



BL/ES 370 - THE WADDEN SEA: INTERTIDAL ECOSYSTEMS ENDANGERED BY HUMAN IMPACT

IES Abroad Freiburg

DESCRIPTION:

The world's largest tidal flat system is at risk! The Wadden Sea stretches around 500 kilometers along the Dutch, German and Danish North Sea coasts and is the world's largest contiguous tidal flat landscape. This ecosystem, which cannot be found anywhere else in the world, is protected as a UNESCO World Heritage Site.

This module will introduce students to the Wadden Sea's dynamics, intertidal ecology and relevant climate-driven changes. Students will learn about sediment transport and coastal risk management, which protect towns and agricultural land from storm surges and sea level rises. Students will gain an awareness of how such safeguards impact the surrounding environment. Another important aim is teaching students to identify and examine key organisms and understand their role in the ecosystem.

This course includes a 3-day field study excursion to the North Frisian Wadden Sea. Together with local park rangers employed by the Wadden Sea National Park Services, students will gain firsthand insights into the ecological role of the tidal flat landscape and its protection. During the field study excursion, students will visit a Hallig (island) as well as an exposed seabed. Students will learn to use several scientific devices, detect several physical factors in the field and benefit from experiential learning to strengthen their desired learning outcomes.

CREDITS: 3

CONTACT HOURS: 45 (taught in the form of a 3-week module)

LANGUAGE OF INSTRUCTION: English

INSTRUCTOR: Michael Anstett

PREREQUISITES: One college level biology course or by discretion of faculty; ability to walk ~ 3 miles (one way) at a steady pace without break on uneven ocean ground.

ADDITIONAL COST: none

METHOD OF PRESENTATION:

- Lectures
- Field study
- Student presentations

REQUIRED WORK AND FORM OF ASSESSMENT:

- Course participation - 15%
- Informative presentation (ca. 5 minutes) during excursion 20%
- Field report
 - Reflection report – 20%
 - Presentation – 20%
- Final exam - 25%

Course Participation - 15%

Students are required to complete all reading assignments and will be expected to demonstrate this through regularly assigned homework, pop quizzes and/or insightful and relevant contributions to in-class discussion. All of these components will count toward the class participation grade. Participation also applies to course-related trips, outings and/or special events in and around Freiburg. A rubric for participation is available in the appendix and on Moodle.

Informative Presentation during excursion 20%

Brief informative presentation on the excursion that serves as an introduction to a topic discussed on site. Duration 5 min.

1-2 pieces of required scientific literature must be prepared for the presentation and will be provided by the instructor.

At the end of first week of the course, a handout (approx. 1-2 pages / approx. 250 words plus pictures / diagrams / graphics) must be submitted to the instructor. This will serve as the basis for the presentation on the excursion.

Topic to be discussed and assigned in agreement with the instructor.

These can include:

- Introduction of a benthic species
- Introduction to the infrastructure protecting human settlements and agricultural land
- Primary producers (algae) and their role in the Wadden Sea ecosystem
- Migratory birds and their population changes over time
- Dune system classification and their typical flora

Field report – 40%

- Students are required to write a short reflection paper (400-500 words) on one of the topics covered during their field study experience at the North Sea. In this report, students should review what they have learned and critically relate it to the course content. The field report follows a standardized structure (provided by the instructor) including basic information (date, location, route), a summary of the factual information provided by the instructor, a summary of the field survey, a reflection on their personal learning outcomes. The topic shall be chosen in consultation with the instructor and may not be the same as the subject of the student's informative presentation. (20%)
- Presentation: In the third week of the course, students will give a more detailed presentation on the subject covered in their field report (10-15 minutes). The presentation on the topic of their field trip report will be based on additional literature (assigned by the teacher) and should provide deeper insights into the subject matter. It is essential that the student discusses the subject matter within the larger context of the seminar by connecting their topic to other material learned in the course. Appropriate forms of media (e.g., PowerPoint slides) should be used to create the presentation, allowing other students and the instructor to easily follow along. (20%)

Final Exam – 25%

The final exam will be a comprehensive assessment of all topics covered in the course. An essay format will be used, and students will have 90 minutes to complete the exam in class. Detailed information on the content of the final exam will be distributed in advance. Question format will include short essay questions.

