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Changing status of *Calystegia soldanella* (Sea Bindweed; Convolvulaceae) on the Sefton Coast, North Merseyside, UK

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Abstract

The results of a survey of the Red-listed *Calystegia soldanella* in summer 2024 on the Sefton Coast, north Merseyside, UK, were compared with those from a similar study in 2010. Fourteen years on, the six patches recorded in 2010 were still extant, all but one having increased in area. Two new patches were discovered and the total area occupied by the plant increased by 90%. With the exception of one patch on a concrete seawall, all were on calcareous sand-dunes, with a mean distance of 70 m from the shore. The number of associated vascular taxa increased from 33 in 2010 to 66 in 2024. Main plant communities changed from fixed-dune to dune grassland, the latter characterised by the appearance of much *Arrhenatherum elatius*, not found in 2010. Although *C. soldanella* appears to show resilience to habitat change, apparent threats to Sefton Coast populations include coastal erosion, a trend towards taller, coarser vegetation, together with scrub formation and loss of bare sand. Possible conservation measures are discussed.

Keywords: conservation; patch area; sand-dunes; threats; vegetation change

Introduction

Calystegia soldanella (L.) R.Br. (Sea Bindweed) (Fig. 1) is a trailing perennial with large pink-and-white striped flowers, succulent kidney-shaped leaves and is found on sand-dunes and on sand and shingle beaches above the strandline (Kay & Mountford, 2023). Ellenberg Indicator Values show that the plant requires full light (L = 9), is adapted to fairly dry soils (F = 4) that are weakly acid to weakly basic (R = 7) and somewhat infertile (N = 4) and is largely confined to coastal sites (S = 3) (Hill *et al.*, 2004). Distribution maps show that *C. soldanella* occurs widely around the coasts of England, Wales, Northern Ireland and Scotland, except for the far north (Kay & Mountford, 2023). However, there has been a 30% decline in the area of occupancy with many losses during the 20th century, especially in southern and eastern England. Although the plant's conservation status is given as 'Least Concern' in Great Britain, it is Red-listed 'Vulnerable' in England (Stroh *et al.*, 2014; 2025) and is a 'Species of Conservation Importance' in Northwest England (Regional Biodiversity Steering Group, 1999).

Figure 1. *Calystegia soldanella*, Ainsdale Sandhills Local Nature Reserve

Methods

In the summer of 2010, Smith & Lockwood (2010) conducted a survey to determine the status of *C. soldanella* on the Sefton Coast in north Merseyside (VC59, South Lancashire), where it had been known to occur since 1801 (Savidge *et al.*, 1963). Six patches of the plant were recorded, ranging in size from 4 to 600 m^2 and covering a total area of 1357 m^2. Fourteen years on, it was thought opportune to review its current status, particularly in the light of recent, possibly deleterious, vegetation changes in the Sefton dunes (Smith, 2021). Accordingly, in late June and early July 2024, known sites for *C. soldanella* were visited by a small team of volunteers. As in 2010, the length (l) and breadth (b) of patches were measured and areas estimated from l x b. Localities of patches were defined using a Garmin Etrex GPS device. *Google Earth* was used to measure distances from the patches to the shore. Notes were taken on habitat features; vascular plant associates were listed and keys and community descriptions in Rodwell (2000) consulted to determine UK National Vegetation Classification (NVC) communities.

Results

Following the 2010 survey, two new patches of *C. soldanella* have been identified on the Sefton Coast, one in 2019 at Cabin Hill National Nature Reserve (NNR) and a second at Ainsdale Sandhills Local Nature Reserve (LNR) in 2022. A total of nine patches was monitored in 2024, Hightown (north) having been divided into two (a & b) by coastal erosion. *Calystegia soldanella* was found in seven tetrads of the National Grid over a linear distance of about 21 km (Fig. 2). All six of the localities

recorded in 2010 still supported *C. soldanella*. National Grid References, dimensions, estimated patch area, habitat and NVC community are listed in Table 1. The new Ainsdale LNR patch was measured in 2022, shortly after its discovery. Patches were located at 0 – 200 m from the shore, the mean distance being 72 m. Estimated areas occupied by the target species ranged from 16.2 to 468.7 m^2, with a combined area of 2582.2 m^2 (0.26 ha). Table 2 shows that only one patch (Birkdale LNR, north) was smaller than in 2010.

