

Study Area

Qikiqtaruk - Herschel Island (N69.6°, W139.0°) is situated off the Yukon Coast on NW Canada (Fig. 1). Continuous ice-rich permafrost builds up the island. The islands' coastline is characterized by permafrost thaw features like retrogressive thaw slumps and eroding permafrost cliffs.

(Lantuit & Pollard, 2006)



Fig. 1: Location of Qikiqtaruk - Herschel Island in NW Canada. Graphic modified from Encyclopaedia Britannica (edited June 2023).

What Nature does for Us

Ecosystem Service

positive direct or indirect benefit that ecosystems or wildlife provide to people

National Wildlife Federation

Ecosystem services include essential environmental benefits like food, clean drinking water, natural flood protection, and cultural heritage sites. These services are particularly significant along Arctic coasts, where communities rely heavily on the land for their livelihoods and traditions. The Arctic is warming nearly four times as fast as the global average (Rantanen et al., 2022), causing rapid changes to these ecosystems at the Arctic coasts and the services they provide. (Schuur & Mack, 2018)

How can we put a price on something as intangible as nature? While some values can be expressed in monetary terms, such as the value of a house or the cost of implementing flood prevention measures, others cannot. As part of my PhD, I will explore different approaches for estimating the monetary value of Arctic ecosystem services. However, cultural and traditional values will always be at the core of our work. These aspects cannot - and should not - be reduced to a price tag.

When it comes to a monetary evaluation of Arctic coastal ecosystem services, the impacts of climate change cannot be ignored. For instance, coastal erosion is expected to intensify by 2100, threatening 379 Arctic coastal settlements, as identified by

Ramage et al. (2021)

(Fig. 5). As climate-induced changes continue to change environmental conditions, the supply of and demand for ecosystem services are also expected to shift. We hope to assess those

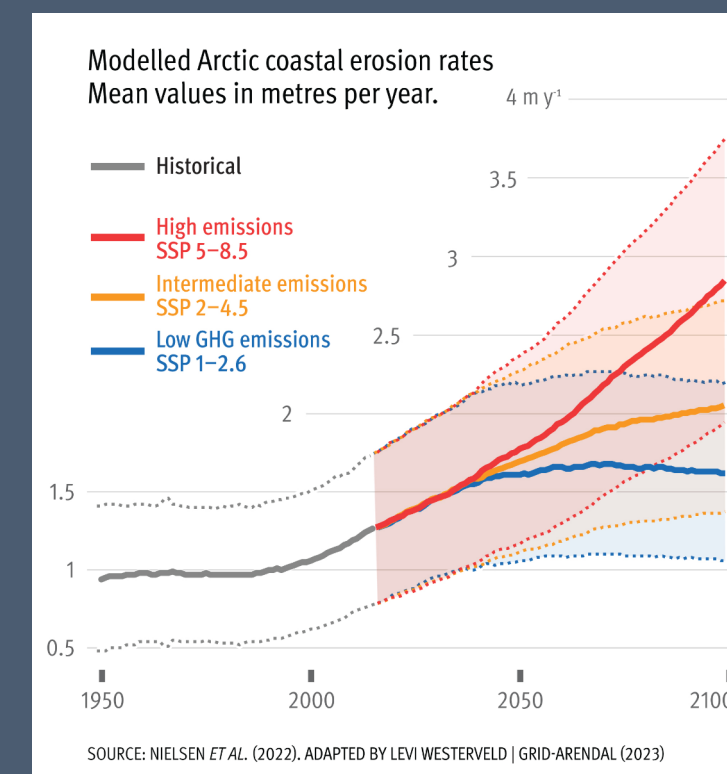


Fig. 5: Projection of mean coastal erosion rates along Arctic coastlines until 2100. GRID-Arendal (2023).

projections of ecosystem services by using the field data from our case study on Qikiqtaruk.

Why should we care?

Arctic coasts are heavily affected by **climate change** (Tanguy et al., 2024). Thawing permafrost, increased flooding, and more frequent storms are altering key ecosystem functions. These changes impact the ecosystem services that Arctic coastal systems provide (Fig. 2). (Schuur & Mack, 2018)

