Glacier fronts and marine mammals in Svalbard

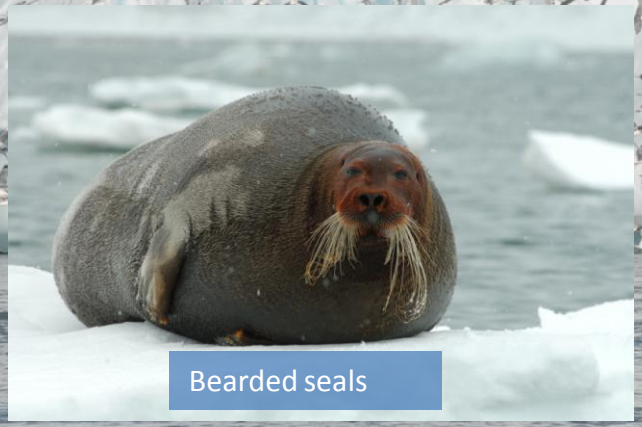
Christian Lydersen
Norwegian Polar Institute



Ringed seals



Polar bears



Bearded seals



White whales

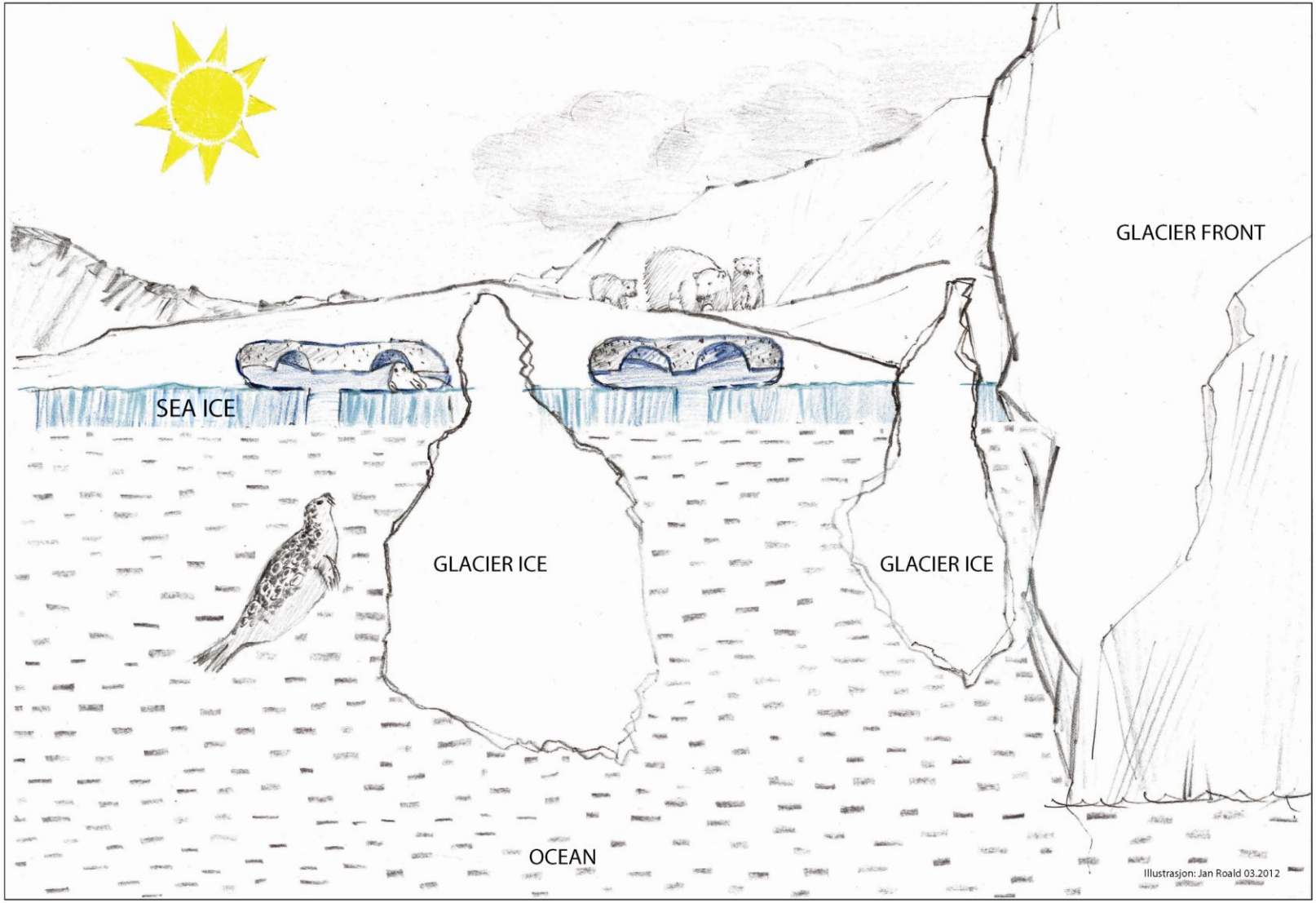
Glacier fronts and marine mammals (winter/spring – with sea ice cover):



- Areas in front of glaciers are the prime pupping habitat for ringed seals in Svalbard[1]
- Important hunting area for polar bears, especially females with cubs in the first period after they leave their den[2]
- White whales and bearded seals – outside the fast-ice edge

1. Lydersen, C. 1998. Status and biology of ringed seals (*Phoca hispida*) in Svalbard. NAMMCO Sci. Publ. 1: 46-62

2. Freitas, C., Kovacs, K.M., Andersen, M., Aars, J., Sandven, S., Skern-Mauritzen, M., Pavlova, O. & Lydersen, C. 2012. Importance of fast ice and glacier fronts for female polar bears and their cubs during spring in Svalbard, Norway. **Mar. Ecol. Progr. Ser.** 447: 289-304.



From: Lydersen, C., Assmy, P., Falk-Petersen, S., Kohler, J., Kovacs, K. M., Reigstad, M., Steen, H., Strøm, H., Sundfjord, A., Varpe, Ø., Walczowski, W. Weslawski, J. M. and Zajaczkowski, M. 2014. The importance of tidewater glaciers for marine mammals and seabirds in Svalbard, Norway. **J. Mar. Syst.** 129: 452-471.

Glacier fronts and marine mammals (winter/spring – without sea ice cover):

- Ringed seals – non-breeding animals stay close to glacier fronts[1]
- Breeding animals must move elsewhere (search for sea ice for pupping – never observed to give birth on shore)

- Adult polar bear females (N=67) (only age/sex group instrumented) stay about one third of recorded time close to glacier fronts[2]

- White whales – no data for this period

- 1. Hamilton, C. D., Lydersen, C., Ims, R.A. and Kovacs, K. M. 2016. Coastal habitat use by ringed seals *Pusa hispida* following a regional sea-ice collapse: importance of glacial refugia in a changing Arctic. **Mar. Ecol. Progr. Ser.** 545: 261-277.

- 2. Hamilton, C. D., Kovacs, K. M., Ims, R. A., Aars, J. & Lydersen, C. Reduced spatial overlap between a predator and its primary prey: polar bears and ringed seals under an altered sea-ice regime In prep

Glacier fronts and marine mammals (winter/spring – without sea ice cover):

- Bearded seals normally pup on small ice floes outside the fast–ice or at the outer edge of the fast-ice [1]

- With no sea ice they pup on glacier ice pieces [2] (pups strong enough to pull themselves up on these high, irregularliy shaped structures)

