

Science, Service, Stewardship



Beaufort Sea:
Perspectives on Climate Change and Fisheries

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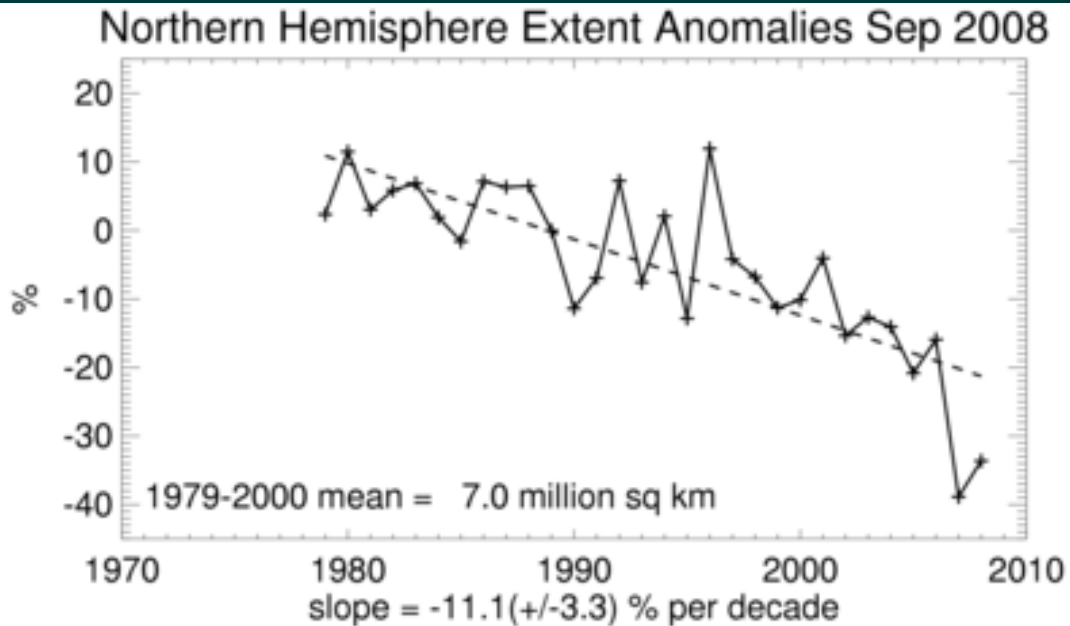
John Horne and Sandra Parker-Stetter
University of Washington

Tom Weingartner
University of Alaska

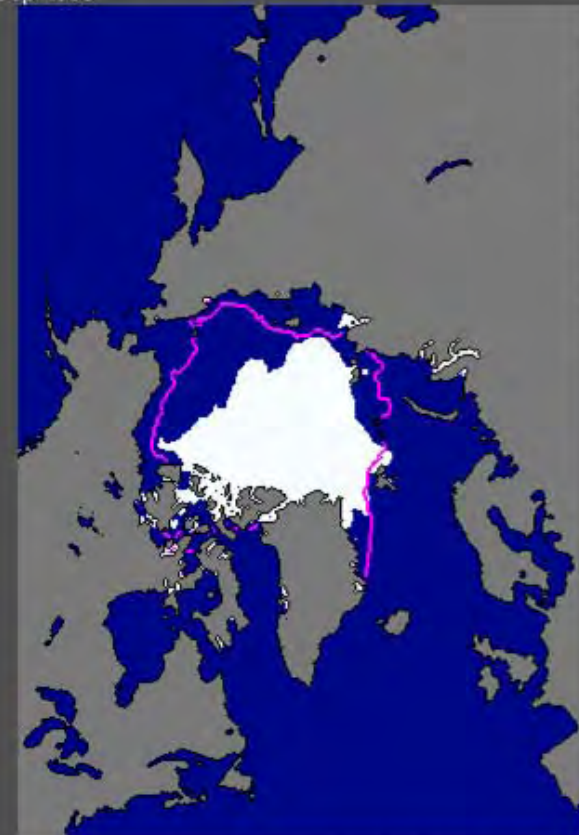
Minerals Management Service

**NOAA
FISHERIES
SERVICE**

Arctic warming



Sea Ice Extent
Sep 2008



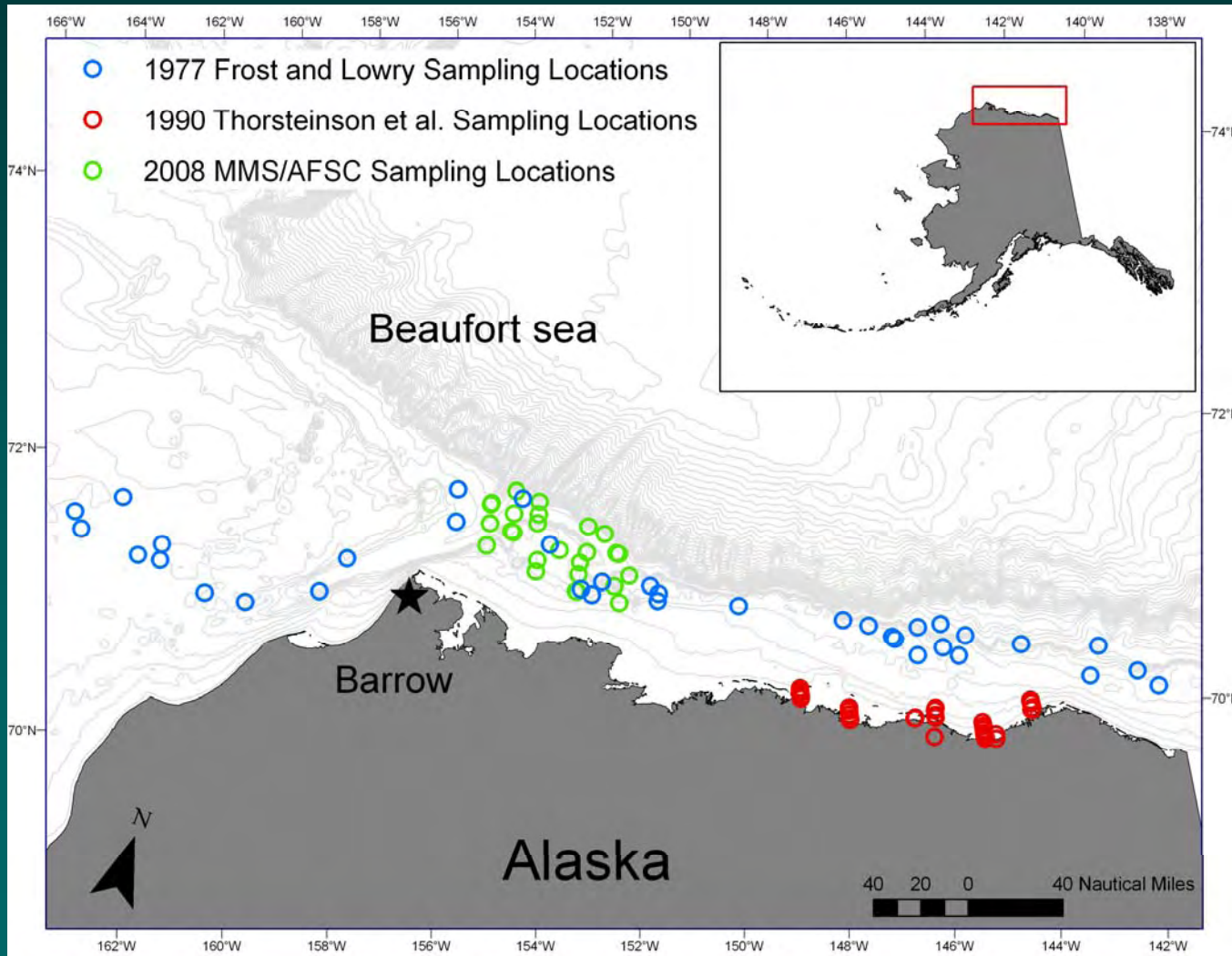
National Snow and Ice Data Center, Boulder, CO

Total extent = 4.7 million sq km

median
ice edge

Beaufort Sea – historical surveys

- 1976-77 Frost and Lowry; opportunistic sampling on CGC Glacier
- 1990 Thorsteinson *et al*; nearshore sampling; further offshore than previous surveys
- No quantitative survey before 2008

