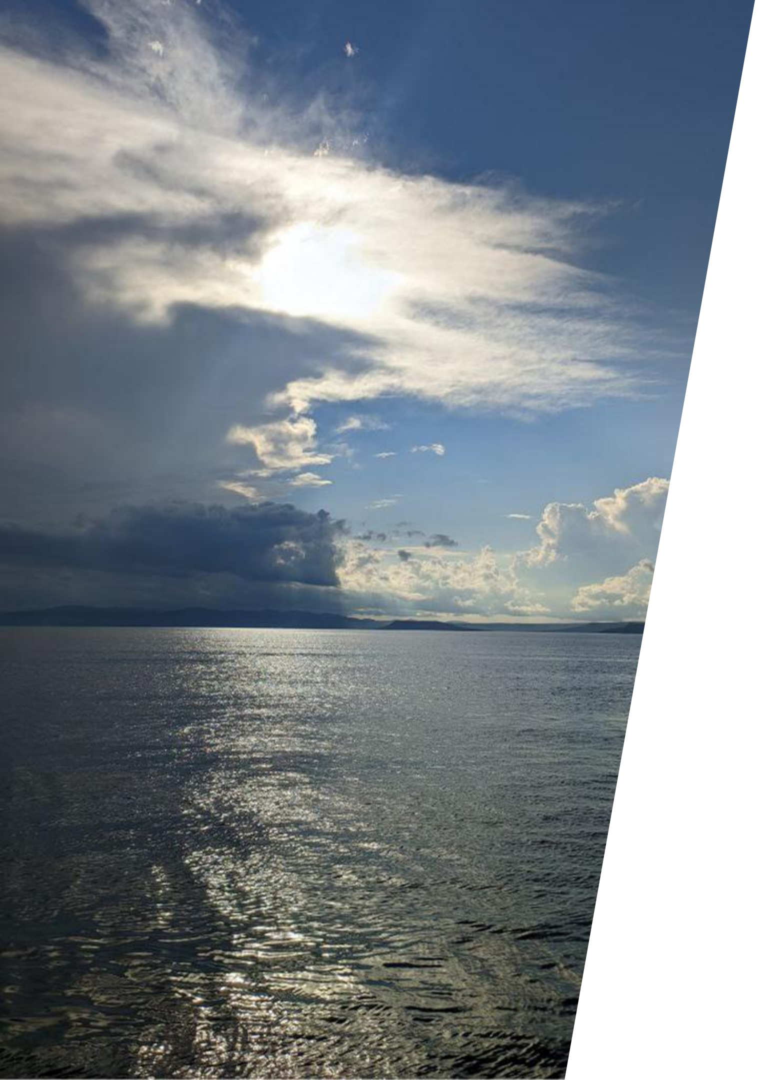

Seasonal dynamics of trophicity in Amur Bay (Japan/East Sea) assessed by nutrients and plankton communities

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Mariia A. Shulgina, Ksenia V. Radchenko

with contributions in sample processing and preparation:
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National Scientific Center of Marine Biology,
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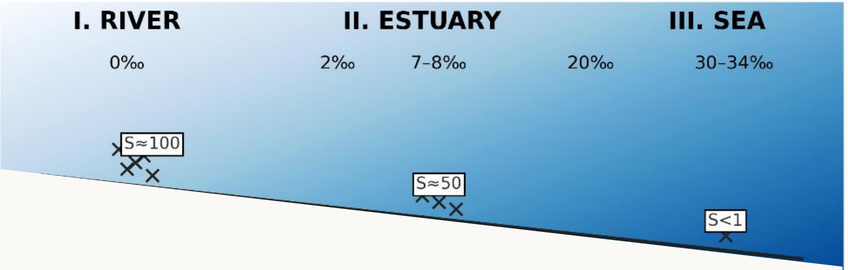
Highlight

Rainfall delivers the nutrients, but zooplankton determine the ecosystem’s final response

Research Relevance



Marginal Filter Effect

(after A. P. Lisitsyn)

Natural filters for catchment areas by trapping pollutants and nutrients from coastal.

Lisitsyn, A. P. (1995). *The marginal filter of the ocean*

Research Relevance

Coastal Eutrophication

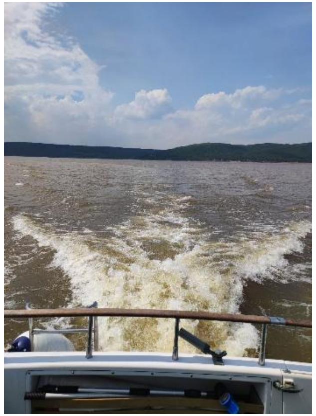
Study the process of eutrophication in coastal ecosystems, particularly in semi-enclosed waters.

Transboundary Nutrient Transfer

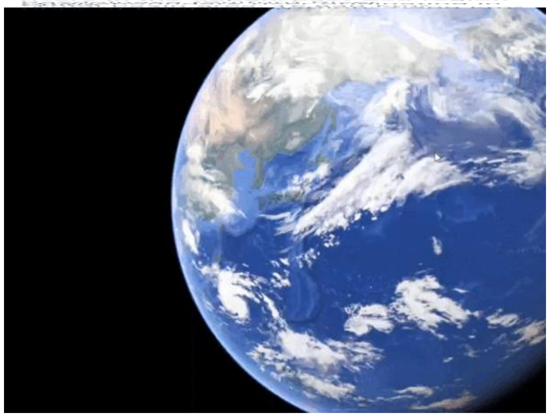
Assess the role of transboundary nutrient transfer (Razdolnaya/Suifen River, originating in China) on bay trophicity.

Seasonal Dynamics

Analyze the interplay between physico-chemical parameters and biological responses on a seasonal scale (May–October).



Research Area and Objectives



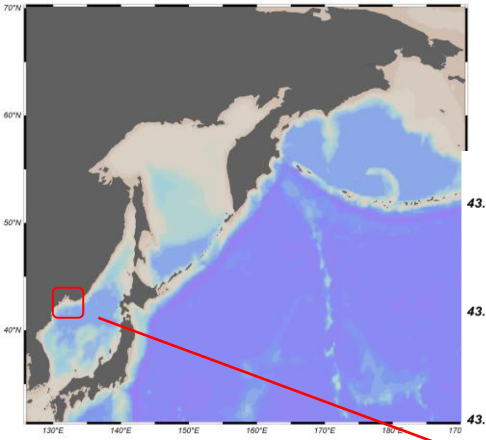
Area of the Amur Bay 1136 km^2.
• Receives inflow from Razdolnaya (Suifen) River, one of the largest rivers in the Japan/East Sea region

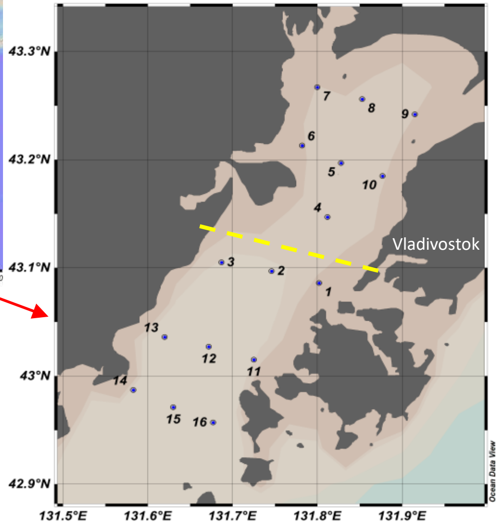
Razdolnaya (Suifen) River
•Transboundary river
•Total basin area: 16,830 km^2
•Russian territory portion: 7,300 km^2 (43% of total basin)

