The Canadian Botanical Association Bulletin

Bulletin de l'Association Botanique du Canada

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Dear CBA/ABC members,



John Markham

Notes about the 2015 meeting in Edmonton
One of the things I've always enjoyed about the CBA is the friendly, laid back atmosphere of our annual meetings. With only a couple of concurrent session at the most, you can take in most of the conference without much effort. This year, with some many societies meeting together, things will be a little different. Registration is now open. As you will see, this year's conference is packed with activities: 18 field trips, 19 symposia, six colloquia and counting! It's going to take some planning to figure out how navigate this one. A few things to keep in mind:

Student social. An all society student social is planned for the Monday evening. CBA student reps are contact with the other societies to plan this event. This will be a great chance to meet students from other societies.

Section meetings. These will take place during the lunch breaks. The teaching section meeting will be on Monday and all other section meeting will be on Tuesday. Details for lunch are still being worked out. On the registration site you will be asked to register for the meetings so we know how many will attend.

Plant Canada symposium. In and effort to bring together its different society members, this year Plant Canada is sponsoring a symposium: Plant Secondary Chemistry: from Biochemistry to Applications. This should be taking place Monday morning.

Awards and AGM. The AGM will take place during the Wednesday lunch period. As was done the last time we met with Plant Canada, we will use part the time to give out awards. Lunch will be provided. On the registration site you will be asked to register for the meetings so we know how many will attend.

Plant Canada Reception. Before the closing social event we are all invited to a Plant Canada reception. Drinks will be provided.

Travel awards. This year will have a little extra money for student travel awards, courtesy of Plant Canada for travel awards.

The Canadian Botanical Association Bulletin

The CBA Bulletin is issued three times a year (March, September and December) and is freely availble on the CBA website. Hardcopy subscriptions are available for a fee.

Information for Contributors

All members are welcome to submit texts in the form of papers, reviews, comments, essays, requests, or anything related to botany or botanists. For detailed directives on text submission please contact the Editor (see below). For general information about the CBA, go to the web site: http://www.cba-abc.ca

Bulletin de l'Association Botanique du Canada

Le Bulletin de l'ABC paraît trois fois par année, normalement en mars, septembre et décembre. Il est envoyé à tous les membres de l'ABC.

Soumission de textes

Tous les membres de l'Association sont invités à envoyer des textes de toute natureconcernant la botanique et les botanistes (articles, revues de publication, commentaires,requêtes, essais, etc.). Tous les supports de texte sont acceptés. Pour des renseignements détaillés sur la soumission de textes, veuillez consulter le rédacteur (voir ci-dessous). Infos générales sur l'ABCà l'url suivant: http://www.cba-abc.ca

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Next issue / Prochain numéro

Texts for the next issue, 48(2), must be received by September 7, 2015
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Celebrate! The closing gathering will not be a sit down meal. Instead small food item will be circulating through banquet hall. Each society will be making an announcement for a single award only, keeping the announcements to a minimum. There will also be screens throughout the hall showing winners of all the awards.

John Markham, CBA President

Pictures Wanted!

At this year's annual meeting the CBA/ABC will have a display booth. We will have an electronic frame showing pictures of the activities of members (past meetings, field trips, lab activities). If you have pictures you would like to share, please send them, along with a caption, to Yolande Dalpé (dalpey@agr.gc.ca).

News & Announcements

Get involved with CBA!

Please consider joining the Executive Board of the CBA to make your voice heard and to help the CBA move forward. This year, at the AGM which will be held in Edmonton, we will be voting for new Directors. We are therefore looking for volunteers or accepting nominations for the following positions in the Executive Board:

- **Secretary:** This position is essential to the good functioning of our association and for the past 3 years has been filled by Santokh Singh.
- **Directors:** As Cindy Ross-Friedman and André Arsenault are finishing their mandate, we need nominations for a Western and an Eastern director, respectively.
- **Student representatives** from both sides of the country as James Jones from the East and Kristen Kilde from the West are soon graduating.

Participating in our association is rewarding. It tightens the links between colleagues! It makes us work with great persons who become very quickly friends! It makes us travel to places all across Canada! Do not hesitate and volunteer!

Frédérique Guinel,
Past-president of CBA/ABC

Appeal for help!

I am close to completing a check list of the vascular flora of the York Factory peninsula but have reached an impasse. Despite trying all the obvious locations I have been unable to track down the collections made by Robert Bell in 1880. These specimens were identified by 'Professor Macoun , F.L.S., of Albert University, Belleville, Ontario' and are listed in Appendix II of the Bell, R. (1881) Report on Hudson's Bay and some of the lakes and rivers lying to the west of it, Geological Survey of Canada, Report of Progress for 1879-80 (pt.C). I need to check some of the identifications which appear to be suspect. If anyone can tell me the whereabouts of these specimens I should be most grateful.

David Punter, punterd@cc.umanitoba.ca

Mycology Section News

We are delighted to remind everyone that our Weresub Lecturer at Botany 2015 will be Dr. Lynne Sigler, professor-scientist at the University of Alberta and the Devonian Botanical Garden. Dr. Sigler is a world-renowned fungal taxonomist in the arenas of medical mycology and soil biology. Her talk is entitled "Curating and characterizing fungi at the University of Alberta Microfungus Collection and Herbarium (UAMH) – a Canadian biodiversity centre" which will permit Dr. Sigler the latitude to relate her journey from novice to veteran over "44 years staring down the microscope".

The Weresub Lecture is open to the general public and promises to be a great journey. It was well attended in Montreal and we hope to repeat this outcome in 2015.

On another front, Dr. Mary Berbee, UBC, is working with Martin Osis, of the Alberta Mycological Society, to organize a mycological foray as part of Botany 2015. Picking permits are being arranged for Elk Island National Park (the last and biggest piece of protected Aspen Parkland in North America).

Stay tuned for more mycological news from Botany 2015 as it develops.

Hugues Massicotte and Shannon Berch
Co-Chairs of the Mycology Section



Rencontre Mycorhizes 2015

LES 8 ET 9 MAI, OTTAWA

Le Centre de recherche de l'est sur les céréales et oléagineux d'Agriculture et agroalimentaire Canada vous invite à participer à la rencontre Mycorhizes 2015. Le thème retenu «Les symbioses, c'est capital» réfère au rôle primordial des mycorhizes en recherche et développement, en production et protection des cultures et pour la durabilité de l'environnement.

Cette rencontre vous permettra de prendre connaissance des plus récentes avancées dans le domaine et offre une opportunité d'y présenter des résultats inédits. Au programme du 8 mai, des présentations orales, affiches et discussions, suivi le 9 mai d'une excursion aux champignons.

Pour obtenir les formulaires d'inscription, contacter Yolande Dalpé à yolande.dalpe@agr.gc.ca

Mycorrhizae 2015 meeting

OTTAWA, MAY 8 -9

The Eastern Cereal and Oilseed Research Centre of Agriculture and Agri-Food Canada is pleased to welcome participants to Mycorrhizae 2015. The theme for the meeting "The symbioses, its capital" was chosen to highlight the important role mycorrhizae play globally in terms of research, development, crop production, plant protection and environmental sustainability.

The meeting's purpose is to highlight the latest knowledge and development made in the diverse symbiosis studies and it offers a good opportunity to present original research. The meeting on May 8th will include oral sessions, posters and discussions and on May 9th a field mushrooming excursion.

To obtain registration forms contact Yolande Dalpé at yolande.dalpe@agr.gc.ca



THOMAS CHRISTOPHER (CHRIS) BRAYSHAW (1919-2014)

Mary Lou Florian, Helen Oldershaw, & Richard Hebda - Times-Colonist Obituaries, January 17, 2015

Prominent Canadian botanist Chris Brayshaw died on December 22, 2014, age 95, in his sleep. Chris was born on July 2, 1919 in Yorkshire, England, and came to Canada with his parents at the age of one. They homesteaded on a farm in Vernon British Columbia, where he grew up in a unique house that still stands today. His father taught at the local school and sold farm vegetables and fruit. He was a renowned fly fisherman and fish artist and his love of nature rubbed off on young Chris. His mother had studied botany at the Max Planck Institute in Germany, and she was a respected botanical artist. Chris was their only child and, as he often mentioned, the last of a long North-Yorkshire lineage. Much to his displeasure, Chris was sent to boarding school in England for his high school years. He returned home and enrolled at the University of British Columbia to train as a geologist just before the war, a field of knowledge that fascinated him. To his disappointment, he was instead put into biology.

At the outbreak of WWII in 1939, Chris enlisted in the Canadian Air Force in Toronto, was sent to Quebec and then to High River AB, at the (just opened) Empire Flying Training School for Navigator and Bombardier training. Seconded to the RAF in England, he served as navigator for coastal defense and U-boat hunting along the Irish coast, where he had many close calls. For his service he received the Distinguished Flying Cross. Chris completed his BA in biology after the war at UBC, and then went to the University of Saskatchewan, where he earned an MA on 'Prairie Grassland Research' in 1950.

From there he returned to UBC, where, in 1954, Chris earned his doctorate, defending his dissertation on 'Ponderosa Pine Ecology'. He was one of a several distinguished botanists who were learning together at UBC at the time, and with his colleagues he began a transformation of our understanding of British Columbia's plants and ecosystems. Joining the Federal Government in 1954, Chris ended up working in Ottawa and nearby Chalk River. His health deteriorated for a while so he adopted the credo that nature is humankind's best medicine. Chalk River is set near extensive forests, hills, and numerous lakes, rich in native wildlife typical of the south edge of the Canadian Shield. Always returning to nature, Chris made numerous field trips, taking extensive notes, and making many excursions into the wilderness of Algonquin Park and his health rapidly improved. Mindful of his love for the outdoors and his health, Chris declined a promotion in Ottawa.

In his own words, Chris "had a canoe, a VW beetle, and some money", and decided to return to British Columbia. He joined the BC Provincial Museum at the Legislative Buildings as a botanist in 1963, his "perfect



job". For the next forty years he served our province advancing and promoting knowledge of plants. He prepared for the move of the collections and facilities from the Legislature to the current site. He wrote several seminal books that he exquisitely illustrated as a true nature artist and son of his mother. He helped plan and develop the new facilities and exhibits, now so famous around the world. His VW Beetle, with canoe on top, traveled our province adding thousands of specimens to the botanical collections.

One of his major achievements was the planning and establishment of the first major Native Plant Garden in western Canada on the grounds surrounding the museum buildings. For the garden, he collected hundreds of living plant specimens around BC, some of which live in the garden today. He loved doing research on native species and tackled botanically challenging plant groups including willows and aquatic plants. At the same time he promoted the field of botany, leading public tours and writing a widely used booklet on plant collecting for the amateur. He broadened his knowledge of plants through trips to exotic lands.

As Curator Emeritus, his botanical contributions continued for 18 years beyond his retirement with the publication of even more books, including the comprehensive and richly self-illustrated *Trees and Shrubs of British Columbia*. He was a passionate supporter and botanical advisor of Beacon Hill Park and the Friends of Beacon Hill Park Society. He was a prime contributor to the living and natural values of the Beacon

Hill Park Official Management Plan. The Park's nationally important flora survives in great part due to his persistent efforts.

Chris never married, but was proud of his family tree and heritage rooted in the landscapes of Giggleswick, in the Craven District of North Yorkshire. His true love was taking his canoe on top of his VW beetle to some lake and spending time collecting plants, fly fishing, and cooking his fresh-caught fish over an open fire. In August 2011, Chris moved into Douglas Care Community on Niagara Street in Victoria, in the block next to his beloved Beacon Hill Park. We would like to thank the staff for their considerate care of, and friendship toward, Chris during his stay at Douglas Care.

Chris had the unique gift of being scientifically aware of the intricacies of nature, yet able to engage ordinary folks with the wonders and surprises of our natural world. He inspired and educated generations of botanists and naturalists. Yet, this gifted man remained humble and unassuming. His legacy will endure long into the future. The people who met and knew Chris will miss him.



Quercus garryana, drawn by Chris Brayshaw

Introducing PlantingScience to Canada

Catrina Adams[1] and Julia Nowak[2]

PlantingScience is an online mentoring program making a big impact on the way science, especially plant science, is taught in middle and secondary schools (grades 6-12). It stems from a challenge issued to scientific societies to bring scientists into the classroom and improve students' scientific literacy.

Students who have participated in this Spore Science Prize award-winning program have shared, through end-of-session surveys, how the program has opened their eyes to plants in their world.

For example, one student wrote: "This experience taught me that plants are more than what they just appear to be, they are creatures that develop in ways that are so different [than] mammals, humans, etc. They are a very beautiful type of species and they are very amazing to learn about."

