JOINT NATURE CONSERVATION COMMITTEE

Coastal Vegetated Shingle Structures of Great Britain

Appendix 2 - Scotland

Coastal vegetated shingle structures of Great Britain: Appendix 2. Shingle sites in Scotland

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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, PE1 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 Scotland. 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 Scotland forms Appendix 2 to the main report. Further reports are appendices giving site descriptions for Wales and England.

Acknowledgements

The production of this report would have been impossible without the cooperation of the regional staff of Scottish Natural Heritage. In each case help was given in the identification of sites and in obtaining permission for access to those sites for fieldwork. Particular thanks are due to Steve North and Jill Matthews for their help at Kingston and Culbin Bar.

Thanks should also be offered to the staff of The Scottish Wildlife Trust, who allowed access to restricted areas of Ballantrae spit during the site visit.

Finally, many thanks to Ian Agnew of the Cambridge Geography Department Drawing Office and Nigel Philips at Monks Wood, both of whom helped in the production of 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.

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 and 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. These 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 scale 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 Scottish sites was conducted between July and October 1988, and between July and October 1989.

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

Figure 1 Sites in Scotland 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 description 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.

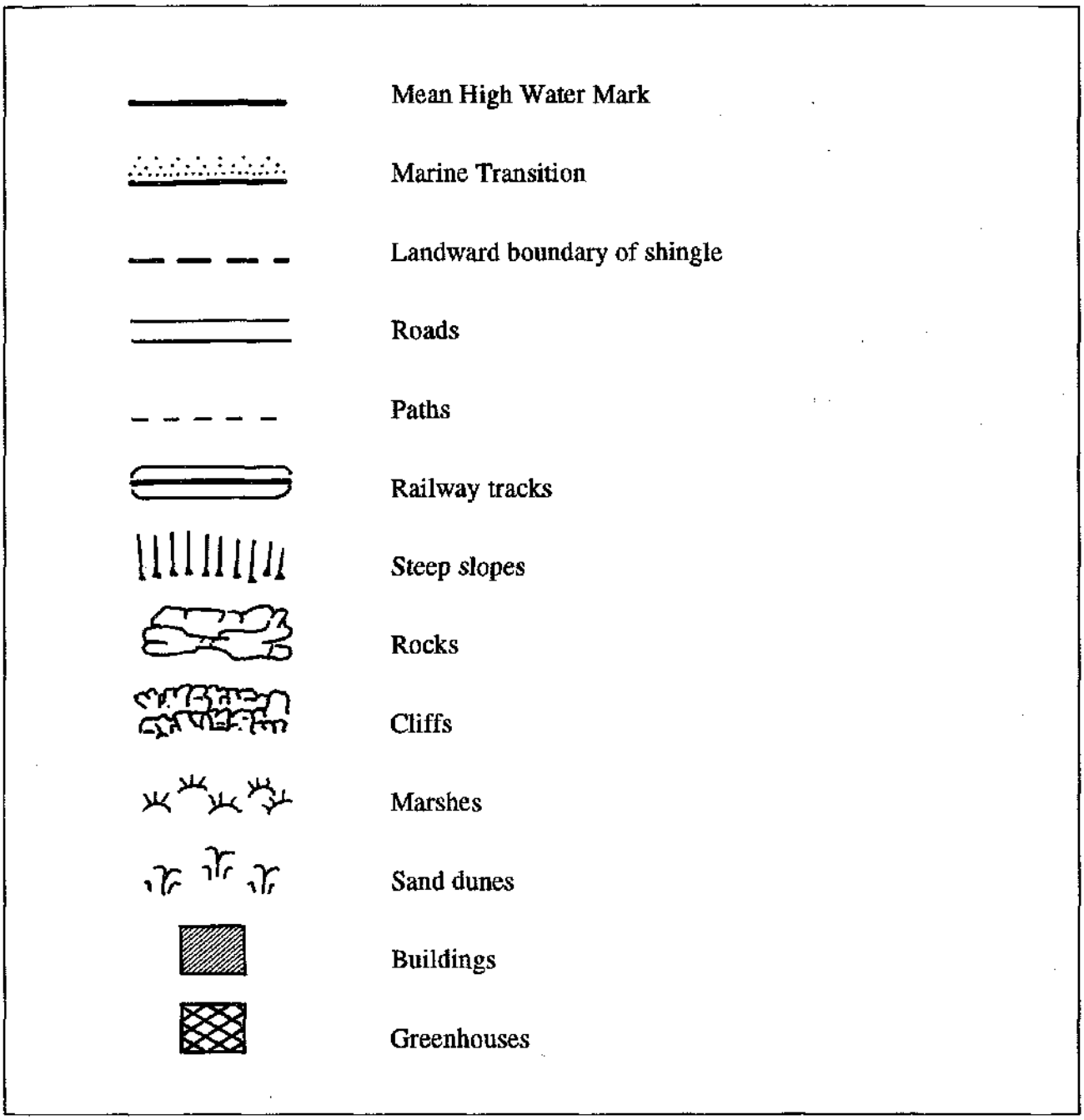

Figure 2 General key to symbols on site maps

Rhunahaorine

Kintyre. NR 695493
Conservation status: SSSI
Area surveyed: 325.8 ha
Fieldwork dates: 5-25/8/89

Introduction
Rhunahaorine Point offers a very good example of a raised cuspate foreland formed during two separate phases of deposition. This site lies 21 km south-west of Tarbert on the west coast of the Kintyre peninsula. The site extends approximately 5 km along the coast.

The series of apposition banks of shingle have produced a cuspate foreland in the lee of Gigha Island. The younger ridges were deposited in a north-west-south-east direction while the ridges laid down in the older phase of deposition run in a south-west-north-east direction. The different phases of deposition are also reflected in varying heights of beach above current sea level. This results from past fluctuations in sea level, with the older ridges raised some 3 metres above the general level of the younger ridges. The raising of the beach has led to poor drainage and the formation of peat.

The ridges, which are clearly visible over the point, can be traced for a short distance to the south of Rhunahaorine. Here the shingle is replaced by fine gravel and sand spreads. The source of the shingle is thought to be from glacial streams draining from a decaying ice lobe situated in West Loch Tarbert.

In the south, a shingle spit growing southwards, has led to the closure of Lochan Luig. This southern section of the site offers examples of wetland communities. For the purposes of description, the site has been divided into two separate areas: the shingle foreland in the north and the wetter area in the south. There is a further distinction drawn between the higher raised beach area on the foreland and the lower level of the foreland.

Little shingle sediment is visible on the foreshore at present because it has all been used in the past to build the foreland.

Threats
The siting of a caravan park on the site in the south has led to some loss of natural vegetation (although parts of the site have been placed in the plantation). The park is sited on the sandier part of the site but also has an impact on the purer shingle areas by heightening recreational pressure on them.

In addition to Rhunahaorine House, there is another set of buildings on the raised area which form part of a fish farm. Each of these result in some direct loss of vegetated shingle.

There is evidence, on the shingle near the foreshore, of both past and current shingle extraction, resulting in major depressions which offer different habitats.

Clearly, the traffic travelling around the caravan site has led to the destruction of vegetation, and in addition, farm vehicles have created tracks in the vegetation on the actual foreland. The resulting damage is moderate and has had a clear effect on the vegetation on a micro-scale.

While the shingle foreland appears to be in equilibrium with existing maritime forces, there is evidence of erosion in the sandy south of the site, near the caravan park, and it has been necessary to place fences along the beach or railway sleepers to halt the erosion at this point.

Management
There are several threats to this site but perhaps the most important is through agriculture. This takes many forms, one of which is the heavy grazing of much of the foreland by cattle and sheep with relatively high stocking levels. This not only has a direct effect on the vegetation but also an indirect effect in the fertilisation it supplies to an otherwise nutrient-poor environment.

In addition, much of the land on the lower, younger ridges has been improved and reseeded which has resulted in a loss of natural vegetation. This has been carried out in strips on the lower beach but has also wrecked much

of the seaward section of the upper beach. There also appears to have been draining of the site in places which will clearly have implications for the flora. Much of the foreland near the road has been lost to crop cultivation.

A large area around Rhunahaorine House has also been lost through the creation of a conifer plantation.

Vegetation

This site offers examples of very varied plant communities, many of which are unique to shingle at this site. The raising of the beach in the north has led to the formation of wetland communities which would not normally be associated with a free-draining substrate such as shingle.

Grassland communities are found across the site, ranging from dune communities in the sandy south to acid grasslands on the raised beach areas in the north-west. Fen communities are found, especially in the south where a spit has trapped a lower-lying, poorly drained area behind, but also in the wetter areas on the shingle in the north.

The drier areas on the main body of the foreland support acid heathland communities and it is interesting to note a clear gradation from the alkaline maritime grasslands through to acid heath vegetation in a comparatively short distance.

The maritime grassland which occupies the raised shingle on the foreshore of the foreland, outside the fenced off area, comprises a *Festuca rubra - Poa pratensis - Plantago maritima - Agrostis stolonifera* herb-rich grassland. *Aira praecox* and *Anthoxanthum odoratum* are minor grass associates in this mixed grassland. This diverse community contains *Trifolium dubium, Plantago lanceolata, Lotus corniculatus, Thymus polytrichus britannicus, Galium verum, Achillea millefolium* and *Euphrasia nemorosa* as the major herb associates. It also has an important bryophyte component with *Dicranum scoparium, Hypnum cupressiforme, Rhytidiadelphus squarrosus* and *Bryum capillare* as minor constants, while *Pleurozium schreberi* is found occasionally.

There are a few heathland species found within this community, in particular *Calluna vulgaris.* The heathland element may be suppressed here because of the maritime influences on the site.

Within the fencing, on the more terrestrial area of the foreland, the grassland gives way to a more acid heathland/grassland characterised by the constant presence of *Calluna vulgaris, Deschampsia flexuosa,* and *Molinia caerulea,* while *Hypnum cupressiforme* and *Potentilla erecta* are the minor constants. Additional heathland indicators include *Erica cinerea* and *Vaccinium myrtillus* as frequent associates while *Erica tetralix* is found occasionally. *Leucobryum glaucum, Pleurozium schreberi* and *Pseudoscleropodium purum* form the moss component which is locally important. Two sedges are commonly associated with this assemblage, namely *Carex vesicaria* and *C. nigra,*

This general community is found across much of the lower beach of the foreland area and in the far north maritime area by the fish farm. Towards the north of the lower beach, near the shore, there is a slight variation in the community with *Myrica gale* found as an additional major constant, perhaps reflecting an area of impeded drainage. This minor variation on a species-rich heath grassland then gives way, to the north, to a less diverse version of the same community with *Juncus squarrosus* rather than *Myrica gale* found as an additional constant. While still displaying heath elements such as *Erica cinerea* and *Vaccinium myrtillus,* the mosses are less important, while *Festuca ovina* is the only major grass associate other than *Deschampsia flexuosa* and *Molinia caerulea. Carex vesicaria* is less common in the community here. This is close to the sharp slope marking the boundary between the lower and the higher raised beach and may reflect an area of impeded drainage.

This *Deschampsia flexuosa - Molinia caerulea - Hypnum cupressiforme - Calluna vulgaris* community is found again on the higher beach at the far northern edge of the site, inland from the fish farm. In this area the *Deschampsia* is a less important species in the heathland, although the community continues to be diverse with *Nardus stricta, Luzula campestris, Juncus squarrosus* and *Trifolium repens* as the

major herb and grass associates, while *Dicranum scoparium* and *Bryum capillare* form the important bryophyte component.

This community may be found in a mosaic with a wetter grassland indicative of poor drainage conditions across much of this site. This community is best described as a *Molinia caerulea - Myrica gale - Eleocharis multicaulis - Eriophorum angustifolium* acid marshland community. In this instance the *Myrica gale* is a less important member in the association. There remain heathland elements within this assemblage, in particular *Erica tetralix* and, less commonly, *Calluna vulgaris* and *Erica cinerea. Leucobryum glaucum* provides much of the ground cover within this community while the occasional presence of *Sphagnum* spp. reflects the high moisture content in this area.

This community is found across much of the rear of the higher beach and in the wetter area close to the plantation in the east of the lower beach. In this case, *Sphagnum palustre* is an additional major constant. *Narthecium ossifragum, Drosera rotundifolia* and *Agrostis canina* are minor constants which confirm the wetter nature of this community. It is, however, tussocky in places, often with standing water in the lower areas (5-10% of the area of each quadrat). While the tussocks commonly support *Calluna vulgaris* and *Carex nigra,* infrequent associates include *Erica tetralix, Pleurozium schreberi, Dicranum scoparium, Hypnum cupressiforme, Vaccinium myrtillus* and *Sphagnum capillifolium.* This community is unique to shingle at Rhunahaorine.

A second wetland community is found in particularly wet areas on the lower foreland beach, frequently found in close proximity to Rhunahaorine burn. This community is a *Juncus effusus - Agrostis canina - Holcus lanatus* community with a high herb content despite the dominance *of Juncus effusus.* Major herb associates include *Epilobium palustre, Myosotis laxa caespitosa, Ranunculus repens, Potentilla anserina, Hydrocotyle vulgaris, Galium saxatile, Cardamine pratensis* and *Lythrum salicaria.* Where the moisture content falls slightly the marsh herbs decline and give way to herbs typical of drier grassland communities, such as *Rumex acetosa* and *Cerastium fontanum. Juncus articulatus* and *Carex lasiocarpa* are found in small amounts throughout this community. In certain areas *Molinia caerulea* becomes locally important within the *Juncus effusus* assemblage.

A *Pteridium aquilinum* dominated community is found in small patches on the lower beach, occupying the slope separating the higher and lower beach, and also in the north of the site by the fish farm. The *Pteridium aquilinum* is found in association with *Molinia caerulea, Potentilla erecta, Anthoxanthum odoratum* and *Deschampsia flexuosa* as key indicators. Other coarse grass species comprise the minor constants with particular emphasis on *Dactylis glomerata, Holcus lanatus* and *Agrostis capillaris.* There is some scrub development within this community, illustrated by the occasional presence of *Rubus fruticosus.*

A major scrub community is found scattered across the lower beach, and also in the north near the fish farm. This is a *Ulex europaeus - Holcus lanatus* scrub community. It is a more diverse community than is normally associated with a *Ulex* dominated assemblage. Minor constants include *Rumex acetosella, Juncus inflexus, Stellaria media, Agrostis capillaris, Galium saxatile* and *Potentilla erecta.* The shade-tolerant moss *Eurhynchium praelongum* is the major bryophyte associate, as is often the case in *Ulex* dominated communities. *Rubus fruticosus* is an occasional associate. In wetter areas this community develops into a *Ulex - Rubus - Deschampsia - Juncus* assemblage with marsh herbs such as *Epilobium palustre* commonly found in association.

The final community found on the major foreland area is an *Agrostis stolonifera -Juncus effusus - Holcus lanatus - Festuca rubra* mixed grassland with *Molinia caerulea, Anthoxanthum odoratum* and *Poa pratensis* as additional, if minor, constants. This is seen on the raised beach in the lows between improved ridges near the sea.

There is a strip of vegetation with arenicolous elements on the shoreward edge of the plantation moving along the track south from the field boundary on the foreland. This area supports an *Ammophila arenaria - Festuca rubra - Senecio jacobaea - Carex arenaria*

dune community on the seaward edge. While up to 60% bare sand is visible in each quadrat, several herb species are commonly recorded within this community, in particular, *Tripleurospermum maritimum, Hypochoeris radicata, Galium verum, Cerastium diffusum* and *Heracleum sphondylium.*

This community gives way behind to grazed machair-type maritime grasslands. The most widely distributed of these is a herb-rich mixed *Festuca* grassland. *Poa pratensis* and *Agrostis stolonifera* are the minor grass associates. The major herb element comprises *Trifolium repens, Plantago lanceolata, Lotus corniculatus, Sagina nodosa, Trifolium hybridum* and *Achillea millefolium.* The influence of sand within the shingle matrix is seen in the frequent presence of *Carex arenaria* and *Cerastium diffusum.*

This community has suffered from heavy grazing. In places it gives way to a slightly different assemblage where the dominance of *Festuca rubra* decreases while *Poa pratensis* becomes a more important component. Herb content remains high with similar species composition, but in this case additional minor herb associates include *Rosa pimpinellifolia, Campanula rotundifolia* and *Euphrasia nemorosa. Agrostis stolonifera* continues to be a minor grass component but is joined by *Koeleria macrantha.* There has been less grazing of this community, perhaps because of the presence of unpalatable *Rosa pimpinellifolia.* This gives way to areas which have been planted with fir leading into the caravan park.

The *Ammophila arenaria - Festuca rubra - Senecio jacobaea - Carex arenaria* foredune community stretches along the foreshore for much of the length of the southern section of the site, adjacent to the caravan park. To the south of the caravan park (where stabilisation measures have been taken), this foredune community gives way to a more maritime dune community characterised by *Leymus arenarius* as the dominant species while *Rumex crispus littoreus, Tripleurospermum maritimum* and *Potentilla anserina* are additional constants. In some cases *Ammophila arenaria* becomes locally important again. This species poor community contains few associates but *Sonchus arvensis, Galium aparine* and *Carex arenaria* are found occasionally in this assemblage.

The remaining areas of the SSSI, which were surveyed for completeness, may not be truly shingle communities, but may be based on a shingle skeleton which is not clearly visible. They have, however, clearly resulted from the growth of a shingle/sand spit. These communities are representative of fen communities and were largely unique to this site.

Much of this area is dominated by a *Phragmites australis - Mentha aquatica* community with occasional marsh species such as *Potentilla palustris, Galium palustre* and *Epilobium palustre.* This community is often found in association with standing water to a depth of 30 cm.

Drier areas around the edge of this part of the site support a *Juncus articulatus - Potentilla palustris - Epilobium palustre* community with some additional aquatic herb associates, in particular, *Mentha aquatica, Pedicularis palustris* and *Hydrocotyle vulgaris.* Additional herbs commonly found in this community include *Prunella vulgaris, Angelica sylvestris, Succisa pratensis, Achillea ptarmica* and occasionally *Filipendula ulmaria* and *Iris pseudacorus.*

In the far south of this section the *Iris* becomes locally dominant and the community composition alters slightly, although the key constants continue to be *Juncus articulatus - Epilobium palustre - Potentilla palustris.* This sub-community is, however, indicative of wetter conditions, as illustrated in the presence of *Myosotis laxa caespitosa, Ranunculus flammula, Hydrocotyle vulgaris* and *Acrocladium cuspidatum,* which are frequently found throughout the assemblage. Indeed, typically there is between 5% and 10% open water in each quadrat.

A small area to the north of this part of the site represents a transition area between the generally drier communities to the north of this section and the major *Phragmites australis* dominated area in the south. This area supports an *Oenanthe lachenalii - Juncus effusus* fen community with *Angelica sylvestris* and

Phalaris arundinacea as the minor constants. This is a relatively species rich community with *Epilobium palustre, Silene dioica, Deschampsia cespitosa, Mentha aquatica, Filipendula ulmaria* and *Iris* as infrequent associates. This community is difficult to define within the shingle classification and so has been listed as a target note.

This part of the site also supports patches of *Ulex - Holcus lanatus* scrub and the *Pteridium aquilinum* dominated community seen in the northern section.

The final community found in the south of the site is a *Salix cinerea* dominated woodland community. *Juncus effusus* and *Oenanthe lachenalii* comprise the major understorey species with *Holcus lanatus* and *Eurhynchium praelongum* as minor associates. The wet nature of this community is also seen in infrequent associates which include *Iris, Mentha aquatica* and *Equisetum* spp., while the epiphytic lichens, *Usnea* spp. and *Hypogymnia physodes* are commonly found on the *Salix cinerea. Pteridium aquilinum* is also found in small amounts in this community.

Key

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

SH103 *Phragmites australis - Mentha aquatica* community;

SHI02 *Epilobium palustre - Hydrocotyle vulgaris - Juncus articulatus* community;

SH101 *Juncus articulatus - Potentilla palustris - Epilobium palustre* community;

SH100 *Juncus effusus - Holcus lanatus - Agrostis canina* community;

SH99 *Salix cinerea - Holcus lanatus - Juncus effusus* community;

SH98 *Juncus effusus - Molinia caerulea - Agrostis stolonifera* community;

SH97 *Pteridium aquilinum* dominated grassland community;

SH95 *Pteridium aquilinum - Molinia caerulea - Anthoxanthum odoratum* community;

SH94 *Potentilla erecta - Molinia caerulea - Anthoxanthum odoratum - Calluna vulgaris* community;

SH88 *Calluna vulgaris - Molinia caerulea - Potentilla erecta* community;

SH87 *Erica tetralix - Myrica gale - Calluna vulgaris* community;

SH86 *Molinia caerulea - Calluna vulgaris - Eriophorum angustifolium* community;

SH62a *Festuca rubra - Agrostis stolonifera - Poa pratensis - Anthoxanthum odoratum* community, *Trifolium repens* sub-community;

SH62 *Festuca rubra - Agrostis stolonifera - Poa pratensis - Anthoxanthum odoratum* community;

SH60 *Agrostis stolonifera - Holcus lanatus - Trifolium repens - Plantago lanceolata* community;

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

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

Tl *Oenanthe lachenalii - Juncus effusus* fen.

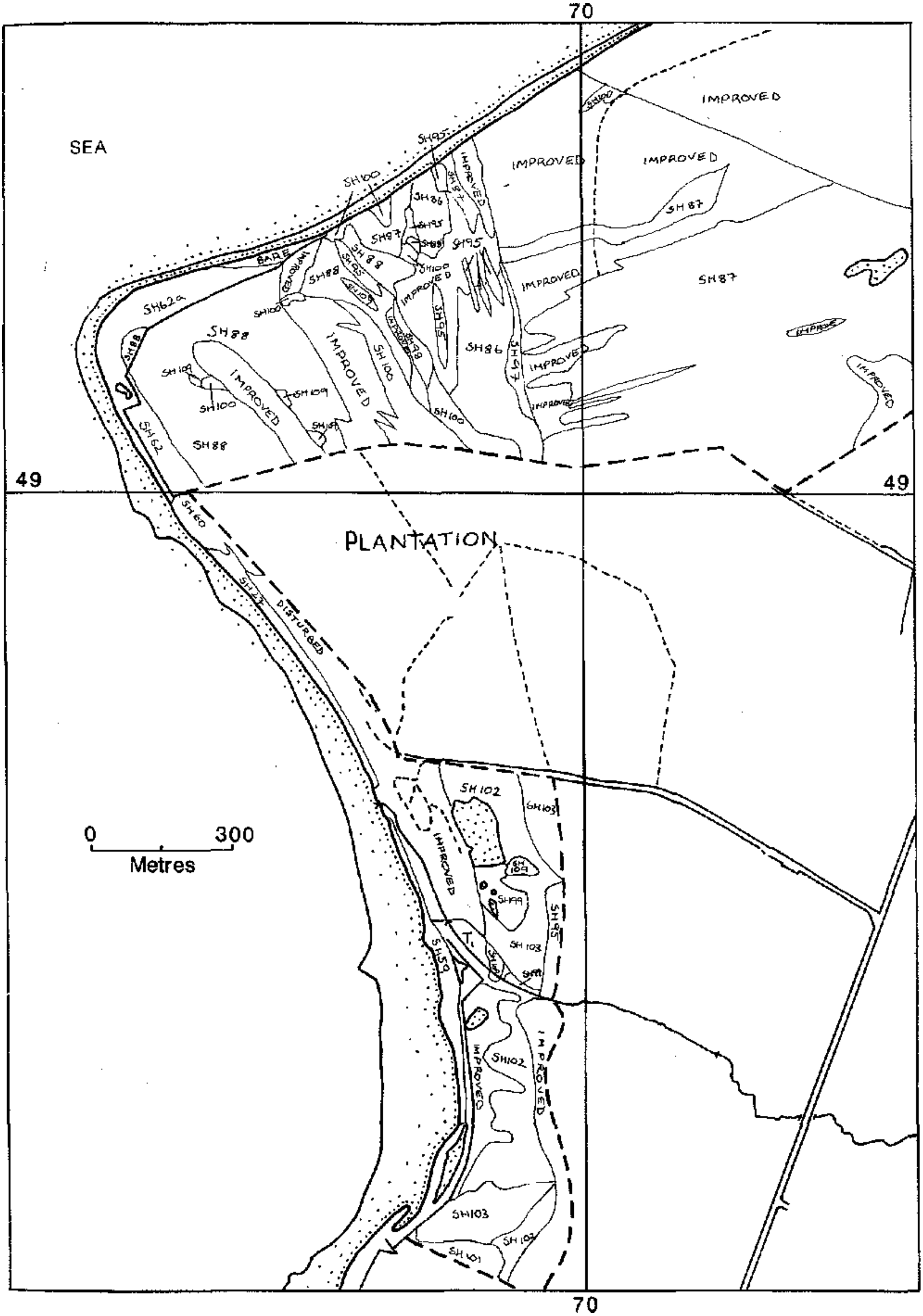

Figure 3a Rhunahaorine (south)

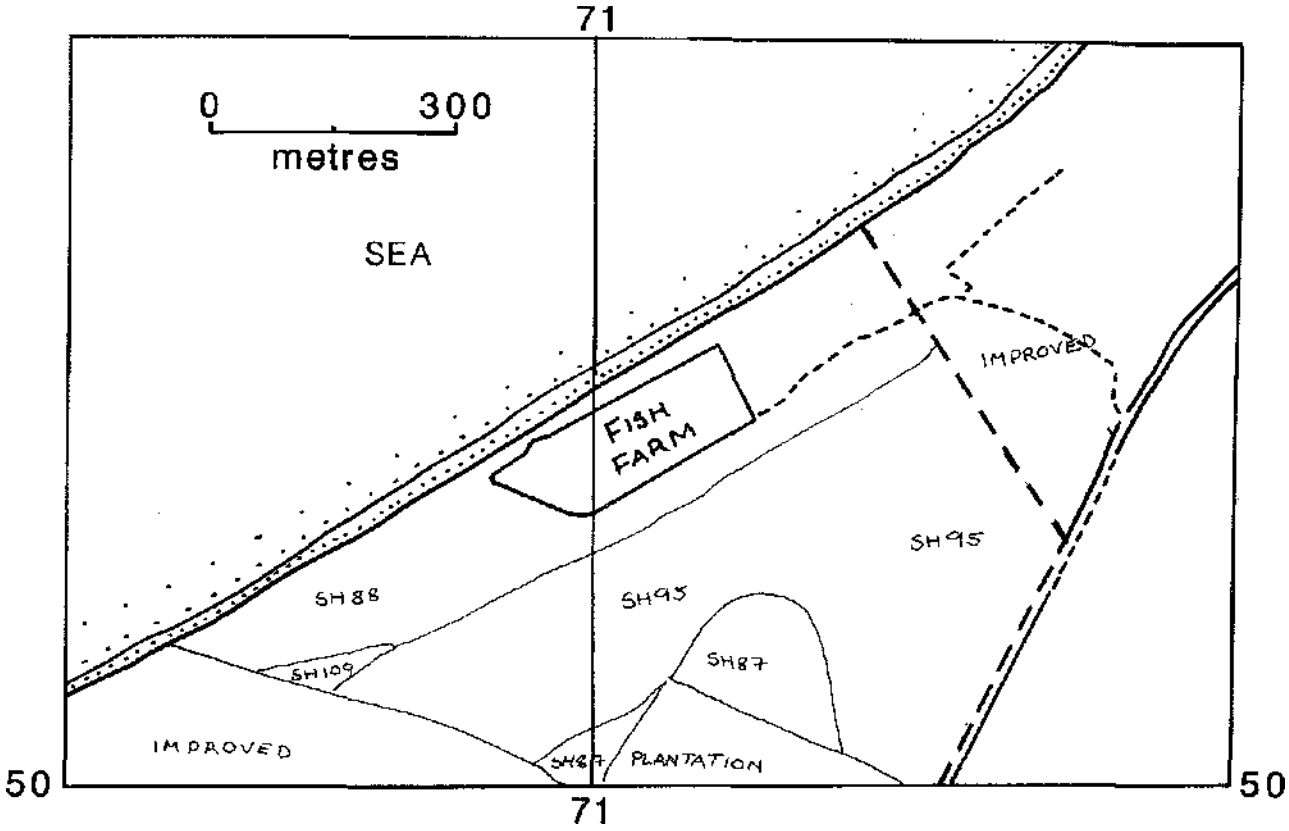

Figure 3b Rhunahaorine (north)

Rhuba Airigh Bheirigh, Arran

Cunninghame. NR 887480
No conservation status Area
surveyed: 4.1 ha Fieldwork
dates: 3/8/89

Introduction
This site comprises an interesting raised apposition beach with fossil ridges clearly visible in the current landscape. It is divided by the main A841 road which runs across the raised part of the site. Above the road, however, the ridges run perpendicular to the existing shoreline, while below the road they run parallel to the current shore. This would suggest at least two different depositional phases illustrated at this site.

An additional feature is a double raised beach in the centre of the site with the upper road level stepping down to a lower level.

This site is pure shingle and forms one of a suite of shingle sites along the west Arran coast which, taken as a whole, warrant inclusion in this survey.

Threats
There are high levels of recreational pressure on this site due to the ease of parking on the lower level. Indeed, there are well worn tracks down onto the central section of the lower level, which have destroyed or severely damaged the vegetation at this point. Vehicular damage is, however, largely confined to these tracks.

More worrying is the damage which results from the camping which is encouraged by the access to a flat area of land. Caravans and tents are sited on the lower level and this leads to litter problems, bonfires which destroy vegetation and to the shading of vegetation under the tents. In addition, some concrete steps have been constructed on the upper level, suggesting past human disturbance.

There has been some excavation of shingle on the steep slopes, clearly showing the shingle structure.

Management
This site is widely grazed by sheep and rabbits and in places the effects of this grazing are severe; however, there has been no agricultural improvement.

There has been turf cutting on the heather grassland in two places which has obviously destroyed the vegetation in these areas. This practice should be limited as it will lead to increased instability on an already steep slope.

Vegetation
The vegetation at this site is characteristic of acid heathlands with four major communities clearly illustrated.

Perhaps the most visually striking community at this site is a *Pteridium aquilinum* dominated association with *Potentilla erecta* and *Agrostis capillaris* as major constants. The *Pteridium aquilinum* provides almost total cover in these areas, but despite this *Holcus lanatus, Oxalis acetosella* and *Galium saxatile* are frequently found in this assemblage, although usually in small amounts.

This community is found across much of the upper section of the site and in patches on the second level, although always on flatter areas rather than the steep terrace edges.

The second major community which is found across much of the site but is most prevalent in the north of the site, where it occupies both the flat top of the raised beach and the steeply cliffed edge of the terrace, is a *Calluna vulgaris - Erica cinerea* heathland characterised by the additional constant presence of *Potentilla erecta, Vaccinium myrtillus* and the heathland moss, *Pleurozium schreberi.*

Frequent associates in this heathland include *Leucobryum glaucum* and *Dicranum scoparium* mosses while the Gramineae component comprises *Festuca ovina* and *Nardus stricta,*

A relatively small area on the second level at this site represents an intermediate community

which may illustrate the invasion of a similar heathland community by the *Pteridium*. This has resulted in a *Molinia caerulea - Calluna vulgaris - Anthoxanthum odoratum - Potentilla erecta* heathland with the minor but constant presence of open *Pteridium aquilinum* cover almost as a 'canopy' vegetation. Additional grass associates include *Festuca ovina, Nardus stricta* and *Agrostis canina*. If this is an invasion of *Pteridium aquilinum* into the heathland it may be necessary to clear it or graze it out.

The final community found at this site may be defined as a species-rich acid grassland characterised by *Festuca ovina - Agrostis stolonifera - Anthoxanthum odoratum - Leontodon autumnalis* as major indicators. This vegetation unit is particularly rich in herb species with *Plantago lanceolata, Trifolium repens, Campanula rotundifolia, Thymus polytrichus britannicus, Vaccinium myrtillus* and *Euphrasia officinalis* agg. as the key associates. *Hylocomium splendens* is the major bryophyte associate. This community has been severely grazed in places and this has clearly had implications for species diversity.

