# Annotated Bibliography on the Ecology and Management of Invasive Species:

## Hairy cat's ear (*Hypochaeris radicata* L.) (synonym *Hypochoeris radicata* L.)


**prepared by**

**Juliet Craig, Silverwing Ecological Consulting, Nelson, BC**

**and**

**Marian McCoy, Vancouver, BC**

**for the Garry Oak Ecosystems Recovery Team**

**and the Nature Conservancy of Canada**


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## Peer-reviewed Journal Articles

**Aarssen, L. W.** 1981. The biology of Canadian Weeds—50: *Hypochoeris radicata* L. Canadian Journal of Plant Science 61 (2): 365-381.

> Author's abstract: This paper summarizes biological data on *Hypochoeris radicata* L. The plant competes well with other grassland species, displacing most other plants in pastures in Britain. *H. radicata* may have allelopathic effects on other species, and was observed to be autotoxic, explaining why plants are normally found as isolated individuals or a few in a group rather than pure stands. *H. radicata* was observed to be one of the first colonizers of pasture after a fire. In British Columbia, two generations per year are frequently found. Adequate control in turf can be obtained by applying 2,4-D or MCPA at 1.12 kg/ha. Susceptibility to other herbicides used in Canada is summarized. Effective control in badly infested fields is typically achieved by ploughing and cultivating for a year or two before re-seeding. *H. radicata* is also suppressed in permanent grasslands by applications of organic and inorganic fertilizers. Complete clearance of *H. radicata* was obtained with a flaming treatment, but after four months, the plants re-established to their original abundance. *Hypochoeris* mosaic virus (HMV) is common in *H. radicata* in western Canada but it is of no known control importance. Data on parasites for extra-Canadian studies are summarized.

**Batson, M. G.** 1999. Effect of pasture renovation on the size and composition of the germinable fraction of the seed pool beneath bent grass (*Agrostis castellana*) pastures in southern Victoria [Australia]. Australian Journal of Agricultural Research 50 (1): 87-92.

> Author's abstract: This paper investigated the potential for propagation of grass weeds from seed by measuring changes in the size and composition of the germinable fraction of the seed pool beneath 4 bent grass (*Agrostis castellana*) pastures in southern Victoria during renovation. Soil samples, for the estimation of the seed pool by seedling emergence in the glasshouse, were taken from a control and a renovated pasture on 3 occasions during renovation at each of the 4 sites. The depth distribution of seeds in the top 0–100 mm was assessed by dividing collected soil samples into depths of 0–30 mm and 30–100 mm.
>
> The total germinable seed pool (0–30 mm) ranged from 17 620 to 83 540 seedlings/m$^2$, as affected by the time of sampling. There were seedlings from 14 grass genera (12% contribution to the total seed pool), *Juncus* (60%), 4 leguminous genera (17%), and 22 other dicotyledonous genera (12%). The percentage change in the number of germinated seeds of grasses and dicotyledons between the first and second sampling was negative (–7.3% to –31.4%) beneath renovated pasture, as opposed to a positive change (29.0–174.4%) beneath undisturbed pasture; this was attributed to the prevention of seeding due to the cultivation of

the pasture associated with renovation. The percentage change in the number of germinated seeds of grasses and dicotyledons did not differ significantly between renovated and undisturbed pasture between the second and third sampling, which suggested that no more seed germinated in response to renovation. Re-distribution of germinable seed to lower depths (30–100 mm) with renovation was apparent for grasses and other dicotyledons, and would depress successful emergence of these seedlings.

Renovation prevented re-seeding of weeds and buried surface seed, but did not significantly stimulate additional seed to germinate the following autumn after renovation. Weed seeds were still present in the soil seed pool after renovation, which indicated that these species could potentially germinate and establish in new pastures.

**Brun, L. A., J. Le Corff, and J. Maillet.** 2003. Effects of elevated soil copper on phenology, growth and reproduction of five ruderal plant species. Environmental Pollution 122 (3): 361-368.

Authors' abstract: The repeated use of copper (Cu) fungicides to control vine downy mildew, caused by *Plasmopara viticola*, has been responsible for the heavy increase of Cu concentration in the upper layers of vineyard soils. To determine the effects of elevated soil Cu on plant development, we created an artificial soil gradient with Cu enrichments ranging from 0 to 400 mg kg(-1). On this gradient, and for five ruderal plant species commonly found in vineyards in southern France (*Poa annua* L., *Dactylis glomerata* L., *Senecio vulgaris* L., *Hypochoeris radicata* L., and *Andryala integriflolia* L.), we quantified survival, growth, and reproduction throughout one flowering season. High concentrations of Cu in the soil resulted in low survival, low total plant biomass, delay in flowering and fruiting, and low seed set. However, the effects differed among species. Furthermore, high soil Cu concentrations had contrasting effects on patterns of resource allocation depending on the plant species.

**Gilfedder, L., and J. B. Kirkpatrick.** 1993. Germinable soil seed and competitive relationships between a rare and native species and exotics in a semi-natural pasture in the Midlands, Tasmania. Biological Conservation 64 (2): 113-119.

Authors' abstract: *Helipterum albicans*, a disturbance-dependent, rare, native daisy, survives in a few semi-natural paddocks grazed by stock in the Tasmanian Midlands. The germinable soil seed bank in a basalt paddock with a large population of this daisy largely consisted of exotic and annual species. The peak germination for native species was in winter and early spring, while exotics dominated from late spring to autumn. The peak germination of *H. albicans* occurred soon after a similar peak of an exotic rosette herb, *Hypochoeris radicata*. An experiment with different mixtures of these two species demonstrated that *H. radicata* had a depressive effect on the growth of *H. albicans* while the reverse was not apparent. As both species colonize bare ground, a managed reduction in *Hypochoeris* density is likely to favour the rare native.

**Hartemink, N., E. Jongejans, and H. de Kroon.** 2004. Flexible life history responses to flower and rosette bud removal in three perennial herbs. Oikos 105: 159-167.

Authors' abstract: In a garden experiment we investigated the response to continuous removal of either flower buds or rosette buds in three perennial grassland species (*Hypochaeris radicata, Succisa pratensis* and *Centaurea jacea*), which differ in longevity and flowering type. We distinguished two possible responses: compensation for lost buds by making more buds of the same type, and switching towards development of other life history functions. Both responses were demonstrated in our experiment, but bud removal had significantly different effects in each of the three species. The degree of compensation and the expression of trade-offs between life history functions differed markedly between species and seem related to longevity and developmental constraints. With respect to switching, our results suggest costs of reproduction and a trade-off between life history functions, at least for *Hypochaeris* and *Succisa*. For these species weight of new rosettes increased when resource allocation to flowering was inhibited. In *Hypochaeris,* both compensation for lost flower buds and switching from lost rosette buds increased production of flower buds, underscoring the pivotal role of sexual reproduction in this short-lived species. The most prominent response seen in *Centaurea* is compensation for lost rosette buds, indicating that this long-lived species with monocarpic rosettes relies on rosette formation. Although *Succisa* does respond to bud removal, time is an important constraint in this species with long-lived rosettes and preformed flowering stalks. Trade-offs in *Succisa* seem to operate at a larger time scale, requiring long-lasting experiments to reveal them. We conclude that the response of these species to inflicted damage is likely to be linked to their longevity and developmental constraints.

