Seabirds and ice in the Canadian Arctic

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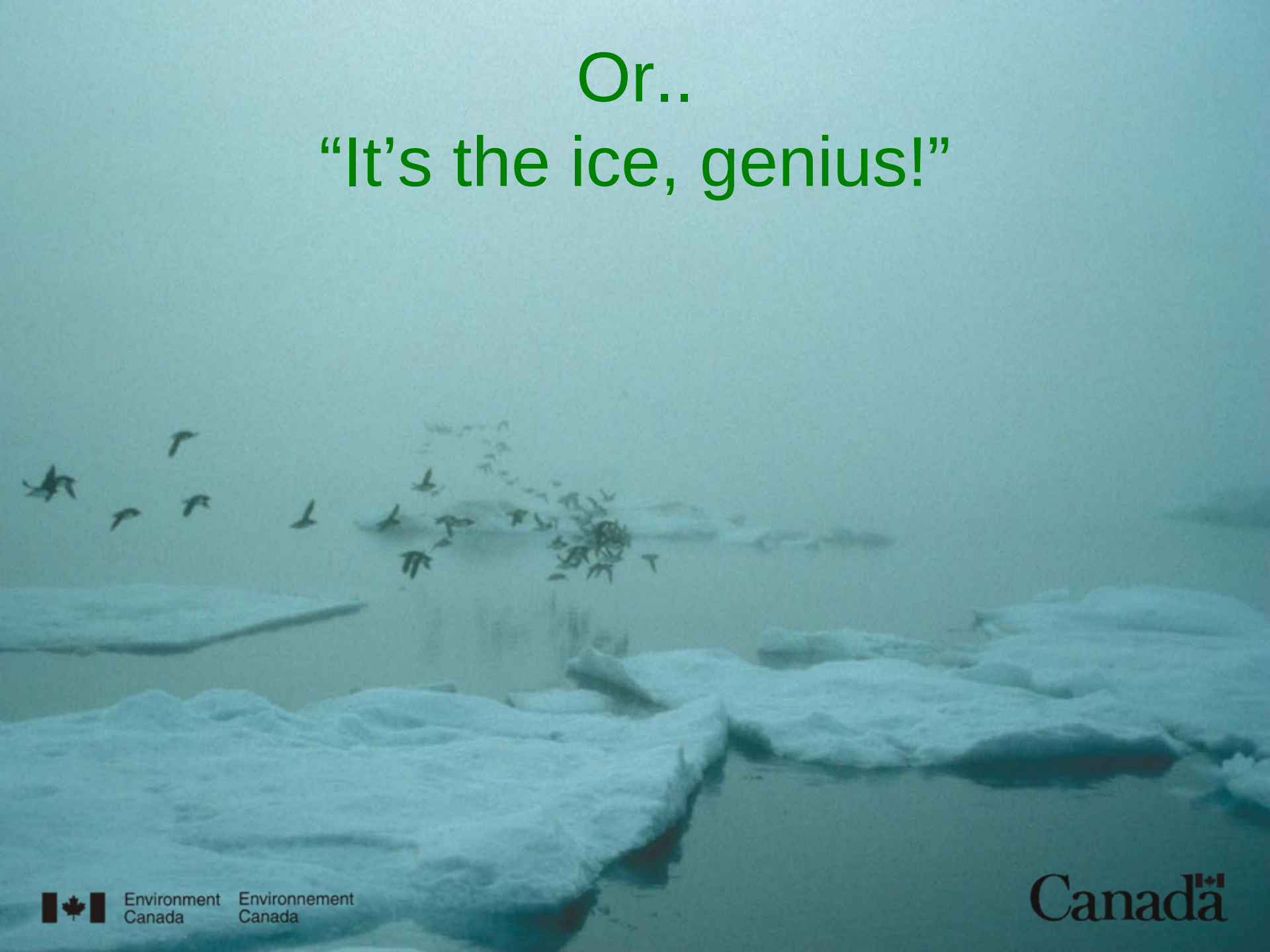
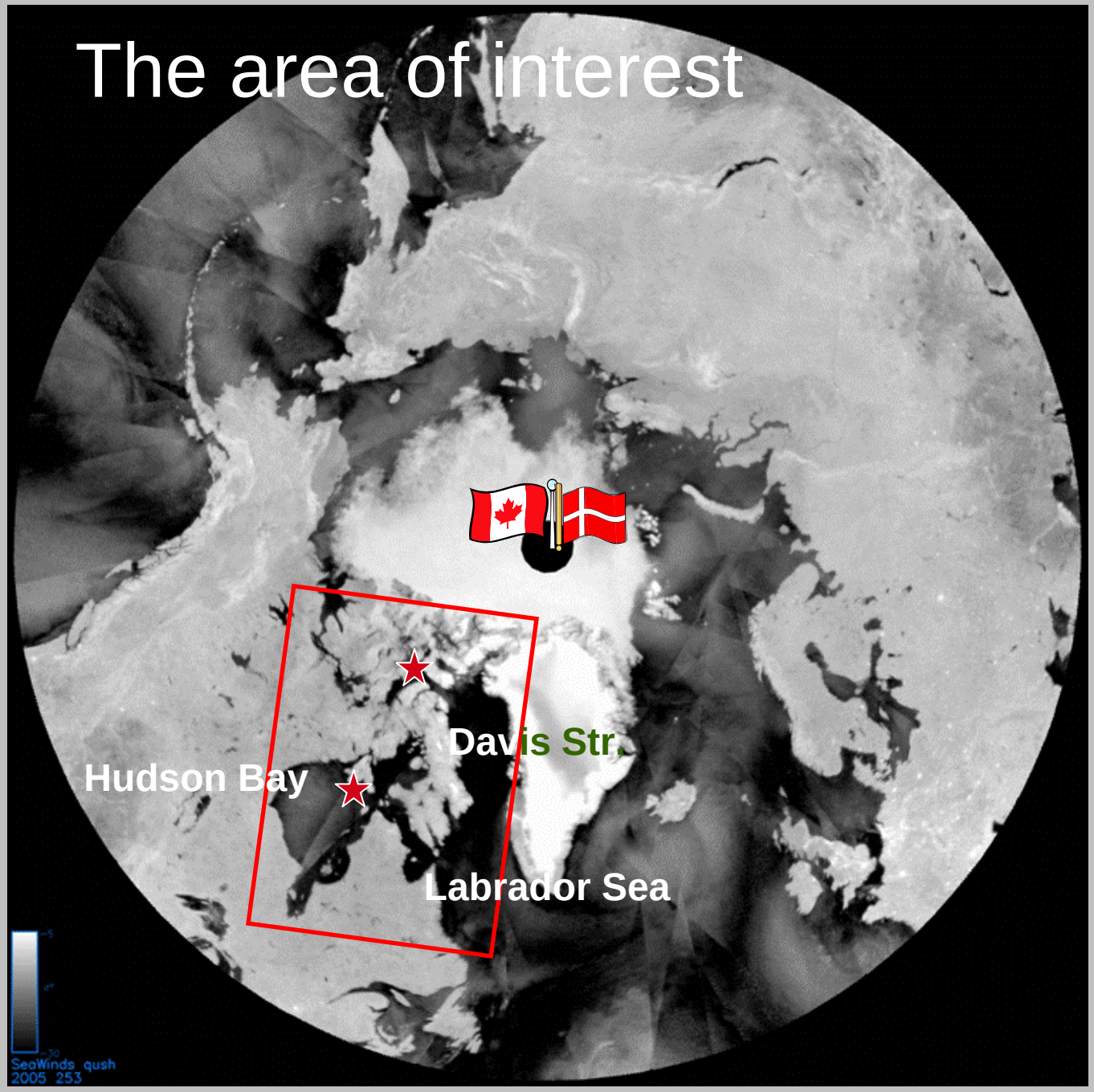
Or..
“It’s the ice, genius!”



The area of interest

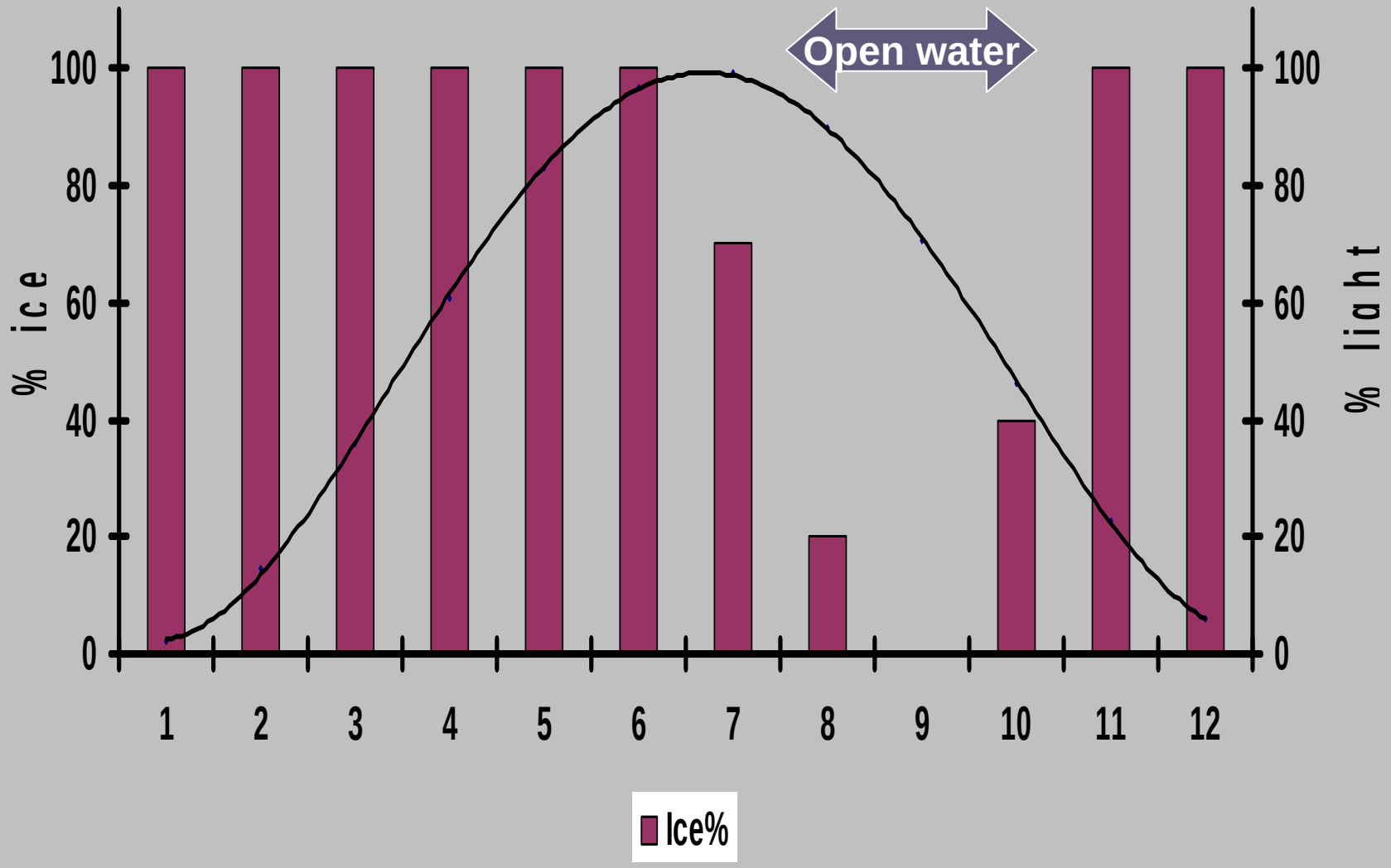


Thoughts on changes in sea-ice cover and the status of air breathing top predators (ice-associated megafauna)

