

Calanus species in the Arctic
Mediterranean: from life history to
ecosystem dynamics

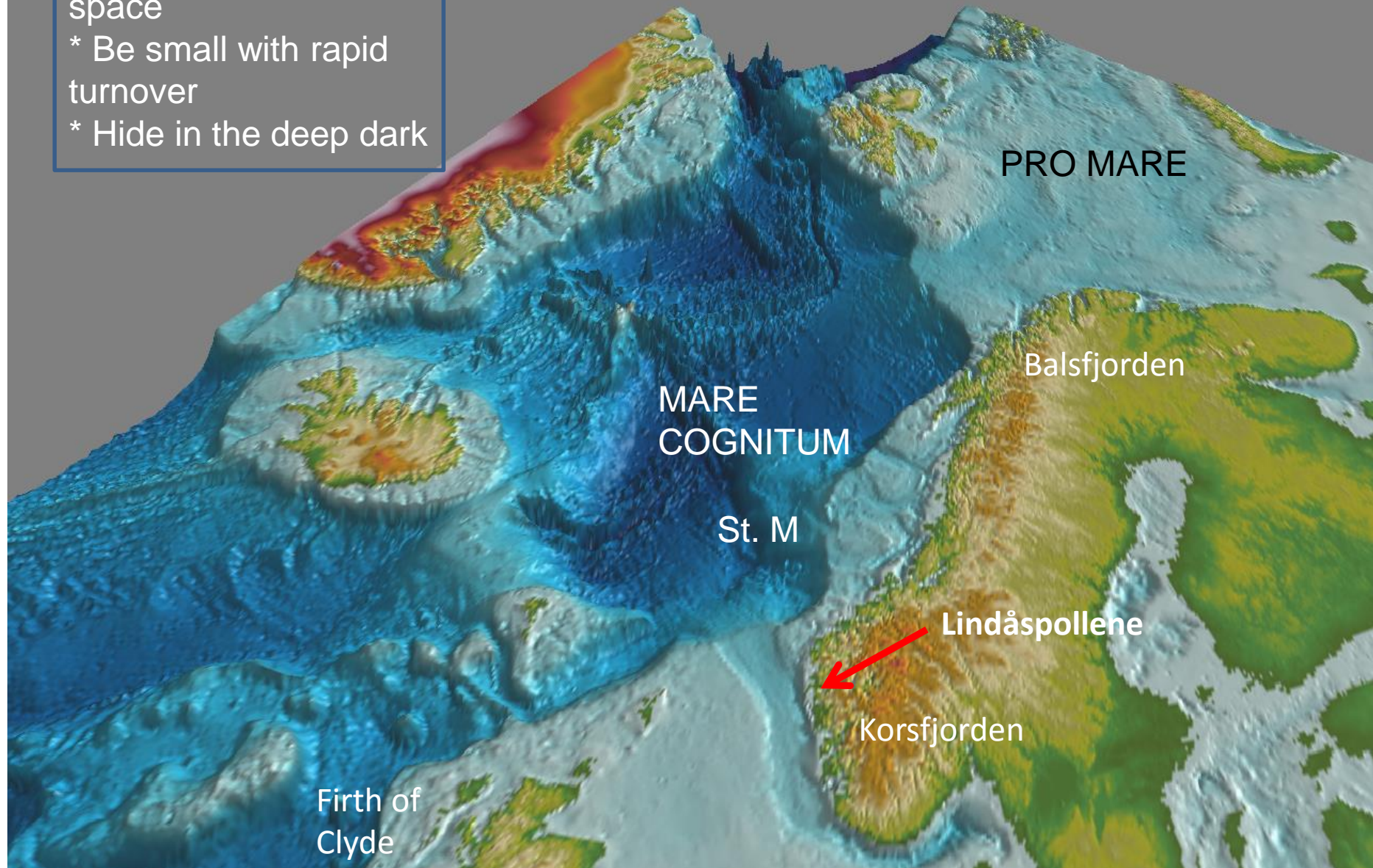
Hein Rune Skjoldal

Institute of Marine Research,
Bergen, Norway

Outline

- Preludium – looking back
- Main part
 - Three *Calanus* species – *finmarchicus*, *glacialis*, *hyperboreus*- Life history features
 - Habitat characteristics – Nordic Seas and Arctic Ocean
 - Ecosystem dynamics – Barents Sea and Norwegian Sea LMEs
- Epilogue – some concluding remarks

Life in pelagial – open space
* Be small with rapid turnover
* Hide in the deep dark



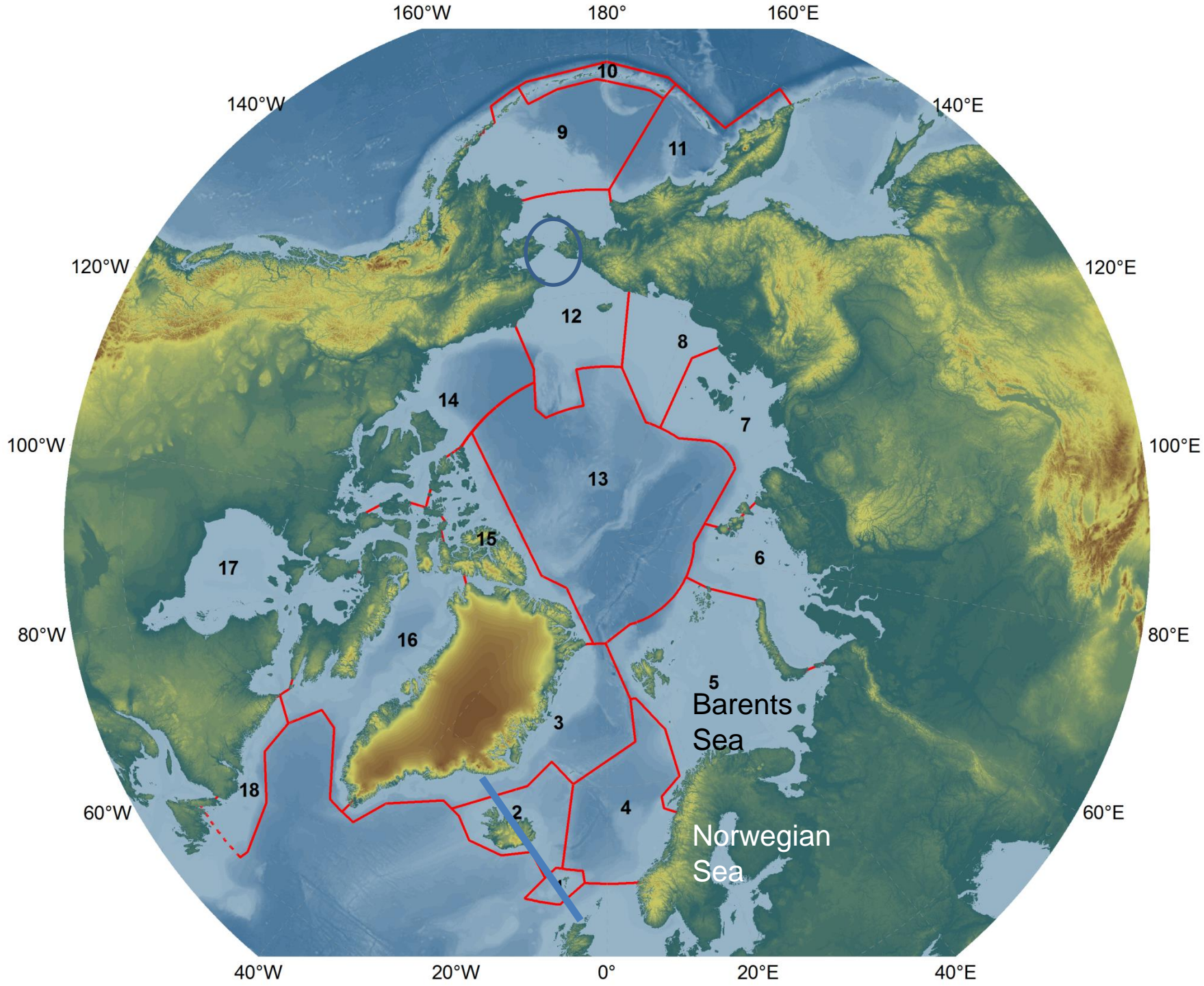
Hein Rune Skjoldal (Ed.)

