The Status of
Wooly Arnica
Arnica angustifolia subsp. *tomentosa*

in Newfoundland and Labrador

Photo: Michael Burzynski

THE SPECIES STATUS ADVISORY COMMITTEE
REPORT NO. 28

February 22, 2012

Recommended Status and Reasons for Designation (to be completed by SSAC)

Recommended Status:	**Alpha-numeric code:**
Endangered	B 2 a) & b) iii)

Reasons for designation:
Small index of area of occupancy, known to exist at < 5 locations and continuing decline in quality of habitat due to climate change and anthropogenic activity such as ATV use and quarry development.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): N/A

Criterion B (Small Distribution Range and Decline or Fluctuation):
B2 Index of area of occupancy estimated to be <5,000 km^2
a)known to exist at $\leq$5 locations and
b) continuing decline in quality of habitat (iii).

Criterion C (Small and Declining Number of Mature Individuals):N/A

Criterion D (Very Small or Restricted Total Population):N/A

Criterion E (Quantitative Analysis):N/A

Author of the original report to the SSAC: Michael Burzynski

TECHNICAL SUMMARY

***Arnica angustifolia* Vahl subsp*. tomentosa* (J. M. Macoun) G. W. Douglas and Ruyle-Douglas**

English common name: Wooly arnica

Nom commun français : Arnica tomenteuse

Range of occurrence in Canada: British Columbia, Yukon, Northwest Territories, Alberta, Newfoundland and Labrador

Demographic Information

Generation time (usual average age of parents in the population)	Unknown
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	N/A
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	No data
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	No data
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	No data
Are the causes of the decline clearly reversible and understood and ceased?	N/A
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	7714 km^2
Index of area of occupancy (IAO) (Total based on 2x2 grid values). [*This includes a 4 km^2 historic population (Table Mountain) because there is a reasonable probability that it may still be present although not yet re-found.]	36 km^{2*}
Is the total population severely fragmented?	Yes
Number of locations [*Based on the major threat identified (climate change), the three Port au Choix populations have been clustered into one location, since the climate change threat almost certainly applies equally to all three Port au Choix populations.]	3 recent 1 historic *
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations?	No
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	Decline in quality of habitat due to climate change and anthropogenic activity such as ATV use and quarry development.
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No

Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals

Population	**N Mature Individuals***
Port au Choix National Historic Site (PACNHS) [**extrapolated – 7 flowering plants in 20% of area x 5 = 35]	(35)**
Port au Choix community barrens, and vicinity [**extrapolated - 390 total plants (flowering and non-flowering, exclusive of the Port au Choix National Historic Site population); this total may be divided by 12 to estimate ~32 flowering plants, based upon a flowering/non-flowering ratio (7:77 = 1:11) recorded for the adjacent PACNHS population (See: Population Size and Area of Occupancy)]	(~32)**
Sandy Barren (Gros Morne NP)	Unknown
Table Mountain [historic location]	Unknown
Cape St. George	Unknown
Total [**extrapolated – see above]	(~67)**

*Based on recent surveys, it appears that the Port au Choix area supports the largest population of *Arnica angustifolia* subsp. *tomentosa* in the province. It also contains about two-thirds of the known habitat for this species. There are not enough field records of flowering plants to provide reliable numbers for this table.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Unknown

Threats (actual or imminent, to populations or habitats)

Climate change has the potential to increase the rate of vegetation growth on the limestone barrens, thereby increasing competition for these slow-growing plants (major threat, this species usually grows on bare limestone gravel or in thin turf).

The Port au Choix community barrens are used for gravel extraction, wood storage, and as a playground for off-road vehicles. Plants in this area are endangered by these activities (medium threat).

Mineral exploration on the Port au Port Peninsula may endanger the limestone barrens habitat around Cape St. George (medium threat).

Hiking trails in Port au Choix National Historic Site expose a small number of plants to potential trampling and picking (minor threat, can be controlled by management actions).

Damage during maintenance of road and hydro infrastructure (minor threat, can be controlled by management actions).

Flower picking (minor due to small number of hikers, restricted habitat, restricted flowering period and low percentage of flowering plants to non-flowering).

Rescue Effect (immigration from outside Newfoundland)

Status of outside population(s)?	
Is immigration known or possible?	No
Would immigrants be adapted to survive in Newfoundland?	N/A
Is there sufficient habitat for immigrants in Newfoundland?	Yes
Is rescue from outside populations likely? *N.B.:* Not naturally, the closest population is about 4,000 km away.	No

Current Status

COSEWIC: Not yet rated
SSAC: Not yet rated

Technical summary prepared by Michael Burzynski.

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STATUS REPORT

Arnica angustifolia Vahl subsp. *tomentosa* (J. M. Macoun) G. W. Douglas and Ruyle-Douglas

Wooly arnica: Arnica tomenteuse

Newfoundland population

Synonyms:

Arnica tomentosa J. M. Macoun
Arnica alpina (L.) Olin subsp. *tomentosa* (J. M. Macoun) Maguire
Arnica pulchella Fernald

Family: Asteraceae (Daisy Family)

Life Form: Showy herbaceous perennial calciphiles.

