The biology and non-chemical control of Mouse-ear-hawkweed (*Pilosella officinarum* L.)

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Mouse-ear-hawkweed
***Pilosella officinarum* F. Schultz & Schultz-Bip.**
(*Hieracium pilosella* L.)

Occurrence
Mouse-ear-hawkweed is a stoloniferous perennial, native in short grassland on well-drained soils (Stace, 1997). It occurs on calcareous pastures, heaths, banks, rocky places and walls, and is locally common throughout the British Isles (Clapham *et al.,* 1987). It is recorded up to 2,400 ft (Salisbury, 1961). It is a weed of degraded pastures, poor lawns and other sparse vegetation (Bishop & Davy, 1994). It thrives in areas of low rainfall and is able to grow on steep slopes. It is abundant on relatively open soil in chalk grassland (Tansley, 1949). It grows on both acid and calcareous soils and can tolerate a broad pH range. Mouse-ear-hawkweed cannot stand a high water table and is absent from wetland (Grime *et al.,* 1988). It does not occur in woodland or other shady places. The root system is superficial, only extending to 10-15 cm and the plant ought to be susceptible to drought. However, mouse-ear hawkweed is able to recover from apparent desiccation, although seedlings and young rosettes may be killed (Bishop & Davy, 1994). It is associated with heavily-grazed short swards (Gibson, 1996).

Mouse-ear-hawkweed comprises a very variable complex (Stace, 1997; Clapham *et al.,* 1987). At least 5 cytotypes exist and numerous subspecies have been described in the past but only 7 are said to occur in Britain (Grime *et al.,* 1988). Hybrids with related species occur naturally and some have been produced experimentally (Bishop & Davy, 1994).

It forms pure stands that exclude other plants (Weber, 2003). There have been suggestions that mouse-ear-hawkweed has an allelopathic effect on other plants (Bishop & Davy, 1994). It contains a number of phenolic compounds with phytotoxic properties. Extracts from the roots inhibit the germination of its own seeds.

It has been used in herbal preparations (Barker, 2001). Extract of mouse-ear-hawkweed has anti-bacterial properties and has been used as an antibiotic against brucellosis (Bishop & Davy, 1994). It has also been used to treat respiratory infections.

Biology
Mouse-ear-hawkweed flowers from May to August (Morse & Palmer, 1925) or May to October (Barker, 2001). Peak flowering occurs in June and a second flowering may take place in late summer (Bishop & Davy, 1994). The flower stalk continues to elongate from bud formation through to fruiting. Seed is produced by apomixis in polyploid races and by insect pollination, in the rest. Apomictic seeds are essentially clones of the parent plant (Bishop & Davy, 1994). Plants reproducing sexually are visited by many different

insects and are self-incompatible. Seed is set within a few weeks of flowering (Grime *et al.*, 1988). Seed numbers per individual flower head range from 63 to 130 (Bishop & Davy, 1994). In grassland, seed shed per m^2 ranged from 500 to 13,000 seeds depending on whether it was grazed or not.

Seeds show great variation in viability (Bishop & Davy, 1994). Freshly shed seeds germinate readily but there is some evidence of dormancy. In Petri-dish tests with seeds in high and low light intensity and in darkness, seed germination was around 96% in the light and 91% in the dark (Grime & Jarvis, 1976). Germination was high at alternating temperatures under a 'safe' green light but less than 50% of seeds germinated in total darkness (Grime *et al.*, 1981). Germination levels may increase following a period of dry storage (Grime *et al.*, 1988). Storage at 5^{o}C increased the germination level from 47 to 81% over a 12-month period. Storage at room temperature had no effect. Light may be required for germination under some circumstances.

Seeds sown in cylinders in the field and cultivated periodically, emerged mainly in July and September following soil disturbance (Bishop & Davy, 1994). Some of the seeds sown in a 75 mm layer of soil in cylinders in the field and stirred periodically emerged in the autumn immediately after sowing in August (Roberts, 1986). In the following and subsequent years the main emergence period was from February to October with peaks in June and September. Flushes of seedling emergence tended to follow cultivations. A decreasing number of seedlings emerged each year over the 5 years of the study.

Seedlings rarely succeed in established grassland. Seeds may germinate and the seedlings emerge in gaps in the vegetation (Grime *et al.*, 1988). Established plants typically form appressed rosettes in grazed grassland. The rosettes are produced on a slender rootstock or vertical rhizome (Bishop & Davy, 1994). New daughter rosettes are produced seasonally on stolons, or in the leaf axils of senescing rosettes, or from an underground bud bank on the rootstock. Mouse-ear-hawkweed has long slender stolons and numerous long epigeal stolons (Clapham *et al.*, 1987). Stolon leaves are smaller than rosette leaves (Bishop & Davy, 1994). Stolons grow up to 30 cm long, are sometimes branched and usually have a rooting terminal rosette of overwintering leaves. The number, length and degree of branching of the stolons depends on population density. Stolons generally form only on rosettes that are due to flower. The stolons start to form as flowering begins. Rosettes may take from 1 to 4 or more years to flower. Within a few months of flowering the parent rosette senesces and the stolons decay leaving independent daughter rosettes.

The outer rosette leaves die back in winter. Rosettes may suffer frost damage but mortality is negligible.

