

The shifting ecology and distribution of one of Britain's rarest plants: *Orobanche picridis* (Orobanchaceae)

F.J. Rumsey¹, C.J. Thorogood^{2,3}

¹Natural History Museum, London; ²University of Oxford Botanic Garden; ³Department of Biology, University of Oxford.

*Corresponding author: Chris Thorogood chris.thorogood@obg.ox.ac.uk

This pdf constitutes the Version of Record published on 28th December 2023

Abstract

Orobanche picridis F.W. Schultz (Picris Broomrape) is perhaps the rarest and certainly the most misidentified British broomrape. This rare plant was perceived to have a distinct ecology in Britain where, until recently, extant populations were virtually restricted to high, chalk sea cliffs. Though widely recorded across Southern England, most records have proven to be erroneous due to confusion with the similar, often co-occurring, common broomrape (*O. minor*). The preference of *O. picridis* for steep and inaccessible chalky ledges affords it some protection from collection, however encroachment of scrub and coastal erosion pose a conservation risk. We present data from a 20-year survey of populations in Kent revealing a fifteenfold fluctuation in annual abundance. We also report the astonishing recent discovery of a thriving metapopulation of *O. picridis* in brownfield sites in South Wales. Finally, in light of these dynamics, we provide practical recommendations for conservation of one of Britain's most elusive and unpredictable species.

Keywords: taxonomy; British Isles; host race; parasitic plant; range expansion

Introduction

Orobanche picridis F.W. Schultz (Picris Broomrape) is perhaps the rarest and certainly the most frequently misidentified of the British broomrapes. Although widespread across Europe, North Africa and Asia Minor, it has been regarded as one of Britain's most endangered plants by Perring & Farrell (1977), listed as EN in the GB Red-list (Cheffings *et al.*, 2005), and protected under Schedule 8 of the Wildlife and Countryside Act since 1981. It is extremely local and strongly southern in distribution (Fig. 1).

Historically the species has been recorded from 19 vice-counties in published accounts, e.g. Druce, 1932, county floras, or on herbarium specimens seen by the authors. Of these we can only confirm five: Wight (v.c.10), East Kent (v.c.15), Berks (v.c.22), Cambs (v.c.29), and Pems (v.c.45), although the specimens supporting claims from another two: Dorset (v.c.9) and East Gloucs (v.c.33) are equivocal. Post 1950 the species was believed to be restricted to two small coastal areas in Wight and Kent, where for several decades in the late 20th century few if any records were made. More exhaustive surveys, documented here, revealed the plant to still be present, although often on inaccessible cliff tops, cliff ledge and slumped undercliffs. Plants were also being overlooked due to confusion with the common *O. minor* Sm. An increase in population sizes from

2005-2007 reduced the species IUCN threat status from EN to VU D_{1,2} in the England Red-list (Stroh *et al.*, 2014); given the species' believed restriction to England this status was adopted for GB in the Year 9 Amendment (Leach & Walker, 2015). Since this time populations have fluctuated conspicuously but not such that the status needed re-assessment. However, the discovery of a large new population in Wales in 2021, triggers the need for a reconsideration of status. Subsequent survey and critical review of earlier data and herbarium material reveal a longer history within this area and evidence for recent wider dispersal, documented below. Here we aim to review the past recording and confusion surrounding what has long been considered one of Britain's rarest plants and consider its apparent changing ecology.