Key

SH97 *Pteridium aquilinum* dominated grassland community;

SH96 *Calluna vulgaris - Festuca rubra - Pteridium aquilinum* community;

SH94 *Potentilla erecta - Molinia caerulea - Anthoxanthum odoratum - Calluna vulgaris* community;

SH90 *Calluna vulgaris - Potentilla erecta - Erica cinerea* community;

SH75 *Agrostis stolonifera - Festuca ovina - Plantago maritima* community.

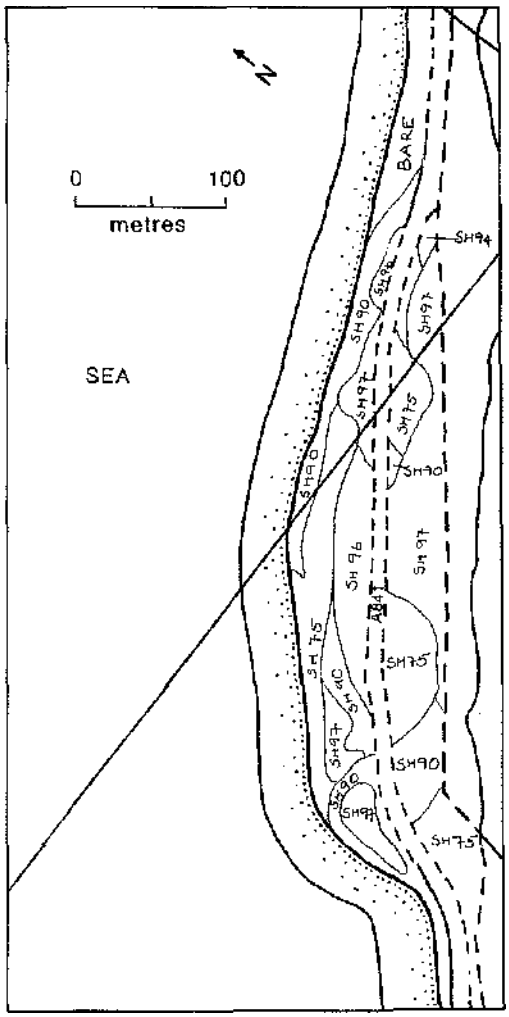

Figure 4 Rhuba Airigh Bheirigh, Arran

Catacol Bay, Arran

Cunninghame. NR 920490
No conservation status Area
surveyed: 2.2 ha Fieldwork
dates: 31/7/89

Introduction
Catacol Bay comprises a raised apposition beach formed by a series of ridges which appear to run parallel to the currently active spits, which have formed across a river mouth. The site is divided by the river with the northern section being generally lower-lying. A second, smaller burn cuts across the site to the east of the main river and this has led to impeded drainage which is reflected in the communities found here.

The rear of the site was taken to be the A841 road, because beyond this it has been greatly disturbed by the formation of a car park.

This site offers a rare example of a silty shingle site on Arran.

Threats
This site is readily accessible from the road and parts of it have suffered from vehicular damage, which takes the form of track marks across much of the site. There has also been some destruction of vegetation on areas which are habitually used for parking. Such localised damage is moderate in degree.

Given the ease of access, it is not surprising that levels of recreational pressure on the site are, in places, severe. In this instance such pressure takes the form of trampling, litter and camping, the effects of which can be seen in the vegetation. Generally, however, although recreational pressure is widespread across the site the damage is only moderate.

There has clearly been some disturbance to the northern section of the site where a terrace has been constructed near the road on which benches are situated.

There is clear evidence of current gravel extraction but this is largely confined to the area north of the site where vegetation development is somewhat restricted.

Management
This site is, like much of the Arran shore, widely grazed by rabbits and sheep; however, in most cases the levels of grazing remain light. There has been no agricultural improvement to this site.

Vegetation
This site supports two types of habitat: the first is an area of poorly drained, lower-lying type, supporting marsh influenced vegetation, while the second type is on the better drained, raised shingle areas.

Among the communities found on the well-drained areas there are two scrub types of vegetation. The first is an *Agrostis capillaris - Ulex europaeus - Galium saxatile* community with *Potentilla erecta* and a particularly important moss component including *Rhytidiadelphus squarrosus, Hypnum cupressiforme* and *Pleurozium schreberi.* This community is found in patches on the southern section of the site but a more mature version is found on the northern section, where the *Ulex* cover is more open as it is beginning to die back, but still occupies a major part of the site.

The second type of community is a *Pteridium aquilinum* dominated unit which occupies large areas on the southern section of the site. The associates are similar to those in the *Ulex* scrub, e.g. *Potentilla erecta, Agrostis capillaris* and *Galium saxatile*, but the *Pteridium aquilinum.* dominates the community providing almost total cover.

This southern section of the site also supports an interesting heathland community on the central section of the site and it is here that evidence of grazing becomes clear. This heathland community is a diverse *Calluna vulgaris - Erica cinerea* community with *Potentilla erecta* and *Pleurozium schreberi* as major constants. *Agrostis stolonifera* and *Nardus stricta* are frequently associated grass species, while a high herb content includes *Polygala serpyllifolia, Euphrasia officinalis*

agg., *Pedicularis sylvatica* and *Campanula rotundifolia*. The stable nature of this community is reflected in the constant, if minor, presence of *Cladonia portentosa.*

The southern section of the site supports two major grassland communities, the most important of which tends to occupy central areas where the maritime influence is weakest. This community is defined by the constant presence of *Poa pratensis - Agrostis stolonifera - Festuca ovina* and *Plantago maritima.* Additional herb associates include *Leontodon autumnalis, Rumex acetosella, Galium saxatile* and *Plantago lanceolata.*

The second of the 'dry' grassland communities is characterised by *Agrostis stolonifera - Festuca ovina,* and is species-rich with *Potentilla erecta* as a major associate along with *Nardus stricta.* A diverse range of herbs are integral to this community; these include *Plantago coronopus, Trifolium repens, Leontodon autumnalis* and *Prunella vulgaris.* There is also an important bryophyte element with the frequent occurrence of *Hypnum cupressiforme, Rhytidiadelphus squarrosus* and *Ceratodon purpureus.*

The northern side of the site supports a very different grassland which reflects a major maritime influence as it is situated along the front of the beach. This grassland is an *Agrostis stolonifera - Festuca rubra - Glaux maritima* grassland with occasional *Juncus* spp. This unit is clearly indicative of saltmarsh conditions associated with its frequent inundation.

There is a small area adjacent to the river, at the rear of the southern section of the site, which may have been disturbed by having been planted in the past. This area supports a species poor *Agrostis stolonifera - Festuca rubra* damp grassland as an understorey with a few *Betula pendula* trees providing a canopy. This is an atypical community on shingle and this fact, combined with the evidence of camping today, suggests that this area is subject to high levels of disturbance.

The remaining communities are wetland communities and are found in the lower area on the southern section of the site. The first of these may be characterised by the constant presence of *Molinia caerulea* and *Myrica gale* with *Festuca rubra.* Additional minor constants are also indicative of wetter areas including *Agrostis stolonifera, Sphagnum* spp., *Carex echinata* and *Epilobium palustre.*

This community is replaced by *a. Agrostis stolonifera - Juncus effusus* flora in the wettest areas. This community shows little diversity, with the *Juncus* and *Agrostis* providing almost total cover. Only *Galeopsis tetrahit* and *Cirsium arvense* are found as frequent associates.

In certain areas there is a sub-community of this *Agrostis - Juncus* fen where *Juncus effusus* is dominant with *Iris pseudacorus* as a major associate, while the minor associates are similar to the community detailed above.

Key

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

SH100 *Juncus effusus - Holcus lanatus - Agrostis canina* community;

SH97b *Pteridium aquilinum* dominated grassland community, moss-rich sub-community;

SH97 *Pteridium aquilinum* dominated grassland community;

SH94 *Potentilla erecta - Molinia caerulea - Anthoxanthum odoratum - Calluna vulgaris* community;

SH93 *Agrostis capillaris - Ulex europaeus - Rhytidiadelphus squarrosus* community;

SH90 *Calluna vulgaris - Potentilla erecta - Erica cinerea* community;

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

SH79 *Festuca rubra - Agrostis stolonifera* community;

SH74 *Agrostis stolonifera - Trifolium repens - Festuca rubra* community.

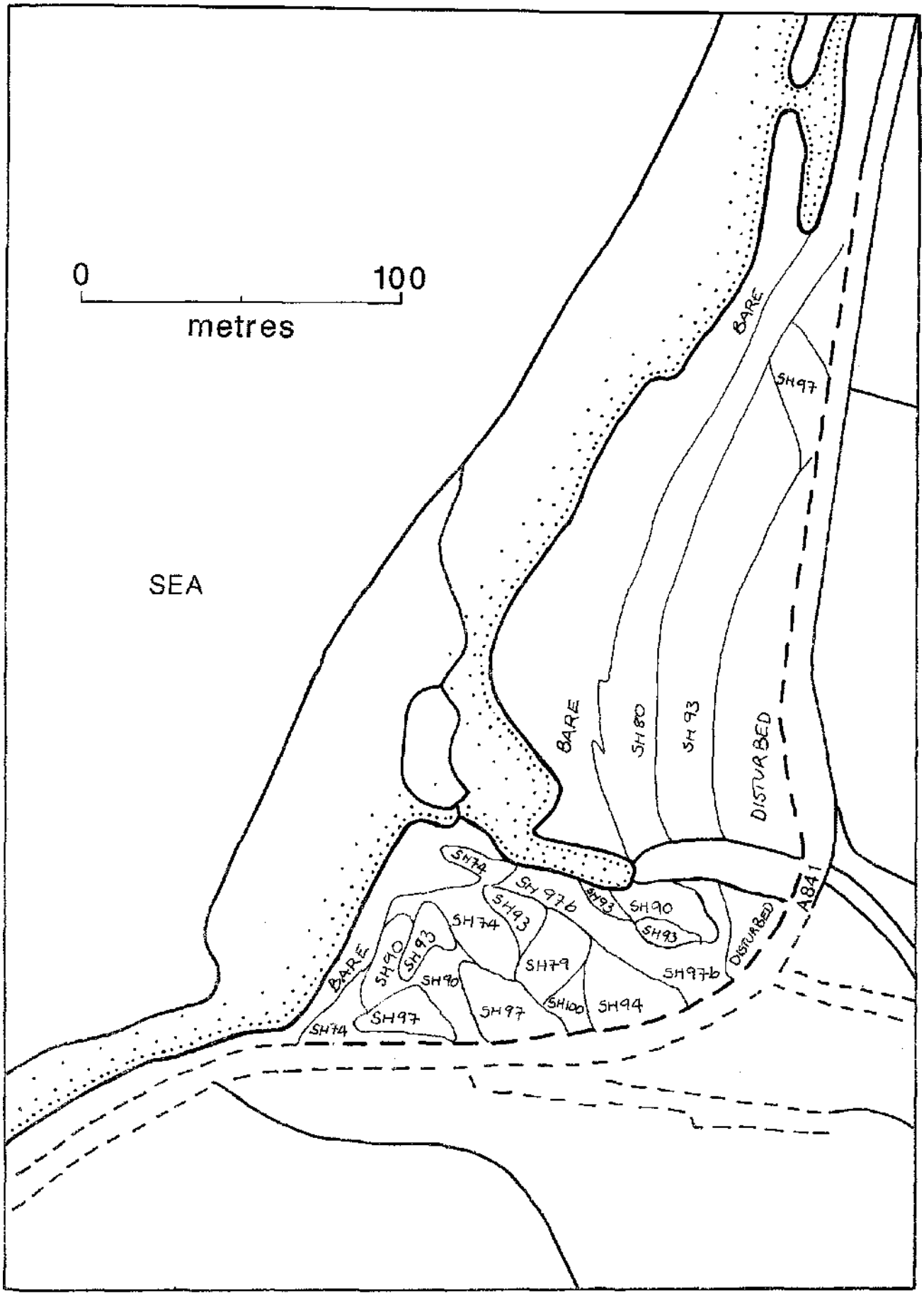

Figure 5 Catacol Bay, Arran

Pirnmill, Arran

Cunninghame. NR 870440
No conservation status
Area surveyed: 2.7 ha
Fieldwork date: 2/8/89

Introduction
This site consists of a section of the raised shingle beach which runs along much of the west coast of Arran. This particular stretch of coastline forms a narrow, raised fringing beach which widens in places, especially where protected by offshore rocks. These rocks serve to decrease energy levels of the onshore waves and have led to the development of saltmarsh communities over the shingle substrate on the foreshore. These communities are clearly subject to frequent inundation.

This type of beach runs along much of the west Arran shore but for sampling purposes was divided into separate sites. The Pirnmill site refers to an area of the fringing beach at Pirnmill, which is somewhat wider than elsewhere; it extends up to the tree on the shore in the north and to the mown area of raised beach used for parking in the south.

Threats
The proximity to the major A841 road on Arran, which serves as a rear boundary to the site, has had some impact on this site, with tyre tracks clearly visible on the shingle. The levels of damage, however, remain relatively light. Despite its proximity to the road the recreational pressure on the site has been negligible.

Although this stretch of coast appears to be in equilibrium with maritime forces, there is evidence of erosion in the south which has necessitated the construction of a sea wall.

A direct loss of vegetated shingle has occurred as a result of drains which have been dug across the beach presumably draining the farm land behind. In addition there has been some extraction of shingle although this is very local and disturbance is restricted to the bare shingle foreshore.

Management
In the south of this site there has been mowing of the coastal grassland to allow parking for the houses on the opposite side of the road and this has had implications for the species composition of these areas.

The whole site is grazed by rabbits and sheep but there has been no obvious agricultural improvement.

Vegetation
Six vegetation communities are represented at Pimmill, several of which are saltmarsh-dominated while the rest are more typical of a shingle substrate.

The saltmarsh communities are primarily confined to the northern section of the site where the offshore rocks protect the marsh formation. The first community is dominated by an *Agrostis stolonifera - Juncus gerardii* grassland with *Holcus lanatus* and *Festuca rubra* as minor grassland constants. This community is characterised by a high herb content including *Filipendula ulmaria, Stachys sylvatica* and *Lathyrus pratensis,* with maritime influences seen in the occasional presence of *Rumex crispus littoreus* and *Potentilla anserina.*

A second community which illustrates a saltmarsh influence is a *Festuca rubra - Trifolium repens* grassland with *Juncus effusus* as an additional constant. This too is a particularly diverse community with *Euphrasia officinalis, Lotus corniculatus* and *Plantago maritima* as the key indicators.

The community which occupies most of the raised beach behind the saltmarsh is found across much of the west Arran coast. This is a herb-rich *Holcus lanatus - Plantago lanceolata* grassland with *Poa pratensis* and *Festuca rubra* as important associates. In addition, *Anthoxanthum odoratum* is locally important within the *Holcus* grassland. The herbs, which form a major component of this community, include *Achillea millefolium, Galium verum, Hypochoeris radicata* and *Campanula rotundifolia.* In places, the stability of this

grassland is illustrated in the presence of the moss *Pseudoscleropodium purum.*

In front of the herb-rich *Holcus lanatus - Plantago lanceolata* grassland, running along the central section of this stretch of coast, there is a very open maritime grassland which is unique to the shingle substrate, being described first at Dungeness in Kent. This grassland is an *Arrhenatherum elatius - Silene vulgaris maritima* grassland. Each quadrat contains approximately 95% bare shingle, but there are occasional associates, in particular *Rumex crispus littoreus, Geranium robertianum* and, in some places, *Teucrium scorodonia.*

At the north of the site the *Holcus* community gives way to a small patch of *Pteridium aquilinum* dominated grassland. Additional constants within this unit include *Potentilla erecta, Agrostis capillaris* and *Holcus lanatus. Filipendula ulmaria* and *Viola riviniana* are found in varying amounts throughout this grassland.

Finally, there is a small patch of *Ulex europaeus - Rubus fruticosus* scrub typical of many shingle sites. This is situated in the south and gives, perhaps, some indication of a likely development of vegetation should the mowing and grazing regime be halted.

Key

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

SH97 *Pteridium aquilinum* dominated grassland community;

SH79 *Festuca rubra - Agrostis stolonifera* grassland;

SH74 *Agrostis stolonifera - Trifolium repens - Festuca rubra* community;

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

SH63 *Festuca rubra - Plantago lanceolata - Dicranum scoparium* community;

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

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

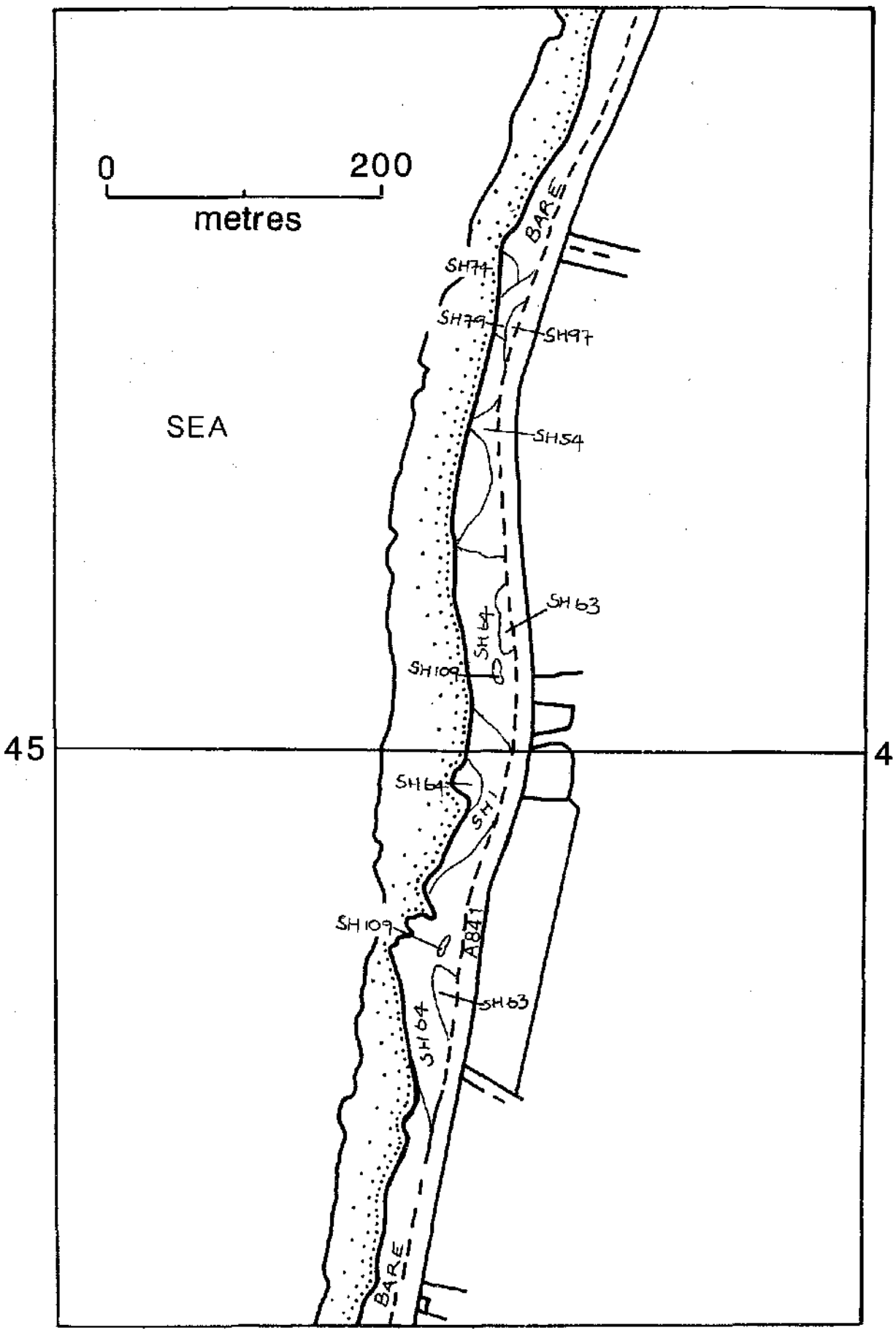

Figure 6 Pirnmill, Arran

Imachar, Arran

Cunninghame. NR 865402.
No conservation status
Area 4.0 ha
Fieldwork dates: 29-30/7/89

Introduction
This site is defined as the area of vegetated shingle lying south of Imachar Point, and may be described as a raised fringing beach which is widest in the north and narrows to a thin strip of undisturbed shingle on the seaward side of the road further south. Much of this site is offered protection by offshore igneous intrusions.

Threats
This site suffers varying levels of vehicular damage with tracks running across parts of it and some areas used as unofficial parking spots. The effects seen across the entire site are generally light, although in places damage is severe. Other than this, recreational pressure on the site is very light.

There is evidence of past gravel extraction at this site. In addition, there has been localised but major disturbance caused by the cutting of drains across the raised beach and discharging onto the foreshore.

Management
The northern part of the site is fenced off and has been extensively grazed by cattle. This part of the site may have been improved because the dominance of *Lolium perenne* is not normally seen on shingle. This was not clear, however, so this community was sampled in the survey.

The rest of the site, south of the field boundary, displays evidence of widespread grazing but in this case the grazers are sheep and rabbits.

There are signs of erosion in places along the site but no coastal defence works.

Vegetation
This site provides examples of saltmarsh-influenced communities, shingle grasslands and displays some development into mature scrub.

There is an area of saltmarsh on shingle which has developed behind the offshore rocks at the northern end of the site. This may be defined as an *Agrostis stolonifera - Festuca rubra - Glaux maritima - Juncus gerardii* maritime grassland with *Bulboschoenus maritimus* as an additional constant which is locally abundant. This community is relatively diverse, with *Potentilla anserina, Armeria maritima* and *Rumex crispus littoreus* as frequent associates.

Behind this area there is an area of almost bare shingle which supports an interesting pure shingle pioneer community characterised by the constant presence of *Silene vulgaris maritima* and *Rumex crispus littoreus.* This is a very open community with as much as 90% bare shingle in any one quadrat. Consequently, it has a species-poor assemblage with very few associates, although *Galium aparine* and *Stellaria media* are often found in this unit. *Senecio viscosus* is also seen occasionally in this community, a species which is rarely found in the north-west of Scotland.

Above this pioneer community there is the start of continuous terrestrial shingle vegetation comprising grassland communities. Many of these grassland communities key out to the same shingle classification unit.

The major vegetation unit for the northern grassland is a *Holcus lanatus - Trifolium repens* mixed grassland with varying amounts *of Agrostis stolonifera* and *Lolium perenne.* This is clearly a stable grassland which has a limited herb content, in particular *Hypochoeris radicata,* but with a major bryophyte component including *Rhytidiadelphus squarrosus* and *Hypnum cupressiforme.* Within the field this shifts to a *Lolium perenne* dominated grassland which is particularly species-poor, suggesting some form of agricultural improvement to the area.

A third grassland community is seen in a strip along the ditch which has been dug along the edge of the field. This is an *Arrhenatherum*

elatius dominated mixed grassland with *Iris pseudacorus* as a major constant, reflecting the poor drainage in this area. This has clearly been disturbed with a high ruderal content, indeed *Urtica dioica* forms a major component.

The final grassland community, which runs along much of the length of the southern part of the site, is a herb-rich *Holcus lanatus - Plantago lanceolata* mixed grassland with *Trifolium pratense, Achillea millefolium, Galium verum* and *Lathyrus pratensis* as the major herb associates. This is similar to the *Holcus lanatus* community described earlier, but has been separated by the higher herb content and the absence of *Lolium perenne* or *Trifolium repens,* and in the additional importance of *Festuca rubra* within the assemblage.

A *Pteridium aquilinum* dominated community occupies the back of the beach immediately south of the field but does not extend much further. As a result of the competitive exclusion strategy of the *Pteridium aquilinum* this is a species-poor community with *Holcus lanatus, Arrhenatherum elatius* or *Dactylis glomerata* as minor, but frequent, associates.

To the south of the thin strip of vegetated shingle there is a very small patch of *Primus spinosa - Rubus fruticosus* scrub with much bare shingle visible under the vegetation. However, there are occasional associates, most commonly *Arrhenatherum elatius, Agrostis capillaris, Silene dioica* and *Galium aparine.* This final strip of coastline was too narrow to map effectively.

Key

SH120 *Prunus spinosa - Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH113 *Urtica dioica - Galium aparine - Holcus lanatus - Rubus fruticosus* community;

SH111 *Pteridium aquilinum - Rubus fruticosus* community;

SH77 *Glaux maritima - Festuca rubra - Juncus maritimus* community;

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

SH60 *Agrostis stolonifera - Holcus lanatus - Trifolium repens - Plantago lanceolata* community;

SH25 *Silene vulgaris maritima - Rumex crispus littoreus - Tripleurospermum maritimum* community.

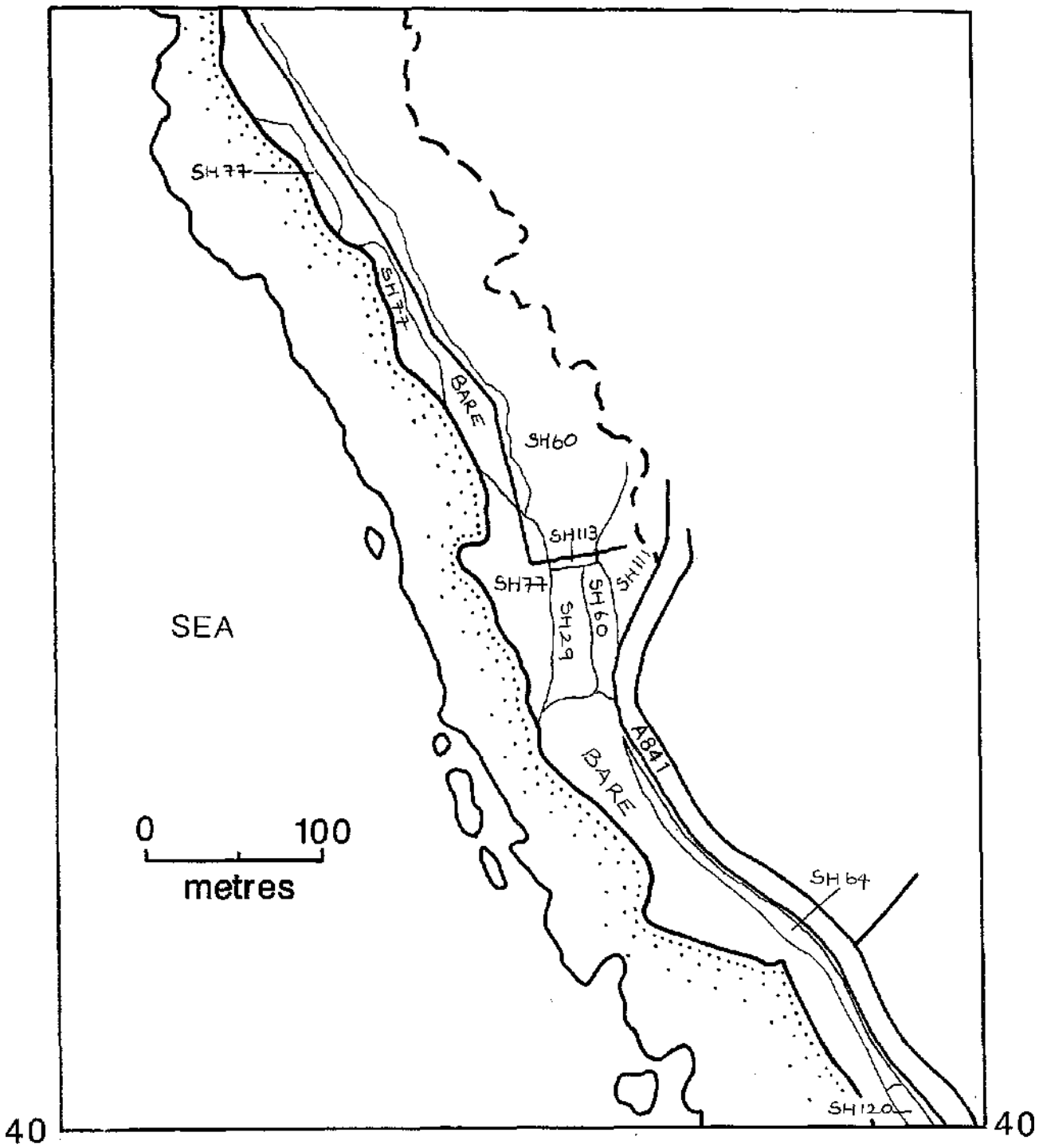

Figure 7 Imachar, Arran

North of Dougerie-Imachar, Arran

Cunninghame. NR 870390
No conservation status
Area surveyed: 3.0 ha
Fieldwork dates: 30/7/89-1/8/89

Introduction
This site comprises a narrow strip of raised fringing beach bounded at the rear by the A841 road and running between Imachar and Dougerie. Most of this strip of stable shingle is approximately 5 metres wide. While this stretch of coast, taken in isolation, does not constitute a major shingle feature, as a component of the entire west coast it warrants inclusion in the study. In several places along this stretch of coast, shingle gives way to a sand dominated substrate. Otherwise, this site is typical of much of the west Arran coast, with the raised sandy shingle beach being cliffed at the front and giving way to a gently sloping bare shingle foreshore which is clearly active.

Threats
The major disturbance to this site is the regular placement of drains along the coast, which have not only led to a reduction in the overall extent of vegetated shingle but have also altered the nature of vegetation in places with the introduction of more freshwater species.

There is some vehicular damage to this stretch of coast, but the narrowness of the stabilised shingle precludes parking in many places so damage is very localised and of a light level. This has no doubt served to limit the levels of recreational pressure.

There is evidence of erosion in this area, with the cliffed edge of the raised beach suggesting that it is clearly active. Indeed, the storms of 1988, which had been particularly severe, had thrown up shingle onto the raised beach and this has now been colonised by pioneer species more commonly found further down the beach profile. The result is a very narrow (30 cm) strip of pioneer vegetation growing within a closed grassland community.

Vegetation
The vegetation here is relatively simple in floristic terms, being dominated by grassland communities but displaying, in places, clear development into scrub communities.

Immediately north of Dougerie there are two major grassland communities. The first is an open maritime grassland which is relatively pioneer in nature. It is characterised by the presence of *Silene vulgaris maritima, Arrhenatherum elatius, Festuca rubra* and *Rumex crispus littoreus.* This community is found in patches along the seaward edge of the raised beach and may reflect a regression of a more mature grassland under the increased maritime influences in recent storms.

The major grassland community in this area, however, is a *Holcus lanatus - Plantago lanceolata* mixed grassland with *Festuca rubra* and *Poa pratensis* as minor constants. There are also varying amounts *of Arrhenatherum elatius, Anthoxanthum odoratum* and occasionally *Agrostis stolonifera.* This diverse grassland is typical of much of the Arran coast and is particularly rich in herb species such as *Centaurea nigra, Galium verum, Campanula rotundifolia, Lotus corniculatus* and, occasionally, *Silene vulgaris maritima* and *Heracleum sphondylium,*

At several points along this coastline there is scrub development. The early stages of development are illustrated in an *Arrhenatherum elatius - Holcus lanatus -Rubus fruticosus* community with *Rumex acetosa, Plantago lanceolata* and *Cirsium arvense* as minor associates. This then develops into a *Ulex europaeus - Rubus fruticosus* scrub where cover remains sufficiently open to allow the survival of more associates than are usually found in such a scrub community. These additional constants are *Arrhenatherum elatius* and *Senecio jacobaea* with *Galium verum* and *Digitalis purpurea* as minor associates.

Moving northwards, away from Dougerie, there is a slight change in the communities with a small area of *Dactylis glomerata* -

Plantago lanceolata mixed grassland which gives way to a community characterised by the constant presence of *Elymus repens - Arrhenatherum elatius - Ammophila arenaria* and some *Rubus fruticosus.* This reflects the increased sand content in the shingle matrix. This community occupies the front of the stable shingle with only a small patch of the *Holcus* mixed grassland.

