Distribution and population sizes of *Asparagus prostratus* Dumort., Wild Asparagus, in Britain

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ABSTRACT

Asparagus prostratus Dumort., Wild Asparagus, is a western European maritime endemic. In Britain it is a Red Data Book species and is listed as a Priority Species under the UK Biodiversity Action Plan. Historical records have been researched and collated with recent field surveys for Britain. A number of records are errors due to confusion with *A. officinalis*. It has been recorded from at least 34 sites in V.c. 1, 2, 9, 13, 41, 45 and 52. It has not been recorded recently in six sites (18% decline), is extinct in West Sussex and Anglesey and is on the verge of extinction in Dorset. Of the 28 extant populations, nine have fewer than ten plants and only three sites have more than 100 plants. At least three extant colonies are declining.

KEYWORDS: *Asparagus officinalis* L. subsp. *prostratus* (Dumort) Corb. England. Wales.

INTRODUCTION

Asparagus prostratus Dumort. (*Asparagus officinalis* L. subsp. *prostratus* (Dumort.) Corb.), Wild Asparagus, is a western European endemic of the coasts of Belgium, Britain, The Channel Islands, France, Germany, Ireland, Spain and the Netherlands. In Britain it is a Red Data Book species classified as 'vulnerable' (Wilkinson 1999) and is a Priority Biodiversity Species (UK Biodiversity Group 1998).

The Biodiversity Action Plan requires that population sizes should be maintained at all known sites (UK Biodiversity Group 1998); in order to maintain the population sizes, it is first necessary

to know what they are. As part of the work towards that action plan objective, information on its distribution was first collated in detail by Kay (1997) whose work has been extended here. The historical records for Britain have been researched in collaboration with the Threatened Plants Database, and are collated with current field survey data partly funded or undertaken by the Botanical Society of the British Isles, the Countryside Council for Wales, the National Museums and Galleries of Wales and the National Trust. Miss S. McSweeny is preparing similar data for the populations in Ireland.

Records of *A. prostratus* need to be carefully assessed as it has often been confused with its close relative *A. officinalis*, for taxonomic and nomenclatural reasons. Historically there has been much uncertainty about whether *A. prostratus* should be a species or a subspecies or variety of *A. officinalis*, and therefore the taxa were not consistently separated. Kay *et al.* (2001) found it merited species status as it differed morphologically with distinctive characters that were retained in cultivation, it was tetraploid compared to the diploid *A. officinalis* (which therefore cannot have been derived from *A. prostratus*), the two taxa were reproductively isolated, and *A. prostratus* is a NW European maritime endemic whilst *A. officinalis* is believed to be of eastern European or western Asian origin. Further confusion has arisen from use of the name *A. maritimus* (L.) Mill. (a Mediterranean taxon) to which coastal populations of both *A. officinalis* and *A. prostratus* were regularly ascribed.

The two species are readily identifiable; characters separating them are given in Table 1. Only very rarely do they grow together and we have not observed them doing so in Britain.

SOURCES OF INFORMATION

Data were abstracted from herbarium specimens in **BEL**, **BIRM**, **BM**, **BMH**, **BREM**, **BRISTM**, **BTN**, **C**, **CGE**, **DBN**, **DZS**, **HLL**, **K**, **L**, **MBH**, **NMW**, **OXF**, **P**, **RNG**, **TBY** and **TCD** (identifications confirmed by Q. O. N. Kay or T. C. G. Rich), published literature sources, Biological Records Centre (B.R.C.), unpublished survey reports, the B.S.B.I. database, correspondence with botanists and field observations in England and Wales. In addition, some data were included from previously abstracted records from **CLE**, **DOR**, **HDD**, **JSY**, **LANC**, **LIV**, **LTR** and **RAMM**, but the identifications have not been checked.

