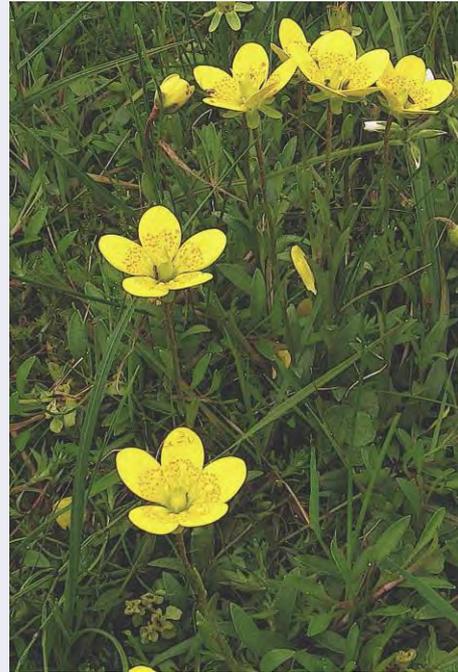


Saxifraga hirculus L.

Marsh Saxifrage

Saxifraga hirculus is a very rare saxifrage with narrow spear-shaped leaves and yellow petals often with distinctive orange spotting. It is a shy-flowering plant of nutrient-poor, moderately base-rich or weakly acidic mossy flushes and mires. It has a restricted distribution, with the bulk of populations found in the North Pennines, with other key locations including the Munsary Peatlands in Caithness and fens and flushes in Bellacorick, West Mayo. Plants are sensitive to alterations in hydrology, soil chemistry and grazing pressure. It is assessed as Vulnerable in Great Britain as a whole, but Least Concern in England due to the recent discovery of a number of over-looked populations.



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IDENTIFICATION

Saxifraga hirculus is very distinctive in bloom, with showy yellow flowers, borne singly, more rarely in pairs. Petals often have distinctive orange spotting. However, flowering is often poor, and vegetative identification is required.

Creeping stolons, partially-embedded in the mossy flushes where the plant grows, are often abundant and bear rather thick, alternate, narrowly lanceolate leaves that are long-tapered to the base.

SIMILAR SPECIES

The petals of *S. hirculus* are narrower than in *Ranunculus flammula* which has multiple carpels, not a single bilocular

ovary. Contrary to some field guides, *S. hirculus* and *S. aizoides* are distinct: *S. hirculus* has a superior ovary (i.e. the petals radiate from its base), usually borne singly; *S. aizoides* has clustered flowers, with a half-inferior ovary that appears 'embedded' in the ring of petals. A differing size-ratio of petals to sepals in the two plants also makes the flowers of *S. hirculus* appear showier, with the petals obstructing the sepals when viewed from above.

Of plants of the same habitat, vegetatively *S. hirculus* may resemble *Epilobium palustre* or *R. flammula*. The leaves of *E. palustre* are opposite, darker green and with a prominent central vein (mid- or yellow-green in *S. hirculus* with obscure vein). Poorly-grown *R. flammula* is more similar, but is almost always glabrous, whereas *S. hirculus* often has small amounts of hairs on the leaf petiole, reflecting variable pubescence usually more apparent higher up.

HABITATS

S. hirculus is a plant of nutrient-poor, bryophyte-rich flushes and mires. In the North Pennines *S. hirculus* occurs chiefly in NVC M38 *Cratoneuron commutatum-Carex nigra* springs. Although substrates are base-rich, the soils are saturated stagno-gleys over shallow peat (Rodwell, 1991) and the flora does not appear as clearly calcicolous as M10 *Carex dioica-Pinguicula vulgaris* mire. Contrary to statements in Averis *et al.* (2004), *S. hirculus* does not occur in M10 mires in the North Pennines.

Welch (1996) cites M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire as the typical vegetation type for *S. hirculus* in Scotland, and some North Pennine stands may also show affinity to this. Although both M38 and M9 are themselves rare and local, locating them is no guarantee of



A recently discovered site for *Saxifraga hirculus* at Red Mea Well, Upper Swaledale. ©Linda Robinson.

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finding *S. hirculus*.

BIOGEOGRAPHY

S. hirculus is a circumpolar species with a Boreo Arctic-montane distribution. Its main distribution in the Arctic comprises Alaska, northern Canada, Greenland, Iceland, Svalbard, Scandinavia and northern Russia through to Beringia (Oliver *et al.* 2006). Further south it has a disjunct distribution in Europe, extending to Switzerland and Central Romania, the Rocky Mountains of Colorado, the Caucasus, Central Asia and the Himalayas.

In Britain *S. hirculus* was once scattered widely from Cheshire to Caithness, although it now has a much more restricted range, with the majority of extant populations in the North Pennines. Key populations are also found at the Munsary Peatlands in Caithness and in fens and flushes near to Bellacorick in West Mayo, Ireland.

