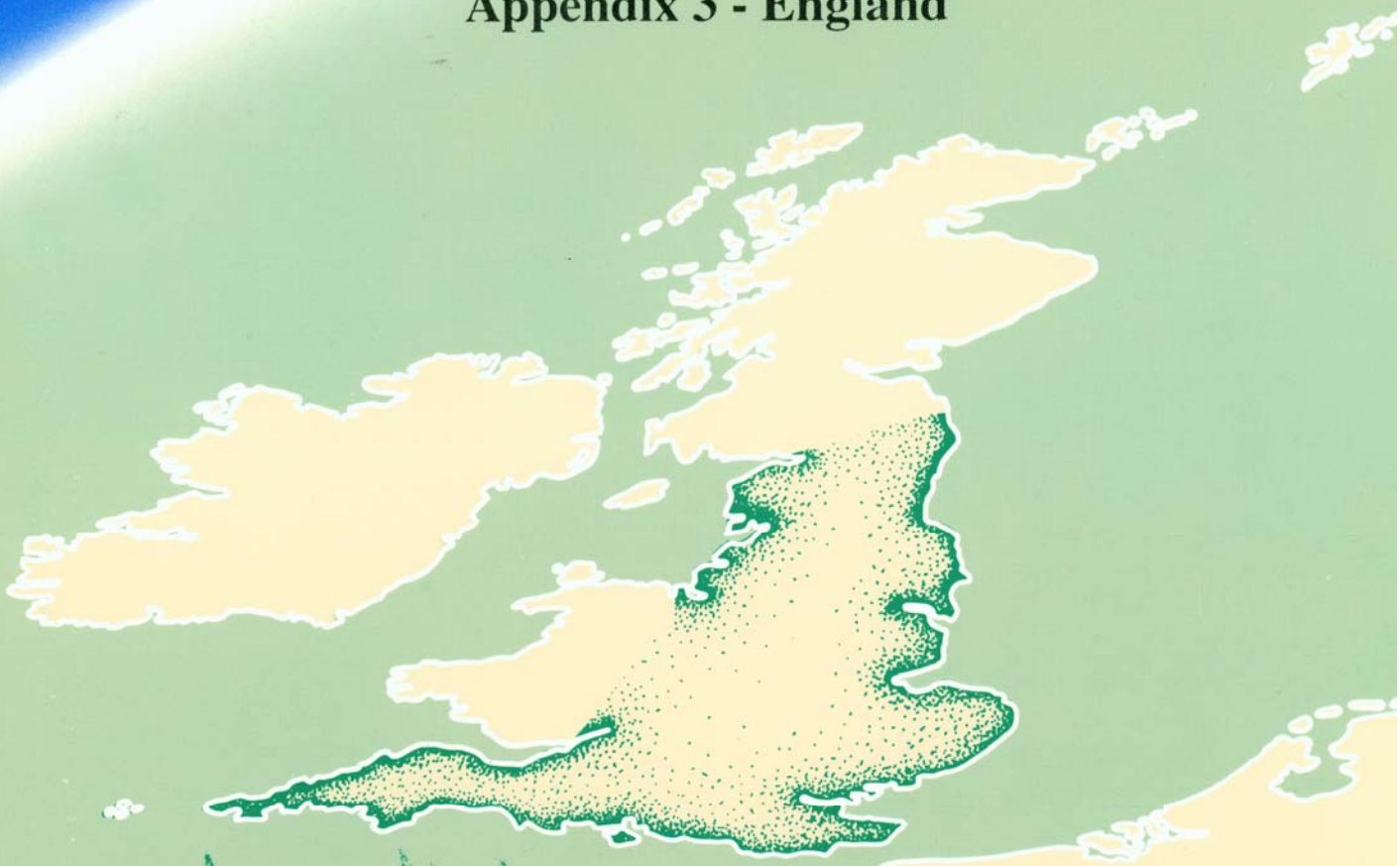
JOINT NATURE CONSERVATION COMMITTEE

Coastal Vegetated Shingle Structures of Great Britain

Appendix 3 - England



Coastal vegetated shingle structures of Great Britain: Appendix 3. Shingle sites in England

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Preface

JNCC's coastal survey programme

The work reported here was originally commissioned by the Coastal Ecology Branch of the Nature Conservancy Council's Chief Scientist Directorate in 1987. The survey forms part of an attempt to describe the size, location and quality of the main coastal habitats in Great Britain (saltmarshes, sand dunes, vegetated shingle, sea cliffs, strandlines, 'reclaimed' land and maritime islands).

The collection of basic data on the main coastal habitats is an important first step in identifying the most important sites, establishing a basis for monitoring and understanding the impact of management operations and major development projects on them.

A survey of saltmarshes in Great Britain was completed in 1989 (Burd 1989) and surveys of the majority of sand dune sites in England and Wales, and a selection of the most important in Scotland, have been completed. Responsibility for completing the existing round of survey passed to the Coastal Conservation Branch of the Joint Nature Conservation Committee's support unit and the results are being published as part of the Branch's publication programme.

This report is one of four covering surveys of vegetated shingle structure in Britain, based on a classification of the main shingle plant communities found on stable or semi-stable shingle structures in Great Britain (Sneddon & Randall 1993). This report provides descriptions of surveyed sites. It does not attempt to provide an assessment of the comparative nature conservation values of the sites surveyed. The report can, however, be used to provide a first indication of importance in relation to the size of the site and the number and representation of the plant communities.

Further information can be obtained from: Dr J.P. Doody, Coastal Conservation Branch, Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PEI 1JY, UK.

Background

A survey of major shingle structures in Great Britain was initiated in 1987 under contract to Girton College, Cambridge, from the Nature Conservancy Council.

This research project provides:

a. an overall report which combines all data in order to determine which plant communities are found on shingle at a national level, and how these relate to existing NVC categories.

b. written descriptions and maps of the major plant communities at each site surveyed, which are collated into regional reports for Wales, Scotland and England;

This report gives a preliminary description of the results of site surveys conducted in England. It forms part of the wider study of the vegetation of major shingle structures in Britain. This work has been conducted within the framework of the National Vegetation Classification (NVC) in order to assess the applicability of existing NVC categories to the shingle communities and, where appropriate, to extend the NVC by highlighting any new communities identified. At the start of the project only one community was specifically attributed to the shingle substrate – SD1, within which two sub-communities had been recognised. This reflected the limited data data supply for the shingle substrate at that time.

The main report (Sneddon & Randall 1993) provides a summary classification which is discussed more fully in the detailed account of Sneddon (1992). This report on the sites in England forms Appendix 3 to the main report. Further reports are appendices giving site descriptions for Wales and Scotland.

NB: The important vegetated shingle structure of Dungeness (Kent) was not covered by the present surveys. A full vegetation survey of Dungeness shingle has been undertaken separately, with mapping by Fuller (1989) based on a vegetation community classification developed by Ferry *et al.* (1990); see also Ferry & Waters (1985).

Acknowledgements

The production of this report would have been impossible without the cooperation of the regional staff of English Nature. In each region help was given in the identification of sites and in obtaining permission for access to those sites for fieldwork.

Thanks should also be offered to the staff of the National Trust, RSPB, Ministry of Defence, Landguard Common Nature Reserve, South Walney Nature Reserve, Rye Harbour Nature Reserve and the Slapton Ley Field Studies Centre who allowed access to shingle sites.

Finally, many thanks to Ian Agnew in the Cambridge Geography Department Drawing Office and to Nigel Philips at Monks Wood for producing the base maps for this report.

Introduction

The term shingle may be applied to any sediment which has a mean grain size of between 2 and 200 mm. Sediments below that size are termed sand, silt or clay, according to mean grain size, while particles of a diameter greater than 200 mm are termed boulders. This empirical distinction reflects a biological distinction based on environmental factors such as moisture content which lead to differing habitats associated with each sediment.

Shingle may occur as a riverine sediment but in the UK it is most commonly found in marine environments around the coast. This marine sediment may have been derived from three major sources:

a) by rivers transporting shingle to the coast;

b) as glacial sediments deposited offshore which have been reworked with rising sea levels to be deposited along the coast;

c) and finally, shingle may result from active erosion of existing coastal cliffs such as the flint shingle derived from chalk cliffs found along much of the south coast.

Five types of shingle beach have been recognised (Sparks 1972, Chapman 1976):

a) fringing beaches;
b) spits;
c) bars;
d) apposition beaches/cuspate forelands;
e) barrier islands.

These categories vary according to their mobility and oceanicity and they therefore offer different habitats.

It has been shown by Randall (1977) that three key factors are required to enable the establishment of vegetation on shingle beaches. The first has been mentioned earlier, the mobility of the beach. Clearly, if a beach is highly mobile then a seed is likely to be washed away before it is able to germinate and so the frequency of inundation of a site will have an important influence on the vegetation of that site. Indeed, this factor was recognised by Scott (1963) in his classification of vegetation on shingle which divides shingle vegetation into five categories according to the stability of sites.

A second factor determining the establishment of vegetation on shingle is the presence of a fine matrix in the shingle (Fuller 1987). The nature of the fine matrix has been shown to influence the type of vegetation with four types of shingle substrate identified by Scott (1963); pure shingle, shingle with a sand admixture, shingle with silt and, finally, shingle with wrack (rotting seaweed).

The final factor influencing the presence of vegetation on a shingle beach is the hydrological properties of the shingle. Clearly, shingle has a high porosity and low water retention. However, this is overcome to some extent by the presence of a fine matrix which serves as a reservoir of water, which is critical at the germination stage of seed development. Once established, the vegetation relies on adaptations to drought conditions, in the form of thick leaf cuticles and the mulching effect on wetter shingle by dry shingle layers above, to provide an adequate water supply (Fuller 1987).

To sum up, the establishment and maintenance of a permanent flora on shingle beaches is dependent upon the mobility, matrix and moisture conditions of that beach.

For a more detailed introduction see the main report (Sneddon & Randall 1993).

Methods

Each site was surveyed within the framework of the National Vegetation Classification; therefore the field techniques were based on those outlined in the NVC field manual.

Potential sites for inclusion in this survey were identified using habitat maps and in consultation with regional staff in NCC. The sites which were covered are illustrated in Figure 1.

Note that for some sites the survey was made for a sample area only, chosen to cover the range of vegetation types present. Hence mapped and measured vegetation areas for some sites do not cover the total areas of vegetated shingle present.

Sites were first surveyed by eye to identify stands of homogeneous vegetation to be used as mappable units. Within these stands, vegetation was sampled using a 4 x 2 metre quadrat, found to be the most appropriate size for the vegetation types encountered, and consistent with the quadrat size previously adopted at other shingle sites (Ferry *et al.* 1985). Wherever possible, a minimum of five quadrats was placed in each stand of vegetation, however, in some cases time constraints permitted only one sample per stand.

All species of vascular plants, bryophytes and lichens (excluding saxicolous lichens) were recorded for each quadrat and each species' abundance/cover measured using the Domin scale. In addition, soil depth and pH were noted, along with the vegetation height and evidence of grazing.

Target notes ('T' notation in keys on maps) were used to describe any features of interest, either physical or biological, which may provide a useful supplement to the quadrat data collected in terms of the analysis of community types.

Site data, such as land use and any forms of disturbance, were collected at each site, while additional site information such as percentage SSSI coverage and past land use were recorded, based on information collected prior to fieldwork.

The quadrat data were entered onto a computer which organised them into classificatory units to be used for mapping. The programmes used were TWINSPAN and TWINTAB as specified by the NVC. These packages combine quadrats of similar floristic composition into groups which were then compared with those already identified by the NVC keys and tables. The classificatory units were then used for mapping.

Two methods for mapping in the field were employed according to the availability of aerial photographs. Where such photographs were readily available at a suitable scale, these would be used to map units in the field. However, availability was rather limited and the second method was most commonly adopted. This method involved sketching units onto an enlarged 1:10,000 map of the sites, on which the position of individual quadrats was marked. The preliminary mapping was used in conjunction with the classification provided by TWINSPAN to allow more accurate mapping onto a final map.

Fieldwork on English sites was conducted between May and July 1988, in October 1989, and between May and August 1990.

Nomenclature follows Clapham, Tutin & Moore (1987), Dobson (1992) and Watson (1968).

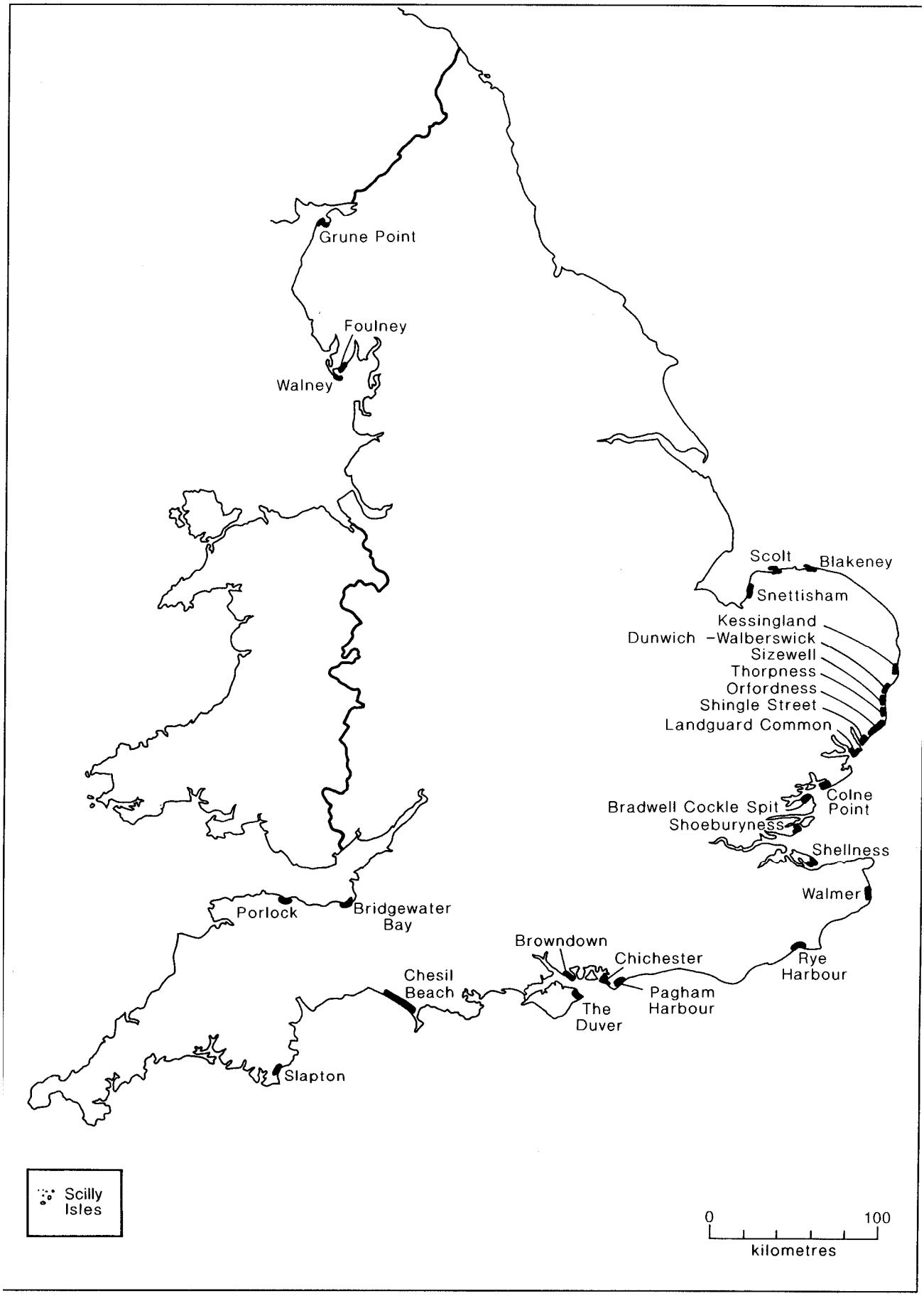


Figure 1 Sites in England with shingle structures covered by this survey

Site reports

The rest of this report provides detailed reports on all the sites visited during the course of the survey.

Site names are those of the shingle structures present at the site, and so some differ from the named localities in Figure 1. The summary information at the start of each site report lists the location of the site by county and by Ordnance Survey grid reference for the centre of the surveyed site. For some large linear sites the grid references for the extremes of the surveyed site are given. The conservation status of the site is listed, along with the site area and dates of field survey.

Not that for some sites only a representative part of the vegetated structure was surveyed. The surveyed part of the structure is that shown on the site map. The area measurement given is that for the shingle structure, both bare and vegetated, in only the surveyed part of site.

Each site description gives a general introduction to the site giving geomorphological details and outlining site boundaries. This is followed by sections on the threats to the site and any current site management.

The final section of each site report provides a detailed floristic decription of the plant communities found on the site. The communities, as defined in the shingle classification, are then used for mapping purposes. These communities are listed also in a key to the maps given at the end of the vegetation section for each site. Shingle communities are defined using a numbering system prefixed by 'SH' to identify it as a shingle unit. The number listed represents an end group identified in the computer classification. Thus, SH60 represents the 60th unit identified in the computer classification. The final part of the community listing is a species definition in which the species listed represent the major constants in that community.

Some listed communities have prefix letters other than 'SH'. These are NVC community codes for habitats other than shingle, except for the code `T' which refers to additional target notes collected during the shingle survey (see Methods).

It should be noted that the shingle classification unit definition may not exactly match the species composition described in the vegetation section of the site report. This is because the definition is only an abbreviated description. For full details on the shingle classification units see the main report (Sneddon & Randall 1993).

Where the shingle structure proved to be entirely unvegetated, or had been wholly or largely destroyed by developments or other human uses, no vegetation survey was undertaken. These sites are identified in the relevant site report.

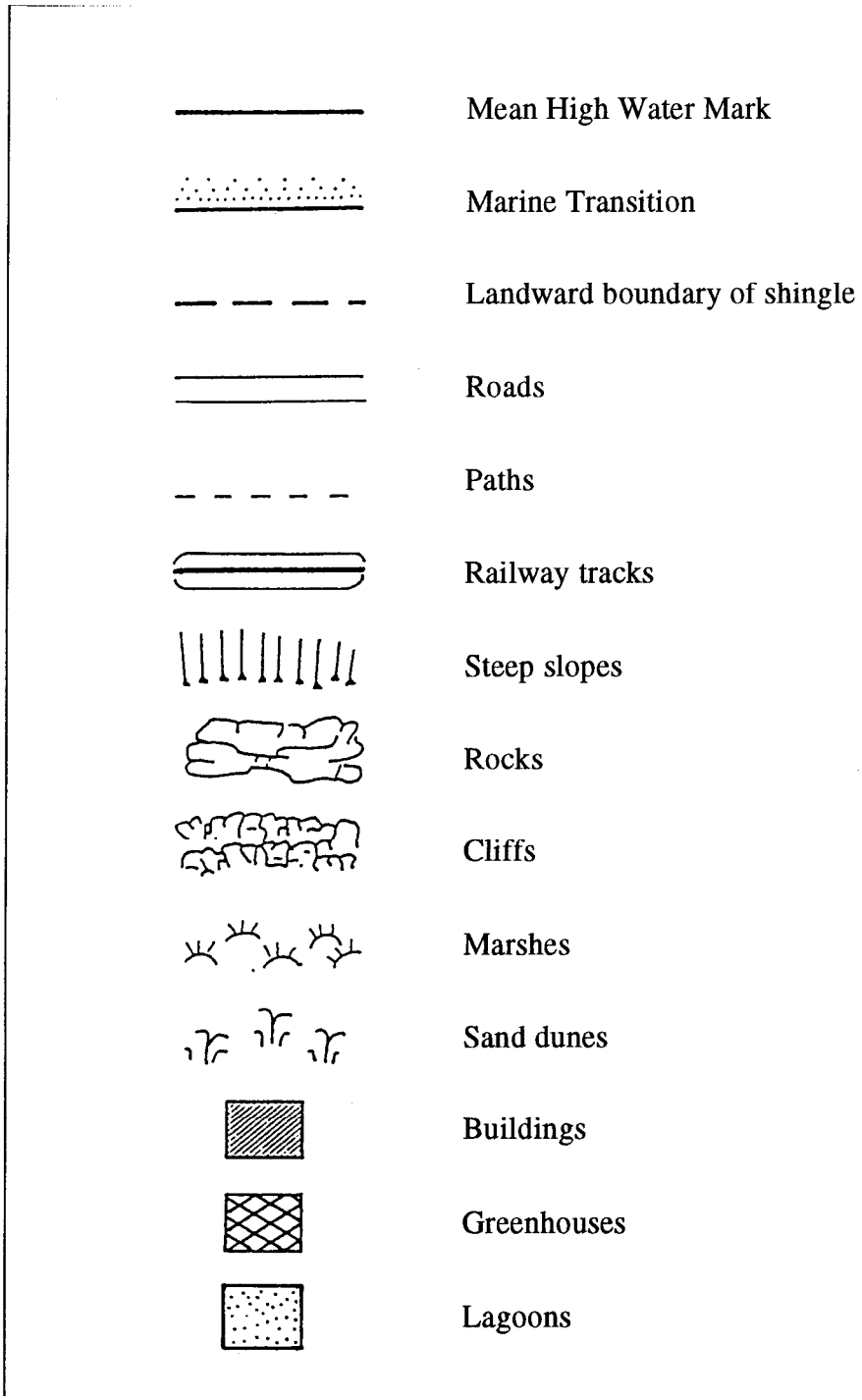


Figure 2 General key to symbols on site maps

Snettisham Spit

Norfolk. TF 650320
Conservation status: RSPB reserve
Area surveyed: 23.8 ha
Fieldwork dates: 25—26/7/90

Introduction
West of Snettisham the fringing shingle beach develops into a spit between the sea and lake system. This diverges into a series of distal ridges and lows inland of Wolferton Creek estuary. The main spit is flint shingle with little matrix but between the distal ridges there are spreads of sandy shingle. Near Wolferton Creek shingle with a silt matrix predominates. Near Snettisham Sailing Club there is a small cuspate structure protected by two shingle spits enclosing a lagoon and sandy shingle spreads at two distinct levels. The whole area has been relatively stable in recent years but lower areas are inundated by the sea during winter storms and parts of the distal end were overtopped and bared of vegetation in 1989/90.

Threats and management
Snettisham is a very popular RSPB bird reserve and an important tourist village. This has led to a loss of vegetated shingle at the eastern end which is built over and receives extensive tourist pressure. Much of the spit adjacent to the lakes is protected by RSPB fencing. The distal spits are relatively undisturbed by man but heavily rabbit grazed. The whole area is outside the sea-wall but also acts as a sea-defence. The site is wardened throughout the year, and access restricted during the tern breeding season.

Vegetation
Although much of Snettisham Spit is shingle grassland there are twelve distinct communities reflecting the height above high water mark and the composition of the shingle matrix. In the silty lows saltmarsh vegetation is present.

Shingle spreads at the mouth of Wolferton Creek present the most maritime shingle and show a very open *Glaucium flavum* dominated pioneer community. This area has a quite sandy matrix and is rich in associate species including *Cynoglossum officinale, Salsola kali, Echium vulgare* and *Sedum acre.* At the eastern end, near Snettisham beach huts, less sand is present and a *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community typical of many shingle sites is present.

On the higher sandy shingle spreads of the sailing club foreland there is a *Plantago coronopus - Armeria maritima - Festuca rubra* grassland which merges inland into an *Arrhenatherum elatius - Silene vulgaris maritima* grassland. Similar communities are present on the inland parts of the sandy-shingle spreads at the Wolferton end. Where these have been stable for a long period they can become quite moss- and lichen-rich.

Much of the main stable ridge of Snettisham Spit is a *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland. On the inland side of the spit where the vegetation is protected by RSPB fencing for much of the year this grades into a particularly rich *Dicranum scoparium - Rumex acetosella - Aira praecox* sward often with over twenty species per quadrat.

Where these stable areas are more sandy a rich *Festuca rubra - Ceratodon purpureus - Sedum acre* grassland results. Lower stable sandy areas have lichen-rich *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland or *Festuca rubra - Plantago lanceolata - Lotus corniculatus* sward. Near the sailing club *Achillea millefolium* replaces *Plantago lanceolata* in a similar grassland.

On low silty shelly shingle near Wolferton Creek there is *Festuca rubra - Silene vulgaris maritima* grassland with *Suaeda vera,* which at the bottom of lows merges into Suaeda vera saltmarsh. Conversely around the lagoon by the sailing club where more disturbance occurs the marsh is mainly *Suaeda maritima* and *Atriplex laciniata* with only occasional bushes of *Suaeda vera.*

Key

SH70 *Festuca rubra - Silene vulgaris maritima - Lotus corniculatus* community;

SH65 *Festuca rubra - Achillea millefolium - Lotus corniculatus* community;

SH54 *Festuca rubra - Plantago lanceolata - Lotus corniculatus* grassland;

SH51 *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland;

SH46 *Festuca rubra - Ceratodon purpureus - Sedum* spp. grassland;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* community;

SH39 *Silene vulgaris maritima - Arrhenatherum elatius* moss- and lichen-rich community;

SH37 *Arrhenatherum elatius - Silene vulgaris maritima grassland;*

SH33 *Plantago coronopus - Armeria maritima - Festuca rubra* grassland;

SH24 *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community;

SH22 *Glaucium flavum* dominated pioneer community;

SM25 *Suaeda vera* saltmarsh;

SM9 *Suaeda maritima* saltmarsh.

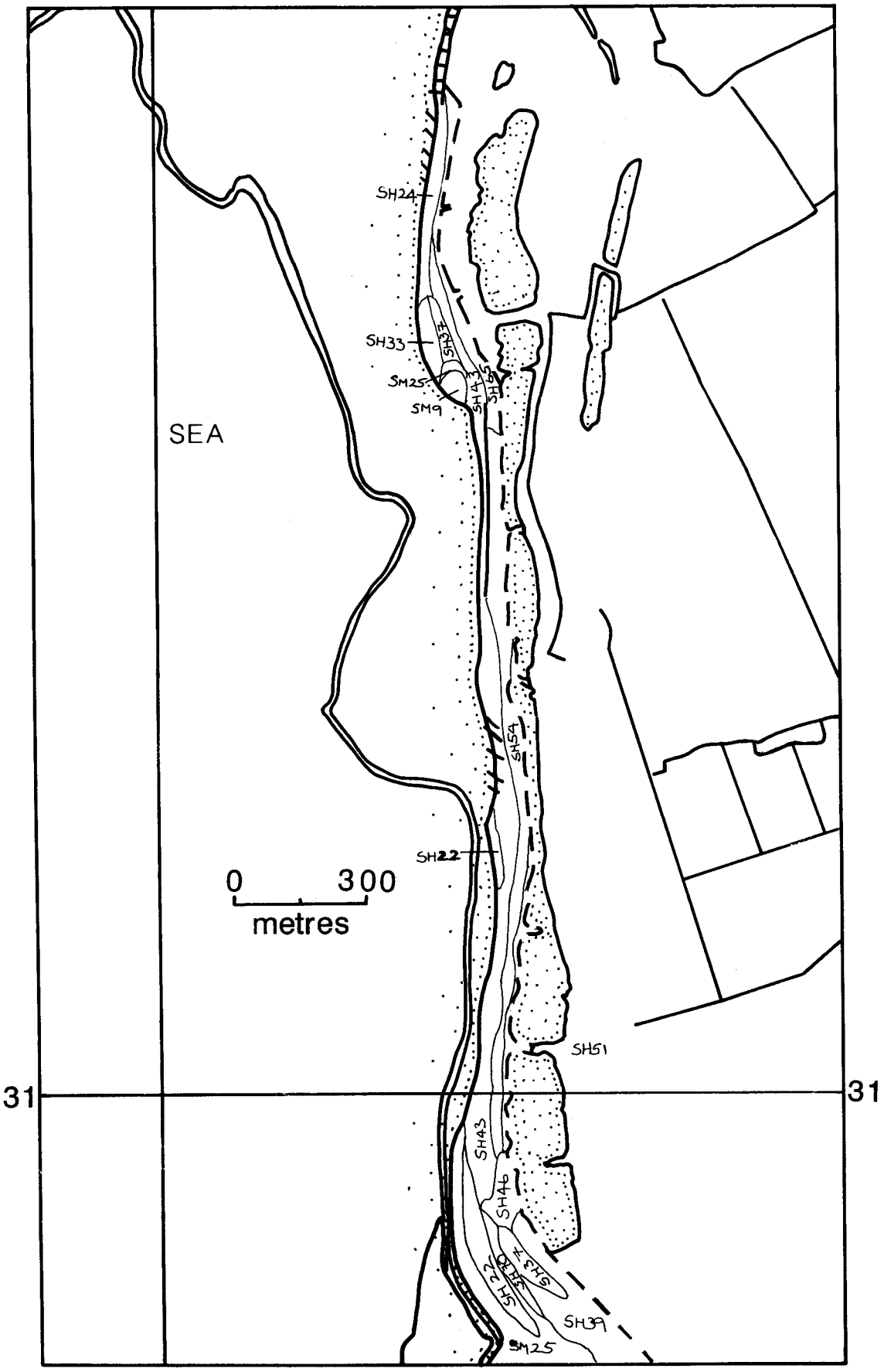


Figure 3 Snettisham Spit

Scolt Head Island

Norfolk. TF 810460
Conservation status: SSSI, NNR
Area surveyed: not measured
Fieldwork date: 7/7/88

Introduction
Scolt Head Island is a barrier island which is positioned off the north Norfolk shore running from Burnham Ovary to Brancaster Staithe. This is an example of a relatively unusual geomorphological structure in this country. It is formed as a shingle skeleton which is growing westward. Aeolian sand has been deposited on top of the shingle skeleton such that in many places the shingle is no longer visible. At the actively accreting western end of the island, there is a series of bare shingle recurves which support an ephemeral flora as they are subject to frequent inundation.

The presence of lateral projections from the lee of the island are features typical of spits and barrier islands. These laterals are perpendicular to the main body of the island and have trapped saltmarsh sediments between them. The laterals have varying amounts of sand within and upon the shingle matrix.

The origin of laterals is the subject of much debate. It is generally thought that they may represent the position of past distal ends of the spit which had recurved so far round that they were no longer active and become embedded in the main body of the spit as it continued to grow. This would, however, require some reworking of the shingle as they are generally straight and perpendicular to the spit body, rather than recurved.

Threats and management
This site is an NNR and falls within the North Norfolk SSSI and, as such, is well protected from all forms of development. The Island is cut off at high tide and is only accessible by boat at that time, or by foot at low tide. As a result there has been no vehicular damage to the site. The protection, along with the problems of access, has served to limit recreational pressure on this fragile site. The active end of the island is a breeding site for terns and is fenced off from the limited numbers of visitors to the site and, in addition, the whole site is wardened. Clearly such measures have protected the vegetation at this site.

There is one building on the island, a hut used by NCC and visiting scientists.

There has been no agriculture on this site but it is widely grazed by rabbits.

Vegetation
Access to the active end of the island was impossible during the site visit due to the terns.

The vegetation sampled on other parts of the island has not been mapped as the site is largely sandy in nature and so is covered in the sand dune survey. There were, however, some areas which supported shingle communities and these are described below.

There are four major communities which are found on the stable shingle at this site. The first is found on the edge of laterals and is a pioneer community typical of sandy shingle sites. This assemblage is dominated by *Honckenya peploides* and *Silene vulgaris maritima* in a very open community with up to *70%* bare shingle in each quadrat. The major associates in this depauperate community include *Senecio jacobaea, Sedum acre, Arenaria serpyllifolia* and *Poa annua.*

Another community is found on stable areas of the laterals where sand has not collected to any great depth over the shingle. In these areas the shingle skeleton remains clearly visible although there is a high sand content within the shingle matrix and this is reflected in the community associates. This assemblage is defined by the constant presence of *Cladonia furcata, Festuca rubra* and *Cochlearia danica.* The stability of such areas is reflected in the diverse lichen content of the community. *Cladonia cervicornis, C. rangiformis, C. coccifera, Hypogymnia physodes* and *Coelocaulon aculeatum* are the major lichen

associates. The continuing maritime influences on this area are illustrated in the presence of maritime species such as *Silene vulgaris maritima* and *Armeria maritima* as key associates along with *Arenaria serpyllifolia, Sedum acre* and *Lotus corniculatus.*

The remaining communities display a clear marsh influence in their species composition. One of these is found on laterals, closer to the marsh edge than the previous community. It comprises a lichen-rich grassland but with *Agrostis stolonifera* as the dominant grass constant rather than *Festuca rubra.* The additional constants include *Plantago coronopus, Armeria maritima* and *Cladonia furcata.* Frequent associates include *Cladonia cervicornis, C. rangiformis, Silene vulgaris maritima* and *Limonium vulgare.* This community represents an area which is inundated at particularly high tides and is, therefore, subject to occasional maritime influences while being stable enough to support lichens.

The final community is found on the intertidal shingle along the marsh edge. It comprises a *Suaeda vera* dominated assemblage typical of shingle/marsh environs associated with spits and barrier islands. Occasional associates include *Atriplex portulacoides, Agrostis stolonifera, Limonium vulgare* and *Elytrigia atherica.*

Key

SH51 *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland;

SH33 *Plantago coronopus - Armeria maritima - Festuca rubra* grassland;

SH26 *Honckenya peploides - Silene vulgaris maritima* pioneer community;

SM25 *Suaeda vera* saltmarsh.

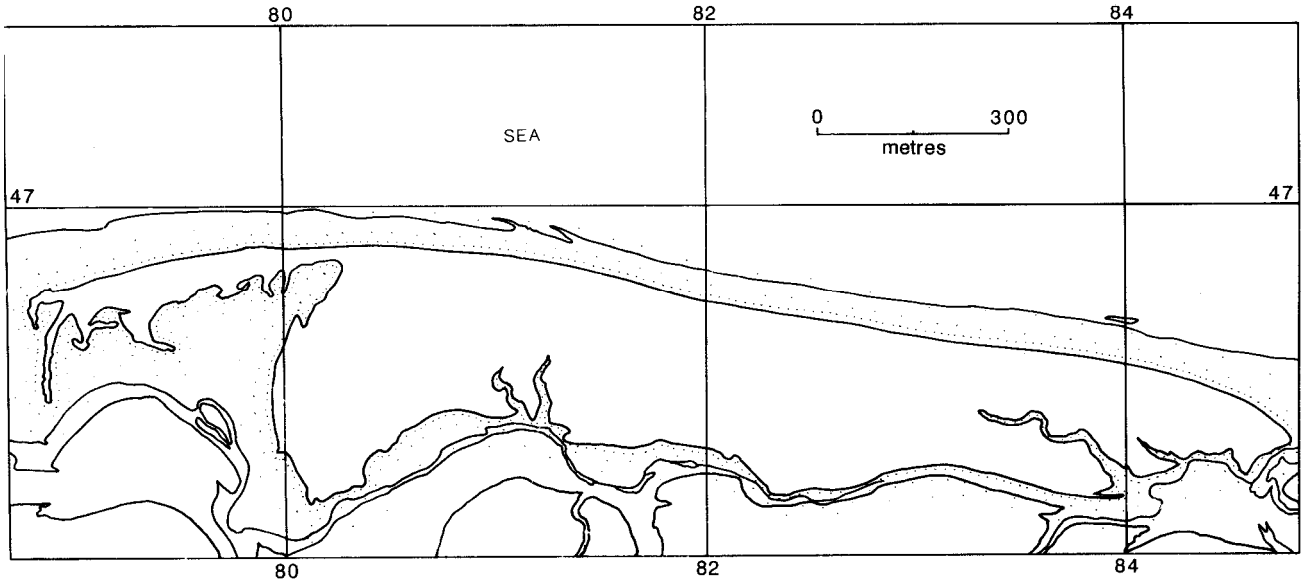


Figure 4 Scolt Head Island
Note: communities not mapped because of their small area (see text).

Blakeney Point

Norfolk. TG 015458
Conservation status: SSSI, National Trust
Area surveyed: 581 ha
Fieldwork dates: 14—16/5/90

Introduction
Blakeney Point is a particularly good example of a shingle spit which is growing westwards from its land-attached proximal end. The structural form of Blakeney Point is typical of all shingle spits with a narrow strip of shingle growing outwards from the shore, ending in a series of recurved shingle hooks at its distal end. These result from the refraction of waves around the end of the spit and from the action of waves from two directions in reworking mobile shingle at this point.

Another feature common to many spits is the positioning of lateral shingle ridges which are perpendicular to the main body of the spit on its lee. In the case of Blakeney these laterals are restricted in growth.

The main body of the spit comprises several shingle storm ridges which have been deposited in successive positions to form a relatively large expanse of stable shingle. The main pebble constituent is flint which is thought to derive either from the cliffs at Sheringham or from off-shore gravel banks, although neither explanation is satisfactory in terms of modern day supplies of material.

The protection afforded by the shingle structure has led to the formation of a saltmarsh in its lee, a feature frequently found in association with shingle spits. Another aspect of this site's geomorphology which is typical of spits generally is the deposition of Aeolian sand which has collected to varying depths over the shingle skeleton on some parts of the spit.

The spit is thought to have originated approximately 6,000 years ago when a rapid rise in sea level could have caused wave conditions suitable for the deposition of large amounts of pebbles along the north Norfolk coast. These would subsequently be reworked by littoral currents to produce the spit structure.

The existing spit is being moved gradually inland as witnessed by the emergence of saltmarsh sediments on the foreshore as shingle is moved back over the marsh. Indeed, shingle fans have been reported spreading out over the marsh following major storm events. This supports the evidence from aerial photographs and maps from earlier this century.

Threats
This site has been notified since 1954 and, as such, has been protected from any major development. There is no vehicular access to the site and, hence, there is no damage attributable to this form of disturbance. The site is, however, widely used for recreational purposes, although the effects of this remain largely negligible to both the structure and the flora of the site. The major threat through recreational pressure would be to the avifauna at this site.

Some vegetated shingle has been lost to the building of the coastguard house on one of the laterals and although no longer inhabited it may have affected the flora in the past.

Management
The distal end of the spit is a breeding ground for terns and is actively wardened during the summer with resident wardens. Hides have been provided for bird watchers. The fencing off of this area thus restricts access and protects plant communities also, although it prevented detailed sampling of the area during this study.

There is no active management of the shingle areas of the site (other than marking nest sites), but part of the dune system has been fenced off, and a boardwalk provided to protect areas where trampling has led to the destruction of vegetation. There is also a need for planting in a blow out.

The site is widely grazed by rabbits.

Vegetation
The sampling of vegetation for the purposes of this study was restricted to those areas which are clearly shingle as the dune system had been previously covered in the sand dune survey. Conflict between the timing of the survey and the tern breeding season precluded the sampling of the distal spit.

The shingle areas of Blakeney Point support three pioneer communities, along with several grassland communities. The foreshore of the spit is steep and active and, hence, supports no vegetation.

Much of the lee slope of the main body of the spit supports a very open pioneer community typical of shingle sites. This comprises a *Silene vulgaris maritima - Glaucium flavum* assemblage with very few associates. The cover offered by these species remains small and as much as 98% of each quadrat remains bare. Occasional associates include *Rumex cripus littoreus* and *Senecio jacobaea.*

In some areas this is replaced by a more diverse pioneer community defined by the constant presence of *Honckenya peploides* with *Silene vulgaris maritima.* Additional indicators of this assemblage are arenicolous in nature illustrating the high proportion of sand in the shingle matrix at this site. These include *Ammophila arenaria, Sedum acre, Phleum arenarium* and *Glaucium flavum,* although these are only frequent associates rather than constants. This community is seen along the main body of the spit but becomes particularly important at the distal end of the spit within the fenced off area (as far as it was possible to sample). Given the known sandy nature of the end of the spit, it seems a fair assumption that this community continues along at least some of its length. In places the *Glaucium flavum* becomes locally important within this assemblage.

Further inland, behind the pioneer communities, on areas with a higher sand content, there is an *Ammophila arenaria - Ceratodon purpureus* assemblage typical of foredunes. Additional arenicolous species which comprise the main associates include *Carex arenaria, Sedum acre,* and *Phleum arenarium.*

A separate community which is found in only one small patch is a *Lathyrus japonicus* dominated community. Occasional associates within this assemblage include *Glaucium flavum, Rumex cripus littoreus* and *Senecio jacobaea* although none provides much cover.

A major assemblage found along much of the spit is defined by the dominant presence of *Suaeda vera,* a species frequently found on shingle/saltmarsh boundaries. This community was beyond the scope of the shingle classification and closely matches SM25. The lichen *Xanthoria parietina* is the minor constant while additional maritime species, e.g. *Rumex cripus littoreus, Silene vulgaris maritima* and *Elytrigia atherica,* are typically found in association.

The laterals support stable grassland communities which reflect the continuing maritime influences on these areas. The most common grassland of such areas is a *Plantago coronopus - Armeria maritima - Festuca rubra* assemblage. The marsh influence is further indicated in the occasional presence of *Limonium vulgare* within the community, while *Silene vulgaris maritima* as a frequent associate illustrates the continuing maritime influence. The stability of the community is indicated in the major lichen component which most commonly comprises *Cladonia furcata, C. cervicornis* and *C. foliacea.*

On particularly stable areas on the long ridge this assemblage develops into a lichen dominated community defined as *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland. The *Cladonia furcata* provides most cover (Domin score 5); however, other *Cladonia* spp. are found as major associates. *Cladonia rangiformis* and *C. foliacea,* along with *Parmelia sulcata,* are most important in this respect. Herb associates include *Silene vulgaris maritima, Armeria maritima, Cerastium diffusum, Crepis capillaris* and *Sedum acre,* while the Gramineae component takes the form of *Poa annua, Corynephorus canescens* and *Aira praecox. Tortula ruraliformis* and *Hypnum cupressiforme* are also important elements in this assemblage.