The vegetation at six localities was recorded as SD9a: *Ammophila arenaria – Arrhenatherum elatius* dune grassland, typical sub-community (Fig. 3); two had accordance with SD7: *Ammophila arenaria – Festuca rubra* semi-fixed dune, while one resembled SD6: *Ammophila arenaria* mobile dune (Rodwell, 2000). Although visits were made during the flowering season, few or no flowers of *C. soldanella* were seen, except near Ainsdale Discovery Centre (site 5) where a total of over 100 blooms was estimated. At most localities, leafy shoots of the target species were sparsely distributed and often hard to find. No colonies were adversely impacted by informal recreation but, as in 2010, many plants were associated with the edges of sandy informal footpaths that traversed some of the patches. One of the Hightown (north) sites was on a frontal dune-cliff eroded by the sea (Fig. 4). Otherwise, bare sand was largely absent from localities occupied by *C. soldanella.*

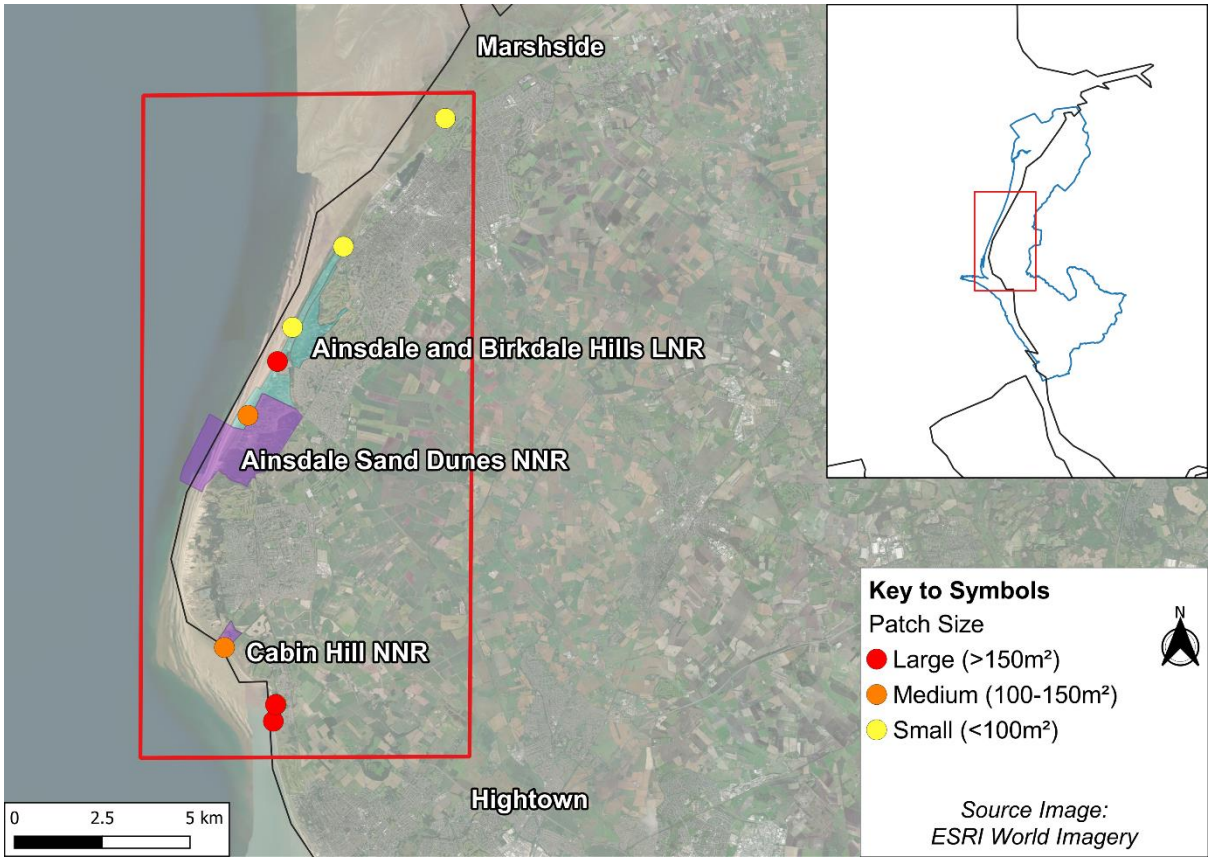

Figure 2. Distribution of *Calystegia soldanella* on the Sefton Coast in 2024. Inset: location of the study area in northwest England

Figure 3. *Calystegia soldanella* habitat at Cabin Hill NNR; tall, dense SD9a

Perceived threats to the habitat were coastal erosion at Hightown (Fig. 4), *Rosa rugosa* (Japanese Rose) spread at Hightown (south), rampant *Hippophae rhamnoides* (Sea Buckthorn) invasion near Ainsdale Discovery Centre (Fig. 5), *Rubus fruticosus* agg. (Bramble) colonisation at Marshside seawall and coarsening of herbaceous vegetation at all localities, except the eroded dune-cliff at Hightown (site 2b; Fig. 4).