Other students mention the impact that working with and getting personalized feedback from a practicing scientist has had on their confidence: "The thing I liked most about this experience was the fact that we had a mentor to guide us along the way, as well as other scientists who jumped in to give us feedback. I liked this the most because when our team wasn't so sure about the decisions we were going to make, our mentor assured us that we were on the right track and that gave us a little more confidence."

The program has been active for a decade, and to date nearly 900 scientists from 14 partnering scientific societies, including the Canadian Botanical Association, have come together to inspire interest in plant science. Together we have mentored over 16,000 students on student-generated plant science projects. Participating classes have come from 38 US states as well as schools from The Netherlands, South Korea, and Nigeria.

Although Canadian scientists have participated over the years as PlantingScience mentors, until just this year, PlantingScience has not been part of Canadian schools. US and other students have had the opportunity to enjoy and learn from this program of 10 years. As the program enters its second decade, let's work to bring the great opportunities of scientist mentors and teaching resources available through PlantingScience to benefit more Canadian students and their schools.

The first Canadian school that has become involved with the program is David & Mary Thomson Collegiate Institute in Toronto. Mr. Edmund Kim, Grade 11 Biology teacher at the school, has just registered with his students for the February 2015 session. Mr. Kim and his students were very excited to participate in PlantingScience and couldn't wait to begin their projects.



Mr. Kim's Grade 11 biology classes, the first Canadian students in the PlantingScience program

Although still new to the program, Mr. Kim feels that PlantingScience provides a great platform for communication between students and mentors "who have genuine interest and enthusiasm in teaching plant biology, science, and inquiry-based learning." The collaboration, he feels, is a very important part of this program and that it is essential for his and other students to have this exposure.

PlantingScience helps students gain a better understanding of how science is done, by learning experimental design, and how to follow through to the end of a project including analyzing their results. The importance of the collaborative interaction between students and mentors cannot be understated. Although there are many great science teachers out there, they cannot provide such extensive support for their students on their own. We know that it can take a village to raise a child; it can take the same to teach science.

This experience taught me that plants are more than what they appear — they are very beautiful and amazing to learn about!

— PlantingScience Participant

[1]Director of Education, Botanical Society of America, St. Louis, Missouri, USA
[2]Postdoctoral Fellow, Southern Crop Protection and Research Centre, Agriculture and Agri-Food Canada, London, Ontario, Canada

My mentoring role has allowed me a chance to reach out to students and schools I would never have had contact with otherwise... I feel like I've also inspired some of these students to look at plants more closely and maybe they've realized just how 'cool' plants can be!

— PlantingScience Mentor

PlantingScience provides the support of almost 900 mentors who each have many years of science experience, great enthusiasm for their field of study, and are eager to share with the younger generation.

As a past PlantingScience teacher writes: "PlantingScience has given me a framework for open inquiry. Students enjoy working with their mentors and it gives each group a chance to have some one-on-one feedback that I don't always have time to give them. Students embrace their projects more than anything else I do in the class and when they give their final presentations, important topics such as finding that similar results are often found between different groups who did similar experiments to show students how bodies of evidence are built up by multiple people studying similar topics."

PlantingScience provides full and complete support for teachers, mentors, and students. This includes extensive weekly newsletters, online resources for everyone involved to facilitate interactions during active sessions, and tips for how to get the most out of this program. Videoconferences are an option, allowing face-to-face interaction between classes of students and mentors, who may be thousands of kilometers away from each other.

Julia, one of 25 Canadian mentors, has been with PlantingScience for eight years and has found it to be a very rewarding experience. The online platform of PlantingScience is very convenient for those of us with busy lives. The interaction with your teams a few times a week for only a few weeks out of the year does not take away from your own research, but in fact can help by making you think about concepts that are important to basic research. You get to show the students what scientists are like and show them that we are also people too. Sharing your knowledge and passing it on to others is probably the most rewarding part of the program.

Catrina, who directs the PlantingScience program, is always looking for new mentors to join our team and help make a difference in the way students experience plant science. She interacts closely with mentors every day and has received enormous amounts of feedback about the benefits mentors get from participation.

As a graduate student mentor writes, "While online mentoring can be challenging, my mentoring role has allowed me a chance to reach out to students and schools I would never have had contact with otherwise...even though we were all once students, it is easy to forget how challenging it was the first time a teacher wanted us to set up an experiment on our own. I feel like I have really helped the students understand that science isn't always about getting the 'correct' results, and that there are always things to learn from 'failed' experiments. I also feel like I've also inspired some of these students to look at plants more closely and maybe they've realized just how 'cool' plants can be!"

Another benefit that mentors often experience firsthand is how important their participation is to breaking down negative stereotypes that students might hold about scientists.

As another mentor writes, "I love this stuff!! Actually, I think I was most impressed by the opportunity for these kids to have personal contact with a scientist. This may be the single most important element of this program. At the time I began my mentoring experience with PlantingScience, I was also doing a unit in a non-biology majors class about the nature of science. Students wrote essays about their experiences and perceptions of science. So many of these perceptions were negative. I think PlantingScience is an important step toward changing the public attitude toward science… This is HUGELY IMPORTANT!!!"

If the program sounds interesting to you, and if you would like to get involved in sharing your passion for science and plants with secondary students, please visit www.plantingscience.org/newmentor to learn more and register. The next session will begin in mid-September 2015. You can see what projects the student teams are working on this spring by browsing the research gallery. We also need your help to increase the number of participating Canadian schools. If you know middle or secondary school science or biology teachers that may be interested in participating with their classes, please direct them to the website (www.plantingscience.org) or contact Julia directly (nowakj3@gmail.com).

At Botany 2015, this summer's joint meeting in Edmonton, we have several events planned where you can learn more about PlantingScience. Please join Catrina and many other active PlantingScience mentors for the evening reception on Monday night from 7-8:30pm and a discussion section about the program (check the schedule for times).

The world can never have too much plant science. Sparking the love of plants in young people is an important step towards the future of plant science. We've heard lots of people say that 'plants are boring.' The students that become involved in PlantingScience learn that this could not be further from the truth. Not only do they learn new things about plants, they learn how science works. The amazing thing about PlantingScience is that the students are learning from those who are at the forefront of plant science: professors, scientists, technicians or graduate students such as you. Even if they do not go on to become plant scientists, at least students can come away from this experience being more science-literate. It all relies on the help of scientists like you, guiding students along in that journey.

Top Canadian Ornamental Plants. 10. Iris

Ernest Small[1,2]

The iris has become one of the leading ornamentals in the gardens of temperate regions. Its gorgeous flowers are unsurpassed in the plant kingdom, with an astonishing range of colours, sizes and interesting forms. The plants can be grown in a wide variety of situations, many are easily cultivated, and some are widely sold by florists as cut flowers for bouquets.



Figure 1. Spectacularly coloured iris flowers. As discussed in the text, these are all rhizomatous bearded irises, the dominant class of garden irises. **Left:** ©Lady Dragonfly (CC BY 2.0). **Centre:** ©Mike Ball (CC BY 2.0). **Right:** Cultivar 'Wild West', ©Kor!An (CC BY 3.0).

Names

Scientific names: The genus name *Iris* is based on *iris*, Latin and Greek names usually interpreted as "rainbow" but also as "a sweet smelling plant." The name is frequently explained as a reference to the many attractive colours of the flowers of the species being reminiscent of the colours of a rainbow.

English name: The common name "iris" has generally been employed to designate all of the species in the genus *Iris*, whether conceived narrowly or comprehensively. A few unrelated species have "iris" as part of their name, and several of the debatably included species are known by other common names. "Iris" is also the name in numerous other languages, including Danish, Dutch, German, Italian, Norwegian, Portuguese, Spanish, Swedish and Turkish.

French name: iris.

History

Irises have been valued since ancient times. Four millennia ago in Crete, the iris was the symbol of royalty and priests. To the early Egyptians, the iris represented power and majesty. The flower was depicted on the brow of the Sphinx and on regal sceptres. In classical Greece, irises were planted on the tombs of women. By Islamic tradition, white-flowered irises were grown on the graves of soldiers. In Christianity, it has been claimed that many Biblical "lilies" were actually irises. Irises have represented the birth of Christ in several well-known paintings, including Dürer's "Madonna with the Iris" and da Vinci's "Madonna of the Rocks." The three-parted flower has been interpreted as reflecting the three virtues of faith, wisdom and courage.

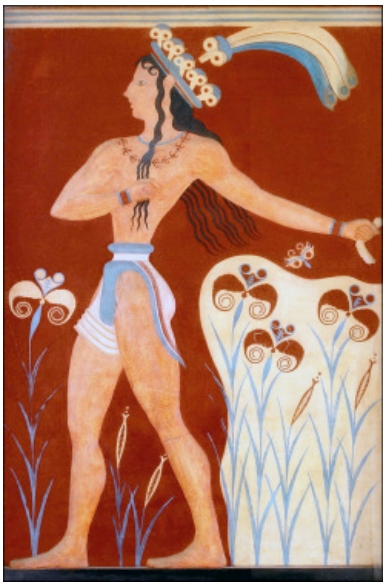


Figure 2. Restored fresco of the Minoan civilization's Priest-King from a wall of the Palace of Knossos in Crete, Greece (public domain photo). The original plaster relief was painted about 2100 B.C. The conventionalized irises shown have often been identified as belonging to the Xiphium category of bulbous irises, discussed in the text.

[1]Science and Technology Branch, Agriculture and Agri-Food Canada, Saunders Bldg., Central Experimental Farm, Ottawa ON, K1A 0C6
[2]©Government of Canada. Verbatim redistribution for personal, non-commercial use is permitted.



Figure 3. The French connection. **Left:** European yellow iris (*I. pseudacorus*), often interpreted as the basis of the fleur-de-lis. Source: Thomé, O.W. 1903. Prof. Dr. Thomé's Flora von Deutschland, Österreich und der Schweiz. Band 1, Fig. 139. H.V. Verlag, Berlin-Lichterfelde, Germany. **Top centre:** The fleur-de-lis backpatch, used as the emblem of Scouts Canada up until 1977. ©Chris (CC BY 2.0). **Bottom centre:** The flag of Quebec, showing four images of the fleur-de-lis and a white cross. Image courtesy of the Government of Quebec. **Right:** The floral emblem of Quebec, blue flag (*I. versicolor*), by Lavonia R. Stockelbach (1874–1966), an unpublished painting associated with the herbarium of Agriculture and Agri-Food Canada in Ottawa. The two emergent aquatic species shown here are allied to the rhizomatous beardless Japanese iris group discussed in the text.

Official symbols

Iris species are fairly widely afforded official symbolic status. *Iris versicolor* has been the floral emblem of Quebec since 1999. *Iris giganticaerulea* (giant blue iris or giant blue flag), a native of the southeastern U.S., was declared to be the official state wildflower of Louisiana in 1990. *Iris lacustris* (dwarf lake iris), a tiny plant endemic to the northern shores of Lake Michigan and Lake Huron, was designated the state wildflower of Michigan in 1998. It occurs in the Bruce Peninsula and Manitoulin Island in Ontario, and has been designated a threatened species in the U.S. and Canada. Iris (no particular species) was recognized as the "state cultivated flower" of Tennessee in 1933. *Iris nigricans* (black iris) is the national flower of Jordan. *Iris croatica* is the national flower of Croatia. The "iris" is often claimed to be the national flower of France. Several cities have designated the iris as their official flower, including Kansas City, Brussels and Athens.

Distribution and ecology

Iris species occur primarily in the Northern Hemisphere, with the greatest diversity in Eurasia (including 60 or so in China). In North America 34 species have been recognized north of Mexico. Habitats mainly include open grasslands, dense woodlands, mountainsides, deserts and sandy coastal areas. *Iris* species are found from sea level to alpine meadows over 4,000 m (13,000 feet), and from the Arctic tundra to the semi-tropics. Most irises (particularly the bearded and bulbous kinds discussed later) are found in circumneutral soils, but some (particularly the beardless kinds) occupy acidic ground. Species are variously adapted to substrates that are poor, fertile or stony. Species also differ in adaptation to wetness of soils, which may be dry, damp or covered by shallow water. Most irises prefer open, sunny locations, some tolerate semi-shade and a few are adapted to shade.

