United States Department of Agriculture
NATURAL RESOURCES CONSERVATION SERVICE
Invasive Species Technical Note No. MT-8
January 2007

Ecology and Management of Houndstongue (*Cynoglossum officinale* L.)

by

Jim Jacobs, NRCS Invasive Species Specialist, Bozeman, Montana
Sharlene Sing, Assistant Research Professor, Montana State University, Bozeman, Montana

Abstract

Houndstongue, *Cynoglossum officinale* (Boraginaceae), is a biennial or short-lived perennial originating from montane zones in western Asia and Eastern Europe. Houndstongue reproduces by seed only, and was probably introduced to North America as a grain seed contaminant. This species was first reported in Montana from Sweet Grass County near Big Timber, Montana in 1900. As of 2006, houndstongue has been reported in 35 of Montana's 56 counties (http://invader.dbs.umt.edu). Houndstongue invades grasslands, pastures, shrublands, forestlands, croplands and riparian areas, and is an effective competitor that readily displaces desirable species, establishing monocultures and further degrading forage quality in disturbed habitats. This species is particularly well adapted to invading and dominating forest openings created through logging activities.

Houndstongue has a number of biological characteristics that contribute to its invasiveness. Houndstongue seeds are covered with barbed prickles that have been referred to as 'nature's Velcro®. These facilitate the effective, widespread dispersal of seeds on the fur, wool or hides of passing wildlife and livestock, and on the cloths of humans. The seeds are also relatively large; this provision of stored energy confers a significant competitive advantage due to high germination rates and seedling establishment. The large taproot developed in the first year of growth enables houndstongue to tolerate environmental stress and produce many seeds in the second year of growth. The low-growing rosettes, impervious to grazing pressure and mowing, are characterized by large leaves, an adaptation for effective photosynthesis under both high light intensity conditions in open grasslands and in shaded conditions under trees and shrubs. The nasty odor and high levels of pyrrolizidine alkaloids in houndstongue leaves deter grazing animals, increasing grazing pressure on neighboring forb and grass species.

Economic reasons for managing this weed include: reduced effective grazing land due to livestock avoidance of infested areas and lower forage production through competition; reduced wildlife habitat; potential poisoning hazard for horses and cattle consuming hay and processed forage contaminated by houndstongue; reduction in market price of wool contaminated with houndstongue seeds; and increased management and veterinary costs arising when foliar exudates cause dermal and ocular irritation and behavioral problems in cattle. Prevention of houndstongue invasion and containment of infestations are difficult because of its adaptation for long-distance transport by domestic and wild animals. Therefore, early detection and prevention of seed production are critical to avoiding problematic infestations. Population increase in all biennial weeds is dependant on seed production; therefore, management to reduce houndstongue populations should target the flowering stage of its life history. Sulfonylurea herbicides are most effective at killing houndstongue plants at all growth stages. Herbicides applied at the early stages of flowering will prevent seed production and reduce first year rosettes. Currently there

are no biological control insects approved for release in Montana due to concerns for negative non-target effects on rare native Boraginaceae species. Using sheep or goats to manage houndstongue is not practical due to the potential for poisoning. However, prescribed grazing that maintains healthy grassland plant communities will reduce houndstongue invasion. Tilling effectively controls houndstongue on cropland and mowing can reduce seed production but will not eliminate rosettes because of their low-growth form and large-root reserves available to maintain growth after mowing. Prescribed burning when nutlets are dry (late summer or early fall) may be affective in preventing spread because the nutlets remain in the grassland canopy where temperatures generated by fire are greatest.

Biology and Identification

Cynoglossum is a combination of the Greek *kynos* which means dog and *glossa* which means tongue and refers to the shape and texture of the rosette leaf. Other common names for houndstongue include beggar's lice, dog's tongue, sheep bur, dog bur, sheep lice, glovewort, and woolmat. No sub-species of houndstongue have been reported.

