Rare and Endangered Plants and Their Habitats in Canada[1]

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Approximately one-third of the native vascular plant taxa known to occur in Canada (1009 of 3269 taxa) were classified as being nationally rare by Argus and Pryer (1990). Of these, 147 taxa are endemics, and 68 are in urgent need of conservation. Most provinces and territories also have lists of species that are considered to be rare within those jurisdictions. Where Natural Heritage Programs exist (e.g., British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec), detailed work on the status, distribution, demographics, ecological requirements, and threats is being conducted, and this work, in conjunction with that by interested field botanists and researchers, has resulted in revisions to the provincial lists of rarities. Refinements have also occurred in the criteria by which rarity is assessed, with the trends being toward increased quantification of status, inclusion of more ecological information, fuller consideration of threats to populations, and standardization among jurisdictions within North America. However, legislative tools for ensuring the protection of these rare species and their habitats are generally inadequate. Very little work has been done on determining the status of non-vascular plants anywhere in Canada. Also, far less work has been done on rare habitats than on their constituent species. This situation is changing slowly (e.g., extensive work on alvar communities in Ontario, Lake Athabasca dunes in Alberta and Saskatchewan, Atlantic Coastal Plain shoreline communities in Nova Scotia and Ontario). However, there are numerous habitats that require detailed attention, some of these being rare or diminishing (tall-grass prairies), while others are more common but support populations of rare plant species (calcareous cliffs, flats, shores, and peatlands).

Key Words: Rare plants, rare habitats, conservation, biodiversity, Canada.

Rare plants and their habitats, as well as rare habitats *per se*, comprise integral components of the biodiversity of any geographically defined area. The original focus for concern over the reduction of biodiversity came from the depauperization of biotas in the tropical forests, where land use practices are jeopardizing the continued existence of numerous species, many of which have not even been described. Even in north temperate, boreal, and Arctic floras, which are better known taxonomically, new species are discovered occasionally (e.g., *Carex juniperorum*, Catling et al. 1993). The level of knowledge about most species (even the common ones), especially with regard to ecological requirements and life history attributes, is very limited.

The Canadian Biodiversity Strategy (Environment Canada 1995b) takes a broad view of the concept of biodiversity, including not only the traditional idea of species richness, but also encompassing ecosystem diversity at all scales, along with the ecological processes that enable those systems and their component species to function and interact. Rare species constitute a part of this concept, as do the habitats and landscapes in which they occur. At least two of the Strategy's goals have direct bearing on the conservation of rare plants and rare habitats; i.e., to "conserve biodiversity and use biological resources in a sustainable manner", and to "improve our understanding of ecosystems and increase our resource management capability" (Environment Canada 1995b, page 3). Conservation actions require knowledge, often at several scales of ecological organization (e.g., population, species, vegetation community, landscape). The cataloguing of the elements of diversity that may be at risk, followed by studies of their ecological requirements and/or composition/structure/function, are the first steps toward generating credible conservation actions.

Over the past two decades, considerable progress has been made in the determination of the status of many species in the Canadian vascular plant flora. This has been due, in large part, to the efforts of dedicated staff members at the National Museum of Natural Sciences in Ottawa (now, the Canadian Museum of Nature), led by George Argus, who initiated the Rare and Endangered Plants Project, and facilitated the completion of the provincial/territorial and national lists (see Table 1). The importance of this work should not be underestimated. These lists have resulted in concerted efforts to rediscover historical populations, search for additional populations of the listed species, and study the demo-

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Table 1. Numbers of rare vascular plant taxa in Canadian provinces and territories.

Province/Territory	Number of Rare Species	Source
Alberta (AB)	350; 360	Argus and White 1978; Packer and Bradley 1984
British Columbia (BC)	816	Straley et al. 1985
Manitoba (MB)	291	White and Johnson 1980
New Brunswick (NB)	207	Hinds 1983
Newfoundland-island (NF)	271	Bouchard et al. 1991
Northwest Territories (NT)	206	McJannet et al. 1995
Nova Scotia (NS)	219	Maher et al. 1978
Ontario (ON)	542	Argus et al. 1982-1987
Prince Edward Island (PE)	191	Day and Catling 1991
Quebec (QC)	408	Bouchard et al. 1983
Saskatchewan (SK)	300	Maher et al. 1979
Yukon Territory (YT)	313	Douglas et al. 1981
Canada	1009	Argus and Pryer 1990

graphics and ecological requirements of some listed species.

There are several groups of plants that have not received the same level of attention, however, including the mosses, liverworts, and algae. Fungi and lichens also lack sufficient data to enable the determination of their species' status, with rare exceptions (see Appendix I, which contains four species of lichens for which national status has been determined). Recent phytogeographical research in some regions of Canada [e.g., the Gulf of St. Lawrence (Belland 1987), Ontario (Ireland and Ley 1992)] has begun to lay the groundwork for an understanding of the status and ecology of mosses. Preliminary or provisional lists of rare mosses have now been prepared for Ontario (Ontario Ministry of Natural Resources 1996*) and Alberta (J. Gould, personal communication), and similar lists of probable or potential rarities are being prepared for the macrolichens and liverworts of Alberta (J. Gould, personal communication). However, much work remains to be done before a set of provincial/territorial lists of rarities can be produced for these elements of the flora.

Some provinces have recently established Conservation Data Centres or Natural Heritage Information Centres to track and coordinate information on the status of rare species and habitats. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec have established (or are in the process of establishing) such agencies. These agencies assign a status ranking to each organism and community type for which there is sufficient data. They also form part of a continent-wide network that also includes all of the state Natural Heritage Programs. The Nature Conservancy (USA) is a major partner with the Canadian Conservation Data Centres, having established database standards, and coordinated the designation of global ranks for all species. The subnational (in our case, provincial) ranks for each species are determined by the individual Conservation Data Centres, with their collaborators.

In many ways, the determination of the status of habitats is more difficult than the determination of the status of species. This is due, in large part, to the lack of a single comprehensive classification system for vegetation communities. Because communities reflect responses of multiple species to multiple abiotic and biotic factors and interactions, the development of classification schemes for communities is a highly complex, and somewhat subjective, task. Nevertheless, at regional scales, it is possible to produce classification schemes that encompass the range of variation in vegetation. Analytical tools that facilitate the mathematical/statistical analysis of large data sets have been used to accomplish this task in various parts of Canada. Classification schemes now exist for forest communities in various provinces, and wetlands have been classified in some areas, as well. Preliminary compehensive classification schemes for all known vegetation types have been developed for southern Ontario, with the aim of ranking those community types that are rare and in need of conservation attention (Wasyl Bakowsky, personal communication). As long as the infrequently occurring community types are recognized and included in the sampling phase of ecosystem classification studies, their attributes can be compared with those of more common community types. As a result, clues regarding the reasons for their rarity (perhaps including such features as unusual species associations, infrequent substrate types, localized microclimatic conditions, etc.) will emerge. However, even in areas where no vegetation analysis has been conducted, or where no ecosystem classification system exists, certain community types stand out as being unusual or rare. Usually, this is due to the presence of infrequent but characteristic and consistent landform/species associations. Long before detailed studies of such communities had occurred, the remnant tall-grass prairies of southwestern Ontario and the alvars of southern Ontario were recognized as infrequent to rare, and also endangered, community types. The same is true for limestone, dolomite, and serpentine cliff, talus, and slope communities in many parts of Canada.

