Hieracium piloselloides

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INTRODUCTORY

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Photo courtesy of Margery Melgaard, University of Wisconsin-Stevens Point

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FEIS ABBREVIATION:
HIEPIO

NRCS PLANT CODE [67]:
HIPI2

COMMON NAMES:
tall hawkweed
king devil
smooth hawkweed

TAXONOMY:
The scientific name of tall hawkweed is *Hieracium piloselloides* Vill. (Asteraceae) [20,22,30,50,51].

Tall hawkweed hybridizes with orange hawkweed (*H. aurantiacum*) in Michigan [70].

In this review, the term "invasive hawkweeds" refers to species in the subgenus *Pilosella* that are nonnative to North America (e.g., tall hawkweed, orange hawkweed, meadow hawkweed (*H. caespitosum*)).

SYNONYMS:
Hieracium florentinum All. [43,54,75]

LIFE FORM:
Forb

DISTRIBUTION AND OCCURRENCE

SPECIES: Hieracium piloselloides

- GENERAL DISTRIBUTION
- HABITAT TYPES AND PLANT COMMUNITIES

GENERAL DISTRIBUTION:
Tall hawkweed is native to central Europe [51]. It was introduced to New York by 1879 [73] and was documented in Massachusetts by 1912 [57] and Michigan by 1914 [70]. As of this writing (2010), tall hawkweed has a limited distribution in North America. It occurs along the Atlantic coast, from Georgia north to Maine and the eastern Canadian provinces. From the north Atlantic coast, it occurs west through the Great Lakes region to Minnesota and Iowa. It also occurs in Montana and Washington [30]. Plants Database provides a distributional map of tall hawkweed.

HABITAT TYPES AND PLANT COMMUNITIES:
Tall hawkweed occurs in a variety of plant communities within its North American distribution, including grasslands and other open plant communities, shrublands, woodlands or savannas, and forests.

Open plant communities: Tall hawkweed often establishes in old fields or other open areas created by human disturbance. In north-central New Jersey, it was present throughout succession in 1- to 60-year-old fields. Species composition changed over time, but fields generally contained a mixture of goldenrod (*Solidago*), bluestem (*Andropogon*), and aster (Asteraceae) [3]. Tall hawkweed was uncommon (<5% cover) in two 6-year-old fields in New Jersey. Dominant species included meadow hawkweed, Virginia strawberry (*Fragaria virginiana*), rice button aster (*Symphyotrichum dumosum* var. *dumosum*), and hairy white oldfield aster (*S. pilosum* var. *pilosum*) in one field and narrowleaf plantain (*Plantago lanceolata*) and common cinquefoil (*Potentilla simplex*) in the other [1]. In southeastern Ontario, tall hawkweed occurred in an abandoned pasture in an early stage of secondary succession. Frequent species in the pasture included Canada bluegrass (*Poa compressa*), timothy (*Phleum pratense*), black medick (*Medicago lupulina*), common St Johnswort (*Hypericum perforatum*), and Queen Anne's lace (*Daucus carota*) [61]. In central New York, tall hawkweed was the primary colonizer of a limestone quarry abandoned 40 years previously. Plant cover on the site was approximately 15 to 20%, with tall hawkweed comprising about 80% of the cover. Associated plants included hawkweed oxtongue (*Picris hieracioides*), common viper's bugloss (*Echium vulgare*),

common St Johnswort, and Queen Anne's lace [45].

Tall hawkweed establishes in other open plant communities, including wetlands, lakeshores, and coastal areas. It occurred in constructed wetlands along the Delaware River in New Jersey [34]. In northern Ohio, tall hawkweed occurred in a man-made freshwater nontidal marsh dominated by common reed (*Phragmites australis*) [72]. Along the northern shores of Lake Michigan, it occurred in a freshwater shoreline plant community dominated by American beachgrass (*Ammophila breviligulata*) on dry dunes and rushes (*Juncus* and *Eleocharis*) on wet, cobblestrewn beaches [21]. On a barrier island along the southern shore of Long Island, New York, tall hawkweed was frequent on dry sandflats and ruderal sites [15]. It occurred in several coastal sandplain communities in Massachusetts. It was most frequent in "weedy" plant communities characterized by wrinkleleaf goldenrod (*Solidago rugosa*), Kentucky bluegrass (*Poa pratensis*), common velvetgrass (*Holcus lanatus*), and sweet vernalgrass (*Anthoxanthum odoratum*). It also occurred in grasslands with little bluestem (*Schizachyrium scoparium*), fescue (*Festuca* spp.), beach pinweed (*Lechea maritima*), sickleleaf silkgrass (*Pityopsis falcata*), and bentgrass (*Agrostis* spp.); little bluestem plant communities with bentgrass, rice button aster (*Symphyotrichum dumosum*), and goldentop (*Euthania* spp.); yellow sedge (*Carex pensylvanica*) plant communities; heath (Ericaceae) grasslands with toothed whitetop aster (*Sericocarpus asteroides*), poverty oatgrass (*Danthonia spicata*), and low sweet blueberry (*Vaccinium angustifolium*)); high-diversity native sandplain grasslands with flaxleaf whitetop aster (*Ionactis linariifolius*), toothed whitetop aster, coastal plain blue-eyed grass (*Sisyrinchium fuscatum*), and kinnikinnick (*Arctostaphylos uva-ursi*); and hairgrass (*Deschampsia*) plant communities with wavy hairgrass (*D. flexuosa*) and kinnikinnick [16].

