Natural England Commissioned Report NECR015

Development of a Coastal Vegetated Shingle Inventory for England

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Introduction

Natural England commission a range of reports from external contractors to enhance our evidence base and assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

A national inventory of coastal vegetated shingle is required for a number of reasons including to:

- Implement Biodiversity Action Plans (BAPs).
- Manage designated sites.
- Develop and implement strategic coastal management.

This project was the second phase of work to develop a uniform age digital inventory of the extent of coastal vegetated shingle based upon surveys undertaken in the 1990s. There were two main objectives:

- To review and improve upon the existing digital inventory (Phase 1, completed in 2004).
- To produce an inventory for all coastal vegetated shingle sites in England showing their extent at a fixed point in time.

The project has provided a Geographical Information System layer for the extent of coastal vegetated shingle in the 1990s. The project findings include:

- There is less of this habitat in England than previously thought.
- It is an extremely rare habitat in England and Europe.
- The development of methods to deal with data quality assurance issues and the transfer of large quanities of mapping data.

Natural England are publishing this report to provide information on:

- The results of this project.
- Recommendations for the future development of all types of digital habitat inventories.

Natural England will use the findings to:

- Promote actions to achieve the UK BAP targets for this habitat.
- Improve the condition of the vegetated shingle feature within protected sites.
- Help to identify locations for further site surveys and enable a more effective assessment of changes in extent for future reporting.

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Further information
This report can be downloaded from the Natural England website: **www.naturalengland.org.uk**. For information on Natural England publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk**

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Preface

A national inventory of coastal vegetated shingle is important in delivering a range of benefits, from the implementation of Habitat Action Plans/Species Action Plans (HAPs/SAPs) under the UK Biodiversity Action Plan to the management of local designated sites and strategic coastal management.

This project produces a uniform age digital inventory of the extent of coastal vegetated shingle based upon surveys undertaken in between 1988 and 1990 and building in the inventory produced for English Nature in 2004.

Summary

Aims

To review, quality assure and build upon the 2004 digital inventory (Land Use Consulants 2004).

To produce an inventory for coastal vegetated shingle sites in England showing their extent at a fixed point in time.

What was done / lessons learnt

It was agreed that the most useful inventory would be one for a fixed point in time rather than one based on data collected from different sites at different points in time. This would help with evaluation of changes over time. As such the inventory was primarily based on survey work undertaken in England between 1988 and 1990, subsequently referred to in this report as the '1990s area' (Sneddon & Randall 1994). However, the spatial quality of this data was acknowledged to have limitations due to the technical applications widely used today (e.g. GPS) being unavailable at the time of the survey. This inventory enables a more accurate assessment of the 1990s area of shingle habitat on these sites to be made: this is lower than the area previously given for this habitat in England.

The project team consisted of environmental GIS data specialists and coastal habitat specialists. It is extremely unlikely that the required skills will be found in a single individual, and forgoing either of these specialties would have significantly reduced the quality of the final inventory.

Five representative sites were used to undertake a pilot phase. This enabled a clear and relevant rule base to be developed and agreed before the majority of the data capture was undertaken. It allowed any problems with the proposed methodology to be identified and solutions agreed before the bulk of the work was undertaken.

In certain areas there was significant overlap with other habitat inventories (e.g. sand dunes), highlighting the importance of not just looking at a single inventory in isolation. Care is also needed when considering inventories of different ages.

Many coastal habitats (especially shingle and sand) can be highly dynamic and their extent will not remain the same over time. This needs to be kept in mind when working with any inventory.

Capturing a digital habitat inventory that is spread over a large length of coast means that large quantities of mapping data need to be transferred. There are suggestions as to how this could be made easier when tendering for and managing future projects of this nature.

Conclusions

A new coastal vegetated shingle digital inventory was produced giving an estimate of 3596 hectares of this habitat present in England in the early 1990s. This adds a further 824 ha to the estimate for the 2004 inventory as a result of the quality assurance process and coastal ecological specialist input. These differences in area are largely due to Phase I incorrectly interpreting shingle vegetation boundaries during the digitisation of the survey sketch maps, discussed in more detail in the report. The inventory area is, however, lower than previous estimates of the 1990s total resource: there are a number of potential reasons for these differences, but the key message is that vegetated shingle remains a very scarce habitat in England.

An additional digital layer was produced giving indications of where it is likely that the habitat extent may have changed significantly since the 1990s surveys. This could help to target any future survey work.

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1. Introduction

UK BAP background

1.1. The UK is one of 188 Parties to the Convention on Biological Diversity which was adopted at the Rio Earth Summit in 1992. This Convention has three main objectives: the conservation of biodiversity; the sustainable use of biodiversity; and the sharing of benefits from the use of genetic resources. In the UK this commitment led to the launch of the UK Biodiversity Action Plan (BAP) in 1994.

1.2. The Plan's overall goal is to conserve and enhance biodiversity within the UK and to contribute to efforts to conserve global biodiversity. The UK BAP targets the recovery of some of our most threatened species and habitats in the terrestrial, freshwater and marine environments. For each priority species and habitat on the original list, an action plan describes the current status and threats, and sets out an action programme for achieving 10-15 year objectives and targets. These action plans, and the UK BAP process as a whole, represent a consensus of Government, the statutory and voluntary conservation sectors, land owners and managers. They give us the best opportunity to date of reversing the major declines in the populations, range and quality of the UK's biodiversity resource.

1.3. Coastal vegetated shingle is one of the UK BAP Priority Habitats for which an action plan has been produced (UKBAP website; http://www.ukbap.org.uk/UKPlans.aspx?ID=29). The current targets for this plan are as follows:

1. Maintain total extent of coastal vegetated shingle habitat throughout the UK and the structures, sediment and coastal processes that support them, approximately 5800 ha. This is a 'no net loss' target to take account of the dynamic nature of shingle. This includes the maintenance of landward and seaward transitions.

2. Achieve favourable or recovering condition by appropriate management of XXha of coastal vegetated shingle systems currently in unfavourable condition by 2010. This should achieve the retention or enhancement of populations of BAP priority species associated with vegetated shingle. (The 2006 targets quoted did not have a figure for the area of unfavourable condition as this was not available at a UK level at the time they were developed- UK SSSI reporting (Williams, J.M., ed. 2006. Common Standards Monitoring for Designated Sites: First Six Year Report. Peterborough, JNCC). does not differentiate shingle in condition reporting but lumps it into 'dunes, shingle and machair' http://www.jncc.gov.uk/pdf/CSM_06habitats.pdf). The report also available on-line at: http://www.jncc.gov.uk/page-3520.

