Academic Year	AY2017/17	**Semester**	2
Course Coordinator	Patrick Martin		
Course Code	ES2303		
Course Title	Introduction to Ecology		
Pre-requisites	BS1001 ES2003		
No of AUs	3		
Contact Hours	39 (26 h lecture, 13 h tutorials)		
Proposal Date	15/08/2017		

Course Aims

You will be taught the main theories and concepts of modern ecology, with the course structure following a hierarchy of biological scales from individuals to ecosystems. The most important aim of this course is to provide the fundamental knowledge that all of the subsequent ecology in the programme will build on. The course further aims to introduce you to practical methods of ecological research, and will help to develop your technical writing skills and ability to analyse ecological data.

Intended Learning Outcomes (ILO)

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

1. Explain key ecological concepts and theories that apply at different levels of ecological organisation; for example, inter-specific competition and trophic cascades
2. Critically analyse and interpret ecological data
3. Statistically analyse a dataset, and present and discuss your results in form of a written report
4. Apply ecological concepts to real-world environmental problems

Course Content

The course will consist of 13 lectures with topical tutorials. The topics will sequentially move through the main levels of ecological organisation, namely (1) Ecology of Individuals; (2) Ecology of Populations; (3) Ecology of Communities; (4) Ecology of Ecosystems. Specific topics that will be covered include: Resource Acquisition and Growth, Evolution and Ecology, Life Histories, Spatial Distribution, Intrinsic and Extrinsic Population Dynamics, Intra- and Inter-Specific Competition, Community Structure, Community Succession and Hysteresis, and Trophic Interactions. Some topics will be spread across multiple lectures. Each week's teaching will consist of a 2-hour period for a lecture and an on-paper problem set, and a 1-hour tutorial. The tutorial will be used to discuss scientific papers that you will be assigned to read, to teach some aspects of experimental design, or to do some computer practical exercises. You will be assigned into groups (of 2-3) at the start of the course and each group will lead a tutorial with a presentation to summarise the paper(s) assigned for that week's reading. These presentations will contribute to the assesment. Tutorials will also be used to teach fundamental aspects of experimental design using a hands-on approach: together with the papers assigned for the weekly reading, you will be asked to design an experiment to answer a specific research question. You will need to first formulate a hypothesis and then devise a specific experimental design to test it. One group will present your design in each week, and the merits and shortcomings of the design will then be discussed in the class. The purpose of this part of the tutorial work is to introduce you to concepts such as the need for independent replicates, how to mitigate possible confounding factors, etc. Two tutorials

will be data analysis computer practicals, in which the you will be introduced to using R for statistical analysis of datasets; this will complement your learning in the Biostatistics course by applying statistical methods to ecological data and questions. Finally, you will be set two written assignments as part of the assessment, for which you will collect, analyse, and interpret an ecological dataset. The first assignment will be undertaken individually, the second assignment will be undertaken in groups of 2 or 3.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment Rubrics
1. Final Examination	1,2,4	Knowledge, Intellectual flexibility and critical thinking	40%	Individual	Appendix 1
2. Written assignment 1	1,2	Knowledge, Formulating questions, Passion and communication	15%	Individual	Appendix 2
3. Written assignment 2	1,2,3	Knowledge, Formulating questions, Passion and communication, Problem solving, Research, Collaboration and leadership	35%	Team	Appendix 2
4. Group paper presentations	1,4	Knowledge, Intellectual flexibility and critical thinking, Passion and communication	10%	Team	Appendix 3
Total			100%		

Formative feedback

You will receive oral and written feedback for your first written assignment before the submission deadline of the second assignment. You will receive more general oral feedback during tutorial discussions and following paper presentations to allow you to gauge your overall progress and deepening understanding. Specimen answers to after-lecture/homework problem sets will be given to you after each week so that you can gauge your ability to apply your knowledge to the kind of questions you will encounter in the final exam. You will also receive written feedback for the second assignment at the end of the course.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lectures	Lectures will efficiently communicate the framework of what knowledge you are expected to have, and will effectively convey the critical concepts and theories of the course (LO1).