Further north, away from the locally sandy substrate, there is the re-emergence of the herb-rich *Holcus lanatus* grassland as the most important community, with occasional patches of the *Ulex europaeus – Rubus fruticosus* scrub. It is within the *Holcus* community that there is a strip of more pioneer vegetation, a relict storm tide mark. This community is a *Silene vulgaris maritima - Rumex crispus littoreus* open pioneer community commonly found on shingle, and which has *Tripleurospermum maritimum, Festuca rubra* and *Arrhenatherum elatius* as minor components. The continuing influence of sand in the matrix is seen in the presence of arenicolous species, in particular *Carex. arenaria.*

Further north still, there is a patch of scrub which is markedly different from the scrub communities described earlier. In this case, the dominant scrub element is *Prunus spinosa* which is found with *Rubus fruticosus* and *Rosa canina.* These species provide much cover and as a result exclude many associates. *Arrhenatherum elatius* and *Urtica dioica* are most frequently found in association.

The mixed grassland continues northwards although there is some variation in the species composition. In places the proportion of *Holcus* is locally reduced and *Festuca rubra* and *Arrhenatherum elatius* become increasingly important elements. However, the herbs remain a strong indicator of the original community comprising a major component. These include *Daucus carota, Veronica chamaedrys, Lathyrus pratensis, Viola riviniana, Achillea millefolium* and *Campanula rotundifolia.*

The open *Rubus fruticosus - Arrhenatherum elatius - Holcus lanatus* scrub continues to be seen in patches along this stretch of coast.

This site eventually adjoins the southern boundary of the site described as Imachar.

The very narrow nature of this stretch of coastline renders it impractical for accurate mapping. However, the following communities are found on this site (see text for relative locations),

Key

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

SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH72 *Arrhenatherum elatius - Rubus fruticosus - Dactylis glomerata* community;

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

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

SH60 *Agrostis stolonifera - Holcus lanatus - Trifolium repens - Plantago lanceolata* community;

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

SH27a *Tripleurospermum maritimum - Atriplex prostrata - Rumex crispus littoreus -Potentilla anserina* community.

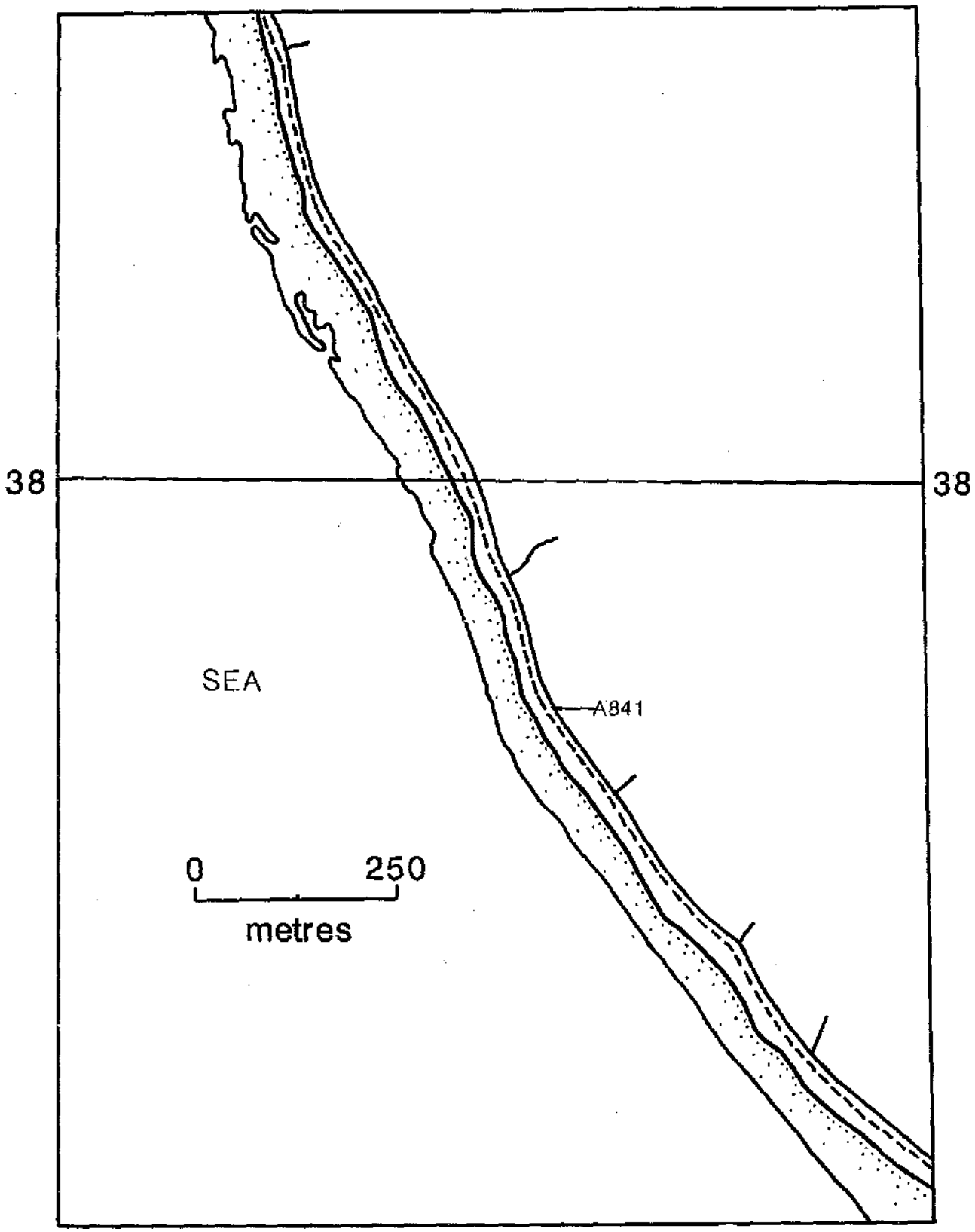

Figure 8 North of Dougerie-Imachar, Arran
Note: the narrow nature of the site does not allow accurate mapping (see text).

Dougerie, Arran

Cunninghame. NR 880370
No conservation status
Area surveyed: 2.1 ha
Fieldwork date: 28/7/89

Introduction
This site comprises a raised fringing beach which reaches its maximum width around the mouth of lorsa Water, then narrows along the road and widens again in the south. The raised section of the beach supports a cliffed edge of 40 cm which gives way to a gently sloping foreshore. The site stretches south from lorsa Water at Dougerie Lodge to the end of the second wider area approximately 1 km to the south. The A841 was taken to be the rear boundary of the site. This is one of the better-developed of the west Arran suite of shingle sites.

Threats
This site is being actively eroded, as illustrated not only by the steep cliffing of the raised beach but also by the need for the construction of a sea wall to shore up the road in the central section of the site. Indeed, this wall is itself being actively undercut.

There has been widespread recreational pressure on this site which has resulted in trampling, litter and evidence of one bonfire.

A more damaging consequence of the recreational pressure is the recurring problem with vehicular damage caused to the site. Cars park freely on the northern section of the site, and while ad hoc parking bays are delimited by the presence of *Ulex* scrub, this has led to locally severe damage in the areas used where much vegetation has been totally destroyed.

There is also one hut on the beach, situated close to the edge of the raised beach on the northern section, with track marks running to it over the shingle.

Management
There has been no agricultural improvement on this site but there is widespread evidence of grazing by rabbits and sheep. Overall levels of grazing remain light.

Other than the sea wall there has been no stabilisation work at Dougerie.

Vegetation
This area supports a relatively simple flora. In the southern section an open maritime grassland gives way to a more terrestrial grassland behind. In the northern section there are more communities on the broader beach, with a pioneer community occupying much of the front of the beach. Here there are several grassland communities with well-developed scrub.

The open grassland, which runs in a thin strip around the seaward edge of the southern part of the site, comprises a *Festuca rubra* grassland with a clearly maritime influence. It is best described as a *Silene vulgaris maritima - Festuca rubra - Plantago lanceolata* open, mixed grassland. There are additional grass species associated with this community, notably *Poa pratensis, Arrhenathemm elatius* and, occasionally, *Holcus lanatus.* There are additional maritime herbs such as *Tripleurospermum maritimum* and non-maritime herbs including *Lotus corniculatus* and *Rumex acetosella,*

This gives way to a more diverse, less maritime *Festuca rubra - Agrostis stolonifera* grassland. *Anthoxanthum odoratum* and *Poa pratense* are minor grassland components. This community is rich in herbs with *Plantago lanceolata, Trifolium pratense, Centaurea nigra, Daucus carota* and *Campanula rotundifolia* as most frequent associates.

In one place there has been some limited scrub development which is *Rubus fruticosus* dominated with *Heracleum sphondylium* as the key associate.

The broader northern section of the site supports more varied communities. Much of the exposed northern foreshore supports pioneer communities with *Silene vulgaris maritima* as the major indicator. Two

communities may be identified according to the associates. The first may be defined as a *Silene vulgaris maritima - Rumex crispus littoreus* association which is generally species poor; *Arrhenatherum elatius* and *Rumex acetosella* are occasionally found with the two constants.

In places this gives way to a second community which is characterised by the constant presence of *Silene vulgaris maritima* and *Tripleurospermum maritimum* with *Elymus repens* and *Honckenya peploides* in association. This clearly reflects an increase in sand within the shingle matrix.

On the foreshore, along the river mouth, there is a small patch *of Arrhenatherum elatius -Rubus fruticosus - Silene vulgaris maritima* grassland community which is relatively rare on shingle. *Geranium robertianum* and *Senecio jacobaea* form an important component of this community which is unique to the shingle substrate.

Further round the foreshore there is a slight variation on the original community. In this case the more sheltered position, or less recreational pressure, has led to the development of a more closed *Festuca rubra - Silene vulgaris maritima - Arrhenatherum elatius* maritime grassland with *Rumex crispus littoreus, Plantago lanceolata* and *Cerastium fontanum* as the key associates.

To the south of this community there is a patch of bare shingle which may be a result of access to the hut as there are track marks clearly visible in the shingle.

Behind this assemblage there is a thin strip of the herb-rich *Festuca rubra - Holcus lanatus - Agrostis stolonifera* grassland seen on the southern section of the Dougerie site.

The final community, which dominates much of this site, is a *Ulex europaeus - Rubus fruticosus* scrub typical of the shingle substrate. This scrub grows up to a height of 2 metres, thus precluding many associates. There are, however, *Silene dioica* and *Digitalis purpurea* along with a major bryophyte flora including *Pseudoscleropodium purum, Hypnum cupressiforme* and *Dicranum scoparium.*

Key

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

SH75 *Agrostis stolonifera - Festuca ovina - Plantago maritima* community;

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

SH62 *Festuca rubra - Agrostis stolonifera - Poa pratensis - Anthoxanthum odoratum* community;

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

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

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

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

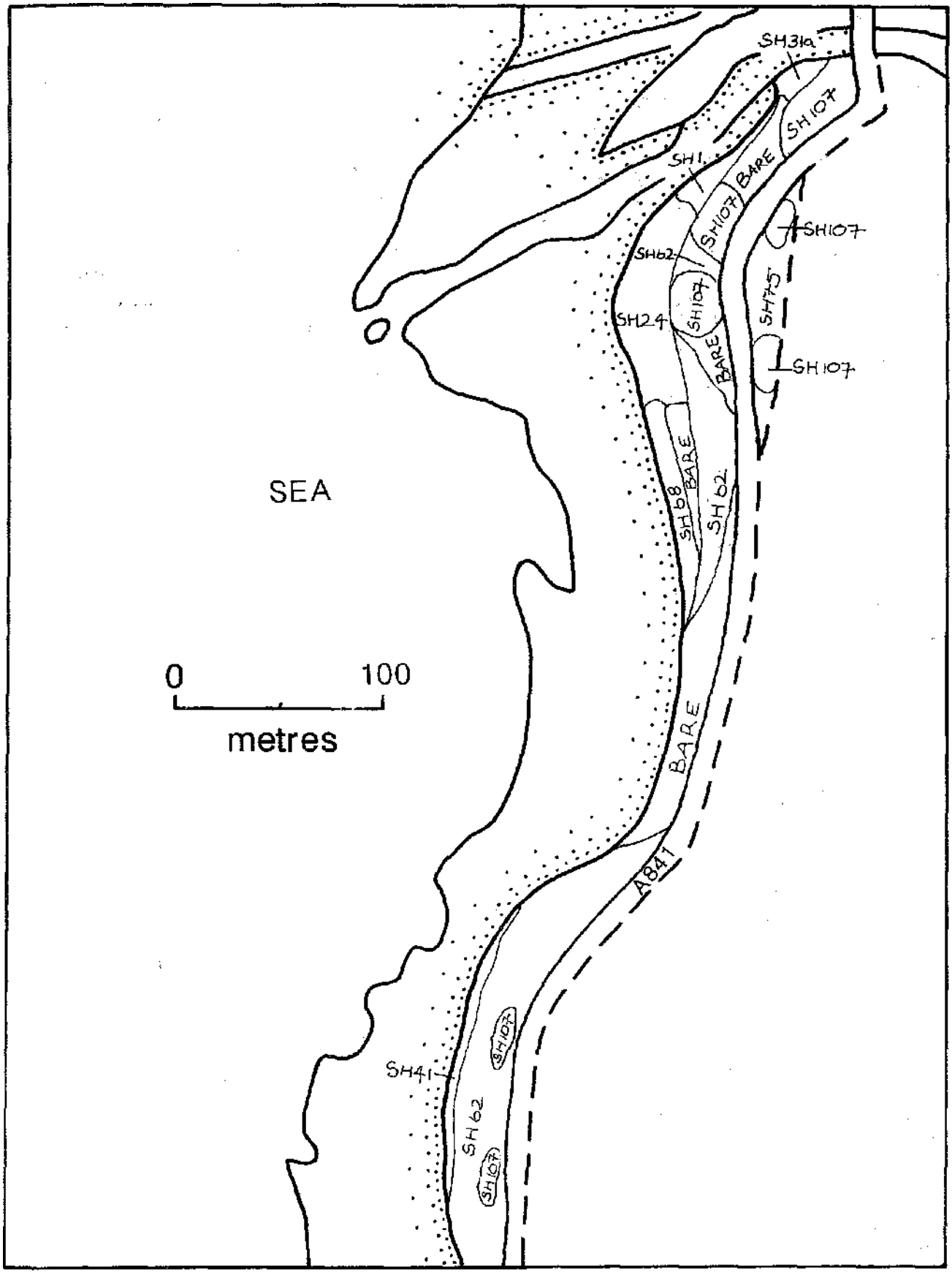

Figure 9 Dougerie, Arran

Machrie, Arran

Cunninghame. NR 890330
No conservation status
Area surveyed: 4.9 ha
Fieldwork dates: 27-28/7/89

Introduction
The Machrie site is defined as the area of coast stretching from the jetty at Cleiteadh Buidhe in the north, to Machriewater Foot in the south.

This site may be divided into two areas, the first comprising a cobble shingle fringing beach backed by dunes which are currently being eroded. At the river mouth there is some vegetation on a beach protected by the northerly growing spit on the opposite shore. This is an example of a sandy shingle site, the extreme of which is seen on the southern shore where the shingle provides a base for sand-capping.

This fringing beach stretches along the entire length of the site, which is bounded at the rear by the golf links or the road.

The second part of the site may be taken as the 'triangle' of raised shingle beach which is delineated by three roads running round the Machrie telephone exchange in the north. This raised beach comprises two clear ridges with a low between. The shingle is close to the surface and can be seen clearly in an area which has been disturbed by large machinery. The soil here is thin and peaty.

Threats
There is very little disturbance to the southern section of the site, other than the obvious erosion in places which has led to a strip of pioneer vegetation at the storm crest; in effect, this forms a bar across a pond.

The northern section of the site has suffered light recreational pressure with a little litter. Parking occurs on an ad hoc basis along the seaward stretch of vegetated shingle. There are more formal arrangements on the raised beach area, where it has been deliberately cleared in places.

Other than the telephone exchange no vegetated shingle has been lost to building.

The major loss of natural vegetation is to the golf links.

Management
There are light levels of grazing on much of the site as a result of sheep and rabbits. There is no evidence of any form of coastal defences.

On the thin strip of vegetated shingle running alongside the golf course there has been some accidental reseeding.

Vegetation
The vegetation at Machriewater Foot displays saltmarsh influences. Immediately to the south of the golf course, on the largely bare shingle, there is a pioneer flora. On the northern section of the site there are heathland communities, a grassland and some scrub development, while on the seaward strip near the road, there is a closed grassland on the raised area which gives way to a pioneer community on the edge of the raised beach.

On the southern section of the site there are five communities. The most exposed seaward area of shingle supports a saltmarsh community which is characterised as a *Festuca rubra - Plantago maritima - Glaux maritima* grassland. The saline influence is clearly seen in the herb associates found in this community. These include *Cochlearia officinalis, Spergularia marginata, Atriplex* spp., *Rumex crispus littoreus* and the major associate, *Puccinellia maritima.* The maritime influences were evident in the presence of drift in the quadrat.

Further round the foreshore along the river mouth, the more protected nature of the site is reflected in the *Elymus repens* dominated community, where *Atriplex* spp. are the usual, but minor, associates.

This is backed by a community which is more typical of the shingle substrate. It is characterised by the constant presence of *Festuca rubra, Silene vulgaris maritima, Tripleurospermum maritimum* and *Plantago*

maritima. This community contains both halophytic and freshwater herbs, e.g. *Cochlearia danica, Sagina nodosa* and *Achillea millefolium.* Additional grassland species include *Agrostis stolonifera* and *Elymus repens,*

The slope at the rear of the site, where the sand content increases, supports a *Rubus fruticosus -Ulex europaeus* assemblage.

The relatively active sandy shingle bar, which delineates the end of the pond, supports a very open pioneer shingle community. This is a *Tripleurospermum maritimum - Silene vulgaris maritima* community which has approximately 90% bare shingle in each quadrat. Minor associates include *Agrostis stolonifera, Rumex crispus littoreus, Potentilla anserina* and *Atriplex* spp.

The thin strip of raised shingle which runs along the seaward side of the road in the northern section of the site supports a mixed *Holcus lanatus - Festuca rubra - Plantago lanceolata - Poa pratensis* grassland, typical of the west coast of Arran. This community has varying amounts of *Anthoxanthum odoratum* and *Agrostis stolonifera.* The associated herbs are diverse with *Potentilla erecta, Galium verum, Achillea millefolium, Lotus corniculatus* and *Campanula rotundifolia* as those most frequently found in association. At the northern limit of the site, on the seaward edge of the raised part of the beach, there is a pioneer community similar to that found on the bar. In this case, however, *Rumex crispus littoreus* is an important constant along with *Silene vulgaris maritima* and *Tripleurospermum maritimum. Geranium robertianum* and *Festuca rubra* are also found in association in this area.

The larger area of the raised shingle beach around the telephone exchange is occupied by an *Anthoxanthum odoratum - Festuca rubra - Agrostis capillaris* herb-rich grassland with *Holcus lanatus* and *Aira praecox* as additional Gramineae components.

There are a large number of herbs found constantly, but in varying amounts, throughout this community. These include *Leontodon autumnalis, Succisa pratensis, Centaurea nigra* and those commonly associated with acid heathlands, e.g. *Teucrium scorodonia, Solidago virgaurea, Thymus polytrichus britannicus* and *Rumex acetosella.* Indeed, *Calluna vulgaris* is found in small amounts within this vegetation unit. There is a major moss component to the community, in particular *Tortula ruraliformis, Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus.* This grassy heath is found across much of the raised beach area but is particularly common on the higher, secondary ridge and at the northern end of the site. The lower ridge and the low between the two ridges may be less well drained and these areas support a more mature heathland which is best described as a *Calluna vulgaris -Anthoxanthum odoratum - Molinia caerulea* heathland, where the *Molinia caerulea* is only a minor indicator. *Potentilla erecta* is the most prevalent herb in this community, although *Rosa pimpinellifolia, Solidago virgaurea* and *Lotus corniculatus* are also found in smaller amounts. *Pleurozium schreberi* is the dominant moss providing much ground cover.

Much of this section of the site appears to be relatively undisturbed and there is some scrub development which is *Ulex europaeus* dominated. Indeed, with almost total cover offered by the *Ulex,* many associates are shaded out. with the shade tolerant *Eurhynchium praelongum* as the key associate. This community is relatively common on the shingle substrate.

The final community found at this site is a *Pteridium aquilinum* dominated assemblage with *Potentilla erecta* and *Agrostis capillaris* as minor constants, while *Teucrium scorodonia* and *Galium saxatile* are infrequent associates. The presence of tyre tracks in the peaty soil under the *Pteridium aquilinum* association suggests that this community may have colonised an area subject to disturbance during the building of the telephone exchange.

Key

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

SH97 *Pteridium aquilinum* dominated grassland community;

SH96 *Calluna vulgaris - Festuca rubra - Pteridium aquilinum* community;

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

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

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

SH62 *Festuca rubra - Agrostis stolonifera - Poa pratensis - Anthoxanthum odoratum* community;

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

T1 *Elymus repens - Atriplex* spp. pioneer community.

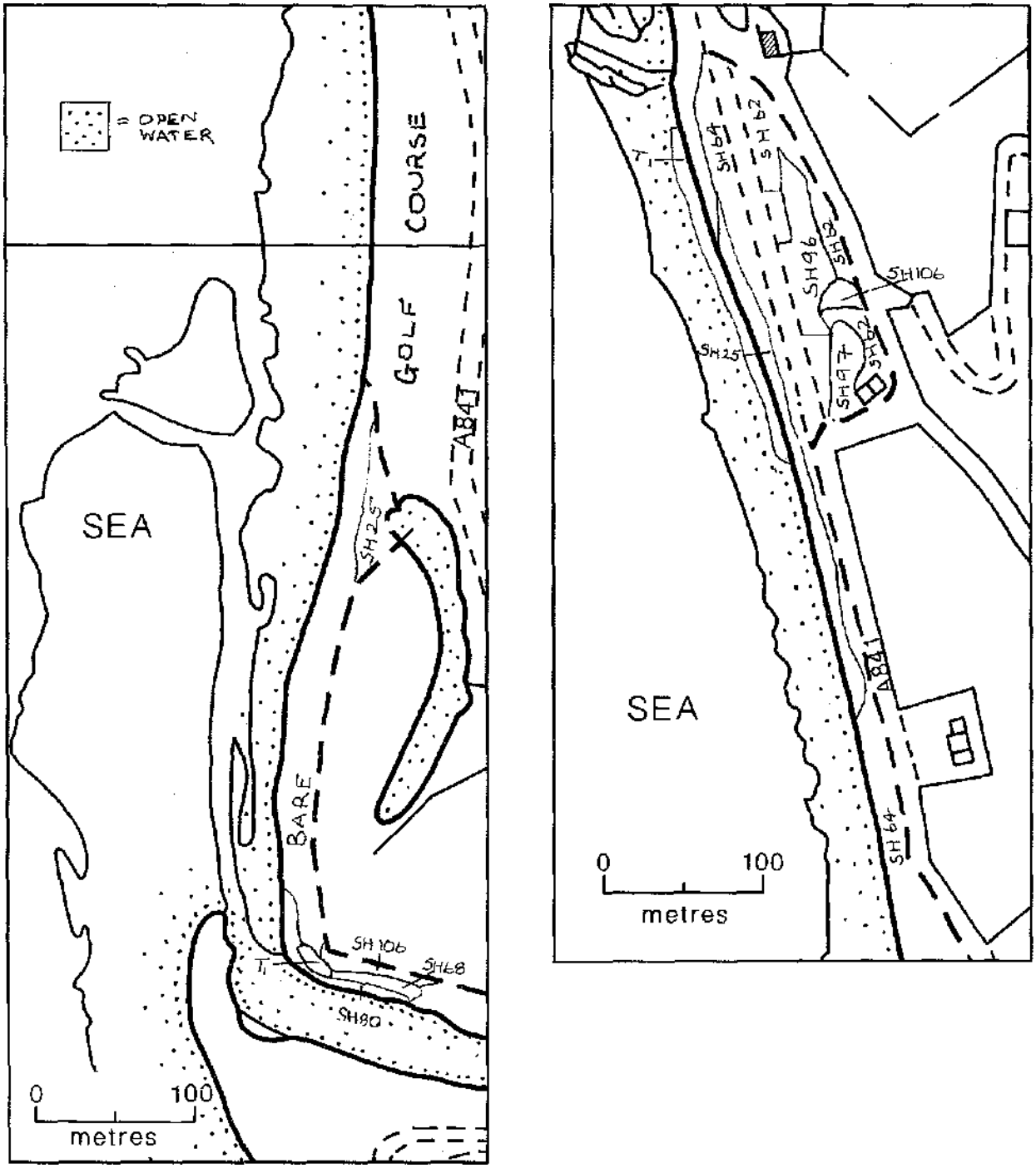

Figure 10 Machrie, Arran

Torrylinwater Foot, Arran

Cunninghame. NR 956 207
Conservation status: SSSI
Area surveyed: 2.1 ha
Fieldwork dates: 25-26/7/89

Introduction
This site represents a transition from a fringing beach to an apposition beach, development of which has been halted with the raising of the beach. There is an extensive raised beach which has been farmed, with only a narrow strip of natural vegetation remaining on either side of the mouth of Torrylinwater. There is a relatively high sand content in the general shingle matrix which is rather coarse.

Threats
This site suffers from recreational pressure in the form of trampling and some litter, although damage is localised and remains light.

The presence of a track leading right down onto the beach has clearly allowed vehicular access, and tyre tracks can be seen on the foreshore. Although they are localised, they have caused moderate levels of damage in these areas.

There has been extraction of sand and gravel from the beach near Torrylinwater.

Management
This site is open to the public and, despite supporting a major colony of *Mertensia maritima,* there is no restriction of access. The storms of 1988 led to a reduction in the size of the colony but this remains a major *Mertensia* site in the region.

Although much of the raised beach is used for grazing cattle, fencing and walls prevent their access onto the natural vegetation on the beach.

The vegetation is found on the sandy areas which are 'cliffed' at the seaward margin (approximately 60 cm) suggesting a current phase of erosion. There are no stabilisation measures at this site.

Vegetation
This site is floristically simple although the presence of *Mertensia maritima* merits its designation as an SSSI. On the western edge of the site, the foreshore supports major stands of *Mertensia maritima* in association with *Atriplex* spp. This gives way to several grassland communities behind, on the more stable shingle which contains a higher sand content, although there remain patches of bare shingle with only saxicolous lichen cover. In places there is some scrub development. This western side of the river is clearly undisturbed.

On the eastern side, however, there is evidence of past excavations from the slack between the first and second shingle ridges and this has led to bare shingle, although saxicolous lichens suggest excavation ceased some time ago. Here too, grassy communities are common with some scrub development.

The only truly pioneer community found at this site is seen along the river edge of the shingle on the relatively steep foreshore and comprises a *Tripleurospermum maritimum - Atriplex prostrata* community with the constant presence of *Mertensia maritima.* The vegetation is very open with around 95% bare shingle in each quadrat.

On each side of the river mouth this community is backed by a more closed maritime grassland characterised by the constant presence of *Silene vulgaris maritima, Festuca rubra* and *Plantago lanceolata.* This herb-rich *Festuca* grassland clearly illustrates the maritime influences in the herb associates.

On the western side of Torrylinwater there are two further grassland communities which are found further back on the shingle and, hence, are subject to less direct maritime influence. The first is a mixed *Dactylis glomerata - Festuca rubra - Arrhenatherum elatius* grassland with *Anthoxanthum odoratum* as a minor constant, along with a major herb component including *Achillea millefolium, Plantago lanceolata* and *Rumex acetosella.*

In places this gives way to a less coarse grassland which is characterised by the constant presence of *Holcus lanatus - Plantago lanceolata - Festuca rubra,* although *Dactylis* continues to be a minor associate.

Where maritime influences are reduced further, particularly on the more riverine shingle, there has been development into scrub vegetation. This comprises a relatively closed *Ulex europaeus - Rubus fruticosus* scrub. Further up by the river this community becomes more open with *Ulex* and *Rubus* found in association with grasses such as *Arrhenatherum elatius* and herbs such as *Senecio jacobaea, Valeriana officinalis* and *Digitalis purpurea.*

On the eastern side of the river mouth the maritime *Festuca* grassland *(Festuca rubra - Silene vulgaris maritima - Plantago lanceolata)* extends all around the coast from the stepping stones on the river edge, to form a thin strip up to the cairn along the eastern shore. Additional maritime herbs include *Cochlearia officinalis* and, occasionally, *Armeria maritima.* Where the shingle beach widens at the river mouth the grassland communities seen on the western side are repeated, with the largest area dominated by the *Festuca rubra - Arrhenatherum elatius - Poa pratensis* mixed grassland. Here too, the stable, less maritime shingle supports a *Ulex - Rubus* scrub community which is more open in places.

Key

SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH108 *Ulex europaeus - Rubus fruticosus* scrub community;

SH72 *Arrhenatherum elatius - Rubus fruticosus - Dactylis glomerata* community;

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

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

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

SH27 *Tripleurospermum maritimum - Atriplex prostrata - Rumex crispus littoreus* pioneer community.

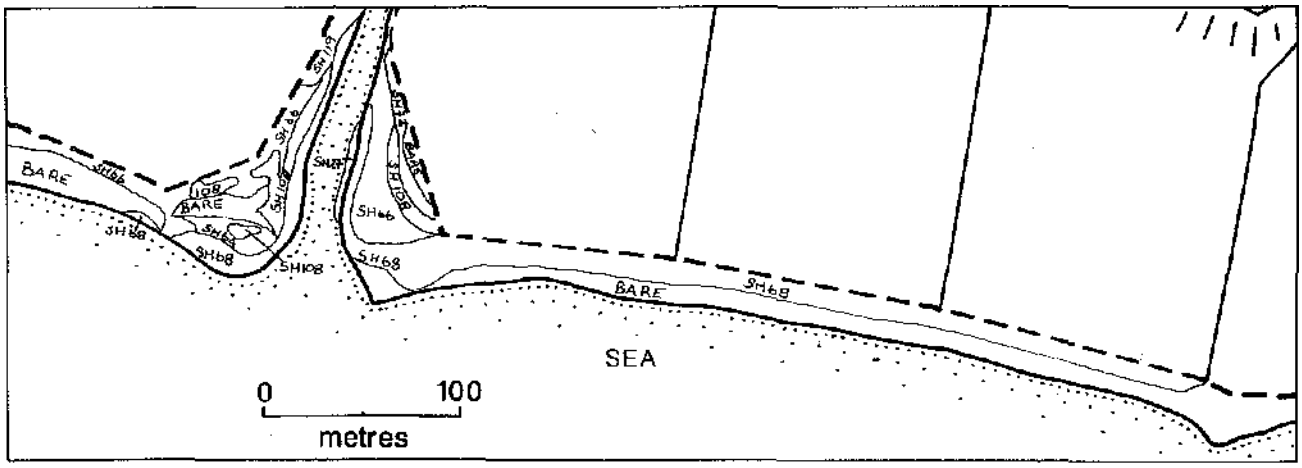

Figure 11 Torrylinwater Foot, Arran

Ballantrae

Strathclyde. NX080818
Conservation status: SSSI, Scottish Wildlife Trust Reserve, LNR
Area surveyed: 16.7 ha
Fieldwork dates: 12-14/7/89 and 21/9/89

Introduction
This site comprises a major shingle spit growing south across the mouth of the River Stinchair. The spit is actively growing and its history can be traced on past Ordnance Survey maps. Its natural growth cycle has, however, been interrupted in recent years, with the artificial breaching of the spit which had deflected the course of the Stinchair south to such a degree that the river was damming up behind the spit and flooding adjacent farmland. The spit is, on average, 50 metres wide, broadening in places to a maximum of 100 metres. The shingle at Ballantrae is derived from the erosion of Ailsa Craig and comprises fine-grained granite.

Despite its highly mobile nature, the spit does contain relict features on its leeward side, with old recurved hooks clearly visible at two points. The protection afforded by the spit has led to the development of a saltmarsh behind, providing varied habitats within one small area. The reworked shingle to the south has led to the formation of a brackish lagoon behind a steep shingle ridge.

Threats
Clearly, the artificial breaching of the spit has had important implications for the natural vegetation. Not only has it resulted in a small loss of shingle available for colonisation, but has led to increased maritime influences on some areas of the spit with the consequent affect on species composition.

