

COSEWIC
Assessment and Status Report

on the

Dense Draba
Draba pycnosperma

in Canada



SPECIAL CONCERN
2022

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Production note:

COSEWIC would like to acknowledge Benoît Tremblay for writing the status report on Dense Draba (*Draba pycnosperma*), in Canada, prepared under contract with Environment and Climate Change Canada. This report was overseen and edited by Del Meidinger, Co-chair of the COSEWIC Vascular Plant Specialist Subcommittee.

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Dense Draba — Photograph by Frédéric Coursol.

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COSEWIC Assessment Summary

Assessment Summary – May 2022

Common name

Dense Draba

Scientific name

Draba pycnosperma

Status

Special Concern

Reason for designation

This small plant occurs on rock outcrops, cliffs, and talus slopes within 2.5 km of the coast along the Gaspé Peninsula and Strait of Belle Isle (Quebec, Newfoundland & Labrador), and is found nowhere else in the world. Fewer than 3000 plants are currently known, occupying a small portion of seemingly abundant suitable habitat. Invasive introduced plant species are degrading the draba's habitat. As most plant colonies consist of only a few individuals and are associated with steep, dynamic substrates, they may be vulnerable to stochastic events such as rockslides. This species is near to qualifying for Threatened status, and failure to effectively mitigate the threats could result in the species becoming Threatened.

Occurrence

Quebec, Newfoundland and Labrador

Status history

Designated Special Concern in May 2022.



COSEWIC
Executive Summary

Dense Draba
Draba pycnosperma

Wildlife Species Description and Significance

Dense Draba is a small perennial plant that grows in dense clumps. Basal rosette leaves are covered with four-rayed cross-shaped hairs, which are sometimes spurred or branched. Flower stalks bear 5–40 white flowers and one to four leaves. The plump inflated dry fruits contain seeds that overlap in shingle-like fashion and that are turned obliquely to the thin wall dividing the two fruit cavities. It is endemic to eastern Canada.

Distribution

This species is limited to the Gaspé Peninsula region and along the north shore of the Gulf of St. Lawrence to Labrador, near the Québec border, with most of the population concentrated around Percé. An additional historical record exists from the island of Newfoundland. Past reports from Nova Scotia are now known to have been incorrect.

Habitat

This species grows in full sun or light shade on mesic to xeric sites, on escarpments, rocky sea cliffs, talus slopes, or rock outcrops at or near the seashore. The parent rock at these sites is composed of mudstone, limestone or calcareous sandstone, and conglomerate.

Biology

The species flowers from late May to July and the fruiting season lasts until late August. Seeds are dispersed mainly by wind and gravity. The flowers are visited by bumble bees and the plant is subject to insect herbivory. The species is limited to cliff or scarp faces where vegetation is very sparse and interspecific competition is low. In the meadows on Bonaventure Island or along the edges of the tops of escarpments or cliffs, a dense cover of graminoids or low shrubs may limit the species' expansion.

Population Sizes and Trends

There are 10 known subpopulations, four of which are historical, but considered extant pending additional search effort. The total known population is 2,742 individuals. However, this is a minimum number, because much of the demographic data are estimates and most sites have only been partially surveyed. The available data do not allow any clear population trends to be determined.

Threats and Limiting Factors

All potential threats are local in nature. The primary threats are the invasion of the species' habitat by introduced plants such as Wild Chervil at some of the Bonaventure Island sites, as well as trampling by visitors in places accessible by trail in the Percé area. Although of unknown impact, the expansion of the Northern Gannet breeding colony on this island could also be detrimental to the species. The very small size of most Dense Draba colonies makes them vulnerable to stochastic events such as the collapse of portions of the rock faces where they grow.

Protection, Status and Ranks

Dense Draba currently has no special status nationally in Canada or internationally. In Québec, it has been designated as threatened since 2010 under the *Act Respecting Threatened or Vulnerable Species*. It is ranked G1 and N1 (Critically Imperilled) by NatureServe. In Québec, the Centre de données sur le patrimoine naturel du Québec (CDPNQ) ranks it as S1 while it is ranked as SH (possibly extirpated) in Newfoundland. The most significant occurrence is in Île-Bonaventure-et-du-Rocher-Percé Provincial Park and hence on public land. The colonies at L'Anse-Blanchette, Anse-Saint-Georges, and L'Anse-aux-Amérindiens, on the Gaspé Peninsula, are afforded protection from being within Forillon National Park.

TECHNICAL SUMMARY

Draba pycnosperma

Dense Draba

Drave à graines imbriquées

Range of occurrence in Canada: Québec, Newfoundland and Labrador

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2011) is being used)	Estimated 5-10 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No. Suspected decline, based on threats
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations, whichever is longer up to a maximum of 100 years]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Suspected decline of <1 – 30 percent over three generations (~ 25 years), based on threat calculator.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any period [10 years, or 3 generations, whichever is longer up to a maximum of 100 years], including both the past and the future.	Unknown
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. Unknown b. Unknown c. Unknown
Are there extreme fluctuations in number of mature individuals?	Unlikely.

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	67,260 km ² , including historical sites.
Index of area of occupancy (IAO)	52 km ² , including historical sites.
Is the population “severely fragmented” i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No

Number of “locations”* (use plausible range to reflect uncertainty if appropriate)	18–23
Is there an [observed, inferred, or projected] decline in extent of occurrence?	No, assuming that all historical sites are extant.
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	No, assuming that all historical sites are extant.
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No, assuming that all historical sites are extant.
Is there an [observed, inferred, or projected] decline in number of “locations”**?	No.
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, observed and inferred decline in quality of habitat.
Are there extreme fluctuations in number of subpopulations?	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 (in each subpopulation)

Subpopulations (give plausible ranges)	N Mature Individuals
Newfoundland, Great Northern Peninsula: Doctor Hill	Unknown
Lourdes-de-Blanc-Sablon	63
Forillon Peninsula	179
La Martre : Chute du Voile de la Mariée	Unknown
Percé : Les Trois Sœurs & Logan Rock	≥ 36
Percé : Coin-du-Banc	Unknown
Percé : Cape Blanc & Birmingham Brook	50
Percé: Mount Sainte-Anne	Ca. 30
Percé: Bonaventure Island	≥2,393
Sainte-Anne-des-Monts: Tourelle	Unknown
Total	> 2,742

Quantitative Analysis

Is the probability of extinction in the wild at least [20% within 20 years or 5 generations whichever is longer up to a maximum of 100 years, or 10% within 100 years]?	No quantitative analyses have been carried out.
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* See Definitions and Abbreviations on [COSEWIC website](#) and [IUCN](#) for more information on this term.

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species?

Yes. Assigned Medium-Low threat impact.

