THE SCHOOL FOR FIELD STUDIES

Principles of Forest Management
SFS 3700

Syllabus

The School for Field Studies (SFS)
Center for Rainforest Studies (CRS)
Yungaburra, Australia

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.

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

Course Overview

In Principles of Forest Management, you will be introduced to tropical rainforests: their current and past distributions, relationships with the abiotic environment, human use, present threats, and restoration practices. This course aims to bring together an understanding of the underlying ecological processes that affect rainforests (and other tropical vegetation) with the role of human society in shaping the present and future rainforests of the Wet Tropics, particularly from a natural resource management perspective. The course will take the Australian Wet Tropics as a case study to investigate this field, yet many of the skills you learn here can be transferred to other systems. Topics covered will include: biophysical determinants of which vegetation type occurs where; past, present, and future threats to Wet Tropics rainforests; and the theory and practice of rainforest restoration.

You will gain both theoretical and practical knowledge, gaining hands-on experience with identifying rainforest plants, measuring vegetation structure and composition, collecting and analyzing data, taking part in restoration plantings and large-scale restoration ecology experiments, and undertaking research into the fundamental ecology of tropical rainforest plants. Recent examples of restoration research are presented to highlight the importance of accurately identifying and managing barriers to restoration. Field components with local Landcare, stream management and tree growing groups reinforce the concepts taught at CRS in field and classroom components. Ultimately, you will develop your understanding of the management tools available to enhance conservation outcomes and ensure the sustainable use and repair of tropical vegetation communities.

Learning Outcomes

During this course, you will develop a working knowledge related to:

1. ***Factors underlying the present distribution and composition of rainforest communities*.** We begin by examining the tropical environment and identifying which resources are available for or limiting to plant growth. We will visit, discuss and structurally assess an array of forest types across the landscape. By doing this we will gain invaluable experience in forest measurement (applicable anywhere in the world) and an understanding of the interactions between factors such as soil type, elevation, rainfall, wind exposure, fire and disturbance in determining rainforest distribution and composition. We will also explore some of the differences among plant species and how different species interaction with the environment and with each other to shape the ecological community of the rainforest.
2. ***Connections between the rainforest and the reef.*** The Great Barrier Reef and its catchments (watersheds) are an inter-connected system. In this semester, we will explore some of the connections between land and sea. We will learn about the ecological processes and human factors that influence rainforest, watershed, and reef management in Queensland's tropical north, and the factors needed to maintain healthy ecosystems in the face of climate change, agricultural activities, development and increasing urbanization.
3. ***Identification of plant species.*** Essential to managing any resource is the accurate documentation and communication of its values. Species identification of rainforest plants is crucial in managing and understanding these forests. Via a series of workshops and experience in using a state-of-the-art electronic key, you will gain an understanding of the key characters involved in distinguishing plant species.
4. ***Field Measurement Skills.*** You will be introduced to some of the fundamental field skills required for measuring vegetation structure and species composition, as well as for monitoring

changes in rainforest plant communities over time. These practical field skills can be used in most forest environments around the world.

5. ***Ecological restoration of rainforest communities.*** Following an introduction to the young field of ecological restoration, the current best practices for restoring rainforest communities are outlined.
6. ***Planning and implementing restoration projects.*** You will gain significant hands-on experience working with the local community in restoring patches of rainforest, for example controlling weeds, collecting rainforest fruits and growing rainforest seedlings.

Themes

This course covers two themes, where two main questions are addressed:

Theme 1: What are the requirements and dynamics of Wet Tropics ecosystems, with a strong emphasis on tropical rainforest? This incorporates knowledge of rainforest ecology and natural history, historical and current relations between rainforests and people, and threats to rainforest systems. This provides the foundations for theme 2.

Theme Two 2: How do we manage tropical forest landscapes to maximise ecological and economic effectiveness? We will address these questions from a resource management perspective, where an understanding of the resource base, degradation and repair are paramount.