A separate grassland is found in patches along the main body of the spit, and along the

western edge of one of the laterals. This community is a *Festuca rubra - Aira praecox - Plantago coronopus* herb-rich grassland. It displays clear maritime influences in the herb components, e.g. *Armeria maritima, Silene vulgaris maritima, Beta vulgaris maritima* and *Cochlearia danica* are all frequent associates, providing relatively high levels of cover *(Silene vulgaris maritima* has an average Domin score of 5). Non-maritime herb associates which are sampled occasionally within this assemblage include *Lotus corniculatus*, *Cerastium semidecandrum* and *Senecio jacobaea.* While there are maritime elements within this community, there are also indicators of long-term stability, in particular the presence of bryophytes such as *Brachythecium albicans* and lichen species such as *Cladonia foliacea.*

Key

SH52 *Ammophila arenaria - Ceratodon purpureus* community;

SH51 *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland;

SH50 *Festuca rubra - Aira praecox - Plantago coronopus* grassland;

SH33 *Plantago coronopus - Armeria maritima - Festuca rubra* grassland;

SH26 *Honckenya peploides - Silene vulgaris maritima* pioneer community;

SH11 *Lathyrus japonicus* pioneer community (not mapped);

SH6a *Silene vulgaris maritima* dominated pioneer community, *Glaucium flavum* sub-community;

SM25 *Suaeda vera* saltmarsh;

SD7 *Ammophila arenaria - Festuca rubra* semi-fixed dune community.

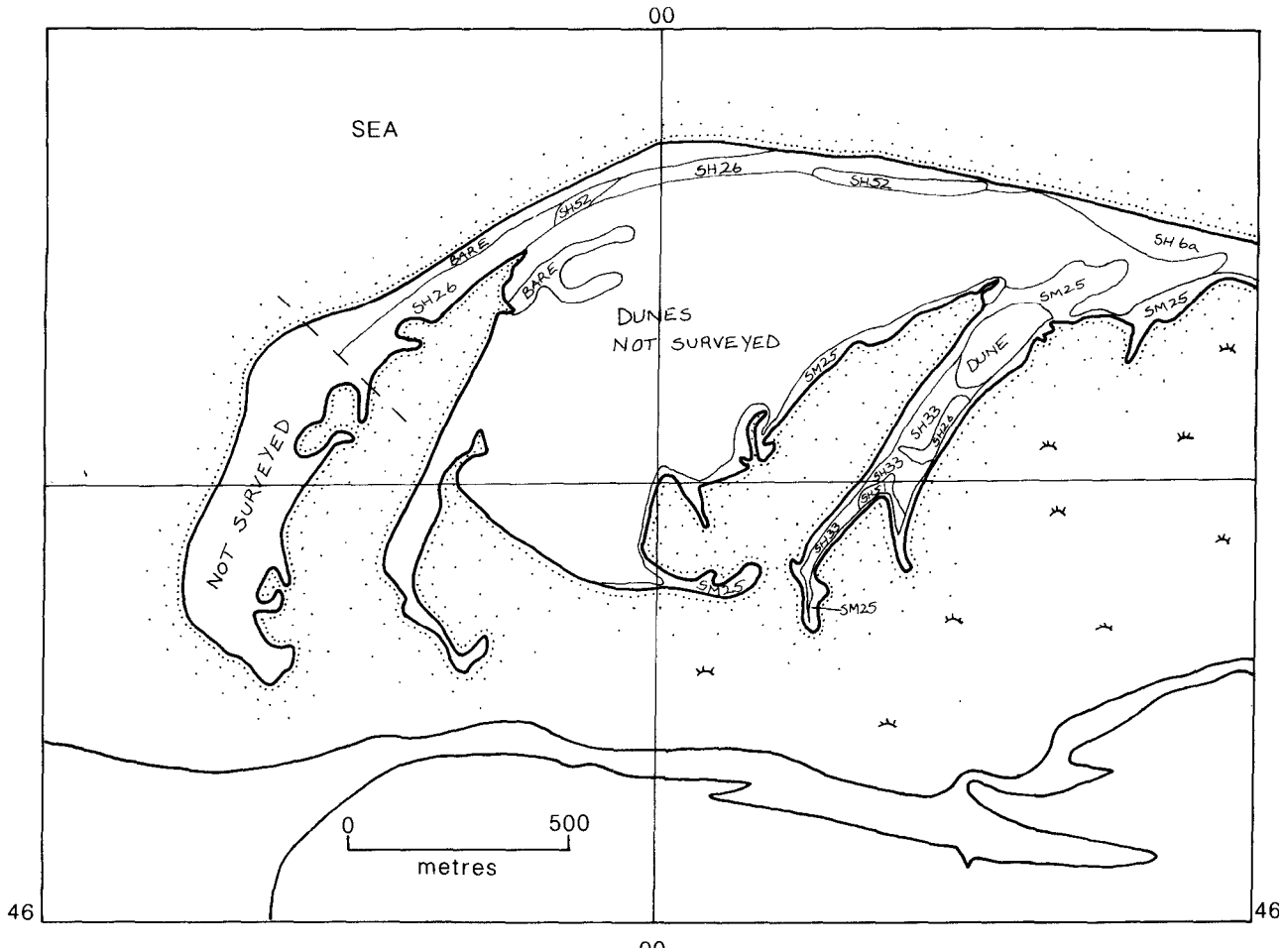


Figure 5a Blakeney Point (west)

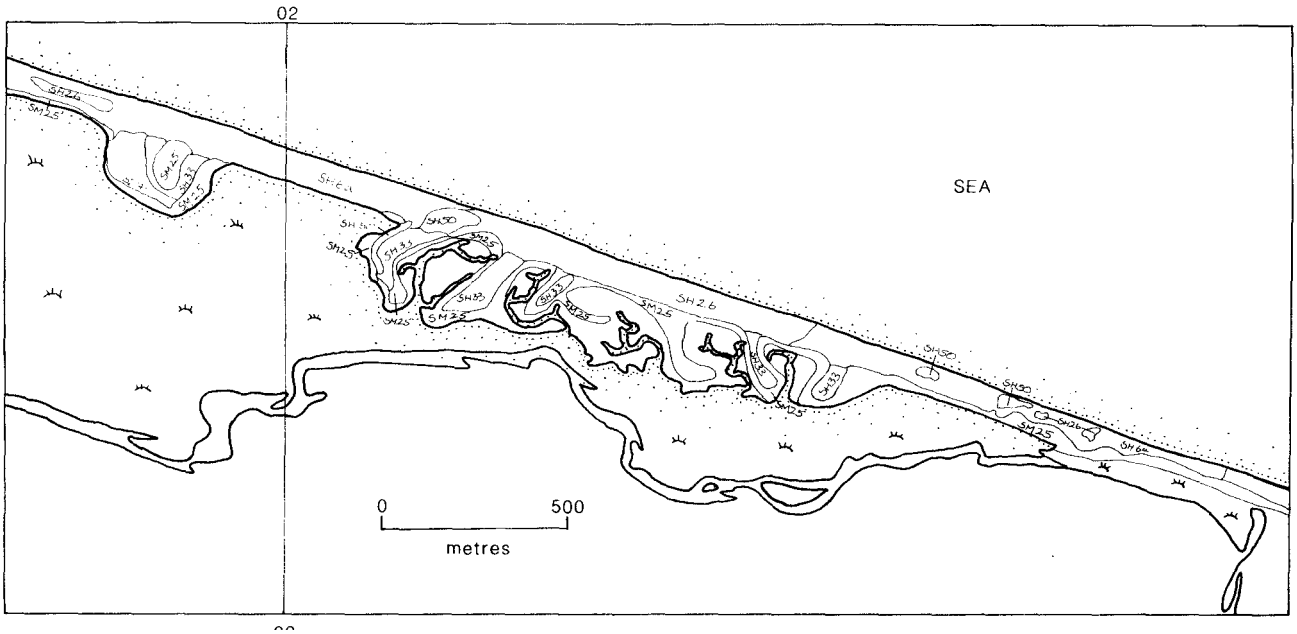


Figure 5b Blakeney Point (east)

Kessingland

Suffolk. TM 540860
No conservation status
Area surveyed: 33.9 ha
Fieldwork date: 22/7/88

Introduction
Kessingland foreland is an apposition beach which has formed by the deposition of successive shingle ridges along the shore at Kessingland to form a large expanse of shingle which is backed by dunes. Indeed, there is a high sand content in the shingle matrix. The ridge structure is still visible across the flat foreland. North of Kessingland the beach thins to a fringing beach. The southern boundary was taken to be the sluice which runs across the beach as south of this the area has been disturbed.

Threats and management
The major threat to this site is posed by the high levels of recreational pressure on it, heightened by the presence of a caravan park behind the dunes. Effects of trampling and bonfires are locally severe on the site leading to the destruction of vegetation in some areas. Trampling is most severe near the access point to the beach near the town. In addition, there are vehicle tracks across the back of the beach which result from the use of Water Authority vehicles. There is no vehicular access to the public.

There are also walkways put down on the shingle by fishermen and these run through the *Lathyrus japonicus* plants down to boats pulled up onto the shingle.

There has been no agricultural improvement to the site but there is widespread grazing by rabbits.

Vegetation
There are four major communities at this site ranging from open pioneer communities to grassland assemblages.

There is a thin strip of open pioneer vegetation running along much of the foreshore, particularly in the northern section of the site. This may be defined by the constant presence of *Ammophila arenaria, Rumex cripus littoreus* and *Senecio viscosus.* Although each quadrat contains 90% bare shingle there are several frequent associates which illustrate the arenicolous nature of the substrate, namely *Desmazeria marina* and *Honckenya peploides.* Additional associates include *Cirsium vulgare, Senecio jacobaea, Cerastium fontanum, Hypochoeris radicata* and *Sonchus arvensis.*

This gives way to a less open community, but one which remains pioneer in nature. It comprises a *Lathyrus japonicus* dominated assemblage with *Cirsium vulgare, Rumex cripus littoreus, R. acetosella, Senecio viscosus* and S. *jacobaea* as associates. Although this is an area subject to slightly less direct maritime influences, being situated further back on the beach, it is on a ridge crest where the proportion of sand within the shingle matrix falls, hence the lack of arenicolous species. At the rear of this zone, some grass species become established in the community, in particular *Ammophila arenaria, Dactylis glomerata* and *Arrhenatherum elatius.*

The remaining communities are grassland assemblages. The first extends down the southern seaward margin of the site. *Festuca rubra, Plantago lanceolata, Lotus corniculatus* and *Hypnum cupressiforme* are the indicator species in this closed grassland. Major herb associates include *Sedum acre, Hypochoeris radicata, Rumex acetosella, Trifolium arvense* and *Sagina apetala.* The arenicolous nature of the substrate is indicated in the frequent, if minor, presence of *Carex arenaria* and *Ammophila arenaria* in the assemblage. The stability of this area is illustrated in the major lichen and bryophyte component, in particular, *Brachythecium albicans, Ceratodon purpureus, Hypnum cupressiforme* and *Cladonia furcata.*

However, a major part of this site supports a different *Festuca rubra* grassland with *Festuca rubra, Aira praecox* and *Plantago coronopus* as the key constants. The levels of disturbance to this area are reflected in the community, with much bare shingle visible in each quadrat.

Desmazeria marina, Poa pratensis and *Lolium perenne* comprise the Gramineae associates while *Ceratodon purpureus* and *Sedum acre* are also frequent associates.

Key

SH50 *Festuca rubra - Aira praecox - Plantago coronopus* grassland;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH21 *Ammophila arenaria - Rumex cripus littoreus-*
Senecio viscosus community;

SH11 *Lathyrus japonicus* pioneer community.

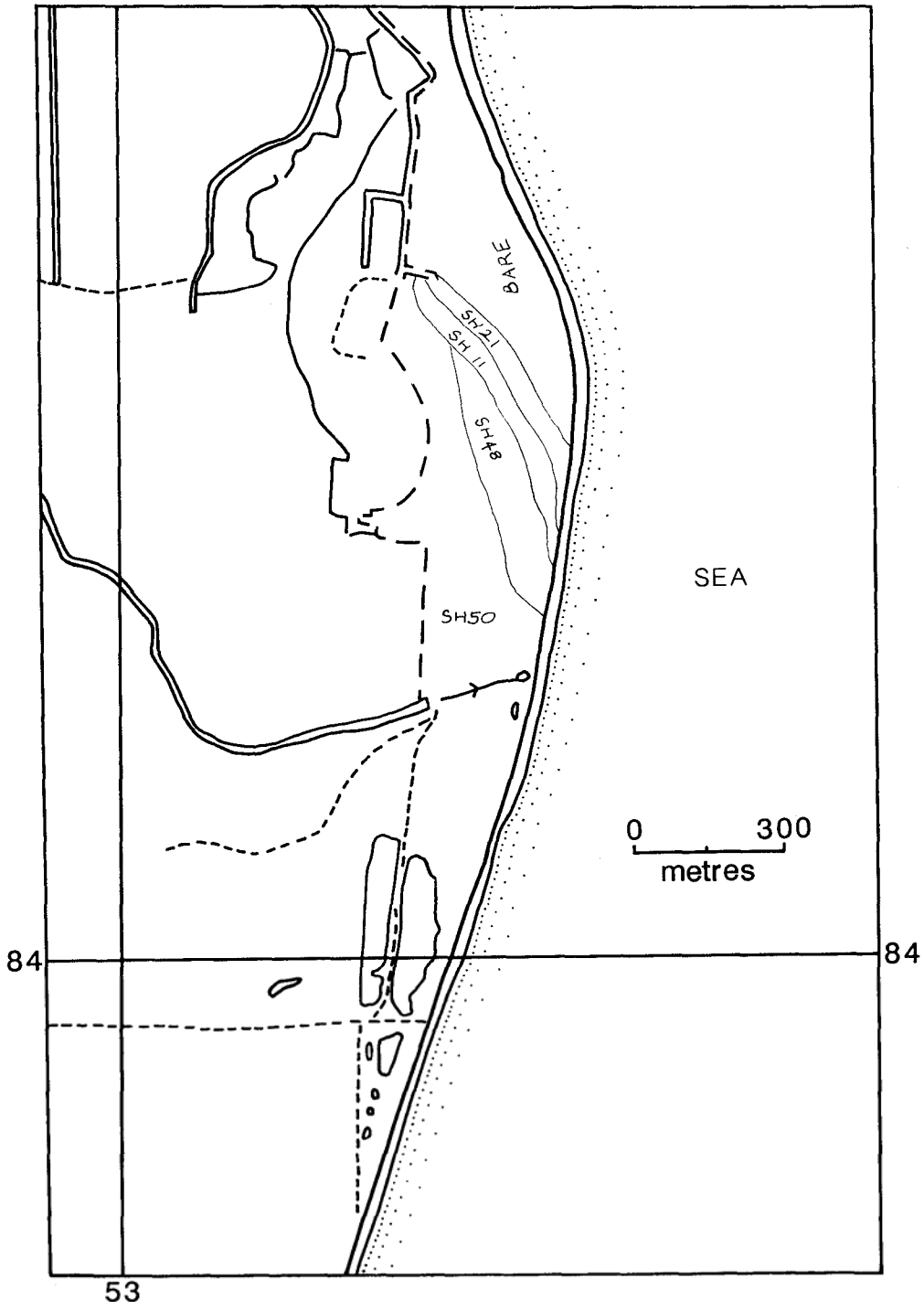


Figure 6 Kessingland

Dunwich—Walberswick

Suffolk. TM 480710
Conservation status: National Trust, LNR
Area surveyed: 17.7 ha
Fieldwork dates: 20–21/7/88

Introduction
This site comprises a largely bare shingle storm ridge which is backed by a low-lying area of shingle. This gives way to a marsh which has developed behind the shingle ridge. This system spreads northward, in the form of a steep shingle ridge stretching up to Walberswick where the marsh is present immediately behind the ridge. This area is clearly subject to relatively high levels of erosion, with a need for reworking of shingle for coastal defence.

Threats and management
This area is subject to high levels of recreational pressure with coach parties brought to the site for bird-watching. The presence of a caravan site nearby also increases levels of public pressure on the site. As a result, there has been a loss of shingle vegetation in the provision of a car park on the flat area of shingle behind the ridge. There is also damage to the vegetation of the site from widespread trampling; indeed, levels of damage are moderate, with clear pathways seen within the shingle vegetation.

There is evidence of limited vehicular damage to parts of this site in the form of tyre tracks; however, this damage is localised and negligible in extent.

The structure of the ridge, with a very steep foreshore and lee slope, suggests that this may be a man-made ridge formed as part of a sea defence scheme. This would clearly have had an effect on the natural vegetation of the shingle.

While there has been no agricultural improvement to the site, there is evidence of local rabbit grazing on the flatter area of shingle between the shingle ridge and the marsh.

Vegetation
This site supports several shingle communities ranging from pioneer assemblages through to grasslands.

The crest and lee slope of the shingle ridge at its northern (Walberswick) end supports two pioneer communities. The more disturbed areas are characterised by *a Glaucium flavum* dominated assemblage with *Chamaenerion angustifolium, Rumex cripus littoreus* and *Cirsium arvense* as frequent associates. This is a very open assemblage with up to 90% bare shingle in each quadrat. On the more stable areas this develops into a more closed pioneer grassland. This assemblage comprises a *Holcus lanatus - Festuca rubra - Senecio viscosus - Rumex cripus littoreus* community with *Agrostis stolonifera* and *Elymus repens* as occasional associates.

Another community which is found at the base of this lee slope along much of the northern length is *a Lathyrus japonicus - Festuca rubra* community. *Rumex cripus littoreus, Elymus repens* and *Cirsium arvense* are the major associates. This assemblage is relatively unusual and as such is hard to define within the shingle classification; it keys out to SH11, a *Lathyrus japonicus* pioneer community.

Three additional *Festuca rubra* grasslands are found on the southern section of the site at Dunwich. One of these occupies the lee slope of the shingle ridge at this point. This is a *Festuca rubra - Holcus lanatus - Plantago lanceolata - Rumex acetosa* grassland. It is a very rich community with, on average, twenty species per quadrat. *Aira caryophyllea, Dactylis glomerata* and *Arrhenatherum elatius* comprise the additional Gramineae associates while *Galium verum, Silene vulgaris maritima, Lotus corniculatus* and *Hypochoeris radicata* comprise the herb element of the .assemblage. Despite its position, this is a relatively stable community with a well-established bryophyte and lichen flora with *Tortula ruraliformis, Cladonia rangiformis* and C. *crispata* as the major components.

This grassland gives way to a separate *Festuca rubra* community which in this case contains

Festuca rubra, Lotus corniculatus and *Plantago lanceolata* as the major constants. This assemblage is also species-rich with *Poa pratensis, Aira caryophyllea* and *Elymus repens* as the key Gramineae associates. The herb associates include *Hypochoeris radicata, Trifolium arvense* and *Rumex acetosella,* along with maritime herbs such as *Lathyrus japonicus* and *Silene vulgaris maritima.* However, the distinguishing factor for this grassland is the important bryophyte and lichen component. *Tortula ruraliformis* is the major moss species in this assemblage providing much cover (Domin score 8) while *Hypnum cupressiforme* and *Ceratodon purpureus* are additional, but minor, moss associates. The major lichen species is *Cladonia rangiformis* but *Coelocaulon aculeatum, Cladonia coccifera, C. chlorophaea, C. coniocraea* and *C. cervicornis* are minor associates.

The final *Festuca rubra* assemblage is found along the shingle/marsh boundary at the rear of the site. This is a disturbed area and the assemblage comprises *a Festuca rubra - Holcus lanatus - Poa pratensis* grassland with *Elytrigia atherica* as a frequent associate. The herb component of this assemblage includes *Cerastium semidecandrum, Galium verum, Rumex acetosella, Hypochoeris radicata* and *Silene vulgaris maritima.* This is a relatively species-poor assemblage with approximately ten species per quadrat.

A different grassland is found in one place on the lee slope of the shingle ridge reflecting, perhaps, an area of disturbance, as it is a very open grassland. This is an *Arrhenatherum elatius - Silene vulgaris maritima - Rumex cripus littoreus* pioneer grassland with up to 50% bare shingle in each quadrat. Additional herb associates found infrequently throughout this assemblage include *Senecio jacobaea, S. viscosus, Cerastium fontanum* and *Sedum acre.*

At the northern edge of the flatter area of shingle behind the ridge, there is a community which is typical of shingle containing a high silt proportion in the matrix. This is defined by the constant presence of *Festuca rubra* and *Elytrigia atherica* with *Juncus effusus. Agrostis stolonifera, Phragmites australis* and *Holcus lanatus* are frequent associates with *Potentilla anserina* and *Stachys palustris* as the occasional associates. This is another community which is not clearly defined in the shingle classification, but it most closely resembles SH79.

Key

SH79 *Festuca rubra - Agrostis stolonifera* community;

SH68 *Festuca rubra - Plantago lanceolata - Poa pratensis* community;

SH64 *Festuca rubra - Holcus lanatus - Plantago lanceolata - Rumex acetosa* community;

SH47 *Festuca rubra - Lotus corniculatus - Plantago lanceolata* community;

SH22 *Glaucium flavum* dominated pioneer community;

SH19 *Senecio viscosus - Rumex cripus littoreus* pioneer community;

SH11 *Lathyrus japonicus* pioneer community;

SH1 *Arrhenatherum elatius - Silene vulgaris maritima - Rumex cripus littoreus* pioneer grassland.

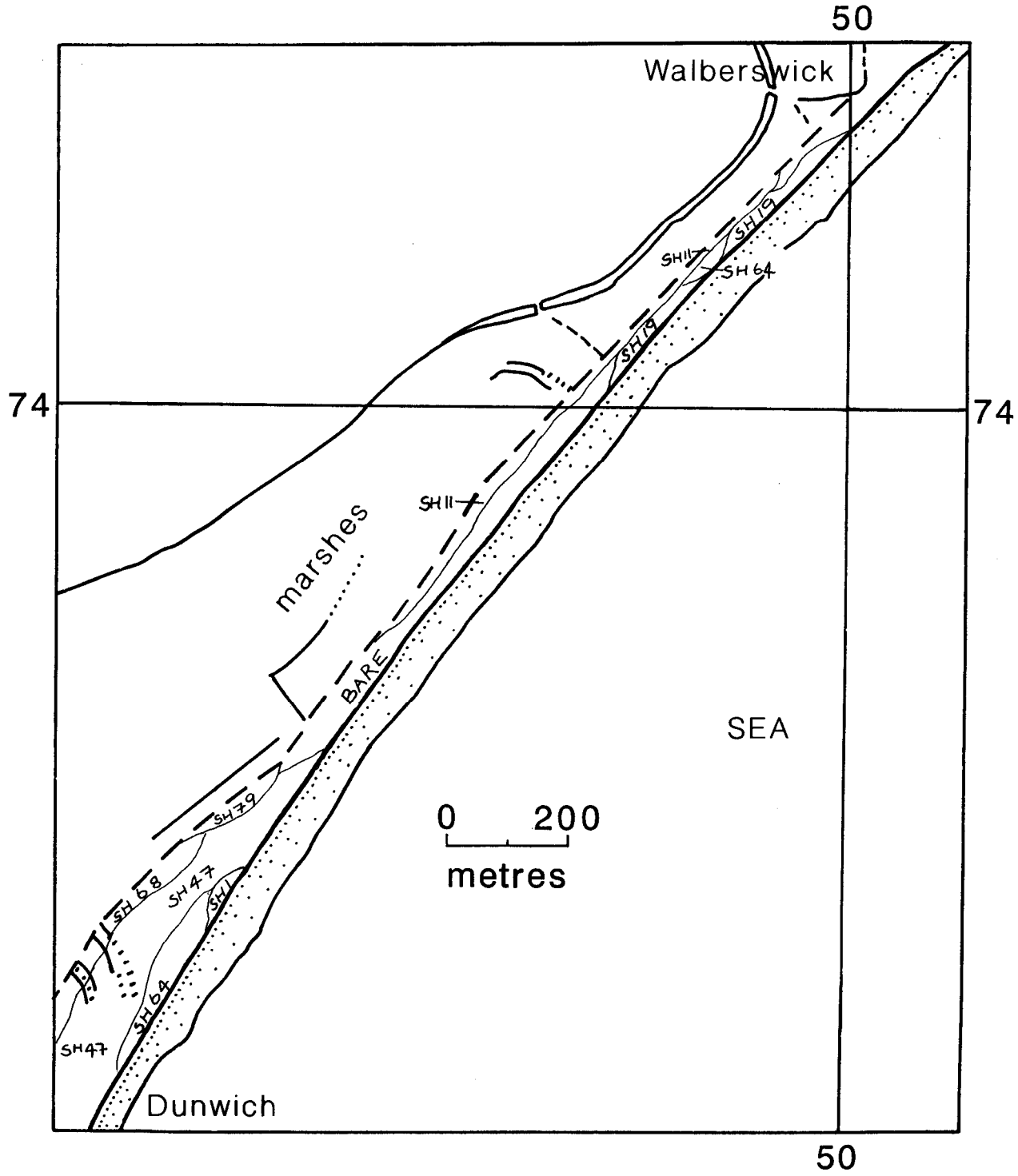


Figure 7 Dunwich—Walberswick

Sizewell

Suffolk. TM 470610
No conservation status
Area surveyed: 6.1 ha
Fieldwork date: 20/7/88

Introduction
This site is a narrow shingle fringing beach which has been included in this survey due to the former extent of the vegetated shingle on the site. It is at the sandy extreme of the definition of shingle substrates with a high proportion of sand within the shingle matrix, and this is reflected in the vegetation.

Threats and management
The extent of the vegetated shingle at this site has been vastly reduced by the construction of the power station and at the time of fieldwork an area of sandy shingle had been fenced off for new building works. In addition, vehicular access to the beach by earth moving equipment has had a direct impact on the remaining area of vegetated shingle.

Vegetation
The communities at this site, not surprisingly, reflect the arenicolous nature of the substrate.

The foreshore supports an *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* assemblage which is very open. Each quadrat contains as much as 90% bare sand and shingle. The occasional associates in this community comprise herbs such as *Glaucium flavum, Sagina apetala* and *Cerastium fontanum* and the additional grass species, *Festuca rubra* and *Poa pratensis.*

The second community on the shingle areas may be defined as an *Ammophila arenaria - Carex arenaria - Festuca rubra* grassland, which is clearly a development of the pioneer assemblage described above. This grassland is less open, being indicative of more stable areas, with 25% bare shingle/sand. Additional herb associates include *Lathyrus japonicus, Honckenya peploides, Trifolium striatum, Rumex cripus littoreus* and *Cerastium fontanum* as most frequent associates.

Key
SH59 *Ammophila arenaria - Carex arenaria - Festuca rubra* community;

SH21 *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* community.

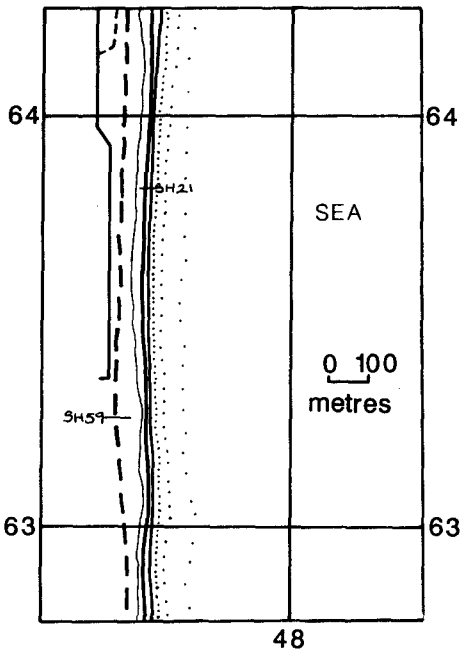


Figure 8 Sizewell

Thorpeness

Suffolk. TM 470600
No conservation status
Area surveyed: 20.5 ha
Fieldwork date: 19/7/88

Introduction
This site comprises a small apposition beach which has been deposited as a succession of shingle ridges to form a larger area of stable shingle which stretches from the cliffs to the north of Thorpeness, down to the Haven, a wider expanse of terrestrial shingle to the south of the town. While this is clearly a shingle site, as with many Suffolk sites, there is a high proportion of sand within the shingle matrix. This site is in equilibrium with existing maritime forces.

Threats and management
The major threat to this site is posed by its widespread use for recreational purposes. This has led to damage to plant communities through trampling and problems of litter. In some areas the damage to plant communities is severe; this is particularly the case in areas close to access points onto the beach. In addition there is evidence of several bonfire sites which have destroyed vegetation in these areas.

There has been some loss of vegetated shingle to a row of houses built at the back of the beach, particularly those at the Haven end of the site. The garden of the final house has also taken an area of vegetated shingle.

The site is widely grazed by rabbits, but there has been no agricultural improvement to the site.

Vegetation
This site supports five major communities including examples of pioneer assemblages and stable grassland communities.

The northern section of this site supports two communities which are typical of many shingle sites. The first is an open pioneer community characteristic of the more maritime area of stable shingle above mean high water mark. This comprises *a Rumex cripus littoreus - Glaucium flavum* community with arenicolous indicators such as *Euphorbia paralias, Carex arenaria* and *Honckenya peploides* as frequent, if minor, associates. This is a very open community with up to 95% bare shingle in each quadrat. *Crambe maritima* and *Lathyrus japonicus* are also found scattered throughout this community as occasional associates.

This gives way to a mixed herb-rich grassland on the less maritime shingle adjacent to the cliff base. This assemblage comprises a mixed *Festuca rubra - Plantago lanceolata - Poa pratensis* grassland with *Holcus lanatus* as an additional major constant. The presence of *Carex arenaria* as a minor constant which becomes locally important illustrates the sandy nature of the substrate. The key herb associates in this assemblage include *Galium verum, Lotus corniculatus, Hypochoeris radicata, Cerastium fontanum* and *Sagina apetala.* In particularly stable areas, a moss and lichen flora develops in this grassland with particular emphasis on *Cladonia rangiformis, C. cervicornis* and *Hypnum cupressiforme.*

A community which stretches along much of the foreshore of this site comprises a *Lathyrus japonicus* pioneer community (Domin score 7-8). The minor constants in this assemblage include *Glaucium flavum* and *Rumex cripus littoreus.* This is a relatively open assemblage with, on average, 50% bare shingle in each quadrat. *Euphorbia paralias, Sonchus asper, Honckenya peploides* and *Ammophila arenaria* are the frequent associates.

The zone of sandy shingle which runs between the houses at Thorpeness and the pioneer community described above supports a rich grassland characterised by the constant presence of *Ammophila arenaria, Hypnum cupressiforme, Lotus corniculatus* and *Plantago lanceolata* within a herb- and lichen-rich grassland. The presence of lichens such as *Cladonia cervicornis* and *C. furcata,* along with the moss *Ceratodon purpureus,* illustrates the stability of these areas. The major herb associates include *Eryngium maritimum,*

Galium verum, Sedum acre, Trifolium striatum, Hypochoeris radicata, Cerastium fontanum and *Plantago coronopus.* This assemblage is species-rich with, on average, twenty species per quadrat.

The final community, which is found on the least maritime shingle on the Haven, is defined by the constant presence of *Dicranum scoparium, Festuca rubra* and *Plantago lanceolata.* The *Dicranum scoparium* is the dominant species although the Domin score varies from 9 to 4 within what appears to be a mosaic patterned community. The additional Gramineae associates include *Holcus lanatus* and *Aira praecox.* This assemblage is rich in *Tripleurospermum*
herbs with particular emphasis on *Sedum anglicum, S. acre, Achillea millefolium, Plantago coronopus, Trifolium striatum, Lotus corniculatus, Cerastium semidecandrum* and *Galium verum. Cladonia* spp. lichens are also typical of this assemblage with *Cladonia cervicornis* and *C. furcata* providing most cover (Domin score 5, on average).

Key

SH68 *Festuca rubra - Plantago lanceolata - Poa pratensis* community;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland community;

SH24 *Rumex cripus littoreus -*

maritimum - Glaucium flavum pioneer community;

SH11 *Lathyrus japonicus* pioneer community.

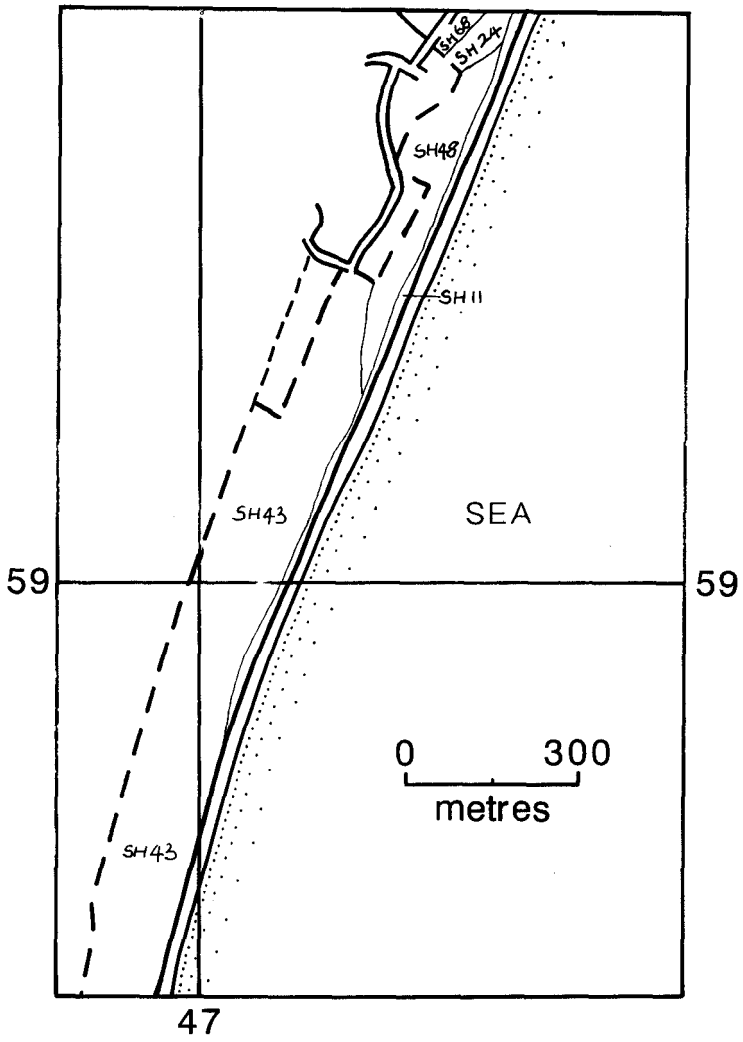


Figure 9 Thorpeness

Orfordness

Suffolk. TM 450490
Conservation status: SSSI, NNR
Area surveyed: 504 ha
Fieldwork dates: 20—23/7/90

Introduction
Orfordness is a shingle foreland and a southward growing spit which has its proximal end attached to the Suffolk coast at Aldeburgh, while North Weir Point, its distal end, lies opposite Shingle Street some 10 miles south. The growth of the spit has led to the deflection of the River Ore south to Shingle Street. Indeed, the history of Shingle Street is closely related to the history of North Weir Point. Breaches of the spit at this point have led to the stranding of shingle on the landward side of the river to form the ridges of Shingle Street.

The pebbles are flint and have been derived from offshore sources and from erosion of glacial cliffs in East Anglia. The spit is composed of a series of ridges which have been deposited almost parallel to the coast and have resulted in the formation of an extensive area of stable shingle fringed by a dynamic coastal ridge. The area is in a dynamic equilibrium with cycles of accretion and erosion.

Threats and management
There has been a loss of vegetated shingle on this site due to the construction of an MOD compound and bombing and firing range, now derelict. The major phase of construction, however, was associated with the Atomic Weapons Research Establishment and the Cobra Mist early warning system in the 1960s.

Vehicular access to the site is limited by the need to use the MOD ferry which is restricted. However, past vehicular damage, particularly during bomb clearance, has caused widespread disturbance to the cuspate foreland, and in many places this damage has been severe, leading to a loss of vegetation or a drop in species diversity.

Coastal defence works at Orfordness have also been damaging with the large scale removal of shingle to fill breaches elsewhere on the coast. The areas of low-lying shingle in excavated pits support a ruderal vegetation.

The natural maritime forces pose a major threat to this site, particularly in conjunction with sea defences nearby. Groynes used to retain shingle at Aldeburgh and defences further north have starved Orfordness and led to instability in certain areas along the spit which could lead to a loss of vegetated shingle.

There is limited public access to the site and damage through trampling is negligible. This is seen in the presence of rare, fragile lichen heath on the spit south of the Ness.

There is farming on the marshes behind the spit but no agricultural activity on the shingle substrate. The site is, however, widely grazed by rabbits and hares.

Vegetation
This site supports several shingle communities with examples of pioneer communities typical of shingle sites, open grassland communities and lowland lichen heath assemblages.

The major expanse of shingle on the Ness, in areas which have been disturbed by MOD activity, supports an *Arrhenatherum elatius - Silene vulgaris maritima - Rumex cripus littoreus* grassland. This is a very open grassland with around 60% bare shingle in each quadrat. There are few associates in this assemblage.

The major nutrient input provided by gulls to this otherwise impoverished environment has led to the development of this community in some areas. This development involves the establishment of a lichen and bryophyte flora with particular emphasis on *Cladonia furcata, C. crispata, C. portentosa, Hypnum cupressiforme* and *Ceratodon purpureus.* Because of the scattered nature of this development (related to past nest sites) it was impossible to map these areas separately.

This community is, however, better developed on the main body of the spit immediately south of the Ness where it is possible to map it as a

separate unit. In this area, there is less open shingle visible with *Arrhenatherum elatius* providing more cover than on the Ness. The increased stability of this area is illustrated in the major lichen and bryophyte component. *Cladonia portentosa, C. furcata, Hypogymnia physodes* and *Hypnum cupressiforme* are the main associates while *Cladonia cervicornis is* an occasional associate, along with the herbs, *Cerastium semidecandrum* and *Sedum anglicum.*

Further south on the spit, a separate community develops in which *Arrhenatherum elatius* plays a less important role. This community is better developed with little open shingle (10% bare shingle in each quadrat). The major constants in this community include *Silene vulgaris maritima, Hypnum cupressiforme* and *Rumex acetosella* while *Arrhenatherum elatius* is only a minor constant. The key associates are *Sedum anglicum, Festuca rubra, Hypochoeris radicata* and *Cerastium semidecandrum.* The undisturbed nature of this area is again seen in the development of a diverse lichen and bryophyte flora. *Brachythecium albicans* is an important element while *Cladonia cervicornis* and C. *arbuscula* form the lichen component.

The foreshore of the spit supports an open pioneer flora typical of many shingle sites. *Lathyrus japonicus* and *Crambe maritima* are the constant species in this community. Indeed, these are the only species in many quadrats. The occasional associates include *Rumex cripus littoreus, Tripleurospermum maritimum, Sedum acre* and *Silene vulgaris maritima.* This community also occupies the major part of the distal end of the spit.

Another pioneer community is found on the shingle areas north of the Ness in excavated areas. In this instance, major constants include *Senecio viscosus* and *Rumex cripus littoreus.* The cover provided by the assemblage remains low with 90% bare shingle in each quadrat. Frequent associates include *Beta vulgaris maritima, Cirsium vulgare* and *Sedum acre* with *Cerastium fontanum, Agrostis stolonifera* and *Festuca rubra* as occasional associates. This community runs along the leeward slope of the shingle storm ridge to the north of the Ness to Aldeburgh.

The shingle/marsh substrate.on the marsh boundary on the lee of the storm ridge supports a *Festuca rubra* grassland with *Armeria maritima* and *Plantago maritima* as minor constants. This is a relatively species-poor assemblage with only six species per quadrat. This is a result of the dominance of *Festuca rubra* (Domin score 9). Minor associates include halophytic species such as *Atriplex portulacoides, Limonium vulgare* and *Beta vulgaris maritima.*

Key

SH39 *Silene vulgaris maritima - Arrhenatherum elatius* moss- and lichen-rich community;

SH38 *Silene vulgaris maritima - Hypnum cupressiforme - Arrhenatherum elatius - Rumex acetosella* grassland;

SH34 *Festuca rubra - Armeria maritima - Plantago maritima* grassland;

SH19 *Senecio viscosus - Rumex cripus littoreus* pioneer community;

SH11 *Lathyrus japonicus* pioneer community;

SH1 *Arrhenatherum elatius - Silene vulgaris maritima - Rumex cripus littoreus* pioneer grassland.

