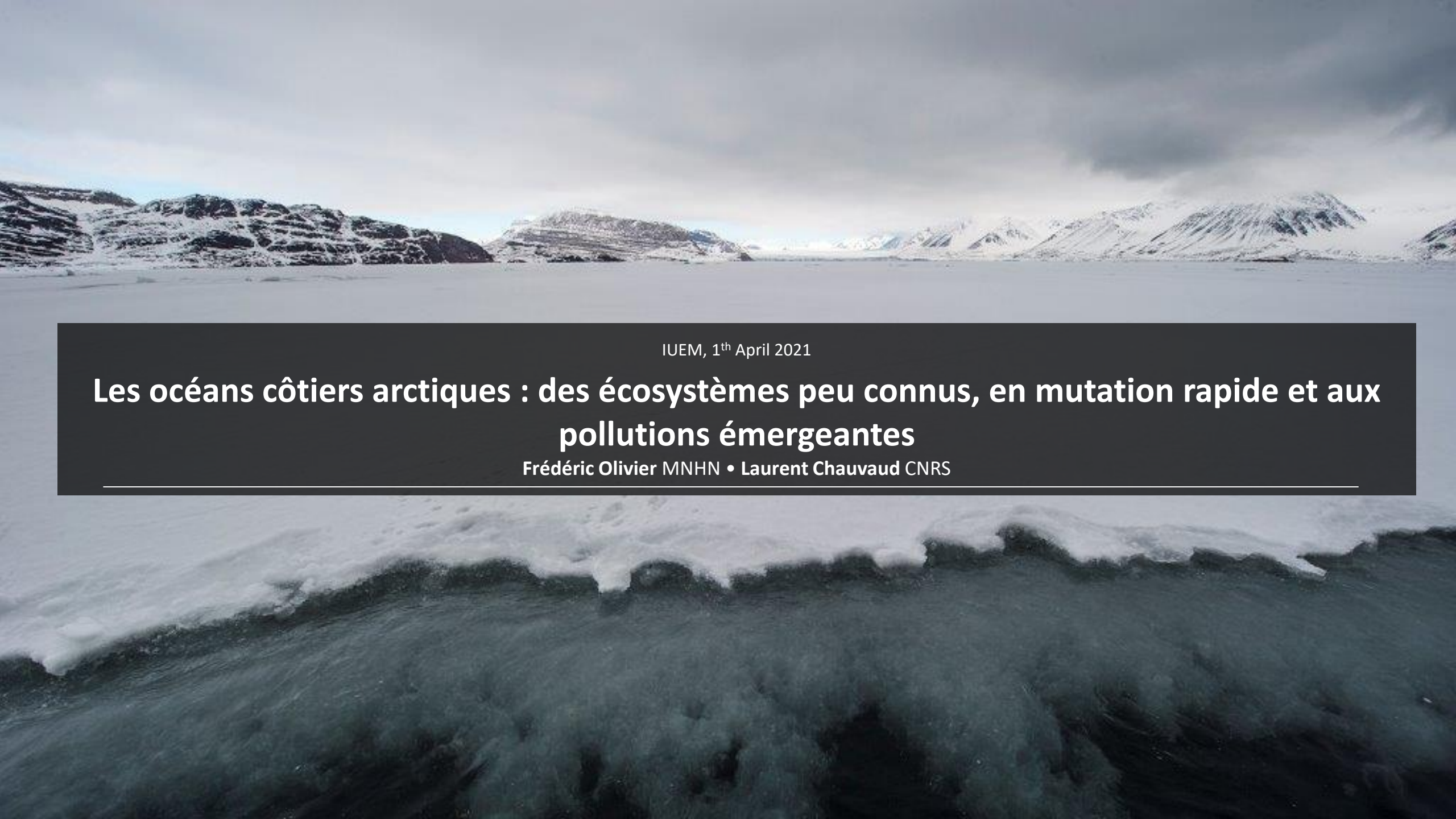
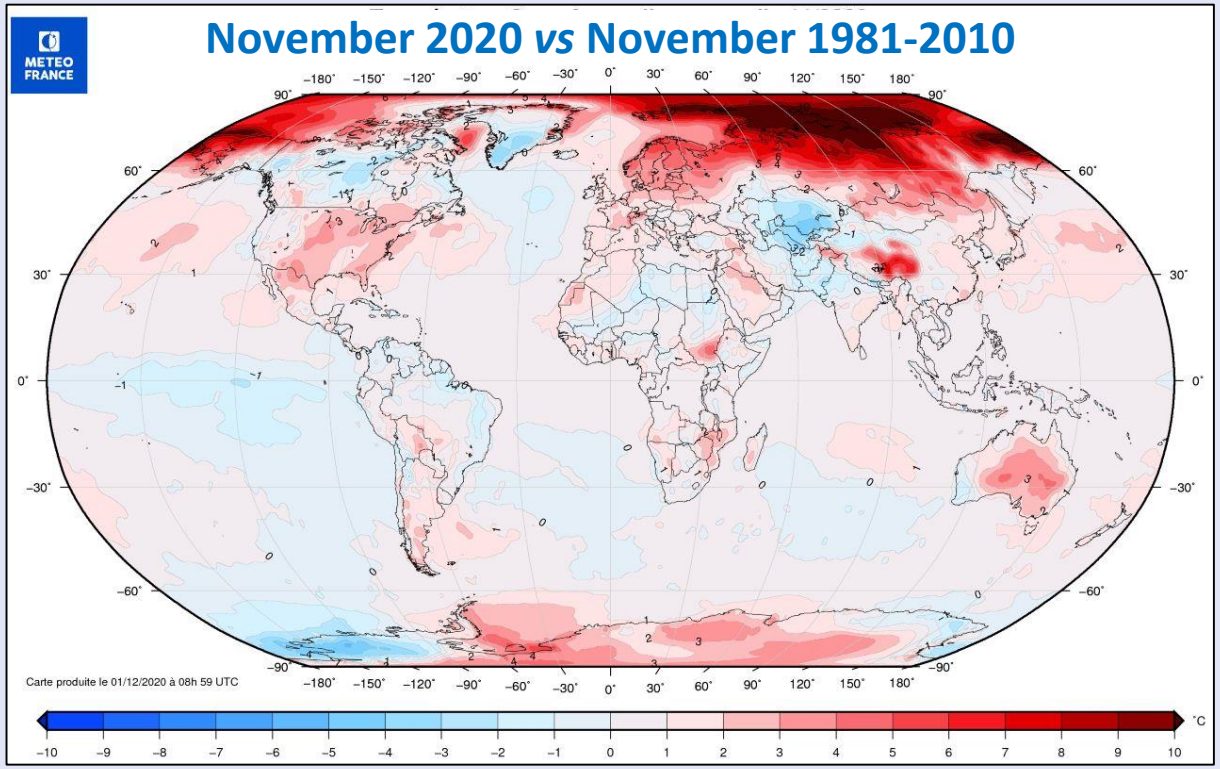


