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The Canadian Botanical Association Bulletin

Bulletin de l'Association Botanique du Canada

March/Mars 2013. Volume 46 No.1/N°1

Message du Président



Frédérique Guinel

On pourrait douter de l'arrivée du printemps alors que le vent plein de grésil et de neige frappe à nos fenêtres. Cependant, je sais qu'il arrive car il y a de la fièvre dans l'air. Plusieurs membres de l'Association sont occupés à préparer la réunion annuelle. L'évènement est organisé avec les plus grands soins par le comité de Kamloops, et par les directeurs de section qui ont invités de superbes scientifiques pour participer aux colloques. Des courriels ont été échangés, des décisions ont été prises, et les plans vont de l'avant. Cette année, il y aura un colloque spécial coparrainé par les Éditions Sciences Canada (voir l'article de Kelly Bogh p.3) et l'ABC / CBA. Il s'adresse à l'ensemble des membres et mettra l'accent sur la biologie des arbres. Avec l'aide de tous les directeurs de section, j'ai pu inviter des scientifiques reconnus, et chacun d'eux discutera des arbres à sa manière. Le colloque se terminera par une discussion à laquelle participeront les orateurs. Je suis impatiente de participer à notre réunion annuelle et je vous invite tous à venir nous rejoindre.

Avant d'avoir pris le poste de Président, je ne réalisais pas à quel point l'exécutif de notre association travaillait derrière la scène. Mes premiers mois ont été une courbe d'apprentissage bien rude, et je voudrais profiter de cette occasion pour remercier chacun d'entre vous, en particulier le pouvoir exécutif et les directeurs de section, pour la preuve de patience que vous m'avez montrée. J'ai accompli un certain nombre de choses; dont certaines ont eu plus de succès que d'autres, mais en tout je regarde ces derniers mois comme un succès.

Un comité travaille toujours sur les révisions de nos règlements administratifs pour que ceux-ci soient conformes aux nouveaux règlements de la loi canadienne sur les organisations à but non-lucratif. Nous espérons vous présenter les règlements à l'Assemblée Générale de notre Association à Kamloops. Un rebondissement dans les histoires de nos archives s'est produit. Je vous en ferai part à la même Assemblée. Dans cette affaire, j'ai été heureuse de recevoir l'aide d'Erich Haber qui était le dernier archiviste à s'entretenir avec les Archives nationales du Canada. Mon but est d'avoir tout régularisé pour le 50e anniversaire de l'association.

Nous savons maintenant que cet événement sera célébré au Jardin botanique de Montréal, en principe du 15 au 19 Juin 2014 – à noter sur le calendrier ! Anne Bruneau, Denis Barabé, et leurs collègues ont commencé à planifier une ardoise étonnante de colloques sur l'histoire de la botanique au Canada. Personne ne voudra manquer cet anniversaire.

Je vous souhaite à tous un bon printemps et j'espère vous voir à Kamloops.

Frédérique

Canadian Botanical Association Bulletin

The CBA Bulletin is issued three times a year (in theory in March, September and December) and is available to all CBA members in electronic format or for an additional fee, in hard copy.

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

Association botanique du Canada Bulletin

Le Bulletin de l'ABC paraît trois fois par année, 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. L'utilisation de documents électroniques peut accélérer la publication. Pour des renseignements détaillés sur la soumission de textes, veuillez consulter le rédacteur (voir ci-dessous) . Infos générales sur l'ABC à l'url suivant: http://www.cba-abc.ca

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Next issue / Prochain numéro
Texts for the next issue, **46(2)**, must be received **before August 2nd 2013**

La date de tombée des textes du prochain numero, le no **46(2)**, est **le 2 août 2013**

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President's Message

One would doubt that the spring is coming as the wind is bringing sleet and snow against my window. Many in the Association are busy with preparations for the Annual meeting, led by folks in Kamloops, while Section Chairs have been aligning speakers for symposia. Emails are being exchanged, decisions are being taken, and plans are moving forward. This year, there will be a special symposium co-sponsored by the Canadian Science Publishing (see article by Kelly Bogh on p. 3) and the CBA/ABC. It is targeted to the entire membership and will focus on Tree Biology. With the help of all Section Chairs, I have been able to invite great speakers, each of whom will discuss trees from his/her own particular perspective.. To complete the symposium, there will be a discussion period; the speakers will act as panelists and a Chair will lead the discussion. I am truly looking forward the meeting and I invite you all to come and join us.
Before I took the position of President, I had not realized the quantity of behind-the-scenes work for which the Executive was responsible. My first few months have followed quite a learning curve, and I would like to take this opportunity to thank all of you, especially the Executive and the Chairs, for your patience. Some things have worked out better than others, but overall, it has been a pretty good start.
A committee is still working on the continuance process and we hope to present the updated by-laws of the Association at the Annual General Meeting of the Society in Kamloops. New developments have occurred about the archives and I will discuss them at the same Meeting. I am pleased to have received the help of Dr. Erich Haber this last term on this matter; Dr. Haber was the last Archivist to be responsible for sorting and submitting record of our Association to the National Archives of Canada. My goal is still to have everything regularized for the 50th anniversary of the association.
We know now that this event will be celebrated at the Botanical Garden in Montreal, tentatively from the 15 to 19 June 2014 – mark it in your calendar! Anne Bruneau, Denis Barabé, and their colleagues have begun to plan an amazing slate of symposia on the history of Botany in Canada. No one will want to miss this.

I wish all of you a good spring and I hope to see you in Kamloops.
Frédérique

Cindy Ross Friedman speaks on Quirks and Quarks!



Cindy spoke on CBC on March 16th 2013 on "The Dwarf Mistletoe plant raises its own temperature in order to explosively launch seeds for dispersal." To download the podcast....
http://podcast.cbc.ca/mp3/podcasts/quirks_20130316_51193.mp3
Congratulations Cindy! Sadly there are very few items on this Science show about plants! Maybe it is time to let Bob know the importance of plants in our world!!! ED.



Photo: H. Massicotte

Association News

New Frontiers in Tree Biology: a symposium sponsored by the CBA/ABC and Canadian Science Publishing

A half-day symposium on "New Frontiers in Tree Biology" will take place on June 4, 2013, during the 49th Annual Meeting and Conference of the CBA/ABC in Kamloops, BC. This symposium will highlight recent progress and future directions in tree biology research and education in Canada. It will span the range of interests represented by the different sections of the CBA/ABC. Speakers include Dr. Rob Guy (University of British Columbia), Dr. Uwe Hacke (University of Alberta), Dr. Marty Kranabetter (BC Ministry of Forests), Dr. Justine Karst (University of Alberta), and Dr. Richard Hamelin (Canadian Forest Service). The proceedings of the symposium will form the basis of a special issue to be published in *Botany* in late 2013 or early 2014.

The symposium is jointly sponsored by the CBA/ABC and Canadian Science Publishing (publisher of the NRC Research Press journals). As a not-for-profit publisher and the largest scholarly publisher in Canada, Canadian Science Publishing (CSP) is committed to supporting Canadian research communities, not only by publishing quality peer-reviewed journals but also by supporting the knowledge-sharing activities of scholarly societies and other partners and clients. In 2012, CSP asked a number of scientific societies to submit proposals to receive funding to support a half-day symposium, and CBA/ABC submitted one of the winning proposals.

The symposium is one more example of the continuing collaboration between CBA/ABC and CSP. Recognizing their shared goal of supporting the communication of Canadian research in botany, CBA/ABC and CSP signed a Memorandum of Understanding in July 2011. The MOU provides opportunities for the two organizations to increase their visibility and reach by leveraging each other's communication channels. The MOU also formalizes CSP's commitment to support the Society's annual meeting, and Society members receive significant discounts on subscriptions to NRC Research Press journals.

About Botany

Botany (formerly the *Canadian Journal of Botany*) publishes articles, notes, methods papers, commentaries, and reviews in English or French. Submissions from CBA/ABC members are especially welcome. The journal offers competitive peer-review times (35 days from submission to first decision in 2012), rapid publication after acceptance (Just-IN manuscripts are published online within 5 days), and wide international readership. *Botany* has no submission or page charges.

About Canadian Science Publishing and the NRC Research Press journals

The NRC Research Press journals were first established by the National Research Council of Canada (NRC) in 1929. In 2009, the NRC concluded that the journals were no longer part of its mandate but were an important Canadian institution that would be sustainable and viable outside of the federal government. Canadian Science Publishing was incorporated in September 2010 for the express purpose of taking control of the NRC Research Press titles and publishing operations. The new company retained the Press's highly skilled staff and expert editorial boards, and today continues a long tradition of quality and innovation. For more information, visit www.nrcresearchpress.com.

Kelly Bogh, Content Development Manager
Canadian Science Publishing / Éditions Sciences Canada
1200 Montreal Road, Building M-55
Ottawa, ON K1A 0R6

Winners at the Regional Undergraduate Conferences.

The Joint Science Atlantic Aquaculture & Fisheries, Biology and Environment conference was held at Acadia University on March 15th to 17th 2013.

Best Botanical Oral Presentation Award was given to Michelle MacDonald (UPEI) for her presentation titled " Assessing pathogenicity and chemical sensitivity of *Fusarium* spp. infecting carrots." Her supervisors are: Dr. Larry Hale and Dr. Jim Kemp at UPEI, and Dr. Rick Peters at Agriculture and Agri-Food Canada.



Photo: Michelle receiving her award from Alyre Chiasson, of Département de biologie, Université de Moncton, and Chair of the Science Atlantic Biology Committee.

Best Botanical Poster Award went to Simon Lay (DAL) for his poster titled: "Seasonality of a Nova Scotian rockweed (*Ascophyllum nodosum*) associated community and the potential impacts of rockweed harvesting."



His supervisor is Dr. Heike Lotze at Dalhousie University. Photo: Simon receiving his award from Heather Hunt (UNBSJ).

Both the above photos were taken by Megan Colwell at Acadia University.

(Continued on following page)

26th Ontario Biology Day (OBD) Conference and was held at McMaster University on March 16 -17, 2013.



Best Oral Presentation: Tarra Degazio, Department of Biology, Laurentian University (supervised by Dr. Peter Ryser). Title "Factors underlying the effect of toxic metals on transpiration rates in radish."

Photo: Tarra in the greenhouse.



Best Poster Presentation: Chelsey Baschuk, Department of Biology, Wilfrid Laurier University (supervised by Dr. Robin Slawson and Dr. Kevin Stevens). Title "The effects of water quality on representative bacteria present in the rhizosphere of the wetland plant *Phalaris arundinacea."*

Photo: Chelsey with her poster.

Congratulations to all the winners and thanks to Michael Stokesbury of Acadia University and Kevin Stevens of Wilfrid Laurier for their assistance, in addition to the judges at the two conferences.

Make a difference: get involved with your CBA!








The CBA executive always welcomes new energy to be a vibrant part of our administrative team. We know great talents (possibly yet undiscovered!) abound out there and we hope to hear from you. The CBA is a wonderful venue to promote and to explore numerous areas within the botanical sciences with like-minded folks, and to discover new regions within Canada during the process. Please contact me (hugues@unbc.ca) or Frédérique (fguinel@wlu.ca) if you are interested and willing to put your name forward, volunteer your time, or perhaps just want to know more about what is involved with some of the executive positions.

At the 49th CBA annual meeting in Kamloops (June 1-5, 2013), we will be looking for:

Nominations for one Eastern Director and one Western Director (Dr Art Fredeen and Dr Moira Galway are finishing their mandate). A director is an important liaison role, ensuring that information about Botany is disseminated to Canadian universities of your region, and that students in botany are aware of opportunities available to them.

Nominations for two student representatives (James Jones, western region, and Adrian Dauphinee, eastern region, are finishing their mandate). A student representative helps with liaison with other students in the CBA, before and during the annual meeting.

Nominations for section chair of Systematics & Phytogeography. This vacant position has recently been filled by Dr. Julian Starr (thanks Julian!), who has agreed to be the interim chair until Kamloops.

Nominations for the position of archivist. If you feel you can contribute in any aspect to help with the CBC/ABC archives in any capacity, we would love to hear from you. Your support to the association is always greatly appreciated!

Hugues Massicotte, CBA/ABC Past President







Impliquez-vous… Et découvrez votre ABC!

Vice President's Report on the Annual Meeting 2013

The 49th Annual Meeting and Conference of CBA/ABC at Thompson Rivers University (TRU) in Kamloops, British Columbia from June 1-5, 2013 is fast approaching! The Local Organizing Committee in Kamloops is very proud to be hosting the conference.
We have extended our Abstract and Early Bird Registration deadlines until **Friday April 5, 2013.** While there are no other changes to our prices and deadlines, we have added a third field trip (see description given for the Monday June 3 events).

Abstracts due Friday April 5, 2013
and
Early Bird registration ends Friday April 5, 2013
Regular CBA member -$250, Student CBA member -$100
Regular Non-CBA member -$325, Student non-CBA member -$140

Late Bloomer registration ends Tuesday April 30, 2013.
Regular CBA member -$275, Student CBA member -$125
Regular CBA member -$350, Student non-CBA member - $165

Symbiont (spouse, etc.) registration is $50

Please visit our webpage www.tru.ca/cba-abc to register and also to access our Abstract Submission form if you would like to present a poster and/or contribute an oral paper. The theme for CBA/ABC 2013 is "Thinking Plants", a broad theme meant to highlight the important scientific advances that are made as plant biologists think about plants as well as the role that plants play in our daily lives.

