

No. 98
NATIONAL SAND DUNE VEGETATION SURVEY
SITE REPORT NO. 48
OXWICH, NICHOLASTON, PENMAEN
AND PENNARD BURROWS
1989

T C DARGIE

Contract HF3-03-434

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NCC COASTAL ECOLOGY RESEARCH PROGRAMME

The Coastal Ecology Branch of the Chief Scientist Directorate was established in August 1979. One of the functions of the branch is to co-ordinate a programme of research and survey in the field of terrestrial coastal conservation. To this end a research programme has been developed with four main aims:

1. 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).
2. To assess the impact of major development projects on sites of national importance for nature conservation.
3. To provide guidance on the management of the main coastal habitats for nature conservation.
4. To investigate the role of physical and biological processes in the maintenance of natural and semi-natural coastal habitats.

The results are disseminated in a variety of Nature Conservancy Council publications.

- a. *CSD Contract reports:* limited numbers with specialist interest are produced. Copies are usually prepared by the contractor and made available as a Chief Scientist Directorate Report in microfiche through the Nature Conservancy Council's Information and Library Services.
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If you would like any further information on this report or on the research programme please contact Dr Doody in Peterborough.

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1. BACKGROUND AND OBJECTIVES

Oxwich, Nicholaston, Penmaen and Pennard Burrows were surveyed as part of the Sand Dune Survey of Great Britain. This project is one of a series of strategic surveys of coastal habitats currently being undertaken by the Nature Conservancy Council. The Survey has two aims:

- i. To produce a vegetation map and description for each sand dune system which will be useful to those involved directly in its conservation;
- ii. To produce a national inventory of the range and extent of sand dune habitats in Great Britain. Such an inventory will then allow the interest of any particular site or group of sites to be placed in its national context.

This contract (HF3-03-434) involved a survey of dunes in South Wales. The specification involved the production of a vegetation map(s) and a botanical survey report for **each** of the following sites or site sets:

- i. Pembrey Coast
- ii. Whiteford Burrows
- iii. Hillend-Llangennith-Broughton-Delvid-Hills Tor Burrows
- iv. Port-Eynon to Horton
- v. Oxwich-Nicholaston-Penmaen-Pennard Burrows
- vi. Black Pill to Bryn Mill
- vii. Crymlyn Burrows

This document is one of the above site reports. In addition, the overall information is synthesized in a Regional Report which reviews the following points: dune distribution, type, size, vegetation communities and relationships, management and special characteristics. This report should be read in conjunction with the regional document if Oxwich, Nicholaston, Penmaen and Pennard Burrows are to be considered in a broader geographical and ecological context.

2. METHODS

Oxwich, Nicholaston, Penmaen and Pennard Burrows were surveyed using the standard techniques of the Sand Dune Survey of Great Britain. Collecting data in a consistent manner will thus enable valid comparisons to be made between sites on a national basis.

The field survey technique and subsequent analysis of the data were carried out using methods similar to those of the National Vegetation Classification (NVC).

Further details of the field techniques, data analysis and vegetation mapping are included in Annex 1. The quadrat data set (in coded format) is presented in Annex 7. Quadrat membership of vegetation types is given in Annex 4.

3. SITE DESCRIPTION

Location, conservation status and land ownership

Oxwich, Nicholaston, Penmaen and Pennard Burrows (Swansea, West Glamorgan) are located in South Gower (Swansea, West Glamorgan) around the shore of Oxwich Bay (Fig. 1). Two of the dune locations (Oxwich, Nicholaston) are part of Oxwich Bay SSSI (427.2 ha) and Oxwich Burrows is part of Oxwich Bay NNR (256.6 ha), all declared at various dates between 1953 and 1979. All four areas form part of the more extensive South Gower Coast site of national nature conservation importance. All are within the Gower AONB.

Oxwich Burrows is managed by the Nature Conservancy Council. Nicholaston and Penmaen Burrows are owned/managed by the National Trust. Permission for access was obtained from these organisations.

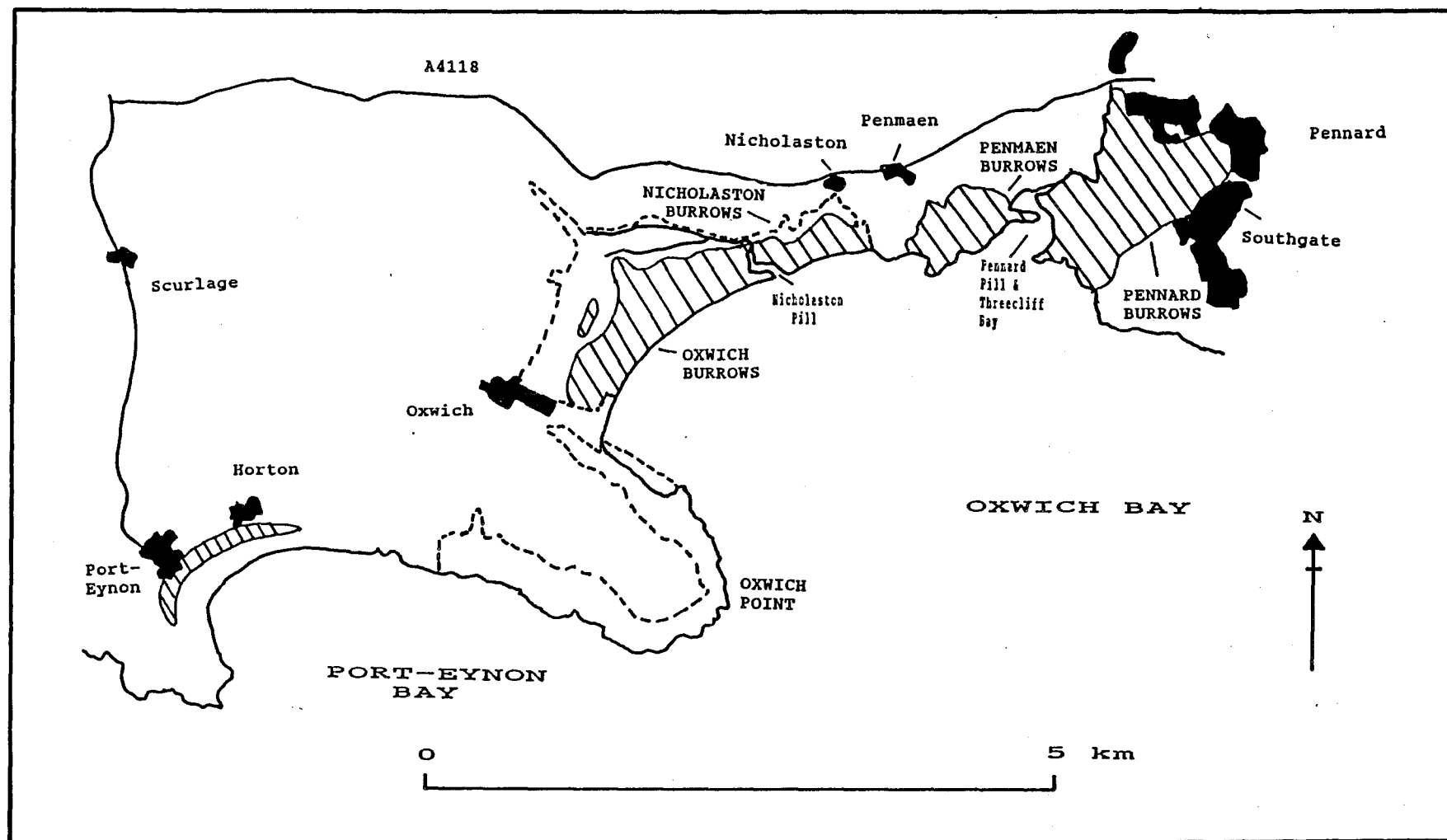


Figure 1 Survey and SSSI boundaries for South Gower study area

Dashed lines are Oxwich Bay SSSI boundaries
Hatching denotes surveyed dune areas

Geomorphology

Two contrasting sets of dune landscape occur in these four areas: an active shingle-cored hindshore system at Oxwich and west Nicholaston, and a bay dune/cliff/plateau system at east Nicholaston, Penmaen and Pennard.

The origin of these contrasts is in part due to geological structure and in part to Devensian/Flandrian environmental change. The western sector of Oxwich Bay is a syncline of softer Limestone Shale (Millstone Grit age) between the harder Carboniferous Limestone anticlines of Oxwich Point and Threecliff Bay. Dune sand is derived from Devensian till and outwash materials deposited in Swansea Bay and south of the Gower Peninsula by piedmont glaciers fed from high land further east. Shingle bars were probably created by a rising Flandrian sea level and these migrated inshore. Formation of the dune barrier at Oxwich is dated at c. 5500 BC (Reynolds 1976).

The advancing Oxwich barrier beach created a poorly-drained depression on its landward side which today is represented by Oxwich Marsh. The basal freshwater peat of this marsh is dated as 600 BC by Reynolds (1976). Streamflow has continued to enter the sea via the Nicholaston Pill but major changes were attempted in the 18th century by constructing a sluice and sea wall, draining the marsh and constructing a serpentine pond. Drainage deteriorated between 1910 and 1945 (Elias 1979), leading to marsh flooding and the return of reedswamp, fen and carr. Saltmarsh has also developed in the area of the sluice which is no longer fully operational.

The hindshore dune system at Oxwich probably has a cyclical pattern of dune ridge construction and then destruction by blowouts, creating favourable conditions for slack formation.

In the other system of bay dunes/cliff/plateau the barrier beaches entered the much narrower cliffed bays and dunes formed above the shingle at the foot of the cliffs. Large poorly-drained depressions were not created and the Pennard Pill (flowing south in a fault-controlled valley) has been able to reach the sea in Threecliff Bay without great difficulty. It has a fringe of saltmarsh in its tidal sector. The most distinctive feature of these bay dunes is sand banked against the cliffs and deposition on the 50m OD plateau above. This was caused by storm conditions between the 14th and 18th centuries which at Pennard forced the abandonment of a settlement and left a church and Pennard Castle as ruins on the plateau top.

Soils

Young sectors of all dune systems are calcareous (pH samples range between 7.4 and 8.2) but there are acidic soils on the plateau surfaces of Penmaen (pH range 5.5 - 6.8) and Pennard (pH range 5.6 - 6.6). Leaching has therefore been most effective on the gentler slopes of such areas and there has probably not been a great input of new calcareous material since the 18th century.

Management

Oxwich

Oxwich Burrows is managed as a National Nature Reserve by NCC. There are four main problems for the dune area: dune erosion, visitor numbers, bracken invasion into stable dune grassland, and controlling slack floristic diversity.

Dune erosion and visitor numbers are clearly related. Prior to the great increase in car ownership Oxwich had large areas of mobile dune and extensive blowout systems. Visitor numbers have increased greatly over 2-3 decades and in 1986 car parks at the south end were dealing with 55,000 vehicles per year, the ten-week summer peak was producing 60,000 visitors and on an annual basis 190,000 people were estimated to visit the area (Parry 1986). A good summer bank holiday brings 20,000 people to Oxwich Beach (Cole 1985). The NCC response has been to exclude the public from large areas of sensitive dune by fencing off six enclosures, improving paths by putting down mollusc shell layers, providing steps and some boardwalk, and educating the public on the importance of dunes (coastal protection, fragility, flora and fauna) via the Oxwich Visitor Centre, pamphlets and nature trail.

Stable dunes on the west of the Oxwich system have been heavily invaded by bracken over a long period and control has been attempted for about ten years, preferring mowing to grazing or Asulox alternatives (Meade 1983). Soil moisture is a determinant of a mown sward, with hay meadow being a long-term possibility on wetter soils. Meade advocates baring dry soils to encourage moss invasion as a first stage in grassland restoration. Mowing was in progress during this survey but little evidence of grassland was found. Grazing by goats is about to be tried and a pen to hold these animals was being constructed in late August 1989.

Many slacks at Oxwich have suffered from invasion by Common Birch (*Betula pubescens*) and Alder (*Alnus glutinosa*), with a fall in floristic diversity resulting from increased shading. Control by cutting and application of stump herbicide has been fairly effective but re-sprouting is common.

Nicholaston

The combined problems of active dune erosion and high visitor numbers are also present at Nicholaston, though visitor totals are probably much smaller because there is no close access from a car park. The major point of entry is by footpath from Nicholaston village but there are also connecting paths from Oxwich and Penmaen.

Former major erosion in the centre of the dune system has been tackled for more than a decade by adding steps to the woodland path down the north cliff, putting down a mollusc shell cover to the principal paths and diverting the public by a V-shaped fence to keep them from the largest expanse of bared sand. This has been quite effective and regeneration is active at present.

Penmaen

Large visitor numbers, many from caravans on adjacent hillslopes, have badly damaged the small areas of young dune on shingle at the cliff-foot between Little and Great Tor, and in Threecliff Bay. The lower cliff between Great and Little Tor is fenced to confine visitors to the beach and a wooden walkway is provided down the cliff slope, though this is in poor repair. In Threecliff Bay eroding dunes have been fenced, marram planted and brushwood laid down to reduce deflation by wind. Parts of this scheme have been effective. Foredune environments are not protected and are heavily trampled.

The cliff plateau is probably grazed by ponies under commoners' rights - droppings were seen but no animals were present at the time of survey.

Pennard

Visitor pressure is severe in many places and attempts at control have not been very effective. Access is mainly from the residential area of Southgate in the east, or by footpath beside the Pennard Pill south from Parkmill. Paths in very poor condition dissect large areas of dune grassland and a wooden walkway around the southwestern corner of the plateau is collapsing. Trampling pressure seems to have initiated small blowouts on the plateau edge. Within the golf course grounds there is little erosion away from paths for public access.

The plateau grasslands are managed as a golf course and considerable areas are mown to provide fairway. Little fertiliser application seems to have been made and the turf is still in good semi-natural condition. Commoners' ponies graze the area and help maintain a low turf of good botanical composition. A small area in the north of the plateau has probably been abandoned for grazing and is rapidly reverting to scrub. Fire is a problem in thick gorse on the southern side of the area.

4. VEGETATION OF OXWICH, NICHOLASTON, PENMAEN AND PENNARD BURROWS

This section contains a general description of the vegetation of Oxwich, Nicholaston, Penmaen and Pennard Burrows. The characteristic species composition of each community is outlined and the mapping legend number and equivalent NVC code(s) are included in brackets. An explanation of the NVC codes can be found in Annex 3 together with further information on the NVC communities, local variations and non-NVC vegetation types. The vegetation map(s) is provided at the end of the report and area data for vegetation types is given in Annex 8.

Strandline

At Pennard there are poorly-developed fragments of strandline above saltmarsh patches beside the Pennard Pill. There is no strandline at Penmaen where it is probably rapidly buried to form a foredune or low mobile dune. At Oxwich and Nicholaston there are fragments in front of low mobile dunes at the mouth of the Nicholaston Pill.

This is a species-rich community dominated by the foredune grass Sand Couch (*Elymus farctus*), and upper saltmarsh grasses Red Fescue (*Festuca rubra*) and Creeping Bent (*Agrostis stolonifera*). There are also additional indicators of strandline, saltmarsh and foredune/mobile dune: Sea Sandwort (*Honkenya peploides*), Spear-leaved Orache (*Atriplex prostrata*), Prickly Saltwort (*Salsola kali*), Sea Beet (*Beta vulgaris maritima*), Rock Sea Lavender (*Limonium binervosum*), Sea Plantain (*Plantago maritima*), Sea Purslane (*Halimione portulacoides*), Marram Grass (*Ammophila arenaria*) and Sea Holly (*Eryngium maritimum*).

This is an intermediate community type which does not fit the NVC. It is mapped as 1 and coded as X1.

Foredune

At Pennard and Penmaen there are two small areas of embryo foredune. These are absent from Nicholaston and Oxwich, perhaps the combined result of trampling and water scour at the foot of the outer dune face. Low embryo foredunes are dominated by Sand Couch (*Elymus farctus*). Additional infrequent species suggest that the sand has buried a strandline: Prickly Saltwort, Spear-leaved Orache, Sea Rocket (*Cakile maritima*), Sea Sandwort and Sea Beet. This is mapped as 2 and the NVC code is SD4.

Far more common at Nicholaston and Oxwich, with a trace at Penmaen, are foredunes which contain both Sand Couch and Marram grass. The strandline indicators above are often present if the foredunes are close to the drift line but higher up the beach additional species suggest mobile dune elements: Sea Holly, Sea Spurge (*Euphorbia paralias*), Evening Primrose (*Oenothera erythrosepala*) and Common Ragwort (*Senecio jacobaea*). This is mapped as 3 and the NVC code is SD6a.

Dune grassland

Between Oxwich and Pennard there is a fine suite of dune grassland types, though many are heavily trampled in areas of path. The grasslands incorporate a contrast between young calcareous types on hindshore and shingle beaches and older acidic types on plateau sand, the latter including a transition to dune heath.

Pennard

The youngest and most mobile grassland (4, NVC SD6d) is located around blowouts in the southwest on the plateau margin. All cases seem to have originated from mobile sand released by path erosion. The community is species-poor and dominated by Marram (*Ammophila arenaria*).

In at least one location on the plateau there is partial stabilisation of mobile dune by a Marram-Red Fescue (*Festuca rubra*) sward with Common Restharrow (*Ononis repens*) - 6 NVC SD7c. There is also one patch just above tide level beside the Pennard Pill.

All other grasslands are fully stable except where eroded by trampling. The most common is 8 - NVC SD8, dominated by Red Fescue and usually with plentiful Lady's Bedstraw (*Galium verum*). Areas in odd corners close to paths used for dog walking are more rank and support False-oat Grass (*Arrhenatherum elatius*), usually without Marram (9 - NVC SD9).

The Type 8 grassland grades northeastwards into a mosaic with Type 10 acidic grassland (NVC SD12), containing Sand Sedge (*Carex arenaria*), Sheep's Fescue (*Festuca ovina*) and Common Bent (*Agrostis capillaris*). This in turn dominates the most eastern parts of this area. Areas of Type 8 and Type 10 grassland are frequently invaded by bracken (*Pteridium aquilinum*).

