

Dawlish Warren

Dawlish Warren is a spit of sand and shingle extending from Langstone Rock across the mouth of the Exe Estuary, leaving a channel at the Exmouth side. The main axis of the spit runs northeast for about 2.5 km. The Warren is unusual in that it is a double spit, the Outer Warren facing the English Channel and the Inner Warren on the inland (river) side (Martin 1872). These are separated by Greenland Lake, now a damp depression, equivalent to a dune slack, but which was once a tidal creek. Initially the inlet was on the north (estuary) side, until the sea broke through the Outer Warren and a barrier was constructed in the 1930s by the railway company (Wallace 1953). Further works to reinforce the seaward face of the dunes have been undertaken since, most recently in 2011. The shape of the Warren has been constantly changing, at least until the last hundred years during which there have been increasing coastal defence works. There is some suggestion that the main outlet of the estuary may at some point have been on the Dawlish side, with the Warren accessible from Exmouth (Martin 1893).

The Outer Warren, including Greenland Lake, is owned and managed by Teignbridge District Council. The Outer Warren consists of mobile and semi-fixed dunes and in some places the succession from strandline vegetation, through fore-dunes to mobile dunes and dune grassland can be seen. However, these natural processes are hindered by the sea defences that help stabilise the spit.

The Warren Golf Course occupies the Inner Warren. The Golf Club was founded in 1892 and thus pre-dates both the construction of the barrier closing Greenland Lake off from the sea and the transfer of the site to the Devon Wildlife Trust in 1962 (DWT 2011), as well as all the environmental legislation that now applies. The Golf Course comprises 32 (*ibid.*) hectares of which some 25 are included in the Site of Special Scientific Interest (Natural England 2011), excluding car parks, buildings, etc.



Looking southwest along the dune ridge with Greenland Lake on the right.

Areas of outstanding botanical interest

There has been some debate as to which part of the Warren formed first: whether the Outer Warren or the Inner Warren is older (Kidson 1963, Mottershead 1986). Floristically, the Inner Warren appears older as it represents a later successional stage than the Outer Warren, so at least the surface layers are older. At the northeastern end the Outer Warren appears to be moving over the Inner Warren. The current Geological Conservation Review (May & Hansom 2003) does not rule out the idea that the Inner Warren is older.

The Warren encloses an area of about 80 ha of saltmarsh and mudflats in the estuary north of the Inner Warren. This area, stretching northwards to Starcross is also owned by Devon Wildlife Trust (Natural England 2011, DWT 2011). The Outer Warren, Greenland Lake and the saltmarsh are designated as a National Nature Reserve (162 ha) and together with the Inner Warren comprise the Dawlish Warren SSSI (207 ha). Dawlish Warren is also designated as a Special Area of Conservation (SAC) under the EC Habitats Directive. All of these areas form part of the much larger (2,190 ha) Exe Estuary SSSI which is also a Special Protection Area and a Ramsar site.

Typical strandline vegetation occurs at the distal end of the spit, where there is still active accretion of sand. Sea Rocket *Cakile maritima* and Oraches *Atriplex* spp. are the most frequent plants, Saltwort *Salsola kali* also occurs occasionally. Further to the south west, the sea reaches the face of the main dunes, which is reinforced with stone gabions, preventing even ephemeral plants from growing.

Sea Sandwort *Honckenya peploides* is also common at the top of the beach and, to a greater or lesser extent, throughout the dune system. As a perennial, it is capable of causing more permanent build-up of sand than the species mentioned above and so can be considered as contributing to the development of the foredunes, where the most important plant is Sand Couch *Elytrigia juncea*. Lyme Grass *Leymus arenaria* has been recorded at Dawlish Warren in the past, but has not been seen recently, although it does occur in small quantity at Exmouth on the other side of the mouth of the river.

The mobile dunes are characterised by Marram *Ammophila arenaria*, which helps create the dunes by trapping blown sand. On the Outer Warren, Marram has been planted in order to help stabilise the dunes and prevent erosion. Other typical plants of moving sand are Sea Bindweed *Calystegia soldanella*, Sea Holly *Eryngium maritimum* and Portland Spurge *Euphorbia portlandica*. Tree Lupin *Lupinus arboreus*, native to California, was also planted to stabilise the dunes. This species is frequent on the Inner Warren and locally abundant on parts of the Outer Warren, despite the fact that measures have been taken to reduce its population in order to meet targets set by Natural England (Natural England 2011).