Suspected significant threats include:

- i. Habitat loss and individual mortality due to competition from native and invasive exotic plants (IUCN 7.3 – Medium impact)
- ii. Trampling linked to off-trail visitor traffic (IUCN 6.1 – Low impact)
- iii. Possible loss of habitat and individuals due to the expansion of Northern Gannet breeding colonies (IUCN 8.2 – Unknown impact)
- iv. Destruction of habitat and loss of individuals from rock blasting (IUCN 4.1 – Unknown impact)
- v. Natural stochastic events of catastrophic magnitude (IUCN 11.1 – Unknown impact)

What additional limiting factors are relevant?

Given the small number of occurrences and very limited total population, the establishment of new colonies and the colonization of new microsites with suitable habitat in areas where the species already occurs is problematic. This could be the result of one or more of the following factors: limited annual seed production, low dispersal capacity, inadequate germination rate *in natura*, and low recruitment rate.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada	This endemic species is confined to Canada.
Is immigration known or possible?	No.
Would immigrants be adapted to survive in Canada?	Not applicable
Is there sufficient habitat for immigrants in Canada?	Not applicable
Are conditions deteriorating in Canada?+	Yes
Are conditions for the source (i.e., outside) population deteriorating?+	Not applicable
Is the Canadian population considered to be a sink?+	Not applicable
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	No
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Status History

COSEWIC Status History: Designated Special Concern in May 2022.

⁺ See [Table 3](#) (Guidelines for modifying status assessment based on rescue effect)

Status and Reasons for Designation

Status: Special Concern	Alpha-numeric codes: Not applicable
Reasons for Designation: This small plant occurs on rock outcrops, cliffs, and talus slopes within 2.5 km of the coast along the Gaspé Peninsula and Strait of Belle Isle (Quebec, Newfoundland & Labrador), and is found nowhere else in the world. Fewer than 3000 plants are currently known, occupying a small portion of seemingly abundant suitable habitat. Invasive introduced plant species are degrading the draba's habitat. As most plant colonies consist of only a few individuals and are associated with steep, dynamic substrates, they may be vulnerable to stochastic events such as rockslides. This species is near to qualifying for Threatened status, and failure to effectively mitigate the threats could result in the species becoming Threatened.	
Applicability of Criteria	
Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Insufficient data to reliably infer, project, or suspect population trends.	
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. The IAO of 52 km ² meets the threshold for Endangered and there is a continuing decline in habitat quality, but the population occurs in >10 locations, is not severely fragmented, and does not experience extreme fluctuations.	
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Population below threshold for Threatened, but continuing decline is only suspected, extreme fluctuations in number of mature individuals is unknown, and at least one subpopulation has more than 1000 mature individuals and none has more than 95% of mature individuals.	
Criterion D (Very Small or Restricted Population): Not applicable. Estimate of > 2,742 mature individuals exceeds thresholds for D1. Although subpopulations vulnerable to stochastic events, impact on population may not result in a rapid and substantial decline.	
Criterion E (Quantitative Analysis): Not applicable. Analysis not conducted.	



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2022)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.
 ** Formerly described as "Not In Any Category", or "No Designation Required."
 *** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

The Canadian Wildlife Service, Environment and Climate Change Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Dense Draba *Draba pycnosperma*

in Canada

2022

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Draba pycnosperma* Fernald & C.H. Knowlt., *Rhodora* 7: 67. 1905.

Synonyms: *Draba canadensis* Brunet var. *pycnosperma* (Fernald & C.H. Knowlt.) O.E. Schulz; *D. glabella* Pursh var. *pycnosperma* (Fernald & C.H. Knowlt.) G.A. Mulligan; *D. hirta* auct. non L. var. *pycnosperma* (Fernald & C.H. Knowlt.) B. Boivin

English common name: Dense Draba

French common name: Drave à graines imbriquées (Brouillet *et al.* 2010+)

Family: *Brassicaceae* (Mustard Family)

Major plant group: Dicotyledons (*Magnoliopsida*)

Dense Draba was discovered on August 17, 1904 on Cape Blanc in Percé by James Franklin Collins, Merritt Lyndon Fernald, and Arthur Stanley Pease. The following year, Fernald and Knowlton (1905) described it as a distinct species (Figure 1A). Fernald (1934) elaborated on that description and on the geographical distribution of the taxon (Figure 1B). Thereafter, Mulligan (1976) reduced it to a variety of Smooth Draba (*Draba glabella*), while Al-Shehbaz *et al.* (2010) reduced it further to a synonym of Smooth Draba, noting however that of all the described segregates of Smooth Draba, this one might warrant taxonomic recognition. Al-Shehbaz and Mulligan (2013) re-evaluated it and re-elevated it to species status while providing an updated morphological description. There is still some debate concerning the validity of this taxon and its taxonomic status, whether it should be recognized as a distinct species or at an infraspecific level under Smooth Draba.

