



S F S THE SCHOOL
FOR FIELD STUDIES

Freshwater Ecosystems in Cambodia

SFS 3211

Syllabus

4 credits

The School for Field Studies (SFS)
Center for Environmental Justice and Mekong Ecologies
Siem Reap, Cambodia

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, this is a field program, and the field can change.

Course Overview

Freshwater ecology is the study of the structure, function, and dynamics of inland aquatic ecosystems (rivers, lakes, streams, wetlands, groundwater systems, etc.). Freshwater environments are essential to global biodiversity, biogeochemical cycling, and human survival. Understanding how physical, chemical, and biological processes interact within freshwater systems is central to addressing today's most pressing environmental challenges, from water scarcity and pollution to climate-driven shifts in hydrology and habitat distribution. The field of freshwater ecology emphasizes the interconnectedness of aquatic and terrestrial systems, and the unique relationships humans have with these ecosystems.

Freshwater ecosystems around the world are being destabilized either directly or indirectly by human activity. In Cambodia, the Tonle Sap Lake and Lower Mekong River and its tributaries are no exception, notably through intensive agriculture, infrastructure projects and resource exploitation. Given that millions depend on this system for food security and survival, it is imperative to gain a comprehensive understanding of the ecological and social-political dynamics that sustain these freshwater ecosystems, allowing for effective intervention.

This course provides an integrated, hands-on exploration of the Mekong River, the Tonle Sap Lake, and their tributaries in Cambodia, one of the world's most productive and unique flood-pulse ecosystems. We'll delve into the physical, chemical, and biological forces that drive the ecosystem's extraordinary productivity and biodiversity, focusing on the dynamic link between the river and the lake. Through extensive fieldwork, students will develop practical skills in aquatic sampling and analysis, including water quality testing, macroinvertebrate surveys, and fish population assessment. They will also gain experience with ecological monitoring techniques and participatory approaches to community-based resource research. Students will gain a deep understanding of tropical river-floodplain ecology, fisheries science, and the human-environment interactions that define the Lower Mekong Basin.

By using the Tonle Sap Lake and Mekong River as a primary study region, the course will integrate perspectives from ecology, hydrology, resource management, climate change and policy/governance as approaches that will allow us to thoroughly analyze and address the multi-faceted environmental challenges within this critical tropical freshwater system.

Learning Objectives

1. Identify and assess the physical, chemical, and biological forces (e.g., sediment loads, nutrient fluxes, primary production) that drive the extraordinary biodiversity and productivity of this tropical freshwater ecology.
2. Identify the critical life cycles, migrations, and dependencies of major aquatic organisms (particularly fish) and associated biodiversity, emphasizing the role of the flooded forest and floodplain habitats.
3. Utilize hands-on techniques for sampling and analyzing key ecological parameters in tropical rivers, lake and pond environments, including basic methods for assessing water quality and aquatic organism populations.
4. Synthesize and integrate data and concepts from ecology, hydrology, resource management, and conservation policy to holistically define and characterize complex environmental problems in the Fresh water ecosystem in Cambodia.

Assessment

The evaluation breakdown for the course is as follows:

Assessment Item	Value (%)
Participation	10
Debate	10
Field Exercise 1	20
Field Exercise 2	20
Stakeholder scenario	10
Final Exam	30
TOTAL	100

Participation (10%)

Everybody should be prepared for each academic and fieldwork session. This implies reading the materials for each session with enough detail to be able to ask relevant questions; and to participate in analytical discussions about the key issues. Active participation during classes, discussions, assignments, and fieldwork is expected.

Dam development debate (10%):

You will participate in a debate about the positive and negative aspects of dam development in and around Cambodia. Working in two groups, you will review literature, articles, and news clips to prepare your arguments to support your position. More details will be provided in class.

Field Exercise 1 (20%)

This FEX will build observational skills and allow us to test a hypothesis regarding fish niche occupancy based on morphological characteristics at Prek Toal. You will be asked to take morphological measurements of a variety of fish species from the Tonle Sap Lake during the field trip. Then you will perform a statistical analysis using morphological data collected to classify fish species based on their morphological characteristics.

Field Exercise 2 (20%)

During this FEX you will work in pairs to survey aquatic macroinvertebrates and identify them under a microscope. You will also collect water parameter data such as dissolved oxygen, turbidity, depth, conductivity, pH, and temperature. Then, you will assess water quality based on the presence of macroinvertebrates as bioindicators.

Stakeholder Scenario Activity (10%)

This assessment requires no prior preparation. Students will be given a fictitious land/water use scenario and assigned the role of a stakeholder. Students will then come up with a position on the land/water use scenario from the perspective of their assigned stakeholder and debate with other stakeholders.

Final Exam (30%)

You will have one final exam at the end of semester, this will be a combined exam with other courses and open book. You will be examined on what you have been exposed to in class (lectures, discussions, and readings) and during field trips throughout the semester.

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 via email 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.

AI Usage for Assignments – SFS acknowledges the growing role of artificial intelligence (AI) tools in education and professional settings. While AI can be a valuable resource for learning and productivity, its use must align with the learning goals and integrity of each assignment. For this reason, students are encouraged to discuss the acceptable uses of AI for each assignment with the instructor. If you wish to use AI for any part of an assignment, consult with the instructor beforehand to ensure that its use adheres to the academic expectations of the course. Let's work together to navigate this evolving landscape responsibly!

Course Content

Type: D: Discussion; FC: Field Component, FEX: Field Exercise, L: Lecture, O: Orientation

*Readings in **Bold** are required.

