Module Handbook

Bachelor of Science
Marine Ecosystem and Fisheries Science

Content

Title:	**Introduction to Biological Oceanography and Fishery Sciences**
Symbol:	BMARSYS-01
Semester:	Winter
Module type	• Compulsory module
Formal requirements for participation	none
Executive professor	Prof. Dr. Christian Möllmann, Phone: 42838 6621, christian.moellmann (at) uni-hamburg.de
lecturer	Prof. Dr. Flemming Dahlke Dr. Jens Floeter Prof. Dr. Inga Hense Dr. Rolf Koppelmann Prof. Dr. Christian Möllmann Prof. Dr. Elisa Schaum
language	German
Educational concept	The students have basic knowledge of the production processes and their controlling factors in the ecosystems and food webs of the different regions of the world ocean. You will also have knowledge of important stocks of marine resources, fishing techniques and trends, and the tasks and methods of the fishery sciences. The students understand the relationship between biotic and abiotic factors influencing marine ecosystems, trophic interactions in food webs and the potential for human use. They thus know and understand basic questions, methods and the current state of knowledge in the fields of Biological Oceanography and Fishery Sciences.
Contents	Regional Oceanography; taxonomic composition, life cycles, distribution and impact on key groups in phytoplankton, zooplankton, benthos and necton; Key habitats in shelf seas, the open oceans and the deep sea; Production processes and control structures in marine food webs; latitudinal gradients and biogeography; Life cycles of plankton species; taxonomic groups of commercial importance and their life cycles; fishing techniques and catch trends of main fish stocks using the example of e.g. cod and herring; introduction to the stock assessment, introduction to recruitment research, introduction to fisheries management.
Courses:	• L: Basics in Biological Oceanography and Fishery Sciences — 5 SEM./HRS • S: Current Literature in Biological Oceanography and Fishery Sciences — 2 SEM./HRS

Workload	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Basics in Biological Oceanography and Fishery Sciences		*70*	*80*	*30*
• S: Current Literature in Biological Oceanography and Fishery Sciences		*28*	*52*	*20*
Total workload	*9*	*98*	*122*	*50*

Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation. *examinations:* Presentation (graded, 100%) and written or oral examination (pass /fail)
Duration	one semester

Frequency of occurrence	annual
Literature:	H Charles B. Miller „Biological Oceanography“; Simon Jennings, Michael J. Kaiser and John D. Reynolds "Marine Fisheries Ecology

Title:	**Organisms of Marine Systems**				
Symbol:	BMARSYS-02				
Semester:	Winter				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	PD Dr. Dörthe Müller-Navarra; doerthe.mueller-navarra (at) uni-hamburg.de				
lecturer	PD Dr. Dörthe Müller-Navarra				
language	German				
Educational concept	Students have knowledge of marine organisms from major marine systematic groups. They recognize the dependencies of abiotic and biotic factors on the occurrence and lifecycle strategies of marine organisms. They understand adaptations to a changing environment and its limits.				
Contents	Biological basics of marine organisms and their ecological context.				
Courses:	• L: Organisms of Marine Systems • S: Organisms of Marine Systems				1 SEM./HRS 1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Organisms of Marine Systems		*14*	*31*	*10*
	• S: Organisms of Marine Systems		*14*	*11*	*10*
	Total workload	3	28	42	20
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, presentation. *examinations:* Written or oral examination (pass/fail)				
Duration	one semester				
Frequency of occurrence	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Experimental physics for biology students**				
Symbol:	PHY-BBIO-02				
Semester:	Winter				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Erika Garutti				
lecturer	N.N.				
language	German				
Educational concept	Students have knowledge of the physical fundamentals that enable them to understand measuring instruments and biological mechanisms and processes; They have a basic understanding of scientific methods and first experiences in the experimental setup, the recording of observations and the evaluation of measurement results.				
Contents	Mathematical basics, error calculation. Physical basics in the fields of mechanics, thermodynamics, mechanical vibrations and waves, electricity and magnetism, optics as well as atomic and nuclear physics. In the practical course simple experiments for a deeper understanding of the lecture material, acquaintance of measuring instruments, protocol management.				
Courses:	• L: Experimental physics • P: Practical course in physics				4 SEM./HRS 1,5 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Experimental physics		*56*	*49*	*30*
	• P: Practical course in physics		*21*	*24*	-
	Total workload	*6*	*77*	*73*	*30*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* None for the first partial examination, for the second partial examination successful completion of the practical course (colloquia, course protocols). *examinations:* The module examination consists of two partial examinations: The first partial examination (written interim exam, graded, 20 points, 40% of the module final grade) in the first half of the semester. The second part examination (written, graded, 30 points, 60% of the module grade) takes place at the end of the semester or during the semester break.				
Duration	one semester				
Frequency of occurrence	annual				
Literature:	Hüttermann et al.: Physik für Mediziner, Biologen, Pharmazeuten. de Gruyter, Berlin. In der jeweils aktuellen Auflage				

Title:	**General and Inorganic Chemistry**				
Module number:	CHE 080 A				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Dr. C. Wittenburg, Phone 42838 4095, Christian.Wittenburg (at) chemie.uni-hamburg.de				
Instructors:	N.N.				
Language	German				
Intended learning objectives:	The students will have an understanding of the fundamentals of general and inorganic chemistry, in particular the transformation of materials, the transfer reactions of electrons and protons, and the energetic and kinetic considerations of chemical reactions. Students will learn important material cycles and reaction types				
Contents	Basic concepts of chemistry, concentration data, stoichiometry, nature of chemical bonding, energetics of chemical reactions, equilibrium reactions, catalysis, gas laws, acid-base reactions, buffers, redox reactions, detection reactions for the most important ions, modern analysis methods, general conciderations from the periodic table, "Chemistry of Materials "- as far as biologically relevant: Fundamentals of the nature of coordinative compounds, complex compounds, bioavailability, biomineralisation.				
Course types and forms of instruction:	• L: General chemistry for students with chemistry as minor subject • E: Exercises in generals chemistry for students with chemistry as minor subject				4 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: General chemistry for students with chemistry as minor subject		*56*	*44*	*20*
	• E: Exercises in generals chemistry for students with chemistry as minor subject		*26*	*24*	*10*
	Total Workload	*6*	*82*	*68*	*30*
Coursework and examinations:	*Formal requirements for examinations:* Successful completion of the exercise by short test *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Foils shown in the lectures and exercises available via e-learning platform				