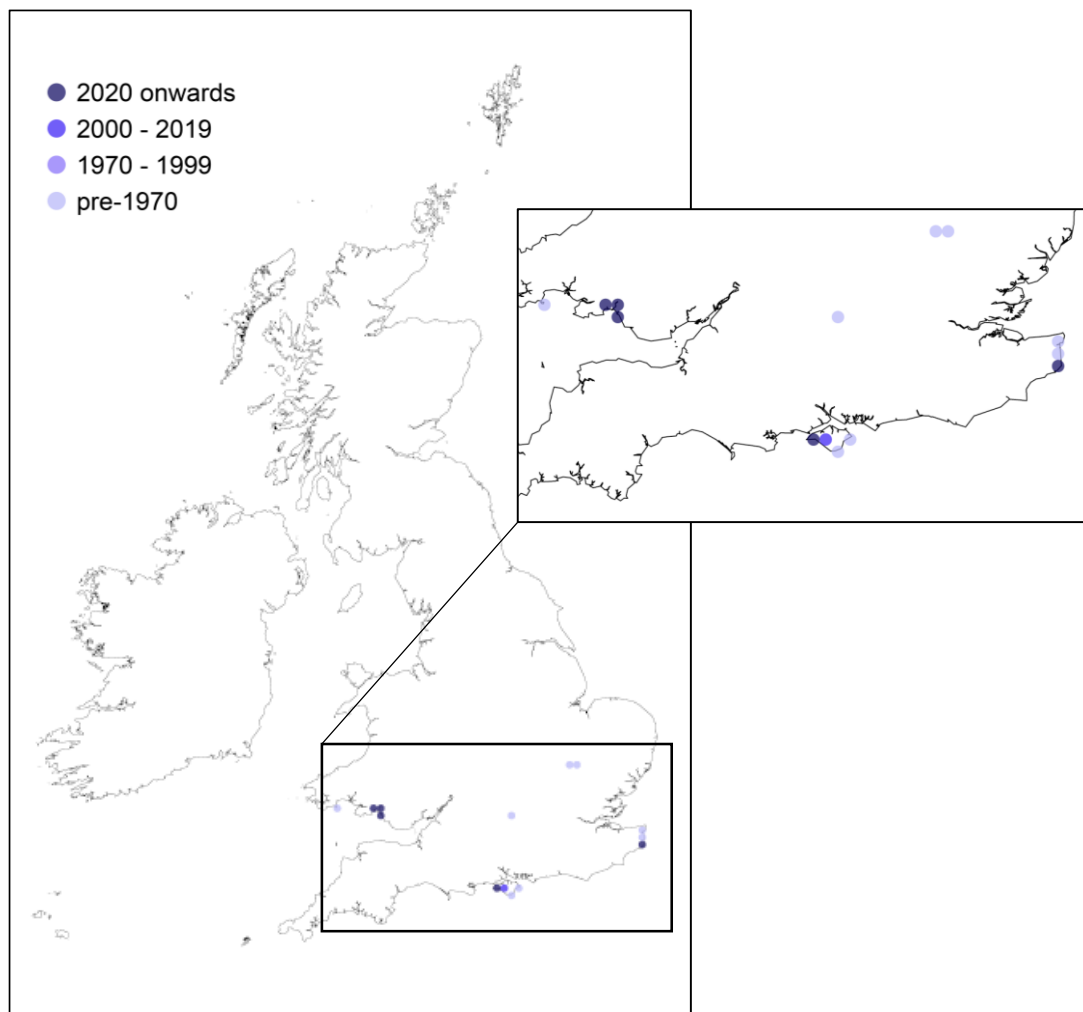


Figure 1. The distribution of *Orobanche picridis* in the UK

Taxonomy and nomenclature

Orobanche picridis has long been confused in the British Isles due to its similarity to other, closely related species in the grex *Minores* (Beck, 1890): a group of similar, small-flowered species (corollas typically <20 mm) that are notoriously challenging to identify in the field and preserve poorly in herbaria (Fig. 2). Beck-Mannagetta (1930), in the last comprehensive monograph of the genus, listed over 345 binomials belonging to this grex, recognising 20 species in this group. He included descriptions of a further six which he considered plausible, recognised 20 varieties, and a total of 69 forms. The most common

species in this complex is Common Broomrape (*O. minor* s.l.). This species is found throughout Britain and Ireland, with several intraspecific taxa recognised (Thorogood & Rumsey, 2020); it is also widespread across Europe, and widely naturalised elsewhere across the globe. Whilst small specimens of *O. picridis* and *O. minor* can be very similar (and co-occur), 'good' specimens are easily differentiated: *O. picridis* differs in its creamy-white corollas with contrasting dark-purple stigmas, porrect upper lip lobes, filiform calyx segments, and copious shaggy white filament hairs. The stems are typically slender, the corollas proportionately larger than in *O. minor*, and British plants are found almost exclusively on *Picris hieracioides* L. (Thorogood & Rumsey, 2020; Thorogood & Rumsey, 2021).

The nomenclatural issues surrounding *O. picridis* are further complicated by nomenclatural and bibliographic studies in the 1980s and 1990s which revealed that the publication date of *O. loricata* (Reichenbach, 1829) just preceded that of *O. picridis* (Schultz, 1830), giving the former priority if those taxa were truly synonymous. Further work then revealed that an even earlier name, *Orobanche artemisiae campestris* Gaudin (1829) (Figs. 5F, 6D, 6H) - first coined by Vaucher (1827) as 'Orobanche de l'Artémise des Champs' - just had priority over *O. loricata*. Gaudin's unhyphenated name was susceptible to charges of being invalid as a polynomial, though correctable with the addition of a hyphen. *Orobanche artemisiae-campestris*, a strict parasite of *Artemisia campestris* L., is synonymous with Reichenbach's plant; however, it is distinct from the parasite of *Picris hieracioides* described by Schultz, as noted by Kreutz (1995); *O. artemisiae-campestris* has rather robust spikes with fewer, larger flowers, rather yellowish in colour, with reddish markings. Thus, our plant was accordingly resurrected under the name first used for it by British authors, *O. picridis*. Intriguingly the separate entity, *O. artemisiae-campestris*, we believe also to have occurred in Britain, but has been overlooked: Specimens collected from the Brecks of Suffolk and Norfolk in the early 20th century from three of the very few localities of *Artemisia campestris* (itself a Schedule 8 plant), possibly correspond to this and not *O. minor* as considered by its collectors (Thorogood & Rumsey, 2021). This tentative identification ideally needs to be verified by molecular data because, again, these closely related species preserve poorly in herbaria. This morass of nomenclatural issues and confusion has infiltrated legislation and early floras, and the heterotypic synonyms *O. loricata* and *O. artemisiae-campestris* are still widely (incorrectly) in use in Britain. Several polynomials have been also used for this plant including *Orobanche picridis-hieracioides* F.W. Schultz in Bot. Lit. Blätt. 5: 500 (1830) – considered a heterotypic synonym, and *Orobanche picridis-hieracioidis* Holandre, a name published in Fl. Moselle: 322 (1829), suggested to be the correct epithet by Plants of the World Online (POWO, 2023). However this polynomial has not been adopted by others, including The World Checklist of Vascular Plants (WCVP) (Govaerts, 2023), Index Orobanchaceae (an authority on the genus) (Sánchez Pedraja et al., 2023), and all regional floras to our knowledge. Indeed, we cannot find this combination in use anywhere, suggesting *Orobanche picridis* should be retained as the *nomen conservandum*. To avoid further confusion, here we refer to *Orobanche picridis* throughout, consistent with other authors.

Orobanche picridis is somewhat invariable in Britain, but for very rare pure yellow forms, and we find no basis for recognising infra-specific varieties. Yellow, anthocyanin-deficient forms occur from time to time in all or most species of *Orobanche* with varying frequency. Inconsistent importance and taxonomic emphasis have been placed on these. In the closely related *O. minor*, we recently recognised such yellow forms at the forma rank: *O. minor* subsp. *minor* f. *lutea* (Tourlet) Thorogood & Rumsey. Similar forms occur in *O.*

picridis, albeit very rarely (only seen in Wight to our knowledge: Fig. 5I). and we suggest these should be treated in a similar fashion.

Recording: historical and present

The past distribution of *O. picridis* in the UK has been difficult to ascertain due to repeated confusion with forms of *O. minor*. Disappointingly, as a consequence of this ambiguity, no attempt was made to summarise or map historical records in the last Red Data Book (Foley, 1999). Aside from an area of Cambridgeshire where it was known to occur sporadically from 1848 to 1935, other records have been fleeting, perhaps chance colonists, apart from two coastal populations: Freshwater Cliffs, Wight, and on the East Kent Coast from Dover to Deal. Plants from these persistent populations show morphological features (for example sub-entire sepals) which the ephemeral, and often contentious, plants do not. This suggests that if the identity of the colonists is correct, they may have had a disparate, perhaps neophytic origin. We reviewed historical records (see examples in Fig. 2) which might have contributed to confusion and found 30 erroneous records dating from 1821 to 1984 (data not shown). Difficulties in identification, especially confusion with *O. minor*, has understandably deterred recording and perpetuated incorrect records. Druce (1932) in his Comital Flora listed 14 vice-counties: 4, 6, 10, 15, 17, 20, 22-24, 26, 27, 29, 37 and 45. We have seen examples so named from all, with the exception of v.c.27, but only accept those from 10, 15, 22, 29 & 45. Petch & Swann (1968) discount earlier records from v.c.27 as *O. minor* var. *compositarum* (see below). *O. picridis* was excluded from the latest Flora of Norfolk (Beckett & Bull, 1999). The work of Pugsley in the 1930s did much to elucidate the identity of several *Orobanche* taxa, including the British species in Beck's grex *minores*. He recognised that a somewhat distinct pale and slender form of *O. minor* that parasitised *Crepis*, which he named var. *compositarum* (Pugsley, 1940) (Fig. 5H), was being routinely misidentified as *O. picridis*; this certainly helped clarify earlier errors, particularly in the Brecks and Surrey heaths.

