3. SURVEY RESULTS

Introduction

Based on the results of the field survey this section examines the findings concerned with the erosion record of the Beauly, Moray and Cromarty Firths. The percentage of the total length of coastline cited is based on the straight- line measurement of each unit as mapped on each of the coloured 1:25,000 map sheet (Maps 1-31). The combined length of all units is 166.8km. This figure was used to establish the percentage frequency of each erosion class. 166.8km 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 indeed other topographical irregularities along this coast, but it does provide an indication of the relative significance of the results.

Erosion Survey

Erosion classes are used as defined in the Historic Scotland procedure document. An analysis of the results are shown in a series of histograms (Figures 3-8) and summarised in Table 2.

The *Stable* and *Definitely accreting* class are more or less equal with 11.2 and 12.4% respectively (n= 14 and 13). The coastal units identified as *Eroding or stable* achieved the highest frequency with 40%. The *Definitely eroding* class is represented by 6.1% with a total of 15 individual coastal units. The *Accreting or eroding* or *Accreting or stable* class is represented by 9.8 and 20.4% respectively.

Erosion Class	Number of units	Total unit length (km)	Total length (%)
Stable	14	18.8	11.2
Eroding or stable	46	69.3	40.8
Definitely eroding	15	10.1	6.1
Definitely accreting	13	20.8	12.4
Accreting/eroding	14	16.5	9.8
Accreting/stable	22	34.1	20.4

Table 2 Summary statistics of the erosion class units lengths.

The results from the *Definitely eroding* class (Figures 5 and 6) confirm that only 6% of the total length of coastline examined is being effected by serious erosion. This class includes areas where there are breaches in existing sea defences (see South of Kiltearn Cottage to Balcarse Point NH 6232 6528) or on undefended cliffs such as St Brighs Chapel (NH 577 615 see below). 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 at a slow rate. Owing to the slow rate at which the cliff is eroding one could also classify the region as relatively stable.

