COURSE CONTENT

Academic Year   2019   **Semester**   1
Course Coordinator   Natasha Bhatia
Course Code   ES4303
Course Title   Marine and Freshwater Ecology
Pre-requisites   ES 2303 Introduction to Ecology
No of AUs   3
Contact Hours   39

Proposal Date
AY 2019/20

Course Aims

This course builds on the basic concepts learned in Introduction to Ecology and will allow you, the student, to apply these to Marine and Freshwater ecosystems. In this course you will become familiar with the major processes, systems and impacts associated with marine and freshwater habitats and related taxa of organisms, and how these habitats and organisms interact.

Intended Learning Outcomes (ILO)
By the end of this course, you (as a student) would be able to:

1. Clearly communicate the key concepts of marine and freshwater processes, systems and impacts orally and in writing

2. Describe, compare and contrast key aquatic habitats

3. Discuss ecological concepts in the context of aquatic ecosystems

4. Address scientific questions related to marine and freshwater ecosystems through critical analysis

5. Discuss a current issue in a measured and concise manner

6. Lead and facilitate a group discussion

7. Analyse and interpret Environmental and Biological data using PRIMER

8. Conduct an in depth literature review and write a topical essay based on an aquatic ecological issue.

Course Content
The course is split into three main sections: (i) Processes, where you will be exposed to the key ecological processes that occur in all aquatic systems, such as production, nutrient cycling and decomposition and remineralisation of organic matter; (ii) Systems, where you will learn how these processes differ in aquatic environments, and how this influences biological communities; and (iii) Impacts, or how anthropogenic influences effect these systems and processes.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes (Appendix I)	Weighting	Team/ Individual	Assessment Rubrics
1. Data report	1,2,3,4,7	1, 2, 3	25%	Individual	App II
2. Tutorial presentation	1,4,5,6	1, 2, 4, 6	25%	Team	App III
3. Final report	1,2,3,4,8	1, 2, 5	35%	Individual	App IV
4. Continuous assessment (Quizzes)	1,2,3,4,5,6	1, 2, 4	15%	Individual	N/A
Total			100%		

Formative feedback
You will receive informal feedback continuously throughout the course where appropriate, and formal feedback following every assignment. In addition, I will be available to answer questions regarding your research or assignments throughout this course.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Active learning	You will engage in active learning techniques periodically throughout lectures, and during tutorial sessions.
Independent learning	This is an upper level course and therefore you are required to show self motivation and initiative in your learning process.

Reading and References
Course textbooks:
- Kaiser, 2011. Marine Ecology: Processes Systems and Impacts. Oxford University Press, 2nd edition. ISBN-13: 978-0199227020
- Dodds & Whiles, 2010. Freshwater Ecology. Academic Press, 2nd edition. ISBN-13: 978-0123747242
- Solon and Whitely, 2016. Stressors in the Marine Environment. Oxford University Press, 1st edition. ISBN-13: 978-0198718833

Supplemental reading will be given for tutorials and debates
Course Policies and Student Responsibilities
(1) General

Students are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions they have missed. Students are expected to participate in all seminar discussions and activities.

(2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Natasha Bhatia	N2-01C-56		nbhatia@ntu.edu.sg

Planned Weekly Schedule

Week	Date	Lecture/Activity	Topic	Course LO tested
1	14.08.19	Lecture	**Introduction to the course and assignments** **Introduction to Marine and Freshwater Ecology** - Evolution of Marine and Freshwater Ecology and why it is important today - Overview of the key differences between Marine and Freshwater Environments	1, 2, 3
2	21.08.19	Lecture	**Patterns in the Marine and Freshwater Environment** - Biogeography and zonation - Biodiversity - Abundance and size	1, 2, 3
		Activity	*Introduction to Computer Lab*	1, 7
3	28.08.19	Lecture	**PROCESSES: Production** - Primary Production - Secondary Production	