Penmaen

Young mobile grassland is rare and occurs as a patch in the bay between Great and Little Tor, and in Threecliff Bay. It is species-poor and dominated by Marram (4 - NVC SD6d).

There is no gradual transition through a range of other grassland types as at Pennard. Instead, there is either rank grassland (9 - NVC SD9) with False-oat grass and shrub invasion by Dewberry (*Rubus caesius*) or there is a sharp change to acidic grassland (10 - NVC SD12) with Sand Sedge, Sheep's fescue and Common Bent. The acidic grassland occurs in a mosaic with dune heath and much is invaded by Bracken.

Nicholaston

Grassland is extensive and shows successional features which relate, first, to a westward dune extension which has diverted the Nicholaston Pill and, second, to recovery after severe trampling erosion.

There are no typical species-poor mobile dunes. In the west former foredunes have a dominant cover of Marram and Red Fescue, plus a high moss cover of *Tortula ruralis* ssp. *ruraliformis* (7 - NVC SD7d). Large pockets of this semi-fixed dune type exist in the centre of the system and mark areas recovering from trampling and wind erosion.

A more stable turf (8 - NVC SD8) occupies an irregular belt running northwest - southeast across the centre, with high cover of Red Fescue and Lady's Bedstraw (*Galium verum*). North of this is a more rank turf with Red Fescue and False-oat Grass (9 - NVC SD9). This is heavily invaded by shrubs, including Dewberry and Burnet Rose (*Rosa pimpinellifolia*), and by the herb Bloody Cranesbill (*Geranium sanguineum*).

There are a few small areas of calcicolous grassland on the eastern cliff which show thin patches of sand overlying limestone bedrock.

Oxwich

Mobile dune communities are now comparatively rare, occurring as a few stands of Type 4 (NVC SD6d) grassland and dominated by Marram. Former areas of mobile dune, most related to old parabolic blowout systems, have recolonised with semi-fixed dune communities. The gentler slopes have Type 6 (NVC SD7c) grassland with Red Fescue and Common Restharrow. The steeper slopes (mainly the steep inner faces of old blowouts) have a high moss cover (*Tortula ruralis* ssp. *ruraliformis*) in a sparse Marram - Red Fescue turf (Type 7 - NVC SD7d). There is a large patch of Red Fescue - Lady's Bedstraw grassland in the northwest (8 - NVC SD8) but considerable Bracken and Blackberry (*Rubus fruticosus*) invasion has almost eradicated stable dune grassland in the west of the system.

There is no acidic grassland but transitional leached examples of Type 8 grassland are found in the northwest.

Dune heath

Only Pennard and Penmaen support dune heath.

Pennard

Scattered patches of heath (11 - NVC H11), often developing from acidic grassland (Type 10), are present along the southern and eastern edges of Pennard Golf Course on the cliff plateau. It is dominated by Ling (*Calluna vulgaris*) with a scatter of Sand Sedge (*Carex arenaria*), Bell-heather (*Erica cinerea*), Sheep's Fescue (*Festuca ovina*) and Common Bent (*Agrostis capillaris*). Some stands are invaded by Bracken. There is usually a thick moss mat of *Hypnum cupressiforme*.

Penmaen

Several extensive patches of heath are present on the cliff plateau, often developing from acidic grassland (Type 10). It is dominated by Ling, occasionally also by Bell-heather and Bilberry (*Vaccinium myrtillus*). Most stands are invaded by Bracken and there is a scatter of Sand Sedge, Sheep's Fescue and Sweet Vernal Grass (*Anthoxanthum odoratum*). The moss *Dicranum scoparium* is common and areas with some bare sand are colonised by the moss *Polytrichum piliferum*.

Dune slack

There are no dune slacks at Pennard or Penmaen.

Nicholaston

There is one damp hollow near the dune centre with a canopy of Common Sallow (*Salix cinerea*). It was mapped as slack woodland (23 - NVC W1).

Oxwich

A large number of slacks exists throughout the Oxwich dunes and most are found in hollows left after the passage of dune blowouts. On the north end there are seepage areas where the dune water table runs into brackish saltmarsh to create a rarer slack environment.

Most slacks are dominated by a cover of Creeping Willow (*Salix repens*) and an extensive moss carpet of *Calliergon cuspidatum* (12b, mapped as 12, NVC SD15). This frequently has a carpet of the Marsh Helleborine orchid (*Epipactis palustris*) and a scatter of the uncommon Variegated Horsetail (*Equisetum variegatum*). Occasionally the slack margins have good populations of Round-leaved Wintergreen (*Pyrola rotundifolia*).

At the north end there is a large area of Type 12 and 13 (NVC SD15c) mosaic and in the latter there is a tall-herb community dominated by Fleabane (*Pulicaria dysenterica*) and sizeable quantities of Yorkshire Fog (*Holcus lanatus*), Water Mint (*Mentha aquatica*), Silverweed (*Potentilla anserina*), Sea Rush (*Juncus maritimus*), Creeping Willow and the moss *Calliergon cuspidatum*. At the south end there is a small depression containing a more acidic type of slack (15 - NVC SD17) with large quantities of Common Sedge (*Carex nigra*) and some Silverweed.

Woodland and scrub

A variety of woodland and scrub types are found in all four areas.

There is no Sea Buckthorn (*Hippophae rhamnoides*) scrub in any locality. Other scrub types include Hawthorn (*Crataegus monogyna*) in all four dune areas (25 - NVC W21a), Blackthorn (*Prunus spinosa*) at Pennard (26 - NVC W22) invading woodland fringe and field edges, large areas of Gorse (*Ulex europaeus*) on thin sand over limestone at both Penmaen and Pennard (27 - NVC W23), thick Blackberry (*Rubus fruticosus*) in all sites (28 - NVC W24) and species-poor Bracken (*Pteridium aquilinum*) at Oxwich and Penmaen (29 - W25).

Woodland types are related to moisture status. Damp areas at Oxwich, and one depression at Nicholaston, have Common Sallow (*Salix cinerea*) and often Common Birch (*Betula pubescens*), with Marsh Bedstraw (*Galium palustre*) in the ground layer (23 - NVC W1). Tall Alder (*Alnus glutinosa*) woodland is well-developed at the north end of Oxwich and one large central depression, sometimes with Common Sallow in the sub-canopy, and usually with Yellow Iris (*Iris pseudacorus*) and Marsh Bedstraw in the ground layer. The best stands are developed close to the upper tidal limit and in places Alder is invading saltmarsh. This type of woodland (30 - X2) is unlike NVC descriptions but is probably close to W6 *Alnus glutinosa* - *Urtica dioica* woodland.

Drier ground in the northwest of Oxwich supports woodland (24 - NVC W10c) dominated by Common Oak (*Quercus robur*). Small quantities of Sycamore (*Acer pseudoplatanus*) are found at Nicholaston and Pennard, mainly as young invasive thickets (32 - X4).

Other habitats

There are areas of saltmarsh around the Nicholaston Pill and Pennard Pill which were not surveyed in detail. There is a transition to reed-bed swamp at Oxwich involving Common Reed (*Phragmites australis*). Calcareous grassland patches and steep cliff habitats were not examined.

Recent changes in vegetation

Early air photos are only available for Oxwich and Nicholaston: 7 July 1946 (Welsh Office 106G/UK/1625, 1:12,000) and (north Oxwich only) 14 September 1970 (University of Cambridge RC8 T46-47, 1: 5,700). A comparison with the 1983 survey photography shows the following main changes:

- i. massive dune stabilisation since 1946 when both Oxwich and Nicholaston were more than 50% bare sand and blowouts were very active indeed (possibly the result of military training in 1944). Much stabilisation had been achieved by 1970 and further recovery to 1983 is patchy - some areas show increased vegetation, others are very similar to 1970 quantities;
- ii. massive slack development at Oxwich involving continuous re-vegetation between 1946 and 1983. In many slacks this is clearly a pattern of coalescing circular clumps of Creeping Willow (*Salix repens*);
- iii. tree expansion in the north over wet ground (into slacks and saltmarsh), probably by Common Sallow (*Salix cinerea*), Alder (*Alnus glutinosa*) and Common Birch (*Betula pubescens*);
- iv. southwesterly migration of the Nicholaston Pill (mainly between 1970 and 1983), eroding the northern point of Oxwich but allowing extension at Nicholaston Burrows via foredune development;
- v. a very large increase in footpaths between 1946 and 1970 at Oxwich, with a reduction in number and some path widths between 1970 and 1983 as visitor control took effect;
- vi. loss of elm trees at Oxwich by Dutch elm disease between 1970 and 1983.

In addition to these points it is also probable that there has been a long-term reduction in grazing pressure upon the dune grasslands in all four sites, leading to formation of a rank turf in many places and allowing shrub invasion.

5. RARE PLANTS

The dune slacks at Oxwich are noted as species-rich, with three national rarities: Dune Gentian (*Gentianella uliginosa*), Fen Orchid (*Liparis loeselii*) and Round-leaved Wintergreen (*Pyrola rotundifolia*). The latter species was plentiful at the time of survey.

6. SITE ASSESSMENT

Taken together, or as individual sites, the dunes at Oxwich, Nicholaston, Penmaen and Pennard are very important because they represent a large area with a diverse range of natural and semi-natural types of habitat. Contrasting geomorphology is a major feature of the four sites, with bay/cliff/plateau dune at Penmaen/Pennard, hindshore dune and slack at Oxwich, and elements of both at Nicholaston. There is a very complete range of community types, including actively accreting foredunes (mainly at Nicholaston), a range of mobile - semi-fixed - fixed dunes including good examples of acidic grassland and dune heath at Penmaen/Pennard. The slacks at Oxwich are of excellent quality.

There are problems affecting site quality. Visitor pressure to all sites is very high but control measures are proving effective at all locations except Pennard where path erosion on the west-facing cliff is severe. There has been a large loss of acidic grassland and heath to golf course at Pennard. Reduced grazing over a long time period, probably in all sites but especially at Oxwich and Nicholaston, has led to rank grassland, to shrub and tree expansion into dune grassland and slack, and perhaps to bracken invasion. Attempts to control these changes at Oxwich have so far been only partly successful.

7. COMMENTS AND SUGGESTIONS

The present survey has confirmed that all sites retain high-quality dune vegetation. Present management is coping well with severe numbers of visitors except at Pennard where rapid attention is needed to combat severe path erosion. Further work on bracken control and improving grazing (or simulating it by mowing) is needed in the short to medium term.

ANNEX 1

METHODS

AERIAL PHOTOGRAPHY

Air photos were used for field navigation and vegetation mapping in all but one site. The following material was supplied or purchased:

Crymlyn Burrows	Cambridge University RC8K 27 May 1987 Colour (poor quality) c. 1:6000 Prints 88-92, 97-105, 121-125
Black Pill to Bryn Mill	None available - field positioning and mapping done by pacing in relation to features on 1:10000 OS map.
Pennard and Penmaen	Hunting Surveys HSL UK 86 023 19 March 1986 Panchromatic (excellent quality) c. 1:5000 Run 17 Prints 2563-2566 Run 18 Prints 2478-2482
Oxwich and Nicholaston	Cambridge University RC8KW 20 June 1983 Colour (fair quality) c. 1:5000 Prints 201-207, 209-213 (212 missing), 218-222.
Port-Eynon to Horton	Cambridge University RC8DA 26 June 1979 Panchromatic (good quality) c. 1:10000 Prints 268-270
Hillend to Whitford	MAFF/ADAS Hasselblad 7 May 1989 Colour (good quality) c. 1:10000 Run 89-18 Prints 43-51, 66-68 Run 89-27 Prints 08-09
Pembrey Coast	MAFF/ADAS 15 June 1986 Panchromatic (excellent quality) c. 1:11000 Film 291 Prints 24-36, 86-98, 157-8

FIELD SURVEY

All major types of vegetation at each site were located by a rapid reconnaissance. Each type was then visited and a visually homogeneous stand was picked out. Vegetation was recorded within 2m x 2m (strand, dune grassland, dune slack, dune heath), 5m x 5m (scrub) and 10m x 10m (woodland) quadrats. The quadrat position and number was located precisely on an acetate overlay fixed to air photos.

The recommended procedure for the National Vegetation Classification (NVC) was followed as often as possible. Most dune vegetation types in each site were recorded with a minimum of five quadrats. Transitional habitats to saltmarsh, swamp and scrub/woodland were sampled less intensively.

Each quadrat was recorded on a standard record sheet (see Annex 2) which incorporated species and special variable number codes for use in later rapid computer data entry. All vascular plants, bryophytes and lichens in a quadrat were recorded on the Domin cover/abundance scale, together with community structure data (strata height and cover). Occasional soil samples (0-10 cm) were collected for most vegetation types and were then air dried prior to pH analysis.

Target notes (see Annex 6) were used for several purposes:

- a. To note particular features;
- b. To comment on land use;
- c. To supplement quadrat records.

Target note positions were also marked in the field upon air photo overlays. Less emphasis was placed on these notes than in other National Sand Dune Survey studies because quadrat data was more intensive in this case.

A total of 640 quadrats was achieved for all sites, numbered as follows:

Crymlyn Burrows	1 - 146
Black Pill to Bryn Mill	147 - 169
Tywyn (Pembrey Coast)	170 - 271
Pembrey Burrows	272 - 347
Pembrey Country Park and Pembrey Forest	348 - 354, 627 - 640
Port-Eynon to Horton	355 - 390
Whiteford Burrows	391 - 468
Nicholaston Burrows	469 - 495
Penmaen Burrows	496 - 522
Oxwich Burrows	523 - 565
Pennard Burrows	566 - 596
Hillend and Llangennith Burrows	597 - 626

Access problems prevented any quadrat collection from Broughton, Delvid and Hills Tor Burrows. In traversing sites obvious vegetation boundaries were marked on air photo overlays and simple codes were marked for vegetation types, both to aid later photo-interpretation. Survey took place in two phases: June/early July and August/early September.

ANALYSIS

Quadrat records were entered into an IBM-XT compatible microcomputer using the RECORD program in the VESPAN2 suite devised by Andrew Malloch of Lancaster University.

An initial classification of all quadrats using the TWINSpan program enabled the clear separation of samples into three sub-sets: strand, dry dune and transitions; wet dune and transitions; scrub, woodland and transitions. Each sub-set of quadrats was then classified by TWINSpan to produce end groups of samples. Each end group was listed in full using the TABLE program to detail all quadrats and species.

These tables enabled a comparison with the keys, tables and descriptions of vegetation types in the various NVC chapters. In many cases there was a direct correspondence with an NVC community, but often not to sub-community level. Some non-NVC groups were found and required separate description. More importantly, the classifications were not perfect and several NVC vegetation types (notably swamp, scrub and woodland transitions represented by low quadrat totals) were scattered amongst other end groups. Once recognised these community samples were aggregated using the SELECT program in VESPAN2.

Several dune vegetation types with large quadrat totals had distinct non-NVC sub-groups and these were described as variants of the NVC community. This important scale of variability is covered under PROBLEMS (see below).

MAP PREPARATION

Following analysis and the recognition of vegetation types, a set of mapping units was created (see vegetation legend sheet in map pocket). For Black Pill to Bryn Mill those mapping units present were marked with approximate boundaries upon a 1:10000 OS map, given that air photos were not available. For all other sites fresh acetate overlays were mounted over field overlays and air photos. The mapping units were then marked on the top overlay using an Old Delft Scanning Mirror Stereoscope to position boundaries. In areas of small-scale rapid transition between communities (usually due to microtopography in slacks and around old small blowouts) the communities were mapped as a mosaic.

Features marked on 1:10000 OS maps were also accurately marked. The top overlay was then removed and OS map features were used to reproduce the photo-map at c. 1:7500 using a Zeiss Sketchmaster. All 1:7500 maps were then mosaiced and drawn as a final vegetation map on Permatrace at c. 1:7500 scale. This was then reduced to 1:10000 on an accurate zoom photocopier for reproduction on A3 paper.

A total of 14 final maps was involved. The legend was too lengthy to reproduce on each map and it is presented separately on A4 sheets in the map pocket of site reports.

AREA MEASUREMENT

One copy of each vegetation map was carefully dissected by cutting around vegetation boundaries with fine scissors. Excised polygons were aggregated into map units and weighed on an accurate balance. The weights were converted to area (hectares) using the known paper weight of a 1 km square (100 ha). Mosaic types had the area allocated equally between component types.

GENERAL INFORMATION

Additional information on sites was obtained from SSSI site descriptions (if an SSSI), discussions with regional staff of NCC and the National Trust, and by consulting reports held at the Oxwich Information Centre.

PROBLEMS

1. **Access** No permission was sought for the Broughton area due to local difficulties. This led to no quadrat recording but the area was visited by public footpaths and reasonable mapping was achieved.
2. **Photo availability** Stereoscopic cover of several sites was not available during survey. Additional cover was purchased for the Pembrey Coast and Pennard-Penmaen. Some cover for Oxwich-Nicholaston was out on loan and was returned late despite repeated requests from local NCC staff. This lack of stereoscopy prevented more emphasis on field boundary identification and slowed down accurate field navigation.
3. **Nomenclature** NVC dune community types and nomenclature changed in the course of survey. Details of the revision (new nomenclature and floristic tables, but no information on slacks) were received between the two field survey periods and required some revision of the first phase results, plus a little re-survey. Detailed descriptions (but only nomenclature and floristic tables for slack types) were received as an NVC strand/dune chapter in November 1989. A wholesale revision of slack types had taken place, to the extent that field mapping could not in most cases be accurately assigned to new units. To make matters worse, the computer groupings of slack communities in this survey did not closely agree with new or old types. All mapping of slack communities should therefore be regarded as very approximate.

4. NVC Community variability Several dune communities, notably *Festuca rubra* - *Galium verum* dune grassland and most slack types, were thoroughly sampled with a large number of quadrats. Classification produced distinct sub-types but these were not readily assigned to NVC sub-communities. The problem lies in continuous variation which is dissected in a parsimonious manner by TWINSpan analysis, both for this quadrat data set and for the more comprehensive set (in a geographical sense) on which NVC types are based.

The solution (i.e. extraction of readily-recognised and spatially recurrent vegetation types) can probably only come from a more rigorous analysis using ordination (to handle continuity) and sound interpretative methods to link continuous variation in several dimensions (succession, habitat gradients, geographical trends), e.g. seriation or canonical correspondence analysis. This was beyond the scope of this study but would be a very desirable feature of the complete national survey.

