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**No. 101**  
**NATIONAL SAND DUNE VEGETATION SURVEY**  
**SOUTH WALES DUNE SURVEY**  
**SITE REPORT NO. 51**  
**WHITEFORD BURROWS**  
**1989**

**T C DARGIE**

Contract HF3-03-434

Nominated Officer: G. Radley, CSD

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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.
- b. *Contract survey reports*
- c. *Research and survey in nature conservation*
- d. *Focus on nature conservation*

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

Whiteford Burrows was 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 Whiteford Burrows is to be considered in a broader geographical and ecological context.

## 2. METHODS

Whiteford Burrows was 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

Whiteford Burrows forms the northwestern point of the Gower Peninsula in South Wales (Fig. 1). The dune area falls within two SSSIs: Cwm Ivy Marsh, Dunes & Tor (76.3ha) and Whiteford Burrows - Landimore Marsh (842ha), both in Swansea District, West Glamorgan. The area is managed as an NNR. Whiteford Burrows is within the Gower AONB and is an integral part of the more extensive Burry Inlet site of international nature conservation importance.

Ownership/management lies with the National Trust/NCC and permission for access was obtained from both organisations.

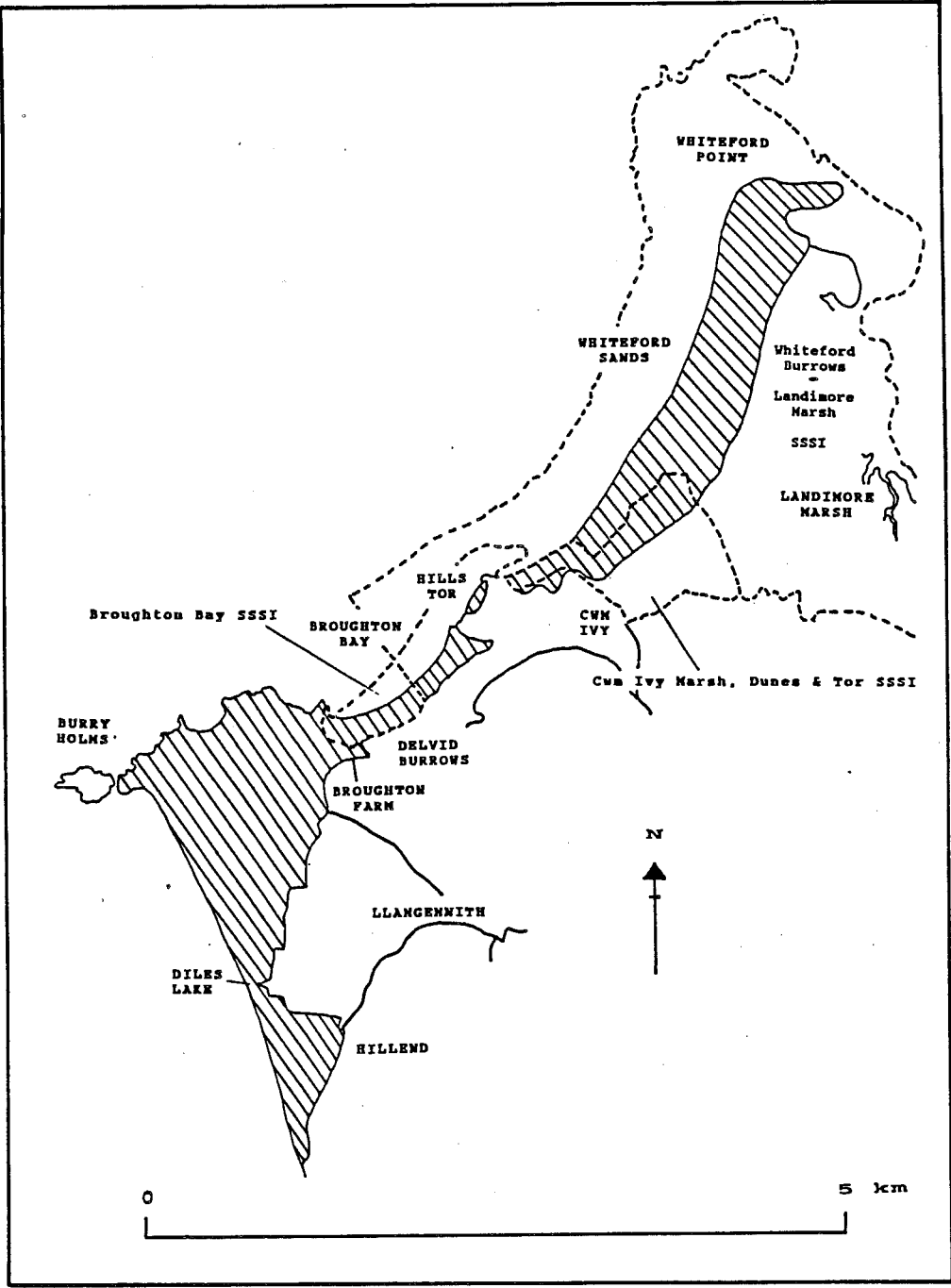


Figure 1 Survey and SSSI boundaries for Northwest Gower study area.

Dashed lines are SSSI boundaries  
Hatching denotes surveyed dune areas

## Geomorphology

Whiteford Burrows is a large (3 km length, 400-600m wide) barrier beach with a core of Devensian end moraine, deposited by ice in the adjoining Loughor Valley (Bridges 1987). As a spit it has several outstanding features (Baye 1981):

- i. seaward deflection of distal end;
- ii. northeastern net longshore transport;
- iii. large mobile dune ridge on west side with parallel line of steep-sided slacks to immediate east, plus secondary blowout system at distal end with young slacks;
- iv. two complex spit recurves of sand and shingle (NB three in 1989);
- v. shallow arcuate dune ridges at distal end giving ridge and swale topography, truncated by recession at proximal end in recent decades (NB truncation at centre in 1989);
- vi. recurved intertidal sand ridge (foreshore spit) which usually dissipates stormwave energy;
- vii. extensive backdune field with slack blowouts and parabolic dunes;
- viii. much evidence of alternating phases of erosion and accretion, the accretion phase leading to a spit recurve and not spit progradation;
- ix. possible tombolo structure if Berges Island (the distal end) was once a detached till island.

The southern sectors contain sand banked against steep Carboniferous Limestone cliff slopes. In other parts of Gower this feature was deposited during stormy conditions between the 14th and 18th centuries. These dates probably also apply to Whiteford.

## Soils

Almost all samples from dune, slack, scrub and woodland were probably calcareous because pH ranged between 6.8 and 8.0. These results show that most environments have been influenced by calcareous beach sand or by an alkaline/brackish watertable.

## Management

Whiteford is managed as an NNR by NCC. Some management responsibility in the south is devolved to the National Trust for maintaining fencing to exclude pony grazing from Corsican Pine plantations. There is no close car park and access has to be on foot from Hills Tor or from Cwm Ivy. This restricts visitor numbers but the southern beach sectors are popular, as is a walk to Whiteford Point and return through the dunes along the eastern sand edge. In general recreational pressure is not great.

