Pelagic ecosystem productivity and the recruitment of juvenile polar cod *Boreogadus saida* in Canadian Arctic Seas

Mathieu LeBlanc[1*], Maxime Geoffroy[2], Caroline Bouchard[3], Stéphane Gauthier[4] & Louis Fortier[1]

[1]Québec-Océan, Department of Biology, Université Laval
[2]Centre for Fisheries Ecosystems Research, Marine Institute of Memorial University of Newfoundland
[3]Greenland Climate Research Centre, Greenland Institute of Natural Resources
[4]Institute of Ocean Sciences, Fisheries and Oceans Canada
[*]mathieu.leblanc.10@ulaval.ca

Context of the study

- Polar cod (*Boreogadus saida*) is the most abundant pelagic fish in Arctic seas and a staple food for many arctic predators.
- Previous work found that an earlier ice breakup and higher spring-summer sea-surface temperatures result in greater juvenile polar cod biomass and recruitment in the fall by enabling early hatchers to survive and reach a large size by late summer thanks to a long growth season.

Objectives

- Test the prediction that increased juvenile recruitment in years of early ice breakup is correlated to an advanced phytoplankton bloom and the resulting higher availability of mesozooplankton (mesozoo).
- Contrast pelagic ecosystem productivity and the recruitment of juvenile polar cod among three provinces of the Canadian Arctic: Southern Beaufort Sea in the Arctic Ocean Basin proper, the shallow Kitikmeot region in the Central Archipelago, and Northwest Baffin Bay comprising the North Water/Lancaster Sound polynya complex.

Study area

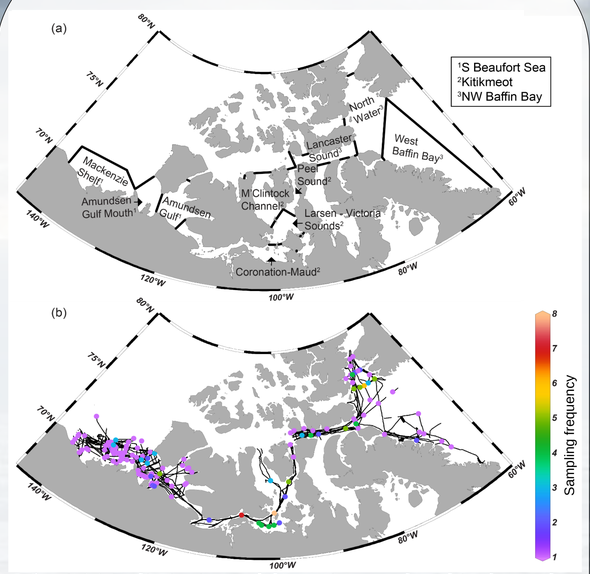


Fig. 1 (a) Delimitations of the regions analysed in the study grouped by oceanographic provinces. **(b)** Hydroacoustic (black lines) and ichthyoplankton (colored dots) sampling from 2006 to 2017.

Materials and methods

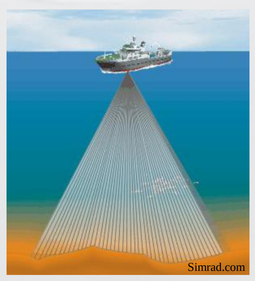
1)

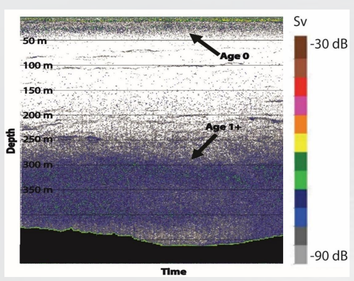
CCGS *Amundsen*

+

F/V *Frosti*

Ichthyoplankton net





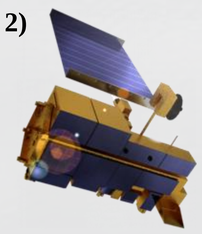
Hull-mounted EK60 echosounder (38 and 120 kHz)

Sampling of epipelagic fish to validate acoustic echoes

Recording of hydroacoustic data

Estimation of mesozooplankton acoustic density and age-0 polar cod biomass

2)



Satellite measurements

Estimation of sea-ice cover and chlorophyll *a* concentration

Results

Fig. 2 Early ice breakup = (a) Early bloom + (b) High Chl. *a*

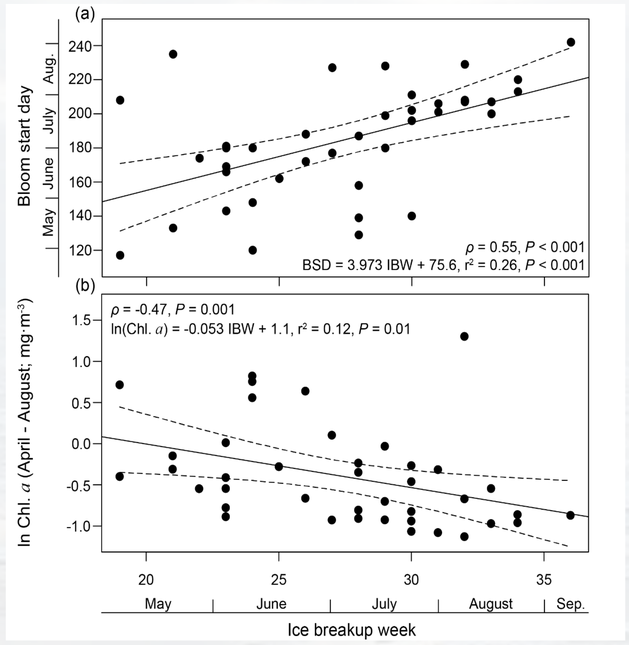


Fig. 5 Similar ecosystem productivity in S Beaufort Sea & NW Baffin Bay; Higher age-0 polar cod biomass in S Beaufort Sea