Flower characteristics

With the exception of orchids, no other popular group of ornamentals has flowers that are as structurally complex as those of iris species. Although the vegetative features of irises are considered attractive, as with the majority of the world's most important ornamentals, the plants are cultivated mostly for their large colourful flowers, particularly the tepals, which are divided into three outer sepals ("falls" in iris terminology) that flex downward and three inner petals ("standards") which remain upright. In some cultivars (especially in the Japanese group) doubling has occurred (i.e., extra petals have been generated). The style of irises is complex: it is divided into three "style arms" or style branches, each of which terminates in an upturned crest (or crest lobes), and at the base of the crest there is a small shelf termed the stigmatic lip. An anther is located under each style arm. The sepals, petals and style arms are often differently coloured, and indeed each of these may be variegated, and (although purple is the dominant hue) an astonishing range of colour combinations has been generated by hybridization and selection.

Like the flowers of many insect-pollinated plant species, the stigma of *Iris* flowers receives pollen from visiting pollinators (especially bees) and the anthers provide a fresh load of pollen to the visitors to fertilize other flowers. However, the *Iris* flower is peculiar in the architectural way it separates these two events. The large petal-like sepals of the iris flower function as a landing platform for flying insects, and markings (guides) direct the visitors to the nectary at the base of the flower. The petal-like style branch (above) and the petal-like sepal (below) provide a channel ("gullet") towards the basal nectary. This channel is partially blocked by the stigma, in the form of a flap, which is cleverly arranged

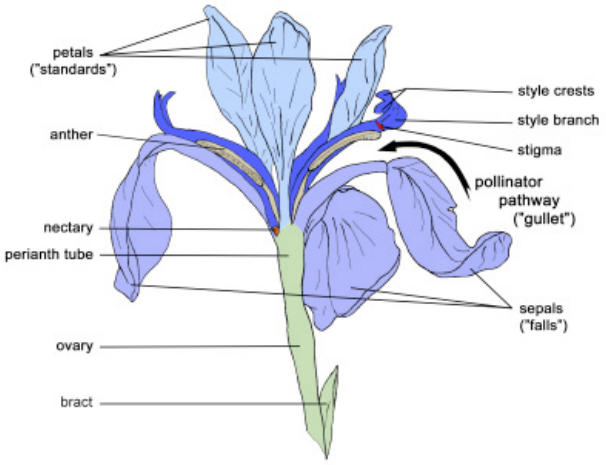


Figure 4. Diagram of the basic parts of an iris flower, based on *Iris versicolor*. Pollinators land on one of the large sepals and are guided towards the basal nectary, through a tunnel ("gullet") formed by the base of the sepal and the overhead style branch. During the inward trip, the insect deposits previously collected pollen on the upper (receptive) part of the stigma flap, and then picks up pollen from the anther; during the outward trip it brushes against the lower part of the stigma flap, but this is non-receptive to prevent self-fertilization. Prepared by B. Brookes.

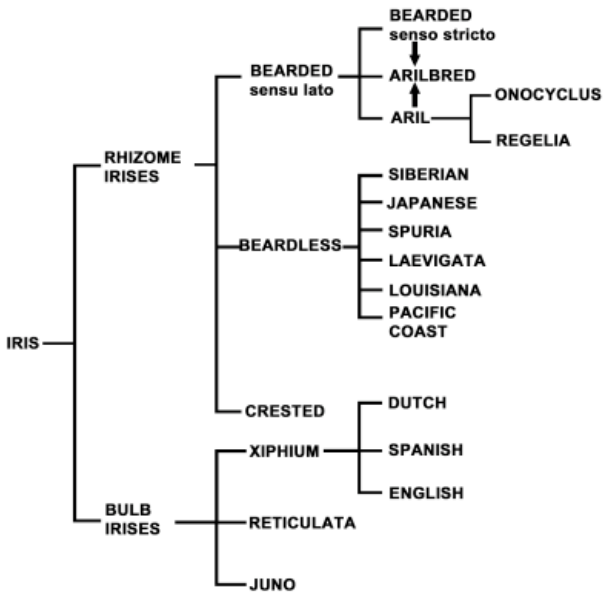


Figure 5. Simplified classification of the groups of cultivated irises discussed in this review. The groups indicated are horticultural (i.e., employed in the ornamental industry), but the hierarchy shown substantially reflects phylogenetic relationships and taxonomic classification. Bearded irises are dominant in Canada, followed by Siberian and Japanese irises.



Figure 6. Contrast of bulbous and rhizomatous irises. **Left:** *Iris persica*, showing bulb. **Right:** *I. pumila*, showing rhizome. Source of illustrations: Sowerby, J. 1787. Botanical Magazine, vol. 1. Public domain photos, placed online by Swallowtail Garden Seeds.

so that the receptive side faces the incoming pollinator. As the pollinator pushes against the stigma flap, the receptive surface removes pollen that was acquired by the insect from previous floral visits. The insect next contacts an anther, and acquires a new load of pollen grains, before reaching the nectary. Finally, while backing out of the flower, the insect comes in contact only with the non-receptive face of the stigma flap. Thus the insect is prevented from depositing its newly collected batch of pollen on the stigma of the same flower. Each of the three divisions of the flower (including a sepal, petal, style, stigma and an ovary locule) effectively functions as a separate flower.

Although the flowers of *Iris* are extremely well adapted for sexual reproduction, the plants (especially the rhizomatous species) spread very extensively by vegetative extension. Clones often persist for decades in abandoned gardens and other locations where they have become established.

Breeding has greatly modified the flowers of *Iris*, resulting in cultivars with unusual floral colours and structure. Some cultivars have been selected for long blooming period, and also for reblooming (although in Canada a second blooming in the autumn can reduce winter hardiness).

Classification

The genus *Iris* has close to 300 species (or much fewer, depending on taxonomic concepts). Specialists have noted that *Iris* can be recognized as a large genus composed of several groupings (subgenera), or as a smaller genus (of about 100 species) while what were previously classified as subgenera are instead recognized as allied separate genera. The simplified scheme shown in Figure 5 is roughly reflective of current taxonomic opinion regarding relationships in *Iris*, and is also basically the grouping system used horticulturally (rarely cultivated groups have been excluded). There are many segregate genera related to *Iris*, sometimes included in the genus, and a few of these (not mentioned in this review) are cultivated.

Iris species are herbs, deciduous or less commonly evergreen (in warm climates). They reproduce by seeds, but also by rhizome or bulb replication. (Plants of a third category, with swollen or “tuberous” roots, are rarely cultivated.) Irises are always referred to as “perennials,” but the above-ground (or water) shoots are usually annual (evergreen shoots might endure longer than a year), and the tissues of the below-ground-level storage organs (rhizomes or bulbs) may often live for only one season before reproducing themselves. Most

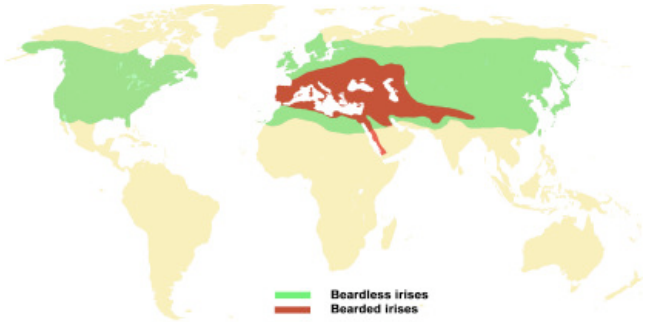


Figure 7. Geographical distribution of species of the two major classes of garden irises, bearded (pogon) and beardless (apogon). After Köhlein (1987). Bearded irises occur only in part of the range of beardless irises, and although a minority of iris species, they are a majority of garden irises.



Figure 8. The three sepal nectar guide systems characterizing the three major horticultural classes of rhizomatous irises. **Left:** bearded guide, representing the bearded group (species not identified), ©Sid Mosdell (CC BY 2.0). **Centre:** Simple distinctly coloured spot guide in *I. versicolor*, representing the beardless group, ©D. Langlois (CC BY 3.0). **Right:** crested guide (with raised areas) in *I. japonica*, representing the crested group, ©Sigusr0 (CC BY 2.0).

horticultural iris specialists employ the presence of rhizomes on the one hand or bulbs on the other as a principal basis for recognizing two broad groups (note Figures 5 and 6). Fibrous roots are attached to the storage organs (whether rhizomes or bulbs). The majority of irises grown in gardens are rhizomatous species. Bulb-bearing species, by contrast, are much less popular because they mostly originate from relatively cool areas of Asia that are supplied with water in early season but the shoots dry up to avoid midsummer droughts, so the floral display period is limited. Moreover, most of the bulbous species are relatively difficult to cultivate. However, many of the bulb-bearing species are suitable for rock gardens, indoor cultivation and the cut-flower industry. In most *Iris* species the foliage is linear and basal. The species with rhizomes usually have a clump (or fan) of sword-shaped leaves, while the species with bulbs often have cylindrical leaves.

Rhizomatous irises

Irises with rhizomes, the most popular kind of iris, are divisible (both taxonomically and horticulturally) into three basic classes, based on differences in nectar guides on the sepals, which assist pollinators in finding nectar. The three classes are bearded, beardless and crested. Most garden irises are hybrids produced between bearded irises, or between beardless irises (bearded irises rarely cross with beardless irises).

Bearded irises

Bearded (or "pogon," based on Greek for bearded) irises constitute the most popular, indeed the dominant class of rhizomatous irises. There are perhaps about 30 species, but additionally many hybrids have been given species names. Bearded iris species are mostly native to central and southern Europe east to Turkey, as well as a few from the Caucasus, North Africa and western Asia. The leaves develop in a fan (i.e. in a horizontal plane), and are usually sword-shaped and broader than in most other irises. Over 30,000 cultivars have been recognized. Bearded irises are characterized by a hairy, caterpillar-like row of trichomes on the distal half of the adaxial side of the sepals (rarely, also elsewhere). *Iris* ×*germanica*, a complex species with hundreds of cultivars, is perhaps the most widely grown. Bearded irises are very variable, and horticulturally have been divided into several height classes. Most garden irises are "bearded irises" in the narrow sense, i.e. excluding the aril irises mentioned next. The flowers of bearded irises have undergone considerable selection. One of the interesting changes has been the selection of so-called "horned irises" which have a distinctive upturned horn at the tip of the beard. More elaborate leafy mutations of the beard have been selected and referred to as "space-age irises," a controversial development intensely disliked by some iris specialists.

Aril irises

"Aril irises" are a class of irises with true arils – appendages on the seeds, which serve as food attractants to insects (particularly ants) for propagule distribution. Aril iris flowers have beards, but these are so sparse that the group is often not considered to be truly bearded. Two small groups of aril irises are



Figure 9. Flower of cultivar 'Thornbird', a "horned iris" (note upturned tip of the beard). ©Hope Abrams (CC BY 2.0).



Figure 10. Examples of some popular rhizomatous species of the beardless class. **Top:** Siberian group (Siberian iris, *Iris sibirica*, showing purple and white selections). ©Manuel (CC BY 2.0). **Centre:** Japanese group (Japanese iris, *I. ensata*) ©Cheryl Marland (CC BY 2.0). **Bottom:** Spuria group (*I. spuria*). ©Manuel (CC BY 2.0). (See Figure 13 for additional illustrations of rhizomatous, beardless species.)

relatively popular, Oncocylus irises (mostly Middle Eastern, extending from southwestern Europe to western Asia) and the closely related Regelia irises (native to open rocky hillsides and high mountains in Afghanistan and Turkestan). There are very attractive hybrid cultivars ("Regeliocyclus" irises) between Regalia and Oncocyclus irises. Because aril irises are adapted to warm, dry areas (in summer), in cold-temperate climates such as Canada they are usually grown in greenhouses. However, very attractive hybrids of aril irises and bearded irises (in the strict sense) have been generated (these are referred to as "arilbreds"). These are easier to grow than aril irises (they are often adapted to temperate areas with low rainfall), are generally tall with large flowers, and are occasionally cultivated in temperate gardens.

Beardless irises

Much Less dominant but still very popular in gardens is the beardless (or "apogon," Greek for beardless) class, in which instead of a fuzzy "beard" to guide pollinators there is simply a distinctive coloured area (generally yellow) signalling pollinators towards the nectary. Beardless irises on the whole do not produce as glamourous flowers as do bearded irises, but nevertheless many cultivars are very attractive. All native North American irises belong to this group. The main subgroupings of beardless irises are noted in the following.

Siberian irises

These are the best known and most popular of the beardless irises. Most Siberians come from Europe, eastern Russia, China and Japan. There are about a dozen species, of which *I. sibirica* and *I. sanguinea* and their hybrids are the most widely grown. Siberians, not surprisingly, grow well in Canada. Some *Iris* species of Oregon and California are closely related, and have been hybridized with the Eurasian species to produce cultivars. Siberians produce smaller but more numerous flowers than the more popular bearded irises. The flowers are available in a smaller, but still interesting range of colours. Siberian irises are fairly resistant to environmental and biotic stresses.