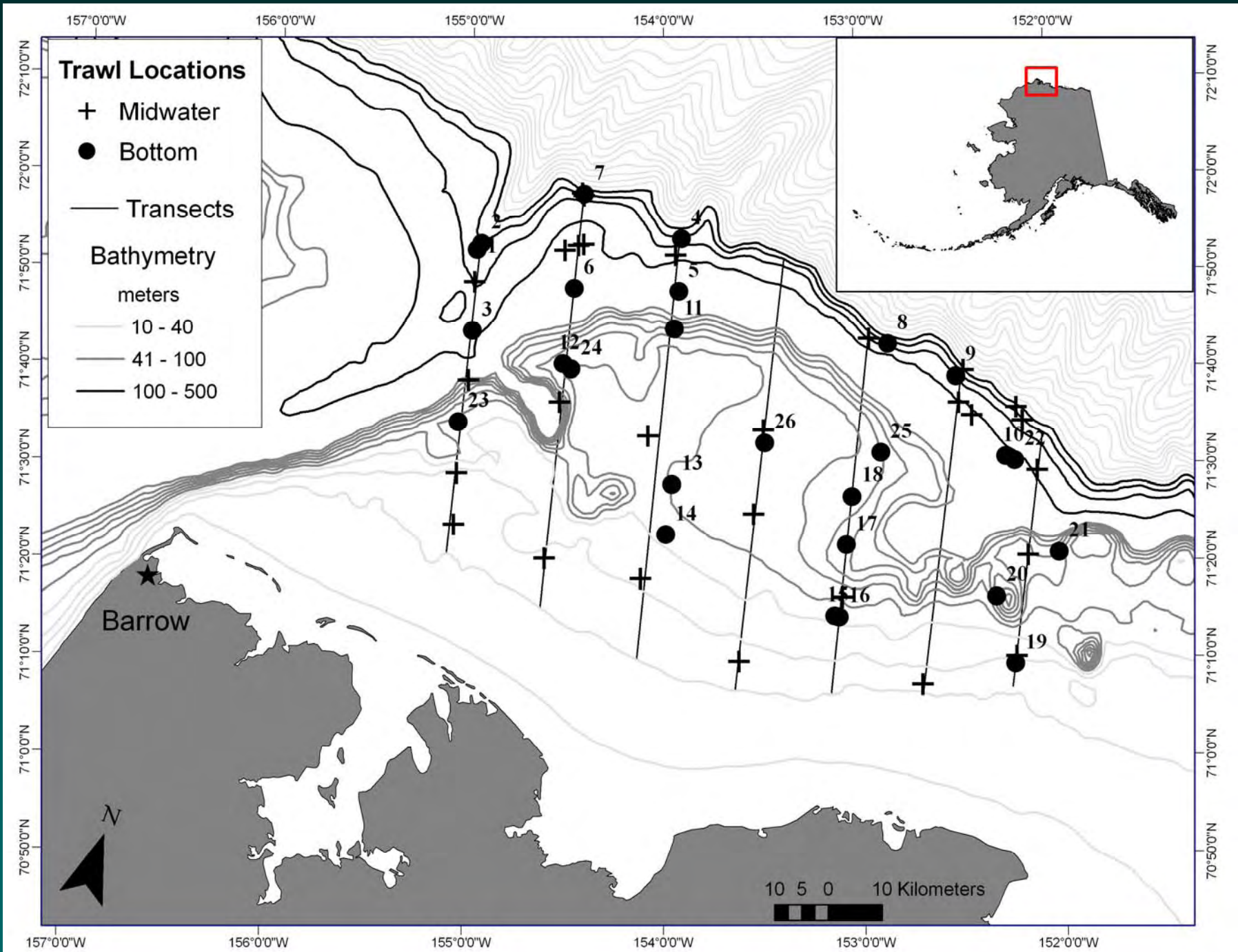


Objectives

- Baseline for oil/gas development and climate change
- Methods for future monitoring surveys
- Species, distribution, abundance, and biological characteristics of fish and invertebrates
- Oceanography and zooplankton
- Seabirds and marine mammals

Details

- 6-22 August 2008
- Charter vessel F/V *Ocean Explorer*
- Bottom trawl
 - 83-112 (1.5”mesh liner)
 - Net height, spread, bottom contact
- Acoustic-trawl
 - Calibrated ES-60 at 38kHz
 - Marinovich mid-water net
- CTDs
- Bongo nets for zooplankton (333 and 150 micron)
- Strip transects for seabirds
- Opportunistic observations of marine mammals



Sampling

- Species composition by weight and number
- Sexed-length-weights
- Otoliths (Arctic cod and pollock)
- Stomachs
- Stable isotopes
- Ovaries (Arctic cod only)
- Genetics
- Fish ID vouchers



Photo by: Jen Nomura

Bottom trawls



Photo by: Heloise Chenelot



Photo by: Darin Vanderpol

Fish (bottom trawl)

36 species identified, 6% of total catch weight

Species	Mean CPUE (kg/ha)
<i>Boreogadus saida</i> (Arctic cod)	24.41
<i>Lycodes</i> sp. (eelpouts; includes 7 species)	3.83
<i>Hippoglossoides robustus</i> (Bering flounder)	0.74
<i>Theragra chalcogramma</i> (walleye pollock)	0.70
<i>Reinhardtius hippoglossoides</i> (Greenland turbot)	0.23
<i>Liparis gibbus</i> (variegated snailfish)	0.17
<i>Liparis fabricii</i> (gelatinous seasnail)	0.09
<i>Myoxocephalus verrucosus</i> (warty sculpin)	0.03
<i>Triglops pingeli</i> (ribbed sculpin)	0.03
<i>Gadus macrocephalus</i> (Pacific cod)	0.02

Additional range extensions

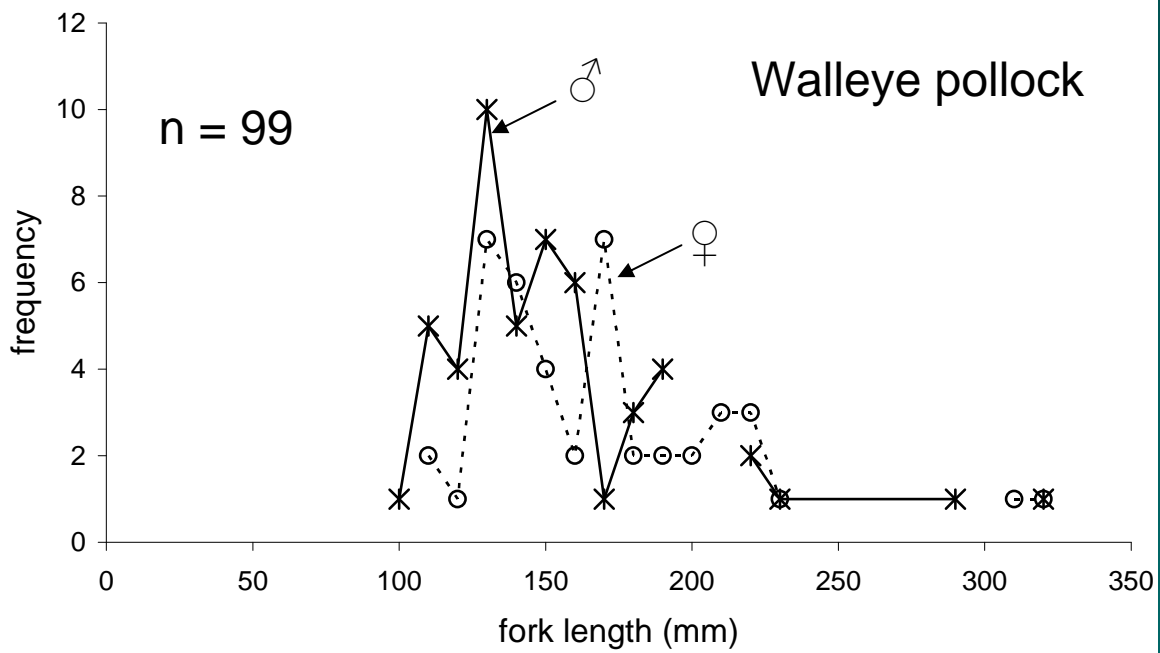
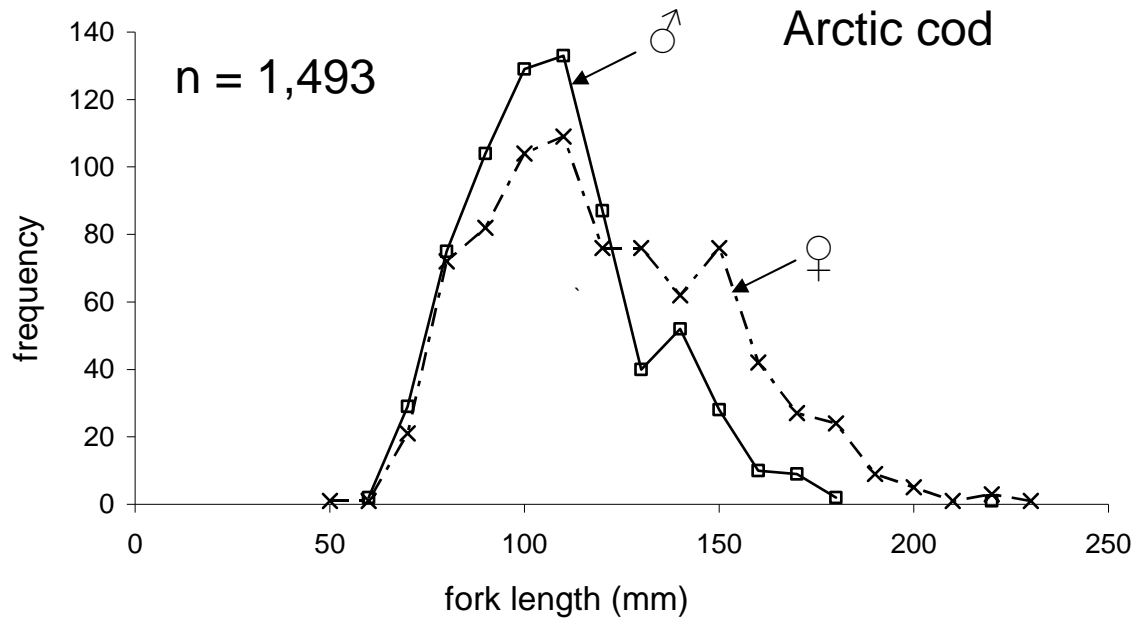
- *Liparis marmoratus* (festive snailfish)
- *Nautichthys pribilovius* (eyeshade sculpin)
- *Triglops nybelini* (bigeye sculpin) *

