SCAPE

Scottish Coastal Archaeology and the Problem of Erosion

A REVIEW OF HERITAGE AT RISK FROM COASTAL PROCESSES IN SCOTLAND

Results from the Scotland's Coastal Heritage at Risk Project 2012-2016

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Summary

Between 2012 and 2016, the SCAPE Trust recruited, trained and supported volunteers to carry out a national survey of coastal archaeological heritage threatened by erosion. The ShoreUPDATE surveys formed part of the wider Scotland's Coastal Heritage at Risk Project (SCHARP). The aim of ShoreUPDATE was to update heritage data collected in Coastal Zone Assessment Surveys (CZAS) of 5,600km, or *c.* 35% of Scotland's coastline, (called the study area in this report) surveyed between 1996 and 2010. The primary focus was to identify the highest priority sites currently at risk within the study area in order to provide a firm evidence base for practical action. This was achieved by updating the site condition records of the 322 highest priority coastal heritage sites that had been highlighted through a desk-based analysis of CZAS data as being of regional or national importance and at high risk of loss from coastal erosion.

Around 500 volunteers took part in the surveys; submitting 1041 updated surveys of CZAS sites and visiting 282 of the 322 highest priority sites, a sample size of 88%. This observational data was moderated by SCAPE officers and used to review the status of every site submitted, with a focus on the high priority sites. As a result of the review, the sites were re-categorised and 145 sites were assigned a highest priority score. Two thirds of these retained their priority status from the original CZAS analysis and one third came from new sites or sites that had not been identified previously as a priority. The proportion of highest priority sites in each region remained similar when compared to the original CZAS analysis. The coastlines of the Northern and Western Isles are most vulnerable to erosion and contain two thirds of all high priority sites.

The 145 ShoreUPDATE highest priority sites are those that are currently at greatest risk within the study area. The research does not interpolate results beyond the study area; and acknowledges that the dynamic nature of the coast means that a site's vulnerability and condition may change rapidly, for the better or worse.

Much of the reduction in the absolute number of highest priority sites can be explained by the ShoreUPDATE survey and analysis methodology, which aimed to highlight sites at greatest risk and assessed the relative condition and vulnerability of each site on a national scale, introducing parity when considering priority across the whole of Scotland. A second factor may be attributed to a general trend of stabilisation of sand dune and machair coastlines compared to conditions when some of the original CZAS surveys were completed. Changes in land management, the timing of the surveys and meteorological trends may account for this. This demonstrates the potential of regular monitoring of eroding coastal heritage sites to describe wider trends of coastal change.

New knowledge has been created and shared through the ShoreUPDATE surveys. They have produced a body of data that can be used to help manage a highly threatened resource. The empirical information resulting from the surveys has led to the highlighting of sites that have significant research and learning potential that will contribute to academic, management and community benefit. It is hoped that this review will provide a catalyst for action that will make the most of a valuable but vulnerable resource before it is lost.

SCHARP has demonstrated that large-scale volunteer input is compatible with high quality information and research outcomes and also provides a model of volunteer involvement which could be effectively applied in future coastal survey.

Key Findings

- Eroding coastal heritage is a valuable resource with significant research and learning potential. It also provides empirical data about past, present and future coastal change.
- Volunteers have provided the capacity to undertake a comprehensive Scotland-wide survey of coastal heritage within a limited time period and have contributed new information that has improved records. This demonstrates the effectiveness and benefits of involving volunteers in the monitoring and recording of coastal heritage at risk.
- Within the study area, observational data of current site condition has reduced the assessment of the number of highest priority sites from the desk-based review of CZAS records by around one half. 145 sites have been assigned a ShoreUPDATE high priority status.
- Of these, 31 have been assigned a priority 1 status and 114 a priority 2 status.
- A new highest ShoreUPDATE priority 1* category has been created for 8 sites, reflecting the urgency of the threat. All these are located in Orkney and the Western Isles.
- 706 sites have retained or been assigned a ShoreUPDATE priority 3 status. These were not the subject of this review, but are an important category because they require monitoring and capture a wide variety of interesting, and often locally valued coastal heritage sites, which may have considerable research and interpretation potential.
- Coastal sand dune and machair environments are most vulnerable to erosion and contain nearly half of all ShoreUPDATE priority sites. Low-lying coasts where till or soft superficial deposits overlie rock platform are also notably vulnerable and contain a quarter of ShoreUPDATE high priority sites.
- The proportion of ShoreUPDATE highest priority sites per region remains similar when compared to the original CZAS review priority sites.
- The Northern and Western Isles are the most vulnerable areas in the study area and contain two thirds of all high priority sites.
- Achieving greater parity of records across the survey areas is probably the most important factor in explaining the reduction in numbers of high priority sites. The ShoreUPDATE survey assessed the relative condition and vulnerability of sites in a national rather than regional context to provide a more consistent judgment of priority for sites across the whole of Scotland.
- The reduction in numbers of priority sites is also a possible reflection of a general (probably short-term) trend of stabilization of the coast edge, particularly in low-lying sandy coasts. Natural meteorological cycles, land management, and the timing of some of the original surveys could account for this change.
- The repeat surveys demonstrate the dynamic nature of the coast and show that site condition can improve or deteriorate depending on environmental, management and meterological factors. This underlines the necessity of continued monitoring as well as practical action at the most vulnerable sites in advance of further damage.

1. Introduction

1.1. Background and context

Iconic sites such as the broch of Mousa in Shetland and Skara Brae in Orkney are known throughout the world. However, archaeological surveys of Scotland's coasts provide evidence of dozens of potential Mousas and Skara Braes. The identified sites may have less visible standing remains, but they contain buried archaeological information that could equal their famous counterparts. And this is the tip of the iceberg. Thousands of archaeological sites of all periods are located at Scotland's coasts. In a country with a mountainous and once thickly forested interior, the abundant resources and fertile land of coastal areas encouraged rich, settled occupation from prehistory. Evidence of this is contained within the settlement mound sites found in the Northern and Western Isles. The few that have been investigated provide evidence of remarkable longevity of use spanning millennia, for example Pool on Sanday occupied from the Neolithic to the Norse period (Hunter *et al.,* 2007).

Photomontage by Eddie Martin

Figure 1. In the case of Pool, previous excavation allows us to decode the long exposure of the eroding section. Pale reddish Neolithic deposits and drystone structures at the base of the section are overlain by darker shell-rich deposits and structures of the Middle Iron Age on the left and Pictish cellular drystone structures on the right.

As an island and sea faring nation, Scotland's political, social, religious and economic heritage is abundantly represented at the coast; in forts, castles, harbours, piers, chapels, settlement sites, burial monuments, fishing stations, kelp kilns, coal mines, salt pans and even chilly seawater swimming pools. The range of sites spans thousands of years, from Mesolithic shell mounds through to World War II anti-tank blocks, glider traps, gun emplacements and pill boxes that are still highly visible along many stretches of shoreline.

These diverse heritage sites hold Scotland's stories. They are a resource of enormous potential that can excite and encourage modern communities to connect with the past through archaeological exploration and enquiry. They can contribute to the understanding of local histories, helping to define present places through the conservation of their visible remains and through interpretation projects.

One thing that the sites have in common is their location within the most dynamic environment of our landscape; the coastal and intertidal zone. They are exposed to the impact of coastal processes, considered by heritage practitioners as the most severe natural agent of change facing the historic environment (Cassar 2005). Coastal change is a result of natural processes and coastlines have always been affected. The degree of change depends upon a variety of factors, but currently in Scotland, the

primary drivers are local geology, post-glacial isostatic readjustment and exposure to wind and waves. The main threat posed by coastal processes is erosion; and wave or wind action can result in shoreline retreat, cliff collapse and dune migration. Even under normal weather conditions, erosion can cause significant cumulative damage to both built and buried archaeology. However, extreme weather events, such as severe storms, can cause major loss or even the complete destruction of our archaeological resources.

Climate change and human actions are both agents that can exacerbate the effects of natural processes. Records show that relative sea level rise in Scotland has accelerated in recent decades (Rennie & Hansom, 2011). Even in lower emission scenarios, sea level in the Edinburgh area is expected to rise by 20-40cm by 2100 (CCC, 2016b), and with observed higher rates of annual sea level rise in the Northern and Western Isles, sea level in these areas is likely to exceed this. Rising sea levels could accelerate erosion by extending the landward reach of waves, thus exposing new land currently unaffected by coastal processes. Increased global warming and relative sea level rise could also result in salt water inundation and the colonisation of new species in the coastal and intertidal zones, both of which may be detrimental to the survival of organic archaeological remains (Sabbioni e*t al*., 2012). There is also broad consensus that the frequency and intensity of storms affecting the British Isles may increase in the future as a result of climate change (Mölter *et al*., 2016; Feser *et al.,* 2014), although this is tempered by a high degree of uncertainty (IPPC 2013).

Historically, development and other human activities at the coast have had a profound influence on how coastal processes impact the coast edge. Development and the construction of coastal defences has secured some historic assets, but it has also resulted in the squeeze of the coastal zone, leading to less recycling of sediment and a consequent loss of coastal heritage. Building sea walls can also concentrate the energy of the sea to a narrower zone or divert wave energy to adjacent, undeveloped or undefended stretches of the coast, disrupting the natural cycle of coastal processes and intensifying damage. Another human impact of particular relevance to Scotland is activity within archaeologically rich machair and sand dune landscapes. These areas have been the focus of settlement for millennia, and the favourable burial environment created by calcareous wind-blown sand has led to remarkable preservation of archaeological materials. Activities such as sand extraction and agricultural practices that damage the vegetation cover can harm these fragile landscapes, leading to sand blow and erosion which can result in devastating damage to the archaeological sites buried within them.

Since the mid-1990s, there has been a sustained strategic research focus in Scotland, led by Historic Environment Scotland, to better understand the archaeological resource within the coastal zone, the scale of the threat it faces from coastal processes and to develop national and regional priorities for action. During this period, there has also been a growing realisation of the potential significance of the amplifier effects of modern climate change to coastal processes (Orkivu 2003) and the need for better documentation to understand the nature of these impacts. In Scotland, the Climate Change (Scotland) Act 2009 requires public bodies to develop climate change risk assessment methodologies, including for some historic assets (e.g. HES 2017). In the light of this, it has never been more imperative to acquire robust and up-to-date information about the condition of the coastal heritage resource against which to measure change and prioritise action.

2. The Scotland's Coastal Heritage at Risk Project (SCHARP) and ShoreUPDATE

Between 2012 and 2016, as part of the Scotland's Coastal Heritage at Risk Project (SCHARP), the SCAPE Trust worked with volunteers to carry out a national survey of coastal archaeological heritage threatened by erosion (ShoreUPDATE). The purpose of the survey was to review the priority status of coastal sites at risk identified through a desk-based analysis of Coastal Zone Assessment Survey data (Dawson, 2010) by carrying out site visits to bring the information up-to-date. In this report we describe the methods of data collection and the subsequent analysis used to review the updated records derived from ShoreUPDATE surveys. We present and evaluate the results of the surveys, and suggest how the updated survey data can be used for both heritage management and more widely, for example, by contributing to research on the nature and rate of coastal change.

