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Davidsonia

Editor

Iain E.P. Taylor
UBC Botanical Garden and Centre for Plant Research
University of British Columbia
6804 Southwest Marine Drive
Vancouver, British Columbia, Canada, V6T 1Z4

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Cover: The glossy, striking foliage of *Magnolia lotungensis*—a widespread species in southern China with surprising cold hardiness. Photo: Peter Wharton
Back Cover: Dick Figlar and Dr. Wang Wei-bin of the Yunnan Academy of Forest Sciences stand next to *Magnolia yunnanensis* growing in the wild, southwest Maguan county, Yunnan. Photo: Dick Figlar.

Editorial

5 years on (or 25)

This issue of **Davidsonia** marks the end of my first term as Editor-in-chief. The last five years have been great fun and at times a great challenge. With the invaluable help and advice from the Editorial Advisory Board and the Associate Editors, **Davidsonia** has been reborn on a firm foundation and is now available in paper and electronic form. We continue to publish two original peer-reviewed papers in each issue and, as we are beginning to attract unsolicited papers from further afield, it is reasonable to predict expansion.

I have agreed to continue for another term as Editor-in-chief, but this will be my last. I hope that many members of the two editorial panels will consider continuing with me. I have been fortunate that several members of those panels have responded to my calls and published in **Davidsonia**. I hope that this will continue because the journal's main goal is to provide an outlet for reports of research in systematics, ecology, horticulture, and landscape that is of interest to all members of the very diverse community of botanical garden researchers and supporters. The botanical history of the Pacific Northwest is much fragmented and recent doctoral research by David Brownstein in the UBC Geography department is one of the most thorough studies of three of BC's botanical pioneers. I hope that **Davidsonia** can attract the science and the history of our immediate surroundings, but also that the journal can grow into a first choice target for like minded researchers from the rest of the world.

I must name the two individuals without whom **Davidsonia's** progress to becoming both a paper and an e-journal could not have occurred. The initial production template was created by Daniel Mosquin.

Iain E.P. Taylor, Professor of Botany and Research Director,
UBC Botanical Garden and Centre for Plant Research,
6804 SW Marine Drive, Vancouver, BC, Canada, V6T 1Z4.
iain.taylor@ubc.ca

I hope that a future issue will be devoted to a portfolio of images from Daniel's internationally known web page feature, "Botany Photo of the Day". Eric La Fountaine, our current production manager, has an uncanny sense of layout and photo selection. He has ensured that graphs, line drawings, maps and photographs are clear and well placed.

Access to the journal through the UBC Botanical Garden web site www.ubcbotanicalgarden.org has given our authors a circulation that few of us anticipated. I know that our first international submissions came because of our web presence. All submissions are peer-reviewed and that plus the opportunities that **Davidsonia** provides for authors augurs well for a very bright future. In the final analysis, it is the Editor who determines the content of the journal. My experiences at **Davidsonia** during the last 5 years assure me that the support and the talent are available for the journal to thrive and for the Editor's job to be a pretty easy one.

Embryological and phenological comparison between *Arceuthobium americanum* (the lodgepole pine dwarf mistletoe) growing on *Pinus contorta* var. *latifolia* in British Columbia and on *P. banksiana* in Manitoba.

Abstract

The genus *Arceuthobium* comprises angiosperms that are aerial parasites on Pinaceae and Cupressaceae. These parasites are serious forest pests in North America, where they damage timber trees. In Canada, *Arceuthobium americanum* (the lodgepole pine dwarf mistletoe) is principally found on *Pinus contorta* var. *latifolia* (lodgepole pine) in British Columbia (BC) and Alberta as well as on *Pinus banksiana* (jack pine) in Alberta, Saskatchewan and Manitoba. Although widespread, *A. americanum* seems morphologically uniform in its range. However, the taxon has been divided into two distinct genetic races based on the variation observed in amplified fragment length polymorphism (AFLP) data. This led us to predict that there would be some variation in anatomical, as opposed to external morphological form. Therefore, the objective of this study was to determine if the embryological anatomy of *A. americanum* growing on *P. contorta* var. *latifolia* in BC differed from that growing on *P. banksiana* in Manitoba. Samples of female flowers were collected from both BC and Manitoba throughout the growing season and prepared for routine light microscopy. Key embryological stages were observed, and the relative timing of these stages were compared between the BC and Manitoba collections. Our results were in direct contrast with our prediction, which had to be falsified: hundreds of prepared sections revealed that major embryological events, including double fertilization and zygotic division, are indistinguishable and occur at essentially the same time. This

Chad D. Stewart and Cynthia M. Ross,
Department of Biological Sciences, Thompson Rivers University,
P.O. Box 3010, 900 McGill Rd., Kamloops, BC, Canada, V2C 5N3.
cross@tru.ca

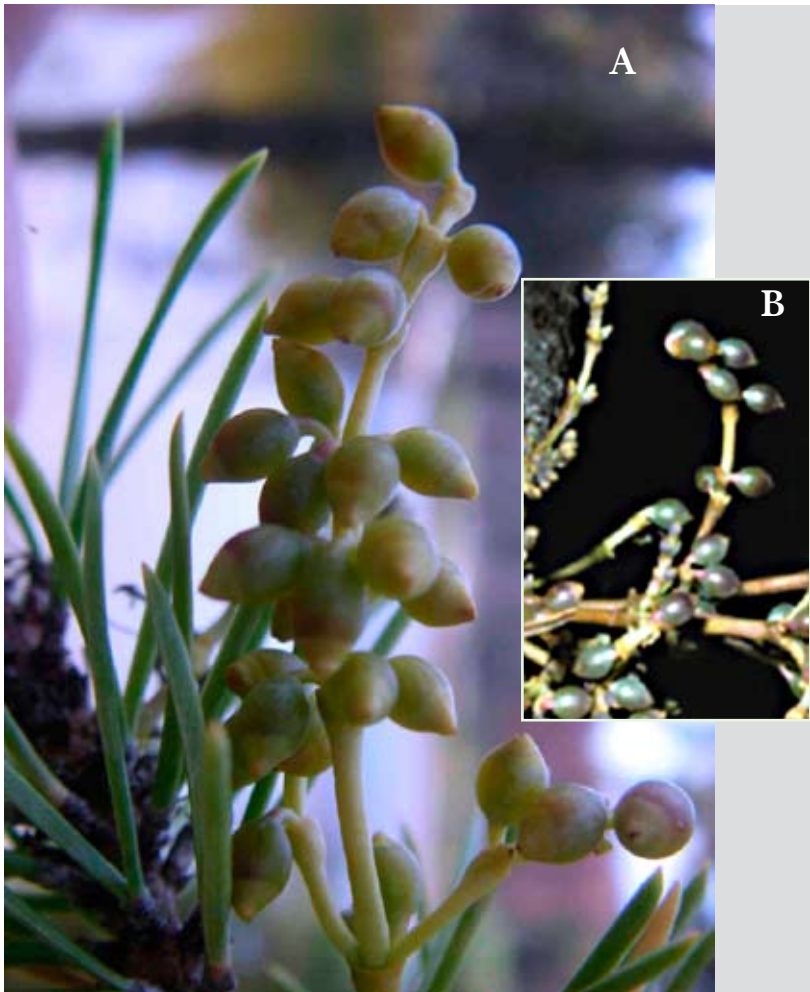
first study on embryology of two plants growing on the two pine species at the extreme geographic ranges shows that the development is similar. Despite climate, host, ecology, and geography, which remain variables of undetermined relative significance, the mechanism for embryological development is likely highly conserved for *A. americanum* across Canada.