Orobanche picridis has a long history of observation and collection in Wight. Pearman (2017) suggests it was first recognised as a British plant by Bromfield (1849): "Observed by myself growing very abundantly ... on July 9th, 1844, upon a ledge of the Freshwater cliffs, called by the cliffs-men Rose Hall Green, but supposed to be only *O. minor* at the time." Almost simultaneously the plant was discovered in Cambridgeshire by W.W. Newbould at Comberton [TL35] (Babington, 1848), which in fact constitutes the first British publication. [Herbarium studies have revealed the plant to have been collected in Kent earlier still but misidentified; see below]. Babington in a journal note for 15 July 1848 describes visiting Comberton with Newbould, where they "...gathered plenty of it in a field just within the Parish of Toft, at the end of the field lane to the left of the road" (Crompton, 2001) (Specimens at **K!** & **E!** are labelled as collected 13.7.1848). It would seem to have last been collected there by G.S. Gibson in 1850 (**NWH**). Newbould subsequently collected it in 1853, "near the road leading north from Caldecot [Caldecote], and to the south of Hardwick Wood [TL35]". (Fig. 2D). This was a site some 3 km east from the first. It was last collected here in 1857 (**BM!**). Babington (1860) also lists an undated Newbould record from between Caxton and Eltisley [TL25], for which no voucher has been traced but given the recorder's familiarity with the plant, it is tempting to accept it.



Figure 2: A-B. The specimen at CGE from Bradford Abbas, v.c.9 upon which *O. picridis* claim as a Dorset plant rests. Coloration and filament pubescence support its determination; however, sepal and stem characteristics cast some doubt. C. An unequivocal specimen of *O. picridis* collected by J.T.B. Syme as '*O. minor*' from near Pangbourne in 1847 (BM). The precise location is unclear. Cuttings through the chalk near the station appear the most suitable habitat today. The GWR railway opened here in June 1840. D. Babington's 1853 specimen from Caldecot, south of Hardwick Wood, CGE. E. Babington's 1848 Giltar specimen (LHS) on a sheet at CGE with a specimen from Bromfield collected at Freshwater in 1849 (RHS)

It would be over 80 years before the plant was reported again from Cambs., but still in the same smallish area. The record was made at Haslingfield Chalk Pit [TL4051] by a Mrs Brindley, in 1935 (K!), a site under 6km southeast of the original encounter. This was to be

its last find in the county. The site was searched by FJR in the late 1990s without success, notwithstanding a suitable habitat remaining (also with *Orchis anthropophora* (L.) All. at its only remaining v.c.29 locality, first found there by Babington in 1855). Leslie (2019) documents records for *O. picridis* by A.S. Shrubbs from the Fleam Dyke [TL55] in 1878 and 1881, although it has not been seen at this well-botanised site by others; we regard these records as errors, along with the other, more recent, reports from Cambridge. The past occurrence of the species in Cambs. is intriguing and difficult to explain. One might regard the Comberton/Caldecote occurrence(s) as the result of an introduction with crop seed, or similar, followed by local dispersal, as seen recently in Kent with *O. crenata* Forssk.; however, the latter is an agricultural pest, more amenable to such introductions. Regardless, *O. picridis* only persisted there for a few years, before a much later occurrence at Haslingfield, on similar soils 6 km away. Disjunct relict occurrences of at least one other taxon, *Cirsium tuberosum* (L.) All., also now extinct as a Cambs. native, are known from this area.

Astonishingly, just over a month after his first encounter with *O. picridis*, Babington discovered it once again in the company of W.W. Newbould, "in an old quarry near Giltar Head, Pembrokeshire", on the 18th Aug.1848 (**CGE!**) (see Fig. 2). It was still present in 1851 but has not been seen there since (Rumsey & Jury, 1991).

Bromfield (1856) in his posthumously published *Flora Vectensis* gives a very complete description of the species and its distinguishing characters. Specimens were collected here by (or for) him, from the ledges of the sea cliff at West High Down on Wight which were harvested for gulls' eggs and samphire. In 1883 it was described by Fred Stratton as plentiful (Bevis *et al.*, 1978), but with erosion and the cessation of the harvesting no records were made from 1892 (J.H.A. Stuart, **E!**) until the discovery by Phoebe Yule of a small plant on the cliff top in 1967 (Pope *et al.*, 2003). In 1986 (a good flowering year countrywide), 20 plants were again found on the cliff top above Bromfield's original site, with yet more visible through binoculars on the ledges below; in 1987 15 plants were observed (Shephard, in litt.). In 1992, another good year, 59 plants were counted (Pope *et al.*, Snow & Allen, 2003). They further comment that since 1999 plants have been found at two well-separated locations along this stretch of downs where the host plant was frequent. However, in 2002, FJR identified 30 plants at six locations from SZ33968551 to SZ31088498. Although there have been no records west of Freshwater Bay since 2013, a detailed survey would probably reveal it still to be present. Plants were recorded on Afton Down (SZ364855) to the east of Freshwater Bay by Paul Stanley in 2005. In the subsequent year the species was recorded by the roadside further west (SZ356856) by Geoff Toone and these were sent to FJR for confirmation. Subsequently it has been found on the adjacent downs and eastwards onto Compton Down. No detailed censuses have been made but anecdotal evidence suggests the plant is expanding its range and is present in far greater numbers than had been associated with the ledge and cliff-edge habitat to the west. It seems unlikely that such a careful and thorough observer as Bromfield would have missed this obvious population had it been present in the 1840s, or indeed later 20th century observers such as the VCR Colin Pope, or his predecessor Bill Shephard, if it was there from the 1960s. It may however have been present at low densities and responded to habitat or climatic shifts promoting an increasing abundance of its somewhat ruderal and ephemeral host. In July 2010 an additional locality was recorded by Paul Stanley at Chessell (SZ39978670), a few km to the northeast, in a small area of disturbed calcareous grassland close to a farm building. A further record was made in this area but ascribed to the adjacent SZ4086 the following year. No subsequent records have been made but the plant