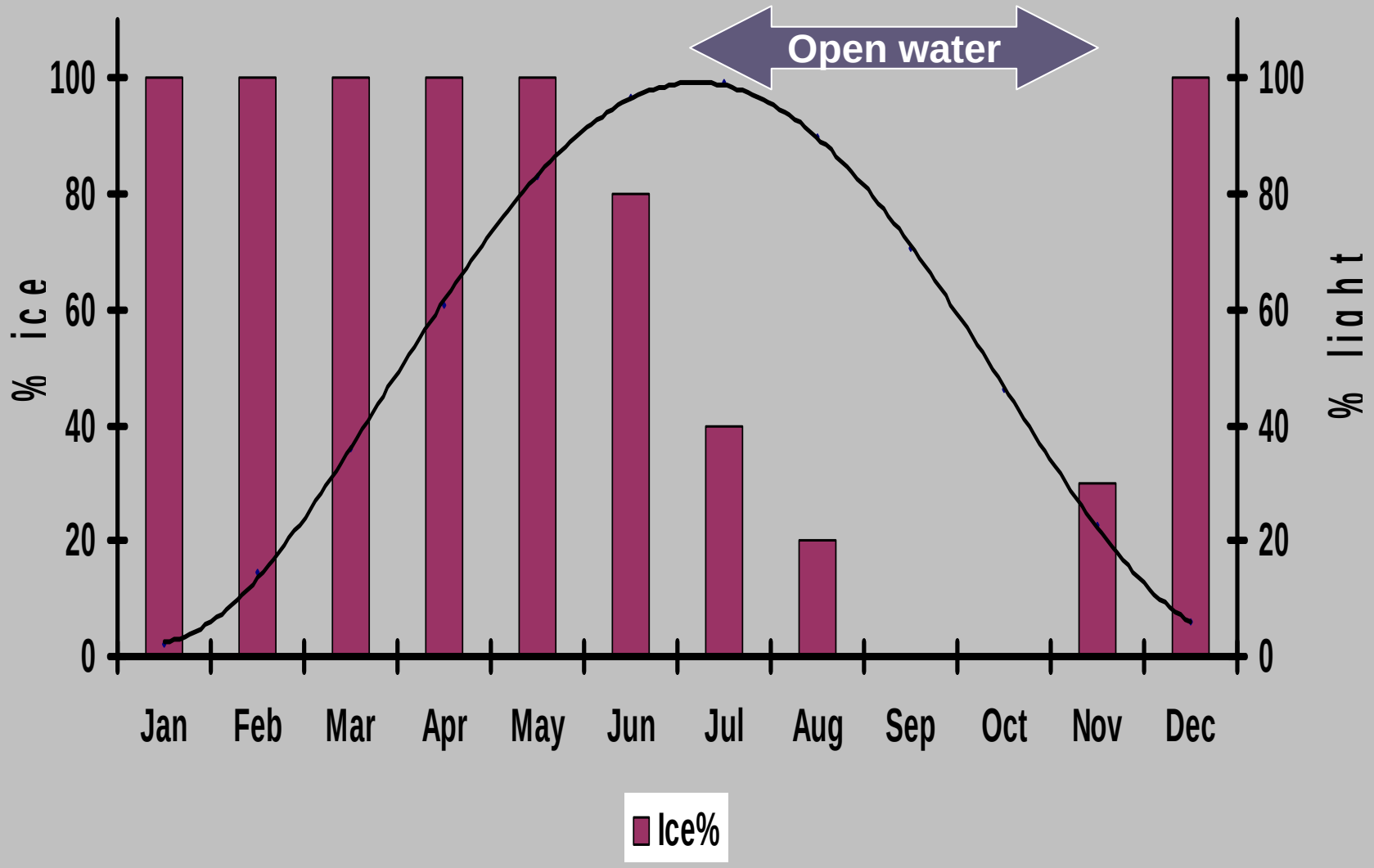
So…

- A major burst of primary production follows the break-up and dispersal of winter ice cover
- Many air-breathing predators only obtain access to the marine food web after break-up begins
- Historically, ice break-up in the eastern Canadian Arctic coincided with midsummer, giving maximum daylight.

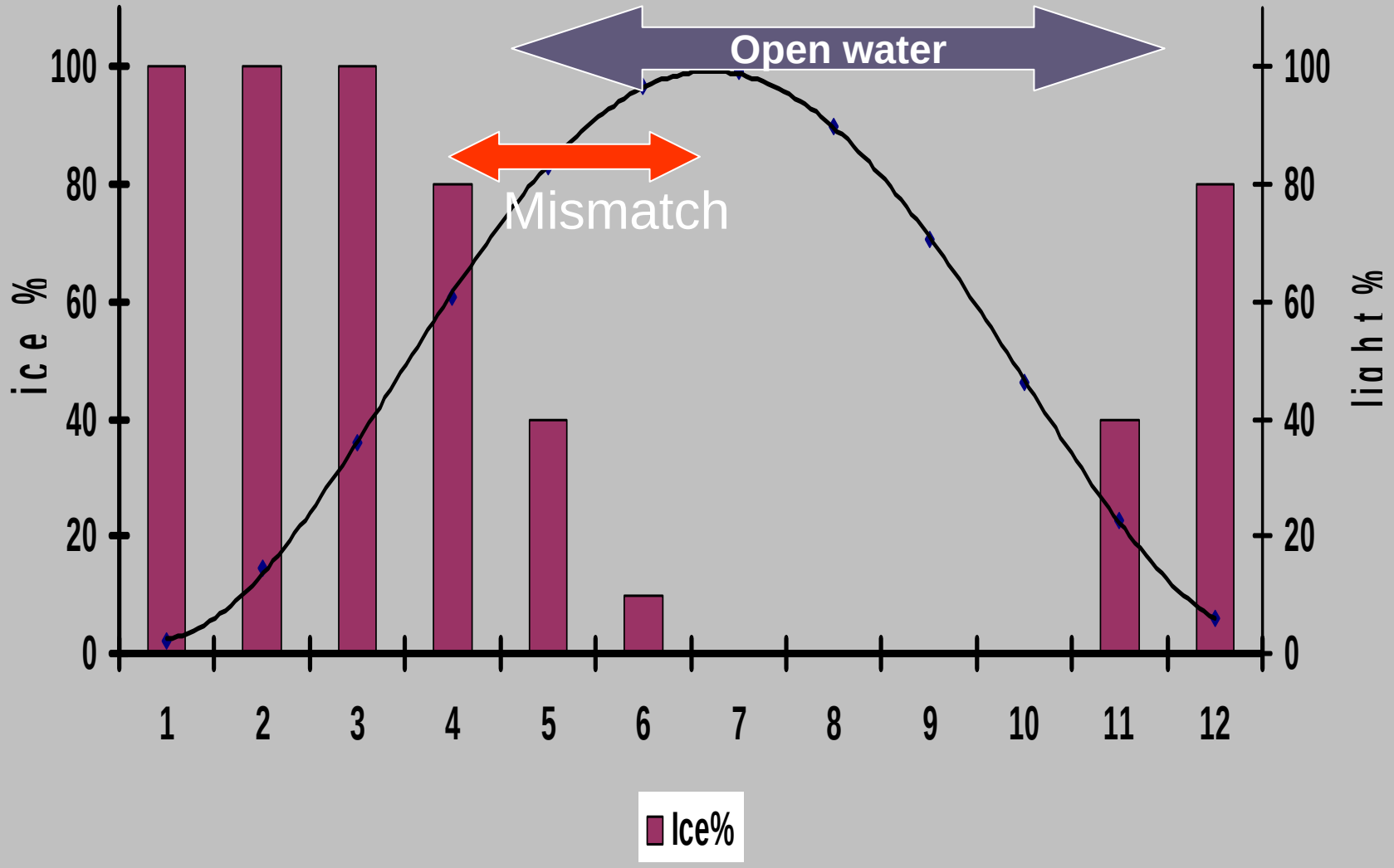
Open water too brief for marine bird reproduction (e.g. McLure Strait)



Situation in N Hudson Bay, 1980s



Situation in N Hudson Bay 2010



As the date of ice break-up advances:

- Peak nutrient release and light availability first converge (timing becomes very peaked, making timing of breeding critical)
- Then diverge, spreading the period of high primary production, moving to a situation where timing is less critical to reproductive success
- Extra open water in fall has little impact on production because light is low and resources have been grazed down
- Timing of spring break-up is critical!

Ice conditions and species distribution limits

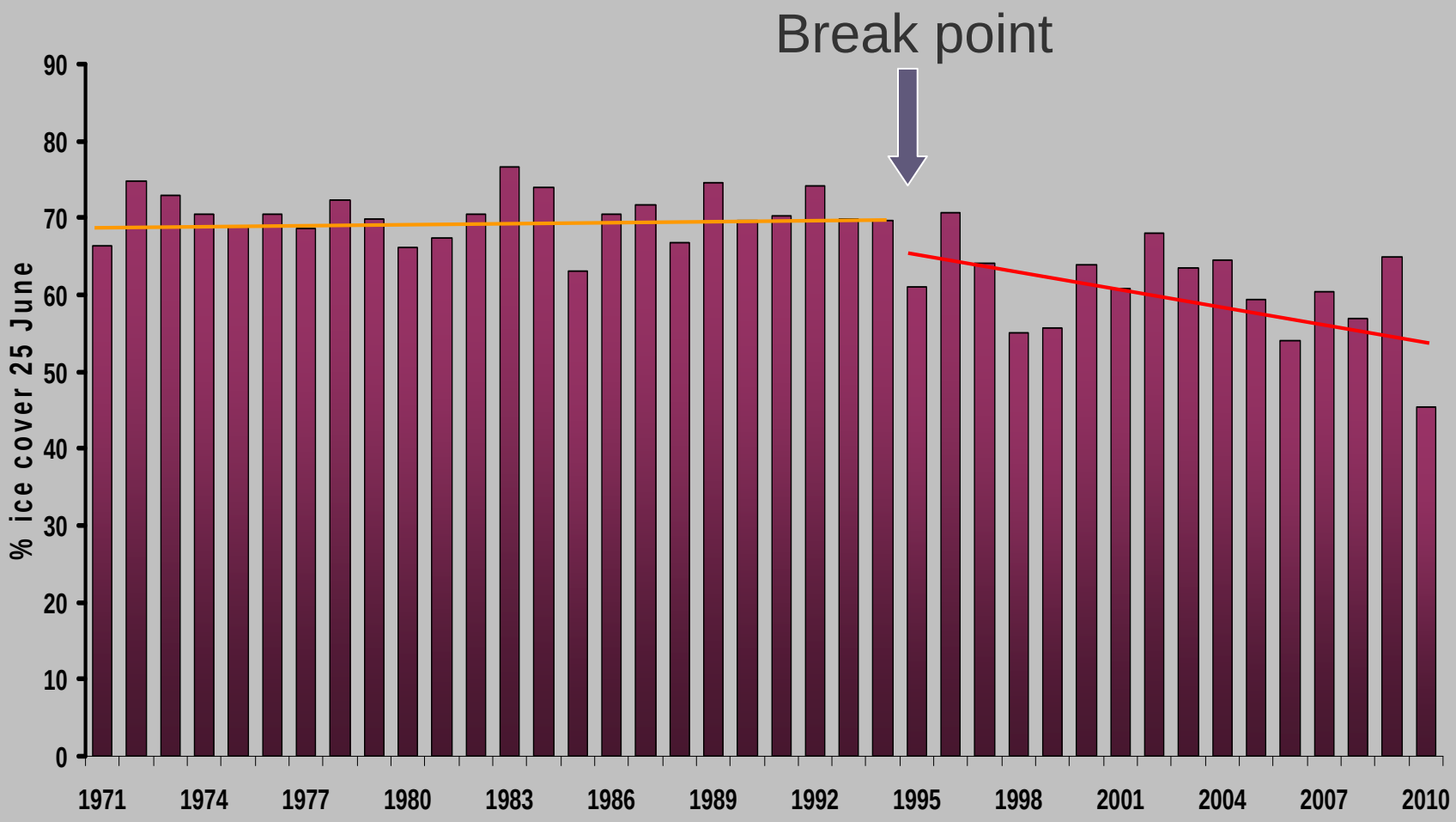
- 2010 situation in northern Hudson Bay resembled the typical timing in northern Labrador Sea, within the Labrador Current region, in the early 1990s
- This area was then, and continues to be, marginal for Polar Bears, Ringed Seals, and Bowhead Whales
- Hence, we may regard it as the limit of conditions for the ice-associated megafauna

As the date of ice break-up continues to advance:

- Conditions in Hudson Bay and Hudson Strait become marginal for the existence of the ice-associated megafauna - This may happen very soon

- And…

Ice trends in the Canadian Arctic, 25 June



Source: Canadian Ice Service

And what about the birds?

