

# Deep-water gastropods of the Central Arctic Ocean and bathymetric faunal transitions across the Arctic deep sea

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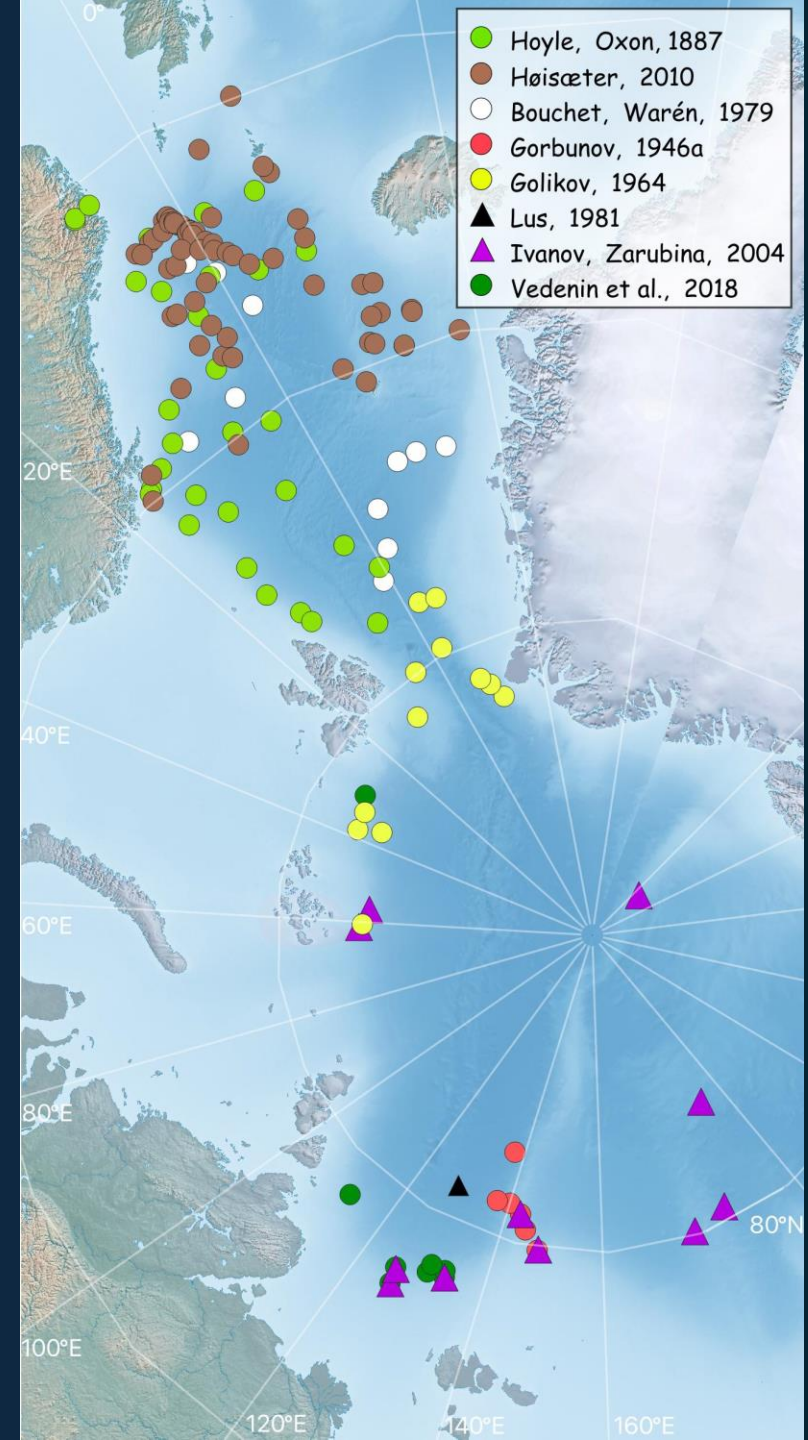
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# Previous studies

Despite intensive studies conducted in the Central Arctic Basin during the 1930s–1980s, only limited faunistic data were published

As a result, nearly all published evidence is concentrated in the Nordic Seas



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# Aim #1

To provide a taxonomic overview of gastropods and scaphopods from the Central Arctic Ocean at depths exceeding 900 m, and to characterize their distribution

# Aim #2

To identify the bathymetric structure of gastropod assemblages across bathyal and abyssal depths of the western Eurasian Arctic and to determine whether this transition represents a sharp boundary or a broad transitional zone

