

*Conservation Assessment
for
Boreal Bedstraw (*Galium kamtschaticum*)*



USDA Forest Service, Eastern Region
February 2003

Janet Schultz
2727 N. Lincoln Rd.
Escanaba, MI 49829
906-228-8491



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This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation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 and its review, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if the reader has any 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.

Table of Contents

ACKNOWLEDGEMENTS	4
INTRODUCTION/OBJECTIVES.....	5
EXECUTIVE SUMMARY	5
NOMENCLATURE AND TAXONOMY	6
SPECIES DESCRIPTION.....	6
RANGEWIDE PROTECTED STATUS	9
HABITAT AND ECOLOGY.....	10
DISTRIBUTION AND ABUNDANCE	12
POPULATION BIOLOGY.....	14
POPULATION VIABILITY AND PROTECTION.....	15
POTENTIAL THREATS.....	15
RESEARCH AND MONITORING	16
SUMMARY	17
REFERENCES.....	18
WEBSITES.....	19
CONTACTS	20

ACKNOWLEDGEMENTS

Outside Reviewers – We would like to thank our academic reviewers and agency reviewers outside of the U. S. Forest Service for their helpful comments and correction on this manuscript.

Ed Voss, Curator Emeritus of Vascular Plants, University of Michigan Herbarium

Hanes Trust Fund – We thank the Hanes Trust for their support in funding this project.

Initial Draft – We are grateful to Shannon McKenny, contract horticulturist, for her efforts in providing us with an original draft for this Conservation Assessment.

Herbarium and Heritage Data – We appreciate the sharing of occurrence information for this species from Heritage personnel both in the United States and Canada, along with the helpful assistance of Herbarium personnel. See Contacts section at end of report for a complete list.

Editorial Committee – We thank Jan Schultz, of the Hiawatha National Forest, for her suggestions and patience through numerous revisions.

Literature Search

- We thank Laura Hutchinson of the North Central Research Library for performing initial species inquiries and sending us relevant research articles.
- We thank Jan Schultz, of the Hiawatha National Forest, for use of her extensive library of materials to begin to compile information on this species.
- We thank Beverly Braden, a contract botanist, for additional literature searches at Northern Michigan University in Marquette and Michigan State University in East Lansing.

INTRODUCTION/OBJECTIVES

The National Forest Management Act and USDA Forest Service policy and require that National Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has established populations and a distribution of reproductive individuals sufficient to ensure the continued existence of the species throughout its range within a given planning area. In addition to those species listed as Endangered or Threatened under the Endangered Species Act, or Species of Concern by the U.S. Fish and Wildlife Service, the Forest Service lists species that are sensitive within each region – Regional Forester Sensitive Species (RFSS). A designation of “sensitive” affords some additional regulatory protection.

Galium kamtschaticum is a Regional Forester Sensitive Species (RFSS) in the Eastern Region of the National Forests. It is listed as an R9 (Region 9) sensitive species on the Hiawatha National Forest.

The objectives of this document are to:

1. Provide an overview of current scientific knowledge for this species.
2. Provide a summary of the distribution and status of this species, both rangewide and within the Eastern Region of the National Forests.
3. Provide the available background information needed to prepare a subsequent Conservation Approach.

EXECUTIVE SUMMARY

Galium kamtschaticum Steller ex J.A. & J. H. Schultes (boreal bedstraw) is designated as an R9 Sensitive Species on the Hiawatha National Forest in Michigan’s Upper Peninsula, Eastern Region of the Forest Service. It is listed as critically imperiled (S1) in the State of Michigan with a G5 global ranking (secure globally, though may be quite rare in parts of its range). The purpose of this document is to provide the background information necessary to prepare a Conservation Approach that will ultimately include management actions to conserve this species.

Commonly known as boreal bedstraw or northern wild licorice, *Galium kamtschaticum* is an inconspicuous rhizomatous perennial herb that reaches 30 cm in height. It has a short blooming period, from June to August. Animals are presumed to be important seed dispersal agent though a specific vector is not known. It is found in cool, moist, shady areas from Asia, Kamchatka, and Korea through the Aleutian Islands, northwest Canada and Washington, disjunct in the eastern Lake Superior area, and again disjunct in the northeastern United States and eastern Canada. The most significant threats to the species appear to be changes to hydrology or sun exposure.

NOMENCLATURE AND TAXONOMY

Class:	Dicotyledoneae
Order:	Rubiales
Family:	Rubiaceae
Scientific Name:	<i>Galium kamtschaticum</i>
USDA NRCS Plant Code:	GAKA (USDA Plants Profile, W-4)
Common Names:	boreal bedstraw (Hinds 1986) northern wild licorice (Welsh 1974)
Synonyms:	<i>Galium rotundifolium</i> var. <i>kamtschaticum</i> (Kuntze 1891) <i>Galium littellii</i> (Oakes 1841)
Origin:	Native
Duration:	Perennial

SPECIES DESCRIPTION

Material for this section is adapted from Hultén 1968, Chadde 1999, Gleason and Cronquist 1991, Hitchcock *et al.* 1969, Potash 1998, Hinds 1986, Voss 1996, Welsh 1974, Argus *et al.* 1982-1987, and Pojar and MacKinnon 1994.

