The effects of loss of summer sea ice on a sea-ice obligate seabird

George Divoky[1] and Matthew Druckenmiller[2]

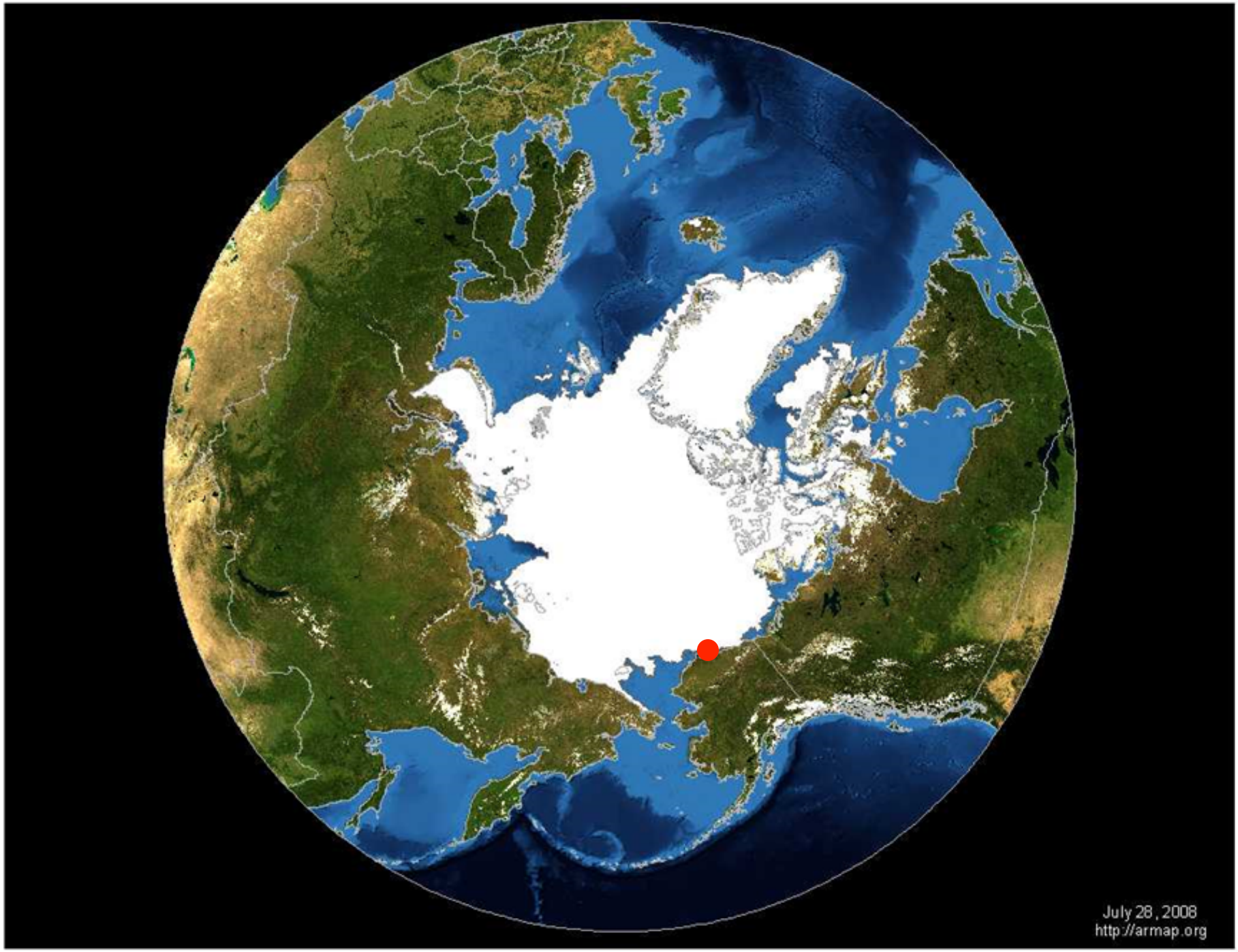
[1]Friends of Cooper Island, Seattle, WA and Barrow, AK
[2] National Snow and Ice Data Center, Boulder CO