* Not known from Alaska

The image shows two fish lying horizontally on a grey, textured surface. The fish at the top is Arctic cod, and the fish at the bottom is walleye pollock. Both fish have silvery, iridescent scales and a dark dorsal fin. The Arctic cod has a slightly more rounded body, while the walleye pollock has a more elongated, slender body. In the background, there are numerous dried, orange-brown fish parts, likely fish bones or heads, scattered across the surface.

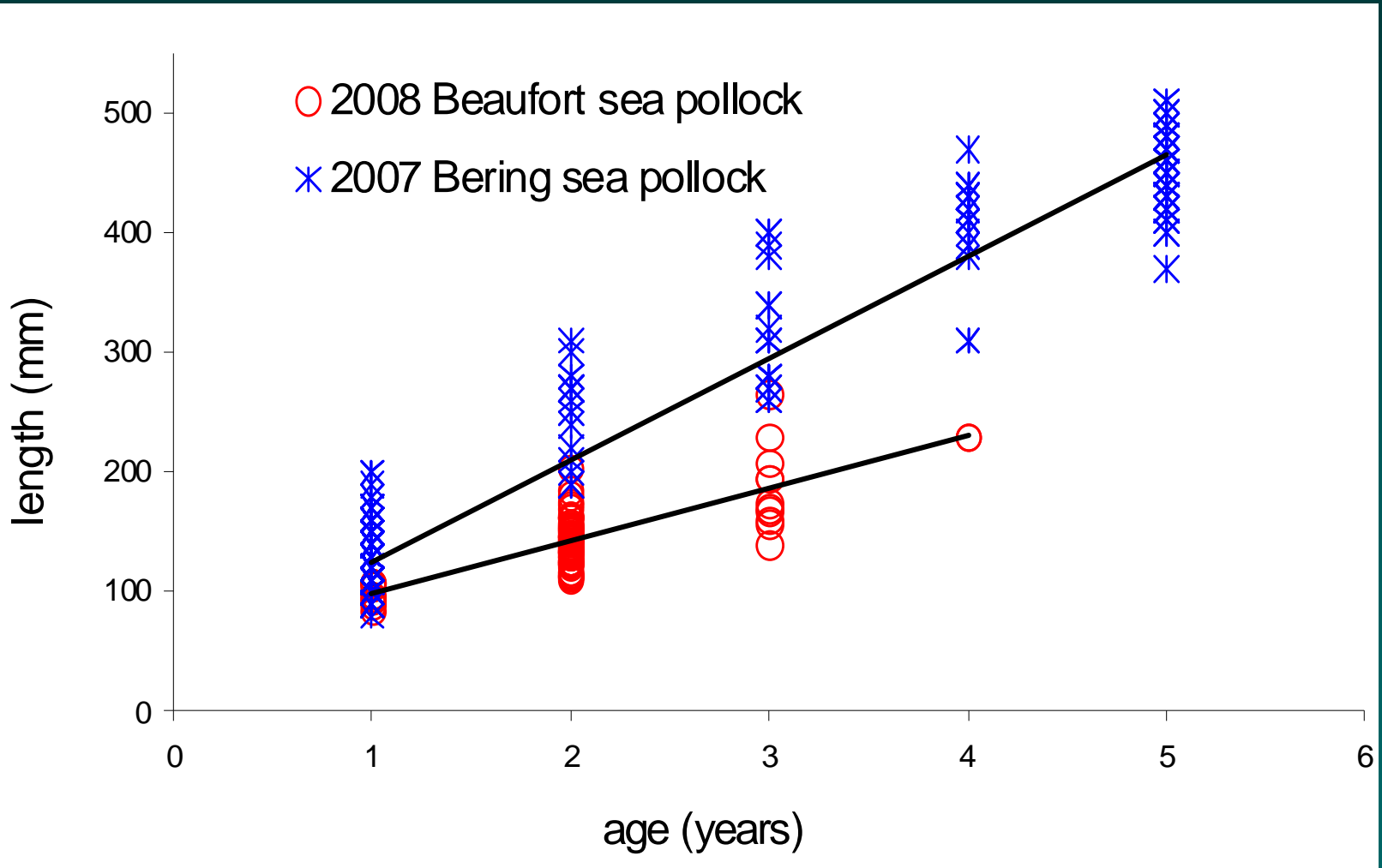
Arctic cod

walleye pollock

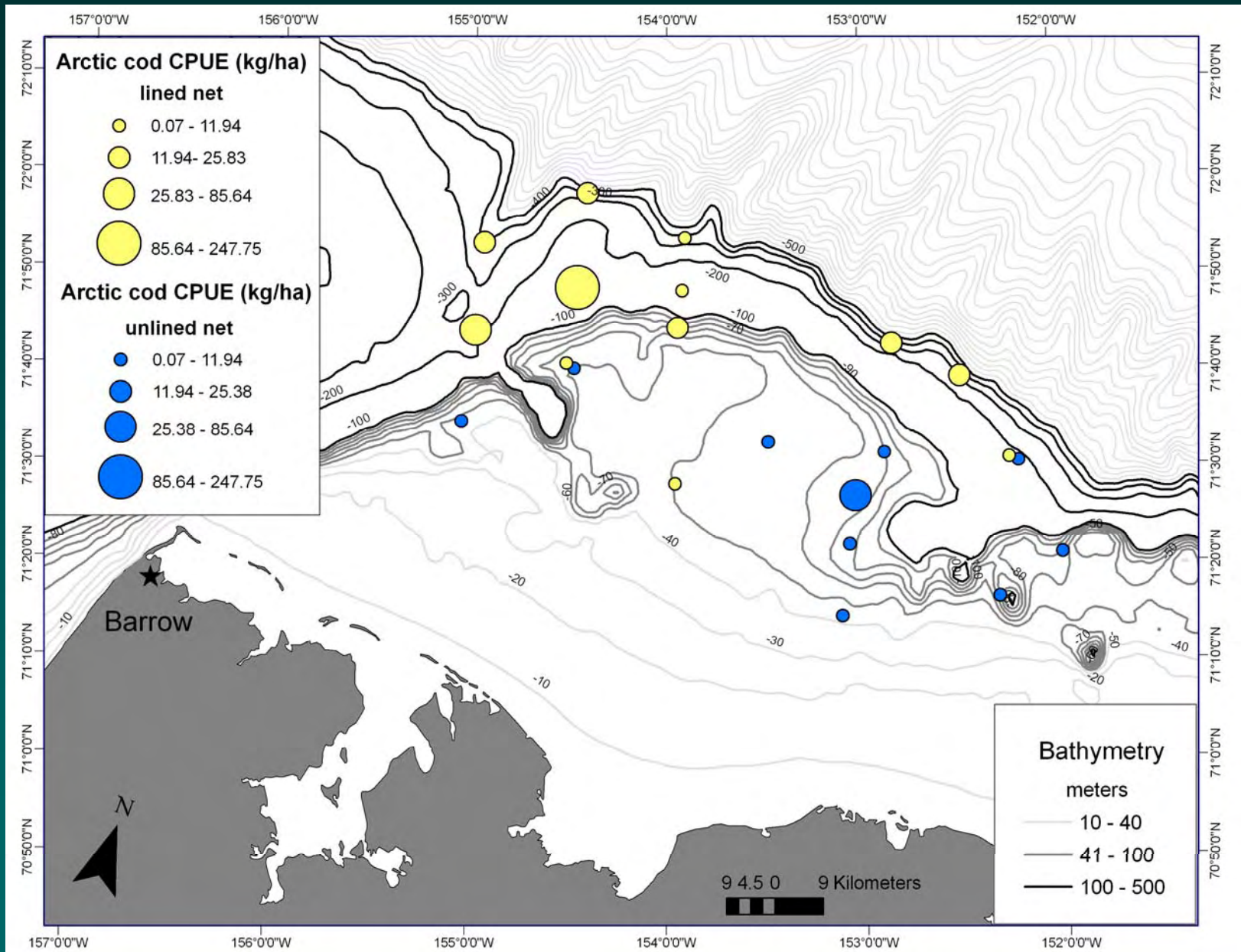


Walleye pollock (length/age)

