

BIB-5724: Tópicos em Sistemática, Evolução & Biogeografia

TÓPICO DESTE OFERECEMENTO: Flowering Plants: Phylogeny, Evolution & Diversification

PROFESSORA RESPONSÁVEL: Profa. Dra. Lúcia G. Lohmann

PROFESSOR COLABORADOR: Prof. Dr. Peter Stevens

DATAS: 26/Maio/2014 – 06/Junho/2014

OBSERVAÇÕES: Este curso será ministrado em inglês. Espera-se que os alunos tenham um conhecimento básico da língua bem como um conhecimento básico em sistemática filogenética.

FLOWERING PLANTS: PHYLOGENY, EVOLUTION & DIVERSIFICATION

COURSE DESCRIPTION:

The main goal of this course is to provide graduate students with a detailed understanding on the morphology, evolution and diversification of flowering plants. A second goal is provide students with an appreciation of how flowering plants and land plants in general have helped shape the biosphere by their interactions with other organisms and the ecological consequences of their physiology.

AIMS:

1. Gain acquaintance with major families of flowering plants
2. Become familiar with plant morphology
3. Understand general phylogenetic relationships and evolutionary patterns in flowering plants
4. Develop an understanding of the impact of flowering plants on the biosphere

BACKGROUND:

Our understanding of relationships within angiosperms has improved considerably due to findings in molecular systematics over the last twenty years. However, understanding morphological and especially eco-physiological evolution remains a challenge, and few attempts have been made to relate the evolution of angiosperms to the great changes in the biosphere over the last 150 million years. Conventional ideas of co-evolution also fail to capture the complexity of the relationships between plants and their associated animals.

Here we lay the foundations for a revised appreciation of the evolution of flowering plants. The laboratory sessions will allow students to develop a firm understanding of the basic principles of the morphology of flowering plants by focusing on the morphology and anatomy of the major groups using fresh and preserved material of exemplar Brazilian families. Associated lectures will give students some of the tools to think about the broad patterns of angiosperm diversity and how to integrate these with issues like the decrease of carbon dioxide concentration in the atmosphere and the diversification of pollinating and herbivorous insects that have occurred along with the evolution of angiosperms since the Cretaceous.

ORGANIZATION & EVALUATION CRITERIA:

Time

- Theory classes will be held in the morning, between 09h00-10h30
- Labs will be held in the afternoon in every session, between 14h00-17h30.

Materials

- Students should bring dissection materials (e.g., razors, fine tweezers, needles) to all Labs.

Evaluation

- Assignment: Choose any family (it does not have to be one we discuss in class) of 500 species and up, or a group of families, and describe its phylogeny and diversification; write your account for a non-botanist.

- Quiz: A quiz will be held every day at the beginning of the class. The quizzes will cover the contents, both laboratory and lecture, of the previous day; there will be no quiz on the first day.
- Laboratory Book: Each student will have his or her own sketchbook that will be provided in the first day of class by the instructors. This book will be used to illustrate all materials covered during labs.
- Final Grading: Assignment (30%), Lab Quiz (30%), Laboratory book (30%), Participation in class (10%).

CONTENTS:

26th May (Monday): Amborellales to Magnoliales

- Thinking about phylogeny, evolution and classification: what do we need to know and do we know it?
- Interpretation of phylogenetic trees.
- How to measure evolutionary success.
- Setting the scene: Alternation of generations, principles of morphology, lignophytes, gymnosperms, and basic seed plant construction.

27th May (Tuesday): Laurales to Asparagales

- Monocots: Different principles of plant construction.
- Orchidaceae: An example of plant diversification?

28th May (Wednesday): Arecales to Zingiberales

- How to be a woody Monocot (Screw pines, palms, bamboos, etc.).
- Grasses, grasslands, and C4 photosynthesis in general.

29th May (Thursday): Ranunculales to Malpighiales 1

- Why dense veins are more important than flowers in biosphere evolution: The evolution of tropical rain forests and the K/T boundary.
- Marine angiosperms: The mangrove and sea-grass ecosystems.

30th May (Friday): Malpighiales 2 to Rosales

- Nitrogen fixation.

