NOVA SCOTIA PLANTS

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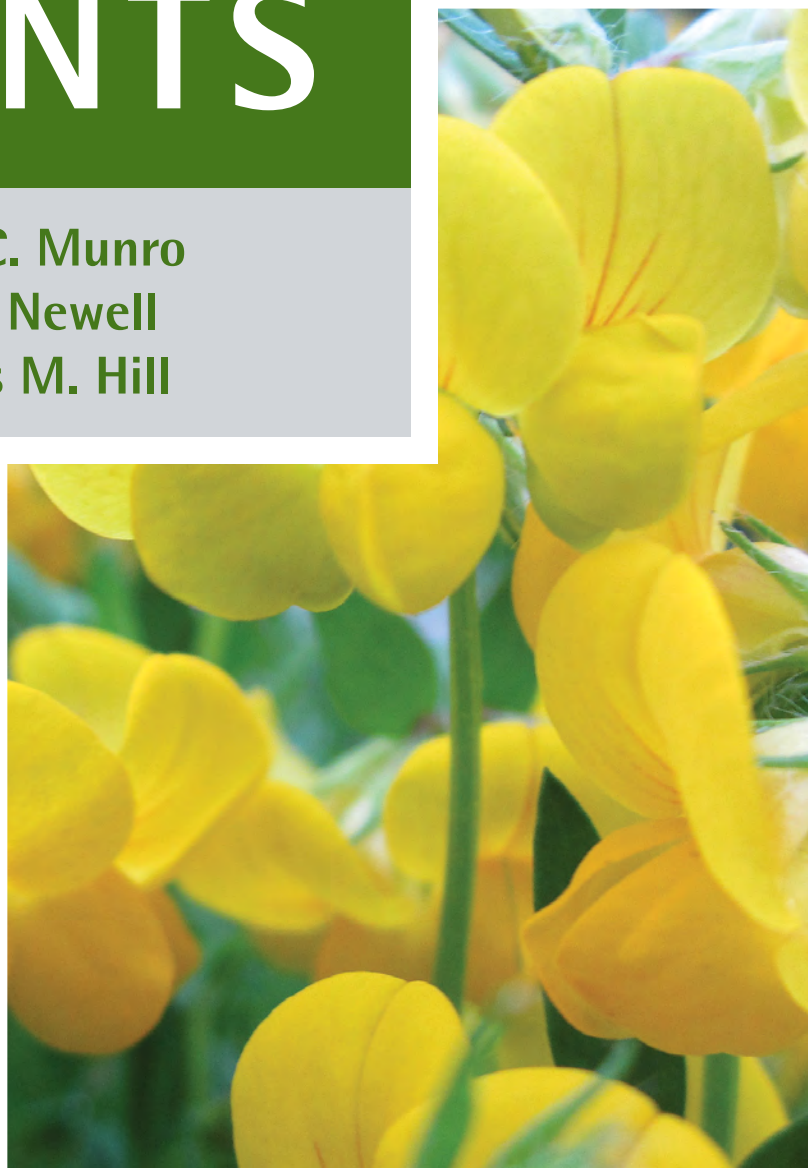

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INTRODUCTION

FOREWORD

Our small province is still offering the botanist and naturalist plenty of challenge and opportunities for new discoveries. With a renewed interest in our plant communities by agencies involved in species protection as well as land development, comes the need for increased documentation. We have attempted in this publication to be as complete and inclusive as possible, accepting submissions as recently as October 1, 2014, 29 days before launch!

I knew soon after the publication of **Roland's Flora of Nova Scotia** (1998) that an eBook was inevitable. Aside from the additional species records gained from countless hours spent in the field, publishing technology was evolving rapidly, embracing the digital delivery.

No document of this size could come together without a great deal of input from many, nearly all of it volunteer efforts. It represents a fine example of horizontal collaboration between The Nova Scotia Museum, Provincial Library staff and the Wildlife Division of the Department of Natural Resources. Continued partnerships with the College of Geographical Sciences and Acadia University effectively delivered content as well as provided students with real work experience. Most of the images were crowd-sourced. And we were successful in illustrating all but 200 plants with at least one image.

I am indebted to everyone who contributed in any way to the manuscript. In particular I want to acknowledge my co-authors, Ruth Newell and Nick Hill who rose to the challenges presented, usually on very short notice. Sherman Boates and Pam Mills began the project with me by supplying digital distribution maps and saw it through to completion by creating updated maps and introductory comments. Our common thread has been and always will be Acadia University's Biology Department. Heartfelt thanks to you all.

Aside from digital maps, I knew we needed to embrace web delivery, and visuals become critical on that platform. After talking with some colleagues and fellow naturalists, I realized that the naturalists who use the book, may also be a source of images. When we pled for donated image use, I was stunned, surprised and pleased at the responses. Each image used has its photographer credited. In addition, their names appear in the metadata for each family of plants, if their images appear in that family. All donated images are appreciated. It was predictable that some of our most beautiful wildflowers would be repeatedly photographed but I am indebted to a number of people who also documented the difficult groups. Roger Lloyd, dried grasses, sedges and willows never looked so artful as they do through your lenses. Thank you for all of your efforts.