Systematic/Taxonomic Clarifications

The name *Arnica angustifolia*, proposed by Vahl in 1816, was originally applied exclusively to plants collected in Greenland. However, it has since been applied, as well, to plants collected in Europe, Asia, and North America, and has been subdivided into half-a-dozen subtaxa. Downie (1988a) used morphological, cytological, and flavonoid differences to show that the *angustifolia* aggregate should be represented by two subspecies. Separation of the subspecies *tomentosa* and *angustifolia* is supported by DNA sequencing (Ekenäs *et al.* 2007), and chromosome number.

Flora of North America (2012) uses the following features to separate the two subspecies:

Arnica angustifolia subsp. *angustifolia*: "Leaves linear to broadly lanceolate, faces glabrous or moderately villous. Involucres: bases densely pilose, sometimes stipitate-glandular as well. 2n = 38, 57, 76, 95."

Arnica angustifolia subsp. *tomentosa*: "Leaves narrowly lanceolate, faces densely white-woolly-villous. Involucres: densely woolly-villous and densely stipitate-glandular. 2n = 57, 76."

Subspecies *angustifolia* is circumpolar in distribution (Greenland; Alberta, British Columbia, Manitoba, Newfoundand and Labrador, Northwest Territories, Nunavut, Ontario, Quebec, Saskatchewan, Yukon; Alaska, Montana; Europe; Asia).

Subspecies *tomentosa* is found in western North America (Alberta, British Columbia, Northwest Territories, Yukon; Montana), with small disjunct populations on the Island of Newfoundland (Flora of North America).

The province of Newfoundland and Labrador contains four taxa of arnica. The most widespread of these is *Arnica angustifolia* subsp. *angustifolia* which has been collected on the west coast of the Island from the Port au Port to Cape Norman, and as far north in Labrador as Ramah Bay (M. Burzynski 2009). On the Island, the most commonly encountered species is probably *Arnica lonchophylla,* which Rouleau and Lamoureux (1992) map as occurring from the Port au Port Peninsula to the northern tip of the Great Northern Peninsula—always in association with basic bedrock. Both *Arnica griscomii* subsp. *griscomii* and *A. angustifolia* subsp. *tomentosa* are restricted to less than a half-dozen sites (all on the west coast of the Island), and are uncommon even there.

Distribution

Global:

Arnica angustifolia subsp. *tomentosa* is found only in North America

North America (excluding Canada)**:**

United States: Montana, Wyoming, Idaho, Colorado (NatureServe Jan. 2012)