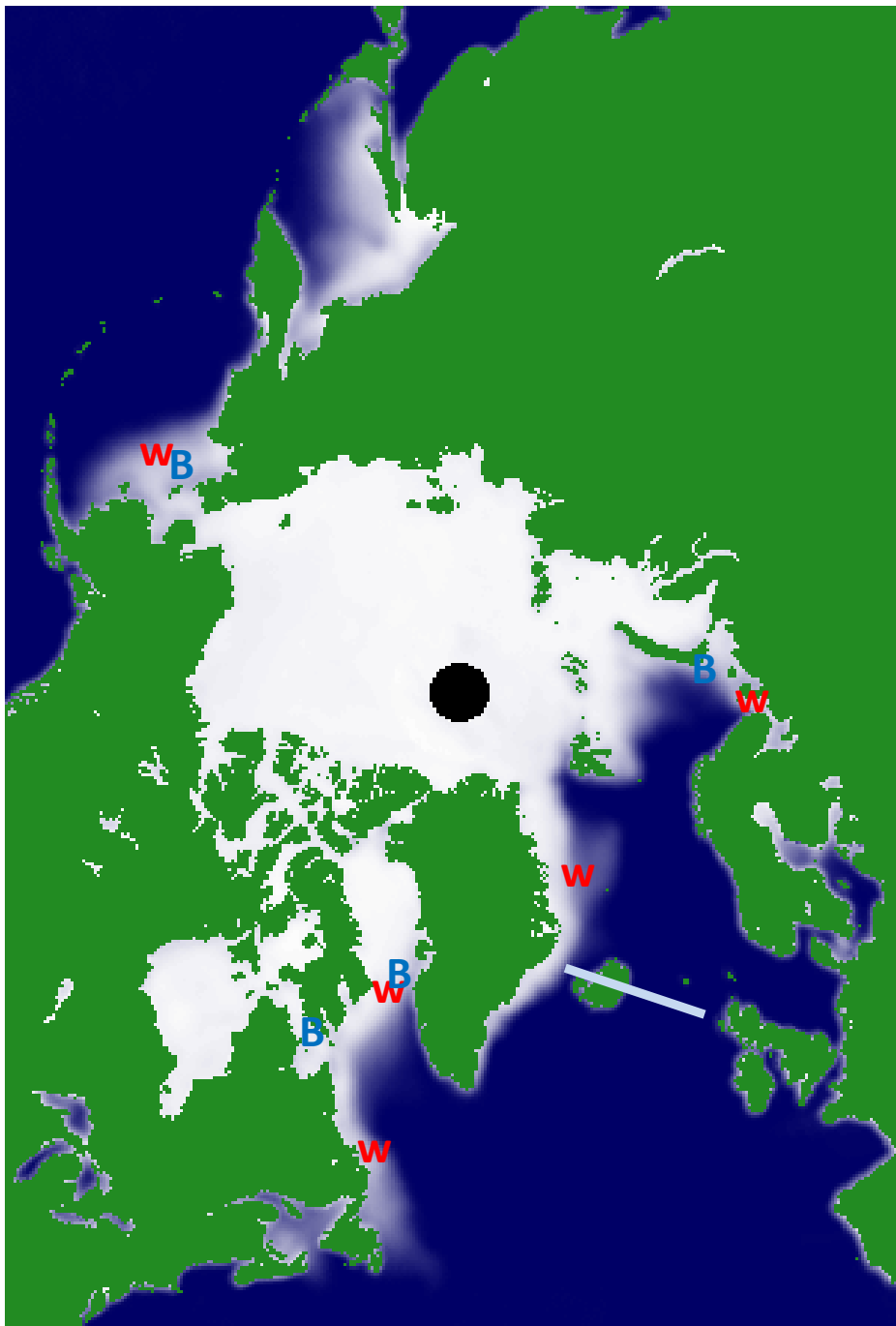
The Norwegian Sea Ecosystem



INSTITUTE OF MARINE RESEARCH

tapir academic press



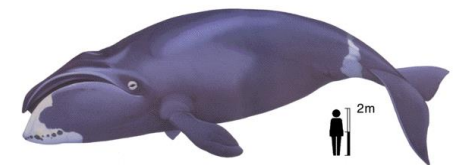


W - Whelping
area seals



Harp Seal *Phoca groenlandica* 1.6-1.7 m

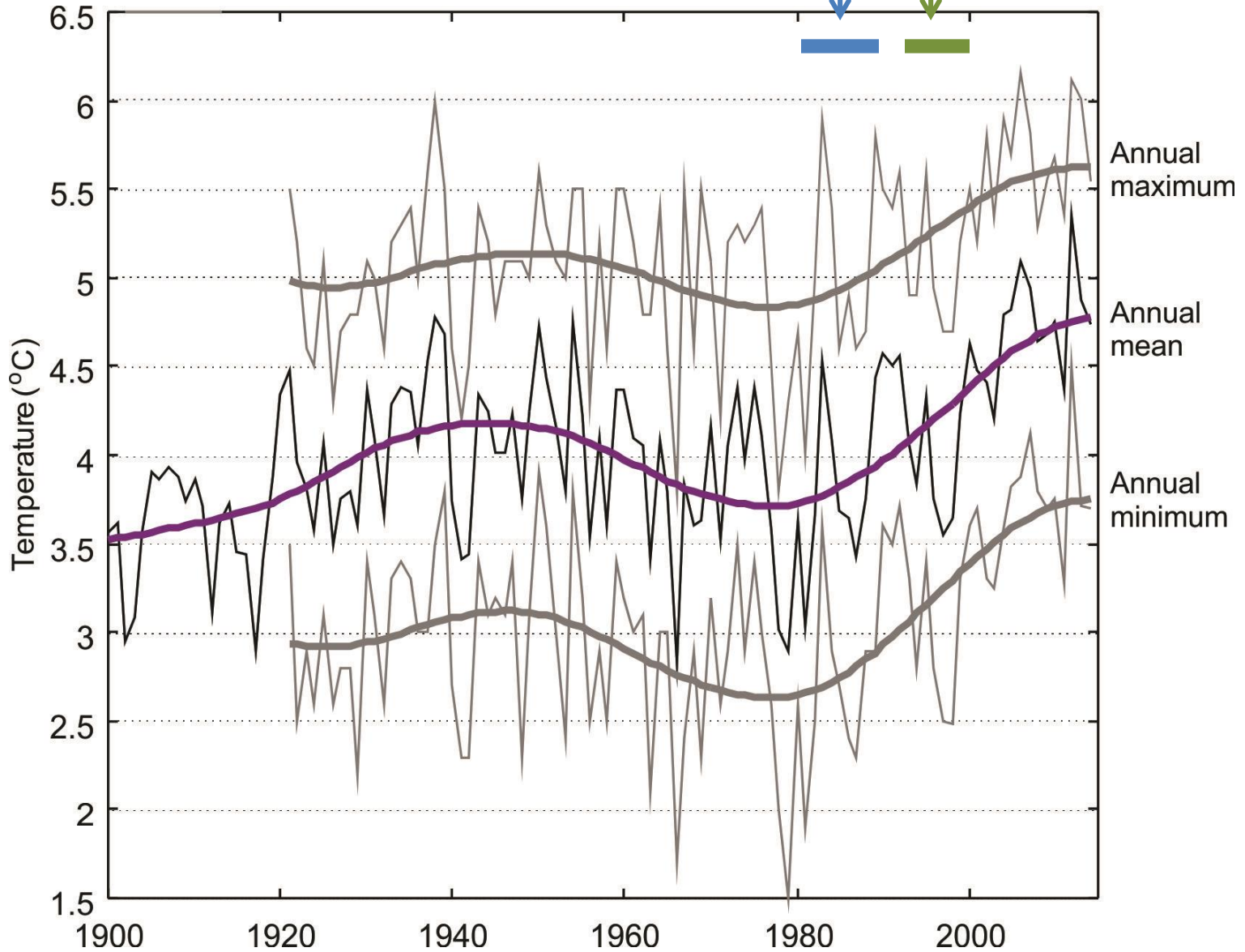
B – Wintering
area Bowhead
and/or beluga

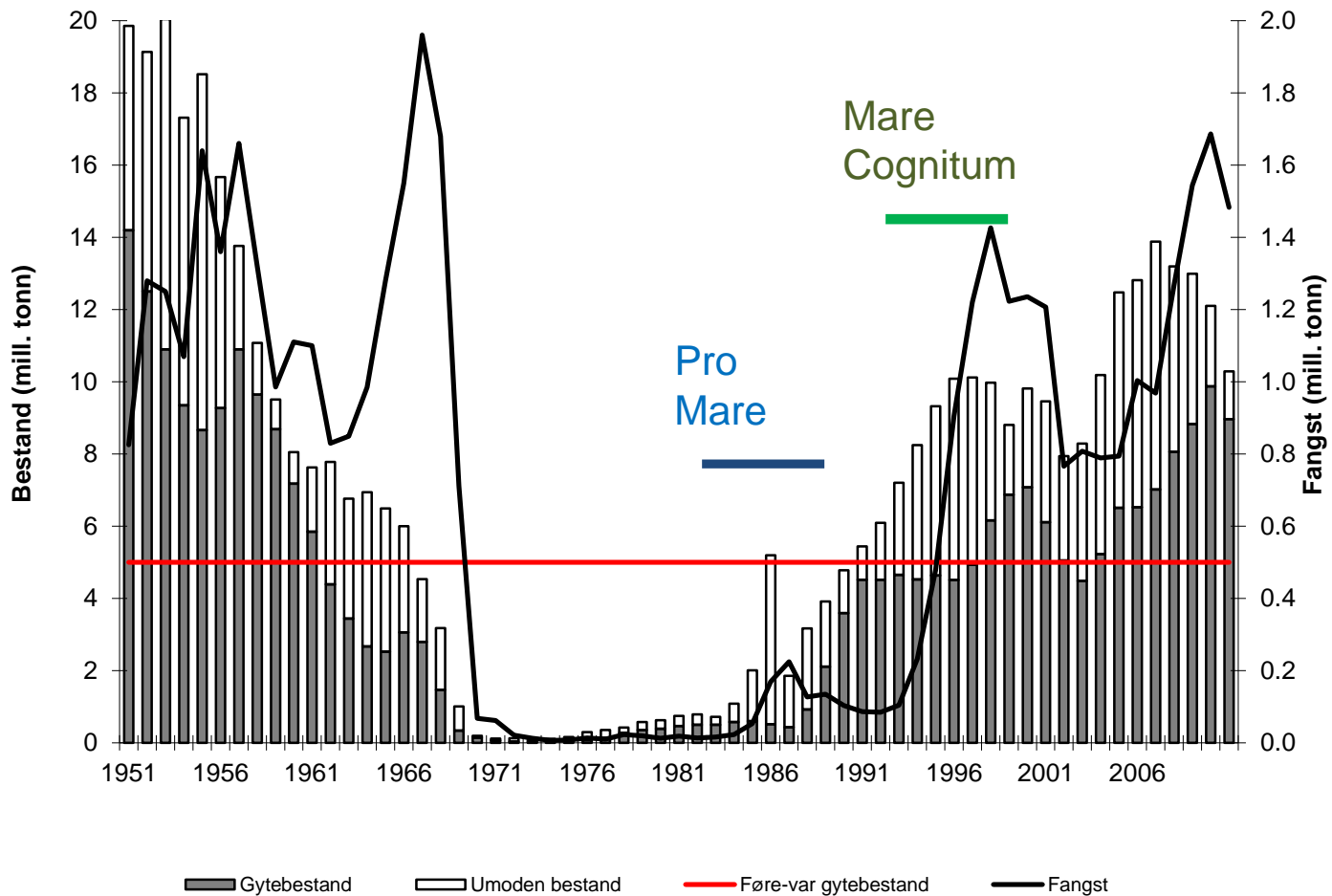


Temperature Kola section

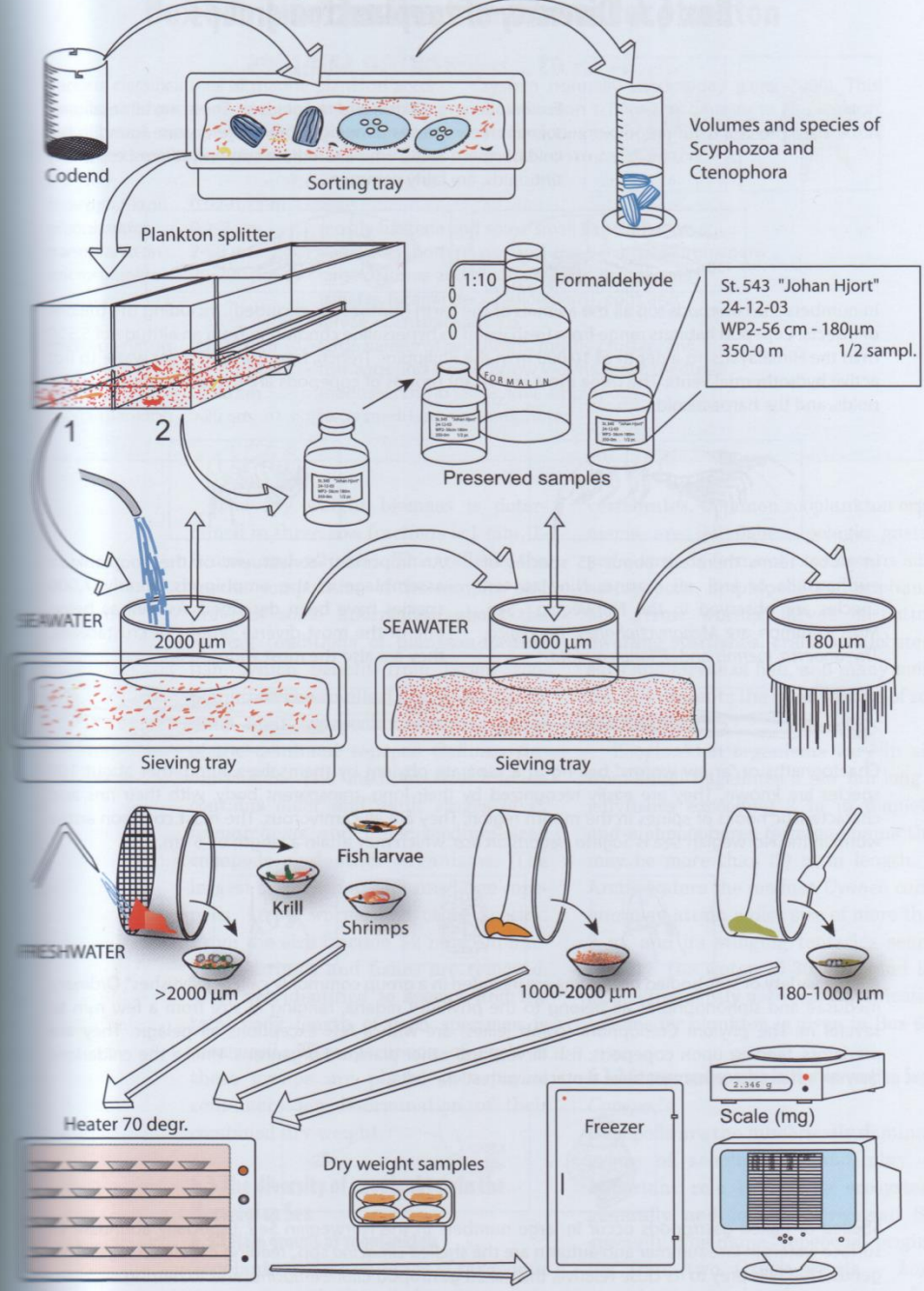
Pro
Mare

Mare
Cognitum

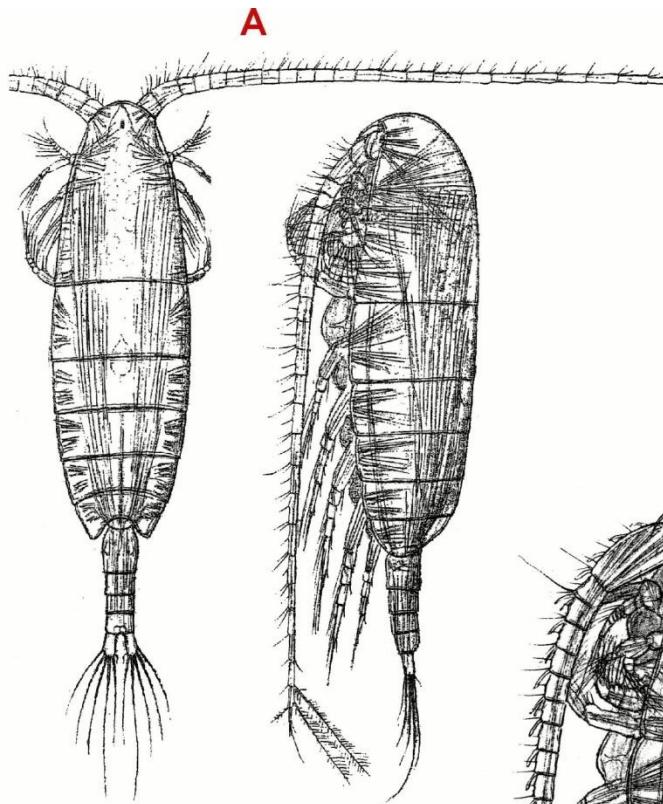




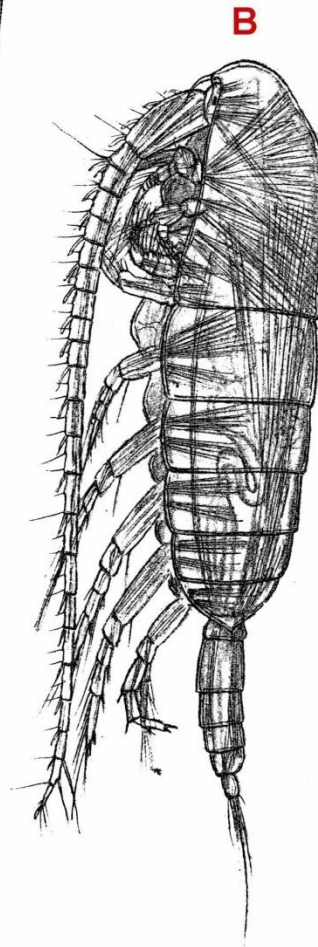
Zooplankton procedures - Institute of Marine Research







Calanus finmarchicus
Monoculus finmarchicus by
Gunnerus 1770



Calanus hyperboreus
Krøyer 1838

Calanus glacialis
Jaschnov 1955



Sars 1903
Ruud 1929
Sømme 1934
Wiborg 1954
Østvedt 1955



*On the biology of
Calanus finmarchicus*
I-XIII – 1933-1966

Marshall and Orr 1955 (1972)
***The biology of a marine
copepod***



1000 + papers

- Conover
- Hirche
- Tande
- Runge
- Melle
- Heath
- Head
- and many others !!

