THE SCHOOL FOR FIELD STUDIES

Principles of Resource Management
SFS 3740

Syllabus

The School for Field Studies (SFS)
Center for Ecological Resilience Studies
Atenas, Costa Rica

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 may present. In other words, the elephants are not always where we want them to be, so be flexible!

Course Overview

The tropics are globally known for their abundant natural resources. For instance, more than half of the world's biodiversity is found in tropical forests, which are considered biodiversity hotspots among terrestrial ecosystems (Mittermeier et al., 2011; Pillay et al., 2022). However, in this biogeographic region increased land use intensification (e.g. industrial agriculture, urban expansion) has resulted in environmental degradation, forest fragmentation and habitat loss, threatening the long-term functioning of ecosystems and the services they provide (Tabarelli, 2004; Alroy, 2017, de Oliveira et al., 2018). It is critical to implement management strategies that allow for the proper use of natural resources, while also ensuring the equity among the actors involved and maintaining ecosystem functionality.

Traditionally, environmental management has assumed that natural resources are static systems, so human intervention must be regulated to maintain their stability. Given the global scale of environmental problems (e.g. climate change) this approach may be unrealistic. As an alternative natural resource managers have proposed new theories based on the concept of resilience (Benson & Garmestani, 2011). Resilience can be defined as the system's ability to absorb internal and/or external change and recover while maintaining long-term functionality (Holling 1973; Benson & Garmestani, 2011). Thus, management of natural resources can focus on identifying key aspects of ecosystems that contribute to their resilience, while also acknowledging the possibility for change and providing a framework for developing adaptive capacity in social and ecological systems (Gunderson et al., 2010). While this approach provides new ways of thinking about social and ecological systems, it also implies modifications to the legal framework and management strategies that are already implemented, which can be challenging, especially in tropical countries such as Costa Rica.

Costa Rica, while having only 0.03 % of the world's land area (51 100 km^2), is home to about 5% of the world's biodiversity (Avalos, 2019). The country is well-known for its conservation efforts, with over a quarter of its land area under some form of protection. Historically, protected areas have been managed under the paradigm of biodiversity protection, with strict controls over the socioeconomic activities that can take place within them. Consequently, these activities have concentrated outside protected areas, where urban expansion and economic incentives for cattle production and agriculture has resulted in drastic deforestation processes (Stan and Sánchez-Azofeifa, 2019). Currently, unplanned urban development, expansion monoculture plantations (e.g. pineapple, bananas, oil palm), and poor management of tourism, exert great pressure on natural resources, increasing forest fragmentation and habitat loss, degrading soils and polluting the environment.

Furthermore, deteriorated infrastructure in combination with weak regulations and enforcement is creating severe pollution and water scarcity in many parts of the country. In Costa Rica 93.4% of the population (about 4.7 million people) has access to potable water, although population growth, lack of financing and vulnerability of water sources, jeopardize this valuable resource (Mora & Portuguez, 2020). This is especially concerning in rural areas where environmental regulations are poorly enforced, and access to drinking water by local communities is more challenging. Due to this, community-based water management has been promoted as a solution for expanding water access in rural communities (Dobbin & Sarathy, 2015). Community water associations provide water service to about 25% of Costa Rican population and manage forest fragments that protect water sources, while conserving multiple species.

The relationship between water source protection and conservation of biodiversity has not been explored in Costa Rica, although forest fragments associated with water protection may serve as refuge for a diverse array of organisms, connecting forested areas and contributing to gene flow (Bogoni et al., 2020).

Understanding these processes is critical for identifying key aspects of ecosystems that contribute to their resilience, ensuring their long-term functioning, which are specially threatened outside protected areas, where the landscape is dominated by forest patches embedded in agricultural and urban matrices (Morera et al., 2018; Stan and Sánchez-Azofeifa, 2019). It is essential to expand natural resource management to areas that are not legally protected and where wildlife-human interactions are more likely to occur. Proper management of these resources can help preserve species in a changing landscape while also strengthening the adaptive capacity in social and ecological systems.

This inter-disciplinary course focuses on principles and applications of natural resources management, exploring alternative ways to ensure equity among the stakeholders involved in the use of these resources, while sustaining social and ecological resilience. The course will introduce the challenges faced by managers of natural resources at the global level, with emphasis on Costa Rica, within the context of a fragmented landscape, agriculture, and urban expansion. Based on specific case studies, illustrated during classes and field trips, the course will show concepts and tools used for addressing complex environmental issues such as mammal conservation, solid waste management and water management problems.

