Conservation Assessment
for
Lake Huron Tansy (Tanacetum huronense) Nutt.

USDA Forest Service, Eastern Region
March 2002

This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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- Claudia Jolls, Associate Professor at East Carolina University; Summer Faculty at the University of Michigan's Biological Station at Pellston, Michigan.

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- Bruce Leutscher, Biologist, Pictured Rocks National Lakeshore

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Initial Draft
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EXECUTIVE SUMMARY

Lake Huron tansy is listed as Threatened in the State of Michigan. Its ranking is G5T4T5/N4? (secure globally, though it may be quite local in parts of its range). Assigning a meaningful global ranking for this species has been difficult since there is considerable disagreement as to what constitutes *T. huronense* and what are related species. *Tanacetum huronense* is a flowering plant broadly dispersed from Maine and the Maritimes, through the Great Lakes Region and much of Canada, to Alaska. In Canada and Alaska *T. huronense* is fairly common, though it is debated

whether it is the same species as found in the Great Lakes Region. In Maine it has an S2 ranking (very rare), in Wisconsin (historically in Door county) it has an S1 ranking (extremely rare).

Primary threats to the survival of Lake Huron tansy include the disturbance or destruction of natural habitat via residential development, damming of rivers, and construction of marinas. The role of hydrology and natural Great Lake level fluctuations as they relate to the temporal and spatial mosaic of the dune ecosystems (Jolls pers. comm. 2001). Recreational threats on public lands include foot traffic, and all terrain vehicles (ATVs).

NOMENCLATURE AND TAXONOMY

(Wisconsin State Herbarium)

Scientific name: *Tanacetum huronense Nutt.*

Common name: Lake Huron tansy
Indian tansy
eastern tansy
floccose Tansy

Family: Asteraceae

USDA Plant Code: TABIH

Synonyms: *Chrysanthemum bipinnatum* L. subsp. *huronense (*Nutt.) Hultén
Chrysanthemum bipinnatum (L.) subsp. *huronense (*Nutt.) Breitung
Tanacetum huronense Nutt.
Tanacetum huronense Nutt. var. *typicum* Fernald
Tanacetum huronense Nutt. var. *bifarium* Fernald
Tanacetum huronense Nutt. var. *floccosum* Raup
Tanacetum huronense Nutt. var. *johannense* Fernald
Tanacetum huronense Nutt. var. *terrae-novae* Fernald

The taxonomy of this species has been debated. Kartesz & Kartesz (1980), the standard reference of The Nature Conservancy, has treated *Tanacetum huronense* as a distinct species from *T. bipinnatum*. Other taxonomists have treated *T. huronense* as a subspecies of the closely related, Eurasian and western Alaskan species, *T. bipinnatum* (Ostlie 1991).

"Fernald (1953) separated *T. huronense* into three distinct varieties: var. *bifarium* (Anticosti Islands and Hudson Bay), var. *terra-novae* (Newfoundland) and var. *johannense* (Gaspe area, New Brunswick and Maine). Later work found that the main characters Fernald used for separation did not hold true throughout their range. Hultén (1971) found populations in Alaska that contained all of Fernald's 'varieties'. Mickelson and Iltis (1966) found that Fernald's character of heads per stem did not hold true in the Great Lakes Region" (*cf.* Ostlie 1991).

Plants of ocean dunes in the Pacific Northwest have been referred to by different authors as *T. huronense* or *T. douglasii* DC. There is not agreement on the significance (if any) of the varieties that have been named in *T. huronense*.

Whatever the taxonomy of this complex might be, "there is no doubt that the Lake Huron tansy *(T. huronense)* applies at least to plants of the Great Lakes since the type specimen was first discovered by Thomas Nuttall near Mackinac Island in 1810" (Voss 1996). The remainder of this document refers to *T. huronense* as defined from the type specimen from Michigan unless explicitly specified.

DESCRIPTION OF SPECIES

Tanacetum huronense is an aromatic perennial herb, which spreads by rhizomes. Stems are mostly 1-2 feet tall. Leaves are 2-3 times pinnately divided; they occurring both as a basal rosette, and alternately along the flowering stem. Both leaves and stem are covered with soft hairs. The flowers are in 1-15 small daisy-like yellow heads (1-2 cm wide) at the end of the stems. *T. huronense* flowers in July and August in Michigan (Chadde 1999).

Tanacetum huronense: (Gleason & Cronquist 1991, Mickelson & Iltis 1966 *cf* Ostlie 1991, Pojar & Mackinnon 1994, Choberka *et al.* 2001)

Form:	Perennial aromatic herb (camphor-like), rhizomatous
Stems:	Erect, 1-3 main stems, 3-6 dm tall, stout, villous pubescent
Leaves:	Persistent basal rosette with alternate stem leaves Bi to tri pinnatifid with narrow ultimate segments Villous-pubescent; stem leaves gradually reduced in size.
Flowers:	Yellow heads on long, stout peduncles; usually 3-12 heads per major stem in compact, somewhat flat-topped cluster. Disk flowers are perfect with 5-toothed corollas 1.3 to 2 cm wide Rays commonly evident, up to 3 mm long.
Fruit:	Achene 5-angled, 2-3.5 mm long; pappus lobes membranceous.