A total of 363 records have been traced. They are summarised below; full details are held in the Threatened Plants Database. Some historical population data are also given. Data from Cornwall have been compiled from surveys carried out for the National Trust, the large amount of fieldwork for the *Flora of Cornwall* (French *et al.* 1999), field work by the authors and some historical data from E. W. Davies and J. Roseweir (now held by T. C. G. Rich). Data for Dorset were compiled by H. J. M. Bowen. Populations in V.c. 41 Glamorgan were surveyed by L. K. and T. C. G. Rich and others 1996–2001. Populations in V.c. 45 Pembrokeshire have been surveyed regularly by S. B. Evans and A. McConnell 1996–2001. These records were used to direct the field surveys in 2001.

It is difficult to know exactly how many individuals there are in a population as some clumps may be composed of more than one individual (as shown by some patches with plants of different sexes). Isolated fronds may be distinct plants or belong to an adjacent clump. The rhizomes of some large plants may also fragment giving the appearance of more than one plant (e.g. Kay & John 1995 found using isozyme analysis a separation of 180 cm between crowns of the largest individual). It is best to regard the population estimates as the number of ‘clumps’ which may or may not be single plants. J. Roseweir for his undergraduate studies in 1959 was often able to distinguish individuals by their unique morphology, showing that more detailed counts may be possible in some cases. Seedlings were counted when seen.

DISTRIBUTION AND POPULATIONS SIZES

Sites are listed in vice-county order, and clockwise around the coast within each vice-county.

V.C. 1, WEST CORNWALL

There are four main groups of sites on The Lizard (SW61, SW71), where plants are scattered along sections of cliff. There are also many records simply ascribed to The Lizard, without specific information.

TABLE 1. CHARACTERS DISTINGUISHING *ASPARAGUS OFFICINALIS* AND *A. PROSTRATUS* (AFTER KAY *ET AL*. 2001)

	Asparagus officinalis	*Asparagus prostratus*
Colour of plant	Usually mid- to olive-green or yellowish-green, often shiny.	Usually glaucous (especially when exposed), sometimes green
Stems	(40–)80–200 cm tall, erect, straight (sometimes sinuous towards apex)	10–70(–130) cm tall, at least the largest usually prostrate, decumbent or ascending, rarely erect with tops curving sideways, usually curved and/or sinuous
Internode length	Mean 12–36 mm (range of all internodes 4–89 mm)	Mean 3–15(–20, exceptionally –50) mm (range of all internodes 2–50 (exceptionally 150) mm)
Longest cladodes (needle leaves) on branches	Mean length (6–)10–32 mm (range 4·5–34 mm), often curved, thin, flexible	Mean length 2–16(–18) mm (range 2–24 mm), straight, often stout and rigid
Flowers	Usually spaced out, sometimes mixed with cladodes on side branches	Usually abundant, mixed with cladodes on side branches
Pedicels	Mean pedicel length (6–)7–15 mm (range 5–17(–25) mm)	Mean length 3·2–10·4 mm (range 2–13 mm)
Male perianth	Mean length 4·0–5·7 mm (range 3·8–7 mm), yellow (rarely flushed pinkish), tips straight	Mean length 4·7–8·0 mm (range 4·2–8·3 mm), often reddish or copper-flushed yellow, out-curved at tip
Female perianth	Mean length 3·1–4·1 mm (range 2·7–4·3 mm), pale yellowish-green, tips straight	Mean length 3·5–5·9 mm (range 3·3–7·5 mm), yellow to whitish-green, out-curved at tips
Chromosome number	Normally 2n = 20 (diploid), rarely some cultivars 2n = 40 (tetraploid)	2n = 40 (tetraploid)

Enys Head to Cadgwith (including Terrick Colt, Kildown Point, Carn Barrow), SW7113–SW7215
It appears to have been first reported from the Cadgwith area in 1847 by C. A. Johns, and has been recorded by numerous botanists since in a series of about six populations over 0·5 km of cliff from Enys Head to the well-known 'Asparagus Ravine' (Terrick Colt) at Cadgwith which has one of the largest and most concentrated populations in Britain. Plants have been variously reported on grassy slopes, on cliffs and rocks, in a gully, in a serpentine quarry, and on hedgebanks.

