PROYECTO DOCENTE

Ecología I

Grp Ecología I.

CURSO 2020-21

Datos básicos de la asignatura	
Titulación:	Grado en Biología
Año plan de estudio:	2009
Curso implantación:	2019-20
Centro responsable:	Facultad de Biología
Nombre asignatura:	Ecología I
Código asigantura:	1530042
Tipología:	OBLIGATORIA
Curso:	3
Periodo impartición:	Primer cuatrimestre
Créditos ECTS:	6
Horas totales:	150
Área/s:	Ecología
Departamento/s:	Biología Vegetal y Ecología

Coordinador de la asignatura

RODRIGUEZ RUIZ AMADORA

Profesorado

Profesorado del grupo principal:

SERRANO MARTIN LAURA

Objetivos y competencias

OBJETIVOS:

1.- Adquirir un cuerpo de conocimientos básicos de la ciencia ecológica (principios, leyes y teorías, hipótesis, modelos, patrones y procesos), así como el vocabulario y terminología adecuados para expresarlo de forma precisa.

2.- Establecer las relaciones de la ecología con otras disciplinas y adquirir una visión integradora de los conocimientos adquiridos que le capacitan para una mejor comprensión de los procesos

ecológicos.

3.- Comprender básicamente la realidad natural, sus elementos y las relaciones que los ligan (lo cual es indispensable para su interpretación posterior), y desarrollar un espíritu crítico que le permita valorar y tomar partido en su caso por diferentes explicaciones, teorías e hipótesis para un mismo fenómeno ecológico.

4.- Que el alumno sepa moverse por los distintos niveles de integración que la Ecología engloba, desde el nivel de ecosistema, reconociendo que escalas de magnitud, espacio y tiempo son pertinentes en cada caso, los principales rasgos ecológicos de cada uno, y los patrones y procesos que subyacen en los mismos, transmitiendo la idea de globalidad e intercomunicación que existe entre los componentes de los sistemas ecológicos.

5.- Conocimiento de las principales técnicas y métodos científicos que se utilicen en la investigación ecológica, y que permitan al alumno el análisis de los datos y la extracción de sus propios resultados y conclusiones.

6.- Buscar y manejar las fuentes de información (documentación bibliográfica), de forma que le permita proseguir con autonomía su labor de formación permanente.

7.- Adquisición de hábitos de observación, de rigor metodológicos, y valoración de la coherencia y el realismo.

8.- Identificar, conocer y saber aplicar los métodos estadísticos e informáticos básicos que se emplean en estas ciencias.

9.- Ser capaz de trasladar los conocimientos ecológicos a la resolución de problemas aplicados, así como de realizar comentarios críticos y del uso de la lógica y el razonamiento para diferentes cuestiones o problemas planteados.

10.- Fomentar en el alumno el espíritu investigador y crítico, que le permita valorar y tomar partido en su caso por diferentes explicaciones, teorías e hipótesis para un mismo fenómeno ecológico y adquirir razonadamente un criterio personal interpretativo sobre la información impartida por el profesor, al mismo tiempo que desarrolla su inquietud intelectual, aceptando los límites del conocimiento y mostrando consideración hacia el trabajo de otros especialistas.

11.- Que el alumno aprenda a desenvolverse adecuadamente en el medio natural.

COMPETENCIAS:

Competencias específicas:

Aprender a analizar, modelar, y predecir el funcionamiento de los sistemas ecológicos.

Aprender las técnicas, protocolos, y estrategias para la obtención de información del medio natural.

Elaboración, discusión y solución de problemas ecológicos.

Capacidad para la consideración sistémica del funcionamiento de la naturaleza

Competencias genéricas:

1.- Estudio, caracterización y gestión de ecosistemas.

2.- Investigación, desarrollo y control de procesos en el seno de los ecosistemas.

3.- Conservación y uso sostenible de ecosistemas, agroecosistemas, sistemas forestales y sistemas acuáticos.

4.- Estudios biológicos y control de la acción de productos químicos y biológicos de utilización en la agricultura, piscicultura y ganadería.

5.- Estudios demográficos.

6.- Enseñanza de la Ecología, Biología, Ciencias de la Tierra y Medio Ambiente en las enseñanzas medias.

7.-Asesoramiento científico y asistencia técnica de problemas ecológicos y medio ambientales.

