

Topic 01 Introduction to Plant Systematics

- Lecture readings:
1. Introduction (pp 1-7) of Rhoads & Block, 2007.
 2. Prather A, et al. 2004. Implications of the decline in plant collecting for systematic and foristic research. *Systematic Botany* 29 (1): 216-220.
 3. Dirig R. 2009. The art of botanical specimen preparation. Bulletin provided by the author.

- Lab readings:
1. Plate 2. Leaf Terminology (pp 980-981) in Rhoads & Block 2007.



I. What is Systematics?

A. Definition & Objectives

...diversity, biogeography, evolution, & classification....



I. What is Systematics?

B. Relation to other fields?

As an umbrella science...

As a foundational science....



I. What is Systematics?

B. Relation to other fields?
As an umbrella science...



The Big Umbrella, twice the radius of the biggest man's umbrella on the market, was designed to shield up to 18 people from the rain. It was a cheerful and simple stylika structure, but did 18 people want to crowd together to avoid getting wet? Does bad weather affect people differently in different parts of the world? To find out, I took my big umbrella on the road between 2003/2004, visiting Paris, London, Chiswick, Copenhagen, New York and Martinique.



I. What is Systematics?

B. Relation to other fields?
As a foundational science...

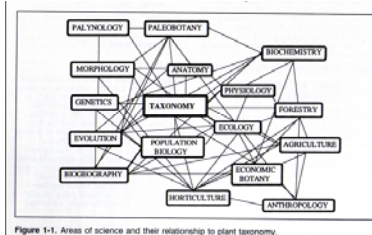


Figure 1-1. Areas of science and their relationship to plant taxonomy.



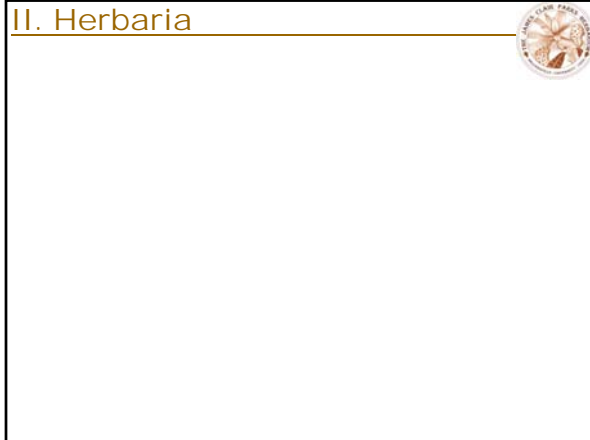
I. What is Systematics?

C. Products

- a. floras, manuals, fieldguides
- b. monographs
- c. scientific articles in peer-reviewed journals
- d. encyclopedic works



II. Herbaria



II. Herbaria

A. Herbarium specimen



11 1/2 in.

16 1/2 in.

Plants of Pennsylvania

Family: Lauraceae
Species: *Lindera benzoin* (L.) Btham
Common name: spicebush

Location: Pennsylvania, Lancaster Co.: Millersville, Millersville University; The "Bush" woodland, 100 feet W of River Trail, ca. 300 ft S of Trolley Trail, on steep slope in small clearing of woodland overlooking the Conestoga River to the east. Wiki-Plant-Atlas estimate of 39.995582449241155 N, -76.34643173214499 W.

Description: Abundant understory shrub 2 m tall. DBH of thickest stem 1.5 cm. Twigs spicy-fragrant and dark brown with prominent round, white lenticels. Flowers (all parts) yellow, abundant along twigs in clusters at nodes.

Coll: Jane P. Rockaway
Date: 6 Apr 2006
Coll. No.: 121

II. Herbaria



II. Herbaria

Zoological analogs of herbaria



II. Herbaria

B. Use of specimens



1. document patterns of morphological and geographical variation in plant diversity: past, present, and future