Title:	**Data Science 1 - Programming and Visualization**
Symbol:	BMarsys-17
Semester:	Winter
Module type	• Compulsory module
Formal requirements for participation	none
Executive professor	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg.de
lecturer	Prof. Dr. Christian Möllmann Dr. Saskia Otto
language	German
Educational concept	Students are familiar with the basic concepts of data science and have practical data processing skills using a spreadsheet program such as LibreOffice Calc. Furthermore, students are familiar with the programming language R and can write well-structured scripts for data analysis and visualization. Students will be able to get an overview of data and describe it in terms of its properties. They are able to find meaningful numerical representations for different data sets and to manipulate them compactly and efficiently. Students are confident in the use of various visualization techniques. The guiding question of the module is: What is data and how do I extract information from it?
Contents	In this module, an introduction to the various components of 'Data Sci-ence' is taught. Building on an introduction to the spreadsheet program LibreOffice Calc, the introduction to the programming language R and the integrated development environment RStudio follows. In this environment, methods and tools for data entry and organization, importing, manipulating, visualizing and describing data are introduced and applied. Different file types as well as numerical representation of data are dealt with in depth. The module is accompanied by application-related exercises and a final case study on descriptive data analysis and visualization using selected sample data sets from the various disciplines of biology.
Courses:	• L: Fundamentals in Data Science and Introduction to Calc and R — 2 SEM./HRS • E: Exercises in Calc, R, Data Processing and Visualization — 2 SEM./HRS

Workload	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Fundamentals in Data Science and Introduction to Calc and R		*28*	*51*	*11*
• E: Exercises in Calc, R, Data Processing and Visualization		*28*	*51*	*11*
Total workload	*6*	*56*	*102*	*22*

Grading framework (possibly including examinations)	*Formal requirements for examinations:* Regular successful completion of the exercises and online quizzes as well as the successful completion of a case study. *examinations:* Written examination (graded; 100%)
Duration	one semester
Frequency of occurrence	In the winter semester as face-to-face courses, in the summer semester as self-study online courses.
Literature:	• Michael J. Crawley (2013): *The R Book*, 2nd edition, Wiley & Sons, Ltd., West Sussex, UK, 975 S. (Online verfügbar als PDF)

	• Hadley Wickham & Garret Grolemund (2017): *R for Data Science,* O'Reilly Media Inc., CA, U.S.A, 494 S. (Online verfügbar) Hadley Wickham (2016): *ggplot2 - Elegant Graphics for Data Analysis*, 2nd edition, Springer International Publishing, Switzerland, 260p.

Title:	**Marine Biodiversity**
Symbol:	BMARSYS-03
Semester:	Summer
Module type	• Compulsory module
Formal requirements for participation	none
Executive professor	Prof. Dr. Nicole Aberle-Malzahn Tel.: 42838 6607, nicole.aberle-malzahn(at)uni-hamburg.de
lecturer	Prof. Dr. Nicole Aberle-Malzahn Prof. Dr. Flemming Dahlke Dr. Jens Floeter Dr. Rolf Koppelmann Dr. Arne Malzahn Prof. Dr. Christian Möllmann Prof. Dr. Elisa Schaum
language	German
Educational concept	Students have knowledge of marine biodiversity with a focus on phyto-, and zooplankton species, commercial fish as well as seabirds and mammals. They know how to assess biodiversity, exemplified in regional case studies (North-, Baltic Sea). Life cycles of key species and spatial distribution pattern are understood.
Contents	Basics of marine biodiversity within its ecological context; life cycles of key species and state of the art biodiversity research topics
Courses:	• L: Introduction in marine biodiversity I — 2 SEM./HRS • S: Seminar to the field trip — 1 SEM./HRS • P: Field trip — 3 SEM./HRS • L: Introduction in marine biodiversity II — 1 SEM./HRS • S: Current topics in marine biodiversity — 1 SEM./HRS • P: Identification and description of marine species — 2 SEM./HRS

Workload	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction in marine biodiversity I		*28*	*50*	*10*
• S: Seminar to the field trip		*14*	*20*	*10*
• P: Field trip		*42*	*30*	
• L: Introduction in marine biodiversity II		*14*	*30*	*10*
• S: Current topics in marine biodiversity		*14*	*20*	*10*
• P: Identification and description of marine species		*28*	*30*	-
Total workload	*12*	*140*	*180*	*40*

Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, two presentations. *examinations:* Protocol (pass / fail), Written or oral examination (graded, 100%)
Duration	two semesters
Frequency of occurrence	annual
Literature:	Will be announced at the beginning of the module

Title:	**Theoretical Ecology**				
Symbol:	BMARSYS-04				
Semester:	Summer				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Inga Hense, Phone: 42838 6641 inga.hense(at)uni-hamburg.de;				
lecturer	Prof. Dr. Inga Hense				
language	German				
Educational concept	The students know and understand theoretical aspects and backgrounds in ecology with a focus on biological oceanography and fishery sciences. They can mathematically describe relevant ecological processes and have the ability to quantitatively simulate these processes on a computer.				
Contents	Theoretical aspects and backgrounds in ecology with a focus on biological oceanography and fisheries; Processes at the individual level (e.g., mortality, growth, exponential function, energy budgets, metabolic theory, consumption); Processes at the population level (e.g., production, logistic population growth, cohort analysis); Species interaction processes (e.g., "allee effect", intra- and interspecific competition, mutalism, "numerical and functional response", food choice, eco-stochiometry, Lotka Volterra model); Ecosystem processes (size spectra, spatial structures, metapopulations, stability and energy fluxes in food webs.				
Courses:	• L: Introduction to theoretical ecology • E: Exercise to theoretical ecology				1 SEM./HRS 1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to theoretical ecology • E: Exercise to theoretical ecology		*14* *14*	*28* *28*	*20*
	Total workload	*3*	*28*	*42*	*20*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation *examinations:* Exercise completion (pass / fail)				
Duration	one semester				
Frequency of occurrence	annual				
Literature:	M. Begon, C.R. Townsend and J.L. Harper “Ecology: From Individuals to Ecosystems“				