Determination of Rarity

Until recently, the definition of rarity has been qualitative. This is due, at least in part, to the fact that there are several mechanisms by which a species or vegetation type might have achieved its current distribution. Rarity may be either an inherent characteristic of a species or vegetation community, or induced by extrinsic factors, such as incompatible land uses that change the features needed for sur-

vival. Early attempts to arrive at general and comprehensive hypotheses to explain rarity were too simplistic. These invoked historical biogeographic explanations or genetic impoverishment mechanisms, which, however, were rarely supported by much data. Drury (1980), Stebbins (1980), and Brouillet (1985) have provided useful reviews of these early hypotheses. In fact, except in cases where the habitat itself is rare, and therefore, by extension, species adapted to those habitat conditions are also rare, each case of rarity has some unique attributes. Even in cases where communities of rare species appear to share general habitat preferences and requirements, and a common biogeographic history (e.g., Atlantic Coastal Plain communities in Nova Scotia and Ontario), the individual species in those communities differ substantially in their abundances, and in their inter- and intra-site microdistributions. Thus, it has been difficult to develop a general set of rules that can be applied to all rarity patterns.

Rarity is also a relative concept that must be defined in a geographic context. In the present discussion, rarity has been dealt with at a provincial/territorial and national scale. A species or vegetation community that is rare in Saskatchewan, for example, may be common (at least locally) in an adjacent geographical area, such as Alberta or Montana. However, this does not detract from the fact that the species or community is an important component of the biodiversity of Saskatchewan, and may require conservation attention there (cf. Wilson 1993).

The series of provincial/territorial and national lists of rare plants serves as a starting point for more formalized recognition of the status of these plants. A national committee (Committee on the Status of Endangered Wildlife in Canada; COSEWIC), composed of representatives from each of the provincial and territorial government wildlife agencies, four federal agencies (Canadian Museum of Nature, Canadian Parks Service, Canadian Wildlife Service, Canadian Department of Fisheries and Oceans), and three national conservation agencies (Canadian Nature Federation, Canadian Wildlife Federation, World Wildlife Fund Canada), deliberates on the national status of plants (and other wildlife, in the broad sense), and also plays a major role in allocating funds for the preparation of status reports that provide the background data necessary for these deliberations. An annual update on Canadian species at risk is issued by COSEWIC (Anonymous 1996*; see Appendix I for the current status assessments for plants). COSEWIC uses a simple qualitative scale of rarity categories. The "extinct" and "extirpated" categories are self-explanatory. The three categories with which we are most concerned here are "endangered", "threatened", and "vulnerable" (synonymous with their earlier use of the term "rare"). "Endangered" species are those "... facing imminent extirpation or extinction". "Threatened" species are "... likely to become endangered if limiting factors are not reversed". "Vulnerable" species are "... of special concern because of characteristics that make it [them] particularly sensitive to human activities or natural events" (Anonymous 1996*). This committee also designates species as "Not at Risk" when, after a status report has been completed, the evidence indicates that there are more and/or larger populations than previously thought, and that those populations are not under threat from exploitation or incompatible land uses. After such studies, the status of some species still cannot be determined adequately, because of insufficient data, and they are placed in an "Indeterminate" category. Such species are candidates for future re-assessment.

At present, COSEWIC designations have no force in law. However, federal protection of endangered species may be realized through legislation such as the Wild Animal and Plant Protection Act (Environment Canada 1991), and the Canadian Endangered Species Protection Act (Environment Canada 1995a). Canada is also a signatory nation to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Argus (1978) summarized the plant species regulated under this convention. All Canadian species covered by CITES are within its Appendix II, which requires export permits from the country of origin. All native Canadian cacti (Cactaceae) and orchids (Orchidaceae) are contained within that Appendix, as is American Ginseng (*Panax quinquefolium*). However, CITES does not regulate intra- or interprovincial trade in any of these species.

Recently, with the establishment of Conservation Data Centres (also known as Natural Heritage Information Centres) in some provinces, there has been a trend toward increasing quantification of status assessments. These agencies assign status ranks at both a global scale [in concert with The Nature Conservancy (USA) and the other North American Natural Heritage Programs (as the equivalent American agencies are called)] and a provincial scale. Three categories of relevance here are used to designate degrees of rarity. The rarest species in a province (subnational region), ranked as "S1", are usually found in five or fewer extant populations within that province, or have very few remaining individuals within the populations that are known to exist. "S1" can be considered to be roughly equivalent to 'Endangered' as used by COSEWIC. These species are extremely susceptible to extirpation (or in the case of endemics, extinction). Species classed as "S2" are very rare, usually with between 6 and 20 extant occurrences in the province, or with large populations in fewer than 6 sites. These taxa may also be susceptible to extirpation or extinction, and may be considered analogous to "Threatened"

species in non-quantitative ranking systems. Species listed as "S3" occur in 21 to 100 locations within the province, or they have large populations in cases where fewer than 21 locations are known. These species are rare to uncommon, but are not in immediate danger of extirpation.

Some provinces, such as Ontario, have also established technical committees, composed of biologists, to assist with the determination of status, for the purpose of official listing or regulation of species under appropriate legislation. It is important to note that the status lists prepared by the Conservation Data Centres do not automatically enter into regulation. On occasion, the status rankings assigned by specialists are not reflected in legislative regulations. Regulation requires vetting through a political process.

Rare Plants

Preliminary inventories of the rare vascular plants of each province and territory (with the exception of Labrador), and for Canada as a whole, have been completed (Table 1). These lists provide a point of departure for detailed work on the ecology and conservation requirements for the rare species, and the data on which they are based enable priority-setting for conservation actions. The list of nationally rare vascular plants contains 1009 taxa, a relatively high proportion of the 3269 species comprising the native vascular plant flora of Canada (Argus and Pryer 1990). Roughly similar proportions of the native floras of each province and territory have been considered to be rare in those jurisdictions. In most cases, species that have been included on these lists have been found to be legitimately rare, in spite of increased field activity. Only in a few cases have species been found to be significantly more common than originally thought, and these cases often involve taxonomic groups that are perceived to be difficult. One such example is Drooping Sedge, *Carex prasina*, which was known from only two recent Ontario locations in 1982 (Ball and White 1982). It was also considered to be rare in Quebec (Bouchard et al. 1983), and was considered to be nationally rare as recently as 1990 (Argus and Pryer 1990). Subsequent to the publication of the rare plant lists and atlases, a flurry of field activity resulted in the discovery of numerous populations of this species, such that it is no longer considered to be rare (Oldham 1996; J. Gagnon, personal communication).