Amur Bay provides spawning and feeding habitats for valuable fisheries resources

- Investigating the impact of transboundary river runoff on the trophic status and plankton communities of a semi-enclosed Amur bay in the Japan/East Sea

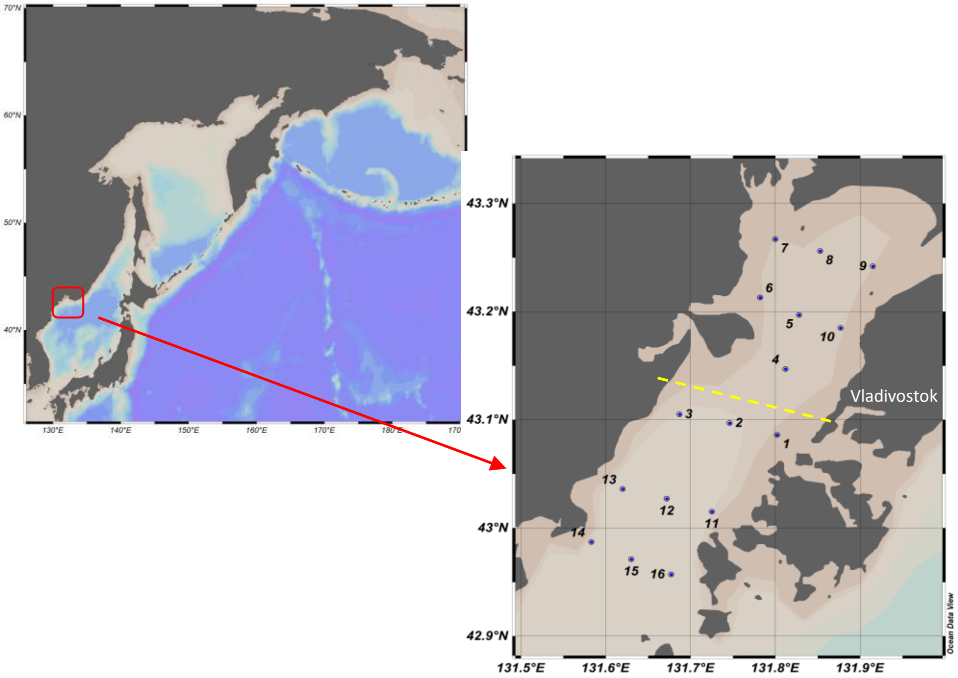
Research Area and Objectives





- The bay is divided into two zones: an inner part heavily influenced by river runoff, and an outer part influenced by the open sea.

Methodology and Data Scope



Data Collection Period
from May to October 2024 across the two distinct parts of the bay

Physico-Chemical Parameters
Rinko ASTD (Temperature, Salinity, Chl *a*)
Lab analysis (Dissolved Oxygen, BOD5, DIP, DIN, DSi, DFe)

Trophic Status & Plankton

Eutrophication Index (TRIX)
Analyzed phytoplankton and zooplankton community structure.

$$TRIX = \frac{(log10[Chla \times |dO2\%| \times DIN \times DIP] + 1.5)}{1.2}$$

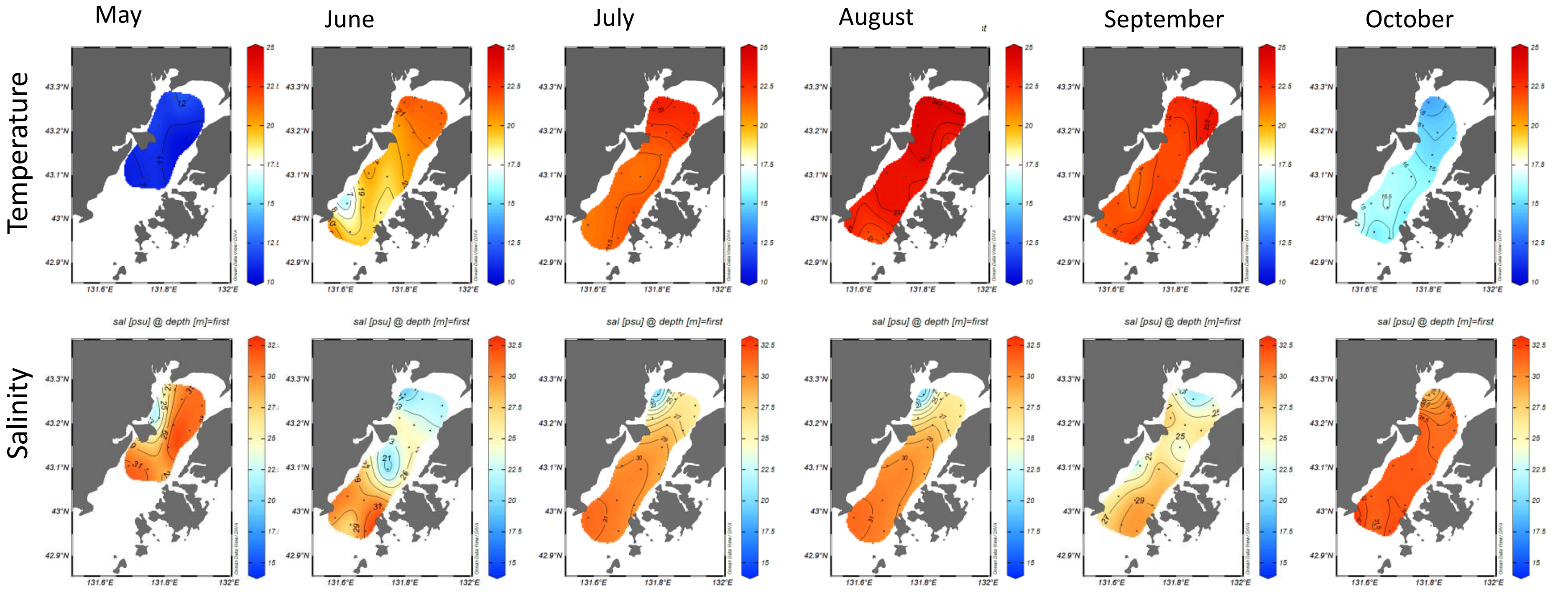
(Vollenveider et al, 1998)

- The bay is divided into two zones: an inner part heavily influenced by river runoff, and an outer part influenced by the open sea.

Seasonal Dynamics of the Abiotic Environment

Temperature and Salinity

Clear gradients observed between the inner and outer parts of the bay. The inner part is significantly freshened by river runoff, especially early and later summer.