Thick-billed Murres returning to the colony

Our bird: Thick-billed Murre *Uria lomvia*

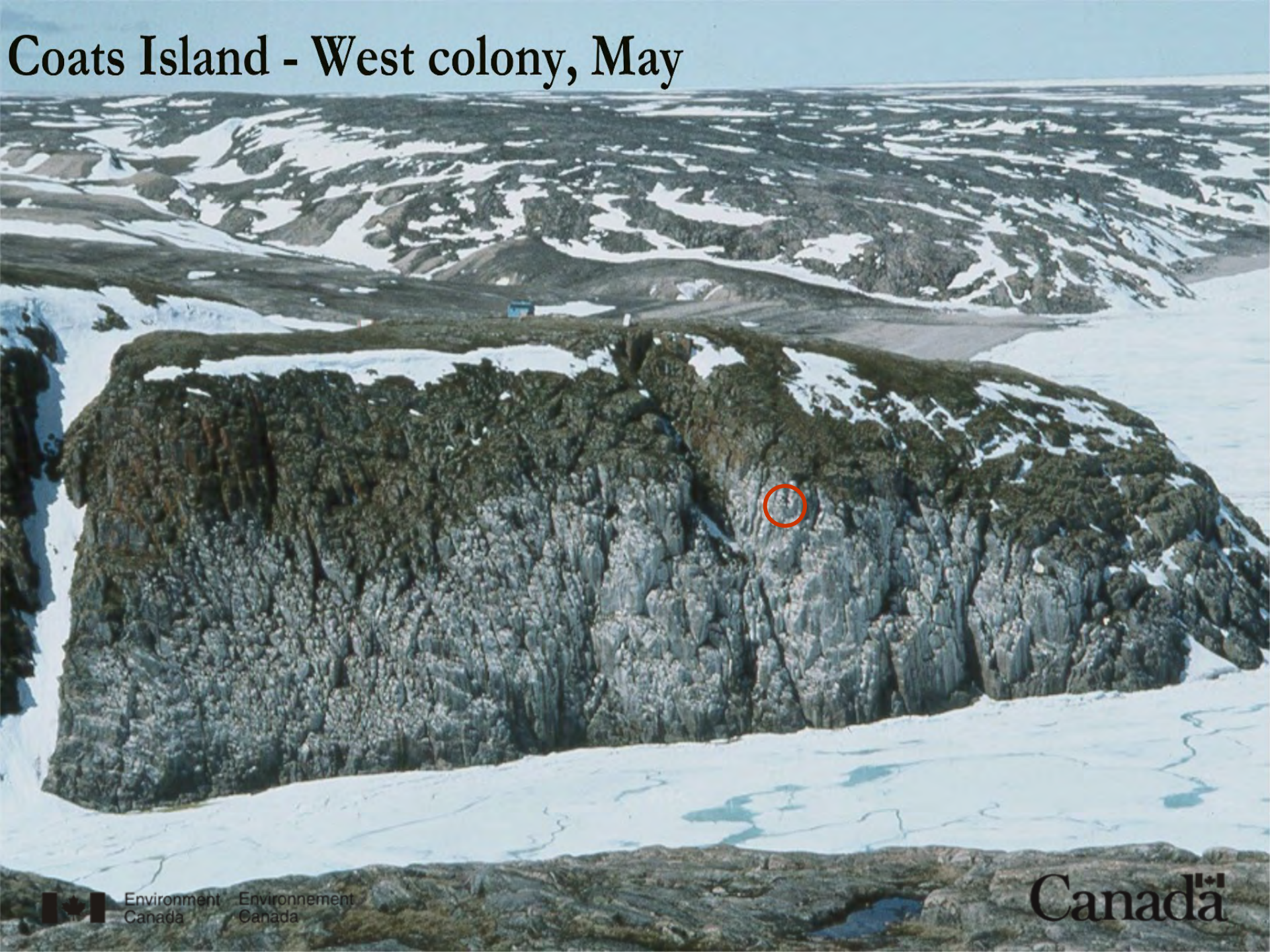
- **Murres dive to 150 m, take invertebrates and fish < 25 cm**
- **>50 species in diet: opportunistic feeders**
- **Dominant seabird throughout Hudson Strait and Bay, Davis Strait and the NW Passage (3 million breeders).**
- **Deliver fish to nestlings held in bill – visible for identification**

So what does the evidence from murre biology tell us about changes to marine ecosystems in the Eastern Arctic?

Comparing Prince Leopold and Coats island colonies

Prince Leopold Island, Nunavut

Coats Island - West colony, May



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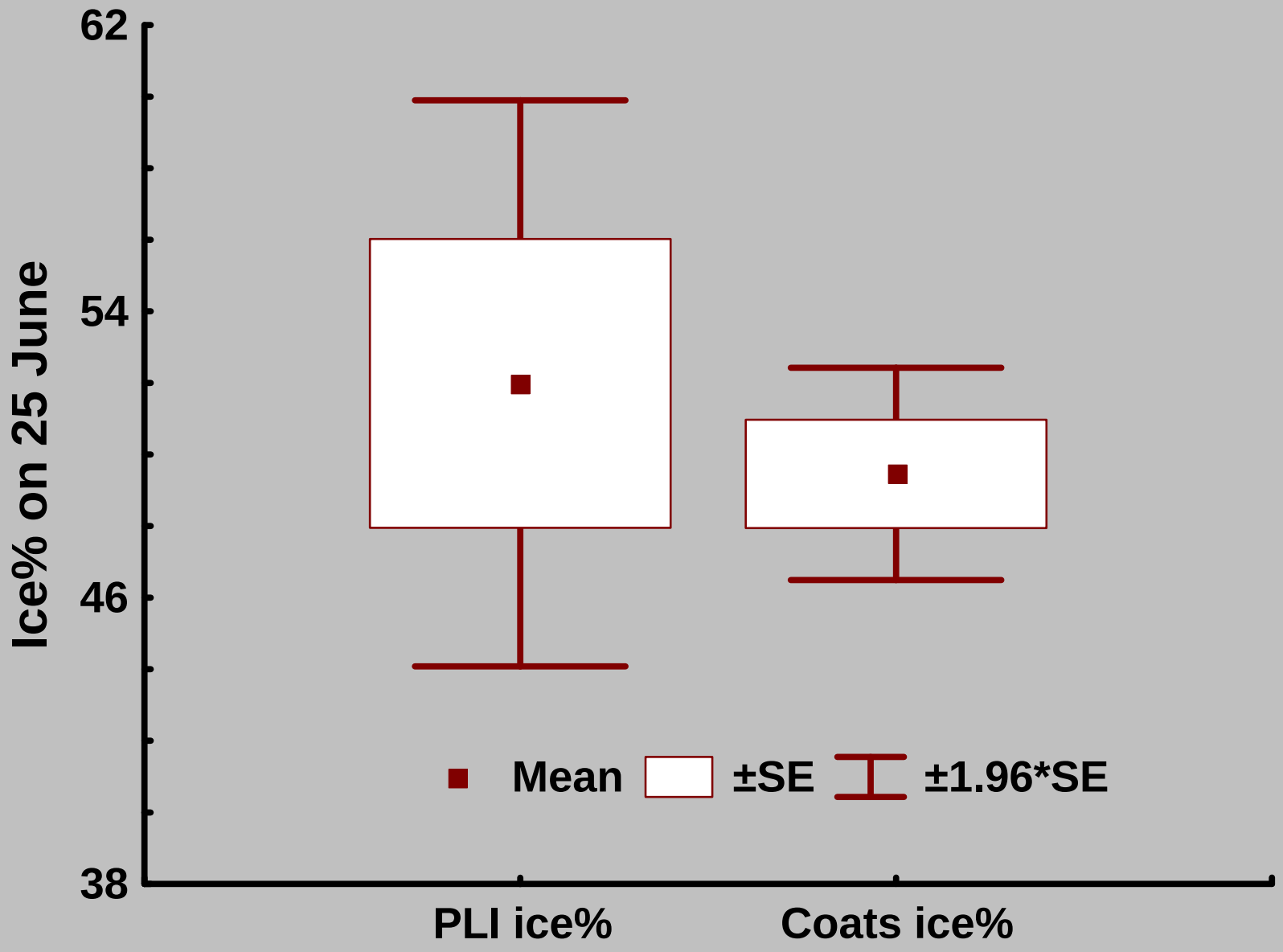
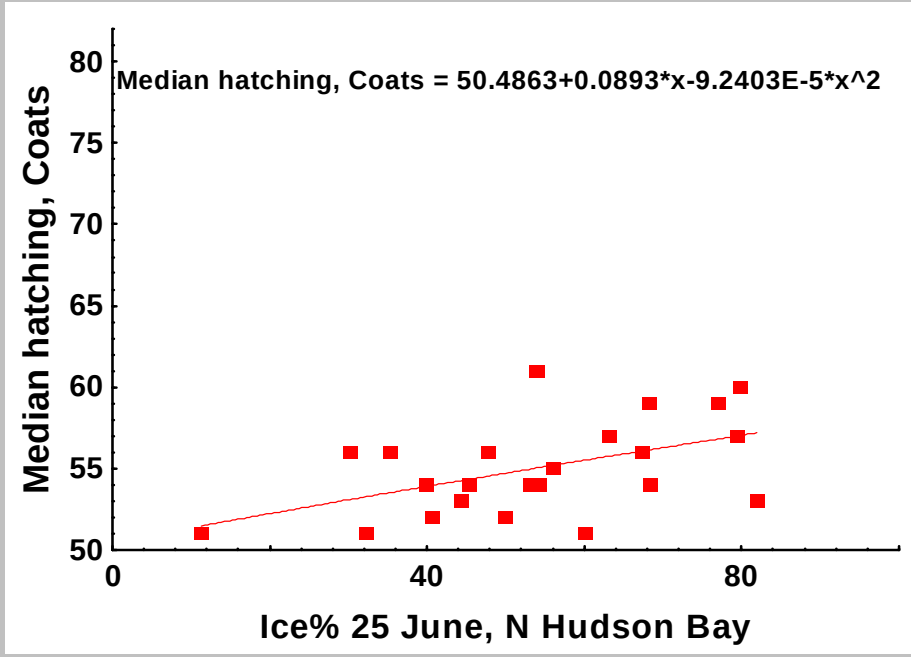
Canada

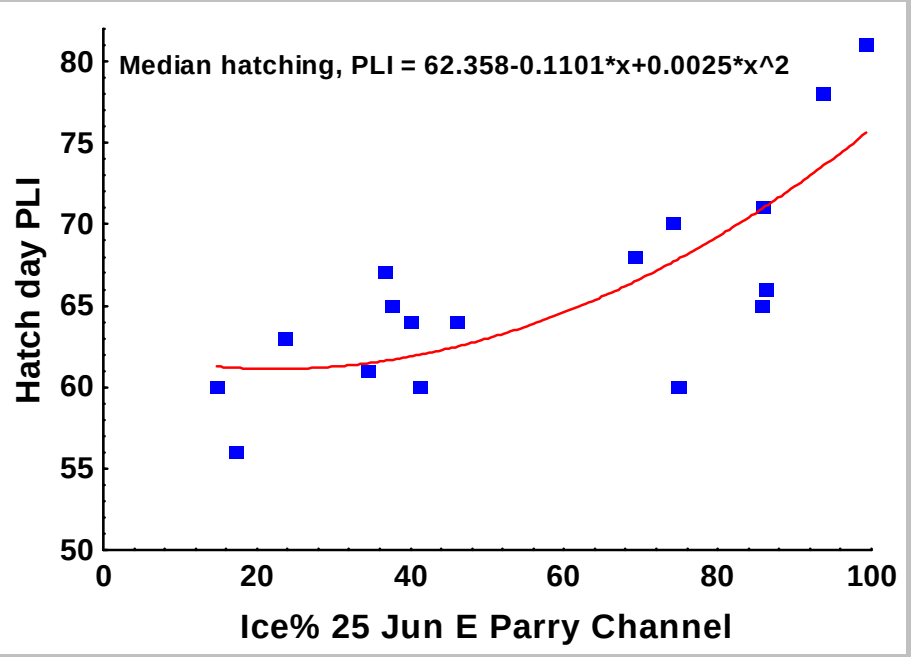
Mean ice% on 25 June (1971-2000) at Prince Leopold and Coats islands