LEARNING OUTCOMES:

By the end of the course students will be able to:

- Draw connections between the Wadden Sea as it is today and the sea level rise after the last ice age
- Describe the food web of the Wadden Sea and its ecological importance
- Analyze sediment transport and connected dune systems as part of the Wadden Sea dynamics
- Implement hands-on techniques to identify and examine important key species from the low trophic levels of the ecosystem, including the very significant lugworm
- Spot, identify and classify microalgae within the ecosystem based on field experience
- Discuss future challenges to flood protection infrastructure that may be caused by the predicted increases in storm surges
- Analyze risks to the ecosystem, its plasticity and the human infrastructure due to rising sea levels and explain strategies for mitigation and their limits
- Assess nature protection strategies in the UNESCO nature World Heritage area Wadden Sea
- Interpret and communicate knowledge acquired in the course in oral (presentation, discussions, round table discussions) and written form (field reports)



Attendance Policy (see also the detailed version on Moodle ESS Academics page)

IES Abroad courses are designed to utilize the unique contribution of the instructor; the lecture/discussion format is regarded as the **primary mode of instruction**. Therefore, attendance is mandatory. Any unexcused absence will incur a penalty on your final course grade. Deductions from grades due to absences are based on contact hours (= 45 minutes). Any unexcused absence will result in a penalty on your final course grade (1 unexcused contact hour absence - 1%, 2nd unexcused contact hour absence -2%, 3rd unexcused contact hour absence – 3% and so on). Any student who misses more than 25% of a course (= more than 11 contact hours), whether the absences are excused or are unexcused, will receive an “F” as the final grade in the course.

ESS courses may have entire course blocks that take place on one day in addition to longer field trips that count for several contact hours. In this case, the actual missed contact hours are added together, and the absences are sanctioned according to the rule above. If you are late for a planned field trip, you will generally not be able to join the trip, since the group needs to leave on time and cannot wait for one person. Punctuality is therefore essential here. If you miss a class, it is **your responsibility** to make up on everything that was covered in class. Tests/presentations missed during unexcused absences **cannot be made up**.

Arriving late for class: Punctuality is important for the planned course schedule. If you are late for class, the late time will be recorded and added up at the end of the course. You will receive a grade reduction based on the accumulated amount of missing contact hours (as outlined above; i.e., if you were late by 15 minutes on 3 days, your grade would be reduced by 1% for 1 missing contact hour).

LATE OR FAILURE SUBMISSION OF ASSIGNMENTS: Late submission of assignments or failure of submission of assignment results in the grade F of that particular assignment. This does not apply to late or non-submission due to illness with an excused absence.

Excused absence: Please call the IES Center before the start of your first class if you are ill and would like to be excused from your course, as outlined in the "Cell Phone and Attendance Policy" handed out during orientation. Student Affairs staff will decide whether your absence can be excused directly or whether a doctor's note is necessary. Absences due to religious observances and family emergencies may be excused at the discretion of the Center Director, with written approval. A petition for an excused absence due to a religious holiday needs to be submitted 2 weeks in advance. If permission is granted, the student needs to inform the Academic Dean, the Student Affairs Team and their instructors. Absences due to private travel or travel delays cannot be excused, even with advanced notice.

ACADEMIC INTEGRITY CODE:

Students are expected to abide by the IES Abroad Code of Academic Integrity. The detailed IES Abroad academic integrity code can be accessed on Moodle.

All work submitted by a student for academic credit should constitute the student's own original work. Regardless of the quality of work, plagiarism will result in a failing grade for the course and/or an academic review and possible expulsion from the program. Plagiarism may be broadly defined as “copying of materials from sources, without acknowledging having done so, claiming other’s ideas as one’s own without proper reference to them, buying materials such as essays/exams, and using AI-generated content without disclosure.”

As AI tools continue to evolve, learning how to use them responsibly is an important emerging skill. Some of our courses allow students to explore the use of generative artificial intelligence (GAI) tools such as ChatGPT for some assignments and assessments. The instructor of each course will communicate whether GAI may be used in a course and provide specific guidelines and procedures for its appropriate use.

Updated information on your course and readings, including additional readings from journalistic articles, can be found on the Moodle platform at <https://moodle.iesabroad.org/login/index.php>

CONTENT:

Week	Content	Assignments and Readings
	Preparatory readings	Preparatory readings / films:

		- Wadden Sea World Heritage Organisation, <i>Welcome to the Wadden Sea World Heritage</i>, 2020. (2 minutes) - Faber, <u>Frisia Coast Trail - How a town drowned overnight</u>. (12 pages) - Faber, <u>Frisia Coast Trail - Grassland conversations</u>. (7 pages)
Week 1 Day 1	Session 1: Introduction to the origin and the intertidal dynamics of the Wadden Sea - Flat sea areas developed after the submergence of the Doggerland following the last ice age - Sediments and their transport, low tide + high tide in the Wadden Sea Assignment of informative presentation topics.	- Oost, Albert et al., <u>Where mud matters</u>, summary, pp. 1, 22-29, 35-37, 93, 105-111 (19 pages) - Deutsche Welle, <i>The Wadden Sea</i>, 2021. (15 minutes) - Vogel, <u>Tide</u> (6 pages) - National Oceanic and Atmospheric Administration, <u>Tides and Oceans</u>. (6 pages) - Geographics, <i>The North Sea Tsunami: Britain's Deadliest Disaster</i>, 2020. (20 minutes)
Day 2	Session 2: Ecosystem Wadden Sea - Connectivity of sea and land ecosystems – mudflats, beaches, dune systems and agricultural land - Habitats and biodiversity: Macrozoobenthos, benthopelagial, plankton and other important sea organisms. The Wadden Sea lugworm.	- Kloepper et al., <u>Wadden Sea Quality Status Report - Introduction</u>, pp. 1-11 (11 pages) - De Groot et al., <u>Wadden Sea Quality Status Report - Beaches and dunes</u>, pp. 1-10, 15-16, 23-30 (20 pages) - Beukema and Dekker, <u>Half a century of monitoring macrobenthic animals on tidal flats in the Dutch Wadden Sea</u>, pp. 1-18 (18 pages) - Wadden Sea World Heritage Organisation, <i>A Call for Cooperation - Saving the Places Migratory Birds Call Home</i>, 2020. (8 minutes) - NIOZ Royal Netherlands Institute for Sea Research is the National Oceanographic

		Institution of the Netherlands, <i>Thinking like a bird</i>, 2015. (8 minutes) - Michael O'Brien et al., <u>The Shorebird Guide</u>, pp. 1-27 (27 pages) - Nationalpark Wattenmeer, <u>Voegel im Nationalpark Wattenmeer</u> (2 pages) - Drent et al., <u>Wadden Sea Quality Status Report – Macrozoobenthos</u>, pp 1-14 (14 pages)
Day 3	Session 3: The Wadden Sea – an international hub for migratory birds - Bird migration - Role of birds in the food web of the Wadden Sea - Nature protection	- Koffijberg et al., <u>Wadden Sea Quality Status Report – Breeding birds</u>, pp. 1-17 (17 pages) - Kleefstra et al., <u>Wadden Sea Quality Status Report - Migratory birds</u>, pp. 1-18 (18 pages) - Wocomo Travel, <i>Germany's North Sea Coast (4/5): Jewels of the Wadden Sea - From St. Peter-Ording to the Halligen</i>, 2022. (52 minutes) - Neuwarft - Hallig Langeneß, <i>Landunter auf Neuwarft / Hallig Langeneß</i>, 2019. (8 minutes)
Day 4	Session 4: Human impact - Natural and partly man-made islands - Dike systems - Threats to infrastructure due to rising sea levels and adaptive solutions - Impacts on the ecosystem due to rising air and seawater temperatures as well as rising sea levels	- Zijlstra et al., <u>Wadden Sea Quality Status Report – Coastal risk management</u>, pp. 1-11 (11 pages) - Philippart et al., <u>Wadden Sea Quality Status Report - Climate change</u>, pp. 1-22 (22 pages) - Wocomo Travel, <i>Germany's North Sea Coast (5/5): The Three Sisters - Sylt, Amrum and Foehr</i>, 2022. (52 minutes) - ARTE, <i>Pacific Oysters Invade the Wadden Sea</i>, 2023. (32 minutes)
Day 5	Session 5: Nature protection and the UNESCO World Heritage site - What limits exist - Acceptance and cooperation with the rural population	- Schroor et al., <u>Wadden Sea Quality Status Report - Landscape and culture</u>, pp. 1-22 (22 pages) - Folmer et al., <u>Wadden Sea Quality Status Report - Beds of blue mussels and pacific oysters</u>, pp 1-16 (16 pages)

