THE SCHOOL FOR FIELD STUDIES

Watersheds of the Wet Tropics

SFS 3161

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

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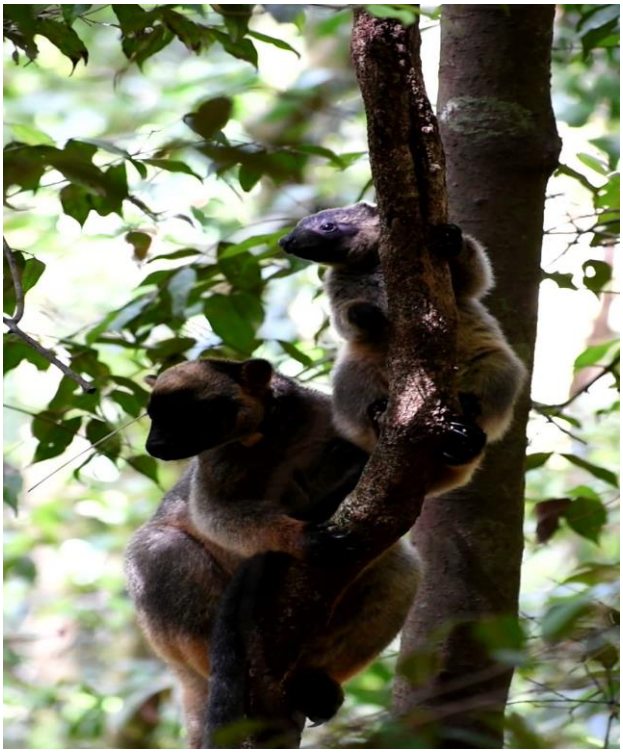
S.1.9

Course Overview

Watersheds of the Wet Tropics:

The Great Barrier Reef and its catchments (watersheds) are an inter-connected system. In this course we will follow a river's journey from the World Heritage listed rainforest ranges to the Great Barrier Reef as we explore the connections between land and sea. Students will learn about the ecological processes and socio-economic factors that shape rainforest, watershed, and reef management in Queensland's tropical north, and the factors needed to maintain healthy ecosystems in the face of climate change, development and increasing urbanization.

Through background lectures, field lectures and excursions led by local SFS faculty with input from local experts, we will examine the Barron River from its source in the highland rainforest and along its 165 kilometer length as it flows across the northern Atherton Tablelands, through Lake Tinaroo (a dam) and dives down the Barron Falls to the coastal plain, meeting the sea and the Great Barrier Reef just north of Cairns. The Barron Catchment is 2, 100 km^2, including all the land drained by the Barron River and its tributaries, and is one of the most modified catchments in the Wet Tropics. It's major land uses include mixed cropping, horticulture, grazing, forestry, sugar cane, water resources, urban and tourism development.



Agricultural chemicals such as fertilizers and pesticides, and run-off from industrial and urban environments can affect various biological functions of marine organisms such as photosynthesis, reproduction and larval development. Such contaminants weaken the resilience of marine ecosystems to other threats such as pests, disease and climate change. We will investigate the downstream effects of watershed activities, particularly on the Great Barrier Reef, and learn about the actions being taken to mitigate these impacts. The course will culminate in a trip on the Great Barrier Reef, including supervised snorkelling, allowing students to appreciate first-hand the influence of watershed and coastal management, including rainforest restoration, on reef ecosystems.

This course centres around four main themes:

1) Introduction to Wet Tropics Bioregion. Two World Heritage Areas sit side-by-side in north-eastern Queensland. The Wet Tropics World Heritage Area (and associated bioregion) represents just 0.26% of Australia's land area, but contains 40% of Australia's bird species, 30% of Australia's mammal species, 60% of Australia's butterfly species, 21% of Australia's reptile species, 21% of Australia's cycad species, 29% of Australia's frog species, 30% of Australia's orchid species, and 65% of Australia's fern species. This world heritage area is ranked as the 6th most irreplaceable of all of Earth's World Heritage Areas. The Great Barrier Reef World Heritage Area stretches along the majority of Queensland's east coast, but the section adjacent to the Wet Tropics World Heritage Area is the most frequently visited by tourists. The Great Barrier Reef contains the world's largest collection of coral reefs and is considered one of the best-managed marine parks in the world. Despite this, coral cover on the Great Barrier Reef has declined substantially since the 1980s and the future of this World Heritage Area continues to be threatened by a number of processes, including poor water quality from nearby watersheds, periodic outbreaks of crown-of-thorns starfish, and climate change.
2) Watersheds, catchment ecology and restoration. Activities occurring in the catchments of the rivers flowing onto the Great Barrier Reef strongly affect the quality of the water that reaches the reef. We will examine how different human activities affect water quality and explore ways in which negative effects of human activities can be ameliorated. We will also explore how restoration of upstream areas can contribute to the conservation of both terrestrial and marine biodiversity.
3) Conservation of coastal areas. We will examine a number of important coastal ecosystems, including river deltas, freshwater wetlands, mangrove forests, mudflats and estuaries. We will explore the connection between upland ecosystems, coastal ecosystems and marine ecosystems.
4) Conservation of the Great Barrier Reef. We will explore aspects of the ecology and management of the Great Barrier Reef. Lectures and field excursions will provide an opportunity to explore how the Great Barrier Reef is affected by upstream processes, as well as activities occurring on the reef itself.