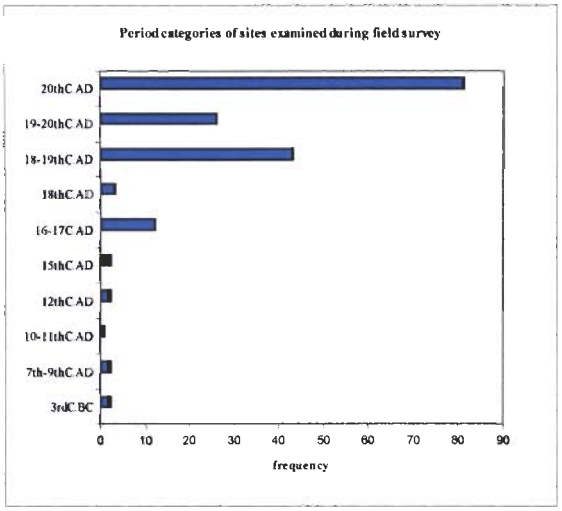


Figure 3. Period categories of sites identified during the survey

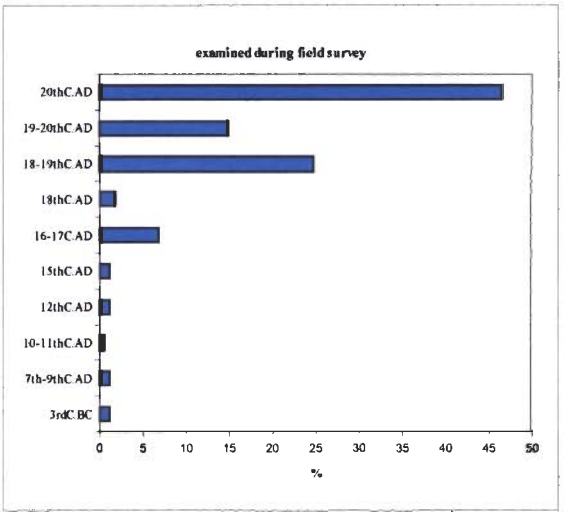


Figure 4. Percentage frequency of period categories

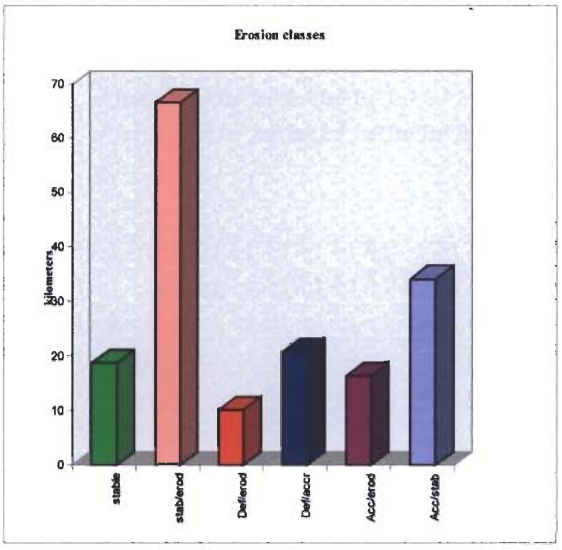


Figure 5. Distance versus erosion/stability classs

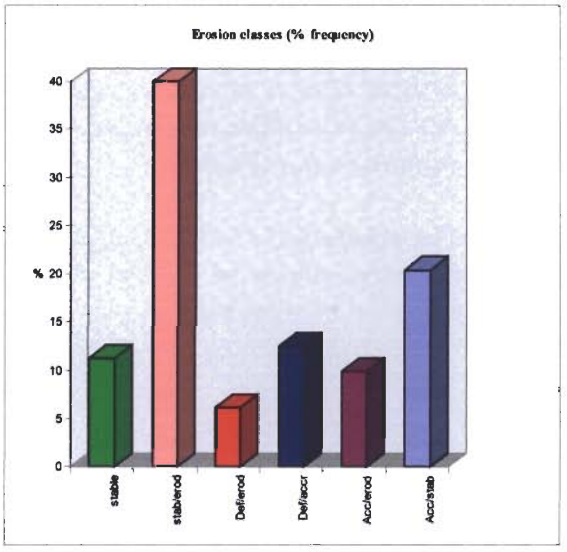


Figure 6. Percentage frequency of distance versus classification

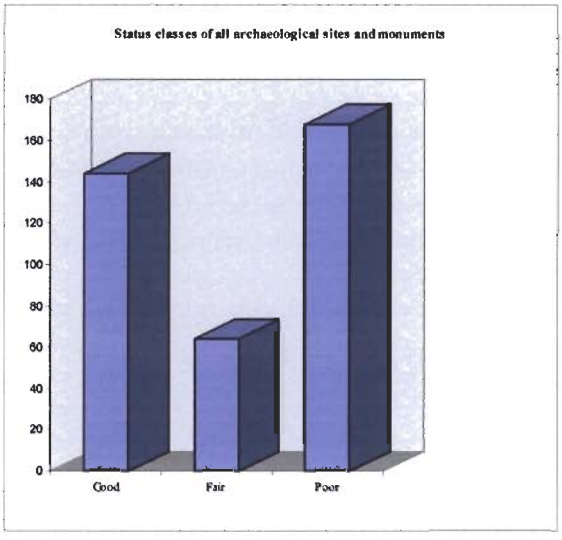


Figure 7 Frequency and condition of all archaeological sites

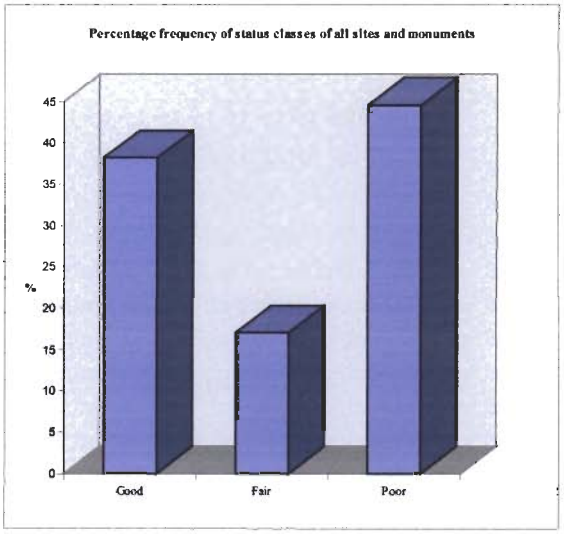


Figure 8. Percentage frequency and condition of all archaeological sites

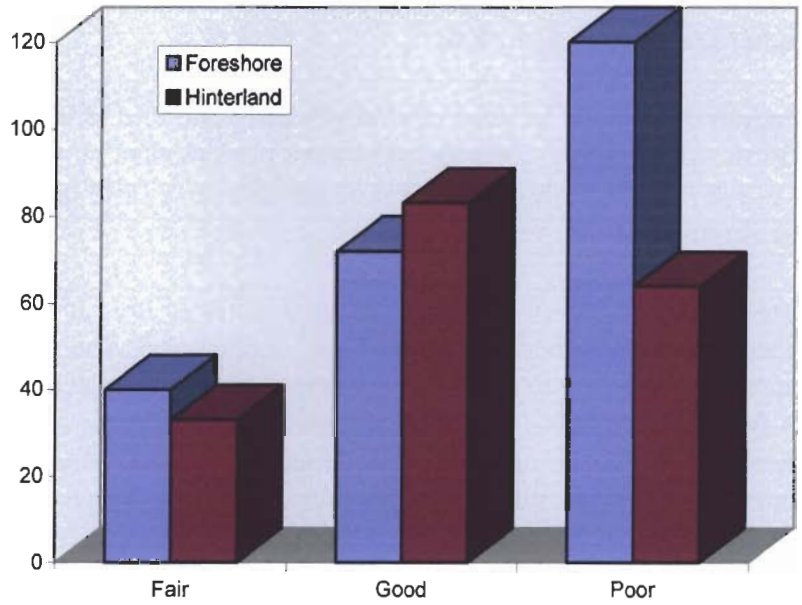


Figure 9. Erosion classes: Foreshore versus Hinterland.

