

B. Biological Oceanography

B.1. Master track: LIMNOLOGY & OCEANOGRAPHY

University of Amsterdam, Institute for Biodiversity & Ecosystem Dynamics.

Level: 400/500; ECTS: 120;

Coordination: Dr. Petra M. Visser, Prof.dr. Jef Huisman.

Websites:

http://www.studeren.uva.nl/msc_limnology_and_oceanography/

<http://www.science.uva.nl/water>

<http://www.science.uva.nl/ibed>

Introduction

Water covers 70% of the Earth's surface and sets our planet apart from all other planets known to mankind. These vast amounts of water play an important role in the global climate and are a source of food, minerals, energy, and recreation. Aquatic ecosystems are teeming with organisms, ranging from the tiny phytoplankton and zooplankton to corals, fish and whales. Unfortunately, aquatic ecosystems are also the dumping places for many of society's wastes and are profoundly affected by global change. To better understand and protect the world's lakes, seas, and oceans, the Universiteit van Amsterdam offers an international MSc program in Limnology and Oceanography, devoted to the biology, chemistry and physics of aquatic ecosystems. This multidisciplinary program is an advanced study focusing on freshwater ecosystems (limnology) as well as on marine ecosystems (oceanography).

Orientation of the Master program

The Master program in Limnology & Oceanography (L&O, in short) emphasizes biological processes in relation to the physical and chemical environment. Important fields of research contributing to this program include Aquatic & Marine Microbiology, Aquatic Ecology, Aquatic Toxicology, Tropical Marine Biology, Theoretical Ecology, Marine Biogeochemistry, and Water Management. Courses and research span a wide variety of topics, ranging from mathematical models of aquatic food webs and global warming, to laboratory experiments with aquatic sediments or planktonic ecosystems, to field studies in lakes, seas, and oceans.

The L&O program works in close collaboration with several national research institutes, such as:

- Netherlands Institute of Ecology (NIOO)
- NIOZ Royal Netherlands Institute for Sea Research
- Institute for Marine Resources & Ecosystem Studies (IMARES)
- National Institute for Coastal Zone Management (Delta Institute/RIKZ)
- National Institute for Inland Water Management & Wastewater Treatment (Delta Institute/RIZA)

This offers students the opportunity to follow courses or MSc research projects at these institutes.

To facilitate research projects abroad, the L&O program has a formal collaboration with marine research stations at Curaçao, at the Azores, at the Mediterranean Sea, and in Norway. Furthermore, the L&O program has strong ties with a wide variety of freshwater and marine research groups all over the world. All external projects of the L&O program, whether at national institutes or abroad, are always guided by a supervisor from the University of Amsterdam and an external supervisor (usually a scientist from the institute concerned).

Organization and entry requirements

The L&O program is organized by the Institute for Biodiversity and Ecosystem Dynamics (IBED) of the University of Amsterdam. It welcomes students with a Bachelor degree in the Biological Sciences, Earth Sciences, Environmental Sciences, and, on certain conditions, also students from Chemistry and Physics.

Aims and goals

The L&O program aims at the development of the following skills:

- A sound understanding of the biological processes in aquatic ecosystems, and how these biological processes interact with the physical and chemical environment
- Translation of fundamental research questions into practical experiments.
- Development of practical skills for sampling of aquatic ecosystems, and application of modern laboratory techniques in the aquatic sciences
- Development of theoretical skills for a conceptual understanding of aquatic processes, and implementation of mathematical models to study aquatic ecosystems.
- Development of communication skills, in writing, in oral presentations, and in scientific discussions.
- Development of a critical academic attitude in water management issues, where a blend of scientific information and socio-economic arguments form key ingredients in decision-making processes.

General structure of the MSc program

The Master program in Limnology & Oceanography consists of two years (120 EC). At the onset of the program, MSc students choose one of the following profiles:

- *Research Profile (R-profile)*: MSc courses, MSc paper, and two research projects (see Table below).
- *Communication and Education Profile (CE-profile)*: the 1st MSc year consists of MSc courses and one research project; the 2nd MSc year consist of specialized educational courses and educational projects, e.g., at high schools, musea, and so on.
- *Science Technology and Public Management Profile (ST and PM-profile)*: the 1st MSc year consists of MSc courses and one research project; the 2nd MSc year consists of specialized management courses and projects at management institutes (e.g., Rijkswaterstaat, local water authorities).