Sean Blaney and David Mazerolle, you do know how envious I am, of all the hours you spend in the field documenting species and sites for the Atlantic Canada Conservation Data Centre, I hope? Many thanks for use of your photographs and for your collegiality over the years. Alain Belliveau contributed lots of pictures, especially whilst employed with the Mersey Tobeatic Research Institute in southwestern NS. Now that you've joined Sean and David, I know we'll see more. Thank you.

Martin Thomas, you are my hero. Thank you for every last image you sent; they numbered in the hundreds. I hope retirement allows you even more outdoor time. The next edition may come sooner than you think!

Retirement also allowed Ross Hall, Wildlife Biologist, DNR time to explore his neighbourhoods. I am glad you enjoyed the aquatic plants, as few others were able. Thank you for the use of your images.

Not-yet-retired Forestry staff of Department of Natural Resources contributed image use where possible: Eugene Quigley and Peter Neily, thanks.

A few of the plant portraits used were 35mm slides from the Collection of the Nova Scotia Museum. Alex Wilson, Mary Primrose and Reta Cook slides were used.

There were many photographers and naturalists who passed through the Museum inquiry program and kindly agreed to share their images when asked. Thanks to you as well.

To all those unnamed here, I am no less grateful for all of your support, patience and friendship over 20+ years and four books.

The use of the Open Journal System (OJS) is provided through Dalhousie University and is maintained locally by the Nova Scotia Museum Publications Committee. Thank you Laura Bennett for steering this committee, and Dyan Perley Bader for providing very simple solutions for templating and uploading the manuscript. I have enjoyed working with you.

Laura Bennett and Stephanie Smith, Manager of Collections and Director, Interpretation, Collections and Infrastructure (ICI): thanks for believing in the project and supporting my dedicated time.

We have made all efforts to eliminate inconsistencies, spell check and scientifically edit the material. I will assume responsibility for any errors or omissions in the edits, translation and uploads.

Readers, we welcome your comments, images and reports. Our contact information is available on these pages. We know you're out there perusing the plants and we know the next edition is not far off. You too can be a part of it!

~ Marian C. Munro

A BRIEF HISTORY OF BOTANICAL EXPLORATION IN NOVA SCOTIA

Many people have contributed to the exploration and documentation of Nova Scotia's wild flora over the last two centuries, either by collecting plant specimens for herbaria, creating herbaria and/or by writing papers or floras. The contributions of only a few are described below. It should be noted that contributors to our knowledge of the flora of Nova Scotia are not limited to professional botanists but have included naturalists, amateur botanists, students or anyone with an interest in our wild flora. Herbarium curators welcome observations on or documented specimens of wild plant species from the general public.

George Lawson (1827 – 1895)

Considered by some as the "father of Canadian botany", George Lawson was professor of chemistry and natural history at Dalhousie University and also served as Secretary of Agriculture for Nova Scotia. He was an avid supporter of the Nova Scotia Institute of Science. He studied and promoted the study of the wild flora of Nova Scotia to amateur botanists. Lawson wrote both the "Fern Flora of Canada" and "The School Fern-flora of Canada in 1889 in which he gives an account of the current state of knowledge of Nova Scotia's fern flora in the 1800's.

John Macoun (1831 – 1920)

As a young man and school teacher in Ontario, he became obsessed with botany and although he had little formal training, soon captured the attention of professional botanists. He ultimately became Dominion Botanist in 1881 with the Geological Survey of Canada. He was a prolific collector of plant specimens and cataloguer of Canadian flora and fauna for many field seasons. He spent a number of summers collecting plants in Nova Scotia in the late 1800's.

Alexander H. MacKay (1848 – 1929)

MacKay was an educator who became the principal of the Pictou Academy and eventually the Superintendent of Education for Nova Scotia. He pursued botanical and zoological research and developed a herbarium of native plants. He strongly promoted the inclusion of the study of natural history in the school curriculum and was responsible for developing a plant watch program which ran from 1898 to 1923. This program involved having rural school children document flowering dates of a select group of plant species every year. This data is still kept at the Nova Scotia Museum and today offers some insight on the topic of climate change.

Margaret S. Brown (1866 – 1961)

Margaret's lifelong hobby was the study of the mosses and liverworts of Nova Scotia. In spite of having limited formal training in the field of bryology, she corresponded and exchanged moss collections with professional bryologists around the world, participated in several field expeditions with botanist Dr. N.L. Britton and his wife, bryologist Elizabeth G. Britton of the New York Botanical Gardens, and published a number of papers in The Bryologist and The Proceedings of the Nova Scotian Institute of Science. One such publication was on the "Liverworts and Mosses of Nova Scotia". Margaret's many collections now reside in herbaria around the world.

Merritt Lyndon Fernald (1873 – 1950)

M. L. Fernald was a Harvard University Professor, Director of the Gray Herbarium and author of the 7th and 8th editions of Gray's Manual of Botany. During his years at Harvard, he published and collected extensively and was considered an expert on the plants of temperate eastern North America. In the summers of 1920 and 1921 he conducted botanical expeditions to southwestern Nova Scotia, using Yarmouth as a base. Throughout these two summers in the province, he was often joined for short periods by his students or various botanical colleagues. As a result of these botanical investigations, Fernald became the first to report extensively on the occurrence of the Atlantic Coastal Plain Floral Element in our province. The results of these expeditions to Nova Scotia are published in the journal Rhodora and make for very interesting reading (Fernald, M.L. The Gray Herbarium Expedition to Nova Scotia, 1920. Rhodora 23: 89–111; 130–171; 184–195; 223–245; 257–278; 284–300). Herbarium specimens resulting from these botanical forays to Nova Scotia currently reside in the Gray Herbarium at Harvard University and at the E.C. Smith Herbarium of Acadia University.