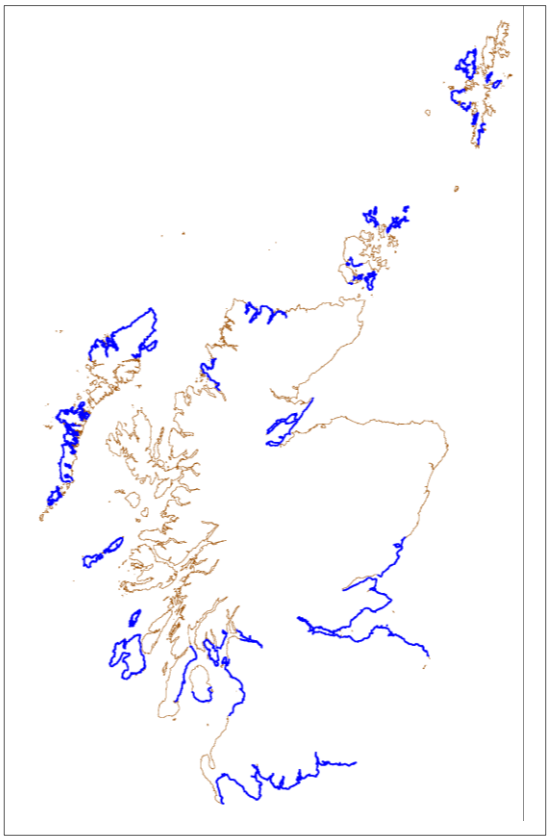


Figure 2. The CZAS and ShoreUPDATE survey areas in blue which cover c. 35% of the Scottish coastline.

2.1. The data behind ShoreUPDATE

2.1.1 Coastal Zone Assessment Surveys (CZAS)

Data on coastal heritage and the physical coastline was collected between 1996 and 2009 in 28 Coastal Zone Assessment Surveys (CZAS) sponsored by Historic Environment Scotland(then Historic Scotland). Covering approximately 35% or *c.* 5,600km of Scotland's 16,035km long coastline, the data, together with the analysis of survey methodology and results by Dawson (2008) formed the basis of our understanding of the coastal heritage resource *in the areas surveyed.* Although difficult to extrapolate to the whole coast, the data provided a valuable guide or proxy for what was happening across the coast of Scotland. The CZAS were largely carried out in accordance with Historic Scotland standards contained within the guidance paper, Archaeological Procedure Paper 4: Coastal Zone Assessment Surveys (Historic Scotland, 1996). Of the 11,500 sites recorded, surveyors recommended further work at 3,768. Around half of the recommendations were to undertake monitoring and around half were for active intervention to gain a better understanding of the site or to rescue information. The majority of these recommendations are yet to be acted upon, as the large number of sites carrying recommendations vastly outstripped the resources available.

It was difficult to obtain an overview of the CZAS results across Scotland because each survey generated a regional picture which, in most cases, was only available as a hard copy report rather than within a database or GIS (all CZAS reports have now been scanned by the SCAPE Trust and are available at

http://www.scapetrust.org/html/publications.html). Furthermore, despite HS APP4 guidelines, data collected and presented in some CZAS reports lacked standardisation, making it difficult to compare like with like across different survey areas. Clearly some means of systematic integration and analysis was required if the CZAS were to achieve their intended aims of assessing the scale of the threat to coastal heritage and developing national and regional priorities.

2.1.2 Prioritisation of Coastal Zone Assessment Survey records

A big step towards realising the potential of the CZAS was achieved in 2010 through an analysis of the data commissioned by Historic Scotland (Dawson, 2010). Referred to as the '*CZAS review*' in this report, the aim of the analysis was to establish a systematic methodology for prioritising action at sites being affected by coastal processes. The full report of the prioritisation methodology, analysis and results are available to download via Appendix 1, but in summary, the work flow was:

1. Digitise all CZAS data (heritage and coastal erosion data)
2. Standardise records
3. Assign a value class to each heritage asset
4. Assign an erosion class to each heritage asset (using site description and GIS analysis)
5. Stakeholder review (verifying value of heritage classes and local erosion threats)
6. Extract and rank sites-at-risk based on the following formula:

Archaeological value x **Erosion risk** = **Priority**

By adopting an agreed methodology for standardising the records and assigning class value to sites, and by focussing on the specific threat of erosion, the number of sites at risk requiring some sort of action was reduced from 3,768 (recommended by the original surveyors) to 1,115. Of these, 322 were given priority 1 or 2 scores, the highest priorities for further action. These represented the most archaeologically significant sites which were either being impacted by, or at real risk of being impacted by, coastal processes. In this report these sites will be referred to as the '*CZAS review high-priority sites'*.

The methodology aimed at making the data contained within the CZAS reports more useable for heritage management and the prioritisation report also recommended staged courses of action for each of the priority sites. However, it was evident that there were inconsistencies in the records, and by 2010, some of the surveys were nearly 20 years old. As the project was a desk-based analysis of historical survey data collected by different organisations over a long period of time, the first recommendation for every high priority site was to re-visit and review its condition and status. This recommended course of action formed the objective and focus for ShoreUPDATE.

2.2. ShoreUPDATE Methods

SCHARP recruited, trained and supported volunteers to re-visit and undertake surveys of sites at risk in their local areas. This element of the project was called ShoreUPDATE. By putting volunteers at the heart of the survey it was intended to build a network of trained coastal stewards, the value of which would outlast the specific project and benefit Scotland's heritage management capacity. The project was also interested in enhancing site records through the contribution of additional locally known information, and of gaining a more nuanced sense, where possible, of the local value of a site.

Volunteers were encouraged to explore all sites previously recorded through CZAS, but there was a clear project focus on updating records of the 322 *CZAS review* high-priority sites to achieve as great a sample size as possible upon which to assess information about sites most at risk nationally.

2.2.1 The data portal

The output of the 2010 study; a single - standardised prioritised database of all sites recorded in the CZAS - formed the data underpinning ShoreUPDATE. These CZAS records together with recommendations were uploaded to a web-based interactive Sites at Risk Map and colour coded according to their priority status (high, medium and low priority – see http://scharp.co.uk/sites-at-risk/). Each site record is a portal from where survey forms can be downloaded, and completed surveys and photographs uploaded to the project database. The interactive map formed the basis of an Android and IOS ShoreUPDATE app, which also contained all CZAS records colour coded by priority, linked to a survey form.

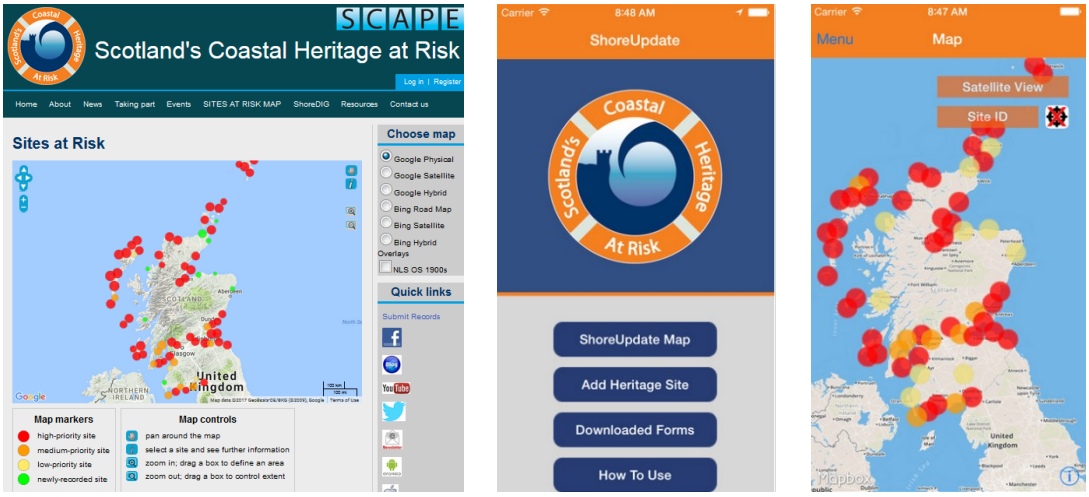


Figure 3 a) Sites at Risk web map. *b) ShoreUPDATE app.*

The purpose of the app was to democratise participation by making the data as widely available as possible, using familiar technology. The app removed the need for volunteers to own cameras, hand held GPS instruments or paper maps. Volunteers were able to use their own devices to download site records and maps for use in the field. Widely-understood mapping and GPS functions helped volunteers to navigate to sites where they could use their device's camera to take photographs before submitting records using Wi-Fi or 3G connectivity.

Functionality	Sites at Risk web map	ShoreUPDATE IOS and Android app
Access CZAS site information	✓	✓
Access on-line survey form to fill in	✓	✓
Submit user records to SCHARP team	✓	✓
Add new sites	✓	✓
Edit site records	✓	✗
Link to further information held in other databases	✓	✗
Access pdf survey forms to print	✓	✗
Download site records and background maps for use in the field	✗	✓
Use GPS to navigate to sites in the field	✗	✓
Take photographs	✗	✓

Table 1. A summary of functionality of the Sites at Risk interactive map, and the ShoreUPDATE app. Some of this is shared, but both the website and the mobile app employed unique elements, giving each an advantage in some respects.

2.2.2 Training

From 2012 to 2016, forty-three training events were delivered around Scotland. The training introduced the aims and objectives of the project, showed users how to use the website and app and included a site visit to practice survey methodology in the field. Eighteen of these training events involved extended periods of field survey with groups of volunteers, increasing participants' confidence and developing skills and consistency in archaeological observation and recording.

Figure 4. ShoreUPDATE training in Falkirk

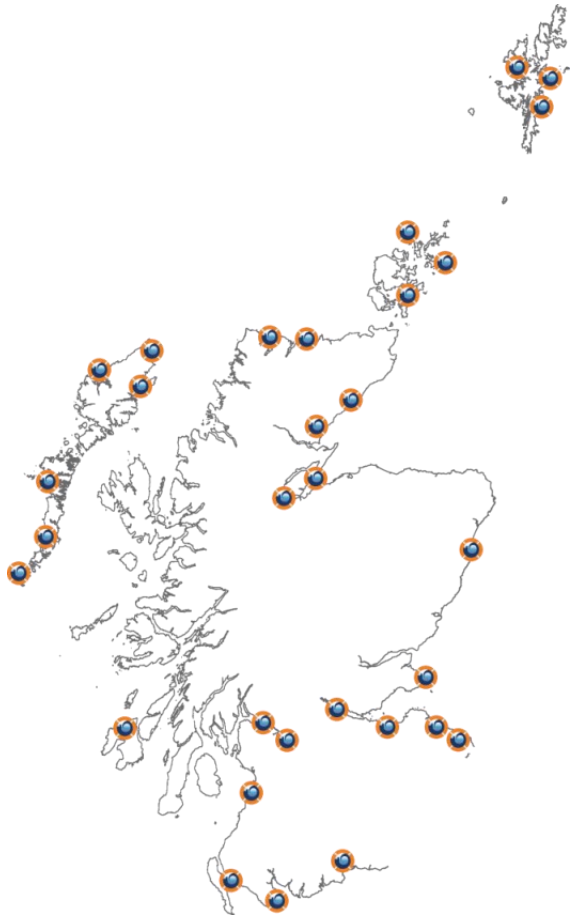


Figure 5. Location of ShoreUPDATE training events and field trips

2.2.3 Participation

Over the course of the SCHARP project, around 500 people took part in surveys and associated activities. Of these, 249 people had already attended ShoreUPDATE training events. After training events, 124 unique volunteers continued to submit ShoreUPDATE records, although in a number of cases, one individual would take responsibility for submitting records for surveys undertaken by groups of people. By the end of December 2016, volunteers had contributed 695 days to coastal surveys and submitted 1,041 ShoreUPDATE records, including 282 (or 88%) of the 322 *CZAS review* high-priority sites. Volunteers also submitted over 400 new site records. [1]