Learning Objectives

1. An introduction to basic principles of natural resources management in the tropics using a resilience-based approach.
2. An awareness of the priorities of sustainable use of natural resources in Costa Rica.
3. An understanding of the importance of balancing biodiversity conservation and natural resource use for social and ecological resilience.

Assessment

Assessment Item	Value (%)
Field Lab 1	15
Field Lab 2	25
Discussion session	20
Field Exercise	30
Participation	20
TOTAL	**100**

Field Lab 1: Mapping Exercise (15%)

Sustainable farming often requires a diversification of activities, such as intercropping, forested areas or education. Mapping represents an essential tool for managing multifunctional farming operations, as it facilitates land-use and conservation planning, crop production, as well as recreational and educational activities. In this exercise students will use aerial images and QGIS software to generate a map and provide a comprehensive description of the land use.

Field Lab 2: Perceptions of water management in a local community in Atenas (25%)

In the county of Atenas, 40% of the population (about 12 000 people) receive water from ASADAs (Administrative Committees of Rural Water Systems). In this field lab students will conduct surveys in two local communities of Atenas to understand people's perception on local water resources and its management.

Discussion Session (20%)
Throughout the semester a group of students will lead a discussion session about a topic related to the course contents. Students will present a paper and prepare at least three questions that will be discussed as a group. Students will prepare a short report highlighting key points of the discussion. Detailed instructions will be given in advance.

Field Exercise: Medium-large mammal richness in two areas associated with water protection (30%)
Agriculture and urban expansion are one of the main drivers of deforestation and forest fragmentation in Costa Rica. Outside protected areas, some forest fragments persist since they are crucial for water protection. Understanding mammal habitat use is a key element to define spatial conservation priorities. In this field exercise students will use camera traps to survey medium and large mammals, and GIS software to represent two areas used as water source. In groups, students will write a report in the form of a scientific paper (2500-3000 words).

Participation (10%)
Everybody should be prepared for each academic session. This implies reading assigned materials with enough detail to be able to ask relevant questions; and to participate in analytical discussions about key issues. Participation will be evaluated during classes and discussions, considering quality and quantity of your contributions.

Grading Scheme

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."*

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 two days past the deadline,

assignments will no longer be accepted. 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.

Course Content

Type: L: Lecture, **FL:** Field Lecture, **GL:** Guest Lecture, **FEX:** Field Experiment, **D**: Discussion, **O**: Orientation, **FLAB:** Field Lab, **LAB**: Lab/workshop.

No	*Title and outline*	*Type*	*Time (hrs)*	*Required Readings*
1	**Introduction to the Natural Resources Management course** – Course overview – Syllabus – Concept of resilience in natural resource management	L	1.0	
2	**History of conservation in CR** – Socio-economic drivers of deforestation in CR – History of Conservation in CR	L	1.0	
3	**Introduction to landscape ecology** – Landscape elements (patch, matrix) – Edge effect – Habitat fragmentation	L	1.0	Perfecto & Vandermeer, (2008)
4	**Protected areas as a conservation strategy** (Discussion session Group 1) – Concept and design of protected areas – Social ecological approach in protected areas – Protected areas in practice – Resilience-based natural resources management	D	1.0	Palomo et al., (2014) Benson & Garmestani, (2011)
5	**Protected areas in Costa Rica** – National System of Protected areas (SINAC) – Management of protected areas in Costa Rica – Concept of biological / ecological corridors for conservation	L	1.0	

