



**Office of Extended Education • Humboldt State University**

**Natural History of the Patagonian Cordillera: Argentina and Chile**  
**INTRODUCTION TO FIELD BOTANY**  
**AND THE FLORA OF PATAGONIA**

Biology (BIOL 180) • 3 semester units

Instructor: Brett Lovelace

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**BRIEF COURSE DESCRIPTION**

This course will provide the student with an introduction into various aspects of botany through lectures, required readings, discussions, and extensive hands-on experience with plants in the field. This course will focus on the identification of major plant groups. Students will learn to identify specimens at the family, genus, and species level through the use of a hand lens and dichotomous taxonomic keys. Topics will include discussion of plant classification and systematics, life history strategies, evolutionary history, habitat relationships, plant community characteristics, rarity and endemism, and other topics in basic plant science.

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**LEARNING OBJECTIVES**

The primary objectives of this course are for students to gain a solid understanding of the following:

- Basic plant taxonomy, reproduction, physiology, and gross anatomical characteristics
- Use of Field Journal as a tool for documenting species and honing one's observational skills
- Relevant field techniques in botanical sciences
- Characteristics of the dominant plant groups found in Argentina/Chile
- The ability to identify plants using dichotomous plant keys
- The ability to perform basic vegetation sampling techniques and botanical field journal entries

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**COURSE OVERVIEW**

Listed below are the various locations visited in our exploration of Patagonia, followed by a brief description of how our time is spent and what our focus is in each location.

**Section 1 (7 days): Estancia Ranquilco, Argentina—Patagonian Steppe (Precordillera/Cordillera Norte Interface)**

The course begins with a focus on the academic foundations of the program and will include lectures on the fundamental principles of ecology and biogeography. Students will be introduced to the natural history and culture of Patagonia through short forays into the surrounding countryside. Here we will begin to develop our observational skills and start to document these observations in our field journals. Estancia Ranquilco will also serve as an excellent location to begin our study of the formative biophysical forces/processes and climatic systems/events that have shaped Patagonia. Part of this introductory period will incorporate informal meetings with local Argentine gauchos.

**Section 2 (23 days): Estancia Ranquilco, Argentina—Patagonian “Altoandino” or “High Andes” (Cordillera de Los Andes)**

We leave the middle reaches of the Río Trocomán watershed near the headquarters of Estancia Ranquilco and travel through the steppe habitats by horse and foot into the mountains of the Andean Plateau of Argentina. We visit *Nothofagus antarctica* and *N. pumilio* scrub habitats along our path into the mountains in addition to spending extended time in the “Altoandino”, or “high Andes”, studying the plant communities and associated fauna adapted to this high elevation, volcanic, and glacially carved landscape.

Such an extended period in this geographical location allows students to become intimately familiar with the montane and high elevation regions of this “rain shadow” side of the Andes, while continuing to investigate new topics, as well as those presented earlier in the program. As species and notable ecological, geological, and meteorological phenomena are encountered, they provide various interesting topics and concepts to be discussed. Along the way students are exposed to the subsistence grazing practices of the local gauchos and are encouraged to compare such practices with those in North America. We discuss the effects of this method of grazing and potential impacts to the native ecosystem. For part of our route, we follow different rivers stocked with exotic trout species and have the opportunity to consider the potential impacts of non-native species introduction to these riparian systems.

**Section 3 (10 days):  
Santuario El Cañi, Chile: Western Slope of the Patagonian Cordillera de Los Andes**

We arrive at our trailhead in the western foothills of the southern Chilean Andes after being picked up on the Chilean side of the international border by our rented Chilean transport van. Here we hike our way up to Santuario El Cañi, an ecological reserve established by the conservation organization, Fundación Lahuen. This reserve, located in an ancient collapsed caldera, contains excellent examples of intact and mature, mixed *Nothofagus* spp. - *Araucaria araucana* (“monkey puzzle”) forests. During this leg of our journey students are introduced to different species of *Nothofagus* as well as *Araucaria araucana*. This unique South American tree species is considered in the context of the global distribution of its genus and family. Students are also introduced to various aspects of forest ecology, biogeography, and plant morphology. Given the geological origin of the location and the dramatic skyline rimmed with volcanoes, we take advantage of the opportunity to consider volcanism as it pertains to this part of the Andes Mountains.