Learning Objectives

During this course, students should develop a working knowledge related to:

1) A basic understanding of the ecology and hydrology of tropical, forested watersheds.

2) The connections between upland ecosystems, coastal ecosystems, freshwater ecosystems and marine ecosystems.

3) Biological, cultural and economic issues in the conservation and management of contested, highly-biodiverse landscapes and seascapes.

4) Processes threatening the long-term conservation of tropical ecosystems.

5) Methods used in the restoration of rainforest and freshwater ecosystems.

Assessment

Lectures, discussions and field excursions will be based at the Center for Rainforest Studies (CRS) and around the Atherton Tablelands, wider Wet Tropics region and inshore locations on the Great Barrier Reef.

Classroom lecture topics will include essential background information and field lectures/exercises are used to reinforce key concepts and provide students with on-ground experiences. Student attention at field lectures/exercises will be enhanced by the requirement for them to complete a Field Journal and students' ability to synthesize the material will be assessed via group presentations.

Assessment Item	Value (%)
Field Journal	30
Literature Review	10
Participation	10
Exam	20
Final Presentations (Group Assessment) ¶	30
TOTAL	**100**

¶*NB.* The group's choice of topic for presentation will be determined following discussion and consultation with faculty.

Field Journal (30%): You will write a field journal to record your observations of each of the locations visited throughout the course. Each journal entry should reflect a thorough understanding of both environmental and human factors and the interplay of these. We expect you to base your entries on your own observations and also encourage you to include pertinent material from guest lectures, reading, interpretive material, quotes, etc. All sources of information other than your own observations must be duly acknowledged.

Literature Review (10%): Each student will lead a 5-10 minute class discussion on an article related to the topic of the day or week.

Exam (20%): You will take a short exam to assess your understanding of the concepts covered in lectures and field lectures.

Final Presentation (30%): You will work in small groups to prepare and present a 15-minute oral presentation on one aspect of the connections between rainforest (terrestrial ecosystems), aquatic ecosystems and the reef (marine ecosystems). You may choose your own topic in consultation with faculty.

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.

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

Electronic copies of the recommended readings will be available prior to class. It may be important that these be read before class since we may use these papers as a starting point for discussion. Faculty will inform you when this is the case.

Plagiarism – Using the ideas and material of others without giving due credit, is cheating and will not be tolerated. A grade of zero will be assigned if anyone is caught cheating or aiding another person to cheat either actively or passively (e.g., allowing someone to copy your work).

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. As such, deadlines are firm and extensions will only be considered under only the most extreme circumstances. If you believe that you have been prevented from completing your work on time for reasons beyond your control (e.g. illness), make sure that you discuss this with the relevant faculty member as soon as possible, and certainly before the assignment is due. Late

assignments will incur a penalty proportional to the length of time that they are late. This means an assignment that is one day late when students were given two days to work on it will have 50% of total points removed from the grade awarded for that assignment, and an assignment that is 2 hours late when two full days (16 hrs) were allocated to work on it will have 12.5% of total points removed from the grade.

Participation - Student must participate in all components of the program. Our program is likely to be more intensive than you might be used to at your home institution, and missing even one lecture or field trip can have a large effect on your final grade simply because there is little room to make up for lost time or opportunities. In addition, your actions can significantly affect the experience you and your classmates have while with SFS and our reputation in the community; therefore, it is important that you are prompt for all activities, bring the necessary equipment for field excursions and simply get involved.

Course Content

Type: D: Discussion, **FL:** Field Lecture, **GL:** Guest Lecture, **L**: Lecture

Lecture #	*Lecture Title*	*Required Readings*	*Type*	*Hours*
	THEME 1: Introduction to the Wet Tropics Bioregion.			
01	Course overview	–	L	1.0
02	Wet Tropics catchments (watersheds) – overview	TBA	L	1.0
	THEME 2: Watersheds, catchment ecology and restoration.			
03	Our local watersheds – The Barron and Johnstone Rivers	Cogle *et al.* (2000), Russell *et al.* (2000)	L/FL	6.0
04	Mountain stream geomorphology and ecology	TBA	FL/GL	1.0
05	Geology and climate in local watersheds	TBA	L/FL	3.0
06	Hydrology and flood flows	TBA	L/GL	1.0
07	Landscape and land use on the Atherton Tablelands	TBA	FL	3.0
08	Tinaroo Dam and Irrigation Scheme	TBA	FL	2.0
09	Catchment (watershed) Management	TBA	L/GL	2.0
10	Nutrients in the environment – from river to reef	Brodie *et al*. (2012), Hunter & Walton (2008), Neil *et al.* (2002)	L	1.0
11	Mitigating downstream impacts – best practices, revegetation, engineering solutions, The Green Corridor	TBA	FL/GL	10.0
12	Barron Falls & Kuranda – tourism and hydro	TBA	FL	1.0
	THEME 3: Conservation of coastal areas.			
13	Coastal geomorphology, soils and climate	TBA	L/FL	3.0
14	The Barron River delta – contested land use	TBA	FL	2.0
15	The Johnstone River catchment – comparisons	TBA	FL/GL	3.0
16	Coastal processes	TBA	FL	2.0
17	Coastal wetlands – Eubanangee Swamp	TBA	FL	1.0
18	Landscape and land use on the coastal lowland	TBA	L/FL/GL	3.0
19	Mangrove ecosystems – ecology, ecosystem services and threats	Duke (1992), Kathiresan & Bingham (2001)	FL	2.0
	THEME 4: Conservation of the Great Barrier Reef.			