There is some recreational pressure on this site which is used for picnics, walking and bird watching; however, this pressure remains localised, and the effects are negligible.

The active nature of this site is reflected in the major changes which occurred as a result of the storms in 1988. The natural reworking of shingle has led to a flattening of the main crest of the spit at its proximal end. This was as a result of the removal of much shingle and the vegetation it had supported. The affected area remains largely bare of vegetation.

Management
This site contains one of the few breeding sites for Little Tern in this area. It is actively wardened during the breeding season and access to much of the spit is restricted. This clearly reduces the chance of damage to vegetation through trampling.

On the southern section of the site dumping has occurred; in particular, farm organic waste has been deposited which has led to eutrophication of the lagoon and may have affected the species composition of the shingle which lies landward of the lagoon.

There is no evidence of vehicular damage to this site, nor is the site grazed.

Vegetation
The active foreshore supports a steep angle and is bare. Vegetation on the northern spit is sparse at its proximal end with occasional scattered plants of *Silene vulgaris maritima.* This gives way to a more closed vegetation towards the distal end of the spit which reflects the increase in sand content. The vegetation cover also increases on the old recurved hook near the distal end with pioneer vegetation giving way to a *Festuca rubra* grassland and some limited scrub development.

The major pioneer community, which occupies much of the storm crest of the northern spit, is *Honckenya peploides* dominated, thus reflecting the sandy nature of the site. This community has *Honckenya peploides* found in association with *Rumex crispus littoreus* and *Silene vulgaris maritima.* It is, however, a very open community with around 60% bare shingle in each quadrat.

Where the spit widens this pioneer community is replaced by a community indicative of more stable conditions. This community may be defined as a *Festuca rubra - Silene vulgaris*

maritima - Plantago maritima grassland with additional maritime herb species, in particular *Tripleurospermum maritimum* and *Rumex crispus littoreus.* Despite a relatively diverse species content, the cover offered by this community remains low at around 50% maximum. It may be that the recent storms have led to an increased maritime influence on an otherwise stable grassland community.

This community is also found on the shingle ridge south of the mouth of the Stinchair. Here it occupies a thin band on the lee slope next to the lagoon. Otherwise, the southern shingle ridge remains bare, probably due to its frequent inundation, evident from the presence of fresh drift on the lee slope.

The sandy nature of the substrate is also indicated by the presence of a small patch of *Ammophila arenaria* at the distal end of the main spit.

It should be noted that *Mertensia maritima,* a nationally rare species, is found on the storm crest scattered amongst the *Honckenya peploides.*

The marsh influence on vegetation is seen on the first, and oldest, recurved hook on the leeward of the spit. This area supports a grassland exhibiting both marsh and shingle characteristics. The marsh influences decrease with increased elevation onto the drier shingle. A thin strip of vegetation nearest the marsh is characterised by the constant presence of *Agrostis stolonifera* and *Festuca rubra,* along with typical saltmarsh species such as *Glaux maritima.* This develops into a herb-rich *Festuca rubra - Trifolium repens* grassland with a major *Lolium perenne* component. The *Lolium* may be an introduction from the farm which lies adjacent to this part of the site. The herb component of this community includes *Plantago lanceolata, Lotus corniculatus, Achillea millefolium* and *Vicia cracca.*

The younger, and larger, recurve at the distal end of the spit displays a zonation of the vegetation which reflects the maritime influences. This is offset to some degree, however, by the increasing marsh influence on the lee slope.

The area behind the storm crest, moving down onto the recurve, supports a pioneer community typical of many shingle sites. This is a *Tripleurospermum maritimum - Silene vulgaris maritima* community. These constant species are found in association with other maritime herbs such as *Atriplex prostrata* and *Plantago maritima,* although it is a generally species-poor community.

Increased stability leads to the development of a *Silene vulgaris maritima - Festuca rubra - Plantago maritima* grassland providing a closed vegetation across much of the main body of this recurve. Additional herb associates include *Achillea millefolium, Vicia cracca* and *Lotus corniculatus.*

This community in turn gives way to a less maritime, mixed, coarse grassland with a major scrub element, characterised by the constant presence of *Festuca rubra* and *Arrhenatherum elatius* along with varying amounts of *Ulex europaeus,* although the cover provided by this species remains small. Although less maritime in nature, this community also supports occasional maritime herbs, in particular, *Silene vulgaris maritima* along with those of a less maritime nature such as *Vicia cracca, Achillea millefolium* and *Centaurea nigra.*

The communities found at the shingle/marsh boundary show some zonation according to the level of protection from direct maritime influences. On the more exposed southerly edge of this recurve the community is more indicative of the shingle substrate, being the *Silene - Festuca - Plantago* community found on the main body of the recurve. However, on the northern edge of this recurve, which is sheltered from direct maritime influences, the marsh influence on the vegetation is greater. Here the community is a herb-rich *Festuca rubra* grassland best defined as a *Festuca - Puccinellia maritima* community with the occasional presence of shingle indicators, e.g. *Rumex crispus littoreus.*

There is some limited scrub development on this recurve with several *Ulex europaeus* bushes. However, scrub is best developed on the older shingle ridges landward of the lagoon on the southern section of the site.

The southern end of the site supports a pioneer flora on the shingle ridge with scrub and grassland communities landward of the lagoon. As stated earlier, this area has been used as a tip for farm refuse. This has clearly disturbed the natural development of the vegetation as it has improved the nutrient status and has resulted in a complicated pattern of communities.

Much of the area is occupied by the coarse, mixed grassland seen on the recurve of the spit and defined as *Festuca rubra - Plantago lanceolata - Poa pratensis* grassland. However, in some areas the grassland has developed into a *Rubus fruticosus - Arrhenatherum elatius* scrub which, in places, gives way to a pure scrub with *Rubus fruticosus* and *Prunus spinosa* as the key indicators, although *Arrhenatherum* continues to play an important role.

These scrub communities occupy the more elevated, older shingle ridges; however, closer to the lagoon there is an increased marsh influence with a *Trifolium repens* grassland and a *Holcus lanatus - Agrostis stolonifera* grassland forming a mosaic. Both of these communities are relatively species-poor and may reflect the heightened nutrient status associated with the farm refuse.

Key

SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

SH74 *Agrostis stolonifera - Trifolium repens - Festuca rubra* community;

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

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

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

SH31a *Honckenya peploides* dominated community;

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

SH25 *Silene vulgaris maritima - Rumex crispus littoreus - Tripleurospermum maritimum* community.

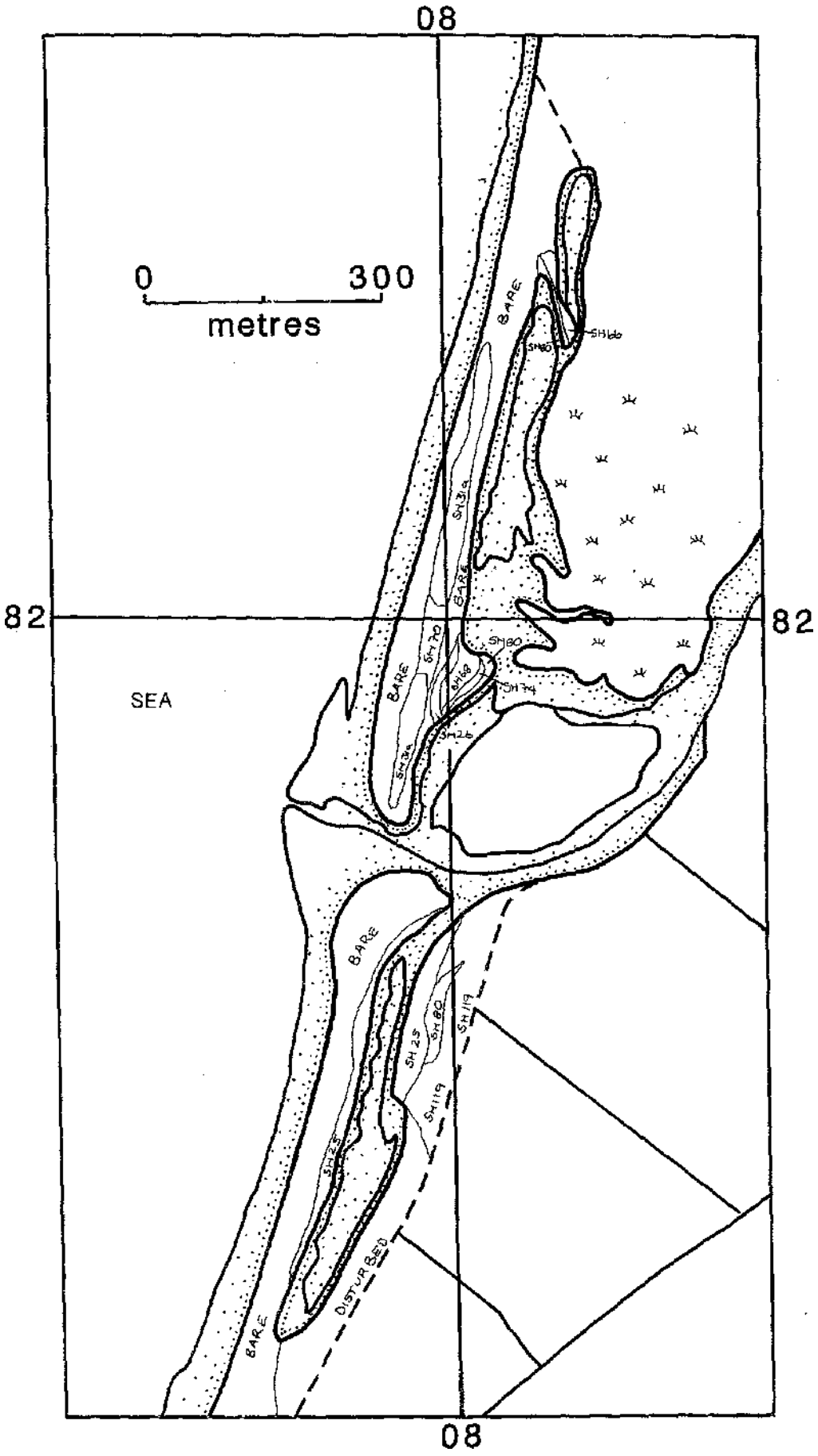

Figure 12 Ballantrae

Morroch Bay

Dumfries and Galloway. NX 040500
No conservation status
Area surveyed: 3.9 ha
Fieldwork date: 20/7/89

Introduction
This site comprises a sandy shingle raised apposition beach which has collected in this bay against the resistant cliffs behind. There is a high proportion of sand within the shingle matrix and there is also some sand capping to a maximum depth of 8 cm.

Threats
Access to Morroch Bay is very restricted from land, although there would be easy access by sea. As a result, there is no vehicular damage to the site, with only one somewhat overgrown track across it, illustrating the isolation of this site.

There are three buildings on the site, two of which are derelict while the third is clearly a holiday home, which was not in use at the time of the survey. The introduction of garden species around these buildings has had a limited influence on the flora immediately surrounding them.

There is much rubbish in the drift line on the gently sloping foreshore. Indeed, there is a large piece of machinery deposited on the beach. This highlights the importance of such a nutrient source for this site.

The site appears to be in equilibrium with no evidence of active erosion or deposition.

Management
Part of the beach, at the northern end, has been fenced off and in the past has been cultivated, although it has since been invaded by *Pteridium aquilinum* from the adjacent cliff. This site has not been grazed.

Vegetation
Morroch Bay is floristically simple with a pioneer community occupying the foreshore above the mean high water mark. The area of stable shingle immediately behind the active beach supports a *Raphanus maritimus* dominated community and this gives way to grassland communities behind.

The pioneer community is dominated by *Honckenya peploides*, which is found in association with small amounts of *Elymus repens* and *Galium aparine* or *Potentilla anserina.* This unit stretches along the southern part of the foreshore where the beach widens, beyond the wave cut platform.

There is also a *Raphanus maritimus - Arrhenatherum elatius* community with the *Raphanus* growing to a height of 1.4 metres. This most closely resembles an *Arrhenatherum elatius - Raphanus maritimus - Tripleurospermum maritimum* assemblage, but in this case there are no other maritime herbs associated with these two species. In fact the associates are most commonly grasses such as *Holcus lanatus*, and this has shifted the definition of some quadrats to the grassland side of the classification. It may be that the high levels of rainfall on this western coast wash the salt from the substrate, thus reducing the maritime influence despite the proximity to the sea.

The area between the holiday home and the old field supports a *Festuca rubra - Trifolium repens* mixed grassland. *Festuca rubra* is found here with *Holcus lanatus* and, less frequently, with *Poa pratensis* and *Agrostis capillaris.* Herb associates include *Plantago lanceolata* and *Cerastium semidecandrum* along with the constant presence, although in small quantities, of *Trifolium repens.*

The final communities, which occupy the remaining area on the stable shingle, may be described as transitional grasslands with some scrub development. The major unit is an *Arrhenatherum elatius - Holcus lanatus* grassland with *Rubus fruticosus* as a frequent but minor associate. This is a species-poor community with very occasional herb species such as *Rumex crispus littoreus.* In places the scrub has developed further and an *Arrhenatherum/ Dactylis - Rubus fruticosus* scrub has formed.

Key

SH116 *Raphanus maritimus - Arrhenatherum elatius - Rubus fruticosus - Dactylis glomerata* community;

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

SH60 *Agrostis stolonifera - Holcus lanatus - Trifolium repens - Plantago lanceolata* community;

SH31b *Honckenya peploides - Potentilla anserina* community;

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

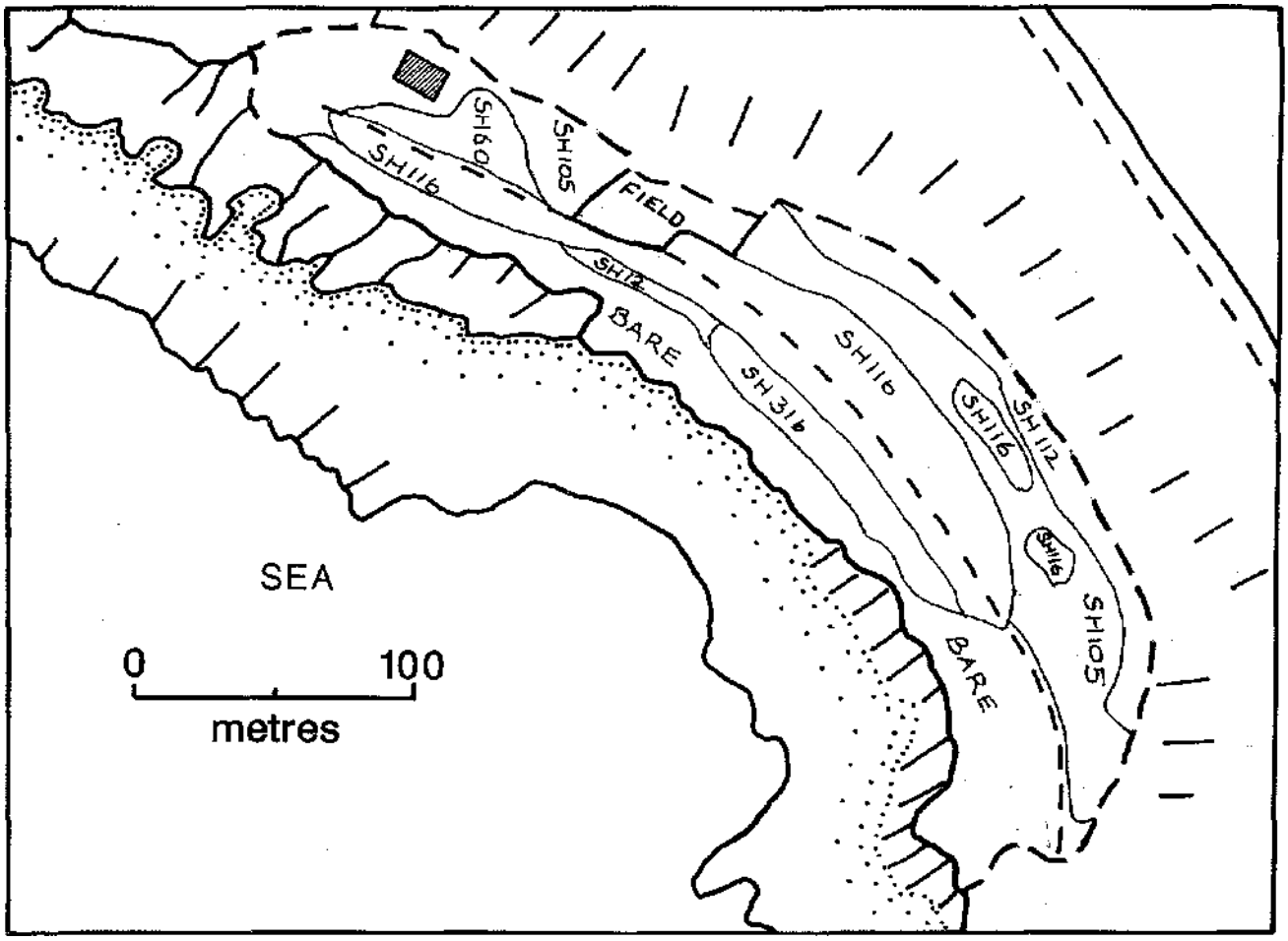

Figure 13 Morroch Bay

Ardwell-Chapel Rossan

Dumfries and Galloway. NX 110450
No conservation status
Area surveyed: not surveyed
Fieldwork date: 20/7/89

Introduction
This site is an example of a raised fringing beach which is very small in size and has a very high sand content. Indeed, the sand content within the shingle matrix develops into a sand capping of up to 15 cm at the rear of the site.

This is a particularly disturbed site with a car park on the natural shingle vegetation while certain areas have been tarmacked. The provision of the car park has inevitably led to increased recreational pressure on the site, along with the siting of toilets and picnic tables on the raised beach. In addition to the direct loss of vegetated shingle there is a loss of vegetation through trampling. There is also a caravan site on the raised beach which has destroyed the natural vegetation and heightened recreational pressure, which is locally severe.

To the north of the site there are holiday homes. The grassland vegetation here seems more natural, but there is continued disturbance of vegetation in the form of vehicle tracks and trampling.

There is also evidence of extraction and reworking of shingle at the burn mouth.

The small size of this site, along with the dominance of sand, and, more importantly, the degree of disturbance, led to the exclusion of this site from the survey.

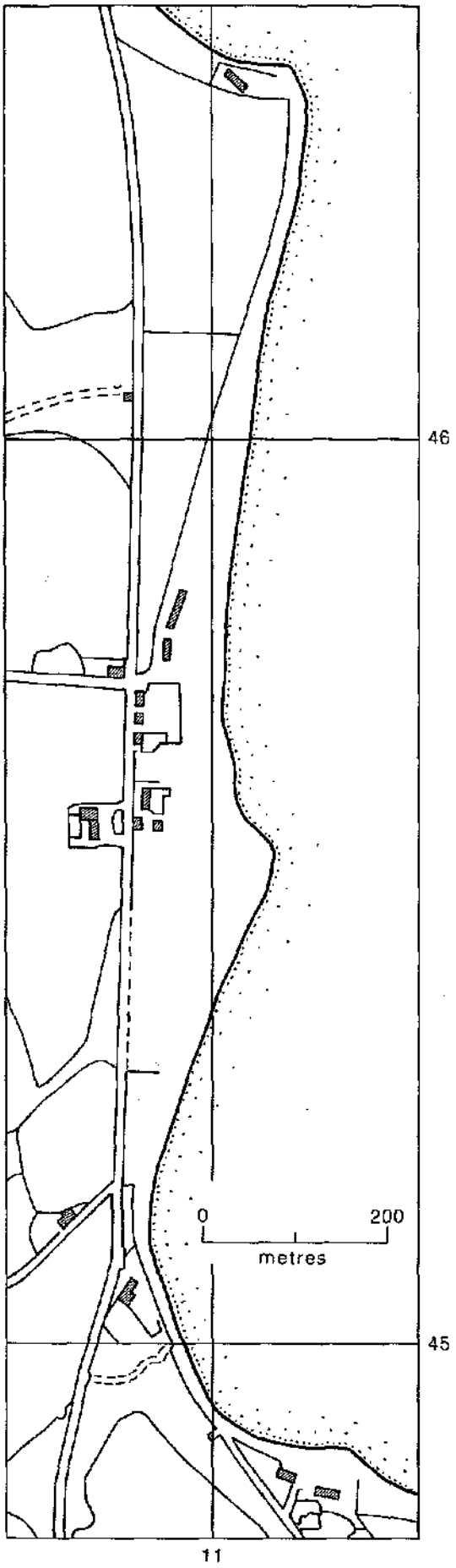

Figure 14 Ardwell-Chapel Rossan

Auchenmalg Bay

Dumfries and Galloway. NX 240520
No conservation status
Area surveyed: 3.6 ha
Fieldwork date: 28/9/89

Introduction
This site comprises a raised fringing beach with a high sand content within the shingle matrix. All along this stretch of coastline the shingle is worked by littoral currents to form cuspate features on a very large scale with maximum development of vegetation commonly found on the limbs of a cusp. This site forms the northern extreme of a stretch of coast running south to Port William, all of which falls into the category of raised fringing beach; thus, taken as an entire unit, this area warrants inclusion in this survey.

The northern boundary within the Auchenmalg site is taken as the edge of the vegetated raised beach where the road cuts across the beach. The southern boundary was taken to be the Auchenmalg sign, as beyond this the vegetation has been disturbed. The maximum width of the beach at this site is 15 metres.

Threats
The siting of a caravan site on the opposite side of the road may have increased recreational pressure on this site but levels of damage due to this are negligible. This is also true of vehicular damage to the site which is very localised. The site has not been developed in any way and appears to be in equilibrium.

The southern boundary of the site was delimited according to levels of disturbance, as beyond this area the vegetation has been modified by mowing, parking and low levels of shingle extraction. Clearly, efforts should be made to discourage the extension of such activities into the currently undisturbed area.

Management
This site has not been improved but is subject to light levels of rabbit grazing. Indeed, the droppings which are seen on the bare shingle, above the high water mark, may be an important source of nutrient input to this otherwise impoverished environment.

Vegetation
This site offers examples of a pioneer community which is typical of sandy shingle substrates and also illustrates the development of vegetation, through to a scrubby vegetation thought to be a Scottish 'climax' community for shingle.

The pioneer community runs in a thin strip along the front of the raised beach. This community may be defined as an open *Tripleurospermum maritimum - Raphanus maritimus* pioneer assemblage which contains other species characteristic of shingle sites. These include *Rumex crispus littoreus, Silene vulgaris maritima and Atriplex* spp.; indeed, in places along the shore the *Silene vulgaris maritima* and *Rumex crispus littoreus* become locally important within the community. There is some zonation in this coastal strip which becomes more diverse to the north with *Glaucium flavum* and *Arrhenatherum elatius* as additional associates. Indeed, this increase in diversity is also seen to develop moving inland from the original pioneer community in the southern part of the site.

It should be noted that there are occasional plants of *Mertensia maritima* scattered across the shingle in the northern section of this site.

Further development of the vegetation is seen in the discontinuous patches of diverse scrub which are found at the rear of the site. This is primarily a *Prunus spinosa - Rubus fruticosus* scrub with *Arrhenatherum elatius, Sambucus nigra* and *Hedera helix* as frequent associates.

A second type of scrub is found locally within this general scrub community reflecting, perhaps, areas where sand is locally important in the shingle matrix. In this case *Rubus fruticosus* is the dominant species with *Arrhenatherum elatius* and *Rosa pimpinellifolia* as minor constants.

Key

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

SH119 *Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH13 *Atriplex prostrata - Raphanus maritimus - Rumex crispus littoreus* pioneer community.

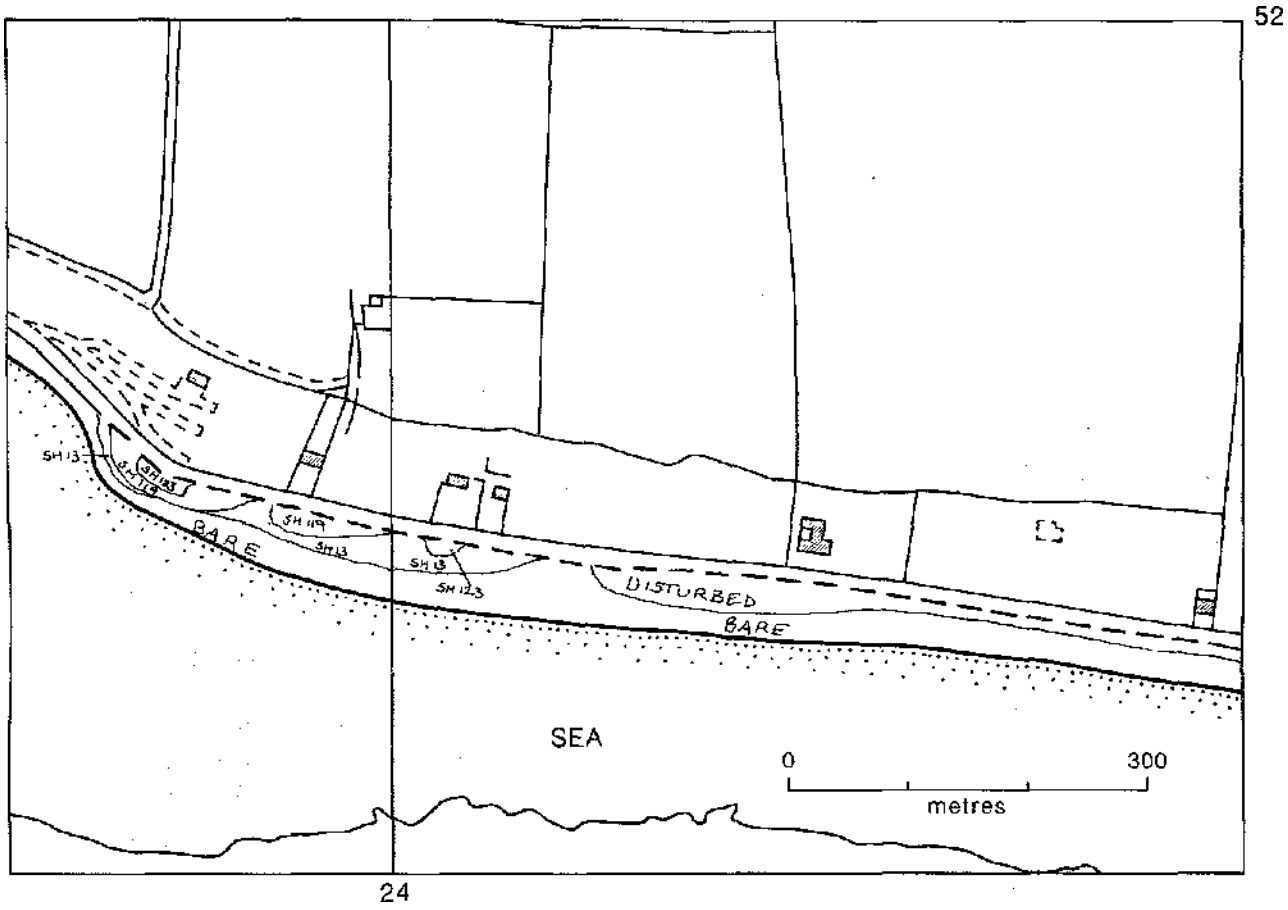

Figure 15 Auchenmalg Bay

Chapel Finian

Dumfries and Galloway. NX 280490
No conservation status
Area surveyed: 3.6 ha
Fieldwork date: 5/10/89

Introduction
This site comprises a stretch of raised shingle fringing beach which is bounded to the north by a wall of the house at Cornwall Point, and to the south where the strip of raised shingle narrows to 5 metres by an ash tree. The inland boundary is taken to be the road. This site is found along the stretch of coast running from Auchenmalg to Port William. At this point the fringing beach widens out and has a well-developed vegetation, hence it was included in the survey.

Threats
The central section of this site has been turned into a car park and the vegetation has been disturbed, not only in the destruction of the natural scrub vegetation at this point, but also by the effect of the vehicles on the resulting grassland. The disturbance of the vegetation has, however, been successfully restricted to this one area. While the easy access has led to increased recreational pressure on the site, the levels of damage have remained negligible.

This stretch of coastline appears to be in equilibrium with little evidence of active erosion or deposition.

Management
There is no evidence that there has been any form of agricultural improvement at this site, nor has there been any grazing.

Vegetation
There are three main plant communities at the Chapel Finian site. The first is a shingle pioneer community which occupies the drift line. Behind this there is an area of bare shingle which is backed by scrub communities. The third type of community is found on the more active foreshore and has developed over the boulders.

The pioneer community is characterised by the dominant presence of *Raphanus maritimus* which is commonly found with *Tripleurospermum maritimum* and *Atriplex* spp. Additional associates include *Arrhenatherum elatius* and *Rubus fruticosus.* As has been seen, this *Raphanus* community is typical of this stretch of coastline.

There are three types of shingle scrub at this site. The major unit may be described as a *Ulex europaeus* dominated scrub. The *Ulex* is most frequently found in association with *Rubus fruticosus.* Additional constants, although only found in small amounts, include *Teucrium scorodonia, Rosa pimpinellifolia, Hedera helix* and, occasionally, *Raphanus maritimus,* reflecting the maritime nature of the area.

The second type of scrub is a *Prunus spinosa* dominated community. The *Prunus* is also found in association with *Rubus fruticosus* and, less commonly, with *Teucrium* and *Rosa pimpinellifolia,* as with the *Ulex* scrub. In this case, however, the occasional associates are more commonly *Crataegus monogyna* and *Arrhenatherum elatius* thus providing the basis for the community definition.

The final scrub community is found at the north of the site and is characterised by the constant presence of *Ulex europaeus* and *Pteridium aquilinum* in large quantities. *Rosa pimpinellifolia, Dactylis glomerata* and the shade tolerant moss *Eurhynchium praelongum* form the minor components of this assemblage.

