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Klaipeda University
Marine Research Institute

Arctic paraglacial lagoons as emerging transitional ecosystems: lessons from Eidemlaguna, Svalbard

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Eidemlaguna, Svalbard. Drone photo: Jakub (Kuba) Witek

THREE TYPES OF LAGOON LANDSCAPES

A continuum of landscape development after glacier retreat

1. PARAGLACIAL

Landforms and processes directly influenced by glacier retreat



- Rapidly changing, short-lived systems
- High sediment supply and turbidity
- Strong physical disturbance (flows, erosion, slope failures)

2. PERIGLACIAL

Cold environments shaped by freeze–thaw and permafrost processes



- Moderate landscape stability
- Shaped by freeze–thaw and permafrost dynamics
- Thermokarst development and ground subsidence
- Clearer waters, lower sediment loads

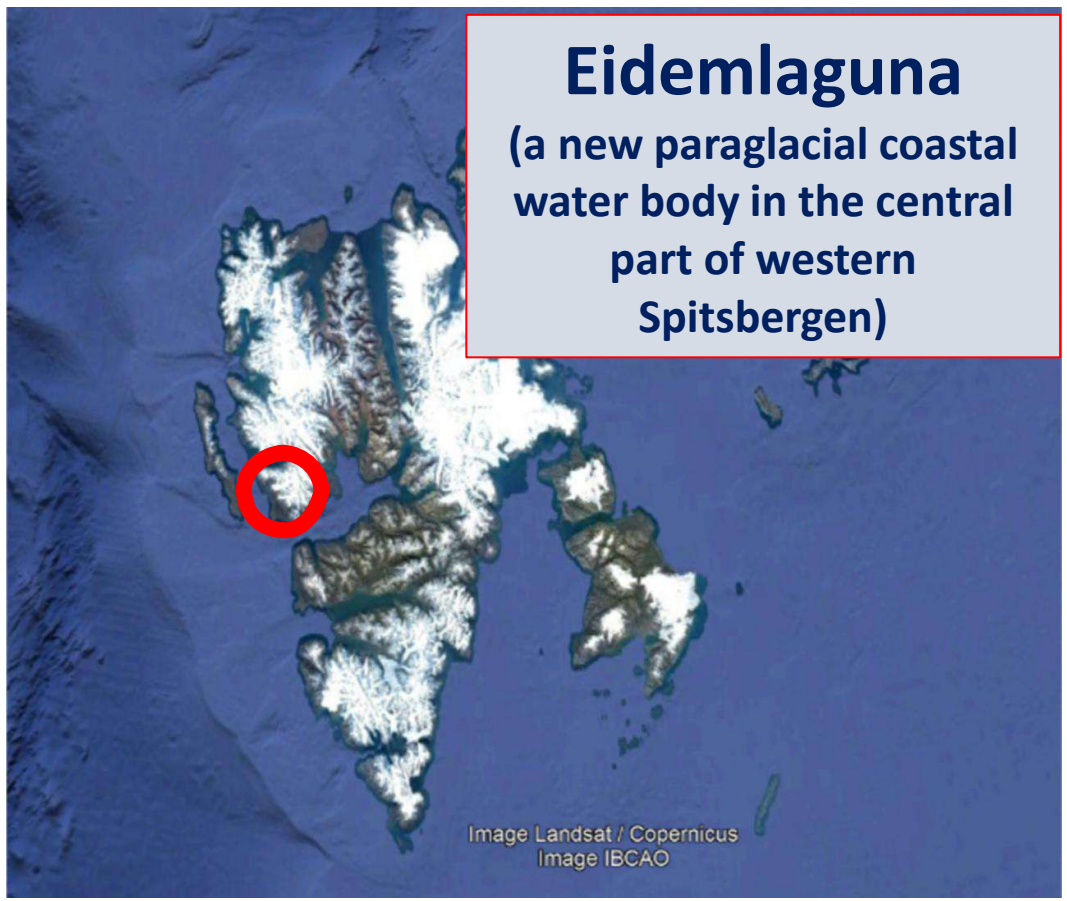
3. POSTGLACIAL

Stabilized ecosystems and landforms developing long after ice retreat, with vegetation and new habitats



- Long-lived and relatively stable systems
- Well-developed soils and vegetation
- Diverse habitats and higher biodiversity
- Organic matter accumulation





Eidemlaguna
(a new paraglacial coastal water body in the central part of western Spitsbergen)