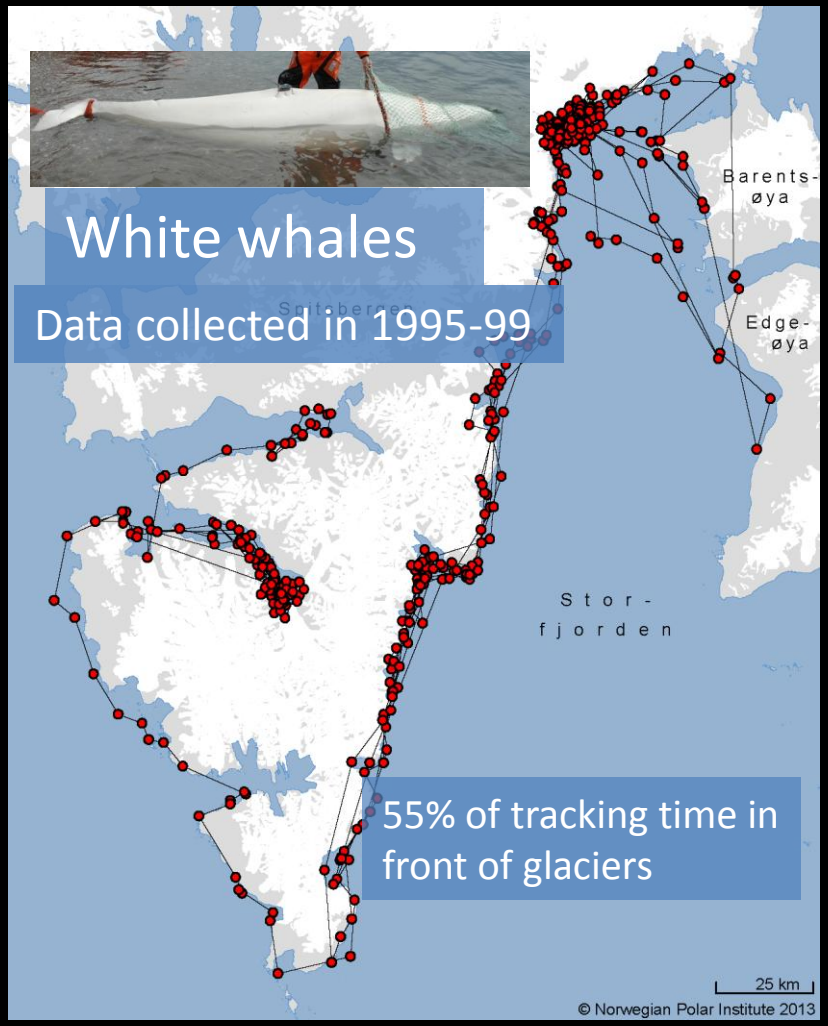
-

- 1. Kovacs, K. M., Lydersen, C. and Gjertz, I. 1996. Birth site characteristics and prenatal molting in bearded seals (*Erignathus barbatus*). **J. Mammal.** 77: 1085-1091.

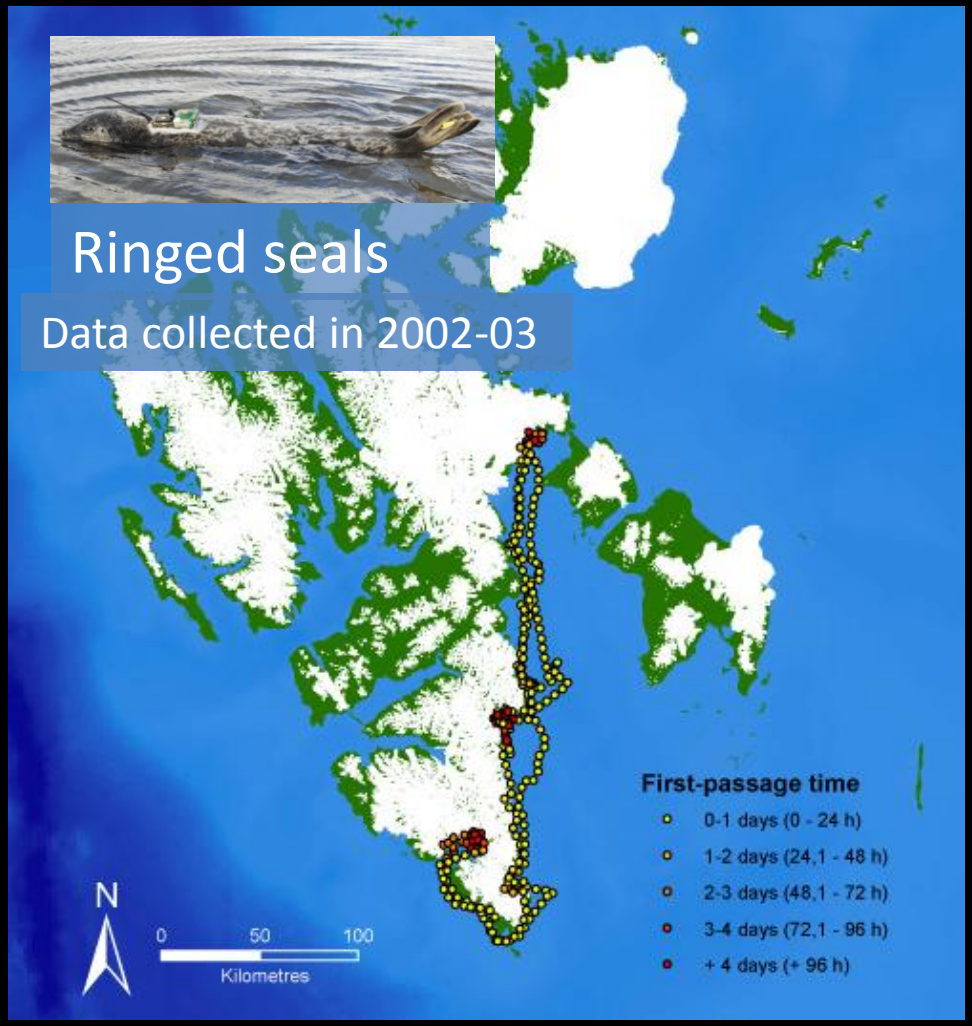
- 2. Kovacs, K. M., Lydersen, C., Overland, J. E. and Moore, S. E. 2011. Impacts of changing sea-ice conditions on Arctic marine mammals. **Mar. Biodiv.** 41: 181-194.

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Glacier fronts and marine mammals (summer– no sea ice):

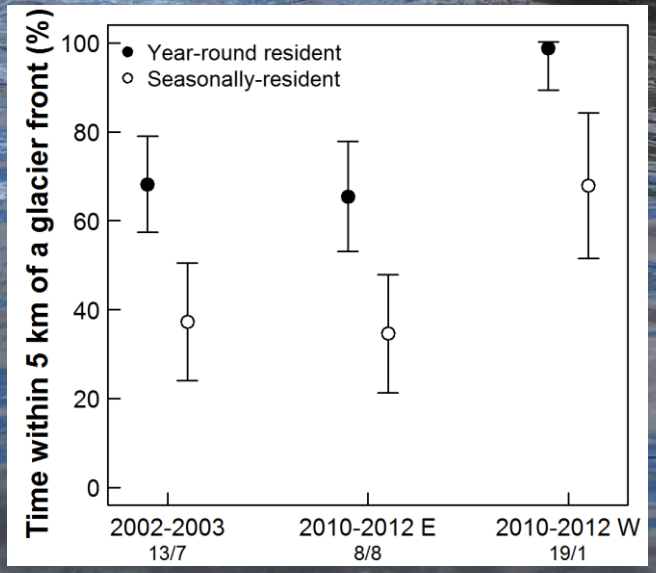


Modified from: Lydersen, C., Martin, A. R., Kovacs, K. M. and Gjertz, I. 2001. Summer and autumn movements of white whales (*Delphinapterus leucas*) in Svalbard, Norway. **Mar. Ecol. Progr. Ser.** 219: 265-274.



Modified from: Freitas, C., Kovacs, K. M., Ims, R. A., Fedak, M. A. and Lydersen C. 2008. Ringed seal post-moulting movement tactics and habitat selection. **Oecologia** 155: 193-204 .

Glacier fronts and marine mammals (summer– no sea ice): Ringed seals



The proportion of time spent within 5 km of a glacier front (%; mean ± 95% CI) for 57 seasonally-resident (white circles) and year-round resident (black circles) ringed seals equipped with Satellite-Relay Data Loggers (SRDLs) in Svalbard, Norway in 2002-2003, 2010-2012 on the east coast and 2010-2012 on the west coast. Sample size is shown below the x-axis with the number of seasonally-resident seals and year-round resident seals before and after the dash, respectively, for the three groups

