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The Canadian Botanical Association Bulletin

Bulletin de l'Association botanique du Canada

March / Mars 2006 Volume 39 No. / N° 1

President's message

Dear CBA/ABC member:

I hope things are going well for each one of you in 2006.

This is the first electronic format of the CBA/ABC Bulletin, a decision that was made by members at the AGM in Edmonton last year. For some of you it may take some time adjusting to this new version, and this is very understandable. If you have any comments on this electronic version please send them to the editor or to any member of the Board. There will be some paper copies produced of the Bulletin and if you wish to receive one, you are asked to indicate that on the CBA/ABC membership renewal/new member form. There is a small fee for paper copy for regular and student members but no charge for retired members.

As you know, our annual meeting this year is at Concordia University in Montreal. There is a separate announcement in this issue of the Bulletin (page 2) regarding information on the program and deadlines by Dr. Daya Dayanandan, Vice-President and Chair of the Local Organizing committee. As always, it will be an exciting event and I shall hope that many of you are able to attend. We will be meeting by ourselves this year and the next time we meet on our own again will be in 2010, as in 2007 and 2009 we meet with Plant Canada and in 2008 with BSA. I would especially like to encourage graduate and undergraduate students to attend. Students can apply for travel subsidy by applying for the **John Macoun Travel Bursary**, check the website at: http://www.abc-cba.ca for information and application procedures.

This is the last issue of the Bulletin under the editorship of Martin Dub**é**. Martin has been the editor for the last 4 years and he has done an excellent job. Please join me in thanking Martin for his hard work and the care with which he produced the best issue of the Bulletin every time. The Association is indebted to him for his dedicated service. Martin has also been working behind the scene on a project relating to the Bulletin and he will be making a presentation on that at the annual meeting in Montreal. I am also pleased to inform you that Christine Maxwell has kindly agreed to take over the job of the editor of the Bulletin starting with the issue after this one. I am sure you will give her your full support.

I look forward to seeing you in Montreal.

Cheers,

Vipen Sawhney, CBA/ABC President

Canadian Botanical Association

Bulletin
The CBA Bulletin is published three times a year (in March, September, and December) and made available to CBA members and to subscribers.

Information for submitting texts
All members are welcome to submit texts in the form of papers, reviews, comments, essays, requests, or anything related to botany or botanists. Any medium is acceptable for submission but electronic documents are likely to speed up the publication. For detailed directives on text submission please feel free to contact the Editor (see below). For general info on CBA, go to the web site:
http://www.cba-abc.ca

Association botanique du Canada

Bulletin
Le Bulletin de l'ABC paraît trois fois par année, en mars, septembre et décembre. Il est rendu disponible aux membres de l'ABC ainsi qu'aux abonnés.

Soumission de textes
Tous les membres de l'Association sont invités à envoyer des textes de toute nature concernant la botanique et les botanistes (articles, revues de publication, commentaires, requêtes, essais, etc.). Tous les supports de texte sont acceptés. L'utilisation de documents électroniques peut accélérer la publication. Pour des renseignements détaillés sur la soumission de textes, n'hésitez pas à contacter le rédacteur (voir ci-dessous). Infos générales sur l'ABC à l'url suivant: http://www.cba-abc.ca

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Next issue / Prochain numéro

Texts for the next issue, **39**(**2**), must be received before **August 15th**, 2006.

La date de tombée des textes du prochain numéro, le n° **39**(**2**), est le **15 août** 2006.

Published in Edmundston, on March 28th, 2006.
Publié à Edmundston, le 28 mars 2006.

ISSN 0008-3046 (paper/version papier)
ISSN 1718-8164 (electronic/version électronique)

42nd Annual Meeting of the CBA/ABC, 26-29 June 2006, Montreal.

We are pleased to welcome you to Montreal for the 42nd annual meeting of the CBA/ABC from 26-29 June 2006. The program will be diverse with symposia, oral and poster presentations, and several social events including field trips, wine and cheese mixers, barbecue, the popular auction by our entertaining Auctioneer **Hugues Massicotte**, and the banquet. These events will provide ample opportunity for our members to exchange ideas and forge research collaborations towards the advancement of many aspects of plant sciences. Please note the **abstract submission deadline : April 15th 2006**.

The venue of the meeting, **Sir George Williams Campus of Concordia University** in the heart of downtown Montreal, is located within easy access to a wide range of botanical and cultural attractions. Moreover, the timing of the meeting coincides with many festivals in Montreal, notably the world-famous Jazz Festival. We have posted information about many attractions on the conference web site so that our delegates may take advantage of these opportunities during their visit to Montreal. As a cosmopolitan city, Montreal has a wide range of accommodations, and many hotels are located within a walking distance to Concordia University. However, the month of June is high tourist season. Therefore, **we strongly urge you to reserve accommodations well in advance to avoid difficulties in finding accommodations within a reasonable budget**. Special group room rates are available for the CBA2006 conference participants (Reservation deadline: April 21st 2006) from the Maritime Plaza Hotel. For more information, visit the Accommodations web page.

Registration fee includes admission to all sessions, the wine & cheese mixer with cash bar on June 26th, the barbecue on June 28th, the banquet on June 29th, and refreshments during coffee breaks. **Regular member**: before April 15th 2006: $225; after April 15th 2006: $250; after May 15th, 2006: $275. **Student member**: before April 15th 2006: $125; after April 15th 2006: $150; after May15th 2006: $175. Additional barbecue tickets for accompanying persons: $15; additional banquet tickets for accompanying persons: $50. T-shirts with the CBA/ABC conference logo: $15.

Please submit applications for **John Macoun Travel Bursary** to:
Dr. Vipen K.Sawhney, President, CBA/ABC, Department of Biology, University of Saskatchewan, 112 Science Place, Saskatoon, SK, Canada S7N 5E2 E-mail: sawhney@admin.usask.ca; Fax: (306) 966-4461.

Please visit the conference web site, **http://csfg.concordia.ca/cba2006/CBA2006.htm** frequently, as we will be updating information on a regular basis. If you would like to communicate with colleagues for organizing informal gatherings or just share information, please let us know and we will gladly post it on the 'Announcements' page of the conference web site. We can be reached at cba2006@gene.concordia.ca or (514)-848-2424 Ext. 3414.

With Best Wishes!

S. Daya Dayanandan, Vice President CBA/ABC

The CBA Board of Direction / Le bureau de direction de l'ABC

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Poorly Known Economic Plants of Canada - 48. Canada yew (*Taxus canadensis* Marsh.)

E. Small and P. M. Catling

National Environmental Program, Biodiversity Section, Agriculture and Agri-Food Canada, Saunders Bldg Central Experimental Farm, Ottawa ON K1A 0C6

You never know which of the thousands of native Canadian plants may suddenly become important for the health and economy of society. Canada yew (*Taxus canadensis*) is a good example. During the last several years a new industry has focussed on this wild plant of eastern Canada. It contains chemicals used to produce drugs for treatment of cancer, the second most frequent cause of death in industrialized countries. Formerly, these drugs were obtained only from Pacific yew (*T. brevifolia*) and some Old World yews, but now Canada yew has become an important source. Although mostly collected from the wild, cultivation is expanding, and several major Canadian companies are now involved in crop management, harvesting, extracting and manufacturing.

Latin Name

Carolus Linnaeus adopted the name *Taxus* for the yew genus without indicating why he had done so (although referring to earlier European literature that had employed the name). Most commonly the genus name is attributed to the early Latin name for yews used by the classical Romans (derived in turn from the Greek *taxos*, yew tree). The Latin name has also occasionally been interpreted to mean bow (tracing to the Greek *toxon*, a bow, and based on the widespread usage of yew wood to make bows). Rarely, *Taxus* has also been interpreted as based on the Greek *toxicon*, poison, reflecting the poisonous nature of the species. *Taxus canadensis* translates as yew of Canada.



Fig. 1. Rose-breasted grosbeaks on Canada yew (in fruit). From Audubon, J.G. 1840-1844. The birds of America, Royal Octavo Edition. J.J. Audubon and J.B. Chevalier, New York, NY. Plate 205

English Names

American yew, Canada yew, Canadian yew, dwarf yew, eastern yew, ground hemlock (so named because the species grows close to the ground and its needles are reminiscent of the foliage of eastern hemlock, *Tsuga canadensis* (L.) Carr.), ground spruce. The English word yew has been claimed to be derived from Celtic *iw*, signifying verdure, and alluding to the yew being an evergreen (a simpler interpretation is that yew comes from the Old English *iw*, also meaning yew, or occasionally bow).

French Names

If du Canada, sapin traînard,buis de sapin, buis (the name buis refers to *Buxus sempervirens* L., the common box, widely used as a low hedge, and so the low stature of Canada yew gave rise to the Canadian French name buis de sapin, “box-fir”).

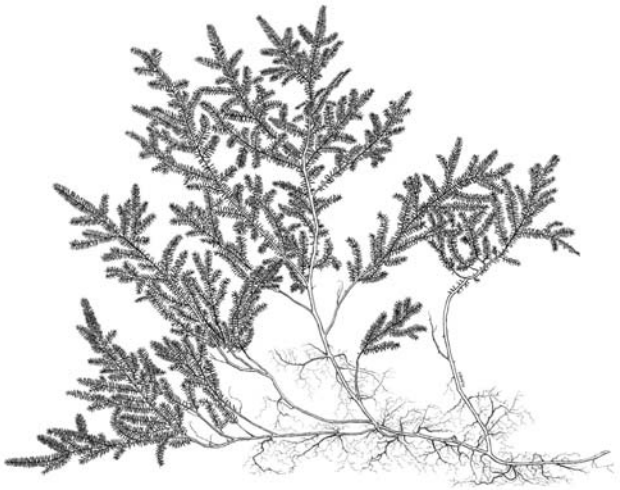


Fig. 2. Portion of a clone of Canada yew (vegetative), excavated to show spreading root system. Drawn by Barry Flahey from a plant collected at Ottawa.

Morphology

Canada yew is a straggling, evergreen, coniferous shrub. The plant usually grows 30–90 cm in height, occasionally up to 2 m, and is rarely arborescent. The leaves are 1–2.5 cm long, 1–3 mm wide, flat, linear, 2-ranked, rigid, and have a short, abrupt point at the tip. The species propagates mainly vegetatively, by new shoots that arise from spreading, arching branches that take root (a process known as layering), thus establishing large clones. The shoots tend to be procumbent, gradually becoming erect at the tips. The bark is thin, brown or reddish, and scaly. *Taxus canadensis* is the only principally monoecious species of its genus, the plants bearing both male and female flowers (there is

considerable variation in the relative proportion of male and female flowers on plants in different populations). Conventionally, the reproductive infructescences of conifers are called cones, but since the female flowering axis of Canada yew only bears a single ovule, it is rather more similar to a berry than to a cone. The flowering axes begin developing during the summer in the axils of the leaves, and overwinter as buds. In the spring, the ovules are fertilized by wind-dispersed pollen. The plant is self-fertile. Mature female fruits develop by the fall, and have just a single, stony, somewhat flattened seed (4–5 mm long) surrounded by a red, fleshy, cup-like aril.

Canada yew is easily distinguished from most eastern Canadian evergreens. Pines (*Pinus* spp.) have leaves in sheathed fascicles of 2–5. Spruce (*Picea* spp.) leaves are more or less square in cross-section. Cedar (*Thuja occidentalis* L.) differs in its short scale-like leaves and the leaves of junipers (*Juniperus*) are either scale-like or needle-pointed. Eastern hemlock (*Tsuga canadensis*) and balsam fir (*Abies balsamea* (L.) Mill.) leaves are more similar to Canada yew than the others, but the leaves of both are whitened on the lower surface instead of pale or yellowish-green and they are also blunt instead of having a short abrupt point.

