

The Ecology of Birkdale Green Beach

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Introduction

The Birkdale Green Beach is linear stretch of recently formed salt-marsh and sand-dune habitat on the foreshore between Weld Road roundabout, Birkdale in the north (SD 321 163) to the Ainsdale Beach Barrier in the south (SD 302 136). Its outstanding ecological interest has been apparent for some years; this report updates Smith (2003).

Origin & history

Birkdale Green Beach began to form in 1986 as scattered patches of Common Saltmarsh-grass (*Puccinellia maritima*) colonising the open shore. These patches soon accumulated silt and blown sand to form low hummocks, the outermost of which grew more rapidly to form a line of embryo dunes about 100m west of the original dune frontage. The early years of this development are described by Edmondson *et al.* (2001). This type of feature has developed previously on the Sefton Coast. E.R. Beattie, writing about his memories of Southport in around 1862 states:

“From now onwards I watched the gradual growth of sandhills and marsh at the Birkdale end of the town, embryo sandhills in little hummocks forming about opposite the site of the Palace Hotel, and on the shore tufts of marsh grass began to appear, spreading and joining each other until what was a level expanse of tide-ribbed sand became a green expanse of marsh, and it was only on a spring tide that the sea reached the Promenade.”

Another Green Beach was studied in greater detail in the early 1930s at Ainsdale (Allen 1932, and see below). However it was later washed away by winter storms. Similarly, at Birkdale from 1974, a 200m-long ridge formed in the same way, isolating a 50m-wide lagoon flooded by a surface water drain. This feature persisted and became known as Tagg’s Island (Sturgess 1988). The present Green Beach is much larger, being currently about 4km long and up to 200m wide. Its area has grown exponentially from about 2ha in 1989 to 62ha in 2005 (Fig. 1). Growth has taken place westwards by the development of a series of parallel embryo dune ridges, between which are areas of salt-marsh and

freshwater marsh, the latter being fed by three surface-water drains. Extensive flooding takes place from autumn to spring but the lagoons usually dry up during the summer.

In spring 2005, the Ainsdale Beach Barrier was moved about 400m south towards Ainsdale to compensate for a similar area of Special Protection Area foreshore at Southport treated with herbicide to remove colonising vegetation. Preventing the driving and parking of cars on this area resulted in a spectacular growth of Common Saltmarsh-grass and the development of three parallel ridges up to 30cm high within six months. By June 2006, this area was extensively vegetated and supported 24 vascular plants (Table 1). A visit in late September 2006 added another eight taxa (Table 1). By September 2007, there were 74 species (Table 2). At the time of writing, patches of *P. maritima* are still establishing on the foreshore west and south of the Green Beach so its growth may continue for some time, though perhaps more slowly.

The long-term survival of Tagg's Island and the Green Beach seems to be attributable to accretion of sand and silt on the foreshore which, as a result, has become progressively wider over recent decades. Thus, wave-energy is largely dissipated as the tide floods and is insufficient, even in winter storms, to erode away the *Puccinellia* hummocks and, later, the embryo dunes. Indeed, most tides barely reach the frontal ridge and, although exceptionally high equinoxial spring tides of 10.4-10.5m O.D. in September 2005, March 2006 and October 2006 flooded the Green Beach to depths of up to 50cm, very little scouring occurred.

Habitats

The westernmost part of the study area consists of sparse, hummocky salt-marsh on the open beach, consisting almost entirely of Common Saltmarsh-grass. This is backed by a strand-line of washed up tidal debris, partly colonised in summer by salt-tolerant annuals, especially Spear-leaved Orache (*Atriplex prostrata*), but also including Sea Rocket (*Cakile maritima*), Red Goosefoot (*Chenopodium rubrum*), Sea Beet (*Beta vulgaris* ssp. *maritima*) and Prickly Saltwort (*Salsola kali*). This habitat also extends along the front of the embryo dunes in the section recently protected by the new Beach Barrier. Here may

also be found such species as Frosted Orache (*Atriplex laciniata*), Grass-leaved Orache (*A. littoralis*) and Ray's Knotgrass (*Polygonum oxyspermum* ssp. *raii*). Very occasionally, the native strand-line plants are accompanied by escapes from cultivation, such as Potato (*Solanum tuberosum*) and Tomato (*Lycopersicon esculentum*).

The outer embryo dune ridge follows, formed, initially, around stems of *Puccinellia maritima* but later colonised by the more effective sand-trappers, Sand Couch (*Elytrigia juncea*) and Lyme-grass (*Elymus arenarius*). Only in a few places is the ridge high enough to support the less salt-tolerant Marram (*Ammophila arenaria*). Sand supply to the embryo ridge has been curtailed by the growth of further vegetation to the west which has intercepted the blowing sand. As a result, its maximum height is only about 1.5m in a few places and often much less. However, the embryo dune ridge along the back of the newly protected stretch south of the original Green Beach is beginning to exceed that height and, remarkably, is formed almost entirely by Common Saltmarsh-grass.

East of the embryo dunes along most of the Green Beach, the habitat is a maturing hummocky salt-marsh. When newly formed, this is dominated by coalescing patches of Common Saltmarsh-grass. Later colonists include a wide variety of halophytes, including Sea Aster (*Aster tripolium*), English Scurvy-grass (*Cochlearia anglica*), Sea Milkwort (*Glaux maritima*), Sea Plantain (*Plantago maritima*), Sea Arrowgrass (*Triglochin maritimum*) and Red Fescue (*Festuca rubra* ssp. *littoralis*). There are also occasional small patches of Common Cord-grass (*Spartina anglica*), while bare mud is variously colonised by Glasswort (*Salicornia* spp.), Frog Rush (*Juncus ambiguus*), Lesser Sea-spurrey (*Spergularia marina*) and Greater Sea-spurrey (*S. media*). The older areas of salt-marsh support Long-bracted Sedge (*Carex extensa*), Saltmarsh Rush (*Juncus gerardii*), Sea Rush (*J. maritima*) and Parsley Water-dropwort (*Oenanthe lachenalii*), among many others, within a sward of Red Fescue with large patches of Hard-grass (*Parapholis strigosa*).

Former embryo-dune ridges behind the salt-marsh have now become semi-fixed dunes colonised by a great diversity of plants which do not tolerate burial in sand. More open

areas support ruderals, such as thistles (*Cirsium* spp.) and Common Ragwort (*Senecio jacobaea*). Closed swards are dominated by Red Fescue and other grasses with a range of legumes, such as Kidney-vetch (*Anthyllis vulneraria*), Bird's-foot-trefoil (*Lotus corniculatus*) and various clovers (*Trifolium* spp). The original hummocks, established during formation, often give a small-scale topography of dry and wet sites, adding to vegetation diversity.

Finally, there is a series of seasonally-flooded freshwater lagoons which resemble sand-dune slacks. The older parts of this system, particularly to the north, support large stands of Sea Club-rush (*Bolboschoenus maritimus*) and Common Reed (*Phragmites australis*) together with occasional Bulrush (*Typha latifolia*), Grey Bulrush (*Schoenoplectus tabernaemontani*) and much Creeping Bent (*Agrostis stolonifera*), while younger areas are much more diverse, being characterised by such species as Strawberry Clover (*Trifolium fragiferum*), Knotted Pearlwort (*Sagina nodosa*), Lesser Water-parsnip (*Berula erecta*), Jointed Rush (*Juncus articulatus*), willowherbs (*Epilobium* spp.), Marsh Pennywort (*Hydrocotyle vulgaris*), Water Mint (*Mentha aquatica*) and marsh-orchids (*Dactylorhiza* spp.).

Backing the lagoons, on what seem to be old strand-lines, are rows of Alder (*Alnus glutinosa*) bushes, originating in about 1998 and now beginning to form a sheltered wet-woodland/scrub habitat. Currently, the bushes reach a maximum height of about 2.5m and show signs of wind/salt-spray damage with dye-back of leading shoots. Thomas (2005) estimated that there were over 3,000 Alder bushes and showed that their ages ranged from seven years in the north to two years in the central and southern sections. He showed that the seed floated but had poor viability in sea-water and therefore could not have travelled far, speculating on an origin in Ribble Valley woodlands. Further studies by Banks (2006) demonstrated that Alder seed could survive in sea-water for up to 16 days, giving further credibility to an origin as far away as the Ribble Valley.