Seeds/Fruit. Houndstongue seeds are large (15.3 mg without the fruit coat) and contained singularly in thick-walled, indehiscent nutlets. Each fruit contains four of the seven mm long nutlets. The thick wall of the nutlet is one mechanism of dormancy; in order for the seed to germinate the wall must be scarified. The entire nutlet surface (with the exception of the point of attachment to the stem on the ventral side) is covered with prickles barbed at the tip (glochidiate) that attach like Velcro® to the fur of animals and the clothing of people. The thick wall and Velcro®-like barbs work together to enhance the long-distance spread and establishment of houndstongue. Viability of freshly collected seeds has been estimated at 90 percent but seeds lose viability in two to three years. Seeds remain dormant in the fall and winter and germinate uniformly in the spring after six to 12 weeks of cool-moist stratification. Although houndstongue does not produce a large soil seed bank, viable seeds may persist in fallen infructescences and on the soil surface (see Figure 1).

Rosettes. Houndstongue seedlings emerge synchronously in March and April and develop into rosettes in the first year of growth. Rosette leaves become large, four to 12 by one to two inches (10-30 cm by 2-5 cm), petiolate, simple with entire margins, ovate or elliptical in shape, veined in a net pattern, and covered with soft hairs (pubescent) (see Figure 2). The shape and texture of the rosette leaf is the source of the common name. Rosette leaves remain grey-green throughout the growing season, even in drought, and throughout the fall, dying after a hard frost. Rosettes leaves grow from the root crown in the second year until the formation of the flower stem in May.

Figure 1. A dried houndstongue infructescence found on grassland protected from livestock grazing.

Figure 2. A houndstongue rosette growing in a grassland protected from livestock grazing.

Roots. Houndstongue plants develop thick, black, branching taproots that can grow to depths of greater than three feet (1 m) in the first year. The taproots store nutrients sufficient for seed production in the second year even if second-year rosette leaves are removed. Houndstongue is considered a hemicryptophyte because the second-year rosettes are produced from perennial buds located on the root crown of first-year rosettes at, or just below, the soil surface.

Flowering. First-year rosettes do not produce flowering stems, suggesting that houndstongue requires a vernalization period in order to initiate bolting. Houndstongue is considered a facultative biennial because second-year rosettes growing under adverse environmental conditions are capable of delaying flowering until the third year or longer until more optimal conditions exist. Most plants are monocarpic, dying after a single season of flowering; however, one study found six out of 55 plants flowered in their second and third years, while two out of 55 flowered in their third and fourth years.

Houndstongue flowers from May through July. Flowering stems grow to a height of one to four feet tall (30 to 120 cm) and flowers are arranged in false racemes on branches growing from the leaf axils or short terminal branches. The flowers are dull reddish-purple, with five triangular-lobed sepals fused to form a star-shaped calyx, and a funnel-form, five fused-petal corolla. The flowers are perfect (anthers and ovaries), with five anthers on the corolla throat and a deeply-lobed ovary and simple style on the pistil, supporting both self- and cross-pollination. Characteristic of Boraginaceae, the ovary is four-parted, maturing into four individual nutlets. The reproductive capacity of a single houndstongue plant ranges from 50 to 800 seeds, and is thought to increase significantly under non-autogamous pollination.

Habitat. Houndstongue occurs on rangeland, pastures, abandoned cropland, roadsides and waste places, at the borders of woods and forests, and along riparian areas. In England it is found on sandy soils and old dune-grasslands and in the Netherlands it has been reported from calcareous coastal dunes but absent from acid coastal dunes. In North America it is found on rocky, sandy, loamy and calcareous soils.

Economic Importance. Populations of houndstongue establish on rangelands and pastures where they displace forage species and decrease grazing capacity. Houndstongue has not been a problem in cultivated fields. Nutlets reduce the value of wool and cause irritation, eye infection, and behavioral problems in cattle. Poisoning has been reported in cattle, horses, and sheep.

Extracts of the roots and leaves of houndstongue have been used in folk remedies for various ailments including fever, eczema, acne vulgaris, and hemorrhoids. The red pigments of the outer root surface are anti-bacterial and reportedly have wound-healing activity. Roots and leaves have been used as pesticides and leaves have been used to repel moles in gardens and rodents from stored foods.

Spread. Long-distance dispersal of houndstongue seeds occurs when seeds attach to the fur of animals. A British Columbia study found that 65 percent of the mature seeds on standing houndstongue plants in one pasture became attached to and were re-distributed by cattle. However, another study found that more than 75 percent of the seeds fell within a five inch (0.12 m) radius of the parent plant. Seeds remain on upright stems and can be dispersed throughout the fall and winter months. Dispersal via streams and irrigation ditches is unlikely because their high-specific gravity prevents seeds from floating.