Goals and target skills (Objetivos y competencias)

In the English group of this discipline, we will take a Case Study approach as a stand off against the hypertrophy of ecological jargon that saturates both the Ecology textbooks and our daily lives through the media. Cases provide ample opportunity for students to think creatively. This approach will also enable us to best clarify the myriad of factors and stakeholders that should be accounted for when general ecological statements are delivered, and ecological solutions are opted for on facing present and future societal challenges.

The running theme throughout our discourse is that processes are key in Ecology. Neither species, habitats, biodiversity or any other tangible feature of the natural world can encompass the myriad of relationships taking place among each and every bit at different scales, from biomolecules to Evolution.

Processes cannot be understood without acknowledging the passing of time; time is the glue that binds together this wide range of pieces with invisible threads from past to future effects. Ecology also creates a web of connections between natural and cultural aspects, and thus ecological studies require a cross-disciplinary understanding of ecosystems as socio-economic systems where ecosystem services can be addressed.

The use of case studies and other resources from the National Science Teachers Association (www.nsta.org) will require some complementary steps. As much as we welcome the communication abilities of English-speaking countries in science, we are aware of some self-centered views that North American ecologists have acquired in past decades, particularly after World War II, when the ecological discourse was recreated in USA with little or no European influence (particular, from Germany). Moreover, the long tradition of ecological sciences developed in Spain, thanks to the work of Ramón Margalef, also demands a ?transfer? of some Anglo-Saxon concepts to a more complex Mediterranean setting, where human activities have been impacting landscape and natural resources from ages. When necessary, some ecological concepts and terms will be translated into Spanish to ensure that knowledge is readily available to our students in both form and content.

Small group Problem-Based Learning method will grant our students several personal and professional skills. Skills will be organized simulating the emergent properties derived from the hierarchical structure of ecological levels (individual, population an community levels). Individual marks will be obtained through the practise of skills such as reading scientific research critically,

spotting pseudoscience, observing and predicting patterns, making inferences, planning experimental designs, using quantitative information, envisioning, analyzing and displaying data, and communicating experimental results. At the population level, collective marks will be achieved by students working in teams where they will be able to communicate and create cross-disciplinary solutions to solve complex real-world problems. Those skills provided at the community level will stem from the interaction between students and teacher while participating in class activities, such as the formulation of questions, reply to enquires, ability to create opinion and debate about ethical and socio-economic implications of scientific research, and the demand of sensible environmental public policies.

Regarding language skills, we are aware of the challenges imposed by teaching in a foreign language. Case-Study, Problem-based and Cooperative Learning are not the best methods to deliver a plethora of facts, definitions and principles, but they are rather suitable to integrate material across many fields which demands critical thinking to asses information. Moreover, these methods are ideal to develop reasoning-skills, and reasoning itself is enhanced when the thinking is done in a language other than your own mother tongue. Grasping concepts rather than memorizing the details describing those concepts is a fertile ground for the development of general inferences, which is a higher-order imaginative skill that every science teacher claims they strive for. Another advantage of teaching science in English is that students will have a more realistic experience of the discovery process as the world-wide scientific community currently delivers and performs their activity in English (it used to be in Latin, some centuries ago, but science is uncontroversially performed in English nowadays).

Given that our students are required to reach the B1 English level prior to obtaining their grade in Biology, we are aware that they will most likely have an English level below the equivalent to a Cambridge First Certificate when joining our classes. Our program involves plenty of oral activities so we will redouble efforts to encourage our students to talk in English in public. Mind you that written essays and final exams will also be performed in English, and that students are recommended to be fluent in English with a qualification equivalent to, at least, a B2 English level before their enrolment in this course.

Contenidos o bloques temáticos

Teoría:

1.- ¿Que es la ecología?

2.- Ambiente e individuos.

3.- Abundancia y distribución de las especies

4.- Adaptación de los organismos a un ambiente multifactorial

5.- Biogeografía.

6.- Introducción a la demografía. La población uniespecífica.

7.- Competencia dentro de la población o intraespecifica

8.- Competencia interespecífica

9.- Mutualismo

10.- Depredación

Problemas:

1.- Técnicas de muestreo de comunidades vegetales.

2.- Técnicas de muestreo de poblaciones de animales en medio terrestre y acuático.

3.- Determinación de tamaño y número de muestras para el estudio de la vegetación.

4.- Muestreo del medio físico y de organismos en medio acuático.

5.- Análisis de los datos: Univariantes.

6.- Determinación de la distribución espacial de los organismos.

7.- Tablas de vida.

Prácticas:

1.- Práctica de campo en los ecosistemas de Doñana.

