

WADDEN SEA

Erasmus+



DYNAMIC SYSTEM AND NATURAL HERITAGE

An international Programme for Erasmus+ exchange students
in Germany

Module handbook



If you are interested in getting to know a unique and fascinating marine as well as terrestrial ecosystem, the Erasmus+ exchange programme Wadden Sea is the right thing for you! Covering one semester (April-September), this programme covers different aspects of oceanography, microbiology and biodiversity of this very special coastal area influenced by a large tidal range. The Wadden Sea will also be studied in respect to nature conservation, anthropogenic pressures and ecosystem based management. With broad expertise in interdisciplinary studies and transdisciplinary projects, the University of Oldenburg, is an excellent place to study the ecology and the sustainable management of ecosystems – close to the sea!

Course table and module description



The programme starts every summer semester in April. All courses are given in English. The programme is tailored to master students of environmental or marine sciences or of an environmental management related Master programmes at one of our Erasmus+ partner universities. Bachelor students in their 5th semester are also welcome to apply!

Compulsory modules

M1: Wadden Sea Programme Introduction
– 6 ECTS

M2: Dynamics of the Wadden Sea World Heritage Site
– 6 ECTS

Specialization modules (select up to 3 modules)

M3: Ecology of Marine Microbial Communities
– 6 ECTS

M4: Microbial Ecology of Marine Sediments
– 9 ECTS

M5: Marine Biodiversity Change
– 9 ECTS

M6: Functional Ecology
– 6 ECTS

M7: Coastal Management
– 6 ECTS

M8: Environmental Management
– 6 ECTS

Transcript of records with up to 30 ECTS

The Erasmus+ programme consists of two compulsory modules (1 & 2) with 6 ECTS each. Then, each student can build his or her own curriculum containing up to three modules with 6-9 ECTS each. The selection can be made out of a set of modules on microbiology, biodiversity and ecosystem management. At the end, you can fulfill this programme with up to 30 ECTS, if you need less credit points for your home university, you can choose less than three of the selective modules. The curriculum may be subject to change.



Module 1—Wadden Sea introduction (compulsory)

1st part: Wadden Sea – programme introduction at the beginning of the programme

- Excursion to the Wadden Sea Island Spiekeroog
- Get to know each other and the programme

Excursion 3 ECTS

2nd part: Wadden Sea – programme synopsis at the end of the programme

- Wadden Sea – Review and reflection of results

Seminar 3 ECTS

Module 2—Dynamics of the Wadden Sea world heritage site (compulsory)

- Wadden Sea – World Natural Heritage Site
- Wadden Sea biotopes and nature conservation
- Regional oceanography

Lecture 1 ECTS

Seminar 2 ECTS

Lecture 3 ECTS

Module 3 – Ecology of Marine Microbial Communities - (elective)

- Biological significance of suspended matter
- Microbial ecology

Lecture 3 ECTS

Lecture 3 ECTS

Module 4 – Microbial Ecology of Marine Sediments - (elective)

- Sediment microbiology
- Microbial ecology of marine sediments

Lecture 3 ECTS

Practical 6 ECTS

Module 5 – Marine Biodiversity Change - (elective)

- Functional consequences of marine biodiversity change
- Functional consequences of marine biodiversity change

Seminar 3 ECTS

Practical 6 ECTS

Module 6 – Functional Ecology - (elective)

- Coastal and regional biotope types
- Functional ecology of communities in spatiotemporally heterogeneous landscapes

Lecture 3 ECTS

Seminar 3 ECTS

Module 7 – Coastal Management - (elective)

- Protected areas and regional development
- Integrated coastal zone management

Seminar 3 ECTS

Excursion 3 ECTS

Module 8 – Environmental Management - (elective)

- Economics of climate change
- International environmental governance

Seminar 3 ECTS

Seminar 3 ECTS

Module 1—Wadden Sea introduction (compulsory)

1st part: Wadden Sea – programme introduction at the beginning of the programme

- Excursion to the Wadden Sea Island Spiekeroog
 - Get to know each other and the programme
- Excursion 3 ECTS

