



NAFO Northwest Atlantic
Fisheries Organization



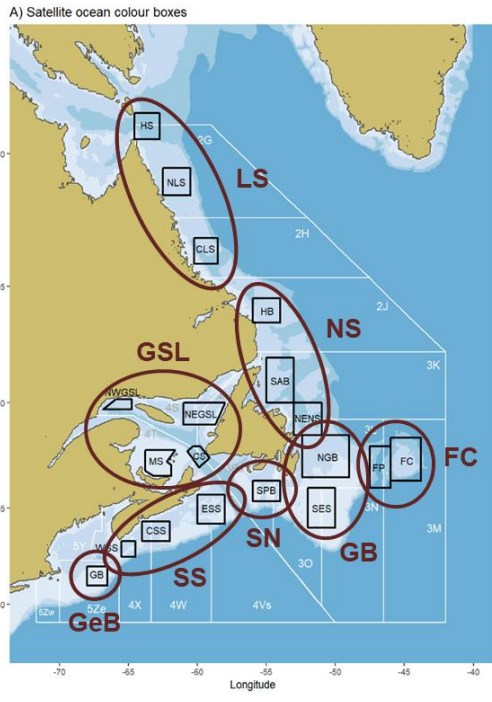
Overview of the Biogeochemical Oceanographic Conditions in the Northwest Atlantic in 2023 in NAFO Subareas 2-3-4



Fisheries and Oceans Pêches et Océans
Canada Canada

Atlantic Zone Monitoring Program (AZMP)
NAFC Oceanography Section

NAFO Subareas 2, 3 & 4 – Map of satellite boxes and AZMP oceanographic sections grouped by NAFO Ecosystem Production Units



Oceanographic sections —

Sampled seasonally (spring, summer and fall)

High-frequency monitoring sites ●

Sampled from weekly to bimonthly

Labrador Shelf (**LS**): 3 boxes, 2 sections

Newfoundland Shelf (**NS**): 3 boxes, 2 sections

Grand Bank (**GB**): 2 boxes, 2 sections, 1 site

Flemish Cap (**FC**): 2 boxes, 3M part of FC section

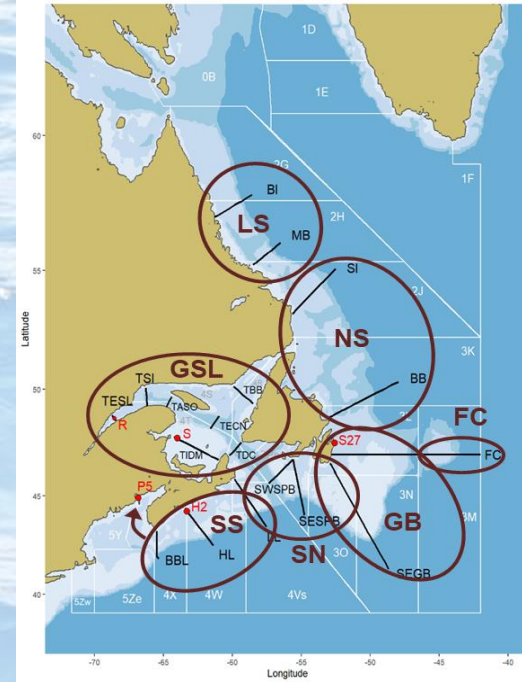
Southern Newfoundland (**SN**): 1 box, 2 sections