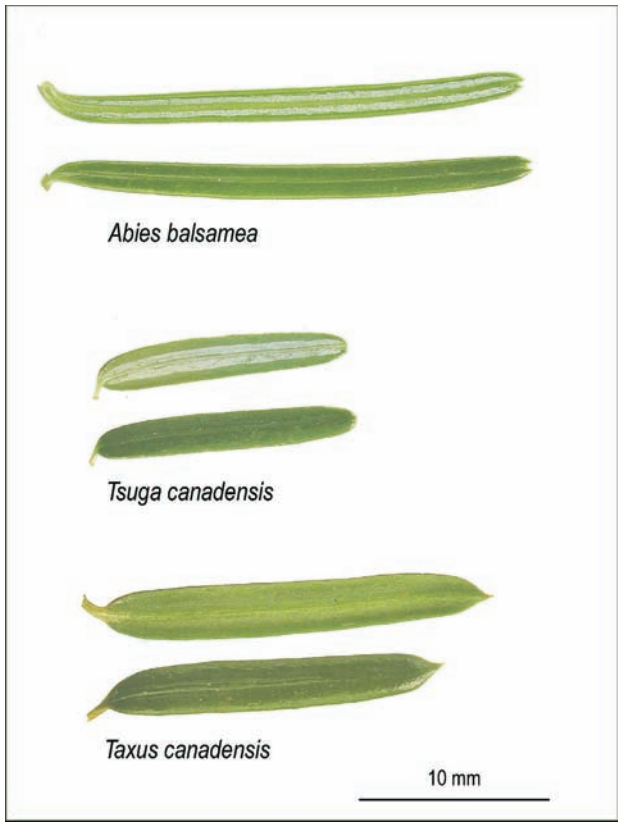


Fig. 3. Leaves of Canada yew and the rather similar leaves of balsam fir and eastern hemlock.

Classification and Geography

The classification of *Taxus* is unsettled, although most authorities accept 6–10 species. In the early 20th century, R. Pilger (see references in Cope 1998) placed all species of *Taxus* in one species. By contrast, Spjut (Website cited below, last modified 2003) has proposed that there are 24 species. Most authorities recognize *T. canadensis* as a species indigenous to eastern North America, but Spjut also includes plants of Europe, northern Africa, and Asia in his much broader concept of *T. canadensis*. Many of the European plants that Spjut includes in *T. canadensis* are arborescent. Spjut recognizes three varieties of *T. canadensis*, each of which occurs both in North America and the Old World. Spjut's classification is not followed by Hils (1993) in his recent analysis of North America *Taxus* species. Species rank for the three closely related taxa, *T. baccata*, *T. canadensis* and *T. cuspidata*, has been recently supported by molecular studies. The following key is based largely on the work of Hils (1993) and Cope (1998).

Key to the species of *Taxus* in the United States and Canada

1a. Trees (cultivated); bud scales either deciduous or not keeled; leaves often gradually pointed.....2
1b. Trees or shrubs (wild and cultivated); bud scales persistent and keeled, leaves often abruptly pointed.....3

2a. Bud scales deciduous; arils 4-7 mm long .....*T. chinensis*
2b. Bud scales persistent; arils more than 7 mm long .....*T. baccata*

3a. Shrubs to 2 m tall, sprawling and without a central stem; usually both male and female flowers on the same plant; arils globose or subglobose, 6-8 mm in diameter; undersurface of leaf mostly without papillae along the stomatal band .....*T. canadensis*
3b. Trees to 15 or even 25 m tall, erect and with a central stem; male and female flowers on different plants; arils ovoid or ellipsoid, usually ca. 13 mm in diameter; undersurface of the leaf with papillae along the stomatal band.....4

4a. Leaves widely spaced along the branches ....*T. Floridana* (also keys out below)
4b. Leaves not widely spaced on the branches.....5

5a. Leaves disposed at various angles on the branchlet but not clearly two-ranked nor forming a V-trough on the upper side of the branchlet .....*T. cuspidata*, *T.* × *hunnewelliana*, *T.* × *media*
5b. Leaves two-ranked and forming a V-trough on the upper side of the branchlet.....6

6a. Leaves dark green below; epidermal cells of leaf isodiametric in cross-section .....*T. floridana*
6b. Leaves yellow-green below; epidermal cells elliptical in cross-section.....*T. brevifolia*

Taxus baccata L., ENGLISH YEW
Trees to 25 m tall native to Europe, north Africa and western Asia, widely cultivated and with many varieties.

Taxus brevifolia Nuttall, PACIFIC YEW
Trees to 25 m tall, native to western North America from British Columbia and Montana south to California, rarely cultivated outside of botanical gardens.

Taxus canadensis Marsh., CANADA YEW
Straggling shrubs to 2 m tall, native to North America from Newfoundland south to Virginia and west to Iowa (Fig. 4). Taxus canadensis is found in cool forests of the northeastern United States and southeastern Canada. It occurs from Newfoundland to Manitoba, extending south to western Virginia, eastern Kentucky and northeastern Iowa, tending to occupy upland regions (up to 1,500 m in altitude) of its southernmost range.

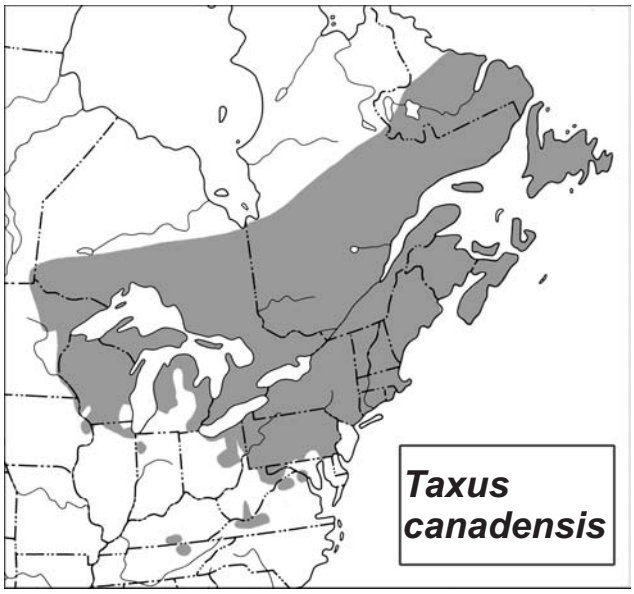


*Fig. 4. Distribution of Canada yew (*Taxus canadensis*).*

Taxus chinensis (Pilger) Rehder, CHINESE YEW
Trees to 15 m tall native to China and Taiwan, rarely cultivated in North America.

Taxus floridana Nuttall, FLORIDA YEW
Trees to 8 m tall endemic to the ravines of the Apalachicola River bluffs in northwestern Florida (where the related tree, Florida torreya, *Torreya taxifolia* Arnott, is also endemic and endangered). Florida yew is very rarely found in cultivation.

Taxus cuspidata Siebold & Zucc., JAPANESE YEW
Trees to 20 m tall, native to Japan, Korea and northeastern China and commonly cultivated in North America.

Taxus × *hunnewelliana* Rehder (*T. canadensis* × *cuspidata*), HUNNEWELL YEW
A hybrid which originated about 1900 in the Hunnewell Estate in Wellesley, Massachusetts, occasionally cultivated in North America.

Taxus × *media* Rehder (*T. baccata* × *cuspidata*), INTERMEDIATE YEW
A hybrid which originated about 1900 in the Hunnewell Estate in Wellesley, Massachusetts, now the most widely cultivated yew in North America.

Ecology

Canada yew is native to rich, upland, wooded areas, but is also found in bogs, swamps, gorges, and on rocky banks and ravine slopes. The plant is usually in moist, well-drained, calcareous soils, typically with a pH range of 5.0–7.0. It is found in the understory of deciduous, mixed, and boreal forests, and is generally characteristic of climax forests, or at least of woodlands in mature successional stages. Although naturally found in shade, where it appears to have an ecological advantage, it has been demonstrated that in cultivation Canada yew grows well in full sun.

Although it spreads mainly vegetatively, spread over longer distances occurs through seed dispersal. The seeds are thought to be distributed by small mammals and birds. Birds including starlings, bluejays, robins, cedar waxwings and rose-breasted grosbeaks (Fig. 1) are reported to eat the fruit. Among the mammals that feed on the foliage and the "berries" are various species of mice, squirrels, moose and, particularly, white-tailed deer. The extirpation of Canada yew from much of its former range in the US and from parts of Canada may have some important implications for biodiversity protection. Small mammal diversity in hardwood stands with a Canada yew understory is greater than in those without. Although animals are important for seed dispersal, they are apparently not required for pollination, since the pollen is wind-dispersed.

The low, spreading habit of Canada yew has been postulated to be adaptive to the browsing of white-tailed deer (*Odocoileus virginianus*). Since much of the branch system is below snow level in the winter, the plant escapes notice of the deer. Another theory holds that the spreading habit enables the plant to capture light that shines through gaps in the forest canopy. With an evergreen habit, the plant is able to take advantage of periods of high sunlight in deciduous forests during the spring and fall.

Medicinal uses

In the last decade, western yew (*Taxus brevifolia*) became the major source of the alkaloid paclitaxel (often called taxol, the basis of Taxol®, a registered trademark name of Bristol-Myers Squibb Company for a drug formulated with paclitaxel), an effective anti-tumour agent [see Small, E., and Catling, P.M. 1995. Poorly known economic plants of Canada - 7. Pacific yew, *Taxus brevifolia* Nutt. Bull. Can. Bot. Assoc. **28**: 62-63; also Small and Catling (1999), and Patel (1998) for details on history of discovery and synthesis]. More recently, several Old World species of *Taxus* have also been employed, and Canada yew has also become an important source. Although partially synthesized forms of paclitaxel have been developed, wild yew species are still considered to be the primary sources for raw materials, although collecting from nature has threatened several wild species. Sustainable collecting from nature and cultivating wild yews is increasingly being practised.

Paclitaxel is a chemotherapeutic agent used extensively to treat aggressive forms of ovarian, lung and breast cancer, as well as AIDS related Kaposi's sarcoma. Its anti-cancer activity was discovered in Pacific yew in the 1960s during a large-scale plant-screening program sponsored by the United States National Cancer Institute. Paclitaxel has become one of the major chemotherapy agents in cancer treatment. It works by inhibiting a cell's ability to break down the mitotic spindle during mitosis, thus blocking a cancer cell's ability to grow. (Technically, as taxanes attach to the

microtubule protein subunits, depolymerization and disassociation of the microtubules is prevented, cell division ceases, and the cell dies.) Because of its toxicity and side effects, patients require careful monitoring. Taxol treatment is expensive, the drug costing between $10,000.00 and $100,000.00 for each patient, depending on number of treatment cycles (one to ten). Paclitaxel is one of over a hundred taxanes known in *Taxus* species. Taxanes have also been employed, at least experimentally, in the treatment of Alzheimers, multiple sclerosis, polycystic kidney disease, psoriasis, rheumatoid arthritis, fungal and viral diseases, and for other medical applications. Paclitaxel is the most important of the taxanes, and often other taxanes are extracted and converted to paclitaxel for commercial purposes.



Fig. 5. Equipment for monitoring levels of paclitaxel extracted from Canada yew. Photo courtesy of Chatham Biotec Ltd., Riverview, N.B.

Despite its toxicity, Canada yew has been employed medicinally by several North American Indian tribes. Ailments treated with leaf concoctions include rheumatism, influenza, and arthritis, all uses curiously parallelled in modern medicinal applications, as noted above.

Pharmaceutical firms are currently working on the production of a range of anti-cancer paclitaxel analogues based on transforming taxanes from *Taxus* species. The best known of such products produced to date is Taxotere® (generic name docetaxel, produced by Rhone Poulenc Rorer Inc.), used particularly to treat certain forms of breast cancer, lung cancer, and prostate cancer.

Toxicity

The foliage and seeds of Canada yew are poisonous to humans. Nevertheless, the Iroquois fermented Canada yew fruits and leaves into a sort of beer, and the Micmac Indians employed the twigs to make a beverage. The aril is generally accepted to be edible. It is sweet and gel-like, but represents an acquired taste, considered delicious by some and objectionable by others. Because of the danger that the seed could be swallowed, it is not recommended that the aril be consumed.

Deer and moose utilize the Canada yew plant as winter forage (curious, since livestock may be fatally poisoned). Birds, chipmunks, squirrels, and mice consume the seeds (and attached aril). Nevertheless, all yew species are considered to be toxic to animals, those animals apparently not being poisoned simply having a relatively greater resistance to the toxins. Taxine, present in several yew species, inhibits sodium and calcium currents, blocking myocardial conduction, and so acting as a cardio-depressant and killing by producing cardiac arrhythmia.