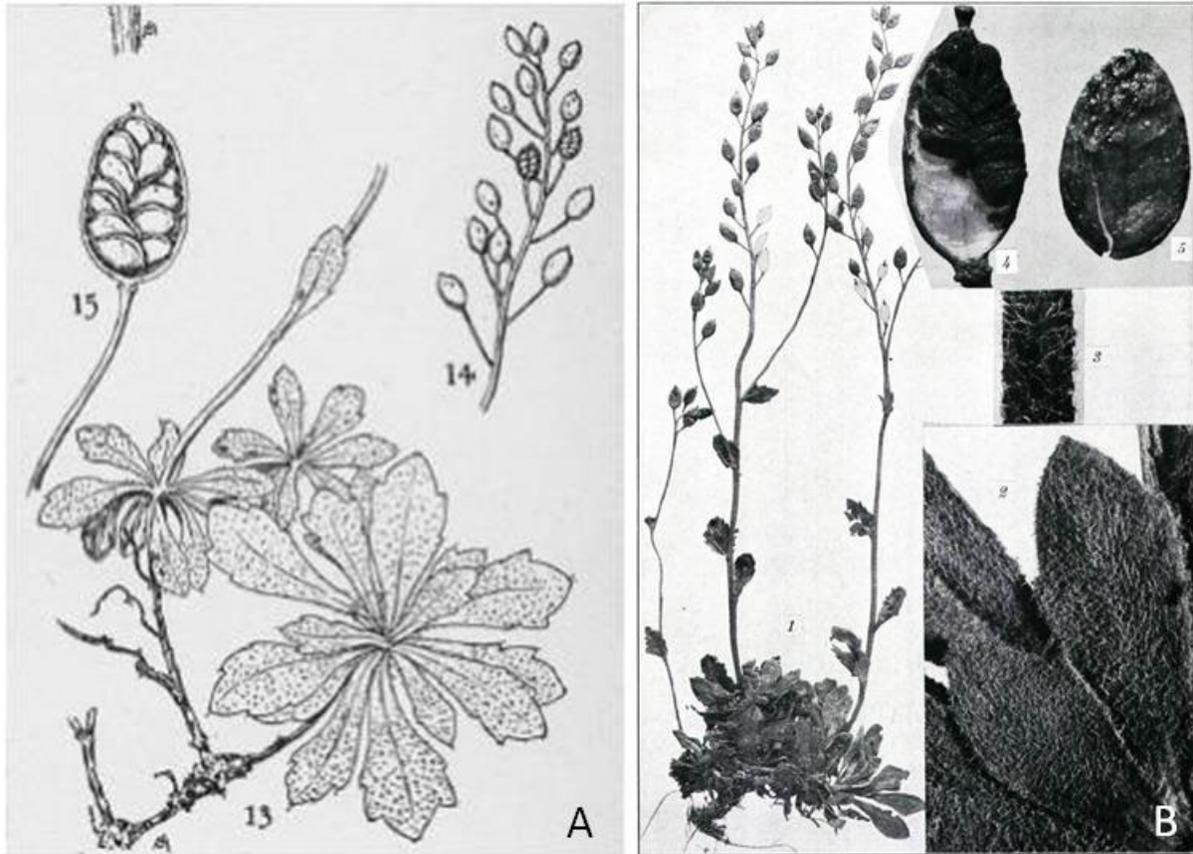


Figure 1. A: Line drawings of basal rosettes, infructescence, and silique with seeds, of Dense Draba showing the obliquely arranged, overlapping seeds within oblong-ovoid siliques (Fernald and Knowlton 1905). B: Photographs of an entire plant, basal leaves and siliques of Dense Draba, from herbarium specimens from the Percé region published in Fernald (1934). Images reproduced with permission.

Morphological Description

Dense Draba (Figure 2) is a small perennial vascular plant, 5–33 cm tall. This caespitose species arises from a simple or several-branched caudex. The persistent basal rosettes of obovate or oblanceolate leaves are entire or 1–4-dentate. Both leaf surfaces are covered with four-rayed cruciform trichomes, sometimes with spurred rays and thus appearing to have as many as eight branches. The inflorescences are simple or are in branched racemes elongated in fruit. There are one to four pubescent cauline leaves. The 5–40 white flowers (Figure 3A) are borne on divaricate-ascending pedicels, 2–8 mm long. The 3–10 mm long, glabrous or pubescent, inflated and plump fruits (silicles) are oblong to ovoid or ellipsoid (Figure 3B), with a 0.1–0.4-mm-long style. The 1–1.4 x 0.6 mm seeds are overlapping (imbricated) and turned obliquely to the septum (central dividing tissue wall).



Figure 2. Dense Draba. Photo: F. Coursol, reproduced with permission.



Figure 3. Dense Draba: flowers (A) and infructescence (B) showing the distinctive inflated, oblong-ovoid siliques. Photos: F. Coursol, reproduced with permission.

The most distinctive morphological characteristics of Dense Draba are the inflated silicles, and the obliquely oriented, overlapping seeds (Fernald and Knowlton 1905; Fernald 1934; Al-Shehbaz and Mulligan 2013). This combination of traits is reported to distinguish it from Rock Draba (*Draba arabisans*) and from the closely related Smooth Draba. Al-Shehbaz and Mulligan (2013) cite several other characters useful in differentiating Dense Draba from Smooth Draba including fewer cauline leaves (1–4 versus 2–17), smaller flowers (sepals 1.5-2 mm versus 2-3.5 mm, petals 2.7-3 mm versus 3.8-4.2 mm), and a leaf indumentum of less-branched trichomes (8-branched versus 7-12 branched).

Population Spatial Structure and Variability

No genetic studies have been conducted on Dense Draba to date. Its genetic links to similar species are unknown, although it is likely most closely related to Smooth Draba, of which it has been reduced to a variety or even a synonym in the past. It often grows in the company of Smooth Draba or Rock Draba, but intergrades have not been reported. In addition, no comparative morphological studies have been conducted on individuals from the species' various subpopulations around the Gulf of St. Lawrence.

Dense Draba is limited to a few scattered subpopulations immediately bordering the Gulf of St. Lawrence, invariably in exposed, craggy habitats composed of basic rocks. It occupies only a small portion of that habitat, which is fairly abundant in this part of Canada. Despite the presence of usually extensive apparently suitable habitat at a given locality, colonies are most often very small, containing from a few to several dozen widely dispersed individuals. Over 90% of the individuals found to date are in the vicinity of the town of Percé in the Gaspé Peninsula region of Québec.

The subpopulations on the Gaspé Peninsula are separated from the small subpopulation at Blanc Sablon on the Strait of Belle Isle by nearly 600 km. This gap consists mainly of open water, with the only suitable habitat here being on Anticosti Island and in the Mingan region, where the species remains unknown.

Designatable Units

No infraspecific entities are recognized for Dense Draba. The Canadian population, which is the only known population worldwide, is limited to several subpopulations along the Gulf of St. Lawrence shoreline. Accordingly, the species is treated as a single designatable unit.

Special Significance

Dense Draba is one of a group of Gulf of St. Lawrence “endemic” plants discovered in the early decades of the 20th century by Merritt Lyndon Fernald and associates (e.g., Fernald 1925, 1926, 1933, 1942; Fernald and Weatherby 1931). Members of this group are typically most closely related to, and/or derived from, arctic-alpine species or those with Cordilleran affinities, which persist in this part of Canada as late-glacial relicts. These vestiges of an ancient flora have managed to survive in places that the boreal-temperate forest has not been able to colonize since the end of the Wisconsin glaciation and the gradual retreat of the Laurentide Ice Sheet.

From a scientific point of view, the species could serve as a model for studying geographic isolation and morphological and genetic differentiation in relation to speciation.

DISTRIBUTION

Global and Canadian Range

Dense Draba is endemic to Canada, occurring along the shoreline of the Gulf of St. Lawrence in Québec and Newfoundland and Labrador. Its occurrence on the island of Newfoundland is historical, based on collections along the west coast at Doctor Hill (Fernald 1934) in 1925. However, it has not been observed there since, despite search efforts. The population centre within its global range is in the Gaspé Peninsula region of Québec in the vicinity of Percé. This species is also known to occur in three coves on the southern side of Forillon Peninsula, in Forillon National Park, where it was discovered in 1923. In addition, Jacques Rousseau found the species at two sites on the north shore of the Gaspé Peninsula—at Tourelle near Sainte-Anne-des-Monts in 1928 and at Ruisseau du Voile de la Mariée in La Martre in 1934—but it has never been found again at these two sites. Dense Draba was (1999) was discovered at Lourdes-de-Blanc-Sablon, Québec, in the Strait of Belle Isle near the Labrador border in 1999, and a specimen was collected nearby, in Labrador (W of Forteau Point) in 2011.

Dense Draba was also reported from Nova Scotia, in the Lockhart Brook valley on Cape Breton Island (Smith *et al.*, July 9, 1952; ACAD). The specimen was originally identified as *Draba clivicola* (= *D. rupestris*). Botanist Alf Erling Porsild then revised it to Dense Draba and Smith subsequently published the record in *Rhodora* under the latter name (Smith and Erksine 1954). Report writer Benoît Tremblay examined Smith’s herbarium specimen in collaboration with botanists Sean Blaney from the Atlantic Canada Conservation Data Centre and Alain Belliveau from the E.C. Smith Herbarium and revised the identification to Smooth Draba. Consequently, Nova Scotia is removed from Dense Draba’s range.