VARIETIES OR RACES

The existence of geographic variation in this complex is acknowledged, but whether the geographic variation warrants separate taxonomic treatment as varieties has been debated (Fernald 1950, Hultén (1971), and Mickelson & Iltis (1966). "Lake Huron tansy is an extremely variable complex especially concerning the degree of pubescence, dissection of leaves, and height of plants. Arctic specimens tend to have fewer flower heads and are shorter plants, while more southern specimens are taller with more flower heads" (Hultén 1971).

***Tanacetum huronense* Nutt. var. *bifarium* Fernald**: "Leaves at most about 1 dm long and 5 cm broad, their bluntish primary segments with rather crowded divisions. Flowering stem to over 3 dm tall, glabrous or sparingly pilose, with up to about 10 sparsely pilose leaves and up to 6 flower heads" (Scoggan 1979). *T. bifarium* is known from the Anticosti Island and the shores of Hudson Bay (Hultén 1971) and eastern James Bay (Scoggan 1979).

***Tanacetum huronense* Nutt. var. *johannense* Fernald:** Heads commonly less than 6, the flowering stems rarely over 4 dm tall. "Leaves to 3 dm long and about 1.5 dm broad, their acute primary segments comparatively remote and with rather remote ultimate segments; flowering stem to 4.5 dm

tall, with up to 5 heads and 10 leaves" (Scoggan 1979). This variety is reported from the Gaspe area, New Brunswick, and Maine (Hultén 1971).

***Tanacetum huronense* Nutt. var. *terrae-novae* Fernald**: "Flowering stem at most about 2 dm tall, copiously lanate, with rarely more than 4 white-lanate leaves, and 1 or 2 heads" (Scoggan 1979). "Differing from the typical form of the species in its subscapose habitat; the stem .7-1.3 dm. high, lanate, 1-3 headed; leaves crowded at the base of the stem, white-tomentose beneath" (Fernald 1923). *T. terrae-novae* is a dwarf plant from the limestone barrens of Newfoundland, later reported from northern Saskatchewan (L. Athabasca), central Ontario, Quebec (eastern James Bay, Ungava Bay, and Anticosti Island) (Scoggan 1979).

***Tanacetum huronense* Nutt. var. *floccosum* Raup**: A very pubescent plant known only from Lake Athabesca. *T. huronense* var. *floccosum* (floccose tansy) is a stout perennial that commonly grows in large clumps from extensively ramifying rhizomes (Raup 1936). It usually grows from 20 to 40 cm tall. Both its stem and finely dissected leaves are covered by densely matted, woolly hairs. Typical flower heads have yellow rays and are arranged in loose clusters at the ends of upwardly branching stems. Floccose tansy occurs on open, active dunes, primarily on dune crests (Environment Canada 2001).

Identification notes:
In the Great Lakes Region, only two varieties of tansy are known (Voss 1996). The common tansy (*Tanacetum vulgare*) is a widespread Eurasian weed of disturbed areas, including dunes, and often forms large colonies (Chadde 1999). "Garden tansy (*T. vulgare*) is readily distinguished by its smooth, non-hairy (glabrous) foliage that is less finely divided", and smaller, usually more numerous flower heads (Choberka *et al.* 2001). Lake Huron tansy *(T. huronense*) is primarily restricted to sand dune habitats or Great Lake shore gravels of Lake Michigan, Superior and Huron (Fernald 1950), and does not form large patches (Chadde 1999).

Flower heads yellow (key by Magee & Ahles 1999; Voss 1996):

Heads 1 cm or less broad, numerous heads, more than 10 per stem (up to 100); leaves, peduncles and involucres essentially glabrous . . . . . *T. vulgare*

Heads more than 1 cm broad, usually 3-12 heads per stem; leaves, peduncles and involucres villous-pubescent . . . . . *T. huronense*

Chromosome number:
The basic haploid chromosome number in *Tanacetum* is 9, the typical variety of *Tanacetum huronense* var. *huronense* indicates hexaploidy with 2n=54 (Pringle 1976). This same chromosome count was also reported for *T. douglasii* D.C. (Taylor & Mulligan 1968 in Pringle 1976) and *T. huronense* var. *floccosum* (Sude & Argus 1969 in Pringle 1976).

DISTRIBUTION AND ABUNDANCE

Tanacetum huronense is a wide-ranging species, if all the recognized varieties are considered. It is distributed in North America from Alaska, Northwest Territories, British Columbia, NE Alberta, Manitoba, Ontario, Quebec, to Newfoundland, Maine, and the Great Lakes Region of Michigan and Wisconsin (Argus & White 1978). Throughout its range, the species appears to be a strict calciphile (Ostlie 1991). *T. huronense* is listed as common in the sub-arctic and present in the low-arctic; it is also found in eastern alpine mountains, the Great Lakes Region, and the Gulf of the St. Lawrence (Given & Soper 1981).