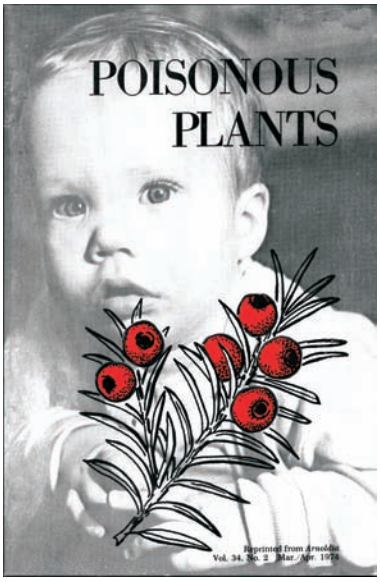


Fig. 6. Cover for Arnoldia*, the magazine of the Arnold Arboretum (Mar./Apr. 1974), vol. 34, no. 2, illustrating the reputation of Canada yew as a poisonous plant. Courtesy of the Arnold Arboretum of Harvard University.*

Non-medicinal Uses

Although employed much less than several of the ornamental yews (especially English yew, *T. baccata*, and Japanese yew, *T. cuspidata*), Canada yew is occasionally used in landscaping. Hybrids with other species are used in horticulture. Canada yew is considered excellent for roadside use in cool climates, although it is not much employed for this purpose.

Agricultural and Commercial Aspects

In the US, the Food and Drug Administration recently enacted regulations requiring that wild material converted into drugs must originate from a program that is "sustainable". *Taxus* species are slow-growing, and while relatively common the plants are sporadically distributed and so susceptible to over-harvest. Although Canada yew is widespread in eastern Canada, it is not abundant everywhere. In Prince Edward Island, where estimated annual sustainable harvest is 630,000 kg, it is found in only 3% of the woodlots and then mostly in hardwoods. The exclusive use of the wild populations throughout Canada is not likely to result in a viable, long-term industry. Some clones high in paclitaxel have been selected and are being cultivated in Canada. Additional breeding of desirable clones could represent a means of meeting the ever-increasing demand for paclitaxel and removing pressure on natural populations.

Harvesting guidelines for wild populations, developed jointly by NR Can, Canadian Forest Service (Fredericton) and PEI Department of Agriculture and Forestry, are available at: http://www.chathambiotec.com/pdf%20files/sustainable/CFS-Harvesting%20Guidelines%202002.pdf. Typically, a maximum of one out of three branch tips are clipped from

shrubs at least 50 cm tall. In Quebec, harvesters have been observed to collect 6–8 kg/hour, valued at $2.25/kg. In parts of eastern Canada private woodlot owners have formed Cooperative marketing groups. In Gaspé, Quebec, all marketing is carried out through the Syndicat des Producteurs de bois de la Gaspésie.



Fig. 7. Establishing a plantation of Canada yew. Photo courtesy of Chatham Biotec Ltd., Riverview, N.B.

Research at the University of Guelph has shown that if taxane yield was greater in plantations, then growing yew as a crop could be quite profitable. The Canadian Forest Service in Fredericton, New Brunswick, has accumulated much information on the possibilities for nursery cropping and considers this a major economic opportunity for utilization of non-timber forest products in Atlantic Canada.



Fig. 8. Cuttings of Canada yew selected for high production of paclitaxel. Photo courtesy of Chatham Biotec Ltd., Riverview, N.B.

Several Canadian companies have been established to harvest Canada yew, or engage in some part of the associated extraction and manufacturing industries. Bioxel Pharm centred in Ste. Foy, Quebec has an exclusive arrangement with the Quebec Ministry of Natural Resources for the rights to harvest yew on 48,000 km of Crown land as well as about 100,000 km^2 of privately owned property. This area is thought to be one of the largest sources of *Taxus* biomass worldwide. Chatham Biotec Ltd. of Riverview, N.B. has an exclusive arrangement with the government of New Brunswick to all of the Canada yew on the province's crown land (ca. 36,000 km2). Atlantis BioActives Corp. of Charlottetown, P.E.I. engages in harvesting of Canada yew and extraction of crude taxanes. Large companies in the US are also involved in collection of biomass, extraction, and preparation of medical products, based on Canada yew, and throughout the world the same activities are conducted based on other species.

Cultivars and Germplasm

There are several ornamental varieties of Canada yew, but distinguishing them is often problematical. 'Pyramidalis' is a dwarf, narrow, upright form that appears bronzed during the winter (this may be the same as the cultivars 'Dwarf Hedge' and 'Stricta' (also known as *T. canadensis* f. *stricta*)). 'Adpressa' and 'Adpressa Aurea' (with yellowish foliage) are probably also cultivars of *T. canadensis*. A cultivar with conical shape and variegated yellow foliage, called 'Aurea', is generally accepted as belonging to *T. canadensis*. 'Fastigiata' and 'Compacta' are additional cultivars. Several horticultural cultivars of *Taxus* are thought to be hybrids, and sometimes their parentage is uncertain. Horticultural varieties of various species are used as sources of paclitaxel. As noted above, selections of *T. canadensis* high in paclitaxel are currently cultivated in Canada.

Canada yew is intolerant of certain kinds of disturbance, particularly clearcutting, and has been extirpated from much of its ancestral rang in the United States as a result of logging, clearing of land for agriculture and urban development and, especially, increased browsing by growing populations of white-tailed deer. The decline of Canada yew in parts of the northeast is a particular concern because genetic diversity is already lower and population differentiation higher than for other conifers and tree species in the boreal-temperate zone.

Prospects

Several species of *Taxus* are currently used as sources of paclitaxel, collected both from wild and cultivated plants, and this is the case in North America, Asia, and Europe. Although paclitaxel has been synthesized from raw starting materials, synthesis is not considered practical. The use of fungi and other species to produce paclitaxel has also not yet proven to be commercially worthwhile. Semi-synthetic procedures, using taxanes from various species of *Taxus*, are currently employed. Selection and breeding of superior-yielding cultivars, and management techniques to increase productivity, are in their infancy. *Taxus canadensis* is the subject of breeding and management studies in Canada, and these studies represent a worthwhile investment, since very large amounts of biomass are currently required to produce paclitaxel, and the demand seems destined to exceed the supply available in the foreseeable future. The demand is growing in various parts of Canada. Cancer is the second most frequent cause of death in industrialized countries, and improved treatments are urgently needed. It has been estimated that in the future over a quarter million people could be treated yearly with paclitaxel. The drug already has a commercial value of several billion dollars annually.

Myths, Legends, Tales, Folklore, and Interesting Facts

- Sex expression in Canada yew is influenced to a considerable extent by environmental factors. Generally, female inflorescences outnumber male inflorescences in a population. However, large plants tend to develop more male inflorescences (although some small plants produce only male flowers). Browsing increases the proportion of exclusively male plants in a population.

- Paclitaxel, the chief anti-cancer alkaloid of *Taxus* species, has recently been found to occur in quite unrelated species. These include several hazelnut (*Corylus*) species and a number of fungi (very curiously, and possibly an example of natural genetic exchange between higher plants and fungi, several of the fungal species are natural associates of the inner bark of *Taxus* species). None of these alternative sources has yet proven capable of replacing *Taxus* species as a commercial source of paclitaxel.

- A “stent” is a small, lattice-shaped, metal tube that is inserted permanently into an artery, to hold it open so that blood can flow through it. Drug-eluting stents contain drugs that reduce the chance that the artery will become blocked again, and paclitaxel is employed in some stents of this nature (Boston Scientific Corporation trademarked the name Taxus for its paclitaxel stent).

- In 1995 Himalayan yew (*Taxus wallichiana*) was listed in Appendix II of the Convention on the International Trade in Endangered Species (CITES) due to excessive harvest of wild populations (http://www.wwf.org.uk/filelibrary/pdf/twallichiana.pdf). Indeed, the species has experienced a 90% decline in recent times and is critically endangered in some regions of Asia. Unfortunately enforcement of conservation measures of the rare Asian yew species is often impossible because of difficulties in identifying them. A review of taxonomy and status of trade involving all the species of *Taxus* has been recommended.

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Acknowledgments

W.J. Cody (review), B. Brookes (artwork).



Fig. 9. Prostrate shoots of Canada yew. Photo courtesy of Atlantis BioActives Corporation, Charlottetown, P.E.I.

Hurricanes and Long Term Research in Wetlands: A Note from Louisiana.

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An offer of employment from Louisiana is a rare event in anyone's life. The offer of an endowed chair and a full time assistant is even rarer. The potential adventure seemed too good to decline. On the professional side, as a professor of biology experienced in the northern temperate zone, I expected the biota of the Gulf coast would challenge some of my preconceptions about how plant communities and wetlands really work. On the personal side, coming from a rather strict British up-bringing, I anticipated that the Louisianans might be able to teach me how to have a good time. "Laissez les bon temps rouler" is, after all, the local motto.

I also thought an endowed chair would allow me to complete some long overdue writing projects. A text book on wetlands, *Wetland Ecology*. A second edition of *Competition*. A multi-authored book *The World's Largest Wetlands* (which I hope to see reviewed in the CBA Bulletin soon). And a new plant ecology text book, *Plants and Vegetation*, due out with Cambridge in 2006. America in 2005 is not a culture that particularly appreciates books or writers, but so long as I can convince my Dean and Provost that some people really do still read books, and that synthesis is important in science, I hope to keep employed.

So Cathy retired from consulting, and we started life anew in the subtopics. It has been a remarkable adventure – even before the hurricanes. We encountered a rich jambalaya (that is, stew, for Canadian readers) containing alligators, snakes, egrets, oppressive heat, torrential rain, unlimited guns, free-flowing alcohol, enormous pick-up trucks, superb cooking, refined culture, beautiful art -- all spiced with a fragrant mixture of extreme kindness, extravagant gossip, and in your face aggression. At least one Canadian friend, who understood my love hate relationship with the United States, predicted that I would not survive here a year. He was wrong. Of course, I do find that it helps to live off in the woods on a dead own road, own a Walther P-38 and a pump action 12 gauge shotgun, practice Buddhist meditation, and recall frequently that I have a house waiting back in Canada should I need it.

But I digress. I mean to write about wetlands and hurricanes, as the title indicated.

The personal side

We live on the edge of a vast wetland that stretches to the northwest of New Orleans (ca 150,000 ha), four miles (that's about ten kilometers, in real distance units) from Lake Pontchartrain, which is a fresh water bay in the Gulf of Mexico. The dominant trees are bald cypress (*Taxodium distichum*) and tupelo (*Nyssa aquatica*). Plants that were relatively uncommon in my Canadian experience – *Peltandra virginica* and *Saururus cernuus* – grow in profusion. They are mixed, however, with species that are common in Canadian wetlands, such as *Cephalanthus occidentalis* and *Pontederia cordata*. Yearly flooding by the Mississippi River was once the dominant factor controlling vegetation patterns, but this processes has been greatly impaired by the construction of artificial levees for flood control. Humans also removed most of the cypress trees in an orgy of logging between 1900 and 1950. Some of the profits from this destruction found their way into the Schlieder Foundation, and now contribute to my salary (well, at least in principle, the income from that endowment being tied to the stock market. This really is the first time in my life that my salary is influenced by the stock market, a clear distinction from the usual circumstances of a Canadian professor.)

Since we were going to live in Louisiana, we decided that we should live in a swamp. Eventually we found 40 acres for sale near the end of a road that dead ends at a boat launch in the Tangipahoa River which empties into Lake Pontchartrain. Hence, we knew to be prepared for the occasional flood. Our house is elevated on pilings, a large propane tank provides for emergencies, and our artesian well flows without electricity. The living room looks out into tupelo swamp. When hurricane Katrina appeared off-shore, we resolved to ride it out. Other storms had passed by with only flooding. The Saturday before Katrina, the day was bright and sunny with a slight breeze – the calm before the storm really exists. To be extra cautious, we put all our valuables in the highest cupboards, reviewed our stock of canned food, and tied our outside belongings (e.g., wheelbarrow, trash can) to trees to ensure they would not float away, nor become projectiles hurled through the windows. As the day passed, a steady breeze stiffened, and an ominous band of dark clouds obscured the southern sky.

Sunday morning the wind had strengthened. I turned to the weather channel on television, learning that overnight Katrina had surged to a category five hurricane, that the eye was projected to pass directly over our house, that winds were expected to exceed 150 miles per hour, and that the storm surge was predicted to be some 20 feet deep. Then the satellite system went blank, leaving a test pattern (a dolphin frolicking in the ocean) which seemed not a good omen. Change of plans.

The nearest town is Ponchatoula, an old railway town that grew up where the railway from New Orleans first hit high ground. Hundred year old buildings that had survived many other storms seemed like a good place to take shelter. In any case, the main roads north were already blocked with cavalcades of evacuees from New Orleans. Fortunately our Irish friends in town owned an old house that had survived countless hurricanes, and had the further advantages of a generous disposition, skillfully used barbeque, swimming pool, and well stocked liquor cabinet. We arrived with our Prius stacked to the roof with essentials (canned food, clothes, liquor, soon-to-thaw frozen meat, passports), not knowing how long it might be until we could return. Even minor tropical storms cover the road to our home with waist deep water churning with tree frogs, amphiumas, cottonmouths, bowfins, and alligators (in increasing order of size).

