

**The Status of
Vreeland's Striped Coralroot**

Corallorhiza striata var. *vreelandii*

in Newfoundland and Labrador



Photo: Michael Burzynski

**THE SPECIES STATUS ADVISORY COMMITTEE
REPORT NO. 20**

March 26, 2009

RECOMMENDED STATUS

Recommended status: ENDANGERED	Current designation: None
Criteria met: B2: Area of occupancy <500 km ² a: known to exist at < 5 locations b: continuing decline observed, inferred or projected in iii: area, extent and/or quality of habitat D1: Number of mature individuals <250	
Reasons for designation: Qualifies as " <i>Endangered</i> " under the criteria B2a, B2biii, and D1: <ul style="list-style-type: none">- area of occupancy only 2.85 km²- only 2 confirmed locations within the Province- habitat quality declining at both locations- habitat loss projected at one location- total number of mature individuals <250- very rare in eastern North America; thus rescue effect very limited	

The original version of this report was prepared by Michael Burzynski and was subsequently edited by the Species Status Advisory Committee.

STATUS REPORT

***Corallorhiza striata* Lindley var. *vreelandii* (Rydberg) L. O. Williams**

Vreeland's striped coralroot, hooded coralroot; Corallorhize striée de Vreeland

Synonyms:

Corallorhiza bigelovii S. Watson

Corallorhiza ochroleuca Rydberg

Corallorhiza striata Lindl. forma *fulva* Fernald

Corallorhiza striata var. *flavida* Todsén and Todsén

Corallorhiza striata var. *striata* forma *eburnea* P. M. Brown

Corallorhiza striata var. *vreelandii* forma *flavida* (Todsén and Todsén) P. M. Brown

Corallorhiza vreelandii Rydberg

Neottia bigelowii (S. Watson) O. Kuntze

Family: Orchidaceae (Orchid Family)

Life Form: Herbaceous, perennial, achlorophyllous, fully mycoheterotrophic, terrestrial orchid

Systematic/Taxonomic Clarifications

When first found in Newfoundland in 1997, this orchid was identified simply as *Corallorhiza striata* (Burzynski *et al.* 2004). Meades *et al.* (2000) subsequently listed the plants as *Corallorhiza striata* var. *striata*.

Paul Martin Brown (2003: 18, 2005, 2006: 48) referred to the Newfoundland plants as *Corallorhiza striata* var. *striata* forma *eburnea* P. M. Brown [TYPE from New Mexico (Brown *et al.* 1995)]. However, in recent years, botanists in Newfoundland have consistently used the name *Corallorhiza striata* var. *vreelandii* for the local plants (J. Maunder, pers. comm.; see also: Digital Flora of Newfoundland and Labrador).

Recent DNA sequencing by Craig Barrett, of Ohio State University (Barrett and Freudenstein, 2009), has confirmed that individuals of both of the Newfoundland populations do, in fact, represent *Corallorhiza striata* var. *vreelandii*; a taxon occurring primarily in the southwestern USA, with widely disjunct populations in Mexico and eastern Canada. However, the Newfoundland examples appear to form a “somewhat distinct” cluster at one extreme of the range of variation of the variety.

Barrett and Freudenstein (2009) summarized the important morphological differences between Newfoundland var. *vreelandii*, and individuals representing populations from elsewhere, by noting that Newfoundland plants characteristically

have stouter perianth parts exhibiting lower length-to-width ratios for labellum, lateral sepals, and dorsal sepals.

Further work by Craig Barrett will involve obtaining high-variation DNA sequences which may reveal additional information about the origin and history of the Newfoundland plants.

For additional information, see Appendix B.

Distribution

Global: (Figure 1)

North America excluding Canada:

United States: Nevada, Idaho, Nebraska, Wyoming, South Dakota, Utah, Arizona, Colorado, and New Mexico.

Mexico: Hidalgo.

The extremes of this variety's occurrence span about 5,000 km - from Arizona and central Mexico to western Newfoundland (Figure 1). Barrett and Freudenstein (2009) postulate that var. *vreelandii* was probably more widespread in eastern North America during former times, but that its range has now been reduced to a main population area with several outliers.

Several disjunct taxa found in our area exhibit a similar, highly interrupted, northeastward-trending, Mexico/southwestern United States/Gaspé Peninsula/western Newfoundland distribution pattern, with the Gaspé Peninsula element being particularly consistent (John Maunder, pers. comm.).