Title:	**Physical Oceanography and Marine Biogeochemistry**				
Symbol:	BMARSYS-05				
Semester:	Summer				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Inga Hense, Tel.: 42838 6641, inga.hense(at)uni-hamburg.de				
lecturer	Prof. Dr. Inga Hense Dr. Rolf Koppelmann Prof. Dr. Elisa Schaum				
language	German				
Educational concept	Students have basic knowledge in physical oceanography and biogeochemical cycles in the ocean. They understand the climatic relevance of the main marine biological processes and the key organisms involved.				
Contents	This course provides the basics of physical oceanography and introduces the most important marine biological processes that play an important role in matter cycling and in the energy budget; so-called functional organism groups are presented.				
Courses:	• L: Basics in Physical Oceanography and Marine Biogeochemistry • S: Seminar on Physical Oceanography and Marine Biogeochemistry				3 SEM./HRS 1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Basics in Physical Oceanography and Marine Biogeochemistry		*42*	*61*	*30*
	• S: Seminar on Physical Oceanography and Marine Biogeochemistry		*14*	*33*	
	Total Workload	*6*	*56*	*94*	*30*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, Presentation *examinations:* Written or oral examination (pass / fail)				
Duration	one semester				
Frequency of occurrence	annual				
Literature:	Will be announced at the beginning of the course				

Title:	**Organic Chemistry**				
Module number:	CHE 081 A				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Gunnar Ehrlich, phone: 42838 2822, Gunnar.Ehrlich (at) chemie.uni-hamburg.de				
Instructors:	Dr. Gunnar Ehrlich				
Language	German				
Intended learning objectives:	Students have basic knowledge of organic chemistry. They know the most important classes of substances, their nomenclature, syntheses and reaction modes including the reaction mechanisms.				
Contents	Alkanes, haloalkanes, nucleophilic substitution on aliphatic systems (SN1, SN2), alkanols, alkenes (elimination, electrophilic addition), aromatic compounds (electrophilic substitution, first and second substitution), alkynes, carbonyl compounds (aldehydes, ketones, carboxylic acids, esters , Fats, oils, waxes, phospholipids), amines, amino acids, peptides, proteins, carbohydrates, isomerism (structural isomers, stereoisomers, conformational isomers, chiral compounds, cis / trans isomerism).				
Course types and forms of instruction:	• L: Organic Chemistry • E: Exercises in Organic Chemistry				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Organic Chemistry		*42*	*63*	*15*
	• E: Exercises in Organic Chemistry		*26*	*20*	*14*
	Total Workload	*6*	*68*	*83*	*29*
Coursework and examinations:	*Formal requirements for examinations:* none. *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Bruice, P.Y.: Organische Chemie. Pearson. In der jeweils aktuellen Auflage Organikum. Wiley VCH. In der jeweils aktuellen Auflage				

Title:	**Inorganic and Organic Chemistry Practice**				
Module number:	CHE 083				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Successful completion of the modules CHE 080 A (General and Inorganic Chemistry) and CHE 081 A (Organic Chemistry)				
Module coordinator:	Dr. Gunnar Ehrlich, Dr. C. Wittenburg,				
Instructors:	N.N.				
Language	German				
Intended learning objectives:	The students have an understanding of the fundamentals of general, organic and organic chemistry, of chemical transformations, transfer reactions of electrons and protons, and of the energetic and kinetic aspects of chemical reactions. They know important material cycles, reaction types, qualitative, and quantitative analysis methods. They have practical skills in handling laboratory equipment, building reaction equipment, and handling organic solvents.				
Contents	Basic concepts of chemistry, concentration data, stoichiometry, nature of chemical bonding, energetics of chemical reactions, equilibrium reactions, catalysis, gas laws, acid-base reactions, buffers, re-dox reactions, detection reactions and initial experience with analytical methods, complex compounds, methods and reactions for the conversion of organic functional groups, eg Esterification, nucleophilic substitution, elimination.				
Course types and forms of instruction:	• P: Inorganic and Organic Chemistry Practice (During the safety briefing, there is a presence obligation)				3 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• P: Inorganic and Organic Chemistry Practice		*60*	*20*	*10*
	Total Workload	*6*	*60*	*20*	*10*
Coursework and examinations:	*Formal requirements for examinations:* none. *examinations:* Traineeship (correctly performed experiments, attestation of the experiments). The module is assessed as passed / failed.				
Duration	one semester				
Module frequency:	annual				
Literature:	Script				

Title:	**Data Science 2 - Statistical Modeling**				
Symbol:	BMarsys-18				
Semester:	Summer				
Module type	• Compulsory module				
Formal requirements for participation	Successful completion of the module Data Science 1 - Programming & Visualization.				
Executive professor	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg.de				
lecturer	Prof. Dr. Christian Möllmann Dr. Saskia Otto				
language	German				
Educational concept	Students have basic knowledge in the basic areas of statistics and probability theory and have an overview of data distributions. Students are able to understand the relationship between biological processes in linguistic description and in mathematical formulation. They have sharpened judgment about appropriate and inappropriate models and have the ability to interpret parameter values. Students will be able to apply this knowledge using the R programming language and build on it in subsequent courses. They will also have an overview of the application of Data Science techniques in the marine sciences.				
Contents	Basic concepts of stochastics (event, probability, conditional probability, independence, random variables); descriptive, exploratory inferential, and Bayesian statistics; measures, distributions, density functions, Central Limit Theorem; correlation, simple regression, likelihood; linear function, exponential function, power function, logistic function as common types of functions to describe biological processes. Determination of parameter values. Biological interpretation of parameters as functions of other variables; introduction to Jupyter Notebook. Seminar will discuss and critique recent developments in the application of Data Science techniques in the marine sciences.				
Courses:	• L: Basics of Statistical Modeling • S: Data Science in Marine Sciences • E: Statistical Modeling Exercises				1 SEM./HRS 2 SEM./HRS 1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Basics of Statistical Modeling		*14*	*50*	*7*
	• S: Data Science in Marine Sciences		*28*	*26*	*8*
	• E: Statistical Modeling Exercises		*14*	*56*	*7*
	Total workload	6	56	102	22
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Exercise completion (successful completion of a case study as part of a datathon). *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Frequency of occurrence	In the summer semester as face-to-face courses, in the winter semester as self-study online courses.				
Literature:	• James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). *An Introduction to Statistical Learning: with Applications in R (Springer Texts in Statistics).* Springer-Verlag. • Kerns, G. J. (2011). *Introduction to Probability and Statistics Using R.* (Online verfügbar als PDF) • Gerald Peter Quinn and Michael J. Keough (2002): *Experimental Design and Data Analysis for Biologists,* Cambridge, UK, 553 S. (Online verfügbar als PDF)				