Grazing is maintained by ponies (though rabbits are plentiful too in the south). Numbers have varied over time, e.g. 50 ponies and 30-100 sheep (Ranwell 1967), 78-90 ponies (Glyn 1975). Grazing exclosure experiments have been reported (Bray 1977). In the past grazing might have been responsible for much erosion in the back dunes where most old parabolic blowouts are restricted in a variety of positions (Baye 1981).

Selective clearance of Corsican Pine has taken place in northern sectors to reduce shade impacts on slack and dune. These areas are still monitored but recovery is slow. The growth of deciduous trees under a Corsican Pine canopy in the south is also being monitored. Sea Buckthorn (*Hippophae rhamnoides*) was previously a problem but clearance was started in July 1967 and the area has been largely clear of this invasive shrub for almost a decade (Davies 1981).

#### 4. VEGETATION OF WHITEFORD BURROWS

This section contains a general description of the vegetation of Whiteford 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 is given in Annex 8.

##### Strandline

The strandline is poorly developed on the exposed outer dune edges and sand burial transforms it into a foredune. In more sheltered locations to leeward, on the transition between saltmarsh and dune, there 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*), 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

On the western side there is a good belt of foredunes for a distance of c. 1.5km from the relative shelter of Hills Tor. Close to the position of the strandline there is a fragmented line of embryo foredunes dominated by Sand Couch (*Elymus farctus*). Additional infrequent species suggest that the sand has buried a strandline: Spear-leaved Orache, Sea Rocket (*Cakile maritima*), Sea Sandwort and Sea Beet. This is mapped as 2 and the NVC code is SD4. Above this position the foredunes 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 (*Eryngium maritimum*), Sea Spurge (*Euphorbia paralias*), Evening Primrose (*Oenothera erythrosepala*) and Common Ragwort (*Senecio jacobaea*). This is mapped as 3 and the NVC code is SD6a.

In the shelter of Whiteford Point the two types of foredune are separated. Type 3 occupies the foot of the northern dune scarp but Type 2 merges with the strandline transition below the recurved spits which run on to saltmarsh.



## Dune grassland

The distribution of dune grassland is made up of three spatial patterns. First, the exposed western edge has a relatively thin (50-100m) outer band of mobile dunes. Second, to leeward, there is a complex mosaic of semi-fixed and fixed grassland related to old and modern blowout distribution, slack presence, afforestation and the stage of dune stabilization attained. Third, at Whiteford Point, there is a mosaic of mobile and semi-fixed dune grassland types related to the exposure, current systems and active blowouts in that area.

The western mobile dunes are a species-poor Marram Grass (*Ammophila arenaria*) dune ridge (4 - NVC SD6d), with a thin strip of Marram - Red Fescue (*Festuca rubra*) mobile dune (5 -NVC SD6e) immediately to leeward on ridge backslopes and basal depressions. Despite exposure there can be shrub invasion in this zone and both Traveller's Joy (*Clematis vitalba*) and Dewberry (*Rubus caesius*) can form extensive patches.

In the more easterly backdunes the most common feature is a mosaic of two semi-fixed dune grassland types. On the gentler slopes there is a mix of Marram, Red Fescue and Common Restharrow (*Ononis repens*) - Type 6 NVC SD7c. This changes to a lower cover of Marram and Red Fescue on steeper dune slopes which were formerly the sides of active blowout systems. A moss sward is usually dominant (*Tortula ruralis* ssp. *ruraliformis*) and annual species are very common: Sand Cat's Tail (*Phleum arenarium*), Thyme-leaved Sandwort (*Arenaria serpyllifolia*), Sea Mouse-ear Chickweed (*Cerastium diffusum diffusum*) and the grass *Vulpia fasciculata*. This is mapped as 7 - NVC SD7d.

In areas of relative shelter, especially close to Hills Tor, a fixed dune grassland (8 - NVC SD8) is found with dominant Red Fescue and frequent Lady's Bedstraw (*Galium verum*). In a few places this shows leaching indicators (the moss *Dicranum scoparium* and the lichens *Cladonia rangiformis* and *C. impexa*) but there is no clear acidic grassland. In the south there are a few patches of very rank grassland with much False-oat Grass (*Arrhenatherum elatius*) mixed with Red Fescue. This is usually heavily invaded by either Blackberry (*Rubus fruticosus*) or Bracken (*Pteridium aquilinum*).

The third area, at Whiteford Point, has several large expanses of Type 4 Marram mobile dune and one large expanse of bare sand. This active blowout system has a fringe mosaic of Type 6 and Type 7 semi-fixed grassland. The recurved spits have a thin sand cover which is generally a mix of Type 6 and Type 7 grassland. This semi-fixed status is maintained by sand inputs from adjacent intertidal exposure and from the nearby active blowout system.

**Dune slack**

Slack environments relate closely to recent geomorphological change and the underlying till bedrock. On the western side of the dune system there is an impressive north-south line of sub-circular and steep-sided slacks just inside the outer dune ridge. All appear to have originated as wind breaches of the mobile dune ridge, followed by rapid dune reconstruction on the western side. In the backdunes further east there are much larger slacks with a topography related to old parabolic dune blowouts. These have considerable floor microtopography including 'baby' dunes and 'hedgehogs' capped with Creeping Willow (*Salix repens*). The third and final type of slack is a long linear wetland stretching most of the eastern side north from Cwm Ivy Marsh. It marks water moving over the underlying till and flushing onto the surface in places (even forming swamp), and grading downslope into saltmarsh.

The youngest slacks have been created in the rear of an active blowout close to Whiteford Point. A very species-rich sward contains Glaucous Sedge (*Carex flacca*), Fiorin (*Agrostis stolonifera*), Variegated Horsetail (*Equisetum variegatum*), Self-heal (*Prunella vulgaris*), Red Fescue, patches of Creeping Willow, the mosses *Bryum pseudotriquetrum* and *Campylium stellatum*, and the liverwort *Aneura pinguis*. There are also indicators of brackish conditions (e.g. Sea Milkwort *Glaux maritima*). This is Type 12a, mapped as 12, NVC SD14c.

Most western slacks are dominated by Creeping Willow and a carpet of the moss *Calliargon cuspidatum* (Type 12b, mapped as 12, NVC SD15). There are plentiful occurrences of the orchid Marsh Helleborine (*Epipactis palustris*).

The extensive backdune slacks (mainly 14 - NVC SD16) represent slacks formed by parabolic blowouts but then partly infilled with sand from dune erosion further west. They are therefore generally drier than other slack types. The sward is dominated by Red Fescue, Yorkshire Fog (*Holcus lanatus*), Bird's-foot Trefoil (*Lotus corniculatus*), Fiorin, Sand Sedge (*Carex arenaria*) and Creeping Willow. There is often a scatter of Common Restharrow.

The most eastern slack (13 - NVC SD15c) extends for almost 1.5km. It is a tall-herb community dominated by a mix of Fleabane (*Pulicaria dysenterica*), Yorkshire Fog, Water Mint (*Mentha aquatica*), Silverweed (*Potentilla anserina*), Sea Rush (*Juncus maritimus*), Yellow Iris (*Iris pseudacorus*), Marsh Pennywort (*Hydrocotyle vulgaris*) and the moss *Calliargon cuspidatum*. Towards its northern end there are stands with Marsh Mallow (*Althaea officinalis*).