National: (Figure 1)

Québec, and Newfoundland and Labrador. In Québec, the variety occurs at three localities in the general Gaspé Peninsula region: near Le Bic, on Percé Mountain, and on Bonaventure Island (Fernald, 1946: 197; Scoggan, 1950, 1978). In Newfoundland and Labrador, it occurs on the west coast of the Island.

The consistent co-occurrence of rare disjunct taxa in both western Newfoundland and in the general Gaspé Peninsula region (as well as at a few other discrete localities within the Gulf of St. Lawrence region, such as Anticosti Island) is a striking element of our northeastern flora.

Orchids have extremely tiny seeds. At some time in the past, the seeds of var. *vreelandii* may have been carried directly from the Gaspé Peninsula to western Newfoundland on the prevailing southwesterly winds. A parallel wind-facilitated event may have been responsible for a similar arrival in western Newfoundland of the equally disjunct orchid *Platanthera foetida* (another SSAC species) from either the Gaspé Peninsula or nearby Anticosti Island (where the latter taxon also occurs).

Provincial: (Figure 2)

Only two occurrences are known for this variety on the Island of Newfoundland; none are known for Labrador. The two Island occurrences are both on the west coast of the Island, north of Deer Lake. The first was found by Marilyn Anions in 1997 near Lomond, Gros Morne National Park; the second was found by Carl Munden in 2003 on the Cormack Road.

The rare occurrence of var. *vreelandii* in Newfoundland is consistent with the fact that the three small historical populations from the Gaspé Peninsula region of Québec, are the only other verified northeastern North American populations known.

Annotated Global Range Map

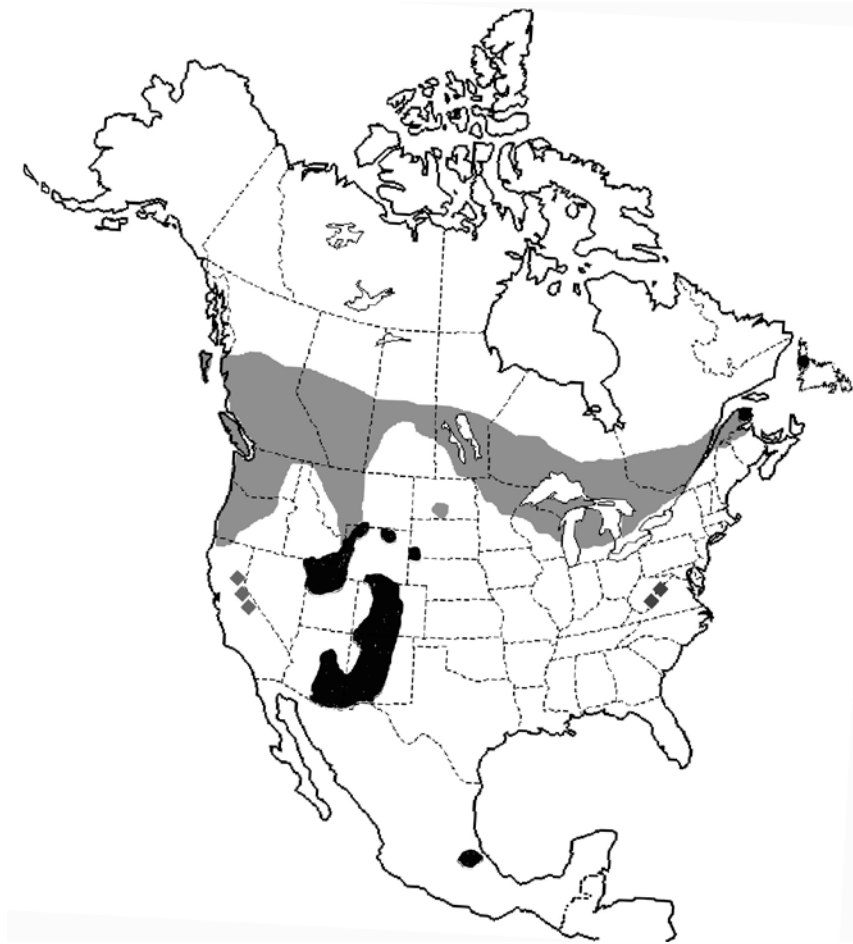


Figure 1. *Corallorhiza striata* in North America. Distribution of the large-flowered *C. striata* var. *striata* is shown in grey, and distribution of the smaller-flowered *C. striata* var. *vreelandii* is shown in black. The intermediate California population is shown as grey diamonds, and the closely allied *C. bentleyi* from Virginia and West Virginia (Freudenstein 1999) is also shown as grey diamonds. Adapted from Luer (1975), *Flora of North America* (2008), and Barrett and Freudenstein (2009).

