Distribution of larval fishes of the Northern Bering and Chukchi Seas

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NOAA FISHERIES

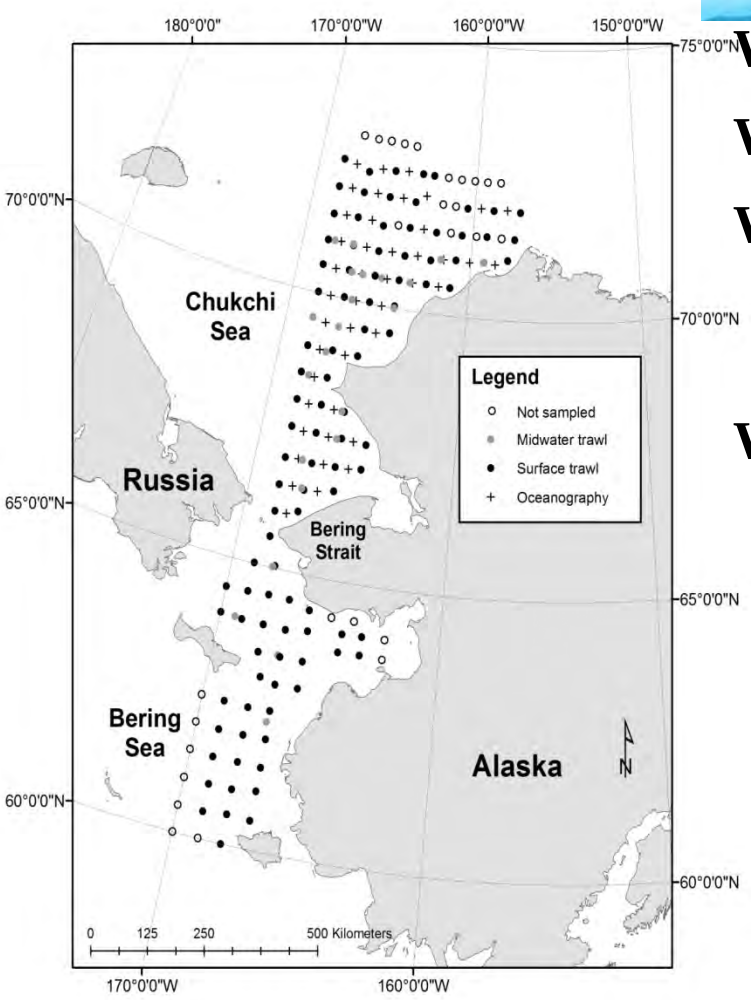
AFSC

EcoFOCI Program

November 2, 2018

PICES Annual Meeting, Yokohama, Japan

Arctic Ecosystem Integrated Survey



When: August / September 2012 & 2013

Where: Chukchi and Northern Bering Seas

Why: Understand the distribution of marine fishes and shellfishes, oceanographic drivers and the plankton they depend upon for food

What:

Physical Oceanography

Biological Oceanography

Fish

https://web.sfos.uaf.edu/wordpress/arcticeis/

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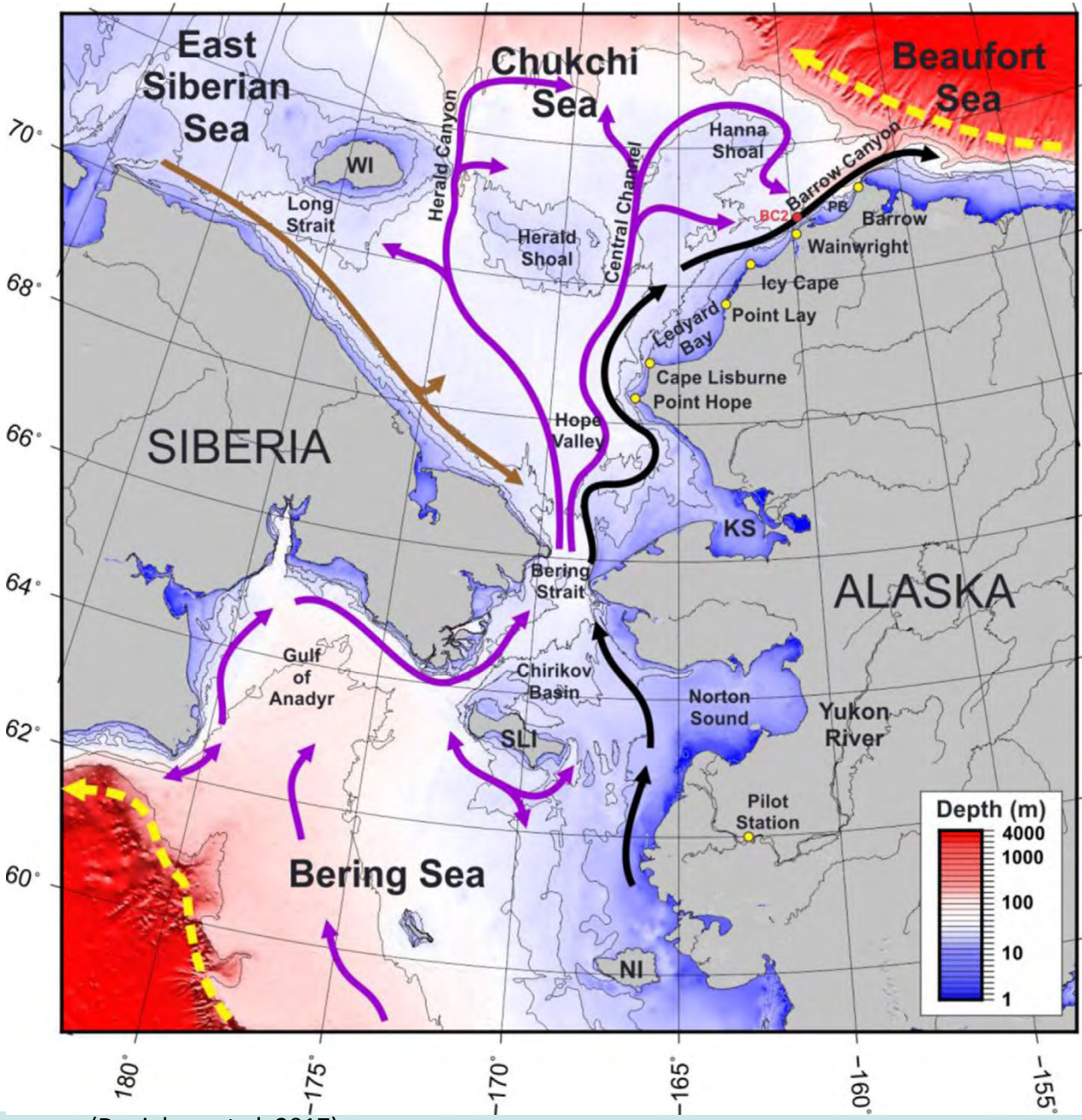
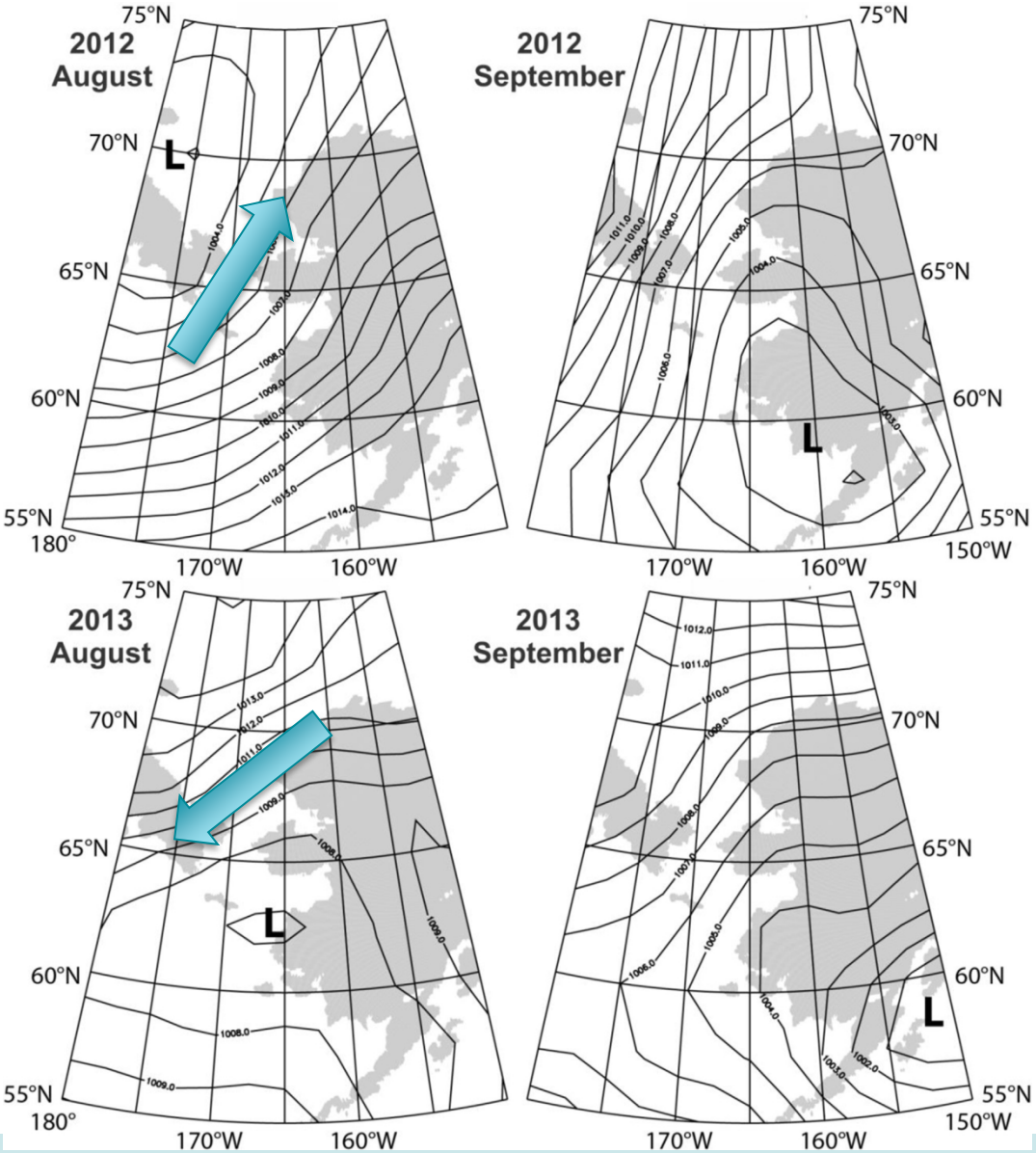
- Northward flow on average
- Winds can weaken or reverse currents
- Anadyr water is nutrient-rich, fuels shelf production
- Coastal water is nutrient-poor