The community on the boulders resembles a saltmarsh community and is a *Festuca rubra* dominated grassland with *Agrostis stolonifera* as an important constant. The clearly maritime nature of this grassland is reflected in the frequent, if minor, presence of pioneer herbs such as *Silene vulgaris maritima, Potentilla anserina, Armeria maritima* and *Cochlearia danica.*

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

SH110 *Dactylis glomerata - Rubus fruticosus Centaurea nigra* community;

SH108 *Ulex europaeus - Rubus fruticosus* scrub;

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

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

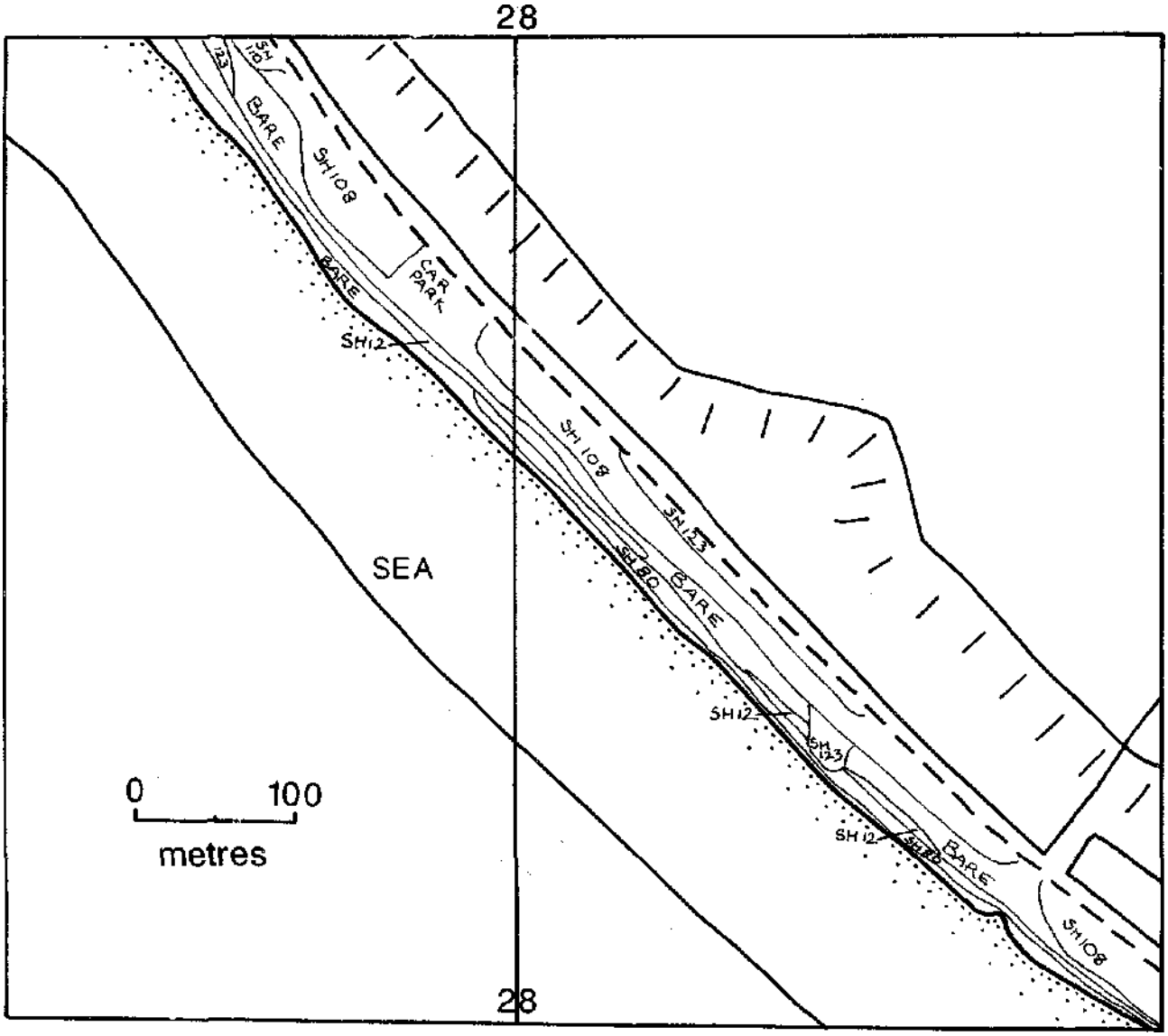

Figure 16 Chapel Finian

Shore Cottage

Dumfries and Galloway. NX 300470
No conservation status
Area surveyed: 3.9 ha
Fieldwork date: 4/10/89

Introduction
This site may be defined as a narrow strip of raised fringing beach running north from Shore Cottage up to its northern extreme which is found across the burn in an area where the beach widens, before becoming too sandy for inclusion in this survey. Indeed, the whole site has a high sand and shell content within the shingle matrix and constitutes the extreme of the sandy shingle definition.

The rear of the site is marked by field boundaries as much of the site has been given over to agriculture.

Threats
Much of the original raised beach has been lost to agriculture with the clearing of natural vegetation, reseeding and grazing of livestock in fields on the shingle.

Other than this, there is relatively little disturbance to the site as access is limited to only one point south of Shore Cottage.

The site appears to be in equilibrium with existing maritime forces.

Management
The area seaward of the field walls shows no sign of agricultural improvement. However, it is clear that the remaining natural vegetation along the foreshore is actively grazed by rabbits and cattle.

Vegetation
This sandy shingle site offers examples of pioneer communities, mature grasslands and scrub communities. Such diversity in a relatively small area is quite unusual.

The first pioneer community stretches along the northern section of the site occupying the foreshore zone. This community is a typical sandy shingle pioneer assemblage with *Rumex crispus littoreus, Tripleurospermum maritimum* and *Glaucium flavum* as the major species, while *Crambe maritima,* the species commonly associated with the shingle substrate, is found occasionally in the very open community (approximately 90% bare shingle/sand in each quadrat). Infrequent associates include *Raphanus maritimus* and *Sedum acre,* an indicator of the arenicolous nature of this site.

The second open pioneer community, which is largely northern in distribution, is a *Raphanus maritimus - Tripleurospermum maritimum* community with *Festuca rubra* and *Dactylis glomerata* as minor constants along with *Rubus fruticosus* and *Atriplex* spp., illustrating an interesting maritime and non-maritime assemblage. This vegetation unit, characteristic of more stable environments, is found in a narrow strip landward of the initial pioneer community.

Behind this, the stable shingle supports two slightly different mature grasslands. The first is a *Festuca rubra - Poa pratensis* grassland with *Peltigera canina* and *Vicia lathyroides* as additional major constants. Less frequent associates within this community include *Dactylis glomerata, Geranium molle, Thymus polytrichus britannicus, Lotus corniculatus* and *Plantago lanceolata.* This community also contains an important diverse bryophyte component with *Dicranum scoparium, Rhytidiadelphus squarrosus, Rhytidiadelphus triquetrus, Hypnum cupressiforme* and *Pseudoscleropodium purum.* It is unusual to find such a well-developed bryophyte flora so close to maritime influences and this gives evidence of the stable nature of the shingle at this site.

The second grassland is similar in its species composition; however, it is the relative dominance of each species which distinguishes it. In this community, the grass species *Festuca rubra* and *Poa pratensis* dominate, with the bryophyte and herb content, while still high, of less importance in terms of cover. This separation of the communities is reinforced by the additional presence of *Arrhenatherum*

elatius and *Dactylis glomerata* as major constants while *Thymus polytrichus britannicus, Peltigera canina* and *Dicranum scoparium* are minor components.

The final communities at the site comprise scrub communities which are found at the northern end of the site where the beach widens. The major scrub community is a *Prunus spinosa - Rubus fruticosus* community which is *Prunus* dominated. *Rosa pimpinellifolia, Hedera helix* and *Elymus repens* are the minor constants.

In places this is replaced by a *Ulex europaeus - Rubus fruticosus* scrub common to stable shingle sites. However, the *Ulex* is not as dominant as is often the case, and as a result this community is relatively species-rich, with *Geranium robertianum, Arrhenatherum elatius* and *Teucrium scorodonia* as frequent associates.

Key

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

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

SH63 *Festuca rubra - Plantago lanceolata - Dicranum scoparium* community;

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

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

SH12a *Raphanus maritimus -Tripleurospermum maritimum -Arrhenatherum elatius* community, *Festuca rubra* sub-community.

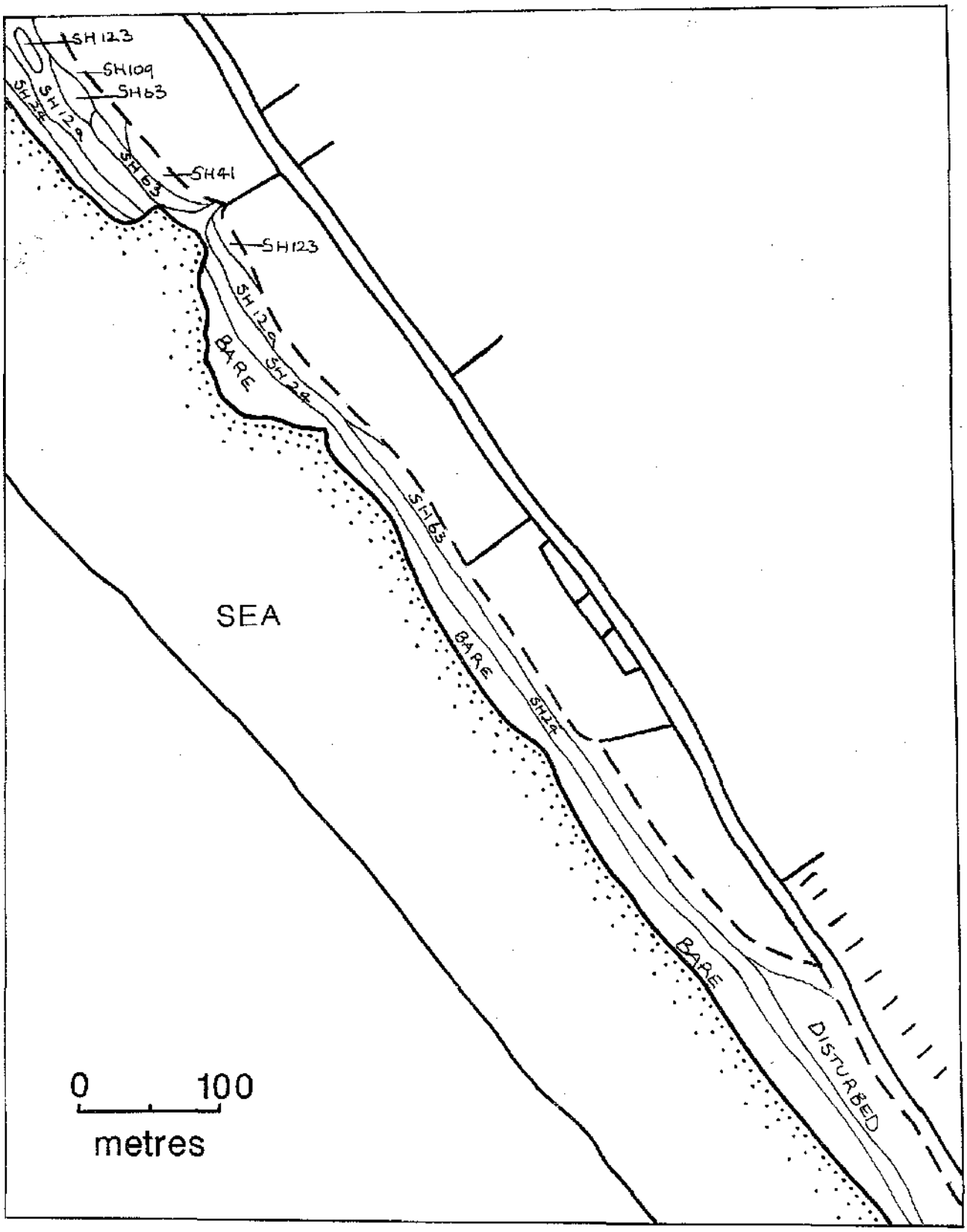

Figure 17 Shore Cottage

Milton Point

Dumfries and Galloway. NX 320460
No conservation status
Area surveyed: 4.1 ha
Fieldwork date: 4/10/89

Introduction
The thin raised beach running along this stretch of coastline widens at Milton Point and there is significant development of vegetation. This raised beach is almost pure shingle, which is relatively unusual on this coast which tends to have a major sand content.

The southern boundary of the site is taken as the tin-roofed house next to the road while the northern limit was drawn where the beach thinned to approximately 4 metres again.

Threats
The siting of a house at the southern end of Milton Point has led to the introduction of some garden species onto the shingle. Although this house is now derelict it has clearly had an impact on the vegetation of the site.

There has also been some excavation of shingle which has resulted in much disturbance to the stable area in the south. This disturbance is heightened by the additional vehicular disturbance consequent on the removal of the shingle.

While there is little evidence of erosion, in the centre of the raised beach there is an area where there appears to have been an incursion of the sea, with a clear driftline further back on the beach out of line with surrounding driftlines.

There are no buildings other than the tin-roofed derelict house to the south.

Management
This site shows no sign of agricultural improvement, nor is it grazed. There has been a drain dug across the site in the past; this has, however, had little impact on the surrounding vegetation.

Vegetation
Although this is a small site it is floristically interesting with examples of patches of bare shingle with prostrate *Prunus spinosa* as the only coloniser. While this does not constitute a community, it highlights the importance of *Prunus* in the succession on shingle at this site. It would appear to correspond to the role played by *Cytisus scoparius* at Dungeness in Kent.

The foreshore supports a community which is not truly pioneer in nature. It is a *Festuca rubra* dominated community with maritime pioneer associates such as *Rumex crispus littoreus, Potentilla anserina, Plantago maritima* and *Tripleurospermum maritimum.* This seems to be a saltmarsh/shingle community which most closely resembles an *Agrostis stolonifera -Festuca rubra* maritime grassland. This community is found on the larger shingle, below the raised beach, and so will clearly be flooded on a regular basis.

Immediately behind this vegetation unit, along the edge of much of the raised beach, there is an open *Raphanus maritimus - Tripleurospermum maritimum* assemblage characteristic of coasts in this area. Between 10% and 40% bare shingle is found in quadrats within this community although there are a number of associated species including *Geranium robertianum, Festuca rubra, Arrhenatherum elatius* and, interestingly, *Rubus fruticosus.* It would seem that this community may represent a delicate equilibrium situation whereby high levels of rainfall are able to leach out sufficient salt to allow the growth of *Rubus* while airborne salt spray may be sufficient to satisfy the needs of maritime species such as *Raphanus maritimus.*

There is further scrub development at Milton Point and this occurs along the edge of the raised beach in patches immediately behind the *Raphanus maritimus* community. This scrub is *Prunus spinosa* dominated with *Rubus fruticosus* as the second major constant. *Rosa canina* and *Senecio jacobaea* are frequently found in this assemblage, as is *Raphanus maritimus,* thus reflecting continuing maritime influences. In several areas the emphasis of the definition shifts such that *Rubus fruticosus* becomes the dominant species.

The largest area of the site supports a *Pteridium aquilinum* grassland which may be divided into two sub-types according to the amount *of Pteridium.*

The first sub-type is found across much of the beach on the more exposed section closest to the seaward margin. This community is characterised by the dominance of *Dactylis glomerata* and *Rubus fruticosus* with *Centaurea nigra* as a major indicator. *Pteridium aquilinum* is, in this case, a minor constant found in small quantities throughout the community. This assemblage is relatively diverse with *Anthoxanthum odoratum, Poa pratensis* and *Phalaris arundinacea* as the Gramineae component and *Filipendula ulmaria Vicia cracca* and *Rumex acetosa* as key herb associates.

Further back, at the rear of the site, along the road, this develops into a *Pteridium aquilinum* dominated *Dactylis glomerata* grassland with *Rubus fruticosus* and *Centaurea nigra* as minor constants. It is the associated species which differentiate between the two sub-types; this *Pteridium aquilinum* dominated sub-type is less diverse, with *Ulex europaeus, Plantago lanceolata, Teucrium scorodonia* and *Elymus repens* the most frequent associates.

Key

SH120 *Prunus spinosa - Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH110 *Dactylis glomerata - Rubus fruticosus Centaurea nigra* community;

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

SH27a *Tripleurospermum maritimum - Atriplex prostrata - Rumex crispus littoreus* pioneer community, *Potentilla anserina* sub-community;

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

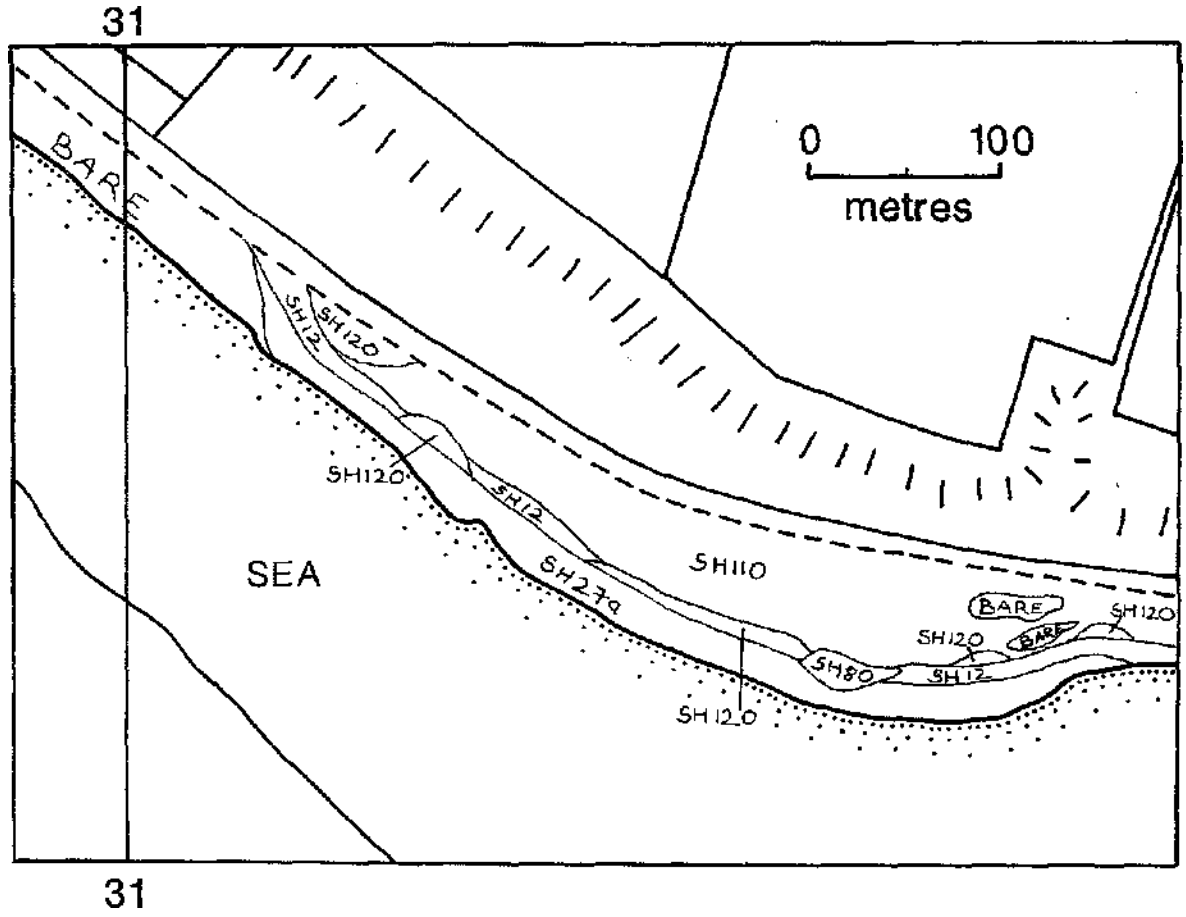

Figure 18 Milton Point

Philip and Mary

Dumfries and Galloway. NX 340430
No conservation status
Area surveyed: 2.7 ha
Fieldwork dates: 29/9/89-3/10/89

Introduction
This site comprises a sandy shingle spit which forms the end of one of the large-scale cusps seen all along this stretch of coast. The spit grows out from the coast in an east-west direction. There is much intertidal shingle which has clearly formed the base of this feature. There is a sand-capping over the shingle base on much of the main body of the spit but the spit is particularly sandy on the southern side. In addition, there is some saltmarsh development on the western tip and the sheltered northern shore of the spit.

A lay-by built onto the spit was used as a rear boundary to the site.

Threats
This site is relatively undisturbed with damage through recreational pressure kept to a light level, and very localised in extent. There is some vehicular damage to the site with tractor tracks out to the southern shore causing light disturbance to the vegetation. There is no evidence of stabilisation works and the site has not suffered any development or extraction works. The site is clearly in equilibrium with the natural maritime forces.

Management
There has been some dumping of farm rubbish on the spit and this has clearly influenced the vegetation in small patches. The site has not, however, been improved, nor has it been grazed.

Vegetation
The communities at this site reflect the various influences of the different substrates found on the spit. Pioneer communities representative of both sandy and shingle substrates are found on this site, along with saltmarsh communities, and there is development from grassland into scrub.

The southern shore is characterised by the sandy shingle pioneer community defined as an *Elymus repens - Raphanus maritimus - Atriplex prostrata* association. This is a very open community with approximately 23% bare sand and shingle within each quadrat.

Behind this community, and stretching around much of the western end of the spit, is a sub-community of this original pioneer association in which *Atriplex prostrata* is the dominant constant found with the same associates; however, in this instance they form only a minor component. This sub-community clearly reflects the position of a relict strandline.

The foreshore at the western end of the spit, and areas along the northern shore, support a fragmented saltmarsh community dominated by *Bulboschoenus maritimus* and characterised by the presence of *Puccinellia maritima, Glaux maritima* and *Plantago maritima* as additional constants. Certain halophytic herbs are found as frequent associates in this community, with particular emphasis placed on *Juncus gerardii, Armeria maritima* and *Aster tripolium* as indicator species.

Behind this assemblage there is an open pioneer community which is typical of shingle sites. This community is a *Silene vulgaris maritima - Rumex crispus littoreus - Tripleurospermum maritimum* association with *Galium aparine* as an additional, but minor, constant. *Raphanus maritimus* and *Sonchus asper* are found in small quantities within this community.

Both ends of the site are characterised by the growth of a *Prunus spinosa* dominated scrub. This scrub community may be divided into two sub-communities which are determined according to the diversity of the associated species. The first of these is a *Prunus spinosa - Rubus fruticosus* scrub with *Hypnum cupressiforme* as the major associate, along with a few maritime indicators such as *Tripleurospermum maritimum* or *Raphanus maritimus.* However, the second sub-community is more diverse with *Prunus spinosa, Rubus fruticosus* and *Arrhenatherum elatius* as dominant indicators while *Rosa*

canina and *Hypnum cupressiforme* form minor components.

A second major scrub community seen across many shingle sites is found at the eastern end of this feature. This vegetation unit has *Ulex europaeus* as the dominant species with *Rubus fruticosus, Raphanus maritimus* and *Dactylis glomerata* as infrequent associates.

Much of the central section of the spit is occupied by a grassland community identified by the constant presence of *Dactylis glomerata, Festuca rubra* and *Arrhenatherum elatius* in a mixed grassland which displays two sub-communities. The main one, found on the southern section of the spit, is a variation of this *Dactylis* dominated mixed grassland with *Raphanus* as an important indicator along with *Elymus repens* and *Tripleurospermum maritimum* to a lesser extent. This sub-community clearly displays a maritime influence.

The less maritime version of this community has *Plantago lanceolata* and *Festuca rubra* as most frequent associates, with scattered *Raphanus* plants being the only maritime species in an otherwise terrestrial assemblage.

There is a small patch of *Festuca rubra - Plantago lanceolata - Hypochoeris radicata* grassland in the centre of the spit reflecting perhaps a local dominance of sand in the substrate. This community is particularly rich in herbs with *Rosa pimpinellifolia, Campanula rotundifolia, Senecio jacobaea* and *Carex arenaria* as major components. In this instance there is evidence of prolonged stability on the site with the presence of *Cladonia furcata* within this unit.

Key

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

SH120 *Prunus spinosa - Rubus fruticosus - Arrhenatherum elatius* scrub community;

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

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

SH77 *Glaux maritima - Festuca rubra - Juncus maritimus* community;

SH73 *Arrhenatherum elatius - Raphanus maritimus* community;

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

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

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

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

SHI 3 *Atriplex prostrata - Raphanus maritimus - Rumex crispus littoreus* pioneer community;

T1 *Atriplex prostrata* dominated SH13.

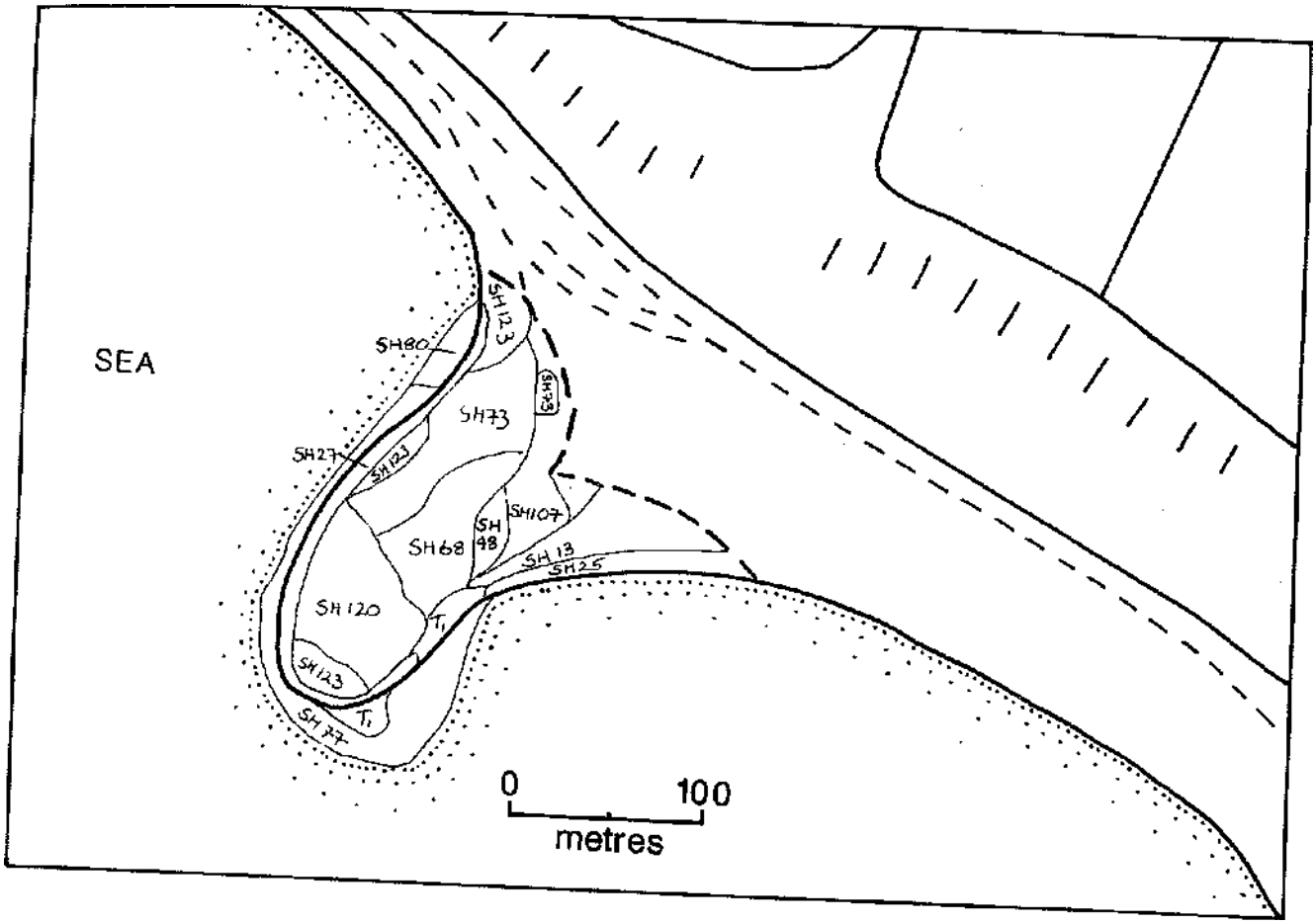

Figure 19 Philip and Mary

Claymoddie

Dumfries and Galloway. NX 430360
Conservation status: SSSI
Area surveyed: 30.0 ha
Fieldwork dates: 22/9/89 and 25-29/9/89

Introduction
The Claymoddie site stretches from the rock outcrops at St Ninian's Cave in the south up to the Point of Cairndoon in the north. This stretch of coast is a good example of a Scottish raised shingle beach which is approximately 5 metres above sea level. This is pure shingle deposited against a (sandstone) cliff. The raised beach is bounded at the back by a field wall, and, indeed, the northern boundary is a field wall which runs across the beach down to the active foreshore. The beach is relatively narrow (15 metres) along much of its length but in areas this widens considerably. The average pebble diameter increases in the north.

Threats
The difficulty in accessing this site (the only point of access is the farm track at Claymoddie) has served to prevent any recreational use of the beach.

The site is clearly in equilibrium with no active erosion or accretion and, hence, no coastal defence measures.

There has been some extraction of shingle in the past but this is now discontinued.

Management
The greatest threat to natural vegetation at this site is posed by agriculture. Farming activities are largely confined to the south where a stretch of the back shore is currently farmed and had been recently ploughed. The use of this site for agriculture has led to a little vehicular damage in the form of tracks along the shingle, although damage remains negligible.

There has been no grazing on most of the site but in the far north there has been grazing by cattle from the field which acts as the northern boundary.

Vegetation
This is a very good shingle site with a diverse range of habitats ranging from freshwater marsh and saltmarsh, to dry heath and scrub.

This site clearly illustrates the importance of nutrient input from the sea with old drift lines clearly visible in the vegetation patterns. The vegetation is not continuous, but rather patchy in nature at the rear of the site with some evidence of succession through to scrub. The pioneer communities are dominated by *Raphanus maritimus.*

Several saltmarsh-influenced communities occur on the shingle, usually on the foreshore at the foot of the raised beach. This appears to be restricted to areas where the raised beach is relatively narrow, perhaps reflecting areas where the freshwater table meets saltwater. There is some evidence to suggest that these communities are associated with a finer clast size in the substrate.

There are large areas at the back of the site where the shingle supports a varied and luxurious lichen flora but is otherwise bare, whereas in situations where moss patches occur they are often in association with vascular plants, especially *Prunus spinosa,* which may perform a seral role corresponding to that of *Cytisus scoparius* seen at Dungeness.

The first community encountered when travelling north from Claymoddie is a *Festuca rubra - Plantago lanceolata - Hypochoeris radicata - Cladonia*-rich grassland. This community runs in two thin strips along either side of the track along the beach at this point and is an area subject to high levels of maritime influences.

Where the beach narrows, to the north of this area, there is a saltmarsh community running along much of the foreshore. This community is best described as an *Agrostis stolonifera - Festuca rubra - Glaux maritima - Juncus gerardii* maritime grassland. In places the *Juncus gerardii* becomes locally dominant and in these areas *Juncus maritimus* is often an additional associate.

Immediately behind this community, and occupying the edge of the raised beach across

much of the southern section of the site, is a *Raphanus maritimus* dominated pioneer community. This is a very open assemblage with each quadrat containing, on average, 50% bare shingle. Despite this, however, there are several associates within this unit, with *Rubus fruticosus* as the key constant and more maritime herbs such as *Rumex crispus littoreus* and *Tripleurospermum maritimum* as important indicators.

In places, particularly those towards the rear of the site where maritime influences are very slightly decreased, this open pioneer *Raphanus* community develops into a more closed *Arrhenatherum elatius - Raphanus maritimus - Tripleurospermum maritimum* grassland with *Teucrium scorodonia, Dactylis glomerata* and *Hypnum cupressiforme* as major associates. This community may be found at the rear of the site, separated from the major *Raphanus maritimus* community by an expanse of bare shingle.

An interesting sub-community, which is rarely found elsewhere on shingle is a *Raphanus maritimus - Hedera helix - Geranium robertianum* association with prostrate *Hedera helix* on the otherwise bare shingle. Indeed, there are patches of shingle where prostrate *Hedera helix* is the only coloniser. These are classified as T1 on the map. It may be that *Hedera helix,* in this case, acts in a similar way to *Cytisus scoparius* at Dungeness.

The *Raphanus* community is replaced along the foreshore in places on the widest expanse of raised beach. At the point immediately south of the wider section there is a community which is typical of the shingle foreshore. It is best defined as a *Rumex crispus littoreus - Tripleurospermum maritimum - Glaucium flavum - Crambe maritima* open pioneer community. There is some floristic indication of finer material in the shingle matrix at this point, with *Euphorbia paralias* as a major associate, along with *Geranium robertianum* and *Sedum anglicum.* The relative diversity of this community suggests a slightly more mature secondary pioneer version of the normal community.

Moving onto the widest section of the raised beach, it is easy to identify the separate shingle ridges representing major storm events. There is, however, an interesting feature immediately behind the most recent ridge, which has not yet been worked back to abut the larger terrestrial mass of shingle. Instead, it has led to the development of lows/slacks between the outer and remaining ridges. These lower areas, with their impeded drainage and frequent flooding, not surprisingly support very different plant communities.

The lowest areas are occupied by a *Juncus maritimus - Agrostis stolonifera* saltmarsh community with *Scirpus maritimus, Glaux maritima* and *Festuca rubra* as associated species. This then develops into a *Festuca rubra - Armeria maritima - Plantago maritima* community on the more elevated areas on the edge of the slacks. Although these constants closely resemble saltmarsh communities, the major associates of *Silene vulgaris maritima, Sedum anglicum* and *Tripleurospermum maritimum* are more indicative of the shingle influence on this community. On the drier areas within this community, *Cladonia portentosa* becomes locally important along with the moss *Ceratodon purpureus.*

A different community which is also found in areas of impeded drainage comprises a *Phragmites australis* reedbed with *Potentilla anserina* and *Tripleurospermum maritimum* as the only associates. This community is found on the southern section of the site, situated on the foreshore. Clearly, this may reflect areas where freshwater springs emerge on the foreshore.