Shrublands: In Isle Royale National Park, Michigan, tall hawkweed was abundant in beaked hazelnut-serviceberry-chokecherry (*Corylus cornuta* subsp. *cornuta-Amelanchier* spp.-*Prunus virginiana*) shrublands occurring on ridges and rocky summits. Characteristic species included black crowberry (*Empetrum nigrum*) and northern mountain-ash (*Sorbus decora*) [60].

Woodlands or savannas: Tall hawkweed establishes in several woodland or savanna plant communities. It occurred in a montane eastern redcedar (*Juniperus virginiana* var. *virginiana*)-hardwood woodland occurring on steep south-facing rock outcrops in eastern North Carolina. Pignut hickory (*Carya glabra* var. *glabra*), mockernut hickory (*C. tomentosa*), and chestnut oak (*Q. prinus*) were common associates [56]. In southwestern Connecticut, tall hawkweed was infrequent on dry rocky ledges on the west side of a basalt ridge system. An eastern redcedar-yellow sedge (*J. virginiana-Carex pensylvanica*) plant community dominated basalt ridges [38]. Tall hawkweed was abundant in sand barren plant communities in southeastern Ontario. Sand barrens were dry openings surrounded by and interspersed with jack pine (*P. banksiana*) forest [9]. In Isle Royale National Park, tall hawkweed was abundant in poverty oatgrass-Canada bluegrass herbaceous plant communities occurring on well-drained rocky granite summits and ridge slopes with exposed granite bedrock. Characteristic species included reindeer lichen (*Cladina* spp.) and xanthoparmelia lichen (*Xanthoparmelia* spp.). Sparse tree cover was mostly white spruce (*Picea glauca*) and quaking aspen (*Populus tremuloides*) [60].

Tall hawkweed occurs in several alvar plant communities in the Great Lakes region. It occurred in the nonvascular pavement plant community found throughout the Great Lakes region and the shagbark hickory/common pricklyash (*Carya ovata*/*Zanthoxylum americanum*) savanna-alvar, found only in southern Ontario. The nonvascular pavement plant community occurred on exposed, flat limestone or dolostone pavement and was characterized by sparse cover of lichens and mosses (e.g., cup lichen (*Cladonia pocillum*), blackthread lichen (*Placynthium nigrum*), tortella moss (*Tortell*a spp.)), forbs (e.g., tall hawkweed, gray goldenrod (*Solidago nemoralis*), red columbine (*Aquilegia canadensis*)), and occasional small shrubs and trees (e.g., common snowberry (*Symphoricarpos albus*), riverbank grape (*Vitis riparia*), common juniper (*Juniperus communis*), northern whitecedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*), eastern redcedar, and butternut (*Juglans cinerea*)). The shagbark hickory/common pricklyash savanna-alvar was sparsely treed (10-25% tree cover). Associated trees included bur oak (*Q. macrocarpa*), chinkapin oak (*Q. muehlenbergii*), white ash (*Fraxinus americana*), and rock elm (*Ulmus thomasii*). Tall hawkweed occurred in grassy patches in the understory with poverty oatgrass, Philadelphia panicgrass (*Panicum philadelphicum*), yellow sedge, Canada bluegrass, and gray goldenrod [46]. It occurred in dry alvar woodlands near Ottawa, Ontario. Woodlands were dominated by northern whitecedar, quaking aspen, balsam fir (*Abies balsamea*), white spruce, and eastern white pine (*Pinus strobus*) [11,12]. In eastern Ontario, tall hawkweed had 58% frequency in transitional areas between alvar shrublands and grasslands. Quaking aspen and white spruce saplings provided some canopy cover [10].

Forests: Tall hawkweed establishes in deciduous, coniferous, and mixed forests in the Northeast and Great Lakes regions of North America.