Gulf of St. Lawrence (**GSL**): 4 boxes, 7 sections, 2 sites

Scotian Shelf (**SS**): 4 boxes, 2 sections, 2 sites

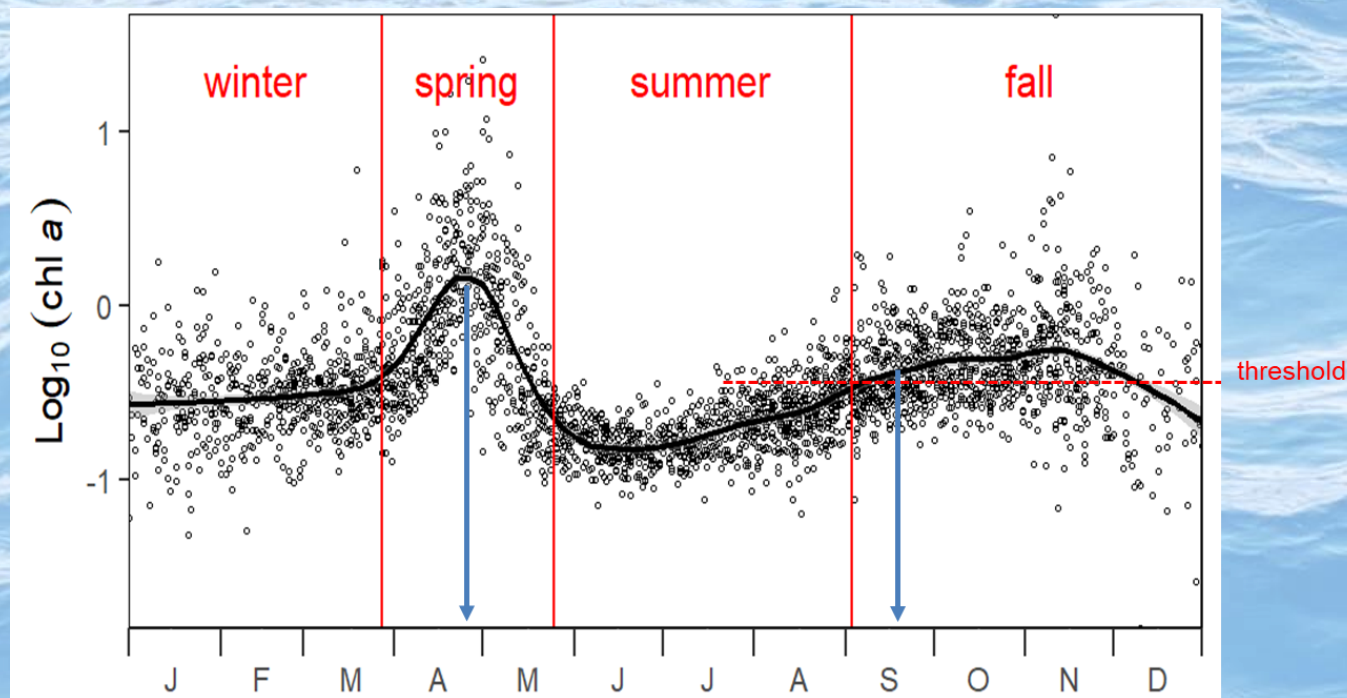
Georges Bank (**GeB**): 1 box

B) AZMP oceanographic sections

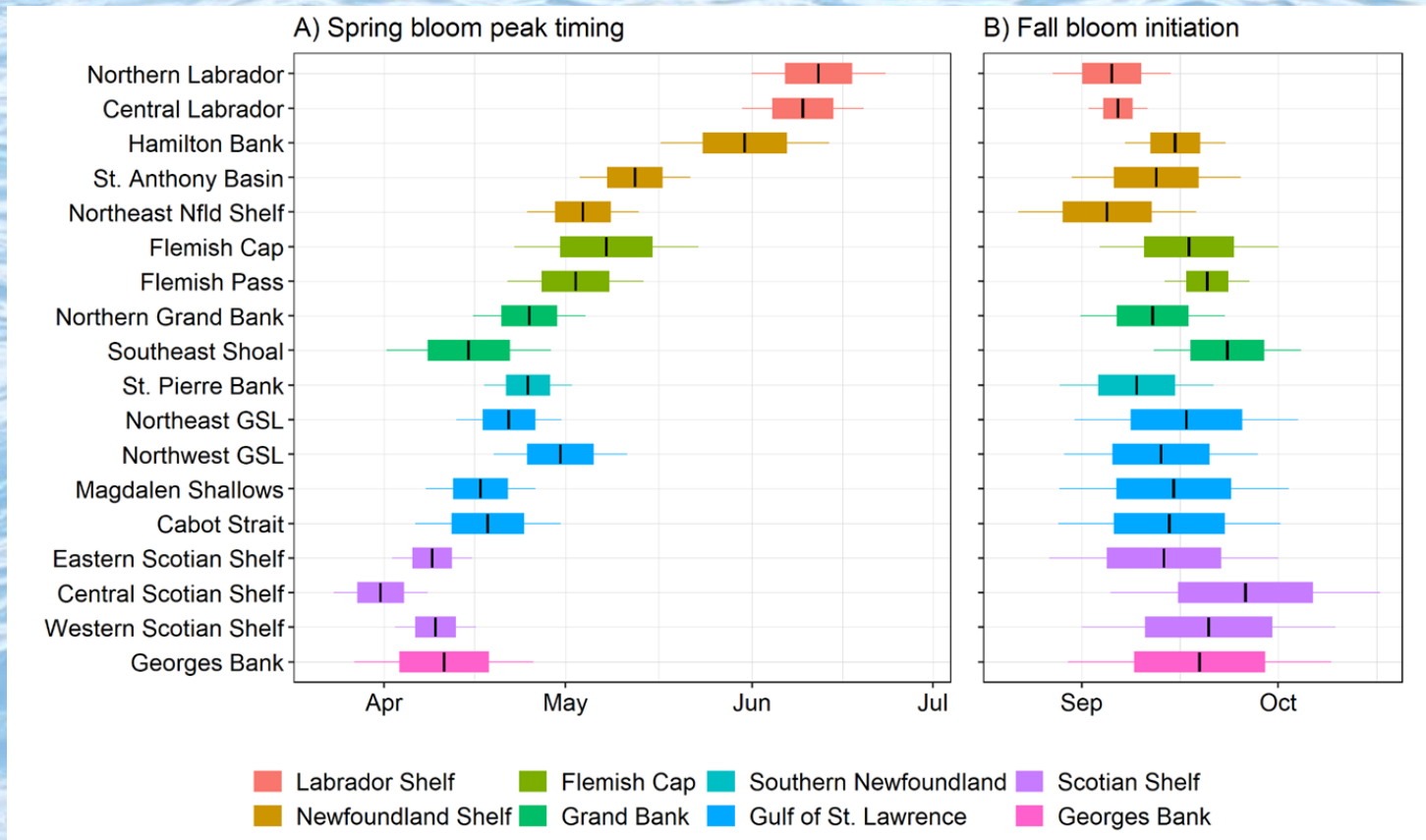


Spring Bloom Indices (satellite data)

- ✓ Spring: DOY at peak production
- **Timing:**
 - ✓ Fall: DOY when chl-*a* rises above threshold
- **Intensity:** Seasonal mean concentration of chl *a* concentration



Spring and Fall Phytoplankton Blooms - 2023