Japanese irises

Japanese irises are largely based on *I. ensata* and have been bred in Japan for at least the last 8 centuries. Many cultivars produce spectacularly large, doubled and often ruffled flowers. The largest iris flowers are produced by Japanese irises, some exceeding 25 cm (10 inches) in width. The species are moisture-loving, and are adapted to areas near ponds and bogs. In warm regions they can be grown submersed – no more than 8 cm (3 inches) has been recommended. In Canada, they will die overwinter in frozen water, and should be grown terrestrially, providing adequate irrigation. The colour range is limited (most cultivars are shades of violet) but wide ranges of colour variegation and floral structure are available.

Laevigata irises

These are wetland species of Eurasia and North America, typically occurring in standing water in their native locations, but capable of being grown in well-watered gardens. Many cultivars have been selected of *I. laevigata* by the Japanese. Blue flag (*I. versicolor*) and Virginia iris (*I. virginica*) of North America, and *I. pseudacorus* of Europe belong to this group, and hybrid cultivars of these species have been bred. These



Figure 11. Examples of the three major classes of the bulb-bearing iris category. **Left:** Xiphium class, "Dutch iris" (*Iris xiphium*) ©Wylie (CC BY 2.0). **Centre:** Reticulata class, *I. reticulata* ©Hedwig Storch (CC BY SA 3.0). **Right:** Juno class, *I. magnifica* ©Denis Prévôt (CC BY 3.0).

species are suitable for water gardens and for naturalizing in privately owned marshy areas.

Spuria irises

Spuria irises are native from western Europe through the Middle East to western China. They are not very popular, but have attractive orchid-like blooms, sometimes reminiscent of bulb irises. The name *I. spuria* has been applied to a complex of species, and the term "spuria irises" is more broadly employed to include over a dozen cultivated species and hybrids. Spuria irises range from dwarfs to quite tall plants. Some of the species are very vigorous, but most are unsuitable for Canadian climates.

Louisiana irises

"Louisiana irises" includes a group of five wetland species native to swamps of the American Gulf Coast (particularly concentrated in Louisiana). They can be grown on dry land, but need acidic soil that is wet in the spring. Hundreds of attractive cultivars, some with flowers 18 cm (7 inches) wide are available. Unfortunately, to overwinter they require a climate that is warmer than found in most of Canada.

Pacific Coast irises

"Pacific Coast irises" or Californian irises include a dozen or so species adapted to the Pacific West Coast of the U.S., particularly California (most are plants of mountainous and forested areas, often found in light shade). The environmental requirements limit cultivation in Canada.

Crested irises

The least popular class of rhizomatous irises, crested irises include about a dozen species, mostly in eastern Asia, with three in eastern North America. These are also called orchid irises (several of the Asian species look remarkably like orchids), and evansia irises (after Thomas Evans who introduced them to England in 1794). Crested irises usually have an elevation (crest), ridge, or occasionally a set of coloured bumps, where the beard or colour signal is found in other rhizomatous irises. Although some species are fairly tall, the group include many miniature cultivars, which are very small and produce tiny blooms. Crested irises are fairly demanding, the half dozen or so cultivated species differing in their growth requirements.

Bulbous irises

Most irises with bulbs are native to high altitudes from Israel and the Russian Caucasus to Turkey, Iran and central Asia. They are adapted to flowering in the high rainfall of spring, and go dormant during the very dry summers. They produce their foliage before flowering. Bulbous irises should be fertilized in the spring while they are growing, and split for replanting when they are dormant. A few of the hardier species can be grown outdoors as perennials in rockeries, borders and protected areas, but most are better suited for raised beds, containers and indoor situations. The bulbs can be lifted and stored overwinter (most but not all cultivars can be maintained dry). Bulb irises are not popular in Canada, indeed not in North America, and the selection of cultivars available is quite limited.

Xiphium irises

Xiphium irises (named for the most common species, *I. xiphium*) includes about eight species native to southern Europe and the Mediterranean area, mostly occupying well drained soils in hot, dry climates. These irises are relatively tall and slender, producing flowers that persist for many days, and leaves that are narrow, deeply channelled, and tending to be semi-circular in cross section. They are not suited to cold climates, although some cultivars can be grown in gardens in the warmest parts of Canada. The group is divided into "Dutch," "English" and "Spanish" irises, although these terms are misleading. The English irises are from *I. latifolium* from the marshy areas in the high Pyrenees of Spain and France; Spanish irises are selections of *I. xiphium*, which occurs in Europe (including Spain) and North Africa; the Dutch irises are hybrids of *I. xiphium* and other xiphium irises, which arose in cultivation (at first in the Netherlands, although none of the xiphium irises are

native there). English and Spanish irises were once popular, but are rarely grown today. They can be cultivated outdoors in mild climates, and the English selections tolerate shade. Spanish irises are sometimes grown as annuals in cold areas. Dutch irises can also be raised outdoors in mild climates, but are now chiefly grown for the cut flower florist's market, because the bulbs can easily be forced to come into flower. The bulbs are discarded after the flowering stems are harvested. Because they are mass-produced, the bulbs are very cheap and can be used to establish potted plants for indoor use.

Reticulata irises

The word "*reticulata*" is Latin for netted, a description of the appearance of the outer coat of the bulbs when stretched out. The dozen or so species are found from the eastern Mediterranean to central Asia. The species of this group are small and have small bulbs. A few species have been grown as rock garden plants, but this is possible only in the warmest areas of British Columbia. However, the bulbs can be started in pots and cold frames and maintained outdoors during the summer.

Juno irises

Junos include 60 or so species of exotic-looking plants of limited stature, but only about four are cultivated as ornamentals, and only infrequently. The bulbs tend to have several long, fairly thick roots, reminiscent of daylilies, and these can be used to grow new plants. Junos are natives of semi-arid areas of Asia, occupying steppes and mountainsides, and climates with hot, dry summers and cold winters. They are usually grown in pots indoors, and because they are very difficult to maintain, and most are not particularly attractive, they are mostly grown by specialists, although a few (such as *I. bucharica*) are occasionally grown in gardens.

Economic aspects

Ornamental usage

Iris species are among the most commonly grown ornamental plants, and are important in the nursery stock industry. There are numerous books dedicated to horticultural aspects, reflective of the popularity of irises.

Cut flowers

Bulbous irises are predominantly used in the cut-flower industry. So-called "Dutch irises" (Xiphium group) are the primary commercial cut-flower irises, and are hybrids of *I. xiphium* and other species, particularly *I. filifolia* and *I. tingitana*. They have been bred specifically for the cut flower market. Some of the other bulbous irises are also employed as commercial cut flowers. In the U.S., irises are about the 6th most important domestically produced cut-flower, with a wholesale value of about $15 million annually (statistics for Canada are unavailable).

Rhizomatous irises from private gardens are often employed in bouquets of cut flowers maintained indoors in residences, although individual flowers of most of the popular bearded irises last only a day or two. Many of the beardless irises also make good cut flowers, and the Japanese irises are very popular in Japan for display in vases. Because of their brief life, stems bearing buds rather than opened flowers are preferable.



Figure 12. Vase with bouquet of cut iris flowering stems, ©Dave Shafer (CC BY 2.0).

Orris root

"Orrisroot powder," prepared by drying and pulverizing the rhizomes of certain *Iris* species (especially the closely related *I. florentina*, *I. pallida*, and *I. germanica*), has been used in spices since the eras of the classical Greeks and Romans. Powdered orris, known as "violet powder," was once widely employed in Europe to scent clothing and linens. The juice of steeped *Iris* rhizomes has imparted a flowery bouquet to Chianti wine. Today, orris is still employed to flavour alcoholic beverages, particularly gin, vermouth and brandy. Orris is also widely used in cosmetics, and especially in perfumes. Irone, an ephemeral fragrance in the rhizomes, produces a pleasant violet odour, and orris also acts as a fixative for other scents. Much of orrisroot today is produced in southern Europe.

Medicinal uses

Iris rhizomes and orrisroot have been used medicinally in Europe since the times of the classical Greeks and Romans, for a wide variety of conditions. Similarly, North American Indians used *I. versicolor* rhizome for a range of medicinal purposes, especially topically to treat wounds, sores, and burns, and internally as a purgative, and to treat rheumatism, as well as disorders of the kidney and liver. Iridin (irisin) is a bitter extract of *I. versicolor* and *I. pseudacorus*, that has been used in herbal medicine for its diuretic (urine-stimulating), laxative, and blood-cleansing properties. Rhizomes of *I.*



Figure 13. Orris root: iris species employed for rhizome extracts, and examples of use in perfumes and gin. **Left:** *Iris germanica*. Source: Thomé, O.W 1885. Prof. Dr. Thomé's Flora von Deutschland, Österreich und der Schweiz. Gera, Germany. **Right:** *Iris pallida*. Source: Köhler, F.E. 1890. Köhler's Medizinal-Pflanzen, vol. 2. **Top centre:** An array of perfumes ©Joeannenah (CC BY 2.0). **Bottom centre:** An array of gins ©JonWorth (CC BY 2.0). The two irises shown here belong to the rhizomatous beardless iris class.

versicolor were even employed as a cure for syphilis. Virtually all medical usages of iris are considered obsolete today and are potentially dangerous, given the toxicity pointed out next. The rhizomes or their extracts have been used as an abortifacient, indicative of the need for caution.

Toxicity

Iris species are well known for their toxicity. Small amounts of the rhizomes or large amounts of the leaves, even if dried, are quite purgative, and can also cause depression and respiratory problems. Consumption of iris bulbs can also result in severe digestive upset. The juice of irises can produce dermatitis in sensitive individuals. Livestock avoid eating iris foliage. Cases of death of humans have been recorded, and ornamental rhizomes that are stored for planting are a potential risk to dogs. Irisin (mentioned above) may be responsible for some of the poisonous effects, but other compounds are suspected of being more toxic.

Cultivation notes

In Canada, most garden irises are bearded irises. Less frequently grown are the more popular non-bearded irises, particularly Siberian irises. Irises can be established from seeds, but this will usually delay the development of flowers for 2 or 3 years, and the hybrids that now dominate garden irises will not reproduce true to type from seeds (some cultivars will not even produce viable seeds). Most irises are started in the form of rhizomes with clipped leaves and roots attached (purchased or obtained by donation or trading). These need to be planted soon, preferably within a week. The rhizomes should be established in well-draining circumneutral soil (ideally 6.8 for bearded irises, slightly more acidic for beardless irises) which preferably has been well worked, with competing nearby grass and weeds removed. Most irises thrive with light fertilization, and high-nitrogen fertilizers should be avoided as they promote soft growth susceptible to stresses. Irises grow best in an open, sunny location (at least 6 hours of direct sunlight daily). Avoiding areas crowded with other plants is a way of increasing air circulation and lessening the humidity that promotes fungal infections. Occasionally iris beds are "contaminated" by seeds formed on the plants that have developed as a result of hybridization with plants outside the bed, and when they grow in the bed the resulting plants are often not as attractive. This can be prevented by removing fruits.

Bearded iris rhizomes should be planted shallowly, the top barely below the surface (after soil settling). However, the earth surrounding the rhizome should be firmly compacted to keep the growing plant from toppling over. Depending on ultimate size, plants should be about 50 cm (18 inches) apart (or more, to lengthen the time necessary to replenish the bed), and several rhizomes can be planted with the growing tips pointed in the same direction so that an area will be filled in during the next few years. Iris specialists commonly plant iris beds in patterns that anticipate even filling of the bed in the future, particularly rows and triangles (one plant at each of the three apices). Water should not accumulate in the planting area, and raised beds and slopes can be employed to promote drainage. Depending on how well the plants grow and become overcrowded (3–5 years, generally), or if rhizomes are frost-heaved out of the ground, new rhizomes should be cut off and used to establish new plantings or to replace old clumps that have become overcrowded. Such new rhizomes should be harvested 1–2 months after flowering (cutting away



Figure 14. Principal parasites of iris. **Top:** Iris borer (larva of the native American night-flying moth *Macronoctua onusta*). This is the most destructive insect pest of irises in North America (Siberian irises are relatively resistant). Eggs are laid among dead foliage in the autumn, a single female depositing as many as 1,000 eggs. In the spring the tiny larvae chew into and mine the leaves (causing evident damage). The caterpillars eventually migrate down and bore into the rhizomes where they grow to 2.5–5 cm (1–2 inches) in length. Iris borer feeding in the rhizomes facilitates the entry of bacterial soft rot. To reduce infestation, remove the previous year's dead stalks and foliage at least by early spring, and destroy visible grubs. **Bottom:** Bacterial soft rot (caused by the bacterium *Pectobacterium carotovorum* = *Erwinia carotovora*). This is the principal disease of bearded irises, and also affects Siberian and Japanese irises, transforming rhizomes into a smelly mush. The first signs of infection are yellowing and falling off of leaves. To prevent spread, lift and discard the rhizomes. Photos ©Bob Gutowski (CC BY 2.0).

the upper two-thirds of the leaves, traditionally so that the remaining fan of leaves is pointed), and also trimming the fibrous roots. It is also possible to transplant entire clumps or portions of clumps (again, trimming the foliage). Transplanting should be carried out to allow 6 weeks or more for roots to establish before a hard freeze. Rhizomes transplanted in late summer should produce flowers the next season. Rhizomes transplanted in the spring may flower the same season, but flower production will be limited.