The type locality is the sandy shores of Lake Huron at the Straits of Mackinac, where it was found by Thomas Nuttall in 1810. *T. huronense* is remarkably restricted in its distribution on the Great Lakes, being found on northern Michigan shores in both the Lower and Upper Peninsulas, and adjacent Ontario shores of Lake Superior to Batchawana Bay. Historically, Lake Huron tansy also was also found on the Door Peninsula of Wisconsin. The typical type found in the Great Lakes may be considered an endemic variety of a more widely dispersed species (Guire & Voss 1963). This species also occurs in Maine and the Maritime Region of Canada, north to Newfoundland along low arctic and sub-arctic coasts (Given & Soper 1981), as well as in the Hudson Bay area and on beaches of Lake Athabaska (Ostlie 1991). The same or very similar species grows in Alaska and the Pacific Northwest. Hultén (1971) included *Tanacetum* in *Chrysanthemum* then treated *huronense* as a subspecies of the similar *C. bipinnatum* L., which is also in Alaska (Voss 1996).

In Michigan, *T. huronense* occurs in the six eastern most counties of the Upper Peninsula: Chippewa, Mackinac, Luce, Schoolcraft, Delta, Alger (MNFI 2001a), and historically Marquette County (Chadde 2000) along Lake Superior sand beach (Dodge in 1918). Mackinac and Schoolcraft counties both have over 15 occurrences listed (MNFI 2001b). In the Lower Peninsula, it occurs along both the Lake Michigan and Lake Huron shorelines in Alpena, Antrim, Charlevoix, Cheboygan, Emmet, Grand Traverse, Leelanau, and Presque Isle counties (MNFI 1999a), and on the northern islands in Lake Michigan (Choberka *et al*. 2001). Statewide 115 occurrences (MNFI 2001b) are listed, though "just over 60 have been discovered or confirmed extant since 1980" (Choberka *et al*. 2001). Ownership seems to have a bearing on what is considered an occurrence. Therefore large tracks of land such as the Hiawatha National Forest, the Lake Superior State Forest, and Pictured Rocks National Lakeshore show fewer occurrences than Lower Peninsula locations where ownership is more subdivided.

HABITAT AND PLANT COMMUNITIES

Canada

In Quebec, *Tanacetum huronense* is fairly common in dry open places, coastal grasslands, and mountain valleys (Ostlie 1991). Scoggan (1979) found it inhabiting calcareous river gravels along the Matapedia and Restigouche Rivers of the Bic and Gaspé peninsulas. Blondeau (1986 *cf* Ostlie 1991) reported occurrences on sandy coastal terraces in dense ribbon-like colonies with *Elymus mollis* and *Saxifraga tricuspidata*. Rousseau (1974 *cf.* Ostlie 1991) described the habitat of Lake Huron tansy in Labrador and Quebec as gravelly shores, seaside terraces, sand beaches, and stream talus (Ostlie 1991).

"In Newfoundland, *Tanacetum huronense* is a common species on limestone gravel and coastal

areas. The species was considered for listing in the province, but was rejected as being too abundant in its habitat" (Ostlie 1991). "Occupied habitats include limestone and serpentine barrens and beaches. In the dense dwarf turf of Cape St. George, associates include *Dryas integrifolia*, *Hedysarum mackenzii*, and *Carex rupestris"* (Ostlie 1991). In New Brunswick, *T. huronense* occurs along gravelly river strands or rocky banks (Hinds 1986).

In Alaska and British Columbia, *T. bipinnatum* ssp. *huronense* is found scattered in coastal sand dunes. Frequently it is associated with *Carex macrocephala* (large-headed sedge) and *Poa macrantha* (seashore bluegrass) (Pojar & MacKinnon 1994).

Maine

In Maine and New Brunswick, *Tanacetum huronense* is endemic to the gravels and sands of the St. John and Restigouche Rivers and their tributaries. Vigorous colonies of over 100 individuals are known along the St. John River (ME EOs 2001). Of the 34 known sites in Maine, 14 were currently listed as extant (ME EOs 2001). In 1998, eleven sites from the most northern county (Aroostook) were known. (ME Dept. of Conservation 1998). A couple of sites previously listed as extant, have since recovered and support healthy populations. These appear to be sites that are subject to periodic scouring. Populations in Maine appear to favor two different habitats. Cobbly beaches along the St. John River appear to be a favored habitat, but *T. huronense* also grows on circumneutral slate ledges along rivers (ME EOs 2001). Populations in Maine are dependent upon maintaining the hydrologic integrity of the river shore habitat. On the cobbly river beaches, Lake Huron tansy generally grows with other species such as *Prunus pumila* var. *depressa*, *Astragalus alpinus* var. *brunetianus*, and *Allium schoenoprasum* (ME Dept. of Conservation 1998).

Michigan

In Michigan, *Tanacetum huronense* thrives on fairly active sand dunes and cobble beaches along the Great Lakes, withstanding some wave action at times of high water (Voss 1996). *T. huronense* occurs most frequently within the first 40 m from the shoreline (Jolls & Sellars unpublished DNR report 1999). Jolls and Sellars (1999) found most plots with *T. huronense* contained greater than 50% sand cover, and almost all plots with seedlings were virtually devoid of competing vegetation. This foredune region is characterized by high winds, temperature extremes, sand movement, low nutrients, and low vegetative cover often dominated by *Ammophila breviligulata* (MNFI 1999b). The rhizomes of *T. huronense* may help in stabilizing sand dunes, although very large colonies of the plant are rarely seen (Voss 1996).