Here too, we begin to consider the scientific method and its application in attempting to answer biological and ecological questions. We examine the development of such questions, varying methods of data collection and analysis, and the difference between descriptive study and manipulative methods (hypothesis testing). We begin to consider causation and correlation, and touch on probability and the use of statistics as it applies to the scientific method in ecological studies. Students are introduced to various field techniques and elements of research design often used to answer ecological questions. As part of the course, students identify research questions and discuss methods to answer these questions. Readings include journal articles from primary, secondary, and tertiary literature.

**Section 4 (13 days):  
Río Cochamó, Chile: Coastal/Montane Western Slope of the Patagonian Cordillera de Los Andes**

From the Lake District of Chile, we drive by rented van, some 9 hours south, to the mouth of the Río Cochamó where it enters the Reloncavi Sound (an inland intrusion of the southern Pacific Ocean.) From the trailhead we begin our journey back towards Argentina. We start out near sea level, hiking through one of the last remaining intact portions of the Valdivian Rainforest. As we continue our nearly two-week trek back towards the continental divide, we leave the almost overwhelmingly biologically species-diverse lower elevations and transition into mixed *Fitzroya cupressoides* (“alerce” or “southern redwood”) - *Nothofagus* (“southern beech”) forests at mid- and higher-elevations. Along our route we have the opportunity to observe different phenomena influencing the ecology of these southern forests (and forests in general) including the effects of aspect, elevation, annual rainfall, temperature, and disturbance regimes (among others). This location also offers an excellent geological contrast to the first, and second, sections of the program (where the landscapes were largely derived from relatively recent extrusive geological origin) in that our final journey is almost entirely through glacially-carved granite substrates.

During this portion of the program we delve into aspects of forest ecology/biology such as parasite and epiphyte biology, as well as other topics related to forest canopy ecology. Students also re-visit the topic of human influence on native biological systems, particularly in light of the effects of timber harvest on forest ecosystems. Our remaining time in these South American forests is complimented by discussions considering the global distribution of the forest taxa observed and different ideas attempting to explain this present day distribution. One of the central goals during this last section is to allow for students to synthesize the various biological, ecological, geological, meteorological, and biogeographical concepts that they have been exposed to throughout the entire program.

We reach our final destination of San Carlos de Bariloche on the evening of March 10, after re-entering Argentina and being delivered to the city by a rented transport van, which meets us at the international border crossing. Time allowing, and if possible, we make a short stop enroute for a guest lecture on fire ecology from a professor from a university in S.C. de Bariloche. S.C. de Bariloche is a fitting final destination, having spent extensive time in both the semi-arid steppe habitats on the rainshadow side of the southern Andes, as well as the temperate coastal/montane rainforests of southern Chile, as it is located along a dramatic Patagonian ecotone. Here, we come full circle.

### COURSE OUTLINE

<p>I. Introduction to the Plant Body</p> <p style="margin-left: 20px;">A. Organography</p> <p style="margin-left: 20px;">B. Basic plant anatomy/morphology</p> <p style="margin-left: 20px;">C. Basic plant physiology</p> <p>II. Basic Plant Reproductive Biology</p> <p style="margin-left: 20px;">A. Sexual vs. asexual reproduction</p> <p style="margin-left: 20px;">B. Variation in life history strategies (life cycles)</p> <p>III. Introduction to Plant Taxonomy</p> <p style="margin-left: 20px;">A. Introduction to major plant groups</p> <p style="margin-left: 20px;">B. Reproductive morphology of higher groups- what is a flower?</p> <p style="margin-left: 20px;">C. Use of floristic identification keys</p> <p style="margin-left: 20px;">D. Plant field journal format</p> <p>IV. Identification of Major Vascular Plant Groups</p> <p style="margin-left: 20px;">A. Ferns and fern allies</p> <p style="margin-left: 40px;">1. Lycophytes (club mosses, etc.)</p> <p style="margin-left: 40px;">2. Sphenophytes (horsetails)</p> <p style="margin-left: 40px;">3. Pteridophytes (ferns, etc.)</p>	<p>B. Gymnosperms</p> <p style="margin-left: 20px;">1. Ephedrales (<i>Ephedra</i>)</p> <p style="margin-left: 20px;">2. Coniferales (<i>Araucaria</i>, <i>Austrocedrus</i>, <i>Fitzroya</i>, <i>Podocarpus</i>, <i>Saxegothaea</i>, etc.)</p> <p>C. Angiosperms</p> <p style="margin-left: 20px;">1. Eudicots</p> <p style="margin-left: 20px;">2. Monocots</p> <p>V. Fungi</p> <p style="margin-left: 20px;">A. “Lower Fungi” (Myxomycetes, Oomycetes, Zygomycetes, etc.)</p> <p style="margin-left: 20px;">B. “True Fungi”: Ascomycota &amp; Basidiomycota</p> <p>VI. Contextual Topics in Field Botany</p> <p style="margin-left: 20px;">A. What is a species?</p> <p style="margin-left: 20px;">B. Phytogeography</p> <p style="margin-left: 20px;">C. Evolution of native flora</p> <p style="margin-left: 20px;">D. Human influences</p> <p style="margin-left: 20px;">E. Identification and classification of plant communities</p> <p style="margin-left: 20px;">F. Endemism and rarity</p>
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### REQUIRED MATERIALS AND TEXTS