Figure 4. Sparse *C. soldanella* patch on eroded dune-cliff at Hightown

Figure 5. *Hippophae rhamnoides* invasion adjacent to *C. soldanella* patch north of Ainsdale Discovery Centre

Table 1. *Calystegia soldanella* patch data, Sefton Coast 2024 (south to north) NVC = UK National Vegetation Classification code; S = south; N = north

Site	Date (2024)	National Grid Ref.	Dimensions (m)	Area (m^2)	Habitat	NVC
1. Hightown S.	21/06	SD29530265	25 x 17.5	437.5	Semi-fixed dune	SD7
2a. Hightown N.	21/06	SD29620313	26. 8 x 7.2 + 13.2 x 11.8	348.8	Dune grassland	SD9a
2b. Hightown N.	21/06	SD29600312	45.8 x 9	412.2	Mobile dune	SD6
3. Cabin Hill NNR	11/07	SD28170476	21.9 x 17.6	385.4	Dune grassland	SD9a
4. Ainsdale LNR	27/06	SD28941132	36.6 x 9.1	333.1	Dune grassland	SD9a
5. Ainsdale Discovery Centre (ADC)	02/07	SD29801283	21.4 x 21.9	468.7	Dune grassland	SD9a
6. Birkdale Green Beach	28/07	SD30241379	18 x 9	162	Dune grassland	SD9a
7. Birkdale LNR (N)	22/06	SD31721605	4.7 x 3.9	18.3	Semi-fixed dune	SD7
8. Marshside	23/06	SD34661963	4.5 x 3.6	16.2	Dune grassland	SD9a
Total				2582.2		

Vascular associates of *C. soldanella* are listed in Table 3. Sixty-six taxa were recorded, the number per locality ranging from nine to 26, with a mean of 18. Only seven (11%) were non-native (neophytes), while six (9%) were regionally or nationally notable. The most frequent associates were *Ammophila arenaria* (Marram), *Arrhenatherum elatius* (False Oat-grass), *Festuca rubra* (Red Fescue), *Hypochaeris radicata* (Cat's-ear) and *Jacobaea vulgaris* (Common Ragwort). Thirty-four taxa (52%) occurred in only one sample, while 25 (76%) identified in 2010 were also present in 2024.

Table 2. Changes in areas occupied by *C. soldanella* on the Sefton Coast, 2010 – 2024

Site no.	Locality	Area 2010 (m^2)	Area 2022 (m^2)	Area 2024 (m^2)	% change
1	Hightown south	280		438	+56
2 (a+b)	Hightown north	600		761	+27
3	Cabin Hill	-		385	-
4	Ainsdale LNR	275		333	+21
5	Ainsdale ADC	-	408	469	+15
6	Birkdale Green Beach	132		162	+23
7	Birkdale LNR (N)	66		18	-72
8	Marshside	4		16	+305
Total		1357		2582	+90

Table 3. Vascular associates of *C. soldanella* on the Sefton Coast in 2024

*= non-native (neophyte) or introduced native taxon; NT = Near Threatened in England; SCI = Species of Conservation Importance in Northwest England

Taxon & status	English name	Site 1	Site 2a	Site 2b	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Tot.
Achillea millefolium	Yarrow						+				1
Ammophila arenaria	Marram	+	+	+	+	+	+	+	+		8
Anacamptis pyramidalis SCI	Pyramidal Orchid	+					+	+			3
Angelica sylvestris	Wild Angelica							+			1
Anthyllis vulneraria	Kidney-vetch	+		+			+		+		4
Arrhenatherum elatius	False Oat-grass	+	+		+	+	+	+	+	+	8
*Asparagus officinalis**	Garden Asparagus				+						1
Avenula pubescens	Downy Oat-grass	+									1
Carex arenaria	Sand Sedge						+				1

