



Sommersemester 24

Module Guide

for the study of

Marine Biology

Master of Science

valid in connection with the examination regulations MPO 2020/2022

Module Guide for the Master's Program Marine Biology

The Master's program includes two fields of study, these are:

- Marine Biology
- International Studies in Aquatic Tropical Ecology (ISATEC)

A change of the chosen field of study is only possible upon application to the examination board.

Structure of Marine Biology:

- Compulsory modules (without master thesis module) 63 CP
- Elective modules (Profilisation and Specialisation) 27 CP
- Master Thesis 30 CP

Structure of International Studies in Aquatic Tropical Ecology (ISATEC):

- Compulsory modules (without master thesis module) 72 CP
- Elective modules (Profilsation and Specialisation) 18 CP
- Master Thesis 30 CP

Generated: April 8, 2024

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Module 02-BIO-MA-MB-A: Concepts of Marine Biology and Biological Oceanography

Concepts of Marine Biology and Biological Oceanography

Assignment to areas of study:

- Profile Marine Biology / Compulsory modules
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

The module starts with an excursion to the North Sea, where students gain an overview on the biodiversity and ecology of important taxa of "Marine Flora and Fauna". This field trip will also provide the opportunity for students with a variety of academic backgrounds and origins to network and socialise and to form a solid common scientific fundament, on which the following courses can be based. The module provides a comprehensive introduction to important concepts of Marine Biology and Biological Oceanography. Students learn what factors govern marine primary and secondary production processes, the role of the ocean for global climate and how marine biota interact with climate change. Fisheries and aquaculture techniques and their environmental impacts are discussed. "Scientific Communication" provides guidance on how to present scientific data in the most accessible way as a poster, oral conference presentation or publication. In addition, students get an insight into the scientific funding system and how to write a convincing proposal for a research project.

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students are able to comprehend general concepts of marine biology and biological oceanography. They are able to use scientific identification keys and to identify the major taxa of marine algae and invertebrates. Students are able to explain different fisheries and aquaculture techniques and to critically evaluate the impacts of fisheries on marine ecosystems. They are able to produce scientific posters and generate oral presentations

Calculation of student workload:

224 h SWS / presence time / working hours
80 h Exam preparation
236 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Kai Bischof

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

18 / 540 hours

Module examinations

Module examination: Concepts of Marine Biology and Biological Oceanography

Type of examination: module exam	
Form of examination: Written examination	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = wirtten exam	

Module courses

Course: Introduction to Aquatic Ecology	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2,5	University teacher: PD. Dr. Broder Breckling PD Dr. Hauke Reuter
Language(s) of instruction: Englisch	
<p>Literature: Kaiser MJ, Attrill MJ, Jennings S, Thomas DN, Barnes DKA, Brierley AS, Hiddink JG, Kaartokallio H, Polunin NVC, Raffaelli DG (2011) Marine Ecology: Processes, Systems, and Impacts. 2nd ed. Oxford University Press, 501 pp. Lalli CM, Parsons TR (1997) Biological Oceanography: An Introduction. 2nd ed. The Open University. Butterworth-Heinemann, Oxford, 314 pp. Valiela I (2015) Marine Ecological Processes. 3rd edition. Springer Miller CB, Wheeler PA (2012) Biological Oceanography. 2nd ed. Wiley-Blackwell Heinrich Böll Foundation Schleswig-Holstein (2017) Ocean Atlas 2017. Facts and Figures on the Threats to Our Marine Ecosystems. 52 pp. Download from: https://meeresatlas.org/wp-content/uploads/2017/06/Ocean-Atlas-Web-EN.pdf</p>	
Teaching method(s): Lecture Seminar	Associated module examination: Modulprüfung Concepts of Marine Biology and Biological Oceanography
Course: Introduction to Aquatic Ecology: Global Climate Change & IPCC	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 0,3	University teacher: Prof. Dr. Hans-Otto Pörtner
Language(s) of instruction: Englisch	

<p>Literature: Kaiser MJ, Attrill MJ, Jennings S, Thomas DN, Barnes DKA, Brierley AS, Hiddink JG, Kaartokallio H, Polunin NVC, Raffaelli DG (2011) Marine Ecology: Processes, Systems, and Impacts. 2nd ed. Oxford University Press, 501 pp. Lalli CM, Parsons TR (1997) Biological Oceanography: An Introduction. 2nd ed. The Open University. Butterworth-Heinemann, Oxford, 314 pp. Valiela I (2015) Marine Ecological Processes. 3rd edition. Springer Miller CB, Wheeler PA (2012) Biological Oceanography. 2nd ed. Wiley-Blackwell Heinrich Böll Foundation Schleswig-Holstein (2017) Ocean Atlas 2017. Facts and Figures on the Threats to Our Marine Ecosystems. 52 pp. Download from: https://meeresatlas.org/wp-content/uploads/2017/06/Ocean-Atlas-Web-EN.pdf</p>	
<p>Teaching method(s): Seminar</p>	<p>Associated module examination: Modulprüfung Concepts of Marine Biology and Biological Oceanography</p>
<p>Course: Marine Flora and Fauna</p>	
<p>Frequency: winter semester, yearly</p>	<p>Are there parallel courses? no</p>
<p>Contact hours: 4</p>	<p>University teacher: Prof. Dr. Kai Bischof Dr. Karin Springer Dr. Simon Jungblut PD Dr. Holger Auel</p>
<p>Language(s) of instruction: Englisch</p>	
<p>Literature: Kaiser MJ, Attrill MJ, Jennings S, Thomas DN, Barnes DKA, Brierley AS, Hiddink JG, Kaartokallio H, Polunin NVC, Raffaelli DG (2011) Marine Ecology: Processes, Systems, and Impacts. 2nd ed. Oxford University Press, 501 pp. Lalli CM, Parsons TR (1997) Biological Oceanography: An Introduction. 2nd ed. The Open University. Butterworth-Heinemann, Oxford, 314 pp. Valiela I (2015) Marine Ecological Processes. 3rd edition. Springer Miller CB, Wheeler PA (2012) Biological Oceanography. 2nd ed. Wiley-Blackwell Heinrich Böll Foundation Schleswig-Holstein (2017) Ocean Atlas 2017. Facts and Figures on the Threats to Our Marine Ecosystems. 52 pp. Download from: https://meeresatlas.org/wp-content/uploads/2017/06/Ocean-Atlas-Web-EN.pdf</p>	
<p>Teaching method(s): Laboratory class Field trip</p>	<p>Associated module examination: Modulprüfung Concepts of Marine Biology and Biological Oceanography</p>
<p>Course: Concepts of Marine Biology and Oceanography</p>	

Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 3,5	University teacher: Prof. Dr. Victor Smetacek
Language(s) of instruction: Englisch	
Literature: Kaiser MJ, Attrill MJ, Jennings S, Thomas DN, Barnes DKA, Brierley AS, Hiddink JG, Kaartokallio H, Polunin NVC, Raffaelli DG (2011) Marine Ecology: Processes, Systems, and Impacts. 2nd ed. Oxford University Press, 501 pp. Lalli CM, Parsons TR (1997) Biological Oceanography: An Introduction. 2nd ed. The Open University. Butterworth-Heinemann, Oxford, 314 pp. Valiela I (2015) Marine Ecological Processes. 3rd edition. Springer Miller CB, Wheeler PA (2012) Biological Oceanography. 2nd ed. Wiley-Blackwell Heinrich Böll Foundation Schleswig-Holstein (2017) Ocean Atlas 2017. Facts and Figures on the Threats to Our Marine Ecosystems. 52 pp. Download from: https://meeresatlas.org/wp-content/uploads/2017/06/Ocean-Atlas-Web-EN.pdf	
Teaching method(s): Lecture Seminar	Associated module examination: Modulprüfung Concepts of Marine Biology and Biological Oceanography

Course: Scientific Writing

Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2,5	University teacher: Prof. Dr. Christian Wild
Language(s) of instruction: Englisch	
Literature: Kaiser MJ, Attrill MJ, Jennings S, Thomas DN, Barnes DKA, Brierley AS, Hiddink JG, Kaartokallio H, Polunin NVC, Raffaelli DG (2011) Marine Ecology: Processes, Systems, and Impacts. 2nd ed. Oxford University Press, 501 pp. Lalli CM, Parsons TR (1997) Biological Oceanography: An Introduction. 2nd ed. The Open University. Butterworth-Heinemann, Oxford, 314 pp. Valiela I (2015) Marine Ecological Processes. 3rd edition. Springer Miller CB, Wheeler PA (2012) Biological Oceanography. 2nd ed. Wiley-Blackwell Heinrich Böll Foundation Schleswig-Holstein (2017) Ocean Atlas 2017. Facts and Figures on the Threats to Our Marine Ecosystems. 52 pp. Download from: https://meeresatlas.org/wp-content/uploads/2017/06/Ocean-Atlas-Web-EN.pdf	

Teaching method(s): Lecture Seminar	Associated module examination: Modulprüfung Concepts of Marine Biology and Biological Oceanography
Course: Fisheries Biology and Aquaculture	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 3,5	University teacher: Christiane Müller Dr. Andreas Kunzmann Dr. Tim Dudeck
Language(s) of instruction: Englisch	
Literature: Kaiser MJ, Attrill MJ, Jennings S, Thomas DN, Barnes DKA, Brierley AS, Hiddink JG, Kaartokallio H, Polunin NVC, Raffaelli DG (2011) Marine Ecology: Processes, Systems, and Impacts. 2nd ed. Oxford University Press, 501 pp. Lalli CM, Parsons TR (1997) Biological Oceanography: An Introduction. 2nd ed. The Open University. Butterworth-Heinemann, Oxford, 314 pp. Valiela I (2015) Marine Ecological Processes. 3rd edition. Springer Miller CB, Wheeler PA (2012) Biological Oceanography. 2nd ed. Wiley-Blackwell Heinrich Böll Foundation Schleswig-Holstein (2017) Ocean Atlas 2017. Facts and Figures on the Threats to Our Marine Ecosystems. 52 pp. Download from: https://meeresatlas.org/wp-content/uploads/2017/06/Ocean-Atlas-Web-EN.pdf	
Teaching method(s):	Associated module examination: Modulprüfung Concepts of Marine Biology and Biological Oceanography

Module 02-BIO-MA-MB-B: Multi-Disciplinary Oceanography**Multi-Disciplinary Oceanography****Assignment to areas of study:**

- Profile Marine Biology / Compulsory modules
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

The module will give an introduction to the general functioning of the system Earth on various time scales as well as the transformation and exchange of elements in the marine environment. It deals with chemical, physical, geological as well as biogeochemical processes and reactions and covers climate variability and driving forces. Based on the understanding of these processes, their impact on marine biota and the evolution of key species will be highlighted.

The various topics include:

- Properties of the ocean and methodology for their measurement
- Dynamic forces in the ocean; equatorial and coastal upwelling, subtropical gyres: Sverdrup circulation, vorticity; formation of water masses; thermohaline convection • Thermodynamics and chemical equilibrium, chemical composition of seawater
- Marine carbon and nutrient cycles in space and time, including anthropogenic impact (e.g. ocean acidification, global warming, eutrophication, sea-level rise) • Sediment Biogeochemistry MB-B/ Multi-Disciplinary Oceanography module code / module title
- Plate tectonics, earth history

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students are able to comprehend essential concepts of neighbouring disciplines important for the interpretation of marine biological scientific data. They have the competence to integrate the important role of the oceans in global biogeochemical cycles. They are able to use scientific terminology to communicate with scientists from related ocean sciences, enabling them to co-operate in interdisciplinary research projects.

Calculation of student workload:

112 h SWS / presence time / working hours

40 h Exam preparation

118 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Holger Auel

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

9 / 270 hours

Module examinations

Module examination: Multi-Disciplinary Oceanography	
Type of examination: module exam	
Form of examination: Written examination	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = written exam	

Module courses

Course: Marine Geosciences	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2	University teacher: Dr. Tim Rixen
Language(s) of instruction: Englisch	
Literature: Segar DA (2018) Introduction to Ocean Sciences. 4th ed. 571 pp. ISBN: 978-0-9857859-1-8. Download from: http://www.reefimages.com/oceansci.php	
Teaching method(s): Lecture Seminar	Associated module examination: Modulprüfung Multi-Disciplinary Oceanography

Course: Physical Oceanography	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2	University teacher: Dr.rer.nat. Christoph Völker Benjamin Rabe PD Dr. Tim Jennerjahn
Language(s) of instruction: Englisch	
Literature: Segar DA (2018) Introduction to Ocean Sciences. 4th ed. 571 pp. ISBN: 978-0-9857859-1-8. Download from: http://www.reefimages.com/oceansci.php	

Teaching method(s): Lecture Seminar	Associated module examination: Modulprüfung Multi-Disciplinary Oceanography
Course: Marine Biogeochemistry	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2	University teacher: Prof. Dr. Björn Rost PD Dr. Tim Jennerjahn
Language(s) of instruction: Englisch	
Literature: Segar DA (2018) Introduction to Ocean Sciences. 4th ed. 571 pp. ISBN: 978-0-9857859-1-8. Download from: http://www.reefimages.com/oceansci.php	
Teaching method(s): Lecture Seminar	Associated module examination: Modulprüfung Multi-Disciplinary Oceanography
Course: Marine Chemistry	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2	University teacher: Prof. Dr. Tilmann Harder
Language(s) of instruction: Englisch	
Literature: Segar DA (2018) Introduction to Ocean Sciences. 4th ed. 571 pp. ISBN: 978-0-9857859-1-8. Download from: http://www.reefimages.com/oceansci.php	
Teaching method(s): Seminar	Associated module examination: Modulprüfung Multi-Disciplinary Oceanography

Module 02-BIO-MA-MB-D: Marine Biological Lab Practical

Marine Biological Lab Practical

Assignment to areas of study:

- Profile Marine Biology / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

Advanced courses in marine biology can be chosen from the following options: Invertebrate Nutrition, Trophodynamic Interactions, Phytoplankton Under Global Change. The students will be engaged in intense lab and/or fieldwork. The methodologies will depend on the selected research topic (physiology, biochemistry, ecology, statistics, etc.) and the courses are usually closely related to the research activities of the involved working group

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students are able to apply state-of-the-art laboratory methodologies in a selected field. Depending on the chosen course, students have the competence to design experiments and to analyse the respective data according to their working hypotheses with the appropriate statistics.

