

## *Tuberaria guttata* (L.) Fourr

### Spotted Rock-rose

*Tuberaria guttata* flowers from May to June and is best searched for on warm and sunny mornings when the bright yellow, purple-blotched petals open widely and are readily visible. Populations are known from northern Wales, western and south-western Ireland, the Channel Islands and western Scotland, although there are doubts about its provenance at the sole Scottish locality. It occurs at coastal locations in exposed, well-drained rocky outcrops on moderately acidic shallow peats, typically where there is sparse vegetation cover, making populations particularly vulnerable to the encroachment of more competitive vegetation. It is assessed as Near Threatened in Britain, but is of Least Concern in Wales.



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#### IDENTIFICATION

In flower *T. guttata* is unmistakable, with bright yellow petals that have purple blotches and opposite leaves that are three-veined and turn reddish with age. Plants are variable in size, ranging from solitary flowers on short stems (1–2 cm) in exposed sites to much taller (to 20 cm) branched stems with multiple flowers in more sheltered localities.

#### SIMILAR SPECIES

Compact plants of *T. guttata* in Wales, Ireland and north-west France with wider leaves, shorter internodes and flowers with bracts have been named variously as species, varieties or the subspecies '*breweri*' in the past, but are now thought to be maritime ecotypes of exposed Atlantic coasts (Proctor, 1962; Stace, 2010).



Three Castle Head, West Cork, one of the few locations for *Tuberaria guttata* in Great Britain and Ireland. ©John Crellin.

#### HABITATS

In Britain and Ireland *T. guttata* grows on exposed rocky outcrops in bare open stony or peaty patches amongst species-poor *Calluna vulgaris*-*Scilla verna* and *C. vulgaris*-*Erica cinerea* heathland (NVC H7, H10), and more rarely *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* (NVC U4d) grassland.

*Tuberaria guttata* tends to be concentrated where there is a sparse cover of grasses, ericaceous shrubs and other small herbs, and often grows in a thin carpet of mosses and lichens. Its most frequent associates are *Agrostis capillaris*, *Aira praecox*, *C. vulgaris*, *Cladonia* spp., *E. cinerea*, *Plantago maritima* and *Sedum anglicum* (Proctor, 1960). In the Channel Islands it grows in a similar habitat, but open areas are more extensive and tend to be more species-rich *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland (NVC U1f) or the *Armeria maritima*-*Cerastium diffusum* therophyte community (NVC MC5c).

In all these sites the soils are well-drained, moderately acid shallow peats overlying a range of hard, non-calcareous often igneous rocks (grits, tuffs, quartzites, sandstones, granites). The soils are often water-logged in the winter but frequently dry out in the summer months. They probably receive salt from sea spray throughout the year although this does not appear to adversely affect *T. guttata*.

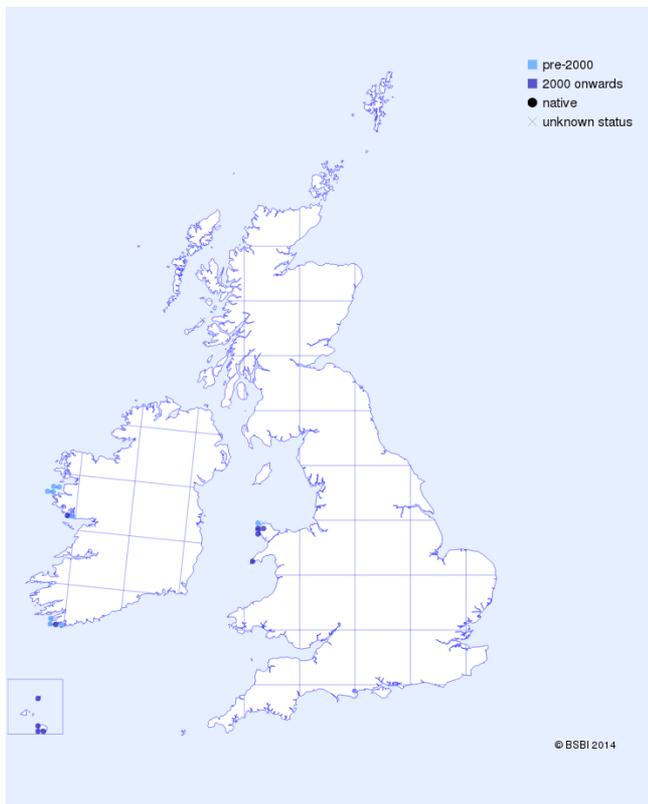
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### BIOGEOGRAPHY

*Tuberaria guttata* is a Mediterranean-Atlantic species that occurs throughout the Mediterranean region extending northwards into western Europe, with isolated occurrences in the Netherlands, central and northwest Germany, Britain and Ireland. It reaches its absolute northern limit in Britain and Ireland (Preston, 2007). Populations in the Azores (Canary Islands) are a few degrees to the west of those in southwest Ireland.

In north Wales *T. guttata* is confined to seven sites on Anglesey, six of which appear to be extant, and one on the Llyn Peninsula where the population is very small. In western and south western Ireland it appears on rocky heathland at a handful of coastal peninsulas and islands in Cork, Galway and Mayo (Proctor, 1960; Akeroyd & Clarke, 1993). In the Channel Islands it is locally common on the western side of Jersey and along a short stretch of cliff in Alderney, and on the Hebridean Island of Coll a small population occurs on open, *Calluna vulgaris*-*Scilla verna* heath (NVCH7c) where it was first discovered in 2000 (Farrell, 2004; 2005). However, the tall stature of the Coll plants and their proximity to a car park has led to doubts over its provenance (Pearman & Preston, 2006).