II. Herbaria

B. Use of specimens

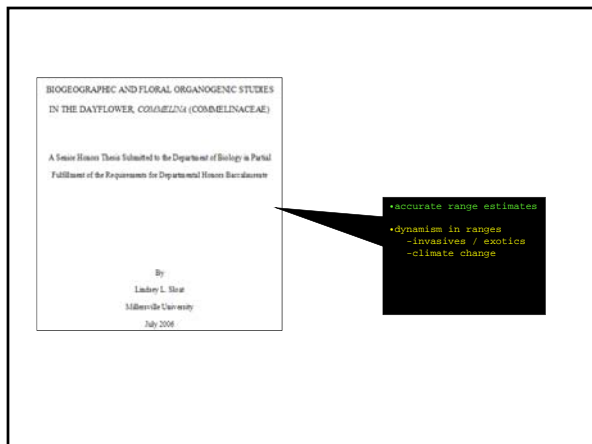


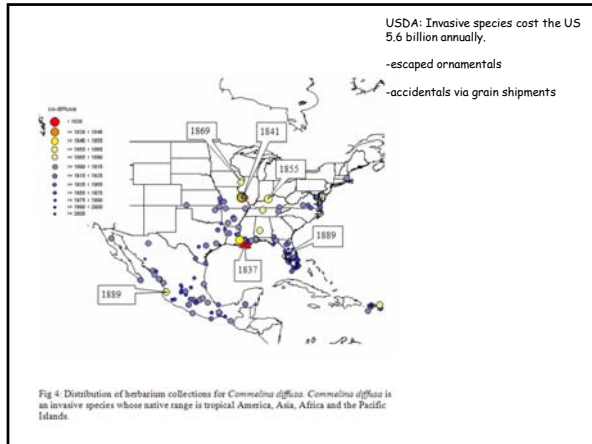
1. document patterns of morphological and geographical variation in plant diversity: past, present, and future











II. Herbaria

B. Use of specimens

2. the basis for new species descriptions and other taxonomic studies,

Systematic Botany (2004), 29(2), pp. 306-333
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Plowmanianthus, a New Genus of Commelinaceae with Five New Species from Tropical America

ACKNOWLEDGEMENTS. We would like to thank the faculty and staff at the following herbaria for providing loans or facilitating herbarium visits or fieldwork required for this study: AAU, AMAZ, B, BH, BM, CAS, COL, CR, CUZ, DUKE, E, FTG, GH, HBG, HUA, K, M, MICH, MO, NY, PMA, QCA, QCNE, S, SEL, STRI, TEX, U, UC, US, and USM. Tana Acton provided the illustrations (excluding the seeds) for *Plowmanianthus perforans*. Alice Tangerini provided the illustration of the flower for *P. grandifolius*. Douglas Daly kindly provided the photograph used for Figure 12C. Urs Jauch assisted with the scanning electron microscopy of stigmas. Deborah Bell, David Brenner, Robert Dressler and the late

ABSTRACT. A new N and morphological data.

This is what the new species look like....

1. *Plowmanianthus panamensis* Eskin & C. R. Hardy, sp. nov. (Fig. 8)—TYPE: PANAMA. Colón: headwaters of Río Boqueron near fork with Río Nombre de Diosito. On wet slopes in forest along stream, ca. 150-175 m, 4 May 2000, *Hardy 242* (holotype: PMA; isotypes: BH, NY, US).

Herb perennial ad 22 cm altam. Folia ad 25.5 cm longam et 6.6 cm latam, ascendentes ubi juvenes, lamina elliptica ad late lanceolatum, lenticr undulata, pilosa pilis longis, apice acuta ad obtuso-apiculatam. Inflorescentia vaginas perforantes, 3.5-5.5 cm longae, cincinnis 5-6 (vel plus) floris. Flores petalis albis, staminibus 3, filamentis barbatis, staminodis 3 microscopicis, stigmatibus ciliatis. Semina pagina ventrali in latere embryostegam versus fissa, hilo C-formi.

Decumbent, perennial rosette herb to 22 cm tall. Leaves petiolate, ascending when young, 11-25.5 × 3-6.6 cm; sheaths 1.5-2 × 1.4-1.8 cm, pilose abaxially; petioles 1.7-5.5 cm long; laminae elliptic to broadly oblanceolate, 8-18.5 × 3-6.6 cm, apex acute to obtuse-apiculate, base cuneate; margins ciliate; surfaces slightly undulate; adaxial surface velvety green with a conspicuous white midrib stripe present or occasionally absent, lightly pilose with uniseriate hairs 1-3.5 mm long; abaxial surface paler green, shorter pilose throughout with uniseriate hairs 1-3 mm long. Inflorescences perforating the leaf sheath, 3.5-5.5 cm long (including the cincinnus peduncle but not including the cincinnus rachis or flowers), consisting of a sinale 0.7 cm), obovate, ca. 1-1.1 cm long, white, fringed distally with moniliform hairs, hairs ca. 1.5 mm long; stamens 3, inserted in upper half of flower opposite outer sepal and inner petals, subequal, 4-5 mm long, antepetalous one shorter than antepetalous two by ± 1 mm; filaments inconspicuously united at the base, 3-4 mm long, bearded distally with moniliform yellow hairs; anthers basifixed to dorsifixed, ca. 1 mm long, the two thecae semicircular in profile and laterally appressed to each other, dehiscence longitudinal, introrse; staminodes 3, in lower half of flower opposite outer petal and inner sepals, microscopic; ovary ovoid, ca. 2.5 mm × 2 mm, solutinos; style terminal, straight to slightly curved (either upwards or downwards), ca. 5.4-5.7 mm long; stigma annular, papillate, ca. 0.3-0.35 mm in diameter, fringed with moniliform hairs. Capsule 3-locular, 3-valved, ovoid, 3-lobed, to ca. 1 × 0.6 cm, yellow-green, short-beaked by the persistent style base, sparsely pilose. Seeds (0.1) 1 (-2) per locule, reniform, foveolate, 5.5-6.2 × 3.6-4 mm, ventral face cleft on the side towards the embryotega; hilum linear, C-shaped; embryotega lateral.

