THE SCHOOL FOR FIELD STUDIES

Patagonian Ecology
SFS 3781

Syllabus
4 credits

The School for Field Studies (SFS)
Center for Climate Studies (CCS)
Puerto Natales, Chile

This syllabus may develop or change over time based on local conditions, learning opportunities, and faculty expertise. Course content may vary from semester to semester.

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COURSE CONTENT SUBJECT TO CHANGE

Please note that this is a copy of a recent syllabus. A final syllabus will be provided to students on the first day of academic programming.

SFS programs are different from other travel or study abroad programs. Each iteration of a program is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- Changes in access to or expiration or change in terms of permits to the highly regulated and sensitive environments in which we work;
- Changes in social/political conditions or tenuous weather situations/natural disasters may require changes to sites or plans, often with little notice;
- Some aspects of programs depend on the current faculty team as well as the goodwill and generosity of individuals, communities, and institutions which lend support.

Please be advised that these or other variables may require changes before or during the program. Part of the SFS experience is adapting to changing conditions and overcoming the obstacles that they may present. In other words, this is a field program, and the field can change.

Course Overview

This course focuses on Ecology with an emphasis on Patagonia's rich biodiversity. We will explore this fascinating region and its habitats shaped by harsh winters and strong winds, examining native flora and fauna, many of which are endemic species. The course will include key topics from various subdisciplines across different spatio-temporal scales, highlighting the interplay between the dynamics of populations, ecosystems, communities, human impacts, climate change effects, and conservation biology. The course will immerse students in a practical approach, deepen their understanding of ecology, and equip them with skills to address real-world environmental challenges. It emphasizes the role of climate in shaping ecosystems and wildlife dynamics. By the end, students will be empowered to be leaders in the field.

Learning Objectives

This course aims to give students a **comprehensive understanding of large-scale evolutionary processes, ecological dynamics, and species distribution patterns unfolding across geological timescales.** By examining these foundational concepts, students will gain critical insights into the ecological factors shaping Patagonian species distributions and the impacts of environmental change on their population dynamics. Such knowledge is crucial for predicting and mitigating the effects of human-induced disturbances on natural landscapes at local and regional scales.

Field-based observations will be crucial to the course, connecting organism-level phenomena with ecosystem-scale processes. These practical experiences will **improve students' ability to analyze the behaviors and interactions of wild species in various spatio-temporal contexts**.

Through engaging classroom and field lectures, fundamental readings of scientific literature, integrative discussions, immersive fieldwork, and practical assignments, students will be challenged to **refine their observational skills, formulate meaningful questions, and cultivate advanced critical thinking abilities.** These competencies will form the foundation for understanding the complex ecological relationships that shape natural systems.

Assessment

The evaluation breakdown for the course is as follows:

Assessment Item	Value (%)
Final Exam	20
Field Exercises (FEX)	15
Quizzes	15
Class Activities	15
Field Notebook	15
Participation	10
Integrated Discussion	10
TOTAL	**100**

Final Exam (20%)

At the end of the course, a comprehensive synthesis exam will be conducted, drawing on material from lectures, assigned readings, and field trip experiences. This exam challenges students to integrate and apply their knowledge while demonstrating scientific thinking. It will assess their ability to analyze, synthesize, and critically evaluate complex ecological concepts and interactions. To support this process, students will have full access to their class materials for reference, allowing them to approach the exam focusing on evidence-based reasoning and thoughtful problem-solving.

Field Exercises (15%)

Students are expected to develop research questions and assess them through data collection while conducting field observations. Students may end the semester by identifying Patagonian flora and fauna species and learning about their natural behaviors, habitat use, population dynamics, and threats from human activities to their feeding, resting, and breeding areas. Among the methods, students will use various equipment, such as binoculars, field notes, and cameras. Students will gather data by individual observation, write notes, and summarize information using tables, draws, schematic diagrams, figures, etc. Drawing during fieldwork will help students to improve their skills in creating figures and analyzing data in class. Proofing and pooling data collected from the field might be essential, and drafting manuscripts will improve their writing skills. Students may want to upload their species identification to several open-access wildlife platforms, including iNaturalist and eBird. This way, students can contribute to Citizen Science initiatives by locally increasing wild species record sightings!