Arctic Observing
Open Science Meeting
November 2015

Synthesis of Arctic Research
SOAR

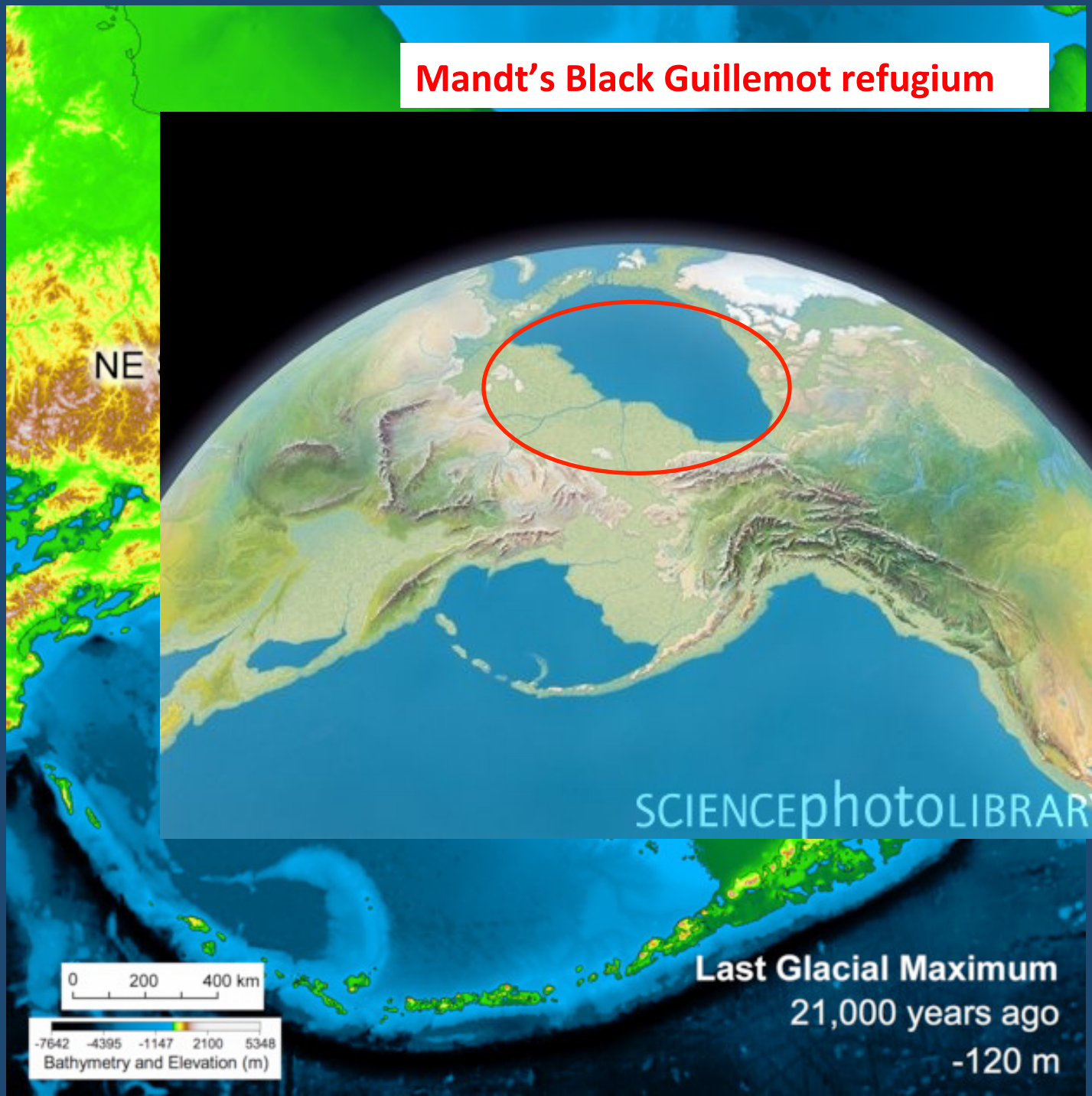
40TH ANNIVERSARY
1975 2015
FRIENDS OF
Cooper Island