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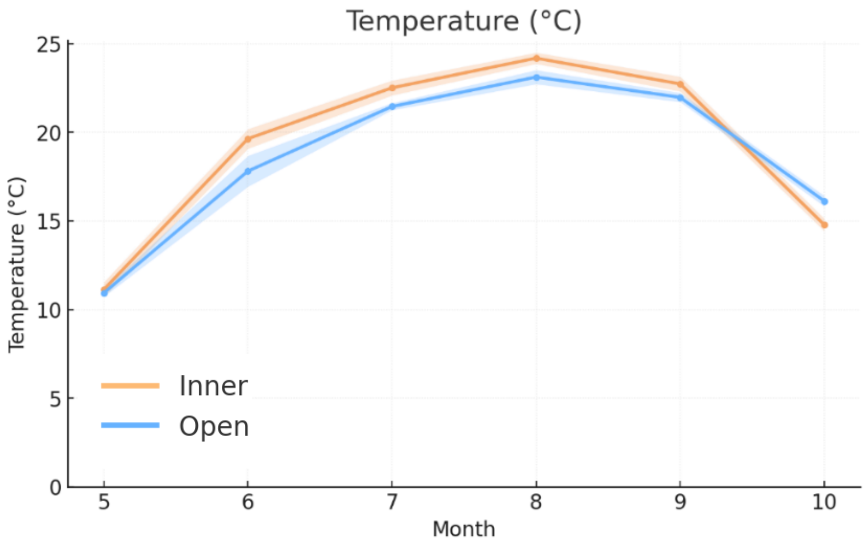
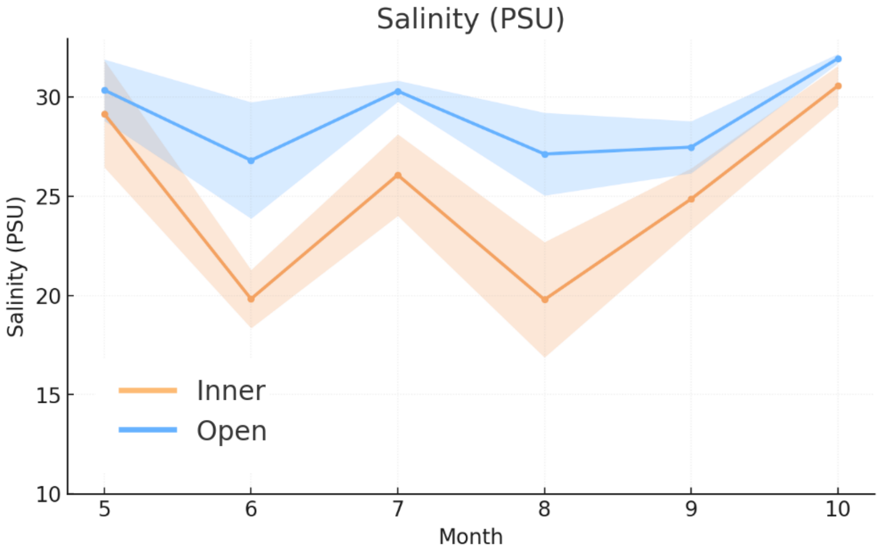
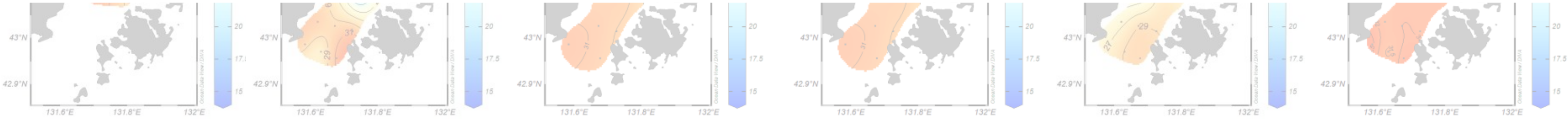


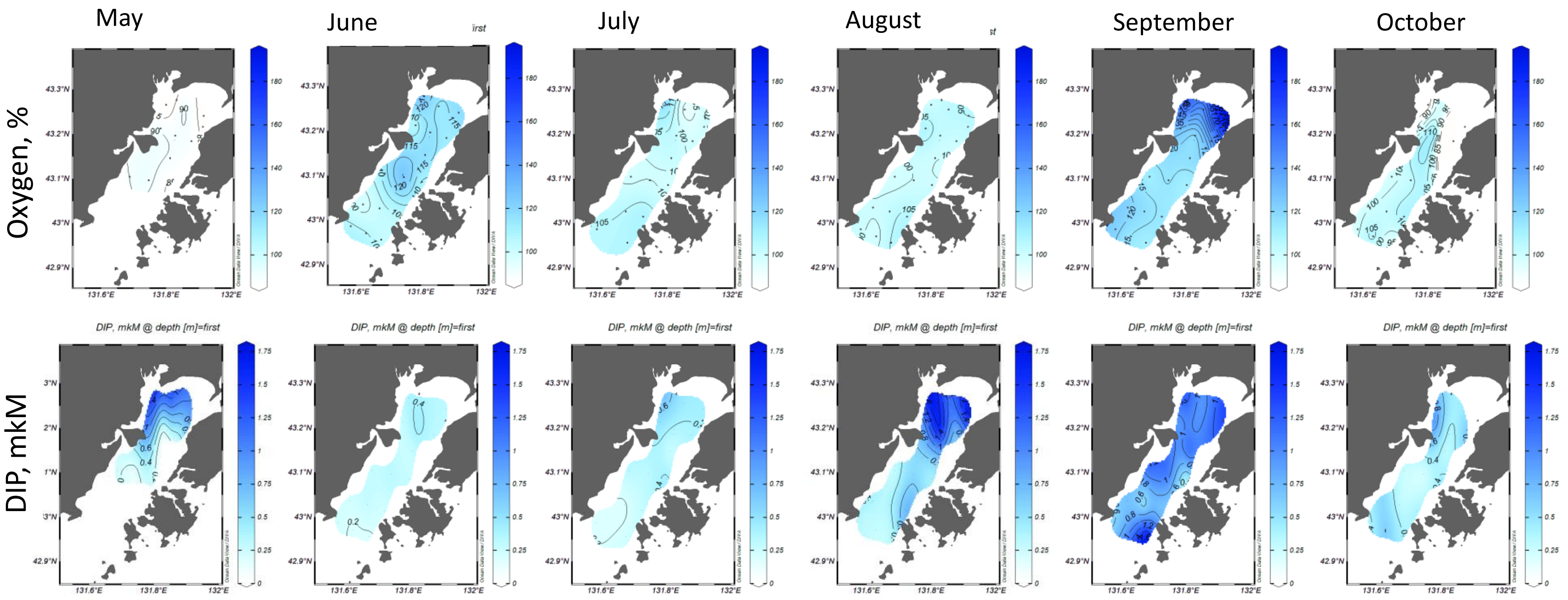




Seasonal Dynamics of the Abiotic Environment

Oxygen and DIP Regime

Oxygen saturation dynamics are closely linked to temperature and biological processes (photosynthesis and respiration).