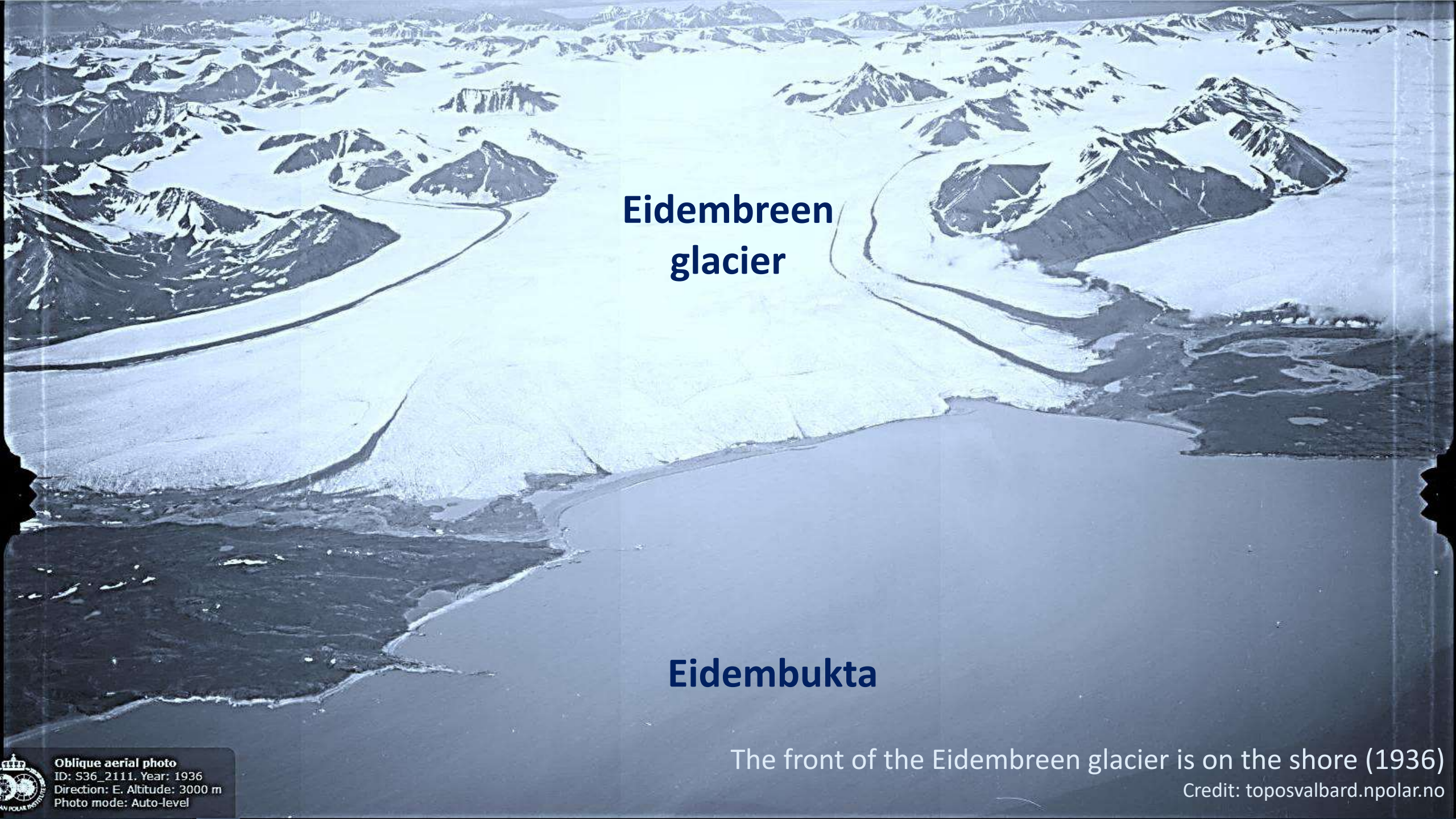
Svalbard

60% of land covered by glaciers

The Arctic has warmed nearly four times faster than the globe since 1979, and Svalbard has warmed twice as quickly as the rest of the Arctic region

(Rantanen et al. 2022)

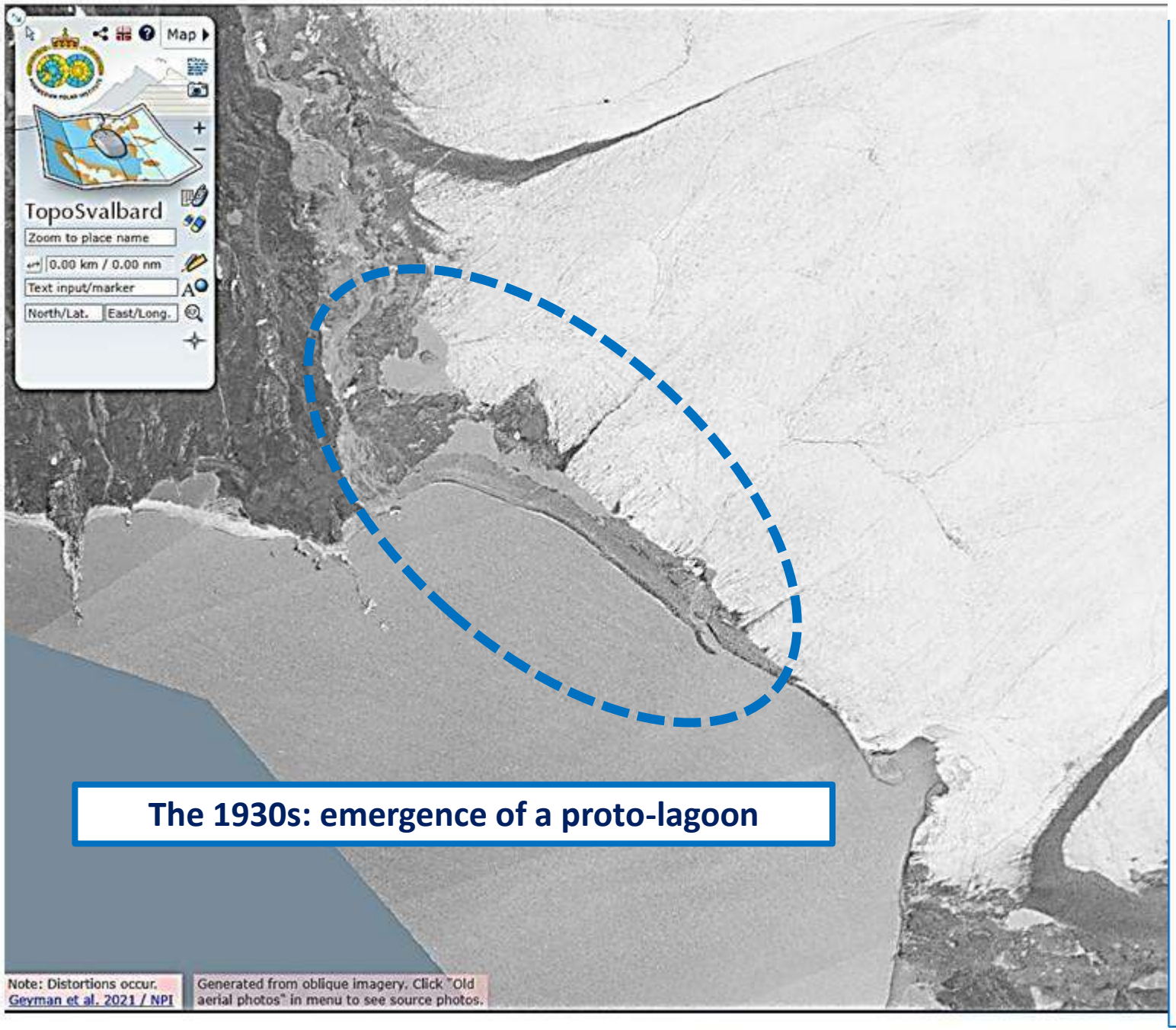
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The front of the Eidembreen glacier is on the shore (1936)