In Michigan, "the dunes are derived from glacial sediments, including lacustrine and outwash sands and sandy tills. Most of our larger dune complexes are associated with the Lake Nipissing stage of the Great Lakes, when water levels were 25 to 30 feet higher than present day lake levels" (Dorr and Eschman 1970). A combination of water erosion and wind deposition resulted in the formation of the Great Lakes dunes (MNFI 1999b).

Albert and Comer (1999) of the Michigan Natural Features Inventory described the foredunes of most dune and swale complexes as 1-2 meters high. The foredunes are commonly quite open, harsh habitats, with moving sand, extremely dry conditions, and little organic material for nutrients (MNFI 1999b). Lichter's (1988) study of dune and swale complexes found foredunes characterized by strong winds, extensive sand burial and erosion, high levels of sunlight, high rates of evaporation, and low available nitrogen and phosphorus. Common plants of the foredune area include beach grass (*Ammophila breviligulata*), dune grass (*Calamovilfa longifolia*), autumn willow (*Salix*

serissima), dune willow (*S. cordat*a) and balsam poplar (*Populus balsamifera*) (Albert & Comer 1999). Other common plants of the foredune include sea rocket (*Cakile edentula*), and wormwood (*Artimesia campestris*) (MNFI 1999b). Foredune habitat is shared with the federally-threatened Pitcher's thistle (*Cirsium pitcheri*) and state-threatened Lake Huron tansy (Albert & Comer 1999).

Tanacetum huronense also occurs as a relic (usually without flowers) on old well stabilized dunes (Voss 1996), and occasionally on upland meadow alvars (Chadde 1999). Within the Hiawatha National Forest on the Lake Michigan shoreline, *T. huronense* was found on more stable habitats within the dunes than Pitcher's thistle (*Cirsium pitcheri*) and was more likely to be found in the lee slopes of dunes, and in and around groves of small trees or shrubs (Alverson 1994).

Lake Huron tansy occurs on shoreline sites in the Lake Superior region only at the southeastern corner of the lake, from Grand Sable to Whitefish Point to Batchawana Bay, Ontario. "Its failure to colonize apparently suitable sites farther to the west around the lake appears merely to be the result of local barriers to dispersal in the form of rocky granitic shores lacking beaches" (Given & Soper 1981).

"At Pictured Rocks National Lakeshore in Michigan, *Tanacetum huronense* plants preferentially inhabit the lee side (back slopes) of active dunes" (Loope pers. comm. 2001). Although this habitat gives the plants greater protection from wind action, plants are subjected to occasional heavy sand deposition from sands blowing off the bluff face (Schultz 1988). The Grand Sable Dunes are a system of perched dunes on ancient glacial moraines with about "one dozen northwest/southeast trending parabolic blowouts extending 1 to 1.5 kilometers from the bluff edge inland to high sand ridges spilling into forest vegetation" (McEachern 1992). Associates at Pictured Rocks include *Agropyron trachycaulum, Agrostis hyemalis, Achillea millefolium, Fragaria virginiana, Arabis lyrata, Hieracium* spp., *Rumex acetosella, Juniperus communis, Pinus banksiana,* and *Solidago racemosa* (Pavlovic *et al.* 1993).

A Hiawatha National Forest (HNF) field study (Alverson 1994), included sampling for *T. huronense* in approximately 4% of the HNF Lake Michigan dune habitat along the beaches of Lake Michigan and Lake Superior. Along transects, 3437 sterile and 940 fertile shoots of *T. huronense* were recorded. Estimates based on these counts per hectare were 1300/ha sterile and 356/ha fertile. Meander searches along Lake Superior resulted in an estimated total of 50,250 stems. This survey was done in September so sterile and fertile stems were lumped together. An estimated minimum of 167,344 shoots of *T. huronense* occur on HNF land on the shorelines of Lake Michigan and Lake Superior. Approximately two-thirds of the shoots occur in the broad beach-dune complexes along the Lake Michigan shoreline with markedly greater densities in the eastern sections. One-third of the shoots occurred in narrow habitats along Lake Superior with greater densities along the western portion near Tahquamenon Bay district along the Lake Superior shoreline (Alverson 1994).

In Michigan, plants occur both in stabilized dunes and open, undisturbed dunes. Associates on open dunes include bearberry (*Arctostaphylos uva-ursi*), sandreed (*Calamovilfa longifolia*), beachgrass (*Ammophila breviligulata*), threesquare (*Scirpus americanus*), little bluestem (*Schizachyrium scoparium*), fescue (*Festuca saximontana*), wormwood (*Artemisia campestris*), false Solomon's seal (*Smilacina stellata*) (Chadde 1999). Other open dune associates include silverweed (*Potentilla anserina*), beach pea (*Lathyrus maritimus* var. *glaber*), sea rocket (*Cakile edentula*), Pitcher's thistle (*Cirsium pitcheri*), sand cherry (*Prunus pumila*), and creeping juniper (*Juniper horizontalis*) (U.S. Dept. of Interior 2000). Associates in inner dunal regions include *Bromus pumpellianus, Juncus*

balticus, Eleocharis spp., *Juncus nodosus, Cerastium arvense, Arabis canadensis, Potentilla anserina, Ammophila hyemale, Achillea millefolium, Stellaria longifolia, Lathyrus japonicus,* and *Calamovilfa longifolia* (MNFI 2001b). Associates in simple linear dunes such as TNC's Grass Bay Preserve in Cheboygan County include: *Ammophila breviligulata, Calamovilfa longifolia, Andropogon scoparius, Juncus balticus, Agropyron dasystachyum, Salix cordata, Salix myricoides, and Equisetum variegatum* (Pavlovic *et al.* 1993).