Figure 6. ShoreUPDATE site visit, Sanday

[1] the SCHARP Final Evaluation Report provides much more detail about the involvement of volunteers. Available at: http://scharp.co.uk/media/medialibrary/2017/09/SCHARP-HLF-EVALUATION_FINAL_web.pdf

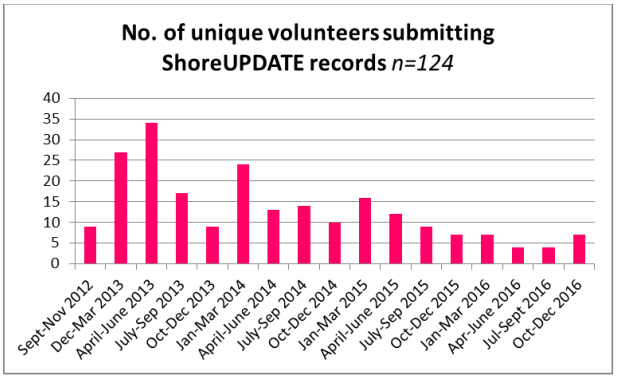
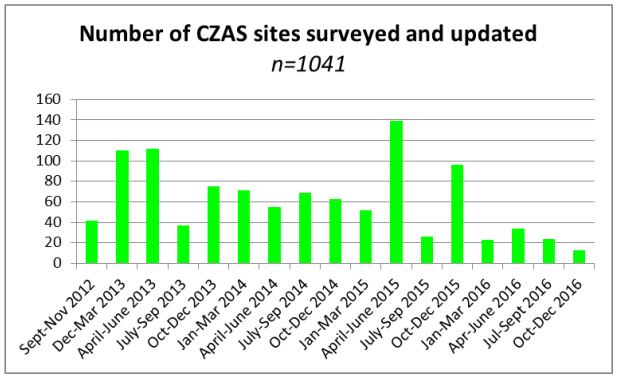


Figure 7a. Unique volunteers submitting surveys by quarter



b. Number of ShoreUPDATE surveys submitted by quarter.

2.2.4 Moderation, analysis and review

Every record submitted was moderated by one of the SCHARP project officers. This was done in order to maintain consistency and ensure accuracy. Once moderated, the surveys and photographs were uploaded to the website so that volunteers could see the results of their contributions. Moderating records allowed project officers to keep track of the information being submitted, and also meant that a dialogue with volunteers was maintained.

Following moderation, the data was analysed so that the *CZAS review* priority scores could be updated. This relied upon the expert judgement of SCAPE officers who analysed the full range of observational data submitted for each site; most importantly, the updated description, surveyor recommendations and site photographs. The status of every record submitted was reviewed, regardless of its original priority score and a recommendation was made regarding its new priority score. The site could either retain its *CZAS review* priority status, or could be revised up or down. Within this report, the new rankings are referred to as *ShoreUPDATE priority* sites.

Figure 8. Review process work flow

Part 2 of this report provides the ShoreUPDATE review recommendation for each of the *CZAS review* high-priority sites visited, and a justification for each new *ShoreUPDATE priority* assigned. The new priority lists were then shared with Local Authority Archaeologists and other stakeholders, and face-to-face meetings were held. The aim of the consultation was to ensure that the revised *ShoreUPDATE priority* sites reflected the local understanding of heritage managers.

2.2.5 Explanation of priority vulnerability scores

Over the course of the ShoreUPDATE surveys and subsequent analysis, the criteria for assigning priority scores with recommended actions were expanded and refined from those used in the CZAS prioritisation project (Dawson, 2010). Definitions of what constituted high, medium and low priority reflect the observations made about site condition in relation to the original CZAS record, including the immediacy of threat from erosion and the urgency and nature of any required action. The criteria used in ShoreUPDATE when reviewing priority scores and recommended action is summarised in Table 2 below.

Score	ShoreUPDATE Priority and Recommendation	CZAS Review Priority and Recommendation
1*	Site has deteriorated since original CZAS. Differentiated from Priority 1 sites on basis of heightened vulnerability; most sites in this category are in soft, sandy coastal areas that show no evidence of stabilising. Recommendation: Urgent action to mitigate loss of information required.	Not used
1	Site has deteriorated or remains unstable since original CZAS. Vulnerable to coastal processes under normal weather conditions. The integrity of the whole site is threatened. Recommendation: Action required to rescue or protect information within management/research framework.	Definitely eroding/at risk of erosion Recommendation: Action urgently needed to rescue information.
2	Site is unchanged or has stabilised somewhat since the original CZAS, but remains vulnerable to coastal processes, even under normal weather conditions. The integrity of the whole site is potentially threatened. A change in condition and status to Priority 1 could happen rapidly. Recommendation: Further characterisation in some cases required. Monitor at least annually and following extreme weather events.	Definitely eroding/at risk of erosion Recommendation: Action highly desirable to rescue information.
3	Site has stabilised since the original CZAS and is vulnerable to extreme weather events. Under normal conditions, parts of the site may be threatened, not the whole site. Condition could change rapidly so retain ability to respond. Recommendation: Monitor after extreme weather events and every 3- 5years.	Action a medium priority and more likely to take place as a result of factors other than purely risk from coastal processes. Recommendation: Action to take place within a wider project or to address a research need.
4	Not used	No action required.
5	Not used	No action required.

Table 2. Explanation of ShoreUPDATE priority scores with reference to original recommendations applied in Dawson 2010

A *ShoreUPDATE priority* 1 score is used to distinguish those sites that are **currently** most at risk, based on observations made in the field. Within this category, a *ShoreUPDATE priority* 1* score has been introduced to draw attention to the small number of sites where action is most urgent. However, for management and monitoring purposes, all *ShoreUPDATE priority sites* scoring either 1 or 2 should be treated as the highest priority. To receive such a score, their archaeological value has been demonstrated; and their location in dynamic coastal areas means that the nature of coastal change is such that a priority 2 site can easily become a priority 1 site and vice versa.

Some *CZAS review* high priority 1 and 2 *sites* located on low-lying soft coastlines sensitive to rapid change, were apparently stable or barely visible when re-visited (for example because they had been re-buried with sand or re-vegetated). In such cases they were generally revised down by only a score of one, (to *ShoreUPDATE priority* 2 or 3 status) in order to keep them 'visible' for future monitoring.

2.2.6 A note on quality control, consistency of the surveys and limitations

With nearly 1,500 *ShoreUPDATE* surveys submitted, there was, inevitably, occasional variation in the quality and level of detail of some records. This problem was successfully mitigated during the moderation process due to the close links that the SCHARP officers had with volunteers. It was always possible to provide feedback to volunteers and to ask for more information or clarification. In addition, SCHARP officers visited a high proportion of the *CZAS priority* 1 and 2 sites.

During the analysis phase, there remained a tiny number of cases where there was uncertainty about a site's priority status. In these cases a precautionary principle was adopted and the site was assigned the highest applicable priority score.

It was not possible to track down the full photographic archives for some of the earlier CZAS surveys, and so we relied on site descriptions and photographs included in the CZAS reports.

The results of the ShoreUPDATE reprioritisation project only apply to the 35% of Scotland's coastline which was examined during the Coastal Zone Assessment Surveys. This is a valuable sample to interpolate general conclusions and trends, but no attempt has been made to predict the potential number of important archaeological sites under similar levels of threat outwith the areas examined.

3. Results

Volunteers submitted updated records for 1,041 sites originally recorded in the CZAS and new records for a further 400 sites. All the data has been shared with the relevant Local Authority Archaeologists and with Historic Environment Scotland. The Sites at Risk map at http://scharp.co.uk/sites-at-risk/ is also, in effect, a living archive of all the revised and new data.

The project visited 282 of the original 322 *CZAS review* priority 1 and 2 sites; a sample of 88%. Forty sites, (8 priority 1 and 32 priority 2), were not visited. The unvisited sites retain their original priority status but are not included in the following results and analysis.

The 629 *CZAS review* priority 3 sites were not the focus of the surveys and were not analysed, so these retained their priority 3 status, except for 10 sites which were elevated to a higher ShoreUPDATE priority.

3.1. Summary of change between CZAS review priority sites and ShoreUPDATE priority sites

In total, 145 sites were assigned a *ShoreUPDATE priority* 1 or 2 status compared to the 282 *CZAS review* priority sites visited. Of these, the number of *CZAS review* priority 1 sites visited has been revised from 85 to 31. Eight of these have been assigned a *ShoreUPDATE priority* 1* status. This new category distinguishes the small number of sites which are the most urgent priorities for mitigation action due to their archaeological value and vulnerability. All *ShoreUPDATE priority* 1* sites identified to date are located in Orkney and the Western Isles. The number of *CZAS review* priority 2 sites has been revised from 237 to 114. Tables 4-6 summarise ShoreUPDATE priority 1*, 1 and 2 sites. Figures 12 and 13 show the distribution of *CZAS review* priority sites and *ShoreUPDATE priority* sites. Part 2 of this report provides the ShoreUPDATE review recommendation for each *CZAS review* priority site visited and each new *ShoreUPDATE priority* assigned.

LA area	CZAS Priority 1	ShoreUPDATE Priority 1	P1 not visited	CZAS Priority 2	ShoreUPDATE Priority 2	P2 not visited
ORKNEY	25	13	2	54	34	10
WESTERN ISLES	23	10	2	58	23	2
SHETLAND	18	4	0	34	11	7
HIGHLAND	6	1	0	21	17	3
WOSAS (Coll & Tiree, Colonsay, Islay, Firth of Clyde)	4	2	3	26	9	9
FIFE	2	0	1	16	6	0
DUMFRIES & GALLOWAY	2	1	0	10	5	0
ANGUS	1	0	0	6	4	0
EAST LOTHIAN	4	0	0	6	3	0
BORDERS	0	0	0	4	1	0
CLACKMANNANSHIRE	0	0	0	1	0	0
FALKIRK	0	0	0	1	0	1
TOTAL ALL CZAS AREAS	**85**	**31**	**8**	**237**	**114**	**32**

Table 3. Summary of change in numbers of priority sites by Local Authority area, and number of sites not visited