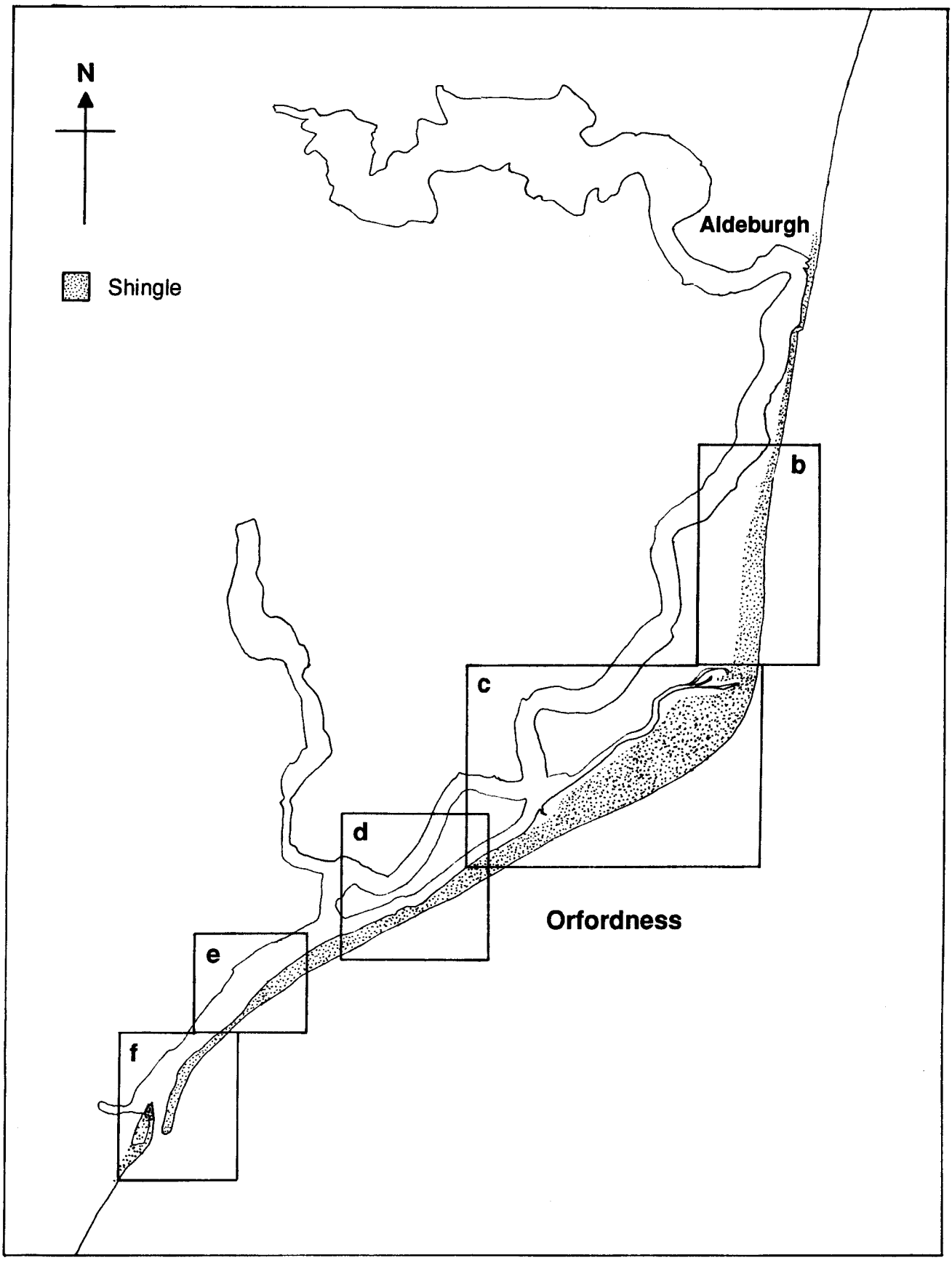
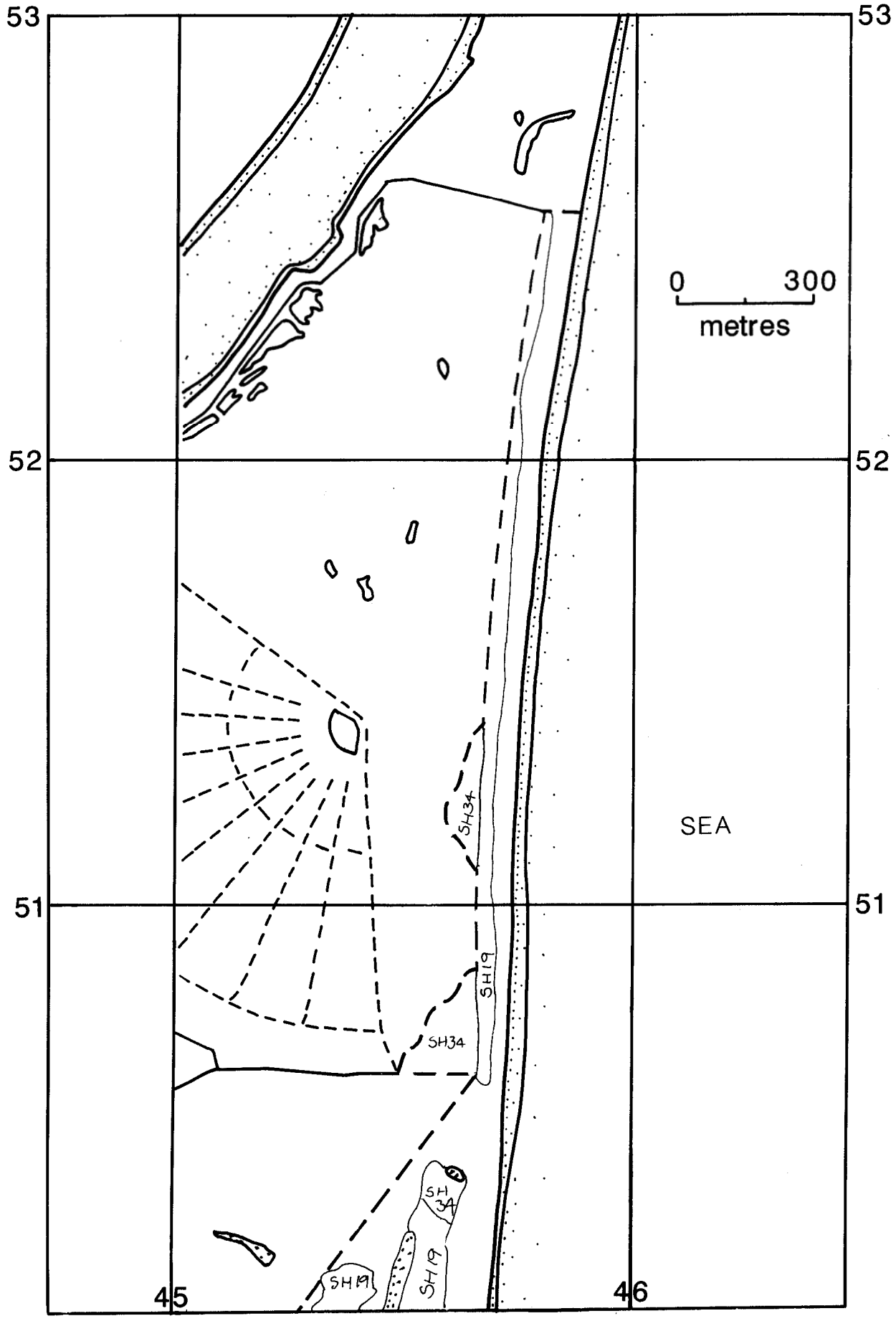


Figure 10a Orfordness — key to maps



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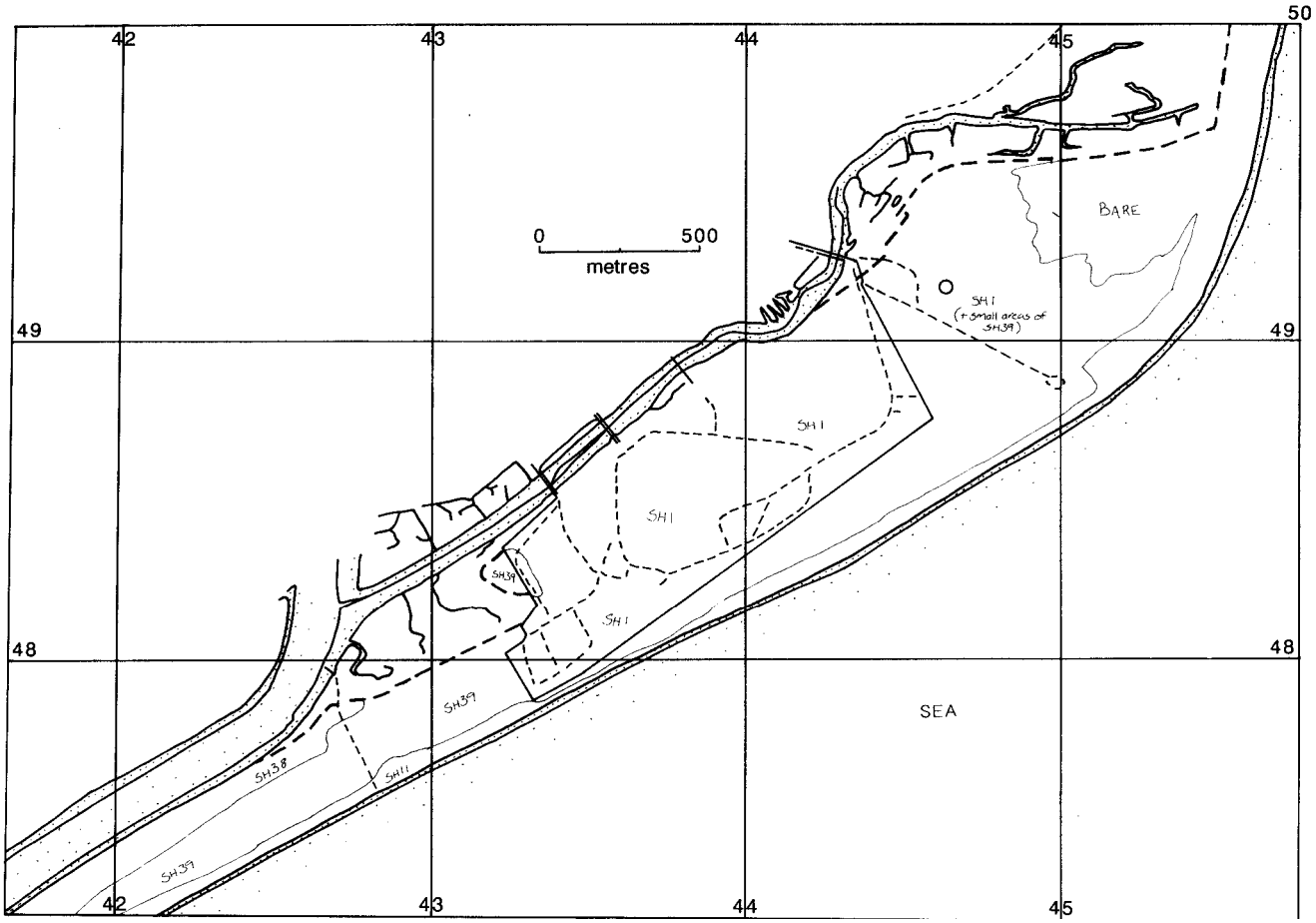

Figure 10c Orfordness

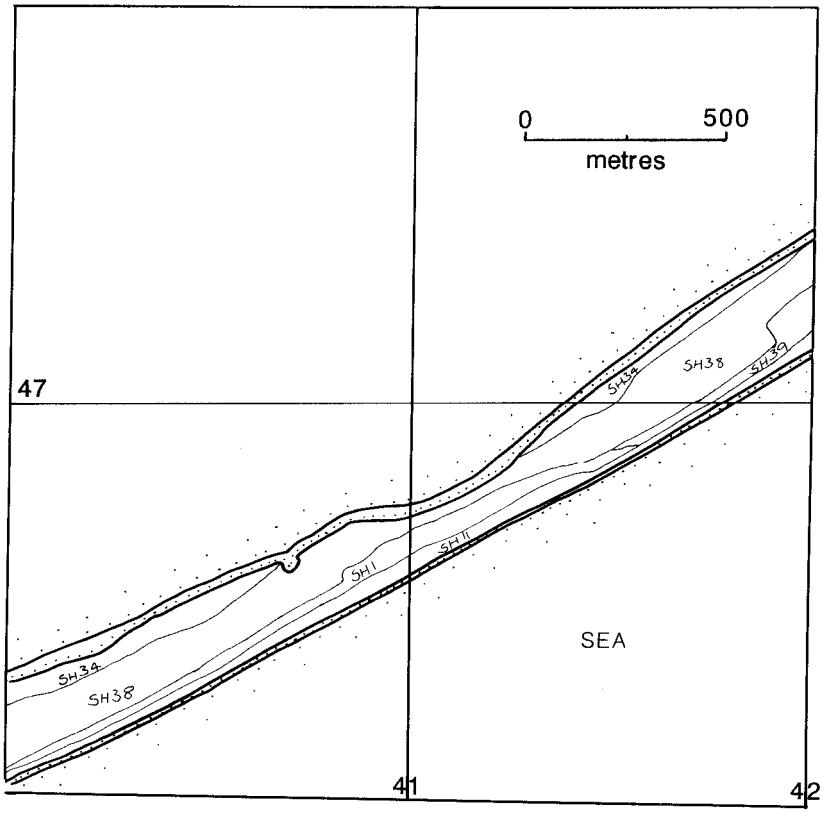

Figure 10d Orfordness

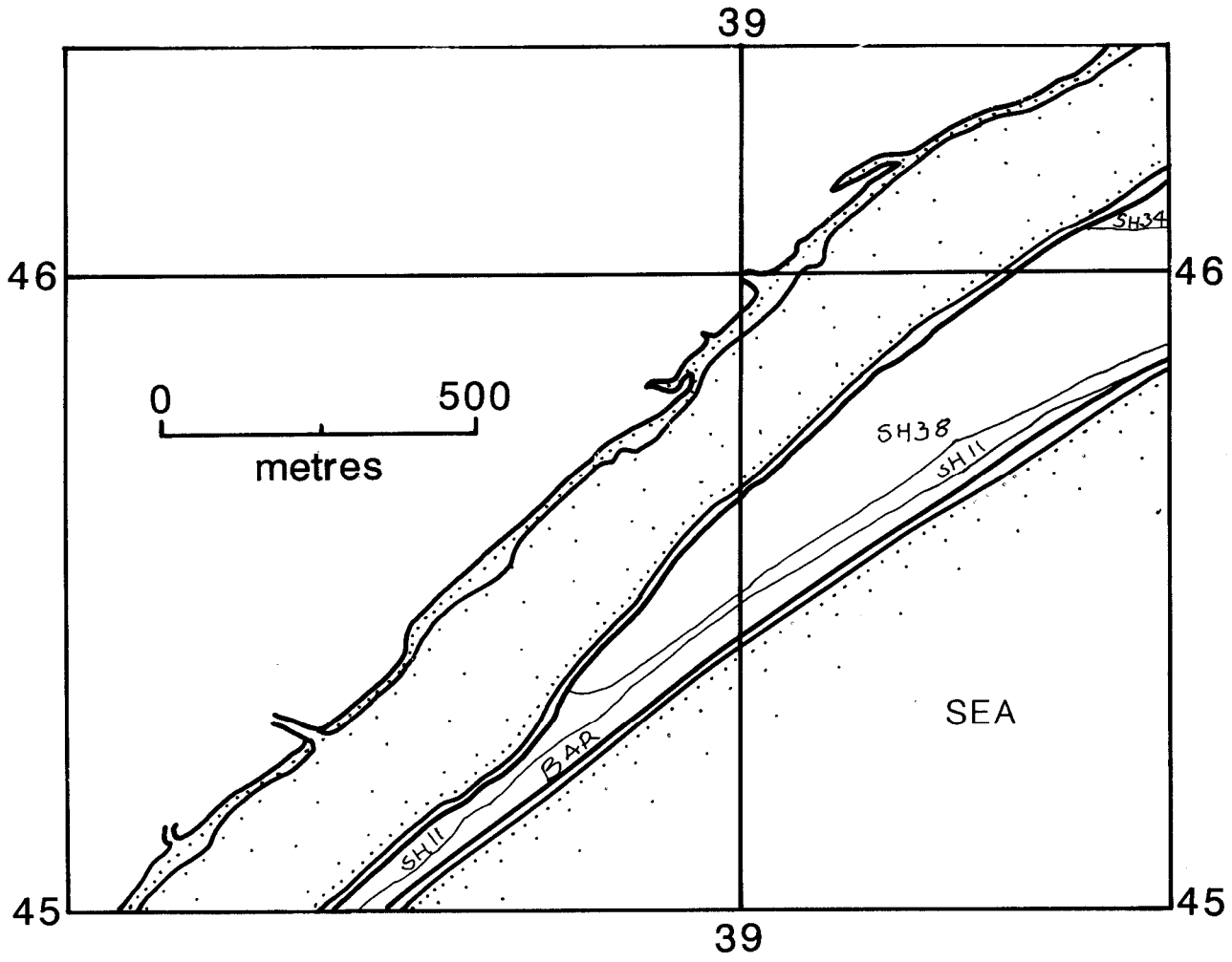

Figure l0e Orfordness

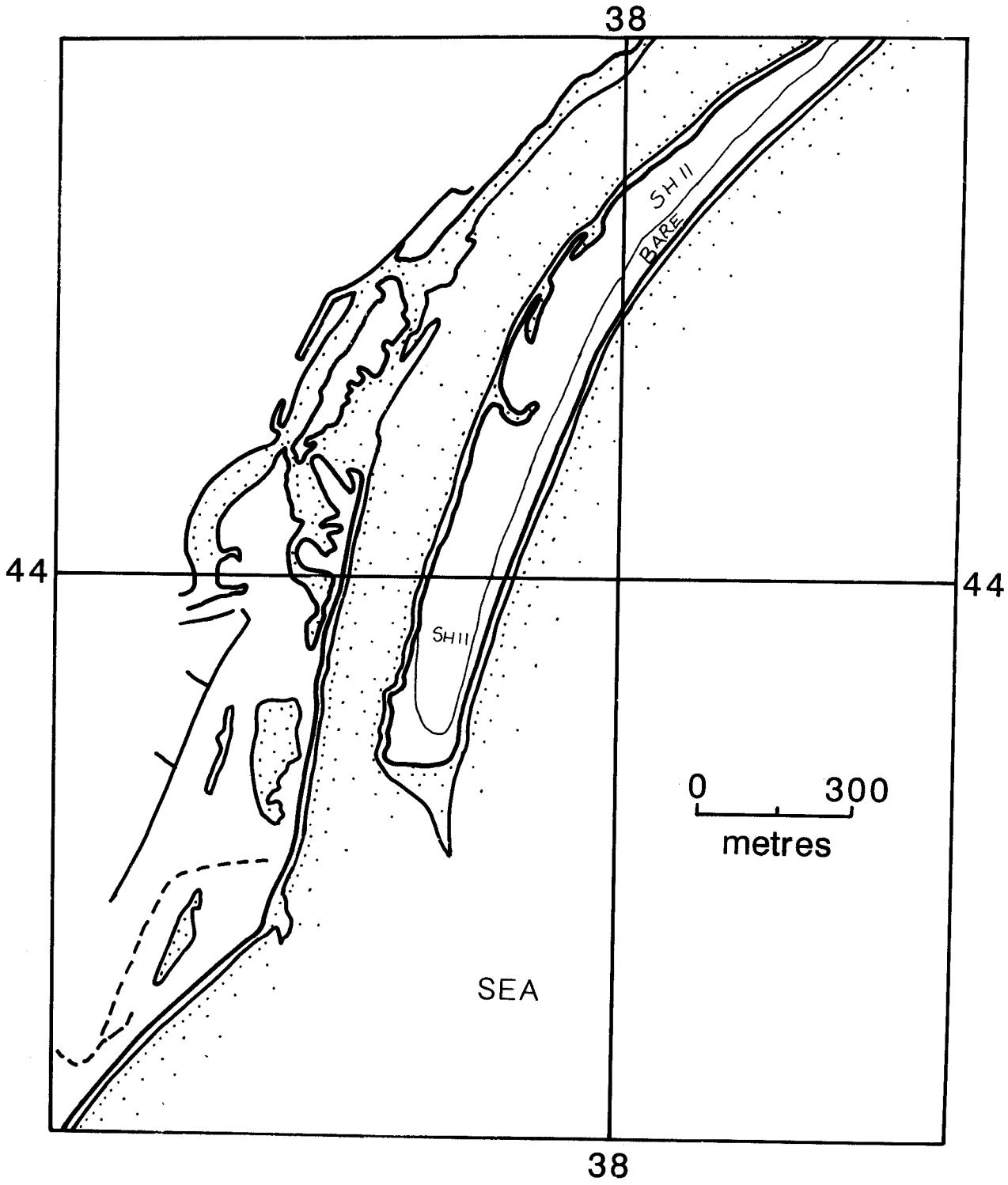

Figure 10f Orfordness

Shingle Street

Suffolk. TM 360420
Conservation status: SSSI
Area surveyed: 36.6 ha
Fieldwork dates: 18–20/7/90

Introduction
Shingle Street is situated on the Suffolk coast opposite the distal end of Orfordness on the west bank of the River Ore. There is an accumulation of shingle on the seaward side of the sea wall in the northern part of the village. It comprises a series of shingle ridges which have been deposited on top of London Clay forming an apposition beach which has enclosed several lagoons. At its northern end there is a shingle spit, behind which there is an arm of the sea.

The geomorphology of this site is directly linked with the history of North Weir Point, the distal end of Orfordness spit. The site is approximately 1,000 metres long and varies in width between 150 and 300 metres. The ridge and low structure of the site remains intact, and ranges in height between 2.0 and 2.5 metres.

Threats and management
Shingle Street is widely used for recreation. However, trampling of vegetation is only local and has caused negligible damage.

Past gravel extraction at the site has led to the formation of a low-lying area of relatively bare shingle. Clearly, this operation has destroyed the natural vegetation of this area.

There is open access for vehicles to this site, although they usually remain on the concrete track provided, hence vehicular damage is localised around the houses on the southern section of the site. These houses have led to a direct loss of vegetated shingle.

This site is not actively managed. There has been no agricultural improvement at the site, but it has been widely grazed by rabbits.

Vegetation
This site supports six major shingle communities with examples of open pioneer assemblages, grasslands and saltmarsh-influenced communities.

Much of the southern foreshore supports an open *Lathyrus japonicus* dominated assemblage. Each quadrat contains between 75% and 90% bare shingle. The major associates in this pioneer community include *Arrhenatherum elatius, Rumex cripus littoreus* and *Crepis vesicaria.*

This develops into a closed, mixed grassland assemblage seen over much of the site, located immediately behind the storm ridge and, hence, subject to relatively high levels of maritime influence. This assemblage does not provide total cover (5–10% bare shingle in each quadrat). The main Gramineae constants in this grassland include *Arrhenatherum elatius* and *Festuca rubra* while the herbs *Silene vulgaris maritima* and *Lathyrus japonicus* indicate the maritime nature of this community. The frequent associates in this assemblage include *Plantago lanceolata, Rumex cripus littoreus, Aira praecox, Cerastium semidecandrum, Vicia sativa* and *Vicia hirsuta.* Despite the maritime influences, this is a relatively stable grassland as illustrated by the occasional presence of bryophyte associates such as *Eurhynchium praelongum* and *Hypnum cupressiforme.*

On more stable areas of the site a more mature *Festuca rubra* grassland is supported. In this case, while *Festuca rubra* and *Arrhenatherum elatius* remain as constants in the assemblage, *Festuca rubra* is the dominant species (Domin score 8). The herb constants comprise *Hypochoeris radicata* and *Silene vulgaris maritima* while *Rumex cripus littoreus, Cerastium semidecandrum, Geranium robertianum* and *Sedum acre* are found frequently throughout the assemblage. The distinction between this and the previous grassland is in the major lichen and bryophyte component, in particular *Dicranum scoparium, Hypnum cupressiforme, Cladonia furcata, C. cervicornis, C. rangiformis, C. chlorophaea* and *C. crispate.* The annual grass *Aira praecox* is locally important in this assemblage. This community is seen across much of the stable shingle at this site.

A different grassland community is found in one small depression and on the distal end of the shingle spit. This assemblage is characteristic of shingle which contains a high proportion of silt in the matrix. The indicator species are *Festuca rubra* and *Elymus pycnanthus,* while the major associates are maritime in nature, e.g. *Armeria maritima, Atriplex portulacoides, Plantago maritima* and *Artemisia maritima.* In some areas, particularly on the far northern tip of the shingle spit, the *Plantago maritima* becomes locally dominant in the assemblage while the grass species are absent. The definition of this community falls outside the shingle classification; it most closely resembles SM16.

The excavated area, immediately to the north of the track, supports a different saltmarsh community with *Beta vulgaris maritima* and *Atriplex portulacoides* as the key indicator species in this very open community (80% bare shingle). Occasional associates include *Silene vulgaris maritima, Festuca rubra, Senecio viscosus* and *Parapholis incurva.* This community keys out to SM14.

Key

SH41 *Arrhenatherum elatius - Festuca rubra - Plantago lanceolata - Silene vulgaris maritima* grassland;

SH40 *Arrhenatherum elatius - Festuca rubra - Silene vulgaris maritima - Hypochoeris radicata* grassland;

SH36 *Elytrigia atherica - Festuca rubra* grassland;

SH11 *Lathyrus japonicus* pioneer community;

SM16 *Festuca rubra* saltmarsh;

SM14 *Atriplex portulacoides* saltmarsh.

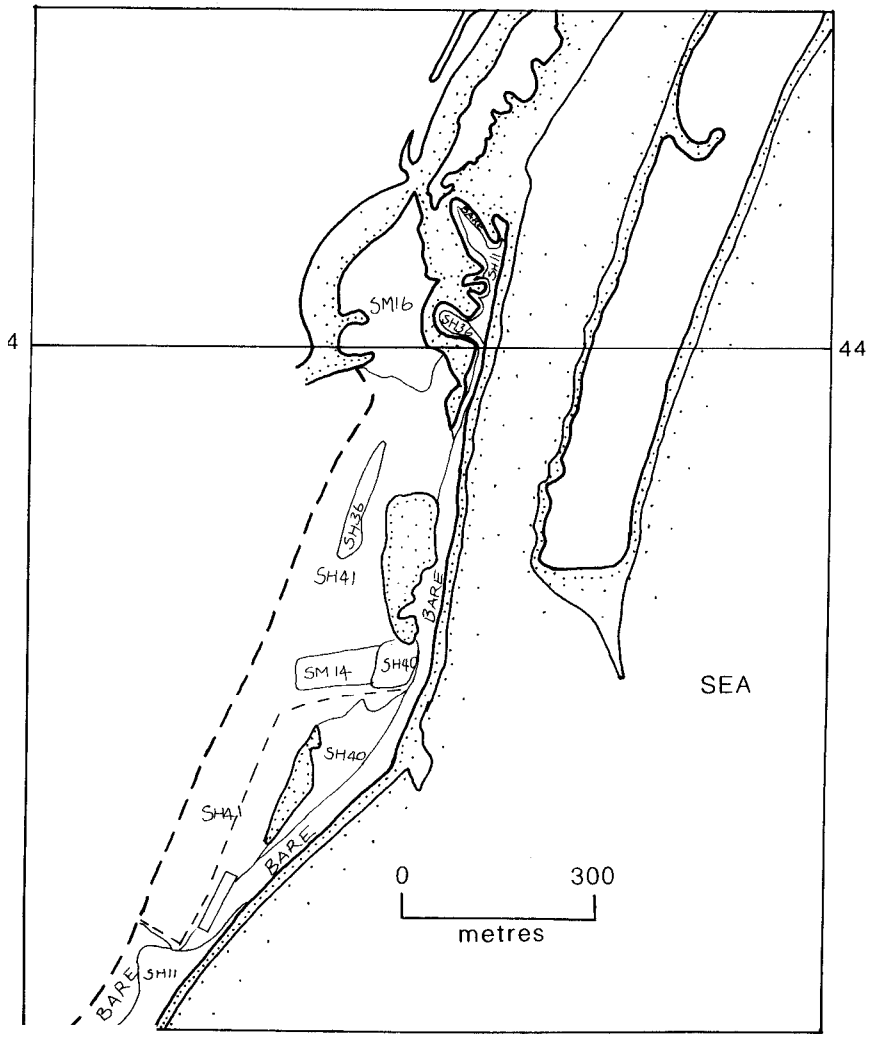

Figure 11 Shingle Street

Landguard Common

Suffolk. TM 285315
Conservation status: SSSI, LNR
Area surveyed: 31.4 ha
Fieldwork dates: 26–28/7/88

Introduction
Landguard Common is a sand and shingle spit which has grown southwards across the estuary which leads into the ports of Harwich and Felixstowe. It consists of a loose shingle foreshore backed by a stabilised shingle beach, which has a high proportion of sand within the shingle matrix.

There is evidence of erosion at this site with the need for major sea defence works, discussed in the following section.

Threats
There has been much disturbance to this site with the presence of Landguard Fort and the extension of buildings associated with the docks onto the Common, accounting for the loss of much vegetated shingle.

Levels of recreational pressure on the site are relatively high, with the presence of a caravan site to the north of the site providing many visitors to the site. Damage due to this pressure is moderate in places.

Sea defences, as mentioned earlier, are required and take the form of groynes along the foreshore and the construction of a large shingle embankment along the northern section of the site. Clearly, this has disturbed the natural vegetation of the area.

The extraction of shingle from the western section of Landguard Common by Halls Aggregates has had an impact on this site. Not only does it reduce the area of shingle but also the constant usage of the track across the site by large lorries has led to strips of disturbed vegetation along the tracks. Clearly, the construction of a concrete track has led to a loss of shingle vegetation. There is no vehicular access to the site other than for the lorries.

Management
Much of the site forms part of a local nature reserve which is actively wardened and this clearly helps protect it from undue disturbance. A section of the foreshore is fenced off to protect breeding terns and this also protects the vegetation in this area. There has been no agricultural improvement to this site.

There has been a problem with rabbits which graze the entire site, often to a severe level. In 1987, 50 rabbits were killed, but the population was growing again by 1988.

Vegetation
This site supports several communities ranging from pioneer assemblages to grassland communities and scrub communities.

The foreshore supports an open pioneer assemblage which is typical of many shingle sites. This comprises a *Crambe maritima* dominated community with few associate species, primarily *Rumex cripus littoreus.* Each quadrat contains approximately 90% bare shingle.

This community gives way to a more diverse, species-rich community on the more stable shingle behind, which is subject to less direct maritime influences. This assemblage is a *Glaucium flavum - Crambe maritima - Rumex cripus littoreus* pioneer community. Major associates include *Senecio viscosus, Cerastium fontanum*, *Sonchus asper* and *Cirsium arvense*, along with the Gramineae species *Vulpia ciliata, Poa pratensis* and *Festuca rubra.* This community is also seen along the foreshore of the northern section of the site. The increase in diversity in this community may reflect an increased sand content seen in the shingle matrix in these areas.

This is certainly the case for the assemblage found immediately behind this. It is an *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* assemblage in which *Ammophila arenaria* is the dominant species. *Cirsium vulgare, Crambe maritima, Anagallis arvensis* and *Arenaria serpyllifolia* are found as frequent associates.

Much of the main body of Landguard Common supports a *Festuca rubra* dominated grassland. The minor constants within this assemblage include *Hypnum cupressiforme, Lotus corniculatus* and *Plantago coronopus.* It is a species-rich assemblage with, on average, 22 species per quadrat. The key herb associates include *Erodium cicutarium, Medicago sativa, M. minima, Geranium dissectum, Vicia lathyroides, Sedum acre* and *Echium vulgare.* Additional Gramineae associates, although found in only small amounts, include *Arrhenatherum elatius, Aira praecox* and *Poa pratensis.* The stability of such areas is illustrated by the presence of lichen and bryophyte species, in particular, *Ceratodon purpureus, Hypnum cupressiforme, Peltigera canina, Cladonia uncialis, C. rangiformis* and *Coelocaulon aculeatum.* Indeed, in places the lichens become locally important within the grassland in terms of cover provided.

A slightly different grassland is found to the west of the track. This area has been disturbed in the past and there is a wide variety of species. The major constants are *Poa pratensis, Festuca rubra* and *Rubus fruticosus,* although the latter is found in only small amounts. This assemblage also contains *Dactylis glomerata* and *Vulpia ciliata* as additional Gramineae associates, while *Chenopodium album, Dipsacus pilosus, Trifolium striatum,' Medicago minima, Erodium cicutarium* and *Sedum acre* comprise the major herb components. There is also a minor lichen presence in the assemblage with *Cladonia squamosa* and *C. portentosa* most commonly found in association.

A very similar community is also found across much of the northern section of this site behind the sea defence embankment. It is a very disturbed part of the site which is crossed by paths. This area does not have any scrub elements but has *Festuca rubra, Poa pratensis* and *Plantago lanceolata* as the key constants with *Dactylis glomerata, Galium verum, Lathyrus nissolia, Arrhenatherum elatius* and *Trifolium striatum* as main associates.

Within this grassland there is one small area which supports a different *Festuca rubra* grassland. In this case, the major constants are *Festuca rubra, Ceratodon purpureus* and *Sedum acre* in a very species-rich assemblage. *Plantago coronopus, Vulpia ciliata, Arenaria serpyllifolia, Galium verum, Trifolium* ***dubium,*** *Hieracium pilosella* and *Aira praecox* are the major associates (24 species per quadrat). There is also a key bryophyte component in this assemblage with particular emphasis on *Brachythecium albicans.*

There is a well-developed scrub community found on one patch of the southern section of the site. This comprises a *Rubus fruticosus - Arrhenatherum elatius* scrub community with *Festuca rubra, Sedum acre, Cirsium arvense* and *Poa trivialis* as the major associates. Despite the high levels of cover provided by the *Rubus fruticosus,* this remains a relatively species-rich assemblage with *Echium vulgare, Senecio jacobaea, Picris echioides* and *Arenaria serpyllifolia* found occasionally.

Key

SHl19 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH68 *Festuca rubra - Plantago lanceolata - Poa pratensis* community;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH46 *Festuca rubra - Ceratodon purpureus - Sedum* spp. grassland;

SH22 *Glaucium flavum* dominated pioneer community;

SH21 *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* community;

SH9a *Crambe maritima - Solanum dulcamara* pioneer community, *Rumex cripus littoreus* sub-community.

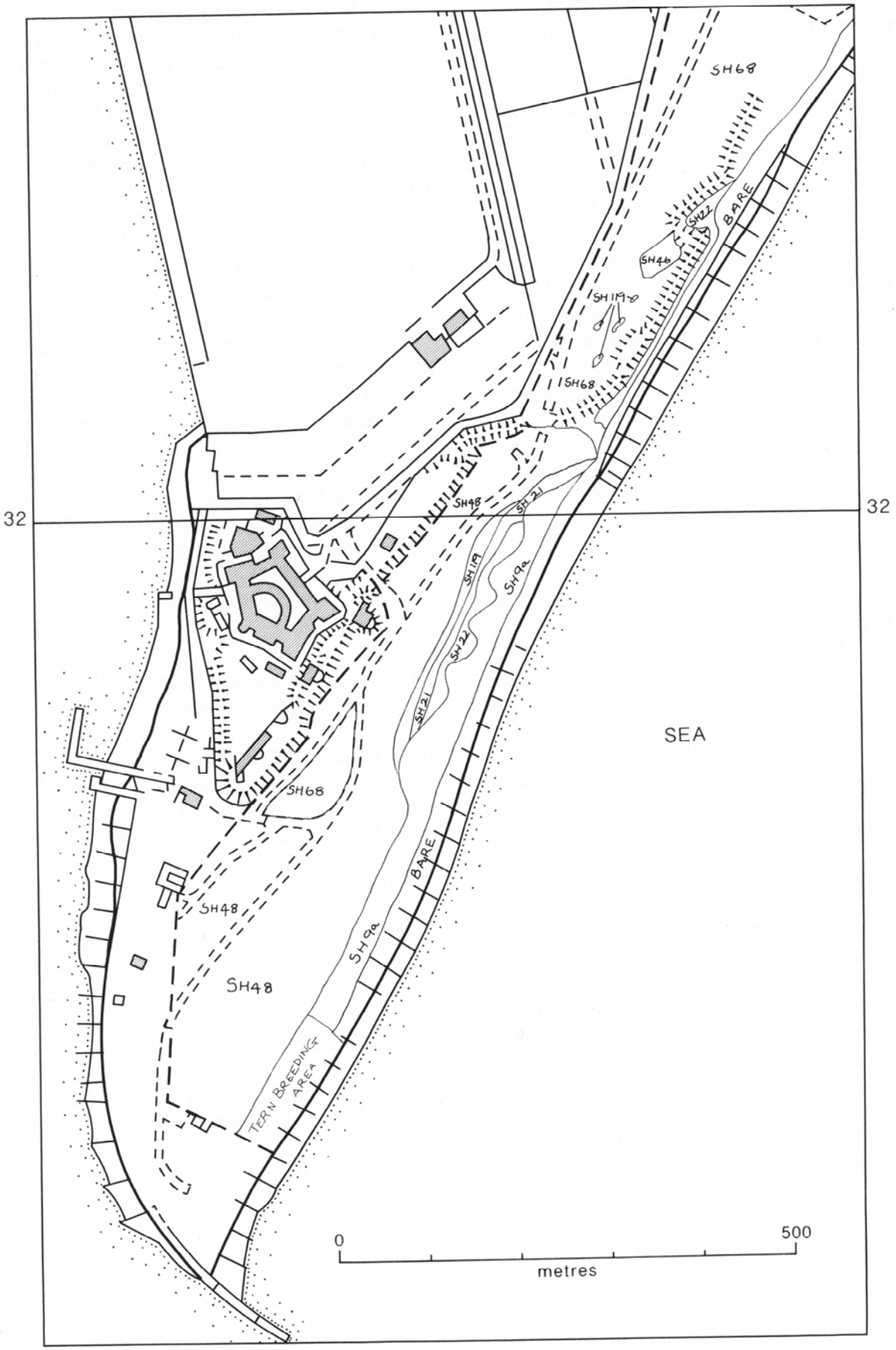

Figure 12 Landguard Common

Colne Point

Essex. TM 018123
Conservation status: part of Colne Estuary SSSI, ENT reserve
Area surveyed: 33.4 ha
Fieldwork date: 22/5/90

Introduction
Colne Point is sited at the mouth of the River Colne and consists of two spits of shingle enclosing a large area of saltings. The shingle and sand ridges are relics of an extensive region of similar geomorphology that existed until 1860 between Walton and St Osyth. Most of this area has now been developed by the seaside holiday industry. Colne Point is the best developed spit on the Essex coast and shows a sequence of parallel ridges at various stages of stabilisation. The site was a gravel workings until 1964 and had its own railway. It has been a nature reserve since 1968. The area suffers considerable wave and storm damage near the point itself; this was especially the case during the winter of 1989/90. Rabbit grazing is highly significant in places.

Threats and management
Since 1964 no gravel has been extracted from this site and there is no vehicular access. Recreational pressure on the northern boundary of the area from the Seawick naturists beach is considerable in summer and the site is quite heavily used by members of the Essex Naturalist Trust who have a residential hut on site. The Trust warden fences off Little Tern colonies and vulnerable areas of vegetation but there is little other management except recommended routes for visitors. The spits are themselves sea defences for the saltings behind.

Vegetation
There are five shingle vegetation communities on this site reflecting the variation from sandy shingle in the north through almost pure shingle to shingle with a mud matrix in low areas. In the lows and on the foreshore where fine sediment covers the shingle saltmarsh communities are present.

The sandy shingle of the old railway embankment has a distinct *Festuca rubra - Aira praecox - Plantago coronopus* community which suffers severe rabbit warren disturbance in places, and can be up to 35% bare soil. Distinctive species are *Poa angustifolia, Carduus tenuiflorus* and *Glaucium flavum.* In places the rabbit grazed sward is dominated by a *Dicranum scoparium - Festuca rubra - Plantago lanceolata* community that is rich in lichens of *Cladonia* spp. Foreshore areas of sandy shingle support a *Honckenya peploides - Elytrigia atherica - Ammophila arenaria* community with *Calystegia soldanella.* These areas are often up to 75% bare.

Less sandy, more gravelly areas of Colne Point support a *Silene vulgaris maritima - Rumex cripus littoreus - Tripleurospermum maritimum* community in which *Vulpia fasciculata* is frequently present. This community is common on the lee side of the main ridge. Gravelly areas of the railway bank support a *Beta vulgaris maritima - Solanum dulcamara - Tripleurospermum maritima* community in which shrubs of *Sambucus nigra* and *Rubus fruticosus* have developed.

Most of the lower areas of Colne Point contain variations of the *Suaeda vera* drift-line saltmarsh community, either as pure stands or, where there is overtopping by sand, with a curious mixture of more arenaceous species - *Ammophila arenaria, Eryngium maritimum, Phleum arenarium.*

Key
SH50 *Festuca rubra - Aira praecox - Plantago coronopus* grassland;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland community;

SH28 *Honckenya peploides - Elytrigia atherica –Ammophila arenaria* community;

SH25 *Silene vulgaris maritima - Rumex cripus littoreus*
– *Tripleurospermum maritimum* community;

SH17 *Beta vulgaris maritima - Solanum dulcamara - Tripleurospermum maritimum* community;

SM25 *Suaeda vera* saltmarsh.

