

SYLLABUS

GENERAL ECOLOGY

INTRODUCTION

Ecology, such and as we know it today, is a relatively new branch of Biology. Their origins, however, can go back to Aristotle's times with their observations and discussions on Nature. The origin of the modern science starts with the works of Darwin and Malthus.

As their name indicates (oikos = home), ecology focus in the study of the environment in which the organisms develop, and of the relationships among them. There are several definitions, but the one that maybe better summarizes the wide range of concepts and work scales, is the following:

Ecology is the study of the interactions between the organisms and its environment, which determine its distribution and abundance, and how they affect the processes of the ecosystem.

Ecology try to respond questions of which, how many, where, and why of the occurrence of certain species, or community, as well as determining the effects of these in relation to the operation of the ecosystem.

In general terms, the ecological explanations of the phenomenon should be interpreted in two levels:

1. It involves a proximal explanation based in the dispersion mechanisms and the populations' maintenance in a certain place and time, and
2. Offers a last answer based in the fundamental phylogenetic reasons that allowed a species to arrive to a place, to survive and to colonize it.

Based in the above-mentioned, one can observe that a narrow relationship exists between the ecology and the evolution of all organisms, for what one can affirm that ecology studies the “theater” in which the work of the evolution develops. It is not possible to understand one without the other.

Today the ecology has taken a protagonist role in the world due to the imbalance that the humanity's actions have caused on the environment, especially in the last 200 years. It is difficult to breakaway from this reality when studying ecology.

In the course we will cover the theoretical and practical bases to provide the students with the elementary ecological knowledge needed to understand the processes that produce the environmental deterioration. We will facilitate them for taking the best decisions in their professional works. For this reason the environmental problems will be covered using concrete cases, emphasizing in the ecological theory that has been developed in recent years.

As all sciences, the ecology elaborates its theories based in the scientific method. This progresses by means of hypothesis testing, generating predictions that can be corroborated or not with field observations or experimentation in model ecosystems. Because it is possible to know with security what gives us the experience, we should only leave on concrete cases to plan more general explanations; we generally work with the deductive method. For limitations of time and resources, not always all the possible cases and their variants are identified to have an exact knowledge of the general panorama. For this reason you can only want to be able to prove if a possible explanation is completed or not in a specific case. If the results of an experiment don't agree with the predictions based on the hypothesis, we can take one of two steps:

1. To decide that this is false, or
2. To modify our perception of the phenomenon to include the new found evidence.

On the other hand, if the results agree with the predictions, it will only have been demonstrated that for that case the hypothesis could not be particularly discarded, but it doesn't confirm the validity of the same one in a universal form. Therefore, what could not demonstrate you as false is probably certain for most of the cases, but it can not make sure that it is it for all.

This logic of science that has been summarized here is important to keep in mind when understanding the theories and models that have been generated in ecology that evolved and continue evolving through time. We should not forget that as a human science, the ecology uses language, either in prose or by means of mathematical formulations that always are not the most appropriate to explain the observed phenomenon, and therefore has expressive limitations that have caused serious disputes among ecologists. This do not necessarily subtracts the validity of the concepts expressed at the present time, although with time these are perfected.

DESCRIPTION

The course of General Ecology (theory and laboratory) looks to give the student the bases to facilitate the understanding of the ecological processes that occurs in ecosystems. The main ecological theories to try to explain the distribution and abundance of organisms in the environment are revised, under the function of the resources and abiotic conditions, as well as the interactions that the different species establish among them, such as competition and predation. These aspects will be fundamental to understand the functioning of the ecosystems as a whole.

Also, the course seeks to give the basic tools that allow the students to outline ecological studies, to design data gathering, and to interpret them in the most appropriate way using statistical techniques and with the use of computers. For it, the course possesses a very strong component in the realization of field projects and directed practices that they should culminate with the presentation of the results of the investigation works through reports in the style of a scientific publication, and in oral form in mini-symposiums.

OBJECTIVES:

1. To understand the concepts and fundamental principles of Ecology.
2. To define the attributes of the ecosystem.
3. To apply classic and contemporary methodological focuses of Ecology.
4. To know the decisive factors that affects the distribution, abundance and populations' dynamics.
5. To understand the relationship that exists between Ecology and other disciplines, so to make an integration of the acquired knowledge until the moment.
6. To value the ecological principles as the determinant of human being survival as a species, and of the sustainable development of their activities.

SCHEDULE

Theory: 3 hours of classes per week.

Laboratory: 2 hours of classes and fieldtrips.

REQUIREMENTS

A statistics course and general knowledge of Botany and Zoology.

METHODOLOGY

Theory:

The classes will be based mainly on lectures by professors, and discussions of additional readings of chapters of recommended text books or papers of interest for the course. For that reason to read the chapters of each lesson before the class is recommended, so to clear up doubts. Also homework can be assigned to apply to the studied models. The whole previous materials will be evaluated in the partial exams.

Finally, and like part of the final evaluation, the students will carry out a little research project, with enough complexity to be developed in the fieldtrip to the Osa Peninsula. The final results will be presented in written and oral formats, the last in a mini-symposium at the end of the semester. The format of the paper will follow that of a scientific publication, according to the pattern described for the reports of the laboratory, and that of oral presentations as they are carried out at professional level.

Laboratory:

It is designed to learn how to carry out field research in this discipline. There are few the research techniques that can be covered during a semester. But the best effort will be made to get the available knowledge about the methods covered. The laboratory will be in two parts, formal classes of ecological and statistical methods to answer the different questions that will be used in field projects and fieldtrips to do the projects.