To leap ahead, we survived, and, three months later, we are back in our house (well, sleeping on the floor in the end that the fallen trees didn't crush), and are still enjoying the simple pleasures of running water and electricity. Part of this article was written on a lap top connected to a marine battery and solar panel, in sweat-sodden clothes, and a diet of MREs. The article

was refined in my home office with a working ceiling fan, a gin and tonic (with fresh lime from the garden), and workmen hammering away at the repairs. We may be back to normal by Christmas. Meanwhile, hardly a tree over ten inches dbh remains standing around my house, our neighbors are well-armed against looters, the National Guard has taken over sections of campus, vast areas of New Orleans are still without light and power, and we are being warned of multiple budget cut backs as the state and cities drift towards bankruptcy.

Well, we did come down for the adventure. But as I tell my students in class here, I still own my house and 700 acres just outside of Ottawa, so when the sea rises more, I can return home to somewhere above sea level. Those who intend to stay here, on the other hand, will have to decide whether they are serious about protecting the state's wetlands. And that is a topic I could lecture on at length. But won't.

The scientific side

When we arrived, my scholarly priority was to tackle some problems that I had been unable to carry out in Canada. I wanted to set up two large long term experiments that expanded themes of my earlier work. The first objective was to measure both main effects and factorial interactions among different types of stress and disturbance in coastal wetlands. The second objective was to study the effects of asymmetric competition on the zonation of a dozen different wetland plants. I will return to the former in a moment.

I have, tangentially, started a few other projects. One of the more controversial has been the possible role of alligators in protecting wetlands. Just as wolves eat the deer that consume trees and herbaceous plants in deciduous forests, alligators eat the (introduced) nutria that consume wetland plants. The state consequently pays hunters to kill nutria ($4.00 each) but so far cannot accept that alligator might do the same – free. Part of the problem is that big alligators eat the most nutria, and big alligators are also preferentially hunted, and preferentially feared. (The 'gator that lives in our back yard is only a seven footer, but he follows Cathy in her walks along the bayou as if anticipating a future meal.) In another project, I suggest four vast (ca 600,000 ha) wilderness areas along the Gulf Coast where flooding and fire would be allowed to recreate natural ecological communities. The fact that neither of these is yet published says something about the reception so far. Even in the land of the free, there is remarkable pressure to conform in act and thought.

Back to the first of those experiments. We set out to manipulate most of the key factors that control coastal marshes. The experiment is the area of several football fields, reached by a half kilometer boardwalk, itself a half hour boat trip from the nearest road. Americans don't do things on a small scale. The dominant plants here are *Schoenoplectus americanus*, *Polygonum punctatum* and *Sagittaria lancifolia* (Figure 1). Since many readers are botanists, Table 1 gives more details. We have three herbivore exclosures (each 40 x 60 m), paired with three control areas (Figure 2). Within these were nested sub-plots having different disturbance regimes (fire, single herbicide, multiple herbicide) and different fertility regimes (fertilizer, sediment, fertilizer and sediment). Treatments manipulating water levels or alligator density remained beyond our experimental capacity. We planned at least a ten-year duration, since many of the biological interactions might be expected to take at least that long to resolve.

Post Katrina and Rita, our boardwalks have been smashed, upturned, draped over the fences meant to exclude nutria, or simply carried away (Figures 3,4). We cannot reach the plots without wading though an eight foot deep channel and picking our way through trees and other debris (Figure 5). The nutria gaily scamper though holes in the fences or use debris as walk-ways. A refrigerator even drifted into one of the plots (Figure 6). I look forward to explaining how the refrigerator caused an outlier in some future manuscript.

Although our scholarly problems are minor compared with those who died or lost their homes, research has to continue. We are now trying to decide whether any of Turtle Cove Experimental Marsh can be resurrected, and what we can legitimately conclude from the half million dollars so far invested in that research. All of which may illustrate why short-term, single-species experiments in flower pots have advantages at least when you live in hurricane country. Perhaps it is time to move back north, buy a growth chamber, and grow *Arabidopsis thaliana*.



Table 1: **VEGETATION TYPE**

	Polygonum	Shrubs	*Eleocharis*	*Schoenoplectus*
Annuals				
Amaranthus australis (Gray) Sauer	1	34	1	1
Aster subulatus Michx.	33	32	12	3
Echinochloa crusgalli (L.) Beauv.	3	21	9	1
Polygonum punctatum Ell.	31	0	15	23
Perennials				
Alternanthera philoxeroides (Mart.) Griseb.	1	16	0	0
Eleocharis cellulosa Torr.	1	1	28	1
Lythrum lineare L.	3	2	9	3
Sagittaria lancifolia L.	13	19	0	1
Schoenoplectus americanus Pers.	0	0	0	58
Schoenoplectus robustus Pursh	5	5	7	0
Vines				
Ipomoea sagittata Poir.	8	7	6	6
Vigna luteola (Jacq.) Benth.	13	5	4	6
Parasites				
Baccharis halimifolia L.	1	11	0	0
Iva frutescens L.	4	16	0	1



Figure 1. An ancient cypress snag surrounded by oligohaline marsh containing Schoenoplectus americanus, Polygonum punctatum *and* Sagittaria lancifolia. *Less than a hundred years ago, this area was forest.*

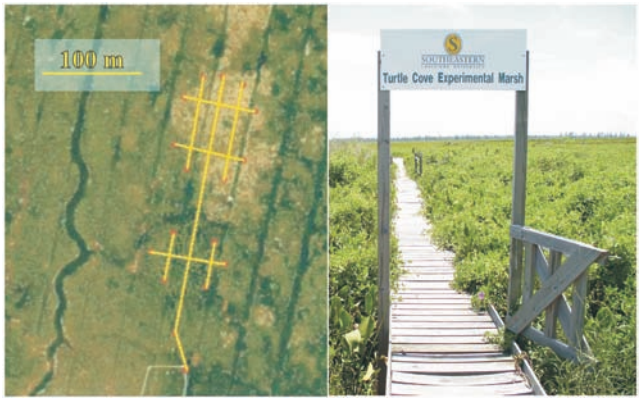


Figure 2. Turtle Cove Experimental Marsh is reached by a 20 minute boat trip and then a half mile of boardwalk. The top view shows that the treatments spread over an area the size of about six football fields. The side view shows the entry sign before the arrival of hurricanes Katrina and Rita.



Figure 3. After hurricanes Katrina and Rita, the entry boardwalk has an abrupt dead end. Only a half mile to go …..



Figure 4. The entry sign, and some boardwalk, neither in a useful position.



Figure 5. An expanse of storm debris (logs, sticks, dead marsh plants and trash) spreads across the experiment. The remains of the boardwalk are in the lower left, while two herbivore exclusion cages can be seen in the background.



Figure 6. The powerful storm surge even carried a refrigerator into one of the experimental plots.



A lesson in plant identification. Frontispiece of: Pallas, P.S. 1784. Flora Rossica. Imperiali J.J. Weitbrecht, Petropoli (St. Petersburg), Russia. vol. 1.

A Short List of References Frequently Used by Professional Botanists For Identification of Canadian Vascular Plants

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There is need for accurate plant identification, particularly in relation to biodiversity protection, alien invaders, and commercial collecting of wild plants. Researchers, agricultural advisers, students, and many others have asked us what literature we use to identify plants. To be practical, a list of identification aids must be relatively short and selective. The objective is to indicate the important, available sources, rather than provide an overwhelmingly complete list. The following is a personal selection, representing the references we use most frequently.

We have included the most complete, current, and useful references for identifying plants in Canada as a whole, and in specific geographical areas. In listing those we consider most relevant, we have often excluded works of narrow coverage. We have included, despite narrow coverage in some cases, texts that are particularly useful for a particular group or a limited area that is otherwise not covered in the major comprehensive works available. For example, for the province of Ontario, which has no comprehensive identification manual, we have listed several sources with relatively narrow coverage, and we have also included a reference to the adjacent Michigan flora. In contrast, for British Columbia, which has a recent authoritative flora, we have not cited several works of narrower scope, despite their excellence.

References listed below include not only books with identification keys, descriptions, and illustrations that are useful for identification, but also major lists of plants. These lists help to indicate what is present, so that a larger floristic guide covering a broad area can be conveniently used (by simply eliminating the species that are not listed for a given region).

Geographically based texts are not the only kinds of identification aids that are available. Others include special bibliographies, vascular plant herbaria and their staff, expert systematists, guides to collecting, and information organized in subject categories such as cultivated plants and poisonous plants. Examples of these kinds of aids are outlined in the concluding section “Additional kinds of identification aids.” Also included in this section is a listing of special information sources that will assist with identifications, determining correct names, and related information. Finally, we present information on the importance of plant identification that may assist those working in this area to encourage the increasing support that is needed to do the job.

Notes on criteria

Various aspects that influenced our choice of identification aids are indicated below in the following list. We emphasize that none of these was essential for inclusion.

1. Quality and recency of publication: accuracy of information. (Classic treatments, although dated, often remain useful, and some outstanding examples are included.)
2. Quantity: inclusion of a substantial number of species in Canada.
3. Coverage: all of the species of a relatively large area. (In cases where regions are not adequately treated in a comprehensive flora, local floras are cited.)
4. Exclusivity: only or mostly the species of a relatively large area. (Floras from adjacent U.S. states are included only when, in the absence of adequate Canadian floras, they substantially assist

in identification of Canadian plants.)

5. Complementarity: references such as simple lists of species and guides to nomenclature that, in combination with other works, assist in identification and provision of correct names.
6. Inclusion of identification keys.
7. Inclusion of information (additional to keys) assisting in identification: illustrations, distribution maps, descriptions.
8. Guides to plants of distinctive, widespread habitats in Canada: northern plants, aquatic plants, weeds.
9. Guides to plants of large and economically important or popular Canadian families or genera: grasses, sedges, ferns.
10. Guides to extremely important classes of economic plants in Canada: trees, toxic plants, cultivated plants.
11. Information on where identification aids can be located for foreign plants of potential danger to Canada as introduced weeds, alien invaders, commodity contaminants, illicit drugs, etc.
12. Key bibliographic tools of assistance to researchers in locating extensive information needed to clarify problems in classification. (This information will be important primarily to Specialists, but occasionally plants are encountered that simply cannot be satisfactorily identified using guides such as listed here, and it will be necessary to search out very specialized publications or locate an expert for help.)

Guides to large areas of Canada

Aiken, S. G., and S. J. Darbyshire 1983. Grass genera of Western Canadian cattle rangelands. Monograph No. 29. Research Branch, Agriculture Canada, Ottawa, ON. 173 pp.
[One of several useful tools for identifying Canadian grasses.]

Best, K. F., and J. B. Campbell 1971. Prairie grasses identified and described by vegetative characters. Publication 1413, Canada Department of Agriculture, Ottawa, ON. 239 pp.
[This guide includes a vegetative key, and describes and illustrates 104 grass species characteristic of rangelands of the Prairie Provinces. For each, details of the top of the leaf sheath are shown.]

Boivin, B. 1966-1968. Énumération des plantes du Canada. Provancheria (Mémoires de l'Herbier Louis-Marie, Université Laval, Québec) no **6**. Irregularly paginated
*[An authoritative compilation of Canadian plant species, with an indication of their provincial distribution and references to related classification literature. Also published in Naturaliste Canadian vols. **93** and **94**.]*

Boivin, B. 1967-1981. Flora of the Prairie Provinces. Provancheria (Mémoires de l'Herbier Louis-Marie, Faculté d'Agriculture,Université Laval). 5 vols.
[Lacking illustrations (except for part 5) and distribution maps, nevertheless the most complete flora for the Prairie Provinces.]
- Part **1** (1967). Pteroids, ferns, conifers and woody dicopsids. Provancheria **2**: 1-202. (Reprinted from Phytologia **15**: 121-159, 329-446; 16: 1-47).
- Part **2** (1968-1969). Digitatae, Dimerae, Liberae. Provancheria **3**: 1-185. (Reprinted from Phytologia **16**, 17, 18).
- Part **3** (1972). Connatae. Provancheria **4**: 1-224. (Reprinted from Phytologia **22**, 23).
- Part **4** (1979). Monopsida. Provancheria **5**: 1-189. (Reprinted from Phytologia **42**, 43).
- Part **5** (1981). Gramineae. Provancheria **12**: 1-107.