Galium kamtschaticum is a rhizomatous perennial herb, with single, smooth, upright stems 10-30 cm tall and square in cross-section (Pojar and MacKinnon 1994). The 3-nerved, oval leaves distinguish this species from other perennials in the bedstraw genus (Voss pers. comm. 2002). The leaves are in 2 to 4 whorls on each stem, 4 leaves in each whorl, with the uppermost leaves being noticeably larger (MDOC, W-1). The inconspicuous flowers (only 3 mm wide) are born on a slender pedicel, are greenish-white in color, and bloom from June to August in the Pacific Northwest (Potash 1998). The small fruits (1-2 mm) are round and covered with hooked bristles (Gleason and Cronquist 1991).

Species Characteristics:

Roots: Slender creeping rhizome, stoloniferous, filiform.

Stems: Glabrous or sparingly hirsute with spreading hairs, upright, 6-10 inches (10-30 cm) long. Square in cross-section.

Leaves: In 2-4 whorls on the stem, upper whorls larger than lower, each whorl with 4 leaves. Broadly ovate or obovate, obtuse, short-mucronate apically. Three main veins, leaf margins antrorsely hispid-ciliate.

Inflorescence: Flowers small, born in cymes on axillary peduncles. Peduncles 1-3, 2-3 flowered from uppermost whorl. Calyx lobes ovate-lanceolate, corolla greenish-white with 4 acute lobes.

Fruits: Seeds born in a small pair of united, round, dry fruits. Fruits only 1-2mm wide, 2-lobed, covered with hooked, bristly hairs.

Identification notes:

Voss (1996) states that *Galium* is a difficult genus to correctly identify, with a high percentage of misidentifications in herbaria. “The characters are sometimes subtle, and pressed specimens may lack the distinctive aspects of fresh material. It is important to consider a balance of characters rather than relying on a single characteristic to separate similar species” (Voss 1996). Another problem is that immature individuals of *Galium* are especially difficult to distinguish from each other. Several species of *Galium* have four leaves per whorl when in the juvenile stage; this means that the best search time is limited. In the western states, *Galium kamtschaticum* can not be positively identified until late July (Potash 1998).

Galium kamtschaticum is distinguished from other perennials in the *Galium* genus by its 3-nerved, oval leaves in 3-4 whorls of 4 leaves each. The flowers are each born on a slender elongated pedicel (1-2) from the uppermost whorl of leaves (Gleason and Cronquist 1991). In contrast to the common sweet-scented bedstraw (*Galium triflorum*), which occurs in similar habitats, each whorl in boreal bedstraw has 4 leaves rather than whorls of 6 leaves. Also, the plants are more upright, rather than the sprawling habitat of *G. triflorum* (Chadde 1999). Another *Galium* that is common in Washington and Oregon is *G. oreganum* (*G. kamtschaticum* var. *oreganum*); it is the southern counterpart of boreal bedstraw, occurring in moist forest and meadows from near sea level to subalpine elevations. In contrast, Oregon bedstraw has a greater number of flowers in a more branched inflorescence, and 5-9 leaf whorls where boreal bedstraw has 2-5. (Pojar and MacKinnon 1994).

Galium kamtschaticum and *G. pilosum* are similar in form though their habitat is quite distinct. *G. kamtschaticum* is a decidedly boreal species of old-growth beech-maple and northern coniferous forests. In the Upper Peninsula of Michigan it is known from

Chippewa County. In the Lower Peninsula, *G. kamtschaticum* occurs along the entire western tier of counties north to the Traverse City area and in the thumb area south to the state line (Voss 1996). *Galium pilosum* occurs in dry sandy woodlands with oak or jack pine, thriving in clearings. See key below for identifying characteristics.