Other shrub species present on the Green Beach are the introduced Sea Buckthorn (*Hippophae rhamnoides*) (being rigorously controlled by pulling and spraying) and

several willows (*Salix*), of which Creeping Willow (*S. repens*) and Grey Willow (*S. cinerea*) are the most frequent. However, these mainly consist of isolated small bushes which, as yet, hardly constitute a habitat.

Vegetation classification

A National Vegetation Classification survey in 2002 by Gateley & Michell deduced that the dominant vegetation type in the northern sector of the Green Beach was S21c (Sea Club-rush swamp, Creeping Bent sub-community) while, to the south, this was largely replaced by SM13 (Common Saltmarsh-grass salt-marsh). In the central sector they mapped a strip of S4d (Common Reed swamp, Spear-leaved Orache sub-community), while the embryo dunes were considered to be a mosaic of SD4 (Sand Couch fore-dune) and SD6 (Marram mobile-dune).

Thomas (2005) thought that the developing Alder scrub habitat approximated to the NVC's W6 (*Alnus glutinosa* – *Urtica dioica* woodland), though Rodwell (1991) makes no mention of this community's occurrence in paramaritime conditions.

Vascular plants

The number of vascular taxa found on the Green Beach has increased progressively from two in 1986 to 269 in 2007 (Fig. 2; Appendix 1). Only 35 (13%) are non-native or introduced native plants, this being a small proportion compared with the 33% aliens for the Sefton Coast sand-dune system as a whole (Smith 2006 c).

Forty-two nationally or regionally notable taxa (16% of the flora) have been recorded: three Nationally Rare, five Nationally Scarce, one Vulnerable, two Near Threatened and 31 Species of Conservation Importance in North West England (SCIs) not included in any other category (Appendix 1) (Cheffings & Farrell 2005; Regional Biodiversity Steering Group 1999).

The Nationally Rare taxa comprise the willow hybrid *Salix x friesiana*, Rock Sea Lavender (*Limonium britannicum* ssp. *celticum*) and Sharp Club-rush (*Schoenoplectus*

pungens). The latter was discovered on the Green Beach in 1999 by Dan Wrench, having presumably spread naturally from a translocation site in the nearby Tagg's Island Marsh. This plant, which has its only British locality at Birkdale, covered an area of about 90m² in 2004 (Smith 2005 b). A single plant of Rock Sea Lavender was found by Pat Lockwood in June 2007.

One of the Nationally Scarce taxa is the Baltic Rush (*Juncus balticus*), which in England is known only from the Birkdale sand-dunes. Originally found on the Green Beach in 2000 as a single small patch, this species has colonised quite widely and, by 2004, was represented by 12 patches covering an area of 4.3m² (Smith 2006a). Two new patches were found in 2006 and another in 2007. Also included in this category are Seaside Centaury (*Centaureum littorale*), the mainly coastal form of Early Marsh-orchid (*Dactylorhiza incarnata* ssp. *coccinea*), Yellow Glasswort (*Salicornia fragilis*) and Dune Fescue (*Vulpia fasciculata*).

In June 2006, a BSBI field meeting resulted in several significant new finds, including Saltmarsh Flat-sedge (*Blysmus rufus*) (SCI), Round-fruited Rush (*Juncus compressus*) (Near Threatened) and a hybrid marsh-orchid (*Dactylorhiza* x *wintoni*), which had not been recorded on the Sefton Coast since 1986, 1933 and 1949 respectively. Also noted was the hybrid sedge *Carex remota* x *C. otrubae* (= *Carex* x *pseudoaxillaris*), not seen in the vice-county of South Lancashire since the 1890s.

SCIs that are particularly well represented on the Green Beach include Wild Celery (*Apium graveolens*), Yellow-wort (*Blackstonia perfoliata*), Lesser Centaury (*Centaureum pulchellum*), Sea Spurge (*Euphorbia paralias*), Frog Rush, Parsley Water-dropwort, Brookweed (*Samolus valerandi*), Grey Bulrush, Strawberry Clover and Marsh Arrowgrass (*Triglochin palustre*).

Bryophytes

In a 2004 survey, David Holyoak (*in litt.*) recorded one liverwort and nine species of moss on the Green Beach (Table 3). The mosses include two Nationally Rare taxa,

Bryum dyffrynense and *B. warneum*, the latter being a UK BAP Priority Species. The population of *B. warneum* here is much larger than all its other British localities combined and was used as the source of material for a reintroduction to Braunton Burrows, Devon, in 2005.

Mammals

Mammals recorded for the Green Beach include the Rabbit, whose grazing has a major impact on vegetation, mainly in the northern third. Warrens are in the older dunes east of the beach and grazing takes place mostly at night. The southern part of the site seems little affected by this species. Also noted under driftwood are Common Shrew and Wood Mouse. Stoat has also been seen.

Birds

In winter, the Green Beach is of value to Snipe (18 in 2004) and Jack Snipe (up to 8 in 2004 and 2005), while up to two Short-eared Owls and two Peregrines have been seen. There is usually a wintering flock of about 100 Linnets, while small flocks of Snow Buntings may also occur infrequently. Spring passage brings Wheatears (up to 27 in 2004), Whinchat (3), White Wagtail (17 in 2005) and Yellow Wagtail (1). Regular breeding species include a few pairs of Mallard, Ringed Plover (15 in 2005), Lapwing (7 in 2005) and Skylark. A pair of Oystercatchers nested unsuccessfully in 2006. A vagrant Pectoral Sandpiper from North America was recorded in September 2003.

Reptiles

Both Common Lizard (*Lacerta vivipara*) and Sand Lizard (*Lacerta agilis*) have been recorded under tide-line timber at the back of the Green Beach, a juvenile of the latter species being seen in September 2006 and two immature males in 2007. A Sand Lizard was once seen to be taken by a Kestrel.

Amphibians

Several Smooth Newts (*Triturus vulgaris*) have been recorded under timber on the Green Beach. Common Toads (*Bufo bufo*) breed in relatively small numbers in the drain

outfalls and lagoonal areas immediately adjacent to these. The Natterjack Toad (*Bufo calamita*) now has an important breeding population here. In spring 2006, about 150 spawn strings were counted at five localities, a majority being at the south end where over 100 males were estimated to be calling at night. Most adults were relatively small; probably only three to four years old. Breeding success was high with thousands of toadlets being estimated from mid-June onwards. By 2007, the number of spawn strings had increased to 218, the exceptional summer weather conditions resulting in four strings being found as late as 24th July.

Invertebrates

The Green Beach seems to be rich in invertebrates but relatively little systematic recording has been carried out. J. M. Newton found 10 species of spiders and harvestmen in 2003 (Table 4). N.A. Robinson has visited twice in July 2004 and August 2005 to record aculeate Hymenoptera. He found five species of bumblebee, six solitary bees, seven solitary wasps and one ant (Table 5). Most notable are the solitary bees *Colletes marginatus* and *Megachile maritimus* (both near their northern limit here), *Andrena nigriceps*, a mostly southern species, and the solitary wasp *Anoplius infuscatus*, which also has a mainly southern distribution

In a study of carabid beetles in 2004, M.P. Wilcox identified nine species, one (*Stenolophus mixtus*) being new to the Sefton Coast (Table 6). The Red Data Book species, Northern Dune Tiger Beetle (*Cicindela hybrida*), has occurred since 2006, in some numbers, on embryo dunes at the southern end of the site. This beetle occurs on only two sand-dune systems in Britain.

Orthoptera have been studied by the author. Three species of grasshopper (Common Green *Omocestus viridulus*, Field *Chorthippus brunneus* and Mottled *Myrmeleotettix maculatus*) are fairly common, especially along the eastern edge. Short-winged Conehead (*Conocephalus dorsalis*) nymphs were discovered on the Green Beach by Chris Felton in 2005. Subsequently, I counted 40 individuals over a distance of about 1.75km, mainly in dense Sea Club-rush. In the hot summer of 2006, it was much more

abundant. Having a mainly southern and eastern distribution in Britain, this species was also found recently at Marshside and Lytham on the Ribble Estuary and at Warton Marsh, the Keer Estuary and Humphrey Head on Morecambe Bay. Previously, its nearest known locality was on Anglesey (Smith & Newton, 2007).