Title:	**Marine Ecosystem Modeling**				
Symbol:	BMARSYS-07				
Semester:	Winter				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Inga Hense, Tel.: 42838 6641, inga.hense (at) uni-hamburg.de				
lecturer	Prof. Inga Hense				
language	German				
Educational concept	Students are able to use the "modelling language", to select the most appropriate methods and approaches for a number of specific applications, to formulate simple ecosystem models, to analyze and present the results. They have learned to identify and evaluate model strengths and weaknesses.				
Contents	The basics of model structures are explained, including factors and processes which are generally considered in aquatic ecosystem models. Focus will be on plankton dynamics: growth and mortality processes of phyto- and zooplankton. Examples of bio-geochemical models based on carbon and nitrogen are presented.				
Courses:	• L: Introduction to Marine Ecosystem Modeling • S: Presentation of the results from practicals • E: Practicals in Marine Ecosystem Modeling				1 SEM./HRS 1 SEM./HRS 2 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Marine Ecosystem Modeling • S: Seminar - Presentation • E: Practicals in Marine Ecosystem Modeling		14 14 *28*	*30* *30* *34*	*20*
	Total Workload	*6*	*56*	*94*	*20*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, Presentation *examinations:* Written or oral examination (graded, 100%)				
Duration	Two semester				
Frequency of occurrence	annual				
Literature:	Will be announced at the beginning of the course				

Title:	**Laboratory Methods in Biological Oceanography and Fishery Sciences**				
Symbol:	BMARSYS-08				
Semester:	Winter				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Nicole Aberle-Malzahn Tel.: 42838 6607, nicole.aberle-malzahn(at)uni-hamburg.de				
lecturer	Prof. Dr. Nicole Aberle-Malzahn Prof. Dr. Flemming Dahlke Dr. Arne Malzahn Prof. Dr. Elisa Schaum				
language	German				
Educational concept	The students have knowledge of important laboratory techniques in Biological Oceanography and Fisheries Sciences and thus the ability to keep marine organisms and to carry out and evaluate laboratory experiments.				
Contents	Basic laboratory techniques in Biological Oceanography and Fisheries Sciences; i.e. maintenance of phytoplankton and zooplankton cultures; keeping of fish; experiments on the effects of biotic (food quality and quantity, competition) and abiotic factors (temperature, salinity, oxygen content) on the reproduction and growth of different life stages of plankton organisms and fish.				
Courses:	• L: Laboratory Methods in Biological Oceanography and Fishery Sciences				3 SEM./HRS
	• S: Laboratory Methods in Biological Oceanography and Fishery Sciences				1 SEM./HRS
	• P: Laboratory Methods in Biological Oceanography and Fishery Sciences				6 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Laboratory Methods in Biological Oceanography and Fishery Sciences		*42*	*84*	
	• S: Laboratory Methods in Biological Oceanography and Fishery Sciences		*14*	*30*	
	• P: Laboratory Methods in Biological Oceanography and Fishery Sciences		*84*	*76*	*30*
	Total workload	*12*	*140*	*190*	*30*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, Presentation *examinations:* Protocol (graded, 100%)				
Duration	One semester				
Frequency of occurrence	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Data Science 3 - Experimental Design**				
Symbol:	BMarsys-19				
Semester:	Winter				
Module type	• Compulsory module				
Formal requirements for participation	Successful completion of the module Data Science 2 - Statistical Modeling				
Executive professor	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg.de				
lecturer	Prof. Dr. Christian Möllmann Dr. Saskia Otto				
language	German				
Educational concept	Students have basic knowledge in designing their own experiments and surveys. They are confident in formulating hypotheses and selecting as well as interpreting statistical tests.				
Contents	This course teaches the basics of planning and conducting scientific investigations (hypothesis generation, determination of sample sizes, pseudoreplication, experimental design) as well as the subsequent analysis using 2- and multi-sample tests, nested and multifactorial analyses of variance and permutation test and resampling methods. As a prerequisite, the handling of factors and strings as data types in R is discussed.				
Courses:	• L: Basics of Experimental Design and Analysis of Variance • E: Exercises on Experimental Design and Analysis of Variance				1 SEM./HRS 1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Basics of Experimental Design and Analysis of Variance		*14*	*24*	*7*
	• E: Exercises on Experimental Design and Analysis of Variance		*14*	*24*	*7*
	Total workload	3	28	48	14
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Exercise completion (successful completion of a case study as part of a datathon). *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Frequency of occurrence	In the winter semester as face-to-face courses, in the summer semester as self-study online courses.				
Literature:					

