

Trollius europaeus L.

Globeflower

Trollius europaeus has tall, hollow stems, large, spherical, lemon-yellow flower heads and basal leaves that are 3-5 lobed and deeply toothed. It is associated with a wide variety of substrates but requires cool, moist conditions and is most often found in upland pastures, rock ledges, hay meadows, damp woodland, river banks and lake margins. It is widespread across Scotland, northern England and Wales, but is an uncommon species in Ireland and is absent from southern England. It is assessed as of Least Concern in Great Britain, but is close to being Near Threatened in England with a decline of almost 20% since 1930.



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IDENTIFICATION

Trollius europaeus has spherical, usually solitary lemon-yellow flower heads borne on erect, hollow and glabrous stems 30-70 cm tall (Poland & Clement 2009; Stace 2010). The 5-15 pale yellow sepals hide much smaller and narrower modified petals (nectaries) **contained within the 'globe'**.

The long-stalked basal leaves (3-11 cm across) are dark green above and paler below, palmately 3-5 lobed, deeply toothed with serrated margins, and hairless (Poland & Clement 2009). Stem leaves are \pm sessile and more deeply cut with narrower segments than basal leaves.

SIMILAR SPECIES

In flower *T. europaeus* is instantly recognisable. When not in



Trollius europaeus on the bank of hay meadow in Upper Teesdale. ©Kevin Walker.

flower, characters useful for separation from other Ranunculaceae include leaf size, pentagonal leaf shape, hollow petioles, and habitat (see below).

HABITATS

A perennial herb of cool, moist habitats, including hay meadows, wet mountain pastures, stream and river banks, lake margins, open damp woodland, and rock ledges (Fitzgerald 2002).

Trollius europaeus can tolerate a wide range of edaphic conditions and is associated with soils ranging from productive to highly unproductive, and from base-rich to acidic, but does require moist conditions. In free-draining soils it is generally restricted to areas where mean annual rainfall exceeds 1,200 mm (Hitchmough 2003).

In Britain, *T. europaeus* is most often associated with upland areas, and has been recorded as an associate of eleven NVC communities (Rodwell 1991, 1992), but is probably most typical of CG11 *Festuca ovina*-*Agrostis capillaris*-*Alchemilla alpina* grass-heath, M26 *Molinia caerulea*-*Crepis paludosa* mire, U17 *Luzula sylvatica*-*Geum rivale* tall-herb community and W3 *Salix pentandra*-*Carex rostrata* woodland.

It is usually found in sub-alpine habitats across its southern and western continental range (e.g. Alps, Pyrenees, Carpathians), and in the north-east of central Europe (e.g. Germany, Poland) it also occurs in lowland, semi-natural fen grasslands (Lemke 2011).

BIOGEOGRAPHY

Considered a sub-alpine species throughout much of its range, *T. europaeus* is widely but patchily distributed in northern

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and central Europe and is described as having a European Boreal-montane distribution (Preston et al. 2002).

In Britain declines have been reported at both a national and local level in recent years, although it is still widespread in northern and western regions. It reaches the southern edge of its GB range in Glamorganshire. *T. europaeus* is classified as vulnerable in Ireland, with populations recorded from the vicinity of Lough Melvin and Upper Lough Macnean and from a small number of sites across east and west Donegal.

The species typically occurs at low altitudes (0 – 1005 m) in northern Europe (i.e. Fennoscandia and Russia). In northern Germany and northern Poland, populations of *T. europaeus* occur at 0-200 m above sea level (Lemke 2011). However, in southern Europe, *T. europaeus* is restricted to mountains above 700 m and has a highly fragmented distribution, especially at the southern edges of its range (Després et al. 2002)

ECOLOGY

Trollius europaeus is a non-clonal perennial (Grime et al. 2007), flowering from May to August. Its large flowers are 2.5–5 cm in diameter and comprise 10 sepals which encase and have taken over the function of the true petals in attracting insects.

Only the underground tap root of *T. europaeus* persists during the winter. Seeds are dormant on dispersal and require a period of vernalisation before they are viable, with germination occurring in the spring (Milberg 1994). *T.*

europaeus does not have a long-lived seed bank (Thompson et al. 1997), and successful germination and seedling establishment appears to depend upon microsites that are relatively open with moderate to high light levels (Hill et al. 2003). A crucial aspect to the survival of seedlings appears to depend on the degree of slug predation, with greater predation of seedlings by slugs taking place in unmown, tall swards (Hitchmough 2003).