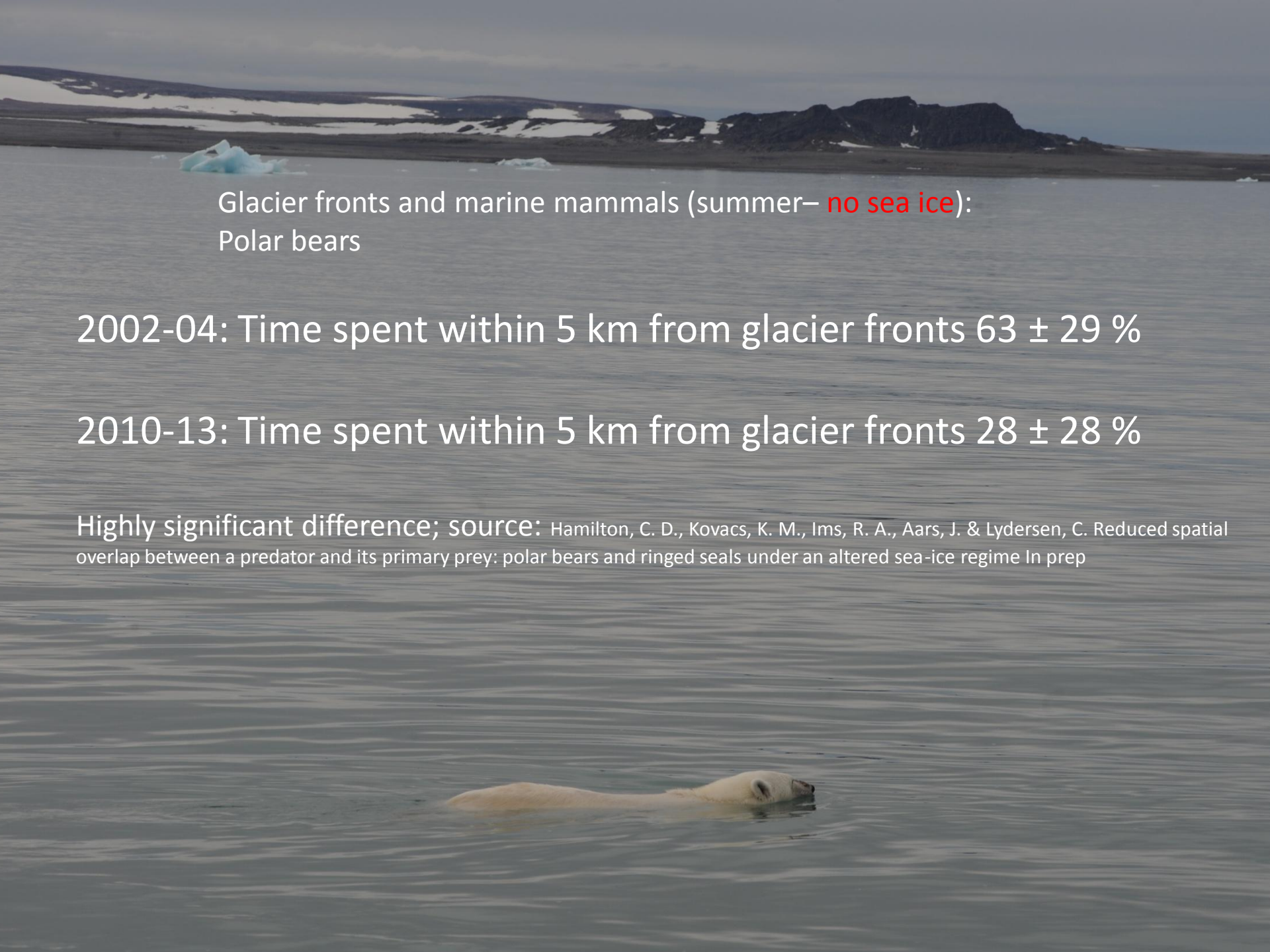
Data from: Hamilton, C. D., Lydersen, C., Ims, R.A. and Kovacs, K. M. 2016. Coastal habitat use by ringed seals *Pusa hispida* following a regional sea-ice collapse: importance of glacial refugia in a changing Arctic. **Mar. Ecol. Progr. Ser.** 545: 261-277.

Glacier fronts and marine mammals (summer– no sea ice):
Polar bears

2002-04: Time spent within 5 km from glacier fronts 63 ± 29 %

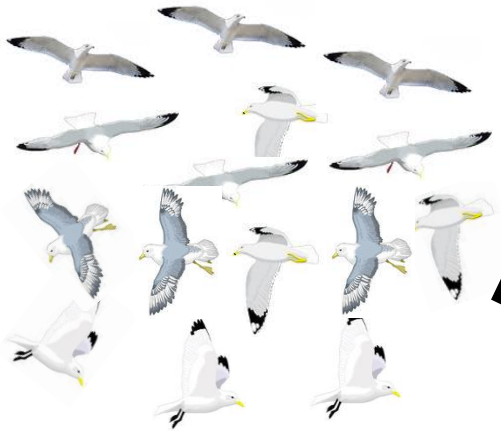
2010-13: Time spent within 5 km from glacier fronts 28 ± 28 %

Highly significant difference; source: Hamilton, C. D., Kovacs, K. M., Ims, R. A., Aars, J. & Lydersen, C. Reduced spatial overlap between a predator and its primary prey: polar bears and ringed seals under an altered sea-ice regime In prep



Why spend time at glacier fronts?





Katabatic winds

0

40

80

120

Sill

Kronebreen

Modified from: Lydersen, C., Assmy, P., Falk-Petersen, S., Kohler, J., Kovacs, K. M., Reigstad, M., Steen, H., Strøm, H., Sundfjord, A., Varpe, Ø., Walczowski, W. Weslawski, J. M. and Zajaczkowski, M. 2014. The importance of tidewater glaciers for marine mammals and seabirds in Svalbard, Norway.

J. Mar. Syst. 129: 452-471.

Euphotic zone

Glacier melt water

Surface fresh water layer

Atlantic inflow

Suspended particles

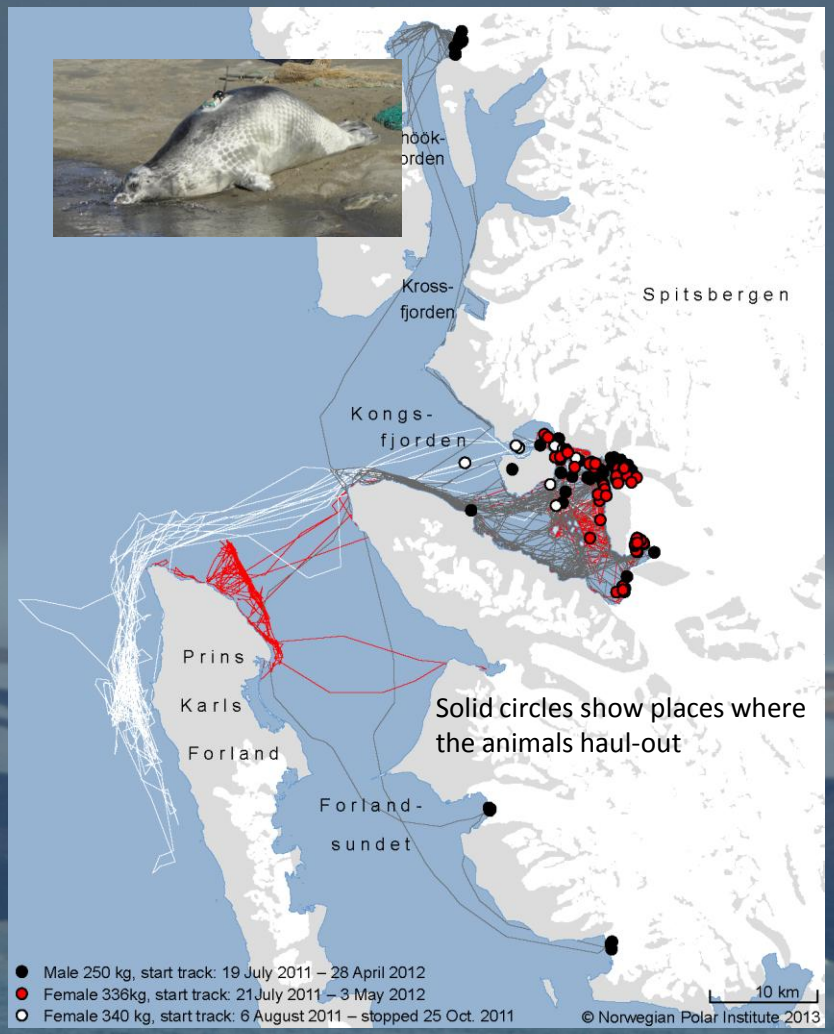


Glacier fronts and marine mammals (summer– no sea ice):

Bearded seals, never tracked to be strongly affiliated with glacier fronts. But do feed into soft bottom sediment[1]

1. Lydersen, C., Kovacs, K. M. and Lydersen, E. 2001. Rust-colored bearded (*Erignathus barbatus*) and ringed (*Phoca hispida*) seals from Svalbard, Norway. J. Mammal. 82: 225-230.

Glacier fronts and marine mammals (summer– no sea ice):
Bearded seals – travel back into fjords to haul-out on glacier ice





Data from: Lydersen, C., Assmy, P., Falk-Petersen, S., Kohler, J., Kovacs, K. M., Reigstad, M., Steen, H., Strøm, H., Sundfjord, A., Varpe, Ø., Walczowski, W. Weslawski, J. M. and Zajaczkowski, M. 2014. The importance of tidewater glaciers for marine mammals and seabirds in Svalbard, Norway. **J. Mar. Syst.** 129: 452-471.