ANNEX 2

FIELD RECORDING SHEET

The sheet below is a reduced-size version of that used in the field. Space at the top and bottom was used for the field notes and listing of species not covered in the printed table. The NVC codes for species and special variables are present to aid rapid computer entry after fieldwork.

SITE

DUNE SURVEY SHEET

Tree hite 9	Shrb hite 10	Herb hite 11	Moss hite 12	Bare grnd 22
Tree covr 13	Shrb covr 14	Herb covr 15	Moss covr 16	
Achi mill 104	Achi ptar 105	Agro capi 123	Agro stol 122	Aira cary 124
Aira prae 125	Alnu glut 153	Alth offi 2656	Anac aren 159	Anac pyra 160
Anag tene 163	Anth odor 171	Anth vuln 174	Aren serp 194	Arac nari 195
Arrh elat 197	Atri hast 217	Atri laci 218	Atri patu 220	Aven prat 655
Aven pube 656	Bell pere 230	Beta vulg 2801	Caki marit 268	Call vulg 278
Caly sold 283	Camp rotu 288	Card prat 295	Care aren 304	Care flac 323
Care nigr 333	Care pani 339	Carl vulg 362	Cent eryt 373	Cera diff 381
Cera font 384	Cera seni 385	Cirs arve 415	Cirs vulg 419	Coch dani 425
Coch offi 427	Cory cane 3075	Crep capi 447	Crit nari 452	Cyti scop 1193
Dact glom 465	Dact inca 467	Dact naja 2828	Dant decu 1249	Dauc caro 475
Desc cesp 477	Desc flex 478	Eleo palu 509	Elya farc 116	Elya pycn 117
Elya repe 118	Epil angu 391	Epip palu 531	Equi arve 532	Equi hyes 534
Equi palu 535	Equi vari 539	Erig acer 543	Erio lati 547	Erod cicu 549
Erop vern 552	Eryn nari 555	Euph offi 568	Euph para 565	Euph port 567
Fest ovin 574	Fest rubr 576	Fili ulma 583	Gali apar 605	Gali palu 609
Gali veru 613	Gent ulig 3052	Glau flav 635	Glau nari 636	Hera spho 661
Hier pilo 965	Hippo rham 678	Hole lana 680	Honk pepl 682	Horn petr 686
Hydr vulg 690	Hypo glab 704	Hypo radi 706	Iris pseu 715	Junc acut 720
Junc arti 722	Junc bufo 725	Junc bulb 726	Junc gera 732	Junc nari 734
Junc squa 736	Koel sacr 746	Leon autu 768	Leon tara 770	Lepi lati 3702
Lino bine 778	Linu cath 786	Lipa loes 3074	Lotu corn 800	Lotu ulig 802
Luzu camp 807	Lych flos 813	Lyco euro 823	Matr nari 1355	Matt sinu 841
Medi lupu 844	Ment aqua 855	Mibo mini 3183	Myos arve 884	Oena lach 911
Oeno bien 912	Onon repe 914	Ophr apif 918	Orob aino 928	Pedi palu 946
Phle aren 958	Phru aust 961	Plan coro 972	Plan lanc 973	Plan nari 975
Poa prat 988	Poa triv 990	Poly oys 1010	Poly vulg 995	Popu trem 1022
Pole anse 1043	Prun vulg 1059	Pter aqui 1066	Puli dyse 1069	Pyro rotu 1073
Ranu acri 1081	Ranu flae 1089	Ranu repe 1095	Rhin aino 1106	Rubu frut 1136
Rue acet 1139	Rue cris 1143	Rue ella 1140	Rue nari 1146	Sagi proc 1158
Sali repe 1179	Sals kali 1184	Samb nigr 1187	Samo vale 1189	Scir nari 1213
Scir seta 1214	Sedu acre 1225	Sene jaco 1239	Sene vulg 1243	Sile conl 3235
Sile vulg 1259	Sola dule 1268	Soli virg 1270	Sonc arve 1271	Sonc aspe 1272
Stel acdi 1298	Tara offi 2982	Tees nudi 1320	Teuc scor 1321	Thym prae 1333
Trif camp 1342	Trif dubi 1343	Trif prat 1349	Trif repe 1350	Trig nari 1353
Trig palu 1354	Ulex euro 1363	Vero cham 1396	Vero offi 1401	Vici sati 2707
Viol cani 1422	Viol rivi 1429	Viol tric 1432	Vulp fasc 1434	
Brac albi 1510	Brac rula 1519	Bryu algo 1545	Bryun sp. 2807	Call cusp 1445
Camp stel 1571	Cera purp 1586	Clad arbu 2340	Clad furc 2362	Clad rang 2381
Clin dend 1593	Corn acul 2410	Dicr scop 1638	Eury prae 1677	Homa lule 1562
Hypn cuor 1766	Hypo phys 2416	Loph bide 2167	Pelt cani 2486	Plag undu 1807
Poly pili 1897	Pseu puru 1914	Rhyt squa 1940	Rhyt triq 1941	Tort rura 2023

ANNEX 3

VEGETATION TYPES

This section contains a description of each vegetation type (NVC and non-NVC) found in this survey of South Wales dunes. Some types may not be present in this site - see Annex 4 and the vegetation map(s) for details of community presence. The account includes variants of NVC dune communities which do not correspond with NVC sub-community types. Particular features of sites are given in some descriptions.

The account is partly based on the relevant chapters of the NVC written by John Rodwell. The codes mainly relate to the different NVC chapters as follows:

- SD Shingle, strandline and sand-dune communities
- S Swamps and tall-herb fens
- SM Saltmarsh communities
- W Woodland and scrubs
- H Heaths
- X Non-NVC or transition types identified in this survey.

One other chapter, mesotrophic grasslands (MG), was not consulted and cases were only mapped in terms of principal dominant (*Arrhenatherum elatius* or *Lolium perenne*).

Most emphasis is placed on SD communities and other vegetation descriptions are abbreviated, reflecting less-intensive quadrat sampling.

1 X1 Dry foredune/saltmarsh/strandline transition community

Strandline vegetation is normally found at the extreme high water mark where washed-up debris becomes buried by blown sand. The normal strandline community within the NVC (SD2 *Honkenya peploides* - *Cakile maritima* strandline) was not found in this survey.

Instead, on exposed shores, the strandline is rapidly buried and a foredune environment persists (see 2 SD4 *Elymus farctus* foredune community). In sheltered environments, to leeward of cusped spits, there is this distinct species-rich strandline transition. The species combination involves a mix of foredune (*Elymus farctus*), saltmarsh (*Festuca rubra*, *Agrostis stolonifera*, *Limonium binervosum*) and strandline (*Honkenya peploides*, *Atriplex prostrata*) indicators. *Cakile maritima* is rare in this environment. Unlike SD2 it is dominated by perennials and it is probably more persistent and less variable than the usual strandline community.

It grades upwards in wet areas to young salt-influenced slacks (see 12(a) SD14c *Salix repens* - *Campylum stellatum* dune slack, *Bryum pseudotriquetrum* - *Aneura pinguis* sub-community) and to a variety of dune grassland types in dry zonations. Downslope it usually grades into SM24 *Elymus pycnanthus* saltmarsh.

As a community type it perhaps deserves recognition in any revised NVC classification of strandline environments. In this survey it was repeatedly found in suitable locations at Crymlyn Burrows, Tywyn (Pembrey Coast) and Pembrey Burrows.

2 SD4 *Elymus farctus* foredune community

Elymus farctus normally dominates this community which is species-poor. Strandline species (notably *Salsola kali*, *Atriplex prostrata*, *Cakile maritima* and *Honkenya peploides*) are also frequent and suggest that in many localities these low dunes are ephemeral summer features forming on the drift line, usually extending by movement a short distance upslope. They are probably destroyed in autumn and winter storms.

In more sheltered locations, particularly at Crymlyn and Pembrey Burrows, the community is persistent and forms the initial phase of sand colonisation which then leads on to a rapid classic psammose via SD6 *Ammophila arenaria* dune. At Pembrey Burrows there has been a recent increase in sand supply (probably from dune erosion in the centre of the Pembrey Coast system) and there has been a very large increase in this community since aerial photography in 1986. The foredunes even extend well downslope into saltmarsh and can include *Puccinellia maritima* and other saline indicators in the species list, though these are rare.

3 SD6a *Ammophila arenaria* mobile dune community *Elymus farctus* sub-community

This type of mobile dune community normally occurs closest to the sea. It is very open (70% bare sand) and usually has only *Ammophila arenaria* and *Elymus farctus* as dominants. Two variants (3v1, 3v2) were recognised after analysis. These show gradation within the sub-community which itself grades downbeach into SD4 and, upwards, into SD6d *Ammophila arenaria* mobile dune, Typical sub-community.

3v1 variant This is usually located above the position of the strandline and often contains *Eryngium maritimum* and *Euphorbia paralias*.

3v2 variant This is usually located on the position of the strandline and often contains strand indicators (*Salsola kali*, *Cakile maritima*, *Rumex crispus* and *Beta vulgaris maritima*). It is more species-rich than 3v1.

4 SD6d *Ammophila arenaria* mobile dune community Typical sub-community

This community has a high cover of *Ammophila arenaria* (Marram) and occurs in areas that have a very high rate of sand deposition, in part the effect of the grass itself in modifying windflow to induce sand burial through which it then grows, often in profusion. Areas recently planted with Marram look very similar to this natural community.

In many British systems the community is very species-poor but in this survey there are reasonable numbers of additional species in most samples. Only one monodominant sample (quadrat 270 at Tywyn) was recorded. This enhanced diversity suggests that sand accumulation rates in the South Wales area are lower than normal, allowing invasion by annuals and suitable perennials.

5 SD6e *Ammophila arenaria* mobile dune community *Festuca rubra* sub-community

Festuca rubra normally forms an open understorey beneath Marram in this sub-community. Sand accumulation is low but still significant, producing vegetation which is still species-poor.

As a mapping unit this community is not very extensive and is best developed on dunes with heavy recreational impact, as at Crymlyn, Black Pill, Port-Eynon and Hillend/Broughton. Trampling, sand burial and litter may make this type more nitrogen-rich than usual, allowing enhanced species diversity compared to the NVC description.

Floristic composition suggests that this vegetation is part of a gradation from SD6a and SD6d to SD7c *Ammophila arenaria* - *Festuca rubra* semi-fixed dune community (*Ononis repens* sub-community). Shrubs can invade (notably *Rubus caesius*) and, at Black Pill, *Populus tremula*.

6 SD7c *Ammophila arenaria* - *Festuca rubra* semi-fixed
dune community
Ononis repens sub-community

These dunes are usually dominated in Britain by Marram, plus substantial amounts of *Festuca rubra* and *Ononis repens*. Reduced sand deposition compared to other communities to seaward enables high vegetation cover and the start of dune stabilisation.

This vegetation type is very extensive in the dunes of this study and it is possible to recognise four variants (6v1-4).

6v1 variant *Ononis repens* is less common (frequency class III) and is often replaced by an alternative legume (*Anthyllis vulneraria* or *Lotus corniculatus*). Small gaps in the turf are frequent and these are often occupied by winter annuals (*Phleum arenarium*, *Sedum acre*, *Arenaria serpyllifolia*). This is the dominant type at Crymlyn Burrows and is transitional from SD6c to SD7d (*Tortula ruralis* ssp. *ruraliformis* sub-community).

6v2 variant *Ononis repens* is very common and achieves a reasonable cover. Other species suggest this is a community of damper ground (hollows and slack margins, especially at Crymlyn), with *Holcus lanatus* and *Agrostis stolonifera* the main moisture indicators. Mesic conditions in some stands may be created by shading from *Rubus fruticosus* agg..

6v3 variant This is the most typical form found, with high cover and a tall sward being invaded by *Rubus caesius*, *R. fruticosus* agg. or *Arrhenatherum elatius*. These successional transitions to shrub or mesotrophic grassland seem in part due to a lack of grazing in most large dune systems.

6v4 variant This is a small quadrat set which is difficult to interpret and may represent rather heterogeneous conditions. It is species-rich and this vegetation is either trampled dune being invaded by *Rubus caesius* (at Oxwich and Hillend), or is developed on thin sand over limestone on cliffs at Pennard.

The extensive quantities of type 6-SD7c vegetation reflect in part the rapid stabilisation of mobile dunes (and perhaps even foredunes at Crymlyn and Pembrey Burrows) which tend to be low in height and inextensive. In addition their extent shows stabilisation of dune systems with extensive parabolic dune blowouts which were recently mobile (Oxwich, Whiteford).

7 SD7d *Ammophila arenaria* - *Festuca rubra* semi-fixed
dune community
Tortula ruralis ssp. *ruraliformis*
sub-community

The usual characteristics of this community in Britain are similar to 6-SD7c: abundant Marram and frequent *Festuca rubra* and *Ononis repens*. It is normally distinguished from SD7c by common *Hieracium pilosella* agg., several species of annual, and often an abundant moss carpet of *Tortula ruralis* ssp. *ruraliformis*. Many of these features are found in South Wales dunes but there are local differences because *Festuca rubra* is comparatively rare and *H. pilosella* has a very weak presence. Winter annuals are a prominent component, especially *Phleum arenarium*, *Arenaria serpyllifolia*, *Cerastium diffusum diffusum*, *Vulpia fasciculata*, *Sedum acre* and *Aira praecox*. More rarely *Viola tricolor*, *Cerastium semidecandrum*, *Arabis hirsuta* and *Desmazeria rigida* can be found.

The community is very common in several locations, colonising SD6 mobile dunes either near actively extending foreshores (Crymlyn, Nicholaston, Tywyn) or on the steep slopes and flanks of vegetated blowouts (Oxwich, Llangennith/Broughton). It is rare at Pembrey Burrows, suggesting that dune orientation in that system is sheltered, not creating the sand burial rates which favour this community. It is very rare at Penmaen and Pennard, occurring only as very isolated and small coverage on thin sandy rendzinas overlying limestone. It was not mapped in these two latter places.

8 SD8 *Festuca rubra* - *Galium verum* fixed dune
community
No clear NVC sub-community

This community in Britain usually consists of a closed sward made up of grasses, dicotyledons and mosses. Marram may be only occasional and often lacks vigour. There is very little sand accumulation and the first signs of leaching impact are often found here in terms of indicators of soil acidity.

There are three potential sub-communities likely to be found in South Wales but none can be proposed with confidence. Instead, five variants can be recognised and related to local succession and moisture conditions. The absence of clear sub-communities is probably the result of no intensive grazing, a finding in studies elsewhere in Britain.

8v1 variant Marram and *Festuca rubra* are dominant, with appreciable quantities of the moss *Homalothecium lutescens* in the turf. *Ononis repens* and *Galium verum* are fairly common (frequency class III) and the variant is probably an early SD8 type emerging in succession from 7-SD7c.

8v2 variant There is little Marram and most cover is contributed by *Festuca rubra* and the moss *Homalothecium lutescens*. There is virtually no *Ononis repens*, *Galium verum* is infrequent and early leaching indicators are quite common (the moss *Dicranum scoparium* and the lichens *Cladonia rangiformis* and *C. impexa*). Soil samples had some of the lowest pH values of SD8 samples. It is probably the oldest SD8 grassland type, grading into 10-SD12 *Carex arenaria* - *Festuca ovina* - *Agrostis capillaris* grassland over time.

8v3 variant Both Marram and *Festuca rubra* are frequent but *Galium verum* is low (class II) in frequency. There is a high moss cover involving pleurocarps (*Homalothecium lutescens* and *Eurynchium praelongum*) and the acrocarp *Dicranum scoparium* to suggest a trend towards acidity. A large proportion of quadrats also shows shrub invasion by *Rubus caesius*. The high frequency of *Holcus lanatus* (class IV) suggests that moisture is an important determinant of the variant.

8v4 variant This is closest to the SD8a Typical sub-community and many quadrats did show signs of close rabbit grazing. It has abundant *Festuca rubra* and *Galium verum*, with plentiful *Plantago lanceolata*. There are, however, significant quantities of shrubs (notably *Rosa pimpinellifolia* and *Rubus caesius*) and other indicators of shading and invasion (*Pteridium aquilinum*, *Geranium sanguineum*). These suggest a former SD8a community in early transition towards scrub, probably following a relaxation in grazing pressure.

8v5 variant This variant is a more extreme form of 8v4. There is a high degree of invasion by *Pteridium aquilinum* and species typical of early scrub and rank growth: *Geranium sanguineum*, *Rubus caesius* and *Rosa pimpinellifolia*. This community is particularly common between Port-Eynon and Horton where there are a few more nitrophilous species to suggest trampling and dog-walking effects.

9 SD9 *Ammophila arenaria* - *Arrhenatherum elatius*
dune grassland
No clear NVC sub-community

In Britain this community is found on less-heavily grazed stretches of fixed calcareous dune systems. There is no clear fit with NVC sub-communities because Marram is rare in variant 9v1 and infrequent in 9v2. The species composition of the two variants suggests that the community is seral in character and that it is undergoing rapid change towards scrub development.

9v1 variant *Arrhenatherum elatius* is relatively infrequent in a rank *Festuca rubra* and *Holcus lanatus* sward which contains large quantities of *Rubus caesius*. There are reasonable quantities of both *Ononis repens* and *Galium verum*, suggesting that the community has developed rapidly from SD7 and SD8 categories. The high quantity of *Holcus lanatus* and occasional presence of *Salix repens* suggest that moist conditions may be a characteristic of sites which have also had a relaxation in grazing.

9v2 variant This variant shows a more advanced stage of scrub development in SD9 communities. There is both a tree and shrub presence in many samples, with quadrats located in a grassland/scrub mosaic at the rear of several systems (notably Crymlyn Burrows, Black Pill, Hillend/Broughton, Pembrey Burrows).

Where both variants occur in a single system, 9v1 tends to be more seaward suggesting the community is currently extending towards younger dune grassland types.