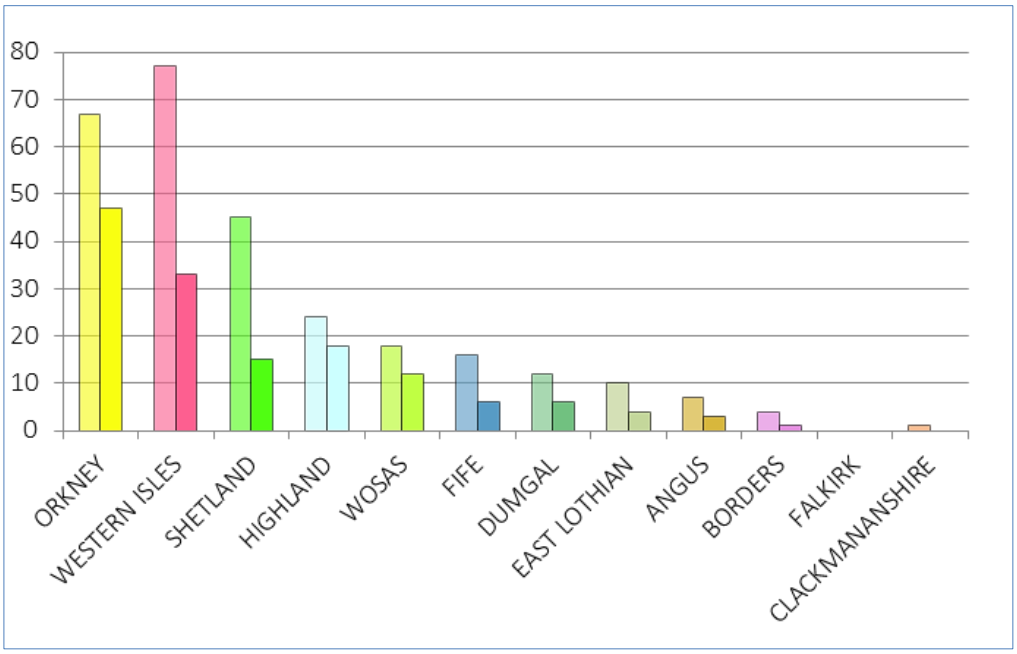


Figure 9. Bar chart showing number of visited CZAS review priority 1 and 2 sites left bar (n = 282), plotted against number of revised ShoreUPDATE priority 1 and 2 sites, right bar (n= 145) for each Local Authority area

Figure 10 summarises the revisions to the *CZAS review* priority sites and the origin of the ShoreUPDATE priority sites. One hundred and five ShoreUPDATE priorities retained their status from the CZAS review priority sites and 39 originated from CZAS non-priorities and new sites. Ninety seven CZAS review priority sites were reassigned a ShoreUPDATE priority 3 (monitor) status. This brings the number of ShoreUPDATE priority 3 sites to 706. Although not discussed here, priority 3 sites are an important category because they capture a variety of interesting, often locally valued coastal heritage sites, which may have considerable research potential as part of a wider group of sites, have interpretation potential and community research potential. Seventy one CZAS review priority sites were removed. The reasons for removal are discussed below in section 4.1.1.

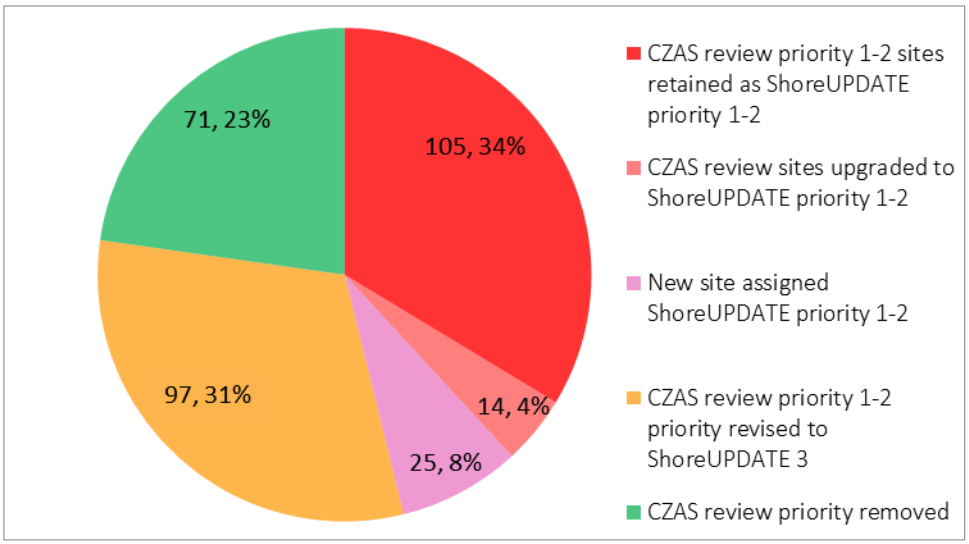


Figure 10 Summary of re-prioritisation results (n = 312[2])

[2] n = 312 includes the 282 *CZAS review* priority sites visited and 30 new sites assigned a *ShoreUPDATE priority* status

Nearly a third of the *ShoreUPDATE priority* 1 and 2 sites originated from either non-priority sites or from new discoveries. This reminds us that there will certainly be sites in the CZAS review 3—5 or non-priority categories that have since become priorities but were not captured in our survey. Although probably not altering the general trend of the results, it does underline the need for repeat surveys of the coast and the monitoring of heritage sites if we are to maintain a true picture of the resource at risk.

3.2. *ShoreUPDATE priority 1* sites*

Local Authority	SCHARP ID	Site Name	Site Type	ShoreUPDATE Priority	Summary of Vulnerability
ORKNEY	6105	BAY OF SKAILL	Multi-period Settlement Mound	1*	Sand dune coast edge, wave & aeolian erosion, slope failure
ORKNEY	6332	COTT	Multi-period Settlement Mound	1*	Low lying sandy coast edge, wave erosion, slope failure
ORKNEY	6367	KING'S CRAIG	Multi-period Settlement Mound	1*	Low lying soft coast edge, wave erosion, slope failure
ORKNEY	6681	BAY OF LOPNESS/ NEWARK	Multi-period Settlement Mound	1*	Sand dune coast edge, wave & aeolian erosion, slope failure
ORKNEY	6817	NORTHSKAILL	Multi-period Settlement Mound	1*	Sand dune coast edge, wave & aeolian erosion, slope failure
WESTERN ISLES	3291	SWAINBOST	Metal Working Site	1*	Machair coast, aeolian, stream & stock erosion, slope failure
WESTERN ISLES	9609	TEANNA MHACHAIR	Wheelhouse (Possible), Midden	1*	Low lying sand dune coast edge, wave & aeolian erosion, slope failure
WESTERN ISLES	9612	NORTH UIST, BALESHARE, CEARDACH RUADH	Wheelhouse, Midden, Cist	1*	Low lying sand dune coast edge, wave & aeolian erosion, slope failure

Table 4. Summary of the eight ShoreUPDATE priority 1 sites by Local Authority area. Each SCHARP ID is hyperlinked to the site record.*

3.3. ShoreUPDATE priority 1 sites

Local Authority	SCHARP ID	Site Name	Site Type	ShoreUPDATE Priority	Summary of Vulnerability
DUMFRIES & GALLOWAY	4081	REDKIRK POINT	Submerged Land Surface	1	Intertidal
HIGHLAND	758	ACHNAHAIRD SANDS	Building Complex, Cairn, Midden	1	Sand dune coast, aeolian, & stock erosion
ORKNEY	6378	MUNKER HOOSE	Broch, Settlement	1	Coast edge, wave erosion, slope failure
ORKNEY	6674	LOPNESS	Settlement	1	Low lying coast edge, wave erosion, slope failure
ORKNEY	6765	NORTH MIRE	Cairn	1	Coast edge, slope failure, wave erosion
ORKNEY	6770	EBB OF SEATER	Mound, Settlement	1	Low lying coast edge, wave erosion, slope failure
ORKNEY	6802	RUNNA CLETT	Mound, Settlement	1	Low lying coast edge, wave erosion, slope failure
ORKNEY	6827	CLEAT	Settlement, Probable Burial Cairn	1	Low lying coast edge, wave erosion
ORKNEY	12899	ORE LEDGE LOPNESS	Broch or Chambered Tomb	1	Low lying coast edge, wave erosion, slope failure
ORKNEY	13134	THE GRITHIES, CATA SAND	Structure	1	Sand dune coast/ intertidal, wave & aeolian erosion
SHETLAND	5473	WEST AYRE, HILLSWICK	Structure, Midden	1	Low lying storm beach, wave erosion
SHETLAND	6597	NETHERTON	Structure	1	Sand dune coast edge, wave & aeolian erosion, slope failure
SHETLAND	6904	BANNAMINN	Structure, Possible House	1	Machair coast edge, wave & aeolian erosion,
SHETLAND	12788	CHANNERWICK	Broch	1	Sandy coast edge, wave erosion, slope failure
WESTERN ISLES	8915	SGIRR NAM PORTAN	Midden, Settlement	1	Low lying coast edge and intertidal, wave erosion

Local Authority	SCHARP ID	Site Name	Site Type	ShoreUPDATE Priority	Summary of Vulnerability
WESTERN ISLES	8955	DUN VULAN	Broch, Settlement	1	Low lying storm beach, wave erosion
WESTERN ISLES	9332	FOSHIGARRY	Township, Wheelhouse, Souterrain,	1	Sand dune & machair coast edge, aeolian, stock & wave erosion
WESTERN ISLES	9358	NORTH UIST, BALELONE	Souterrain	1	Sand dune & machair coast edge, aeolian, stock & wave erosion
WESTERN ISLES	9387	NORTH UIST, AIRD AN RUNAIR, AN CAISTEIL	Dun, Midden, Cists	1	Sand dune & machair coast edge, aeolian, stock & wave erosion
WESTERN ISLES	12571	TRAIGH NA CILLE, PABAY MOR	Structure, Midden	1	Sand dune coast edge, wave & aeolian erosion, slope failure
WESTERN ISLES	13304	LIONACLEIT	Submerged Land Surface	1	Intertidal
WOSAS	7565	ARDNAVE	Midden and Stone Spread	1	Sand dune coast, aeolian erosion
WOSAS	12807	NEWSHOT ISLAND	Maritime Craft (Diving Bell Barge)	1	Intertidal

Table 5. Summary of twenty three ShoreUPDATE priority 1 sites by Local Authority area. Each SCHARP ID is hyperlinked to the site record.

Since the ShoreUPDATE surveys were carried out, new fieldwork has been initiated at Swainbost (Site 3291) by MacLeod Archaeology and ORCA; The Grithies, Cata Sand (Site 13134) by UHI Orkney and University of Central Lancashire; West Ayre, Hillswick (Site 5473) by Archaeology Shetland; Channerwick (Site 12788) by SCAPE and Archaeology Shetland; and Newshot Island (Site 12807) by SCAPE and the Nautical Archaeology Society.