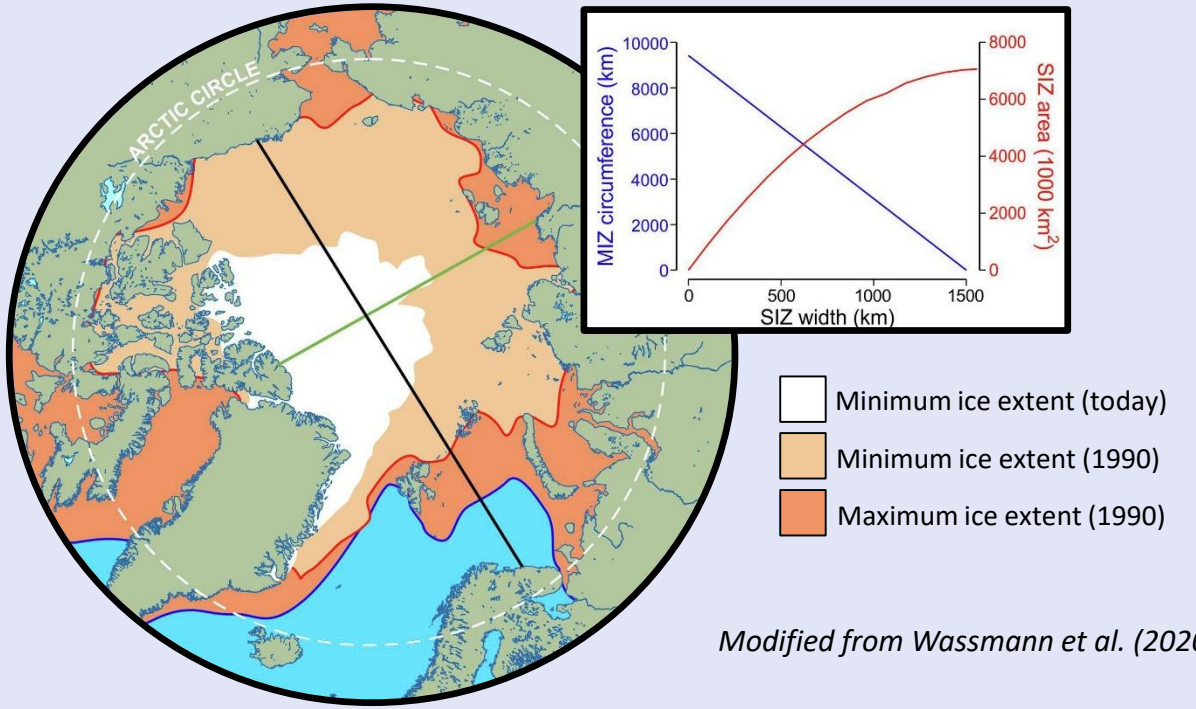
IUEM, 1th April 2021

Les océans côtiers arctiques : des écosystèmes peu connus, en mutation rapide et aux pollutions émergeantes

Frédéric Olivier MNHN • **Laurent Chauvaud** CNRS

Introduction – Climate change

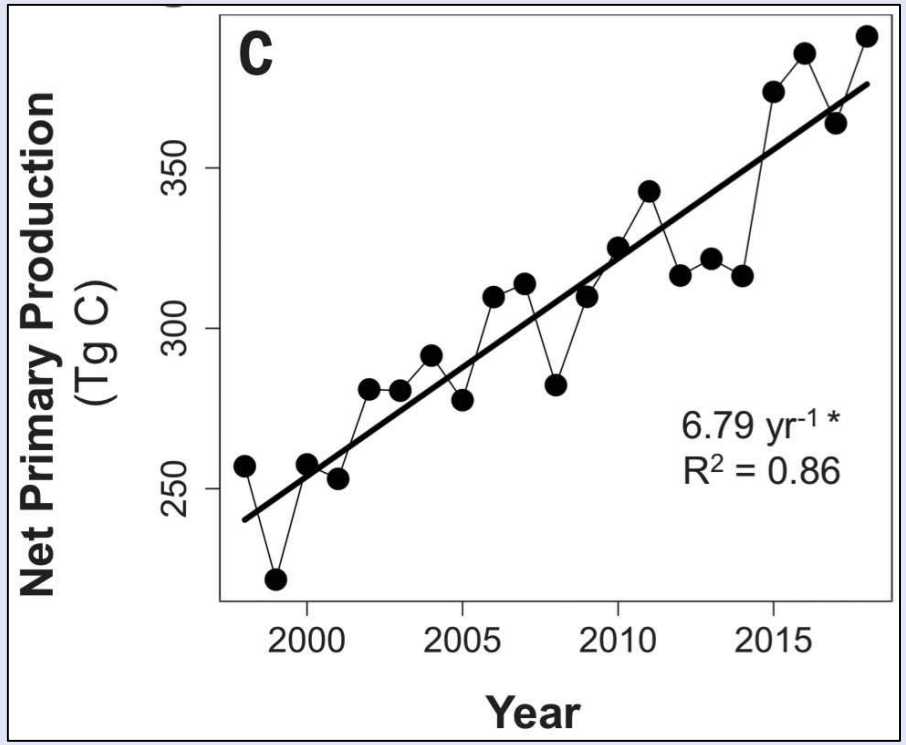




Modified from Wassmann et al. (2020)

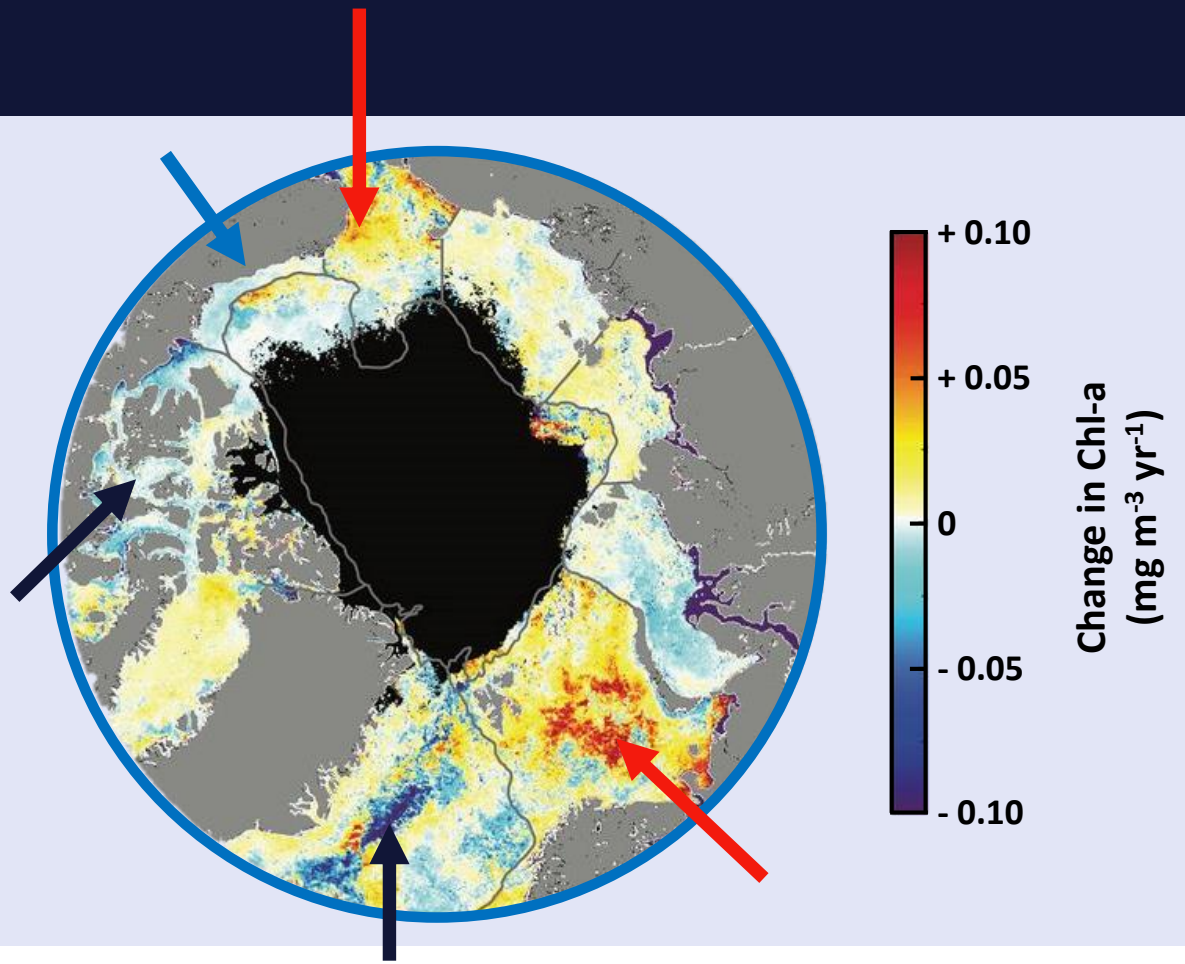
- Warming of atmospheric temperatures **2-3 times higher than the global average**
- Strong decrease in sea ice extent (i.e. summer sea ice has decreased by **– 40% since the 1970s**)
- Numerous other environmental changes: → increases in freshwater inputs
  → increases in seawater stratification
  → local increases in horizontal advection