A schedule of events is posted on our website. In addition to business meetings and regular contributed oral papers, here are some highlights to the week:

Saturday June 1
- Art of Botany Show and Welcome Mixer.

Sunday June 2
- Keynote Speaker: Dr. Diana Beresford-Kroeger, a botanist, medical biochemist and self-described "renegade scientist" will discuss her "Botanical Bucket List".
- Teaching Section Symposium, "Distilling Plant Science: Botanical Education and Outreach in the 21st Century".
- Evening Poster Session Wine and Cheese.
- Student Mixer at Manhattan Grill to follow poster session.

Monday June 3
- Field Trips! Please note that we have added a **third** field trip!
  - Wells Gray Park (full day)
  - Lac du Bois Grasslands (full day)
  - **New! Secwepemc Museum and Heritage/Ethnobotanical Garden Visit (morning only)**
- Evening BBQ with Entertainment! Enjoy Live Latin Music by "Caliente" while you dine followed by a Live Auction with CBA/ABC's famous Auctioneer, Hugues Massicotte.

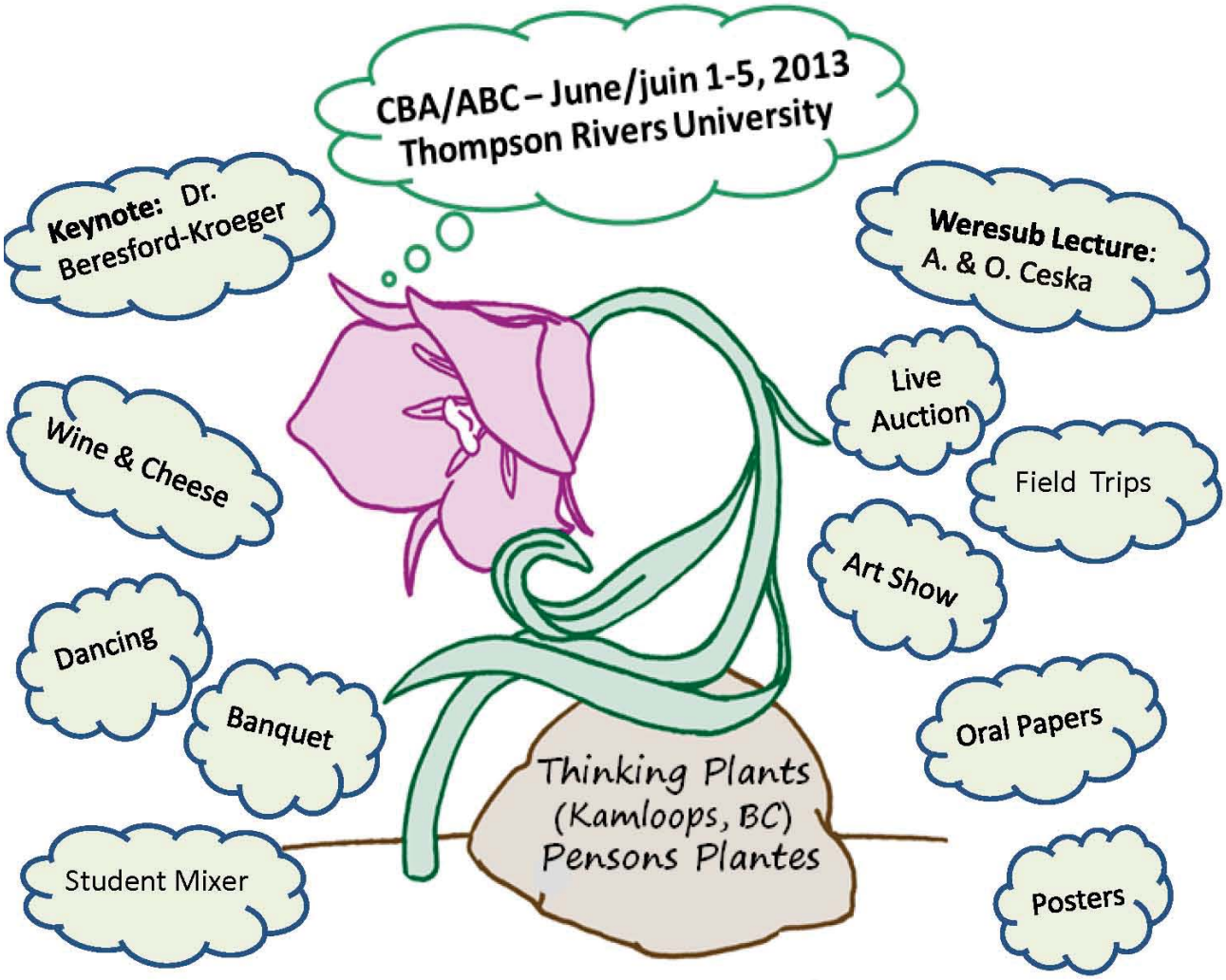
Tuesday June 4
- Special Canadian Science Publishing (CSP) Symposium: "New Frontiers in Tree Biology."
- Conservation and Ecology Section Symposium: "Seeing the Forests for the Bryophytes: Bryophyte Diversity and Ecosystem Function within Managed Forests."
- The Luella K. Weresub Memorial Lecture by Adolf and Oluna Ceska: "Mycofloristics is an Uphill Battle: Eight years of the Observatory Hill Survey for Macrofungi."

Wednesday June 5
- Plant Development Section Symposium: "New Frontiers in Cell and Developmental Botany."
- Closing Banquet in featuring local foods, including Pacific wild Sockeye salmon, and a live dance band "THE YOUNGUNS."

Again, please visit our webpage for more information, and feel free to contact me or the organizing committee's co-chair, Christine Petersen (cpetersen@tru.ca) for any assistance.

Cynthia Ross Friedman, Vice-President, Canadian Botanical Association, L'Association Botanique du Canada

NEW DEADLINE Abstracts & Early Registration: April 5, 2013:
$250 (regular members of CBA/ABC); $100 student members of CBA/ABC)



The Southern Interior Wood Management Committee | THOMPSON RIVERS UNIVERSITY TRU WORLD | TRUEOUTDOORS | UBC a place of mind THE UNIVERSITY OF BRITISH COLUMBIA

Symposia

- Canadian Science Publishing: *New Frontiers in Tree Biology*
- *Seeing the Forests for the Bryophytes*
- *New Frontiers in Cell & Developmental Botany*
- *Distilling Plant Science: Botanical Education & Outreach in the 21st Century*

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visit www.tru.ca/cba-abc

News from the Sections/ Nouvelles des Sections.

Mycology Section.



Photo: H Massicotte

Currently, the mycology section judges for the Weresub Award for best student publication in fungal biology are busy adjudicating the submissions received and we fully anticipate that the winner (or co-winners) will be announced for the Kamloops meeting in June.

To keep current with on-line publications, we have modified one of the rules for future Weresub Award competitions: The paper must have been officially published during the year preceding the CBA/ABC annual meeting (i.e. on-line or print publication in 2013 for award consideration in 2014). Should the paper still be in press by the deadline, it will be eligible the following year.

As indicated in the previous Bulletin, the mycology section is technically taking a pause by not sponsoring a mycology symposium at the 2013 annual meeting in Kamloops this coming June, but we would like to start thinking about ideas for the 2014 meeting which will have a history flavor as it will be our 50th.

A reminder to put the Weresub Lecture on your not-to-be-missed list in Kamloops as Adolf and Oluna Ceska will be delivering a joint presentation on their inventory of macrofungi at the Centre of the Universe (NRC astronomy interpretive centre located on the top of Observatory Hill in Victoria, BC).

As always, we welcome all who might be interested in participating in the Section Meeting in Kamloops. We discuss a lot of mycology-related issues in an informal manner and it is always interesting.

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

Ecology and Conservation.

The Ecology and Conservation section is trying to maintain its activities over the past few months. We have a committee Stan Rowe Award and are still waiting for a few more nominations to come in. If you have a nomination in the works and not sent yet, please contact me as soon as possible.

In the last Bulletin, we referred to a letter that would be sent to Minister Peter Kent to offer the expertise of our association for the review of SARA. This was done under our President Frédérique Guinel and we finally received some news. The door is not completely closed and he welcomes possible comments. Therefore, if any of you are interested, please contact me. In the next few weeks, there will be an invitation for selecting a date for the next electronic meeting. Anyone interested and possibly not on the list just needs to send me a message so I can add them to the list.

With the spring, it is time to plan new activities! First I will certainly invite all of you to the Section symposium of the entitled “Seeing the Forests for the Bryophytes: Bryophyte Diversity and Ecosystem Function within Managed Forests”, organized by Nicole Fenton and Lyn Baldwin, which will be held on June 4th at the Kamloops meeting. Second, as in the past years we will have a round table discussion at the pub (also on June 4th) to work on an issue that is quite important to us: revisiting our position paper on transplantation. After the successful symposium that we organized jointly last year in Columbus, OH, and the up-coming publication of a special issue on the subject in Botany, we are now a step closer to developing the position paper. You are all invited to come and contribute to the discussion and ultimately to the redrafting of the position paper.

For the designation of areas of special conservation concerns, there have been a few suggestions but I am still waiting for something firm. Anyone interested, please contact me. Last year we first approved the procedure for the designation and we then approved the Tusket River system in Nova Scotia as our first designation. It would be good to keep up the momentum with another one either this year or the next. I am very well aware that some of our ecosystems are increasingly threatened and our role can help contribute to an increased awareness of their fragility.

I wish to all a great spring and see you in Kamloops!

Liette Vasseur, Chair Ecology and Conservation Section.
lvasseur@brocku.ca

Écology and Conservation.

La section écologie et conservation essaie de maintenir ses activités qui avaient débuté dans les derniers mois. Nous avons un comité prêt à juger le prix Stan Rowe et encore à finaliser quelques nominations de plus. Si vous aviez une nomination qui n'avait pas encore été envoyée, s'il-vous-plait, communiquez avec moi aussitôt que possible.

Dans le dernier Bulletin, nous mentionnions qu'une lettre devait être envoyée au Ministre Peter Kent pour offrir les services de notre association à la revue de la loi sur les espèces en péril. Cela a été fait sous la direction de notre Présidente Frédérique Guinel et nous avons finalement reçu des nouvelles. Bine que la lettre soit un peu limitée, la porte n'est pas fermée et il accueillera des suggestions possibles. Si quelqu'un est intéressé par cela, m'hésitez pas à me contacter.

Dans les prochaines semaines, vous allez recevoir une invitation pour choisir la prochaine date pour une réunion électronique. Si vous n'êtes pas sur la liste mais aimeriez y être, encore une fois, ne pas hésiter à me contacter.

Avec le printemps, il est temps de planifier les nouvelles activités de cette anné! Premièrement, je vous inviterez certainement le symposium de la section intitulé « Lever le voile sur les bryophytes forestiers: diversité et fonction des bryophytes dans les forêts aménagées », organisé par Nicole Fenton and Lyn Baldwin, qui se tiendra le 4 juin. Deuxièmement, comme dans les années passées, nous allons avoir notre table ronde de discussion au resto sur un enjeu important pour nous : revisiter notre papier de position sur la transplantation (aussi le 4 juin). Après le symposium productif de l'an dernier à Columbus, OH, et la publication prochaine d'un numéro spécial sur ce sujet dans Botany, nous sommes maintenant à l'étape de travailler sur notre document.

Pour la désignation des aires de conservation préoccupante, nous avec reçu quelques suggestion mais j'attends encor

quelque chose de confirmé. Si une personne est intéressée, prière me contacter. Nous vous rappeler, l'an dernier nous avons en premier approuvé la procédure pour cette désignation et puis nous avons approuvé le système de la rivière Tusket en Nouvelle Écosse comme notre première nomination. Il est bien de maintenir le tempo avec une autre désignation cette année ou l'en prochaine. Je suis consciente que plusieurs de nos écosystèmes sont de plus en plus menacés et notre rôle peut aider à contribuer à une meilleure reconnaissance de leur fragilité.
Je vous souhaite toutes et tous un bon printemps et à bientôt à Kamloops !

Liette Vasseur. lvasseur@brocku.ca

Systematics and Phytogeography.