Key adapted from Voss (1996); therefore this key is of greatest assistance in Michigan and other Great Lakes states. (In Michigan, Voss distinguishes between 20 species of *Galium*). In the key, U.P. refers to the Upper Peninsula of Michigan)

1. Ovary and fruit spreading-bristly, and/or leaves with 3 prominent longitudinal veins
 2. Leaves all or mostly in whorls of 6-8 with only one prominent longitudinal vein; plant reclining or trailing *G. aparine*, *G. odoratum*, *G. triflorum*
 2. Leaves all in whorls of 4 (or fewer), often with a pair of weaker longitudinal veins besides the midrib at the base of the blade; plant erect.
 3. Branches of the inflorescence with lateral flowers (and fruits) mostly sessile or nearly so; corolla yellow-green to deep maroon
 4. Principal leaves broadly ovate-elliptic, obtuse, mostly less than 2.5 times as long as broad; internodes and outside of corolla usually pubescent; corolla greenish (primarily in Southern MI, not U.P.)..... *G. circaezans*
 4. Principal leaves broadly lanceolate, acute, 2.6-4.2 times as long as broad; internodes and outside of corolla glabrous; corolla maroon (entire State) *G. lanceolatum*
 3. Branches of the inflorescence with all flowers (and fruits) distinctly pediceled; corolla white to whitish green
 5. Leaves linear-lanceolate, the principal ones mostly 4-14 times as long as broad; fruit either without bristles, or if present not hooked (entire State, various habitats)*G. boreale*
 5. Leaves broadly ovate-elliptic, less than 3 times as long as broad; fruit (and ovary) with bristles hooked at the tip
 6. Plants low, 3-5 whorls of leaves, upper ones clearly the largest; stems glabrous; leaves not gland-dotted (only U.P.; moist woods) ...*G. kamtschaticum*
 6. Plants tall, with numerous whorls of leaves, upper leaves smaller; stems pubescent; leaves obscurely to distinctly gland-dotted beneath (Southern MI and along Lake Michigan, not in U.P.; dry sandy oak or jack pine and openings)*G. pilosum*
1. Ovary and fruit smooth or at most roughened; leaves with only the midrib prominent (12 additional species of *Galium* detailed)

RANGEWIDE PROTECTED STATUS

(NatureServe, W-2)

Currently, the official status for *Galium kamtschaticum* with respect to federal, state, and private agencies is:

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

Global Heritage Status Rank: G5 (25Sept1997)

U.S National Heritage Status Rank: N3 (02Oct2000)

Canada Heritage Status Rank: N3 (14July 1996)

With a global rank of 5 and U.S. National Rank of 3, The Nature Conservancy defines these rankings as:

N3: Reasonably widespread, but may be more limited in portions of its range

G5: Demonstrably widespread, abundant, and secure globally (Maine DOC, W-1)

U.S. Forest Service: Region 9 Sensitive on Hiawatha National Forest (MI). Recent occurrence on White Mountain National Forest (2001); known historically (early 1900s). Region 6 Forester's Sensitive Species List (USDA FS 1991).

The Regional Forester has identified it as a species for which viability is a concern on Hiawatha National Forest as evidenced by: a) significant current or predicted downward trends in population numbers or density, and or b) significant current or predicted downward trends in habitat capability that would reduce its existing distribution (FSM 2670.5.19).

U.S. State Heritage Ranks (NatureServe, W-2)

Alaska	S2	New York	S1
Maine	S2?	Vermont	S2
Michigan	S1	Washington	S2S3
New Hampshire	SR		

Canadian Province Ranks (NatureServe, W-2)

British Columbia	S3	Northwest Territories	SR
New Brunswick	S2	Nova Scotia	SR
Newfoundland	SR	Ontario	S2
Newfoundland Island	SR	Quebec	SR

Definitions (NatureServe, W-2)

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 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 destroyed.

S?: The species is either unranked or has a questionable ranking.

HABITAT AND ECOLOGY

Throughout its range, habitats for *Galium kamtschaticum* are generally described as moist, cold, coniferous forests and mossy places (Chadde 1999; Hitchcock *et al.* 1959; Hultén 1968; Potash 1998; Scoggan 1979; Welsh 1974).

Michigan

In Michigan, *G. kamtschaticum* is found in or near small shaded seasonally-wet seeps near stream channels in mesic hardwood forests of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*) and yellow birch (*Betula alleghaniensis*). The Michigan Natural Features Inventory (MNFI) community types are Mesic Northern Forest and Hemlock Forest (Chadde 1999). It was initially discovered in Michigan in a beech-maple forest south of Lake Superior during the summer of 1995, at the base of a north facing ridge with seepy areas nearby (M. Jaunzems, voucher 934). MNFI lists 2 element occurrences (MNFI 2002). At the University of Michigan there are 4 vouchers, but all known occurrences are within a mile of each other so it is quite reasonable to group specimens as one occurrence (E.G. Voss pers. comm. 2002). Associated overstory species in Michigan include *Acer saccharum*, *Acer rubrum*, *Tsuga canadensis*, *Fagus grandifolia*, and *Betula alleghaniensis*. Other associated species in Michigan include *Carex scabrata*, *Chrysplenium americanum*, *Impatiens capensis*, *Viola cucullata*, *Lycopodium lucidulum*, *Galium triflorum*, *Thelypteris noveboracensis*, *Mnium* spp., and other mosses (Chadde 1999).