Boivin, B. 1992. Les Cypéracées de l'est du Canada. Provancheria **25**: 1-230.
[A guide to the sedge family of Canada, with all species illustrated.]

Budd, A. C., J. Looman, K. F. Best, and J. Waddington 1987. Budd's flora of the Canadian Prairie Provinces. (Latest revision.) Research Branch Publication 1662. Agriculture Canada, Ottawa, ON. 863 pp.
[Includes many illustrations but not distribution maps.]

Cody, W. J., and D. M. Britton 1989. Ferns and fern allies of Canada. Publication 1829/E. Agriculture Canada Research Branch, Ottawa, ON. 430 pp.
[Includes illustrations and distribution maps. Also issued in French as Les fougères et les plantes alliées du Canada]

Crow, G. E., and C. B. Hellquist 2000. Aquatic and wetland plants of northeastern North America: a revised and enlarged edition of Norman C. Fassett's A manual of aquatic plants. University of Wisconsin Press, Madison, WI. 2 vols.
[A useful and current text with keys and numerous line drawings.]

Darbyshire, S. J. 2005. A key to the common grasses of southeastern Canada by vegetative characteristics. Can. Bot. Assoc. Bull. **38**: 58-63.
[A very useful tool for identifying grasses.]

Darbyshire, S. J., M. Favreau, and M. Murray 2000. Common and scientific names of weeds in Canada / Noms populaires et scientifiques des plantes nuisibles du Canada. Research Branch Publication 1387/B. Agriculture and Agri-Food Canada, Ottawa, ON. 132 pp.
[A valuable list giving accurate scientific and one selected common English name and one French name for 1130 taxa of weedy plants.]

Farrar, J. L. 1995. Trees in Canada. Fitzhenry & Whiteside Ltd., Markham, ON, and Canadian Forest Service, Natural Resources, Ottawa, ON. 502 pp.
[Includes useful line drawings, colour photographs, and distribution maps.]

Fernald, M. L. 1950. Gray's manual of botany. 8th edition. Van Nostrand Reinhold, New York, NY. 1632 pp.
[One of the most useful floras ever produced and still very useful despite its age. Page 6 notes that this guide covers "the area south of the Straits of Belle Isle and from Anticosti Island westward along the 49th parallel of latitude in Quebec to the northwestern corner of Minnesota." This includes the southern tip of NF-LAB; all of NF-NFLD, NS, PE, and NB; southern, central, and northwestern ON; and southern QC; useful for southern MB, but not intended to cover this region. The 1970 printing includes corrections.]

Flora of North America Editorial Committee. Flora of North America north of Mexico. Oxford University Press, New York, NY.
*[Eight of the 30 volumes planned to cover the entire flora of North America are currently available as outlined below. There is much variation in the quality of the treatments in this work, but many are written by world authorities and include the most current taxonomic decisions. In press and expected in early 2006 are the following: Volume **19**, Magnoliophyta: Asteridae, Part 6: Asteraceae, part 1; Volume **20**, Magnoliophyta: Asteridae, Part 7: Asteraceae, part 2; and Volume **21**, Magnoliophyta: Asteridae, Part 8: Asteraceae, part 3. Scheduled for publication in late 2006 is Volume **7** (Magnoliophyta: Dilleniidae, part 2). Scheduled for publication in 2007 are Volume **6** Magnoliophyta: Dilleniidae, part 1), and Volume **8** (Magnoliophyta: Dilleniidae, part 3; and Rosidae, part 1). Most of the information is available online: http://www.efloras.org/flora_page.aspx?flora_ed=1]*
1993. Vol. **2**, Pteridophytes and Gymnosperms. 475 pp.
1997. Vol. **3**, Magnoliophyta: Magnoliidae and Hamamelidae. 590 pp.
2000. Vol. **22**, Magnoliophyta: Alismatidae, Arecidae, Commelinidae (in part), and Zingiberidae. 352 pp.
2002. Vol. **26**, Magnoliophyta: Liliidae and Orchidales. 723 pp.
2002. Vol. **23**, Magnoliophyta: Commelinidae (in part): Cyperaceae. 608 pp.
2003. Vol. **25**, Magnoliophyta: Commelinidae (in part): Poaceae, part 2. 783 pp.
*[This volume covers over half of the grass family in North America north of Mexico. It and vol. **24** (containing Poaceae, part 1, still in preparation) differ from the other Flora of North America volumes in that they were originally intended for publication under a separate title within a single volume—a successor to Hitchcock's classic Manual of Grasses of the United States. With identification a key focus, this volume has many more illustrations than other FNA volumes: almost every species is illustrated. Also included are species known only from cultivation, and species that are considered serious threats to American agriculture but which are not yet established.]*
2003. Vol. **4**, Magnoliophyta: Caryophyllidae, part 1. 559 pp.
2005. Vol. **5**, Magnoliophyta: Caryophyllidae, part 2. 656 pp.

Frankton, C., and G. A. Mulligan1987. Weeds of Canada (revised). NC Press Ltd., Toronto, and Agriculture Canada, Ottawa, ON. 217 pp.
[A guide to 230 weedy species of Canada, mostly illustrated.]

Gleason, H. A. 1968. The new Britton and Brown illustrated flora of the Northeastern United States and adjacent Canada. Hafner, New York, NY. 3 vols.
[This very useful, illustrated manual is superseded by the combination of Gleason and Cronquist (1991) + Holmgren (1998).]

Gleason, H. A., and A. Cronquist. 1991 (7th printing, 2004). Manual of vascular plants of Northeastern United States and adjacent Canada. 2nd edition. The New York Botanical Garden, Bronx, NY. 993 pp.
[Covers NS, PE, NB, southern QC, southern and central ON; useful for northwestern ON and southern MN, but not intended to cover this region. Page numbers in this non-illustrated manual correspond to the illustrations on the matching page numbers in Holmgren 1998, listed

below. The 7th printing, 2004, includes corrections and other changes, outlined in Foreword on p. v).]

Hitchcock, A. S. 1971. Manual of the grasses of the United States. 2nd edition. Dover, New York. 2 vols. (1051 pp.).
[A much-used tool for identifying grasses. Abundantly illustrated.]

Hitchcock, C. L., and A. Cronquist 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle. 730 pp.
[An authoritative flora with illustrated keys. Includes "an indefinite fringe of British Columbia."]

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson (Editors). 1955-1969. Vascular plants of the Pacific Northwest. Compositae. University of Washington Press, Seattle, WA.
[A classic and popular flora that includes "an indefinite southern fringe of British Columbia." Has excellent descriptions, illustrations and keys. Hitchcock and Cronquist (1973), listed above, is a condensed version.]
1955. Part **5**, Compositae. 343 pp.
1959. Part **4**, Ericaceae through Campanulaceae. 510 pp.
1961. Part **3**, Saxifragaceae to Ericaceae. 614 pp.
1964. Part **2**, Salicaceae to Saxifragaceae. 597 pp.
1969. Part **1**, vascular cryptogams, gymnosperms and monocotyledons. 914 pp.

Holmgren, N. H. 1998. Illustrated companion to Gleason and Cronquist's Manual. The New York Botanical Garden, Bronx, NY. 937 pp.
[This is the illustrated companion to the most current floristic guide to northeastern North America (see Gleason and Cronquist 1991).]

Johnson, D., L. Kershaw, A. MacKinnon, and J. Pojar 1995. Plants of the western boreal forest & aspen parkland. Lone Pine Publishing, Edmonton, AB. 392 pp.
[This guide includes many colour photographs, as well as illustrated keys, and covers a large area of western Canada.]

Kartesz, J. T., and C. A. Meachum 1999. Synthesis of the North American Flora, version 1.0. North Carolina Botanical Garden, Chapel Hill, North Carolina.
[A CD-ROM with interactive software. This is a comprehensive, authoritative source of names of vascular plants and their synonyms combined with information on geography, common names biological attributes and uses.]

McGregor, R. L., and T. M. Barkley (Editors) 1977. Atlas of the Flora of the Great Plains. The Iowa State University Press, Ames, IO. 600 pp.
[Presents distribution maps for species treated in the following flora. Useful for determining which species occur at the Canadian border.]

McGregor, R. L., T. M. Barkley, R. E. Brooks, and E. K. Schofield (Editors) 1986. Flora of the Great Plains. University Press of Kansas, Lawrence, KS. 1392 pp.
[The plains region extends into the southern portions of AB, SK, and MB. Although most of the Great Plains are in the U.S., a large proportion of the species also occurs in Canada.]

Polunin, N. 1940. Botany of the Canadian eastern arctic. Bull. 92. Nat. Mus. Can., Ottawa, ON. 408 pp. *[A classic and comprehensive work.]*

Polunin, N. 1959. Circumpolar arctic flora. Oxford Univ. Press, Oxford, U.K. 514 pp.
[Although dated, this is still a very valuable reference. Includes many illustrations, but no distribution maps.]

Scoggan, H. J. 1978–1979. The flora of Canada. National Museum of Natural Sciences, Ottawa, ON. 4 vols.
[A valuable compilation of information on the Canadian flora, includes identification keys and information on distribution, but lacks descriptions and illustrations.]
- Part **1** (1978): General survey. Publications in Botany **7**(1): 1-89.
- Part **2** (1978): Pteridophyta, Gymnospermae, Monocotyledoneae. - Publications in Botany **7**(2): 93-544.
- Part **3** (1978): Dicotyledoneae (Saururaceae to Violaceae). Publications in Botany **7**(3): 547-1115.
- Part **4** (1979): Dicotyledoneae (Loasaceae to Compositae). Publications in Botany **7**(4): 1117-1711.

Swink, F. 1990. The key to the vascular flora of the northeastern United States and southeastern Canada. Plantsmen's Publications, Flossmore, IL. 514 pp.
[A useful identification aid.]

GUIDES FOR PROVINCES AND TERRITORIES

Alberta

Hallworth, B., and C. C. Chinnappa. 1997. Plants of Kananaskis Country, in the Rocky Mountains of Alberta. University of Alberta Press, Edmonton, AB. 366 pp.
[An excellent guide with line drawings, keys, colour photographs, and descriptions. Although local, it applies to much of the Rocky Mountain area.]

Kershaw, L., J. Gould, D. Johnson, and J. Lancaster 2001. Rare vascular plants of Alberta. Univ. Alberta Press, Edmonton, AB and Nat. Resour. Can., Can. For. Serv., North For. Cent., Edmonton, AB. 484 pp.
[Describes and provides excellent colour photographs of about 485 species of rare native vascular plants of Alberta.]

Kuijt, J. 1982. A flora of Waterton Lakes National Park. The University of Alberta Press, Edmonton, AB. 684 pp.
[A well illustrated and useful guide, covering a large portion of the Rocky Mountains.]

Moss, E. H., and J. G. Packer 1983. Flora of Alberta. 2nd edition. University of Toronto Press,Toronto, ON. 687 pp.
[Has distribution maps, no illustrations.]

British Columbia

Note: There are numerous excellent guides to specific groups of plants of British Columbia that have been produced by the Royal British Columbia Museum, but these are superseded by Douglas et al., cited below, for identification purposes. However, in many cases they contain additional information, and deserve to be on the bookshelf of any serious student of the B.C. Flora.

Calder, J. A., and R. L. Taylor 1968. Flora of the Queen Charlotte Islands. Part 1, Systematics of the Vascular Plants. Monograph No 4 Part 1. Canada Department of Agriculture, Ottawa, ON. 659 pp.
[Includes a few illustrations and many distribution maps.]

Douglas, G. W., et al. (Editors). 1999-2002. Illustrated Flora of British Columbia.
[Note the two series below. This flora includes many illustrations in each volume and distribution maps in volume 8. Provides up-to-date and definitive coverage of the flora of British Columbia. Also note E-Flora BC, Electronic atlas of the plants of British Columbia, http://www.geog.ubc.ca/~brian/florae/efloraintroductionpage.html, which presents much of the information in this flora (note cautions regarding validity of map data).]

Douglas, G. W., G. B. Straley, D. Meidinger, and J. Pojar (Editors). 1999-2002. Illustrated Flora of British Columbia, Victoria, BC. Ministry of Environment, Lands and Parks, and Ministry of Forests, British Columbia. Vols. 1-2.
Volume **1** (1998): Gymnosperms and Dicotyledons (Aceraceae through Asteraceae). 436 pp.
Volume **2** (1998): Dicotyledons (Balsaminaceae through Cuscutaceae). 401 pp.
[This series is continued below, without Straley as an editor.]