(Danielson et al. 2017)

Interannual variability

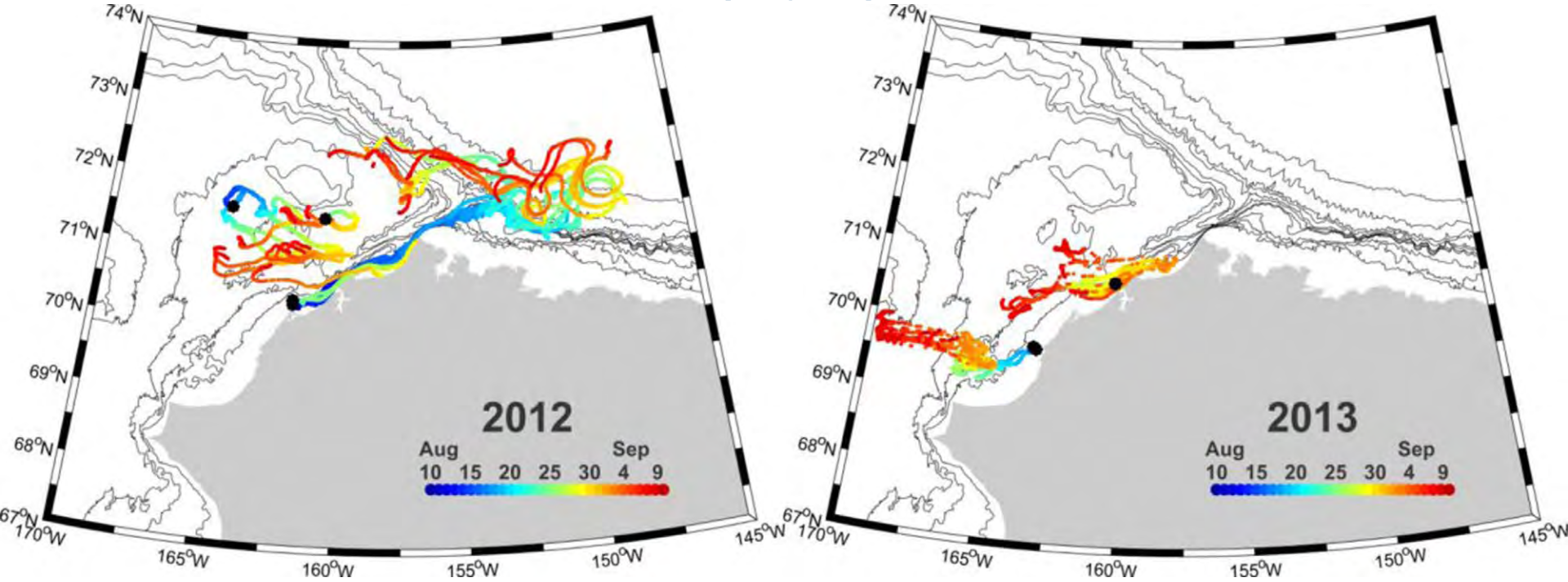
- Sea level pressure
- Wind



Danielson et al. 2017

Interannual variability

- Currents; nutrient and phytoplankton distribution



Surface (1-m) drogued satellite-tracked drifters deployed over 10–24 August 2012 (left) and 17–24 August 2013 (right). Color denotes the date of each location fix. Black dots locate the deployment sites (Danielson et al., 2017).

Questions

- Do larval fish distributions reflect changes in oceanography between 2012 and 2013?
- Are larval fish associated with particular water masses?
  - If so, what are the characteristics of those water masses?

Larval fish catch

Scientific Name	Common Name	Total catch
Limanda aspera	Yellowfin sole	654
Hippoglossoides robustus	Bering flounder	84
Boreogadus saida	Arctic cod	50
Mallotus villosus	capelin	48
Stichaeus punctatus	Arctic shanny	36
Liparis gibbus	variegated snailfish	20
Ammodytes hexapterus	Arctic sand lance	18
Limanda proboscidea	longhead dab	15
Liparis tunicatus	kelp snailfish	14
Limanda sakhalinensis	Sakhalin sole	10
Gymnocanthus tricuspis	Arctic staghorn sculpin	8
Eumesogrammus praecisus	fourline snakeblenny	8
Eleginus gracilis	saffron cod	7
...34 species total		

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...34 species total		

Arctic cod life history

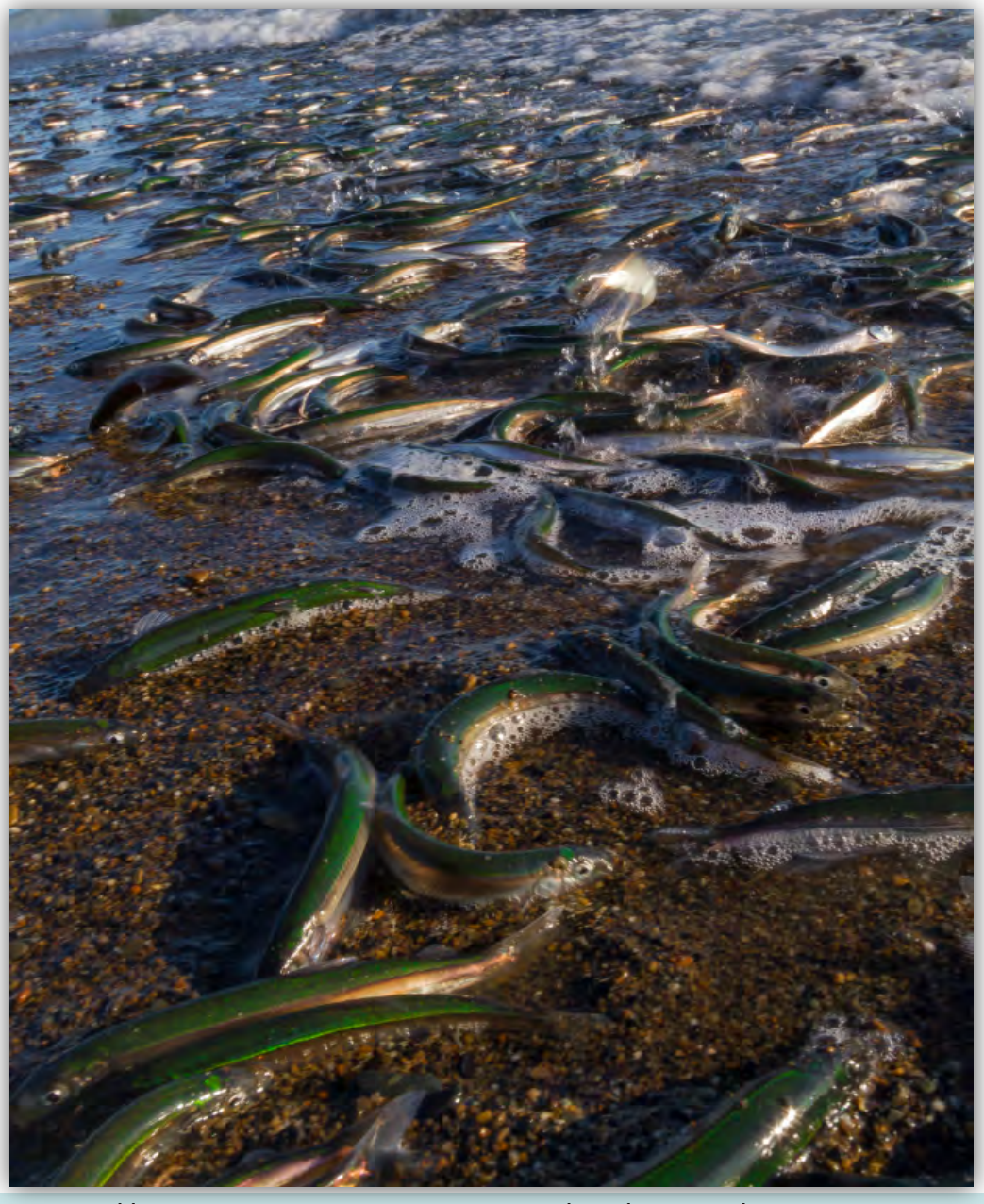
- Spawn under ice in winter
- Larval diets
  - Rotifers
  - Nauplii and copepodites of large copepods (*Calanus*)
  - Small copepods (e.g., *Pseudocalanus*)