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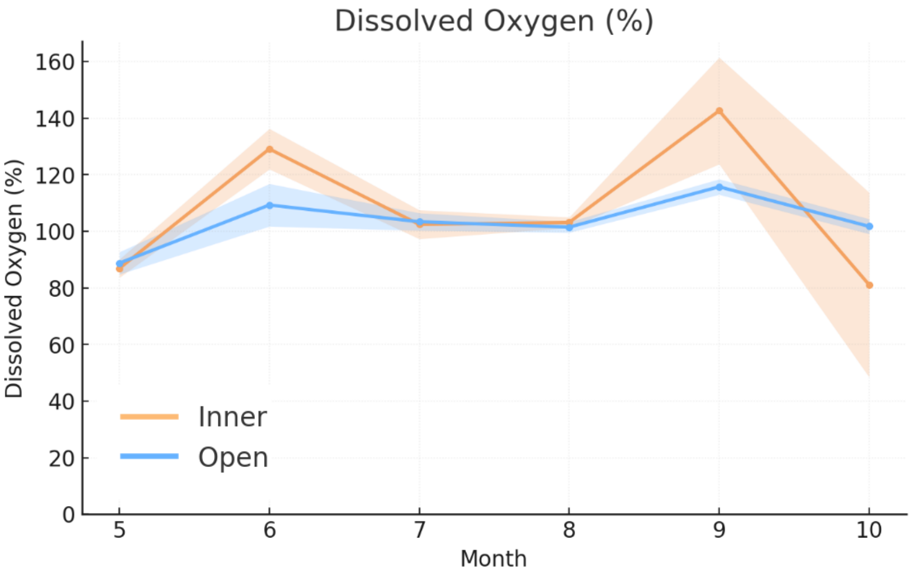
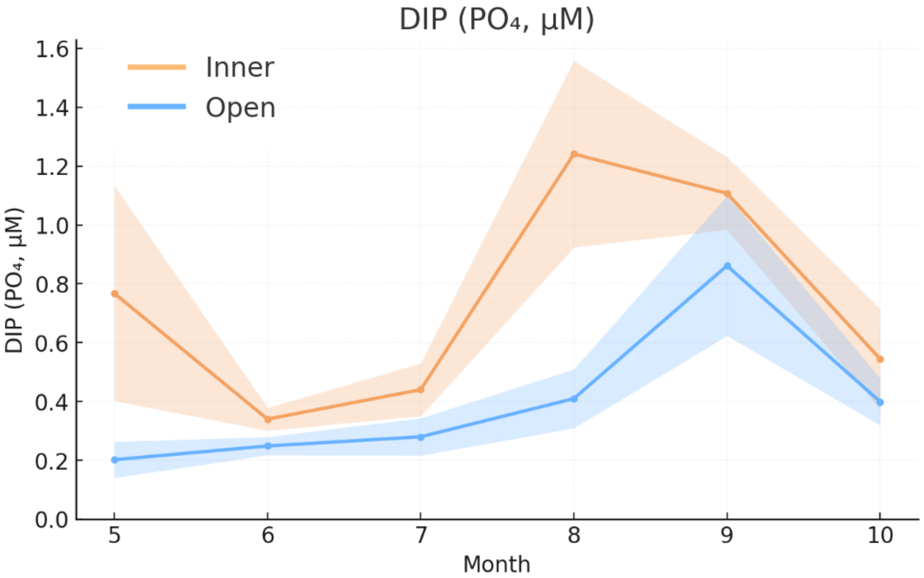
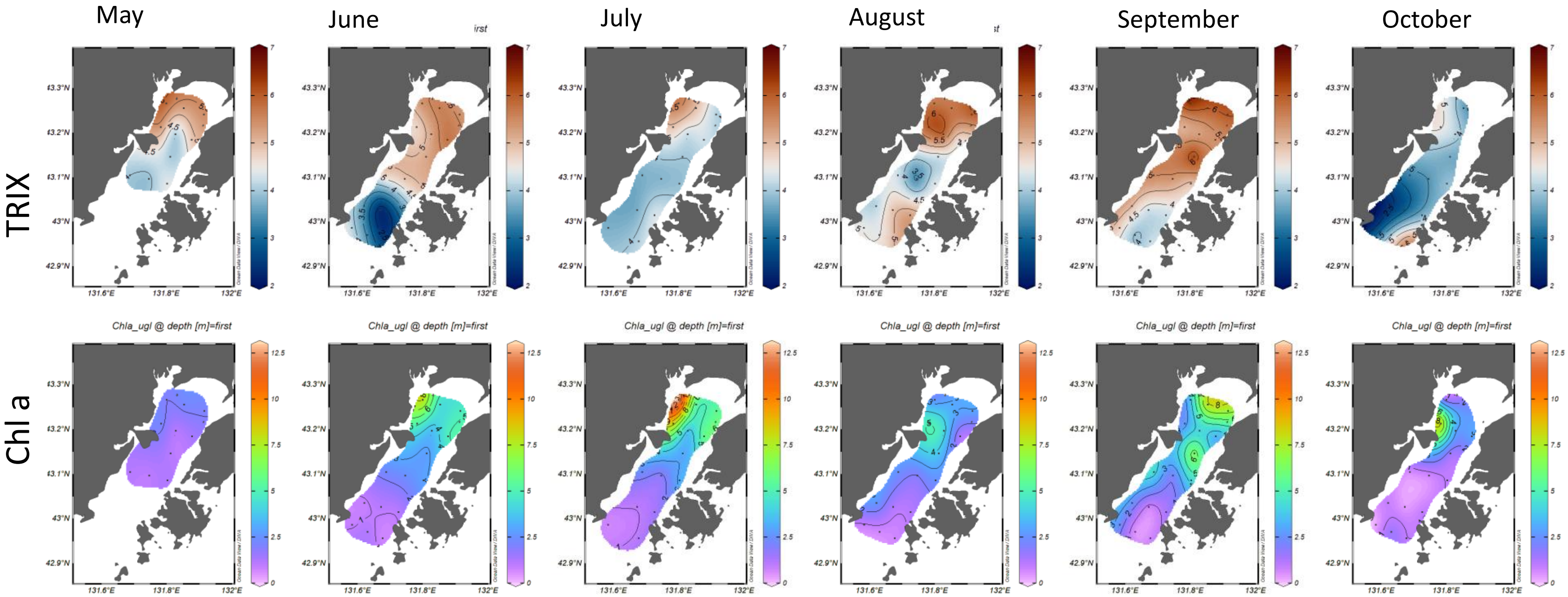




Seasonal Dynamics of the Environment

TRIX and Chl a

The eutrophication index showed a significant seasonal increase, highlighting the dominant driver of trophic state.