Both ringed seals and white whales obvious “candidate” species; chose white whales

GLAERE

Glaciers as Arctic Ecosystem Refugia

Polish-Norwegian Research Programme

norway grants

po polsku

HOME | PARTICIPANTS | DESCRIPTION | WORK | DISSEMINATION | CALENDAR | RESULTS | LINKS | LITERATURE

Project funded by Norwegian Funding Mechanism in 2013 nr DZP/POL-NOR/1876/2013 6th August 2013
RIS 6783

This project will assess the importance of glacial bays as foraging areas for selected top predators and as habitats for cold water fauna in a quantitative manner. This assessment will be based on a combination of archival data and new data collected during this program. In this assessment, future scenarios in relation to the predicted fate of these glacial hotspots in Svalbard will be addressed, in addition to possible compensatory effects via the influences of river mouths and mudflats in areas where glaciers retreat onto land.



photo J. M. Węsławski



photo Ch. Lydersen





Ringed seal and

NORWEGIAN POLAR INSTITUTE
CENTRE FOR ICE, CLIMATE AND ECOSYSTEMS

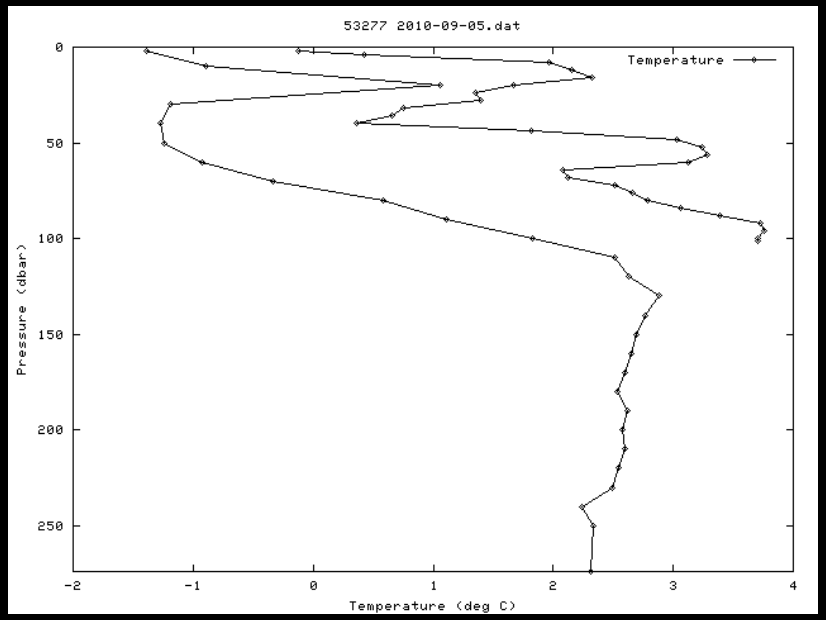
Developed some new types of satellite tags
…….all have CTD

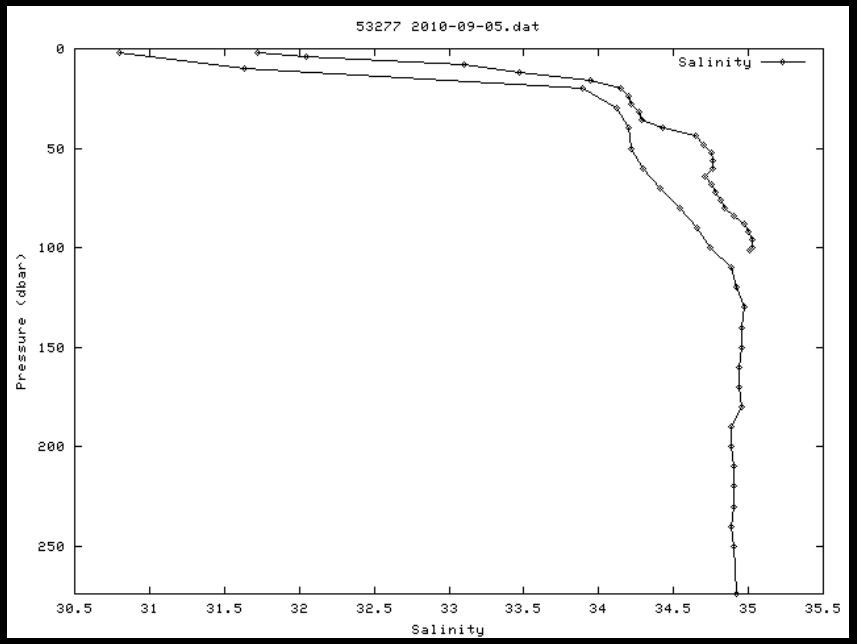
CTD-GPS SRDLs

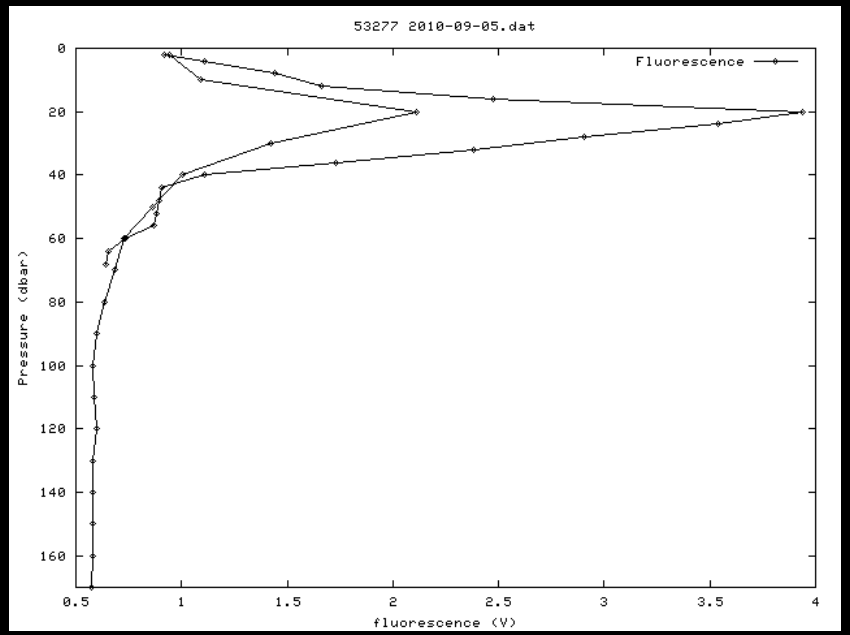
CTD-Fluoro SRDLs

CTD SRDLs




53277 2010-09-05.dat
Temperature
Pressure (dbar)
Temperature (deg C)
0
50
100
150
200
250
-2
-1
0
1
2
3
4


53277 2010-09-05.dat
Salinity
Pressure (dbar)
Salinity
0
50
100
150
200
250
30.5
31
31.5
32
32.5
33
33.5
34
34.5
35
35.5


53277 2010-09-05.dat
Fluorescence
Pressure (dbar)
fluorescence (V)
0
20
40
60
80
100
120
140
160
0.5
1
1.5
2
2.5
3
3.5
4