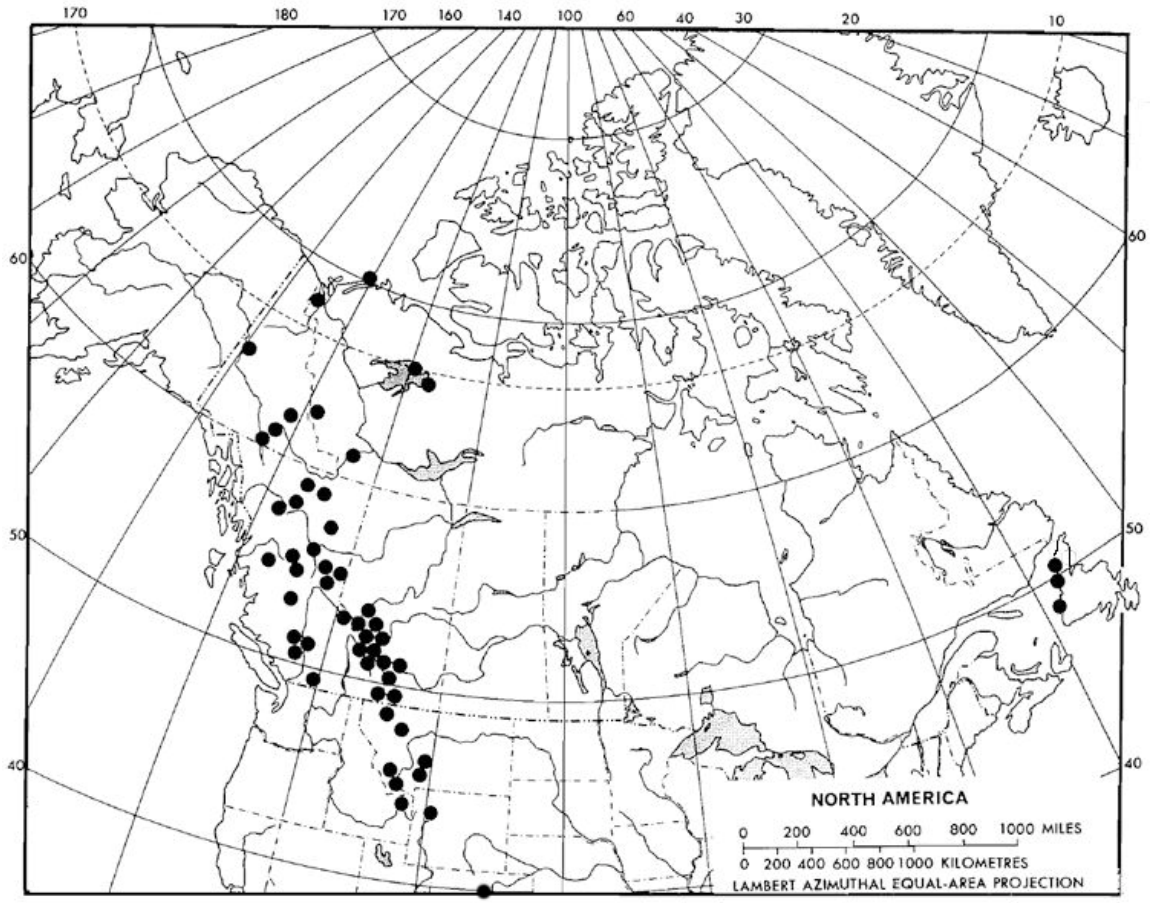

Figure 1: Distribution of *Arnica angustifolia* subsp. *tomentosa* in North America. Map: Adapted from Downie (1988a) [Idaho, Wyoming, and Colorado dots added, Newfoundland sites corrected], © 2008 Canadian Science Publishing or its licensors, Reproduced with permission. *N.B.*: Many American biodiversity sites (*e.g.*: Flora of USA, and Canada, Native Plant Database) incorrectly map subspecies *tomentosa* as present in Québec.

National:

Found in western and northwestern Canada, with small disjunct populations on the Island of Newfoundland: Yukon, Northwest Territories, British Columbia, Alberta, Newfoundland and Labrador.

Provincial: (Showing collectors, and collection dates)

Port au Choix town barrens, Hanel and Lavers, 1999; Charest and Djan-Chékar, 1999

Port au Choix Peninsula, Eastern Point, Fernald, Long, and Fogg, 1929; Penson, 1941; Hay and Bouchard 1974, Bouchard, Hay, Brouillet, and Jean, 1991; Newfoundland Rare Plant Project 1999

Point Riche Peninsula, Bouchard, Hay, Brouillet, and Jean, 1991

Sandy Barren, near St. Pauls Inlet, Gros Morne National Park, Hay and Bouchard, 1974

Table Mountain, Port au Port Bay, Fernald and St. John, 1914 [historic location]