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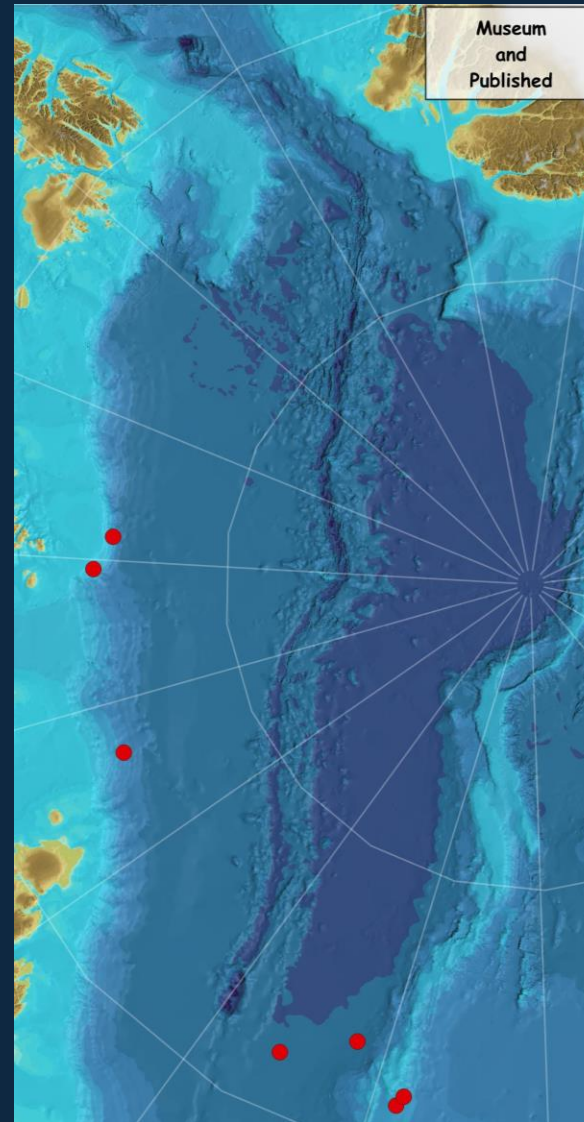
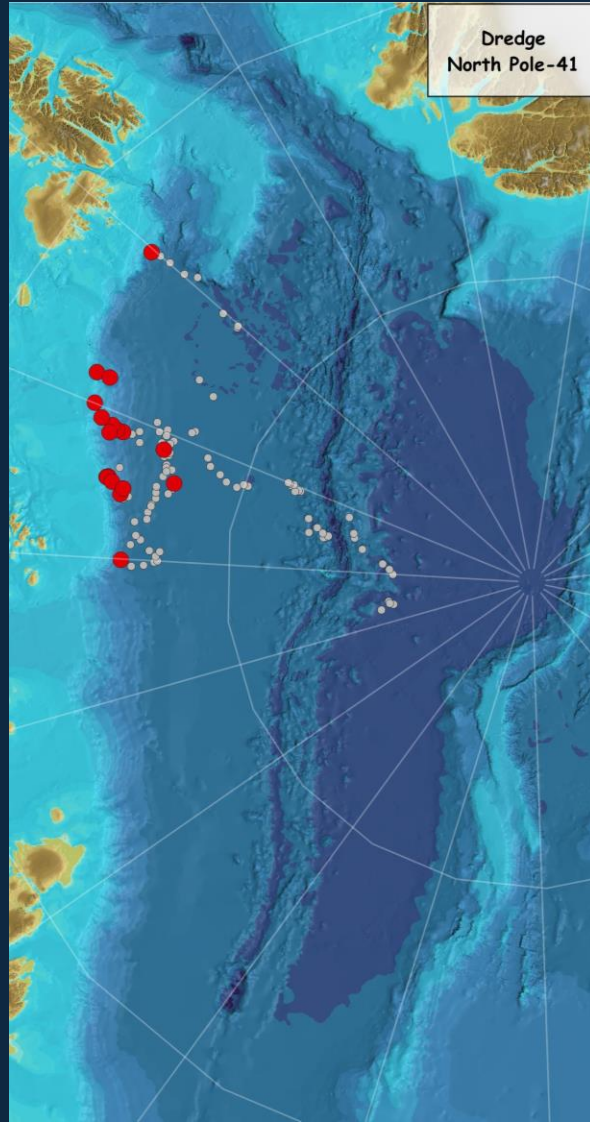
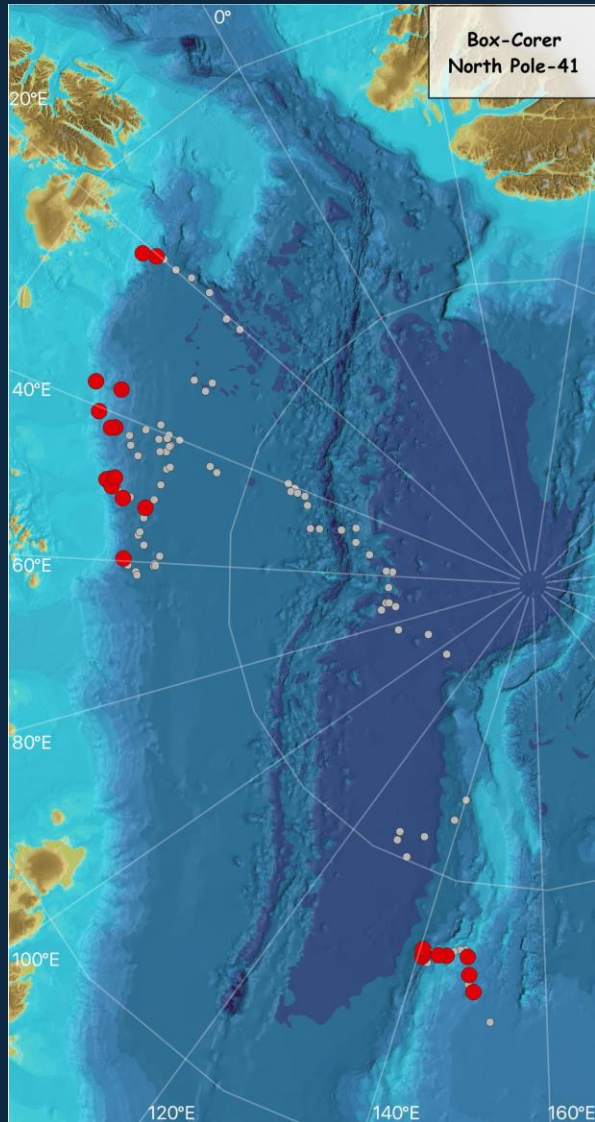
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# Our sources for Central Arctic



Only records deeper 900 m

● Gastropods or Scaphopods found

● Gastropods or Scaphopods not found

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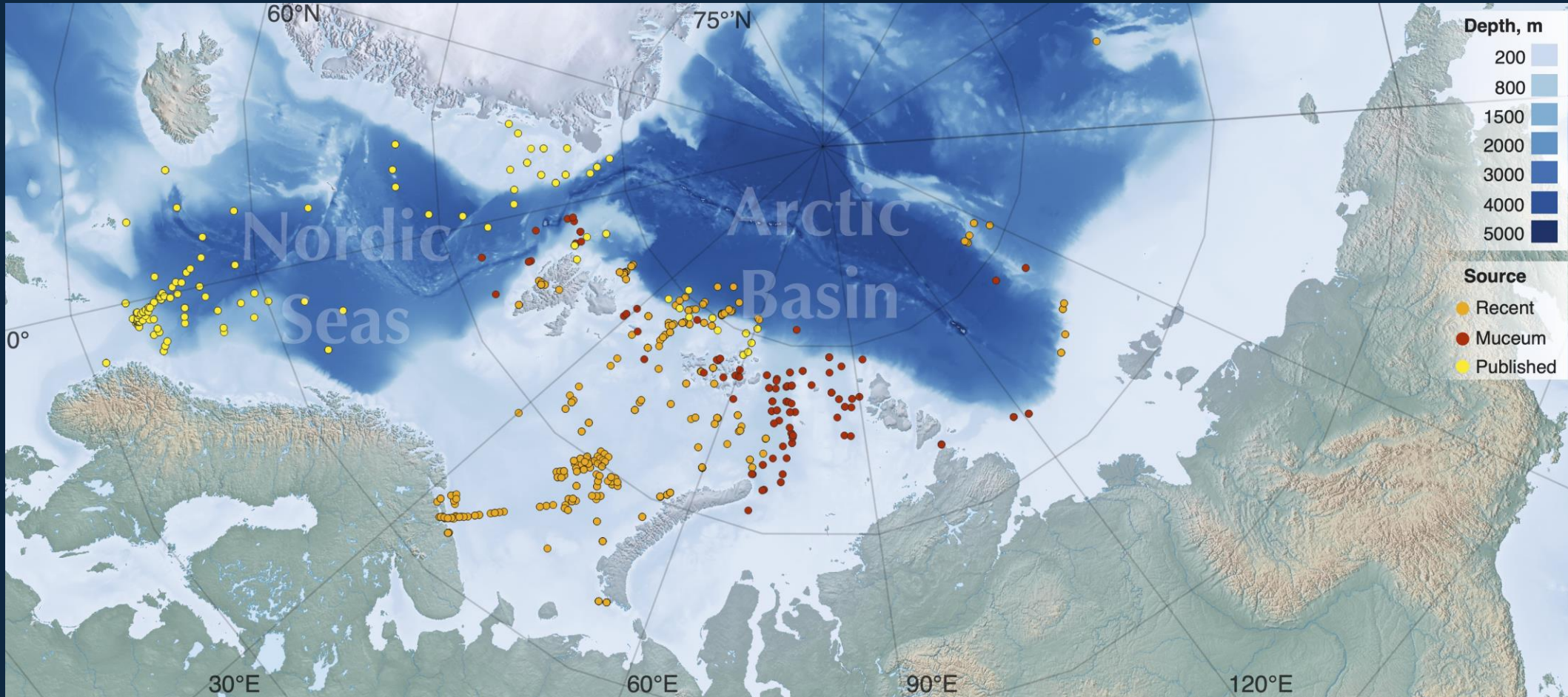
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# Our sources for the Eurasian Arctic