One hundred and forty-seven of the nationally rare vascular plant taxa are endemics, restricted in their distributions to small geographic areas (e.g., Queen Charlotte Islands, Lake Athabaska sand dunes, High Arctic islands, Newfoundland's Northern Peninsula, Great Lakes near-shore swales). Forty of these endemic taxa are considered to be of top conservation priority (Argus and Pryer 1990), implying that they may be in imminent danger of extinction without conservation efforts. It is likely that many of these taxa have always been rare and restricted in distribution. However, there are situations where endemic taxa are being endangered by human actions, such as the drainage or development of Great Lakes marshes. These situations require immediate remedial action to prevent the extirpation of populations, or the ultimate extinction of these taxa.

Many of the rare species on the national list occur near the edges of their ranges in Canada. These are often referred to as peripheral species. This, however, does not diminish their importance as components of biodiversity. British Columbia and Ontario are particularly rich in nationally rare species (426 and 355, respectively). Large proportions of these rare species are peripheral in their distributions. These include British Columbia species with affinities to the California Floristic Province, including the Cascade Ranges [portions of the Coast Forest Region (Rowe 1972); Hickman 1993]. They also include Ontario species of the Deciduous Forest Region (also known as Southern Deciduous Forest or Carolinian Forest), with affinities to the northeastern and north-central United States, the upper Mississippi Valley, and the northern Appalachian Mountains (Allen et al. 1990; Maycock 1963; Rowe 1972). Substantial proportions of the other provincial/territorial sets of rare species also are comprised of species near the limits of their geographic distributions.

Habitats of Rare Plants

In order to ascertain patterns among the habitat preferences of Canadian rare vascular plants, each provincial and territorial rare plant list was examined, and the habitat descriptions contained therein were scored for each species. There are inherent difficulties with this approach. Habitat descriptions generally are derived from specimen labels. Thus, variability in detail on the labels will lead to a substantial level of generalization in the habitat descriptions published in the lists. Also, the various authors of the provincial and territorial lists will have had different concepts of some habitat or community types (this was especially evident in wetland types, such as bogs, fens, and conifer swamps). The approach taken here has been, again, to generalize as much as possible, while maintaining habitat categories that will still provide some insight into habitat preferences of rare species. Where highly specific ecological conditions are known to be required by a species, these have been maintained as distinct habitat categories (e.g., margins of hot springs, snowbeds, calcareous substrates). Because of the variability in detail in the data sources, a scale (1-3) has been used in Table 2, to indicate the relative frequency of rare species' habitat preferences within a province or territory. The range in number of habitat occurrences within each category in this scale is

TABLE 2. Habitats of the rare vascular plants of the provinces and territories of Canada.

Habitat Description	Province/Territory of Occurrence*											
	AB	BC	MB	NB	NF	NT	NS	ON	PE	QC	SK	YT
ARCTIC/SUBARCTIC												
Arctic/subarctic beaches/meadows	-	-	3	-	-	3	-	3	-	2	-	2
Arctic/subarctic/alpine tundra	1	3	3	-	-	3	-	1	-	2	1	3
ALPINE/SUBALPINE/MONTANE												
Alpine/subalpine meadows	3	3	-	1	1	3	-	-	-	1	-	3
Alpine/subalpine cliffs/rocky slopes/ talus/scree/outcrops	3	3	-	1	1	3	-	-	-	1	-	3
Alpine seepage areas	-	1	-	-	-	-	-	-	-	-	-	1
Snowfields/snowbeds	1	1	-	-	2	1	-	-	-	1	-	1
Margins of mineral springs	-	-	-	1	-	-	-	-	-	-	-	3
Margins of hot springs	1	1	-	-	-	1	-	-	-	-	-	1
Montane meadows/prairies	-	1	-	-	-	-	-	-	-	-	-	2
Montane slopes/outcrops	2	2	-	-	-	1	-	-	-	-	-	1
Montane/subalpine forests	2	1	-	-	-	-	-	-	-	1	-	-
OUTCROPS/BARRENS												
Rocky slopes/ridges/outcrops/barrens	3	3	3	3	3	3	3	3	1	3	3	2
Rocky slopes/ridges/outcrops/ barrens - dry	2	3	2	-	1	-	-	3	-	-	3	1
Rocky slopes/ridges/outcrops/ barrens - moist	1	2	1	-	-	1	3	1	-	-	1	1
Rocky slopes/ridges/outcrops/ barrens - calcareous	1	1	1	3	3	2	1	3	-	3	1	1
Rocky slopes/ridges/outcrops/ barrens - gypsum	-	-	-	1	-	-	1	-	-	-	-	-
Lava talus	-	1	-	-	-	-	-	-	-	-	-	-
Granite/gneiss cliffs/outcrops	1	-	-	-	1	-	1	1	-	1	1	1
Serpentine	-	1	-	-	1	-	-	-	-	1	-	-
Basalt	-	1	-	-	-	-	-	-	-	-	-	-
Shale	1	1	-	-	-	1	-	1	-	1	1	1
Schist	-	-	1	-	-	-	-	-	-	-	-	-
Sandstone	-	-	-	-	1	-	-	1	1	1	-	-
Slate	-	-	-	-	1	-	-	-	-	-	-	-
Quartzite	-	-	-	-	1	-	-	-	-	-	-	-
Siliceous rocks/soils	-	-	-	-	1	-	-	-	1	1	-	-
MEADOWS/PRAIRIES												
Open sandy/gravelly slopes/hills	3	3	3	1	1	1	1	2	1	1	3	1
Fields/meadows - dry	1	1	1	2	1	1	1	1	3	2	-	-
Fields/meadows - moist to wet	3	3	3	3	2	3	3	3	3	3	3	3
Fields/meadows - calcareous	1	1	1	1	1	1	1	-	1	1	1	1
Sagebrush hillsides	-	3	-	-	-	-	-	-	-	-	-	-
Dry prairies/grasslands/steppes	3	3	3	-	-	1	-	3	-	-	3	-
Moist prairies	-	-	1	-	-	-	-	3	-	-	1	-
Dry gravel	-	1	1	-	-	-	-	1	-	1	1	1
Dry acidic soil	1	-	-	-	-	-	-	1	-	-	-	-
MOIST TO WET, OPEN HABITATS, WETLANDS												
Moist to wet calcareous gravels/shores	1	1	1	2	2	-	1	1	-	1	1	1
Clay soil	1	1	1	-	1	-	-	1	-	1	1	-
Muddy shores/mudflats	2	2	1	-	-	-	-	1	-	1	1	1
Fresh-water marshes	2	2	1	1	1	2	1	2	1	2	1	1
Salt/brackish marshes	1	2	2	2	1	1	1	1	2	1	1	1
Saline/alkaline flats/floodplains/ meadows	2	2	1	-	-	3	-	1	-	-	1	2
Seepage areas/springs	1	1	1	-	1	-	1	1	1	1	1	-
Lakeshores/shorelines	3	3	3	3	3	3	3	3	3	3	3	2
Seashores/coastal beaches	-	2	-	2	3	1	1	-	2	2	-	-
Sea cliffs/bluffs/headlands	-	2	-	1	2	1	1	-	1	-	-	-
Shallow water (lakes, ponds, streams)	3	3	3	3	3	3	2	3	3	3	3	2

Continued

TABLE 2. (*Continued*).