This grassland is typical of grazed acidic sands in Britain and in systems which are initially calcareous it is found on older dunes where leaching has been effective. The rear of most South Wales dune systems, where such swards are likely, has been highly altered in most cases (often to provide golf courses). Reasonable examples of the community type can be found in the fringes of rough around fairways, notably at Crymlyn and Pennard Burrows (the latter system is also grazed by ponies). Further pony grazing by ponies at Penmaen probably also helps maintain the community. Elsewhere the dune systems are either too young or lack of grazing has allowed SD9 rank near-mesotrophic grassland to develop.

There is no very close agreement with NVC sub-communities but two local variants can be recognised.

10v1 variant This resembles in part the SD12a *Anthoxanthum odoratum* sub-community but lacks Marram and shows early bracken invasion. There is also floristic evidence of sufficient leaching to allow heath indicators (e.g. *Calluna vulgaris*) into the sward.

10v2 variant This is bracken-invaded and much more species-poor as a result of shading and litter accumulation. It is restricted to leached acidic sands on the cliff tops at Penmaen and Pennard. As in 9v1 there is strong floristic evidence of a trend towards heath vegetation.

Some good examples of heath developed on sand were found but in general these were rare. Communities with *Calluna vulgaris* dominant (and, less commonly, *Erica cinerea* and *Vaccinium myrtillus*) are restricted to leached sands banked against the old seacliff at the rear of Crymlyn Burrows, and to the thinner sands deposited on top of cliffs at Penmaen and Pennard. At Crymlyn the community grades into normal H10 *Calluna vulgaris* - *Erica cinerea* heath on the top of the cliff as the sand rapidly thins.

SLACK COMMUNITIES

Low-lying areas under the influence of the dune water table (slacks) are usually markedly different from dry dune grasslands. A major revision in NVC slack types took place after field mapping (though description of the new types was not provided). Computer analysis of quadrat data found end groups which did not closely fit old or new NVC classifications (see Annex 1 - Problems). The five quadrat groupings (12a, 12b, 13, 14, 15) are therefore presented as a series with what are probably their closest types in the revised NVC system of November 1989. The fit is far from perfect and all slack classification must be considered approximate.

12a SD14c *Salix repens* - *Campylium stellatum* dune slack
Bryum pseudotriquetrum - *Aneura pinguis*
sub-community

This community probably represents young slacks formed by the enclosure of depressions by spit extension (as at Tywyn) or in deflation hollows left after the passage of a parabolic dune blowout (north Whiteford). There is a slight saline influence at Tywyn shown by the low frequency of *Glaux maritima*. The community has patches of bare ground and *Salix repens* often shows a pattern of small circular and coalescing colonies, a feature of early succession. The community is very rich in species.

12b SD15a/b *Salix repens* - *Calliergon cuspidatum* dune slack
Carex nigra sub-community (a)
Equisetum variegatum sub-community (b)

There is abundant *Salix repens* over a carpet of *Hydrocotyle vulgaris* and the moss *Calliergon cuspidatum*. *Equisetum hyemale* is very common in this turf and orchids (commonly *Epipactis palustris* and *Dactylorhiza majalis*) are abundant. There is still a saline element in some slacks, shown by *Juncus maritimus*, *J. acutus* and *Oenanthe lachenalii*.

13 SD15c *Salix repens* - *Calliergon cuspidatum* dune slack
Carex flacca - *Pulicaria dysenterica*
sub-community

This slack community is one of the most distinctive due to the prominence of tall herbs, with much *Juncus maritimus*, *Pulicaria dysenterica*, *Eupatorium cannabinum*, *Filipendula ulmaria*, *Lotus uliginosus* and *Lychnis flos-cuculi*. It often features the start of slack woodland by *Salix cinerea* and *Alnus glutinosa* at Tywyn. At Whiteford it is very extensive on the eastern side, grading into saltmarsh. It seems to prefer steeper slack gradients and may reflect lateral subsurface water flow.

14 SD16a/b *Salix repens* - *Holcus lanatus* dune slack
Ononis repens sub-community (a)
Rubus caesius sub-community (b)

14 SD16c/d *Salix repens* - *Holcus lanatus* dune slack
Prunella vulgaris - *Equisetum variegatum*
sub-community (c)
Agrostis stolonifera sub-community (d)

A heterogeneous set of slack and slack transition habitats is represented in this group. The topographic differences within the quadrat set are not clearly distinguished by species composition which overall suggest relatively dry slack conditions. Three main types of topography are involved:

- drier slack margins receiving sand input from adjacent dunes (common at Whiteford in western slacks).
- clustered large hummocks ('hedgehogs') up to 2m high and 4-5m in diameter, usually with a strong cover of *Salix repens*. These are believed to be due to dune building controlled by upward growth by *Salix* in areas suffering sand burial in the past. These are present at Pembrey Burrows and Whiteford.
- a transition involving damp grassland at Tywyn which runs for much of the length of the dune system along its eastern side.

15 SD17 *Potentilla anserina* - *Carex nigra* dune slack
No clear NVC sub-community

This slack type is the least common in samples and in Britain is believed to be older and less calcareous than others. *Carex nigra* is usually a prominent feature but only *Mentha aquatica* is consistently present. Other species offer few clues to more precise habitat or successional relationships.

SALTMARSH

- 16 SM18b *Juncus maritimus* saltmarsh
Oenanthe lachenalii sub-community

This is common at Crymlyn, Oxwich (unsampled), Whiteford and Tywyn. It represents the highest saltmarsh community in areas which are also flushed by fresh and brackish water draining from dune slacks. It grades upwards into 13-SD15c dune slack, especially at Whiteford.

- 17 SM24 *Elymus pycnanthus* saltmarsh

This was noted (but not accurately mapped in terms of full extent) at Crymlyn, Pennard (very restricted), Oxwich-Nicholaston (not recorded), Whiteford, Pembrey and Tywyn. It represents the highest saltmarsh community in areas which are reasonably dry and uninfluenced by slack water. It also contains strandline indicators.

SWAMP COMMUNITIES

- 18 S4a *Phragmites australis* swamp and reed-beds
Phragmites australis sub-community

This tall reed-bed community is present in restricted quantity at Crymlyn Burrows and is abundant at Oxwich. Grazing by ponies at Whiteford has probably excluded it as a component of the wet eastern transition from slack to wet saltmarsh.

- 19 S4d *Phragmites australis* swamp and reed-beds
Atriplex hastata sub-community

- 19 S21b *Scirpus maritimus* swamp
Atriplex hastata sub-community

The sheltered strandline at Pembrey Burrows above saltmarsh is the only mapped location for a *Phragmites australis* - *Scirpus maritimus* mosaic (hence the presence of *Atriplex prostratus* and *Elymus pycnanthus*). Discharges from an adjacent sewage outfall pipe probably helps explain the thick growth in this area and the absence of these types from equivalent positions in other parts of the Pembrey Burrows marsh.

- 20 S12b *Typha latifolia* swamp
Mentha aquatica sub-community

This is rather restricted. At Whiteford it is found in a concentrated zone of flushing below a large slack on the transition to saltmarsh. At Tywyn it is found in two man-made slacks adjacent to targets, the sand having been excavated to provide a raised surface for the target zone. A reasonable aquatic flora (including *Chara* sp.) is developing in these excavated hollows.

SCRUB AND WOODLAND COMMUNITIES

- 21 SD18a *Hippophae rhamnoides* scrub
Festuca rubra sub-community

This sub-community did not appear as an end-group in computer analysis and was obtained by selecting all quadrats containing *Hippophae rhamnoides* and then rejecting those belonging to the 22-SD18b set. This vegetation type represents the early stage of dune scrub invasion, most cases coming from the Pembrey Coast where this process is very frequent. Associated species suggest that 4-SD6d, 5-SD6e and 7-SD7d are the initial invaded communities. This is clear in Pembrey Coast vegetation maps.

- 22 SD18b *Hippophae rhamnoides* scrub
Urtica dioica - *Arrhenatherum elatius*
sub-community

In this community *Hippophae rhamnoides* is the major dominant. Shading and excreta from birds feeding on berries helps produce a flora characteristic of soils enriched with nitrogen and phosphorus (e.g. *Urtica dioica*, *Galium aparine*). *Sambucus nigra* is occasional and suggests shrub diversification is taking place in larger and older stands. The sub-community is not fully typical of the NVC because *Arrhenatherum elatius* is rare.

- 23 W1 *Salix cinerea* - *Galium palustre* woodland

This community is dominated by *Betula pubescens*, with reasonable quantities of *Salix cinerea* in places. *Galium palustre* and *Iris pseudacorus* are consistently present. All small thickets of *Salix cinerea* were mapped as this category and a reasonable number of quadrats were recorded for this type. However, only seven quadrats formed this clear end-group. A larger number was scattered in various slack end-groups (especially 13), suggesting that such willow scrub is recent and that it has not developed a very distinct flora. Some stands of *Salix cinerea* showed signs of sand burial, notably at Llangennith and Whiteford.

- 24 W10c *Quercus robur* - *Pteridium aquilinum* -
Rubus fruticosus agg. woodland
Hedera helix sub-community

This community is dominated by *Quercus robur* and has a scattered tall-shrub understorey of *Crataegus monogyna* over a floor often dominated by *Rubus fruticosus* agg. Shading is effective and there is little *Pteridium aquilinum*. This category was not an end-group in analysis and was obtained by selection of high-cover *Quercus robur* stands. Only five such stands were found, scattered in end-groups representing well-developed scrub.

- 25 W21a *Crataegus monogyna* - *Hedera helix* scrub
Hedera helix - *Urtica dioica* sub-community

This is the commonest form of non-*Hippophae* scrub quadrat recorded in survey and shows active succession. The tall shrub or tree component rarely forms a continuous canopy and thick *Rubus fruticosus* agg. is the most consistent woody species present. A mix of trees and tall shrubs is present in the group in addition to *Crataegus*: *Quercus robur*, *Prunus spinosa*, *Acer pseudoplatanus*, *Fraxinus excelsior*, *Corylus avellana*, *Pinus nigra*. It seems a clear precursor to a variety of woodland types.

- 26 W22 *Prunus spinosa* - *Rubus fruticosus* agg. scrub
No clear NVC sub-community

A small number of samples was dominated by *Prunus spinosa* but these quadrats were scattered amongst scrub end-groups (especially 25-W21a) and were found by selection. One stand on the Pembrey Coast contained dead *Hippophae rhamnoides* beneath the closed *Prunus* canopy and this provides some evidence of active succession towards non-dune scrub and woodland types. No clear NVC sub-community can be distinguished within the small quadrat total (9) separated by selection.

- 27 W23 *Ulex europaeus* - *Rubus fruticosus* agg. scrub
No clear NVC sub-community

Ulex europaeus is a fairly common scrub type at the rear of the Crymlyn and Pembrey Burrows dune systems, and upon steep cliff slopes at Nicholaston, Penmaen and Pennard. It usually contains sizeable quantities of *Rubus fruticosus* agg. and sometimes *Pteridium aquilinum* or *Arrhenatherum elatius*. In some locations it seems to have developed from a lower scrub cover of *Rosa pimpinellifolia*. Several stands in cliffed sites showed regeneration after burning, especially at Pennard. This vegetation type did not form an end-group in analysis and had to be selected from other scrub-dominated end-groups.

- 28 W24 *Rubus fruticosus* agg. - *Holcus lanatus*
underscrub
No clear NVC sub-community

Rubus fruticosus agg. is very widespread in a variety of dune, scrub and woodland communities. In analysis it forms one heterogeneous end-group which has other shrub species patchily present (*Rosa pimpinellifolia*, *Ulex europaeus*, *Crataegus monogyna*). At Black Pill the community contains much *Populus tremula* and is dominant at the rear of the dune system.

- 29 W25 *Pteridium aquilinum* - *Rubus fruticosus* agg.
underscrub
No clear NVC sub-community

Bracken-invasion of dune and cliff vegetation is widespread in South Wales and *Pteridium aquilinum* is usually accompanied by a large cover of *Rubus fruticosus* agg.. A shaded community results which has woodland elements (e.g. *Geranium robertianum*, *Glechoma hederacea*, *Silene dioica*). Other shrub species are few (*Ulex europaeus* is rare) and *Acer pseudoplatanus* is the only (infrequent) tree to be recorded. Seral progression beyond this community stage may not therefore be very active.

- 30 X2 *Alnus glutinosa* slack woodland

This community represents the commonest woodland type found in damp habitats. It probably represents the most mature community development in slack conditions. *Alnus glutinosa* is the usual dominant but *Salix cinerea* is also present in large quantity. It probably develops from type 23-W1 woodland. There is no close affinity with other NVC alder woodland types.

Iris pseudacorus, *Galium palustre* and *Rubus fruticosus* agg. are frequent beneath the canopy, with a scatter of shade-tolerant herbs (notably *Oenanthe crocata*, *Berula erecta*, *Lycopus europaeus* and *Carex remota*).

In several locations the community is developed adjacent to saltmarsh (at Crymlyn, Oxwich and Whiteford). Young alder thickets are particularly common at Tywyn where rapid scrub succession is taking place. Old inland examples are found as scattered remnants within Pembrey Forest.

- 31 X3 *Pinus nigra/sylvestris* woodland

Pembrey Forest and Pembrey Country Park are dominated by very large expanses of *Pinus nigra* plantation, some dating back to the 1930's. Old and thinned stands support a reasonable woodland groundflora with some shrub development (a scatter of *Crataegus monogyna*, *Prunus spinosa* or *Ligustrum vulgare*, occasionally *Hippophae rhamnoides* in well-thinned places). Several small stands are also present at Whiteford where there is some regeneration from seed. In addition there has been removal and thinning at Whiteford designed to improve shaded dune communities beneath.

This category did not form a clear end-group in analysis and had to be selected. Of seventeen samples, twelve are represented here and the remaining five are shaded slacks which were classified correctly and were thus retained in slack classes. Shading effects were, however, very clear in each case.

- 32 X4 *Acer pseudoplatanus* woodland

Sycamore woodland did not form a classification end-group but five quadrats could be selected. The vegetation type is found at Whiteford on sand blown on to a hillslope at the south of the survey area, and it is present in small quantity at the Pembrey Coast. Young stands are developing between Port-Eynon and Horton. The community is rather species-poor and lacks much ecological interest.

ANNEX 4

QUADRAT MEMBERSHIP OF VEGETATION TYPES

Quadrat membership of vegetation types at these sites is listed below. Some quadrats appear in more than one vegetation type. These are transitional samples identified in classification and placed in more than one end group of the three main TWINSpan hierarchies.

Only mapping unit numbers (plus variant type) are listed against quadrats. For full NVC nomenclature consult Annex 3 and the vegetation legend in the rear map pocket.

The floristic characteristics of each vegetation type are given in Annex 5. Descriptions of each vegetation type, plus notable characteristics of these sites, are given in Annex 3.

OXWICH

Q	VT	Q	VT	Q	VT	Q	VT
523	7	524	8v5 29	525	9v2 13	526	8v5
527	22	528	29	529	15 29	530	29
531	9v2 15	532	18 29	533	25 30	534	14 23
535	8v5	536	10v1	537	14	538	6v1
539	12(b)	540	7	541	6v4	542	6v4
543	7	544	29	545	30	546	7
547	14	548	14	549	7	550	3v1 4
551	8v1	552	13 14	553	25 30	554	24 25
555	25	556	10v1	557	25 30	558	9v1 24
559	8v1	560	6v4	561	13 15	562	13 15
563	30	564	3v2	565	3v2		

NICHOLASTON

Q	VT	Q	VT	Q	VT	Q	VT
469	3v1 4	470	2	471	3v2	472	7
473	7	474	7	475	6v3	476	7
477	8v2	478	29	479	4 7	480	25
481	23 25	482	8v5	483	8v1	484	10v1
485	10v1	486	7	487	7	488	8v5
489	7	490	10v1	491	25	492	25 32
493	10v1	494	27 29	495	8v4		

PENMAEN

Q	VT
496	10v1 27
500	8v4
504	7
508	11
512	10v2 11
516	10v2 29
520	4

Q	VT
497	29
501	8v5
505	10v1 27
509	10v1
513	10v1
517	8v4
521	6v3

Q	VT
498	8v4
502	8v5
506	8v4
510	10v2 11
514	10v2 11
518	25
522	29

Q	VT
499	8v4
503	7
507	9v2 29
511	10v2 11
515	10v1 11
519	8v5

PENNARD

Q	VT
566	6v4
570	6v4
574	10v1
578	9v2 27 29
582	10v2 11
586	10v1
590	16
594	10v1

Q	VT
567	25 26
571	8v4
575	27 29
579	29
583	10v1
587	10v1
591	8v4
595	7

Q	VT
568	24 25
572	10v1
576	8v4
580	9v2 29
584	11
588	10v1
592	8v5
596	9v1 27 29

Q	VT
569	29
573	8v1
577	8v4
581	9v1
585	10v1
589	7
593	6v4

ANNEX 5

FLORISTIC DETAILS OF
VEGETATION TYPES

The following pages include the vegetation types present in the site(s). Community structure data on height and cover are provided, plus information on bare ground, pH and mean species diversity. Species are listed in order of decreasing frequency:

V	=	>80%
IV	=	>60% - 80%
III	=	>40% - 60%
II	=	>20% - 40%

Very infrequent species are excluded to restrict table length. Domin values are the most common (i.e. they are modal scores).