Dear members of the CBA Systematics and Phytogeography section, I still have not received any applications or nominations for the A.E. Porsild Award for the best paper by a student in Systematics and Phytogeography in 2012! As I said in the previous Bulletin, I strongly feel that one of my most important and certainly rewarding roles as Chair of our section is to be involved in the awarding of the A.E. Porsild Award, but I am empty handed! Please help me find a deserving student as it would be a great disappointment if I did not get the chance to award the Porsild in Kamloops during my first year as Chair.
Please send applications as soon as possible to me, Julian Starr, acting chair of the Systematics and Phytogeography Section via email (jstarr@uottawa.ca). A PDF of the publication accompanied by a cover letter explaining the role of the principal author and the significance of the work would be greatly appreciated.
Herbarium News. Among many recent success stories from the National Collection of Vascular Plants (**DAO**) at Agriculture and Agri-Food Canada (AAFC), Ottawa, such as the discovery of a new alfalfa and the rediscovery of a rare and valuable hop for making beer ('Cogneau') comes the news that the collection itself is becoming more and more valuable to researchers worldwide. Over the past year it is estimated that at least 100 peer-reviewed publications and University dissertations have incorporated information from the AAFC National Collection of Vascular Plants. An analysis of publications, loans, information requests, identifications and reasons recorded for visitors coming to consult the collection demonstrates that the collection's practical and scientific importance has only increased over the past few decades. In particular, the number of visitors has increased by a factor of 4 over the past decade and that trend continued in 2012. As noted in a recent scientific journal "…plant specimens stored in herbaria are being used as never before …" (see Lavoie C. 2013. Biological collections in an ever changing world: Herbaria as tools for biogeographical and environmental studies. *Perspectives in Plant Ecology, Evolution and Systematics* 15: 68-76.).
The Green Plant Herbarium of the Royal Ontario Museum (**TRT**) is one of the participants in CANADENSYS, a network of systematic collections of plants, fungi, and insects from across Canada (http://www.canadensys.net/). The CANADENSYS network came about as part of a major infrastructure grant to the Université de Montréal (led by Anne Bruneau), and has funded collection digitization equipment and salaries for databasing and georeferencing specimens at each member institution. Thanks to CANADENSYS support TRT has been able, not only to upgrade, consolidate, and add to its specimen database, but also to georeference almost 10,000 specimen records (http://data.canadensys.net/explorer/search?view=map&1_f=8&1_o=EQ&1_v_1=Green+Plant+Herbarium+%28TRT%29). During 2011 TRT acquired two major plant collections totaling 30,500 specimens: the James B. Phipps Hawthorn Research Collection, and the personal herbarium of the late John K. Morton. The Phipps collection has already proved invaluable for ongoing studies of *Crataegus* evolution, and both of these collections will be of immense value in documenting the flora of Ontario. Thanks to CANADENSYS, data for a portion of the Phipps collection is already accessible online. Funding for the acquisition and integration of these collections has come from the Louise Hawley Stone Charitable Trust, the Royal Ontario Museum, and from NSERC.

Julian Starr, Acting Chair of the section.

Teaching

1.Annual CBA/ABC meeting and conference in Kamloops:
The CBA/ABC Teaching section is organizing a Teaching Section Symposium, Contributed Papers session and Poster session at the annual CBA/ABC meeting and conference in Kamloops during June 1-5, 2013 (see below):.
A.Teaching Section Symposium: Title: "Distilling Plant Science: Botanical Education and Outreach in the 21st Century" will be held at 1pm - 3pm on Sunday, June 2nd. Four speakers have been invited to present at the symposium. It will be followed by a panel discussion (see below):

- Jean Becker (Wilfrid Laurier University), Title: "Indigenous Education: Critical Issues"
- George Haughn (University of British Columbia), Title: "What does it take to be a successful teacher?"
- Michael Runtz (Carleton University), Title: "Why Plants are Animals: Making Botany Come Alive"
- David Pearson (Laurentian University), Title: "Communicating science – your science – in a noisy world

B.Teaching Section Contributed Papers and Poster Sessions: Do you have exciting teaching-related information/news about teaching methodology, pedagogy, new lab/course/curriculum development that you want to share with your peers? Please consider presenting a contributed paper or poster at the Teaching Section's Contributed Papers or Poster sessions at the annual CBA/ABC meeting in Kamloops.

2. Undergraduate conferences:
i.Science Atlantic Undergraduate Biology Conference (AUBC): Since 1970, the Biology Committee has organized the AUBC for undergraduate biology students in Atlantic Canada. Since 1990, this event has been held in conjunction with the Aquaculture & Fisheries Conference. You can learn more about the Biology student awards on the Biology Awards page. 2013 Conference was held March 15-17, 2013, at Acadia University. Visit the Science Atlantic Site at : www.scienceatlantic.ca
ii.Ontario Biology Day (OBD): The next OBD was hosted by McMaster University, in Hamilton, on the week-end of the 16th and 17th of March. The contact person of the CBA in charge is Kevin Stevens.
iii. Multidisciplinary Undergraduate Research Conference (MURC): MURC 2013 is taking place on Saturday, March 23rd in the Irving K. Barber Learning Centre in the University of British Columbia, Vancouver. More

information is available at http://murc.ubc.ca/attend-murc-

iv. The BC Regional Inter-Universities Undergraduate Conference will be held at Trinity Western University on April 5, 2013. The contact person is Eve Stringham stringha@twu.ca

v. UBC Botany Graduate Students Symposium: UBC Botany Graduate Students Association (BGSA) is planning to organize the Botany Graduate Students Symposium on April 12, 2013.

International "Fascination of Plants day (FoPD)": The first International "Fascination of Plants day" (FoPD) was launched under the umbrella of the European Plant Science Organization (EPSO). FoPD has been adopted by forty four countries including Canada. The next international FoPD is taking place on May 18, 2013. If you (or your department/institute) are interested in taking part in the 2013 FoPD activities and require more information, you can visit the FoPD website http://www.plantday12.eu/home.htm#

Respectfully submitted, Santokh Singh. Chair of the section.

Graduate Student Profiles.

Stephanie Riviere. Wilfrid Laurier University.


Stephanie Riviere

My master's project is about studying peculiar structures found in the flowers of the parasitic plant *Cuscuta* – infrastaminal scales (IFS)! These are finger-like appendages that are found at the base of each of the five stamens in the flower, and they vary in shape and size between species. There have not been many studies on the IFS, and their function had not been tested either. Along with my supervisor Dr. Mihai Costea, I performed a comparative study of the scales from herbarium specimens of about 150 *Cuscuta* species by using light, scanning, and transmission electron microscopy. To test the hypothesis that the role of IFS is related to sexual reproduction of *Cuscuta*, I analysed the correlations between IFS characters and the production of pollen/ovules in the flower and the number of stomata found in the nectary at the base of the ovary. I also looked at relationships between the three subgenera of the genus: *Cuscuta*, *Grammica*, and *Monogynella*. It seems that the relationship between IFS size with both pollen/ovule ratios and nectary stomata number is weak at the level of the entire genus, but subgeneric partitions revealed a strong correlation in subgenus *Monogynella*. This suggests that the scales in *Cuscuta* evolved from nectar holding in the first diverged subgenus *Monogynella*, to ovary protection against herbivorous insects in the derived subgenera *Cuscuta* and *Grammica*. My study also further details the morphological diversity of the IFS in *Cuscuta*, showing that they are important for taxonomy and systematics at the species-level. This project was especially interesting for me because of all the different scientific techniques learned and used, including learning how to use a scanning-electron microscope, learning different histochemical techniques, and going out into the field!

Katya Boudko. University of Ottawa.


Katya Boudko

I am in the process of completing my Master's degree at the University of Ottawa under the supervision of Dr. Lynn Gillespie from the Canadian Museum of Nature. Over the past 2 years I have had the opportunity to do phylogenetic work on an interesting subtribe in the grass family (Poaceae). As it is known today, subtribe Alopecurinae *sensu lato* consists of 7 genera encompassing anywhere from 1-50 species. Of these genera, some have a cosmopolitan distribution while others are endemic to the Mediterranean region. Although the genera have been thought to be similar morphologically (thus being placed together in a single subtribe), previous in-depth morphological studies exist for only 5 of the genera, while only 3 have ever been included in a molecular analysis.

The goal of my research was to expand genera and taxon sampling within subtribe Alopecurinae and to sequence a variety of nuclear and plastid DNA regions in an effort to discover whether this is a real group or if it should be re-classified. As part of my methodology I received the chance to travel to Turkey (the hub of diversity and centre of distribution for subtribe Alopecurinae members) and searched through various herbaria to find as many taxa representing the subtribe as possible. It was also important to include some closely-related subtribe members in order to figure out relationships within and between Alopecurinae members. I then extracted DNA from the plants, amplified 2 nuclear and 4 plastid regions and sequenced the amplified products. In order to visualize my multiple sequence alignment I used maximum parsimony and bayesian analyses aimed at deciphering genetic information and buliding a "tree-of-life" for my particular subset of plants. The results show that the genera in subtribe Alopecurinae are actually not as closely related as previously thought and that they are dispersed throughout a closely-related subtribe (Poinae). My research shows that this similarity in morphology must be a result of convergent evolution rather than common descent and that a subtribe re-classification is in order. Additionally my work brought to light some new potential species relationships and the need to re-classify sections in the largest Alopecurinae genus, *Alopecurus.*

(Continues on Page 12)

A Tribute to Laurie Consaul



By Lynn Gillespie, Research Scientist, Canadian Museum of Nature. Adjunct Professor, University of Ottawa, Canadian Museum of Nature, PO Box 3443, Station D Ottawa ON K1P 6P4 CANADA

Laurie Lynn Consaul (1960 - 2012), Ph.D. in Plant Science, McGill University, 2008; M.Sc. in Biology, University of Ottawa, 1988; B.Sc. in Plant Sciences, University of Western Ontario, 1983.



Laurie in Tuktut Nogait National Park, N.W.T. holding *Plantago canescens.* Photo: Lynn Gillespie

Laurie was in my mind first and foremost an Arctic botanist. We first met in the summer of 1991 at Alexandra Fiord, Ellesmere Island (where I was assisting at an entomology camp, my first trip to the Arctic). Laurie had helicoptered in for the afternoon to collect a few grasses. We both were astonished to so unexpectedly come across another botanist in so remote a place! Laurie was pleased to meet someone who could direct her to her species of interest, and I was delighted to meet another botanist passionate about arctic plants. We both caught the arctic bug that summer. Although we didn't suspect it at the time, we would eventually spend six summers together in the Arctic. Wonderful Arctic memories of plant discoveries, long hikes, and contemplating the tundra, hands warming around mugs of tea. Hours upon hours examining and pressing our plant collections in a small dome tent, eventually emerging to enjoy the midnight sun, the long arctic twilight and wide open spaces. These images all spring to mind when I think of fieldwork with Laurie. I vividly remember sitting with Laurie on a hillside on Melville Island – Laurie and I likely the only humans on this large arctic island at the time –watching a wolf family with three young cubs. We weathered our worst storm together at Polar Bear Pass field station on Bathurst Island, enduring 36 hours of violent winds and horizontal snow with all radio communication down (this was long before the days of satellite telephones). I convinced Laurie not to venture outside – I really thought she might blow away in the strong winds. That was her personality, although petite, she was tough, and never complained, preferring a smile through the worst the field could throw her way. Laurie was an excellent field companion, and an extremely dedicated field botanist who loved the Arctic.

Her first research trip to the Arctic was with Susan Aiken in 1990 to Ivavik National Park in northern Yukon. Her last Arctic adventure was in 2010 to the Belcher Islands in Hudson Bay, as the botanist on an ethnobotanical study. During the years between, Laurie travelled throughout the Canadian Arctic, from Quttinirpaaq National Park on northern Ellesmere Island to Tuktut Nogait National Park on mainland N.W.T, and from the Savage Islands on the southeastern tip of Baffin Island to the southwestern tip of Banks Island. In all Laurie spent 11 field seasons in the Canadian Arctic, including eight Canadian Museum of Nature field expeditions. As part of her Ph.D. programme Laurie led two field expeditions to the Arctic and from 2002 to 2005 also undertook research on the use of native plant species to stabilize and revegetate of mine tailings at Voisey Bay, Labrador.

Laurie's love of nature was by no means limited to vascular plants. She was a passionate birder, active with the Ottawa Field Naturalist's Club, partaking in local annual bird counts, competing in numerous bird count competitions, and always on the watch for interesting birds. Wherever Laurie travelled, in the Arctic or on one of her many vacations with her husband Mark to faraway places, she delighted in nature, from lichens and mosses to the largest trees, from insects to birds, meticulously observing and always recording detailed notes.



Laurie collecting grasses in Newfoundland. Photo: Mark Armstrong.

Born in Bracebridge, Ontario, on March 22, 1960, Laurie grew up in Fort William, Kapuskasing, and, from the age of 11, Alliston, Ontario. Laurie completed her undergraduate degree in Plant Sciences at the University of Western Ontario, London, in 1983. Her honours research thesis was entitled "Changes in chloroplast proteins during leaf development in *Vicia faba L.* (Fabaceae)." Switching her research interests to plant systematics, a field that would become her lifelong passion, Laurie continued her studies under Dr. John McNeill at the University of Ottawa. In 1988, she completed her MSc with her thesis, "The biosystematics of *Polygonum lapathifolium L.*(Polygonaceae) in North America." Returning to the University of Western Ontario (1986-1990), Laurie worked for Dr. Jim Phipps in a variety of

roles as research assistant, helping with his systematic research on *Crataegus*, as assistant herbarium curator, and as assistant curator of the U.W.O Sherwood Fox Arboretum. Her work on *Crataegus* and *Polygonum,* two taxonomically difficult genera marked the beginning of a passion for challenging taxa.