	Deadline end of day: Submit the handout for the informative presentation on the excursion	- Common Wadden Sea Secretariat, <u>Eleventh Trilateral Governmental Conference on the Protection of the Wadden Sea of the Common Wadden Sea Secretariat. Wadden Sea Plan 2010</u>, pp 7-10 (4 pages) - Reide Corbett, <i>Science on the Sound- Beach Nourishment on the OBX: Addressing the what, why, and potential impacts</i>, 2022. (53 minutes)
Week 2 Day 1	5-day excursion to the Wadden Sea (including informative presentations from students) Journey from Freiburg to the Wadden Sea	- Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein, <i>The Schleswig-Holstein Wadden Sea National Park</i>, 2021. (12 minutes) - Asmus, <u>Functioning of Intertidal Ecosystems of the Wadden Sea</u>, pp. 1-11, 22-26 (16 pages) - Wang et al., <u>Morphodynamics of the Wadden Sea and its barrier island system</u>, pp. 39-57 (19 pages)
Day 2	Field Study – The Wadden Sea Field study 1: Exploring the Wadden Sea – hike to a Hallig (island) above an exposed seafloor: - Intertidal ecology - Identification of benthic species - The effects of climate warming on the ecosystem and other changes - Dike systems and the acclimatization of human populations to storm surges Time set aside for readings and writing of field trip report.	- Exploring GB, <u>Doggerland: The Lost World Beneath the North Sea</u> (11 pages) - McGreevy, <u>Study Rewrites History of Ancient Land Bridge Between Britain and Europe</u> (3 pages) - National Geographic Education, <u>Doggerland - The Europe That Was</u> (3 pages)

Day 3	Field study 2: The Multimar Wattforum Centre • Exploration and interpretation of the exhibit • Primary producers of mud flats Field study 3: Migratory birds • Identification • Role in the ecosystem • Protection efforts and limitations Time set aside for readings and writing of field trip report.	• https://multimar-wattforum.de/ • Van Roomen et al., <u>Wadden Sea Quality Status Report - East Atlantic Flyway</u>, pp. 1-15 (15 pages)
Day 4	Field study 4: Dune systems • Ecology and dynamics • Interconnection of neighboring ecosystems Field study 5: Island stabilization • Shoreline stabilization and storm surge events Time set aside to write field trip report.	• Oost et al., <u>Wadden Sea Quality Status Report – Geomorphology</u>, pp. 1-6, 11-23 (19 pages)
Day 5	Return trip North Sea to Freiburg	• Faber, <u>Frisia Coast Trail. Manual – Making a Terp in 12 Steps</u> (13 pages)
Week 3	Deadline to submit field trip report.	• Interreg North Sea region, <u>National Analysis Germany</u>, pp. 1-13, 30-31 (15 pages)
Day 1	Session 1: Reflection and round table discussion about the excursion to the Wadden Sea	• Schultze and Nehls, <u>Wadden Sea Quality Status Report - Extraction and dredging</u>, pp 1-8 (8 pages)
Day 2	No class	Time to prepare student presentation and study for final exam.
Day 3	Session 2: Student presentations	
Day 4	Session 3: Student presentations	

Day 5	Session 4: Final exam	
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COURSE-RELATED TRIPS:

- Week 2: 5 days to the North Sea coast of Germany (arrival day, 3 days on site, departure day)

REQUIRED READINGS:

- Asmus, Harald. *Functioning of Intertidal Ecosystems of the Wadden Sea. Material exchange of the Sylt-Rømø Bight and its relation to habitat and species diversity*. Kiel: Alfred-Wegener-Institut für Polar- und Meeresforschung, 2011.
- Beukema, J. J. and Dekker, R. "Half a century of monitoring macrobenthic animals on tidal flats in the Dutch Wadden Sea" in *Marine Ecology Progress Series*, 656 (2020), pp 1-18.
- Common Wadden Sea Secretariat. "Eleventh Trilateral Governmental Conference on the Protection of the Wadden Sea of the Common Wadden Sea Secretariat. Wadden Sea Plan 2010." Wilhelmshaven: 2010. (URL: https://www.waddensea-worldheritage.org/sites/default/files/2010_Wadden%20Sea%20Plan.pdf - last access 17 June 2024).
- Exploring GB. "Doggerland: The Lost World Beneath the North Sea." (URL: <https://www.exploringgb.co.uk/blog/doggerland-the-lost-world-beneath-the-north-sea> - last access 17 June 2024).
- Faber, Hans. "Frisia Coast Trail." 2017. (URL: <https://frisiacoasttrail.blog/2020/10/18/grassland-conversations/> - last access 17 June 2024)
 - "Frisia Coast Trail - How a town drowned overnight."
 - "Frisia Coast Trail. Manual – Making a Terp in 12 Steps."
 - "Frisia Coast Trail - Grassland conversations."
- Interreg North Sea region. "Building with nature." National Analysis Germany / Lower Saxony NLWKN. (URL: national-analysis-nlkwn-final-draft-12_2018.pdf (northsearegion.eu) - last access 17 June 2024).
- National Geographic Education. "Doggerland - The Europe That Was." (URL: <https://education.nationalgeographic.org/resource/doggerland/> - last access 17 June 2024).
- Kloepper, S. et al. (eds). "Wadden Sea Quality Status Report." Wilhelmshaven: Common Wadden Sea Secretariat, 2017. (URL: <https://qsr.waddensea-worldheritage.org/> - last access 17 June 2024).
- McGreevy, Nora. "Study Rewrites History of Ancient Land Bridge Between Britain and Europe," *Smithsonian magazine*, 2 December 2020. (URL: <https://www.smithsonianmag.com/smart-news/tiny-islands-survived-tsunami-almost-separated-britain-europe-study-finds-180976430/> - last access 17 June 2024).
- National Oceanic and Atmospheric Administration, "Tides and Oceans." (URL: <https://scijinks.gov/tides/> - last access 17 June 2024).
- Nationalpark Wattenmeer, *Poster. Voegel im Nationalpark Wattenmeer*.
- O'Brien, Michael et al. *The Shorebird Guide*. Boston: Houghton Mifflin Harcourt, 2006.
- Oost, Albert et al. "Where Mud Matters. Towards a Mud Balance for the Trilateral Wadden Sea Area: Mud supply, transport and deposition." Leeuwarden: Wadden Academy, 2021. (URL: https://exchange.waddensea-worldheritage.org/sites/default/files/2023-04/documents/ef2e1b4f/2021-02-report-Where_Mud_Matters.pdf - last access 17 June 2024)
- Vogel, Tracy. "Tides, NASA Online source." (URL: <https://science.nasa.gov/moon/tides/> - last access 17 June 2024).
- Wang, Z.B. et al. "Morphodynamics of the Wadden Sea and its barrier island system" in *Ocean & Coastal Management*, 68 (2012), pp. 39-57.