MAP VEGETATION
UNIT UNIT

2 SD4 *Elymus farctus* foredune community

Tree height (m) -
Shrub/bracken height (m) -
Herb height (cm) 25
Tree cover (%) -
Shrub cover (%) -
Herb cover (%) 20
Cryptogam cover (%) -
Bare surface (%) 80
pH 8.1-8.5
Mean species per quadrat 5.2

FREQ- DOMIN
UENCY VALUE

Elymus farctus V 5
Salsola kali III 4
Atriplex prostrata III 4
Cakile maritima II 1
Horkensya peploides II 3
Beta vulgaris maritima II 3

MAP VEGETATION
UNIT UNIT

3 SD6a *Amnophila arenaria* mobile dune community
Elymus farctus sub-community
Variant 1

Tree height (m) -
Shrub/bracken height (m) -
Herb height (cm) 50
Tree cover (%) -
Shrub cover (%) -
Herb cover (%) 30
Cryptogam cover (%) -

Bare surface (%) 70
pH 7.9-8.2
Mean species per quadrat 4.6

FREQ- DOMIN
UENCY VALUE

Elymus farctus V 5
Amnophila arenaria V 4
Eryngium maritimum III 2
Euphorbia paralias III 4
Oenothera erythrosepala II 1
Senecio jacobaea II 2

MAP VEGETATION
UNIT UNIT

3 SD6a *Amnophila arenaria* mobile dune community
Elymus farctus sub-community
Variant 2

Tree height (m) -
Shrub/bracken height (m) -
Herb height (cm) 30
Tree cover (%) -
Shrub cover (%) -
Herb cover (%) 30
Cryptogam cover (%) -

Bare surface (%) 70
pH 7.9-8.1
Mean species per quadrat 6.0

FREQ- DOMIN
UENCY VALUE

Amnophila arenaria V 3
Elymus farctus V 4
Salsola kali V 3
Cakile maritima IV 2
Eryngium maritimum II 1
Euphorbia paralias II 1
Rumex crispus II 1
Beta vulgaris maritima II 3

MAP VEGETATION
UNIT UNIT

4 SD6d *Amnophila arenaria* mobile dune community
Typical sub-community

Tree height (m) -
Shrub/bracken height (m) -
Herb height (cm) 70
Tree cover (%) -
Shrub cover (%) -
Herb cover (%) 50
Cryptogam cover (%) -

Bare surface (%) 50
pH 7.8-8.2
Mean species per quadrat 7.1

FREQ- DOMIN
UENCY VALUE

Amnophila arenaria V 7
Senecio jacobaea III 3
Hypochaeris radicata III 3
Eryngium maritimum III 3
Sonchus asper III 2
Euphorbia paralias II 3
Elymus farctus II 3
Cerastium diffusum diffusum II 3
Oenothera erythrosepala II 2
Arenaria serpyllifolia II 3
Rubus caesius II 3

MAP VEGETATION
UNIT UNIT

6 SD7c *Ammophila arenaria* - *Festuca rubra*
semi-fixed dune community
Ononis repens sub-community
Variant 1

Tree height (m) -
Shrub/bracken height (m) -
Herb height (cm) 50
Tree cover (%) -
Shrub cover (%) -
Herb cover (%) 70
Cryptogam cover (%) 20

Bare surface (%) 10
pH 7.6-8.1
Mean species per quadrat 13.8

FREQ- DOMIN
UENCY VALUE

Ammophila arenaria V 5
Festuca rubra V 6
Hypochaeris radicata IV 3
Leontodon hispidus III 3
Ononis repens III 4
Eryngium maritimum III 2
Carex arenaria III 3
Oenothera erythrosepala III 3
Rubus caesius III 3
Anthyllis vulneraria II 4
Cerastium diffusum diffusum II 2
Senecio jacobaea II 3
Eurynchium praelongum II 4
Phleum arenarium II 2
Brachythecium rutabulum II 3
Sedum acre II 3
Barbula vinealis II 4
Arenaria serpyllifolia II 2
Poa pratensis II 3
Brachythecium albicans II 4
Taraxacum sp. II 3
Rhynchosinapis cheiranthos II 2

MAP VEGETATION
UNIT UNIT

6 SD7c *Ammophila arenaria* - *Festuca rubra*
semi-fixed dune community
Ononis repens sub-community
Variant 3

Tree height (m) -
Shrub/bracken height (m) 0.4
Herb height (cm) 40
Tree cover (%) -
Shrub cover (%) 10
Herb cover (%) 90
Cryptogam cover (%) 20

Bare surface (%) 5
pH 6.8-8.1
Mean species per quadrat 14.0

FREQ- DOMIN
UENCY VALUE

Festuca rubra V 7
Ammophila arenaria V 5
Carex arenaria IV 4
Poa pratensis IV 3
Holcus lanatus IV 3
Ononis repens IV 5
Eurynchium praelongum III 5
Plantago lanceolata III 3
Senecio jacobaea III 2
Lotus corniculatus II 3
Anthyllis vulneraria II 3
Arrhenatherum elatius II 4
Dactylis glomerata II 3
Galium verum II 4
Hypochaeris radicata II 2
Rubus caesius II 5
Rubus fruticosus agg. II 5
Polypodium vulgare II 3
Taraxacum sp. II 2
Oenothera erythrosepala II 2
Hieracium pilosella agg. II 3

MAP VEGETATION
UNIT UNIT

6 SD7c *Ammophila arenaria* - *Festuca rubra*
semi-fixed dune community
Ononis repens sub-community
Variant 4

Tree height (m) -
Shrub/bracken height (m) 0.4
Herb height (cm) 30
Tree cover (%) -
Shrub cover (%) 40
Herb cover (%) 80
Cryptogam cover (%) 10

Bare surface (%) 5
pH 6.7-7.6
Mean species per quadrat 11.1

FREQ- DOMIN
UENCY VALUE

Festuca rubra V 6
Ononis repens IV 5
Carex arenaria III 3
Rubus caesius III 7
Senecio jacobaea III 1
Ammophila arenaria III 5
Poa pratensis III 3
Galium verum II 4
Lotus corniculatus II 4
Plantago lanceolata II 3
Homalothecium lutescens II 5
Hypochaeris radicata II 1

MAP VEGETATION
UNIT UNIT

7 SD7d *Ammophila arenaria* - *Festuca rubra*
semi-fixed dune community
Tortula ruralis ssp. *ruraliformis*
sub-community

Tree height (m) -
Shrub/bracken height (m) 0.3
Herb height (cm) 20
Tree cover (%) -
Shrub cover (%) 5
Herb cover (%) 40
Cryptogam cover (%) 30

Bare surface (%) 30
pH 7.3-8.1
Mean species per quadrat 16.2

FREQ- DOMIN
UENCY VALUE

Phleum arenarium V 3
Ammophila arenaria IV 5
Arenaria serpyllifolia IV 3
Cerastium diffusum diffusum IV 3
Hypochaeris radicata IV 3
Carex arenaria IV 3
Oenothera erythrosepala IV 3
Tortula ruralis ssp. *ruraliformis* III 5
Leontodon hispidus III 3
Vulpia fasciculata III 4
Senecio jacobaea III 2
Sedum acre III 3
Ononis repens III 4
Festuca rubra II 4
Ceratodon purpureus II 5
Holcus lanatus II 4
Rubus caesius II 4
Aira praecox II 3

MAP VEGETATION			MAP VEGETATION			MAP VEGETATION			MAP VEGETATION			MAP VEGETATION		
UNIT	UNIT		UNIT	UNIT		UNIT	UNIT		UNIT	UNIT		UNIT	UNIT	
8	SDB	<i>Festuca rubra</i> - <i>Galium verum</i> fixed dune community No clear NVC sub-community Variant 1	8	SDB	<i>Festuca rubra</i> - <i>Galium verum</i> fixed dune community No clear NVC sub-community Variant 2	8	SDB	<i>Festuca rubra</i> - <i>Galium verum</i> fixed dune community No clear NVC sub-community Variant 3	8	SDB	<i>Festuca rubra</i> - <i>Galium verum</i> fixed dune community No clear NVC sub-community Variant 4	8	SDB	<i>Festuca rubra</i> - <i>Galium verum</i> fixed dune community No clear NVC sub-community Variant 5
Tree height (m)	-		Tree height (m)	-		Tree height (m)	-		Tree height (m)	-		Tree height (m)	-	
Shrub/bracken height (m)	0.3		Shrub/bracken height (m)	0.3		Shrub/bracken height (m)	0.4		Shrub/bracken height (m)	0.4		Shrub/bracken height (m)	0.6	
Herb height (cm)	20		Herb height (cm)	30		Herb height (cm)	40		Herb height (cm)	30		Herb height (cm)	60	
Tree cover (%)	-		Tree cover (%)	-		Tree cover (%)	-		Tree cover (%)	-		Tree cover (%)	-	
Shrub cover (%)	10		Shrub cover (%)	10		Shrub cover (%)	10		Shrub cover (%)	20		Shrub cover (%)	40	
Herb cover (%)	90		Herb cover (%)	60		Herb cover (%)	80		Herb cover (%)	90		Herb cover (%)	90	
Cryptogam cover (%)	40		Cryptogam cover (%)	60		Cryptogam cover (%)	30		Cryptogam cover (%)	20		Cryptogam cover (%)	10	
Bare surface (%)	5		Bare surface (%)	-		Bare surface (%)	1		Bare surface (%)	1		Bare surface (%)	1	
pH	6.8-7.6		pH	6.5-7.2		pH	6.9-7.1		pH	7.0-7.4		pH	6.9	
Mean species per quadrat	19.0		Mean species per quadrat	17.1		Mean species per quadrat	15.8		Mean species per quadrat	15.0		Mean species per quadrat	10.2	
	FREQ- UENCY	DOMIN VALUE		FREQ- UENCY	DOMIN VALUE		FREQ- UENCY	DOMIN VALUE		FREQ- UENCY	DOMIN VALUE		FREQ- UENCY	DOMIN VALUE
<i>Amophila arenaria</i>	V	5	<i>Festuca rubra</i>	V	6	<i>Festuca rubra</i>	V	7	<i>Festuca rubra</i>	V	7	<i>Pteridium aquilinum</i>	IV	6
<i>Festuca rubra</i>	V	7	<i>Homalothecium lutescens</i>	V	5	<i>Amophila arenaria</i>	V	5	<i>Galium verum</i>	IV	4	<i>Carex arenaria</i>	IV	3
<i>Hypochoeris radicata</i>	V	3	<i>Dicranum scoparium</i>	V	5	<i>Carex arenaria</i>	IV	3	<i>Plantago lanceolata</i>	IV	4	<i>Geranium sanguineum</i>	IV	6
<i>Homalothecium lutescens</i>	V	6	<i>Carex arenaria</i>	IV	3	<i>Holcus lanatus</i>	IV	4	<i>Poa pratensis</i>	IV	3	<i>Rubus caesius</i>	IV	6
<i>Ononis repens</i>	IV	4	<i>Holcus lanatus</i>	IV	4	<i>Homalothecium lutescens</i>	III	4	<i>Carex arenaria</i>	IV	3	<i>Amophila arenaria</i>	IV	5
<i>Anthyllis vulneraria</i>	IV	5	<i>Amophila arenaria</i>	III	3	<i>Hypochoeris radicata</i>	III	3	<i>Dactylis glomerata</i>	III	4	<i>Festuca rubra</i>	IV	5
<i>Rubus caesius</i>	IV	5	<i>Anthoxanthum odoratum</i>	III	4	<i>Polypodium vulgare</i>	III	3	<i>Rosa pimpinellifolia</i>	III	5	<i>Rosa pimpinellifolia</i>	III	6
<i>Carex arenaria</i>	III	3	<i>Galium verum</i>	III	4	<i>Rubus caesius</i>	III	4	<i>Anthoxanthum odoratum</i>	III	4	<i>Convolvulus arvensis</i>	II	3
<i>Galium verum</i>	III	5	<i>Hypochoeris radicata</i>	II	2	<i>Senecio jacobaea</i>	III	2	<i>Agrostis capillaris</i>	III	4	<i>Galium verum</i>	II	4
<i>Hieracium pilosella</i> agg.	III	4	<i>Hieracium pilosella</i> agg.	II	3	<i>Anthyllis vulneraria</i>	III	3	<i>Sanguisorba minor</i>	III	4	<i>Holcus lanatus</i>	II	4
<i>Crepis capillaris</i>	III	3	<i>Plantago lanceolata</i>	II	3	<i>Lotus corniculatus</i>	III	4	<i>Holcus lanatus</i>	II	4	<i>Poa pratensis</i>	II	3
<i>Leontodon hispidus</i>	III	2	<i>Poa pratensis</i>	II	3	<i>Hieracium pilosella</i> agg.	III	3	<i>Rubus caesius</i>	II	5	<i>Sanguisorba minor</i>	II	3
<i>Luzula campestris</i>	III	3	<i>Lotus corniculatus</i>	II	4	<i>Poa pratensis</i>	II	3	<i>Avenula pubescens</i>	II	4	<i>Brachythecium rutabulum</i>	II	5
<i>Sedum acre</i>	III	2	<i>Polypodium vulgare</i>	II	5	<i>Galium verum</i>	II	5	<i>Ononis repens</i>	II	3	<i>Eurynchium praelongum</i>	II	3
<i>Senecio jacobaea</i>	III	2	<i>Cladonia rangiferina</i>	II	4	<i>Hieracium vulgatum</i> agg.	II	2	<i>Pteridium aquilinum</i>	II	5	<i>Dactylis glomerata</i>	II	4
<i>Poa pratensis</i>	III	3	<i>Taraxacum</i> sp.	II	1	<i>Hippophae rhamnoides</i>	II	5	<i>Thymus praecox arcticus</i>	II	4			
<i>Cladonia pocillum</i>	III	3	<i>Anthyllis vulneraria</i>	II	4	<i>Leontodon hispidus</i>	II	2	<i>Veronica chamaedrys</i>	II	3			
<i>Polypodium vulgare</i>	II	4	<i>Crepis capillaris</i>	II	3	<i>Oenothera erythrosepala</i>	II	2	<i>Achillea millefolium</i>	II	4			
<i>Anacamptis pyramidalis</i>	II	1	<i>Rosa pimpinellifolia</i>	II	4	<i>Plantago lanceolata</i>	II	3	<i>Lotus corniculatus</i>	II	4			
<i>Centaurea erythraea</i>	II	3	<i>Cladonia impezia</i>	II	4	<i>Rubus fruticosus</i> agg.	II	4	<i>Pseudoscleropodium purum</i>	II	5			
<i>Cerastium fontanum</i> triviale	II	2				<i>Eurynchium praelongum</i>	II	5	<i>Geranium sanguineum</i>	II	5			
<i>Avenula pubescens</i>	II	4				<i>Taraxacum</i> sp.	II	2						
<i>Oenothera erythrosepala</i>	II	2				<i>Arrhenatherum elatius</i>	II	4						
<i>Phleum arenarium</i>	II	2				<i>Cerastium fontanum</i> triviale	II	2						
<i>Thymus praecox arcticus</i>	II	4				<i>Ononis repens</i>	II	4						
<i>Viola tricolor</i>	II	2				<i>Anacamptis pyramidalis</i>	II	1						
<i>Peltigera canina</i>	II	3				<i>Luzula campestris</i>	II	3						
<i>Aira praecox</i>	II	3				<i>Dicranum scoparium</i>	II	5						
<i>Hieracium vulgatum</i> agg.	II	1												
<i>Lotus corniculatus</i>	II	4												
<i>Plantago lanceolata</i>	II	3												
<i>Polygala vulgaris</i>	II	2												
<i>Rhinanthus minor</i>	II	3												
<i>Sonchus oleraceus</i>	II	1												
<i>Brachythecium albicans</i>	II	6												