In 1990, Laurie moved to Ottawa to work as a Research Assistant at the Canadian Museum of Nature, the start of a 22 year career with the Museum. Working within the Botany group, Laurie was instrumental in the success of numerous research projects, from lichens to grasses, and local Ontario to Arctic floras. Working with Dr. Irwin Brodo, she learned much about lichens and assisted in preparing and editing his monumental book Lichens of North America. Laurie worked extensively with Dr. Susan Aiken on Arctic grasses, the grass genus *Festuca,* and the Arctic flora. As project assistant, author, and editor of the interactive CD and web-based Flora of the Canadian Arctic Archipelago (Aiken et al. 2007), she was instrumental in seeing this project to completion. Over her many years at the Museum Laurie became a competent and experienced systematist, gaining a broad knowledge of botany, a dedication to collections-based herbarium research, and exceptional laboratory skills. Passionate about research and extremely hardworking, when a project piqued her interest (which was often!), she put in long hours, often continuing her work at home. Detail oriented, Laurie kept voluminous notes whether in the field or lab. I have many memories of Laurie writing her field notes and diary long into the cold Arctic night while snuggled in her sleeping bag (as I drifted off to sleep exhausted).

With determination (and bravery!) Laurie decided to go back to school while in her 40s to obtain her Ph.D. Laurie took a leave of absence from the Museum to attend McGill University, under the supervision of Dr. Marcia Waterway at the Macdonald Campus. Through a combination of hard work and creativity, Laurie obtained her own funding through an NSERC Industrial Postgraduate Scholarship and several smaller awards and grants, allowing her to work on the systematics of a group of Arctic grasses that had long fascinated her. Laurie tackled the alkali grass genus *Puccinellia*, one of the most taxonomically difficult (some would say impossible) genera in the Poaceae. Laurie combined painstaking growth experiments with equally detailed molecular and morphological analyses, successfully untangling the complex evolution of the Canadian Arctic diploid and polyploid species. Graduating in 2008, Laurie produced a superb dissertation entitled “The Role of Polyploidy in the Evolution and Systematics of Arctic *Puccinellia* (Poaceae)”. The resulting series of papers is undoubtedly the most in-depth systematic study of a genus in the Canadian Arctic (Consaul et al. 2008a,b,c; 2010). Laurie was dedicated to plant systematics, and recognized internationally as an expert in Arctic plants and specifically Puccinellia. She authored 29 scientific publications, ten as first author, and an additional five popular natural history articles. In addition to those cited above, she coauthored the very useful treatments of Puccinellia for the Flora of North America and the Manual of Grasses for North America (Davis & Consaul 2007a,b). Laurie was a long-time member of the Canadian Botanical Association (a student member in the 1980s, a regular member from 1994), serving as Association Secretary from 2009-2011.

In 2011, Laurie accepted a position as Assistant Professor in the Biology Department at Memorial University, St. John's, Newfoundland and Labrador. This was to be the pinnacle of her career, a goal Laurie had worked so hard and with such determination to obtain.

Just prior to moving to St. John's Laurie became ill while attending the 2011 CBA annual meeting in Halifax. Diagnosed with a brain tumour, she spent the next year and a half bravely fighting her illness with great determination, with the loving care and support of her husband Mark. Laurie lost her battle with cancer on December 18, 2012. Canada lost an excellent Arctic botanist and plant systematist, the CBA lost an avowed supporter, and many from across Canada and around the world lost a dear friend.



Laurie working in the National Herbarium of Canada, Canadian Museum of Nature. Photo: Jennifer Doubt

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Davis, J. I. and L. L. Consaul. 2007a. Puccinellia. Pages 459-477 in M. E. Barkworth, K. M. Capels, S. Long, L. K. Anderton, and M. S. Piep, editors. Flora of North America North of Mexico. Oxford University Press, New York and Oxford.

Davis, J. I. and L. L. Consaul. 2007b. Puccinellia. Pages 106-110 in M. E. Barkworth, L. K. Anderton, K. M. Capels, S. Long, , and M. S. Piep, editors. Manual of Grasses for North America. Intermountain Herbarium and Utah State University Press, Logan, Utah.

Corrina Copp, Memorial University.


Corrina Copp

I am currently a M.Sc. student in Dr. Hermanutz's "Conservation of Northern Ecosystems" lab at Memorial University, St. John's, NL. My research pertains to habitat conservation of the endangered endemic plant, Long's braya (*Braya longii*), through the development of habitat restoration protocols. These protocols will address the re-establishment of human disturbed Limestone Barrens habitat in a degraded quarry site on the Great Northern Peninsula, NL. Limestone Barrens is a globally at-risk landscape threatened by human activities. It is characterized by limestone and dolomite bedrock, arctic alpine-like plant communities and cold soil processes. Cold soil processes create small-scale disturbance via frost heave and patterned ground formation. This disturbance is critical to the habitat as it maintains open, non-vegetated areas ideal for native flora, where "*B. longii…exploit[s] gaps in the vegetation produced by small-scale disturbance, such as frost action…, to survive*"[1]. Threats to Long's braya include habitat loss due to quarrying and its legacy effects, community expansion, off-road vehicles, non-native pests and pathogens, and climate change[2]. Aerial images have been used to assess landscape change, and to develop a 3D reconstruction of the landscape to inform restoration activities in the recovery of landscape features. Protocols are being developed from the bottom up, using experimental design to determine a substrate composition (i.e. particle fraction) that will promote cold soil processes. The protocols will guide current and future quarry rehabilitation globally, using Limestone Barrens as a reference, and ensure sufficient critical habitat for the conservation of viable Long's braya populations as outlined by Environment Canada's Recovery Strategy (http://publications.gc.ca/collections/collection_2012/ec/En3-4-119-2012-eng.pdf).

[1]Squires, S. et al (2009). *Cons. Biol.* 142, 203-211.; [2]Environment Canada (2012). *Species at Risk Act* Recovery Strategy Series. v + 38 p.

Christian Huynh. Wilfrid Laurier University


Christian Huynh

Early in my Master's program, I had a chance to meet with other members of CBA at Plant Canada 2011 in Halifax. I received the John Macoun Travel Bursary to attend this meeting and an honorable mention for my poster. This remains one of the highlights of this endeavour since I had the great opportunity to introduce myself and my research to the Association. I felt both welcome and the camaraderie of the Association . It has been awhile since this meeting and I wanted to announce that I have graduated from the M.Sc. Integrative Biology program at Wilfrid Laurier University under the supervision of Dr. Frédérique Guinel. My hard work in combination with the careful supervision of Dr. Guinel has allowed me to defend my thesis successfully and with high honor as I have been nominated for the Gold Medal of the University. Currently, I am entertaining the possibility of taking up a Ph.D. position while working out of Guelph, ON. I have had a very fulfilling experience and I want to thank CBA for its part in this.

The Auctioneer will be back in action!



Plan to attend the live auction on Monday June 3rd 2013, following the BBQ. Watch the actions of our famous auctioneer, Hugues Massicotte, as he skillfully persuades you to part with your money!!!

Please bring items to donate to the auction. Items, preferably of a botanical nature, will be collected on the first two days of the conference. All funds raised go to a good cause, the Macoun fund, which allows us to help bring students to our conferences

The current Editor of the Bulletin plans to step down in the summer of 2014, after 7 years! If you are interested in taking over the position please contact Frédérique Guinel (fguinel@wlu.ca), or Hugues Massicotte. (hugues@unbc.ca).

MAJOR INVASIVE ALIEN PLANTS OF NATURAL HABITATS IN CANADA

6. European Frog-bit, Common Frog-bit, hydrocharide grenouillette,

Paul M. Catling and Gisèle Mitrow

Hydrocharis morsus-ranae L.
Synonyms: no common synonyms
Infrataxa: No infraspecific taxa have been described.



Figure 1. *Hydrocharis morsus-ranae*. Photo by Christian Fischer, North-eastern Lower Saxony, Germany. Used with permission.

The genus name comes from the Greek "hydro" meaning water and "charis" meaning plant. The species name "morus" means bite and "rana" means frog. Frogs are sometime seen biting at the leaves in an attempt to catch caterpillers. The genus name "*Hydrocharis"* is also applied to a group of insects.

Identification and Classification

The genus *Hydrocharis* belongs to the Frog-bit family (Hydrocharitaceae) and consists of three species. The other two are *H. dubia* of southern and eastern Asia and *H. chevalieri* of the western part of central Africa. *Hydrocharis morsus-ranae* differs from these in the combination of paired stipules and three pairs of primary veins in the leaves. A recent phylogenetic treatment of the family recognizes four subfamilies and genera (in brackets) as follows: Hydrocharitoideae (Hydrocharis, Limnobium), Stratiotoideae (Stratiotes), Anacharidoideae (Apalanthe, Appertiella, Blyxa, Egeria, Elodea, Lagarosiphon and Ottelia) and Hydrilloideae (Enhalus, Halophila, Hydrilla, Maidenia, Najas, Nechamandra, Thalassia, Vallisneria). The round leaves with 5 or 7 primary converging veins distinguish *H. morsus-ranae* from most other aquatics with floating leaves. The species that is most likely to be confused with European Frog-bit is North American Frog-bit (*Limnobium spongia*) which does not occur in Canada, but does extend north to New Jersey, New York and northwestern Indiana. European Frog-bit differs from this species in having free stipules in pairs instead of a single adnate stipule, mostly unbranched roots instead of roots with numerous simple branches, and stolon buds developing one instead of numerous roots initially. The American Frog-bit may have emergent leaves with truncate bases and lacking aeremchyma on the undersurface and/or floating leaves with more aerenchyma than is characteristic of European Frog-bit. There are also differences in the flowers. Water Shield (*Brasenia schreberi*) has a mucilaginous coating over all submersed parts and is not free-floating, the leaves coming from a creeping rhizome and not forming a rosette. Species of Floating-hearts (*Nymphoides* spp.) have a 5-parted corolla (instead of 3-parted) and the leaves are on long petioles with a cluster of spur-like roots near petiole summit.

Description (See Figures 1, 2, 3, 4, 5, 8)

Free-floating, perennial (by overwintering stolon buds) aquatic with individual rosettes 1-30 cm across but stoloniferous and often forming patches 0.1-1.5 m across. Plants are mostly dioecious. Roots usually unbranched, to 50 cm long, and with numerous long root hairs. Stolons more or less persistent through the season. Overwintering stolon buds (turions) are produced in the autumn. They are ellipsoidal, 5-7 (-9) mm long and have a distinct abcission layer, detaching and sinking before winter, and germinating in April and early May. Turions and stolon buds develop a single root initially. Young rosettes rise to the surface and become mature rosettes by late May. The original rosette will have given rise to six rosettes joined by stolons by mid to late June. More rapidly elongating stolons and many additional rosettes are produced during the summer. The floating, circular leaves with an indented (cordate) base are entire, 1.2-6 cm long, 1.3-6.3 cm wide and have aerenchyma on the undersurface near the midvein. The slender petioles are 6-14 cm long with two, free, lateral stipules to 2.5 cm long at the base.

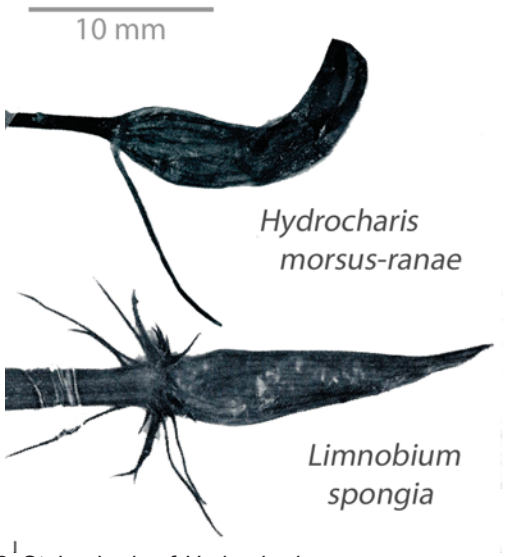


Figure 2. Stolon buds of *Hydrocharis morsus-ranae* and *Limnobium spongia*. Former: Rideau River, Merrickville, Lanark Co., Ontario, 24 August 1965, *W.G. Dore 21790 and C. Crompton* (DAO). Latter: Sumter Wildlife Management Area, Sumter Co., Florida, 13 Aug. 1958, *R. Kral 7869* (GH). Photo by P.M. Catling.

Flowering begins in mid-June, peaks in mid-July and is often over by mid-August. The flowers are usually unisexual. Male flowers, of which there are (1-) 2-5 arise consecutively from a spathe consisting of two bracts, each 1-1.2 cm long on a peduncle 0.7-5.5 cm long. The flowers have pedicels to 4 cm long. Sepals are 4-5.5 mm long, and white or greenish-white. Petals are broadly obovate to orbicular, white and 9-19 mm long. There are 9-12 stamems each 2-3.5 mm long, arranged in 4 whorls, the two outer whorls being fully fertile, the inner whorls being sterile or partly sterile. The oval anthers are ca. 1 mm long. The pollen grains are 15 microns in diameter and are rounded without apertures, radiosymmetric and covered with echinate processes 0.5 microns in height. Female flowers are on peduncles up to 9 cm long. Sepals 4-5 mm long are greenish-white. Petals are broadly obovate to orbicular, white or with a faint pinkish tinge, 10-15 mm long, and have bifurcate or bifid, simple staminodes. There are 6 stigmas to 5 mm long, divided to 1/4-2/3 of their length.