Evolution of Primary Production



From Lewis et al. (2020)

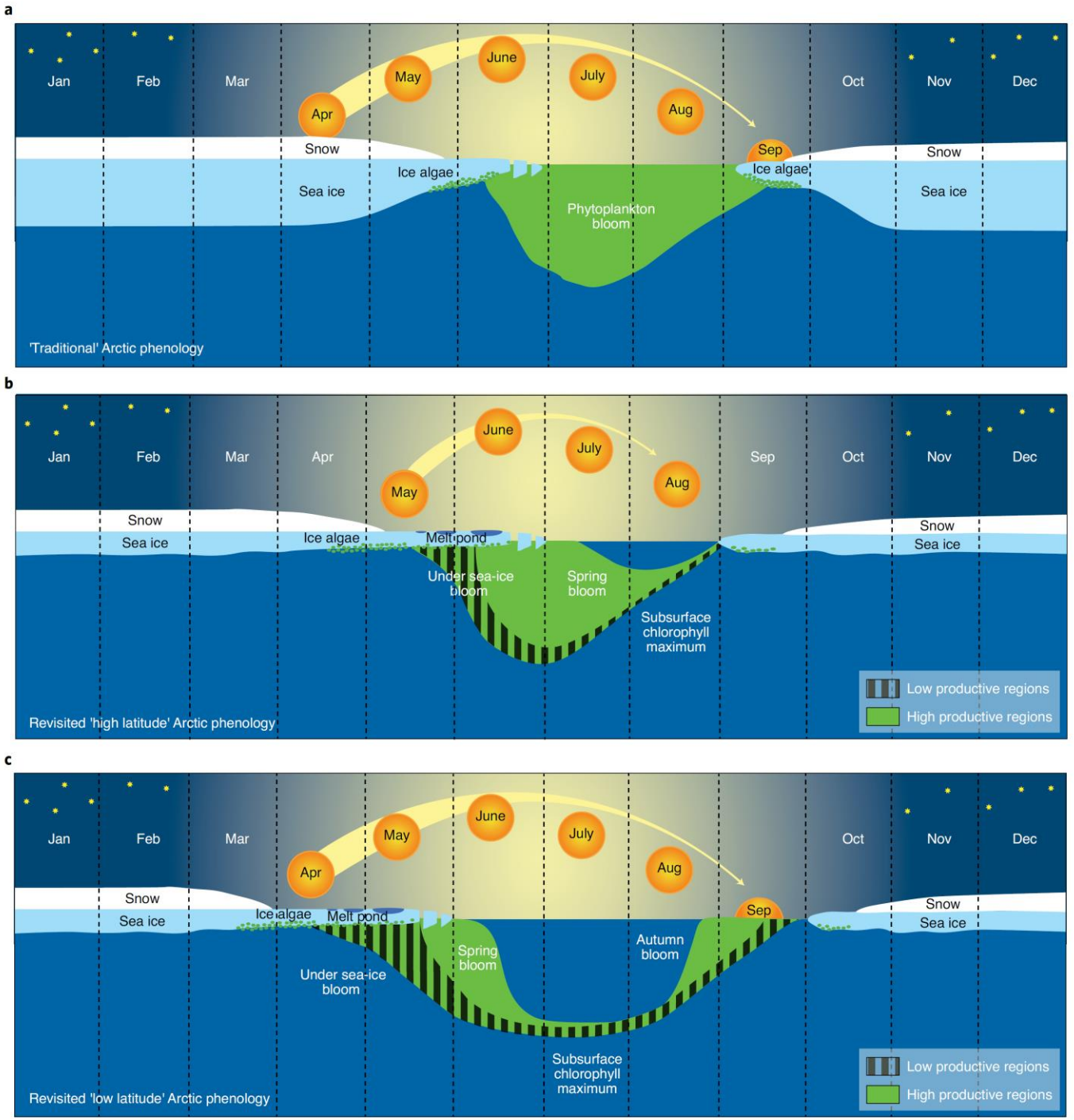
+ 57 %



- Overall increase in pelagic primary production of **+ 57% since the 2000s**

- Such a trend hide high variable evolutions at the regional scale
  - → **Strong increases** in pelagic PP in **inflows shelves** (Chukchi & Barents seas)
  - → **Slow increases** in pelagic PP in **interior shelves**
  - → **Stable** or even **slight decrease** in pelagic PP in **outflows shelves** (Canadian Arctic Archipelago & East Greenland Shelf)

→ Reflect complex interactions between several environmental factors



PHILOSOPHICAL TRANSACTIONS A

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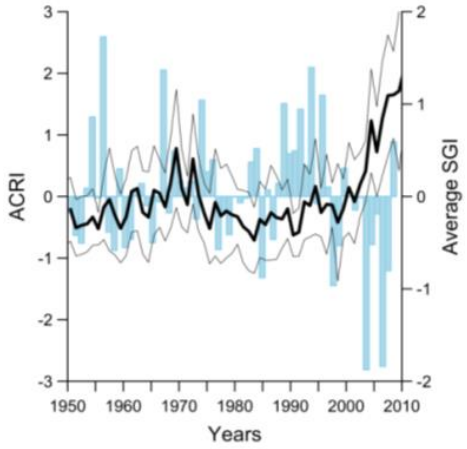
Research