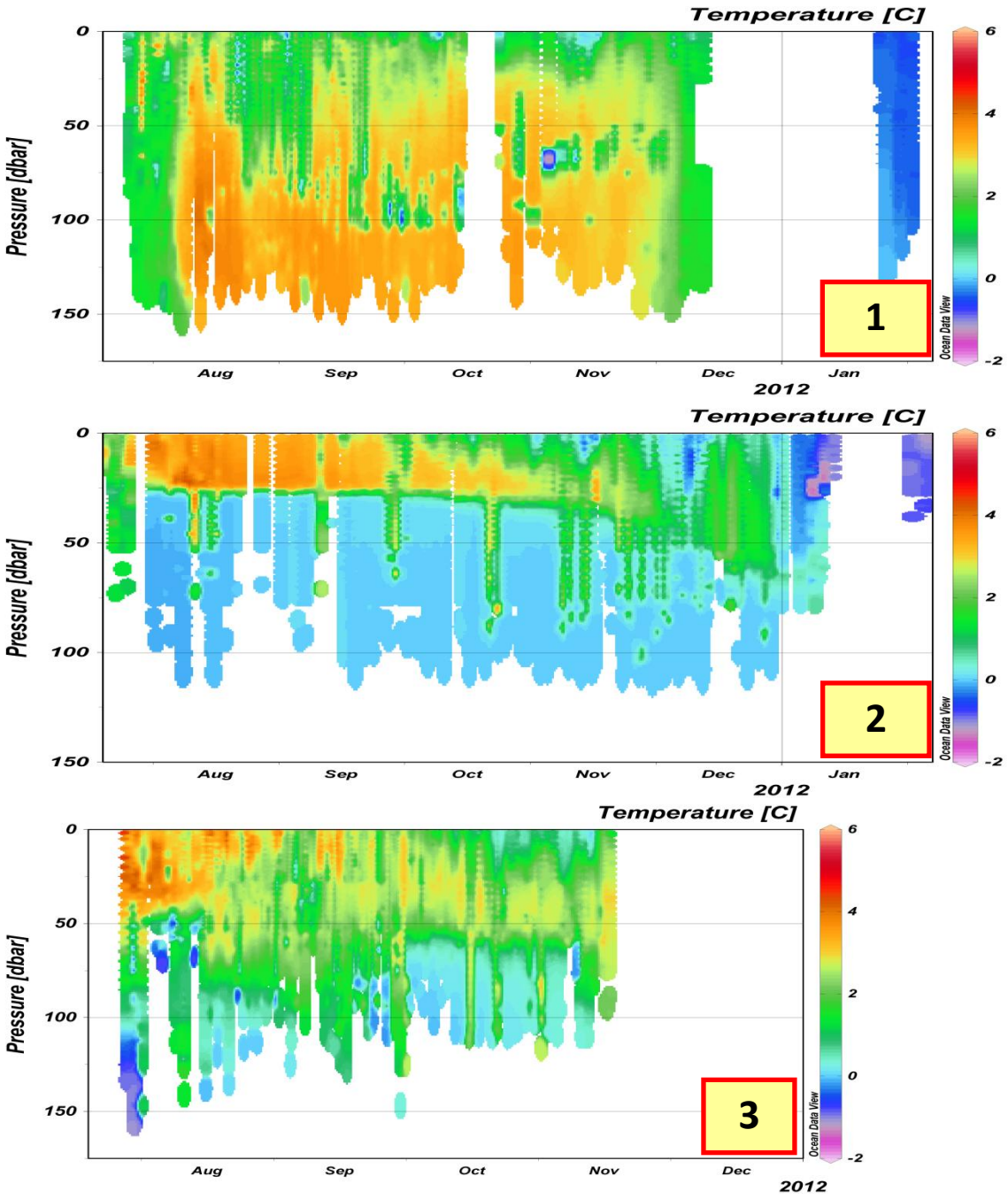
Temperature Time Series

1. KN: Lack of cold water at depth

2. KS: warm surface layer that cools in September and is subducted below the emerging cold surface water until the stratification breaks up in late December

3. St.J. similar evolution as KS – but not as clear – (due to two glaciers??)





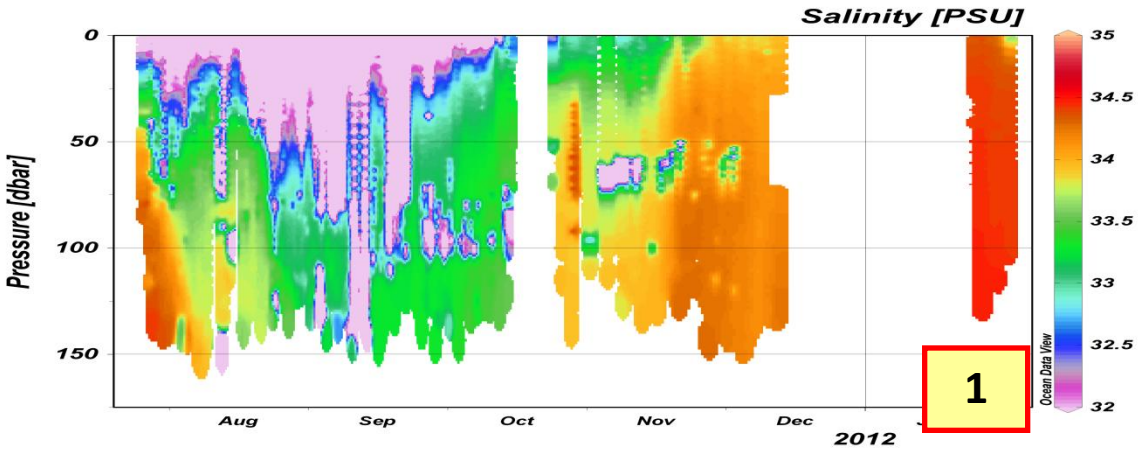
Salinity Time Series

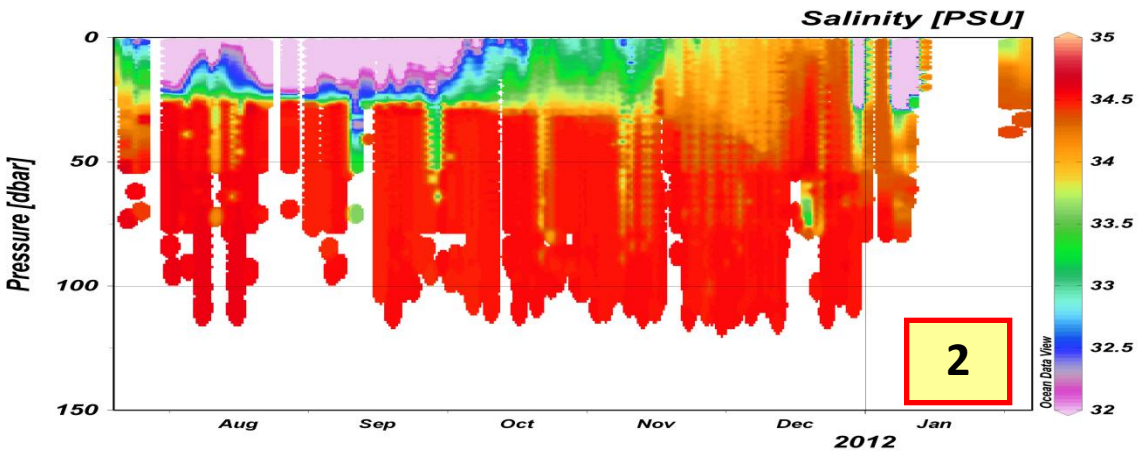
1. KN: Lack of saline water at depth until late Jan.

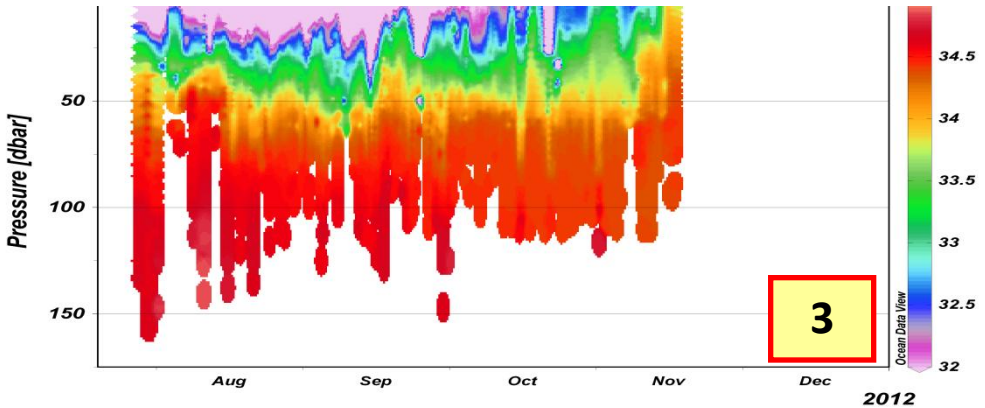
2. KS: nice fresh surface layer which starts to dissapear in Sept when output from glaciers is reduced.