NSIDC
National Snow and Ice Data Center

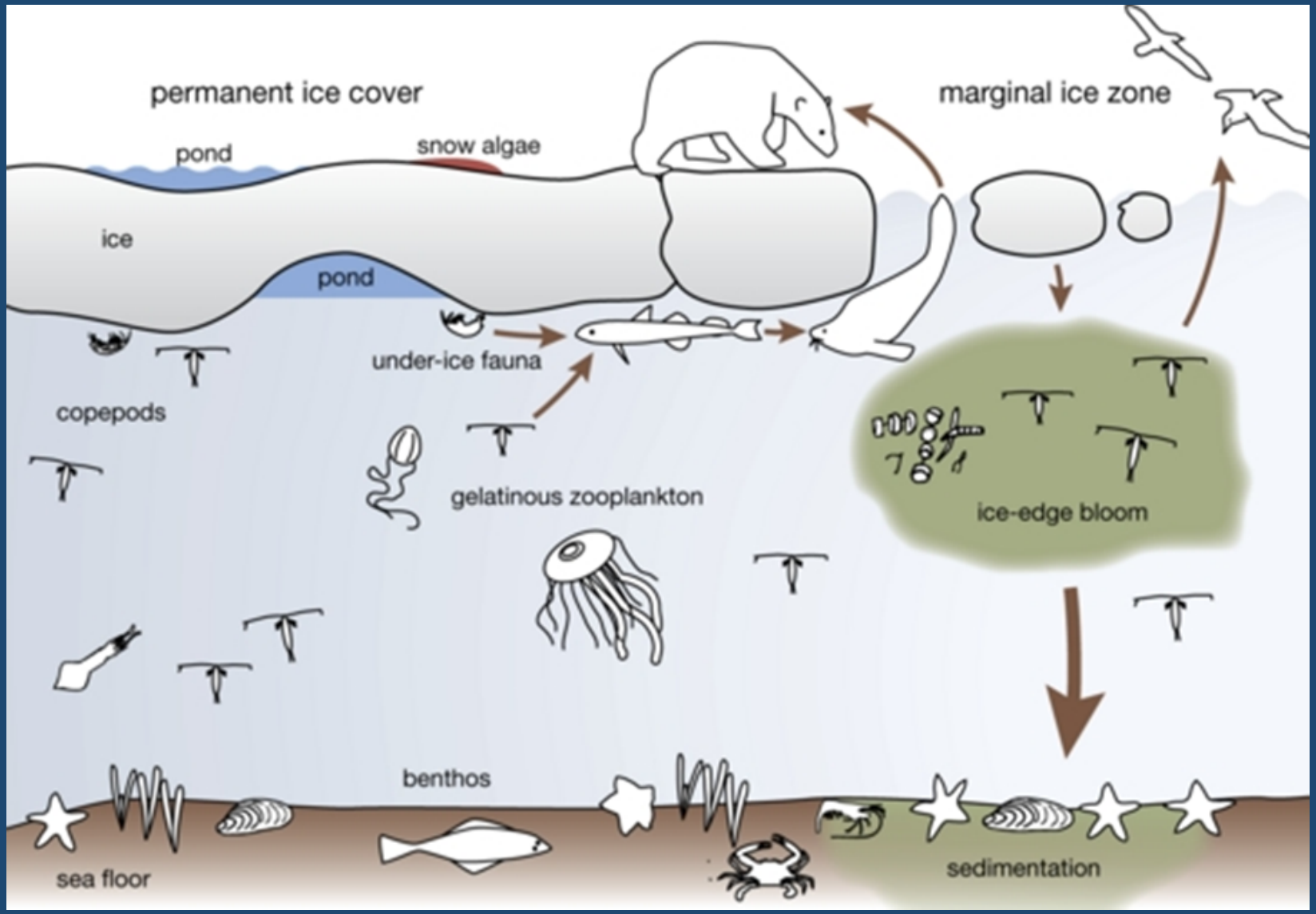

July 28 , 2008
http://armap.org