Check for updates

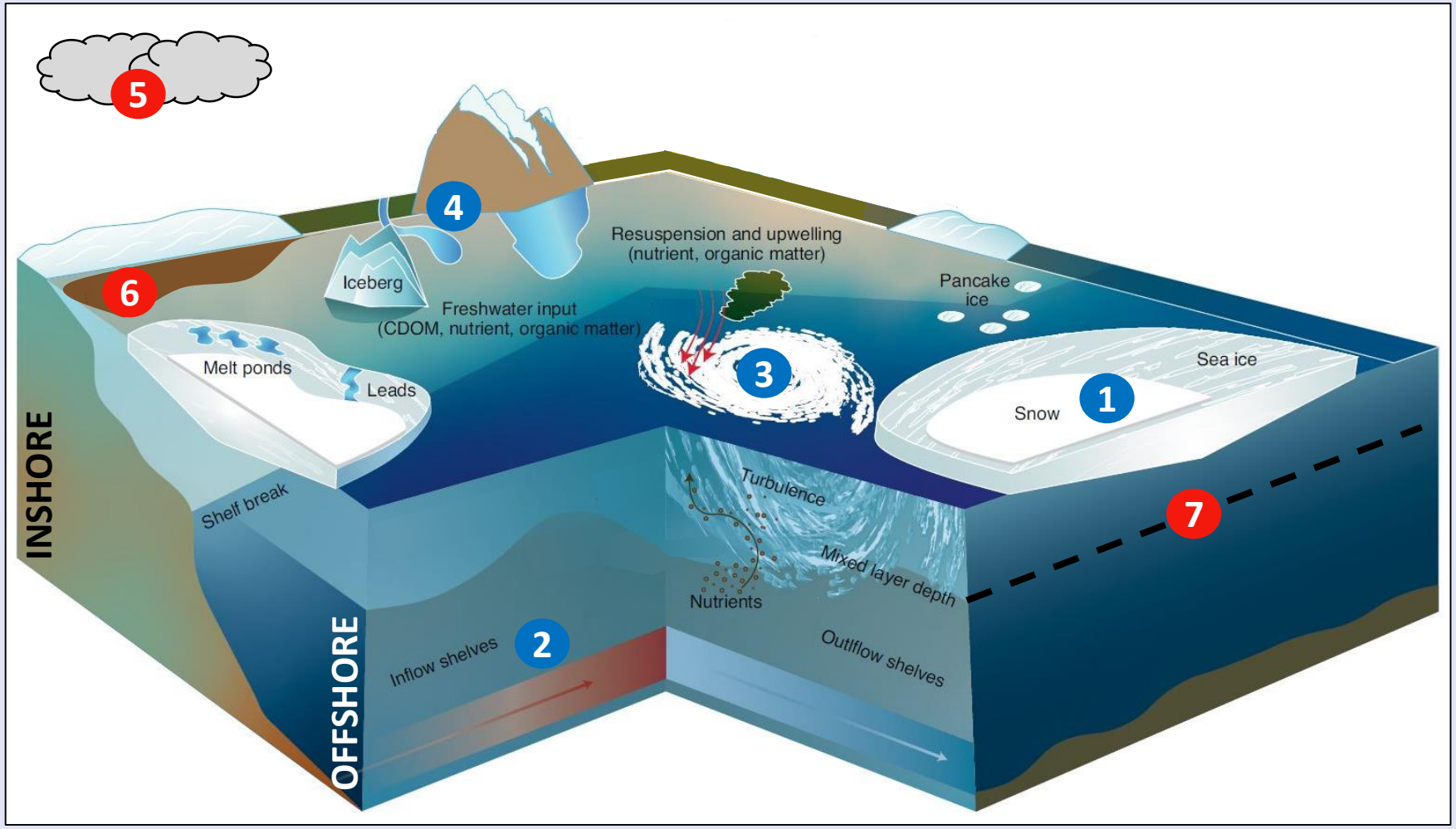
Cite this article: Olivier F *et al.* 2020 Shells of the bivalve *Astarte moerchi* give new evidence

Shells of the bivalve *Astarte moerchi* give new evidence of a strong pelagic-benthic coupling shift occurring since the late 1970s in the North Water polynya



Ardyna and Arrigo, 2020

Factors controlling primary production



From Ardyna & Arrigo (2020)

Positive factors

1. Sea-ice extent retreat
2. Horizontal advection
3. Storm frequency
4. Nutrient river inputs

Negative factors

5. Cloudiness
6. Turbidity
7. Stratification

Arctic/sub-Arctic marine biodiversity

Ursus maritimus
© Stuart Thomson

Odobenus rosmarus rosmarus
© Erwan Amice

Delphinapterus leucas
© National Geographic

Monodon monoceros
© National Geographic

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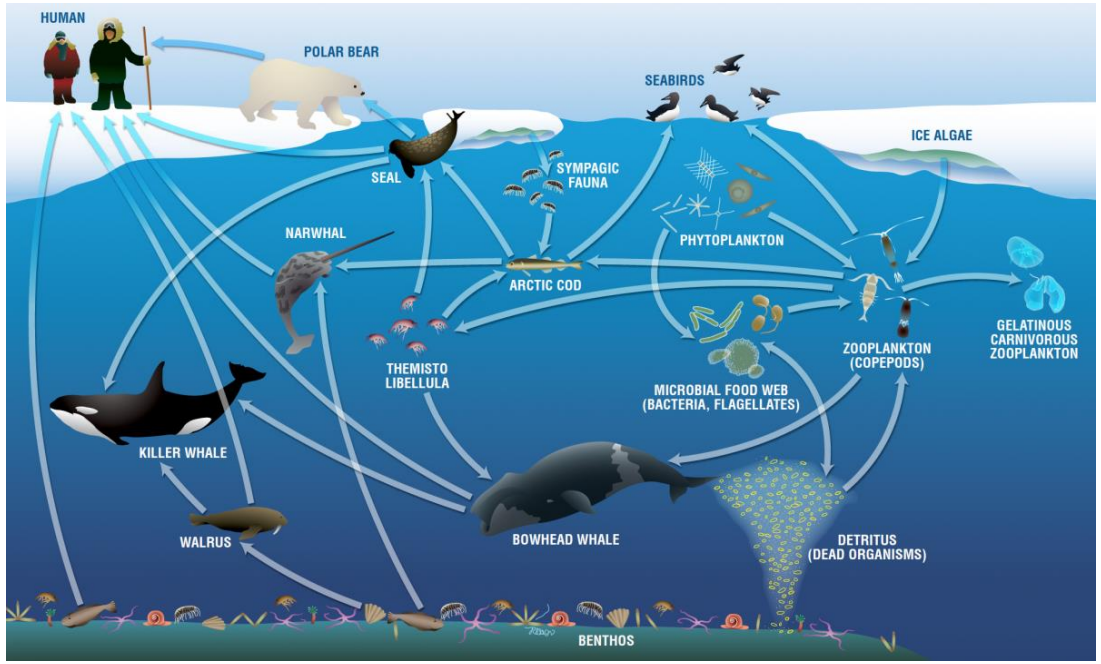

Arctic/sub-Arctic marine biodiversity

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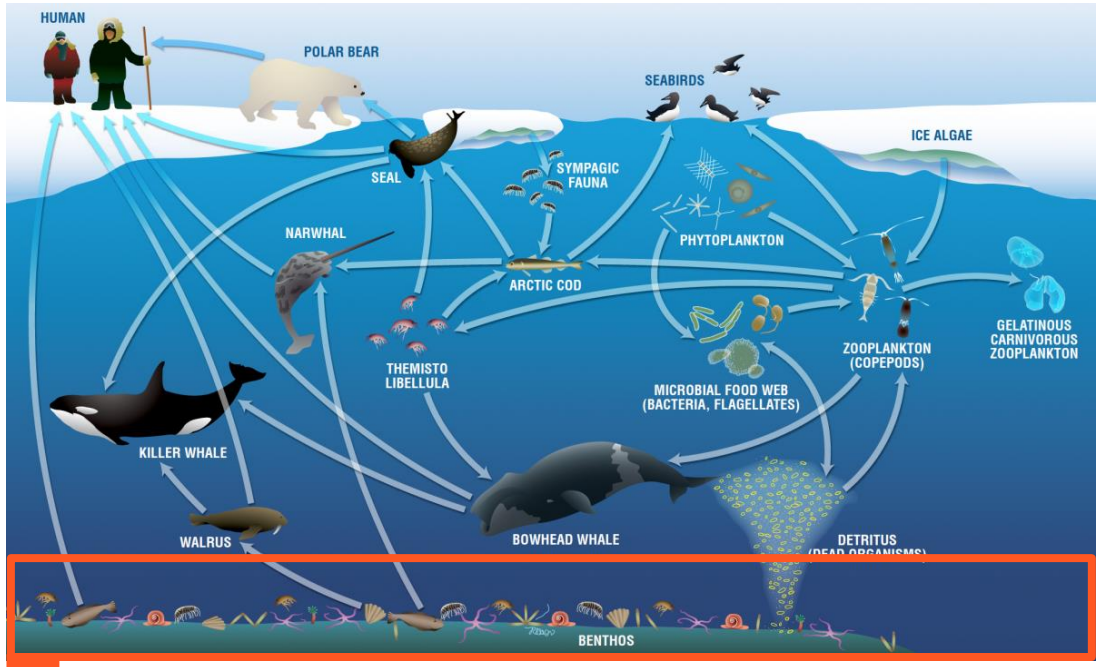