Paratypes: PANAMA. Colón: headwaters of Río Boqueron near fork with Río Nombre de Diosito, on wet slopes in forest along stream, ca. 150-175 m, 21 Jul 1978, *Hammel 302f* (MO); headwaters of Río Boqueron, 15-20 min walk up from confluence with Río Nombre de Diosito, wet slopes in forest along multiple streams, ca. 155-175 m, 3 May 2000, *Hardy 241* (BH, NY; PMA, US); Camino Rev trail, southeast bank of

This is how to tell the new species apart (a dichotomous key)....

KEY TO THE SPECIES OF *PLOCHMANANTHUS*

- 1. Younger leaves ascending, older leaves variably ascending to descending; primary (distal) cincinnus well-developed, several to many-flowered; leaves 11-36.65 cm long, glabrescent to densely pilose; plants relatively robust, to 40 cm tall 1. *P. panamensis*
- 2. Seeds 10-11 (-2) per locale, uniform, ventral face cleft on the side towards the embryotega, 5.5-6.2 mm long, hilum strongly curved (i.e., C-shaped); pedicel less than 1 cm long; inflorescence perforating the leaf sheath, lacking glandular hairs; leaves 11-25.5 cm long, long pilose; Panama 1. *P. panamensis*
- 2. Seeds 2-4 per locale, weakly reniform, ventral face not cleft on the side towards the embryotega, 6-8.2 mm long, hilum gradually curved (not C-shaped); pedicels usually greater than 1 cm long (0.9-2.5 cm); inflorescence perforating or not perforating the sheath, usually with glandular hairs; leaves (11.2-)12.5-36.65 cm long, glabrescent to pilose; Amazonian Colombia, Ecuador, Peru, and Brazil 2. *P. grandifolius*
- 1. Leaves all patent; primary cincinnus usually poorly developed, with just one flower maturing; leaves less than 15 cm long, variably pubescent but never glabrous or glabrescent; plants relatively small in stature, to 10 cm tall 3. *P. peruvianus*
- 3. Inflorescence perforating the leaf sheath, 4.2-5.5 cm long including the cincinnus peduncle; cincinnus truly 1-flowered, and with a single bracteole; pedicels 0.7-1.25 cm long; macroscopic staminoles 2; stigma lacking; mesoiliform hairs; leaf apex round-obtuse; Peru 3. *P. peruvianus*
- 3. Inflorescence not perforating the leaf sheath, less than 3 cm long; cincinnus few-flowered, although often seemingly 1-flowered due to failure of later buds to fully develop; pedicels <0.5 cm long; macroscopic staminoles absent; stigma peripherally ciliate with mesoiliform hairs; leaf apex obtuse, slightly apiculate to mucronate; Panama or Peru 4. *P. densiflorus*
- 4. Ventral two fruit locales with 1 seed each (dorsal locale with 1-2 seeds); leaf surface undulate; adaxial surface with hairs longer than 2 mm; bracts and sepals with glandular hairs only; Panama 4. *P. densiflorus*
- 4. All fruit locales with 2 seeds each; leaf surface flat, adaxial surface with hairs 1.5 mm or shorter; bracts and sepals with glandular and eglandular hairs; Amazonian Peru 5. *P. peruvianus*

This is where they grow and where you'll find them....



FIG. 1. Distribution of *Plochmananthus*. Species and subspecies numbered according to the order of their appearance in the key: 1 = *P. panamensis*; 2a = *P. grandifolius* subsp. *grandifolius*; 2b = *P. grandifolius* subsp. *robustus*; 3 = *P. peruvianus*; 4 = *P. densiflorus*; 5 = *P. peruvianus*; ? = undetermined locale specimen (Lorenis et al. 1969, 2°32'S, 79°49'W, 230 m, QCNEB). Multiple numbers in circles represent multiple collections from the same general area.