3. In key locations initiate restoration of shingle communities on arable land over shingle deposits by 2015.

1.4. Further information on each of these targets can be found at UK HAP targets[1].

1.5. Each of the four countries of the UK has subsequently produced country strategies for biodiversity. The England Biodiversity Strategy was published in 2003; it identified new approaches and partnerships across sectors as being essential for achieving the conservation of biodiversity.

1.6. At the Gothenburg Summit in 2001 the EU committed itself to the objective of halting the rate of biodiversity loss, with the aim of achieving this by 2010. At the World Summit on Sustainable Development in 2002, Heads of Government committed themselves to achieving a significant

[1] Full link - https://www.ukbap-reporting.org.uk/plans/targets.asp?HAP=%7BA9DB9FBB%2D26A6%2D4D52%2DB264%2D13FCA4C482E4%7D&SAP=&M=1

reduction in the rate of biodiversity loss by 2010. These, and other, multilateral environmental agreements cover the UK's action to conserve biodiversity both globally and within the UK.

1.7. Clearly one of the key requirements for measuring success or failure is establishing a baseline for condition and extent of a habitat or species. This project attempts to provide a GIS dataset describing the extent of coastal vegetated shingle in England at a particular point in time (based on national surveys undertaken in early 1990's). These surveys indicated that most of the habitat is found around the English coastline.

Coastal Vegetated shingle

1.8. Shingle is defined as sediment with particle sizes in the range 2-200 mm. Shingle beaches are widely distributed round the coast. However most of this length consists of simple fringing beaches where the shingle remains mobile as result of storms and waves and vegetation is restricted to temporary and mobile strandline communities.

1.9. Shingle structures that can support a wider range of vegetation take the form either of spits, barriers or barrier islands formed by longshore drift, or of cuspate forelands where a series of parallel ridges piles up against the coastline. Sand dunes may form over shingle bars as a result of rising sea levels leading to increased deposition of sand. In some parts of the country there are shell or shell/gravel 'cheniers' found over saltmarshes or mudflat (Edwards & Pye 2001): these can sometimes support similar vegetation to the shingle communities and may be considered as part of the resource.

1.10. The origin of coastal shingle (or gravel) varies according to location. In southern England, much of it is composed of flint. Shingle deposits of Ice Age origin lying on the sea bed may be reworked by wave action and redeposited or moved by longshore drift along the coast. Little new sediment is entering these systems, so this is essentially a finite resource. Shingle structures are of considerable geomorphological interest, especially if the surface sediments have been undisturbed.

1.11. The vegetation communities of shingle features depend on the amount of finer materials mixed in with the shingle, and on the hydrological regime. The National Vegetation Classification (NVC) has limited coverage of shingle communities (Rodwell 2000). Driftline vegetation can include NVC types SD2 *Honkenya peploides –Cakile maritima* strandline community and SD3 *Matricaria maritima – Galium aparine* strandline community on stony substrates. MC6 *Atriplex prostrata – Beta vulgaris* ssp. *maritima* sea-bird cliff community and other vegetation with abundant orache *Atriplex* spp. may also occur on shingle shores. The Shingle survey of Great Britain (Sneddon & Randall 1993) provides a comprehensive classification of largely perennial shingle vegetation types, some of which have equivalents in the NVC. Dungeness has also been covered by earlier vegetation classifications (Ferry et al 1996). Both classifications are listed in the 'habitat types' section of the metadata for the shingle polygons, depending on their original source.

1.12. The classic pioneer species of the perennial vegetation on the seaward edge include sea kale *Crambe maritima*, sea pea, *Lathyrus japonicus* and sea campion *Silene uniflora*; such species can withstand exposure to salt spray and some degree of burial or erosion. Further from the shore, where conditions are more stable, more mixed communities develop, leading to mature grassland, lowland heath, moss and lichen communities, or even scrub. Some of these communities appear to be specific to shingle, and some are only known from Dungeness. On the parallel ridges of cuspate forelands, patterned vegetation develops, due to the differing particle size and hydrology. The bare areas within the hollows between the ridges ('lows') form part of the structure and function of this habitat. Some shingle sites contain natural hollows which develop natural wetland communities. These are probably unique to Dungeness.

1.13. Open water can also develop following gravel extraction. Shingle structures may support breeding birds including gulls, waders and terns. Diverse invertebrate communities are found on coastal shingle, with some species restricted to shingle habitats.

1.14. Shingle structures sufficiently stable to support perennial vegetation are a comparatively rare feature even in the UK. The estimated area in the Coastal Vegetated Shingle HAP is 5800ha, of which 86% is in England. The main concentrations of vegetated shingle occur in East Anglia and on the English Channel coast. Dungeness, in southern England, is by far the largest site, with an estimated 2000 ha of shingle. The driftline habitats are even more scarce and their extent has never been mapped at a national level due to their ephemeral nature. One study in The Solent has attempted to assess this driftline habitat at a local scale (Cox & Crowther 2001).

1.15. (Further information about classification, management, monitoring and site protection for shingle habitats can be found in Doody & Randall (2003), JNCC (2005) and Mcleod et al (2007). The condition of shingle habitats is described in the conservation status assessments prepared by JNCC in 2007 http://www.jncc.gov.uk/page-4064.

Coastal Vegetated Shingle Survey 1988-1990

1.16. This survey was carried out between 1988 and 1990 as part of a wider national programme of coastal habitat surveys covering England, Scotland and Wales. A key aim of the survey was to develop a vegetation classification for shingle habitats (Sneddon & Randall 1993). This was an important milestone for raising the profile of this scarce habitat.

1.17. To develop the classification, recording of quadrat data took precedence over detailed site boundary survey. A lone worker carried out the surveys without the aid of modern GPS, detailed aerial photography and with only limited time. This meant that for many of the sites the approach adopted involved sketching vegetation units onto enlarged 1:10000 maps of the sites. These maps were then reproduced in the Appendices of the main report, Appendix 3 covered England (Sneddon & Randall 2004). At very large sites, the survey excluded some remote areas of shingle habitat, such as the inaccessible Blakeney Point. Here and elsewhere, this resulted in the mapping ending along a grid line. At other sites, the landward boundary is difficult to match up with the situation on the ground. This has led to inaccuracies when the first phase of the inventory in 2004, which used these sketch maps for digitisation, as the spatial limitations of this data were not fully recognised. Area figures given in the individual site reports, which were summed to give an estimate for the total extent of shingle, were not necessarily accurately measured from the site survey maps in the final report, but were estimates of the overall extent of the area of shingle, not all of which may have been surveyed.

1.18. Note the largest shingle site, Dungeness, was excluded from this survey as it had been the subject of a three year mapping project, completed in 1989 (Ferry et al. 1990). Measurements from these maps may well have been subject to some inaccuracies due to the techniques available at that time.