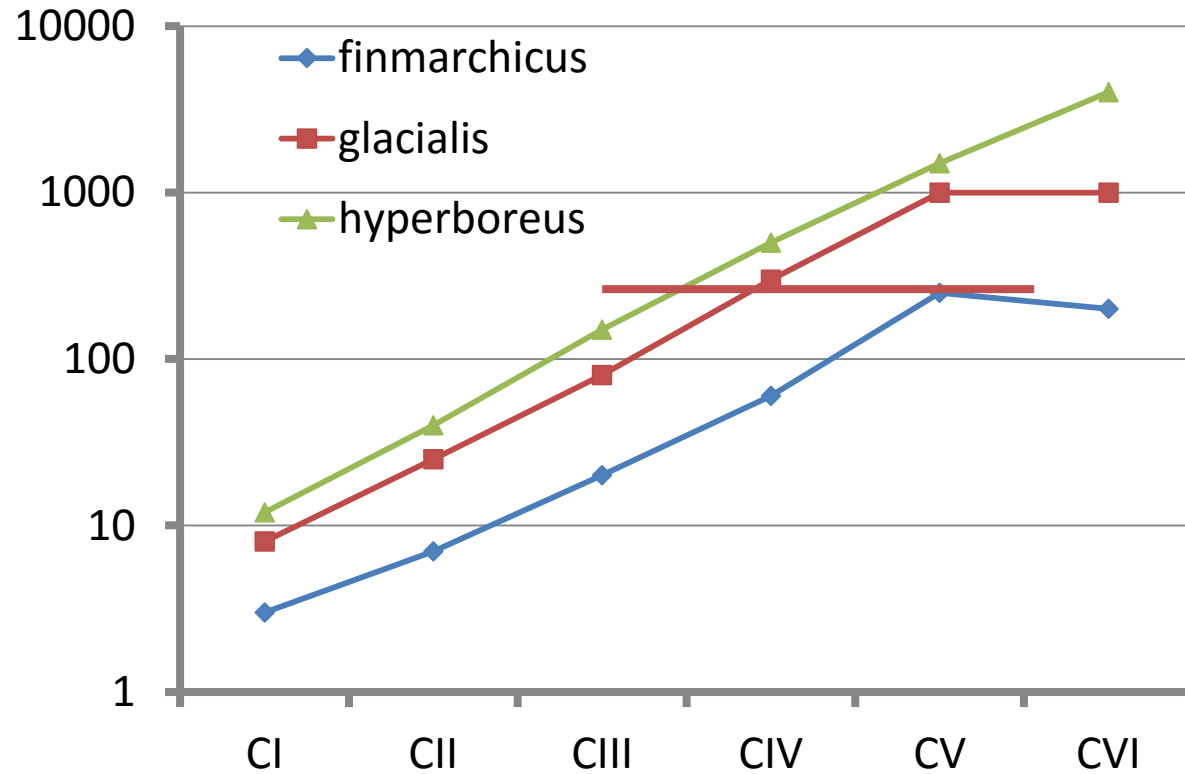
Growth

- Exponential growth – copepodites different from nauplii
- **Equiproportional** rule
- Allometric – weight-specific decline
- **Temperature** dependent
 - Bèhlerádek's equation (development time)
 - Generation length 1 → 5 mo for 10 to 0 C

Size

- Variation within stage
 - By an **order of magnitude** in weight
 - By a factor 2 in linear dimension
- Individual – normal distribution
- Within stage – **factor ca 3**
- Sex – bimodal
- Temperature (latitude) - **decrease**
- Food - **increase**

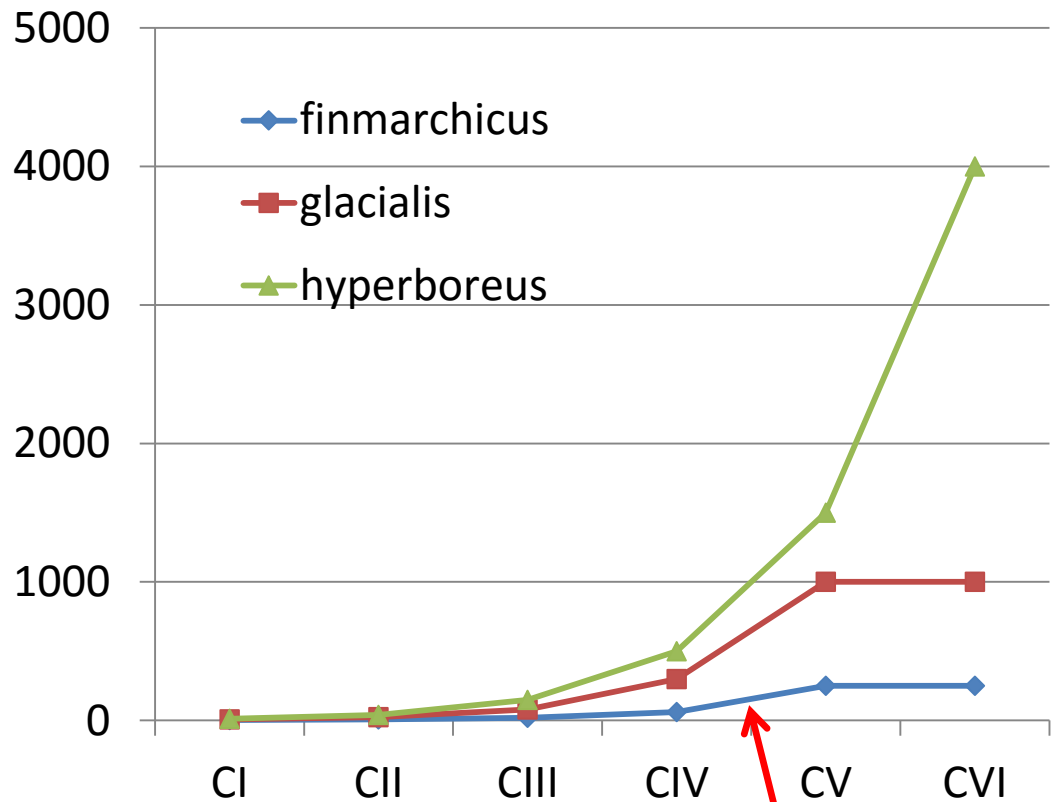
Growth of Calanus species copepodites
Dry weight – ug per individual



CV fin =
CIV glac =
CIII hyp

Growth of *Calanus* species copepodites

Dry weight – ug per individual



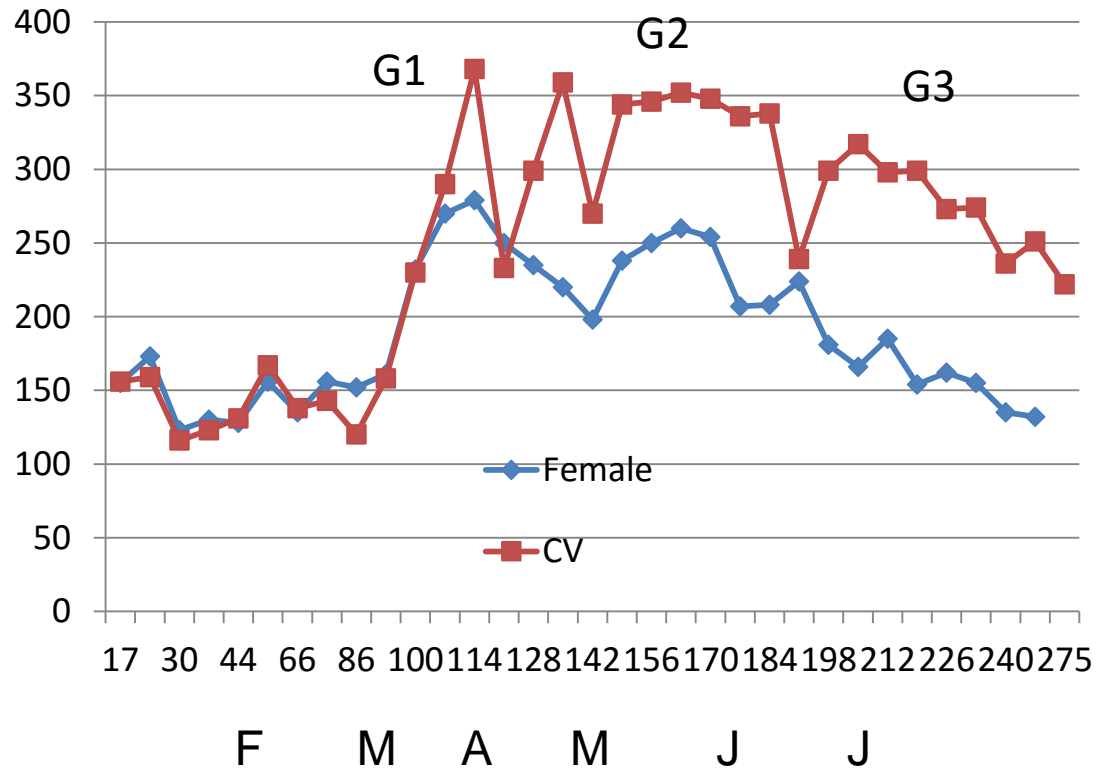
Wintering



Predation



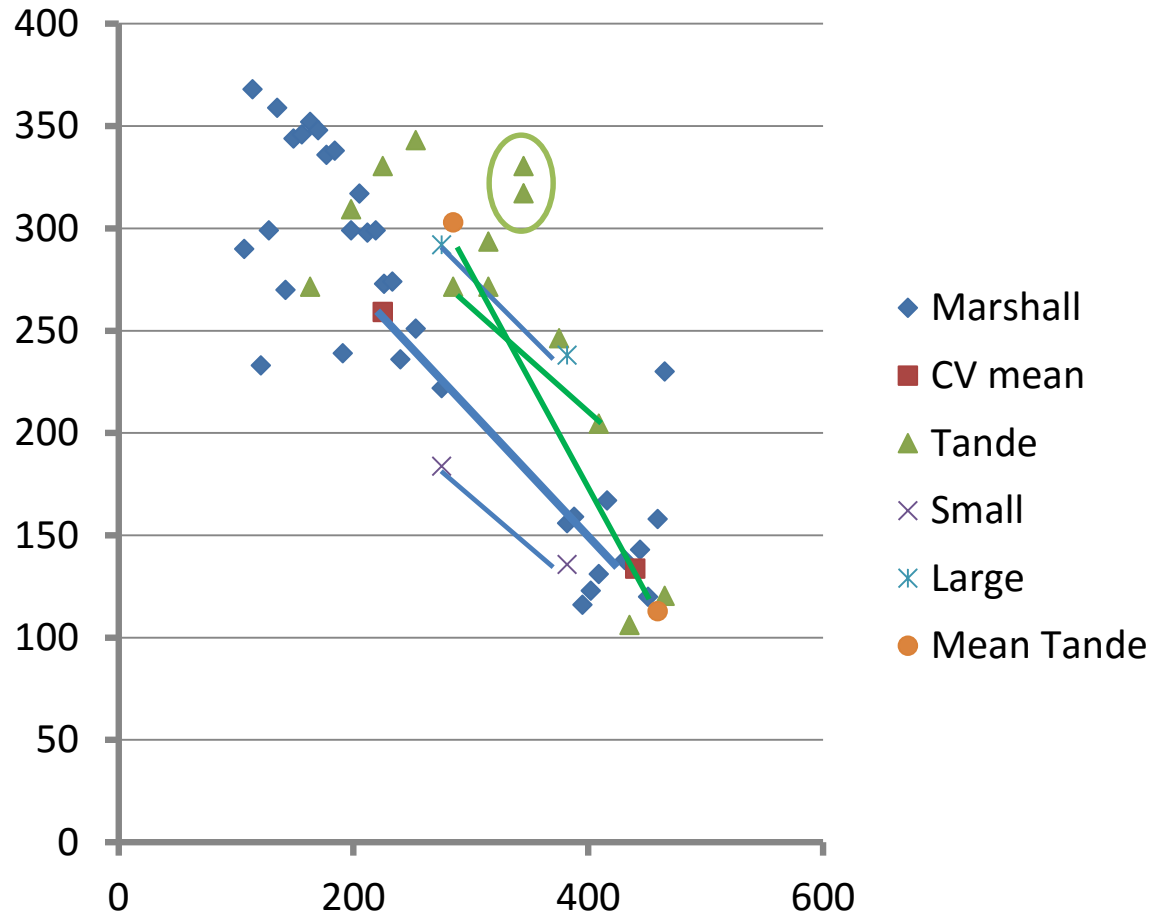
Marshall et al. 1934 – Loch Striven, Clyde Sea