Five major topics will be developed as laboratory practices. The first, **Environment**, is designed to learn how some environmental variables are measured, or in other words, how some of the conditions affect organisms to survive and the relation with the activity of one or various species. The second, **Spatial Distribution**, is to begin to study the patterns of dispersion of the organisms in space and time. Also doing this for two or more species we can start studying the association those species have and to begin discussing the

interactions among species. This will be made with plants so it is also a method to study abundance of non moving organisms. This is an important practice because it is the kind of project that exemplifies well the effect of quadrat size and shape to study a species. Also it is a good example of the effect that the different distribution patterns have when designing research. The third, **Life Tables**, is to study some population demography parameters. The fourth, **Population Size**, seeks to measure abundance in movable organisms and to continue discussions on the relationships among the organisms, inferring how a species limit each other in the use of resources. The fifth and last, **Diversity or Niche**, seek to give the bases of how to characterize the biological communities, or to establish the role of the organisms in their environment.

In all the practices, the students will participate in planning, getting data, introducing the data with the use of spreadsheets, and finally data analysis with the use of software available. The results will be presented individually in written form.

TEXTBOOKS:

Theory:

1. Smith, R.L. & T.M. Smith. 2000. *Ecología*. 4a ed. Addison Wesley, Madrid. 642 p.
2. Townsend, C.R., J.L. Harper & M. Begon. 2000. *Essentials of Ecology*. Blackwell Science. Massachusetts. 552 p.
3. **Begon, M., J. Harper & C. Townsend. 1996. *Ecology: Individuals, populations, communities*. 3rd. ed. Blackwell, Boston. 1017 p.**
4. Ricklefs, T. 1990. *Ecology*. 3rd. ed. Freeman.
5. Krebs, C.J. 1985. *Ecología: Estudio de la distribución y la abundancia*. Harla, Mexico. 753p.
6. Krebs, C.J. 1994. *Ecology*. 2da. Ed. Harper Collins College Pub. 801 p.
7. Guariguata, M.R., and G. H. Kattan (compiladores). 2002. *Ecología y conservación de los bosques neotropicales*. LUR, Cartago. 690 p

Laboratory:

1. **Brower, J., J. Zar and C. von Ende. 1997. *Field and Laboratory Methods for General Ecology*. 4a ed. WCB/McGraw Hill. USA. 273 p.**
2. **Krebs, C.J. 1999. *Ecological Methodology*. 2a ed. Addison-Welsey Educational Publishers, Inc. USA. 620 p.**
3. Siegel, S. 1978. *Estadística no Paramétrica: Aplicada a las Ciencias de la Conducta*. Trad. J. Aguilar. Editorial Trillas. México. 346 p.
4. Sokal, R.R. and F.J. Rohlf. 1979. *Biometría: Principios y Métodos Estadísticos en la Investigación Biológica*. Trad. J.D. Pérez. H. Blume Ediciones. Spain. 832 p.
5. Underwood, A.J. 1997. *Experiments in Ecology: Their Logical Design and Interpretation Using Analysis of Variance*. Cambridge Univ. Press. UK. 528 p.
6. **Zar, J. H. 1996. *Biostatistical Analysis*. 3a ed. Prentice Hall, Inc. USA. 662 p.**

EVALUATION:

Theory:

1. Three partial exams, with 25% of the final grade each one.
2. Final Project, with 25% of the final grade:
 - a. Written Paper: 70%. (Digital and printed in double space).

- b. Oral Presentation: 30%.

Laboratory:

1. For each practice the student will give a written report in double space. It will be evaluated with the following approach (total of 60%, 12% each):
 - a. Title 5%
 - b. Introduction 20%
 - c. Materials and methods 20%
 - d. Results 25%
 - e. Discussion 25%
 - f. Bibliography 5%
2. At the end of the course there will be an exam that will evaluate the learning of the directed practices (20%).
3. Fieldtrip report: each student will elaborate one paper of other projects organized by visiting resource people or teaching assistants on fieldtrips. Those will be presented orally while in the field (20%).

CHRONOGRAM:

Theory:

1. Orientation
2. Introduction: Domain of Ecology: definitions and foundations. Ecosystem concept. The theory of natural selection and the concept of adaptation.
3. Basic requirements for life. Components of the environment. Resources and restrictive factors. Limits of tolerance.
4. Habitat selection and dispersion mechanisms. History of life: Variations, strategies and commitments.
5. Abundance. Fluctuations of abundance. Survival, life tables and cycles.
6. Population dynamics: models. The population regulation.
7. I PARTIAL EXAM.
8. Intra-specific competition.
9. Inter-specific competition. Competitive exclusion or coexistence.
10. Predation and other types of interactions. Communities: description and delimitation. Temporary changes.
11. Free
12. Spatial heterogeneity and diversity. Organization of the community.
13. II PARTIAL EXAM.
14. Metabolism and stability of communities.
15. Primary and secondary productivity.
16. Energy and nutrient flows in the ecosystem.
17. Island biogeography and conservation biology.
18. III PARTIAL EXAM: 09:00-11:00 am.

Laboratory:

1. Orientation
2. Introduction. Reports
3. Basics of Statistical Analysis. Environment practice on fieldtrip.
4. Data Analysis of Environment practice.

5. Sampling methods. How to measure Spatial Distribution and practice on fieldtrip.
6. Data Analysis Spatial Distribution practice.
7. Life Tables and practice on fieldtrip
8. Data Analysis Life Tables practice.
9. Population Size and practice in fieldtrip.
10. Free.
11. Diversity and Niche breadth and overlap and practice in fieldtrip.
12. Data analysis of diversity or niche.
13. Individual final project on fieldtrip.
14. More on Diversity and Niche.
15. Data analysis of individual final project.
16. Comparing the mean of one, two or more samples.
17. Studying the relation among two or more variables.
18. Exam