## Woodland and scrub

There is little scrub at Whiteford. It no longer has Sea Buckthorn (*Hippophae rhamnoides*) in any quantity. There are several stands of Blackthorn (*Prunus spinosa*, Type 26 NVC W22) in the southern dunes on steep blowout sides. Grasslands on the slopes of Hills Tor and Cwm Ivy Tor are often shrub-invaded, especially close to Sycamore (*Acer pseudoplatanus*) woodland (32 - Non-NVC X4).

There are several blocks of planted Corsican Pine (some also contain Scots Pine *Pinus sylvestris*) and the southernmost have grazing excluded. All are mapped as 31 (non-NVC X3). Soil moisture is the main determinant of ground flora in the southern stands, reflecting the dune and slack topography before planting. Hawthorn (*Crataegus monogyna*) and Common Oak (*Quercus robur*) are sporadically present in ungrazed pine woodland. Unthinned plantings of pine are very species-poor and shading effects on slack areas are often pronounced even with much thinning.

Wet ground supports two further woodland types. Thickets of Common Sallow (*Salix cinerea*) are common in backdune slacks and all were mapped as 23 - NVC W1, though many samples still retained more of a slack flora due to relative immaturity. There is one stand of mature Alder (*Alnus glutinosa*) at the distal end, occupying part of the slack-saltmarsh transition. This is not a clear NVC type and was mapped as 30 - non-NVC X2. It resembles in part W6 *Alnus glutinosa* - *Urtica dioica* woodland.

## Other habitats

There are large areas of saltmarsh and some swamp in the eastern part of Whiteford Burrows. These were not surveyed in detail but close to the strandline there is Sea Rush (*Juncus maritimus*) saltmarsh (SM18b) in wet areas. The main swamp (20 - NVC S12b) former is Bulrush (*Typha latifolia*), found in transition zones with much surface water flushing. Grazing by ponies might also have eradicated a Common Reed (*Phragmites australis*) swamp from these areas. Calcareous grassland probably exists on the slopes of Cwm Ivy Tor but none was found in a very rapid reconnaissance of cliff slopes.

## Recent changes in vegetation

No early air photos were available to compare with 1989 survey material for an analysis of change. Field observations suggested that dunes were in a stable phase and recovering after at least one period of high dune mobility. This would explain much of the vegetation mosaic patterning and the different successional status of much dune grassland.

## 5. RARE PLANTS

The SSSI descriptions cite the following dune species with local and rare distribution: *Anacamptis pyramidalis*, *Dactylorhiza incarnata*, *D. praetermissa*, *Gentianella uliginosa*, *Mibora minima*, *Rumex maritimus* and *Liparis loeselii* (most abundant location in county).

## 6. SITE ASSESSMENT

Whiteford Burrows is important as a high-quality site of geomorphological and biological interest. It is a large dune system and most communities are natural types with little anthropological influence. It has a good range of community diversity in its dune vegetation, including actively accreting foredunes and a range of mobile, semi-fixed and fixed grasslands. It lacks only acidic grassland and dune heath. Unlike most dune systems in South Wales it still maintains a reasonable level of grazing by pony stock. There are also several local or rare species, most of which are present in reasonable numbers.

There are no severe problems affecting site quality. Trampling by walkers has created a small path network but recreational pressure is slight. There is some scrub encroachment taking place in the southern dune sectors but this is not serious.

## 7. COMMENTS AND SUGGESTIONS

The present survey has confirmed that the site still retains high-quality dune vegetation and that there are few immediate problems. A full monitoring programme on a variety of research projects is maintained, backed up by several baseline surveys. There appear to be few gaps though the link between grazing, management and possible erosion (past and future) is still not fully clear.

## 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	Anno aren 159	Anac pyra 160
Anag tene 163	Anth odor 171	Anth vuln 174	Aren serp 194	Arac aari 195
Arrh elat 197	Atri hest 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 semi 385	Cirs arve 415	Cirs vulg 419	Coch dani 425
Coch offi 427	Cory cane 3075	Crep capi 447	Crit aari 452	Cyti scop 1193
Dact glom 465	Dact inca 467	Dact maja 2828	Dant decu 1249	Dauc caro 475
Desc cesp 477	Desc flex 478	Eleo palu 509	Elym fere 116	Elym oycn 117
Elym repe 118	Epil angu 391	Epip palu 531	Equi arve 532	Equi hzem 534
Equi palu 535	Equi vari 539	Erig acer 543	Erio lati 547	Erod cicu 549
Erop vern 552	Eryn aari 555	Euph offi 568	Euph para 565	Euph port 567
Fest ovin 574	Fest rubr 576	Fili ulna 583	Gali apar 605	Gali palu 609
Gali veru 613	Gent ulig 3052	Glau flav 635	Glau aari 636	Hera spho 661
Hier pilo 965	Hippo rham 678	Hole lana 680	Horn pepi 682	Horn petr 686
Hydr vulg 690	Hypo glob 704	Hypo radi 706	Iris pseu 715	Junc acut 720
Junc arti 722	Junc bufo 725	Junc bulb 726	Junc gera 732	Junc aari 734
Junc squa 736	Koel macr 746	Leon autu 768	Leon tara 770	Lepi lati 3702
Liao bine 778	Linu cath 786	Lipa loea 3074	Lotu corn 800	Lotu ulig 802
Luzu camp 807	Lych flos 813	Lycu euro 823	Matr aari 1355	Matr sinu 841
Medi lupu 844	Ment aqua 855	Mibo aini 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	Phra aust 961	Plan coro 972	Plan lanc 973	Plan aari 975
Poa prat 988	Poa triv 990	Poly olys 1010	Poly vulg 995	Popu trem 1022
Pote anse 1043	Prun vulg 1059	Pter aequi 1066	Puli dyse 1069	Pyro rotu 1073
Ranu acri 1081	Ranu flaa 1089	Ranu repe 1095	Rhin aino 1106	Rubu frut 1136
Ruae acet 1139	Ruae cris 1143	Ruae ella 1140	Ruae aari 1146	Sagi proc 1158
Sali repe 1179	Sals kali 1184	Samb nigr 1187	Samo vale 1189	Scir aari 1213
Scir seta 1214	Sedu acre 1225	Sene jaco 1239	Sene vulg 1243	Sile coni 3235
Sile vulg 1259	Sola dulc 1268	Soli virg 1270	Sone arve 1271	Sone aspe 1272
Stel nedl 1298	Tara offi 2982	Tees nudl 1320	Teuc scor 1321	Thya prae 1333
Trif camp 1342	Trif dubi 1343	Trif prat 1349	Trif repe 1350	Trig aari 1353
Trig palu 1354	Ulex euro 1363	Vero chaa 1396	Vero offi 1401	Vici sati 2707
Viol cani 1422	Viol rivi 1429	Viol tric 1432	Vulp fasc 1434	
Brac albi 1510	Brac ruta 1519	Bryu alpo 1545	Bryu sp. 2807	Call cusp 1445
Camp stel 1571	Cera purp 1586	Clad arbu 2340	Clad furc 2362	Clad rang 2381
Clia dend 1593	Corn acul 2410	Dier scop 1638	Eury prae 1677	Hoaa lute 1562
Hypo cuor 1766	Hypo phys 2416	Loph bide 2167	Pelt cani 2486	Plag undu 1807
Poly pili 1897	Pseu puru 1914	Rhyt soua 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 XI 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* - *Campyllum stellatum* dune slack, *Bryum pseudotriquetrum* - *Aneura pinguis* sub-community) and to a variety of dune grassland types in dry zonation. 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*.