2004 inventory

Limitations of 2004 inventory

1.19. A draft GIS inventory was compiled in 2003/04 for selected areas based on existing survey data, undertaken by Land Use Consultants. A number of shortcomings in the data sources were acknowledged at the time of this work. The dataset was therefore produced with some inadequacies and errors which restricted its usefulness. The biggest source of error was probably caused by digitising registered sketch maps without reference to underlying Ordnance Survey / aerial photography. This is discussed in more detail in the rule base section below.

Implications for future shingle inventories

1.20. Shingle is a dynamic habitat and this needs to be kept in mind when working with shingle inventories so as not to attribute a false level of accuracy to them. One storm can re-arrange parts of the habitat overnight. Shingle habitats also have a height dimension (beaches are not flat), so even though a beach may have become smaller in width as the result of a storm, the ridge may be higher

because there is the same volume of sediment. There are some site specific examples in the appendices showing the types of changes that have been noted.

2. 2007 inventory methodology

Inclusion of shingle structures

2.1. Difficulties arise in distinguishing vegetated shingle from non-vegetated fringing shingle beaches. The more mobile, fringing shingle beaches are more likely to support temporary or mobile strandline communities, whereas the more stable vegetated shingle structures support a variety of more enduring vegetation communities landward of the beach ridge. Although percentage cover of vegetation will vary across the shingle; the whole of the shingle structure (including bare shingle) should be included. This is because the fringing beaches and the more stable landward shingle can form part of the same structure, and the pattern of vegetation can naturally include bare areas that reflect the process of plant colonisation and succession.

2.2. There are potential difficulties with separating the more stable examples of this habitat from Saltmarsh, Sand Dunes, Lowland dry acid grassland and perhaps some other habitats, especially where there is a high percentage cover of vegetation. In addition, coastal habitats can occur in complex mosaics which interact over time.

2.3. This 2007/08 project was purely desk based, with no additional field survey, so all the data captured had to be based upon existing survey data sources/remote sensing. It is recommended that this report should be read by all potential users of the inventory in order to use it effectively.

Pilot followed by full capture

2.4. The approach used for this work by exeGesIS SDM Ltd was to undertake a small pilot area first (typically 5 -10%) which allowed cost-effective use of the available resources in particular to:

- agree methodology with Natural England and discuss any issues of interpretation that are needed before carrying out a full run of data capture;
- involve the habitat specialist from the initial QA process in the pilot phase to the final stages
- obtain all the data within the timescale for the project;
- provide the opportunity to agree revised pricing if the initial pilot shows the overall estimate to be significantly inaccurate (in either direction), and;
- Achieve best value for Natural England.

2.5. We believe that this methodology worked well for this project.

Mixed team of habitat and data specialists

2.6. Capturing this type of data requires individuals who:

- Have extensive ecological knowledge of the habitat in question, preferably with personal knowledge of a range of the sites.
- Have significant experience in working with GIS systems, aerial and ordnance survey datasets *and* digitising and attributing habitat data sets with all the vagaries and interpretation issues that are entailed.
- Have practical experience of mapping data in the field and producing GIS based habitat datasets so that they are aware of the types of errors that can occur.

2.7. Unfortunately these requirements will virtually never be found in the same individual meaning that a team approach is best. The quality of the resulting dataset will largely be down to the range of individual expertise in the team.

What year should the dataset be based upon?

2.8. Coastal habitats in particular are often subject to continual change in their extent. This is particularly true in the case of vegetated shingle which is has a high degree of dynamism as it is subject to a wide range of physical coastal processes.

2.9. Inventory datasets are usually based upon the most recent data available. However for this project, after extensive discussions with Natural England staff and the specialist shingle ecologists, it was decided to establish a baseline in line with the date of the last national survey, i.e. the early 1990s. The reasons for this were:

- Almost all the shingle areas were surveyed in the early 1990's and reported in Sneddon and Randall (1994), *Coastal vegetated shingle structures of Great Britain.* This was the last time that many of the areas were surveyed. Some individual sites have been surveyed more recently, at least partially, but often with different methodologies / criteria.

- One of the main uses of the inventory is to identify the extent of the shingle habitat resource and to act as a baseline for measuring change. If the dataset is based upon the most recent data available it would mean different sites would have been mapped at anywhere between 1990 and 2007 making the dataset quite inconsistent.

- Additionally if the most recent available data had been used, for any area that had been surveyed more recently, the 1990s data would effectively be ignored meaning that change comparisons would have to wait until some stage in the future. Using a consistent dataset collected in the early 1990s means that for some sites changes in extent could potentially be examined now.

- There was no capacity at this stage in the project to re-survey all the known shingle sites.

Base data used

2.10. Key background datasets that were used (in addition to specific shingle references) were:

- Ordnance survey master map data (this will be current – not early 1990's).

- Aerial photography – ideally from the early 1990's but in many cases more recent aerials had to be used.

- The 2004 shingle inventory.

2.11. The exact age of the data used for any particular captured polygon will be mentioned in the metadata relating to that polygon.

2004 shingle dataset: quality issues

2.12. In the course of undertaking the digitisation and checking of the 2004 dataset a number of issues were discovered:

- It appeared that often the primary source used for digitising was the hand drawn sketch map in Sneddon and Randall (1994) which was scanned and registered (Land Use Consultants, 2004) then traced with little or no reference to background Ordnance survey / aerial data. This leads to polygon boundaries which are clearly mismatched with the background data. This was one of the issues noted with the 2004 shingle dataset.

- These errors are likely to have come from a range of sources:

1) There are some areas where the sketch maps themselves are almost certainly wrong, which is not surprising when it is remembered that these were drawn before GPS was available and it is easy to get “out of synch” on a long stretch of featureless shore which leads to a map becoming compressed / stretched.

2) Some of the sketch maps lack sufficient base map features, or grid lines to provide an accurate basis for registering a scan, different sites had varying levels of detail and sometimes were at different scales.

3) Without the additional input from aerial photography and a shingle ecologist some of the sketch maps were incorrectly interpreted (i.e. the wrong line was traced).

4) Potential inconsistencies in the QA of the final dataset, especially with regard to boundaries and bare shingle, perhaps as a result of a lack of knowledge of the individual sites.

2.13. Care has to be taken when interpreting the sketch maps against background Ordnance survey / aerial data sources, especially when the ages of these sources differs. However it is often possible to distinguish features which will not have changed in the last 15 years (and therefore will be safe to snap the line to). See the rule base section for further details of the assumptions made.