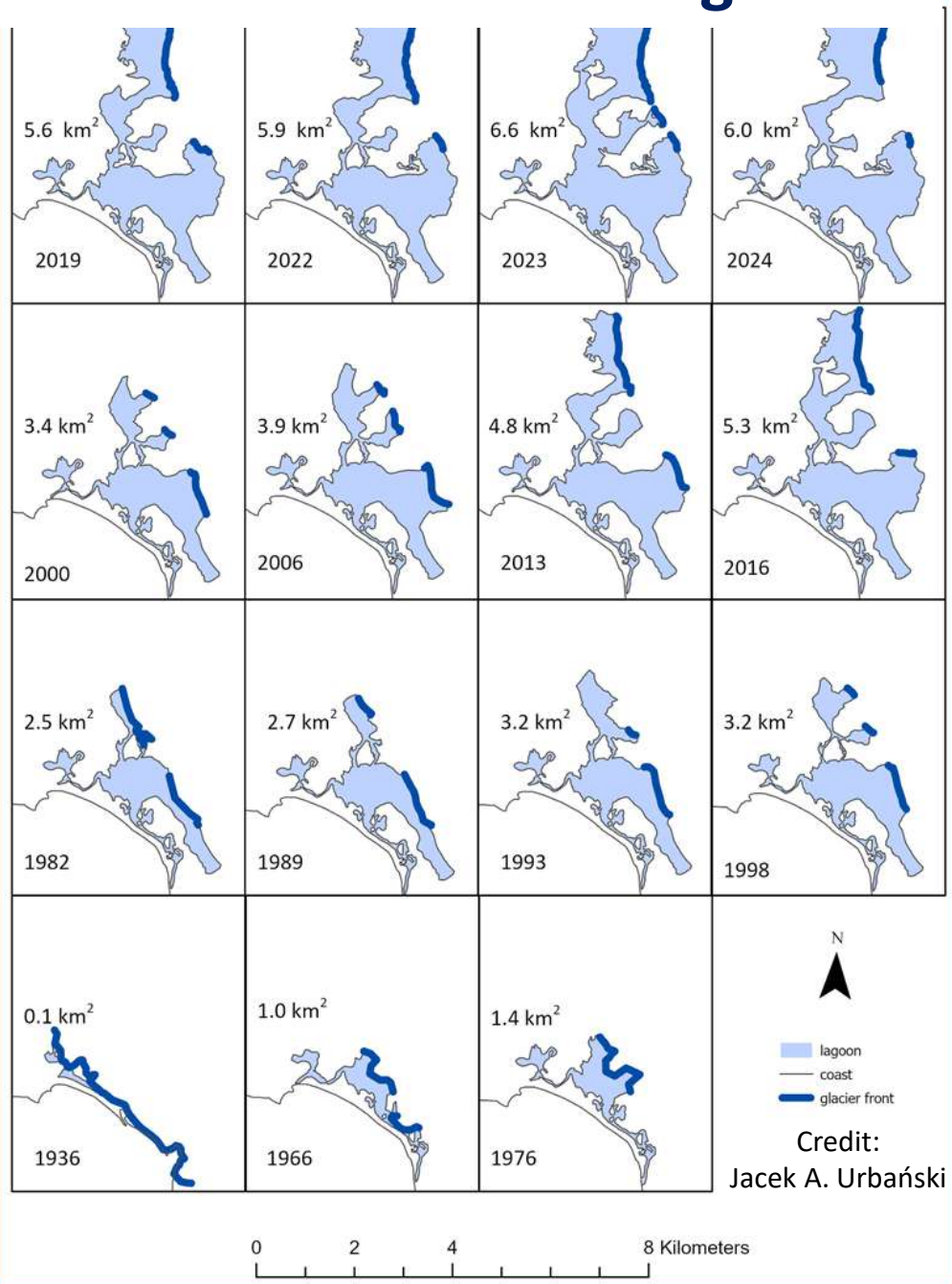
Credit: toposvalbard.npolar.no

https://toposvalbard.npolar.no/



The 1930s: emergence of a proto-lagoon

Evolution of Eidemlaguna



Credit:
Jacek A. Urbański

7.1 km²

The historic island center of Venice

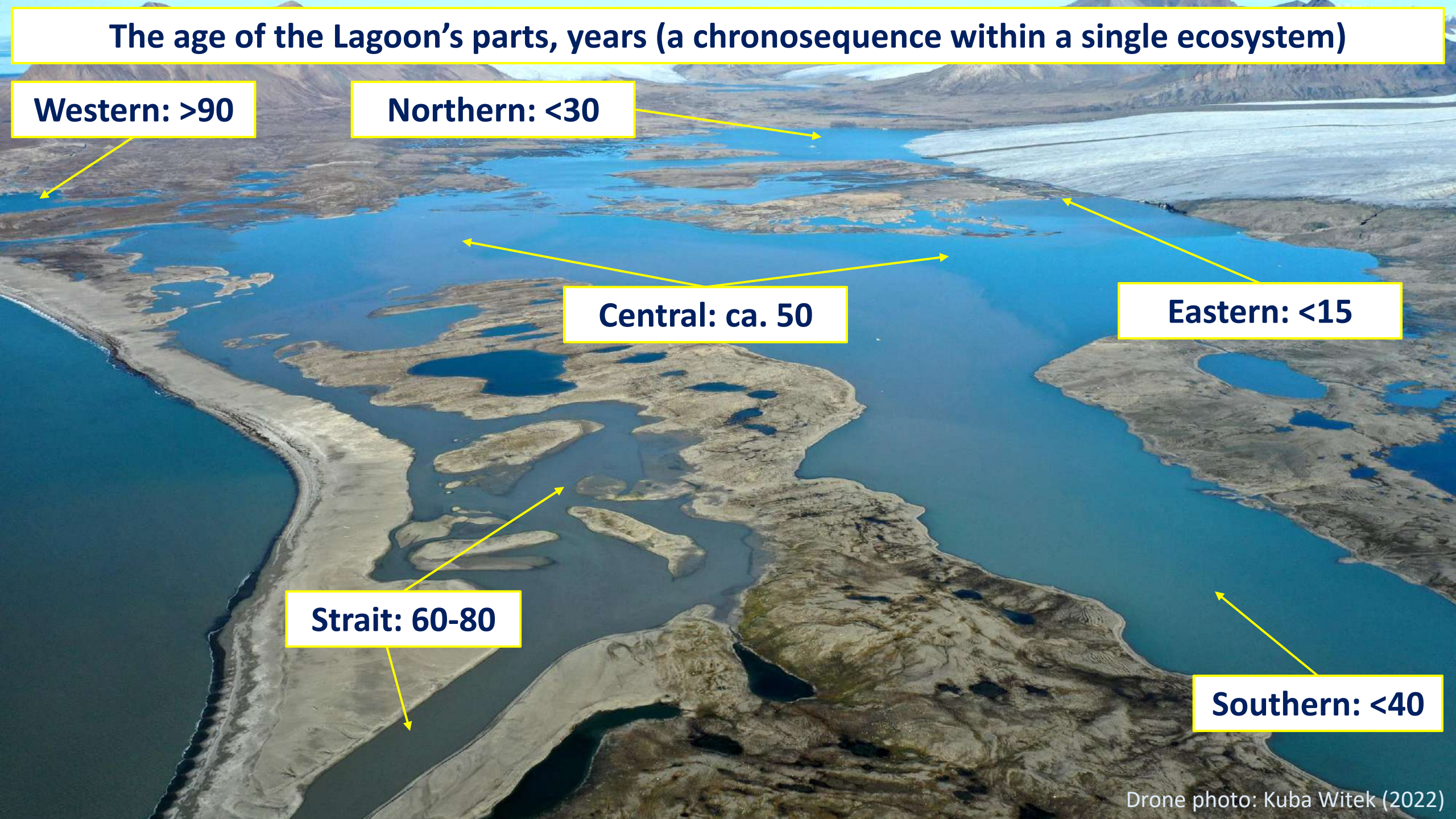


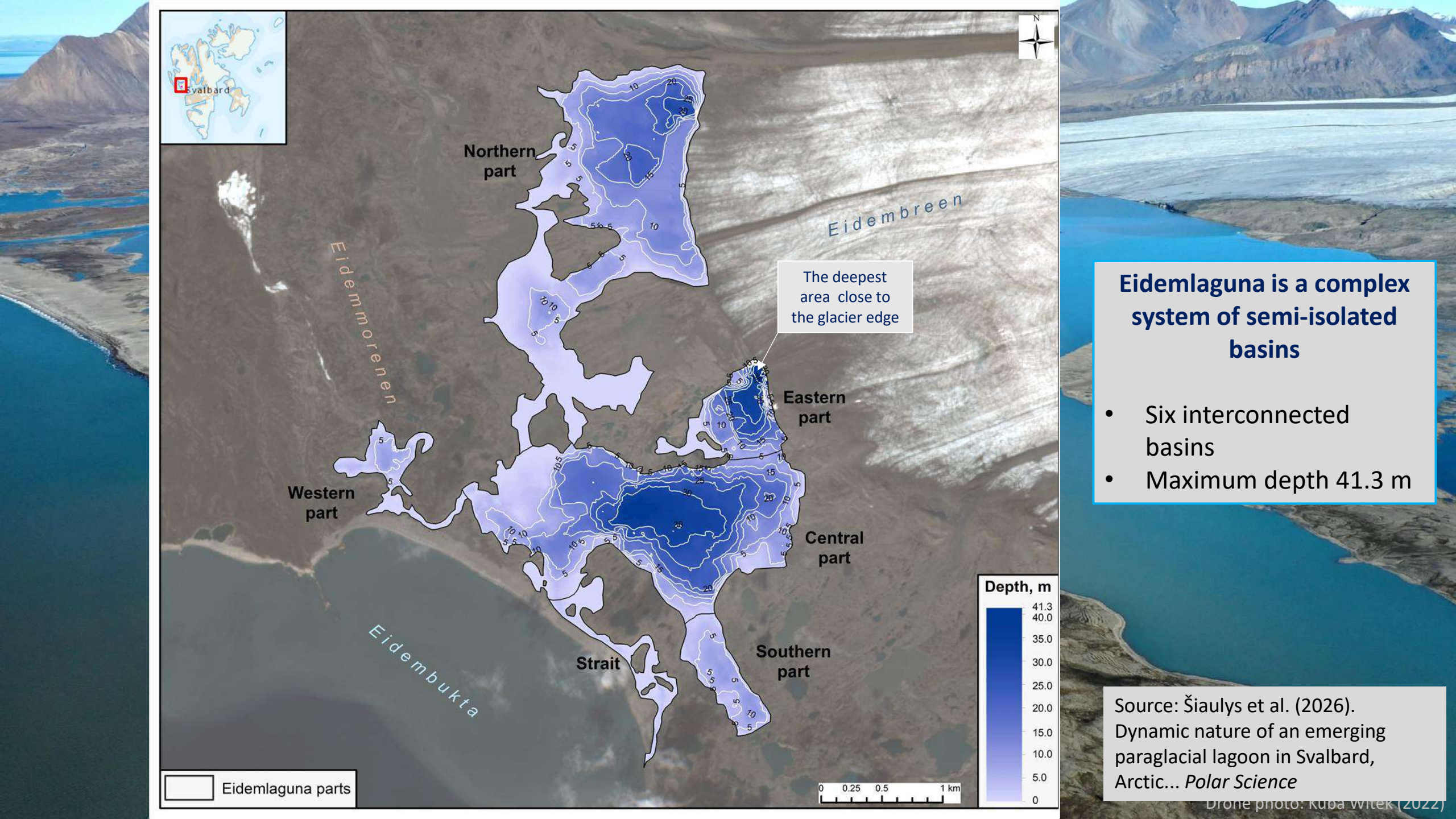
6.6 km²

The current area of Eidemlaguna (2023)



- **2021, First encountering**
