Syllabus

Subject

Subject / Group	11673 - Phytoplankton Ecology / 1
Degree	Master's in Marine Ecology
Credits	5
Period	2nd semester
Language of instruction	Spanish

Professors

Lecturers	Office hours for students					
	Starting time	Finishing time	Day	Start date	End date	Office / Building
Nona Sheila Agawin Romualdo nona.agawin@uib.es	You need to book a date with the professor in order to attend a tutoring session.					

Context

The objective of the subject is to impart knowledge on the phytoplankton communities in the different marine systems, the regulation of their abundance and production, their relation with other marine communities, their role in the trophic webs and their global importance in the carbon and nitrogen fluxes with special emphasis on picofitoplancton (the smallest phytoplankton, which contributesignificantly to the functioning of the oceans), and in the atmospheric nitrogen-fixing cyanobacteria. The subject involves both theoretical and experimental sessions. Students will learn the theoretical basis of the ecology of phytoplankton and the different techniques (eg.classical methods and new methods of counting, identification, determination and measures of growth, production and losses).

The subject counts on the teaching assistanceof Dr. Eva Alou Font of the SOCIB (Balearic Islands Coastal observing and forecasting System) and of Victor Fernandez Juárez (UIB, for the practical part).
The subject can be taught entirely or partially in english if the students agree.

Requirements

Recommended

Knowledge on general ecology is recommended

Skills

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Specific

* To know how to apply the methods and techniques of the scientific work in the marine environment, through sampling campaigns and subsequent analysis of the samples in the laboratory.
* Train to design and manage scientific projects in marine ecology.
* Train to evaluate anthropic impacts in the marine environment.

Generic

* Possess and understand knowledge that provide a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
* To develop the capacity to achieve a critical and self-critical attitude, both in the strictly scientific area and in other areas of application of its knowledge.
* That students can apply the knowledge acquired and its capacity to resolve problems in new or relatively unknown environments and in wider contexts (or multidisciplinary).
* That the students possess the skills of learning that they allow them to keep on studying of a way that will have to be to a great extent self-guided or autonomous.
* To study real cases and solve the problems related to each case, through the development of a project carried out in small groups and individually.
* To acquire the ability to draw conclusions and communicate them, and also the ecological and biological knowledge learned, with expert and general public audiences in a clear concise and unifying way.

Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

Content

Range of topics

Theoretical lectures. Class lectures

1. General introduction on phytoplankton

2. Diversity of phytoplanktonic communities (diverse taxonomic groups, prokaryotes and eukaryotes) with special emphasis on:

(HABs (Harmful Algal Blooms)
Picophytoplankton
Nitrogen-fixing cyanobacteria

3. Roles of phytoplankton in trophic webs

4. Role of phytoplankton in cycles of nutrients (C, N)

5. Ecological factors that regulate the growth and primary production of phytoplankton:

Light
Nutrients (N, P, trace metals)
Temperature

6. Ecological and anthropological factors that regulate the losses of phytoplankton:

Predation
Ultraviolet radiation (UVR)

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Marine contamination

7. Growth and losses of phytoplankton: the balance between the two processes and how it controls the distribution and abundance of phytoplankton

8. Phytoplankton communities and their dynamics in different marine systems (Polar: Antarctic and Arctic; Tropical and Subtropical Systems).

9. Different techniques in the study of phytoplankton

Practical exercises. Practicals in the laboratory

1. Techniques in the study of identification, counts anddiversity

• Microscopy techniques (International guidelines; Best practices, identifications by large groups, genus, most relevant species, biovolume, phytoplankton web pages, data processing.
• Flow cytometry techniques (will depend on the availability of cytometer)

2. Different experiments (e.g. UV light exposure, P limitation) and responses (growth, production of reactive oxygen species, alkaline phosphatase activity,APA)

Teaching methodology

In-class work activities (1.2 credits, 30 hours)

Modality	Name	Typ. Grp.	Description	Hours
Theory classes		Large group (G)	Lectures on the various topics established in this guide, using the whiteboard or through digital presentations. Studentsare encouraged to participate orally by asking questions/comments and/or answering questions posed by teachers.	23
Seminars and workshops		Medium group (M)	Oral presentation of each work/practical exercise bygroup of what has been done.	2
Practical classes		Medium group (M)	The class will be divided into mid-size groups(3-4) and an experiment will be assigned to each group in which the different methods described in the practical content of this guide will be applied.	5
Assessment		Large group (G)	Solving problems and exercises in a session of examination	0

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Aula Digital platform.

Distance education tasks (3.8 credits, 95 hours)

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Modality	Name	Description	Hours
Individual self-study		Understanding the theoretical concepts and the practical content of the subject, and preparation of reports.	95

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

Frau en elements d'avaluació

In accordance with article 33 of Regulation of academic studies, "regardless of the disciplinary procedure that may be followed against the offending student, the demonstrably fraudulent performance of any of the evaluation elements included in the teaching guides of the subjects will lead, at the discretion of the teacher, a undervaluation in the qualification that may involve the qualification of "suspense 0" in the annual evaluation of the subject".