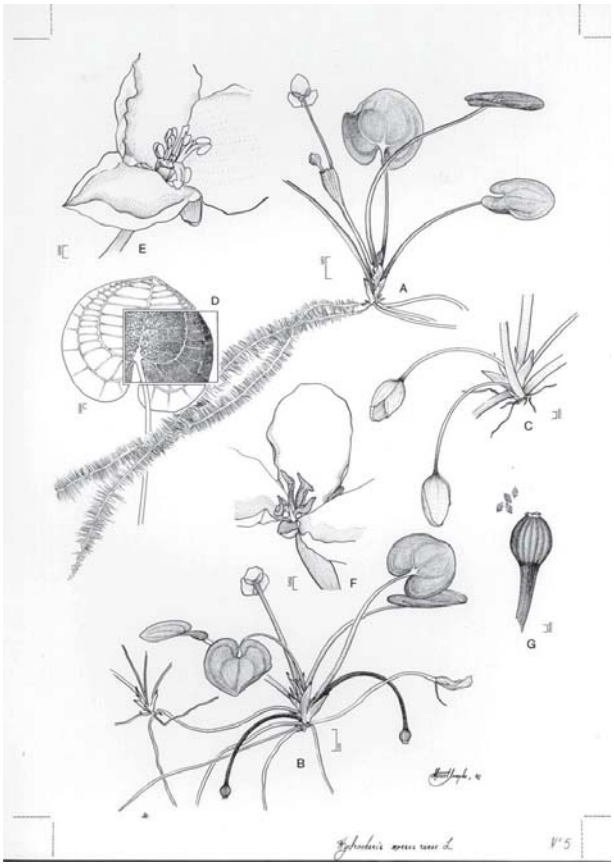


Figure 3. *Hydrocharis morsus-ranae*. A, habit showing two staminate flowers arising from the same spathe; B, habit showing plantlets, pistillate flower and recurved fruiting peduncles; C, portion of plant base with two overwintering turions; D, detail of undersurface of leaf; E, staminate flower; F, pistillate flower; G, fruit and seeds. Drawing by Marcel Jomphe from material collected at Constance Creek, Ontario.

In most cases, 26-42 seeds are produced in each fruit. The transversely elliptic seeds approximately 1 mm long, have a spiral pattern on the outer surface and are densely covered with stout blunt processes. Apparently the pattern of drying mucilage that surrounds each seed has given rise to erroneous reports of ridged or winged seeds. The chromosome number is 2n = 28.



Figure 4. *Hydrocharis morsus-ranae*. From Johann Georg Sturm, 1796, Deutschlands Flora.

Distribution and History

European Frog-bit is native to western and central Europe. Its spread in North America is well known because it is an easily recognized plant. Its present North American distribution includes southeastern Michigan and northern Ohio northeast to the Ottawa and St. Lawrence valleys of Ontario and Quebec and south to western Vermont and northern New York with a disjunct occurrence in the Dryden area of northwestern Ontario. The accompanying Canadian distribution map (Figure 6) is based on 420 specimens from the following herbaria: ACAD, CAN, DAO, MT, MTMG, OAC, QFA, QK, QUE, SASK, TRT, TRTE, UBC, UNB, UWO, V, WAT and WIN. The fact that European Frog-bit occurs in North America from the south shore of Lake Erie to the Dryden area of Ontario and Quebec city suggests that North American genotypes have a broad climatic tolerance and the North American distribution is likely to increase much beyond the present limits.

European Frog-bit was introduced to Ottawa in 1932 as a cultivated plant in water gardens. By 1954 it occurred in the Rideau Canal region around Ottawa and along much of the Ottawa River between Ottawa and Montreal. By 1967 it had spread upstream of Montreal and Ottawa and it had reached eastern Lake Ontario by 1972. Most of the St. Lawrence and lower Ottawa Rivers and eastern Lake Ontario were occupied by 1980. In 1995 it occurred in a number of sites on the north shore of Lake Erie, south shore of Lake Ontario, Lake Champlain and many inland locations in this general region. It was first found in Michigan in 2000 and is now known from the Lake St. Clair region and the Detroit area. In 2001 it was reported from the state of Washington. In 2004 it was first reported in Ohio in Lucas County on the south shore of Lake Erie. The most recent major extension of



Figure 5. European Frog-bit at Dinorwic Lake in northwestern Ontario, a major recent range extension. Photo by Carolle Eady on 2 Aug. 2012. Used with permission.

range has been to the Dryden area of northwestern Ontario where it was first found by Darlene Salter in 2007, but is now known from three sites in that region. General rate of spread in the east has been approx.16 km/year and has been attributed primarily to dispersal on boats and boat trailers. The mostly acidic and/or nutrient poor waters of the Canadian Shield and northern Appalachian region appear to have been a partial barrier to spread.



Figure 6. *Hydrocharis morsus-ranae*. Photo taken at Breney Common Nature Reserve, near Lanivet, Bodmin, Cornwall, 21 August 2006, by David Fenwick. Used with permission.

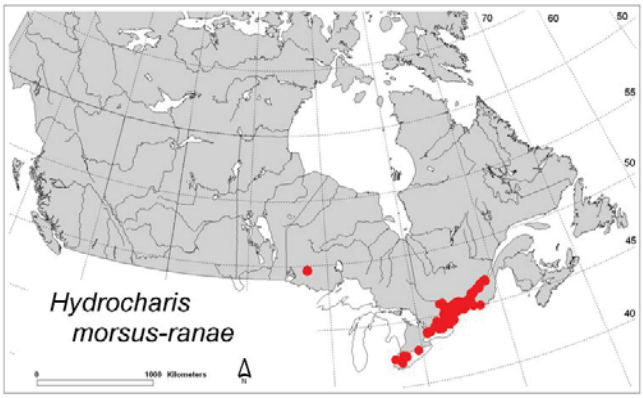


Figure 7. Current distribution of European Frog-bit in Canada based on 420 specimens from the following herbaria: ACAD, CAN, DAO, MT, MTMG, OAC, QFA, QK, QUE, SASK, TRT, TRTE, UBC, UNB, UWO, V, WAT and WIN.

Ecology

European Frog-bit is free-floating on open water but occurs in sheltered areas where it is protected from piling by wind and waves. It does well in nutrient-rich, often calcium-rich, eutophic or mesotrphic waters with a pH of 6.5-7.8. Frequent associated species include *Typha* spp., *Lemna* spp., and *Nuphar variegata*. The flowers last for a single day and produce a sweet nectar and an odour. Many kinds of insects visit and presumably pollinate the flowers, but the primary pollinators are hover flies (e.g. *Toxomerus marginatus*) and solitary bees (*Dialictus* spp.). Peduncles of fertilized flowers recurve so that seeds develop under water. The released seeds float on the surface. Their viscid coating is thought to promote adheasion to waterfowl. Up to 3,000 seeds may be produced by a mat of plants covering a square meter. Dispersal by waterfowl may be effective, but movement of seeds, turions, and whole plants in currents of rivers, or by people on boats and boat trailers, is likely the most important means of dispersal over both long and short distances. Another method of spread is by the horticultural trade. Although Minnesota treats European Frog-bit as a prohibited exotic species, it was one of the most frequently supplied to the state by aquatic plant vendors in an experimental study. A Canadian survey of water garden owners suggested that “the water garden trade should not be overlooked as a vector for aquatic invasive species into Canadian fresh waters.” Thirty owners had European Frog-bit in their gardens! European Frog-bit is also grown in aquariums and dumping of aquarium contents into the wild may also lead to establishment in new sites. In most parts of Canada, it is illegal to release any aquatic organisms into the wild without a permit.

In Canada and Elsewhere

European Frog-bit appears on a number of lists of serious invasive alien plants including for example those produced by Environment Canada and the Dept. of Fisheries and Oceans. It is listed as one of the eleven highly invasive species in Canada by the Canadian Botanical Conservation Network. It was ranked as the tenth in a prioritized list of the most serious invasive aliens of natural habitats in Canada (CBA/ABC Bulletin 38(4): 55-57. 2005.) It has been listed among 28 top priority invasive exotic species for control in southern Ontario by the Ontario Invasive Plants Working

Group. It is also one of the five invasive alien plants that has been reported to have had a major impact on natural ecosystems in Canada.
European Frog-bit is considered a “very high” impact species in the state of New York (http://www.dec.ny.gov/animals/65408.html). It is also on the noxious weed lists for at least 6 states (California, Indiana, Maine, Minnesota, Vermont, Washington).

Damage (significance is suggested by the number of asterisks to 5 for highly significant)

Biodiversity
(1) Dense floating mats of European Frog-bit have been shown with field experiments to severely reduce growth of a diversity of native submersed aquatic plants which appear to support a great diversity of native aquatic animals.*****
(2) It has become dominant in many places and resulted in major changes in the structure of the aquatic environment such as less submersed surface area, vastly reduced light penetration, etc. *****
(3) It has replaced native aquatic species that provide valuable food for wildlife.*****
(4) Management and control to protect valuable biodiversity is costly.***
(5) Many kinds of control required to satisfy human needs may have adverse environmental effects.**
(6) Decomposing mats in water may lead to oxygen depletion and have been associated with fish kill.*

Recreation and Economy
(7) Large free-floating mats of intertwining plants restrict water traffic and prevent swimming and fishing. *****
(8) It replaces plants that provide food for ducks therefore reducing hunting opportunity.****

Health
(9) Chemical control may result in threats to health.**

Agriculture
(10) Limits water flow in ditches and canals.*

Beneficial Aspects

(1) European Frog-bit is used as food by a variety of animals, especially in its native European range. *****
(2) The large, clear, unicellular root hairs have proven very valuable in studies of plant physiology and development.****
(3) A potential for use in forage and compost has been reported.*
(4) It is a popular plant for water gardens and aquaria.*
(5) With other species of aquatics it may be helpful in improving water quality.*

Management

Control of European Frog-bit is difficult and eradication is usually unlikely. The fact that it is free-floating enables manual and mechanical methods to be applied effectively, especially over small areas. These methods are not without environmental effects and advice is often useful. For example, a group of students raking may be less damaging to threatened Blanding`s Turtles than a mechanical harvester. Since European Frog-bit is free-floating, the horizontal harvester blades may be turned off to reduce damage to a variety of animals.

Biological Control:
There is no information available on biological control of European Frog-bit. It is however, used as food by a some native Canadian insects. Larvae of the Pondside Pyralid Moth (*Munroessa icciusalis*) feed on the leaves and make protective envelopes from them. Their feeding on the leaves is restricted to feeding tracks leaving much of the leaf intact, so despite several generations of these moths in a year, they appear not to adversely affect the plants.



Figure 8. The native Pondside Pyralid Moth (*Munroessa icciusalis*). The larvae of this moth make protective cases from the leaves of European Frog-bit and also feed on the leaves. Photo by Mike Boone, Neebish Island, Chippewa County, Michigan, USA, 26 June 2005. Used with permission.

Manual and Mechanical Methods: Raking is best done in the late spring before extensive growth and development of turions. It can be done from a solid shore or from a boat. Harvested plants should be removed from the wetland area to prevent run-off of nutrients from decomposition into the water. Monitoring may not prevent persistence or establishment, but may limit proliferation.

Water Level Adjustments: Since European Frog-bit can grow in mud and sediment, it is not as effectively controlled by late spring or early summer drawdown as submersed aquatic plants.

Chemical Control: Since European Frog-bit can be controlled by ongoing raking or some kind of mechanical harvesting, the use of chemicals is less important than it is for rooted aquatics like European Common Reed. See the discussion of the control of the latter species for the information on chemical control permits (CBA/ABC Bulletin 44(2): 59. 2011).

General Considerations: The spread might be slowed if the following steps were taken:
Boaters, fishermen, hunters:
(1) Remove plant material from boat and equipment (hull, drive unit, trim and trolling plates, prop, prop guards, transducers, anchor, chain, rope, decoys, nets, tackle), as well as trailer and car to prevent transport to another water body. (2) Empty bait bucket on land or in trash. The seeds are small and easily overlooked. (3) Empty water from motor, bilge pumps, and live wells. (4) Remove what you cannot see using a high pressure hose or let your boat and equipment dry in the sun for 5 days. See also http://www.protectyourwaters.net

Water garden, aquarium owners: (1) Obtain permits as required. (2) Use native species. (3) Never discard unwanted plants into natural habitats. (4) Prevent runoff into surface waters. (5) Do not collect plants from the wild assuming that they are native.

Prospects

European Frog-bit is still extending its range in North America. With a number of effective dispersal methods including people (boats, bait buckets, aquariums and water plants trade), water currents and waterfowl, it will likely reach the Canadian Prairie Provinces and southern British Columbia within a decade based on its rate of spread in the east and its climatic tolerance. The increasing collaborative monitoring programs in North America may help to document this expansion and provide data for researchers and policymakers.

Believe it or not

- Over 100 turions may be produced by a single plant in a single year, and from a single turion a plant may cover an area approximately 1m^2 by the end of the season.
- European Frog-bit has declined or is extirpated in parts of its European range. Although it has declined in natural habitats in the UK, it has been reported from canals well outside its native range.
- In an extensive marshland, European Frog-bit can become dominant 5 years after arrival.
- State law in Minnesota and Maine prohibits possession, sale, import and transport of European Frog-bit, including accidental transport on boats and boat trailers. The fine is up to $500.
- Some recent guides to wetland restoration note the danger of accidentally transplanting invasive aliens into restoration sites. This has happened with European Frog-bit.
- European Frog-bit is sufficiently popular to have been featured on china and postage stamps.
- As a result of being ordered on the web, it is possible that new genotypes of European Frog-bit are still entering Canada from Europe.