Introduction

Arceuthobium americanum (the lodgepole pine dwarf mistletoe) has the most extensive distribution of any North American dwarf mistletoe. In Canada, these aerial parasites are principally found on *Pinus contorta* var. *latifolia* (lodgepole pine) in BC and Alberta as well as on *Pinus banksiana* (jack pine) in Alberta, Saskatchewan and Manitoba (Hawksworth and Wiens 1996). Jerome and Ford (2002) argued that amplified fragment length polymorphism (AFLP) data showed enough variation to justify dividing the taxon into distinct genetic races, even though there are no apparent morphological or phenological differences among *A. americanum* growing in the different regions or on different hosts (Figure 1). We tested Jerome and Ford's hypothesis for genetic races, by looking for variation in anatomical, as opposed to external morphological, form. Such anatomical variation might be detected via an embryological study.

Differences in embryological development are often used as taxonomic characters (Friedman 2001; Verdu 2006; Raghavan 2006). Ross and Sumner (2005a, 2005b) made detailed descriptions of key early embryological events and their timing as they occurred in *A. americanum* infecting *P. banksiana* in Manitoba. These events included double fertilization, subtension of the embryo by three endosperm cells, transverse zygotic division and formation of a two-celled embryo, formation of the four-celled embryo, and formation of the eight-celled embryo.

Therefore, the objective of this study was to observe and map the relative timing of these same embryological stages in *A. americanum* growing on *P. contorta* var. *latifolia* in BC and compare the results to those obtained in Manitoba to determine if there was anatomical variation. While site differences might generate variation in timing, major discrepancies in comparative embryology could point to either a host influence and (or) differences in the genetic pathway for embryology



Images: Chad D. Stewart and Cynthia M. Ross

Figure 1: Pistillate plants of *A. americanum* with fruit growing on (A) *P. latifolia* var. *contorta*; (B) *P. banksiana*. These plants were sampled at the same time in the year (mid August), are at the same stage of development, and are essentially indistinguishable.

between the two groups. This would provide more support for Jerome and Ford's (2002) division of the taxon into distinct races. This is also the first comparison of the embryology of any *Arceuthobium* species growing on two different hosts.

Methods

Study Sites and Collection

At least thirty pistillate aerial shoots of *Arceuthobium americanum* were sampled from infected *Pinus contorta* var. *latifolia* in an area adjacent to Stake Lake (located 30 km south of Kamloops, BC at 50° 31' N, 120°28' W) over one growing season daily from May 1, 2005 through Sept 1, 2005. Similarly, thirty pistillate aerial shoots had previously been collected from infected *P. banksiana* in the Belair Provincial Forest (within 5 km of Belair, Manitoba at 50°36' N, 96°32' W) biweekly from March 15, 1995 through March 15, 1997 (Ross and Sumner 2005a, 2005b). At each site, the shoots were placed into a fixative consisting of 2% paraformaldehyde + 2% glutaraldehyde in a 0.1 M phosphate buffer (pH 6.8). The material was taken immediately to the laboratory and placed at 4 °C overnight for fixation, rinsed in the same buffer, and post fixed with 2% osmium tetroxide in the same buffer for 4 h. The material was dehydrated in an ethanol series and embedded in Spurr's resin (Spurr 1969).

Light Microscopy and Documentation

Sections 2 µm thick were obtained with a Sorvall Porter-Blum JB-4 microtome (Sorvall, Newtown, Connecticut) and affixed to gelatin-coated glass slides (Jensen 1962). The slides were routinely stained with 2% crystal violet in a 0.05 M ammonium oxalate buffer (pH 6.7) and were observed and photographed with a Nikon Optiphot compound light microscope (Nikon, Tokyo, Japan). In order to describe and accurately time the occurrence of key embryological stages, at least fifteen representative sections from fifteen different female flowers displaying the same embryological stage needed to be observed before an event date was ascribed. Relevant temperature data for the two sites were obtained from FORECA's open source climatological data.

Results and Discussion

Based on the variation observed in AFLP data, Jerome and Ford (2002) divided *Arceuthobium americanum* into distinct genetic races. This led us to predict that there would be some variation in anatomical, as opposed to external morphological, form. As patterns of embryology have been used as taxonomic characters (Friedman 2001; Verdu 2006; Raghavan 2006), we thought that perhaps differences in embryology might distinguish *A. americanum* growing on the different hosts in the different regions, even if these differences could not necessarily be disentangled from ecological ones. However, our prediction was shown to be incorrect. There was remarkable similarity not only in the physical attributes of key early embryological stages in *A. americanum* infecting *Pinus contorta* var. *latifolia* in BC and *P. banksiana* in Manitoba (Figure 2), but also in the relative timing of the events (Table 1). Therefore, embryological development in *A. americanum* is likely highly conserved across Canada, despite climate, host, ecology, and geography, which remain variables of undetermined relative significance.