Cape St. George, Port au Port Peninsula, Charest, Hanel, and Djan–Chékar, 1999

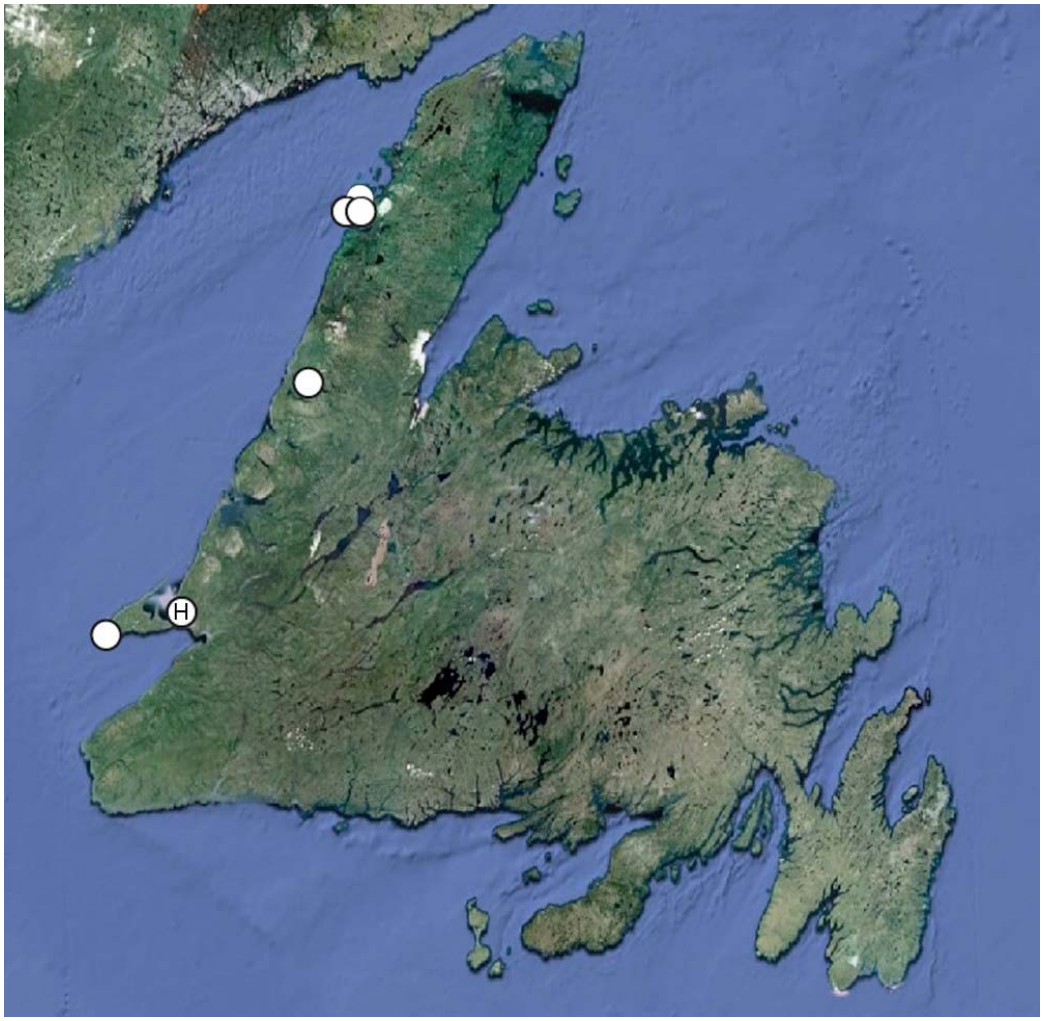

Figure 2: Distribution of *Arnica angustifolia* subsp. *tomentosa* populations in the province of Newfoundland and Labrador. “H” marks the historic population at Table Mountain. Base map: Google Earth.

Description

Arnica angustifolia subsp. *tomentosa* is a low-growing perennial. The flowers are daisy-like, with a single, relatively large, bell-shaped, yellow flower per flowering stem. Flowerheads are borne 20 to 25 cm above the ground, and face upwards at about a 45-degree angle, becoming fully upright as the seeds mature. The base of the flowerhead and the flowering stem are covered with dense wooly white hairs with an under-layer of tiny stalked glands (visible only with a magnifier). Leaves are narrowly lanceolate with densely woolly white hairs on both surfaces. The leaves are held at about a 45-degree angle from the ground. Plants usually grow singly or in small clusters, with one or two flowering stems and several smaller non-flowering plants nearby, probably linked by underground stems. Non-flowering plants usually consist of only 3 to 6 leaves. See Appendix B, Figures 3, 4, and 5 for photographs of this subspecies and comparisons with subsp. *angustifolia*.

Habitat

In its western range, this species is described as growing on alpine slopes and in subalpine meadows at altitudes between 500 and 2,500 metres.In Newfoundland, the species always grows on limestone gravel, usually within a few kilometres of the ocean. At Port au Choix it is between 10 and 30 m of sea level, and ranges up to 340 m at Table Mountain [historic location]. These differences in ecological preference may indicate at least minor genetic differences between the western and eastern populations.

In Newfoundland, this plant has always been found growing in full sunlight away from shading vegetation. It rarely grows on bare limestone, but it is never far from it, and is usually found in small vegetation islands or at the edges of large vegetated expanses within the limestone barrens. It has not been found to form dense clusters.

Usual plant associates are: *Dryas integrifolia, Dasiphora fruticosa, Juniperus horizontalis, Larix laricina, Anemone parviflora, Antennaria* spp., *Cladonia* lichens, *Myrica gale,* and *Actostaphylos uva-ursi. Arnica angustifolia* subsp. *tomentosa* often grows intermixed with, or near, *A. angustifolia* subsp. *angustifolia*, *A. griscomii* subsp. *griscomii*, and *A. lonchophylla* (see Appendix B, Figure 6).

Altitudes of the various barrens on which *A. angustifolia* subsp. *tomentosa* is growing in Newfoundland:

Port au Choix town barrens, 20 m
Port au Choix Peninsula, Eastern Point, 10 to 30 m
Point Riche Peninsula, 15 to 30 m
Sandy Barren, 220 m
Table Mountain, 340 m [historic location]
Port au Port Peninsula, 270 m

See Appendix B, Figures 7, 8, 9, 10, 11, and 12 for habitat photographs.

Overview of Biology

Little is known of the life history of this species. It seems to be a slow-growing, long-lived perennial that does not tolerate competition for sunlight. The plant grows only in very low heath vegetation at the edges of limestone barrens. Usual flowering period is from mid-July to early August. This taxon does not form dense clumps, and is thinly spread even in prime habitat.

Each achene (cypsela) is surmounted by a long pappus and can be windborne. Winds frequently exceed 80 km/hr at all of the known locations for this species, so potential for dispersal is high, but seed production is low [usually only one flowerhead per plant with about 30 seeds per flowerhead (estimated from number of disk flowers and from photographs of maturing seedheads)], and appropriate habitat is limited and patchy, so successful seeding is probably very low.