Annotated Provincial Range Map



Figure 2. Known occurrence localities for *Corallorhiza striata* var. *vreelandii* in Newfoundland and Labrador: 1. Lomond area, Gros Morne National Park; 2. Cormack Road.

Description

Corallorhiza striata var. *vreelandii* is a perennial terrestrial orchid. It is achlorophyllous, appearing yellowish overall. It is usually between 10 and 44 cm tall, and its leaves are reduced to several small bracts attached to tubular basal sheaths. Up to 28 flowers are borne in a raceme, and are dull yellow with longitudinal magenta stripes. The labellum is yellowish with magenta stripes that unite towards the tip. Flower stalks often grow in dense clumps. The rhizome is clubbed and coralloid. (Figure 3) For additional information, see Appendix B.



Figure 3. Flowers and bracts of *Corallorhiza striata* var. *vreelandii* near Lomond.
Photos: M. Burzynski.

Habitat

In the USA, *Corallorhiza striata* (*sensu lato*) is generally found in cool conifer-dominated forest growing on calcium-rich bedrock, often in open cedar stands and mixed forest, and can be locally abundant (Luer 1975). As a variety, or as Barrett and Freudenstein (2009) postulate, a separate but closely related species, var. *vreelandii* exhibits a similar preference for sites with coniferous forest growing on a calcareous substrate.

In Québec, the Percé Mountain population of var. *vreelandii* was found on cold limestone slopes in a thicket of Eastern White Cedar (*Thuja occidentalis*) (Fernald 1946: 197). Near Le Bic and on Bonaventure Island the habitat was conifer woods on limestone substrate (Scoggan, 1950; Stuart Hay, pers. comm.).

In Newfoundland, at both occurrence localities, var. *vreelandii* inhabits semi-open second-growth forest of Balsam Fir (*Abies balsamea*), Black Spruce (*Picea mariana*), Balsam Poplar (*Populus balsamifera*), Eastern Larch (*Larix laricina*), Mountain White Birch (*Betula cordifolia*), and Speckled Alder (*Alnus incana* subsp. *rugosa*). Both localities are close to roads, and at Lomond some plants actually grow in a rehabilitated abandoned roadbed.

The underlying bedrock at the Lomond site is Ordovician limestone, while at the Cormack Road site it is a mix of calcareous Carboniferous sedimentary rocks including limestone and gypsum.

Associated understory species at the two Newfoundland localities include: *Acer spicatum*, *Aralia nudicaulis*, *Cornus canadensis*, *Cornus stolonifera*, *Linnaea borealis*, *Amelanchier* sp., *Ilex mucronata*, *Juniperus horizontalis*, *Viburnum edule*, *Pinguicula vulgaris*, *Fragaria virginiana*, *Rubus pubescens*, *Equisetum arvense*, *Dasiphora fruticosa*, *Solidago* spp., *Taraxacum officinale*, and *Centaurea nigra* (Figure 4). The last two species are non-native and somewhat invasive.



Figure 4. Habitat of *Corallorhiza striata* at Lomond. Photos: M. Burzynski.

Overview of Biology

Corallorhiza striata var. *vreelandii* is a fully mycoheterotrophic orchid that lives holoparasitically on ectomycorrhizal soil fungi (closely related to the genus *Tomentella*; C. Barrett pers. comm.) that are engaged in a mutualistic relationship with surrounding trees. Although it can be *locally* common, the variety is uncommon to rare throughout its range.

The varieties *striata* and *vreelandii* are typically pollinated by insects, often ichneumonid wasps. However, Barrett and Freudenstein (2009) believe that the two populations in Newfoundland are self-pollinated, based on photographs showing ovary swelling and seed development in all of the flowers (as opposed to far fewer of them) of a raceme before the flowers have actually opened (*sensu* Catling, 1990: 127). They attribute this apparent breeding strategy to the reduced growing season in our northern region (although the Lomond and Cormack areas probably have some of the best growing conditions in western Newfoundland, and orchids such as *Cypripedium reginae* do very well there), small population size, distance from others of the same species, and possible absence of appropriate pollinating insects.