Total dataset includes 1508 records from 150 m to 4723 m

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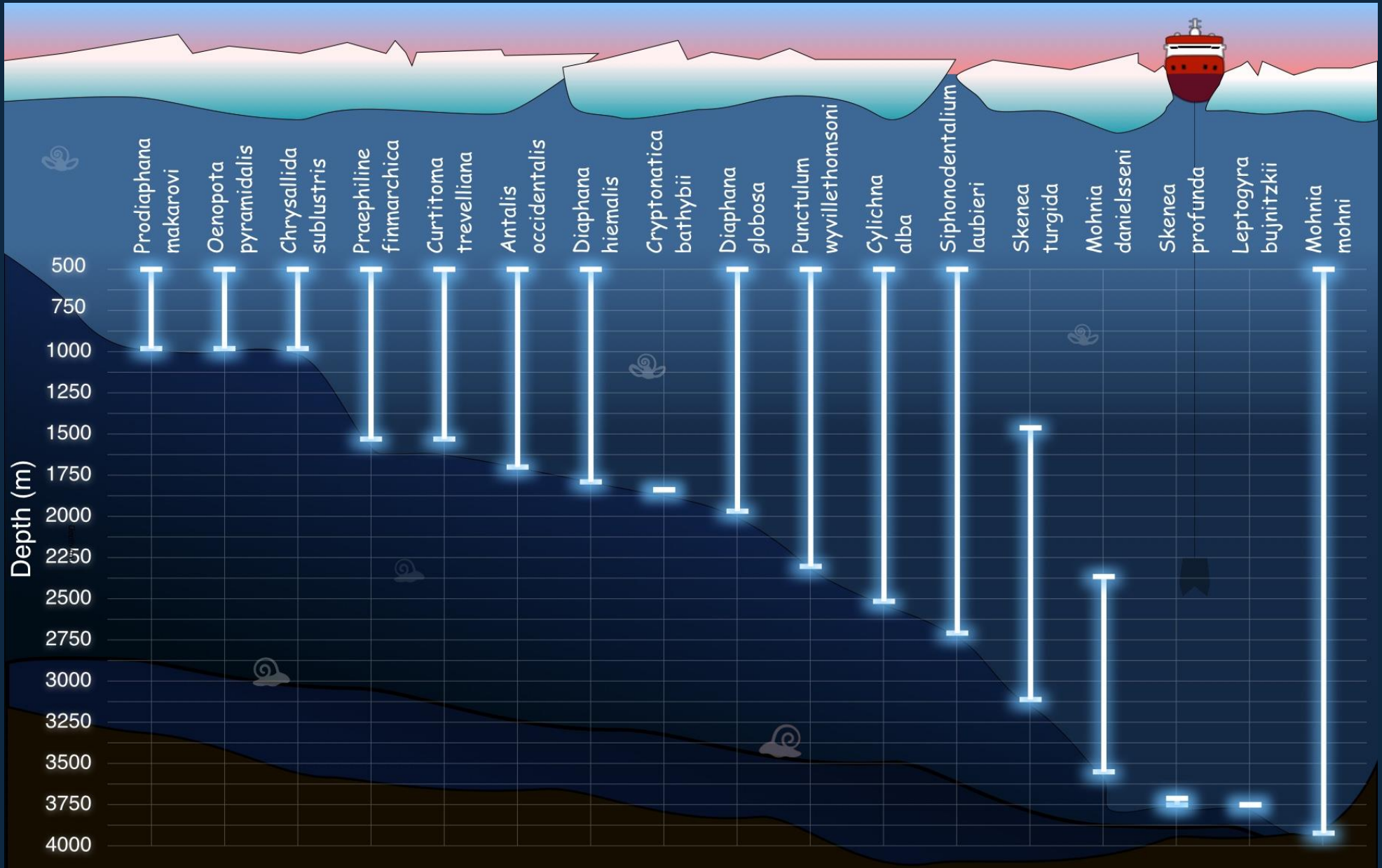
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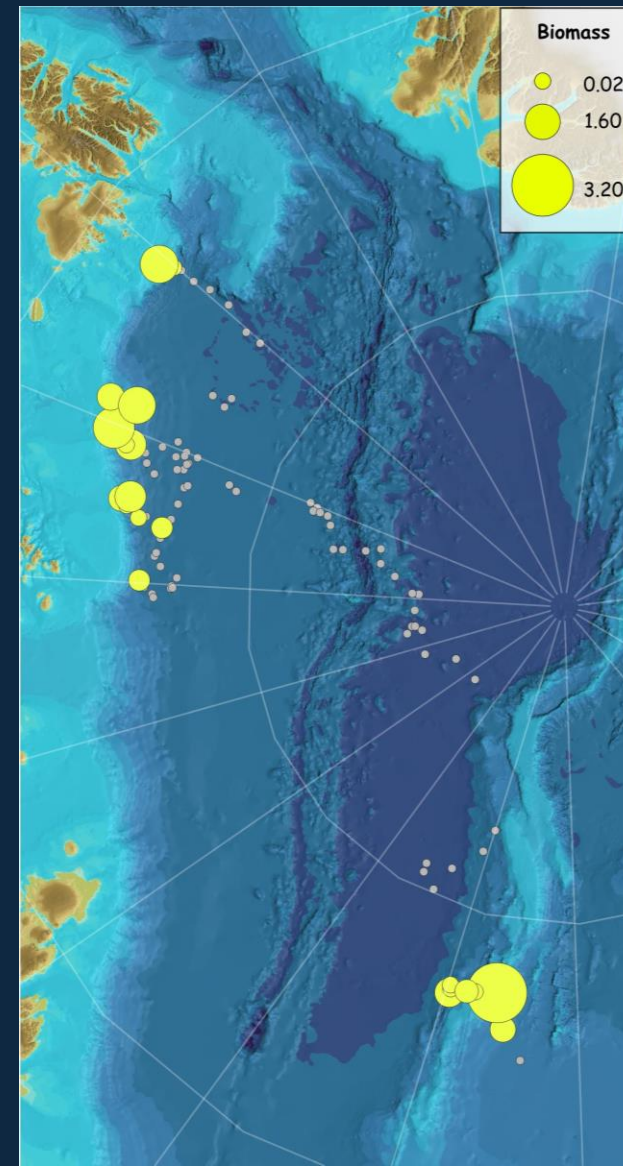
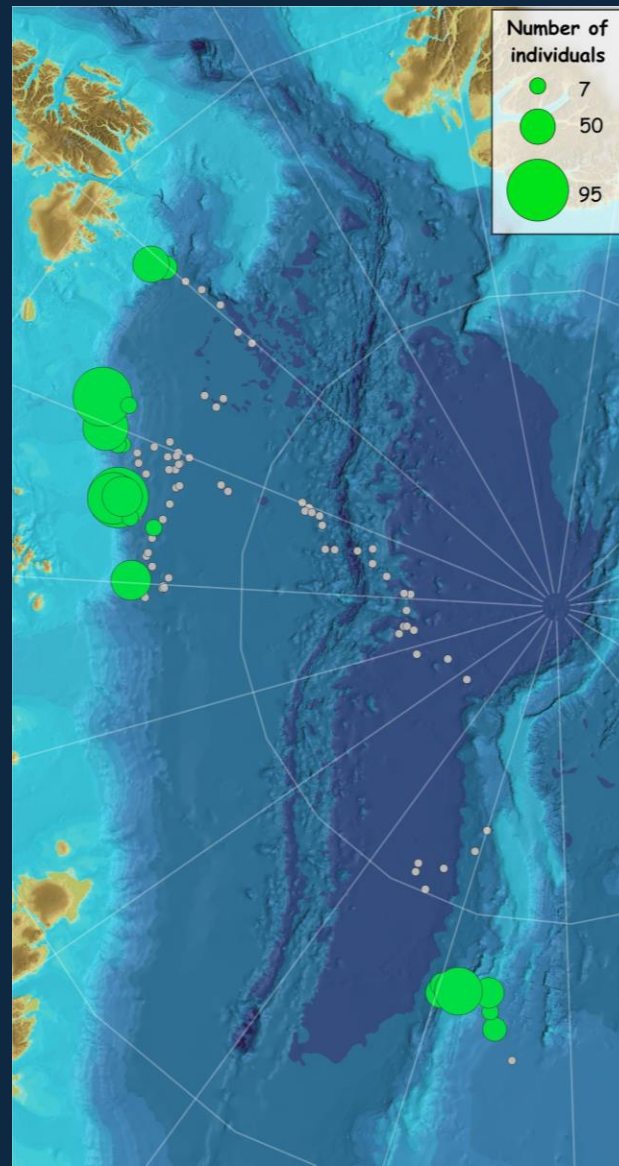
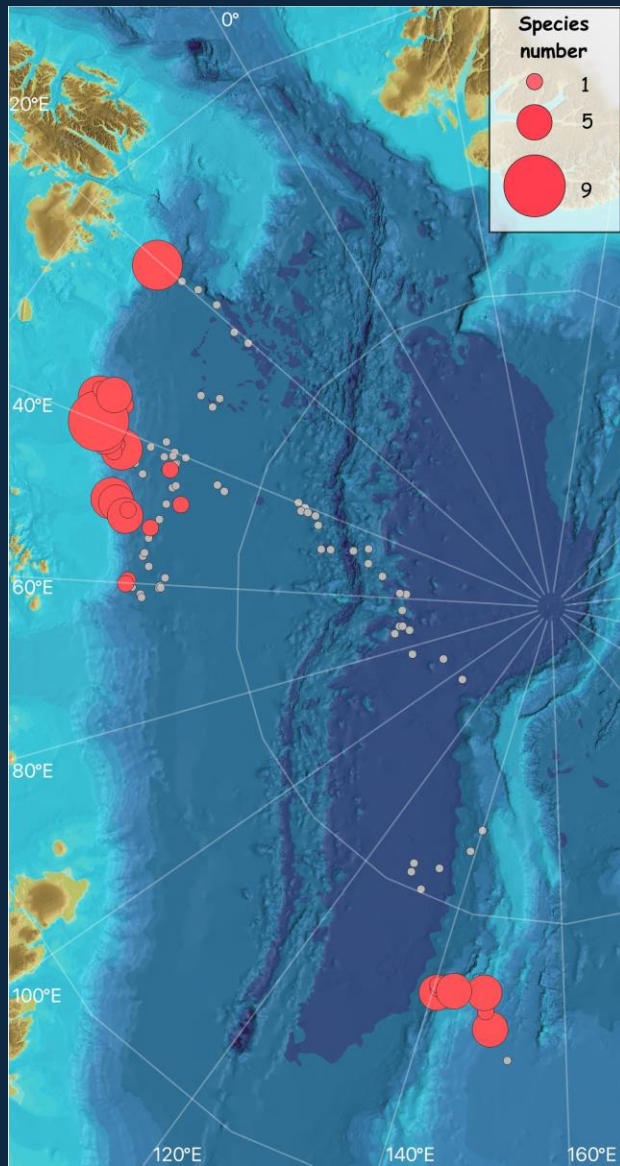
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15 gastropod and 2 scaphopod species are known from >900 m