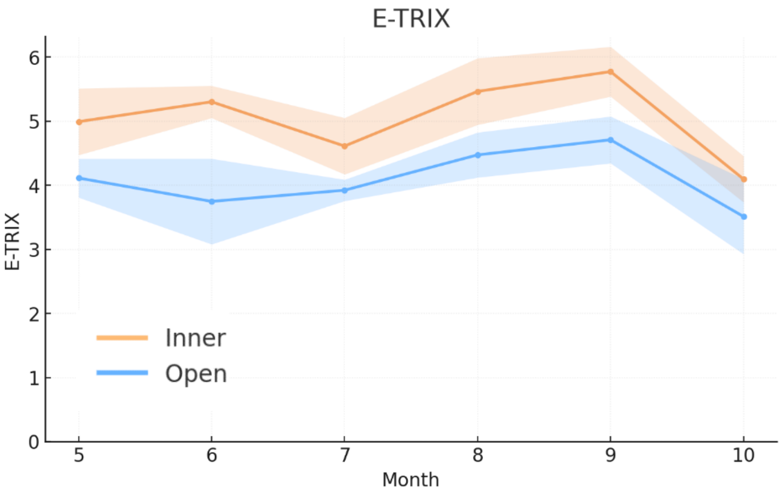


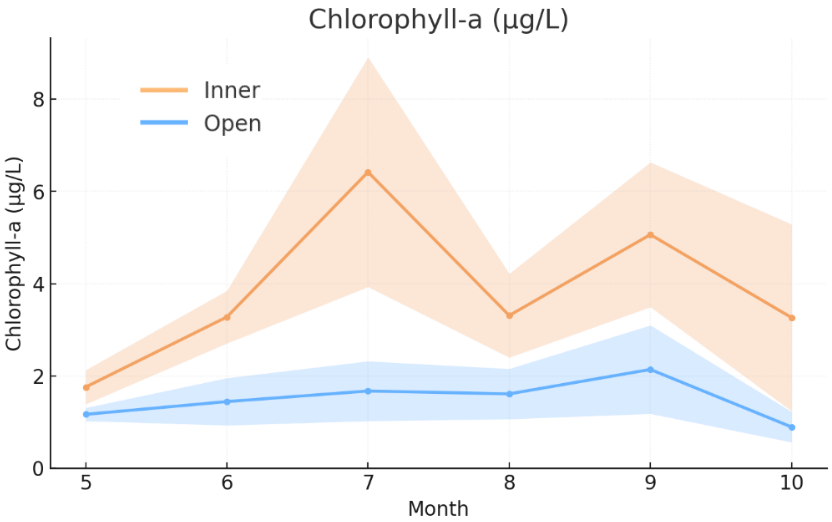
Seasonal Dynamics of the Environment

The peak trophic state occurs in September, not during maximum warming (July-August), indicating that nutrients input from river runoff is the leading factor.

Conditions	TRIX units	Trophic state*
Oligotrophic	< 4	Elevated
Mezotrophic	4 - 5	Good
Mezotrophic	5 - 6	Mediocre
Eutrophic	> 6	Bad

*Rinaldi and Giovanardi, 2011

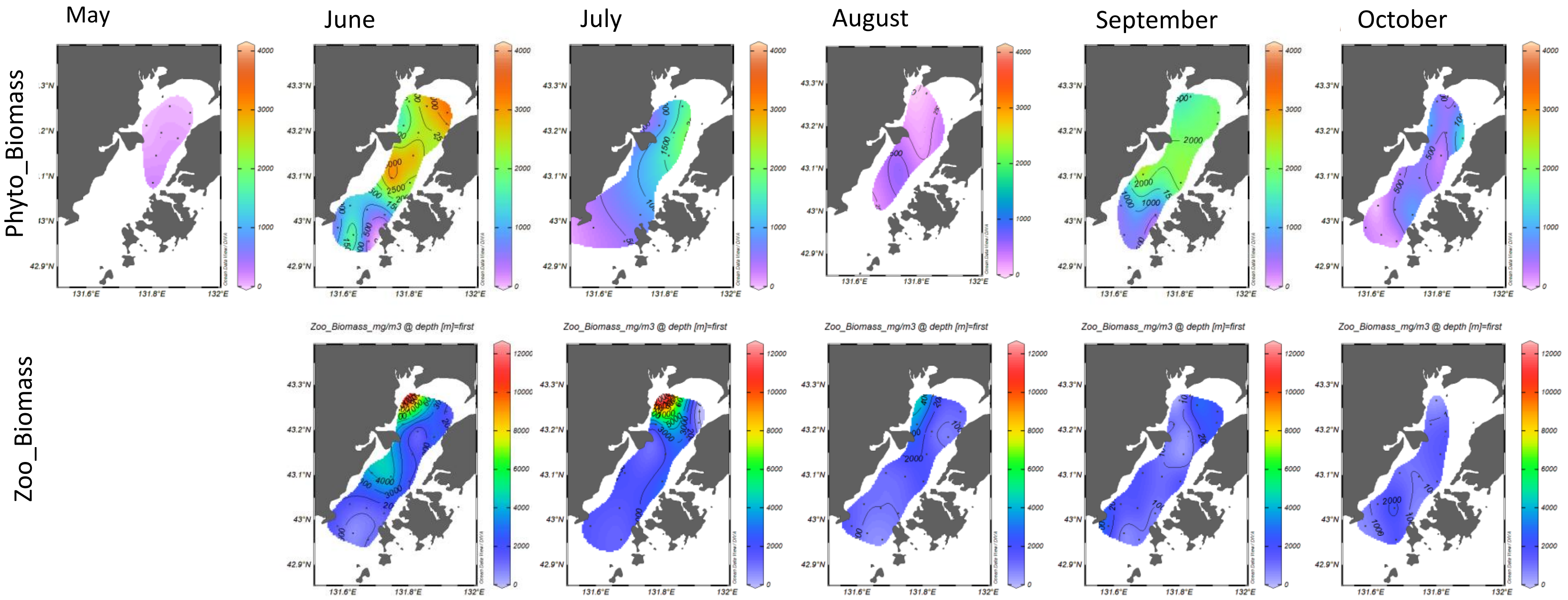




Plankton Response: Productivity Peaks

Phyto- and Zoo-

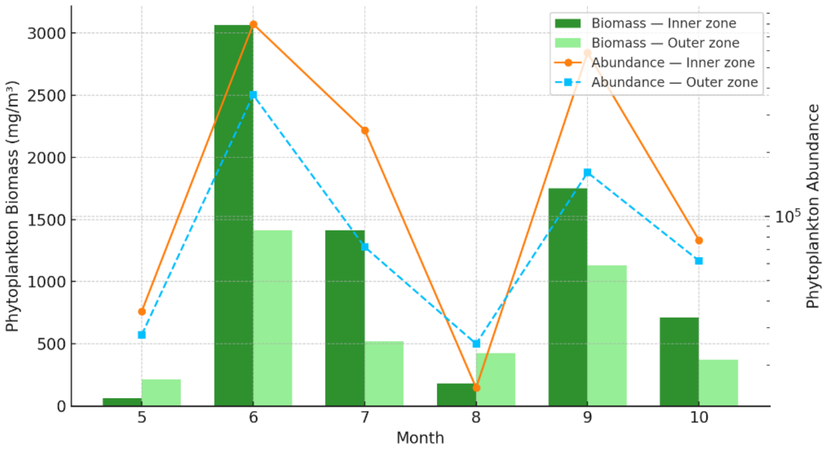
The phytoplankton community exhibits two distinct peaks: a spring bloom and an autumn bloom – a pattern characteristic of subarctic regions.

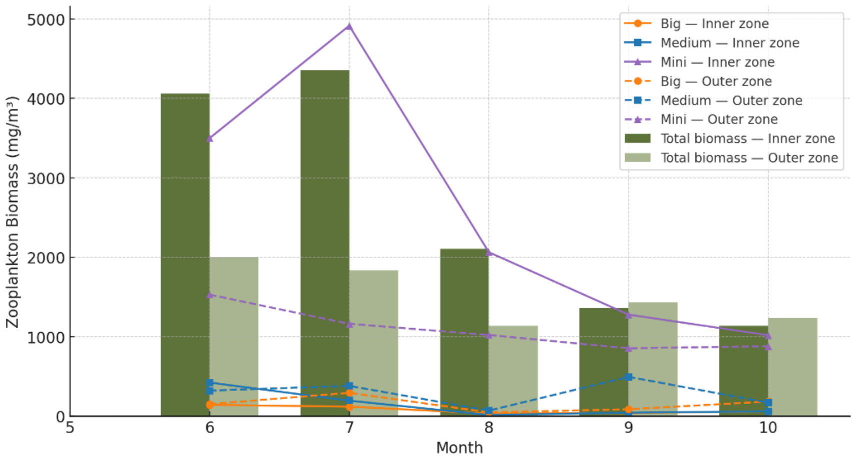


Plankton Response: Productivity Peaks

Phyto- and Zoo-

The autumn TRIX peak emerges from a trophic mismatch: reduced zooplankton grazing fails to control phytoplankton biomass, raising the trophic index.