→ Spring blooms initiate later at high latitude sites (**Labrador**).

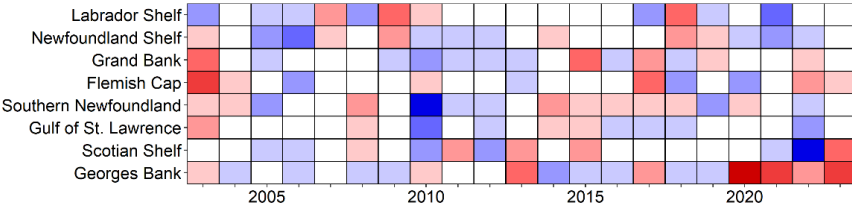
→ Blooms peak sometime between April and June off the northern **Labrador Shelf** and **Georges Bank** and **Scotian Shelf**.

→ The timing of the fall bloom doesn't exhibit a latitudinal gradient.

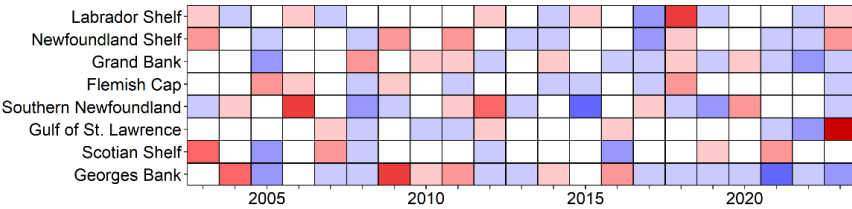


Spring and Fall Phytoplankton Blooms

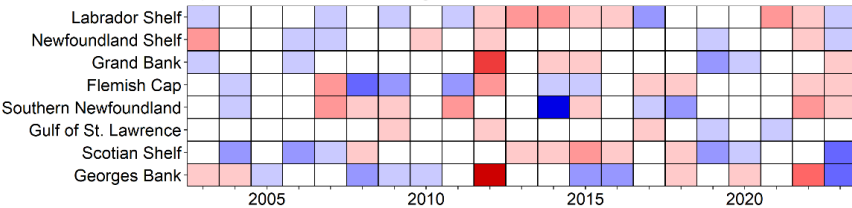
A) Spring bloom peak timing



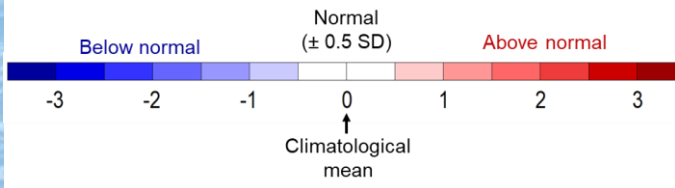
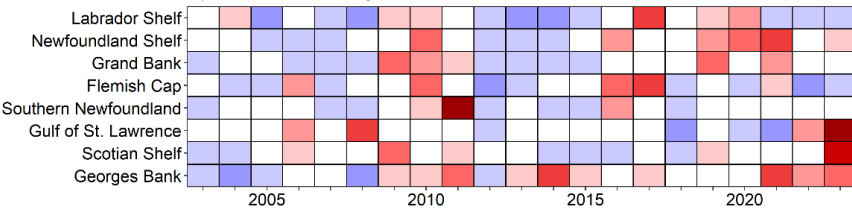
B) Spring bloom intensity