Claymoddie offers examples of several scrub communities, which are commonly found at the rear of the site where maritime influence is least, although patches are occasionally found further forward on the beach. The major scrub community is a *Rubus fruticosus - Arrhenatherum elatius - Prunus spinosa* dominated scrub with *Crataegus monogyna* and *Hedera helix* as additional components while *Dactylis glomerata* and *Lonicera periclymenum* are frequent associates. This community is more diverse than is often the case for scrub on shingle, with *Ulex europaeus, Rosa pimpinellifolia* and *Teucrium scorodonia* as additional major associates. In certain areas *Rosa canina* replaces *Prunus* as a major constant.

In more sheltered areas *Prunus spinosa* becomes locally important and the community definition becomes a *Rubus - Prunus* scrub with *Rosa pimpinellifolia* and *Dactylis glomerata* as minor constants. Bryophyte species play an important role in this community, perhaps because the cover afforded by the *Prunus* is such that it shades out many potential associates. *Pseudoscleropodium purum* and *Eurhynchium praelongum* comprise the major bryophyte component, while *Rosa canina* and *Hedera helix* are infrequent scrub associates.

In more exposed areas there is a very different type of maritime scrub characterised by *Rubus fruticosus* and *Arrhenatherum elatius* as the dominant species while *Raphanus maritimus* and *Geranium robertianum* are frequent associates, along with *Rosa pimpinellifolia* and *Hypnum cupressiforme.*

This site also supports a very interesting mature grassland which is best described as an *Arrhenatherum elatius - Anthoxanthum odoratum - Festuca rubra* herb-rich grassland with an important moss component. The prime herb associates include *Plantago lanceolata, Lotus corniculatus, Rosa pimpinellifolia* and *Thymus polytrichus britannicus.* Additional Gramineae species include *Dactylis glomerata* and *Agrostis capillaris,* while the frequent presence of *Centaurea nigra, Sedum anglicum, Hypochoeris radicata* and *Stachys arvensis* serve as useful indicators for this community. The bryophyte component is also a particularly important element in this assemblage with emphasis on *Pleurozium schreberi, Dicranum scoparium, Hylocomium splendens* and *Pseudoscleropodium purum.* Such diversity within a grassland is relatively unusual on shingle.

In some areas this community develops into a *Rosa pimpinellifolia - Dicranum scoparium - Festuca rubra - Teucrium scorodonia* community. It is relatively species-poor because the *Rosa* and *Teucrium* dominate the community, with *Arrhenatherum elatius, Hypnum cupressiforme* and *Rubus fruticosus* as occasional associates.

Key

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

SH121 *Rubus fruticosus - Prunus spinosa - Arrhenatherum elatius - Crataegus monogyna* community;

SH117 *Rubus fruticosus - Hypnum cupressiforme - Arrhenatherum elatius - Raphanus maritimus* community;

SH116 *Raphanus maritimus - Arrhenatherum elatius - Rubus fruticosus - Dactylis glomerata* community;

SH103 *Phragmites australis-Mentha aquatica* community;

SH80 *Agrostis stolonifera - Festuca rubra* saltmarsh community;

SH77 *Glaux maritima - Festuca rubra - Juncus maritimus* community;

SH63 *Festuca rubra - Plantago lanceolata - Dicranum scoparium* community;

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

SH36 *Elymus pycnanthus - Festuca rubra* grassland;

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

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

SH13 *Atriplex prostrata - Raphanus maritimus - Rumex crispus littoreus* pioneer community;

T1 *Hedera helix* community.

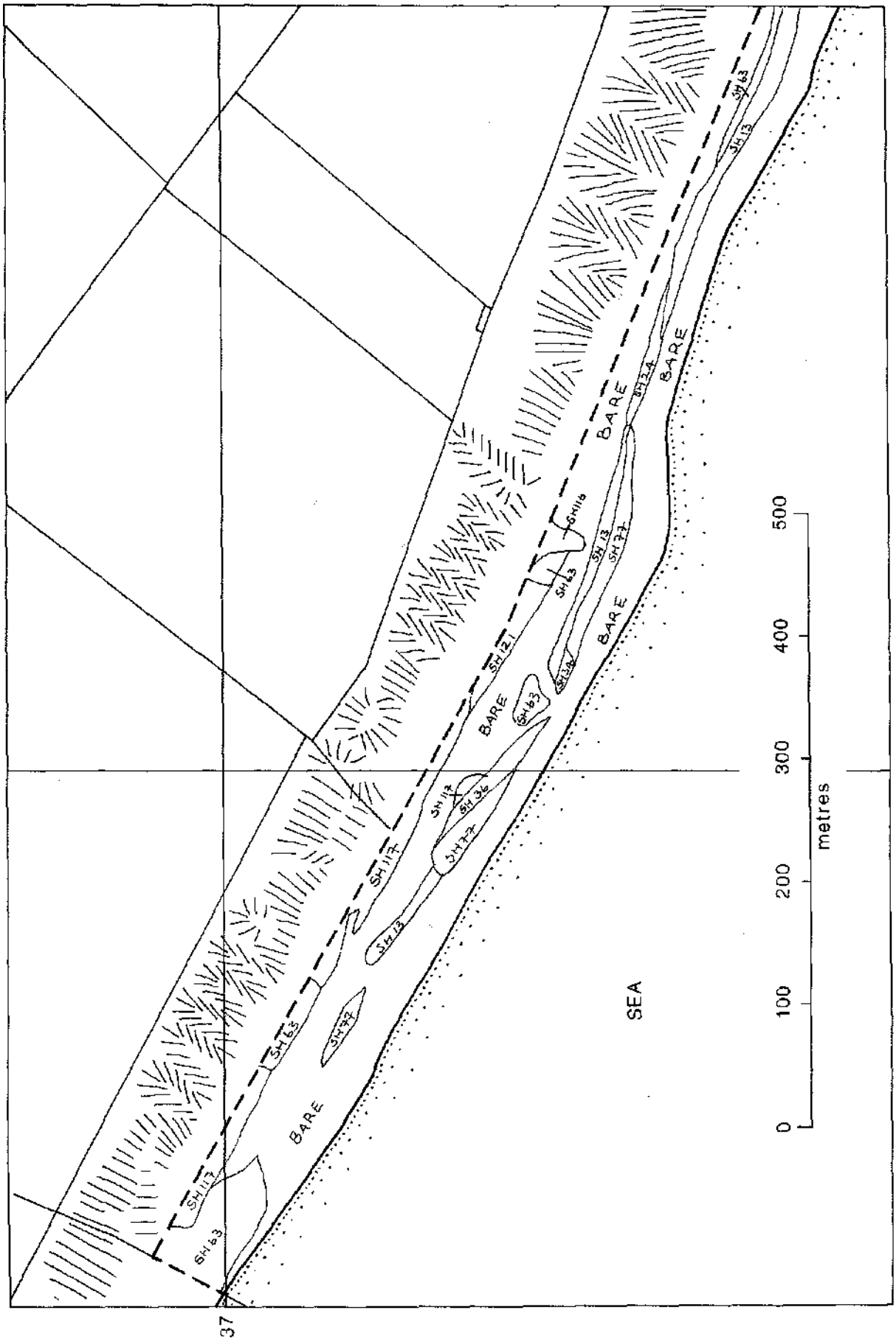

Figure 20a Claymoddie (west)

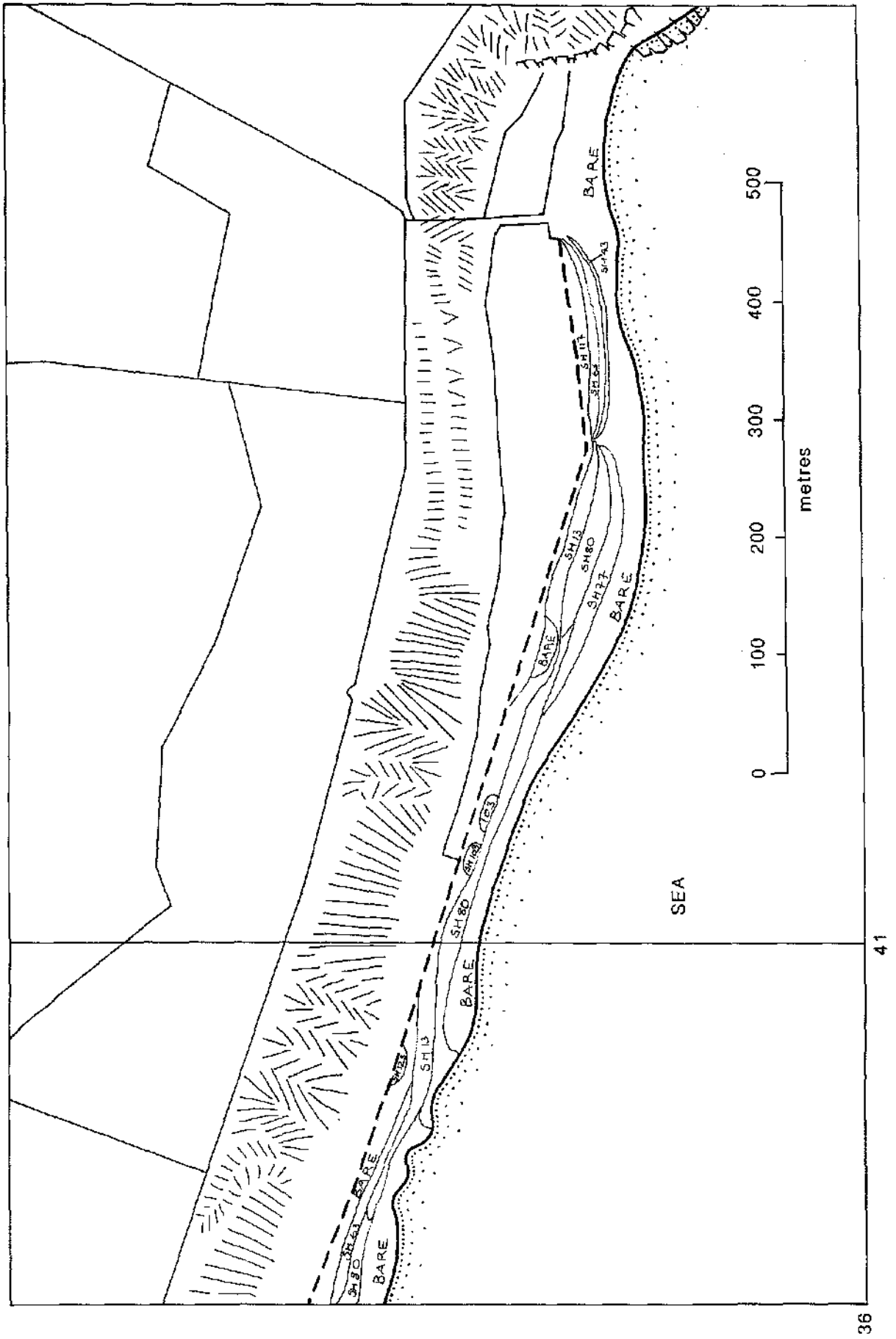

Figure 20b Claymoddie (east)

Rascarrel Bay

Dumfries and Galloway. NX 810470
No conservation status
Area surveyed: 4.75 ha
Fieldwork dates: 17-19/7/89

Introduction
This site comprises a boulder shore backed by a raised shingle beach. The boulders are intertidal and immediately behind them there is a bay-head marsh which has developed over shingle sediments. Further inland, with increased elevation, the shingle is clearly visible. The raised shingle beach is backed by cliffs.

The shingle backshore is widest at the western end of the site and narrows to the east, giving way to calcareous sand sediments on the eastern edge of the bay.

The rear of the site is defined by a farm wall in the west and the break of slope at the base of the cliff in the east.

Threats and management
There has been some residential development at the rear of the site at either end of the bay. This takes the form of holiday chalets built on the shingle and has resulted in a small loss in area of vegetated shingle, although there has been little further disturbance associated with the development. Vehicular access to the site is limited with one, poorly-maintained track running across it to the eastern end chalets. However, there is no further damage attributable to vehicle tracks.

In general, the site is undisturbed. The site has not been improved, nor is it grazed,

Vegetation
The communities at this site range from those displaying a clear saltmarsh influence found on the foreshore through to *Salix* damp woodland or *Pteridium aquilinum* scrub at the rear of the site.

The major saltmarsh community which runs along the foreshore is an *Agrostis stolonifera - Festuca rubra - Glaux maritima* community. In this case *Juncus maritimus* is a frequent associate.

The saltmarsh is best developed at the western end of the site, by the river mouth, with a large area occupied by a *Festuca rubra - Plantago maritima - Glaux maritima* community. Additional constants include halophytic herbs such as *Cochlearia officinalis* and *Triglochin maritima.* The area subject to both riverine and maritime influences, along the river edge, which is slightly elevated, supports a more diverse grassland with *Festuca rubra, Elymus repens* and *Puccinellia maritima* as the main constants, along with less frequent herb associates such as *Armeria maritima, Plantago maritima* and *Potentilla anserina.*

A similar community is found along the shore behind the *Festuca rubra - Plantago maritima - Glaux maritima* grassland. In these areas, which are subject to less direct maritime influence, *Juncus inflexus* becomes dominant in a *Festuca rubra - Elymus repens* grassland. *Rumex crispus littoreus, Potentilla anserina* and *Cochlearia officinalis* are found as frequent associates. These areas may reflect a freshwater spring line as, in places, water is seen to drain out across the beach. At these points, the freshwater influence is clearly visible in the vegetation with *Phragmites australis* reed beds. Despite the dominance of the *Phragmites australis* there are associated species in this community including *Vicia cracca, Galium aparine, Sonchus arvensis* and *Carex disticha.*

Moving back from the foreshore, onto the stable raised shingle beach, the western end of the beach supports a strip of *Raphanus maritimus - Arrhenatherum elatius* community with *Holcus lanatus, Elymus repens* and maritime herbs, such as *Atriplex* spp. and *Rumex crispus littoreus,* as frequent associates. Although this area is some way from the mean high water mark the occasional inundation during storms clearly provides sufficient saline influence to encourage maritime herbs.

The stable shingle supports three major communities, indicative of less maritime

microclimates. The largest area is occupied by a damp *Salix cinerea - Rubus fruticosus* woodland with *Holcus lanatus, Deschampsia cespitosa, Filipendula ulmaria* and *Pteridium aquilinum* as the major understorey components in the *Salix* woodland.

The second community is quite common on shingle sites and is characterised by the constant presence of *Ulex europaeus* and *Rubus fruticosus.* In places, the dominance of the *Ulex* excludes the presence of other vascular species, with only the shade-tolerant moss *Eurhynchium praelongum* found in association. In many cases, however, the *Ulex-Rubus* scrub is more open and contains minor grass and herb associates, in particular *Arrhenatherum elatius, Digitalis purpurea* and *Silene dioica.*

The final major community type displays some east-west zonation. The eastern extreme of this community is a *Pteridium aquilinum* dominated assemblage. The *Pteridium aquilinum* is found in association with *Arrhenatherum elatius* and *Holcus lanatus,* with very little ground cover. This community appears to reflect a substrate with a very high sand content. Further east, where shingle is more dominant in the substrate, the community is more open, although *Pteridium aquilinum* continues to be an important component. In this case a freshwater influence is clearly seen, with the constant presence of *Filipendula ulmaria, Arrhenatherum elatius, Dactylis glomerata* and *Rubus fruticosus* found with the *Pteridium aquilinum.*

In one area there is a small patch of *Rubus fruticosus - Prunus spinosa* scrub which has *Filipendula ulmaria* and *Raphanus maritimus* as additional constants.

Although this is a small site, it offers examples of several communities typical of Scottish shingle sites. Its diversity of communities along with the lack of human disturbance make this a particularly interesting site.

Key

SH120 *Prunus spinosa ~ Rubus fruticosus - Arrhenatherum elatius* scrub community;

SH118a *Corylus avellana - Salix cinerea - Rubus fruticosus - Holcus lanatus* community;

SH118 *Salix cinerea - Rubus fruticosus - Holcus lanatus* community;

SH111 *Pteridium aquilinum - Rubus fruticosus* community;

SH108 *Ulex europaeus - Rubus fruticosus* scrub community;

SH78 *Elymus pycnanthus - Vicia cracca* community;

SH77 *Glaux maritima - Festuca rubra - Juncus maritimus* community;

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

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

T1 *Phragmites australis* reedbed, associates include *Elymus pycnanthus* and *Potentilla anserina.*

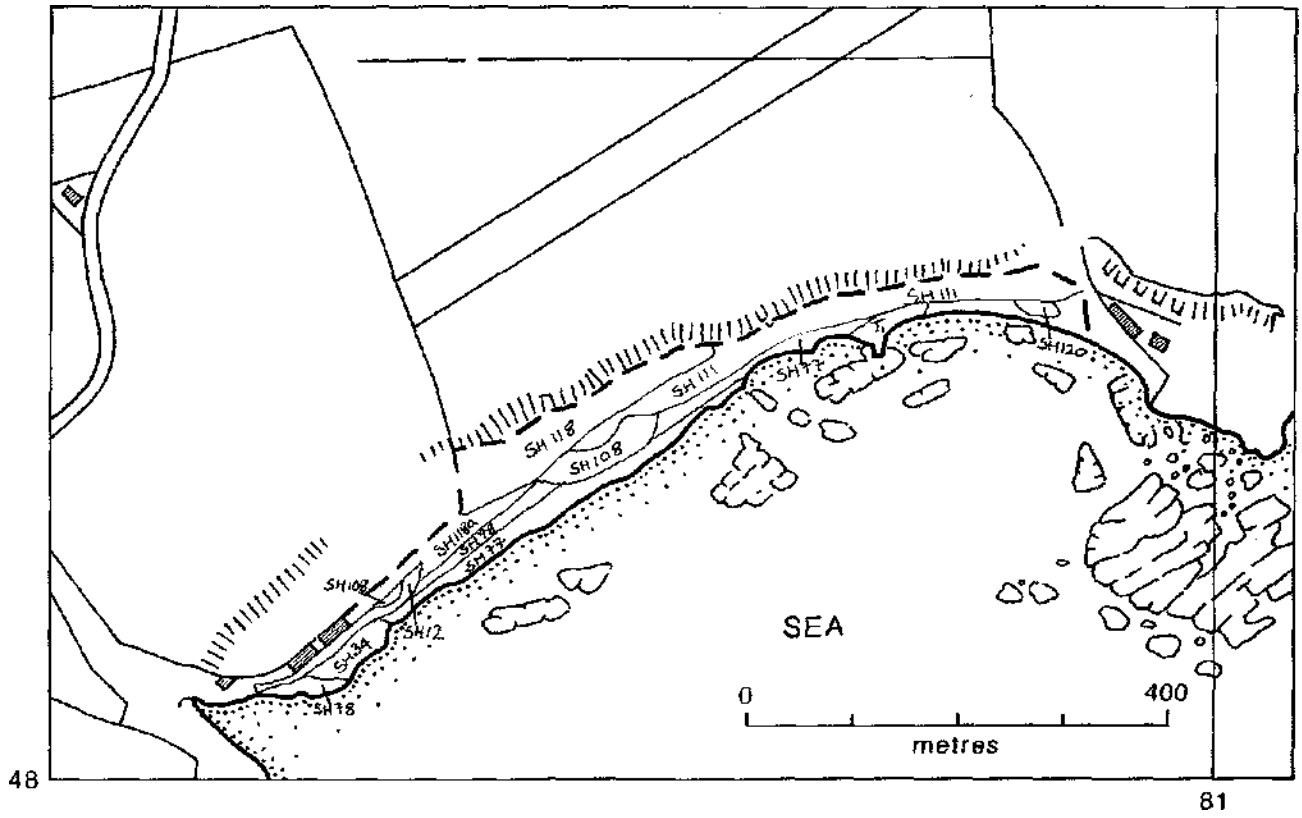

Figure 21 Rascarrel Bay

Powfoot

Dumfries and Galloway. NY 180650
Conservation status: SSSI
Area surveyed: 9.0 ha
Fieldwork date: 10/7/89

Introduction

A shingle fringing beach extends from Powfoot to Dornoch on the north shore of the Solway Firth. This is the only shingle found in this area. In the western section of this site the beach forms only a fringing beach at the base of raised marsh deposits and sandstone cliffs. This part of the site supports only a very narrow strip of vegetation, often *Phragmites australis* or *Honckenya peploides* depending on the adjacent cliffs.

It is in the east that the shore widens back to the cliffs and forms a small, slightly raised area of shingle. This then gives way to a small shingle spit built out across the River Annan.

Threats

This site is clearly subject to erosion and stabilisation works have taken the form of bolstering the cliffs with concrete blocks, bricks and rubble. Indeed, in places the cliff face has been concreted over to protect particularly vulnerable sections. This site is relatively inaccessible and as a result there is little recreational pressure on it.

Management

There is some evidence that this site may have been actively grazed in the past. This is seen in the presence of old fencing around certain areas and in the presence of farm buildings nearby. In addition, there may have been agricultural improvement on the spit. This is suggested by the particularly luxuriant growth of the grasses. The site is currently grazed by rabbits.

Vegetation

There are three communities on the raised fringing beach area to the west of the spit. These mark a zonation away from the high water mark reflecting a reduction in maritime influence.

The first community is an open *Honckenya peploides* dominated community. The *Honckenya* is found in association with *Tripleurospermum maritimum* and *Potentilla anserina* reflecting both sand and marsh influences. Indeed, such is the open nature of this community that each quadrat contains approximately 40% bare shingle with 10% bare sand.

This area is backed by a raised area supporting an *Arrhenatherum elatius - Festuca rubra* dominated mixed grassland with *Elymus repens* and *Holcus lanatus* as additional minor constants. Occasional herb associates in this community include *Vicia cracca, Galium verum* and *Achillea millefolium.*

The third community along this stretch of coast occupies a sandy slope behind the raised area. This community is a *Ulex europaeus - Rubus fruticosus* scrub community with infrequent minor grass associates such as *Holcus lanatus, Elymus repens* and *Agrostis stolonifera.*

Further east, on the spit itself, there are two communities. The first, a pioneer community, occupies the steep shingle foreshore and is characterised by an open association dominated by *Tripleurospermum maritimum, Potentilla anserina* and *Rumex crispus littoreus,* with *Galium verum* and *Atriplex prostrata* as associated species.

Behind this the most stable area supports a mixed *Arrhenatherum elatius* dominated grassland, a variation of the community seen on the raised fringing beach, but in this case with a lower herb content. This community is an *Arrhenatherum - Holcus* mixed grassland with *Festuca rubra, Dactylis glomerata* and very occasional herbs, e.g. *Galium verum,* or ruderals such as *Urtica dioica.* In places, *Festuca rubra* becomes a more important element and the grassland may be defined as a *Festuca rubra - Plantago lanceolata - Poa pratensis* community. This area has a very rich, deep soil development of up to 10 cm, which is relatively unusual on dry shingle sites such as this. It is this level of soil development which suggests the likelihood of agricultural improvement.

This is not a particularly important site for shingle vegetation and comprises only a fringing beach and small spit which have clearly been disturbed.

Key

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

SH71 *Arrhenatherum elatius* grassland community;

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

SH31b *Honckenya peploides - Potentilla anserina* community;

SH27a *Tripleurospermum maritimum - Atriplex prostrata - Rumex crispus littoreus* pioneer community, *Potentilla anserina* sub-community.

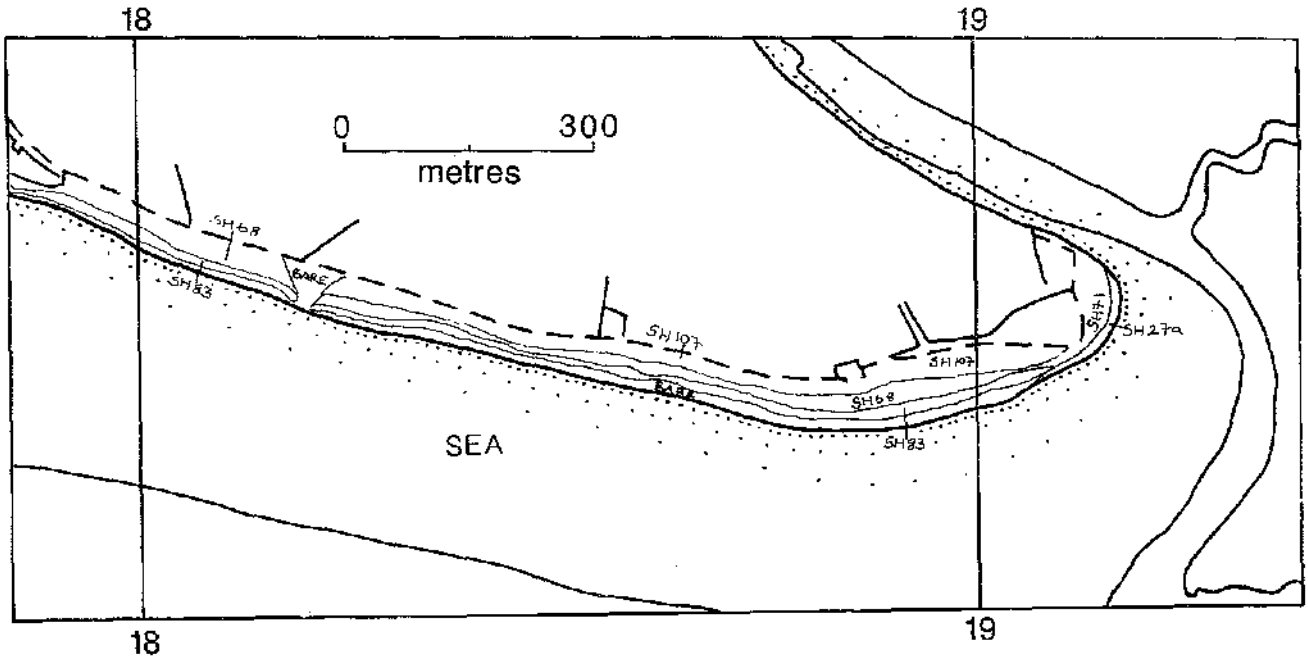

Figure 22 Powfoot

Kingston Shingles

Grampian. NJ 325660
Conservation status: SSSI
Area surveyed: 127 ha
Fieidwork dates: 23/8-17/9/88, 17-25/10/88

Introduction
This site comprises the major section of a larger Spey Bay shingle formation. This is the largest shingle complex in Scotland and rivals Dungeness, Kent, in size. The site lies on the north-east section of the Moray Firth on the east coast of Scotland.

It is an example of a shingle apposition beach which has been laid down against the Binn Hill cliffs, believed to have been cut when the sea-level was 25 feet higher than at present. The full Spey Bay site lies between the mouth of the Lossie in the west through to Spey mouth in the east. The apposition beach consists of a series of clearly defined shingle ridges which were laid down with a successive lowering of sea level following the last ice age, and are thought to date from 8,000 years ago.

While the complex system of ridges stretches along the coast to Lossiemouth, for the purposes of this survey of vegetation the natural or semi-natural vegetation was only sampled for approximately 1 km from Speymouth, as beyond this point the proportion of sand-capping over the underlying shingle increases.

The shingle east of the mouth of the Spey is thought to have been part of a spit, deflecting the course of the Spey to a mouth 1.5 km west of its current position. The foreshore comprises a steep storm ridge of bare shingle with a slack area behind, which gives way to the raised beach of shingle ridges behind.

Stripe Burn, a small stream, runs through much of the site and drains into a flooded hollow in the east. Perhaps the most interesting feature of this apposition beach, however, is the presence of shingle ridges at the rear of the site which remain largely bare of vegetation, supporting only saxicolous lichens.

Threats
This site has been greatly disturbed in the past, but this has resulted in the presence of a rich variety of plant communities, including several which are unique to Kingston Shingles.

While there is little indication of early human occupation, it is man's more recent quarrying activities which have posed the major threat to the natural shingle habitat.

Gravel mining at this site was started in 1935 with extraction from the bare shingle foreshore, but with the purchase of part of the raised beach mining was then extended. It has been estimated that 60% of the shingle area has been reduced to damp shingle lows, which are between 2 and 3 metres below the general beach level. A lowering of this magnitude has marked consequences for the level of the freshwater table and potential saline seepage and, therefore, has important implications for the vegetation.

Lichen evidence suggests that active mining ceased in the western region 30-40 years ago, while more eastern depressions were more recently abandoned.

The village of Kingston has been built on the shingle and this has clearly led to the destruction of vegetation. Recreational pressure on the site is moderate but damage is almost negligible, with evidence of occasional bonfires and some litter.

Additional buildings include a farm built on an inland ridge and a concreted area presumably marking the position of an old building.

Vehicular access to the site is largely restricted to two main tracks, running through the site parallel to the shore, and to a large flat area in the east by the village which tends to be used as a car park. In these areas, the damage to vegetation has been locally severe.

In addition, in the pine plantation which has been established on the site (see below), there is evidence on the bare shingle of damage to 'islands' of vegetation by plantation equipment

and MOD vehicles, as well as the damage such movements have caused to the ridge structure.

There is a vehicle dump at the south-eastern corner of the site containing a wide range of vehicular rubbish, especially tyres, which has effectively destroyed any natural vegetation in this area.

Concrete posts erected in the shingle slack during the last war were used as an anti-glider device, and have not only reduced the area of vegetated shingle but will have caused past disturbance to this area. At present they serve to illustrate the recession of the shingle storm crest which is clearly moving inland.

An additional threat, to fauna in particular, is posed by the noise pollution associated with low flying aircraft which regularly fly across the site.

Management
Part of the rear of the site (12 ha) has been fenced off and is actively grazed by cattle. This area has been cleared of the natural scrub and carr vegetation found in the surrounding undisturbed areas, thus leading to very unnatural boundaries in the vegetation. The rest of the site is widely grazed by rabbits, although the levels of grazing are only light.

The major loss of natural vegetation on shingle at Kingston has resulted from the planting of a pine plantation on the western part of the site. The shingle ridge structure and, indeed, bare shingle, remain clearly visible. There are some 'islands' of natural vegetation on the bare shingle in this area.

The plantation has not only caused a direct loss of vegetated shingle but has major implications for species composition in undisturbed areas. *Pinus sylvestris* trees are found within the woodland communities on the stable shingle in the east. Clearly such colonisation should be prevented by the removal of seedlings wherever possible.

An additional management issue which had threatened the site, although on geomorphological rather than directly floristic grounds, was the removal of shingle from the bare ridges by a local farmer. Such removal has led to the formation of a large pond and has now been prevented by financial incentives to the farmer to cease the excavation. This practice is to be encouraged in order to prevent any further loss of this unusual feature.

Within the plantation, the MOD operates a firing range which has led to the clearance of pines and allowed some regeneration of natural scrub, although these communities are cleared regularly to keep sight-lines free. The clearance has been conducted by hand, rather than by machine, and consequently disturbance has been kept to a minimum.

Vegetation
The levels of disturbance of this site, along with its size, have led to the development of a particularly varied flora with certain communities unique to the shingle at this site. The community types range from maritime grasslands through heathlands and fen communities to scrub and carr communities.

The slack immediately behind the storm crest at the western end of the site supports an interesting maritime grassland comprising a *Festuca rubra* dominated herb-rich grassland. The maritime herbs *Armeria maritima* and *Plantago maritima* are the additional constants, but this community is more diverse than would normally be associated with a *Festuca -Armeria - Plantago* grassland, with *Empetrum nigrum* as a major associate. *Anthyllis vulneraria, Plantago lanceolata, Potentilla anserina, Trifolium repens* and *Sagina nodosa* are the key herb associates, while *Viola riviniana, Rhinanthus minor* and *Gentianella campestris* are found as infrequent associates.

This community extends along the foreshore even in the plantation, although here there are some areas which are poorly-drained, and where the grassland is replaced by wetland communities. In the far west, an area in the slack is occupied by a *Schoenus nigricans - Acrocladium cuspidatum* community with *Potentilla anserina, Hydrocotyle vulgaris, Agrostis canina* and *Empetrum nigrum* as major associates. The maritime nature of the wetland is illustrated in the minor presence of *Juncus gerardii.* This community is unique, on shingle, to Kingston and as such was not included in the main classification data. This

area gives way at its western limit to a *Festuca rubra - Schoenus nigricans* mixed grassland with *Poa pratensis* and *Agrostis canina.* The major herb species in this instance include *Salix repens, Trifolium repens, Erica tetralix, Empetrum nigrum* and *Anthyllis vulneraria.* This clearly represents a transition from the *Schoenus* community to a *Festuca rubra* grassland seen elsewhere in the slack.

