

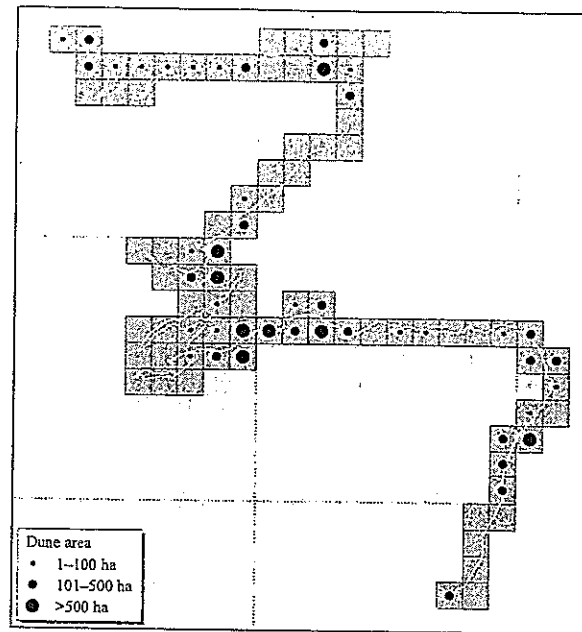
## 3.2 Sand dunes

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### 3.2.1 Introduction

The region contains an exceptionally large and varied set of sand dune systems, with a total of 83 dune and machair sites and an estimated 12,329 ha of vegetated sand and other land cover (including car parks etc.). They make up an estimated 39% of the dune resource for Scotland, 49% of that of the North Sea coast and 25% of all British dunes, the largest percentage for any region. Vegetated sand dunes in the region are therefore clearly of great importance in the national context (Table 3.2.1). The overall distribution of vegetated sand dunes in the region is shown in Map 3.2.1, with major concentrations in north-east Highland, around the Moray Firth and the Fraserburgh - Aberdeen coast.

Some 80 NVC (National Vegetation Classification) communities have so far been recorded for Scottish dunes, with a total of 110 types for communities and sub-communities combined, out of 90 communities and 156 sub-communities recorded for all England, Scotland and Wales, not all of them exclusive to dunes. Dunes thus show great habitat diversity, involving many types of vegetation (Rodwell in prep.). Scotland is particularly notable in having the largest national area of all sand dune NVC vegetation types combined, especially in terms of the extent of semi-fixed dune (SD7 marram *Ammophila arenaria* - red fescue *Festuca rubra* community), fixed calcareous dune grassland (SD8 red fescue *Festuca rubra* - lady's bedstraw *Galium verum* community), acidic dune grassland (SD12 sand sedge *Carex arenaria* - sheep's fescue *Festuca ovina* - common bent *Agrostis capillaris* community), lichen-rich dune (SD10 sand sedge *Carex arenaria* - lichen *Cornicularia aculeata* community) and dune heath (H11 sand sedge *Carex arenaria* - heather *Calluna vulgaris* community). Scottish dunes also have a large area of wet heath, mire and swamp habitat (c. 3,800 ha). Some NVC surveys suggest that vegetation types in parts of Scotland are anomalous to the NVC system and new NVC community types might be required to accommodate this variation. Poor conifer growth after planting at Culbin (Lusby 1990) and Littleferry has allowed vegetation similar to native pine woodland (NVC community W18 Scots pine *Pinus sylvestris* - feather moss *Hylocomium splendens*) to develop. The NVC dune vegetation and other vegetation types can be aggregated into eleven groups, which represent the major dune habitats



Map 3.2.1 Areas of sand dune by coastal 10 km square. Source: JNCC Sand Dune Database.

(Table 3.2.2). No nationally rare species confined to dunes are found in Scotland.

The large extent and diverse range of dune types make the sand dunes of the region of great interest. This is reflected in eleven Site of Special Scientific Interest (SSSI) designations and four National Nature Reserves (NNRs) (see also sections 7.3.1 and 7.3.2). The total area of dune vegetation of SSSI status is probably c. 7,080 ha (c. 57% of the regional dune extent). Several sites fall within National Scenic Areas (see also section 7.3.4).