Surveys of the sub-populations were carried out on 1 July 2001 by I. J. Bennallick. At Enys Head (SW7215), 31 plants were found. Between Enys Head and Asparagus Ravine (SW7214), 13 plants were found. At Asparagus Ravine (SW7214), 177 plants were observed, and five more inaccessible plants occurred on cliffs towards Cadgwith.

Two sites south-west of Cadgwith (SW7214 and SW7113), each with single plants, were first found by R. Holder in 2000 during a vegetation survey for the National Trust and both were seen again on 5 July 2001 by I. J. Bennallick.

Lizard Point area (including Lizard Head, Lizard Lighthouse, Pen Olver), SW7011–SW7111
Plants were first reported from Lizard Point by J. Ray in 1667 (Ray 1690). Plants are now well known on sea cliffs near the Lighthouse, but not from Lizard Point itself; all records may refer to sites near the Lighthouse. There is further confusion about records cited for Lizard Point or Lizard Head as both names have been used for the southernmost point in SW7011 and the headland to the west in SW6911; it has not been confirmed in SW6911.

In 1959 J. Roseweir recorded seven plants below the lighthouse. On 2 July 2001, 30 plants were found by I. J. Bennallick in two sub-populations in the lighthouse area (SW7011).

The population at Pen Olver (SW7111, Signalhouse Point) was first reported in 1994 by the National Trust. On 2 July 2001, four plants and two seedlings were found by I. J. Bennallick.

Kynance to The Horse (including Asparagus Island, Lawarnick Pit, Rill Ledges, Rill Head), SW6813–SW6713

Plants have been widely reported from this area since at least 1829 on rocks and in coastal grassland in at least five sites. In 1959 J. Roseweir recorded c. 24 plants on Asparagus Island and 13 plants at Rill Cove with one seedling.

Surveys of the sub-populations were carried out on 2, 3, 8 and 15 July 2001 by I. J. Bennallick. On Asparagus Island (SW6813), 44 plants were found. At Lawarnick Pit (SW6813), 68 plants were found. At Kynance Cliff (SW6713), 23 plants were found. At Rill Cove (SW6713), 17 plants were found. From Rill Cove to north of The Horse (SW6713 to SW6714), 398 plants were found.

George's Cove to Mullion, SW6615–SW6619

A further group of four populations occurs on sea cliffs to the north of Kynance in what could be regarded as an extension of the previous population group. There is a record for Mullion in 1904 by Mrs Woods, which may refer to Lower Predannack Cliffs or Pol Cornick, or perhaps another historical site to the north. The sites are on precipitous sea cliffs and are very difficult of access.

At George's Cove (SW6715) about 50 plants were reported by A. J. Byfield and R. FitzGerald in 1983, and probably about the same number are still present on an inaccessible slope visible with binoculars, 8 July 2001, I. J. Bennallick.

It was first reported from Pol Cornick (SW6615) in 1977 by D. E. Coombe, and was seen again in 1988 by P. A. Gainey and R. F. John. A survey on 8 June 2001 by I. J. Bennallick was unsuccessful, though P. A. Gainey has seen a few plants within the last three years (pers. comm. 2001); there has been a cliff fall at this site recently so plants may have been lost but the difficulties of survey make this impossible to confirm.

P. A. Gainey has seen a few plants at Lower Predannack Cliffs (SW6615) within the last three years (pers. comm. 2001). No plants were seen on the steep cliffs with binoculars by I. J. Bennallick on 8 July 2001.

A few plants have been seen by P. A. Gainey at Laden Ceyn SW6617, which is south of Mullion Cove, within the last three years (pers. comm. 2001). The area was searched by I. J. Bennallick on 15 July 2001 without success.

The Vessacks, St Levan, SW3721

Jones (1821) noted 'our search for *Asparagus officinalis*, which has been found on rocks between Land's End and Castle Treryn [= Treryn Dinas], was not successful'. This record, which is most likely to refer to *A. prostratus*, is assumed to be the site on sea cliffs near The Vessacks at which *A. prostratus* was refound in 1992 by M. Thomas (**LANC**). On 7 July 2001, one plant was seen by I. J. Bennallick.