Although sometimes found as single stems, this species usually forms clumps, sometimes with dozens of stems crowded closely together. Reddoch and Reddoch (1979) reported that one colony of *C. striata* varied between 0 and 155 flowering stems over a 29 year period, and that for four non-consecutive years there were no flowers at all. Luer (1975) mentioned that, like other coralroot species, *C. striata* has the "...disturbing habit of not reappearing in exactly the same spot each year...". They often grow in proximity with other coralroot species. Clumps seem to flower for several years (as has been learned locally from marked clumps and by observation of previous years' flowering stems), but then the clumps go dormant, or die. New clumps usually appear somewhere nearby (M. Burzynski, pers. obs.). Luer (1975) gave a possible explanation when referring to the genus *Corallorhiza* as a whole: "These plants often seem to disappear from an area only to reappear many years later. The rhizomes live in symbiosis [*sic*] with fungi and multiply until maturity. The flowering stems are produced in a favourable season, following which the rootstock may lie dormant for years. Subsequent flowerings will occur elsewhere from other long-dormant beds of rhizomes..."

Flowering period of the Newfoundland plants is between June 27 and August 12 (M. Burzynski, pers. obs.; J. Maunder, pers. comm.).

The lifespans of a colony or of a clump are not known (coralroots may not first flower until nearly 10 years old; Reddoch and Reddoch (1997) mentioned a 29-year study of a single colony). It is not clear whether clumps represent individual plants or whether clumps are an interconnected clone. Seedling survivorship is not known. Time to flowering from seed is not known. Local pollinators are not known. Local herbivores, pathogens, and parasites are not known.

Craig Barrett, University of Ohio, is in the process of identifying typical mycobionts (fungal root partners) across the entire range of var. *vreelandii*.

Population Size and Area of Occupancy

On the Island of Newfoundland, var. *vreelandii* has been found at only two sites, 28.1 km apart. The colonies have not been known for long, but based upon observations over several years, the total annual population of these two sites has fluctuated between 12 and 21 clumps (with *clump* meaning any occurrence of an isolated flowering stem or of multiple closely clustered stems). Typical of coralroots, at both sites the number of flowering clumps and stems changes annually. Lomond has had between 31 and 95 flowering stems per year, and Cormack has had between 5 and 30 [these numbers are additive only for 2003 (44) and 2006 (40); see tables in Appendix A].

The known area of occupancy for this species at the Lomond site is 0.0063 km² and at the Cormack Road site it is 0.0001 km². Thus the total area of occupancy in the province is just over half a hectare (6400 m², or 0.0064 km²).

Aboriginal, Traditional and Local Ecological Knowledge

Kevin Barnes, Vice-President, Federation of Newfoundland Indians, was contacted, but did not have any information about this species.

There is no information about this species in Arnason *et al.* (1981), or Kingsbury (1964).

Trends

The number of clumps at both sites is so small, and the observation period has been so short, that it is difficult to be sure of trends at either site.

The Lomond population appears to have spread in total area since it was first discovered. As well, the number of clumps has increased. However, there has been a dramatic decrease in the size of the clumps, and the total number of flowering stems has decreased, with most plants now being found as single stems. The small Cormack Road population appears to have declined in the five years since its discovery, according to Carl Munden, the discoverer. However, there was a sharp peak in the number of single stems present in 2007. In 2008 there were no multi-stem clumps, and only five small single stems.

Threats and Limiting Factors

General:

Orchid enthusiasts travel great distances to see and photograph uncommon species and forms (eg. Nelson, 2008). General orchid field guides (eg. Brown, 2003, 2006) now refer to Newfoundland, and a local field guide to the wild orchids of Newfoundland is already available (Voitk and Voitk 2006). Particularly worrisome is that several botanical tour operators appear to already know of both of our var. *vreelandii* localities (J. Maunder, pers. comm.).

Lomond site:

This site is located within a national park. There are no obvious, imminent, major threats or limiting factors relating to the plants present. However, a potential minor threat is the number of visits by photographers and orchid enthusiasts, who have already caused a small amount of trampling around some clumps. This disturbance will probably increase. The decreasing number of flowering stems is also a concern, but may be the temporary result of varying weather or other natural conditions.