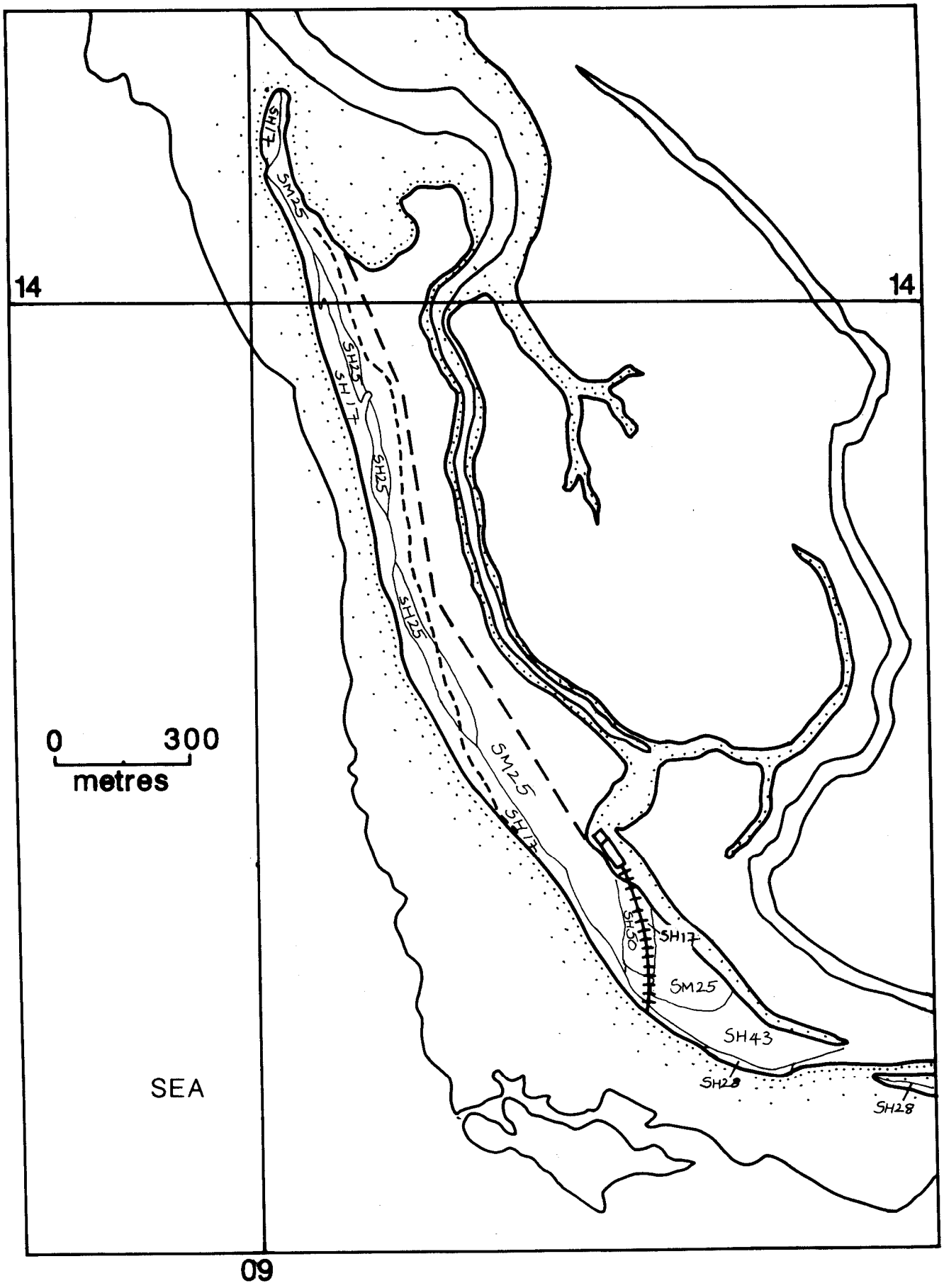

Figure 13 Colne Point

Bradwell Shell Bank (also known as Cockle Spit)

Essex. TM 035081
Conservation status: (part of) Dengie coast SSSI
Area surveyed: approx. 8 ha (20 acres) including saltings
Fieldwork date: 23/5/90

Introduction
This is a small sand and shingle spit with large admixtures of cockle shells extending from Sales Point south-eastwards to Gunners Creek, near St Peter's chapel. The spit marks the outer fringe of the Dengie saltmarsh in this area. The site supports only a narrow strip of vegetation on the crest of the spit and it recurves and shows marked evidence of severe recent erosion with much of the front ridge having been overtopped and folded over on itself during the winter of 1989/90.

Threats and management
The site is held under licence from the owners, Messrs Strutt and Parker, and managed in agreement with the Essex Birdwatching and Preservation Society, as it supports a small colony of little tern, ringed plover and oystercatcher. There is no public access to the site which serves to protect both flora and avifauna. The site can be observed from hides on the sea wall nearby. There are no human threats to the site but storms and a relative sea-level rise are reducing the site markedly at present.

Vegetation
There are two shingle communities on Bradwell Spit with saltmarsh in the lows where the substrate is dominated by cockle shells in a mud matrix.

The first community is a pioneer community dominated by *Beta vulgaris maritima* but also containing *Glaucium flavum, Tripleurospermum maritimum* and *Elymus farctus* reflecting a mixture of sand and saltmarsh influences. This area is extremely open in nature with quadrats containing up to 75% bare substrate.

To the lee of the main ridge there is an even more open grassland community with up to bare substrate but with a small cover of *Beta vulgaris maritima, Tripleurospermum maritimum* and *Elytrigia atherica* with *Festuca rubra* and *Ammophila arenaria.* Occasional herbs of this community include *Sonchus asper.*

In the lows between the shell ridges saltmarsh associations are present, characteristic of drift lines at the saltmarsh/shingle interface. The dominant species is *Suaeda vera* with *Atriplex portulacoides* constant. These occur as scattered bushes with *Elytrigia atherica, Armeria maritima* and *Limonium vulgare* scattered below. In several quadrats *Inula crithmoides* is also present, apparently where the cockle shell component of the substrate is greatest.

Key
SH24 *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community;

SH16 *Beta vulgaris maritima - Festuca rubra - Tripleurospermum maritimum* grassland;

SM26 *Inula crithmoides* saltmarsh;

SM25 *Suaeda vera* saltmarsh.

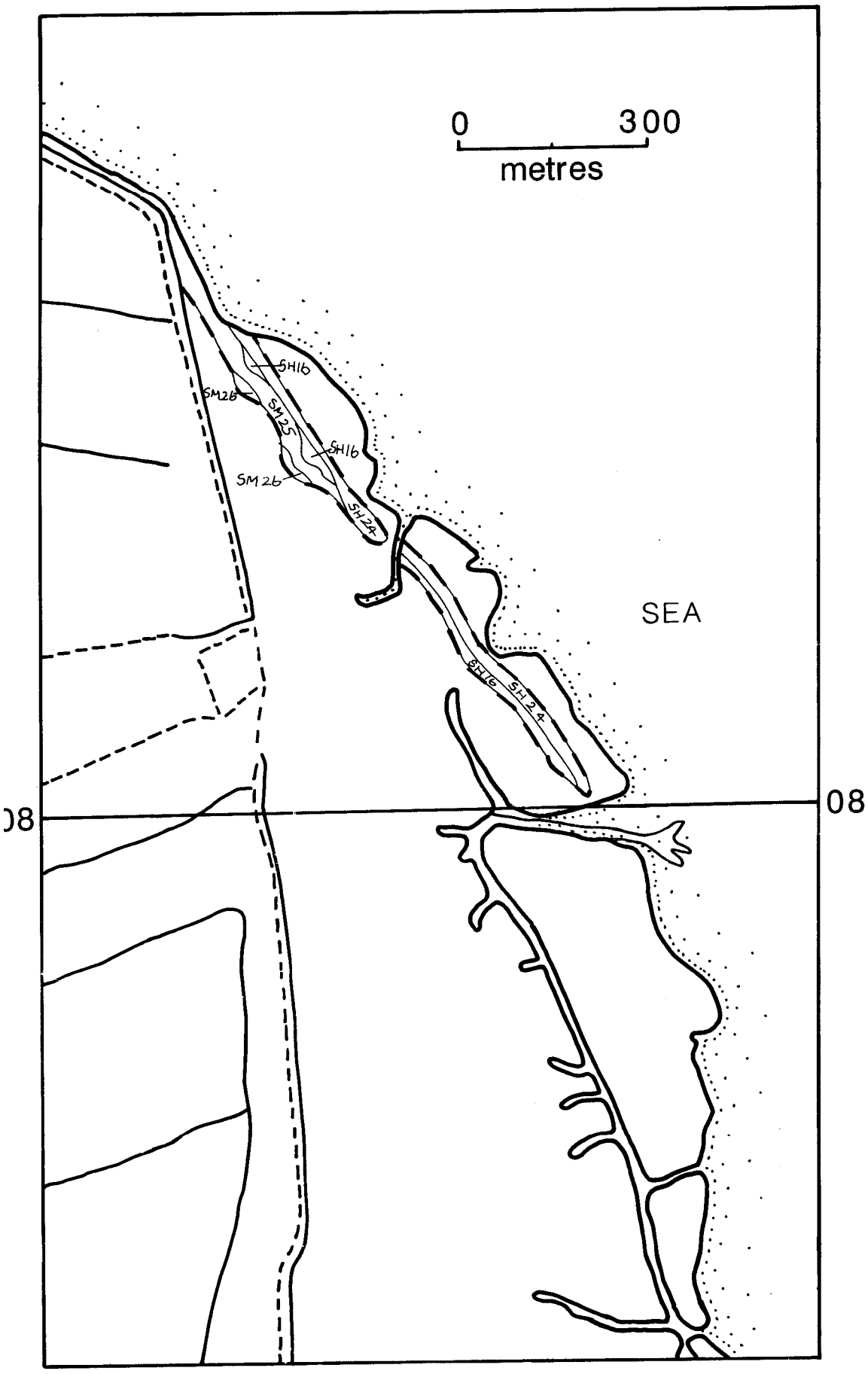

Figure 14 Bradwell Shell Bank

Shoeburyness Old Ranges

Essex. TQ 930842
Conservation status: LNR/ENT
Area surveyed: 6.5 ha
Fieldwork date: 24/5/90

Introduction
This is an area of ancient common land and rifle ranges on undulating sandy shingle ridges and lows at the point of Shoeburyness. Similar vegetation occurs on the land immediately to the east in the grounds of the coastguard station and to the west on MOD land, although limited access to these areas prevented survey work. The area is physically stable but is heavily grazed by rabbits giving local erosion. The site receives under 50 cm rainfall per annum.

Threats and management
In the past, this site was used extensively for grazing and as a rifle-range but is now enclosed as a nature reserve. Hence it has seen increasing stability in recent years. Coast defence work on the shoreward boundary keeps the site undisturbed from the sea. There is some local unauthorised entrance by persons wishing to play in the old building on the site, but little disturbance to the vegetation. The conservation strategy is to leave the area unmanaged.

Vegetation
Three communities can be recognised on the site, all of which are remarkably rich in species. These distinguish areas of deeper sand over shingle, areas where shingle is close to the surface and areas of extreme rabbit disturbance.

Most common is a *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community with between 28 and 30 species per quadrat, but with between 5% and 50% bare sand. Where this semi-fixed dune vegetation is heavily disturbed around rabbit warrens, species richness declines to 15–20 species per quadrat and a *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland occurs, rich in annuals.

The surface shingle areas are without *Carex arenaria* or *Holcus lanatus* and develop a lichen dominated *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland with between 10% and 25% bare substrate and up to 80% lichen cover. Disturbed areas have a cover of annual grasses and herbs.

This is not a particularly important shingle site because so much of the area is covered by deep sand, but it is a good example of the vegetation response to heavy grazing in a low rainfall area.

Key
SH51 *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland community.

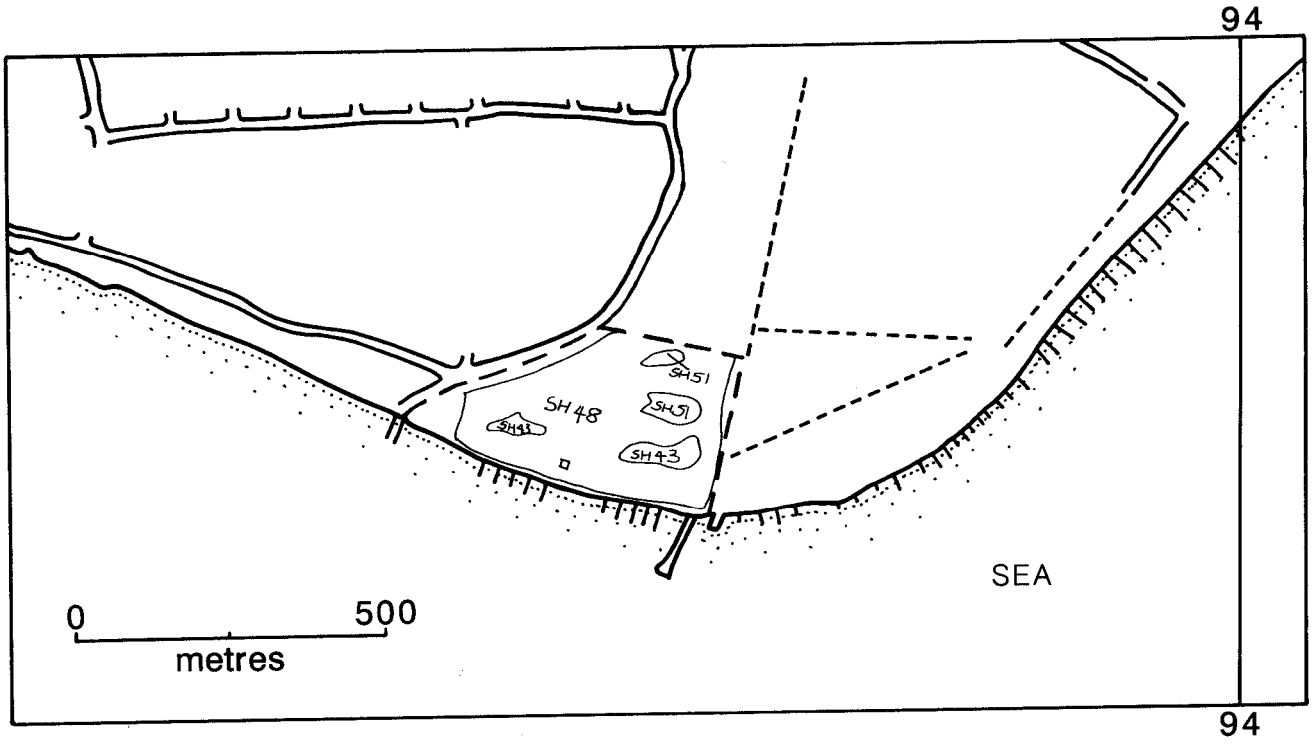

Figure 15 Shoeburyness Old Ranges

Shellness

Kent. TR 050680
Conservation status: part of Swale NNR
Area surveyed: 10.2 ha
Fieldwork date: 26/7/90

Introduction
Shellness is a shingle spit running eastwards up the Swale estuary at the southern limit of the estuarine saltmarsh. It is composed of cockle shells with some oyster shell and occasional flint in a matrix of comminuted shell fragments and fine sediment. The area is protected because of its importance as a Little Tern nesting colony and it is heavily rabbit grazed. At the eastern end the spit substrate includes moderate proportions of sand and to the north of Shellness hamlet there is a higher shell and sand `dune' ridge which is used as a naturists' beach. The lower, interior shell spreads have a higher fine sediment content and a saltmarsh flora. There is current evidence of severe overtopping during the storms of the 1989/90 winter and subsequent erosion of the foreshore.

Threats and management
The area is managed as a tern colony and nesting sites are cordoned off. A footpath extends from Shellness hamlet and sea wall to the distal point of the spit and there is evidence of considerable summer recreational pressure, but there is no vehicular access beyond the sea wall. The area is subject to considerable disturbance from winter storms.

Vegetation
Six different pioneer communities occur on the spit, each depending upon the composition of the substrate and the amount of disturbance.

An unusual community is found in the most heavily rabbit grazed areas which are up to 90% bare shell with occasional plants of *Tripleurospermum maritimum* and clumps of *Lepidium ruderale.* In more sandy locations the vegetation cover is somewhat greater, up to 50%, and *Festuca rubra, Elymus farctus, Senecio jacobaea* and *Plantago lanceolata* are present.

Away from the main warrens, open (more than 75% bare) pioneer vegetation is more typical with *Rumex cripus littoreus, Tripleurospermum maritimum* and *Atriplex* spp. as the major components. Some of these areas have a distinctive *Glaucium flavum* dominated pioneer community where it is more sandy whereas *Elytrigia atherica* dominates where the substrate is finer. On the sandy shell ridge to the north, an almost closed semi-fixed dune vegetation is present with *Festuca rubra* dominant and a rich cover of herbs including *Plantago lanceolata, Senecio jacobaea, Echium vulgare, Lactuca virosa, Silene vulgaris maritima* and *Lotus corniculatus.*

The lower shell recurves that spread into the adjoining marsh develop open *Atriplex portulacoides* saltmarsh, sometimes in pure stands, but also with *Beta vulgaris maritima, Suaeda maritima* and occasional *Salicornia europaea* or *Spergularia marina. Atriplex portulacoides - Beta vulgaris maritima* sequences are typical only of shingly saltmarsh.

Key
SH27 *Tripleurospermum maritimum - Atriplex prostrata - Rumex cripus littoreus* pioneer community;

SH24 *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community;

SH22 *Glaucium flavum* dominated pioneer community;

SH16 *Beta vulgaris maritima - Festuca rubra - Tripleurospermum maritimum* grassland;

SH12 *Raphanus maritimus - Tripleurospermum maritimum - Arrhenatherum elatius* community;

SM14 *Atriplex portulacoides* saltmarsh;

SM10 Transitional low marsh vegetation.

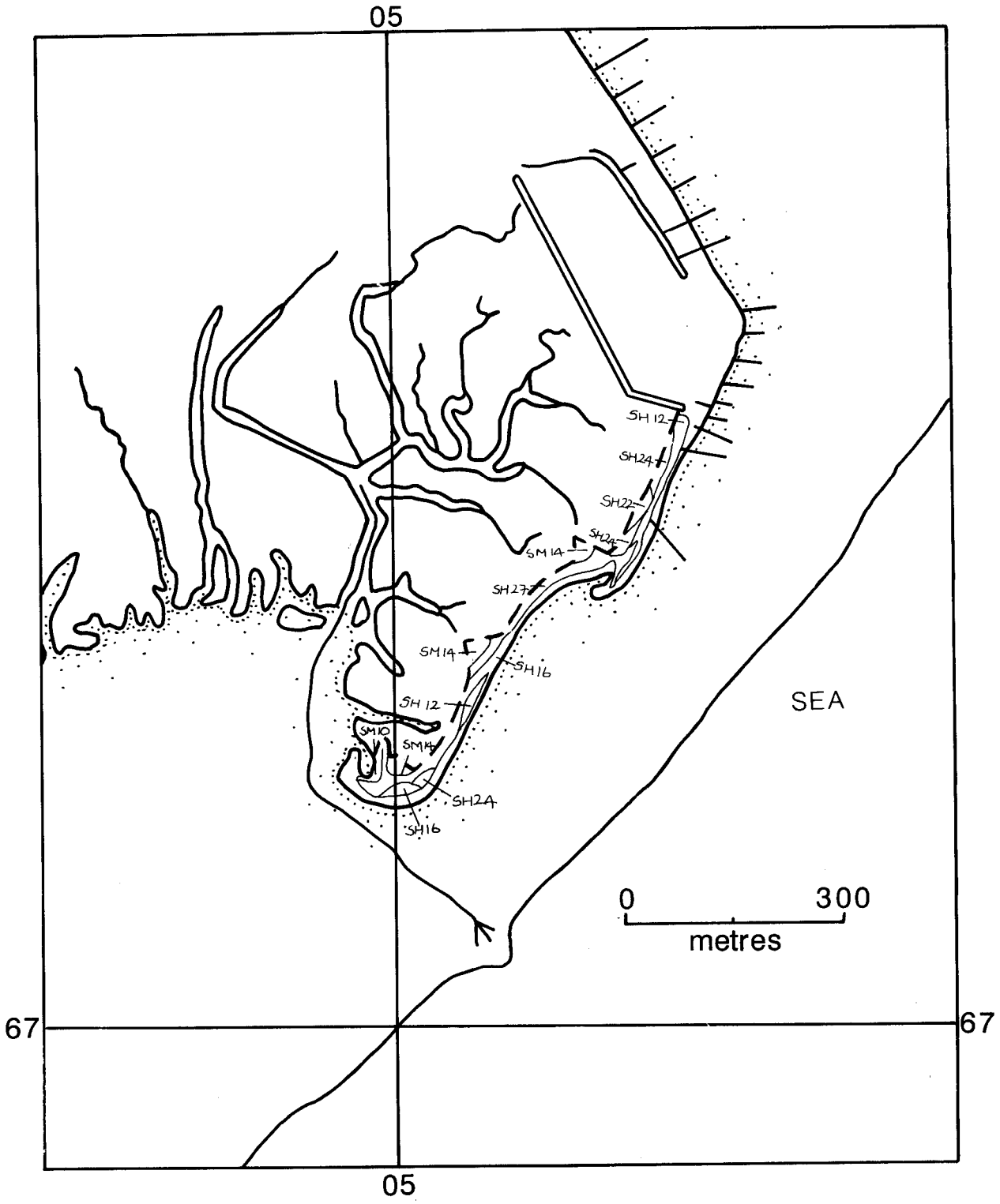

Figure 16 Sheilness

Walmer

Kent. TR 370500
No conservation status
Area surveyed: 49 ha
Fieldwork date: 27/7/90

Introduction
This site comprises a series of apposition banks to the north and south of Walmer castle. To the north the site narrows but continues in front of the built-up area of Walmer town and to the south it is disturbed and less vegetated at Kingsdown. The landward limit of the site is the coast road. The foreshore ridge is pure shingle without matrix. There are four or five banks further inland with patchy vegetation and some matrix either of coarse sand or organic debris.

Threats and management
There is a car park for this shingle structure near Walmer castle and the beach is used for local recreation, but there is no vehicular access and most visitors are attracted to the town rather than the beach. Hence this stretch of coast is relatively undisturbed. There is no evidence of recent natural disturbance but no conservation management. Some garden vegetation has established on the shingle at the Kingsdown end of the site.

Vegetation
Walmer displays a classic sequence of pure shingle succession from pioneer foreshore vegetation through open stable communities to scrub. Not surveyed, because it is probably in part planted, is an open `woodland' of *Fraxinus excelsior, Acer pseudoplatanus, Clematis vitalba, Crataegus monogyna, Betula pendula* and *Chamaenerion angustifolium* that has established by the car park only 200 metres from the shore. All tree tops are salt-trimmed.

Along the foreshore there is a pioneer community, often up to 90% bare shingle dominated by *Senecio viscosus* but with *Glaucium flavum* and *Rumex cripus littoreus* virtually constant. *Solanum dulcamara* is also frequent as is *Lathyrus japonicus.* A wide variety of other species occur occasionally including *Centranthus ruber* and *Papaver rhoeas.* In a few patches there is a distinct *Lathyrus japonicus* pioneer community seaward of the main vegetation, either growing alone or occasionally with *Crambe maritima.*

Interior ridges are dominated by open *Dicranum scoparium, Rumex acetosella* and *Aira praecox* mossy grassland, often up to 35% bare. This community too is rich in species, including the local *Galium parisiense* and occasional specimens of *Quercus ilex* and *Acer pseudoplatanus.* When the matrix is minimal the vegetation is somewhat simpler with *Arrhenatherum elatius* dominant and a small number of other grasses and ruderals at low cover. *Lathyrus japonicus* may however still be present. Conversely, where the matrix of sand and organic matter is greater a more established sward has developed containing *Festuca rubra, Hypnum cupressiforme, Lotus corniculatus, Plantago lanceolata* and many other species including *Allium vineale, Achillea millefolium* and *Phleum arenarium.* At the Kingsdown end this community is very stable with a considerable lichen cover and *Rubus fruticosus* straggling over the shingle. In some places the alien *Senecio cineraria* is common. In the lows between the most inland ridges the vegetation may often be virtually non-existent because of the lack of humus, but in places there is an extremely low cover of *Arrhenatherum elatius* with trailing *Rubus fruticosus.*

Key
SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH71 *Arrhenatherum elatius* grassland community;

SH68 *Festuca rubra - Plantago lanceolata - Poa pratensis* community;

SH66 *Festuca rubra - Plantago lanceolata - Lotus corniculatus* community;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH44 *Dicranum scoparium - Rumex acetosella - Aira praecox* community;

SH39 *Silene vulgaris maritima* - community. *Arrhenatherum elatius* moss- and lichen-rich community;

SH11 *Lathyrus japonicus* pioneer community; -

SH8 *Senecio viscosus - Glaucium flavum - Rumex cripus littoreus* pioneer

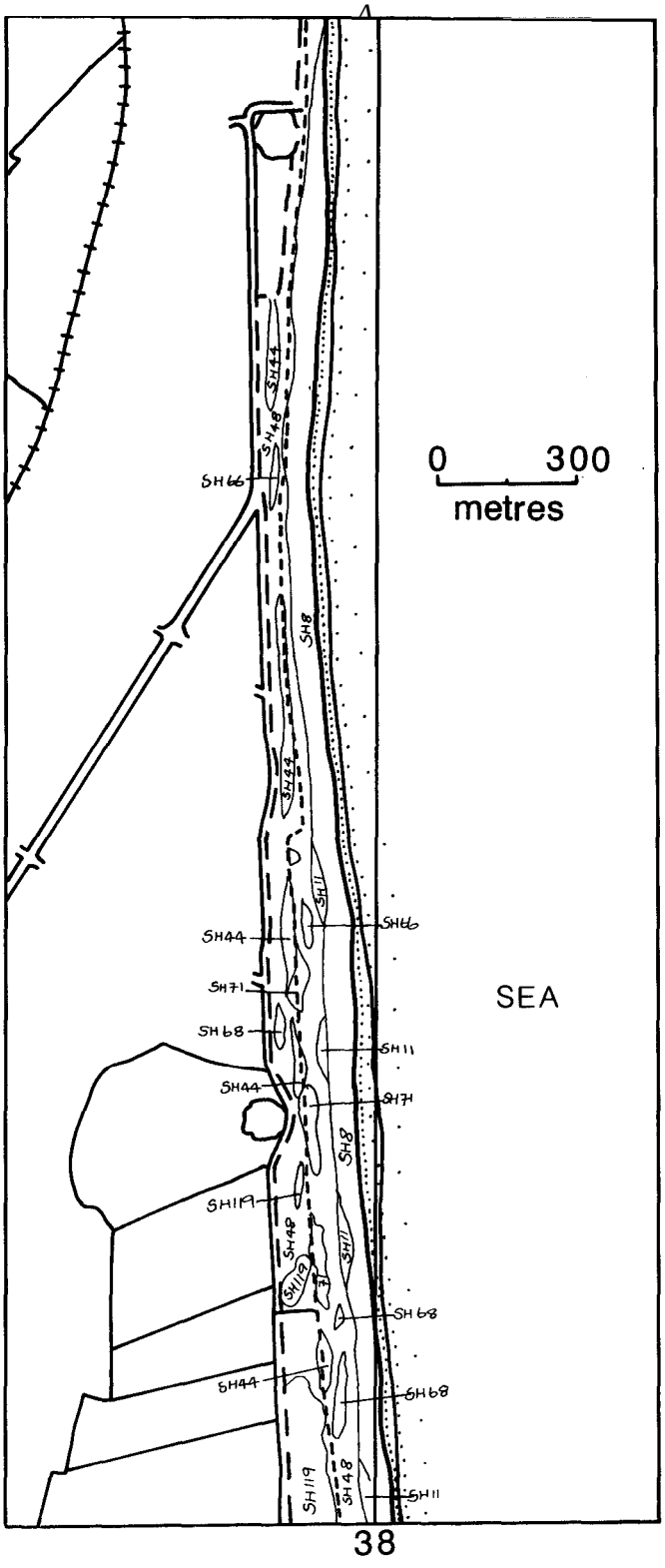

Figure 17 Walmer

Rye Harbour

East Sussex. TQ 935180
Conservation status: SSSI, LNR
Area surveyed: 721 ha
Fieldwork dates: 21/5/90–4/6/90

Introduction
This site is an example of a complex apposition beach which comprises the only extensive tract of shingle in this county. The total shingle area may be described as a triangular area of shingle delimited by the Winchelsea beach road and the road to Rye Harbour, with the shoreline forming the southern boundary.

The shingle beach is accreting southwards and the deposition of successive shingle ridges dating back to the 12th century, has led to the formation of a large fan-shaped area of shingle. This shingle is largely terrestrial in nature, with only the areas in the south being subject to continued maritime influences.

The shingle ridges are found in conjunction with intervening marshes in lower-lying areas where silts and sand have collected between ridges. The growth of the shingle/marsh sequence has been comparatively recent and has accreted across the mouth of the River Rother. Indeed, it was this process which led to the silting up of Rye Harbour.

The shingle ridges spread out in a north easterly direction, from a focal point on Winchelsea beach. The original sequence of ridges was laid down in a north–south direction, but more recent ridges were deposited in a north-east–south-west direction. Three major systems of shingle ridges have been identified at the Rye Harbour site and these have been correlated to the ridge sequences which have been identified at Dungeness in Kent. Indeed, this site is considered to form part of the Dungeness shingle complex. The beach is accreting at the eastern end but is eroding at Winchelsea beach.

Threats
This site has been subject to many forms of threat in the past and some disturbance continues.

Perhaps the most obvious disturbance has been the extraction of large amounts of shingle from the bare shingle areas at the south eastern tip of the site, immediately behind the storm crest, and in the area to the north of Nook Beach. This extraction has led to the production of a series of water-filled gravel pits which range from brackish to freshwater in quality. Excavation of the area immediately behind the storm crest in the south-east has led to a low-lying area which is subject to occasional flooding.

The shingle ridges around Camber Castle have been used in the past for a golf course which may have led to reseeding of this area.

Recreational pressure on the site is localised and damage due to such pressure is negligible. The provision of a tarmac road running along the southern edge of the site, behind the storm crest, for the use of Water Authority and reserve vehicles only, restricts the adverse effects to vegetation associated with vehicular damage and, indeed, trampling. This is an important measure as the siting of a caravan park at Rye Harbour clearly increases such pressure on the site.

There are buildings on the shingle, particularly those on the road to the Watch House. These have caused a limited loss of natural vegetation, but the amount is minimal compared that lost to other threats.

The most immediate threat to areas currently supporting natural vegetation is through vehicular damage by Water Authority vehicles used in sea defence works. These vehicles do not remain on the road and their tracks have led to moderate damage on a local scale. This is particularly important, however, given the well-developed *Lathyrus japonicus* population at this site. This species has been shown to be particularly vulnerable to trampling and vehicular damage.

There is an additional threat posed by the actual sea defences which take the form of groynes both on and adjacent to the site, reworked shingle, the building of a sea wall

and constant beach feeding. Many of these operations are potentially damaging to natural vegetation on this site.

Another threat is associated with the agricultural practices on parts of the site. These have taken the form of ploughing and planting of fields where shingle is clearly visible in the ploughed soil. This action not only destroys the structure of the shingle feature, and the natural vegetation, but also introduces alien species such as oil-seed rape into the seed bank.

Cattle grazing on the site is largely restricted to marshy areas, while the evidence of rabbit grazing may be seen across most of the site.

Management
Much of Rye Harbour has been designated a local nature reserve which is actively wardened. Clearly, this helps to protect the site from undue damage. The provision of an information centre in the car park at Rye Harbour encourages people to observe the marked footpaths within the reserve area.

In addition, large areas of the bare shingle are fenced off during the breeding season to protect breeding terns from disturbance. An electric fence runs round these areas and prevents access, thus protecting the vegetation. There will clearly be some effect on the vegetation from the guano supplied by birds.

Unfortunately, the conflicting interests in conservation have been illustrated at this site in the past with the ploughing of areas of vegetated shingle to clear the vegetation in order to encourage terns to nest. Given the rarity of vegetated shingle as a habitat, it is hoped that such a practice will not be repeated.

Vegetation
The active shingle foreshore is very steep and does not support any vegetation. The storm ridge and the coastal plain behind this are only sparsely vegetated, supporting very open communities. In more stable areas at Rye Harbour there has been some development of scrub communities and grasslands, particularly around the Camber Castle area.

Fen vegetation is associated with the wetland areas on the site, but the plants are rooted in silt deposits and so will not be discussed as part of this study.

The area of shingle immediately behind the storm crest is largely bare but supports patches of vegetation, often associated with fine material within the shingle substrate, caused by previous disturbance. These patches support several *Festuca rubra* dominated grassland communities.

The first of these comprises a *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* species-rich grassland (on average 22 species per quadrat). The diverse species composition of this community is testament to the stability of these areas. Indeed, there is a well-developed lichen flora within this assemblage, with *Cladonia crispata, C. cervicornis* and C. *rangiformis* as frequent associates. Major herb. associates include *Achillea millefolium, Hieracium pilosella* and *Sedum acre* while *Bromus hordeaceus, Dactylis glomerata, Aira praecox* and *Poa pratensis* are additional Gramineae species. An occasional associate in this community is *Lathyrus japonicus.* In some patches the *Festuca rubra* is replaced by *Vulpia bromoides* and the lichen *Cladonia furcata* becomes a more important component.

There is a similar grassland community found in a few places in this area. In this case the assemblage keys out to a *Festuca rubra - Ceratodon purpureus - Sedum acre* grassland. This is also a species-rich assemblage with *Arenaria serpyllifolia, Erodium cicutarium, Plantago lanceolata, Crepis vesicaria* and *Lotus corniculatus* as major herb associates. *Bromus hordeaceus, Desmazeria marina* and *Dactylis glomerata* are the Gramineae associates while *Brachythecium albicans* and *Hypnum cupressiforme* comprise the bryophyte component.

A large area of the southern part of the site, supports an open pioneer vegetation which is defined by the constant presence of *Crambe maritima* and *Solanum dulcamara.* This is a species-poor community with, on average, three species per quadrat. The most common associates include *Rumex cripus littoreus, Senecio viscosus* and *Lathyrus japonicus.* However, cover remains small and each quadrat contains

at least 95% bare shingle. This assemblage is found behind the storm crest along much of the shoreline and it is within this community that the patches of stable *Festuca rubra* communities are found. The *Crambe maritima - Solanum dulcamara* community is also found within the area which is fenced off to protect the terns.

In places on the foreshore, the *Crambe maritima - Solanum dulcamara* community is replaced by a *Solanum dulcamara - Arrhenatherum elatius* community where the *Crambe maritima* is a less important component. The minor constants in this assemblage are *Cochlearia danica* and *Rumex cripus littoreus,* while *Lathyrus japonicus* is an occasional associate.

Sampling within the tern breeding area had to take the form of quick visual inspection of communities during a walk across the site. No quadrats were thrown in this area as it was thought that this would cause too much disturbance to the birds. The major communities within this area include the *Festuca rubra - Ceratodon purpureus - Sedum* spp. grassland and the *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community which is rich in lichens. Indeed, the heightened stability of this area is reflected in the more important role of *Cladonia* spp. lichens in this area, in particular *C. rang iformis.*

The other major community within this area is an open *Geranium robertianum - Arrhenatherum elatius* grassland with occasional herb associates such as *Echium vulgare, Hieracium pilosella* or *Senecio jacobaea.* There is no moss or lichen in this community. It may be that this area has been disturbed in the past.

The area which had been flooded during previous winter storms was occupied by a dead *Festuca rubra* grassland with *Cochlearia danica, Ceratodon purpureus* and *Sedum acre.*

Immediately behind this low-lying area there is a field of oilseed rape, but on the northern boundary of this field, separating it from another cultivated field, there is a thin strip of shingle which, while no doubt subject to some disturbance, supports communities typical of shingle substrates. Part of it supports the *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* grassland and the *Festuca rubra - Ceratodon purpureus - Sedum* spp. assemblage described earlier. However, there is also an *Arrhenatherum elatius* grassland sampled in this area. The majority of the cover in this assemblage is provided by *Arrhenatherum elatius* (Domin score 9) but there is a high herb content. *Geranium molle, Senecio jacobaea, Sonchus asper, Plantago lanceolata* and *Vicia lathyroides* comprise the major associates. There is also a limited development of a bryophyte flora with particular emphasis on *Hypnum cupressiforme.*

A more open version of this grassland is found at the western end of the strip of shingle, the area which is subject to most disturbance. In this case there are few associates in the open *Arrhenatherum elatius* dominated grassland. Each quadrat contains at least 50% bare shingle. *Vicia sativa* and *Solanum dulcamara* are the major associates although neither has a particularly high Domin score (3 maximum).

At the far western end of the fenced off tern area there is a small depression in the shingle, no doubt reflecting an area of past extraction. This area is clearly subject to regular flooding; indeed, there was a small pool of open water in the depression during fieldwork. The major community found in this area comprises a *Festuca rubra* dominated grassland with *Plantago lanceolata, Rumex acetosa* and *Senecio jacobaea* as major associates. Much of the *Festuca rubra* sward was dead at the time of sampling. This community keys out to SH70 although *Silene vulgaris maritima* and *Lotus corniculatus,* the additional indicator species, are only found occasionally.

The area of shingle which remains relatively undisturbed on Nook beach supports several scrub communities. Much of the area supports *a Rubus fruticosus - Arrhenatherum elatius* scrub community. The *Rubus fruticosus is* the dominant component within the assemblage, which is generally species-poor. Additional scrub elements in the community include *Sambucus nigra, Crataegus monogyna* and *Prunus spinosa,* each of which become locally

dominant. *Urtica dioica, Lonicera periclymenum* and *Cirsium arvense* comprise the key herb associates. The scrub is well-developed in this area growing to a height of 2 metres on average.

In certain areas, where *Prunus spinosa* becomes a particularly important component such that it is found with none of the other scrub elements, it falls into a different shingle category. In this case *Prunus spinosa* out-competes other species and the additional, if minor, constant is *Eurhynchium praelongum*, the shade-tolerant moss. Occasional associates include *Agrostis capillaris, Vicia sativa* and *Cirsium arvense.*

The scrub communities are found in several patches on this part of the site. The areas between them are occupied by grassland communities. The most widespread of these, found on lower lying areas at the rear of this section of the site, is an *Arrhenatherum elatius* grassland. Additional Gramineae constants, although minor in terms of cover, are *Agrostis stolonifera* and *Festuca rubra,* while herbs form the major associates, in particular *Geranium molle, Rumex acetosa, Echium vulgare, Cirsium vulgare* and *Vicia sativa.* This community has suffered much grazing by rabbits.

Another grassland, which was found on the drier shingle areas, is the *Festuca rubra - Ceratodon purpureus - Sedum* spp. community identified earlier. In this case, however, the relative importance of the *Festuca rubra* is slightly reduced and the herbs become more important components. *Geranium molle, Echium vulgare, Sagina nodosa, Rumex acetosella* and *Hieracium pilosella* are the main herbs. Additional associates include *Hypnum cupressiforme* and *Peltigera canina* which provides much cover (Domin score 5).

Another area of shingle which has semi-natural or natural vegetation is found behind the caravan park. This area has clearly been excavated in the past, but is otherwise relatively undisturbed. The depression contains standing water and supports a *Salix cinerea - Phragmites australis* wet woodland and fen community. This area also supports the major scrub community which is defined as a *Rubus fruticosus - Arrhenatherum elatius* community described in detail earlier. Once again, *Urtica dioica* and *Senecio jacobaea* form the main associates. This community is seen across all of this site but is well-represented in this area. There is also a small patch of *Ulex europaeus - Rubus fruticosus* scrub with *Solanum dulcamara, Carduus tenuiflorus* and *Echium vulgare* as key associates. This is not a closed community, with around 40% bare shingle in each quadrat.

The final section of the Rye Harbour site is the old beach which is found around Camber Castle. Most of this area supports a *Vulpia bromoides - Bromus hordeaceus - Hypochoeris radicata - Festuca rubra* grassland. *Brachythecium albicans, Erodium cicutarium* and *Hypnum cupressiforme* comprise the minor constants. Additional herb associates include *Rumex acetosella, Medicago lupulina* and *Plantago lanceolata.*

A separate community is found in the lows between the shingle ridges. This assemblage is characterised by the constant presence of *Festuca rubra - Dactylis glomerata - Lolium perenne - Bromus hordeaceus* in a closed grassland. The key herb associates include *Vicia sativa, Geranium molle, Trifolium pratense* and *Galium verum.*

Along the southern border of this area around the gravel pits, there is a scrub community defined as a *Ulex europaeus - Rubus fruticosus - Agrostis stolonifera* assemblage with *Hypnum cupressiforme* and *Eurhynchium praelongum* as major associates.

Key

SH122 *Prunus spinosa - Eurhynchium praelongum* community;

SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH109 *Ulex europaeus - Rubus fruticosus - Agrostis capillaris* scrub community;

SH71 *Arrhenatherum elatius* grassland community;

SH70 *Festuca rubra - Silene vulgaris maritima - Lotus corniculatus* community;

SH67 *Festuca rubra - Dactylis glomerata - Lolium perenne - Bromus hordeaceus* community;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH46 *Festuca rubra - Ceratodon purpureus - Sedum* spp. grassland;

SH45 *Vulpia bromoides - Bromus hordeaceus - Hypochoeris radicata* grassland community;

SH37 *Arrhenatherum elatius - Silene vulgaris maritima* grassland;

SH10 *Solanum dulcamara - Arrhenatherum elatius* community;

SH9 *Crambe maritima - Solanum dulcamara* pioneer community;

SH2a *Geranium robertianum - Arrhenatherum elatius* open grassland.

