

## OROBANCHE RAPUM-GENISTAE

### Orobanchaceae

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**Summary.** The distribution, ecology and taxonomic history of *Orobanche rapum-genistae* Thuill. are discussed with particular reference to the British Isles and elsewhere in Europe where the plant has retracted markedly within its former range. The variation present within the species is described and the typical form is illustrated. The outlook for this sharply declining species is considered in the broader context of parasitic plant ecology and conservation.

*Orobanche rapum-genistae* belongs to a genus of holoparasites (*Orobanche* L. family Orobanchaceae) that are completely parasitic on the roots of other plants and lack chlorophyll. These unusual and striking plants unsurprisingly have long attracted attention and aroused interest. Early European herbalists were aware of *Orobanche rapum-genistae* in particular and it was this species that was responsible for the genus' common name; the specific name means literally 'turnip of broom', a reference to the swollen stem base of the plant, attached to the roots of its host (which is often broom, *Cytisus scoparius*). As early as 1548 William Turner recorded the species in Northumberland in northern Britain as "newe chappel floure" (Britten, 1881) and it was well known to Gerarde (1597) who listed it in his herbal along with its host, as though a strange manifestation of that plant.

Whilst many *Orobanche* species are rare and local across their ranges, few if any have suffered such a decline as *O. rapum-genistae* in North-Western Europe. Prior to the agricultural revolution the most common Broomrape across much of its range; in Britain the species is still extant in c. 32 vice-counties, but has suffered a significant, if largely historical, decline here. This decline continued through the twentieth century, although a brief resurgence occurred after the great storms of 1987, when the windfall in coniferous forestry plantations on acid soils saw the return of hosts and parasite from the soil seedbank (Rumsey & Headley, 1998). Subsequently populations have remained almost stable, although losses are still occurring and significantly the species is not being found in new sites, just recurring sporadically in old ones. In ten vice-counties in Britain it is now restricted precariously to a single location, often with just one or two clumps. In five of these no records have been made in the last ten years, while in its last Kent locality no plants flowered in 2020-1. The situation in Ireland, where it has always been scarcer, is comparable. Previously recorded from nine vice-counties, since 2010 it has only been documented in two, but might still be present in two further where single sites have produced plants post-2000.

Most parasitic plants have been neglected from conservation focus because of their perceived intractability in cultivation. Some species of *Orobanche* are afforded protection by the habitats in which they grow, and may require minimal intervention. For example *O. picridis* which is very rare in Great Britain, and protected by law, grows on inaccessible sea cliffs, although increasing rates of coastal erosion may pose a threat. *O. rapum-genistae* is also arguably afforded some protection growing as it does under dense and often spiny shrubby hosts. This may deter herbivory from larger animals but not from molluscs, or smaller vertebrates. The unstable nature of its habitat may facilitate contact between parasite seeds with host roots. By contrast, the preferred habitats of *O. rapum-genistae* tend to be somewhat less disturbed than those of other *Orobanche*, for example

rough grassland, heaths and sandy, coastal scrub, where its host plants (typically broom and gorse) are abundant. Unlike most apparently monocarpic species, *O. rapum-genistae* is a perennial in which fresh flowering spikes can be seen growing alongside withered spikes from the previous year. Nevertheless in undisturbed environments in which soil churn is absent, the rate at which weakly perennial clumps die out may exceed that of colonisation of hosts, leading to a decline. It has been observed that the species favours isolated host plants over dense, continuous stands, although the reasons for this remain to be elucidated. These exposed host individuals are often in poor health, although whether this is as a consequence of the attack rather than its summoner is unclear. However, the presence of the parasite inevitably seems to weaken its host, eventually bringing about its demise, although this may be an extremely protracted process. Some largely moribund broom and gorse clumps known to the authors in North Somerset, the Isle of Wight and N. Hants. have supported the parasite over several decades. Seed is potentially long-lived (>30 years) within the soil and dense seed-banks must form immediately adjacent to plants parasitised over lengthy periods. In this way the plant may lurk unseen, loyal to a site after the death of its host, awaiting recruitment of novel hosts from their seed-banks with sufficient growth to stimulate germination. Vectors for dispersal to new localities and fresh host plants are not obvious. Suitable habitats from which the plant remains absent are plentiful in Britain and in an increasingly favourable climate for this species (it is more common in the Mediterranean) indicates that poor seed dispersal may be a contributory factor in its continued decline.

Whilst parasitic plants are generally considered challenging to cultivate, and largely absent from collections, it would not be difficult to grow *O. rapum-genistae*; broom and gorse can be grown readily, and two years after sowing the seed of the parasite on the roots of the host, flowering spikes can be anticipated. Several species of *Orobanche* have been cultivated at Bristol Botanic Garden and efforts to grow *O. rapum-genistae* (and its relatives) are underway at the University of Oxford Botanic Garden. It is hoped that these efforts will culminate in a series of re-introductions of the plant in the longer term. Internationally, parasitic plants in decline present a challenge to conservation biologists. Botanic gardens may play a vital role for species for which propagation is feasible. In plants that are currently intractable, for example tropical *Rafflesia*, conservation efforts have involved augmenting the pool of available hosts in fragmented habitats (Pelser et al. 2017). Creative approaches may therefore be required for conserving rare and poorly understood species such as parasitic plants with complex ecological interdependencies (Siti-Munirah, et al, 2021).