Assessment

Lectures, discussions and field excursions will be based at the Centre for Rainforest Studies and around the Atherton Tablelands. Classroom lecture topics will include essential background information and field lectures will be used to reinforce key concepts and provide you with field-based experiences. Extended field trips will enable you to examine forest structural elements across the landscape to allow a comparison of the influences of landscape parameters on forest communities. We will conduct a field exercise to practice the skills necessary for collecting data in the field, analyzing those data, and presenting and interpreting those data. We will also undertake a number of excursions to the Great Barrier Reef, to explore some of the ways that land use practices and global changes affect the reef.

Assessment Item	**Value (%)**
Field Exercise	
Methods Quiz	10
Plant Identification Quiz	15
iNaturalist observations	15
Threats to the Great Barrier Reef	
Annotated Bibliography (Group Assessment)	15
Group Presentations	20
Final Exam	25
TOTAL	**100%**

Field Exercise (40%)
The aim of the field exercise is to give you experience at conducting field research, preserving your data for future use, and analysing your results. This exercise will entail measuring trees within several survey plots. There are two main study objectives to the field exercise:

(1) to introduce you to field techniques used to sample vegetation; and

(2) to provide you with experience in field data collection, data entry and statistical analysis.

Field techniques used will include plant identification and tree measurement techniques for tropical rainforest.

Methods Quiz (10%): You will take a 1-hour quiz to examine your understanding of the material covered during the field exercise, including both field methods and data analysis.

Plant Identification Quiz (15%): You will take a 1-hour quiz to examine your understanding of the use of plant identification keys to identify three plant specimens to genus level.

iNaturalist Observations (15%): Herbarium specimens collected around the world over the past few hundred years have allowed researchers to study many important questions in ecology, e.g. changes in plant morphology and distribution in response to climate change, species' climatic requirements, patterns of weed invasion, patterns of species extinction, and begin to understand the biodiversity of different ecosystems around the world. All of these studies, however, require that herbarium specimens collected by many different people provide enough reliable information to be of use to current and future researchers. You will be introduced to traditional and emerging methods for collecting and identifying voucher plant specimens.

For this assessment, you will be introduced to the **iNaturalist** project, which is an online project for observations of different taxa, and taught how to submit data to this project. For this assessment, you will be required to submit complete observations of **at least 4 plant taxa** from each of the following locations: the Centre for Rainforest Studies (CRS), the Daintree area, the Chillagoe area, Eubenangee Swamp, the Fruit Forest Farm (in the Mission Beach region, south of Innisfail), and Orpheus Island. You are encouraged to submit observations from other locations if you have the opportunity. This is an individual assessment.

Threats to the Great Barrier Reef (Group Assessment; 35%): What happens on land does not necessarily *stay* on land. In this course, we will be exploring some of the many ways that human activities in the watersheds of the Wet Tropics bioregion affect the health of freshwater ecosystems and marine ecosystems in the Great Barrier Reef world heritage area. This will culminate with a field trip to Orpheus Island, where James Cook University maintains a long-term research station (https://www.jcu.edu.au/orpheus-island), which will allow us to visit a coral reef, as well as a number of coastal and intertidal ecosystems (you will also have the opportunity to visit a number of different ecosystems on other field excursions during the semester, and should include your observations from these ecosystems – *if applicable* – in this assessment).

Before, during and after our stay at Orpheus Island, you will work in groups of four or five to:

- Identify a topic relating to the ecological health of at least one marine ecosystem in the Great

Barrier Reef World Heritage Area (a list of suggested topics will be provided but you are free to choose a topic of your own in consultation with CRS faculty);
- Research the topic: this may involve literature searching, interviews, data collection, etc.;
- Identify threatening processes;
- Prepare an annotated bibliography of 8 papers relevant to your research topic; and
- Prepare a short power-point presentation (maximum 15 minutes presentation and 5 minutes for questions) and present your findings to the class.

Time will be provided during the Orpheus Island field trip to work on your presentations. The annotated bibliography will be worth **20%** of your final grade. The group presentation will be worth **20%** of your final grade.

Final Exam (25%): This exam will assess your understanding of the material covered in lectures, field lectures and workshops. The aim is to test your understanding of key concepts and critical thinking skills. You will be assessed individually.

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

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 look at your exam).

Deadlines for written and oral assignments are instated to promote equity and to allow faculty ample time to review and return assignments before others are due. As such, deadlines are firm and extensions will only be considered under extenuating 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 me as soon as possible, and certainly before the assignment is due. Late assignments will incur a penalty proportional to the length of time given to prepare them. This means an assignment that is one day late when you 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.