Flatfish life history

- Spawning
  - Bering flounder – April to June; Bering and Chukchi Seas
  - Yellowfin sole – June and July; shallow waters Bering Sea
- Larval diet
  - Calanoid and cyclopoid eggs, nauplii, copepodites

Capelin life history

- Spawning
  - Spring-summer
  - Nearshore
  - Throughout Alaska
- Larval diets
  - Copepod eggs and nauplii



https://arcticberingia.wordpress.com/tag/capelin/

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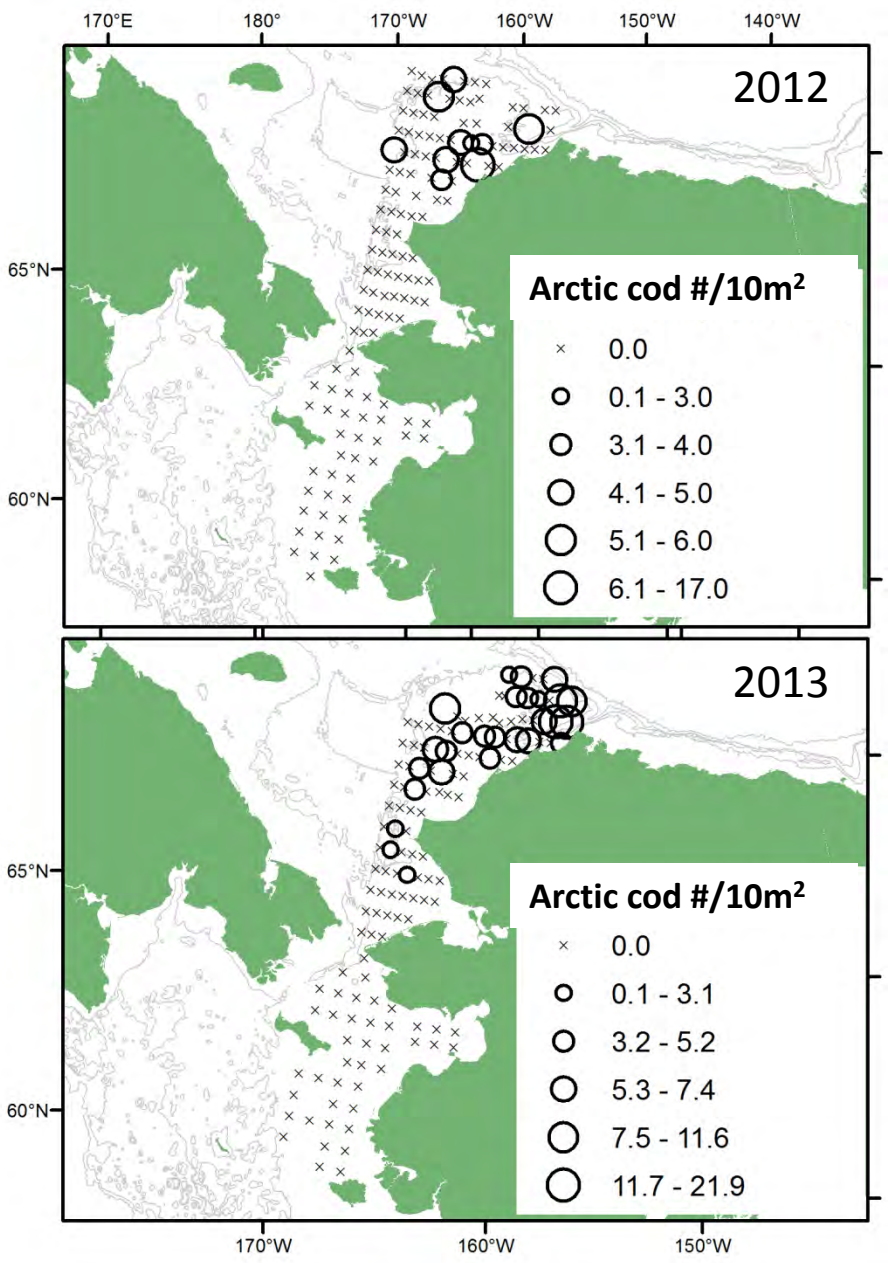
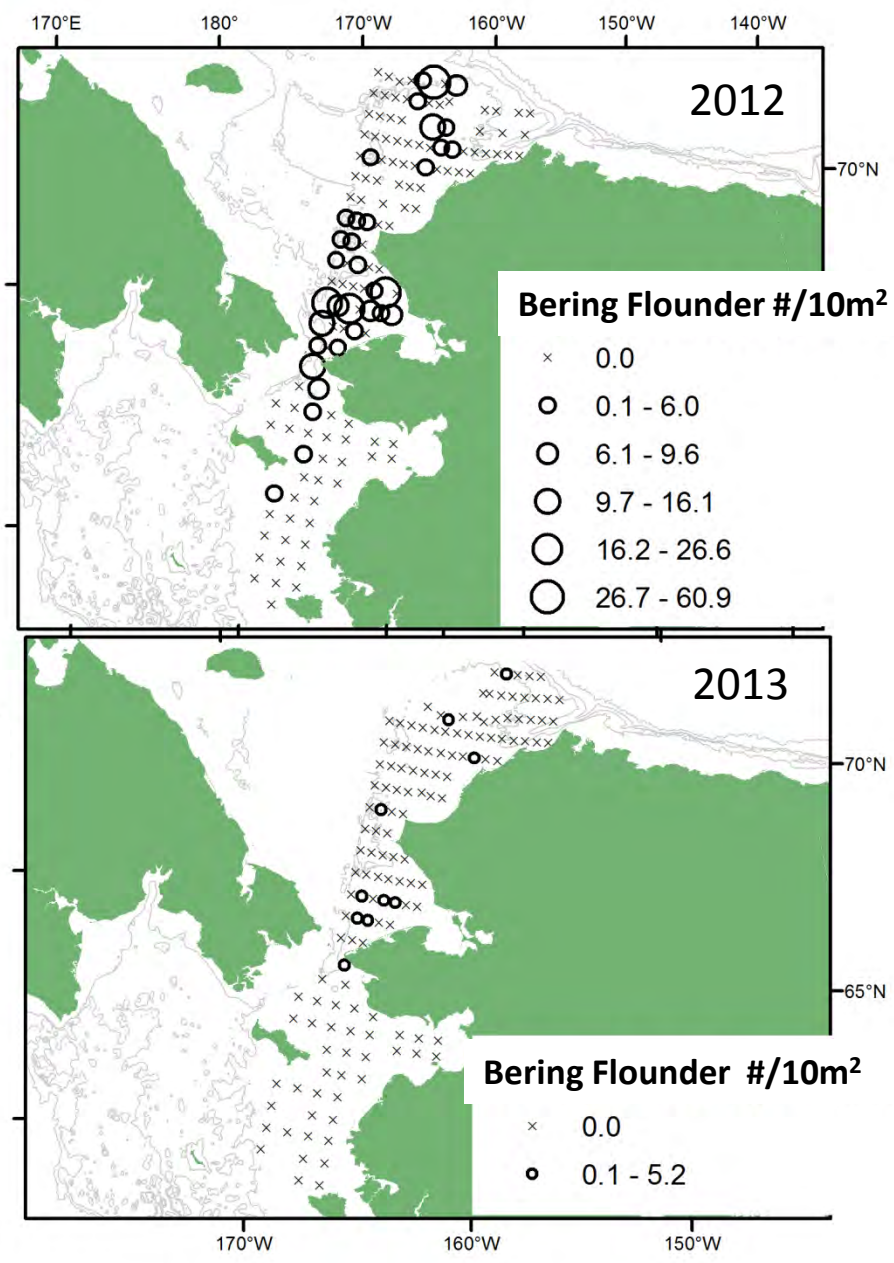
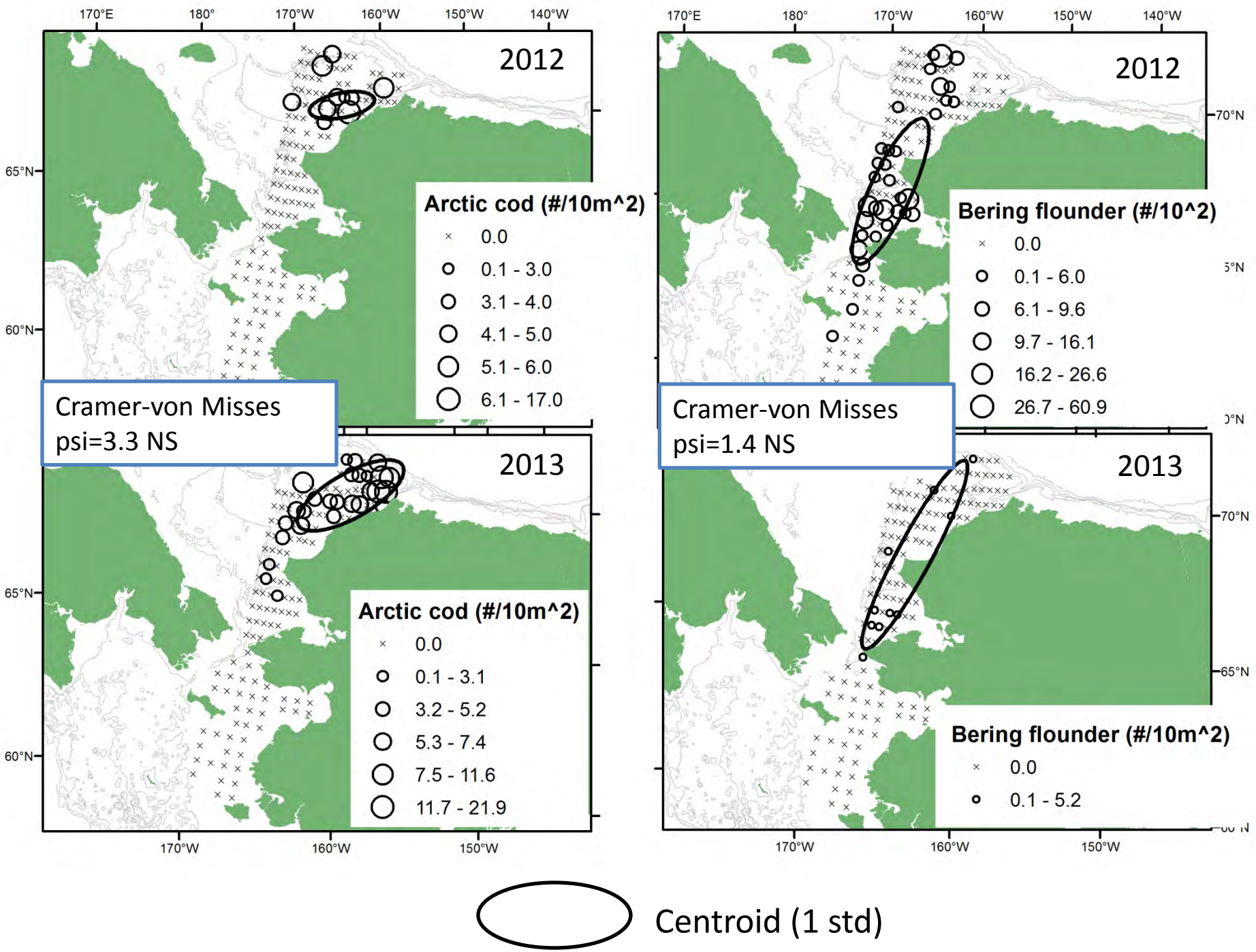
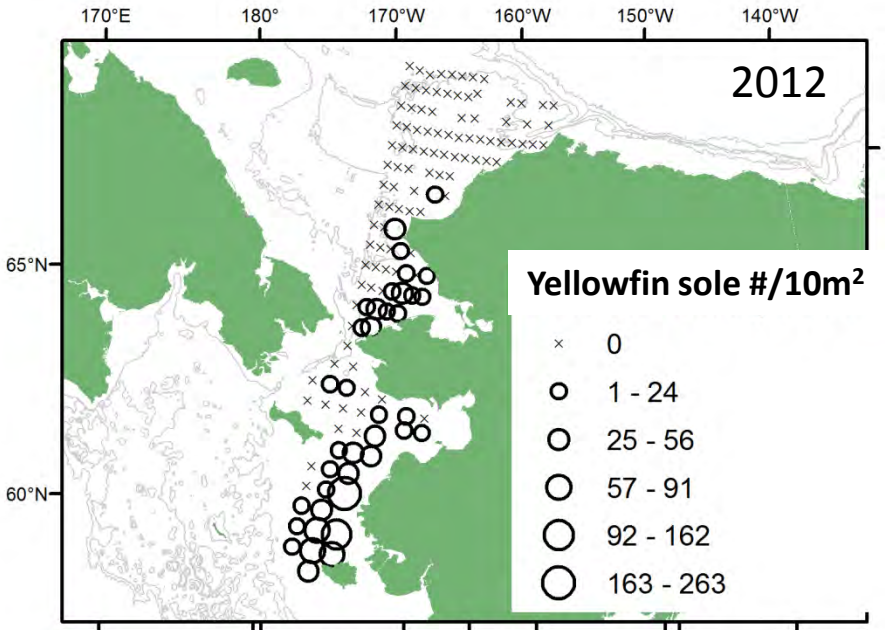
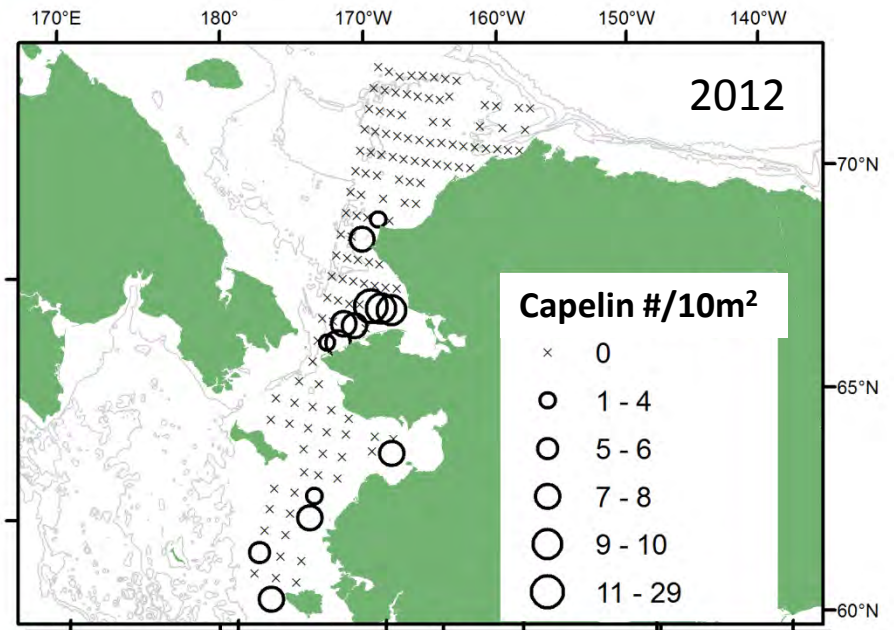
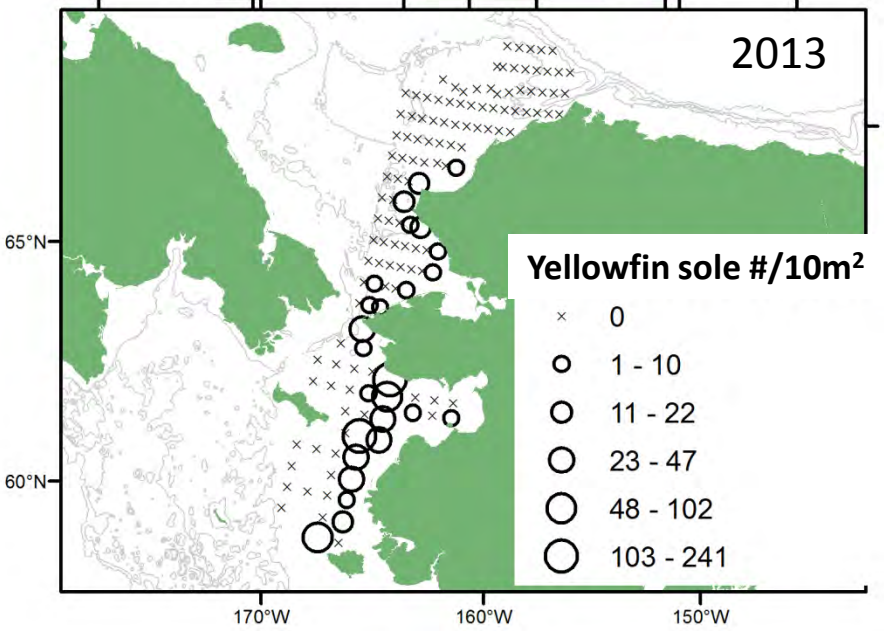