*Orobanche rapum-genistae* is a variable species across its range (Figure 2). There exists significant variation in corolla and stem colour especially. Pure yellow forms lacking purplish pigmentation named f. *flavescens* Durand (syn. f. *hypoxantha* G. Beck) (Figure 2A) have been photographed throughout much of the range of the species, usually co-occurring with typical examples, but occur at lower frequency than leucistic examples of many other *Orobanche* species, such as *O. minor* and *O. hederæ*. Chater & Webb (1972) recognised three subspecies in Europe, the most common and widespread of which was subsp. *rapum-genistae*. Of the others, subsp. *benthamii* (Timb.-Lagr.) P. Fourn., Quatre Fl. Fr. 796 (1937) from southwest Europe and northern Italy, which they distinguished by its bracts at least  $1\frac{1}{2}$  x the length of the corolla and the corolla more or less erect with a 2-lobed upper lip, is now generally regarded as not worthy of subspecific recognition (eg. Tison & de Foucault, 2014), whereas conversely subsp. *rigens* (Loisel.) P. Fourn., loc. cit. (1937) is now considered as a distinct species, *O. rigens* Loisel., Fl. Gall.:384 (1807), endemic to Corsica and Sardinia (Domina et al., 2011). It is a shorter plant ( $\leq 40$  cm tall); the bracts, corolla, style and filaments glabrous or subglabrous; dark red in colour, the more or less erect corolla with a shortly 2-lobed upper lip. Within the Mediterranean region a number of other often confused *Orobanche*

species share similar hosts and may be of similar stature and general appearance, most however differ in having darker crimson interiors to their corollas.

*Orobanche rapum-genistae* appears to be locally host specific. For example on the southwest sea cliffs of Jersey and Alderney in the Channel Islands (Figure 4A), and on the coast of north Devon (Figure 3B), the plant parasitises prostrate broom (*Cytisus scoparius* subsp. *maritimus*) exclusively, even though the more common broom (*Cytisus scoparius* subsp. *scoparius*) does occur there as a potential available host in the wider area. These populations possess subtly distinct traits such as rather dark maroon spikes with the lower portion of the stems devoid of flowers and densely clothed in bracts; to what extent these characteristics may be influenced by ecology (exposed coastal cliffs) remains undetermined. Meanwhile on Mount Etna in Sicily, the plant grows on *Genista aetnensis* (Figure 4B, 4C). The extent to which these plants are genetically distinct or physiologically adapted to specific hosts is unclear and warrants further investigation. Host specificity is established to be an important evolutionary driver of speciation in other species in the genus *Orobanche*, for example *O. minor* (Thorogood et al., 2008; 2009a; 2009b).

## Description

*Orobanche rapum-genistae* Thuill., Fl. Paris, 2nd ed., 317 (1800)

A typically brownish, yellowish, or reddish, often clumped perennial (all yellow in f. *flavescens*). Flowering stem simple, 20-90 cm, glandular-hairy, strongly swollen at the base, usually a dull pale brownish colour, sometimes lemon yellow, reddish or pinkish. Inflorescence rather compact, laxer below, extending over most of the shoot, the lowest flowers well-separated. Bracts 15-30 mm, linear-lanceolate, generally markedly exceeding the flowers. Calyx 8-15 mm, each lip usually equally bifid. Corolla 20-25 mm, pale yellow or brown to reddish outside, more strongly flushed red inside, sub-erect to erecto-patent, campanulate, inflated at the base in front; upper lip rather hooded, almost entire with spreading margins, lower lip with the middle lobe largest, all lobes ciliate, rather wavy and indistinctly toothed; back of corolla curved throughout, glandular pubescent. Stamens inserted near the base (not more than 2 mm above); filaments hairless below, glandular-pubescent above. Style glandular-pubescent; stigma lobes yellow, markedly distant. Flowering period April to June (rarely to early July) depending on the location and altitude. Visited by bees and wasps. Parasitic on various shrubby Fabaceae in the tribe Genisteae.

## Distribution

*Orobanche rapum-genistae* is native across Western Europe from the British Isles, where it reaches its northernmost station in Dumfriesshire; it extends eastwards through the Low Countries to Central Germany and south to the Mediterranean coasts, through the mountains of Sicily to Northwest Africa. Records from Saudi Arabia require confirmation.

## Habitat

*Orobanche rapum-genistae* tends to grow in relatively undisturbed nutrient-poor pastures (Figure 3C), on woodland margins and in thickets as well as in coastal cliff-top habitats (Figure 3B, 4A), all typically on acid, free-draining, often sandy soils. In the far south of its range it occurs from sea level, extending to montane habitats (Figure 4B, 4C).

## References

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## Figures

**Figure 1.** The typical form of *Orobanche rapum-genistae* (*O. rapum-genistae* subsp. *rapum-genistae*).

**Figure 2. A.** The unusual yellow form of *Orobanche rapum-genistae* (forma *flavescens*) in Somerset; B. The typical form of the species growing in the same location; C. Typical form of the species in the New Forest, Hampshire; D. The coastal form of the species parasitizing prostrate broom in Devon. Photos A-C by Grahame Preston; photo D by David Pearman.

**Figure 3. A.** The divergent stigma lobes, a diagnostic feature of *Orobanche rapum-genistae*. B. The coastal habitat at Stanbury Mouth, Devon. C. A typical habitat of the species depicted here in Hampshire. Photo B by David Pearman.

**Figure 4. A.** A mixed population of the typically-coloured *Orobanche rapum-genistae* and forma *flavescens* growing on prostrate broom on the coast of Alderney in the Channel Islands. B-C. *Orobanche rapum-genistae* growing on *Genista aethnensis* on Mount Etna, Sicily. Photo A by Lindsay Pyne; photos B-C by Gianniantonio Domina.

**Figure 5. A.** Habit. B. Seed. C. Stigma (note the well-separated lobes). D. Lower corolla lobe middle lip. E. Corolla in profile. F. Corolla, front view. G. stamen. H. Pistil. I. Corolla cross section showing the androecium. J. Calyx lobes. K. Bract.