Moreover, even though the sampling from the two sites was accomplished in different years, the calendar month dates of the embryological events were essentially identical (Table 1): for example, double fertilization in BC took place on May 30 in 2005 and similarly occurred in Manitoba on May 30 in 1995, 1996, and 1997. This suggests that *Arceuthobium americanum* embryology is under strict regulation, at least in its Canadian range. As the latitudes of the two sites were essentially the same (50° 31' N for Stake Lake, BC, 50° 36' N for Belair, Manitoba), day length is likely the main controlling factor. Temperature might also play a governing role; the temperature highs and lows were notably similar at both sites on each event date (Table 1).

Our results are significant because they indicate that the embryology of *Arceuthobium americanum* in its Canadian range is predictably uniform, and so embryological patterns could be considered to be reliable characteristics of the species. Species in *Arceuthobium* are notoriously difficult to distinguish from each other by morphology (Hawksworth and Wiens 1996). Perhaps the predictable embryology of *A. americanum* will help to distinguish it from other members of the genus. While search of the plant and animal literature has yielded no descriptions of the comparative embryology of parasites growing on different hosts and limited embryological comparisons of any one species (parasitic

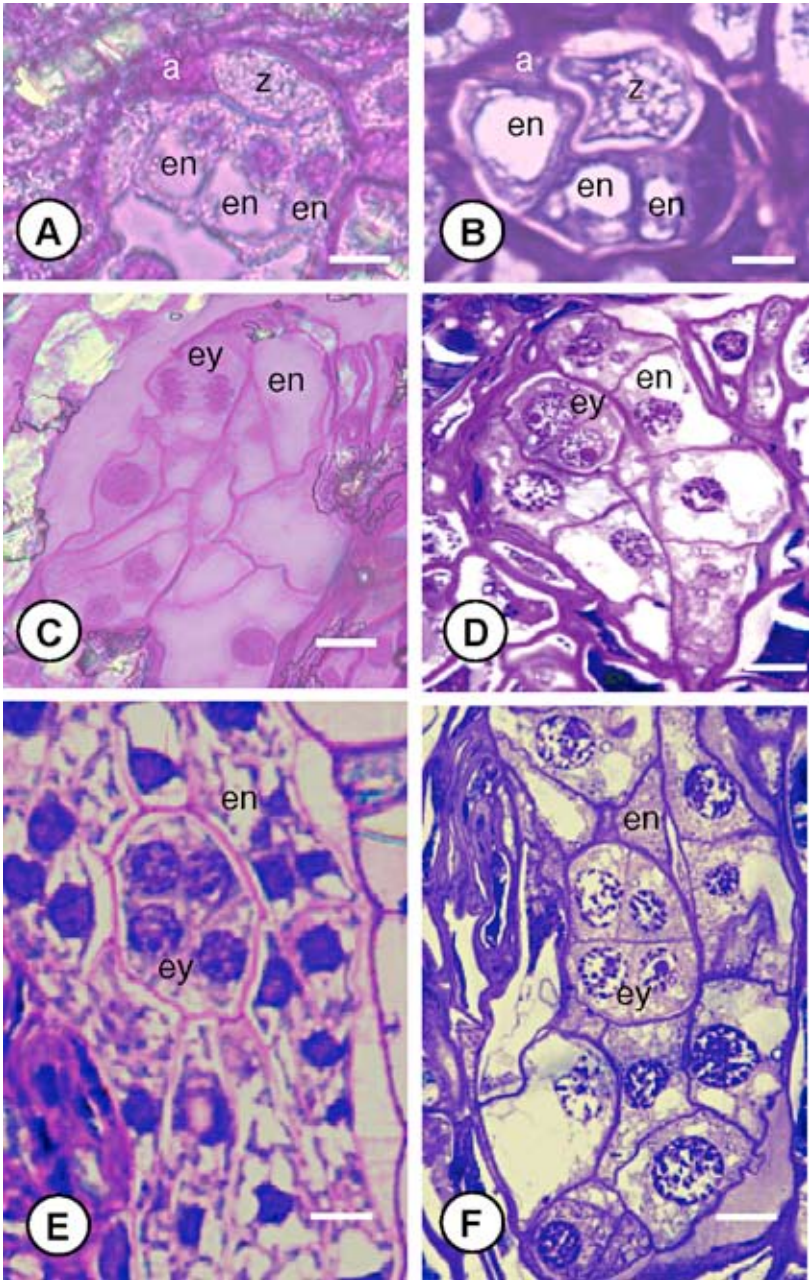


Figure 2: Some examples showing early embryological stages of *A. americanum* growing on *P. latifolia* var. *contorta* (A, C, E) compared with the same species growing on *P. banksiana* (B, D, F;

these three figures originally appeared in Ross and Sumner 2005b and are reprinted here with permission). (A) Growing on *P. latifolia* var. *contorta*, the *A. americanum* zygote has just been subtended by three endosperm cells, which are beginning to crush the antipodals (July 10 in 2005); (B) as in (A), but on *P. banksiana* (July 10 in 1995, 1996, and 1997); (C) newly formed two-celled *A. americanum* embryo (transverse zygotic division had just taken place) observed on *P. latifolia* var. *contorta* (August 8 in 2005); (D) as in (C), but on *P. banksiana* (August 9 in 1995, 1996, and 1997); (E) Formation of the four-celled *A. americanum* embryo as observed on *P. latifolia* var. *contorta* (August 15 in 2005); (F) as in (E), but on *P. banksiana* (August 15 in 1995, 1996, and 1997). The similarity in the structures, relative timing, and actual calendar date are striking. a = antipodals (crushed), en = endosperm (or cell of), ey = embryo; z = zygote. In (A) and (B), scale bar = 12 μm ; in (C) and (D), scale bar = 20 μm ; in (E) and (F) scale bar = 15 μm .

or otherwise) across wide geographical ranges, our study is novel, and should be repeated for other parasites and hosts to see if differences can be detected.