2012
Arctic cod #/10m²
0.0
0.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 17.0
2013
Arctic cod #/10m²
0.0
0.1 - 3.1
3.2 - 5.2
5.3 - 7.4
7.5 - 11.6
11.7 - 21.9
170°E
180°
170°W
160°W
150°W
140°W
65°N
60°N

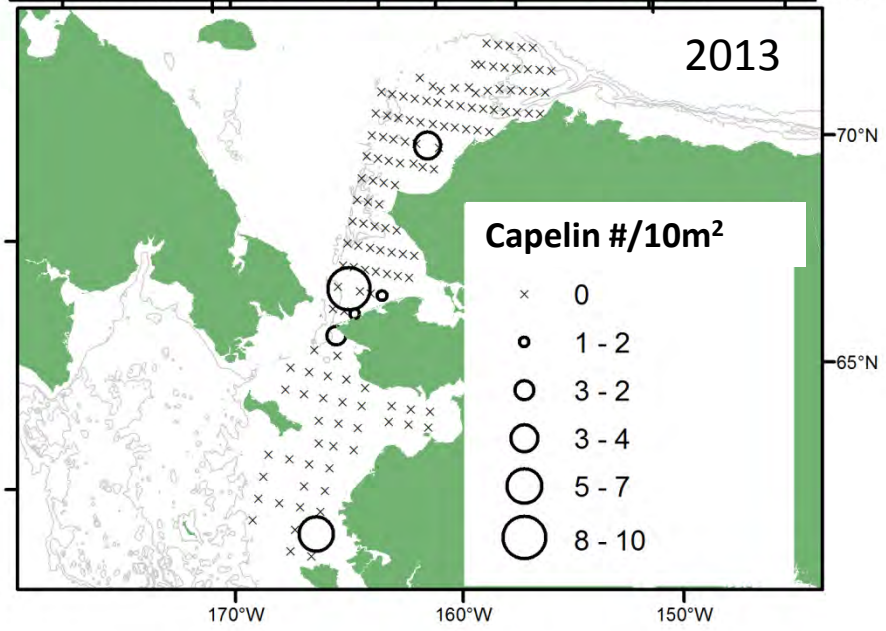

2012
Bering Flounder #/10m²
0.0
0.1 - 6.0
6.1 - 9.6
9.7 - 16.1
16.2 - 26.6
26.7 - 60.9
2013
Bering Flounder #/10m²
0.0
0.1 - 5.2
170°E
180°
170°W
160°W
150°W
140°W
70°N
65°N

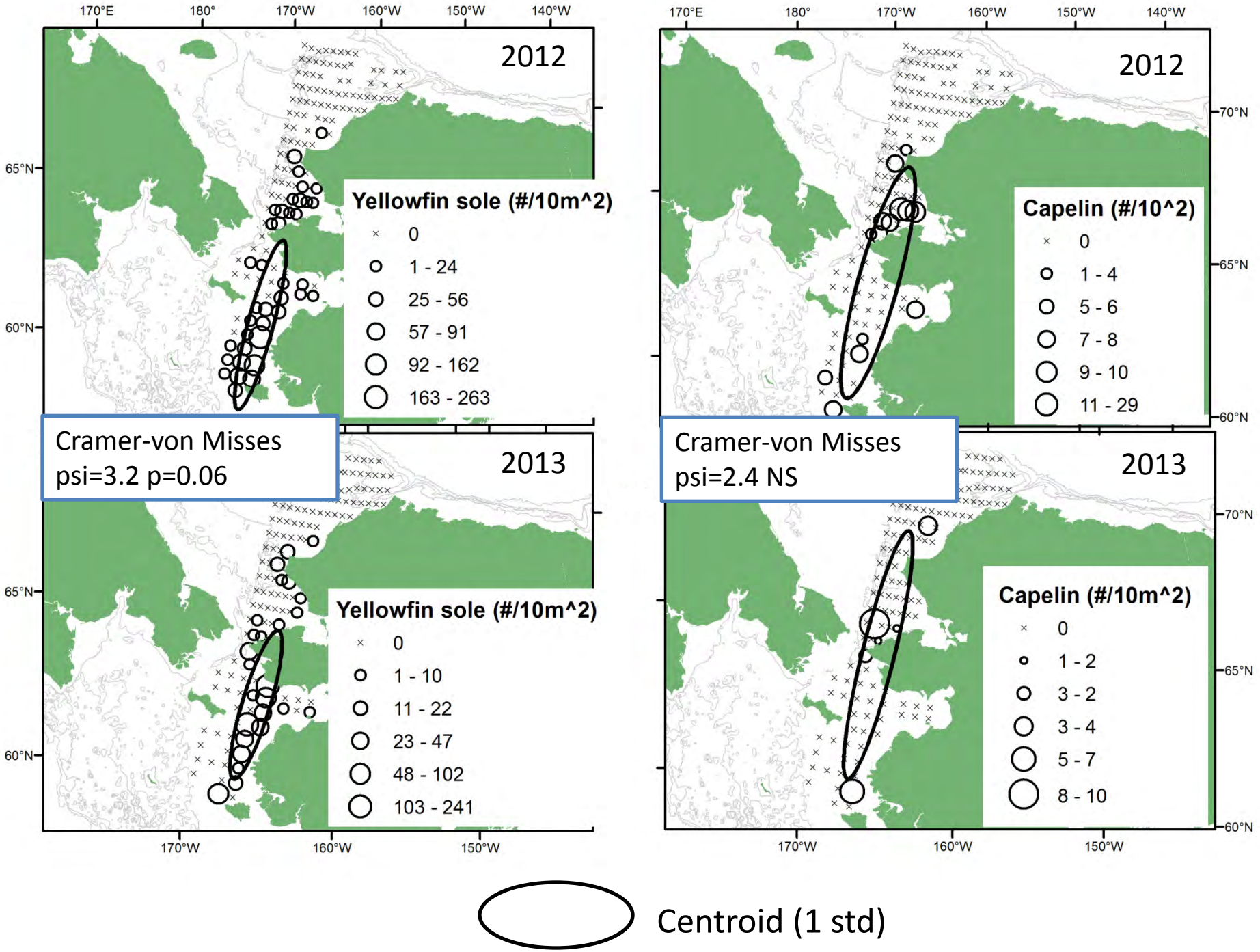

2012
Arctic cod (#/10m^2)
0.0
0.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 17.0
Cramer-von Misses
psi=3.3 NS
2012
Bering flounder (#/10^2)
0.0
0.1 - 6.0
6.1 - 9.6
9.7 - 16.1
16.2 - 26.6
26.7 - 60.9
Cramer-von Misses
psi=1.4 NS
2013
Arctic cod (#/10m^2)
0.0
0.1 - 3.1
3.2 - 5.2
5.3 - 7.4
7.5 - 11.6
11.7 - 21.9
2013
Bering flounder (#/10m^2)
0.0
0.1 - 5.2
Centroid (1 std)


2012
Yellowfin sole #/10m²
0
1 - 24
25 - 56
57 - 91
92 - 162
163 - 263
170°E
180°
170°W
160°W
150°W
140°W
65°N
60°N


2012
Capelin #/10m²
0
1 - 4
5 - 6
7 - 8
9 - 10
11 - 29
170°E
180°
170°W
160°W
150°W
140°W
70°N
65°N
60°N


2013
Yellowfin sole #/10m²
0
1 - 10
11 - 22
23 - 47
48 - 102
103 - 241
170°W
160°W
150°W
65°N
60°N


2013
Capelin #/10m²
0
1 - 2
3 - 2
3 - 4
5 - 7
8 - 10
170°W
160°W
150°W
70°N
65°N


2012
Yellowfin sole (#/10m^2)
0
1 - 24
25 - 56
57 - 91
92 - 162
163 - 263
2012
Capelin (#/10^2)
0
1 - 4
5 - 6
7 - 8
9 - 10
11 - 29
Cramer-von Misses
psi=3.2 p=0.06
2013
Yellowfin sole (#/10m^2)
0
1 - 10
11 - 22
23 - 47
48 - 102
103 - 241
Cramer-von Misses
psi=2.4 NS
2013
Capelin (#/10m^2)
0
1 - 2
3 - 2
3 - 4
5 - 7
8 - 10
170°E
180°
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140°W
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Centroid (1 std)