- **2022-2025, detailed interdisciplinary ecosystem surveys:** from geomorphology and hydrology to biodiversity and biogeochemistry


The age of the Lagoon's parts, years (a chronosequence within a single ecosystem)
Western: >90
Northern: <30
Central: ca. 50
Eastern: <15
Strait: 60-80
Southern: <40
Drone photo: Kuba Witek (2022)



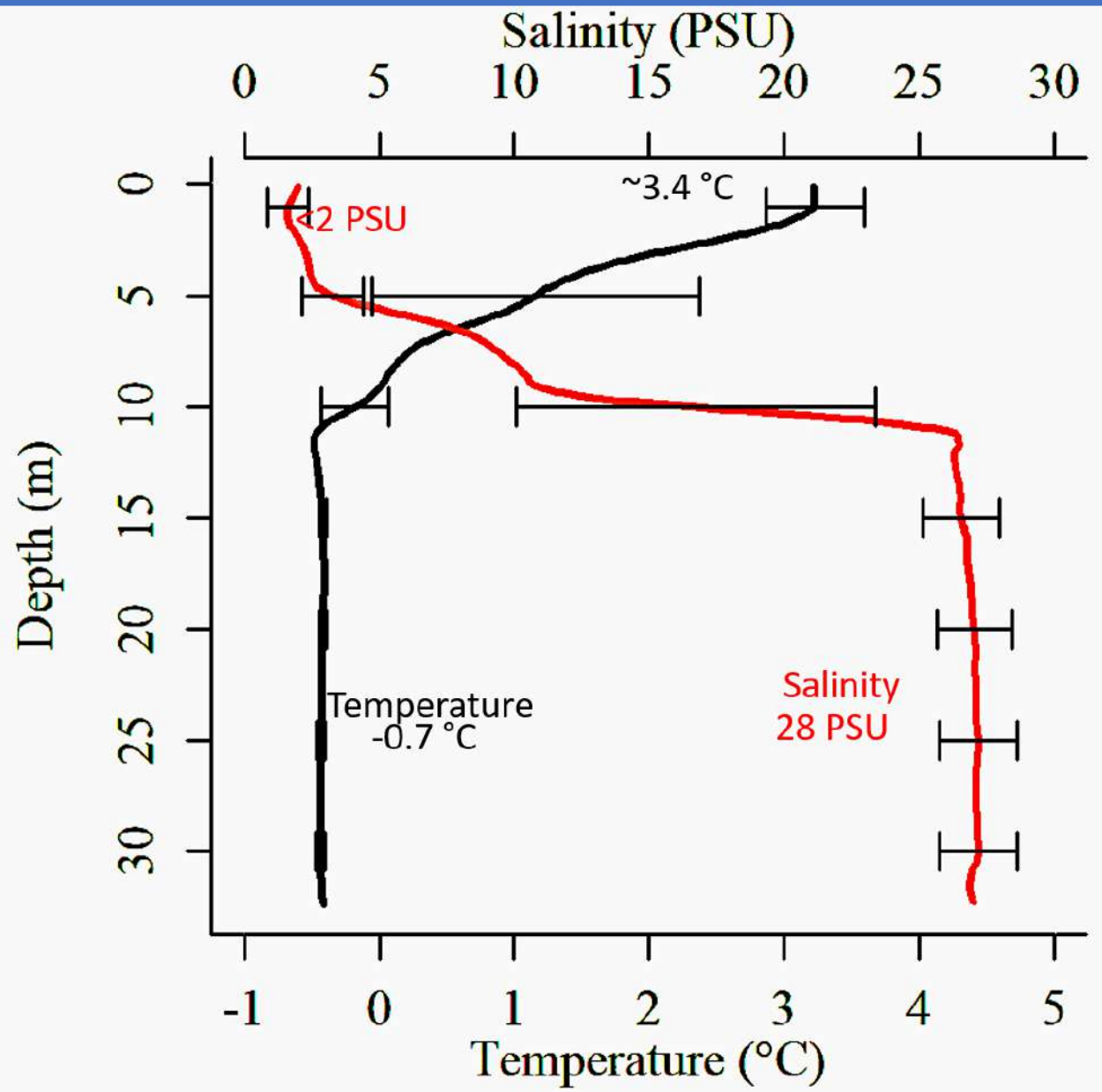
Eidemlaguna is a complex system of semi-isolated basins