REQUIRED FILMS AND PODCASTS:

- ARTE, *Pacific Oysters Invade the Wadden Sea*, 2023. (32 minutes)
- Welle, *The Wadden Sea*, 2021. (15 minutes)
- Geographics, *The North Sea Tsunami: Britain's Deadliest Disaster*, 2020. (20 minutes).
- Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein, *The Schleswig-Holstein Wadden Sea National Park*, 2021. (12 minutes)

- Neuwarft - Hallig Langeneß, *Landunter auf Neuwarft / Hallig Langeneß*, 2019. (8 minutes)
- NIOZ Royal Netherlands Institute for Sea Research is the National Oceanographic Institution of the Netherlands, *Thinking like a bird*, 2015. (8 minutes)
- Reide Corbett, *Science on the Sound- Beach Nourishment on the OBX: Addressing the what, why, and potential impacts*, 2022. (53 minutes)
- Wadden Sea World Heritage Organisation, *A Call for Cooperation - Saving the Places Migratory Birds Call Home*, 2020. (8 minutes)
- Wadden Sea World Heritage Organisation, *Welcome to the Wadden Sea World Heritage*, 2020. (2 minutes)
- Wocomo Travel, *Germany's North Sea Coast (4/5): Jewels of the Wadden Sea - From St. Peter-Ording to the Halligen*, 2022. (52 minutes)
- Wocomo Travel, *Germany's North Sea Coast (5/5): The Three Sisters - Sylt, Amrum and Föhr*, 2022. (52 minutes)

Appendix:

Rubric for course participation:

A	Excellent participation The student's contributions reflect an active reading of the assigned bibliography. Skillfully synthesizes the main ideas of the readings and raises questions about the applications and implications of the material. Demonstrates, through questions and comments, that he or she has been capable of relating the main ideas in the readings to the other information discussed in the course, and with his or her own life experience. The student makes informed judgments about the readings and other ideas discussed in class, providing evidence and reasons. He/she respectfully states his/her reactions about other classmates' opinions and is capable of contributing to the inquiry spiral with other questions. The student gets fully involved in the completion of the class activities.
B	Very good participation The student's contributions show that the assigned materials are usually read. Most of the time the main ideas are identified, even though sometimes it seems that applications and implications of the information read were not properly reflected upon. The student is able to construct over others' contributions, but sometimes seems to interrupt the shared construction to go over tangents. He/she is respectful of others' ideas. Regularly involved in the activities but occasionally loses concentration or energy.
C	Regular participation The participant evidences a regular reading of the bibliography, but in a superficial way. He/she tries to construct over others' ideas, but commonly provides comments that indicate lack of preparation about the material. Frequently, contributions are shallow or unarticulated with the discussion in hand.
F	Insufficient participation Consistently, the participant reads in a shallow way or does not read at all. Does not participate in an informed way and shows lack of interest in constructing over others' ideas.