This arnica, like all of the arnicas that grow in the province, is apomictic (see breeding system information in Additional Sources of Information, below). Considering that all four taxa of arnica can be in flower in close proximity at the same time at the same site, the lack of intergrading hybrids illustrates their reproductive isolation. Not only do the taxa not interbreed, but even within each of the taxa cross-fertilization is probably rare or non-existent. Within each taxon, the physical separation of subpopulations and their apomictic breeding system suggest that for conservation purposes each subpopulation may have to be regarded as genetically unique.

No signs of herbivory have been noted.

Memorial University of Newfoundland (MUN) Botanical Garden has not grown this species (Todd Boland pers. comm.). Generation time is not known.

For the purpose of this report, the definition of a mature plant follows COSEWIC guidelines (adapted from IUCN 2010), and includes only those individuals "known, estimated, or inferred to be capable of reproduction", excluding individuals that will never produce new recruits. Reproducing units within a clone are considered individuals. Re-introduced plants must produce viable offspring before being counted as mature individuals.

Population Size and Area of Occupancy

There is little demographic information available.

The only population assessments in the Atlantic Canada Conservation Data Centre (ACCDC) records are for: [1] a limestone barren northeast of Barbace Cove on the Port au Choix Peninsula, where Wentzell, Pollock, and Charest estimated 200 plants in 1999; [2] about 2 km up the old coastal road outside the town of Port au Choix where they found 215 plants; and [3] a site north-northwest of the airstrip, where they found 175.

M. Burzynski (2011) undertook a partial survey of Port au Choix National Historic Site (which includes portions of both the Point Riche and the Port au Choix peninsulas) for arnicas in July of 2011, during which this species was found at two locations. A "plant" was considered to be any whorl of basal leaves, with or without flowers. At these two locations there were a total of 7 flowering plants and 77 non-flowering plants, for a total of 84 plants. The plants were either single or in loose clusters of up to a dozen plants. During this survey, only about 20% of the appropriate habitat in the national historic site was surveyed, and from earlier work at this site, this represents only a fraction of the site's population of *A. angustifolia* subsp. *tomentosa.* If the remaining habitat is equally productive, there are probably 84 x 5 = 420 plants of this taxon in the entire Port au Choix National Historic Site (and using the 11:1 non-flowering:flowering ratio, 420/12 = 35 of those should be mature). This number (420) corresponds fairly well with the 1999 estimate of 200 plants from the Barbace Cove barrens (a significant portion of the Port au Choix National Historic Site) in the ACCDC records (see preceding paragraph).

If they are again assumed to conform to the 11:1 ratio of non-flowering to flowering plants suggested above, it can be extrapolated for the plants in the ACCDC records (above) that about 33 (390/12) of the plants from the 1999 survey of the area outside Port au Choix National Historic Site were mature/ flowering.

Port au Choix area populations (Port au Choix Peninsula, Point Riche Peninsula, and the Port au Choix community barrens): The Area of Occupancy is 24 km^2

based on a 2 square km grid, and 7 km^2 based on a 1 square km grid.

Sandy Barren, St. Pauls Inlet, Gros Morne National Park population: The Area of Occupancy is 4 km^2 based on a 2 km square grid, and 1 km^2 based on a 1 km square grid.

Cape St. George, Port au Port population: Again, the location of the actual collection site is not defined (only a partial UTM), but because the appropriate habitat is limited, the Area of Occupancy can be estimated to be 4 km^2 based on a 2 km square grid.

Table Mountain, Port au Port Bay population [historic location]: Even though the actual collection site is not known, the Area of Occupancy can be estimated because the appropriate habitat is limited. The estimated Area of Occupancy is thus 4 km^2 based on a 2 km square grid and 1 km^2 based on a 1 km square grid. The IAO includes the estimate of the historic population at Table Mountain because the area has not been well searched.

Aboriginal, Traditional and Local Ecological Knowledge

Requests were made to members of Miawpukek First Nation and Qalipu Mi'kmaq First Nation, but no known aboriginal, traditional, or local ecological knowledge has been forthcoming for this taxon. No mention of this taxon can be found in Arnason *et al*. (1981).

Trends

No repeat surveys have been made of this taxon, so trends cannot be determined.

Threats and Limiting Factors

Threats to *Arnica angustifolia* subsp. *tomentosa*:

Northern Peninsula limestone barrens are particularly threatened by climate change. Downscaling models by Slater (2005) predict a mean annual air temperature rise of approximately 4°C by the 2080s. Southern barrens, such as Port au Port, Gros Morne National Park, and Port au Choix, are expected to experience an increase in minimum air temperatures (thus there will probably be less snow cover to protect plants and soil from winter wind desiccation). Precipitation will probably increase throughout the barrens. There will also be a

longer snow-free period and increased degree-days of heat. The result will probably be the incursion of more substantial vegetation onto the barrens, further reducing available habitat for this arnica and other limestone barren species.

The Port au Choix community limestone barrens are subject to bulldozing and gravel extraction, waste storage, heavy use of off-road vehicles, and wood storage. This causes physical damage to plants and to soil.