- Six interconnected basins
- Maximum depth 41.3 m

Source: Šiaulys et al. (2026). Dynamic nature of an emerging paraglacial lagoon in Svalbard, Arctic... *Polar Science*

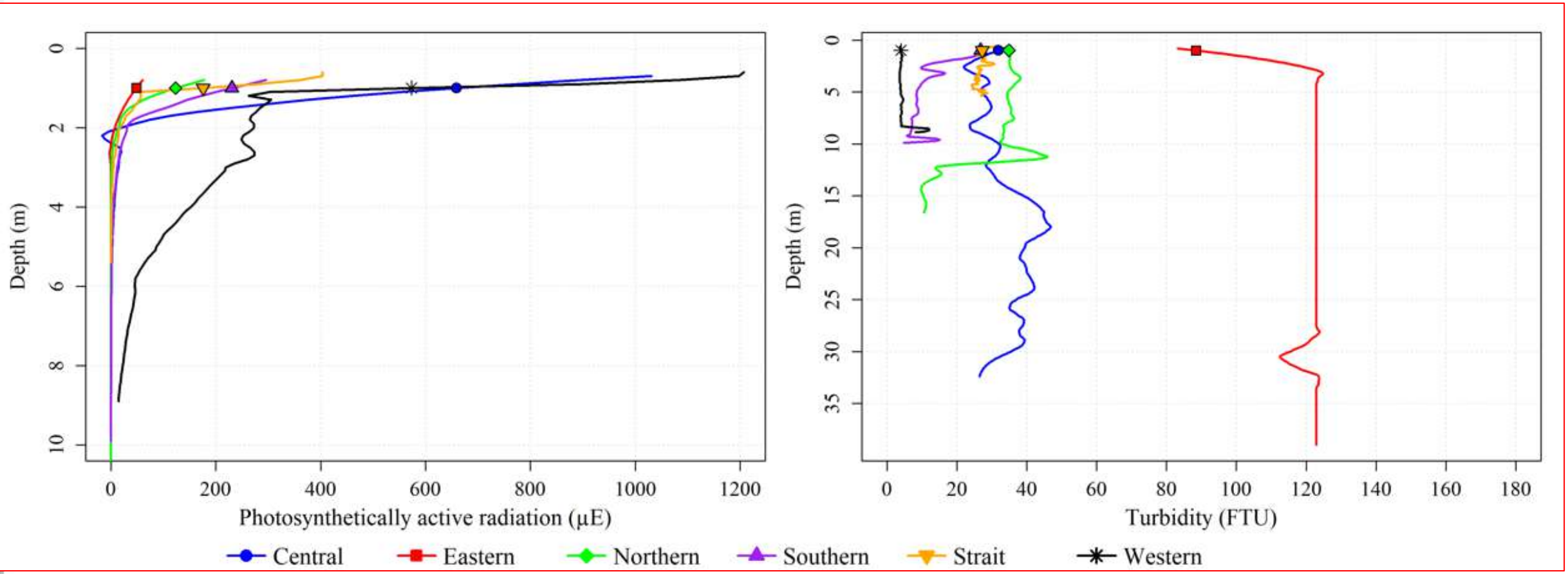
Drone photo: Kuba Wilek (2022)

Eidemlaguna is a strongly stratified transitional water body



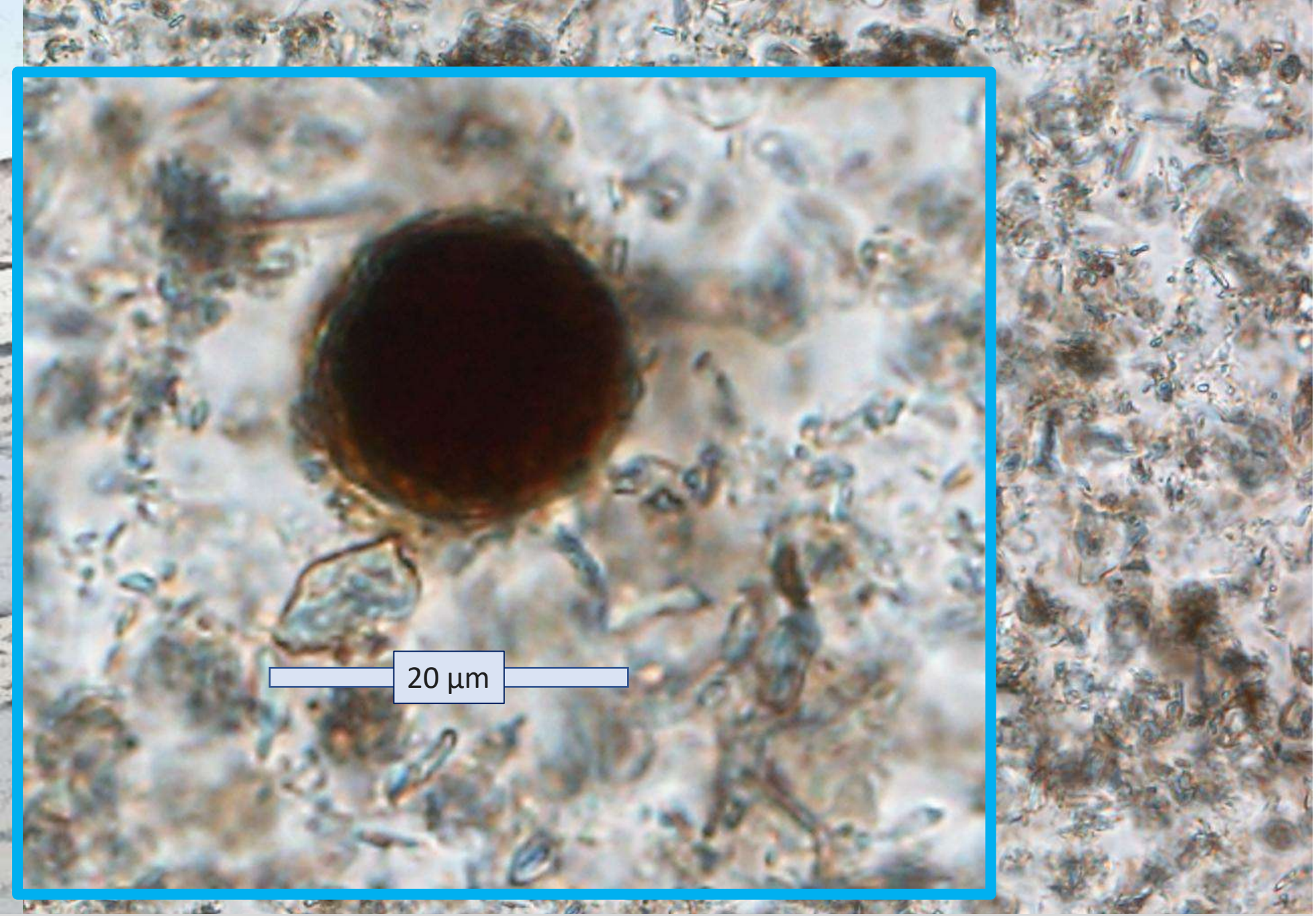
- Warm, fresh–brackish surface layer
- Cold, saline deep layer
- Deep saline water probably enters during winter and remains trapped
- Even the bottom layer remains well oxygenated (O_2 >7.5 mg L-1)