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* - *Campyllum 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 *Lycchnis 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:

- a. drier slack margins receiving sand input from adjacent dunes (common at Whiteford in western slacks).
- b. 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.
- c. 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.

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.

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.

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.

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.



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 hillside at the south of the survey area, and it is present in small quantity at the Pembrey Coast. Young stands are developing between Fort-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 this site 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 this site, are given in Annex 3.

Q	VT	Q	VT	Q	VT	Q	VT
391	3v2	392	4	393	6v1	394	6v1
395	9v1	396	8v1	397	8v5	398	8v4
399	8v5	400	9v1	401	8v4	402	8v4
403	29 32	404	29 32	405	29	406	8v4 9v1
407	29	408	29	409	9v1	410	13 15
411	25 31	412	25 31	413	25 31	414	25 31
415	25 31	416	31	417	25 31	418	25 26
419	25 26	420	31	421	9v1 14	422	14
423	8v1	424	7	425	3v1 4	426	6v3
427	7	428	10v1	429	14	430	12(a)
431	12(a)	432	13 15	433	13 15	434	15 16
435	16	436	14	437	7	438	10v1
439	6v3	440	14	441	7	442	14
443	14	444	14	445	14	446	10v1
447	13 15 23	448	13 15	449	13 15	450	12(b)
451	13 15	452	16	453	16	454	14
455	12(a)	456	12(a)	457	4 7	458	4 5
459	7	460	3v2	461	3v1	462	3v1
463	2	464	1	465	16	466	17
467	30	468	15 16				

## 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	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT
1	XI	2	3	3	3	3
Dry foredune/saltmarsh/strandline transition community						
Tree height (m)	-	Tree height (m)	-	Tree height (m)	-	Tree height (m)
Shrub/bracken height (m)	-	Shrub/bracken height (m)	-	Shrub/bracken height (m)	-	Shrub/bracken height (m)
Herb height (cm)	20	Herb height (cm)	-	Herb height (cm)	30	Herb height (cm)
Tree cover (%)	-	Tree cover (%)	-	Tree cover (%)	-	Tree cover (%)
Shrub cover (%)	-	Shrub cover (%)	20	Shrub cover (%)	-	Shrub cover (%)
Herb cover (%)	40	Herb cover (%)	-	Herb cover (%)	30	Herb cover (%)
Cryptogam cover (%)	-	Cryptogam cover (%)	-	Cryptogam cover (%)	-	Cryptogam cover (%)
Bare surface (%)	60	Bare surface (%)	80	Bare surface (%)	70	Bare surface (%)
pH	8.3	pH	8.1-8.5	pH	7.9-8.1	pH
Mean species per quadrat	9.7	Mean species per quadrat	5.2	Mean species per quadrat	6.0	Mean species per quadrat
FREQ- DOMIN UENCY VALUE						
<i>Elymus farctus</i>	V	<i>Elymus farctus</i>	V	<i>Amophila arenaria</i>	V	<i>Elymus farctus</i>
<i>Festuca rubra</i>	V	<i>Salsola kali</i>	III	<i>Elymus farctus</i>	V	<i>Amophila arenaria</i>
<i>Aprosis stolonifera</i>	IV	<i>Atriplex prostrata</i>	III	<i>Salsola kali</i>	V	<i>Eryngium maritimum</i>
<i>Honkenya peploides</i>	III	<i>Cakile maritima</i>	II	<i>Cakile maritima</i>	IV	<i>Euchorbia peraltis</i>
<i>Limonium binervosum</i>	III	<i>Honkenya peploides</i>	II	<i>Eryngium maritimum</i>	II	<i>Genothera erythrosepala</i>
<i>Plantago maritima</i>	III	<i>Beta vulgaris maritima</i>	II	<i>Euchorbia peraltis</i>	II	<i>Senecio jacobaea</i>
<i>Amophila arenaria</i>	III			<i>Rumex crispus</i>	II	
<i>Eryngium maritimum</i>	III			<i>Beta vulgaris maritima</i>	II	
<i>Helianthemum portulacoides</i>	III					
<i>Plantago coronopus</i>	III					
<i>Atriplex prostrata</i>	II					
<i>Setaria prostrata</i>	II					
<i>Beta vulgaris maritima</i>	II					
<i>Desazeria maritima</i>	II					
<i>Parapholis striposita</i>	II					
<i>Carex arenaria</i>	II					
<i>Salsola kali</i>	II					
FREQ- DOMIN UENCY VALUE						
<i>Elymus farctus</i>	V	<i>Elymus farctus</i>	V	<i>Amophila arenaria</i>	V	<i>Elymus farctus</i>
<i>Festuca rubra</i>	V	<i>Salsola kali</i>	III	<i>Elymus farctus</i>	V	<i>Amophila arenaria</i>
<i>Aprosis stolonifera</i>	IV	<i>Atriplex prostrata</i>	III	<i>Salsola kali</i>	V	<i>Eryngium maritimum</i>
<i>Honkenya peploides</i>	III	<i>Cakile maritima</i>	II	<i>Cakile maritima</i>	IV	<i>Euchorbia peraltis</i>
<i>Limonium binervosum</i>	III	<i>Honkenya peploides</i>	II	<i>Eryngium maritimum</i>	II	<i>Genothera erythrosepala</i>
<i>Plantago maritima</i>	III	<i>Beta vulgaris maritima</i>	II	<i>Euchorbia peraltis</i>	II	<i>Senecio jacobaea</i>
<i>Amophila arenaria</i>	III			<i>Rumex crispus</i>	II	
<i>Eryngium maritimum</i>	III			<i>Beta vulgaris maritima</i>	II	
<i>Helianthemum portulacoides</i>	III					
<i>Plantago coronopus</i>	III					
<i>Atriplex prostrata</i>	II					
<i>Setaria prostrata</i>	II					
<i>Beta vulgaris maritima</i>	II					
<i>Desazeria maritima</i>	II					
<i>Parapholis striposita</i>	II					
<i>Carex arenaria</i>	II					
<i>Salsola kali</i>	II					
FREQ- DOMIN UENCY VALUE						
<i>Elymus farctus</i>	V	<i>Amophila arenaria</i>	V	<i>Amophila arenaria</i>	V	<i>Elymus farctus</i>
<i>Festuca rubra</i>	V	<i>Elymus farctus</i>	V	<i>Elymus farctus</i>	V	<i>Amophila arenaria</i>
<i>Aprosis stolonifera</i>	IV	<i>Salsola kali</i>	V	<i>Salsola kali</i>	V	<i>Eryngium maritimum</i>
<i>Honkenya peploides</i>	III	<i>Atriplex prostrata</i>	IV	<i>Cakile maritima</i>	IV	<i>Euchorbia peraltis</i>
<i>Limonium binervosum</i>	III	<i>Cakile maritima</i>	II	<i>Eryngium maritimum</i>	II	<i>Genothera erythrosepala</i>
<i>Plantago maritima</i>	III	<i>Honkenya peploides</i>	II	<i>Euchorbia peraltis</i>	II	<i>Senecio jacobaea</i>
<i>Amophila arenaria</i>	III	<i>Beta vulgaris maritima</i>	II	<i>Rumex crispus</i>	II	
<i>Eryngium maritimum</i>	III			<i>Beta vulgaris maritima</i>	II	
<i>Helianthemum portulacoides</i>	III					
<i>Plantago coronopus</i>	III					
<i>Atriplex prostrata</i>	II					
<i>Setaria prostrata</i>	II					
<i>Beta vulgaris maritima</i>	II					
<i>Desazeria maritima</i>	II					
<i>Parapholis striposita</i>	II					
<i>Carex arenaria</i>	II					
<i>Salsola kali</i>	II					



MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT
8	508	508	508	508	508	508	508	508
Festuca rubra - Galium verum fixed								
dune community								
No clear MWC sub-community								
Variant 1								
Tree height (m)	-	-	-	-	-	-	-	-
Shrub/bracken height (m)	0.3	0.4	0.6	0.6	0.6	0.6	0.6	0.6
Herb height (cm)	20	30	60	60	60	60	60	60
Tree cover (%)	-	-	-	-	-	-	-	-
Shrub cover (%)	10	20	40	40	40	40	40	40
Herb cover (%)	90	90	90	90	90	90	90	90
Cryptogam cover (%)	40	20	10	10	10	10	10	10
Bare surface (%)	5	1	1	1	1	1	1	1
pH	6.8-7.6	7.0-7.4	6.9	6.9	6.9	6.9	6.9	6.9
Mean species per quadrat	19.0	15.0	10.2	10.2	10.2	10.2	10.2	10.2
FREQ- DORMIN UENCY VALUE	V 5	V 7	IV 6	IV 6	IV 6	IV 6	IV 6	IV 6
<i>Amophila arenaria</i>			<i>Pteridium aquilinum</i>					
<i>Festuca rubra</i>		<i>Festuca rubra</i>	<i>Carex arenaria</i>					
<i>Hypochaeris radicata</i>		<i>Galium verum</i>	<i>Geranium sanguineum</i>					
<i>Homalothecium lutescens</i>		<i>Plantago lanceolata</i>	<i>Rubus caesius</i>					
<i>Ononis repens</i>		<i>Poa pratensis</i>	<i>Amophila arenaria</i>					
<i>Anthyllis vulneraria</i>		<i>Dactylis glomerata</i>	<i>Festuca rubra</i>					
<i>Rubus caesius</i>		<i>Rosa pimpinellifolia</i>	<i>Rosa pimpinellifolia</i>					
<i>Carex arenaria</i>		<i>Anthranthum odoratum</i>	<i>Convolvulus arvensis</i>					
<i>Galium verum</i>		<i>Agrostis capillaris</i>	<i>Galium verum</i>					
<i>Hieracium pilosella</i> agg.		<i>Galium verum</i>	<i>Holcus lanatus</i>					
<i>Crepis capillaris</i>		<i>Poa pratensis</i>	<i>Poa pratensis</i>					
<i>Leontodon hispidus</i>		<i>Rubus caesius</i>	<i>Sanguisorba minor</i>					
<i>Luzula campestris</i>		<i>Avenula pubescens</i>	<i>Brachythecium rubrabulum</i>					
<i>Sedum acre</i>		<i>Ononis repens</i>	<i>Eurynchium proteropium</i>					
<i>Senecio jacobaea</i>		<i>Pteridium aquilinum</i>	<i>Dactylis glomerata</i>					
<i>Poa pratensis</i>		<i>Thymus praecox arcticus</i>						
<i>Cladonia pocillum</i>		<i>Veronica chamaedrys</i>						
<i>Polypodium vulgare</i>		<i>Achillea millefolium</i>						
<i>Ascaepis pyramidalis</i>		<i>Lotus corniculatus</i>						
<i>Centaurium erythraea</i>		<i>Pseudiscleropodium purum</i>						
<i>Cerastium fontanum</i> <i>triviale</i>		<i>Geranium sanguineum</i>						
<i>Avenula pubescens</i>								
<i>Genothera erythrosepala</i>								
<i>Phlox arenaria</i>								
<i>Thymus praecox arcticus</i>								
<i>Viola tricolor</i>								
<i>Pellifera emina</i>								
<i>Aira praecox</i>								
<i>Hieracium vulgatum</i> agg.								
<i>Lotus corniculatus</i>								
<i>Plantago lanceolata</i>								
<i>Polygala vulgaris</i>								
<i>Rhinanthus minor</i>								
<i>Senecio oleraceus</i>								
<i>Brachythecium albicans</i>								
FREQ- DORMIN UENCY VALUE	V 5	V 7	IV 6	IV 6	IV 6	IV 6	IV 6	IV 6
<i>Amophila arenaria</i>			<i>Festuca rubra</i>					
<i>Festuca rubra</i>		<i>Galium verum</i>	<i>Carex arenaria</i>					
<i>Hypochaeris radicata</i>		<i>Plantago lanceolata</i>	<i>Geranium sanguineum</i>					
<i>Homalothecium lutescens</i>		<i>Poa pratensis</i>	<i>Rubus caesius</i>					
<i>Ononis repens</i>		<i>Dactylis glomerata</i>	<i>Amophila arenaria</i>					
<i>Anthyllis vulneraria</i>		<i>Rosa pimpinellifolia</i>	<i>Festuca rubra</i>					
<i>Rubus caesius</i>		<i>Anthranthum odoratum</i>	<i>Rosa pimpinellifolia</i>					
<i>Carex arenaria</i>		<i>Agrostis capillaris</i>	<i>Convolvulus arvensis</i>					
<i>Galium verum</i>		<i>Galium verum</i>	<i>Galium verum</i>					
<i>Hieracium pilosella</i> agg.		<i>Poa pratensis</i>	<i>Holcus lanatus</i>					
<i>Crepis capillaris</i>		<i>Rubus caesius</i>	<i>Poa pratensis</i>					
<i>Leontodon hispidus</i>		<i>Avenula pubescens</i>	<i>Sanguisorba minor</i>					
<i>Luzula campestris</i>		<i>Ononis repens</i>	<i>Brachythecium rubrabulum</i>					
<i>Sedum acre</i>		<i>Pteridium aquilinum</i>	<i>Eurynchium proteropium</i>					
<i>Senecio jacobaea</i>		<i>Thymus praecox arcticus</i>	<i>Dactylis glomerata</i>					
<i>Poa pratensis</i>		<i>Veronica chamaedrys</i>						
<i>Cladonia pocillum</i>		<i>Achillea millefolium</i>						
<i>Polypodium vulgare</i>		<i>Lotus corniculatus</i>						
<i>Ascaepis pyramidalis</i>		<i>Pseudiscleropodium purum</i>						
<i>Centaurium erythraea</i>		<i>Geranium sanguineum</i>						
<i>Cerastium fontanum</i> <i>triviale</i>								
<i>Avenula pubescens</i>								
<i>Genothera erythrosepala</i>								
<i>Phlox arenaria</i>								
<i>Thymus praecox arcticus</i>								
<i>Viola tricolor</i>								
<i>Pellifera emina</i>								
<i>Aira praecox</i>								
<i>Hieracium vulgatum</i> agg.								
<i>Lotus corniculatus</i>								
<i>Plantago lanceolata</i>								
<i>Polygala vulgaris</i>								
<i>Rhinanthus minor</i>								
<i>Senecio oleraceus</i>								
<i>Brachythecium albicans</i>								
FREQ- DORMIN UENCY VALUE	V 5	V 7	IV 6	IV 6	IV 6	IV 6	IV 6	IV 6
<i>Amophila arenaria</i>			<i>Festuca rubra</i>					
<i>Festuca rubra</i>		<i>Galium verum</i>	<i>Carex arenaria</i>					
<i>Hypochaeris radicata</i>		<i>Plantago lanceolata</i>	<i>Geranium sanguineum</i>					
<i>Homalothecium lutescens</i>		<i>Poa pratensis</i>	<i>Rubus caesius</i>					
<i>Ononis repens</i>		<i>Dactylis glomerata</i>	<i>Amophila arenaria</i>					
<i>Anthyllis vulneraria</i>		<i>Rosa pimpinellifolia</i>	<i>Festuca rubra</i>					
<i>Rubus caesius</i>		<i>Anthranthum odoratum</i>	<i>Rosa pimpinellifolia</i>					
<i>Carex arenaria</i>		<i>Agrostis capillaris</i>	<i>Convolvulus arvensis</i>					
<i>Galium verum</i>		<i>Galium verum</i>	<i>Galium verum</i>					
<i>Hieracium pilosella</i> agg.		<i>Poa pratensis</i>	<i>Holcus lanatus</i>					
<i>Crepis capillaris</i>		<i>Rubus caesius</i>	<i>Poa pratensis</i>					
<i>Leontodon hispidus</i>		<i>Avenula pubescens</i>	<i>Sanguisorba minor</i>					
<i>Luzula campestris</i>		<i>Ononis repens</i>	<i>Brachythecium rubrabulum</i>					
<i>Sedum acre</i>		<i>Pteridium aquilinum</i>	<i>Eurynchium proteropium</i>					
<i>Senecio jacobaea</i>		<i>Thymus praecox arcticus</i>	<i>Dactylis glomerata</i>					
<i>Poa pratensis</i>		<i>Veronica chamaedrys</i>						
<i>Cladonia pocillum</i>		<i>Achillea millefolium</i>						
<i>Polypodium vulgare</i>		<i>Lotus corniculatus</i>						
<i>Ascaepis pyramidalis</i>		<i>Pseudiscleropodium purum</i>						
<i>Centaurium erythraea</i>		<i>Geranium sanguineum</i>						
<i>Cerastium fontanum</i> <i>triviale</i>								
<i>Avenula pubescens</i>								
<i>Genothera erythrosepala</i>								
<i>Phlox arenaria</i>								
<i>Thymus praecox arcticus</i>								
<i>Viola tricolor</i>								
<i>Pellifera emina</i>								
<i>Aira praecox</i>								
<i>Hieracium vulgatum</i> agg.								
<i>Lotus corniculatus</i>								
<i>Plantago lanceolata</i>								
<i>Polygala vulgaris</i>								
<i>Rhinanthus minor</i>								
<i>Senecio oleraceus</i>								
<i>Brachythecium albicans</i>								







MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT	MAP VEGETATION UNIT
26	22	23	30	31	32
<i>Prunus spinosa</i> - <i>Rubus fruticosus</i> spp. scrub	<i>Pteridium aquilinum</i> - <i>Rubus fruticosus</i> spp. underscrub	<i>Alnus glutinosa</i> albeck woodland	<i>Pinus mitralis/vestris</i> woodland	<i>Acer pseudoplatanus</i> woodland	
No clear NVC sub-community	No clear NVC sub-community				
Tree height (m)	Tree height (m)	Tree height (m)	Tree height (m)	Tree height (m)	Tree height (m)
2-5	1-3	2-12	10-18	4-16	
Shrub/bracken height (m)	Shrub/bracken height (m)	Shrub/bracken height (m)	Shrub/bracken height (m)	Shrub/bracken height (m)	
30	40-120	1-3	3-4	0-6	
Tree cover (%)	Tree cover (%)	Tree cover (%)	Tree cover (%)	Tree cover (%)	
60-100	80-100	70-100	40-90	20-40	
Shrub cover (%)	Shrub cover (%)	0-40	5-100	0-50	
5-80	30	50	10-30	20-50	
Herb cover (%)	Herb cover (%)	20	-	10	
Cryptogam cover (%)	Cryptogam cover (%)				
Bare surface (%)	Bare surface (%)	Bare surface (%)	Bare surface (%)	Bare surface (%)	Bare surface (%)
7.4	6.8-7.4	5.9-6.5	5.6-6.4	6.3	
pH	pH	pH	pH	pH	
Mean species per quadrat	Mean species per quadrat	Mean species per quadrat	Mean species per quadrat	Mean species per quadrat	Mean species per quadrat
12.6	9.7	11.7	12.0	12.0	
FREQ- DORTIN UENCY VALUE	FREQ- DORTIN UENCY VALUE	FREQ- DORTIN UENCY VALUE	FREQ- DORTIN UENCY VALUE	FREQ- DORTIN UENCY VALUE	FREQ- DORTIN UENCY VALUE
V 8	V 7	IV 5	V 7	V 9	
<i>Prunus spinosa</i>	<i>Pteridium aquilinum</i>	<i>Iris pseudacorus</i>	<i>Pinus mitralis/vestris</i>	<i>Acer pseudoplatanus</i>	
<i>Eurychium procerosum</i>	<i>Rubus fruticosus</i>	<i>Rubus fruticosus</i> spp.	<i>Crataegus monogyna</i>	<i>Rubus fruticosus</i>	
<i>Urtica dioica</i>	<i>Urtica dioica</i>	<i>Galium palustre</i>	<i>Dryopteris filix-mas</i>	<i>Hyacinthoides non-scripta</i>	
<i>Crataegus monogyna</i>	<i>Geranium robertianum</i>	<i>Alnus glutinosa</i>	<i>Geranium robertianum</i>	<i>Geranium robertianum</i>	
<i>Dactylis glomerata</i>	<i>Glechoma hederacea</i>	<i>Salix cinerea</i>	<i>Rubus caesius</i>	<i>Hedera helix</i>	
<i>Rosa pimpinellifolia</i>	<i>Holcus lanatus</i>	<i>Solanum dulcamara</i>	<i>Rubus fruticosus</i> spp.	<i>Arum maculatum</i>	
<i>Rubus fruticosus</i> spp.	<i>Silene dioica</i>	<i>Calliergon cuspidatum</i>	<i>Epilobium angustifolium</i>	<i>Crataegus monogyna</i>	
<i>Festuca rubra</i>	<i>Acer pseudoplatanus</i>	<i>Phragmites australis</i>	<i>Rosa pimpinellifolia</i>	<i>Glechoma hederacea</i>	
<i>Geranium robertianum</i>	<i>Arrhenatherum elatius</i>	<i>Geranium crocota</i>	<i>Solanum dulcamara</i>	<i>Pteridium aquilinum</i>	
<i>Glechoma hederacea</i>	<i>Hedera helix</i>	<i>Holcus lanatus</i>	<i>Phyllitis scolopendrium</i>	<i>Rubus caesius</i>	
<i>Hedera helix</i>	<i>Quercus robur</i>	<i>Lyropus europaeus</i>	<i>Silene dioica</i>	<i>Silene dioica</i>	
<i>Quercus robur</i>	<i>Sambucus nigra</i>	<i>Agrostis stolonifera</i>	<i>Urtica dioica</i>	<i>Brachythecium rutabulum</i>	
<i>Silene dioica</i>	<i>Arrhenatherum elatius</i>	<i>Berula erecta</i>	<i>Prunus spinosa</i>		
<i>Athyrium filix-femina</i>	<i>Athyrium filix-femina</i>	<i>Carex roscita</i>			
<i>Brachypodium sylvaticum</i>	<i>Brachypodium sylvaticum</i>	<i>Filipendula ulmaria</i>			
<i>Carex arenaria</i>	<i>Dryopteris filix-mas</i>	<i>Geranium robertianum</i>			
<i>Dryopteris filix-mas</i>	<i>Epilobium montanum</i>				
<i>Fragaria vesicaria</i>	<i>Galium verum</i>				
<i>Galium verum</i>	<i>Phyllitis scolopendrium</i>				
<i>Plantago lanceolata</i>	<i>Plantago lanceolata</i>				
<i>Pteridium aquilinum</i>	<i>Rubus caesius</i>				
<i>Rubus caesius</i>	<i>Senecio jacobaea</i>				
<i>Senecio jacobaea</i>	<i>Stachys sylvatica</i>				
<i>Stachys sylvatica</i>	<i>Tamus communis</i>				
<i>Tamus communis</i>					