Quizzes (15%)

Short quizzes will be utilized to evaluate the effectiveness of lectures delivered in classroom and field settings. These quizzes are designed to assess the student's comprehension of the material and ensure a solid grasp of key concepts. They will serve as a valuable feedback mechanism for both students and instructors, helping to highlight areas of strength and identify topics that may require further clarification or review. Active commitment to these quizzes will enhance each student's overall learning experience and foster a deeper understanding of the course content.

Class Activities (15%)

Students may work individually, in pairs, or in small groups to engage in various in-class activities throughout the semester. These activities include discussing specific literature on relevant topics, brainstorming ideas, engaging in critical thinking, and drawing conclusions. Oral presentations on ecological topics are highly encouraged. These presentations will have time limits and will be graded based on the following criteria: the connection of selected articles to the chosen ecological topic, the accuracy of the information presented, adherence to time limits, and the overall quality of the presentation. Presentations in PowerPoint format are highly preferred.

Field Notebook (15%)

Each field expedition provides a unique opportunity for observation, learning, and connecting course concepts to real-world environments. As the semester progresses, students will increasingly recognize class themes manifesting in the landscape, deepening their ecological understanding. Maintaining a field notebook is essential for recording observations and reflections throughout the semester. Developing the habit of attentively observing surroundings and linking them to broader ecological processes is a key goal of the course. Field excursions are invaluable for strength observational skills, and students are

encouraged to use their field notebooks not merely for summarizing academic concepts but as a space for personal insights, thoughts, sketches, and reflections. These entries should capture their authentic engagement with the field experience. During each trip, ample time will be allotted to allow students to document their observations and ideas, ensuring their notebooks become a meaningful record of their intellectual and creative growth.

Participation (10%)

Students must actively engage in every classroom session and demonstrate initiative during field activities. This includes thoroughly reviewing and reading assigned literature before each session, contributing thoughtful and relevant questions, offering meaningful insights during discussions, and taking the lead on assignments related to designated topics throughout the semester. Active participation is essential to foster a collaborative learning environment and deepen the collective understanding of course material.

Integrated Discussion (10%)

To review and develop our understanding of the topics explored in the field, we will have two integrated discussions. Since all field locations provide context for observation and learning, this activity will take advantage of your Field Notebook entries and class notes to integrate knowledge. For each integrated discussion, the class will be broken into four (4) groups, with each group overseeing connecting specific themes with specific field locations. More detailed instructions are forthcoming in the beginning for each activity.

Grading Scheme

Grade corrections in any of the above items should be requested in writing at least 24 hours after assignments are returned. No corrections will be considered afterwards.

A	95.00 - 100.00%	B+	86.00 - 89.99%	C+	76.00 - 79.99%	D	60.00 - 69.99%
A-	90.00 - 94.99%	B	83.00 - 85.99%	C	73.00 - 75.99%	F	0.00 - 59.99%
		B-	80.00 - 82.99%	C-	70.00 - 72.99%		

General Reminders

Honor Code/Plagiarism – SFS places high expectations on their students and we hold students accountable for their behaviors. SFS students are held to the honor code below. SFS has a zero-tolerance policy towards student cheating, plagiarism, data falsification, and any other form of dishonest academic and/or research practice or behavior. Using the ideas or material of others without giving due credit is cheating and will not be tolerated. Any SFS student found to have engaged in or facilitated academic and/or research dishonesty will receive no credit (0%) for that activity.

> *"SFS does not tolerate cheating or plagiarism in any form. While participating in an SFS program, students are expected to refrain from cheating, plagiarism and any other behavior which would result in a student receiving credit for work which they did not accomplish on their own. Students are expected to report any instance of cheating or plagiarism by others."*

Use of Artificial Intelligence – AI will be used as a complementary tool for learning and should not replace human interaction in the educational process. Teachers will remain responsible for guiding, supporting, and assessing students.