Hiking trails in Port au Choix National Historic Site may endanger a small number of plants by exposing them to potential trampling (some grow within 50 cm of the edge of the trail), to picking (Bouchard *et al* 1991), and to damage during trail maintenance (see Appendix B, Figure 12).

Plants on the Cape St. George barrens may be damaged by mineral (*i.e.* petroleum) exploration work.

The major limiting factors for this taxon are that it grows in small isolated populations, lives in restricted limestone habitat, and has very limited seed production. Although its seeds are windborne, chances are very low for successful movement from one patch of habitat to another.

Existing Protection

The plants growing on the limestone barrens at Port au Choix National Historic Site are within a protected area, and Sandy Barren is within Gros Morne National Park. The plants at these sites are protected by the National Historic Parks Wildlife and Domestic Animals Regulations and the Canada *National Parks Act*, respectively.

Plants outside protected areas, including those on the limestone barrens outside the town of Port au Choix, on Table Mountain [historic location], and at Cape St. George, have no protection.

Special Significance

Apart from its significance as a rare and beautiful species that has helped the Limestone Barrens Species at Risk Recovery Team convince local residents of the importance and value of the limestone barrens of western Newfoundland, and its incalculable biodiversity and conservation values, this taxon has no known special scientific or cultural significance.

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Personal Communications

Adam Durocher, Atlantic Canada Conservation Data Centre, Corner Brook.

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Claudia Hanel, Ecosystem Management Ecologist (Botany), Endangered species and Biodiversity Section, Wildlife Division, NL. Dep't of Environment and Conservation.

Kevin Barnes, Western Region Vice-Chief, Qalipu Mi'kmaq First Nation Band.

Todd Boland, Research Horticulturalist, Memorial University of Newfoundland Botanical Garden; Botanical Survey Contractor with Newfoundland and Labrador Hydro.

Luc Brouillet, Professor, Department of Biological Sciences, University of Montreal; Curator of the Marie-Victorin Herbarium, Institut de recherche en biologie végétale.

Maggie John, Aboriginal Liaison, Parks Canada.

Stella Mailman, Summer Resident, St. John Island.

John E. Maunder, Curator Emeritus, Natural History, Provincial Museum of Newfoundland and Labrador [now: The Rooms Provincial Museum].

Susan J. Meades, Botanical Researcher, Director of Northern Ontario Plant Database project.

Carson Wentzell, Botanical Survey Contractor with Newfoundland and Labrador Hydro.

Additional Sources of information

All four Newfoundland and Labrador arnicas (*Arnica angustifolia* subsp. *angustifolia*, *A. angustifolia* subsp. *tomentosa*, *A. lonchophylla*, and *A. griscomii* subsp. *griscomii*) were encountered at Port au Choix, often closely associated, sometimes intermixed. The most frequently encountered species at the site are *Arnica angustifolia* subsp. *angustifolia* and *A. lonchophylla,* which are seen in throughout the barrens. *A. griscomii* subsp. *griscomii* can be found in dense clones, but its distribution is patchy. *A. angustifolia* subsp. *tomentosa* is

uncommon and difficult to find.

Following is a simple key to vegetative material that will usually separate the four arnica taxa found in Newfoundland and Labrador:

A. Basal leaves linear or lanceolate, stiff, upright, edges with few or no teeth. …….. C.

A. Basal leaves oblong or ovate, hairless, or becoming hairless, flat to ground or held low, single or double teeth irregularly and sparsely spaced along edges.

B. Basal leaves (both surfaces) and stems densely covered with white silky hairs; involucre covered with hairs and small stalked glands. ……. *A. angustifolia* subsp*. tomentosa*

B. Basal leaves smooth to sparsely hairy…….. *A. angustifolia* subsp*. angustifolia.*

C. Basal leaves angled slightly upwards, tinged with red or purple with 5 main veins smoothly curving from tip to base of leaf….*A. lonchophylla.*

C. Basal leaves flat to the ground, green, and somewhat fleshy with 3 main veins, the two lateral veins abruptly bending in towards the midvein just above the petiole. ……. *A griscomii* subsp. *griscomii*

Breeding systems of arnicas of Newfoundland and Labrador (with sources):

Arnica angustifolia subsp. *angustifolia,* apomictic, triploid, tetraploid, and pentaploid populations in eastern NA and Greenland (Wolf 1980).
Arnica angustifolia subsp. *tomentosa,* apomictic (Downie 1988b).
Arnica lonchophylla, apomictic (Barker, 1966).
Arnica griscomii subsp. *griscomii*, apomictic, tetraploid (Wolf 1980).

Collections Examined

Gros Morne National Park Herbarium (GMNP), three collections examined.

The Rooms Provincial Museum (formerly the Provincial Museum of Newfoundland and Labrador) Herbarium (NFM) eight collections examined by proxy (by John Maunder and Nathalie Djan-Chékar).