No	Title and outline	Type	Time (hrs)	Required Readings
6	**Orientation hike Monteverde** – Premontane forest: Natural history and ecological basis for conservation and management	O	1.5	
7	**Guest Lecture and Farm tour at Life Monteverde** – Sustainable agricultural practices, conservation and agro-ecotourism in the Monteverde area	FL; GL	2.0	
8	**Agroecology** (Discussion session Group 2) – Sustainable agriculture in the tropics – Coffee agroforestry systems (e.g. windbreaks, shade trees) as a conservation strategy.	D	1.0	Tscharntke et al., (2011) Hernández et al., (2013) Brownson et al., (2020)
9	**Mammals of Costa Rica (part 1)** – Introduction to the mammals of Costa Rica – Medium-large mammals as indicator species for conservation – Natural history of common medium-large mammals of Costa Rica	L	2.0	**Field guides:** Wainwright, (2007) Reid, (2009)
10	**FLAB 1. Instructions** – Introduction to GIS Operation of GPS receivers How to generate field data: mapping points of interest, trails, etc.	L; LAB	1.0	Video: Why all world maps are wrong (6 min)
11	**Briefing Braulio Carrillo – Manú Center – El Progreso**	L	0.5	
12	**Orientation hike at Braulio Carrillo** – Tropical lowland rainforest: Natural history and ecological basis for conservation and management	O	1.0	
13	**Mammals of Costa Rica (part 2)** – Introduction to the mammals of Costa Rica – Natural history of common medium-large mammals of Costa Rica	L	1.0	**Field guides:** Wainwright, (2007) Reid, (2009)
14	**Orientation hike at Manu Center** – Tropical lowland rainforest: Natural history and ecological basis for conservation and management	O	1.5	
15	**El Progreso farm tour** – Agroecosystems in the humid tropics – Sustainable agricultural practices – Organic farming	O; FL	2.5	

No	Title and outline	Type	Time (hrs)	Required Readings
16	**Agricultural intensification in tropical regions** (Discussion session Group 3) – Social and ecological implications of monocrops for biodiversity in tropical rainforests in the Caribbean slope of Costa Rica	D	1.0	Shaver et al., (2015)
17	**FEX Instructions** – Camera trap survey design – Camera trapping for animal monitoring and management of protected areas	FEx	1.0	
18	**Descriptive data analysis workshop** – Organize data using Excel Measures of location and dispersion Graphic representation of data	LAB	2.5	
19	**Camera trapping for mammal conservation** – Landscape ecology and conservation of large and medium-sized terrestrial mammals in the Golfo Dulce forest reserve (Osa Peninsula, Costa Rica)	GL	1.0	Salom-Pérez et al., (2021) Cove et al., (2013)
20	**FLAB 1. Mapping exercise** – Create a suitable map from field data – Introduction to free, open source GIS software	LAB	3.0	
21	**FEX Data collection** – Setting camera traps	FEx	1.5	
22	**Descriptive data analysis workshop (R)** – Introduction to R and R studio – Importing data to R – Basic functions and packages	LAB	2.0	
23	**Water and waste management in Costa Rica** – Two of the greatest challenges for NRM in CR: Waste and water management – Ecological and socioeconomic impacts – Case of Tárcoles River	D	1.0	Bower, (2014)
24	**Local water management in Costa Rica** – ASADAS (Associations for Water Supply and Sewage Systems) – Community initiatives to manage local protected areas – Proyecto ASADAs resilientes	L	1.0	Dobbin & Sarathy, (2015)
25	**Briefing ASADA**	O	0.5	
26	**Visit to an ASADA** – Study case of an ASADA (Administrative Associations for Water Supply and Sewage Systems)	FL	2.0	

No	Title and outline	Type	Time (hrs)	Required Readings
27	**FLAB 2 Data collection** – Surveys on perception on water management by a local community in Atenas	FLAB	2.0	
28	**FLAB 2 Data analysis and writing**	FLAB	3.0	
29	**Water co-management in Costa Rica** (Discussion session Group 4) – Role of ASADAs in rural water access in Costa Rica – Challenges and limits to water co-management in Costa Rica	D	1.0	Dobbin & Sarathy, (2015)
30	**Briefing El Toledo**	O	0.5	
31	**Sustainable coffee production** – Sustainable agricultural practices on small farms – Organic farming	FL	2.5	Häger et al., (2021)
32	**Organic farming** (Discussion session Group 5) – Role of organic production in biodiversity conservation – Challenges and opportunities of organic production in Costa Rica	D	1.0	
33	**FEX Data processing**	LAB	3.0	
34	**FEX Data analysis and writing**	LAB	3.0	
35	**Intro to water management in Panama** – Biogeographic, political and socioeconomic context of water management in Panama	L	1.0	Larsen, (2019)
36	**Local initiatives for bird conservation and agritourism in a biological corridor** – Role of "Fundación Bosque Nuboso de Occidente" in biodiversity conservation and socioeconomic development in the Montes del Aguacate Biological Corridor. – Agritourism in La Paz, San Ramón	FL; GL	2.0	
37	**Biological corridors as a conservation strategy** (Discussion session Group 6) – Mesoamerican biological corridor – Effectiveness of biological corridors for conservation	D	1.0	(Holland, 2012)
38	**Integrated discussion**	D	1.0	
	Total hours		**56.5**	

