

14 May 2025

To: High Commission of the Commonwealth of The Bahamas in London

I am a British marine ecologist, social scientist, and National Geographic Explorer joining a Bahamas-flagged cruise ship as a Visiting Scientist for an 8-day Icelandic itinerary to conduct opportunistic research on seaweed. The voyage starts and ends in Reykjavik, with several stops around the Icelandic coast. The Vessel is the *MS National Geographic Explorer*, owned and operated by Lindblad Expeditions.

My colleague, Luisa, and I have been working with a number of Icelandic contacts, and the UK Foreign, Commonwealth, and Development Office to secure the correct permits to conduct our research. In pursuing our foreign research declaration from the Icelandic government, we were informed that we require a permit from the Ministry of Industry to conduct work within the Icelandic EEZ/fisheries zone. Specifically, the FDCO (Ocean Policy Unit – Legal Directorate) stated, "As this vessel will use a Bahamas-flagged vessel, the application must be officially submitted to the Icelandic government via the Bahamas."

Respectfully, I request that you please submit the following to Iceland on my behalf, included below in this document:

1. Research Details
2. Vessel Information
3. Personnel Information
4. Project Timeline
5. Supporting Documentation

Please note that Lindblad Expeditions have informed me that they possess all appropriate permissions to operate the vessel in Iceland according to the itinerary. This request is specifically to cover the opportunistic research we will be conducting while aboard.

If you require additional information, I am ready to act quickly. I realise this request is coming with a short timeline. I would be grateful for your attention to this matter. In future, applications will be submitted with a longer lead time now that we are aware of the process.

Thank you,



Chloe Nunn
Visiting Scientist/National Geographic Explorer
UK Polar Network
+44 (0) 7519 038 793
chloebnunn@gmail.com

1. Research Details:

Name, affiliation, and email address of the Principal Investigator:

Chloe Nunn (United Kingdom), UK Polar Network, chloebnunn@gmail.com, +44 (0) 7519038793

Additional Team Members:

Luisa Düsedau (Germany), Aarhus University, Department of Ecoscience,
luisa.duesedau93@gmail.com, +45 20782432

The onboard team is comprised of Chloe and Luisa. Chloe brings a background in marine ecology and ecosystem services, while Luisa is experienced in molecular biology and seaweed ecology. Together they cover the needed skills to collect data onboard, process the data, and contextualise it for guests.

Purpose of the cruise

This is a tourism cruise that also carries researchers. The purpose of the cruise is a tour along the coast of Iceland (tourism cruise for up to 140 guests). The researchers onboard will conduct opportunistic science. The vessel has already obtained all necessary permissions to operate this voyage with guests.

Timeline:

29th July, 2025 to 5th August, 2025

Project Title:

Monitoring Macroalgae Extent and Biodiversity in the Arctic - a novel approach using eDNA

Project history, background, and objectives

The Arctic and sub-Arctic are home to hundreds of seaweed species. As the dominant intertidal organism, macroalgal growth cycles are shaped by nutrient availability and light levels. The sub-Arctic, has macroalgae assemblages at the northern end of their habitat, and Arctic assemblages at the southern end of their habitat. This makes the biomes of Iceland interesting transition zones as the region experiences the impacts of climate change.

The well-being humans receive from local and global systems breaks down into direct and indirect 'ecosystem services'. Macroalgae ecosystems perform many of these services at a proximate coastal level and at a global level, including as food, medicines, biofuels, habitat for other species, water quality, flood/storm protection, carbon sequestration, recreation, and cultural connection. Climate change impacts such as warming have been found to cause seaweed species to retreat north, while other temperate species encroach from the south. Freshening of seawater and increased turbidity caused by the melting cryosphere will restrict it.

As seaweed importance to community well-being grows in the face of anthropogenic impacts, understanding the extent and resilience of current seaweed ecosystems to inform sustainable management is crucial.

The extent of macroalgae in the Arctic and sub-Arctic is relatively unknown or unrecorded, limiting our ability to predict ecosystem changes. Direct in situ sampling to obtain presence/absence data, let alone species level data is time and finance expensive in remote places. The objective of this project is to pilot a methodology to test the accuracy of habitat suitability modelling for macroalgae using environmental DNA (eDNA) sampling. Using an existing species distribution model for seaweed in the Western sub-Arctic, and eDNA water sampling techniques, we will identify whether the seaweed species biodiversity sampled in situ matches the predicted distribution of the model.

Project Purpose

The purpose of the research project is to collect environmental DNA (eDNA) water samples along the Icelandic coast to document macroalgal (seaweed) biodiversity in remote and under-sampled marine environments. This research will contribute baseline data on species presence to support long-term monitoring and management of nearshore ecosystems in Iceland. All sampling will be conducted using a low-impact, in situ water filtration method either from shore or small vessels, with strict contamination controls in place. To support ground truthing of the eDNA data, small numbers of seaweed specimens will also be collected for morphological identification and DNA barcoding, following best practices for minimal impact and proper preservation. The project includes public engagement components, such as onboard educational activities and opportunities for guests to observe or assist with sampling, to foster broader awareness of Iceland's coastal biodiversity and the value of non-invasive monitoring techniques.

Scope of work to be achieved on board the proposed voyage

The eDNA sampling will be conducted aboard the proposed Lindblad voyage. To collect the water samples, we will use a custom-built battery powered in situ filtering pump. The pump is powered by a standard lithium-ion battery with the filter situated before all pipework to reduce contamination. Filters used are self-desiccating to reduce risk of losing samples through the preservation process.