Figure 9 demonstrates three preservation criteria for archaeological sites and monuments within the foreshore and hinterland. Within the foreshore category of sites, 40 are identified as *Fair*, Seventy-two sites were seen to be in a *Good* state of preservation whilst 120 were seen as *Poor*. In the hinterland category, 33 sites were found to be in a *Fair* state, 83 sites were found to in a *Good* state of preservation with 64 sites in a poor state of preservation.

These data show 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. Unlike sites located on the foreshore, archaeological sites and monuments in the hinterland are susceptible to other forms of attrition leading to their decline, these might include; neglect, abandonment, weathering, and quarrying.

Archaeology

Evidence of Mesolithic activity in the study area was confirmed by the excavations of two shell middens in Inverness (Myers & Gourlay 1991). Lithic scatters associated with shell middens suggested that one of the sites was a tool production site. The sites occupy a terrace on the delta at the mouth of the River Ness, at approximately 8-10 m above current sea-level. Worked flint tools of Mesolithic and Neolithic age are also recorded from Seafield West, near Inverness (NH 694 455).

South of the study area, Neolithic sites include Clava-cairn type sites whilst to the north, the Orkney-Cromarty types are common monuments. Additionally, henge and hengiform sites have been discovered, including the concentration of sites around Muir of Ord and Beauly.

Bronze Age sites include the two cist cemetery sites at Dalmore and Seafield. The site at Dalmore was adjacent to the survey area and contained a series of cists containing urns, vessels and burnt bone (Jolly 1879). The site at Seafield, Inverness was recently excavated and found a cist cemetery. One of the graves included a Butterwick type bronze dagger in a leather sheath (Cressey 1996).

Iron Age sites in the region include the hillforts of Craig Phadrig and Ord Hill at the mouth of the Beauly Firth. Additionally, forts and duns have been located on the hills to the south and west of the Beauly Firth. To the west of the Cromarty Firth lies the vitirfied hillfort site of Knockfarril.

There are large number of Pictish symbol stones located in the area of the survey. The Clach A'Mheirlich, class 1 symbol stone dates to the 7th-9th century AD. The stone is sandstone pillar bearing a step symbol on one side and a crescent above what appears to be a pair of pincers symbol on another. Other Pictish symbol stones in the region include the Rosemarkie cross-slab, now held in Groam House museum, Rosemarkie, the Nigg cross-slab and the Shandwick stone, now contained in a glass house. Although further from the current shoreline these two like Clach A'Mheirlich appear to have been positioned in close proximity to their contemporary coastal margins.

The pre-reformation chapel at Newhall point, now built on by recent housing, is associated with an extensive burial ground, from which radiocarbon dating on the skeletal remains produced dates of the 10th and 11th centuries AD (Reed 1986). A shallow ditch was found to surround the burial ground during the excavations. There was little evidence of the chapel buildings found by excavation. The Dunscaith castle site is the only motte site in the survey area. It was fortified by William the Lion in 1179 and currently consists of two concentric semi-circular ditches. Substantial plough damage has affected the upstanding remains of the site.

Four castles in the survey area dating from this period appear in various states of repair and condition. Shandwick castle was built around 1460 is completely destroyed. Stone was robbed freom the site in 1942 for road ballast. Castle Craig on the southern shore of the Cromarty Firth is the upstanding remains of a four storey vaulted floored tower house. The remains, which comprise the roofed NE wing and some low-lying walling, have been damaged by general climatic weathering, the effect of which has caused some large pieces of masonry to fall on to the foreshore below the castle. The Redcastle on the northern shoreline of the Beauly Firth is reported to be located on the site of Ederdour, erected by William the Lion in the 12th century AD. The castle was greatly added to in the 16th century and now stands as a roofless shell, affected by general climatic weathering and deterioration.

Surrounding the Inner Moray and Cromarty Firths are five 17th century grain stores or girnals. These large multi-storey, rectangular plan buildings were used by agricultural producing estates to store grain which could be accessed from both the production zones and the Firth. The girnals are associated with trackways leading from the hinterland to the shoreline, where landing places for boats have been located. In the case of the Foulis point girnal a number of hulks were recorded around the adjacent foreshore during the current survey.

The Caledonian canal was one of the largest engineering projects in the early 19th century in the survey area. The sea lock and associated basin, cottages, workshops and hand crane are currently all in good states of repair and are an excellent example of Industrial heritage of the region. Quarries and associated piers and quays are a feature in the Beauly Firth, providing stone for the canal and also a concentration of similar sites were recorded on the southern shore of the Cromarty Firth. The quays and stone piers are all in poor states and require monitoring and many of the quarries have suffered cliff failure and are now overgrown.