MAP UNIT	VEGETATION UNIT	MAP UNIT	VEGETATION UNIT	MAP UNIT	VEGETATION UNIT	MAP UNIT	VEGETATION UNIT	MAP UNIT	VEGETATION UNIT
9	SD9 <i>Amophila arenaria</i> - <i>Arrhenatherum elatius</i> dune grassland No clear MVC sub-community Variant 1	9	SD9 <i>Amophila arenaria</i> - <i>Arrhenatherum elatius</i> dune grassland No clear MVC sub-community Variant 2	10	SD12 <i>Carex arenaria</i> - <i>Festuca ovina</i> - <i>Agrostis capillaris</i> grassland No clear MVC sub-community Variant 1	10	SD12 <i>Carex arenaria</i> - <i>Festuca ovina</i> - <i>Agrostis capillaris</i> grassland No clear MVC sub-community Variant 2	11	H11 <i>Calluna vulgaris</i> - <i>Carex arenaria</i> heath
Tree height (m)	-	Tree height (m)	0-6	Tree height (m)	-	Tree height (m)	-	Tree height (m)	-
Shrub/bracken height (m)	0.4	Shrub/bracken height (m)	0-4	Shrub/bracken height (m)	0.4	Shrub/bracken height (m)	1.0	Shrub/bracken height (m)	0.4-1
Herb height (cm)	40	Herb height (cm)	50	Herb height (cm)	30	Herb height (cm)	80	Herb height (cm)	30
Tree cover (%)	-	Tree cover (%)	0-60	Tree cover (%)	-	Tree cover (%)	-	Tree cover (%)	-
Shrub cover (%)	20	Shrub cover (%)	0-70	Shrub cover (%)	20	Shrub cover (%)	70	Shrub cover (%)	70
Herb cover (%)	90	Herb cover (%)	60	Herb cover (%)	70	Herb cover (%)	90	Herb cover (%)	50
Cryptogam cover (%)	20	Cryptogam cover (%)	10	Cryptogam cover (%)	50	Cryptogam cover (%)	20	Cryptogam cover (%)	20
Bare surface (%)	1	Bare surface (%)	1	Bare surface (%)	1	Bare surface (%)	-	Bare surface (%)	-
pH	5.8-6.5	pH	6.2-6.4	pH	6.1-7.1	pH	5.8	pH	5.2-6.3
Mean species per quadrat	16.6	Mean species per quadrat	14.1	Mean species per quadrat	17.3	Mean species per quadrat	9.7	Mean species per quadrat	11.4
FREQ- UENCY	DOMIN VALUE	FREQ- UENCY	DOMIN VALUE	FREQ- UENCY	DOMIN VALUE	FREQ- UENCY	DOMIN VALUE	FREQ- UENCY	DOMIN VALUE
<i>Festuca rubra</i>	V 6	<i>Arrhenatherum elatius</i>	IV 5	<i>Hypochoeris radicata</i>	V 3	<i>Carex arenaria</i>	V 4	<i>Calluna vulgaris</i>	V 7
<i>Holcus lanatus</i>	V 5	<i>Eurynchium praelongum</i>	IV 4	<i>Carex arenaria</i>	IV 3	<i>Festuca ovina</i>	V 5	<i>Carex arenaria</i>	V 4
<i>Carex arenaria</i>	IV 3	<i>Festuca rubra</i>	III 4	<i>Festuca ovina</i>	IV 5	<i>Pteridium aquilinum</i>	V 8	<i>Pteridium aquilinum</i>	V 5
<i>Rubus caesius</i>	IV 5	<i>Rubus fruticosus</i> agg.	III 5	<i>Agrostis capillaris</i>	IV 5	<i>Deschampsia flexuosa</i>	IV 7	<i>Agrostis capillaris</i>	IV 4
<i>Arrhenatherum elatius</i>	III 5	<i>Holcus lanatus</i>	III 5	<i>Anthoxanthum odoratum</i>	IV 5	<i>Agrostis capillaris</i>	III 5	<i>Deschampsia flexuosa</i>	IV 4
<i>Dactylis glomerata</i>	III 4	<i>Dactylis glomerata</i>	III 4	<i>Hypnum cupressiforme</i>	III 6	<i>Anthoxanthum odoratum</i>	III 4	<i>Festuca ovina</i>	IV 5
<i>Ononis repens</i>	III 3	<i>Carex arenaria</i>	II 3	<i>Luzula campestris</i>	III 3	<i>Potentilla erecta</i>	III 3	<i>Anthoxanthum odoratum</i>	III 4
<i>Plantago lanceolata</i>	III 3	<i>Heracleum sphondylium</i>	II 3	<i>Thymus praecox arcticus</i>	III 4	<i>Teucrium scorodonia</i>	III 4	<i>Agrostis capillaris</i>	III 2
<i>Poa pratensis</i>	III 3	<i>Plantago lanceolata</i>	II 3	<i>Galium verum</i>	III 4	<i>Hypnum cupressiforme</i>	III 6	<i>Holcus lanatus</i>	II 3
<i>Centaurea nigra</i>	III 3	<i>Rubus caesius</i>	II 6	<i>Plantago lanceolata</i>	III 4	<i>Digitalis purpurea</i>	II 1	<i>Dicranum scoparium</i>	II 5
<i>Galium verum</i>	III 3	<i>Amophila arenaria</i>	II 4	<i>Pteridium aquilinum</i>	III 5	<i>Rubus fruticosus</i> agg.	II 4	<i>Hypnum cupressiforme</i>	II 7
<i>Heracleum sphondylium</i>	III 3	<i>Rumex acetosa</i>	II 3	<i>Dicranum scoparium</i>	III 5	<i>Rumex acetosa</i>	II 3	<i>Aira praecox</i>	II 3
<i>Lophoclea bidentata</i>	III 3	<i>Senecio jacobaea</i>	II 3	<i>Cladonia implexa</i>	III 3	<i>Vaccinium myrtillus</i>	II 4	<i>Erica cinerea</i>	II 7
<i>Oenothera erythrosepala</i>	II 2	<i>Populus tremula</i>	II 6	<i>Aira praecox</i>	III 3	<i>Agrostis vinealis</i>	II 4	<i>Hypochoeris radicata</i>	II 3
<i>Senecio jacobaea</i>	II 2	<i>Ulex europaeus</i>	II 7	<i>Hieracium pilosella</i> agg.	III 3			<i>Plantago lanceolata</i>	II 3
<i>Eurynchium praelongum</i>	II 5	<i>Centaurea nigra</i>	II 4	<i>Poa pratensis</i>	II 3			<i>Danthonia decumbens</i>	II 3
<i>Rumex acetosa</i>	II 3	<i>Hedera helix</i>	II 4	<i>Cladonia furcata</i>	II 4			<i>Eurynchium praelongum</i>	II 4
<i>Salix repens</i> agg.	II 8	<i>Rumex crispus</i>	II 2	<i>Festuca rubra</i>	II 4			<i>Polytrichum piliferum</i>	II 7
<i>Pseudoscleropodium purum</i>	II 5	<i>Salix cinerea</i>	II 6	<i>Ononis repens</i>	II 4			<i>Cladonia furcata</i>	II 4
<i>Vicia sativa</i>	II 3	<i>Lophoclea bidentata</i>	II 4	<i>Holcus lanatus</i>	II 5				
<i>Anthyllis vulneraria</i>	II 3	<i>Vicia sativa</i>	II 3	<i>Pseudoscleropodium purum</i>	II 5				
<i>Equisetum arvense</i>	II 3			<i>Crepis capillaris</i>	II 3				
<i>Hieracium vulgatum</i> agg.	II 3			<i>Leontodon hispidus</i>	II 2				
<i>Hypochoeris radicata</i>	II 2			<i>Lotus corniculatus</i>	II 3				
				<i>Senecio jacobaea</i>	II 2				
				<i>Calluna vulgaris</i>	II 5				
				<i>Rubus caesius</i>	II 6				
				<i>Teucrium scorodonia</i>	II 3				
				<i>Peltigera canina</i>	II 4				

MAP VEGETATION
UNIT UNIT

12 SD15a/b *Salix repens* - *Calliergon cuspidatum*
dune slack
Carex nigra sub-community (a)
Equisetum variegatum sub-community (b)

Tree height (m) -
Shrub/bracken height (m) 0.4
Herb height (cm) 40
Tree cover (%) -
Shrub cover (%) 30
Herb cover (%) 40
Cryptogam cover (%) 70

Bare surface (%) -
pH 7.4-7.9
Mean species per quadrat 16.8

FREQ- DOMIN
UENCY VALUE

Hydrocotyle vulgaris V 6
Salix repens agg. V 6
Epipactis palustris IV 4
Equisetum variegatum IV 4
Calliergon cuspidatum IV 8
Agrostis stolonifera III 4
Carex nigra III 5
Holcus lanatus III 3
Juncus maritimus III 5
Mentha aquatica III 4
Potentilla anserina III 4
Galium palustre III 3
Iris pseudacorus III 3
Denanthe lachenalii III 3
Ranunculus acris III 3
Dactylorhiza majalis III 2
Carex arenaria II 3
Carex flacca II 3
Pulicaria dysenterica II 4
Ranunculus flammula II 3
Salix cinerea II 4
Carex otrubae II 3
Festuca arundinacea II 3
Juncus acutus II 4
Poa pratensis II 3
Rubus fruticosus agg. II 4
Trifolium pratense II 4

MAP VEGETATION
UNIT UNIT

13 SD15c *Salix repens* - *Calliergon cuspidatum*
dune slack
Carex flacca - *Pulicaria dysenterica*
sub-community

Tree height (m) -
Shrub/bracken height (m) 0.6
Herb height (cm) 80
Tree cover (%) -
Shrub cover (%) 40
Herb cover (%) 80
Cryptogam cover (%) 30

Bare surface (%) -
pH 7.6-8.3
Mean species per quadrat 15.6

FREQ- DOMIN
UENCY VALUE

Pulicaria dysenterica IV 6
Holcus lanatus IV 4
Mentha aquatica IV 4
Potentilla anserina III 4
Juncus maritimus III 5
Salix repens agg. III 7
Rubus caesius III 5
Equisetum arvense III 3
Eupatorium cannabinum III 5
Festuca rubra III 5
Hydrocotyle vulgaris III 5
Agrostis stolonifera II 4
Carex nigra II 4
Filipendula ulmaria II 5
Calliergon cuspidatum II 9
Lotus uliginosus II 4
Carex flacca II 3
Lychnis flos-cuculi II 3
Angelica sylvestris II 2
Cirsium palustre II 3
Denanthe lachenalii II 2
Plantago lanceolata II 4
Salix cinerea II 4
Trifolium pratense II 3

MAP VEGETATION
UNIT UNIT

14 SD16a/b *Salix repens* - *Holcus lanatus*
dune slack
Ononis repens sub-community (a)
Rubus caesius sub-community (b)
Prunella vulgaris - *Equisetum variegatum*
sub-community (c)
Agrostis stolonifera sub-community (d)

Tree height (m) -
Shrub/bracken height (m) 0.4
Herb height (cm) 40
Tree cover (%) -
Shrub cover (%) 40
Herb cover (%) 80
Cryptogam cover (%) 25

Bare surface (%) 1
pH 7.5-7.9
Mean species per quadrat 17.0

FREQ- DOMIN
UENCY VALUE

Holcus lanatus IV 4
Festuca rubra IV 6
Lotus corniculatus IV 5
Agrostis stolonifera IV 5
Carex arenaria IV 3
Salix repens agg. IV 7
Carex flacca III 4
Equisetum variegatum III 4
Poa pratensis III 4
Trifolium pratense II 4
Plantago lanceolata II 4
Epipactis palustris II 3
Euphrasia officinalis agg. II 3
Hypochoeris radicata II 3
Ononis repens II 4
Taraxacum sp. II 3
Blackstonia perfoliata II 1
Mentha aquatica II 3
Phragmites australis II 3
Prunella vulgaris II 4
Juncus maritimus II 4
Potentilla anserina II 6
Radiola linoides II 3
Rhinanthus minor II 3
Rubus caesius II 4
Calliergon cuspidatum II 6

MAP VEGETATION
UNIT UNIT

15 SD17 *Potentilla anserina* - *Carex nigra* dune slack
No clear NVC sub-community

Tree height (m) -
Shrub/bracken height (m) 0-3
Herb height (cm) 80
Tree cover (%) -
Shrub cover (%) 30
Herb cover (%) 90
Cryptogam cover (%) 30

Bare surface (%) -
pH 6.8-7.9
Mean species per quadrat 14.4

FREQ- DOMIN
UENCY VALUE

Mentha aquatica V 5
Carex nigra III 4
Hydrocotyle vulgaris III 6
Pulicaria dysenterica III 5
Iris pseudacorus III 4
Equisetum arvense III 3
Filipendula ulmaria III 5
Holcus lanatus III 4
Potentilla anserina III 4
Salix repens agg. III 6
Juncus maritimus II 5
Lythrum salicaria II 4
Calliergon cuspidatum II 9
Agrostis stolonifera II 4
Eupatorium cannabinum II 5
Lotus uliginosus II 4
Salix cinerea II 4
Denanthe lachenalii II 2
Rubus caesius II 3
Rubus fruticosus agg. II 5
Angelica sylvestris II 2
Arrhenatherum elatius II 4
Eleocharis palustris II 4
Lychnis flos-cuculi II 3
Juncus subnodulosus II 5

MAP VEGETATION
UNIT UNIT

16 SM18b *Juncus maritimus* saltmarsh
Denanthe lachenalii sub-community

Tree height (m) -
Shrub/bracken height (m) -
Herb height (cm) 50
Tree cover (%) -
Shrub cover (%) -
Herb cover (%) 80
Cryptogam cover (%) 30

Bare surface (%) 10
pH 7.8-8.3
Mean species per quadrat 12.3

FREQ- DOMIN
UENCY VALUE

Denanthe lachenalii V 3
Agrostis stolonifera V 6
Juncus maritimus III 4
Juncus gerardi III 5
Glaux maritima III 5
Festuca rubra III 6
Potentilla anserina III 5
Juncus acutus II 5
Carex distans II 3
Carex otrubae II 4
Plantago maritima II 3
Carex extensa II 3
Rumex crispus II 2
Suaeda valerandi II 3
Scirpus maritimus II 5
Eleocharis palustris II 4
Hydrocotyle vulgaris II 4
Mentha aquatica II 3
Phragmites australis II 4
Drepanocladus aduncus II 6
Plantago coronopus II 5
Triglochin maritima II 2

MAP VEGETATION
UNIT UNIT

18 S4a *Phragmites australis* swamp and reed-beds
Phragmites australis sub-community

19 S4d *Phragmites australis* swamp and reed-beds
Atriplex hastata sub-community

19 S21b *Scirpus maritimus* swamp
Atriplex hastata sub-community

20 S12b *Typha latifolia* swamp
Mentha aquatica sub-community

	S4a	S4d	S21b	S12b
Tree height (m)	-	-	-	-
Shrub/bracken height (m)	-	-	-	-
Herb height (cm)	200	200	100	40-100
Tree cover (%)	-	-	-	-
Shrub cover (%)	-	-	-	-
Herb cover (%)	100	100	100	20-40
Cryptogam cover (%)	-	-	-	80

Bare surface (%)	-	-	-	-
pH	-	-	-	-
Mean species per quadrat	2.7	2.5	3.0	11.3

DOMIN VALUES

<i>Phragmites australis</i>	10	10	-	-
<i>Lythrum salicaria</i>	1	-	-	-
<i>Rubus fruticosus</i> agg.	4	-	-	-

<i>Scirpus maritimus</i>	-	-	8	4
<i>Atriplex prostrata</i>	-	4	4	-
<i>Elymus pycnanthus</i>	-	8	8	-
<i>Juncus maritimus</i>	-	-	6	-

<i>Typha latifolia</i>	-	-	-	5
<i>Mentha aquatica</i>	-	-	-	4
<i>Chara</i> sp.	-	-	-	9
<i>Carex nigra</i>	-	-	-	3
<i>Eleocharis palustris</i>	-	-	-	3
<i>Galium palustre</i>	-	-	-	3
<i>Hydrocotyle vulgaris</i>	-	-	-	3
<i>Juncus articulatus</i>	-	-	-	3
<i>Ranunculus flammula</i>	-	-	-	3
<i>Salix repens</i> agg.	-	-	-	4
<i>Scirpus lacustris tabernaem.</i>	-	-	-	4
<i>Drepanocladus aduncus</i>	-	-	-	6

MAP VEGETATION
UNIT UNIT

22 S018b *Hippophae rhamnoides* scrub
Urtica dioica - *Arrhenatherum elatius*
sub-community

Tree height (m)	-
Shrub/bracken height (m)	2-6
Herb height (cm)	40
Tree cover (%)	-
Shrub cover (%)	80
Herb cover (%)	60
Cryptogam cover (%)	20

Bare surface (%)	10
pH	6.6-7.5
Mean species per quadrat	9.7

FREQ- DOMIN
UENCY VALUE

<i>Hippophae rhamnoides</i>	V	8
<i>Galium aparine</i>	V	4
<i>Eurynchium praelongum</i>	IV	5
<i>Rubus fruticosus</i> agg.	IV	5
<i>Urtica dioica</i>	IV	6
<i>Brachythecium rutabulum</i>	III	5
<i>Sambucus nigra</i>	III	5
<i>Solanum dulcamara</i>	III	4
<i>Holcus lanatus</i>	II	3
<i>Polypodium vulgare</i>	II	3
<i>Evernia prunastri</i>	II	2

MAP VEGETATION
UNIT UNIT

23 W1 *Salix cinerea* - *Galium palustre* woodland

Tree height (m)	4-8
Shrub/bracken height (m)	0-6
Herb height (cm)	20-150
Tree cover (%)	30-80
Shrub cover (%)	0-80
Herb cover (%)	30
Cryptogam cover (%)	40

Bare surface (%)	-
pH	6.7
Mean species per quadrat	10.3

FREQ- DOMIN
UENCY VALUE

<i>Betula pubescens</i>	V	6
<i>Galium palustre</i>	V	5
<i>Iris pseudacorus</i>	V	4
<i>Agrostis stolonifera</i>	IV	4
<i>Ophioglossum vulgatum</i>	IV	3
<i>Phragmites australis</i>	IV	6
<i>Rubus fruticosus</i> agg.	IV	2
<i>Salix cinerea</i>	IV	5
<i>Calliergon cuspidatum</i>	IV	5
<i>Juncus effusus</i>	III	4
<i>Solanum dulcamara</i>	III	2
<i>Epilobium palustre</i>	II	3
<i>Equisetum sylvaticum</i>	II	3
<i>Eriophorum angustifolium</i>	II	2
<i>Hydrocotyle vulgaris</i>	II	3
<i>Salix repens</i> agg.	II	4

MAP VEGETATION
UNIT UNIT

24 W10c *Quercus robur* - *Pteridium aquilinum* -
Rubus fruticosus agg. woodland
Hedera helix sub-community

Tree height (m)	2-14
Shrub/bracken height (m)	0-2
Herb height (cm)	30
Tree cover (%)	60-100
Shrub cover (%)	0-100
Herb cover (%)	30-100
Cryptogam cover (%)	0-30

Bare surface (%)	-
pH	5.9
Mean species per quadrat	14.4

FREQ- DOMIN
UENCY VALUE

<i>Quercus robur</i>	V	9
<i>Crataegus monogyna</i>	V	4
<i>Hedera helix</i>	IV	6
<i>Galium aparine</i>	III	4
<i>Geranium robertianum</i>	III	3
<i>Rubus fruticosus</i> agg.	III	7
<i>Arrhenatherum elatius</i>	II	4
<i>Brachypodium sylvaticum</i>	II	4
<i>Fraxinus excelsior</i>	II	4
<i>Holcus lanatus</i>	II	5
<i>Polypodium vulgare</i>	II	3
<i>Tamus communis</i>	II	2
<i>Urtica dioica</i>	II	4

MAP VEGETATION
UNIT UNIT

25 W21 *Crataegus monogyna* - *Hedera helix* scrub
Hedera helix - *Urtica dioica* sub-community

Tree height (m)	0-4
Shrub/bracken height (m)	1-5
Herb height (cm)	20-100
Tree cover (%)	0-80
Shrub cover (%)	30-100
Herb cover (%)	60
Cryptogam cover (%)	10

Bare surface (%)	-
pH	6.1-7.2
Mean species per quadrat	13.3

FREQ- DOMIN
UENCY VALUE

<i>Crataegus monogyna</i>	IV	5
<i>Geranium robertianum</i>	IV	3
<i>Hedera helix</i>	IV	6
<i>Rubus fruticosus</i> agg.	IV	7
<i>Urtica dioica</i>	III	4
<i>Quercus robur</i>	III	4
<i>Silene dioica</i>	II	3
<i>Fraxinus excelsior</i>	II	4
<i>Prunus spinosa</i>	II	4
<i>Phyllitis scolopendrium</i>	II	3
<i>Rosa pimpinellifolia</i>	II	3
<i>Solanum dulcamara</i>	II	4
<i>Tamus communis</i>	II	3
<i>Acer pseudoplatanus</i>	II	3
<i>Brachypodium sylvaticum</i>	II	4
<i>Epilobium montanum</i>	II	2
<i>Galium aparine</i>	II	4

MAP VEGETATION
UNIT UNIT

26 W22 *Prunus spinosa* - *Rubus fruticosus* agg. scrub
No clear MVC sub-community

Tree height (m) -
Shrub/bracken height (m) 2-5
Herb height (cm) 30
Tree cover (%) -
Shrub cover (%) 60-100
Herb cover (%) 5-80
Cryptogam cover (%) 10-40