2.- Muestreo de la vegetación en el campo.

3.- Análisis de los datos recogidos.

4.- Análisis Univariantes.

5.- Elaboración de tablas de vida de una población.

List of topics (Contenidos o bloques temáticos)

Everything in Ecology is so tightly interconnected that it is not essential the point we chose for starting, following or finishing it up (Margalef, 1974). A few general principles set the basis for most ecological processes. These principles are related to natural selection, the ecological niche concept and some biogeographical notions, and they, in turn, are interrelated with each other. Thus, the ecosystem notion emerges from these interactions as the most suitable conceptual framework to envision global processes through the quantification of energy flux, biomass transfer and biogeochemical cycles. The selection of topics will be organized around the following units:

T1: EVOLUTION BY NATURAL SELECTION

-Classroom: ?A whale of a tale. The evidence for the evolution of whales?

-Problem-based Learning: ?Peppered moths and the Industrial Revolution: barking at the wrong tree??.

-Practical lesson P1: ?Field trip to the Doñana Natural Area?. Students will visit an array of different habitats to experience environmental change in contrasting landscapes, and will learn to find patterns through visual observation and inductive thinking.

T2: THE ECOSYSTEM CONCEPT

-Classroom: ?Salmon forests. Ecology or Myth??

-Problem-based Learning: ?Fish as fertilizers?

-Practical lesson P2: ?Plant data collection in the field (Parque del Alamillo)?. Students will perform several data collection methods using plotless and line transects to quantify some plant variables such as composition, abundance and cover in a Mediterranean shrub-community vegetation.

T3: ENVIRONMENTAL INTERACTIONS & ADAPTATIONS

-Classroom: ?No longer down under for eucalypt trees. A tree which does not make a forest, or does it??.

-Problem-based Learning: ?Plants and animals in classic experiments of niche quantification?.

-Practical lesson P3: ?Plant data analysis?. Once in the laboratory, students will be ask to estimate species population abundance using the data collected in field the day before (P2). They will also explore the species-area relationship, compare results of different methods for the same variable quantification, and consider the proper sampling technique for plant community studies.

T4: POPULATION DYNAMICS & INTERACTIONS

-Classroom: ?How wolves change rivers?. Video at Vimeo. ?The return of Canis lupus??

-Problem-based Learning: ?Life Tables, Darwin's Finches, and the dynamics of small island populations?.

-Practical lesson P4: ?Biodiversity loss in your generation: data collection?. Students are asked to create a spatially-explicit database of species of fauna which are no longer commonly found in their own family environment. They will ask their parents (and any other elder relative) about the animal species that used to be found in their own home and surroundings when they were kids, and contrast the information with their own experience in the same surroundings. They will come to the computer lab with the list of species which they would have previously elaborated at home. Students will then share all the information to produce a map & infographics showing the extent (in space and

time) of the virtual biodiversity loss of each species.

T5: COMPLEX ECOLOGICAL INTERACTIONS

-Classroom: ?The red sore eyes of the black-necked grebes: complex ecological interactions in the Odiel and Tinto marshes?.

-Problem-based Learning: ?Flower Power. Pollination and predation paradoxes?.

-Practical lesson P5: ?Biodiversity loss in your generation: hypothesis testing?. Using previous information from P4, students will be asked to infer some hypothesis which will be tested using univariate parametric and non-parametric statistical analyses.

Relación detallada y ordenación temporal de los contenidos

Everything in Ecology is so tightly interconnected that it is not essential the point we chose for starting, following or finishing it up - Margalef, (1974)

A few general principles set the basis for most ecological processes. These principles are related to natural selection, the ecological niche concept and some biogeographical notions, and they, in turn, are interrelated with each other. Thus, the ecosystem notion emerges from these interactions as the most suitable conceptual framework to envision global processes through the quantification of energy flux, biomass transfer and biogeochemical cycles. The selection of topics will be organized around the following units:

T1: EVOLUTION BY NATURAL SELECTION

-Classroom (C1): A whale of a tale. The evidence for the evolution of whales.

-Problem-based Learning (PBL1): Peppered moths and the Industrial Revolution: barking at the wrong tree?.

-Practical lesson P1: Field trip to the Doñana Natural Area. Students will visit an array of different habitats to experience environmental change in contrasting landscapes, and will learn to find patterns through visual observation and inductive thinking.

T2: THE ECOSYSTEM CONCEPT

-Classroom (C2): Salmon forests. Ecology or Myth?