**Hopkins, A., R. F. Pywell, S. Peel, R. H. Johnson, and P. J. Bowling.** 1999. Enhancement of botanical diversity of permanent grassland and impact on hay production in Environmentally Sensitive Areas in the UK. Grass and Forage Science 54 (2): 163-173.

Authors' abstract: Five methods for increasing the botanical diversity of permanent grassland, either by sowing site-specific species-rich grass/forb seed mixtures (strip-seeding; or over-sowing after sward disturbance by light harrowing, partial rotary cultivation or turf removal), or by introducing transplanted plug plants, were compared with a control treatment in replicated field experiments on six farm sites in Environmentally Sensitive Areas (ESAs) in England and Wales. Effects on herbage production under hay cutting in July and on botanical composition were recorded in the two subsequent years. Turf removal before sowing was the only treatment that significantly reduced herbage production; this treatment also had the greatest effect on increasing botanical diversity (to a mean of twenty-eight plant species per site compared with fifteen species for the control two years after sowing). The least successful establishment of sown species resulted from light harrowing before sowing; the rotary-cultivated and strip-seeded treatments increased species diversity, although by less than turf removal. Successful establishment of introduced species was greatest on sites having a low soil nutrient status. Species that established successfully from seed on most sites and treatments included the grasses *Alopecurus pratensis, Cynosurus cristatus, Festuca rubra* and *Phleum pratense,* and the forbs *Achillea millefolium, Leucanthemum vulgare, Plantago lanceolata* and *Prunella vulgaris*; in addition, *Centaurea nigra, Hypochoeris radicata* and *Lotus corniculatus* were also established by one or more methods on most sites, *Lychnis flos-cuculi* established successfully on mesotrophic sites, and *Medicago lupulina* on calcareous sites. Several species failed to establish at all or most sites where they were sown, e.g. *Helianthemum nummularium*, *Pimpinella saxifraga* and *Rhinanthus minor*. Most transplanted plug-plant species established successfully in the short term, but many failed to persist or their frequency in the sward remained low; exceptions included *A. millefolium* and *P. lanceolata*. The results are discussed in relation to the requirements for management to further the objectives of ESAs and agri-environmental schemes.

**Leigh, J. H., D. H. Wood, A. V. Slee, and M. D. Holgate.** 1991. The effects of burning and simulated grazing on productivity, forage quality, mortality and flowering of eight sub-alpine herbs in Kosciusko National Park. Australian Journal of Botany 39 (2): 97-118.

Authors' abstract: The effects of simulated grazing and burning on biomass production, forage quality (crude protein and dry matter digestibility), plant mortality and flowering of four native perennial grasses (*Poa phillipsiana, P. sieberana, Danthonia pilosa* and *Festuca asperula*) and four perennial forbs (*Aciphylla simplicifolia, Arthropodium milleflorum, Bulbine bulbosa* and *Hypochoeris radicata*) growing in Kosciusko National Park were studied over a 16-month period. Cutting at 8-weekly intervals reduced the amount of regrowth at successive harvests as well as the survival of individuals. The season in which a single cut was made generally had a greater effect on the amount of regrowth than length of the regrowth period. Burning promoted flowering and improved the forage quality of the grasses. Rabbits bred only when they were able to obtain forage with a minimum protein content of 14%, provided mainly by the forb species. The management implications resulting from the interaction of fire and grazing, particularly by rabbits and domestic stock, for ecosystem quality are discussed.

**Moles, R., J. Breen, and B. O'Regan.** 2005. A pilot scale long-term experimental study on the effects of grazing and gap creation on Burren grassland dynamics: implications for conservation. Biology and Environment: Proceedings of the Royal Irish Academy 105B (1): 15-32.

Authors' abstract: Burren grassland is an important habitat for biodiversity conservation, but studies to date have not provided sufficient scientific understanding of vegetation dynamics to inform selection of appropriate management prescriptions. This paper reports on a pilot scale study on a small grassland patch on limestone pavement near Mullach More in the Burren National Park. Through experimental manipulation, it examines the effects of grazing and bare soil gap creation on vegetation dynamics and reproductive success over six years, with a focus on temporal changes in cover, species richness, flowering rates, turnover and mobility. Cessation of grazing resulted in very marked frequency reductions for most species, but increases for some grasses and increased flowering frequency in some forb species. Gap creation resulted in vegetation change that persisted for at least two years under ungrazed treatment, but for six years in grazed sward. Soil depth decreased under grazing but increased under ungrazed treatment. The grassland patch had attributes suggestive of both equilibrium and non-equilibrium vegetation dynamics. As the small study area selected may not be fully representative of the markedly heterogeneous Burren landscape, this paper does not arrive at conclusions in relation to all Burren grasslands and their conservation, but rather identifies some attributes important in informing prescription selection that require further testing at larger scale.

[*Hypochaeris radicata* was included among the plant species measured, and the paper outlines the plant communities that this species falls within.]

**Oliveira, S., and T. Maria.** 1992. Effects of mollusc grazing on the development of grassland species. Journal of Vegetation Science 3 (2): 267-270.

Authors' abstract: The effects of grazing by the molluscs *Helix aspersa* and *Deroceros reticulatus* on five plant species of early successional plant communities was studied. Mixtures of *Hypochoeris radicata, Plantago lanceolata, Plantago major, Ranunculus acris* and *Lolium perenne* were grown from seed and subjected to grazing. Percentage cover and total yield were determined for razed and un-razed mixtures. Grazing had a significant effect on four out of the five species and the differences between the two mollusc species were significant for four species.

**Pauchard, A., and P. B. Alaback.** 2004. Influence of elevation, land use, and landscape context on patterns of alien plant invasions along roadsides in protected areas of south-central Chile. Conservation Biology 18 (1): 238-248.

Also online: http://www2.udec.cl/~pauchard/villa02.pdf

This research found *Hypochaeris radicata* to be the most common and abundant species on roadsides surveyed in Chile. The species was also found at high elevations and in grazed pastures.

**Pico, F. X., N. J. Ouborg, and J. Van Groenendael.** 2004. Influence of selfing and maternal effects on life-cycle traits and dispersal ability in the herb *Hypochaeris radicata* (Asteraceae). Botanical Journal of the Linnean Society 146 (2): 163-170.

Authors' abstract: The ecological and evolutionary implications of dispersal are many. Pollination type and maternal effects may affect plant fitness traits, including life-cycle traits as well as dispersal ability. This study investigated the joint influence of pollination type and maternal effects on both life-cycle traits and dispersal ability in the herb *Hypochaeris radicata*. We conducted experimental crosses to obtain selfed and outcrossed progeny. Individual seeds and their pappuses were measured to determine seed terminal velocity. Seed size was also used to assess maternal effects. Selfing dramatically decreased seed set, indicating that *H. radicata* is self-incompatible. However, the few selfed seeds produced outperformed outcrossed seeds in seed size and flowering probability, surely as a result of an effective reallocation of resources among selfed seeds. None of the life-cycle traits was affected by seed size, the estimate of maternal effects. Selfed seeds were larger and bore a smaller pappus than outcrossed seeds. As a result, dispersal ability was lower for selfed than outcrossed seeds. Several factors, such as the low proportion of plants that produced selfed seeds, the low number of selfed seeds produced per plant, and the lack of self-fertility mechanisms might act in concert to prevent the evolution of selfing in *H. radicata*.