Black Guillemot

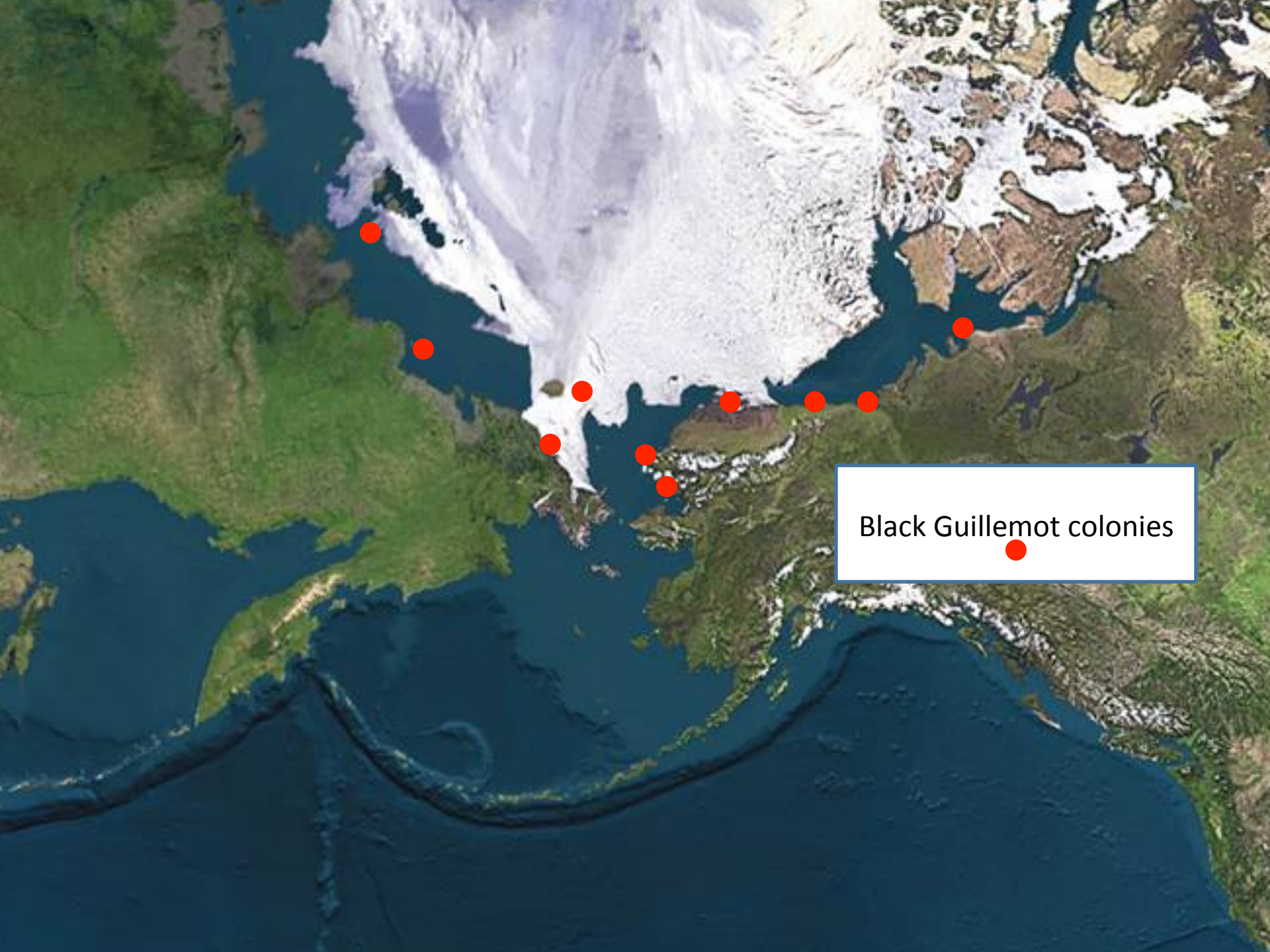
Mandt's Black Guillemot refugium



Cryopelagic ecosystem