Wintering

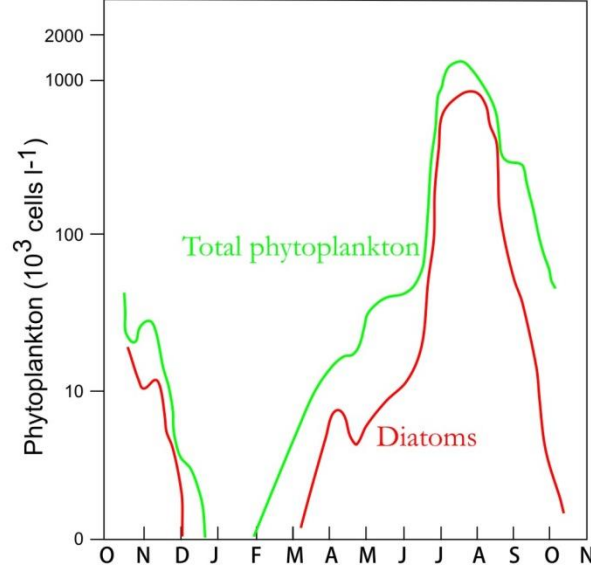
- Dormant, inactive state – diapause?
- **Maturation** process ongoing
- Active metabolism reflected in **weight loss**
- Ca 0.5 ug dry weight per day at 4C
- Apparently Lower than predicted from respiration - Saumweber and Durbin 2006
- **Limited capacity for wintering** in a non-feeding state – they burn up through metabolism