Overlapping inventories

2.14. As sand dunes and shingle are often a continuum in many places, the exact boundary between the two habitat types can be difficult to establish. This was highlighted in areas such as Blakeney Point (TG015466) where there is a fair degree of overlap between the sand dune inventory digital dataset and the shingle inventory digital dataset. There will be a number of reasons for this:

- Both habitat types are dynamic, and as they are not captured at the same point in time there is likely to have been some movement.

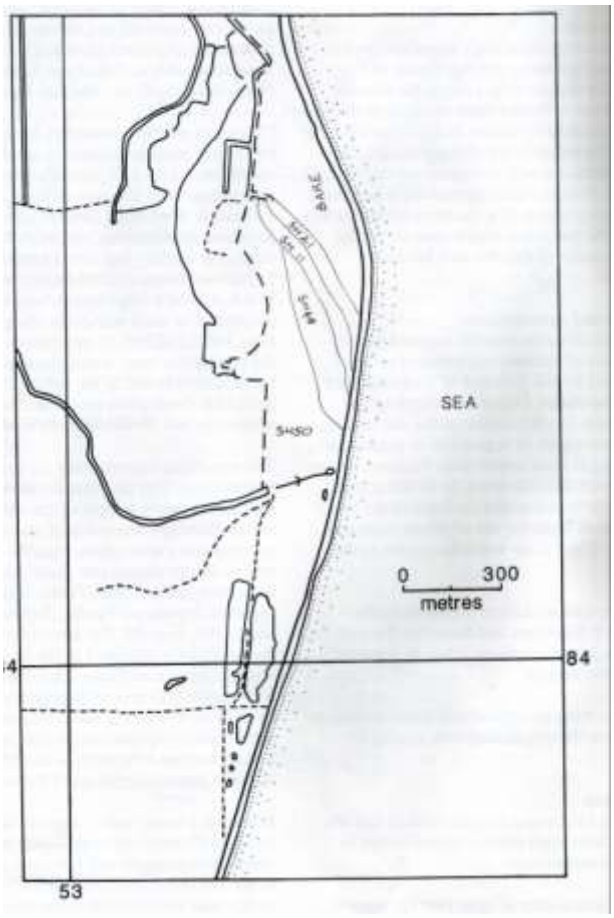
- However the sand dune GIS inventory was largely based upon the sand dune survey (Radley, G.P 1994) but with field survey undertaken between 1987 and 1990. When the Blakeney site report and maps were checked in more detail (Doarks et al 1990), it was noted that many of the areas that had been digitised as sand are actually identified as shingle in the original field survey report. In addition most of the digitising appears to have been referenced to the UK perspective aerial photographs which were taken significantly after the survey work was done leading to another source of inaccuracy.

- An inclusion rather than an exclusion policy was applied to most habitat inventory data sets where there was uncertainty over the presence of a habitat.(NBN SW Pilot 2002).

Rule base 2007

2.15. In order to try and be consistent in the way that shingle data was captured for the 2007 project, a pilot phase was used to establish a rule base which could be applied to the rest of the data capture. The rule base was reviewed and agreed with Natural England at the end of the pilot phase.

- The existing inventory digital polygons were checked against paper copies (mostly Sneddon and Randall (1994)). In some cases with the help of specialist/local knowledge it was determined that the hand drawn maps had been incorrectly interpreted when they were digitised. In this case the polygon boundaries were CHANGED to match what was considered to be the correct interpretation. The original maps were simply sketched maps, so without specialist knowledge it would be possible to misinterpret some of them.



Sneddon & Randall 1994 copyright JNCC

Figure 1. Example sketch map of Kessingland (TG015466) from Sneddon & Randall 1994

- Existing polygons were checked against aerial photographs and Ordnance Survey master map data. In many cases the existing inventory can be seen to have a boundary in the wrong place due to simply following the line shown on the sketch map without reference to underlying base mapping. However as the aerial photographs and the master map data is more recent than the survey data and shingle is a dynamic habitat a degree of interpretation was required.
    - Where the shingle specialist was confident that boundaries would have remained unchanged since the original survey, then the polygon was CHANGED to match underlying OS master map data (snapping where appropriate) and / or drawn to encompass the feature as shown on aerial photographs. Examples of these would be inland field boundaries.
    - If the boundary may well have changed since the original survey was carried out – then the polygon boundary was left UNCHANGED. Examples of this are most seaward boundaries (as Ordnance Survey HWS line on master map data may well have been re-surveyed more recently)– and the best estimate of the 1990s seaward limit is probably the original survey diagram. Another example would be where shingle extent has increased / decreased moving along the shore (Rees 2005). Clearly some of these will be judgement calls based on the shingle specialists expert knowledge – but we are reasonably confident that sensible decisions can be made in most cases.
- There are some registration errors in the maps used for the existing shingle inventory (many of the sketch maps lack sufficient points for them to be accurately registered). Where this is clear – and we are confident by referring to the aerials that the boundary has not changed significantly – we will “stretch” the existing polygons as appropriate. If it is not obvious what to

do – the default position has to be to leave as is (and add an appropriate note in the metadata).

- There are areas where it is likely that the original survey was in error. Remembering that this was all done pre-GPS, it is very easy for a map to get cumulatively distorted working along a shore. These errors can be difficult to distinguish from registration errors, but the treatment is similar. As above – where the error can be corrected without moving the boundary to today's position (as opposed to the early 1990s) it was moved – otherwise it was left in the original position and noted in the metadata.
- There are some areas (especially Dungeness) where unmade vehicle tracks across shingle have been excluded from the habitat, partly because these were mapped as 'built up' areas in Fuller (1985). This makes the polygons quite complicated, and also excludes areas of shingle: these tracks are clearly on compacted shingle and could be restored to some degree if vehicle access was stopped or limited. After consultation it was agreed to include these within the habitat polygon as they were still considered to be part of the overall shingle structure, despite being damaged at the time of the original survey.
- Bare shingle that existed in 1990s should be included in the main data layer and appropriately attributed. Some of these may be naturally bare because of the way in which the shingle substrate and surface geomorphology influences colonisation by vegetation.
- Disturbed shingle that existed in 1990s was possibly not vegetated at the time of the original survey, but that has the potential to be, should be included. Some of these may support some form of secondary vegetation that has recovered or been restored since the original survey.
- All polygons in the existing inventory should have metadata updated – even if no change was made to the polygon / attributes otherwise. This makes clear that polygon was checked as part of this contract and deemed to be correct according to the rule base used.
- Where a small additional polygon is added it should not be merged to the main polygon so as to keep the audit trail in the metadata clear.
- If the polygon boundary was adjusted slightly (e.g. snapped to an underlying master map feature) this was not added as a separate polygon, but the metadata added to in order to show the new primary data source.

Note – The appendices discuss how the rule base was applied on a site by site basis and how any decisions were taken.