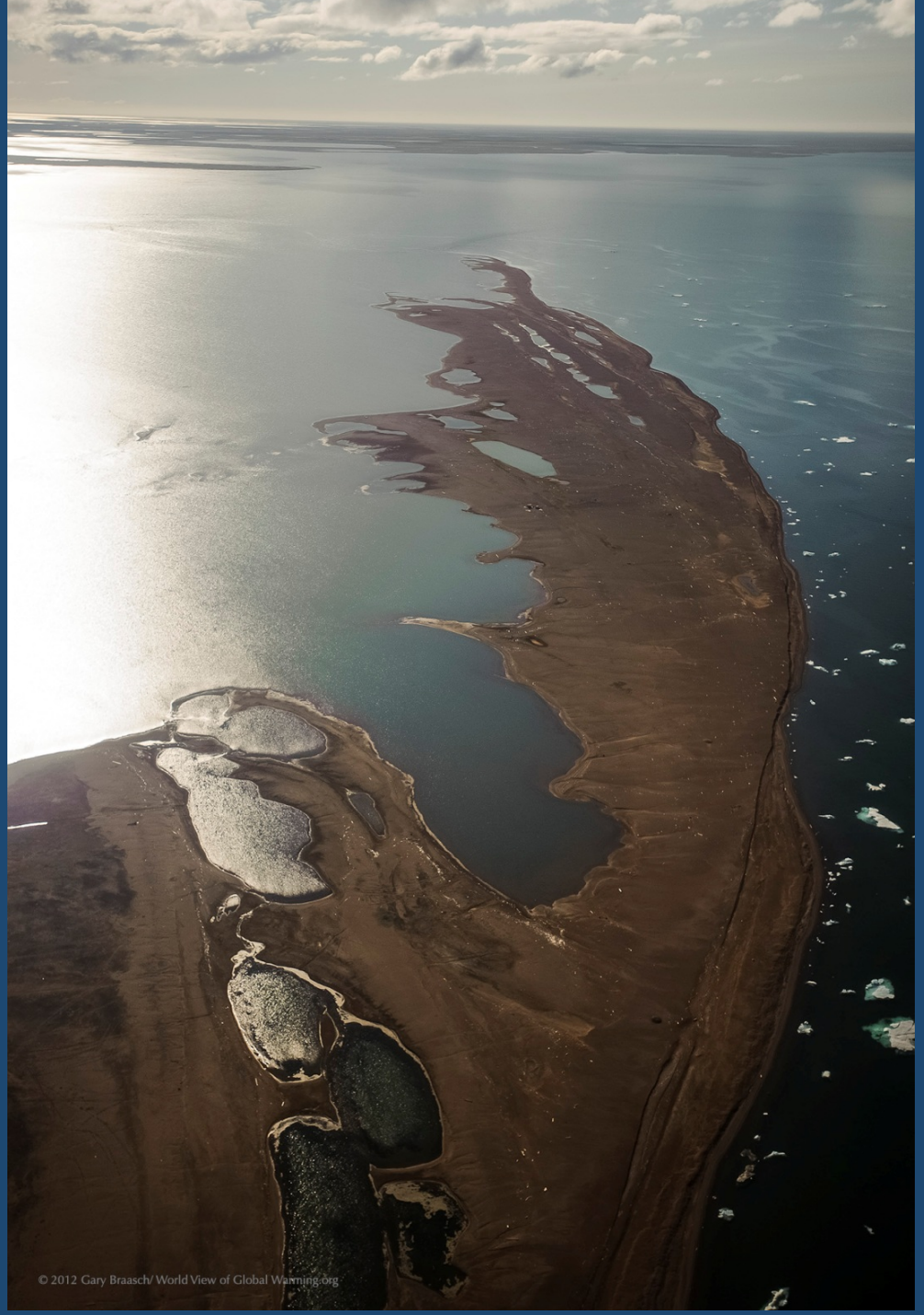


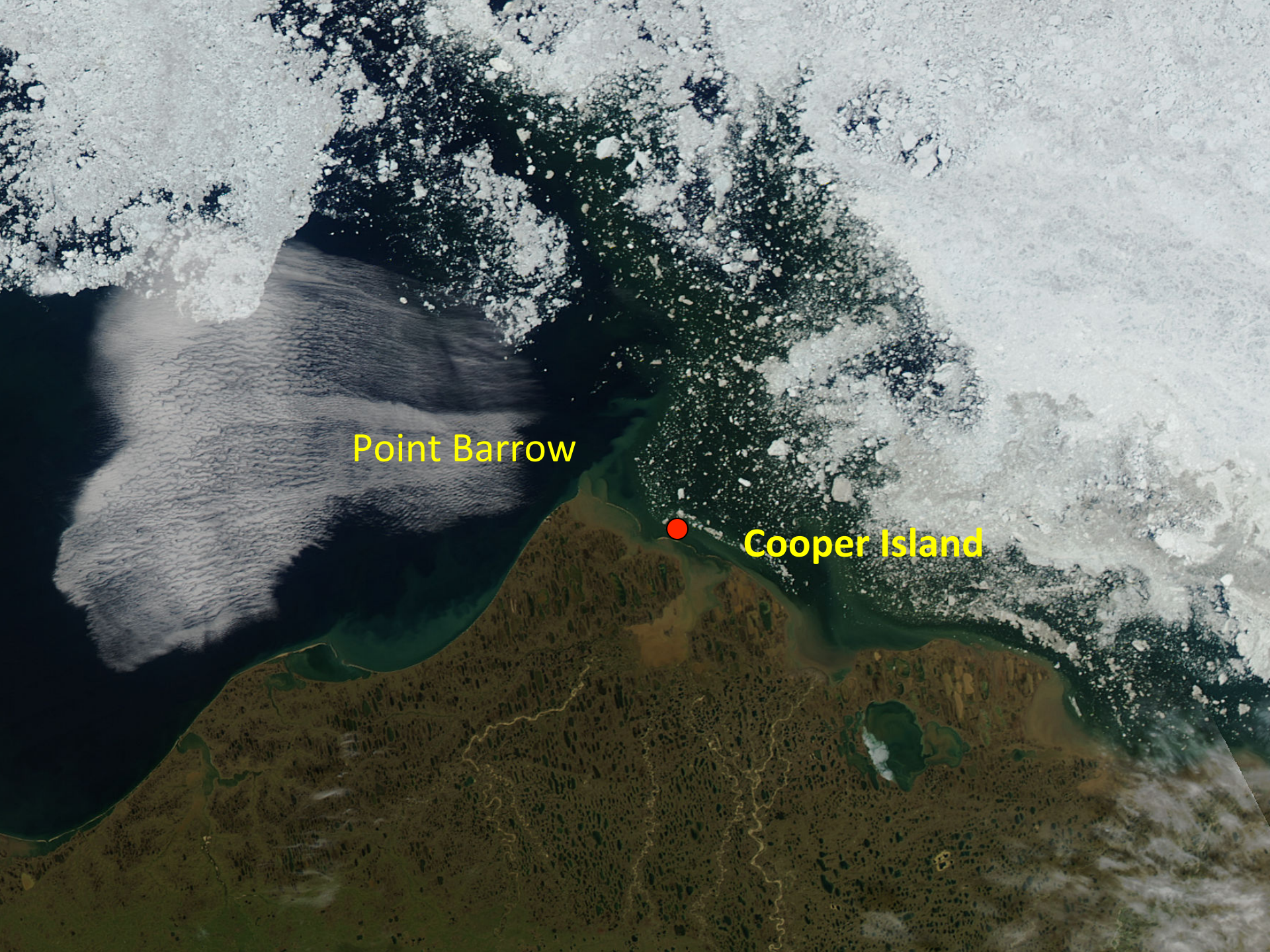
Under-ice fauna of invertebrates and fish