Calculation of student workload:

112 h Preparation / follow-up work

56 h SWS / presence time / working hours

12 h Exam preparation

Are there optional courses in the modules?

yes

Elective compulsory module for Marine Biology students (not available for ISATEC students) Students choose from a selection of practical courses addressing different scientific topics and laboratory methods.

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Holger Auel

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

6 / 180 hours

Module examinations**Module examination:** Marine Biological Lab Practical**Type of examination:** module exam**Form of examination:**

Announcement at the beginning of the semester

The examination is ungraded?

no

Number of graded components / ungraded components / prerequisites of the examination:

1 / - / -

Language(s) of instruction:

Englisch

Description:

PL 1 = Oral presentation, poster or project report depending on the laboratory practical chosen. Lecturers will inform students about the type of assessment at the start of the course.

Module courses

Course: Marine Phytoplankton under Global Change	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 4	University teacher: Prof. Dr. Björn Rost
Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Biological Lab Practical
Course: Invertebrate Nutrition	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 4	University teacher: Dr. Reinhard Saborowski
Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Biological Lab Practical
Course: Marine Chemical Ecology: Part 1	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 2	University teacher: Prof. Dr. Tilmann Harder
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	Associated module examination: Modulprüfung Marine Biological Lab Practical
Course: Marine Chemical Ecology: Part 2	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 4	University teacher: Prof. Dr. Tilmann Harder

Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Biological Lab Practical
Course: Trophodynamic Interactions: Field Course on Helgoland	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 4	University teacher: Prof. Dr. Maarten Börsma
Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Biological Lab Practical
Course: Coral Reef Ecology Literature Seminar	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 4	University teacher: Prof. Dr. Christian Wild Dr. Sebastian Ferse
Language(s) of instruction: Englisch	
Teaching method(s): Seminar	Associated module examination: Modulprüfung Marine Biological Lab Practical
Course: Statistics and Mathematical Methods with R for Marine Biologists	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 4	University teacher: PD Dr. Holger Auel
Language(s) of instruction: Englisch	
Teaching method(s): Tutorial Seminar	Associated module examination: Modulprüfung Marine Biological Lab Practical

Module 02-BIO-MA-MB-F: Marine Ecological Field Practical

Marine Ecological Field Practical

Assignment to areas of study:

- Profile Marine Biology / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

Field methods in marine biological research for the assessment of marine biodiversity and community composition. Depending on the field practical chosen, students will be exposed to either marine coastal communities in different seas (Bay of Biscay, Brittany, Mediterranean Sea) or field work on a research vessel. They will learn different sampling methods for plankton, benthic animals and fish as well as supplementary physical data (e.g. temperature, salinity). Methods for biodiversity assessment and community analysis will be applied to marine ecosystems from different regions. Students learn how to conduct vertical zonation studies in the field and experimental approaches with living organisms such as feeding studies.

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students have gained first-hand experience regarding biodiversity and community composition of marine ecosystems in other regional seas or oceans. They are able to apply and adjust field methods to different marine habitats.

Calculation of student workload:

84 h SWS / presence time / working hours

6 h Preparation / follow-up work

Are there optional courses in the modules?

yes

The selection of marine ecological field practicals on offer may change between years. So far, the regular selection included field practicals in Brittany, France, and at the Mediterranean Sea. Alternatively, student participation in research expeditions can be accepted as marine ecological field practical. Students may also choose excursions or field practicals offered by other universities or research institutions. For instance, field courses offered by UNIS on Svalbard or by Aarhus University on Greenland are very popular among Marine Biology students.

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Holger Auel

Frequency:

(depending on capacity) winter or summer semester

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

3 / 90 hours

Module examinations**Module examination:** Marine Ecological Field Practical**Type of examination:** module exam

Form of examination: Announcement at the beginning of the semester	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Productivity, Trophic Interactions and Functional Biodiversity of Pelagic Communities Throughout the Atlantic Ocean	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: PD Dr. Holger Auel
Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Ecological Field Practical
Course: Phycological Field Trip to Brittany	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Dr. Klaus-Ulrich Valentin
Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Ecological Field Practical
Course: Marine Ecological Field Practical	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Prof. Dr. Kai Bischof PD Dr. Holger Auel
Language(s) of instruction: Englisch	
Teaching method(s): Seminar Laboratory class	Associated module examination: Modulprüfung Marine Ecological Field Practical

Associated module courses

Marine Ecological Field Practical (Field trip)

Module 02-21-03 MB-G: Professionalisation and Internationalisation

Professionalisation and Internationalisation

Assignment to areas of study:

- Profile Marine Biology / Compulsory modules
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

1) Student Research Project:

From a large spectrum of scientific projects students can select their preferred topic and research group. They will get involved in all phases of an experimental research project: Development of working hypotheses, experimental design, method selection, practical work, analytics, data treatment and statistics, writing a research report and presenting the project results in a seminar.

2) Grant Proposal:

Theoretical knowledge:

- Presentation of the different funding institutions, explanation of funding guidelines
- Explanations and advice on proper project management

Practical skills:

- Writing of a grant proposal (in context with the planned thesis work)
- Defence (oral presentation and discussion) of the grant proposal (to supervisors and co-students)

Supplementary information on part 1)

By default, the module consists of a Student Research Project (SRP) embedded in a marine research team at Bremen University or at one of the associated research institutions.

This part includes compulsory elective choices (Wahlpflicht WP) of 14 weeks duration (upon application up to 26 weeks) for Marine Biology students and a compulsory choice for ISATEC students (Pflicht, P):

WP1: Students undertake the practical work integrated in a research group at the University of Bremen

WP2: Students undertake the practical work as internship students integrated in an external national or international research group.

WP3: Marine Biology students may opt to (partly) replace the SRP by additional advanced university courses, for instance during a study period abroad at an international partner university (e.g. via Erasmus+ or Promos exchange). If so, type of examination and form of assessment may differ. Bremen University will acknowledge the grades obtained at partner universities.

P: For ISATEC students, the SRP must be conducted as a research stay in a tropical country under the supervision of lecturers from Bremen.

Learning outcomes / competencies / targeted competencies:

During practical courses the students will get acquainted with various research topics and working groups at the participating institutions. In the selected research project, the students will learn how to address scientific questions. They will get involved in all phases of an experimental research project: Development of working hypotheses, experimental design, method selection, experimental work, analytics, data treatment and statistics, writing a research report and presenting the project results in a seminar. During their field trip, the students will learn to observe and investigate ecological or physiological phenomena at field stations or on board research vessels, they will deepen their taxonomic knowledge and if performing a mini-project during a field trip, they will learn the relevant concepts and methodologies.

Calculation of student workload:

602 h SWS / presence time / working hours

208 h Preparation / follow-up work

Are there optional courses in the modules?

yes

yes for Marine Biology students; no for ISATEC students

By default, the module consists of a Student Research Project (SRP) embedded in a marine research team at Bremen University or at one of the associated research institutions.