The Centre de données sur le patrimoine naturel du Québec (CDPNQ) notes 15 occurrences of Dense Draba in Québec which, along with the Newfoundland record, makes for 16 known occurrences globally. Five of these are historical, not having been seen again for at least 40 years. The NatureServe methodology (2020) stipulates that two point locations separated by less than 1 km—or from 1 to 3 km apart, unless there is a gap of unsuitable habitat more than 1 km wide—are considered to form the same element occurrence. In this context, the three occurrences at Forillon National Park could be merged into a single occurrence, as could a number of occurrences in the town of Percé. In the absence of other information, occurrences are considered as subpopulations in this report. Based on this approach and the merging mentioned above, Dense Draba would have 10 distinct subpopulations, four of which are historical (Table 1). Note that historical subpopulations are presumed extant at this time, pending additional search effort.

Table 1. Synthesis of occurrence data on Dense Draba in Canada.

Subpopulation	Sites	Date of most recent observation	Searched for and when (for historical observations)	No. of individuals
Québec /Labrador				
1. Lourdes-de-Blanc-Sablon	Lourdes-de-Blanc-Sablon W of Forteau Pt., NL	2009 August 21, 2011		63 Not specified
2. Forillon Peninsula	L'Anse-aux-Amérindiens	2021		80 (2009)
	Anse-Saint-Georges L'Anse-Blanchette	2009 2021		75 15 (approx..)
3. La Martre	Chute du Voile de la Mariée	July 20, 1934 (historical)	Yes, a few times between 1998 & 2002	Not specified
4. Percé	Les Trois Soeurs	July 24, 1923 (historical)	Yes, in 2001 & 2002	Not specified
	Logan Rock	2009		36
5. Percé	Coin-du-Banc	July 9, 1939 (historical)	Yes, in 1999	Not specified
6. Percé	Cape Blanc	2009		30
	Birmingham Brook	1999		20
7. Percé	Mount Sainte-Anne	June 19, 2002		A few tens (estimate at 30 for count)
8. Percé: Bonaventure Island	9 different sites in all	2012		≥ 2,393
9. Sainte-Anne-des-Monts	Tourelle	July 17, 1928 (historical)	Yes, in 2001 & 2002	Not specified
Newfoundland				
10. Great Northern Peninsula	Doctor Hill	August 24, 1925 (historical)	Yes, in 2005 & 2010	Not specified
			Total:	> 2,742

Extent of Occurrence and Area of Occupancy

The minimum extent of occurrence for Dense Draba is 67,260 km² (Figure 4). However, the vast majority of this area contains unsuitable habitat for the species, primarily open water. The index of area of occupancy (IAO) is made up of 13 cells, each 2 km x 2 km, or a total of 52 km² (9 cells or 36 km² without historical occurrences). The biological area of occupancy was not calculated but represents only a tiny fraction of the IAO.

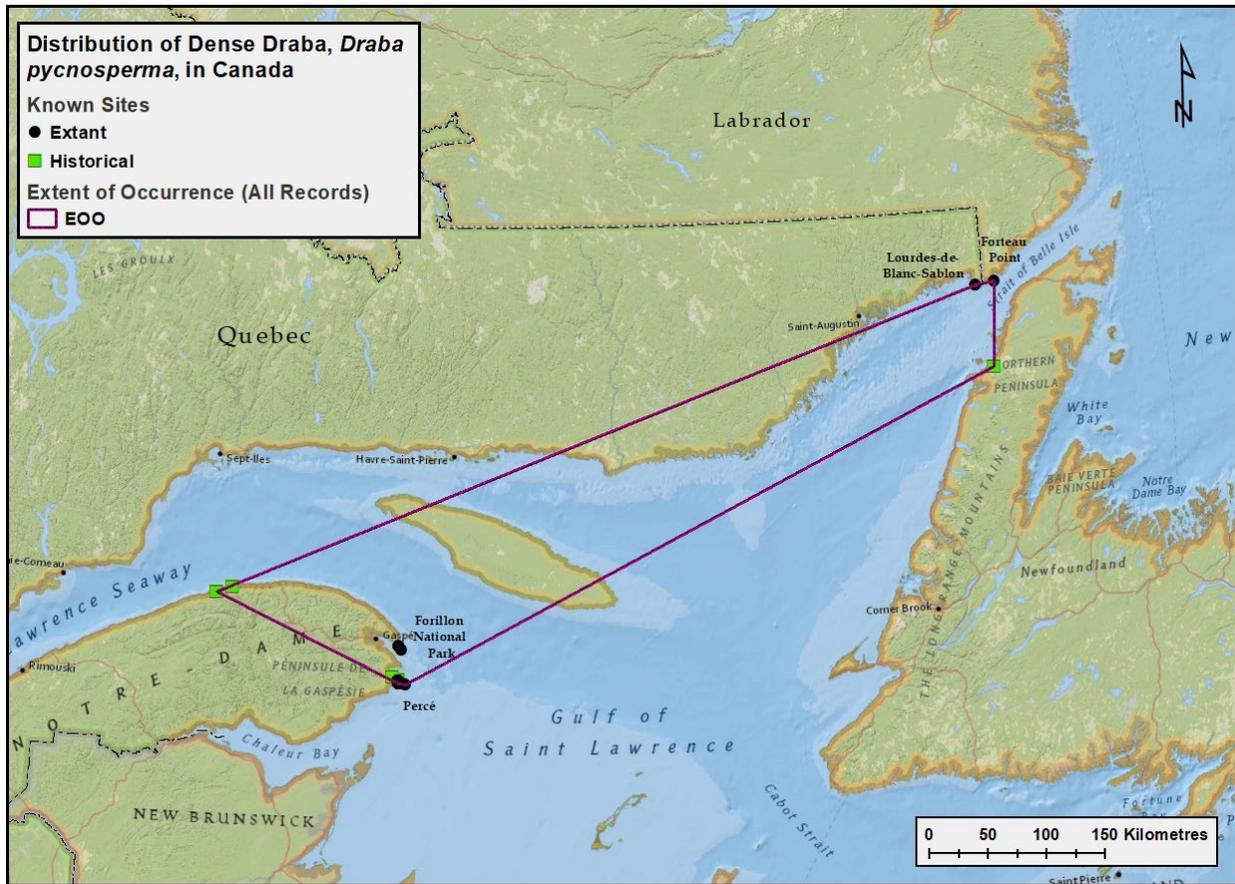


Figure 4. Distribution of Dense Draba in Canada: calculation of the extent of occurrence (EOO) and of the index of area of occupancy (IAO). Map produced by COSEWIC Secretariat.