Douglas, G.W., D. Meidinger, and J. Pojar (editors). 1999-2002. Illustrated Flora of British Columbia. Ministry of Environment, Lands and Parks, and Ministry of Forests, British Columbia, Victoria, BC. Vols. 3-8.
Volume **3** (1999).: Dicotyledons (Diapensiaceae through Onagraceae). 423 pp.
Volume **4** (1999): Dicotyledons (Orobanchaceae through Rubiaceae). 427 pp.
Volume **5** (2000): Dicotyledons (Salicaceae through Zygophyllaceae) and Pteridophytes. 389 pp.
Volume **6** (2001): Monocotyledons (Acoraceae through Najadaceae). 361 pp.
Volume **7** (2001): Monocotyledons (Orchidaceae through Zosteraceae). 379 pp.
Volume **8** (2002). General summary, maps and keys. 457 pp.

MacKinnon, A., J. Pojar, and R. Coupé 1992. Plants of Northern British Columbia. Lone Pine Publishing, Edmonton, AB. 345 pp. + index.
[A very useful, user-friendly text for the northern part of the province. It includes keys and illustrations (many in colour).]

Manitoba

Cody, W. J. 1988. Plants of Riding Mountain National Park, Manitoba. Publication 1818. Research Branch, Agriculture Canada, Ottawa, ON. 319 pp.
[Has keys and descriptions of 669 species, and hundreds of illustrations. Also available in French.]

Scoggan, H. J. 1957. Flora of Manitoba. National Museum of Canada Bulletin 140, Biological Series 47. Department of Northern Affairs and National Resources, Ottawa, ON. 619 pp.

[An excellent, although dated, compilation of the vascular flora of the province, but lacks illustrations and distribution maps. Additions to this work have been published in the Canadian Field-Naturalist, and are on file in the Manitoba Museum of Man and Nature.]

New Brunswick

Hinds, H. R. 2000. Flora of New Brunswick. 2nd edition. University of New Brunswick, Fredericton, NB. 695 pp.
[Maps and illustrations provided for most species. Additions and corrections available at http://www.unb.ca/biology/Flora.html.]

Also see Haines and Vining (1998) under Quebec.

Newfoundland and Labrador

Bouchard, A., S. Hay, and E. Rouleau 1978. The vascular flora of St. Barbe South district, Newfoundland; an interpretation based on biophysiographic areas. Rhodora **80**: 228-308.
[This describes the flora of a large part of Newfoundland in terms of biophysiographic units.]

Damman, A. W. H. 1965. Key to the *Carex* species of Newfoundland by vegetative characteristics. Publication No. 1017. Canadian Department of Forestry, Ottawa, ON. 39 pp.
[A useful guide to the identification of a large and difficult group of Newfoundland plants.]

Hay, S. A., A. Bouchard, and L. Brouillet. 1990. Additions to the flora of the Island of Newfoundland. Rhodora **92**: 277-293.

Meades, S. J., S. G. Hay, and L. Brouillet 2000. Annotated list of the plants of Newfoundland and Labrador. http://www.nfmuseum.com/meades.htm
["This checklist documents over 1,300 taxa of plants known to occur in the Province of Newfoundland and Labrador, Canada. It includes scientific names, English and French common names, key synonyms, range and specific habitat preferences, and notes on scarcity, notable range extensions, questionable reports and taxonomic problems. The checklist is available for download as a set of WordPerfect, or MSWord files."]

Robertson, A. W. 1984. *Carex* of Newfoundland. Ministry of Supply and Services, Ottawa, ON. 252 pp.
[Distributed by Canadian Forestry Services, St. John's Newfoundland. A guide to the sedges of Newfoundland.]

Rouleau, E., and G. Lamoureux 1992. Atlas of the vascular plants of the island of Newfoundland and of the islands of Saint-Pierre-et-Miquelon. / Atlas des plantes vasculaires de l'Île de Terre-Neuve et des îles de Saint-Pierre-et-Miquelon. Groupe Fleurbec, Saint-Henri-de-Lévis, QC. 777 pp.
[Presents a checklist and over a thousand excellent, detailed distribution maps.]

Rousseau, C. 1974.
[This is listed below for Quebec, and gives information on many plant distributions for Labrador.]

Northwest Territories and Nunavut

Aiken, S. G., M. J. Dallwitz, L. L. Consaul, C. L. McJannet, L. J. Gillespie, R. L. Boles, G. W. Argus, J. M. Gillett, P. J. Scott, R. Elven, M. C. LeBlanc, A. E. Zamluk, and A. K. Brysting 2002. Flora of the Canadian Arctic Archipelago: descriptions, illustrations, identification, and information retrieval. Version: 25th March 2002. http://www.mun.ca/biology/delta/arcticf/
[Provides illustrated, interactive, identification to the more than 300 taxa known to occur on the Canadian Arctic Islands. A useful source of information, including descriptions, illustrations, and distribution maps.]

Catling, P. M., W. J. Cody, and G. Mitrow 2005. A compilation of additions to the flora of the continental portions of Northwest Territories and Nunavut. Botanical Electronic News. *In press.*
[Includes all additions to the 1980 flora (below) reported up to 2004.]

Mallory, C., and S. Aiken 2004. Common plants of Nunavut. Nunuvut Department of Education, Nunavut Wildlife Management Board, and Canadian Museum of Nature. Ottawa, ON. 400 pp. (200 in English, 200 in Inuktituk).
[A popular guide with colour illustrations.]

Porsild, A. E., and W. J. Cody 1980. Vascular plants of Continental Northwest Territories, Canada. National Museums of Natural Sciences, National Museums of Canada, Ottawa, ON. 667 pp.
[This flora includes the previous Districts of Mackenzie, Franklin, and Keewatin, portions of which are now included in Nunavut. Nunavut was created in 1999 from a large portion of the "Northwest Territories," including Keewatin, northeastern Mackenzie, and a portion of Franklin. Additions to this flora have been published mostly in the Canadian Field-Naturalist.]

Porsild, A. E. 1964. Illustrated flora of the Canadian Arctic Archipelago. National Museum of Canada Bulletin 146. 218 pp.
[Covers Canadian Arctic Islands. Includes illustrations and distribution maps.]

Nova Scotia

Roland, A. E., and E. C. Smith 1969. The flora of Nova Scotia. The Nova Scotia Museum, Halifax, NS. 746 pp.
[An updated version is indicated below, but this original manual remains very useful, and contains some information not included in the update.]

Roland, A. E., and M. Zinck. 1998. Roland's flora of Nova Scotia. Nimbus Publishing and Nova Scotia Museum, Halifax, NS. 2 vols.
[Includes many illustrations and distribution maps.]

Nunavut

See "Northwest Territories and Nunuvut."

Ontario

Alex, J. F. 1992. Ontario weeds: descriptions, illustrations and keys to their identification. Ontario Ministry of Agriculture and Food, Toronto. 304 pp.
[A very useful text for identifying common weedy plants.]

Baldwin, W. K. W. 1958. Plants of the Clay Belt of northern Ontario and Quebec. Bulletin No. 156. National Museum of Canada, Ottawa, ON. 324 pp.
[Contains much information on the vegetation and status of plants in the Clay Belt region.]

Contributions to a flora of New York state.
[New York State Museum bulletins published by the State Education Department, Albany, NY. These recent, comprehensive treatments have keys, extensive descriptions and useful illustrations, and can be used to identify plants from much of southern Ontario. Contribution 3, dealing with mosses, is not listed below.]
1. Mitchell, R. S., and J. K. Dean 1978. Polygonaceae (buckwheat family) of New York State. Contr. to a Flora of New York State I. New York State Mus. Bull. 431. 80 pp.
2. Mitchell, R. S., and E. O. Beal 1979. Magnoliaceae through Ceratophyllaceae of New York State. Contr. to a Flora of New York State II. New York State Mus. Bull. 435. 62 pp.
4.Mitchell, R. S., and J. K. Dean 1982. Ranunculaceae (crowfoot family) of New York State. Contr. to a Flora of New York State IV. New York State Mus. Bull. 446. 100 pp.
5. Mitchell, R. S. 1983. Berberidaceae through Fumariaceae of New York State. Contr. to a Flora of New York State V. New York State Mus. Bull. 451. 66 pp.
6. Mitchell, R. S. 1988. Platanaceae through Myricaceae of New York State. Contr. to a Flora of New York State VI. New York State Mus. Bull. 464. 98 pp.
7. Clemants, S. E. 1990. Juncaceae (rush family) of New York State. Contr. to a Flora of New York State. VII. New York State Mus. Bull. 475. 68 pp.
8. Furlow, J. J., and R. S. Mitchell 1990. Betulaceae through Cactaceae of New York State. Contr. to a Flora of New York State VIII. New York State Mus. Bull. 476. 94 pp.
9. Cope, E. A. 1992. Pinophyta (Gymnospermae) of New York State. Contr. to a Flora of New York State IX. New York State Mus. Bull. 483. 80 pp.
10.Clemants, S. E. 1992. Chenopodiaceae and Amaranthaceae of New York State. Contr. to a Flora of New York State X. New York State Mus. Bull. 475. 100 pp.
11. Mitchell, R. S. 1993. Portulacaceae through Caryophyllaceae of New York State. Contr. to a Flora of New York State XI. New York State Museum Bull. 486. 124 pp.

Dickinson, T., D. Metsger, J. Bull, and R. Dickinson. 2004. The ROM field guide to wildflowers of Ontario. Royal Ontario Museum and McClelland and Stewart, Toronto, ON. 416 pp.
*[A valuable reference with colour photos, that treats 550 species (reviewed in CBA/ABC Bull. **38**(3): 40 (2005).]*

Dore, G. D., and J. McNeill 1980. Grasses of Ontario. Agriculture Canada Research Branch Monograph 26. 566 pp.
[Includes illustrations and distribution maps.]

McKay, S. M., and P. M. Catling 1979. Trees, shrubs & flowers to know in Ontario. J.M. Dent & Sons (Canada) Ltd., Don Mills, ON. 208 pp.
[A useful and well-illustrated guide to common species.]

Meades, S. J., D. Schnare, K. Lawrence, and C. Faulkner. 2004 (and onwards). Northern Ontario Plant Database Website. Version 1, January 2004. Algoma University College and Great Lakes Forestry Centre, Sault Ste. Marie, ON.
Http://www.northernontarioflora.ca/
[Lists records in northern Ontario herbaria and provides links to descriptions and illustrations.]

Morton, J. K., and J. M. Venn 2000. The flora of Manitoulin Island and the adjacent islands of Lake Huron, Georgian Bay and the North Channel. 3rd edition. University of Waterloo, Waterloo, ON. 375 pp.
[Although this annotated checklist features Manitoulin Island, it can be used effectively as an identification aid for much of the northern Lake Huron region of Ontario.]

Newmaster, S. G., and R. Subramanyam 2005. Flora Ontario - integrated botanical information system (FOIBIS), phase 1, 2005. http://www.uoguelph.ca/foibis/
[Latin, English, and French names as well as classification information is provided for 4,780 species including vascular plants, bryophytes and lichens.]

Newmaster, S., A. Harris, and L. Kershaw 1997. Wetland plants of Ontario. Lone Pine, Edmonton, AB. 240 pp.
[A guide to over 450 species of wetland plants, with numerous line drawings.]

Newmaster, S. G., A. Lehela, P. W. C. Uhlig, S. McMurray, and M.J. Oldham 1998. Ontario plant list. Forest Research Information Paper 123. Ontario Forest Research Institute, Sault Ste. Marie, ON. Irregularly paginated.
[An authoritative, current list of plant names for Ontario, including synonyms and an indication of conservation status.]

Riley, J. L. 2003. Flora of the Hudson Bay Lowland and its postglacial origins. NRC Research Press, Ottawa, ON. 236 pp.
[A valuable list of species of an extensive northern region of the province. Includes distribution maps and considerable information.]

Soper, H. J., and M. L. Heimberger 1982. Shrubs of Ontario. Royal Ontario Museum, Toronto, ON. 495. Pp.
[Includes illustrations and distribution maps for all species.]