-Problem-based Learning (PBL2): Fish as fertilizers

-Practical lesson P2: Plant data collection in the field (Parque del Alamillo). Students will perform several data collection methods using plotless and line transects to quantify some plant variables such as composition, abundance and cover in a Mediterranean shrub-community vegetation.

T3: ENVIRONMENTAL INTERACTIONS & ADAPTATIONS

-Classroom (C3): No longer down under for eucalypt trees. A tree which does not make a forest, or does it?

-Problem-based Learning (PBL3): Plants and animals in classic experiments of niche quantification.

-Practical lesson P3: ?Plant data analysis?. Once in the laboratory, students will be asked to estimate species population abundance using the data collected in field the day before (P2). They will also explore the species-area relationship, compare results of different methods for the same variable quantification, and consider the proper sampling technique for plant community studies.

T4: POPULATION DYNAMICS & INTERACTIONS

-Classroom (C4): How wolves change rivers (Video at Vimeo). The return of Canis lupus?

-Problem-based Learning (PBL4): Life Tables, Darwin's Finches, and the dynamics of small island populations.

-Practical lesson P4: ?Biodiversity loss in your generation: data collection?. Students are asked to create a spatially-explicit database of species of fauna which are no longer commonly found in their own family environment. They will ask their parents (and any other elder relative) about the animal species that used to be found in their own home and surroundings when they were kids, and contrast the information with their own experience in the same surroundings. They will come to the computer lab with the list of species which they would have previously elaborated at home. Students will then share all the information to produce a map & infographics showing the extent (in space and

time) of the virtual biodiversity loss of each species.

T5: COMPLEX ECOLOGICAL INTERACTIONS

-Classroom (C5): The red sore eyes of the black-necked grebes: complex ecological interactions in the Odiel and Tinto marshes.

-Problem-based Learning (PBL5): Flower Power. Pollination and predation paradoxes.

-Practical lesson P5: Biodiversity loss in your generation: hypothesis testing. Using previous information from P4, students will be asked to infer some hypothesis which will be tested using univariate parametric and non-parametric statistical analyses.

Actividades formativas y horas lectivas

Actividad	Créditos	Horas
A Clases Teóricas	3	30
B Clases Teórico/ Prácticas	1	10
E Prácticas de Laboratorio	0,7	7
G Prácticas de Informática	0,3	3
I Prácticas de Campo	1	10

Metodología de enseñanza-aprendizaje

Clases teóricas

Horas presenciales: 30.0

Horas no presenciales: 60.0

Metodología de enseñanza-aprendizaje

1- Exposición de conceptos. Los alumnos podrán preparar y presentar al resto de compañeros en clase aspectos concretos de cada parte del temario.

2- Actividades formativas. Los alumnos podrán presentar actividades propuestas por el profesor o los alumnos para profundizar sobre los aspectos estudiados en cada parte del temario.

3- Trabajos prácticos. Se podrán realizar individualmente o en pareja.

Competencia que desarrolla:

Aprender a analizar, modelar y predecir el funcionamiento de los ecosistemas acuáticos.

Aprender las técnica, protocolos y estrategias para la obtención de información del medio natural.

Elaboración, discusión y solución de problemas ecológicos.

Capacidad para la consideración sistémica del funcionamiento de la naturaleza.

Prácticas de Laboratorio:

Horas presenciales: 7.0

Horas no presenciales: 0.0

Competencia que desarrolla:

Aprender a analizar, modelar y predecir el funcionamiento de los ecosistemas acuáticos.

Aprender las técnica, protocolos y estrategias para la obtención de información del medio natural.

Elaboración, discusión y solución de problemas ecológicos.

Capacidad para la consideración sistémica del funcionamiento de la naturaleza.

Prácticas de Informática

Horas presenciales: 3.0

Horas no presenciales: 0.0

Competencia que desarrolla:

Aprender a analizar, modelar y predecir el funcionamiento de los ecosistemas acuáticos.

Aprender las técnica, protocolos y estrategias para la obtención de información del medio natural.

Elaboración, discusión y solución de problemas ecológicos.

Capacidad para la consideración sistémica del funcionamiento de la naturaleza.

Prácticas de Campo

Horas presenciales: 10.0

Horas no presenciales: 0.0

Competencia que desarrolla:

Aprender a analizar, modelar y predecir el funcionamiento de los ecosistemas acuáticos.