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Majority of records at the continental and Lomonosov Ridge  
 Gastropods and scaphopods are almost absent in central part

# Decline with depth

Gastropods and scaphopods were found at depths of up to 3,922 m, although records deeper than 3,000 m were rare

Multi-way ANOVA identified depth as the dominant spatial predictor of declining species richness ( $F = 131$ ,  $p = 3.45 \times 10^{-23}$ ), while both abundance and biomass in box-corer samples decreased significantly with depth (Spearman's  $\rho = -0.582$  and  $-0.578$ , respectively)



*Mohnia mohni* is the deepest known gastropod from CAO

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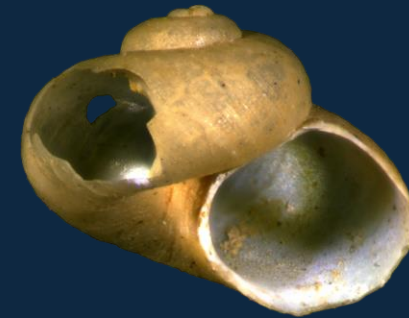
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# Chemosynthetic communities

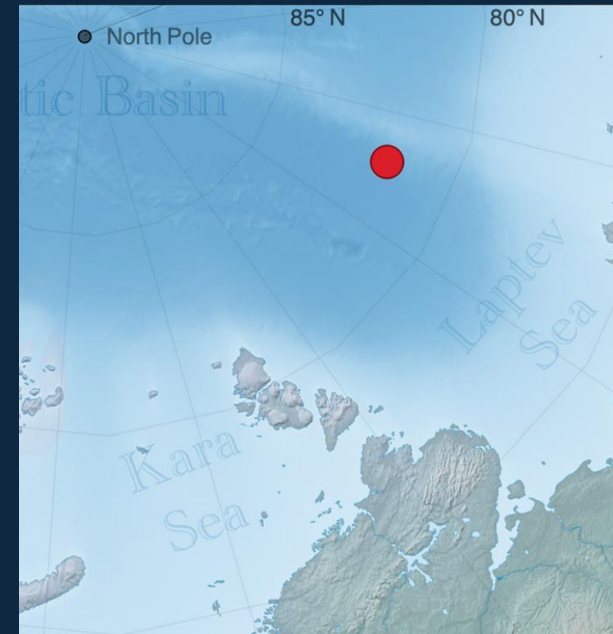
Numerous chemosynthesis-based habitats, such as hydrothermal vents and cold seeps, are known from the Central Arctic and adjacent seas

Species composition and abundance in these habitats differ markedly from those in surrounding background communities

A sample containing *Leptogyra bujnitzkii* and *Skenea profunda*, collected in 1938, may indicate the presence of food falls along the Transpolar Drift Stream (see our papers)