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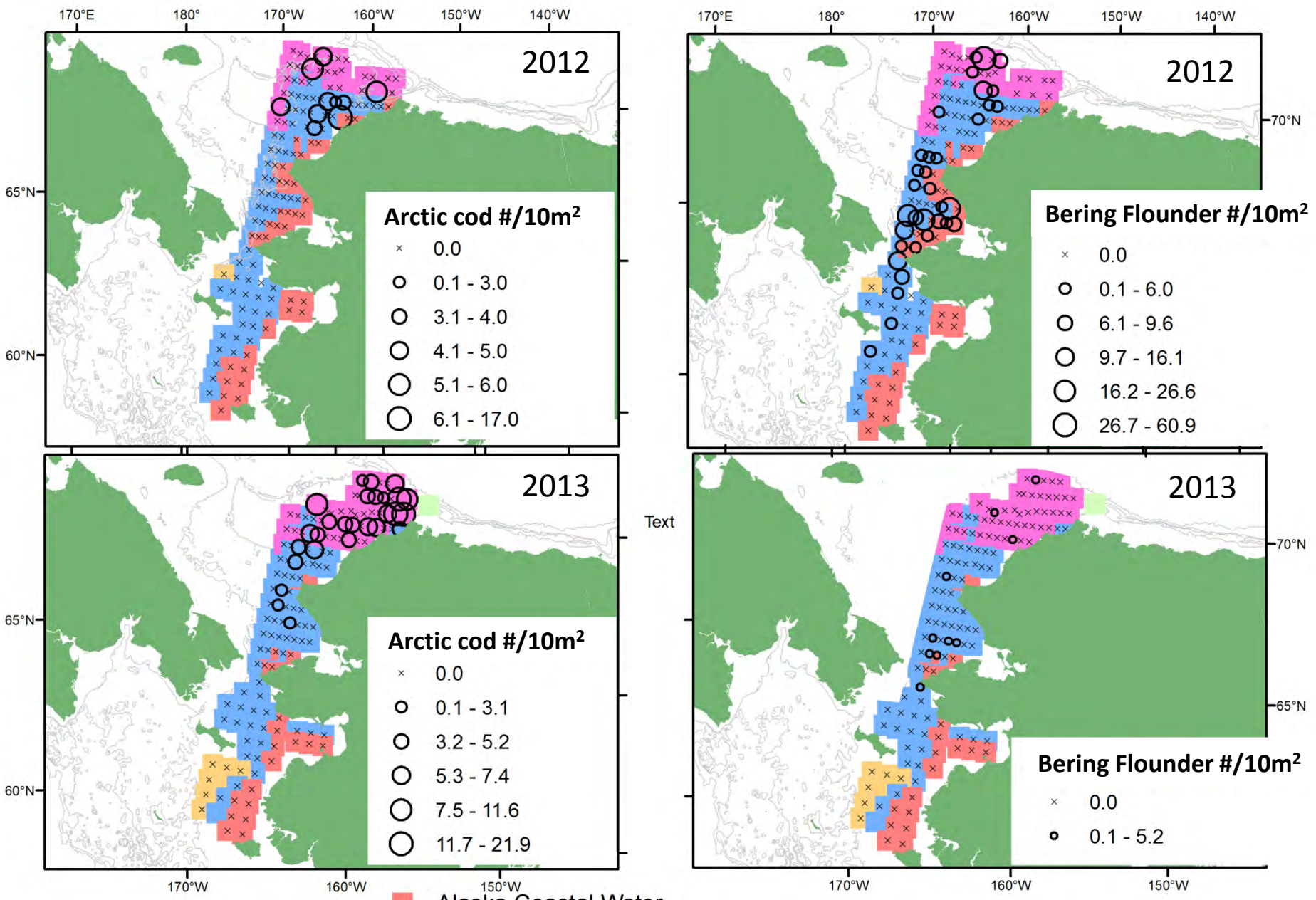

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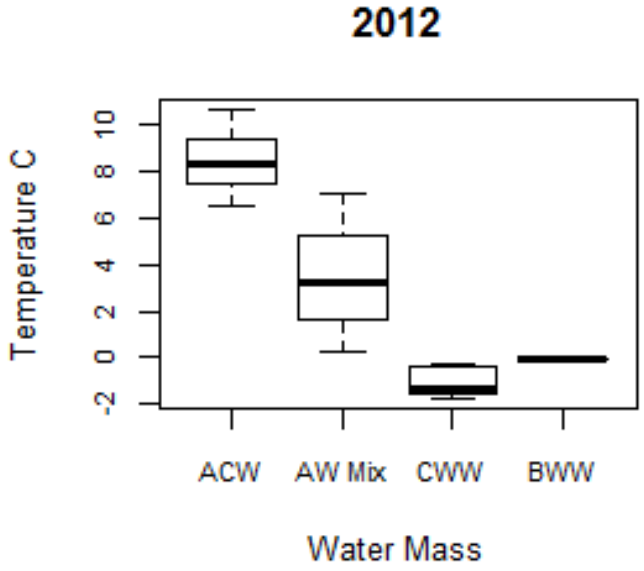
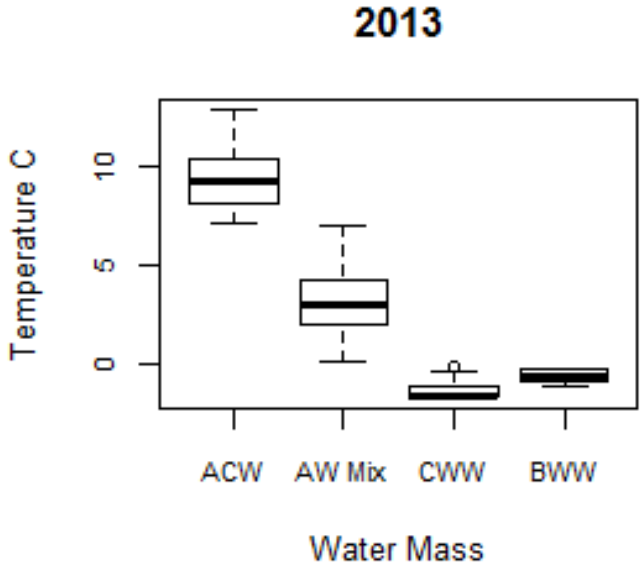
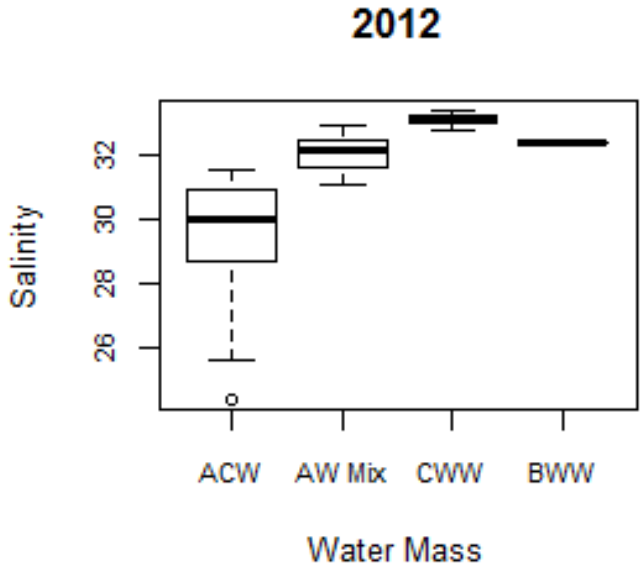
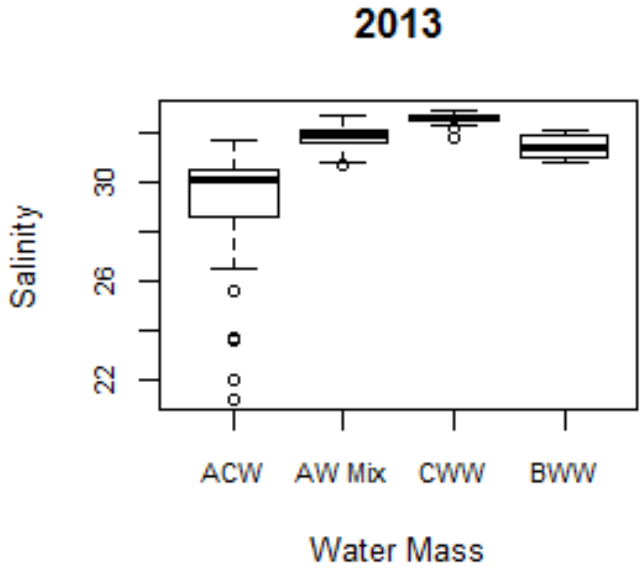
Water mass characteristics