Cormack Road site:

The proximity of this site to a commercial development (the site is on private land) presents a significant general threat. Aggravating the situation is the fact that the site is so small and so accessible. It covers an area of only about 100 square metres within a small patch of forest surrounded on three sides by anthropogenically altered landscape (including a highway), and on the fourth by a brook.

However, the main threat to this site is also visits by photographers and orchid enthusiasts. When Carl Munden visited in July 2008, the proprietor of the adjacent commercial operation told him that at least 25 people had already visited the site that year (pers comm. *via* J. Maunder).

More specifically, there have been signs of significant trampling at the site (M. Burzynski, pers. obs.). The damage appears to have been caused by photographers and orchid enthusiasts. Playing children may also have been a factor. Carl Munden reported evidence to suggest that some orchids had been excavated in 2008 (pers comm. *via* J. Maunder).

Conservation:

Because of the obligatory relationship between *Corallorhiza striata* and its ectomycorrhizal fungus hosts, conservation efforts will need to protect both the surrounding trees and shrubs, and their fungal symbionts, in order to protect the orchids (Barrett and Freudenstein, 2009). A true habitat approach will be

required. At the Cormack Road site, the cutting of just a few trees could prove critical. The orchid's requirement for a fungal host that lives with mature woody plants will make it very difficult to use typical restoration or multiplication techniques such as *ex situ* propagation in greenhouse conditions. Because of the lack of endosperm in the seeds, direct seeding of orchids tends to have a minuscule success, since it is dependent on the immediate presence of the fungal hosts. Propagation of this species is a tremendous challenge. Achlorophyllous orchids can be propagated by cell culture (e.g.: Nakamura 1981), however transplanting them to natural habitats still requires the presence of appropriate healthy fungal hosts at the site, and some way of connecting the seedlings to these hosts.

Existing Protection

The population near Lomond is within the boundaries of Gros Morne National Park. The plants are theoretically protected from collection, physical damage, and habitat disturbance under the provisions of the Canada National Parks Act, but the site is not under specific observation. The population on the Cormack Road has no protection.

Special Significance

Craig Barrett (pers. comm.) has tentatively concluded that var. *vreelandii* in Newfoundland represents a northern ecotype of that variety, but that it is not a species or variety separate from other populations of var. *vreelandii*. He found that the Newfoundland plants are "somewhat morphologically distinct" from those of the US Midwest, and that isolation of the Newfoundland plants may have led to a strategy of self-pollination. The Newfoundland population is very significant for its rarity, isolation, and morphological differences.

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Personal Communications

Kevin Barnes (Vice President, Federation of Newfoundland Indians)

Craig Barrett (PhD student, University of Ohio, USA)

Sean Blaney (Botanist, Atlantic Canada Conservation Data Centre, Sackville NB)

Stefen Gerriets (Data Manager, Atlantic Canada Conservation Data Centre, Sackville NB)

Stuart Hay (Assistant Curator, Herbarium Marie-Victorin, Université de Montréal)

Henry Mann (Professor of Botany, Sir Wilfred Grenfell College, Corner Brook - retired)

John E. Maunder (Curator of Natural History, Provincial Museum of Newfoundland and Labrador - retired)

Carl Munden (Author: Native Orchids of Nova Scotia, a field guide)

Meherzad Romer (Data Manager, Atlantic Canada Conservation Data Centre, Corner Brook)

Andrus Voitk (Author: Orchids on The Rock: the wild orchids of Newfoundland)

Collections Examined

Gros Morne National Park Herbarium

Two herbarium specimens.

Ohio State University

Live specimens of rhizome collected from both sites by Michael Burzynski for DNA analysis at OSU by Craig Barrett.

Rank or Status

Global	<i>C. striata</i> var. <i>vreelandii</i>
G-rank	G5TNR
IUCN	not listed
National	
N-rank	NH
National General Status	not listed separately
COSEWIC	not listed
Provincial	
Provincial General Status	2 (listed as <i>C. striata</i>)
Newfoundland S-rank	S1 (listed as <i>C. striata</i> var. <i>striata</i>)
Newfoundland General Status	2 (listed as <i>C. striata</i>)
Labrador S-rank	does not occur
Labrador General Status	does not occur
Adjacent Jurisdictions	
Nova Scotia S-Rank	does not occur
Nova Scotia General Status	does not occur
Prince Edward Island S-Rank	does not occur
Prince Edward Island General Status	does not occur
New Brunswick S-Rank	does not occur?
New Brunswick General Status	does not occur?
Québec S-Rank	SH
Québec General Status	variety not listed separately

(NatureServe; Canadian Endangered Species Conservation Council (CESCC). 2006. Wild Species 2005; Wildlife Division, Newfoundland and Labrador.)