Voss, E. G. 1972-1996. Michigan flora. Cranbrook Institute of Science, Bloomfield Hills, MI. 3 vols.
[This outstanding guide to the plants of Michigan applies very well to much of southern and central Ontario. Includes some illustrations and distribution maps for Michigan.]
Part **1** (1972), Gymnosperms and monocots. Cranbrook Institute of Science Bulletin **55**. 488 pp.
[Printings with corrections in 1990 and 1992.]
Part **2** (1985), Dicots (Saururaceae-Cornaceae). Cranbrook Institute of Science Bulletin **59**. 727 pp.
[Second printing 1998, with corrections and additions on pages 725–727.]
Part **3** (1996), Dicots (Pyrolaceae-Compositae). Cranbrook Institute of Science Bulletin **61**. 622 pp.

Prince Edward Island

Erskine, D. S., P. M. Catling, and R. B. MacLaren 1985. The plants of Prince Edward Island, with new records, nomenclatural changes, and corrections and deletions. Research Branch Publication 1798. Agriculture Canada, Ottawa, ON. 272 pp. + map.
[Has distribution maps but not illustrations of species.]

Quebec

Blondeau, M., and C. Roy 2004. Atlas des plantes des villages du Nunavik / Atlas of plants of the Nunavik villages. Éditions MultiMondes, Sainte-Foy, QC. 610 pp.
[A useful guide for the far northern regions of Quebec. Has excellent maps and illustrations. In French, English, and Inuktitut.]

Fleurbec (group: G. Lamoureux et al.) 1978. Plantes sauvages des villes et des champs, vol. 1. Fleurbec, Montreal, QC. 273 pp.
[Colour photographs. Includes about 85 species.]

Fleurbec (group: G. Lamoureux et al.) 1981. Plantes sauvages comestibles. Fleurbec, Saint-Cuthbert, QC. 167 pp.
[Colour photographs. Includes 28 species.]

Fleurbec (group: G. Lamoureux et al.) 1983. Plantes sauvages des villes et des champs, vol. 2. Fleurbec, Saint-Augustin, QC. 208 pp.
[Colour photographs, distribution maps. Includes about 90 species]

Fleurbec (group: G. Lamoureux et al.) 1985. Plantes sauvages du bord de la mer. Fleurbec, Saint-Augustin, QC. 286 pp.
[A guide to 55 species, colour photographs and distribution maps.]

Fleurbec (group: G. Lamoureux et al.) 1987. Plantes sauvages des lacs, rivières et tourbières. Fleurbec, Saint-Augustin, QC. 399 pp.
[Colour photographs and distribution maps. Treats about 60 species.]

Fleurbec (group: G. Lamoureux et al.) 1993. Fougères, prêles et Lycopodes. Fleurbec, Saint-Henri-de-Lévis, QC. 511 pp.
[Colour photographs and distribution maps.]

Fleurbec (group: G. Lamoureux et al.) 2005. Plantes sauvages au menu: Cuisine raisonnée. 2nd edition. Fleurbec, Saint-Henri-de-Lévis, QC. 192 pp.
[A guide to edible wild plants.]

Haines, A., and T. F. Vining 1998. Flora of Maine: a manual for identification of native and naturalized vascular plants of Maine. V. F. Thomas Co., Bar Harbor, ME. 847 pp.
[Can be used for parts of Quebec adjacent to Maine.]

Labrecque, J., and G. Lavoie 2002. Les plantes vasculaires menacées ou vulnérables du Québec. Gouvernement du Québec, ministère de l'Environnement, Direction du patrimoine écologique et du développement durable, QC. 200 pp.
[Brief information and distribution maps for 375 species.]

Lamoureux, G. 2002. Flore printanière (une mise à jour de Plantes Sauvages printanières, 1975). Fleurbec, Saint-Henri-de-Lévis, QC. 576 pp.
[A guide to 123 spring-flowering wild plants of eastern North America, with colour photographs and distribution maps, as well as extensive ecological information.]

Louis-Marie, P. 1967. Flore-manuel de la province de Québec, Canada. 4th edition. Centre de Psychologie et Pédagogie, Montréal. QC. 317 pp.
[An old but very popular and useful text. The 4th edition of 1967 is a re-impression in pocket book format of the 2nd edition (1953), with three pages added at the end. The 3rd edition (1959) presents drawings in colour]

Marie-Victorin, Frère 1997. Flore Laurentienne. 3rd edition. Updated and annotated by L. Brouillet, S. G. Hay, I. Goulet, M. Blondeau, J. Cayouette, and J. Labrecque. Presses de l'Université de Montréal, Montréal, QC (and also republished in 2002 by Gaëtan Morin, Boucherville, QC). 1093 pp.
[The most complete flora of Quebec available at this time. Like the 1995 edition, this work has been referred to as the "third edition," although the 1997 and 2002 printings (which are identical) have many corrections and additions. Includes illustrations, many in colour.]

Marie-Victorin, Frère, and Frère Rolland-Germain 1969. Flore de L'Anticosti-Minganie. Les Presses de l'Université de Montréal, Montréal, QC. 527 pp.
[Provides useful coverage for the Gulf of St. Lawrence area.]

Rousseau, C. 1968. Histoire, habitat et distribution de 220 plantes Introduites au Québec. Nat.can. **95**:49-171. *[A valuable source of information on introduced plants.]*

Rousseau, C. 1974. Géographie floristique du Québec/Labrador. Distribution des principales espèces vasculaires. Les Presses de l'Université Laval, QC. 799 pp.
[Not an identification guide, but presents ecological and distributional information for a little over 1,000 species, as well as distribution maps.]

Scoggan, H. J. 1950. The flora of Bic and the Gaspé Peninsula. National Museum of Canada Bulletin 115, Biological Series 47. Canada Department of Resources and Development, Development Services Branch, Ottawa, ON. 399 pp.
[A classic flora, still very useful.]

Saskatchewan

Note: Although there are few works dedicated to Saskatchewan alone, and no complete flora designed for identification, the guides listed for the adjacent provinces of Alberta and Manitoba are useful, and so are the general guides for the prairie region and boreal forest listed above.

Hudson, J. H. 1977. *Carex* in Saskatchewan. Bison Publishing House, Saskatoon, SK. 193 pp.
[A guide to 100 species, with keys, descriptions, illustrations, and distribution maps.]

Harms, V. L. 2003. Checklist of the vascular plants of Saskatchewan and provincially and nationally rare native plants of Saskatchewan. University of Saskatchewan Press, Saskatoon, SK. 328 pp.
[A complete and authoritative annotated checklist.]

Yukon

Cody, W. J. 2000. Flora of the Yukon Territory. 2 ndedition. NRC Research Press, Ottawa, ON. 669 pp.

[The definitive identification guide to this region. Updates giving additions and range extensions have been published in the Canadian Field-Naturalist.]

Hultén, E. 1968. Flora of Alaska and neighboring territories. Stanford University Press, Stanford, CA. 1008.
[Includes illustrations and circumpolar distribution maps.]

Welsh, S. L. 1974. Anderson's flora of Alaska and adjacent parts of Canada. Brigham Young University Press, Provo, UT. 724 pp.
[Includes a limited number of species illustrations but no distribution maps.]

Additional kinds of identification aids

a. Special bibliographies

A number of bibliographies are available to help the researcher find out exactly what has been done in the past. In some cases complete lists of references concerning the flora of a region exist only as a few copies of old unpublished documents on the shelves of provincial museums or provincial or regional conservation data centres (CDCs). A current list of such resources is beyond the scope of this article (e.g. see the following (also see Pringle (1995) in section g):

Catling, P. M., B. S. Brookes, Y. M. Skorupinski, and S. M. Malette 1986. Bibliography of vascular plant floristics for New Brunswick, Newfoundland (insular) and Nova Scotia. Technical Bulletin 1986-3E. Agriculture Canada Research Branch, Ottawa, ON. 28 pp.
[A comprehensive list of floristic references for the Maritimes.]

Douglas, G.W., A. Češka, and G. G. Ruyle 1983. Afloristic bibliography For British Columbia. Province of British Columbia Ministry of Forests, Land Management Report Number 15. 143 pp.
[References are listed by plant family and author.]

With increasing frequency, plants are being imported or introduced to Canada that are not part of the established flora, and it is important to know what tools are available for identification of such foreign material. Frodin (2001) provides a list of the major references:

Frodin, D. G. 2001. Guide to the standard floras of the world. Cambridge University Press, Cambridge, UK. 1100 pp.
[A monumental guide to world floras.]

b. Vascular plant herbaria

Vascular plant herbaria in Canada contain authoritatively identified reference specimens that can be used for comparison in identification. Moreover, the staff are often experts on plants of the local region or on particular groups of plants. Some of the herbaria have websites that provide information on services available [see for example the Agriculture and Agrifood Canada vascular plant collection website http://res2.agr.ca/ecorc/dao/index_e.htm]. Information on herbaria is available from various sources, ranging from regional to world coverage, and some principal guides are listed below. (Also see the appendix in Pringle (1995), listed below.)

Boivin, B. 1980. Survey of Canadian herbaria. Provancheria (Mémoires de l'Herbier Louis-Marie) 10. 187 pp.
[A comprehensive review of Canadian herbaria, with much useful historical information.]

Holmgren, P. K., and N. H. Holmgren. 1998 onwards (continuously updated). Index herbariorum. New York Botanical Garden, Bronx, NY. http://sciweb.nybg.org/science2/IndexHerbariorum.asp
[The herbaria of the world are listed. This can be used to locate Canadian herbaria: in "Search by Institution" simply type in "Canada" for country, and details for more than 100 Canadian herbaria will be presented.]

Rothfels, C. 2003. Synopsis of Ontario herbaria. Field Botanists of Ontario Newsletter **16**(1): 7-19.
[An example of a recent regional compilation, including some information that is not available elsewhere.]

c. Experts

Index Herbarium mentioned above lists staff and their specialties (in "search by Person" type in "Canada" for country, and details of about 200 Canadians associated with herbaria will be presented). Local experts capable of assisting with plant identification may also be found in universities, museums, conservation data centres, natural resource departments, and the Canadian Botanical Association.

The website of the American Society of Plant Taxonomists (with about 1300 members) lists experts by taxonomic groups (e.g. genera). See http://www.aspt.net/. (However, many experts are not members of the society, and will not be listed.)

d. General information on collecting and identifying plants

Bowles, J. M. Guide to plant collection & identification http://biology.queensu.ca/~fowler/Bowles.htm
[An online version of a booklet prepared by Dr. Bowles, containing much useful information.]

Brigham, T., M. Schröder, W. Cocksedge, W. 2004. Good practices for plant identification for the herbal industry. Saskatchewan Herb and Spice Association, SK. 54 pp. http://www.saskherbspice.org/Good%20Practices%20for%20plant%20identification.pdf
[A practical guide prepared for the purpose of providing reliable identifications of plants collected for the Canadian herbal and medicinal industries.]

Lamoureux, L., and P. Nantel 1999. Cultiver des plantes sauvages... Sans leur nuire. Fleurbec, Saint-Henri-de-Lévis. QC. 81 pp.
[Provides information on wild plants of Quebec that have potential to be cultivated. While not primarily intended for identification, this is an admirable synthesis of the subject.]

Savile, D. B. O. 1962. Collection and care of botanical specimens. Research Branch Publication 1113. Canada Department of Agriculture, Ottawa, ON. 124 pp.
[A comprehensive and excellent source of information on making plant collections. Also available in French as Cueillette et montage de spécimens botaniques.]

e. Cultivated plants

Bailey, L. H. 1949. Manual of cultivated plants. MacMillan Publishing Co. New York, NY. 1116 pp.
[Out of date, but this classic and extensive work is still very useful.]

Bailey, L. H., E. Z. Bailey, and staff of the Liberty Hyde Bailey Hortorium 1976. Hortus Third. A concise dictionary of plants cultivated in the United States and Canada. Macmillan, New York, NY. 1290 pp.
[A very large encyclopedia providing information on ornamental plants. This does not have keys and there are very few illustrations, but is useful when trying to find information about a cultivated plant when at least the genus is known.]

Facciola, S. 1998. Cornucopia II. A source book of edible plants. Kampong Publications, Vista, CA. 713 pp.
[Does not have keys, but extremely useful for finding information on available cultivars when the species name is known.]

Huxley, A., M. Griffiths, and M. Levy. (Editors) 1992. The new Royal Horticultural Society dictionary of gardening. MacMillan, London, U.K. 4 vols.
[An extremely large encyclopedia giving information on ornamental plants of the world. This does not have keys and there are very few illustrations, but has a wealth of information, particularly concerning cultivars.]