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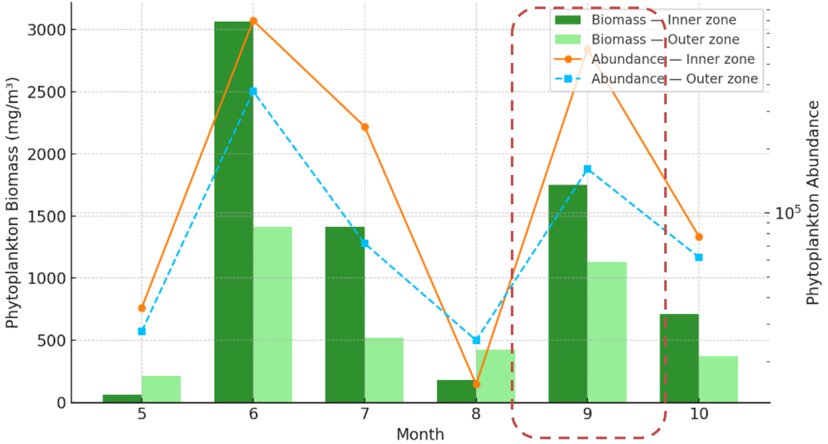
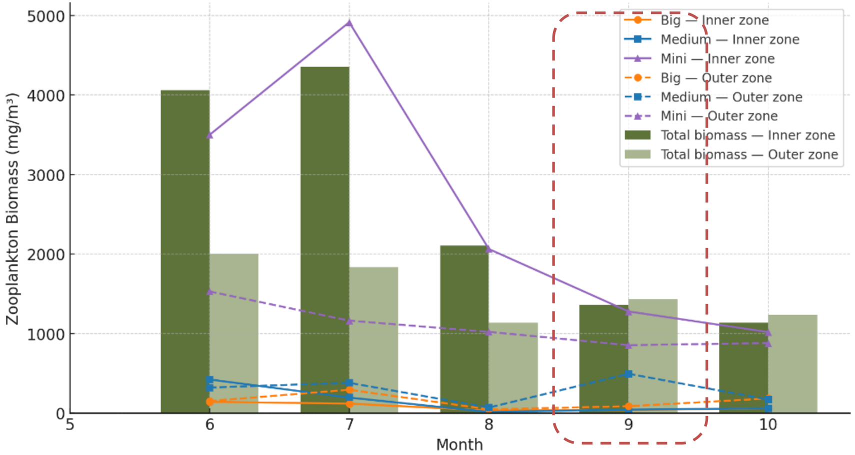


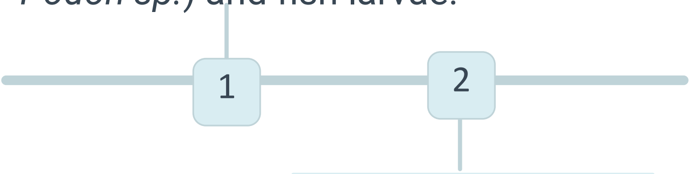


TRIX	**May-June**	**September**	**October**
Inner	5.0 ± 0.7	5.8 ± 0.3	3.9 ± 0.3
Outer	3.6 ± 0.5	4.3 ± 0.7	3.3 ± 0.5

Zooplankton Community Restructuring

Early Summer

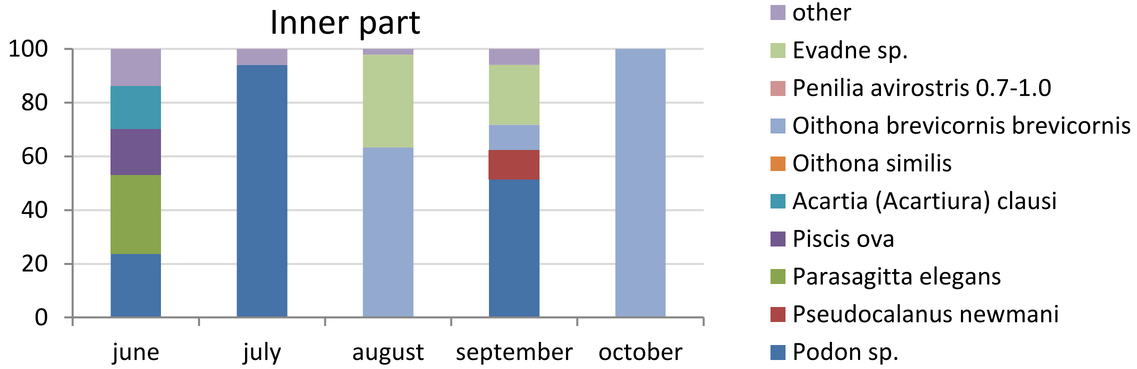
Dominated by predatory chaetognaths (e.g., *Parasagitta elegans*, *Podon sp.*) and fish larvae.

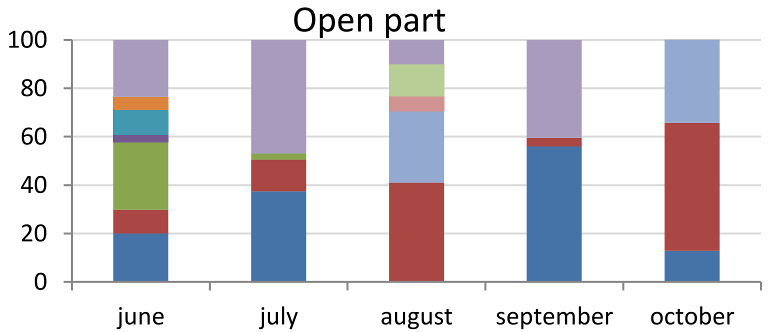


Late Summer/Autumn

Shift to crustaceans (Cladocerans like *Evadne sp.*, *Oithona sp.*, copepods) responding to increased food resources.

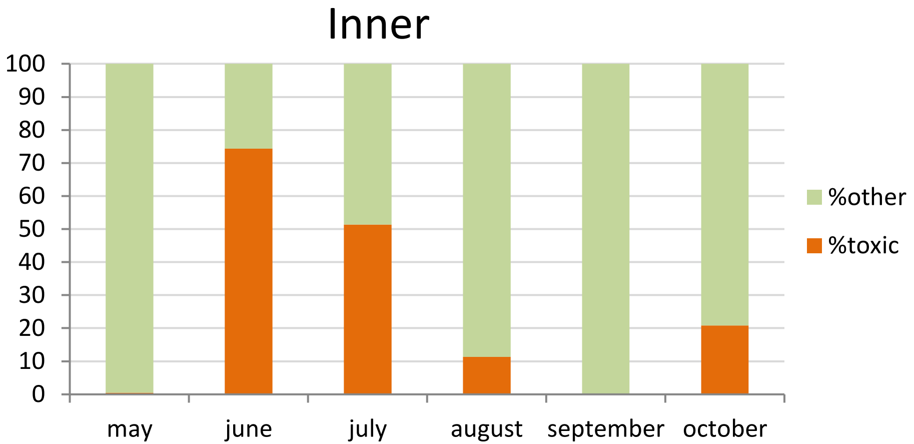
Zooplankton communities show a sequential shift in dominant trophic groups in response to changing productivity and food availability.