New York Botanical Garden Virtual Herbarium: 1914, Fernald and St. John, Table Mountain specimen, 158477 http://sweetgum.nybg.org/vh/specimen.php?irn=627283, examined (image).

A Digital Flora of Newfoundland and Labrador Vascular Plants. http://digitalnaturalhistory.com/flora_asteraceae_index.htm#arnicaangustifoliatomentosa, 3 specimens examined (images).

Rank or Status

Global	
G-rank	G5T5 (NatureServe Jan. 2012)
IUCN	Not listed
National	
N-rank	N5 (ACCDC)
National General Status	4 - Secure (for *Arnica angustifolia*, subspecies are not assessed) (ACCDC)
COSEWIC	Not ranked
Provincial	
Provincial General Status	2 – May Be at Risk (ACCDC)
Newfoundland S-rank	S1 (Bouchard *et al.* 1991)
Newfoundland General Status	N/A
Labrador S-rank	SNA (ACCDC)
Labrador General Status	N/A
Adjacent Jurisdictions	
Nova Scotia S-Rank	Not present
Nova Scotia General Status	N/A
Prince Edward Island S-Rank	Not present
Prince Edward Island General Status	N/A
New Brunswick S-Rank	Not present
New Brunswick General Status	N/A
Québec S-Rank	Not present
Québec General Status	N/A

Appendix A. Population Information

Recently Verified Occurrences/Range Use (recorded within the last 25 years)

Sensitive location information removed. Data included in report from Atlantic Canada Conservation Data Centre (14 collections and 8 Historical Verified Occurrences), Gros Morne National Park Herbarium (2 collections), M. Burzynski (4 records).

Recent Search Effort (areas searched within the last 25 years with estimate of effort)

Known Locations

Port au Choix National Historic Site: Between 2001 and 2011, Michael Burzynski, general rare species inventories, 50 hours.

Port au Choix community barrens: Claudia Hanel, several hours in the area of the airstrip, did not find Arnica. Carson Wentzell for NL Hydro, 2010, did not find Arnica.

Sandy Barren: 2002, July 22, M. Burzynski, general rare species inventory, 0.5 hour searching the barren area of the summit. This represents about 10% of the limestone barren on this hill, but the lower portions are almost vertical and are inaccessible from the top. The summit is only accessible by helicopter.

Table Mountain [historic location]: 2005, May, and 2011, June 16, Limestone Barrens Species at Risk Recovery Team (LBSARRT) team spent 4 hours searching for *Braya humilis*. If *Arnica angustifolia* subsp. *tomentosa* had been encountered it would have been recorded, although it was early in the year and only leaves would have been present.

Cape St. Gregory: 2011, June 14, spent 4.5 hours on barrens during LBSARRT fieldwork and would have recorded *Arnica tomentosa* if it had been encountered.

Other Locations

General Surveys: In 1999 and 2001, the Newfoundland Rare Plant Project surveyed 1,645 sites on the west and northeast coasts of Newfoundland, with special emphasis on the Point Riche-Port au Choix-St. John Island area. Rare

plant inventories have been conducted by Parks Canada personnel in Gros Morne, Port au Choix, and other Parks Canada Agency sites in western Newfoundland and Labrador since 1996. John E. Maunder, formerly of the Provincial Museum, has checked sites throughout the west coast of the Island, as have Botanical Researcher Susan J. Meades (1990s), Henry Mann of Sir Wilfred Grenfell College (1970s to present), and Nathalie Djan-Chékar of the Provincial Museum.

Targeted Surveys: In 1976, Stuart G. Hay produced "*The Vascular Flora of St. Barbe South, Newfoundland*. André Bouchard and his team from l'Université de Montréal did botanical field work throughout western Newfoundland between 1984 and 1990, leading to the publication of *The Rare Vascular Plants of the Island of Newfoundland"* in 1991. They also concentrated on Parks Canada sites, producing rare plant reports for Gros Morne National Park (1986 and 1996), Port au Choix National Historic Site (1992), and L'Anse aux Meadows National Historic Site (1993). Claudia Hanel, Ecosystem Management Ecologist, Wildlife Division, Newfoundland and Labrador Department of Environment and Conservation, has conducted surveys and inventories of rare plant species throughout western Newfoundland, with special emphasis on limestone barrens and slopes.

Potential Sites Unexplored

The large area of bulldozed barrens around Port au Choix community should be explored more thoroughly.

The barrens in the Cape St. Gregory area may also harbour more plants.

Appendix B. Supplementary Details

Description

Figure 3: Leaf comparison, *Arnica angustifolia* subsp. *tomentosa* above; *Arnica angistifolia* subsp. *angustifolia* below. Photo: M. Burzynski

Figure 4: Flowerhead comparison, *Arnica angustifolia* subsp. *tomentosa* left; *Arnica angustifolia* subsp. *angustifolia* right. Photos: M. Burzynski.