II. Herbaria

B. Use of specimens



- 3. teaching aids,

II. Herbaria



B. Use of specimens



- 4. reference specimens for applications requiring accurate species identification (e.g., forensics or taxonomic and floristic surveys)



Cannabis and herbarium taxonomists in the 1960's & 1970's

<p><i>Cannabis sativa</i> Linnaeus (widely cultivated) <i>Cannabis indica</i> Lamarck (India) <i>Cannabis ruderalis</i> Janischevsky (Russia)</p> <p>Richard E. Schultes (1915-2001)</p> 	<p><i>Cannabis sativa</i> subsp. <i>sativa</i> <i>Cannabis sativa</i> subsp. <i>indica</i> <i>Cannabis sativa</i> subsp. <i>ruderalis</i></p> <p>Arthur J. Cronquist (1919-1992)</p> 
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II. Herbaria

B. Use of specimens



- 4. reference specimens for applications requiring accurate species identification (e.g., forensics or taxonomic and floristic surveys)

advice: Stay inside today

Wind chill of minus 20 predicted tonight

By DEN KLUFF

By Monday high temperatures should be just below freezing. All but the most tough of skins, then, in the mountains, people should stay in their homes or hotels or the like.

After overnight lows of around 4 above, the temperature today is expected to rise only to about 12, but with wind dropping to 10-15.

The temperature tonight will dip to about zero, with a wind chill approaching 20 below zero, says Richard of the Lancaster General Hospital emergency room.

The temperature can be as low as the 10s or 20s below, "but that's only if you're out there," says the elderly, children and people with little special equipment, who are particularly vulnerable.

People who do venture outside should dress for wind and wear hats for the face, says a staff nurse at the hospital, who adds a word of warning: "If you're out there in the night, the wind, it's really dangerous."

Dr. John Latta, of Lancaster Emergency Services, said people who are out there at these times should be alert for frostbite.

"They're serious," he said. "If you see the amount of exposed skin, and that's a lot — most just will freeze."

from Harrisburg

bonsai

Pruning is a small part of maintaining these artistic plantings

Page B1

Page A4

Wing and a prayer

Pilot puts disabled plane in river; all survive



Passengers standing on the steps of a jetliner that ditched in the waters of New York's Hudson River Thursday said to be picked up by a ferry.

BY BARRY R. CASSELL and NICHOLS FRANKLIN

Rescue by Clifton, N.J., area's first boat during bailout mission

... terrified

... the river said

... John Rodriguez, a paramedic



updated 6:00 a.m. EST, Thu February 13, 2009

Canada geese brought Flight 1549 down, NTSB says


STORY HIGHLIGHTS

- Struck geese cause
- Canada geese crash
- Bird ingestion forces
- All 155 passengers

Read Article in U.S. >

NEWS PHOTOS AUDIO

WASHINGTON (CNN) — Canada geese got into both engines of US Airways Flight 1549 and forced the plane to ditch into the Hudson River last month, the National Transportation Safety Board said Thursday.



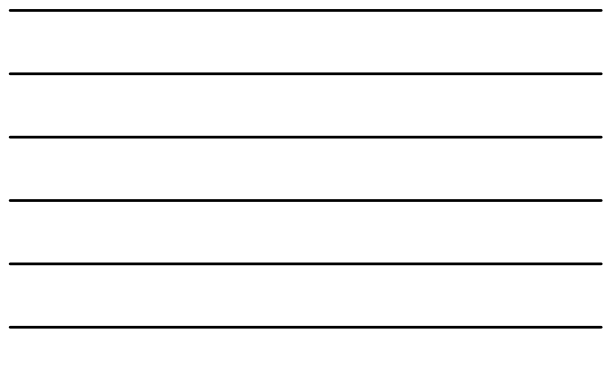
The flight crew of the Airbus A320 put the plane down gently on the river, which separates New York from New Jersey, after the bird ingestion caused both engines to lose power on January 15. All 155 people aboard survived.

Adult Canada geese weigh between 5.8 and 10.7 pounds, although birds from resident populations rather than migratory populations can be heavier.

The plane's CFM56-5B1P turbofan engines were certified in 1995 as being able to withstand bird ingestion of 4 pounds.

The NTSB said last week that both engines contained the remains of birds, confirming the pilots' report that the engines shut down after colliding with birds less than two minutes after taking off from New York's LaGuardia Airport.

Material from both engines was sent to the Smithsonian Institution in Washington for identification of the bird species.



5. archived voucher specimens to document the species identity of plants used for various other biological investigations.