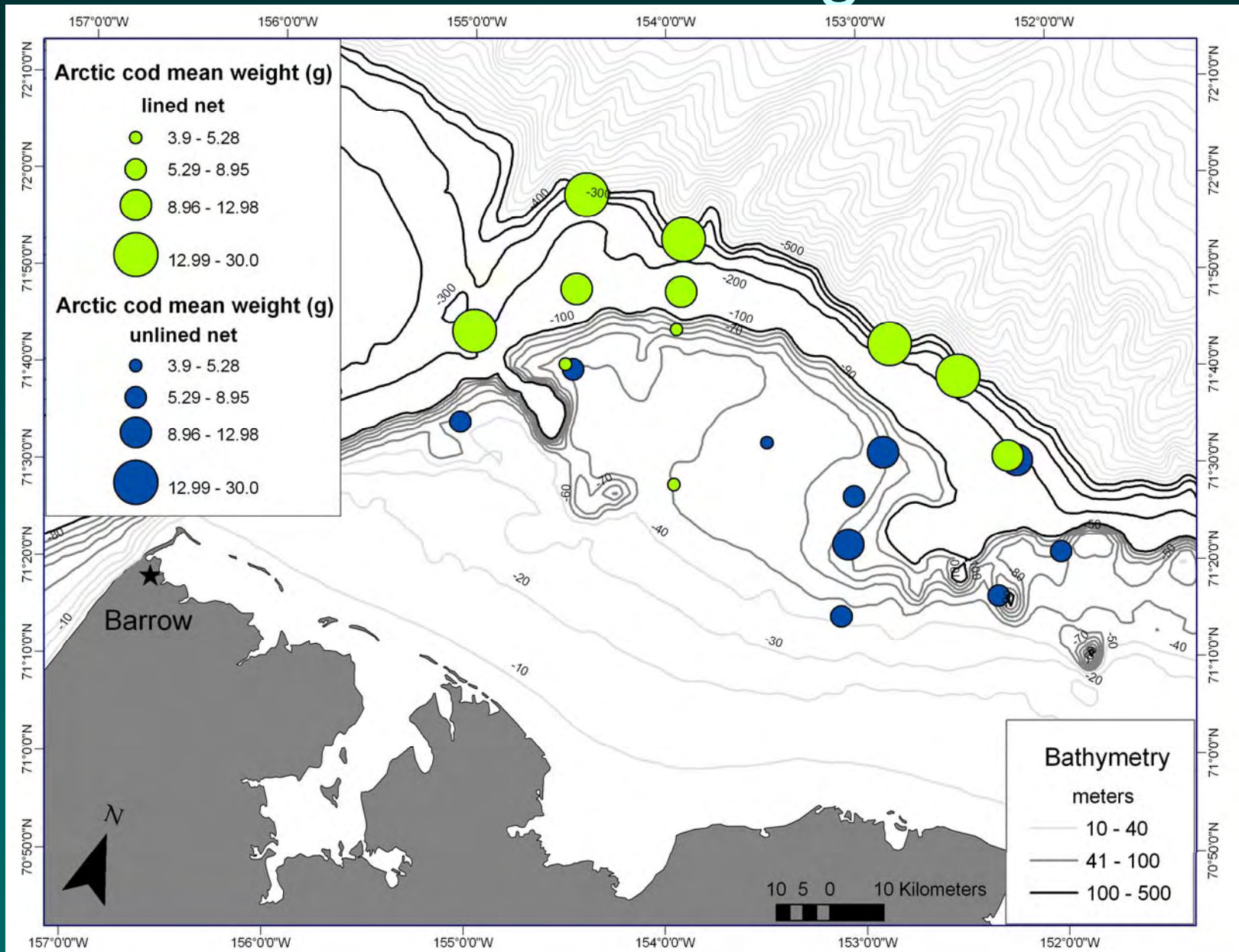
Beaufort sea pollock were ~ 1 year older at length than Bering sea pollock



Arctic cod CPUE

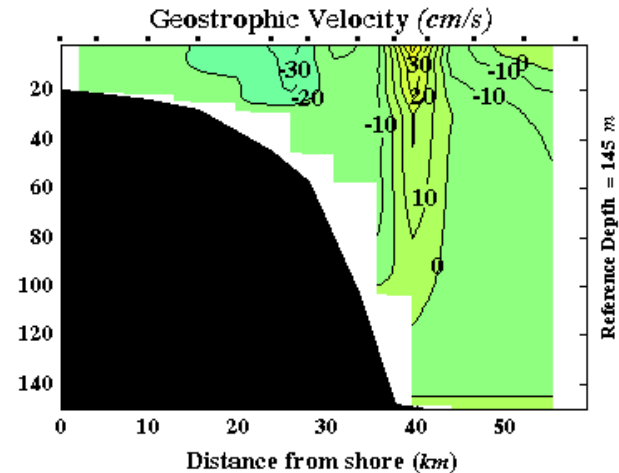
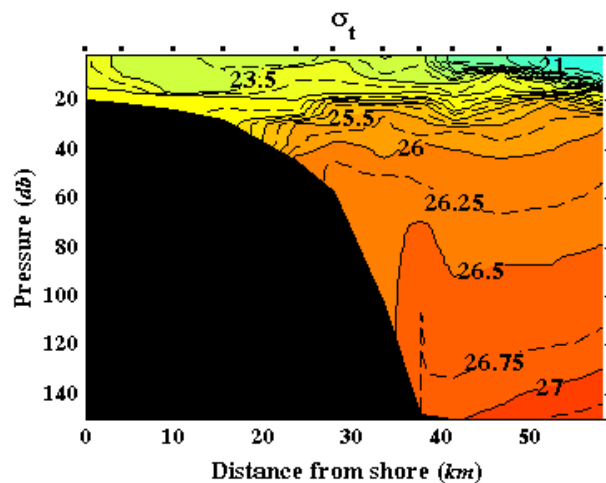
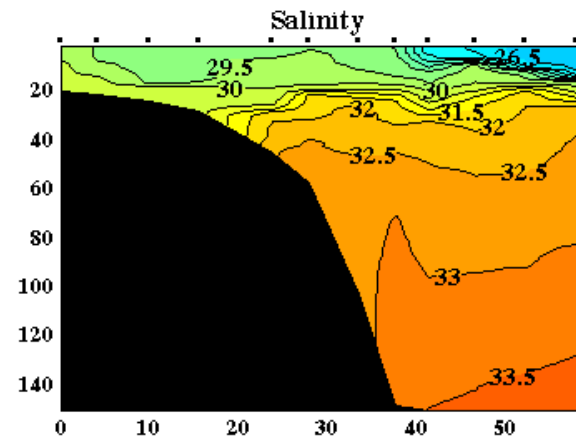
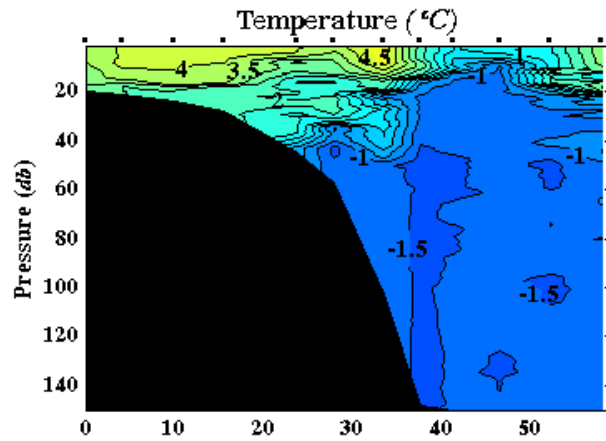