General Methods

Sampling will involve the collection of environmental DNA (eDNA) from seawater to assess seaweed biodiversity along the Icelandic coast. Water samples will be collected from small vessels (e.g., Zodiacs) or from shore, using a portable, battery-powered in situ filtration pump. At each site, four 2-liter water samples will be filtered directly into self-desiccating filter units to preserve DNA for later analysis. Temperature, salinity, and GPS coordinates will be recorded alongside each sample. Where conditions and logistics allow, shore-based quadrat surveys in the intertidal zone will also be conducted to visually assess seaweed species and abundance. Small tissue samples from representative seaweed specimens will be collected for DNA

barcoding to help ground-truth eDNA results. All methods are designed to minimize environmental impact and ensure data integrity, with contamination controls in place throughout the sampling process.

Geographical area in which the ship will operate

The ship will be travelling around Iceland clockwise from Reykjavik to Reykjavik, within a rectangle. Corner boundaries: 66.736820, -24.979452; 66.684696, -13.224081; 63.220215, -13.048300; 63.111109, -24.869589

Sampling Plan

Water samples can be taken at any location via Zodiac or on the shoreline. Constraints around sampling are to do it at a reasonable distance from the ship and as near to the seaweed communities of interest as possible e.g. above seaweed forests or close to the shore.

Four 2L samples is the target for each collection site. We would expect to do one collection session per expedition day when Zodiacs are in use or the shore is visited. If there are opportunities to have an additional sample site in one day we would take advantage of that. Over the voyage, we would expect to have five collection sites at minimum.

It takes approximately 15 minutes to collect the temperature, salinity, and water samples.

Filters will be kept in a small storage area aboard the ship. Total area needed is approximately 1m by 1m.

All sampling can be done by the visiting scientists if needed, however guest participation would be welcomed.

Zodiac based: Kit: temperature & salinity probe, GPS unit, 4 x filters, the filtration pump, 4 x sample labels and data recording sheets, writing implement, and 2-4 x pairs of gloves plus spares.

Method: We will travel to the sample site via Zodiac and collect samples from the vessel. GPS coordinates will be recorded. The temperature and salinity probe will be deployed to get a reading for temperature and salinity which will be recorded. For the water sample, the filter is attached to the end of the filtration pump system. Water is fed through the filter, by the pump. 2L of water is pumped per filter. Individuals handling the filters and sample bags should wear gloves to avoid contamination and disinfect their gloved hands between each sample to avoid cross contamination. The sample bag is sealed. The whole process is repeated for a total of four samples all taken in the vicinity (about 3-5m radius) of the first.

Shorebased: Kit: quadrat, camera, GPS unit, data recording sheets, writing implement, waders, measuring tape, plastic bags.

Method: When time, location, and safety measures (e.g. polar bear guard) permit, we will conduct random sampling in the intertidal zone to collect seaweed biodiversity data. This will aid in ground truthing the eDNA data. The quadrat will be laid at three transects in the high, mid and low intertidal zone in each shore-based site. Total seaweed coverage, identification of seaweed species, and approximate ratios of seaweed species will be recorded. An image of

each quadrat will be taken. Representatives of interesting seaweed species might be sampled for species identification through DNA barcoding. In those cases, a small tissue sample will serve as the DNA voucher and will be preserved in silica gel while the rest of the thallus will be pressed as the herbarium voucher. This data collection activity is complimentary to the Zodiak based fieldwork, however the density of shore-based samples is less of a concern. We are able to work with any intertidal samples as logistics allow, i.e. if there are only a few sites where a polar bear guard is able to support our fieldwork, then this doesn't detract from the efficacy of the project.

Optional Shipboard Engagement Activity (seaweed pressing): Kit: seaweed biological samples, seaweed press, cardboard sheets, deep tray herbarium paper, flat bowls, beakers with seawater, lamination sheets, laminator.

Method: The seaweed samples will be arranged on the paper and pressed in the seaweed press by guests. Once pressed, pressings can be laminated for safekeeping.

Post voyage - the filtered samples will be transported to the lab for eDNA analysis once ashore.

Social Science Methods: Pre or post voyage (dates to be determined), we intend to deliver 1-2 workshops co-developed with local based organisations for local participants. The aims of the workshops are to increase local understanding of the contributions of seaweed to people and to refine the use of the results following the fieldwork. The intended workshop outputs may include resources to aid community communication about their local seaweeds; a toolkit to facilitate community led seaweed monitoring; decision making support mechanisms to empower community members to play an active role in seaweed industry development. We anticipate that the workshop(s) will allow us to ensure that our eDNA data analysis results following the expedition can be fed back to the community in a useful format.

Data/samples collected during onboard research activities

Data format: water samples

Volume: The filtered samples weigh approximately 5-15 grams each. The maximum anticipated number of samples is 50.

Biological collections: We intend to collect 3 samples per species and expect to collect from 30-40 species identified through morphological features. These are primarily for ground truthing eDNA data and for guest engagement to use in the seaweed pressing activity to produce bookmarks. We will bring storage bags, labels, silica beads and herbarium materials to preserve up to 100 small biological samples.

Type and volume post-collection: All samples under maximum sampling conditions will fit into one box or bag of maximum size 1m x 1m

Outreach Plans

Pre-voyage: engagement with the marine biodiversity monitoring community through online meetings/workshops to present our project plan. eDNA samples will indicate broader biodiversity beyond seaweed and it will be beneficial to make the broader community aware of our data collection so that they may benefit from its outputs as well. We hope to run pre/post-

expedition workshops with local organisations. This will inform our project outputs and support local communities in stewarding their local seaweed habitats. The Arctic Science Summit Week conference will be held in Denver, CO in March and offers an opportunity to continue building engagement in this work amongst the academic and scientific community, including with Indigenous knowledge holders.