Habitat Description	Province/Territory of Occurrence*											
	AB	BC	MB	NB	NF	NT	NS	ON	PE	QC	SK	YT
Shallow water - calcareous	1	-	1	1	1	-	1	1	1	-	1	1
Vernal pools	-	1	-	-	-	-	-	-	-	-	-	-
Coastal waters	-	1	-	-	-	-	-	-	-	-	-	-
Streamsides/sandbars/riparian floodplains	3	3	2	3	3	3	2	3	1	3	3	3
Waterfalls	-	1	-	-	-	-	-	1	-	-	-	-
Rapids	-	-	-	1	-	-	1	1	-	1	-	-
Ditches	1	1	1	1	-	1	1	1	1	1	1	-
Fens/sedge meadows	1	1	1	2	3	2	1	1	1	1	3	2
Swamps/wet woods	1	2	1	2	1	1	2	3	3	1	1	1
Bogs/muskeg/wet Black Spruce woods	2	3	3	2	1	2	2	2	2	3	3	3
DRY, OPEN HABITATS												
Sand dunes	1	2	1	1	1	1	1	2	2	1	2	1
Sand barrens/blow-outs	1	1	1	-	-	1	-	1	-	-	1	-
Burns	-	-	-	-	-	-	-	-	1	1	1	-
Thickets/brush/scrub	2	2	2	1	3	1	1	3	3	3	1	2
FORESTS AND SAVANNAHS												
Boreal forest (Jack Pine/upland Black Spruce/White Spruce)	-	1	-	1	1	1	1	1	1	1	2	-
Dry aspen woods	-	-	1	-	-	1	-	-	-	-	1	-
Moist coniferous forest	3	3	1	-	2	2	-	1	-	-	2	2
Moist/rich deciduous forest	1	1	1	3	1	-	3	3	1	3	2	1
Calcareous woods/hardwoods	-	-	1	1	-	-	-	1	-	1	-	-
Moist/rich mixed forest	-	-	2	1	-	-	1	2	1	1	2	-
Dry oak/oak-hickory woods	-	1	-	-	-	-	1	1	-	1	1	-
Oak-pine woods	-	-	-	-	-	-	-	1	-	1	-	-
Pine woods	1	1	-	-	1	-	-	1	1	1	2	-
Pine plantations	-	-	-	-	-	-	-	1	-	-	-	-
Red Juniper savannah	-	-	-	-	-	-	-	1	-	-	-	-
Oak savannah	-	-	-	-	-	-	-	2	-	-	-	-
Dry open woods	3	3	2	3	-	1	2	3	3	3	2	1
Moist/rich woods	3	2	2	-	-	1	-	2	2	-	1	-
Dry deciduous forest	-	-	-	1	-	-	-	1	1	1	-	-
EPIPHYTES AND PARASITES												
Epiphyte	-	1	-	-	-	-	-	-	-	-	-	-
Parasitic on *Alnus*	1	1	-	-	-	-	-	-	-	-	-	-
Parasitic on Apiaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on *Arctostaphylos*	-	1	-	-	-	-	-	-	-	-	-	-
Parasitic on Asteraceae	1	1	1	-	-	-	-	1	-	-	-	-
Parasitic on Chenopodiaceae	-	1	-	-	-	-	-	-	-	-	-	-
Parasitic on Convolvulaceae	-	1	-	-	-	-	-	-	-	-	-	-
Parasitic on Fabaceae	-	1	-	-	-	-	-	1	-	-	-	-
Parasitic on *Fagus*	-	-	-	-	-	-	-	-	1	-	-	-
Parasitic on Lamiaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on Linaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on Lythraceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on Malvaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on Onagraceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on *Picea*	-	-	-	-	1	-	-	-	-	-	-	-
Parasitic on Poaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on Polygonaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on *Quercus*	-	-	-	-	-	-	-	-	-	1	-	-
Parasitic on Rosaceae	-	-	-	-	-	-	-	1	-	-	-	-
Parasitic on conifers	-	1	-	-	-	-	-	-	-	-	-	-

*provincial and territorial abbreviations as in Table 1. Relative rankings (1-3) for habitat preferences of rare species are based on the following ranges (NB, NT: 1-7 reports [tallies] = 1; 8-14 = 2; 15+ = 3. AB, MB, NF, NS, PE, SK, YT: 1-9 = 1; 10-19 = 2; 20+ = 3. BC, ON, QC: 1-14 = 1; 15-29 = 2; 30+ = 3). See text.

province-dependent. Thus, a province with relatively few rare species, such as Prince Edward Island, required fewer rare species habitat preferences to achieve a score of "3", than did a province such as British Columbia, with a large number of rare species. The scale was applied after tallying of habitat preferences was completed. This approach allowed for each province and territory to be dealt with equally. Although somewhat subjective, it is hoped that this approach provides insights into both regional and national trends in habitat preferences, and that it may assist in priority-setting with regard to habitats that may be in need of conservation actions (because of the concentrations of rare species within them).

Certain patterns are immediately evident and easily explained. The regions that contain mountains (British Columbia, Alberta, Northwest Territories, Yukon Territory) have a preponderance of rare species in the alpine, subalpine, and montane habitat types, but particularly in moist meadows. Alpine and subalpine, open, rocky habitats are also concentration points for rare plants in these regions. There is not necessarily a concentration on calcareous sites, although this may be an artefact of how habitats were characterized in the provincial/territorial lists, or of the lack of detail at the source (specimen labels). It is interesting to note that montane and subalpine forests are not habitats with major concentrations of rare vascular plants. However, open, rocky montane slopes and outcrops support more rare species. In fact, open, rocky habitats of all sorts, at all elevations and latitudes, are extremely important for their concentrations of rare vascular plants (Table 2). Although the more specialized habitats within these rock outcrops/slopes/barrens have not been consistently described in the provincial/territorial lists, it is apparent from Table 2 that there are many specialized niches to which rare species have become adapted. Some examples of such specialized habitats include lava talus (British Columbia), gypsum outcrops (New Brunswick, Nova Scotia), serpentine outcrops (British Columbia, Newfoundland, Quebec), and alvars (included within calcareous barrens; Ontario). Drury (1969) suggested that specialization on limestone or serpentine substrates might be a response to competition, rather than physical stress. However, this may to be too simplistic an explanation, since Kruckeberg (1984) has noted a wide range of evolutionary responses to the serpentines in California. Brunton (1979) provided an informative example of how three closely related taxa of cliff-brake ferns were partitioned among microsites on limestone substrates in Alberta. Western Cliff-brake, *Pellaea occidentalis*, is found on dry, exposed, southwest-facing sites; Smooth Cliff- brake, *P. suksdorfiana*, occurs on shaded, cool, east- or north-facing cliffs by water; and Purple Cliff-brake, *P. atropurpurea*, is located on dry, partially shaded, southwest-facing sites.