C) Fall bloom initiation timing



D) Fall bloom intensity



Spring bloom:

- **Near-normal** timing in **NL region** and **GSL**.
- **Late** timing on the **SS** and **GeB**.
- More **intense** bloom on the **NL shelves** compared to the south (except for **GSL**).

Fall bloom:

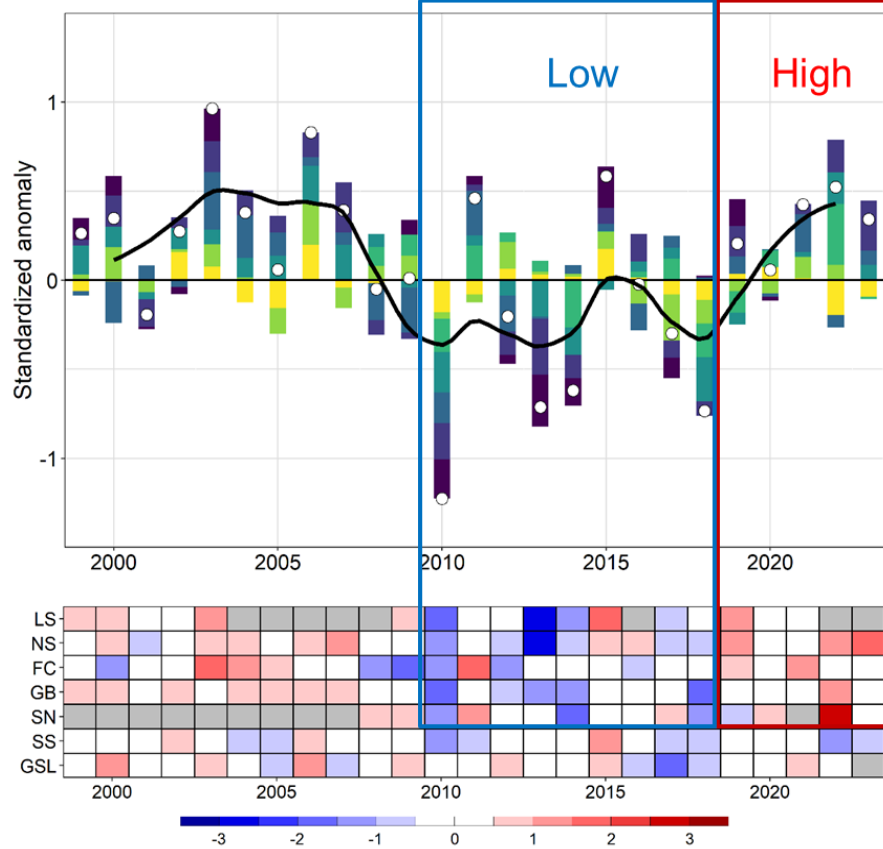
- **Late** blooms on **GB**, **FC** and **SN**, **early** bloom elsewhere except in **GSL**.
- **Intense** blooms in the south and in the **GSL**

Gulf of St. Lawrence:

- Record-high intensity for both spring and fall bloom in 2023



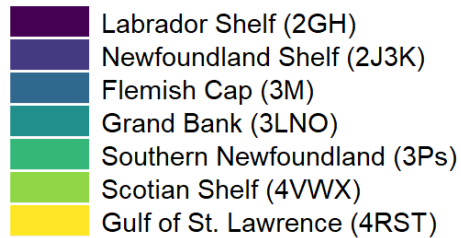
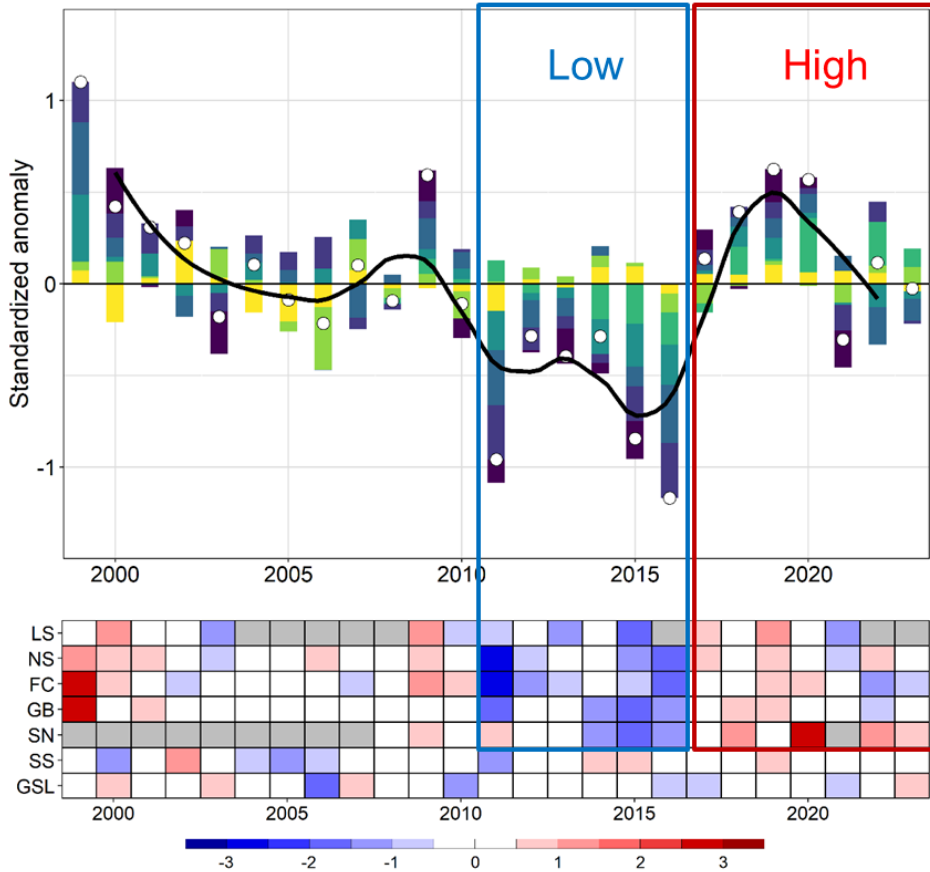
Nitrate Inventories



- General **increase** in **nitrate** inventories from Southern Newfoundland to the north since the late 2010s
- Mainly **near-normal** inventories in 2023 except for record-high nitrate levels on the **Newfoundland Shelf**.
- No clear broad-scale temporal trend for **Scotian Shelf** and the **Gulf of St. Lawrence**.



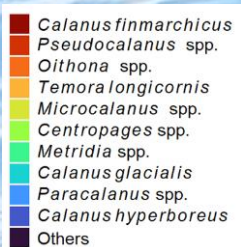
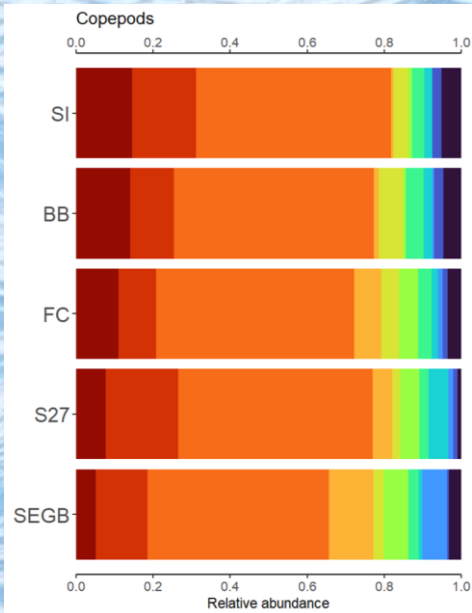
Chlorophyll Inventories



- General **increase** in **chl-a** inventories from Southern Newfoundland to the north since the late 2010s
- **Variable** inventories in 2023 with no strong departure from the climatological average.
- No clear broad-scale temporal trend for **Scotian Shelf** and the **Gulf of St. Lawrence**.