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 program is mandatory because 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 exercises and simply get involved.

Course Content

TYPE- L: Lecture, **FL:** Field Lecture, **LAB:** Laboratory, **A:** Assessment, **D:** Discussion, **FW:** Field Work, **FEX:** Field Exercise, **GL:** Guest Lecture

No	Overview	Type	Suggested Readings
Theme One: The Australian Wet Tropics; ecology and threatening processes.			
NRM01 (2.0 hr)	**Overview of NRM course & objectives:** You will be introduced to the lecturer, the course and main assessment tasks. You will also be given a brief introduction to the geography and plant ecology of the Australian Wet Tropics. You will also be introduced to the history and general vegetation of the CRS property.	L/FL	Adams P. (1994) *Australian Rainforests.* Oxford University Press, Oxford. (Chapter 1, pp. 1–12). Metcalfe D.J. & Ford A.J. (2009) A re-evaluation of Queensland's Wet Tropics based on "primitive" plants. *Pacific Conservation Biology* 15: 80–86. Stork N.E., Goosem S. & Turton S.M. (2011) Status and threats in the dynamic landscapes of northern Australia's tropical rainforest biodiversity hotspot: the Wet Tropics. Chapter 17 IN F.E. Zachos & J.C. Habel (eds) *Biodiversity Hotspots. Distribution and protection of conservation priority areas*. Springer, Berline Heidelberg. pp. 311–332. Whitmore T.C. (1991) *An Introduction to Tropical Rainforests.* Oxford University Press, Oxford. (Chapter 2, pp. 9–12).
NRM02 (1.0 hr)	**Tropical Environments.** You will be introduced to the physical environment of Earth's tropical regions (e.g., climate, soil, etc.) and the ways this environment shapes tropical vegetation.	L	Janzen D.H. (1967) Why mountain passes are higher in the tropics. *American Naturalist* **101**: 233–249. Janzen D.H. (1970) Herbivores and the number of tree species in tropical forests. *American Naturalist* **104**: 501–528. Ghalambor C.K., Huey R.B., Martin P.R., Tewksbury J.J. & Wang G. (2006) Are mountain passes higher in the tropics? Janzen's hypothesis revisited. *Integrative and Comparative Biology* **46**: 5–17. Stevens G.C. (1989) The latitudinal gradient in geographical range: how so many species coexist in the tropics. *American Naturalist* **133**: 240–256.
NRM03 (1.0 hr)	**Climate, fire and the limits of rainforest distribution:** We will explore the importance of climate, soil and fire, and the feedbacks between fire and vegetation, in determining the limits of rainforest distribution in Australia and elsewhere in the tropics.	L	Staver A.C., Archibald S. & Levin S.A. (2011a) The global extent and determinants of savannah and forest as alternative biome states. *Science* **334**: 230–232. Staver A.C., Archibald S. & Levin S. (2011b) Tree cover in sub-Saharan Africa: rainfall and fire constrain forest and savannah as alternative stable states. *Ecology* **92**: 1063–1072.
NRM04 (5.0 hr)	**Plant Identification (introduction to electronic key) group rotation:** You will be introduced to plant species identification: • Why identify • Characters used to differentiate species • Characters used to identify plants • Use of a identification keys	LAB	Hyland, B. P. M., T. Whiffin, D.C. Christophel, B. Gray and R.W. Elick. (2003) *Australian Tropical Rain Forest Plants: Trees, Shrubs and Vines.* CSIRO, Collingwood, Vic. Hyland B.P.M., Whiffin T., Zich F.A., Duffy S., Gray B., Elick R., Venter F. & Christophel D. (2010) *Australian Tropical Rainforest Plants. Edition 6: Trees, Shrubs, Vines, Herbs, Grasses, Sedges, Palms, Pandans & Epiphytes*. CSIRO, Collingwood, Vic. URL: http://keys.trin.org.au/key-server/data/0e0f0504-0103-430d-8004-