The major part of the Outer Warren consists of semi-fixed dunes in which the dune-forming Marram has become less vigorous and is replaced by other grasses, principally Fescues *Festuca* spp., and Sand Sedge *Carex arenaria*. As the sand becomes more stable the diversity of broad-leaved species increases. Characteristic plants are Rest-harrow *Ononis repens*, Lady's Bedstraw *Galium verum*, Wild Thyme *Thymus polytrichus*, and Hare's-foot Clover *Trifolium arvense*. The non-native Evening Primroses *Oenothera* spp. are particularly striking. Amongst rarer species, Hound's-tongue *Cynoglossum officinarum* is notable.

Throughout the area the tendency for succession to scrub is evident. As well as the Tree Lupin, Tamarisk *Tamarix gallica* presumably also results from having been planted originally, and native scrub species include Bramble *Rubus fruticosus* agg., Traveller's-joy *Clematis vitalba* and Wild Madder *Rubia peregrina*. Potentially larger woody plants such as Sycamore *Acer pseudoplatanus* and Turkey Oak *Quercus cerris* are also present.

Since it was cut off from the sea, Greenland Lake has lost its salinity and now supports a dune slack community. Sedges *Carex* and Rushes *Juncus* spp. are abundant, with other typical marsh plants such as Marsh Pennywort *Hydrocotyle vulgaris* and Southern Marsh-orchid *Dactylorhiza praetermissa*. Adder's-tongue *Ophioglossum vulgatum* and the much rarer Small Adder's-tongue *Ophioglossum azoricum* also occur. Species that are rarer in Devon include Marsh Helleborine *Epipactis palustris* and Yellow Bartsia *Parentucellia viscosa*, both of which are locally abundant here. Non-native Michaelmas-daisy *Aster* spp., Garden Asparagus *Asparagus officinalis* and American Blue-eyed-grass *Sisyrinchium montanum* are frequent. Although Sea Rush *Juncus maritimus* is still plentiful, most of the salt-marsh plants listed by Wallace (1953) have gone.



The northeast end of the golf course with the bird observation hide by the Exe Estuary.

A large proportion of the area of the golf course consists of short acid grassland. It is this grassland that forms the major part of the fairways. Typical plants in this short turf are Stork's-bill *Erodium* spp., Sea Mouse-ear *Cerastium diffusum*, Buck's-horn Plantain *Plantago coronopus*, Sheep's Sorrel *Rumex acetosella* and Common Bird's-foot *Ornithopus perpusillus*. A number of small clovers are present, including Bird's-foot Clover *Trifolium ornithopodioides*, Subterranean Clover *T. subterraneum* and Suffocated Clover *T. suffocatum*. Notable rarer species are Clustered Clover *T. glomeratum* and Smooth Cat's-ear *Hypochaeris glabra*. The more stabilised parts of the Outer Warren support a similar vegetation.

This grassland is particularly notable for the presence of Sand Crocus *Romulea columnnae*, for which Dawlish Warren is the classic site on the British mainland, having first been reported in 1834. Until the species was rediscovered at a site in Cornwall in 2002 after a gap of 121 years, this was the only known extant site. Details of the populations at Dawlish Warren and their monitoring can be found in the species account. Sand Crocus occurs in short acid grassland on a sandy soil, in addition to the above, associated species include Shepherd's Cress *Teesdalia nudicaulis* and Upright Chickweed *Moenchia erecta*. Indeed, it was the presence of this last species that prompted the search that led to the re-discovery of Sand Crocus in Cornwall (Bennallick 2002).

Throughout most of the Golf Course, bands of heath occupy the higher parts of the slightly undulating terrain. The strips of heath alternate with the lower-lying grassland, and run northeast, parallel to the main axis of the Warren, suggesting that they were originally the dune ridges from which the minerals have been leached, giving rise to an acid soil supporting a heathland community. This is probably the only site in Devon where there is significant development of dune heath. Characteristic species are Heather *Calluna vulgaris*, Bell Heather *Erica cinerea*, accompanied by Fescues *Festuca* spp., Bent-grasses *Agrostis* spp., Heath Bedstraw *Galium saxatile* as well as many of the species mentioned above for the acid grassland.

It seems likely that the difference between the grassland and the alternating bands of heath is natural rather than resulting from management, and that the design of the course has been influenced by the natural aspect of the ground rather than *vice versa*.