2nd part: Wadden Sea – programme synopsis at the end of the programme

- Wadden Sea – Review and reflection of results
- Seminar 3 ECTS

Assessment:	Oral presentation incl. discussion
Managing lecturer:	Dr. Ferdinand Esser
Lecturers:	Prof. Dr. Ingo Mose, Dr. Thomas Klenke, Dr. Birte Junge, Priv. Doz. Dr. Holger Freund and a group of lecturers of the programme
Prerequisites/corequisites:	none

Topical Classes, Modes of Teaching:

1st part: Wadden Sea – Programme introduction: Excursion to the Wadden Sea Island Spiekeroog, get to know each other and the programme (3 ECTS);

2nd part: Wadden Sea – programme synopsis at the end of the programme, Review and reflection of results Seminar (3 ECTS).

Aims and Content

- to socialise with students and staff
- to provide an overview of keys of the Wadden Sea heritage
- to synthesise fragmented facts and results of individual studies of the exchange students
- to provide a forum for the exchange students to communicate own work with other students and an experienced audience.



Learning outcomes:

- Students will be enabled to understand and apply advanced conceptual frameworks covered in the module to interpret coastal dynamic systems.
- Students will have an advanced understanding

of and be able to interpret the interactions between

- human and 'natural' environmental processes.
- Students will be able to demonstrate a good grasp of the challenges involved in the interdisciplinary study of coastal systems and transdisciplinary approaches to the management of such systems.
- Students will develop skills in the interpretation and application of conceptual frameworks for understanding dynamic ecosystems and human impacts on such systems through individual work on case studies.
- Students will be able to apply the ideas covered in the course to formulate proposals for intervention strategies or research in science based coastal management.
- Students will understand how concepts and theories of environmental sciences and coastal management have been tested empirically using different approaches to formulate a sound conceptual framework, suitable to undertake a master's level dissertation focused on a specific aspect of fundamental ecosystem research or ecosystem based management.
- Students will be familiar with the German university system.
- Students will have basic knowledge of the German language.
- Students will be enabled to debate ideas, while recognizing and respecting the viewpoints of others.
- Students will be trained in verbal presentation and written communication.
- Students will be trained in team work in a workshop format.

Module 2—Dynamics of the Wadden Sea

World heritage site (compulsory)

• Wadden Sea – World Natural Heritage Site	Lecture	1 ECTS
• Wadden Sea biotopes and nature conservation	Seminar	2 ECTS
• Regional oceanography	Lecture	3 ECTS

Assessment:	Written thesis (portfolio)
Managing lecturer:	Prof. Dr. Ingo Mose
Lecturers:	Prof. Dr. Ingo Mose, Prof. Dr. Gudrun Massmann, Prof. Dr. Luise Giani
Prerequisites/corequisites:	none

Topical Classes, Modes of Teaching:

Wadden Sea - world nature heritage site (1 ECTS);
Wadden Sea biotopes and nature conservation (2 ECTS);
Regional oceanography (3 ECTS)

Aims and Content

The module is

- to focus the Wadden Sea as a World Natural Heritage Site and the means of protection connected with this international status of UNESCO
- to focus the to focus biodiversity of the unique Wadden Sea ecosystem including physiological processes
- to consider biodiversity as foundation of nature conservation and management
- to be familiarised with the interrelation of biotopes and geotopes and soil-water interactions
- to focus the flow of energy and matter in the Wadden Sea basins and the exchange with the open North Sea, respectively
- to reflect on recent results of coastal environmental studies and modelling.



Learning outcomes:

- Students will understand the character of UNESCO World Natural Heritage Sites and the challenges connected with this status.
- Students will be enabled to understand and apply advanced biological and physico-chemical frameworks covered in the module to interpret coastal bio-physical dynamic systems.
- Students will have an advanced understanding of and be able to interpret the interactions between human and fundamental environmental processes of the Wadden Sea.
- Students will have an advanced understanding of analytical methods and models in coastal environmental sciences.
- Students will be able to apply knowledge introduced in the course to formulate opinions on research for science based coastal management.
- Students will understand concepts and theories of environmental sciences, in particular in the field of biodiversity, ecosystem services and complex systems.
- Students will be enabled to work with scientific literature.
- Students will be trained in written communication.