**Rew, L. J., C. L. Alston, S. Harden, and W. L. Felton.** 2000. Counts versus categories: choosing the more appropriate weed scoring method. Australian Journal of Experimental Agriculture 40 (8): 1121-1129.

Authors' abstract: Weed sampling can be a time consuming and repetitive task if populations are to be adequately monitored. In situations where there are a range of species densities, high numbers of samples are required, and/or where the sample area is large, it may be appropriate to group weed densities into ordinal categories. An ordinal system is outlined in which weed densities were categorised into 8 groups. Weed species composition and density were assessed using the category and count methods, on 10 fields in northern New South Wales. A multinomial distribution was used within a generalised linear model framework, to assess the validity of the category method. A simulation study was also conducted to assess the performance of the 2 scoring methods. The main difference between the count and category predictions is that count data produce a population mean, whereas ordinal scores provide a mean within a categorical range. Collecting categorical data is less time consuming, particularly for higher weed densities. However, the simulations showed that to determine significant differences between population means required more samples using the category method (15-30) compared with less than 20 for the count method, assuming a satisfactory study power of 0.9. The category method is reliable, particularly where general trends or baseline information are required from the data. When the population density is low and more detailed information is required, counts are a more appropriate methodology.

**Soons, M. B., and G. W. Heil.** 2002. Reduced colonization capacity in fragmented populations of wind-dispersed grassland forbs. Journal of Ecology 90 (6): 1033-1043.

Authors' abstract: Habitat fragmentation as a result of intensification of agricultural practices decreases the population size and increases the site productivity of remnant populations of many plant species native to nutrient-poor, species-rich grasslands. Little is known about how this affects the colonization capacity of populations, which is highly important for regional species survival. We studied the effects on four wind-dispersed forbs that represent two major dispersal strategies in grasslands: *Cirsium dissectum* and *Hypochaeris radicata*, which have plumed seeds and are adapted to long-distance dispersal by wind, and *Centaurea jacea* and *Succisa pratensis*, which have plumeless seeds and are adapted to only short-distance dispersal by wind. Colonization capacity decreased with decreasing population size. This was due to lower seed germination ability in all species, and a lower seed production and a narrower range of seed dispersal distances in the species with plumed seeds. Inbreeding depression is the most likely cause of this. We found no evidence for a stronger selection for reduced dispersal in smaller populations. Increasing site productivity changed the colonization capacity of all species. The capacity for colonization of nearby sites increased, due to higher seed production and seed germination ability, but the capacity for colonization of distant sites decreased, due to a lower long-distance dispersal ability. Seed dispersal ability and germination ability were negatively correlated in the species with plumeless seeds, but not in the species with plumed seeds. The dispersal ability of individual plumed seeds remained constant under changes in population size and site productivity. This indicates a strong selection pressure for long-distance dispersal ability in these species. When habitat fragmentation results in a simultaneous decrease in population size and increase in site productivity, both the local survival probability and the colonization capacity of remnant populations of wind-dispersed grassland forbs are likely to be severely reduced. This increases regional extinction risks of the species.

**Sun, D., and M. J. Liddle.** 1993. Plant morphological characteristics and resistance to simulated trampling. Environmental Management 17 (4): 511-521.

Authors' abstract: The relationship between responses of plants to trampling and their morphological characteristics was studied in a glasshouse experiment. Thirteen species with four different growth forms were used in this experiment. They were: five tussock species, *Chloris gayana, Eragrostis tenuifolia, Lolium perenne, Panicum maximum*, and *Sporobolus elongates*; three prostrate grasses, *Axonopus compressus, Cynodon dactylon*, and *Trifolium repens*; two herbaceous species, *Daucus glochidiatus* and *Hypochoeris radicata*; and three woody species, *Acacia macradenia, Acrotriche aggregata*, and *Sida rhombifolia*. These species were subjected to three levels of simulated trampling. For each species, measurements were taken of aboveground biomass, root biomass, leaf length, leaf width, leaf thickness, leaf number, broken leaf number and plant height. Overall, these measurements were greatest in the control plants, moderate in the level of light trampling, and the lowest in the level of heavy trampling. Biomass was used as a basis of the assessment of plant resistance to trampling. Three tussock species, *Eragrostis tenuifolia, Lolium perenne*, and *Sporobolus elongatus,* had a high resistance. Woody and erect herbaceous plants were more intolerant to trampling. There appear to be two processes involved in the reduction of the plant parameters: direct physical damage with portions of the plants detached, and physiological changes, which slow down vegetative growth rates. Plant height was found to be the most sensitive indicator of trampling damage.

**Tsuyuzaki, S. 2002.** Vegetation development patterns of ski slopes in lowland Hokkaido northern Japan. Biological Conservation 108 (2): 239-246.

Author's abstract: The montane zones of Japan are usually covered with well-developed forests, and most ski resorts are also constructed there. The construction of ski slopes therefore requires the destruction of forest ecosystems. To detect vegetation development patterns on ski slopes, I assessed vegetation on seven ski slopes in the lowland of Hokkaido Island, Japan, using 155 2 m x 2 m plots. The surrounding vegetation consisted mostly of broad-leaved forests with a floor of dwarf bamboo, *Sasa senanensis*. The ski slopes were established 5-28 years before the surveys by scraping off the topsoil, followed by artificial seeding. The data of vegetation, which I analyzed using TWINSPAN, resulted in six different grassland types: (A) *Miscanthus sinensis-Hypochaeris radicata*, (B) introduced herbs with low richness, (C) introduced herbs, (D) *Artemisia montana*, (E) *M. sinensis-Pueraria lobata-A. montana*, and (F) *Solidago gigantea* var. *leiophylla*. *H. radicata* and *S. gigantea* var. *leiophylla* are alien species. Vegetation dominated by introduced grasses for erosion control, such as *Dactylis glomerata* and *Poa pratensis*, should be initial vegetation on the ski slopes. Most tree pioneer species established in vegetation type A, which was the most natural vegetation on the ski slopes. Type A had highest species richness, and seemed to proceed from types B and C where the latter two types were in decline. Therefore, type A should be preferable for the management and restoration of ski slope vegetation. Type D established on newer ski slopes, while types E and F established on older ski slopes. Results including detrended correspondence analysis suggested that vegetation types D, E, and F proceeded through a distorted process of succession, i.e. biological invasion changed the native successional sere. Based on these results, I recommend that the restriction of alien invasion and careful monitoring on *M. sinensis* grasslands are required to restore the natural vegetation.

**Tveten, R. K., and R. W. Fonda.** 1999. Fire effects on prairies and oak woodlands on Fort Lewis, Washington. Northwest Science. 73 (3): 145-157.