Centaurium erythraea	Common Centaury				+						1
Cerastium fontanum	Common Mouse-ear	+				+	+	+			4
Chamaenerion angustifolium	Rosebay Willowherb				+	+					2
Cirsium arvense	Creeping Thistle				+	+	+	+			4
Crepis capillaris	Smooth Hawk's-beard					+	+	+	+	+	5
Dactylis glomerata	Cock's-foot	+							+	+	3
Dactylorhiza praetermissa	Southern Marsh-orchid							+			1
Daucus carota	Wild Carrot				+						1
Elymus junceiformis	Sand Couch			+							1
Elymus repens	Common Couch									+	1
*Epilobium ciliatum**	American Willowherb					+	+				2
Equisetum arvense	Field Horsetail		+					+			2
Erigeron acris	Blue Fleabane				+						1
*Erigeron canadensis**	Canadian Fleabane				+						1
Ervilia hirsuta	Hairy Tare						+				1
Eryngium maritimum NT SCI	Sea-holly	+	+	+	+						4
Euphorbia paralias SCI	Sea Spurge			+							1
Festuca rubra agg.	Red Fescue	+	+		+	+	+	+	+	+	8
Geranium molle	Dove's-foot Crane's-bill					+					1
Geranium robertianum	Herb-Robert									+	1
Hieracium umbellatum	Umbellate Hawkweed	+							+		2
*Hippophae rhamnoides**	Sea Buckthorn						+				1
Holcus lanatus	Yorkshire-fog	+	+		+	+		+			5
Hypochaeris radicata	Cat's-ear	+	+	+	+	+	+	+	+		8
Jacobaea vulgaris	Common Ragwort	+	+	+	+	+	+	+	+		8

Lactuca virosa SCI	Great Lettuce				+						1
Lathyrus pratensis	Meadow Vetchling		+								1
Lotus corniculatus	Common Bird's-foot-trefoil	+	+			+		+			4
Luzula campestris	Field Wood-rush						+				1
Oenanthe crocata	Hemlock Water-dropwort				+						1
Oenothera × *fallax**	Intermediate Evening-primrose			+	+		+	+		+	5
Ononis repens	Common Restharrow		+		+	+	+	+	+		6
Pastinaca sativa	Wild Parsnip	+	+					+	+		4
*Petrosedum rupestre**	Reflexed Stonecrop								+		1
Phleum arenarium NT SCI	Sand Cat's-tail						+				1
Pilosella officinarum	Mouse-ear-hawkweed								+		1
Plantago lanceolata	Ribwort Plantain					+				+	2
Poa pratensis	Smooth Meadow-grass					+		+	+		3
Polygala vulgaris	Common Milkwort					+					1
Polypodium vulgare	Common Polypody	+				+		+	+		4
Potentilla anserina	Silverweed	+									1
Prunus sp.	Cherry	+									1
Raphanus raphanistrum subsp. *maritimus* SCI	Sea Radish									+	1
Rhinanthus minor	Yellow-rattle					+					1
*Rosa rugosa**	Japanese Rose		+	+			+				3
Rubus caesius	Dewberry	+	+		+	+	+	+	+		7
Rubus fruticosus agg.	Bramble						+			+	2
Rumex crispus	Curled Dock							+		+	2

Sedum acre	Biting Stonecrop					+	+				2
Sonchus arvensis	Perennial Sowthistle				+						1
Tragopogon pratensis	Goat's-beard	+				+	+				3
Trifolium campestre	Hop Trefoil					+					1
Trifolium repens	White Clover					+					1
Tussilago farfara	Colt's-foot						+				1
Vicia cracca	Tufted Vetch		+								1
Vivia sativa	Common Vetch						+				1
Total 66 taxa		20	15	9	20	24	26	21	16	11	

Discussion

This study revealed marked changes to the status and habitat of *C. soldanella* on the Sefton Coast over a period of 14 years. Two new patches were found, while the area occupied by the plant increased by 90% from 1357 m^2 to 2582 m^2, all but one patch showing an increase. In 2010, habitat types supporting *C. soldanella* were described as fixed or semi-fixed dunes while, in 2024, the main habitat was dune grassland (Table 1). Similarly, the plant communities changed from mainly SD7: *Ammophila arenaria – Festuca rubra* semi-fixed dune or SD8: *Festuca rubra – Galium verum* fixed dune, to mostly SD9a: *Ammophila arenaria – Arrhenatherum elatius* dune grassland. This was mainly due to the appearance of *A. elatius* in the sward, a trend that is attributed by Rodwell (2000) to insufficient grazing of dune vegetation and nutrient enrichment from aerial deposition of nitrogen. None of the Sefton Coast localities supporting *C. soldanella* has been grazed by livestock in recent decades (personal observations), nor was evidence of Rabbit (*Oryctolagus cuniculus*) grazing found during either survey. Nitrogen deposition in the region is thought to be as much as 15 kg N $ha^{-1}yr^{-1}$ (Jones *et al.*, 2004). Although the N-deposition rate has declined in Europe since about 1990 (Kammer *et al.*, 2022), it may still be above the critical level for oligotrophic dune habitats (Pakeman *et al.*, 2016). Jones *et al.* (2004) found that above-ground dune biomass, derived mainly from increased height and cover of *Ammophila arenaria*, was positively related to N-inputs, while a 'critical load range' for UK coastal dunes was considered to be 10-20 kg N $ha^{-1}yr^{-1}$.