		Activity	Computer Lab: PRIMER session I	1, 4, 7
4	04.09.19	Lecture	**PROCESSES: Organic Material** - Production and degradation - Guest lectures from members of the Microbial Ecology group	1, 2, 3
		Activity	Computer Lab: PRIMER session II	1, 4, 7
5	11.09.19	Lecture	**SYSTEMS: Lentic Systems** - Lakes and Reservoirs	1, 2, 3
		Activity	Tutorial 1: Water Grabbing on the Mekong	1, 5, 6
6	18.09.19	Lecture	**SYSTEMS: Lotic Systems** - Rivers and Canals	1, 2, 3
		Activity	Tutorial 2: A decade of Deepwater Horizon. Are the effects still seen?	1, 5, 6
7	25.09.19	Lecture	**SYSTEMS: Estuaries and Coasts** - Estuaries - Rocky/Sandy shores	1, 2, 3
		Activity	Tutorial 3: Is the rise of marine plastics our greatest ecological issue?	1, 5, 6
R E C E S S W E E K				
8	09.10.19	Lecture	**SYSTEMS: Tropical and Sub-tropical** - Mangrove Forests and Seagrass Beds - Coral Reef	1, 2, 3
		Activity	Tutorial 4: Is exploratory drilling in the Amazon coral reef justified?	1, 5, 6
9	16.10.19	Lecture	**SYSTEMS: Open water** - Continental Shelf Seabed - Pelagic Ecosystems	1, 2, 3
		Activity	Tutorial 5: Does Japan have the right to resume commercial whale hunting?	1, 5, 6
10	23.10.19	Lecture	**SYSTEMS: Extremities** - The Deep Sea - Polar regions	1, 2, 3
		Activity	Tutorial 6: Deep sea mining, coming soon to an ocean near you.	1, 5, 6
11	30.10.19	Lecture	**IMPACTS: Threats and Management** - Fisheries - Aquaculture	1, 2, 3, 4
		Activity	Tutorial 7: A Pacific Bluefish Tuna recently sold for $3 million USD. Can the species be saved?	1, 5, 6
12	06.11.19	Lecture	**IMPACTS: Threats and Management** - Pollution - Disturbance	1, 2, 3, 4

			- Climate change	
		Activity	Tutorial 8: Will climate change really effect marine mammals?	1, 5, 6
13	13.11.19	Lecture	**IMPACTS: Threats and Management** - Marine Protected Areas - Guest lecturer	1, 2, 3, 4
		Activity	Tutorial 9: Are Marine Protected Areas in SE Asia worth the effort?	1, 5, 6

Appendix I. ASE learning outcomes

At the completion of your course of study in ASE, you will be able to:

- Demonstrate intellectual flexibility and critical thinking in order to apply environmental knowledge in the real world

- Communicate environmental concepts with enthusiasm to varied audiences both orally and in writing

- Formulate scientific questions, and be able to access and analyse quantitative and qualitative information to address them

- Exhibit the motivation, curiosity and skills for lifelong learning

- Demonstrate ethical values and responsibility

- Collaborate and lead by influence

Appendix II. Assessment Criteria for Data Report

Grade / Numerical Score	Criteria
A+ (Exceptional) A (Excellent)	- Exceptional understanding of PRIMER software. - Student can communicate orally and in writing the processes and reasons behind this analysis, and can aid other students in their learning. - Analysis is all completed correctly. - Interpretation of the results is insightful, focused and well researched. - Report is written and formatted to professional standards.
A- (Very good)	- Good understanding of PRIMER software. - Student can communicate orally and in writing the processes and reasons behind this analysis. - Analysis is all completed correctly. - Interpretation of the results is clear, concise and well researched. - Report is written and formatted to semi-professional standards.
B+ (Good) B (Average)	- Some understanding of PRIMER software. - Student can somewhat communicate orally and in writing the processes and reasons behind this analysis. - Analysis is mostly completed correctly. - Interpretation of the results is correct and researched. - Report is written and formatted well.
B- (Satisfactory) C+ (Marginally satisfactory) C (Bordering unsatisfactory)	- Limited understanding of PRIMER software. - Student shows limited communication orally or in writing of the processes and reasons behind this analysis. - Analysis is somewhat completed correctly. - Interpretation of the results is somewhat correct. - Report is not well written or formatted
C- (Unsatisfactory) D (Deeply unsatisfactory)	- No understanding of PRIMER software. - Student cannot communicate orally and in writing the processes and reasons behind this analysis, and can aid other students in their learning. - Analysis is not completed correctly. - Interpretation of the results is incorrect. - Report is written and formatted very poorly.
F (0-44)	Failure to submit report