TECHNICAL SUMMARY

Distribution and Population Information	Criteria Assessment
<i>Extent of occurrence (EO)(km²)</i>	The two occurrences are 28.1 km apart. With a 50 m buffer on all sides, the area enclosed by a polygon around both occurrences would be about 2.85 km ²
<i>Area of occupancy (AO) (km²)</i>	Lomond - 0.0063 km ² Cormack Road - 0.0001 km ² Total AO - 0.0064 km ²
<i>Number of extant locations</i>	2
<i>Specify trend in # locations, EO, AO (decline, stable, increasing, unknown)</i>	Number of locations stable. Lomond - very slight increase in AO. Cormack - no change in AO.
<i>Habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat</i>	Habitat quality declining at both sites. Actual habitat loss is projected for the Cormack Road site.
<i>Generation time (average age of parents in population)</i>	Unknown. However, coralroots may not flower until they are nearly 10 years old,
<i>Number of mature individuals (capable of reproduction) in the Provincial population</i>	The number of flowering stems changes annually. Lomond has had between 31 and 95 flowering stems per year, and Cormack has had between 5 and 30. [These numbers are additive only for 2003 (44) and 2006 (40).]
<i>Total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals or number of populations</i>	Lomond - apparently declining. Over the short period of observation the population has spread in area, and increased in the number of clumps, but has declined in the number of flowering stems. Cormack Road - apparently declining. Over the short period of observation the small population has declined in both number of clumps and number of flowering stems. However the apparent declines may be the temporary result of varying weather or other natural conditions
<i>Are there extreme fluctuations (>1 order of magnitude) in number of mature individuals, number of locations, AO and/or EO?</i>	No
<i>Is the total population severely fragmented (most individuals found within small and isolated populations)</i>	Yes
Rescue Effect (immigration from an outside source)	
<i>Does species exist elsewhere?</i>	Yes
<i>Status of the outside population(s)?</i>	Very rare in eastern North America
<i>Is immigration known or possible?</i>	Possible
<i>Would immigrants be adapted to survive here?</i>	Probably
<i>Is there sufficient habitat for immigrants here?</i>	Apparently

Appendix A. Population Information

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

Lomond Site:

Lomond area, just northwest of the parking lot for the Lomond River and Stuckless Pond trails. NAD 83 21U 0446263E 5475238N

- 1997, August, plants found, partial specimen collected, Marilyn Anions, Gros Morne Herbarium
- 1999, July 14, population survey and herbarium specimen collection Nfld GMNP 28-1 by C. Wentzell and B. Pollock,
- 2000, July, survey by C. Wentzell.
- 2002, July 15, herbarium specimen, GMNP 2002-025, M. Burzynski
- 2003, July 16, population survey, M. Burzynski
- 2003, July 18, photography, J.E. Maunder
- 2004, August 12, photography, M. Burzynski
- 2006, July 1, photography, J.E. Maunder
- 2006, July 20, population survey and specimen collection for C. Barrett, M. Burzynski
- 2006, August 12, population survey and photography, M. Burzynski
- 2007, June 30, photography, M. Burzynski.

Cormack Road Site:

Cormack Road, at Rocky Brook, NAD 83 21U 0467544E 5456937N

- 2003, July 14, population discovered, C. Munden
- 2003, July 17, area surveyed A. Voitk, H. Mann
- 2003, July 17, photography, H. Mann
- 2005, June 27, photography, H. Mann
- 2006, July 22, population survey and specimen collection for C. Barrett, M. Burzynski
- 2007, Site visit, C. Munden
- 2008, July, area survey, C. Munden, no additional plants found

See additional population information in table below:

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

A. Surveys and re-surveys of the two known sites:

Lomond Site

Year	# of Searchers	# of Hours	# of Clumps	# of Flowering Stems
1997 incomplete count	1	1	1 clump	1
1999	2	3	7 clumps (4 multiple stems, 3 single stems)	81
2000	1	2	6 clumps	95
2003	1	1		31
2006	1	1.5	14 clumps (1 multiple stems, 13 single stems)	31