Wisconsin

"In Wisconsin, *Tanacetum huronense* is rare but locally abundant on Lake Michigan shores in Door County, where it occupies open habitats such as stony calcareous beaches, cracks in limestone barrens, dune and interdunal wetlands" (Ostlie 1991). *T. huronense* is probably extirpated within the state (WI DNR 1993); it was last collected in 1982 (WI EOs). Associates included *Ammophila breviligulata, Agropyron psammophilum, Solidago houghtonii, Cirsium pitcheri, Prunus pumila, Salix syrticola*, and other Great Lakes species (Mickelson & Iltis 1966 *cf.* Ostlie 1991).

PROTECTION STATUS

U.S. Fish and Wildlife Service: Not Listed (None)

U.S. Forest Service: R9 Sensitive on Hiawatha National Forest

Global Conservation Status Rank: G5 T4T5

(G5 = Common, widespread, and abundant globally, although it may be rare in parts of its range, particularly on the periphery. Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.)

(T4 = Species is globally or nationally widespread, abundant, or apparently secure, but with cause for long-term concern.)

(T5) = See above definitions for G5

National Conservation Status Rank: United States: N4? (March 2002)
Canada: N4 (02 Feb 1995)

U.S. & Canada State/Province Conservation Status Ranks:

Michigan = State Threatened, Wisconsin = State Endangered, Minnesota = Unknown

United States	
Alaska	S3
Maine	S2
Michigan	S3
Wisconsin	S1

Canada	
Alberta	S1
British Columbia	S3 S4 [1]
Manitoba	SR
New Brunswick	SR
Newfoundland	S2 S3 [2]
Northwest Territories	SR
Nunavut	SR
Ontario	S4
Quebec	S2 S3 [3]
Saskatchewan	S2 S3
Yukon Territory	S3 [4]

1 Marta Donovan, Biological Information Center Coordinator, British Columbia Conservation Data Centre (21 Eos)
2 Sean Blaney, Botanist, Atlantic Canada Conservation Data Centre
3 Jacques Labrecque, Botanist, Ministery of Envirment of Quebec (17 Eos)
4 Bruce Bennett, Biologist, Yukon Renewable Resources (20 Eos)

Definition of Conservation Status Ranks

S1 = Extremely rare; typically 5 or fewer known occurrences in the state; or only a few remaining individuals; may be especially vulnerable to extirpation.

S2 = Very rare; typically 5 between 6 and 20 known occurrences; may be susceptible to becoming extirpated.

S3 = Rare to uncommon; typically 21 to 50 known occurrences; S3-ranked species are not yet susceptible to becoming extirpated in the state, but may be if additional populations are put at risk.

S4 = Common, apparently secure under present conditions; typically 51 or more known occurrences, but may be fewer with many large populations; usually not susceptible to immediate threats.

S5 = Very common; demonstrably secure under present conditions.

SR = Reported from the state, but without persuasive documentation that would provide a basis for either accepting or rejecting the species.

S? = Not enough information available to assess at this time; more field studies and/or specimen identification is needed.

LIFE HISTORY

T. huronense blooms from mid July to the end of August in the Great Lakes Region (Voss 1996), with a peak blooming period in July (Choberka *et al.* 2001). It can be cross pollinated by insects and reproduces from seeds as well as vegetatively by means of horizontal rhizomes producing clonal colonies. Some seeds mature by late August, but many remain on the dried plants over the winter (Ostlie 1991). Little is known about seed dispersal, and fertility. Seed germination and seedling growth has been observed in moist depressions, at the bases of leeward dune slopes, and in dune slacks (McEachern 1992). Lake Huron tansy is dependent on the continuing natural disturbance of actively shifting sand dunes; the seed appears to be adapted to burial and germination appears to be light-inhibited (Jolls & Sellars, unpublished DNR report 1999). *T. huronense* is a colonizing species that helps bind the shifting sands and hold them in place. However, whenever the vegetation density increases and dunes become semi-stabilized by a local predominance of shrubs, the tansy becomes

reduced in numbers and eventually disappears (Environment Canada, 2001).

Sellar observed (Jolls & Sellars 1999) various non-specific insects visiting Lake Huron tansy. Among them a true bug (Anthocoridae), true flies (various Syrphidae), spider wasps (Pompilidae) and sphecid wasps (Sphecidae). *Tanacetum huronense* appears to be capable of being self-compatible and autogamous. No significant reduction in seed set was detected when pollinators were excluded from flowering heads with mesh bags. The first summer, seed set ranged from approximately 20% to over 40%. However, seed set during a subsequent growing season was extremely low, 6-23% due to natural variation or premature collection of heads (Jolls and Sellars, unpublished DNR report 1999).