Authors' abstract: Before 1800, frequent fires maintained Idaho fescue prairies and Garry oak woodlands on Fort Lewis. Fire exclusion in the 1900s, however, has allowed Scot's broom, Douglas-fir, and numerous herbaceous aliens to invade native prairies and oak woodlands. Since 1978, a management program using prescribed fires on 3-5 yr rotations has been used in an effort to maintain the open communities. We evaluated the role of fire on fescue prairies, oak woodlands, and broom thickets using prescribed fires in fall 1994 and spring 1995, and compared preburn/postburn species frequency to identify fire maintainers, increasers, and decreasers. Fall fires were more effective than spring fires, and best promoted native species and communities. Prescribed fires had no effect on Idaho fescue frequency, which maintained dominance in the postfire prairie. Other native prairie graminoids and forbs, and hairy cats-ear, a prominent alien, were maintained by fire. Prescribed fires also maintained open Garry oak woodlands, reduced Scot's broom cover in broom thickets, and killed small Douglas-fir trees. These fires, however, tended to favour alien species rather than native species. A large prairie subjected to >50 years of broadcast burns ignited annually by artillery fire has been converted from fescue prairie to an open meadow dominated by hairy cats-ear and alien grasses, such as sweet vernal grass. Of the three regimes we investigated, fire intervals shorter or longer than the 3-5 yr fire rotation now employed on Fort Lewis are detrimental to fescue prairie and oak woodland. Excessive burning or fire exclusion causes loss of prairie and oak woodland.

**Wilson, J. B., P. A. Williams, and W. G. Lee.** 1989. Vegetation composition and segregation in relation to the environment at low altitudes in the Upper Clutha basin, New Zealand. New Zealand Journal of Ecology 12: 103-116.

Also online: http://www.nzes.org.nz/nzje/free_issues/NZJEcol12_103.pdf

Authors' abstract: The vegetation of an area of the Upper Clutha basin, New Zealand, with a "semi-arid" climate, was sampled with 95 quadrats in a nested randomised design. All types of vegetation were sampled, from near natural to managed pastures. Twenty-four environmental factors were measured in each quadrat. Five "formations" are described, and 14 "communities" recognised within them, although there are few constant or faithful species. Such weak structure, and relatively weak correlation with the environment, are partly attributed to non-equilibrium. All formations, and many of the communities, are scattered over the area. The most important environmental factors in determining the vegetation are latitude, elevation, soil fertility (especially sulphate) and water. All sites contain exotic species; some contain only exotics. Correlation between the sizes of the native and exotic guilds gave no evidence that natives and exotics were competing for niches. The lowest proportion of exotics is at higher elevations and on steeper slopes. Analyses showed a strong gradient from near-natural vegetation to managed pastures, but with no discontinuity. Agricultural communities, especially lucerne fields, include species typical of unmanaged sites in similar conditions.

[*Hypochaeris radicata* was included among the plant species measured, and the paper outlines the plant communities that this species falls within.]

# Other Published Sources

**Douglas, G. W., G. B. Straley, D. V. Meidinger, and J. Pojar (eds.).** 1998. Illustrated Flora of British Columbia, Volume 1: Gymnosperms and Dicotyledons (Aceraceae through Asteraceae). BC Ministry of Environment, Lands and Parks and BC Ministry of Forests, Victoria, BC. 436 pp.

This comprehensive reference has excellent identification keys and detailed technical descriptions of vegetative and sexual morphology. This flora is the taxonomic authority for the invasive species fact sheets (unless otherwise indicated). Douglas et al. describe the habitat of *Hypochaeris radicata* L., as mesic to dry roadsides, lawns, pastures and waste places in the steppe and lowland zones; common in southwest BC; introduced from Europe.

**Fairbanks, M., and K. Wilkinson.** 2003. COSEWIC status report on the coastal Scouler's catchfly *Silene scouleri* ssp. *grandis* in Canada, *in* COSEWIC assessment and status report on the coastal Scouler's catchfly *Silene scouleri* ssp. *grandis* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 1-17 pp.

Also online:
http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fcoastal%5Fscouler%5Fcatchfly%5Fe%2Epdf

The coastal Scouler's catchfly occurs on three small islands off Victoria and is an endangered species that is associated with Garry oak ecosystems. Its distribution is limited and this report states that *Hypochaeris radicata* is an associated species. There is no reference to actual impacts of *Hypochaeris* on catchfly.

**Fairbarns, M.** 2004. COSEWIC status report on the rosy owl-clover *Orthocarpus bracteosus* in Canada, *in* COSEWIC assessment and status report on the Rosy owl-clover *Orthocarpus bracteosus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 1-18 pp.

Also online: http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Frosy%5Fowl%5Fclover%5Fe%2Epdf

> This report, which outlines the status of the endangered rosy owl-clover, indicates that *Hypochaeris radicata* is infesting the only population known of this species in Canada, located near Victoria, BC. According to the document, there is a limited degree of invasion by *Hypochaeris radicata* at this site, and it is "not clear whether their populations can increase further." *Hypochaeris* is considered a potential threat to this site as a component of alien invasion and habitat degradation.

**Gilkey, H. M.** 1957. Weeds of the Pacific Northwest. Oregon State College, Corvallis, OR. 441 pp.

> This book includes a descriptive paragraph, line drawings, and brief discussion about how and how readily *Hypochaeris radicata* spreads. No information on control measures.

**Knight, A. P., and R. G. Walter (eds.).** 2004. A Guide to Plant Poisoning of Animals in North America. Teton NewMedia, Jackson, WY.

Also online: http://www.ivis.org/special_books/Knight/chap9/chapter_frm.asp?LA=1#Flatweed

> This book and website provide an overview of toxic plants including habitat, description and grazing impacts of *Hypochaeris radicata*. According to this site, "no specific toxin has been identified in flatweed. Horses preferentially grazing flatweed have been reported to develop a unique lameness syndrome described in Australia as Australian stringhalt. A similar syndrome has been reported in horses grazing flatweed in California. Attempts at experimentally reproducing the disease by feeding flatweed to horses have been unsuccessful, suggesting that other factors may be involved in the pathogenesis of the disease."

**Penny, J. L., and B. Costanzo.** 2004. COSEWIC status report on the dwarf sandwort *Minuartia pusilla* Canada, *in* COSEWIC assessment and status report on the dwarf sandwort *Minuartia pusilla* Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 1-17 pp.

Also online: http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fdwarf%5Fsandwort%5Fe%2Epdf

> This report outlines the status of the endangered dwarf sandwort, and indicates that *Hypochaeris radicata* is associated with the only confirmed site in Canada on southern Vancouver Island.

**Ryan, M., and G. W. Douglas.** 1996. COSEWIC status report on seaside birds-foot lotus *Lotus formosissimus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. 1-18 pp.

Also online: http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fseasidebird%5Ffoot%5Fe%2Epdf

This report outlines the conservation of seaside birds-foot lotus, a rare plant species found only at five sites in Canada, including Victoria and nearby islands. The vegetation at some of these sites includes the introduced *Hypochaeris radicata*, although impacts of this species on the lotus's habitat is not mentioned.

**Taylor, R. J.** 1990. Northwest Weeds: The Ugly and Beautiful Villains of Fields, Gardens and Roadsides. Mountain Press Publishing, Missoula, MT. 177 pp.

This book includes a descriptive paragraph and good photos that allow comparison to similar species with which *Hypochaeris radicata* may be confused. No information on control measures.