Another obvious pattern relates to arctic/subarctic habitats. In provinces with limited arctic/subarctic area (relative to their total areas), many species occurring in these areas are considered to be provincially rare. In some cases, this may be due to a lack of botanical exploration. However, such areas in Manitoba, Ontario, and Quebec also contain many species that reach the limits of their ranges in these arctic/subarctic fringes (i.e., they are at the peripheries of their ranges). Nevertheless, they are naturally occurring components of the biodiversity of these jurisdictions. The Northwest Territories and Yukon Territory contain abundant habitat in the arctic/subarctic zones. It has been difficult, however, to further subdivide the habitat types in these areas, because the lists of rare plants for these regions contain general habitat descriptions, for the most part. It is evident, however, that both coastal beaches and meadows, as well as tundra further inland, are important habitats for both territorial and provincial arctic/subarctic rarities.

Natural meadows, fields, and grasslands form another nucleus of important habitat types for rare vascular plants in Canada. Moist to wet meadows support far more rare species in almost all jurisdictions, than do dry meadows. Again, calcareous meadows constitute a subset of the field/meadow category that is important for some species. There may be some inconsistency among authors in the distinction between calcareous meadows, fens, and sedge meadows. When the fen/sedge meadow category is examined, the importance of these minerotrophic, moist to wet habitats is accentuated. Several provinces and territories have high scores for this vegetation class (Table 2). Moist to wet, open, calcareous gravels and shores also support rare species in most jurisdictions.

Although wet, open meadows predominate in the field/meadow category, some dry grassland communities also contain numerous rare vascular plant species. This is particularly true of dry prairies, probably because most of them have been converted to agricultural uses. British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario all have many rare species that are associated with dry prairie conditions. Another rare habitat rich in rare species is the xeric sagebrush hillside/slope, which is restricted to southern interior British Columbia.

Moist prairies have also dwindled to a small fraction of their former extent. The rare species categorized as preferring moist prairies in the provincial lists tend to be associated with tall-grass prairies. Southwestern Ontario is the focal point for these remnant habitats, but southeastern Manitoba also contains significant amounts of this vegetation type. These moist prairies generally are not excessively

alkaline. In the prairie provinces, alkaline flats, floodplains, and meadows, which usually are moist in the spring, and desiccate during the summer, support substantial numbers of rarities, as well. The Northwest Territories, Yukon Territory, British Columbia, and Alberta are rich in species preferring these habitats.

Several other moist to wet habitats consistently support many rare species in all jurisdictions. The shores of lakes, ponds, rivers, and streams fall into this category, as do riparian habitats (open and shaded). Each jurisdiction also contains several rare aquatic macrophytes. Some of these clearly are associated with calcareous waters. Two of the specialized aquatic habitats occupied by rare plants are vernal pools [northern limit of a threatened habitat type characteristic of the California Floristic Province (Holland and Jain 1988); British Columbia], and rapids (which contain the nationally rare Riverweed, *Podostemum ceratophyllum*, in Ontario, Quebec, New Brunswick, and Nova Scotia). Open and wooded wetlands of several types, including coniferous and hardwood swamps, ombrotrophic bogs, muskeg, and fens (noted above), all support several rare vascular plant species in most or all jurisdictions. Moist woodlands support more rare species than do dry woodlands (a situation parallel to that for open habitats; however, see below). Rich, moist hardwood forests, especially in Ontario, Quebec, New Brunswick, and Nova Scotia, are particularly important. Moist coniferous forests are important habitats for rare species in boreal and montane regions.

Dry woodland communities appear to be less rich in terms of their rare species content. However, certain provinces contain concentrations of rare species in such habitats. Ontario is one case where numerous species rely on dry hardwood forests with southern affinities. This includes both closed-canopy oak-hickory and maple-beech forests, as well as more open oak savannahs. Dry coniferous forests are far less diverse, but some rare species do require dry pine- or spruce-dominated forests.

It is also important to recognize that there are a few groups of rare vascular plants that are highly specialized in the sense that they require specific hosts. A rather long list of hosts is found in Table 2. The parasitic species are found mainly within the Dodder family (Cuscutaceae) and the Mistletoe family (Viscaceae). British Columbia and Ontario have the most rare parasitic species. This is consistent with their having the largest floras and the highest numbers of rare species in their floras (Table 1).

Rare Habitats

The previous discussion focussed on the habitats of the provincially/territorially rare vascular plants. Not all of the habitats in which rare species occur are themselves rare. The factors that lead to rarity in a species are frequently unknown. Some habitat types, especially those related to localized substrate outcroppings or unusual hydrological features, are rare in their own right. Other habitat types may have been widespread at one time, but are now rare due to land use activities, such as ploughing, grazing, clearing, mining, flooding, draining, logging, and urbanization/development. Examples in the latter category include some types of old-growth forests, Great Lakes marshes, and all types of prairies. Although no national (or even provincial) inventory of rare habitats exists, a brief discussion of a few habitat types that are generally considered to be rare will assist in explaining some of their features, and perhaps also provide some clues as to the reasons for their rarity.