may still be present. Investigations in several herbaria revealed an additional possible locality with the discovery of a specimen in **BON!** labelled as "Colwell, 9th June 1875", collected by Miss Livens only a few km to the north of Freshwater Downs. An unlocalised anonymous record for SZ57 from 1889 on the BSBI database (<https://database.bsbi.org/>) may be based on a specimen at **CGE!** labelled "nr Ventnor" and collected by A. Stewart [=J.H.A. Steuart], another specimen labelled from "nr Ventnor" by this collector but from July 1888 is at **BM!**. There is also a rather poor, damaged specimen at **BM** collected by H.E. Wilkinson on 26/6/1882 from "Cliffs above Ventnor", [presumably Bonchurch Down]. Evidence for another possible site is provided on a sheet of the distantly related yarrow broomrape, *Phelipanche purpurea* (Jacq.) Soják at **LIV!** collected by J.H.A. Steuart from Red Cliff [nr. Sandown SZ6285] in July 1885. It contains one putative sample of *O. picridis* among multiple specimens of *P. purpurea* (perhaps muddled during mounting; although specimens of *O. picridis* from Freshwater at **BM** & **LIV** were collected some years later in 1888, 1889 and 1892). Together these records indicate that *O. picridis* had a wider distribution on the island's southernmost coast in the 19th century.

Orobanche picridis has also long been recorded to grow on the chalk cliffs of the south-east Kent coast. The first record of the species here was by Syme (1866) in the 3rd Ed. of Sowerby's English Botany. He describes it as "very abundant on the undercliff between St. Margaret's Bay and Kingsdown, South Kent... Probably frequently passed over as *O. minor*" [TR34]. It had certainly been collected earlier, in 1840, by Rev. G.E Smith on the cliffs at Dover (E!) [TR34] and in the same year by Miss E. Harvey (K-HCW!) on the undercliff at St. Margaret's [TR34] and also from "sandhills east of Deal" [TR35], from which no more recent records exist. The earliest specimen so far found is that of N.B. Ward from Kingsdown, on 27/7/1837, **BM!** [TR34]. In the first Flora of Kent, Hanbury & Marshall (1899) give Syme's record and one from Deal by H.C. Watson (presumably based on Miss Harvey's collection), but no others. This is surprising given the wealth of specimens collected at these classic localities by a range of the day's finest botanists, for example A. Bennett, who had published notes on the genus. Francis Rose in his unpublished mss. flora noted plants only on the ledges of steep chalk cliffs, including at Dover East Cliff, (where reported in 1947, with records in most years to 1962) and at St. Margaret's Bay, where it was abundant in 1957, and at a site ¼ mile northeast, present in 1946 and 1947 but not seen in 1953 (Kitchener, 2021). The plant is mentioned here by Lousley (1950) in his New Naturalist on the Flowers of Chalk and Limestone and was collected by him in St. Margaret's Bay in 1947 (**RNG!**). Rose also received reports of its occurrence on waste ground south of Ebbsfleet House, Richborough Port, (TR36) by various botanists in 1949 and 1962 (Kitchener, 2021). We have not seen unequivocal specimens to support these records but have no reason to doubt them (the plant might even persist in the Ebbsfleet site despite the development of the area; neither author has checked). In the 1980s NCC rare plant surveys located extremely small populations in the Dover area, but despite repeated searches the plant had not been seen at the well-known sites in St. Margaret's Bay for some time (Philp, 1982). However, in 1986 Ro Fitzgerald reported a population of 10 plants on the chalk ledges and in the same year a few plants were re-found on clifftops at Freshwater, after almost two decades without records (see Pope *et al.*, 2003). By the time of his second Kent Flora Philp (2010) gives the situation in Kent as known to him as, "at Dover TR34F & TR34G where numbers of flowering spikes can vary between 1 to 50, and on the cliffs at Oldstairs Bay TR34Y with up to ten flowering spikes most years." This is in fact a significant under-estimate and demonstrates what can be missed by the casual observer, emphasising the need for targeted surveys.

Investigations started by FJR in 1991 initially revealed a population of 23 flowering plants on ledges at the eastern end of St. Margaret's Bay and it was realised that, while indeed rare, the species was undoubtedly being overlooked. Five plants were seen here the following year by T. Lording. The reporting to FJR (as BSBI referee) of a large number of *Orobanche* plants of uncertain identity on the SUSTRANS trackway above Dover harbour in 1996 - later confirmed to be *O. picridis* - triggered a campaign of annual surveys of the known Kent populations that spanned over 20 years (Fig. 3). Initially this just covered the recently documented area of occurrence, which had been established in 1997 following a detailed search from Dover Harbour to 'The Cut', a cliff beyond Dover Patrol, east of St. Margaret's. Once alerted to the species presence further north on the Kingsdown ranges in 2004, the area included within the survey was extended. The Kingsdown range area and the cliff edges immediately above it have consistently supported the largest number of specimens, before the recent increases reported in Wight and, as we report here, in Glams, often supporting >75% of the known British population.

The plant is probably under-recorded along this 'White Cliffs' section of the Kent coast due to the physical inaccessibility of its habitat; notwithstanding, the data we have collected over two decades show that population numbers fluctuate markedly from year to year, ranging from just 74 spikes in 2003 (excluding Kingsdown) to 1120 in 2007 and 1034 in 2020. Lower numbers (100-300) make up for over half the annual totals, while in 21% of surveyed years, 800 to over 1000 were counted. Due to an inconsistency of sampling and eight missing years, it is impossible to ascertain with certainty whether numbers in Kent are increasing or in decline but a steady uplift in numbers seems possible. Nevertheless, the outlook here is less than stable: in the two years when counts exceeded a thousand, 89% and 94% of plants counted respectively, fall in one small area (Kingsdown cliffs), highlighting a point of vulnerability. Similarly in Wight, numbers are now concentrated in a small area on and around Afton Down.