Written problem sets after lectures / as homework	Completing these problem sets will deepen your knowledge and will train you to apply that knowledge to unfamiliar situations. The problem set questions will be similar in style to the final exam, giving you practice in applying your ecological knowledge under these circumstances (LO1, LO2, LO4).
Tutorial paper discussions and ecological methods teaching	Reading and discussing a broad range of ecological research papers, both older "classic" papers and very recent contributions, will consolidate your knowledge and help you to critically evaluate scientific papers. Through in-class discussions, you will train your ability to formulate ecological arguments, propose research questions, and make connections between the various lecture topics. Moreover, several tutorials will focus on teaching experimental design by making you prepare and present possible experiments to test a specific hypothesis. A group discussion about the proposed experimental design will be undertaken to develop an improved design (if necessary) or discuss why the proposed design is suitable (LO1, LO2, LO4).
Computer data analysis practicals	There will be two tutorial sessions to undertake statistical data analysis using R. The first tutorial will teach you how to analyse population growth data to estimate growth rates and carrying capacities using a logistic model, which you will then need to apply independently to different data as part of your first written assignment. In the second session, you will work through a problem set that essentially makes you repeat the data analysis from a published journal paper. For both practicals, you will be provided with the analysis code but will need to answer and discuss questions about the data, the statistical output, and the experimental design to ensure that you understand the script properly.
Written assignments	The written assignments will train you in technical writing, presenting data graphically, formulating a research question, analysing data, and drawing conclusions from the data (LO1, LO2, LO3).

Reading and References

1. Ricklefs RE, Miller GL, 2014, *Ecology: The Economy of Nature*, 7th Edition, Macmillan
2. Begon M, Howarth RW, Townsend CR, 2014, *Essentials of Ecology*, 4th Edition, Wiley

Course Policies and Student Responsibilities

(1) General

You 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. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions you have missed. You are expected to participate in all seminar discussions and activities.

(2) Absenteeism

Absences from tutorials and lectures will likely affect your overall course grade. If you miss a

lecture or tutorial, you must inform me in advance by e-mail (pmartin@ntu.edu.sg). There will be no make-up opportunities for in-class activities.

(3 Compulsory Assignments

You are required to submit the two written assignments on due dates via the Turnitin system. Extensions will not be granted unless you have a valid reason, e.g. illness as supported by a medical certificate. If you do need an extension for a valid reason, you must inform me as soon as possible by e-mail (pmartin@ntu.edu.sg).

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
Patrick Martin	N2-01C-46	6513 8683	pmartin@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction: ecological scales, and evolution	1,2,3,4	See note below
2	Resource acquisition and foraging	1,2,3,4	
3	Life histories	1,2,3,4	
4	Population growth and intra-specific competition	1,2,3,4	Computer practical for data analysis using R
5	Population dynamics and predation	1,2,3,4	Predation modelling practical using Populus
6	Distribution of individuals of a population	1,2,3,4	Plant sampling practical

7	Inter-specific competition	1,2,3,4	
8	Mutualism	1,2,3,4	
9	Community structure and diversity	1,2,3,4	
10	Trophic interactions, cascades, and keystone species	1,2,3,4	
11	Community succession	1,2,3,4	
12	Community stability / resilience, alternate stable states	1,2,3,4	
13	Biogeochemistry: from ecosystems to atoms and back again	1,2,3,4	Computer practical for data analysis using R

NOTE: The course is based on the textbook by Rickleffs, but the book is intended as a complementary resource – no parts of the textbook will be assigned as compulsory reading. Instead, original research and review papers will be set as weekly compulsory reading in advance of tutorials. Papers will vary from year to year as new research is published.

Appendix 1: Assessment Criteria for Final Exam

Marks	Criteria
A+ (Exceptional) A (Excellent	Exhaustive answer with compelling and original argumentation that is entirely to the point, without irrelevant tangents.
A- (Very good) B+ (Good)	All relevant points are identified, but some deficiencies in argumentation; or compelling argumentation but fails to mention some aspects
B (Average) B- (Satisfactory) C+ (Marginally satisfactory)	Some relevant points not identified, and argumentation not entirely compelling. Answer is broadly correct, but the student clearly struggles to explain it in detail. Any errors are relatively minor ones.
C (Borderline unsatisfactory) C- (Unsatisfactory)	Only some points of the answer are identified, leaving important omissions. Argumentation is somewhat confused and/or poorly developed, and there are significant errors.
D, F (Deeply unsatisfactory)	Major points are omitted, there are significant inaccuracies, and any argumentation is rudimentary and confused.