*Leptogyra bujnitzkii*



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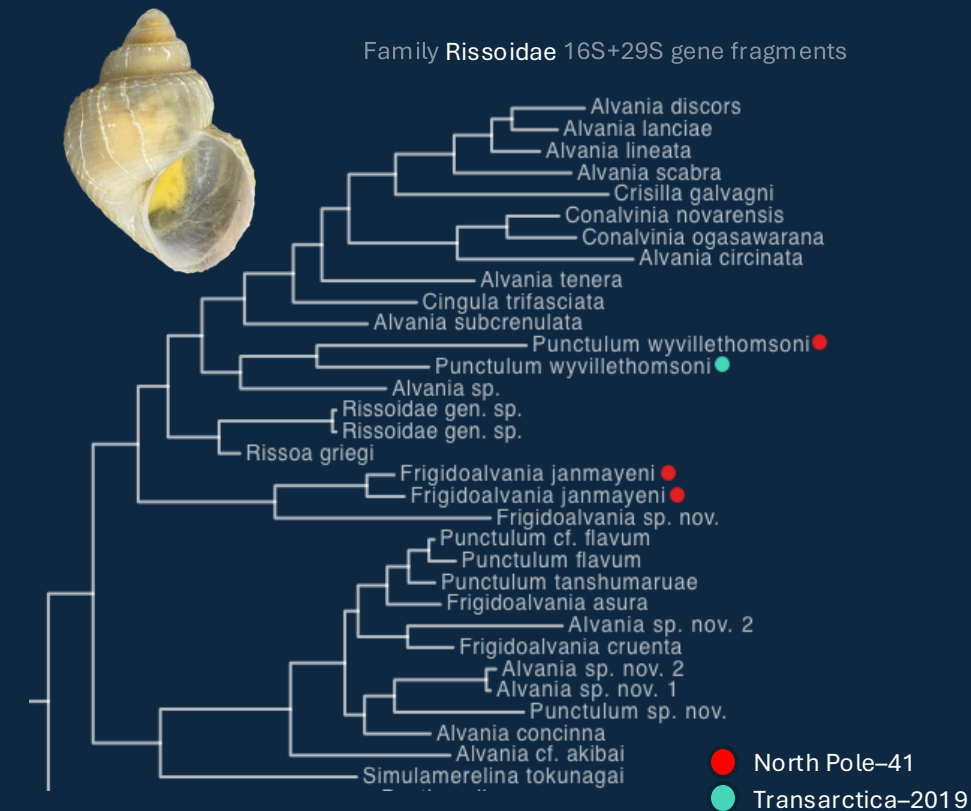
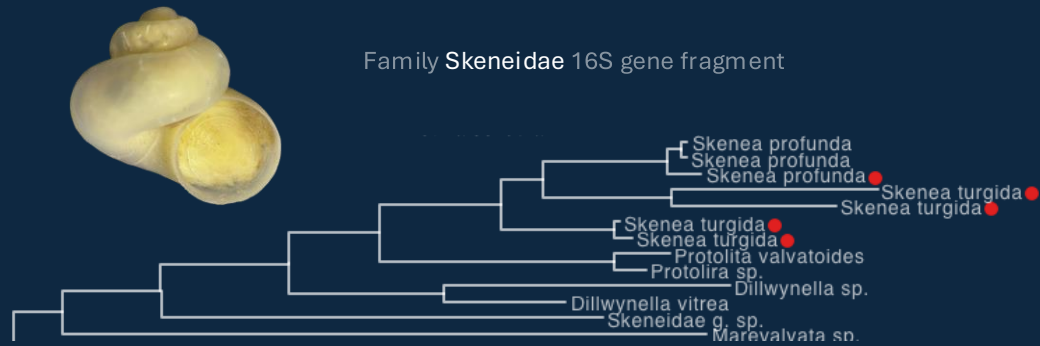
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# Hidden diversity

Our preliminary genetic analysis reveals a high degree of pseudocryptic diversity within common species in the Central Arctic

Specimens identified as *Skenea turgida* belong to several deeply divergent lineages

Genetic splits were also found among populations of two species of the family Rissoidae



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# Limitations of current taxonomy

The taxonomy of a substantial proportion of Arctic molluscs is based primarily on easily observable shell characters, whereas anatomical and molecular data are rarely used

*Systematics and Biodiversity* (2020), **18**(8): 794–809



## Research Article

### Hidden under ice and mud: diversity of shell-bearing microgastropods in the eastern Arctic seas

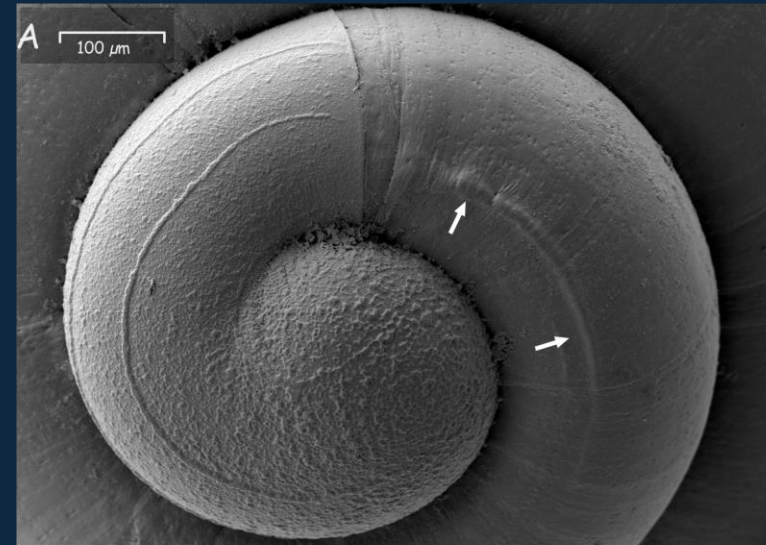
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(Received 2 April 2019; accepted 17 June 2020)

The arctic environment continues to undergo a rapid transformation due to climatic shifts, human invasive species. Revealing ecosystem responses to these stressors requires extensive knowledge about the Arctic fauna and flora. Gastropoda is one of the most diverse invertebrate groups within the ma



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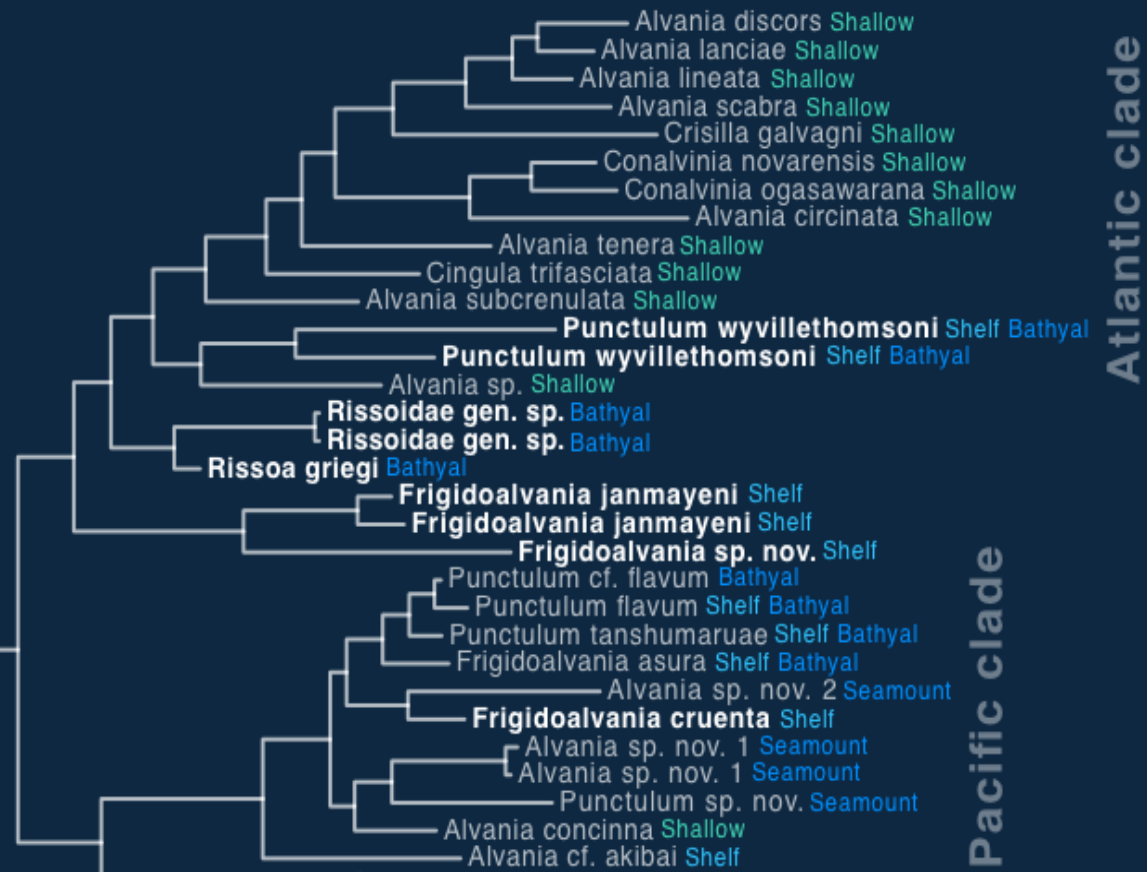
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# Ways of fauna formation

