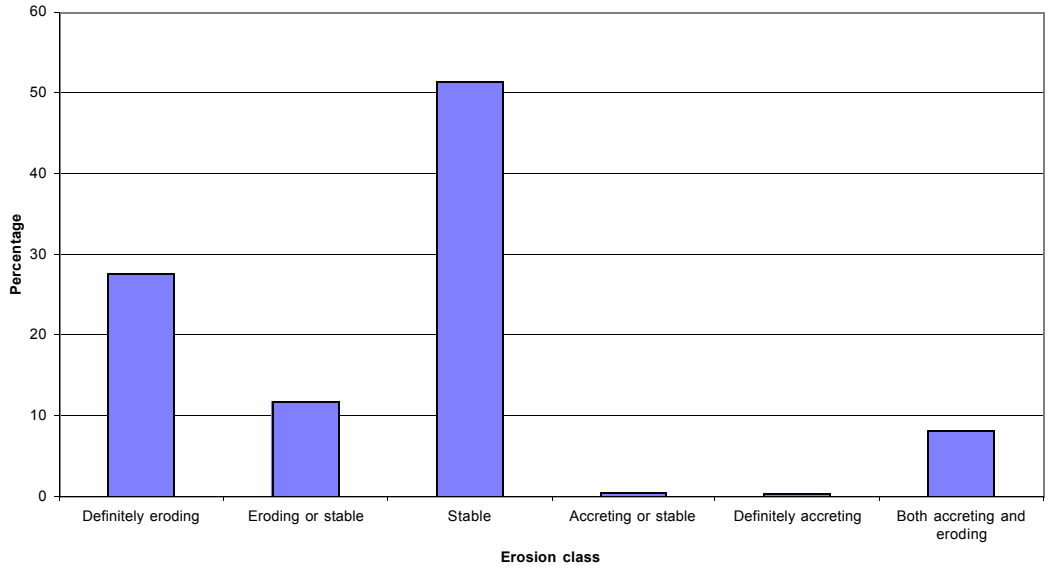

Figure 9.9. Graph showing erosion classes for the coastline surveyed.

(78 per cent) of which were newly added to the overall archive. The range extends from prehistoric sites (up to c AD 600) to those relating to the recent past. The majority of the sites are from the historical periods, especially the post-medieval, post-improvement and modern periods, although there are significant additions to the understanding of earlier periods. Only 22 sites have some degree of 'official' protection at present (4.5 per cent).

The nature of the survey, being necessarily rapid, did not allow for particular areas to be visited more than once or to be visited at different times in the tidal cycle. Multiple visits at different times of the day and in different seasons of the year would be a basic requirement in order to produce a definitive document. It should be borne in mind, therefore, that any conclusions drawn here are tentative and that the true value of this analysis will be as a comparative study for more intensive future work.

Of the 28 sites (5.6 per cent) which appear to be prehistoric, ten are newly recorded. The earliest site recorded was a potentially Mesolithic midden at Smoo Cave, but the range extends through Neolithic/Bronze Age (7 cairns), Bronze Age/Iron Age (6 hut-circles) to Iron Age (4 brochs, 3 promontory forts, and a souterrain). This survey thus complements the detailed survey work and associated excavations undertaken over three decades ago on the prehistoric archaeology of Durness Parish (Reid *et al* 1967).

Two hundred and nine sites (41.6 per cent) have been assigned to a category covering the 7th century to late 18th century, ie medieval and post-medieval (although it is conceivable some may be later). A putative Early Christian monastery (Figure 9.10), a Viking grave, a Viking or late Norse midden, possible Late Norse structures and midden, a medieval tower house and 11 other sites may come from the medieval period. Within their regional context, each of these is extremely important - and the small concentration of Viking and Late Norse sites in the Durness area is particularly significant in providing back-up to the linguistic heritage of the area as reflected in place names (Waugh 2000, 13–23).

Figure 9.10. Aodhan Mor, a putative early Christian monastic site.

The vast majority of the sites form elements of the general agricultural landscape, sometimes surviving in a remarkable condition from the post-medieval period, although – apart from the deserted settlement at Kinloch – many of the accompanying buildings appear to have disappeared. These are of significance in relation to general discussions about MOLRS (Hingley 1993), and may in several cases mask land-use patterns from an earlier period. Of the higher echelons of

society (and their built heritage in the post-medieval period) little is visible, apart from the foundations of Tongue House, Balnakeil Church, and a burial ground at Skerray.

Sixty-two sites (12.3 per cent) are considered to be characteristic of an 18th–19th century post-improvement landscape, associated with the activities of the Sutherland estate. Of particular interest here are the township of Laid, the fishing-stations of Rispond and Portnancon, the industrial site of Ard Neackie, the harbour at Skullomie, 22 other marine sites, and the grand houses at Balnakeil and Tongue.

One hundred and twenty-seven sites (25.2 per cent) are categorised as modern. These include nucleated settlements such as Durness, at the coast, as well as other landscape features and a number of sites associated with the crossing of the Kyle of Tongue. However, the largest sub-group of sites within this category is that associated with military activity, both World War II and more recent. Many of these are in poor condition and merit comprehensive survey in the near future.

Seventy-seven sites (15.3 per cent) were categorised as being of 'Unknown Date', although there is little doubt that over 70 per cent of these relate to the general agricultural landscape. These, and the remaining sites in this category, simply require more comprehensive attention within a broader landscape survey setting.

It is estimated that 52.4 per cent of the coastline examined was currently in a stable condition (or accreting). This undoubtedly reflects the large stretches of coast with high rock cliffs. However, several significant areas of this stretch of coastline are actively eroding (39.4 per cent), especially around low-lying parts of the north–south indented Lochs and Kyles of Durness, Eriboll and Tongue, with particularly vulnerable sand dune areas on the exposed north-facing coast between these Kyles. Indeed, most of the 'softer' coast exhibited some evidence of erosion (the remaining 8.2 per cent was both accreting and eroding). Major problems are clearly experienced at, for instance, Balnakeil Bay, Sangobeg, Coldbackie and Skerray.

A significant number of sites were recorded in low-lying and exposed positions (53 in the intertidal zone and 64 at the High Water Mark: 23.2 per cent of the total), which would be vulnerable to changes in climatic regimes and/or sea level changes. When this is considered in the context of an estimated 39.4 per cent of the coast actively eroding, there is clearly a potential major problem. The dramatic find of a Viking burial in Balnakeil Bay in 1991 (Low *et al* 2000, 24–34) exemplifies the vulnerability of archaeological deposits in such positions and the unpredictability of exposure; less immediately dramatic, but no less important, are the severely eroding deposits at Sangobeg, which appear to contain remnants of Norse settlement. However, although the 'soft' coastline is particularly vulnerable, the deteriorating condition of the later monumental pier-site at Skullomie shows that other areas also have problems. The experience of the impact of changes in tidal pattern at the Kyle of Tongue and the west shore of Loch Eriboll clearly demonstrates the need for vigilance in monitoring the effects of modern 'improvements' at the coast-edge. Other, natural, forces which have not been exacerbated by man-made structures, are clearly also at work. This is demonstrated in the Kyle of Durness where, for instance, the interesting site of Altanan, originally well above the shoreline, is now at the High Water Mark and eroding.

It is evident that this area, with the exception of the Durness Parish sub-area (studied over 30 years ago), has received little attention in the past and that, despite its apparently remote situation on the mainland of Scotland, its archaeology and built heritage are of considerable importance. There is an interesting range of sites of all periods, although the area's greatest contribution in terms of sheer numbers may be in terms of landscape exploitation and settlement evolution in the historic periods: it has an enormous potential for contributing to understanding of MOLRS and the improved landscape. However, the small numbers of early prehistoric and Viking/Late Norse sites have a significance out of proportion to their numbers. Even the World War II sites are of vital significance in the overall picture of 'The Defence of Britain' project.

Recommendations

Sites within the intertidal zone and those at the High Water Mark together represent almost 25 per cent of all the sites recorded by the survey. Individual sites such as Sangobeg require urgent attention in the form of a rescue excavation to salvage what little is left of the cultural landscape (Brady forthcoming). Whilst such drastic action is the exception, there is little doubt that much of the archaeology and built heritage of the Sutherland coastal zone require further attention. Monitoring of many of the sites listed in the gazetteers of the full report (Brady & Morris 1998) is recommended and advisable. This would most sensibly be done against a background of further and more extensive surveys which could fit the coastal elements of extended settlements into their wider geographical and cultural context. The monitoring of the stability of the coastline itself must be ongoing. It is only through regular and systematic observance in the field that trends can be established and satisfactory conclusions drawn. The almost total lack of previous

geomorphological work in the survey area has seriously limited the qualitative conclusions which can be drawn from this programme of work. This is also true for the level of previous archaeological work in the area.

The implications are obvious: in general a more detailed survey (outwith the 50–100 m parameters) that puts these coastal sites into their broader topographical and chronological settings is required in purely research terms. This is as true for the World War II material as for the early prehistoric. However, there is an imperative in relation to a number of the sites on this coastline. Unlike the relatively small number of sites under threat in Long's Wester Ross survey (only 5 listed: Long 1996, 118–9), here there are many. Some of these are of major, if not outstanding, importance and should not be left to deteriorate (some at a rapid rate) without at least a more comprehensive record by survey, and in a few cases by excavation. The recommendations for each individual site are given in the relevant gazetteer entry in the full report (Brady & Morris 1998), and in many cases these are of some urgency. But, as is clear from that report, sites within the sub-areas of Balnakeil Bay, Sangobeg, Coldbackie and Skerray, where there is either rapid erosion or particular problems evident, merit (or even demand) immediate attention.

Further, it is clear from both McGlashan's initial geomorphological report (1998), and from the sections excerpted into this paper, that a more comprehensive coastal stability survey is required, against which to place the archaeological and built heritage material and to judge the medium- and longer-term threats to them as well as the immediate short-term problems.

Similarly, this area requires a more intensive examination under less stringent parameters than are delineated by *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* (Historic Scotland 1996). Inevitably, parameters which emphasise speed of survey, a basic level of recording and maximum coverage present problems in the execution of the work. Both the Wester Ross survey (Long 1996) and, more particularly, this North Sutherland survey, have had to overcome a lack of even basic information since very little work had previously been undertaken in these areas; as a result the surveyors had a far less developed database than would normally be expected, upon which to build. The large number of sites (and the extremely large proportion of newly recorded sites) in North Sutherland stretched resources to the limit within the parameters, a factor which was exacerbated by working in a region of Scotland where terrain and climatic conditions can often be extreme.

References

Armit, I (ed) 1990 *Beyond the Brochs. Changing Perspectives on the Atlantic Scottish Iron Age* Edinburgh University Press, Edinburgh.

Ashmore, P J 1994 *Archaeology and the Coastal Zone: Towards a Historic Scotland Policy* Historic Scotland, Edinburgh.

Batey, C E 1993 'The Viking and Late Norse Graves of Caithness and Sutherland' in Batey, C E, Jesch, J & Morris, C D (eds) *The Viking Age in Caithness, Orkney and the North Atlantic* Select Papers from the 11th Viking Congress, Thurso and Kirkwall 1989, Edinburgh,148–64.

Beaton, E 1987 'Notes on some building types and traditions in Tongue and Farr parishes' in Morrison, A (ed) *North Sutherland Studies*, Scottish Vernacular Buildings Working Group, Glasgow 62–72.

Beaton, E 1995 *Sutherland. An Illustrated Architectural Guide* RIAS/The Rutland Press, Edinburgh.

Brady, K J (forthcoming) *Sangobeg 2000: Survey and Excavation* Glasgow University Archaeological Research Division, Glasgow.

Brady, K J & Morris, C D 1998 *North Sutherland Survey: Coastal Zone Assessment 2* vols, GUARD 516/516.2, Glasgow University Archaeological Research Division, Glasgow.

Carter, R W G 1988 *Coastal Environments: An Introduction to the Physical, Ecological and Cultural Systems of Coastlines* Academic Press, London.

Close-Brooks, J 1986/1995 *The Highlands* Exploring Scotland's Heritage/RCAHMS, HMSO, Edinburgh (1st ed 1986, 2nd ed 1995).

Cox, R A V 1994 'Descendants of Norse *Bolstad*? A re-examination of the lineage of *Bost* & Co' in Baldwin, J R (ed) P*eoples and Settlement in North-West Ross* Scottish Society for Northern Studies, pub no 7, Edinburgh, 43–67.

Crawford, I A 1967 'The divide between mediaeval and post-mediaeval in Scotland' *Post-Medieval Archaeol* 1 (1967), 110–13.

Dawson, A G 1992 *Ice Age Earth: Late Quaternary Geology and Climate* Routledge, London.

Dawson, S & Smith, D E 1997 'Holocene relative sea level changes on the margin of a glacio-isostatically uplifted area: an example from northern Caithness, Scotland' *The Holocene* 7(1) (1997), 59–77.

Evans, D J A 1991 'Glaciated land on the rebound' *Geog Rev* 4 (5) (1991), 2–6.

Fairhurst, H 1964 'The Surveys for the Sutherland Clearances 1814–1820' *Scottish Stud* 8 (1964), 1–18.

Fairhurst, H 1968 'Rosal: a Deserted Township in Strath Naver, Sutherland' *Proc Soc Antiq Scot* 100 (1967–8), 135–69.

Fairhurst, H & Petrie, G 1964 'Scottish Clachans II: Lix and Rosal' *Scottish Geog Mag* 80, no 3 (1964), 150–63.

Fraser, I A 1995 'Norse settlement on the north-west seaboard' in Crawford, B E (ed), *Northern Isles Connections* Orkney Press, Kirkwall, 92–105.

Henshall, A 1982 'The Distant Past' in Omand, D (ed) *The Sutherland Book* Northern Times, Golspie, 135–45.

Henshall, A S & Ritchie, J N G 1995 *The Chambered Cairns of Sutherland. An Inventory of the Structures and their Contents* Edinburgh University Press, Edinburgh.

Hingley, R (ed) 1993 *Medieval or Later Rural Settlement. Management and Preservation* Historic Scotland, Ancient Monuments Division, Occ Paper no 1, Edinburgh.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Hume, J R 1977: *The Industrial Archaeology of Scotland II. The Highlands and Islands* Batsford, London.

Linton, D L 1963 'The forms of glacial erosion' *Trans Inst Brit Geog* 33 (1963), 1–28.

Long, A 1996 *Coastal Assessment Survey. Ullapool to Lochinver* 2 vols, Dept of Archaeology, University of Glasgow, Glasgow.

Low, D M, Batey, C E & Gourlay, R B 2000 'A Viking burial at Balnakeil, Sutherland' in Baldwin, J R (ed) *The Province of Strathnaver* Scottish Society for Northern Studies pub no 9, Edinburgh, 24-34.

MacKie, E W 1994 'Aspects of the Origin of the Brochs of Atlantic Scotland' in Baldwin, J R (ed) *Peoples and Settlement in North-West Ross* Scottish Society for Northern Studies, pub no 7, Edinburgh, 15–42.

McCarroll, D, Ballantyne, C K, Nesje, A and Dahl, S 1993 'Nunataks of the last ice sheet in northwest Scotland' *Boreas* 24 (1993), 305–23.

McGlashan, D J 1998 *Coastal Zone Assessment Survey. Coastal Stability – Sutherland* Unpubl report for GUARD, Glasgow.

Morris, C D, Barrett, J H & Batey, C E 1994 'The Viking and Early Settlement Archaeological Research Project: past, present and future' in Ambrosiani, B & Clarke, H (eds) *The Twelfth Viking Congress. Developments Around the Baltic and the North Sea in the Viking Age, = Birka Studies 3* The Birka Project, Riksantikvarieämbetet och Statens Historiska Museer, Stockholm, 144–58.

Morrison, A 1987 'Strathnaver - Some Notes on Settlement History' in Morrison, A (ed) *North Sutherland Studies* Scottish Vernacular Buildings Working Group, Glasgow.

Morrison, A 2000 'Souterrains in Sutherland' in Baldwin J R (ed) *The Province of Strathnaver* Scottish Society for Northern Studies pub no 9, Edinburgh, 215-315.

Omand, D & Talbot, E 1982 'The Picts and the Early Church' in Omand, D (ed) *The Sutherland Book* Northern Times, Golspie, 169–79.

Pollard, T 1992 *GUARD 60. Smoo Cave* Glasgow University Archaeological Research Division, Glasgow.

Price, R J 1983 *Scotland's Environment during the last 30,000 years* Scottish Academic Press, Edinburgh.

RCAHMS 1911a *Second Report and Inventory of Monuments and Constructions in the County of Sutherland* Royal Commission on the Ancient and Historical Monuments of Scotland, Edinburgh.

RCAHMS 1911b *Third Report and Inventory of Monuments and Constructions in the County of Caithness* Royal Commission on the Ancient and Historical Monuments of Scotland, Edinburgh.

Rea, B R & Evans, D J A 1996 'Landscapes of areal scouring' *Scottish Geog Mag* 112 (1996), 47–50.

Reid, D, Omand, D & Blood, K 1982 'Bronze Age to Brochs' in Omand, D (ed) *The Sutherland Book* Northern Times, Golspie, 146–68.

Reid, R W K, David, G & Aitken, A 1967 'Prehistoric Settlement in Durness' *Proc Soc Antiq Scot* XCIX (1966–7), 21–53.

Shennan, I, Green, F, Innes, J, Lloyd, J, Rutherford, M & Walker, K 1996 'Evaluation of Rapid Sea Level Changes in North West Scotland During the Last Glacial - Interglacial Transition: Evidence from Ardtoe and other Isolated Basins' *J Coastal Res* 12(4) (1996), 862–74.

Small, A 1982 'Viking Sutherland' in Omand, D (ed) *The Sutherland Book* Northern Times, Golspie, 180–4.

Steers, J A 1973 *The Coastline of Scotland* Cambridge University Press, Cambridge.

Sutherland, D G 1994 'The North West Highlands: Introduction' in Gordon, J E & Sutherland, D G (eds) *Quaternary of Scotland* Chapman & Hall, Cambridge, 103–4.

Waugh, D 2000 'The Place-names of Strathnaver' in Baldwin, J R (ed) *The Province of Strathnaver* Scottish Society for Northern Studies pub no 9, Edinburgh, 13–23.

10 ASSESSMENT SURVEY: ULLAPOOL TO LOCHINVER

ANDREW LONG

Introduction

In August 1996, Andrew Long and Associates undertook a systematic coastal assessment survey (henceforth referred to as the ULCAS) of the coastal littoral between the towns of Ullapool and Lochinver, Highland Region. The project was funded by Historic Scotland through Glasgow University Archaeology Department. Consistent with other coastal assessments funded by Historic Scotland at this time, the principal aims of the study were to collect data on the nature, distribution and significance of the built heritage and archaeological record of the coastal zone, and to assess the geomorphological processes likely to affect their future preservation.

A total of 93 km of coastline was surveyed, including the north-western shoreline of Loch Broom, the Coigach Peninsula and the south-eastern fringes of Enard Bay, but excluding the offshore island groups (Figure 10.1).

The coastal topography was dominated by a mountainous backdrop of steep hillslopes and outcrops of highly resistant rock strata, predominantly Torridonian group sediments and Lewisian gneiss, indented by narrow bays and inlets containing raised beaches, storm bars and alluvial fans. The coastline is not significantly developed in modern terms, though the past occupation of the region has clearly focused on the coastal littoral. To date, the ULCAS is the only coastal assessment of the western seaboard of mainland Scotland. This imbues the results with particular value for future management planning in Highland Region in general.

Previous Work

When the study was conceived in 1994, there was no systematic data on the archaeological record of the study region. A small number of sites had been inspected by staff from the Ordnance Survey and Highland Region council. However, by coincidence, the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) undertook an Afforestable Land Survey (ALS) of the Coigach Peninsula in 1994. This included much of the coastline within the ULCAS study area. While on face value this survey appeared to have achieved many of the site recording aims of the ULCAS, the geomorphology and erosional class remained unassessed. Furthermore, the newly acquired ALS data also provided a useful opportunity to compare the results from a general landscape survey with one specifically dedicated to coast-edge assessment, which has demonstrated the significant value of undertaking this form of assessment. It would not have been possible to achieve so much without the generosity of RCAHMS in sharing their unpublished survey data at this time.

Methods

The project methodology was defined in standard guidelines for coastal assessment released by Historic Scotland (1996), and consisted of the systematic field survey of the intertidal zone, coast-edge and a 50 m wide hinterland strip extending inland from the coast-edge. Any specific coastal landforms occurring outside this zone (eg extensive dune systems) were also assessed. The field assessment and recording was undertaken by two teams of two–three fieldworkers, achieving an average of 3–7 km of coastline per day. Owing to the complexity of the built heritage and archaeological record, sites were defined and assessed in terms of both *landscapes and landscape elements*, with only the elements located in the coastal zone being recorded in detail. This was particularly important in order to rationalise the extensive numbers of buildings and landscapes relating to contiguous pre- and post-improvement settlements, which occurred both within and adjacent to the coastal strip. The survey results were documented in a full report to Historic Scotland (Long 1996) and in an abstract published in *Discovery and Excavation in Scotland* (1996).

Analysis

Built heritage

One hundred and seventy-nine individual sites and places were defined, 120 of which were new recordings. It should be noted that the definition of an individual site was highly problematic, and open to variations in interpretation. For the purposes of this review, field boundaries, cultivation strips, clearance cairns, slipways, peat cuttings and other landscape elements were only recorded as separate ‘sites’ where they were *not* associated with definable buildings or

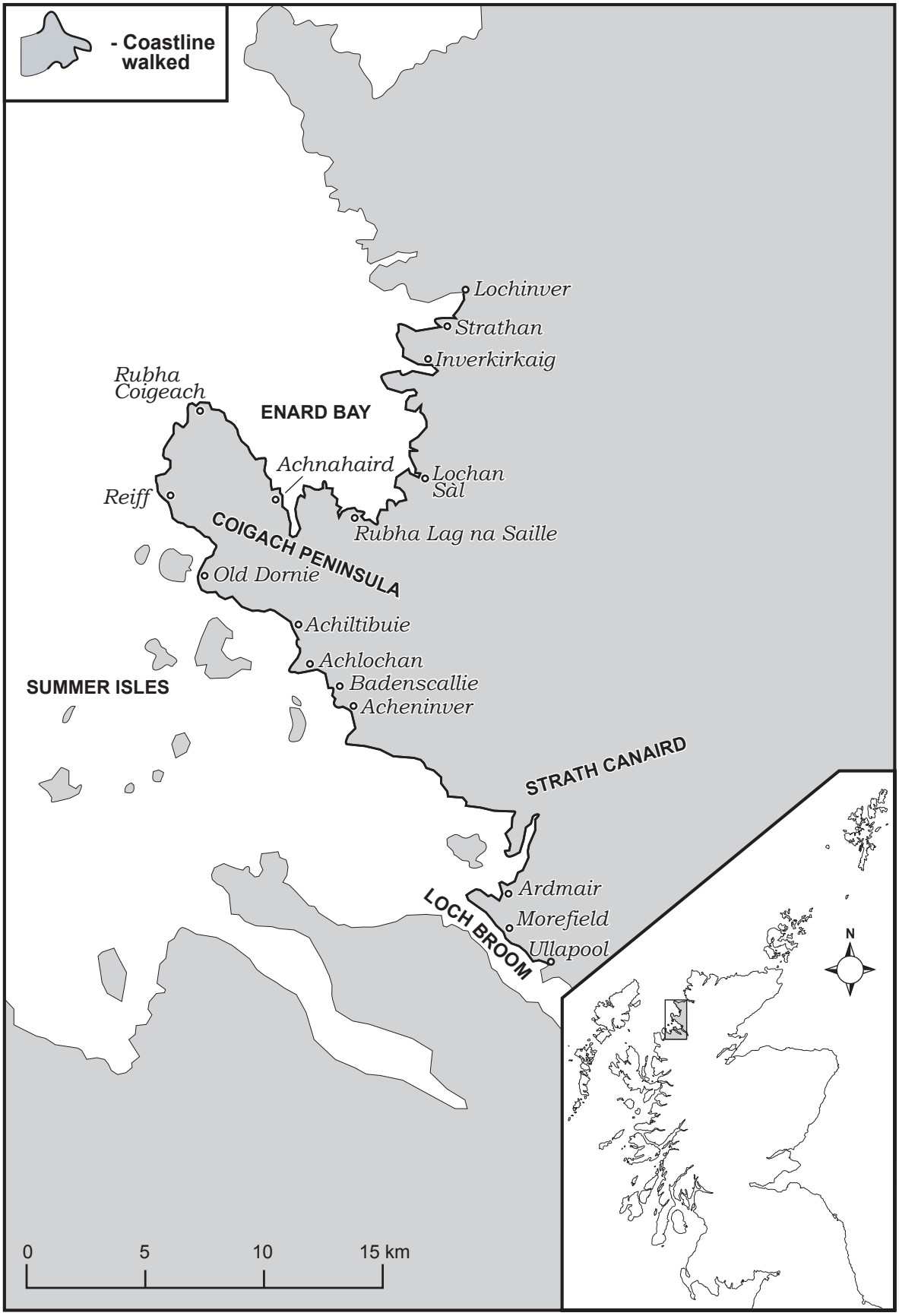

Figure 10.1. Location map showing the area of survey and places mentioned in the text.