Rehder, A. 1951. Manual of cultivated trees and shrubs hardy in North America. 2nd edition. Macmillan, New York, NY. 996 pp.
[An extensive classic work, treating over 2,500 species.]

f. Poisonous plants

Poisonous plant guides have limited identification utility unless it is already suspected that a certain genus is responsible for poisoning, or (in the case of guides organized by symptoms) there is knowledge of the specific effects that have resulted from suspected poisoning. This brief list is included because even limited identification value may be important in cases of poisoning of humans, pets, or livestock.

Burrows, G. E., and R. J. Tyrl 2001. Toxic plants of North America. Iowa State Press (Blackwell Publishing Company), Ames, IA. 1342 pp.
[The most extensive source of information on North American toxic plants, includes both wild and commonly cultivated plants, has many illustrations and distribution maps. Organized by plant family and genus. The keys deal only with a few species and are of very limited use. Review: Small, E. 2005. Agriculture, Ecosystem & Environment

***110**: 327-238.]*
Frohne, D., and H. J. Pfänder 1983. A colour atlas of poisonous plants. Wolfe Publishing Ltd., Stuttgart, Germany. 291 pp.
[Includes descriptions, photographs and reference to microscopic characters]
Hardin, J. W. 1969. Human poisoning from native and cultivated plants. Duke University Press, Durham, NC. 167 pp.
[A concise guide to over 300 plants with descriptions and illustrations.]
Kingsbury, J. M. 1964. Poisonous plants of the United States and Canada. Prentice-Hall, Englewood Cliffs, NJ. 626 pp.
[Dated, but still useful. Organized by plant family and genus.]
Knight, A. P., and R. G. Walter 2001. A guide to plant poisoning of animals in North America. Teton NewMedia, Jackson, WY. 367 pp.
[Available as a book, CD and online by subscription. Organized on the basis of symptoms (plants affecting digestive system, nervous system, kidneys, musculoskeletal system, etc.), rather than on taxonomic relationships of the plants. Colour photographs.]
Lewis, W. H., and M. P. F. Elvin-Lewis 2003. Medical botany: plants affecting man's health. Second edition. John Wiley & Sons, Hoboken, NJ. 812 pp.
[An extremely useful source of information on poisonous plants and the symptoms of poisoning.]
Mulligan, G. A. 1990. Poison-ivy, western poison oak and poison sumac (revised edition). Agriculture Canada Publ. 1699E. 13 pp.
[A very large proportion of requests for identification concern these plants. Also available in French as L'herbe à la puce, le sumac à vernis et le rhus diversiloba.]
Mulligan, G. A., and D. B. Munro 1990. Poisonous plants of Canada. Agriculture Canada Publ. 1842E. 96 pp.
[A useful source of information for those interested in plants that poison humans and livestock. Available in French as Plantes toxiques du Canada. Also see Munro, below.]
Munro, D. B. Canadian poisonous plant information system. http://www.cbif.gc.ca/pls/pp/poison?p_x=pxtitle.html
[Provides information on native Canadian and some cultivated plants that are toxic to livestock, pets and humans. Based on literature up to 1993.]

g. Special information sources

Having used the kinds of references listed above to make an identification, it is sometimes desirable to ensure that the most current classification and nomenclature has been employed. There are numerous monographs of specific genera, families, etc. that are more up to date than some of the references listed above. These can be found through standard literature searches (e.g. AGRIS, AGRICOLA, BIOSIS, etc.).

The International Plant Names Index (IPNI), online at http://www.ipni.org/index.html
[This is a database of the names and associated basic bibliographical details of all seed plants, ferns and fern allies. Its goal is to eliminate the need for repeated reference to primary sources for basic bibliographic information about plant names. The data are freely available and are gradually being standardized and checked. This is an excellent source for confirming bibliographic details of names, but is by no means infallible.]
The Integrated Taxonomic Information System (ITIS), available online at http://www.itis.usda.gov
[Another important developing source of basic information on plant names.]
Plants database (of the United States Department of Agriculture) http://plants.usda.gov/cgi_bin/topics.cgi?earl=checklist.html
[Has illustrations, U.S. distribution maps, and considerable information on thousands of North American species.]
Flora of North America Newsletter http://hua.huh.harvard.edu/FNA/newsletter.shtml
[This presents current information on the Flora of North America project (see "Guides to large areas of Canada"), and the status of upcoming FNA volumes, as well as new publications and resources concerned with plant identification and classification.]

The biology of Canadian weeds. A series of reviews on weeds of Canada, published in the Canadian Journal of Plant Science, starting in 1973, and continuing to the present. A list of the 131 published papers is available at: http://www.cwss-scm.ca/Biology_of_weeds/chronological_list.htm. The papers have been republished as 5 volumes:

Mulligan, G. A. (Editor) 1979. The biology of Canadian weeds: contributions 1-32. Publication 1693. Agriculture Canada, Ottawa, ON. 512 pp.
Mulligan, G. A. (Editor) 1984. The biology of Canadian weeds: contributions 33-61. Publication 1765. Agriculture Canada, Ottawa, ON. 415 pp.
Cavers, P. B. (Editor) 1995. The biology of Canadian weeds: contributions 62-83. Agricultural Institute of Canada, Ottawa, ON. 338 pp.
Cavers, P. B. (Editor) 2000. The biology of Canadian weeds: contributions 84-102. Agricultural Institute of Canada, Ottawa, ON. 335 pp.
Cavers, P. B. (Editor) 2005. The biology of Canadian weeds: contributions 103-129. Agricultural Institute of Canada, Ottawa, ON. 516 pp.

The Canadian Museum of Nature published a series of reviews on rare vascular plants of each Canadian province and territory. A list of these, along with other references concerning rare Canadian plants is available in:

Catling, P. M. 2001. Protecting vascular plant biodiversity in Canada: progress and problems with the taxon approach. Pp. 62-81 *in* J. B. Phipps and P. M. Catling, eds. Proceedings of the Canadian Botanical Association Conference Symposium in London, Ontario, June 2000. Canadian Botanical Association.

It is often necessary to use the names of authors to trace their work. Articles treating botanical history and bibliographies arranged by author are useful for these purposes. The following two are particularly pertinent to Canadian taxonomic literature.

Pringle, J. S. 1995. The history of the exploration of the vascular flora of Canada. Canadian Field-Naturalist **109**(3): 291-356.
Small, E., J. Cayouette, B. Brookes, and W. Wojtas 1995. Canadian biodiversity: a guide to botanical specialists and literature / Biodiversité canadienne: répertoire des botanistes actuels et de leurs publications. Agriculture and Agri-Food Canada, Research Branch, Central Experimental Farm, Ottawa.
[Electronic publication available at: http://www.eman-rese.ca/eman/ecotools/botanists/
In English and French. Provides full literature citations of thousands of publications dealing with Canadian plants.]

Value of Identification

The value of plant identification is immense, although greatly under-appreciated, and requires continuing education of biologists. For additional information, see the following.

Small, E. 1993. The economic value of plant systematics in Canadian agriculture. Can. J. Bot. **71**: 1537-1551.
Small, E., J. Cayouette, P. M. Catling, and B. Brookes 1995. An opinion survey of priorities for plant systematics and phytogeography in Canada. Can. Bot. Assoc. Bull. **28**(2): 19-22.
Catling, P. M. 2001. A never ending role for biosystematics in the protection of vascular plant biodiversity in Canada. Pp. 3-27 in J. B. Phipps and P. M. Catling, eds. Proceedings of the Canadian Botanical Association Conference Symposium in London, Ontario, June 2000. Canadian Botanical Association.

Acknowledgments

Reviewers: W.J. Cody, J. Cayouette. Artwork: B. Brookes.



Canadian Medicinal Crops / Les cultures médicinales canadiennes: Books available online.

The national Research Council of Canada has produced 73 monographs (http://pubs.nrc-cnrc.gc.ca/rp/rp2_mono_e.html). The English (Canadian Medicinal Crops) and French (Les cultures médicinales canadiennes) versions of one of these is now available free online (http://pubs.nrc-cnrc.gc.ca/medicinal_crops/).

The increased interest in herbal medicine has highlighted the need for accurate and detailed information on medicinal crops in Canada, not just for the public, but for those working in agriculture, the health-care profession, and the pharmaceutical industry. *Canadian Medicinal Crops* analyses the most promising possibilities for new native medicinal crops.

The book is an encyclopedic reference of Canadian medicinal plants that offers useful information for growers, processors, marketers and others in the agricultural community. However, Canadian Medicinal Crops will be equally of interest to a wide variety of professionals and the general public.

The book features species that are now, or have the potential to be, commercially profitable, such as ginseng, echinacea, Pacific yew, goldenseal, cascara, witch hazel, and kelp. For each species, there are attractive color illustrations and maps showing the plant's geographic distribution, along with information on the plant's scientific classification, medicinal uses, ecology, toxicity, chemistry, and agricultural and commercial aspects.

There are interesting and entertaining myths, legends, tales, folklores, and interesting facts for each plant. For instance, the generic name for yarrow is *Achillea*, after the legendary Greek hero Achilles, who is said to have used the foliage to stanch the flow of blood from wounded fellow soldiers during the Trojan War. Closer to home, echinacea, otherwise known as the purple coneflower, was called "the hairs of Grandmother Earth's head" by the native American Weskwaki tribe.

Canadian Medicinal Crops is written by Ernest Small and Paul Catling, research scientists at Agriculture and Agri-Food Canada in Ottawa. The book is available in French (*Les cultures médicinales canadiennes*) and in a unique on-line format with features such as Web links and author updates.

NRC Research Press is the publishing arm of the Canada Institute for Scientific and Technical Information (CISTI). Part of the National Research Council of Canada, CISTI is one of the world's leading providers of scientific, technical and medical information.

The correct citations for the book versions are:

Small, E., and P. M. Catling 1999. Canadian medicinal crops. NRC Press, Ottawa. 240 pp. NRC Press, Ottawa. x + 240 pp.

Small, E., and P. M. Catling 2000. Les cultures médicinales canadiennes. CNRC-NRC, Ottawa, x + 281 pp.

News from Teaching Section

The teaching section is planning a **session of contributed papers** at the 2006 annual meeting at Concordia. The session will take place on **Tuesday afternoon, June 27th**.

A keynote presentation will be made by **Sylvie Laliberté** on the very successful **Problem-based learning** (PBL) program developed in The Biology department at the Université du Québec à Montréal (UQAM). The change from the traditional courses took place in 1996 and has resulted in students with a high degree of self-learning and communication skills, who are motivated and more curious about their subject. We would welcome contributions from other participants on the topic of problem-based learning, or on any other aspect of teaching botany at the high school or university level.

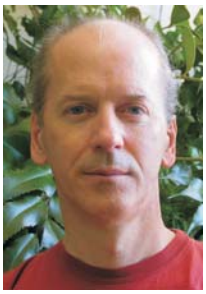
We are hoping that we will have time for a discussion on PBL in Botany. A reception will follow the session. The **Teaching section Meeting** will be held, most likely on **Wednesday, June 28th** at noon. Details will be posted at a later date. Anyone who is interested in teaching is most welcome to attend!

Christine D. Maxwell
Chair, Teaching Section

Mot du rédacteur

À partir de ce numéro, vous le savez maintenant, le Bulletin de l'ABC devient disponible sous deux formes, papier et électronique (format pdf). La publication électronique ouvre de nouvelles possibilités et s'affranchit des sérieuses limitations imposées à la production d'une copie papier toujours dispendieuse. Toutefois, les deux versions demeureront identiques à l'exception de l'utilisation de la couleur et du numéro ISSN (voir en page 2, en bas, à gauche).

Lors du prochain congrès de l'ABC à Montréal, je présenterai le résultat de mon projet de numérisation de tous les numéros du Bulletin parus depuis sa création, c'est-à-dire un cédérom qui sera alors offert à un prix très modique. Au plaisir de vous y rencontrer.



Martin Dubé

Editor's Message

Starting with this issue, the CBA Bulletin becomes available under two formats: paper and electronic (pdf). Electronic publication permits a lot of things otherwise impossible or too much expensive. However, the two versions of the Bulletin will remain identical, except for the colour and the ISSN number (see on page 2, at the bottom on the left).

At the next CBA Meeting in Montreal, I will make a presentation of the final product of my digitalization project of all issues of the Bulletin since its creation: a CD-ROM which will be on sale at a really low price. It will be nice to meet you there!

PLANT CANADA 2007
University of Saskatchewan, Saskatoon, Saskatchewan, June 10th-14th 2007