Bare surface (%) -
pH 7.4
Mean species per quadrat 12.6

FREQ- DOMIN
UENCY VALUE

Prunus spinosa V 8
Eurynchium praelongum IV 6
Urtica dioica IV 3
Crataegus monogyna III 5
Dactylis glomerata III 3
Rosa pimpinellifolia III 5
Rubus fruticosus agg. III 4
Festuca rubra II 4
Geranium robertianum II 3
Glechoma hederacea II 4
Hedera helix II 9
Quercus robur II 4
Sambucus nigra II 6
Silene dioica II 3
Arrhenatherum elatius II 2
Athyrium filix-femina II 1
Brachypodium sylvaticum II 3
Carex arenaria II 3
Dryopteris filix-mas II 4
Epilobium montanum II 2
Fraxinus excelsior II 4
Galium verum II 4
Phyllitis scolopendrium II 4
Plantago lanceolata II 3
Pteridium aquilinum II 4
Rubus caesius II 4
Senecio jacobaea II 2
Stachys sylvatica II 3
Tamus communis II 1

MAP VEGETATION
UNIT UNIT

27 W23 *Ulex europaeus* - *Rubus fruticosus* agg. scrub
No clear MVC sub-community

Tree height (m) -
Shrub/bracken height (m) 1-3
Herb height (cm) 20-100
Tree cover (%) -
Shrub cover (%) 40-90
Herb cover (%) 40-80
Cryptogam cover (%) 0-10

Bare surface (%) -
pH 5.9-6.8
Mean species per quadrat 12.6

FREQ- DOMIN
UENCY VALUE

Ulex europaeus V 8
Holcus lanatus IV 4
Rubus fruticosus agg. IV 6
Arrhenatherum elatius III 5
Festuca rubra III 4
Dactylis glomerata III 4
Galium aparine II 3
Pteridium aquilinum II 5
Rosa pimpinellifolia II 5
iubus caesius II 6
Urtica dioica II 3
Agrostis stolonifera II 2
Carex arenaria II 3
Poa pratensis II 3
Solanum dulcamara II 3
Eurynchium praelongum II 4
Agrostis capillaris II 6
Anthoxanthum odoratum II 3
Crataegus monogyna II 5
Plantago lanceolata II 3

MAP VEGETATION
UNIT UNIT

29 W25 *Pteridium aquilinum* - *Rubus fruticosus*
agg. underscrub
No clear MVC sub-community

Tree height (m) -
Shrub/bracken height (m) 1-3
Herb height (cm) 40-120
Tree cover (%) -
Shrub cover (%) 80-100
Herb cover (%) 30
Cryptogam cover (%) -

Bare surface (%) -
pH 6.8-7.4
Mean species per quadrat 9.7

FREQ- DOMIN
UENCY VALUE

Pteridium aquilinum V 7
Rubus fruticosus V 7
Urtica dioica III 4
Geranium robertianum II 4
Glechoma hederacea II 4
Holcus lanatus II 4
Silene dioica II 3
Acer pseudoplatanus II 4
Arrhenatherum elatius II 4
Festuca rubra II 4

MAP VEGETATION
UNIT UNIT

30 X5 *Alnus glutinosa* slack woodland

Tree height (m) 2-12
Shrub/bracken height (m) 1-3
Herb height (cm) 30-50
Tree cover (%) 70-100
Shrub cover (%) 0-40
Herb cover (%) 50
Cryptogam cover (%) 20

Bare surface (%) -
pH 5.9-6.5
Mean species per quadrat 11.7

FREQ- DOMIN
UENCY VALUE

Iris pseudacorus IV 5
Rubus fruticosus agg. IV 5
Galium palustre IV 3
Alnus glutinosa IV 9
Salix cinerea III 7
Solanum dulcamara III 4
Calliergon cuspidatum III 6
Phragmites australis II 3
Oenanthe crocata II 4
Holcus lanatus II 4
Lycopus europaeus II 3
Agrostis stolonifera II 3
Berula erecta II 2
Carex remota II 4
Filipendula ulmaria II 3
Geranium robertianum II 4

MAP VEGETATION
UNIT UNIT

32 X7 *Acer pseudoplatanus* woodland

Tree height (m) 4-16
Shrub/bracken height (m) 0-6
Herb height (cm) 20-40
Tree cover (%) 60-95
Shrub cover (%) 0-50
Herb cover (%) 20-50
Cryptogam cover (%) 10

Bare surface (%) -
pH 6.3
Mean species per quadrat 12.0

FREQ- DOMIN
UENCY VALUE

Acer pseudoplatanus V 9
Rubus fruticosus IV 4
Hyacinthoides non-scripta III 3
Geranium robertianum III 3
Hedera helix III 6
Arum maculatum II 1
Crataegus monogyna II 3
Glechoma hederacea II 4
Pteridium aquilinum II 2
Rubus caesius II 4
Silene dioica II 2
Brachythecium rutabulum II 4

ANNEX 6

TARGET NOTES

These are marked on the site map sheet(s) as TNn.

PENNARD

- 1 Acidic dune grassland in this area damaged by turf stripping, probably by local residents for lawns. At time of survey this area was the main grazing for commoners' ponies which are unperturbed by golf.
- 2 Severe erosion around footpaths (leading to collapse of wooden walkways in places). May be responsible for re-activation of blowouts in some localities.
- 3 Turf heavily trampled by illicit camping but not yet broken and eroded. Adjacent scrub on hill heavily fouled with human excreta.
- 4 *Spiranthes spiralis* (Autumn Lady's Tresses) present in short turf away from eroding footpaths up to plateau.
- 5 Very rapid succession to various types of scrub taking place on top and edge of slope - was probably effectively fenced and grazed in the past.
- 6 Gorse scrub (27) is heavily burnt in this locality (several fires in very recent years) but there is very active regeneration.

PENMAEN

- 1 *Rubus fruticosus* agg. is dominant in area of former *Ulex europaeus* scrub - old burnt stems of latter protrude through thick regrowth.
- 2 An area of young dunes detached from main system and formerly badly damaged by trampling. Now fenced off and brushwood laid, plus planted Marram, to encourage regeneration. Very successful in several places.
- 3 Hummocky ground very clear in field and on air photos but exact origin uncertain (OS map marks remains of chapel in area but this is probably not the cause). Microrelief has no very clear impact on vegetation.

ANNEX 6

TARGET NOTES

These are marked on the site map sheet(s) as TNn.

NICHOLASTON

- 1 Buried drystone wall exposed in sand showing former old field boundary.
- 2 Small outcrop of bedrock limestone exposed by deflation.
- 3 Path erosion was formerly very serious in the centre of the dune system where various tracks to sea diverged. Some control now in effect by fencing and layer of mollusc shell on path to reduce deflation - adjacent vegetation is regenerating quite quickly at present.
- 4 The only real evidence of a slack at Nicholaston - patchy 3m high *Salix cinerea* with a thick tall herb ground layer (close to type 13 vegetation) in which there is abundant *Carex acutiformis*. Mapped as type 23 because of *Salix* quantity.
- 5 Gabirons have been constructed in mouth of Nicholaston Pill and there have been large local changes in strandline, foredune and low mobile dune positions compared to the aerial photographs.

OXWICH

- 1 Bracken-infested stable dune grasslands are mown in this area in attempt to restore a diverse sward. At time of survey pens were being erected to receive goats as re-introduction of grazing.
- 2 Large numbers of dead *Ulmus* sp. present on transition to damp ground. A thick and nearly impenetrable scrub growth has invaded (*Pteridium*, *Rubus*, *Convolvulus arvensis*, *Sambucus nigra*).
- 3 Boardwalk cuts through S4 *Phragmites* swamp and features a raised observation platform.
- 4 A series of fenced exclosures are in position for a considerable length of frontal dune to exclude people and to assist revegetation.
- 5 Brushwood laid in recent blowout in dune front to attempt stabilisation.
- 6 See Nicholaston note on gabirons in position here.
- 7 Extension of alder woodland into saltmarsh is being partly controlled by cutting and herbicide.

ANNEX 7

QUADRAT DATA (COMPUTER FORMAT)

Full tabulation of all quadrat data as sample-species tables is too costly in terms of space. A reduced version of the data in NVC format for use in the VESPAN2 package is given here. A copy of this data aggregated for all sites has been supplied to the NCC Nominated Officer on floppy diskette. For readers with access to VESPAN2 it is thus possible to obtain the data and display individual quadrats in full format.

The species characteristics of vegetation types are presented in great detail in Annex 5 (apart from infrequent species), based on data from all sites. Particular characteristics of this site are emphasised under descriptions of vegetation types in Annex 3. Quadrat membership of vegetation types is listed in Annex 4. This organisation of information should satisfy most readers.

469 9 0 10 0 11 50 13 0 14 0 15 30 16 0 22 70 116 3 159 6
 469 268 2 555 5 565 4 682 3 913 11272 1
 470 9 0 10 0 11 25 13 0 14 0 15 20 16 0 22 80 116 5 117 2
 470 210 1 555 1 565 1 636 2 778 1 975 21143 1
 471 9 0 10 0 11 40 13 0 14 0 15 50 16 0 22 50 116 5 159 5
 471 218 3 268 3 283 1 452 4 555 5 565 11143 21184 31272 31355 4
 472 9 0 10 0 11 40 13 0 14 0 15 10 16 60 22 40 116 2 159 5
 472 194 3 381 3 555 4 682 2 706 3 711 4 769 2 913 3 914 4 958 3
 472 1434 31510 42023 7
 473 9 0 10 0 11 40 13 0 14 0 15 10 16 80 22 10 116 2 159 4
 473 194 3 381 3 680 1 706 4 711 3 769 2 913 5 958 41015 41123 1
 473 1225 41434 21510 41586 81562 42023 52362 42377 42416 22486 4
 473 2586 1
 474 9 0 10 0 11 40 13 0 14 0 15 10 16 80 22 5 159 5 194 2
 474 304 2 381 3 680 2 706 3 711 2 769 1 913 1 958 4 965 41015 5
 474 1127 51239 21501 41510 31586 71562 62023 32366 42377 42391 4
 474 2416 32486 5 447 3
 475 9 2 10 0 11 60 13 1 14 0 15100 16 40 22 0 159 6 304 3
 475 465 4 576 7 589 1 680 5 701 4 913 1 973 2 988 31015 11078 1
 475 1123 51127 31143 31239 31586 62362 42486 4
 476 9 0 10 0 11 10 13 0 14 0 15 20 16 90 22 0 159 4 194 2
 476 304 4 381 2 421 4 680 2 701 3 706 4 711 3 769 2 958 3 965 5
 476 988 21015 11123 41225 41270 31321 31432 21434 31586 51562 5
 476 2362 22366 42377 42486 6
 477 9 3 10 0 11 50 13 10 14 0 15 80 16 60 22 0 159 3 304 3
 477 381 2 421 7 576 3 587 1 589 4 652 4 680 4 711 1 958 11015 5
 477 1123 61270 41321 21638 61562 52167 42362 32366 32486 3
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 480 1368 41677 7
 481 9 4 10 1 11100 13 60 14 70 15 70 16 20 22 0 113 6 302 7
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 481 1445 5
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 482 1321 41914 6
 483 9 0 10 0 11 30 13 0 14 0 15 60 16 80 22 5 159 5 304 3
 483 576 6 631 5 706 2 769 2 807 3 914 51066 41123 41205 31333 4
 483 1562 71914 62023 42377 3 447 3
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 484 2362 42366 32377 4
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 487 1123 31205 41225 21239 21432 41434 41510 41586 52023 7

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 492 441 6 445 4 516 3 522 2 589 4 630 3 637 4 652 61136 91254 2
 492 1321 31429 31519 4
 493 9 0 10 1 11 25 13 0 14 1 15100 16 50 22 0 123 4 171 5
 493 465 3 576 4 613 5 631 6 654 7 776 1 988 31066 41123 41127 4
 493 1321 31638 51801 61914 52366 4
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 494 441 5 652 6 798 71066 51123 31126 31136 81313 41363 61368 2
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 495 124 3 171 5 371 2 465 5 574 4 576 7 613 3 654 7 656 6 973 4
 495 988 51053 51321 31914 5

496 9 0 10 1 11 40 13 0 14 60 15 50 16 20 22 0 123 6 171 3
 496 247 3 323 3 465 4 654 6 973 3 988 41053 41066 41126 41136 6
 496 1321 51363 81914 5
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 497 1126 61136 101321 6
 498 9 0 10 0 11 30 13 0 14 0 15100 16 0 22 0 104 4 113 3
 498 123 5 171 4 415 3 465 6 574 4 576 7 680 6 706 2 800 4 973 5
 498 988 41050 51396 4
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 499 171 2 304 3 362 3 465 5 576 5 610 4 680 8 800 3 988 51066 8
 499 1396 4
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 500 310 4 323 4 388 1 465 3 574 6 576 4 654 6 800 3 965 3 973 4
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 502 576 5 613 5 631 7 680 4 800 41053 31066 51127 51321 21677 3
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 503 1434 4
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 508 1894 51897 72362 4
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 511 478 3 541 10 574 3 674 11046 31066 81375 31766 62701 4
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 521 1677 4
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 522 1136 61368 3

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534 1127 31169 41179 81914 8
535 9 0 10 1 11 30 13 0 14 80 15 25 16 25 22 0 159 3 304 3
535 465 4 522 1 576 5 630 4 776 9 914 21066 41127 41239 31519 6
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543 304 3 369 3 381 3 385 3 543 2 680 2 706 3 807 3 913 1 914 5
543 958 41066 51127 51434 31586 62023 72377 42486 5
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544 557 1 576 4 630 7 634 11066 81136 91254 41368 41396 41519 5
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546 194 4 304 3 373 2 543 3 706 3 769 2 913 2 958 2 973 1 988 2
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551 1562 4 447 2
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554 630 3 652 61015 31078 91136 101254 41368 6
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555 589 5 630 2 634 4 652 8 864 4 990 31015 41056 41136 61368 3
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556 576 4 613 6 680 6 706 4 769 3 807 4 913 1 914 2 973 3 988 4
556 1015 31078 11127 61239 31249 31638 41766 82362 42486 6 447 2
557 9 12 10 0 11 20 13 60 14 0 15 70 16 20 22 0 153 6 236 8
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559 965 4 988 41127 61225 21239 21562 72362 72366 42486 5 447 3
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560 304 4 373 2 568 2 576 3 680 3 706 1 800 4 807 4 914 5 965 7
560 1127 51239 21321 21562 62362 52486 5
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561 558 6 680 3 734 8 813 3 831 2 855 4 911 31069 51143 31677 4
561 2714 1
562 9 3 10 0 11150 13 60 14 0 15100 16 0 22 0 122 4 153 8
562 433 5 558 6 680 3 734 7 813 3 831 2 855 6 911 2 961 51069 7
563 9 10 10 1 11 40 13 90 14 30 15 60 16 10 22 0 122 4 153 9
563 350 2 909 4 433 6 445 1 532 2 558 2 630 3 652 5 715 4 823 3
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564 555 11184 3
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565 159 3 268 51184 42801 5

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567 1368 51429 32936 8
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572 1914 51940 42362 42486 5 447 3
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574 171 5 574 5 613 4 631 1 706 3 769 1 807 4 914 4 965 4 973 5
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575 988 41066 91136 51363 61429 2
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576 576 9 613 3 680 5 973 3 988 31066 71139 41396 4
577 9 0 10 1 11 90 13 0 14 80 15 80 16 0 22 0 576 6 613 2
577 973 3 988 41066 71127 9
578 9 0 10 2 11160 13 0 14 80 15 50 16 0 22 0 103 4 104 3
578 197 4 445 5 522 3 558 2 576 4 587 2 605 3 637 5 680 4 973 2
578 988 31066 71078 41127 41136 71139 31313 31363 81368 3
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579 445 4 558 4 576 4 630 2 637 2 680 5 988 41066 101136 81254 2
579 1368 32982 1
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580 197 2 576 4 680 5 988 51066 91136 51429 21677 42936 3
581 9 0 10 0 11 30 13 0 14 0 15100 16 0 22 0 113 2 123 5
581 371 4 460 4 465 7 576 6 680 5 706 1 758 4 807 2 973 41066 4
581 1139 41239 3
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583 171 4 304 3 574 7 706 4 988 31066 41638 51677 41914 7
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585 278 4 304 4 574 7 769 31638 61897 42362 42366 42410 3
586 9 0 10 0 11 5 13 0 14 0 15 70 16 50 22 2 123 6 125 3
586 171 4 304 4 568 2 574 7 613 4 706 3 769 21205 41239 21333 5
586 1638 61766 61897 41940 52486 5 447 3
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587 1914 6

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588 2366 72410 4
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591 9 0 10 0 11 15 13 0 14 0 15100 16 70 22 0 171 5 576 7
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591 1350 31914 61940 41941 6
592 9 0 10 0 11 40 13 0 14 0 15100 16 10 22 0 159 5 171 3
592 304 2 576 8 631 8 769 1 914 51066 51677 4
593 9 0 10 0 11 10 13 0 14 0 15100 16 10 22 0 174 5 241 1
593 251 5 288 3 323 3 460 3 574 5 576 6 631 4 800 5 914 5 965 3
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594 195 4 202 4 574 8 576 4 613 4 706 4 746 4 800 4 965 4 973 4
594 975 31205 41244 51333 51766 42362 42366 5
595 9 0 10 0 11 15 13 0 14 0 15 50 16 15 22 50 159 6 174 3
595 194 3 283 4 381 2 576 4 613 4 680 3 706 4 746 4 914 5 958 3
595 973 31205 41239 21333 41562 31562 32023 4
596 9 0 10 1 11 30 13 0 14 60 15 50 16 0 22 0 123 8 171 4
596 680 31066 51136 61321 71363 6

ANNEX 8

AREAS OF VEGETATION TYPES

The table below lists the area (in hectares) of vegetation types at this site(s). Results are based on weighing on a balance accurate to 10mg - small categories may not be fully accurate. O = Oxwich, N = Nicholaston, PM = Penmaen, PN = Pennard. CG = Calcareous grassland, G = Golf fairways and greens.