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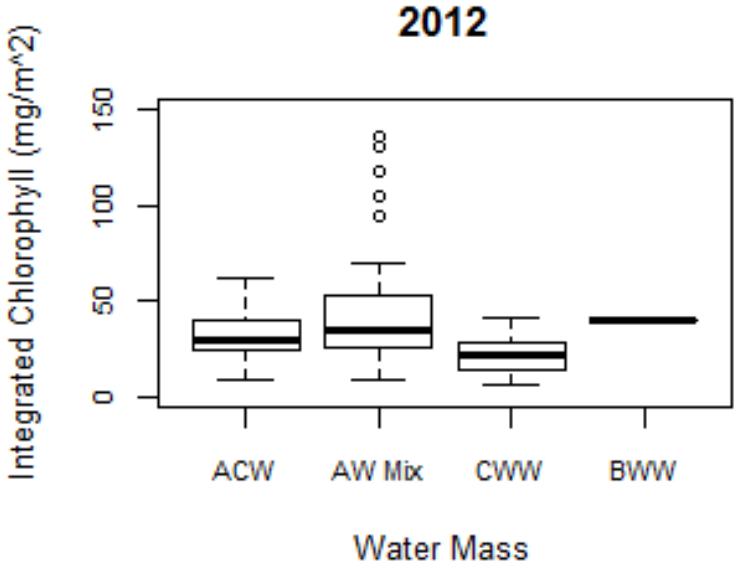