George E. Nichols (1882 – 1939)

Nichols, an eminent American bryologist, published a significant paper on the ecology of the vascular flora of northern Cape Breton Island in 1918. He also published several papers on the bryophytes of Nova Scotia (1916, 1918).

Lily May Perry (1895 – 1992)

Lily May Perry received a B.Sc. with Honours in 1921 from Acadia University. She went on to receive a PhD. in the United States and worked at both the Gray herbarium at Harvard University and the Arnold Arboretum where among other projects, she studied the medicinal plants of Southeast Asia. In 1929, she and Dr. Muriel V. Roscoe spent a month on St. Paul Island, 12 mi off the northern tip of Nova Scotia documenting the vascular flora of this rugged, remote island. A number of new records for the province

were discovered at this time. Duplicate sets of specimens currently reside at the E.C. Smith Herbarium of Acadia University and Harvard University.

John S. Erskine (1900 – 1981)

John Erskine was a teacher in the Annapolis Valley for many years. He was a keen student and observer of the fields of natural history and archaeology and spent his summers travelling the province studying plants and archaeological sites. He indeed wrote about being able to discern old Acadian sites by means of the particular plant species occurring at these locations. He collected botanical specimens extensively for the Nova Scotia Museum. He wrote prolifically about his botanical findings over the years. Two of his documents were "The Hepatics or Liverworts of Nova Scotia" and "An Introductory Moss Flora of Nova Scotia" (1968).

Albert E. Roland (1911? – 1991)

A.E Roland taught botany for many years at the Nova Scotia Agricultural College (now the Faculty of Agriculture, Dalhousie University). He was also Provincial Botanist for the Nova Scotia Department of Agriculture and Marketing. He was the first to write a comprehensive book on Nova Scotia's wild flora entitled the Flora of Nova Scotia (Roland, 1944). The second edition of The Flora of Nova Scotia was co-authored with E. Chalmers Smith of Acadia University (Roland and Smith, 1969). Dr. Roland was working on a third edition of the Flora of Nova Scotia when he passed away in 1991. This edition was subsequently completed through the efforts of Marian Zinck and the Nova Scotia Museum and co-published in 1998 with Nimbus Publishing. Other books by Dr. Roland include "The Ferns of Nova Scotia" (1944) and "Geological Background and Physiography of Nova Scotia (1982). Dr. Roland's plant specimens are currently housed in a number of Canadian herbaria.

E. Chalmers Smith (1912 – 1992)

Chalmers Smith was a Biology professor and later, Vice President Academic at Acadia University from 1947-1975. Some of his botanical course offerings included The Flora of Nova Scotia and Plant Ecology. Over the years, he and his students collected thousands of botanical specimens from throughout the province of Nova Scotia with special attention given to Cape Breton Island where rare arctic alpine species had been poorly documented. Many of these specimens/collections are housed in the herbarium at Acadia University. Dr. Smith and his students published numerous articles on the flora of Nova Scotia many of which were published in Rhodora (a journal of the New England Botanical Club promoting the study of the flora of New England and adjacent areas). Dr. Smith collaborated with Dr. A.E. Roland on the 2nd edition of "The Flora of Nova Scotia" (1969). In 1970, Acadia University named the university herbarium, the E.C. Smith Herbarium in honour of Dr. Smith and his accomplishments.

Sam P. vander Kloet (1942 – 2011)

Dr. Sam vander Kloet was a Biology Professor and Director of the E.C. Smith Herbarium at Acadia University from 1972 until he retired in 2001. Following his retirement, he remained on at Acadia as University Botanist collecting plant specimens for both the E.C. Smith Herbarium and the Harriet Irving Botanical Gardens and conducting research. During his career, Sam travelled and collected plant specimens all over the world and was recognized internationally as a global authority on blueberries (*Vaccinium* spp.). He published extensively and mentored many. His boundless enthusiasm inspired many students to continue in the field of botany including the authors of this e-flora.

Atlantic Canada Conservations Data Centre (ACCDC) – 1997 to present

The ACCDC was established in Atlantic Canada in 1997. It is a non-government organization which gathers and maintains data on species and ecological communities of conservation concern. This information is utilized for conservation planning and decision making and research in Atlantic Canada. Sean Blaney is the director of the ACCDC and senior botanist. Since 1997, ACCDC staff has conducted extensive field work which has generated thousands of specimen based records and been responsible for the discovery of a substantial number of new records from throughout Atlantic Canada.