Beardless irises are cultured somewhat different from bearded irises. Siberian and Japanese irises are the principal categories grown in Canada. As most require higher soil moisture, planted rhizomes should be maintained moist, and well-watered when planting. Allowing the young plants to become dry during early growth is a common cause of mortality. The rhizomes should be buried shallowly, but deeper than for bearded irises (a least 2.5 cm or 1 inch). Transplanting rhizomes is commonly done in the fall (allowing at least a month before freeze-up to allow root establishment), but Siberian irises also transplant particularly well in the spring. Many Siberian iris cultivars will tolerate light shade. Japanese irises grow best in slightly more acidic substrates (5.0–6.5). They also grow better in richer soils than most irises, and benefit from spring and post-flowering fertilization, and incorporation of organic matter into the soil. Also, rhizomes should be planted deeper (5–8 cm or 2–3 inches). Unlike most large rhizomatous irises, Japanese irises grow well in containers.

Curiosities of Science and Technology

- In ancient Greece, Iris was the Greek goddess of the rainbow, daughter of the ocean spirit Electra, and a messenger of the gods. Depicted with rainbow wings, she is said to have used the rainbow as a pathway through the sky, and wherever her feet touched earth there appeared iris flowers in a rainbow of colours.
- Shah Jahan had the world-famous Taj Mahal erected in India after the death of his favourite wife in 1631. Some of the rooms are decorated with stone inlay based on an iris motif (daffodils, narcissus, tulips and poppies are also illustrated). There are old bearded iris cultivars named 'Shah Jahan' and 'Taj Mahal'.
- The Ojibwa carried a piece of blue flag iris as a charm against snakes. The Arizona Indians are believed to have chewed blue flag before holding rattlesnakes in their mouths during snake dances, the odour said to be protective against bites.
- A solution of the flowers of blue flag produces a blue dye that has been employed like litmus paper to test for pH.
- Adding a cut daffodil stem to a bouquet of cut iris flowering stems in water delays senescence of the iris flowers, due to the presence of the compound



Figure 15. Canadian coin and stamp featuring irises. **Left:** the 2013 $20 coin (marketed for $120.00) is based on blue iris (*Iris versicolor*). It contains 99.99% silver, and the sepals are dotted with sparkling Swarovski crystals. **Right:** the stamp (issued in 2004) is identified as "purple Dutch iris" (a domesticated form of *I. xiphium*, as noted in the text). It features a "kiss cut" (simulated perforations on top and bottom), and the $1.45 cost represented the international rate at the time.



Figure 16. Left: Taj Mahal ©Yann and Jim Cartar (CC BY SA 3.0). **Right:** Limestone wall in the Taj Mahal, showing floral carvings (below) and inlays of semi-precious stones in the form of stylized flowers (above) ©Buddhika Siddhisena (CC BY 2.0).

narciclasine in daffodil mucilage. By contrast, adding a daffodil stem to other common flowers (tulips, for example) greatly hastened their senescence (Van Dorn et al. 2004).

- While most irises have nectar guides on the sepals, and indeed produce nectar for pollinators, some Asian species lack both nectar guides and nectar. These nevertheless lure pollinators (large male bees), apparently by providing early morning warmth. The flowers are quite dark, absorbing heat in the cool early morning, allowing the bees which shelter overnight inside the flowers to emerge earlier (Sapir et al. 2005, 2006).
- The fleur-de-lis, interpreted as the iris, was the royal badge of France until the end of the 19th century, when the French Revolution dissolved the monarchy. The French revolutionaries adopted the violet as their floral symbol, and anyone found wearing an iris went to the guillotine.
- The leaves of *Iris florentina* yield iris green, a natural colouring once popular with artists. Curiously, irises have also been popular subjects for artists, particularly Vincent Van Gogh (1853–1890).

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Note: Irises may be second only to roses in the number of gardening books dedicated to them. Those cited here are relatively recent and comprehensive.

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Figure 17. Photo (public domain) of one of Vincent van Gogh's several paintings entitled "Irises," currently owned by the Getty Museum in Los Angeles. This version was painted in 1989 while van Gogh was in an asylum in France. In 1987 it sold for $53,900,000, at the time the highest selling price ever obtained for a painting.

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Key Websites

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British Iris Society – http://www.britishirissociety.org.uk/

Canadian Iris Society – http://www.cdn-iris.ca/ [Includes cultural information for growing bearded, Siberian and Japanese irises in Canada.]

Acknowledgements

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Figure 18. Vintage seed catalogues featuring bearded irises. Public domain photos, placed online by Swallowtail Garden Seeds. (See Figure 1 for additional illustrations of rhizomatous bearded irises, the dominant class of garden irises.)

Major invasive alien plants of natural habitats in Canada. 11. Flowering-Rush, butome à ombelle: *Butomus umbellatus* L.

Paul M. Catling[1,2], Gisèle Mitrow[1] and Amanda Ward[1]

Flowering-Rush was listed as number 25 in the prioritized list of 81 major invasive aliens of natural habitats across Canada. Although in many respects it is a distinctive plant, there are two noteworthy aspects of identification: deeply submersed non-flowering plants may be confused with other species and there is morphological evidence for more than one taxon in Canada, although only one taxon has been recognized worldwide in recent literature. The plant is extending its range into western Canada and may be more of a problem there than it has been in the east.

Classification and Identification

Flowering-Rush is in the Flowering-Rush Family, Butomaceae, which is native to Eurasia and contains the single genus *Butomus* with the single species *umbellatus* L. It is a distinctive plant that is not likely to be confused with any other plant when in flower. Prior to flowering or in deep water without flowers, it may be confused with *Acorus* spp., *Vallisneria* spp., *Juncus* spp., *Sparganium* spp. and *Typha* spp. The leaves of some of these species differ by not being triangular and having a prominent midvein. A pressed leaf of Flowering-Rush with its triangular stem (in a herbarium specimen) and with a pointed edge facing up may give the impression of a midvein, but it is of course not seen when the leaf is turned over. The dry and pressed leaves often have transverse, or obliquely transverse or wavy-transverse septa (raised and thickened areas). Leaves are without a ligule at the junction of the sheath and the blade (a transverse band of tissue), and the rhizome is short and thick instead of narrow and elongate or lacking as in species of *Pontederia*, *Sagittaria*, *Sparganium*, and *Vallisneria*. The pinkish colour of the bases of Flowering-Rush leaves is also helpful for identification.

Rarely a specimen of Flowering-Rush is confused with ornamental Onions (*Allium* spp.) and even more rarely mistaken for a native Onion. A flower of Flowering-Rush has 9 rather than 6 stamens, and 6 separate simple pistils instead of a single compound pistil.

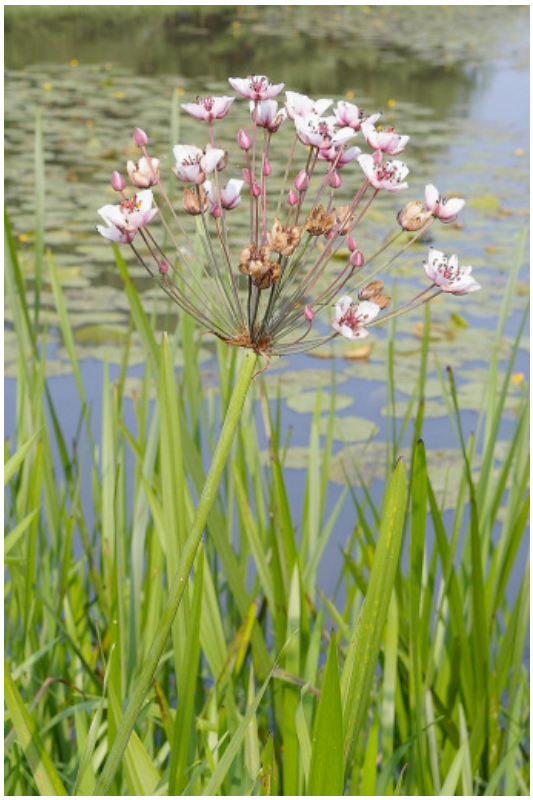


Figure 1. Plant of Flowering-Rush, 13 June 2007, North-eastern Lower Saxony, Germany, ©Christian Fischer (CC BY-SA 3.0).

Description of Flowering-Rush

Smooth perennial herbs with scapes 0.5–1.5 m tall, rounded in cross sections, arising from large horizontal rhizomes with fibrous roots and sometimes with vegetative buds (bulblets, also referred to as bulbils or turions), and a sequence of rosettes. Leaves in a basal rosette, linear, triangular in cross-section, sheathing at the base, sometimes twisted and as long as the leafless stems (reported to be up to 2.7 m long (probably when submersed), mostly 1-1.5 m long, 6-10 mm wide). Inflorescence umbellate, cymose, involucrate with 2 to 3 lanceolate-acuminate bracts up to 25 mm long and 6-8 mm wide, and numerous bractioles, 10-25(30) flowered, pedicels 4-10 cm. Flowers pink, reddish-pink, or pinkish-white, 2-3.5 cm in diameter; perianth segments 6, in two series, outer tepals 6-7.5(13) mm long and 2-2.5(8) mm wide, elliptic or obovate, acute; inner tepals 9-14(17) mm long and 4.5-6(8) mm wide, elliptic to oblonceolate or broadly obovate, apex obtuse, entire or erose. Stamens 5-9 or more; filaments linear, basally dilated, free or slightly connate at the base, 3-7 mm long, anthers ovate to oblong or linear-oblong in young flowers, 2-4 mm long, carpels mostly 6-9, 3-5.5 mm long, free to basally connate, obovate; style simple, terminal, persistant; stigma ventral, initially straight becoming curved. Ovules numerous. Fruit many-seeded, beaked follicles, 7-10 mm long, 3-3.5 mm broad; seeds oblong and winged, 1.5-2 mm long.

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[2]©Government of Canada. Verbatim redistribution for personal, non-commercial use is permitted.



Figure 2. Flowering-Rush in Flora von Deutschland Österreich und der Schweiz (1885)



Figure 3. Flowers of Flowering-Rush, 22 May 2009, Botanical Garden, Karlsruhe, ©H. Zell (CC BY-SA 3.0).

THE JUNCEA *DILEMMA*

In the Flora of USSR, *Butomus umbellatus* var. *junceus* (Turcz.) Micheli is described as a smaller plant with smaller flowers from Asia whereas the larger European plants were treated as var. *umbellatus*. The qualitative character given to distinguish var. *junceus* is a straight stigma compared to the curved stigma in var. *umbellatus*. However, observations of many Canadian plants do not suggest a clear correlation between flower and plant size and whether or not the stigma is curled. Furthermore when flowers first open and pollen is released, the stigmas appear straight but in older (female) flowers where pollen has already been dispersed, they curve to produce a larger stigmatic surface. Not only are individual flowers protandrous (male first), but protandry is synchronous (synchronous dichogamy) in an inflorescence, so that all open flowers tend to look the same. Flowers of both kinds do occur in the same inflorescence, but at different times. Regardless, protandry may have led to the curved stigma character, which therefore may not be a result of genetic differentiation. Thus the straight or curved stigma requires more study prior to use as a taxonomic character. It is also more complex than it appears because anthers are said to open and close to avoid bad weather and to prolong pollen longevity.

We might easily dispense with var. *junceus*, as recent authors have done, were it not for two observations. Firstly a paper provided evidence that var. *junceus* occurred in the Maritime Provinces, St. Lawrence region, Lake Ontario, and western New York (as well as New England, i.e. northeastern North America) and that plants from Lake Erie westward were var. *umbellatus*. The sample size was small but it was at least a very interesting hypothesis and included evidence of two different points of introduction to support the two different North American distributions. The authors did not necessarily consider the genus to have two species and they emphasized the need for further study. Secondly, the legendary botanist from Ohio State University, Dr. Ronald L. Stuckey, believed in the separation and he produced a more complete map. His support for the idea meant a great deal, but it was evidently preliminary and was not synthesized into a scientific paper.