The *Salix repens* community is also found occupying one of the depressions on the eastern section of the site in the old gravel workings. In this case the key indicators are *Salix repens* and *Carexpanicea* and the mosses *Campylium stellatum* and *Acrocladium cuspidatum. Juncus bulbosus* and *Juncus balticus* are the major associates, along with *Carex nigra* and *Trifolium repens. Stachys arvensis, Prunella vulgaris* and *Pedicularis palustris* are among the major herb indicators, while *Galium aparine, Ranunculus flammula* and *Epilobium palustre* are occasional associates. In places, *Schoenus nigricans,* which is found in small quantities throughout the community, becomes locally dominant, along with *Scorpidium scorpioides* and *Hydrocotyle vulgaris,* serving as indicators of wetter conditions within this community. This is a less maritime version of the *Schoenus* community described earlier. There is some invasion of *Salix cinerea* and *Betula pendula* within this community.

It is the wetland communities which are particularly interesting at this site, with a small inland area supporting a *Juncus effusus* dominated community with *Agrostis stolonifera, Holcus lanatus* and *Festuca rubra* as minor constants. There is a minor herb component in this community, with *Valeriana officinalis, Ranunculus sceleratus, Cardamine pratensis* and *Galium palustre* as infrequent associates. This community occupies a poorly drained area round the eastern end of Stripe burn with approximately 40% open water, to a depth of 20 cm, in each quadrat. While such a situation would not normally be associated with a shingle habitat, there was shingle below the water and mud. However, it implies the presence of an impermeable layer below the shingle.

The major grassland community found inland in the east of the site may be described as a mixed grassland with an important herb and bryophyte component. The key indicator species are *Agrostis capillaris, Festuca rubra, Poa pratensis* and *Holcus lanatus* along with *Peltigera canina* an indication of the generally stable nature of this grassland. The major herb associates include *Cerastium semidecandrum, Jasione montana, Anthyllis vulneraria, Thymus polytrichus britannicus, Hieracium pilosella* and *Lotus corniculatus* found in varying amounts. The bryophytes provide a major element of the cover and they form a particularly diverse element, with *Pseudoscleropodium purum, Polytrichum piliferum, Ceratodon purpureus, Rhytidiadelphus squarrosus* and *Dicranum scoparium* most frequently sampled. Other than *Peltigera canina,* the major lichen species is *Cladonia rangiformis,* with C. *furcata* and *C. cervicornis* found in lesser amounts. A less diverse version of this *Agrostis capillaris* grassland is found on the disturbed area used for parking behind the storm crest in the east. In this case the *Agrostis capillaris* mixed grassland is found in association with *Plantago coronopus* and fewer herbs.

This grassland is often found in close proximity to a scrubby grassland characterised by the constant presence of *Ulex europaeus, Rubus fruticosus* and *Eurhynchium praelongum* with *Rosa pimpinellifolia* and *Teucrium scorodonia* as frequent associates. While *Ulex* is a constant, it does not dominate in the same way as is common on shingle. This is a scrubby grassland with *Festuca rubra, Poa trivialis, Arrhenatherum elatius, Agrostis canina* and *Holcus lanatus* as the key Gramineae species. While the shade tolerant *Eurhynchium praelongum* is the most important moss species, *Rhytidiadelphus triquetrus* and *Pseudoscleropodium purum* are occasionally found in this assemblage. This community covers much of the site extending back to the ridges at the rear of the site.

Another assemblage which is a scrubby community is found behind the storm crest on those areas which are not excavated, or on the higher ridges within the past excavations. This is a *Ulex* heathland with *Erica cinerea, Calluna vulgaris, Anthoxanthum odoratum* and *Festuca rubra* as minor constants. This community is again more diverse than most *Ulex* communities with a major herb content,

including *Plantago lanceolata, Lotus corniculatus, Hypochoeris radicata, Rosa pimpinellifolia, Potentilla erecta, Achillea millefolium* and *Viola hirta* as common associates. *Empetrum nigrum, Teucrium scorodonia, Jasione montana* and *Cytisus scoparius* are found infrequently throughout this community.

In some areas the *Ulex* is less important and the *Calluna vulgaris* becomes dominant within this species composition. This change is accompanied by an increase in the importance and diversification of the lichen flora with *Cladonia portentosa, C. cervicornis, C. furcata* and *C, chlorophaea* as the main lichen species. This slight shift towards a more heathland type of community is seen on the lower area south of the track, which is more likely to flood. There is some invasion of *Pinus sylvestris* and *Salix cinerea* at the south-western edge of the community, with seedlings having become firmly established.

There is a re-emergence of the *Ulex - Erica - Calluna* heathland with *Festuca rubra* and *Empetrum nigrum* as additional constants, on a ridge found at the western end of the slack. This ridge is almost perpendicular to the storm crest and either represents past human disturbance or a minor depositional phase. The well-developed lichen flora at this site suggests that this area has been stable for a considerable length of time. *Juniperus communis* is an infrequent associate in this community.

A separate grassy heathland community is found in the excavated area where the excavation ridge structure is still clearly visible. The importance of microtopography in influencing vegetation is seen in this area. The ridges support a *Festuca rubra - Ulex europaeus - Rosa pimpinellifolia - Cladonia portentosa* species-rich heathland community. The major grass associate in this case is *Anthoxanthum odoratum*, with *Agrostis capillaris* and *Aira praecox* found frequently in association.

The bryophyte component is dominated by *Eurhynchium praelongum, Pleurozium schreberi* and *Rhytidiadelphus triquetrus* with *Dicranum scoparium* and *Polytrichum piliferum* as minor associates. A large range of *Cladonia* spp. lichens are found in this community, but the most important species are *C. arbuscula, C. rangiformis, C. chlorophaea* and *C. cervicornis.* There are relatively few herb associates in this community, with *Hypochoeris radicata* and *Crepis capillaris* found frequently but in small amounts while *Jasione montana* is an occasional addition.

This contrasts with the community found in the lows between these excavation ridges and in the older western excavations, which clearly offer wetter environments. In this instance the community is characterised by the constant presence of *Festuca rubra, Anthoxanthum odoratum* and *Plantago lanceolata,* with *Ulex europaeus* and *Rosa pimpinellifolia* continuing to be present but in a minor role. This assemblage is less a heathland than a herb-rich grassland with *Thymus polytrichus britannicus, Teucrium scorodonia, Viola hirta* and *Lotus corniculatus* as the major herb associates, while *Empetrum nigrum, Jasione montana, Erica cinerea* and *Erica tetralix* are found infrequently throughout the community. There remains a lichen component in the assemblage but in this case it is *Cladonia ciliata, C. coniocraea* and *C. uncialis* which are present in small quantities.

Much of the largely undisturbed areas at Kingston support a *Ulex* dominated scrub, best illustrated immediately behind the shingle slack, close to the edge of the plantation. This scrub is characterised by the constant presence of *Ulex europaeus, Rubus fruticosus,* and *Eurhynchium praelongum,* with *Viola canina* and *Teucrium scorodonia* in minor amounts. *Agrostis capillaris* and *Holcus lanatus* are often found in association with the scrub species. This particular community, close to the storm crest, is consistently more diverse than the similar community found towards the rear of the site, which is presumably older. Here, the dominance of *Ulex* (Domin score 9-10) is such that there are few associates other than *Eurhynchium praelongum* and *Rubus fruticosus* found in small quantities.

The relatively diverse *Ulex* grassland is also found within the plantation, firstly near the range at the seaward edge of the site, an area which appears to be relatively undisturbed in recent times.

A slightly different community is, however, found in small patches within the plantation where areas have been left undisturbed. Here the *Ulex* is a major constant along with *Holcus lanatus, Agrostis capillaris* and *Festuca rubra.* Additional minor constants include *Rosa pimpinellifolia, Anthoxanthum odoratum, Arrhenatherum elatius* and *Hypochoeris radicata.* This is a herb-rich community, with *Cerastium fontanum, Teucrium scorodonia, Polygala serpyllifolia, Galium verum, Viola riviniana* and *Potentilla erecta* as frequent associates.

An additional, and very different, scrub community, found at the rear of the site along the edge of the unvegetated shingle ridges, is a *Pteridium aquilinum - Prunus spinosa - Rubus fmticosus* community with an extremely high moss content, with particular emphasis on *Rhytidiadelphus triquetrus, Hylocomium splendens* and *Pseudoscleropodium purum,* and with a minor role played by *Pleurozium schreberi, Dicranum scoparium, Eurhynchium praelongum* and *Ceratodon purpureus.* Grass associates within this scrub assemblage include *Arrhenatherum elatius,* and *Holcus lanatus.* The *Prunus* scrub is more characteristic of north-western shores and so it is interesting to note its presence at Kingston.

This assemblage is found at the edge of a community which is largely confined to this site, being typical of conditions wetter than those normally associated with shingle. It is a *Salix cinerea - Deschampsia cespitosa - Pseudoscleropodium purum* damp woodland community, which occupies the lows between the older, bare shingle ridges at the rear of the site. This is the wetland extreme version of the community, which illustrates a moisture gradient across the site. In this case there are very few associated species other than epiphytic lichens such as *Evernia prunastri* or *Hypogymnia physodes,* because even in late summer open water accounts for 95% of the area of each quadrat.

In drier areas this community develops into a *Salix cinerea - Deschampsia cespitosa ~ Rubus fruticosus* wetland scrub with *Rosa canina, Rosa pimpinellifolia* and *Prunus spinosa* as associated scrub species. With no open water, much of the ground cover is provided by bryophyte species, in particular, *Dicranum scoparium* and *Hypnum cupressiforme.* The continuing influence of the water table on this community is seen in the constant, if minor, presence of marsh herbs, e.g. *Galium palustre* and *Epilobium palustre,* along with other herb species such as *Potentilla erecta* and *Viola riviniana. Betula pendula* is found occasionally in this community, in the drier areas.

These two assemblages represent the extremes of a moisture gradient, but the largest area of the site is occupied by a community which is basically a wetland *Salix cinerea* woodland but with less open water and, hence, limited development of an understorey. This modal community is characterised by the constant presence of *Salix cinerea, Deschampsia cespitosa* and *Equisetum arvense* with the epiphytic lichens *Evernia prunastri* and *Parmelia sulcata. Juncus effusus* and *Holcus lanatus* are found as frequent associates, along with a locally high herb content (where there is little open water). The herbs found here include *Callitriche stagnalis, Ranunculus sceleratus, Galium palustre, Cardamine pratensis* and *Myosotis sylvatica.*

A separate *Salix* dominated community is characteristic of the dry shingle ridges which are found intact in the central section of the site. This community is a *Salix - Betula - Calluna* mixed heathy woodland with *Empetrum nigrum, Festuca rubra* and the lichens *Peltigera canina* and *Evernia prunastri* as minor constants. Additional heathland associates include *Rosa pimpinellifolia* and *Erica cinerea,* while *Erica tetralix* and *Vaccinium myrtillus* are only occasional associates. *Ulex europaeus* is also an occasional associate; however, in some areas this species becomes locally dominant. Occasional grassland species include *Agrostis capillaris, Holcus lanatus* and *Deschampsia cespitosa.* This may represent an area of heathland which is maturing through the invasion of *Salix* and *Betula;* however, these species do not yet provide the dense cover to shade out associates.

A second *Pteridium* community occupies the area on the rifle range where much scrub has been cleared by hand. This community gives an interesting insight into the process of

vegetation regeneration under such a regime. In this instance the consequent community is a *Pteridium aquilinum* dominated heathland. The *Pteridium aquilinum* is found with *Deschampsia flexuosa, Calluna vulgaris* and *Pseudoscleropodium purum* as the major constants. Key additional associates include *Rosa pimpinellifolia, Ulex europaeus, Hypogymnia physodes* and *Teucrium scorodonia.* The additional bryophyte species are *Hylocomium splendens, Eurhynchium praelongum* and *Hypnum cupressiforme,* while infrequent Gramineae components include *Agrostis canina* and *Anthoxanthum odoratum. Betula pendula* and *Rubus fruticosus* are infrequent associates illustrating the regeneration of scrub in this community.

The importance of microtopography is once again seen here with the mixed *Pteridium aquilinum* community described above giving way to a *Juncus conglomeratus – Carex flacca - Nardus stricta* dominated community in depressions between ridges. This area was too small to map at this general level, but is interesting to note nonetheless.

A slightly different woodland community is encountered within the plantation. This may reflect direct planting, or the plantation may have provided the seed source. This woodland comprises a *Betula pendula* canopy with *Pteridium aquilinum, Deschampsia flexuosa* and *D. cespitosa* as the major understorey indicator species. A major role is, however, also played in the understorey by bryophytes, with particular emphasis on *Rhytidiadelphus triquetrus, Pseudoscleropodium purum, Pleurozium schreberi, Dicranum scoparium* and *Hylocomium splendens.* Here too, heathland elements are seen in the community with *Calluna vulgaris, Rosa pimpinellifolia, Erica cinerea* and *Festuca ovina* as minor constants.

The final community represented at this site is a *Calluna vulgaris - Hypogymnia physodes - Empetrum nigrum - Cladonia portentosa* heathland. This is found on islands of vegetation, occurring on the otherwise bare shingle which has been left unplanted within the plantation borders. *Erica cinerea, Thymus polytrichus britannicus* and *Rosa pimpinellifolia* comprise the key herb associates, while both the abundance and diversity of the bryophytes form a major component within this community. *Rhytidiadelphus triquetrus, Polytrichum piliferum, Pseudoscleropodium purum* and *Dicranum scoparium* are commonly associated with this vegetation unit.

There appears to be some development of this community, seen on certain islands of vegetation, where the heathland species and bryophytes are constant throughout but the *Rosa pimpinellifolia* becomes a more important element, and the importance of scrub is reflected in the additional constant presence of *Juniperus communis.* These areas may be considered a more mature sub-community of the original heathland.

These islands of vegetation are particularly hard to map on this scale, but may provide an important insight into the process of vegetation change on shingle.

Key

SH122 *Prunus spinosa - Eurhynchium praelongum* community;

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

SH108 *Ulex europaeus - Rubus fruticosus* scrub community;

SH103 *Phragmites australis - Mentha aquatica* community;

SH100 *Juncus effusus - Holcus lanatus - Agrostis canina* community;

SH99 *Salix cinerea - Holcus lanatus - Juncus effusus* community;

SH92 *Calluna vulgaris - Cladonia portentosa* community;

SH91 *Calluna vulgaris - Erica cinerea - Hypogymnia physodes - Cladonia* spp. community;

SH85 *Pseudoscleropodium purum - Polypodium vulgare - Dicranum scoparium* community;

SH84 *Holcus lanatus - Rosa pimpinellifolia - Festuca rubra* heath community;

SH82 *Salix repens - Carexpanicea - Agrostis stolonifera* community;

SH81 *Salix cinerea - Evernia prunastri - Hypogymnia physodes* community;

SH79 *Festuca rubra - Agrostis stolonifera* community;

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

SH61 *Festuca rubra - Anthoxanthum odoratum - Lotus corniculatus* community;

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

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

T1 *Pteridium aquilinum - Rhytidiadelphus triquetrus* community;

T2 *Betula pendula - Pteridium aquilinum - Deschampsia cespitosa* community;

T3 *Schoenus nigricans - Acrocladium cuspidatum* wetland community;

T4 Islands of mixed vegetation;

T5 *Pinus sylvestris* invasion.

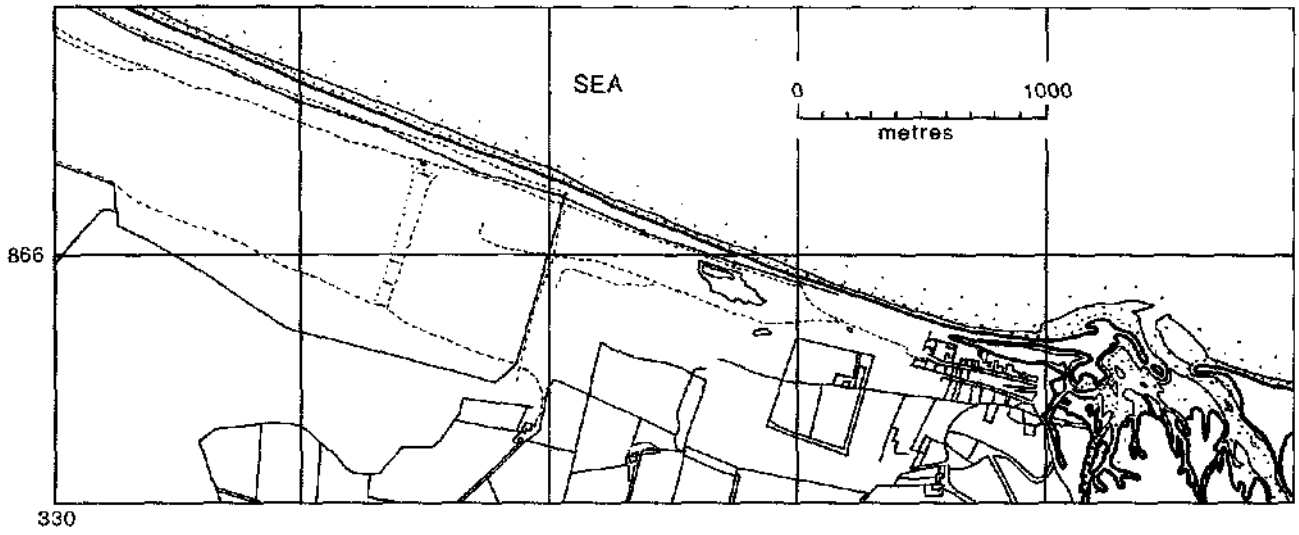

Figure 23a Kingston Shingles (general)

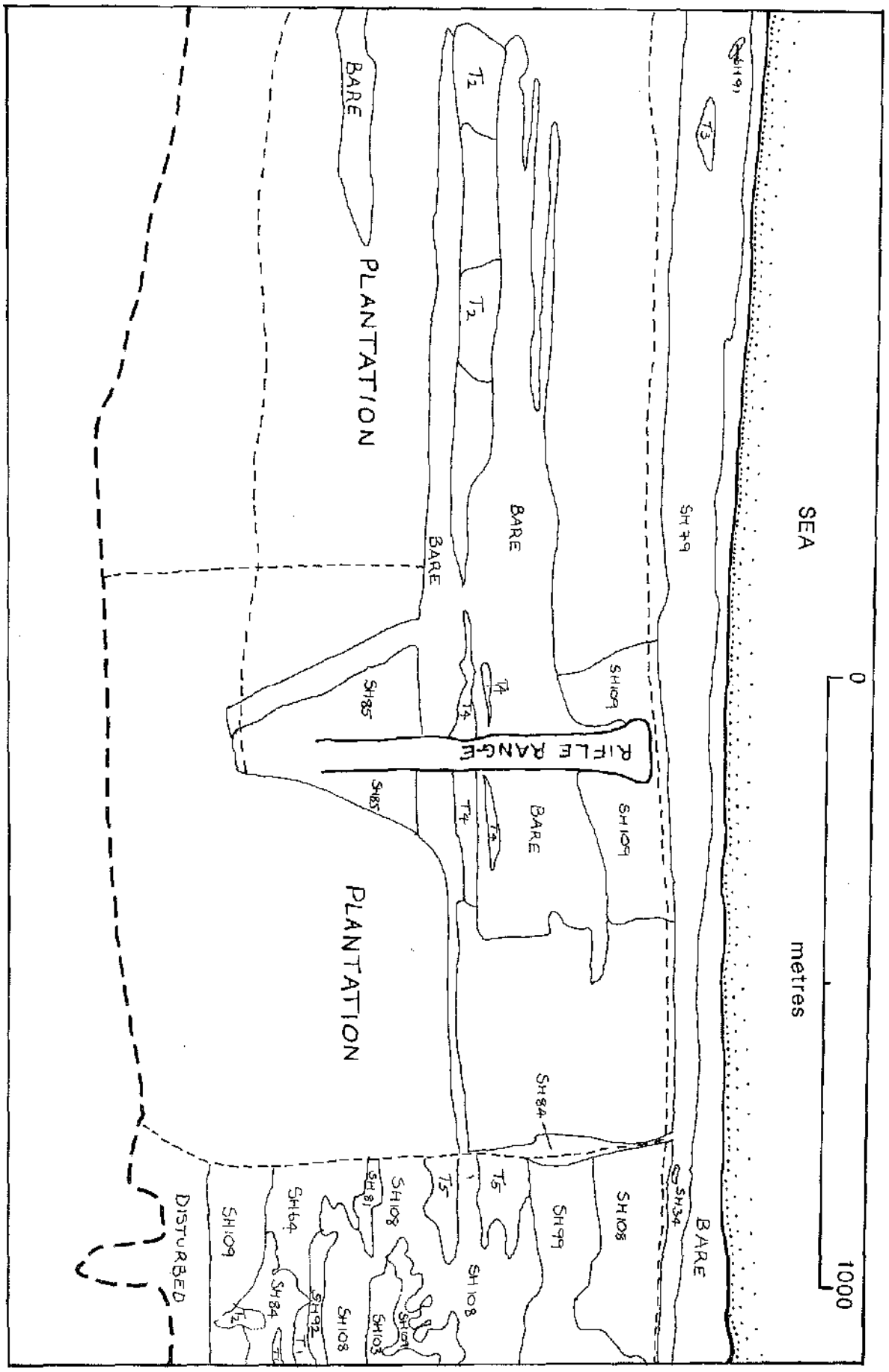

Figure 23b Kingston Shingles (west)

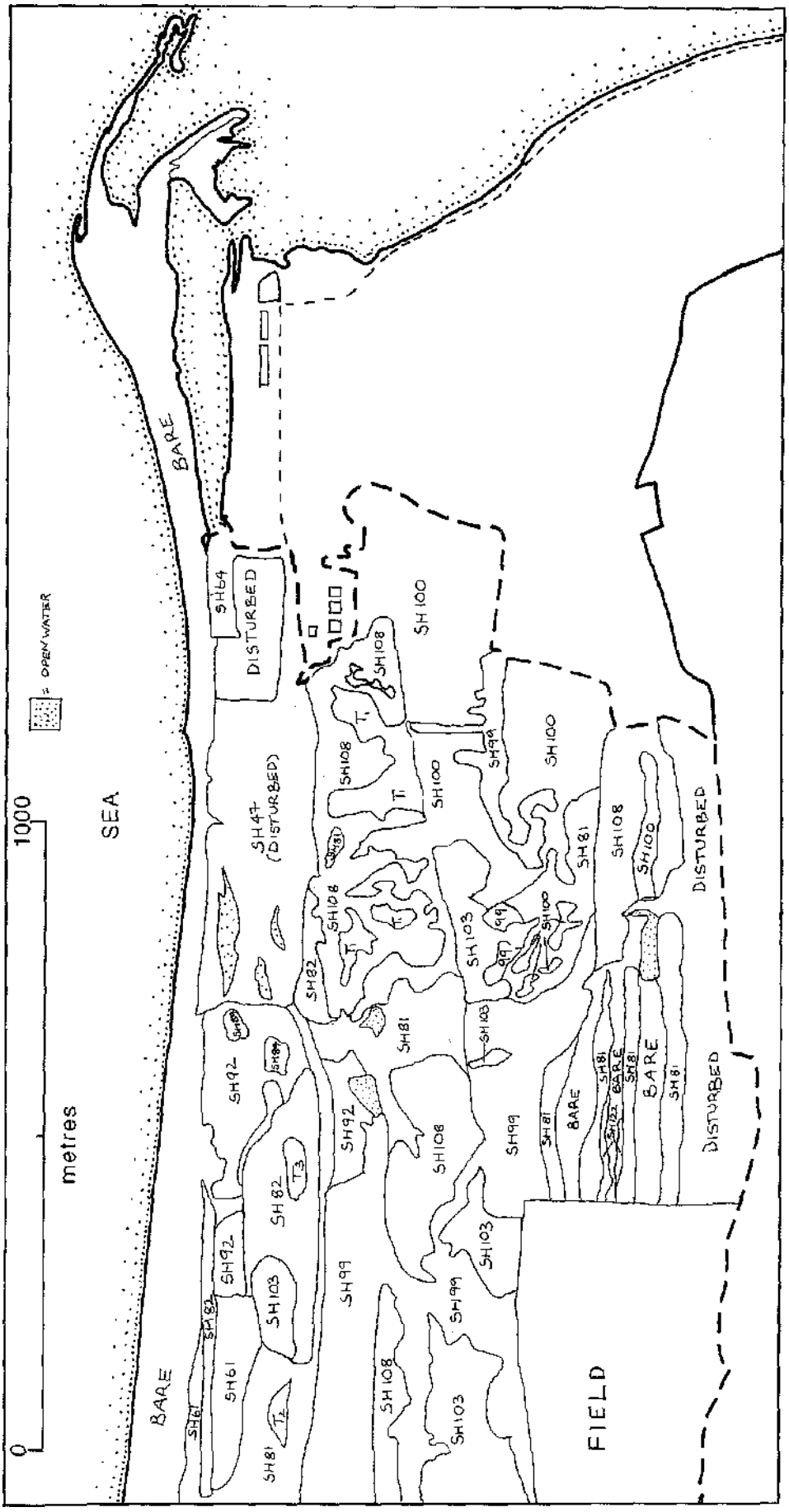

Figure 23c Kingston Shingles (east)

Culbin Bar

Highland. NH 920600
Conservation status: SSSI
Area surveyed: 27 ha
Fieldwork dates: 19-23/9/88 and 7/10/88.

Introduction
Culbin Bar comprises a 7 km raised offshore shingle barrier island. This is found lying off the south shore of the Moray Firth and forms the outermost part of a much larger sand dune and shingle ridge system. The bar runs on a north-east-south-west axis similar to Whiteness Head and has a maximum width of approximately 300 metres. The bar is separated from the mainland part of the system by 1.5 km of intertidal sand flats and saltmarsh.

The origin of the bar (discussed in detail by Steers 1973) is thought to have been as a spit growing out from the eastern shore of the River Findhorn. The spit breached in the eighteenth century and has since migrated south-west at a rate of 12 metres per year.

The far western end of the bar is the area considered in this survey because it is clearly a shingle feature, while to the east the bar is sand dominated. The western and eastern sections are separated by a thin strip of active shingle in the form of a storm crest. This is very narrow and could breach in major storms. The migration of the bar occurs through the erosion of the eastern end of the system with the active accretion at the western end.

The shingle bar forms a complex ridge system with six main shingle ridges which have four or five central ridges within the lows between them. There is a large area of largely bare shingle on the western foreshore where the only colonisers are encrusting saxicolous lichens. At the rear of the western bar the amount of sand-capping over the shingle structure increases; indeed, at the active western end there are large dunes forming.

The leeward edge of the bar displays major laterals commonly associated with such shingle features. The laterals enclose saltmarsh.

Threats
The remoteness of this site, which may be accessed on foot only at low tide across the marsh, or by boat, has served to protect the structure and plant communities. There is little evidence of human disturbance with just one building on the bar. This is an old fishing bothy, now derelict, and has led to limited disturbance. There are two sites of old bonfires on the island near the bothy, but other than this recreational pressure is negligible. There are vehicle tracks on the narrow shingle strip connecting the western and eastern sections of the bar and this practice should be discouraged as it serves to weaken an already fragile stretch of foreshore. There are vehicular tracks on the bar itself but damage attributable to this disturbance is localised and minor in extent.

There is noise disturbance in the form of low-flying jets from RAF Kinloss.

The continued migration of the bar does not appear to threaten the status of the vegetation. There are no stabilisation measures on the bar.

Management
There is little need for active management of the site because of its isolation. There is, however, a potential problem with the seeding of *Pinus sylvestris* which have spread from the plantation on the mainland. However, significant colonisation by pines is unlikely because of the exposure of the site.

There is evidence of widespread, but light, rabbit grazing on the bar. The site has not been used for agriculture.

Vegetation
The bare shingle ridges on the western section support only saxicolous lichens, but where the sand content in, or on, the shingle increases, there is a closed vegetation with grassland and heathland communities along with some scrub development. Indeed, there are five major communities illustrated at Culbin.

The first community encountered at the edge of the bare shingle, at the younger western end, is an open pioneer community typical of many

shingle sites. It is described as a *Rumex crispus littoreus - Tripleurospermum maritimum* community with a sand influence seen in the presence of *Ammophila arenaria, Elymus pycnanthus, Sedum acre* and *Cerastium diffusum* as occasional associates. This pioneer community does not stretch along the entire length of the bare shingle and is clearly representative of a younger, more maritime situation.

The actively accreting western end of the bar is particularly sandy and this is reflected in the vegetation. The major community on the newly accreted, active end is an *Ammophila arenaria* foredune community with *Senecio jacobaea, Ceratodon purpureus* and *Chamaenerion angustifolium.* In places where the community is particularly stable *Cladonia* spp. and *Tortula ruraliformis* are occasionally found.

With increased stability this community develops, on the older part of the bar, into a more closed dune grassland. In this case, while *Ammophila arenaria* remains the dominant species, it is found in association with *Arrhenatherum elatius, Agrostis capillaris, Festuca rubra* and *Pleurozium schreberi* as additional constants. The increased stability is reflected in the diverse lichen flora in this community, along with the bryophyte species, in particular *Pseudoscleropodium purum.* This serves as a transitional zone into the more stable, older areas characterised by a *Poa pratensis - Festuca rubra - Ammophila arenaria - Vicia lathyroides - Peltigera canina* shingle/dune community. The proportion of *Ammophila* decreases as the stability increases and diversity rises. This is a particularly diverse unit containing approximately eighteen species per quadrat. Additional grass species include *Agrostis capillaris* and *Holcus lanatus* while *Cladonia cervicornis* and C. *portentosa* form the lichen component. This community is particularly rich in bryophytes with *Pseudo-scleropodium purum* and *Rhytidiadelphus triquetrus* as the key associates.

While the *Ammophila* dominated community is in general confined to the main body of the bar, a slight variation of this is found on the marsh edge of the laterals. In this case the marsh influence is seen in the mixed *Ammophila arenaria - Arrhenatherum elatius* grassland with the constant, if minor, presence of maritime herbs such as *Cochlearia danica, Rumex crispus littoreus* and *Tripleurospermum maritimum.*

The sandy grassland stretches along the front of the main body of the bar to a point almost half way along. There is some variation within the community composition, with *Ammophila arenaria* becoming a less important component while *Festuca rubra* becomes the dominant grass species. It is found along with the original associates, but also with *Festuca ovina* and *Anthoxanthum odoratum* as additional, minor constants. The lichen component also becomes more diverse and important with *Cladonia portentosa, C. squamosa, C, ciliata, C. chlorophaea* and *C.furcata* as the major associates. *Lotus corniculatus, Viola tricolor, Galium saxatile* and *Hieracium pilosella* are also found infrequently. This slight shift in species composition reflects the increasing maturity of the community and, perhaps, the increased importance of humus within the soil in relation to the pure sand content.

A similar sub-community is found immediately to the west of the hut where *Festuca rubra* becomes the dominant grass species, with *Holcus lanatus, Viola riviniana, Senecio jacobaea, Lotus corniculatus* and *Pleurozium schreberi* as the major associates.

In general the grassland communities give way to a heathland community behind, on the older shingle ridges and on the main body of most laterals.

Here too, the community is generally more diverse than heathland communities encountered elsewhere on shingle. This heathland is characterised by the constant presence of *Calluna vulgaris - Hypogymnia physodes - Empetrum nigrum - Cladonia portentosa.* However, even here the sandy influence may be seen in the presence of *Ammophila arenaria* and *Carex arenaria* in small amounts. *Cytisus scoparius* is also found in varying amounts throughout much of the community, and in some places becomes a locally important species.

