

Potentilla crantzii (Crantz) G.
Beck ex Fritsch.

Alpine Cinquefoil

Potentilla crantzii has large, five-petaled flowers with an orange spot near the base, and palmate basal leaves with five leaflets. It occurs on dry base-rich rock faces and ledges, limestone grassland and occasionally on scree and gravels, river shingle, limestone pavement and heathy grassland. In Great Britain it is commonest in the central Scottish Highlands, whilst in England it is confined to Durham, Yorkshire, Cumberland, Westmoreland and Derbyshire, and in Wales it is now found only in Snowdonia. It is absent from Ireland. *P. crantzii* is assessed as of Least Concern in GB, but as Endangered in Wales.



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IDENTIFICATION

The yellow flowers of *Potentilla crantzii* are the largest of any British cinquefoil (15-25 mm across), have five petals usually with an orange spot near to the base and are borne on few-flowered cymes that arise laterally from the sides of the basal leaves.

The basal leaves are palmate with five leaflets. The vegetative stems are short and not rooting or mat-forming, unlike in *P. neumanniana*. *P. crantzii* comprises several polyploid cytotypes ($2n = 28, 42, 49$) but despite this British populations are remarkably uniform in terms of morphology (Smith 1963, 1971; Hörandl *et al.* 2011).

SIMILAR SPECIES

In Britain well-grown *P. crantzii* is unlikely to be confused

with any other species except *P. neumanniana* due to the size of the flowers, habitats and distribution. *P. neumanniana* has sepals that are clearly visible between the petals and the whole plant is prostrate and mat-forming with the vegetative stems rooting at the nodes (Poland & Clement 2009). The stipules of the stem leaves are linear, acute and entire in *P.*

neumanniana and lanceolate, obtuse, and herbaceous with scarious margins in *P. crantzii*.

Plants intermediate in habit, flower-size and stipule shape have been reported from Northern England and Scotland. These probably arose through sexual crossing (see below), and have recently been named as a new endemic species: *P. cryeri* (Grassington Cinquefoil; Sell & Murrell 2014).

In grazed turf plants rarely flower and distinction from *P. erecta* is troublesome. The leaves look initially similar; however, whereas the former has numerous basal and fewer cauline leaves, long petioles and five leaflets (excluding bracts), the latter has almost sessile leaflets in threes which appear similar because of additional two leaflet-like stipules

HABITATS

Potentilla crantzii occurs on dry base-rich rock faces, cliffs and ledges, close-grazed limestone grassland and, more occasionally, river shingle, screes and gravels, limestone pavement and species-rich heathy grassland (Bradshaw & Doody 1978a,b; Bradshaw 1985; Slack 1994; McCosh 2002).

On limestones in northern England most populations occur in NVC CG9 *Sesleria albicans-Galium sternerii* and CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland. On grazed slopes at higher altitudes, often below crags, it is more typical of CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grass-heaths, whereas on calcareous rock



Potentilla crantzii at Crowdundle Beck, Cumberland. ©Jeremy Roberts.

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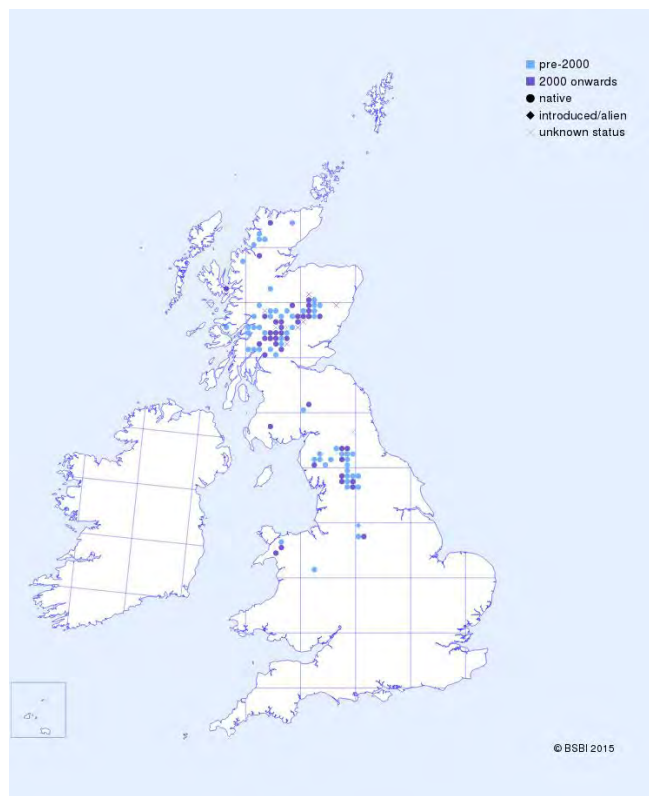
outcrops, for example in the Breadalbanes, it mainly occurs in CG12 *Festuca ovina*-*Alchemilla alpina*-*Silene acaulis* dwarf-herb vegetation, or where inaccessible to livestock and deer CG14 *Dryas octopetala*-*Silene acaulis* cliff-ledge communities. On less basic, inaccessible rock ledges it also occurs in U17 *Luzula sylvatica*-*Geum rivale* tall-herb vegetation.

BIOGEOGRAPHY

Potentilla crantzii has an amphi-atlantic distribution in the Northern Hemisphere, extending from Central Asia and Scandinavia, across Greenland and as far as Hudson Bay in Northern Canada (Slack 1994). Its main distribution is in Europe where it belongs to the Eurosiberian Boreo-arctic Montane element (Preston & Hill 1997). In central and southern Europe it occurs in all the main mountain ranges mainly at altitudes above 800 m (Smith 1963); it also occurs in North Africa.