Tubby's Head, SW6950

It was first reported at Tubby's Head by L. J. Margetts in 1976, when 49 plants were found. On a B.S.B.I. field meeting on 28 May 1989, more than 80 plants were recorded. The colony, which occurs in maritime heath, the edges of flushes and on old mine spoil, is still thriving. On 12 June 2001, 220 plants were found by I. J. Bennallick.

Dinas Head, SW8576

15 plants were first reported from the inaccessible base of the cliffs at this site in 1977 by L. J. Margetts. Most recently two plants were reported by J. Stewart on 28 July 1997, but there is unlikely to have been a decline. On 19 July 2001, 17 plants were found by I. J. Bennallick.

A record for SW716146 in French *et al*. (1999) is an error for Cadgwith (R. J. Murphy, pers. comm. 2000).

V.C. 2, EAST CORNWALL

Rocky Valley, SX0789

Six plants were reported at Rocky Valley by R. E. N. and C. J. Smith, 2 July 1988, on a steep, rocky slope, and 10–20 plants were subsequently reported by Miss R. J. Murphy and Mrs M. G. C. Atkinson on 5 September 1991. On 11 June 2001, five discrete clumps, one of which was very large and could have contained more individuals, were found by I. J. Bennallick and T. C. G. Rich.

Trevalga Cliffs, Darvis's Point, SX0790
A. and M. G. C. Atkinson found several inaccessible plants on the edge of a cliff on 25 June 1996. On 28 June 2001, two discrete clumps were found by I. J. Bennallick.

V.C. 6, SOMERSET/V.C. 34, WEST GLOUCESTER
Ray (1724) cited a record from 'below Looks Folly, two miles from Bristol' which probably refers to *A. officinalis*. There is a specimen in **BRISTM** from rocks in the Avon Gorge composed of a mixture of *A. prostratus* and *A. officinalis*; it is likely that there has been some confusion of specimens. Other records from the various floras of Somerset and Gloucestershire refer to *A. officinalis* (Kay 1997).

V.C. 9, DORSET
There are a number of records for the Isle of Portland and Weymouth purporting to date from W. Turner in 1551 onwards (H. J. M. Bowen in Kay 1997) but the references cited have not been verified. The earliest unambiguous reference is that of Turner & Dillwyn (1805), and the earliest dated herbarium specimen is from 1822, J. Sowerby (**BM**), though it is probable other records such as A. B. Lambert's record in Smith (1800) also refer to *A. prostratus*. The records probably refer to one of the two following sites.

Portland Bill, SY6768
Turner & Dillwyn (1805) noted it at the 'extremity of the island', and Barrett (1912) noted 'a fine plant in depressions of an unquarried stone, close to cliff, towards Lower Lighthouse, 1876', and may have been seen by J. C. Mansel-Pleydell some time before 1895 (Mansel-Pleydell 1895). The site was probably quarried away with Portland Stone.

Ferrybridge – Small Mouth, SY6774–SY6675
There are many records for near the Ferry, Small Mouth or Chesil Beach from about 1782, W. Sole onwards (Barrett 1912), often cited as occurring on sandy waste and in sandy fields. It was in 'great abundance' at Small Mouth in 1795 (Good 1948). J. W. White recorded that plants he had seen in 1885 subsequently had a torpedo factory built on them, and the population seems largely to have been lost until rediscovered on a nearby old railway in 1951 by A. W. Graveson and then lost again after 1961 (Kay 1997). One clump was rediscovered in 1997 by P. Sterling & R. J. Surry, which was nearly destroyed by drainage works in November 2000 (D. A. Pearman, pers. comm. 2000).

There are a number of other Dorset records which have not been accepted. A record for Chesil Beach south of Moonfleet, 1970s, J. K. Hasler (Bowen 2000) is possible but requires confirmation. Specimens from Poole Harbour are *A. officinalis* (e.g. Lilliput and Saltern's Pier, **BMH** cf. Mansel-Pleydell 1895, Bowen 2000).