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P: For ISATEC students, the SRP must be conducted as a research stay in a tropical country under the supervision of lecturers from Bremen.

Language(s) of instruction: English	Responsible for the module: PD Dr. Holger Auel
Frequency: winter semester, yearly	Duration: 1 semester[s]
The module is valid since / The module is valid until: SoSe 24 / -	Credit points / Workload: 27 / 810 hours

Module examinations

Module examination: Professionalisation and Internationalisation

Type of examination: combination exam	
Form of examination: See free text	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 2 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral examination PL 2 = other (announcement at the beginning of the semester)	

Module courses

Course: Professionalisation and Internationalisation	
Frequency: winter semester, yearly	Are there parallel courses? yes
Contact hours: 3	University teacher: N. N.
Language(s) of instruction: Englisch	
Literature: Pertinent publications and literature will be provided by the lecturers.	
Teaching method(s): Seminar	Associated module examination: Kombinationsprüfung Professionalisation and Internationalisation

Module 02-BIO-MA-MB-E01: Global Change Ecophysiology**Global Change Ecophysiology****Assignment to areas of study:**

- Profile Marine Biology / Elective modules
Profilisation and Specialisation
- Profil International Studies in Aquatic Tropical
Ecology (ISATEC) / Elective modules
Profilisation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

Climate change causes oceans to warm and stratify, sea level to rise, and Arctic summer sea ice to shrink. Warming causes oceans to lose oxygen overall and hypoxic water layers to expand. Concomitantly, the accumulation of anthropogenic CO₂ in ocean surface waters disturbs water chemistry and causes acidification. Ocean warming, deoxygenation, and acidification alter ocean ecosystems and the services they provide. As a result species are constrained to limited thermal ranges of performances which define species fitness, including their capacity to interact with each other. Recent meta-analyses indicate that ambient temperature and hypoxia extremes in some regions are already close to tolerance limits of marine organisms and their limits to evolutionary adaptation. The current picture suggests that these changes occur too fast for organisms to be able to adapt, although functional adaptation may occur on longer time scales. The course will focus on the following physiological responses: Monitoring of organism performance parameters in marine animals, energy demand and budget, metabolic changes at whole organism and cellular levels, ion and osmoregulation.

Methods: Respirometry (closed and flow-through systems), Spectrophotometry, HPLC / ion chromatography / capillary electrophoresis, Doppler and infrared sensors, Magnetic resonance imaging and spectroscopy, Protein chemistry and transcriptomics

Learning outcomes / competencies / targeted competencies:

After completion of the module, students understand the principles of acclimation and adaptation of marine animals to climate change, are able to conduct and perform scientific experiments, have acquired experience in state-of-the-art techniques for physiological and molecular investigations, have the ability to calculate, evaluate and present scientific data and to discuss scientific findings

Calculation of student workload:

40 h Exam preparation

84 h SWS / presence time / working hours

146 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Hans-Otto Pörtner

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until: SoSe 20 / -	Credit points / Workload: 9 / 270 hours
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Module examinations

Module examination: Global Change Ecophysiology	
Type of examination: module exam	
Form of examination: Internship report	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = project report	

Module courses

Course: Global Change Ecophysiology	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Dr. Gisela Lannig-Bock Prof. Dr. Hans-Otto Pörtner Dr. Christian Bock
Language(s) of instruction: Englisch	
Literature: Pörtner HO (2002) Climate variations and the physiological basis of temperature dependent biogeography: systemic to molecular hierarchy of thermal tolerance in animals. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 132(4), 739-761. Dinkwater KF, Beaugrand G, Kaeriyama M, Kim S, Ottersen G, Perry RI, Pörtner HO, Polovina JJ, Takasuka A (2010) On the processes linking climate to ecosystem changes. Journal of Marine Systems, 79(3-4), 374-388. Storch D., Menzel L., Frickenhaus S., Pörtner H.O. (2014) Climate sensitivity across the domains of life: Limits to evolutionary adaptation shape species interactions. Global Change Biology 20, 3059-3067 Pörtner HO, Karl DM, Boyd PW, Cheung WL, Lluich-Cota SE, Nojiri Y, Schmidt DN, and Zavialov PO (2014) Ocean systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R.	

Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 411-484.

Teaching method(s):

Lecture

Seminar

Laboratory class

Associated module examination:

Modulprüfung Global Change Ecophysiology

Associated module courses

Global Change Ecophysiology (Laboratory class)

Module 02-BIO-MA-MB-E02: Ecological Modelling: Populations, Climate, Conservation

Ecological Modelling: Populations, Climate, Conservation

Assignment to areas of study:

- Profile Marine Biology / Elective modules
Profilisation and Specialisation
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Elective modules
Profilisation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

- Model representation of self-organisation processes and emergent properties, analysis of causal networks
- Non spatial approaches to ecological modelling: Population dynamics age-structured approaches and with differential equations
- Spatial explicit approaches to ecological modelling: Individual-based models and Actor-based models to represent processes involving spatio-temporal dynamics, meta-population models
- Risk assessment framework (stochasticity, causes of extinction, "Population Viability Analysis" -PVA)
- Diffusion, Dispersal and connectivity processes
- Food web interactions
- Representation of biological processes in global climate models (from NPZD – nutrient, phytoplankton, zooplankton, detritus – to more sophisticated models (e.g. Geider model)
- Model use in conservation, Population dynamics of key species, MPA design
- Model parameterisation and evaluation
- Model application examples

Learning outcomes / competencies / targeted competencies:

- Participants have learned how to analyse complex interaction networks and the formal representation of complex interactions.
- Participants have learned to deal with interdisciplinary applications of systems approaches in different fields and as a management tool.
- Participants have gained basic knowledge on different mathematical representation of ecological dynamics and acquired and understood the role of models in ecological knowledge acquisition.
- Participants acquired knowledge to apply different ecological models to specific problem settings in conservation biology and climate models, including choice of modelling approach, evaluation and estimation of time and effort for the model development process

Calculation of student workload:

146 h Preparation / follow-up work

84 h SWS / presence time / working hours

40 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Hauke Reuter

Frequency: summer semester, yearly	Duration: 1 semester[s]
The module is valid since / The module is valid until: SoSe 20 / -	Credit points / Workload: 9 / 270 hours

Module examinations

Module examination: Ecological Modelling: Populations, Climate, Conservation	
Type of examination: module exam	
Form of examination: See free text	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = Poster presentation on one of the course topics with application/development of a small model	

Module courses

Course: Ecological Modelling: Populations, Climate, Conservation	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Prof. Dr. Ulrike Haug Dr. Marc Taylor Judith Hauck PD. Dr. Broder Breckling PD Dr. Hauke Reuter
Language(s) of instruction: Englisch	
Literature: Jopp, Breckling, Reuter 2011 Modelling Complex Ecological Interactions, Springer, Chapters 1-13, 23,24 Burgmann, M.A., Ferson, S. and Akcakaya, 1993. Risk assessment in conservation biology. London: Chapman & Hall. Fennel, W. Neumann, T., 2015: Introduction to the Modelling of Marine Ecosystems (Second Edition), Elsevier, ISBN 978-0-444-63363-7 Crawley, M.J., 2011. The R book, Reprinted with corrections 2009, reprinted. ed. Wiley, Chichester. Hanski, I. 1990. Metapopulation Ecology. Oxford University Press Morris, W.F., Doak, D.F. 2002. Quantitative Conservation Biology: Theory and Practise of Population Viability Analysis. Sinauer Associates, Sunderland	

