

**University of Manitoba
Faculty of Agricultural and Food Sciences
SOIL 7270 Advanced Soil Ecology**

**Course Outline Winter 2014/15
Instructor: Prof. Mario Tenuta
Department of Soil Science**

Introduction

Soil ecology is the study of interactions between soil organisms and the soil environment. The field is of interest to a broad range of scientists including environmentalists, agronomists, plant pathologists, food scientists and ecologists. The need to understand the relation of the soil environment to the presence and functioning of species and communities of soil organisms unifies studies in soil ecology. A theme throughout this course will thus be the complexity of the soil environment is reflected in the kinds and functions of organisms from the individual to community level of organization. Our goal in this course is to develop a level of comprehension at the graduate level in how soil biological communities respond to soil environmental conditions, plants, and land management. The course is tailored to the interests of the students. The topic areas to be covered will be developed with consultation of students. This course is offered in the winter term if there are more than 4 students enrolled. The course structure has usually been a mix of lectures by the instructor and students. Discussion and analysis of research papers is also done to obtain depth in understanding in key topics. Students have been graded based on their lecture presentation, a major report reviewing the subject area of their presentation, short assignment for each paper discussed in class, and class participation.

Instructor

Prof. Mario Tenuta
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Lectures

3 hours / week (W F 10:00-11:30)
Soil Science (room 342)

Textbook

None
required

Course Materials

Suggested books as general references
Fundamentals of Soil Ecology 2nd Edition, Elsevier Academic Press (Coleman et al. 2004)
The Living Soil, Science Publishers Inc. (Gobat et al. 2004)
Soil Microbiology, Ecology, and Biochemistry 3rd Edition, Academic Press (ed. E. Paul 2007)

Website

Course materials will be posted at the following website (material password protected)
[http://home.cc.umanitoba.ca/~tenutam/SoilEcology/Soil Ecology Home Page.html](http://home.cc.umanitoba.ca/~tenutam/SoilEcology/Soil_Ecology_Home_Page.html)

Menu tabs also provide further information contained in the Soil Ecology SOIL 4400 website.

Prerequisites

Any of the following at the undergraduate level: soil microbiology, plant pathology, senior undergraduate level course in microbiology, food microbiology, environmental chemistry, or soil ecology

Course Evaluation

Student Presentation.....	20%
Major Report	30%
Reading Assignments.....	30%
Group Assignments.....	20%

Student Presentation

Students will prepare and deliver a 50 minute lecture to the class on a topic of relation to their graduate program and their major report in consultation with Dr. Tenuta. This will be followed by a discussion on the topic. Grading will be based upon the quality of the lecture content, delivery, and success in engaging the class to participate with questions and comments. Students are to meet with Dr. Tenuta 3 weeks before their lecture to establish the subject topic and areas to be covered in the presentation and major research report. A draft of the presentation is to be provided to Dr. Tenuta 7 days in advance to the student presentation and the final version of the presentation 1 day before the presentation.

Major Report

Students will prepare a review paper synthesizing the important literature and topic areas of the research field they gave their Student Presentation on. The paper is to be no longer than 25 pages double spaced. Students will prepare:

Outline of their paper due Feb 5

Draft of paper due March 19

(marked draft will be available April 2)

Final Revised Paper due April 16

Reading Assignments

Associated with instructor lead classes, one or two original research papers will be given as readings. Readings will be posted on the web under the Graduate menu tab on the Soil Ecology SOIL 4400 website. Students must have read and analyzed the readings before coming to class. Further, students are required to actively participate in discussion of the readings. Students are to prepare a max 3 page response to the following questions:

- a) What ecological principles or understanding does the paper set out to challenge or substantiate?
- b) What are the novel point(s) of the paper?
- c) What did you learn most from the paper?
- d) How would you have done the study differently? For review articles discuss how you would have structured the paper differently, included different topics or had a different emphasis. Explain why you would make the differences.
- e) How would you have analyzed the results differently or altered the discussion? Do not answer this question for review papers but elaborate on a) instead.