Early 20th century monuments include WWI and II military complexes on the North and South Sutors. This heavy military presence attests to the importance of the Cromarty Firth, especially as a Naval base during both wars. The Firth has had military connections since the mid 19th century during which Admiralty building occurred at places such as Cromarty harbour. Other later military sites include the remains of the large airfield at Evanton and the RAF seaplane base at Alness Point.

Currently the greatest visual impact in the survey area is the oil fabrication yard at Nigg and the various other associated sites around the Cromarty Firth. The Firth itself is a deep water terminal for oil rigs and platforms, which can often be seen along the middle of the firth, during periods of refitting and renovation.

4. CASE STUDIES

Introduction

Three case studies are provided to illustrate in further detail the range of coastal erosion or accretion that is effecting a variety of archaeological remains on the Moray coast. The first case study considers the marine crannogs in the Beauly Firth which have been dated recently using radiocarbon assay to the later 1st Millenium BC. The second case study is based on the chapel site of *Cille Bhrea* (also known as St. Brighs) where severe coastal erosion has truncated part of the site. The third case study concerns the various types of fish trap remains located along the entire length of the survey area. Examples of their typology and distribution within the survey area are presented. The archaeological importance of the case studies is contrasted by the affects of the various coastal processes reported in the previous chapter.

CASE STUDY ONE: BEAULY FIRTH MARINE CRANNOGS

Four large stone mounds have been recorded below high water mark in the Beauly Firth. These marine crannogs are large stone mounds situated on sandbanks or surrounded by mudflats. Although not visited during the current survey a number of physical characteristics were recorded from the fieldwork and the preliminary aerial photographic archive survey. The sites vary in size from approximately 20 to 70 m in length, they are oval in plan, with the exception of the Redcastle site which is irregular. The sites are all low mounds capped with large regular sized stones which appear similar to those on the current shorelines. They are all fully submerged at high tide and become exposed at various times during the ebb tide, depending on their relative heights

Brief history

Documentary evidence records descriptions and previous investigations of the marine crannogs in the Beauly Firth, including the following from the Old Statistical Account of Scotland (1799):

> "There are three cairns at considerable distances, one from the other. The largest is in the middle of the frith (sic), a huge heap of stones. This cairn is accessible at low water".

Odo Blundell, renowned for diving on Highland freshwater crannogs, visited the largest site in the middle of the firth, Carn Dubh in the summer of 1908 with the intention of diving. However, he discovered that it was high and dry on a sandbank. He rowed out to the site and found a number of large wooden timbers and possible artefacts (Blundell 1909).

Recent research

More recent research has surveyed and sampled all of the sites and produced a chronology based on radiocarbon dates from a sequence of structural timbers, showing that they were used during the 3rd century BC (DES 1995). Sampling specific to the Redcastle site has identified two structural sequences; the initial phase consisted of oval, wattle-sided pits, approximately 1-2 m diameter dug into the sub-surface sands. These pits appeared to be partially clay lined and were possibly used as hearths. The second phase was directly on top of the first and consisted of an extensive horizontal