> 90 % of all Arctic invertebrate species are benthic

Some common benthic species:

Ophiocten sericeum — **Echinoderms**

Diastylis goodsiri — **Arthropods**

Astarte montagui — **Mollusks**

Eteone Longa — **Annelida**

Arctic/sub-Arctic benthic ecosystems

Erwan AMICE © CNRS

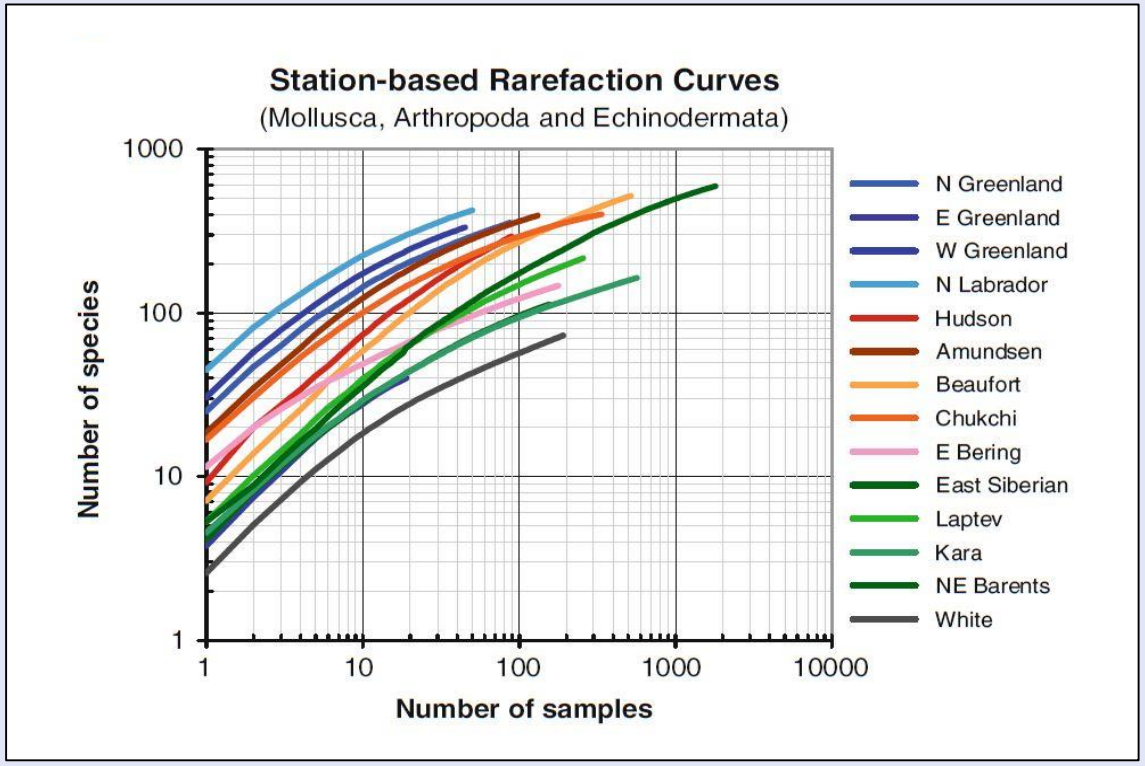
Arctic benthic biodiversity

- Long-living species (several centuries)
- Slow-growing species
- Reproduction tightly synchronized with prim. prod. seasonality

→ **Highly sensitive to any environmental disturbances**

Introduction – Arctic/sub-Arctic benthic ecosystems

Erwan AMICE © CNRS



Piepenburg et al. (2011)

Arctic benthic biodiversity

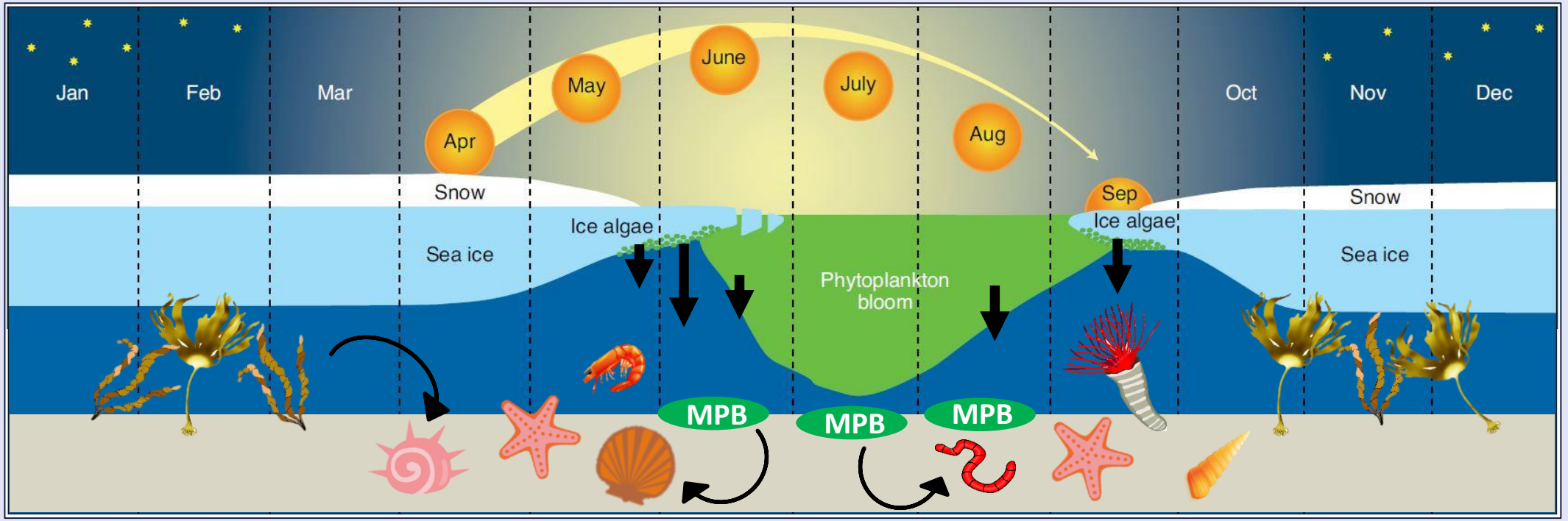
- Long-living species (several centuries)
- Slow-growing species
- Reproduction tightly synchronized with prim. prod. seasonality

→ **Highly sensitive to any environmental disturbances**

Arctic benthic biodiversity

- Benthic biodiversity is still poorly known
- Most species-rich taxa: Arthropods, Echinoderms & Mollusks
- Most biomass dominant-phyla: Arthropods & Mollusks
- No particular endemism (≠ Antarctica)

Introduction – Pelagic-benthic coupling



From Ardyna & Arrigo (2020)