Black Guillemot colonies

Cooper Island, Alaska

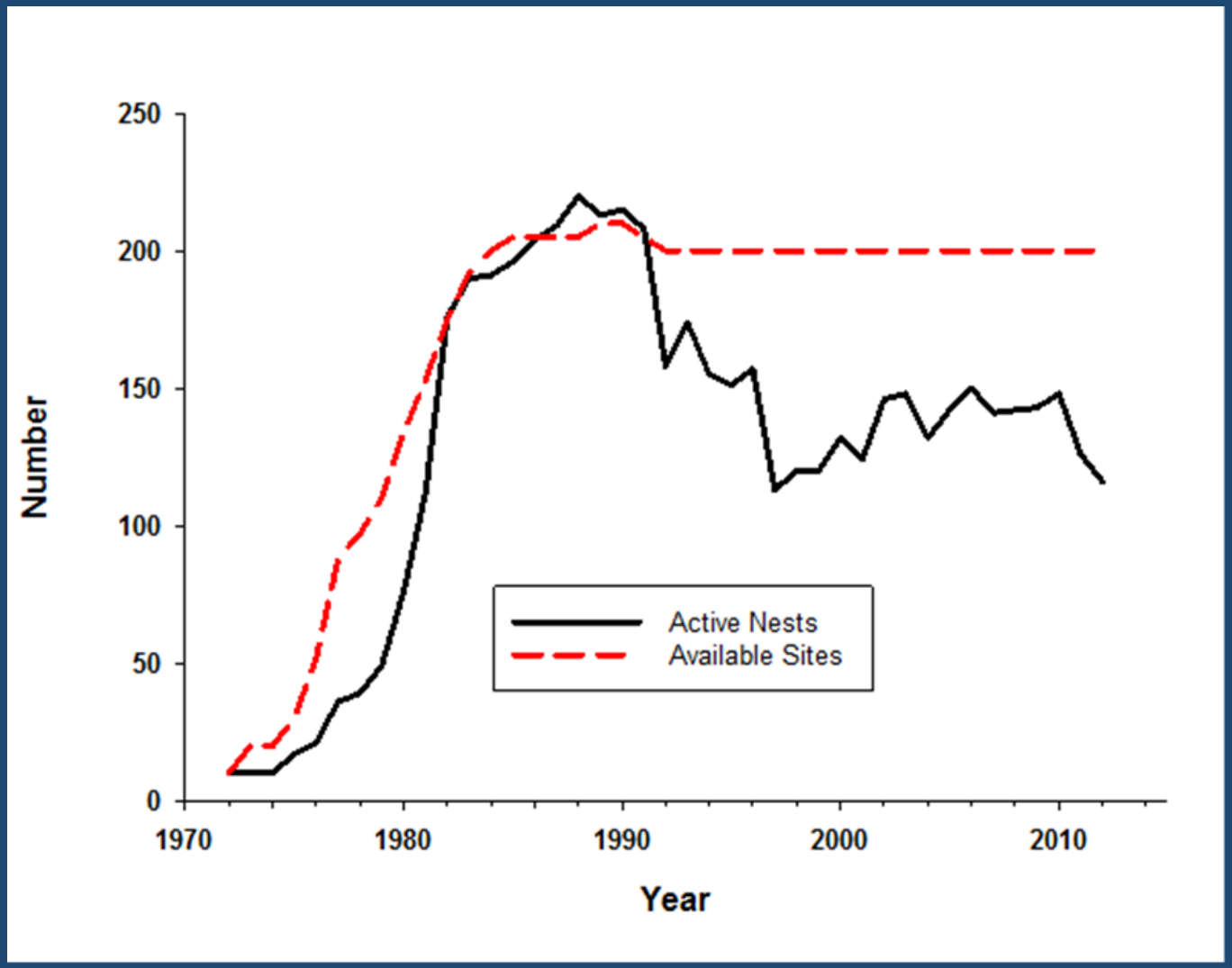
Black Guillemot Colony
Monitored Annually
since 1975




Point Barrow
Cooper Island

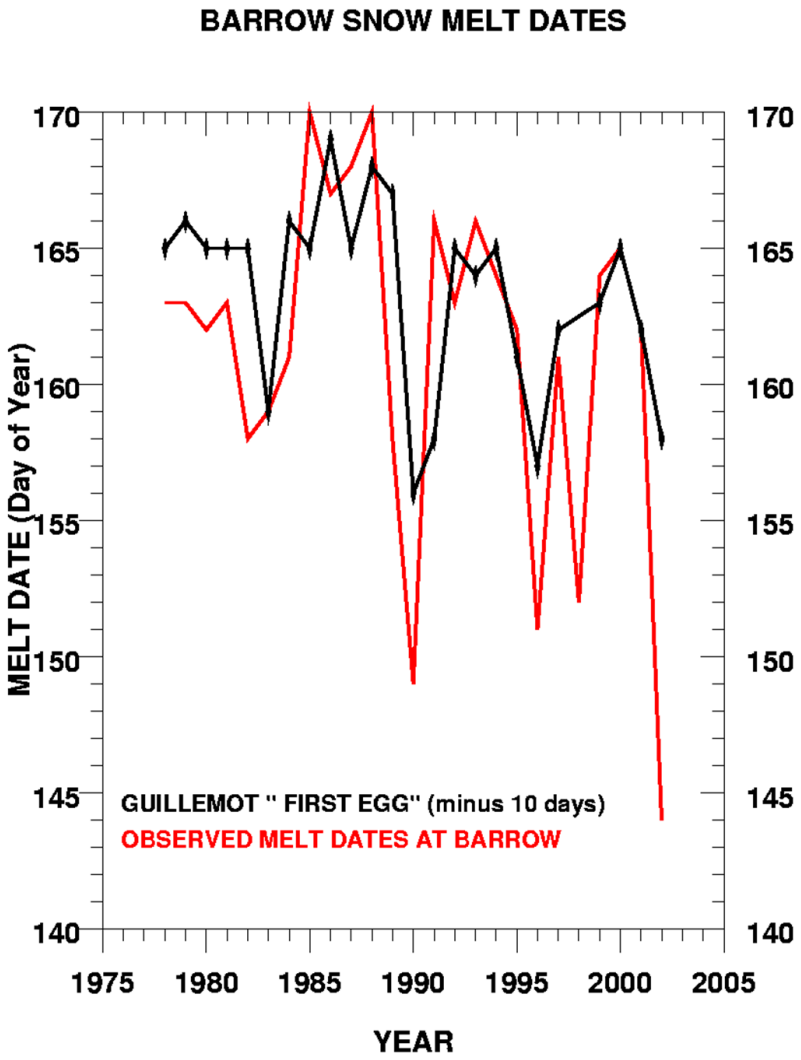
Colony of ten pairs found in 1972 increased to 200 pairs by nest-site creation