3.4. ShoreUPDATE priority 2 sites

Map No.	Local Authority	SCHARP ID	Site Name	Site Type
1	ANGUS	11560	Red Castle, Lunan	Castle & Midden
2	ANGUS	11572	Boddin Point	Lime Kiln
3	ANGUS	11649	Kaim Of Mathers	Ruined Castle
4	ANGUS (MORAY)	12824	Findhorn Bay	Maritime Craft/ Boat Graveyard
5	BORDERS	9873	Eyemouth, Kings Mount	Fort
6	DUMGAL	3877	Garlieston Bay	Mulberry
7	DUMGAL	3946	Nun Mill Bay	Shipwreck
8	DUMGAL	3851	Burrow Head	Promontory Fort
9	DUMGAL	3951	Gibbhill, Castledykes Point	Shipwreck, Jetty & 'Yair'
10	DUMGAL	4084	Redkirk Point	Pottery & Pottery Kiln Findspot
11	EAST LOTHIAN	588	Seacliff Tower	Tower
12	EAST LOTHIAN	10056	Seacliff	Midden And Cist Burials
13	EAST LOTHIAN	10089	Dunbar Castle	Castle
14	FIFE	1303	Newark Castle	Defence; Residential/ Castle
15	FIFE	1480	Crail Salt Pans	Salt Pans
16	FIFE	1048	Seafield Tower	Tower And Midden
17	FIFE	1811	Balmerino, Flisk Seabraes	Submerged Forest/Intertidal Peat
18	FIFE	1310	St Monance, East Braes	Salt Pans
19	FIFE	13572	Pettycur Harbour	Harbour
20	HIGHLAND	5163	Skullomie	Harbour; Quay; Sea-Wall
21	HIGHLAND	4530	Castlecraig	Tower-House
22	HIGHLAND	4626	Balintraid Pier	Pier
23	HIGHLAND	4821	An Fharaid	Structural Remains
24	HIGHLAND	4939	Eriboll	Lime-Kiln
25	HIGHLAND	5119	Eilean Thunga	Wrecks
26	HIGHLAND	11937	Brora	Salt Works
27	HIGHLAND	11713	Spinningdale	Cotton Mill, Watermill
28	HIGHLAND	11940	Brora Salt Pans	Midden
29	HIGHLAND	11942	Brora Links	Building
30	HIGHLAND	11938	Brora Salt Pans	Track
31	HIGHLAND	12674	Skelbo Dunes, Loch Fleet	Buried Land Surface
32	HIGHLAND	12857	An Fharaid	Burnt Mound
33	HIGHLAND	13434	Sron Rubha Na Gaoithe	Shell Midden
34	HIGHLAND	13231	Brora Salt Works	Salt Works
35	HIGHLAND	13435	Sron Rubha Na Gaoithe	Shell Midden
36	HIGHLAND	13573	Loch Fleet	Maritime Craft/ Boat Graveyard
37	ORKNEY	6228	East Surrigarth	Chambered Cairn
38	ORKNEY	6235	Swartmill	Structural Remains
39	ORKNEY	6236	Ayre Of Swartmill	Indeterminate Remains
40	ORKNEY	6128	Biggings	Mounds & Possible Settlement Debris
41	ORKNEY	6725	Ladykirk	Mound & Coastal Exposure

Map No.	Local Authority	SCHARP ID	Site Name	Site Type
42	ORKNEY	5877	Windwick	Anthropogenic Deposits
43	ORKNEY	5906	Hillock Of Fea	Anthropogenic Deposits
44	ORKNEY	5942	North Links	Settlement & Artefact Scatters
45	ORKNEY	5947	Weddell Point	Buried Land Surface; Structure
46	ORKNEY	6023	Castle Of Burwick	Promontory Fort
47	ORKNEY	6042	Mayfield	Enclosure
48	ORKNEY	6133	Queena Howe	Settlement & Mound
49	ORKNEY	6169	Kestro	Structure & Anthropogenic Deposits
50	ORKNEY	6176	Hodgalee	Broch, Settlement, Noosts
51	ORKNEY	6183	Branstone Hill	Structure, Mound & Noost
52	ORKNEY	6198	Peterkirk	Chapel, Broch
53	ORKNEY	6199	Peterkirk	Possible Burial Mounds
54	ORKNEY	6304	Bu Of Cairston	Settlement, Possible Broch
55	ORKNEY	6657	Buryan	Broch
56	ORKNEY	6689	Hangie Head, Tres Ness	Mound & Earthwork
57	ORKNEY	6704	Russ Ness	Mound & Coastal Exposure
58	ORKNEY	6710	Augmund Howe	Cairn
59	ORKNEY	6726	Ouse Point	Coastal Exposure
60	ORKNEY	6736	Backaskaill	Possible Broch
61	ORKNEY	6750	Bay Of Stove	Coastal Exposure: Settlement Remains
62	ORKNEY	6764	Pool	Settlement
63	ORKNEY	6793	Rethie Taing	Possible Chambered Cairn
64	ORKNEY	6803	Woo	Coastal Exposure: Settlement
65	ORKNEY	6829	Peterkirk	Mound & Coastal Exposure
66	ORKNEY	12218	Crow Taing, Tofts Ness	Mound And Coastal Exposure
67	ORKNEY	12492	Langamay	Midden
68	ORKNEY	12495	Langamay	Wall
69	ORKNEY	13233	Long Taing Of Newark	Wall
70	ORKNEY	6346	Hookin	Farmstead & Farm Mound
71	SHETLAND	12784	Mail/Bur Ness	Structure
72	SHETLAND	5369	Ness Of Garth	Promontory Fort
73	SHETLAND	6562	Mail	Settlement
74	SHETLAND	6557	South Voxter / Mail	Human Burials
75	SHETLAND	6586	Sands Of Cumblewick	Structural Remains & Anthropogenic Deposits
76	SHETLAND	6927	Duncansclett	Settlement
77	SHETLAND	6966	Whalsies Ayre	Structure, Possible Longhouse
78	SHETLAND	6970	Whalsies Ayre	Structure, Possible Long House
79	SHETLAND	12782	Vardasta Gletness	Building
80	SHETLAND	12939	Sna Broch, Ness Of Snabrough	Broch
81	SHETLAND	12940	Suther Ness	Structure
82	WESTERN ISLES	1875	Mealista	Dyke And Shell Midden
83	WESTERN ISLES	2669	Bostadh	Cell: Midden, Shell
84	WESTERN ISLES	3062	Arnol	Settlement

Map No.	Local Authority	SCHARP ID	Site Name	Site Type
85	WESTERN ISLES	3130	Barvas	Settlement
86	WESTERN ISLES	3225	Galson	Settlement Mound
87	WESTERN ISLES	3483	Laxdale	Settlement Mound
88	WESTERN ISLES	3734	Bostadh	Midden And Cell
89	WESTERN ISLES	3755	Bostadh	Settlement
90	WESTERN ISLES	4275	Port Na Cille	Broch, Midden, Enclosure
91	WESTERN ISLES	4297	Traigh Varlish	Midden
92	WESTERN ISLES	9777	Seidinish	Midden
93	WESTERN ISLES	8836	Cnoc Sornain	Mound And Coastal Section With Anthropogenic Deposits
94	WESTERN ISLES	8903	Rubha Ghaisinis, Carnan, Sig More	Chambered Cairn
95	WESTERN ISLES	8917	Sithean Biorach	Coastal Exposure With Anthropogenic Deposits
96	WESTERN ISLES	9306	Sithean Mor, Calarnais	Mound; Middens; Souterrain (Possible); Pottery; Cairn (Possible)
97	WESTERN ISLES	9375	Traigh Bhan	Midden
98	WESTERN ISLES	9386	Aird An Runair, Hougharry	Midden
99	WESTERN ISLES	9391	Aird An Runair	Wall
100	WESTERN ISLES	9416	Loch Paible	Dun (Possible)
101	WESTERN ISLES	9812	Rudh'An Duin	Dun
102	WESTERN ISLES	9851	Gearraid Mhartainn	Midden
103	WESTERN ISLES	12841	Aird An Runair	Midden
104	WESTERN ISLES	9779	Seidinish	Structure
105	WOSAS	7388	Dunivaig Castle, Lagavulin Bay	Dunivaig Castle
106	WOSAS	7460	Sanaigmore Bay	Deflation Hollow With Artefact Scatters
107	WOSAS	8051	Cardross Shore	Posts
108	WOSAS	8186	Dumbuck Crannog	Crannog
109	WOSAS	8335	Erskine Crannog	Crannog
110	WOSAS	12681	Newshot Island	Maritime Craft (Schooners)
111	WOSAS	12948	Ardnave Te-Sgeir	Structure & Midden
112	WOSAS	12950	Ardnave Te-Sgeir	Walls & Midden
113	WOSAS	12955	Ardnave, Sgeir Na Nighinn	Structure, Midden, Artefact Scatter
114	WOSAS	7038	Traigh Tuath, Sorisdale	Old Ground Surface, Midden

Table 6. Summary of ShoreUPDATE priority 2 sites by Local Authority area. Each SCHARP ID is hyperlinked to the site record.

The results of the ShoreUPDATE analysis reduced the number of priority 1 and 2 sites in every Local Authority area. However, as Figure 11 shows, the percentage of *ShoreUPDATE priority* 1 and 2 sites as a proportion of the total number of sites remains broadly similar when compared to the *CZAS review* results. The greatest change is seen in Shetland, where there is a proportional decrease and Orkney where there is a proportional increase. The results confirm the findings of the original CZAS analysis that the Northern and Western Isles and Highland region contain the overwhelming majority of vulnerable priority coastal heritage sites.

	Orkney, Western Isles, Shetland, Highland	**All remaining LA areas**
CZAS review priority 1 and 2	214	68
%	**76%**	**24%**
ShoreUPDATE priority 1 and 2	114	32
%	**78%**	**22%**

Table 7. Comparison of number and % of CZAS review priority sites and ShoreUPDATE priority sites visited between Northern Isles, Western Isles, and Highland region, and the rest of the LA areas.

Orkney and the Western Isles alone account for 56% of all *ShoreUPDATE priority 1 and 2* sites and 74% of the *ShoreUPDATE priority 1* sites and are clearly the areas with the greatest number of high value archaeological sites at greatest risk.

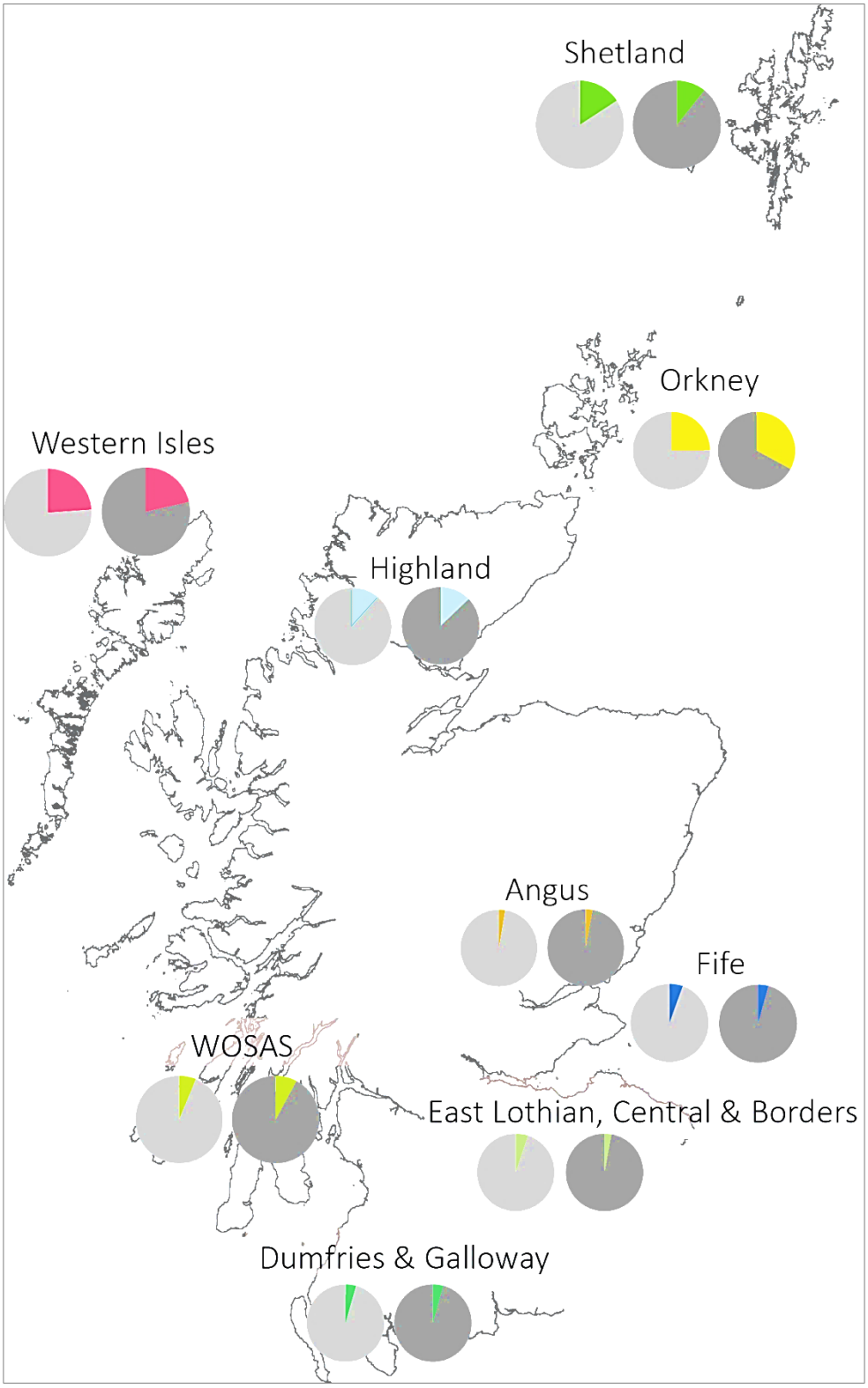


Figure 11. Proportion of CZAS review priority 1 and 2 sites in each region relative to all CZAS review priority sites (left pie chart) and proportion of ShoreUPDATE priority 1 and 2 sites in each region relative to all ShoreUPDATE priority sites (right pie chart).