The Research Profile:

Courses in Limnology and Oceanography	15-30 EC
Courses outside the Limnology and Oceanography program	max. 15 EC
MSc Paper	10 EC
Research projects	80 EC
Total	120 EC

Marine courses in the Bachelor and Master program of the UvA

The University of Amsterdam combines both freshwater and marine research. As a result, many courses comprise a mixture of freshwater and marine components. The table below gives an overview of the Bachelor and Master courses in the marine sciences at the University of Amsterdam. The number between brackets gives an indication of the magnitude of the marine component in the course.

BSc Courses for 'Limnology & Oceanography' Program.

Course name/subject	Course #	BSc level	ECTS
Marine Biology	IB308	3 rd year	10
Microbial Ecology	IB311	3 rd year	10

MSc courses for 'Limnology & Oceanography' Program.

Course name/subject	Course #	ECTS
Introduction to Limnology & Oceanography	BS006	10
Benthic Ecology	BS007A	5
Coral Reef Ecosystems	BS007B	5
Aquatic Ecotoxicology and Water Quality	BS008A	6
Food Webs	BS003B	4
International Excursion Biological Oceanography	BS014	4

MSc Lecture Series

Course name/subject	Course #	ECTS
People and the Sea	IIPAS46	6

Total 60 ECTS

Additional MSc courses

The L&O program is part of the MSc School in the Life and Earth Sciences of the University of Amsterdam. This school also organizes many additional MSc courses that are not strictly marine, but that can be of considerable interest for Marine Scientists to broaden their expertise.

To name a few:

- Courses in Earth Sciences like Climatology, Remote Sensing, Geographical Information Systems, Chemistry of Soil Water Atmosphere, Modelling Geo-Ecological Processes.
- Courses in Biology like Evolution, Animal Systematics, Paleo-Ecology, Population Biology, Adaptive Dynamics, Theoretical Biology, Bio-informatics, Statistics, Integrated Coastal Dune Management.

B.2. Master track: MARINE BIOLOGY & OCEANOGRAPHY

University of Groningen, Faculty of Mathematics and Natural Sciences,
Departments Ocean Ecosystems, Marine Benthic Evolution and Ecology
Centre for Ecological and Evolutionary Studies (CEES)

Coordinators: Prof. J. Olsen, Prof. H. de Baar, Prof. W. Stam, Prof. V. de Jonge

Website:

<http://www.rug.nl/biologie/onderzoek/onderzoekgroepen/marienebiologie/onderwijs/index>

Introduction

The major discipline Marine Biology & Oceanography offers the complete BSc-MSc-PhD program in a collaborative joint program since 1965 between the University of Groningen (RuG) and the NIOZ Royal Netherlands Institute for Sea Research (Texel); and since ca. 1995 also including the Netherlands Institute for Ecological Research / Centre for Estuarine and Marine Ecology (NIOO/CEME, Yerseke), the National Institute for Fisheries Research (RIVO in IJmuiden now part of IMARES in Wageningen), and the ecotoxicology branch of RIKZ (now Delta Institute) at Haren. This is the only existing program in Marine Biology & Oceanography in The Netherlands, and the longest existing marine science education program in the nation. **At all times every course is open for students from every other university in The Netherlands as well as from other nations.** Every year ca. 3-6 students from other Dutch universities, and another 3-6 from other nations, take part in our courses. Several faculty in the program have joint appointments between the University of Groningen and the above institutes, thus ensuring efficient teaching based on state-of-the-art research. The major B.Sc. degree program permits entry into the M.Sc. program as well as into our sister M.Sc. program in Ecology. Every year 25±5 students enter the B.Sc. program, of which ca. 20 eventually obtain the M.Sc degree. The remaining five either returning to their home universities, or having opted for an M.Sc. degree in Ecology. There are 15-20 PhD candidates (assistant in opleiding, aio) in the program, and every year 4-6 PhD degrees are granted by the University of Groningen. The history of the joint program dates back to 1931. Over the years a major proportion of marine biologists of The Netherlands have been trained in the program, and many currently active marine scientists at various places all over the world received their PhD degree at the University of Groningen. The international network of alumni also serves for arranging MSc student projects both at the national institutes and worldwide.

Within the Centre for Ecological and Evolutionary Studies (CEES) of the University of Groningen, the departments Ocean Ecosystems (chair H. de Baar) and Marine Benthic Ecology and Evolution (chair J. Olsen) represent marine biological sciences in context of overall seven biological departments. The Centre for Ecological and Evolutionary Studies (CEES) and parallel Groningen Biomolecular and Biotechnology (GBB), Centre for Behaviour and Neuroscience (CBN) and Pharmacy jointly offer the Life Sciences education. This context offers a wide variety of optional courses and research projects.

