

## *Geranium sylvaticum* L.

### Wood Crane's-bill

*Geranium sylvaticum* is a glandular-hairy plant with palmate, deeply divided leaves attached to petioles that become progressively shorter up the stem. The pinkish-purple flowers are white at the base and on pedicels that remain upright after flowering. It is a plant of moderately acid or neutral soils of low to intermediate fertility, and found in a variety of grassland habitats, including upland hay-meadows, roadside verges, streamsides and montane rock-ledges. It is widespread in northern England and Scotland, rare in Wales and the north of Ireland. It was assessed as of Least Concern in Great Britain as a whole, but as Near Threatened in England and Critically Endangered in Wales.



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#### IDENTIFICATION

A glandular-hairy plant with tall (-80 cm), erect or ascending pale green stems with alternate leaves, occasionally arranged opposite each other near the top of the stem. Leaves are medium-green on the upper surface and paler beneath, divided palmately up to four-fifths of the way to the base into seven or nine shallowly toothed lobes (Sell & Murrell 2009) which have  $\pm$ acute teeth 1.5 - 2 $\times$  longer than wide (Poland & Clement 2009). The lower leaves have long petioles (-25 cm), but they become shorter until almost absent in the uppermost leaves (Sell & Murrell 2009).

Plants produce one to several flowering shoots per ramet, with cup-shaped flowers (22-30 mm) borne in a dense inflorescence (Yeo 2001) and on pedicels that remain upright after flowering. Each flower has five ovate-lanceolate sepals (5-7 mm) with a short narrow mucronate tip almost one-fifth

as long as the sepal, and five obovate petals, the colour of which is variously described as pinkish-purple (Stace 2010) and purplish-violet (Sell & Murrell 2009; Yeo 2001) but almost always with white at the base. Petals (12-16  $\times$  8-12 mm) have a rounded or slightly notched apex (Stace 2010), and fruits are 17-21 mm with glandular-hairy mericarps (4 mm) rounded at the base (Sell & Murrell 2009).

#### SIMILAR SPECIES

*Geranium pratense* has larger petals (>16 mm), fruit stalks that are spreading or reflexed when ripe, rather than upright, and a mucronate tip to the leaf that is more than one-fifth as long as the sepal (Stace 2010). Although their distributions overlap, in general terms *G. pratense* is found in the lowlands and *G. sylvaticum* in the uplands.

#### HABITATS

*Geranium sylvaticum* is a species of moderately acid or neutral soils of intermediate fertility, found in damp meadows, roadside verges and hedgebanks, lightly-shaded woodland rides, stream banks, gullies and rock ledges (Yeo 2001; Leach 2002; Sell & Murrell 2009).

In Great Britain it is known from several different NVC types, most notably MG3 *Anthoxanthum odoratum*-*Geranium sylvaticum* upland hay meadows (the British representative of the *Polygono-Trisetion* alliance; see Rodwell et al. 2007), but also CG14 *Dryas octopetala*-*Silene acaulis* ledge community, U16 *Luzula sylvatica*-*Vaccinium myrtillus* tall-herb community and (south of the Great Glen) species-rich U17 *Luzula sylvatica*-*Geum rivale* tall-herb community (Rodwell 1992). It occurs in similar habitats across the rest of its range.



Upland hay meadows near to Holwick, Teesdale – typical habitat for *Geranium sylvaticum*. ©Kevin Walker.

# *Geranium sylvaticum* (L.)

## BIOGEOGRAPHY

*Geranium sylvaticum* is a Eurasian species with a distribution centred on regions with a montane or continental climate. It is common in the meadows and mountains of southern Europe above 300-400 m, and further north and east it occurs down to sea level (Yeo 2001). It reaches the southern limit of its range in northern Turkey, and its northern limit in Scandinavia.

In Great Britain it is widespread from central Yorkshire northwards to East Ross, with outlying populations in Monmouthshire, Pembrokeshire and Worcestershire. It is very local in central England, rare in Wales, where there are perhaps as few as 30 native plants (Dines 2008), and also in Ireland with the majority of recent records confined to the east Antrim coast. It is occasionally grown in gardens but rarely naturalised elsewhere (Sell & Murrell 2009).

## ECOLOGY

A perennial, self-compatible hemicryptophyte, found in a wide range of soil types, flowering from the end of May into July.

*Geranium sylvaticum* produces hermaphrodite and female individuals (gynodioecious) although intermediate plants are often present within most populations. Female plants produce no functional anthers, whilst hermaphrodite plants produce ten functional anthers, and intermediate (bisexual) plants have one to nine functional anthers per flower (Årgren & Willson 1994; Varga & Kytöviita 2014). Flowers are protandrous (presenting the pollen before the stigma becomes receptive) and are pollinated by a variety of insects including

bumblebees and syrphid flies.