Use of WMS service and Microsoft virtual earth

2.16. exeGesIS SDM setup a web mapping service to display the data as it was being worked on, and displayed this on Microsoft virtual earth. This allowed the shingle specialist and Natural England staff to examine the data as it was being worked overlaying it on aerial photographs without having to have specialist software and gigabytes of data.

2.17. This proved a very efficient method for the communication and discussion of specific questions as the data capture progressed. It also enabled the maps to be viewed by the project officer and contractor at the same time without the need to send large volumes of data by email.

Data supply from Natural England

2.18. A project such as this requires large amounts of background mapping data to be supplied (Ordnance Survey master map tiles and aerial photography). The mechanics of extracting, transferring and working with this amount of data is not always straightforward. All data supply and use had to comply with relevant licence conditions.

2.19. exeGesIS SDM were supplied with the coast of England buffered to a distance of 5km. The buffer depth was set at 5Km to allow for inlets and estuaries. Also the coastline used to select the tiles was most likely captured against 1:100,000 data. Ordnance Survey master map data and two sets of aerial photography were supplied as the contract required additions and amendments, therefore the exact extents were unknown.

2.20. Data supplied was:

OS Master map	236 Gigabytes	206372 files in 5993 folders
2002 Aerials	218 Gigabytes	462655 files in 1 folder
2005 Aerials	140 Gigabytes	246540 files in 1 folder

2.21. We suspect the format that data is supplied in is simply an artefact of the translation process, but certainly when this volume of data is provided to consultants having it split into so many individual tiles makes it almost unusable. Most of the tools available (including the basic Microsoft Windows file manager - start to fail with this number of tools).

2.22. Issues encountered included:

- Number of files;
- MapInfo's problems with opening thousands of files;
- Windows XP's problems with single folders containing massive amounts of files;
- USB2 speed when reading large folders can take 5 minutes to display. Selecting/moving nearly impossible, and;
- Windows search tool not working.

Recommendations for future projects requiring provision of map data

2.23. NB These recommendations would apply to all types of inventory development, not just coastal habitat inventories

- Natural England project officer to discuss with in-house GIS specialists the need for datasets required at the tender stage so preparations and extractions can be timetabled in before contracts are let. This stage should also clarify any licensing issues for use of data.
- Future inventory projects should involve similar cross-disciplinary teams to ensure the objectives of the project are widely understood and that the most suitable sets of data are identified at an early stage. If a pilot phase is involved, the most appropriate sites need to be agreed and data supplied for these at an early stage.
- Have a an additional translation done based around the OS 25K tile references, then each 100Km grid square (e.g. SK) will have 16 folders, keeping table file sizes usable.
- The 16 folders of tables can then be seamlessly mapped creating a layer like "SK_TopoLine". From experience, translating a 100Km tile ref creates files to large for Windows XP or MapInfo to handle.
- Splitting into 16 still provides data that can be supplied on DVDs. This means if a consultant needed the whole of SK instead of getting 10000 folders containing 350,000 files, which can't be seamlessly mapped, the data could be opened immediately. *Note*: MapInfo can't create a seamless table of 10000 tables easily or quickly hence this suggestion for the translation stage.
- All sources and likely costs of information should be considered-for example in this project, the potential value of historical air photos was recognised, but could not be made available in time. Other relevant datasets might include the SeaZone /Marine digimap.

Metadata

2.24. Each polygon was attributed with metadata in line with Natural England's data capture tool.

2.25. This included the inclusion of the following data for all polygons added to the final layer. An example is listed below

Unique ref	0121:0001432
Habitat layer information	Coastal vegetated shingle
NBN Primary habitat	NBNSYS0000004631
NBN Broad habitat	NBNSYS0000004558
Polygon reliability	See User Guide V2.doc page 9
Source data information	Dungeness: a vegetation survey of a shingle beach
Habitat class*	Fuller 1989 Coastal Vegetated Shingle
Habitat types*	#A3#B1#Bare Shingle#B2#A2#H#E#P#I
Base mapping scale	1:2500
Base mapping quality	Medium
Polygon creation date	28/01/2004
Added by	exeGesIS SDM Ltd

An estimate of the confidence of the assessment was determined by Pat Doody.

* Shingle vegetation class/types will be either the Dungeness classifications derived by Ferry (1990), or the Sneddon and Randall (1993) shingle vegetation types for all other sites

3. Outputs

- The main output is the electronic data layer. The final dataset was supplied as one data layer to Natural England, with appropriately attributed metadata.
- A secondary layer (points and polygons) was also supplied indicating areas where large change is known / thought likely since the 1990s survey. This would be a good starting point for bringing the inventory up to date.
- Additionally summaries of areas of shingle found on each site are in the Appendix, along with specific comments made by the shingle specialist during the project.
- This report, which should be read by potential users of the habitat inventory and those planning any future updates.

4. Recommendations for future work

4.1. The revised inventory (with a link to this report) should be made available via the Natural England website www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp

4.2. The next priority task would be to bring the habitat inventory layer up to date as far as is possible. This would include targeted ground truthing for areas where a recent survey has not been undertaken, combined with remotely-sensed information to determine site boundaries Any sites not covered by the Sneddon and Randall survey should also be surveyed to include in any further updates, for example shingle sites in the Solent (Cox & Crowther 2001). The dynamic nature of shingle means that this should be considered as an 'active' inventory.

4.3. This inventory can be used to aid targeting of conservation initiatives in England such as:

- Mapping current extent of shingle will enable an assessment of change since the 1990s;
- The inventory should be compared with SSSI site units which include shingle features;
- More detailed site surveys of areas identified as 'damaged', both to assess the quality of any secondary vegetation and target priorities for further restoration;
- Use this inventory to target shingle sites for the acquisition of LIDAR data to enable analysis of volume of shingle structures and relate this to any area changes, and;
- Resources needed for updating habitat information can be assessed more accurately by using the extent information. The key regions for shingle habitats can be identified.

4.4. Updated information would enable future versions of the Natural England 'State of the Natural Environment' reports to reflect more accurate figures for the extent of shingle, and future reporting on progress with the Coastal Vegetated Shingle HAP targets.

4.5. To enable the importance of shingle habitats in England to be put into context, and support the delivery of UK HAP targets, consideration should be given to using this dataset to contribute to a UK inventory.

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Appendix 1 Summaries of changes and specialist comments on shingle inventory sites

These notes provide an audit trail of why/how changes were made, comments from the shingle specialist (PD=Dr. Pat Doody) and summarise the differences in extent of mapped areas as a result.

Sites are presented alphabetically. OS Grid references given are indicative. 'NA' means no amendment to area. Unless otherwise indicated original data was from Sneddon & Randall (1994).