Evidence for variable effects of timing

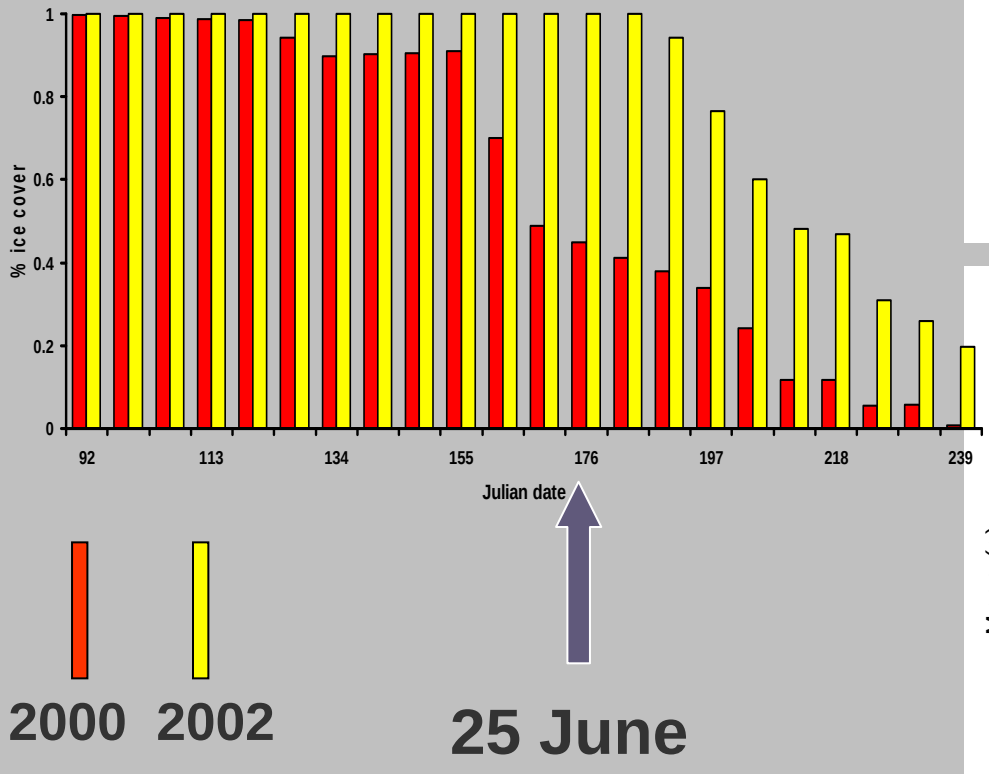


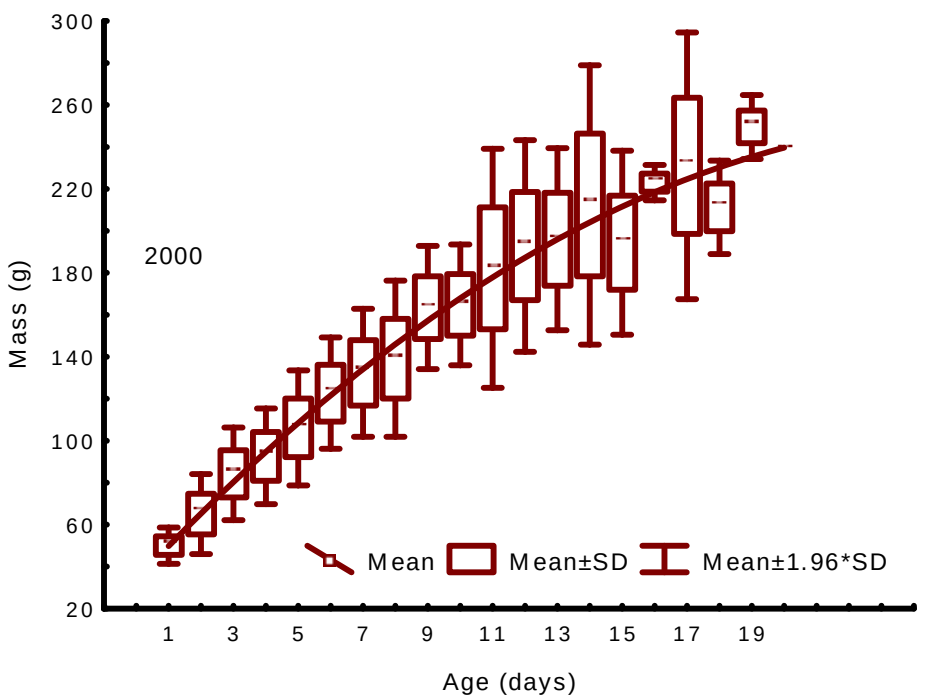
Coats Island

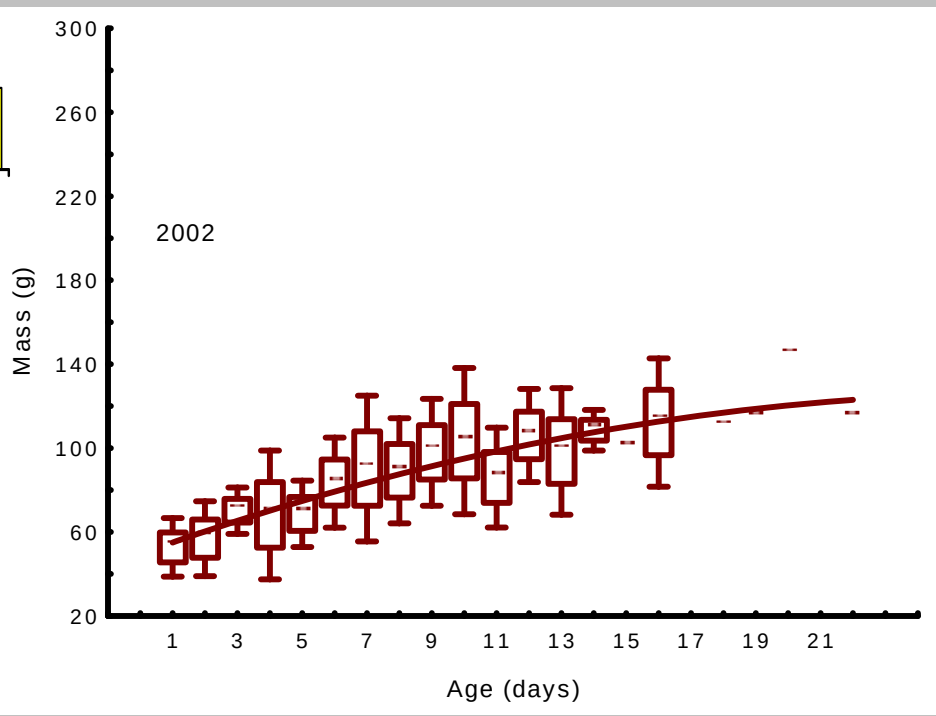


Prince Leopold Island

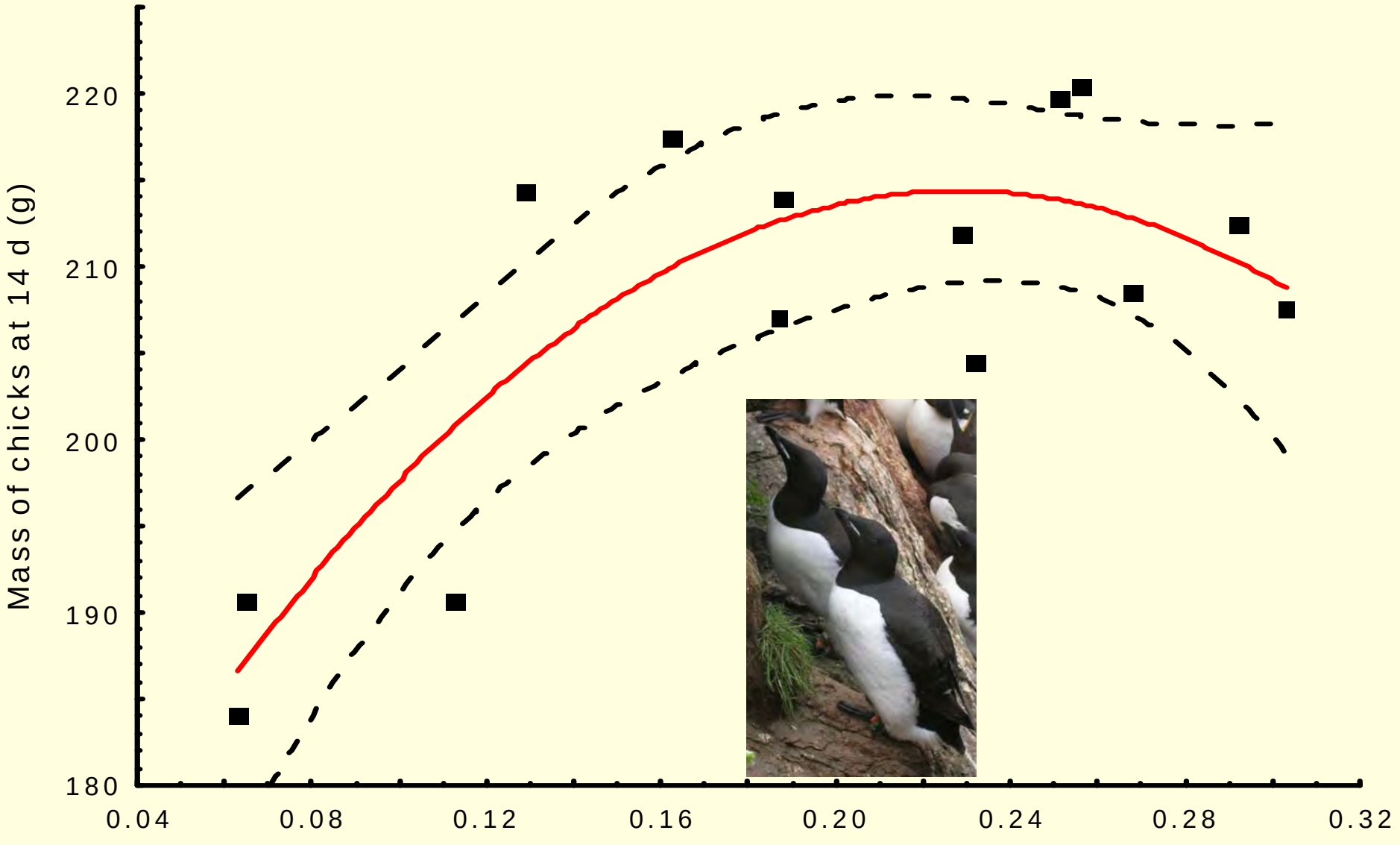
Results of changing ice conditions on chick growth, Prince Leopold