Module 3 – Ecology of Marine Microbial Communities - (elective)

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|---|---------|--------|
| • Biological significance of suspended matter | Lecture | 3 ECTS |
| • Microbial ecology | Lecture | 3 ECTS |

Assesment: Written tests (or several short tests) about the contents of the lectures.

Managing lecturer: Prof. Dr. Heribert Cypionka / Prof. Dr. Meinhard Simon

Lecturers: Prof. Dr. Peter Schupp; Dr. Bert Engelen; Dr. Maren Striebel

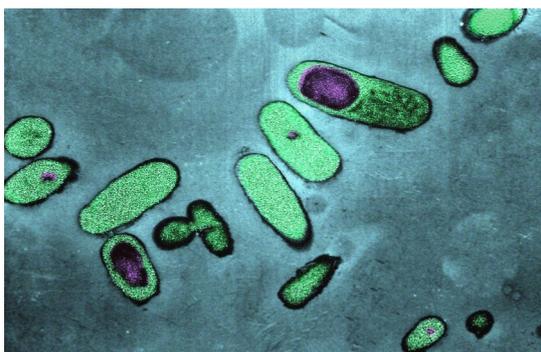
Prerequisites/corequisites: none

Aims and Content

- The lecture “**Biological significance of suspended matter**” presents:
 - * Origin, classification and distribution in waters analytics,
 - * transport and sedimentation, aggregation and
 - * aggregate formation mechanisms, case studies of aggregation
 - * events, microbial colonization, microbial
 - * metabolism activity, structural analysis of aggregateassociated
 - * bacterial communities.
- The lecture “**Microbial Ecology**” presents principles of biogeochemistry, global element cycles, mineralization of organic substances, chemotaxis, aquatic habitats, terrestrial habitats, deep subsurface biosphere, syntrophy and symbiosis, microbes in earth history, methods in microbial ecology, isotope fractionation, applied microbiology, bioremediation.

Learning outcomes:

- **Biological significance of suspended matter:** The students know the basics of microbial ecology and the biogeochemistry of important microbial habitats. They know molecular and chemical-analytical methods of microbiology. The have experience with the field study of microorganisms.
- **Microbial ecology:** They know the basics of microbial ecology and the biogeochemistry of important microbial habitats. Students know molecular and chemical-analytical methods of microbiology. The have experience with the field study of microorganisms.



Module 4 – Microbial Ecology of Marine Sediments - (elective)

• Sediment microbiology	Lecture	3 ECTS
• Microbial ecology of marine sediments	Practical	6 ECTS

Assessment:	Written thesis (portfolio)
Managing lecturer:	Dr. Bert Engelen
Lecturers:	Dr. Bert Engelen; Heribert Cypionka
Prerequisites / corequisites:	none

Aims and Content

- The lecture ***Sediment Microbiology*** presents state of the art knowledge about occurrence, life and activities of microorganisms in these environments. Physiological issues are addressed as well as evolutionary and applied aspects. Topics are:
 - * Formation, diagenesis and special features of sediments
 - * physico-chemical conditions and geological records
 - * interpretation of gradients
 - * microbes and biological processes in sediments
 - * methods for cultivation of sediment organisms
 - * molecular methods
 - * biogeochemical methods
 - * quantification of prokaryotes and viruses
- ***Microbial ecology of marine sediments***: The physiological diversity of microorganisms and their spatial distribution within marine sediments are demonstrated according to chemical and physical parameters. Different physiological groups are analysed along the sediment column of intertidal sandflat or beach. Sediment sampling is performed at the back barrier area of the island “Spiekeroog” at the beginning of the course. Oxygen penetration, porewater sulfate and methane concentrations are measured down to a depth of app. 5 meters. As microbiological parameters, total cell numbers are counted and the numbers of archaea and bacteria are calculated after quantitative PCR (qPCR). More specifically, the relative amounts of sulfate reducers and methanogens are also determined by qPCR targeting key-genes for sulfate reduction and methanogenesis. Furthermore, every single group of students will specifically enrich one physiological type of microorganisms from distinctive sediment layers. Microbial growth and activity

are monitored over the whole period of the course. Accompanying the course, all participants will give a talk to introduce “their” physiological group concerning its ecology, physiology, and strategies for a specific enrichment. All the data and observations of the single groups will be combined at the end of the course to draw an overall picture of microbial diversity and the occurrence of the different physiological groups corresponding to relevant geochemical gradients.