**Whitson, T. D.** 2002. Weeds of the West. 9th edition. Western Society of Weed Science in cooperation with the Western United States Land Grant Universities Cooperative Extension Services and the University of Wyoming, Laramie, WY. 628 pp.

This book provides photographs of *Hypochaeris radicata,* and information on identification and distribution.

## Unpublished Sources and Websites

**Calflora.** No date. *Hypochaeris radicata* L. Calflora, Albany, CA.
http://www.calflora.org/cgi-bin/species_query.cgi?where-cname=hairy+catsear

This website contains information about the distribution of *Hypochaeris radicata* in California and links to other information sources. In California, this species' status is "Need More Information."

**Charters, M. L.** No date. *Hypochaeris radicata* (Rough Cat's Ear). Southern California Wildflowers and Other Plants, CA.
http://www.calflora.net/bloomingplants/roughcatsear.html

Excellent photos and a brief summary for identification.

**Dellow, J. J., W. M. King, G. C. Wilson, and B. A. Auld.** 2004. *Hypochaeris radicata* L., The Most Common Broadleaf Weed of the Perennial Pasture Zone of New South Wales. *In* Sindel, B. M., and S. B. Johnson (eds.). Proceedings of the 14th Australian Weeds Conference, Weed Society of New South Wales, Sydney, Australia.

Authors' abstract: Surveys of the temperate perennial pasture zone of New South Wales in spring 1999, autumn 2001 and spring 2001 recorded *Hypochaeris radicata* L. (catsear or flatweed) as the most common broadleaf weedy species. The pasture species, *Trifolium subterranean* L. was the only broadleaf species which exceeded or equaled *H. radicata* in paddock frequency for each of the three seasons surveyed. The weediness of *H. radicata* remains a vexed question when the plant's grazing attributes are taken into consideration.

**Descriptions of Plant Viruses.** 1983. *Hypochoeris* Mosaic Virus. Association of Applied Biologists, Warwick, England.
http://www.dpvweb.net/dpv/showadpv.php?dpvno=273

This website describes a virus whose only known hosts are *Hypochaeris radicata* and *Leontodon autumnalis*.

**Enature.** No date. Camas Pocket Gopher. National Wildlife Federation, San Francisco, CA.
http://www.enature.com/fieldguide/showSpeciesSH.asp?curGroupID=5&shapeID=1037&curPageNum=7&recnum=MA0377

According to this website, the camas pocket gopher (*Thomomys bulbivorus*) cuts and stores the roots of *Hypochaeris radicata* to eat them later.

**Endangered Species Information System.** 1996. Oregon Silverspot Butterfly. Conservation Management Institute, Blacksburg, VA.
http://fwie.fw.vt.edu/WWW/esis/lists/e501002.htm

The Oregon silverspot butterfly is considered threatened. This website describes the taxonomy, habitat and life history of this butterfly species. Locations are described where the butterfly uses *Hypochaeris radicata*, along with other native and exotic species, as a source of nectar.

**ESSA Technologies Ltd.** 2002. Top 10 Invasive Plant Species Currently Threatening GOEs in British Columbia. Vancouver, BC.
http://www.essa.com/projects/descriptions/garryoak/top10.htm

Experts were asked to rank a list of candidate species according to three separate criteria: 1. Significance of impact, 2. Difficulty of control or management, and 3. Urgency of control or management. *Hypochaeris radicata* was ranked very highly by the experts interviewed for "significance of impact."

**Fitzpatrick, G.** 2004. Techniques for Restoring Native Plant Communities in Upland and Wetland Prairies in the Midwest and West Coast Regions of North America. City of Eugene—Parks and Open Space Division, Eugene, OR.
http://www.ci.eugene.or.us/parks/wetlands/pdfs/EPA-WhitePaperFinal.pdf

Author's abstract: Prairies are unique from other biomes, in that they are open habitats comprised mainly of herbaceous plants with only a scattering of trees. One of the important ecological attributes of prairies is their high plant species richness. Midwest and West Coast prairies exhibit major differences in climate, vegetation types, disturbance regimes (e.g., fire and grazing), and soils, which provide an important context for restoration activities. Most prairies in the Midwest and West Coast regions have been reduced to less than 1-2 percent of their former size. The remaining remnant prairies are generally small in comparison to historic sizes, exist in isolation and are degraded due to invasion of introduced species and disruption of ecological processes such as fire. Successful ecological restoration of land that was originally prairie requires accomplishing certain objectives: 1) reducing the abundance of non-native species and woody vegetation, 2) reducing the weed seed bank, 3) improving the competitive environment for natives, 4) successful planting of native species, and 5) successful post-seeding management.

After reviewing the scientific literature on prairie restoration in the Midwest and the West Coast regions of the United States, I suggest various restoration techniques for addressing the five objectives, including: cultivation, herbicides, flaming/infrared burning, solarization, carbon addition/nutrient immobilization, mycorrhizal inoculation and implementing various seeding methods and seed mixes. Short and long-term management techniques include hand weeding, herbicides, mowing, grazing and prescribed burning. One of the essential lessons learned by restoration ecologists and practitioners trying to restore native prairie, is that there is not one technique or combination of techniques that work for all restoration sites, i.e., there is no magic bullet. Restoration techniques will need to be site specific and may depend on many things including past disturbance events, assemblage of plants, including non-natives and natives, and site conditions such as soils, topography, hydrology, and climate.

[Excerpts from the report (including references to other studies): Nighttime tilling of an upland pasture field being restored to native prairie was ineffective at reducing the cover of *Hypochaeris radicata*. Field observations in Oregon have found that *H. radicata* increased after flaming, possibly due to protective hairs on their leaves and their ability to quickly colonize open soil. In Oregon in an upland field, researchers using an infrared burner after tilling and prior to seeding found burning to be more effective than a single application of glyphosate at reducing introduced forbs (*H. radicata*). In a wetland prairie, solarization reduced the emergence of dicots and reduced seeds of *H. radicata* compared to the control. Burning significantly increased seedling establishment of some non-native species compared to unburned plots, including *H. radicata*. A long-term study in an Oregon wet prairie showed that some non-natives (e.g., *H. radicata*) that showed an initial increase in population after burning retained this advantage 10 years after burning ceased.]

**FloraBase.** No date. *Hypochaeris radicata*. The Western Australian Flora, Western Australian Herbarium, Western Australia.
http://florabase.calm.wa.gov.au/browse/flora?f=345&level=s&id=9352

This website provides general botanical information about *Hypochaeris radicata*, as well as its specific distribution in Western Australia.

**Gucker, C.** No date. Hairy Catsear *(Hypochaeris radicata)*. University of Idaho, Moscow, ID.
http://www.cnr.uidaho.edu/range454/2003%20Pet%20weeds/hiary_cats_ear.html

An overview of *Hypochaeris radicata* including description, identification, distribution, biology, ecology, impacts and management options.

**Hawaiian Ecosystems at Risk Project.** 2001. *Hypochaeris radicata* L. A Global Compendium of Weeds.
http://www.hear.org/gcw/html/index.html

Very basic information on *Hypochaeris radicata*, and crosslinks to related references from around the world.

**Hilty, J.** 2004. Rough Cat's Ear. Illinois Wildflowers, IL.
http://www.illinoiswildflowers.info/weeds/plants/rgh_catear.htm

This website provides information on identification, cultivation, range and habitat, faunal associations, and general comments.