It descends to much lower altitudes in northern Europe, including the British Isles, where its altitudinal range is from 250 m in Assynt to just over 1000 m on Ben Lawers in Scotland and Snowdon in North Wales and 790 m on Hellvellyn in England.

In Britain it is most abundant in the Central Highlands of Scotland, especially Perthshire, with outlying populations on Skye, in East and West Ross, Sutherland and a few sites in Dumfries and Galloway. In England it is thought to be confined to Durham, Yorkshire (but see comments on *P. cryeri* in the Ecology section), Cumberland, Westmorland and



Distribution of *Potentilla crantzii* in Great Britain and Ireland.

Monks Dale in Derbyshire. In Wales it has been recorded from four peaks in Snowdonia and Breidden Hill in Montgomeryshire where it was last recorded in 1871 (Ellis 1983).

From the Tien Shan eastwards plants resembling *P. crantzii* occur amongst *P. gelida*, an Asian species from which *P. crantzii* was probably derived (Soják 2010).

ECOLOGY

A long-lived non-rhizomatous polycarpic perennial with an unbranched woody rootstock. Purely vegetative spread appears restricted (unlike in *P. neumanniana*) and populations usually consist of discrete individuals, presumably established from seed, especially on rock ledges where plants are often protected from grazing animals (Smith 1963; Bradshaw & Doody 1978a, b). In closely grazed situations *P. crantzii* rarely produces seed due to herbivory by sheep and rabbits but appears to persist for long periods with no ill effect (Bradshaw 1985), with plants recorded on Widdybank Fell in Upper Teesdale doubling in size over several years (Bradshaw & Doody 1978b).

P. crantzii is a pseudogamous apomict i.e. the pollen only stimulates the formation of the seed (Smith 1963; Hörandl *et al.* 2011). Consequently, the offspring of such crosses usually closely resemble the female parent (i.e. maternal inheritance). However, the production of plants with much higher chromosome counts (e.g. $2n = 70$) and intermediate characters suggests that limited sexual crossing can take place and this might account for intermediates between *P. crantzii* and *P. neumanniana* that occur in Northern England and Scotland (Briggs & Walters 1997). Sell & Murrell (2014), as noted above, have recently determined one of the intermediate populations in Yorkshire as a new endemic species: *P. cryeri*.

The conspicuous hermaphrodite flowers produced in June and July are mainly 'pollinated' by hoverflies (Slack 1994). Individual flowers produce 5-13 seeds; these are small (1.6 × 1.2 mm; 0.4-0.8 mg) and have no specialized structures to aid dispersal. Consequently seed dispersal is expected to be localized although seeds can float for on average 15 days (up to 181 days), suggesting that water-borne dispersal may be an important mechanism for colonization of new sites (Danvind & Christer 1997).

P. crantzii is also known to produce a large and long-lived seed bank with significant regeneration having been reported from disturbed plots within long abandoned lowland calcareous grassland (Kalamees *et al.* 2012), an alpine heath (Klanderud 2010) and an alpine meadow (Olofsson & Shams 2007). In the latter study the negative relationship between the number of seedlings and moss biomass (and to a lesser extent vascular plant biomass) suggests that the recruitment of *P. crantzii* is limited by the availability of gaps within arctic and alpine environments with low productivity (Olofsson & Shams 2007).

There appear to be few physiological differences between low and high altitude populations of *P. crantzii*. For example,

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Kudo *et al.* (2001) found no significant differences in leaf mass or leaf longevity along climatic gradient from subalpine to alpine conditions, although there was a significant increase in leaf nitrogen content in colder climates along with all other herbaceous species studied. Indeed, exposure of *P. crantzii* to higher temperatures has been shown to increase relative growth rates, arbuscular mycorrhizal infections and photosynthetic nitrogen-use efficiency, but decrease shoot nitrogen content (Kytöviita & Ruotsalainen 2007).

Although *P. crantzii* shows abundant arbuscular mycorrhizal infection in the field, experimental inoculation with *Glomus claroideum* produced no benefit in terms of plant growth and nutrient acquisition at 12°C but increased phosphorous capture and photosynthetic nitrogen-use efficiency at 17°C (Kytöviita & Ruotsalainen 2007). *P. crantzii* has been shown to respond positively to increased nutrient levels (but not simulated warming) in an alpine heath, both in terms of abundance (Klanderud 2008) and seedling recruitment (Klanderud 2010)

THREATS

Within open habitats (i.e. pastures, meadows, heaths, etc.) both over- and under-grazing would appear to be the main threats to *P. crantzii*, as too little is likely to restrict sites for recruitment and too much will reduce seed production. Populations on rock outcrops and ledges are probably less susceptible, although small populations are likely to be more susceptible to stochastic events such as rock-falls as well as damage from recreational activities (e.g. erosion, disturbance, etc.).

MANAGEMENT

Potentilla crantzii appears to rely on disturbance to create gaps for recruitment. For example in parts of Finland it is confined to cattle grazed pastures but is absent from abandoned pastures or abandoned pastures where grazing had been reintroduced (Pykälä 2005). In addition, experimental disturbance to reduce the cover of mosses increased local colonization, seedling emergence and recruitment of *P. crantzii* in alpine meadows in Sweden (Olofsson & Shams 2007). Some form of grazing, rather than mowing, preferably avoiding the main flowering period, is therefore likely to be essential to ensure survival on many sites.

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