The Green Beach is visited by several of the common butterflies of the sand-dunes, such as Common Blue, Small Copper, Small Skipper, Large Skipper, Small Heath, Meadow Brown, Gatekeeper, Wall Brown, Grayling, Small Tortoiseshell, Peacock, Red Admiral, Painted Lady and Green-veined White. No doubt several of these breed.

A major event at the end of August 2007 was the discovery of the Sandhill Rustic (*Luperina nickerlii* ssp. *gueneei*) on Green Beach embryo-dunes by P. Gahan. Night-time visits located a total of sixteen individuals on Common Saltmarsh-grass and Sand Couch. This colony of an endemic Red Data Book moth is 11km north of its only other known locality on the Sefton Coast at Altcar Rifle Range. Sub-species *gueneei* is restricted to a few coastal sites in North Wales and North-west England.

Dragonflies recorded on the Green Beach include the Blue-tailed Damselfly (*Ischnura elegans*), Emerald Damselfly (*Lestes sponsa*), Emperor Dragonfly (*Anax imperator*), Migrant Hawker (*Aeshna mixta*), Broad-bodied Chaser (*Libellula depressa*) and Common Darter (*Sympetrum striolatum*). Some of these may breed in the drain outfalls but most are probably just using the site for feeding.

Several other groups, such as flies (Diptera) and bugs (Hemiptera), would no doubt repay study, especially those associated with the developing Alder woodland.

Comparison with earlier features

Allen (1932) gives a vivid description of a “sea-beach flora” which developed between Ainsdale and Freshfield in the early 1930s. It was first noticed in September 1930 by W.G. Travis but grew rapidly in 1931 about 10 yards from the base of the frontal dunes. By early May, a strip of vegetation consisting entirely of Common Saltmarsh-grass was

150 yards long and 5 yards wide. A month later, it was 300 yards long and much broader; a second, parallel strip 6 or 7 yards nearer the sea had appeared and seedlings of Sea Plantain were then present. By mid-June 1931, the original strip was 400 yards long and showed “an uprising of regular little hillocks.” These were measured as 4 inches high. Sea Aster was well-established and the second strip was 200 yards long.

During the next two weeks a large number of new colonists was identified (Table 7), consisting both of salt-marsh and freshwater (slack) species and some ruderals, almost all of which are found on the present Green Beach. By then, the hillocks were up to 5 feet in diameter and a third line of *Puccinellia* was appearing 10 yards seaward of the second strip. Over the 1931/32 winter, it was noted that the first and second strips were separated by a “large pool of practically fresh water”, in which various algae could be found.

Clearly, this feature has close similarities with the origin and early development of the current Green Beach and its recent southern extension, the occurrence of the same mix of plant species, the formation of parallel vegetation strips and the presence of a seasonal “slack” being particularly interesting.

The Ainsdale NNR archive has a photograph of the Freshfield sea-beach flora by R.K. Gresswell and others, taken by D. Coult in the late 1940s, of a similar but undescribed formation on Ainsdale beach.

Tagg’s Island began to form in 1974, also as a strip of Common Saltmarsh-grass about 200m long and about 50m west of the frontal dunes at Birkdale. By 1978, embryo dunes were quite well developed and the following year brushwood was used to encourage the accretion of sand. At this time, cars were still driving along the shore inland of the new ridge but the deposition of silt created increasingly muddy conditions and it was decided to close off the route by adding sand and beach cleanings to both ends of the ridge, joining these to the adjacent fore-dunes. Discharge from a surface-water drain flooded the lagoon thus formed and the site soon became a Natterjack Toad breeding pool. Vascular plant lists were compiled in 1981 and 1988 (Sturgess 1988). The first list for

the marsh area comprised 38 taxa, including several maritime species, such as Sea Aster, Spear-leaved Orache, Saltmarsh Rush, Reflexed Saltmarsh-grass (*Puccinellia distans*), Common Saltmarsh-grass, Glasswort, Sea Club-rush, Common Cord-grass and Sea Arrowgrass. By 1988, the plant community was dominated by Sea Club-rush, Creeping Bent, Common Reed and rushes (*Juncus* spp.); the total list had increased to 79 species, Glasswort and Common Cord-grass having disappeared. Sturgess (1988) remarked that the site had changed from a brackish marsh to more freshwater conditions as the tide had not breached the island since 1983.

A study in 2003 showed that the plant list had declined to 64 taxa (Smith 2006 b). Presently, the northern part of Tagg's Island marsh is dominated by a dense bed of Common Reed while the southern end has much Sea Club-rush and a more diverse plant community associated with the fringes of a scrape dug in 1986. These changes resemble those that are currently taking place in the northern and central sectors of the Green Beach, especially the increase with time of Common Reed and Sea Club-rush.

Comparison with features elsewhere

This type of habitat is hard to find in the standard texts on sand-dune and salt-marsh formation (e.g. Ranwell 1972; Packham & Willis 1997), though it does bear some similarities to Berrow Marsh, Somerset described by Packham & Willis. An earlier account by Willis & Davies (1960) shows that a linear expanse of pioneer salt-marsh, dominated by Glassworts and Common Saltmarsh-grass, began to form in 1910. Cord-grass was first noticed in 1920 and came to dominate the lower part of the marsh. Between the 1940s and 1960s, a broken ridge of low embryo formed, separating the lower marsh from an upper zone which was rarely flooded by the tide and was affected by freshwater seepage from landward dunes. Behind the embryo ridge were three main vegetation zones, the lowest dominated by Cord-grass, followed by Sea Club-rush. By 1960, the upper zone had a rich mixture of species, the co-dominants being Saltmarsh Rush, Parsley Water-dropwort, Red Fescue, Long-bracted Sedge, Sea Plantain and Sea Milkwort. Other associates included Glaucous Sedge (*Carex flacca*), Hemlock Water-dropwort (*Oenanthe crocata*), Silverweed (*Potentilla anserina*), Strawberry Clover,

Creeping Bent, Marsh Arrow-grass, False Fox-sedge (*Carex otrubae*) and Wild Celery. The landward margin of the marsh supported Yellow Iris (*Iris pseudacorus*), Common Reed and Bulrush. The similarity of this flora with that of Birkdale Green Beach is apparent but it developed over a much longer time-scale.

A similar feature is described by Gimingham (1953) (quoted in Burnett, 1964) at St Cyrus, N.E. Scotland. This is a transitional zone between salt-marsh and sand-dune in which zonation moves from Common Saltmarsh-grass to Red Fescue with increasing amounts of Thrift (*Armeria maritima*) to an upper zone of dense Sea Sandwort (*Honckenya peploides*) with some Sea Couch (*Elytrigia atherica*). The upper extremity of the salt-marsh is an area of scattered sandy hummocks, occasionally inundated by the tide and littered with drift. This supported a mixture of dune, salt-marsh and ruderal plants, the most abundant being Thrift (a), Babington's Orache (*Atriplex glabriuscula*) (a), Sea Pearlwort (*Sagina maritima*) (a), Prickly Sow-thistle (*Sonchus asper*) (a), Silverweed (a), Buck's-horn Plantain (*Plantago coronopus*) (a), Creeping Bent (f), Marram (f), Red Fescue (f), Common Saltmarsh-grass (f), Cleavers (*Galium aparine*) (f) and Curled Dock (*Rumex crispus*) (f). Less common were False Fox-sedge (r), Creeping Thistle (*Cirsium arvense*) (o), Common Scurvy-grass (*Cochlearia officinalis*) (o), Sea Milkwort (o), Red Campion (*Silene dioica*) (o), Sea Plantain (o) and comfrey (*Symphytum* sp.). There are clear parallels with the Birkdale Green Beach, though some of the plants are different.

While Alder is normally associated with freshwater conditions, Packham & Willis (1997) describe a transition from salt-marsh to tidal woodland on the upper reaches of the Fal Estuary, Cornwall, the woodland being dominated by Alder, Grey Willow and Oak (*Quercus robur*). During equinoxial tides, the flood water at the woodland boundary had one-tenth the salinity of seawater, while around the tree roots it fell to one-twentieth.

Somewhat similar may be the site known to H. McAllister (*in litt.*) on especially the northern shore of Loch Riddon, near Glendaruel in Argyll. Here an almost continuous

band of Alder trees lines a sheltered sea-loch, high spring tides reaching the bases of the trees.