On Prince Edward Island, tall hawkweed occurred along the edge of an upland hardwood forest characterized by yellow birch (*B. alleghaniensis*), sugar maple (*Acer saccharum*), and American beech (*Fagus grandifolia*) [36]. In northern Lower Michigan, tall hawkweed occurred at low levels in both recently clearcut (3- to 12-year-old) and mature (55- to 80-year-old) dry-mesic forests dominated by bigtooth aspen (*Populus grandidentata*) [49]. On Michigan's Upper Peninsula, tall hawkweed occurred in northern hardwood forests dominated by sugar maple [7,27] and American beech [27]. In northern Wisconsin, tall hawkweed occurred at low levels along roadsides in logged forests. All sites were dominated by sugar maple and basswood (*Tilia americana*), with varying levels of yellow birch, white ash, black ash (*F. nigra*), American elm (*U. americana*), and red maple (*A. rubrum*) [76].

Tall hawkweed was uncommon (2.5% frequency; 1.6% cover) in the interior of 8- to 10-year-old jack pine plantations regenerating after clearcutting in northern Wisconsin [17].

In central New York, tall hawkweed occurred on a well-drained hillside in an open-canopied forest that had been logged several years prior to survey. Overstory trees included northern red oak (*Q. rubra*), eastern hemlock (*Tsuga canadensis*), sugar maple, red maple, white oak (*Q. alba*), American beech, black cherry (*Prunus serotina*), and basswood [40]. In northern Lower Michigan, tall hawkweed was a relatively minor component in open-canopied forest containing northern red oak, bigtooth aspen, and red pine (*P. resinosa*) [25]. In the same region, it was frequent in second-growth forests transitioning from bigtooth aspen to eastern white pine, red pine, northern red oak, and red maple [53].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Hieracium piloselloides

- GENERAL BOTANICAL CHARACTERISTICS
- SEASONAL DEVELOPMENT
- REGENERATION PROCESSES
- SITE CHARACTERISTICS
- SUCCESSIONAL STATUS

GENERAL BOTANICAL CHARACTERISTICS:

- **Botanical description**
- **Raunkiaer life form**

Botanical description: This description covers characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [22,37,43,70,73,75]).

Tall hawkweed is a perennial herb that exudes a milky sap when broken. Plants have a basal rosette and flowering stems that reach 12 to 42 inches (30-107 cm) in height. Inflorescences are 2 or more clusters of yellow flowers at the end of stems [13]. Tall hawkweed seeds are small (1.5-2 mm) achenes with a row of bristles [20]. One flora states that tall

hawkweed may be variable in form [70].

Tall hawkweed has short [13,22,61], stout rhizomes [61] but lacks stolons [13,73]. In old fields in north-central New Jersey, one author observed that tall hawkweed had shallow roots [3]. In central New York, tall hawkweed roots penetrated approximately 7 inches (17 cm) into a substrate of finely ground limestone [77].

Photo courtesy of Richard Bauer, University of Wisconsin-Stevens Point

Density of tall hawkweed populations is variable. In a revegetating limestone quarry in central New York, the density of adult rosettes ranged from 34.0 plants/m² to >100 plants/m² [45]. In a field in southeastern Ontario, a nearly pure population of tall hawkweed covered 300 acres (125 ha), with an average density of 860 plants/m² [28]*. In an abandoned pasture in southeastern Ontario, tall hawkweed populations were patchy but not dense [61].

An invasive plant guide for the Upper Midwest states that invasive hawkweeds may be allelopathic [13].

*Some information in General Botanical Characteristics comes from Johnson and Thomas [28], who tentatively identified the hawkweed studied as tall hawkweed, but noted that it differed morphologically from other tall hawkweed populations in Ontario. The authors reported that the species had been identified in the past as either *H. florentinum* [28], now considered a synonym of tall hawkweed [10,51,65], or *H. praeltum* var. *decipiens* [28].

Raunkiaer [44] life form:
Hemicryptophyte
Geophyte

SEASONAL DEVELOPMENT:
In a revegetating limestone quarry in central New York, tall hawkweed plants established in the spring and developed small rosettes during their first growing season. First-season growth was described as slow due to the harsh microclimatic conditions of the quarry floor. Young plants overwintered as green leafy rosettes and continued vegetative growth during their 2nd and 3rd growing seasons. Some plants flowered during their 4th growing season, producing a single, leafless flowering stem with one to numerous heads in May or June [45]. Tall hawkweed flowering dates range from May to September in different parts of its North American range.

Months of flowering for tall hawkweed in different parts of its North American range	
Location	Month
Michigan	June to July [18]

New York	mid-May [14], June [15]
North and South Carolina	May to September [43]
Wisconsin	late June to early July [62]
Northeast United States and Canada	June to September [22]
Nova Scotia	mid-June to mid-July [50]
Ontario	mid-May [61]

In New York, tall hawkweed seeds matured in mid-June [45]. In an abandoned pasture in southeastern Ontario, seeds matured from late June to early July. Flowering stems died in August and were replaced by new vegetative stems arising from the axil buds of the oldest leaves on rhizomes [61].