Figure 10.2. Loch of Reiff, showing typical elements of the multi-period landscape, including field boundaries, lazy beds and modern houses constructed within the ruins of a pre-improvement township. Partially submerged peat deposits at the shore of the loch are clear evidence for recent marine transgression.

structures in the coastal zone. In some cases, recorded sites comprised new elements of previously recorded site complexes, and as a result the differential between new and previously recorded sites should be considered approximate. Similarly, the RCAHMS First Edition Survey Project (FESP) had previously identified most of the township complexes, though very few had been field inspected.

This problem also applies to the interpretation of age and function. These were frequently not apparent by field assessment alone due to an absence of empirical dating evidence, artefactual material and/or diagnostic architectural traits. Many sites and site complexes apparently relate to occupation over several time periods, though for simplicity each site or place has been categorised by its earliest, diagnostic evidence. As such, the archaeological record and much of the built heritage can essentially be described as a multi-period landscape (Figure 10.2), largely characterised by a range of structures and other features, such as field systems relating to medieval or later rural settlement (MOLRS). Various aspects of these cultural landscapes have been the subject of much theoretical and practical research in recent years (cf Atkinson *et al* 2000).

Problems of definition and interpretation aside, it is clear that the ULCAS has added significantly to our knowledge of past human interaction with the coast-edge. Even within the previous ALS study area, the ULCAS has doubled the number of landscape elements in the coastal strip, in particular documenting several new sites, such as boat nausts, slipways and hulks at the coast-edge, and in the intertidal zone (Figure 10.3).

Figure 10.3. A typical coast edge site at Rubha Lag na Saille, consisting of a drystone building, slipway and naust. The steep hillsides in the background are characteristic of Lewisian gneiss coastal landforms.

The majority of recorded sites and site elements were components of the 14th–20th-century MOLRS landscape (Figure 10.4), relating to either pre- or post-improvement settlements clustered along raised beaches, in the lower reaches of alluvial valleys or bays. These elements have been predominantly defined as agricultural, domestic, or maritime in nature, with frequent evidence of multiplicity of function, as in the case of coastal dwellings with associated field-systems and 'harbour' facilities in the form of boat nausts and slipways (Figure 10.5). Other site types recorded included weirs, fish traps, fords, sheilings, and other miscellaneous drystone constructions.

The number of exclusively maritime site complexes is very low, generally limited to 19th/20th-century structures, such as a lighthouse, a salmon fishing station, and an oyster farm, demonstrating the comparatively low level of coastal development since the abandonment and/or contraction of the townships. Recorded shipwrecks mostly consisted of 19th/20th-century fishing vessels abandoned on the foreshore, often adjacent to boast nausts and slipways. Two reported offshore shipwrecks were also documented, though not inspected, during the field assessment.

The industrial, ecclesiastical and funerary monuments also tended to occur as elements of the townships. Sites of an industrial nature largely consisted of 18th/19th-century kelp kilns, and extensive deposits of 16th/17th-century artefactual and ecofactual debris at Achnahaird Sands (Figure 10.6).

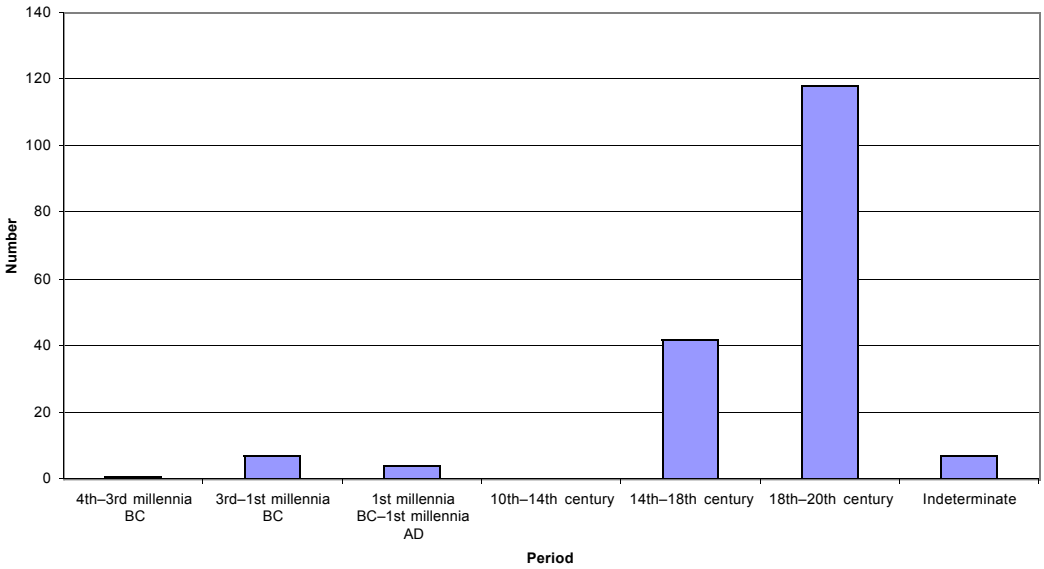

Figure 10.4. Graph showing the total number of sites located, grouped by date.

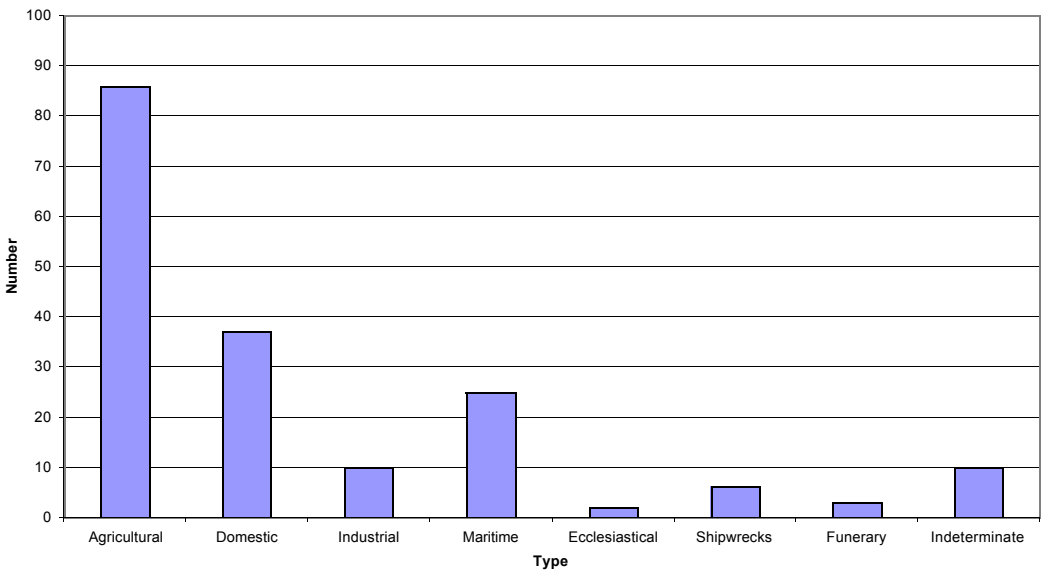

Figure 10.5. Graph showing the total number of sites located, grouped by type.

Figure 10.6. Tidal marshes at the southern end of Achnahaird Bay, looking towards an eroding dune system containing late Medieval and early post-medieval archaeological deposits. Oral and documentary sources suggest that the dune and associated machair system formerly extended across this entire view. Note the submerged peat deposits exposed at low tide.

At this point in time, Achnahaird Sands is arguably unique in the archaeological record of the West Highland seaboard, owing to the circumstances of site exposure and the diversity of stratified structural, artefactual and environmental deposits. The site setting is also unusual in the study area, being located on the margin of a shallow sandy bay surrounded by extensive machair deposits, which offers a sheltered anchorage for large vessels, as well as inland access for smaller boats via an extensive chain of freshwater lochs.

Preliminary analysis of the site context and previously collected material indicates that the remains relate to a significant 16th/17th-century industrial and trading complex, where various materials were worked including stone, iron and non-ferrous metals, such as copper and lead. Livestock, fish and shellfish were potentially being processed on an industrial scale (Long in prep.). Interestingly, the presence of large numbers of low denomination coinage and trading weights suggests the existence of a developed monetary economy, which has not been previously identified in the context of a secular rural site in the Western Highlands. All the evidence points to the site having functioned as a local emporium and/or entrepot, linking communities in the hinterland, the surrounding coast and islands with other political and trading centres in the wider province.

There was very limited evidence of any form of medieval occupation, though it is highly likely that elements of ostensibly post-medieval site complexes originate in this period. A number of sites defined as ‘indeterminate’ may fit into this category, though there is insufficient evidence to be more certain. Achnahaird Sands, for example, contains traces of medieval artefactual material, though the complex as a whole is dominated by its post-medieval assemblage.

The prehistoric landscape was less apparent, though a number of large, obtrusive structures, including a broch, a vitrified fort and two duns, clearly exploited natural defensive positions provided by the coast-edge. A rock shelter containing shell midden deposits is tentatively interpreted as a Mesolithic site, while various hut-circles, possible burial cairns, and a standing stone were also present in the coastal hinterland. Achnahaird Sands has revealed indications of potential late prehistoric occupation, supported by the close proximity of the Brae of Achnahaird dun, though the artefactual evidence will remain inconclusive until more detailed research is undertaken. The reasons for this overall lack of representation are probably more a factor of the subsequent, extensive use of the landscape and relative absence of ground surface visibility than an absence of occupation or use of the coast-edge.

Geology/geomorphology

The overall geological and geomorphological characteristics of the study area indicate a slowly developing erosional landscape in a relatively early stage of evolution. The process of glaciation has defined the topography and morphology of the region and the subsequent drowning of the landscape in the post-glacial period has emphasised this underlying form, rather than creating a coast edge with an entirely different character. This is a result of the relatively recent occurrence of this marine transgression (c 6000 BP) and the high degree of resistance in the dominant local bedrock, which primarily comprised Torridonian group sedimentary rocks in the central and southern sections (Johnstone & Mykura 1989, 3–41), and Lewisian gneiss in the north of the study area.

These two rock types have created coastlines with a distinctly different character, though both display similarities such as the overall rarity of major coastal cliffs and wide wave-cut platforms, weak wave-notch development and the prevalence of sub-aerial

weathering processes actively affecting the underlying glacial landforms. The resulting coast-edge is characterised by glacially smoothed surfaces or scree slopes with low, sloping rock platforms or shelves at sea level. Strong coastal cliff development displaying evidence of bedrock failure is restricted to exposed headlands (eg Rubha Còigeach) and offshore islands, particularly in Torridonian sandstone areas.

The frequent bays and inlets situated around the coast are considered to reflect the underlying topography, as opposed to being the result of the cumulative effects of mechanical wave action on weaknesses in the bedrock. This is supported by the strong correlation between the distribution of these bays and raised beach deposits. On a smaller scale, however, wave action has resulted in the formation of narrow, steep-sided inlets (geos) and caves in exposed areas.

Offshore islands immediately adjacent to the mainland are frequently protected by cobble bars or tombolos (eg Loch of Reiff) formed by longshore drift or under storm conditions. The presence of substantial storm bars composed of massive boulders stands as testimony to the past activity of high-energy waves. While there was little evidence of modern storm bar construction, at Achlochan a broch was constructed onto an existing storm bar, indicating that high-energy waves did play a role in the development of the coastline in the 1st millennium BC or earlier (Long 1996, vol 1, 107).

The influence of isostatic uplift in the area between c 5000 and 2000 BP has resulted in the formation of raised beach deposits along coastal shelves throughout the study area (Price 1983, 182–3). It is also apparent that the process of storm bar formation was either associated with, or immediately post-dated, this period. Storm bars are certainly a feature associated with the modern coast-edge, and have not been observed above raised beach deposits. Active accretion is currently a very rare occurrence in the study area, and has only been observed in estuaries or at the mouths of river valleys; often these deposits have been reworked and sometimes formed into small spits by longshore currents.

Erosion

In general the coastline was considered to be either stable, or, eroding or stable (78.8 per cent) with a negligible rate of regression (Figure 10.7). This state was accentuated by variations in the degree of exposure and bedrock resistance. Definite erosion was noted along 8.6 per cent of the coastline. There was very little evidence of active accretion (1.3 per cent), and this was entirely represented by the development of small spits at river mouths. In certain complex estuarine environments, both accretion and erosion was occurring (11.3 per cent). This effectively amounted to a superficially stable situation, though minor coast-edge erosion was frequently occurring to surrounding drift deposits.

Approximately 4.8 km^2 of the hinterland is situated less than 10 m above sea level, and much of this is located in a few extensive river valleys (eg Strath Canaird). The majority of the hinterland is composed of steep rocky hills and compared to lowland areas is not seriously threatened by the prospect of marine transgression.

The study area contains ample evidence of a post-glacial rise in relative sea level, notably the unmistakable underlying form of a drowned, glaciated

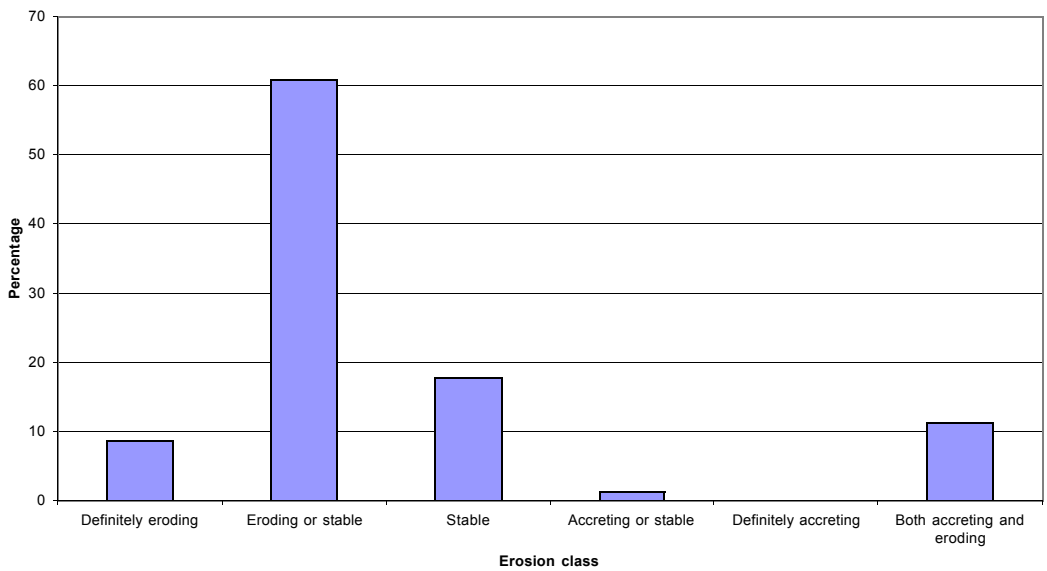

Figure 10.7. Graph showing the erosion classes for the coastline surveyed.

landscape and various specific locality examples of recent inundation (cf Long 1996, vol 1, 104). It is not clear whether these examples represent regional trends or merely the effects of local factors within estuarine environments. However, they do illustrate the vulnerability of much of the cultural landscape in this region. Approximately 75 per cent of recorded sites and most archaeologically sensitive areas were either wholly or partially located less than 10 m above sea level.

The area has not been the subject of any detailed geomorphological studies, and for this reason it is difficult to determine conclusively the current trend in sea level fluctuation. It is possible that the rate of eustatic sea level rise is either matched or being outstripped by isostatic uplift, as raised beach deposits were generally observed to be intact, with few indications of active erosion or inundation. Therefore, it is probably reasonable to conclude that relative sea level is fairly constant, and that with the exception of certain estuarine situations which characteristically have high tidal ranges, the trend of slow land surface re-emergence is probably continuing.

Much of the coastline is sheltered from the full effects of high-energy wave activity by a group of offshore islands (The Summer Isles), but some exposed headlands do display clear evidence of mechanical erosion. In general, the underlying bedrock is highly resistant to erosion, though substantial raised beach deposits which would be vulnerable to concerted wave activity under adverse conditions are located throughout the study area. These deposits are often located in relatively exposed situations, such as the relatively populous Achiltibuie/Badenscallie area (Figure 10.8).

Figure 10.8. Low, peat covered shelves and raised beach deposits characteristic of the relatively fertile coastal landscape of Badenscallie, showing lazybeds and field boundaries extending to the coast edge. Torridonian sandstone is the underlying bedrock.

In this area several archaeological sites are located along the coast-edge. In particular, an 18th/19th-century structure at Port Allt a' Ruisteal, Achiltibuie is currently collapsing as a result of wave erosion (Figure 10.9). Unfortunately, there have been no detailed geomorphological studies into wave or tidal behaviour in this area (Bryan 1994, 3.1–3.5), and so the full extent of this potential problem is difficult to assess. In particular, the normal limit of the wave-affected zone under storm conditions and the documented effects of extreme events on the coast-edge are not known.

Figure 10.9. A structure at Port Allt a' Ruisteal experiencing active coast edge erosion. This was an unusual occurrence in the study area.

In general, the sites inspected during the field survey are not greatly at risk from coastal-related erosion (Figure 10.10), with only limited indications of active erosion, the principal exception being a highly significant structural complex and midden deposits exposed in a degraded sand dune system at Achnahaird Sands. However, owing to the close association between human activities and the sea, 26 per cent of recorded sites are considered vulnerable to future erosion or inundation. This particularly applies to low-lying sites in exposed situations close to the coast-edge (eg Achlochan Broch), which have begun to degrade more significantly in recent years. There is clearly a need for ongoing monitoring of these areas to ensure that management decisions are based on the most up-to-date information on erosional status.

The human impact on the coast-edge from the construction of coastal defences, harbour reconstruction, residential development and other processes is minor at present, though seven locations were identified as having experienced recent developments, having developments in progress, or having further developmental potential. The list below indicates the nature of coastal developments in the study area and thus provide a basis on which such activities can be monitored.

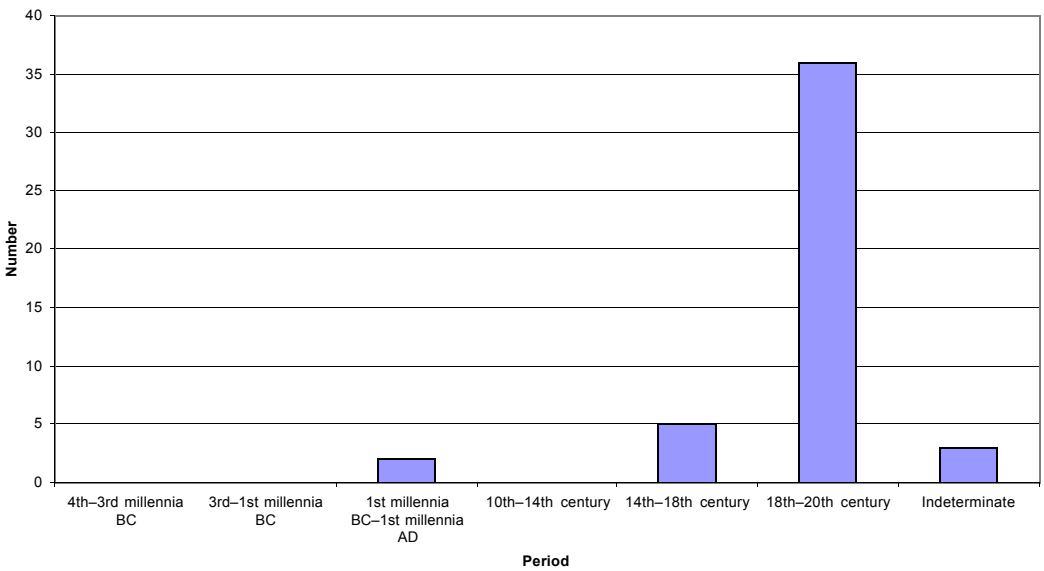

Figure 10.10. Graph showing the number of vulnerable sites, grouped by date.

- *Morefield* – Building site is under construction on the north side of the Ullapool River. This area contains a documented 18th-century settlement.
- *Ardmair Point* – Recent caravan and chalet park constructed on the site of an 18th/19th-century township and fishing depot.
- *Poll a' Chreadha, near Ardmair* – Recent salmon farm depot constructed on the site of lazy bed cultivation plots and a possible structure.
- *Lochan Sàl* – Recent salmon farm complex occupying site of an 18th/19th-century building.
- *Inverkirkaig* – Recent chalet construction in the area of an 18th/19th-century township.
- *Strathan* – Recent chalet construction in the area of an 18th/19th-century township.
- *Lochinver* – Recent construction of new harbour facilities in the town.

Discussion

The study results demonstrate that in general the coastline between Ullapool and Lochinver is slowly eroding, though there are few significant sites under immediate threat from coastal erosion or related processes. The reasons for this are considered to be:

- the sheltered aspect of much of the coastline
- the resistance of the underlying bedrock
- the limited effects of sea level change
- the restricted number of fragile coastal dune systems
- a low level of coastal development in the region.