This heath is particularly rich in herbs with *Lotus corniculatus, Galium verum, Vicia lathyroides* and *Erica cinerea* as frequent

associates. In addition to *Cladonia portentosa*, the presence of *C. ciliata, C. squamosa, C. rangiformis, C. gracilis* and *C. cocci/era* form a major lichen component, along with the occasional presence of *Evernia prunastri.* This diverse heathland then develops on the older laterals into a *Calluna vulgaris* dominated heath with fewer associates. In this sub-community the *Calluna* has a Domin score of 9-10. While *Empetrum nigrum, Hypogymnia physodes and the Cladonia* spp. remain key indicators, they are only minor constants in this case.

A second community found on the older stable shingle ridges and laterals is a *Cytisus scoparius - Agrostis capillaris - Hypnum cupressiforme – Rubus fruticosus* scrub with *Holcus lanatus, Carex arenaria* and *Festuca ovina* as major associates. *Chamaenerion angustifolium, Rosa canina, Polypodium vulgare* and *Junipems communis* are the occasional associates. There continues to be some heathland presence within this community, with *Calluna vulgaris* and *Hypogymnia physodes* found in small amounts. Clearly, the *Cytisus* is invading areas previously supporting heath communities. In some areas, the *Cytisus* is not yet dominant, and here the *Rubus fruticosus, Agrostis capillaris* and *Hypnum cupressiforme* become more important with *Chamaenerion angustifolium* as a locally important constant.

At the far eastern end of the bar, where maritime influences increase, there is a community which displays elements of scrub vegetation along with the sandy grassland. It is characterised by the constant presence of *Ammophila arenaria, Rubus fruticosus* and *Agrostis capillaris.* Additional grass species include *Festuca ovina* and *Poa pratensis* while the herb content comprises *Galium saxatile, Senecio viscosus* and *Rumex crispus littoreus.*

The final community is found on the first small lateral, subject to major maritime and marsh influences. This community is a *Festuca rubra - Lotus corniculatus - Cladonia portentosa - Hypogymnia physodes* grassland with *Carex arenaria* locally dominant. Additional associates include *Dicranum scoparium, Pleurozium schreberi, Poa pratensis* and *Galium verum,* while *Polytrichum piliferum, Cladonia furcata, Calluna vulgaris* and *Empetrum nigrum* are minor associates.

Key

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

SH92 *Calluna vulgaris - Cladonia portentosa* community;

SH91 *Calluna vulgaris - Erica cinerea - Hypogymnia physodes - Cladonia* spp. community;

SH83 *Agrostis capillaris - Dicranum scoparium - Hypnum cupressiforme - Galium saxatile* community;

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

SH55 *Holcus lanatus - Agrostis capillaris - Ammophila arenaria - Hypochoeris radicata* grassland community;

SH52 *Ammophila arenaria - Ceratodon purpureus* community;

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

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

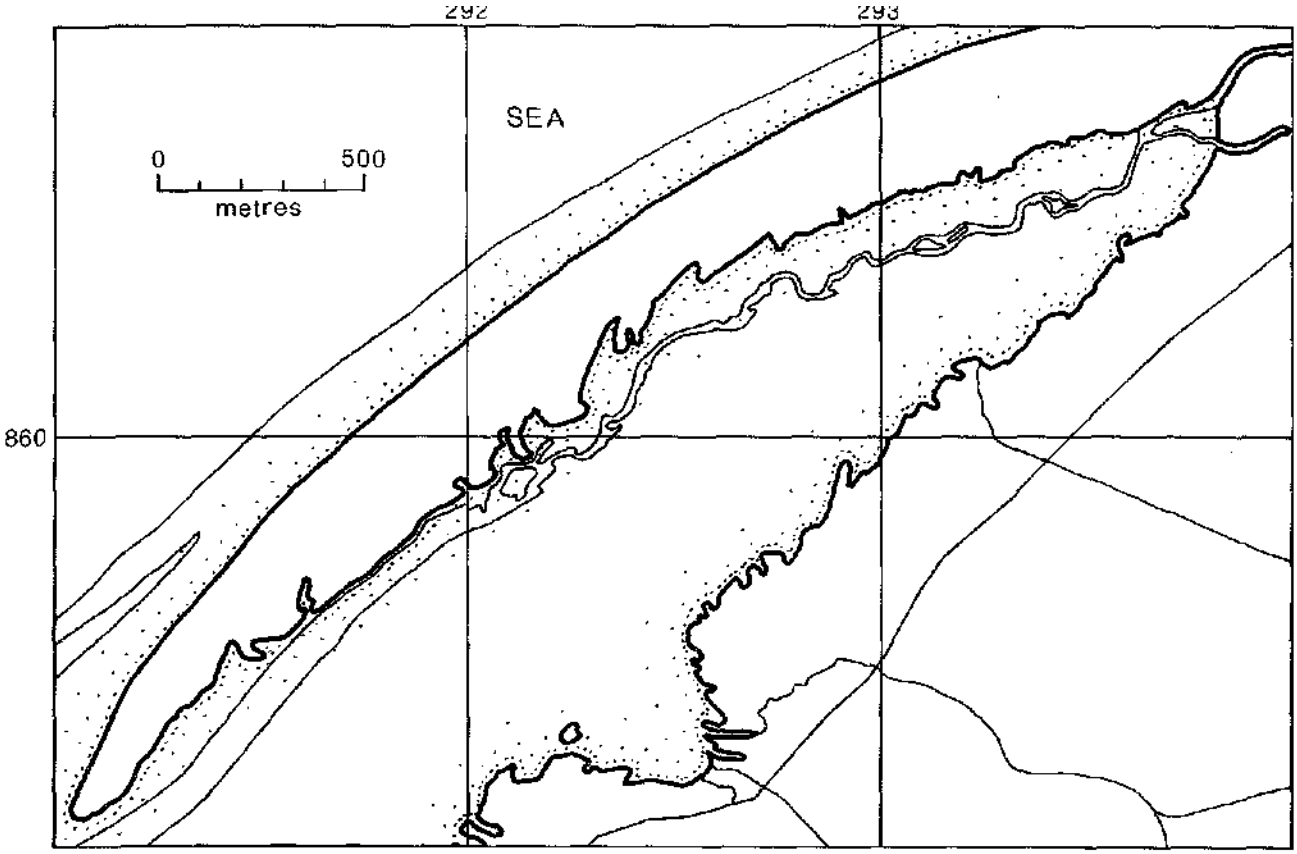

Figure 24a Culbin Bar (general)

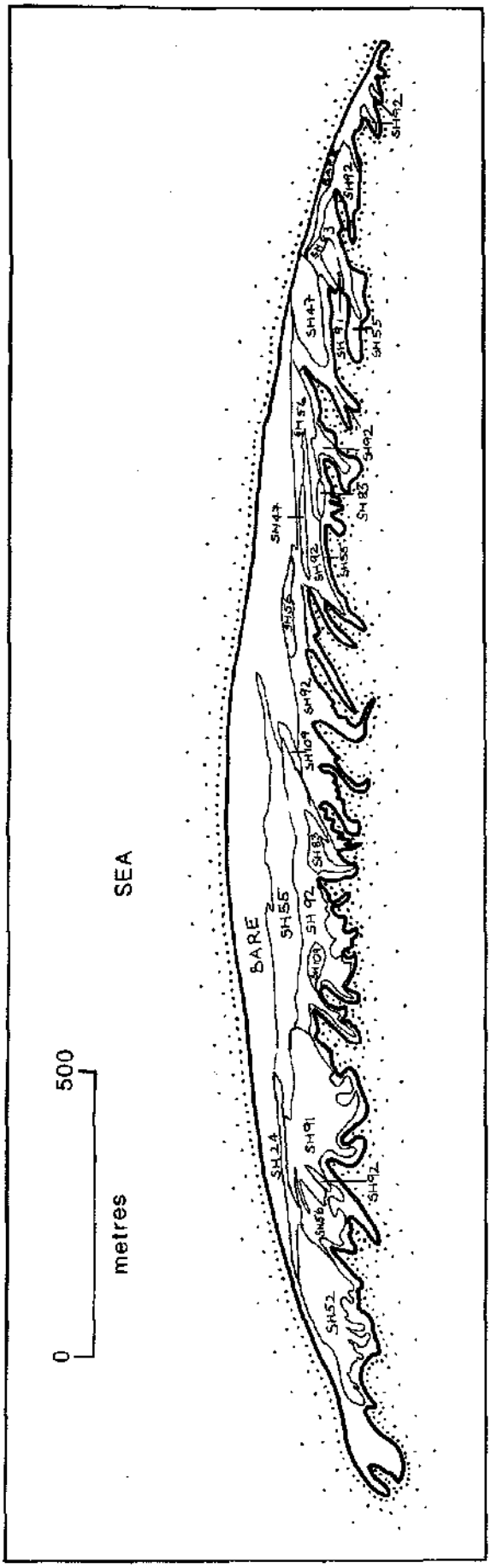

Figure 24b Culbin Bar (vegetation)

Whiteness Head

Highland. NH 820570
Conservation status: SSSI
Area surveyed: 45 ha
Fieldwork dates: 26-30/9/88

Introduction
Whiteness Head is a shingle spit extending westwards along the Moray Firth between Nairn (the proximal end) and Fort George (the distal end), a length of 3.2 km. A saltmarsh exists to the landward of the spit and is included in the SSSI boundary; however, the survey of this site was confined to the actual spit area.

The spit consists of several shingle ridges built out from the coastline where the Moray Firth swings round towards Inverness to the west. The spit is narrowest at its proximal end where it consists of only an active shingle storm ridge, which is subject to regular nutrient inputs from both sea and marsh.

The spit widens to a maximum of 200 metres in the west with a bare shingle ridge running along the seaward border. Behind this ridge there is a slightly lower area of vegetated shingle which gives way to a sandy ridge at the distal end of the spit. Clearly, the shingle has acted as a skeleton for the build up of sand along the length of the spit and, hence, Whiteness should be defined as having a sandy shingle substrate.

The storm crest of bare shingle supports a very steep foreshore at the proximal end of the spit indicative of active erosion in this area. This contrasts with the active deposition at the distal end, which has been reported as growing at a rate of 17 metres per year on average between the 1940s and 1970s. This rate of spit elongation suggests that the age of this spit is in the region of 200 years.

Threats
A bothy exists half way along the spit and tyre marks are visible over the shingle and vegetation, evidence of past human disturbance to the site. The building of the McDermott construction yard on the opposite shore has restricted vehicular access to the site and, hence, has limited human impact in recent years.

Continued erosion at the eastern end of the spit could lead to a breach in the future, thus heightening the isolation and allowing the undisturbed development of existing communities.

Management
The physiography of the site seems to have been little altered by man other than the shoring up of the landward side of the spit opposite the dock for the construction yard. The most obvious human disturbance to the site is the litter washed up along the marsh driftline which is obviously derived from the construction yard.

There is little grazing on this site.

Vegetation
This site offers examples of northern communities typical of sandy shingle sites. The vegetation may be divided into six major communities with two principal axes of vegetation change. One axis runs along the length of the spit east-west and probably reflects an ageing factor, while overlaid on this axis there exists some evidence of zonation parallel to the shoreline, relating to the amount of sand in the shingle/sand mix.

Running along the seaward margin of the spit there exists a rather open community of strandline species. This community appears, however, to be more permanent than a true strandline community, being situated beyond the high water driftline.

This community is characterised by the constant presence of *Honckenya peploides, Ammophila arenaria,* and *Rumex crispus littoreus* with *Tripleurospermum maritimum* as an additional major constant. The presence of arenicolous species highlights the importance of sand within the shingle matrix. *Cerastium diffusum* is an occasional associate within this community.

A slightly different, poorly developed sub-community emerges at the proximal end of the spit where overall cover is reduced, presumably due to increased maritime influences, resulting from the instability in this area. *Rumex crispus littoreus* and *Tripleurospermum maritimum* continue to form a major component of the community, along with *Cerastium diffusion*, but in this case *Puccinellia maritima* and *Armeria maritima* are also closely related, thus reflecting the saltmarsh influence on the spit at this point. This differentiation is too minor to be reflected in the classification.

There is some development of this open pioneer community at the distal end of the spit reflecting the nutrient enrichment provided by birds nesting in this area. In this instance the community is characterised by the constant presence of *Festuca rubra - Rumex crispus littoreus -Tripleurospermum maritimum. Ceratodon purpureus, Poa pratensis* and *Sedum acre* form minor associates in this community.

The remainder of the spit may be divided into two broad community types, one a grassland and the other a heath community. The grassland communities dominate the western end of the spit and, in most parts, reflect the sandy nature of the substrate.

An *Ammophita arenaria - Agrostis stolonifera - Carex arenaria - Senecio jacobaea* community occupies the largest area of the spit with *Pleurozium schreberi* also playing an important role. There is some zonation even within this community, with *Festuca rubra* present throughout but generally declining in importance at the eastern margin of this zone. *Holcus lanatus, Anthoxanthum odoratum* and *Poa pratensis* also appear in this grassland but less frequently.

This is a very diverse grassland with a high herb content, the most important of which include *Lotus corniculatus, Vicia lathyroides* and *Galium verum* while *Cerastium fontanum, Viola riviniana, Rumex acetosella* and *Centaurea nigra* are found occasionally. The presence of various lichen species illustrate the undisturbed nature of this grassland, with *Peltigera canina, Cladonia ciliata* and *C. macilenta* as key indicators.

Beyond this there is a *Leymus arenarius* community occupying the westernmost end of the spit. *Leymus arenarius* dominates this species-poor community, offering almost total ground cover and thus excluding many vascular species. However, bryophyte species form an important component of this community, in particular *Hypnum cupressiforme* and *Ceratodon purpureus.*

At the eastern edge of the main *Ammophila - Agrostis* community, separating this from the second major vegetation type (acid heath), there is a short mixed grassland turf situated close to the storm crest. This zone supports *Festuca rubra, Poa pratensis* and, to a lesser degree, *Anthoxanthum odoratum* and *Agrostis stolonifera* in association with *Peltigera canina, Vicia lathyroides* and *Cladonia* spp., such as *Cladonia rangiformis, C. furcata, C. ciliata* and *C. cervicornis.* There is a major bryophyte component, such as *Hypnum cupressiforme* and *Rhytidiadelphus triquetrus.*

A similar community is found at the western end of the major sandy grassland community with *Festuca rubra - Poa pratensis - Vicia lathyroides* and *Peltigera canina* as the dominant species. Here too, the bryophyte and *Cladonia* spp. lichen component form a major part of the community. This assemblage may reflect increased maritime influences as it is found immediately behind the storm crest in the east and west but not behind the high storm crest in the central section of the spit.

The final grassland community is found in one small patch behind the storm crest and is best defined as a *Festuca rubra - Plantago lanceolata - Lotus corniculatus* maritime grassland with a high herb content. The herb associates include *Sagina nodosa, Hieracium pilosella, Trifolium repens* and *Honckenya peploides,* but with no lichen or bryophyte presence; this may reflect an area which had been disturbed in the past.

The second major vegetation type on Whiteness Head is the acid heath which dominates much of the proximal portion of the spit. This may be characterised as a *Festuca rubra - Calluna vulgaris - Erica cinerea - Ulex europaeus* heath with a high lichen content. The proportion of *Ulex* varies across the

community ranging from dense cover (Domin score 8-9) to a merely scattered cover (Domin score 1-2). Clearly, in places where the cover is most dense, the community is slightly less diverse; however, there still remains an unusually high number of associates in this rich heathland. The major associates are lichens, with *Cladonia chlorophaea, C. gracilis, C. cervicornis* and C. *foliacea* frequently found, along with *Hypnum cupressiforme* and *Peltigera canina.*

Some patterning is evident within this zone, with the *Ulex* dominated community confined to the ridge tops at the zone's seaward edge, while the lows support a slight variation on this community with only occasional young *Ulex* plants. This may reflect a pattern in the pebble size which is known to differ across ridges and lows. This would, in turn, have implications for relative rates of drainage over ridges and lows and thus affect the vegetation.

In some areas the community becomes more diverse with grassland species playing a more important role along with the *Calluna vulgaris* and *Erica cinerea.* In particular, *Festuca rubra, Anthoxanthum odoratum* and *Agrostis stolonifera* are important constants. The *Cladonia* content is similar to that mentioned earlier although *C. squamosa* is also found here. The bryophyte component also becomes more important with *Hypnum cupressiforme, Dicranum scoparium* and *Polytrichum piliferum* as the key associates. Additional herbs include *Lotus corniculatus, Viola riviniana* and *Rumex acetosella.*

Key

SH91 *Calluna vulgaris - Erica cinerea - Hypogymnia physodes - Cladonia* spp. community;

SH84 *Holcus lanatus - Rosa pimpinellifolia - Festuca rubra* heath community;

SH61 *Festuca rubra - Anthoxanthum odoratum - Lotus corniculatus* community;

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

SH56a *Festuca rubra - Peltigera canina - Senecio jacobaea* community, *Armeria maritima - Sedum acre* sub-community;

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

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

SH42 *Dicranum scoparium - Cladonia portentosa - Festuca rubra* grassland;

SH24a *Rumex crispus littoreus - Tripleurospermum maritimum - Glaucium flavum* pioneer community, *Cerastium diffusum* sub-community.

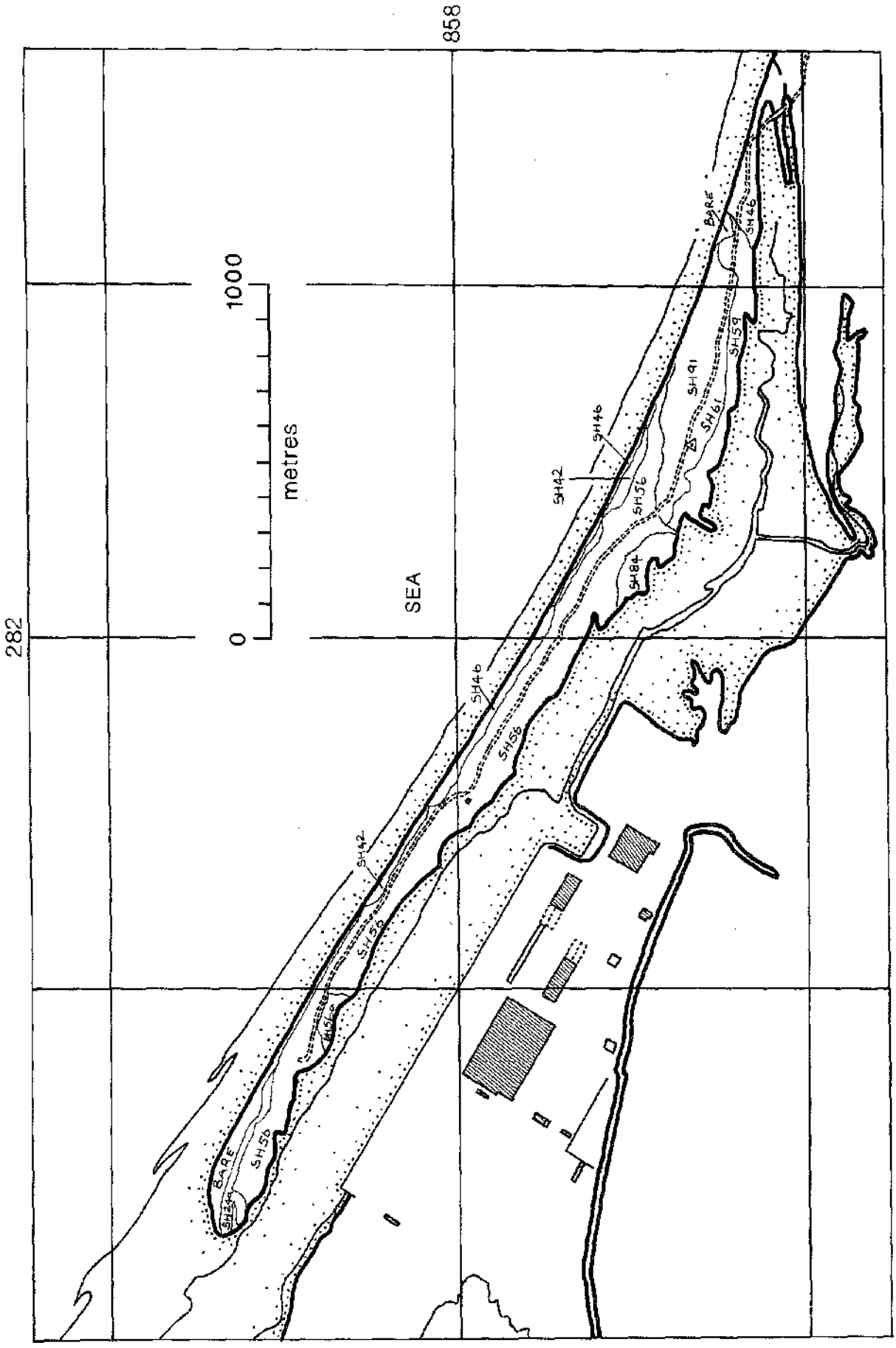

Figure 25 Whiteness Head

Cuthill Links

Highland. NH 750860
Conservation status: SSSI
Area surveyed: 40.0 ha
Fieldwork dates: 10-11/10/88

Introduction
This is an area of raised, fossilised shingle ridges which are still clearly visible in the landscape. This is an apposition foreland and beach. The site extends to Meikle Ferry in the west and through to Dornoch in the east, although the shingle ridges are not clearly visible beyond Ard na Curr.

There is a major sand component at this site with the ridges overlayed by sand in varying amounts. At Ard na Curr some shingle remains visible in patches within the vegetated areas. There is a bare shingle foreshore which is clearly frequently inundated and supports a strandline vegetation. This site is at the sandy extreme of the stabilised shingle spectrum but has been included because of patches of shingle at the surface and the clear ridge formation.

The major loss of vegetated shingle in recent years is through the construction of the A9 link straight across the site on the Ard na Curr point. Other than the actual loss of land involved, however, there appears to have been little disturbance to the flora or geology of the site. More worrying, however, is the potential increase in recreational pressure which may accompany the opening of this road. At present this site is rather remote and has suffered very little recreational pressure. There is one track across the site which is used by farm vehicles only as it is accessed via a locked gate.

There is a lower area of shingle within the ridge system east of the path which clearly represents past gravel extraction. There is no evidence of current extraction.

To the west of the point, where the sand content increases, there is also evidence of past extraction. In addition, there are parking sites on the shingle in the west but levels of damage remain light. There are also small dumps of glass and rubbish near one of these parking sites.

Management
The farm, situated north-east of the point, has fenced off parts of the fossilised ridge system and this area has now been lost to grazing by sheep.

The undisturbed site, however, is also grazed, although in this case only by rabbits and hares. While levels of grazing are only moderate at this time there may be a need to monitor levels to prevent irreparable damage to the overall flora.

There has been some burning of the *Ulex europaeus* on the western section of the site and this appears to be a deliberate attempt to maintain a grassy heathland in this area.

Vegetation
This site supports a very well-developed heathland flora with a major lichen component and is a good example of a sandy shingle heath. Indeed, this site is listed as a Grade 2 site of national importance for its lichen flora alone.

The major heathland community at Cuthill is a *Calluna vulgaris - Erica cinerea - Hypogymnia physodes - Cladonia portentosa* lichen-rich heath. This community extends across much of the site. While it is *Calluna vulgaris* dominated, this assemblage has a peculiarly diverse *Cladonia* flora. Other than *Cladonia portentosa* the major lichen constants include *C. rangiformis, C. gracilis, C. cocci/era* and C. *cervicornis*, while *C. ochlochlora, C. arbuscula* and C. *coniocraea* are minor associates. *Coelocaulon aculeatum, Usnea* spp. and *Peltigera canina* are also found in this community.

In addition this community also supports a major herb component with a diverse range of species found in small amounts, in particular, *Veronica officinalis, Veronica serpyllifolia, Rumex acetosella, Viola hirta* and *Cerastium*

semidecandrum. In addition, *Anthoxanthum odoratum* and *Agrostis capillaris* are found as minor associates.

There is a major bryophyte component in this unit comprising *Hypnum cupressiforme, Pleurozium schreberi* and *Polytrichum piliferum.* This vegetation unit is widely grazed by rabbits and has many rabbit warrens.

There is a slight variation on this community found in a lower area on the eastern section of the site. In this instance, while *Calluna* remains the major species along with *Cladonia portentosa* and a major lichen content, there are no herbs or grass species, and moss plays a less important role. This is a species-poor version of the initial heathland community. There is a slight variation within the lichen flora with *Bryoria fuscescens* and *Parmelia sulcata* as additional lichen species.

The second major heathland community is characterised by the constant presence of *Calluna vulgaris, Hypogymnia physodes, Ulex europaeus* and *Cladonia portentosa.*

Although this description of the community is in some ways similar to the first community, closer inspection reveals that this is a generally less diverse community in terms of lichens. In this instance the bryophyte component is the key indicator in its diversity, with *Pseudoscleropodium purum* and *Hypnum cupressiforme* as major indicators while *Pleurozium schreberi, Dicranum scoparium* and *Rhytidiadelphus triquetrus* are minor associates.

Veronica officinalis, Luzula spp. and *Agrostis capillaris* are the remaining important associates and these are found in varying amounts across the community.

In some areas this heathland community is replaced by a sandy *Cladonia* heath where *Calluna* plays a minor role. This assemblage does not emerge as a separate community in the classification but deserves mention at a site level. It is a *Festuca rubra - Lotus corniculatus - Cladonia portentosa* association. It includes a major bryophyte component with *Pleurozium schreberi, Pseudoscleropodium purum, Dicranum scoparium* and *Hylocomium splendens* as the major moss associates. This community may reflect areas where the sand content increases in conjunction with heightened maritime influences, as illustrated by the constant, if minor, presence of *Ammophila arenaria* and *Carex arenaria.* The diversity is illustrated in the presence of *Hieracium pilosella, Rosa pimpinellifolia, Veronica officinalis* and *Trifolium repens* along with *Agrostis capillaris* and *Anthoxanthum odoratum* as major associates. Additional lichens include *Peltigera canina, Cladonia gracilis, C. cervicornis* and *C. coccifera.*

The sandy influence illustrated within this community is even stronger in the community which mainly occupies the western seaward edge of the foreland. This community is dominated by *Ammophila arenaria* and *Carex arenaria. Festuca rubra, Anthoxanthum odoratum, Holcus lanatus, Agrostis capillaris* and *Poa pratensis* are found throughout the community, which comprises a herb-rich, mixed grassland. Major herb associates include *Achillea millefolium, Viola hirta, Thymus polytrichus britannicus, Galium verum* and *Prunella vulgaris.* The bryophyte component comprises *Rhytidiadelphus squarrosus* and *R. triquetrus* as major constants with *Hylocomium splendens* and *Pleurozium schreberi* found occasionally.

The area around the point supports a *Ulex europaeus* dominated assemblage best defined as a *Ulex europaeus - Agrostis capillaris ~ Festuca rubra* community. The *Ulex,* in effect, out-competes most associates such that the only additional species found in this depauperate assemblage are *Holcus lanatus, Viola hirta* and *Senecio jacobaea.*

The rear of the site on the point is occupied by a grassy heathland community. This is an *Agrostis capillaris - Festuca rubra - Calluna vulgaris - Galium saxatile* grassland where *Calluna* is a very minor constant. *Potentilla erecta* is a minor constant along with *Pseudoscleropodium purum.* Additional species include *Hylocomium splendens, Pleurozium schreberi, Polygala serpyllifolia, Galium saxatile* and *Holcus lanatus. Ulex europaeus* is an occasional associate which seems to be confined to the ridge tops within this general community.

The final community is found in a small patch on the main body of the foreland east of the A9 extension. This is a *Rosa pimpinellifolia - Holcus lanatus - Agrostis capillaris - Festuca rubra* community with *Rosa pimpinellifolia* as the dominant species in this relatively species-poor community. Occasional associates include *Urtica dioica, Viola hirta* and *Achillea millefolium*, while *Carex arenaria, Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus* occur as minor constants.

Key

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

SH93 *Agrostis capillaris - Ulex europaeus - Rhytidiadelphus squarrosus* community;

SH92 *Calluna vulgaris - Cladonia portentosa* community;

SH91 *Calluna vulgaris - Erica cinerea - Hypogymnia physodes - Cladonia* spp. community;

SH84 *Holcus lanatus - Rosa pimpinellifolia - Festuca rubra* heath community;

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

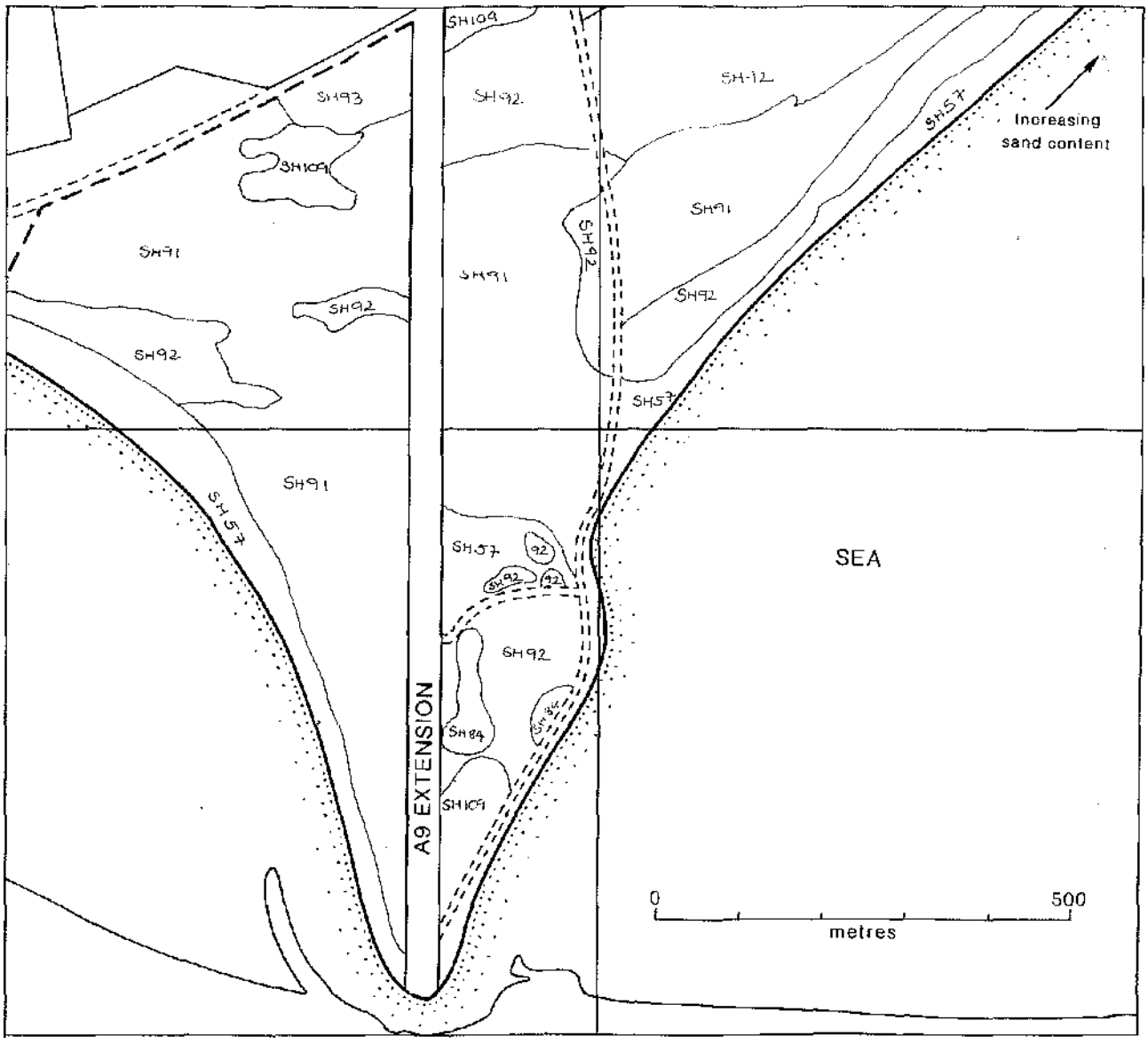

Figure 26 Cuthill Links

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For all key references relating to shingle vegetation, see:

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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.

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