Weight loss (dry weight ind-1) of CV Calanus finmarchicus CV through winter

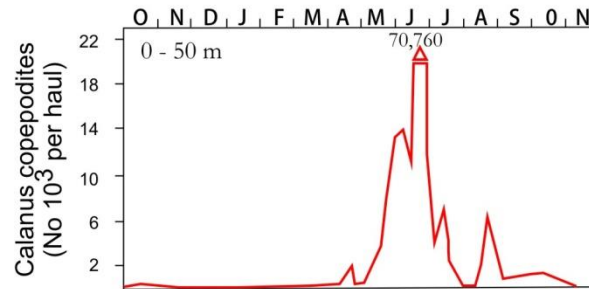


**Weather ship
Station 'M'**

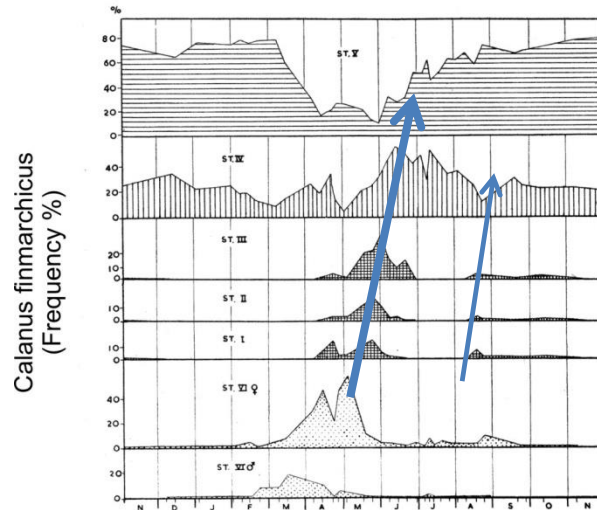
**Weekly
sampling
Oct 1948 –
Nov 1949**

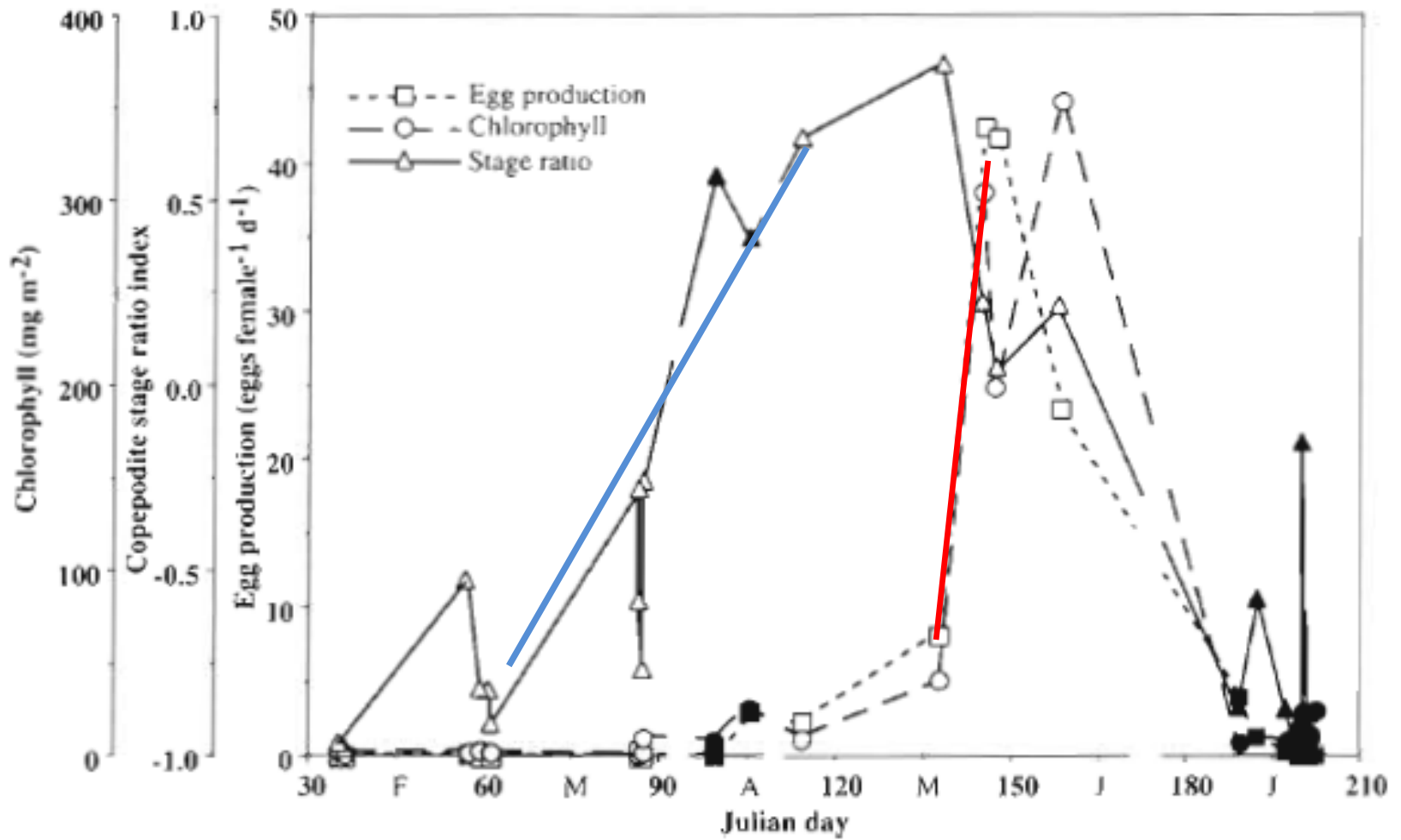


Halldal 1953

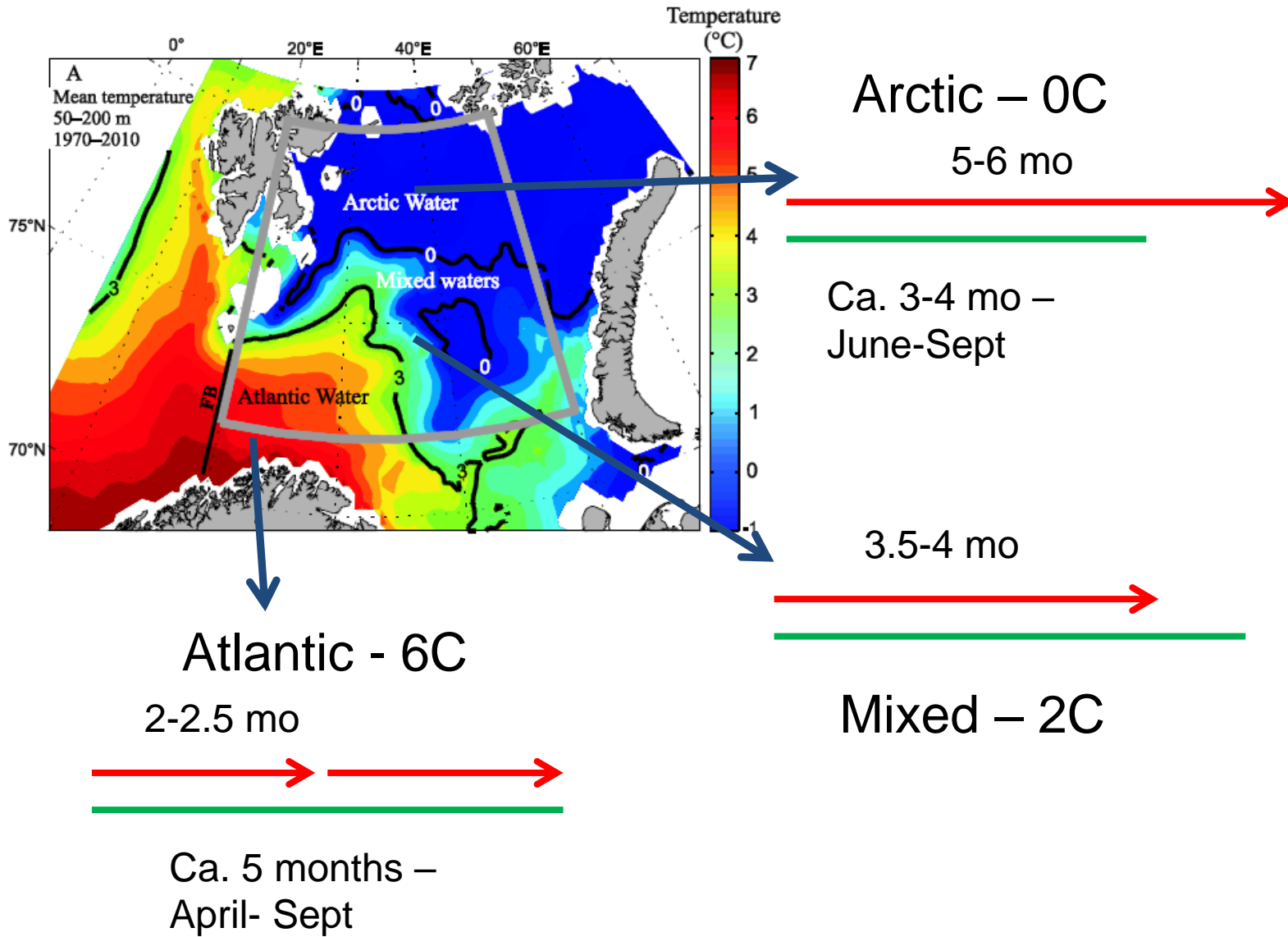


Østvedt 1955



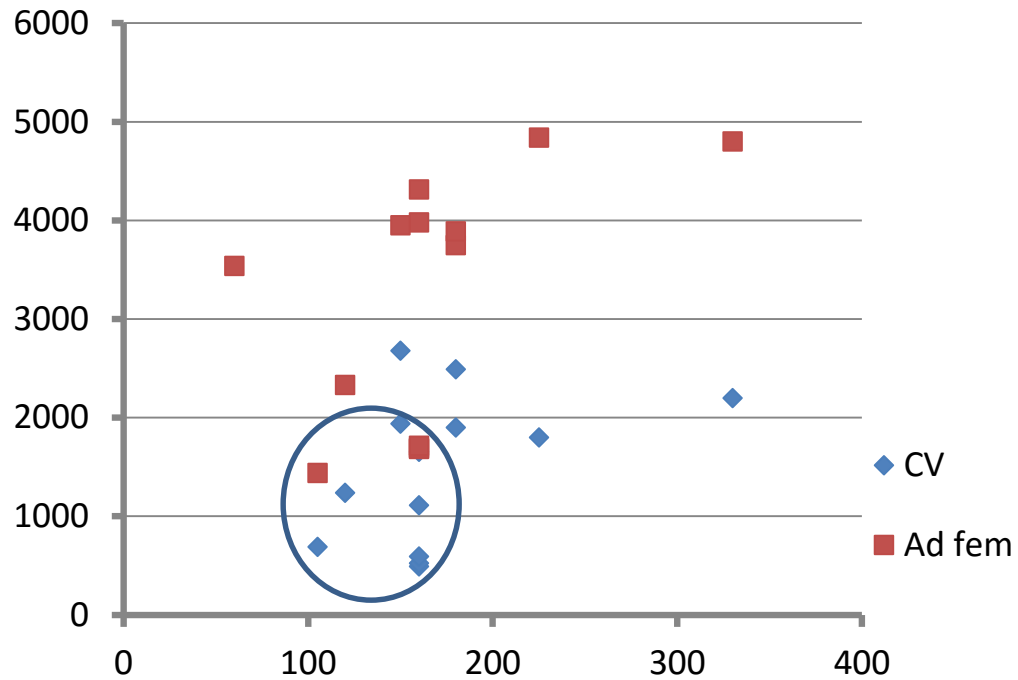