During Voyage: engagement with non-technical audiences through social media posts, blogs, and talks aboard the ship for guests. Blogs will be disseminated broadly across our networks to reach individuals who have a vested interest in Arctic science and marine biodiversity. This includes organisations such as the UK Polar Network, The Association of Polar Early Career Scientists (international and Iceland), ArcticHub (Greenland), ArcticNet, the Study for Environmental Arctic Change, and local community groups.

We would be delighted to have guests participate in our research. The Zodiac based sampling method is quick and easy, with low contamination risk, making it accessible to non-scientists. Guests in our Zodiac will be able to conduct all aspects of water sample collection. We will predominantly have them deploy the temperature and salinity probe, position the filtration system, and transfer to sample bags. Our visiting science team will be responsible for accurately recording and labelling samples. More engaged guests will be welcome to aid in the intertidal quadrat sampling where this is logistically possible and safe. The methodology is straightforward, but would require a longer time commitment from guests. Aboard the ship, guests will be welcome to make their own seaweed pressing bookmark with biological seaweed samples collected specifically for this purpose. We will also be happy to show interesting seaweed structures under the microscope in the science hub for interested guests.

We will deliver talks covering sub-Arctic and Arctic seaweed, their importance to local and global communities, and how they are and will be impacted by climate change. We may also present a more focused talk explaining this research project specifically: the challenges of finding, monitoring, and sampling kelp in the Arctic and sub-Arctic and how we are trialling new methods.

Post Voyage: We will continue blogs and social media activity following the cruise. Additionally, we will communicate the findings of the project as eDNA is analysed and results are interrogated. These outcomes will be communicated through the following avenues (target audiences in parentheses): non-technical visual infographic summary (voyage guests and other interested non-technical audiences); blogs and articles in mainstream media outlets (non-technical general audiences); virtual and in person talks inc. at events (local communities, networks of researchers and practitioners); academic publication (researchers).

Previous permitted research in international waters

Team member Luisa Düsedau has conducted permitted research, including water sampling for eDNA metabarcoding and macroalgal sampling for DNA barcoding in Svalbard and Northern Norway. Surface water samples and macroalgal specimens collected along the fjord axis of Kongsfjorden (Svalbard) and Porsangerfjorden (Finnmark) were used for eDNA metabarcoding and the establishment of a local DNA barcode library. For eDNA metabarcoding a novel primer pair targeting Ulvophyceae (Ulva like green algae: Weinberger & Steinhagen, 2021) was applied successfully (Düsedau, 2024).

2. Vessel Information

Name of Research Ship: MS National Geographic Explorer

Dates of Cruise: July 29th 2025 to August 5th 2025

Operating Authority: Lindblad Expeditions

Operations telephone number: +1 206 403 1570

Particulars of ship

- Name: MS National Geographic Explorer
- Registration Number: 8001438
- Nationality: Bahamas
- Overall length: 112m
- Maximum draught: 4.9m
- Net tonnage: 1,942NT
- Propulsion, e.g. diesel/steam: diesel
- Call sign: C6WR2

Master of Ship: Yuriy Tupikov or Peik Aalto

Crew capacity:

- Deck 18 (5 officers + 1 doctor + 12 crew)
- Engine 12 (6 officers + 6 crew)
- Hotel 53 (3 Officers + 50 Crew)
- Staff 15
- Officer Cabins 13 singles
- Crew Cabins 8 singles / 26 doubles / 5 triples
- Total Officer/Crew Beds 88
- Staff Cabins 11 + 2 LEX assigned cabins
- Officers' Messroom 13 seats -self service style
- Crew's Messroom 64 seats -self service/cafeteria type

The *MS National Geographic Explorer* is a passenger vessel transporting tourists on a leisure cruise around Iceland. It has all the necessary permissions in place to do so. Please liaise with relevant agencies if you would like evidence of these permissions. The research team is joining the voyage for the dates specified to conduct opportunistic research. We are not operating the vessel ourselves and do not have oversight or access to the Ship's certificates and insurances.

Planned route:

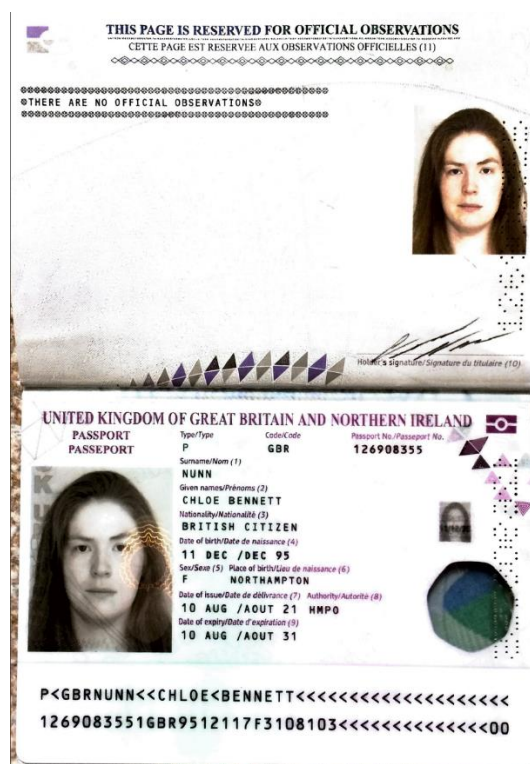


Port calls and anticipated dates during the voyage:

29-Jul-25	REYKJAVIK, ICELAND
30-Jul-25	DYNJANDI WATERFALL
	VIGUR
31-Jul-25	SIGLUFJORDUR
1-Aug-25	Husavik
2-Aug-25	Bogarfjardarhofn
3-Aug-25	DJUPIVOGUR
4-Aug-25	HEIMAEY, WESTMAN IS
	SURTSEY, WESTMAN IS
5-Aug-25	REYKJAVIK, ICELAND

Full names and credentials of all researchers:

Passport No: 126908355



2025 – Present: Visiting Scientist, National Geographic – Lindblad Expeditions (NG-LEX)

2024 – Present: Consultant, UN Ocean Decade (IOC-UNESCO)

2024 – Present: National Geographic Photo Expert, NG-LEX

2023 – 2024: Marine Project Coordinator, North Devon UNESCO Biosphere

2022 – 2024: Consultant – Marine Environment, NIRAS

2020 – 2022: Science and Operations Officer, UN Ocean Decade (IOC-UNESCO)

2019 – 2020: Environmental Compliance Advisor, Valpak

2016 – 2018: Marine Science Student Assistant, University of Southampton

2015 – 2018: Specimen Curator and Cataloguer, Discovery Collections

2014 - 2015: Marine Ecology Instructor, YMCA Camp Fuller

Projects:

Monitoring Macroalgae Extent and Biodiversity in the Arctic, *Principal Investigator, National Geographic Lindblad Expeditions Visiting Scientist Programme*, Dec 2024 – Present

- Project management and team leadership including expedition logistics
- Development of novel eDNA methodology for ship-based seaweed sampling

Let's Kelp our Coasts: Seaweed and Sustainability, *NGS Explorer, National Geographic Educator-Explorer Exchange*, Jun 2024 - Present

- Educational collaboration teaching seaweed ecology and community resilience

Championing Coastal Coordination, *Marine Project Coordinator, North Devon UNESCO Biosphere*, 2023 - 2024

- Co-development of Marine Roadmap, including public engagement
- Coordinating marine contract delivery

Plymouth Ocean Hackathon, *Competitor, Team CoastTrack*, 2023

- Presented data processing solution for CoastSnap data and won the Plymouth competition

Ocean Community Empowerment and Nature Fund, *Fund Engagement Manager, NIRAS*, 2023 – 2024

- Significant role in development of successful tender to Defra
- Stakeholder engagement during Fund development

Clean Planet Peninsula Project, *Training Coordinator, UK Polar Network*. 2023

- Project coordination, including risk assessments and logistics management

Co-Design Training Course, *Science and Operations Officer, UN Ocean Decade*. Sep. 2022 – Dec. 2022

- Coordination across partners, participants, and technical delivery platforms

Call for Decade Actions, *Science and Operations Officer, UN Ocean Decade*. Dec. 2020 – Dec. 2022

- Development and implementation of processes and data management
- Touch point for ocean stakeholders
- Technical reviews of scientific proposals and report writing

Constructive Visions, *Author, Engagement Lead, Project Manager*, 2020 – 2024

- Co-led chapters and supported 30+ educational partnerships across the world
- Coordination of engagement activities and dissemination of grants

Atlantic Deepwater Ecosystem Observatory Network III aboard R/V Endeavor (EN626), *Volunteer scientist for Dr J. Miksis-Olds & Dr J. Warren*. Oct. – Nov. 2018

- Scientific sampling using nets, active acoustic monitoring equipment, and a CTD at each site, alongside marine mammal observations, processing biological samples, and monitoring the ship's log

- Watch keeping and health & safety compliance

An Exploration of Resiliency in Uummannaq, Greenland, Supervised by Dr E. Thompkins, Dr M. Edwards, Dr S. Boxall, with the assistance of A. Andreassen. For MSc Sustainability. May – Sep. 2018

- Ethnographic data collection and qualitative analysis

Understanding Water and Sediment Flux at the Chaktomuk Junction, Supervised by School of Geog. and Env. academic leaders. For MSc Sustainability. Jan 2017.

- Taught undergrads how to use an aDcp and analyse the resulting data
- Took water samples and water and sediment flow data from a Mekong River boat
- Coordinated group during fieldwork, analysis, presentation, and reporting stages

Education & Training:

Leadership Training, National Geographic Society, Completed May 2024

How to Start a Kelp Farm, GreenWave, Completed January – February 2023

Arctic Winter College, Migration in Harmony Research Coordination Network, Ecologic Institute & the Arctic Institute, Completed April 2021

ScienceTelling Bootcamp, National Geographic Society, Completed October 2019

MSc Sustainability (Distinction), University of Southampton, Awarded December 2018

Introduction to Data Analysis and Ecosystem Modelling (6ECTS), ICBM Summer School on Coastal Systems, University of Oldenburg, Completed August 2017

BSc Oceanography (Hons, 2.1), University of Southampton, Awarded July 2017

Publication Highlights:

- Turner, D., et al. 2025. **Nunakut Naguatun Atugluu/ Co-Stewardship: ‘Co-production’ through the lens of the Study of Environmental Arctic Change’s Human Wellbeing Team**. PLOS Climate. Under Review.
- [IOC-UNESCO. 2024. *Building a Roadmap for the implementation of the Ocean Decade in the Tropical Americas and Caribbean \(TAC\) Region*. UNESCO, Paris. \(The Ocean Decade Series, 59\). Editor.](#)
- [Nunn, C., et al. 2023. *The Growing Popularity of Polar Science*. The Observer.](#)
- [Hancock, S., Janoski, K., Leidman, S., Nunn, C., Reinert, A. 2023. *Community Wellbeing in the North American Arctic*, Arctic Winter College 2023.](#)
- [SEARCH and Justin 2022. *Consequences of rapid environmental Arctic change for people*. Arctic Report Card 2022, M.L. Druckenmiller, T.A. Moon, and R.L. Thoman, Eds.](#)
- [Nunn, C. 2022. *Lessons in Cross-Cultural Communication About Climate Change*. The Circle, WWF.](#)

- [Ponce de Leon Barido, D., et al. 2021. **Constructive Visions: Stories for a more sustainable post-pandemic future**. A global collaboration.](#)
- [The Intergovernmental Oceanographic Commission of UNESCO. 2021. **A Brave New Ocean, Inspiring the Start of the Ocean Decade**, ECO Magazine.](#)
- [Nunn, C., et al. \(2020\). **The Living Breakwater Tackles the SDGs**. ESRI StoryMap.](#)
- Nunn, C. 2020. **Scavenging for Knowledge**. Muse Magazine, Cricket Media.
- Nunn, C. 2019. **Making Maps, Dolphin Style**. Muse Magazine, Cricket Media.

Awards

2024 Phase 3 Championing Coastal Coordination Environment Agency Fund: 24,000 GBP for North Devon UNESCO Biosphere

2024 Visiting Scientist National Geographic Grant: 20,000 USD for NG-LEX ship-based research

2023 Clean Planet Foundation financial support to deliver UKPN training course

2023 British Antarctic Territory Grant: 8,000 GBP for UK Polar Network

2022 Community Grant: 2,000 USD for event at the Plymouth Aquarium

2022 National Geographic Collaboration Grant: 71,500 USD for educational partnerships

2020 National Geographic Collaboration Grant: 12,500 USD for book publication

2018 Dean's List Award: MSc overall performance & MSc dissertation

2018 National Geographic Early Career Grant: 5,734 USD

2017 Caroline Cliff Travel Award: 150 GBP

Luisa Düsedau (Germany), Aarhus University, Department of Ecoscience,
luisa.duesedau93@gmail.com, +45 20782432



Academic education and work experience

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|-------------|--|
| Since 2025 | University of Aarhus (Denmark) |
| | Postdoc for Arctic macroalgal research (projects: BlueCea, BlueArc and CARMA) |
| 2021 - 2025 | Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (Germany) and University of Bremen (Germany) |
| | PhD fellow in the frame of the European Horizon 2020 project FACE-IT |
| 2019 - 2021 | GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany) |
| | Scientist |
| | Joint Sino-German macroalgal research project "Invasion" |
| 2016 - 2019 | Goethe-University Frankfurt am Main (Germany) |
| | Master of Science - Ecology and Evolution (Overall Grade: 1,5) |
| 2017 - 2017 | GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany) and |
| | Israel Oceanographic & Limnological Research (Israel) |
| | International research and student training programme GAME |
| | Global approach: "Grazing in a warming ocean - investigating the latitudinal effect of temperature dependent consumption rates in marine ectotherms" |
| 2015 - 2016 | Ernst-Moritz-Arndt-University Greifswald (Germany) |

Master of Science - Biodiversity and Ecology

2011 - 2014 University Rostock (Germany)

Bachelor of Science – Biosciences (Overall Grade: 2,1)

Publications

Düsedau, L. (2025). Assessment of Macroalgal Biodiversity and Habitat Change in the European Arctic. Doctoral dissertation, University of Bremen

Bartsch, I., **Düsedau, L.**, Savoie, A., Schlegel, R., Comeau, S., Krause-Jensen, D., & Diehl, N. (2024). Deliverable 2.3: Macroalgal genetic sequence database. The Future of Arctic Coastal Ecosystems – Identifying Transitions in Fjord Systems and Adjacent Coastal Areas. FACE-IT Project. <https://www.face-it-project.eu>

Mudlaff, C. M., Weinberger, F., **Düsedau, L.**, Ghotbi, M., Kuenzel, S., & Bonthond, G. (2024). Seasonal cycles in a seaweed holobiont: A multiyear time series reveals repetitive microbial shifts and core taxa. *bioRxiv*, 2024-10.

Düsedau, L., Fredriksen, S., Brand, M., Fischer, P., Karsten, U., Bischof, K., ... & Bartsch, I. (2024). Kelp forest community structure and demography in Kongsfjorden (Svalbard) across 25 years of Arctic warming. *Ecology and Evolution*, 14(6), e11606.

Düsedau, L., Ren, Y., Hou, M., Wahl, M., Hu, Z. M., Wang, G., & Weinberger, F. (2023). Elevated temperature-induced epimicrobiome shifts in an invasive seaweed *Gracilaria vermiculophylla*. *Microorganisms*, 11(3), 599.

Steinhagen, S., Düsedau, L., & Weinberger, F. (2021) “DNA barcoding of the German green supralittoral zone indicates the distribution and phenotypic plasticity of *Blidingia* species and reveals *Blidingia cornuta* sp. nov.”, *TAXON*, 70(2), 229-245.