3. St.J. similar evolution as KS –

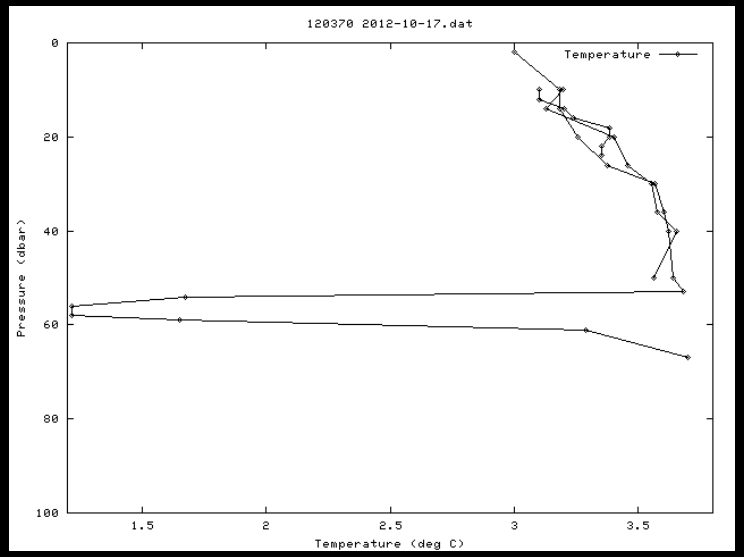


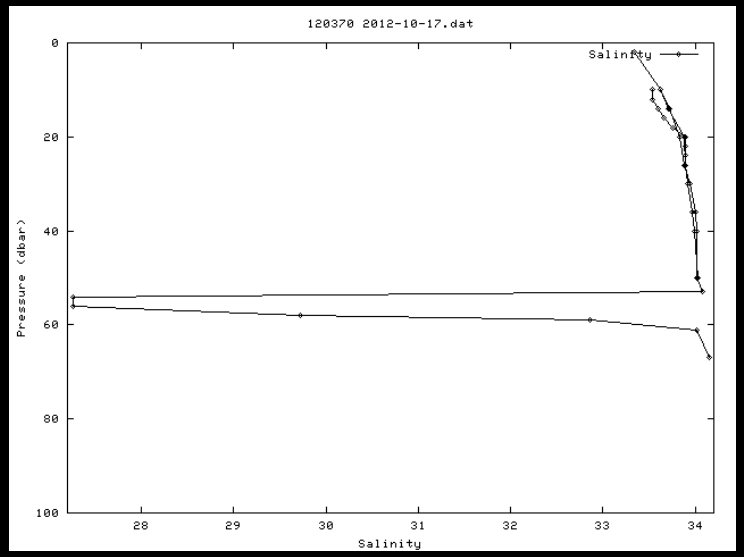


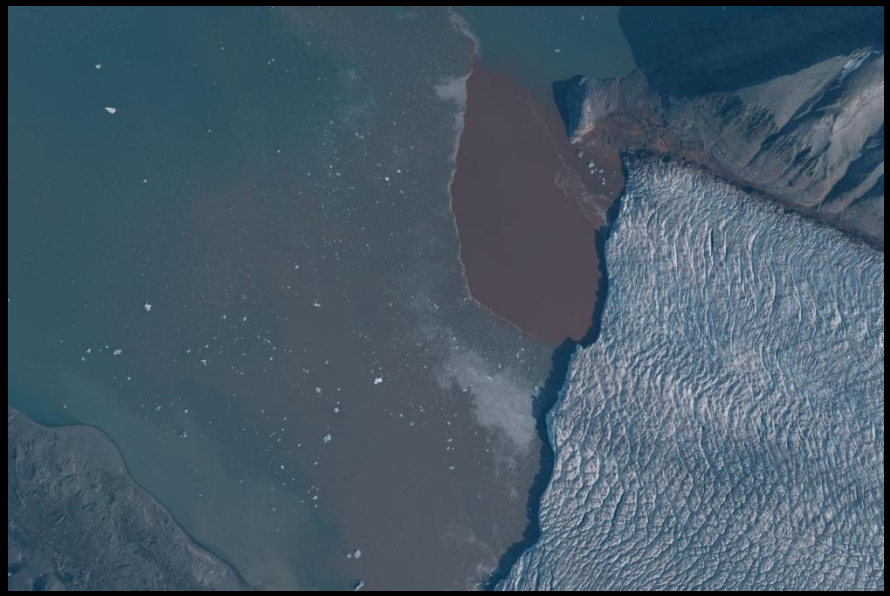




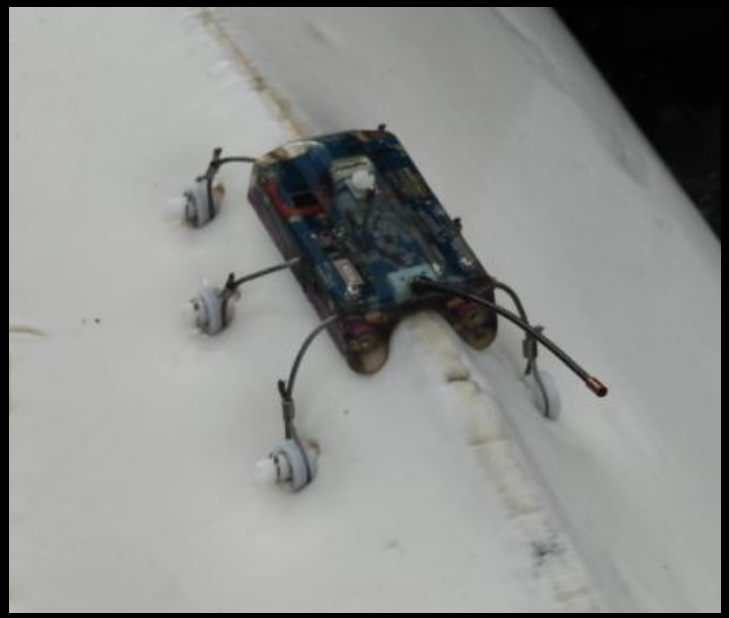
Use the CTD-GPS SRDLS to study THE PLUME







So we wanted these types of tags for the white whales.....



”Standard ” SRDL from SMRU

New design to for this projectcto fit on the dorsal ridge

- Argos positions
- dive depths and duration
- temperature

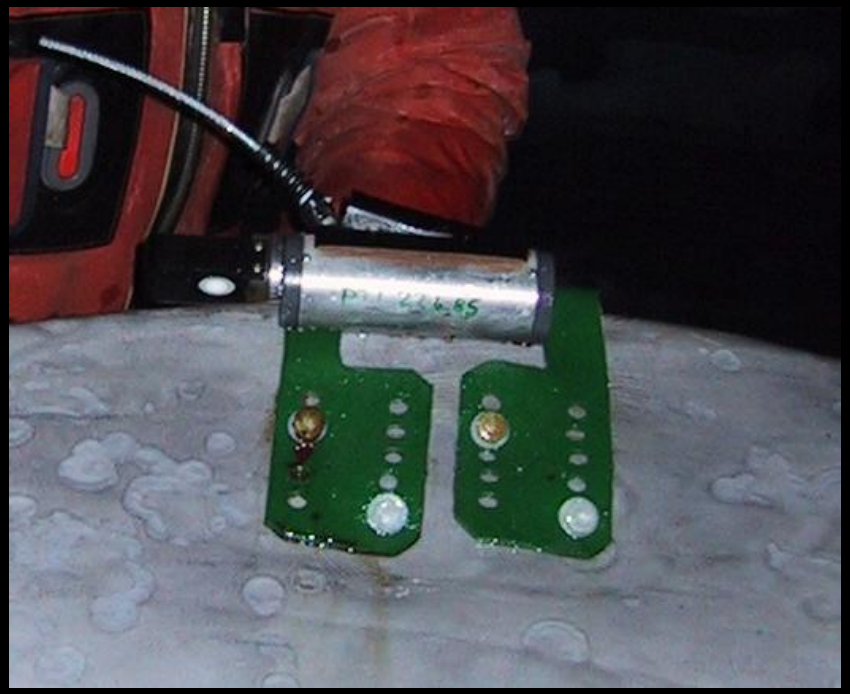


GPS-CTD- SRLD from SMRU

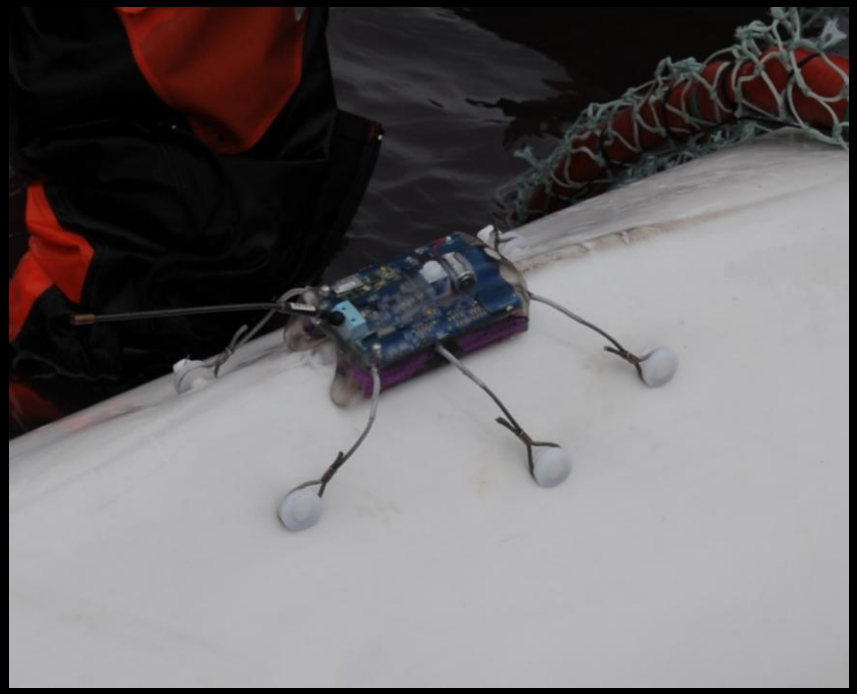
Custom made for this project

- GPS positions
- Argos positions
- dive depths and duration
- temperature
- salinity