If distinct genetic races of *Acenthobium americanum* do exist (Jerome and Ford 2002), early embryological development cannot be used to tease them apart, and our results do not support the division of the taxon. This first study on the embryos of *A. americanum* growing on two pine species at the extreme geographic ranges of the species reveals that the embryo structures are similar. A useful exercise for the future would be to map and compare embryological stages occurring prior to double fertilization and after formation of the eight-celled embryo, as well as to examine stages of staminate development. It would also be useful to eliminate geography and site differences as variables: the embryology of *A. americanum* could be observed as it occurs in Alberta, where the two host pines are found growing side by side. The rigour shown in embryological development promises potential for widespread disease control, because it is likely that *A. americanum* across Canada reach similar stages of development at similar times; if a certain stage turns out to be vulnerable to a management tool, that stage could be targeted ubiquitously.

Acknowledgements

The first author wishes to thank Thompson Rivers University (TRU) for funding provided by its Comprehensive University Endowment Fund (CUEF), as well as Dr. Don Nelson for his encouragement and support throughout the project. The second author thanks the Natural Sciences and Engineering Research Council (NSERC) of Canada for the postgraduate scholarships she received during her PhD work in Manitoba as well as for the Discovery Grant she was awarded at TRU.

Table 1

Embryological Event in <i>A. americanum</i>	On <i>P. contorta</i> var. <i>latifolia</i> in BC (2005)		On <i>P. banksiana</i> in Manitoba (1995, 1996, and 1997)	
	Event Date	†Temperature Range on Event Date (low, high) in °C	Event Date	†Mean Temperature Range on Event Date (low, high) in °C
double fertilization	May 30	10, 23	May 30	10, 20
zygote subtended by three endosperm cells	July 10	14, 28	July 10	16, 26
transverse zygotic division/ two-celled embryo	August 8	14, 28	August 9	15, 26
four-celled embryo	August 15	13, 27	August 15	15, 25

†Temperature data from FORECA ($\pm 2^\circ\text{C}$)

Comparative timeline of key embryological events and temperature data for *A. americanum* infecting *P. contorta* var. *latifolia* in BC and *P. banksiana* in Manitoba. Key events occurred essential on the same calendar date, regardless of the site or year. In order to describe and accurately time the occurrence of key embryological stages, at least fifteen representative sections from fifteen different female flowers displaying the same embryological stage needed to be observed before an event date was ascribed. This was not difficult: in all cases aside from formation of the eight-celled embryo, all fifteen replicates per case were found in order and exclusive of variation. Furthermore, for the eight-celled embryo stage, only two samples differed: one in 1996 in Manitoba, and one in BC, and only by one day later in both cases. The temperature highs and lows were notably similar at both sites on each event date.

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Evergreen magnolias growing at UBC Botanical Garden, Vancouver, Canada: a progress report

Figlar (Figlar, 2005) recently published a comprehensive review of Asiatic evergreen magnolias, which outlined the recent advances in our understanding of these ancient and ornamental plants. He is a world authority on the taxonomy of the Magnoliaceae and past president of the Magnolia Society International. He proposed that I write an account of progress on the introduction and growth of some of the many evergreen magnolias that have arrived at the UBC Botanical Garden from China and northern Vietnam (Figure 1) in the last two decades. I hope that this paper will allow a more informed comparison between the behavior of plants growing at UBC with those growing under the more rigorous conditions of eastern North America and western Europe.

The UBC Botanical Garden is located on Point Grey at the western tip of the city of Vancouver, atop 100m cliffs that overlook the Strait of Georgia. The relatively benign microclimate of the garden is due in part to this body of water, which separates the BC mainland from Vancouver Island and the greater Pacific Ocean beyond. We have been growing deciduous magnolias successfully for nearly 30 years in the David C. Lam Asian Garden. Some individuals of *Magnolia campbellii*, *M. campbellii* subsp. *mollicomata* and *M. sargentiana* var. *robusta* have grown to nearly 20m and are covered with blooms nearly every spring. This paper is restricted to evergreen magnolias, an intriguing group of species from China and northern Vietnam that have become established in the Asian Garden over the last 18 years.

The works of Figlar and Nooteboom(2004), Kumar (2006), Liu (2004) , and Nooteboom (2000), plus the phylogenetic advances reported by Azuma et al. (1999; 2001) and Kim et al. (2001) have provided

A. Peter Wharton, Curator, David C. Lam Asian Garden,
UBC Botanical Garden and Centre for Plant Research,
6804 SW Marine Drive, Vancouver, BC, Canada, V6T 1Z4.



Photos: Peter Wharton, Inset: Tom Hudson

Figure 1. 'Five Fingers Peak', Ban Khoang, Lao Cai province, northern Vietnam. The rich broadleaved evergreen subtropical and temperate-montane cloud forests of this region are home to *Magnolia fulva* (inset) and at least 14 other magnolia taxa.

greater taxonomic precision and clarified our understanding of the relationships between *Magnolia* taxa. I am surprised that the Flora of China project has so far not responded to these fresh interpretations. My fieldwork in the People's Republic of China has helped me to understand the variation within species, especially those with extensive natural geographic distributions.

The magnolia collections in the Asian garden at UBC Botanical Garden are being specifically assembled to contain only accessions of known wild origin. These are to be supported with accurate field data and herbarium, DNA and digital (photographic) vouchers. Our research mission demands this level of documentation, but we still grow a num-

ber of undocumented specimens that were planted in the formative days of the garden, and will remain until replacements of known provenance become available. It is important to note that these specimens have provided vital information regarding adaptability and horticultural potential. The acquisition of wild germplasm is our greatest challenge and remains a slow process as we meet the numerous and largely necessary requirements of international regulatory policies and phytosanitary regulations.

In recent years there has been an intense debate regarding the classification of the Magnoliaceae. The original 11 genera defined by James E. Dandy of the British Museum of Natural History were based solely on morphological observations. His reliance on applying strong taxonomic emphasis to three rather weak characters, axillary flowers, minor variations in fruit dehiscence, and a stipulate gynoeceum, were understandable in the absence of other modern investigative options. He did not observe “living” characters, such as precocious flowering and proleptic/sylleptic branching (Figlar, 2000), and this combined with no access to DNA sequencing, prevented him from making a more accurate classification. Contemporary researchers have now placed the former genus *Michelia* into the subgenus *Yulania* (Figlar, 2000, Figlar and Nootboom, 2004). These are evergreen members of the well known deciduous section *Yulania*, which includes *Magnolia campbellii* and *M. sargentiana*. For a full discussion of more recent research, readers are directed to the paper by Figlar and Nootboom (2004). The following discussion follows the order used by Dick Figlar (2005).