Hand lens or “loup”, 10x or 14x (preferable)

Young, P. 1982. *The Botany Coloring Book*. Harper Perennial. New York, New York.

Wilcox, K. 1996. *Chile’s Native Forests. A Conservation Legacy*. Ancient Forests International. Redway, California.

**Course Reader:** instructor-compiled selection of readings (see below) from a variety of books and journals (available to student at cost)

Ahrens, D. C. 2000. *Meteorology Today: An Introduction to Weather, Climate, and the Environment*. Sixth Edition. Brooks/Cole, Thomson Learning. Pacific Grove, California.

- Cox, C. B. 1990. *New geological theories and old biogeographical problems*. Journal of Biogeography 17: 117-130.
- Enright, N. J. and R. S. Hill. (Eds.). 1996. *Ecology of the Southern Conifers*. Smithsonian Institution Press. Washington D.C.
- Gifford, E. M. and A. S. Foster (Eds.). 1989. *Morphology and Evolution of Vascular Plants. Third Edition*. W.H. Freeman and Company. New York, New York.
- Heads, M. J. 1990. *Mesozoic tectonics and the deconstruction of biogeography: a new model of Australasian biology*. Journal of Biogeography 17: 223-225.
- Judd, W. S., C. S. Campbell, E. A. Kellogg, and P. F. Stevens (Eds.). 1999. *Plant Systematics: A Phylogenetic Approach*. Sinauer Associates, Inc. Sunderland, Massachusetts.
- Lawford, R. G., P. B. Alaback, and E. Fuentes (Eds.). 1996. *High-Latitude Rainforests and Associated Ecosystems of the West Coast of the Americas: Climate, Hydrology, Ecology, and Conservation (Ecological Studies, Volume 116)*. Springer-Verlag. New York, New York.
- McEwan, C., L. A. Borrero, and A. Prieto. 1997. *Patagonia. Natural History, Prehistory, and Ethnography at the Uttermost End of the Earth*. Princeton University Press. Princeton, New Jersey.
- Raffaele, E. and T. T. Veblen. 2001. *Effects of cattle grazing on early post fire regeneration of matorral in northwest Patagonia, Argentina*. Natural Areas Journal 21: 243-249
- Schoenherr, A. A. 1992. *A Natural History of California*. University of California Press. Berkeley, California.
- Veblen, T. T., R. S. Hill, and J. Read. (Eds.). 1996. *Ecology and Biogeography of Nothofagus Forests*. Yale University Press. New Haven and London.
- Zug, G. R., L. J. Vitt, and J. P. Caldwell (Eds.) 2001. *Herpetology: An Introductory Biology of Amphibians and Reptiles. Second Edition*. Academic Press. San Diego, California.
- Winkworth, R. C., S. J. Wagstaff, D. Glenney, and P. J. Lockhart. 2002. Plant dispersal N.E.W.S. from New Zealand. Trends in Ecology and Evolution 17(11): 514-519.