In 2021, CJT was shown a photograph of a plant from a private industrial estate in Port Talbot, tentatively identified by a bird ecologist as *O. minor*, but suspected by CJT to be *O. picridis*. With site owner permission, CJT and FJR visited the area in June 2021 and, astonishingly, found *O. picridis* in numbers likely to equate to several thousand individuals in about a square mile (Figs. 4B; 5C-D), making a substantial contribution to the UK population. The plants occur in abundance on sidings, roadsides and turf, on sand and coarse, largely artificial substrates. The population is subtly morphologically distinct from those in Kent and I.O.W., with denser inflorescences (Fig. 6F), more robust stems, rather similar to those found in continental Europe. It co-occurs on the site with sparse stands of typical *O. minor* and also the unusual form of *O. minor* forma *lutea* with particularly dense, sub-globose spikes that has also been long-recorded to grow on sand banks and railway sidings around Newport Docks (Fig. 5G) (Thorogood & Rumsey, 2020). Putative hybrids between *O. picridis* and *O. minor* also occur infrequently among the parent species (see below). The population was monitored again in 2022 and still found to be thriving; in 2023, numbers appeared to have declined perhaps in response to climatic factors and almost all had finished flowering by mid-June. The population blooms particularly early in this location, emerging in May and typically setting seed by late June; almost a month before the plants in Kent. This may be due to the westerly location and heat generated from industrial activity on the site. The extent of the population suggests it has been established for some time overlooked until an ecological survey was conducted. Earlier finds made by Barry Stewart at the site have now been re-assessed and it is believed that the plant has been present since at least 2008. Intriguingly, prior to the discovery, a herbarium specimen

at BM collected in Port Talbot Docks by H.J. Riddelsdell in 1910 had been determined by FJR as '*O. picridis*'. This suggests a far longer occupancy in this area. Since 2021, when local recorders and consultants became aware of the species, plants have been found outside the private estate in the wider area on roadsides, disused railway sidings and other brownfield sites. Plants are now known to have been present in at least 45 100m grid cells extending over two hectads [SS78 & SS79]. More targeted fieldwork would undoubtedly reveal the plant to be present elsewhere, indeed in late May 2023 50+ plants were found by Barry Stewart on a brownfield development site in Swansea [SS69].

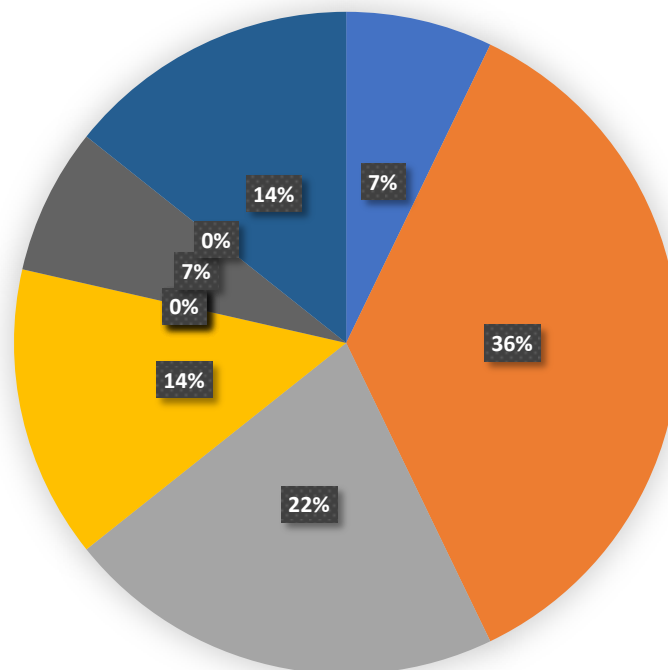
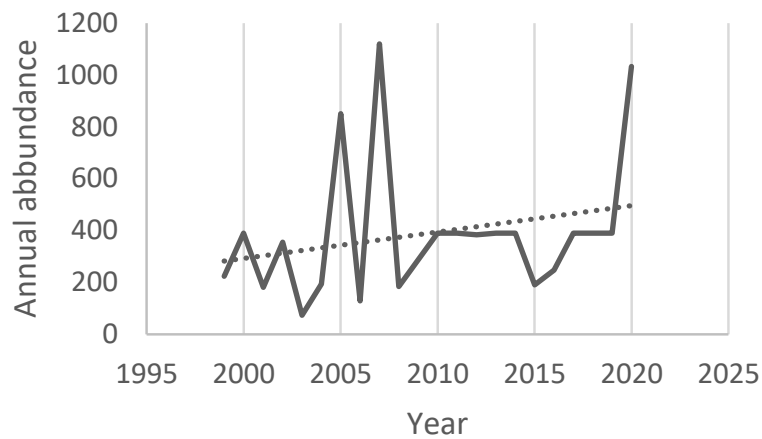


Figure 3. Above: the annual fluctuation in abundance of *O. picridis* in Kent from 1999 to 2020. Counts were made at the end of each season (late July). For missing seasons (2000, 10, 11, 13, 14, 17-19), the mean of other seasons is plotted. Below: the relative frequency of plants during the 20-year period expressed by percentage across seasons: <100 spikes (light blue), 100-200 (orange), 201-200 (light grey), 301-400 (yellow), 801-900 (dark grey), >1000 (dark blue)



Figure 4: The various habitats of *Orobanche picridis*. A. Specimen growing on *Eryngium maritimum* on the coast of Holland, near Wijk aan Zee, on coastal dunes. B. Plants in a ruderal environment on private land in South Wales. C. The extensive population on Afton Down on Wight. D. View from the western end of Afton Down looking across Freshwater Bay to the original sites on the cliffs of the Western High Down. E. The Dover Harbour Trackway, showing the impracticalities for comprehensive survey. F. View looking north past The Cut (above the cliff face scrub) showing the Bockhill Farm fields to the left. Much of the cliff edge is an unsuitable habitat with just a vertical bare face. G. Lighthouse Down, a typical habitat in Kent. Photograph A by Ted Smit

It is possible that the plant occurred on the dunes of Port Talbot and spread to the industrial works alongside its ruderal host; but it seems more likely that seed may have been introduced inadvertently, as has presumably happened repeatedly for *O. minor* s.l. in the UK. This area supports many intriguing alien taxa with more Mediterranean distributions, amongst them an increasing meta-population of the neophyte hemiparasite *Odontites jaubertianus* (Boreau) D.Dietr. native to southern France, also first detected in 2008. CJT and FJR are working with the site's staff and local botany specialists to develop management and conservation plans for the newly recorded population of *O. picridis* (much of which is not publicly accessible).