Old attachment



New attachment



Purpose – (more than tracking……):

1. Determine space use over the entire annual cycle - to discern how these whales move in relation to sea ice, bathymetry, glacier fronts and oceanographic conditions
2. Assess diet via stable isotope and fatty acid analyses bases on blood and blubber samples from live-captured whales
3. Update the general health status of Svalbard's white whales based on screening of serum samples
4. Conduct a screening of levels of various pollutants based on blood and blubber samples from live-captured whales


Meridian
Meridian








Two “methods” for capturing white whales




Norsk
Polarinstitutt


Norsk
Polarinstitutt




Norsk
Polarinstitutt


Norsk
Polarinstitutt



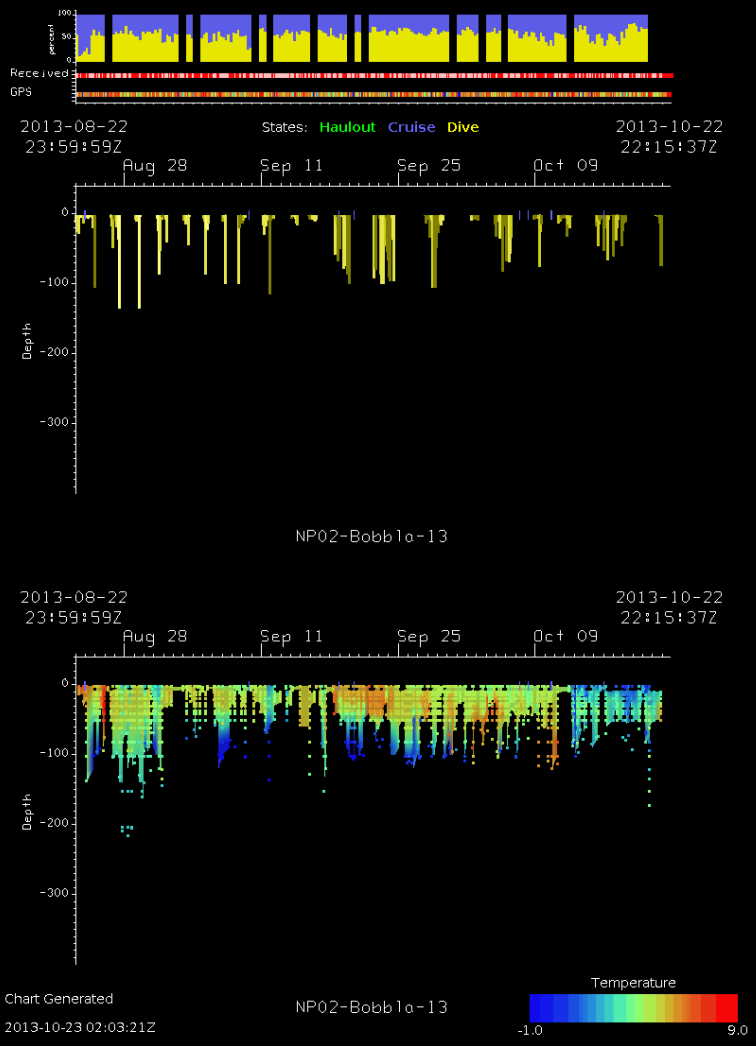

9
10
11
12
13
14
2|2
2|3
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2|6
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2|8
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3|1
3|2
3|3
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3|5
3|6
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4|1




Norsk
Polarinstitutt


Status May 2016:
Instrumented and collected samples for various other investigations from 13 white whales

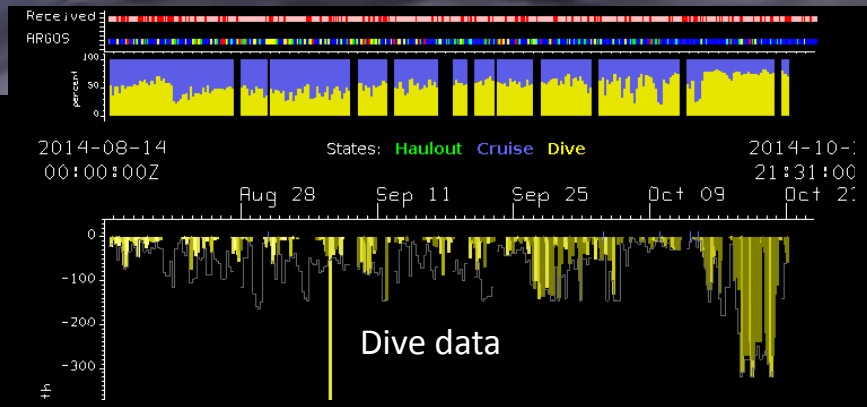
Still extreme coastal movement patterns



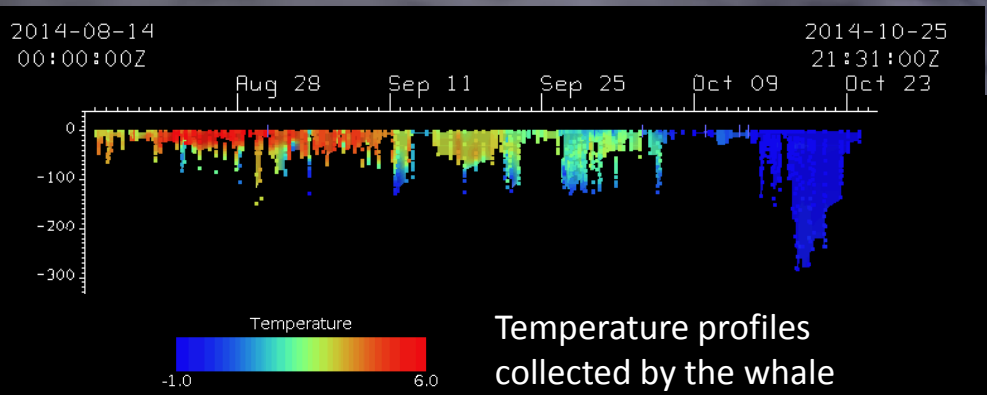


Navratilova Aug. 14- Oct. 25

When ice forms they are “forced offshore (see red circle)