#### **Reference Texts Available During Program:**

- Bisheimer, M. V. and E. M. Fernández. 2000. *Árboles de los Parques Nacionales del Sur*. Grafica Pinter. Buenos Aires, Argentina. (In Spanish)
- Burns, B. R. 1991. *The Regeneration Dynamics of Araucaria araucana*. Ph.D. Dissertation. Department of Geography, University of Colorado. Boulder, Colorado.
- Correa, Maevia, N. (Ed.) 1998. *Flora Patagónica (Volumes I-VII)*. Instituto Nacional de Tecnología Agropecuaria (INTA). Buenos Aires, Argentina. (In Spanish)
- De La Pena, R. and M. Rumboll. 1998. *Birds of Southern South America and Antarctica*. Princeton University Press. Princeton, New Jersey.
- Dimitri, M. J. 1972. *La Región de Los Bosques Andino-Patagónicos: Sinopsis General*. Instituto Nacional de Tecnología Agropecuaria (INTA). Buenos Aires, Argentina. (In Spanish)
- Hickman, J.C. (Ed.) 1993. *The Jepson Manual*. University of California Press.
- Hoffman, A. H. J. 1998. *Flora Silvestre de Chile: Zona Central. Fourth Edition*. Fundación Claudio Gay. (In Spanish)
- Hoffman, A. H. J., M. K. Arroyo, F. Liberona, M. Muñoz, and J. Watson. 1997. *Plantas Altoandinas: en la Flora Silvestre de Chile. Fourth Edition*. Fundación Claudio Gay. (In Spanish)
- Manos, P. S. 1997. Systematics of *Nothofagus* (Nothofagaceae) based on rDNA spacer sequences (ITS): Taxonomic congruence with morphology and plastid sequences. American Journal of Botany 84(8): 1137-1155.
- McCune, B., and L. Geiser. 1997. *Macrolichens of the Pacific Northwest*. Oregon State University Press. Corvallis, Oregon.
- Moore, D. M. 1983. *Flora of Tierra del Fuego*. Anthony Nelson, England. Missouri Botanical Garden, USA.
- Nash, T. (Ed.). 1996. *Lichen Biology*. Cambridge University Press. Cambridge, UK.
- Neira, E., H. Verscheure, and C. Revenga. 2002. *Chile's Frontier Forests: Conserving a Global Treasure*. Global Forest Watch, Chile.
- Press, F. and R. Siever. 1998. *Understanding Earth. 2<sup>nd</sup> Edition*. W.H. Freeman and Company. New York, New York.
- Raven, P., R. F., Evert, S. E. Eichorn. 1999. *Biology of Plants. Sixth Edition*. W. H. Freeman & Company. New York, New York.

Rivademar, D., and A. Winograd. 2002. *Patagonia: Land of Giants*. Island Press, Washington DC.

Sabatini, M. de C. and R. M. Rodríguez Iglesia. 2001. A global context for the evolution and current status of protected areas in Argentina. *Natural Areas Journal* 21: 274-281.

Tell, G., I. Izaguirre, and R. D. Quintana. 2003. *Flora Y Fauna Patagónicas*. Ediciones Caleuche. San Carlos de Bariloche, Argentina. (In Spanish)

Tilton, B. 2004. *Wilderness First Responder. Second Edition*. The Globe Pequot Press. Guilford Connecticut.

Veblen, T. T., W. Baker, G. Montenegro, and T. W. Swetnam (Eds.). 2003. *Fire and Climatic Change in Temperate Ecosystems of the Western Americas (Ecological Studies, Volume 160)*. Springer-Verlag. New York, New York.

Zomlefer, W. B. 1995. *Guide to Flowering Plant Families*. University of North Carolina Press. Raleigh, North Carolina.

## EVALUATION

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25%	Field Journal Evaluation*
30%	Quizzes: To be announced
15%	Participation in Discussions
30%	Final exam

### \*Detailed Species Accounts:

One detailed species account for one floral taxon for *both* sides of the Cordillera (10% of Field Journal grade).

The grades used in this course will be as follows:

A+	98-100	B+	87-89	C+	77-79	D+	67-69	F	Below 60
A	93-97	B	83-86	C	73-76	D	63-66		
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

## COURSE SCHEDULE

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Specific topics covered in each section of the program correspond to the Course Outline. These topics are mentioned where introduced, and our consideration of specific aspects of each are continued and re-visited throughout our travels as we explore the various habitats of the Patagonian cordillera. Both day-hikes and hikes from location to location are typically dynamic and punctuated with spontaneous lectures depending upon the species and phenomena encountered along our way. These spontaneous moments also prove to be an excellent time for students to review and incorporate information previously introduced, as well as to generate questions about observations for future discussions.

Typical field days incorporate one hour of lecture in the morning, at least three hours of focused field experience pertaining to the appropriate courses in the late morning or afternoon, followed by an hour of discussion (based on the morning lecture and assigned readings) in the late afternoon or evening. Such a field day results in approximately five hours dedicated to the described courses for each academic field day.

Listed below are the various locations visited in our exploration of Patagonia, followed by a brief description of how our time is spent, what our focus is in each location, and important evaluations of student performance (e.g. quizzes, presentations, field journal evaluations, examinations, etc.) Relevant topics and corresponding pertinent reading assignments from course reader and/or backcountry library (specified within “[ brackets ]”) are included for each respective location.