New England

In New England, *G. kamtschaticum* is restricted to the northern portion of Maine, Vermont and New Hampshire (USDA FS 2001). Eastern populations are associated with woodlands in mountainous regions such as the White Mountains in New Hampshire (Magee & Ahles 1999). In Vermont, all stations (11 Element Occurrences) except those near the Canadian border are in mountainous locations (1580-2100 ft. elev.) (USDA FS 2001). *Galium kamtschaticum* often grows in wet springy places or seeps in boreal forests, especially near the timberline (Jenkins 1981). Soil permeability at these sites is

expected to be slow (USDA FS 2001). Stand age (both mature forests and clear cuts) is variable. The location within the stand appears variable as well since the species occurs in the forest interior, along streams and springs, and in thickets (USDA FS 2001).

A recently located site (2001) on the White Mountain National Forest was in saturated soil, at mid-slope of 15-35%, with a north aspect, at 2900-2950 feet. Associates at this site were Sphagnum moss, *Listera convallarioides*, *Streptopus amplexifolius*, *Circaea alpina*, *Aster acuminatus*, and *Aster novae-angliae* (USDA FS 2001 plant survey).

Wynne-Edwards (1937) notes that among the cordilleran arctic-alpine flora, many ferns and leafy flowering plants are confined to sheltered and moist habitats, among them *Galium kamtschaticum*. Another 'relic' area is around the shores of the Gulf of the St. Lawrence. Among plants from further north that thrive in these calcareous soils are *G. kamtschaticum*, *Lycopodium sabinaefolium*, *Arenaria macrophylla*, and *Ozmorhiza divaricata* (Wynne-Edwards 1937).

Western states

Western populations are found in the Olympic Forest and other coastline rainforests as well as other western mountains, preferring cold, moist, steep terrain. From Washington north, *G. kamtschaticum* is scattered in moist coniferous (especially alluvial) forests, thickets, stream banks, grassy or mossy talus slopes, generally of northern aspect, (1930-2900 feet) at low to middle elevations (Hitchcock *et al.* 1959; Pojar and MacKinnon 1994; Potash 1998).

In the Western Cascades, *Galium kamtschaticum* occurs on low percent slopes in gentle depressions. Seventy-three percent of the sites occur on slopes of 10 percent or less. The majority of sites (64%) were in old-growth coniferous forest. Five sites (17 %) located in younger plantations (sapling-pole stage) were continuous with a larger adjacent old-growth stand (Potash 1998). *Galium kamtschaticum* appears to be restricted to seeps with nearly year-round saturated soil. Plants were never found growing in standing water, but there was often surface water in the vicinity. Although a technical wetland delineation was not conducted it is expected that this species would be classified as an obligate, i.e. there is a 99 percent probability that it would be found growing in an area technically classified as a wetland (Reed 1988).

On the Olympic Peninsula, *G. kamtschaticum* is found among silver fir (*Abies amabilis*) and mountain hemlock (*Tsuga mertensiana*) plant associations, in wet canopy gaps, on northerly aspects, from 643-967 m (1930-2900 ft) in elevation. Of five sites, one is terraced while the other four are on slopes ranging from 25 to 65 percent (Potash 1998).

G. kamtschaticum is found in 76 locations on the Mt. Baker-Snoqualmie National Forest in the western Cascades. It occupied low angled slopes with saturated soils, dense shrub thickets, and old-growth forest canopy gaps from 500-1166 m (1500-3500 ft) in elevation. One large and vigorous population occurs on steep talus with a dense shrub cover and surface seepage. The Wenatchee National Forest populations, near Snoqualmie Pass, are found in similar habitat. Associated species in the western

Cascades along with percent frequency include *Rubus spectabilis* (84%), *Athyrium filix-femina* (82%), *Oplopanax horridum* (76%), *Ribes bracteosum* (53%), *Tiarella unifoliata* (47%), *Vaccinium alaskense* (46%), *Lysichitum americanum* (41%), *Gymnocarpium dryopteris* (39%), *Blechnum spicant* (36%), *Rubus pedatus* (30%), *Sphagnum* spp. and other mosses (30%) (Potash 1998). On the 11 sites with moss, moss represented 63% of the cover and the most dominate taxa on these sites (Potash 1998).

In the western Cascades, the canopy gaps in which *G. kamtschaticum* is found are the result of soils too saturated for tree growth. The plants do not grow in standing water, but are usually found close to surface water on sites saturated nearly year-round. Any *G. kamtschaticum* plants observed growing in direct sunlight seem to be somewhat chlorotic, but it can tolerate canopy gaps since the surrounding canopy creates filtered light. It is, however, most frequently found underneath dense shrub cover (Potash 1998).