Section MICHELIA

Many species in this section are known to be tough and adaptable in the Pacific Northwest. Members of the section are easily identified by their characteristic retention of only the current year’s leaves. We have observed that taxa whose natural range is in southeastern China show better cold hardiness than those with more western or southwestern distributions.

***Magnolia cathcartii* (*Alcimandra cathcartii*)**

This new introduction from Subsection *Maincola* is represented in the garden by HWJ 9953, a Dan Hinkley collection from the Tram Ton Pass, near Phan Si Pan Mountain, in north-western Vietnam, at the southern edge of its distribution. This came to us as *Magnolia cavaleriei* and first flowered in spring 2006. The blooms developed at the end of elongate shoots. First-time flowers are notorious for being undersized and malformed, so we will have to wait for future flowers to see their potential. Phan Si Pan, a peak of 3142m overlooking the resort town of Sapa, is very rich in magnolias, with perhaps 20 taxa on this mountain alone. Phan Si Pan is part of the Hoang Lien Son mountain range, which crosses the border between southern Yunnan and northern Vietnam before extending southeastwards to Sapa and Van Ban. It is a region where the Sino-Japanese, Yunnan-Himalayan and Indo-Malayan floras mingle, amongst local and endemic Vietnamese floristic elements. Other exciting introductions from this region are likely in the future.

***Magnolia doltsopa* (*Michelia doltsopa*)**

We received our first plants of this species from Sean Hogan and Rodger Warner (Portland, OR) during 1995, with the now invalid name *Magnolia opipara*. This species was distributed in the early 1990's by Piroche Plants (Pitt Meadows, B.C.), though it has been in general cultivation in North America, especially coastal California for many years. We initially chose a bright, sheltered site in the Asian Garden, where it thrived, but subsequently it had to be moved to a shadier location, where it unfortunately is not doing as well. In the Pacific Northwest, our warming climate could favor this species, particularly on naturally moist sites. The extensive range of this taxon throughout the eastern Himalayas into southwestern China certainly indicates the possibility of more cold hardy and garden-adaptable provenances.

***Magnolia ernestii* (*Michelia wilsonii*)**

Our plants came to us from Sean Hogan in 1995. The species has also been distributed by Piroche Plants. Many have noted the toughness, vigor and adaptability of this species, and this certainly applies to our plants. A 20m tree in the wild, it forms scattered populations

along the southern and western fringes of the Red Basin of Sichuan and adjoining areas of Chongqing municipal region, Hunan and Guizhou. Our plants are now nearly 16m tall, growing amongst vigorous *Thuja plicata* (western red cedar) and *Tsuga heterophylla* (western hemlock). The annual growth rate of this species is impressive, with up to 60cm growth recorded in some years. In the coastal Pacific Northwest region on sites that are naturally moist throughout the year, this species could become a giant. Between 2004 and 2006 these trees produced a profusion of small (8cm across) white flowers, with not a hint of the commonly reported yellow colouration. The flowers are clustered along main laterals in late April. Although the flowers are borne high in the crown, a perceptible sweet scent can be detected some distance away. With us, it is a first rate plant, and we wait with excitement for the larger, yellow flowered forms that are reported in the wild. I recently saw the related *Magnolia chapensis* used as a street tree in some of the smaller cities of southern Sichuan.

***Magnolia floribunda* (*Michelia floribunda*)**

We received a plant of this from Dan Hinkley in 2004 (number DJHC 548), which he collected from northwest Yunnan in 1996. It was only recently planted in the Asian Garden, but is already showing the vigor of *M. ernestii*. In early November 2006 temperatures dipped to -9° C accompanied by 60cm of heavy wet snow. Our specimen was unaffected. The younger leaves and shoots are covered in fine sericeous hairs, which give this plant a very elegant appearance. We wait with anticipation for the flowers, which are silvery white, with a custardy-honey like fragrance. *Magnolia floribunda* has a remarkable natural distribution, from western Hubei, through Sichuan, Yunnan, parts of Myanmar (Burma) and northern Vietnam. In the mountain forests of Phan Si Pan at 2200m, I have seen fine 22m trees of the southern geographical variant, *M. floribunda* var. *tonkinensis*. In this area near Sapa, many trees start flowering in early November, which to me is quite unusual. In the same vicinity, Tom Hudson (owner of Tregrehan House, Cornwall, U.K., a garden noted for its collection of rare woody plants from wild origin) has also collected this species, under his number TH 1707.

Magnolia foveolata (Michelia foveolata)

Of the evergreen species new to cultivation in the Asian Garden, this is my favourite. (Figure 2) Its foliage looks fantastic next to several young *Rhododendron sinogrande* with their ‘pachydermal’ foliage. It appears to be completely hardy at UBCBG and will, I expect, be favoured over *Magnolia grandiflora*, once it becomes better known to growers. Our plant came to us from the Hogan/Warner connection in 1998, but sadly without collection data. Ideally we should replace it with wild documented plants from different sources across its natural range. Our plant has substantial, glossy, leathery, lanceolate leaves, which can be over 30cm long. The stems and both sides of mature leaves are covered in conspicuous silvery pubescence, while the buds have light coppery silky hairs. As Figlar (2005) points out, the extensive natural distribution of this species in China, from western Hubei, southern Hunan to Jiangxi, southwards across parts of Guizhou and Yunnan and into northern Vietnam, indicates considerable variation in hardiness. The morphological variability also appears extensive and bodes well for future ornamental selections. The plant we grow approaches the expression of var. *cinerascens*, as the silvery hairs retained on the adaxial leaf surfaces are poorly developed, giving the foliage a very dark appearance. The flowers are borne on axillary shoots and range from butter to pale yellow to white or greenish white. Steve Hootman, director of the Rhododendron Species Foundation Botanical Garden, Federal Way, Washington, U.S.A. recently saw a very fine yellow flowered individual of this species in north-eastern Vietnam. I wait with bated breath for our plant to flower.