N.A. Robinson (*in litt.*) has visited a 50m-wide belt of patchy Alder scrub on a freshwater seepage zone at the head of Sandyhills Bay, Dumfries & Galloway. This is a gently shelving shoreline with some sand accumulation. The degree of tidal inundation is not known.

Aerial photographs of Tentsmuir Point, Fife taken in 1956 show “an extensive line of flood-line Alder colonisation” (Wittington 1996) in an area known as the Great Slack which was periodically flooded by seawater. According to the modern Tentsmuir NNR Teachers Pack “*Life on the Sands*” these trees mark previous water-lines in the old slacks. Alder cones were blown into the flooded slacks and then stranded as the water-table dropped. The seeds germinated in lines, growing into trees, some of which are now quite tall. Similarities with the pattern of Alder colonisation on the Green Beach are apparent.

Some recent Dutch reports give a fascinating insight into Green Beach development on the Netherlands coast which has similar dune systems to that of Sefton. Bakker *et al.* state that the Wadden Sea island of Schiermonnikoog featured a small green beach in the 1960s. This became separated from the shore by an artificial sand dyke and transformed into a species-rich dune slack. A further green beach began to form in the 1990s, becoming 200-400m wide and 10km long. Salt-marsh plants occur along the whole length but dune-slack species are restricted to areas where fresh-water seepage occurs from the high dunes in the centre of the island.

Another example of green beach has developed over the last decade on the island of Ameland. (van Tooren & Krol). Important invading species were *Glaux maritima*, *Salicornia europaea*, *Puccinellia maritima* and *P. distans*. There are also small dunes with *Elytrigia juncea*. Over a few years, denser vegetation formed, including much *Phragmites australis*.

Kers & Koppejan report on green beach development in the shelter of a sand bank on the northwestern side of the Wadden Sea island of Rottumerplaat. Similar features to the southwest are threatened by erosion.

Assessment

The Birkdale Green Beach is making an outstanding contribution to the biodiversity of the Sefton Coast (Smith 2007). In particular, it provides a significant area of pioneer habitat in a dune system which has suffered from over-maturity in recent decades (Smith 1999). This is reflected in a high species-richness, especially of vascular plants; the 269 taxa recorded (16% nationally or regionally notable) represent 25% of the entire sand-dune flora. It may be surmised that this diversity is, in part, due to the presence of bare/disturbed sites for plant colonisation; about 33% of vascular taxa on the coast is associated with disturbed ground (Smith 2006c). As a locality for the rare moss *Bryum warneum*, the Green Beach is internationally important.

The site has also recently become important for the nationally endangered and specially protected Natterjack Toad, a UK Biodiversity Action Plan Priority Species. The Sefton Coast supports one of the highest populations of this species in the British Isles. Breeding birds include Skylark, which is on the Red List of Species of Conservation Concern in the UK, while Lapwing and Ringed Plover are Amber listed. Although only about 50% of the pairs are successful, the Green Beach now has the second largest concentration of breeding Ringed Plovers in “Lancashire”.

Recent discoveries of Northern Dune Tiger-beetle and Sandhill Rustic means that the Green Beach is nationally important for invertebrates.

The Green Beach lies within the Sefton Coast SSSI and is proposed as an extension to the Ainsdale & Birkdale Sandhills Local Nature Reserve. It is also protected under the EU Birds and Habitats Directives as part of the Sefton Coast Special Protection Area and Special Area of Conservation within the Natura 2000 network.

Conservation

Despite its recent origin, parts of the Green Beach are already beginning to show signs of increasing maturity with dense beds of Sea Club-rush and Common Reed dominating and replacing the more diverse vegetation in the northern and central sectors. This process may be slowed to some extent by Rabbit grazing. Similarly, in recent years, there has been a rapid development of Alder scrub in the central sector, although this is becoming an important habitat in its own right. A potential problem with invasive Sea Buckthorn is being kept in check by active management but, as yet, no attempt has been made to control the Alder as this is a natural colonist. The continuing westwards growth of the Green Beach should maintain the representation of pioneer communities for at least the foreseeable future. Fore-dune development around Common Saltmarsh-grass, especially in the southern sector, is of inherent scientific interest as it seems not to have been described in the standard texts on dune formation (e.g. Packham & Willis 1997; Ranwell 1972).

In an attempt to retain water for breeding Natterjacks, in spring 2005, 2006 and 2007, sand-dams were erected across the freshwater outflows near the southern end of the Green Beach. This promoted successful metamorphosis in the first two years

N.A. Robinson (pers. comm.) has drawn attention to the importance for invertebrates of the large barks of timber and tree trunks washed up from time to time. As they age and weather, these are increasingly used as nesting and basking sites by solitary bees and wasps, while such debris is also useful as hiding places for Natterjacks and lizards as well as invertebrates.

Although visitor interest in the Green Beach has been encouraged in the north by the development of a way-marked footpath, the Velvet Trail, and the construction of a board-walk, much of the site remains relatively quiet, this being crucial to its continuing importance for breeding birds.

Acknowledgements

I am grateful to Richard Thomas for providing his data on Green Beach area. M.P. Wilcox, E.F. Greenwood and Prof. R. Bateman assisted with the identification of some critical vascular plant taxa.

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Fig. 1. Changes in the area of Birkdale Green Beach, 1986 to 2005.

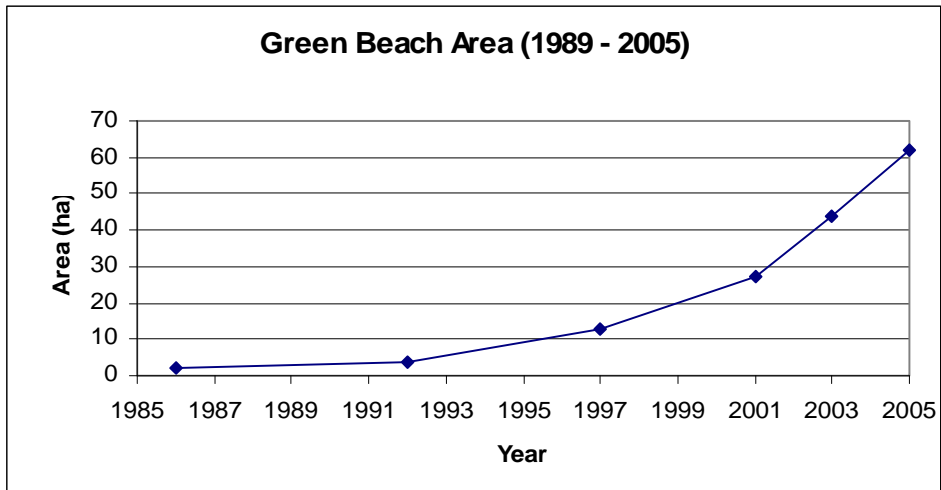


Fig. 2. Changes in the number of vascular plant taxa, 1986 to 2006.

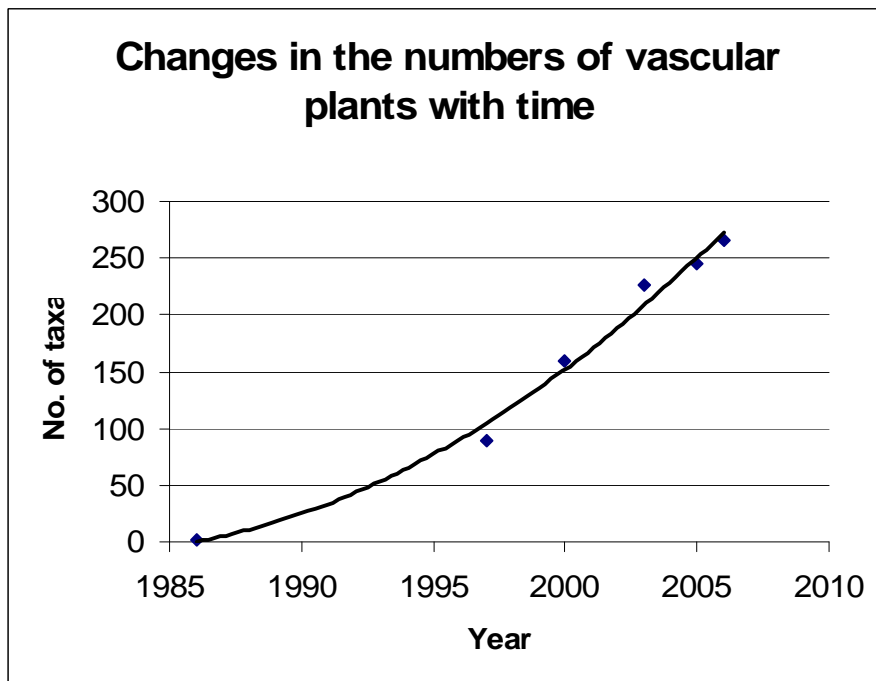


Table 1. Frequency (DAFOR scale) of vascular plants on the southern extension of the Green Beach in June 2006, 15 months after enclosure.