The built heritage and archaeology of the study area are significantly influenced by the coastal littoral, demonstrating the strongly maritime character of the regional economy. Raised beach deposits and other coastal terraces formed a significant focus for settlement throughout the post-medieval period, with comparatively limited development of the hinterland. Historically, the Coigach Peninsula and other outlying coastal settlements have been dependent on the sea for a range of resources and communications, and this is reflected in the distribution and character of archaeological sites and the built heritage. There is good evidence to suggest that the local townships had considerably greater contact with the offshore islands and adjacent coastal communities than with the rugged and mountainous hinterland, which acted as a considerable impediment to inland communications.

One reflection of this local dependence on the sea is a very high proportion of sites with a coastal-related function (eg boat nausts and kelp kilns), associated with places of an otherwise domestic or agricultural character. The distribution of other activities, such as cultivation and peat cutting, also appears to have been strongly influenced by the sea, partly due to the availability of good soils on raised beach deposits, but also due to the relative ease of access by boat, as attested by the number of tiny, isolated plots of cultivated land nestled in remote inlets around the eastern shore of Enard Bay.

It is consequently unsurprising that many sites are located in highly exposed situations on the coast-edge (eg Achlochan Broch) and may be vulnerable to coastal erosion if there is a general worsening in climatic conditions, a rise in sea level, or during extreme storm events. Approximately 75 per cent of all recorded sites

are located in a zone less than 10 m above sea level, including extensive settlements and field-systems occupying low-lying river valleys which extend a considerable distance from the coastline (eg Strath Canaird). Sites in these locations may be at risk from marine transgression. At present, the effects of submergence are localised to certain bays and inlets (eg Loch of Reiff and Achnahaird Bay; Figure 10.11), where existing land surfaces are experiencing increasing tidal inundation and erosion.

Figure 10.11. A former dyke along the western side of Achnahaird Bay, showing the effects of marine transgression.

There was observable evidence of active erosion at various points along the coast, and five sites (2 per cent of site population) are considered to be under threat from coastal erosion or related processes. In general, it is considered that the threats to these sites are minimal, and the generally low significance of the archaeology does not warrant immediate intervention. However, the site of Achnahaird Sands is considered of exceptionally high significance and the threat to the exposed structures and deposits is immediate. The geomorphology and topographic setting of this site are unique throughout the study area, and the exceptional site exposure is providing a remarkable opportunity to study the late prehistoric to post-medieval occupation of the Highlands at a single site. It is probable that sites similar to Achnahaird Sands are situated in positions of similar local importance around the western seaboard, though to date Achnahaird represents the only documented example. This is due to a combination of the exposure conditions, the context provided by this study and the depth of associated research (Long in prep).

In addition, a buried structure at Acheninver has not yet been fully assessed. Sub-surface testing and/or trial trenching is required in order to determine its full significance. It is located in a fragile environment and it is possible that sand quarrying will recommence and further disturb the structural remains.

In general, very few site elements have been directly affected by land development, though that which has occurred has focused on raised beach deposits in the proximity of documented townships and associated field-systems. It is apparent that these areas have acted as a focus for settlement since their formation in the period 5000–2000 BP, and therefore have high archaeological sensitivity.

On a methodological note, the involvement of local groups, such as the Loch Broom Field Club, in an ongoing consultative process has had considerable value in both facilitating the fieldwork and providing support for management recommendations outlined in the report (Long 1996). As a result, the significant multi-period occupation site at Achnahaird Sands is now the subject of a salvage recording and survey project initiated and managed locally through the Coigach Community Council (Farrell & Ross in prep). This local interface has been instrumental in guiding the project through important community issues concerning land access, ownership of information, and publicity releases. This approach may not have been possible through traditional government sponsored or university research programmes.

Recommendations

The extent to which the coastal situation between Ullapool and Lochinver reflects the overall status of the western mainland seaboard is unclear at present, given the absence of comparative research. While the general processes observed in this stretch of coastline will be broadly similar at a regional level, variations in aspect, exposure and geology may significantly affect the local erosional status. If the evidence provided by the ULCAS can be considered representative of the West Highland coast as a whole, it is anticipated that there is considerable unrecorded coastal archaeology. Only a small proportion of this is at risk thanks to a combination of factors, including the resistance of the bedrock, the limited effects of sea level change, and isolation from commercial development. Nevertheless, in localised areas, significant sites will occur in highly fragile landforms which are experiencing erosional threats, in particular coastal machair, dune systems, low-lying raised beaches, and alluvial fans.

In this sense, the erosional status of this region appears to be different from the research presented from the Outer Hebrides, Northern Isles, or the estuarine environments of southern and eastern Scotland, where the erosion of the archaeological record is perhaps more pronounced and less localised. Given the extended length and isolation of the Highland coastline, the priority for future research should arguably be the rapid identification of sensitive locations, perhaps through a thorough desktop assessment, followed by a programme of small pilot surveys, rather than the wholesale survey of arbitrary stretches of coastline. These could be followed by more intensive site recording projects, leading to detailed management planning documents. While the ideal would be to aim for complete coverage of the western seaboard, the practicalities and expense of undertaking field survey in relatively inaccessible parts of the mainland coastline, not to mention offshore islands, would prohibit the effective collection of data within a reasonable time frame, thereby compromising site integrity in the short to medium term.

In future studies of this nature in the Highlands, it is recommended that the survey area be expanded to include all land less than 10 m above sea level. This study has demonstrated the correlation between settlement and the flat, low-lying land suitable for cultivation on raised beaches and in river valleys, and the degree to which this land extends inland from the immediate coastal strip. The potential risk to these sites would be high in the event of marine transgression.

In relation to the specific ULCAS study area, it is recommended that:

- Further work should involve an examination of the marine zone, concentrating on selected slipway and boat naust complexes in the area (eg Old Dornie). There was a high correlation between the occurrence of recent boat remains and these sites, and it may be possible to demonstrate an early phase of use for these features through an examination of the marine zone in conjunction with local oral research and the excavation of selected nausts. This is considered of particular value given that sites on the coast-edge are especially vulnerable to mechanical wave erosion.
- The offshore islands (eg The Summer Isles) require a separate investigation to establish the nature of the archaeology and built environment in these locations, and the effect of coastal processes on the natural and human environment. It is postulated that a greater degree of erosion will be observed due to their increased exposure, particularly on their western coasts. The sheltered nature of much of the mainland coast is due in part to the interruption to longshore wave activity caused by offshore islands. To date, there has been no systematic survey of these islands, though several important chance discoveries have been made, including Early Christian sculpture and a large steatite bowl. As discussed above, the strongly maritime character of the local economy would suggest that the coastal archaeology of these islands is likely to be as rich and diverse as the mainland.
- Any future developments involving extensive ground disturbance to raised beach deposits should be monitored closely given the clear association between these locations and past human activity. This is particularly important given the current poor understanding of human occupation in the Highlands apart from the immediately evident 18th/19th-century settlement pattern.

References

Atkinson, J, Banks, I & MacGregor, G (eds) 2000 *Townships to Farmsteads: Rural Settlement Studies in Scotland, England and Wales* British Archaeological Reports British Series 293, Oxford.

Bryan, A 1994 *The Minch Review* Unpublished report, Scottish Natural Heritage and Comhairle nan Eilean.

Farrell, S & Ross, F in prep *Achnahaird Sands; Survey and Salvage Excavation 2000* Unpublished draft report to Historic Scotland and Highland Council.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Historic Scotland Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Johnstone, G & Mykura, W 1989 *The Northern Highlands of Scotland* Fourth edition, British Regional Geology, HMSO, London.

Long, A 1996 *Coastal Assessment Survey, Ullapool to Lochinver* 2 vols, Unpublished report to Historic Scotland.

Long, A in prep *Achnahaird Sands, Achiltibuie; an Assessment of a Late Medieval Highland Settlement and its Implications for the Wider Region* Unpublished MLitt thesis, Department of Archaeology, Glasgow University.

Price, R 1983 *Scotland's Environment during the last 30,000 years* Scottish Academic Press, Edinburgh.

11 ASSESSMENT SURVEY: THE INNER MORAY FIRTH

ALEX HALE AND MIKE CRESSEY

Introduction

The Inner Moray Firth Coastal Assessment Survey was undertaken in 1998 by the Centre for Field Archaeology, University of Edinburgh (CFA). CFA also undertook the Coastal Assessment of the Solway North Coast (Finlayson & Cressey this volume). The Inner Moray Firth survey encompassed the 160 km coastal strip from Inverness to Tarbat Ness (Figure 11.1). The area was chosen to encompass a variety of shoreline geology, coastal processes, and archaeological remains.

The project fits into the larger review of coastal archaeology funded by Historic Scotland. It also contributes to the wider regional interest of the management of the Moray Firth. The Moray Firth Partnership (MFP) has generated a management document which considers many topics, including: the landscape and cultural heritage; geology and geomorphology; marine and coastal environments; ecology; social and economic resources; and recreation and tourism. It also looks at coastal protection, planning and management (MFP 1999). The survival, detection and current state of the archaeological resource clearly cross-cuts a number of these subjects.

This paper illustrates the variety of archaeology within the survey area and analyses the survival and destruction of said archaeology with examples. It concludes with recommendations for future research.

Previous Work

Previous archaeological investigations have taken place along the coastal foreshore and the intertidal zone in the area over the past 100 years. In 1908, for example, the Reverend Odo Blundell visited a site in the middle of the Beauly Firth and after a brief investigation declared the site a crannog (Blundell 1909–10). More recent research into two shell middens revealed Mesolithic activity in the Inverness area and lithic scatters associated with one of the middens suggested that the site was used for tool production (Myers & Gourlay 1991). Intertidal research into the Beauly Firth crannogs established a chronological framework for the sites and limited excavations on one of the sites investigated structural and functional attributes of marine crannogs (Hale 2000 and this volume).

Methods

The aims of the survey were to gain baseline information, produce an inventory of the coastal archaeology, and provide a basis for more work including:

- detailed survey of important areas identified by the survey, prior to protection, excavation or abandonment
- monitoring of sites and stretches of coastline by local organisations and people

The methods used to undertake the survey were developed from Historic Scotland policy and procedure papers (Ashmore 1994; Historic Scotland 1996). Prior to the fieldwork, a full desk-based assessment was undertaken. This included:

- identification of a series of zones of accretion, stability or recession which were subsequently ground-truthed to verify the preliminary conclusions on their characteristics
- analysis of the local geological (drift and solid) maps, which provided background information on the types of foreshores and hinterland that would be encountered
- collation of the National Monuments Record of Scotland (NMRS) listings of sites and monuments in the survey area, with information from the Highland Council Sites and Monuments Record (SMR) and information from Historic Scotland on scheduled and listed buildings and designed landscapes

Aerial photographs were studied during the desk-based assessment. There are several series of aerial photographs relevant to the study area, including runs from the immediate post-war period, and surveys from the 1960s and 1970s, undertaken for land-use capability studies. More recent aerial surveys commissioned by Scottish Natural Heritage (SNH) were scrutinised for additional information. Although the Historic Scotland Procedure Paper on coastal zone assessments (Historic Scotland 1996) notes that the examination of several series of photographs and map sources can be expensive, it was considered that the time employed repaid the investment. This was especially true given the importance attached to aerial photographic analysis for the intertidal zone. In addition, it can be difficult in the field to determine

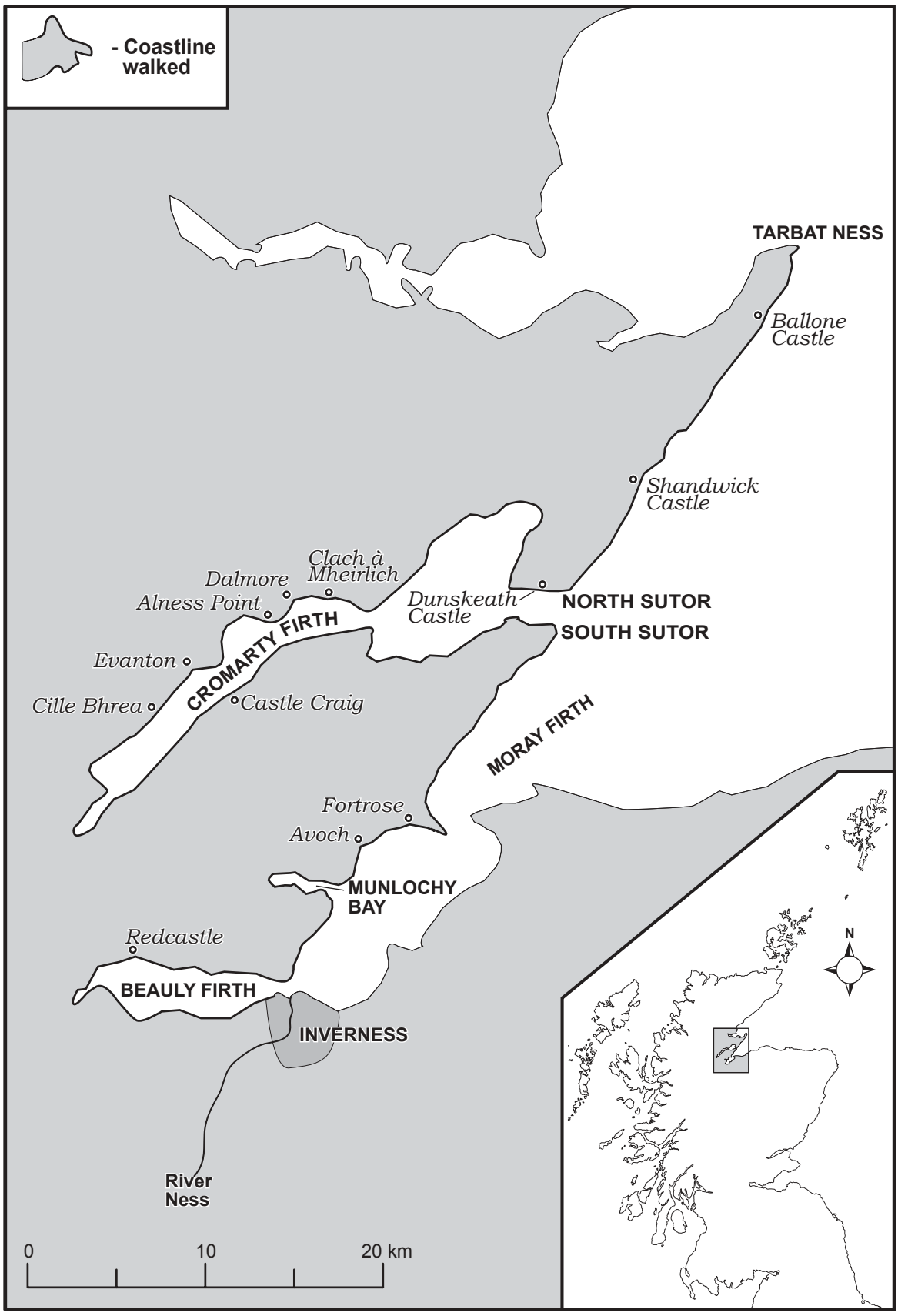

Figure 11.1. Location map showing the area of survey and places mentioned in the text.

whether a given stretch of foreshore is accreting, stable, or eroding; the aerial photographic record spanning over 40 years facilitated this.

Several geomorphological studies of the Inner Moray Firth coast have been undertaken. Recent work by Dr Andrew Haggart of London Guildhall University assessed the previous models of coastal change over the last 10,000 years. Using multi-analysis methods, he has proposed a remodelled sea level curve for the area (Haggart 1987; 1988). Some of the palaeo-environmental data required for the purposes of the project have also been consulted. However, as some of that work has not been directly driven by archaeological research, there are complications with compatibility of information.

Fieldwork

Information obtained during the desk-based stage ensured that the field survey covered a representative sample of the various combinations of environmental settings and monuments. Also, completion of the desk-based study before the fieldwork allowed the field team to be supplied with data assembled from the range of checked sources.

The initial fieldwork was undertaken in September 1998, during which full advantage was taken of the equinoctial tides and no time was lost to inclement weather. Two teams, each comprising two people, conducted an archaeological fieldwalking survey of the 160 km of coastline, during which they recorded the erosion status of sites, assessed vulnerable parts of the landscape, and checked the geomorphological observations. Hand-held Magellan GPS sets were used to generate 8-figure grid references for the location of sites, where local mapped features could not be used to provide a fix. The beaches beneath the North and South Sutor cliffs were not surveyed due to Health and Safety restrictions imposed by the restricted tidal exposure and access limitations.

Analysis

The results of the fieldwork are divided into two parts: the archaeology encountered; and the types of conditions that were affecting the archaeology. An overall view of the archaeology is outlined and is described in broad chronological divisions. The archaeology varied both in condition and period and this diversity is illustrated with two case studies.

Those sites in the NMRS and Highland SMR which are either find-spots or sites identified by aerial photography are not included in the survey data gathered here (Figure 11.2). Some other sites identified in the desktop assessment were not located, and there is a chance that some of these may have been lost due to coastal erosion. If the period of a site was unclear, either from structural form or previous record, it was included in the category 'Uncertain'.

Sites by date

The excavation of two shell middens in Inverness (Myers & Gourlay 1991) confirmed evidence of Mesolithic activity in the study area. The two sites occupy a terrace at about 9 m above current sea level on the delta formed at the mouth of the River Ness. No additional Mesolithic sites were discovered during the survey and the recognition of the above deeply buried sites resulted from development work.

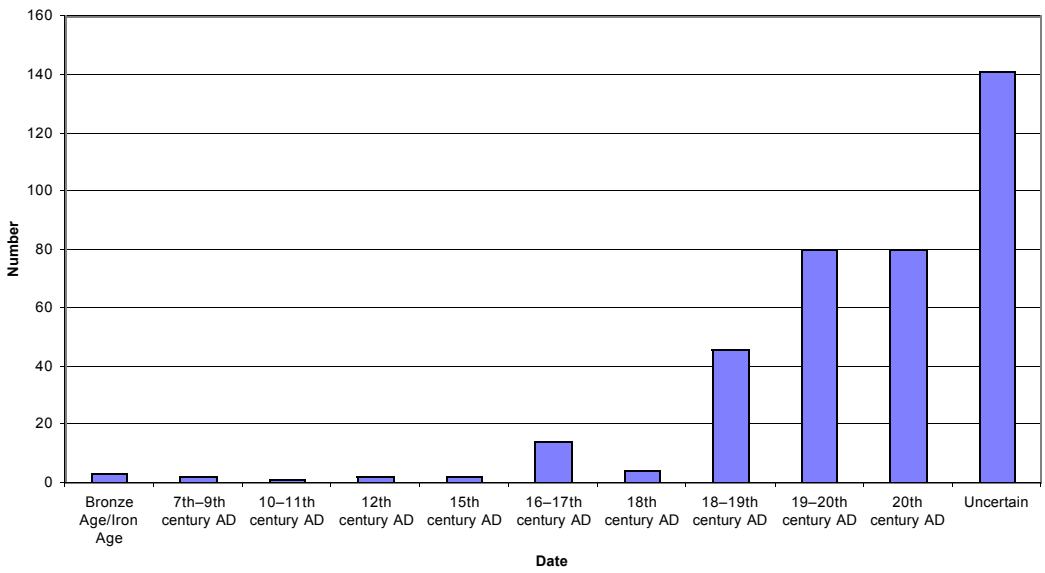

Figure 11.2. Graph showing the total number of sites located, grouped by date.

Despite there being Neolithic monuments in the region – Clava-cairn-type sites to the south and south-east and Orkney-Cromarty-type cairns to the north and west – no such monuments were recorded in the survey area.

There are two Bronze Age cist cemetery sites in close proximity to the survey area. The site at Dalmore on the northern shore of the Cromarty Firth was partially excavated during the latter part of the 19th century (Jolly 1879). The site contained a series of cists containing urns, vessels and burnt bone. The marine crannogs in the Beauly Firth were investigated recently and radiocarbon dates from three of the sites indicate that they were constructed and used in the later Bronze Age and Iron Age (Hale 2000).

There are a large number of Pictish Age symbol stones in or close to the survey area. The Clach A'Mheirlich, for example, which stands on the northern shore of the Cromarty Firth, is a class 1 symbol stone and probably dates to between the 7th and 9th century AD. Other Pictish symbol stones in the region are situated in close proximity to their contemporary coastal margins.

The pre-Reformation chapel, Cille Bhrea (Figure 11.6), is associated with an extensive burial ground. Radiocarbon dating of the skeletal material found there produced dates of the 10th and 11th centuries AD. Dunskeath Castle, standing on the southern edge of the North Sutor, is the only motte site in the survey area. It was fortified by William the Lion in 1179. The remains are now damaged by a military road and from ploughing. There are four other castles in the survey area. Shandwick Castle was built in 1460 and was subsequently completely destroyed; Castle Craig, on the southern shore of the Cromarty Firth, is a fine example of a 16th-century tower house with vaulted main floors. It remains in a poor condition with only the eastern wing standing to its full height. Redcastle, on the northern shore of the Beauly Firth, is reported to be located on the site of Edradour, erected by William the Lion. The castle was modified in the 16th and later centuries and now stands as a roofless shell. Ballone Castle, a late 16th-century, Z-plan tower house, on the southern shores of the Tarbat peninsula has recently been restored and is currently occupied.

Surrounding the Inner Moray Firth and the Cromarty Firth are five 17th-century grain stores known as girnels. These two-storey buildings were built by agricultural estate owners to store grain close to the production zones and also adjacent to the firths. Currently they are in good condition. Four are used as private housing and one, on the north shore of the Cromarty Firth, as a heritage museum.

The Caledonian Canal was one of the largest engineering projects in the early 19th century in Scotland and the sea lock, basin, lockkeepers' cottages, workshops, and hand crane are all included in the survey area. Other industrial archaeological sites include the harbours designed by Thomas Telford at Avoch and Fortrose. Quarries that provided stone for these structures, and the piers along which this stone was transported to awaiting barges, were located around the Beauly Firth and a concentration is found along the southern shore of the Cromarty Firth.

Early 20th-century monuments include World War I and World War II military complexes on the North and South Sutors (Figure 11.3), the remains of an airfield at Evanton and the RAF seaplane base at Alness Point. The heavy military presence attests to the importance of the Cromarty Firth, especially as a naval base, during both wars.

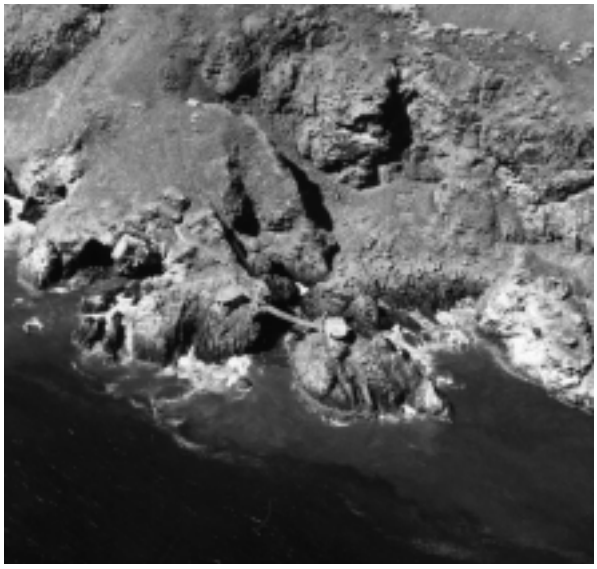

Figure 11.3.Aerial photograph of North Sutor coastal batteries.