**Honeybee Australis.** No date. Flatweed, False Dandelion. Australia. http://www.honeybee.com.au/Library/pollen/radicata.html

This website outlines *Hypochaeris radicata* as a pollen source for bees. According to this website, the pollen is not good quality but very palatable for bees.

**Jongejans, E.** 2004. Life history strategies and biomass allocation: The population dynamic of perennial plants in a regional perspective. Wageningen University dissertation no. 3668, Wageningen, the Netherlands.

Full abstract online: http://library.wur.nl/wda/abstracts/ab3668.html

Author's abstract (abridged): This study explores how plants respond to adverse influences of intensified land use. In particular, attention was paid to the ways in which life history strategies change in order to buffer environmental variation, and which important parts of the life cycle are affected most. … In this study I concentrate on four co-occurring perennial herbs in nutrient-poor, species-rich meadows. With three species from the Asteraceae (*Cirsium dissectum* (L.) Hill, *Hypochaeris radicata* L. and *Centaurea jacea* L.) and one from the Dipsacaceae (*Succisa pratensis* Moench), the species are phylogenetically related but have contrasting life history strategies as they differ in the life-span of their rosettes and in the rate of clonal propagation. …

In a one-season garden experiment we continuously removed either rosette buds or flower buds to study the responses to damage. All investigated plants compensated for the removed buds. The short-lived species (*H. radicata*) showed stronger compensation for lost flower buds than the longer-lived species (*S. pratensis* and *C. jacea*), and the species with a high clonal propagation rate (*C. jacea*) compensated more strongly for lost rosette buds than the infrequently ramifying species. However, two species (*H. radicata* and *S. pratensis*) also switched to increased rosette formation when flower buds were removed. … Mortality rates increased under fertilization in two target species (*H. radicata* and *C. dissectum*) probably because they lacked a means of competing with the grasses. Three target species increased their relative allocation to flowers and seeds when their plots were enriched, while their relative allocation to storage did not decrease but in some species even slightly increased. …

By sampling flowering plants and flower heads with seeds and by performing seed addition experiments we quantified for each species all involved steps: flower head production, flower production, seed set, seed predation and establishment as seedlings. The two infrequently ramifying species (*H. radicata* and *S. pratensis*) had high numbers of seedlings per flowering rosette: more than one on average. …

The whole life cycle is studied for three species (*S. pratensis*, *H. radicata* and *C. jacea*). … The calculated population growth rates were lowest in the most short-lived species (*H. radicata*) and most stable in the most clonal species (*C. jacea*). … In order to model effects on life history components and plant traits we built a hierarchical matrix in which each element was a function of life history components and many of the components in turn were functions of plant traits. The negative effects of fertilization on the population growth rate by increased mortality rates in the two weak competitors (*C. dissectum* and *H. radicata*) overruled other effects and caused strong population declines. …We therefore conclude that although the life history responses of these perennials are rather flexible, their populations will go extinct in grasslands that have become more productive through succession and nutrient enrichment. The decline of small populations can be expected to be even accelerated by inbreeding depressions. However, when increased allocation to sexual reproduction leads to increased seed production for the total population, this flexible life history response may have positive effects on the dynamics of a species in the landscape through increased colonization probabilities.

**Klinkenberg, B.** 2004. E-Flora BC: Atlas of the Plants of British Columbia. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver, BC. http://www.eflora.bc.ca/

This site provides information on the distribution of *Hypochaeris radicata* in BC as well as information on identification, ecology, habitat and nomenclature with links to other relevant websites.

**Natural Resources Conservation Service.** No date. Plants Profile: *Hypochaeris radicata* L. Hairy Catsear. United States Department of Agriculture Plants Database, Washington, DC. http://plants.usda.gov/index.html

This website provides excellent information including an illustrated description of *Hypochaeris radicata*, alternative nomenclature, distribution by state, the classification system for this species and the invasiveness and noxious status for each state. The site also provides links to other US websites.

**NatureServe.** 2005. Invasive Species Impact Ranks for the United States. Arlington, VA. http://www.natureserve.org/getData/plantData.jsp

NatureServe is assessing all of the estimated 3500 non-native plant species that have escaped from cultivation in the US using a new methodology called “Invasive Species Assessment Protocol.” This system, developed by NatureServe, the Nature Conservancy and the National Park Service, creates a prioritized list of non-native plants and their impact on biodiversity. The site also includes citations and references used in assessing the species. According to this matrix (January 10, 2005), *Hypochaeris radicata* has a national impact rank of high/low.

**NatureServe Explorer.** 2005. Comprehensive Report *Hypochaeris radicata*. NatureServe, Arlington, VA.
http://natureserve.org/explorer/servlet/NatureServe?searchName=Hypochaeris%20radicata

This website provides a distribution map for *Hypochaeris radicata* in Canada and the United States and provides information on the species’ status (exotic). According to this distribution map, *H. radicata* is found primarily in coastal regions of the continent.

**Neumann, A. J.** 1999. “Doc, I’d Like to Know More About Stringhalt.” The Draft Horse Journal, Waverly, IA.
http://www.drafthorsejournal.com/vetcolumns/autumn99/autumn99.htm

Information on stringhalt, the condition in livestock thought to be associated with toxicity of *Hypochaeris radicata*.

**Ohio State University.** No date. Seed Biology. Department of Horticulture and Crop Science, Ohio State University, Columbus, OH.
http://www.ag.ohio-state.edu/~seedbio/seed_id/asteraceae/hypochaeris_radicata.html

This website contains a close-up photo of *Hypochaeris radicata* seeds for identification.

**Plants for a Future Database.** No date. *Hypochoeris radicata*. Plants for a Future, Chapel Hill, NC.
http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Hypochoeris+radicata&CAN=COMIND

This database provides information on physical characteristics, habitats and locations, edible and medicinal uses, cultivation and propagation. There are also links to numerous other sites.

### General summaries of basic information, or fact sheets:

- http://www.ipm.ucdavis.edu/PMG/WEEDS/spotted_catsear.html
- http://www.plant-identification.co.uk/skye/compositae/hypochaeris-radicata.htm
- http://www.nwcb.wa.gov/weed_info/Written_findings/Hypochaeris_radicata.html
- http://www.wildflower2.org/NPIN/Plants/Detail.asp?Scientific_Name=Hypochaeris%20radicata
- http://www.naturewatchbaltic.org/tools/booklets/sanddune/main/78.htm
- http://www.ppws.vt.edu/scott/weed_id/hryra.htm
- http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/wildflowers/hypochoeris_radicata.html
- http://www.weeds.asn.au/weeds/txts/cats_ear.htm

### Excellent photos:

- http://www.missouriplants.com/Yellowalt/Hypochaeris_radicata_page.html
- http://www.drgndrop.com/garden/localPlants/pioneers/catsEar.html

# Personal Communications

**Arnold, John.** 2005. *Personal communication*. Supervisor for Woodlands, Government House, Victoria, BC. March 22, 2005.

Arnold has treated hairy cat’s ear at Government House in Victoria. He digs the plants out with small hand mattocks. He notes that there are so many plants that it is difficult to be effective.