Family Rissoidae 16S+29S gene fragments



Arctic species are shown in bold

16 out of 17 gastropod and scaphopod species recorded from the Central Arctic are shared with the Nordic Seas

Phylogenetic analysis of the family Rissoidae supports the hypothesis of an Atlantic origin for the Arctic deep-water fauna

The shelf fauna of the family has a mixed Atlantic–Pacific origin

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# Species richness across depth gradient

We tested record-based and range-based matrices; the most evident results were obtained using the range-based approach

Cluster analysis revealed four bathymetric faunal complexes across the whole region, as well as separately in the Nordic Seas and the Arctic Basin: the upper, middle, and lower bathyal, and the abyssal zone. Their presence was supported by ANOVA

All bathymetric regions are characterized by different proportions of turnover and nestedness

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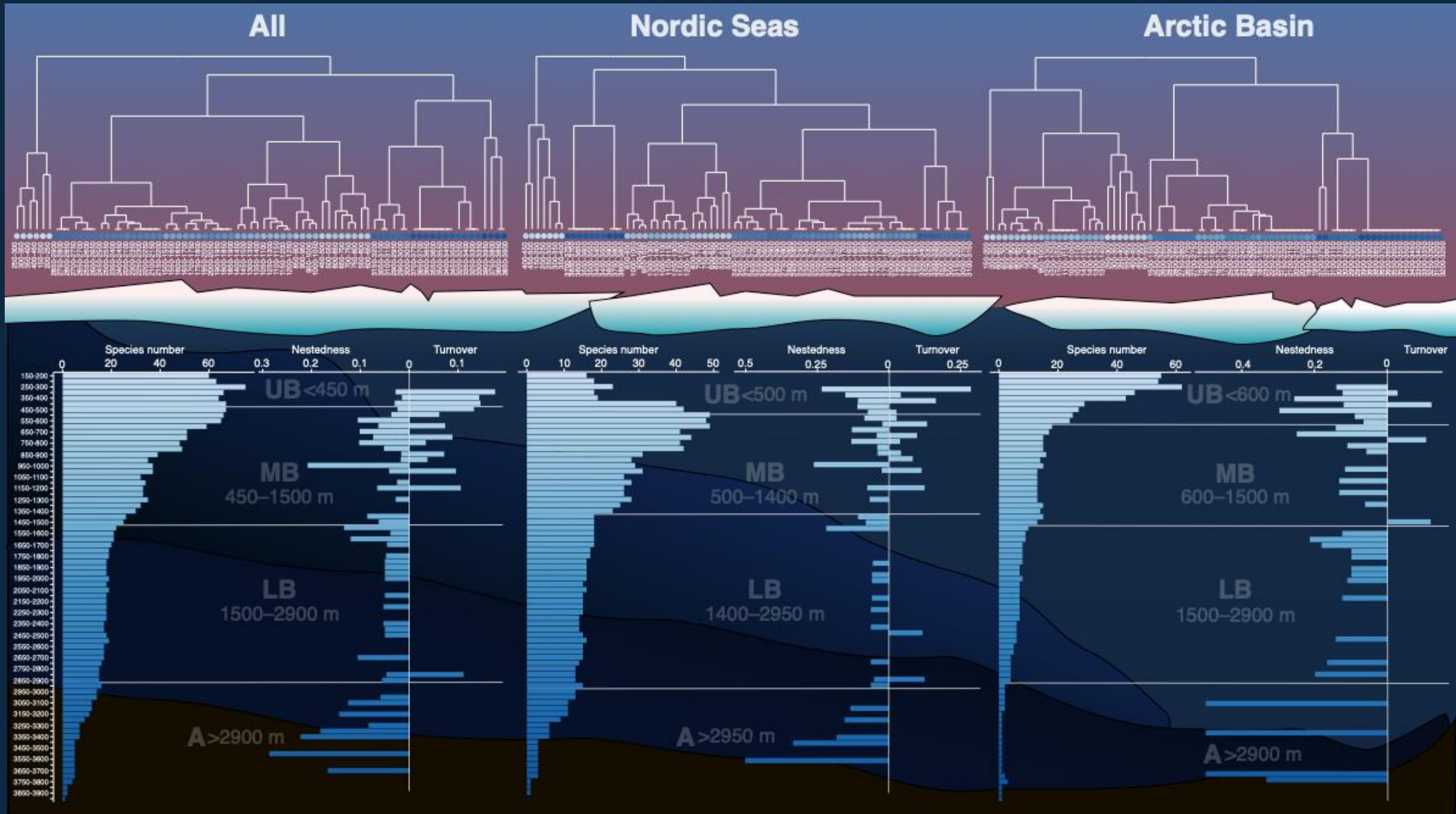
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# Species richness across depth gradient