**MPB = Microphytobenthos*

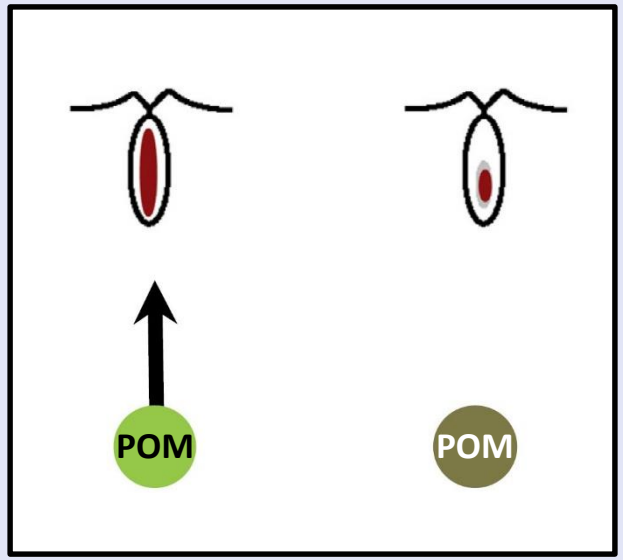
- **Arctic**: Highly-seasonal production of phytoplankton and ice-algae (sometimes < 2-3 months year)
- **Sub-Arctic**: Seasonal production of phytoplankton

- Tight pelagic-benthic coupling on Arctic shelves
  - → Shallow depths
  - → Low grazing pressure
  - → Ice-algae

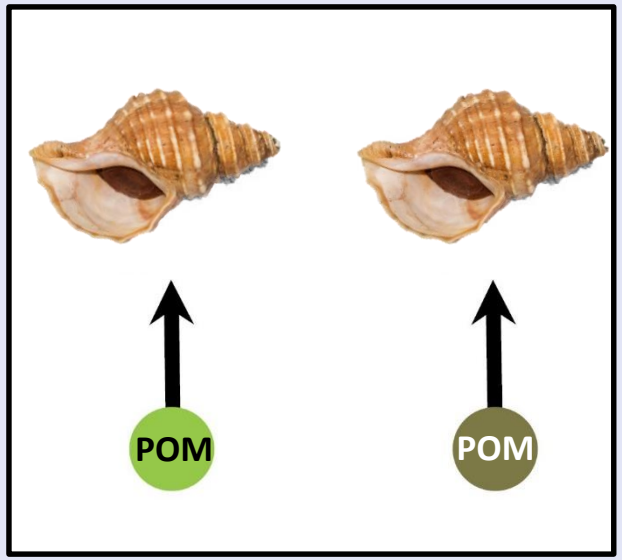
- Benthic primary production in shallow coastal areas (i.e. < 30 m)

Trophic strategies

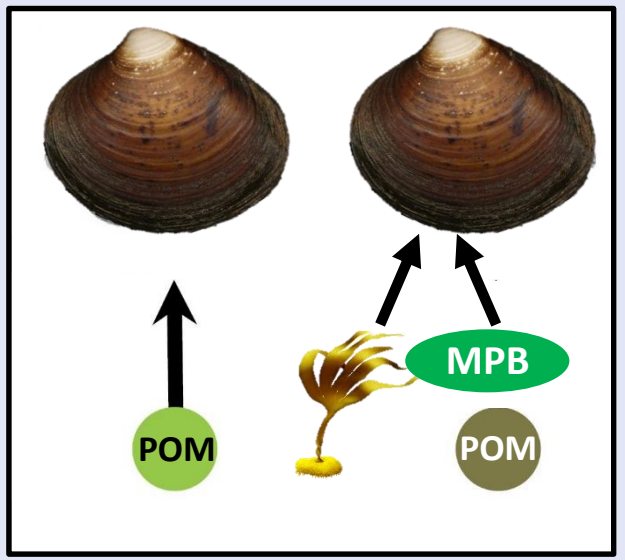
Feeding interruption



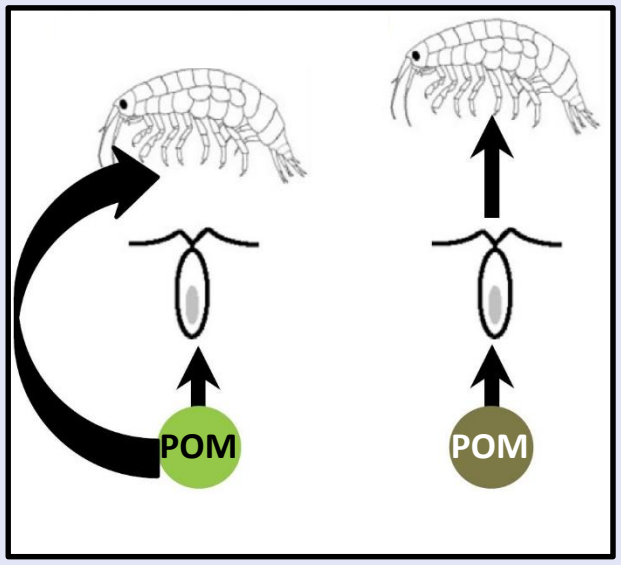
Detritus-based diet



Trophic plasticity



Omnivory



Modified from McMeans et al. (2020)

Good trophic conditions

Poor trophic conditions

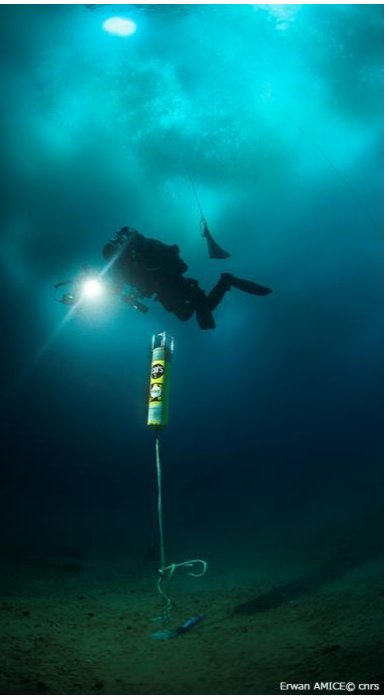
- **Feeding interruption**: Some species stop their feeding activities when they experience poor trophic conditions
- **Detritus**: Some species assimilate any food sources, regardless of their quality
- **Trophic plasticity**: Some species switch their diet from phytoplankton to more abundant/bioavailable food sources
- **Omnivory**: Some species feed omnivorously on primary producers or primary consumers, depending on their relative abundances


Erwan AMICE© cnrs Spitzberg 2018

…introduction d’espèces

Pollutions émergeantes (plastiques, bruit,…)