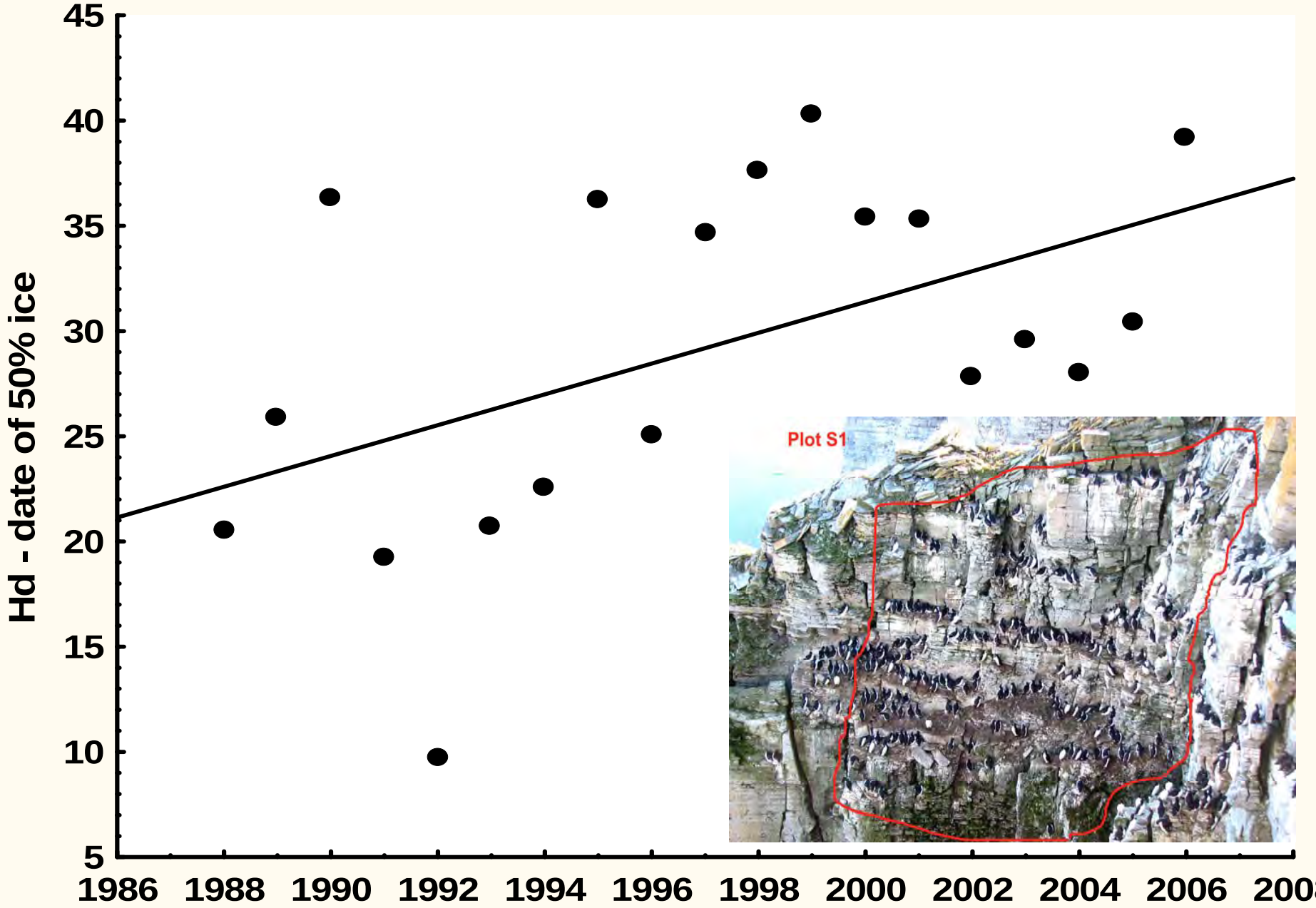




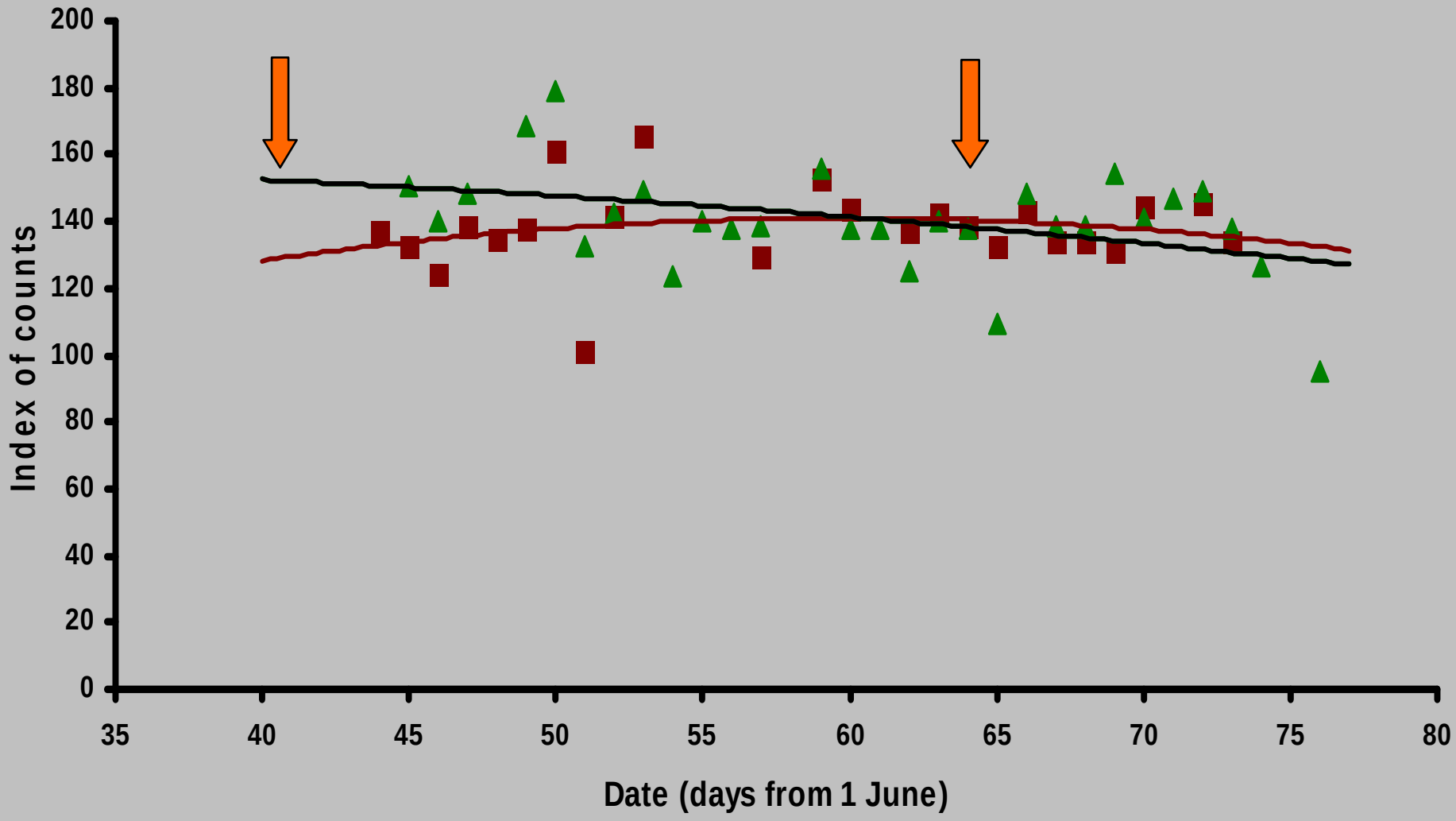


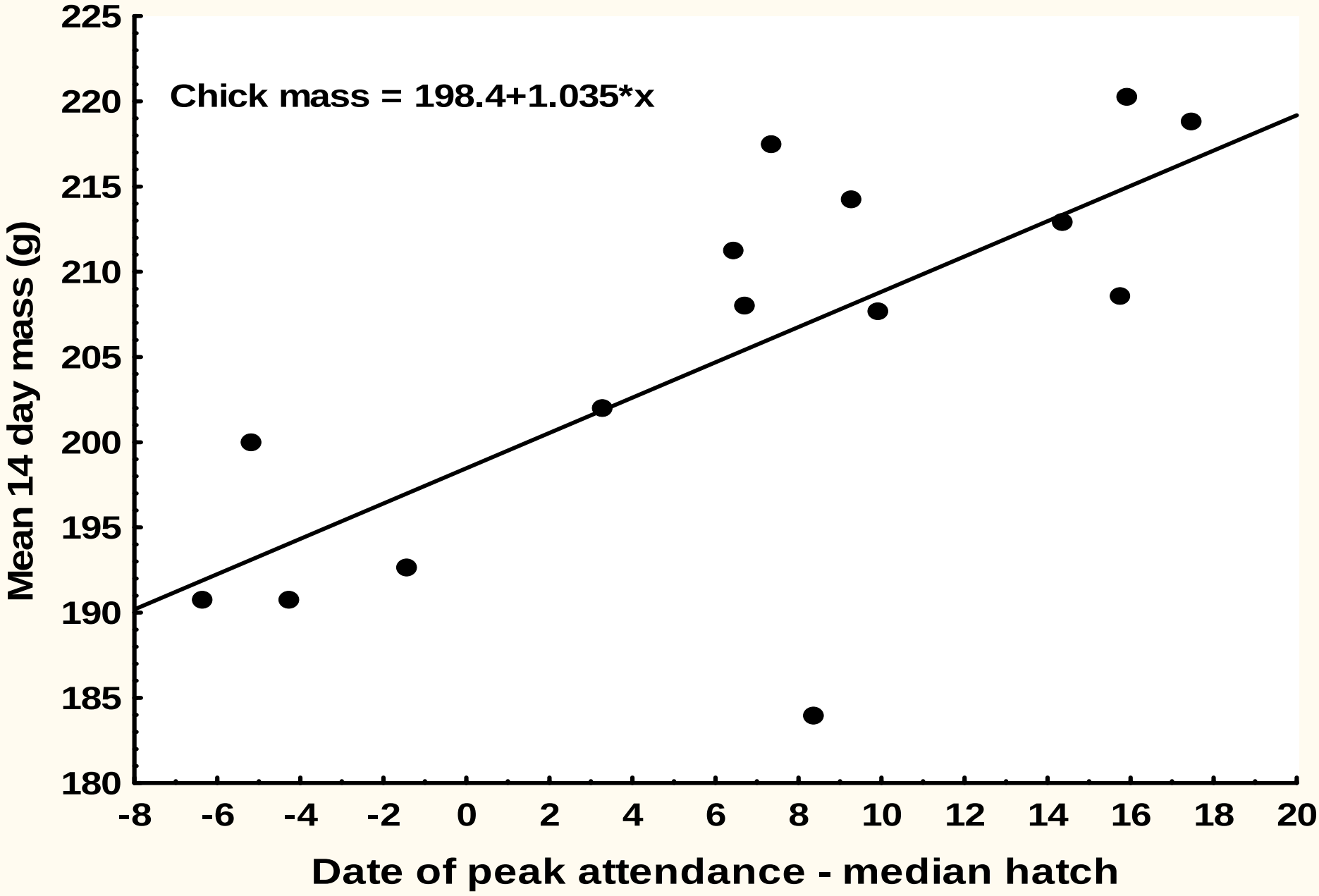
Effect of ice cover on chick growth, Coats




Hd - date of 50% ice
45
40
35
30
25
20
15
10
5
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Plot S1

Timing of peak attendance




Chick mass = 198.4+1.035*x
Mean 14 day mass (g)
225
220
215
210
205
200
195
190
185
180
-8
-6
-4
-2
0
2
4
6
8
10
12
14
16
18
20
Date of peak attendance - median hatch

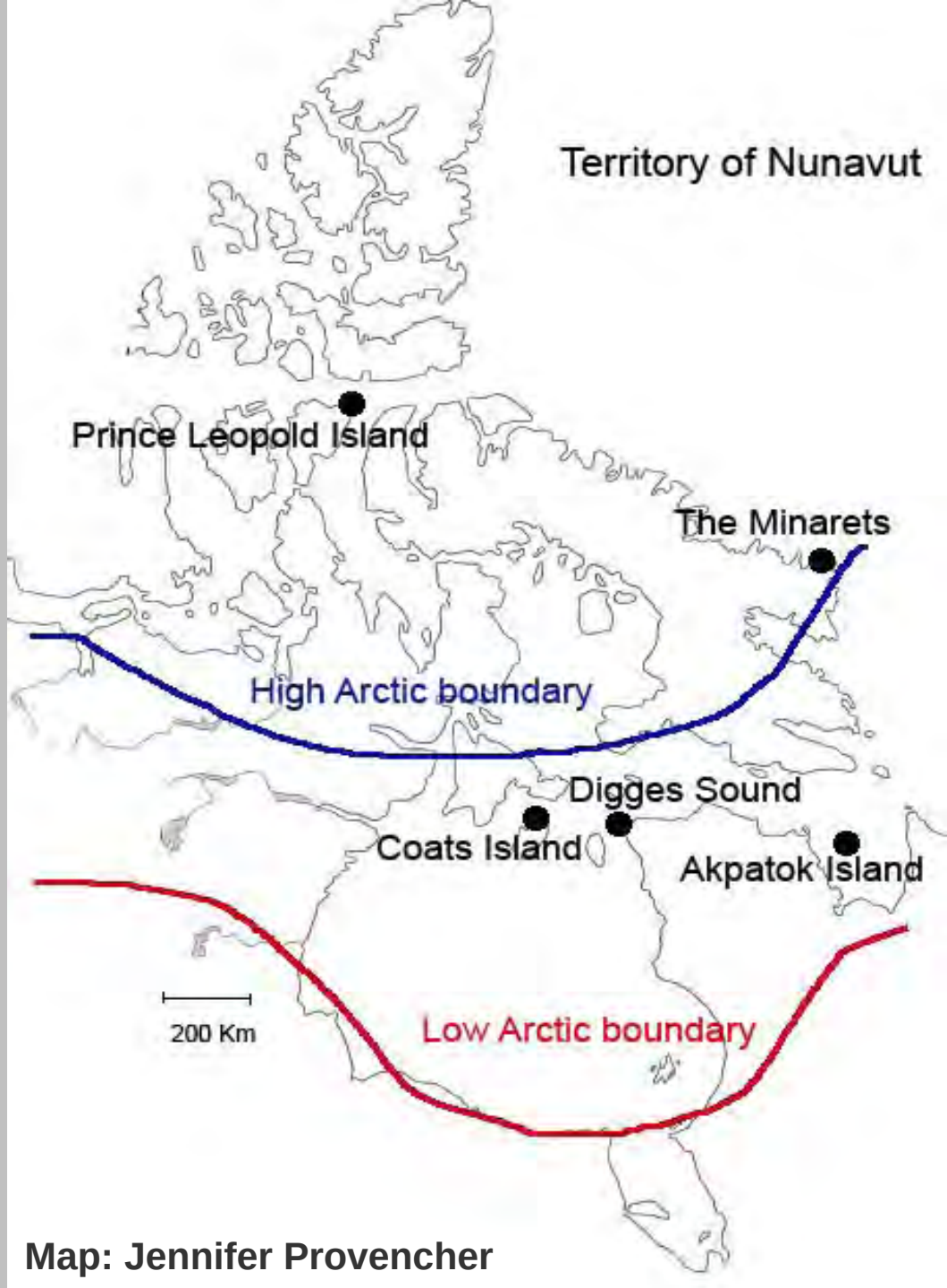
Summary

- Ice conditions *per se* affect nestling growth, but mostly in years of very early ice break-up
- More important in recent decades has been the mismatch between date of peak food availability and date of hatch.

Diet: several lines of evidence…

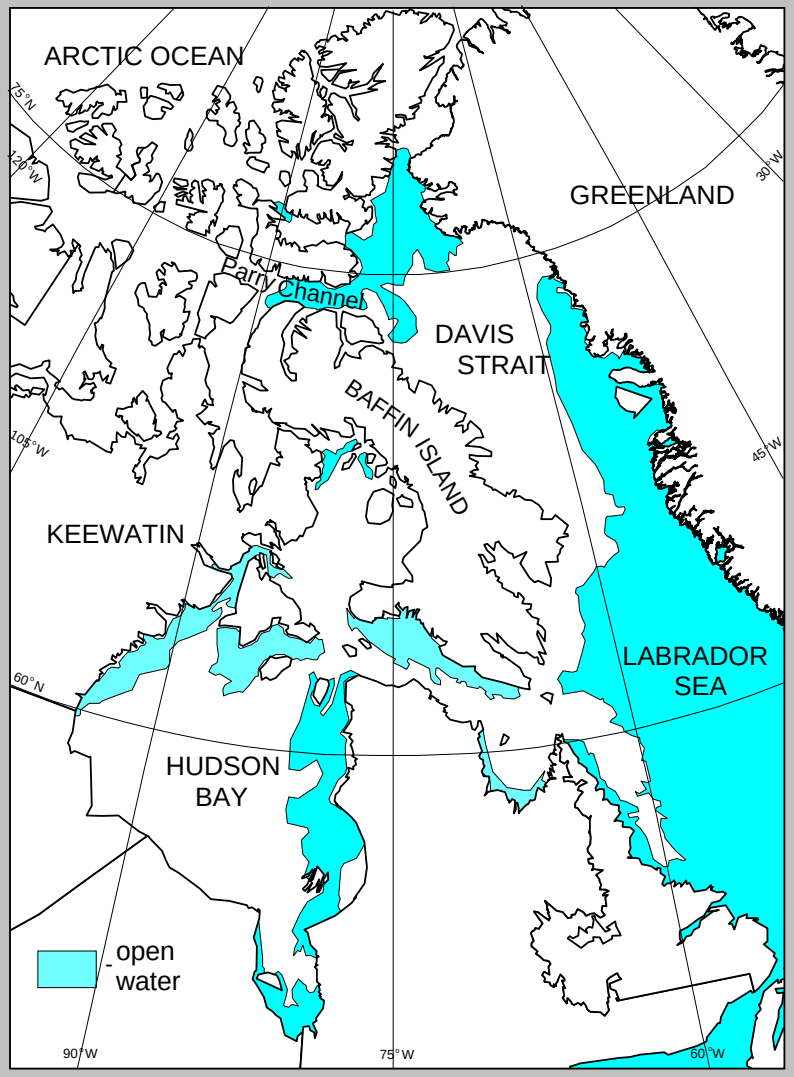
- Differences in diet among low and high Arctic colonies
- Changes in fish consumed by adults between the 1970-80s and the IPY period (2007-09)
- Changes in fish delivered to nestling Thick-billed Murres at Coats Island since 1981