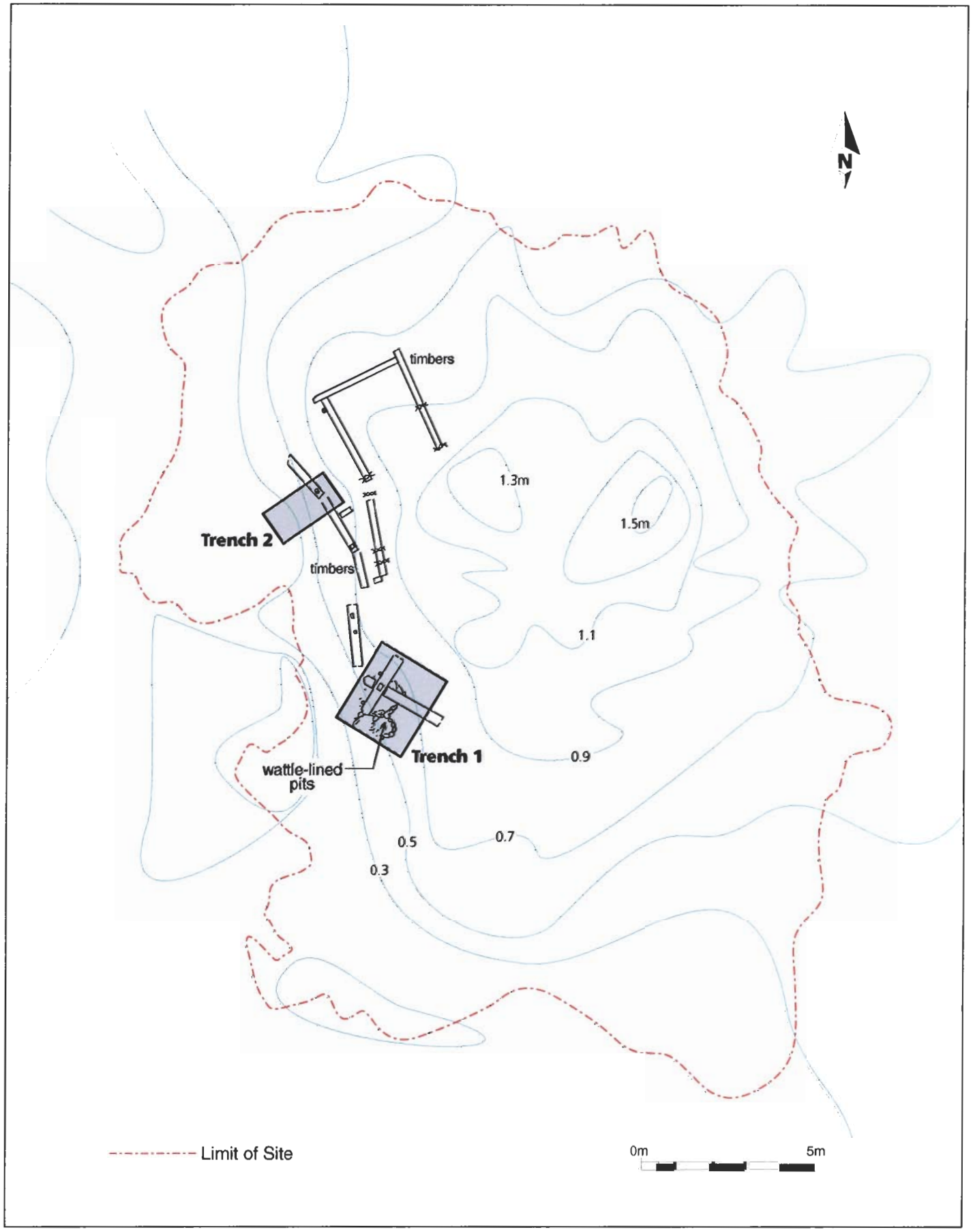


Figure 10. Contour plan of Redcastle Intertidal Crannog.

timber framework made up of large alder (*Alnus glutinosa*) planks that had been cut to shape with an adze-like tool. Associated with both construction phases were large quantities of animal bones, organic remains including woodchips and small fragments of leather. The research only investigated a small part of the site but the quality and variety of preservation of structural, artefacts and ecofacts was excellent

Sedimentary survey
Over a period of 18 months During 1996-7, the Redcastle crannog was monitored for sedimentary movement. The survey monitored points both on-site and adjacent to the exposed archaeology in undisturbed areas. There were also monitoring points off-site designed to measure changes of sediment levels on both the exposed and leeward sides of the site. During the survey a number of vulnerable areas were identified, these included the area sampled for both structural remains and radiocarbon dating. Disturbed by previous sampling, this area became consistently more exposed with animal bone loosened and occasionally removed. The timbers exposed during sampling were also subject to localised erosion and in the case of one horizontal timber, the western end became totally exposed. Despite protection measures using sandbags these areas continue to erode.

The results indicate various changes on and off-site which are identified as diurnal, seasonal or annual events, these included the erosion of sediment from the exposed south west edge of the site with accretion around the leeward north-east side. It was also evident that the surface stone cover and interstitial sediments act as protection of the underlying deposits. However, once exposed the underlying archaeological remains are threatened by a number of damaging processes ranging from plant colonisation, erosion of sediment, accretion and scouring by stone movement.

CASE STUDY TWO: CILL BHREA CHAPEL

Introduction
Cille Bhrea, Lemlair, Highland (NMRS ref: NH 56 SE 3) was chosen for this case study on the grounds that it provides an excellent example of coastal erosion directly effecting a medieval archaeological site. Recent excavations at the site are part of Historic Scotland's policy of *Managed Retreat* with the main criterion of removing skeletal material from an eroding cliff which are likely to be exposed as the cliff continues to recede.

Brief history
Cill Bhrea was reputedly founded in 1198 (Wordsworth 1997 citing Woodham). Cross slabs found at the site by R Gourlay in 1983 suggest that there may have been an earlier church. The present chapel is one of seven in the parish of Kiltearn (Wordsworth 1997). The church was first excavated in 1966 by Dr Tony Woodham. His unpublished excavation revealed a rectangular building with walls less than a metre high, a stone font, a possible communion table and grave slabs. Numerous burials were also recorded (Wordsworth *ibid*). The site was afforded *Scheduled Monument Protection* in 1970. A detailed survey of the site was carried out by RCHAMS in 1979. Further work was undertaken by Gourlay in 1983. His sketch of the site denotes that 15m of cliff with a height of 6m was actively eroding (see Figure 4 in Wordsworth 1997) with six burials exposed in the cliff section. Sometime after

1966 a revetment wall was built at the base of the cliff in an attempt to slow down the rate of erosion, this has subsequently been lost. Based on the findings of the *Damage Assessment Report* undertaken by Wordsworth 1997, which noted the exposure of human skeletal remains in the cliff section and scattered on the foreshore, further remedial work was undertaken in 1998.