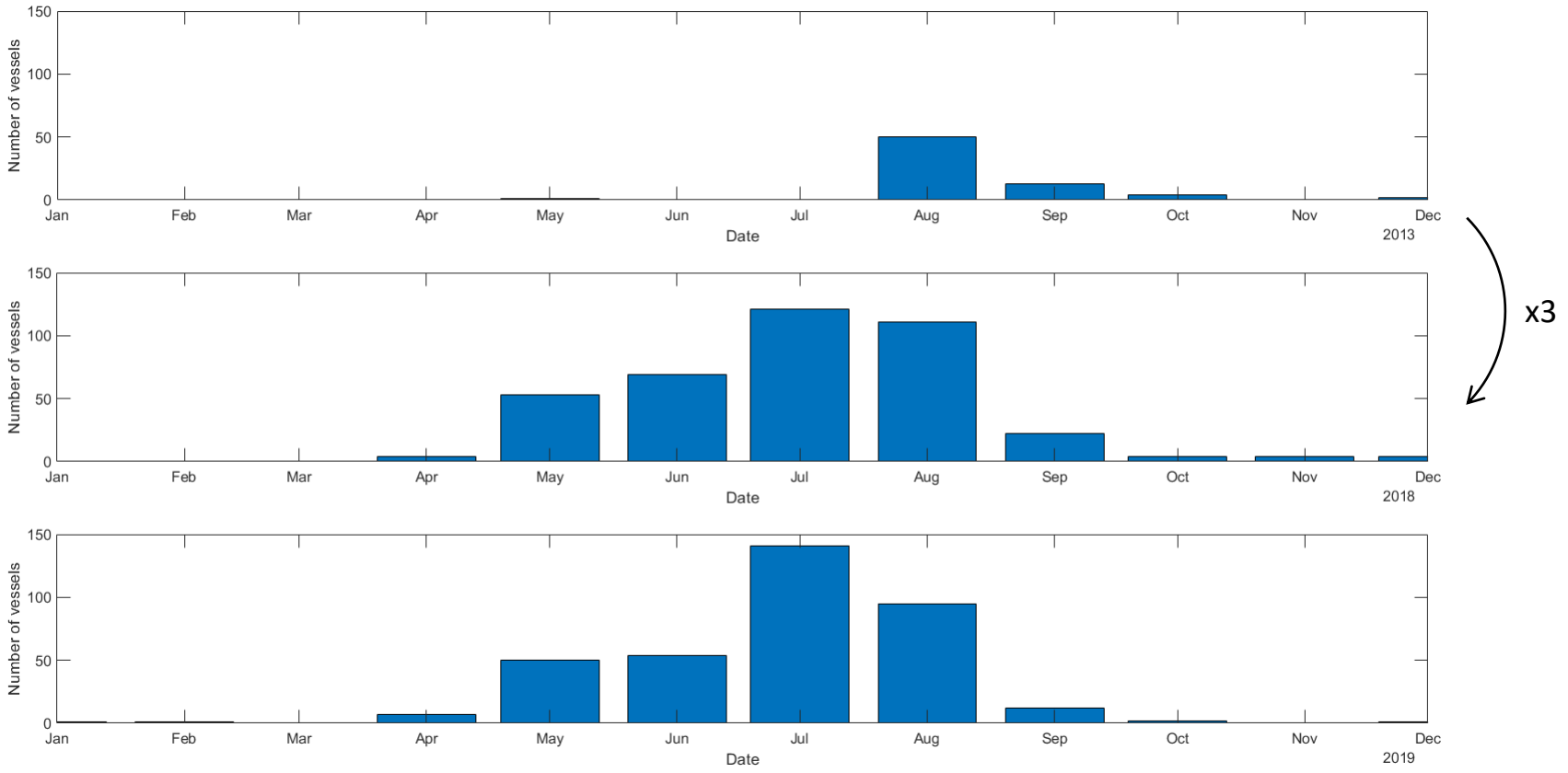
Déploiements acoustiques à long terme: surveiller l'évolution de la pression antropique et développer des outils pour monitorer l'impact du bruit anthropique sur la faune marine.



2013

2018

2019



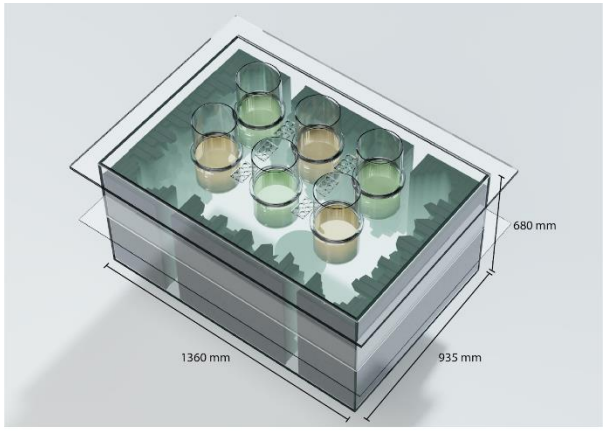
Augmentation du trafic des navires de croisière à Ny-Alesund entre 2013 et 2018

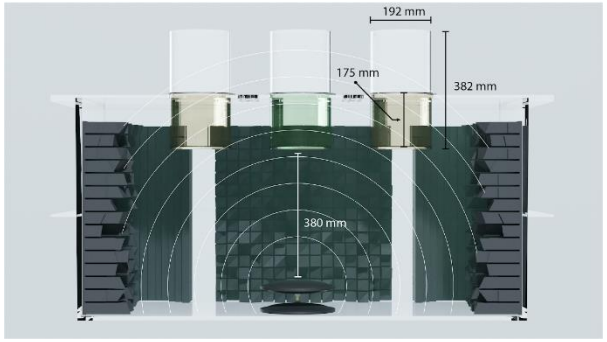
INTAROS

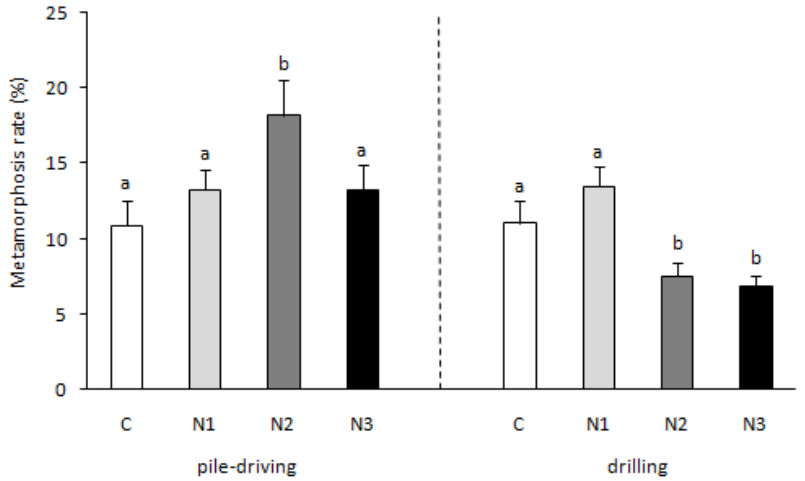
Projet IMPAIC impact des sons anthropiques sur le recrutement des coquilles St-Jacques *(Thèse CNRS/UBO, M. Gigot)*

Approche expérimentale Larvosonic:

Battage de pieux et forage







Le taux de métamorphose des larves est modulé par la nature et le niveau des sons anthropiques !

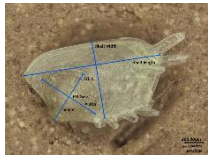
Pecten rade de Brest habitués à l'anthropophonie,

quid des *Hiatella* et autres espèces polaires vivant dans le silence d'un fjord protégé des icebergs?

Projet PRIVARC (IPEV): recrutement en zone polaire très mal connu:

Veillard, Tremblay, Sejr, Chauvaud, Cam, Olivier soumis Ecology

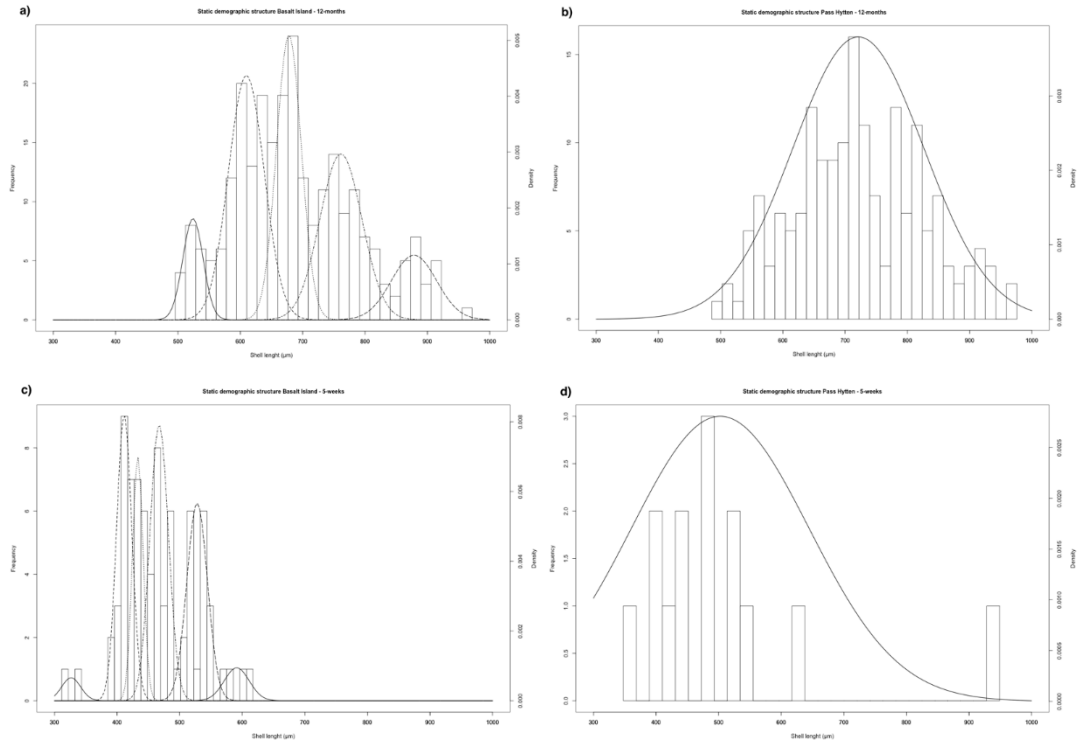
Hiatella arctica proie préférée du morse:



Milieu du fjord YS ***Fond du fjord YS***

12 months

5 weeks



1) Recrutement plus intense au centre du fjord avec 5 vagues de pontes après la débâcle ;

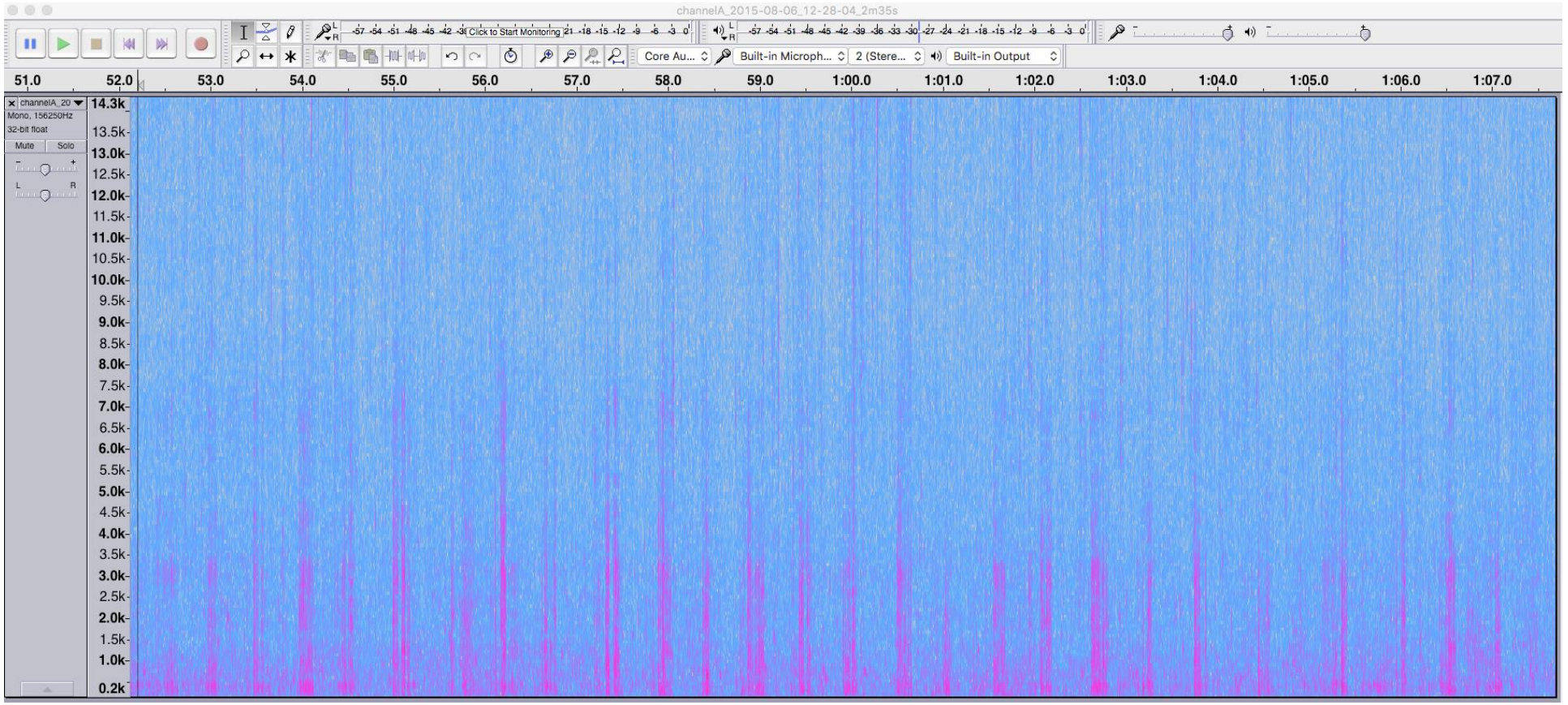
2) Meilleure croissance pour la première cohorte synchronisée aux blooms de microalgues ;

3) Contraste avec le fond du fjord : très faible recrutement et migrations secondaires supposées (dérive dans l'eau des juvéniles) ;

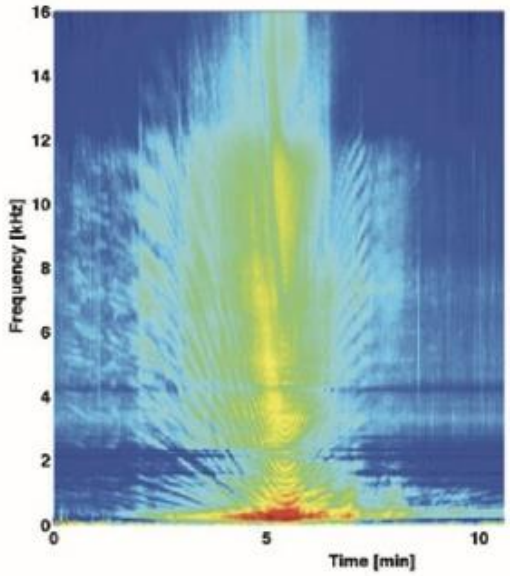
4) Analyses génétique des *Hiatella* entre Brest et le Groenland : Master 2 IUEM/UBO F. Cornet (G. Charrier/ F. Olivier / J. Grall)

Groenland

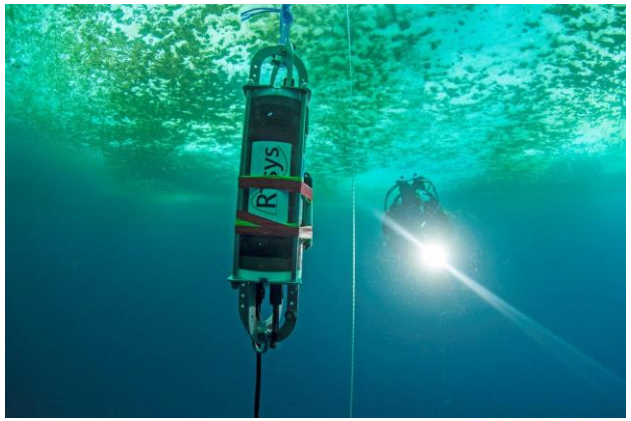
- **Morse – bruit d’alimentation**



Projet AUDITIF (ANR/FRQ) impact du trafic maritime sur les invertébrés marins : quid des zones polaires (Svalbard, passages du NW et NE…)



OBAMA à DDU



Thank you for your attention!