Title:	**Population Dynamics of Marine Resources**				
Symbol:	BMARSYS-09				
Semester:	Winter				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Christian Möllmann, Phone: 42838 6621, christian.moellmann(at)uni-hamburg.de				
lecturer	Dr. Jens Floeter Prof. Dr. Christian Möllmann				
language	German				
Educational concept	Students will have an overview of modern, theoretical methods for analysing population dynamics of marine resources in the context of ecosystem and fisheries management. They are also capable of understanding and calculating the basic models applied in fisheries assessment to derive quota advice.				
Contents	Quantitative recording of important parameters of a population and their variability; introduction to the models and concepts applied in fisheries management; methods for estimating biomass and abundance and their change by mortality, growth and reproduction; fishing mortality and natural mortality, modeling of stomach evacuation and consumption rates, fishing effort and catch per unit of effort, Shepherd model and logistic biomass growth; Beverton and Holt Model and growth overfishing, virtual population analysis and catch quota calculation; management concepts and the principle of multi-species models; food web modeling				
Courses:	• L: Population Dynamic Models • S: Assessment of Marine Resources • E: Modeling Marine Resources				2 SEM./HRS 1 SEM./HRS 3 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Population Dynamic Models		*28*	*23*	
	• S: Assessment of Marine Resources		*14*	*13*	
	• E: Models for Modeling Marine Resources		*42*	*30*	*30*
	Total workload	*6*	*84*	*66*	*30*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, presentation *examinations:* Written or oral examination (graded, 100%)				
Duration	One semester				
Frequency of occurrence	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Ecosystem Management and Environmental Policy**				
Symbol:	BMARSYS-10				
Semester:	Summer				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Christian Möllmann, Tel.: 42838 6621, christian.moellmann (at) uni-hamburg.de				
lecturer	Dr. Jens Floeter Prof. Dr. Christian Möllmann				
language	German				
Educational concept	The students are aware of the political and legal background of environmental protection and resource management with a focus on Germany and the EU. They know various "assessment" methods in environmental protection and resource management, as well as the concepts and principles of ecosystem-based management. Students are also able to discuss and evaluate problems and conflicts within ecosystem management.				
Contents	Basic principles of the management of marine ecosystems; development of a sector-specific focus (eg fishing, pollution, etc.) on an Ecosystem Approach to Management (EAM) approach, legal and political background of EAM; international agreements and current EU directives; principles, concepts and instruments of the EAM (e.g. indicator systems, marine protected areas), case studies of the EAM; approaches to the assessment of marine ecosystems; problems between ecosystem management and nature conservation; conflicts between ecological, economic and social interest groups				
Courses:	• L: Ecosystem Management and Environmental Policy • S: Current Topics in Ecosystem Management and Environmental Policy				2 SEM./HRS 2 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Ecosystem Management and Environmental Policy		*28*	*42*	*40*
	• S: Current Topics in Ecosystem Management and Environmental Policy		*28*	*42*	
	Total workload	*6*	*56*	*84*	*40*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, presentation *examinations:* Exercise completion (graded, 100%)				
Duration	One semester				
Frequency of occurrence	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Field Methods in Biological Oceanography and Fishery Sciences**				
Symbol:	BMARSYS-11				
Semester:	Summer				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Flemming Dahlke, Tel.: 42838 6600, flemming.dahlke (at) uni-hamburg.de				
lecturer	Prof. Dr. Nicole Aberle-Malzahn Prof. Dr. Flemming Dahlke Dr. Jens Floeter Dr. Rolf Koppelmann Dr. Arne Malzahn Prof. Dr. Christian Möllmann Prof. Dr. Elisa Schaum				
language	German				
Educational concept	The students are familiar with the sampling techniques of marine research. They have the ability to use sampling equipment from research vessels and in shallow water. Furthermore, they have the ability to plan, carry out, and analyse the results of the sampling of different trophic levels of marine ecosystems in small project groups. They can set the results of these analyses in the context of current research topics of Biological Oceanography and Fisheries Sciences.				
Contents	Sampling techniques of marine research, i.e. plankton nets, fishing gear, hydro-acoustic methods, video-assisted zooplankton sampling, benthos grabs and dredges; basic population and community characteristics (e.g., species composition, abundance, biomass, population structure, growth, condition, reproduction, mortality)				
Courses:	• L: Field Methods in Biological Oceanography and Fishery Sciences • S: Field Methods in Biological Oceanography and Fishery Sciences • P: Field Methods in Biological Oceanography and Fishery Sciences				3 SEM./HRS 1 SEM./HRS 6 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Field Methods in Biological Oceanography and Fishery Sciences		*42*	*80*	
	• S: Field Methods in Biological Oceanography and Fishery Sciences		*14*	*20*	
	• P: Field Methods in Biological Oceanography and Fishery Sciences		*84*	*80*	*40*
	Total workload	*12*	*140*	*180*	*40*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation, presentation *examinations:* Protocol (graded, 100%)				
Duration	One semester				

Frequency of occurrence	annual
Literature:	Will be announced at the beginning of the module

Title:	**Data Science 4 - Big Data: Data Management and Communication**				
Symbol:	BMarsys-20				
Semester:	Summer				
Module type	• Compulsory module				
Formal requirements for participation	Successful completion of the module Data Science 3 - Experimental Design				
Executive professor	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg . de				
lecturer	Prof. Dr. Christian Möllmann Dr. Saskia Otto				
language	German				
Educational concept	Students will have an in-depth look at all 4 components of 'Data Science' and basic knowledge of handling and managing big data. Upon successful completion of this module, students will be able to independently retrieve and process data from publicly available databases directly from R. In doing so, they will have learned to represent slices of the real world in the tabular form of the relational world, and acquired basic skills in using the SQL database language and embedding it in R. In addition, students will be able to create a scientific report using R Markdown and then convert it to various formats such as Word, PDF, or HTML and publish it via a 'git repository' in the spirit of transparent, open science.				
Contents	This module represents a deepening of 'Data Science', with a focus on data management and communication in the spirit of `open science`: database systems (MySQL, PostgreSQL, SQL Lite, etc.) and their added value in data-intensive applications; sensible database design, tabular storage and query in the relational model; public-access, biological databases; basics of the SQL programming language and queries from R; immersion in R Markdown and introduction to 'git' and 'repositories'; teaching the 'Open Science' concepts. The module is accompanied by a final 'Datathon'.				
Courses:	• L: Data Management and Communication of Large Data • E: Exercises on Data Management and Communication				1 SEM./HRS 1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Data Management and Communication of Large Data		*14*	*24*	*7*
	• E: Exercises on Data Management and Communication		*14*	*24*	*7*
	Total workload	3	28	48	14
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Exercise completion (successful completion of a case study as part of a datathon). *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Frequency of occurrence	In the summer semester as face-to-face courses, in the winter semester as self-study online courses.				
Literature:					

Title:	**External Internship**				
Symbol:	BMARSYS-13				
Semester:	Winter or Summer				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Elisa Schaum, Phone: 42838 6625, elisa.schaum (at) uni-hamburg.de				
lecturer	Diverse				
language	German				
Educational concept	The students acquire knowledge about their own abilities, talents, interests, possibilities in the practical application in the professional field and recognize own deficits.				
Contents	Applying acquired knowledge to practice; working areas, industry structure, operational procedures, biological areas in economy, administration and authorities				
Courses:	• L: Job descriptions of biologists • P: External internship (at least 4 weeks)				2 SEM./HRS 6 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Job descriptions of biologists		*28*		
	• P: External internship		*142*		*10*
	Total workload	*6*	*170*	-	*10*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* none *examinations:* Project completion (confirmation of activities by the company)				
Duration	one semester				
Frequency of occurrence	Each semester				
Literature:					

Title:	**Examining Module**				
Symbol:	BMARSYS-14				
Semester:	Winter or Summer				
Module type	• Compulsory module				
Formal requirements for participation	The compulsory modules scheduled for the first three semesters must be completed successfully. Successful participation in compulsory modules scheduled for the fourth semester is strongly recommended				
Executive professor	N.N.				
lecturer	N.N.				
language	German				
Educational concept	Students acquire in-depth knowledge of selected basic and / or current research topics. They can put a research question in the context of marine biological and fishery science topics and have understood the complexity of ecological processes.				
Contents					
Courses:	• S: Preparation Seminar				1 SEM./HRS
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Preparation Seminar		*14*		*166*
	Total workload	*6*	*14*	-	*166*
Grading framework (possibly including examinations)	*Formal requirements for examinations:* none *examinations:* Oral examination (100%)				
Duration	one semester				
Frequency of occurrence	Each semester				
Literature:					