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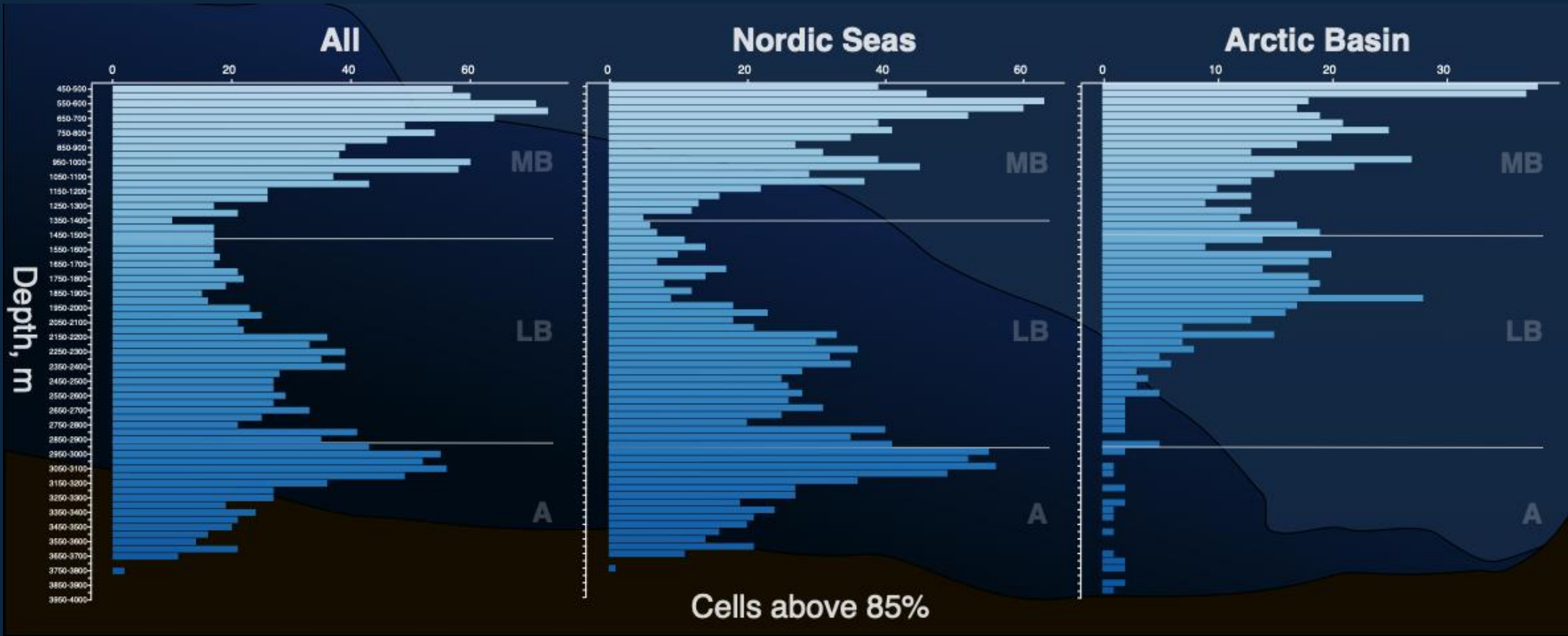
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# Species border concentration



Peaks in the concentration of species range boundaries were observed at depths of 700–1000 m (middle bathyal) and 2900–3300 m (abyssal)

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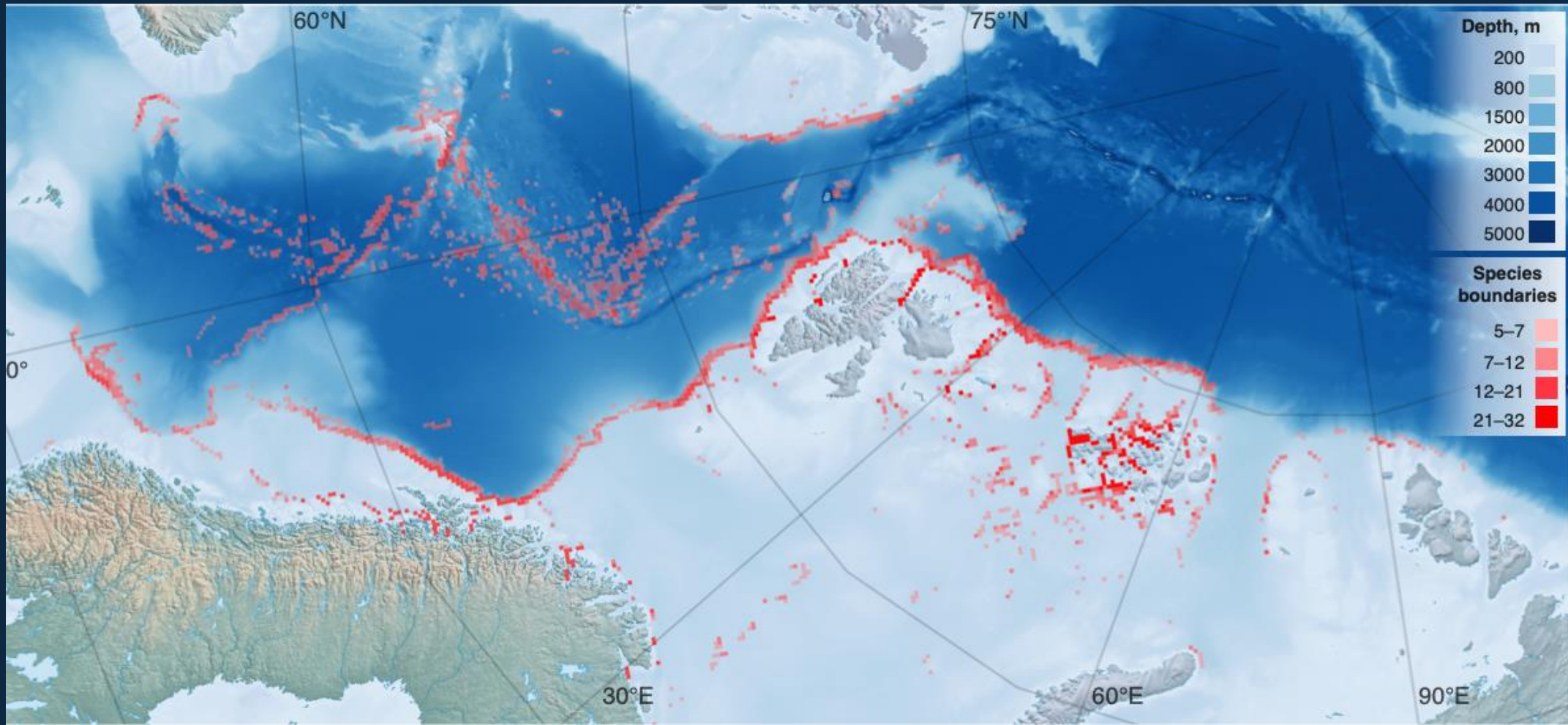
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# Species border concentration