Taxon	English name	Frequency
<i>Agrostis stolonifera</i>	Creeping Bent	o
<i>Ammophila arenaria</i>	Marram	r
<i>Aster tripolium</i>	Sea Aster	r
<i>Atriplex prostrata</i>	Spear-leaved Orache	o
<i>Bolboschoenus maritimus</i>	Sea Club-rush	r
<i>Cakile maritima</i>	Sea Rocket	r
<i>Carex arenaria</i>	Sand Sedge	r
<i>Cochlearia anglica</i>	English Scurvy-grass	o
<i>Elytrigia juncea</i>	Sand Couch	r
<i>Elytrigia repens</i>	Common Couch	o
<i>Epilobium hirsutum</i>	Great Willowherb	r
<i>Festuca rubra</i>	Red Fescue	r
<i>Holcus lanatus</i>	Yorkshire-fog	r
<i>Juncus bufonius</i>	Toad Rush	o
<i>Leymus arenarius</i>	Lyme-grass	r
<i>Lolium perenne</i>	Perennial Rye-grass	r
<i>Plantago coronopus</i>	Buck's-horn Plantain	r
<i>Plantago maritima</i>	Sea Plantain	r
<i>Puccinellia maritima</i>	Common Saltmarsh-grass	a
<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup	r
<i>Spergularia marina</i>	Lesser Sea-spurrey	r
<i>Spergularia media</i>	Greater Sea-spurrey	r
<i>Triglochin maritimum</i>	Sea Arrowgrass	r
<i>Tripleurospermum maritimum</i>	Sea Mayweed	o

Additional vascular taxa recorded on 25th September 2006

Taxon	English name	Frequency
<i>Chenopodium rubrum</i>	Red Goosefoot	r
<i>Salicornia ramosissima</i>	Purple Glasswort	o
<i>Salix alba</i>	White Willow	r
<i>Salix fragilis</i>	Crack Willow	o
<i>Samolus valerandi</i>	Brookweed	r
<i>Spartina anglica</i>	Common Cord-grass	o
<i>Suaeda maritima</i>	Annual Sea-blite	o
<i>Typha latifolia</i>	Bulrush	o

Table 2. Vascular plant list, New Birkdale Green Beach May-October 2007, compared with 2006

* = non-native taxon

Taxon	English name	Freq. 2007	Freq. 2006
<i>Agrostis stolonifera</i>	Creeping Bent	la	o
<i>Alnus glutinosa</i>	Alder	r	
<i>Alopecurus geniculatus</i>	Marsh Foxtail	r	
<i>Ammophila arenaria</i>	Marram	o	r
<i>Angelica sylvestris</i>	Wild Angelica	r	
<i>Armeria maritima</i>	Thrift	r	
<i>Artemisia vulgaris</i>	Mugwort	r	
<i>Aster tripolium</i>	Sea Aster	o	r
<i>Atriplex prostrata</i>	Spear-leaved Orache	lf	o
<i>Bellis perennis</i>	Daisy	r	
<i>Bolboschoenus maritimus</i>	Sea Club-rush	la	r
<i>Cakile maritima</i>	Sea Rocket	r	r
<i>Carex arenaria</i>	Sand Sedge		r
<i>Carex extensa</i>	Long-bracted Sedge	r	
<i>Carex otrubae</i>	False Fox-sedge	r	
<i>Centaureum pulchellum</i>	Lesser Centaury	lo	
<i>Cerastium fontanum</i>	Common Mouse-ear	o	
<i>Cerastium semidecandrum</i>	Little Mouse-ear	r	
<i>Chenopodium rubrum</i>	Red Goosefoot		r
<i>Cirsium arvense</i>	Creeping Thistle	r	
<i>Cochlearia anglica</i>	English Scurvy-grass	o	o
<i>Daucus carota</i>	Wild Carrot	r	
<i>Elytrigia juncea</i>	Sand Couch	o	r
<i>Elytrigia repens</i>	Common Couch	o	o
<i>Epilobium hirsutum</i>	Great Willowherb	o	r
<i>Epilobium montanum</i>	Broad-leaved Willowherb	r	
<i>Epilobium obscurum</i>	Short-fruited Willowherb	r	
<i>Epilobium palustre</i>	Marsh Willowherb	r	
<i>Epilobium parviflorum</i>	Hoary Willowherb	o	
<i>Euphorbia paralias</i>	Sea Spurge	r	
<i>Festuca rubra</i>	Red Fescue	la	r
<i>Glaux maritima</i>	Sea Milkwort	o	
<i>Hippophae rhamnoides</i>	Sea Buckthorn	r	
<i>Holcus lanatus</i>	Yorkshire-fog	o	r
<i>Hypochaeris radicata</i>	Cat's-ear	o	
<i>Juncus ambiguus</i>	Frog Rush	lf	
<i>Juncus articulatus</i>	Jointed Rush	f	
<i>Juncus bufonius</i>	Toad Rush	f	o
<i>Juncus gerardii</i>	Saltmarsh Rush	r	

<i>Juncus maritimus</i>	Sea Rush	r	
<i>Leymus arenarius</i>	Lyme-grass	o	r
<i>Lolium perenne</i>	Perennial Rye-grass	o	r
<i>Lycopus europaeus</i>	Gypsywort	o	
<i>Odontites vernus</i>	Red Bartsia	lf	
<i>Oenanthe crocata</i>	Hemlock Water-dropwort	o	
<i>Oenanthe lachenalii</i>	Parsley Water-dropwort	r	
<i>Parapholis strigosa</i>	Hard-grass	o	
<i>Plantago coronopus</i>	Buck's-horn Plantain	o	r
<i>Plantago major</i>	Greater Plantain	o	
<i>Plantago maritima</i>	Sea Plantain	r	r
<i>Poa annua</i>	Annual Meadow-grass	r	
<i>Polygonum oxyspermum raii</i>	Ray's Knotgrass	lo	
<i>Puccinellia maritima</i>	Common Saltmarsh-grass	a	a
<i>Pulicaria dysenterica</i>	Common Fleabane	r	
<i>Ranunculus flammula</i>	Lesser Spearwort	o	
<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup	o	r
<i>Rubus caesius</i>	Dewberry	r	
<i>Rumex crispus</i>	Curled Dock	o	
<i>Rumex obtusifolius</i>	Broad-leaved Dock	r	
<i>Sagina apetala</i>	Annual Pearlwort	o	
<i>Sagina nodosa</i>	Knotted Pearlwort	lo	
<i>Salicornia ramosissima</i>	Purple Glasswort		o
<i>Salix alba</i>	White Willow		r
<i>Salix fragilis</i>	Crack Willow		o
<i>Salsola kali</i>	Prickly Saltwort	r	
<i>Samolus valerandi</i>	Brookweed	o	r
<i>Schoenoplectus tabernaemontani</i>	Grey Club-rush	o	
<i>Senecio jacobaea</i>	Common Ragwort	o	
<i>Senecio vulgaris</i>	Groundsel	r	
<i>Sonchus arvensis</i>	Perennial Sow-thistle	o	
<i>Sonchus asper</i>	Prickly Sow-thistle	o	
<i>Spartina anglica</i>	Common Cord-grass	o	o
<i>Spergularia marina</i>	Lesser Sea-spurrey	lo	r
<i>Spergularia media</i>	Greater Sea-spurrey	lo	r
<i>Suaeda maritima</i>	Annual Sea-blite		o
<i>Taraxacum officinale</i>	Dandelion	o	
<i>Trifolium hybridum</i>	Alsike Clover	r	
<i>Triglochin maritimum</i>	Sea Arrow-grass	o	r
<i>Triglochin palustre</i>	Marsh Arrow-grass	lf	
<i>Tripleurospermum maritimum</i>	Sea Mayweed	o	o
<i>Tussilago farfara</i>	Colt's-foot	r	
<i>Typha latifolia</i>	Bulrush	o	o
Total taxa		76	32