No	Overview	Type	Suggested Readings
	• Collecting and preparing appropriate specimens for plant identification • Pressing, drying and mounting plant specimens You will be guided in the use of an electronic identification key to Australian tropical rainforest trees, shrubs and vines during a workshop (Hyland *et al*. 2003).		060d07080d04/media/Html/index.html
NRM04 b (1.0 hr)	**Plant Identification Quiz:** You will be tested on your ability to use the plant identification key to identify three plant specimens to genus level (*15% of final grade*).	A	–
NRM05 (1.0 hr)	**Vegetation structure, disturbance, macroclimate and microclimate:** You will be introduced to: • The relationships between macroclimate (e.g., mean annual temperature, mean annual precipitation, etc.) and rainforest structure; • How physical disturbances affect the structure of rainforest vegetation; and • How rainforest vegetation structure shapes the understorey microclimate (e.g., temperature, humidity, moisture availability, wind speed, light availability, etc.).	L, FL	Adam P. (1994) *Australian Rainforests.* Oxford University Press, Oxford. (Chapter 2, pp. 24–30; Chapter 3, pp. 46–51). Brown N. (1993) The implications of climate and gap microclimate for seedling growth conditions in a Bornean lowland rain forest. *Journal of Tropical Ecology* **9**: 153–168. Tracey J.G. (1982) *The Vegetation of the Humid Tropical Region of North Queensland.* CSIRO, Melbourne. Turton S.M. (2008) Landscape-scale impacts of Cyclone Larry on the forests of northeast Australia, including comparisons with previous cyclones impacting the region between 1858 and 2006. *Austral Ecology* **33**: 409–416. Turton S.M. & Siegenthaler D.T. (2004) Immediate impacts of a severe tropical cyclone on the microclimate of a rain-forest canopy in north-east Australia. *Journal of Tropical Ecology* **20**: 583–586.
NRM06 (2.0 hr)	**Aspects of Australian Ethnobotany.** Ethnobotany is the study of the traditional knowledge of a people of the uses of their native plants. Australia's Indigenous peoples have maintained some of the oldest, continuous cultures on Earth (≥ 50,000 years) and their knowledge of Australian plants has only begun to be appreciated by western scientists in recent years. In guest lectures and field lectures, we will learn about *some* of these traditional plant uses.	GL	TBA ***Safety warning:*** *do not attempt to eat any plant parts without first verifying that it is safe to do so. Do not eat parts of any plants that have been recently sprayed with herbicide or pesticide.*

No	Overview	Type	Suggested Readings
NRM07 (1.0 hr)	**Plant Functional Traits 1: Responses to Light.** Shade tolerance is one of the most important characteristics determining how a rainforest plant responds to the environment. The pioneer–climax species continuum is a convenient way to describe how species respond to light availability. You will be introduced to this continuum, the trade-offs that underlie it, and to some of the other important plant functional traits that influence the structure and composition of rainforest plant communities.	L	Agyeman V.K., Swaine M.D. & Thompson J. (1999) Responses of tropical forest tree seedlings to irradiance and the derivation of a light response index. *Journal of Ecology* **87**: 815–827. Agyeman V.K., Swaine M.D., Thompson J., Kyereh B., Duah-Gyamfi A., Foli E.G. & Adu-Bredu S. (2010) A comparison of tree seedling growth in artificial gaps of different sizes in two contrasting forest types. *Ghana Journal of Forestry* **26**: 14–40. Pérez-Harguindeguy N., *et al*. (2013) New handbook for standardized measurement of plant functional traits worldwide. *Australian Journal of Botany* **61**: 167–234. Reich P.B. (2014) The world-wide 'fast–slow' plant economics spectrum: a traits manifesto. *Journal of Ecology* **102**: 275–301.
NRM08 (1.0 hr)	**Plant Functional Traits 2: Responses to Fire:** The occurrence of fire sets the boundary between rainforest (pyrophobic vegetation) and sclerophyll vegetation (pyrophytic vegetation, e.g., open forest, woodland, savannah, grassland, heath, etc.). Within pyrophytic communities, the fire regime (i.e., fire frequency and intensity) determine the structure and composition of the vegetation. We will explore some of the functional traits that shape the responses of different plant species to the fire regime (and which can, in turn, influence the fire regime itself).	L	TBA
NRM09 (1.5 hr)	**Overview of Plant Phylogeny:** We will review the major plant taxonomic groups and explore the evolutionary relationships between them. Particular emphasis will be given to those taxonomic groups represented in the Australian Wet Tropics.	L	TBA
NRM10 (1.5 hr)	**Australian Vegetation History:** You will gain insight into the Gondwanan origins and subsequent influences of past climate change on the distribution and current extent of Australian Rainforests. We will pay particular	L	Adam P. (1994) *Australian Rainforests*. Oxford University Press, Oxford. Chapter 6, pp. 137–171. Crisp M.D. & Cook L.G. (2013) How was the Australian flora assembled over the last 65 million years? A molecular phylogenetic perspective. *Annual Review of Ecology, Evolution and Systematics* **44**: 303–324.