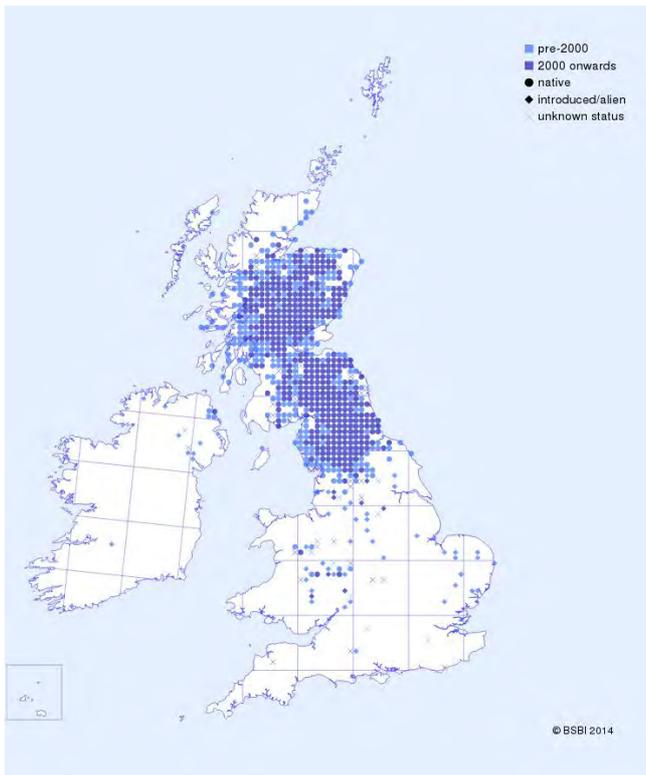
Fruits (known as schizocarps) have two ovules and contain a maximum of five seeds which mature about three weeks after pollination. Seeds are expelled short distances (two to three metres) by the explosive break-up of the fruit as it dries out (Yeo 2001; Toivonen & Mutikainen 2012).

*Geranium sylvaticum* has a transient seed bank (Thompson et al. 1997) and develops ripe seeds at about the same time as hay is cut, resulting in seed fall and the potential for germination in gaps left by light disturbance following hay making practices. However, experiments in the application of green hay from an MG3 donor site in Cumbria failed to establish *G. sylvaticum* in a scarified sward at the receptor site despite the species being scattered throughout the donor sward (Kirkham et al. 2012). Baskin & Baskin (2001) state that seeds of female and hermaphrodite *G. sylvaticum* plants usually germinate equally well but female plants can on occasion germinate less well than those of hermaphrodite plants. Asikainen & Mutikainen (2003) found that female plants produced more seed than hermaphrodite plants in a study of 23 populations in Finland, and furthermore that relative seed fitness between female and hermaphrodite plants was related to population sex ratio.

Individual *G. sylvaticum* plants can live for over 20 years (Klimešová & de Bello 2009), but only flower after 7-10 years (Salomonson et al. 1994) and so vegetative spread is an important means of reproduction. This is achieved via short, unbranched rhizomes (3–10 cm), with meristems on the rhizome giving rise to clonal offspring and the expansion of populations over time and under suitable field management (Klimeš & Klimešová 1999). Maron & Kauffman (2006) found that low levels of grazing in Norwegian mountain pastures increased rates of clonal reproduction, and Smith et al. (1996) also found that light grazing stimulated the abundance of *G. sylvaticum*, either by seed production or by vegetative growth, although some authors have reported that livestock tend to avoid eating plants because leaves accumulate unpalatable tannins (Hæggström 1990; Moen et al. 1996).

Whilst the dispersal of *G. sylvaticum* seeds over longer distances via endozoochory has been recorded (e.g. Ernst et al. 2013), previously mentioned traits (e.g. slow clonal spread, transient seed bank) strongly point to *G. sylvaticum* having restricted dispersal potential. Consequently, the maintenance of high quality habitat at the local scale through appropriate management for this species is paramount.

Pacha & Petit (2008) demonstrated that the extinction rate of *G. sylvaticum* in northern England was higher in low quality and isolated fields (see also Dupre & Ehrlén 2002) and a study in Germany also found that fragmented, edge of range populations were particularly susceptible to extinction due to poor dispersal potential and a predicted significant altitudinal retraction in the area suitable for *G. sylvaticum* (Ernst et al. 2013).



Distribution of *Geranium sylvaticum* in Great Britain and Ireland.

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### THREATS

The main threats to extant populations of *G. sylvaticum* include ploughing and re-seeding, changes in farming practices from hay-making to silage production (Jefferson 2005; Bradshaw 2009), cessation of cutting or failure to remove arisings over prolonged periods of time, extended spring grazing (Pacha & Petit 2008), and changes to woodland management from coppice to high forest.

### MANAGEMENT

In general terms, hay meadow management should aim to restrict grazing to the spring and autumn months, with livestock 'shut up' from May onwards and hay cut in mid-July, although timing is weather-dependent and will inevitably differ between years. The occasional application of low levels of farmyard manure in the spring can help to produce a healthy crop without adversely affecting species diversity, and the occasional application of lime may also be desirable at some locations to maintain neutral soil pH conditions.

Roadside verge, hedgebank and woodland ride management should replicate the timing of cutting for hay meadow management described above, with cuttings removed wherever practicable. Pasture management should avoid both overstocking and high levels of grazing, but low levels of grazing are beneficial to *G. sylvaticum*.