Magnolia martinii (Michelia martinii)

This is another “tough customer” with an extensive range from southern Henan and western Hubei, southwards across central and southern Sichuan to northeastern Yunnan. I recently saw this species on the celebrated Emei Shan (Mt. Omei), and was much impressed by the vigor and delightful poise of its small finger-sized glossy lance-shaped leaves. The promise of pale- to butter-yellow flowers certainly gives this plant an allure. We have two plants that are growing well, despite being transplanted as quite large trees. One is now reestablished in a pro-



Figure 2. *Magnolia foveolata* is found in northern Vietnam and southern China. This pale yellow form was photographed in Ha Giang province in Vietnam.

tected, but well-lit site. The other is recovering after being side-swiped by a huge, wind-thrown, dying western hemlock. Such are the perils of growing magnolias in a forest garden! Despite a number of very dry summers recently and little supplemental irrigation, they are thriving.

***Magnolia maudiae* (*Michelia maudiae*)**

In Vancouver and the Pacific Northwest, this species has perhaps had the most immediate impact on horticulture. It was Sean Hogan who first understood its potential for a community street planting in Portland. It caused a local sensation when the trees started flowering in 1997, creating a spectacular display that immediately caught the attention of the local media. In addition, the whole neighbourhood was blanketed with an intense heady fragrance. Hogan (pers. comm. 2006) described the flowers, "...[they] look like a pile of white tissues and have a heady lily fragrance you can smell a block away." Our plants are derived from my collection (PW 126) made close to the Dayao Shan, Guangxi, China, in 2001, from maturing coppiced trees in degraded woodland. This is a very widespread species ranging across most of the southern and central provinces of China, from coastal Zhejiang to Guizhou in the west. At the time, I was searching for the endemic *Magnolia crassipes*, which is notable for its beautiful purple flowers. I did not find it, but seeing *Magnolia maudiae* in the wild was compensation enough. Three plants derived from this collection were set out in the Asian Garden. All are conspicuous for their glabrous, bluish green leaves and were completely unaffected by our early November freeze (-9°C) in 2006.

These young Guangxi plants produce normal and numerous axillary flower buds, clustered along the outer branchlets. In Vancouver they open sequentially during late April to early May, which is much later than cultivated plants (from Piroche Plants, BC) that can be plagued by early frosts, as they are in the eastern U.S.A. In the wild, this species can attain 20m in moist, deep bottomland soils. Given similar soils and time, such dimensions should be possible in cultivation, certainly in areas such as southern coastal Oregon. The wide geographical distribution of this species also suggests a broad spectrum of regional and genotypic variation and considerable potential for breeding and selection.



Photo: Peter Wharton

Figure 3. *Magnolia officinalis*. A well-known deciduous member of the section *Rhytidospermum*.

Section MANGLIETIA

This rather distinctive group of largely evergreen magnolias, formerly grouped in the genus *Manglietia*, is now placed in *Magnolia*. The close relationship with the deciduous Section *Rhytidospermum* (Subsection *Cubenses*) (Figure 3) is at first glance surprising, as they are evergreen (except for *M. decidua*), yet the production of false whorls or early spring flushing is typical of their deciduous relatives, such as *Magnolia obovata* (Figlar, 2005). Figlar and Nooteboom (2004) provide a thorough analysis of the Section *Manglietia* and the rationale for placing it within the genus *Magnolia*.

Magnolia chevalieri

We have been growing the same Dan Hinkley collection (HWJ 99621) as Figlar mentions in his account (Figlar, 2005), but with greater success. The difference is that this collection over-winters successfully at UBC, and the plants are vigorous trees, now just over 3m high. Their narrow, glossy, dark green leaves are arranged in false whorls, a characteristic feature of this section. The 2003-2005 winters in Vancouver were very mild, but the minor leaf bronzing after the early November 2006 frost

in the Asian Garden gives us some grounds for optimism. This is a taxon recorded from northern Vietnam south to the Dalat region and westwards into Laos. I believe that it may occur in neighbouring border regions of Yunnan, though it is presently unrecorded there.

Magnolia conifera* var. *chingii

This is another species that came to us without background information in 1998 from Piroche Plants. Sean Hogan (Grimshaw, in press) reports that some seed batches received by Piroche Plants in the 1990s from Nanjing Botanical Garden as *Manglietia chingii* (now *Magnolia conifera* var. *chingii* (Dandy) V.S. Kumar) are in fact a 'congested' form of *Magnolia insignis*.

Our plant (var. *chingii*) has performed well, after a slow start, and is now a tight-crowned, thriving specimen of just over 5m. Extension growth in this species often develops false whorls of leaves with leafless internodes. In the fall, a small proportion of the previous year's leaves are shed, often turning a respectable orange-yellow. The net effect is to create a rather sparse appearance during the winter. We eagerly await the small, but interesting white flowers, which are produced on long peduncles. The specific epithet *conifera* relates to the fruiting body of this species, but it could also describe the neat, symmetrical habit of this species. A semi-sheltered, well drained, yet year-round moist site seems to suit this species well. It is a native across southern China from Guangdong to Guangxi and southern Yunnan into northern Vietnam. The variety *chingii* appears to have a more eastern distribution in Guangdong and Guangxi (Kumar, 2006).

***Magnolia fordiana* (*Manglietia fordiana*) and *M. yuyuanensis* (*Manglietia yuyuanensis*)**

We have grown *M. fordiana* for many years. It is derived from a wild seed collection made by Peter Bristol, Lawrence Lee and myself in 1988 near the Huangshan, in southern Anhui province. This collection has been rather disappointing with its weak, unattractive growth habit, rather chlorotic foliage and propensity to snow breakage. This species has an extensive range across southern China, from Fujian westwards to Yunnan.

These comments do not apply to the closely related *Magnolia yuyuanensis* (Figure 4), sometimes regarded as a variety or subspecies of *M. fordiana*. Originally described from southern Zhejiang province, the range of *M. yuyuanensis* extends southwards through Fujian, Jiangxi and Anhui to northern Guangdong and southern Hunan. It is an eastern, more cold hardy expression of *M. fordiana*. This species has recently been delineated by V.S. Kumar of the Botanical Survey of India (Kumar 2006) on the basis of clear morphological differences, including glabrous, yellowish-brown (vs. reddish brown) twigs, and leaf apices that are caudate-acuminate (vs. acute). In the Asian Garden, *M. yuyuanensis* has developed into a fine tree with a lovely, tapered ovoid crown, delicate, pleated leaves and attractive flowers. It has flowered profusely each July, beginning in 2003, but the fragrance is disappointing. The creamy-white tepals contrast beautifully with the basal plum-purple stamens. Each flower only lasts about 36 hours before turning brown and collapsing. Despite this, they are produced in good numbers, sequentially, over a period of several weeks, providing an exotic visual effect in the garden. I am impressed at the snow shedding qualities of this species and the strong branch attachments to the main stem—all traits that give this species a robust constitution. We received plants of this species in 1989 from J. C. Raulston, under the name *Manglietia yunnanensis*, which is clearly a misreading of the original Chinese place name in Zhejiang, from which the specific name is derived.