Title:	**Introduction to Scientific Work**				
Symbol:	BMARSYS-15				
Semester:	Sommer				
Module type	• Compulsory module				
Formal requirements for participation	none				
Executive professor	Prof. Dr. Christian Möllmann, Tel.: 42838 6621, christian.moellmann (at) uni-hamburg.de				
lecturer	N.N.				
language	German				
Educational concept	Students have the ability to write or critically review and evaluate scientific applications and articles, conduct literature research, and have experience with databases; professional presentation through knowledge of different presentation techniques.				
Contents	Introduction to scientific work: development of a research question; preparing an overview article on a current topic or creating a research proposal; scientific presentation in the form of a lecture.				
Courses:	• E: Introduction to Scientific Work				2 SEM./HRS
Workload	• E: Introduction to Scientific Work	*credits*	P (hrs) *28*	S(hrs) *132*	EP (hrs) *20*
	Total workload	*6*	28	132	20
Grading framework (possibly including examinations)	*Formal requirements for examinations:* Active participation *examinations:* Final Exercise (100%)				
Duration	one semester				
Frequency of occurrence	annual				
Literature:					

Title:	**Project**				
Symbol:	BMARSYS-16				
Semester:	Winter or Sommer				
Module type	• Compulsory module				
Formal requirements for participation	Advanced knowledge of biology is recommended. Occasionally individual elective and / or compulsory elective modules are recommended.				
Executive professor	N.N.				
lecturer	N.N.				
language	German				
Educational concept	Students acquire in-depth knowledge of selected basic and / or advanced research topics. In marine biological and fishery science project studies, the students' ability to actively develop and reflect on detailed insights will be reinforced, scientific research and the presentation of scientific findings will be intensified. Through advanced marine-biological case studies, students are introduced to ways of working and developing own ideas in research.				
Contents	Project specific				
Courses:	• Project Study				1 SEM./HRS
Workload	• Project Study	*credits*	P (hrs)	S(hrs)	EP (hrs)
	Total workload	*6*	*180*		
Grading framework (possibly including examinations)	*Formal requirements for examinations:* none *examinations:* Examination (pass or fail)				
Duration	one semester				
Frequency of occurrence	Each semester				
Literature:					

Title:	**Final Module**				
Symbol:	BMARSYS-AB				
Semester:	Winter or Sommer				
Module type	• Compulsory module				
Formal requirements for participation	Advanced knowledge of biology, usually proven by the successful completion of modules amounting to 120 credit points. Sometimes specific modules are recommended.				
Executive professor	N.N.				
lecturer	N.N.				
language	German				
Educational concept	Students acquire in-depth knowledge of selected basic and / or current research topics.				
Contents	In-depth study of a current or fundamental biological topic in the working group of a university teacher with experimental design, preparation of a work plan and if necessary revision of it within the progress of the project, literature research (in the library and with data bases), learning the subject-specific methodology, documentation and (statistical) evaluation of the data, evaluation of results, critical discussion compared to scientific publications and lectures.				
Courses:					
Workload		*credits*	P (hrs)	S(hrs)	EP (hrs)
	Total workload	*12*	*360*		
Grading framework (possibly including examinations)	*Formal requirements for examinations:* none *examinations:* Exam components of the final module are the written preparation of the Bachelor thesis (graded 100%) and an oral exam (pass or fail). The Bachelor thesis can be written in German or English. The Bachelor thesis is to be preceded by a summary in English and German. (pass or fail)				
Duration	one semester				
Frequency of occurrence	Each semester				
Literature:					

Compulsory elective modules

Title:	**Current Issues on Marine Ecology and Fisheries Sciences**				
Module number:	BMARSYS-23				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	None				
Module coordinator:	Prof. Dr. Christian Möllmann, Phone.: 42838 6620, christian.moellmann (at) uni-hamburg.de				
Instructors:	Prof. Dr. Christian Möllmann				
Language	German				
Intended learning objectives:	Students have an in-depth understanding of the state of knowledge and research topics in fisheries science. They have explicit knowledge of the effects of overfishing and climate change on commercial fish stocks and marine food webs. Furthermore, students know the current literature on the topic of social-ecological systems analysis in the field of exploited marine ecosystems.				
Contents	Definition of overfishing; climate influence on productivity (recruitment and growth) and geographic distribution of exploited fish stocks; relevance of climate change to modern ecosystem-based fisheries management; vulnerability analyses; ecosystem indicators; conflicts in fisheries management; participatory modeling; interactions among ecological, societal, and economic system components.				
Course types and forms of instruction:	• S: Current Topics on Marine Ecology and Fisheries Sciences				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Current Topics on Marine Ecology and Fisheries Sciences		*28*	*80*	*162*
	Total Workload	*9*	28	80	162
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar, talk *examinations:* Term paper (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Biology of Algae**
Module number:	BBIO-WPW-13
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dieter Hanelt, Phone: 42816 372, dieter.hanelt(at) uni-hamburg.de
Instructors:	Prof. Dr. Dieter Hanelt
language	German
Intended learning objectives:	The students are able to recognize the most important species of algae, to assign them to the botanical terminology and to address the evolution of aquatic plants. They will learn the ecophysiological adaptation of plants to their aquatic habitat and the industrial use of algae. This will enable students to compete in the field of modern aquaculture. By this module, the students gain knowledge about how the aquatic ecosystem is affected by climatic and oceanographic factors, so that they can also work in the field of climate research and coastal or marine protection.
Contents	Understanding the variety of aquatic plants as well as their taxonomy, ecophysiology and economic importance. Development of the organisms (phylogenesis), presentation of the theory of endosymbiosis, the variety of life cycles, and the development from the haploid to the advanced diploid life cycle. Understanding of the aquatic ecosystem as an essential factor in relation to global climate change and the coastal zone as a unique ecosystem deserving natural protection.
Course types and forms of instruction:	• L: Biology of Algae — 2 SEM./HRS • P: Marine Botanical Excursion — 6 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Biology of Algae		*28*	*62*	
• P: Marine Botanical Excursion		*140*		*40*
Total Workload	*9*	*168*	*62*	*40*

Coursework and examinations:	*Formal requirements for examinations:* Written or oral examination on the topics of the lecture. *Examinations:* Independent preparation of an experiment/demonstration and its presentation in front of the classmates (graded, 34%), Excursion: Quality of the assembly of a herbarium (graded, 33%), Presentation of a seminar talk (graded, 33%).
Duration	one semester
Module frequency:	annual
Literature:	van den Hoek: Algae. Thieme, Stuttgart. Lüning, K.: Seaweeds: Their Environment, Biogeography and Ecophysiology. Wiley, New York Strasburger, E.: Handbook of Botany, Spektrum Hurd et al. Seaweed Ecology and Physiology, Cambridge University Press Kirk, J.T.O., Osmund, J.T.: Light and photosynthesis in aquatic ecosystems. Cambridge Univ. Press.