Canada

Specific habitat was noted (Calder & Taylor 1968) for the Queen Charlotte Islands near Vancouver, British Columbia. “*Galium kamtschaticum* occurs only in rather open mature coniferous woods bordering creeks and on open, grassy, stabilized subalpine talus slopes. It is best developed on well-drained but rich sandy alluvial soils where it is frequently associated with *Polystichum braunii* (Braun’s holly-fern) and *Circaea alpina* (alpine enchanter’s nightshade)”. Its distribution on the islands appears to be restricted to the mountains and their adjacent flanks (Calder & Taylor 1968).

DISTRIBUTION AND ABUNDANCE

Galium kamtschaticum is a circumboreal species occurring sporadically from eastern Asia and Korea, through the Aleutian Islands and Alaska, British Columbia, the Northwest Territories, and Washington (Pojar and MacKinnon 1994; Hitchcock *et al.* 1969; NatureServe; Welsh 1974). The species is disjunct in the eastern Lake Superior area, and again disjunct from northeastern United States and eastern Canada (Hinds 1986; Gleason and Cronquist 1991; Marquis & Voss 1981; Voss 1996). *Galium kamtschaticum* occurs in the northern boreal woods from Newfoundland and Cape Breton to northern New England and New York (USDA FS 2001).

United States distribution of *Galium kamtschaticum* includes Alaska, Washington, Michigan, New York, Vermont, New Hampshire, and Maine (NatureServe, W-2). From the Aleutians through the Panhandle, *G. kamtschaticum* is found in coastal and insular southern Alaska to ca. 59 deg N (Scoggan 1979; Welsh 1974). In Washington, *G. kamtschaticum* does not extend south of Snoqualmie Pass in the Olympic Mountains, Cascade Range (Potash 1998). The state rank in Maine is S2?, occurring historically but its present status is unclear (Maine DOC, W-1). In New York, Vermont and New Hampshire, distribution is concentrated in the mountains (Scoggan 1979).

Marquis and Voss (1981), in their paper discussing plants of western North America disjunct in the Great Lakes Region, categorized *Galium kamtschaticum* as belonging to the group of plants found in western North America, the Great Lakes, and the St.

Lawrence without an intermediate population in the Black Hills of South Dakota. Other plants that share the same distribution pattern are *Arabis holboellii* (a northern sand cress), *Arenaria macrophylla* (bigleaf sandwort), *Dryas drummondii* (yellow mountain-avens), and *Mimulus moschatus* (muskflower), *Poa canbyi*, *Polystichum lonchitis* (Northern holly-fern), *Vaccinium ovalifolium* (tall bilberry).

New England Region

In New England it is at the southern limit of its range and is restricted to the northern portions of Maine, New Hampshire, and Vermont (USDA FS 2001). Vermont harbors 11 extant occurrences. With the exception of a couple of stations near the Canadian border, all sites are in mountainous regions: Jay, Mt. Mansfield, Mount Horrid, Camels Hump, Stratton, and Killington (Jenkins 1981). Maine has 3 historic occurrences, 4 extant occurrences in Franklin County and 1 extant occurrence in Somerset County (USDA FS 2001). In New Hampshire it is known from Coos and Grafton Counties (Magee & Ahles 1999). Within the Green Mountain National Forest in Vermont there are three occurrences from the early 1900s. Within the White Mountain National Forest in New Hampshire, an occurrence was documented recently (2001) during a survey for *Listera convallarioides* on Mt. Washington; it was found about mid-slope in saturated soils (USDA FS 2001 plant survey).

Washington

The majority of known *G. kamtschaticum* sites in Washington are in the western Cascades on the Mt. Baker-Snoqualmie National Forest (76 sites or 46 element occurrences). The western Cascades also have 2 sites on land administered by the Wenatchee National Forest, and 2 sites on land administered by the Washington State Department of Natural Resources. There are six known sites on the Olympic Peninsula all in federal ownership (Potash 1998). *G. kamtschaticum* is state ranked as vulnerable to imperiled in Washington (NatureServe, W-2).

Canada

Galium kamtschaticum was known for many years from forests north of Sault Ste. Marie in Ontario, having been collected on the east side of Lake Superior in 1935 (Marquis and Voss 1981). *Galium kamtschaticum* is a recent discovery in Michigan, first discovered in 1995 on the Hiawatha National Forest (Jaunzems #934 at MICH). The initial discovery was in an old-growth beech-maple forest ca. 3 mi. south of Lake Superior, north of Eckerman. *G. kamtschaticum* and is still only known from a few locations in northern Chippewa county and state ranked as Threatened in Michigan (MNFI 2002).

Canadian distribution includes British Columbia, the Northwest Territories, Ontario, Quebec, New Brunswick, Newfoundland (Newfoundland Island), and Nova Scotia (NatureServe, W-2). In British Columbia, *G. kamtschaticum* is found along the coast to ca. 55 deg 20'N, on Vancouver Island (Scoggan 1979), and the Queen Charlotte Islands of Graham Island and Moresby Island (Calder & Taylor 1968). Its distribution on these islands is restricted to the mountains and their adjacent flanks (Calder & Taylor 1968).