Ecology

Most British species of *Orobanche* are annuals or short-lived monocarpic perennials. Most are unpredictable in their appearance and vary greatly in abundance (sometimes by several orders of magnitude) at a given site from year to year. Their considerable seed bank may lie dormant in the soil for decades in the absence of a suitable host, therefore broomrapes often respond to disturbance events facilitating parasite seed to host root contact. Hence, unstable environments such as cliffs and dunes are a stronghold for natural populations of annual species such as *O. picridis*, and also *O. minor* sensu lato with which the species often co-occurs. Whilst such habitats are often inaccessible and must afford the plants some protection, they are particularly vulnerable to encroachment by secondary vegetation and scrub that outcompetes their host plants, stabilises substrates, and reduces opportunities for parasite seed-host root contact. These exacting requirements for a particular habitat and host plant, and the requirement for at least some soil disturbance, probably explains why these plants are rare and local. *O. picridis* is Britain's most thermophilous native species and the last to commence flowering, in some years well into August (in Kent at least), reflecting the fact that it is here at the northern edge of its distribution. Populations on the south coast, though long-established, may have originated from wind-swept seed from Continental Europe, since the plant is common in northern Holland where it grows in dunes and ruderal sites and often has a more robust habit. Similarly, *O. caryophyllacea* is restricted to a few downs and dunes in east Kent, not far from the populations of *O. picridis*. It too is frequent on fixed dunes in Holland and its restriction to the very far southeast of Britain likewise indicates a climatic limitation, given that its host is widespread across the British Isles. *Picris hieracioides* is frequent on dry, calcareous soils and in disturbed areas, especially in southern England, and could be locally increasing due to increased urbanisation.

Orobanche picridis has a distinct ecology in Britain where the classic populations in Kent and Wight are virtually restricted to the dry turf on the edges and ledges of chalk sea cliffs and the rocky scrub that collects at their bases (Fig. 4D-G). It is parasitic almost exclusively on *Picris hieracioides* but has also been observed on *Pilosella officinarum* Vaill. on a cliff edge on Lighthouse Down and was seen by the authors on *Inula conyza* DC. in Kent in 2020 (but poor specimens). In continental Europe the plant is recorded frequently on *Daucus maritima* (also a host of *O. minor*), and in a thriving population on coastal dunes on Holland it has occurred repeatedly on *Eryngium maritimum* L. – confirmed by excavation (Fig. 4A) – also a host of the scarce *O. minor* var. *pseudoamethystea* Thorogood & Rumsey, and (from France southwards), the Mediterranean species *O. amethystea* Thuill. (Fig. 6B, 6G). Perhaps the closest taxon in ecology to *O. picridis* in Britain is *O. minor* subsp. *maritima* (Pugsley) Rumsey, a Nationally Scarce native subspecies that grows on *Daucus carota* subsp. *gummifer* (Syme) Hook.f. in coastal stations. It can be superficially

similar to *O. picridis* (with which it co-occurs in east Kent) but has more purple stems, shorter bracts and calyx lobes, and a corolla mouth with distinctive yellow bosses on the lower lip. It too is a rare plant, but with a distribution more closely matching the entirety of that of its host. Exclusively coastal, it occurs on southern sea cliffs and dunes, particularly loose sands and shallow turf on the rocky shelves of cliffs – precisely the habitat of *O. picridis*.

The recent discovery of the UK's largest thriving population of *O. picridis* on an industrial estate in South Wales seems remarkable, yet the plant is found in similar situations in continental Europe, for example in Dunkerque Port in northern France (Fig. 5E), just c. 100 km from the populations in Kent, and c. 300 km from those on the coast of Holland (and further populations are likely to exist between these sites). It is possible that the plant occurs in similar ruderal environments across its range and has been overlooked or, again, confused with *O. minor*. *O. picridis* seems to have tracked its host plant in a range expansion into artificial habitats, probably reinforced by regular soil disturbance. We are unaware of a similar example of a rare species with such marked ecology expanding its range in such a way. A perhaps similar case exists in the common and widespread *O. minor* var. *heliophila* which has colonised *Brachyglottis* cultivars (derived from a species native to New Zealand) often used in amenity planting; the parasite appears in large numbers in car parks, new housing estates and gardens. CJT observed a new population of this variety outside Witney in 2023 on a new housing estate; with increasing urbanisation range expansion of this taxon is likely.

Orobanche picridis and *O. minor* are the only species likely to hybridise in the UK with any regularity. Intermediate morphotypes in Kent have long-been suspected to be hybrids. Hybrids between these species have been raised by the authors artificially and do indeed resemble morphotypes that exist in natural populations (Thorogood & Rumsey, 2020; 2021). DNA sequence data failed to provide conclusive evidence of hybridisation in natural populations in Kent (Thorogood CJ, unpublished data). Since then, further specimens were found in 2021-2022 in Port Talbot that are almost certainly hybrids (Fig. 5F); they resembled the parent species and failed to produce viable seed. Given the parent species are annuals and mostly selfing, any hybrids that might arise occasionally would only ever be ephemeral. Nevertheless, hybrids could have been under-recorded because they are likely to be overlooked given the issues of taxonomic complexity described above.

Conservation Perspectives

Orobanche picridis remains one of Britain's rarest broomrapes. Its classic populations occur on inaccessible sea cliffs, affording the plants some protection. Here their main threat is encroachment by secondary vegetation and scrub that outcompetes their host plants, stabilises substrates, and reduces opportunities for parasite seed-host root contact. Increased rates of coastal erosion with major cliff falls as a possible consequence of climate change may also pose a major threat to the species in its 'natural' habitat. The recent astonishing discovery of populations on brownfield sites in South Wales calls for a reconsideration of this rare species, which is declining in some locations, but certainly increasing in others.