Aprender las técnica, protocolos y estrategias para la obtención de información del medio natural.

Elaboración, discusión y solución de problemas ecológicos.

Capacidad para la consideración sistémica del funcionamiento de la naturaleza.

Problemas

Horas presenciales: 10.0

Horas no presenciales: 30.0

Competencia que desarrolla:

Aprender a analizar, modelar y predecir el funcionamiento de los ecosistemas acuáticos.

Aprender las técnica, protocolos y estrategias para la obtención de información del medio natural.

Elaboración, discusión y solución de problemas ecológicos.

Capacidad para la consideración sistémica del funcionamiento de la naturaleza.

Teaching methodology (Metodología enseñanza-aprendizaje)

Problem-based Learning emerged as a teaching method in science only a few decades ago as an opposition to the traditional mega-class faculty lecturing. Since then, it has rapidly evolved into a new teaching technique for those in search of a change towards a more interactive and cooperative approach, and a source of motivation for science teachers around the world (Herreid et al., 2012).

In essence, case studies are stories with an educational message. First, we will focus on a few vital topics (or paradigms) that can encompass a multitude of concepts and bind together the entire discipline of Ecology. Secondly, we will encourage topic discussion of unresolved questions. Case studies show the process of science in action better than any other teaching experience ?excluding doing research oneself. It is in contentious issues where the scientific enterprise is particularly exposed. Thus, we will focus on failure and error to present the evolution of scientific ideas with the drama and excitement encountered by scientists along their discovery process. Thirdly, we will emphasize the historical context of ecological research with its societal and ethical challenges.

The final picture we are aiming at is to infer abstract ecological thinking step by step: starting from tangible day-to-day stories, ground-breaking flashy news, or government policies to reveal the ecological mechanisms behind them, down to their evolutionary, physiological, physico-chemical, and methodological pieces, before presenting the theoretical concepts that the scientific community has elaborated to understand them, and why those concepts have become fixed in some Ecology textbooks.

Sistemas y criterios de evaluación y calificación

Examen de la parte teórica que habrá que aprobar obligatoriamente.

Preguntas a desarrollar, preguntas cortas, preguntas de razonamiento y problemas y preguntas test.

Las actividades formativas computarán en la nota final siempre que el examen esté aprobado.

Evaluation and scoring systems (Sistemas y criterios de evaluación y calificación)

Case studies will be presented by the teacher in the classroom to promote collective discussion, followed by individual or small-group activities by students and their corresponding evaluation in English. Activities will be compulsory and will take many forms: written questions, keywords sorting, scientific paper commentaries, oral presentations, numerical ecology problems, experiment designs, field data collection, statistical data analyses, infographic displays, and debates. The evaluation of practical lessons will include student attendance, conduct, and engagement, as well as written replies to a set of questions and activities. Throughout the course, students will be able to achieve their marks by aggregation of these activities which would reflect the acquisition of certain skills.

In order to achieve at least 50% of the whole mark range (5 out of 10 points), students are required to perform, at least, one oral individual presentation (up to 1,5 points), the set of all written replies to both the 5 cases (up to 1 point) and the 5 practical lessons (up to 1 point), participate in both oral and written team activities (up to 0.5 points, each), as well as engage in the classroom with the teacher and other students (up to 0.5 points). The remaining 50% of the score could be achieved in a similar fashion by those students willing to perform the rest of optional activities.

Final evaluation: on the date planned for the exam by the Faculty (1st call in January, and 2nd call in September) students who have already achieved at least 50% of their total mark range will have an optional test to improve their marks: making a short oral presentation of those keywords they have been collecting over the semester, and displaying them on a 3D object (?the ecological prism?) to provide a unified vision of the relationships among those concepts; in case they aspire to improve their marks further, they could put forth any other activity which they might have missed during classes. Those students who do not even reach 50% of the total score will be entitled to attend final exams, which will involve the delivery of a written solution to a problem-based question followed by a

short interview with the teacher to help clarify their results.

Examen de problemas que habrá que aprobar obligatoriamente.

Diversos problemas a resolver de forma satisfactoria

Las actividades formativas computarán en la nota final siempre que el examen esté aprobado.

Examen de prácticas que habrá que aprobar obligatoriamente.

Examen de la parte prácticas, si no consigue su superación de forma práctica.

Preguntas de desarrollo, preguntas de razonamiento, preguntas cortas y de test sobre la materia.

Las actividades formativas computarán en la nota final siempre que el examen esté aprobado.