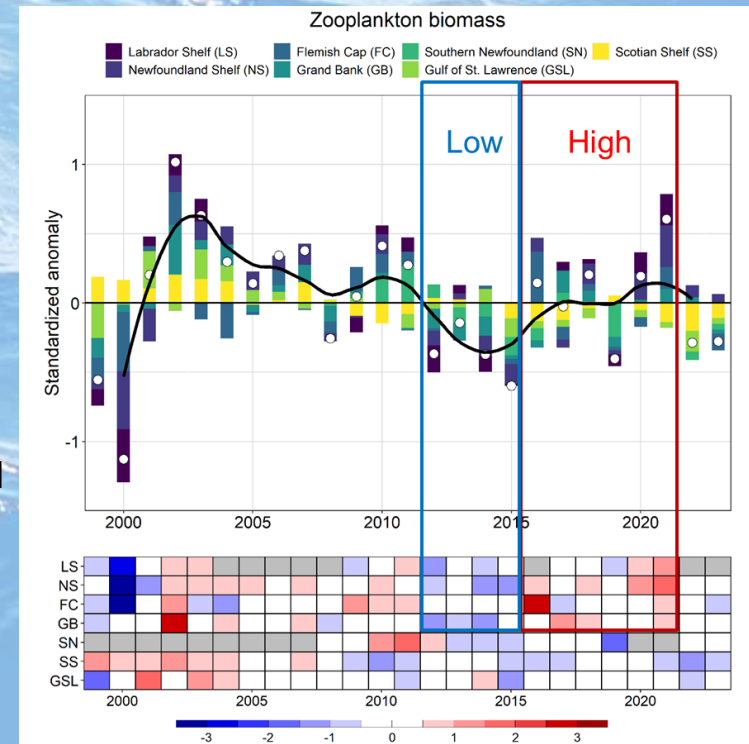


Zooplankton Biomass & Copepod Assemblages

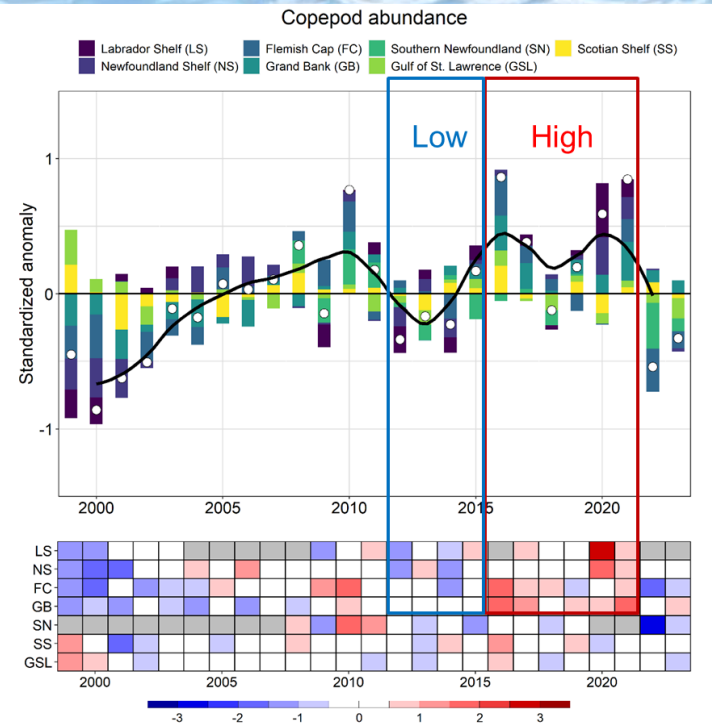


- **Copepods dominate** zooplankton assemblages in the Northwest Atlantic.
- **Large and energy-rich *C. finmarchicus*** copepods dominate zooplankton biomass.
- Smaller but **more abundant *Pseudocalanus* spp.** copepods are an **indicator** of the **abundance of other small taxa**.

- **Increase** in zooplankton biomass from the **Grand Bank** to the north since the mid-2010s.
- Biomass has remained near to below normal on **Scotian Shelf** and **Gulf of St. Lawrence** since the mid-2000s.
- **Small decline** across the zone **over the past 2 years**.