~ Ruth E. Newell

THE FLORAL ELEMENTS OF NOVA SCOTIA

Nova Scotia is a peninsula, nearly a collection of islands, whose long axis parallels eastern North America. The climates and the vegetation of the province are markedly different from its southern tip at the latitude of southern Maine to its northern tip in line with northern New Brunswick. The southern flora of the tri-counties—Yarmouth, Digby and Queens—contains more than a hundred species of a "flora" whose main range occurs on the unglaciated Atlantic Coastal Plain of the eastern United States. The flora in the two counties that form the northern tip of Cape Breton includes arctic-alpine plants and disjunct populations of wide-ranging boreal species. So the Coastal Plain and the Arctic-Alpine represent the two extremes of biogeographic origin present in our flora. They include many of the rarest and at risk plants in the province. Other elements in our flora have been described by two of the giants of Nova Scotian botany, Albert E. Roland and E. Chalmers Smith. In the **Flora of Nova Scotia** (1969), the authors divided the flora into the following seven elements or groupings: Arctic-Alpine and Boreal Disjuncts, Boreal, Canadian, Alleghanian, Southwestern (*viz*. Atlantic Coastal Plain), Seashore, and Introduced Plants and Weeds. The first five divisions relate to a biogeographic origin of the species of the element, the latter two refer to common habitat or habit. Introduced plants stand out as simply not being from around here since they include plants of a diversity of origins.

The arctic-alpine/boreal disjunct element, includes plant species that grow in cool climatic conditions in Nova Scotia, but have their main ranges or population based in arctic, alpine or boreal zones. Many of the distributions of these species appear relic; their presence in an area may reflect an extensive post-glacial colonization of a denuded landscape and a subsequent retraction of these ranges in the warm Hypsithermal period thereafter. Roland and Smith (1969) listed nearly 60 of these plants that in the main occur in ravines, dripping cliffs, bogs and barrens, and forest at high elevation northern Cape Breton, or in various near sea-level habitats around the province that cooled by the Gulf of St. Lawrence, the Labrador Current or upwellings of the Bay of Fundy. In the case of *Geum peckii*, the eastern mountain avens, demonstrates the paradox of an arctic-alpine relic whose Canadian distribution depends on sea-level wetlands on Brier Island at the very southern end of Nova Scotia. The Nova Scotian sea-level population is disjunct from the only other global location, the White Mountains of New Hampshire. The Bay of Fundy gives the Nova Scotian setting cool summer temperatures (average for July from 15–17^{o}C) and many fog-bound days, in common with its alpine New Hampshire counterpart.

The boreal element includes species whose main range occurs in the Boreal Forest Region, a climatic zone whose southern border is defined by a mean July temperature below 18^{o}C. Species belonging to the boreal element in Nova Scotia occur broadly beyond this July isotherm condition and major constituents of peatland communities throughout the province are principally composed of woody boreal elements such as the trees, *Picea mariana* (black spruce) and *Larix laricina* (larch), and shrubs, *Chamaedaphne calyculata* (leatherleaf), *Ledum groenlandicum* (Labrador tea) and *Myrica gale* (sweet gale). Common boreal peatland sub-shrubs include *Empetrum nigrum* (crowberry), *Rubus chamaemorus* (bakeapple), *Vaccinium oxycoccos* (small cranberry), *Cornus canadensis* (bunchberry) and herbs include *Trichophorum cespitosum* (deergrass), *Carex magellanica* (bog sedge), and *Eriophorum* spp. (*E. polystachion* and *E. chamissonis*—common and rusty cottongrasses). The Boreal Forest in its main range has been shaped by fire, and boreal fire-adapted assemblages in Nova Scotia include *Pinus*

banksiana (jack pine), *Arctostaphlos uva-ursi* (bearberry) and *Vaccinium vitis-idaea* (foxberry) as well as various short-lived, deciduous forest trees (*Betula papyrifera, Betula populifolia, Populus tremuloides*). The long-standing practice of short-rotation forestry has greatly increased the abundance of the latter species as well as that of *Abies balsamea* (balsam fir).

The Canadian Floral Element is the background flora according to Roland and Smith (1969). These are our most common forest plants with temperate, eastern North American affinity. The herbs of this group are found in forests dominated by red spruce, hemlocks, white pines or even upland mixed woodlands dominated by tolerant hardwoods (e.g. American beech, red and sugar maples, yellow birch). Our typical woodland, Canadian Element herbs include: *Maianthemum canadense, Trientalis borealis, Clintonia borealis, Aralia nudicaulis, Trillium undulatum, Michella repens, Streptopus rosea, Cypripedium acaule*, and *Medeola virginiana* (ie. wild lily of the valley, starflower, yellow clintonia, wild sarsaparilla, painted trillium, partridge berry, rosy twisted-stalk, moccasin flower and cucumber-root). As noted by Lucy Braun (1950), it is most often the forest herbs that most reliably reflect forest soil conditions and the consistent appearance of these species throughout woodlands in Nova Scotia delimits the Acadian Forest (*sensu* Halliday, 1937) as well as the combinations of forest trees. In terms of strict biogeography, the defining tree of the Acadian Forest and the Canadian Element is *Picea rubens*. Other trees assigned to the Canadian element such as yellow birch, white ash, red maple, eastern hemlock, white pine or sugar maple have solid southern ranges into the southern Appalachian forest and some extend to the Gulf of Mexico.