S. hirculus is morphologically and cytologically variable. Tetraploid ($2n = 32$) circum-boreal montane populations have tall flower stems with two flowers and the sepals reflexed at anthesis (subsp. *hirculus*). The predominantly circumpolar, arctic diploid and tetraploid populations ($2n = 16, 32$) have shorter, less leafy stems with solitary flowers and the sepals erect or spreading at anthesis (subsp. *compacta*, subsp. *propinqua*, subsp. *coloradensis*; Hedberg, 1992), although recent molecular work provides little evidence to support the separation of these subspecies (Oliver *et al.* 2006). As far as is known, only subsp. *hirculus* occurs in the British Isles (Welch



Distribution of *Saxifraga hirculus* in Great Britain and Ireland.

1993).

It has a broad altitudinal range in the British Isles, formerly occurring at sea level, but now extant from c.300 m to 750 m (Mickle Fell, North-west Yorkshire).

ECOLOGY

S. hirculus is a loosely tufted, shortly rhizomatous perennial herb, with shoots that die-back to resting buds just below the soil surface in September. It is typically rooted in a saturated 'mossy bed' where the water table is high, at least in the spring, and the water is usually flowing, sometimes very weakly, along a small slope or from a spring, thereby guaranteeing good circulation of oxygen (Vittoz *et al.* 2006). The fen waters are usually cold and neutral to slightly acid.

Flowering shoots and numerous leafy stolons are produced in the following spring. The runners often become overtopped by moss growth and remain attached to the parent rhizome for at least one growing season before becoming independent shoots that form new rhizomes (Ohlson 1987). Some rhizomes do not produce flowering shoots in some years, but there are normally 1-5 runners (Olesen & Warncke 1989a).

The flowering shoots are typically 15-20 cm tall in Britain, with a single terminal inflorescence, although 2-3 occasionally occur. Flowering is relatively late extending from July to September. The flowers are strongly protandrous but self-compatible, although self-pollinated flowers produce very few seeds (Olesen & Warncke 1989a).

The flowers are visited by a large spectrum of insects but mainly syrphid flies (Warncke *et al.* 1993). Flowers spend about nine days in the male phase and three days in the female phase although the numbers of days when pollination is possible is about a third less than the number of days that flowers are open due lack of female flowers early and late in the season (Olesen & Warncke 1989a).

Large numbers of viable seeds are produced per plant with output varying depending on habitat and ramet size (Ohlson, 1988). The seeds have no special adaptations for dispersal and are dropped near to the parent plant when shaken from the capsules by wind or rain, the average distance being 13 cm (Olesen & Warncke 1989b). However, it has been suggested that dispersal over greater distances may occur in regions where snow covers the ground at the time of dispersal (Ohlson 1989b) or where large herbivores carry seeds in either dung or on their fur (Olesen & Warncke 1990). Having said that, populations in the North Pennines show fixed differences in chloroplast DNA suggesting that gene flow (dispersal and establishment) is not occurring over distances as short as 8 km (Oliver *et al.* 2006). In Denmark the situation is even more marked with haplotypes differing between populations isolated in habitat patches as close as 9-45 m apart (Oliver *et al.* 2006). Seedling recruitment appears to depend on the availability of suitable bare ground (Ohlson 1989).

Welch (2009) cites good seed-viability and describes successful *ex-situ* conservation and re-introduction measures

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for Scottish sites; Roberts (2010a) also gives figures for fruit-set in England. Huge populations of vegetative shoots may occur. Although stolon size may be environmentally determined (Ohlson 1986), it seems likely that stolon production is a useful adaptation in a readily poached, localized habitat favoured by herbivores.

THREATS

During the nineteenth and twentieth centuries populations of *S. hirculus* in the southern part of its European range suffered a serious decline attributable to habitat degradation and fragmentation, afforestation, drainage and overgrazing. As a consequence it is now extinct in Austria, Czech Republic and The Netherlands, and much depleted in the British Isles, southern Sweden, Germany, the Alps, Poland and the Baltic States (Oliver *et al.* 2006).

In the British Isles, **drainage ('moor gripping')** has proved to be one of the most serious threats in the past (Robinson 2012) with modern drain-blocking paradoxically also potentially posing localised risks. In the North Pennines the permanent enclosure of its flush habitat has been employed as an overly simplistic response to grazing difficulties but appears to have resulted in reduced cover and localized extinction due to growth of tall herbs (Welch & Rawes 1964; Roberts 2010a; Robinson 2012). However, new sites for the plant are still being discovered.

MANAGEMENT

In Britain shyness of flowering is probably a reflection of preferential grazing of the habitat by un-shepherded, predator-free herbivore populations, exacerbated by high post-war stocking densities, although there is evidence that flowering is also influenced by mire chemistry (Ohlson 1986; Roberts 2010a).

The fencing of populations can bring about increases in flowering in the short-term, and some spectacular flowering followed the reductions in grazing levels caused by foot-and-mouth disease in 2001 (Roberts 2010b). Counts by Roberts (2010a), however, show that flowering is now poor in the longest-established enclosures, reflecting the plant's poor competitive abilities, but that localized yet significant flowering can still occur in populations open to (now) reduced stocking levels.

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