### 3.2.2 Important locations and species

The distribution of sites of vegetated blown sand shows contrasts between scattered small areas (with the exception of Dunnet Bay) along the northern Sutherland and Caithness coast and a major concentration on the Inner Moray Firth, with an intermediate pattern on the eastern Grampian coast. The size of most sites is unknown but the region contains four very large dune systems: Dunnet Bay (690 ha), Sands of Forvie (763 ha), Morrich More (1,240 ha) and Culbin Sands (c. 3,100 ha, the largest site in Britain). The majority of sites are small bay dunes on the north coast, developed upon sand trapped within the shelter of rock headlands. The largest of these bay dune systems is Dunnet Bay, which also contains grassland of subdued relief, forming a dune plain termed machair (Ritchie 1976). Such machair is an exposed form of hindshore dune, developed above beaches with a good sand supply and an onshore prevailing wind which drives sand inland (Ranwell & Boar 1986). A further feature of bay dunes on the northern Sutherland and Caithness coast is sand blown up steep slopes, forming a thin layer of climbing dune. Underlying geology is a strong influence and the Durness limestone of

Table 3.2.1: Region 3 vegetated dune resource\* in context

	Total area (ha)	% of total in Region 3
Highland east of 5°W	5,307	43.0
Grampian	7,022	57.0
<b>Region 3</b>	<b>12,329</b>	<b>100</b>
Scotland	31,540	39.1
North Sea Coast	25,356	48.6
GB	50,200	24.5

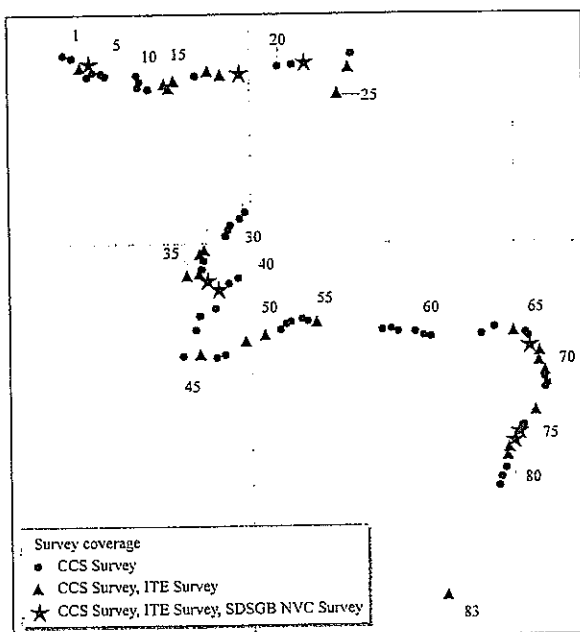
Sources: Dargie (1993, 1995), Radley (1994), JNCC Coastal Resources Database. Key: \*all figures have been rounded to the nearest whole hectare. Note: totals for Scotland and therefore Great Britain are provisional estimates.

Table 3.2.2 Areas of dune vegetation types (ha)<sup>a</sup>

	Strand and embryo dune	Mobile and semi-fixed dune	Acidic fixed dune grassland	Neutral and calcareous fixed dune grassland	Dune heath and bracken	Dune slack	Other dune wetland	Dune woodland and scrub	Transitions to salt-marsh	Transitions to maritime cliff	Other land cover
Highland east of 5°W	7	130	54	665	406	91	150	200	200	3	rare
Grampian	7	312	170	181	312	35	64	3,500	0	1	rare
Region 3	14	443	224	846	718	125	214	3,700	200	4	rare
Scotland	61	4,059	4,125	10,513	2,113	1,095	3,817	5,500	217	41	587
North Sea Coast	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Great Britain	340	8,504	4,953	15,228	2,615	2,175	4,114	8,965	836	64	2,406