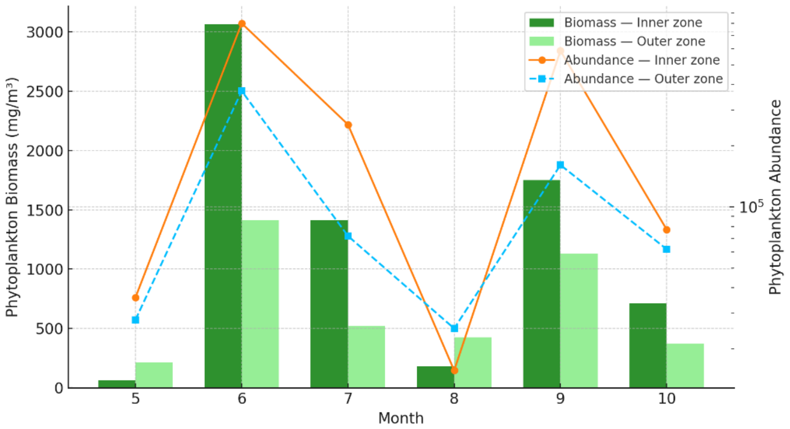


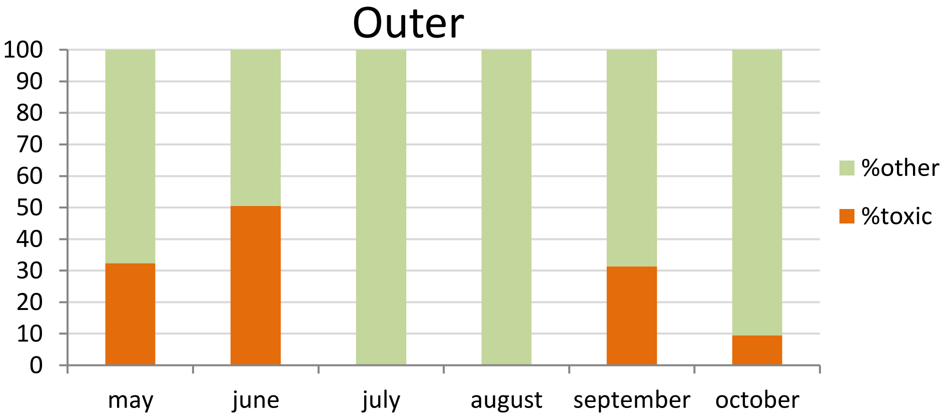


Seasonality of toxic phytoplankton

Dinophysis acuminata
Protoperidinium pellucidum
Pseudo-nitschia delicatissima
Prorocentrum minimum
Prorocentrum triestinum
Dinophysis rotundata

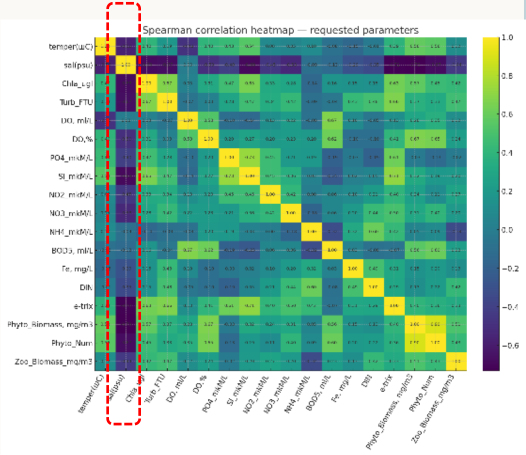


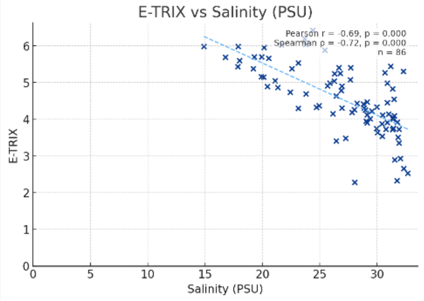


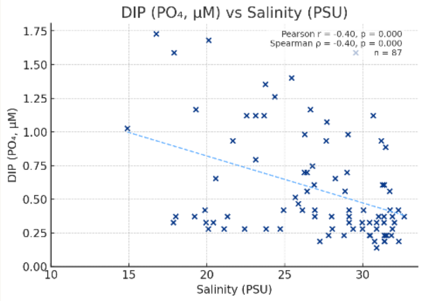


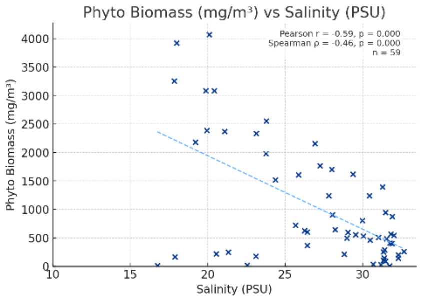
Driving Forces: The Role of River Runoff

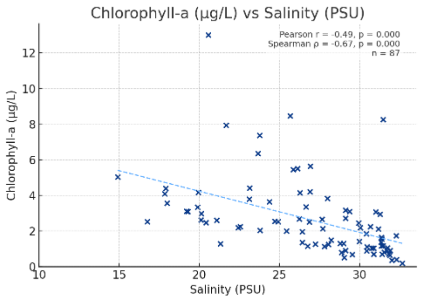
The bay shows a strong correlation between eutrophication parameters and the salinity (the influence of the Razdolnaya River).