Table 3. Bryophytes of the Birkdale Green Beach

Taxon	Comments on status
Liverworts	
<i>Aneura pinguis</i>	
Mosses	
<i>Henidiella heimii</i>	Almost entirely coastal
<i>Didymodon tophaceus</i>	
<i>Funaria hygrometrica</i>	
<i>Ceratodon purpureus</i>	
<i>Bryum trichotomum</i>	Local and scarce but increasing
<i>Bryum gemmiferum</i>	
<i>Bryum dyffrynense</i>	Nationally Rare
<i>Bryum warneum</i>	Nationally Rare; UK BAP Priority
<i>Bryum algovicum</i> var. <i>rutheanum</i>	

Table 4. Harvestmen and spiders of Birkdale Green Beach

Harvestmen
<i>Phalangium opilio</i>
Spiders
<i>Erigione atra</i>
<i>Bathyphantes gracilis</i>
<i>Lepthyphantes tenuis</i>
<i>Larinioides cornutus</i>
<i>Pardosa pullata</i>
<i>Trochosa terricola</i>
<i>Arctosa perrita</i>
<i>Pirata paraticus</i>
<i>Heliophanes flavipes</i>

Table 5. Ants, bees and wasps of Birkdale Green Beach

Taxon	Comments on status
Ants	
<i>Myrmica rubra</i>	Common
Bees	
<i>Bombus lucorum</i>	Common
<i>Bombus terrestris</i>	Common
<i>Bombus pascuorum</i>	Common

<i>Bombus lapidarius</i>	Common
<i>Psithyrus campestris</i>	Common
<i>Hylaeus brevicornis</i>	Local
<i>Colletes fodiens</i>	Common
<i>Colletes marginatus</i>	Notable; near northern limit
<i>Epeolus variegatus</i>	Common
<i>Andrena nigriceps</i>	Notable; mainly southern
<i>Megachile maritimus</i>	At northern limit
Wasps	
<i>Crossocerus wesmaeli</i>	Common in dunes
<i>Ectemius continuus</i>	Common
<i>Diodontus minutus</i>	Common in sandy places
<i>Pemphredon inornata</i>	Common
<i>Pompilius cinereus</i>	Common
<i>Anoplius infuscatus</i>	Mainly southern
<i>Omalus auratus</i>	Widespread but not common

Table 6. Carabid beetles of Birkdale Green Beach

Taxon	Comments
<i>Nebria brevicollis</i>	Common
<i>Notiophilus biguttatus</i>	Frequent
<i>Elaphrus cupreus</i>	
<i>Broscus cephalotes</i>	Coastal
<i>Pterostichus nigrita</i>	
<i>Calathus erratus</i>	
<i>Calathus mollis</i>	
<i>Agonum marginatum</i>	
<i>Stenolophus mixtus</i>	New to Sefton Coast

Table 7. Vascular plants recorded for the Freshfield “sea-beach flora” in 1931/32.

Salt-marsh species	
<i>Aster tripolium</i>	Sea Aster
<i>Atriplex prostrata</i>	Spear-leaved Orache
<i>Bolboschoenus maritimus</i>	Sea Club-rush
<i>Cochlearia anglica</i>	English Scurvy-grass
<i>Glaux maritima</i>	Sea Milkwort
<i>Plantago maritima</i>	Sea Plantain
<i>Puccinellia distans</i>	Reflexed Saltmarsh-grass
<i>Puccinellia maritima</i>	Common Saltmarsh-grass
<i>Rumex crispus</i>	Curled Dock

<i>Salicornia</i> sp.	Glasswort
<i>Suaeda maritima</i>	Annual Sea-blite
<i>Triglochin maritimum</i>	Sea Arrowgrass
Freshwater species	
<i>Agrostis stolonifera</i>	Creeping Bent
<i>Alisma plantago-aquatica</i>	Water-plantain
<i>Alopecurus geniculatus</i>	Marsh Foxtail
<i>Apium nodiflorum</i>	Fool's Water-cress
<i>Baldellia ranunculoides</i>	Lesser Water-plantain
<i>Callitriche stagnalis</i>	Common Water-starwort
<i>Juncus articulatus</i>	Jointed Rush
<i>Myosotis laxa</i>	Tufted Forget-me-not
<i>Phalaris arundinacea</i>	Reed Canary-grass
<i>Phragmites australis</i>	Common Reed
<i>Ranunculus aquatilis</i>	Common Water-crowfoot
<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup
<i>Ranunculus trichophyllus</i>	Thread-leaved Water-crowfoot
Others	
<i>Juncus bufonius</i>	Toad Rush
<i>Lolium multiflorum</i>	Italian Rye-grass
<i>Lolium perenne</i>	Perennial Rye-grass
<i>Poa annua</i>	Annual Meadow-grass
<i>Potentilla anserina</i>	Silverweed
<i>Rumex obtusifolius</i>	Broad-leaved Dock
<i>Tripleurospermum inodorum</i>	Scentless Mayweed

Appendix 1. A vascular plant list for Birkdale Green Beach

This list is based on those completed in 2000 and 03, with additions for 2004, 05, 06 and 07.

NR = Nationally Rare; NS = Nationally Scarce; VU = Vulnerable; NT = Near Threatened; SCI = Species of Conservation Importance in North West England;

* = non-native or introduced native taxon.

Frequency is given using the DAFOR scale. Parentheses indicate taxon only recorded in 2000. Nomenclature follows Stace's *New Flora of the British Isles*.

Taxon	English name	04	05	06	07	Freq.	Status
<i>Aesculus hippocastaneum</i> *	Horse-chestnut					r	
<i>Agrimonia eupatoria</i>	Agrimony					r	
<i>Agrostis capillaris</i>	Common Bent					lf	
<i>Agrostis stolonifera</i>	Creeping Bent					ld	
<i>Aira caryophylla</i>	Silver Hair-grass					vlf	

<i>Aira praecox</i>	Early Hair-grass			+		o	
<i>Alisma plantago-aquatica</i>	Water Plantain					r	
<i>Alnus glutinosa</i>	Alder					la	
<i>Alopecurus geniculatus</i>	Marsh Fox-tail				+	r	
<i>Ammophila arenaria</i>	Marram					vla	
<i>Angelica archangelica</i> *	Garden angelica					lo	
<i>Angelica sylvestris</i>	Wild Angelica					o	
<i>Anthyllis vulneraria</i>	Kidney Vetch					la	
<i>Antirrhinum majus</i> *	Snapdragon					r	
<i>Apium graveolens</i>	Wild Celery					lf	SCI
<i>Apium nodiflorum</i>	Fool's Water-cress					la	
<i>Arctium minus</i>	Lesser Burdock					r	
<i>Arabidopsis thaliana</i>	Thale-cress			+		o	
<i>Arenaria serpyllifolia</i>	Thyme-leaved Sandwort					lo	
<i>Armeria maritima</i>	Thrift					r	
<i>Arrhenatherum elatius</i>	False Oat-grass					lf	
<i>Artemisia vulgaris</i>	Mugwort					r	
<i>Asparagus officinalis</i> *	Garden Asparagus					r	SCI
<i>Aster novi-belgii</i> *	Confused Michaelmas-daisy					r	
<i>Aster tripolium</i>	Sea Aster					f	
<i>Atriplex glabriuscula</i>	Babington's Orache					r	
<i>Atriplex laciniata</i>	Frosted Orache					r	SCI
<i>Atriplex littoralis</i>	Grass-leaved Orache					r	
<i>Atriplex portulacoides</i>	Sea Purslane					r	
<i>Atriplex prostrata</i>	Spear-leaved Orache					lf	
<i>Bellis perennis</i>	Daisy					r	
<i>Berula erecta</i>	Lesser Water-parsnip					la	
<i>Beta vulgaris maritima</i>	Sea Beet					r	
<i>Bidens tripartita</i>	Trifid Bur-marigold					r	
<i>Blackstonia perfoliata</i>	Yellow-wort					o	SCI
<i>Blysmus rufus</i>	Saltmarsh Flat-sedge			+		vla	SCI
<i>Bolboschoenus maritimus</i>	Sea Club-rush					ld	
<i>Brassica napus</i> *	Rape					r	
<i>Brassica rapa</i> *	Turnip				+	r	
<i>Cakile maritima</i>	Sea Rocket					o	
<i>Calystegia sepium roseata</i>	Hedge Bindweed					r	
<i>Cardamine hirsuta</i>	Hairy Bitter-cress			+		r	
<i>Cardamine pratensis</i>	Cuckooflower			+		o	
<i>Carex arenaria</i>	Sand Sedge					lf	
<i>Carex distans</i>	Distant Sedge					r	
<i>Carex extensa</i>	Long-bracted Sedge					f	
<i>Carex flacca</i>	Glaucous Sedge					o	
<i>Carex otrubae</i>	False Fox-sedge					o	