Search Effort

For over a century, considerable effort has been devoted to searching for Dense *Draba*, both directly and indirectly. The exposed carbonate rock habitats (outcrops, escarpments, sea cliffs, and talus slopes) around the Gulf of St. Lawrence¹ are well known for their remarkable flora and have been extensively botanized since the early 20th century. Led by a variety of experienced botanists, these expeditions have produced very few new Dense *Draba* sites. Dignard (2003) examined over a hundred apparently suitable sites while preparing a provincial report on the species' status; however, these visits resulted in the addition of only two new occurrences. In the last 20 years, the report writer explored dozens of rocky escarpments, talus slopes, and sea cliffs suitable for the species in the Bic and Rimouski regions, in the Gaspé Peninsula, on Anticosti Island, and on some of the islands in the Mingan region, without discovering a single new site. In addition, Frédéric Coursol spent many days exploring Bonaventure Island in 2002 and again in 2012 (Coursol 2002, 2013). This large island, with roughly 8.5 km of shoreline, is almost completely surrounded by rocky cliffs hospitable to the species, many of which have not been explored or have only been lightly explored to date. Bonaventure Island can therefore be expected to contain more Dense *Draba* sites and individuals than currently recorded.

Comparable detailed investigations since 1999 in and about the Doctor Hill site in Newfoundland (Hanel pers. comm. 2019) and on the Gaspé Peninsula North Shore (Dignard 2003) have been unsuccessful. Recently, two new sites were discovered: one in Labrador and one in Forillon National Park. It therefore seems prudent to consider the possibility that the species persists at one or more of the historical sites—or at yet undiscovered ones. The rocky escarpments and sea cliffs that make up the species' preferred habitat are very difficult to access and virtually impossible to explore systematically.

HABITAT

Habitat Requirements

The Dense *Draba* population occurs in an area with mean annual temperatures between 0.8°C and 2.7°C and total annual precipitation between 1,129 mm and 1,268 mm (inferred from Gérardin and McKenney 2001). It is a rupicolous species, growing exclusively in rocky habitats with non-existent or thin surficial deposits. Although drainage conditions in these habitats range from mesic to xeric, Dense *Draba* tends to be more xerophytic, most often occupying dry, exposed or partially shaded microsites. It is a calciphile, with all known occurrences having alkaline sedimentary bedrock.

The species has a strong coastal affinity, with most sites located very near the sea, and none further than about 2.5 km inland (historical Newfoundland occurrence).

¹ Quebec: Bic region, Gaspé Peninsula, Anticosti Island, Mingan region, Magdalen Islands, Blanc-Sablon region. Newfoundland: west coast. Nova Scotia: Cape Breton Island.

Dense *Draba* grows mainly on ledges or benches, in crevices, on rocky escarpments, seaside cliffs, or on large, isolated boulders (Figure 5). It is also sometimes found on talus slopes and on bedrock outcrops in meadows. The species occupies a very narrow strip on the top of the escarpment forming the southern and eastern sides of Mount Sainte-Anne in Percé. This exposed, very windy site has very little vegetation, and is located right next to the cliff edge, just a few metres away from the tall shrub formations or forest growing on the summit. In this marginal habitat, it is often wedged right against the cliff edge by the advancing, dense mats of Creeping Juniper (*Juniperus horizontalis*). Throughout its range, Dense *Draba* is patchily and sporadically distributed within its suitable habitat.



Figure 5. Preferred Dense *Draba* habitat at the top of the calcareous conglomerate sea cliff on Bonaventure Island, across from the town of Percé (Québec). Photo: Frédéric Coursol, reproduced with permission.

Habitat Trends

Suitable habitat for Dense Draba is seemingly abundant around the Gulf of St. Lawrence. There are no indications that the area of this habitat has diminished since the discovery of the species over a century ago, or that habitat loss will occur in the foreseeable future. Although the potential habitat is naturally fragmented, the Gulf of St. Lawrence contains long uninterrupted stretches of escarpments composed of basic rocks that could support the species. Throughout its range, however, Dense Draba apparently occupies only a tiny fraction of the locally available suitable habitat. Its rarity may result from intrinsic biological factors such as the number, quality, and viability of seeds produced, their germination rate, seedling survival, dispersal capacity, etc., rather than from lack of habitat.

Some authors have noted a local decline in habitat quality. This is especially the case on Bonaventure Island, where some areas appear to be affected by trampling by visitors, by fluctuations in the area occupied by the Northern Gannet breeding colony, and by the expansion of invasive plant populations (Coursol 2013).

It is difficult to predict how climate change will influence the dynamics of rocky escarpments and how the resulting changes will affect the quality and quantity of Dense Draba habitat. The preferred escarpment habitat is composed of friable sedimentary rocks that are very susceptible to weathering. Weathering in these escarpments is mainly governed by three processes, all of them climatic in nature: frost weathering (freeze-thaw cycles); moisture expansion from liquid precipitation (particularly in these porous rocks); and eolian processes (strength and direction of prevailing winds, squalls, etc.). On sea cliffs, ocean water levels and tidal and wave amplitude also play a role in cliff face weathering. This sun-loving plant requires its habitat to remain open, with relatively sparse vegetation, to avoid undue levels of competition from tall herbaceous or woody vegetation. Should climate change cause decreased precipitation, diminished freeze-thaw cycles, and reduced wind strength and wave action, this could increase cliff and escarpment stability. That in turn could result in the gradual overgrowth of suitable Dense Draba microsites by taller vegetation. Conversely, should climate change contribute to maintaining or amplifying these phenomena, it could help to keep habitats open and create new suitable habitats. What is clear is that the small size of colonies makes them vulnerable to local stochastic phenomena, particularly if the soil seed bank is depleted or non-existent.

BIOLOGY

Little is known about the biology of Dense Draba. The following account is based mainly on the report writer's observations, as well as those of Dignard (2003) and Coursol (2013).

Life Cycle and Reproduction

Dense *Draba* is a perennial that survives the winter owing to its caudex, a thickened and lignified portion of the stem at ground level. The caudex lengthens from year to year, and develops branches with time, resulting in a more or less dense carpet of basal rosettes. The species' longevity is unknown, as is the average age at first flowering although a germination and cultivation experiment (F. Coursol pers. comm. 2019) suggests that age at first flowering is about 5 years (see under next heading). It flowers from the end of May to early July and produces fruits from the second half of June to late August. The raceme and silicles eventually dry up and the valves of the silicles become partially detached, exposing the mature seeds, which are attached to the septum (central dividing tissue wall). Shaking of the stem by repeated gusts of wind releases the seeds, which are dispersed by wind, water, or gravity.