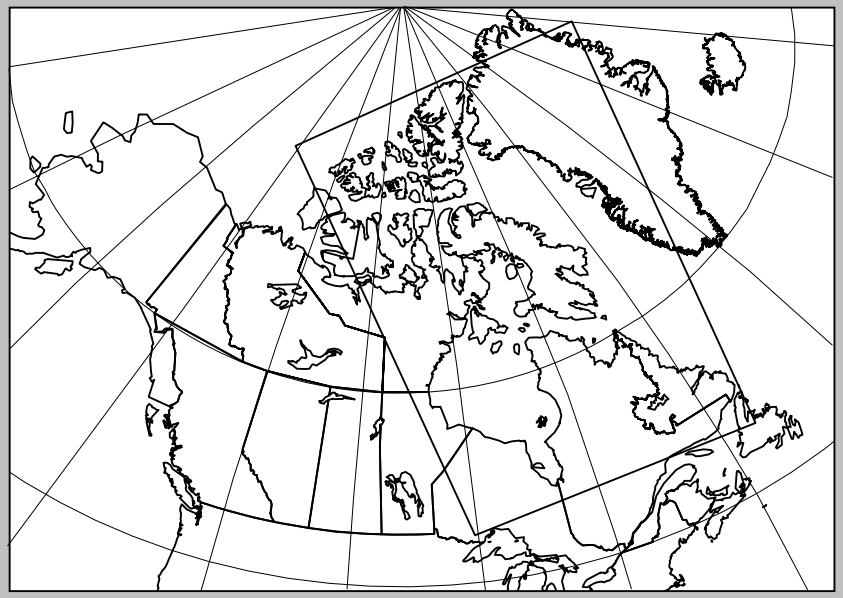
Murre colonies sampled



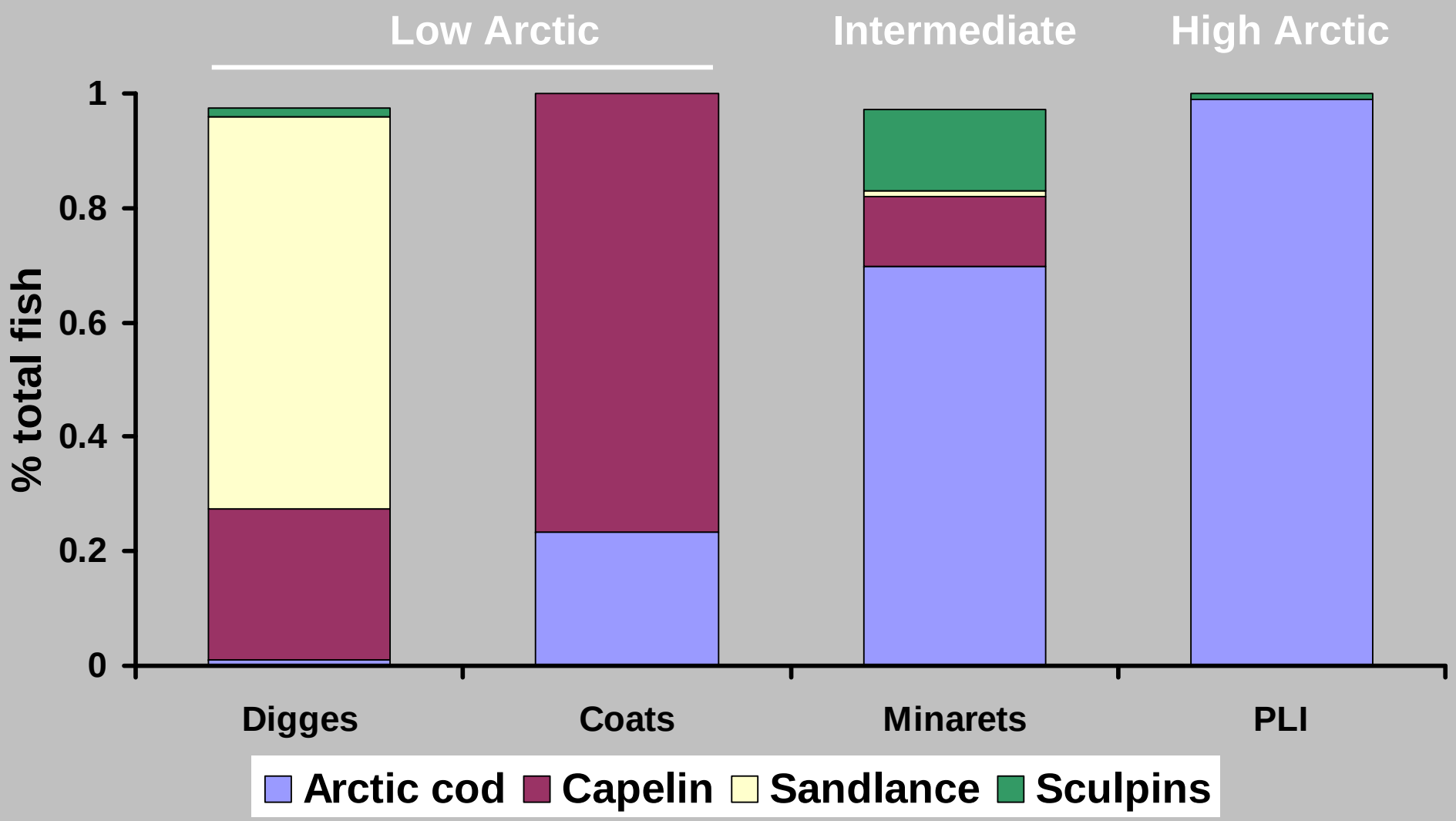
Map: Jennifer Provencher

June ice conditions

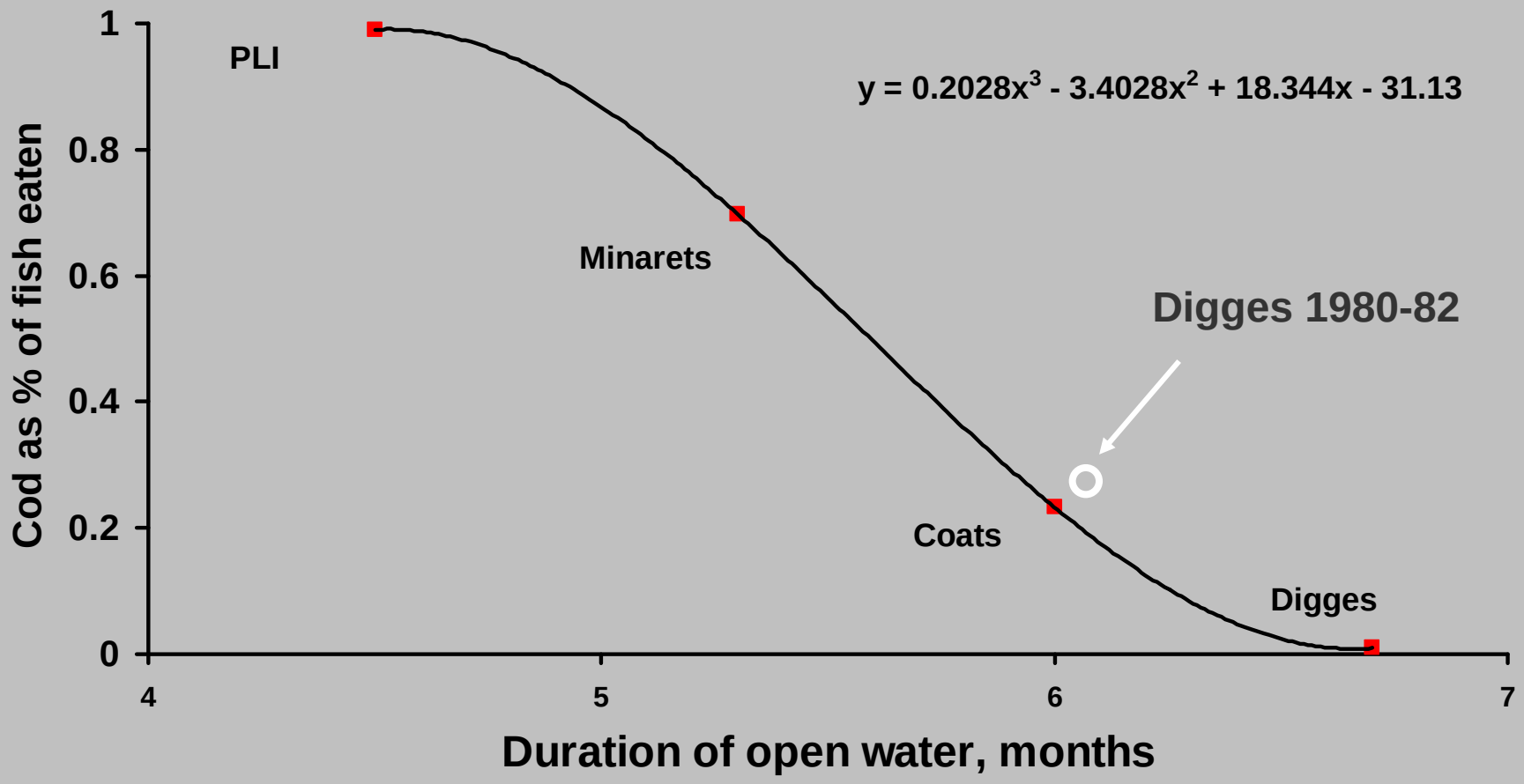




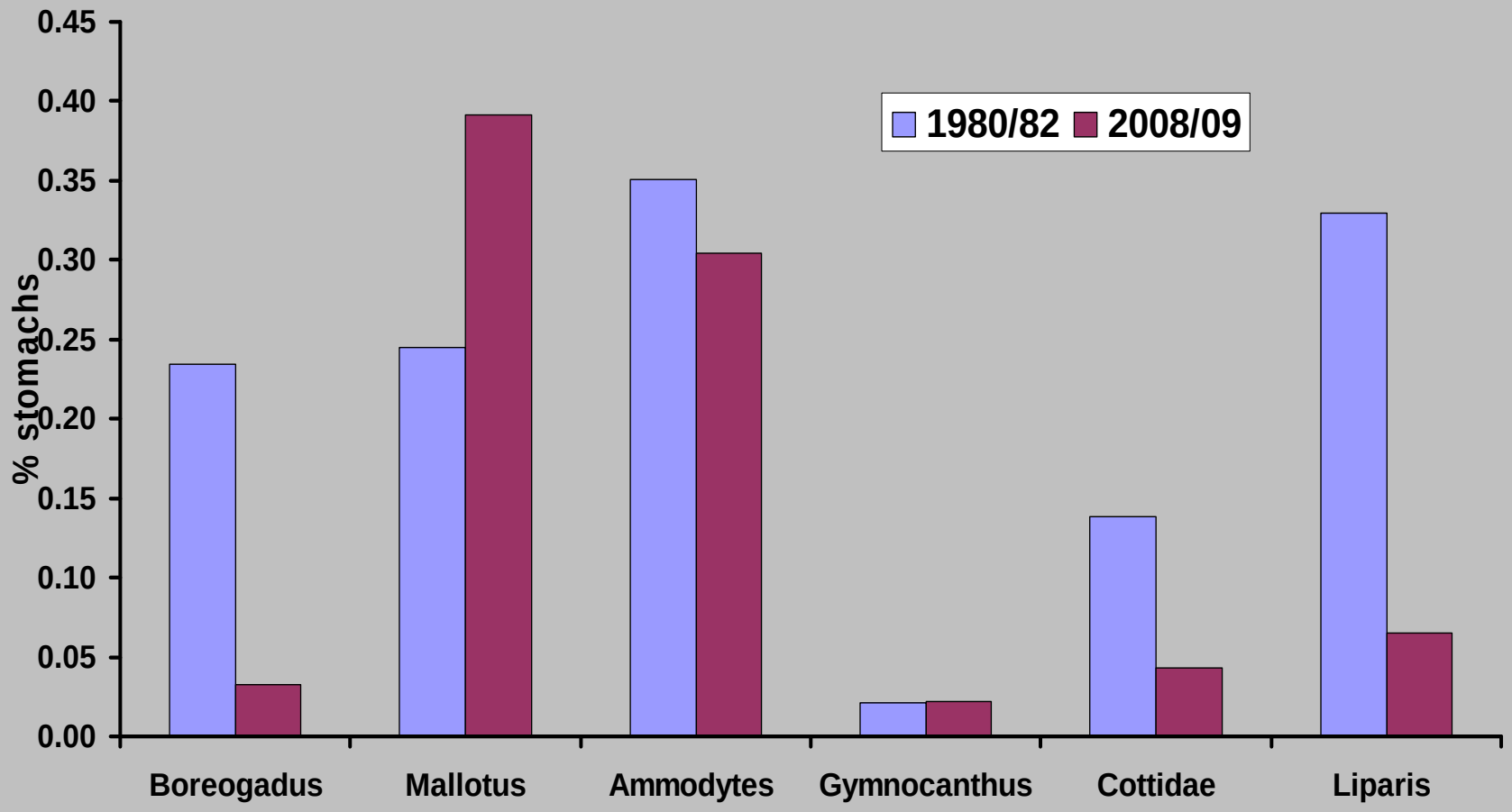
Fish in adult diets, recent



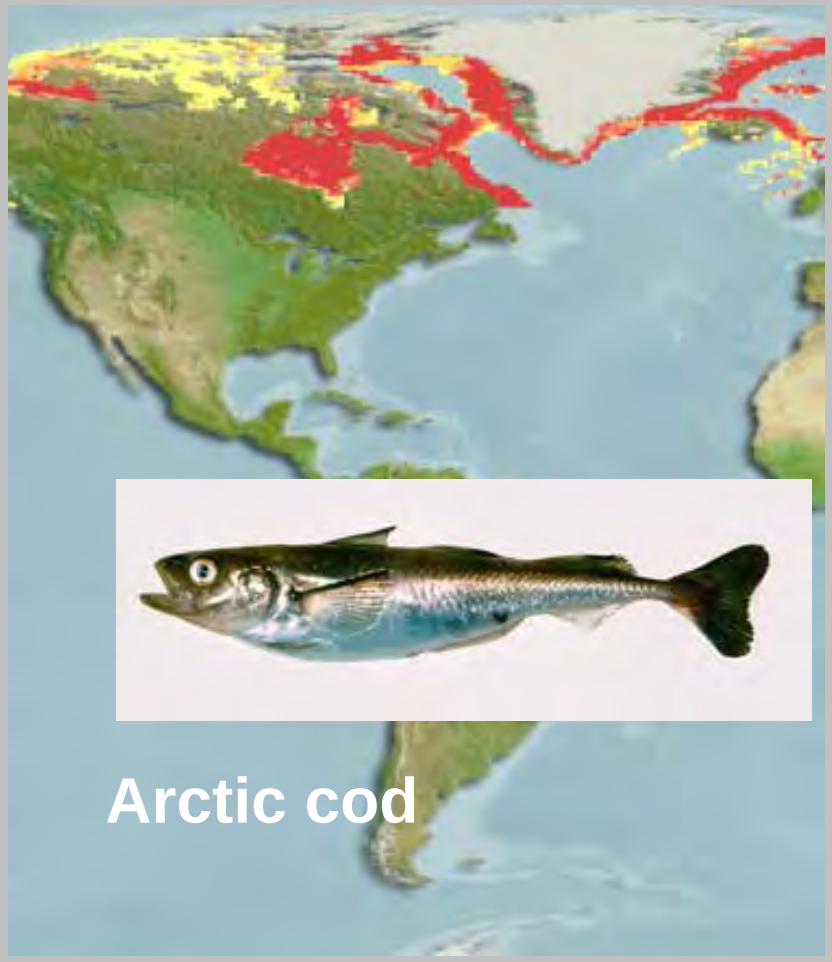