Cormack Road Site

Year	# of Searchers	# of Hours	# of Clumps	# of Flowering Stems
2003	3	2	3 clumps with multiple stems (5, 2, and 3 stems), 3 clumps with single stems. One stem was between 25 and 30 cm tall, one separate stem was very small (C. Munden and H. Mann pers. comm.).	13
2006	1	1	8 clumps (1 double stems, 7 single stems)	9
2007	1	1	2 large clumps, several single stems	25 to 30 stems
2008	1	2.5, searched upstream 0.25 km	No large clumps, 5 small single stems	5

(Burzynski *et al.* 2004)

B. Broad-based Surveys throughout the Province:

John Maunder has compiled a useful general summary of search effort within the Province. It is quoted verbatim, below, from Species Status Advisory Committee (2008):

“General rare plant surveys of the west and northeast coasts of the Island were conducted by members of the Newfoundland Rare Plant Project (*q.v.*), specifically during 1999 to 2001, when 1645 individual sites were surveyed and 7622 plant collections were made. Additional general rare plant surveys have been conducted within the Province by various National Parks personnel, and by J. E. Maunder of the Provincial Museum and H. Mann of Sir Wilfred Grenfell College (early 1970’s to present), as well as by N. Djan-Chékar of the Provincial Museum (2002 to present). Significant additional general collecting has been conducted, on the south coast of the Island, by R. Etcheberry, of St.-Pierre et Miquelon (1986, 1987, 1989, 1990, 1992, and 1993).

Targeted rare plant surveys were conducted by personnel from the Université de Montréal, during the course of the preparation of the publication “The Rare Vascular Plants of the Island of Newfoundland” (Bouchard *et al.* 1991), in: 1984 and 1985 (Gros Morne National Park), 1986 (southwest coast, and the general Port au Port area), 1987 (Great Northern Peninsula), 1988 (Baie Verte Peninsula, Notre Dame Bay, and central and eastern Newfoundland), 1989 (Gros Morne National Park, and the south coast), and 1990 (west coast, and Great Northern Peninsula).

Geographically focused rare plant surveys were conducted by personnel from the Université de Montréal, during the course of the preparation of contracted rare plant reports for Port au Choix National Historic Park (Bouchard *et al.* 1993), L’Anse aux Meadows National Historic Park (Bouchard *et al.* 1993), Gros Morne National Park (Anions, 1994; Bouchard *et al.*, 1985, 1986, 1991, 1994, 1996; and Brouillet *et al.*, 1998), and Terra Nova National Park (Brouillet *et al.* 1997). Additional geographically focused rare plant surveys were conducted in the Squid Cove and Doctors Brook areas, and the Labrador Straits region by C. Hanel (2004, 2005a, 2005b).”

More specifically, an extensive targeted survey of the greater Cormack Road area, looking for additional *Corallorhiza striata* var. *vreelandii* populations was carried out by Carl Munden in 2008. Several less extensive surveys of the general Cormack Road area have also been undertaken by several local botanists since the discovery of the site. No new sites have been found.

Within Gros Morne National Park, extensive botanical surveying has been conducted during the last 19 years. Since the site was discovered in 1997, wide-ranging vegetation fieldwork and several dozen intensive searches for other rare plant species have been conducted by teams on the Lomond Peninsula, around the Lomond *Corallorhiza* site, in nearby forest, and throughout the park, without locating any more sites for this species (M. Burzynski, pers. obs.).

Potential Sites Unexplored

Downstream from the Cormack Road site is a limestone gorge that may contain rare plant species, but because of its vegetation this site is unlikely to support this orchid because the fungal host is probably not present. Upstream is a terrace that has so far not yielded any more specimens (C. Munden, pers. comm.). Additional searches of calcareous woodlands throughout the west coast of the province might turn up a few additional sites. However, given the amount of botanical fieldwork that has been conducted in Newfoundland throughout the years, the chance of finding additional sites does not seem to be very great. Craig Barrett's work to identify the orchid's fungal host(s) may possibly help to narrow down the search area.