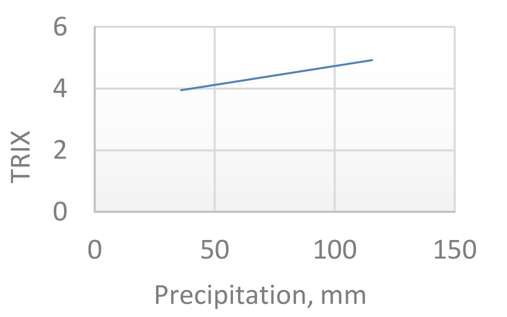


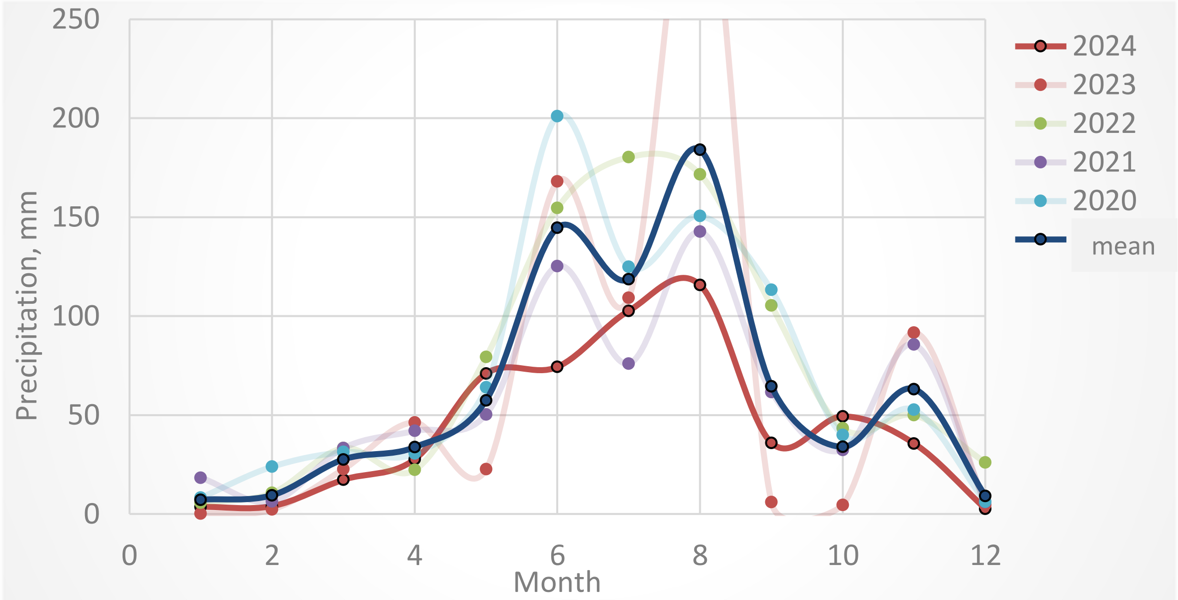




Driving Forces: The Role of River Runoff

Average TRIX value in the inner part of the bay and precipitation in the river's catchment area with a lag of -1 month





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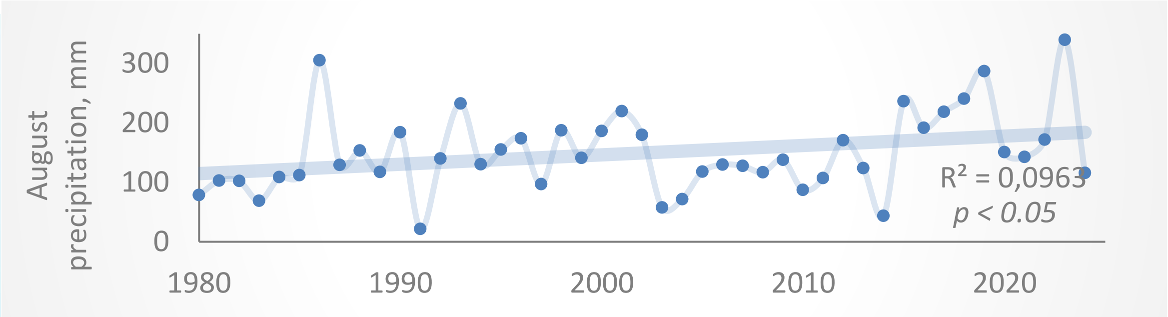
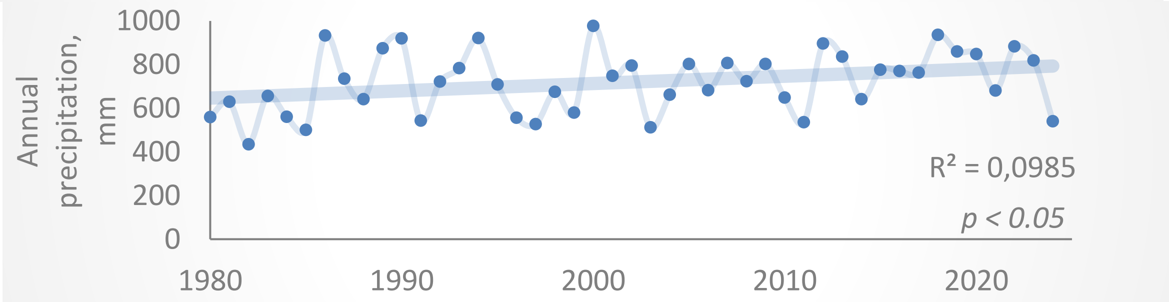
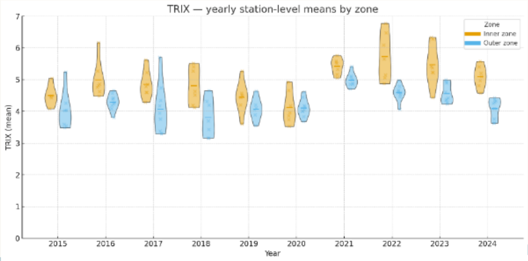




The decadal trend for the average annual TRIX index is weak, the bay remains under constant pressure from nutrient input, but autumn-winter cooling help the ecosystem recover.



Data spanning 45 years show a statistically significant increase in the august precipitation (and annual) in the river basin.

Conclusions and Future Monitoring

1 Complex Dynamics

Rainfall delivers the nutrients through transboundary river, but zooplankton determine the ecosystem’s final response

2 River-Driven Eutrophication

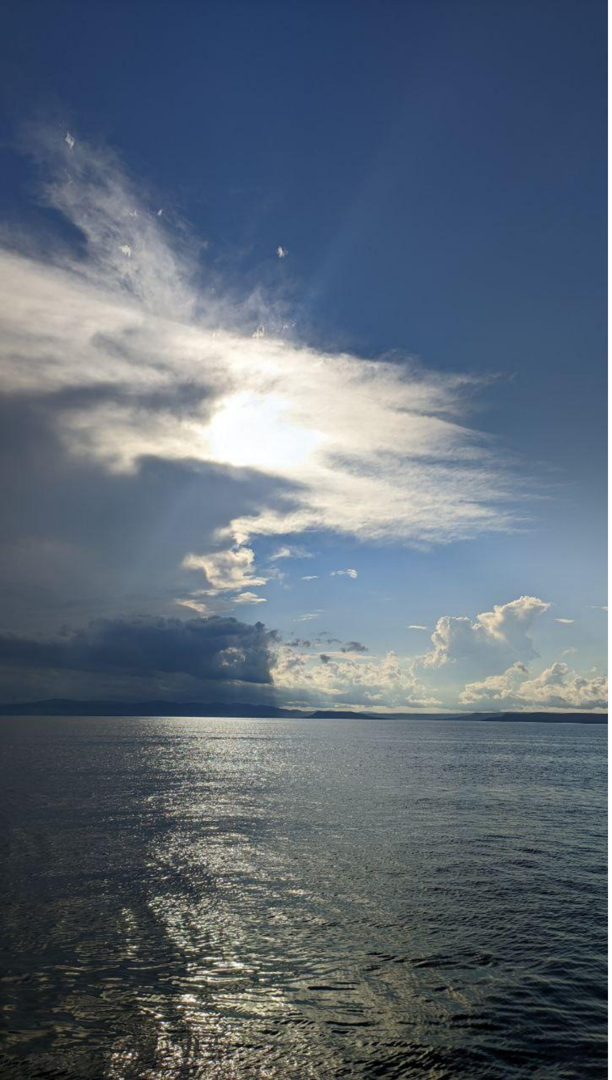
The September TRIX peak confirms the limiting role of nutrient input from the Razdolnaya/Suyfen River basin.

3 Future Risk

Observed increases in precipitation create preconditions for potential future intensification of eutrophication.

4 Management Strategy

Zonal management is crucial for predicting critical events like hypoxia and harmful algal blooms.



Thank you for your attention

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