Vegetative reproduction does not occur in the genus *Draba*. Dense *Draba* may be able to reproduce sexually through both outbreeding and autogamy. Self-fertilization is known to be very common in the genus, particularly in arctic and alpine species (Mulligan and Findlay 1969; Jordon-Thaden and Koch 2008; Karl and Koch 2013). Dense *Draba* produces hermaphroditic (perfect) flowers. However, according to Brochmann (1993), autogamous species in this genus are characterized by small, unscented, non-protogynous, and rapidly self-pollinating flowers. Although the flowers of Dense *Draba* are indeed small and unscented as attributed to self-pollinating taxa, Dignard (2003) reports seeing bumble bees on the flowers, suggesting these insects could be involved in pollination.

Physiology and Adaptability

Dense *Draba* is a calciphile found in a variety of rocky habitats with varying degrees of shade. It seems able to adapt to a fairly wide range of conditions as long as it can access the underlying calcareous rock, the microsite is not too wet, and the vegetation cover is neither too high nor too dense.

Coursol (2013) reports collecting seeds during his inventories on Bonaventure Island in 2012 to determine how easy they are to conserve, and to estimate germination rates. After being collected in July 2012, the seeds were kept at room temperature and then planted in February 2013. Germination was not specifically assessed but was estimated to be near 100%, suggesting limited occurrence in the field is due to other limitations.

The Dense *Draba* plants cultivated from seed at the Montreal Botanical Garden in 2013 are still alive (Coursol pers. comm. 2019) and produced fruits in 2018.

Dispersal and Migration

The seeds of Dense *Draba* are thin and small and are mainly wind dispersed. They are also dispersed by gravity and likely by water. The widely dispersed subpopulations on the Gaspé Peninsula and the subpopulations 600 km across the Gulf of St. Lawrence in the

Strait of Belle Isle area suggest either occasional long-distance dispersal (possibly by birds) or limited persistence within a formerly more continuous range.

The large number of and extent of unoccupied but apparently suitable potential sites around the Gulf of St. Lawrence suggests that dispersal presents a significant constraint on current distribution.

Interspecific Interactions

Bumble bees (*Bombus* spp.) are known to visit the flowers and may be involved in pollination. In addition, an examination of herbarium specimens shows signs of damage to the leaves or fruits from grazing by insects on 91% of specimens (Dignard 2003).

Although interspecific competition is not a constraint in open, rocky habitats, where the vegetation cover is usually very sparse, it does pose a problem in its largest subpopulation in the meadows of Bonaventure Island (Percé area). In this area, the species' expansion is limited by the areas of dense herbaceous cover, consisting mainly of grasses (Poaceae) and also locally of Wild Chervil (*Anthriscus sylvestris*), a very aggressive introduced plant (Coursol 2013). Interspecific competition is also observed at the top of rocky escarpments, where the species colonizes the narrow strip of short, sparse vegetation between the cliff edge and nearby tall woody vegetation formations (shrubby and treed areas). Ground-hugging shrubs such as Creeping Juniper often form dense carpets within this strip, limiting colonization opportunities for Dense Draba.

In 2002, Northern Gannet (*Morus bassanus*) on Bonaventure Island expanded their breeding colony on the eastern side of the island, at the apparent expense of Dense Draba habitat. The situation seemed to have improved in 2012 as the breeding colony had decreased in size in the areas where the main Dense Draba colonies are established (Coursol 2013).

The closely related Smooth Draba and Rock Draba are frequently infected by one or more species of rust, but such infections have never been observed on Dense Draba.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Sampling activities were not carried out as part of the preparation of this report. The information used to determine the population size comes from:

- 1) Previous inventories, the most recent being in 2012 (Dignard 2003; Coursol 2013);
- 2) Occurrence data obtained from the Centre de données sur le patrimoine naturel du Québec (CDPNQ); in many cases, the demographic information provided is the product of estimates rather than precise counts.

In the case of the four historical occurrences (one in Newfoundland and three in the Gaspé region), data are only available from herbarium labels, which include no demographic data. In addition, no systematic surveys of any colonies have been conducted to date. There also are no abundance data for any occurrences or subpopulations found before 1999. Accordingly, demographic comparisons over time cannot be made.

In the literature that is available, the inventory methods used by the various authors and the exact area of the habitats searched are not always specified. Consequently, the search effort at the various sites and the proportion of suitable habitat covered at each occupied site cannot be accurately reported or used to establish reliable trends for occurrences that have had repeated visits.

Abundance

A total population of 2,742 individuals has been determined from the most reliable and current information available (Table 1). The proportion of this count made up of mature individuals is not known but it can be assumed that it represents the majority, as detection of seedlings or small immature individuals is likely quite difficult in its habitat, as well as their positive identification to Dense Draba, which frequently grows with other draba species.

This is a minimum number including some estimates, because the potential habitat was not fully searched at all localities. Nevertheless, on the basis of density—which is extremely low in most cases because individuals are found in only a tiny proportion of the potential habitat and considering the unfruitful exploration of scores of suitable habitats by experienced botanists over the last 20 years—it can be reasonably argued that the actual total population is probably not much greater than what is currently known.

It should be noted that the Percé area alone accounts for 91% (2,509) of the total number of individuals enumerated to date. Bonaventure Island, with at least 2,393 individuals in 2012 (87% of the total population), represents the species' main stronghold.

Fluctuations and Trends

Dignard (2003) considers the species to be stable or declining at some sites, primarily in the Percé area. The decline there appears to be due to habitat modifications such as coastal erosion, changes in the physiognomy of the vegetation cover and, on Bonaventure Island, competition from invasive exotic species. No accurate data are available to demonstrate or quantify such a decline. Although the species may be extirpated from certain historical occurrences that have been searched unsuccessfully, the currently available data are insufficient to determine trends in the Dense Draba population.

Rescue Effect

Given that Dense Draba is endemic to Canada, there is no possibility of rescue from populations outside the country.

THREATS AND LIMITING FACTORS

Threats

Dense Draba is vulnerable to the effects of various threats. These factors are categorized below and in Appendix 1, following the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system (based on Salafsky *et al.* 2008). The evaluation assesses impacts for each of 11 main categories of threats and their subcategories, based on the scope (proportion of population exposed to the threat over the next 10-year period), severity (predicted population decline among those exposed to the threat, during the next 10 years or 3 generations, whichever is longer), and timing of each threat. The overall threat impact is calculated by considering the separate impacts of all threat categories and can be adjusted by the species experts participating in the evaluation.

For Dense Draba, the calculated threat impact is Medium; however, the Assigned threat impact, is **Medium-Low** (see Appendix 1 for details), corresponding to an anticipated decline of between 0.1 and 30% over the next 20-30 years. The actual rate of change is expected to be closer to the low end of this range. Threats are discussed below, in order of decreasing severity of impact.