Collections Examined - Details

Gros Morne National Park Herbarium:

Nfld GMNP 28-1: 1999 July 14, C. Wentzell and B. Pollock
GMNP 2002-025: 2002 July 15, M. Burzynski

Ohio State University:

Live specimens of rhizome collected from both sites by M. Burzynski for DNA analysis at OSU by Craig Barrett:

LR_NL Lomond Population
RB_NL Cormack Road Population

Appendix B. Supplementary Details

Systematic/Taxonomic Clarifications

Two well-defined varieties of the North American orchid *Corallorhiza striata* have been recognized: var. *striata*, and var. *vreelandii*. Recent molecular studies have indicated that an additional supposed variety, var. *involuta*, from Mexico, does not constitute a distinct entity; and that the affinities of an intermediate form from California remain problematic (Barrett and Freudenstein, 2008; Freudenstein and Senyo, 2008; Barrett and Freudenstein, 2009). (Figure 1)

The occurrence of the transcontinental var. *striata* is quite well understood throughout its range. However, the occurrence of the primarily southwestern var. *vreelandii* was not clearly established within northeastern North America until quite recently.

In 1905, M. L. Fernald (Fernald, 1946: 197) described *Corallorhiza striata* var. *fulva*, from Percé Mountain on the eastern tip of the Gaspé Peninsula, Québec. In 1992, J. V. Freudenstein annotated Fernald's Percé Mountain collection to var. *vreelandii* (see image of original herbarium sheet at: <http://ids.lib.harvard.edu/ids/view/4782551>). Interestingly, Magrath and Freudenstein (2002), in their Flora of North America (FNA) treatment of *Corallorhiza striata* var. *vreelandii*, stated that (although) "Small specimens from Quebec will key to this variety [ie. var. *vreelandii*]; they are not thought to be closely related to [var. *vreelandii*] populations from the southwest"; nonetheless, the distribution map associated with the FNA entry does show var. *vreelandii* as present on the Gaspé Peninsula in Québec.

Although Brown (2006) assigned forma *fulva* to *C. striata* var. *striata*, he showed *C. striata* var. *vreelandii* as present on the Gaspé Peninsula of Québec, apparently on the basis of Fernald's original forma *fulva* record. He also suggested that an eastern Ontario record of *C. striata* forma *fulva* in Whiting and Catling (1984) might turn out to be var. *vreelandii*.

Description

Corallorhiza striata var. *vreelandii*

Roots: No true roots; only brittle, clubbed, coralloid rhizomes.

Stems: Achlorophyllous, yellowish, glabrous, 10 to 44 cm tall, herbaceous, succulent.

Leaves: Reduced to several achlorophyllous bracts arranged above the stem atop long pinkish tubular basal sheaths.

Inflorescence: Loose raceme, 2 to 28 dull, magenta-yellow, nodding or rotated flowers. Petals and sepals 5 to 11 mm long, lip 2 to 7 mm long. Petals and

sepals oblong to elliptic-oblongate, yellowish with longitudinal magenta stripes. Lateral sepals are often broad at the base and almost auriculate. Labellum yellowish with dull magenta stripes that unite towards the tip. The flowers of the Newfoundland representatives differ from what is typical of var. *vreelandii*, throughout the rest of its range, by their “stouter perianth parts, with lower length-to-width ratios for labellum, lateral sepals, and dorsal sepals...” (Barrett and Freudenstein, 2009).

Capsule: Ellipsoid, 11 to 23 mm long, pendant at maturity.

Growth habit: Single or in clumps, often with 20 or more flowering stems per clump. Each clump flowers for only a few years (Luer 1975, FNA 2008).

Barrett and Freudenstein (2009) summarize important morphological differences between Newfoundland plants and other var. *vreelandii* populations

“Several individuals from western Newfoundland were found to be identical to individuals from populations in southeastern Arizona, USA (ptDNA type C1). However, these individuals have a somewhat distinctive morphology from other accessions in clade C, including those that have identical ptDNA types from Arizona. The Newfoundland individuals characteristically have stouter perianth parts, with lower length-to-width (l/w) ratios for labellum (mean $l/w = 1.19$), lateral sepals (mean $l/w = 1.80$), and dorsal sepals (mean $l/w = 2.20$); var. *vreelandii* excluding the Newfoundland collections had mean l/w of 1.69, 2.47, and 3.00 for all three ratios, respectively. It is possible that these represent an ecotype associated with high latitude environments, since the northernmost populations of var. *vreelandii* in the Continental USA are found in Utah, more than 900 km to the south of Newfoundland (considering latitude only).”