Arctic cod weight



Water column profiles

2008 Beaufort Sea: line1



Acoustics (with midwater trawls)

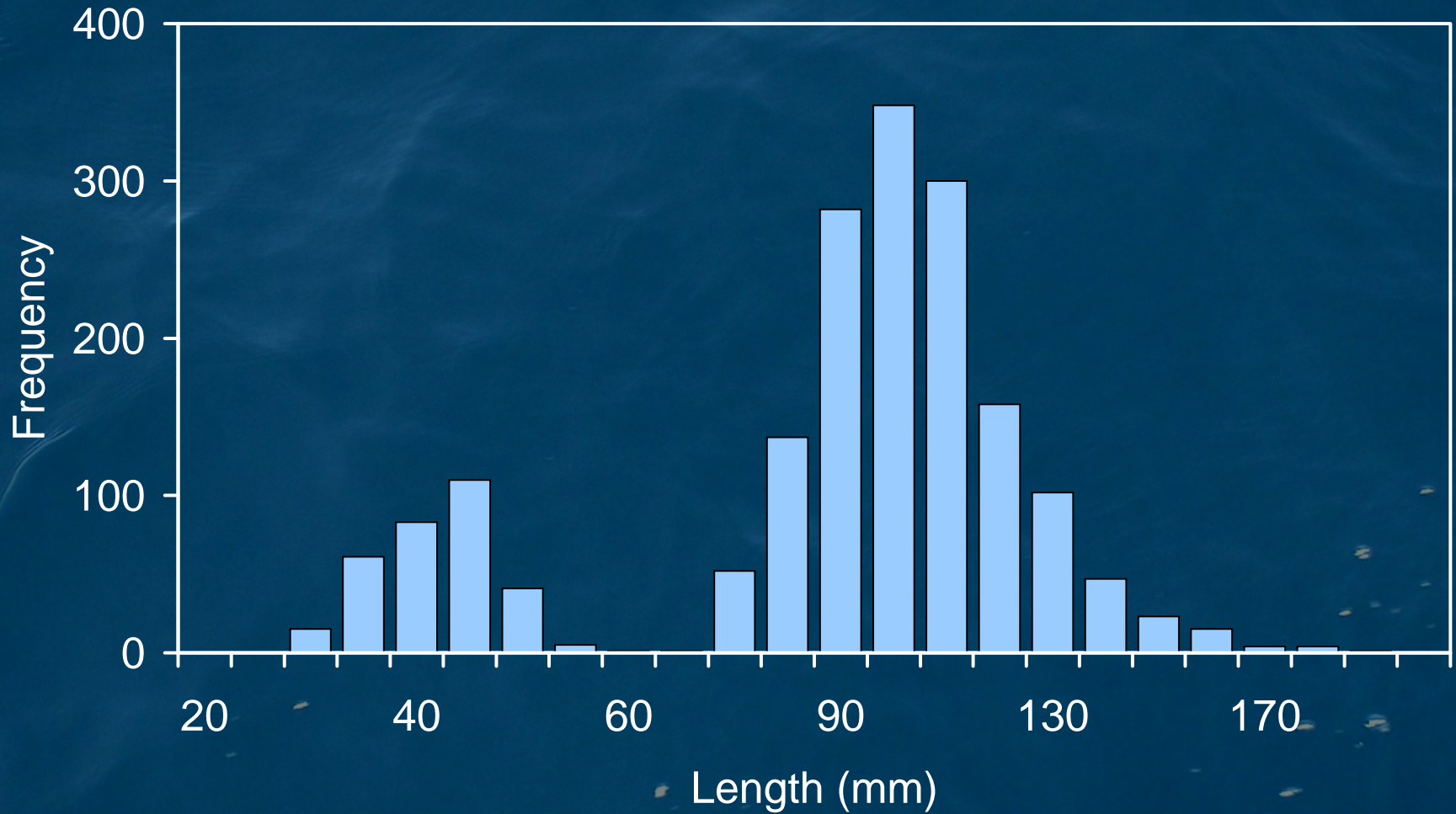


Midwater trawl



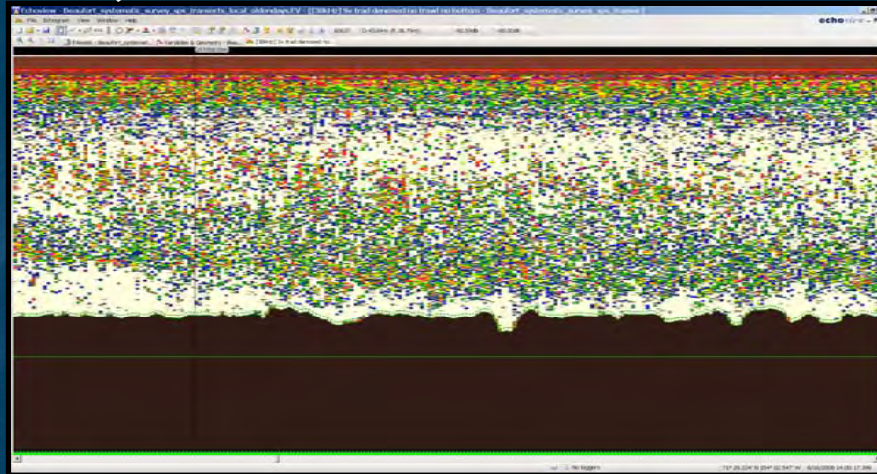
Photo by:
Erika Acuna

Arctic cod length frequency

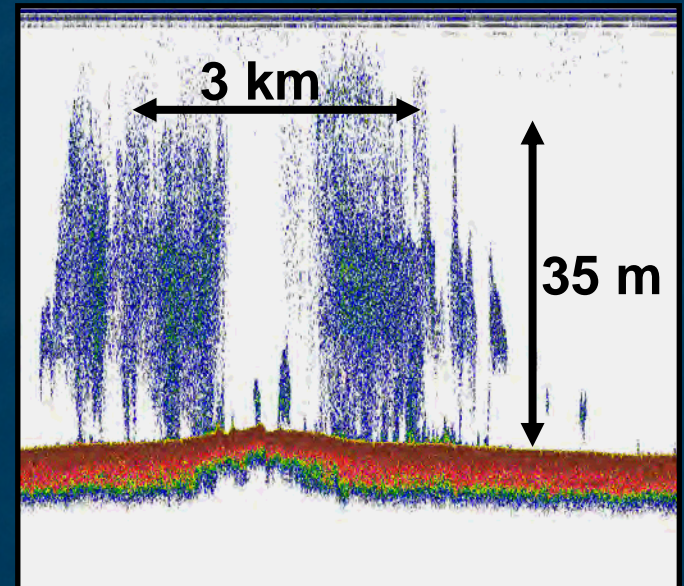
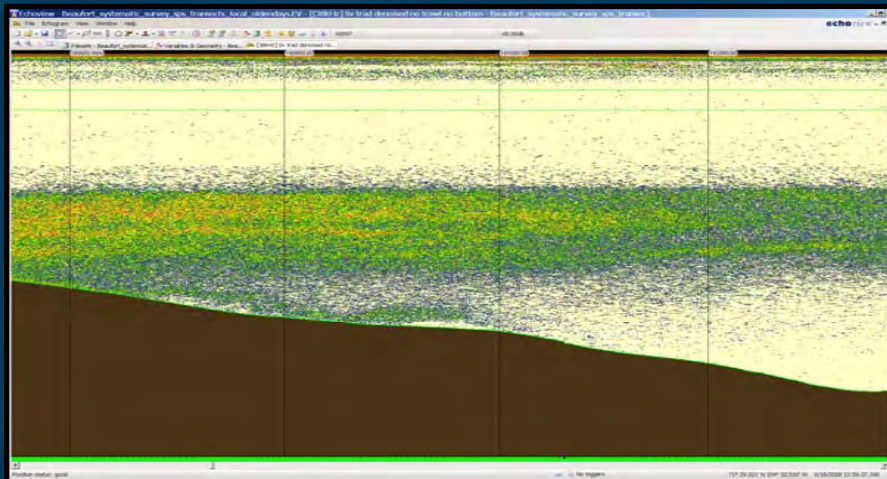