Map Unit	NVC or non-NVC Unit	O	N	PM	PN	TOTAL
1	X1	0.51	0.64	-	-	1.15
2	SD4	-	-	0.26	0.64	0.90
3	SD6a	1.41	2.56	0.13	-	4.10
4	SD6d	1.92	-	1.15	1.54	4.61
5	SD6e	-	-	-	-	-
6	SD7c	24.68	-	0.38	1.03	26.09
7	SD7d	10.26	4.49	-	-	14.75
8	SD8	3.21	1.92	0.13	26.92	32.18
9	SD9	0.38	2.56	1.92	1.54	6.40
10	SD12	-	-	3.85	16.02	19.87
11	H11	-	-	2.56	3.84	6.40
12	SD14c-SD15a/b	5.13	-	-	-	5.13
13	SD15c	2.56	-	-	-	2.56
14	SD16a/b-SD16c/d	1.03	-	-	-	1.03
15	SD17	0.13	-	-	-	0.13
16	SM18b	0.96*	-	-	-	0.96
17	SM24	-	-	-	-	-
18	S4a	3.21*	-	-	-	3.21*
19	S4d-S21b	-	1.03*	-	-	1.03*
20	S12b	-	-	-	-	-
21	SD18a	-	-	-	-	-
22	SD18b	-	-	-	-	-
23	W1	7.05	0.38	-	-	7.43
24	W10c	3.21	-	-	-	3.21
25	W21a	1.02	1.55	1.92	1.41	5.90
26	W22	-	-	-	0.51	0.51
27	W23	-	-	1.28	7.57	8.85
28	W24	3.85	0.52	5.13	2.57	12.07
29	W25	3.85	-	1.92	-	5.77
30	X2	6.40	-	-	-	6.40
31	X3	-	-	-	-	-
32	X4	-	1.03	-	1.16	2.19
1-11 (strand/ grassland/heath)		42.37	12.17	10.38	51.53	116.45
12-15 (dune slacks)		8.85	-	-	-	8.85
16-20 (saltmarsh/ swamp)		4.17*	1.03*	-	-	5.20*
21-32 (scrub/ woodland)		25.38	3.48	10.25	13.22	52.33
Other: CG		-	0.51	0.38	-	0.89
G		-	-	-	19.23	19.23
Total		80.77	17.19	21.01	83.98	202.95

(* = incomplete total, not fully surveyed)

ANNEX 9

SITE BIBLIOGRAPHY

Most information held at the Oxwich Information Centre by the NCC applies only to Oxwich Burrows. There is a very limited amount on Nicholaston and Penmaen Burrows. There is no literature on Pennard Burrows.

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MAPPING AND VEGETATION UNITS FOR 1989 SOUTH WALES DUNE SURVEY

STRAND, DUNE AND TRANSITIONS

a	b	
1	X1	Dry foredune/saltmarsh/strandline transition community
2	SD4	<i>Elymus farctus</i> foredune community
3	SD6a	<i>Ammophila arenaria</i> mobile dune community <i>Elymus farctus</i> sub-community
4	SD6d	<i>Ammophila arenaria</i> mobile dune community Typical sub-community
5	SD6e	<i>Ammophila arenaria</i> mobile dune community <i>Festuca rubra</i> sub-community
6	SD7c	<i>Ammophila arenaria</i> - <i>Festuca rubra</i> semi-fixed dune community <i>Ononis repens</i> sub-community
7	SD7d	<i>Ammophila arenaria</i> - <i>Festuca rubra</i> semi-fixed dune community <i>Tortula ruralis</i> ssp. <i>ruraliformis</i> sub-community
8	SD8	<i>Festuca rubra</i> - <i>Galium verum</i> fixed dune community No clear NVC sub-community
9	SD9	<i>Ammophila arenaria</i> - <i>Arrhenatherum elatius</i> dune grassland No clear NVC sub-community
10	SD12	<i>Carex arenaria</i> - <i>Festuca ovina</i> - <i>Agrostis capillaris</i> grassland No clear NVC sub-community
11	H11	<i>Calluna vulgaris</i> - <i>Carex arenaria</i> heath

a = mapping unit b = vegetation unit
X = Major non-NVC category or transitional type

MAPPING AND VEGETATION UNITS FOR 1989 SOUTH WALES DUNE SURVEY

SLACK, SALTMARSH AND SWAMP

a	b	
12	SD14c	<i>Salix repens</i> - <i>Campylium stellatum</i> dune slack <i>Bryum pseudotriquetrum</i> - <i>Aneura pinguis</i> sub-community
12	SD15a/b	<i>Salix repens</i> - <i>Calliargon cuspidatum</i> dune slack <i>Carex nigra</i> sub-community (a) <i>Equisetum variegatum</i> sub-community (b)
13	SD15c	<i>Salix repens</i> - <i>Calliargon cuspidatum</i> dune slack <i>Carex flacca</i> - <i>Pulicaria dysenterica</i> sub-community
14	SD16a/b	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack <i>Ononis repens</i> sub-community (a) <i>Rubus caesius</i> sub-community (b)
14	SD16c/d	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack <i>Prunella vulgaris</i> - <i>Equisetum variegatum</i> sub-community (c) <i>Agrostis stolonifera</i> sub-community (d)
15	SD17	<i>Potentilla anserina</i> - <i>Carex nigra</i> dune slack No clear NVC sub-community
16	SM18b	<i>Juncus maritimus</i> saltmarsh <i>Oenanthe lachenalii</i> sub-community
17	SM24	<i>Elymus pycnanthus</i> saltmarsh
18	S4a	<i>Phragmites australis</i> swamp and reed-beds <i>Phragmites australis</i> sub-community
19	S4d	<i>Phragmites australis</i> swamp and reed-beds <i>Atriplex hastata</i> sub-community
19	S21b	<i>Scirpus maritimus</i> swamp <i>Atriplex hastata</i> sub-community
20	S12b	<i>Typha latifolia</i> swamp <i>Mentha aquatica</i> sub-community

a = mapping unit b = vegetation unit

X = Non-NVC category or transitional type

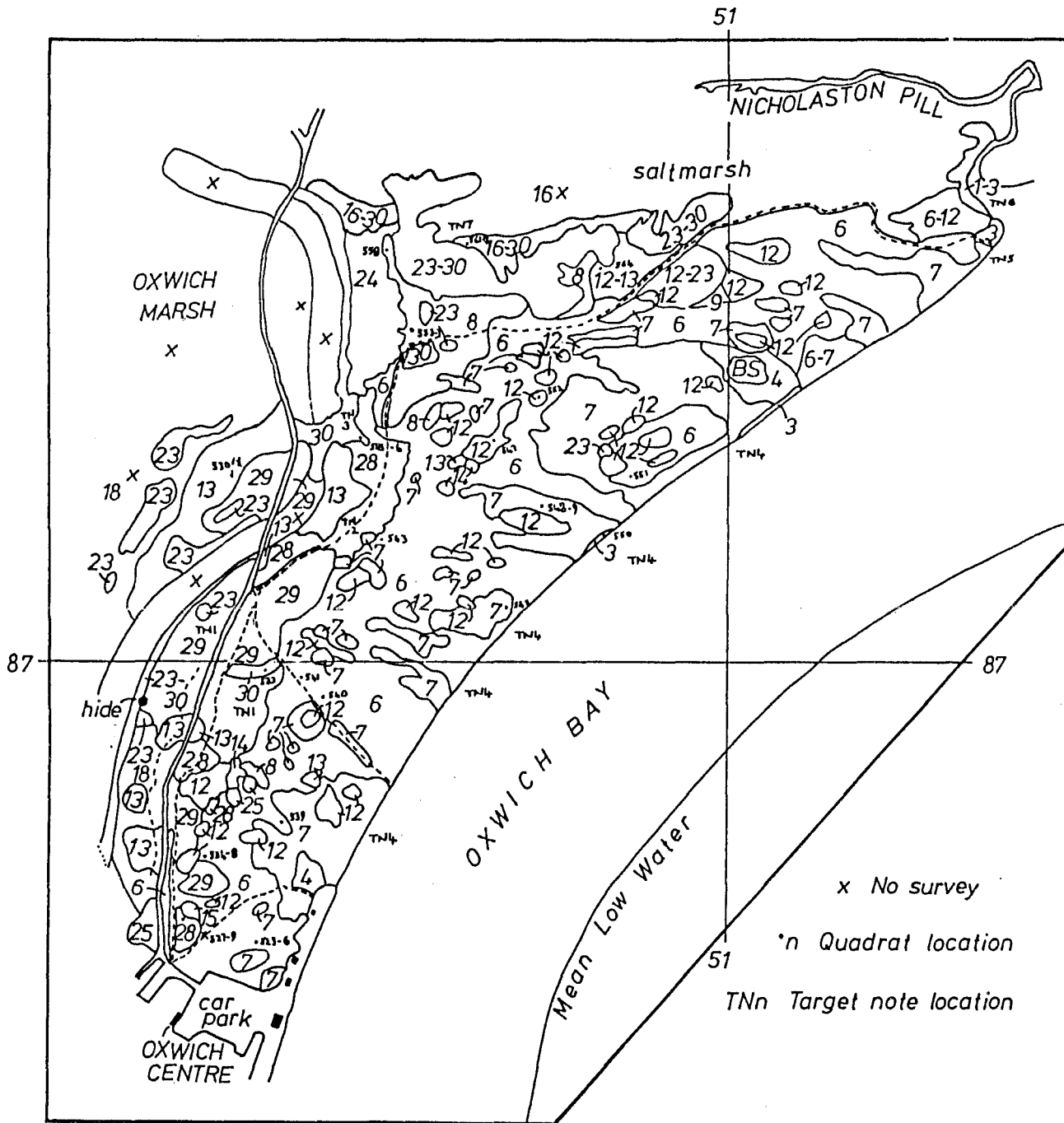
MAPPING AND VEGETATION UNITS FOR 1989 SOUTH WALES DUNE SURVEY

WOODLAND AND SCRUB

a	b	
21	SD18a	<i>Hippophae rhamnoides</i> scrub <i>Festuca rubra</i> sub-community
22	SD18b	<i>Hippophae rhamnoides</i> scrub <i>Urtica dioica</i> - <i>Arrhenatherum elatius</i> sub-community
23	W1	<i>Salix cinerea</i> - <i>Galium palustre</i> woodland
24	W10c	<i>Quercus robur</i> - <i>Pteridium aquilinum</i> - <i>Rubus fruticosus</i> agg. woodland <i>Hedera helix</i> sub-community
25	W21	<i>Crataegus monogyna</i> - <i>Hedera helix</i> scrub <i>Hedera helix</i> - <i>Urtica dioica</i> sub-community
26	W22	<i>Prunus spinosa</i> - <i>Rubus fruticosus</i> agg. scrub No clear NVC sub-community
27	W23	<i>Ulex europaeus</i> - <i>Rubus fruticosus</i> agg. scrub No clear NVC sub-community
28	W24	<i>Rubus fruticosus</i> agg. - <i>Holcus lanatus</i> underscrub No clear NVC sub-community
29	W25	<i>Pteridium aquilinum</i> - <i>Rubus fruticosus</i> agg. underscrub No clear NVC sub-community
30	X2	<i>Alnus glutinosa</i> slack woodland
31	X3	<i>Pinus nigra/sylvestris</i> woodland
32	X4	<i>Acer pseudoplatanus</i> woodland

a = mapping unit b = vegetation unit
X = Non-NVC category or transitional type

Oxwich

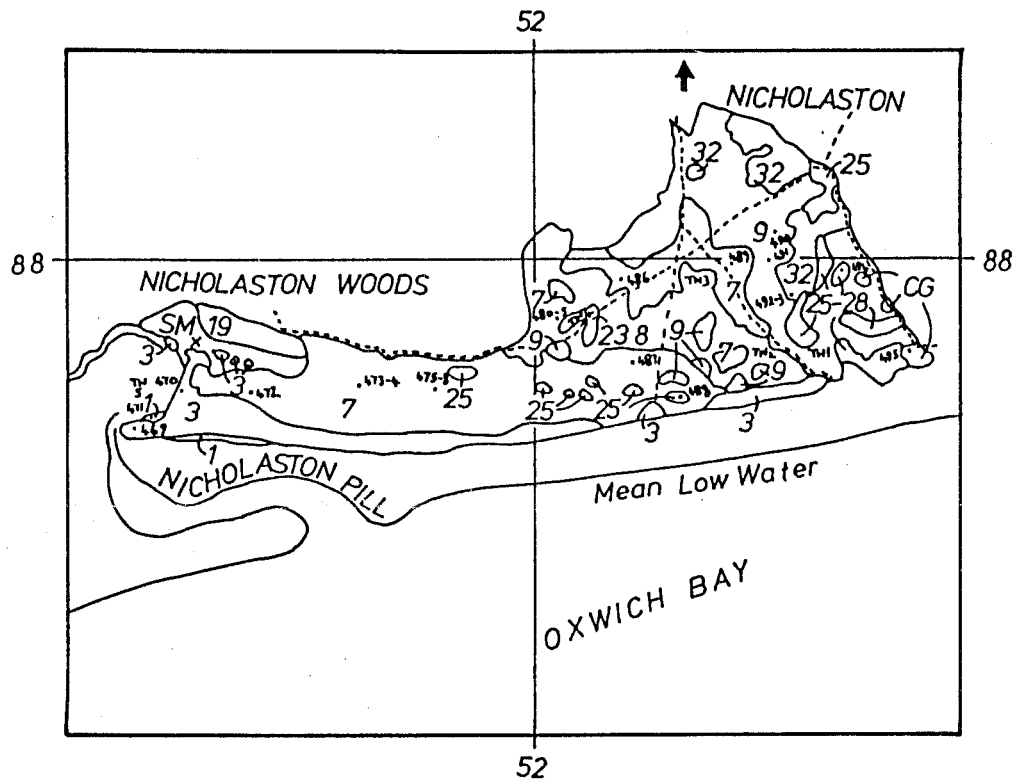


Vegetation legend on separate sheet

Surveyed 1989 by T.C.D. Dargie

0 500 1000 metres

Nicholaston



•n Quadrat location TNn Target note location x No survey

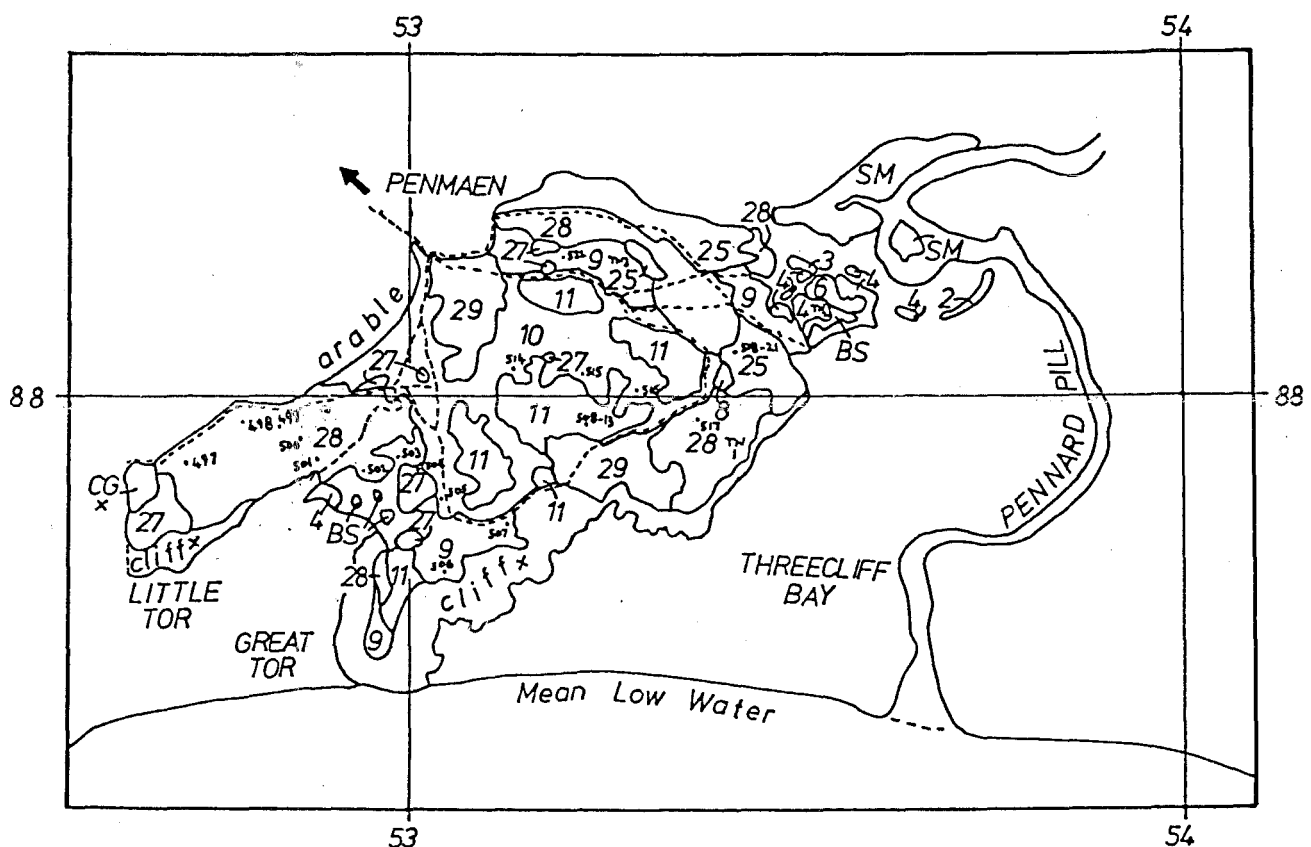
CG Calcicolous grassland SM Saltmarsh

Vegetation legend on separate sheet

Surveyed 1989 by T.C.D. Dargie

0 500 1000 metres

Penmaen



•n Quadrat location TN Target note location CG Calcareous grassland x No survey

Vegetation legend on separate sheet

Surveyed 1989 by T.C.D. Dargie

0 500 1000 metres

•n Quadrat location
 TN_n Target note location

BS Bare Sand

SM Saltmarsh

G Golf greens and fairways

IG Improved grassland

x Not surveyed

Vegetation legend on separate sheet