Teaching method(s): Lecture Tutorial Seminar	Associated module examination: Modulprüfung Ecological Modelling: Populations, Climate, Conservation
Associated module courses Ecological Modelling: Populations, Climate, Conservation (Tutorial)	

Module 02-BIO-MA-MB-E03: Rocky Shore Ecology on Helgoland

Rocky Shore Ecology on Helgoland

Assignment to areas of study:

- Profile Marine Biology / Elective modules
Profilsation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

The structure and function of rocky shore communities will be assessed in the framework of emerging topics in marine environmental change. The course will provide an understanding of the principal biotic and abiotic factors shaping algal zonation or the distribution patterns of intertidal invertebrates, epibiosis, competitive interactions of native species and neobiota, or the impact of marine litter in the marine and coastal environment. The course will integrate physiological and ecological methods, introduce into experimental design, community analyses, physiological stress indicators, and will apply the appropriate statistical tools for each topic.

Learning outcomes / competencies / targeted competencies:

After successful completion of this course, students are familiar with basic concepts and current topics in rocky shore ecology, are capable of formulating research questions based on (their own) field observations, are able to design experiments tailored to answer the respective research questions and can apply state-of-the-art tools in community analyses and ecophysiology.

Calculation of student workload:

84 h SWS / presence time / working hours

40 h Exam preparation

146 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Kai Bischof

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

9 / 270 hours

Module examinations**Module examination:** Rocky Shore Ecology on Helgoland**Type of examination:** module exam**Form of examination:**

Oral

The examination is ungraded?

no

Number of graded components / ungraded components / prerequisites of the examination:

1 / - / -

Language(s) of instruction:

Englisch

Description:

PL 1 = oral presentation

Module courses**Course:** Rocky Shore Ecology on Helgoland**Frequency:**

summer semester, yearly

Are there parallel courses?

no

Contact hours:

6

University teacher:

Dr. Inka Bartsch

Dr. Lars Gutow

Language(s) of instruction:

Englisch

Teaching method(s):

Lecture

Seminar

Laboratory class

Associated module examination:

Modulprüfung Rocky Shore Ecology on Helgoland

Associated module courses**Rocky Shore Ecology on Helgoland** (Field trip)

Module 02-BIO-MA-MB-E05: Marine Biodiversity and Food Webs**Marine Biodiversity and Food Webs****Assignment to areas of study:**

- Profile Marine Biology / Elective modules
Profilisation and Specialisation
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Elective modules
Profilisation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

The course will introduce students to concepts and methodologies related to marine biodiversity and food webs, focusing both on plankton and benthos communities. Students will learn about abundance, biomass, taxonomic composition, and community structure of plankton and benthos communities and how to sample them. They acquire a sound knowledge of the major taxonomic groups and how to identify them. Zooplankton vertical distribution and vertical migrations will also be covered. Students will analyse biodiversity patterns with different metrics including species richness, evenness, and different biodiversity indices. Multivariate statistics will be introduced for community analysis, including cluster analysis and multi-dimensional scaling. Students will learn about population dynamics, growth, and feeding ecology of benthic communities, individual and population energy budgets, focusing on the North Sea and Wadden Sea as example regions. Data will be assembled for a basic food web model of the North Sea and compared to other climate zones on a global scale.

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students understand principles determining marine biodiversity and how to measure them. They have a sound knowledge about plankton and benthos ecology and are familiar with the major taxonomic groups. Students can apply methods to analyse biological communities. They understand population dynamics and can quantify carbon and energy fluxes through marine food webs.

Calculation of student workload:

84 h SWS / presence time / working hours

40 h Exam preparation

146 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Holger Auel

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

9 / 270 hours

Module examinations**Module examination:** Marine Biodiversity and Food Webs

Type of examination: module exam	
Form of examination: Oral	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral examination	

Module courses

Course: Marine Biodiversity and Food Webs	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Dr. Barbara Niehoff Dr. Jan Beermann PD Dr. Holger Auel Dr. Jürgen Laudien Prof. Dr. Thomas Brey Dr. Scarlett Trimborn
Language(s) of instruction: Englisch	
Literature: Pertinent publications and literature will be provided by the lecturers.	
Teaching method(s): Lecture Seminar Laboratory class	Associated module examination: Modulprüfung Marine Biodiversity and Food Webs
Associated module courses Marine Biodiversity and Food Webs (Laboratory class)	

Module 02-BIO-MA-MB-E07: Fisheries Biology

Fisheries Biology

Assignment to areas of study:

- Profile Marine Biology / Elective modules
Profilsation and Specialisation
- Profil International Studies in Aquatic Tropical
Ecology (ISATEC) / Elective modules
Profilsation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

The module introduces students to the basic concepts in fisheries biology including aspects of aquaculture as well as fisheries and aquaculture economics and management. This includes a systematic overview of the diversity of fishes, their ecological and anatomic variability as well as insights into fish husbandry and breeding and their diseases. An introduction to methods for estimating the most important biological parameters is provided to describe individual fitness and health and to model population dynamic processes as a basis for fish stock assessment and management.

During the introduction to the different elements of the course students will gain an overview on the environmental requirements of and anthropogenic impacts on aquatic living resources in open and managed systems as well as the economics thereof. During the lab practicals, students will be introduced to the comparative anatomy/morphology of fish, species identification with a focus on the north Atlantic as well as a stock structure analysis comprising: practical work with selected fish species to obtain information about fish length, weight, age, sex, maturity status, common diseases and parasites as well as immune status estimation; preparation of fish otoliths for age reading; based on data obtained from the practical work with fish, students will investigate fish stock demography and extract basic information needed to describe and model fish population dynamics, such as size and age structure of the stock, sex ratios, maturity ogives and aspects related to fish nutrition, such as condition factor. Students will apply basic population dynamic equations to determine e.g. mortality and growth rates of fish. Lectures will be given on aquaculture as a form of husbandry of fish and other aquatic organisms in controlled conditions.

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students have a basic understanding of the taxonomy, ecology and evolution of fish, their biodiversity and interactions with environmental variables. They will comprehend general concepts in fishery biology, e.g. determining fish stock structures and are able to apply the fundamental equations of population dynamics to determine mortality and growth rates of exploited fish populations. Students have gained insight into the principles of fish stock assessment and management including economic and social dimension of fisheries as well as into basics of aquaculture. Students are able to explain different fishing gears and production technologies and to critically evaluate the impacts of fisheries and aquaculture on fish stocks, habitats and ecosystems.