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Figure 9. *Hydrocharis morsus-ranae* from Axel Magnus Lindman, 1917-1926, Bilder ur Nordens Flora.



Figure 10. *Hydrocharis morsus-ranae* produced on the Royal Copenhagen Flora Danica service.

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Figure 11. European Frog-bit growing with a species of Mare's-tail (*Hippuris* sp.) in a pond near Wien, Austria. Photograph by Ir Robert Ulsamer on 21 July 2003. Used with permission

Book Review

Vladimir Krajina – WorldWar II Hero and Ecology Pioneer by Jan Drabek 2012.

Publisher: Ronsdale Press; 1 edition (Oct 15 2012)
Language: English
ISBN-10: 1553801474 ISBN-13: 978-1553801474
Price $23:00



This unusually personal biography is probably the most accurate account of Vladimir Krajina's life and times. The book's introduction tells of the close relationship between the Krajina and Drabek families and shows us the context for Vladimir's divided life as an ecologist, the leader of the Czech resistance to Nazi occupation, and then a leader in British Columbia plant ecology. Vladimir certainly led a 'charmed life' before, during and after WWII. His ability to keep a low profile and very tight lips meant that even after his arrest in 1943, the Nazi's kept him alive in case he should accidentally reveal the identities of his underground colleagues.

He was recognized in the UK parliament for the priceless supply of intelligence that he arranged to send to Winston's British government, although when he fled to London after the Communist takeover in 1948, he was classified as a 'Displaced Person' and no jobs were available. According to his daughter Milena, the journey to Canada was a voyage of hope. He had worked in Hawaii before the war and came to Vancouver seeking a Professor Hutchinson. The Hutchinson in Vancouver was not in fact the ecologist whom he hoped to meet, but Andrew Hutchinson (a tree geneticist and Head of the UBC Botany Department) made Vlad and his family welcome and arranged a lectureship in the Botany Department.

The story of the next 25+ years is best described by Krajina's two major achievements. He prepared a Biogeoclimatic Zone map of British Columbia, which remains a key resource for both plant and forest ecology management in the Province. He proposed, lobbied for and achieved legislation to establish the British Columbia Ecological Reserves programme that resulted in establishment of more than 100 areas that were seen to be of critical importance for future research on the undisturbed natural places within the province. He worked tirelessly to persuade academic, government, and industrial ecologists to describe the unique vegetation of these Reserves, and although relatively little work has been done, these special areas remain protected. The Vladimir J. Krajina trail in the UBC Botanical Native Garden is a very appropriate recognition.

Those of us who knew Vladimir (always Dr Krajina to his students) remember a remarkable human being who was driven by his obsessive concern for family and friends, the fundamentals of democracy, and forest ecology. This very well written book is a 'must' for those who are interested in how scientifically strong advocacy can achieve success even among the conflicting interests that typify BC politics and forest ecology management.

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TOP CANADIAN ORNAMENTAL PLANTS. 4. Tulips

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Figure 1. A display of tulips, illustrating common colours. Photo by Sister 72/Jackie (CC By 2.0).

Tulips are unique. No other ornamental plant provides a comparably dazzling, exuberant display of eye candy when planted en masse. Tulip beds can paint stretches of landscapes in astonishingly vivid and glorious colours. But individual tulips also have remarkable charm. Despite its simple structure, the tulip is so elegant and endearing in form that it is the plant most often drawn by young children. And, of course, the tulip is the quintessential star of the spring garden. Plump, gorgeous flowers swaying in the breeze are a welcome harbinger of a new season of growth.

Names

SCIENTIFIC NAMES: *Tulipa* species and hybrids. The collective species *T. gesneriana* L. includes most cultivated ("garden") tulips. These are sometimes identified as *T. hybrida* hort. or *T.* ×*hybrida*, which are pseudo-scientific horticultural names not employed in formal taxonomic nomenclature. The genus name *Tulipa* is based on the Ottoman Turkish *tülbend*, ultimately tracing to the Persian *dulband*, meaning turban, almost universally interpreted as a reference to the tulip flower. The folds of a turban, reminiscent of tulip petals (especially when they overlap, as in young, unopened flowers), may be the basis of the name.
ENGLISH NAMES: tulip, garden tulip, Dutch tulip.
FRENCH NAME: tulipe.

The plants

There are over 100 species of tulips (*Tulipa* species), although the exact number is uncertain. Tulips are perennial herbaceous plants of the lily family (Liliaceae) with large, showy flowers. Wild tulip species range from southern Europe and North Africa to north-western China. The centre of distribution is central Asia, particularly Kazakhstan. The

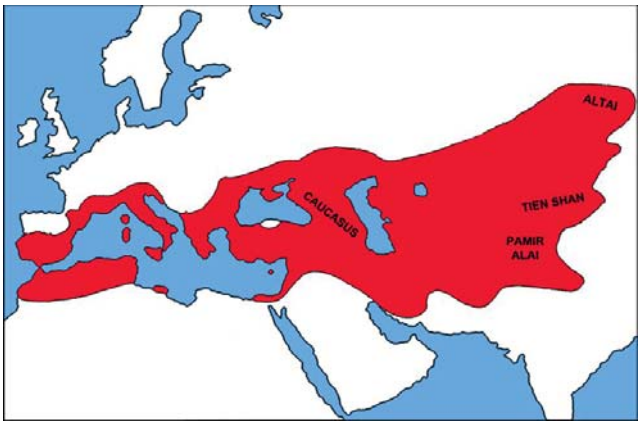


Figure 2. The geographical distribution range of wild tulip species, stretching from south-western Europe to north-western China and the Western Himalaya. Figure based on Wilford (2006).



Figure 3. Tulip bulbs. Photo by Mariluna (CC By 3.0).



Figure 4. Close-up of tulip reproductive organs – stamens in purple, pistil in yellow. Photo by cbransto (CC By 2.0).

plants occur in hilly or mountainous areas in temperate climates with long, cool springs followed by dry summers. Tulip species overwinter by bulbs, which in the spring produce a small number of basal, strap-shaped leaves, with prominent parallel venation. The plants also develop flowers in the spring, on erect stalks that are 10–70 cm (4–28

28 inches) tall depending on species. A tulip grown from seed usually requires 5 to 7 years to produce its first flower. Vernalization (typically 15 to 24 weeks of cold) is required to induce the ability to flower in tulip bulbs. Most tulip species and cultivars have only one floral stalk (peduncle), and this has a solitary flower (a few tulips have more than one flower on the peduncle). The flowers are usually cup- or star-shaped, with three petals and three sepals, these six perianth segments so similar that they are usually collectively referred to as tepals or petals. The outer three tepals are generally broader at the base and more rounded, while the inner three are narrower at the base and often wedge-shaped. Most garden tulips have little or no scent, although a few fragrant cultivars are offered by the nursery trade. Nectaries are absent. The fruit capsules contain many (often 200 to 300) small seeds, in two rows in each of the three segments.

In the horticultural trade, a variety of underground organs composed of stem tissue modified for food storage are often termed bulbs or characterized as bulbous. True bulbs are condensed stems made up mostly of scaly, fleshy, storage leaves, which are attached below to a “basal plate”, beneath which roots emerge (the flattened base of a tulip bulb is usually easily observed). True bulbs are, for the most part, simply buds surrounded by swollen leaves. Tulip produces true bulbs, and so do onion, lily, and narcissus (nearly all true bulbs are monocots). Other so-called bulbous organs include corms, tubers, and rhizomes. These are incorrectly called bulbs, and in all cases they are mostly made up of undifferentiated tissues, so that a cross section does not show layers as in true bulbs. Although tulips are perennial, the bulbs are annual, all of the stored energy being depleted to develop new plants in the spring.

Many garden tulips are self-fertile, but the pollen from the six stamens starts to shed before the stigma matures, promoting outcrossing. However, most modern tulip cultivars are sterile, and when seeds are available from cultivars they usually produce plants with inferior floral displays. Accordingly, almost all garden tulips are grown from daughter bulbs (sometimes called “bulblets”, or more colourfully “maidens”) that develop as offsets from the axils of the fleshy leaves of the maternal bulb. Typically two to three offset bulbs are produced annually. Commercial tulip farms excavate and grade all of their tulip bulbs at the end of the season. Smaller bulbs usually result in poorer tulips, and so are not marketed. Instead, the small bulbs are replanted (for several years, if required) until they grow large enough to be sold. Tulip bulbs are standardly measured by circumference (in centimetres) in a horizontal plane at the middle height of the bulb. For most cultivars, the recommended ideal top size for tulips is 12 cm or more (some cultivars have naturally smaller bulbs). Tulip bulbs are usually slightly flattened on one side, and on that side there may be a small scar where the bulb was attached to the previous year's flowering stem. A smooth, brownish layer, the tunic, covers the bulb, and tulip breeders favour cultivars with tough tunics to protect them during handling. A long section of a tulip bulb reveals four or five layers (each representing a fleshy leaf) which surround the embryonic shoot that will produce the flowering stem.

Like many other low-growing plants that flower in the early spring and become dormant in early summer, most tulip species take advantage of the limited competition from other plants in the early season. The bulbs supply energy that allows the leaves to develop quickly before taller plants produce their foliage and shade out the tulips. The presence of both seeds and bulbs provides reproductive insurance for tulips, the bulbs representing a way of staying in an area that has proven to be conducive to tulip growth, and the many seeds representing a means of colonizing distant areas.

The garden tulip is a spring-flowering ornamental, a given plant maintaining its flower in good condition for only a week or so (about the same limit for a bouquet in a vase). An early season heat wave can cause tulips to dramatically abbreviate their flowering period. However, different cultivars are available, which can provide a range of flowering times extending over 2 months. Planting bulbs in semi-shady areas can lengthen the flowering period.

Although tulips are perennials, in cultivation most garden tulips are either (1) treated as annuals (the offset daughter bulbs are effectively treated like seeds, to be replanted for the ensuing season), or (2) regarded as short-lived perennials because they deteriorate rapidly, and should be discarded after a few years. Tulips are always grown as annuals in the coolest season of otherwise very hot climates, as bulbs become degraded rapidly, and there isn't the necessary cold period for vernalization and induction of flowering. Tulips are also often grown only for one season in cold climates, simply to avoid the work involved in harvesting and storing the offset bulbs.

The wild ancestors

Tulip cultivars are derived from at least 15 wild species, some more or less directly from one species, many with ancestry tracing to more than one. Central Asia is considered to be the cradle that gave birth to the majority of domesticated tulips. *Tulipa gesneriana* is the principal species from which most garden varieties have been derived. There are some cultivars of *T. fosteriana* Hoog ex W. Irving (emperor tulip), and also many cultivars which are hybrids of *T. gesneriana* and *T. fosteriana*. In addition, cultivars (and hybrids) of several other wild tulip species are grown as garden ornamentals, and are popularly known as “species tulips”, less commonly as “botanical tulips”. These include *T. bakeri* Hall, *T. clusiana* D.C., *T. greigii* Regel, *T. kaufmanniana* Regel (waterlily tulip), *T. tarda* Stapf, and others.

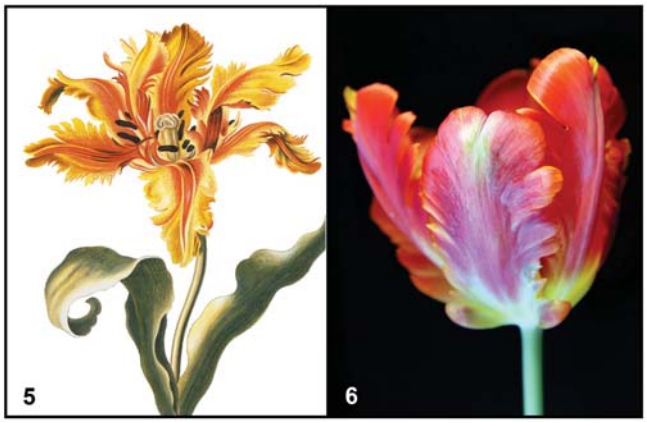
History of the ornamental forms

Classical Greek, Roman, and Byzantine civilizations were apparently unacquainted with tulips. The first evidence of interest in tulips traces back at least a thousand years in Central Asia, primarily in Anatolia and Persia. Tiles with pictures of tulips appeared in the 11th century in Anatolia, and garden forms were probably selected by the 12th century.

Footnote

[1] The Netherlands (strictly the Kingdom of the Netherlands) is frequently referred to as “Holland” in the wide sense, a usage that is often considered undesirable except in a historical context. Holland in the narrow sense is located in the mid-western, coastal part of The Netherlands, and existed as a separate country until 1581. It now constitutes North Holland and West Holland, two of the 12 provinces of of The Netherlands. “The Netherlands” is often rendered “the Netherlands”, authorities differing on capitalization of the “T”. Just “Netherlands” is mostly encountered in lists, although some have argued that “The” should always be omitted.