Appendix 2: Assessment Criteria for First and Second Written Assignments

Marks	Criteria
A+ (Exceptional) A (Excellent	All-round excellent report with clear and concise introduction and purpose; clear and appropriate methodology that is not overly exhaustive but does not omit any aspects; has excellent and clear presentation of data that is immediately understandable and fully appropriate for the purpose (tables and/or figures); all calculations / analyses are performed correctly; results are described very clearly and in appropriate detail, highlighting both all of the key features as well as any subtler aspects; and the discussion and conclusions are original, thoughtful, entirely appropriate and supported by the data, and exhaustive without including irrelevant details. The report is extremely well structured, the language is not long-winded, and is free of mistakes and repetition. Any references are appropriate and cited correctly and listed in full in a bibliography.
A- (Very good) B+ (Good)	Very good report that only has minor flaws in a small number of the aspects listed above. These flaws must be sufficiently minor to not introduce any significant flaws, any significant barriers to understanding, or be indicative of any significant deficiencies in the student's grasp of the material.
B (Average) B- (Satisfactory) C+ (Marginally satisfactory)	Overall good report, but with numerous flaws in several aspects of the report that are significant enough that they represent a barrier to understanding, e.g. data presentation not entirely appropriate or with significant scope for improvement, argumentation not entirely compelling or logical, missing some aspects of the data even though the major points are identified. Some deficiencies in structure and language throughout the report. However, report contains no major errors.
C (Borderline unsatisfactory) C- (Unsatisfactory)	Report contains significant errors or other deficiencies. Structure is poor and hard to follow, there are deficiencies in data presentation, and only the more obvious results are highlighted and discussed. Discussion is limited to obvious points, arguments do not follow logically, and important connections to the ecological concepts taught in class are missing.

D, F (Deeply unsatisfactory)	Numerous major errors or flaws together with a poor structure, incomplete description of the results, very poor data presentation, rudimentary discussion with serious deficiencies in argumentation and logic.

Appendix 3: Assessment Criteria for Group Paper Presentations

Marks	**Criteria**
A+ (Exceptional)	Excellent summary of the paper that clearly and concisely details the objectives, methodology, results, and implications of the study. Presentation includes critical evaluation of the paper based on the students' ecological knowledge. Care has been taken to design high-quality slides to aid understanding, and explanations of difficult concepts thought through very well. Students clearly demonstrate a high degree of understanding of the paper, and of its ecological context. Any gaps in comprehension concern only advanced-level technical details that the students cannot reasonably be expected to fully grasp at this introductory stage. Possibly very good use of innovative presentation methods (e.g. excellent whiteboard presentation instead of Powerpoint)
A (Excellent A- (Very good)	Very good summary of the paper that details most of the objectives, methodology, results, and implications well, with only minor aspects being omitted. Presentation includes some critical evaluation of the paper. Slide design (or equivalent alternative presentation medium) perhaps somewhat less polished, and less effort expended to communicate and explain the concepts well.
B+ (Good) B (Average) B- (Satisfactory)	Good summary of the paper, but with some significant omissions. Lack of understanding of more fundamental aspects of the paper and the ecological context of the study is evident, and overall presentation quality is less polished. Students clearly not putting in extra effort to think of how to really communicate and explain the concepts. At most limited critical evaluation of the paper, or attempts at critical evaluation that are beside the point.
C+ (Marginally satisfactory) C (Borderline unsatisfactory) C- (Unsatisfactory)	Marginal summary of the paper that misses critical aspects of the work, and shows significant lack of understanding of the paper and the underlying ecological concepts. Poor presentation quality overall, shoddy slide design (e.g. many things illegible), no effort expended to try and help listeners understand the paper. No critical evaluation, or entirely inappropriate critical evaluation.
D, F (Deeply unsatisfactory)	Shambolic presentation that fails to summarise and explain the study. Students clearly neither understand the paper nor appear to care about understanding the paper. No evidence of effort to prepare for presentation.