No	Title and outline	Type	Time (hrs)	Required Readings
1	Course Introduction	O	1.0	
2	Freshwater ecosystems - Global importance of freshwater ecosystems - Freshwater ecosystems in Cambodia - Flood-pulse concept	L	2.0	Lamberts & Ollevier (2013)
3	Ecosystem services of wetlands - Watershed functions - Watersheds in Cambodia	L; FC	3.0	
4	Wetland chemistry - Nutrient cycling - Carbon sequestration - Denitrification	L	1.5	Sok et al (2022a) Khanal et al (2021)
5	Water quality testing - Water quality indices - Natural fluctuations in quality - Impacts of agricultural runoff & other human caused disturbance - Sediment loads	L; FC	4.0	Soum et al (2021)
6	Aquatic organisms - Bioindicator species - Threatened species - Primary production - Invasive species	L; D	1.5	
	Water Quality FEX - Macroinvertebrate survey - Collecting and analyzing water samples - Assessing species richness and abundance - Data collection and analysis		5.0	
7	Fish ecology and physiology and migration - Niche occupancy & resource partitioning - Morphology	L; FC	1.5	Chevalier et al (2023) Sor et al (2023)
	Fish Niche and Morphology FEX - Practice fish morphology identification and observation - Measure morphological traits of species - Analyze data on niche occupancy		5.0	

No	Title and outline	Type	Time (hrs)	Required Readings
8	Fish ecology continued - Organic pollutants in fish - Microplastics	L; D	2.0	
9	Hydrological shifts - Natural - Anthropogenic - Dams and dam debate - Impacts of hydropower on productivity	L; FC	5.0	Krittasudthach eewa & Apirumanekul, (2008)
10	Climate change impacts - Ecosystem respiration - Loss of respiratory carbon	L; D	3.0	Morovati et al (2023) Sok et al (2022b)
11	Climate change impacts continued - Greenhouse gas fluxes - Water quality	L	1.5	
12	Resource limitations to fisherfolk - Tragedy of the commons - Fishing –down-the-food-web	L; FC; D	4.0	Thapa et al (2021)
13	Freshwater conservation and restoration - International NGO approaches - Community based NGO approaches - Government approaches	L; FC	4.0	Loury et al (2021)
14	Stakeholder scenario exercise	D	2.0	
15	Aquaculture and Aquaponics - Alternative livelihoods - Sustainable practices	L; FC	3.0	Chhainnon & Mardy (2024)
	Course summary and exam review	D	1.0	
	Total		50	
	UMN Instructional Hours*		60	

*[UMN defines](#) an instructional hour as a 50-minute block. SFS syllabi are written in full 60-minute hours for programming purposes. Therefore 50 full hours = 60 UMN instructional hours (for four credit courses) and 25 full hours = 30 UMN instructional hours (for two credit courses).

Reading List

1. Chhainon, Y., & Mardy, S. (2024). The potential of aquaponics systems for enhancing food security and resource efficiency: a systematic review. *Indonesian Journal of Social Economics and Agricultural Policy*, 1(1), 1-9.
2. Chevalier, M., Ngor, P. B., Pin, K., Touch, B., Lek, S., Grenouillet, G., & Hogan, Z. (2023). Long-term data show alarming decline of majority of fish species in a Lower Mekong basin fishery. *Science of the Total Environment*, 891, 164624.
3. Lamberts, D., & Ollevier, F. (2013). The role and significance of the flood pulse in the functioning and management of the Tonle Sap ecosystem, Cambodia.
4. Loury, E. K., Eschenroeder, J. C., Seat, L., Chea, S., Chhut, C., Kritsanavarin, S., ... & Hogan, Z. S. (2021). Communicating for aquatic conservation in Cambodia and beyond: lessons learned from in-person and media-based environmental education and outreach strategies. *Water*, 13(13), 1853.
5. Morovati, K., Tian, F., Kumm, M., Shi, L., Tudaji, M., Nakhaei, P., & Olivares, M. A. (2023). Contributions from climate variation and human activities to flow regime change of Tonle Sap Lake from 2001 to 2020. *Journal of Hydrology*, 616, 128800.
6. Khanal, R., Uk, S., Kodikara, D., Siev, S., & Yoshimura, C. (2021). Impact of water level fluctuation on sediment and phosphorous dynamics in Tonle Sap Lake, Cambodia. *Water, Air, & Soil Pollution*, 232(4), 139.
7. Krittasudthacheewa, C., & Apirumanekul, C. (2008). Change of hydrology and fishery impacts in the Tonle Sap. *Change of Hydrology and Fishery Impacts in the Tonle Sap*, 10.
8. Sok, T., Oeurng, C., Kaing, V., Sauvage, S., Lu, X., & Pérez, J. M. S. (2022a). Nutrient transport and exchange between the Mekong River and Tonle Sap Lake in Cambodia. *Ecological Engineering*, 176, 106527.
9. Sok, T., Ich, I., Tes, D., Chan, R., Try, S., Song, L., ... & Oeurng, C. (2022b). Change in hydrological regimes and extremes from the impact of climate change in the largest tributary of the Tonle Sap Lake Basin. *Water*, 14(9), 1426.
10. Sor, R., Ngor, P. B., Lek, S., Chann, K., Khoeun, R., Chandra, S., ... & Null, S. E. (2023). Fish biodiversity declines with dam development in the Lower Mekong Basin. *Scientific Reports*, 13(1), 8571.
11. Soum, S., Ngor, P. B., Dilts, T. E., Lohani, S., Kelson, S., Null, S. E., ... & Chandra, S. (2021). Spatial and long-term temporal changes in water quality dynamics of the Tonle Sap ecosystem. *Water*, 13(15), 2059.
12. Thapa, J., English, M., Ou, C., Lanoue, J., & Walker, R. H. (2024). Assessment of the floodplain fishery of Tonle Sap Lake in Cambodia. *Fisheries Management and Ecology*, 31(3), e12683.