Sources: Dargie (1993; 1995), Radley (1994), JNCC Coastal Resources Database. Key: <sup>a</sup> all figures have been rounded to the nearest whole hectare; n/a = not available. Note: totals for Scotland and therefore Great Britain are provisional estimates.

the Kyle of Durness and Torrisdale Bay/Invernaver have unique montane grassland and heath types developed on climbing dunes at very low altitudes. Spit dunes are also common, usually developing at the mouths of estuaries. Large examples are developed at the mouth of the Ythan Estuary (Sands of Forvie), Dornoch Firth (Dornoch Point) and Loch Fleet (Littleferry Dunes and Coul Links), with a smaller example at Findhorn. Strong currents on the southern Moray Firth coast also form spits or offshore islands at Whiteness Head and Culbin, without an active river influence. Ness or foreland dunes (e.g. Morrich More, Cuthill to Dornoch) are rare in the region, developing on shores with sand supply from two directions and gradually extending (prograding) seawards. Morrich More is a very large site developing in association with large extents of saltmarsh behind an offshore island and bar (Smith & Mather 1973). The very extensive sand dunes of Culbin are developed on a ness/foreland system of shingle ridges but most typical dune vegetation and bare sand have been replaced by conifer afforestation. Parabolic dunes at Culbin, stabilised by forestry, are the largest in Europe (Comber, Hansom & Fahy 1993). Vegetated sand dune sites in the region are listed in Table 3.2.3 and shown on Map 3.2.2.



Map 3.2.2 Surveyed dune sites. Numbers refer to Table 3.2.3. Source: JNCC Sand Dune Database.

In the region calcareous dunes are largely restricted to the machairs of the north coast, with acidic dune grasslands predominating elsewhere, often with extensive lichen dune and dune heath. Several of the region's dune systems are rich in bryophytes, and lichen diversity is particularly high (Fletcher *et al.* 1984; Fryday 1992). Balnakeil Bay and Dunnet Bay are recognised as important sites for machair lichens. For acidic substrates Culbin is outstanding for lichens, for which Sands of Forvie, Cuthill, Littleferry Dunes, Coul Links and Whiteness Head are also of great interest. New NVC SD7 and SD12 types might be needed to cover two vegetation communities found in this region: one rich in feather mosses (e.g. *Hylocomium splendens*), the other comprising dune scrub with juniper *Juniperus communis communis* (Dargie 1993). All five nationally scarce dune species found in Scotland occur in the region: seaside centaury *Centaureum littorale*, variegated horsetail *Equisetum variegatum*, Baltic rush *Juncus balticus*, rush-leaved fescue *Festuca juncifolia* and curved sedge *Carex maritima*.

The larger dune systems in the region develop a watertable which influences the vegetation of depressions, forming a distinct and nationally rare type of wetland termed dune slack. In machair and large spit dune systems slacks form in depressions in the rear of parabolic dune blowouts, which are initiated by storms and migrate across a site. The best regional examples are at Sands of Forvie (Landsberg 1955; Spiller 1980). Ness/foreland slacks usually develop from saltmarsh isolated from tidal influence by developing dunes, and young examples show strongly brackish characteristics, e.g. at Morrich More (Dargie 1989). Large bay dunes often develop a slack termed a winter loch behind the outer dune ridge. In some cases open water is present all year: the Loch of Strathbeg is the largest dune freshwater system in Britain.

Dune water bodies support internationally significant bird numbers at Loch of Strathbeg, with foreshore areas equally important at Loch Fleet, Lower Dornoch Firth, the Moray Firth (Munlochy Bay to Findhorn Bay) and Sands of Forvie (Stroud, Mudge & Pienkowski 1990). JNCC's Invertebrate Site Register indicates that Culbin and St. Cyrus are outstanding sites, with Loch Fleet (Littleferry and Coull), Morrich More, Invernaver, Lossiemouth, Findhorn and Sands of Forvie all of high interest (see also section 5.3).