Deadlines – Deadlines for written and oral assignments are instated to promote equity among students and to allow faculty ample time to review and return assignments before others are due. As such, deadlines are firm; extensions will only be considered under extreme circumstances. Late assignments will incur a penalty of 10% of your grade for each day you are late. After 48 hours past the deadline, assignments will not be accepted anymore. Assignments will be handed back to students after a one-week grading period. Grade corrections for any assessment item should be requested in writing at least 24 hours after assignments are returned. No corrections will be considered afterwards.

Content Statement – Every student comes to SFS with unique life experiences, which contribute to the way various information is processed. Some of the content in this course may be intellectually or emotionally challenging but has been intentionally selected to achieve certain learning goals and/or showcase the complexity of many modern issues. If you anticipate a challenge engaging with a certain topic or find that you are struggling with certain discussions, we encourage you to talk about it with faculty, friends, family, the HWM, or access available mental health resources.

Participation – Since we offer a program that is likely more intensive than you might be used to at your home institution, missing even one lecture can have a proportionally greater effect on your final grade simply because there is little room to make up for lost time. Participation in all components of the course is mandatory, it is important that you are prompt for all activities, bring the necessary equipment for field exercises and class activities, and simply get involved.

A Note About Class Readings - Many of the classes have two or more papers associated with them. In these cases, different readings will be assigned to different reading groups. The members for each group will be expected to have read the key portions of their article for the upcoming class, so as to help lead the discussion on the topics covered in their paper. Many research articles use data collection and analysis methodologies that are unfamiliar, and each reading group will be advised about the sections they will be responsible for reading in their papers.

Course Content

O: Orientation, CA: Class activity, L: Lecture, FEX: Field Exercise, FL: Field Lecture, GL: Guest Lecture, WS: Workshop, ID: Integrated Discussion

Code	Title and Outline	Type	Hours	Readings
ECO01	**Course overview and objectives**	O	0.5	
ECO02	**Patagonian mountain landscapes and associated biodiversity**	FL, CA	1.5	
ECO03	**General Introduction to Ecology (Part I)** Biotic and abiotic components. Food chains, trophic levels, and food webs. Energy flow and primary productivity. Population and Community Ecology. The Ecological Niche Theory. Major ecology subdisciplines.	CL, CA	4.0	*Antonelli (2017)* *Polechova & Storch (2018)* *Holt (2009)* *Iriarte et al. (2010)* *Gonzalez et al. (2013)*
ECO04	**Biological adaptations of wildlife to the landscapes of Torres del Paine (Part I)** Ecological succession: microhabitats and primary succession. Ecology of lichens 'saxicolous' on rock surfaces.	FL	1.0	*Armstrong (Review)* *Garibotti and Villalba. (2009)* *Garibotti et al. (2011)* *Arya et al. (2024)*
ECO05	**Biological adaptations of wildlife to the landscapes of Torres del Paine (Part II)** Case study: Restoration of Magellanic Forest trees in degraded areas impacted by wildfires and livestock.	GL, CA	2.0	
ECO06	**Biological adaptations of wildlife to the landscapes of Torres del Paine (Part III)** Case study: A long-term study on Guanacos populations from southwest Chilean Patagonia.	GL	1.0	
ECO07	**General Introduction to Ecology (Part II)** The Biosphere. Matter cycle. Biogeochemical cycles. Hydrological cycle. Watersheds. Wetland types. Case study: Patagonian Fjord ecosystems in southern Chile as vulnerable region.	CL	3.0	*Iriarte et al. (2010)*
ECO08	**Freshwater ecosystems of Southwestern Patagonia (Part I)** Hydrography. Freshwater biodiversity (invertebrates, fish, amphibians, birds & mammals). Case studies: Introduced salmonids. Native lampreys.	CL, CA	1.5	*Reid et al. (2022)* *Cussac et al. (2008)* *Cussac et al. (2016)*