Age-0 & Age-1+ echograms

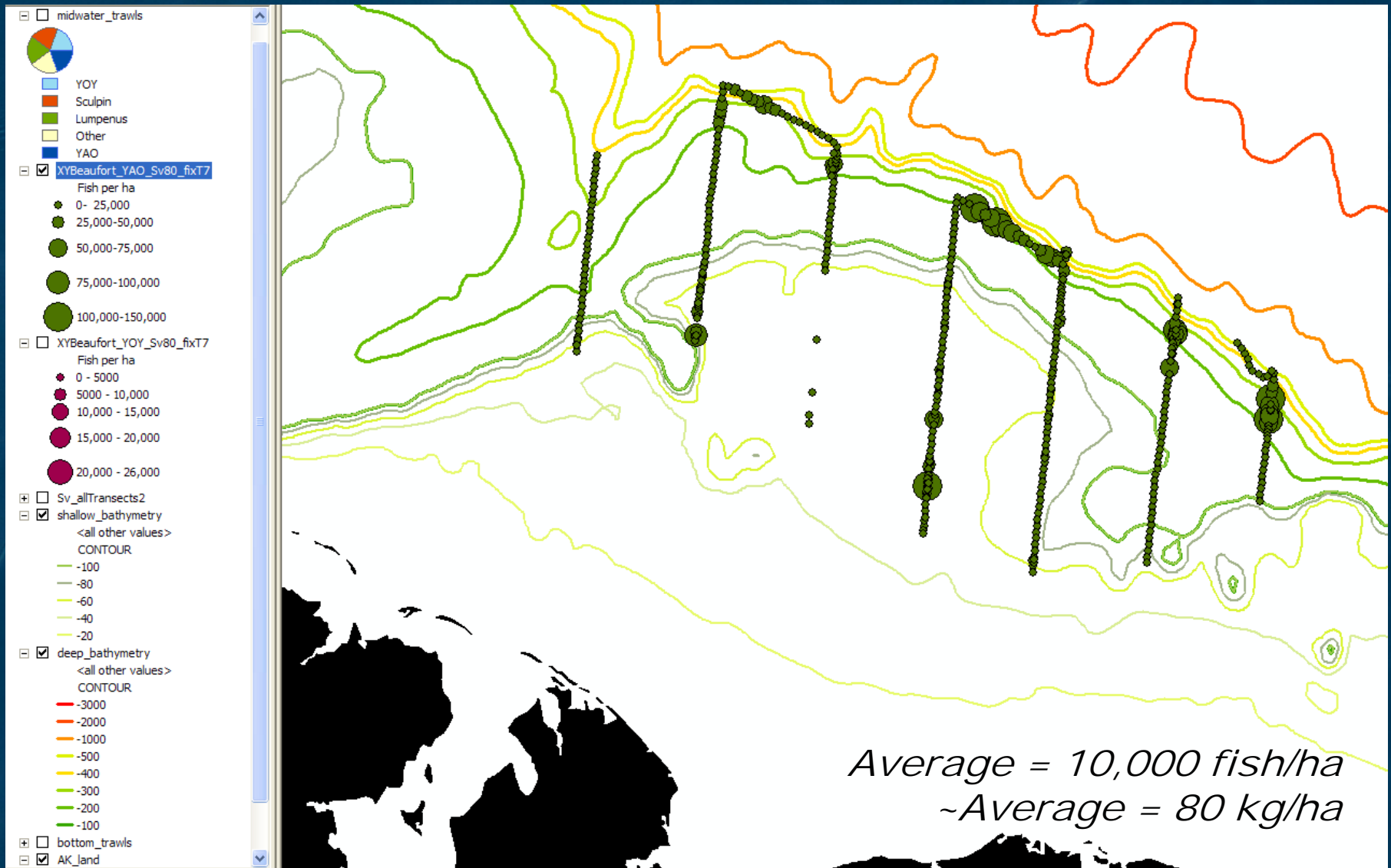
Age-0 Arctic cod
(+sculpin, stickleback)



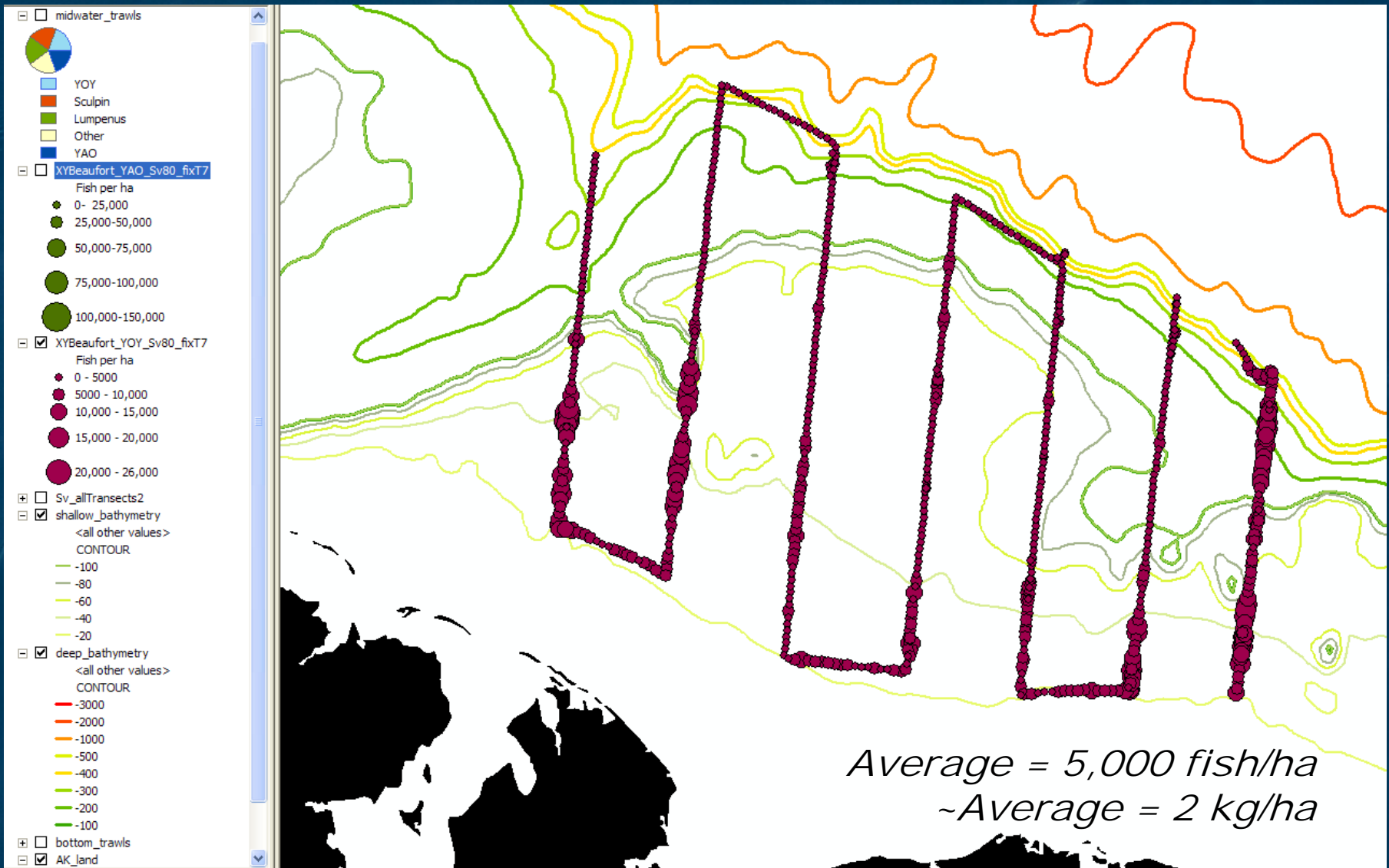
Age-1+ Arctic cod



Age-1+ Arctic cod density distribution



Age-0 Arctic cod density distribution



Invertebrates (bottom trawl)

174 species identified, 94% of total catch weight

Species	Mean CPUE (kg/ha)
<i>Ophiura sarsi</i> (brittle star)	225.16
Empty shells (bivalve/gastropod)	123.02
<i>Musculus niger</i> (mollusk)	85.91
<i>Urticina lofotensis</i> (sea anemone)	63.06
<i>Chionocetes opilio</i> (snow crab)	49.67
<i>Ctenodiscus crispatus</i> (starfish)	29.58
<i>Vulcanella</i> (sponge)	27.69
<i>Strongylocentrotus</i> sp. (sea urchin)	21.80
<i>Psolus phantapus</i> (sea cucumber)	15.51
<i>Phascolosomatidae</i> (worms)	14.34



Photo by: Erika Acuna

Opilio crab

(*Chionocetes opilio*)