Table 3.2.3 Sand dune sites in region

Site no. <sup>a</sup>	Name	Grid ref.	Area (ha) <sup>b</sup>	Conservation status	Dune type	Survey type
1	Kervaig Bay	NC292728			Bay, machair, climbing	CCS
2	Keoldale	NC382662			Bay, machair	CCS
3	Kyle of Durness	NC370680			Bay, machair, climbing	CCS, ITE
4	Balnakeil Bay	NC393694	166		Bay, machair, climbing	CCS, ITE, SDSGB
5	Creag Thairbe	NC406685			Bay	CCS
6	Sango Bay	NC409675			Bay	CCS
7	Sangobeg	NC428662			Bay	CCS
8	Traigh Allt Chailgeag	NC443655			Bay	CCS
9	Achiniver	NC574650			Bay, machair	CCS
10	Talmine	NC586627			Bay	CCS
11	Melness	NC588606			Bay, machair	CCS
12	Coldbackie	NC610603			Bay	CCS
13	Torrisdale Bay	NC690619		NSA	Bay	CCS, ITE
14	Invernaver	NC700615		NNR, NSA, SSSI	Bay, climbing	CCS, ITE
15	Farr Bay	NC713625			Bay, machair, climbing	CCS, ITE
16	Armadale	NC793646			Bay, machair, climbing	CCS
17	Strathy	NC836661			Bay, machair	CCS, ITE
18	Melvich	NC885651			Bay, machair	CCS, ITE
19	Sandside Bay	NC963653	80	SSSI	Bay, machair	CCS, ITE, SDSGB
20	Thurso Bay	ND115687			Bay	CCS
21	Murkle Bay	ND170693			Bay	CCS
22	Dunnet Bay	ND215695	690	NNR, SSSI	Bay, machair	CCS, ITE, SDSGB
23	Sannick	ND397736			Bay	CCS
24	Freswick	ND377675			Bay, climbing	CCS, ITE
25	Sinclair's Bay	ND340580			Bay, spit	CCS, ITE
26	Kilmote	NC978111			Bay	CCS
27	Crakaig	NC961098			Bay	CCS
28	Kintradwell	NC920072			Bay	CCS
29	Brora Dalchalm	NC915055			Bay	CCS
30	Brora South	NC905033			Bay	CCS
31	Littlefery to Golspie	NH820970		SSSI, SWT	Spit, bay	CCS, ITE
32	Coul Links	NH815947		SSSI, SWT	Spit, bay	CCS, ITE
33	Embo	NH818930			Bay	CCS
34	Dornoch North	NH807905			Bay	CCS
35	Dornoch South	NH805890		NSA, SSSI	Spit	CCS, ITE
36	Cuthill Links	NH754875		NSA, SSSI	Relict, bay	CCS, ITE
37	Morrish More	NH835857	1,240	NSA, SSSI	Island, ness/foreland	CCS, ITE, SDSGB
38	Inver to Arbol	NH875828	28		Bay, spit	CCS, ITE, SDSGB
39	Portmahomack	NH915844			Bay	CCS
40	Wilkhaven	NH946872			Bay	CCS
41	Balintore	NH860753			Bay	CCS
42	Nigg	NH800723			Bay	CCS
43	Cromarty	NH784673			Climbing	CCS
44	Rosemarkie	NH738576			Bay	CCS
45	Whiteness Head	NH803587		SSSI	Spit	CCS, ITE
46	Nairn West	NH860568			Bay	CCS
47	Nairn East	NH895576			Bay	CCS
48	Culbin	NH980630		SSSI	Island, spit, ness/foreland	CCS, ITE
49	Findhorn	NJ050648			Spit	CCS, ITE
50	Burghead Bay	NJ110680			Bay	CCS
51	Cummingstown	NJ132693			Bay	CCS
52	Hopeman	NJ143698			Bay	CCS
53	Covesea	NJ195713			Bay	CCS
54	Stotfield	NJ224709			Bay	CCS
55	Lossiemouth East	NJ250696			Bay	CCS, ITE
56	Cullen Bay	NJ500677			Bay	CCS
57	Findlater	NJ537673			Bay	CCS
58	Sandend	NJ557662			Bay	CCS
59	Whyntie Head	NJ630660			Bay	CCS
60	Boyndie Bay	NJ671647			Bay	CCS
61	Banff Bay	NJ695641			Bay	CCS
62	New Aberdour	NJ886647			Bay	CCS
63	Rosehearty	NJ935676			Bay	CCS
64	Fraserburgh Bay	NK010654			Bay	CCS
65	Inverallochy	NK050645			Bay, spit	CCS, ITE
66	St. Combs	NK053637			Bay	CCS