Anti-Cancer Drug Discovery and Development in Brazil: Targeted Plant Collection as a Rational Strategy to Acquire Candidate Anti-Cancer Compounds

DENNIS R.A. MANN, ADRIANA B. DA ROCHA, GILBERTO SCHWARTSMANN

Comparative Cancer Centre (CCC/CAN), South American Office for Anti-Cancer Drug Development (NOAD), Lutheran University of Brazil, Caixa, ES, Brazil

Key Words: Drug discovery; Natural products; South America; Compound acquisition; Compound selection

ABSTRACT

The natural medical history, plant products have been shown to be valuable sources of novel anti-cancer drugs. Examples are the Taxane alkaloids, the taxanes, and the irinotecan, a topoisomerase II inhibitor, derived from the plant *Camptotheca acuminata*.

The plant *Camptotheca acuminata*, the Chinese quinine tree, is the source of the anti-cancer drug irinotecan, a topoisomerase II inhibitor. The species are selected phytochemicals through ethnobotanical knowledge, chemical screening, and organic synthesis, and

... extracts are evaluated at a concentration of 10 µg/ml for antiproliferative activity against the cell line. Extracts that significantly inhibit the growth of the cells (50% or more) are selected.

Materials and Methods

Collection of plant

Cordyline terminalis Kunth. (Liliaceae) was collected from the district of Narali during the month of January 2003 in its flowering stage and was identified by the National Herbarium of Bangladesh (accession no. 29752).

Extraction

The collected plant parts (leaves) were washed with water, separated from undesirable materials or plants or plant parts. They were sun-dried for one week after cutting into small pieces and were ground into a fine powder with the help of a suitable grinder (Cancerist steel



II. Herbaria



C. How to make a specimen

1. Collecting
2. Pressing & Drying
3. Mounting

Collecting



1. Clippers, trowel
2. Diagnostic parts
 - Flowers or fruits, plus the following:
 - Herbs: roots, stem, leaves.
 - Woody: stem, leaves.
3. Wikiplantatlas.org map or GPS
4. Field notebook
 - Your collection number
 - Location description
 - Plant description (leaf, flower, fruit color) & measurements (e.g., height for herbs, shrubs; DBH for trees)
 - Abundance info
5. Plant press

Collecting




Information to record in notebook based on what must go on final label when mounted:

Plants of the Bush @ Millersville University	Plants of Pennsylvania
<p>Family: Lamiaceae Species: <i>Lindera benzoin</i> (L.) Blume Common name: spicebush</p> <p>Location: Pennsylvania; Lancaster Co.; Millersville; Millersville University; The "Bush" woodland, 100 feet W of River Trail, ca. 300 ft S of Trolley Trail, on steep slope in small clearing of woodland overlooking the Conestoga River to the east. WikiPlants-Atlas estimate of 39.99598249241155 N, -76.34643171214489 W.</p> <p>Description: Abundant understory shrub 2 m tall. DBH of thickest stem 1.5 cm. Twigs spicy-fragrant and dark brown with prominent round, white lenticels. Flowers (all parts) yellow, abundant along twigs in clusters at nodes.</p> <p>Coll: Jose P. Rockaway Coll. No.: 121 Date: 6 Apr 2006</p>	<p>Species: <i>Polystichum acrostichoides</i> (Michx.) Schott Vernacular: Christmas fern Family: Polypodiaceae</p> <p>Location: Pennsylvania; Lancaster; Millersville Borough; Conestoga River watershed; The Bush of Millersville University; N-aspect slope aside stream in humus-rich soil covered by leaf-litter.; Lat 39.99640677121804, Lng -76.3464792072773 (Precise within 2-10 m).</p> <p>Wild Status: Wild; Phenology: Flowers/Sporer/Pollen, No Fruits; Abundance: Greater than 100 plants; Other Comments: Christmas fern. Leaves dark green, plants evergreen. Fertile leaflets in distal third of leaf and smaller than vegetative leaflets; sori brown.</p> <p>Coll: Christopher R. Hardy 1111 Date (dd/mm/yyyy): 28/11/2011</p>

Pressing


1. Plant press
 - Two 12.5x18.5 wood panels
 - Two straps
 - Newsprint
 - Blotters or foam (12 x 18)
 - Corrugates (12 x 18)



© Univ. Fl. Herbarium


Pressing

2. Each plant is pressed between:
 - One fold of newsprint
 - Two blotters (or foam)
 - Two corrugates



Pressing

The specimen can fit the final sheet in a variety of ways.



© Univ. Reading

Pressing

The specimen can fit the final sheet in a variety of ways.



Pressing

3. Drying



Mounting

More on this in Dirig (2009)