Areas of outstanding botanical interest

If left to itself, the heathy areas would revert to scrub, as would eventually the grassland, Common Gorse *Ulex europaeus* on the heath and Bramble on the grassland. The management objectives include control of the scrub, but where it is left uncut, there are signs of succession to woodland. Wallace (1953) reported only four trees, Turkey Oaks, on the Warren, but this is now self-seeding vigorously and has been joined by Sycamore, Birch *Betula* spp., and Willows *Salix* spp. in the wetter areas.

The estuary (upriver) edge of the Inner Warren is bounded by a sea wall, inside which there is a strip of lower lying marshy grassland. A ditch and a series of small ponds between the marsh and the sea wall represent the borrow dyke typical of the landward side of sea walls, and marshy areas could be considered equivalent to the transition zone between upper saltmarsh and freshwater marsh. Prominent species are Common Reed *Phragmites australis* and Sea Club-rush *Bolboschoenus maritimus*. Sea Milkwort *Glaux maritima* is locally abundant in short turf around some of the pools and Strawberry Clover *Trifolium fragiferum* occurs where the vegetation is taller.

The sea wall itself supports a mixture of maritime species such as Sea Couch *Elytrigia atherica*, and non-maritime species typical of rough grassland such as Cock's-foot *Dactylis glomerata*. At its foot the strandline at the upper edge of the saltmarsh has been colonised by Oraches *Atriplex* spp., Sea Beet *Beta vulgaris* subsp. *maritima* and Sea Mayweed *Tripleurospermum maritimum*.

Beyond the sea wall, the saltmarsh is dominated mainly by Common Cord-grass *Spartina anglica*, which was introduced in 1935 (Martin & Fraser 1939) in order to stabilise the mudflats. This grass forms a monoculture over much of the area, excluding other species. Small Cord-grass *Spartina maritima* was once present here, at its only Devon location, but it has not been seen since 1962. A fringe of Sea-purslane *Atriplex portulacoides* borders the creeks and pools. Small areas of more species-rich 'general saltmarsh' (Ranwell 1972) do occur, but they do not form a significant proportion of the whole area.

Mudflats between the edge of the saltmarsh and Starcross also fall within the SSSI and are part of the DWT reserve. *Salicornia* spp. colonise the more elevated parts of the mudflats, while beds of Eel-grass *Zostera* species occur lower on the shore. Several species of *Salicornia* occur here, most notably *S. pusilla*, and both of the currently recognised *Zostera* species have been recorded: Eelgrass *Z. marina*, including the narrow-leaved var. *stenophylla*, and Dwarf Eelgrass *Z. noltei*. The available records suggest that more work is needed on the distribution and abundance of *Zostera* spp., but it is possible that more specialised and targeted surveys have taken place, but have not reached the general botanical recording community. Condition assessments including the health of the *Zostera* beds have been made, but data used for these have not been reflected in the available records.

The main challenge on the terrestrial parts of the Reserve to date has been the control of scrub and non-native species, principally Tree Lupin (which was, of course, originally introduced). Another problem has been the lowering of the water table leading to drying out, most noticeably on Greenland Lake. This may be a result of scrub development or other processes of natural succession, or may be related to management of the golf course. However, more substantial changes are possible in the future. The mobile dunes on the seaward side of the proximal half of the spit have consistently 'failed' their condition assessment (Natural England 2011), because the sea defences did not allow the natural development of the dune system. This has resulted in a change of policy consistent with the concept of 'coastal realignment'. Some of the stone gabions on the seaward side of the dunes are to be removed (even though they were being added as recently as 2011), so as to increase the mobility of the sand. There is by no means any certainty as to what will be the outcome. 'Natural processes' are unlikely to follow targets set by government agencies. Much of the floristic interest of the Warren is in the plant communities of Greenland Lake, which have developed since the area was closed off from the sea in the 1930s. Removing some of the defences could lead to the dunes being breached and re-flooding of Greenland Lake with sea water, turning it into a saltmarsh. Alternatively increased mobility of the sand could lead to the dunes overwhelming Greenland Lake, and possibly even the golf course with its nationally important populations of Sand Crocus. However, as a precaution, a considerable 'flood wall' has already been constructed just east of the visitor centre to protect the tourist attractions at the Dawlish end of the Warren.

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