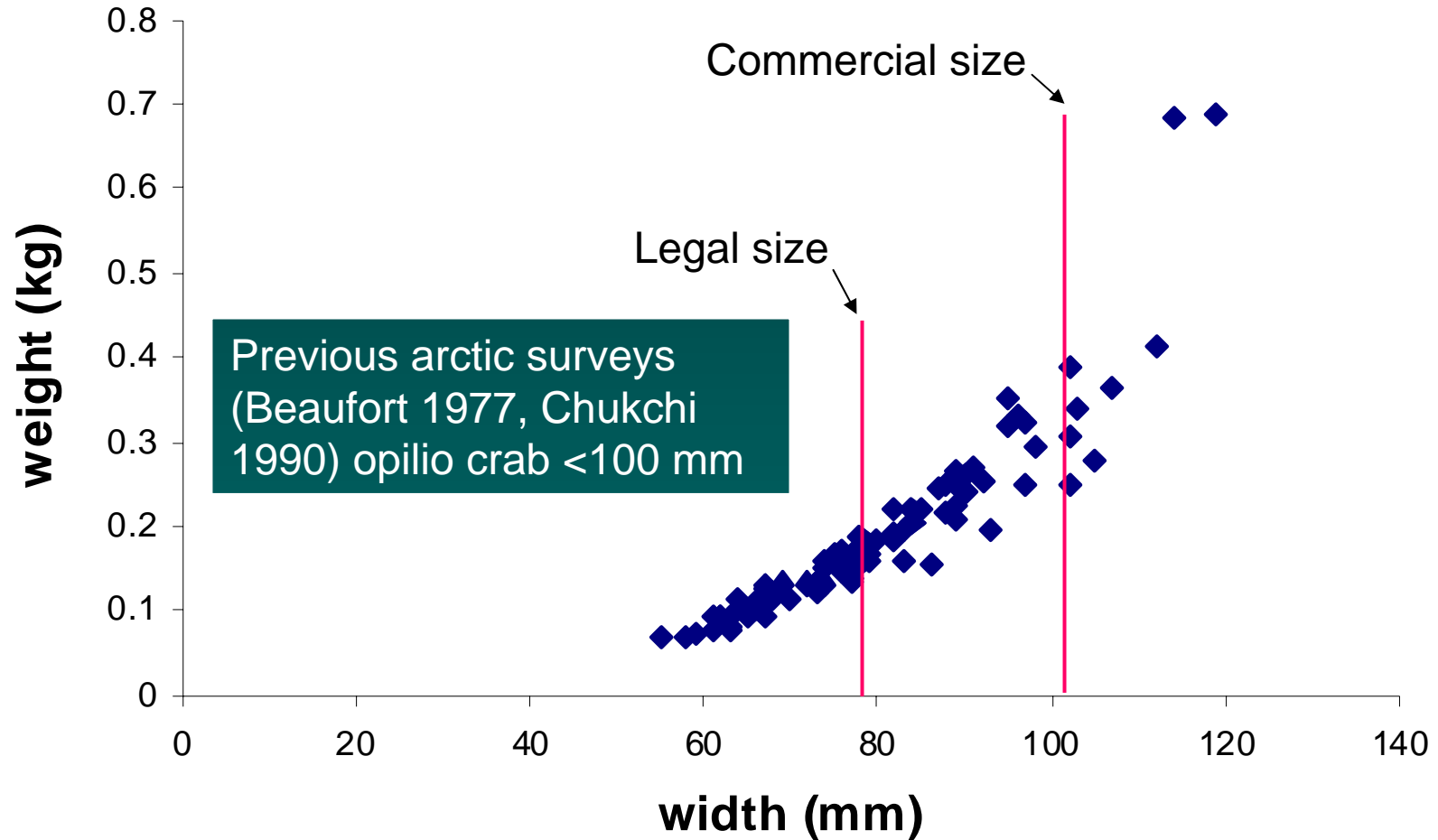


Photo by: Heloise Chenelot

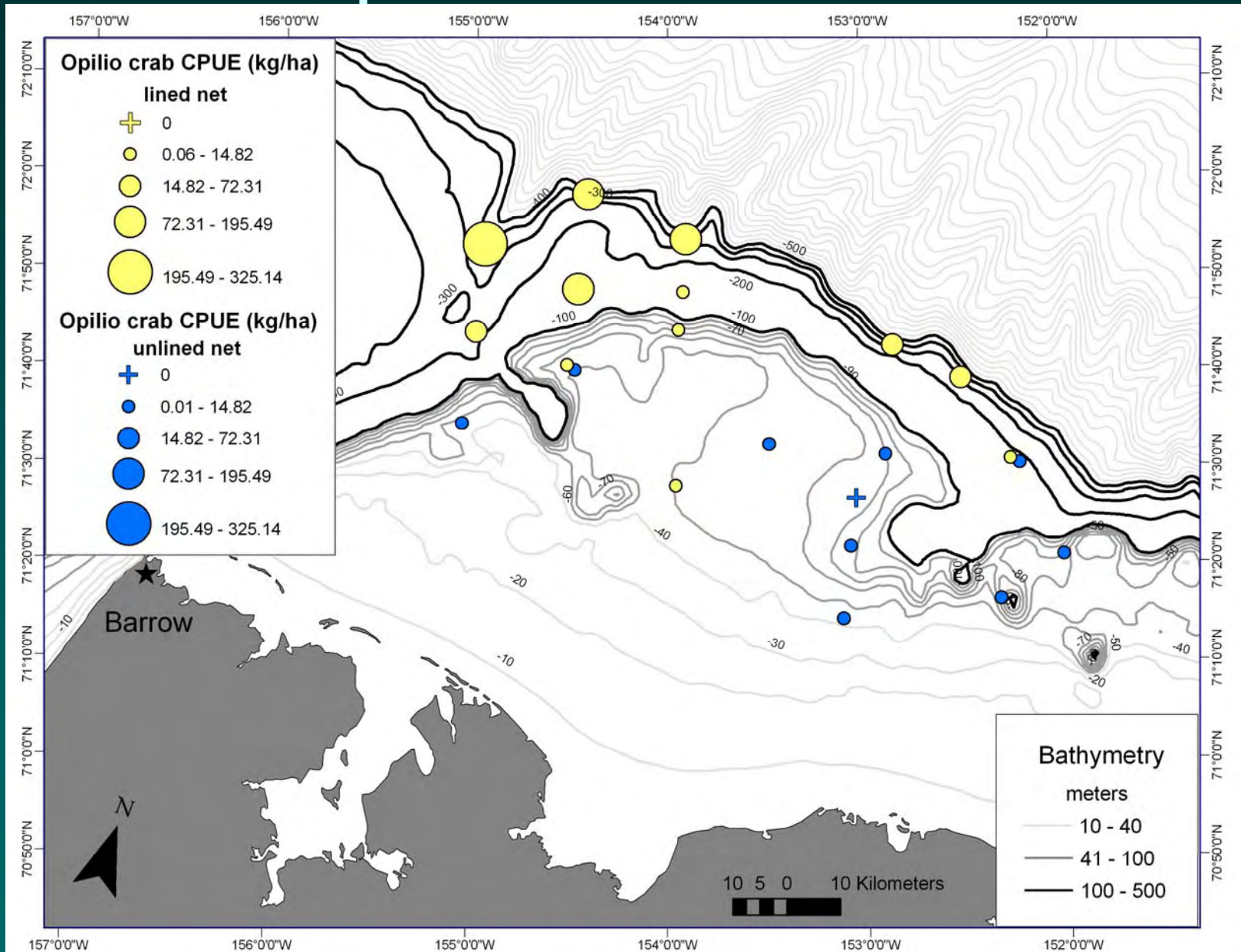
- 10% total weight of invertebrate catch