On the east shore of Lake Superior there are several sites (at least 7); the first known site from Ontario is at Mamainse Mountain, about 40 mi. NW of Sault Ste. Marie, and 8 miles inland from Lake Superior (Hosie 1938). Brome, Portneuf, Quebec, and Temiscouata Counties in Quebec, along with the Shickshock Mountains of the Gaspé Peninsula, have occurrences of *G. kamtschaticum*. In New Brunswick, this species is found at Summit Depot, Restigouche County, on Cape Breton Island, Inverness County. It is also found in Victoria County in Nova Scotia (Scoggan 1979).

Life Cycle

Galium kamtschaticum is a perennial herb with creeping slender rhizomes (Hitchcock *et al.* 1969). Potash (1992) studied this species on the Mt. Baker-Snoqualmie National Forest in Washington. On 18 sites, an average of 48 percent of the plants were either in flower or fruit when observed. The sites were visited several times from first emergence until a killing frost in the late fall; over the entire summer 85 percent of the plants had developed fruit. Therefore it appears that the actual time of blooming for a particular plant may be very brief (Potash 1992). In Michigan this species flowers in July (Chadde 1999). The pollen vectors for *Galium kamtschaticum* are unknown (Potash 1998). In general, bedstraws with masses of small, shallow, fragrant white to yellowish flowers are visited by a variety of Lepidoptera, beetles, flies, ants, wasps, and short or long tongued bees (Batra 1984). Research specific to *G. kamtschaticum* is needed to determine pollen vectors for this species.

Presumably distribution of seeds by animals is an important dispersal strategy for this species since fruits are armed with numerous hooked barbs and readily attach themselves to passing fur or feathers. This would allow the seeds of *Galium kamtschaticum* to be disseminated over large distances (Potash 1998). When *G. kamtschaticum* was found in Michigan the closest known station was 75 miles north of Sault Ste. Marie (Scoggan 1979). Establishment usually occurs in shady, moist, cool, often moss covered sites. In both the western and eastern United States this species is found within mountains at high altitudes. In Michigan it is found near Lake Superior which likely provides a cold microclimate for this species.

POPULATION BIOLOGY

Galium kamtschaticum is a perennial herb with creeping rhizomes (Hitchcock *et al.* 1969). Colonies generally show well developed vegetative reproduction, but only a few plants in any one colony produce flowers or fruit (as observed in the Mt. Baker-Snoqualmie National Forest) (Potash 1998). Well developed vegetative reproduction was also observed on the Queen Charlotte Islands, British Columbia. However, only a few plants from each colony produced flowers or fruit (Calder & Taylor 1968). Actual blooming time for each individual plant appears to be brief, with a long blooming season from June to August, depending in part on latitude and altitude (Potash 1998). In Maine, it was reported that populations (1999) in Prentiss and Kibby Counties produced mature fruit (USDA FS 2001).

Distribution of seeds by animals is presumed to be an important dispersal strategy for this species, though a specific pollen vector is unknown. The hooked bristles covering the fruits of *G. kamtschaticum* readily attach themselves to fur, feather, and fabric allowing the seeds to be distributed over large distances. Establishment of new colonies is limited, however, habitat requirements (Potash 1998).

POPULATION VIABILITY AND PROTECTION

Galium kamtschaticum is circumboreal in its distribution, but “rare and local” throughout its range (Hitchcock *et al.* 1969). The species is limited to moist, cold, coniferous forests and mossy places in low to middle elevations on mildly angled slopes with saturated soils (Chadde 1999; Hitchcock *et al.* 1959; Hultén 1968; Potash 1998; Scoggan 1979; Welsh 1974; Pojar and MacKinnon 1994). While *Galium kamtschaticum* does not grow in standing water, it is often found somewhere in the vicinity of surface water or on sites saturated part of the year (Potash 1998). In Michigan, *G. kamtschaticum* occurs in damp hollows of beech-maple forests in shade (Voss pers. comm. 2002). *G. kamtschaticum* appears to grow best when out of direct sunlight. Where *G. kamtschaticum* has been observed growing in direct sunlight, the plants appear chlorotic (Potash 1998). In the western United States, it commonly grows under dense shrub thickets or in canopy gaps where the surrounding stands modify light penetration (Potash 1998).

On the Mt. Baker-Snoqualmie National Forest there are 46 element occurrences. Many of these populations (41 out of 46 records) occur in protected areas of the Forest (26 in either a Late-Successional Reserve or Wilderness Area). Populations in the western Cascades varied from 2 individuals (stems) to several hundred stems (Potash 1998). In contrast, on the Olympic Peninsula this species is not very well distributed; six populations occur in the same township and range in a Late-Successional Reserve. Long-term survival on the Olympic Peninsula would be increased if populations occurred over a broader geographic area. This would provide protection from stochastic events such as a wildfire possibly eliminating the entire group of sites (Potash 1998).