Group Assignments: Space – The Final Frontier

Students are to form groups of three for two assignments. The student composition of groups is to vary between assignments.

Group Assignment 1: Methods of Extraterrestrial Detection of Soil Organisms – due Jan 30. Each group is to provide a 10 page report and a 10 minute presentation.

Group Assignment 2: What is the Role of Soil Microorganisms in Growing Plants in Space? – due March 6. Each group is to provide a 10 page report and a 10 minute presentation.

Instructor Lead Classes

Dr. Tenuta will lead the class in the following lectures and discussions:

Date	Lecture/topic	Leader
Jan 9	General Introduction	Mario
Jan 14	The Soil Environment	Mario
Jan 16	The Soil Environment	Mario
Jan 21	Soil Biological Diversity	Mario
Jan 23	Soil Biological Diversity	Mario
Jan 28	Methods in Soil Ecology	Mario
Jan 30	Methods in Soil Ecology	Mario/Groups
Feb 4	Soil Food Webs	Mario
Feb 6	Soil Health	Mario
Feb 11	Soil Organic Carbon Cycling	Mario
Feb 13	Soil Organic Carbon Cycling	Mario
Feb 25	Soil Nitrogen Cycling	Mario
Feb 27	Soil Nitrogen Cycling	Mario
March 4	Rhizosphere Associations	Mario
March 6	Rhizosphere Associations	Mario/Groups
March 11		
March 13		
March 18		
March 20		
March 25		
March 27		
April 3		
April 8		
April 10		

Student Presentation Topics:

Tillage Effects on diversity and function of soil food webs

Application of bioindicators to soil health

Control of gaseous products of nitrification and denitrification by enzymes and soil conditions

Stabilization of organic carbon in soil: Processes, potential and comparison of environments

Metagenomics applied to soil microbial communities: Methods, application and potential

Microbial inoculants: Do they work and what is their future potential?

What is the role of Black Carbon in SOM dynamics and C sequestration in soil?

The Century Model: Assumptions, Structure and application to prediction of SOM levels in soil

The DNDC Model: Assumptions, Structure and application to prediction of nitrous oxide emissions from soil

Role of microorganisms in bioremediation

Late Submissions

10% will be deducted per day for late submissions. Let's not need to go there.

Book Bibliography

Fundamentals of Soil Ecology, Coleman et al. 2004 2nd Edition, Elsevier Academic Press, New York, USA
(good overview)

Manual of Soil Analysis: Monitoring and Assessing Soil Bioremediation (Soil Biology), Margeain and Schinner 2005, Springer (practical and focused)

Modern Soil Microbiology 2nd Edition van Elsas et al. 2007, Marcel Dekker (compilation of topics by experts)

Principles and Applications of Soil Microbiology 2nd Edition, Sylvia et al. 2005, Pearson/Prentice Hall
(highly recommended)

Soil Biology Guide, Dindal 1990, John Wiley and Sons (out of print, pity a smashing book on organism diversity)

Soil Biology Primer, Ingham 2000, http://soils.usda.gov/sqi/concepts/soil_biology/ (general highschool level)

Soil Ecology, Killham 1994, Cambridge University Press (basic overview)

Soil Ecology, Lavelle and Spain 2002, Springer

Soil Microbiology, Ecology and Biochemistry 3rd edition, Clark 2007, Academic Press

Soil Microbiology 2nd Edition. Tate 2000. John Wiley and Sons, Toronto

The Biology Of Soil: A Community And Ecosystem Approach (Biology of Habitats), Bardett 2005, Oxford University Press

The Living Soil. Fundamentals of Soil Science and Soil Biology. Gobat et al. 2004, Science Publishers, Inc., Enfield, New Hampshire, USA

By the end of the course we hopefully will be able to ascertain if Mr. Oppenheim is correct.

*The foolish person seeks happiness in the distance,
the wise grows it under his feet.*
- James Oppenheim