Darkness and burial appear to suppress germination of one-year old Lake Huron tansy seeds. Seeds on the sand surface (0 cm depth) were more likely to germinate than those buried at even 2 cm depth, 37.6% vs. 6.2% (Jolls and Sellars, unpublished DNR report 1999).

POPULATION BIOLOGY

Tanacetum huronense is a perennial forming small to large colonies. "Abundant seed production coupled with rhizomatous growth enables the plant to survive on the shifting beach and dune sands of the Great Lakes Region" (Ostlie 1991). Lake Huron tansy reproduces sexually; seeds are produced on three to twelve composite heads on a main stem, which can grow 30 to 75 cm high. In Michigan, *Tanacetum huronense* flowers throughout July, with fruit forming shortly thereafter in August, and September. Lake Huron tansy also reproduces vegetatively via rhizomes (Ostlie 1991).

T. huronense and related varieties do well in recently disturbed sites. In the sub-polar Urals 1-3 years after a mining operation *Poa pratensis, Epilobium angustifolium,* and *Tanacetum bipinnatum* were well represented at all four previously mined sites (Martynenko 1986).

When foredunes are effected by high winds, waves or human activities, parabolic blowouts push inland from the trough providing foredune-like habitats for beach and foredune species. By colonizing blowouts, Pitcher's thistle and Lake Huron tansy, characteristic species of the near-shore, windblown dune locations can persist for a time at scattered sites within the more protected secondary dunes. In years when the foredunes are truncated by high lake levels or storm activity such sites may serve as refugia for those species, contributing to eventual beach and foredune recolonization. Therefore, larger dune fields are less likely to lose these species because they offer mosaics of dune formation (Pavlovic et al. 1993).

An early study done to investigate the influence of winter temperatures upon seed germination found that *Tanacetum huronese* favored cold temperatures for greater/increased seed germination (Nichols 1934). Of 200 seeds, 118 germinated after refrigeration for 70 days compared to 24 that germinated without refrigation (Nichols 1934). "Current recommendations are to sow seeds at 20° C (68° F) in light; if there is no germination in 3-4 weeks, move containers to -4 to +4° C (24-39° F) for 2-4 weeks with thin cover" (Clothier 2001). Clothier further notes that although *Tanacetum huronense* is a rare species in its native habitat, it appears that it could become invasive in fertile soil. Clothier (2001) further noted that three small seedlings from 1998 had become a solid 2 ft. by 2 ft. block of "attractive" plants in 1999, with a height of 20 inches.

The primary threat to *Tanacetum huronense* is the disturbance or destruction of natural shoreline periodic disturbance regimes by altered longshore transport and sedimentation (Jolls pers. comm. 2001). The use of a wide variety of shoreline stabilizing structures such as retaining walls or rip-rap to prevent erosion "collectively impede natural sand movement and nourishment processes that maintain the integrity of coastal dune systems (Choberka *et al*. 2001). The natural temporal and spatial mosaic of the dune ecosystem is important for maintenance of this species as new colonies establish in more dynamic habitat at the same time as older colonies often die back over time due to natural succession. Natural lake-level fluctuations are critical to maintaining dune heterogeneity (Jolls pers. comm. 2001). "Lakeshore or river gravel habitats are maintained through a dynamic water level fluctuation regime. Damming of rivers or other activities that impact this water level cycle may prove deleterious to this plant's occurrence; therefore, protection must take into account the maintenance of natural flood cycles and water level fluctuations" (Ostlie 1991). In addition, past and sometimes current marina development has resulted in the fragmentation of nearby sand dunes and potential habitat for Pitcher's thistle and the Lake Huron tansy (Pavlovic *et al*. 1993). Even as far north as New Brunswick, many former sites for *T. huronense* have been destroyed by hydroelectric developments (Hinds 1986).

Development of shoreline dunes for secondary homes is a major threat to this species on privately owned lands in the Great Lakes Region (Ostlie 1991). Residential development of dunes is not forbidden, but it is somewhat restricted by law. Building structures, constructing roads, or changing contours on slopes steeper than 33% is prohibited (MNFI 1999b). Development causes both the elimination of habitat, and a secondary effect of the alteration of natural mechanisms for dune formation (McEachern 1992). Construction of coastal roads which fragment sand dune habitat and spur subsequent shoreline development is also a threat to this species. In addition, road access provides easy access for destructive recreational activities such as ORV (Off Road Vehicles) use (Ostlie 1990). The Nature Conservancy, Michigan Chapter, reports that ORV damage continues even after talking to local neighbors, involving local DNR Conservation Officers, extensive signing, and barricading of their shoreline preserves (Ewert pers. comm. 2000).

In sand habitats, *Tanacetum huronense* is extremely susceptible to erosion via foot traffic (Clampitt pers. comm. 2001). At Sleeping Bear National Lakeshore, the park is building elevated walkways to reduce the impacts from hiking and trampling (Updike 2001). Circumstantial evidence at Indiana Dunes National Lakeshore indicates that Pitcher's thistle, often an associated species, has populations that are smaller and more widely scattered where visitors are allowed to wander the dunes, than at adjacent fenced and boardwalk areas (Pavlovic *et al.* 1993). All-terrain vehicles (ATV) or similar off-road activities can significantly damage occupied habitats (Ostlie 1991). Collection of dried *Tanacetum huronense* flower heads for fall bouquets is another human-use threat. Continued collection may undermine the ability of the species to reproduce thus threatening the population at a given site (Ostlie 1991).