% cod in relation to duration of open water

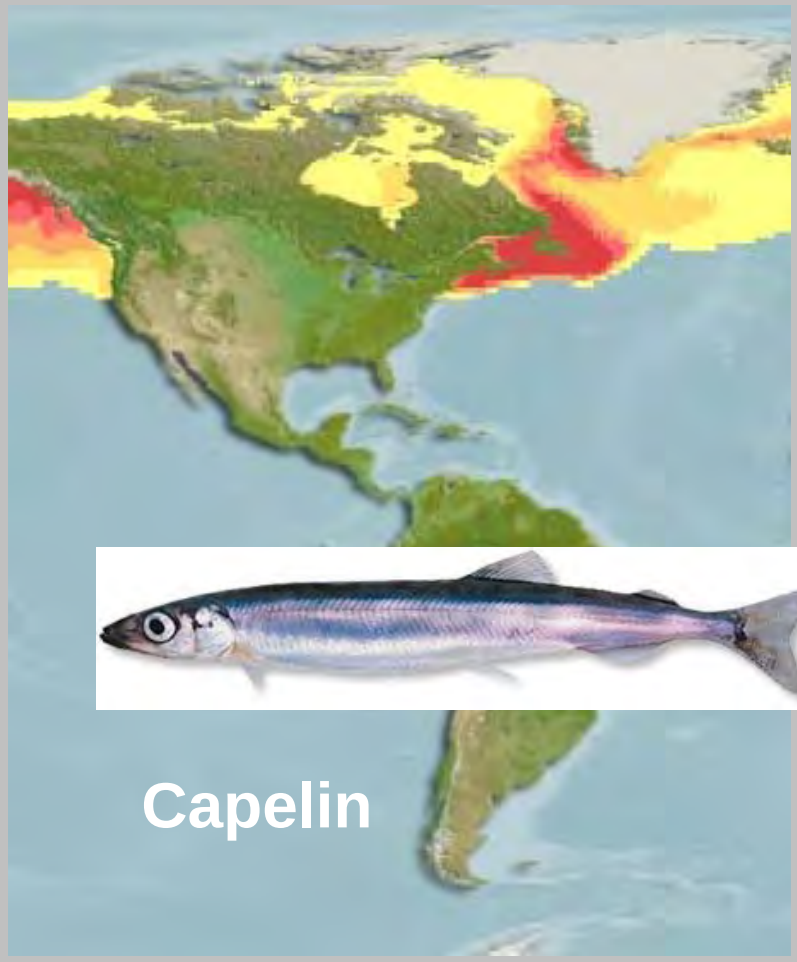


Fish in adult diet, Digges/Ivujivik area



Distributions: Arctic cod vs capelin

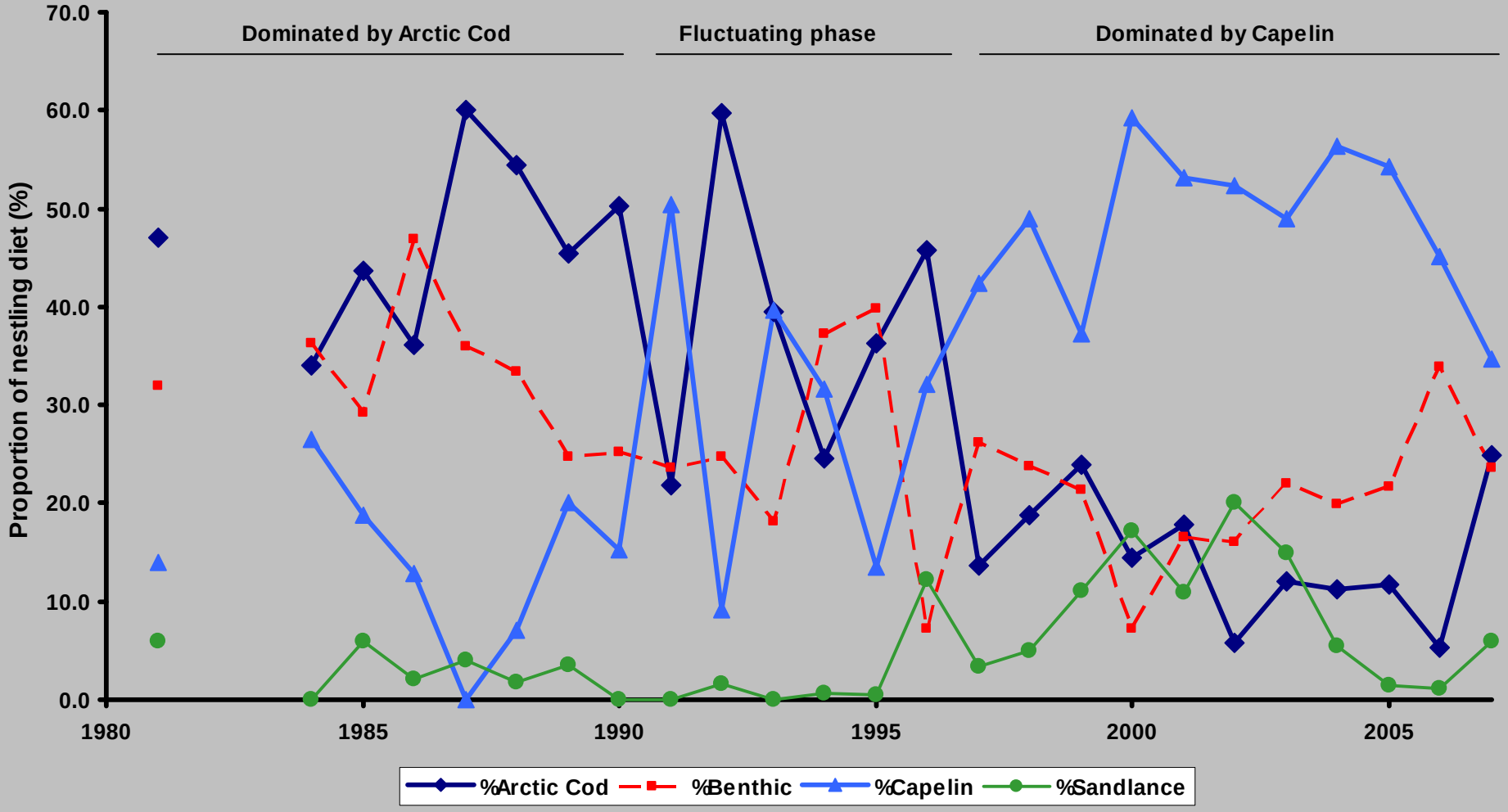




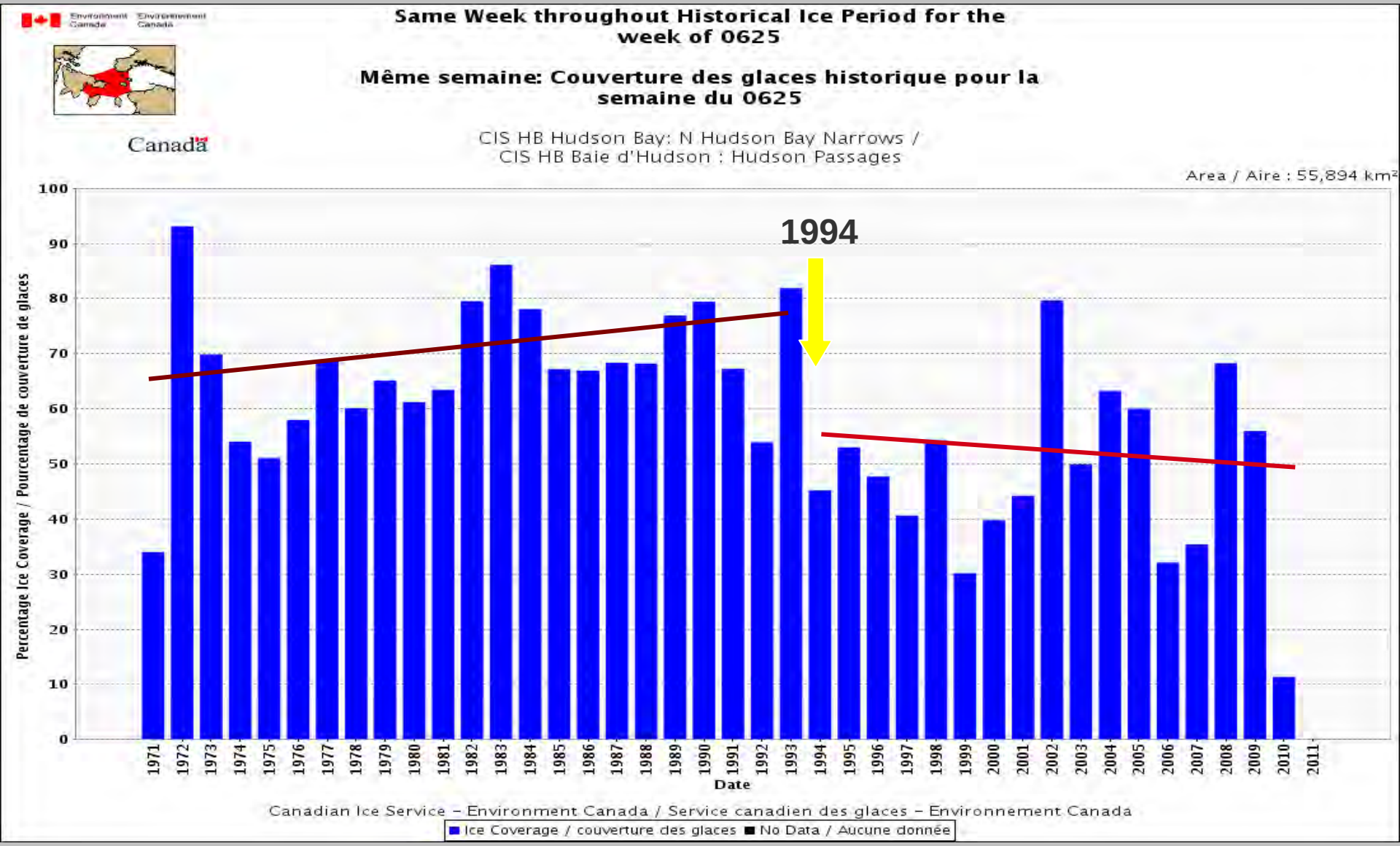
Coats Island study plot – the view from the blind