Vulnerable sites

Analysis of the sites situated on the foreshore and hinterland (Figure 11.4) shows that within the foreshore category 40 sites were identified to be in a 'Fair' state of preservation, 72 were seen to be in a 'Good' state, and 120 were recorded as 'Poor'. In the hinterland category, 33 sites were found to be in a 'Fair' state, 83 were classified as 'Good' and 64 as 'Poor'. This analysis shows that there is a two-fold increase in the number of sites classified as 'Poor' in the foreshore category. This pattern is not unexpected given the number of sites seen to be undergoing active erosion. However, unlike sites located on the foreshore, archaeology in the hinterland is susceptible to additional forms of attrition, such as quarrying, plough damage, development projects and agricultural practices that may adversely affect the remains.

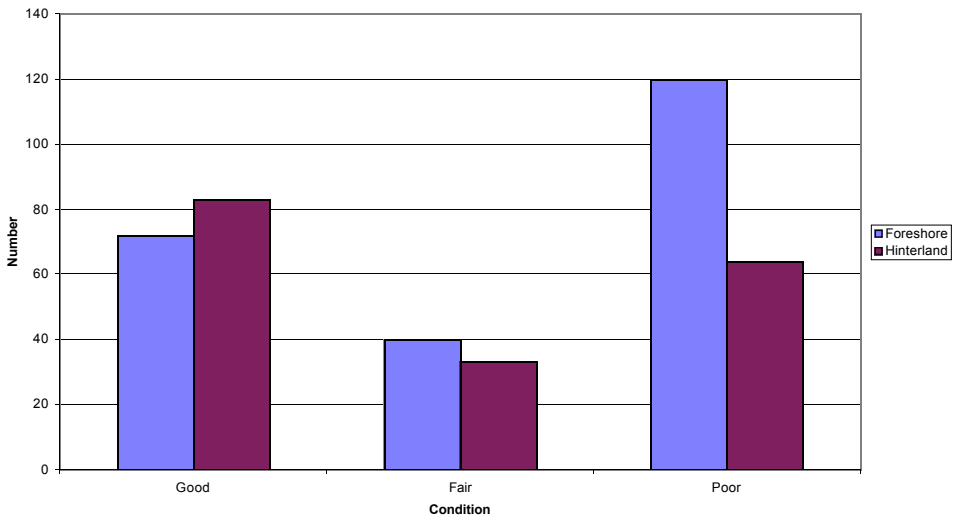

Figure 11.4. Graph showing the condition of sites on the foreshore and in the hinterland.

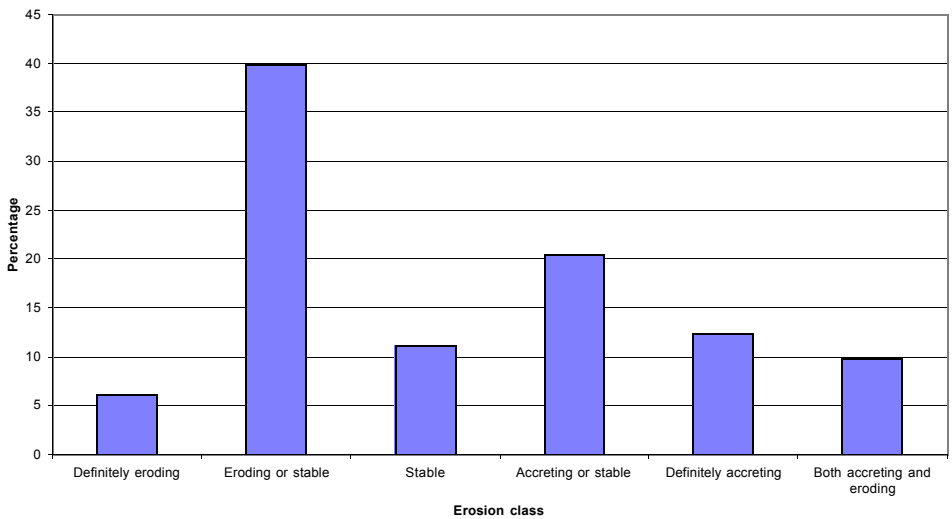

Figure 11.5. Graph showing the erosion classes for the coastline surveyed.

Geology and geomorphology

The study area as defined for the project comprises a wide variety of coastal landforms as a result of both the drift and solid geologies and coastal and terrestrial geomorphological processes. The landforms include precipitous cliffs characterised by the North and South Sutors at the mouth of the Cromarty Firth and north-east of Fortrose to Tarbat Ness. Estuarine environments are predominant within the Beauly and Cromarty Firths and Munlochy Bay, where intertidal mudflats, macro-tidal river channels and salt marsh are common. The geological structure of the Moray Firth has been comprehensively mapped and described by the British Geological Survey in *The Northern Highlands of Scotland* (1989). The dominant basement lithology comprises metamorphosed Moine sediment, unconformably overlain by Old Red Sandstone of Devonian Age. The Old Red Sandstone is locally exposed along much of the coastal sections and is overlain by younger rocks of Permo-Triassic and Jurassic Age. These rocks are derived from mainly non-marine sources such as aeolian dune sand and freshwater/brackish alluvial sediments.

Coastal erosion

The percentage of the total length of coastline cited is based on the straight-line measurement of each unit as mapped on the 1:25,000 map sheets. The combined length of all units is 166.8 km. The figure was used to establish the percentage frequency of each erosion class (Figure 11.5). This figure, however, is an underestimate of the true length of the coastline surveyed, as it does not incorporate the mean length of meandering rivers, deeply incised cliff-edges and other topographical irregularities along the coast. The figure does provide an indication of the relative significance of the results.

The 'Stable' and 'Definitely accreting' classes are more or less equal with 11.2 and 12.4 per cent respectively. The coastal units identified as 'Eroding or stable' achieved the highest frequency with 40 per cent. The 'Definitely eroding' class is represented by 6.1 per cent with a total of 15 individual coastal units. The 'Both accreting and eroding' and 'Accreting or stable' classes are represented by 9.8 per cent and 20.4 per cent respectively.

The results from the 'Definitely eroding' class confirm that only 6 per cent of the total length of coastline examined is being affected by serious erosion. This class includes areas where there are breaches in existing sea-defences or on undefended cliffs such as those below Cille Bhrea chapel. A great majority of the 'Eroding or stable' units are confined to the exposed rocky coastline of the North and South Sutors where erosion is ongoing, albeit slowly. Owing to the slow rate at which the cliffs are eroding, the locality could be classified as relatively stable.

Case Studies

The following case studies were chosen to illustrate the range of coastal erosion or accretion that is affecting some of the archaeology on the Moray Firth coastline. The archaeological importance of the case studies is contrasted with the effects of the various coastal processes.

Case Study 1: Cille Bhrea chapel

Cille Bhrea at Lemlair, on the north shore of the Cromarty Firth, was chosen on the grounds that it provided an excellent example of coastal erosion directly affecting a medieval archaeological monument (Figure 11.6). Recent excavations at the site (Rees 1998) focused on removing skeletal material from an eroding cliff, exposed as the shoreline continues to recede.

Cille Bhrea was reputedly founded in 1198 (Wordsworth 1997, citing Woodham 1956). The chapel was first excavated in 1966 and the excavation revealed a rectangular building with walls less than 1 m in height, a stone font, a possible communion table, and grave slabs. Numerous burials were also recorded (Wordsworth ibid). After 1966, a revetment wall was built at the base of the cliff in an attempt to slow down the rate of erosion, but this was subsequently lost. The site was afforded Scheduled Monument Protection in 1979. Further work was undertaken by Highland Region archaeologist Robert Gourlay in 1983. His sketch of the site denotes that 15 m in length of the 6 m high cliff was actively eroding, with six burials exposed in the cliff section. Based on the findings of the Damage Assessment Report undertaken by Wordsworth in 1997, which noted the exposure of human skeletal remains in the cliff section and scattered on the foreshore, further remedial work was undertaken by AOC in 1998 which aimed to place coconut fibre matting on the upper part of the cliff scarp to encourage vegetation growth and help to stabilise the section.

Figure 11.6. Cille Bhrea chapel under excavation by AOC in 1998.

The AOC excavation recovered valuable information on the density and nature of the burials within the graveyard and chapel. In particular, the presence of deep, complex archaeological deposits beneath the chapel suggest an extended use of the site (Rees 1998). The archaeological deposits were found to be shallow within the exposed cliff section (c 0.9 m) resting on unconsolidated marine sands and gravel.

Assessment of the site and its environs show that the stretch of coastline is affected by predominantly south-easterly winds and high spring tide surges. The site is therefore affected most adversely when these factors occur simultaneously, leading to erosion in what would be considered a relatively sheltered location. Prior to the AOC excavation, the unconsolidated nature of the exposed cliff was estimated to be retreating at about 1 m every 10 years. The archaeological and remedial work aims to reduce the loss of skeletal material from the cliff section for the next 20 years. However, unless the cliff is better protected by effective measures to reduce wave-hammer action and cliff undercutting, erosion will continue to affect the site. The case study demonstrates that the soft character of the underlying geology is a causative factor in coastal erosion at this site.

It can be concluded that erosion has been active over a long period of time and, even after the remedial works were implemented, skeletal remains have been found eroding out of the cliff section and lying on the beach below the site.

Case Study 2: Intertidal fishtraps

Fishtraps were one of the more common monuments recorded along the survey area in the intertidal zone (Figure 11.7). Fishtrap sites have been recorded in English, Welsh and Irish estuaries and further research would aim to complement previously known sites.

The fishtraps recorded during the survey were found in the intertidal zone between Mean High Water Mark (MHWM) and Mean Low Water Mark (MLWM). They are concentrated in two locations: the Beauly Firth and the Cromarty Firth, situated on shallow gradient mud or sand flats. They were built during the 17th–19th centuries to catch fish, especially salmon, that were abundant in the Inner Moray Firth. Seasonal runs of migratory salmon and sea trout swim through marine river channels that, at low water, often act as holding pools. The fish then use the ebb or flood tide to progress further down or upstream. The traps were placed at right-angles or oblique to the channels so that the fish were prevented from continuing their journey. Subsequently, as the tides fell, the fish were forced into the angles of the traps where they were unable to swim upstream or towards MHWM. They could then be caught with hand nets or in static nets.

Figure 11.7. Aerial view of two fishtraps on the southern shore of the Beauly Firth.

Three different types of fishtrap have been identified from documentary evidence: yairs; stake nets; and bag nets. Yairs are curvilinear stone or wooden structures that run perpendicular to the shoreline and curve, usually upstream, to form a bent arc. Wooden stakes interwoven with wattle have been recorded in some yairs, which show complex wattle and stake features at points along their length. Other yairs have been recorded with zigzag plans, designed to trap fish on both the ebb and the flood of the tide. Stake net traps comprise lines of stone mounds into which wooden stakes were driven and between which nets were strung. Bag nets comprise single lines of nets with stakes at either end, usually at MLWM. Evidence of these traps was found as single mounds in the survey area.

Sixty-two fishtraps were recorded in the survey area, compared with over 70 sites marked on cartographic sources dating between 1817 and 1909. Although the variation is not necessarily significant because it does not define the time-depth of individual monuments, it does indicate that the survival of these monuments is dependent on environment and situation. The surviving sites are located in sheltered situations in the Beauly Firth, Munlochy Bay and the Cromarty Firth and there are no remains found on the rocky shorelines between these firths and bay. All of the sites recorded were found to be in poor condition, probably caused by the effects of coastal erosion and/or accretion.

Discussion and Recommendations

Within the limitations of the rapid survey methodology, the results show that post-medieval archaeology is well represented and that many of these sites are located within the foreshore area. The survey also demonstrated that a great number of intertidal archaeological sites are being severely eroded. With reference to the fishtraps, the number of sites has been increased from 31 previously known to 62. Figure 11.4 illustrates the general condition of and disparity between sites and monuments located on the foreshore and those recorded in the hinterland at the time of the survey.

It is recommended that all sites identified as fishtraps that are currently affected by active erosion should be surveyed as soon as possible. The final loss of these remains is imminent and they should be subjected to detailed analysis.

The marine crannogs in the Beauly Firth represent almost 50 per cent of the total number of known crannogs in the intertidal waters of the Scottish coastline and therefore represent an important national resource. Monitoring of this limited resource would enable future management strategies to be developed for intertidal monuments of a similar nature. Additionally, further research into the structural and functional attributes of these sites would enhance the current database.

It is hoped that the results from this survey will contribute to any future policy on Coastal Zone Management and to a Shoreline Management Plan for the area. The results of the survey must be considered only as a snapshot and reflect the observations during the fieldwork season of September 1998. A new programme, including survey, should be undertaken within five years to compare and assess the changes that will have occurred since 1998. This form of medium-term survey project should also be incorporated into a long-term research and management strategy for the archaeology found associated with the coastline of Scotland.

Acknowledgements

The following contributed information and assistance prior to, during and after the Inner Moray Coastal Assessment Survey was undertaken and they are acknowledged with thanks: Rachel Harding-Hill and Heather Corpe at the Moray Firth Partnership; staff at the SNH office in Dingwall; and at the NMRS, RCAHMS, especially for aerial photographic and archive material; John Wood and Dorothy Low at Highland Council Archaeology Service for SMR data; Tom Rees at AOC Scotland Ltd, who provided unpublished archaeological data from the Cille Bhrea chapel excavation; HM Coastguard, Aberdeen, for tide tables and advice on health and safety issues; Mr P W Christie at Highland Council for geomorphology information and sea-defence data; and Annette Jack for information regarding local sites and useful advice for the survey team.

References

Ashmore, P J 1994 *Archaeology and the Coastal Erosion Zone: Towards a Historic Scotland Policy* Historic Scotland, Edinburgh.

Blundell, O 1909–10 'On further examination of artificial islands in the Beauly Firth' *Proc Soc Antiq Scot* 44, 12–33.

British Geological Survey 1989 *The Northern Highlands of Scotland* HMSO, London.

Cressey, M 1996 *Archaeological excavations of a Bronze Age cemetery at Seafield West, Inverness, Highland Region* Centre for Field Archaeology Report No 288.

Haggart, B A 1987 'Relative sea-level changes in the Moray Firth area, Scotland' in Shennan, I & Tooley, M J (eds) *Sea Level Changes* IBGSP 20, Blackwell, Oxford.

Haggart, B A 1988 'The stratigraphy, depositional environment and dating of a possible tidal surge deposit in the Beauly Firth area, north-east Scotland' *Palaeogeography, Palaeoclimatology, Palaeoecology* 66, 215–30.

Hale, A. 2000 *Marine crannogs: the archaeological and palaeoenvironmental potential* Unpublished PhD thesis, University of Edinburgh.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Jolly, W 1879 'Notice of the excavation and contents of ancient graves at Dalmore, Alness, Ross-shire' *Proc Soc Antiq Scot* 13, 252–64.

Moray Firth Partnership 1999 *The Moray Firth Management Guidelines and Action Programme* Internal report.

Myers, A M & Gourlay, R B 1991 'Muirtown, Inverness: preliminary investigation of a shell midden' *Proc Soc Antiq Scot* 121, 17–26.

Rees, T 1998 *An archaeological investigation of Cille Bhrea, Chapel: The data structure report* AOC Archaeology Group Report.

Woodham, A A 1956 'A survey of the Prehistoric monuments in the Black Isle' *Proc Soc Antiq Scot* 88, 65–95.

Wordsworth, J 1997 *Cille Bhrea Chapel and Graveyard* Damage Assessment Report commissioned by Historic Scotland.

12 ASSESSMENT SURVEY: FIFE

PHILIP ROBERTSON

Introduction

The coastline of Fife was surveyed on two occasions in 1996 by Maritime Fife, University of St Andrews (Figure 12.1 and Figure 18.1). The first survey (referred to in this report as the south survey) covered the north shore of the Forth Estuary and Firth of Forth from Kincardine to Fife Ness, a section of approximately 107 km in length. Two teams of two archaeologists completed the fieldwork over a period of 12 days in January 1996 (Robertson 1996). The second survey (subsequently referred to as the north survey) extended from Fife Ness to the Fife boundary west of Newburgh, a section of approximately 85 km in length, and was undertaken over a period of 11 days in October 1996 (Robertson & Miller 1997). Due to lessons learned after the completion of the south survey, it was decided to add a geomorphologist to the survey teams.

Previous Work

There have been numerous general works about the Fife coastline (eg Martin 1989), but before Historic Scotland's Coastal Survey initiative (Ashmore 1994; Historic Scotland 1996), only limited survey work had been undertaken on isolated sections of coastline. Attention has been given to particular aspects of importance, such as: the collection of caves around East and West Wemyss (Walker & Ritchie 1987); the Mesolithic site at Morton Farm (Coles 1971); the small harbours of Fife (Graham 1968–9); industrial monuments associated with saltworkings (Ewart 1993); coal workings (Martin 1979); wartime defences (Guy 1994); shipwrecks (Dobson 1996; 1997) and the Tay Estuary salmon industry (Robertson 1998).

Aspects of geomorphology have been examined in some detail by several studies (eg McManus & Wal 1996; Jarvis & Riley 1987). Erosion has also been written about, but from a geomorphological

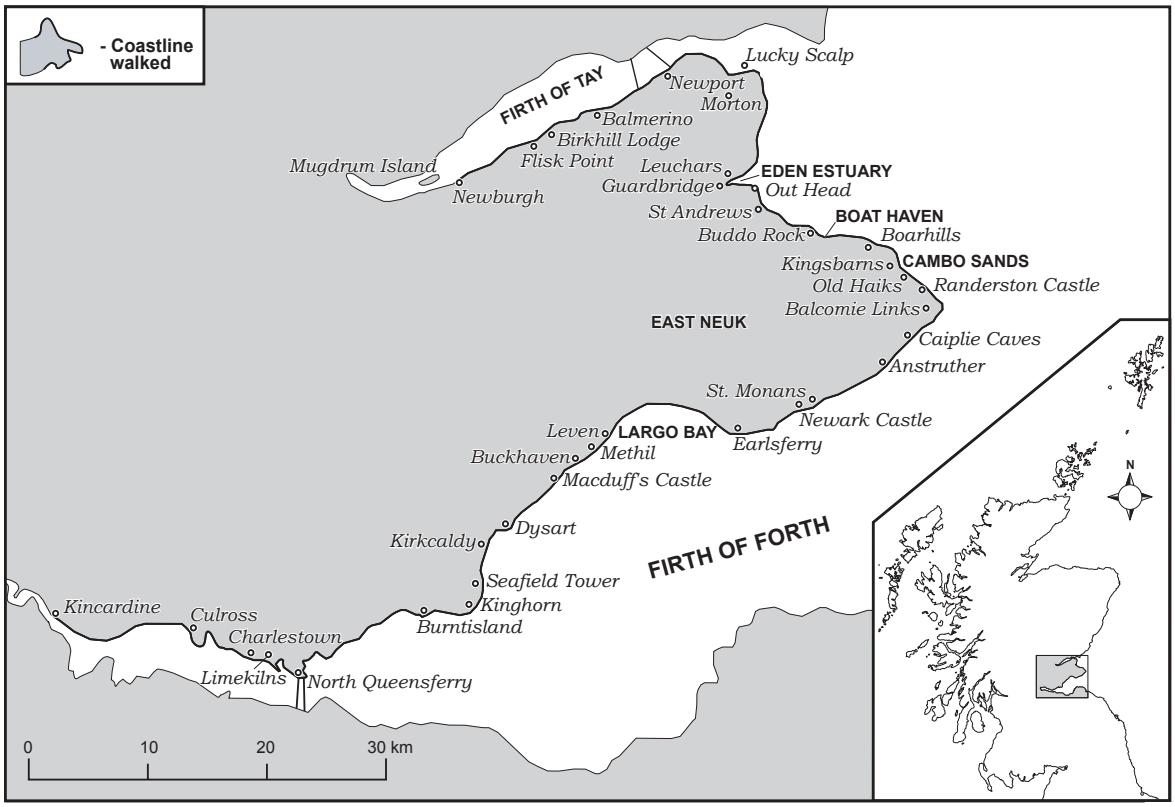

Figure 12.1. Location map showing the area of survey and places mentioned in the text.

perspective, and particularly in relation to known trouble spots such as West and East Wemyss (Miller 1997).

Methods

Research into documentary sources (Fairfax 1996) and aerial photographs preceded the field surveys. The principal objective was to undertake a rapid assessment of the coast edge, intertidal zone, and a 100 m landward strip. Surveys were timed, where possible, to coincide with low water windows and all records were plotted onto Ordnance Survey 1:25,000 Pathfinder maps. Field positions were derived from a hand-held GPS unit to an estimated accuracy of 30–100 m depending on signal strength. However, a number of sites low down on the intertidal zone may have been missed due to tidal height fluctuations. Ministry of Defence restrictions limited recording of the coast-edge adjacent to Leuchars RAF base and Rosyth Naval base.

Analysis

Built heritage

Monument status	Number of sites, south survey	Number of sites, north survey
Protected Ancient Monuments	44	11
Other known monuments	471	6
Monuments formally proposed for designation	3	1
Listed Buildings	14	91
Wrecks	11	5
Designed landscapes	2	0
Sites discovered during survey	179	203
Total	724	317

Table 12.1. Sites according to status, north and south survey.

The south survey identified 724 sites within the target area, 179 of which were not listed in the National Monuments Record of Scotland (NMRS) or the Fife Sites and Monuments Record (SMR). The north survey located a further 317 sites, 203 of which were not previously recorded (Table 12.1; Figure 12.2). The majority of these 'new' sites were identified on the foreshore, where little survey work has been undertaken to date. A smaller number were seen on the eroding face of the coast-edge.

Sites by period

Period	Number of sites, south survey	Number of sites, north survey
Uncertain	78	60
Prehistoric	4	11
Roman to Early Christian	9	2
Medieval	20	20
Post-medieval	516	150
20th-century	97	74
Total	724	317

Table 12.2. Sites by period, north and south survey.

Evidence of a very early environment can be seen in the fossilised trees visible on the shore near Crail. An early land surface was also exposed on the muddy foreshore of the Tay Estuary between Birkhill Lodge and Flisk Point. Here remains can be seen intermittently along a 1.5 km stretch of coast, visible where localised scour has removed the thick alluvial deposits which form the mudflats elsewhere. The land surface is characterised by outcrops of waterlogged organic remains of trees, shrubs, and seeds of other plants in a 17 m wide strip that runs parallel to the shoreline and is exposed only at low water. This land surface, if it is contemporaneous with the peats found below the Morton Lochs National

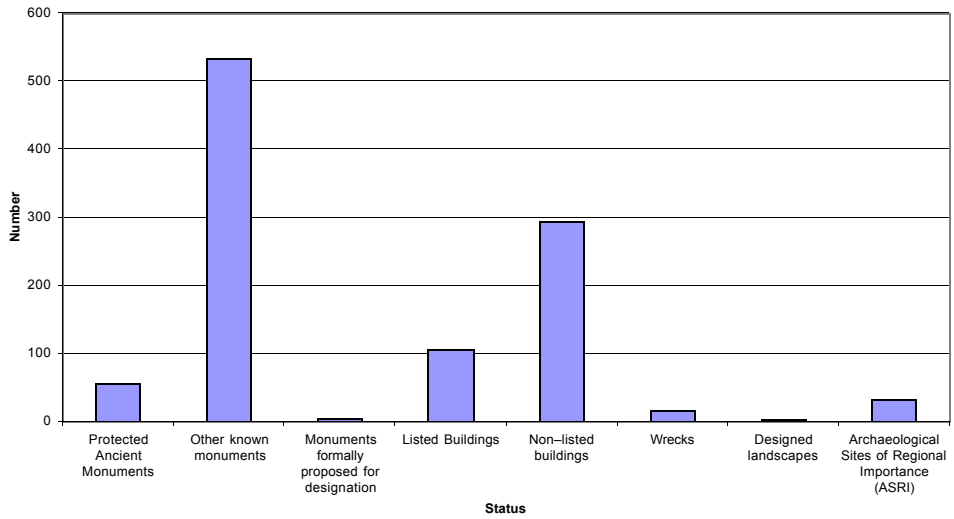

Figure 12.2. Graph showing the total number of sites located, grouped according to status.