***Magnolia insignis* (*Manglietia insignis*)**

This species is now becoming well known in cultivation, due to its adaptable nature and spectacular creamy white through pink to scarlet flowers, which are produced even on young plants. In the wild it has an enormous distribution throughout southern China and bordering regions. In western areas of the Fraser Valley and much of Vancouver it thrives, growing into an open branched tree with dark green, coriaceous leaves. The popularity of this species locally is due in part to the active distribution of plants in the mid-1990s by Piroche Plants. In addition, a former employee of that nursery, Bruce Rutherford, was responsible for selecting a particularly good red flowered form that is currently being



Figure 4. *Magnolia yuyuanensis*. The flowers of this species appear in early June and though lasting only a few days, they are borne sequentially over several weeks.

used by several North American magnolia hybridizers. Our plant is derived from Piroche, but there is no field data, so we await collections of documented material. This widespread species ranges from southern central China across Yunnan and northern Vietnam, the border areas of Myanmar (Burma) to northeast India, and west to Nepal. This extensive natural distribution has already provided western growers with a good number of hardy regional forms. Like so many magnolias, year-round moisture promotes the best growth. Our plant is now 7m high, growing vigorously and flowering well beside a stream, despite considerable competition from neighbouring cultivated Asian species and native *Acer macrophyllum* (big-leaved maple).

Magnolia* aff. *conifera

We received a plant from Sean Hogan in 1995 under the name *Manglietia aromatica* (now *Magnolia aromatica*). The true form of this species is now a rare and highly endangered tree in southern China, growing to an imposing 35m. It has always been greatly valued for its fine timber, which sadly has resulted in intense exploitation. The natural distribution is now reduced to scattered trees or groves in parts of south-west Guangxi, Guizhou and south-east Yunnan. There is some hope that this species spills over into the trans-border forests of northeastern Vietnam. Our tree has displayed good cold hardiness having been undamaged by the frost in early November 2006. It is now 5.5m high and growing vigorously, despite being in a shady protected site, close to towering conifers. The leaves are coriaceous, narrowly oblanceolate to oblong, attractively arranged along branches in a narrowly tiered, branched crown. Our tree sheds heavy wet snow in a similar manner to *Magnolia yuyuanensis*.

I was perplexed at the hardiness of our plant, which in the wild has such a southern distribution in China. I described our plant to Dick



Figure 5. *Magnolia delavayi*. Although there are strong morphological similarities to *Magnolia grandiflora*, it lies in a different section, *Gwillimia*.

Figlar, who coincidentally had just received a plant from Josh McCullough of Cistus Nursery (Portland, OR) under *Magnolia aromatica*. This plant did not agree with published descriptions of this taxon. The key characters of *M. aromatica* are the totally glabrous twigs, except the buds, which are covered with white adpressed, villose hairs. The plant from Cistus Nursery and our specimen in the Asian Garden have a similar morphology, red brown pubescence on the buds and also on the last two or three branch internodes. *Magnolia aromatica* is one of the few in section *Manglietia* without rufous hairs. As the specific name implies it is also a highly aromatic, yet when the leaves and stems of the Cistus and UBC plants are torn or crushed the fragrance is weak compared to most Magnoliaceae.

This interesting, hardy magnolia has much in common with *Magnolia conifera* var. *chingii*, but is distinct from our specimen in the Asian Garden described here. Figlar feels that this could be a new taxon, as species within this section ‘show great uniformity in both vegetative and floral morphology’ (pers. comm. 2007). For the moment we consider it to be close to *Magnolia conifera*.

Section GWILLIMIA

Magnolia delavayi

We received our first wild collected seed of *M. delavayi* (Figure 5) in the 1980s, and the seedlings were unfortunately badly damaged by -13°C temperatures. The November 2006 cold snap and heavy wet snow scorched our plants so badly that they may not recover. This has dampened my optimism for this quite exceptional species because in the wild it is a great survivor, often occurring in crevices on karst (limestone) ridges in its native range of south-western Guizhou, south-western Sichuan, Yunnan and northern Vietnam. Our recently killed plants were derived from seed collections made by Peter and Kenneth Cox, Peter Hutchinson and Steve Hootman (their number CCHH 8026) made at low elevation (1870m) from the hot, dry, Nujiang (Salween) Valley in Yunnan. The paddle shaped leaves have an attractive, almost bluish-pewter hue that contrasts well with the ephemeral six-tepaled, creamy white flowers. An additional three outer tepals reflex downwards and initially have a curious greenish pallor, which quickly turns

buff brown as they age over 24 hours. The flowers on our plants do not seem to have a strong fragrance. Hopefully, this is a characteristic that develops with age. We may not match the specimen at Yufeng Temple in Lijiang, Yunnan (claimed to be 700 to 800 years old), but if we can obtain hardier material from other provenances, we may eventually see this species growing to maturity in coastal areas of Vancouver and southern Vancouver Island.

Section GYNOPODIUM

We grow two species in this section, *Magnolia lotungensis* and *M. yunnanensis*, all of which are glabrous, which is a key character of this section. These two species were planted out in the Asian Garden in the mid-1990s in very protected sites, anticipating they would be quite tender. In retrospect, sunnier, more open sites perhaps would have benefited them. John Grimshaw (in press) rightly points out that many evergreen species have a juvenile stage in the shade of the forest understory, before assuming dominance as an emergent in the forest canopy. We may, in fact be following a ‘natural script’. In the past members of this section have been placed in the genus *Parakmeria*, this naming persists in China.