Persistence and Spread

Thompson *et al.* (1993) suggest that based on seed characters, mouse-ear hawkweed seed should persist for less than 5 years in soil. Seed sown in the field continued to emerge over a 5-year period but seedling numbers had decreased by year 5.

Mouse-ear hawkweed can spread rapidly by seed and by vegetative means (Watt, 1981). Populations increase, mature, senesce and degenerate over time leaving bare patches. The populations then settles back to a lower level. Seedlings can remain in a juvenile, non-rosette form for several years (Bishop & Davy, 1994). Individual plants may live for over 10 years but ageing clones may lose vigour and some seedling development is essential for the population's survival.

The feathery pappus facilitates wind dispersal (Bishop & Davy, 1994). Dispersal occurs over several days. Dispersal by water may occur but the seeds float for less than 18 hours (Bishop & Davy, 1994). Seedlings have been raised from bird droppings (Salisbury, 1961). Mouse-ear-hawkweed seed has been a found as a contaminant of crop seeds. It was introduced into New Zealand in the 1920's as a contaminant of crop seeds (Cossens *et al.,* 1989).

Management

Heavily grazed swards are characterised by the presence of certain weeds including mouse-ear hawkweed (Gibson, 1997). Mouse-ear hawkweed can be a serious weed in nutrient poor, overgrazed pasture. Plants should be spudded out to prevent seeding (Morse & Palmer, 1925). Improvements such as increased fertility and the prevention of rabbit grazing can lead to a dramatic decline in mouse-ear-hawkweed (Bishop & Davy, 1994). The weed benefits from rabbit activity except in drought conditions when the rabbits may eat into the stolons. In contrast, mouse-ear-hawkweed did not become a serious problem in New Zealand until the rabbit population declined in the 1950's (Cossens *et al.,* 1989). Rabbits rarely eat the rosettes but feed on the developing flower stalk and buds. Under heavy rabbit grazing all the flowers may be removed. Sheep also eat the flowers.

Infestations were reduced in grassland by topdressing with superphosphate and overdrilling with clover followed by strategic sheep grazing after 12 months. After 3 years the ground cover of the weed had declined from 58% to just 2%.

Mouse-ear-hawkweed is attacked by insects that feed on the leaves and sap (Bishop & Davy, 1994). The caterpillars of several Lepidoptera are found on it. A limited number of pathogens infect it including a rust fungus. Nematodes and certain snails also attacked it.

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References

Barker J (2001). *The medicinal flora of Britain and Northwestern Europe*, Winter Press, West Wickham, Kent, UK.

Bishop G F & Davy A J (1994). Biological flora of the British Isles. *Hieracium pilosella* L. (*Pilosella officinarum* F. Schultz & Schultz-Bip.). *Journal of Ecology* **82**, 195-210.

Clapham A R, Tutin T G, Moore D M (1987). Flora of the British Isles, 3rd edition, Cambridge University Press, Cambridge, UK.

Cossens G G, Mitchell R B, Crossan G S (1989). Matagouri, hawkweed and purple fuzzweed control with sheep, goats and legumes in the New Zealand tussock grassland. *Proceedings of the Brighton Crop Protection Conference – Weeds*, 879-884.

Gibson C W D (1996). The effects of horse grazing on species-rich grassland. *English Nature Research Report* No. **164**, English Nature, Peterborough.

Gibson C W D (1997). The effects of horse and cattle grazing on English species rich grassland. *English Nature Research Report* No. **210**, English Nature, Peterborough.

Grime J P, Hodgson J G, Hunt R (1988). *Comparative Plant Ecology*, Unwin Hyman Ltd, London, UK.

Grime J P & Jarvis B C (1976). Shade avoidance and shade tolerance in flowering plants II. Effects of light on the germination of species of contrasted ecology. Reprinted from: *Light as an Ecological Factor :II, The 16th Symposium of the British Ecological Society, 1974*, Blackwell Scientific Publications, Oxford, 525-532.

Grime J P, Mason G, Curtis A V, Rodman J, Band S R, Mowforth M A G, Neal A M, Shaw S (1981). A comparative study of germination characteristics in a local flora. *Journal of Ecology* **69**, 1017-1059.

Morse R & Palmer R (1925). *British weeds their identification and control*. Ernest Benn Ltd, London.

Roberts H A (1986). Seed persistence in soil and seasonal emergence in plant species from different habitats. *Journal of Applied Ecology* **23**, 639-656.

Salisbury E J (1961). *Weeds & Aliens*. New Naturalist Series, Collins, London.

Stace C (1997). *New Flora of the British Isles*. 2nd edition. Cambridge University Press, Cambridge, UK.

Tansley A G (1949). The British Islands and their vegetation. Volume II, 2nd Edition, Cambridge University Press.

Thompson K, Band S R, Hodgson J G (1993). Seed size and shape predict persistence in soil. *Functional Ecology* **7**, 236-241.

Watt A S (1981). Further observations on the effects of excluding rabbits from Grassland A in east Anglian Breckland: the pattern of change and factors affecting it (1936-73). *Journal of Ecology* **69**, 509-536.

Weber E (2003). *Invasive plant species of the world. A reference guide to environmental weeds*. CABI Publishing, Cambridge, UK.