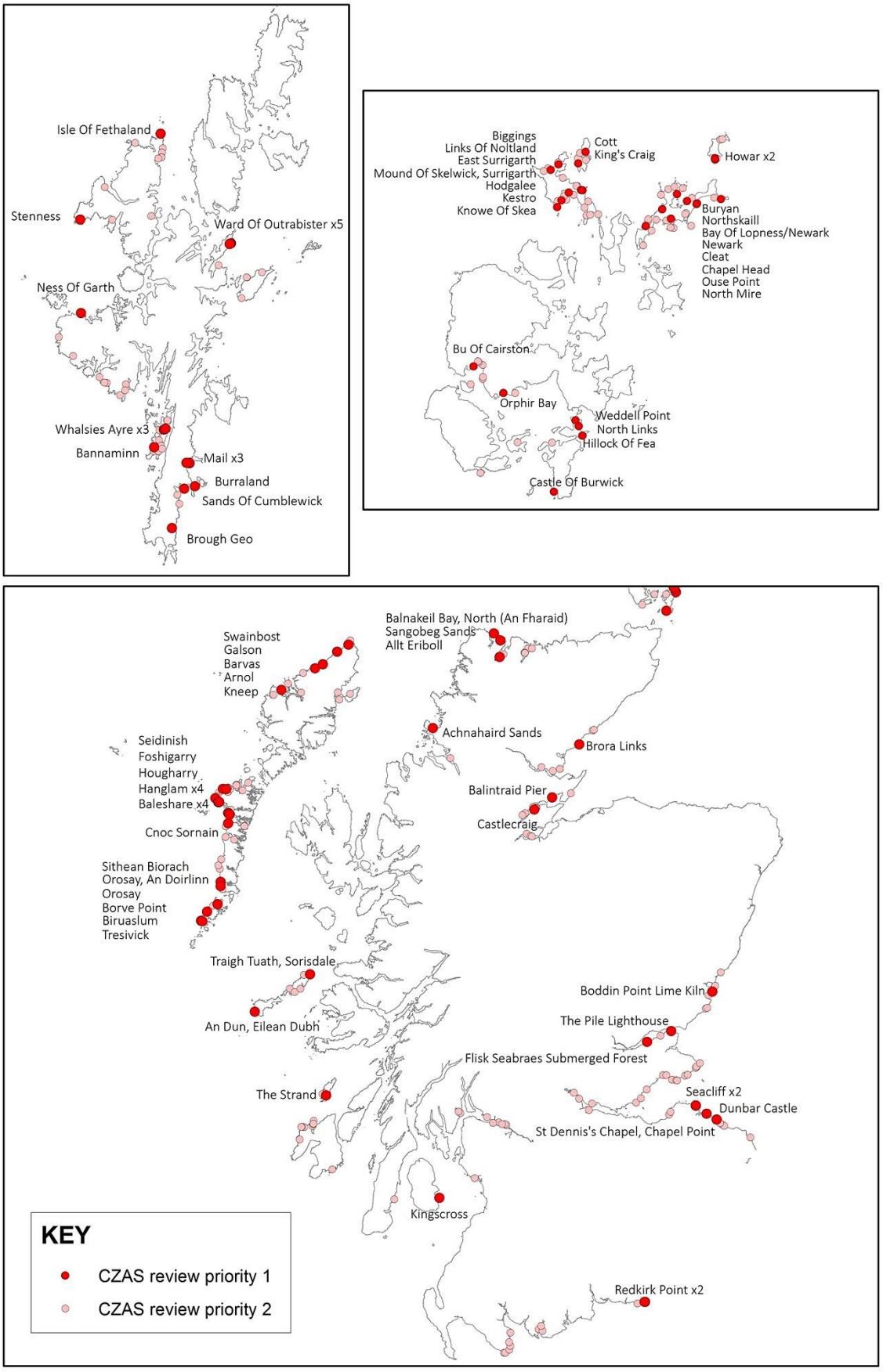


Figure 12. Distribution of all CZAS review priority 1 (red) and 2 (pink) sites (after Dawson, 2010). Priority 1 sites are labelled with site name. Number of original priority 1 sites = 85 and priority 2 sites = 237, total 322

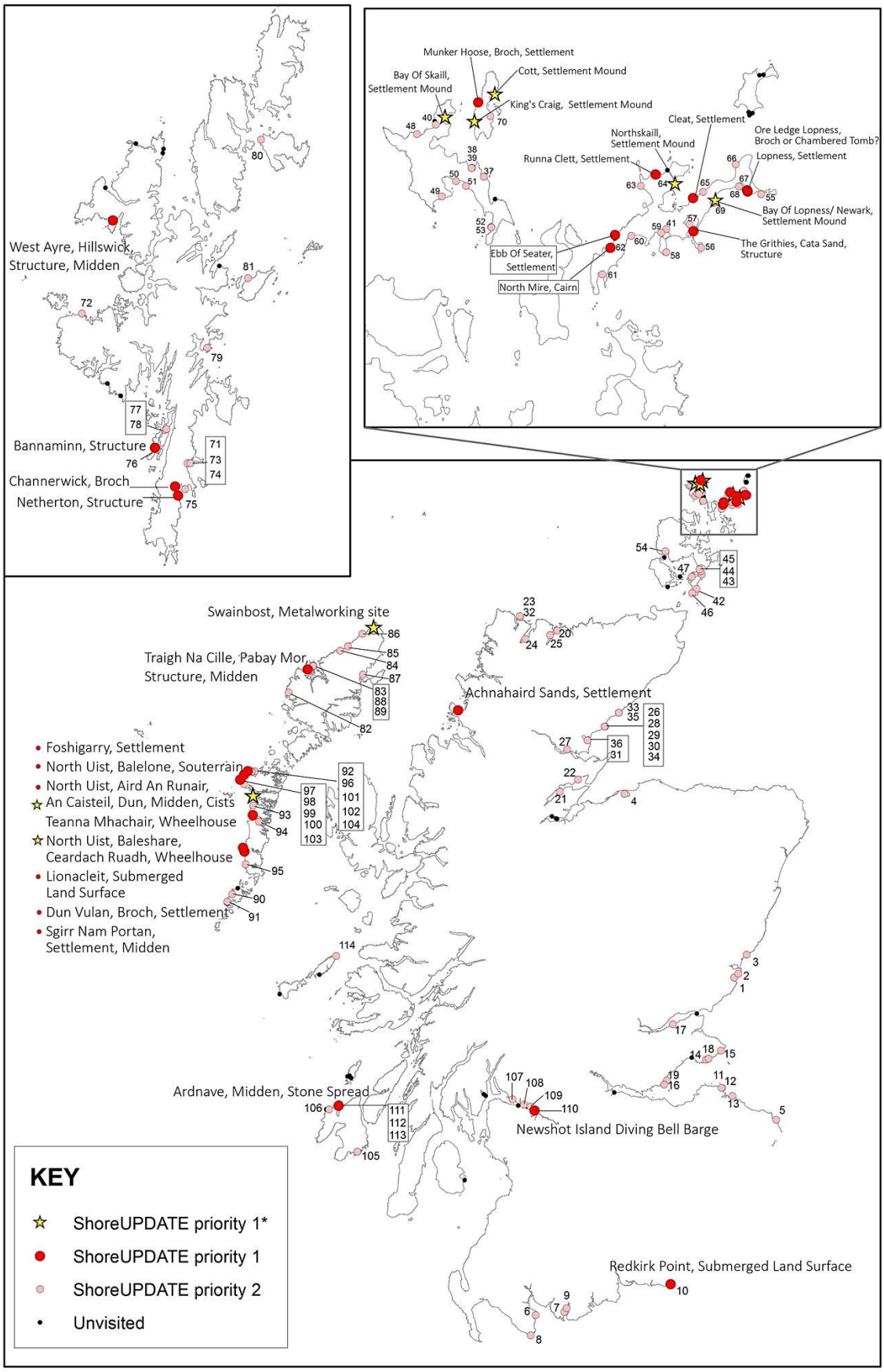


Figure 13. Distribution of ShoreUPDATE priority 1 (yellow star), priority 1 (red) and 2 (pink) sites. Priority 1* and 1 sites labelled with site name and summary site type. Number of revised priority 1 sites = 31 and priority 2 sites = 114, total = 145.*

3.5. Sites at risk and type of coastline

The geology and geomorphology of the coast edge was found to correlate strongly with the distribution of priority sites.

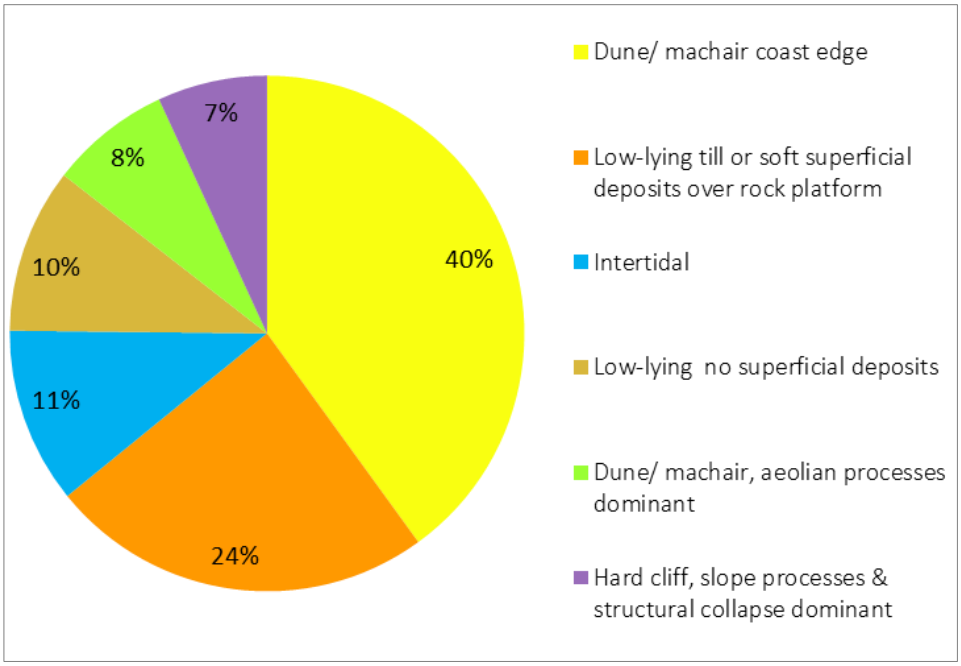


Figure 14. Proportion of ShoreUPDATE priority sites occurring in the main coastal environments (n = 145)

- Sand dune and machair coastlines, a feature of the Northern and Western Isle, account for 40% of all ShoreUPDATE priority sites.
- A further 8% are located further inland but still within coastal sand dune and machair environments, and are being impacted by aeolian erosion.
- Nearly a quarter of priority sites are located on low-lying till over rock platform coast edges, common in Orkney.
- Intertidal locations account for 11% of priority sites.
- Low lying coasts with no superficial deposits account for a further 10% of priority sites.
- Hard cliff coastlines have the lowest percentage of priority sites, but the nature of sudden cliff collapse can cause catastrophic damage to vulnerable archaeological sites in these locations.