We prefer to recognize only *Butomus umbellatus*. The reason is that it seems inappropriate to split the taxon without some more supportive information from its native range. The classification should be based on the full range of genotypes that exist in the native range rather than a few, or even a few dozen, that have been introduced to North America. Additionally, common garden experiments may prove useful to determine the extent to which the size is phenotypic or genotypic. Taking this approach we need not worry about whether or not there have been multiple introductions and the likelihood of introduction by the English or French from

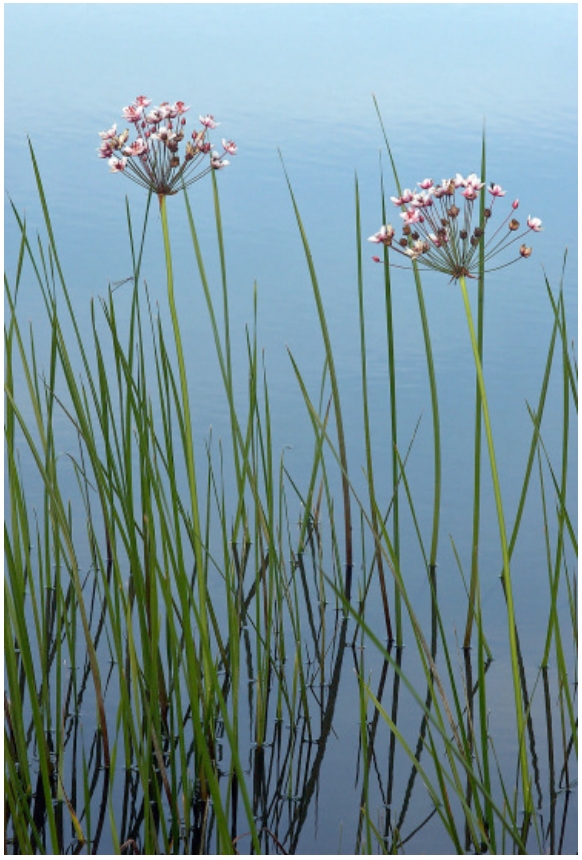


Figure 4. Plants of Flowering-Rush, 10 Sept. 2011, North-eastern Lower Saxony, Germany, ©Christian Fischer (CC BY-SA 3.0).



Figure 5. Fruit of Flowering-Rush, ©Meneerke Bloem (CC BY-SA 3.0).

China (as required for var. *junceus* in the St. Lawrence).

The extent to which two taxa within *B. umbellatus* (which have been described to some extent as differeing in size) are associated with two ploidy levels (see below under ecology) requires more study. There are both diploid and triploid plants. Diploids are self-compatible, flower abundantly, produce a large amount of seed, and also produce bulblets on rhizomes and in inflorescences, whereas the triploids are self-sterile within clones, flower less frequently, produce a smaller amount of sterile seed, and do not produce bulblets in the inflorescence. Diploid populations are said to be more frequent than triploids in parts of the Great Lakes Region and they appear to be less frequent and more restricted than triploids in the European range. The polyploids may have a broader distribution in North America due to greater ecological tolerance. Hybridization between diploids and triploids and between different triploid populations has been reported.

Plants from deep water which have slender and flaccid leaves, up to 2 m long and which do not flower have been referred to f. *vallisneriifolius* (Sagorski) Glück. When plants of f. *vallisneriifolius* are transplanted to shallower water, they become the normal flowering plants with stiffly erect leaves, and when normal plants are transplanted to deeper water they come to look like f. *vallisneriifolius*. Since it is simply a deep water growth form, *vallisneriifolius* does not deserve taxonomic recognition.

A form with variegated leaves is in cultivation in Europe but it is not vigorous and seldom seen.

Distribution

Flowering-Rush is native to Eurasia and introduced in southern Canada and adjacent United States. Its date of arrival in North America is difficult to ascertain but it seems likely that early colonization involved at least two separate introductions, one in the St. Lawrence River region and another around Lake St. Clair. In the latter area on River Rouge marshes at Detroit “before the operations of the Ford Motor Company [1930s], it covered acres of marshes … there is nothing to prove or disprove the belief that the plant was brought over by Cadillac’s party more than three centuries ago and that it has persisted ever since”. In Canada it was first discovered in 1897 in Montreal and was present in Quebec City 1922, a major period of invasion occurred in the St. Lawrence region between 1932 and 1935 but spatial distribution has not expanded much in the east since 1935.

Based on the examination of 811 herbarium specimens from across Canada, the earliest specimens were collected in eastern Canada, and this species shows the east to west expansion pattern of some other invasives, particularly European Common Reed (number 1 in this series, see CBA/ABC Bull. 44(2): 52-61). The

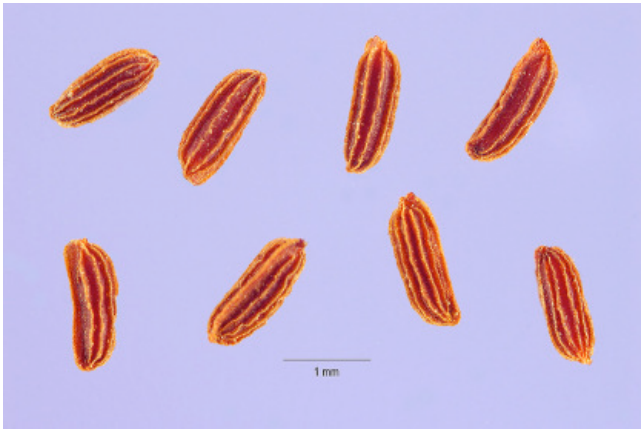


Figure 6. Seeds of Flowering-Rush, photographed at Lake Champlain, New York USA by Steve Hurst, hosted by the USDA-NRCS PLANTS Database. Used with permission.



Figure 7. Flowers of Flowering-Rush, 1 Aug. 2007, North-eastern Lower Saxony, Germany, ©Christian Fischer (CC BY-SA 3.0).

earliest dates in each province are: Quebec in 1887 (first observation), but first collected at Montreal in 1905 at Longueuil (MT); Ontario first reported in 1906 in Ottawa and first collected in 1912 in Ottawa near Bank Street and canal (CAN, DAO); Prince Edward Island in 1953 (DAO); Nova Scotia in 1958 at Annapolis (ACAD, DAO, MT); Manitoba in 1964 at Netley Creek (DAO); British Columbia in 1978 at Hatzic Lake (V, ALTA); New Brunswick in 1982 at Eel River estuary (NBM); Alberta in 1990 at St. Albert (ALTA, DAO); and Saskatchewan in 2003 east of Young (SASK).

It is likely that since the first colonization there have been numerous intentional introductions of Flowering Rush, both from outside Canada and within. For example it was imported from Scotland 1940 (TRT) to be planted on the shore of Grenadier Pond in Toronto. It was also imported by Manitoba Natural Resources in 1948 when 11,000 corms were sent from Chatham, Ontario "for trial planting in the province" (DAO herbarium records).



Figure 8. Submersed plant of *Butomus umbellatus* found on Lake Pend Oreille, Idaho, ©Dr. John Madsen. Used with permission.

Three accompanying maps showing distribution in Canada are based on collections from ACAD, ALTA, CAN, DAO, HAM, LKHD, MMMN, MT, MTMG, NBM, NSPM, OAC, QFA, QUE, SASK, TRT, TRTE, UAC, UBC, UNB, UWO, V, WAT and WIN. The total distribution map suggests abundance in the Upper St. Lawrence and lower Great Lakes regions with a sporadic distribution in the Maritime provinces (where it is said to be abundant only in the Eel River estuary) and across central and western Canada. Another map indicates that the submersed form has been found primarily associated with fluctuating water levels in the St. Lawrence region but may be expected anywhere since it is simply a deeper water growth form (see above). The map illustrating different size classes of inner tepals suggests that plants with larger tepals occur in peripheral and more northern populations, as might be expected if their larger size is indicative of hardier triploids.

Flowering-Rush appears to be in the process of expanding across western Canada. Its main expansion will likely be via presently known colonies and possibly unknown sites in the west as well as from areas in the adjacent western states where it has already become a problem. The United States Environmental Protection Agency considers it to be actively expanding in the U.S.

Ecology

Flowering-Rush is usually aquatic, occurring in water up to a depth of 3 m but may found in wet soil of ditches, shorelines, meadows and marshes, especially when water levels have dropped. Substrates may vary from gravel and sand to clay. It is said to tolerate a substantial pH range, but has been found mostly in calcareous alkakine and neutral waters in Canada. In some shoreline areas there are plants growing along an entire gradient from wet soil to water 2 m deep. Triploids are larger, more viable under eutrophic conditions, and occur further north in parts of Europe and possibly also in Canada.

A major dispersal agent in North America is still humans through gardeners and garden supply companies, and dispersal in this manner can occur over

great distances. Significant dispersal by humans can also occur through plants attaching to boats and boat trailers. Dispersal over short distances is by readily creeping rhizomes, and over longer distances by small buds (also referred to as turions, tubers, bulbils and bulblets) disconnecting from the rhizome or inflorescence and carried by water. Rhizomes may be dislodged and dispersed naturally by floodwaters, and by birds and mammals seeking nesting or building material (especially muskrats and beavers). The inflated follicles and seeds can be dispersed by water. Finally the seeds can be dispersed by adhesion to mammals and birds. In the St. Lawrence River it has been transported in sediments trapped in ice that floats downstream after flooding in spring.

Nectar is secreted into the base of the flower. The pollinators include and bees, butterflies, moths, flies, wasps, and beetles. It has been shown that an increased seed production occurs in expanding North American populations compared to European populations, but there is some evidence (not clearly quantified) that recruitment from seed rarely occurs in introduced populations.

Detrimental Aspects

Significance is suggested by the number of asterisks, 0 indicated least- and 5 most significant.

In Canada it is regulated (covered by weed legislation) in Alberta, British Columbia and Saskatchewan. In the US it is regulated in Colorado, Connecticut, Illinois, Minnesota, Montana, New Hampshire, North Dakota, Oregon, Utah, Vermont, Washington and Wisconsin. It is listed as one of 29 top priority invasive plants for control in southern Ontario by the Ontario Invasive Plants Working Group. The Horticulture Society of Quebec (Fédération interdisciplinaire de l`horticulture ornementale du Québec) advises against planting it. In Canada the release of invasive aquatic plants and environmental changes resulting from their control is an offence under the federal Fisheries Act and Migratory Birds Act.

(1) Negative effects on biodiversity *****

There are no field experiments to prove displacement of native species of plants and animals but there is circumstantial evidence, and Flowering–Rush certainly occupies habitats that would otherwise be occupied by native species. In the St-Lawrence Region *Butomus umbellatus* has been rated as having a lesser impact on plant diversity then Common Reed and Reed Canary Grass and is the third most frequent plant occurring in 46% of sample sites. It may have reduced native plants along the St. Lawrence River estuary almost 100 years ago (see text box with quote from Fernald in 1929). Current studies therefore may be post-impact in this region. There are now 17 native plants on the shores of the St. Lawrence River that are still potentially threatened by Flowering-Rush. It was found at a third of the sampled coastal wetlands on Lakes Erie and Ontario

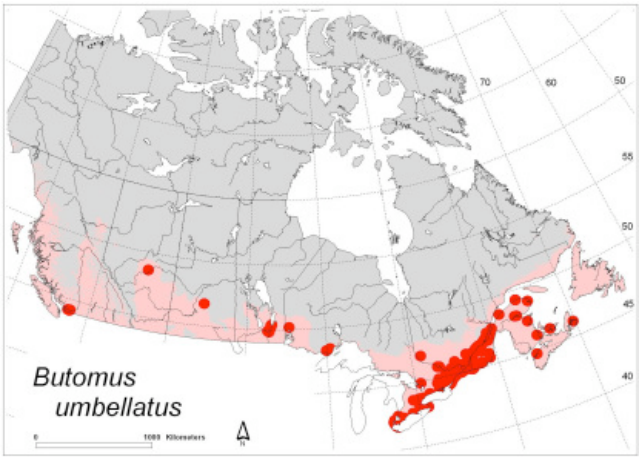


Figure 9. Distribution of Flowering-Rush in Canada from herbarium specimens as described in the text. The pink shaded area indicates hardiness zones 2a and above indicating potential climatic tolerance in Canada based on the northernmost occurrences.