Melle and Skjoldal 1998

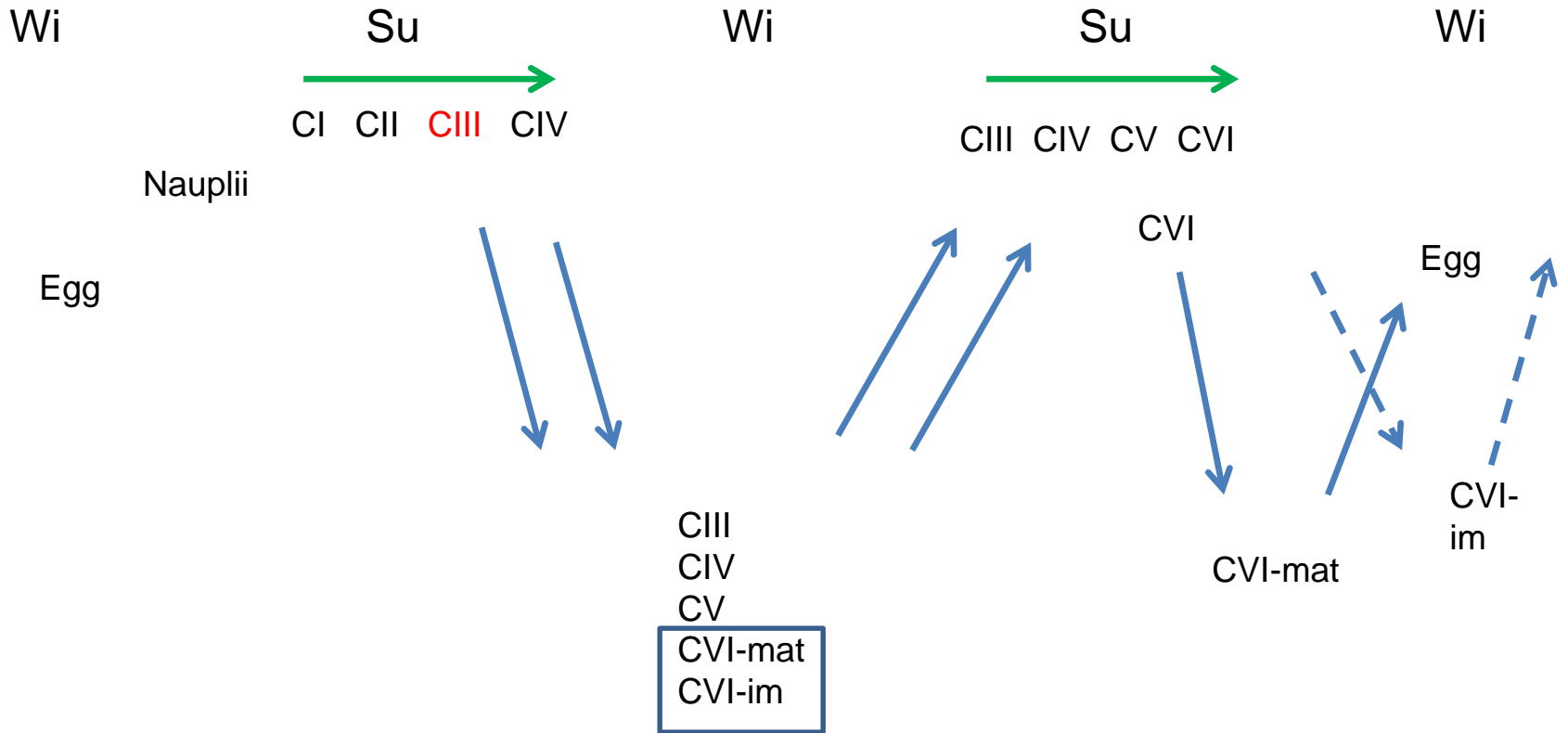


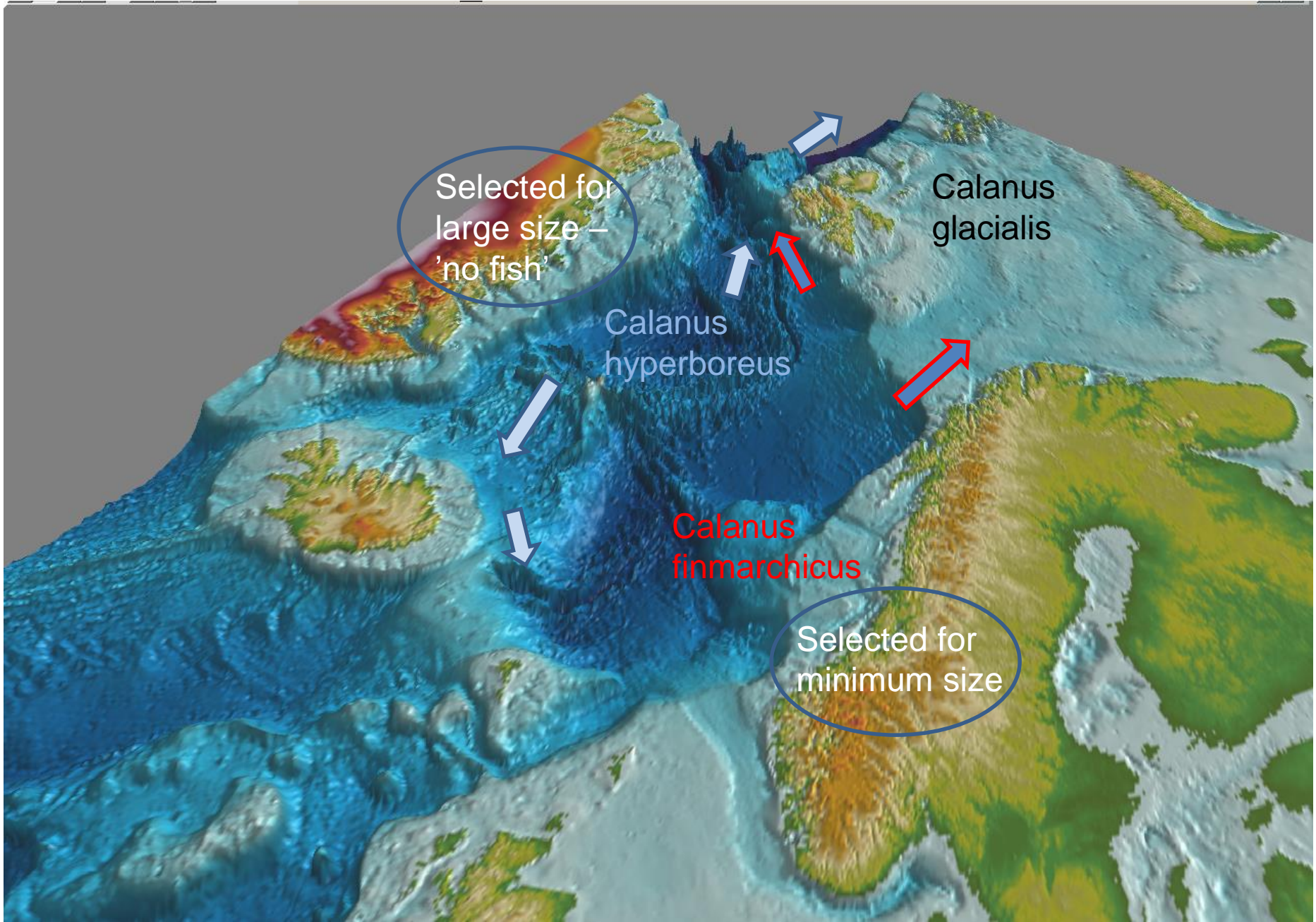
Calanus hyperboreus

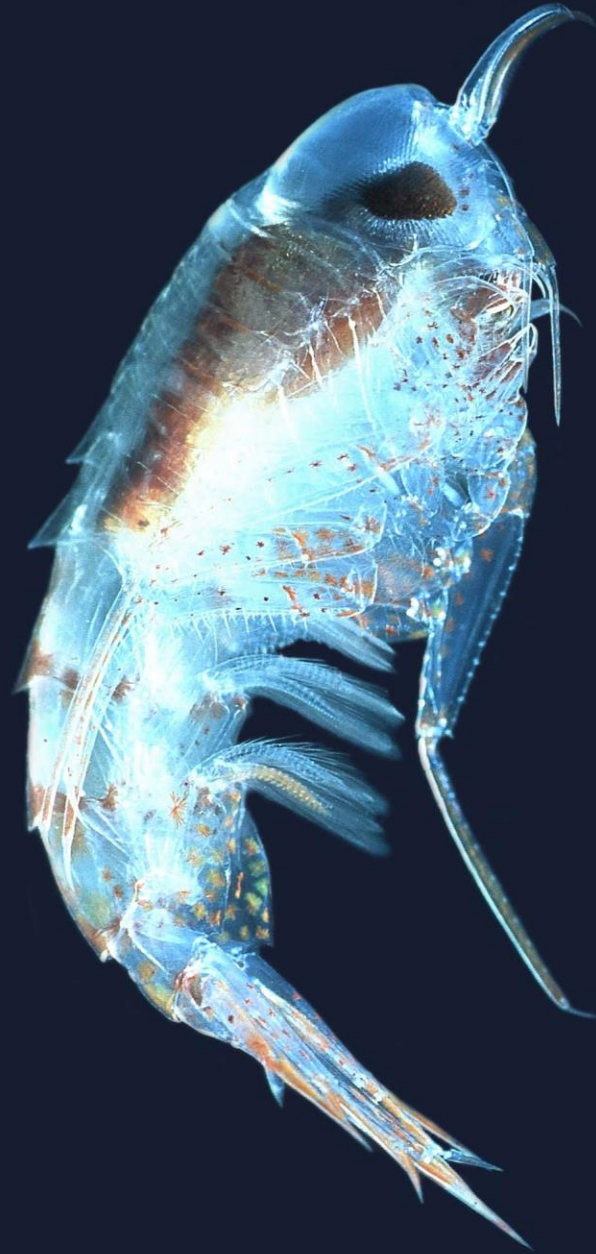
Dry weight ug ind-1



Life cycle – *Calanus hyperboreus*



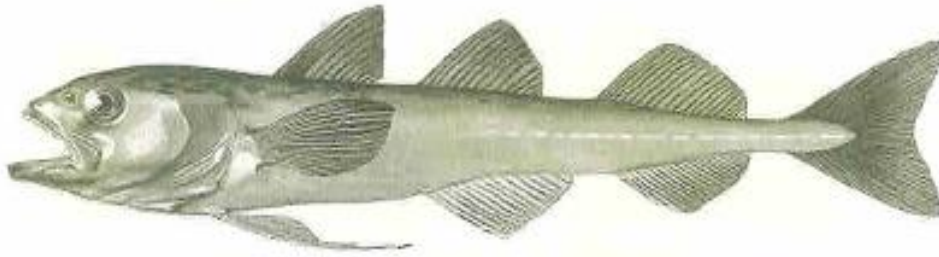




WGICA

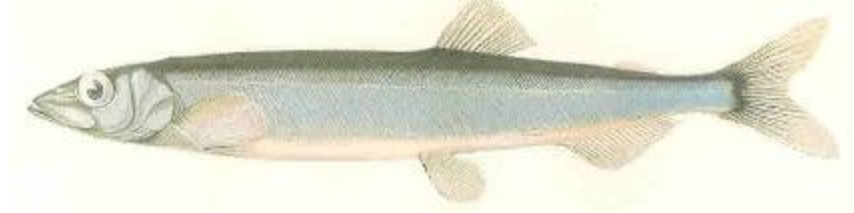


Integrated Ecosystem Assessment Groups in ICES



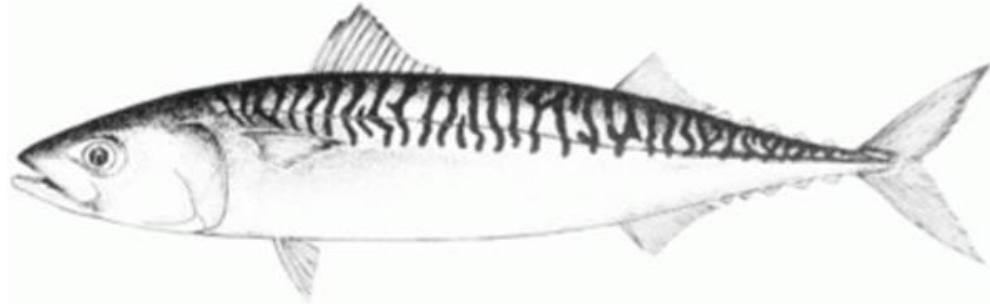