V.C. 10, ISLE OF WIGHT
Grose (1935) reported '*A. maritimus*' from Norton Spit; there are no specimens in his herbarium at **DZS** or **BM** and all other specimens seen from this site and elsewhere on the Isle of Wight are *A. officinalis.*

V.C. 13, WEST SUSSEX
All the Sussex records are referred to *A. officinalis* with the following exceptions.

Shoreham, TQ20
Three independently-collected vegetative herbarium specimens demonstrate its occurrence on Shoreham Beach between 1877, Mrs Bell Oakeshott and 1895, T. Hilton (**BTN**, **BM**); the T. Hilton record from Southwick Beach in Wolley-Dod (1937) probably also refers to this site. It is surprising, given the number of botanists visiting Shoreham beach to look for *Trifolium stellatum*, that it has not been more widely reported and it may have been a transient population.

V.C. 41, GLAMORGAN
Sker Sands, Porthcawl, SS7979 (or possibly SS87)
Plants were first found on coastal sand hills at Sker Point, Porthcawl on 7 June 1901 by W. A. Shoolbred and E. S. Marshall (**BM**, **CGE**, **NMW**). They were last seen by Miss E. M. Thomas in 1933 and 1935 (**NMW**).

The site has been fairly heavily sheep-grazed for the last 50 years, and the plant is not known to the local tenants (J. Blundell, pers. comm. 2001). It has been searched on a number of occasions (e.g. in 2000 and 2001 by T. C. G. Rich), and it is considered extinct. Sker Point is adjacent to the ungrazed but very well-recorded Kenfig NNR where no asparagus has been reported.

Oxwich Bay to Three Cliffs Bay, SS5287–SS5487
Plants were first recorded from cliffs in Oxwich Bay by H. J. Riddelsdell in June 1904 (**BM**, manuscript in **NMW**) but the exact site at which he saw them is unknown. We have traced no further records for the area until plants were rediscovered in 1989.

Two discrete populations are currently known. The first occurs mostly on wind-blown sand on low cliffs with 21 plants in two sub-populations 1996–1999. In 2001 only 19 plants were recorded, two small vegetative plants having been lost, one through localised natural erosion and the other possibly through shading by *Ulex*. The second population on limestone cliffs was refound during a National Trust survey in 1996, and may be Riddelsdell's site. A maximum of 26 plants have been recorded 1997–1999; 24 plants were seen in 2001. Fruiting is observed regularly though variable between years in both sites, but there is no obvious recruitment at the former site (L. K. Rich, unpublished data).

Culver Hole, Port Eynon, SS4684
It was first recorded at this site in 1821 (**OXF**; no recorder) and this appears to have been the best-known and most-visited Glamorgan site since. It is possible that the population has been significantly reduced historically by collecting.

When Q. O. N. Kay was first shown the site in by G. Goodman in 1965, fewer than ten plants survived. In 1984, Kay & John (1995) recorded only six plants. One plant was lost to coastal erosion perhaps aggravated by footpath trampling in 1991, and another to natural erosion of the soil by storms in about 1998. The population in 1999–2001 consists of four plants and no recruitment has been observed (L. K. & T. C. G. Rich, unpublished data).

Worm's Head, SS4087
Dillwyn (1840) reported it 'On the Wormshead, and several other cliffs in Gower'. Vachell (1936) noted it 'flourishes on rocks near the Worm's Head' but there are no further specific details in her diaries or specimens at **NMW**, and she may have been citing Dillwyn's record. Worm's Head has been well studied in recent years, and there are no further reports (T. King, pers. comm. 2000).

Broughton Bay, SS4293
A record for 'sands of Broughton Bay near Whiteford Burrows' by H. J. Riddelsdell (Riddelsdell 1907, and unpublished manuscript in **NMW**) is accepted as *A. prostratus* although no specimen has been traced and it has not been refound.