Seminars and workshops

Modality	Seminars and workshops
Technique	Observation techniques **(non-retrievable)**
Description	Oral presentation of each work/practical exercise bygroup of what has been done.
Assessment criteria	Quality and clarity of the oral presentation.

Final grade percentage: 25%with a minimum grade of 5

Practical classes

Modality	Practical classes
Technique	Student internship dissertation **(non-retrievable)**
Description	The class will be divided into mid-size groups(3-4) and an experiment will be assigned to each group in which the different methods described in the practical content of this guide will be applied.
Assessment criteria	Correction and quality of the results as well as quality and clarity of the presented work.

Final grade percentage: 25%with a minimum grade of 5

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Assessment

Modality	Assessment
Technique	Short-answer tests **(retrievable)**
Description	Solving problems and exercises in a session of examination
Assessment criteria	Correction of results, clarity of answers

Final grade percentage: 50%with a minimum grade of 5

Resources, bibliography and additional documentation

Basic bibliography

1. Bougis P. 1974. Ecologie du plankton marin Tome I Phytoplancton. Masson Paris.
2. Harris G. 1986. Phytoplankton Ecology: Structure, Function and Fluctuations. Chapman and Hall Ltd.
3. Falkowski P. and Woodhead A. 1992. Primary Productivity and Biogeochemical Cycles in the Sea. Plenum Press.
4. Kirk 1994. Light and Photosynthesis in Aquatic Ecosystems. Cambridge University Press.
5. Nybakken J. 1997. Marine Biology: An Ecological Approach. Addison-Wesley Educational Publishers.
6. Lalli, C. M. and T.R. Parsons. 2000. Biological Oceanography: an introduction. Oxford, UK: Butterworth-Heinemann
7. Reynolds C. 2006. Ecology of phytoplankton. Cambridge University Press.
8. Smayda T. and Shinizu T. (Eds). 1993. Toxic phytoplankton blooms in the sea. Elsevier.
9. Sommer U. 1989. Plankton Ecology: Succession in Plankton Communities. Brock-Springer.
10. Van der Spoel S. and Pierrot-Bults AC. 1999. Zoogeography and diversity of plankton. Arnold.
11. Tomas C. 1997. Identifying Marine Phytoplankton. Academic Press.
12. Miller C. and Weeler P. 2012.Biological Oceanography. Wiley-Blackwell.
13. Rodríguez J. 2016. Ecología (Ciencia y Técnica). Pirámide.

Complementary bibliography

Selection of research articles:

1. Agawin NSR, Rabouille S, Veldhuis MJW, Servatius L, Hol S, Van Overzee HMJ, Huisman J. 2007. Competition and facilitation between unicellular nitrogen-fixing cyanobacteria and non-nitrogen-fixing phytoplankton species. Limnology and Oceanography 52: 2233-2248.
2. Agawin NSR, Agustí S. 1995. Prochlorococcus and Synechococcus cells in the Central Atlantic Ocean: distribution, growth and mortality frazing rates.Vie Et Milieu, Life and Environment 55: 165- 175.
3. Agawin NSR, Duarte CM, Agustí S, McManus L. 2003. Abundance, biomass and growth rates of Synechococcus sp. in a tropical coastal ecosystem (Philippines, South China Sea). Estuarine Coastal and Shelf Science 56: 493-502
4. Agawin NSR and Duarte CM. 2002. Evidence of direct particle trapping by a tropical seagrass meadow. Estuaries 25:1206-1210.
5. Agawin NSR, Agustí S, Duarte CM. 2002. Abundance of Antarctic picophytoplankton and their response to light and nutrient manipulation. Aquatic Microbial Ecology 29:161-172.
6. Agawin NSR, Duarte CM, Agustí S. 2000. Nutrient and temperature control of the contribution of picoplankton to total phytoplankton biomass and production. Limnology and Oceanography 45(3): 591-600.
7. Agawin NSR, Duarte CM and Agustí S. 1998. Growth and abundance of Synechococcus sp. in a Mediterranean Bay: Seasonality and relationship with temperature. Marine Ecological Progress Series 170: 45-53.

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8. Arrigo KR, Marine microorganisms and global nutrient cycles. Nature 437: 349-355
9. Christaki, U., Giannakourou, A., Van Wambeke, F., Gregory, G. 2001. Nanoflagellate predation on auto- and heterotrophic picoplankton in the oligotrophic Mediterranean Sea. Journal of Plankton Research 23: 1297-1310.
10. Duarte CM, Agusti S, and Agawin NSR. 2000. Biomass and production responses to nutrient addition of Mediterranean phytoplankton: A mesocosm experiment. Marine Ecology Progress Series 195: 61-70.
11. Llabrés, M., and Agustí S. 2006. Picophyoplankton cell death induced by UV radiation: Evidence for oceanic Atlantic communities. Limnology and Oceanography 51: 21-29.
12. Zwirglmaier, K., Jardilllier L., Ostrowski, M., Mazard, S., Garczarek, L., Vaulot, D., Not, F., Massana, R., Ulloa, O. and Scanlan D.J. 2008. Global phylogeography of marine Synechococcus and Prochlorococcus reveals a distinct partitioning of lineages among oceanic biomes.