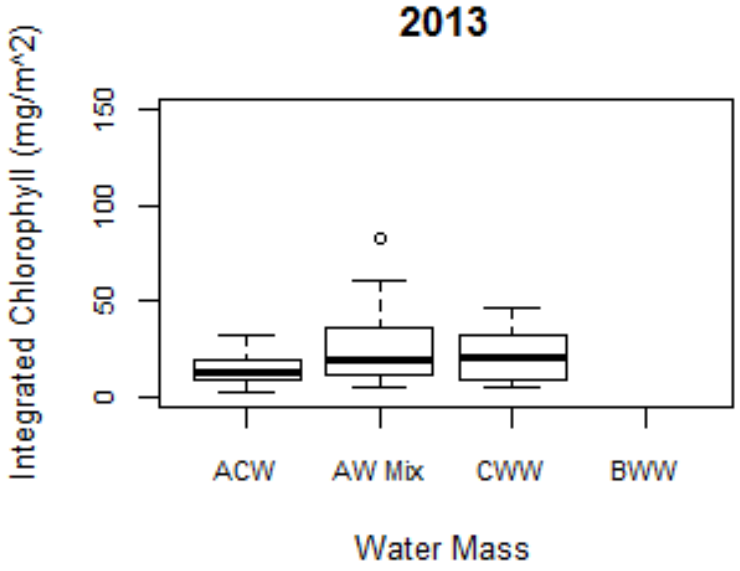

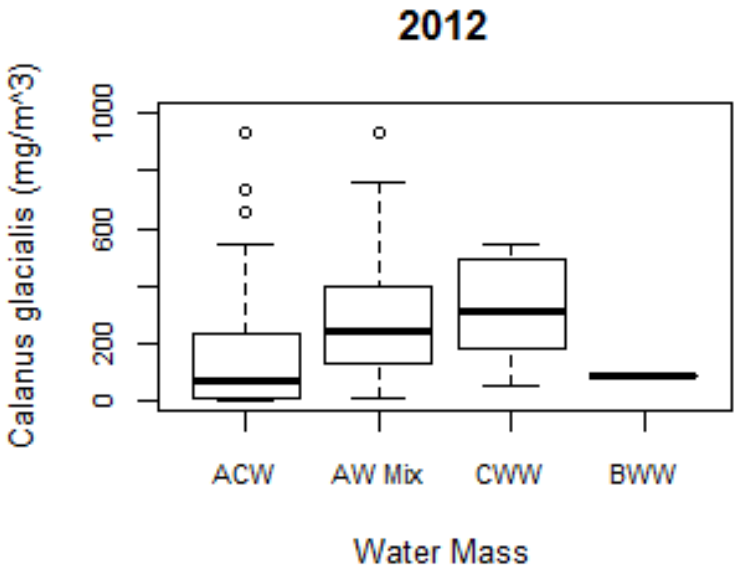

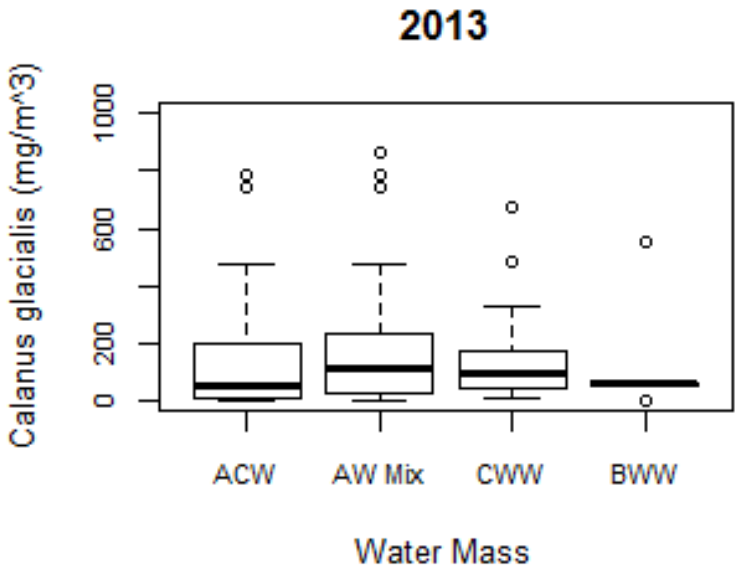

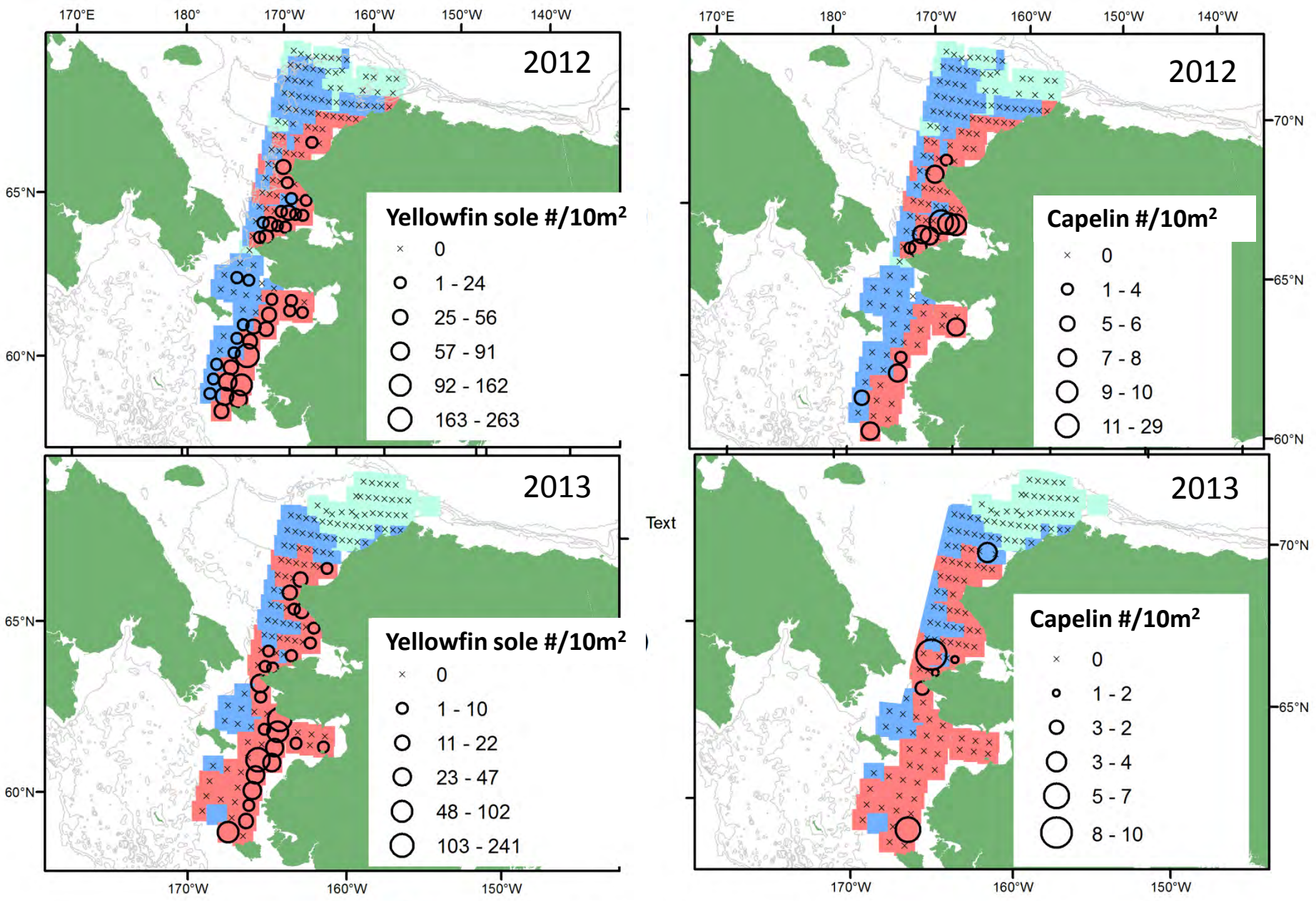

Text

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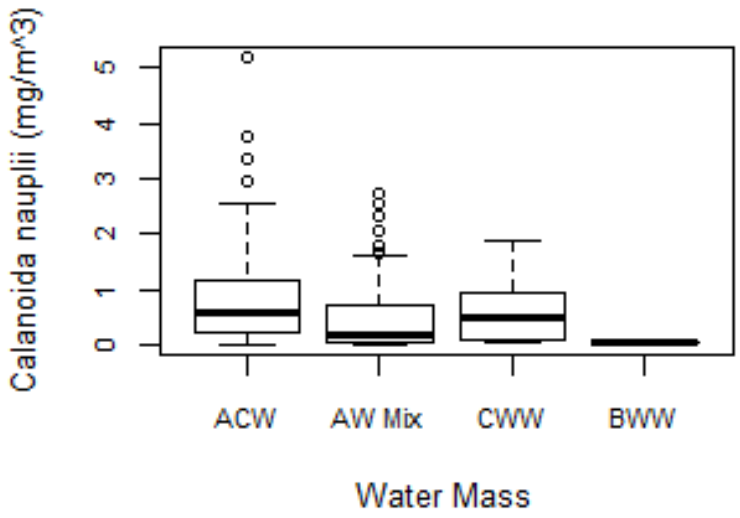
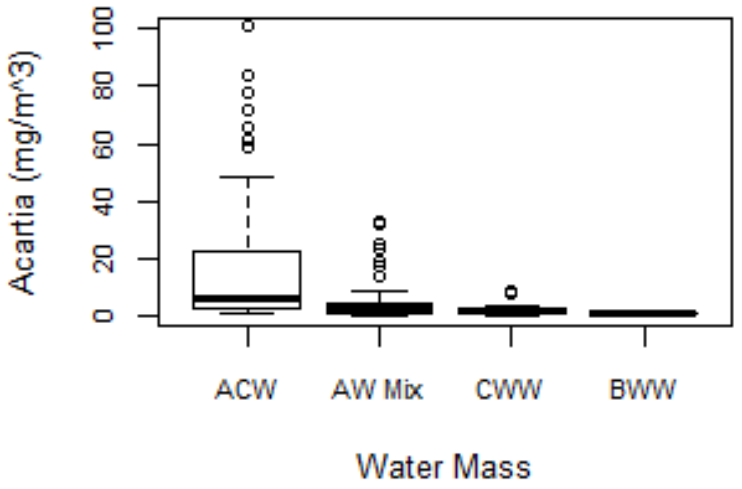
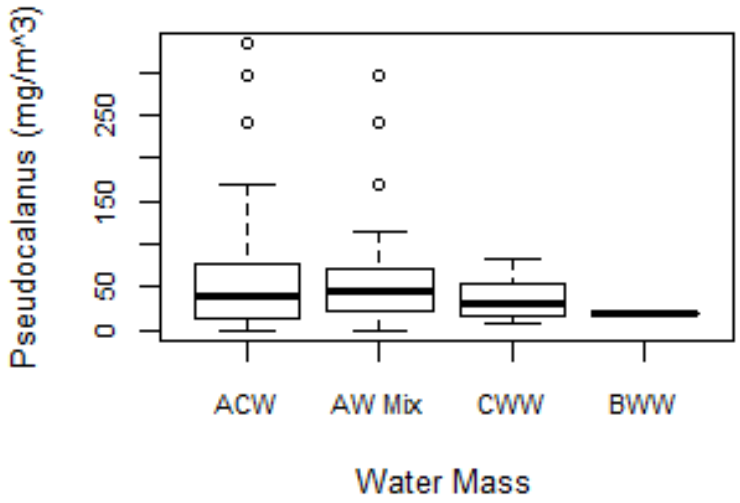
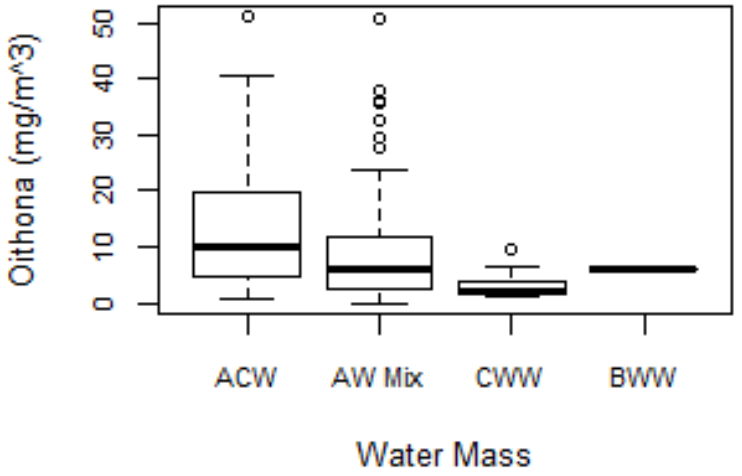
Water mass characteristics 2012









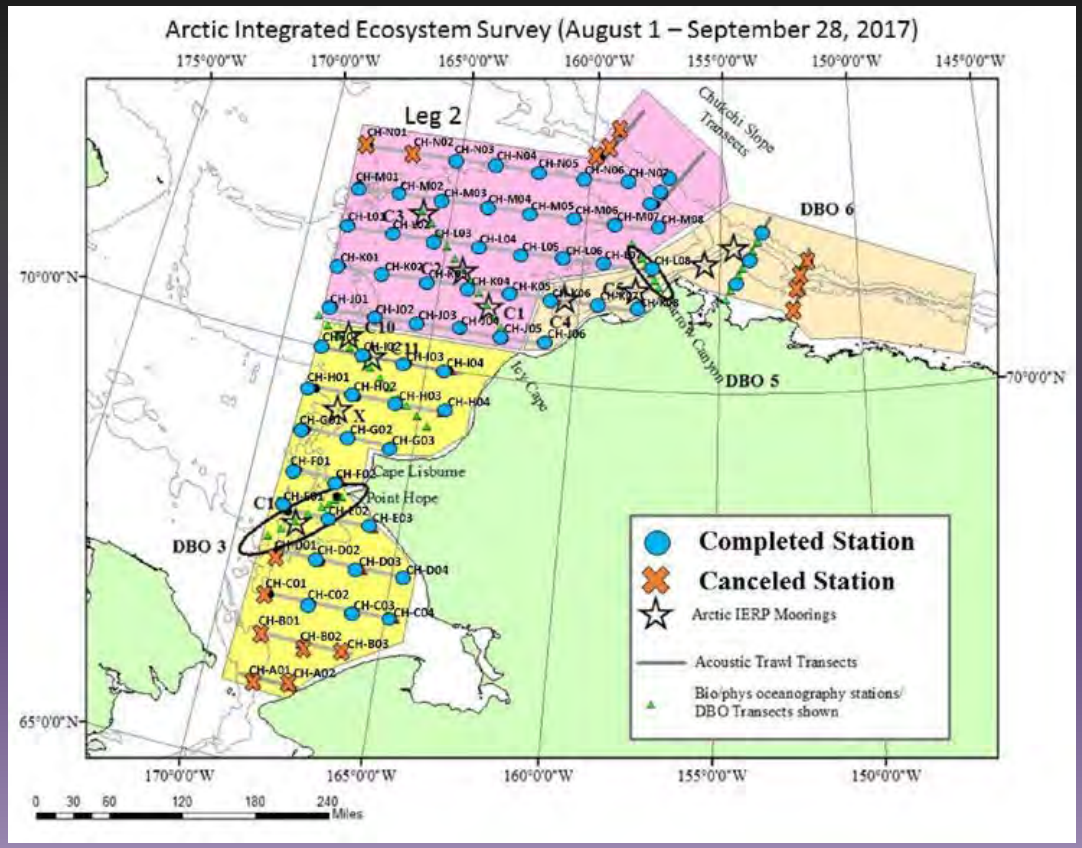
Discussion/ Conclusions

- Larval fish distributions were not significantly different between 2012 and 2013, despite different oceanographic conditions
- Larval fish were associated with particular water masses that had characteristics favorable for feeding

- Arctic fishes have evolved spawn timing and location such that their larvae “end up” in favorable feeding areas even as oceanographic processes, such as transport, vary from year to year

Arctic Integrated Ecosystem Research Program

Late Summer Research Surveys: 2017 & 2019



Acknowledgements

EcoFOCI
Ecosystems & Fisheries-Oceanography Coordinated Investigations

Official Website of the
NORTH SLOPE BOROUGH

ありがとう
ございます!