Reading List

1. Alroy, J. (2017). Effects of habitat disturbance on tropical forest biodiversity. *Proceedings of the National Academy of Sciences*, *114*(23), 6056–6061. https://doi.org/10.1073/pnas.1611855114
2. Avalos, G. (2019). Still Searching the Rich Coast: Biodiversity of Costa Rica, Numbers, Processes, Patterns, and Challenges. In T. Pullaiah (Ed.), *Global biodiversity. Volume 4: Selected countries in the Americas and Australia* (pp. 101–138). Apple Academic Press.
3. Benson, M. H., & Garmestani, A. S. (2011). Can We Manage for Resilience? The Integration of Resilience Thinking into Natural Resource Management in the United States. *Environmental Management*, *48*(3), 392–399. https://doi.org/10.1007/s00267-011-9693-5
4. Bogoni, J. A., Peres, C. A., & Ferraz, K. M. P. M. B. (2020). Extent, intensity and drivers of mammal defaunation: A continental-scale analysis across the Neotropics. *Scientific Reports*, *10*(1), 14750. https://doi.org/10.1038/s41598-020-72010-w
5. Bower, K. M. (2014). Water supply and sanitation of Costa Rica. *Environmental Earth Sciences*, *71*(1), 107–123. https://doi.org/10.1007/s12665-013-2416-x
6. Brownson, K., Cox, C., & Padgett-Vasquez, S. (2021). The impacts of agricultural windbreaks on avian communities and ecosystem services provisioning in the Bellbird Biological Corridor, Costa Rica. *Agroecology and Sustainable Food Systems*, *45*(4), 592–629. https://doi.org/10.1080/21683565.2020.1838029
7. Cosgrove, W. J., & Loucks, D. P. (2015). Water management: Current and future challenges and research directions: Water management research challenges. *Water Resources Research*, *51*(6), 4823–4839. https://doi.org/10.1002/2014WR016869
8. Cove, M. V., Spínola, R. M., Jackson, V. L., Saenz, J. C., & Chassot, O. (2013). Integrating Occupancy Modeling and Camera-Trap Data to Estimate Medium and Large Mammal Detection and Richness in a Central American Biological Corridor. *Tropical Conservation Science*, *6*(6), 781–795. https://doi.org/10.1177/194008291300600606
9. de Oliveira Roque, F., Menezes, J. F. S., Northfield, T., Ochoa-Quintero, J. M., Campbell, M. J., & Laurance, W. F. (2018). Warning signals of biodiversity collapse across gradients of tropical forest loss. *Scientific Reports*, *8*(1), 1622. https://doi.org/10.1038/s41598-018-19985-9
10. Dobbin, K. B., & Sarathy, B. (2015). Solving Rural Water Exclusion: Challenges and Limits to Co-Management in Costa Rica. *Society & Natural Resources*, *28*(4), 388–404. https://doi.org/10.1080/08941920.2014.948245
11. Gunderson, L. H., Allen, C. R., & Holling, C. S. (Eds.). (2010). *Foundations of ecological resilience*. Island Press.
12. Häger, A., Little, M., Amel, E., & Calderón, G. (2021). Transformation Toward Sustainability on a Costa Rican Coffee Farm. *Case Studies in the Environment*, *5*(1), 1227777. https://doi.org/10.1525/cse.2021.1227777
13. Hernandez, S. M., Mattsson, B. J., Peters, V. E., Cooper, R. J., & Carroll, C. R. (2013). Coffee Agroforests Remain Beneficial for Neotropical Bird Community Conservation across Seasons. *PLoS ONE*, *8*(9), e65101. https://doi.org/10.1371/journal.pone.0065101
14. Holland, M. B. (2012). Mesoamerican Biological Corridor. In J. A. Hilty, C. C. Chester, & M. S. Cross (Eds.), *Climate and Conservation* (pp. 56–66). Island Press/Center for Resource Economics. https://doi.org/10.5822/978-1-61091-203-7_5

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19. Morera, C., Sandoval, L. F., & Alfaro, L. D. (2021). Ecological corridors in Costa Rica: An evaluation applying landscape structure, fragmentation-connectivity process, and climate adaptation. *Conservation Science and Practice*, *3*(8). https://doi.org/10.1111/csp2.475

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