Calculation of student workload:

84 h SWS / presence time / working hours

40 h Exam preparation

146 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction: English	Responsible for the module: Dr. Gerd Kraus
Frequency: summer semester, yearly	Duration: 1 semester[s]
The module is valid since / The module is valid until: SoSe 22 / -	Credit points / Workload: 9 / 270 hours

Module examinations

Module examination: Modulprüfung Fisheries Biology	
Type of examination: module exam	
Form of examination: Oral	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral examination	

Module courses

Course: Fisheries Biology	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Christoph Stransky Jörn Scharsack Karl-Michael Werner Dr. Martin Werner Dr. Gerd Kraus Dr. Marko Freese Anna Akimova
Language(s) of instruction: Englisch	
Literature: Pertinent publications and literature will be provided by the lecturers.	
Teaching method(s): Lecture Seminar Laboratory class	Associated module examination: Modulprüfung Fisheries Biology
Associated module courses	

Module 02-BIO-MA-MB-E08: Marine Molecular Biology**Marine Molecular Biology****Assignment to areas of study:**

- Profile Marine Biology / Elective modules
Profilsation and Specialisation
- Profil International Studies in Aquatic Tropical
Ecology (ISATEC) / Elective modules
Profilsation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

The course provides theoretical and practical foundations for using molecular methods in marine biodiversity and micro- and macro-evolutionary research. Overview lectures and hands-on practicals lead the students from laboratory protocols through data analysis to interpretation. A) The main topics are: 1- marine molecular ecology: an overview of methods and approaches 2- introduction to molecular phylogenetics and phylogeography: the tree of life; phylogenetic marker sequences and their evolution and species identification via DNA barcoding 3 - sequence analysis basics: sequence alignment, search tools (e.g. BLAST), primer design and in silico evaluation (e.g. intro to ecoPrimers and ecoPCR), and phylogenetic inference 4 - population genetics basics: intraspecific genetic variation and markers; linkage disequilibrium, Hardy-Weinberg, population structure 5 - genotyping and fragment analysis; microsatellite, ddRADSeq and PoolSeq data analysis 6 - Introduction to landscape/seascape genetics 7 - high throughput sequencing in marine molecular ecology: Metabarcoding and metagenomics 8 - An introduction to gene expression and transcriptomics 9 - Case studies B) Methodologies, applied in the laboratory part: 1- DNA extraction and quality checking: (spectrophotometry - NanoDrop, fluorometer (Qubit or others), gel electrophoresis - Bioanalyser) 2- PCR amplification of marker sequences (ribosomal DNA sequences) 3- - High resolution genotyping methods: microsatellites, (dd)RADSeq, PoolSeq): laboratory methods and fragment analysis 4-- Metabarcoding libraries, sequencing, and analysis.

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students have an understanding of the principles of molecular evolution, phylogenetics and population genetics as applied in marine biodiversity research. Application of basic methods of molecular phylogenetics and populations genetics from bench work to data analysis. Learn outcome: Understanding the specific application ranges of different types of molecular markers and their survey methods.

Ability to design and conduct a molecular phylogenetic or population genetic survey in a specific project. An understanding of high-throughput sequencing studies including metabarcoding, metagenomics and transcriptomics

Competence in the interpretation and transfer of problems and concepts in molecular biodiversity research and the ability to present and discuss in an audience. They are able to produce scientific posters and generate oral presentations

Calculation of student workload:
 146 h Preparation / follow-up work
 84 h SWS / presence time / working hours
 40 h Exam preparation

Are there optional courses in the modules?
 no

Language(s) of instruction: English	Responsible for the module: Prof. Dr. Bela H. Buck
Frequency: summer semester, yearly	Duration: 1 semester[s]
The module is valid since / The module is valid until: SoSe 22 / -	Credit points / Workload: 9 / 270 hours

Module examinations

Module examination: Modulprüfung Marine Molecular Biology	
Type of examination: module exam	
Form of examination: Oral	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral examination	

Module courses

Course: Marine Molecular Biology	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Dr. Charlotte Havermans
Language(s) of instruction: Englisch	
Literature: Pertinent publications and literature will be provided by the lecturers	
Teaching method(s): Lecture Seminar Laboratory class	Associated module examination: Modulprüfung Marine Molecular Biology

Associated module courses

Marine Molecular Biology (Laboratory class)

Module 02-BIO-MA-MB-E10: Productivity, Trophic Interactions and Functional Biodiversity of Pelagic Communities Throughout the Atlantic Ocean and Their Impact on the Carbon Cycle

Productivity, Trophic Interactions and Functional Biodiversity of Pelagic Communities Throughout the Atlantic Ocean and Their Impact on the Carbon Cycle

Assignment to areas of study:

- Profile Marine Biology / Elective modules
Profilisation and Specialisation
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Elective modules
Profilisation and Specialisation

Content-related prior knowledge or skills:

Application by letter of motivation. Examination candidates are given preference.

Learning content:

Ship-based research and training expedition on different research vessels and to different target regions with a focus on the biology of pelagic ecosystems and biological oceanography.

Learning outcomes / competencies / targeted competencies:

Students

- are able to apply a broad spectrum of modern marine biological and oceanographic methods at sea.
- can deploy different plankton nets and water samplers to collect planktonic organisms on board.
- understand the relationship between different hydrographic parameters and the biological productivity of different ocean regions and the distribution of pelagic organisms.
- know basics of biodiversity and identification of zooplankton organisms.

Calculation of student workload:

30 h Exam preparation

240 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Holger Auel

Frequency:

Duration:

The module is valid since / The module is valid until:

SoSe 22 / -

Credit points / Workload:

9 / 270 hours

Module examinations

Module examination: Modulprüfung Productivity, Trophic Interactions and Functional Biodiversity of Pelagic Communities Throughout the Atlantic Ocean and Their Impact on the Carbon Cycle

Type of examination: module exam

Form of examination:

Project report

The examination is ungraded?

no

Number of graded components / ungraded components / prerequisites of the examination:

1 / - / -

Language(s) of instruction:

Englisch

Description:

Project report consisting of a written report and video documentation of the project work

Module courses**Course:** Biodiversity of Pelagic Communities Throughout the Atlantic Ocean and Their Impact on the Carbon Cycle**Frequency:****Are there parallel courses?**

no

Contact hours:

8

University teacher:

PD Dr. Holger Auel

Language(s) of instruction:

Englisch

Additional comments:

Lab course at sea

Block course, by arrangement

Course can optionally also be recognized for module MB-F with 3 CP

Attendance time is at least 6 SWS, usually 8 SWS and varies depending on the expedition

Teaching method(s):

Laboratory class

Associated module examination:

Modulprüfung Productivity, Trophic Interactions and Functional Biodiversity of Pelagic Communities Throughout the Atlantic Ocean and Their Impact on the Carbon Cycle

Module 02-BIO-MA-MB-E11: Aquaculture Practical

Aquaculture Practical

Assignment to areas of study:

- Profile Marine Biology / Elective modules
Profilsation and Specialisation
- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Elective modules
Profilsation and Specialisation

Content-related prior knowledge or skills:

Basic knowledge in water chemistry (nutrient cycles, nitrification/denitrification), biology of marine organisms

Learning content:

Students will gain an insight into current topics in marine aquaculture, with a practical focus on recirculating aquaculture (RAS). In addition to the basics in global production, the techniques used from land to sea, and the topics of feed, ecological consequences and its solutions, the course includes comprehensive information on the design and installation of a RAS plant, its technical processes, the treatment of process water, hydraulic residence times, nutrient budgets including nitrification and denitrification, and process engineering aspects. Practical demonstrations of the operating and feeding regimes will be carried out on different target species.