REGENERATION PROCESSES:

- **Vegetative regeneration**
- **Pollination and breeding system**
- **Seed production**
- **Seed dispersal**
- **Seed banking**
- **Germination**
- **Seedling establishment and plant growth**

Some information in this section (Regeneration Processes) comes from Johnson and Thomas [28], who tentatively identified the hawkweed studied as tall hawkweed, but noted that it differed morphologically from other tall hawkweed populations in Ontario. The authors reported that the species had been identified in the past as either *H. florentinum* [28], now considered a synonym of tall hawkweed [10,51,65], or *H. praeltum* var. *decipiens* [28]. Because of the uncertainty of identification, quotation marks are used to refer to information on "tall hawkweed" from this study

Tall hawkweed reproduces via seed and also spreads vegetatively. Two sources suggest that vegetative spread is a more common means of regeneration than seed production. Observations from Ontario suggested that seedlings were rare in an established population of tall hawkweed, and most young plants were sprouts from the roots of existing plants [42]. In a revegetating limestone quarry in central New York, the number of tall hawkweed seedlings was low, representing <4% of young plants [45].

Vegetative regeneration: Tall hawkweed has rhizomes [13,22,61] and sprouts from adventitious root buds [41,42,61]. One study reported that rhizomes were not important for vegetative reproduction [61]. Observations from Ontario suggested that most young tall hawkweed plants had sprouted from the roots of existing plants. Young individuals dug up at the outer edge of an expanding population were often connected to a larger plant by roots [42]. In an abandoned pasture in southeastern Ontario, root buds were common but not abundant. Buds arose from roots near the surface of the soil at varying distances from the parent plant, resulting in a patchy, but not dense, stand structure [61]. One laboratory study found that seedlings produced leaves and a well-developed root system within several weeks of germination. Many of the roots had already produced buds, which developed leaves and eventually produced a root system. Laboratory studies confirmed that root fragments (excised root tips) could produce lateral roots and buds [42].

It is not clear what factors promote vegetative growth or survival. In greenhouse experiments, fertilization increased root bud production; nonflowering tall hawkweed plants exposed to high nitrogen levels (210 mg/L) produced 6.92 root buds/plant, while plants exposed to low nitrogen levels (15 mg/L) produced 0.87 root bud/plant [41]. Low light levels may keep tall hawkweeds in a vegetative state and limit flowering. In one greenhouse study, tall hawkweed seedlings were maintained in a vegetative state by providing seedlings with 8 hours of light and 16 hours of darkness [41]. Survival of tall hawkweed plants of vegetative origin appears to be high; in a revegetating limestone quarry in

central New York, the survival of vegetative juveniles ranged from 82.6% to 100% [45].

Pollination and breeding system: Tall hawkweed is apomictic [64].

In Wisconsin, a variety of insects visited tall hawkweed flowers, including bees (*Andrena* spp., *Bombus* spp., Halictidae) and syrphid flies (Syrphidae) [62]. Butterflies [69] and 36 species of bees [18] visited tall hawkweed flowers in Michigan.

Seed production: Tall hawkweed may produce many seeds. In southeastern Ontario, seed rain from a "tall hawkweed" population was estimated at 40,190 seeds/m² [28]. In central New York, tall hawkweed plants produced 32.4 mature seeds/head and 129.6 seeds/plant in a revegetating limestone quarry and 36.6 mature seeds/head and 175.7 seeds/plant in an adjacent meadow. Not all tall hawkweed rosettes flowered every year; one year, about 60% of tall hawkweed rosettes produced flowering stems [45].

Seed dispersal: Tall hawkweed seeds are wind dispersed [13,20]. Seeds have a row of bristles [20] that may aid in dispersal, though this means of dispersal was not documented in the available literature.

Seed banking: As of this writing (2010), little information was available regarding seed banking of tall hawkweed. In an alvar plant community in Ontario, tall hawkweed seedling emergence from soil samples was low compared to tall hawkweed presence in the extant vegetation. Tall hawkweed seedlings emerged from 5 of 60 samples taken from the top 4 inches (10 cm) of soil. Tall hawkweed was detected in 39 of 60 vegetation surveys [48]. In ruderal fields recovering from industrial waste deposition in Germany, it was not found in the soil seed bank through 3 years of sampling, though it was present in the extant vegetation [71].

Germination: Tall hawkweed seeds do not require cold stratification for germination. Laboratory experiments in Ontario showed that, "tall hawkweed" seeds germinated immediately upon exposure to unlimited water and temperatures ($\bar{x}$=77 °F (25 °C)). In the field, most germination and seedling emergence occurred in the days following relatively high rainfall [28]. In germination trials from field-collected seeds in central New York, seeds kept at room temperature and those kept at 32 °F (0 °C) had similar maximum germination percentages (63% and 65%, respectively). Water stress reduced seed germination to <25% [45]. In a revegetating limestone quarry in central New York, large quantities of viable seeds were produced but few germinated. The author suggested that harsh microsite conditions (e.g., substrate of coarse limestone fragments, poor soil water retention, and high soil surface temperatures ($\bar{x}$=118 °F (48 °C)) might have limited germination [45].