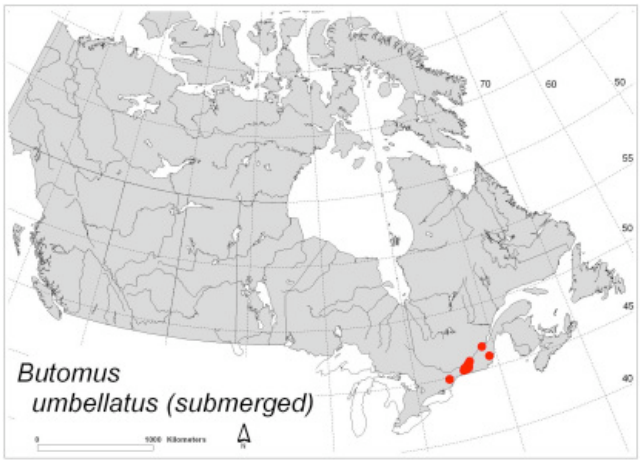


Figure 10. Distribution of the submersed form of Flowering-Rush in Canada based on herbarium specimens.

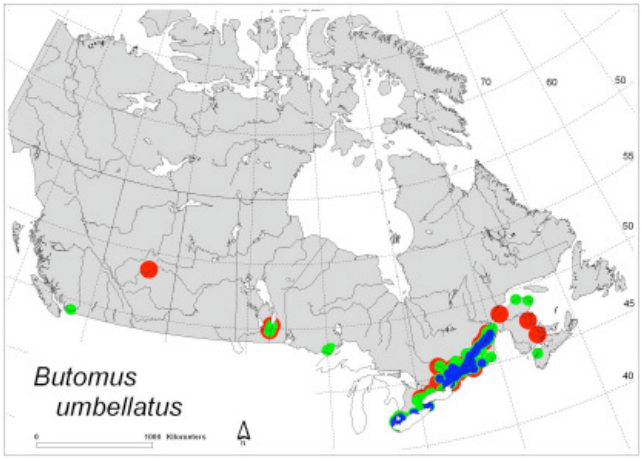


Figure 11. Distribution of inner tepal lengths in Flowering-Rush herbarium specimens. Tepals less than 10 mm long are the smallest blue dots plotted over top of all others. Tepals 10.1 to 13.9 mm long are shown with medium-sized green dots. The largest tepals 14 to 17 mm long are shown with red dots which are the largest and therefore still visible despite the lowest plotting priority.



Figure 12. Flowering-Rush obstructing water movement in a ditch, Innisfail, Alberta, ©L. Gillespie (CC BY-NC-ND 3.0)

and it forms dense stands in parts of Lake Champlain where it appears to displace native species.

(2) Blockage of drainage and irrigation **
In the Flat Head Valley of Montana it has colonized 150 miles of the main irrigation canal reducing water availability to crops and requiring costly removal every two or three years. It has been reported as an irrigation problem in other parts of the western US and has potential to be damaging in Canadian irrigation districts in Alberta. It is reported to block irrigation canals in the native range in Romania and other parts of Europe.

(3) Impact on native fish **
In parts of western North America it is beneficial to introduced fish such as smallmouth bass, northern pike and yellow perch but deleterious to native Salmonid fish which require open water to spawn and are preyed upon and compete with the introduced species. It can also negatively impact native fish by forming dense stands and changing the aquatic plant community.

(4) Obstructs traffic and recreation **
In the western US it has been reported to obstruct water traffic and water based recreation including swimming and fishing.

(5) Negative impact on Wild Rice **
Flowering-Rush has been identified in both Canada and the United States as a potential risk in the cultivation of Wild Rice. It has resulted in decline of some populations of the very restricted Dwarf Wild Rice (*Zizania palustris* var. *brevis*) in the tidal estuary of the St. Lawrence River in Quebec. It also occurs as a weed in cultivated rice in Italy.

(6) Public health *
It has led to increased in populations of the great Pond Snail (*Lymnaea stagnalis*) which is an intermediate host of the trematode *Trichobilharzia ocellata*, responsible for Swimmer's Itch.

Beneficial Aspects

(1) Food **
The rhizomes, with more than 50% starch, are edible (peeled and rootlets removed). They can be dried and ground into powder to thicken soups and sauces or added to cereal flour for making bread. They have been used as food in parts of northern Europe. Since they may concentrate toxic chemicals, rhizomes from polluted areas should not be used for food.

(2) Use by wildlife *
Ducks graze on Flowering-Rush in Europe. It is provides cover for aquatic animals (but see above). It may also sustain some pollinating insects.

(3) Gardening *
It is an attractive plant in water gardens but is either prohibited or discouraged throughout its North American range. A better use for it in North American gardens may be as compost.

Management

Horticultural Substitutes:
The following plants are suggested as wetland restoration substitutes; Northern Blue Flag (*Iris versicolor*), Hardstem Bulrush (*Schoenoplectus acutus*), Giant bur-reed (*Sparganium eurycarpum*), Sweet Flag (*Acorus americanus*), Arrowhead (*Sagittaria latifolia*), Western Blue Iris (*Iris missouriensis*) and various sedges

No rush to buy Flowering Rush!

Flowering Rush is still widely available as a garden plant on-line and in garden centers. The best method to control this invasive plant is to not buy it or plant it.

It grows aggressively, displaces native vegetation through its thick root system, and reduces biological diversity. In areas of dense infestation , it can clog irrigation canals and interfere with boating and other recreational activities.

— Sandi Faber Routley
Manitoba Invasive Species Council

Dispossessing and Pre-emptive

*Today for many miles, from Montreal to below Quebec, the formerly unique and endemic flora of the estuary is being rapidly obliterated by the crowding and handsome but overwhelming flowering rush (*Butomus umbellatus*) and Purple Loosestrife (*Lythrum salicaria*), both gorgeous to look upon but unscrupulous and without mercy for the insignificant endemics, which cannot last many years longer.*

— M.L. Fernald, 1939

(*Carex* spp.). In southern parts of Ontario and Quebec, the seeds of *Hibiscus moscheutos*, especially from the US (since the plant is endangered in Canada), may be sown to produce a very attractive substitute.

Manual and Mechanical Methods:

Both cutting below the water surface and hand digging have been applied to control populations. It is important to repeat the former. With regard to the latter, all parts of the plant should be removed so as to prevent regrowth.

One of the first protocols for manual removal of flowering rush was recently developed in Saskatchewan where an attempt was made to remove an entire population. The Saskatchewan project became a model for "early detection and response" to control a recently arriving invasive. Total eradication is planned for 2017. The project was supported by Agriculture and Agri-Food Canada through the Canadian Agricultural Adaptation Program (CAAP) and delivered by the Agricultural Association in Saskatchewan. Funding was also provided by Environment Canada through the Invasive Alien Species Partnership Program and the Environmental Damages Fund, and by the Saskatchewan Ministry of Environment's Fish and Wildlife Development Fund.

Biocontrol

A Flowering-Rush Biocontrol Symposium was recently held to coordinate a project through partnership with CABI (formerly the Commonwealth Agricultural Bureau). Foreign exploration aimed at discovering control agents started in 2013 with funds from Montana, Washington and British Columbia. Four fungi and 18 insects are found to develop on Flowering Rush in Europe and two weevils and two flies are potentially monophagous. In 2014, it was intended to establish a rearing colony of the weevil *Bagous nodulosus* at CABI in order to begin host-specificity tests. The beetles proposed as biocontrol agents are on the IUCN red lists and threatened and endangered in Europe. People rarely think of an endangered species being worth millions as a biocontrol agent. Based on initial observation, biocontrol is promising but requires substantial continued funding.



Figure 13. Flowering-Rush in a dense and extensive stand on the St. Lawrence River. The photo by Dr. L.O. Gaiser was probably taken in 1949 (DAO records).

Chemical Methods:

Complete control using chemicals may require combinations of chemicals including both contact and systemic herbicides, and it may also require repeated applications. A number of herbicides have proven effective in control and were a major feature of a Flowering-Rush Symposium in California in 2014. Comparison of glyphosate, imazaphyr and triclopyr indicated that imazaphyr provided the best control when two feet of leaf was above water. In another study submerged growth of Flowering-Rush was best controlled with Diquat. Herbicides are quickly washed off or diluted in wetlands and also pose a threat to the entire aquatic ecosystem. Since Flowering-Rush may not be organized into a connected clonal patch like European Common Reed, it may not be as easily controlled by painting herbicide on stems. Herbicide applications may require provincial or federal permits depending on circumstances. See "The regulation of pesticides in Canada" - for more information: http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/reg-pesticide/index-eng.php

Prospects

Flowering-Rush is similar to Purple Loosestrife in its ecology and consequently it seems likely that biocontrol would be very useful (some suggest that it is a "no-brainer") but research in this most important area has only recently been initiated. The increasing impact in western North America may ensure that appropriate levels of funding for biocontrol research are continued, otherwise much more will be spent in unsuccessful control accompanied by environmental damage. Over the next few decades Flowering-Rush will likely become well established in the Canadian prairie provinces. Hopefully control through early detection, as done in Saskatchewan, will reduce the rate of spread until biocontrol agents are available to provide a level of control with minimal costs.

Believe it or not

- To demonstrate their confidence in their own reputation the Three Musketeers, who were excellent swordsmen, and fully devoted to the protection of King and country, once substituted their swords for leaves of Flowering-Rush found in stream near Paris. Their offer for a dual was declined!
- "*Butomus*" is derived from "Bous" meaning "ox" and "tome" meaning "cut", a reference to the sword-like leaves.
- When is a Rush not a Rush? When it is a Flowering-Rush! The true rushes are grass-like (to a non-botanist) plants mostly in the genus *Juncus* (Rush Family – Juncaceae) and Wood Rushes are in the genus *Luzula* (also Rush Family) and Bulrushes are in the genus *Scirpus* (Sedge Family – Cyperaceae). As well as Flowering-Rush, other plants with longer and narrower leaves than their close relatives have the word "rush" in their common names: Rush Aster (*Symphyotrichum boreale*), Rush Skeletonplant (*Lygodesmia juncea*), etc.
- Flowering-Rush is endangered in Israel.

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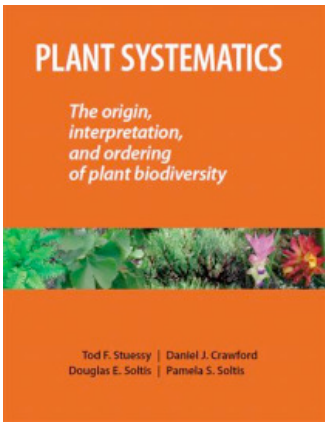


Figure 14. *Butomus umbellatus* from Deutschlands Flora in Abbildungen by Johann Georg Sturm, painter Jacob Sturm, 1796.

Book Review

Plant Systematics: The origin, interpretation, and ordering of plant biodiversity

Stuessy, Tod F., Crawford, Daniel J., Soltis, Douglas E. and Soltis, Pamela S. 2014. Koeltz Scientific Books. 425 pp. ISBN 978-3-87429-452-2 $USD 135.70



Plant systematics is a broad and active discipline, and the rapid development of the field in recent years presents a challenge to instructors. Excellent textbooks are available for survey courses (eg. Judd et al. 2007, Simpson 2010), and Stuessy (2009) provides an encyclopedic treatment of classification. However, for an upper-level undergraduate course on plant taxonomy, covering micro-evolutionary theory, phylogeny reconstruction, and associated data sources and analysis, teaching resources are limited. This is the gap that *Plant systematics: the origin, interpretation, and ordering of plant biodiversity* is intended to fill.

The book is laid out in five parts, each written primarily by a different author (Pamela Soltis reviewed and edited the entire volume). The first two parts (5 chapters) are written by Tod Stuessy. Part I is a brief overview of the importance of plant systematics to biodiversity. Part II is a survey of the various sources of data employed by systematists. The text is updated and condensed from Stuessy's (2009) *Plant Taxonomy* textbook. As in the previous book, the text is thick with citations, providing many opportunities for interested students to dive deeper into the material. The sources include a good mix of classic papers and recent innovations, and include many interesting examples to illustrate the different techniques discussed.

Daniel Crawford takes over for Part III, five chapters covering the micro-evolutionary processes that generate and structure diversity. This includes population genetics, ecological and biogeographic divergence, speciation, hybridization and polyploidy. The concepts are clearly presented, and provide a concise overview of the most vexing problems faced by taxonomists.

Part IV, written by Doug Soltis, covers phylogenetic reconstruction, including support, consensus, character evolution and molecular clocks. Soltis frequently refers the reader to online documentation for the various programs he mentions, reflecting the rapid rate at which the field is developing. I found myself simultaneously wishing he'd provide deeper discussion of the material, and wondering how long it would take before the text was rendered obsolete by the pace of development. Ultimately I think he struck an effective balance, given the constraints of a conventional publication.