As in 2010, most of the patches of *C. soldanella* were found on sand-dunes near the shore. Only one was on embryo or mobile dunes that are said by some authors to be the typical habitat of this species (Halliday, 1997; Hepburn, 1952). Salisbury (1952) lists *C. soldanella* as a typical component of "early yellow" and "late yellow" (mobile) dunes. However, Garrard & Streeter (1983) characterize its habitat as from early *Ammophila*-dominated stages to the typical vegetation of fixed dunes. The northernmost locality is the northwest-facing slope of a concrete seawall with localised sandy accumulations. Even here, at what might be considered a sub-optimal habitat, the patch of *C. soldanella* increased by over 300% in 14 years (Table 2).

Sefton duneland has become more consolidated over the last 70 years or so, with a loss of over 80% of bare sand (Delgado-Fernandez *et al*., 2019). However, this has not, so far, adversely impacted the populations of *C. soldanella.* None of the patches known to have been present in modern times has been lost and all have persisted for many years. Smith & Lockwood (2010) estimated the Ainsdale LNR patch to be over 60 years old. Therefore, its current age may now be at least 75 years. These authors deduced from a literature search that the status of this species on the Sefton Coast had improved since the 19th century, a trend that has continued. Salisbury (1952) found that *C. soldanella* had the capacity for rapid lateral spread by as much as 5 – 7 feet (1.5 – 2.1 m) annually, patches more than doubling in a single season. This may account, in part, for the 90% increase in the area occupied by the plant on the Sefton Coast since 2010.

The vascular plant assemblage associated with *C. soldanella* was similar to that recorded in 2020, with 76% of the 2010 taxa also listed in 2024. However, the number of associates of *C. soldanella* has doubled since 2010, from 33 to 66 taxa. The reasons for the latter change are not immediately apparent, though the extra two sites, a much larger area occupied by the plant and more personnel searching probably contributed. The associates are all typical Sefton Coast dune plants and most are common native species (Smith, 2021). Only 11% are neophytes, a slightly higher proportion than the 9% in 2010, while 9% are regionally or nationally notable (15% in 2010). This compares with about 38% 'alien' (Smith, 2020) and 17% notable taxa for the dune system as a whole (Smith, 2015). The differences may be attributed to most *C. soldanella* colonies being remote from gardens, which are the origin of many duneland neophytes (Smith, 2020). Also, *C. soldanella* is a dry-site species (Ellenberg F = 4), while a high proportion of 'notable' duneland plants is associated with wetlands, especially slacks (Smith, 2021) Three of the most constant associates of *C. soldanella* (*Ammophila arenaria*, *Festuca rubra* and *Hypochaeris radicata*) were common to both surveys; however, *Arrhenatherum elatius* was absent from the associates list in 2010.

Comparisons with the 2010 dataset suggest that *C. soldanella* is prospering in the Sefton dunes. However, a trend towards taller, coarser SD9 vegetation in the frontal dunes, with much *Arrhenatherum elatius*, together with scrub formation and loss of bare sand (Smith, 2021), is a matter for concern. Although *C. soldanella* can be shy of flowering (Smith & Lockwood, 2010), the paucity of flowers seen during the current study and the low frequency of stems at most sites give the impression that the plant is "just hanging on". Conservation of this species could be assisted by increased scrub control, expanding livestock grazing into frontal dunes and increasing dynamism in the dune system. The *Dynamic Dunescapes* project has recently conducted a successful control programme against invasive *Rosa rugosa* along the Sefton Coast, while removal of large scrub patches, mainly of *Hippophae rhamnoides*, by the National Trust, Sefton Council and volunteer groups may also promote conservation of *C. soldanella* in the long term. To monitor future trends, surveys of *C. soldanella* should ideally be repeated at about ten-year intervals.

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