ECO09	**Freshwater ecosystems of Southwestern Patagonia (Part II)** Ecosystem services. Impacts and threats. Site-based conservation efforts. Integrated watershed management. Current challenges.	CL	1.0	*Reid et al. (2022)* *Cussac et al. (2008)* *Cussac et al. (2016)*
ECO10	**Full-day Skill Workshop**	WS	4.0	
ECO11	**Magellanic penguins in the Strait of Magellan** Breeding biology. Chick-rearing behaviors. Molting. Ecophysiology implications for migration.	FEX	2.0	
ECO12	**King Penguins of Tierra del Fuego** Breeding biology. Relevance of the conservation at their northernmost continental colony.	FEX	2.0	
ECO13	**Glacial ecology** Ecological dynamic and implications of a post-glacial landscape for biological communities. Case studies and examples from Patagonian glaciers.	CL	2.0	*Stibal et al. (2020)* *Miserendino et al. (2018)* *Manquehual- Cheuque et al.* *(2020)*
ECO14	**First Integrated Discussion**	ID	4.0	
ECO15	**Urban wetlands & aquatic biodiversity (Part I)** Waterbirds as bioindicators. Quantification of habitat quality. Environmental and human factors as primary modulators of wetland dynamics.	FEX	3.0	*Mott et al. (2023)*
ECO16	**Rural wetlands and biological invasions in native ecosystems (Part I)** Ecological implications, threats, and impacts of introduced species.	FL	2.0	
ECO17	**Population ecology (Part I)** Demography. Population size and density. Population dynamics (exponential and logistic growth). Population growth regulation.	CL	2.0	
ECO18	**Population ecology (Part II)** Methods for measuring population size (quadrats, transects, mark-recapture/resighting). Species distribution and dispersion patterns.	CL	2.0	*Pedrana et al. (2011)*

ECO19	**Urban wetlands & aquatic biodiversity (Part II)** The importance of biodiversity conservation of waterfowl. Provision of ecosystem services to nearby settlements. Case study: A monitoring and management project by a local NGO.	FL	2.0	
ECO20	**Sub-antarctic Magellanic forests (Part I)** Relevance of water resources and watershed dynamics. Implications for the Magellanic forest and it's biodiversity	FL	1.0	
ECO21	**Sub-antarctic Magellanic forests (Part II)** Evidence of constant winds shaping forest communities. Coastal biodiversity of the Strait of Magellan.	FL	1.0	
ECO22	**Fire ecology** The role of fire in shaping ecosystems and communities. Historical and ecological timescales of wildfires. Effects of wildfires in Patagonia. Implications for conservation and restoration of landscapes.	CL	2.0	
ECO23	**Rural wetlands and biological invasions in native ecosystems (Part II)** Case study: Challenges for conservation and management plans for eradication of flora and fauna invasive species. Examples of current projects in Patagonia.	FEX	3.0	*Huertas-Herrera et al. (2020)*
ECO24	**Effects of Climate Change (Part I)** Alteration in ecosystems functioning and species distribution: impacts of global temperature changes on biodiversity loss.	CL	3.0	*Habibullah et al. (2022)*
ECO25	**Effects of Climate Change (Part II)** Climate and ecological grief. Emotional awareness and mental health impacts. Coping mechanisms and strategies.	CL, CA	2.0	*Pihkala (2022)* *Cunsolo & Ellis (2018)*
ECO26	**Effects of Climate Change (Part III)** Drivers of change in ecosystems of Chilean Patagonian: current and projected trends.	CL, CA	2.5	*Nahuelhual and Carmona (2023)*
ECO27	**Second Integrated Discussion**	ID	4.0	
ECO28	**Final Semester Review/Queries**		1.0	
		Total	60	

Reading List

1. Amigo, J. & Rodríguez-Guitián, M. A. Bioclimatic and phytosociological diagnosis of the species of the Nothofagus genus (Nothofagaceae) in South America. 2011.

2. Antonelli, A. Drivers of bioregionalization. Nature Ecology and Evolution 1, 1–2 (2017).

3. Birrell, J. H. et al. Insects in high-elevation streams: Life in extreme environments imperiled by climate change. Glob. Change Biol. 26, 6667–6684 (2020).