Selected presentations at conferences

Düsedau, L., Weinberger, F., Bartsch, I., Fredriksen, S., Savoie, A., (2024) „Novel molecular assessment of marine macroalgae from two Arctic fjords reveals a high proportion of cryptic biodiversity”, Oral presentation: Arctic Frontiers, Tromsø, Norway

Düsedau, L., Bartsch, I., Weinberger, F., Savoie, A., (2023) “The importance of DNA reference libraries for metabarcoding biodiversity assessments”, Guest speaker oral presentation: ICYMARE conference for young marine researchers, Oldenburg, Germany

Düsedau, L., Fredriksen, S., Brand, M., Fischer, P., Karsten, U., Bischof, K., Bartsch, I. (2023) “Influence of recent warming on kelp forest structure in Kongsfjorden (western Svalbard) over time”, Oral presentation: 8th European Phycological Congress, Brest, France

Düsedau, L., Savoie, A., Fredriksen, S., Bartsch, I. (2023) “Intertidal macroalgal communities in the European Arctic”, Poster presentation: 8th European Phycological Congress, Brest, France

Düsedau, L., Fredriksen, S., Brand, M., Savoie, A., Bartsch, I. (2023) “Kelp forest biomass and biodiversity development in Kongsfjorden”, Oral presentation: Arctic Science Summit Week, Vienna, Austria

Düsedau, L., Savoie, A., Fredriksen, S., Bartsch, I. (2023) “Macroalgal communities in the European Arctic”, Poster presentation: Arctic Science Summit Week, Vienna, Austria

Düsedau, L., Fredriksen, S., Brand, M., Savoie, A., Jungblut, S., Molis, M., Niklass, J., Buschbaum, C., Bischof, K., Bartsch, I. (2021) “Macroalgal biodiversity and biomass of Kongsfjorden through time and space”, Poster presentation: Svalbard Science Conference, Oslo, Norway

Expeditions and research stays

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| 2025 | Research stay at the University of the Faroe Islands

ddPCR analysis of macroalgal DNA in fjord and continental shelf sediments |
| 2024 | Kongsfjorden expedition, Ny-Ålesund, Svalbard

Field PI, Intertidal seaweed biomass sampling at six locations along the fjord axis, morphological biodiversity assessment, cooperation with eULVA (Ulvaes barcoding) and CCTBON (Rocky shore documentation) on Arctic biodiversity |
| 2024 | Research stay at the Canadian Museum of Nature, Ottawa, Canada

Final data analysis for a novel macroalgal genetic sequence database |
| 2023 | Research stay at the Canadian Museum of Nature, Ottawa, Canada

DNA barcoding laboratory work, data analysis, microscopy, metadata and herbarium management for a novel macroalgal genetic sequence database |
| 2022 | Porsangerfjorden expedition, Finnmark, Norway

Intertidal seaweed biomass sampling at five locations along the fjord axis, morphological biodiversity assessment, tissue samples and herbarium vouchers for a novel macroalgal genetic sequence database |
| 2021 | Kongsfjorden expedition, Ny-Ålesund, Svalbard

Kelp forest biomass survey at the Hansneset depth transect, seaweed biodiversity sampling along the fjord axis, morphological biodiversity assessment, tissue samples and herbarium vouchers for a novel macroalgal genetic sequence database |

Academic honors and awards

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| 2021 | “Early Career Poster Competition” Award

Awarded at the Svalbard Science Conference for the poster on: “Macroalgal biodiversity and biomass of Kongsfjorden through time and space” |
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Supervision

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| 2024 | Research supervisor bachelor student University Bremen |
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Additional practical experience

- 2020 Scientific Diving Center University Kiel (Germany)
 Research diving training and certification
 “Certified Research Diver/European Scientific Diver”
 “NITROX for certified Research Divers”
- 2018 - 2019 GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany)
 Student assistant for molecular macroalgal work and taxonomic identification of
 benthic organisms
- 2014 Expedition on the research vessel „Elisabeth Mann-Borgese“
 Monitoring the benthic communities of the Baltic Sea
- 2013 - 2014 Leibniz-Institute for Baltic Sea Research Warnemünde (Germany)
 Student assistant for digital scientific of Amphipoda (Zettler & Zettler 2017)
- 2013 Marine Science Centre of University Rostock (Germany)
 Student assistant for public outreach on marine mammal research

Grants received

- 2024 National Geographic Lindblad Expeditions Visiting Scientist Programme
- 2023 Travel support from POLMAR Graduate School
- 2023 Travel support from International Arctic Science Committee (IASC)
- 2023 Short term research grant from POLMAR Graduate School
- 2021 Travel support from Association of Polar Early Career Scientists (APECS)
- 2020 Transnational Access program ASSEMBLE Plus

Outreach

- 2024 Arctic policy meeting at the German embassy in Ottawa (Canada)
- 2024 Nature News Section article "Hello puffins, goodbye belugas: changing Arctic fjord hints
 at our climate future"
 FACE-IT info sheet: “Biodiversity and Novel ecosystem”
- 2023 Open public talk about Arctic macroalgal research in the lecture series “Wissen um 11”,
 Haus der Wissenschaft
- 2023 Studienkompass: Online Q&A session for high school students from non-academic
 families to pursue a career in science

- 2023 Invited (online) talk for Youth for Arctic Nature at the Kvivik School, Faroe Islands
- 2022 Invited (online) seminar talk at University of Tromsø, Norway
- 2021 Open public talk about Arctic macroalgal biodiversity in the lecture series
“Meeresforschung früher, heute und in Zukunft”, Überseemuseum Bremen, Germany
- 2020 “Scientific Diving in Germany”, (online) workshop, YOUMARES Conference for young
marine researchers
- 2018 “Worldwide Master projects in marine ecology: Who wants to play the GAME?”, Oral
presentation, YOUMARES Conference, Oldenburg, Germany
- 2017 Public talk “Grazing in a warming ocean”, GAME master programme speaking tour at the
Universities of Kiel, Hamburg, Greifswald, Rostock and Oldenburg