Figure 5: A. The various forms of *Orobanche picridis* and related taxa. A. Plants growing at the foot of the cliff at Kingsdown, in the single thriving colony in Kent; B. *O. picridis* on the cliffs in Wight; C. *O. picridis* growing in private land in South Wales; D. *O. picridis* growing in a similar environment in Dunkerque Port; E. putative *O. picridis* x *O. minor* in South Wales; F. *O. artemisiae-campestris* in southern Czechia. G. The distinctive short, densely-flowered form of *O. minor* f. *lutea* that known from two sites on private land in South Wales (here in cultivation on *Trifolium*); H. *O. minor* var. *compositarum* (sourced from the Somerset coast) in cultivation at Oxford Botanic Garden on *Crepis*. I. *O. picridis* f. *lutea* on I.O.W. Photographs B and I by Graham Preston; photograph E by Filip Verloove; photograph F by František Lamla

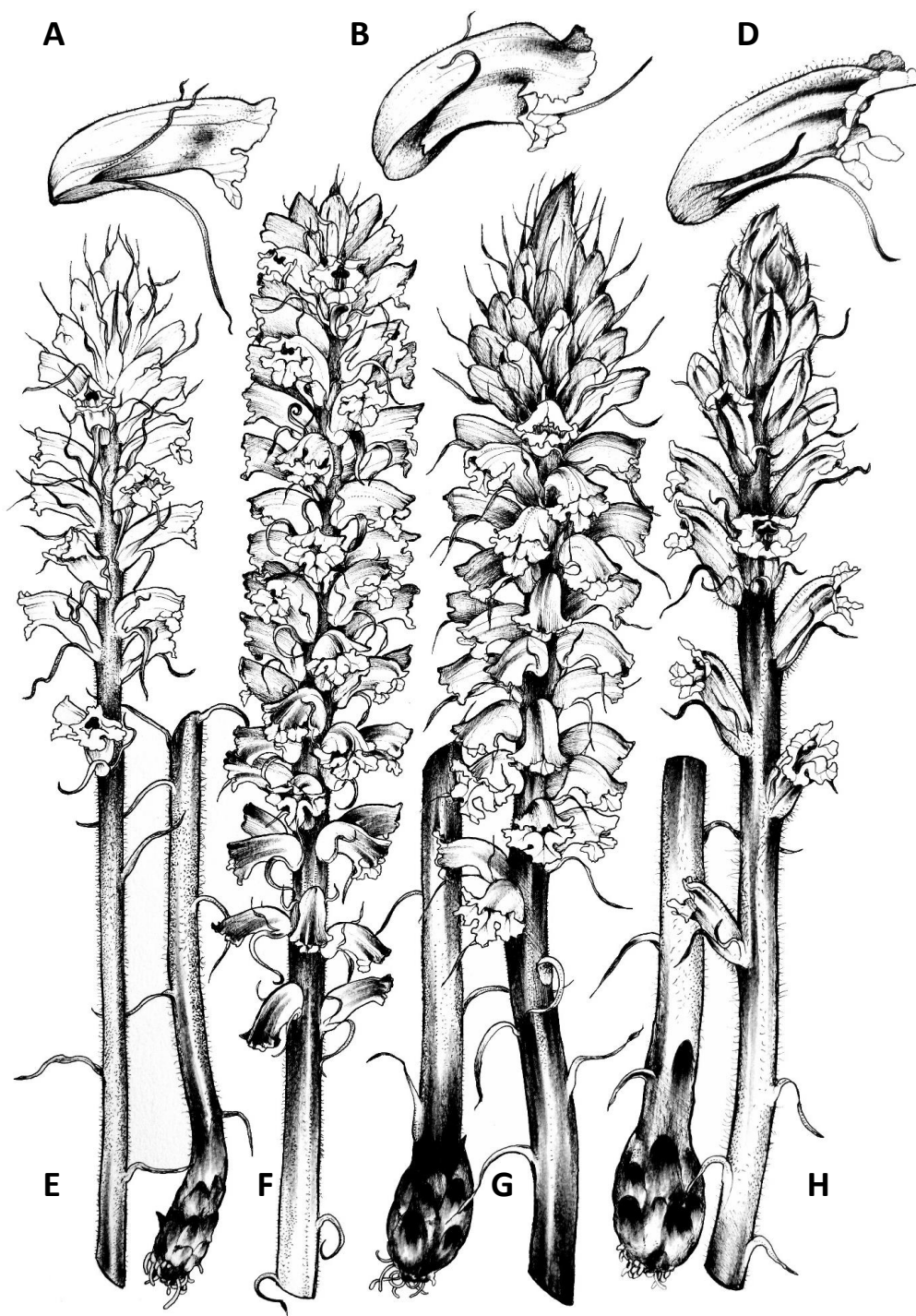


Figure 6. Corollas in profile of A. *Orobanche picridis*; B. *O. amethystea*; C. *O. artemisiae campestris*. E. The slender form of *O. picridis* found in Kent; F. The more robust inflorescence of *O. picridis* illustrated from material in South Wales; G. The inflorescence and stem base of *O. amethystea*; H. The inflorescence and stem base of *O. artemisiae campestris*

Orobanche picridis has been cultivated in an *ex situ* collection at the University of Oxford Botanic Garden (OBG) on pot-grown *Picris hieracioides* along with several other *Orobanche* species (Thorogood et al., 2022). The plant is an easily-grown annual, but

disappears quickly without intervention; it was introduced to the University of Bristol Botanic Garden in 2009 but subsequently vanished, long before the host, which still appears there sporadically. OBG has successfully reintroduced *O. rapum-genistae* Thuill. at receptor sites in Oxfordshire where the species is now long extinct (using seed collected, with permission, from the nearest extant colony in Hampshire). Similar efforts could be possible for *O. picridis* but are rather more impractical owing to this species' annual life history and the need for close management and regular intervention; habitat management in existing colonies is a more feasible approach. In summary we recommend a three-pronged approach to conserving this rare and erratic species:

1. Targeted monitoring across multiple populations over extended periods, to allow for marked inter-seasonal fluctuations;
2. Seed banking from multiple populations to conserve genetic diversity;
3. A proactive approach to habitat management including the control of scrub encroachment, and dedicated set aside areas in ruderal sites. Such an approach is arguably the single most important means of protecting existing populations which are typically concentrated in a small area and highly sensitive to land use change.

Acknowledgements

Thanks to Sophie Young, Fiona Brown, Darryl Spittle and Owain Gab and colleagues for access to and information on the locations of *O. picridis* populations in South Wales. FJR would like to thank Michael Jones, Ro Fitzgerald, Phil Chantler, Colin Pope, Geoff Toone, Geoffrey Kitchener, Dave Green and Barry Stewart for information on sites and records, Julian Woodman (NRW) for assistance with permits and to the many herbarium curators in Britain and Ireland who have allowed access to their collections. Our thanks too to Peter Stroh (BSBI) for assistance with generating the distribution map. Thanks to Graham Preston, Filip Verloove and František Lamla for providing photographs.