Beachy Head to Brighton (TV 429 996) + 0.64 Ha

Original data was captured in 2004 from 'Vegetated shingle of the Sussex coast' (Williams & Cooke 1993). 1990's aerial photos were available for the whole section of coast.

Possible large additional areas of 'Bare Shingle' here but not able to verify 1990 coverage using data held. Without some ecological data relating to the 2004 survey it's not viable to extend polygons based on colour variation of beaches relative to adjacent polygons. e.g. Where there is a polygon boundary with no underlying mapping/aerial photograph change. In these positions covered by Sneddon and Randall it is possible to extend/add polygons to match aerial photographs with a high degree of accuracy.

Small area increase due to slight corrections to OS data.

Further additions here but would a require site visit by specialist to confirm.

	Size (ha) GIS	Shingle Type
Original inventory	27.02	Various
New inventory	27.66	Various

Blakeney Point (TG 093 447) + 68.82 Ha

Survey seemed to have missed areas for no apparent reason. Massive area at the end of the spit was not surveyed, therefore not included even though shingle, added (Polygon 0101:0000024) and attributed against 2004 APs.

Addition (Polygon 0101:0000036). Shoreline to the east was also not surveyed, PD has local knowledge of the area and therefore the boundaries have been extended as he instructed.

Several polygons moved landward due to digitising errors. Major overlap with sand dune inventory, ((Doarks et al 1990a) site survey required to clarify relative proportions of different features.

PD Comment*: "Eastern end of site at polygon (0101:0000036) was a section not surveyed 1990. As the beach (before 2004) was regraded periodically as part of sea defence strategy the precise location at the time of the survey cannot be determined. However the length and width of the beach will be more or less correct, its landward position may not be, hence the "unreliable" rating".*

To the west (Polygon 0121:0001186) is fine to match aerial photo, as reliable as is possible in this dynamic environment.

Blakeney Point is illustrative of several issues associated with validating the shingle survey:

1. *The spit is dynamic and without aerial photographs dating from the time of the survey any boundaries must be considered to be a 'best guess';*
2. *There is extensive sand dune habitat overlaying the shingle base, this is also highly dynamic and may obscure the underlying shingle from time to time;*
3. *Human interference can modify the location and vegetation on the shingle surface, as can storm events and overwashing*
4. *General points about surveying representative sections of large sites apply.*

	Size (ha) GIS	Shingle Type
Original inventory	57.17	Various
New inventory	120.99	Various

Bradwell (TM 033 082) NA

This area was assessed and 2004 digitised boundary deemed fit for purpose based on 1990 survey. The only change was a shift inland (50 metres) based on aerial photographs; this was a correction to previous capture.

PD comment: *"The cockle spits may well be more or less in the right position as there is a normal landward progression. If contemporary air photos are available it could clarify this but I do not think it is particularly significant. Cockle ridges certainly existed at the southern end of the Dengie peninsula though these were not surveyed. I cannot determine their precise locations as the area has been greatly influenced by polders designed to prevent saltmarsh erosion. Contemporary air photos would help but again I am not sure how much effort should be put into this. They are very small and ephemeral. Ken Pye did some work on these, there may be a paper available with more information"*

	Size (ha) GIS	Shingle Type
Original inventory	2.29	Various
New inventory	2.29	Various

Bridgwater Bay (ST 268 472) + 15.97 Ha

Large area of bare shingle (Polygon 0101:0000043) added around current vegetated shingle. The polygons previously captured were moved seaward around 80 metres due to registration errors.

PD comment: *"This is a difficult site where it is inevitable errors will occur. There are small areas of shingle and the beach is eroding landward. If the digitisation can be corrected by using a landward boundary then the survey should be accurate. There is no indication on the vegetation maps showing areas of bare shingle, these are present between the digitised areas and seaward. Photography from 1982, 1984 and 2002 verify this, no reason not to include in 1990 inventory"*

The shingle foreshore moves constantly. Show here an approximation, based on the original survey of the extent of shingle. This is mostly a series of shingle ridges lying at the upper levels of the tidal foreshore. See Picture taken in 1980: Looking west from ST250452. The area of enclosed (by the shingle ridges) saltmarsh lies to the left of the picture. There is a sea wall in the background. These show the shingle ridges within (Polygons 0101:0000043 & 0121:0001090).

	Size (ha) GIS	Shingle Type
Original inventory	1.95	Various
New inventory	17.92	Various

Brighton to Bognor (TQ 084 014) + 0.06 Ha

Original data was captured in 2004 from 'Vegetated shingle of the Sussex coast'(Williams & Cooke 1993).. 1990's aerial photography was available for the eastern section although not used. (See note on Beachy Head to Brighton)

Possible large additional areas of 'Bare Shingle' here but not able to verify 1990 coverage using data held.

Further additions here but would a require site visit by specialist to confirm.

Small area increase due to slight corrections to OS data.

	Size (ha) GIS	Shingle Type
Original inventory	17.47	Various
New inventory	17.53	Various

Chesil Beach (TQ 084 014) + 72.07 Ha

Large areas of bare shingle were missed from the survey these have now been added as new polygons.

Whole site boundary was corrected to landward OS boundaries

	Size (ha) GIS	Shingle Type
Original inventory	249.02	Various
New inventory	321.09	Various

Colne Point (TM 097 134) NA

PD comment: *"There is a need to rectify the original inland boundary line. This may be due to survey or digitising error. Spit to the north is almost certainly new since the survey. Extant shingle probably was present to the east as a narrow strip, consult contemporary air photos"*

	Size (ha) GIS	Shingle Type
Original inventory	16.71	Various
New inventory		

Dungeness (TR 045 201) + 423.14 Ha

Survey seemed to have missed areas for no apparent reason. Massive area around power station now added, also tracks now included as recoverable bare shingle.

All of the additions were considered present in 1990, there are possible further additions here from 2004 aerial photographs.

Ideally local knowledge and specialist site visit would be required to assess the extent of current vegetated shingle.

	Size (ha) GIS	Shingle Type
Original inventory	1319.37	Various
New inventory	1742.51	Various

Dunwich to Walberswick (TM 494 733) - 0.03 Ha

Small area decrease due to slight corrections to OS data.

Area also checked against 1990's aerial photography, very good match.

	Size (ha) GIS	Shingle Type
Original inventory	13.35	Various
New inventory	13.32	Various

East Head (SZ 772 988) - 4.25 Ha

Survey appeared to have been drawn and digitised incorrectly, massive errors with positioning and shape.

The new boundary was taken from a sand dune vegetation survey map 'East Head – West Wittering (Doarks et al 1990b). The new boundary was captured against an accurately registered map; this now highlights some digitising errors with the sand dune inventory, with dunes being further to sea than shingle!