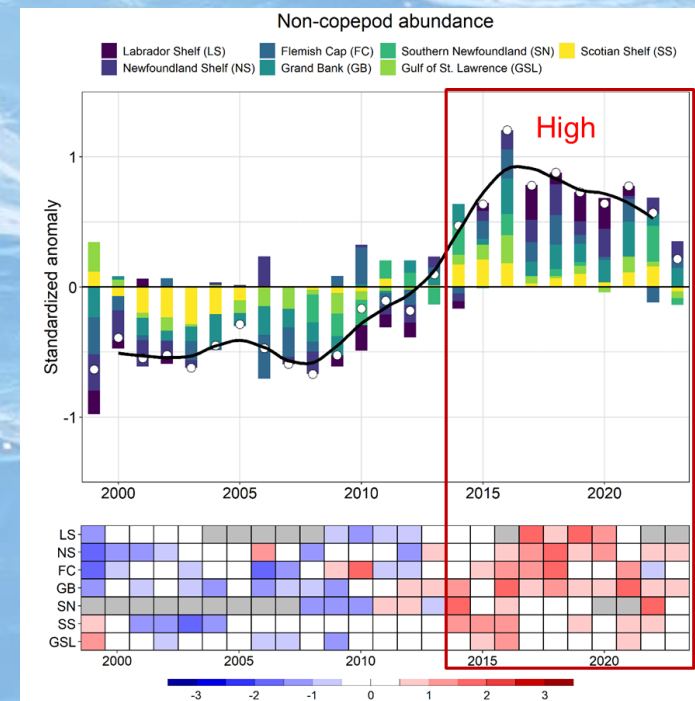


Zooplankton – Copepod & Non-Copepod Abundance

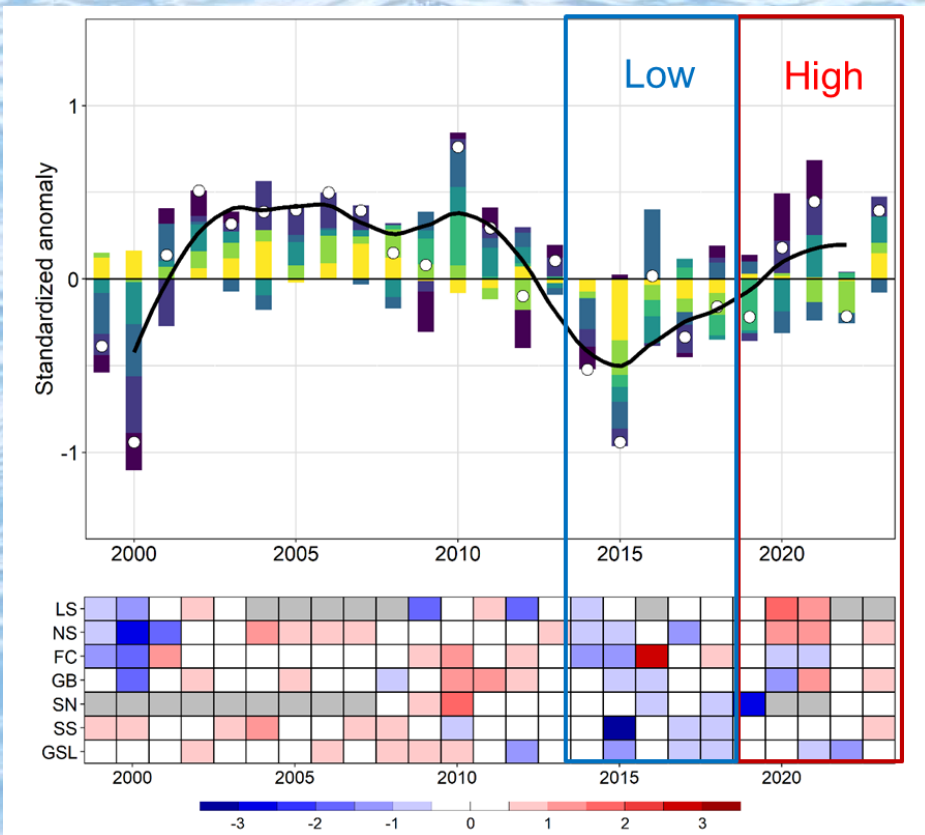


- **Increase** in zooplankton abundance from the **Grand Bank** to the north since the mid-2010s.
- **No clear temporal trends** from the Southern Newfoundland to the **south**.
- Decline in total copepod abundance over the past two year from Grand Bank to the north.
- Two consecutive years of **below-normal** levels on **Southern Newfoundland** and **Flemish Cap**.

- Abundance of non-copepod zooplankton mainly driven by appendicularians (pelagic tunicates) and pteropods (pelagic gastropods).
- **Non-copepod** abundance drastically increase between 2010 and 2015 and has remained primarily **above normal** since the mid-2010s.