Glacial turbidity strongly limits light



- **Highest turbidity near the glacier (123 FTU) / lowest (3.6 FTU) in the oldest lagoon area**
- **Sufficient light for photosynthesis: only upper ~6 m (PAR > 1 µE m^{-2} s^{-1})**

(Šiaulys et al., 2026. Dynamic nature of an emerging paraglacial lagoon in Svalbard... Polar Science)



Alexandrium minutum (Dinophyceae) *densely surrounded by quartz particles. Photo: Irina Olenina*

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Life occurs even below the halocline

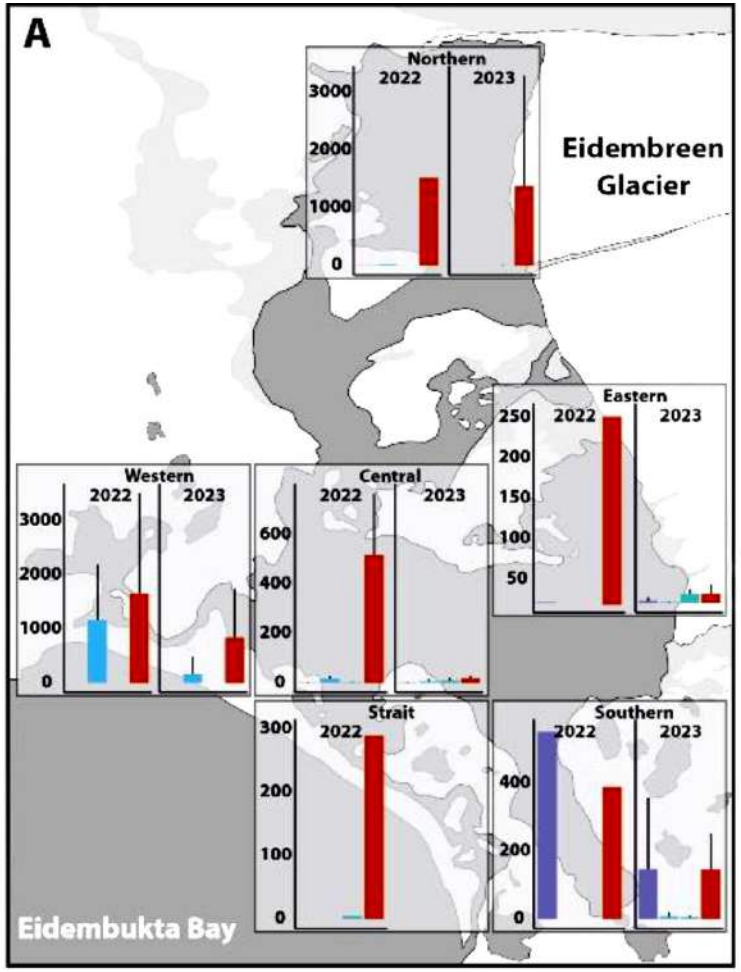
- The observation of up to 10 phytoplankton taxa (cryptophytes, diatoms and dinophytes) at 20 m is surprising!
- In total 60 species (10 classes of algae and cyanobacteria).

- Baccillariophyceae
- Chlorophyceae
- Chrysophyceae
- Cryptophyceae
- Cyanophyceae
- Dictyochophyceae
- Dinophyceae
- Euglenophyceae
- Telonemea
- Trebouxiophyceae

(Lukashanets et al., 2026, Plankton distributional patterns in an emerging paraglacial Arctic lagoon… *Polar Biology*, *49)*

Zooplankton: a mixture of freshwater and marine/brackish water taxa





- **Highest zooplankton abundance in the oldest western basin**

Calanoida
Cyclopoida
Harpacticoida
Rotifera

Zooplankton abundances (ind m^{-3}) in different lagoon parts

(Lukashanets et al., 2026, Plankton distributional patterns in an emerging paraglacial Arctic lagoon… *Polar Biology*, *49)*

The emergence of a novel ecosystem



Polar bear
Ursus maritimus



Harbor seal
Phoca vitulina

Fry of a salmonid fish (presumably *Salvelinus alpinus*)





Mysis oculata



Chironomidae gen. sp



Bivalve *Yoldiella intermedia*



Polychaete *Harmothoe impar*



Charophyte *Cosmarium* sp.



Dinoflagellate *Alexandrium minutum*

Glacier retreat doesn't just remove ice — it creates complex, dynamic habitats freshwater, marine and terrestrial communities meet

All photos taken during field expeditions to Eidemlaguna, 2022–2024. Photography: Bryan Waitkus, Sergej Olenin, Irina Olenina, Aleksandra Izotova.

A new Arctic coastal reality:

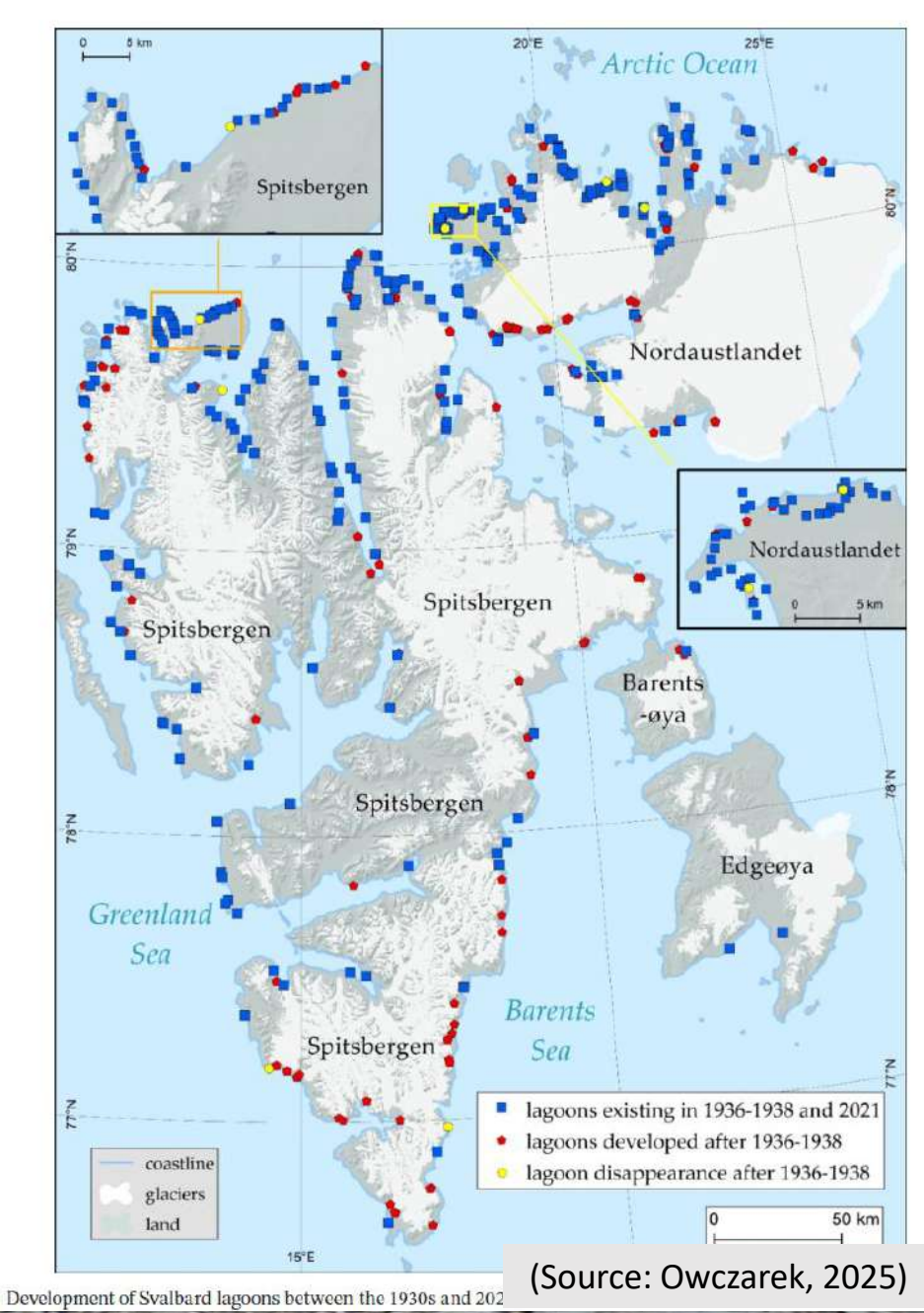
from glacial fjords to emerging coastal systems



98 new lagoons since the 1930s

434 coastal lagoons identified across Svalbard

(Source: Owczarek, 2025; Owczarek et al., 2026)

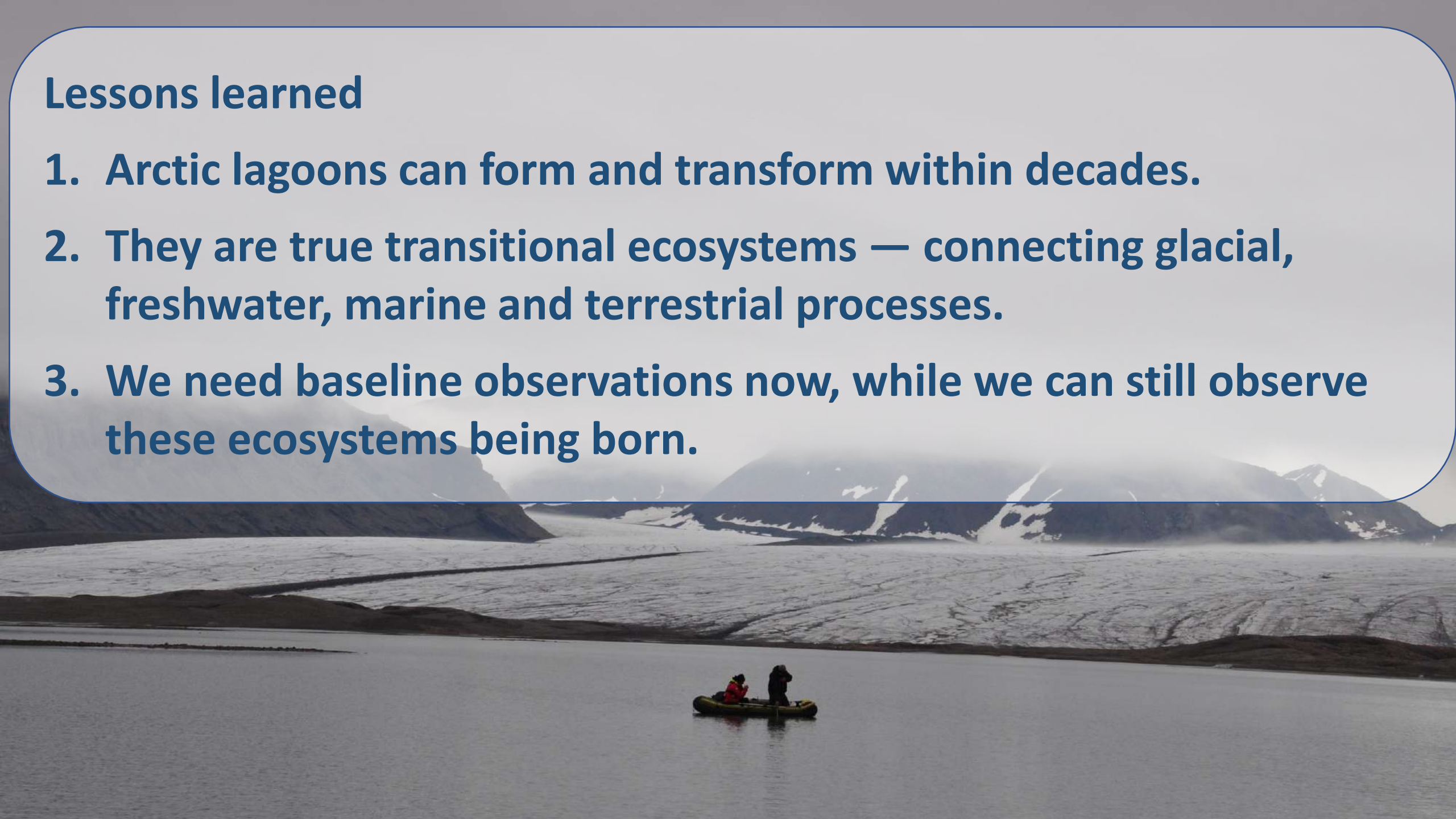


Development of Svalbard lagoons between the 1930s and 202

(Source: Owczarek, 2025)

Lessons learned

1. Arctic lagoons can form and transform within decades.
2. They are true transitional ecosystems — connecting glacial, freshwater, marine and terrestrial processes.
3. We need baseline observations now, while we can still observe these ecosystems being born.