4. Project Timeline

Day by day schedule of research activities

29-Jul-25	REYKJAVIK, ICELAND
30-Jul-25	DYNJANDI WATERFALL - Zodiac based sampling (1-2 sites)
	VIGUR - Zodiac based sampling (1-2 sites) - Intertidal sampling (1 site)
31-Jul-25	SIGLUFJORDUR - Zodiac based sampling (1-2 sites) - Intertidal sampling (1 site)
1-Aug-25	Husavik - Zodiac based sampling (1-2 sites)
2-Aug-25	Bogarfjardarhofn - Zodiac based sampling (2-3 sites) - Intertidal sampling (2-3 sites)
3-Aug-25	DJUPIVOGUR - Zodiac based sampling (1-2 sites)
4-Aug-25	HEIMAHEY, WESTMAN IS - Zodiac based sampling (1-2 sites)
	SURTSEY, WESTMAN IS - No sampling (protected area)
5-Aug-25	REYKJAVIK, ICELAND

Team member Chloe Nunn will be working on two prior voyages along the same itinerary in June as the National Geographic Photo Expert. During this time, she will identify more specific sampling locations at each stop so ensure efficient data collection during this voyage. She will also connect with private landowners where intertidal sampling may be suitable to ensure permission is granted in advance.

Contingency Plans

In the event that Zodiac-based sampling is not possible due to weather, safety concerns, or operational constraints, the research team will prioritize shore-based sampling where feasible and permitted. If both Zodiac and shore access are restricted, onboard engagement activities

such as seaweed pressing or microscopy demonstrations will be expanded to maintain scientific and outreach value. Sampling plans are designed to be flexible, with the goal of achieving a minimum of five sites over the voyage. Opportunities for additional sampling will be taken whenever conditions allow to offset any missed sites. The presence of experienced researchers and pre-identified alternate sampling opportunities ensures that the project's core objectives can still be met despite unforeseen disruptions.

Data management and sharing protocols

The project's data will adhere to FAIR (findable, accessible, interoperable, and reusable) data management principles and CARE (collective benefit, authority to control, responsibility, ethics) Principles of Indigenous Data Governance which can apply to local communities. To do this we will follow the Interagency Arctic Research Policy Committee guidelines and recommendations to ensure that our data are stored in an appropriate repository. We will use our existing contacts to speak directly with community members about how they might best use data we collect, support them in this use, and produce outputs which they request or recommend as useful. eDNA data will be processed using openly accessible bioinformatics pipelines and will be shared to the OBIS and OBON data repositories if appropriate.

The data will be used for a scientific article to be published in an open access journal. This is expected to be by the end of 2026. The data will be published alongside the article in a public data repository (e.g. GBIF or BOLD).

Post-research reporting commitments

We will communicate the findings of the project as eDNA is analysed and results are interrogated. These outcomes will be communicated through the following avenues (target audiences in parentheses): non-technical visual infographic summary (voyage guests and other interested non-technical audiences); blogs and articles in mainstream media outlets (non-technical general audiences); virtual and in person talks inc. at events (local communities, networks of researchers and practitioners); academic publication (researchers).

Research results will also be directly reported to our funder, National Geographic Society, and our hosts, National Geographic – Lindblad Expeditions following the cruise.

5. Supporting Documentation

Local Collaborators

We have been working with three Icelandic researchers in planning for this project. Their details are below:

- Alessandra Schnider, alessandra@holar.is
- Karl Gunnarsson, karl.gunnarsson@hafogvatn.is
- Lilja Gunnarsdóttir, lilja.gunnarsdottir@hafogvatn.is

We do not have formal agreements with them, however we plan on collaborating with them to design workshops in Reykjavik for young people, families, and the local community to share our research. We will also work with Alessandra and her outreach platform to share fieldwork progress and research outcomes digitally. Karl and Lilja are leading macroalgal experts in Iceland. We will share our research outcomes with them and look for other collaboration opportunities as we publish our results.

Funding details and support letters

Our voyage offer email is below. We opted for the EX72562 – CIVN itinerary due to availability of team members. We have received funding of \$20,000 USD from Lindblad Expeditions – National Geographic Fund. We can provide a letter confirming the grant if needed.

VOYAGE Offering: Chloe Nunn 

 **Lindblad Science** <Science@expeditions.com>
to me, Teresa, Sven 

Fri, Jan 17, 12:04 AM    

Hello Chloe,

Thank you for the clarifications on your project. Lindblad Expeditions and National Geographic Society would like to offer you the following voyage to join the *National Geographic Endurance* or *NG Explorer* this upcoming season in Iceland to conduct your project (as discussed). We may have some follow-up details to work out, but in general we believe your project can be conducted successfully on one of the below voyages.

Below you have a choice of these trips based on the availability you provided. You are welcome to take two back-to-back voyages on the NGEX, but please know they will likely visit many of the same spots. Since we are currently holding these voyages open for you, please let us know ASAP which one(s) you would prefer for your work aboard.