Appendix III. Assessment Criteria for Tutorials

Grade / Numerical Score	Criteria
A+ (Exceptional) A (Excellent)	- Exceptionally prepared for oral communication. - Content covers all the required elements, excellent structure, and introduces additional knowledge through secondary readings at appropriate times. - Delivery is clear, articulate and concise. - Discussion is lead with a clear trajectory. - Discussion points are insightful, relevant and thought provoking. - The session is consistently managed to optimize discussion time on the most interesting points. - Shows exceptional ability to manage group discussions - Any questions are answered knowledgably. Questions asked are thoughtful, insightful and unexpected, sometimes presenting a new viewpoint to the discussion. - Student asks thoughtful questions to the other presenters, showing understanding and engagement with the rest of the class, and has read given materials as well as several additional materials for context
A- (Very good)	- Well prepared for oral communication. - Content covers all the required elements and is structured well - Delivery is clear, articulate and concise. - Discussion is lead with a clear trajectory. - Discussion points are relevant and thought provoking. - The session is managed to optimize discussion time on the most interesting points. - Any questions are answered knowledgably. Questions asked are thoughtful. - Student asks thoughtful questions to the other presenters, showing understanding and engagement with the rest of the class, and has read given materials and sometimes additional materials for context
B+ (Good) B (Average)	- Somewhat prepared for oral communication. - Content covers most of the required elements, could be structured better. - Delivery is somewhat clear, articulate and concise. - Discussion is lead well - Discussion points are relevant. - Any questions are answered somewhat knowledgably. - Student sometimes asks thoughtful questions to the other presenters, showing understanding and engagement with the rest of the class, and has read given materials.
B- (Satisfactory) C+ (Marginally satisfactory) C (Bordering unsatisfactory)	- Some or little preparation for oral communication. - Content covers some of the required elements, poorly structured. - Delivery is not very clear, articulate and concise. - Discussion is not lead with any intent. - Discussion points are somewhat relevant. - Only some questions can be answered. - Student sometimes asks questions to the other presenters, and has read most of the given materials.
C- (Unsatisfactory) D (Deeply unsatisfactory)	- No obvious preparation for oral communication. - Content misses many of the required elements, poor structure. - Delivery is unclear and poorly articulated. - No attempt to manage the discussion - Unable to answer questions. - Student asks no questions to the other presenters, and has not read the given materials
F (0-44)	Failure to participate

Appendix IV. Assessment criteria for Final Research Report

Grade / Numerical Score	Criteria
A+ (Exceptional) A (Excellent)	- Question is addressed in way which is thoroughly thoughtful, relevant, interesting, unexpected and challenging. - Shows clear ability to search for and read scientific texts, and originality in interpreting them in the context of their research. - Shows clear ability to translate this information into engaging prose, which provides specific context for their research project. - Review/essay provides appropriate background information to add context to the research project, without diverging too much from topics which are directly linked. - Correct use of referencing throughout. - Use of stylish scientific language, with no grammatical or spelling errors. - Ability to introduce, review and engage critically with secondary readings (where relevant) - Shows clear understanding of key concepts and theories, and interpretation of wider context issues. - Formatted in the correct scientific specification.
A- (Very good)	- Question is addressed in way which is thoughtful, relevant, interesting, unexpected and challenging. - Shows clear ability to search, read and interpret scientific texts. - Shows ability to translate this information into prose, which provides specific context for their research project. - Review/essay provides appropriate background information to add context to the research project, without diverging too much from topics which are directly linked. - Correct use of referencing throughout. - Use of scientific language, with few grammatical and no spelling errors. - Shows an understanding of secondary readings/research - Shows an understanding of the key concepts and theories. - Formatted to the correct scientific specification.
B+ (Good) B (Average)	- Question is addressed in way which is somewhat thoughtful, relevant, interesting, unexpected and challenging. - Shows some skills in searching for, reading and interpreting scientific texts. - Shows ability to translate this information into prose, which provides specific context for their research project. - Review/essay provides some background information to add context to the research project. - Correct use of referencing throughout most of the paper. - Fair use of scientific language, with some grammatical and spelling errors. - Shows a fair understanding of secondary readings/research - Shows some understanding of the key concepts and theories. - Formatted to the correct scientific specification.
B- (Satisfactory) C+ (Marginally satisfactory) C (Bordering unsatisfactory)	- Question is addressed in way which is not thoughtful, relevant, interesting, unexpected or challenging. - Shows limited skills in searching for, reading and interpreting scientific texts. - Shows limited ability to translate this information into prose, which provides specific context for their research project. - Review/essay provides limited background information, does not adequately add context to the research project. - Correct use of referencing throughout some of the paper. - Some use of scientific language, with grammatical and spelling errors. - Identifies secondary readings/research - Identities key concepts and theories.

	- Some attempt to format to the correct scientific specification.
C- (Unsatisfactory) D (Deeply unsatisfactory)	- Question is addressed in way which is completely thoughtless, irrelevant, uninteresting, expected and easy. - Little or no attempt to search for, read and interpret scientific texts. - Shows little or no ability to translate this information into prose. - Review/essay provides no or inappropriate background information, adds no or inappropriate context to the research project. - Incorrect use of referencing throughout most of the paper. - No scientific language, with grammatical and spelling errors. - No secondary readings/research referenced. - No identification or misinterpretation of key concepts and theories. - Incorrect formatting.
F (0-44)	Failure to submit Assessment