In addition, there are a number of other unconfirmed or erroneous Glamorgan records (see Kay 1997). A record for Bacon Hole, 30 June 1917, E. Vachell is a transcription error for Culver Hole mentioned as being visited on that day in her diaries. Another 1942, E. Vachell record for Barry Island (ST06) is more likely to refer to *A. officinalis* which is currently naturalised on sea cliffs there; no specimens have been traced though there is some suitable habitat.

V.C. 44, CARMARTHEN
Reported from Pembrey by Marshall & Shoolbred (1900) and Hamer (1912), but all material seen from this site is *A. officinalis* (e.g. **NMW**).

V.C. 45, PEMBROKE
Giltar Point area, SS1298–SS1198
It was first found on the 'cliff beyond at Giltar Point' by E. Lees in 1836 (**BM**, **CGE**) and has since been seen regularly in the area, even being described as 'plentiful' in 1847 by Falconer (1848). The exact number of populations is not clear. Whilst many records refer to the Point itself, some, like Lees' original record and another in C. C. Babington's diaries at **CGE** ('saw Asparagus at Giltar Head or rather halfway between it and Lydstep Haven') indicate two sites.

Detailed surveys by R. A. Jones (Jones 1993, 1994) and by S. B. and A. E. Evans and A. McConnell 1996–2001 (unpublished data) show two populations at or near Giltar Point which probably correspond to the historic sites. The first in rank *Festuca rubra* grassland has seven

scattered plants, and the second in grazed pasture several hundred metres to the west has 15 clumps in five clusters.

The B.R.C. record for Manorbier, 1936, E. Brazier plotted in SS09 in Wilkinson (1999) is an error resulting from a mistranscription on a record card (J. Croft, pers. comm., 2000).

V.C. 52, ANGLESEY

Llanfaelog, SH3271

The Anglesey records were discussed by Rich, Jones & Lockton (2000). It was first recorded by Edward Lhwyd in 1694 'near the pool at Llanfaelog' on a sandy hillock by the sea, and last recorded in 1889 by J. E. Griffith who described it as 'only in one spot on Maelog Sands, between Llyn Maelog and Trecastell, near the beach' (Griffith 1895). All accounts suggest it occurred in small quantity (e.g. 'confined to one spot only two yards across', **P**).

SCOTLAND

An undated specimen of *A. prostratus* in **BM** is labelled 'Gosforth, Scotland, Mr Lees', but the specimen and label have been remounted and it is possible some confusion may have occurred. There are no Gosforths in Scotland, although there is a Gosford in the Lothians. It is considered that this is an error.

DISCUSSION

Asparagus prostratus has been recorded from at least 34 sites in v.cc. 1, 2, 9, 13, 41, 45 and 52. It has not been recorded recently (post-1999) in six sites where it is probably extinct (18% decline), is extinct in West Sussex and Anglesey and is on the verge of extinction in Dorset. The records are mapped in Figure 1.

There are a significant number of erroneous records due to confusion with *A. officinalis*; we have been fairly strict in what we have accepted and, in the absence of voucher material or other confirmation, have not accepted some records though they are possible (e.g. Moonfleet). The relatively recent discovery of a number of new sites in Cornwall and rediscovery of a lost one in Glamorgan, coupled with the dangerous, inaccessible nature of its typical cliff habitat, suggests there may be more unknown populations around the coast. It can also be a very difficult species to see amongst other vegetation, the two best times to survey being May–June before other vegetation grows up, and in autumn when the berries ripen and senescent plants appear yellow.