The Atlantic Coastal Plain vegetation of Nova Scotia and Ontario has been studied intensively by Paul Keddy and his colleagues. In these infertile sand and gravel shoreline habitats, subject to fluctuating water levels and intense wave exposure, individual species vary in their responses to the exposure. Water depth and wave energy are both important factors in determining within-lake distributions of species. Species with Atlantic Coastal Plain affinities tend to be most abundant where exposure to waves is most intense. The wave action serves to reduce soil fertility by washing away the finest sand particles, as well as organic matter, and also serves to limit the establishment of shrubs and coarse herbaceous vegetation (P. A. Keddy 1981, 1983; P. A. Keddy and Wisheu 1989). Some of the species with this floristic affinity are locally abundant within a small geographic area (e.g., Virginia Meadow-beauty, *Rhexia virginica*, and Southern Yellow- eyed Grass, *Xyris difformis*), in the Muskoka-Parry Sound area of central Ontario. Others, with the same floristic affinity, are extremely rare within the same area (e.g., Screw-stem, *Bartonia paniculata*, and Engelmann's Quillwort, *Isoetes engelmannii*). These Atlantic Coastal Plain shoreline habitats may be threatened in various ways. In many cases, these communities have developed on the shorelines of lakes that are also considered to be prime sites for cottage development. The pressures on such sites in both Nova Scotia and Ontario are intense (C. J. Keddy and Sharp 1989*; P. A. Keddy and Wisheu 1989; personal observations). Another source of potential damage to these communities is from water-level alteration and control. The gradual reduction in water levels through the summer is an essential attribute for the annual and short-lived perennial species that occupy the emergent shoreline communities (P. A. Keddy and Reznicek 1982; Reznicek 1994; Sharp and Keddy 1993*). Water level control is likely to have an adverse effect, unless water-level fluctuations are managed in accordance with the ecological requirements of the species that make up these rare communities (Sharp and Keddy 1993*).

Tall-grass prairies and oak savannahs provide examples of community types that are both rare in their own right, and that contain numerous provincially (and nationally) rare species. These vegetation types formerly were much more extensive than they are today; perhaps less than 1% of the pre-settlement tall-grass prairie and savannah remain in southern Ontario (Bakowsky and Riley 1994). The coincidence of some of the remaining prairies with portages, ancient lake bluffs, and other traditional campsites, suggests that aboriginal use of fire as a tool, as well as natural fires, and warmer- and drier-than-normal site conditions, played an important role in the persistence of these habitats (Bakowsky and Riley 1994; Catling et al. 1992). Faber-Langendoen and Maycock (1994) described six prairie types in Ontario (dry; dry mesic; mesic sandy loam; wet mesic; wet mesic sandy; wet mesic sandy loam), which have characteristic vegetation patterns correlated with site differences. All of these types are now rare. Agricultural and, to some extent, suburban/ urban land uses have resulted in the rarity of these vegetation types. Another threat to the remaining fragments of these habitats is fire suppression. Without proper fire management, the remaining sites will become overgrown or close in with fuller canopy development, resulting in the probable loss of some rare species, as well as the communities themselves.

Rarity due to the localized occurrence of unusual or uncommon edaphic/geological features is well known. This has been alluded to above **(Habitats of Rare Plants).** A few additional examples are helpful in understanding the patterns and causes of rarity. Areas of endemism often coincide with unusual substrate conditions. A good example is found in the active sand dune systems along the south shore of Lake Athabasca, in northern Saskatchewan and Alberta. This area extends for approximately 90 km along the shore, and for up to 20 km inland (Argus and Steele 1979; Raup and Argus 1982). Argus and Steele (1979) have studied the morphology and phenolic glycosides of the endemic Tyrrell's Willow, *Salix planifolia* subsp. *tyrrellii*, on these dunes, and have found that this taxon has adapted to the active dune conditions by developing genetically controlled prolonged apical dominance, which enables shoots to continue growing upward through the constantly accreting sand, so that portions of the plant can remain exposed on the crests and flanks of these dunes. A different adaptation to the same conditions has evolved in another endemic, Sand Dune Long-stalked Chickweed, *Stellaria longipes* subsp. *arenicola*. In the typical subspecies, cross-pollination is the normal breeding system. However, in the sand dune endemic, the breeding system has switched to self-pollination. In addition, the capsules of the endemic subspecies dehisce to release their seeds soon after maturity, unlike the widespread typical subspecies (Ramamoorthy and Chinnappa 1995).

Another example of a rare (and threatened) vegetation complex is the alvars of the Great Lakes region. Alvars are naturally open areas of thin soil over relatively flat Ordovician and Silurian limestone and dolomite (and sometimes Precambrian marble) pavement, that support relatively sparse vegetation. They remain open because of seasonal extremes in soil moisture content (wet in spring, desiccated in summer), extremely thin, poorly developed soils, and, at least historically, occasional fires. Ontario contains over 90% of the total Great Lakes alvar landscape (Catling and Brownell 1995; Catling et al. 1975). Alvars support a rich diversity of provincially and nationally rare vascular plants, including at least one endemic, Lakeside Daisy, *Hymenoxys herbacea* (Catling 1995; Catling and Brownell 1995; Catling et al. 1975; Cusick 1991). Catling and Brownell (1995) described two major types of alvars (shoreline and plateau), the latter having various expressions depending on the nature of the rock exposures and the degree of soil development. They characterized these variants as alvar grassland, alvar pavement, alvar savannah, and pavement ridge. The highest diversity of alvar specialists is found on the alvars of the western Lake Erie region, Manitoulin Island, and the Napanee Plain. Alvar-like communities on marble substrates are not nearly as species-rich, but do contain a few of the characteristic limestone/ dolomite alvar specialists (personal observations). The major threats to alvars arise from conversion to alternative uses. A major current use of alvars is as pastureland. This form of land use has variable effects. On one hand, grazing may serve to keep woody vegetation from invading sites with better than usual soil development. However, some of the alvar species may suffer from overgrazing. These effects are not yet known. Lands that are being used for pastures are also likely to be protected from fire more diligently than are inactive alvars. Catling et al. (1975) also noted that some of the alvars they studied were being used as unauthorized dumps. Perhaps the most serious threat to alvars is from mining and aggregate production. Given the close proximity of many of the alvars to the Greater Toronto Area, and the easy access to crushable limestone for gravel and cement, because of the negligible overburden, some of the major alvars are undergoing extraction at an increasing rate. Thus, an already geographically limited habitat type is under threat from a non-renewable resource extraction activity. Similar threats face other limestone-, gypsum-, and sandstone-based habitats in many parts of Canada (e.g., Fahselt et al. 1979).

Conclusion – Future Priorities

A considerable amount of progress has been made over the past 20 years in our understanding of the status, distribution, and ecology of the rare vascular plants and their habitats in Canada. Having said that, however, there is still an enormous amount to be learned before effective conservation measures can be applied for more than a handful of species. Unfortunately, botanists often are requested to recommend conservation actions in the absence of adequate data. For this reason, it may be necessary to find new ways of generating status reports, or of dealing with conservation requirements of vulnerable, threatened, and endangered plants and communities. This is not to say that the traditional single-species approach should not continue. However, it seems necessary to find new, more efficient ways of obtaining the necessary data on more species and vegetation communities in less time. Also, efforts should be focussed on the taxa or communities with the most pressing conservation needs. This requires a priority-setting mechanism(s). COSEWIC has a process for determining priorities for funding allocations for status reports, which appears to combine an assessment of submitted proposals with an assessment of threats to each taxon. Argus and Pryer (1990) developed a priority-rating system for the nationally rare vascular plants that takes into account each taxon's Canadian range, population sizes, threats, and rarity in all jurisdictions of occurrence. Using this system, they ranked 68 species as having top priority for conservation action. This set of 68 vascular plants should serve as a starting point for further studies, not only on status and demographics, but also on ecological requirements. A quick perusal of these 68 species indicates that approximately half have had status reports prepared (see Appendix I). Approximately 35 of these species still require assessments. Several of the other species assessed by COSEWIC fall within the second priority category of Argus and Pryer (1990).