Learning outcomes:

- ***Sediment microbiology***: Introduction into sediment microbiology including anaerobic processes, energy metabolism, cultivation of sediment bacteria, adaptation to environmental conditions, molecular biological methods, quantification of microorganisms and sampling at sea.
- ***Microbial ecology of marine sediments***: Physico-chemical conditions, microbial processes and methods of studying these processes in sediments. Intensive description of a several meter long sediment core from a North Sea tidal flat. Sediment sampling, measurement of geochemical profiles, cell counts, molecular quantification of phylogenetic and physiological groups and cultivation of various phenotypes from different sediment horizons. The experiments are carried out, typically in groups of two students guided by a teacher or PhD student. The seminar will be held by the students to introduce the other students into the specific physiologic guild they are working with. The results are documented and discussed in a protocol fulfilling scientific level requirements.



Module 5 – Marine Biodiversity Change - (elective)

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|---|-----------|--------|
| • Functional consequences of marine biodiversity change | Seminar | 3 ECTS |
| • Functional consequences of marine biodiversity change | Practical | 6 ECTS |

Assessment: Presentation, homework, written examination, practical training about the contents of the lectures.
Managing lecturer: Prof. Helmut Hillebrand
Lecturers: Dr. Stefanie Moorthi, Dr. Maren Striebel
Prerequisites/corequisites: none

Aims and Content

- The lecture functional consequences of Functional consequences of marine biodiversity change
- The practical course 'Functional consequences of marine biodiversity change' is conceived for Master Students who have basic knowledge in ecological principles and lab skills. This course covers current topics of marine biodiversity research and is associated to scientific projects of the Planktology group. As starting point one focus of the

course is literature work related to the scientific background of the experiment. Lab and /or field experiments from small to large scale are conducted and the students are involved in a variety of different sampling and lab procedures related to the experiments. Data handling and analysis as well as the presentation of the data are another main focus of the course.



Module 6 – Functional Ecology - (elective)

- Coastal and regional biotope types – Lecture – 3 ECTS
- Functional ecology of communities in spatiotemporally heterogeneous landscapes – Seminar – 3 ECTS

Assessment: Written thesis (portfolio)

Managing lecturer:

Lecturers: Prof. Dr. Michael Kleyer

Prerequisites/corequisites:

Aims and Content

Coastal and regional biotope types
Functional ecology of communities in spatio-temporally heterogeneous landscapes

Learning outcomes:

Coastal and regional biotope types
Functional ecology of communities in spatio-temporally heterogeneous landscapes



Module 7 – Coastal Management - (elective)

- Protected areas and regional development – Seminar – 3 ECTS
- Integrated coastal zone management – Excursion – 3 ECTS

Assesment:	Written tests (or several short tests) about the contents of the lectures.
Managing lecturer:	Prof. Dr. Ingo Mose
Lecturers:	Prof. Dr. Ingo Mose, Dr. Leena Karrasch, NN
Prerequisites/corequisites:	none

Aims and Content

- to address the dynamics of land-use conflicts emerging from competing interests and actors in coastal areas and the need for steering and management
- to provide an overview of the concept of Integrated Coastal Zone Management and the underlying targets
- to learn to know Integrated Coastal Zone Management in practice by the example of selected areas of action
- to address the specific needs for nature conservation in coastal areas and other types of landscapes
- to learn to know conceptual, strategic and instrumental approaches to nature conservation with a special focus on large protected areas
- to explore and discuss the implications of area protection for regional development and the potential synergies but also conflicts that may result from it

Learning outcomes:

- students will understand the character of Integrated Coastal Zone Management and its potential applications on the German North Sea coast
- students will have learned to know selected actors and areas of action connected involved in Integrated Coastal Zone Management
- students will understand the specific needs for nature conservation in coastal areas and beyond
- students will be able to distinguish different conceptual approaches to area protection and their specific targets and values
- students will be able to reflect about the different needs for land-use management with special emphasis on environmental demands and in a sustainability perspective



Quelle Satellitenbild: Landsat 7 ETM. Copyright 2003 Common Wadden-Sea Secretariat, Wilhelmshaven & Brockmann-Consult GmbH, Geesthacht

Module 8 – Environmental Management - (elective)

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|--|---------|--------|
| • Economics of climate change | Seminar | 3 ECTS |
| • International environmental governance | Seminar | 3 ECTS |

Assessment: Term paper, presentation or oral exam
Managing lecturer: Prof. Dr. Bernd Siebenhüner
Lecturers: Prof. Dr. Christoph Böhringer, Dr. Jan Schneider, Dr. Emmanuel Asane-Otoo, Prof. Dr. Stefanie Sievers-Glotzbach
Prerequisites/corequisites: none

Aims and Content

- Discussing topics of sustainability, economics and management with students from different scientific disciplines.
- Learning about sustainability, economics and management in different scientific contexts.
- Basics about the natural science of climate change and the main statements of climate research about the anthropogenic contribution to it.
- Economic interpretation of too high pollution as symptom of a market failure then leads to the treatment of policy instruments, and the understanding of economic efficiency as a prerequisite for effective climate policy.
- Decision under Risk and Uncertainty - methods to deal with risk and uncertainty and imprecise information.

Learning outcomes:

- Understanding the complexity of sustainability, economics and management.
- Ability to collaborate on topics of sustainability, economics and management with individuals from various scientific disciplines.
- Ability to present and evaluate different concepts of sustainability, economics and management.
- Understanding of reasons, goals and instruments for climate policy, as well as implied complications due to the international dimension of climate change.
- Ability to discriminate between risk and uncertainty model preferences under risk.
- With successful completion of the course, students shall be able to judge climate policy issues on an informed scientific basis (natural science and economics).

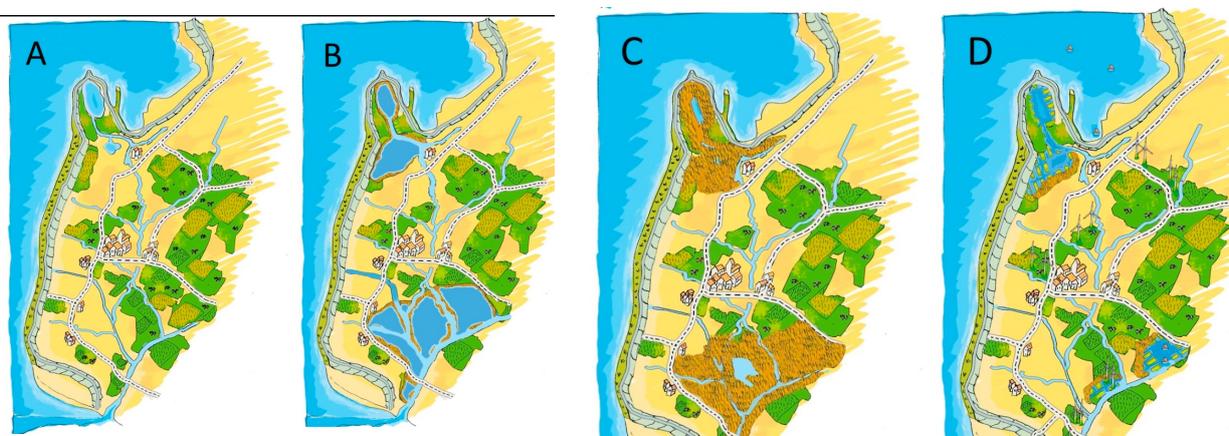


Figure: Art-based illustrations of the co-designed land management scenarios: (A) trend; (B); water management; (C) carbon sequestration; and (D) actor-based.

Contact

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