Dive data

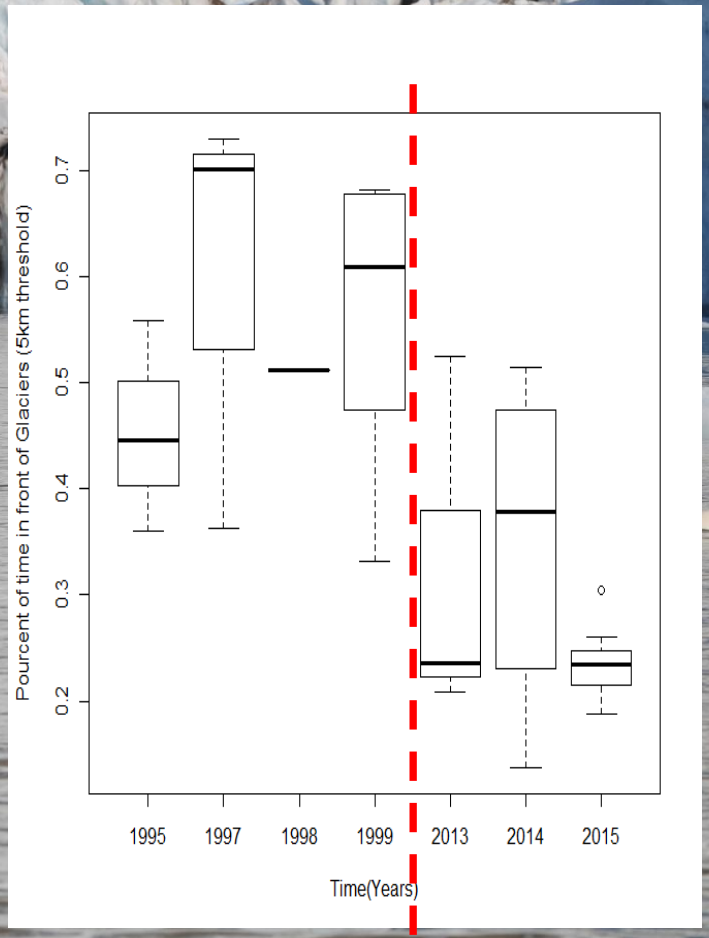


Temperature profiles collected by the whale



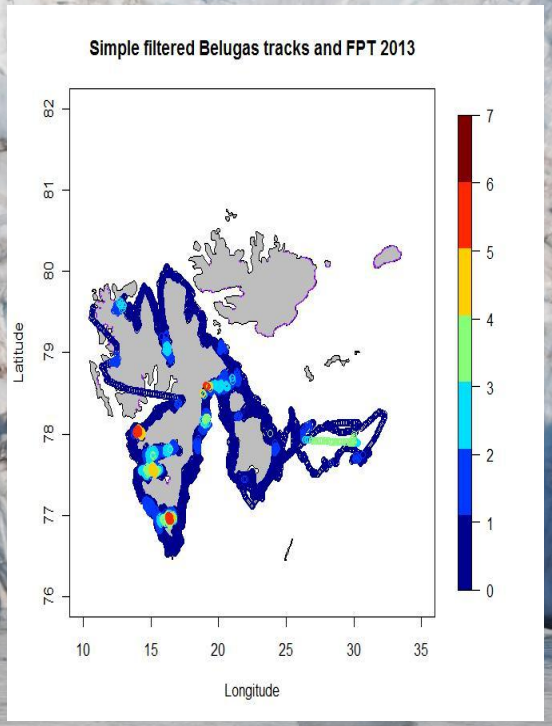
More than 20,000 positions collected in the period 2013-15. Movement pattern so coastal that you see “the map” of Svalbard when plotting all location

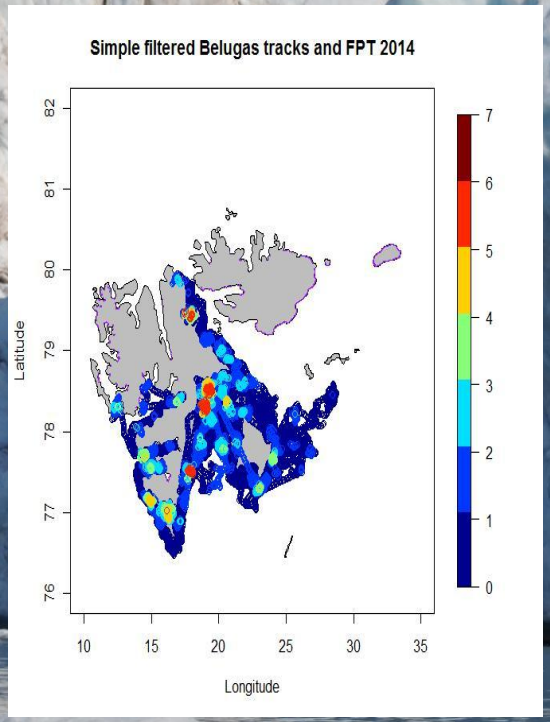
Change in time spent in front of glaciers??

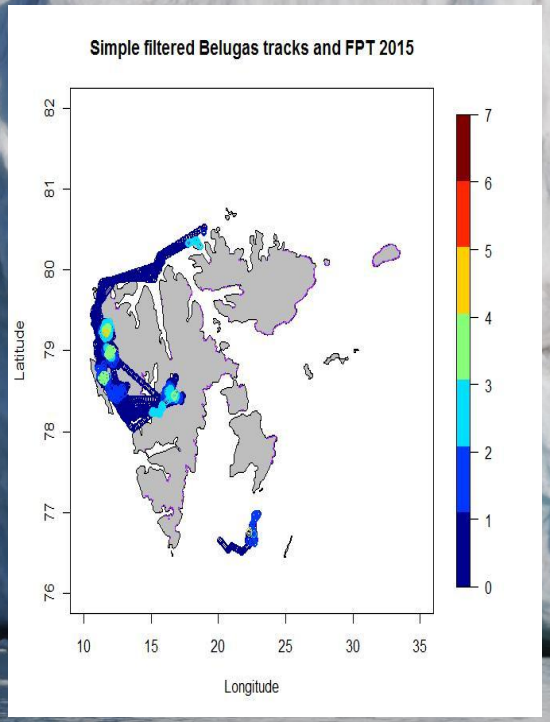


Percent_1995-1997-1998-1999 = 0.54± 0.14

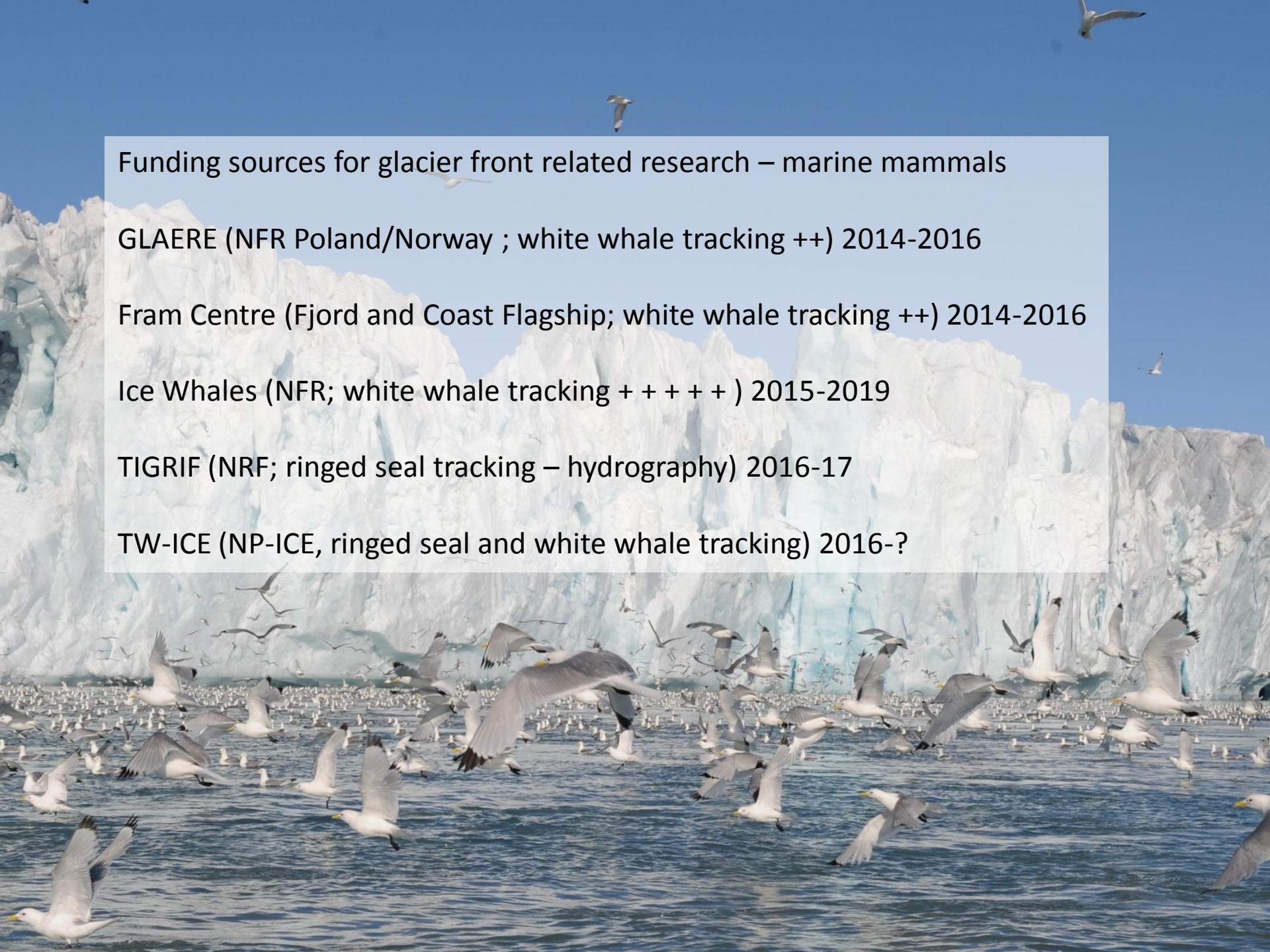
Percent_2013-2014-2015 = 0.30 ± 0.13







More time spent inside fjords but away from the fronts; feeding on Atlantic species?



Funding sources for glacier front related research – marine mammals

GLAERE (NFR Poland/Norway ; white whale tracking ++) 2014-2016

Fram Centre (Fjord and Coast Flagship; white whale tracking ++) 2014-2016

Ice Whales (NFR; white whale tracking + + + + +) 2015-2019

TIGRIF (NRF; ringed seal tracking – hydrography) 2016-17

TW-ICE (NP-ICE, ringed seal and white whale tracking) 2016-?


Film?!