***Magnolia lotungensis* (*Parakmeria lotungensis*)**

Figlar has reported (Figlar, 2005) that *Magnolia lotungensis* (Figure 6 Front Cover) is a hexaploid species and is genetically very different from *M. nitida* (diploid), a species that was associated with this plant for many years. The genetic robustness of this species perhaps explains its superiority in our collections, compared with *M. nitida*, which we introduced as seed from Caerhays Castle, Cornwall, U.K. in the early 1980s. Plants derived from this introduction failed at UBC when temperatures dropped to as low as -13°C . In the Asian Garden, specimens of *M. lotungensis* derived from Piroche Plants in the 1990s have grown vigorously and continue to thrive even on dry sites amongst large conifers. They are neat upright trees with small glossy elliptic to ovate-lanceolate leaves that often emerge bright red. Some individuals can have the appearance of varnished red candle-wax or lipstick, sometimes maroon or just plain bright green. These ‘hot reds’ have obvious commercial

appeal, and some individuals retain this coloration year round, especially when successive pulses of new growth occur in moist locations during the summer. Several of our trees are now over 5m high and are forming a range of crown profiles, from tight pillars to open-branched, tiered crowns. This is certainly a tough species having that suffered no damage after both the -13°C frosts in the 1980s and the events of early November 2006. This is a large forest tree up to 30m (Wuyishan, Fujian) with a natural distribution through southeastern subtropical China, notably on the island of Hainan, and appears to have very good frost tolerance in these locations. The flowers of this species are small and rather disappointing, though selection could probably change this situation.

***Magnolia yunnanensis* (*Parakmeria yunnanensis*)**

This species (Figure 7 Back Cover) is larger than *M. lotungensis*, with larger, broader leaves and lovely, substantial flowers. This is a fine tree (to nearly 40m tall), that ranges through south-eastern Yunnan, northern Guangxi and south-eastern Guizhou at 1400-1500m elevation. I think that it occurs in northern Vietnam, though it has not been recorded there. With us it appears to have surprising cold hardiness, with no damage recorded since it was planted out in 1996. Our original plant, from Sean Hogan, has grown to over 4m high in a very shaded site. In May, the unfurling leaves (7-15 × 5-6cm) in length) are spectacular, often a subtle blend of intense bronzy orange to crimson. The fragrant flowers are very beautiful (we wait in anticipation), consisting of 12 tepals in 4 whorls, varying from creamy white (often with the outer tepals stained red) to good clear yellows. This is a species that has considerable potential in the Pacific Northwest, especially if superior flower forms are introduced. I look forward to further introductions of this species with good field documentation.

Concluding Comments

The recent introductions of evergreen magnolias from southern China and northern Vietnam have given horticulturists a fresh palette of ornamental species, some of which have shown surprisingly good cold hardiness here. A major challenge for many species is sudden cold, often with heavy wet snow, a common winter event in the Pacific Northwest. Branch and crown form, strength of branch and stem attachments, branch flexibility, and the snow shedding attributes of leaves are all factors that influence survival and attractiveness under this threat. A number of other species not represented in UBC's collections have been introduced into cultivation in the west. Some are subtropical in origin and doubtfully winter hardy, but there are a number of highly ornamental taxa that would be well worth trialing here, including *Magnolia chapensis*, *M. dianica*, *M. macclurei* and *M. pachyphylla*.

Scientifically meaningful collections require that all species that are introduced and propagated have complete and accurate documentation from wild seed collections. Anyone who has traveled recently in the field in southern China and particularly, in northern Vietnam, cannot fail to have noticed the pace of forest destruction and degradation. Those evergreen magnolias that are already in cultivation with information on nativity are immensely valuable. Efforts to conserve magnolias in the wild (in situ) are vital and deserve to be enthusiastically supported by institutions that have a specific interest in these plants. UBC Botanical Garden is actively working with a number of international, governmental and non-governmental bodies, such as Botanical Garden Conservation International, in concert with Chinese botanical institutions to carry forward this important work.

There are distinct challenges for botanical institutions introducing and carrying out research on rare and imperiled magnolia species. As an institution we have to work within the existing regulations of the international Convention on Biological Diversity, respect the laws of host nations and observe Canada's plant protection regulations. We have begun a series of new initiatives to facilitate this kind of research and look forward to the day when we can demonstrate more fully the remarkable diversity of this ancient lineage of flowering plants.

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Gleanings

Notes on papers (some technical and others less so) that caught the Editor's eye

Long term climate and weather patterns in relation to crop yield: a minireview

**McKeown, A.W., Warland, J., and McDonald, M.R.
July 2006.**

Canadian Journal of Botany 84: 1031-1036.

A brief review on the benefits of using long-term yield data on vegetable crops to tease out the combined effects of numerous environmental variables. The authors conclude that we need specific models for individual vegetable crops. "Yields of cool season vegetables appear to be decreasing as temperatures and carbon dioxide increase. There is also concern about the effects of rising temperature on nutritional quality."

Restoration of forests attacked by mountain pine beetle: misnomer, misdirected, or must-do?

**Philip J. Burton
2006.**

**BC Journal of Ecosystems and Management
7 (2): 1-132**

This paper is the first in a Special Issue of the BC Journal of Ecosystems and Management devoted to the mountain pine beetle epidemic. In a 'Perspective' article Burton points out that much of the forest killed by *Dendroctonus ponderosae* may be best left to recover using the underlying vegetation that has not been degraded by the insect. 40% of the degraded stands have adequately stocked understoreys. He also argues that restoration by replanting risks creating another even age stand that may fall victim to beetle infestation when those trees reach their susceptible age.

**A Celebration of the Canadian Society of
Plant Pathologists 75th Anniversary
Canadian Journal of Plant Pathology
28: Supplement 385pp
NRC of Canada Research Press**

Many botany students throughout the world first heard about Botany in Canada during lectures and labs on wheat rust. This celebratory issue of the Canadian Society of Plant Pathologists 75th anniversary will surely serve as a milestone for the Society, and be an excellent 'how to manual' for other scholarly societies seeking to lay out their communal record. The subsections are: Early Plant Pathologists; Historical Papers; Proceedings of the symposium held at the 75th anniversary meeting of the society; and Reminiscences. The founding fathers would be pleased indeed to see that their legacy is growing in the labs and field stations of this country. This book provides clear evidence showing why Canadian plant biology is so deeply rooted in plant pathology.

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