The Alleghanian Element in the Nova Scotian botanical tradition, is equivalent to the Carolinian flora of Ontario, the Rich Mesophytic, or the Appalachian Deciduous Forest. These are all descriptors of hardwood associations on base-rich soils. This element has never been static, despite the view of Lucy Braun (1950) that the Mixed Mesophytic was an evolutionary cauldron of this diverse flora because this southern Appalachian zone had never been glaciated. She did, however, appreciate that there was a shift from mixed hardwood forests of no dominance to sugar maple/beech forests coincident with the Wisconsin glaciation line. These maple/beech forests on poor upland soils are found throughout the northern Appalachian hardwood forests of Maine and they occur throughout the Cobequid Hills of Nova Scotia. Under poor soils, the herb flora is restricted to various of the Canadian Element herbs described above as well as ferns. The most common shrub is Canadian Element, *Lonicera canadensis*, American fly-honeysuckle. In Nova Scotia, many members of the Alleghanian Element are rare because this association is restricted to rich soils of floodplain forests or a few cove forests of western Cape Breton. There has been a large loss of the principal habitat base, the floodplain forest, of this Element but these forests have a wide collection of hardwoods (elm, ironwood, black cherry, sugar maple, red maple, yellow birch, white ash), shrubs (chokecherry, *Prunus virginiana*; American hawthorn, *Crataegus chrysocarpa*; and highbush cranberry, *Viburnum opulus*) and herbs. Again, it is the herb community that identifies the Alleghanian Element in Nova Scotia (Hill and Garbary, 2010). It is distinctive for its large fraction of large seeded species (*Caulophyllum thalictroides, Triosteum aurantiacum, Sanguinaria canadensis, Arisaema trifolium, Allium tricoccum*—blue cohosh, horse gentian, bloodroot, jack-in-the-pulpit, and wild leek), and vernal herbs, many characteristic of the cove forests described by Braun for the southern Appalachians (e.g. *Viola pubescens, Uvularia sessifolia, Trillium cernuum, Dicentra cucullaria, Cardamine diphylla, Tiarella cordifolia, Claytonia caroliniana, Hepatica americana, Erythronium americanum* –yellow violet, bellwort, nodding trillium, dutchman's breeches, toothwort, Alleghany foamflower, Carolina spring beauty, hepatica and trout lily). This Element

may have enlarged its range in the province during the Hypsithermal and then retracted to the floodplain and rich soil areas described. There is evidence that the recent anthropogenic land use has subsequently further undermined this element as the current records for a few notable rarities (e.g. *Adiantum pedatum, Hepatica americana, Viola canadensis*—maidenhair fern, hepatica and Canada violet) show sharp declines.

All of the above species occur in rich soils and all of these areas lie west of the "Meguma" line on mainland Nova Scotia which separates hard resistant rock types from that which weathers to produce base-rich soils. The same situation applies in the more complex geological patterns in Cape Breton, the Alleghanian Element is particularly rich along the River Denys and in productive hardwoods around Mabou. Soil calcium is a particular indicator of the richness of the flora of the Appalachian Deciduous Forest, here or throughout eastern North America. Soil calcium depends upon the underlying rock substrate, but it is also clear that it may be vulnerable to the decades of acid precipitation that has stripped calcium throughout eastern North America (Jeziorski *et al.*, 2008). A guild of calciphiles has long been known to occur on Carboniferous gypsum outcroppings laid down on ancient seafloor between Windsor and Cape Breton. This flora was introduced in John Erskine's "In Forest and Field" in the essay "Plaster Rock" (Erskine, 1976). The flora contains no particular trees but there are shrubs (*Cornus rugosa*, *Dirca palustris*, and *Shepherdia canadensis*—round-leaved dogwood, leatherwood, and sheperdia), rare orchids (*Cypripedium calceolus* and *C. arietinum*—yellow lady's slipper and ram's head lady's slipper) and other herbs (*Erigeron hyssopifolius, Packera paupercula, Cystopteris bulbifera*—hyssop-leaved fleabane, balsam ragwort, and bulbet fern) that are unique in Nova Scotia to a small area of unquarried gypsum landscape.

The Atlantic Coastal Plain Flora in Nova Scotia is largely restricted to wetlands in the southwest of the province. These habitats, formed on a basis of quartzite, slate and granite, are infertile and acidic (normal pH range from 4 to 5), the opposite of the conditions required by the Alleghanian Element or the gypsum flora. It is important to note that Nova Scotia is not part of the Atlantic Coastal Plain geological province which is based on unglaciated sediments that were eroded from the Appalachian Mountains and deposited in a marine environment in Triassic time (Christensen, 1988). Despite this, our glaciated province contains an internationally significant assemblage of Atlantic Coastal Plain plants that are disjunct from their main ranges that may occur to the north of the geological province in glaciated New England or over the unglaciated Coastal Plain that extends from New York to Florida and then west along the Gulf of Mexico.The repeating pattern observed for many of these plant species in our province shows a distribution with its northern limit in southwestern Nova Scotia and its main range largely restricted to east coast United States. Nova Scotian populations are the disjunct outliers, a phenomenon also observed in the flora of various states (and Ontario) with wetlands bordering the Great Lakes. Keddy (2010) was first to point out that the coastal plain plants in Nova Scotia only occurred in naturally stressed and disturbed habitats because they were through long evolution adapted for slow growth under infertile conditions. The flora was restricted to such habitat in Nova Scotia because the plants are naturally poor competitors and are eliminated from more fertile regions. The two most exceptional rivers for Atlantic Coastal Plain Flora diversity and rarity in Nova Scotia are the Medway with nationally rare, yellow flowered monocots, goldencrest (*Lophiola caroliniana*) and redroot (*Lachnanthes tinctoria*) and the Tusket with its globally rare Plymouth gentian (*Sabatia kennedyana*) and pink coreopsis (*Coreopsis rosea*). The Tusket River was formally recognized by the Canadian Botanical Association in 2012 as a river of special conservation concern. The restriction of the coastal plain