Figure 5: Habit comparison, *Arnica angustifolia* subsp. *tomentosa* on left. Note densely villous leaves and densely woolly-villous and stipitate-glandular involucre. Also note that this small cluster of plants is typical of this species, and is assumed to represent a clone; *Arnica angustifolia* subsp. *angustifolia* on right. Photos: M. Burzynski.

Figure 6: *Arnica angustifolia* subsp. *tomentosa* growing with *Arnica griscomii* subsp. *griscomii* at Port au Choix National Historic Site. Photo: M. Burzynski.

Habitat

Figure 7: Habitat for *Arnica angustifolia* subsp. *tomentosa* on Port au Choix Peninsula, several hundred plants live along the edge of the escarpment in the centre. Note Newfoundland and Labrador Hydro travel route. Photo: M. Burzynski.

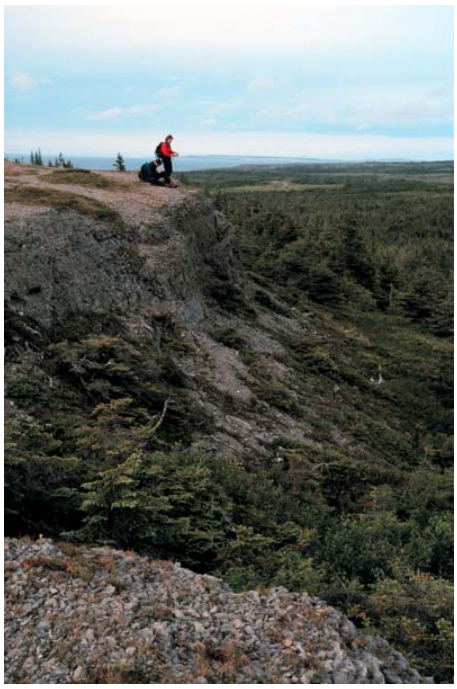

Figure 8: Crow Head, Limestone escarpment on Point Riche Peninsula. Photo: M. Burzynski.

Figure 9: Open barrens habitat for *Arnica angustifolia* subsp. *tomentosa* on Port au Choix Peninsula. Soil here has active cryogenic movement in spring and fall. Photo: M. Burzynski.

Figure 10: *Arnica angustifolia* subsp. *tomentosa* habitat on Sandy Barrens, near St. Pauls Inlet in Gros Morne National Park. Most of this small site is a very steep talus slope. Photo: M. Burzynski.

Figure 11: Table Mountain, Bay St. George. Narrow limestone barrens run along the top of the ridge. Photo: M. Burzynski.

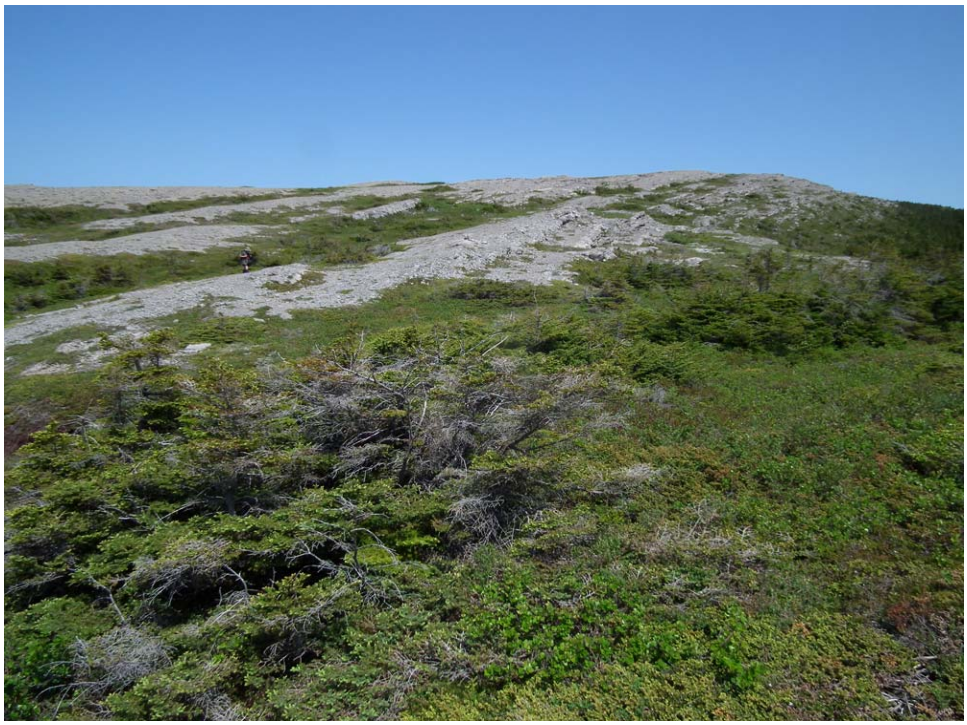

Figure 12: Cape St. George barrens. Photo: M. Burzynski.

Figure 12: *Arnica angustifolia* subsp. *tomentosa* along the Dorset Trail in Port au Choix National Historic Site. Photo: M. Burzynski.