<i>Carex ovalis</i>	Oval Sedge	+				r	
<i>Carex pendula</i>	Pendulous Sedge					r	
<i>Carex remota</i>	Remote Sedge					r	
<i>Carex remota</i> x <i>C. otrubae</i>	Hybrid sedge			+		r	
<i>Centaurea nigra</i>	Common Knapweed	+				r	
<i>Centaureum erythraea</i>	Common Centaury					r	
<i>Centaureum</i> x <i>intermedium</i>	Hybrid Centaury					r	
<i>Centaureum littorale</i>	Seaside Centaury					o	NS
<i>Centaureum pulchellum</i>	Lesser Centaury					a	SCI
<i>Cerastium diffusum</i>	Sea Mouse-ear			+		o	
<i>Cerastium fontanum</i>	Common Mouse-ear					f	
<i>Cerastium semidecandrum</i>	Little Mouse-ear			+		r	
<i>Chamerion angustifolium</i>	Rosebay Willowherb					o	
<i>Chenopodium album</i>	Fat-hen					r	
<i>Chenopodium rubrum</i>	Red Goosefoot					lf	SCI
<i>Cirsium arvense</i>	Creeping Thistle					o	
<i>Cirsium vulgare</i>	Spear Thistle					o	
<i>Cochlearia anglica</i>	English Scurvy-grass					lf	
<i>Conyza canadensis</i> *	Canadian Fleabane					lf	
<i>Crepis capillaris</i>	Smooth Hawk's-beard					o	
<i>Crithmum maritimum</i>	Rock Samphire			+		r	SCI
<i>Cruciata laevipes</i>	Crosswort					r	
x <i>Cupressocyparis leylandii</i> *	Leyland Cypress					r	
<i>Cyperus longus</i> *	Galingale					r	NS NT
<i>Dactylis glomerata</i>	Cock's-foot					r	
<i>Dactylorhiza incarnata coccinea</i>	Early Marsh-orchid					lf	NS
<i>Dactylorhiza incarnata incarnata</i>	Early Marsh-orchid			+		lo	SCI
<i>Dactylorhiza fuchsii</i>	Common Spotted-orchid			+		r	
<i>Dactylorhiza</i> x <i>grandis</i>	Hybrid Marsh-orchid			+		r	
<i>Dactylorhiza praetermissa</i>	Southern Marsh-orchid					lf	
<i>Dactylorhiza</i> x <i>wintoni</i>	Hybrid Marsh-orchid			+		r	
<i>Daucus carota</i>	Wild Carrot					r	
<i>Dipsacus fullonum</i>	Teasel					r	
<i>Eleocharis palustris</i>	Common Spike-rush	+				la	
<i>Eleocharis quinqueflora</i>	Few-flowered Spike-rush					r	SCI
<i>Elytrigia juncea</i>	Sand Couch					la	
<i>Elytrigia</i> x <i>laxa</i>	Hybrid Couch					r	
<i>Elytrigia repens</i>	Common Couch					o	
<i>Epilobium hirsutum</i>	Great Willowherb					o	

<i>Epilobium ciliatum*</i>	American Willowherb					r	
<i>Epilobium montanum</i>	Broad-leaved Willowherb					o	
<i>Epilobium palustre</i>	Marsh Willowherb					lf	
<i>Epilobium parviflorum</i>	Hoary Willowherb					o	
<i>Epilobium tetragonum</i>	Square-stalked Willowherb					r	
<i>Epipactis palustris</i>	Marsh Helleborine					lo	SCI
<i>Erigeron acer</i>	Blue Fleabane					lf	
<i>Eriophorum angustifolium</i>	Common Cottongrass					r	
<i>Erodium cicutarium</i>	Common Stork's-bill					r	
<i>Eryngium maritimum</i>	Sea Holly					lo	SCI
<i>Eupatorium cannabinum</i>	Hemp-agrimony					r	
<i>Euphorbia paralias</i>	Sea Spurge					lf	SCI
<i>Euphorbia portlandica</i>	Portland Spurge					r	SCI
<i>Euphrasia</i> sp.	Eyebright					lf	
<i>Euphrasia tetraquetra</i>	Eyebright		+			o	SCI
<i>Festuca arundinacea</i>	Tall Fescue					o	
<i>Festuca rubra</i>	Red Fescue					la	
<i>Festuca rubra juncea</i>	Red Fescue					r	
<i>Festuca rubra litoralis</i>	Red Fescue					la	
<i>Filipendula ulmaria</i>	Meadow-sweet					r	
<i>Galeopsis tetrahit</i>	Common Hemp-nettle					(r)	
<i>Galium aparine</i>	Cleavers					(vlf)	
<i>Galium palustre</i>	Marsh Bedstraw					r	
<i>Glaucium flavum</i>	Yellow-horned Poppy					(r)	SCI
<i>Glaux maritima</i>	Sea Milkwort					la	
<i>Helianthus annuus*</i>	Sunflower					r	
<i>Hippophae rhamnoides*</i>	Sea Buckthorn					o	
<i>Holcus lanatus</i>	Yorkshire-fog					f	
<i>Honckenya peploides</i>	Sea Sandwort					r	
<i>Hordeum</i> sp.*	Barley					(r)	
<i>Hydrocotyle vulgaris</i>	Marsh Pennywort					la	
<i>Hypochaeris radicata</i>	Cat's-ear					lf	
<i>Impatiens glandulifera*</i>	Indian Balsam					r	
<i>Iris pseudacorus</i>	Yellow Iris					o	
<i>Isolepis setacea</i>	Bristle Club-rush					r	
<i>Juncus ambiguus</i>	Frog Rush					lf	SCI
<i>Juncus articulatus</i>	Jointed Rush					f	
<i>Juncus balticus</i>	Baltic Rush					o	NS
<i>Juncus bufonius</i>	Toad Rush					lf	
<i>Juncus compressus</i>	Round-fruited Rush			+		lf	SCI NT
<i>Juncus effusus</i>	Soft Rush					r	
<i>Juncus gerardii</i>	Saltmarsh Rush					f	

<i>Juncus inflexus</i>	Hard Rush					r	
<i>Juncus maritimus</i>	Sea Rush					o	SCI
<i>Juncus x surrejanus</i>	Hybrid Rush		+			r	
<i>Juncus tenuis</i> *	Slender Rush					r	
<i>Leontodon autumnalis</i>	Autumn Hawkbit					r	
<i>Leontodon saxatilis</i>	Lesser Hawkbit					o	
<i>Leymus arenarius</i>	Lyme-grass					la	
<i>Limonium brittanicum</i> ssp. <i>celticum</i>	Rock Sea-lavender				+	r	NR
<i>Limonium vulgare</i>	Common Sea-lavender				+	r	
<i>Linum usitatissimum</i> *	Flax					r	
<i>Lobelia erinus</i> *	Garden Lobelia					(r)	
<i>Lolium perenne</i>	Perennial Rye-grass					o	
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil					la	
<i>Lotus pedunculatus</i>	Greater Bird's-foot-trefoil					r	
<i>Lychnis coronaria</i> *	Rose Champion					r	
<i>Lychnis flos-cuculi</i>	Ragged-Robin	+				r	
<i>Lycopersicon esculentum</i> *	Tomato					lo	
<i>Lycopus europaeus</i>	Gypsywort					o	
<i>Melilotus altissimus</i> *	Tall Melilot					r	
<i>Melilotus indicus</i> *	Small Melilot			+		r	
<i>Melilotus officinalis</i> *	Ribbed Melilot					r	
<i>Mentha aquatica</i>	Water Mint					lf	
<i>Myosotis laxa caespitosa</i>	Tufted Forget-me-not					o	
<i>Odontites vernus</i>	Red Bartsia					o	
<i>Oenanthe crocata</i>	Hemlock Water-dropwort					o	
<i>Oenanthe lachenalii</i>	Parsley Water-dropwort					f	SCI
<i>Oenothera fallax</i> *	Intermediate Evening-primrose					o	
<i>Oenothera glazioviana</i> *	Large-flowered Evening-primrose					r	
<i>Ononis repens</i>	Common Restharrow					r	
<i>Panicum miliaceum</i> *	Common Millet					r	
<i>Parapholis strigosa</i>	Hard-grass					la	
<i>Parnassia palustris</i>	Grass-of-Parnassus	+				vlo	SCI
<i>Pastinaca sativa</i>	Wild Parsnip					r	
<i>Phleum arenarium</i>	Sand Cat's-tail					r	SCI
<i>Phleum pratense</i>	Timothy					r	
<i>Persicaria lapathifolia</i>	Pale Persicaria					r	
<i>Persicaria maculosa</i>	Redshank					r	
<i>Phalaris arundinacea</i>	Reed Canary-grass					r	