### Section 1 (10 days)

#### Estancia Ranquillo, Argentina—Patagonian Steppe (Precordillera/Cordillera Norte Interface)

Total class hours: 23.5

Subject	Readings
Course Introduction/syllabus-materials review	[Syllabus]
What is a “plant?”/What is “Botany?”	[Young 1982: To Be Announced]
Introduction to Basic Plant Biology	[Raven et al. 1999 (1): 1-14; (5): 93-97; Young 1982: TBA]
Basic Reproductive Biology of “Flowering Plants”	[Young 1982: To Be Announced]
Estancia Garden Plants/Fruits labs	[Young 1982: To Be Announced]
Introduction to Plant Communities & Habitats of Patagonia:	[Rivademar & Winograd 2002 (The Steppes): 89-131] [Enright & Hill 1996 (6): 127] [Correa 1998: 155-156]
Introduction to Botanical Field Journal Methods	Handout

### Section 2 (23 days)

#### Estancia Ranquillo, Argentina—Patagonian “Altoandino” or “High Andes” (Cordillera de Los Andes)

Total class hours: 24

#### Evaluation:

Field Journal Evaluation

2 Quizzes

Subject	Readings
Plant Nutrition & Soils – Vegetation Response to Geological/Meteorological Regimes	[Raven et al. 1999 (30): 726-748]
Intro to Basic Plant Biology (Cont’d): Anatomy/Morphology	[Young 1982: To Be Announced]
Intro to Basic Plant Biology (Cont’d): Physiology	[Young 1982: To Be Announced]
The Process of Evolution	[Raven et al. 1999 (12): 235-257]
Systematics: The Science of Biological Diversity	[Raven et al. 1999 (13): 261-275] [Judd et al. 1999 (1): 1-6; (2): 9-32] [See Brett for Manos 1997 (an example of systematic study of <i>Nothofagus</i> spp.)]
Introduction to Use of Taxonomic Keys for Identification	[Judd et al. 1999: To Be Announced; Hickman 1993: TBA]
Study and Identification of Encountered Taxa	
Introduction into General Life Cycles	[Handouts; Young 1982: TBA]
Bryophyte Life Cycle	[Handouts; Young 1982: TBA]
Introduction to Gymnosperms	[Raven et al. 1999 (20): 467-492]
Gnetophytes (Special Field Journal Exercise)	[Judd et al. 1999 (7): 158-159] [Gifford & Foster 1989 (18): 455-481]
Introduction to Angiosperms	[Raven et al. 1999 (22): 517-551]
Introduction to the Nothofagaceae	[Judd et al. 1999 (8): 308-309]
Introduction to Botanical Field Journal Methods (Cont’d)	

### Section 3 (10 days)

#### Santuario El Cañi, Chile: Western Slope of the Patagonian Cordillera de Los Andes.

Total class hours: 16

#### Evaluation:

Field Journal Evaluation

1 Quiz

Subject	Readings
General Life Cycle Review	
<i>Lycopodium</i> sp., <i>Equisetum</i> sp., and Pteridophyte Life Cycles	[Handouts; Young 1982: TBA]
Introduction to Conifers	[Judd et al. 1999 (7): 152-157] [Gifford & Foster 1989 (17): 401-408]
Study and Identification of Encountered Taxa (Cont’d)	
Evolution from “Lower Plant Groups”	[Handouts; Young 1982: To Be Announced]
Human Influence/Impact to Forested Habitats: Forestry/Logging	[Wilcox 1996: 43-69]

**Section 4 (13 days)**

**Río Cochamó, Chile: Coastal/Montane Western Slope of the Patagonian Cordillera de Los Andes**

2 Quizzes

Total class hours: 19

Evaluation:

Final Field Journal Evaluation

Final Examination

<b>Subject</b>	<b>Readings</b>
Study and Identification of Encountered Taxa (Cont'd)	
Evolution from "Lower Plant Groups" (Cont'd)	[Handouts; Young 1982: To Be Announced]
Gymnosperm Life Cycle	[Handouts; Young 1982: To Be Announced]
Angiosperm Life Cycle	[Handouts; Young 1982: To Be Announced]
Fungi: "Lower Fungi"	[Handouts; Young 1982: To Be Announced]
Fungi: "True Fungi": Ascomycetes & Basidiomycetes	[Handouts; Young 1982: To Be Announced]

**TOTAL CLASS HOURS: 82.5**