Management Alternatives

Houndstongue is a biennial dependant on seed production to spread and maintain populations. Therefore management should target the flowering stage of growth to prevent seed production. The potential for long-distance immigration of seeds often makes houndstongue a long-term management problem, even where it has been locally eradicated.

Herbicide.[1/] First-year rosettes can be killed using auxin-type herbicides including 2,4-D and dicamba (but not picloram). However, after bolting, these herbicides become less effective. Sulfonylurea herbicides including chlorsulfuron, metsulfuron, and trisulfuron are most effective at killing houndstongue plants at all growth stages. Application of 0.5 ounce/acre (product) of metsulfuron (Escort®) at the first sign of flowering will kill plants and prevent seed production. Including a non-ionic surfactant is necessary when applying metsulfuron and all sulfonylurea herbicides, and is especially important with houndstongue because the leaf pubescence impedes herbicide penetration. Imazapic (Plateau®) at 8-12 ounces of product per acre should be applied with one quart methylated seed oil (MSO) to rosettes or bolting plants. Two quarts 2,4-D amine should be applied to rosettes before they bolt. Although houndstongue is usually avoided by livestock, it may become more palatable after herbicide application, making grazing animals on treated areas more susceptible to poisoning. It is therefore advised to avoid grazing livestock for two weeks post-application on houndstongue-infested pastures that have been treated with herbicides.

Table 1. Chemical and product name, recommended application rate, soil residual half life, and eco-toxicity of herbicides commonly used to control houndstongue. The eco-toxicity is the lethal concentration of the herbicide when applied in a single dose kills 50 percent of the tested organism (the lower the number the more toxic the herbicide). Follow label guidelines for rangeland use and all other label requirements when applying herbicides to avoid damage to desirable plant species.

Chemical name	Product name	Rate/acre	Half life-days	Eco-toxicity (LC_{50}/EC_{50})
Imazapic	Plateau	8-12 oz	31-233	>100 mg/L
Metsulfuron	Escort/Cimarron	0.5-1.0 oz	14-180	>150 mg/L
2,4-D	Many names	2 qt	7	1-10 mg/L

[1/]Any mention of products in this publication does not constitute a recommendation by the NRCS. It is a violation of Federal law to use herbicides in a manner inconsistent with their labeling.

Hand Pulling and Grubbing. Houndstongue plants can be pulled at any time during the growing season. Plants tend to break off at the root crown and using a shovel to pry up the taproot can facilitate pulling the root crown to prevent regeneration of the plant. Collecting seeds and burning them or disposing of them in the garbage will prevent spread. Inflorescences can be collected any time during the year, however, nutlets attached to dried inflorescences tend to break off easily and fall to the ground during collection.

Grazing and Mowing. Using sheep or goats to manage houndstongue is not practical due to the risk of poisoning. However, prescribed grazing that maintains healthy grassland plant communities will reduce houndstongue invasion. Mowing during flowering but before seed set may be used to reduce seed production, but it may not affect populations of rosettes.

Biological Control. Biological control of houndstongue has been investigated as a potential management alternative for this weed since 1988. Five biological control insects identified as potential agents for the control of houndstongue include: the root-mining hoverfly *Cheilosia pascuorum* Becker (Diptera: Syrphidae); the root-mining flea beetle *Longitarsus quadriguttatus* Pontoppidan (Coleoptera: Chrysomelidae); and the houndstongue root-mining (*Mogulones cruciger* Herbst), seed-feeding (*Mogulones borraginis* [Fabricius]) and stem-feeding *Mogulones trisignatus* Gyllendal weevils (Coleoptera: Curculionidae). The first North American releases for classical biological control of houndstongue were made with *L. quadriguttatus* and *M. cruciger* in British Columbia, Canada, in 1997-1998. Populations of *L. quadriguttatus* on release sites have not increased or dispersed as rapidly as *M. cruciger*. *Mogulones cruciger* is now established at several sites in British Columbia and Alberta; significant, persistent decline in houndstongue populations on release sites is evident.