B.Sc. Marine Biology & Oceanography by RuG/NIOZ/NIOO-CEME/RIVO-IMARES					
<i>Course</i>	<i>Coordinator</i>	<i>Course #</i>	<i>weeks</i>	<i>ECTS</i>	<i>% marine</i>
* Biological Oceanography	H. de Baar	BI208O	4	5.7	100
* Marine Biology I	W. Klaassen	BI208M	4	5.7	100
* Marine Biology II	W. Klaassen	BI204	4	5.7	100
Mediterranean Rocky Shores Ecosystems	E. Stamhuis	BI2I4	4	5.7	100
Water Quality	A. Buma	BI2U4A	4	5.7	100
*Marine Ecosystems	G. Herndl	BI2YY	4	5.7	100
Management & Policy of Coast and Sea	V. de Jonge	BI2A21	4	5.7	100
*) <i>mandatory</i>					

M.Sc. Marine Biology & Oceanography by RuG/NIOZ/NIOO-CEME/RIVO-IMARES

The Master of Science (M.Sc.) program lasts two years and leads to a MSc in Marine Biology and Oceanography. The program consists of specialized courses and research projects supervised by the staff. The specialized courses are open for M.Sc. as well as Ph.D. students, with permission B.Sc. students may also take part. The first research subject always has to be carried out either at the Department of Marine Biology at Haren (near Groningen) or at one of the participating scientific institutes (NIOZ, NIOO-CEME, RIVO-IMARES, RIKZ-Haren). Brief descriptions of suitable first projects are available on the website. The second and sometimes third research subject can be done at the same institutes, or anywhere else in the world, depending on the availability of good supervision. The students own choice and any further arrangements for the first, second (and third) research projects are discussed and approved by one of the study-leaders profs. Olsen, Stam and De Baar. The discussion also aims at identifying the most suitable host-institute and scientist for the project of interest. Additional requirements are an oral presentation (colloquium) and a literature study. The entire MSc program is taught in English.

Most students choose their second project in a foreign institute in e.g. Australia, Argentina, Hawaii, or aboard foreign research vessels, or at polar research stations e.g. Davis (Antarctica) or Svalbard, Spitsbergen. This is accommodated via long-term collaborations, and sometimes bilateral agreements, with such institutes as Woods Hole Oceanographic Institution, University of California at Santa Cruz, Australian Antarctic Survey, British Antarctic Survey, Alfred Wegener Institute, and several more.

M.Sc./Ph.D. Courses Marine Biology & Oceanography

<i>Course</i>	<i>Coordinator</i>	<i>Course#</i>	<i>target</i>	<i>ECTS</i>	<i>%marine</i>
Polar Ecology & Management	A. Buma		f + a	5	80
Global Change of the Seas	W. Klaassen		f + a	5	90
Ecophysiology of Plankton	A. Buma		f	5	100
Fish swimming	E. Stamhuis		f	5	100
Coral Reef Ecology	J. Olsen		f	5	100
Marine Genomics	J. Olsen		f	5	100
Fisheries Biology	A. Rijnsdorp		f + a	5	100
Trace Elements & Isotopes	H. de Baar		f	5	100
Marine Conservation	J. Olsen		f + a	5	100
Marine Community Ecology	K. Eriksson		f	5	100
Soft Bottom Ecology	K. Eriksson		f	5	100
Advanced Oceanography (NEBROC course)	alternating at Texel or Bremen		f	5	100

target: f= fundamental, a= applied

Secretariat Marine Biology & Oceanography:

ms. G. Van Roon -ter Horst, ms. J. de Vries-Veldkamp

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Ocean Ecosystems:

prof. H. de Baar (chair), prof. G. Herndl, prof. V. de Jonge, prof. A. Rijnsdorp; dr. P. Boelen, dr. K. de Boer, dr. A. Buma, dr. C. Halsband-Lenk, dr. W. Klaassen, dr. W. van de Poll, dr. E. Stamhuis, dr. H. van der Strate; mr. H. de Groot, ms. L. Venekamp, ing. R. Visser, mr. J. de Wiljes

Marine Benthic Ecology and Evolution:

prof. J. Olsen (chair), prof. W. Stam, prof. C. Heip, prof. A. Rijnsdorp, dr. K. Eriksson, dr. J. Coyer, dr. G. Hoarau, ms. S. Boele-Bos, mr. J. Veldsink