**ANNEX 6**  
**TARGET NOTES**

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

**WHITEFORD BURROWS**

- 1 Self-sown Corsican Pine.
- 2 Woodland rides shaded (frequent *Brachypodium sylvaticum*) and quite heavily scrubbed (*Rosa canina*, *R. pimpinellifolia*, *Rubus fruticosus* agg.).
- 3 Little Bracken found north of this approximate suggesting it has invaded from the south where it is frequent in type 8 grassland and in scrub of woodland fringe.
- 4 Large rabbit population in this area.
- 5 Scattered Norway Spruce (*Picea abies*) in area.
- 6 Well-developed *Salix repens* 'hedgehog' dunes.
- 7 Remains of concrete structure.
- 8 Large quantities of prostrate *Clematis vitalba* in young dunes of this area.
- 9 Several rabbit-proof exclosures scattered in various communities in this area.

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.

391	9 0 10 0 11 90 13 0 14 0 15 40 16 0 22 60 116 4 159 6	1254 31368 52920 72936 1	412
391	268 11184 3	9 14 10 0 11 20 13 60 14 0 15 30 16 0 22 0 203 3 391 3	413
392	9 0 10 0 11100 13 0 14 0 15 80 16 0 22 20 159 9 565 1	445 4 500 5 522 2 630 4 652 3 962 51123 42920 8	413
392	1239 11272 1	9 14 10 0 11 20 13 40 14 0 15100 16 0 22 0 201 2 391 5	414
393	9 0 10 0 11 20 13 0 14 0 15 60 16 0 22 40 159 5 174 5	421 9 445 4 500 4 522 1 630 3 652 7 681 3 962 31136 41187 4	414
393	195 4 241 1 304 2 576 7 706 1 769 2 800 5 995 11239 11434 3	1254 31313 31360 31368 32920 5	414
394	9 0 10 0 11 30 13 0 14 0 15100 16 5 22 0 124 3 159 5	526 3 583 5 630 5 681 4 701 3 715 5 802 5 855 4 962 4 971 6	415
394	174 4 304 3 576 8 631 3 680 3 706 3 769 3 800 5 914 5 988 4	1095 41136 71137 41170 51254 51268 31368 4	415
394	1259 31562 21677 4	9 12 10 0 11 30 13 40 14 0 15100 16 0 22 0 279 3 415 4	416
395	9 0 10 0 11 70 13 0 14 0 15100 16 80 22 0 103 1 159 5	526 4 558 4 630 4 701 4 715 5 823 3 855 6 971 61095 51127 4	416
395	288 2 304 3 421 1 465 3 522 1 576 7 589 1 674 3 680 5 706 2	1136 41169 41254 31268 41368 4	416
395	786 1 800 1 968 4 988 41059 31066 51396 41429 31914 82167 4	9 12 10 1 11 20 13 60 14 60 15 30 16 15 22 0 445 4 500 4	417
396	9 0 10 0 11 10 13 0 14 0 15 60 16 40 22 20 124 2 125 3	558 4 630 5 681 4 776 8 962 41123 31127 31254 21268 41368 5	417
396	159 5 304 4 369 2 576 5 613 5 631 2 680 3 706 2 786 1 914 5	2920 82936 1	417
396	958 2 988 4 995 21127 11239 11272 11432 31510 7	9 12 10 3 11 20 13 90 14 60 15 40 16 60 22 0 103 5 201 2	418
397	9 0 10 0 11 50 13 0 14 0 15100 16 2 22 0 159 4 304 3	589 9 630 3 637 6 652 51254 31293 41368 21677 82936 7	418
397	576 6 613 3 631 6 680 3 973 1 988 31053 41066 71123 61127 6	9 0 10 2 11 20 13 0 14 60 15 60 16 60 22 0 247 3 445 6	419
397	1324 41677 3	500 4 526 2 630 3 637 4 681 3 962 41078 41123 61127 41254 5	419
398	9 0 10 0 11 10 13 0 14 0 15100 16 10 22 0 123 4 159 4	1293 31368 21677 82936 6	419
398	171 3 202 2 288 2 304 3 568 1 576 7 613 3 631 5 680 3 769 2	9 10 10 1 11 20 13 80 14 30 15 10 16 0 22 0 391 1 637 3	420
398	800 3 973 3 988 4 995 11053 41123 51127 61333 21396 41519 4	1015 41123 61127 42920 9	420
399	9 0 10 0 11 40 13 0 14 0 15100 16 0 22 0 159 5 304 2	9 0 10 1 11 30 13 0 14 85 15 20 16 0 22 10 174 2 304 3	420
399	576 6 613 2 631 4 680 3 800 3 973 3 988 31053 31123 41127 8	530 1 576 5 680 3 706 2 769 2 855 2 914 3 988 41127 31179 9	421
399	1324 31429 21677 2	9 0 10 1 11 30 13 0 14 50 15 60 16 20 22 0 171 3 323 5	421
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401	9 0 10 0 11 5 13 0 14 0 15100 16 30 22 0 171 3 202 4	504 1 576 5 613 5 674 1 706 3 807 3 914 5 965 5 973 3 988 2	423
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402	202 3 251 3 304 3 576 8 613 4 631 5 968 2 973 3 988 41053 4	958 31127 71225 51239 21333 52023 9 447 3	424
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406	576 5 613 3 630 3 680 3 988 31066 51136 5	251 3 304 2 323 5 460 4 539 2 576 5 680 4 706 3 720 5 800 5	429
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407	1066 41136 101254 41368 41519 41677 4	1519 31914 61940 52982 3	429
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412	9 14 10 0 11 20 13 50 14 0 15100 16 0 22 0 103 1 201 1	1127 51169 41179 5	432
412	414 4 421 4 445 1 500 4 630 5 652 10 681 3 962 41187 51220 1		