References

- Amphlett, J. & Rea, C. 1909. *The Botany of Worcestershire*. Birmingham: Cornish Brothers Ltd.
- Babington, C.C. 1848. *Orobanche picridis* F.W. Schultz. *Annals and Magazine of Natural History*, ser. 2, 2: 149.
- Babington, C.C. 1860. *Flora of Cambridgeshire*. London: John van Vorst.
- Beckett, G. & Bull, A. 1999. *Flora of Norfolk*. Gillian Beckett.
- Bevis, J., Kettell, R. & Shephard, B. 1978. *Flora of the Isle of Wight*. Newport: Isle of Wight Natural History and Archaeological Society.
- Bromfield, W.A. 1856. *Flora Vectensis*. London: W. Pamplin.
- Cheffings, C.M., Farrell, L. (eds.), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D. Rumsey, F.J. & Taylor, I. 2005. *The Vascular Plant Red Data List for Great Britain*. Species Status 7: 1-116. Peterborough: Joint Nature Conservation Committee.
- Crompton, G. 2001. *Catalogue of Cambridgeshire Flora records since 1538*. Part 1., Privately Printed.
- Dines, T.D. 2008. *A Vascular Plant Red Data List for Wales*. Salisbury: Plantlife International.
- Druce, G.C. 1926. *Flora of Buckinghamshire*. Arbroath: T. Buncle & Co.
- Druce, G.C. 1927. *Flora of Oxfordshire*, 2nd. ed. Oxford: Oxford University Press.

- Druce, G.C. 1932. *The Comital Flora of the British Isles*. Arbroath: T. Buncle & Co.
- Foley, M.J.Y. 1999. in Wiggington, M.J. *British Red Data Books 1. Vascular Plants*, 3rd ed., Peterborough: JNCC.
- Good, R. 1948. *A Geographical Handbook of the Dorset Flora*. Dorchester: Dorset Natural History and Archaeological Society.
- Govaerts, R. 2023. The World Checklist of Vascular Plants (WCVP). Royal Botanic Gardens, Kew. [online]. [Accessed 14 August 2023]. Available at: <https://doi.org/10.15468/6h8ucr>
- Hanbury, F.J. & Marshall, E.S. 1899. *Flora of Kent*. London: F.J. Hanbury.
- Hind, W.M. 1889. *Flora of Suffolk*. London: Gurney & Jackson.
- Keble-Martin, W. & Fraser, G.T. 1939. *Flora of Devon*. Arbroath: T. Buncle & Co.
- Kitchener, G. 2021. Kent Rare Plant Register. [online]. [Accessed 14 August 2023]. Available at: <https://bsbi.org/kent/kent-v-cc-15-16-rare-plant-register>
- Kreutz, C.A.J. 1995. *Orobanche. Die Sommerwurzarten Europas. I. Mittel – und Nordeuropa*. Stichting Natuurpublicaties Limburg, Maastricht.
- Leach, S.J. & Walker, K.J. 2015. The vascular plant Red Data List for Great Britain: a summary of amendments in years 8 and 9 (2013-14) of the annual amendments process. *BSBI News 128*: 47-54.
- Leslie, A.C. 2019. *Flora of Cambridgeshire*. London: RHS.
- Lousley, J.E. 1950. *Wild flowers of Chalk and Limestone*. London: Collins.
- Pearman, D.A. 2017. *The Discovery of the Native Flora of Britain & Ireland*. Bristol: BSBI.
- Perring, F.H. & Farrell, L. 1977. *British Red Data Books 1: Vascular Plants*. Lincoln: SPNC.
- Petch, C.P. & Swann, E.L. 1968. *Flora of Norfolk*. Norwich: Jarrold,
- Pope, C.R., Snow, L. & Allen, D.E. 2003. *The Isle of Wight Flora*. Wimborne: The Dovecote Press.
- POWO (2023). Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. [online]. [Accessed 4 August 2023]. Available at: <http://www.plantsoftheworldonline.org/>
- Pugsley, H.W. 1940. Notes on *Orobanche* L. *Journal of Botany (London)* 78: 105–116.
- Roe, R.G.B. 1981. *Flora of Somerset*. Somerset Archaeological and Natural History Society.
- Rumsey, F.J. & Jury, S.L. 1991. An account of *Orobanche* L. in Britain and Ireland. *Watsonia* 18:257-295.
- Sánchez Pedraja, Ó., Moreno Moral, G., Carlón, L., Piwowarczyk, R., Laínz, M. & Schneeweiss, G.M. 2023. Index of Orobanchaceae. [online]. [Accessed 14 August 2023]. Liérganes, Cantabria, Spain. ISSN: 2386-9666. Available at: <http://www.farmalierganes.com/Otrospdf/publica/Orobanchaceae%20Index.htm>
- Simpson, F.W. 1982. *Simpson's Flora of Suffolk*. Suffolk Naturalists Society.
- Stroh, P.A., Leach, S.J., August, T.A., Walker, K.J., Pearman, D.A., Rumsey, F.J., Harrower, C.A., Fay, M.F., Martin, J.P., Pankhurst, T., Preston, C.D. & Taylor, I. 2014. *A Vascular Plant Red List for England*. Bristol: Botanical Society of Britain and Ireland.
- Syme, J.T. B. 1866. *English Botany*, 3rd ed., London: G. Bell & Sons.
- Thorogood, C.J. & Rumsey, F.J. 2020. An account of Common Broomrape *Orobanche minor* (Orobanchaceae) in the British Isles. *British & Irish Botany* 2(3): 223-239.

Thorogood, C. & Rumsey, F.J. 2021. *Broomrapes of Britain & Ireland*. BSBI Handbook 22. Durham: BSBI.

Thorogood, C.J., Witono, J. R., Mursidawati, S., & Fleischmann, A. 2022. Parasitic plant cultivation: examples, lessons learned and future directions. *Sibbaldia: The International Journal of Botanic Garden Horticulture*, 21: 109–136.

Copyright retained by author(s). Published by BSBI under the terms of the [Creative Commons Attribution 4.0 International Public License](#).

ISSN: 2632-4970

<https://doi.org/10.33928/bib.2023.05.303>