Title:	**Biology of Algae (3 ECTS)**
Module number:	BBIO-WPW-13
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dieter Hanelt, Phone: 42816 372, dieter.hanelt (at) uni-hamburg.de
Instructors:	Prof. Dr. Dieter Hanelt
language	German
Intended learning objectives:	The students are able to recognize the most important species of algae, to assign them to the botanical terminology and to address the evolution of aquatic plants. They will learn the ecophysiological adaptation of plants to their aquatic habitat and the industrial use of algae. This will enable students to compete in the field of modern aquaculture. By this module, the students gain knowledge about how the aquatic ecosystem is affected by climatic and oceanographic factors, so that they can also work in the field of climate research and coastal or marine protection.
Contents	Understanding the variety of aquatic plants as well as their taxonomy, ecophysiology and economic importance. Development of the organisms (phylogenesis), presentation of the theory of endosymbiosis, the variety of life cycles, and the development from the haploid to the advanced diploid life cycle. Understanding of the aquatic ecosystem as an essential factor in relation to global climate change and the coastal zone as a unique ecosystem deserving natural protection.
Course types and forms of instruction:	• L: Biology of Algae — 2 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Biology of Algae		*28*	*42*	*20*
	Total Workload	*3*	*28*	*42*	*20*

Coursework and examinations:	*Formal requirements for examinations:* none *Examinations:* Written examination (100%)
Duration	one semester
Module frequency:	annual
Literature:	van den Hoek: Algae. Thieme, Stuttgart. Lüning, K.: Seaweeds: Their Environment, Biogeography and Ecophysiology. Wiley, New York Strasburger, E.: Handbook of Botany, Spektrum Hurd et al. Seaweed Ecology and Physiology, Cambridge University Press Kirk, J.T.O., Osmund, J.T.: Light and photosynthesis in aquatic ecosystems. Cambridge Univ. Press.

Title:	**Diversity and Evolution of Molluscs**				
Module number:	BBIO-WPW-55				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Berhard Hausdorf, Tel.: 238317-617, b.hausdorf (at) leibniz-lib.de				
Instructors:	Prof. Dr. Bernhard Hausdorf,				
Language	German (on demand English)				
Intended learning objectives:	The students have knowledge of native land and freshwater molluscs and possess the ability to survey and assess mollusc communities, as well as the ability to work taxonomically. They also have knowledge of the basics of molecular phylogeny and can compute and evaluate molecular trees.				
Contents	Systematics of native land and freshwater molluscs, collecting techniques, preparation, determination. Foundations of molecular phylogeny, computation and evaluation of molecular trees.				
Course types and forms of instruction:	• L: Diversity, Evolution and Ecology of Molluscs • S: Evolution, Diversity and Ecology of Molluscs • P: Systematic and Ecology of Molluscs				1 SEM./HRS 1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Diversity, Evolution and Ecology of Molluscs		*14*	*15*	*15*
	• S: Evolution, Diversity and Ecology of Molluscs		*14*	-	*30*
	• P: Systematic and Ecology of Molluscs		*42*	*45*	*20*
	Total Workload	*6*	*70*	*45*	*65*
Coursework and examinations:	*Formal requirements for examinations:* Active participation, presentation. *Examinations:* Oral examination (graded, 100%) on the content of the lecture and practical course, in which at least sufficient knowledge of the contents of the module is shown.				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Introduction to Estuary Research**
Module number:	BMARSYS-26
Semester:	summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Dr. Justus van Beusekom; Justus.van.Beusekom (at) uni-hamburg.de
Instructors:	Dr. Justus van Beusekom
Language	German
Intended learning objectives:	Students have a deeper insight into biological and biogeochemical processes in estuaries and the effects of human interventions on these processes. They know different sampling techniques for zooplankton and phyto-plankton, water samples and sediment and can determine turnover rates (respiration, primary production, nitrogen turnover in sediments). They know the most important plankton species. They can evaluate ship data from autonomous measuring systems (underway-data). Through the module, students gain knowledge of how estuarine ecosystems are affected by human intervention and climatic factors, so that they can also work in the field of coastal or marine protection.
Contents	Ship excursion with sampling. Chemical analyses. Species identification of the dominant plankton species with microscopes. Experiments with water and sediment samples. Evaluation of measured data. Evaluation of long-term data. Presentations of the results. Seminar presentations of selected topics.
Course types and forms of instruction:	• L: Introduction to Estuary Research — 1 SEM./HRS • P: Introduction to Estuary Research — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to Estuary Research		*14*	*14*	*14*
• P: Introduction to Estuary Research		*28*	*28*	*82*
Total Workload	*6*	42	42	96

Coursework and examinations:	*Formal requirements for examinations:* Active participation, presentation. *Examinations:* Internship completion (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	

Title:	**Introduction to Machine Learning for Biologists**
Module number:	BMARSYS-24
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	None
Module coordinator:	Prof. Dr. Christian Möllmann, Phone.: 42838 6620, christian.moellmann (at) uni-hamburg.de
Instructors:	Prof. Dr. Christian Möllmann
Language	German
Intended learning objectives:	Students have an in-depth understanding of the state of knowledge and research topics in fisheries science. They have explicit knowledge of the effects of overfishing and climate change on commercial fish stocks and marine food webs. Furthermore, students know the current literature on the topic of social-ecological systems analysis in the field of exploited marine ecosystems.
Contents	Definition of overfishing; climate influence on productivity (recruitment and growth) and geographic distribution of exploited fish stocks; relevance of climate change to modern ecosystem-based fisheries management; vulnerability analyses; ecosystem indicators; conflicts in fisheries management; participatory modeling; interactions among ecological, societal, and economic system components.
Course types and forms of instruction:	• L: Introduction to Machine Learning for Biologists — 2 SEM./HRS • S: Current Case Studies of Machine Learning in Biology — 1 SEM./HRS • E: Introduction to Machine Learning for Biologists — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to Machine Learning for Biologists		*28*	*28*	*28*
• S: Current Case Studies of Machine Learning in Biology		*14*	*14*	*10*
• E: Introduction to Machine Learning for Biologists		*70*	*68*	*10*
Total Workload	*9*	*112*	*110*	*48*