An alternative approach to priority-setting for conservation has been referred to as "species triage" (McIntyre et al. 1992). This approach is rooted in the philosophy that it is not possible to protect all species from extinction, and that focussing efforts on the rarest of the rare is often both cost- and time-intensive. Rather, they suggest that a primary goal of conservation efforts should be to provide habitat and landscape diversity that maximizes the range of selective pressures and the number of species that are able to exist. Another way of thinking about this concept is to ensure the provision of as broad a range of niches or site conditions as possible for the most species. This approach may lean too far in the other direction. However, some intermediate approach, which combines single-species and habitat approaches, should be feasible. An adaptation of the "species triage" concept that enables an assessment of the probability that conservation actions will provide the desired result (i.e., maintenance of viable populations in the wild) may be worthy of further consideration. This could be thought of as a form of risk/benefit assessment.

The idea of focussing on habitats rather than species is not new. Most conservation agencies realize that there are far too many rare species to deal with effectively, individually. One concept that has been suggested in Ontario, but not yet attempted, was the idea of multi-species status reports, for situations where assemblages of rare species occur together (Bowman 1991). Such status reports could include selected demographic data on the individual rare species, but would focus on the status of the habitat in which they occurred. Some of the habitats of rare species in which this approach might be feasible have been discussed above, and include tallgrass prairies, alvars, Atlantic Coastal Plain communities, snowbeds in certain mountain ranges, serpentine outcrops, etc. This approach would be analogous to the "guild" approach sometimes advocated in species monitoring programs.

For certain plant groups, such alternative approaches are not yet feasible, because little is known about the target organisms or their ecological requirements. In the case of such groups (bryophytes, algae, lichens, fungi), attempts must first be made to address the question of which taxa (and which habitat attributes) require conservation attention. As noted earlier, some work has been done on compiling data on the rare species in some of these groups, in some jurisdictions, but much more work is needed. It may well be that some of the rarities in these groups co-occur with the rare vascular plants. However, at the present time, we do not know.

The move to establish Conservation Data Centres in several provinces is positive, and should continue. The staffs in these Centres have the specific task of tracking and updating knowledge on rare organisms and ecosystems in their jurisdictions. Ultimately, each province and territory should establish such agencies.

There also is a need for diversified and strengthened legislative tools to promote conservation of both rare species and significant habitats and landscapes. Most legislative tools that exist at the present time appear to be too weak. These weaknesses are manifested in several ways. Invariably, Canadian legislation contains incomplete and inadequate lists of rare species. In some cases, the regulations attached to these acts easily can be circumvented, or are overly permissive in terms of allowances for land uses that may not be compatible with the goal of sustaining healthy ecosystems and populations of the listed or regulated species. Enforcement of the

regulations in these acts also is problematic in several ways. There are insufficient personnel to enforce the regulations, evidence often is difficult to obtain for prosecution, and in some cases, upon conviction, penalties are trivial.

Canada, along with its provinces and territories, has made significant progress in cataloguing rare vascular plants, and has begun to develop tools and mechanisms to conserve these elements of its biodiversity. Continued efforts at the species level, but also especially on ecosystems, are now needed to ensure that as much of the natural diversity as possible is conserved for future generations.

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APPENDIX I. Status designations for flowering plants and lichens, assessed through the auspices of the Committee on the Status of Endangered Wildlife in Canada, as of September 1996 (Anonymous 1996; Erich Haber, personal communication; Sylvia Normand, personal communication). Provincial and territorial acronyms are the same as those used in Table 1.

Species	Common Name	Canadian Occurrence	Status	Year
Flowering Plants, Ferns and Allies				
Abronia micrantha	Sand Verbena	AB, SK	Threatened	1992
Adiantum capillus-veneris	Southern Maidenhair Fern	BC	Endangered	1984
Agalinis gattingeri	Gattinger's Agalinis	ON	Endangered	1988
Agalinis skinneriana	Skinner's Agalinis	ON	Endangered	1988
Aletris farinosa	Colicroot	ON	Threatened	1988
Arisaema dracontium	Green Dragon	ON, QC	Vulnerable	1984
Armeria maritima ssp. *interior*	Athabaska Thrift	SK	Threatened	1981
Aster anticostensis	Anticosti Aster	NB, QC	Threatened	1990
Aster curtus	White-top Aster	BC	Threatened	1996
Aster divaricatus	White Wood Aster	ON, QC	Threatened	1995
Aster laurentianus	Gulf of St. Lawrence Aster	NB, PE, QC	Vulnerable	1989
Aster subulatus var. *obtusifolius*	Bathurst Aster	NB	Vulnerable	1992
Aster yukonensis	Yukon Aster	NT, YT	Not at Risk	1996
Azolla mexicana	Mosquito Fern	BC	Threatened	1984
Balsamorhiza deltoidea	Deltoid Balsamroot	BC	Endangered	1996
Bartonia paniculata	Branched Bartonia	ON	Vulnerable	1992
Brickellia grandiflora	Large-flowered Brickellia	AB, BC	Not at Risk	1996
Buchnera americana	Bluehearts	ON	Threatened	1985
Cacalia plantaginea	Indian Plantain	ON	Vulnerable	1988
Camassia scilloides	Wild Hyacinth	ON	Vulnerable	1990
Carex nebrascensis	Nebraska Sedge	AB	Not at Risk	1995
Castanea dentata	American Chestnut	ON	Threatened	1987
Castilleja levisecta	Golden Paintbrush	BC	Threatened	1995
Celtis tenuifolia	Dwarf Hackberry	ON	Vulnerable	1985
Cephalanthera austinae	Phantom Orchid	BC	Vulnerable	1992
Chenopodium subglabrum	Smooth Goosefoot	AB, MB, SK	Vulnerable	1992
Chimaphila maculata	Spotted Wintergreen	ON	Endangered	1987
Cicuta maculata var. *victorinii*	Victorin's Water-hemlock	QC	Vulnerable	1987
Cirsium pitcheri	Pitcher's Thistle	ON	Threatened	1988
Clethra alnifolia	Sweet Pepperbush	NS	Threatened	1986
Collinsia verna	Blue-eyed Mary	ON	Extirpated	1987
Coreopsis rosea	Pink Coreopsis	NS	Endangered	1984
Cypripedium candidum	Small White Lady's-slipper	ON, MB	Endangered	1981
Desmodium illinoense	Illinois Tick-trefoil	ON	Extirpated	1991
Draba kananaskis	Kananaskis Whitlow-cress	AB	Indeterminate	1992
Drosera filiformis	Thread-leaved Sundew	NS	Endangered	1991
Epipactis gigantea	Giant Helleborine	BC	Threatened	1984
Erigeron philadelphicus ssp. *provancheri*	Provancher's Fleabane	QC	Vulnerable	1992
Erigeron radicatus	Dwarf Fleabane	AB, BC, SK	Not at Risk	1996
Erysimum angustatum	Narrow-leaved Wallflower	YT	Not at Risk	1993
Floerkea proserpinacoides	False Mermaid	NS, ON, QC	Not at Risk	1984
Frasera caroliniensis	American Columbo	ON	Vulnerable	1993
Fraxinus quadrangulata	Blue Ash	ON	Threatened	1983
Gentiana alba	White Prairie Gentian	ON	Endangered	1991
Gentiana victorinii	Victorin's Gentian	QC	Vulnerable	1987
Geum peckii	Eastern Mountain Avens	NS	Endangered	1986
Gymnocladus dioica	Kentucky Coffee-tree	ON	Threatened	1983
Halimolobos virgata	Slender Mouse-ear Cress	AB, SK	Endangered	1992
Hibiscus moscheutos	Swamp Rose-mallow	ON	Vulnerable	1987
Hordeum pusillum	Little Barley	AB	Indeterminate	1993
Hydrastis canadensis	Golden Seal	ON	Threatened	1991
Hydrocotyle umbellata	Water Pennywort	NS	Endangered	1985
Iris missouriensis	Western Blue Flag	AB, BC	Threatened	1990
Isoetes bolanderi	Bolander's Quillwort	AB	Vulnerable	1995
Isoetes engelmannii	Engelmann's Quillwort	ON	Endangered	1992
Isopyrum biternatum	False Rue-anemone	ON	Vulnerable	1990
Isotria medeoloides	Small Whorled Pogonia	ON	Endangered	1982