Seedling establishment and plant growth: The little available information available (2010) suggests that moisture favors tall hawkweed establishment, growth, and survival. However, few studies addressed this topic, and most information came from either a population only tentatively identified as "tall hawkweed" [28] or a site (revegetating limestone quarry [45]) where field conditions may not resenble those of other plant communities where tall hawkweed occurs.

In southeastern Ontario, most "tall hawkweed" seedlings emerged in the days following relatively high (0.7-3.8 inches (18-97 mm)) rainfall. Most seedling mortality occurred after periods of low rainfall in July and August. Seedling emergence and mortality were higher on bare soil microsites compared to goldenleaf campylium moss (*Campylium chrysophyllum*) microsites. In artificially seeded field plots, 1-year seedling survival was higher on moss than on bare soil (14.2% versus 6.3%, respectively). The authors suggested that moss microsites retained the moisture needed for "tall hawkweed" seedlings to survive [28].

Tall hawkweed plant growth may be inhibited by poor soil conditions, including low moisture, low nutrients, or heavy metal contamination. In central New York, tall hawkweed plants growing in a revegetating limestone quarry allocated more resources to roots than aboveground parts compared to populations in nearby meadows, a pattern the author attributed to moisture and nutrient deficiencies in the quarry [45]. In field experiments in Ontario, contamination by low levels of heavy metals (copper, nickel, cadmium, and zinc) was correlated with low tall hawkweed leaf production, low plant mass, and delayed phenological development [52].

One study suggests that once established, tall hawkweed populations persist in the short term. In a revegetating limestone quarry in central New York, established tall hawkweed rosette survival was high (90% to 100%), and survival and density did not change significantly over 3 years of study [45].

SITE CHARACTERISTICS:
Tall hawkweed establishes on sites with a range of soil and climate conditions and does not appear to have specific elevation requirements. Floras report tall hawkweed occurring primarily in disturbed areas, including fields [22,37,43,70,75], pastures [22,43], meadows [22], roadsides [22,37,43,70,75], gravel pits, and along railroads [70]. Floras also report tall hawkweed establishing in dry woods, sandy and rocky openings, even, wet ground [70], and open woodlands [43]. See Habitat Types and Plant Communities for detailed descriptions of plant communities where tall hawkweed occurs.

Soil: As of this writing (2010), the soil preferences of tall hawkweed were unknown, though an invasive plant guide for the Upper Midwest reports that invasive hawkweeds prefer sandy or gravelly and slightly acidic soils [13]. Tall hawkweed occurred on glacial outwash sands [49] and sandy or gravelly hillsides [19] in Michigan and on rocky soil clearings in New Hampshire [4].One study from central New York reported that it commonly established on calcareous soils in the Northeast and documented it establishing on coarse limestone fragments with pH ranging from 7.8 to 8.3 [45]. In the Great Lakes region, tall hawkweed occurred in several alvar plant communities with limestone or dolostone bedrock [10,11,12,46].

Tall hawkweed appears to prefer moist soil (see Germination and Seedling establishment and plant growth), though it may establish in areas where soils are dry and experience high summer temperatures [45,46]. In central New York, tall hawkweed established in an abandoned limestone quarry where surface temperatures commonly reached 118 °F (48 °C) in the growing season [45].

Tall hawkweed appears to tolerate poor soils, though such conditions may not be favorable (see Seedling establishment and plant growth). It may establish in soils with low organic matter [49], low nutrients [45], or high salinity [77]. In laboratory tests, it tolerated soils with low levels of heavy metal contamination [52]. In Ontario, it was a common species on acidic mine tailings with high concentrations of heavy metals [39].

Climate: The climatic preferences of tall hawkweed are unknown. In North America, it occurs in areas with continental climates like those found in New Hampshire [4] and Connecticut [38]. In places like northern Wisconsin, tall hawkweed populations are exposed to a short growing season and moderately long winters with persistent snow cover and frequent extreme cold temperatures. Average annual temperatures range from 35 °F to 50 °F (2-10 °C) [76]. Tall hawkweed is not reported from sites in North America with low annual precipitation.

Average annual precipitation of sites with tall hawkweed within its North American distribution	
Location	Precipitation (mm)
Michigan	770 [49], 800 [53]
New Hampshire	1,132 [4]
New Jersey	1,150 [1]
Wisconsin	610 to 1,150 [76]
Ontario	900 [61]

Elevation: Tall hawkweed occurs at a range of elevations in North America.