On the Green Mountain (Vermont) and White Mountain National Forests (New Hampshire) even though there are few documented occurrences, its Forest-wide viability was given a B rating by a panel of botanists/ecologists. The primary rationale is that its preferred habitat is not considered rare or threatened and its preference for seep habitat limits its suitability to other species (USDA FS 2002).

POTENTIAL THREATS

Change in hydrology may be the major viability consideration for this species. Management activities that affect downslope hydrology (e.g. road construction) could potentially make a site too dry since *G. kamtschaticum* grows in areas with shallow water tables. Conversely, stream diversion or other management activities that could flood a site with water would also be detrimental because the plant does not grow in standing water (Potash 1998). Where this species occurs near streams, it might be less threatened

by natural succession as periodic flooding would likely keep out potential competing species (USDA FS 2001). Climate changes causing disturbance in hydrology systems would be equally detrimental (Potash 1998, USDA FS 2002).

This species is small and inconspicuous, with fragile herbaceous stems and slender rhizomes. Direct impacts such as trampling or crushing by hiking, mowing, etc. would greatly damage plants (Potash 1998).

Most *G. kamtschaticum* plants receive only partial or indirect sunlight and would not grow as vigorously if light intensity were increased (Potash 1998). Also *G. kamtschaticum* is generally found in relatively undisturbed plant communities. Therefore, infestations of noxious weeds could have a detrimental effect on this species (Potash 1998).

Loss of populations due to management activities that impact shade cover and soil saturation are major viability considerations. Compaction of saturated soils could alter wetland hydrology and could destroy the shallow rooted underground rhizomes (Potash 1998). Timber harvest, trampling from recreational use, and climate change could all cause a decline in populations of *Galium kamtschaticum*.

Management Recommendations (Potash 1998)

1. Maintain existing drainage patterns (hydrology) and avoid compaction of saturated soils.
2. Maintain existing light and temperature regime by maintaining associated understory species and filtered light in the canopy.
3. Avoid direct impacts that would crush the plants. Redirect hiking trails, avoid timber harvest and associated equipment use.
4. Avoid soil disturbance since that could facilitate the invasion of weedy species.

RESEARCH AND MONITORING

Information on *Galium kamtschaticum* is quite limited. Long-term monitoring of this species has not yet been conducted in the western United States and research is limited (Potash 1998). In the western United States, *Galium kamtschaticum* often grows in patches under very dense shrub cover so it is difficult to move around in these sites. Sampling designs that require placement of gridlines are not practical for this species. In the Cascades, random sampling from all potential habitat is not productive as entire mountains could be considered potential habitat (Potash 1998).

Potential research questions for this species (Potash 1998):

1. What variables should be measured to determine the health or fitness of an individual.
2. Can this species withstand canopy removal if any associated shrub layer is left intact and the hydrology is not significantly altered?
3. What is the role of sexual reproduction vs. vegetative reproduction for this species? What are the pollen vectors for this species?
4. Is it important to distinguish between genetically distinct “individuals” or are the number of clonal stems an adequate way to quantify the population.
5. What distribution is necessary to maintain connectivity?

There are 19 weedy *Galium* species in the United States (Batra 1984). Much of the research monies for *Galium* are spent on controlling agricultural nuisance *Galium* species (Batra 1984).

Monitoring of species like *Galium kamtschaticum* that are at the southernmost edge of their natural range is important. These populations are more vulnerable, especially to climate change. Also plants at the edge of their natural range are often genetically distinct from populations at the core of their range due to adaptation to different habitat conditions and microclimates (Potash 1998).

Value and Use

Bedstraws (*Galium* spp.) are eaten by livestock and wild rabbits, but this appears to not be a preferred food (Batra 1984). *Galium* could possibly cause skin irritation or sensitization as the anthraquinones contained have low systemic toxicity to mammals. Some of these compounds have allelopathic, fungistatic, or repellent effects. These compounds are used as purgatives and in the manufacture of vat dyes; they are applied to seeds to make them distasteful to birds, and may make *Galium* repellent to insects (Batra 1984).

SUMMARY

Galium kamtschaticum is circumboreal in distribution (G5 global status), but rare within its range, especially in the Great Lakes Region (S1 status in MI) probably because it is at its southern limit. In Michigan and Ontario, it is found in and near small shaded seeps and stream channels in rich northern hardwood forests. In western states and Canada, *G. kamtschaticum* can generally be found in moist, cold, coniferous forests and mossy places, at low to mid elevations, in saturated soil, and in partial or indirect sunlight. Any management actions or climate changes that affect the saturation of the soil or exposure

to sunlight could be detrimental to this species. It is also vulnerable to direct impacts like trampling or crushing due to its fragile stems and slender rhizomes.