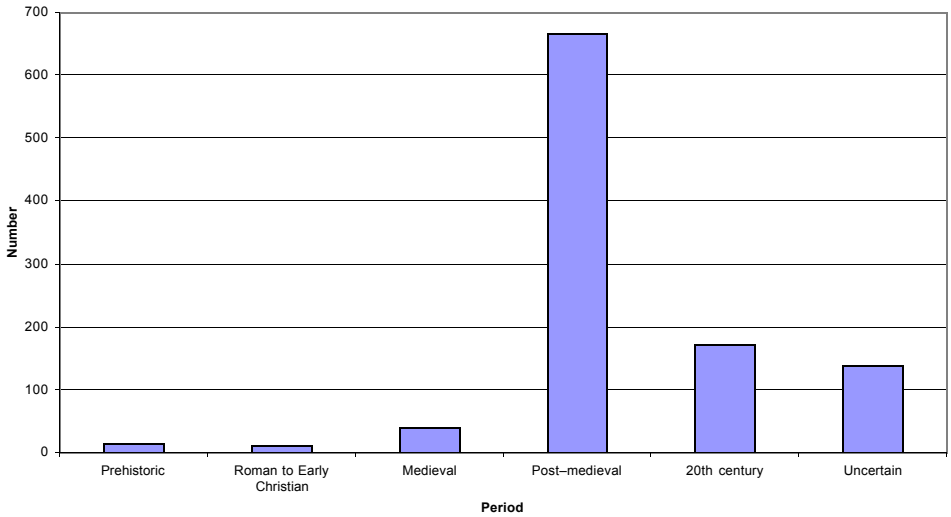

Figure 12.3. Graph showing the total number of sites located, grouped by period.

Nature Reserve, may date to around 5500 years ago (McManus 1999).

As far as we know, the earliest settlement of the Fife coast took place during the Mesolithic (Figure 12.3), as can be seen in a series of temporary camps discovered, including one at Fife Ness (Wickham Jones & Dalland 1998) and a second at Morton, Tentsmuir (Coles 1971).

The identification of a number of shell and pottery middens along the coast-edge of the East Neuk (Elie; Pittenweem; Crail) may be prehistoric, but could be more recent (Sloan 1984). The same is true of a number of intertidal sites, cautiously identified as fishtraps. Many of these sites may have been in use recently, and have been included in the 'uncertain date' category. The NMRS lists several scattered finds dating from the Bronze Age or earlier. Examples include beaker pottery from St Andrews and a Neolithic flint mace-head found in the banks of the Tay at Newburgh. Mugdrum Island, opposite Newburgh, has yielded some Bronze Age artefacts. Taken together, these finds confirm settlement of the upper Tay Estuary since prehistoric times.

Eleven sites of Roman to Early Christian date were identified. Evidence of Roman activity along the Fife shore is limited to scattered finds (eg Boat Haven pottery and finds from Constantine's Cave), pointing to contacts between Romans and natives of Fife (Hunter 1996).

The Picts have left more of a mark on the Fife coastal landscape with both burial sites (eg Old Haiks Long Cist; Lundin Links) and carvings within cave systems (Constantine's Cave; Randerston Castle Cave; Kinkell Cave) which are found in raised beach deposits to the south-east of St Andrews. Other caves with Early Christian carvings include those at East Wemyss and Caiplie.

The early medieval period saw the development of the feudal state and reorganisation of the Church. Many of the important ecclesiastical monuments and buildings at St Andrews date to this period and a Cistercian monastery was established at Balmerino. As transport by sea was the cheapest form of travel, these ecclesiastical centres also became administrative and trading hubs for produce and minerals from the fertile farmlands and the coastal fringe.

The majority of sites identified during the survey were of post-medieval date. This reflects the considerable development and industrialisation which has taken place since the 19th century. The majority of 20th-century coastal sites are military defences from World War I or II.

Sites of all date by type

Parts of the coast of Fife have been heavily developed in the past, especially the north shore of the Forth. There are also major conurbations at St Andrews, and in the coastal fringe between Tayport and Wormit. This is reflected in the number of buildings and other large built structures noted. A domestic or industrial function can be attributed to the majority of these buildings. In terms of domestic architecture, the town of St Andrews is important for its medieval buildings. The burgh of Culross is also particularly important and has a number of listed building in its coastal zone. Newport and Tayport have significant numbers of listed buildings behind the coast-edge. These mostly date from the 19th century when the area was developed as an attractive suburb of Dundee. The vernacular architecture of some of the East Neuk fishing villages is also worthy of note.

The majority of the industrial structures noted relate to the coal, salt, lime, or shipbuilding trades on which the area thrived following the Industrial Revolution. The

Figure 12.4. Wreck on the foreshore at Wormit with the Tay Railway Bridge behind.

best examples of coal workings, complete with associated structures, can be found at Frances Colliery, north-east of Dysart. Saltpans were established as early as the 16th century at Kirkcaldy, Dysart, Culross and West Wemyss (Ewart 1993), and limekiln working was concentrated in the area around Charlestown and Limekilns. The main shipbuilding centres were at Kincardine, Burntisland, Kinghorn and St Monans (Middlemiss 1995).

The development of quays and wharves at Guardbridge, on the Eden Estuary, is associated largely with the paper mill. The south shore of the Tay also supported several industries, and Newburgh and Tayport were long-time centres of linen manufacture in north Fife. Tayport had a jute and linen spinning mill and two linen factories. Tayport also had a sawmill which supplied shipbuilding concerns elsewhere in Fife.

The coastal location of these industrial centres afforded ease of transport by sea to the market-place. Poor roads made transport by sea desirable (Figure 12.4).

By the 10th century, there were reports of at least ten landing points on the Firth of Forth (Graham 1968–9). St Andrews overlooked a natural harbour at the mouth of the Kinness Burn and this was developed. Increasing trade in and out of the royal burghs saw the development of a string of harbours from the 16th century, and new harbours such as Charlestown, were built in the 18th century to serve new industries. A private landowner built the harbour at Kingsbarns for the export of potatoes. While some of these harbours were of considerable size, there are also numerous rudimentary landing places where natural features have been crudely enhanced These appear to be most common between Elie and Fife Ness and there are examples at Earlsferry and near Randerston Castle.

Fife has several coastal castles, built by prominent medieval families (Fawcett 1992). However, the majority of defensive or military sites are more recent (Guy 1994). The industrial hub and naval bases of the Forth were a target for German attack during the two world wars. Military defences such as anti-aircraft positions and radar posts are scattered along the prominent headlands of the Forth, while tank traps (eg North Queensferry) can be found along sandy beach locations to prevent air or seaborne invasion.

The coastline around Tentsmuir was also considered a potential landing point for seaborne invasion during World War II. The dune systems and sand beaches in the vicinity preserve evidence of a wide range of associated features including tank traps, glider traps, observation posts, command posts, and pillboxes (Figure 12.5).

Marine produce was an important part of the diet of the first inhabitants of Fife as is evident from fish bone finds identified at Morton. A number of fishtraps were found varying from cruive banks (Kincardine), to a possible stone fish trap (Leven), and stake net traps (Leven and Largo Bay). Fishtraps were also recorded in the Eden Estuary and east of Tayport. Many of these

Figure 12.5. Collapsed tank traps at Tentsmuir, originally built on dry land.

traps were used until very recent times. The dating and interpretation of these and other intertidal features, such as a possible crannog discovered near Crombie, requires more study. This 'crannog' was interpreted as a temporary boat hard in a subsequent study (Wood 1997b).

Collapsing bothies, fishing platforms, decaying harbours, and salmon cobles associated with the salmon fishing industry are commonplace, particularly on the south shore of the Tay, but isolated examples are found elsewhere (Boarhills; Kingsbarns). Salmon fishing on the Tay has probably taken place since at least Roman times and certainly since the 12th–13th centuries. An industry centred on Newburgh has been in existence for almost 250 years (Robertson 1998; Atkinson 1996).

While harvesting of marine produce has been important since Mesolithic times, farmers working the rich agricultural land on the southern banks of the Tay and along the coastal fringe of the East Neuk also benefited from the sea. Cart tracks cut into the rock platform (eg Pittenweem) allowed access onto the shore for the harvesting of marine produce to fertilise fields. Evidence of the reorganisation of land during the 19th century can be seen in the form of stone dykes marking field boundaries. In places, these extend well down onto the foreshore.

The intertidal muds which dominate the shore west of North Queensferry are very conducive to the preservation of organic remains. At Kincardine, the maritime history of the town is preserved in a collection of 14 foreshore ship hulks, cruive banks, walkways and piers (Wood 1997a). Navigation of the numerous sandbanks, rocks and islands of the Forth caused numerous shipwreck casualties (Dobson 1996). The coastline from Fife Ness to Tentsmuir Point was also treacherous. These hazards in turn brought about the construction of buoys, beacons, lightships and lighthouses around the Fife coast from the 18th century. Notable sites include the Pile Lighthouse, east of Tayport, and the lighthouse construction site at Fife Ness. At Fife Ness, circular indentations have been carved into flat bedrock on the foreshore. A pivot hole, 0.7 m in diameter, can be seen at the centre of one circle. Other indefinite traces of rock cuttings in the rocks can be seen nearby. These features mark the base for construction work carried out in the early 19th century on Robert Stevenson's lighthouse for the North Carr Rocks.

Despite efforts to warn ships of danger, between 1898 and 1908 there were 87 shipping casualties between the Eden Estuary and Anstruther (Dobson 1996). Along exposed sections of coast, such as the East Neuk, the major reminders of such incidents that have survived are the boats that have come to rest in soft sediments. The sandy beach at West Sands has helped to preserve remains of the *Wilhelmina* or the *Jean*. Low down on the foreshore near Cambo Sands can be found the remains of what may be the Torpedo destroyer *HMS Success*. A lone steam boiler, reputed to be from the steam trawler *Gairloch*, lies on the shore near Anstruther. Wrecks were also found in soft seabed sediments at Tayport and near Newport. The latter site is located adjacent to a complex of collapsed wharves connected with the construction of the Tay bridges (Wood 1997d).

The non-local, coarse pebbles and cobbles which comprise the island of Lucky Scalp, east of Tayport, may be ship's ballast. It is suggested that this was transported to Tayport on lighters prior to trans-shipping of cargoes for Perth from larger vessels moored off Tayport (McManus 1999). Salmon fishermen subsequently used ballast piles to create the island of Lucky Scalp as a source of shelter and refuge. The island hosted a stone-built 20 m high structure which combined the functions of salmon fishing

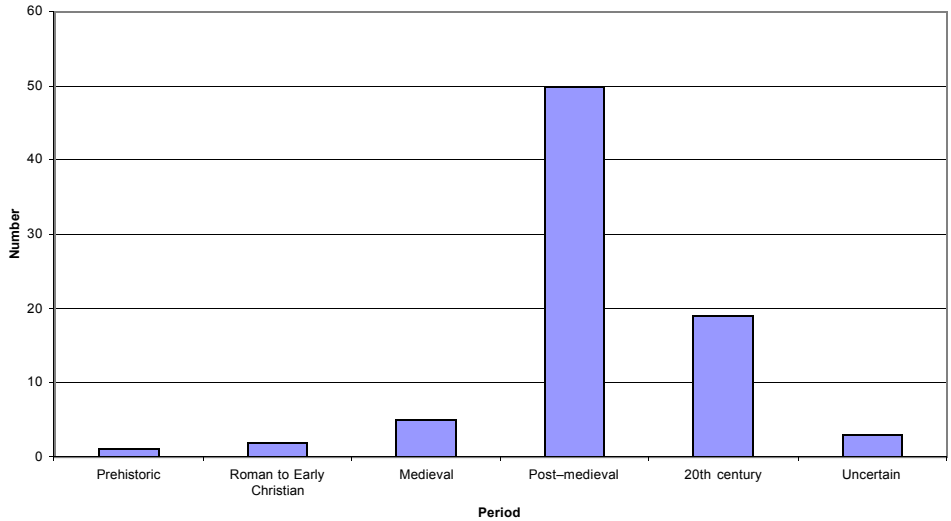

Figure 12.6. Graph showing the total number of vulnerable sites, grouped by period.

station and navigation beacon (McManus 1999). Ballast remains can be found elsewhere on the shores of the Tay. Estimates suggest that between 100,000 and 200,000 tons of material were imported to the Tay Estuary by shipping during a period of at least 100 years (McManus 1999).

Vulnerable sites by period

Period	Number of sites, south survey	Number of sites, north survey
Prehistoric	0	1
Roman to Early Christian	2	0
Medieval	5	0
Post medieval	15	35
20th-century	6	13
Uncertain	3	0
Total	31	49

Table 12.3. Vulnerable sites by period, north and south survey.

Potentially the earliest site to be at threat from erosion (Figure 12.6) is the land surface situated between Birkhill Lodge and Flisk Point. At the time of survey, the area may have been undergoing accretion, but localised scour at the visible edge of this mudflat was caused by the flow of the estuary, and hollows in the flat indicate that cyclical erosion has exposed this feature in the past.

Other early sites which appear to be vulnerable include middens and burials found in soft deposits along an eroding face. Middens at Crail and Pittenweem were identified as being at risk. As they are situated above the High Water Mark, the present threat to them is more from wind, frost, and water run-off erosion than from marine action.

The Pictish cist at Lundin Links is also threatened. Three bones were discovered protruding from a topsoil and sand layer which overlies bedrock. These originated from a collection of long cists first identified during quarrying work in the 19th century (Henshall 1956). The cists have eroded due to slumping of the coast-edge deposits, a process which has been continuously observed since their discovery (Maclagan-Wedderburn 1967). Erosion was occurring rapidly during the time of the survey due to strong easterly winds and high spring tides.

The erosion of coastal deposits north-east of Macduff's Castle is of particular importance because the coastline here conceals a string of sandstone caves protected by boulder defences (Figure 12.7).

Figure 12.7. Aerial view of MacDuff's Castle, East Wemyss, with the caves visible at the base of the cliff.

The Wemyss Caves bear Pictish inscriptions dating broadly to the 1st millennium AD (Walker & Ritchie 1987). It must be stressed that the caves are not imminently threatened by coastal erosion. However, the boulder defences deployed parallel to the caves do not appear to be stable in the long term and the situation needs to be monitored.

Other important caves (Constantine's Cave; Randerston Castle Cave; Kinkell Cave) are not immediately threatened by erosion. They are mostly set back from the coast-edge and the heavy undergrowth obstructing access to them confirms their present stability from coastal erosion. However, the erosion of raised beach deposits at certain locations along the coast between Fife Ness and St Andrews may impact on undiscovered sites such as middens.

A small standing stone identified close to Kinkell Cave requires further attention. No inscriptions were visible on the surface of the stone, which was heavily eroded by calcareous weathering.

Many of the features at threat from erosion are of fairly recent date. The Pile Lighthouse is a Listed Building and although from a distance its structure appears to be sound, its exposed location and disuse mean that it may soon be at risk from damage caused by erosion and lack of maintenance. The lighthouse construction site at Fife Ness is a similar case. Erosion of the stone indentations is occurring due to shingle scouring and other marine action.

The destructive effect of wave action on the site of East Wemyss and Buckhaven Gasworks was clear, with inundation of the building foundations. Comparisons of the present site (Wood 1997c) with builders' plans from the mid-19th century suggest that 30 per cent of this site has already been lost to the sea.

Vulnerable sites by type

A selection of sites has been identified where erosion is not occurring to the monuments themselves but where deterioration of the surrounding environment and deposits suggests that there may be a problem in the future. Examples which fit this category and which may become threatened within five years from the survey date include the following Protected Ancient Monuments: Seafield Tower; Newark Castle; and the Wemyss Caves.

The condition of the small harbours of Fife must be a matter of concern. Recent breaches in the harbour walls at Cellardyke and second-hand reports of erosion to Anstruther Easter and Pittenweem harbours indicate that these important sites may be in a serious state of disrepair. While erosion is undoubtedly a factor in this, the decline in use of these harbours in the last 100 years has been marked by a piecemeal approach to their maintenance (Moore 1992).

Kingsbarns harbour experienced erosion to its harbour walls throughout the short history of its occupation (Figure 12.8) and this has now resulted in the collapse of much of the wall structure.

Figure 12.8. Footings of the collapsed north west pier of Kingsbarns Harbour.

Deterioration was noticeable at Fife Ness harbour, the St Andrews Castle piers, Newburgh harbour and Tayport harbour. Despite Tayport harbour being a Listed Building, the sloping cobble wall at the southern end of the main basin is collapsing due to drainage problems, while erosion at the end of the north-west pier has been caused by marine action. Considerable remedial work has been done to St Andrews harbour and the need for periodic refurbishment and maintenance is clear.

The decline of the salmon fishing industry has implications for the conservation of an important part of the Tay industrial landscape. Collapsing bothies, fishing platforms, decaying harbours, salmon cobles and other associated remains are all visible and suffering from neglect, but, in the majority of cases, coastal erosion is not a factor in their decline.

The survey team failed to identify two pillboxes on the coast-edge by Balcomie Links. Both were recorded in 1992 and one of them had been scheduled in 1996. It is feared that they may have been lost to erosion. Concrete debris was noted dumped on the coast-edge nearby. Several other military features may be at risk from erosion. Scouring has exposed some buried

features along eroding sections of Tentsmuir beach, while shifting sands have obscured tank traps and other military features close to the coast-edge at the same location.

Geology, geomorphology and land-use

Carboniferous geology dominates the Forth shoreline with coal seams, bedded ironstones and oil-shales a part of the stratigraphic sequence (JNCC 1986). Carboniferous rocks can be seen around Buckhaven and Culross. The coal seams exposed at the coast are intersected by the Forth, which became an estuary following inundation caused by rising sea levels after the last ice age. Glacial till forms in small cliffs and bays where large boulders of glacial origin are sometimes strewn across the shoreline (JNCC 1986).

The net transport of sediment along the Fife coastline is mostly wave induced (H R Wallingford 1997). The prevailing winds in the Forth are westerlies and south-westerlies, but an increase in east and north-east winds has been observed recently. Strong winds from an easterly direction are an important cause of coastal erosion, particularly along the exposed sectors of the East Neuk.

In the Forth, there are two types of wave – those generated by wind (wind waves) and those originating from outside the area (swell waves). Wind waves generate a wide variety of wave patterns, both in terms of height and period, and tend to be generated locally. Wind waves are therefore an important factor in the Forth and Tay Estuaries where there is a limited 'on-shore fetch', or distance over which a wind can blow to generate increasing wave energy. West of the Forth Bridges the 'on-shore fetch' is 0.5–15 km. Swell waves tend to be generated in the North Sea and travel into the Firth of Forth from a northerly or easterly direction.

Estuarine areas such as the section of coastline between Kincardine and Rosyth receive mostly tidal wave energy with wind-generated wave energy restricted to waves created within the estuary itself. Stable mudflats are more common in this more sheltered environment, accumulating in bays and overlying bedrock. In places, the depth of mud exceeds 2 m. The mud probably originated from the River Forth.

East of Dalgety Bay, where the Forth opens out and the coastline is more exposed to wave energy from the North Sea, the coast is characterised by sandy bays interspersed by rocky headlands. In the east, these bays extend up to 5 km in length, but this distance shortens further west until the bays measure less than 1 km across. The coast is heavily developed and sea-wall protection is widespread in this area.

From Elie to Fife Ness, the coastline is exposed to the sea. Being less developed, coastal barriers are not as widespread as on the coastline to the south. The erosive force of the sea, at its worst during periods of easterly gales and spring tides, was evident in damage to the fabric of several small harbours. The coastline here is dominated by a foreshore of igneous intrusions and bare sedimentary rock backed by low cliffs and agricultural land. The lack of sediment lying on the foreshore means that only the most durable archaeological objects have been preserved. Nevertheless, the coast-edge appears to be fairly stable.

From Fife Ness to St Andrews, a platform composed of Carboniferous rocks dominates the foreshore. Fringing sand and shingle beaches exist at points where breaks in the rock platform have allowed sand to accumulate, most notably at Balcomie and Cambo Sands. Behind the isolated sandy beaches, dune ridges can be seen at the coast-edge, while the hinterland consists of blown sand deposits which have built up in low-lying ground between resistant rock headlands. At these points a raised beach rises as a gentle escarpment some distance behind the coast-edge.

Two beaches, East and West Sands, flank the town of St Andrews. The beaches are divided by a rock platform with several fringing beaches. West Sands is a wide sand beach with a low gradient and surplus blown sands nourish the active dune zone which can be seen along the coast-edge. The hinterland comprises an extensive raised beach and links area with blown sand deposits. Relic dunes within the golf course illustrate that West Sands has accreted seawards over time. The northern point of West Sands, Out Head, is a dynamic sand formation which is migrating north-eastwards towards the Eden Estuary. Since the early 1960s, the natural balance between accretion and erosion has been upset by the interference of man. A tip was initiated at the northern margin of Out Head to gain land. Ongoing erosion of this tipped waste means that the sea is now re-establishing a state of equilibrium. West of Out Head, the blown sand at the golf course edge has been eroded and coastal defence measures, such as groynes and gabion baskets, have been deployed to combat this problem.

The inner estuary of the Eden is composed of thick alluvial muds stabilised by marshland. The outer estuary experiences the redistribution of silts and sands by coastal processes and dramatic changes in the position of the main channel have been recorded in the past.

Tentsmuir beach has one of the largest dune systems in Scotland. The extensive dune area is the result of considerable post-glacial sea level fall which left a wide beach zone upon which dunes developed. Blown sand and dunes encroached westwards over low raised beaches. At Tentsmuir Point, a complex interplay of waves and tidal currents occurring at the mouth of the

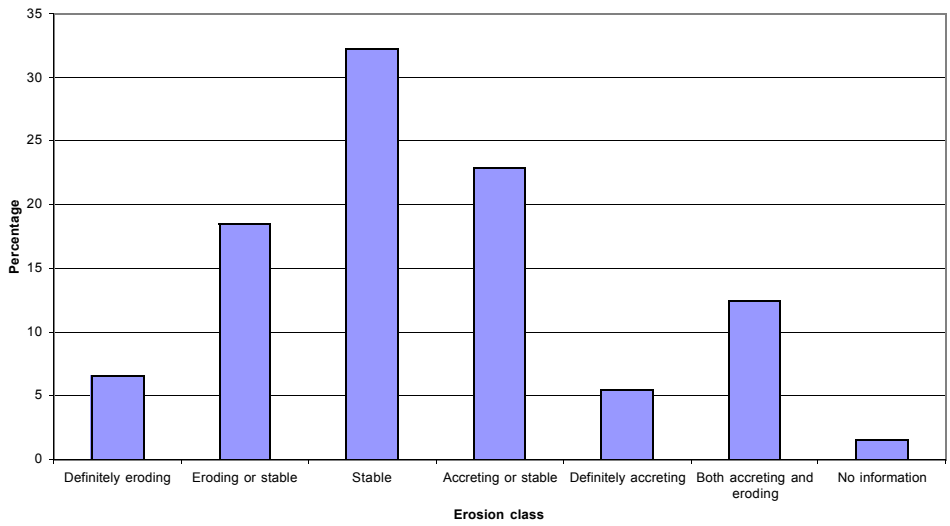

Figure 12.9. Graph showing the erosion classes for the coastline surveyed.