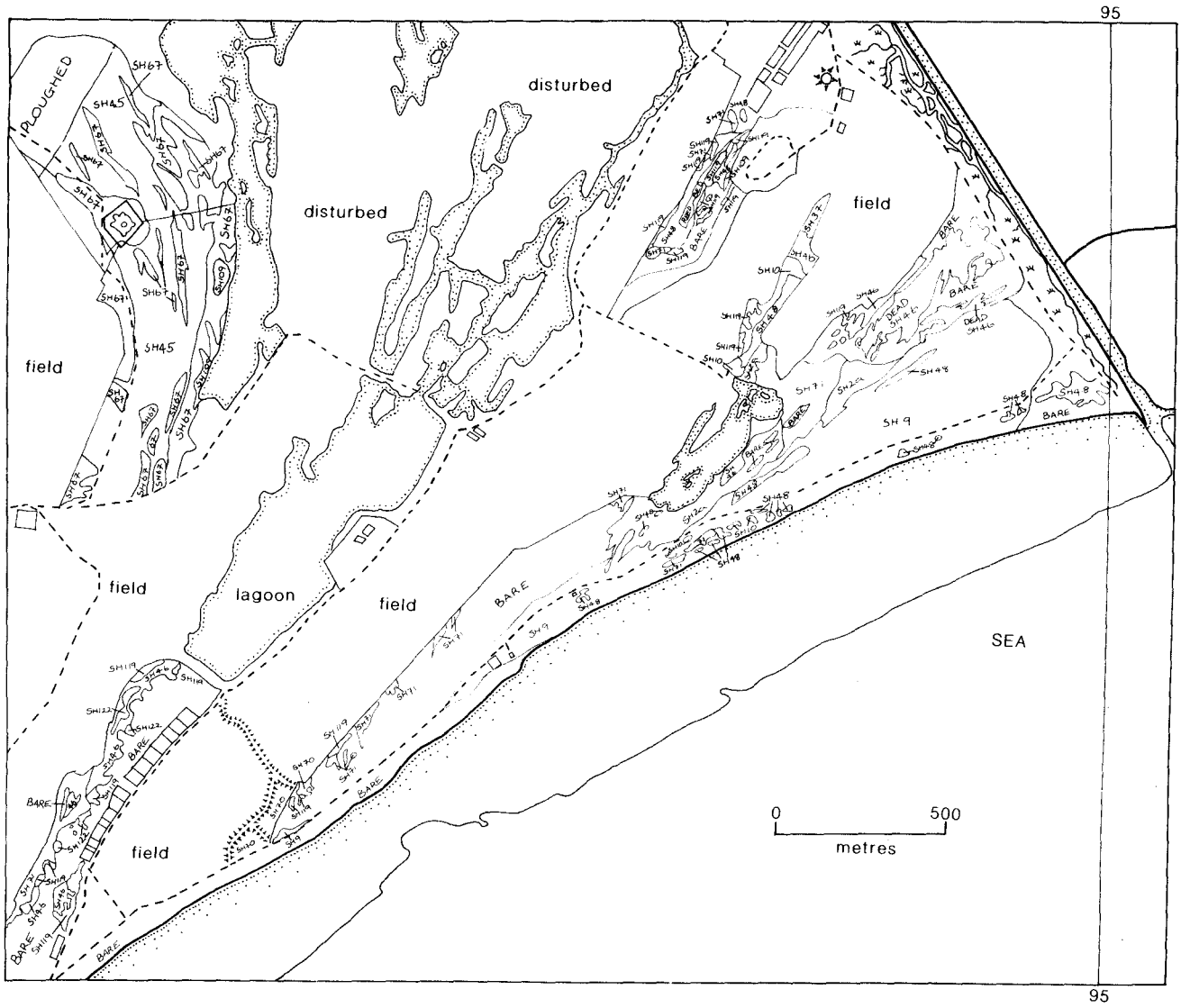

Figure 18 Rye Harbour

Pagham and Church Norton Spits

West Sussex. SZ 880950
Conservation status: LNR, SSSI
Area surveyed: 42.4 ha
Fieldwork dates: 2–3/8/90

Introduction
Pagham and Church Norton Spits are in effect a breached barrier bar across the entrance to Pagham Harbour. The position of the gap, formed initially by storm surge action under the influence of dominant waves from the south or south-east has varied considerably under the combined effects of longshore drift and tidal scour (Rayner 1981), but has been stabilised by a man-made cut since the 1960s. Church Norton Spit is composed of flint shingle with a fine shingle matrix and merges inland to saltmarsh with some recurves into the marsh. South-westwards it becomes an extension of Selsey Bill foreshore shingle but with multiple apposition ridges. Pagham Spit comprises multiple ridges of flint shingle with little matrix. There is little evidence of current erosion but sea defence works have disturbed the shingle between Little Lagoon and the harbour.

Threats
Recreational pressure is limited on Church Norton Spit because it is not easy of access - the nearest car park being small and at Church Norton. There are no other threats to the site except visitors who walk from Church Norton or Selsey. Pagham Spit, however, has been extensively built over at its north-eastern end and is also the site of a large car park which has disturbed the vegetation. The area receives many tourists especially in summer and has also been considerably disturbed near the breach for sea defence works.

Management
Pagham Harbour is owned by Southern Water who manage the drainage channels which control some 5,000 ha of agricultural land. The breach at the harbour mouth is therefore currently stabilised by a series of groynes. Since 1972 the County Council have managed the area as a nature reserve and Church Norton Spit is fenced for nesting in spring and summer. Since 1978 an information centre has been provided at Sidlesham Ferry.

Vegetation
The vegetation of Pagham Harbour spits is of three basic types – that of the main shingle ridges, the scrub communities to the lee of the main ridges abutting freshwater and the communities on shingle with a silt matrix abutting the saltmarsh.

Much of the foreshore vegetation of both spits is composed of a *Senecio viscosus - Glaucium flavum - Rumex cripus littoreus* pioneer community often with *Solanum dulcamara* and *Arrhenatherum elatius* or other pioneers. This may be up to 90% bare, but often has six or seven species per quadrat. On parts of Church Norton Spit this merges into *Arrhenatherum elatius - Silene vulgaris maritima* grassland with *Rumex cripus littoreus* and *Rubus fruticosus.* Towards Selsey there is a linear pioneer stand of open *Crambe maritima - Solanum dulcamara* on the front ridge where the matrix is more sandy. *Glaucium flavum* dominated pioneer communities occur in lines on both the foreshore and further back on ridges where tidal debris has been deposited in the past. Occasionally there are quite `dune-like' patches with *Cerastium fontanum, Desmazeria marina* and *Cirsium vulgare.*

Around the Little Lagoon on Pagham Spit a grassland community has developed with hints of saline influence. Much of this is a *Festuca rubra - Aira praecox - Plantago coronopus* open sward rich in herbs and mosses but down the lagoon slopes this becomes more affected by salt and species such as *Atriplex portulacoides, Beta vulgaris maritima* and *Suaeda maritima* join the flora. At the base of the slope adjacent to the water's edge there are distinct saltmarsh zones of *Atriplex laciniata, Suaeda maritima* and *Atriplex portulacoides.* The area of the spit to the lee of the lagoon has a distinct organic matrix and has developed a *Ulex europaeus* scrub cover. Lower areas have a ground cover of *Silene vulgaris maritima* and

Suaeda maritima but the higher areas are *Ulex europaeus - Rubus fruticosus* scrub with *Solanum dulcamara* undergrowth. Away from saline influence this becomes a *Hedera helix - Rubus fruticosus - Arrhenatherum elatius* community but with some *Ulex europaeus* and *Rosa canina* present.

On Church Norton Spit the lee side vegetation on shingle spreads at the head of the saltmarsh is more straightforward *Suaeda maritima - Salicornia europaea* marsh, but further south-westwards beyond the sea wall near the freshwater marsh *Ulex europaeus - Arrhenatherum elatius - Rubus fruticosus* scrub develops into an open lichen-rich damp scrub with *Hedera helix, Quercus robur, Cytisus scoparius* and *Phragmites australis* or the more traditional *Prunus spinosa* dominated scrub with *Quercus robur* and *Hedera helix.*

Key

SH124 *Prunus spinosa* dominated scrub with *Hedera helix - Rubus fruticosus;*

SH114 *Hedera helix - Rubus fruticosus – Arrhenatherum elatius* community;

SH112 *Pteridium aquilinum – Arrhenatherum elatius - Rubus fruticosus* community;

SH108a *Ulex europaeus - Rubus fruticosus* scrub community, *Solanum dulcamara* sub-community;

SH106 *Ulex europaeus - Arrhenatherum elatius - Rubus fruticosus* scrub community;

SH51 *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland;

SH50 *Festuca rubra - Aira praecox - Plantago coronopus* grassland;

SH25 *Silene vulgaris maritima - Rumex cripus littoreus - Tripleurospermum maritimum* community;

SH22 *Glaucium flavum* dominated pioneer community;

SH21 *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* community;

SH9 *Crambe maritima - Solanum dulcamara* pioneer community;

SH8 *Senecio viscosus - Glaucium flavum - Rumex cripus littoreus* pioneer community;

SH1 *Arrhenatherum elatius - Silene vulgaris maritima - Rumex cripus littoreus* pioneer grassland;

SM9 Suaeda maritime saltmarsh.

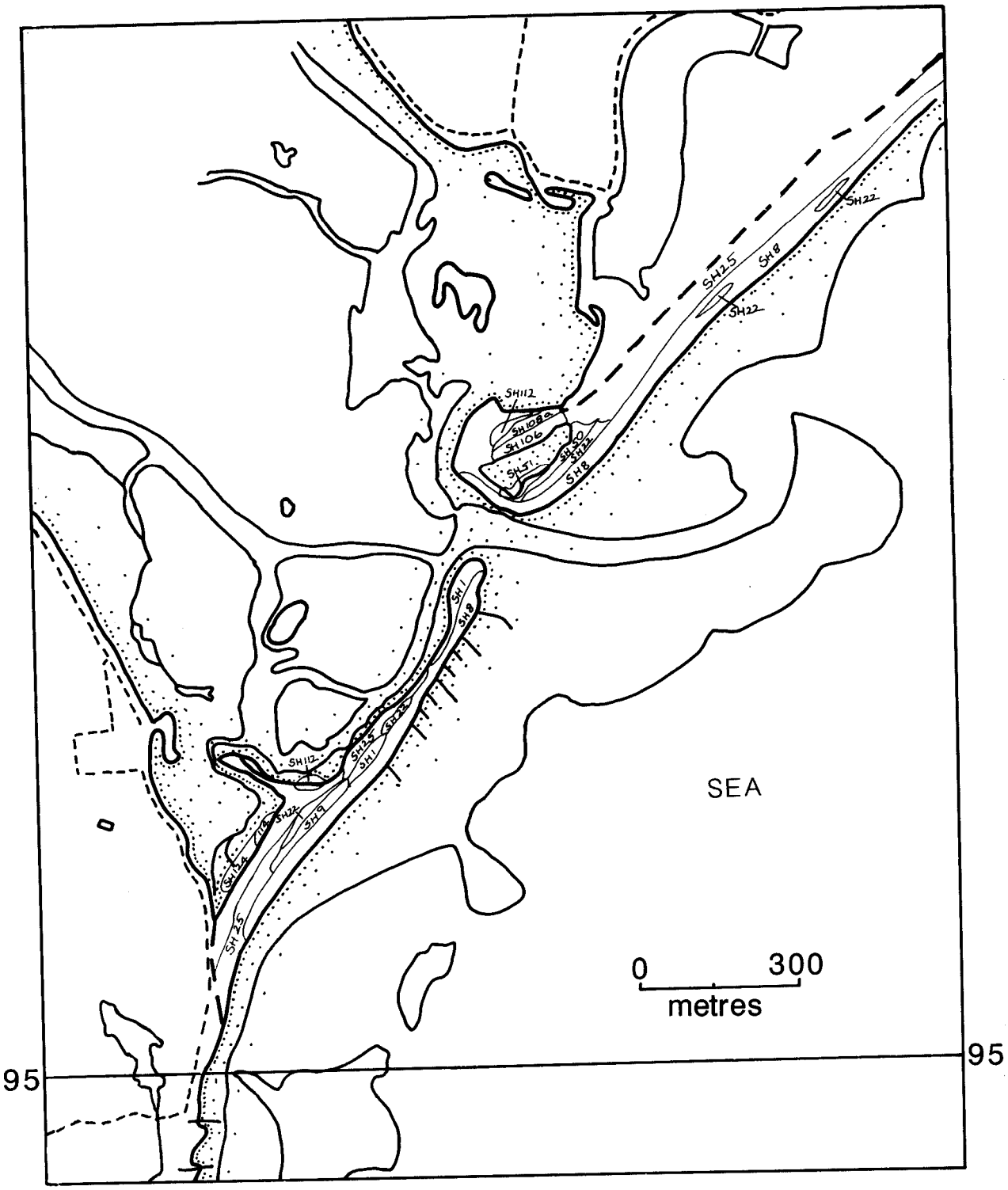

Figure 19 Pagham and Church Norton Spits

East Head, West Wittering

West Sussex. SZ 770980
Conservation status: National Trust
Area surveyed: 14.1 ha
Fieldwork date: 2/8/90

Introduction
East Head is a sandy shingle spit projecting into Chichester Harbour in part overlain by sand dunes and backed by saltmarsh. Only the foreshore area has significant shingle vegetation. The area is protected from natural disturbance within Chichester harbour.

Threats and management
This site is an extremely popular tourist venue in summer and suffers considerable erosion thereby. The National Trust protect bird nesting sites by roping them off and are also involved in restoration projects on the dunes. There is significant rabbit grazing at the southern end near the access.

Vegetation
Lower areas of the western backshore contain a slightly saline open pioneer community with *Beta vulgaris maritima* and *Rumex cripus littoreus* with *Spergularia marina* and *Juncus gerardii.* Where this is more sandy *Salsola kali* and *Elymus farctus* replace the marsh species. At higher elevations a more classic sandy shingle pioneer community has developed with *Rumex cripus littoreus, Tripleurospermum maritimum* and *Glaucium flavum* constant and *Crithmum maritimum, Eryngium maritimum, Honckenya peploides* and *Euphorbia paralias* common. Even here the community is very open with up to 80% bare shingle. With deeper sand this merges into a *Honckenya peploides, Ammophila arenaria* community with *Calystegia soldanella, Euphorbia paralias* and dune ruderals. In contrast, erosion of the dunes has resulted in low sandy spreads of shingle on the eastern side of the spit with *Limonium vulgare, Armeria maritima, Spergularia marina* and *Spartina anglica* - in fact a dry saltmarsh. Where shingle and sand comprise the marsh substrate there is a curious mixture of *Atriplex portulacoides* with *Beta vulgaris maritima, Elytrigia atherica* and *Honckenya peploides,* again a saltmarsh community.

Key
SH28 *Honckenya peploides - Elytrigia atherica - Ammophila arenaria* community;

SH24 *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community;

SH16 *Beta vulgaris maritima - Festuca rubra - Tripleurospermum maritimum* grassland;

SH15 *Beta vulgaris maritima - Rumex cripus littoreus* pioneer community.

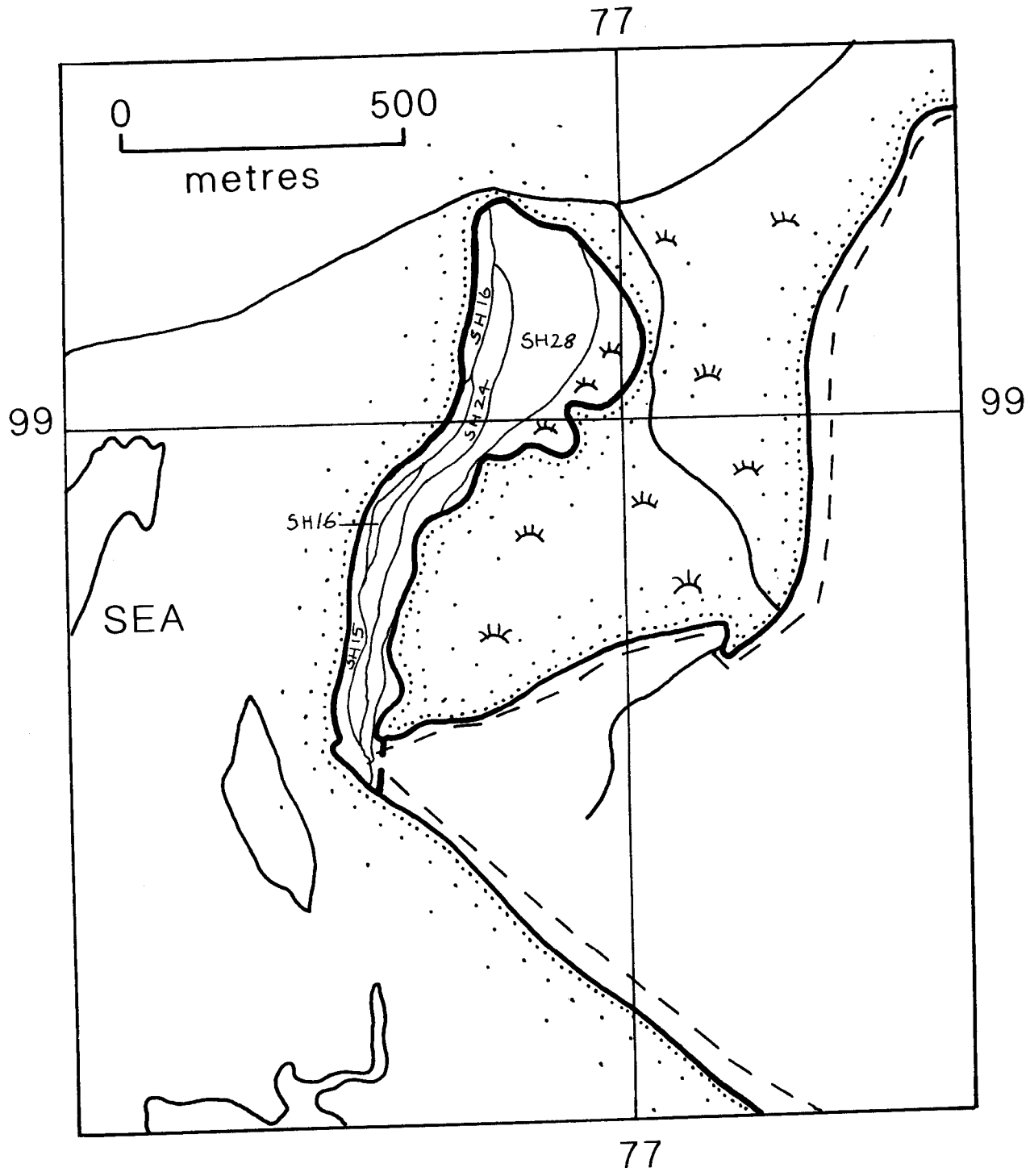

Figure 20 East Head

Browndown

Hampshire. SZ580990
Conservation status: SSSI
Area surveyed: 64.3 ha
Fieldwork dates: 4—8/6/90

Introduction
Browndown comprises a shingle apposition beach consisting of a series of shingle ridges deposited against the small gravel cliff face of a raised beach behind. The old cliff line provides a convenient rear boundary to the site. This is a permeable Pleistocene plateau. The shingle ridge structure is not clearly visible at ground level, due to the only minor differences in relief. However it is more obvious on aerial photographs of the site. Those ridges which have been undisturbed retain a clear grading of pebbles.

Threats
The main threat to this site at present is its continued use as a site for military training associated with the Browndown Training Camp. The positioning of the rifle ranges on this site has in the past required the clearance of natural vegetation, to maintain clear sight-lines to targets. In addition, there has been major structural disturbance of shingle near the shore in order to build large bluffs.
The areas excavated to provide this source material are now depressions which support saltmarsh vegetation associated with poorer drainage. Shooting on the site ceased in 1977 so clearance of sight-lines is no longer necessary, although the affects of past clearance can still be seen in the vegetation.

The building of tracks in the past across much of the site has clearly affected the natural vegetation.

Disturbance at this site also takes the form of tyre tracks from military vehicles which are seen across the shingle. The tracks have led to severe damage to the ridge structure and vegetation in certain areas. There has been some loss of vegetated shingle to buildings for military purposes on the site, in particular to Browndown Battery.

The restricted access associated with a military site clearly has advantages in terms of protection of flora from trampling and other forms of damage associated with recreational pressure. However, since the cease-fire in 1977, public access to the site has become easy and the site is widely used for recreational purposes. Any damage associated with these activities is, however, localised and negligible in extent.

Management
The site is managed by the MOD in conjunction with the Brownddwn Conservation Group and this has resulted in a more careful policy adopted by the military towards the site with efforts made to avoid areas of ecological sensitivity, e.g. those containing *Geranium purpureum*. The Browndown Conservation Group has been responsible for hand-clearing scrub invasion on parts of the site.

There is arable farming on the raised gravel next to the B3333 road, but there has been no agricultural improvement to the beach. It is, however, widely grazed by rabbits.

Browndown is subject to erosion, particularly at the western extreme, and this has necessitated the positioning of groynes and concrete blocks on the foreshore. Indeed, the vulnerability of the site to flooding poses a major threat to the vegetation. In spring 1990 floods breached sea defences at the western end of the site. This caused a saline inundation of well-established lowland heath communities and the effects were clearly visible over much of the western half of the site. This is clearly a major problem given the possibility of rises in general sea levels in the future.

Vegetation
Despite the disturbance of this site it provides examples of several interesting communities, in particular lowland heath, a nationally rare assemblage. In addition, there are grassy heath communities, scrub communities and a woodland assemblage.

At the eastern end of the site, on the cleared shingle around the radar masts, and in the

cleared area immediately in front of the training camp, there is a rather open community which is pioneer in nature (each quadrat contains 95% bare shingle). It is characterised by the constant presence of *Rumex cripus littoreus, Tripleurospermum maritimum* and *Glaucium flavum,* pioneer species typical of many shingle sites. This community would normally be associated with more maritime environments, however in this case disturbance of the site has led to a reversion to a secondary pioneer community. This is seen in the relatively high number of associates found in this assemblage. The main associates include the grasses *Arrhenatherum elatius* and *Bromus hordeaceus* while the occasional herb associates include *Silene vulgaris maritima, Silene nutans, Teucrium scorodonia* and *Cerastium diffusum.*

On inland areas this develops into an unusual grassland community dominated by *Vulpia bromoides* and *Festuca rubra* with herbs such as *Chaemaenerion angustifolium, Aira praecox, Taraxacum* agg., *Hieracium pilosella* and *Teucrium scorodonia.* This does not correspond to any of the shingle communities and is marked as T1.

A small area on a shingle ridge in the eastern section of the site supports a *Festuca rubra - Ceratodon purpureus* community which is rich in herbs. This species-rich community contains, on average, twenty species per quadrat, reflecting the higher fine content within the shingle matrix in this area. *Ononis repens, Echium vulgare, Hieracium pilosella, Lotus corniculatus, Plantago lanceolata* and *Potentilla reptans* comprise the major herb associates in this assemblage. The presence of arenicolous species such as *Carex arenaria* and *Brachythecium albicans* illustrates the presence of sand fractions within the matrix.

The low-lying area of shingle, also at the eastern end of the site, is occupied by an unusual community which is characterised by the constant and major presence of the moss *Hypnum cupressiforme,* along with the herbs *Potentilla reptans* and *Plantago coronopus. Agrostis stolonifera* is a minor component in this community, while *Tripleurospermum maritimum, Aira praecox* and *Plantago lanceolata* are occasional associates within the assemblage. This area is subject to flooding. The assemblage is unique to this site and is not easily allocated within the shingle classification. It keys out to SH48 but it does not contain any *Festuca rubra.*

Another *Festuca rubra* community is seen in patches across the site, but is commonly sampled at the western end of the site. This assemblage comprises a *Dicranum scoparium - Festuca rubra - Plantago lanceolata* herb-rich grassland. The stability of the areas supporting this community is illustrated in the major bryophyte and lichen flora, with particular emphasis on *Cladonia furcata, C. cervicornis* and *Ceratodon purpureus. Sedum anglicum, Aira praecox, Teucrium scorodonia, Hieracium pilosella* and *Cerastium diffusum* comprise the key associates in this assemblage. This is the area which was flooded in spring 1990 and, as a result, it was not possible to determine which *Agrostis* species was found in association. Past records suggest that it is *A. curtisii* or A. *capillaris.* The recent maritime incursion in this area is illustrated by the presence of maritime herbs such as *Silene vulgaris maritima* and *Rumex cripus littoreus* within this mature community.

The depressions found adjacent to the bluffs support clearly maritime communities which fall outside the shingle classification. The most common assemblage is a *Atriplex portulacoides* dominated community which is typically found in the deepest depressions. *Juncus maritimus* and *Suaeda maritima* are the minor constants, with few associates. On slightly elevated areas within the depressions, where moisture levels drop slightly, a different community develops. In this case, *Beta vulgaris maritima* is the major constant providing most cover in this relatively open community (Domin score 6, on average) with approximately *60%* bare shingle in each quadrat. *Armeria maritima* is the minor constant while halophytic herbs such as *Atriplex littoralis, Atriplex portulacoides* and *Suaeda vera* comprise the major associates.

Much of the central section of the site supports a lowland heath community defined as a *Calluna vulgaris - Dicranum scoparium - Rhacomitrium canescens* heath. The *Calluna vulgaris* is dominant and provides most cover

(Domin score 8); this precludes many associates in the assemblage, more commonly found as a species-rich assemblage. The major associates are lichens with *Cladonia coccifera, C. cervicornis verticillata, C. rangifonnis* and *C. foliacea* most commonly sampled in this assemblage. *Agrostis capillaris* forms the major Gramineae component of this community while *Erica cinerea* is the major herb associate. Occasional associates include *Ulex minor* and *Festuca ovina.* It is this community which has suffered at the western end of the site from the flooding which has led to die-back in the *Calluna vulgaris* with some invasion by more ruderal grass species.

A scrub community is found in small patches across much of this site. This assemblage is a *Ulex europaeus* dominated community with *Rubus fruticosus* and *Agrostis capillaris* as the minor constants. Indeed, the dominance of the *Ulex europaeus* is reflected in the depauperate nature of this assemblage which, on average, contains only five species per quadrat. The most frequent associates, although found only in small amounts, are *Calluna vulgaris, Galium saxatile* and *Cirsium arvense,* while *Rosa canina* and *R. pimpinellifolia* are also found occasionally throughout the assemblage.

In some areas the *Agrostis capillaris* is replaced by *Arrhenatherum elatius.* In these areas, the role of *Rubus fruticosus* relative to *Ulex europaeus* increases and this leads to a shift in the community definition to *Ulex europaeus - Rubus fruticosus - Arrhenatherum elatius* scrub. This community contains even fewer associates than that discussed above as the dense cover provided by both scrub species shades out most associate species. *Teucrium scorodonia,* however, is occasionally found in areas where cover is less dense at the edge of patches.

A separate community, which contains scrub elements, is also seen at this site. In this instance, while *Ulex europaeus* and *Rubus fruticosus* continue to play an important role in the assemblage, it is the presence of *Quercus robur* as a major constant which distinguishes this community. The scrub provides less cover than in the other scrub communities and this, combined with relatively open canopy of *Quercus robur,* has encouraged the development of ground cover. Major herb associates include *Silene nutans, Teucrium scorodonia* and *Rosa pimpinellifolia.* The mosses *Ceratodon purpureus* and *Tortula ruraliformis* are also important components while *Anthoxanthum odoratum, Vulpia bromoides* and *Festuca ovina* provide the Gramineae component. A well-developed lichen flora has established within this assemblage with particular emphasis on *Cladonia furcata* and C. *chlorophaea.* Despite the range of species this remains a relatively open community with 30% bare shingle in each quadrat. This may be due to deliberate clearing to allow vehicular access to all areas of the site. *Quercus ilex* is an occasional associate in this assemblage.

The final community found at Browndown comprises a *Pteridium aquilinum - Rubus fruticosus* scrub which occupies small patches across much of the shingle site and most of the slope which serves as the rear boundary to the site. *Calluna vulgaris, Teucrium scorodonia* and *Galium saxatile* are the major herb associates; indeed, *Calluna vulgaris* is almost constant throughout the community. The Gramineae component of the community comprises *Agrostis capillaris* and *Anthoxanthum odoratum.* This is a relatively species-poor community reflecting not only the high level of cover offered by the *Pteridium aquilinum* (Domin score 8) but also the amount of litter on the ground which prevents growth of potential herb associates (70% of each quadrat is covered by litter under the vegetation).

Key

SH111 *Pteridium aquilinum - Rubus fruticosus* community;

SH109 *Ulex europaeus - Rubus fruticosus - Agrostis capillaris* scrub community;

SH107 *Ulex europaeus - Rubus fruticosus - Arrhenatherum elatius* community;

SH104 *Ulex europaeus - Rubus fruticosus - Quercus robur* community;

SH89 *Calluna vulgaris - Dicranum scoparium - Rhacomitrium canescens* community;

SH48 *Festuca rubra - Hypnum cupressiforme Lotus corniculatus - Plantago lanceolata* community;

SH46 *Festuca rubra - Ceratodon purpureus-Sedum* spp. grassland;

SH43a *Dicranum scoparium - Festuca rubra-Plantago lanceolata* grassland community, *Sedum anglicum* sub-community;

SH24 *Rumex crispus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community;

SM 14 *Atriplex portulacoides* saltmarsh;

T1 *Vulpia bromoides - Festuca rubra - Epilobium angustifolium* assemblage.

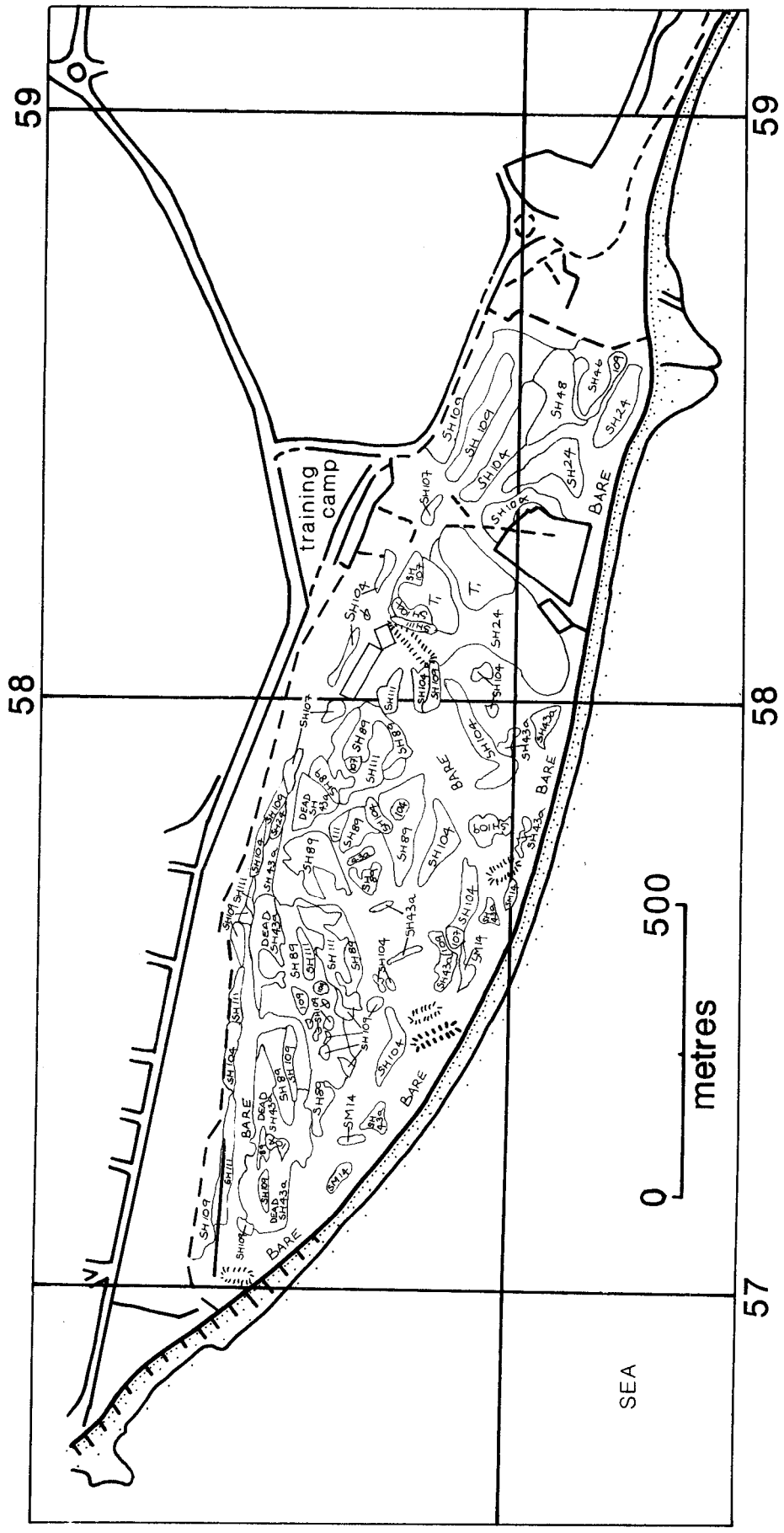

Figure 21 Browndown

St Helens Common, The Duver

Isle of Wight. SZ 640880
Conservation status: Common land managed by the National Trust
Area surveyed: 19.1 ha
Fieldwork date: 12/7/90

Introduction
The Duver is a small sand and shingle spit developed from the northern bank of the estuary of the River Yar enclosing saltmarsh. The eastern seaward ridge is capped by dune sand to the south and is protected from the ravages of the sea by a sea wall and promenade on which are located old railway carriage beach huts. The site is delimited by the river to the south, saltmarsh to the west and higher land of St Helens village to the north.

Threats and management
The Duver is managed as a recreational area by the National Trust and includes a car park and mown areas. There is heavy visitor pressure especially near the sea and around the car parks and there is evidence that the scrub areas were fired in summer 1989. The lower areas adjacent to the saltmarsh are flooded during winter storms as happened in the 1989/90 winter. Vehicles do not damage the area as a road runs through the centre of the site.

Vegetation
As might be expected with a spit that is in part highly sandy and elsewhere has a clay matrix, the end members of the vegetation sequence are saltmarsh and sand dune. On the lowest muddy shingle there is an open community, up to 50% bare, with *Armeria maritima, Atriplex portulacoides, Atriplex* spp. and the moss *Hypnum cupressiforme.* Conversely, on the top of the sandy front ridge there is dune scrub dominated by *Hippophae rhamnoides* and *Rubus fruticosus,* sometimes with *Sambucus nigra* and ground vegetation of *Smyrnium olusatrum, Urtica dioica, Beta vulgaris maritima, Solanum dulcamara* and various grasses and ruderals including *Carex arenaria, Galium aparine* and *Senecio vulgaris.*

Immediately to the rear of the beach huts there is a *Beta vulgaris maritima* dominated community with *Elytrigia atherica, Tripleurospermum maritimum* and foreshore annuals. Behind the dune scrub there is a sand shingle grassland often dominated by the moss *Dicranum scoparium* but with *Rumex acetosella, Aira praecox* and *Festuca rubra* very common. This community is often up to 50% bare substrate but in places becomes more closed, with *Plantago lanceolata, Lotus corniculatus* and the moss *Hypnum cupressiforme.* In some areas this sandy shingle has developed a *Ulex europaeus, Rubus fruticosus, Sambucus nigra* scrub with a ground cover of *Hedera helix* and *Teucrium scorodonia.*

The lower areas of The Duver to the rear, west of the road, have a finer matrix among the shingle and display a classic open community of *Armeria maritima, Plantago coronopus* and *Festuca rubra* sometimes with *Hypochoeris radicata* or other ruderal species. The higher shingle areas contrast with a *Prunus spinosa* dominated scrub, with *Hedera helix, Rubus fruticosus, Crataegus monogyna* and in places *Quercus robur, Lonicera periclymenum* and *Ulex europaeus.* This community seems to be the end point of succession on southern British shingle.

Key
SH124 *Prunus spinosa* dominated scrub with *Hedera helix - Rubus fruticosus;*

SH108a *Ulex europaeus - Rubus fruticosus* scrub community, *Solanum dulcamara* sub-community;

SH104 *Ulex europaeus - Rubus fruticosus - Quercus robur* community;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus - Plantago lanceolata* community;

SH44 *Dicranum scoparium - Rumex acetosella - Aira praecox* community;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland community;

SH36 *Elytrigia atherica - Festuca rubra* grassland;

SH33 *Plantago coronopus - Armeria maritima - Festuca rubra* grassland;

SH17 *Beta vulgaris maritima - Solanum dulcamara - Tripleurospermum maritimum* community;

SH16 *Beta vulgaris maritima - Festuca rubra - Tripleurospermum maritimum* grassland.

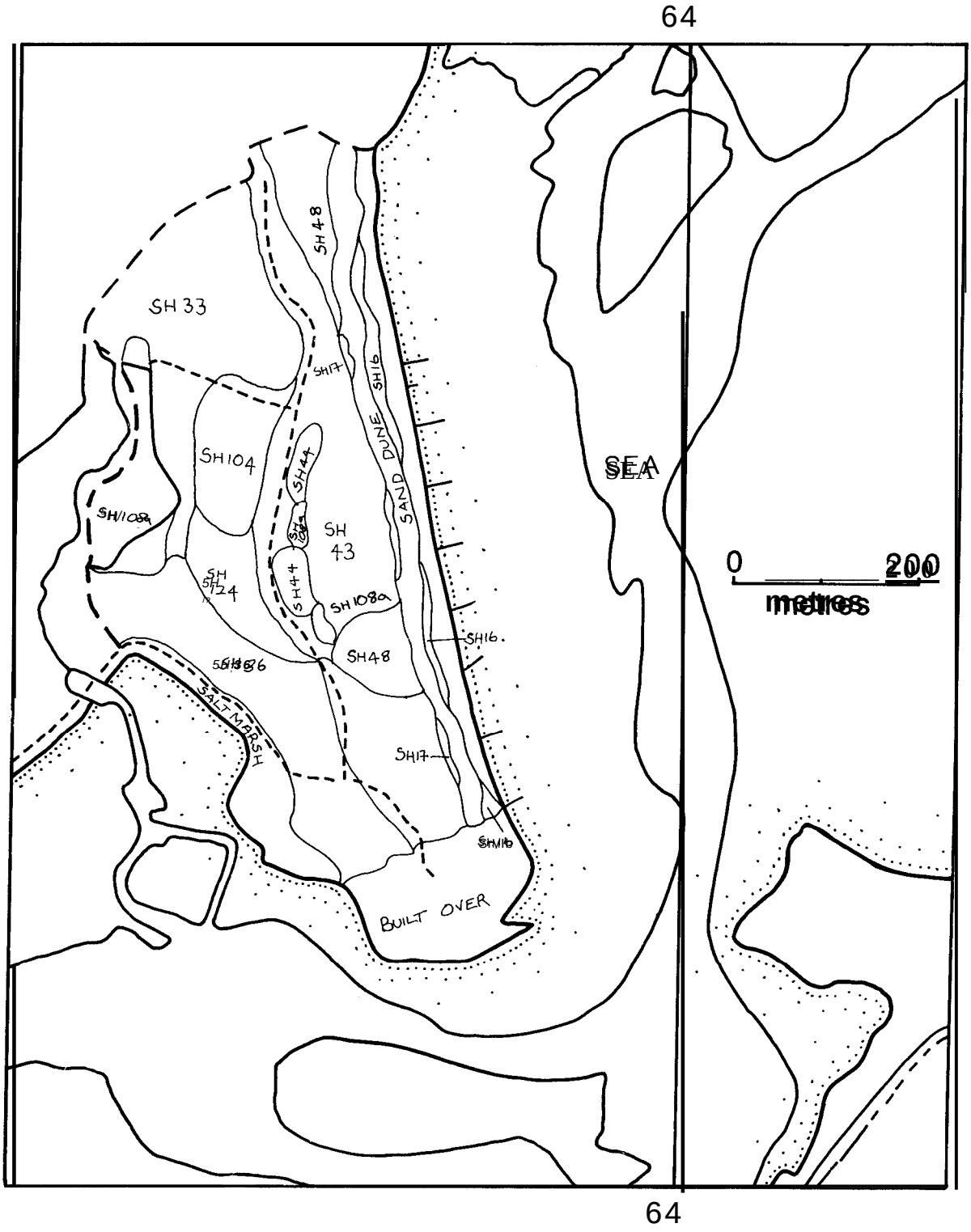

Figure 22 St Helens Common, The Duver

Chesil Beach

Dorset. SY 550880—SY 670740
Conservation status: SSSI, LNR, National Trust
Area surveyed: 250 ha
Fieldwork dates: 11—14/6/90

Introduction
This site comprises a narrow strip of shingle which forms a fringing beach in its western section (Burton Bradstock—Abbotsbury), and then a shingle bar which runs from Abbotsbury to Portland Bill and forms a fine example of a tombolo. The bar has led to the formation of the Fleet lagoon which is trapped behind the shingle. Between West Bexington and Abbotsbury the beach is backed by clay cliffs and, at the western end of these, shingle has been deposited on top of the cliffs to a depth of 20 cm. Further east along the cliffs, where their height increases, there is no shingle capping.

The beach extends along 28 km and is 150—200 metres in width. The action of longshore drift has led to a gradation in pebble size from east to west. This is one of the major shingle structures in Britain and is of geomorphological, as well as floristic, importance.

Threats
There are several threats, both to the structural stability and to the vegetation of this site. The extraction of gravel from both the foreshore and the lee slope of the bar poses a threat to the overall stability of the bar, and so should be discouraged. In places, extraction on the lee slope, combined with the natural undercutting by water percolating through at high tides has led to a retreat of the lee slope towards the storm crest. The removal of much shingle into the Fleet has also led to the formation of a very steep lee slope (45°).

There are several buildings on the shingle which are used by fishermen. These have led to a small loss of vegetated shingle. The larger problem associated with these buildings is the concentration of trampling around each and the tracks associated with the vehicles used by the fishermen. These tracks are localised but damage is moderate to severe in certain areas. The tracks can be seen clearly in both bare and vegetated shingle. Given the fragile nature of the vegetation and its inability to recover fully, it would seem sensible to restrict any lateral movement of vehicles along the bar to the foreshore below the storm crest, where there is no vegetation.

There is considerable recreational pressure on certain parts of Chesil beach, namely at the car park at the eastern end, at Abbotsbury and at West Bexington. In these areas, trampling has led to light levels of disturbance to the vegetation. Fortunately, the effects are localised due to the difficulty of walking on unconsolidated shingle.

There is a natural threat from the undercutting mentioned earlier and this has led to shingle fans and buttresses on the lee slope. The shingle has been greatly reworked in two ways. Firstly, through overtopping of the shingle during storm events, which throws fresh shingle and drift over the storm crest onto the stable shingle of the lee slope. Evidence of this may been seen in the presence of fresh drift on the lee slope. This not only alters the structure of the bar, but also buries existing vegetation. The second means of reworking is through the reactivation of the shingle fans through undercutting, and the creation of new fans. This has resulted in the mass movement of shingle down slope covering areas of stable vegetation.

Management
Much of the main body of the bar, running alongside the Fleet, has been fenced off during the breeding season. At the Abbotsbury end this is due to protection for the swannery, whereas on the central section and at the eastern end it is in order to protect breeding terns. Clearly such a measure also serves to protect the vegetation.

The positioning of a boardwalk at Abbotsbury has restricted trampling of the shingle vegetation.

Much of the site has been grazed by rabbits.