Table 3.2.3 Sand dune sites in region (continued)

Site no. <sup>a</sup>	Name	Grid ref.	Area (ha) <sup>b</sup>	Conservation status	Dune type	Survey type	
67	Strathbeg	NK080597	450	RSPB, SSSI	Spit, bay	CCS, ITE, SDSGB	
68	Ratray Head	NK104580			Bay	CCS, ITE	
69	Ratray Bay	NK104550			Bay	CCS, ITE	
70	Kirkton	NK119506			Bay	CCS, ITE	
71	Ugie to Lunderton	NK117490			Bay	CCS	
72	Peterhead	NK124452			Bay	CCS	
73	Sandford Bay	NK123438			Bay	CCS	
74	Cruden Bay	NK084350	763	NNR, SSSI	Bay	CCS, ITE	
75	Collieston	NK040285			Bay	CCS	
76	Sands of Forvie	NK020270			Spit, bay, climbing	CCS, ITE, SDSGB	
77	Foveran to Drums	NK003233			SSSI	Bay, spit	CCS, ITE, SDSGB
78	Menie to Pettens	NJ990205			SSSI	Bay	CCS, ITE
79	Balmedie	NJ978177			Bay	CCS, ITE	
80	Blackdog to Murcar	NJ965135			Bay	CCS	
81	Bridge of Don	NJ956105			Bay	CCS	
82	Aberdeen	NJ953070			Bay	CCS	
83	St. Cyrus	NO753644			Bay, spit	CCS, ITE	

Sources: Dargie (1993); Mather & Ritchie (1978); Ritchie & Mather (1969, 1970, 1984); Ritchie, Smith & Rose (1978); Smith & Mather (1973); Research and Advisory Services Directorate, Scottish Natural Heritage. Key: <sup>a</sup>see Map 3.2.2; <sup>b</sup>all figures have been rounded to the nearest whole hectare; NNR = National Nature Reserve; NSA = National Scenic Area; RSPB = Royal Society for the Protection of Birds Reserve; SSSI = (Biological) Site of Special Scientific Interest; SWT = Scottish Wildlife Trust Reserve; CCS = Countryside Commission for Scotland (University of Aberdeen beach reports); ITE = Institute of Terrestrial Ecology Scottish Coastal Survey; SDSGB = NCC's Sand Dune Survey of Great Britain.

### 3.2.3 Human activities

In general, sand dunes are amongst the least heavily modified of terrestrial habitats. Conservation is now a major activity in many locations, with many sites having one or more designations or forms of planning control (Table 3.2.3). However, the inner edge of many sand dune sites in the region has been affected by a variety of human impacts, sometimes leading to major habitat loss or conversion to vegetation that is common and lacks typical dune species (Doody 1989). The most notable case is the loss of a large dune area to afforestation at Culbin. Industrial development has destroyed the coastal edge of dunes at Nigg, and pipeline fabrication yards impact locally on dunes at Sinclair's Bay and Morrich More. Gas pipeline landfalls are routed through dunes at Cruden Bay and Ratray Bay. However, the total area of damage to dune habitat from such development is low. Recreational development has encroached on many sites, and car parks, caravan and camp sites and golf courses are very common (Harding-Hill 1993). A total of 26 sites contain golf courses, but most cause little damage, though the course at Durness is routed through rare habitats and has created concern (Evans 1987). Military use is present on several sites (notably Morrich More), but the total area of impact and damage is slight (Hansom & Leafe 1990). Heavy visitor pressure has been present for at least two decades at Sango Bay, Dunnet Bay, Dornoch South, Nairn West, Nairn East, Findhorn, Stotfield, Peterhead, Bridge of Don, Aberdeen and St. Cyrus, but severe problems of widespread erosion, vegetation trampling or dune destabilisation are rare. Most dune sites are grazed by stock on an extensive scale, which maintains biological diversity, though winter feeding and consequent grassland improvement have occurred at Loch of Strathbeg. Uncontrolled rabbit grazing is common on most dunes and causes local erosion at a few sites (e.g. Farr Bay). Re-seeding and fertiliser addition have modified