Opilio crab

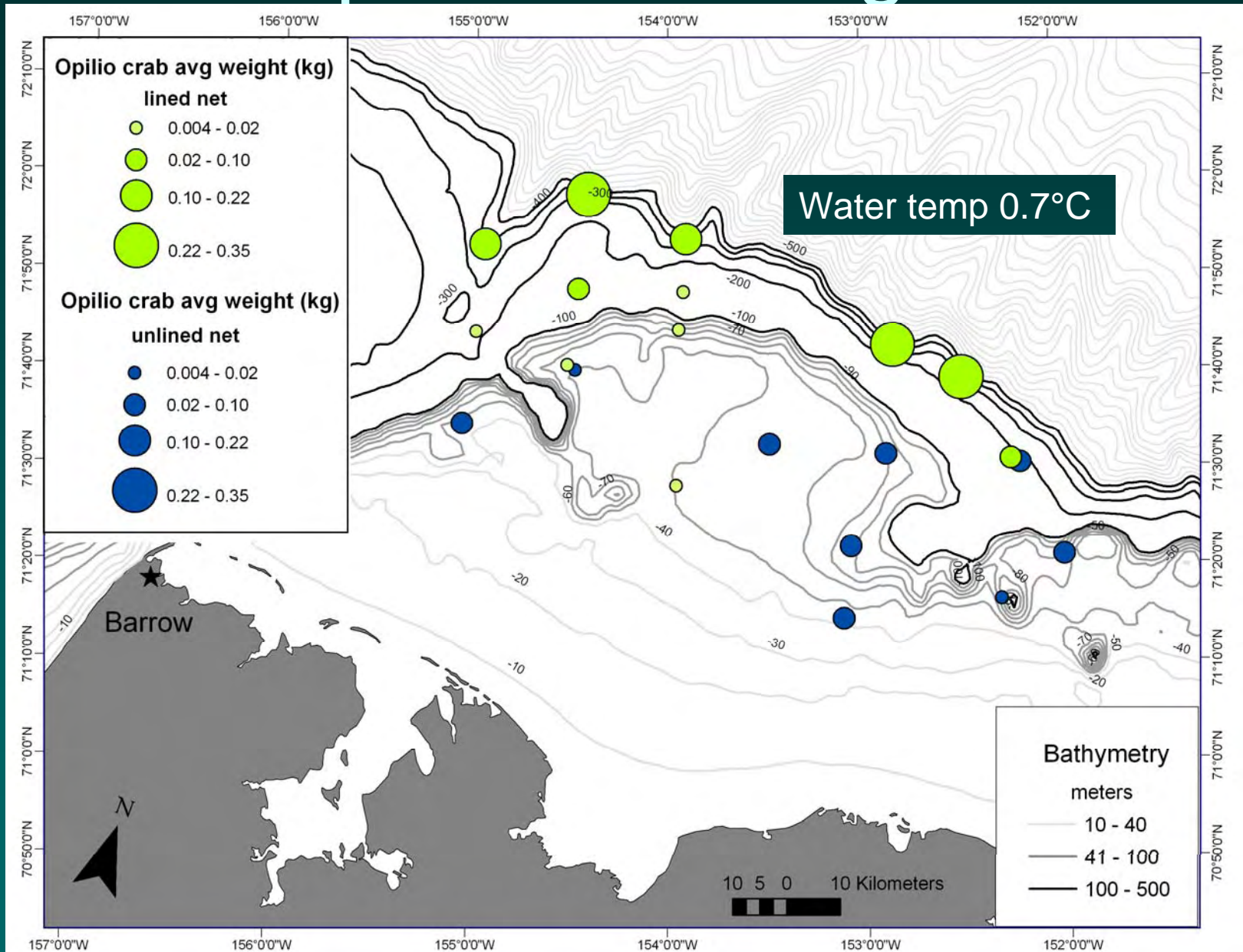
Opilio crab weight vs. carapace width



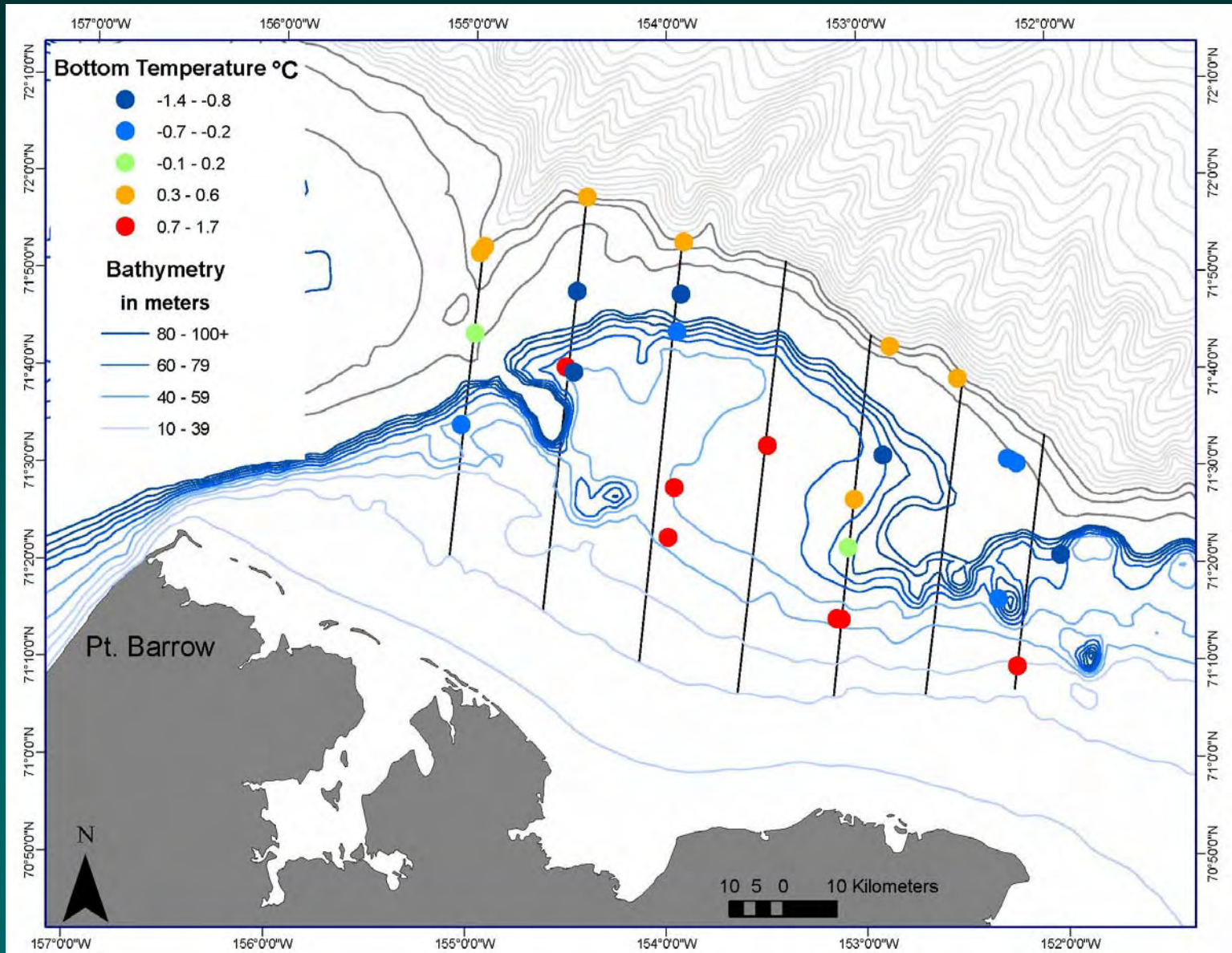
Opilo crab CPUE



Opilio crab weight



Bottom temperature



Geographic and historic comparisons



Geographic comparisons

Species	Beaufort Sea 2008 ¹ CPUE (kg/ha)	Chukchi Sea 1990 ² CPUE (kg/ha)	Bering Sea 2008 ³ CPUE (kg/ha)
Arctic cod	6.12	3.02	1.04
Arrowtooth flounder	*	*	11.87
Bering Flounder	0.11	0.18	0.45
Cottidae (sculpin family)	0.03	0.76	4.22
Flathead sole	*	*	10.81
Greenland turbot	*	<0.01	0.27
Northern rock sole	*	*	41
Pacific cod	*	0.12	8.65
Saffron cod	*	0.39	<0.01
Walleye pollock	0.13	0.02	61.2
Yellowfin sole	*	*	42.4
Zoarcidae (eelpout family)	0.03	0.21	0.5
Snow Crab	0.47	6.73	72.3

¹ this study ² Barber et al., 1997 ³ Eastern Bering Sea 2008 survey (Jason Conner, AFSC, pers. com)

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Historical comparison

Species	Beaufort Sea 2008 CPUE (kg/ha)	Beaufort Sea 1977 No. individuals
Arctic cod	24.41	194
marbled eelpout	2.51	7
Canadian eelpout	0.78	81
fish doctor	< 0.01	23
Bering flounder	0.74	*
walleye pollock	0.70	*
Greenland turbot	0.23	*
variegated snailfish	0.17	*
gelatinous seasnail	0.09	*
unidentified snailfish	0.01	29
warty sculpin	0.03	*
ribbed sculpin	0.03	2
spatulate sculpin	< 0.01	14
twohorn sculpin	*	74
Pacific cod	0.02	*
Snow (opilio) crab	0.47	49

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Summary

- First offshore marine fish survey of the Beaufort Sea since 1977
- Arctic cod dominant in benthic and pelagic communities
- Range extensions of 5 species (incl. Pacific cod and pollock)
- Commercial-size snow (opilio) crab observed for the first time in the Arctic
- Pollock well below commercial size

Thanks



To the science and vessel team and
RACE Groundfish Assessment

For more information...

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206-526-4231

www.afsc.noaa.gov/REFM/Stocks/fit/Beaufort.php