Recent Record

Historic Scotland commissioned AOC Scotland to carry out an excavation and survey of the site, which resulted in the partial excavation of the chapel and graveyard covering a total area of 155 m^2. The strategy developed to address the objectives identified by Historic Scotland consisted of:

- cleaning and recording the site before excavation
- cleaning and recording the erosion face
- excavating the church, complete with a 2m wide strip all round it (Areas A, B, C & D in (Figure 4*)
- excavating a 3m wide strip along the erosion front of the site (Areas E & F in (Figure 11)
- recording the church structure in full.

Further work following the excavation at the cliff-edge included sowing grass seed over geotextile matting to promote greater stability.

The results of the excavation (carried out between 10th-31st August 1998) recovered valuable information on the density and nature of burials within the graveyard and chapel. In particular the presence of deep, complex archaeological deposits beneath the chapel suggest a long and complex use of the site (Rees 1998). The archaeological deposits were found to be shallow within the exposed cliff section (c0.90m) resting on unconsolidated marine sand and gravel.

Erosion

It would appear that the sites along this stretch of coastline are effected by predominantly south-easterly gales and high storm-tide surges, this appears to be the only explanation to account for causative factors leading to erosion in what is considered to be a fairly sheltered location Prior to the recent excavation, the unconsolidated nature of the exposed cliff was estimated to be retreating at about 1m every 10 years. The archaeological and remedial work mentioned will undeniably reduce the loss of skeletal material from the cliff section for the next 20 years. However we are of the opinion that until the cliff is better protected by rock armour to effectively reduce direct wave hammer and cliff under-cutting, erosion will continue to effect the site. In conclusion this case study demonstrates that the soft character of the underlying geology is a causative factor in coastal erosion at this site and further east along the Kiltearn Parish shoreline (see MAP 19 NH 620650). It can be concluded that erosion has been active over a long period of time thus resulting in the loss of part of the chapel and skeletal remains.

Figure 11: Site plan of Cille Bhrea chapel (courtesy of AOC Scotland).

CASE STUDY THREE: INTERTIDAL FISHTRAPS

Fish-traps are one of the most common foreshore monuments to be recorded during this survey and their forms and uses deserve further discussion. Similar features have been recorded in both Welsh and Irish estuaries and this research aims to complement their study.

Location

The fish-traps recorded during the survey are positioned in the intertidal zone between Mean High Water Mark and Mean Low Water Mark. They are concentrated in two main locations; the Beauly Firth and the Cromarty Firth. They were designed primarily to catch salmon that were abundant in the Moray Firth during and prior to the 17th, 18th and 19th centuries. 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 flood tide to progress further upstream. The traps were placed at right-angles or oblique to the channel so the fish could be funnelled into the traps interior. The remains currently vary from low mounds or arcs of stone, small concentrations of wooden stakes protruding from the foreshore and composite wooden and stone structures.

Brief history

Fish-traps or 'yairs' in the Moray Firth have been in use as early as 1638 (RHP 561, 1820). The 1837-8 'Chart of the Firth of Cromarty' showed the different yair and stake net sites. A record in the Old Statistical Account for Scotland describes their use:

'there are a good number of salmon caught on the sea coast, chiefly by means of yaires, or small enclosures, built in a curve or semicircular form near the shore. At high water the salmon comes within these yaires, and at low water is easily taken, having no way of escape. This is the simplest and cheapest mode of fishing that can be derived. There are usually four or five yaires kept up in the parish; and each proprietor takes enough to supply himself and a few friends. In a good season he can send some to market. Flounders, herring-fry or sprats are frequently taken in these yaires' (OSA 1799, 488).

The siting of the traps appears to have been a critical factor in their productivity and both good and bad seasons were encountered. An OSA entry for Dingwall Parish provides an interesting pointer to low catch-rates:

'Owing to the distance to which the tide recedes at ebb, the muddy nature of the bottom, the freshness of the water from the influx of the Conon, and the other streams which discharge themselves into it here, the firth in this parish is very unproductive, - affording no fish, with the exception of a few flounders and some salmon, the latter of which are taken in yairs in the summer' (Vol.14 214)

The fish-traps were built up until the late 1830s when they were declared illegal, in favour of portable fishing rights. A map of all fish traps recorded between 1817 and 1909, has been compiled to show their distribution with previously unrecorded traps (see Figure 12).

Structural variations

Three different types of fish-trap were identified from the documentary evidence these include; yairs, stake nets and bag nets. Yairs are curvilinear stone mounds that are positioned perpendicular to the shore. They bend almost at right angles in places at which point small semicircular features are included in the plan. In places, wooden stakes were recorded in the semicircular features and evidence from English, Welsh and Irish examples point to the use of wattle panels in their construction (Aston 1988, O'Sullivan 1995). Some yairs show double semicircular features at points along their length and others have curved features towards Low Water Mark. Others fishtraps are recorded as a zig-zag plan that also included semicircular features. Cruives-type traps were recorded on the lower stretches of the River Beauly in *Country Life Magazine*, (1904) and they were designed to restrict the available passage for the migrating salmon. Yairs were built in the shallow estuarine areas of the Moray Firth and were also designed to trap salmon, although other fish were caught.