Tay Estuary has developed the spit/bar of Abertay Sands, sheltering Tentsmuir Point and altering the position of the main estuary channel. This has dictated the cycles of accretion and erosion along Tentsmuir Sands.

The Tay Estuary defines the northern coastal boundary of Fife. The heaviest development is in the vicinity of Tayport and the two Tay bridges. At the mouth of the Tay, a low coast-edge of blown sand deposits persists and localised erosion of these deposits can be seen. The intertidal zone east of Tayport is favourable for the preservation of archaeology. West of Tayport, cliffs composed of resistant basaltic and andesitic Devonian rocks reach down to the coast-edge and curved beaches have developed between the igneous rock promontories. As the estuary progresses westwards, the foreshore narrows where deep tidal channels flow close to the coast-edge. West of Balmerino, marshland stabilises the thick alluvial muds which have accumulated on the upper foreshore.

Erosion

Erosion status	Km of coastline, south survey	Km of coastline, north survey
Definitely eroding	3.21 km	9.55 km
Eroding or stable	18.19 km	17.5 km
Stable	31.03 km	31.08 km
Accreting or stable	29.96 km	14.1 km
Definitely accreting	6.42 km	4.3 km
Both accreting and eroding	14.98 km	9.15 km
No information	3.21 km	0 km
Total	107	85.68

Table 12.4. Erosion classes for the north and south surveys.

Although erosion rates were seen to vary substantially, even between adjacent sections of coastline, it is possible to identify the following trends in coastal erosion along the survey section (Figure 12.9).

The coastal stretch between Kincardine and Rosyth is mostly experiencing sediment accretion. Between North Queensferry and Dysart, the coastline is mostly stable with localised accretion or erosion. Between Dysart and Buckhaven, unprotected sections of coast are experiencing erosion, which may be occurring rapidly in places. Between Methil and Earlsferry, erosion of sand along the coast-edge is commonly redeposited on the foreshore. Between Earlsferry and Fife Ness, erosion of the unprotected coast-edge can be seen in many places. Sand is accreting on the foreshore of sheltered bays such as at Earlsferry and Elie.

Along the exposed coastline between Fife Ness and Kingsbarns, the sea is exploiting breaks in the rock-cut platform resulting in localised undercutting of the coast-edge. Erosion of raised beach deposits around Buddo Rock was noted. East Sands, St Andrews, is generally stable despite experiencing temporary changes of up to 1 m in beach height. This results from the complex interplay of tides and currents transporting sediment between the beach zone and offshore sinks and bars. West Sands, St Andrews, experiences cycles of erosion and accretion with dune rehabilitation maintaining the stability of this beach zone. In contrast, human interference at Out Head has induced erosion at the northern point. The southern sector of Tentsmuir sands is experiencing accretion, while the northern sector is being eroded. This is the result of natural change due to the complex interplay of tidal currents and waves which occurs at the mouth of the Tay Estuary. The erosion of the northern sector of Tentsmuir has been a matter of recent concern because

the High Water Mark is retreating inland at a substantial rate. This situation should be monitored and work might have to be undertaken to stabilise dune vegetation in the area.

The Tay Estuary is generally experiencing accretion of sediments resulting from agricultural run-off from farming and land-use upstream. However, localised erosion is occurring where estuarine currents at high waters flow close to the coast-edge. In built-up areas, erosion is caused by drainage run-off from the land.

Discussion and Recommendations

The surveys achieved their principal objectives, a rapid assessment of the coast-edge, intertidal zone, and 100 m land strip. However, two surveys, lasting 23 days in total, of a coastline 192 km in length with 1041 sites cannot achieve total coverage and further work is required.

The field team located 382 sites which did not appear in NMRS or in the Fife SMR. The majority of these were found on the foreshore where little systematic recording had been done before these surveys. Of these newly identified sites, the intertidal wrecks and associated structures at Kincardine, the wide range of fishtraps identified along the coast, and the coast-edge middens at Elie, Pittenweem and Crail were of particular interest.

Further work is required in identifying some of the intertidal features seen. The range of functions and origins attributed to the site originally called the 'Crombie Crannog' may be a case in point. Here, functions may have been attributed based on the personal specialist knowledge of particular observers rather than on any in-depth examination.

In most cases, these surveys confirmed the existing bibliographic records of the 659 sites already noted in the NMRS or Fife SMR. But, in some cases, changes had occurred, mostly due to coastal erosion. The value of ongoing monitoring became clear because rapid changes set off by some environmental or man-made trigger were seen to be occurring to coastal sites. Without periodic monitoring, it would be impossible to identify sites under threat or to react to any threat posed.

Conclusions

Several conclusions can usefully be drawn. The factors perceived to play a major part in controlling erosion rates along the coastal edge include the deployment of coastal defence measures, the local geology, and the degree of shoreline exposure. Coastal defences were seen to be effective in limiting erosion along protected stretches, such as at St Andrews Castle, but the resulting effects on unprotected sections of coastline, while difficult to quantify, need to be considered.

Erosion rates varied between a coast-edge comprising resistant bedrock geology and that comprising raised beach and marine deposits, blown sand or landfill. For instance, the unprotected coastline between West Wemyss, East Wemyss and Buckhaven, which comprises drift clay or landfill deposits, is experiencing rapid erosion, whereas the unprotected bedrock promontories between North Queensferry and Kinghorn appear stable.

The coast between Fife Ness and the Forth Road Bridge is fully exposed to the open sea, with the effects of erosion seen to be particularly destructive during prolonged periods of easterly gales and spring tides. In contrast, the sheltered estuarine area to the west of the Forth Road Bridge displays an altogether different picture, with sediment accretion along the foreshore, comprising mostly mud originating from the upper reaches of the River Forth. There is similar accretion in the Tay Estuary.

Erosion may be having a detrimental effect on 80 sites within the survey area. The Pictish cist at Lundin Links was the site thought to be most under threat. Considerable deterioration was identified at the site of the East Wemyss Gas Works, and more gradual deterioration at Crail and Pittenweem midden sites. The condition of the small harbours of the Firth of Forth, with anecdotal evidence of recent damage to Cellardyke, Pittenweem and Anstruther Easter, and the loss of the two World War II pillboxes, must also give cause for concern.

There is a need to carry out more detailed recording of many of the sites identified because, as time passes, certain material will be lost. For instance, evidence for rudimentary landing places along the Fife coast exists in the worked rock of the foreshore. While this evidence may last for years, information on the enhancement of these natural harbours by, for example, iron fittings will be lost due to corrosion of iron in sea water.

Not unsurprisingly, coastal erosion is not a new problem in Fife with records from the 18th century detailing spectacular flooding events. In the future, it is likely that coastal erosion of archaeological sites will continue to occur. Any prediction for global sea level rise for the 21st century is complicated by regional and climatic variables.

Changes in sea level complicate the task of tracing coastal communities into prehistory. It is therefore important to remember in the future that, just as traces of coastal activity can be found inland on the raised beaches of the Forth (Price 1982), we may also find submerged coastal evidence buried deep in estuarial mud deposits.

The following recommendations (Table 12.5) concern both previously unrecorded sites where there is further need for investigatory fieldwork, and recorded sites where the survey team recommended that further work should be carried out because the site appeared to be in poor condition or because erosion represented a threat to its fabric.

Action	Number of sites, south survey	Number of sites, north survey
Survey	86	44
Monitor	21	10
Survey and monitor	22	4
Nil -no action required	595	259
Total	724	317

Table 12.5. Recommendations for further work.

In response to these recommendations, Maritime Fife has undertaken some follow-up survey work as part of the Historic Scotland focal study initiative (Wood 1997 a, b, c, d; Oxley this volume). In addition, site visits were made to record the loss of archaeological deposits from the Pictish cist at Lundin Links (Will 1996). By the time of this second visit, the deposits identified during the coastal survey project had disappeared.

Acknowledgements

The author is grateful to Chris Burgess, Alex Hale, and Rudiger Bahr for their contributions to the fieldwork. Kathryn Miller's expertise as a geomorphologist was extremely beneficial in the survey of the north shore. Ian Oxley provided helpful managerial support and both he and Deanna Groom gave constructive criticism at various stages of report writing.

References

Atkinson, D 1996 *The Salmon Fishing Industry on the River Tay since the 18th Century* Thesis submitted for MLitt at University of St Andrews.

Coles, J M 1971 'The Early Settlement of Scotland: Excavations at Morton, Fife' *Proceedings of the Prehistoric Society* Vol 37, part 2.

Dobson, N 1996 *An Analysis of Shipping Incidents and Losses off the Fife Coast between the River Eden and Anstruther from 1800 to the Present Day* MLitt dissertation, University of St Andrews.

Dobson, N 1997 *Shipwreck Heritage of Fife* Unpublished report, Maritime Fife, University of St Andrews.

Ewart, G 1993 'Preston Island Saltworks' *Discovery and Excavation in Scotland*.

Fairfax, D 1996 *A Compilation of the Listed Historic Buildings in the Coastal Zone of Fife* Unpublished report, Maritime Fife, University of St Andrews.

Fawcett, R 1992 *Castles of Fife: A Heritage Guide* Fife Regional Council, Fife.

Graham, A 1968–99 'Archaeological notes on some of the harbours of Eastern Scotland' *Proc Soc Antiq Scot* (1968–9), 201–85.

Guy, J A 1994 *The World War One and Two Defences of Fife: A Survey* vols 1 & 2, unpublished report for Historic Scotland.

Henshall, A S 1956. 'Long cist cemetery at Lasswade, Midlothian' *Proc Soc Antiq Scot* 89 (1955–6) 252–84.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

H R Wallingford 1997 *Scottish Natural Heritage Research, Survey and Monitoring Report No 56: Coastal Cells in Scotland* Scottish Natural Heritage, Edinburgh.

Hunter, F 1996 'Recent Roman Iron Age metalwork finds from Fife and Tayside' *Tayside and Fife Archaeological Journal* 2, 113–25

Jarvis, J & Riley, C 1987 'Sediment transport in the mouth of the Eden Estuary' *Estuarine Coastal and Shelf Sciences*, vol 24 no 4, April 1987.

JNCC 1986 *Coasts and Seas of the United Kingdom Region 4 South East Scotland Montrose to Eyemouth* Joint Nature Conservation Committee, Peterborough, Consultation draft.

Maclagan-Wedderburn, L M 1967 'Lundin Links Long Cist cemetery' *Discovery and Excavation in Scotland.*

Martin, C 1979 *Excavations at St Monance Coal Farm* Unpublished report for RCAHMS.

Martin, P 1989 *The Coast of Fife: a Heritage Guide* Fife Council, Fife.

McManus, J 1999 'Coastal Estuary Mouth Ballast Gravel Deposits: A Sourcing Case History' *Estuarine, Coastal and Shelf Science* 48, 677–82.

McManus, J & Wal, A 1996 'Sediment accumulation mechanics on the Tentsmuir Coast' in Whittington, G (ed.) 1996 *Fragile Environments: the use and management of Tentsmuir National Nature Reserve, Fife* Scottish Cultural Press, Edinburgh, 1–15.

Middlemiss, N L 1995 *British Shipbuilding Yards Vol 3 Belfast, Merseyside, Barrow and all other areas* Shield Publications, Newcastle.

Miller, K A 1997 *Sediment Dynamics on Wemyss Beach* Masters dissertation, University of St Andrews.

Moore, J 1992 *St Andrews Harbour 1700–1850: an archaeological and historical investigation* MPhil dissertation, University of St Andrews.

Price, R 1982 'The magnitude and frequency of late Quaternary environmental change in Scotland: implications for human occupation' *Scottish Archaeological Review* 1.2, 61–72.

Robertson, I A 1998 *The Tay Salmon Fisheries since the Eighteenth Century* Cruithne Press, Glasgow.

Robertson, P 1996 *Coastal Assessment Survey for Historic Scotland: Fife – Fife Ness to Newburgh* Maritime Fife archive report.

Robertson, P & Miller, K 1997 *Coastal Assessment Survey for Historic Scotland: Fife – Kincardine to Fife Ness* Maritime Fife archive report.

Sloan, D 1984 'Shell middens and chronology in Scotland' *Scottish Archaeological Review* 3.2: 73–9.

Walker, B & Ritchie, G 1987 *Exploring Scotland's Heritage, Fife and Tayside* RCAHMS: HMSO, Edinburgh

Wickham-Jones, C & Dalland, M 1998 'A small Mesolithic site at Fife Ness, Fife, Scotland' *Internet Archaeology.*

Will, B 1996 *Pictish Cemetery, Lundin Links, Lower Largo, Fife* Glasgow University Archaeological Research Division, Glasgow.

Wood, A J P W 1997a *Kincardine Foreshore Survey* Unpublished report, Maritime Fife, University of St Andrews.

Wood, A J P W 1997b *Crombie Point* Unpublished report, Maritime Fife, University of St Andrews.

Wood, A J P W 1997c *East Wemyss Gasworks* Unpublished report, Maritime Fife, University of St Andrews.

Wood, A J P W 1997d *Newport on Tay Wreck* Unpublished report, Maritime Fife, University of St Andrews.

13 ASSESSMENT SURVEY: THE FIRTH OF FORTH (DUNBAR TO THE BORDER OF FIFE)

HEATHER F JAMES

Introduction

A rapid coastal survey was undertaken by Glasgow University Archaeological Research Division (GUARD) of the south shore of the Firth of Forth from Dunbar to Stirling and along the north shore to the Fife border, a distance of 170 km (Figures 13.1 and 13.2). A brief assessment was also made of a number of sites between Dunbar and the English border. The survey took place in February and March 1996 and reported in April 1996. The Firth of Forth is located on the east coast of Scotland and starts as a narrow meandering river at Stirling, widening out to c 2.5 km at Grangemouth and 15 km at North Berwick. There was a lack of previous archaeological survey, but three geomorphological studies (Firth *et al* 1995; Halliwell 1995; H R Wallingford 1995) had been undertaken.

Methods

The aim of the survey was to assess the effects of erosion on the archaeology and built environment within the coastal strip and highlight sites under direct threat of destruction. For the purposes of this survey the coastal strip was defined by Historic Scotland (1996) as the area between Low Water Mark and 50 m inland, thus including the intertidal zone. Sites between 50 m and 100 m inland were included in the gazetteer but not visited. An attempt was made to locate all the known sites included in the National Monuments Record of Scotland (NMRS) and those depicted on the first edition Ordnance Survey (OS) maps. Any new sites or features of archaeological interest discovered during the fieldwork were recorded. The condition of each site was assessed. Based on this assessment, a subsequent recommendation was made to survey, monitor or 'do nothing'.

Listed buildings, designed landscapes, scheduled and unscheduled monuments were all included in the survey. Due to a lack of time, the possible sites identified from an inspection of oblique and vertical aerial photographs in the NMRS could not be checked in the field and so their inclusion as archaeological sites remains unverified.

The fieldwork was undertaken simultaneously by two teams, each of two archaeologists, over a period of 10 days. One team studied the coastal strip east of Cramond (approximately halfway) and the other worked to the west. The teams generally walked each section of coast once, in whichever direction was most convenient. The ideal methodology would have been to walk the coastline at different states of the tide and in different directions as this would have greatly increased the chances of finding new sites, but unfortunately the time-scale did not allow this.

The survey included an assessment of the hinterland geology, coastal geomorphology and current rates of erosion. This assessment was undertaken by archaeologists at the request of Historic Scotland, but it is now recognised that a long-term assessment by professional geomorphologists would be more appropriate and exact. The assessment observed the coastal conditions and grouped lengths of coast which had similar properties. In this way the coast was divided into 53 'units' of varying length. The location, length, foreshore type, coast-edge and hinterland type of each unit was recorded. Also recorded was the condition of each unit, ie eroding, accreting or stable, the condition of sea walls, the presence of other coastal works, and any relevant local knowledge.

Analysis

Built heritage

Prior to the survey, about 210 archaeological sites or find-spots were recorded in the NMRS (including six designed landscapes). The fieldwalking and examination of documentary sources identified 82 new sites and consultation of the aerial photographs detected 134 possible or potential sites which require verification. Therefore the total number of archaeological sites in the survey report (including the *possible* sites) was 423. Twenty-six of the known archaeological sites are Scheduled and eight are in the care of the Secretary of State for Scotland (in Guardianship). In addition, about 229 listed buildings were recorded within the coastal strip.

As this was one of the first coastal surveys undertaken, no statistical analysis of the sites by date, function or character was carried out. It has only been possible to undertake a brief overview of the results for this report.

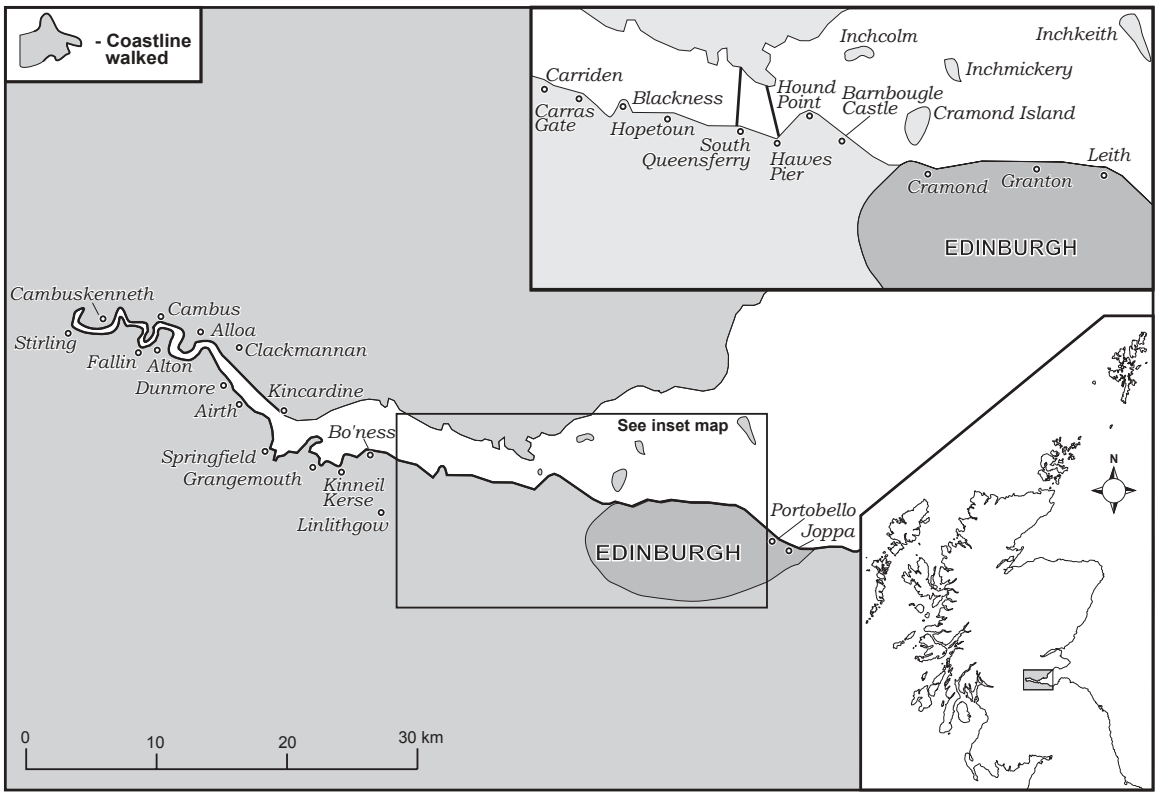

Figure 13.1. Location map showing the western half of the survey and places mentioned in the text.

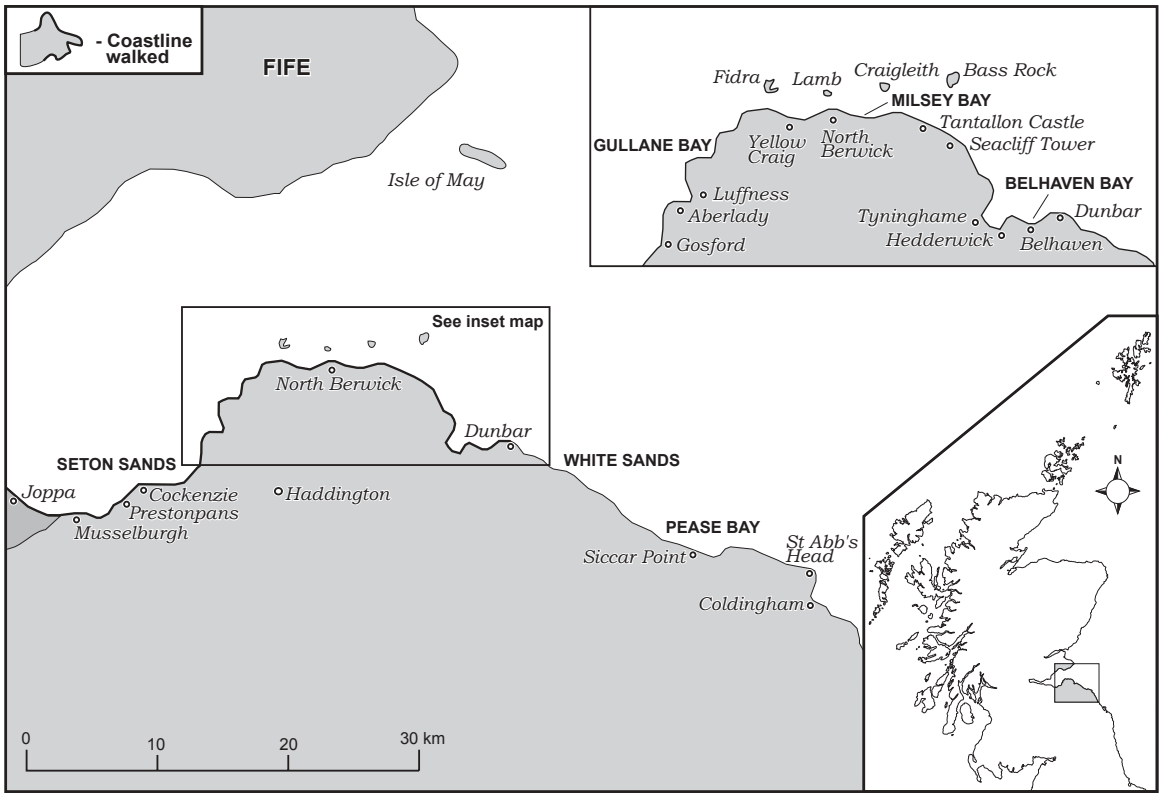

Figure 13.2. Location map showing the eastern half of the survey and places mentioned in the text.