Tod Stuessy returns for Part V, which covers classification. As in Part I and II, he has updated and rewritten material from his previous book, with discussion of the different schools (cladistics, phenetics and phyletics), and an overview of issues particular to specific taxonomic categories (subspecies and varieties, species, genera and higher levels).

While each author has provided an authoritative treatment of the topics they cover, the different sections could be better integrated. For example, Stuessy devotes six pages to describe the nuclear, chloroplast and mitochondrial genomes in Chapter 4, including a full-page illustration of the chloroplast genome and a diagram of the rDNA loci. Soltis provides another six pages to describe the same thing in Chapter 16, including a different full-page chloroplast genome map and rDNA diagram. Similarly, Soltis provides five full chapters on various aspects of phylogeny reconstruction. Twenty pages later, Stuessy provides his own, comparatively simplistic example of cladistic analysis. Consequently, the book reads like three different, loosely coordinated mini-textbooks bound together.

That said, there is much to recommend this book for its stated purpose. It provides a thorough and accessible introduction to the practice of modern plant systematics. The content will be accessible to advanced undergraduates who have completed an introductory taxonomy or plant diversity course. There's enough detail to invite lively classroom discussions, and the references will provide graduate students with useful direction for more detailed exploration of the literature. Were I responsible for delivering an upper-year plant systematics course, this book would very likely be the required text I would be using.

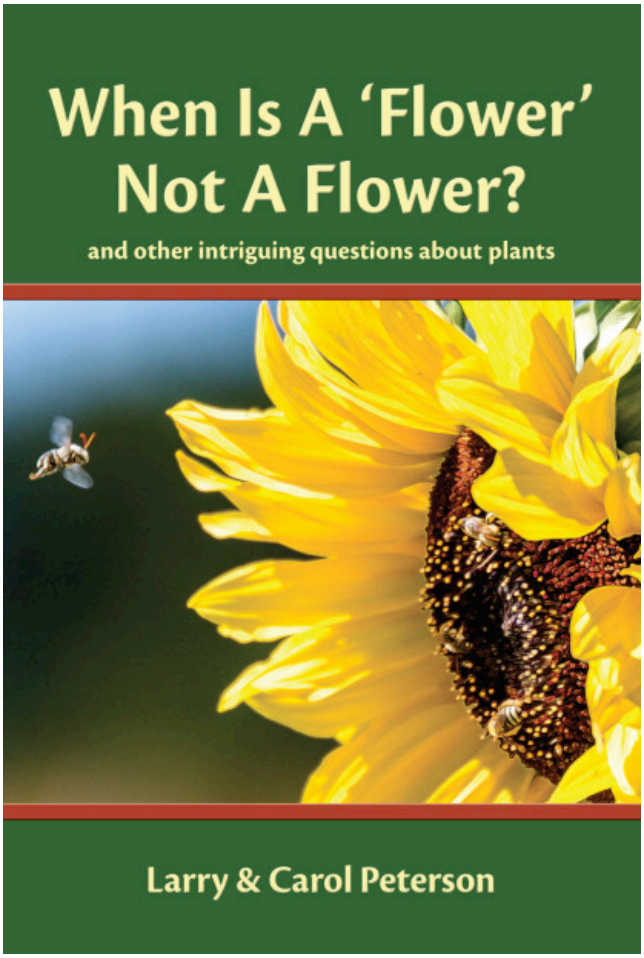
Tyler Smith, Agriculture and Agri-Food Canada, Ottawa

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New Publications



When is a 'flower' not a flower? and other intriguing questions about plants

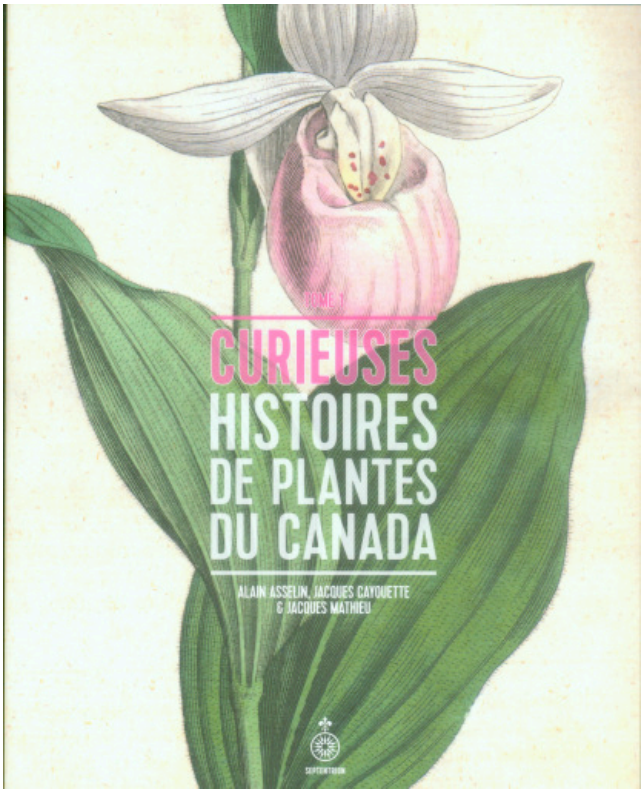
By Larry & Carol Peterson

After life-times of university teaching, researching, and publishing information about plants, the Petersons have written a book for the general public. This unique full-colour book takes common observations of plants and presents scientific explanations for them that the non-specialist can understand. Using a question-and-answer format, 140 questions are posed, and each is followed by an answer illustrated with beautiful macroscopic and/or microscopic images. A total of 450 images are included.

The general public (in addition to botanists, horticulturalists, naturalists, and gardeners) will find the book interesting because all our lives intersect with plants in so many ways – as food, wood, textiles, medicines, ornamentals, allergens, and invasive species. The book will also provide an excellent source of information about plants for elementary to high-school students, and their teachers. In addition, it would make a valuable contribution as a supplementary text for introductory Biology courses at colleges and universities.

Published by Volumes Publishing Ltd.
Available at: www.volumesdirect.com
or
by contacting Larry Peterson (lpeterso@uoguelph.ca)

New Publications



Plantes du Canada et leurs usages

Une investigation historique et scientifique

L'évolution des connaissances historiques sur les plantes du Canada et leurs usages fait partie du patrimoine culturel et scientifique nord-américain. Dans le premier tome de Curieuses histoires de plantes du Canada, vingt et une histoires de découvertes et d'usages de plantes d'Amérique du Nord sont présentées de façon chronologique, documentée et vulgarisée. Ces histoires, illustrées et accompagnées fréquemment d'encadrés pour mieux cerner le contexte de l'époque, débutent avec l'exploration des Vikings à Terre-Neuve vers l'an mille et se terminent durant la décennie 1670 en Nouvelle-France. En introduction, des chapitres abordent l'histoire de la botanique avant et durant la période de découvertes d'espèces canadiennes par les Européens surtout francophones. Un chapitre souligne la contribution historique, souvent mésestimée, des savoirs amérindiens relatifs aux végétaux. Au long des histoires, des explorateurs, des marchands, des botanistes, des médecins, des apothicaires, des jardiniers du roi de France et des missionnaires jésuites et récollets décrivent une diversité d'usages, souvent surprenants et oubliés, d'espèces alimentaires, médicinales, tinctoriales, ornementales, symboliques et même rituelles. Dans le tome 2, à paraître en 2015, près d'une trentaine d'histoires couvrent la période entre la décennie 1670 en Nouvelle-France et la fin du Régime français en 1760. Le livre est destiné au grand public et aux experts intéressés par les sciences naturelles, la botanique, la médecine, la pharmacie et l'histoire canadienne et nord-américaine.

Les auteurs de Curieuses histoires de plantes du Canada

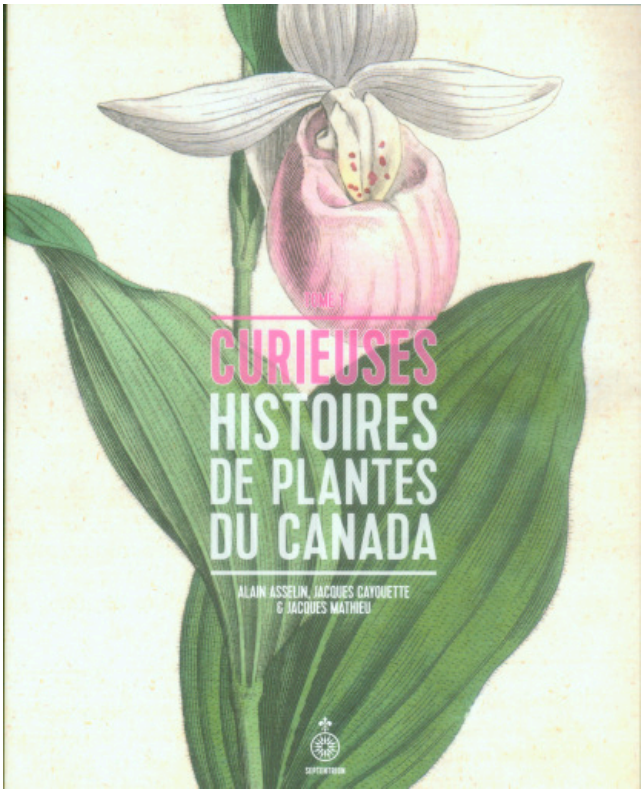
Alain Asselin est professeur à la retraite du département de Phytologie de la Faculté des sciences de l'agriculture et de l'alimentation de l'Université Laval (Québec, Canada). Il est l'auteur d'une centaine de publications scientifiques dans divers domaines de la biologie et de la biochimie végétales.

Jacques Cayouette est botaniste et chercheur à Agriculture et Agroalimentaire Canada à Ottawa (Ontario) depuis 1984. Il a participé à l'élaboration de diverses flores et, en 2014, il est l'auteur du livre À la découverte du Nord décrivant l'exploration de la flore nordique du Québec et du Labrador.

Jacques Mathieu, historien et professeur émérite de l'Université Laval, a publié une vingtaine de livres principalement sur l'histoire de la Nouvelle-France. En 2014, il est le récipiendaire du Prix du Québec Gérard-Morisset pour sa contribution à la promotion du patrimoine québécois.

Autres informations sur le livre *Curieuses histoires de plantes du Canada* par Alain Asselin, Jacques Cayouette et Jacques Mathieu. 2014, 286 pages, Français.

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Canadian plants and their uses

A HISTORICAL AND SCIENTIFIC INVESTIGATION

The evolution of historical knowledge about Canadian plants and their uses is part of the cultural and scientific heritage of North America. The first volume of Curieuses histoires de plantes du Canada is a chronological survey of the discovery of North American plants and their uses, written in non-technical language with supporting references. The twenty-one richly illustrated accounts are accompanied by numerous text boxes which provide background information on the era beginning with the Vikings' explorations in Newfoundland around the year 1000 and ending in New France during the 1670s. The introductory chapters cover the history of botany before and during the period of European (mostly French) exploration in Canada which resulted in the discovery of numerous plant species. One chapter is devoted to the historical importance of North American Indians' knowledge of plants, which has often been overlooked. In these accounts, explorers, merchants, botanists, physicians, apothicaries, gardeners of the King of France, and Jesuit and Recollet missionaries describe a diversity of uses for plant species—dietary, medicinal, tinctorial, ornamental, symbolical and even ritual—many of them surprising and long-forgotten. Volume 2, to be published in 2015, will contain about thirty stories covering the period from the 1670s in New France to the end of the French regime in 1760. This book is intended for the general public and for experts interested in natural science, botany, medicine, pharmacology and Canadian and North American history.

THE AUTHORS OF CURIEUSES HISTOIRES DE PLANTES DU CANADA

Alain Asselin is a retired professor in the Plant Science Department of the Faculty of Agriculture and Food Science at Université Laval in Quebec City, Canada. He has authored about one hundred scientific publications on a variety of topics in plant biology and biochemistry.

Jacques Cayouette is a botanist and researcher who has worked for Agriculture and Agri-Food Canada in Ottawa, Ontario since 1984. He has collaborated on the production of a number of floras and, in 2014, wrote a book entitled À la découverte du Nord which describes the botanical exploration of northern Quebec and Labrador.

Jacques Mathieu, a historian and professor emeritus of Université Laval, has published about twenty books primarily on the history of New France. In 2014, he received a Government of Quebec award, the Prix Gérard-Morisset, in recognition of his contribution to promoting Quebec heritage.

Curieuses histoires de plantes du Canada by Alain Asselin, Jacques Cayouette and Jacques Mathieu. 2014, 286 pages, French.

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