Polar cod -
Boreogadus

Capelin

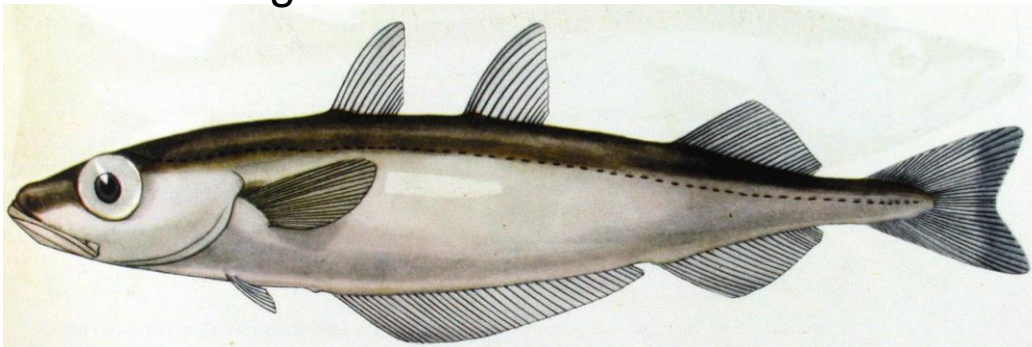


Herring

Mackerel

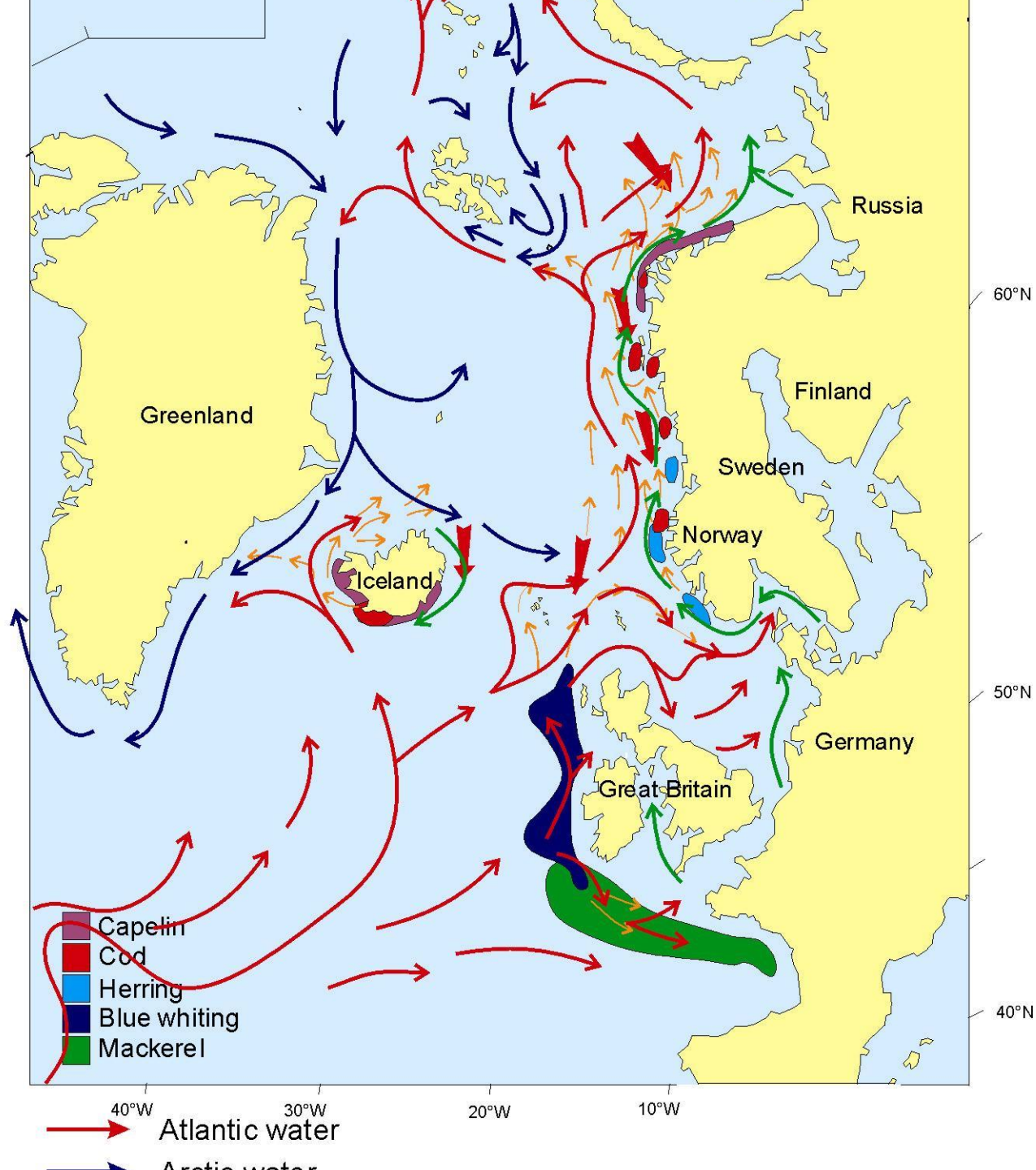


Blue whiting

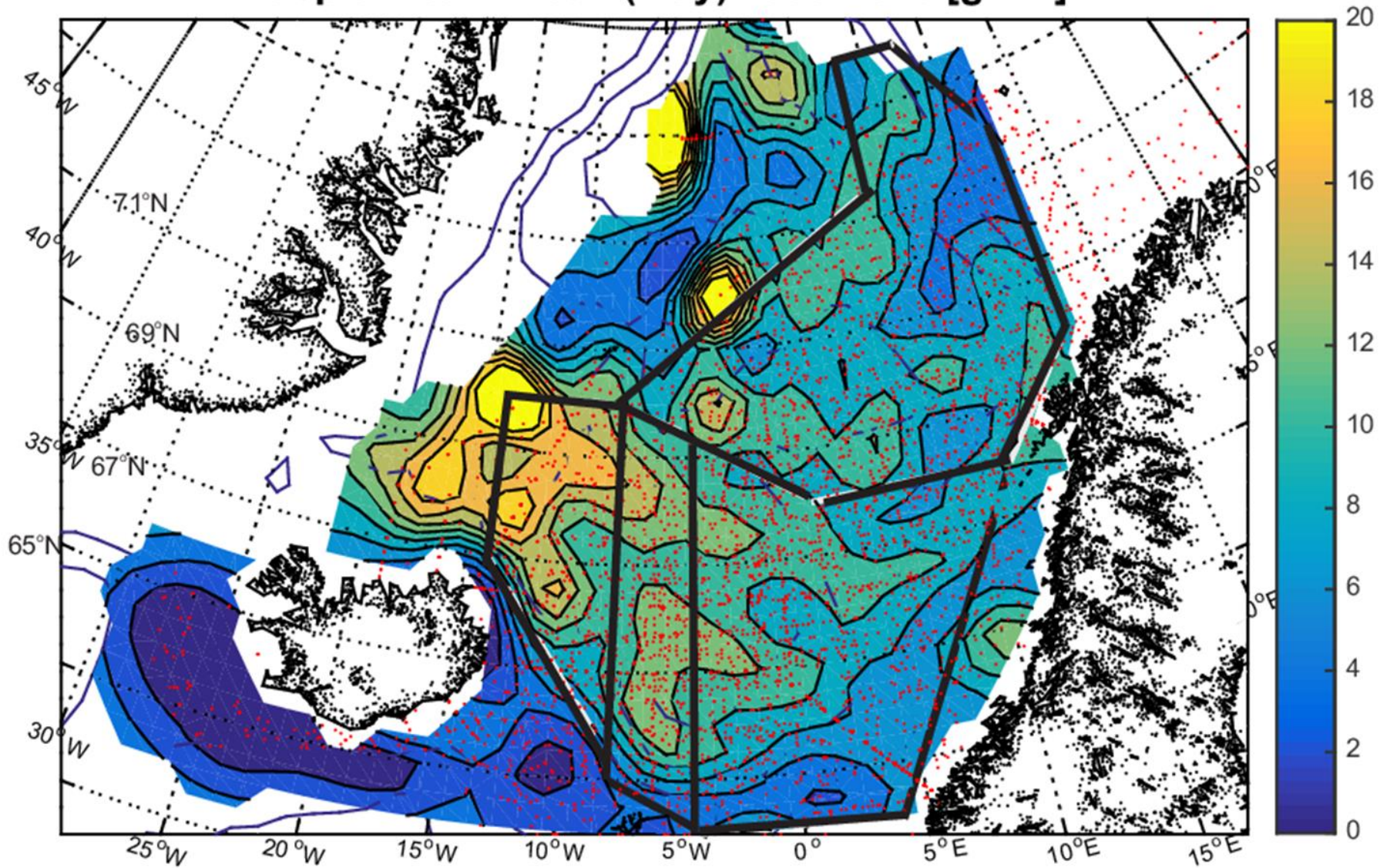


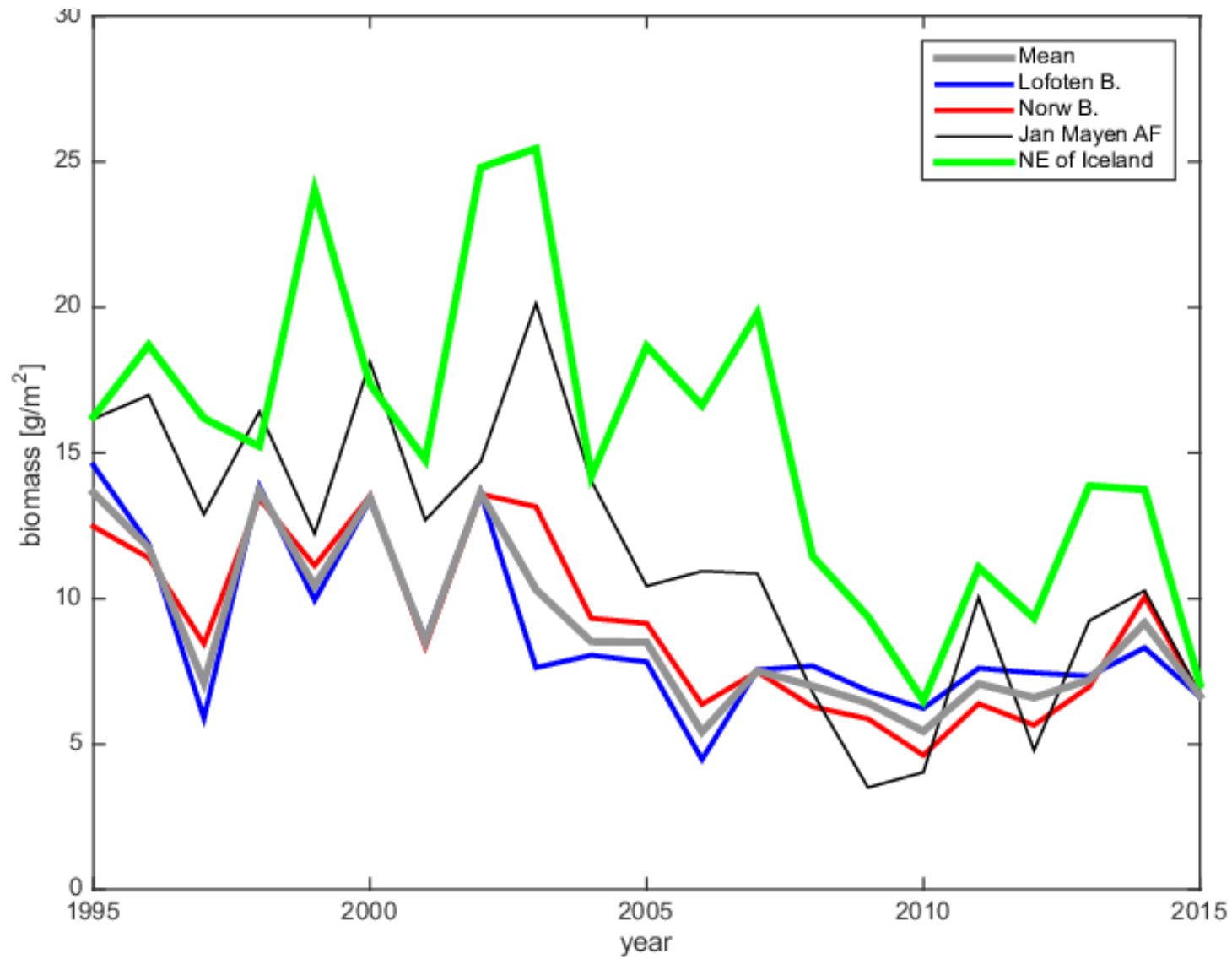
Myctophid



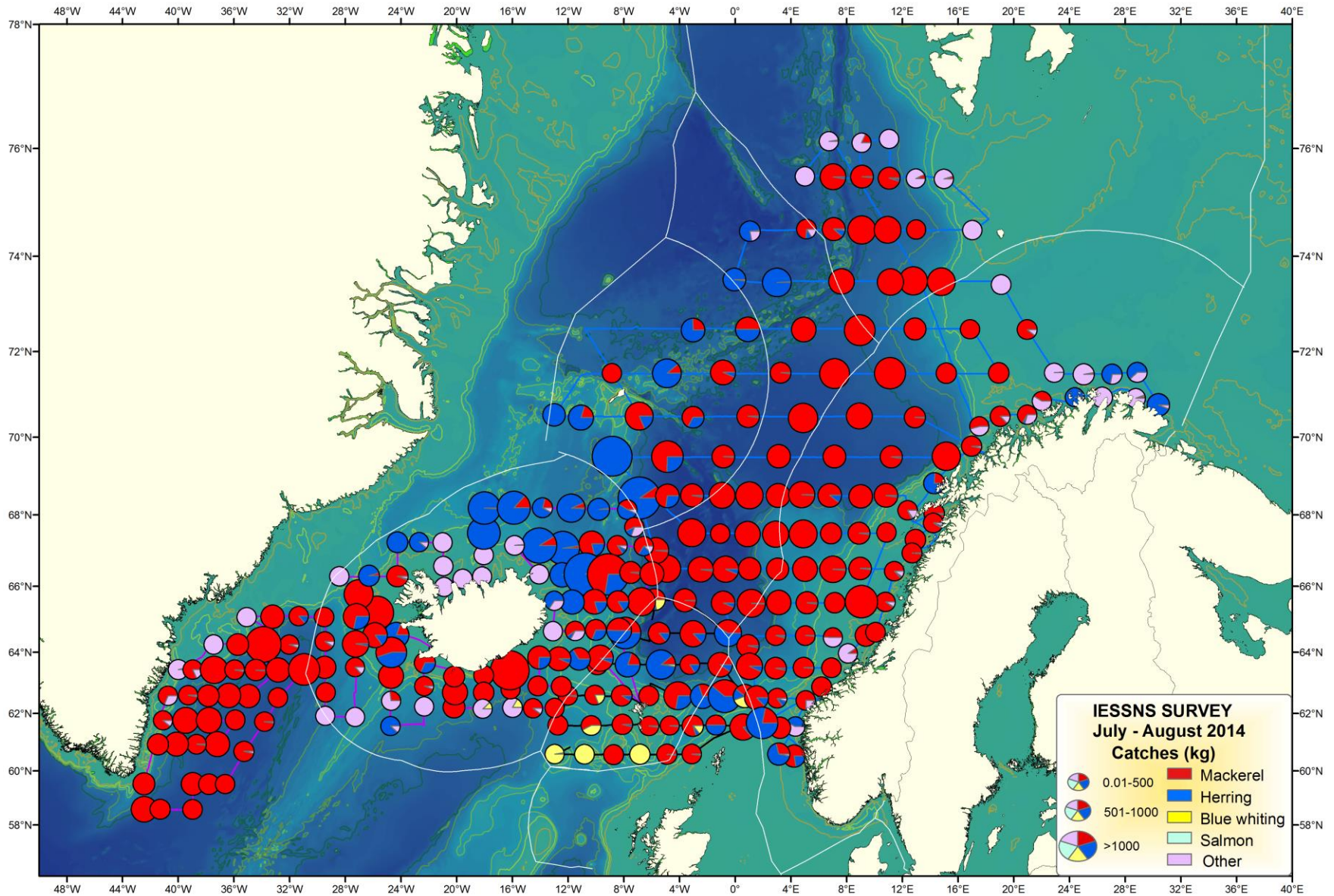


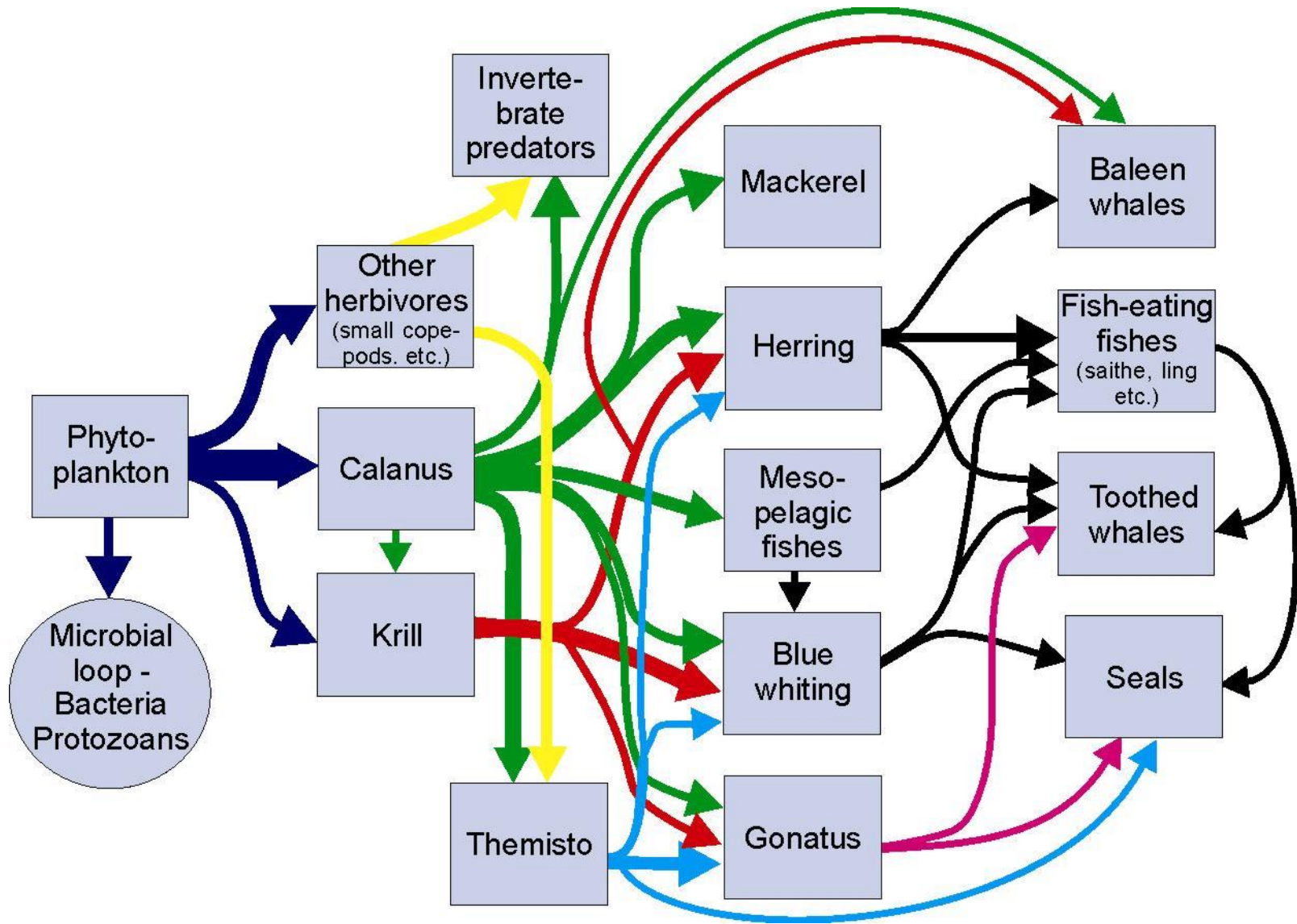
Zooplankton: Mean (May) 1995-2015 [gm^{-2}]