flora to southwestern Nova Scotia has been related to the infertility associated with the predominating rock types (above) as well as to the more mild winter climate in the southwest. Plants of southern origin should be more prevalent in southwest Nova Scotia. In addition, several rare coastal plain plants are restricted to river lakeshores that are protected in winter by high water levels that keep plants insulated until late May. In addition to species of coastal plain herbs, southwestern Nova Scotia has the province's only monocot vine, the cat-brier (*Smilax rotundifolia*) and a complex of both common (e.g. inkberry, *Ilex glabra*) and rare (poison sumac, *Toxicodendron vernix*; sweet pepperbush, *Clethra alnifolia* ; and maleberry, *Lyonia ligustrina*) shrubs. The commingling of these southern coastal plain plants with northern boreal plants astonished the great Harvard botanist, Merritt Fernald on his first trip to southwestern Nova Scotia (Fernald, 1921).

Exceptional cases of rare and disjunct Atlantic Coastal Plain plants in Nova Scotia are not confined to lakeshores, neither are they wholly restricted to the southwest. A globally significant population of New Jersey rush (*Juncus caesariensis*) was discovered in Cape Breton fens, forty years before its original collection was rediscovered in the E.C. Smith Herbarium (Newell and Newell, 1992). The coastal plain flora is common in bogs and fens from the diminutive curly-grass fern (*Schizaea pusilla*), to pink orchids, the grass pink (*Calopogon pulchellus*) and rose pogonia (*Pogonia ophioglossoides*), and common shrubs (bog huckleberry, *Gaylussacia dumosa*; bayberry, *Morella pensylvanica*). The most unusual occurrence is that of the thread-leaved sundew, *Drosera filiformis*, restricted to a few plateau bogs near Shelburne. This plant is Endangered in Canada but is a common element in the New Jersey Pine Barrens and our variety (*Drosera filiformis* var *filiformis*) ranges from Cape Cod to northern Florida. The thread-leaved sundew belongs to a burgeoning number of plants that have been discovered since the publication of the Roland and Smith, **Flora of Nova Scotia** in 1969. In the years that followed an attempt to mine the peat for its energy potential, Landry and Cwynar (2005) discovered evidence using ^{14}C analysis on peat surrounding macrofossil seeds of this species, that the plant had been in residence in one bog a minimum of 4000 years before present. There have been various theories about how the coastal plain species arrived in Nova Scotia. Older theories suggested that the coastal plain flora were the first plants to colonize Nova Scotia after glaciation because during glaciation, sea levels were lower and there would have been a land bridge between the Cape Cod area and southwest Nova Scotia. During deglaciation, the ice sheet over the province melted and as sea levels rose, populations of Atlantic Coastal Plain and Boreal plants colonized the newly exposed landscape (Roland and Smith, 1969). The most recent examination of the evidence by Clayden *et al*. (2010) disputes the offshore boggy refugium hypothesis, citing a lack of correlation between the stages and dates of sea level rise and the availability and proximity of land that could allow a step by step colonization via an offshore route. Although this refutation undermines a convenient "Just So" story, it is in keeping with our understanding that the distribution of coastal plain plants reflects current day conditions (e.g. Hill and Keddy, 1992) and it must rest on research to identify the critical environmental factors that control distributions. Without such an understanding, we have limited ability to protect and manage current habitat or to restore former habitat.

The Coastal Plain geological province contains a variety of habitat in addition to wetland and there is a disjunct assemblage of xeric plants of Atlantic Coastal Plain affinity that occur on sand and rock barrens habitat in Nova Scotia. Broom crowberry (*Corema conradii*) and golden heather (*Hudsonia ericoides*) occur on rock outcrops on the Atlantic coast but also on the esker and wind-formed dunes of the Triassic sands of the Kingston Sand Barrens (Roland, 1980). These

two plants become established from seed shortly after fire and fire is required to maintain the assemblage. Other notable plants in this coastal plain, Broom Crowberry mat are of wide geographic origin: the boreal mountain sandwort (*Minuartia groenlandica*, the Greenland Stitchwort) and pinweed (*Lechea intermedia*). The latter plant has a Canadian Flora distribution as does a plant new to the Maritimes, forked blue curls (*Trichostema dichotomum*) discovered in 2013 (C.S. Blaney). There are differences between the sand and the rock barrens community. On the rock barrens, the boreal jack pine (*Pinus banksiana*) has a high percentage of trees with serotinous cones that require heat to release seeds. The Sand Barrens has wide areas dominated by bearberry (*Arctostaphylos uva-ursi*) and succession without fire leads to a domination by white and red pine or the invasive Scot's pine. The lack of fires in the Sand Barrens imperils a declining population of the provincially Endangered Canadian frostweed (*Helianthemum canadense*) which as recent work has revealed may be a genetically distinct sub-population unlike Queens County plants that have been clustered with New England or Quebec populations (Yorke *et al*., 2011).