3.6. Sites at risk and type of site

Settlement sites including settlement mounds and specific building types (broch/dun/wheelhouse) make up half of all ShoreUPDATE priority site types. If specific sites which also infer settlement such as structures, fortified sites and middens are included, this rises to three quarters. [3] The categories are necessarily broad and many sites described as 'settlement' contain elements of other categories, for example funerary monuments, evidence of industrial activity and submerged elements.

[3] This is partly a reflection of how archaeological value was defined in the CZAS review (Dawson 2010).

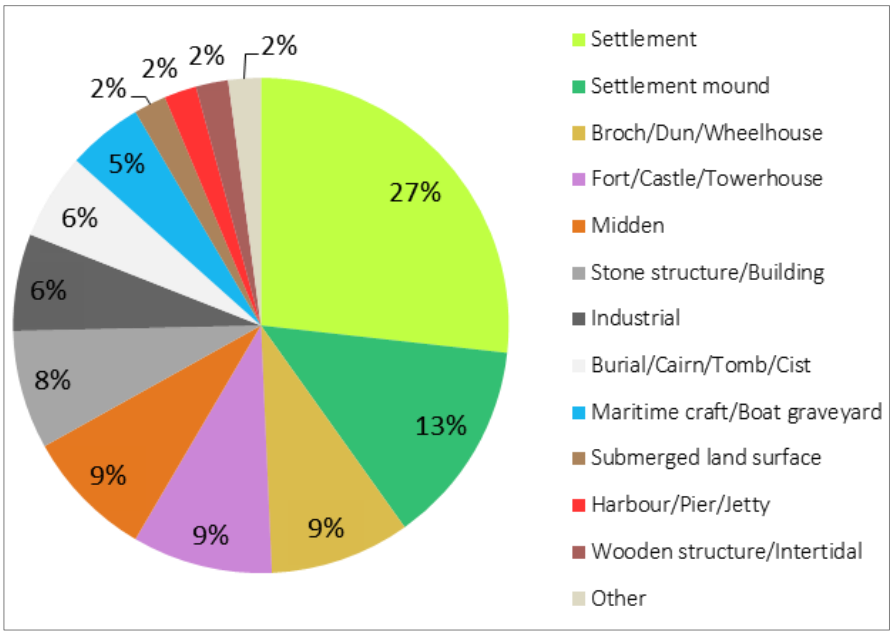


Figure 15. ShoreUPDATE priority site types by proportion (n = 145)

Many of the *ShoreUPDATE priority* sites that fall within the wider settlement category are comprised of complex, extensive and multi-period archaeological deposits and remains. They are generally prehistoric, but at least ten sites of the early medieval and Norse periods occur in this category (and many sites are poorly dated or undated). These complex sites are concentrated in Orkney and the Western Isles and are highly vulnerable to erosion due to their present proximity to coastal processes (as a result of post-glacial isostatic adjustments) to which they were not originally exposed. Many other sites categorised as settlements are either undated or poorly dated, and it is necessary to characterise these sites more fully.

Few in number but significant because of their rarity and because they are only found in the intertidal zone [4]are maritime craft and boat graveyards. Only seven examples are included within the *ShoreUPDATE priority* sites. Other rare intertidal zone sites are submerged land surfaces, of which there are three examples in the *ShoreUPDATE priority* sites. These types of site are found around the whole coast of Scotland.

[4] As noted by Dawson (2008) this may in part be due to the way that coastal surveys were conducted in Scotland, with many taking place in the winter to take advantage of low vegetation, which also meant short daylight hours – sometimes leading to surveys being undertaken when the tide was not suitable to locate intertidal sites.

4. Discussion of results

The results of the ShoreUPDATE surveys underline the concentration of priority sites in the Northern and Western Isles. This is largely due to their recent geological history, high proportion of low-lying soft coastline, and their geographical location in the North Atlantic. Driven by isostatic readjustment since the last ice age, the soft coastlines of these islands have been subject to progressive coastal submergence, erosion and shoreline retreat. This is why terrestrial archaeological heritage is found at the coast edge and intertidal zone in such abundance in these areas. Furthermore, the islands are located in the pathway of North Atlantic storm tracks which have shaped their coastlines throughout the Holocene. There is evidence that erosion has accelerated from the 15th century as a result of a sustained increase in North Atlantic storminess. This is recorded in the Greenland GISP2 ice core record, as elevated concentrations of sodium (sea salt), which is taken as a proxy of storminess, from around 1420 and continuing to the present (Dawson 2007).

It is anticipated that these underlying physical and meteorological conditions will continue to make the Northern and Western Isles the parts of Scotland most affected by coastal erosion, and hence these are the areas that will have the greatest concentrations of eroding heritage in the future.

4.1. Why are there fewer numbers of highest priority sites as a result of ShoreUPDATE?

Although the results of the ShoreUPDATE surveys support the trend of distribution of coastal heritage at risk being concentrated in the Northern and Western Isles, it also found that the *number* of observed high priority sites being damaged by erosion was less than the numbers derived from the analysis of the original CZAS reports. The reasons for this are varied, and an explanation for the re-assignment of priority status for each individual *CZAS review* high priority site is provided in Part 2 of this report. However, we can summarise some of the factors that may explain the reduction in the absolute numbers of high priority sites.

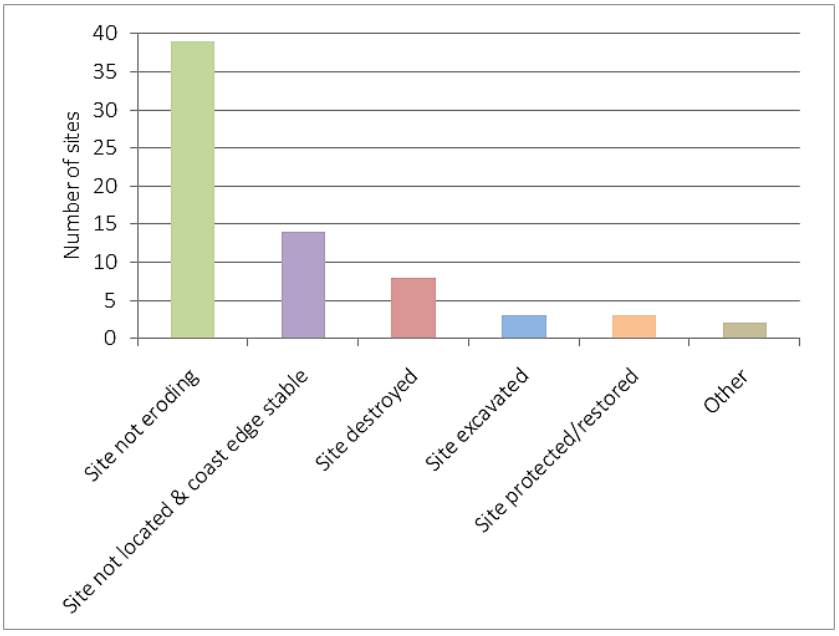


Figure 16. Summary of main reasons for removal of CZAS review priority 1 and 2 status, n = 71

4.1.1 Lost, defended and investigated sites

Some of the reduction or removal of high priority status is explained by a change in condition or understanding of a site. Of the 71 *CZAS review* priority 1 and 2 sites removed, at least eight sites visited were known to have been destroyed and a further fourteen not found in or near their recorded location. A total of six sites visited had been either conserved or defended, or comprehensively excavated. A number of other *CZAS review* priority sites have been investigated, and/or the part of the site being most impacted by erosion recorded, since the original CZAS. In some cases this resulted in a revision of priority status depending on how successful the work had been in mitigating the impact of the erosion; either by improving the understanding of site significance, or by rescuing information that would have been lost.

4.1.2 Greater parity across survey areas

Achieving greater parity of records across the survey areas is another important factor in explaining the reduction in priority sites. As noted in Dawson's original review (2008), the original surveys were conducted at a regional scale, and there were discrepancies in the way that some surveys were recorded, hence the need for revisiting sites. The ShoreUPDATE surveys overcame some of the main inconsistencies of the original CZAS by assessing the relative condition and vulnerability of sites at a *national* rather than regional scale. This was achieved by carrying out the update surveys over the whole of Scotland in a relatively short period of time (three years) together with a high degree of consistency of survey and recording methodology and moderation of records, overseen by the same SCAPE officers throughout the project.

This national focus helped correct regional discrepancies in the assessment of site condition and vulnerability to provide a more consistent judgement of priority status for sites across Scotland.

Standardisation of assessment of threat and urgency of action also accounts for the majority of cases where the priority status of a site was downgraded due to there being either no evidence or potential of significant coastal erosion (Figure 16). In some of the earlier CZAS, when HS APP4 standards and guidance were in preparation or very new, the surveyors regarded both actual and potential threats, often of differing magnitudes, as requiring similar action. Guidelines on ranking severity of threat had yet to be developed. For example, no distinction was made between a site where salt spray was affecting vegetation and an actively eroding site where elements were actually being lost to the sea. In early surveys, recommendations for action could also be weighted towards the potential research value of sites, rather than observed impact from coastal processes. This particularly affected Shetland and partly explains the reduction in number of priority sites here.

4.1.3 A story of stabilisation?

There was also a significant reduction in the number of priority sites *within* regions. Stabilisation of sites previously described as eroding was the most common reason for demoting or removing a high priority status. We believe that the ShoreUPDATE surveys may have captured a general trend of recent stabilisation of the coast edge, and hence a reduction in the number of sites at risk observed across all areas since the original CZAS surveys. This is especially relevant to the fragile machair and sand dune environments which, as we have seen in Figure 14, contain 48% of all *ShoreUPDATE priority* sites.

4.1.3a Stabilisation following extreme storms

Stabilisation was most evident in the Western Isles, where the number of priority sites reduced by 57%. Two of the major surveys of this area, North Uist and South Uist & Benbecula, were originally surveyed in 2005 - two months after a powerful Atlantic storm had hit the area. This storm was described at the time as a 'once in a generation event' and caused severe erosion of the western seaboard of North Uist, Benbecula and South Uist (Dawson 2007). The original CZAS documented extensive stretches of freshly-eroded coast edge, which in a number of locations contained visible archaeological deposits and structures. The ShoreUPDATE surveys of the Uists, carried out ten years later, generally document the natural process of stabilisation of the coast edge that has taken place in the intervening decade. In some areas, there was no visible sign of the archaeological sites that the original surveys had described.