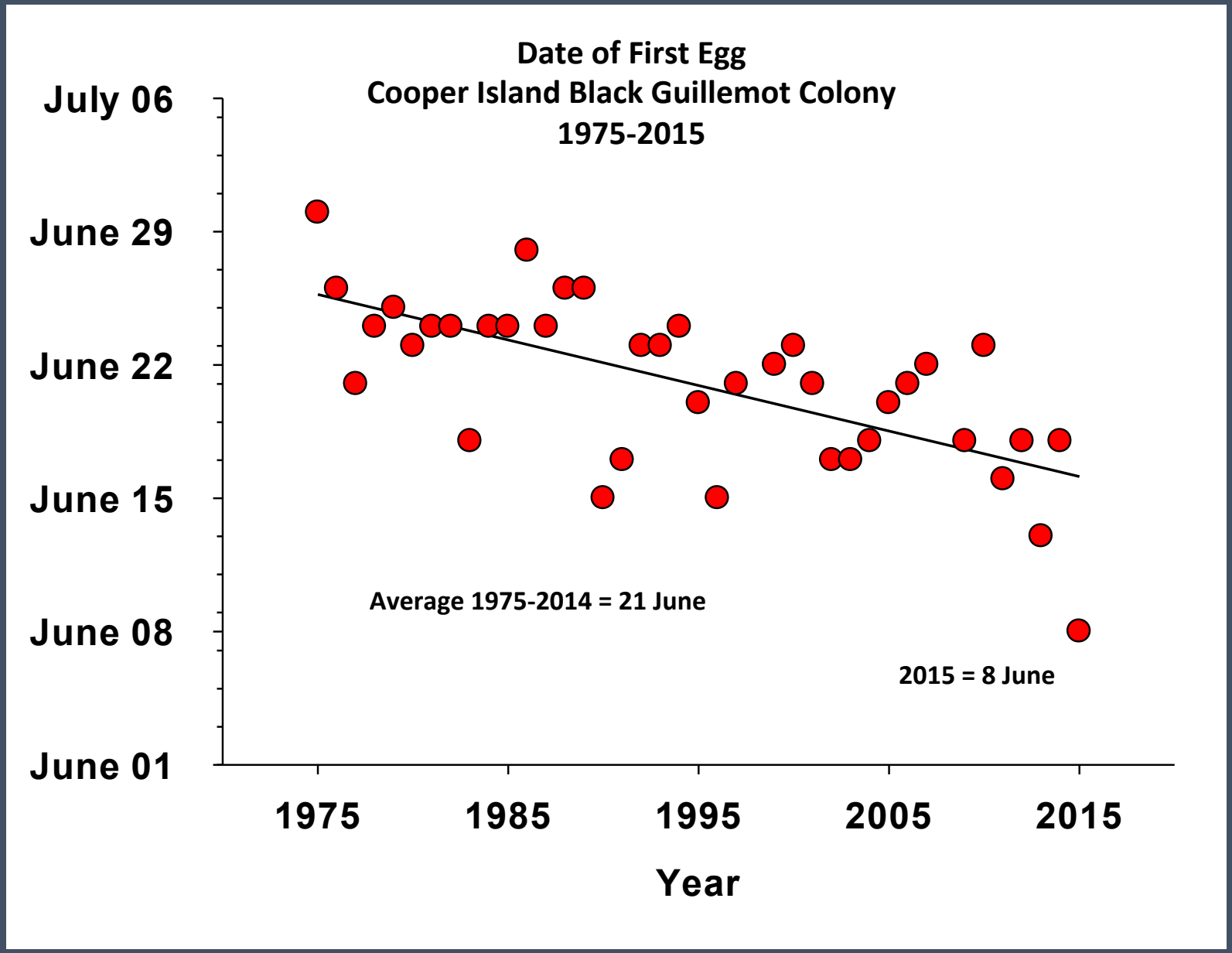
Active and Available Black Guillemot Nest Sites on Cooper Island



Black Guillemot colony on Cooper Island largest (and least attractive) in Alaska.