Roland and Smith (1969) recognized a sixth assemblage, or floral element, in the plants that are restricted to its seashores. Roland was also a redoubtable geologist who described in his **Geology of Nova Scotia** (1980), the post-glacial dynamics of this coast. Although the current flora is not a stand-alone conservation document, it must be noted that in this period of crust subsidence accompanied with real sea level rise, the fraction of the province's coastal perimeter that qualifies as unmodified may be at its lowest level. The securement, however, of whole islands along the Eastern Shore, will allow the assemblages belonging to this seashore flora to adjust to the projected changes in sea-level without the added disruption from local anthropogenic shoreline disturbances. The seashore community is an amalgam of elements of the boreal and the exotic floras mixed together with saltmarsh plants that are generally distributed in such habitat, the length of the eastern North Atlantic shore from Georgia to Nova Scotia. The boreal seashore community's treeline includes three boreal conifers (balsam fir, white spruce and black spruce) as well as the mat-forming black crowberry. This ground-hugging evergreen heath is circumboreal and is best developed on exposed Atlantic coasts filling in where white spruce has been blown over. On these same exposed coasts are small boreal shrubs (*Vaccinium vitis-idaea, Gaultheria hispidula*—foxberry and snowberry) along the inland face and various boreal herbs including the rare or uncommon *Rhodiola rosea*, *Carex viridula* var *saxilittoralis*, *Senecio pseudo-arnica*, and *Sagina nodosa* (roseroot, little green sedge and beach ragwort and knotted pearlwort). The exotic flora is best developed on seashores of unstable boulders or between the sea and the dune grasses on sand beaches. This flora is mixed with native annuals such as sea rocket (*Cakile edentula*) and fowler knotweed (*Polygonum fowleri*) and the exotic annuals (e.g. wild radish, pigweed) appear to predominate where seaweed wrack is extensive.

The saltmarsh flora extends into these seashore communities as outlined. The saltmarsh ecosystem has been much reduced historically, particularly along the early settled Fundy coast where as much as 80% of this habitat may have been lost to dyking. There are three major areas of saltmarsh in the province that can be assigned as the Fundy, Tusket and Petpetswick areas. These marsh areas in sheltered embayments on fine sediment, are colonized by the same two dominants, the low marsh American cordgrass (*Spartina alterniflora*) and high marsh, saltmarsh hay (*Spartina patens*). A suite of saltmarsh grasses, oddities, and forbs occur in the upper marsh but the Tusket marshes additionally contain a group of southern Atlantic Coastal Plain species that are rare on a national level (Mersey Tobeatic Research Institute, 2011). These include two

rare sedges (Beaked Spikerush, *Eleocharis rostellata*; and Olney's Bulrush, *Schoenoplectus americanus*), and two Endangered species, the Saltmarsh False-Foxglove (*Agalinus maritima*) and the Groundseltree (*Baccharis halimifolia*).

The final floral element, the introduced plants and weeds, is distinguished by its lack of any single area of origin or of any particular habitat type. Although "introduced" is often a synonym for exotic, MacDougall (2003) discusses the evidence for northward introductions of plants by indigenous groups during the Holocene. Indeed, some extremely patchy distributions in Nova Scotia (e.g. *Zizia aurea*, golden alexanders; *Allium tricoccum*, wild leek) as well as wide distributions of species with poor reproductive abilities (*Apios americana*, groundnut; *Fraxinus nigra*, black ash) give credence to this process. While the cultural tracks of particular native plants are difficult to follow in regions where they naturally occur, there is a group of plants brought by the Acadians that have naturalized and clearly stand out as exotic in our flora. The occurrence of a group of such plants (e.g. *Daphne mezereum*, daphne; *Inula helenium*, elecampane; *Tanacetum vulgare*, tansy; and *Lysimachia nummularia*, creeping jenny) together in a locality suggests an early Acadian settlement. Introduced or exotic plants, account for at least a third of all plants recorded for Nova Scotia, although as Blaney notes (Hill and Blaney, 2010) this may overemphasize their contribution since many records are of waifs and most of the exotic species are infrequent. Exotics make up a similar proportion of the floras of the provinces and states neighbouring Nova Scotia. In eastern Canada, the overwhelming majority of exotic plants are of Eurasian origin. Historically, the plants of greatest concern were those listed under the Noxious Weed Act of Nova Scotia. This list has changed since 1986 and today it includes nine mainly perennial plants that might pose threat to agriculture, and one poisonous plant, the rare thorn-apple (*Datura stramonium*). The most common arable land, annual weeds are exotics (e.g. *Ambrosia artemisiifolia, Raphanus raphanistrum, Chenopodium album*) as are almost all of the beneficial plants found in both hayland and pastures. The current focus on exotic plants is for the threat they pose as invasive plants that disrupt native ecosystems. In a recent review of the region's exotic and invasive vascular plants, Hill and Blaney (2010) listed four current pests and eleven potential pests. According to the definition of "invasive" set out by these authors, two plants from the current list (*Frangula alnus* and *Pinus sylvestris*) and one plant from the list of potential pests (*Rosa rugosa*) have infiltrated native habitat in sufficient numbers to alter the dynamics of these communities. Despite the remarkable spread of *Frangula alnus* throughout early successional upland forests and swamps, there is as yet no peer reviewed research on any aspect of its biology in this region. There have been distributional studies of the impact of rugosa rose on seashore communities (Hill and Garbary, 2010) and of Scots pine on sand heath communities (Catling and Carbyn, 2005).