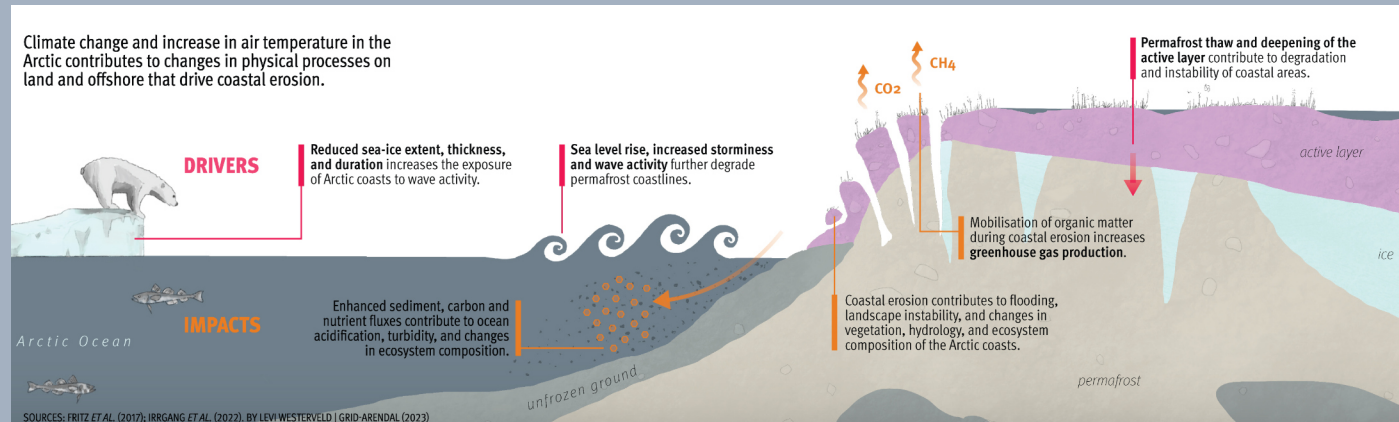


Fig. 2: Changes in physical processes due to climate change at Arctic permafrost coasts. GRID-Arendal (2023).

Around 1 Mio. **people** are living in the proximity of Arctic coasts (Ramage et al., 2021). Their homes, livelihoods, and way of life are increasingly at risk due to coastal erosion and other climate change-related environmental changes. Mapping and describing ecosystem services of Arctic coasts can provide a valuable framework for policymakers. It can help to identify locally important areas, such as culturally significant sites and hunting ground, and it supports decisions that reflect both ecological and community needs.



Fig. 3: Loss of housing and cultural sites along the Canadian Arctic coast due to coastal erosion. Photos by Benjamin M. Jones (2005, 2007).



Fig. 4: Qikiqtaruk - Herschel Island camp at the coast partly flooded. Photo by Weronika Murray (2022).

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assessment of ecosystem functions

mapping of ecosystem services

participatory mapping + questionnaire



Let's talk!

Where can you put your research?