4. Cifuentes, A. N., Viveros, R. B. & Poblete, C. M. Forest fire monitoring system, with visible spectrum cameras, in Torres del Paine National Park; Chilean Patagonia. 2017 CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies, CHILECON 2017 - Proceedings 2017-Janua, 1–7 (2017).

5. Cussac, V. E., Fernández, D. A., Gómez, S. E. & López, H. L. Fishes of southern South America: A story driven by temperature. Fish Physiology and Biochemistry 35, 29–42 (2009).

6. Elser, J. J. et al. Key rules of life and the fading cryosphere: Impacts in alpine lakes and streams. Glob. Change Biol. 26, 6644–6656 (2020).

7. Garay, G. & Johnson, W. E. Relative abundance of aquatic birds and their use of wetlands in the Patagonia of southern Chile. Revista Chilena de Historia Natural 64, 127–137 (1991).

8. Garibotti, I., Pissolito, C. & Villalba, R. Spatiotemporal pattern of primary succession in relation to meso-topographic gradients on recently deglaciated terrains in the patagonian andes. Arctic, Antarctic, and Alpine Research 43, 555–567 (2011).

9. González, B. A., Samaniego, H., Marín, J. C. & Estades, C. F. Unveiling current guanaco distribution in Chile based upon niche structure of phylogeographic lineages: Andean puna to subpolar forests. PLoS ONE 8, 12–14 (2013).

10. Hampe, A. & Petit, R. J. Conserving biodiversity under climate change: The rear edge matters. Ecology Letters 8, 461–467 (2005).

11. Huber, U. M. & Markgraf, V. European impact on fire regimes and vegetation dynamics at the steppe-forest ecotone of southern Patagonia. The Holocene 13, 567–579 (2003).

12. Huertas Herrera, A., Lencinas, M. V., Toro Manríquez, M., Miller, J. A. & Martínez Pastur, G. Mapping the status of the North American beaver invasion in the Tierra del Fuego archipelago. PLoS ONE 15, e0232057 (2020).

13. Lacy, S. N. Freshwater Ecosystems: A Foundation for Life on Land. in Life on Land (eds. Leal Filho, W., Azul, A. M., Brandli, L., Özuyar, P. G. & Wall, T.) 1–10 (Springer International Publishing, 2020). doi:10.1007/978-3-319-71065-5_75-1.

14. Lacy, S. N., Ugalde, F. & Mao, L. Invasive Rainbow Trout (Oncorhynchus mykiss) Are Not Affected

by Different Land Uses in a Multi-Use, Mediterranean Climate Landscape. Fishes 3, 37 (2018).

15. Martin, F. M. & Borrero, L. A. Climate change, availability of territory, and Late Pleistocene human exploration of Ultima Esperanza, South Chile. Quaternary International 428, 86–95 (2017).

16. Mataix-Solera, J. et al. Soil Vulnerability Indicators to Degradation by Wildfires in Torres del Paine National Park (Patagonia, Chile). Span. J. Soil Sci. 11, 10008 (2021).

17. Pihkala, P. Toward a Taxonomy of Climate Emotions. Front. Clim. 3, 738154 (2022).

18. Promis, A., Cruz, G., Reif, A. & Gärtner, S. Nothofagus betuloides (Mirb.) Oerst. 1871 (Fagales: Nothofagaceae) Forests in Southern Patagonia and Tierra Del Fuego. Anales Instituto Patagonia (Chile) 36, 53–67 (2008).

19. Rozzi, R. et al. Árboles nativos y exóticos en las plazas de magallanes. 27–42 (2003).

20. Zamorano, D. et al. Assessing the effect of fish size on species distribution model performance in southern Chilean rivers. PeerJ 7, e7771 (2019).

21. Zemlak, T. S. et al. Across the southern Andes on fin: Glacial refugia, drainage reversals and a secondary contact zone revealed by the phylogeographical signal of Galaxias platei in Patagonia. Molecular Ecology 17, 5049–5061 (2008).