Vegetation

The vegetation on Chesil beach is confined to the more stable lee slope behind the storm crest. The vegetation is largely pioneer in nature, although on the bar itself there has been development of a stable, lichen-dominated flora. Along the lee edge of the bar the marsh influence associated with a high silt content in the shingle matrix is reflected in the vegetation.

The vegetation was particularly poor during the field season when this site was visited due to the storms of winter 1989/90.

Several open, pioneer communities occupy the top of the lee slope. One of the most common assemblages comprises a *Silene vulgaris maritima* dominated community. This is an open community with, on average, 70% bare shingle in each quadrat; *Silene vulgaris maritima* provides much cover (Domin score 6-8). This is a particularly depauperate community with only infrequent maritime herb associates, commonly *Beta vulgaris maritima, Atriplex* spp., *Sonchus arvensis* and *Glaucium flavum.* This community is most commonly found at either end of the site, especially at the eastern end.

The constant presence of *Rumex cripus littoreus,* along with *Silene vulgaris maritima,* leads to the formation of a separate community which is seen along much of the length of the shingle beach. This is another species-poor assemblage and is even more open than the previous one (95% bare shingle in each quadrat). The occasional associates in this community are *Geranium robertianum* or *G. purpureum.*

Another open, pioneer community with *Silene vulgaris maritima* is found in small patches on the lee slope. In this instance, *Silene vulgaris maritima* is found in association with *Cochlearia danica* as the key additional constant, while *Beta vulgaris maritima, Raphanus maritimus* and *Arrhenatherum elatius* may be found as occasional associates.

Where *Rumex cripus littoreus* becomes a more important component, this community is replaced by a slightly different assemblage characterised by the constant presence of *Rumex cripus littoreus* and *Cochlearia danica. Silene vulgaris maritima* may also bc; present in this assemblage while *Geranium robertianum* and *Glaucium flavum* are additional associates. The communities detailed above are largely unique to Chesil beach.

A community largely confined to the western end of the site, from Burton Bradstock to West Bexington, is defined by the constant presence of *Silene vulgaris maritima* and *Crambe maritima.* There are few associates in this assemblage with *Glaucium flavum* and *Sonchus arvensis* as the only occasional associate species.

Another pioneer community which is sampled across much of Chesil beach is a *Lathyrus japonicus* community. This is almost a monospecific stand in many places with much bare shingle visible (95% in each quadrat). In some areas, however, *Silene vulgaris maritima* becomes a locally important species. The lack of vegetation cover may reflect the mobility of the shingle, even on the lee slope, or more probably the lack of nutrient input within the shingle matrix.

A community which is found to the west of West Bexington car park is an assemblage typical of many shingle sites. It comprises a *Silene vulgaris maritima - Rumex cripus littoreus - Arrhenatherum elatius* assemblage. This is similar to the pioneer community across much of the site, but in this instance, disturbance has led to the introduction of additional species, e.g. *Sonchus arvensis, Leontodon hispidus* and *Solanum dulcamara.*

Another grassland community is found along the top of the raised shingle beach at West Bexington, and along the base of the lee slope on the western section of the site. This may reflect a high silt content in the shingle matrix. The assemblage is characterised by the constant presence of *Festuca rubra, Silene vulgaris maritima* and *Lotus corniculatus* in a grassland which is rich in maritime herbs. The key associates include *Armeria maritima, Cochlearia danica* and *Ononis repens.*

A Suaeda vera dominated saltmarsh community is found in a narrow strip along the edge of the Fleet. This community contains *Atriplex portulacoides, Beta vulgaris maritima* and the lichen *Xanthoria parietina* as

minor constants. *Suaeda vera* has been seen to respond well to burial by shingle and this was borne out by the new growth of *Suaeda vera* bushes through the new shingle deposited during the last storms.

The community typical of areas of stable shingle on the lee slope, often found at the base of the slope where the slope angle is less steep, is characterised by a major lichen component. The community is defined by the constant, and major, presence of *Cladonia furcata, Festuca rubra* and *Cochlearia officinalis.* This is a very rich assemblage with, on average, fifteen species per quadrat. While *Cladonia furcata* is the major constant lichen species, there are many other *Cladonia* spp. typical of this community, in particular, *C. portentosa, C. cervicornis* and C. *crispata.* It is the fragility of these lichen species which causes problems with vehicular damage to the community. These species are indicators of stability as they take a long time to become established and are easily disturbed.

This assemblage is rich in herb associates, most commonly *Plantago coronopus, Sedum acre, Silene vulgaris maritima, Cerastium diffusum, Cerastium glomeratum* and *Plantago lanceolata.* In addition there is a well-developed bryophyte flora within this assemblage with *Ceratodon purpureus* and *Hypnum cupressiforme* forming the major components.

Key

SH70 *Festuca rubra - Silene vulgaris maritima - Lotus corniculatus* community;

SH51 *Cladonia furcata - Festuca rubra - Cochlearia danica* grassland;

SH25 *Silene vulgaris maritima - Rumex cripus littoreus - Tripleurospermum maritimum* community;

SH11a *Lathyrus japonicus* pioneer community, *Silene vulgaris maritima* sub-community;

SH11 *Lathyrus japonicus* pioneer community;

SH7 *Silene vulgaris maritima* dominated pioneer community;

SH6 *Silene vulgaris maritima - Crambe maritima* pioneer community;

SH5 *Cochlearia danica - Silene vulgaris maritima* community;

SH4 *Rumex cripus littoreus - Cochlearia danica* pioneer community;

SH3 *Rumex cripus littoreus - Silene vulgaris maritima* pioneer community;

SM25 *Suaeda vera* saltmarsh.

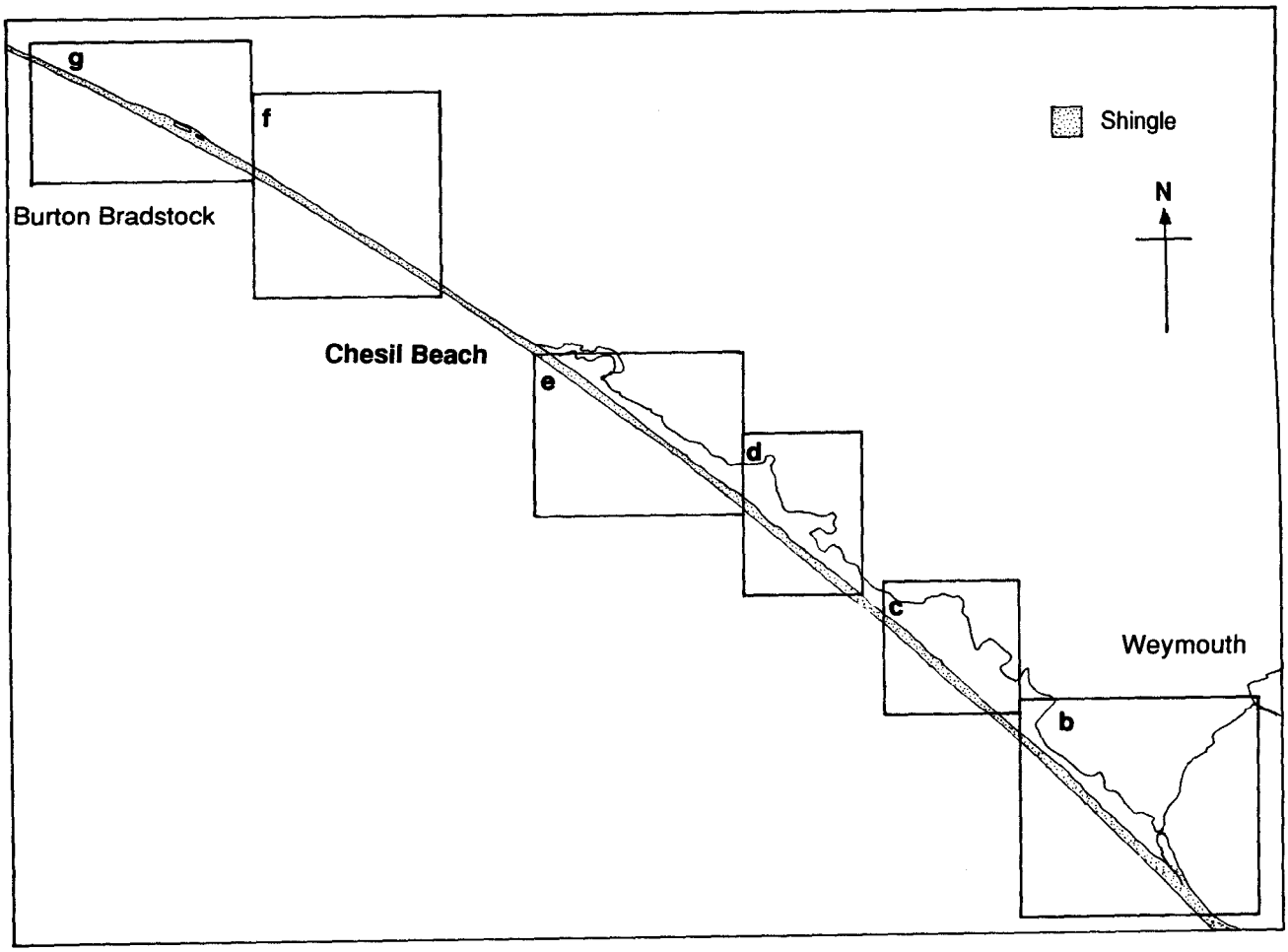

Figure 23a Chesil Beach — key to maps

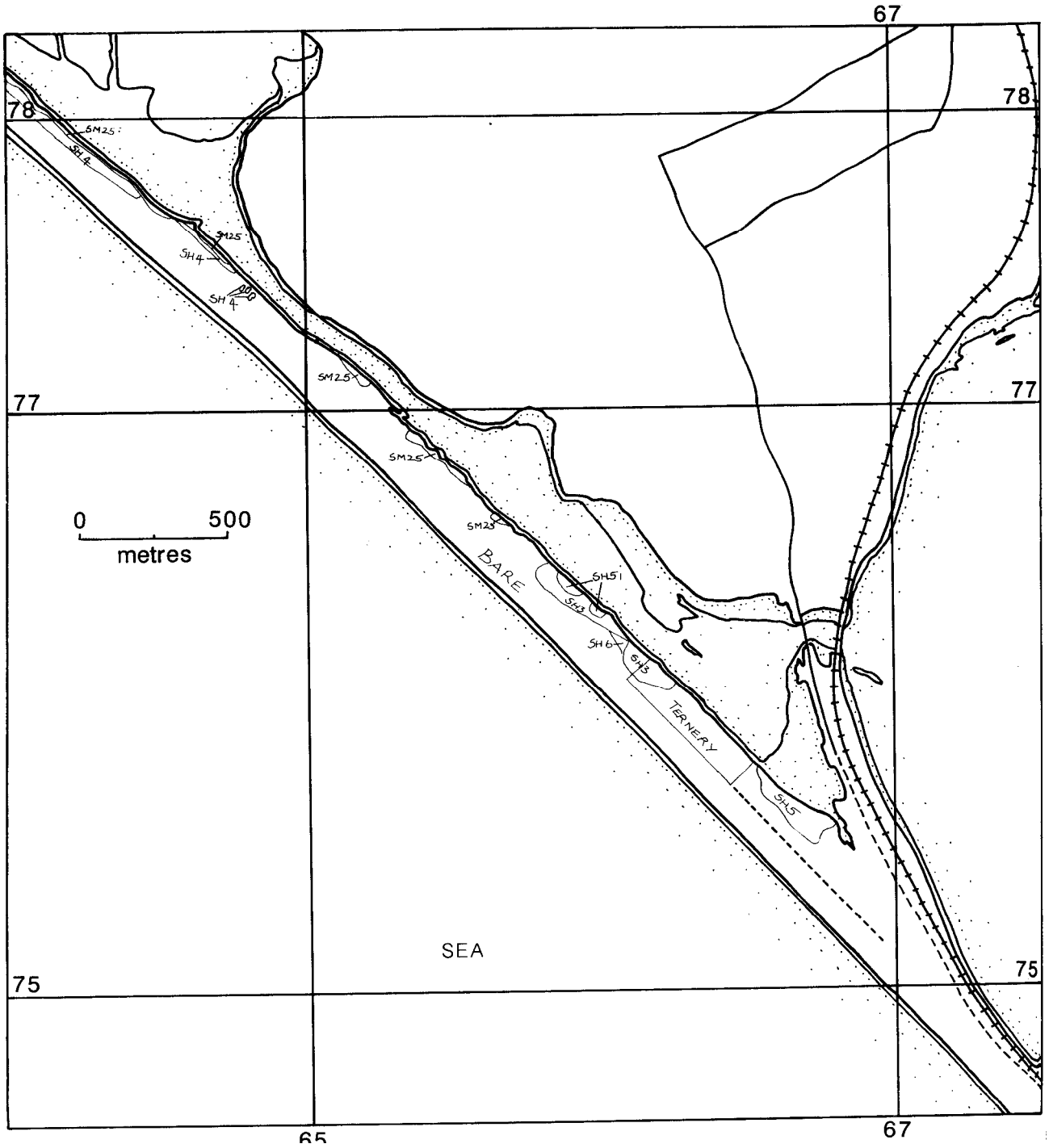

Figure 23b Chesil Beach

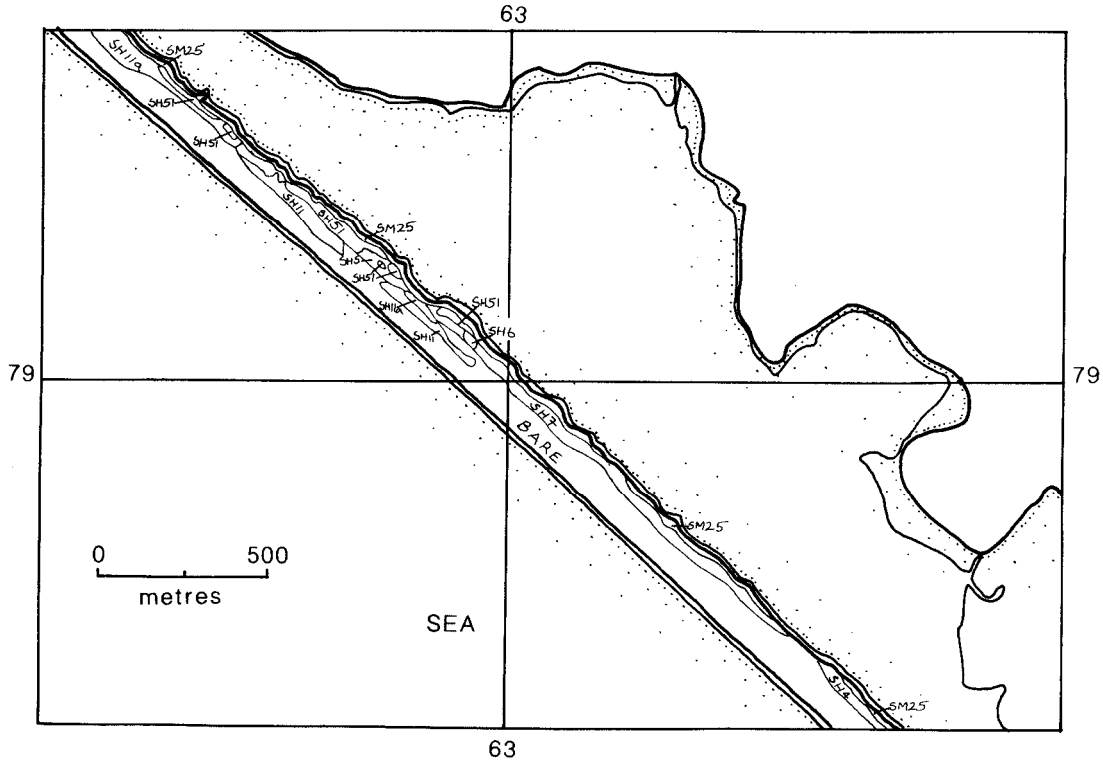

Figure 23c Chesil Beach

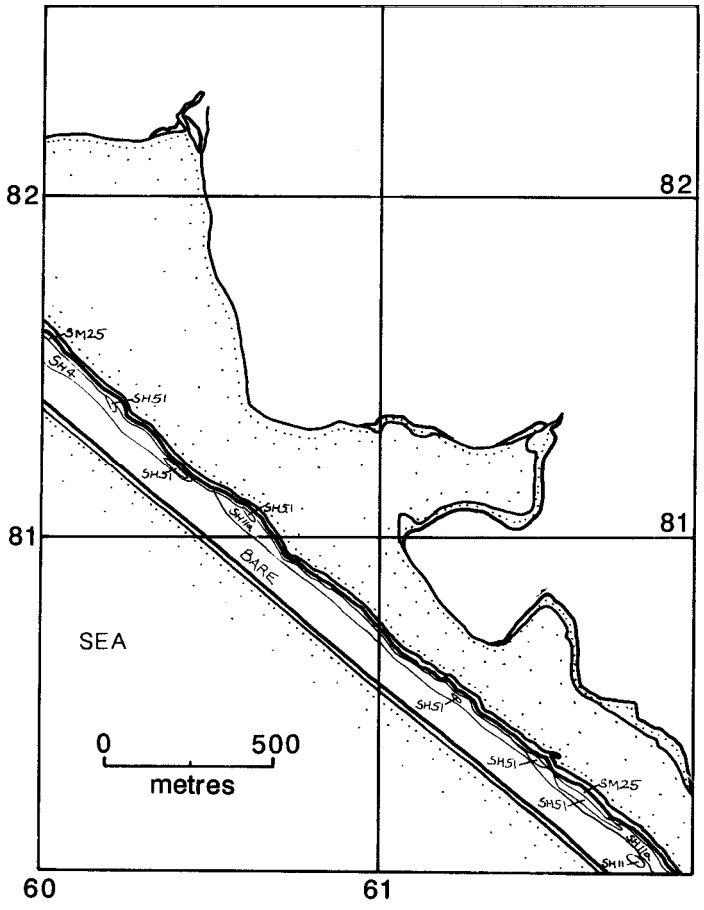

Figure 23d Chesil Beach

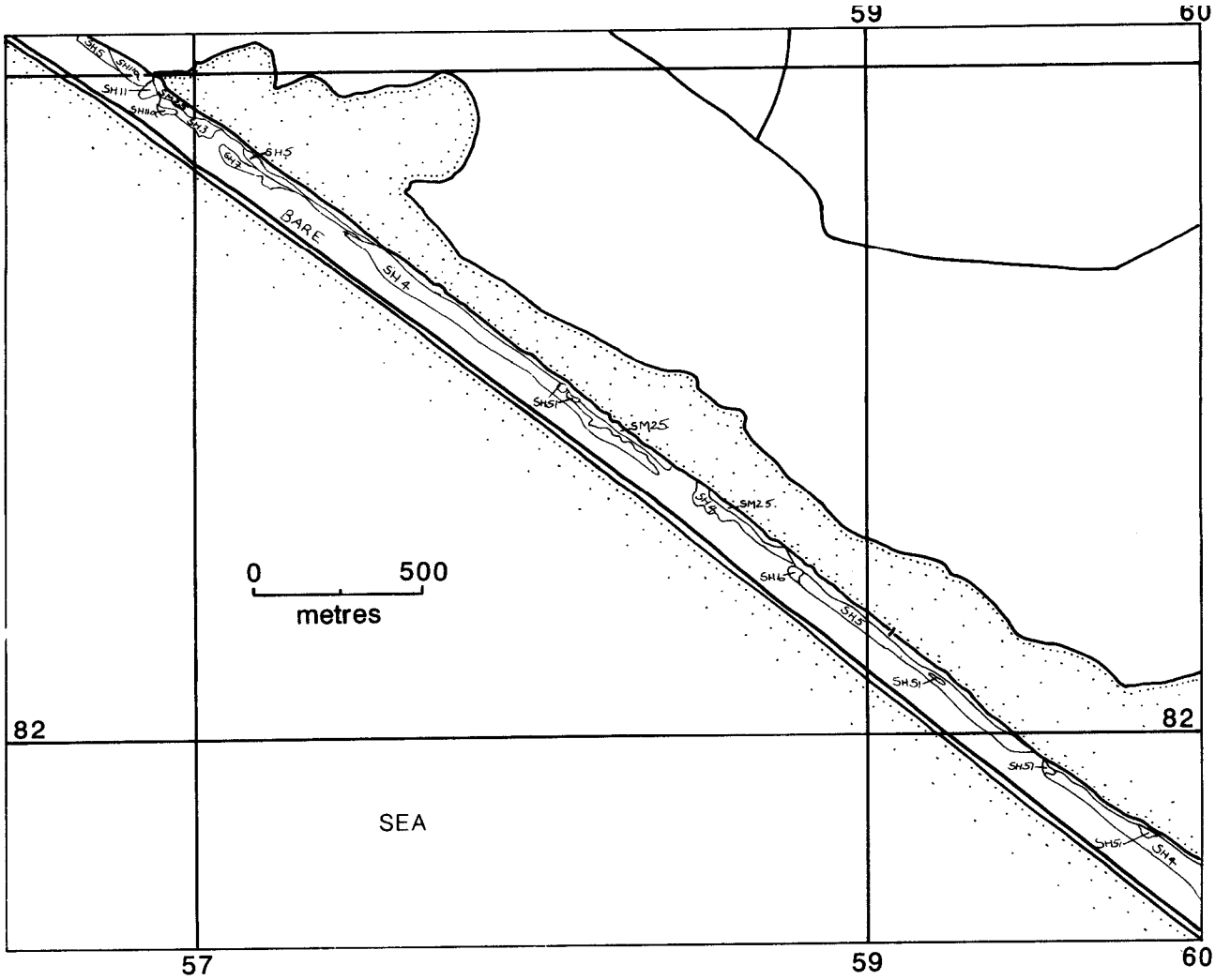

Figure 23e Chesil Beach

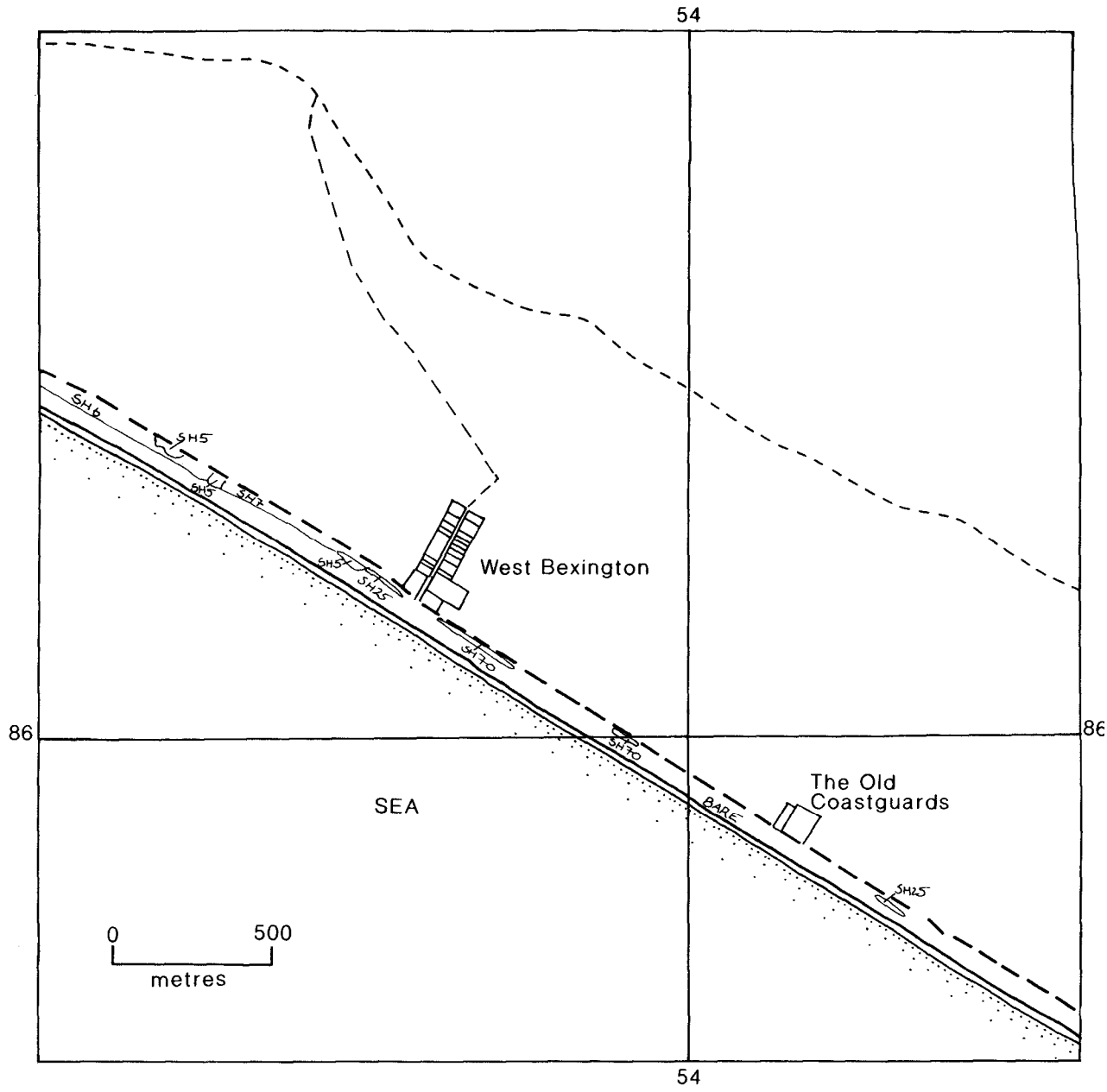

Figure 23f Chesil Beach

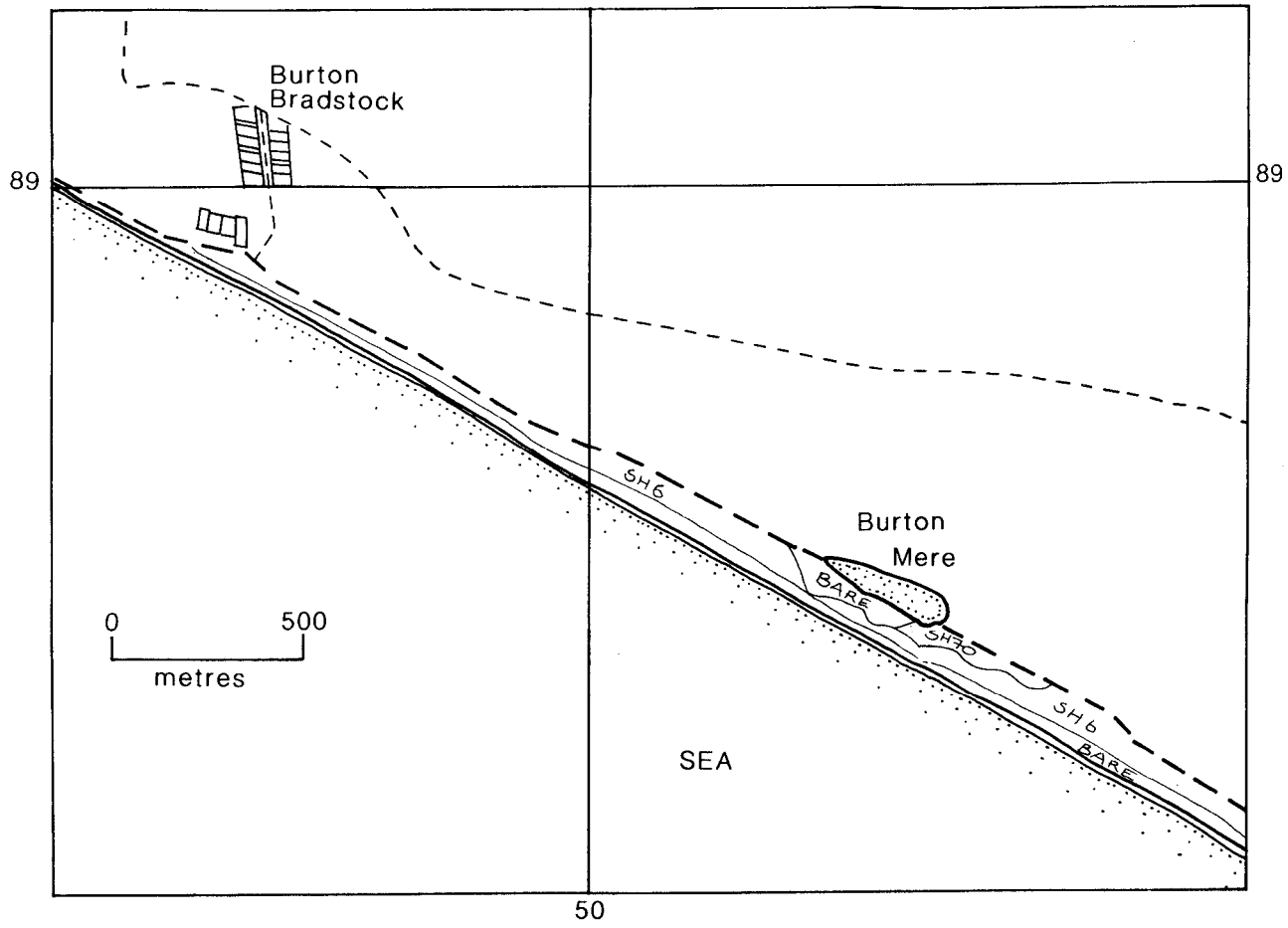

Figure 23g Chesil Beach

Slapton Bar

Devon. SX 826441
Conservation status: SSSI, LNR, Devon AONB
Area surveyed: 34 ha
Fieldwork dates: 20–24/6/90

Introduction
This site comprises a sandy shingle bar which has served to dam a former estuary. It is the landward movement of an offshore shingle bar that has led to the damming effect and this has subsequently led to the formation of a eutrophic freshwater lagoon in the south (Lower Ley), and a marshy area supporting fen and carr vegetation in the north (Higher Ley). A variety of rock types can be seen in the shingle although most commonly pebbles are derived from local slate.

Overall, the bar is in equilibrium with maritime forces, although there is some erosion at the southern end of the site at Torcross and this has necessitated the building of a sea wall at this point.

Threats
A road runs along the length of the bar, situated on the ridge crest, and this has not only led to the direct destruction of an area of vegetated shingle, but has also led to increased recreational pressure on the site. This is seen in the presence of a large car park on the foreshore side of the bar opposite the causeway separating the Higher and Lower Leys. Despite the presence of a car park there are some vehicle tracks on the shingle bar; however, the presence of small posts has largely eliminated such indiscriminate parking so that vehicular damage remains local in extent and has caused negligible damage. Recreational pressure takes the form of trampling.

Management
The shingle bar forms part of a wider Slapton Ley SSSI, much of which is under the supervision of the Field Studies Council and the Herbert Whitely Trust. This has led to the protection of the site. There is no evidence of grazing on the shingle bar.

Active management of the site on the northern section of the lee shore has taken the form of clearing a large area of natural scrub vegetation using a bulldozer. This action has resulted in the formation of a ruderal flora, rather than reverting to the grassland flora which was being encouraged. Clearly the use of large vehicles poses a threat to other communities on the bar. There was a proposal to burn out other areas of scrub but this was discouraged due to the lack of control inherent in this method and the potential effects on the very thin soil development over the shingle on the bar. Selective clearing by hand was advised as the best means of clearance for future actions.

Small areas on the southern foreshore have been fenced off to conduct experiments investigating the effects of different levels of trampling on the flora of such areas.

During the summer months the local council clears the drift from the foreshore as it is considered unsightly. Clearly, such actions may have an effect on the long term supply of nutrients to an otherwise impoverished foreshore environment.

Vegetation
The shallow foreshore slope supports pioneer vegetation while the raised part of the ridge immediately behind this supports a herb-rich grassland. The road serves as a convenient boundary between the foreshore and lee shore. The lee slope supports coarse mixed grassland communities over much of its area while scrub communities have developed where the bar widens.

Much of the southern foreshore supports a thin strip of pioneer vegetation which is typical of sandy shingle sites. This community is characterised by the constant presence of *Tripleurospermum maritimum, Euphorbia paralias* and *Glaucium flavum* while *Ononis repens* and *Daucus carota* are occasional associates. This is a very open pioneer community with, on average, 95% bare shingle visible in each quadrat. In places this community is replaced by small patches of *Elymus farctus boreali-atlanticus - Honckenya*

peploides as constants with *Calystegia soldanella* as an additional constant.

This develops into a more stable grassland community further back on the area which is less likely to be subject to maritime disturbance. This assemblage comprises a *Festuca rubra - Achillea millefolium - Lotus corniculatus* herb-rich grassland. While *Festuca rubra* is the major element in the grassland, it offers relatively little cover (Domin score 6), and while each quadrat contains on average seventeen species, overall cover remains low with approximately 60% bare shingle visible in each quadrat. Additional herb associates include *Geranium molle, Plantago lanceolata, Ononis repens, Bellis perennis, Hypochoeris radicata, Trifolium dubium* and *Armeria maritima,* while *Poa pratensis* and *Bromus hordeaceus* are the Gramineae associates.

This community runs along the crest of the foreshore slope for the entire length of the bar up to the end of the Higher Ley where it gives way to the pioneer vegetation which occupies all of the shingle fringing beach on the northern section of the bar. This pioneer community is similar to that described earlier but with the additional and major presence of *Echium vulgare* and *Centranthus ruber.*

Much of the southern section of the lee slope of the bar supports a coarse, mixed *Arrhenatherum elatius - Raphanus maritimus* grassland. *Dactylis glomerata* is an additional, if minor, constant, while *Festuca rubra is* an additional Gramineae associate. This assemblage is relatively species-poor although there are locally diverse areas. The major associates include *Heracleum sphondylium, Plantago lanceolata, Artemisia vulgaris* and *Galium verum.* In addition, some maritime herbs are found as occasional associates, in particular *Rumex cripus littoreus* and *Beta vulgaris maritima.*

In some areas on the lee slope, particularly those closer to the road, and, therefore, subject to less lacustrine influences, there is a different grassland community. In this case, the mixed grassland is a herb-rich *Festuca rubra* dominated grassland which is similar to that seen on the foreshore. In this instance, however, the community is better developed, with no bare shingle visible. This community is defined by the constant presence of *Festuca rubra - Lotus corniculatus - Achillea millefolium* along with *Centaurea nigrum, Plantago lanceolata* and *Galium verum.* It is the cover provided by the *Festuca rubra* (Domin score 8) which distinguishes this community from the *Festuca rubra* community seen on the foreshore. The more stable nature of this community is also seen in the presence of bryophyte species such as *Pseudoscleropodium purum.*

There are several scrub communities found on the lee slope. On the southern lee slope there is a scrubby grassland community which displays maritime elements. This assemblage is found in patches on the main body of the bar, but is particularly common along the lee edge, and thus subject to lacustrine influences and may have maritime influences from water percolating through the bar from the foreshore. This community is characterised by the constant presence of *Raphanus maritimus, Arrhenatherum elatius* and *Rubus fruticosus.* This is a relatively species-poor community, a reflection of the cover provided by the *Rubus fruticosus* (Domin score 8). Associates include *Heracleum sphondylium, Artemisia vulgaris* and, occasionally, *Beta vulgaris maritima.*

A similar community is seen on the widest part of the bar on the southern section, where there is a distinct ridge structure visible. In this case *Rubus fruticosus* continues to be a major element in the assemblage, while *Arrhenatherum elatius* and *Raphanus maritimus* are less important. However, *Hedera helix* is an additional constant while *Teucrium scorodonia, Rumex cripus littoreus* and *Achillea millefolium* are frequent associates within the scrub.

Further north along the southern section, this assemblage gives way on inland areas to a scrub community which is differentiated from others by the constant and major presence of *Ulex europaeus* along with *Rubus fruticosus* and *Arrhenatherum elatius.* It should be noted that there is also *Ulex gallii* found scattered throughout this community. Associate species include *Teucrium scorodonia, Digitalis purpurea, Holcus lanatus* and *Galium aparine.*

In some areas the *Ulex europaeus* is less well-developed and this represents an earlier stage in the development of scrub. This comprises an *Arrhenatherum elatius - Rubus fruticosus - Ulex europaeus* grassy scrub community. Major associates include *Raphanus maritimus, Teucrium scorodonia* and *Anthoxanthum odoratum* along with *Heracleum sphondylium, Linaria vulgaris* and *Achillea millefolium* as minor associates. This assemblage occupies much of the lee slope of the northern section of the site. It is within this area that a patch of ground was cleared by the warden and it is now dominated by *Digitalis purpurea.*

An even earlier stage in the development of *Ulex europaeus* scrub on this site is found on the northern section. This assemblage comprises an *Ulex europaeus - Arrhenatherum elatius - Rubus fruticosus* scrub where *Ulex europaeus* is only a minor constant (Domin score 3) within a relatively species-rich mixed grassland, with *Holcus lanatus, Dactylis glomerata* and *Anthoxanthum odoratum* as additional Gramineae constants. The major herb associates include *Raphanus maritimus, Geranium robertianum, Heracleum sphondylium* and *Silene dioica.* This appears to represent a transition between the herb-rich grassland community and the *Ulex europaeus* dominated scrub.

A separate scrub assemblage is found along the rear of the northern section of the bar. This is a *Pteridium aquilinum* dominated scrub with almost total cover provided by the *Pteridium aquilinum,* while *Rubus fruticosus* and *Arrhenatherum elatius* are the minor constants. The cover provided by the *Pteridium aquilinum* effectively excludes any associates with only the occasional presence of *Heracleum sphondylium* and *Galium aparine.*

There is a thin strip of a different scrub community found on the southern section of the bar. This comprises a *Prunus spinosa* dominated scrub with *Hedera helix* and *Rubus fruticosus* as the minor constants. The dominance of *Prunus spinosa* is reflected in the lack of many associates with *Silene dioica, Teucrium scorodonia* and *Arrhenatherum elatius* as most frequent associates.

Key

SH124 *Prunus spinosa* dominated scrub with *Hedera helix - Rubus fruticosus;*

SH115 *Raphanus maritimus - Arrhenatherum elatius - Rubus fruticosus* community;

SH114 *Hedera helix - Rubus fruticosus - Arrhenatherum elatius* community;

SH112 *Pteridium aquilinum - Arrhenatherum elatius - Rubus fruticosus* community;

SH107 *Ulex europaeus - Rubus fruticosus - Arrhenatherum elatius* community;

SH106 *Ulex europaeus - Arrhenatherum elatius - Rubus fruticosus* scrub community;

SH105 *Arrhenatherum elatius - Rubus fruticosus - Ulex europaeus* community;

SH73 *Arrhenatherum elatius - Raphanus maritimus* community;

SH69 *Festuca rubra - Achillea millefolium - Lotus corniculatus - Silene vulgaris maritima* community;

SH65 *Festuca rubra - Achillea millefolium - Lotus corniculatus* community;

SH30 *Elymus farctus boreali-atlanticus - Honckenya peploides - Eryngium maritimum* community;

SH23 *Tripleurospermum maritimum - Silene vulgaris maritima - Euphorbia paralias* community.