Field guide to the fish…

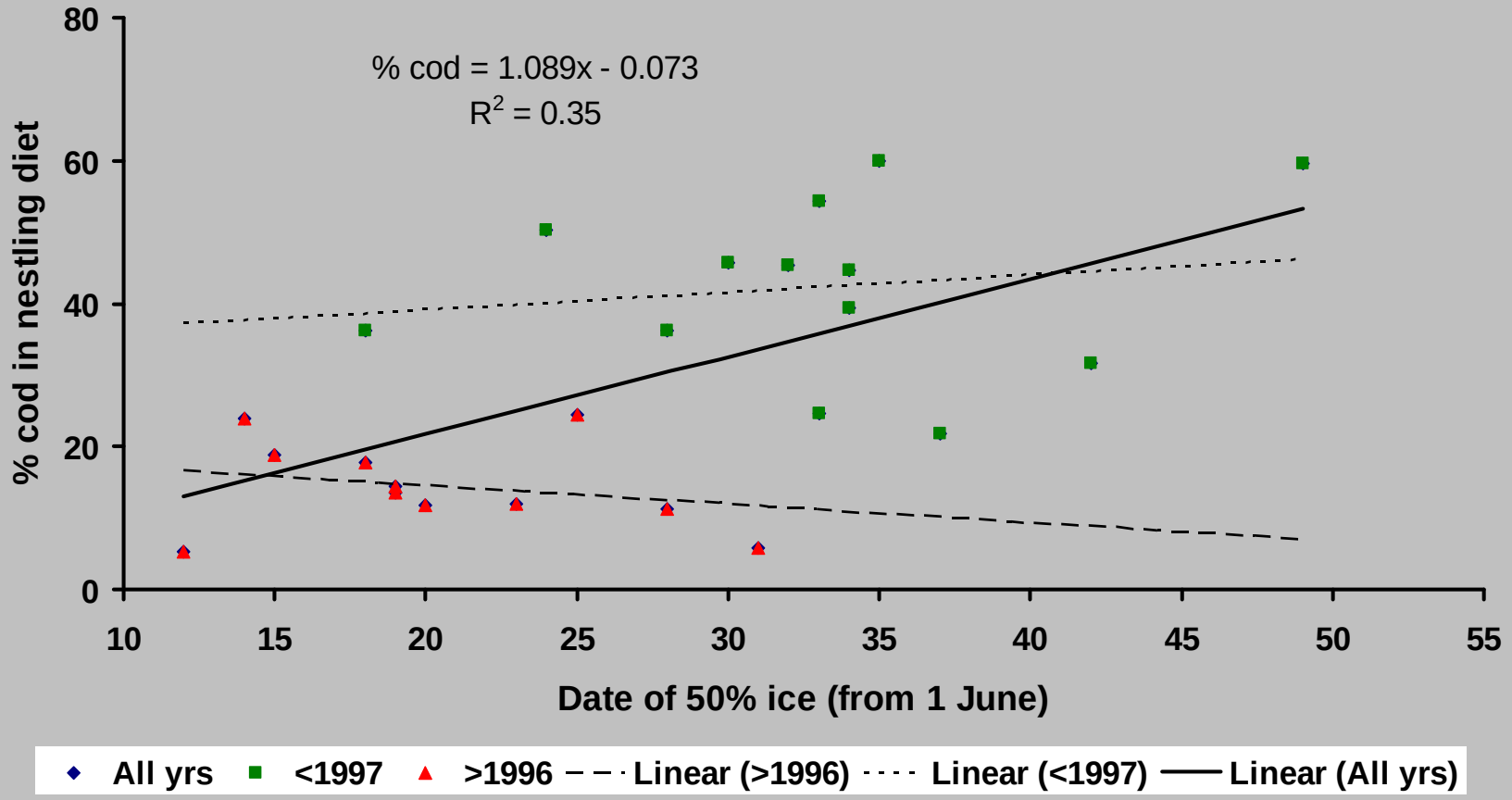
Trends in nestling diets at Coats Island



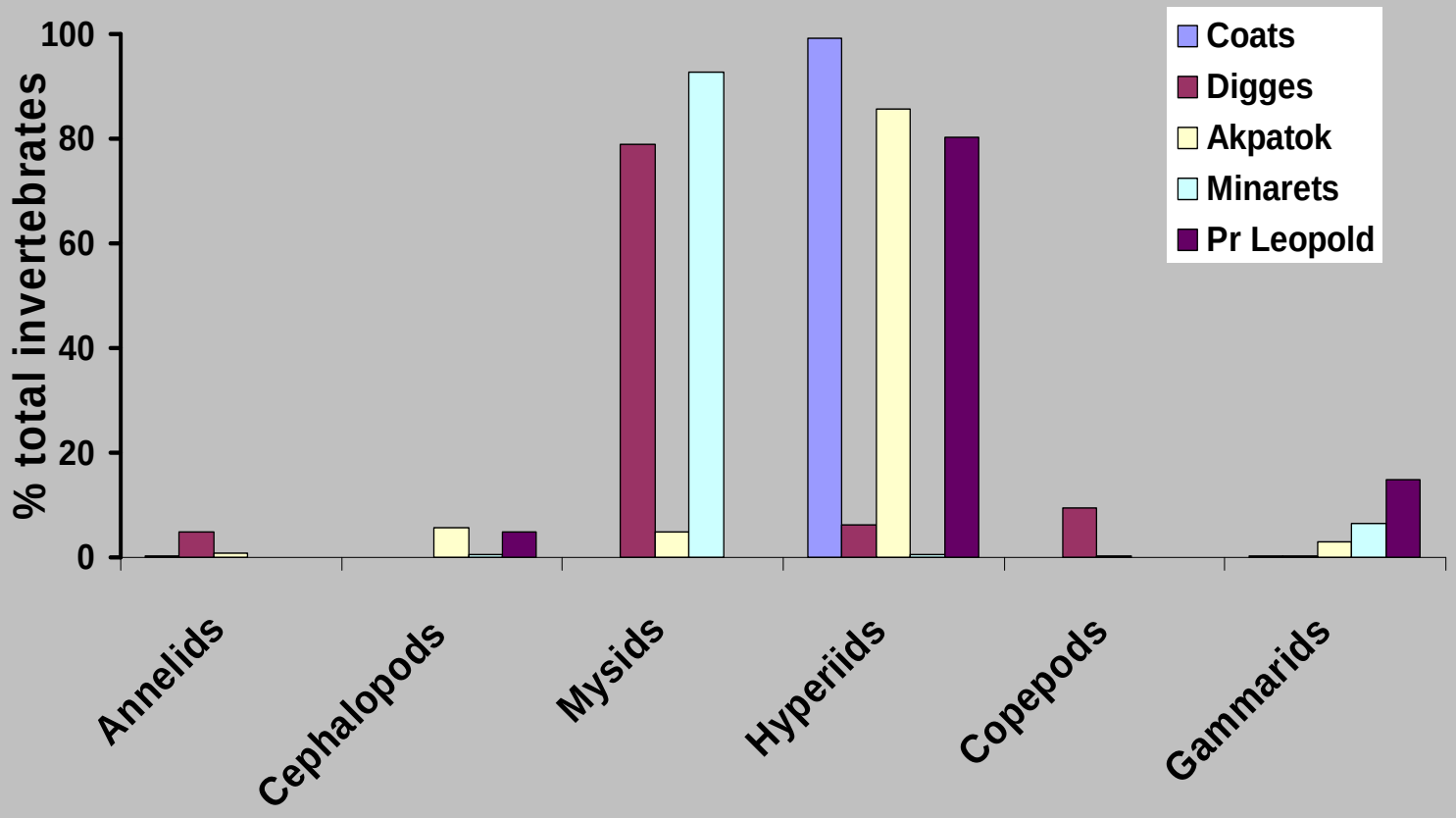
Changes in ice% on 25 June, NE Hudson Bay



% cod in relation to date of 50% ice

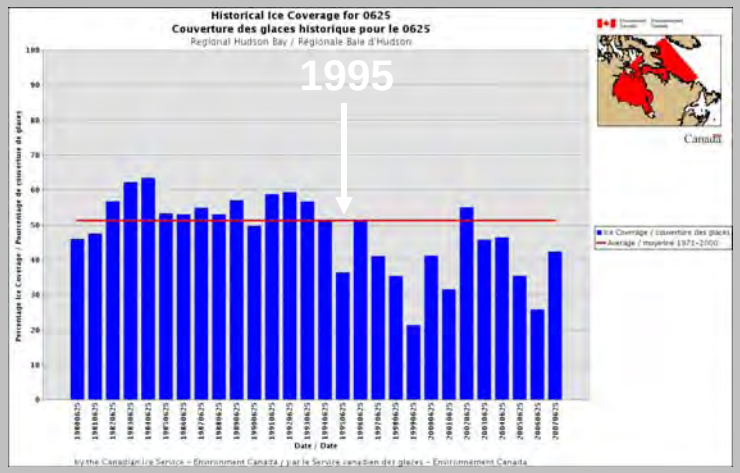


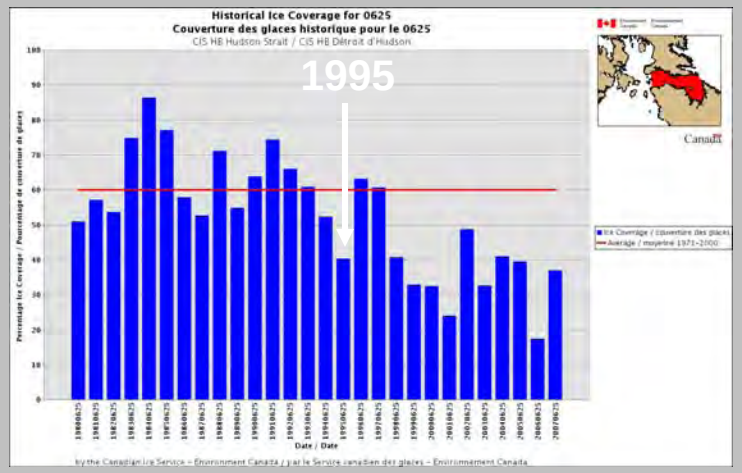
Representation of invertebrates in adult diets

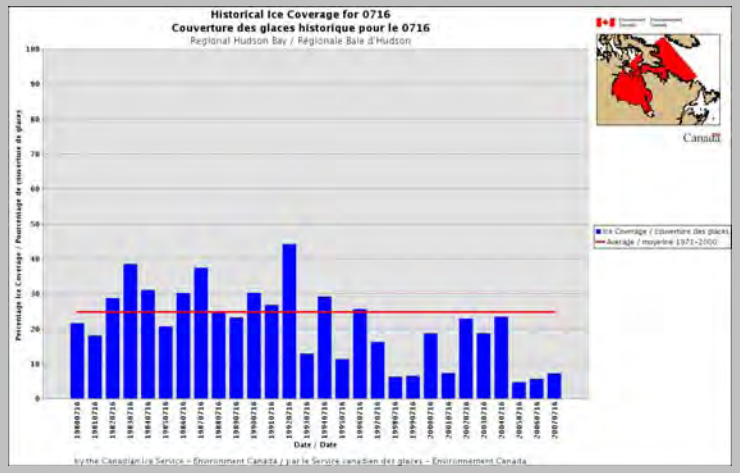


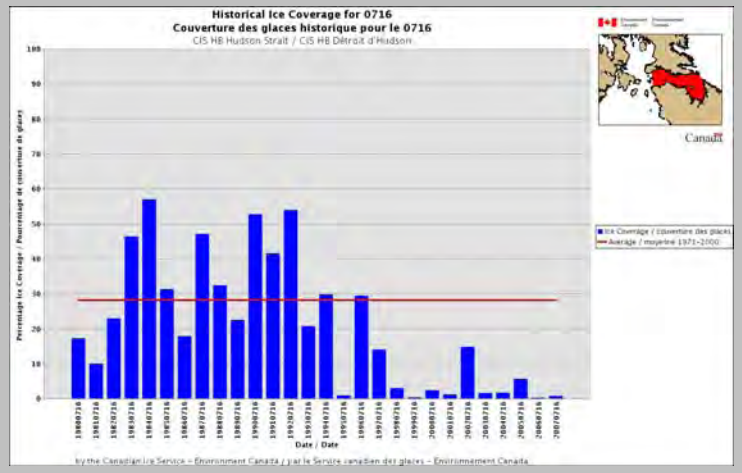
Changes in ice conditions, 1980-present, during Thick-billed Murre incubation period

25 June









16 July

Summary, murre diets

- Fish species taken by Thick-billed Murres vary from Low to High Arctic with an increasing proportion of Arctic cod as ice-free season diminishes
- Changes in ice conditions have been associated with a decline in Arctic cod taken by murres at Low Arctic and intermediate colonies and an increase in capelin
- This change has been step-like, rather than continuous at Coats Island – possibly a characteristic of climate-driven changes

Thanks to…

- Federal International Polar Year Programme; Natural Sciences and Environment Research Council; Polar Continental Shelf Project of Natural Resources Canada; Nunavut Research Institte; Qiqiktarjuaq HTO; Environment Canada, S&T Branch

- Jason Akearok, Gail Davoren, Garry Donaldson, Christine Eberl, April Hedd, Timothy Lash, Bill Montevecchi, Jo Nakoolak, Rob Rankin, Stacey Robinson, Guy Savard, Paul Smith, Steve Smith, Sandy Super, Ilya Storm, Julia Szucs


Thank you for listening