Sites by date

The prehistoric period is clearly under-represented in the archaeological record. The attribution of date in this report is as given by NMRS and has not been reconsidered in the light of recent archaeological knowledge. A single shell midden (Kinneil Kerse) and an antler implement are the only indications of two possible Mesolithic sites. Similarly, the Neolithic period is represented by two find-spots, Hedderwick, which has produced Neolithic pottery, and a single stone axe found elsewhere in the coastal strip. The Bronze Age is slightly better represented with seven sites. These consist of six short cists or groups of short cists, and a single Late Bronze Age sword. Eleven sites are thought to date to the Iron Age. These include two promontory forts (Carras Gate and Siccar Point), two caves, a 'building' which has been associated with Iron Age midden material, two groups of cists, an Iron Age 'burial', a brooch, a small group of Iron Age rings and a copper cauldron.

Nineteen sites of uncertain date are also considered to be prehistoric. These include nine 'forts', enclosures or earthworks, one barrow with associated cists, five other groups of undated cists, one midden, and one site which revealed human remains. The only potentially *new* prehistoric sites were two crop mark enclosures detected on aerial photographs.

The Roman period is represented by ten sites, consisting of three forts (Cramond, Blackness and Carriden), a promontory fort, a possible temporary camp, a watching tower, an altar, a possible breakwater, a trumpet brooch, and a Roman coin.

The Early Historic (or Early Christian) period in this area is represented by 18 sites. These comprise 14 long cist cemeteries (two are *possible* sites), a chapel, and three monastic settlements (all at St Abb's Head). There are also two Anglo-Saxon sites consisting of a cairn and a timber hall (Dunbar).

Fifty-four sites are attributed to the medieval period. These include six castles (Figure 13.3), one abbey, five churches, one nunnery, two battle sites, four chapels, two wharves or harbours, and two deserted medieval settlements.

Eight areas of rig and furrow (evidence for earlier cultivation) seen from aerial photographs could be medieval or later in date. The remaining 300 sites are attributed to the post-medieval period. These include industrial, commercial and domestic buildings, harbours, docks, piers, wartime defences, designed landscapes, wooden structures, wrecks, sea-wall defences, and outdoor swimming pools.

Figure 13.3 View of the covered passage leading from Dunbar Castle to the blockhouse.

Listed Buildings

One hundred and fifty-five Listed Buildings (of medieval and post-medieval date) lie within 50 m of the coast-edge. These buildings are concentrated in South Queensferry, Musselburgh, Prestonpans, North Berwick, Belhaven and Dunbar. The majority were domestic houses of the 18th and 19th centuries and are often still inhabited; however, many of them have been converted for other uses, such as shops. There are five listed churches, in North Berwick, South Queensferry and Preston Pans. Two castles are listed, Tantallon Castle (Figure 13.4), and Barnbougle Castle.

Figure 13.4.Tantallon Castle, built in about 1360.

Listed harbours include Bo'ness, Queensferry, Hawes Pier (and lighthouse), Fisherrow Harbour (Musselburgh), Cockenzie, and Dunbar (including the

Battery). Listed industrial buildings include the glass cone at Alloa Glassworks (Figure 13.5), the Thistle Pottery at Portobello, and four maltings or warehouses in Dunbar. More unusual listed structures include the drinking fountain at Bayswell Park, Dunbar, Luffness dovecot, and the 18th-century gatepiers at the old burial ground, South Queensferry.

Figure 13.5. Alloa Glassworks.

The fabric of these structures is adversely affected by the salty environment, but the fact that they are used and maintained by their owners has ensured their survival. They are not particularly suffering from erosion of the coast-edge because of the presence of sea walls.

Vulnerable sites

There are several upstanding structures which are neither listed nor scheduled, nor are they protected or maintained. They are therefore vulnerable to erosion. These include the medieval Seacliff Tower (Figure 13.6) which is actively eroding into the sea, the post-medieval limekiln at Fallin, mine workings at Musselburgh, rock-cut salt pans at Joppa, and the possible remains of a pan house at Cockenzie. The industrial remains within the Firth of Forth are generally vulnerable because they have not been recognised and valued as part of the national heritage.

One of the most vulnerable types of site consists of unconsolidated midden deposits. The archaeological record includes 10 sites where midden material has been exposed in the past, such as Hedderwick, where a short cist containing a human skeleton was found along with hundreds of pottery sherds, flints and stone axes. The site is located on a rapidly eroding plateau 6 m above the shore which indicates that it has already been partly destroyed. No newly exposed or eroding midden was found here or elsewhere during the survey, perhaps partly because slumping of the sandy coast-edge has masked the midden deposits, or perhaps because of the susceptibility of midden deposits to complete and rapid removal by the effects of tides, wind and erosion of the coast-edge. Some sites may not have been discovered because of their inaccessibility, because they were hidden by the high tide at the time of the visit, or because they were located on steep gradients which were unsafe to scramble over.

Figure 13.6. Seacliff Tower, East Lothian.

Also vulnerable to the effects of erosion are sites constructed of wood, such as old piers, sea defences, bank revetments, glider traps, fish weirs and fishtraps. There are 20 sites which consist of wooden piles or posts located within the eroding or stable shoreline. Only one possible fishtrap was noted during this survey but others may still await identification. Wooden hulled shipwrecks within the intertidal zone are also highly sensitive to erosion; two in particular were noted in Aberlady Bay.

The survey recorded many previously unrecorded World War II defences such as lines of anti-tank traps consisting of either concrete cubes or cones, gun batteries, pill boxes, gun emplacements, and a searchlight base (Figure 13.7). Despite being built of concrete and brick, these are threatened because of their proximity to the coast (and exposure to coastal erosion) and because they have not generally been appreciated as part of the historic environment. Many have been actively destroyed, sometimes blown up by the landowner. Slit trenches were also seen, but can be easily overlooked in thick undergrowth or sand dunes, as they are merely cut into the ground surface.

Figure 13.7. A World War II brick searchlight base.

Geology and geomorphology

The underlying geology of the study area includes the basaltic rocks of the North Berwick coast and limestone to the east, which are resistant to erosion and form the higher cliffs. The sedimentary rocks of the western section are less resistant to erosion and form gently rolling lowlands. The overlying glacial sediments were deposited during the Late Devensian glaciation. These deposits have been reworked by the processes of coastal erosion, which has moved material along the coast and added to it by the deposition of river alluvium and by sand blown from intertidal sand banks.

Post-glacial changes in sea level have also affected the coast-edge and have influenced the location and visibility of prehistoric sites. A combination of isostatic rebound and rising sea levels resulted in a series of raised beaches extending from Stirling to Dunbar (Sissons *et al* 1966). Lambeck has predicted that the maximum sea level occurred about 6000 years BP, which corresponds with the Main Post-glacial Shoreline seen in eastern Scotland (Lambeck 1995, 447). The present shoreline was therefore submerged for some periods during the post-glacial period, which may explain the absence of prehistoric sites.

The nature of the coast-edge is quite varied along its length. The western section of the estuary from Stirling to Grangemouth consists of a meandering tidal river with a low coast-edge that has been defended with revetments in several places. Mudflats are exposed at low tide and many tidal reed beds fringe the shoreline. The mudflats continue east of Grangemouth while the coast-edge consists of reclaimed land protected by sea walls. Between the rocky headland at Blackness and Hound Point the low coast-edge continues and raised beach deposits and occasional rocky outcrops are found. From Hound Point to Granton there are extensive sandflats.

From Granton eastwards to Seton Sands are the built-up areas of Edinburgh, Musselburgh, Preston Pans and Cockenzie. Here the coast-edge consists of sea walls which front a rocky or sandy foreshore.

From Seton Sands to North Berwick the coast consists of wide sandy bays, such as the Gosford Sands, between rocky promontories; Aberlady Bay and Gullane Bay are also backed by extensive sand dunes. In the vicinity of Tantallon Castle the coast-edge rises to form cliffs over 20 m high. From here the Forth becomes more exposed as it faces the North Sea, but the coast is still varied.

The estuary of the River Tyne opens out into Belhaven Bay where extensive sand spits have built up across its mouth, allowing mud and sand flats to form. From Belhaven to Dunbar the coast-edge is increasingly dramatic with cliffs up to 100 m high. The upper edges of the cliffs consist of steeply sloping overburden which is gradually slumping into the sea. Along this stretch are a few small sandy bays such as White Sands and Pease Bay.

Some of the small rocky offshore islands within the Firth of Forth were considered by the survey but (with the exception of Cramond) could not be visited in the time available. These include Inchkeith, Inchmickery, Fidra, the Lamb, Craigleath, and the Bass Rock. Other islands further from shore not included in the survey include Inchcolm, and the Isle of May.

Erosion

The above factors have combined to create a complex pattern of erosion along the coastline. This pattern has been affected (probably far more so than any other area under study in Scotland) by human interference as the intensity of settlement, industry, reclamation and agricultural activity has resulted in the construction of protective sea walls and earthen banks. These have generally slowed the recession of the coastline in particularly sensitive areas, but this has often resulted in greater erosion in unprotected areas.

The study concluded that about 16 per cent of the coast-edge was actively eroding, 55 per cent was eroding or stable, about 15 per cent was stable and the remaining 14 per cent was classified as either stable or accreting (Figure 13.8).

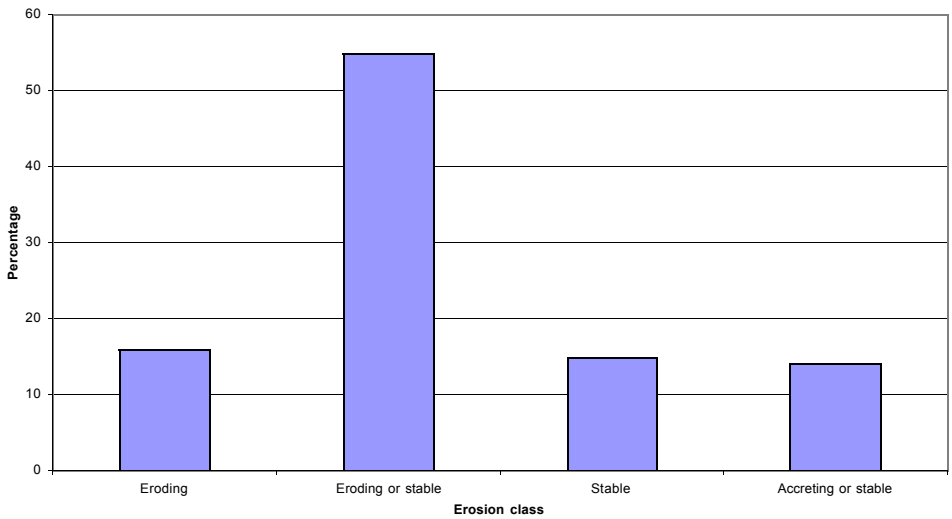

Figure 13.8. Graph showing the erosion classes for the coastline surveyed.

The most serious erosion was thought to be taking place from Bo'ness to just west of Blackness Castle, from Hound Point to Cramond, in Gullane Bay, from North Berwick to Belhaven Bay, the southern part of Belhaven Bay, and from Dunbar towards St Abb's Head. Only those areas which were protected by sea walls were classified as stable, yet they too were showing signs of the destructive effects of the waves. Accretion was noticeably taking place in limited areas such as Aberlady Bay, Milsey Bay, and Belhaven Bay.

In the absence of scientific measurement, there was scant evidence for the actual speed of erosion. At Gosford and Tyninghame the presence of ruined sea walls shows that in the past 100 years the coastline has receded between 5 m and 7 m. At Hedderwick Sands the eroding coast-edge forms sand and mud cliffs up to 3 m high and the local Scottish Natural Heritage (SNH) warden suggested that 0.3–0.4 m was being lost every year. There is therefore much work that should be done in measuring the rates and nature of erosion in the Firth of Forth.

Discussion

The interaction of the coastal region with its hinterland and the sea, islands and land beyond is complex and varies along the length of the coast. Changing social and economic conditions have resulted in changing foci for this interaction and differing survival of earlier patterns, some of which have been incorporated into the landscape and some destroyed. It is difficult also to consider the importance of sites without consideration of the wider landscape, as coastal sites did not function in isolation from their hinterland. This, however, was beyond the scope of the rapid survey.

There is evidence for prehistoric settlement in the Lothians dating from at least 4500 BC (Ashmore 1996), yet there is a general paucity of sites within the coast-edge. There are at least three possible reasons for this under-representation:

- The sea level was formerly higher than at present, creating the raised beaches; the present coast-edge would have been submerged and therefore unavailable for settlement.
- Many prehistoric sites have been masked or obliterated by later occupation or cultivation which in the case of this area of study has been intense.
- Little work has been done in this area to look specifically for prehistoric sites within the intertidal zone or beneath deep deposits of wind-blown sand.

This dearth of prehistoric sites contrasts with the relatively large number of long cist cemeteries within the archaeological record. Long cist cemeteries generally date from the 5th century to the 11th century (Henshall 1956; Dalland 1992). They are found in coastal locations, often in sand dunes, specifically in south-east Scotland. No cemeteries appear to be exposed in the coastal strip at present, though some are within actively eroding zones. It is well-known in Scotland that this situation can change very rapidly as previously unknown cists are often exposed after storms.

The area around Cambuskenneth Abbey produced a previously unrecognised crop mark feature. This was subsequently investigated by a team from GUARD and the associated geophysical and topographical surveys have shown the area to be under-researched and well worth further study and possibly more extensive statutory protection (Etheridge 2000).

Graham (1969), in his study of the harbours of the Firth of Forth, has highlighted the connection between the inland royal burghs such as Haddington and Linlithgow with their coastal harbours Aberlady and Blackness. These harbours were also important for fishing, particularly for herring, in the 18th and 19th centuries. Other known medieval harbours are located at Belhaven, Queensferry, North Berwick, Leith, Cramond, and Stirling. Some of these medieval harbours, such as Queensferry, Leith and Cramond, would have been incorporated into the later harbour fabric, leaving little or nothing visible. Lack of detailed analysis of the harbours and unmonitored development may result in the destruction of the medieval remains. Belhaven harbour, founded in the middle of the 12th century and used by the Isle of May Priory, now lies within reclaimed ground behind a sea-wall. Parts of masonry were still visible in 1841 and in 1966 other masonry was discovered (Graham 1969, 216).

In between the official harbours, the surviving stone-built piers, ports and jetties are remnants of post-medieval industry and are reminders of the importance that the water used to have for transport up the Forth and across to Fife. This survey has shown that several of these features shown on the first edition OS map still survive, although in a much decayed state, such as at Cambuskenneth and Dunmore. Further work on these features could assess their rate of decay by comparison with Graham's photographs.

The islands of the Forth were not included in the survey but are clearly also affected by coastal erosion and are an important part of the archaeological landscape. In the past, the sea has been a conduit rather than a barrier for contact between settlements in the Lothians, Fife, the rest of Scotland, and with the continent. These islands have evidence of settlement (some dating from the prehistoric period), and medieval castles. The presence of Early Christian and medieval monastic retreats and prisons shows that their relative isolation was also a factor in their settlement.

Several stretches of the coast-edge are included within 18th- and 19th-century designed landscapes associated with large estates. Many features such as areas of woodland and rides survive, while others have been lost due to changes in fashion and a decline in the maintenance of grounds as the priorities of the landowners changed. At Hopetoun House, crop marks show the location of old gardens beneath the turf (Cruft 1981). Although the coast-edge is not generally the focal point of an estate or designed landscape, it does form an integral part and because of this, has been protected by the construction of sea-walls, as at Gosford and Tyninghame.

There are several areas of the upper Forth where much of the coast-edge has been reclaimed by farmers wishing to improve their properties. At Airth, successive embankments since the 18th century have reclaimed large areas of the flood plain (Driscoll 1994). Reclamation has also taken place at Clackmannan, Cambus and Alloa Inch, south of Kincardine Bridge to Bo'ness, east of Cramond to Leith, and at Musselburgh. The implication of this reclamation is that these areas can be considered archaeologically sterile except for those features belonging to the post-medieval period.

Recommendations

- All the sites identified from aerial photographs should be checked in the field and further aerial surveys in the vicinity should be planned. Aerial photographs also indicate that there are potentially some very interesting sites, the most exciting of which is a possible new long cist cemetery site near Gosford. Several areas of rig and furrow and many World War II sites were also recorded. Crop mark enclosures were seen at Taylorton Piggery, (near Stirling), Alton, Yellow Craig, the Lamb, and Seacliff. A possible promontory fort was noted at Coldingham. Other crop marks which may be of archaeological interest were seen at Dunmore and Springfield. All of these should be further investigated.
- The coastline should be monitored regularly in order to detect sites exposed by episodes of coastal erosion caused by storms, extreme high tides, or the slumping of overburden or sand dunes.
- Scientific measurement of coastal retreat should take place where erosion is most severe. Carter (1990) has attempted to measure the rate of recession of the Northern Irish coast by comparing maps, charts, documents and photographs of the past 150 years. He suggests that this method, supplemented with field surveys, can produce a reasonably accurate picture of the coastal changes.
- Future survey teams should include a geologist/geomorphologist.
- Specific examination of the intertidal zone should be organised. This would enable the detection of any of these particularly vulnerable, but as yet under-researched, sites.
- There should be further research into specific themes associated with the coastal strip, for example fish weirs and traps, harbours, river transport, and salt panning. Research into related themes not specific to the coast-edge should also be undertaken, for example prehistoric settlement, medieval deserted villages, and a detailed study of Cambuskenneth Abbey.

- There should be consideration of the known sites within the wider landscape, especially of how the sites inter-reacted with their hinterland.
- Surveys of the islands of the Firth of Forth, with the exception of the Isle of May which has already been looked at in detail (James & Yeoman forthcoming), should be undertaken as they were excluded from this survey.
- It is suggested that Listed Buildings should be dealt with separately from the other archaeological sites. The work involved in gathering data about them proved time-consuming and, considering the 'rapidity' of this survey, perhaps was not time well spent.

Acknowledgements

The author would like to acknowledge the work of the survey teams: Susan Bain, Alan Radley, Mairi Logie and Stuart Halliday. Catriona Leask provided a summary of the Statistical Accounts. Dave Etheridge undertook the other documentary research and consultation of aerial photographs. The author would like to thank Tessa Poller for her very helpful comments on the text.

References

Ashmore, P 1996 *Neolithic and Bronze Age Scotland* Batsford, London.

Carter, R W G 1990 'Coastal Erosion in Northeast Ireland - Part I: Sand beaches, dunes and river mouths' *Irish Geography* 23 (1), 1–16.

Cruft, C H 1991 'The State of Garden Archaeology in Scotland' in Brown, A E *Garden Archaeology* CBA Report No 78, London, 175–89.

Dalland, M 1992 'Long Cist Burials at Four Winds, Longniddry, East Lothian' *Proc Soc Antiq Scot* 122 (1992), 197–206.

Driscoll, S 1994 *Kincardine Crossing* Glasgow University Archaeology Research Division, Report 174.

Etheridge, D 2000. *Cambuskenneth Abbey Environs Project* Glasgow University Archaeological Research Division, Report 415.

Firth C R, Collins P E F & Smith D E 1995 *Focus on Firths, Coastal Landforms, Processes, and Management Options IV. The Firth of Forth* Division of Geography and Geology, Brunel University College, Report to Scottish Natural Heritage.

Graham, A 1969 'Archaeological notes on some harbours in Eastern Scotland' *Proc Soc Antiq Scot* 101 (1968–69), 200–85.

Halliwell, R 1995 *Coastal Processes and Management of Gullane Beach and Dune System, East Lothian* Institute of Offshore Engineering, Heriot Watt University, Report for Scottish Natural Heritage and East Lothian District Council.

Henshall, A 1956. 'Long cist cemetery at Lasswade, Midlothian' *Proc Soc Antiq Scot* 89 (1955–6) 252–84.

Historic Scotland *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

H R Wallingford 1995 *Coastal Cells in Scotland* Draft report for Scottish Natural Heritage.

James, H F & Yeoman, P (forthcoming) *Excavations at St Ethernan's Priory, Isle of May* TAFAC monograph.

Lambeck, K 1995 'Late Devensian and Holocene shorelines of the British Isles and North Sea from models of glacio-hydro-isostatic rebound' *Journal of the Geological Society, London* vol 152 (1995), 437–48.

Sissons, J B, Smith, D E & Cullingford, R A 1966 'Late Glacial and Post-glacial Shorelines in South-East Scotland' *Transactions of the Institute of British Geographers* 39, 9–18.

14 ASSESSMENT SURVEY: SOLWAY FIRTH (MULL OF GALLOWAY TO SARK BRIDGE, GRETNA GREEN)

BILL FINLAYSON AND MIKE CRESSEY

Introduction

The Centre for Field Archaeology (CFA) carried out a rapid Coastal Assessment on behalf of Historic Scotland during the autumn and winter of 1996 (Cressey & Toolis 1997). The survey followed the guidelines and procedures outlined in *Coastal Assessment Survey: Archaeological Procedure Paper 4* (Historic Scotland 1996). The survey area extended from the Mull of Galloway to Sark Bridge near Gretna Green (Figure 14.1) and included a coastal corridor approximately 50 m wide and covering a combined map unit length of 318 km. The primary objectives were to establish which areas of the Solway Firth coastline were eroding and to what extent this was having an effect on the archaeological record. A series of case studies was carried out to compare and contrast the differing rates of erosion and accretion at selected representative environments within the study area.

Environmental Setting

The Scottish part of the Solway Firth included within the study comprises a wide variety of coastal settings that include precipitous cliffs and a variety of depositional areas, such as sand dunes, intertidal mud flats, estuaries, lagoon complexes, and salt and freshwater marsh. The total length of coast in Dumfries and Galloway is estimated at 447 km (Ritchie & Mather 1984), and the Solway Coast study area comprises a significant proportion of this area. Within the coastal region of Dumfries and Galloway, there are an estimated 35.4 km of beach formations. The total area of sand in Dumfries and Galloway, including beaches, dunes and links is 2368 ha, representing 4.7 per cent of the Scottish total, but, at least in 1984, there were no beaches with high perceived erosion damage. Seventy-eight per cent of the beaches have raised beaches in their hinterland, representing an important resource for early prehistory in the area.