No	Overview	Type	Suggested Readings
	attention to the Quaternary Period, during which the Earth has undergone numerous glacial–interglacial cycles which have had a profound effect on the survival and distribution of rainforest species in Australia (and, in fact, on most species around the world). We will examine how these dramatic climate oscillations have affected the Australian Wet Tropics and the importance of refugial areas within the Wet Tropics for the persistence of tropical rainforest in Australia.		Hilbert D.W., Graham A. & Hopkins M.S. (2007) Glacial and interglacial refugia within a long-term rainforest refugium: The Wet Tropics Bioregion of NE Queensland, Australia. *Palaeogeography, Palaeoclimatology, Palaeoecology* **251**: 104–118.
NRM11 (8.0 hr)	**Botanical Research:** Through fieldwork and a series of workshops we will: (a) practise vegetation survey methods; (b) practise plant identification techniques; (c) learn good data management practices; (d) discuss experimental design; (e) learn simple methods of quantitative data analysis (including some basic statistical analyses); (f) learn methods of presenting results; and (g) practise interpreting experimental results.	FEX	TBA
NRM12 (1.0 hr)	**Methods Quiz:** You will be tested on your understanding of field methods and data analysis methods for vegetation research. This assessment will be done individually (15% final grade).	A	–
NRM13 (15.0 hr)	**Wet Tropics forest types:** You will be taken on guided walks through upland and lowland tropical rainforest, littoral rainforest, tropical savanna, freshwater palm wetlands, freshwater *Melaleuca* wetlands, and mangrove forest at various locations (including the Atherton Tablelands, the Daintree lowlands, Orpheus Island, the Palmerston/Innisfail/Tully lowlands, and	FL	TBA

No	Overview	Type	Suggested Readings
	the Chillagoe region). Forest structure and composition will be contrasted among these different forest types.		
NRM14 (1.0 hr)	**Effects of Selective Logging:** Most of the accessible rainforests in the Australian Wet Tropics have been subjected to "selective" logging in the past 150 years. Much of this logging activity was not strongly regulated and few control (unlogged) areas of rainforest remain in the Australian tropics. We will discuss some of the short-term and long-term effects of selective logging on rainforest structure and ecosystem function.	L	TBA
NRM15 (1.0 hr)	**Dynamics of Tropical Savannas.** Savanna forms an alternative stable state to rainforest in many tropical landscapes. We will explore the relationship between savanna vegetation structure and the fire regime, as well as some of the ways that this relationship may be influenced by different land uses (e.g., grazing) and the changing climate.	L	TBA
NRM16 (3.0 hr)	**Climate Change and Tropical Ecosystems:** Over the past ten years, scientists have become increasingly aware of the threat that global warming poses to tropical species and ecosystems. We will cover some of the following issues: • Responses of tropical species to current levels of global warming • Vulnerability of tropical species to future warming • The potential responses of plant physiology to CO_2, precipitation and temperature • The potential responses of rainforest plant dynamics (and thus rainforest structure) to climate change	L	Clark D.A. (2004) Tropical forests and global warming: slowing it down or speeding it up? *Frontiers in Ecology and Environment* **2**: 73–80. Colwell R.K., Brehm G., Cardelus C.L., Gilman A.C. & Longino J.T. (2008) Global warming, elevational range shifts, and lowland biotic attrition in the wet tropics. *Science* **322**: 258–261. Deutsch C.A., Tewksbury J.J., Huey R.B., Sheldon K.S., Ghalambor C.K., Haak D.C. & Martin P.R. (2008) Impacts of climate warming on terrestrial ectotherms across latitude. *Proceedings of the National Academy of Science, USA* **105**: 6668–6672. Williams S.E., Bolitho E.E. & Fox S. (2003) Climate change in Australian tropical rainforests: an impending environmental catastrophe. *Proceedings of the Royal Society of London, Series B* **270**: 1887–1892.