An indirect effect of foot traffic at Pictured Rocks National Lakeshore is the introduction and spread of non-native species to invade dune habitats and displace native vegetation resulting in further degradation (Penskar *et al.* 1996). White sweet clover (*Melilotus alba*) is abundant in blowouts at Pictured Rocks (McEachern 1992). Spotted knapweed (*Centaurea maculosa*) and hawkweed (*Hieracium* spp.) are common at Pictured Rocks National Lakeshore, especially in the area north of Grand Sable Lake (Leutscher pers. comm. 2001). In the summer of 2001, spotted knapweed was

removed by pulled starting near the west end of the dunes and working back towards Grand Marais (Leutscher pers. comm. 2001). At Sleeping Bear National Lakeshore, baby's breath (*Gypsophila paniculata*) and spotted knapweed (*Centaurea maculosa*) are the two most prevalent weedy species (Pavlovic *et al.* 1993). Another potential threat in the more weedy areas, could be the potential for hybridization with *T. vulgare* (C. Jolls, pers. comm. 2001).

Below ground herbivory (a cutworm moth caterpillar from the family Noctuidae) was observed on *T. huronense* during the summer of 1999 at Pointe aux Chenes on the Hiawatha National Forest (Vogel unpublished research). Preliminary observations did not indicate whether the observed below ground herbivory was detrimental to the population of plants at this site (J. Vogel, pers. comm. 2001). Field botanists should continue to be on the lookout for signs of below-ground herbivory to assess whether this might have an affect on known populations.

Protection efforts designed for Lake Huron tansy populations must encompass the immediate buffer areas surrounding the populations. Factors essential for maintaining the quality of existing habitat should be taken into account. In dunes, all areas immediate to *T. huronense* should be protected from structures designed to reduce windthrow (jetties, fences, retaining walls, and planting of ground covers). These structures alter the amount and direction of longshore sand flow that is an essential part of the dune rebuilding process (Jolls & Sellars unpublished DNR report 1999). Man-made structures accelerate sand erosion on the windward side and accelerate sand deposition on the leeward side (D'Ulisse & Maun 1996). At Sleeping Bear Dunes, it was determined that parking lots were adversely affecting the dune dynamics; subsequently, one parking lot was relocated (Updike 2001).

RESEARCH AND MONITORING

The Nature Conservancy, Michigan Chapter gives the following monitoring recommendations for *T. huronense*: "(1) assess the stability of populations over time, (2) determine the ability of the species to disperse from existing colonies and (3) determine the ability of the species to respond to natural changes within its habitat. Consequently, monitoring must track the status of extant populations as well as the habitat of current populations" (Ostlie 1991).

Since *T. huronense* is a rhizomatous species, assessments of population stability using individual counts may be difficult. Instead, assessments may be determined through counts of flowering stems, area of colony coverage, or a combination of both. The stage classes of juveniles and seedlings may also be estimated to give an indication of future population trends.

In dense colonies, permanent plots should be placed along transects in areas occupied by *T. huronense* and also adjacent areas not currently inhabited. Plots placed adjacent to occupied regions should document movement of the colony. Flowering stems per quadrant, seed set per flower, and percent coverage by *T. huronense* should be documented. Photo-monitoring stations may be established to document population changes (Ostlie 1991) and/or GPS (Global Position System) can be used to map plant locations, and the size of populations (Jolls, pers. comm. 2001). Monitoring populations and habitats over a decade would be helpful to note changes due to succession and to detect responses due to fluctuating lake levels.

Existing populations should continue to be studied to better understand demographics, gene flow,

and metapopulation dynamics, as well as the species response to both natural and anthropogenic stressors. Monitoring of changes in habitat may be done through studies of vegetational composition and percent cover of vegetation within occupied habitats.

Two monitoring methodologies have been utilized by the Michigan Chapter of The Nature Conservancy on their preserves. At Grass Bay Preserve, distribution of plants were described relative to dune configuration (TNC 1987). However, *T. huronense* population appeared to be maintaining itself at the site and the moitoring protocol is no longer being used (Clampitt pers. comm. 2001). In small populations, actual counts of plants may be undertaken; at the Pawler-Gates-Wilcox Preserve actual counts were taken annually for several years (Ostlie 1991). Surface coverage, flower stalks per plant and seed set per flower may also be determined and tracked.

Pictured Rocks National Lakeshore has implemented a monitoring program for *T. huronense*. Thirty permanent plots were established at three locations in and around the dunes in 1988 (Schultz 1988). Quadrant locations were chosen to reflect the various stages of successional habitat that *T. huronense* typically occupies. At each site, the total number of individuals and flowering individuals were counted. Overstory, sapling and seedling component measurements were also made as part of the 1988 study. Locations of *T. huronense* were mapped using GPS (summer 2000) in the Grand Sable dunes within Pictured Rocks as part of an initial exotic plant survey (Loope pers. comm. 2001). Pictured Rocks National Lakeshore is also using GPS data to model potential habitat within the Grand Sable dunes for protection from exotic invasions (Leutscher pers. comm. 2002).