Developing the Eidemlaguna Story:

research papers published and in progress

Klaipeda University
Marine Research Institute



Data in Brief 59 (2025) 111304

Contents lists available at ScienceDirect

Data in Brief

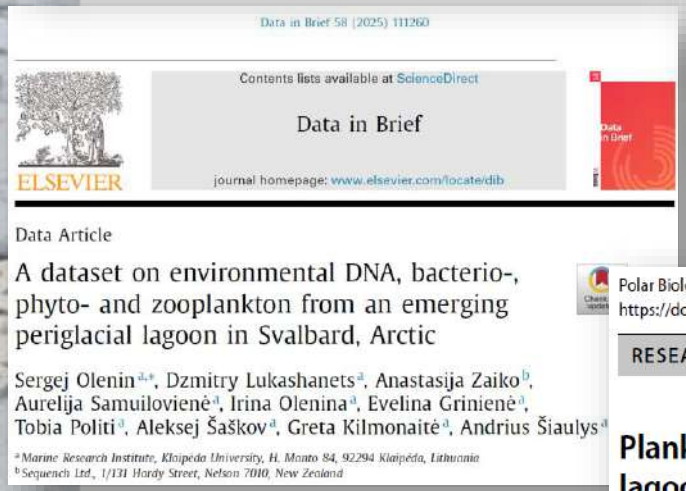
journal homepage: www.elsevier.com/locate/dib

Data Article

A dataset on bathymetry and hydrology of an emerging periglacial lagoon in Svalbard, Arctic

Andrius Šiaulys[a,*], Aleksej Šaškov[a], Greta Kilmonaitė[a], Dzmitry Lukashanets[a], Tobia Politi[a], Aurelija Samuilovienė[a], Anastasija Zaiko[b], Sergej Olenin[a]

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Data in Brief 58 (2025) 111260

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

A dataset on environmental DNA, bacterio-, phyto- and zooplankton from an emerging periglacial lagoon in Svalbard, Arctic

Sergej Olenin[a,*], Dzmitry Lukashanets[a], Anastasija Zaiko[b], Aurelija Samuilovienė[a], Irina Olenina[a], Evelina Grinienė[a], Tobia Politi[a], Aleksej Šaškov[a], Greta Kilmonaitė[a], Andrius Šiaulys[a]

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Polar Science 48 (2026) 101363

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Polar Science

journal homepage: www.elsevier.com/locate/polar

Dynamic nature of an emerging paraglacial lagoon in Svalbard, Arctic: hydrological and geomorphological features

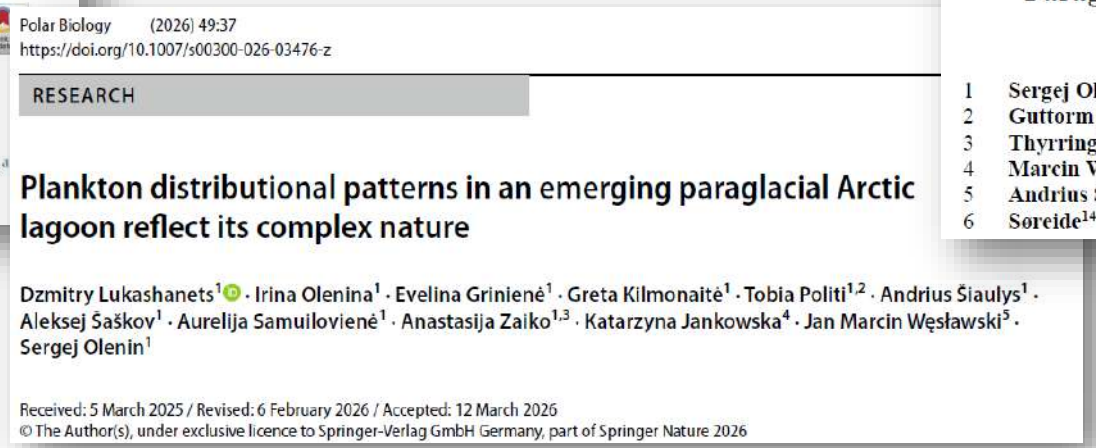
Andrius Šiaulys[a,*], Aleksej Šaškov[a], Jacek A. Urbański[b], Greta Kilmonaitė[a], Dzmitry Lukashanets[a], Tobia Politi[a], Aurelija Samuilovienė[a], Anastasija Zaiko[c], Sergej Olenin[a]

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PeerJ — Manuscript to be reviewed

1 **Environmental DNA (eDNA) metabarcoding reveals**
2 **biodiversity gradients in an emerging paraglacial**
3 **Arctic lagoon**
4
5
6 Anastasija Zaiko[1,2], Aurelija Samuilovienė[2], Tobia Politi[2,3], Andrius Šiaulys[2], Dzmitry
7 Lukashanets[2], Aleksej Šaškov[2], and Sergej Olenin[2]
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9 [1]Seqnench Ltd, Nelson, New Zealand
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11 [3]Department of Marine Sciences, University of Gothenburg, Gothenburg, Sweden



Polar Biology (2026) 49:37
https://doi.org/10.1007/s00300-026-03476-z

RESEARCH

Plankton distributional patterns in an emerging paraglacial Arctic lagoon reflect its complex nature

Dzmitry Lukashanets[1] · Irina Olenina[1] · Evelina Grinienė[1] · Greta Kilmonaitė[1] · Tobia Politi[1,2] · Andrius Šiaulys[1] · Aleksej Šaškov[1] · Aurelija Samuilovienė[1] · Anastasija Zaiko[1,3] · Katarzyna Jankowska[4] · Jan Marcin Węsławski[5] · Sergej Olenin[1]

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Paraglacial Lagoons of Svalbard: Emerging Ecosystems at the Arctic Land-Sea Interface

1 **Sergej Olenin[1*], Jan Kavan[2], Mateusz C. Strzelecki[3], Kit M. Kovacs[4], Christian Lydersen[4],**
2 **Guttorm Christensen[5], Tobia Politi[6], Dzmitry Lukashanets[1], Anastasija Zaiko[7], Jakob**
3 **Thyrring[8], Jia-An Ye[9], Ta-Kang Liu[9], Marta Barone[10], Inta Dimante-Deimantovica[11], Jan**
4 **Marcin Węsławski[12], Wojciech Piskorski[3], Joanna Pluto-Kossakowska[13], Arunima Sen[14],**
5 **Andrius Šiaulys[1], Ahmed Abdelgayed[15], Malin Daase[14], Maria Ansine Jensen[14], and Janne E.**
6 **Søreide[14]**

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Svalbard Strategic Grant Workshop

SVALBARD LAGOONS: GEOMORPHOLOGICAL EVOLUTION, BIODIVERSITY, AND BIOGEOCHEMICAL & ECOLOGICAL ROLE

(At Svalbard Science Conference, 28-29 Oct. 2025)

- **From Eidemlaguna to Svalbard**
- **Emerging paraglacial lagoon ecosystems**
- **Cross-disciplinary integration**
- **Regional upscaling**
- **Climate significance**
- **Future collaborative research**



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Field research projects

The Poland–Lithuania Cooperation Program DAINA **Project ADAMANT** *"Arctic benthic ecosystems under change: the impact of deglaciation and boreal species transportation by macroplastic"*. **2019-2021**

EIDEMBUKTA project (Research Council of Lithuania) *„Formation of a novel coastal lagoon ecosystem following glacier retreat, Eidembukta, in Svalbard Arctic"* **2022-2024**

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Further lagoon research: strategic planning

Svalbard Strategic Grant Project (Research Council of Norway) *"SVALBARD LAGOONS: GEOMORPHOLOGICAL EVOLUTION, BIODIVERSITY, AND BIOGEOCHEMICAL AND ECOLOGICAL ROLE"* (Oslo, 2025, Svalbard 2026)