### REFERENCES

- Ågren, J. & Willson, M.F. 1994. Cost of seed production in the perennial herbs *Geranium maculatum* and *G. sylvaticum*: an experimental field study. *Oikos* 70: 35–42.
- Asikainen, E. & Mutikainen, P. 2003. Female frequency and relative fitness of females and hermaphrodites in gynodioecious *Geranium sylvaticum*. *American Journal of Botany* 90:224–232.
- Baskin, C.C. & Baskin, J.M. 2001. *Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination*. Academic Press, California.
- Bradshaw, M.E. 2009. The decline of Lady's-mantles (*Alchemilla vulgaris* L. agg.) and other hay meadow species in Northern England since the 1950s. *Watsonia* 27: 315–321.
- Dines, T. 2008. *A Vascular Plant Red Data List for Wales*. Plantlife International, Salisbury.
- Dupre, C. & Ehrlén, J. 2002. Habitat configuration, species traits and plant distributions. *Journal of Ecology* 90: 796–805.
- Ernst, A., Sauer, J., Wittig, R. & Nowak, C. 2013. Local genetic structure of a montane herb among isolated grassland patches: implications for the preservation of genetic diversity under climate change. *Population Ecology* 55: 417–431.
- Hæggröm, C. 1990. The influence of sheep and cattle grazing on wooded meadows in Åland, SW Finland. *Acta Botanica Fennica* 141: 1–28.
- Jefferson, R.G. 2005. The conservation management of upland hay meadows in Britain: a review. *Grass and Forage Science* 60: 322–331.
- Kirkham, F.W., Bhogal, A., Chambers, B.J., Dunn, R.M. & Tallwin, J.R.B. 2012. Effects of spreading species-rich green hay on the botanical composition of an agriculturally improved hay meadow in northern England. *Grass and Forage Science* 68, 260–270.
- Klimeš, L. & Klimešová, J. 1999. CLO-PA2—a database of clonal plants in Central Europe. *Plant Ecology* 14: 9–19.
- Klimešová, J. & de Bello, F. 2009. CLO-PLA: the database of clonal and bud bank traits of Central European flora. *Journal of Vegetation Science* 20: 511–516.
- Leach, S.J. 2002. *Geranium sylvaticum*. In: C.D. Preston, D.A. Pearman & T.D. Dines (eds & comps) 2002. *New Atlas of the British and Irish Flora*, p.445. Oxford University Press, Oxford.
- Maron, J.L. & Kauffman, M.J. 2006. Habitat-specific impacts of multiple consumers on plant population dynamics. *Ecology* 87: 113–124.
- Moen, J., Gardfjell, H., Ericson, L. & Oksanen, L. 1996. Shoot survival under intense grazing for two broad-leaved herbs with different chemical defense systems. *Oikos* 75: 359–364.
- Pacha, M.J. & Petit, S. 2008. The effect of landscape structure and habitat quality on the occurrence of *Geranium sylvaticum* in fragmented hay meadows. *Agriculture, Ecosystems and Environment* 123: 81–87.
- Poland, J. & Clement, E. 2009. *The Vegetative Key to the British Flora*. Botanical Society of the British Isles, London.
- Rodwell, J.S. (ed.) 1992. *British Plant Communities. Volume 3. Grasslands and Montane Communities*. Cambridge University Press, Cambridge.
- Rodwell, J.S., Morgan, V., Jefferson, R.G. & Moss, D. 2007. *The European context of British lowland grasslands*. Joint Nature Conservation Committee (JNCC) Report No. 394. JNCC, Peterborough.
- Salomonson, A., Ohlson, M. & Ericson, L. 1994. Meristem activity and biomass production as response mechanisms in two forest herbs. *Oecologia* 100: 29–37.
- Sell, P. & Murrell, G. 2009. *Flora of Great Britain and Ireland, Volume 3: Mimosaceae – Lentibulariaceae*. Cambridge University Press, Cambridge.
- Smith, R.S., Buckingham, H., Bullard, M.J., Shiel, R.S. & Younger, A. 1996. The conservation management of mesotrophic (meadow) grassland in northern England. 1. Effects of grazing, cutting date and fertilizer on the

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- vegetation of a traditionally managed sward. *Grass and Forage Science* 51: 278–291.
- Stace, C. A. 2010. *New Flora of the British Isles*, third edition. Cambridge University Press, Cambridge
- Thompson, K., Bakker, J.P. & Bekker, R.M. 1997. *The soil seed banks of North West Europe: methodology, density and longevity*. Cambridge University Press, Cambridge.
- Toivonen, E. & Mutikainen, P. 2012. Differential costs of reproduction in females and hermaphrodites in a gynodioecious plant. *Annals of Botany* 109: 1159–1164.
- Varga, S. & Kytöviita, M. 2014. Variable mycorrhizal benefits on the reproductive output of *Geranium sylvaticum*, with special emphasis on the intermediate phenotype. *Plant Biology* 16: 306–314.
- Yeo, P.F. 2001. *Hardy Geraniums*. Batsford Press, London.

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