Since *T. huronense* is a disturbance-dependent species, a better understanding of the response of the taxon to natural disturbance regimes is needed. "Currently, there is no information available to determine how successful *T. huronense* is in the dispersal and establishment of seeds. In addition, the identification of *T. huronense* pollinators is needed in order to better understand the reproduction potential of the species and provide better management information" (Ostlie 1991) .

MANAGEMENT CONCERNS

Although the largest populations of Lake Huron tansy are within publically owned lands, this does not guarantee protection. Both Sleeping Bear and Pictured Rocks National Lakeshore populations are impacted by recreational use, primarily by hikers. In order to reduce the impact of hikers, Sleeping Bear National Lakeshore is building elevated walkways (Updike 2001). There is a need for more designations such as Research Natural Areas and Essential Habitat Zones in dune habitat. The Grand Sable Dunes area in Pictured Rocks National Lakeshore is designated as a Research Natural Area (Leutscher pers. comm. 2002). On Beaver Island, a State Wildlife Research Area designation has restrictions on use affording additional protection. Within Michigan, some of the State Parks favor wide public beaches over Lake Huron tansy habitat. In the Upper Peninsula of Michigan, several beaches offer default protection in that the adjacent forest is a cedar swamp making beach access via land difficult.

Lake Huron tansy is an early successional plant; without natural wind currents and sand deposition regimes its populations naturally decline over time. Several Michigan Element Occurrences (2001) document reductions of populations over time:

Cheboygan 1976 1000s of plants	1996 about 500 plants
Charlevoix 1981 locally frequent	1992 scattered clumps

Presque Isle 1981 common	1996 60 mature plants
Mackinac 1960 common	1986 100+ plants scattered along shoreline.

Rather than reliance only on seed set and extensions of existing clones by rhizomatous growth, it may be possible to augment existing populations by planting rhizome fragments (Jolls & Sellars unpublished DNR report 1999). From preliminary transplanting tests using rhizome lengths of two or three nodes, *T. huronense* showed good survival potential. Planting in spring or early summer appears to be a viable option for restoration efforts for *T. huronense* (Jolls & Sellars unpublished DNR report 1999). Rhizome fragments of 2 or 3 nodes were able to produce aboveground ramets from 2 cm burial. However no emergence occurred with deeper burials of 4 and 8 cm depth. Twelve per cent of the two node fragments and 25% of the three node fragments produced aboveground ramets (Anna Williams, University of Michigan Biological Station student, summer 2000). Over time, reliance on genetic fragments could result in less genetic diversity within a population and perhaps lead to imbreeding (Jolls pers. comm. 2001).

The Great Lakes Shoreline dune systems are unique habitats that are being threatened by developmental pressure, fragmentation and off-shore stabilizing structures which alter natural wind patterns. Increased recreational use via ATVs are highly destructive. Increasingly exotic weeds such as spotted knapweed, baby's breath, white sweet clover and hawkweeds compete successfully for habitat, stabilizing dunes and allow woody plants such as sand cherry and creeping juniper to succeed.

SUMMARY

The rarity of Lake Huron Tansy is impacted on a global level by the continued questions as to what subspecies are included in this species. If narrowly defined then the type for *T. huronense* is known from the Great Lakes Region. If defined more broadly then its range includes much of Canada and Alaska. These questions effect its Global ranking for rarity. In Canada, the habitat is often calcareous river gravels and sandy coastal terraces which are somewhat common. In Michigan, its primary habitat is open dunes along our Great Lakes. This is a specialized habitat that is threatened by man-made structures that alter longshore transport of sands. Natural lake-level fluctuations are critical to maintaining a mosaic of habitats allowing new areas for colonization as older areas often succeed to more woody species. Even in parks and preserves, foot traffic can cause too much disturbance and decreased numbers; even worst is use of ORVs. All threats to the dune habitat greatly effect populations of Lake Huron tansy in the Great Lakes Region.

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CONTACTS

Marta Donovan, Biological Information Center Coordinator, British Columbia Consservation Centre (250) – 356-0928
Sean Blaney, Botanist, Atlantic Canada Conservation Data Centre
sblaney@mta.ca
Jacques Labrecque, Botanist, Ministery of Envirment of Quebec
jacques.labrecque@menu.gouv.qc.ca
Bruce Bennett, Biologist, Yukon Renewable Resources
Bruce.Bennett@gov.yk.ca
Merel Black, Botany professor, University of Wisconsin—Madison Herbarium
mblack@facstaff.wisc.edu
Emily Pinkham, Hertiage Data Coordinator for Maine
Emily.Pinkham@state.me.us
Jan Schultz, Hiawatha National Forest, Forest Plant Ecologist, (906)-228-8491
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Vogel, Jon. 2001. PhD. Student, Michigan State University, Biology program
Williams, Anna. 2000. University of Michigan Biological Station student
Jolls, Claudia. 2001. Associate Professor, East Carolina University, Greenville, NC
Jollsc@mail.ecu.edu