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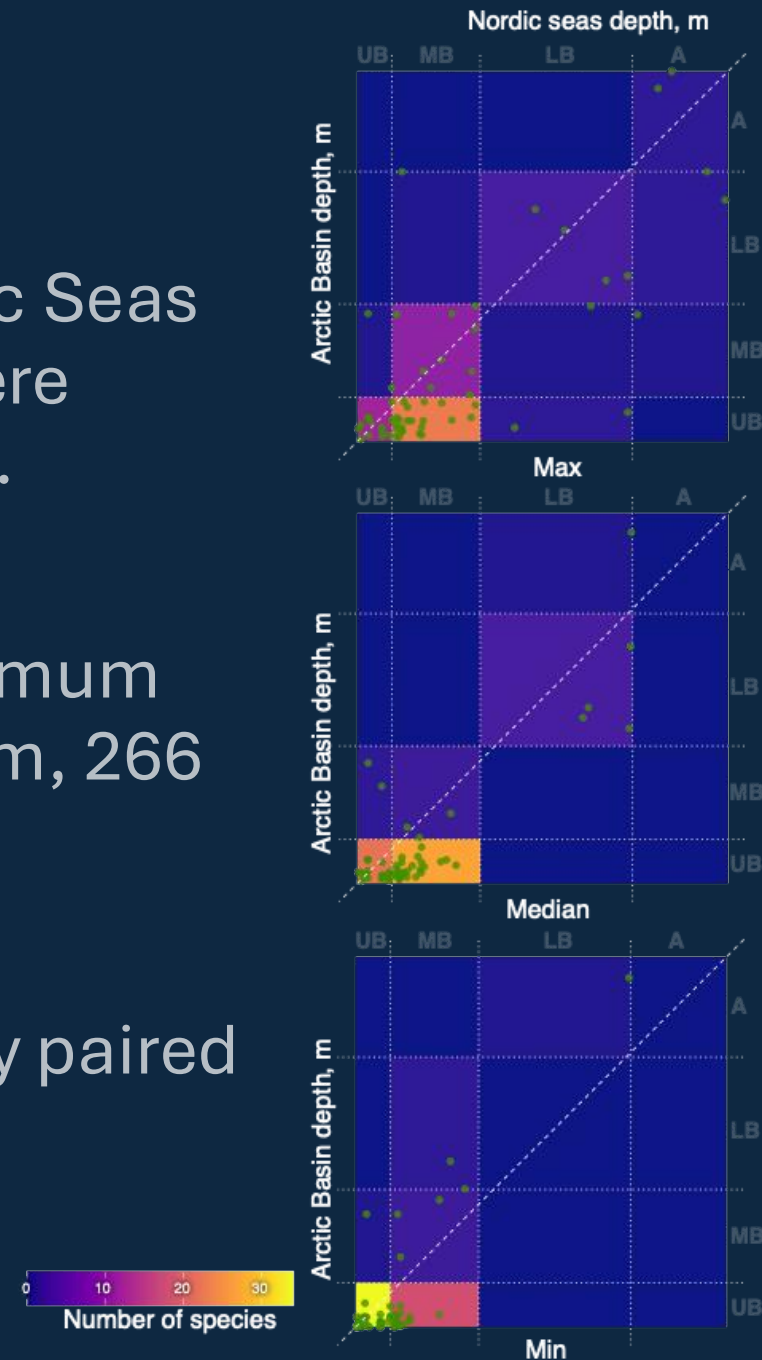
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# Going towards the sunlight!

For 59 species shared between the Nordic Seas and the Arctic Basin, all depth records were consistently shallower in the Arctic Basin.

On average, minimum, median, and maximum occurrence depths were reduced by 199 m, 266 m, and 208 m, respectively.

All differences were strongly supported by paired Wilcoxon tests ( $p < 0.001$ )



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# Conclusions

The fauna of the Central Arctic remains poorly studied compared to that of the Nordic Seas and currently includes only 15 species of Gastropoda and 2 species of Scaphopoda. However, this number may be strongly underestimated due to insufficient sampling and high cryptic diversity

Species richness and population density decrease significantly with depth

The deep-water fauna of the Central Arctic is of Atlantic origin, whereas the shelf fauna has a mixed origin

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Across the Eurasian Arctic, the transition between shallow-water and deep-sea faunas forms a broad zonal gradient rather than a sharp boundary. Arctic gastropod assemblages form four major bathymetric zones

Faunal differentiation is driven mainly by progressive impoverishment with depth, while species turnover plays a secondary role

The middle bathyal represents a broad transitional zone with balanced turnover/nestedness and the highest concentration of species range boundaries

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# Challenges

Insufficient attention is paid to the long-term processing and preservation of material during expedition planning. As a result, much of the collected material is absent from museum collections and remains unavailable for further study

Modest resources would make it possible to preserve an enormous scientific heritage

Data from Arctic chemosynthesis-based communities remain extremely limited

Molluscan taxonomy is still based primarily on shell morphology, while suitable material (and other resources) for molecular phylogenetic studies are largely lacking

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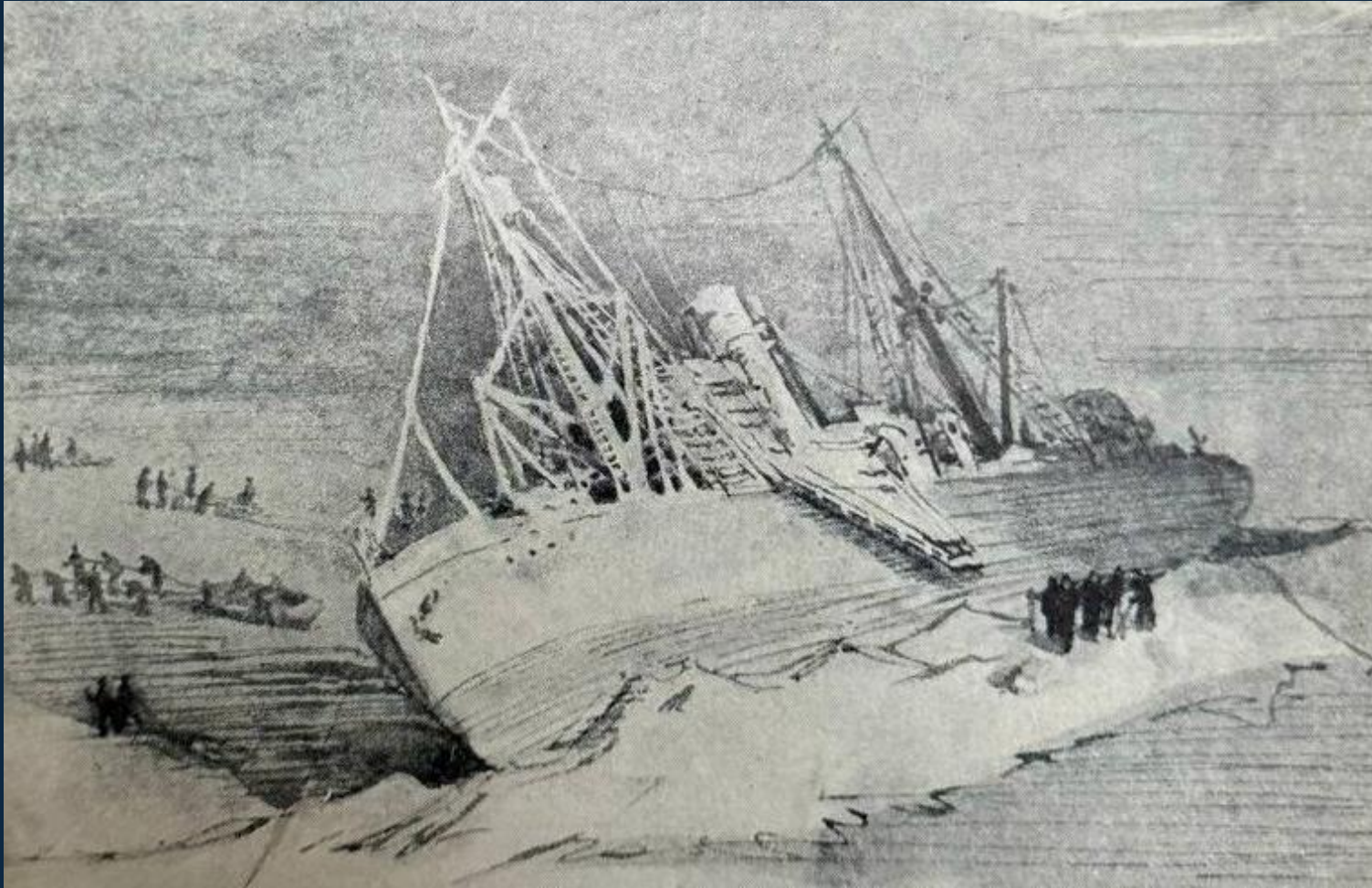
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# Thank you for the attention!



Icebreaker *Sedov* in the Ice. After Badygin, 1950

ResearchGate



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