Trollius europaeus is an obligate outcrosser and depends almost exclusively on a seed parasite for pollination throughout its geographical range (Pellmyr 1989; Hemborg & Després 1999). Small anthomyiid (*Chiastocheta*) flies are able to penetrate **the compact 'globe' of sepals that encloses c. 30** spirally arranged carpels (Jaeger et al. 2001) at an early stage of flowering, with males and females feeding, resting and mating inside the flowers, pollinating them passively (Després et al. 2002). Eggs are deposited on carpels, and larvae develop and feed on seeds. However, seed predation is thought to be limited due to a combination of aggressive interactions between larvae within the flower and the early dehiscence of seeds prior to the end of larval seed predation activity (Jaeger et al. 2001).

The dense clusters of mature fruits open naturally along one side about 3 weeks after flowering, releasing seeds and pupae that fall to the ground. The pupae then overwinter in the soil, emerging the following spring.

Up to six species of *Chiastocheta* flies are known to co-exist and contribute to pollination, with sympatric speciation resulting in different pollination and predation strategies for each species (Després & Jaeger 1999).

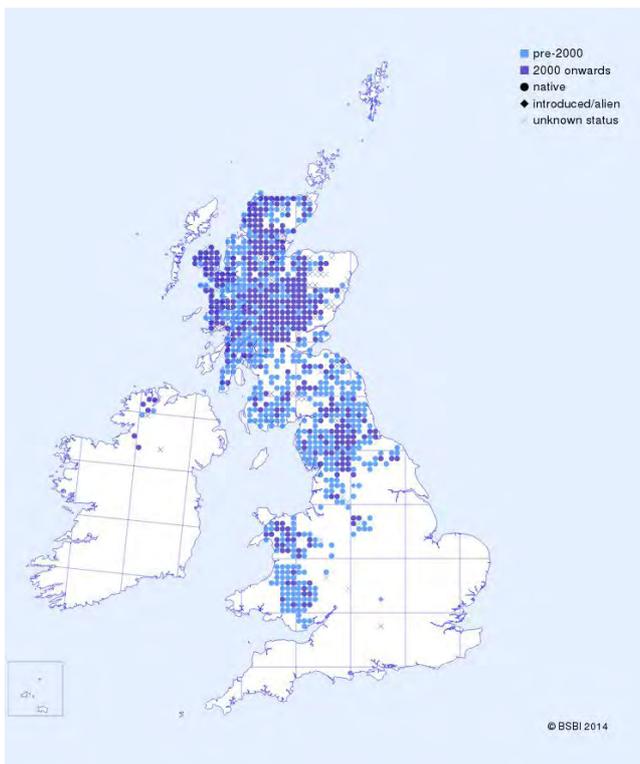
THREATS

Population declines have been attributed to agricultural improvement, drainage, changes from hay to silage production, grazing pressure and herbicide application.

Although *T. europaeus* often occurs in inaccessible montane sites with limited grazing, such sites are typically associated with nutrient-poor substrates that help to limit the growth of the surrounding vegetation. However, it may decrease in abundance or disappear entirely if historical mowing or grazing regimes previously in place cease for prolonged periods of time. This is particularly relevant in locations where sward productivity has increased due to the past application of fertiliser, with rank swards also more likely to lead to increased predation of *T. europaeus* seedlings by slugs.

As a secondary threat, its mutualistic dependence on *Chiastocheta* flies means that a decline in the local population of the pollinator species is likely to impact upon small and declining populations of *T. europaeus*, leading to a limitation of pollen quantity and a higher likelihood of selfing or inbreeding (Lemke & Porembski 2013).

MANAGEMENT



Distribution of *Trollius europaeus* in Great Britain and Ireland.

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Suitable management should aim to remove or reduce grazing pressure in the months of peak flowering and fruiting (May–July). Cutting for hay or for other purposes should also not be undertaken during flowering or fruiting in most years. Management should aim for a mid-late summer cut in most years, with cuttings removed. This regime may have to be modified in some years depending on the presence of other species (both flora and fauna) that require specific and sometimes conflicting management requirements.

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