However, few records of tulip cultivation are available prior to the 16th century. From Turkey, tulips were first imported into Europe in the mid-16th century, at the conclusion of which they were particularly grown in Holland[1]. (Bermejo and Sánchez (2009) suggest that tulips were introduced into Spain about the end of the 11th century, 500 years before the time that is commonly accepted for the first European introductions.)



Figures 5 and 6: tulips of the parrot class (note feather-like petals). Figure 5 shows a painting of the 'King of France' tulip in Hortus nitidissimis (1750–1786, by C.J. Grew and G. D. Ehret), photo by Shanta Rohse (CC By 2.0). Figure 6 is by Ebelien (CC By 2.0).



Figures 7 and 8: exquisite tulips with doubled flowers (i.e. with extra petals). Figure 7 is by Tom Caswell. Figure 8, by choking sun, shows the “fringed petal” condition that is admired in some cultivars. (Both photos CC By 2.0).

Classification of garden tulips

Most modern tulip cultivars belong to the collective species *T. gesneriana*. Over 3,000 cultivars have been recognized historically, over 2,000 still available. Almost all tulip cultivars are clones, reproduced year after year by genetically identical offset bulbs. Most cultivars are complex hybrids, the result of crossing of older cultivars, some of which may have been interspecific crosses. Informal (i.e.



Figure 9. Lily-flowered tulips (note the long-pointed, reflexed tepals, and the urn shape of the flowers).

non-Latinized) horticultural classifications of these into groupings trace back centuries. The most commonly used current system of grouping tulip cultivars was devised by England's Royal Horticultural Society and the Royal General Bulb Growers Society in 1967. Fifteen classes were recognized; 11 of the groups deal basically with *T. gesneriana*, and are loosely based on height, flower shape, and blooming time, and the remaining four groups are concerned with other species or hybrids. Numerous websites and books reproduce the traditional 15-class tulip classification. However, groups have become increasingly difficult to delimit because of extensive breeding, selection, and hybridization, and many cultivars have ancestry tracing to more than one of the traditional groupings.

“Darwin tulips”, named after Charles Darwin, were first marketed at the beginning of the 20th century. These vigorous, tall, well-coloured tulips became very popular subsequently, with hundreds of varieties recognized, but widespread hybridization substantially obliterated the distinctiveness of the Darwin tulip class. “Darwin Hybrid Tulips” are hybrids (mostly sterile triploids) of Darwin cultivars and *T. fosteriana*. These very popular tulips are characterized by exceptional height, large, beautiful flowers, and vigour (the plants sometimes last for several years without annual replanting).

Most cultivated tulips have flowers of traditional appearance, i.e. with six unaltered tepals. However, several kinds of tulip flower with modified corolla features have been selected. Each of the following is often recognized as a distinctive tulip class. (1) Doubled flowers (i.e. with extra petals) have been bred, some cultivars having flowers that are remarkably similar to the doubled flowers of peonies and roses (Figs. 7 and 8). (2) “Parrot” cultivars have laciniate or scalloped petals (also often ruffled, curled, or twisted) that are reminiscent of feathers (Figs. 5 and 6). (3) Fringed cultivars have petals with fringes (especially on the distal parts; Fig. 8). (4) Lily-flowered cultivars have flowers that are quite reminiscent of garden lily flowers (Fig. 9), and tend to flower fairly late in the season. (5) Most cultivars bear only one flower per stem; “multiflowering tulips”, however, develop a branching stem that bears several flowers (typically three to seven), each on its own stalk.

Tulip break virus

In 17th century Holland, tulip plants with fantastically coloured flowers became very popular. The flowers were

characterized by very attractive mosaic colour patterns on the petals, often resembling flames, bars, stripes, streaks, or featherings. The plants were referred to as “broken tulips”, because their floral patterns were “broken” by comparison with the solid floral colours of most cultivars that were available. Not until the 1920s was it discovered that a virus, tulip breaking virus, is responsible for this condition (the nature of viruses was not appreciably clarified until the 1890s). The symptoms of this virus were first described in 1576 by Carolus Clusius, a Flemish professor of Botany at Leiden. Long considered to be the earliest recorded plant virus, it is now thought that the symptoms of another virus, tobacco leaf curl virus, were recorded as early as the 9th century. Tulip break virus was being spread among tulips by the peach potato aphid (*Myzus persicae*), which was widespread because of the popularity of peach trees. Tulip colour is determined by anthocyanins immersed in a base of yellow-white pigments. The virus irregularly suppresses the anthocyanins, allowing the yellow-white pigments to show through. After it was realized in the 1920s that the virus infection weakened tulips, which consequently produced fewer and smaller offset bulbs, broken tulips were systematically eliminated, along with most of the virus. Plants with multi-coloured flowers resembling broken tulips are available today, the result of breeding, and not the presence of the virus. Some of the classical broken tulip varieties are still extant, but trade in virus-infected plants is forbidden in most countries where tulips are grown (the virus is lethal to lilies, so its presence in gardens is very undesirable). The virus-infected, broken tulips were often referred to as “Rembrandt tulips”, presumably a complement to the 17th century Dutch master, reflecting the apparently artfully painted flowers. (Although Rembrandt tulips were illustrated by many of the famous Dutch painters, Rembrandt himself never painted them.) The phrase “Rembrandt tulips” is also applied to modern, virus-free cultivars with colourful flowers reminiscent of the old broken tulips.

Tulipomania

Tulip bulbs were first imported into Holland from Constantinople in 1593. Amsterdam merchants displayed their success by surrounding their estates with flower gardens, and became enchanted with the tulips, which quickly became a status symbol for the aristocratic class. With competition for novelty colours in the early 17th century, especially as exhibited by the broken tulips described above, prices for elite specimens climbed to exaggerated values. Tulips often sold for more money than commoners earned in a year. Lured by tales of sudden wealth, people traded their land, livestock, farms, homes, and life savings, sometimes just for a single tulip. By the fall of 1635, rather than purchasing actual tulips, investors turned to offerings in market exchanges, which were much like modern stock markets (the practice came to be known as “wind trade”). The so-called “colleges” in which trading transactions occurred were generally taverns, and it was customary at the conclusion of every trade for a fee (termed “wine money”) to be used to buy wine and beer for everyone present. Speculation rose to alarming levels in 1636, and it soon became evident that tulips had been greatly overvalued. In 1637 the tulip market crashed, prices plummeted, speculators went bankrupt, and the frenzy for tulips ended.
The tulip financial folly has become known as “tulip mania”



Figures 10 and 11. Variegated tulip flowers. Figure 10. Painting of a 17th century “broken” (virus-infected) tulip. This particular cultivar ('Semper Augustus') was the most celebrated and expensive tulip ever sold – 10,000 guilders for one bulb, debatably equal to as much as $500,000 in modern currency (see text). The cultivar is extinct, and only existed in a dozen or so specimens in the 1620s, mostly in the garden of Dr. Adriaen Pauw, a tulip fancier and the director of the new East India company. To magnify the attractiveness of his plants, he built an elaborate gazebo around them, with mirrors that multiplied the beauty of the flowers. Public domain illustration (photo CC By 3.0). Figure 11. A modern tulip (so-called “Rembrandt tulip”) with variegated colours mimicking a broken tulip. Photo by Ben Schumin (CC BY-SA 3.0).

or tulipomania, and represents one of the first “economic bubbles”. During the early 17th century, the most expensive tulip bulbs sold for as much as 750 Dutch guilders, alleged by some to be equivalent to about $35,000.00 in modern currency. (The guilder was replaced by the euro in 2002.) A top-selling tulip could purchase the equivalent of 15 fat pigs, 4 metric tons of butter, the work of a skilled labourer for 3 years, or a country estate. Tulipomania is a most interesting story, and has become widely cited by economists as representative of the dangers of economic bubbles eventually bursting. However, several recent analyses have suggested that both the purchasing power of fancy tulips and the enthusiasm for unwise investment in them during tulipomania have been significantly exaggerated. In any event, some economists have concluded that foolish investment can be beneficial for investors, so long as there are further investments by even foolisher speculators (“the greater fool theory”; there are analogies with pyramid and Ponzi schemes). Despite the rather shameful aspects, tulipomania may have contributed to the ultimate establishment of The Netherlands as the dominant commercial tulip-growing nation.
A second, albeit smaller rage for tulips took place in Turkey. The “Tulip Period” or “Tulip Era” refers to a peaceful, prosperous time from 1718 to 1739 in Ottoman history, when a craze for tulips developed among Ottoman court society. Once again, the elite competed for the best tulips. Prices rose dramatically in the late 17th century, peaking in 1726–1727, at which time the state intervened and set limits on tulip prices.



Figure 12. An 1882 Painting by J.-L. Gérôme illustrating an incident during the 17th century tulipomania craze in The Netherlands. Soldiers are trampling tulip flowerbeds in a governmental attempt to stabilize the tulip market by limiting the supply. Photo by Walters Art Museum (CC By 3.0).

The Canadian connection

During the Second World War when The Netherlands was occupied by the Nazis, the princesses of the Dutch Royal family – Princess Juliana (Queen between 1948 and 1980) and her daughters Beatrix and Irene – took refuge in Ottawa, from 1940 to 1945. A third princess, Margriet, was born in Ottawa's Civic Hospital in 1943 (Margriet was named for the "marguerite", species of daisy-like flowers worn as symbols by the Dutch resistance). The Canadian governments proclaimed that the maternity ward was "extraterritorial", as sole Dutch citizenship was necessary for the purpose of royal succession. To thank Canada for providing a safe haven and to acknowledge the important role of Canadian troops in liberating the Netherlands, in the fall of 1945 Princess Juliana presented Ottawa with 100,000 tulip bulbs, and promised an annual gift of tulips for the rest of her life. Upon her death in 1994, an agreement between Canada and the Netherlands provided that the annual gift of 20,000 bulbs would continue in perpetuity. Several thousand of the bulbs are dedicated to the Civic Hospital where Margriet was born.

In 1953 the first Canadian Tulip Festival was held in Ottawa, and has become the largest tulip festival in North America. Famous entertainers who attended the festival include Liberace (1972), Tiny Tim (1984), and Alanis Morissette (1987). Currently, over a million bulbs representing more than 100 cultivars are planted annually. The festival now attracts over 500,000 visitors every spring.



Figures 13 and 14: Ottawa Tulip Festival scenes. Figure 13. Roadside tulip bed. Photo by Paul Shannon (CC BY-SA 2.5). Figure 14. Red tulips beneath the Peace Tower on Parliament Hill. Photo by Kasia/flickr/Catherine Bulinski (CC BY-ND 2.0).



Figure 15. Some of the 150 five-foot fiberglass tulips created for the 2008 Canadian Tulip Festival on the occasion of the 150th anniversary of Ottawa being chosen as Canada's capital in 1858. Photo by elPadawan (CC BY-SA 2.0).

Tulip colours

Almost all colours can be found in tulip flowers, with the most notable exception of blue, the bluest ones showing tinges of violet. Flowers with solid (uniform) colour rather than mixed colouration remain the most popular kinds. In a survey of tulip bouquet colour preferences by the American Floral Marketing Council, men purchased (in decreasing order) red, yellow, pale pink, hot pink, white, and purple tulips, while women bought pale pink, pale purple, hot pink, peach, red, and yellow. Overall, red is the top-selling colour for all tulip sales.

Although the colour black is associated with evil and danger (the blackness of night has always seemed threatening to humans), black flowers have been especially desired for centuries. However, black flowers are very rare in nature, and indeed in cultivation. Black tulips have been elusive. 'Queen of Night' is regarded as the cultivar that is closest to producing black flowers, but the hue is a dark maroon. *The Black Tulip* is a celebrated novel by the famous French writer Alexandre Dumas (1802–1870). The plot concerned a competition in 17th century Holland to grow the blackest tulip, and how greed for a prize of 100,000 guilders led to disaster for the competitors. At the time, no available tulip was really blackish, and Dumas provided a rather silly explanation for how to produce a black tulip: simply spray the bulb with black dye, and the flowers will develop black colouration.



Figure 16. An example of a “black tulip”; in reality, black tulips are deep maroon or purple. Photo by quattrostagioni (CC By 2.0).

Toxicity

Up until the 17th century in Europe, gardens were primarily devoted to medicinal and edible plants. When tulips were first introduced to European countries, people sometimes used them medicinally (for example, as a remedy for flatulence), and the bulbs as food. During the Second World War, famine forced some people in the Netherlands to eat tulip bulbs, although they are not safe to consume. Tulip flowers have occasionally been used in culinary dishes and to flavour wine. Tulip bulbs are considered to be toxic to dogs, cats, and horses, but many mammals appear to be immune. Rabbits and rodents (notably squirrels, mice, and rats) are very fond of the bulbs, and are capable of causing extensive damage to tulip beds. Skunks, raccoons, voles, and birds sometimes also consume the bulbs. Some people are allergic to tulips, suffering dermatitis and breathing problems. Tuliposides and tulipalins are the compounds responsible for the allergies. Tulipalin A is particularly known for inducing occupational dermatitis in tulip bulb sorters and florists; it is present in all parts of the plant, but the highest concentration is in the bulbs.



Figure 17. A Dutch tulip field. Photo by Alessandro Vecchi (CC By 3.0).