**Beckwith, Brenda.** 2005. *Personal communication*. Ethnoecologist, University of Victoria, Victoria, BC. March 18, 2005.

Beckwith considers hairy cat’s ear to be the most overlooked, ignored and invasive herbaceous weed in Garry oak ecosystems. It is ubiquitous and likely will be very difficult to get rid of at this point. She notes that its large leaves can block other plants and she has seen it successfully outcompete native plant species. In her vegetation plots on rock outcrop/ meadow sites she noted that there was camas underneath the leaves of hairy cat's ear, and the camas was working its way up through this invasive plant in a twisted, contorted fashion. Cat's ears' leaves are close to the ground, and she has observed that they block space and light and essentially suffocate other species.

Data from her research plots in Garry oak ecosystems suggest that disturbance, particularly soil disturbance, favours growth and establishment of hairy cat's ear, but repeated burning may decrease cover over time. She also observed that doing nothing maintains hairy cat's ear at low cover, but, of course, the seeds are just waiting for a disturbance to happen. She found that the sites with the highest cover of hairy cat's ear also had the most moisture and deeper soils, and a bit of disturbance helped the hairy cat's ear become more established. The site with the lowest cover of hairy cat's ear had repeated burning, and the first summer fire was reportedly extremely hot, probably causing many of the seeds in this shallow-soiled site to be burned. Hairy cat's ear cover at a different site remained low because of the density of the camas, or because hairy cat's ear never was introduced to the site.

Beckwith predicts that climate change to drier conditions may affect hairy cat's ear, since she has observed that the plants on more xeric sites tend to be smaller and have shorter seed heads. For control methods, she notes that cat's ear plants have long taproots and must be pulled in their entirety. She suggests that mulching may work for this species, but that some native species may be hindered by this method.

**Betts, Michael.** 2005. *Personal communication*. Weed Specialist, Ministry of Agriculture, Food and Fisheries, Victoria, BC. March 22, 2005.

Betts notes that hairy cat's ear (also known as spotted cat's ear) is quite an aggressive species if it is not managed. It grows in similar habitats to dandelion, and some people call it "false dandelion." It does well in dry land situations, like lawns and turf grass areas. Because it has a deep taproot with several fibrous roots coming off it, hand-digging can be problematic. The species spreads well if the root system is broken up, with new growth coming from pieces of the root. Cat's ear plants seem to outcompete turf and don't respond well to cutting. It is a prolific early seed producer and spreads readily that way. Chemical control for this species would be effective.

**Boyer, Lynda.** 2005. *Personal communication*. Restoration Biologist and Native Materials Manager, Heritage Seedlings Inc., Salem, Oregon. March 21, 2005.

Boyer notes that in the prairie and oak habitats she has been restoring, hairy cat's ear is present but not dominant. If the desire is to selectively remove invasive species from a prairie remnant and hairy cat's ear is one of the problem species, she has found that the most effective herbicide for composites and legumes is one containing clopyralid (e.g. Confront). The best time to spot-spray this chemical is in the rosette stage. The effects can be seen in only a day so plants that were missed can be easily spotted. A chemical dye can also be added to the herbicide to ensure all plants are sprayed. However, clopyralid has a long life in the soil so it should be very carefully spot-sprayed. Spot-spraying is preferable to broadcast-spraying, which requires that native composites or legumes not be reintroduced until after one to two years, when the chemical degrades.

Boyer and others in the restoration community feel the largest threats to native species persistence on Garry oak prairies are perennial pasture grasses such as tall oatgrass, tall fescue, bentgrass and velvet grass. However, in some sites, invasive forbs such as hairy

cat's ear can also have a devastating impact due to their highly competitive nature and lack of natural predators.

**Ceska, Adolf.** 2005. *Personal communication*. Botanist, Victoria, BC. March 16, 2005.

Ceska has observed hairy cat's ear, along with a similar invasive species that he is concerned about, *Leontodon saxatillis*, most frequently in open areas associated with Garry oak, as well as in shallow-soil Garry oak ecosystems. He notes that the rosettes of these species take up space that would otherwise be utilized by native species, particularly native annuals that germinate in open areas.

**Costanzo, Brenda.** 2005. *Personal communication*. Plant Species at Risk Biologist, Ministry of Water, Land and Air Protection, Victoria, BC. February 28, 2005.

Costanzo has observed hairy cat's ear in disturbed areas, including old fields and pastures. This species, in conjunction with non-native grasses, can dominate sites that were once used for agricultural purposes. Since hairy cat's ear has a deep taproot that is difficult to kill, Costanzo predicts that the most successful control method would be herbicide use. She suggests the spread of this species could be reduced by preventing people from dumping compost and garden waste in Garry oak meadows.

**Delvin, Eric.** 2005. *Personal communication.* Thurston County Project Manager, The Nature Conservancy, Olympia, WA. March 14, 2005.

Delvin reports that hairy cat's ear is growing extensively throughout Olympia, Washington, especially in disturbed sites. In all lands that he works with, hairy cat's ear is either present or pervasive, more so in prairie sites than in Garry oak woodlands. Since its range is so extensive, it would be too difficult to hand-pull it all, and if herbicide is used, it would kill everything else including desired plants. Also, if herbicide treatment is used on grasses, it tends to open up bare soil allowing for the invasion of hairy cat's ear. Delvin notes that prescribed burning appears to have a positive influence on hairy cat's ear since the plant is not killed and the fire reduces competition. The Nature Conservancy has not specifically targeted hairy cat's ear for management because it is not a high priority of concern and it doesn't appear to change vegetative structure or soil characteristics. Delvin notes that many butterflies are nectaring on hairy cat's ear and, since native nectar sources are low, the Nature Conservancy is reluctant to remove this species without another nectar source to replace it.

**Erickson, Wayne.** 2005. *Personal communication*. Wildlife Conservation Ecologist, Ministry of Forests, Victoria, BC.

Erickson has done vegetation plots in various Garry oak ecosystems. He notes that hairy cat's ear was already widely established on most sites when he surveyed in 1993 and 1994. Its abundance was usually low (< 1% cover). It was a constant species (on all sites) on several of the more disturbed communities but reached its highest abundance (up to 10% cover) on a couple of the xeric but less disturbed communities. These data show the potential of hairy cat's ear to establish and even reach a degree of sub-dominance on some sites. The data do not include early seral or pioneer stages where the species is probably most important. The data also do not actually show whether cat's ear can be expected to decline with succession on these sites. However, if the ameliorization of site conditions with soil moisture regime is considered to be parallel to ameliorization with succession on xeric

sites, then a decline is indicated. Erickson predicts that the species will probably maintain an important role only in earlier successional sequences.

**Fairbarns, Matt.** 2005. *Personal communication*. Plant Ecologist, Aruncus Consulting, Victoria, BC. February 22, 2005.

Fairbarns has noticed hairy cat's ear growing in high abundance in most Garry oak ecosystems and meadow plots or vernal pool plots that he has ever measured, and considers it to be one of the most successful invasive weeds. It can lose out in competition with or suppression by tall grasses in deeper soil sites, but has probably displaced a lot of native plants. This species is found most commonly on shallow soils such as rocky soils, coastal bluffs and vernal pools. On deeper soils, he notes that it is quite rare, likely because it can't tolerate the shade of even forbs or shrubs. Fairbarns has tried pulling this species out of his lawn and has found that if the taproot is removed, the plant will not grow back. Since this species produces vast amount of seed (airborne achene with pappus), he concludes that control isn't very effective if there is still a seed source. Populations can explode so the most effective management technique would be to avoid creation of suitable microsites for germination and establishment. *Hypochaeris* is too widespread to eradicate now.