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482	418	3	558	3	576	6	583	3	680	4	690	6	734	7	823	3	855	5	911	1
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488	532	3	576	4	680	3	690	6	715	4	720	4	734	5	813	3	855	5	973	4
489	1043	3	1059	3	1069	5	1081	3	1179	8	1445	9								
490	9	0	10	0	11	10	13	0	14	0	15	90	16	0	22	10	122	9	336	4

## 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.

Map Unit	NVC or non-NVC Unit	WHITEFORD
1	X1	1.86
2	SD4	2.88
3	SD6a	3.20
4	SD6d	7.70
5	SD6e	3.85
6	SD7c	27.75
7	SD7d	29.75
8	SD8	9.61
9	SD9	3.20
10	SD12	-
11	H11	-
12	SD14c-SD15a/b	15.00
13	SD15c	11.54
14	SD16a/b-SD16c/d	5.77
15	SD17	0.26
16	SM18b	-
17	SM24	-
18	S4a	-
19	S4d-S21b	-
20	S12b	1.03
21	SD18a	-
22	SD18b	-
23	W1	2.56
24	W10c	-
25	W21a	-
26	W22	1.92
27	W23	-
28	W24	-
29	W25	-
30	X2	1.28
31	X3	24.55
32	X4	1.28
1-11	(strand, grassland and heath)	89.80
12-15	(dune slacks)	32.57
16-20	(saltmarsh and swamp)	1.03
21-32	(scrub and woodland)	31.59
Other:	Woodland ride	1.28
Total		156.27

## ANNEX 9

## SITE BIBLIOGRAPHY

A running list of reports relating to Whiteford Burrows is kept at Oxwich Reserve Centre. The following items are those cited in this report. A more comprehensive listing is given in the Regional Report.

- Baye, P. (1981) A study of dune morphology and the effects of a storm on 13 December 1981. Report, Oxwich Reserve Centre.
- Bray, G.C. (1977) A study of the grazing exclosures on Whiteford Burrows NNR. University College of Cardiff.
- Bridges, M. (1987) Classic Landforms of the Gower Coast. Geographical Association, Sheffield.
- Davies, M. (1981) Sea Buckthorn (*Hippophae rhamnoides*) and tree species survey at Whiteford NNR. Report, Oxwich Reserve Centre.
- Glyn, P.J. (1975) A study of the effects of pony grazing. Zoology Department, Royal Holloway College.
- Hughes, M.R. (1981) Whiteford National Nature Reserve: Description and classification of dune slacks and their vegetation.
- Ranwell, D.S. (1967) Visit to Whiteford Burrows NNR. Report, Oxwich reserve Centre.

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>Calliergon 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>Calliergon 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

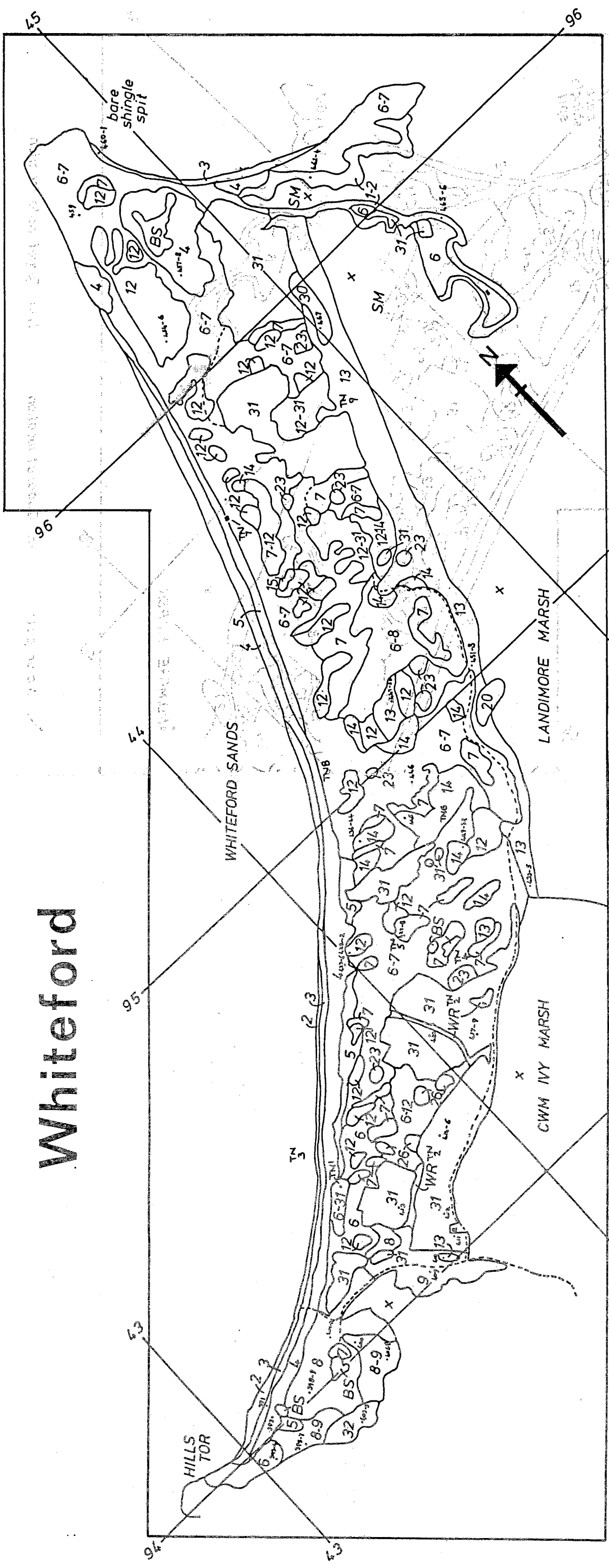
MAPPING AND VEGETATION UNITS FOR 1989 SOUTH WALES DUNE SURVEY

WOODLAND AND SCRUB

a	b		
21	SD18a	<i>Hippophae rhamnoides</i> scrub <i>Festuca rubra</i> sub-community	81
22	SD18b	<i>Hippophae rhamnoides</i> scrub <i>Urtica dioica</i> - <i>Arrhenatherum elatius</i> sub-community	81
23	W1	<i>Salix cinerea</i> - <i>Galium palustre</i> woodland	81
24	W10c	<i>Quercus robur</i> - <i>Pteridium aquilinum</i> - <i>Rubus fruticosus</i> agg. woodland <i>Hedera helix</i> sub-community	81
25	W21	<i>Crataegus monogyna</i> - <i>Hedera helix</i> scrub <i>Hedera helix</i> - <i>Urtica dioica</i> sub-community	81
26	W22	<i>Prunus spinosa</i> - <i>Rubus fruticosus</i> agg. scrub No clear NVC sub-community	81
27	W23	<i>Ulex europaeus</i> - <i>Rubus fruticosus</i> agg. scrub No clear NVC sub-community	81
28	W24	<i>Rubus fruticosus</i> agg. - <i>Holcus lanatus</i> underscrub No clear NVC sub-community	81
29	W25	<i>Pteridium aquilinum</i> - <i>Rubus fruticosus</i> agg. underscrub No clear NVC sub-community	81
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

# Whiteford



- x No survey
- BS Bare sand
- WR Woodland ride
- Building
- Major path
- n Quadrat location
- TNn Target note location

Vegetation legend on separate sheet

Surveyed 1989 by T.C.D. Dargie