No	Overview	Type	Suggested Readings
Theme Two: Addressing threats to the Australian Wet Tropics.			
NRM17 (1.0 hr)	**Secondary Rainforest:** You will be introduced to secondary rainforest succession, including a number of the more prominent patterns and theories related to plant succession.	L	TBA
NRM18 (1.0 hr)	**Introduction to Rainforest Restoration:** You will be introduced to the relatively new field of ecological restoration and the principles underlying rainforest restoration practices: • Definitions • Role of restoration in conservation • History of restoration • Barriers to rainforest restoration • Rainforest species regeneration strategies • Linking the theory and the common practices	L	Goosem S. & Tucker N.I.J. (2013) *Repairing the rainforest* (second edition). Wet Tropics Management Authority and Biotropica Australia Pty. Ltd., Cairns, QLD. Hobbs R. J. & Norton D.A. (1996) Towards a conceptual framework for restoration ecology. *Restoration Ecology* **4**: 93–110.
NRM19 (5.0 hrs)	**Rainforest Restoration Practices:** Students receive hands on experience, with guided tuition, in an array of restoration practices: • Controlling woody weeds • Controlling herbaceous weeds • Collecting and processing rainforest fruits • Propagation of rainforest seedlings • Developing and maintaining a riparian restoration site • Planting new rainforests at a variety of sites • Monitoring restoration plantings ***This will also include a series of guest lectures.***	GL/ FW	Various handouts Goosem S. & Tucker N.I.J. (2013) *Repairing the rainforest* (second edition). Wet Tropics Management Authority and Biotropica Australia Pty. Ltd., Cairns, QLD. Tracey J.G. (1982) *The Vegetation of the Humid Tropical Region of North Queensland*. CSIRO, Melbourne.
NRM20 (1.0 hr)	**Response to climate change.** The Earth's climate is currently warming at a pace faster (by *at least* an order of magnitude) than at any time in the geological record. In the Australian Wet Tropics, many of our endemic species of flora and fauna are adapted to cool,	L/D	Shoo L.P., Storlie C., Vanderwal J., Little J. & Williams S.E. (2011) Targeted protection and restoration to conserve tropical biodiversity in a warming world. *Global Change Biology* **17**: 186–193.

No	Overview	Type	Suggested Readings
	upland habitats – precisely the habitats that are most threatened by a warming climate. We will review and discuss some of the strategies we might employ to conserve our biodiversity in the face of anthropogenic global warming.		
NRM21 (3.0 hr)	**Managing the Matrix.** Activities in anthropogenically-modified landscapes (i.e., "the matrix") affect the biodiversity and ecosystem function of remaining natural ecosystems (e.g., rainforest fragments, streams and rivers, etc.). If the matrix becomes too "hostile", remaining natural ecosystems will experience more severe degradation (e.g., loss of biodiversity, pollution, edge effects, colonisation by invasive species, potential loss of remaining habitat remnants, etc.). We will explore methods that are being developed to reduce negative effects of human activities in the matrix (e.g., agriculture, grazing, urban development) on natural ecosystems.	GL, FL, L, D	TBA
NRM22 (1.0 hr)	**Exam Review and Discussion:** We will review the concepts covered in the course.	D	–
NRM23 (1.0 hr)	**Final Exam:** You will be tested on your understanding of the concepts covered in the course. This assessment will be done individually (25% final grade).	A	–
60.0	**TOTAL CONTACT HOURS**		

Note: we will be using the freely available software program PAST (Hammer *et al.* 2001). The latest version of this software is available online (http://folk.uio.no/ohammer/past/) but we will also place copies of the software onto the student drive.

Hammer Ø., Harper D.A.T., Ryan P.D. (2001) PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* **4(1):** 9pp. URL: http://palaeo-electronica.org/2001_1/past/issue1_01.htm