Dense Draba subpopulations appear to face five main threats:

1. Invasive non-native/alien species/diseases [IUCN 7.3 Other ecosystem modifications]: habitat degradation and competition from invasive exotic. Medium threat impact.
2. Recreational activities [IUCN 6.1]: trampling from visitors venturing off marked trails. Low threat impact.
3. Problematic native species/diseases [IUCN 8.2]: loss of habitat and individuals linked to the expansion of Northern Gannet breeding colonies. Unknown threat impact.
4. Roads & railroads [IUCN 4.1]: destruction of plants and their habitat by blasting from road work. Unknown threat impact.
5. Habitat shifting & alteration [IUCN 11.1]: natural stochastic events of a catastrophic magnitude, such as portions of the rock face falling from an escarpment. Unknown threat impact.

Each threat only affects certain occurrences, except for natural stochastic events (Habitat shifting & alteration; 11.1), which could impact any colony established on a rocky escarpment or talus slope.

The first three threats listed above primarily or exclusively involve individuals on Bonaventure Island. Coursol (2013) suggests certain colonies could be damaged through trampling by visitors venturing off the trails and approaching the cliff edge. This threat could also affect plants growing near the edge of the escarpment on Mount Saint-Anne (Percé), where there is a hiking trail. Coursol (2002) also cited the expansion of the Northern Gannet breeding colony on the eastern side of Bonaventure Island, where the main Dense Draba colonies occur, as a potential threat. The Bonaventure Island Northern Gannet's reproductive success seems to undergo significant interannual fluctuations (Gagné 2012; Rail *et al.* 2013; Shields 2016; Philibert 2017; Fauteux 2018; Bérubé 2019) and impacts on Dense Draba linked to the expansion or reduction of the size of the colony including the spatial extent of the threat are not clear. Lastly, Coursol (2013) reports finding Wild Chervil at roughly 15 of 46 waypoints on Bonaventure Island. This aggressive invasive species, which forms dense monospecific colonies, already represents a threat to Dense Draba at certain sites on the island. Provincial Park employees are trying to prevent the species' spread, but apparently some colonies are difficult to control or eradicate. Two other introduced invasive plants could eventually threaten certain Dense Draba colonies on Bonaventure Island if their expansion is not curbed: Common Valerian (*Valeriana officinalis*) and Smooth Bedstraw (*Galium mollugo*).

Blasting operations on rocky escarpments for road work may have impacted the occurrences in Tourelle and La Martre, or other suitable habitat sites on the rocky cliffs of the north shore of the Gaspé Peninsula between Sainte-Anne-des-Monts and Rivière-Madeleine. There, certain rock faces overlooking the St. Lawrence River have been blasted to provide boulders for riprap along route 132, to protect the road embankment from wave action.

Rock face weathering is a natural process in this habitat. Erosion helps to keep microsites like the escarpment ledges and benches where Dense Draba occurs open by limiting height and density of growth in herbaceous and woody plants. This geomorphological process also helps to create new microsites suitable for the species. However, given the small size of most of the known colonies, a stochastic event of catastrophic magnitude such as the collapse of a portion of a rock face could result in the local extinction of an occurrence. It remains unclear whether climate change will influence rock face erosion dynamics in the future and, if it does, how it may affect Dense Draba or vary among sites.

Limiting Factors

The species' small colony size and affinity for sunny sites are believed to limit its potential colonization and expansion capacities. This is particularly true in the rocky meadows where it grows on Bonaventure Island and on the edges of certain escarpments, where it cannot compete with the graminoids or low or creeping shrubs that form a dense cover. However, the main factors responsible for the species' extreme rarity and small total population are not clear. As explained earlier, these factors are probably biological in nature and linked to the quality and quantity of seeds produced annually, low dispersion capacity as well as germination and recruitment rates, which are all likely low in the natural environment.

Number of Locations

Because all the potential threats to the species are local in extent and would occur independently at a given site, almost every habitat where the plant is found in a given place could be considered to represent a location—for example, an escarpment, talus slope, isolated boulder, or coastal meadow that contains one or more closely spaced colonies. Therefore, Dense Draba has 23 locations, 18 if historical locations are excluded, with Bonaventure Island itself containing nine locations.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Dense Draba has no legal global or national protective status. In Québec, it has been designated Threatened since 2010 under the *Act Respecting Threatened or Vulnerable Species* (R.S.Q., chapter E-12.01). According to Section 16 of the Act, no person may have any specimen of a threatened or vulnerable plant species or any of its parts, including its progeny, in their possession outside its natural environment, or harvest, exploit, mutilate, destroy, acquire, transfer, offer to transfer or genetically manipulate it.

Non-Legal Status and Ranks

Dense Draba is ranked Critically Imperilled (G1 and N1) both globally and in Canada (NatureServe 2019), Critically Imperilled (S1) in Québec (Tardif *et al.* 2016) and Possibly Extirpated (SH) in Newfoundland (NatureServe 2019). It has not been assessed yet by the International Union for Conservation of Nature (IUCN).

Habitat Protection and Ownership

The most significant subpopulation of the species, on Bonaventure Island, is within Île-Bonaventure-et-du-Rocher-Percé Provincial Park. The sea cliffs subpopulation at L'Anse-Blanchette, Anse-Saint-Georges, and L'Anse-aux-Amérindiens is in Forillon National Park. All the sites in the vicinity of Percé are within the Percé UNESCO Global Geopark (Géoparc

mondial UNESCO de Percé 2019); however, these geoparks do not convey any legal-based protection. The individuals on Mount Saint-Anne, on Cape Blanc and in the Birmingham Brook area in Percé are on private land. The ownership of the land containing other recent or historical occurrences of the species in Québec is unknown. The historical site in Newfoundland is on provincial Crown land proposed for protection as an Ecological Reserve under the Protected Areas Plan for the Island of Newfoundland (Wilderness and Ecological Reserves Advisory Council 2020).

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Benoît Tremblay has a B.Sc. in biology with specialization in ecology from the Université du Québec à Rimouski (UQAR) and a Master's in arctic plant ecology from the Université du Québec à Trois-Rivières (UQTR). He has been working as a botanist for more than 20 years, both as an independent consultant and as an employee of academic institutions and the Government of Quebec. An expert in arctic environments, he has conducted a large number of plant and phytosociology surveys since 2003 and has written several works on the flora, vegetation and ecosystems of Nunavik. During his many years of field experience, he has developed in-depth knowledge of Quebec's flora and ecosystems, particularly those of High-Boreal and Arctic regions and of the Gulf of St. Lawrence. He is a member of the advisory committee on threatened and vulnerable flora of Quebec. Since 2017, he has been project manager, conservation of threatened and vulnerable flora with the Quebec Department of Environment and the Fight Against Climate Change.

COLLECTIONS EXAMINED

- E.C. Smith Herbarium, Acadia University (ACAD) *Smith et al.* 6376, July 9, 1952 (Nova Scotia, Lockhart Brook), revised to *Draba glabella* Pursh
- Benoît Tremblay's personal herbarium *Tremblay* s.n., June 19, 2002 (Quebec, town of Percé, Mount Sainte-Anne) *Tremblay* s.n., June 19, 2002 (Quebec, town of Percé, Logan Rock)

Appendix 1. Threat assessment for Dense Draba.