**Fitzpatrick, Greg.** 2005. *Personal communication*. Stewardship Coordinator for the Willamette Valley, The Nature Conservancy, Corvallis, OR.

Fitzpatrick has observed hairy cat's ear in prairie ecosystems of Oregon, but not in the Garry oak woodlands of the area. In prairies, he has seen this species forming monocultures in some areas and predicts that it is displacing native species. In a prairie restoration study, Fitzpatrick assessed four treatments for invasive species: infrared treatment (flame underneath a hood), solarization (black plastic), nighttime tilling and herbicide. He found that infrared was fairly effective at reducing the cover of hairy cat's ear for one year, but it was a short-term effect. By the following year, the population had increased. The infrared treatment occurred after the site had been plowed so it was targeting only small juvenile plants. He notes that burning or using a flamer sets back the plants and kills the tops, but does not kill the plants completely. He has found that infrared or any kind of high heat is fairly effective against juvenile plants before they grow a long taproot, and is best used after plowing or another major disturbance.

Fitzpatrick found that solarization was also effective, although it was carried out after plowing so the roots were exposed under the plastic. The use of nighttime tilling was based on the theory that many seeds need a flash of light to start the germination process, but he noticed that it didn't seem to reduce germination or cover of exotic weeds. Finally, Fitzpatrick tried Roundup, an effective herbicide, but he found that the seed bank of hairy cat's ear is so large that a one-time treatment doesn't work.

Fitzpatrick has observed that broadcast burning isn't effective for invasive plant control, since it tends not to get very hot and has a spotty burn pattern. Hand-pulling may be another control option, except that the taproot of this species is difficult to remove. For prevention of hairy cat's ear, Fitzpatrick suggests seeding with native plant species and minimizing soil disturbance.

**Fraser, Dave.** 2005. *Personal communication*. Species Specialist, Species at Risk, Ministry of Water, Land and Air Protection, Victoria, BC. March 21, 2005.

Fraser notes that he visited a site for an extremely rare (and about to be COSEWIC-listed) plant species (*Meconella oregana*), and found *Hypochaeris radicata* and *Hypochaeris glabra* were both on the site competing with the rare species, a small poppy.

**Gibble, Wendy.** 2005. *Personal communication*. Graduate student, University of Washington, Seattle, WA. March 18, 2005.

Gibble has observed hairy cat's ear throughout western Washington in urban and suburban areas, in south Puget Sound prairies, along logging roads and in other disturbed areas. She notes that this species is widespread in the Garry oak and prairie ecosystems of western Washington. She has observed that it outcompetes native grasses and forbs, and it can constitute up to 10% cover in some areas of the prairie. It appears to do very well in areas that were previously dominated by Scotch broom. The Nature Conservancy has done prescribed burns on the prairies, and cat's ear does not seem to be affected by the burn and may even be favoured by it. She notes that hairy cat's ear is very hardy in dry soils. It continues to flower throughout the summer on very droughty soils in the south Puget Sound prairies, when just about all of the native species have completely finished flowering and fruiting and are senescent. Therefore, it has a very long flowering season and may be using a niche not exploited by the native forbs.

**Hebda, Richard.** 2005. *Personal communication*. Curator of Botany and Earth History, Royal BC Museum, Victoria, BC. March 16, 2005.

Hebda has observed hairy cat's ear throughout Garry oak ecosystems, as well as widely growing in roadsides and waste sites. This species is particularly abundant in shallow moss or turf over rocks. Thus, hairy cat's ear competes with small annual species such as *Collinsia* or with small mosses or lichens. It might also affect the rare owl clover in places like Cattle Point. Controlling hairy cat's ear is very difficult. Although individual plants can be removed, the species is widespread and seeds are windblown, so removing the seed source would be difficult. As with other weed species, Hebda cautions against disturbing the soil, which provides a new seed bed for invasive species. He has not observed this species having as great an impact as other larger and taller invasive species in Garry oak ecosystems.

**Lomer, Frank.** 2005. *Personal communication*. Naturalist, New Westminster, BC. March 8, 2005.

Lomer has observed hairy cat's ear infesting Garry oak meadows, and although it covers a relatively small amount of area, hairy cat's ear takes space away from native species. He has discovered that hand-pulling is the only way to get rid of this plant, but a substantial part of the root needs to be removed which is difficult to achieve. He has found that using a screwdriver to get deep into the root gets them out, but the plants always end up coming back. Lomer notes that this species is tenacious and invades rock crevices, dry lawns, rock cliffs and Garry oak meadows.

**Polster, Dave.** 2005. *Personal communication*. Plant Ecologist, Polster Environmental Services Ltd., Victoria, BC. February 21, 2005.

Polster has observed hairy cat's ear throughout Garry oak ecosystems, particularly where people are walking or mowing. He notes that it can be a problem in deep, nutrient-poor soils, or mildly disturbed sites. He has observed that this species does not form a dense mat, but rather is scattered amongst other plants, often making up 5-10% of total plant cover. This species establishes and spreads rapidly with windborne seeds. He has observed that, as Garry oak ecosystems are drying out, hairy cat's ear remains green. He hypothesizes that hairy cat's ear may be extracting moisture when all other plants are brown, and thus may be affecting native plants.

**Ralph, Dave.** 2005. *Personal communication*. Provincial Weed Technologist, Ministry of Agriculture, Food and Fisheries, Kamloops, BC. March 22, 2005.

Ralph has seen hairy cat's ear primarily in coastal areas. He notes that this species is aggressive in turf and he has also seen it in unused areas (such as roadsides), where it is able to get a foothold. Ralph notes that this species can suppress grasses if let go. Killex formula (2,4-D dicamba mecoprop mix) is effective in controlling hairy cat's ear in turf and lawn. Repeated cutting might eliminate seed production over the long term and might reduce populations somewhat, but the plant grows quite quickly and outgrows the grass. Good turf management, such as aeration, fertilization and thatching, is important to create healthy, vibrant grass that will outcompete the cat's ear.

**Roemer, Hans.** 2005. *Personal communication*. Botanist, Victoria, BC. March 17, 2005.

Roemer has observed hairy cat's ear in every Garry oak community, even those that are quite isolated. He notes that because this species forms a basal rosette, a strong plant can cover a square decimeter (10 cm by 10 cm), causing small native plants (like small *Trifolium* species) to be displaced. He has observed that hairy cat's ear grows in a scattered, evenly distributed pattern rather than in a dense monoculture and suggests that the species will degrade the ecosystem to some extent but not exclude other species. He notes that this species can probably coexist with the native flora rather than changing the composition. Regarding control, he suggests that in a small area, the plants could be weeded, but they have a very big taproot and can resprout to some extent if a small piece is left. Also, if there are any patches of open soil or any disturbance, plants will come back easily. Because this species inhabits a large area and the seeds are dispersed by wind, long-term control is virtually impossible.