REFERENCES

- Argus, G.W., Keddy, C.J., Pryer, K.M., and D.J. White. 1982-1987. Atlas of the Rare Vascular Plants of Ontario. Vol 2. (Rubiaceae) National Museum of Natural Sciences.
- Batra, S.W.T. 1984. Phytophages and Pollinators of *Galium* (Rubiaceae) in Eurasia and North America. Entomology 13: 1113-1124.
- Britton, N.L. and Brown A.B. 1970. An Illustrated Flora of the Northern United States and Canada (Vol. III), Dover Publication Inc. New York. p. 261.
- Calder, J.A. and R.L. Taylor. 1968. Flora of Queen Charlotte Islands, British Columbia. Part 1. Systematics of the vascular plants. Canadian Department of Agricultural Research Monograph 4(1): 1-659, p. 510.
- Chadde, S. 1999. A Forester's Field Guide to the Endangered and Threatened Plants of Michigan's Upper Peninsula. Pocketflora Press: Calumet, Michigan. pp. 11-12.
- Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada (2nd ed.). The New York Botanical Garden. p. 507.
- Hinds, H. 1986. The Flora of New Brunswick. Primrose Press: University of New Brunswick. Fredericton, New Brunswick. p. 365.
- Hitchcock, C.L., A. Cronquist, M. Ownbey, and J.W. Thompson. 1959. Vascular Plants of the Pacific Northwest. Vol. 4. University of Washington Press: Seattle, Washington and London, England. p. 450.
- Hosie, R.C. 1938. Botanical Investigations in Batchawana Bay Region, Lake Superior. National Museum of Canada, Bulletin 88 (Biological series 23).
- Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press: Stanford, California. p. 839.
- Jenkins, J. 1981. The rare plants of the Green Mountain National Forest and their potential habitats: *Galium kamtschaticum*. A research report prepared for the Supervisor's Office. Green Mountain National Forest. Rutland, Vermont.
- Marquis, R.J. and E.G. Voss. 1981. Distributions of some western North American Plants Disjunct in the Great Lakes Region. The Michigan Botanist Vol. 20 pp. 66-67.

- Pojar, J. and A. MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine Publishing. Canada. p. 331.
- Potash, L.L. 1998. Management Recommendations for Boreal Bedstraw (*Galium kamtschaticum* Stellar ex Schult. And Schult.) V. 2.0. Unpublished manuscript. USDA Forest Service, Washington (Mt. Baker-Snoqualmie National Forest, Olympic National Forest). Pp. 1-18.
- Reed, P. B. 1988. National list of plant species that occur in wetlands. Northwest (Region 9) U.S. Fish and Wildlife Service Biological Report 88 (26.9) pp. 1-89.
- Scoggan, H.J. 1979. The Flora of Canada Part IV. National Museum of Science, National Museums of Canada. Publ. in Bot 7(4). Ottawa, Canada. pp. 1410-1411.
- USDA Forest Service. 2001. Species data collection form for *Galium kamtschaticum*. SVE process. Green Mountain and White Mountain National Forests. Prepared by Peter Steckler. Pp. 1-16.
- USDA Forest Service. 2002. SVE-Upland Forest Plants Panel for *Galium kamtschaticum*. Green Mountain and White Mountain National Forests. June 3-4, 2002. Panel: Brett Engstrom, Charlie Cogbill, and John Williams.
- Voss, E.G. 1996. Michigan Flora. Vol. III. Cranbrook Institute of Science. Bulletin 59. Ann Arbor, Michigan. p. 285.
- Welsh, S.L. 1974. Anderson's Flora of Alaska and adjacent parts of Canada. Brigham Young University Press: Provo, Utah. pp. 399-400.

WEBSITES

- W-1. Maine Department of Conservation, (Maine DOC) Natural Areas Division
<http://www.state.me.us/doc/NRIMC/MNAP/factsheets/snameindex.htm>
- W-2. NatureServe 2002 *Galium kamtschaticum* <http://www.natureserve.org/...>
- W-3. New York State Dept. of Environmental Conservation Protected Native Plants – Endangered <http://www.dec.state.ny.us/index.html>
- W-4. USDA Plants Profile http://www.plants.usda.gov/plants/cgi_bin/plant_profile.cgi

CONTACTS

Hiawatha National Forest: Janet Schultz, Forest Plant Ecologist 906-228-8491

White Mountain National Forest: Leighlan Prout, Forest Biologist (603) 528-8752

Green Mountain National Forest: Diane Burbank, Forest Ecologist (802) 388-4362

University of Michigan Herbarium: Ed Voss, Curator (*Michigan Flora* author)
(734) 764-2431

Library Services, North Central Research Station: Laura Hutchinson
lhutchinson@fs.fed.us