Elevation of sites with tall hawkweed within its North American distribution	
Location	Elevation (feet)
Connecticut	550 [38]

Montana	3,700 [47]
Wisconsin	761 to 1,506 [17]
Ontario	1,076 [61]

SUCCESSIONAL STATUS:
Tall hawkweed is frequently documented in early-successional plant communities or disturbed areas (see Site Characteristics), though it also occurs in plant communities with no documentation of disturbance. Some studies suggest that it does not persist past early succession or is restricted to disturbed areas. In a study examining old-field succession in central New Jersey, tall hawkweed was detected the first year after agricultural abandonment, but it was not detected subsequently [33]. On northern Cape Breton Island, Nova Scotia, it was restricted to disturbed areas such as fields, meadows, pastures, and roadsides [58]. However, other studies report tall hawkweed establishing best in midsuccession. In old fields in north-central New Jersey, tall hawkweed was present throughout succession in 1- to 60-year-old fields but was most abundant in 5- to 40-year-old fields [3]. A study in eastern Ontario reported tall hawkweed was present 37 years after prescribed fire, though no information was available on tall hawkweed's abundance in the years before the fire or immediately afterward. Tall hawkweed occurred with 58% frequency but had sparse cover in transitional areas between alvar shrubland and alvar grassland that had been cleared, burned, and scarified [10]. In central New York, tall hawkweed was among the secondary species establishing on a saline residue dump. It persisted through several stages of succession but was eventually replaced by other species [77]. Tall hawkweed occurs in logged areas [17,40,49,76], though no clear patterns of establishment are evident from the available literature. In northern Lower Michigan, tall hawkweed occurred at low levels in both recently clearcut (3- to 12-year-old) and mature (55- to 80-year-old) dry-mesic forests (0.2% cover in young; 0.1% in mature) [49]. In northern Wisconsin, tall hawkweed occurred at low levels in logged hardwood forests, but its occurrence was restricted to roadside areas [76].

It is not clear whether tall hawkweed would influence the successional trajectories of native plant communities where it establishes. This topic had not been addressed in the literature as of this writing (2010).

FIRE EFFECTS AND MANAGEMENT

SPECIES: Hieracium piloselloides

- FIRE EFFECTS
- FUELS AND FIRE REGIMES
- FIRE MANAGEMENT CONSIDERATIONS

FIRE EFFECTS:

- **Immediate fire effect on plant**
- **Postfire regeneration strategy**
- **Fire adaptations and plant response to fire**

Immediate fire effect on plant: As of this writing (2010), little information was available on the immediate effects of fire on tall hawkweed. Tall hawkweed is likely top-killed by fire; belowground rhizomes and root buds may survive. Tall hawkweed sprouted from rhizomes and/or root crowns within 100 days of a severe fire in alvar woodlands near Ottawa, Ontario [11]. As of 2010, no information was available regarding fire effects on or heat tolerance of tall hawkweed seeds.

Postfire regeneration strategy [59]:
Surface rhizome and/or a chamaephytic root crown in organic soil or on soil surface
Rhizomatous herb, rhizome in soil

Geophyte, growing points deep in soil
Ground residual colonizer (on site, initial community)
Initial off-site colonizer (off site, initial community)
Secondary colonizer (on- or off-site seed sources)

Fire adaptations and plant response to fire:

Fire adaptations: Tall hawkweed exhibits some characteristics that make it likely to survive and/or establish after fire. It is rhizomatous [13,22,61], and it is likely that rhizomes below the soil surface survive fire. It sprouted from rhizomes and/or root crowns within 100 days of a severe fire in alvar woodlands near Ottawa, Ontario [11]. Tall hawkweed also sprouts from adventitious root buds [41,42,61]. Though not documented in the available literature, it is likely that tall hawkweed root buds could survive and sprout after fire. Tall hawkweed seeds have the potential for long-distance dispersal. The authors of one study from northern Lower Michigan suggested that tall hawkweed established in burned areas via wind-dispersed seeds [53]. A row of bristles on tall hawkweed seeds [20] may facilitate other means of dispersal (e.g., attachment to clothing, fur, or feathers) into burned areas. The emergence of a few tall hawkweed seedlings from soil samples collected in Ontario [48] suggests that it is possible for tall hawkweed to establish in burned areas via soil-stored seed (see Seed banking). Though tall hawkweed is frequently documented in early-successional plant communities or disturbed areas (see Site Characteristics), it is not clear which characteristics of these sites favor tall hawkweed.

Plant response to fire: Information on the response of tall hawkweed to fire was sparse in the literature as of this writing (2010). Tall hawkweed has been documented in burned areas in Michigan [53] and Ontario [10,11,12]. The scarcity of studies and lack of details about fire characteristics, pre- and postfire vegetation, and tall hawkweed response limit the inferences that can be made regarding fire effects on tall hawkweed.