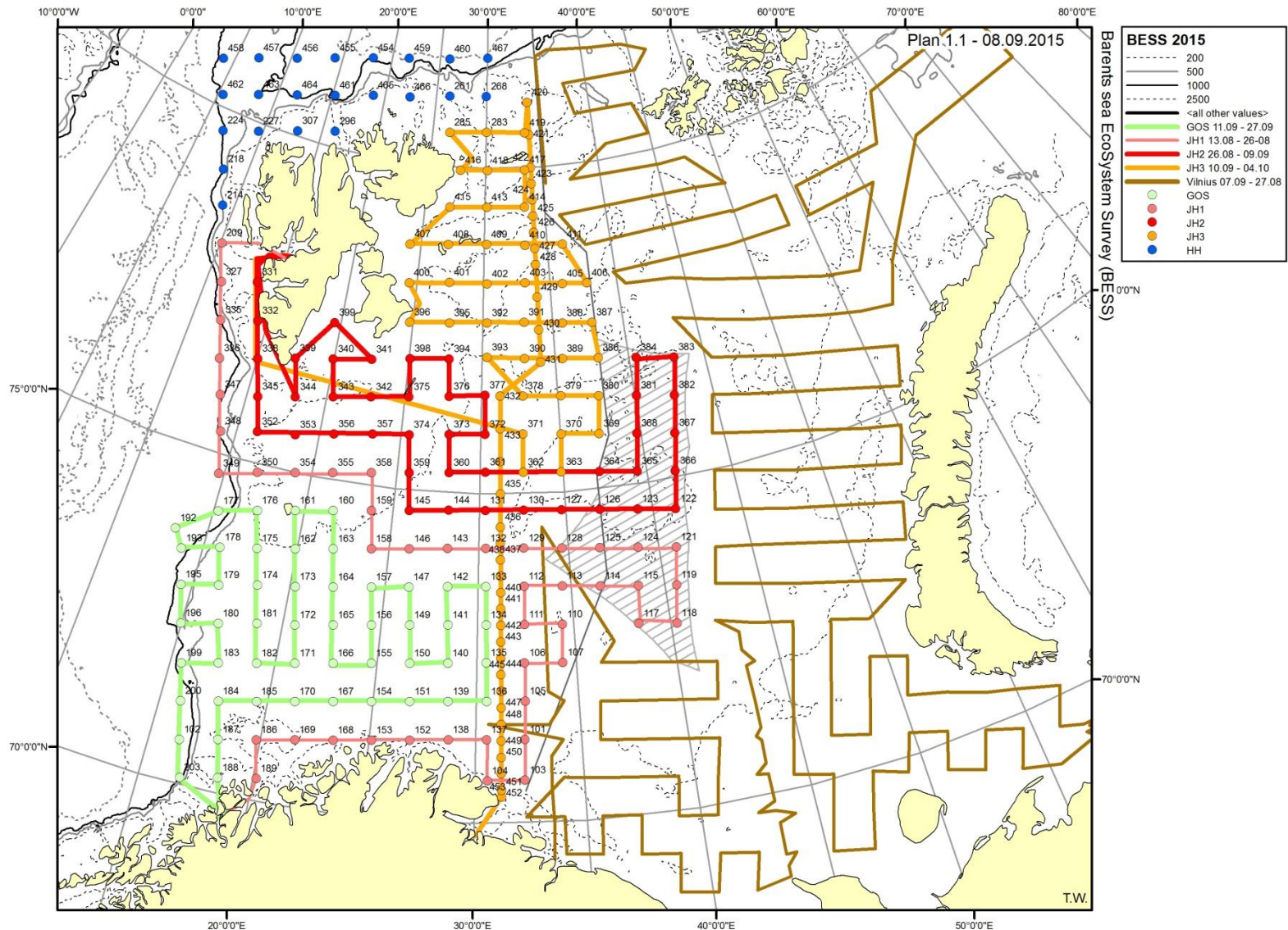


Distribution and overlap of mackerel and herring





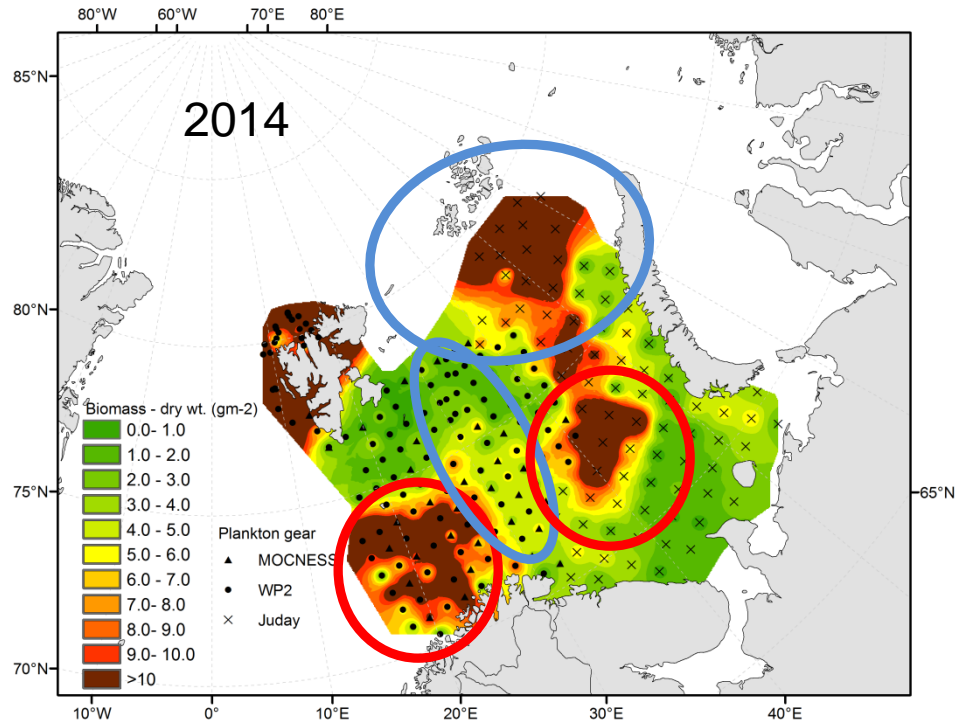
Survey design 2015



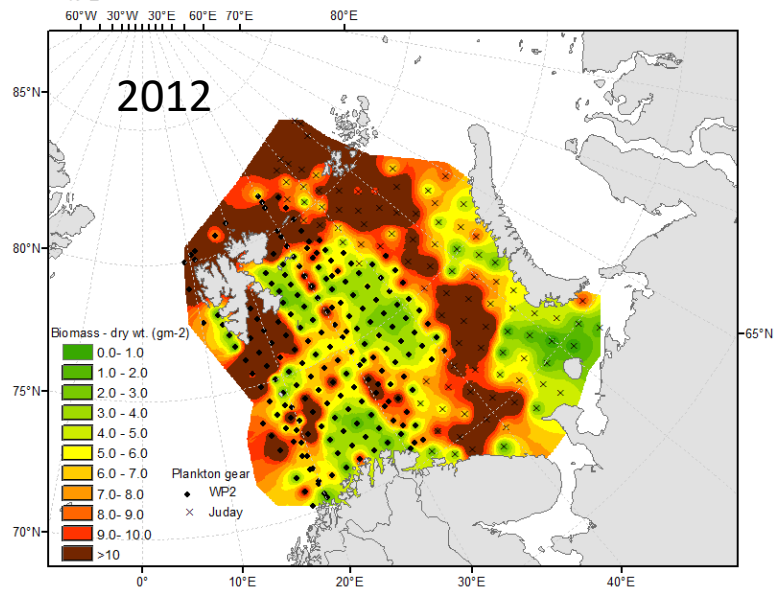
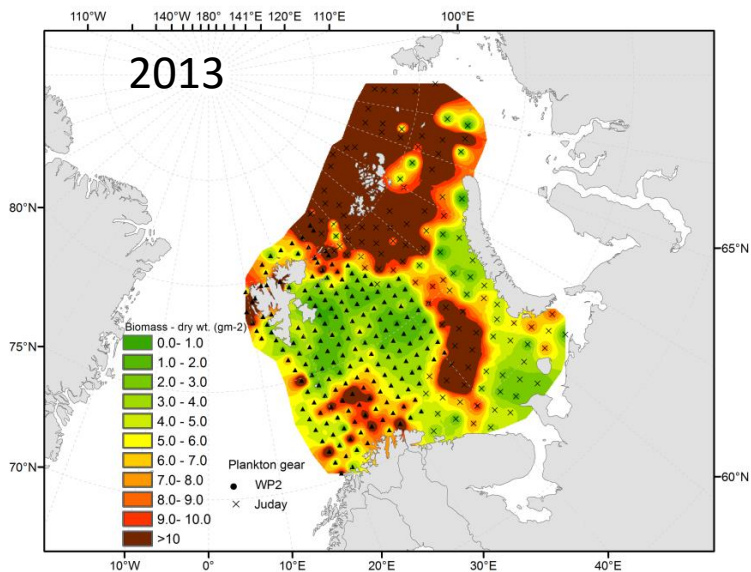
Hydrography and plankton stations

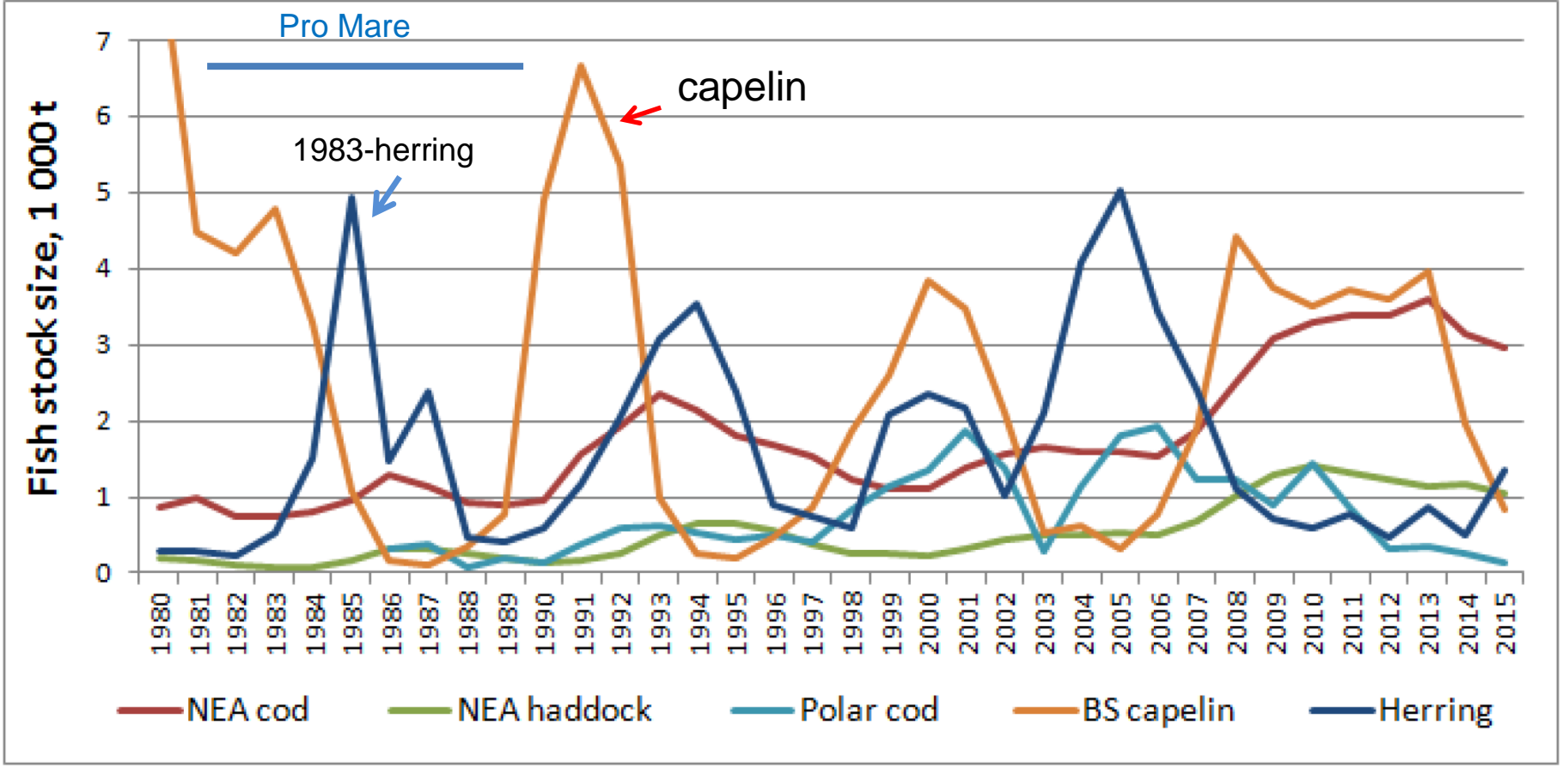
Bottom and pelagic trawl stations

Biomass distribution- PINRO/IMR

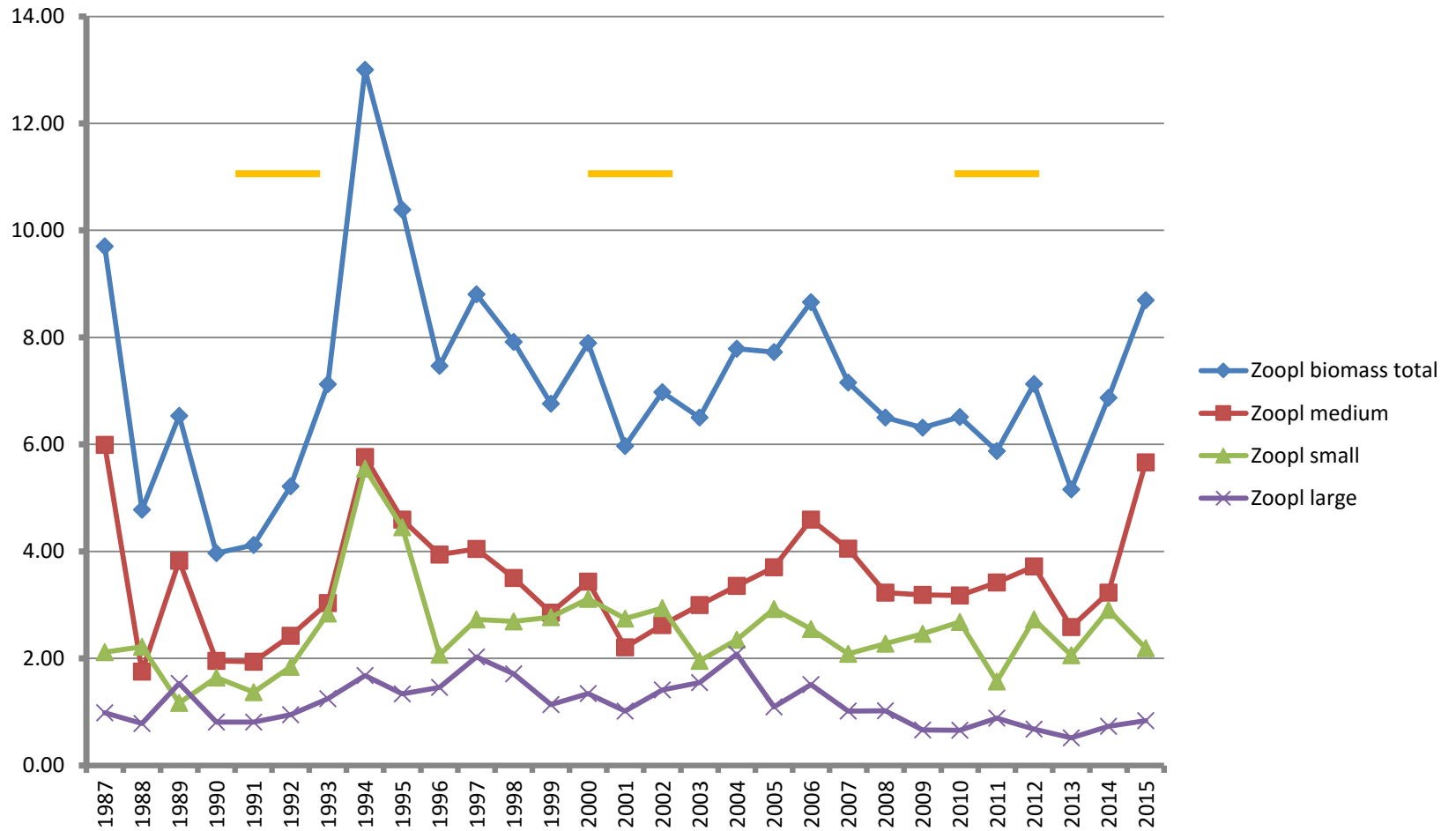


2014 - 6.7 gm⁻² (232 st.)
2013 - 7.1 gm⁻² (305 st.)
2012 - 7.6 gm⁻² (287 st.)





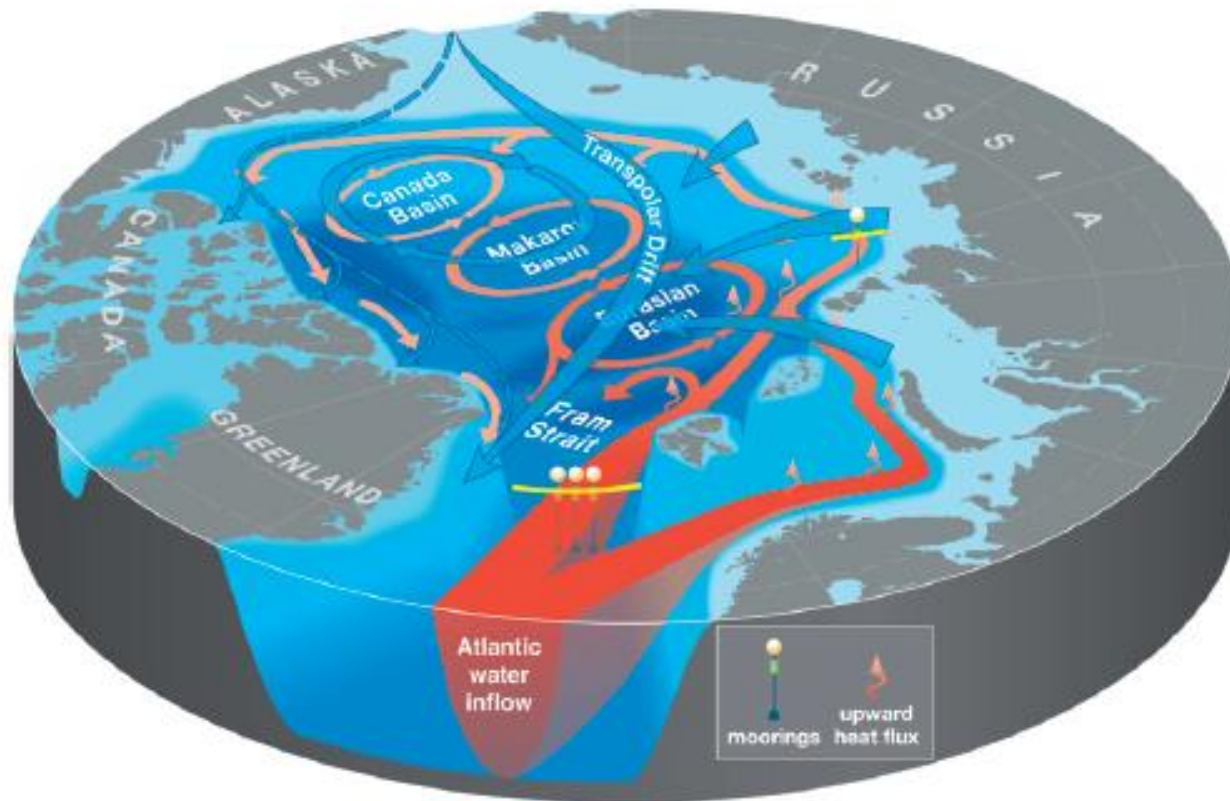
Zooplankton biomass g dry weight m-2



Bowhead



Atlantic inflow



Polyakov et al. (2012) Journal of Climate