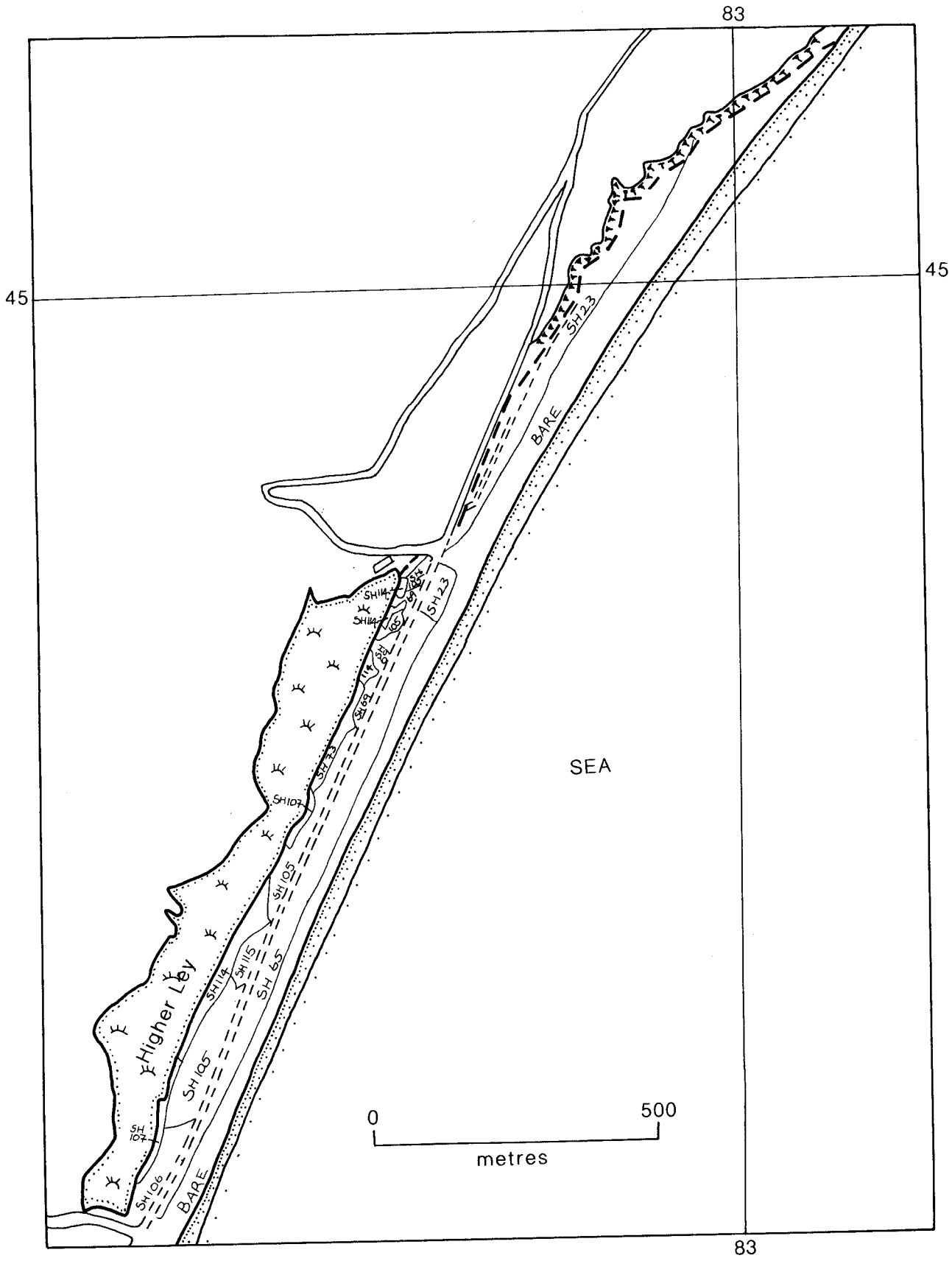

Figure 24a Slapton Bar (north)

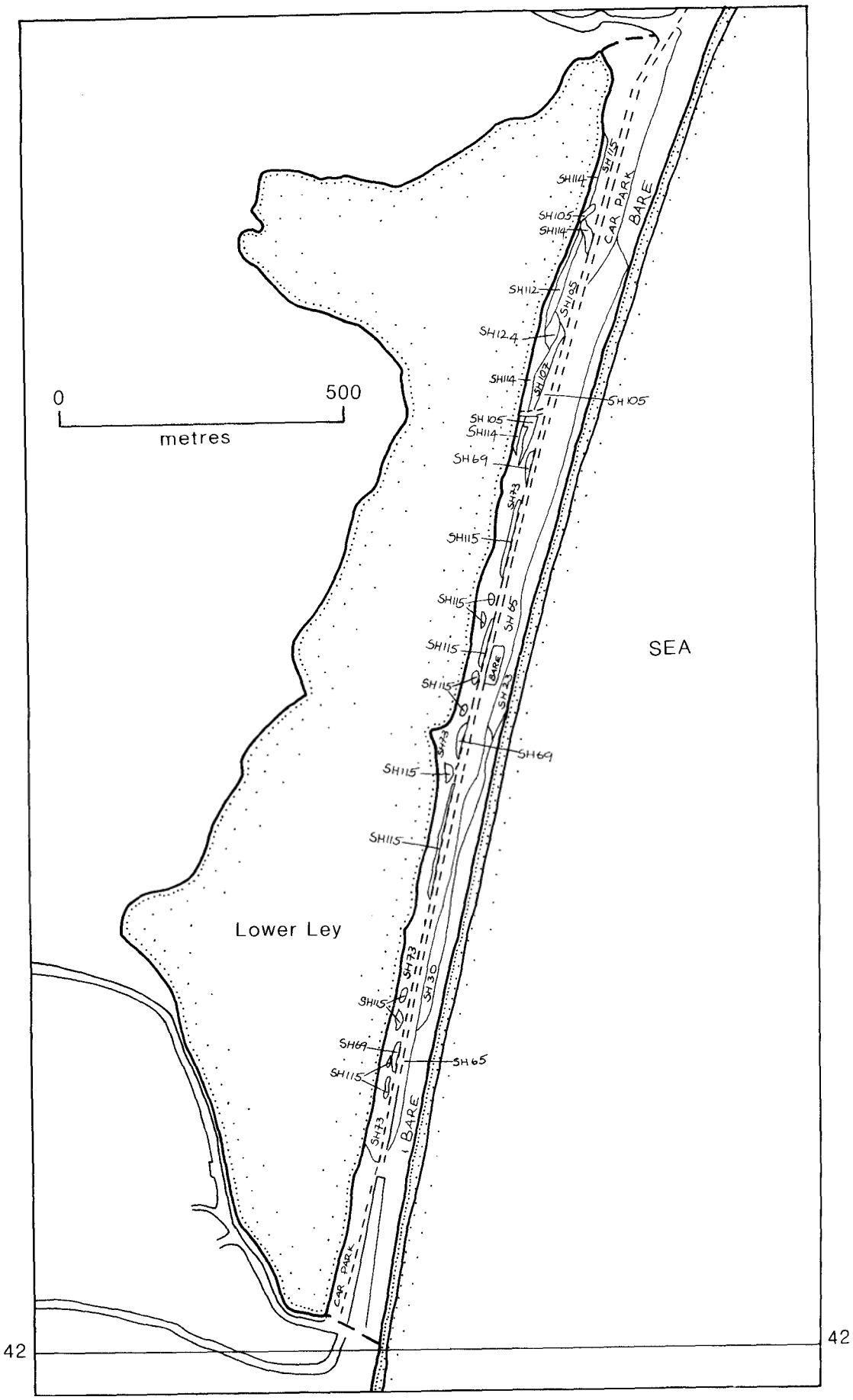

Figure 24b Slapton Bar (south)

Isles of Scilly

Cornwall and the Isles of Scilly
Conservation status: SSSI
Area surveyed: not measured
Fieldwork dates: 4—9/6/89

Introduction
This is not one site but a series of bars, raised beaches and shingle spreads throughout the Isles of Scilly. There are no vegetated shingle structures on Tresco and only a small area at Old Town on St Mary's but good examples are present on most of the other major islands and the smaller island groups.

Shingle bars are extremely characteristic formations in the islands and are discussed by Steers (1964). He quotes (p. 167) the bar between St Agnes and Gugh, but such features are also present in the Eastern Isles (linking Great and Little Ganinick, Great, Middle and Little Arthur and Great Ganilly and Nornour). Similar features occur between St Martins and White Island, and on Bryher and Samson. In some cases these shingle bars have been covered with finer sediments so that the present surface is sandy, but in high energy situations these features may be composed of granite boulders up to 400 mm diameter. In the most exposed situations in the Western Rocks (e.g. Rosevear and Melledgan), sediments of a similar size and nature cover the flat surfaces of the islets at around 5 metres asl.

Raised or storm shingle and cobble beaches fringe parts of the coasts of St Helens, Northwethel and Tean, Annet and the western shore of St Agnes, with finer material of pea gravel size in the east-facing Wingletang Bay, St Agnes. Frequently these are extensive enough to become stable structures and are therefore part of this survey. Because of the exposed nature of the island group these features are subject to overtopping by storm waves but are remarkably stable. The pattern of vegetation communities that results is determined by a combination of exposure and matrix.

Threats and management
All the sites examined are within the Isles of Scilly SSSIs and the island of Annet is closed to visitors throughout the seabird breeding season. However, the islands are very popular tourist locations and most of the main island sites suffer visitor pressure. The uninhabited isles are less disturbed, except for Samson, but some of the Western Rocks and Eastern Isles are influenced by zooplethismic activity.

Vegetation
In the most extreme locations of the Western Rocks on Rosevear the high levels of salt spray give a saltmarsh sward of *Atriplex* spp. and lush *Cochlearia officinalis.* In places this sward may also include *Spergularia rupicola* and *Beta vulgaris maritima.* Storm conditions cause an overwash of the whole island but in the interior there is a distinct shingle community containing *Atriplex* spp., *Lavatera arborea* and *Rumex cripus littoreus.* A similar community is present on the interior of Melledgan. Both islands have large colonies of cormorant, razorbill and great black-backed gull, and seals pull out on Melledgan, their presence enriching the nutrient status of this community. A somewhat similar but species-richer community can be found on the exposed western coasts of Annet and Bryher.

In the bay east of Tolman Point, St Mary's, large cobbles with a gravel and wrack matrix have a species-rich variant of a *Beta vulgaris maritima - Rumex cripus littoreus* pioneer community with *Crithmum maritimum* and the alien *Escallonia rubra.*

On the stable parts of exposed bars such as on Great Arthur, between St Martins and Pernagie and on Bryher and Samson, a *Beta vulgaris maritima - Festuca rubra - Tripleurospermum maritimum* grassland has developed. This usually contains *Armeria maritima, Solanum dulcamara* and a series of other shingle pioneers, and locally may contain the rare *Rumex rupestris.*

By far the commonest shingle vegetation throughout the Isles of Scilly is a *Beta vulgaris maritima - Solanum dulcamara - Tripleurospermum maritimum* community. In sites with large boulders and a highly organic matrix (wrack) there is a sub-community with *Crithmum maritimum* constant. Such communities are present around St Agnes and Gugh, especially at Dropnose Porth where there is a good example of storm organic infill. On Annet this community almost invariably contains *Armeria maritima* tussocks, which give it a distinctive appearance, and *Lavatera arborea* is also frequently present. On St Helens, Northwethel and White Island this community occurs on raised or storm beaches. It is also found in similar situations at the 'necks' of bars between islands and their islets. Typical examples are the low, central area of Samson, the gravel spreads of Popplestone Neck, Bryher and in the Eastern Isles between Great Ganilly and Nornour and on the bars of the Arthurs.

Special local situations have resulted in other pioneer communities occurring. On the east side of Great Ganilly a beach of 30–40 cm shingle has fine sand infill, resulting in a *Crambe maritima* dominated community with fifteen other species including *Glaucium flavum, Euphorbia portlandica* and other sand and shingle species. At Wingletang, St Agnes, heavy rabbit grazing on 4–5 mm gravel has resulted in a rich but open community of *Rumex cripus littoreus, Tripleurospermum maritimum* and *Glaucium flavum* with *Armeria maritima.* On Bryher, a coarse sand matrix and grazing on Popplestone Bank and Great Porth have resulted in a *Honckenya peploides - Silene vulgaris maritima* pioneer community with *Crithmum maritimum* and *Festuca rubra.* In places this community also contains the naturalised alien *Carpobrotus edulis.* Where the sand is finer and deeper such as on the west side of Gugh Bar the *Silene vulgaris maritima* is replaced with more arenaceous species such as *Eryngium maritimum, Calystegia soldanella* and *Carex arenaria.*

Virtually all interior stabilised shingle has some sort of *Festuca rubra* grassland community. In exposed situations this may be rich in *Armeria maritima,* such as behind the main bar at Troytown campsite, St Agnes, or on Annet, Samson and the west coast of Bryher. Over much of the interior of Annet, however, the *Armeria maritima*-rich sward is dominated by *Holcus lanatus* with *Carex arenaria, Sedum anglicum* and *Pteridium aquilinum.* At Wingletang Bay, St Agnes, the stabilised pea gravel furthest inland has a humus overlay and a rich cover of mosses and lichens within the *Festuca rubra - Armeria maritima* sward.

In those locations where the *Festuca rubra* sward is never overwashed or is protected from salt spray a species-rich community reminiscent of grazed fixed dune is present. On the north end of St Martins opposite White Island there is a *Festuca rubra - Lotus corniculatus - Plantago lanceolata* community with over twenty species per quadrat on a 2–3 metre raised beach. A similarly well-protected raised beach in north St Agnes displays a closely related community. On the interior raised beaches of Tean and Samson somewhat greater exposure results in a more 'maritime' arenaceous grassland, with *Festuca rubra, Aira praecox* and *Plantago coronopus* as constants, and species such as *Euphorbia paralias, Sagina maritima* and *Cochlearia danica* also present.

The above community types can in places merge into raised beach 'grass heath' on parts of the west coast of St Agnes, where *Pteridium aquilinum, Digitalis purpurea, Viola riviniana, Luzula campestris* and *Rubus fruticosus* are present. A somewhat similar community is found in the least exposed parts of Annet where even *Hyacinthoides non-scripta* is present. The most extreme form of shingle heathland is found on southern Annet and southern Samson, where a shingle community of *Pteridium aquilinum, Holcus lanatus, Rubus fruticosus, Hyacinthoides non-scripta* and *Silene dioica* is present. In places this may have other species such as *Beta vulgaris maritima, Glechoma hederacea* or *Teucrium scorodonia.*

Key

SH111 *Pteridium aquilinum - Rubus fruticosus* community;

SH59 *Ammophila arenaria - Carex arenaria - Festuca rubra* community;

SH56 *Festuca rubra - Peltigera canina - Senecio jacobaea* community;

SH50 *Festuca rubra - Aira praecox - Plantago coronopus* grassland;

SH47 *Festuca rubra - Lotus corniculatus - Plantago lanceolata* community;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland community;

SH36 *Elytrigia atherica - Festuca rubra* grassland;

SH35 *Armeria maritima* rich *Festuca rubra* grassland;

SH28 *Honckenya peploides - Elytrigia atherica - Ammophila arenaria* community;

SH26 *Honckenya peploides - Silene vulgaris maritima* pioneer community;

SH24 *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community;

SH22 *Glaucium flavum* dominated pioneer community;

SH18 *Atriplex* spp. - *Lavatera arborea - Rumex cripus littoreus* community;

SH17a *Beta vulgaris maritima - Solanum dulcamara - Tripleurospermum maritimum* community, *Crithmum maritimum* sub-community;

SH17 *Beta vulgaris maritima - Solanum dulcamara - Tripleurospermum maritimum* community;

SH16 *Beta vulgaris maritima - Festuca rubra - Tripleurospermum maritimum* grassland;

SH15 *Beta vulgaris maritima - Rumex cripus littoreus* pioneer community;

SH14 *Cochlearia officinalis - Atriplex littoralis* community;

SM *Beta vulgaris maritima - Cochlearia officinalis* marsh.

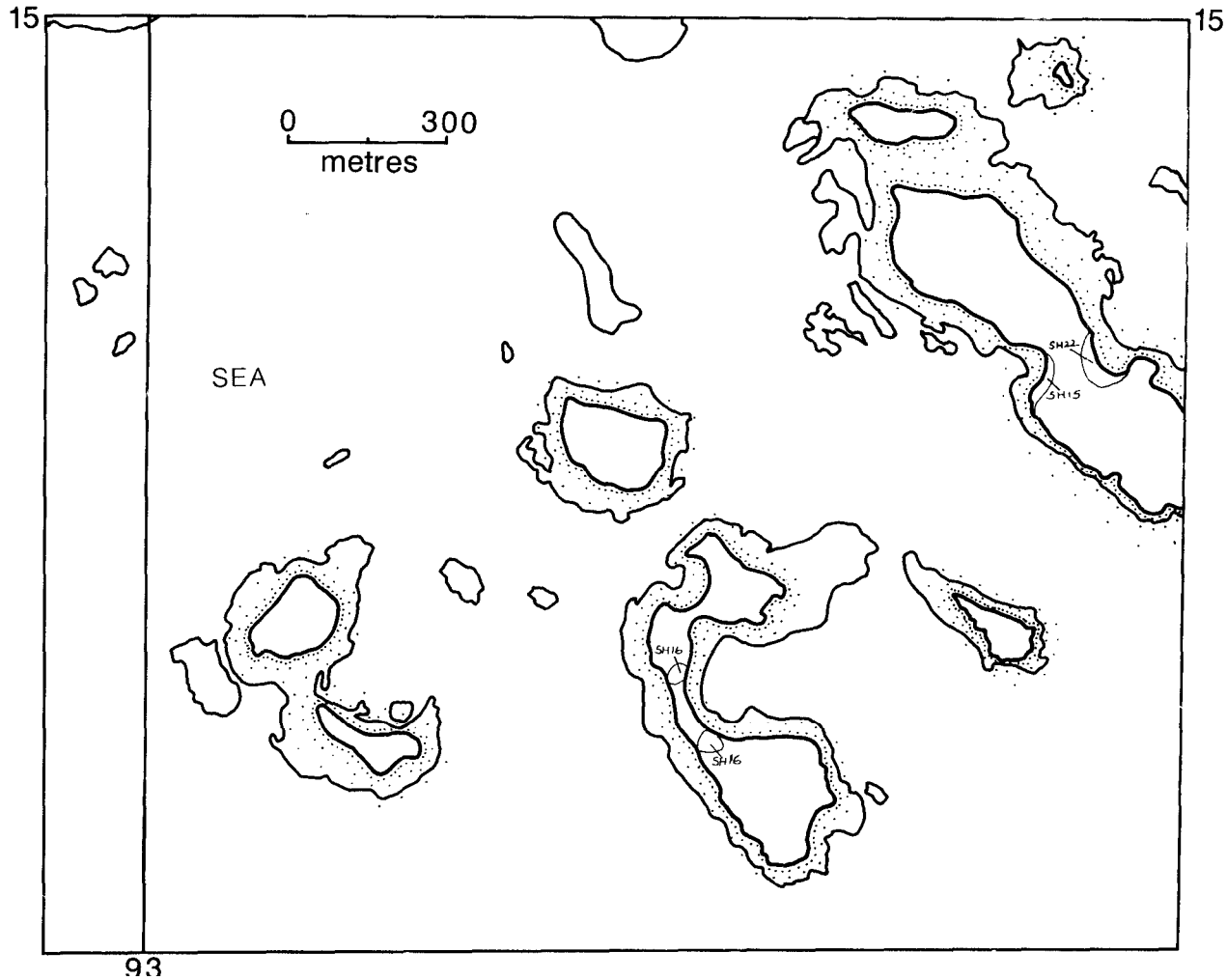

Figure 25a Isles of Scilly: Eastern Isles

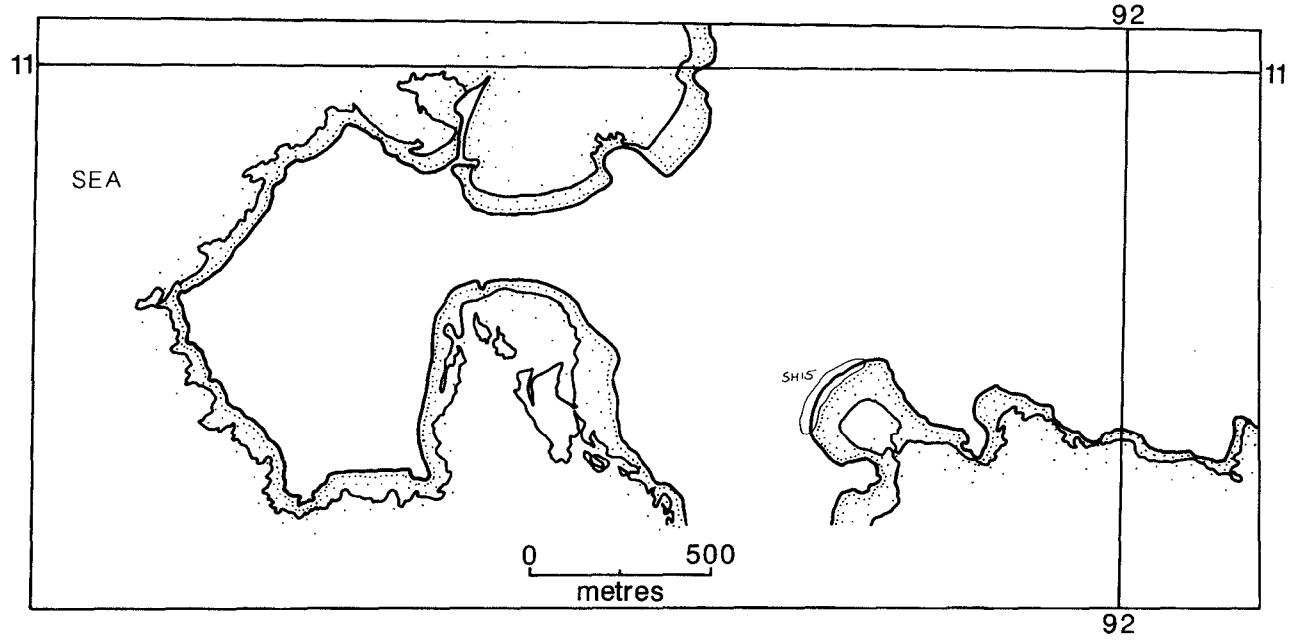

Figure 25b Isles of Scilly: St Mary's (south)

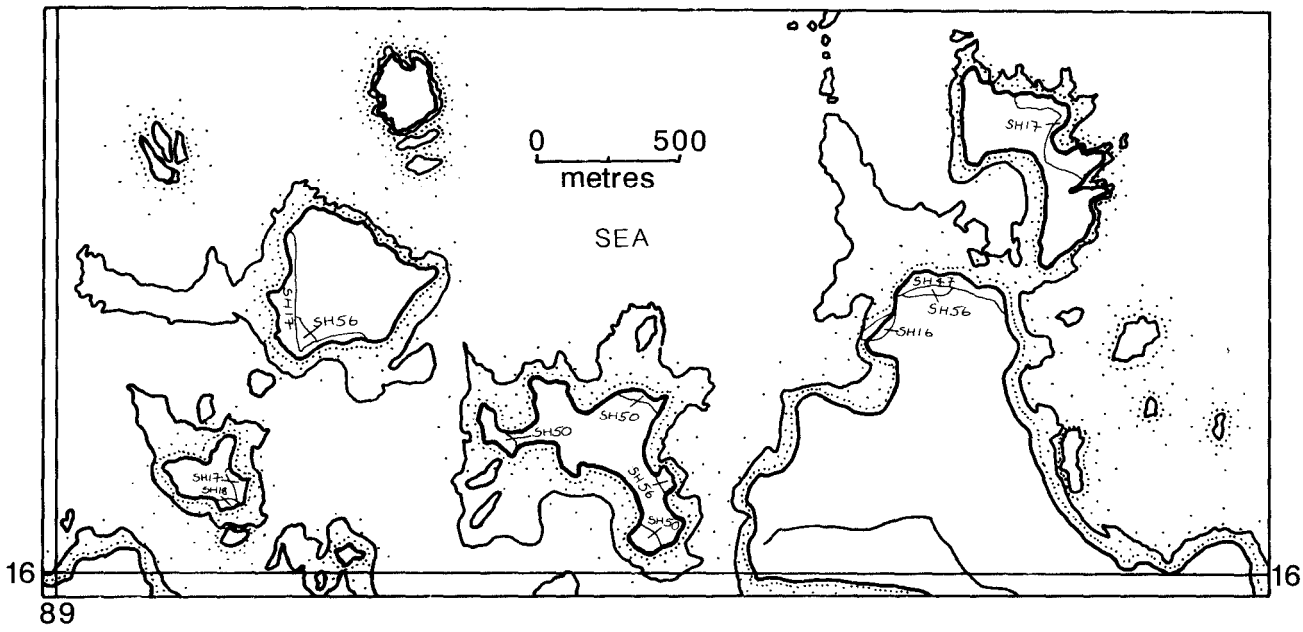

Figure 25c Isles of Scilly: St Helens, White Island and Tean

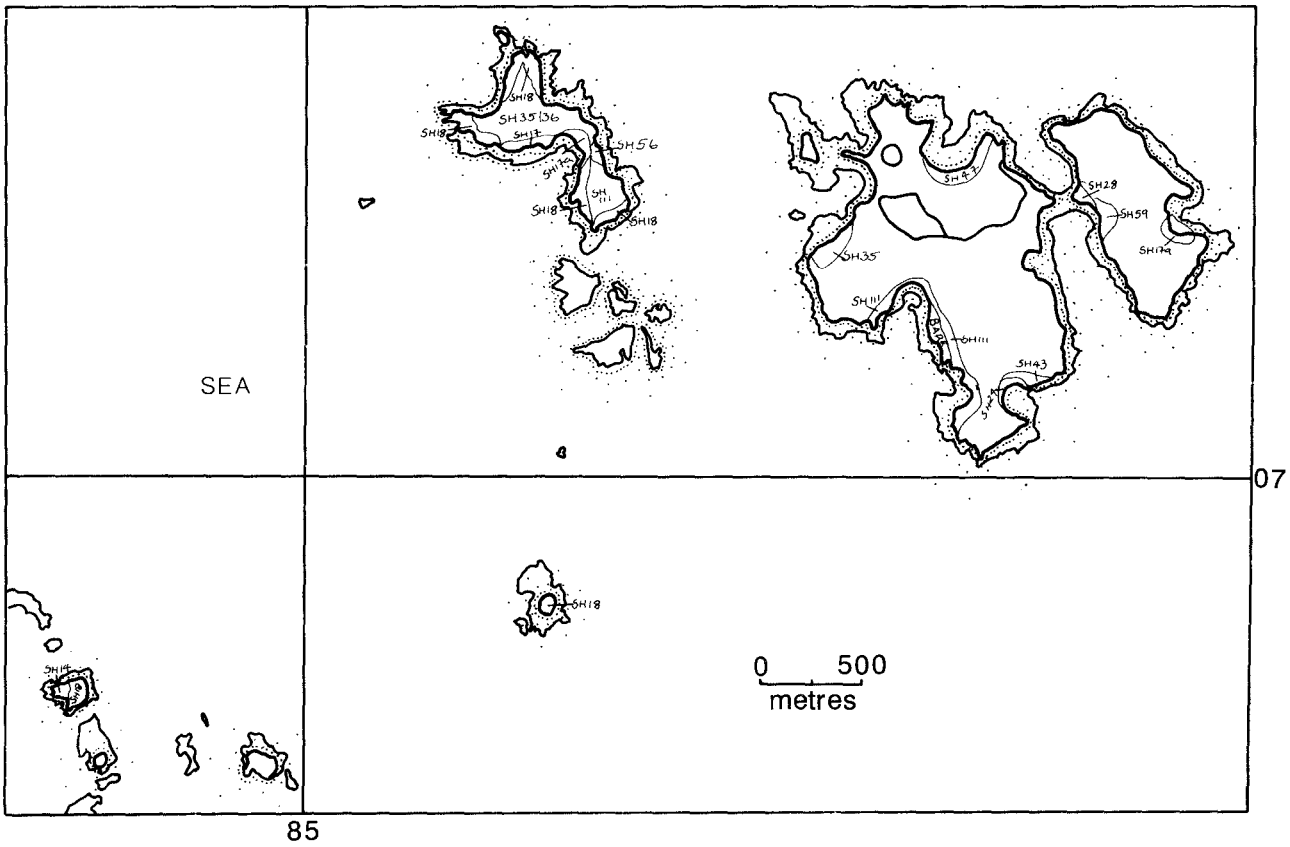

Figure 25d Isles of Scilly: St Agnes and Annet

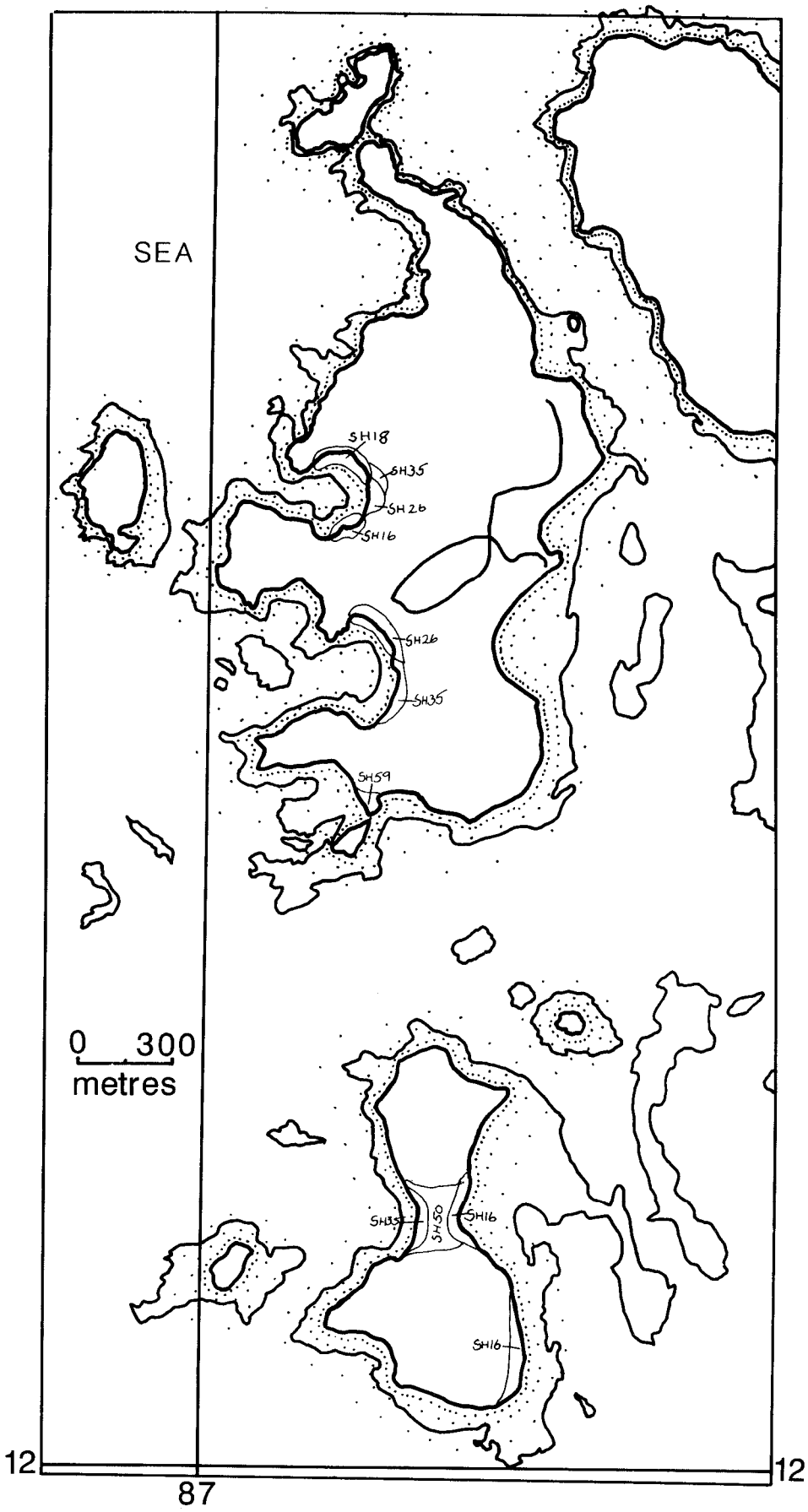

Figure 25e Isles of Scilly: Bryher and Samson

Porlock Beach

Somerset. SS 890484
Conservation status: National Trust
Area surveyed: 28 ha
Fieldwork dates: 25–26/6/90

Introduction
Porlock Beach is a long shingle storm beach with a very steep unvegetated foreshore. Behind the shingle ridge there is a flat area of improved farmland. Access to the beach is via a path from Bossington or from Porlock weir.

The beach is subject to erosion in certain sections and there was evidence of recent storm damage. The reappearance of marsh sediments at the front of the beach also illustrates the erosion at this site.

Threats and management
The Somerset and North Devon coastal path runs along the length of the beach and this has led to some recreational pressure, but the effects of trampling are localised and cause negligible damage.

The major threat to the beach appears to be the natural effect of tidal damage to the structure of the ridge. This has resulted in the need for a variety of stabilization measures, including the presence of groynes, a sea wall at the south-western end of the beach, and the reworking of shingle in the central section. Clearly, this reworking damaged the limited shingle flora at this site both by the act of moving the shingle and by the vehicles crossing the site.

There has been no form of agriculture on the shingle beach, although there is livestock farming on the alluvial area behind the beach. There is no evidence of grazing on the beach.

Vegetation
The shingle ridge supports very little flora, a reflection, perhaps, of the recent storm damage. There are three older shingle ridges inland which support an open scrub community but the improvement of the grassland around these bars may have influenced the species composition.

The vegetation on the shingle ridge is found in patches on the lee slope. Within these patches there are several communities represented ranging from scrub assemblages to pioneer communities. The open pioneer community seen in several places along the beach is a *Rumex cripus littoreus - Silene vulgaris maritima* community which contains very few associate species. Typically, these include *Atriplex prostrata* and *Plantago coronopus.*

In places this develops into a *Festuca rubra* grassland community. This is characterised by the constant presence of *Festuca rubra* and *Plantago coronopus* while additional maritime herbs such as *Armeria maritima* and *Atriplex prostrata,* along with non-maritime species such as *Plantago lanceolata,* are also important components. The *Festuca rubra* provides much cover in these areas (Domin score 8–9); however, there is still 20% bare shingle in each quadrat.

A second grassland community, seen across much of the lee slope, is very different in nature. This is a very open *Arrhenatherum elatius* dominated community. Herb associates include *Rumex acetosella, Silene vulgaris maritima, Geranium robertianum* and *Sedum anglicum.* However, these are only very minor elements.

This grassland may be a precursor to the development of a *Rubus fruticosus - Arrhenatherum elatius* scrub community which occurs along much of the beach. This is a very species-poor assemblage with *Plantago lanceolata* as the major associate.

The final community is defined by the importance of *Ulex europaeus* which has an average Domin score of 8–9. *Rubus fruticosus* is the only associate in this scrub.

Key
SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH108 *Ulex europaeus - Rubus fruticosus* scrub community;

SH37 *Arrhenatherum elatius - Silene vulgaris maritima*
maritima grassland;

SH32 *Festuca rubra - Plantago coronopus* grassland;

SH3 *Rumex cripus littoreus - Silene vulgaris*
pioneer community;

T1 bare shingle ridge supporting *Rubus fruticosus, Crataegus monogyna* and scattered *Geranium robertianum.*

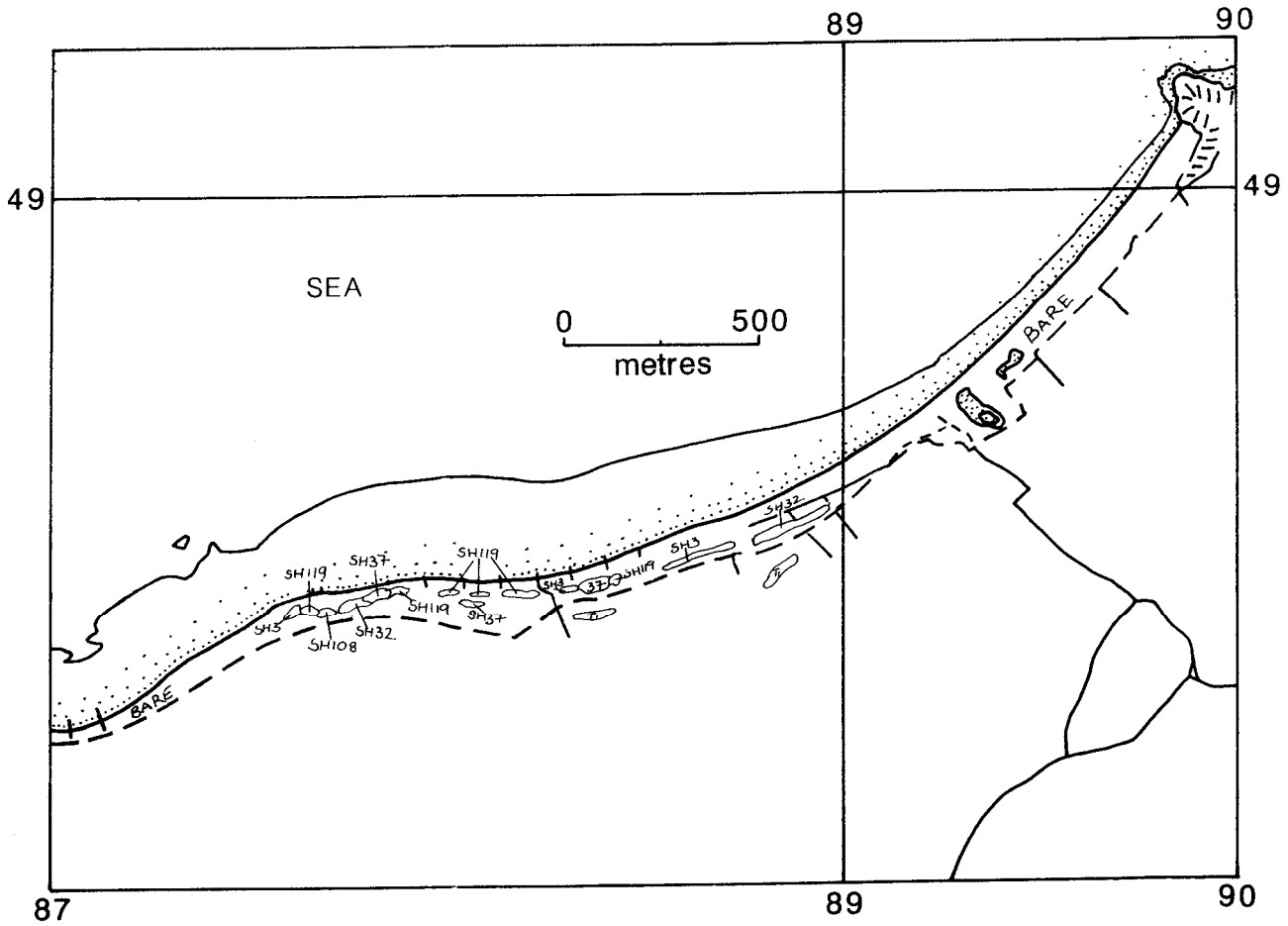

Figure 26 Porlock Beach

Bridgwater Bay

Somerset. ST 239457
Conservation status: SSSI, NNR
Area surveyed: 25.3 ha
Fieldwork dates: 24-25/6/90

Introduction
This site comprises a series of shingle ridges which run west-east along the shore of Bridgwater Bay, with Hinkley Point serving as the western delimiter of the ridges. These ridges have led to the enclosure of areas of saltmarsh trapped behind or between them. Many of the ridges are currently active and subject to maritime influences and, hence, largely bare. However, behind the active shingle ridges, there is a clear shingle base for the alluvial sediments with, at most, 5 cm of alluvium above shingle; these were, therefore, sampled. Some of the older ridges are visible in the landscape. The recent storms have resulted in over-topping of a sea wall in places.

Threats and management
There is grazing across much of the grassland behind the sea wall at Wall Common, and on the grassland behind the shingle ridge. There is evidence of reworked shingle in areas which would, clearly, influence the natural vegetation. In addition there is evidence of local vehicular damage to the site which is moderate in extent. There has clearly been some gravel extraction at this site, an operation which is not to be encouraged given the obvious erosion at the site.

The site is widely used for recreational purposes; however, any ill-effects associated with this are negligible.

Vegetation
The communities found on the shingle areas largely reflect the saltmarsh influences on this site, although there is some development of scrub in the east.

Most of the areas behind the active shingle ridge support a *Festuca rubra - Plantago coronopus* grassland. Additional minor constants include *Plantago lanceolata, Lolium perenne* and *Atriplex prostrata.* There is some variation in the cover provided by this community which ranges from 5% bare shingle in each quadrat to 70% bare shingle with 10% silt. The stability of certain areas supporting this community is illustrated in the presence of moss and lichen species, in particular *Cladonia furcata* and *Hypnum cupressiforme.*

Other areas support more obvious saltmarsh communities, notably a *Festuca rubra - Plantago maritima - Hordeum maritimum* grassland (which keys out as SM 16), a *Suaeda maritima - Puccinellia maritima* assemblage (keying out as SM9), and an *Elytrigia atherica* grassland (which is SM24).

In one small area there is a more closed and species-rich grassland, found where the proportion of silt in the matrix is slightly lower. This community is a *Festuca rubra* rich grassland with *Hypnum cupressiforme, Lotus corniculatus* and *Plantago lanceolata* as additional constants. *Cirsium vulgare, Leontodon hispidus, Hieracium pilosella* and *Daucus carota* are frequent associates in this herb-rich grassland.

There is also a scrub community which is found at the base of the lee slope at the western end of Wall Common. It is characterised by the constant presence of *Prunus spinosa* and *Rubus fruticosus,* while *Hedera helix* is an occasional scrub associate. Herb associates include *Urtica dioica, Galium aparine* and *Solanum dulcamara.*

Key
SH123 *Prunus spinosa* dominated scrub with *Rubus fruticosus - Dactylis glomerata - Rosa pimpinellifolia* community;

SH48 *Festuca rubra - Hypnum cupressiforme - Lotus corniculatus- Plantago lanceolata* community;

SH32 *Festuca rubra - Plantago coronopus* grassland;

SM24 *Elytrigia atherica* saltmarsh;

SM16 *Festuca rubra* saltmarsh;

SM9 *Suaeda maritima* saltmarsh.

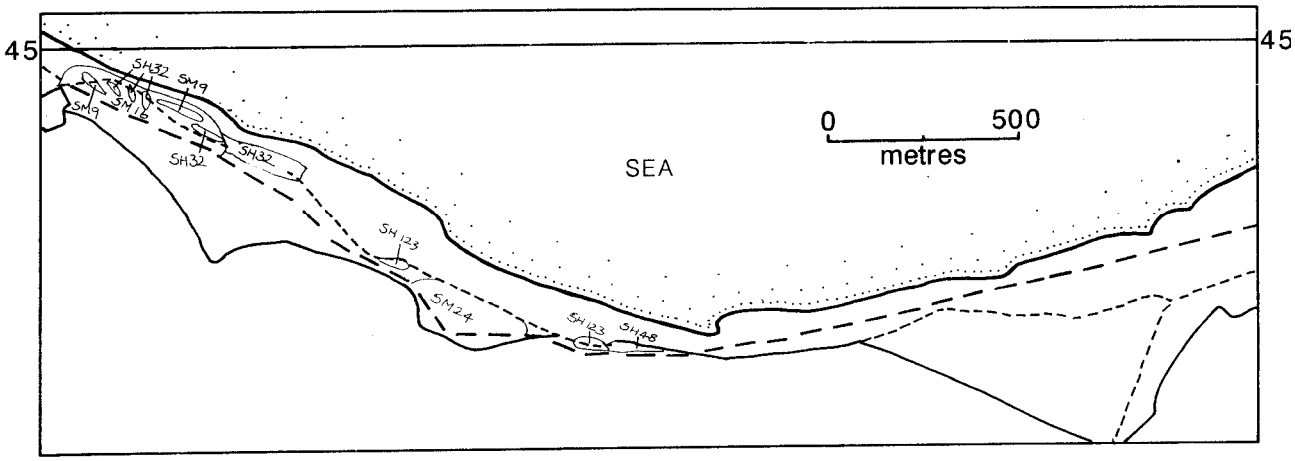

Figure 27 Bridgwater Bay

Foulney Island

Cumbria. SD 240650
Conservation status: SSSI
Area surveyed: 21.6 ha
Fieldwork dates: 23–27/10/89

Introduction
Foulney Island is a spit with an island at its distal end which is formed by several recurved hooks at the end of the spit with lower areas of marsh sediments trapped between ridges. The currents in this area have led to a very pronounced recurve and the bare, active part of the spit at the distal end is, in fact, parallel to the narrow limb of the spit. The Foulney embankment, which joins the spit to the mainland, is covered at high tides and so is devoid of vegetation.