Continued

APPENDIX I. *Continued.*

Species	Common Name	Canadian Occurrence	Status	Year
Isotria verticillata	Large Whorled Pogonia	ON	Endangered	1985
Juncus caesariensis	New Jersey Rush	NS	Vulnerable	1992
Justicia americana	American Water-willow	ON, QC	Threatened	1984
Lachnanthes caroliniana	Redroot	NS	Threatened	1994
Lespedeza virginica	Slender Bush-clover	ON	Endangered	1986
Liatris spicata	Dense Blazing Star	ON	Vulnerable	1988
Lilaeopsis chinensis	Lilaeopsis	NS	Vulnerable	1987
Limnanthes macounii	Macoun's Meadowfoam	BC	Vulnerable	1988
Liparis liliifolia	Purple Twayblade	ON	Threatened	1989
Lipocarpha micrantha	Small-flowered Lipocarpha	BC, ON	Threatened	1992
Lophiola aurea	Golden Crest	NS	Threatened	1987
Lotus formosissimus	Seaside Bird's-foot Lotus	BC	Endangered	1996
Lupinus lepidus var. *lepidus*	Prairie Lupine	BC	Endangered	1996
Magnolia acuminata	Cucumber-tree	ON	Endangered	1984
Morus rubra	Red Mulberry	ON	Threatened	1987
Opuntia humifusa	Eastern Prickly-pear Cactus	ON	Endangered	1985
Oxytropis lagopus	Hare-footed Locoweed	AB	Vulnerable	1995
Panax quinquefolius	American Ginseng	ON, QC	Threatened	1988
Pedicularis furbishiae	Furbish's Lousewort	NB	Endangered	1980
Phegopteris hexagonoptera	Broad Beech Fern	ON, QC	Vulnerable	1983
Phlox alyssifolia	Blue Phlox	AB, SK	Not at Risk	1996
Plantago cordata	Heart-leaved Plantain	ON	Endangered	1985
Platanthera leucophaea	East. Prairie White-fringed Orchid	ON	Vulnerable	1986
Platanthera praeclara	West. Prairie White-fringed Orchid	MB	Endangered	1993
Polemonium van-bruntiae	van Brunt's Jacob's Ladder	QC	Threatened	1994
Polygala incarnata	Pink Milkwort	ON	Endangered	1984
Potamogeton hillii	Hill's Pondweed	ON	Vulnerable	1986
Psilocarphus tenellus var. *tenellus*	Slender Woolly-heads	BC	Not at Risk	1996
Ptelea trifoliata	Hop Tree	ON, QC	Vulnerable	1984
Pycnanthemum incanum	Hoary Mountain-mint	ON	Endangered	1986
Quercus shumardii	Shumard's Oak	ON	Vulnerable	1984
Ranunculus alismaefolius var. *alismaefolius*	Water-plantain Buttercup	BC	Endangered	1996
Rosa setigera	Climbing Prairie Rose	ON	Vulnerable	1986
Sabatia kennedyana	Plymouth Gentian	NS	Threatened	1984
Salix planifolia ssp. *tyrrellii*	Tyrrell's Willow	SK	Threatened	1981
Scirpus longii	Long's Bulrush	NS	Vulnerable	1994
Scirpus verecundus	Few-flowered Club-rush	ON	Vulnerable	1986
Smilax rotundifolia	Round-leaved Greenbrier	ON (Carolinian population)	Threatened	1994
Stellaria arenicola	Sand Stitchwort	AB, SK	Not at Risk	1992
Stephanomeria runcinata	Pink Rush	BC	Not at Risk	1996
Stylophorum diphyllum	Wood Poppy	ON	Endangered	1993
Talinum sediforme	Fameflower	BC	Not at Risk	1990
Tephrosia virginiana	Goat's-rue	ON	Threatened	1996
Tradescantia occidentalis	Western Spiderwort	AB, MB	Threatened	1992
Trillium flexipes	Drooping Trillium	ON	Endangered	1996
Triphora trianthophora	Nodding Pogonia	ON	Threatened	1988
Vaccinium stamineum	Deerberry	ON	Threatened	1994
Viola pedata	Bird's-foot Violet	ON	Threatened	1990
Viola praemorsa ssp. *praemorsa*	Yellow Montane Violet	BC	Threatened	1995
Virgulus sericeus	Western Silver-leaf Aster	MB, ON	Vulnerable	1988
Woodsia obtusa	Blunt-lobed Woodsia	ON, QC	Threatened	1994
Yucca glauca	Soapweed	AB	Vulnerable	1985
Lichens				
Heterodermia sitchensis	Seaside Centipede	BC	Endangered	1996
Hypogymnia heterophylla	Seaside Bone	BC	Vulnerable	1996
Nephroma occultum	Cryptic Paw	BC	Vulnerable	1995
Pseudocyphellaria rainierensis	Oldgrowth Specklebelly	BC	Vulnerable	1996