Commercial aspects

Today, tulips are widely grown as ornamentals in large outdoor flower beds by government agencies and private companies, and by homeowners in private gardens. Almost all of these plants are raised from bulbs, which are produced on tulip farms. Tulip bulbs are produced commercially in many lands. The Netherlands has the largest area devoted to tulip farms (over 6000 ha or 15,000 acres), followed by the U.K., Denmark, and Japan, with a dozen or so other countries producing appreciable acreages. The Netherlands also leads the world in tulip exports, and indeed almost half of the flower bulb area in the country is devoted to tulips. Three billion bulbs are produced every year, two-thirds for export. Why did Holland (western Netherlands) become the predominant tulip grower and trader? It has been suggested that the monotone gray dress that was popular in the 17th century (because of Calvinism's religious intolerance of showy personal displays) predisposed the population to being attracted to the gaudy colours of tulips, and led to the Dutch love affair with the flower. The sandy soils of old Holland, when appropriately fertilized, are ideal for growing tulips (offset bulbs develop very well and are easily harvested from sand). During the 1600s the Netherlands was a major sea power, responsible for about half of Europe's shipping trade, so it was natural to seize on the export of tulip bulbs as a marketing opportunity. And, the Dutch were astute traders (most notably in 1626, when Dutch colonists purchased Manhattan Island from Indians for goods estimated to be worth only $24.00).

There is a huge domestic and international trade in fresh-cut flowering tulip stems sold as bouquets for exhibition in homes. (There is also a much smaller market for potted tulips for both indoor and outdoor display.) Forcing of bulbs to produce cut flowers out-of season is the basis of this industry, and occurs primarily from early December to May in the Northern Hemisphere. Valentine's Day (Feb. 14), Easter (varies between 22 March and 25 April), and Mother's Day (different dates; second Sunday in May in Canada and the



Figures 18 and 19: cut tulips. Figure 18. Tulip bouquets on sale in Amsterdam. Photo by jimdera (CC By 2.0). Figure 19. A vase of tulips. Photo by shaferlens/Dave Shafer (CC By 2.0).

U.S.) are key sales periods for cut tulips. Most forcing of tulip bulbs occurs in cool greenhouses, often employing soilless production systems (such as hydroponics). However, in some places the climate permits tulips to be grown outdoors in raised beds to produce flowers naturally for spring sales. Recently, Southern Hemisphere countries such as Australia, New Zealand and Chile have taken up cut tulip production to provide an out-of-season supply to the Northern Hemisphere.

Statistics

The tulip is the world's most important ornamental flower cash crop, with more than 10,000 ha (25,000 acres) in production worldwide. Tulips are the leading cut flower in Canada, in terms of stems produced (the same is true for the United States); in recent years, Canadian greenhouses have produced nearly 100 million cut tulips annually. Canadian greenhouses also produce about 2 million potted tulips (there is greater production of potted plants of seven other ornamentals). Tulip bulbs are produced commercially on farms in Canada and the U.S., but statistical information is unavailable, and most bulbs are imported.

Cultivation

Almost all tulips are grown today from bulbs, not from seeds. Tulips require vernalization to produce offset bulbs. This is achieved in nature by cold-season dormancy. When tulip bulbs are grown in warm climates that lack sufficiently cold winters, offset bulbs are fewer and smaller and are of limited suitability for production of tulips in the following season. In such warm climates, tulips are often grown as annuals, the plants discarded after they flower. As noted below, most tulip plants tend to produce poorer plants the second season, even if the climate is ideal, unless the offset bulbs are excavated and replanted.

Cultivation tips

PURCHASING

● Buy bulbs that are “top size” (with a circumference of at least 11cm or 4.5 inches, although the bulbs of species tulips are often only 7–9 cm or 2.5–3.5 inches). They should be firm to the touch, and free of dents, blemishes, and mould (especially on the basal plate). Small nicks and loose skin are not significant.

PLANTING

● Soil: Plant tulip bulbs (pointed end up) in deep, fertile, humus-rich, well-drained soil (recommended pH 6 to 7). Sandy soil is best (but compost should be added), and heavy clay soils are unsuitable (unless amended with organic material or vermiculite). If available soil is quite inappropriate, consider bringing in soil and creating raised beds. The soil should be thoroughly tilled to a depth of 30–45 cm (12–18 inches) before planting. Purchased bulbs should be accompanied by recommendations for planting depth. Generally, plant 10–15 cm deep (4–6 inches, and larger bulbs are best planted deeper (rule of thumb: plant at a depth that is three times the length of the bulb). Deeper planting can discourage rodents from digging up bulbs. After planting, thoroughly water the soil.

● Location: Plant tulips in full sun, preferably where they will receive a minimum of 4 to 6 hours of bright sunlight when the foliage is green. Light shade is tolerated, and some mid-day shade is often recommended to avoid drought stress at the hottest time of the day. Tulips can be planted near deciduous trees and shrubs. Shady locations prevent vigorous development of offset bulbs which are needed for reproduction in the following season. Plant in sheltered locations, but not near heated basements. Most garden tulips are ideal for beds and borders, and many of the smaller species tulips are best in rock gardens. Dwarf forms need to be located in containers or in locations that facilitate viewing.

● Planting time: Plant bulbs before deep frost hardens the ground, but when the weather will remain sufficiently cool to



Figures 20 and 21: tulip farm, Agassiz, British Columbia. Figure 20 photo by keepitsurreal/Kyle Pearce (CC BY-SA 2.0). Figure 21 by miss605/Rebecca Bollwitt (CC By-NC-SA 2.0).

prevent bulbs from beginning shoot growth in the fall.
● Flowering time: Consider the blooming times desired; generally the labels of packaged tulips will indicate whether the cultivars are intended to flower in early spring, early to mid-spring, mid-spring, or late spring. This information should also be available on the pictured example that accompanies bulbs purchased in bulk from bins.
● Layout: For outdoor display, tulips are almost always laid out in beds or borders, except for dwarf *Tulipa* species grown in rock gardens. Single tulips are not particularly attractive, and groupings of no less than a dozen or so are recommended. Bulbs are usually laid out 10–16 cm (4–8 inches) apart, depending on the size of the cultivar (not the size of the bulb). To produce uniform height, bulbs should be about the same size. Beds showing flowers of one solid colour are very attractive, as are beds of contrasting colour blocks, but randomly or systematically mixing colours can also be attractive. Planting tulips in grass is strongly discouraged. Planting in mixed beds with other ornamental species is often done, to avoid the unkempt and unoccupied appearance of the bed after the tulips die down.
MAINTENANCE
● Disease control: Ideally to prevent build-up of disease organisms, tulips should be planted in a new location each year, rotating with other plants, waiting 5–7 years before planting again. Some gardeners will remove the top layer of soil before replanting tulips in the same area. For most people, finding a new location for tulips after they have been grown in the same site for several years is a good idea. Excavate and discard diseased plants as soon as possible.
● Irrigation: Tulips should be watered well right after fall planting to encourage root formation before freeze-up (but very late planting will merely delay emergence in the spring). Tulips need regular moisture from first appearance in the spring until the foliage yellows in the fall. Once the plants are dormant, discontinue watering. Avoid over-watering. Keeping the foliage and flowers damp for prolonged periods can encourage fungal disease such as botrytis. Soaker hoses are often preferable to overhead watering.
TO OBTAIN NEW BULBS TO RE-PLANT FOR THE NEXT SEASON:
● To encourage development of offset bulbs, work some quality compost and a slow-release nitrogen fertilizer into the bed before planting (do not place fertilizer in direct contact with the bulbs). To encourage re-blooming of established plants, apply a complete fertilizer with fast-release nitrogen in the spring, just as shoots are emerging. Or, just use a "bulb food" intended for tulips. Highly nitrogenous fertilizers and fresh manure should not be applied, as they encourage disease and vegetative growth rather than flowering.
● "Deadhead" after flowering, cutting away fading flowers and developing seedheads, which deplete food reserves from the developing offset bulbs (a third of the bulb's energy can be diverted into seed formation).
● Remove the leaves after flowering, waiting until they are quite yellow or brown, and dry or limp (and easily pulled free), as their photosynthesis provides storage carbohydrates for the developing offset bulbs. Tulip may need about 6 weeks to die back before leaves may be removed.
● Offset tulip bulbs intended for growing the plants in the next season should be lifted out of the soil after the leaves have died, and stored in a cool (preferably 2–10 C or 35–50 F), well ventilated place until planted in the late fall (store in paper bags, never in plastic).
TO PROLONG A TULIP BED WITHOUT REPLANTING
● Use robust cultivars that are capable of persisting for several seasons, although degeneration of the bed is inevitable (in particular, small offset bulbs tend to produce inferior, crowded plants). Tulips with considerable parentage of *T. fosteriana* (such as the Darwin hybrid tulips), and species tulips (such as Greigii and Kaufmanniana tulips) are known for their ability to perennialize, i.e. regrow and rebloom for several years after planting.
● Mulch for the winter, using material that does not pack down (which could inhibit emergence in the spring). Remove or reduce mulch in the spring; thick covers can suppress growth. Keep in mind that mulches can be an invitation to small mammals to nest in the location, and devour the bulbs.

Symbolism

● Tulips have acquired the symbolism of perfect love, passion, and romance.
● The tulip is recognized as the official flower of Turkey (and is accepted as the emblem of Istanbul). It is also considered to be the unofficial national flower of the Netherlands. Several cities have adopted tulips as their emblem (either officially or by common consent). The tulip was declared to be the official flower of Ottawa in 2001. The cultivar 'Orange Wonder' became the emblem of Albany, New York, in 1948. Japanese cities recognizing tulips as their emblem include Nigata City and Yubetsu Town.
● In 1980, J.W.S. Van der Wereld, a Dutch horticulturalist who had Parkinson's disease, produced a red and white tulip, which in 1981 he named the 'Dr. James Parkinson' tulip in honour of the man who described the medical condition. Subsequently in 2005, the "Red Tulip" was recognized as the worldwide symbol of the disease at the 9th World Parkinson's disease Day Conference in Luxembourg.



Figure 22: Madame de Pompadour (1721–1764), official chief mistress of Louis XV, showing the lavish use of fresh flowers including tulips in gowns, at the French court. Painting (public domain) by François Boucher in 1856.

Curiosities of science and technology

● The courts of the French kings of the 17th and 18th centuries were marked by decadent opulence. Ladies of the court paraded in gowns marked by deep décolletage accentuated with the most expensive ornaments, which often included tulip blossoms.
● Calvinism is a major branch of Western Christianity that follows practices of John Calvin (1509–1564) and other

Protestant Reformation theologians who separated from the Roman Catholic Church. Five chief doctrinal points of Calvinist theology are sometimes referred to by the acronym TULIP. This stands for: “Total depravity” (everyone is born into sin); “Unconditional election” (God elects to give mercy to those receiving salvation through Christ); “Limited atonement” (atonement is limited to some); “Irresistible grace: (the irresistible call to grace by God); and “Perseverance of the saints (all who are truly saintly will be saved).

- Sultan Ahmed III (1673–1736), who came to rule the Ottoman Empire in 1703, was a tyrant who lived in a luxurious lifestyle while his people suffered. He was quite obsessive about tulips, insisting that his guests harmonize their clothing with the flowers at his tulip festivals. Showing up in the wrong costume was a very bad idea, since his gardeners also served as state executioners.
- Sheik Mohammed Lalizari (lalizari means “tulip lover”) was another 18th century Turkish ruler with a fanatical enthusiasm for tulips. A manuscript he authored mentioned 1,323 kinds of tulips, and he had more than 500,000 varieties in his gardens.
- In the Netherlands, presenting a bouquet of less than ten tulips as a gift is considered to be a gross social blunder.
- It has been estimated that the 3 billion tulip bulbs produced in the Netherlands, if planted 10 cm (4 inches) apart, would circle the globe at the equator seven times.
- It is possible to grow a tulip from bulb to flowering plant in total darkness.
- Cut tulips turn toward the light, so fresh flowers in a vase may become awkwardly displayed. The stems often grow 2.5 cm (1 inch) in length while in the vase, causing drooping over the edge of the vase. To maintain an attractive arrangement, rotate the vase a quarter turn each day and straighten any drooping stems.

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Figures 23, 24, 25: whimsical creations made of tulip flowers in May, 2012, from the Springfields Festival Gardens, Spalding, Lincolnshire, the site of the largest annual tulip festival in the U.K. (To encourage offset bulb production, tulip farms cut off the flowers, which are accordingly available to decorate such sculptures.) Figure 23. Aviator, photo by Jim Linwood (CC By 2.0). Figure 24. Snail, photo by Paul Stainthorp (CC BY-SA 2.0). Figure 25. Teddy bear, photo by Jim Linwood (CC By 2.0).

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Key websites

Production of tulips as cut flowers –extension.umd.edu/publications/pdfs/fs837.pdf [A brief practical guide.]
The tulip gallery – http://www.thetulipgallery.com/cat/10 [Extensive presentation of colour photos of tulip cultivars.]
Tulips in the Capital – http://www.canadascapital.gc.ca/celebrate/tulips [Provides map showing where tulip cultivars are located for the 2012 Canadian Tulip Festival in Ottawa, and photos of a wide variety of tulips.]

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