Most colonies in Britain and Ireland are close to sea-level but reach 120 m on Anglesey, and across its range up to 1300 m on the Canary Islands (Proctor, 1960). Its northern limit appears to be limited to areas where the average temperature for January is close to or exceeds 6 °C.



Distribution of *Tuberaria guttata* in Great Britain and Ireland.

### ECOLOGY

*Tuberaria guttata* is an annual that germinates in the late summer or early autumn, occasionally later, and over-winters as a small rosette (ca. 4 × 2 cm). The roots are fibrous and shallow and are usually infected by mycorrhizae. The main flowering period lasts from the end of May through to the end of June, with seeds being shed from June onwards, but the duration of both flowering and seed-shed is highly dependent on weather conditions. In wet summers there may be a second generation, with germination, flowering and seed-shed all completed within a few weeks.

The yellow flowers are 8-12(-15) mm in diameter and open widely in the morning in warm sunny weather with the petals normally falling by midday. The flowers produce little pollen, secrete no nectar and attract few insect visitors other than pollen-collecting solitary bees (Kay & John, 1995; Herrera, 2004). Reproduction is autogamous with most plants being automatically self-pollinated (Herrera, 1992), even in poor weather when the petals fail to expand (Kay & John, 1995). The stigmas remain free of the pollen till the petals drop, but self-pollination is then inevitable as the sepals close together, pressing the stamens against the gynoecium (Herrera, 1992). The number of ovules inside the ovary decreases towards the top of the inflorescence, from ca. 70 in the lowermost flowers to ca. 50 in those at the top (Herrera, 2004). Seed-set (i.e. number of ovules producing seed) appears to be very high, averaging 92% in a study in Southern Spain (Herrera, 2004) and unlike other reproductive traits does not appear to be related to plant height (see below).

Seeds are very small and light but rather variable in size (0.5-0.6 mm long; 0.0001-0.05 mg), with larger seeds producing more vigorous seedlings (Kay & John, 1995). Around 35-40 (30-50) seeds are produced per capsule (Proctor, 1960; Kay & John, 1995) but the number of capsules produced is highly variable and, unlike seed-set, is strongly related to plant height, with smaller plants only producing between 1-3 on average (Kay & John, 1995). The capsules open widely when they dehisce and the seeds are readily ejected when shaken by strong winds or rain-splash (balistochory), although most are likely to fall within 10 cm of the parent plant (Guarino *et al.*, 2005). Consequently *T. guttata* often has a localized distribution. In arid environments such as Mediterranean dry grassland seed harvesting by ants reduces the abundance of heavier-seeded, more competitive species, allowing small-seeded therophytes such as *T. guttata*, which are largely ignored by the ants, to become more abundant in the vicinity of nests (Guarino *et al.*, 2005).

Seeds display a degree of dormancy and germination has been shown to increase significantly after two years in cold storage (Walsh *et al.*, 2003). This dormancy is caused by the impermeability of the testa to water, and consequently seed that are scarified germinate much more rapidly in moist conditions and can achieve 100% germination (Kay & John, 1995). There is no published seed bank information, but persistence would be expected given the findings on dormancy and seed longevity.

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*Tuberaria guttata* is phenotypically highly variable, with differences in the field attributed to habitat conditions, especially water supply, exposure and competition (Proctor, 1962). Plants in more sheltered localities in the Channel Islands can reach 30 cm and produce 100 or more capsules, whereas those in dry, exposed sites in Wales and Ireland are typically 5-7 cm (less in dry seasons) with some 4-10 capsules (Proctor, 1960). Herreras (2004) showed that petal size and the number of fruits, stamens, ovules and seeds per capsule all increased significantly with plant height and therefore that fecundity is likely to be tightly controlled by environmental conditions.

All Welsh, Irish and Channel Island plants are hexaploid ( $2n = 36$ ; Proctor, 1955; Kay & John, 1995) as elsewhere in Europe (Gallego & Aparicio, 1993). A limited genetic survey of Welsh, Irish and Channel Islands populations has shown that levels of variation and diversity between populations are unexpectedly high and appear to be unrelated to geographic proximity of the populations (Kay & John, 1995). Indeed, the differences between some Welsh populations were even greater than those that separate them from Jersey or Irish populations (Kay & John, 1995).

### THREATS

Historically, coastal habitats on Anglesey have been much reduced by the spread of housing and caravan sites and in some cases this has made surviving sites for *T. guttata* more difficult to manage (Kay & John, 1995). Recent surveys have shown that Welsh populations have suffered dramatic declines in numbers since the 1980s and 1990s although currently the populations seem relatively stable with a slight recovery in some areas. Although all but one of the populations are on SSSIs, they all are potentially vulnerable to habitat loss. The only site not on a SSSI (Ddraenen) appears to have vanished due to the spread of gorse.

### MANAGEMENT

*Tuberaria guttata* appears to largely escape grazing, and stems branch diffusely if damaged by grazing or trampling (Proctor, 1960). Some grazing and trampling by cattle or sheep is required to maintain the sparsely vegetated patches of soil required for seedling establishment, but it is a fine balance as too much is likely to damage this fragile habitat. Anecdotal evidence suggests that occasional burning of heather and gorse may also be beneficial by reducing the vigour of woody species, although declines at some Welsh sites have been attributed to too much burning in the past (e.g. Proctor, 1960).

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### AUTHOR VERSION

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