Practical issues could be linked to the following research projects: <https://www.awi.de/en/science/special-groups/aquaculture.html>

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students have an understanding of concepts of modern aquaculture approaches, their respective advantages and disadvantages. Students are able to evaluate the suitability of aquaculture approaches to a specific environmental and socioeconomic setting.

Calculation of student workload:

146 h Preparation / follow-up work
84 h SWS / presence time / working hours
40 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Bela H. Buck

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 22 / -

Credit points / Workload:

9 / 270 hours

Module examinations

Module examination: Modulprüfung Aquaculture Practical

Type of examination: module exam

Form of examination: Presentation, oral	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral presentation	

Module courses

Course: Aquaculture Practical	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: N. N. Prof. Dr. Bela H. Buck Dr. Matthew James Slater
Language(s) of instruction: Englisch	
Literature: Pertinent publications and literature will be provided by the lecturers during the first week. For the practical course, in addition to information from the internet and relevant papers, the following book is recommended: Recirculating Aquaculture by Timmons et al.	
Teaching method(s): Lecture Seminar Laboratory class	Associated module examination: Modulprüfung Aquaculture Practical
Associated module courses	
Aquaculture Practical (Laboratory class)	

Module 02-BIO-MA-MB-C: Tropical Coastal Ecosystems**Tropical Coastal Ecosystems****Assignment to areas of study:**

- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

The lecture will give an introduction into general characteristics of the tropics (geography, climate, trade winds and monsoon influence, major currents etc.) and coastal ecosystems (tides, marine-terrestrial gradients, etc.). Tropical coastal habitats will be introduced in detail (mangroves, coral reefs, sandy beaches, mudflats, rocky shores, seagrass meadows). Interactions and connectivity of individual ecosystems with each other will be addressed as well as biodiversity, productivity, biomass and turnover. Examples will be presented from current and former projects of the ZMT. The economic and social importance of these ecosystems for local populations and human influences, as well as issues of coastal conservation and management are discussed

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students are able to understand structure and functioning of tropical coastal ecosystems. They are able to critically evaluate anthropogenic impacts and their consequences for marine communities and coastal populations.

Calculation of student workload:

56 h SWS / presence time / working hours

84 h Preparation / follow-up work

40 h Exam preparation

Are there optional courses in the modules?

yes

M.Sc. Marine Biology (compulsory module for ISATEC students; elective module for Marine Biology students)

Language(s) of instruction:

English

Responsible for the module:

PD Dr. Holger Auel

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

6 / 180 hours

Module examinations**Module examination:** Tropical Coastal Ecosystems**Type of examination:** module exam**Form of examination:**

Written examination

The examination is ungraded?

no

Number of graded components / ungraded components / prerequisites of the examination:

1 / - / -

Language(s) of instruction:

Englisch

Description:

PL 1 = wirtten exam

Module courses

Course: Tropical Coastal Ecosystems

Frequency:

winter semester, yearly

Are there parallel courses?

no

Contact hours:

4

University teacher:

Prof. Dr. Claudio Richter

Prof. Dr. Martin Zimmer

Language(s) of instruction:

Englisch

Literature:

Pertinent publications and literature will be provided by the lecturers.

Teaching method(s):

Lecture

Seminar

Associated module examination:

Modulprüfung Tropical Coastal Ecosystems

Module 02-BIO-MA-MB-E04: Costal Planning, Management and Governance

Costal Planning, Management and Governance

Assignment to areas of study:

- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Compulsory modules

Content-related prior knowledge or skills:

none

Learning content:

Marine sciences requires an understanding of the human dimension. This course gives an introduction to methods, theories, concepts and approaches in the field of marine social sciences. Social-ecological systems and their resilience, sustainability and sustainable development are important concepts to be taught. Marine governance is at the centre of the course, and is dealt with in an interdisciplinary social science perspective, ranging from law to planning, ecological economics and environmental psychology. Interdisciplinarity between natural and social sciences is addressed. Important social science methods applied in the field are introduced, like participatory methods, stakeholder analysis, surveys, economic valuation and social science experimental design.

Learning outcomes / competencies / targeted competencies:

- Students, who successfully participated in the course, have
- knowledge of basic social science research principles for natural scientists
- an overview of social science theories and methods applied in marine and coastal research contexts
- understood the legal and ethical considerations of participatory research
- understood the importance, potential, pathways, and complexities of inter- and transdisciplinary research
- an overview of the law of the sea and environmental maritime law
- an overview of social-ecological systems concepts and ecological economics

Calculation of student workload:

188 h Preparation / follow-up work

60 h Exam preparation

112 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Dr. Achim Schlüter

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

12 / 360 hours

Module examinations

Module examination: Costal Planning, Management and Governance

Type of examination: module exam

Form of examination: Oral	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral examination	

Module courses

Course: Coastal Planning, Management & Governance including Law of the Sea and International Environmental Marine Law	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 8	University teacher: Dr. Bernhard Fuchs Dr. Sebastian Ferse Dr. Stefan Partelow Dr. Achim Schlüter Matthias Füracker Dr. Annette Breckwoldt
Language(s) of instruction: Englisch	
<p>Literature:</p> <p>Aust A (2005) Handbook of International Law. Cambridge University Press.</p> <p>Bernard R (2006) Research Methods in Anthropology, 4th Edition. Lanham, MD: AltaMira Press.</p> <p>Bryman A (2001) Social Research Methods. Oxford, UK: Oxford University Press.</p> <p>Bunce L, Townsley P, Pomeroy RS, Pollnac R (2000) Socioeconomic Manual for Coral Reef Management. Townsville, Australia: Global Coral Reef Monitoring Network (GCRMN) and Australian Institute of Marine Science (AIMS).</p> <p>Churchill RR, Lowe AV (1999). The law of the sea. Manchester University Press.</p> <p>Common M, Stagl S (2005) Ecological Economics: an introduction. University Press, Cambridge.</p> <p>Dixon M (2007) Textbook on International Law. Oxford University Press.</p> <p>Oeberg G (2011) Interdisciplinary Environmental Studies: A Primer. Wiley-Blackwell.</p> <p>Poteete AR, Janssen M, Ostrom E (2010) Working Together: Collective Action, the Commons and Multiple Methods in Practice. University Press, Princeton.</p> <p>Sohn LB (1984) The Law of the Sea: in a Nutshell St. Paul: West Public.</p> <p>United Nations Convention on the Law of the Sea of 1982.</p> <p>Apart from the mentioned textbooks the course is mainly based on recent research articles, showing practical examples of tropical coastal marine social science or social ecological science research.</p>	

Teaching method(s): Lecture Tutorial Seminar Field trip	Associated module examination: Modulprüfung Coastal Planning, Management and Governance
Associated module courses Coastal Planning, Management & Governance (Tutorial) Law of the Sea and International Environmental Marine Law (Tutorial)	

Module 02-BIO-MA-MB-E06: Cell Physiology of Marine Organisms**Cell Physiology of Marine Organisms****Assignment to areas of study:**

- Profil International Studies in Aquatic Tropical Ecology (ISATEC) / Elective modules
Profilisation and Specialisation

Content-related prior knowledge or skills:

none

Learning content:

In this course, the students will deepen their knowledge of cell physiology of marine ectotherms such as fish and bivalves. The topics will be i) environmental impact on function of cells and mitochondria, ii) aerobic and anaerobic energy metabolism, iii) cellular energy budget and metabolite status and iv) analytical Nuclear Magnetic Resonance (NMR) techniques. The students will be introduced to the following methods i) isolation and preparation of primary cells/tissue samples, ii) respirometry (closed and flow-through systems), iii) spectrophotometry and iv) NMR spectroscopy. Students will be involved in the conceptual development of experiments, perform in vivo experiments on freshly isolated cells/tissue samples, quantify cellular processes (e.g. ATP-synthesis, protein synthesis) and identify a selective number of metabolites to detect changes from "normality" (metabolic fingerprinting).