Voyage	Ports	Embarkation	Disembarkation	
EX72554 CIVN	Reykjavik/ Reykjavik	3-Jun-25	10-Jun-25	CIVN is a 7-day voyage

EX72560 CIVN	Reykjavik/ Reykjavik	15-Jul-25	22-Jul-25	
EX72561 CIVN	Reykjavik/ Reykjavik	22-Jul-25	29-Jul-25	
EX72562 CIVN	Reykjavik/ Reykjavik	29-Jul-25	5-Aug-25	
EX72563 CIVN	Reykjavik/ Reykjavik	5-Aug-25	12-Aug-25	

Voyage	Ports	Embarkation	Disembarkation	
ED142514 CICE	Reykjavik/ Reykjavik	18-Jul-25	27-Jul-25	CICE is a 10-day voyage

(you can click on the voyage above to connect to the description on the website)

Please note that the above are embarkation/disembarkation dates of the ship and there may be additional travel dates at either end to/from your home and the ship's port. These will be discussed soon, but please buffer these in as you evaluate the dates.

Some timelines and dates to consider:

1. We need to receive your acceptance of this offer by 24 January 2025. If you need additional time to consider, please let us know.
2. We need to discuss the permitting timeline to consider for your voyage and dates. Please send the attached information (and/or questions) to science@expeditions.com and Sven Andes (svenandes@ngs.org) ASAP so we can get this process started and moving along.
3. Upon your acceptance of this voyage offer, you will receive an email from NGS regarding the funding opportunity and budget details required.

If you are bringing a team member, please include their name and email address here. If you need additional time to tell us who this person will be, please let us know. We need to book your team ASAP so please have them selected by the end of January. As outlined in the RFP we can provide one shared cabin that includes two bunks, one desk, and one bathroom. We don't typically ask our staff to mix genders in a cabin, but this is possible if all parties agree. Please confirm that all you and your team member are consenting to sharing the cabin.

We look forward to working with you and learning more details of your project.

Thank you,
Ashley



Ashley Knight/Expedition Science Committee
Fleet Science Operations Manager
2505 2nd Ave. Suite 300, Seattle, WA 98121
www.expeditions.com
science@expeditions.com
Pioneering Responsible Exploration

13 March 2025

Dear Chloe Nunn,

We look forward to hosting you onboard our tourism vessel *M/V National Geographic Explorer* from 29 July through 5 August, 2025 as we travel round trip around Iceland from/to Reykjavik. As we take guests/passengers on our itinerary [*Fire and Ice: An 8-Day Sail Around Iceland*](#), we will, when possible, support you to collect marine macroalgae and seawater samples in the intertidal areas as part of your research project *Monitoring Macroalgae Extent and Biodiversity in Iceland - a novel approach using eDNA*.

As a part of this “Platform of Opportunity” we will supply you with a cabin and meals onboard, and (where applicable) seats on some private, group, LEX-arranged charter flights to arrive/depart port cities for embarkation/disembarkation to the vessel. We will endeavor to support you in the collection of marine macroalgae and seawater samples in the intertidal areas, provided you have acquired the appropriate access, research, and sampling permits required by local authorities and other bodies as needed.

You are responsible for your own research permits, collection permits, sample transport permits and arrangements, as well as any large equipment transport (beyond what can be provided on charter flights).

Thank you,
Ashley Knight



National Geographic-Lindblad Expeditions
Science Operations Manager
ashleyk@expeditions.com

Risk Assessment

The project will finalise and adhere to a risk assessment for all sampling. This will outline emergency procedures and be based upon the risk assessment outcomes from the National Geographic - Lindblad Expeditions (NG-LEX) team. Their team will be providing us with support and will play a key role in deployment of emergency procedures relating to health and safety. The NG-LEX team members will be primarily responsible for ensuring that equipment not in use is secure and cannot pose a security threat to individuals or the site.

The core fieldwork team is made up of two trained researchers. They will be supported by naturalists and powerboat drivers from the NG-LEX team, as well as citizen scientist guests aboard the National Geographic Explorer. The researchers and NG-LEX team members will establish effective communication avenues for the duration of the fieldwork. This continual communication will facilitate any adaptation of each day's plans required to ensure a successful field day and the safety of all involved. They will also be supervised at all times by at least one of the researchers to ensure that sample collection is taking place according to all requirements for successful research and integrity of the local natural environment.

To ensure the general public or other individuals are aware of the research activities when sampling is taking place, and maintain site safety, we will provide information cards explaining the project. We will also provide contact details for relevant authorities and ourselves in case members of the public would like to reach out afterwards to ask for further information. We will be happy to discuss with members of the public during the fieldwork, what it is we are doing as education and outreach are key components of the project.

All sampling will be conducted in appropriate PPE. This includes sturdy, protective, insulative, and waterproof footwear and clothing. Additionally, lifejackets will be worn. To avoid contamination of the samples and surrounding habitat, outerwear will be rinsed after each site visit. Researchers will wear sterile gloves when collecting samples. All individuals involved in fieldwork will be briefed on the emergency procedures and first aid procedures as set out by the NG-LEX team. Guest participants will be expected to wear appropriate PPE and will be briefed regarding the relevant procedures.

To ensure the general public or other individuals are aware of the research activities when sampling is taking place, and avoid any health and safety breaches, we will clearly mark where we are sampling and avoid moving to a new sampling area unless it is free of non-project individuals. Information cards about the project will flag any health and safety issues which the general public should be aware of with regards to our sampling protocols.

No equipment will need to be stored outside of work hours, at the site. When we leave the sampling site we will take all of our equipment and samples with us. No further site monitoring will be required to maintain health and safety.

Both members of the research team are covered by travel insurance including medical insurance covering the planned activities. We can provide evidence of this as required.