Criterios de calificación del grupo

Evaluation and scoring systems (Sistemas y criterios de evaluación y calificación)

Case studies will be presented by the teacher in the classroom to promote collective discussion, followed by individual or small-group activities by students and their corresponding evaluation in English. Activities will be compulsory and will take many forms: written questions, keywords sorting, scientific paper commentaries, oral presentations, numerical ecology problems, experiment designs, field data collection, statistical data analyses, infographic displays, and debates. The evaluation of practical lessons will include student attendance, conduct, and engagement, as well as written replies to a set of questions and activities. Throughout the course, students will be able to achieve their marks by aggregation of these activities which would reflect the acquisition of certain skills.

In order to achieve at least 50% of the whole mark range (5 out of 10 points), students are required to perform, at least, one oral individual presentation (up to 1.5 points), the set of all written replies to both the 5 problem-based cases (up to 1 point) and the 5 practical lessons (up to 1 point), participate in both oral and written team activities (up to 0.5 points, each), as well as engage in the classroom with the teacher and other students (up to 0.5 points). The remaining 50% of the score could be achieved in a similar fashion by those students willing to perform the rest of optional activities.

Final evaluation: on the date planned for the exam by the Faculty (1st call in January, and 2nd call in September) students who have already achieved at least 50% of their total mark range will have an optional test to improve their marks: making a short oral presentation of those keywords they have been collecting over the semester, and displaying them on a 3D object (?the ecological prism?) to provide a unified vision of the relationships among those concepts; in case they aspire to improve their marks further, they could turn in any other activity which they might have missed during classes. Those students who do not even reach 50% of the total score will be entitled to attend a final exam, which will involve the delivery of a written solution to a problem-based question followed by a short interview with the teacher to help clarify their results.

Horarios del grupo del proyecto docente

https://biologia.us.es/es/docencia/titulaciones/

Calendario de exámenes

https://biologia.us.es/es/docencia/titulaciones/

Tribunales específicos de evaluación y apelación

Presidente: CARLOS ANTONIO GRANADO LORENCIO
Vocal: AMADORA RODRIGUEZ RUIZ
Secretario: MARIA CRUZ DIAZ ANTUNES-BARRADAS
Suplente 1: MANUEL ENRIQUE FIGUEROA CLEMENTE
Suplente 2: JUAN BAUTISTA GALLEGO FERNANDEZ
Suplente 3: MARIA LOURDES ENCINA ENCINA

Bibliografía recomendada

INFORMACIÓN ADICIONAL

Resources

Each topic presentation will be provided with links to scientific papers, specific web sites, textbooks and other learning resources. The following examples include their corresponding URL at the CRAI

Library.

General bibliography

Foundations of Ecology: classic papers with commentaries. 1991. L.A. Real & J.H. Brown (eds). Published in association with the Ecology Society of America, University Chicago Press. USA. 905 pp.

Science stories using case studies to teach critical thinking. 2012. C.F. Herreid, N.A. Schiller & K.F. Herreid. (Paper and electronic book available). National Science Teaching Association press. USA. 410 pp.

Our Biosphere. 1997. R. Margalef. Excelence in Ecology vol 10. Ecology Institute. Germany. 176 pp.

Some web sites

Darwin Online. The world's largest and most widely used resource on Darwin. http://darwin-online.org.uk/

Understanding Evolution: your one-stop source for information on evolution. https://evolution.berkeley.edu/evolibrary/article/evo_01

Simple statistical Analyses.

https://www.skillsyouneed.com/num/simple-statistical-analysis.html

Some specific books

Ecología. 2005. R. Margalef. Omega Ed. Barcelona. 951 pp.

Limnología. 1983. R. Margalef. Omega Ed. Barcelona. 1010 pp.

Riparia. Ecology, conservation, and management of streamside communities. 2005. R.J. Naiman, H. Décamps, M.E. McClain. Elsevier Academic. 445 pp.

The ecosystem approach: its use and abuse. 1992. G. E. Likens. EEBooks. 166 pp.

Elements of Ecology. 2000. R.L. Smith & T.M. Smith. Addison Wesley Longman. 567 pp.

The balance of nature and human impact. 2013. K. Rohde (ed.). Cambridge University Press. 413 pp.

Hyperobjects: philosophy and ecology after the end of the world. 2013. T. Morton. University of Minesota Press. 244 pp.

The view from Lazy Point: a natural year in an unnatural world. 2012. C. Safina. New York, Picador. 401 pp.