Learning outcomes / competencies / targeted competencies:

Upon completion of the module, students are able to comprehend general concepts of marine biology and biological oceanography. They are able to use scientific identification keys and to identify the major taxa of marine algae and invertebrates. Students are able to explain different fisheries and aquaculture techniques and to critically evaluate the impacts of fisheries on marine ecosystems. They are able to produce scientific posters and generate oral presentations.

Calculation of student workload:

84 h SWS / presence time / working hours

70 h Exam preparation

116 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Dr. Gisela Lannig-Bock

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

9 / 270 hours

Module examinations**Module examination:** Cell Physiology of Marine Organisms**Type of examination:** module exam

Form of examination: Oral	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = oral examination	

Module courses

Course: Cell physiology of marine organisms: cellular energy budget and metabolic fingerprinting	
Frequency: summer semester, yearly	Are there parallel courses? no
Contact hours: 6	University teacher: Dr. Gisela Lannig-Bock Dr. Christian Bock
Language(s) of instruction: Englisch	
Literature: Pertinent publications and literature will be provided by the lecturers.	
Teaching method(s): Lecture Seminar Laboratory class	Associated module examination: Modulprüfung Cell Physiology of Marine Organisms

Module 02-BIO-MA-MB-H Application: Module Master Thesis (incl. Colloquium)
 Module Master Thesis (incl. Colloquium)
Assignment to areas of study:

- Master thesis

Content-related prior knowledge or skills:

none

Learning content:

As the concluding module of the MSc programme, it comprises the research-specific objectives, methodologies, **practical work**, data analysis and critical evaluation as well as thesis writing and defence.

Thereby, the students will investigate a specific research question.

The module Master Thesis aims at the training and individual independent performance of a research project under supervision of a senior scientist in the framework of inquiry-based learning. The master thesis project is supervised and conducted under the conditions of the respective department at the University of Bremen and the examination regulations of the respective study programme.

The module includes compulsory elective choices (Wahlpflicht WP) of 24 weeks (or upon request 28 weeks):

WP1: The practical work is conducted in a research group at the University of Bremen

WP2: The practical work is conducted as internship student integrated in an external national or international research group.

Learning outcomes / competencies / targeted competencies:

The graduates will have a proven level of knowledge and understanding of marine biology and related disciplines, with particular expertise in their specific field of research. They will be able to apply their academic knowledge and understanding in a broad and multidisciplinary context and acquire new knowledge. They will know how to approach and to conduct a largely self-directed complex scientific project (including analytical applications), solve problems and present and defend their data and conclusions to a scientific auditorium. They have learned to manage and complete a clearly defined research project within a given time frame (24 weeks).

Calculation of student workload:

900 h Preparation / follow-up work

Are there optional courses in the modules?

yes

The module includes compulsory elective choices (Wahlpflicht WP) of 24 weeks (or upon request 28 weeks):

WP1: The practical work is conducted in a research group at the University of Bremen

WP2: The practical work is conducted as internship student integrated in an external national or international research group

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Kai Bischof

Frequency:

each semester

Duration:

1 semester[s]

The module is valid since / The module is valid until: SoSe 20 / -	Credit points / Workload: 30 / 900 hours
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Module examinations

Module examination: Master Thesis (incl. Colloquium)	
Type of examination: module exam	
Form of examination: Master Thesis	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 2 / - / -	
Language(s) of instruction: Englisch	
Description: PL 1 = Master Thesis 75% PL 2 = Colloquium 25%	

Module examination: Master Thesis	
Type of examination: module exam	
Form of examination: Master Thesis	The examination is ungraded? no
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module examination: Colloquium	
Type of examination: module exam	
Form of examination: Colloquium	The examination is ungraded? yes
Number of graded components / ungraded components / prerequisites of the examination: 1 / - / -	
Language(s) of instruction: Englisch	

Module courses

Course: Master Thesis incl. Colloquium	
Frequency: each semester	Are there parallel courses? no
Contact hours: -	University teacher: N. N.

Language(s) of instruction:

Englisch

Teaching method(s):

Self-study unit

Associated module examination:

Master Thesis (incl. Colloquium)

Associated module courses**Marine Biology Master Thesis and Colloquium (ISATEC)** (Seminar)**Marine Biology Master Thesis and Colloquium (MarBioI)** (Seminar)

Module 02-BIO-MA-0-MB: Supplementary Courses in the Master Marine Biology

Supplementary Courses in the Master Marine Biology

Assignment to areas of study:

- Supplementary Courses

Content-related prior knowledge or skills:

none

Learning content:
Learning outcomes / competencies / targeted competencies:
Calculation of student workload:
Are there optional courses in the modules?

no

Language(s) of instruction:

German / English

Responsible for the module:

N.N.

Frequency:

(depending on capacity) winter or summer semester

Duration:

1 semester[s]

The module is valid since / The module is valid until:

WiSe 23/24 / -

Credit points / Workload:

0 / 0 hours

This module is ungraded!

Module examinations

Module examination: with examination or without examination

Type of examination: module exam

Form of examination:

See free text

The examination is ungraded?

no

Number of graded components / ungraded components / prerequisites of the examination:

- / 1 / -

Language(s) of instruction:

Englisch

Description:

with examination or without examination

Module courses

Course: Lab Safety and Fire Prevention Workshop (in English)

Frequency:

(depending on capacity) winter or summer semester

Are there parallel courses?

no

Contact hours:
University teacher:

N. N.

Language(s) of instruction: Englisch	
Teaching method(s): Lecture Tutorial	Associated module examination: with examination or without examination
Associated module courses	
Lab Safety and Fire Prevention Workshop (in English) (Lecture)	
Course: Introduction to the Master program	
Frequency: winter semester, yearly	Are there parallel courses? no
Contact hours:	University teacher: N. N.
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	Associated module examination: with examination or without examination
Course: Jour fixe	
Frequency: (depending on capacity) winter or summer semester	Are there parallel courses? no
Contact hours:	University teacher: N. N.
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	Associated module examination: with examination or without examination
Course: Jour fixe	
Frequency: (depending on capacity) winter or summer semester	Are there parallel courses? no
Contact hours:	University teacher: N. N.
Language(s) of instruction: Englisch	
Teaching method(s): Lecture	Associated module examination: with examination or without examination