THREATS ASSESSMENT WORKSHEET			
Species or Ecosystem Scientific Name	<i>Draba pycnosperma</i>		
Element ID	ELEMENT_GLOBAL.2.141969	Elcode	PDBRA113D0
Date	2020-11-03		
Assessor(s):	Del Meidinger (moderator, SSC Co-Chair), Benoît Tremblay (report writer), Danna Leaman (VP SSC), Stephanie Pellerin (VP SSC),	Jacques Labrecque (QC), Jana Vamosi (SSC Co-Chair), David Mazerolle (VP SSC), Dan Brunton (VP SSC), Paul Knaga (CWS), Jessica Humber (NL), Angèle Cyr (Secretariat), Bruce Bennett (VP SSC) Fred Coursol, Antoine Plouffe-Leboeuf (Parks Canada)	
References:	Coursol (2002, 2013)		
Overall Threat Impact Calculation Help:		Level 1 Threat Impact Counts	
Threat Impact		high range	low range
A	Very High	0	0
B	High	0	0
C	Medium	1	1
D	Low	1	1
Calculated Overall Threat Impact:		Medium	Medium
Assigned Overall Threat Impact:		CD = Medium - Low	
Impact Adjustment Reasons:		Habitat alteration by invasive species is the main threat and although the impact may be Medium, as calculated, due to the difficulty of managing the invasives in the Draba habitat, it could also be in the Low impact range due to uncertainty in expansion of the invasive species. As such, the impact was assigned Medium-Low.	
Overall Threat Comments		Generation time of 5-10 yrs; for purposes of threats assessment, three generation time frame about 25 (20-30) yrs. Most of population on Bonaventure Island	

Threat	Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Residential & commercial development				
1.1	Housing & urban areas				
1.2	Commercial & industrial areas				
1.3	Tourism & recreation areas				
2	Agriculture & aquaculture				
2.1	Annual & perennial non-timber crops				
2.2	Wood & pulp plantations				

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2.3	Livestock farming & ranching						
2.4	Marine & freshwater aquaculture						
3	Energy production & mining						
3.1	Oil & gas drilling						
3.2	Mining & quarrying						
3.3	Renewable energy						
4	Transportation & service corridors		Unknown	Unknown	Extreme (71-100%)	High - Low	
4.1	Roads & railroads		Unknown	Unknown	Extreme (71-100%)	High - Low	This threat is associated with the blasting of coastal rock cliffs by the Quebec Ministry of Transportation. The boulders are used to stabilize and protect the regional road (road 132) on the north shore of the Gaspé Peninsula, which has been subjected in recent years to severe storms and waves which crash over the enrockment, thus eating away the road's backfill material. The recent higher frequency of storms of greater strength is likely linked with climate change. Although it is impossible to conclude a direct impact of these blasting activities on <i>Draba pycnosperma</i> individuals, there are historical occurrences on some coastal cliffs of the north shore of the Gaspé Peninsula in the vicinity of blasting operations observed by the report writer. If some individuals are still present in cliffs affected by these blasting operations, the dramatic consequence on their survival is evident.
4.2	Utility & service lines						
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.1	Recreational activities	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	Essentially a local threat associated with tourists trampling plants located near hiking trails on Bonaventure Island and on Logan Rock (Percé), when they tread outside of the marked trails. This threat, although local and of relatively minor consequence, can never be completely eliminated as a continuous surveillance of every colony near trails would be required.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						
7	Natural system modifications	C	Medium	Restricted (11-30%)	Extreme - Serious (31-100%)	High (Continuing)	
7.1	Fire & fire suppression						
7.2	Dams & water management/use						
7.3	Other ecosystem modifications	C	Medium	Restricted (11-30%)	Extreme - Serious (31-100%)	High (Continuing)	Coursol (2013) has reported the presence of Wild Chervil (<i>Anthriscus sylvestris</i>) at 15 waypoints on Bonaventure Island. This weedy and aggressive species, which forms dense monospecific colonies, already represents a severe threat locally for Dense Draba on this island. Although efforts are currently deployed by the Bonaventure Island and Percé Rock National Park employees to limit the expansion of this introduced species, some colonies are difficult to control or eradicate as they occur on steep cliffs. Wild Chervil can completely replace the vegetation on a site, as shown at the initial site on Bonaventure Island. Moreover, Coursol (2013) mentioned the presence on Bonaventure Island of two other introduced weedy species which could pose a threat to Dense Draba if their expansion is not curbed: Common Valerian (<i>Valeriana officinalis</i>) and Smooth Bedstraw (<i>Galium mollugo</i>).
8	Invasive & other problematic species & genes		Unknown	Small (1-10%)	Unknown	High (Continuing)	
8.1	Invasive non-native/alien species/diseases						See impact of invasive species under 7.3 - Other ecosystem modifications as it impacts on the habitat quality.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.2	Problematic native species/diseases		Unknown	Small (1-10%)	Unknown	High (Continuing)	Coursol (2002) mentioned as a potential threat the recent expansion of the breeding colony of gannets on the east side of Bonaventure Island, where the island's main population of Dense Draba is established. However, this threat seemed to have lessened later on when he visited the site again in 2012. As recent surveys have shown, the colony has since re-expanded and may again present a problem for local dense draba habitat. In past 20 years the colonies have fluctuated year to year. However, both species have co-existed for quite a while and it is uncertain whether the relationship is positive or negative to the Draba. The gannet activity may keep habitat open, but there is also guano and trampling by birds. Not really good evidence that there is a threat here so severity scored as 'unknown'.
8.3	Introduced genetic material						
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	Pollution						
9.1	Domestic & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents						
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						Landslides treated under habitat shifting and alteration.
11	Climate change & severe weather		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.1	Habitat shifting & alteration		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Threat linked to stochastic events of catastrophic scope, like the detachment of large parts of rock cliffs where <i>Draba pycnosperma</i> grows, as a consequence of ongoing erosion. Climate change scenarios suggest more precipitation to the area, which might bring higher rates of erosion. These events may cause the local extinctions of subpopulations. However, they may also create new suitable habitat for the species, and contribute to maintaining existing habitat as suitable by helping to keep it open and at the "pioneer stage". It is not clear how climate change will impact <i>Draba pycnosperma</i> 's habitat in the future. Globally, it may or may not be favorable for the species, and locally (at given sites) the effects may vary from positive to negative or even be nonexistent. In this sense, this threat is quite hard to accurately assess or to do so with a high degree of confidence. As impact may be both positive and negative, severity scored as 'unknown'.
11.2	Droughts						Might be an issue but <i>Draba</i> grows on dry sites so its tolerance of drought should be high. Droughts are longer now at some sites in Gaspé. Unclear right now what the overall impact is going to be for droughts and drought periods so not assessed.
11.3	Temperature extremes						
11.4	Storms & flooding						
11.5	Other impacts						
Classification of Threats adopted from IUCN-CMP, Salafsky <i>et al.</i> (2008).							