One study reported tall hawkweed surviving fire. A severe fire occurred in late June in alvar woodlands near Ottawa, Ontario. The fire burned 376 acres (152 ha), moving up to 50 feet (15 m)/minute, with flames reaching >100 feet (30 m) in height. One hundred days after the fire, vegetation surveys were conducted in 5 areas where all vegetation was top-killed or killed by fire. Tall hawkweed sprouted from rhizomes and/or root crowns in all 5 sampling areas, with an average frequency of 6.4 % (range 2-14%) [11].

Though tall hawkweed may be frequent on some burned sites, no pattern of change through time was evident in the literature. In northern Lower Michigan, tall hawkweed occurred in successional forests burned by both wildfire (1 fire: 1911) and prescribed fires (4 fires: 1936, 1948, 1954, 1980). Treatment information was limited to the most recent fire, which was described as similar to the 3 previous fires. The forest was clearcut in the fall of 1979 and spring of 1980, then burned in August 1980. The fire was patchy and left approximately 15% of the site unburned. Vegetation sampling was conducted in the same stand for 3 years following the 1980 fire and for 1 year (1981) in 4 other stands of various ages. Prefire vegetation was not reported. Tall hawkweed showed no clear response to time since fire. In the single stand where it was monitored for 3 postfire years, its frequency increased between the 1st and 2nd year after fire but decreased slightly the 3rd year. In the 5 stands monitored in 1981, tall hawkweed was present in stands of all ages; however, it was most frequent in the stand burned 27 years prior to the survey and least frequent in the stand burned 1 year prior to the survey [53].

Tall hawkweed frequency (% of sampling areas where the species was detected) in upland pine-hardwood forests at various stages after fire in northern Lower Michigan [53]

	Same stand			Four different stands			
Sampling year	1981	1982	1983	1981	1981	1981	1981
Years since fire	1	2	3	27	33	45	70
Tall hawkweed frequency	8	20	16	66	40	32	Present

The authors hypothesized that tall hawkweed established in burned areas via wind-dispersed seeds [53].

One study showed tall hawkweed was more frequent on bulldozed than burned sites. In a study investigating the effects of disturbance in alvar woodlands in eastern Ontario, tall hawkweed was detected most frequently in woodlands sampled 465 days after bulldozing compared to areas sampled 100 days and 1 year after a high-severity fire and an adjacent undisturbed area. Because the bulldozed areas were related to fire-control efforts, fire suppression may have introduced tall hawkweed or produced conditions favoring its increase [12].

Frequency (%) of tall hawkweed in areas with different disturbances or different times since disturbance in alvar woodlands in eastern Ontario [12]

	Days since disturbance	Frequency
Undisturbed	Not applicable	9
Burned	100	6.4
Burned	365	11.3
Bulldozed	465	27

FUELS AND FIRE REGIMES:

- **Fuels**
- **Fire regimes**

Fuels: As of this writing (2010) there was no information available regarding the fuels characteristics of tall hawkweed.

Fire regimes: It is not known what fire regime tall hawkweed is best adapted to. In North America, tall hawkweed occurs in a wide variety of plant communities, and consequently, a range of fire regimes. See the Fire Regime Table for further information on fire regimes of vegetation communities in which tall hawkweed may occur.

FIRE MANAGEMENT CONSIDERATIONS:

Potential for postfire establishment and spread: Tall hawkweed possesses several traits that make it adapted to surviving and/or establishing after fire (see Fire adaptations), and postfire establishment has been documented (see Plant response to fire). Disturbances associated with fire (e.g., bulldozing firelines [12]) may also encourage tall hawkweed establishment.

Preventing postfire establishment and spread: Because of its potential for long-distance seed dispersal and the possibility that tall hawkweed established on burned sites via wind-dispersed seed [53], monitoring areas in close proximity to known tall hawkweed populations is advised.

Preventing invasive plants from establishing in weed-free burned areas is the most effective and least costly management method. This may be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of invasive plant propagules into burned areas. General recommendations for preventing postfire establishment and spread of invasive plants include:

- Incorporate cost of weed prevention and management into fire rehabilitation plans
- Acquire restoration funding
- Include weed prevention education in fire training
- Minimize soil disturbance and vegetation removal during fire suppression and rehabilitation activities
- Minimize the use of retardants that may alter soil nutrient availability, such as those containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases
- Clean equipment and vehicles prior to entering burned areas

Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation
- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration
- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics, see the following publications: [2,5,23,66].

Use of prescribed fire as a control agent: The limited available literature suggests that prescribed fire is not an effective method for controlling tall hawkweed because tall hawkweed may either survive fire or establish in burned areas (see Plant response to fire). However, this topic had not been well studied as of this writing (2010).