The invasive plants considered above as well as several others of concern (e.g. *Phalaris arundinacea, Alliaria petiolata, Rhamnus cathartica,* and *Poa nemoralis*) have expanded in habitats whose successional paths have been greatly modified by anthropogenic disturbances. The footprint of the nearly 800 exotics in this region, largely reflects human activity. The conservation outlook for plant biodiversity in the region is tied to the conservation management of habitat. Over eastern North America, more land is now in forest than any time in the past century, however that forest is relatively young and where forests have grown back from widespread agriculture, a time lag in the regeneration of diversity will be linked to regeneration of forest soils and conditions as well as to the limitations of seed dispersal. In Nova Scotia, such a return from agriculture to forest has occurred in all areas with agricultural soils, however whether these more fertile sites will support forest herb diversity, will depend upon the

protection of these soils from short-rotation forestry. Similarly, forestry policies that affect what are now mature forests, have large potential impacts on a suite of slow-growing orchids (*Goodyera pubsecens, G. oblongata, Platanthera hookeri, P. macrophylla, P. orbicula, Listera convallarioides*). The Wetland Policy has the potential to prevent further losses of various high diversity habitats such as river floodplain, freshwater marshes and saltmarsh. Estimates of habitat losses are only available for the latter, but similar losses might be expected to have occurred in freshwater marsh and floodplain, two of the most naturally fertile, freshwater wetland types. There is wide recognition of the international significance of the Atlantic Coastal Plain wetland habitats in southwestern Nova Scotia yet this flora will require an ongoing commitment to maintaining water quality in these river systems.

Much of the flora can be safeguarded by passive management, habitat acquisition, and ensuring habitat connectivity but there are elements in the flora, in the Atlantic Coastal Plain Flora and the Boreal Flora in particular, that require active management. Not enough is known of the impact of fire on Nova Scotian coastal plain wetlands. Nova Scotia has one of the two largest populations of the globally imperilled, Long's Bulrush (*Scirpus longii*), a New Jersey Pine Barrens plant, that requires fire for flowering. There has been no regeneration of this fire-dependent bulrush from seed in Canada for a century, since the last fire in its Queens County fen at the turn of the 20th Century. Another fire-dependent community occurs on granite barrens along the Atlantic coast. Periodic wild fires have ensured the continuance of *Corema conradii, Lechea, Hudsonia ericoides, Minuartia groenlandica, Carex adusta* and *Pinus banksiana* in barrens near Herring Cove but elsewhere as at the Kingston Sand Barrens, the globally rare, broom crowberry (*Corema conradii*) community is in decline. Fire suppression and housing development have combined to greatly reduce barrens habitat area and its integrity, threatening the rare, eastern Canadian population of *Helianthemum canadense* (Canada frostweed).

Nova Scotia Plants is a record of the plants known to occur in the province. Thousands and thousands of records have been added through the work of amateur and professional botanists alike. There has also been invaluable support for exploration through government programs (Nova Scotia Department of Natural Resources, The Nova Scotia Museum), university research, community group involvement and the work of the Atlantic Canada Conservation Data Centre. As well, systematic plant surveys have been increasingly required for environmental assessment, resource use and land stewardship purposes. This has enabled us to build beyond the general occurrence and distribution for plant species to, in some cases, detailed mapping of rare species, habitats, threats and ecosystem features and functions. Further, experimental studies including genetic analysis are helping us better understand the taxonomy and ecology of the province's flora. This increased knowledge and understanding has helped us address growing threats to plants and their habitats that result from climate change, development, resource use and other anthropogenic activities. As a result of recent tools for protecting plant species and ecosystems including the Nova Scotia Endangered Species Act (1998) and the General Status of Wildlife program, many species of plants are formally protected by law because they are at high risk of extinction in the province. Many others are protected through stewardship efforts at sites where there are serious conservation concerns. Nova Scotia's ambitious Protected Area and Parks System Plan has identified and protected many areas of crown land that support endangered plants and rare plant communities. Expanded private land acquisition efforts by the Nature Conservancy of Canada, the Nova Scotia Nature Trust and others have also resulted in the protection of very significant examples of the province's flora.

Finally, local community-based environmental stewardship groups like the Mersey Tobeatic Research Institute, have helped many private landowners identify, appreciate and care for important plant species and habitats. This new eFlora will be available to almost all Nova Scotians and will continue to support our fascination, appreciation and efforts to ensure that the province's remarkable treasury of plants will be around for future Nova Scotians to study and enjoy.

Our understanding of the plants of Nova Scotia and the floral elements described in this introduction clearly show that through the efforts of many, much has been learned. However, some of the most exciting finds will continue to be made despite the fact that there are fewer and fewer areas that have escaped the botanist's boot.

~ Nicholas M. Hill and J. Sherman Boates

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