Stake nets were illustrated on the 1837-8 map of the Cromarty Firth with lines of stone mounds interconnected by netting. The stone mounds were small, often circular and supporting posts onto which the nets were strung. During the survey, one of the mounds still contained the remains of wooden stakes.

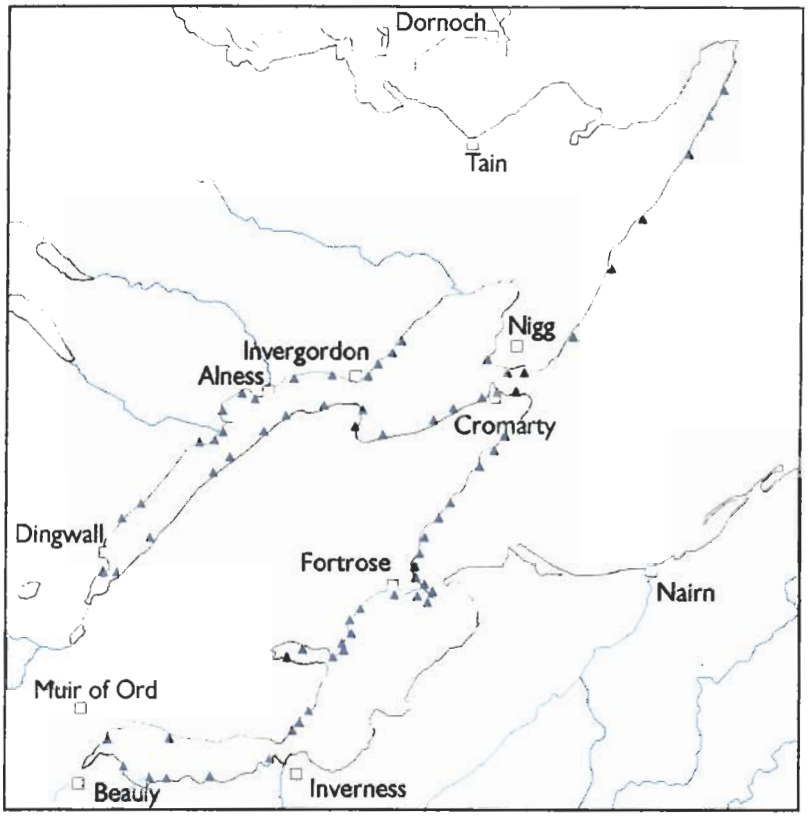
The third group of sites are bag nets that consist of single lines of nets with a stake at the Low Water end of the structure and at right angles to the main net line was a shorter net. During the current survey evidence of these types of yairs were found only as single mounds in the intertidal zone.

Current condition

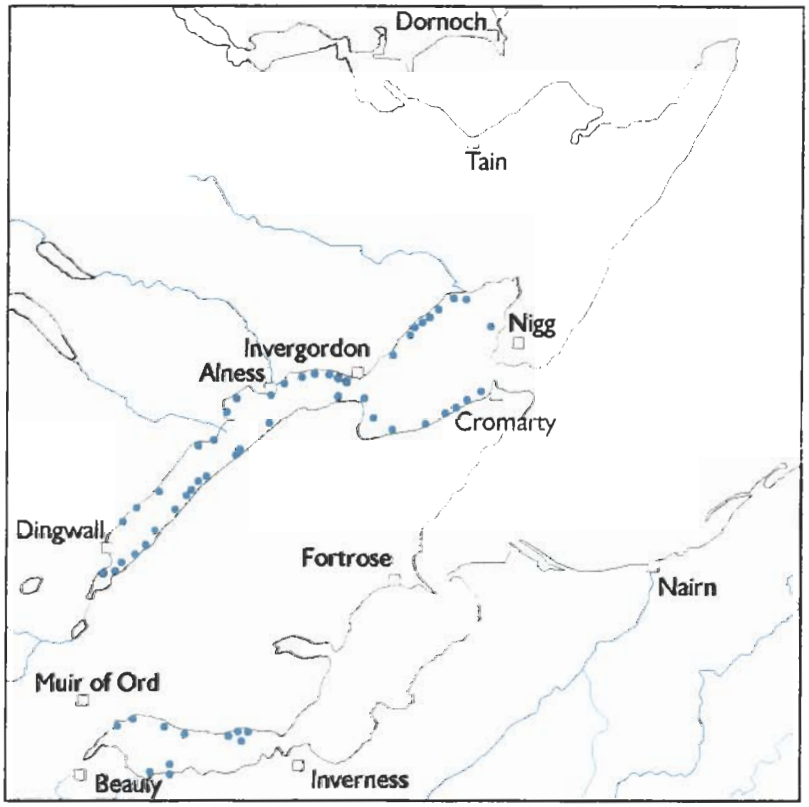
All the sites recorded were in poor condition that indicates both their fragility and the extent to which they have been affected by coastal erosion or accretion. Sixty-two remaining fish traps were recorded along the length of the survey area and the different forms and frequency are shown in Table 3.