MANAGEMENT CONSIDERATIONS

SPECIES: Hieracium piloselloides

- FEDERAL LEGAL STATUS
- OTHER STATUS
- IMPORTANCE TO WILDLIFE AND LIVESTOCK
- OTHER USES
- IMPACTS AND CONTROL

FEDERAL LEGAL STATUS:
None

OTHER STATUS:
Information on state-level noxious weed status of plants in the United States is available at Plants Database.

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
As of this writing (2010), no information was available regarding the importance of tall hawkweed to wildlife and livestock.

Palatability and/or nutritional value: No information is available on this topic.

Cover value: No information is available on this topic.

OTHER USES:
No information is available on this topic.

IMPACTS AND CONTROL:
Impacts: No information is available on this topic.

Control: Information on the control of tall hawkweed was lacking in the literature as of this writing (2010). Control of tall hawkweed is complicated by the presence of rhizomes and adventitious root buds (see Vegetative regeneration) that may sprout following control treatments. For information on the control of other invasive hawkweeds, see FEIS reviews for orange and meadow hawkweeds. It should be noted that other invasive hawkweeds may possess botanical traits (e.g., stolons) that differ from tall hawkweed.

Control of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a

tactical approach focused on battling individual invaders [35]. In all cases where invasive species are targeted for control, no matter what method is employed, the potential for other invasive species to fill their void must be considered [6].

Prevention: It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [35,55] (e.g., avoid road building in wildlands [65]) and by monitoring several times each year [27]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility is likely to be more effective than managing solely to control the invader [26].

Weed prevention and control can be incorporated into many types of management plans, including those for logging and site preparation, grazing allotments, recreation management, research projects, road building and maintenance, and fire management [66]. See the Guide to noxious weed prevention practices [66] for specific guidelines in preventing the spread of weed seeds and propagules under different management conditions.

Fire: For information on the use of prescribed fire to control this species, see Fire Management Considerations.

Cultural control: An invasive plant guide for the Upper Midwest states that invasive hawkweeds can be controlled by repeated cultivation or through "competition" with more aggressive native species [13].

Physical or mechanical control: An invasive plant guide for the Upper Midwest states that hand digging may control invasive hawkweeds. Mowing may prevent seed formation but does not prevent vegetative spread [13].

Biological control: No information is available on this topic.

Chemical control: No information is available on this topic.

Integrated management: No information is available on this topic.

APPENDIX: FIRE REGIME TABLE

SPECIES: Hieracium piloselloides

The following table provides fire regime information that may be relevant to tall hawkweed habitats based on plant community descriptions in the available literature (2010). Follow the links in the table to documents that provide more detailed information on these fire regimes. If you are interested in fire regimes of plant communities not listed here, see the Expanded FEIS Fire Regime Table.

Fire regime information on vegetation communities in which tall hawkweed may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [32], which were developed by local experts using available literature, local data, and/or expert opinion. This table summarizes fire regime characteristics for each plant community listed. The PDF file linked from each plant community name describes the model and synthesizes the knowledge available on vegetation composition, structure, and dynamics in that community. Cells are blank where information is not available in the Rapid Assessment Vegetation Model.

Great Lakes	Northeast	Southern Appalachians

Great Lakes

- Great Lakes Woodland
- Great Lakes Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Great Lakes Woodland					
Great Lakes pine barrens	Replacement	8%	41	10	80
	Mixed	9%	36	10	80
	Surface or low	83%	4	1	20
Northern oak savanna	Replacement	4%	110	50	500
	Mixed	9%	50	15	150
	Surface or low	87%	5	1	20
Great Lakes Forested					
Northern hardwood maple-beech-eastern hemlock	Replacement	60%	>1,000		
	Mixed	40%	>1,000		
Maple-basswood	Replacement	33%	≥1,000		
	Surface or low	67%	500		
Maple-basswood mesic hardwood forest (Great Lakes)	Replacement	100%	>1,000	≥1,000	>1,000
Pine-oak	Replacement	19%	357		
	Surface or low	81%	85		

Northeast

- Northeast Woodland
- Northeast Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Northeast Woodland					
Rocky outcrop pine (Northeast)	Replacement	16%	128		
	Mixed	32%	65		
	Surface or low	52%	40		

Northeast Forested					
Northern hardwoods (Northeast)	Replacement	39%	≥1,000		
	Mixed	61%	650		
Northern hardwoods-eastern hemlock	Replacement	50%	≥1,000		
	Surface or low	50%	≥1,000		
Beech-maple	Replacement	100%	>1,000		

Southern Appalachians

- Southern Appalachians Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southern Appalachians Forested					
Mixed mesophytic hardwood	Replacement	11%	665		
	Mixed	10%	715		
	Surface or low	79%	90		
Appalachian oak-hickory-pine	Replacement	3%	180	30	500
	Mixed	8%	65	15	150
	Surface or low	89%	6	3	10

*Fire Severities—
Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; may or may not cause a lethal effect on the plants.
Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area [24,31].

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