some vegetation at Dunnet Bay and Loch of Strathbeg. At the latter, sand is being removed from the beach in four 1 km squares and from dunes in three. Findhorn has recently required major coastal defences to protect residential and recreational development, with some fear that new groyne will reduce sediment supply to Culbin and enhance rates of erosion to parts of the SSSI frontage (ASH Consulting Group 1994). Rock riprap has been placed along most of the dune edge at Dornoch North beach. Coastal zone management issues in the Moray Firth are being examined by Scottish Natural Heritage as part of the Focus on Firths initiative (see also Chapter 10).

### 3.2.4 Information sources used

Three main sets of surveys cover the region. Seven sites have been surveyed as part of the Sand Dune Survey of Great Britain (Dargie 1993) using the National Vegetation Classification (NVC) (Rodwell 1991a, 1991b, 1992, 1995, in prep.). This work was initiated by the Nature Conservancy Council in 1987 and was continued after 1992 by the Joint Nature Conservation Committee on behalf of country nature conservation agencies. NVC surveys use a reliable, consistent methodology yielding very detailed information (Rodwell in prep.). The vegetation is mapped and described, and information on coastal erosion and accretion, atypical vegetation and adjoining land use is also recorded. The data represent a sound baseline for future dune vegetation studies and both strategic and local management of the dune resource. A national report for Scotland (Dargie 1993) is available, which synthesises all site information and discusses regional trends. Scottish Natural Heritage has commissioned a project to complete the NVC survey of Scottish dunes by 1998; until then it is not possible to give accurate figures on extent for either the North Sea coast or

Great Britain. An estimate of dune habitats for Scotland is used in Table 3.2.1, based on a sample set of sites (Dargie 1993).

Dune geomorphology is covered in beach reports for all beaches in Scotland, sponsored by the Countryside Commission for Scotland (Ritchie & Mather 1969, 1970, 1984; Ritchie, Smith & Rose 1978; Smith & Mather 1973). Ecological content is limited but information on site use, especially for recreation, is detailed and forms a good baseline for the survey date.

At selected sites, vegetation has been examined by the Institute of Terrestrial Ecology (ITE) (Shaw, Hewett & Pizzey 1983). Unfortunately the computer-based study lacked the precision of more modern vegetation description systems such as the NVC. No mapping was done and the extent of vegetation types is unknown. A useful descriptive site account is included and species records for each site are available.

### 3.2.5 Acknowledgements

Assistance with sources was kindly provided by Research and Advisory Services Directorate of Scottish Natural Heritage and JNCC's Species Conservation Branch.

### 3.2.6 Further sources of information

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#### B. Further reading

- Further details of coastal habitat sites, including sand dunes, are available on the *Coastal & marine UKDMAP datasets* module disseminated by JNCC Coastal Conservation Branch, Peterborough (Barne et al. 1994).
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### C. Contact names and addresses

Type of information	Contact address and telephone no.
Flora, fauna, habitat information, location of site reports, site management - Scotland	*Coastal Ecologist, Aquatic Environments Branch, SNH, Edinburgh, tel: 0131 554 9797
Issues, coastal zone management initiatives	*Project Officer, Moray Firth Initiative, Scottish Natural Heritage, Inverness, tel: 01463 712221
Advice on national and international policy and dune conservation	*Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626

\* Starred contact addresses are given in full in the Appendix.