Mapping Nature's Benefits

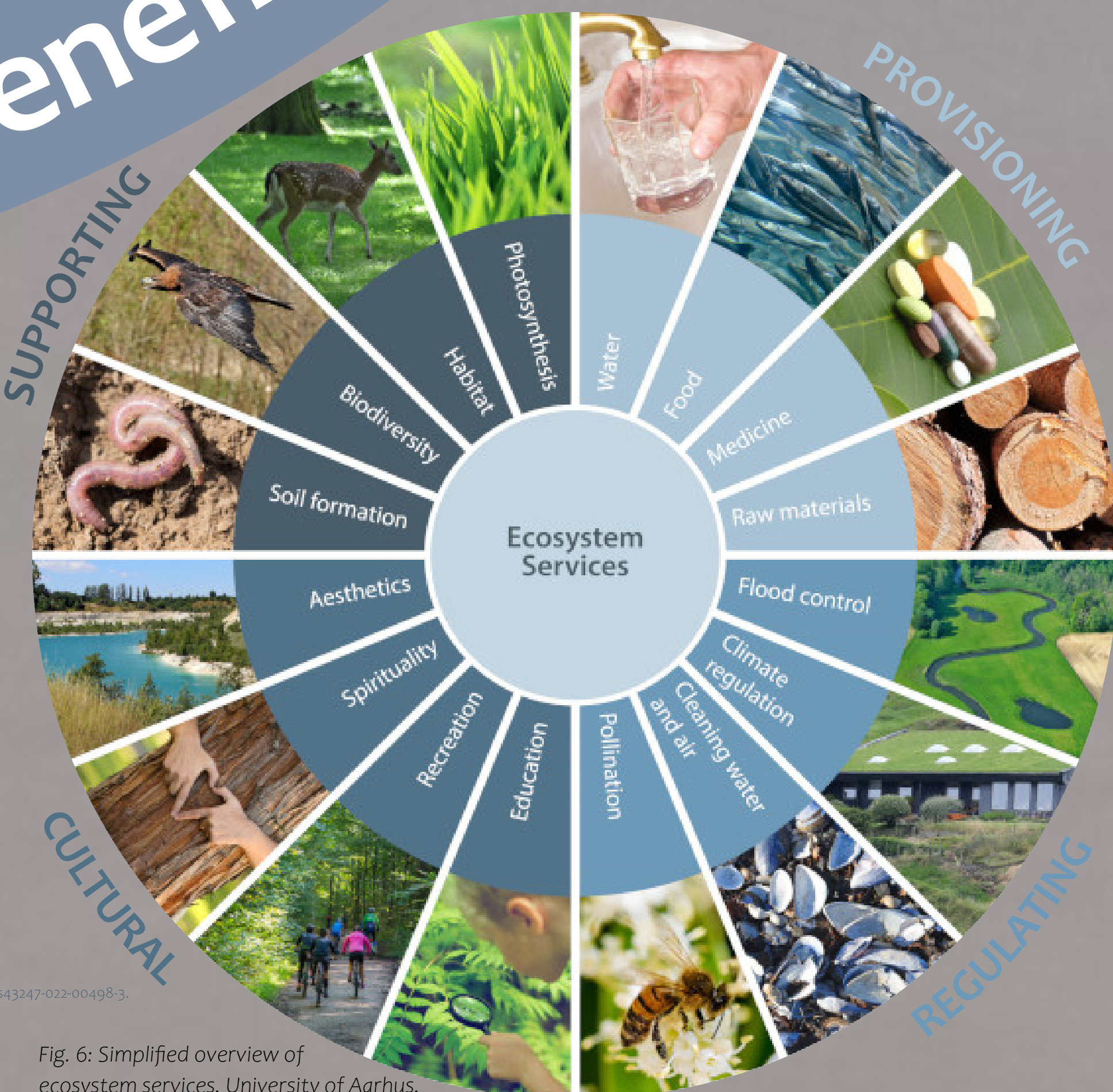


Fig. 6: Simplified overview of ecosystem services. University of Aarhus.

Preliminary PhD Plan

Start January 2025
literature review
preparation fieldwork

Fieldwork and Consultations:
Qikiqtaruk and Inuvik, Canada
July and August 2025

Fieldwork and Workshops:
Inuvik and Aklavik, Canada
March or July 2026

work on results from fieldwork and workshops

writing on publications
adjusting of plans...
End of PhD Thesis
December 2027

References

- Background photo by Michael Fritz (2024)
- Fig. 1: Map Northern Canada - Encyclopaedia Britannica, Inc. (edited)
- Fig. 2: Arctic Permafrost Atlas, GRID-Arendal, 2023
- Fig. 3: Photos by Benjamin M. Jones (2005, 2007)
- Fig. 4: Photo by Weronika Murray (2022)
- Fig. 5: Arctic Permafrost Atlas, GRID-Arendal, 2023
- Fig. 6: Aarhus University <https://news.au.dk/en/research-areas/society-environment-and-resources/biodiversity-and-ecosystem-services> (last visited 05.06.2025)

"Ecosystem Services." National Wildlife Federation, <https://www.nwf.org/Home/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services> (June 6, 2025).

Lantuit, H., and W. H. Pollard. 2006. "Thirty Years of Coastal Erosion and Retrogressive Thaw Slump Activity on Herschel Island, Southern Beaufort Sea, Yukon Territory, Canada." *Geomorphology* 95(1): 84-102. doi:10.1016/j.geomorph.2006.07.040.

Ramage, Justine, Lenisea Jungsberg, Shiran Wang, Sebastian Westermann, Hugues Lantuit, and Timothy Helms. 2021. "Population Living on Permafrost in the Arctic." *Population and Environment* 43(1): 22-38. doi:10.1007/s11111-020-00370-6.

Rantanen, Mika, Aleksey Yu Karpechko, Antti Lippinen, Kalle Nordling, Otto Hyvärinen, Kimmo Ruosteenoja, Timo Vihma, and Ari Laaksonen. 2022. "The Arctic Has Warmed Nearly Four Times Faster than the Globe since 1979." *Communications Earth & Environment* 3(1): 1-10. doi:10.1038/s43247-022-00498-3.

Schuur, Edward A. C., and Michelle C. Mack. 2018. "Ecological Response to Permafrost Thaw and Consequences for Local and Global Ecosystem Services." *Annual Review of Ecology, Evolution, and Systematics* 49(Volume 49): 279-301. doi:10.1146/annurev-ecolsys-121415-032349.

Tanguy, Rodrigue, Arnett Bartsch, Ingmar Ntze, Anna Ingang, Pia Petzold, Barbara Widhalm, Clemens von Beckmann, et al. 2024. "Pan-Arctic Assessment of Coastal Settlements and Infrastructure Vulnerable to Coastal Erosion, Sea-Level Rise, and Permafrost Thaw." *Earth's Future* 12(12): e2024EF005013. doi:10.1029/2024EF005013.

Pictograms used from Microsoft PowerPoint
Texts were partly edited with DeepL and ChatGPT



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