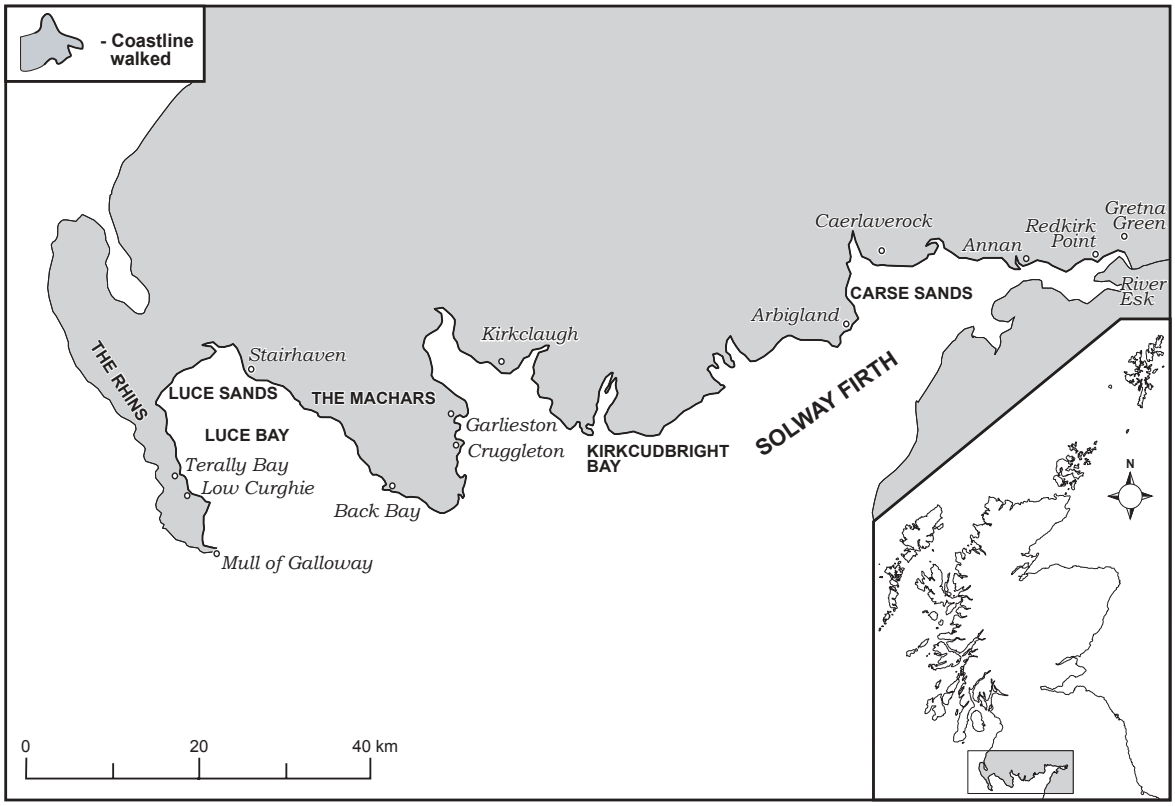

Figure 14.1. Location map showing the area of survey and places mentioned in the text.

Previous Work

Relative sea level changes make the coastal environment both complex and rewarding to study. As early as 1856, coastal erosion led to the discovery of Bronze Age cist burials and intertidal sub-fossil timbers in the Annan region. In recent times there has been a considerable amount of archaeological research in the study area. Much of this research has been prompted by coastal erosion, for example the work at Cruggleton Castle (Ewart, 1985) and Luce Sands (Cowie 1996). Local researchers such as Cormack and others have made a substantial contribution to our knowledge of this shore (Cormack & Coles 1968). A great deal of palaeo-environmental research has been conducted on intertidal areas such as the extensive tidal flats towards the head of the Solway Firth (Jardine 1980; Wells 1999; Dawson *et al* 1999). These researchers have clearly demonstrated the wealth and diversity of the archaeological potential within this area of south-west Scotland.

Methods

In accordance with the framework devised by Historic Scotland (1996), CFA adopted a four-phase approach that included the following elements:

- base-map preparation
- full desk-based survey
- field survey
- case studies and reporting

Phase 1 – Preliminary base-map preparation

Preliminary base-map preparation was undertaken for archaeological, geological and geomorphological aspects of the survey and included a rapid scan of the whole study area. During this initial start-up period, contact was made with the Scottish Wildlife Trust, Scottish Natural Heritage, the Ministry of Defence and other relevant landowners to arrange access.

Phase 2 – Desk-based survey

The results of the rapid scan assessment formed the necessary framework to undertake the full desk-based study. In addition to heritage information, this research identified a series of coastal zones characterised by respective accretion, stability and recession. CFA was allowed access to new aerial survey data housed at Scottish Natural Heritage, Dumfries, that provided invaluable support to the geomorphology database. The desk-based study was completed before fieldwork commenced, allowing the field teams to be supplied with 1:25,000 scale map sheets with colour-coded baseline information on geology, shoreline geomorphology, built heritage and archaeology.

Phase 3 – Archaeological, geological and geomorphological survey

The archaeological survey was systematic and conducted in all relevant land parcels (with the exception of areas thought to be unsafe, see below). Two teams of archaeologists working in close liaison with the geomorphology team carried out the survey. In essence, the fieldwork comprised standard archaeological field survey combined with the recording of the erosion status of sites. The assessment of vulnerable parts of the landscape, and the addition of new information was plotted onto the archaeological map sheets along with erosion classification. In areas with no accurate control points, hand-held GPS sets were used to assist in locating sites for mapping as required in the Historic Scotland procedure.

Survey conditions were not always ideal and extensive areas of dense vegetation cover above the High Water Mark, potentially masking small-scale archaeological features, proved to be a problem. Although the survey was conducted in the autumn and early winter, few problems were encountered with weather conditions. There were sections which could not be walked for safety reasons. These included some areas of cliffs and, most significantly along the Solway coast, areas of intertidal mudflats that could not be traversed on foot.

The geological and geomorphological features identified by the desk-based survey were ground-truthed by a team of geomorphologists to verify the preliminary results of the desk-based study. Ground-truthing was conducted at 50 sample locations, as opposed to examination of continuous lengths of coastline. An important aspect of this work was to assess the reliability of available geological maps within the study area.

Phase 4 – Case studies and reporting

The final survey report (Cressey & Toolis 1997) contained 168 colour-coded maps. It also included four case studies of archaeological remains, illustrating in greater detail the effects of coastal erosion. The archaeological importance of the sites was presented and the effects of localised and more massive coastal erosion were brought into focus. The first study assessed the upstanding remains of Stairhaven Harbour and the subsequent recession of the cliffs and the loss of the harbour. The second study examined the effects of erosion on a later prehistoric promontory fort at Back Bay. The third study examined the loss of intertidal peat and archaeological remains at Redkirk Point. The fourth case study was presented as a contrast to the other aforementioned case studies and reviewed the effect of both accretion and erosion over the last 140 years at Caerlaverock Merse, a large area of salt marsh landscape that has shifted its position many times over this period.

Analysis

Built heritage

In accordance with the guidelines set down in *Coastal Assessment Survey: Archaeology Procedure Paper 4* (Historic Scotland 1996) the archaeological sites were separated into broad chronological groups: early prehistoric; later prehistoric and early medieval; medieval; post-medieval; early 20th century.

Early prehistoric sites (8000–1000 BC)

A small, scattered distribution of early prehistoric sites is affected by coastal erosion. They comprise a flint scatter at Terally Bay in The Rhins, a find-spot of a hammer stone at Kirkcudbright Bay, and the Mesolithic occupation site and associated finds at Redkirk Point. Localised coastal erosion and instability of the foreshore account for the erosion at the first two sites, while massive coastal erosion affects the last-named site. That so few early prehistoric sites were located is probably a result of geomorphological processes. A variety of effects will have taken place over the long period covered by this chronological class. Many of the earliest sites known in the area, dating to the Mesolithic, are on raised beaches which are outwith the coastal survey zone. Other sites are almost certainly buried within river sediment, or lie in the tidal mudflat zone. These sites are not readily visible to conventional fieldwalking. This means that these locations, therefore, will be severely under-represented. Unfortunately, the fact that these locations are formed of soft sediments means that they are potentially at serious threat from rapid erosion. When seen, their appearance may be temporary and brief, following localised storm events and before being reburied or destroyed.

Later prehistoric and early medieval sites (1000 BC – AD 1000)

A larger, scattered distribution of later prehistoric and early medieval sites, dominated by the cluster of promontory forts around the southern tip of The Machars, are adversely affected by coastal erosion. They consist mainly of promontory and cliff forts, but also include ‘homesteads’, a possible galleried dun, a broch (Figure 14.2), and some less strictly defined settlements. The known sites appear overwhelmingly to indicate places of settlement which are located on the limits of the land.

This offers a marked contrast with the settlement record of the early medieval period, during which this geographical setting seems to have been much less favoured.

Medieval sites (AD 1000 – AD 1700)

A small, scattered distribution of medieval sites is suffering from coastal erosion. Localised coastal

Figure 14.2. Stairhaven broch.

erosion affects Kirkclaugh Motte and Cruggleton Castle (Figure 14.3), while massive erosion has obliterated the remains of the church and related medieval remains at Redkirk Point. These sites should be monitored on a frequent basis, although, given the severity of erosion in the intertidal area compounded by incisions caused by channels of the River Esk, it is unlikely that medieval structural remains now survive at Redkirk Point. However, isolated finds may continue to be revealed by the erosion of the foreshore.

Figure 14.3. Cruggleton Castle.

Post-medieval sites (AD 1700 – AD 1900)

Constituting by far the largest group of archaeological sites on the Solway Coast, the extensive but generally scattered distribution of more recent sites is nevertheless dominated by clusters of monuments and remains, particularly within the numerous bays and inlets of the coastline. The group as a whole differs markedly in nature from the preceding groups and includes piers, harbours, shipwrecks and fisheries. Predominantly maritime and industrial in character, the majority of sites are located on the foreshore and are particularly vulnerable to violent wave action. Although monitoring was recommended, detailed survey of a representative sample may be the best response to the erosion affecting this class.

Early 20th century (1900–1945)

A small distribution of monuments, mainly comprising World War II defences, designed landscapes, coastal defences and fishtraps (Figure 14.4), and largely clustered at Garlieston Bay, Carse Sands, and Arbigland, are affected by severe coastal erosion processes.

Figure 14.4. Fishtraps, Monreith Bay.

The gardens of Galloway House border on a severely eroding coastline at Cruggleton Bay, south of Garlieston, while on the foreshore of Garlieston Bay itself, the rusting hulk of a Mulberry harbour, used in training exercises during World War II, is vulnerable to violent wave action. The general dilapidated condition of many of the World War II defences was recorded during the field survey (Figure 14.5). A general monitoring and surveying programme may represent the best response for this group of sites.

Figure 14.5. An eroding pillbox, one of many severely threatened sites from this period recorded during the survey.

Erosion and affected sites

Three hundred and thirty-four archaeological sites were recorded in the assessment survey. Of these 118 sites or 35.3 per cent of the population were identified as eroding. These eroding sites were further separated into two groups, one where the erosion was generally *Fair* (ie moderate erosion), the other *Poor* (ie severe erosion). The results show that moderate coastal erosion affected 16.2 per cent and severe coastal erosion was recognisable at 19.1 per cent of the total population of known archaeological sites (Figure 14.6).

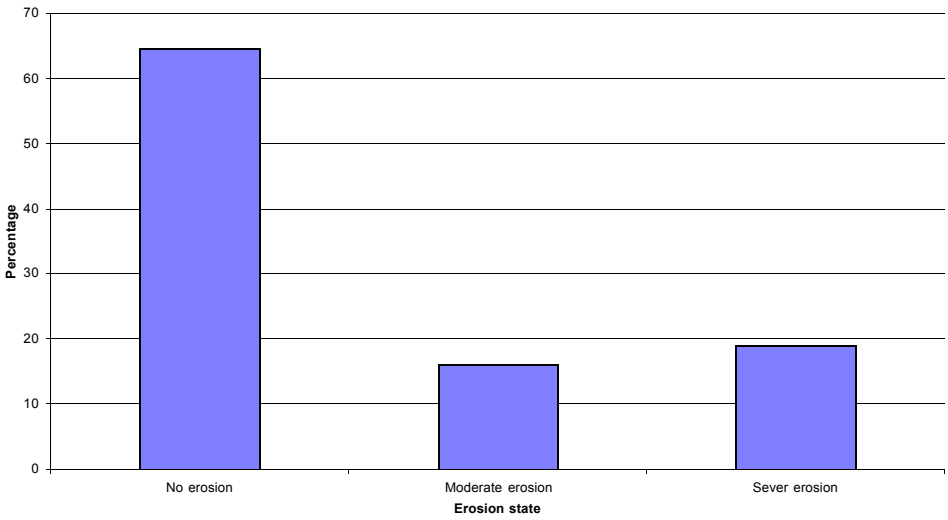

Figure 14.6. Graph showing the erosion state of all archaeological sites located during the survey.

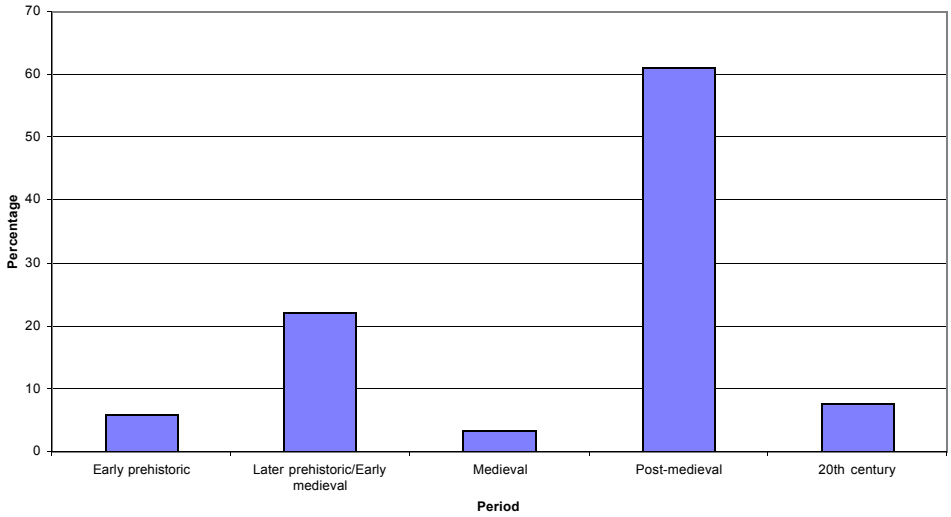

Figure 14.7. Graph showing the number of eroding sites from each period, expressed as a percentage of the total population of eroding sites.

The extent of coastal erosion affecting each chronological group can be gauged from Figure 14.7, where the number of sites in a group is expressed as a percentage of the total population of eroding sites. As can be seen, most of the eroding sites are from the post-medieval period. There are, however, a worryingly large number of later prehistoric and early medieval sites affected.

For interpretative purposes the sites were also split into eight classes of archaeological site type (Figure 14.8). As can be seen, erosion is affecting all types of site, with structures associated with World War II being the most vulnerable.

Coastal erosion

The percentage of the total length of coastline cited is based on the linear measurement of each unit as mapped on the 1:25,000 map sheets within the report. The combined length is 318 km. This figure was used to establish the percentage frequency of each erosion class (Figure 14.9). 318 km is acknowledged to be an underestimate of the true length of the coastline surveyed, as it does not incorporate the mean length of meandering rivers or deeply incised regions of cliff-edge and indeed other topographical irregularities along this coast.

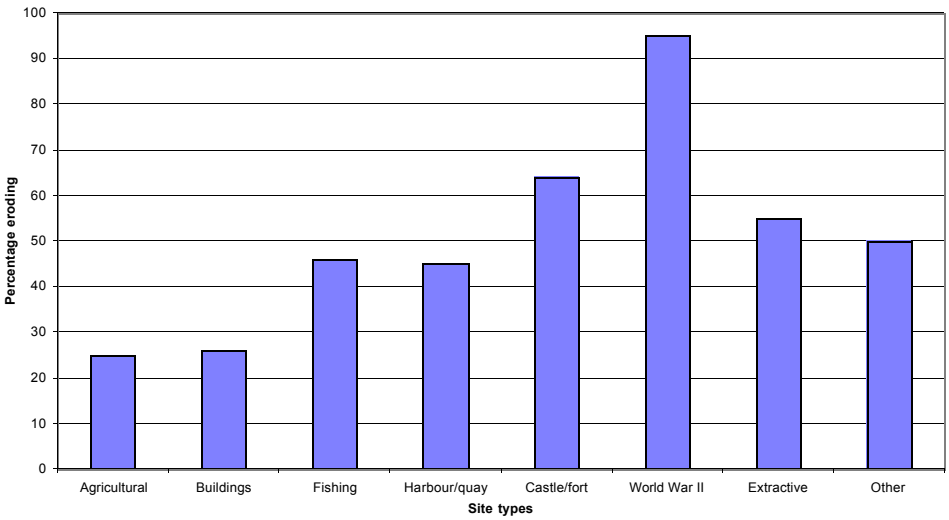

Figure 14.8. Graph showing the percentage of eroding sites from each site type class.

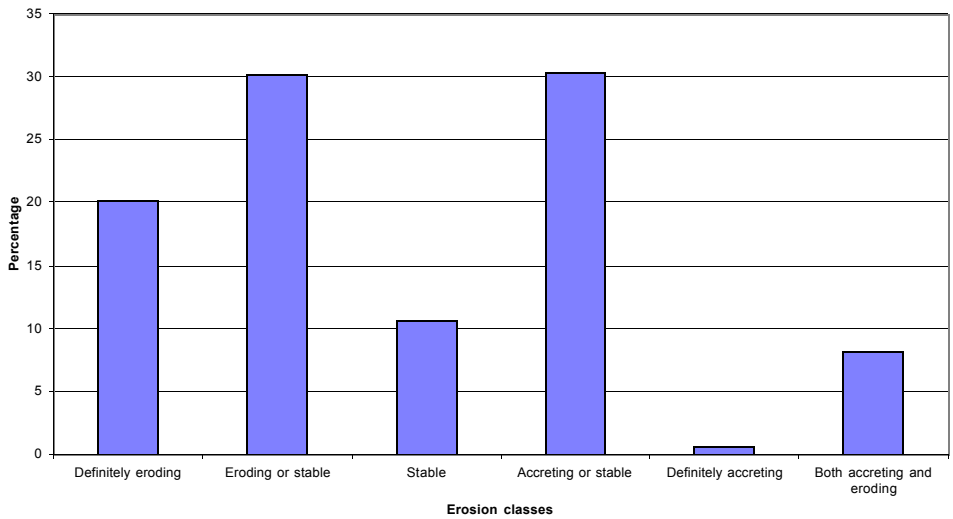

Figure 14.8. Graph showing the percentage of eroding sites from each site type class.

The *Accreting or stable* and the *Eroding or stable* classes have the same percentage frequency of 30 per cent. The units identified as *Definitely eroding* were found to comprise 20 per cent of the total length of the survey. *The Stable*, *Definitely accreting* and the *Both accreting and eroding* erosion classes are much lower in frequency with 10.6 per cent, 0.6 per cent and 8.2 per cent respectively.

The results from the *Definitely eroding* class confirm that a substantial portion (20 per cent) of the Solway coast is being affected by serious erosion. This class includes areas where there is a direct failure of existing sea defences such as at Low Curghie, Stairhaven Bay, and south of Garlieston pier. The greater majority of units in this class occur on the eastern Solway coast towards Annan, where the coast-edge is generally soft.

Discussion

This survey represents a snapshot of the condition of the archaeological remains that were visible in late 1996 and as stated above, a broad range of archaeological sites on the Solway Coast were seen to be affected by a series of erosion processes. These can be seen generally to correspond to different groups of chronologically distinct archaeological monuments and remains, reflecting the varying topographical locations and building techniques of the relevant sites. Briefly, the results of the survey have revealed the following general trends affecting vulnerable sites on the Solway Coast:

- A small number of early prehistoric settlement sites are vulnerable to localised or more massive coastal erosion.

- A larger number of later prehistoric and early medieval settlement sites are again affected by localised coastal erosion, often exacerbated by agricultural pressure and erosion from grazing animals. These factors contribute to the occurrence of specific erosion processes, and can form an integral part of the general erosion pattern. Therefore, it is fundamental when drawing up measures to alleviate erosion of coastal archaeological sites to take into account the erosion dynamics in their entirety.
- A small number of medieval settlement sites share the same trend as the early prehistoric sites.
- The largest groups of sites, comprising monuments and remains of an industrial and maritime nature from the post-medieval period, is adversely affected primarily by violent wave action.
- The range of monuments of the early 20th century exhibit severe vulnerability to coastal erosion.

Following on from the publication of the Rapid Coastal Assessment, Historic Scotland and Scottish Natural Heritage, with support from Society of Antiquaries of Scotland, funded some further research in the Upper Solway Firth (see Focal Study, Cressey, this volume).

Recommendations

A number of recommendations were proposed based on the survey results:

- to establish a local network of interested parties to undertake regular monitoring of areas of soft sediments, in order to assess the rates of erosion and the appearance of new archaeological sites
- to conduct more detailed geomorphological studies and provide a more detailed chronology for coastal sediments, allowing inferences to be made regarding the likely presence and period of buried archaeological remains
- to conduct more detailed survey of a number of specific, representative sites
- to ensure that a systematic programme of monitoring of known threatened sites is established
- to maintain good communications with other agencies interested in the management of the coast

We consider that these recommendations can only be achieved by a combination of joint initiatives. Some of the work might be achieved directly by Historic Scotland through the Monument Wardens, or indirectly by the award of grants for specific pieces of research. Wider (and more frequent) monitoring will require additional efforts and must include the Local Authority Archaeologist, Museum Officers, and the participation of local groups. The Council for Scottish Archaeology and SCAPE may have a role to play in coordinating local society efforts. Such locally-based monitoring is probably the only way that sites located in soft sediments will be observed as mudflats and river banks move during the course of the year.

Acknowledgements

The authors wish to express thanks to the field archaeologists who carried out the survey under the supervision of Kirsty Cameron. They are also grateful to Ronan Toolis who assembled most of the archaeological field monument data and assisted in researching the case studies. Kevin Hicks and George Mudey are thanked for their assistance with the illustrations in the report. All the landowners are thanked for their kind permission and co-operation in conducting this survey, and the local people who shared their knowledge with us. Finally, Patrick Ashmore is thanked for overseeing the project on behalf of Historic Scotland, who funded this project.

References

Ashmore, P J 1994 *Archaeology and the Coastal Erosion Zone. Towards a Historic Scotland Policy* Historic Scotland, Edinburgh.

Cowie, T 1996 'Torrs Warren, Luce Sands, Galloway: a report on archaeological and palaeoecological investigations undertaken in 1977 and 1979' *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society* 71, 11–105.

Cormack, W F & Coles, J M 1968 'A Mesolithic Site at Low Clone, Wigtownshire' *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society* 45, 44–72.

Cressey, M & Toolis, R 1997 *Coastal Assessment Survey: Solway North Coast* Centre for Field Archaeology Report 312, vol 1–3, 1–490.

Ewart, G 1985 *Cruggleton Castle, Report of Excavations 1978–1981* Dumfriesshire and Galloway Natural History and Antiquarian Society, Dumfries.

Historic Scotland 1996 *Coastal Zone Assessment Survey: Archaeological Procedure Paper 4* Historic Scotland, Edinburgh.

Jardine, W G 1980 'Holocene raised coastal sediments and former shorelines of Dumfriesshire and Eastern Galloway' *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society* 55, 1–59.

Ritchie, W & Mather, A S 1984 *The Beaches of Scotland* Aberdeen University Department of Geography for the Countryside Commission for Scotland.

Wells, J B 1999 'Brighouse Bay: Coastal evolution and relative sea-level changes' in Tipping, R M (ed) *The Quaternary of Dumfries & Galloway: Field Guide* Quaternary Research Association, London, 44–50.