2nd June (Monday): Curcubitales to Sapindales

- Fungi and plants, a central role in carbon sequestration? Endophytes, ecto- and endo-mycorrhizae, and mycoheterotrophs.

3rd June (Tuesday): Huerteales to Caryophyllales

- Extreme ecophysiological variation: Carnivores, and plants of saline habitats and deserts.

4th June (Wednesday): Cornales, Ericales, Garryales and Aquifoliaceae

- The Asterids and diversification, what is the connection? Tropical Rain Forests again.

5th June (Thursday): The Asterid I/Lamiid Clade. Gentianales to Lamiales

- Plant-pollinator interactions and rethinking co-evolution: the many and the few, or why specialized flowers are pollinated by generalist pollinators.

6th June (Friday): The Asterid II/Campanulid Clade. Asterales to Dipsacales.

- Plants and changing climates: What has happened since the Devonian?
- Summary: Flowering plants, evolution and diversification

BIBLIOGRAPHY (** - particularly useful):

**Bell, A. D., & Bryan, A. 2008. Plant Form: An Illustrated Guide to Flowering Plant Morphology, "New Edition". Timber Press, Portland, Oregon. A beautifully illustrated book, sort of a glossary, but far more; very accessible.

Dickison, W. C. 2000. Integrative Plant Anatomy. Harcourt/Academic Press, San Diego. Useful introduction to plant anatomy, etc.

Eichler, A. W. 1875-78. Bluthendiagramme Construirirt und Erlautert. 2 vols. Wilhelm Engelmann, Leipzig. A classic.

Endersby, J. 2009. Imperial Nature. Joseph Hooker and the Practices of Victorian Science. Chicago University Press.

**Endress, P. K. 1994. Diversity and Evolutionary Biology of Tropical Flowers. Cambridge University Press, Cambridge. Good survey.

Gifford, E. M., & Foster, A. S. 1988. Morphology and Evolution of Vascular Plants, ed. 3. W. H. Freeman, New York. Still very useful.

**Judd, W. S., Campbell, C. S., Kellogg, E. A., Stevens, P. F., & Donoghue, M. J. 2008 [2007]. Plant Systematics: A Phylogenetic Approach, ed. 3. Sinauer, Sunderland, Mass.

Kaplan, D. R. 1997. Plant and Microbial Biology. 3 vols. Odin Readers. Strange title; book is the best classical morphology.

Kenrick, P., & Crane, P. R. 1997. The Origin and Early Diversification of Land Plants. Smithsonian Institution, Washington. For that part of land plant evolution we do not cover.

**Kubitzki, K. (ed.). 1993-onwards. The Families and Genera of Vascular Plants. Vol. II onwards (Vol. I is gymnosperms, etc.) Springer-Verlag, Berlin. 11 volumes so far, vol. 12, grasses, just finished. Technical, but very useful.

Leins, P., & Erbar, C. 2010. Flower and Fruit. Schweizerbart, Stuttgart. Well illustrated; summary of their own work.

**Mabberley, D. J. 2007. Mabberley's The Plant Book. Ed. 3. Cambridge University Press, Cambridge. A dictionary of plant names, and more; essential for anybody with a strong interest in plants.

Morton, A. G. 1981. History of Botanical Science. Academic Press, London. Treats all of botany.

Payer, J.-B. 1857. Traité d'organogénie comparée de la fleur, 2 vols. Victor Masson, Paris. Another classic, illustrations almost as good as s.e.ms.

Prenner, G., Bateman, R. M., & Rudall, P. J. 2010. Floral formulae updated for routine inclusion in formal taxonomic descriptions. Taxon 59: 241-250. Rather overdone, but useful introduction.

**Ronse de Craene, L. P. 2010. Floral Diagrams: An Aid to Understanding Flower Morphology and Evolution. Cambridge University Press. An intellectual descendent of Eichler (see above).

Stevens, P. F. 1994. The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature and the Natural System. Columbia University Press, New York.

**Stevens P. F. 2001 onwards. Angiosperm Phylogeny Website.
<http://www.mobot.org/MOBOT/research/APweb/>

Weberling, F. 1989. Morphology of Flowers and Inflorescences. Cambridge University Press. An introduction to inflorescence morphology.