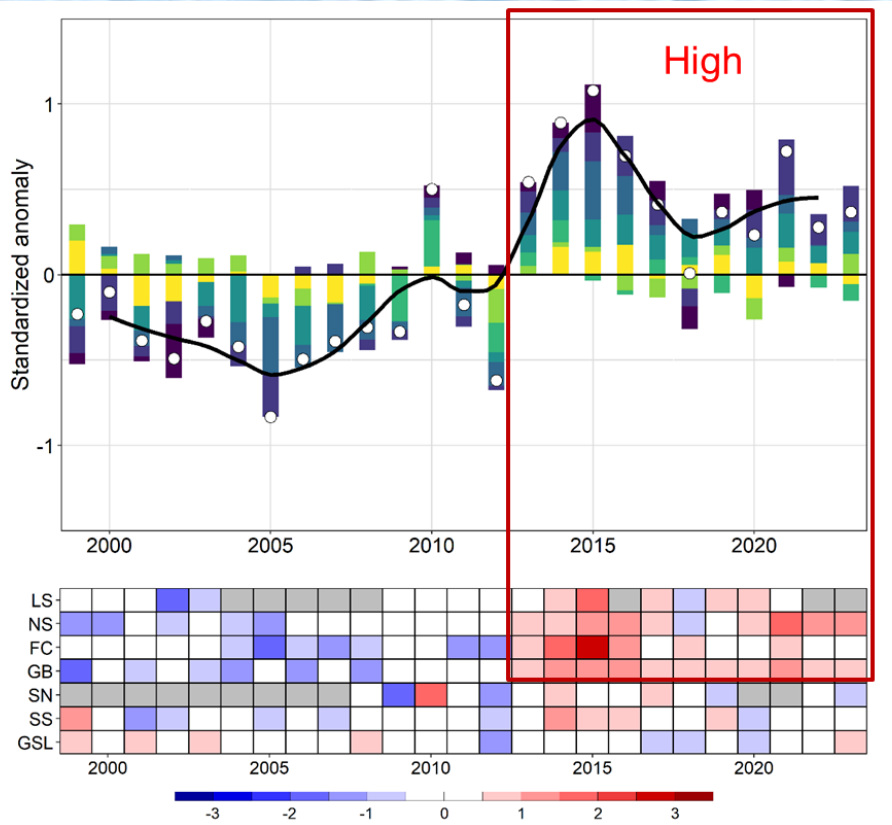
Calanus finmarchicus Abundance



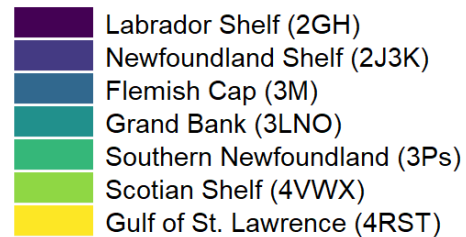
- General **increase** in *C. finmarchicus* abundance since the mid-2010s.
- Mostly near to **above-normal** levels from the **Grand Bank** to the **north** since 2020.
- **2023** was the **first year with no negative anomalies** since 2013.
- **Above-normal** abundance of *C. finmarchicus* on the **Scotian Shelf** for the first time in 15 years.



Pseudocalanus spp. Abundance



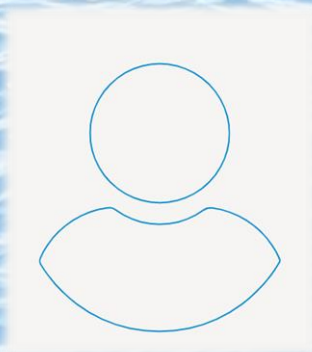
- *Pseudocalanus* spp. abundance has remained mainly **above normal** from the **Grand Bank** to the **north** since 2013.
- **Eleven consecutive years** of **above-normal** abundance on the **Grand Bank**.
- **Above-normal** abundance of *Pseudocalanus* spp. in the **Gulf of St. Lawrence** for the first time in 15 years.



Highlights

- **Distinct trends** in biogeochemical indices between the **north** (Newfoundland and Labrador Region) and the **south** (Gulf of St. Lawrence and Scotian Shelf) .
- **Improved conditions** for the **Newfoundland Region** (increased nitrate, chl *a*, zooplankton biomass and copepod abundance) observed after ~2015 have **slowed down over the past two years**.
- In the **south** (Southern Newfoundland, Gulf of St. Lawrence, and Scotian Shelf), most indices have been **variable** during the same period and have exhibited primarily **near to below-normal conditions** compared to the 1999-2020 climatology.





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Source:

Bélanger, D., G. Maillet, P. Pepin. (2023). Biogeochemical oceanographic conditions in the Northwest Atlantic (NAFO subareas 2-3-4) during 2023, NAFO SCR Doc. 24/011.



Additional information:

Cyr, F., K. Lewis, **D. Bélanger**, P. Regular, S. Clay, E. Devred, (2024). Physical controls and ecological implications of the timing of the spring phytoplankton bloom on the Newfoundland and Labrador shelf. *Limnology and Oceanography Letters* 9:191–198
<https://doi.org/10.1002/lol2.10347>