The anticipation that *M. cruciger* would be highly effective in controlling invasive houndstongue in North America was based on the following attributes: 1) its distribution throughout a wide native range indicates that it is highly phenotypically plastic and therefore readily adaptable to succeed in a variety of habitats, and 2) it has a propensity to build up to high local populations in a short time in response to newly arising host plant populations. The U.S. Fish and Wildlife Service has elected to withhold approval for U.S. release of this agent based on a perceived threat to a closely related, endangered native species, *Cryptantha crassipes*, indigenous to the Chihuahuan Desert in Texas (Story 2002, *pers. comm.*). To answer these concerns, further host screening evaluations were conducted in Alberta at the Agriculture and Agri-Food Canada Lethbridge Research Centre and at the CABI International Institute of Biological Control European Station in Switzerland. Laboratory no-choice experiments indicated that of 22 native North American Boraginaceae species evaluated, ten were attacked by *M. cruciger*. However, under simulated 'field conditions' approximated by an open (non-caged) release, attack on non-target species was found to be negligible in the presence of the target weed. Study results identified two biennial or perennial species, *Hackelia floribunda* (stickseed) and *Cryptantha celosioides* (miner's candle), as native North American species of concern because they were found to be consistently accepted and viable hosts for *M. cruciger*. Annual species were judged to be at reduced risk because *M. cruciger* larvae must over-winter in the roots of the host plant (Schwarzlaender 1997). In addition, both of these species are sympatric with northern U.S. distributions of houndstongue. Research efforts continue with the task of identifying and characterizing potential non-target impacts associated with *M. cruciger*, and on host specificity screening of the other candidate agents.

Burning. All houndstongue top growth, including seeds still attached to the inflorescence, is susceptible to heat damage and burning. However, post-burn growing conditions (open canopy, bare soil and reduced competition) may actually favor houndstongue invasion and re-establishment from surviving or migrant seed and taproot re-growth. Prescribed burning in late summer and early fall may reduce the spread of houndstongue.

Tilling. Houndstongue in cropland can be managed with minimum tillage. A single shallow tillage will kill rosettes and root crowns.

Re-vegetation. Houndstongue population establishment, growth and expansion are all positively related to disturbance. However, because houndstongue is characterized by a relatively low growth rate and weak competitive ability, rapid restoration, reclamation and re-vegetation of

disturbed sites can prevent or significantly reduce houndstongue establishment. Establishing competitive perennial grasses, followed by prescribed grazing management to maintain grass vigor will suppress houndstongue and prevent spread by seed. Refer to Montana Plant Materials Technical Note 46, 'Seeding Rates and Recommended Cultivars,' and Extension Bulletin EB19 'Dryland Pasture Species for Montana and Wyoming' for seeding rate guidance and re-vegetation species selection. State and area resource specialists can help determine the most appropriate, site-specific species mix, timing of seeding, and seeding methods.

Integrated Pest Management. An integrated houndstongue weed management program will include prevention, early detection and small-scale eradication, containment, and large-scale population reduction. Prevention is guided by how houndstongue spreads and its requirements for establishment and includes maintaining competitive plant communities and preventing seed imports by livestock and people. Early detection and small-scale eradication is achieved through persistent survey and aggressive herbicide application. Houndstongue populations are contained by herbicidal control of population borders and satellite populations, persistent low input control actions such as biological control insect releases that reduce seed production, and through cultivation of competitive plants. Large-scale population reduction is achieved over the long-term by applying management alternatives such as prescribed grazing to maintain healthy, competitive perennial grasses and judicial application of herbicides to reduce houndstongue populations.

References

De Clerck-Floate, R. 1997. Cattle as dispersers of hound's-tongue on rangeland in southeastern British Columbia. Journal of Range Management 50: 239-243.

De Clerck-Floate, R. and M. Schwarzlander. 2002. Host specificity of *Mogulones cruciger* (Coleoptera: Curculionidae), and biocontrol agent for houndstongue (*Cynoglossum officinale*), with emphasis on testing of native North American Boraginaceae. Biocontrol Science and Technology 12: 293-306.

Story, J.M. 2005. Houndstongue. In: Coombs, E.M., J.K. Clark, G.L. Piper, and A.F. Cofrancesco, Jr. (Eds), Biological Control of Invasive Plants in the United States. Oregon State Univ. Press, Corvallis. Page 445.

Upadhyaya, M.K., H.R. Tilsner, and M.D. Pitt. 1988. The biology of Canadian weeds. 87. *Cynoglossum officinale* L. Can J. Plant Sci. 68: 763-774.

Zouhar, K. 2002. *Cynoglossum officinale*. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/forb/cynoff/all.html