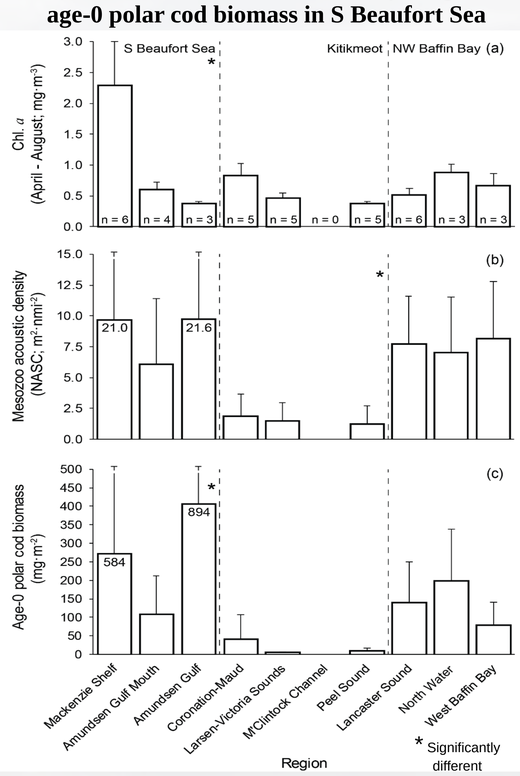


Fig. 3 Early (a) ice breakup + (b) bloom = High mesozooplankton density; (c) High Chl. *a* = High mesozoo density

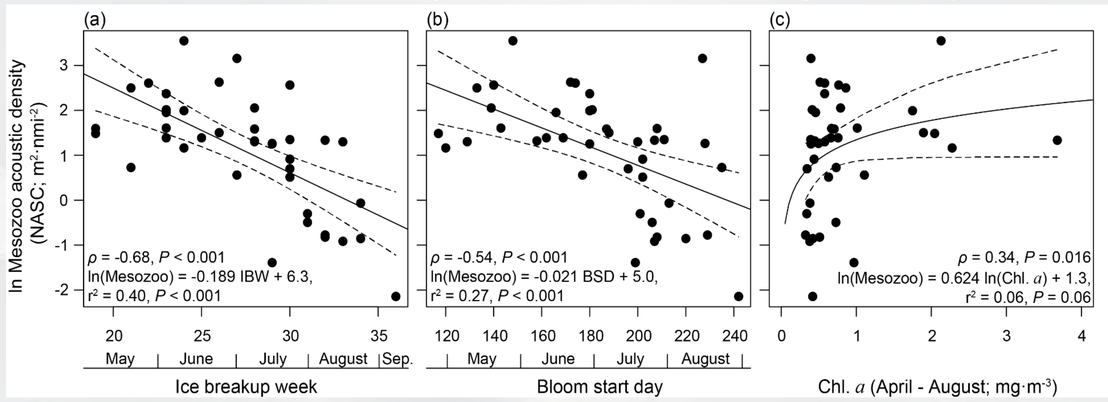
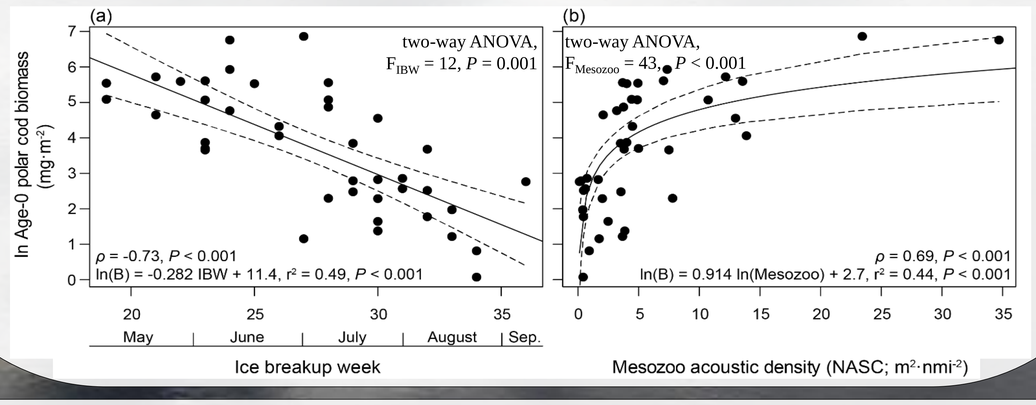


Fig. 4 (a) Early ice breakup = High age-0 polar cod biomass; (b) High mesozoo density = High age-0 polar cod biomass



Conclusions

- Early ice breakups in Canadian Arctic seas led to advanced phytoplankton blooms and higher ecosystem productivity.
- Mesozooplankton density was the main determinant of juvenile polar cod recruitment, indicating that food availability, more so than abiotic factors, promotes the growth and survival of age-0 fish in years of early ice breakup.
- Ecosystem productivity (Chl. *a* + mesozooplankton) was similar in the southern Beaufort Sea and the North Water/ Lancaster Sound polynya complex (in NW Baffin Bay), but juvenile polar cod biomass was higher in the Beaufort Sea. Intense avian predation could explain the lower biomass of juvenile cod in the polynya complex, confirming its reputation as a biological hotspot for the transfer of energy to higher trophic levels.

Acknowledgements

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