Fishtrap Type	Morphology	Frequency
Yairs	Curvilinear	8
-----	Curvilinear, complex	7
-----	Zig-zag	0
Stake net mounds	Linear	3
-----	Linear, multi-mound	2
-----	Curvilinear, multi-mound	3
Bag nets	----	0
Uncertain	Wooden piles	5
-----	Stone mounds	9
-----	Stone lines	13
-----	Unclear	12
-----	-----	**62 Total**

Table 3 Summary table showing the frequency and a preliminary typology of fish-traps within the survey area.



Distribution of fishtraps observed from cartographic sources (1817 - 1909)



Distribution of fishtraps observed during the 1998 Coastal Survey

FIGURE 12: DISTRIBUTION OF FISHTRAPS IN THE SURVEY AREA

5. SUMMARY AND RECOMMENDATIONS

Coastal Erosion

The survey results are summarised in Table 4 below. Within the classification associated with erosion, 69km (40%) of the coastline was seen to be *Stable or eroding* and 10.8km (6.1%) was classified as *Definitely eroding*. A distance of 18.8km (11.2%) was classified as *Stable*. The *Accreting or stable* and *Accreting or eroding* class attained a distance of 34.1 (20%) and 16.5km (9.8%) respectively.

Erosion classification	distance	% frequency
Stable	18.8	11.2
Stable or eroding	69.3	40.8
Definitely eroding	10.18	6.1
Definitely accreting	20.8	12.4
Accreting or eroding	16.5	9.8
Accreting or stable	34.1	20.4
Total unit distance	**169.68**	**100.7**

Table 4 Summary table of classification units by distance and % frequency

The study also demonstrates that coastal units formed in areas derived from Holocene marine sand and gravel which are found mainly within the Beauly and Cromarty Firths are more susceptible to erosion than the harder sandstone geologies of the North and South Sutors. The survey has identified a number of other important factors controlling erosion within given coastal units. Erosion is not only occurring as a result of wave hammer and scouring during storm conditions, but also as a result of continuing wastage through water currents and shifts in river channel configuration at the head of the Beaulay and Cromarty Firths. A good example at the latter location can be seen in the partial loss of the fishtrap on the foreshore at Dingwall (NH 5619 5818 Map 17). There are a number of other factors occurring that may have little to do with storm-wave activity and these have to be considered as part of the ongoing processes of erosion. These include heavy rain and run off, cryoturbation (freeze-thaw action in the case of exposed soft sections), local topography and geological structure. Recent land use and drainage regime along with modern or 19th century sea defences can also be a contributing factor in limiting or promoting erosion.

Short- term effects on archaeological sites and monuments

Within the limitations of the rapid survey methodology, our results show that post-medieval archaeology is well represented and that many of these archaeological sites are located well within the intertidal area. We have also demonstrated that a great deal of the intertidal archaeology is being severely eroded. With reference to the fish trap sites we have increased the number from 31 previously known sites to 62 an increase of 31. Table 5 below demonstrates the disparity and general condition at the time of the survey between sites and monuments located on the foreshore and those recorded in the hinterland.

LOCATION	FAIR	GOOD	POOR
FORESHORE	40	72	120
HINTERLAND	33	83	64

Table 5 Summary of relative condition of archaeological sites and monuments

General Recommendations

It is recommended that all the sites identified as fish-traps that are currently effected by active erosion should be surveyed as soon as possible. The final loss of these sites is imminent and their remains should be subjected to detailed analyses and survey. These sites are part of the local economic history and should be afforded full recognition as important wetland sites.

The marine crannogs in the Beauly Firth are a part of the total sample of similar sites from around the Scottish coastline and as such represent an important resource. Their survival in the intertidal environment appears to be under threat and future research is recommended to assess the nature of these sites, their use and propose measures to protect the resource.

The severe erosion on the south-east facing cliff around Port an Righ and the discovery of a new shell midden containing possible Iron Age artefacts demonstrates the need for more detailed survey. Excavation and sampling of the midden with adjacent landscape survey would explorethe hypothesis that the area was an important locality of Iron Age occupation, given the proximity to the hinterland fort and dun at NH 8434 7362.

The results of this coastal survey should be fully integrated into any future policy on Coastal Zone Management and future Shoreline Management Plans.

This work must be considered only as a snapshot and reflecting observations during the months of August and September 1998. A new survey should be commissioned within five years to compare and assess the changes that have occurred since this present work was carried out.

Acknowledgements

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