	Size (ha) GIS	Shingle Type
Original inventory	13.89	Various
New inventory	9.64	Various

Foulney (SD 242 641) NA

This area was assessed and deemed fit for purpose based on 1990 survey.

	Size (ha) GIS	Shingle Type
Original inventory	15.05	Various
Corrected inventory	15.05	Various

Gosport / Browndown (SZ 584 988) NA

Original data was captured in 2004 from 'Vegetated shingle of the Sussex coast'(Williams & Cooke 1993).. Possible error with digitisation of landward boundary seems to include wooded areas.

Amendments here but would a require site visit by a specialist to confirm.

	Size (ha) GIS	Shingle Type
Original inventory	59.46	Various
New inventory	59.46	Various

Grune Point (NY 134 564) - 6.31 Ha

Removed what appeared to be a digitising error (from polygon 0121:0001235). Fields removed and line traced to OS shoreline.

Additional polygon added on North West shoreline under PD instructions (Polygon 0101:0000041).

	Size (ha) GIS	Shingle Type
Original inventory	29.63	Various
Corrected inventory	23.32	Various

Hastings to Beachy Head (TQ 650 023) + 1.95 Ha

Original data was captured in 2004 from 'Vegetated shingle of the Sussex coast'(Williams & Cooke 1993).. 1990's aerial photography was available for the south west section although not used. (See note on Beachy Head to Brighton). Areas appearing built over (Polygons 0121:0001215, 0121:0001213, 0121:0001214, 0121:0001476, 0121:0001475 and 0121:0001220). 0121:0001261 has no mapping or photo match.

Possible additional areas of 'Bare Shingle' here, not able to verify 1990 coverage using data held. Further additions here but would a require site visit by specialist to confirm

Small area increase due to slight corrections to OS data.

	Size (ha) GIS	Shingle Type
Original inventory	36.35	Various
Corrected inventory	38.30	Various

Isles of Scilly (SV 894 118) NA

No base mapping supplied so unable to check or verify any of these polygons.

	Size (ha) GIS	Shingle Type
Original inventory	61.57	Various
Corrected inventory	NA	NA

Kessingland (TM 535 839) - 0.06 Ha

Survey looked incorrect as it included part of a caravan park; also an area at the south of the site was omitted due to the page size in report!!

The removal and addition balanced out leaving the site roughly the same area.

PD had recently carried out a report (in Rees, 2005) so had first hand specialist knowledge of the site.

	Size (ha) GIS	Shingle Type
Original inventory	30.86	Vegetated
	9.35	Bare
Corrected inventory	30.91	Vegetated
	9.24	Bare

Landguard Common (TM 287 319) + 4.40 Ha

Several areas of shingle not surveyed in 1990, now added. These included a tern breeding area (Polygon 0101:0000022) and an area not surveyed inland near the caravan park (Polygon 0101:0000040).

Part of Polygon 0121:0001128 in the North East corner was removed (part of a car park).

Large sections of the landward boundary were also snapped to OS features.

	Size (ha) GIS	Shingle Type
Original inventory	20.28	Various
Corrected inventory	24.78	Various

Orfordness & Shingle Street (TM 412 473) + 53.49 Ha

Orfordness (+ 53.74 Ha) – Whole site was verified against 1990s aerial photographs. To the north three polygons (0101:0000054, 0101:0000055, 0101:0000053) were added around the radar station, these were correcting areas not covered by the survey. They have been attributed as 'bare disturbed shingle.

It was also discussed whether the radar station was sited on natural deposits of shingle. It was decided not to include for the 1990 inventory as it was considered that the shingle was artificially moved onto this area during construction (i.e. not natural), Mid way between the radar station and the southern spit a small area (Polygon 0101:0000019) was added.

Addition to the north (Polygon 0101:0000074) was added due, although this was not surveyed in 1990. Sue Rees of Natural England confirmed this addition.

In some places the boundaries were snapped to OS features, although this was not done along the seaward/inland water boundaries as these could be a real change since 1990.

	Size (ha) GIS	Shingle Type
Original inventory	358.74	Various
Corrected inventory	412.48	Various

Shingle Street (- 1.25 Ha) – Whole site was verified against 1990s aerial photographs. This site had two possible additions to the south where the survey had an artificial cut-off. These were not included at Natural England's request. Site was left unchanged except for the landward boundary which was trimmed to the sea wall as PDs request. Whole site doesn't match OS base data or 1990's aerial photographs that closely and seems to cover built over areas and a car park

Scope for current additions/changes here but would a require site visit by specialist to confirm.

PD comment: "*The current movement of the shingle 'ness' southwards as noted from current photography is a real phenomenon. There were 'percolation lagoons' present in 1980 see picture to right. Matching the original survey with 'fixed features' on the ground was not easy. The site survey did not extend south of grid line 43. Because of the uncertainties associated with extending the communities to the south these were not added in the final version"*

Boundaries were snapped to OS boundaries where appropriate.

	Size (ha) GIS	Shingle Type
Original inventory	20.17	Various
Corrected inventory	18.92	Various

Pagham & Church Norton Spits (SZ 885 959) + 10.25 Ha

Section of bare shingle added (Polygon 0101:0000052). See PD comment below.

"Establishing what would have been present in 1990 would require contemporary air photos. Quite a lot of the area was obviously present but not surveyed. It should be possible from the new survey to make an educated guess as to what was present in the 1990s"

All polygons for site visually checked against 1990 aerial photographs.

Boundaries were snapped to OS boundaries where appropriate.

	Size (ha) GIS	Shingle Type
Original inventory	33.22	Various
Corrected inventory	43.47	Various

Porlock (SS 885 483) +3.99 Ha

Two additional polygons added here to West of the site (0101:0000034, 0101:0000035). These were verified by PD. See his comments and photograph below.

Boundaries were snapped to OS boundaries where appropriate.

PD comment: *"Areas to the west of the site add as bare shingle not surveyed. Fix landward boundary to fence line. Image shows shingle ridge looking east from the western edge of Porlock Bay, 2002"*

	Size (ha) GIS	Shingle Type
Original inventory	31.72	Various
Corrected inventory	35.71	Various

Rye Harbour (TQ 940 177) + 68.63 Ha

Survey seemed to have missed areas for no apparent reason. Area at north of site extended to match report.

Points to discuss

- Areas of Bare/Vegetated match report but nothing on ground
- Large areas (50-70ha) in report noted as disturbed, possibly recoverable

	Size (ha) GIS	Shingle Type
Original inventory	166.25	Various
Corrected inventory	234.88	Various

Selsey Bill (SZ 820 947) + 0.11 Ha

Original data was captured in 2004 from 'Vegetated shingle of the Sussex coast'(Williams & Cooke 1993).. Possible large additional areas of 'Bare Shingle' here but not able to verify 1990 coverage using data held.