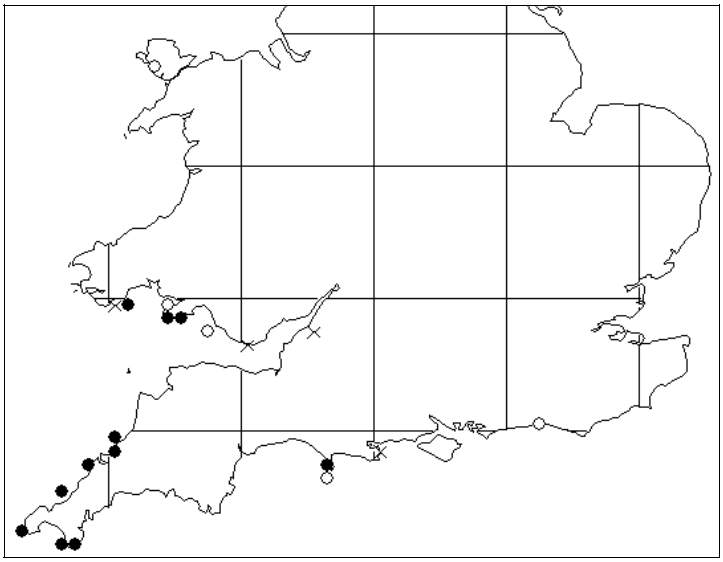

FIGURE 1. Distribution map of *Asparagus prostratus* in England and Wales.
●, 1999–2001. ○, pre-1999. ×, Error

We would welcome details of any further populations. Given its rarity and small population sizes please do not collect plants; photographs are sufficient for identification in most cases.

It is difficult from the limited historic population data to be certain whether individual populations are declining, stable or increasing. The evidence for decline on most sites is weak, and differences between observers and the types of survey being a major compounding factor. For instance, population counts have been made independently for nine sites during brief visits by T. C. G. Rich between 1999 and 2001 whilst either recording vegetation or looking specifically for *Asparagus*. On average only about half of the number of plants were recorded during these non-dedicated surveys (unpublished data). Many of the differences result from not having full details of the previous records to work from, limited time, and failure to find some of the very small

TABLE 2. SUMMARY OF POPULATION SIZES OBSERVED IN *ASPARAGUS PROSTRATUS* DURING DETAILED SURVEYS 1999-2001

SITE	**Number plants 1999–2001**
1. Enys Head	31
2. Enys Head-Asparagus Ravine	13
3. Asparagus Ravine	177
4. West of Asparagus Ravine	5
5. South of Cadgwith	1
6. Carn Barrow	1
7. Pen Olver	6
8. Lizard lighthouse area	30
9. Asparagus Island	44
10. Lawarnick Pit	68
11. Kynance Cliff	23
12. Rill Cove	17
13. Rill Cove – The Horse	398
14. George's Cove	c. 50
15. Pol Cornick	few
16. Lower Predannack cliffs	few
17. Laden Ceyn	few
18. The Vessacks	1
19. Tubby's Head	220
20. Dinas Head	17
21. Rocky Valley	5
22. Darvis's Point	2
23. Portland Bill	Extinct
24. Ferrybridge – Small Mouth	1
25. Shoreham	Extinct
26. Sker Sands	Extinct
27. Oxwich Bay 1	19
28. Oxwich Bay 2	24
29. Port Eynon	4
30. Worm's Head	Extinct
31. Broughton Bay	Extinct
32. Giltar Point 1	7
33. Giltar Point 2	15
34. Llanfaelog	Extinct
Total	c. 1200 plants in 28 sites

populations. This indicates the likely reliability of historic counts, i.e. they may be significant under-estimates. At many sites the historic estimates and current population counts are remarkably similar. At some sites such as Tubby's Head, the numbers of plants appears to be increasing as further surveys are carried out; this may be a function of being able to add to existing knowledge or could represent a real increase. Other than the six extinct sites, there is probably only strong evidence for decline at Ferrybridge – Small Mouth, Culver Hole and possibly Giltar Point. There is a clear need for regular, consistent survey and monitoring to determine population trends.

The population sizes found in 1999–2001 after reasonably detailed surveys are summarised in Table 2, which now give a firm baseline against which the success of the UK Biodiversity Action Plan in maintaining the populations can be assessed. Of the 28 populations known in 1999–2001, four have single plants and another five have fewer than ten plants; these might all be regarded as at significant risk of extinction (in effect, those with a single plant are already doomed as there will be no regeneration unless plants of a different sex colonise their sites). Only three populations have more than 100 plants, and could be regarded as secure.

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