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the excercise *examinations:* Final excercise (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	François Chollet: Deep Learning mit Python und Keras: Das Praxis-Handbuch vom Entwickler der Keras-Bibliothek. MITP, 2018, ISBN 978-3-95845-838-3

Title:	**Molecular Biological Basics in Marine Biology**
Module number:	BMARSYS-27
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Elisa Schaum, Phone: 42838 6625, elisa.schaum (at) uni-hamburg.de
Instructors:	Dr. Luisa Listmann Prof. Dr. Elisa Schaum
Language	German
Intended learning objectives:	Students have an in-depth insight into relevant molecular biological methods in marine sciences. They have explicit knowledge about the biological basics as well as the application of the most common methods, e.g. PCR/qPCR, whole genome sequencing, metabarcoding and know for which questions they are to be applied. In the practical course, the methods worked on in the seminar are applied as far as they are within the scope of the research taking place at the IMF.
Contents	Methods in marine sciences, PCR/qPCR, whole genome sequencing, metabarcoding.
Course types and forms of instruction:	• S: Molecular Biological Basics in Marine Biology — 2 SEM./HRS • P: Molecular Biological Basics in Marine Biology — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S: Molecular Biological Basics in Marine Biology		*28*	*28*	*34*
• P: Molecular Biological Basics in Marine Biology		*42*	*10*	*38*
Total Workload	6	70	38	72

Coursework and examinations:	Formal requirements for examinations: Active participation, Talk examinations: Protocol (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	To be announced at the beginning of the course.

Title:	**Molecular Biological Basics in Marine Biology**				
Module number:	BMARSYS-27a				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Elisa Schaum, Phone: 42838 6625, elisa.schaum (at) uni-hamburg.de				
Instructors:	Dr. Luisa Listmann Prof. Dr. Elisa Schaum				
Language	German				
Intended learning objectives:	Students have an in-depth insight into relevant molecular biological methods in marine sciences. They have explicit knowledge about the biological basics as well as the application of the most common methods, e.g. PCR/qPCR, whole genome sequencing, metabarcoding and know for which questions they are to be applied.				
Contents	Methods in marine sciences, PCR/qPCR, whole genome sequencing, metabarcoding.				
Course types and forms of instruction:	• S: Molecular Biological Basics in Marine Biology				2 SEM./HRS
Workload (module components and total):	• S: Molecular Biological Basics in Marine Biology	*credits*	P (hrs) *28*	S(hrs) *28*	EP (hrs) *34*
	Total Workload	3	28	28	34
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Talk (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	To be announced at the beginning of the course.				

Title:	**Ecology of Tidal Flats**				
Module number:	BBIO-WPW-51				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Andreas Schmidt-Rhaesa, Phone: 238317-638, andreas.schmidt-rhaesa(at)uni-hamburg.de				
Instructors:	Prof. Dr. Andreas Schmidt-Rhaesa				
Language	German				
Intended learning objectives:	The students are able to formulate scientific questions, to design, execute and, if necessary, to modify appropriate experiments. They have acquired knowledge of the diversity and ecology of organisms in the Wadden Sea area.				
Contents	Knowledge of marine invertebrates - Ecology of the Wadden Sea - Fundamentals of marine biology - Implementation of multi-day field experiments - Independent planning and modification of experiments - Multiple interim reports and final report - Written protocol in the form of a scientific publication				
Course types and forms of instruction:	• P: Ecology of Tidal Flats				6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• P: Ecology of Tidal Flats		*84*	*68*	*28*
	Total Workload	*6*	*84*	*68*	*28*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Protocol (graded; 60%), Presentation (graded; 40%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Is given in the course				

Title:	**Ecology of the Baltic Sea**				
Module number:	BBIO-WPW-57				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Veit Hennig, Phone: 42838 4235, veit.hennig (at) uni-hamburg.de				
Instructors:	Dr. Veit Hennig				
Language	German				
Intended learning objectives:	The students have an overview of ecology, species groups and biotic communities of the Baltic Sea and are able to carry out the planning and execution of quantitative ecological investigations under water, independently.				
Contents	The module teaches fundamentals of Baltic ecology in theory and practice. The focus is on the communities of the sublittoral and the abiotic framework parameters, which are also recorded in the internship. For this purpose, qualitative and semi-quantitative methods with the special features of underwater detection are being tested.				
Course types and forms of instruction:	• S: Ecology of the Baltic Sea - Communities of the Littoral • P: Communities of the Littoral				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Ecology of the Baltic Sea - Communities of the Littoral		*28*	*40*	*22*
	• P: Communities of the Littoral		*84*	*96*	-
	Total Workload	*9*	*112*	*136*	*22*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Is given in the course				

Title:	**Plankton and Climate**				
Module number:	BMARSYS-25				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Inga Hense, Phone: 42838 6641, inga.hense(at)uni-hamburg.de				
Instructors:	Prof. Dr. Inga Hense Dr. Rolf Koppelmann Prof. Dr. Elisa Schaum				
Language	German				
Intended learning objectives:	Students know the effect of climate on plankton organisms and populations and their importance for the function of marine ecosystems and marine matter fluxes. They are also familiar with current topics and problems of planktology in the context of climate research.				
Contents	Definition of climate, climate cycles, and climate change; climate gases and their cycles; relevance of climate to the ocean; contribution of plankton to climate change (e.g., carbon pumps); plankton as indicators of climate change (e.g., "regime shifts"); climate engineering (e.g., iron fertilization, "CO2 dumping"); ocean acidification.				
Course types and forms of instruction:	• V: Introduction to Estuary Research • S: Elbe Internship: Introduction to Estuary Research				1 SEM./HRS 1 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• V: Introduction to Estuary Research		*14*	*14*	*60*
	• S: Elbe Internship: Introduction to Estuary Research		*14*	*28*	*50*
	Total Workload	*6*	*28*	*42*	*110*
Coursework and examinations:	Formal requirements for examinations: Active participation, presentation examinations: Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				