Small area increase due to slight corrections to OS data.

Further additions here but would a require site visit by specialist to confirm.

	Size (ha) GIS	Shingle Type
Original inventory	6.10	Various
Corrected inventory	6.21	Various

Shellness (TR 051 676) + 2.43 Ha

This area was assessed against some early 1990's aerial photography and found to be far too small, additional surrounding area captured. This was confirmed by specialist.

See image to right, red showing the previous boundary, black dots being the new boundary.

The data held looked to have been poorly registered and possibly drawn around newer photography (seemed to fit that better than 1990's).

The shingle type of the original area was attributed against the additions.

Landward site boundary corrected to OS boundaries where appropriate.

	Size (ha) GIS	Shingle Type
Original inventory	2.07	Various
Corrected inventory	4.50	Various

Shoeburyness (TQ 933 846) + 1.37 Ha

Area added (Polygon 0101:0000028) at North of the site under PD instructions (See comment below). A polygon containing a car park was also removed and the whole site boundary was corrected to OS data.

"I have suggested a slight boundary extension to the north to fit with a more obvious landward boundary. The description indicates that "similar vegetation exists to the east and west though access was not possible". Ground checking would be required to verify this"

	Size (ha) GIS	Shingle Type
Original inventory	9.24	Various
Corrected inventory	10.61	Various

Sizewell & Thorpeness (TM 471 606) + 88.58 Ha

Large area increases on this section of coast due to areas not surveyed in 1990. These have now been added and whole section corrected to OS boundaries. The area matches well to early 1990s aerial photography.

Part (Polygon 0121:0001122) here seems to be built over and was in 1990 (checked against aerial photographs), but the polygon shape and position appears correct as in 1990 report so not removed.

PD comment*: "Typically along this stretch of coast the shoreline consists of a narrow shingle/sandy beach with sand/shingle dune vegetation and a further shingle ridge landward (ground photos taken by me in 1984). Defining the landward boundary is difficult in some areas"*

a. Shingle/sand foreshore;
b. Shingle with *Lathyrus japonicus*;
c. Sand dune over shingle;
d. Bare shingle ridge.

	Size (ha) GIS	Shingle Type
Original inventory	31.54	Various
Corrected inventory	120.12	Various

Slapton (SX 836 444) + 0.13 Ha

Areas added and removed at this site. Polygons with a tarmac car park and built over area at the south of the site (Polygons 0121:0001244, 0121:0001093) were removed. Two sections were added to the north, these were not surveyed in 1990.

Whole site corrected to OS boundaries where appropriate.

PD comment: *"This site seems to fit pretty well, note the beach is retreating and at one point has undermined the road. Remove car park polygon at south and also extend in the north to the edge of cliff line"*

	Size (ha) GIS	Shingle Type
Original inventory	48.50	Various
Corrected inventory	48.63	Various

Snettisham (TF 650 321) + 2.50 Ha

Area at south of site added (Polygon 0101:0000018), foreshore moved seaward removing polygon with caravans.

Whole site corrected to OS boundaries where appropriate. Areas not previously included could benefit from a site survey.

	Size (ha) GIS	Shingle Type
Original inventory	26.88	Various
Corrected inventory	29.38	Various

St Helens Common (SZ 636 890) - 2.70 Ha

This site was reduced in size as there appeared to be some errors with the previous digitising.

Several built over areas were omitted and the boundary was pulled in line with sand dune inventory.

Whole site corrected to OS boundaries where appropriate.

PD Comment: *"The 1990 boundary appears inaccurate, hence my suggestion to use the sand dune boundary. This site lies at the very extreme of the range of shingle vegetation sites. A site visit is really required to validate the boundary"*

	Size (ha) GIS	Shingle Type
Original inventory	13.56	Various
Corrected inventory	10.86	Various

Walmer (TR 377 506) + 14.86 Ha

This site was increased in size as there appeared to be some errors with the previous digitising, there was an artificial cut off with the survey. This has now been corrected. Also noted that large areas have been built over, therefore site visit required to assess 'current' shingle coverage.

Whole site corrected to OS boundaries where appropriate.

PD Comment: *"There seems to be no reason why this boundary is not accurate in so far as it goes. I do not know this site. To the north the boundary requires rectification to fit landward boundary but the single probably only stretches as a very narrow band. There is clearly an artificial cut off along a grid line to the south; possible extension though needs contemporary air photos/local knowledge to verify"*

	Size (ha) GIS	Shingle Type
Original inventory	41.03	Various
Corrected inventory	55.89	Various

Walney (South) (SD 232 632) + 5.66 Ha

This site increased in size as there appeared to be some errors with the previous digitising.

Whole site corrected to OS boundaries where appropriate.

PD Comment: *"Having studied this site it appears the previous digitisation has not followed the area of shingle surveyed. Report map suggests more shingle much further east than shown"*

	Size (ha) GIS	Shingle Type
Original inventory	6.82	Various
Corrected inventory	12.48	Various

Appendix 2 Site summary totals (Area in Hectares)

Site Name	Original	Corrected	Change
Beachy Head to Brighton	27.02	27.66	0.64
Blakeney Point	52.17	120.99	68.82
Bradwell	2.29	2.29	0
Bridgwater bay	1.95	17.92	15.97
Brighton to Bognor	17.47	17.53	0.06
Chesil beach	249.02	321.09	72.07
Colne Point	16.71	16.71	0
Dungeness	1319.37	1742.51	423.14
Dunwich to Walberswick	13.35	13.32	-0.03
East Head	13.89	9.64	-4.25
Foulney	15.05	15.05	0
Gosport / Browndown	59.46	59.46	0
Grune point	29.63	23.32	-6.31
Hastings to Beachy Head	36.35	38.3	1.95
Isles of Scilly - No Mapping supplied	61.57	61.57	0
Kessingland	40.21	40.15	-0.06
Landguard Common	20.38	24.78	4.4
Orfordness	358.74	412.48	53.74
Pagham & Church Norton Spits	33.22	43.47	10.25
Porlock	31.72	35.71	3.99
Rye	166.25	234.88	68.63
Selsey Bill	6.1	6.21	0.11
Shellness	2.07	4.5	2.43
Shingle Street	20.17	18.92	-1.25
Shoeburyness	9.24	10.61	1.37
Sizewell & Thorpeness	31.54	120.12	88.58
Slapton	48.5	48.63	0.13
Snettisham	26.88	29.38	2.5
St Helens Common	13.56	10.86	-2.7
Walmer	41.03	55.89	14.86
Walney	6.82	12.48	5.66
TOTALS	***2771.73***	***3596.44***	***824.7***