20	The Great Barrier Reef – overview	TBA	L/GL	2.0
21	Threats to the Great Barrier Reef - overview	De'ath *et al*. (2009, 2012), Roff *et al.* (2013)	L/FL/GL	3.0
22	Water quality and coral loss	De'ath & Fabricius (2010), McCulloch *et al.* (2003)	L/GL	1.0
23	Managing the Great Barrier Reef	Knowlton (2012)	L/FL/GL	3.0
24	What have we learnt? Pulling it all together.	–	D	3.0
	TOTAL			**60**

Reading List (Preliminary)

Brodie J.E., Kroon F.J., Schaffelke B., Wolanski E.C., Lewis S.E., Devlin M.J., Bohnet I.C., Bainbridge Z.T., Waterhouse J. & Davis A.M. (2012). Terrestrial pollutant runoff to the Great Barrier Reef: An update of issues, priorities and management responses. *Marine Pollution Bulletin* **65**: 81–100.

Clark T.R., Roff G., Zhao J., Feng Y., Done T.J., McCook L.J. & Pandolfi J.M. (2017). U-Th dating reveals regional-scale decline of branching *Acropora* corals on the Great Barrier Reef over the past century. *PNAS* **114**: 10350–10355.

Cogle A.L., Langford P.A., Kistle S.E., Ryan T.J., McDougall A.J., Russell D.J. & Best E.K. (2000). *Natural resources of the Barron River catchment 2. Water quality, land use and land management interactions.* QI00033. Queensland Department of Primary Industries, Brisbane, Australia.

De'ath G. & Fabricius K. (2010).Water quality as a regional driver of coral biodiversity and macroalgae on the Great Barrier Reef. *Ecological Applications* **20**: 840–850.

De'ath G., Fabricius K.E., Sweatman H. & Puotinen M. (2012). The 27-year decline of coral cover on the Great Barrier Reef and its causes. *PNAS* **109**: 17995–17999.

De'ath G., Lough J.M. & Fabricius K.E. (2009). Declining coral calcification on the Great Barrier Reef. *Science* **323**: 116– 119.

Duke N.C. (1992). Mangrove floristics and biogeography. Chapter 4 *IN* Robertson A.I. & Alongi D.M. (eds) *Coastal and estuarine studies series*. American Geophysical Union, Washington, U.S.A. 63–100.

Hunter H.M. & Walton R.S. (2008). Land-use effects on fluxes of suspended sediment, nitrogen and phosphorus from a river catchment of the Great Barrier Reef, Australia. *Journal of Hydrology* **356**: 131–146.

Kathiresan K. & Bingham B.L. (2001). Biology of mangroves and mangrove ecosystems. *Advances in Marine Biology* **40**: 81–251.

Knowlton N. (2012). Iconic coral reef degraded despite substantial protection. *PNAS* **109**: 17734–17735.

McCulloch M., Fallon S., Wyndham T., Hendy E., Lough J. & Barnes D. (2003). Coral record of increased sediment flux to the inner Great Barrier Reef since European settlement. *Nature* **421**: 727–730.

Neil D.T., Orpin A.R., Ridd P.V. & Yu B. (2002). Sediment yield and impacts from river catchments to the Great Barrier Reef lagoon: a review. *Marine & Freshwater Research* **53**: 733–752.

Roff G., Clark T.R., Reymond C.E., Zhao, J., Feng Y., McCook L.J., Done T.J. & Pandolfi J.M. (2013). Palaeoecological evidence of a historical collapse of corals at Pelorus Island, inshore Great Barrier Reef, following European settlement. *Proceedings of the Royal Society, Series B* **280**: 20122100.

Russell D.J., McDougall A.J., Ryan T.J., Kistle S.E., Aland G., Cogle A.L. & Langford P.A. (2000). *Natural resources of the Barron River catchment 1. Stream habitat, fisheries resources and biological indicators.* QI00032. Queensland Department of Primary Industries, Brisbane, Australia.

Waterhouse J., Brodie J., Lewis S. & Mitchell A. (2012). Quantifying the sources of pollutants in the Great Barrier Reef catchments and the relative risk to reef ecosystems. *Marine Pollution Bulletin* **65**: 394–406.