Threats and management
There is clearly erosion at this site with attempts made to bolster the spit at its narrowest point. A sea wall has been built along the western shore of the main limb of the spit, where it narrows and runs the risk of breaching. There is a track which runs out to halfway along the spit and there is some vehicular damage to this part of the site. However, the damage is localised and only negligible in extent. The same is true of the limited recreational pressure on the site.

There is a building on the spit limb and this has clearly led to a loss of shingle vegetation, but this is minimal.

Although there is no agricultural improvement to the site, there is widespread grazing by rabbits.

Vegetation
There are several communities found on Foulney spit, ranging from pioneer assemblages through to grassland communities.

On the active part of the spit, the high organic input has encouraged the development of a particularly rich pioneer flora. This is characterised by the constant, and major, presence of *Beta vulgaris maritima.* The prime associates in this community are *Rumex cripus littoreus, Sinapis arvensis, Poa pratensis* and *Dactylis glomerata.* The nutrient input to this area has led to an unusually luxuriant growth of *Beta vulgaris maritima* which provides more cover than would normally be associated with such an exposed area (Domin score 7–9) with little bare shingle visible. This area is clearly subject to regular inundation as illustrated by the presence of drift in the quadrats.

This community gives way to a more typical shingle pioneer assemblage which is more open in nature (95% bare shingle in each quadrat). The key constants in this assemblage are *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* with *Silene vulgaris maritima* and *Geranium robertianum* as frequent associates. This part of the spit is more exposed but being closer to the terrestrial area of the spit gets less nutrient input.

The thin strip of shingle running around the southern edge of the spit, immediately above mean high water mark, supports a slightly different pioneer community. In this case it is the relative importance of *Silene vulgaris maritima* and *Glaucium flavum* which leads to the community distinction. In this assemblage *Silene vulgaris maritima* becomes the dominant species providing most cover (Domin score 7–8). *Rumex cripus littoreus* and *Tripleurospermum maritimum* are the minor constants while *Cakile maritima, Atriplex* spp. and *Plantago lanceolata* are the major associates.

The main body of the island formed by the recurved hooks supports two major communities, both of which are *Festuca rubra* dominated grasslands. The first is a *Festuca rubra - Plantago lanceolata - Poa pratensis* mixed grassland with *Dactylis glomerata* and *Arrhenatherum elatius* as major associates. This assemblage has a major herb element, with particular emphasis on *Achillea millefolium, Rumex acetosa, Galium verum, Vicia lathyroides, Geranium molle* and *Stachys arvensis.*

The second *Festuca rubra* dominated assemblage is defined by the constant presence

of *Festuca rubra - Plantago lanceolata - Lotus corniculatus. Dactylis glomerata* and *Poa pratensis* are also found in this assemblage, but they occur only as occasional associates. The major associates in this case include *Ranunculus repens, Senecio jacobaea, Hypochoeris radicata* and *Silene vulgaris maritima.* This is a less diverse community than that described above.

Another grassland found on the island at the end of the spit is typical of lower areas with a high silt proportion in the shingle matrix. This assemblage comprises a *Festuca rubra - Armeria maritima - Plantago lanceolata* grassland, with additional maritime species commonly found in association. The main associates include *Elymus repens, Cochlearia officinalis* and *Silene vulgaris maritima.* This grassland is dominated by *Festuca rubra* (Domin score 9, on average), and this is reflected in the lack *of* associate species. This community gives way to a different *Festuca rubra* grassland in a low-lying depression between the first two ridges at the junction *of* the island and the main body of the spit.

This assemblage is defined by the additional constant and important presence *of Plantago coronopus* in a *Festuca rubra - Armeria maritima* grassland with *Plantago maritima* as a frequent associate. The major difference, however, between this and the previous community is the major lichen component in this assemblage. *Cladonia rangiformis* and *C. furcata* are the main lichen associates.

This develops into a *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland assemblage on sheltered areas. This community is a species-rich assemblage typical of a more stable environment associated with areas less prone to flooding. The stability is illustrated not only in the presence of the moss *Dicranum scoparium* but also in a diverse lichen flora which, in this case, includes *Cladonia furcata* and *C. portentosa.* This assemblage is rich in herbs with *Rumex acetosa, Galium verum, Vicia lathyroides, Silene vulgaris maritima, Cerastium fontanum* and *Sedum acre* as major associates, along with the moss *Hypnum cupressiforme.*

The final community on this site is found on the shingle/marsh boundary which runs around the northern edge of the island. It comprises a *Atriplex portulacoides - Elymus repens* community with *Cochlearia officinalis, Beta vulgaris maritima* and *Salicornia* agg. as frequent associates. This community was sampled to facilitate complete mapping of the site although it falls outside the shingle classification, keying out to SM14.

Key

SH68 *Festuca rubra - Plantago lanceolata - Poa pratensis* community;

SH66 *Festuca rubra - Plantago lanceolata - Lotus corniculatus* community;

SH43 *Dicranum scoparium - Festuca rubra - Plantago lanceolata* grassland community;

SH34 *Festuca rubra - Armeria maritima - Plantago maritima* grassland;

SH33 *Plantago coronopus - Armeria maritima* – *Festuca rubra* grassland;

SH25 *Silene vulgaris maritima - Rumex cripus littoreus*
– *Tripleurospermum maritimum* pioneer community;

SH24 *Rumex cripus littoreus - Tripleurospermum maritimum - Glaucium flavum* community;

SH15 *Beta vulgaris maritima - Rumex cripus littoreus* pioneer community;

SM14 *Atriplex portulacoides* saltmarsh.

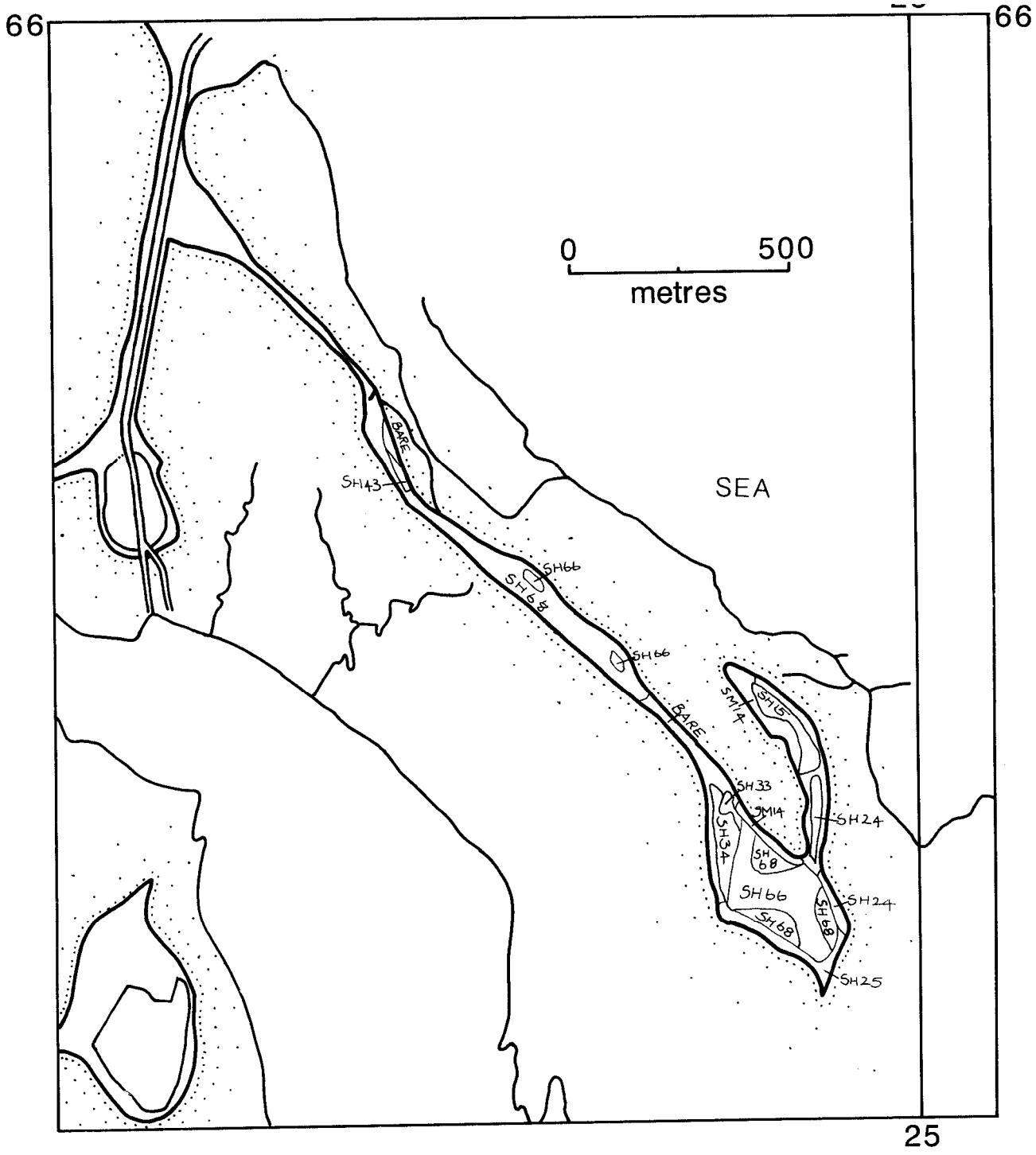

Figure 28 Foulney Island

South Walney

Cumbria. SD 234620
Conservation status: SSSI, NNR
Area surveyed: 11.38 ha
Fieldwork dates: 13—15/10/89

Introduction
This site is the southern end of Walney Island, a barrier island which has developed off the south eastern shore of Cumbria. The main area of shingle takes the form of a spit which is situated at the southern end of South End Haws. The spit is a pure shingle structure with a high sand content at the distal end where separate recurved hooks have trapped saltmarsh sediments in lows between hooks.

The spit is in equilibrium with natural maritime forces although it is occasionally inundated during particularly high tides.

Threats and management
The South End Haws forms part of a nature reserve managed by the Cumbria Trust for Nature Conservation and this has restricted any damage to the site. In particular, vehicular access to the site is restricted with limited access to the oyster farm and the lighthouse only.

This site is a major breeding ground for gulls and, on the shingle spit, for terns. This tends to limit the recreational use of the site to bird watchers. Public access is restricted during the breeding season and efforts are made to encourage the use of set routes across the site. Clearly this serves to protect plant communities also, especially those on the spit which is fenced off for much of the year.

Much of the sand dunes and marshes adjacent to the site are used for grazing sheep and cattle, which graze on the shingle spit at low tide. Other than this fertilization of the site, there has been no further agricultural influence on the spit.

A major threat to the more terrestrial areas of the site is posed by the effects of past gravel extraction from the shingle skeleton. This has led to the formation of gravel pits which have been flooded and are currently used for oyster farming. The initial extraction has clearly led to a loss in natural vegetation of the site and current disturbance continues to disrupt the new communities. This disturbance takes the form of trampling and influences from the controlled introduction of sea water into the pits, and so into terrestrial environments. There is also some vehicular damage associated with the oyster farm and some loss of vegetation associated with buildings. The rearrangement of pit boundaries also causes disturbance to vegetation and difficulties in mapping vegetation in this area.

The presence of nesting birds on the spit leads to an unusually high input of nutrients which, combined with high organic input from drift, leads to the development of very rich plant assemblages.

Vegetation
The spit illustrates examples of rich pioneer communities, along with grasslands and saltmarsh-influenced assemblages. The area around the oyster farm supports grassland and scrub communities.

At the southern, proximal, end of the spit, the sandy nature of the substrate is reflected in the community found there. The proportion of sand in the matrix at this point is very high as it blows onto the shingle from the adjacent dunes. It comprises an *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* assemblage with few associates. These are chiefly *Erodium cicutarium, Sedum acre* and *Honckenya peploides,* although none provides any great cover.

This gives way to a pioneer community which is found on much of the main limb of the spit. It is characterised by the constant presence of *Silene vulgaris maritima, Rumex cripus littoreus* and *Cochlearia officinalis* with *Lolium perenne* as the Gramineae constant. This community contains ten species per quadrat; more than would normally be expected from pioneer communities. The major associates include *Tripleurospermum maritimum, Taraxacum*

officinalis agg., *sedum acre, Senecio viscosus, Honckenya peploides* and *Stellaria media.* This is an unusual assemblage which keys out to SH26.

A separate pioneer community is seen on the eastern foreshore of the spit. This is a *Tripleurospermum maritimum - Glaucium flavum - Senecio viscosus* community which is very open (95% bare shingle in each quadrat). *Rumex cripus littoreus* and *Silene vulgaris maritima* are most commonly found in association with the constants in this assemblage.

At the northern end of the spit, where the recurves lead to a wider area of shingle being formed, a community which is unique to the site develops. This community may be defined by the constant and major presence of *Lolium perenne, Stellaria media* and *Sedum acre.* This community is found at the north-eastern edge of this area. On the more stable, inland areas of the spit, this develops into a *Lolium perenne - Stellaria media - Sedum acre - Geranium molle* community where the *Geranium molle* becomes a very important element in the assemblage. Major associates include *Sisymbrium officinale, Hypochoeris radicata, Erodium cicutarium* and *Tripleurospermum maritimum* in this unusually rich community (twenty species per quadrat, on average). This community is widely grazed and fertilized by cattle and sheep.

The lower areas between the recurved shingle hooks support very different communities associated with less well-drained conditions and a higher silt content in the shingle matrix. The first of these comprises a *Beta vulgaris maritima - Elymus repens - Atriplex littoralis* assemblage which lies outside the shingle classification; it most closely resembles SM28. In some areas this community gives way to a *Cochlearia officinalis* dominated assemblage. The *Cochlearia officinalis* provides a high degree of cover (Domin score 8) and this precludes the occurrence of many associates. *Atriplex littoralis* and *Elymus repens* are minor constants in this assemblage, which is clearly inundated at regular intervals, as illustrated by the presence of fresh drift in quadrats.

On the better drained shingle ridge at the north of this part of the site, an area which is exposed to marsh and maritime influences, a slightly different community develops. This is a *Beta vulgaris maritima - Rumex cripus littoreus* community with marsh and shingle elements. *Lolium perenne* and *Sisymbrium officinale* play an important role in the assemblage which seems to be a transition between the communities described in the two previous paragraphs.

There is a major depression on the south-western edge of the recurves between the two external shingle ridges. This is a much wetter area with poor drainage; indeed, at the time of fieldwork it contained a small pool of standing water. This area supports a community which is clearly saltmarsh in nature. It is an example of SM13, a *Puccinellia maritima* dominated assemblage with *Spergularia marginata* and *Cochlearia officinalis* as frequent associates. This community is also found around the marsh edge of the small projections of shingle on the western edge of the spit (incipient laterals). On better drained shingle on the southern lateral, this community develops into a *Spergularia marina - Plantago maritima - Festuca rubra* assemblage with *Puccinellia maritima* and *Cochlearia officinalis* as minor constants.

The areas surrounding the very disturbed shingle of the oyster farm support two shingle communities. The first is the *Lolium perenne - Stellaria media - Sedum acre* community which is also seen on the distal end of the spit. This has *Geranium molle, Erodium cicutarium, Echium vulgare* and *Urtica dioica* as the major associates, and is found on the walkways between gravel pits and around the pier.

A *Rubus fruticosus* dominated scrub is found on much of the area around the gravel pits. This scrub community contains *Sambucus nigra, Lolium perenne, Cirsium vulgare, Echium vulgare* and *Urtica dioica* as associates. The *Rubus fruticosus,* however, provides almost total cover (Domin score 9-10), and this may exclude many associates.

Key

SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH76 *Spergularia marina - Plantago marina - Puccinellia maritima* community;

SH26 *Honckenya peploides - Silene vulgaris maritima* pioneer community;

SH24 *Rumex cripus littoreus - Tripleurospermum littoreus maritimum - Glaucium flavum* pioneer community;

SH21 *Ammophila arenaria - Rumex cripus littoreus - Senecio viscosus* community;

SH20a *Lolium perenne - Stellaria media - Sedum acre* open community, *Geranium molle* sub-community;

SH20 *Lolium perenne - Stellaria media - Sedum acre* open community;

SH15 *Beta vulgaris maritima - Rumex cripus* pioneer community;

SH14 *Cochlearia officinalis - Atriplex littoralis* community;

SM28 *Elymus repens* saltmarsh;

SM13 *Puccinellia maritima* saltmarsh.

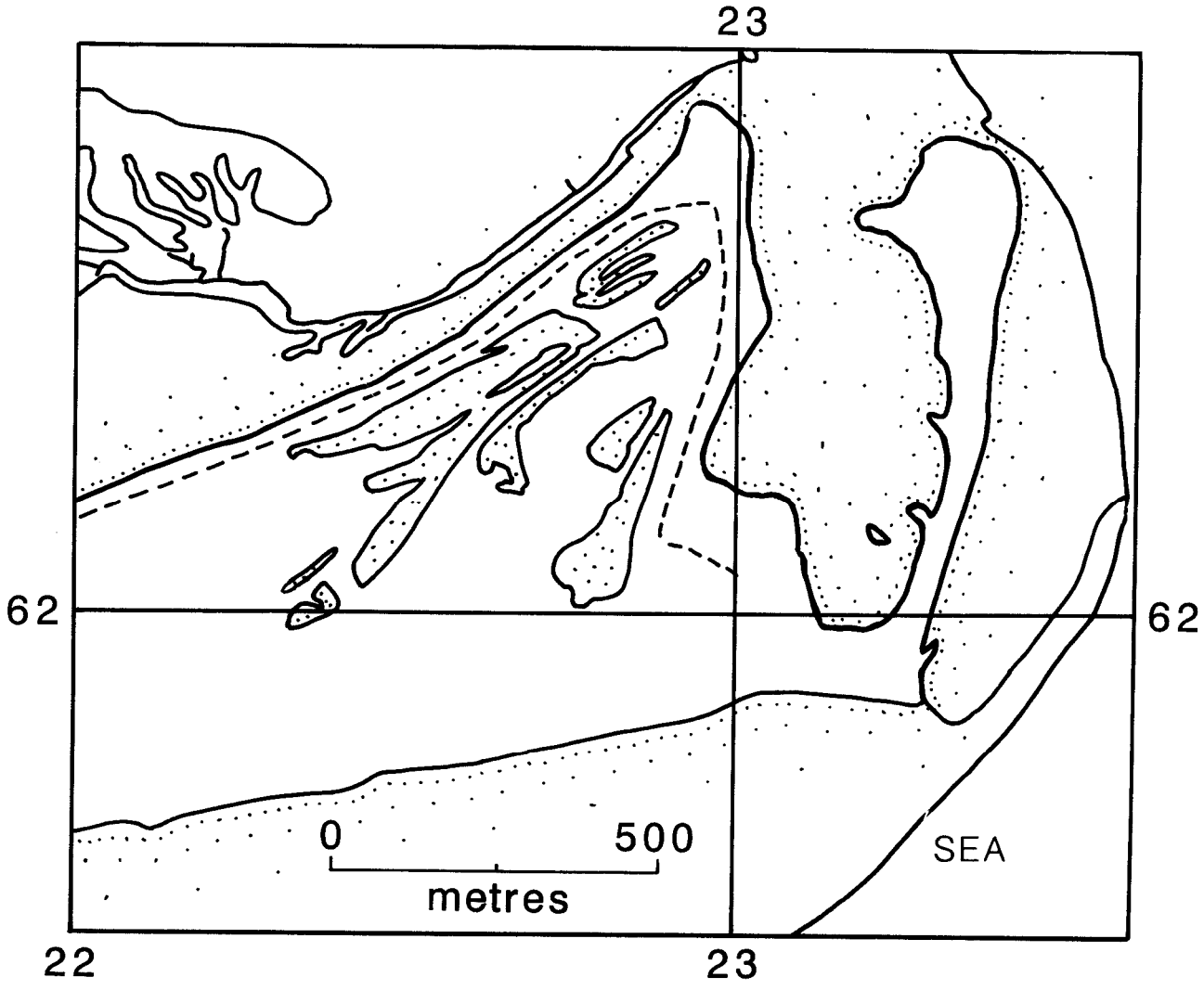

Figure 29a South Walney (site)

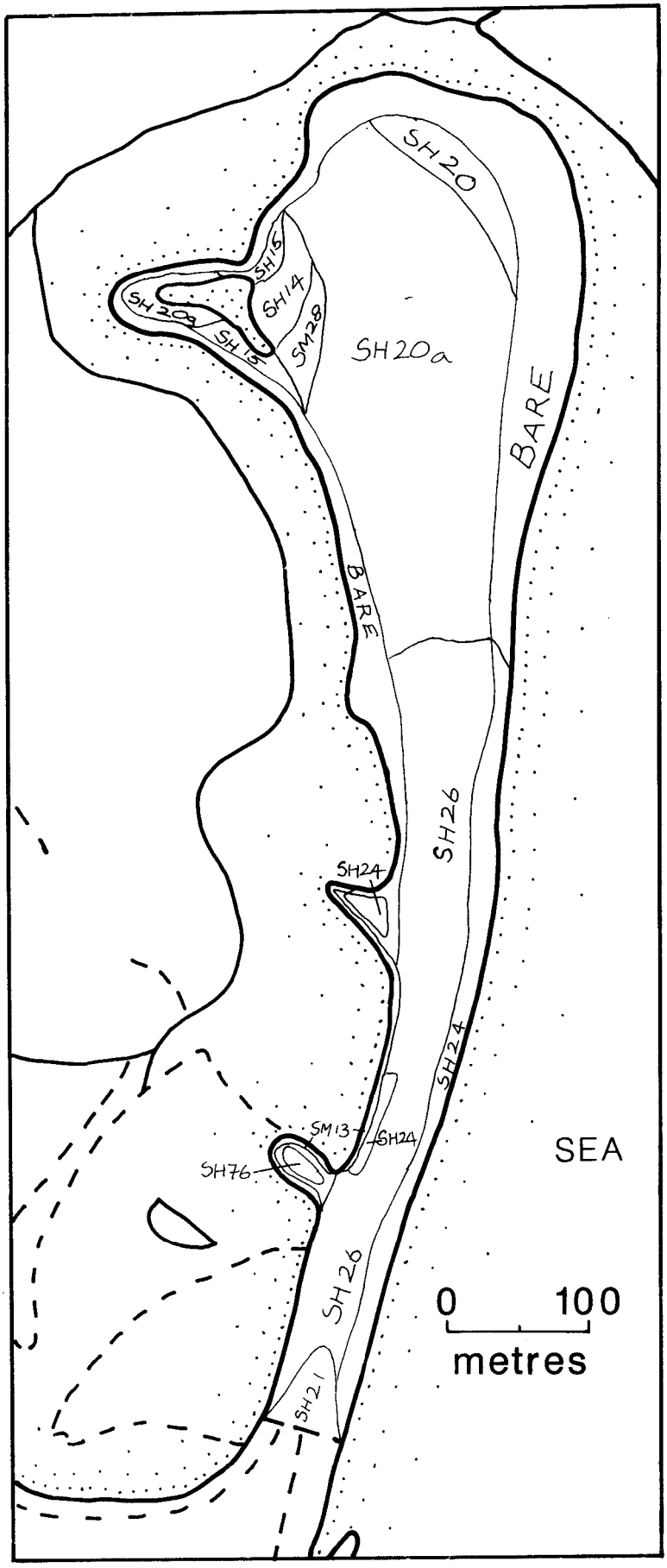

Figure 29b South Walney (vegetation)

North Walney

Cumbria. SD 177724
Conservation status: SSSI, NNR
Area surveyed: not measured
Fieldwork date: 5/7/89

Introduction
This site lies at the northern end of Walney Island, an example of a barrier island, a relatively rare geomorphological feature in Britain. The island is the product of erosion and the subsequent reworking of glacial boulder clay. While shingle may form the skeleton of the island, an extensive dune system has developed over much of the island. Indeed, the northern section of the site consists primarily of dunes, which are fed by sand sediments from the intertidal zone. However, in a slack area, immediately behind the foredunes at the northern extreme of the terrestrial part of the site, there is a small area where shingle is clearly visible in the substrate. Indeed, this area displays the regular ridge and low structure characteristic of shingle deposits. Although this is clearly shingle, there remains a high proportion of sand within the shingle matrix. This is the area which has been sampled for this survey. Owing to the presence of mixed sand and shingle, this site was not mapped accurately for area measurement.

Threats and management
Clearly, the fact that this is within an SSSI has led to protection from development. In addition, this area is relatively remote from the major car park to the south, and is, therefore, largely undisturbed. There is no vehicular access to the site north of the aerodrome and any recreational pressure on the site is local and causes negligible damage.

There is no agricultural improvement of this part of the site, but it is widely grazed by rabbits.

Vegetation
Two communities are found on vegetated shingle on this site. The first is a strandline community which is found on the shingle foreshore which runs along the western shore from the sea defence works, south to the car park. It is an intermittent community of pioneer species. It is defined by the constant presence of *Honckenya peploides, Elytrigia atherica* and *Ammophila arenaria.*

The second assemblage, found in the stable shingle slack, is a grassland community characterised by the constant presence of *Festuca rubra - Lotus corniculatus - Thymus polytrichus britannicus - Cladonia furcata;* indeed, there is a very major lichen component in this community. The fragility of lichen floras is illustrated here where a footprint can cause great damage. A more natural threat to this community is the picking of clumps of moss by birds. The major moss associates include *Dicranum scoparium* and *Hypnum cupressiforme.*

Key
SH49 *Festuca rubra - Lotus corniculatus - Thymus polytrichus britannicus- Cladonia furcata* grassland;

SH28 *Honckenya peploides - Elytrigia atherica - Ammophila arenaria* community.

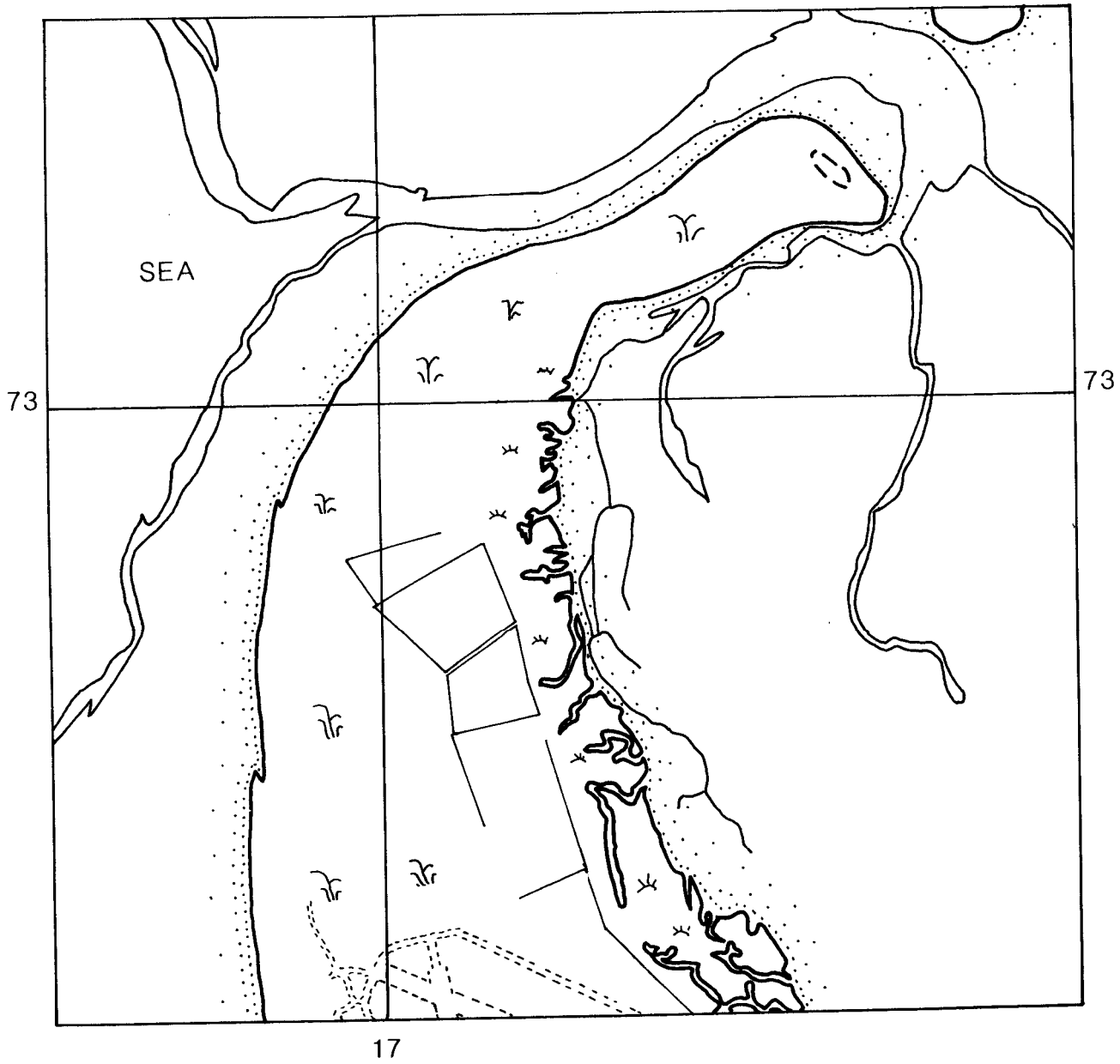

Figure 30 North Walney

Grune Point

Cumbria. NY 140560
Conservation status: none (adjacent to SSSI
Area surveyed: 23.1 ha
Fieldwork dates: 9–10/10/89

Introduction
This site is a composite spit which has built out from the north Cumbria coast at Skinburness. Topographically it is clear that the existing spit represents a series of spits illustrating different depositional phases. These spits have recurved hooks at the distal end which have now enclosed low-lying areas which contain saltmarsh sediments. The current foreshore is shingle with sand and the spit is clearly still accreting, with younger hooks supporting pioneer vegetation on the western edge of the spit. In these areas the low-lying depressions remain unvegetated suggesting that they continue to be inundated at frequent intervals.

While the structure of this feature indicates the presence of a shingle substrate with shingle clearly visible in places, this has served as a skeleton on which sand has accumulated. The sand-capping ranges in depth from 5 cm to more than 30 cm and so vegetation is not indicative of a truly shingle substrate. Sampling was, therefore, restricted to areas where sand-capping is less than 20 cm.

Threats
Much of the main body of the spit is used for recreational purposes, in particular for birdwatching. This has led to localised damage of the flora on pathways; however, overall damage from recreational activities remains negligible.

While vehicular access to the site is restricted, tyre tracks on the spit illustrate the potential damage which would result from wider access. At present, however, damage is localised and negligible in extent.

There has been some loss of natural vegetation through the building of Grune House on the spit but, other than this, there has been no development on the spit.

Management
A large part of the eastern section of the spit has been lost to agriculture with fields fenced off and used for grazing livestock. Indeed, the open access section of the spit is also widely grazed by sheep, although selective grazing favours the communities in the low-lying areas.

Vegetation
Sampling of vegetation for this survey was restricted to the distal section of the spit where the shingle influence is more clearly displayed.

There is a scrub community found across much of Grune Point, which comprises an *Ulex europaeus* dominated assemblage. The dominance of *Ulex europaeus*, in terms of the cover provided (Domin score 9–10), excludes the presence of many associates in this community. *Agrostis capillaris* is the minor constant while additional Gramineae species are found as frequent associates, in particular *Dactylis glomerata*, *Festuca rubra* and *Elymus repens*, although these offer very little cover (Domin score 2, on average). In more stable areas, this community supports a well-established bryophyte flora with *Eurhynchium praelongum* and *Hypnum cupressiforme* as the major moss associates.

A second community with a scrub element is found at this site. In this case, however, the *Ulex europaeus* is less dominant and is found within a well-developed, mixed grassland assemblage. This may represent an early stage in the development of the scrub community described above. This assemblage may be defined by the constant presence of *Ulex europaeus*, *Festuca rubra* and *Poa pratensis* in a species-rich grassland. The *Ulex europaeus* is only a minor constant, offering little cover (Domin score 4–5), while *Agrostis capillaris* is an additional important constant. *Elymus repens*, *Dactylis glomerata* and *Anthoxanthum odoratum* comprise the additional, if minor, Gramineae components in this mixed grassland. The major herb associates include *Cerastium fontanum*, *Achillea millefolium*, *Trifolium repens*, *Hypochoeris radicata* and *Vicia lathyroides*, while the mosses *Pseudoscleropodium purum* and

Rhytidiadelphus squarrosus are also found as frequent associates.

There is a clear arenicolous influence on the major grassland communities found across much of the spit. The major assemblage found on the seaward margin of the spit and subject to maritime influences is characterised by the constant presence of *Ammophila arenaria, Carex arenaria* and, to a lesser extent, *Festuca rubra.* Despite the importance of *Ammophila arenaria* in terms of cover (Domin score 7-8), this is an open community with up to 70% bare sand in each quadrat. *Elymus farctus boreali-atlanticus* and the herbs *Galium verum, Achillea millefolium* and *Ononis repens* are the most frequent associates in this species-poor community.

On less maritime, more stable areas of the spit, this community develops into a closed grassland, although the sandy substrate remains a clear influence on species composition. *Festuca rubra, Poa pratensis, Ammophila arenaria* and *Carex arenaria* are the major indicator species for this community. This is a species-rich assemblage with 22 species per quadrat. The major herb associates include *Hypochoeris radicata, Galium verum, Vicia lathyroides, Trifolium repens, Lotus corniculatus, Leontodon autumnalis, Cerastium fontanum* and *Vicia cracca* while *Plantago lanceolata, Taraxacum officinalis* agg. and *Achillea millefolium* are minor associates. There is a major bryophyte component in this stable grassland with particular emphasis on *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum.*

The low-lying areas support two *Festuca rubra* grassland communities. The first is a *Festuca rubra - Armeria maritima - Plantago maritima* community typical of areas with a high silt content in the shingle matrix. The *Festuca rubra* is the dominant component providing almost total cover and, hence, the community is relatively species-poor with few associates.

In areas which are less likely to be inundated, this grassland develops into a more diverse *Festuca rubra* assemblage which again has *Armeria maritima* and *Plantago maritima* as associates but with *Plantago coronopus* as an additional constant. The *Festuca rubra* is less dominant and this leads to the presence of more associates, in particular *Agrostis stolonifera, Elytrigia atherica* and *Cerastium* sp.

Key

SH109 *Ulex europaeus - Rubus fruticosus - Agrostis capillaries* scrub community;

SH59 *Ammophila arenaria - Carex arenaria - Festuca rubra* community;

SH58 *Ulex europaeus - Festuca rubra- Poa pratensis* mixed grassland community;

SH57 *Festuca rubra - Poa pratensis - Ammophila arenaria - Carex arenaria* grassland;

SH34 *Festuca rubra - Armeria maritima - Plantago maritima* grassland;

SH33 *Plantago coronopus - Armeria maritima - Festuca rubra* grassland.

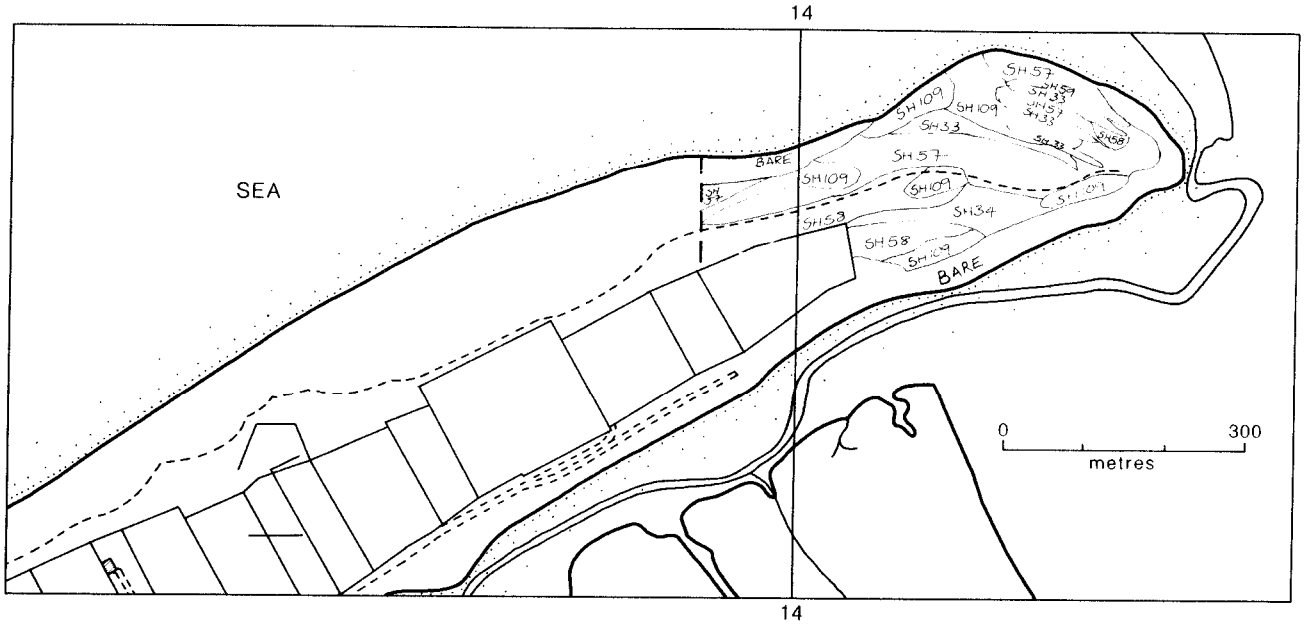

Figure 31 Grune Point

References

For all key references relating to shingle vegetation see:

Sneddon, P., & Randall, R.E. 1989. *Vegetated shingle structures survey of Great Britain: Bibliography.* Peterborough, Nature Conservancy Council. (Research & survey in nature conservation, No. 20.)

Additional references cited in this text are:

Burd, F. 1989. *The saltmarsh survey of Great Britain.* Peterborough, Nature Conservancy Council. (Research & survey in nature conservation, No. 17.)

Chapman, V.J. 1976. *Coastal Vegetation.* Oxford, Pergamon Press.

Clapham, A.R., Tutin, T.G., & Moore, D.M. 1987. *Flora of the British Isles.* 3rd ed. Cambridge, Cambridge University Press.

Dobson, F. 1991. *Lichens.* 3rd ed. Slough, Richmond Publishing.

Ferry, B., & Waters, S. 1985. *Dungeness ecology and conservation.* Peterborough, Nature Conservancy Council. (Focus on nature conservation, No. 12.)

Ferry, B., Lodge, N., & Waters, S. 1990. *Dungeness: a vegetation survey of a shingle beach.* Peterborough, Nature Conservancy Council. (Research & survey in nature conservation, No. 26.)

Fuller, R.M. 1987. Vegetation establishment on shingle beaches. *Journal of Ecology, 75:* 1077—1089.

Fuller, R.M. 1989. *Dungeness vegetation survey — mapping.* Peterborough, Nature Conservancy Council. (CSD report, No. 729.)

Randall, R.E. 1977. Shingle formations. *In: The Coastline,* ed. by R.S.K. Barnes. London, Wiley.

Randall, R.E., Sneddon, P., & Doody, J.P. 1990. *Coastal shingle in Great Britain: a preliminary review.* Peterborough, Nature Conservancy Council. (Contract surveys No. 85.)

Rayner, R.W. 1981. *The natural history of Pagham Harbour.* Bognor Regis Natural Science Society.

Scott, G.A.M. 1963. The ecology of shingle beach plants. *Journal of Ecology, 51:* 733—742.

Sneddon, P. 1992. *Variations in shingle vegetation around the British coastline.* PhD. Thesis, University of Cambridge.

Sneddon, P., & Randall, R.E. 1993. *Coastal vegetated shingle structures of Great Britain: main report.* Peterborough, Joint Nature Conservation Committee.

Sparks, B. 1972. *Geomorphology.* London, Longman.

Steers, J.A. 1964. *The coastline of England and Wales.* Cambridge, Cambridge University Press.

Watson, E.V. 1968. *British Mosses and Liverworts,* Cambridge, Cambridge University Press.

The Joint Nature Conservation Committee is a forum through which the three country nature conservation agencies, the Countryside Council for Wales, English Nature and Scottish Natural Heritage, deliver their special statutory responsibilities for Great Britain as a whole and internationally. These special responsibilities, known as the special functions, contribute to sustaining and enriching biological diversity, enhancing geological features and sustaining natural systems. These special functions are:

- to devise and maintain common standards and protocols for nature conservation;
- to promote, through common standards, the free interchange of data between the country agencies and with external partners;
- to advise on nature conservation issues affecting Great Britain as a whole;
- to pursue wider international goals for nature conservation (encouraging sustainable development, biological diversity and earth science conservation), including the provision of relevant advice to the Government;
- to commission new research and collate existing knowledge in support of these activities, and to disseminate the results.

Coastal Conservation Branch JNCC

Coastal Conservation Branch supports the JNCC and provides essential information and advice on coastal conservation issues in the UK.

The Branch provides an advisory service to the country agencies, as well as information and advice to Government on UK and international issues. It also provides a UK-wide link between conservation bodies, government ministers,
research organisations and conservation managers concerned with coastal management for nature conservation.

The Coastal Review Unit within the Branch facilitates these aims through the collection, collation and analysis of data on coastal wildlife and human activities. Its information base will be linked to other data sources and made available in standardised ways, providing a basis for monitoring, assessment of potential impacts and the development of Coastal Zone management policies.

The Sand Dune Survey of Great Britain, the Inventory of UK Estuaries and the Directory of the North Sea Coastal Margin are some recent projects which contribute to the information base.

JOINT NATURE CONSERVATION COMMITTEE

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