<i>Phalaris canariensis</i> *	Canary-grass		+			r	
<i>Phragmites australis</i>	Common Reed					ld	
<i>Pisum sativum</i> *	Garden Pea					(r)	
<i>Plantago coronopus</i>	Buck's-horn Plantain					o	
<i>Plantago lanceolata</i>	Ribwort Plantain					r	
<i>Plantago major</i>	Greater Plantain					lo	
<i>Plantago maritima</i>	Sea Plantain					o	
<i>Poa annua</i>	Annual Meadow-grass					o	
<i>Polygonum arenastrum</i>	Equal-leaved Knotgrass					r	
<i>Polygonum ariculare</i>	Knotgrass					r	
<i>Polygonum hydropiper</i>	Water-pepper					r	
<i>Polygonum oxyspermum raii</i>	Ray's Knotgrass					r	SCI
<i>Populus sp.*</i>	Poplar					r	
<i>Potentilla anserina</i>	Silverweed					la	
<i>Puccinellia distans</i>	Reflexed Saltmarsh-grass					r	SCI
<i>Puccinellia maritima</i>	Common Saltmarsh-grass					ld	
<i>Pulicaria dysenterica</i>	Common Fleabane					la	
<i>Quercus petraea</i>	Sessile Oak					r	
<i>Ranunculus acris</i>	Meadow Buttercup					r	
<i>Ranunculus flammula</i>	Lesser Spearwort					o	
<i>Ranunculus lingua</i>	Great Spearwort	+				r	
<i>Ranunculus repens</i>	Creeping Buttercup					o	
<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup					lf	
<i>Raphanus raphanistrum maritimum</i>	Sea Radish					r	SCI
<i>Rhinanthus minor</i>	Yellow-rattle					o	
<i>Rorippa nasturtium-aquaticum</i>	Water-cress					vla	
<i>Rorippa palustris</i>	Marsh Yellow-cress					(r)	
<i>Rorippa sylvestris</i>	Creeping Yellow-cress					r	
<i>Rosa rugosa</i> *	Japanese Rose					r	
<i>Rubus caesius</i>	Dewberry					r	
<i>Rumex conglomeratus</i>	Clustered Dock					r	
<i>Rumex crispus</i>	Curled Dock					r	
<i>Rumex obtusifolius</i>	Broad-leaved Dock					r	
<i>Rumex sanguineus</i>	Wood Dock					r	
<i>Ruppia maritima</i>	Beaked Tasselweed			+		r	SCI
<i>Sagina apetala</i>	Annual Pearlwort					o	
<i>Sagina maritima</i>	Sea Pearlwort					o	
<i>Sagina nodosa</i>	Knotted Pearlwort					la	
<i>Sagina procumbens</i>	Procumbent Pearlwort					o	

<i>Salicornia europaea</i>	Common Glasswort					r	
<i>Salicornia dolichostachya</i>	Long-spiked Glasswort					lo	
<i>Salicornia fragilis</i>	Yellow Glasswort					lo	NS
<i>Salicornia ramosissima</i>	Purple Glasswort					lo	
<i>Salix alba</i>	White Willow		+			o	
<i>Salix caprea</i>	Goat Willow					r	
<i>Salix cinerea</i>	Grey Willow					f	
<i>Salix x friesiana</i>	Hybrid Willow					r	NR
<i>Salix repens argentea</i>	Creeping Willow					lf	
<i>Salix repens repens</i>	Creeping Willow					r	
<i>Salix x rubens</i>	Hybrid Crack-willow					o	
<i>Salix x sericans</i>	Broad-leaved Osier					r	
<i>Salix x subsericia</i>	Hybrid Willow	+				r	
<i>Salix viminalis</i>	Osier					r	
<i>Salsola kali kali</i>	Prickly Saltwort					lo	VU
<i>Samolus valerandi</i>	Brookweed					la	SCI
<i>Schoenoplectus pungens</i>	Sharp Club-rush					vla	NR
<i>Schoenoplectus tabernaemontani</i>	Grey Bulrush					o	SCI
<i>Scrophularia auriculata</i>	Water Figwort					r	
<i>Sedum acre</i>	Biting Stonecrop					lo	
<i>Senecio jacobaea</i>	Common Ragwort					lf	
<i>Senecio squalidus*</i>	Oxford Ragwort					r	
<i>Senecio vulgaris</i>	Groundsel					lo	
<i>Silene dioica</i>	Red Campion					r	
<i>Silene latifolia</i>	White Campion					r	
<i>Silene uniflora</i>	Sea Campion			+		r	SCI
<i>Sisymbrium officinale</i>	Hedge Mustard					r	
<i>Sisyrinchium californicum*</i>	Yellow-eyed Grass					r	
<i>Solanum dulcamara</i>	Bittersweet					r	
<i>Solanum nigrum</i>	Black Nightshade					r	
<i>Sonchus arvensis</i>	Perennial Sow-thistle					lf	
<i>Sonchus asper</i>	Prickly Sow-thistle					o	
<i>Sonchus oleraceus</i>	Smooth Sow-thistle					r	
<i>Sparganium erectum</i>	Branched Bur-reed					r	
<i>Spartina anglica*</i>	Common Cord-grass					lo	
<i>Spergularia marina</i>	Lesser Sea-spurrey					lf	
<i>Spergularia media</i>	Great Sea-spurrey					lf	
<i>Stachys palustris</i>	Marsh Woundwort					r	
<i>Stellaria media</i>	Common Chickweed					r	
<i>Suaeda maritima</i>	Annual Sea-blite					lo	
<i>Taraxacum</i> sect. <i>Erythrosperma</i>	Dandelion					r	
<i>Taraxacum</i> sect. <i>Ruderalia</i>	Dandelion					o	

<i>Trifolium dubium</i>	Lesser Trefoil					lo	
<i>Trifolium fragiferum</i>	Strawberry Clover					la	SCI
<i>Trifolium hybridum*</i>	Alsike Clover					la	
<i>Trifolium pratense</i>	Red Clover					o	
<i>Trifolium repens</i>	White Clover					la	
<i>Triglochin maritimum</i>	Sea Arrow-grass					o	
<i>Triglochin palustre</i>	Marsh Arrow-grass					lf	SCI
<i>Tripleurospermum maritimum</i>	Sea Mayweed					o	
<i>Triticum aestivum*</i>	Bread Wheat					r	
<i>Tussilago farfara</i>	Colt's-foot					o	
<i>Typha angustifolia</i>	Lesser Bulrush					vla	
<i>Typha x glauca</i>	Hybrid Bulrush		+			r	
<i>Typha latifolia</i>	Bulrush					lf	
<i>Urtica dioica</i>	Common Nettle					r	
<i>Valeriana officinalis</i>	Common Valerian					r	
<i>Valerianella locusta</i>	Common Cornsalad			+		r	SCI
<i>Vicia cracca</i>	Tufted Vetch					lf	
<i>Vicia sativa nigra</i>	Common Vetch					r	
<i>Viola tricolor tricolor</i>	Wild Pansy					(r)	
<i>Vulpia fasciculata</i>	Dune Fescue					o	NS

Total taxa = 269; alien = 35 (13.0%); Total notable = 42 (15.6%) (NR = 3; NS = 5; VU = 1; NT = 2; SCI = 31).