4.1.3b Stabilisation as a result of land management

The CZAS of Lewis, Shetland and Orkney were undertaken between 1997 and 1999, at least 15 years before the ShoreUPDATE surveys. Again, we observed a general trend of stabilisation when comparing site descriptions with those of the original surveys. In the absence of a specific extreme weather event, the explanation for this is not as clear cut as in the Uists. However, human activity and changes in land use may be partly accountable. During the ShoreUPDATE surveys on Islay, Lewis and Barra, information from the local community suggested that lower stock numbers and rabbit control has improved the condition and stability of machair and coastal sand dunes over recent decades. This could have led to a reduction in aeolian erosion, which is a significant factor in 15 of the 31 *ShoreUPDATE priority* 1 sites.

4.1.3c Stabilisation as a result of longer-term meteorological trends

Periods of reduced windiness and storminess may also result in greater stability of soft coast edges. There is poor consensus in the scientific community concerning trends in storminess in NW Europe, which, over long timescales, is mainly characterised by large fluctuations with no clear link to climate change or atmospheric and ocean dynamics (Feser *et al.,* 2014). However, within this long-term natural variability, regional trends in storminess over recent centuries and decades have been detected by a number of recent studies using a range of proxies and modelling approaches. Orkivu *et al.* (2003) in a study based on wind speeds from 1950 to 2000 found that the number of storm days were higher in the final two decades of the 20th century, which partly accounted for coastal erosion observed in areas of isostatic uplift in Estonia. Hanna *et al*. (2008) used atmospheric pressure as a proxy of storminess in the North Atlantic and an examination of records starting in the 1830s revealed periods of enhanced storminess around 1900 and during the first half of the 1990s. A similar conclusion was gained by Feser *et al.* (2014) in a wide-ranging review of all published studies of storminess in the North Atlantic and Northwestern Europe. This found elevated storminess in the British Isles in the late 19th century and first half of the 1990s (*ibid* Figure 2). Using records of gale frequency recorded in Stornoway, Lewis from 1876 to 1996 and 1980 to 2006, Dawson *et al.* (2007) found a peak in storminess in the late 19th century, but no evidence of elevated storminess in local records during the late 20th or early 21st centuries in the Western Isles. This shows how localised and variable historical records of storminess can be, however, a regional trend of elevated storminess in the late 19th century and first half of the 1990's seems to emerge, and this may be of relevance in explaining the differences in coastal erosion observed and documented in the CZAS records and the ShoreUPDATE surveys. The CZAS of the Northern Isles were carried out between 1997 and 1999, following one of the periods of elevated storminess documented by the majority of studies. The ShoreUPDATE surveys were undertaken at least

15 years later, following at least a decade of relative low storm activity. This could account for some of the stabilisation trends we observed in the condition of priority sites and coast edges, especially in Orkney and Shetland and parts of the Western Isles.

4.1.4 A word of caution

Even against a backdrop of a period of relative calm in terms of storminess around the Scottish coast, the devastation caused by the 2005 storm which affected the Uists and Benbecula, reminds us of the major role played by single extreme weather events in the destruction of coastal heritage and the unpredictable and episodic nature of coastal erosion. Damaging easterly storms of 2012/13 exposed a previously unrecorded broch at Channerwick, Shetland, consequently investigated and documented in a SCHARP community project; and destroyed the substantial remnants of a 17th century salt pan building in Brora, East Sutherland, previously excavated by SCAPE and the Clyne Heritage Society. The following winter of 2013/14 has been documented as one of the stormiest on record in the British Isles region (Kendon & McCarthy, 2015; Masselink *et al.,* 2016; Matthews *et al.*, 2016; 2014). Although these events do not necessarily indicate an increasing storminess trend, they underline the role of one-off weather events and individual seasons of elevated storminess that results in the most dramatic damage and loss of coastal heritage.

This constant change of state at the coast emphasises the value of retaining a monitoring network; of constantly reappraising sites; and of undertaking action in advance of unpredictable destructive storm events.

5. Conclusions and suggestions for next steps

5.1. What is most vulnerable?

The consistency of the ShoreUPDATE survey and moderation of records has introduced a parity across survey areas which, building on the original CZAS review, adds weight to the identification of the 31 most vulnerable *ShoreUPDATE priority 1* sites, including the eight given a new priority score of 1* summarised in Tables 4 and 5. These sites are of potential national, and international, importance, and work is needed to assess their importance and to rescue information.

Next steps

These sites represent the most urgent national priorities for mitigation action in the areas surveyed. However, many of these sites are large and complex, and the sector needs to consider how to make the most of this threatened, but important resource before it is lost. Discussions will need to involve local and national heritage managers, other stakeholders (potentially including international partners), funding bodies and the interests of, local communities, academic researchers and heritage professionals.

5.2. Where is most vulnerable?

This survey and analysis has resulted in a decrease in the absolute numbers of priority sites at risk from coastal processes but has also shown that the proportion of priority sites at risk in each area remains similar and that two thirds of these are located in the Northern and Western Isles. This is due to the density of high-value coastal archaeological sites in these regions, the influence of post-glacial isostatic readjustment, the physical nature of the coast edge and exposure to North Atlantic storm tracks. Although there is a high degree of uncertainty over future increases in the intensity and frequency of storms, there is broad consensus that climate change is likely to exacerbate the impact of future storms in the British Isles region (Feser *et al.,* 2014), and it is the Northern and Western Isles and their coastal heritage sites that will be the most vulnerable.

Next steps

Orkney and the Western Isles will face continuing and possibly worsening erosion of valuable coastal heritage and the sector should expect and plan for how to respond to this. The picture is less clear for the sites in Shetland that have been revisited in the ShoreUPDATE surveys, but the archipelago's location means it is vulnerable to extreme weather events with consequent, yet difficult to predict, loss of valuable heritage, and so a preparedness to respond is important.

5.3. Priority sites are a valuable research and learning resource

The sites presented and discussed in this report are a result of a repeat field survey and analysis of eroding coastal archaeological heritage of the 35% or *c.* 5,600km of Scotland's 16,035km long coastline. They form a large sample of consistent, well-described observational data about what has happened to a range of archaeological sites and to different coastal environments around Scotland over the last 20 years. This data has significant research potential in its own right, above and beyond heritage management.

Next steps

All of the priority sites, by definition, are a valuable but vulnerable archaeological resource and information about them and their potential could be promoted more widely amongst the archaeological research community and local communities. One way of encouraging action would be to align them with current national and emerging regional ScARF research priorities and Scotland's Archaeology Strategy objectives to make the most of their research and learning potential for academic, heritage management and community benefit.

5.4 Priority sites are archives and indicators of coastal and environmental change

Many coastal archaeological sites contain proven histories of past and recent change to coasts and sea levels. It is possible that, already, the surveys are detecting meteorological and other impacts which affect coastal erosion at a national scale, and over decadal timeframes. The implications of this are important for understanding the effects of natural climate variability upon coastal processes, and detecting trends which may be related to climate change.

The surveys have also highlighted sites or groups of sites, (e.g. settlement mounds and submerged land surfaces), with long temporal continuity and well-preserved sedimentological and palaeo-environmental archives. These have potential for more detailed understanding of past local coastal and environmental change.

Next steps

The national network of priority sites should be included in a programme of regular monitoring in order to build time series data about the impact of coastal processes to coastal heritage and to describe wider trends of coastal change. Within this network, the potential of suitable 'indicator' sites should be investigated as case studies for more detailed investigation of past, current and future local coastal and environmental change. This will improve data about the response of coastlines to coastal processes, and provide new data about the effects of climate change upon coastal processes.

5.5 Priority sites provide empirical data about coastlines

In Scotland, meteorological trends are the most significant, but unpredictable, factor in determining erosion. The physical vulnerability of the coastline is, therefore, the most reliable predictor of where coastal heritage is more likely to be impacted by coastal processes. Currently the Natural Susceptibility to Coastal Erosion (NSCE) model commissioned by the Scottish Environment Protection Agency (SEPA) is the most widely-used model of coastal susceptibility. It is used in risk assessments by agencies and Local Authorities, many of which have been undertaken in response to the Flood Risk Management (Scotland) Act 2009 and Climate Change (Scotland) Act 2009 (e.g. Historic Environment Scotland, 2017). The NSCE model has been further refined in the Coastal Erosion Susceptibility Model (CESM) by Fitton *et al*. (2016). Despite this, it is acknowledged by the model developers that that the models are poorly validated, mainly due to the limitation of field data (SEPA, 2013). The CESM, for example is validated with observed coastal erosion data for less than 100km or 0.54% of Scotland's coastline (Fitton *et al*., 2016, Tables 6 & 7). The CZAS and ShoreUPDATE surveys have produced empirical data about

archaeological sites in different coastal environments that are definitely eroding over nearly 6,000 km of Scotland's coastline.

Next steps

Empirical data collected through the CZAS and ShoreUPDATE surveys and analysis should be used to validate and refine simulations of coastal vulnerability, thereby improving the reliability of modelled erosion susceptibility.

5.6 SCHARP provides a model of volunteer involvement in coastal heritage survey

SCHARP has demonstrated an effective, inclusive and sustainable methodology for collecting, reviewing and sharing information about Scotland's coastal heritage. The project has developed a two-way IT infrastructure through which anyone can both access coastal heritage site records and contribute new information about that data; and a training programme that prepares and supports non-professionals to take part. SCHARP has resulted in a legacy of good quality, up-to-date information for the areas surveyed and has created a network of trained volunteers embedded in local communities around the country who continue to make a significant contribution to our knowledge and understanding of coastal heritage.

Next steps

The Sites at Risk web map portal and ShoreUPDATE app should be maintained as an active database of coastal heritage data and as a means of capturing new information. Encouragement and support, coordinated at a national level, should be provided to ensure the continued involvement and development of volunteers across the country in contributing to the monitoring and updating of records of coastal heritage at risk. Although we have a good understanding of the state of the coastal heritage resource within the 35% of the coast covered in CZAS, 65% of Scotland's coastline has not had a systematic CZAS. It is time to instigate new CZAS targeted at vulnerable coastlines, which involve volunteers from the coastal communities within the survey areas. SCHARP provides a model of how to achieve this.

6. Project structure and management

This research was undertaken as part of the Scotland's Coastal Heritage at Risk Project which ran from 2012-2016.

Project staff

SCAPE manager	**Tom Dawson**
SCHARP project manager	**Joanna Hambly**
SCHARP project officer	**Ellie Graham**
CBA bursary (2012-13)	**Natalia Bain**
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SCHARP Advisory Group and position when appointed

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Part 2:

ShoreUPDATE review recommendations for all visited CZAS review priority sites, organised by Local Authority Area

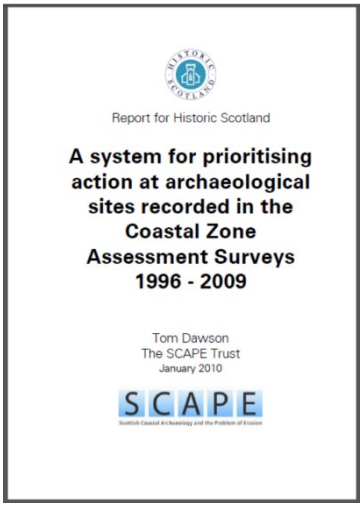
or go to

https://scapetrust.org/wp-content/uploads/2023/07/Part2_PriorityReviewRecommendations.pdf

Appendix 1

A system for prioritising action at archaeological sites recorded in the Coastal Zone Assessment Surveys 1996–2009

Tom Dawson 2010



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