Correlation of annual snowmelt at Barrow and Cooper Island




Date of First Egg
Cooper Island Black Guillemot Colony
1975-2015
July 06
June 29
June 22
June 15
June 08
June 01
Average 1975-2014 = 21 June
2015 = 8 June
1975
1985
1995
2005
2015
Year

Recording climate change from the top of the world

Barrow reports record-breaking 2015 Spring warming

News Categories

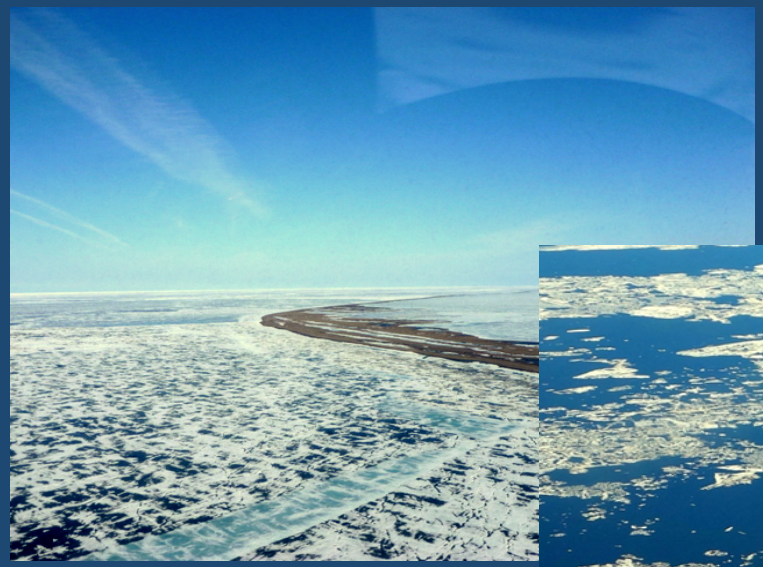
- Press Release (31)
- Air Quality (36)
- Arctic (25)
- Climate (115)
- Ecosystems (35)
- Fisheries & Seafood (24)
- Great Lakes (13)
- Marine Science (24)
- Ocean Exploration (18)
- Weather (63)

Research Headlines

Raise two chicks that have a ten-fold increase in weight over 35 days

Island surrounded by ice in early June and ice-free in early September

Early June

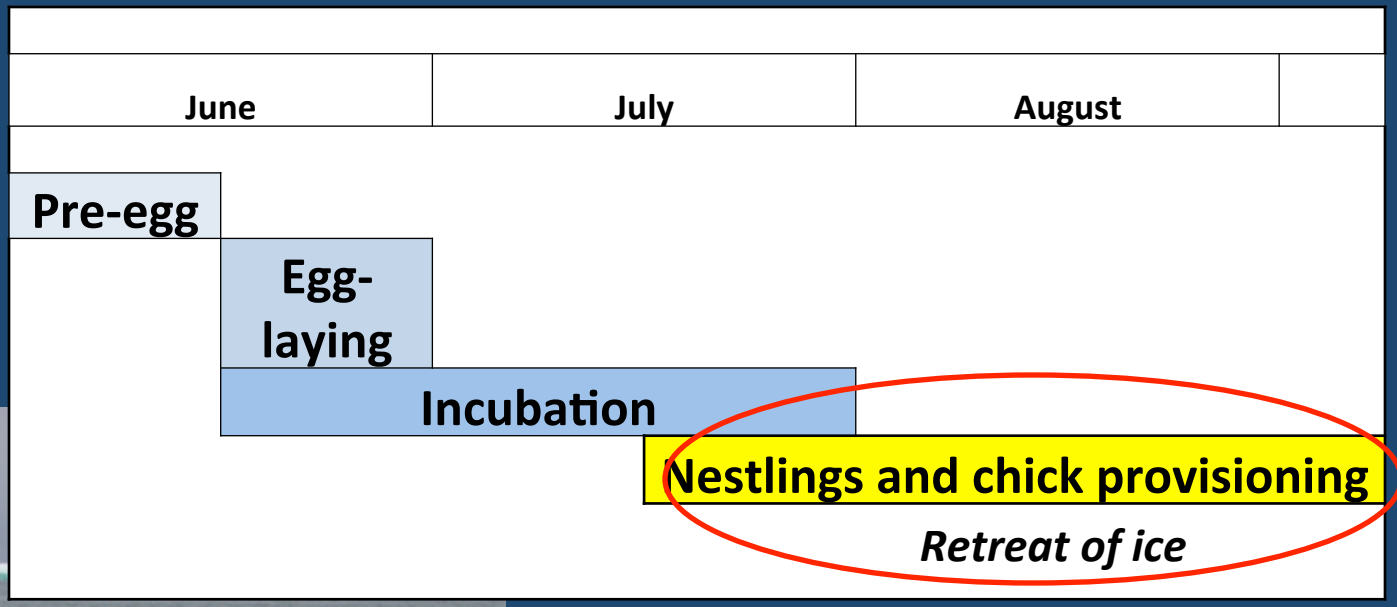


Mid-July

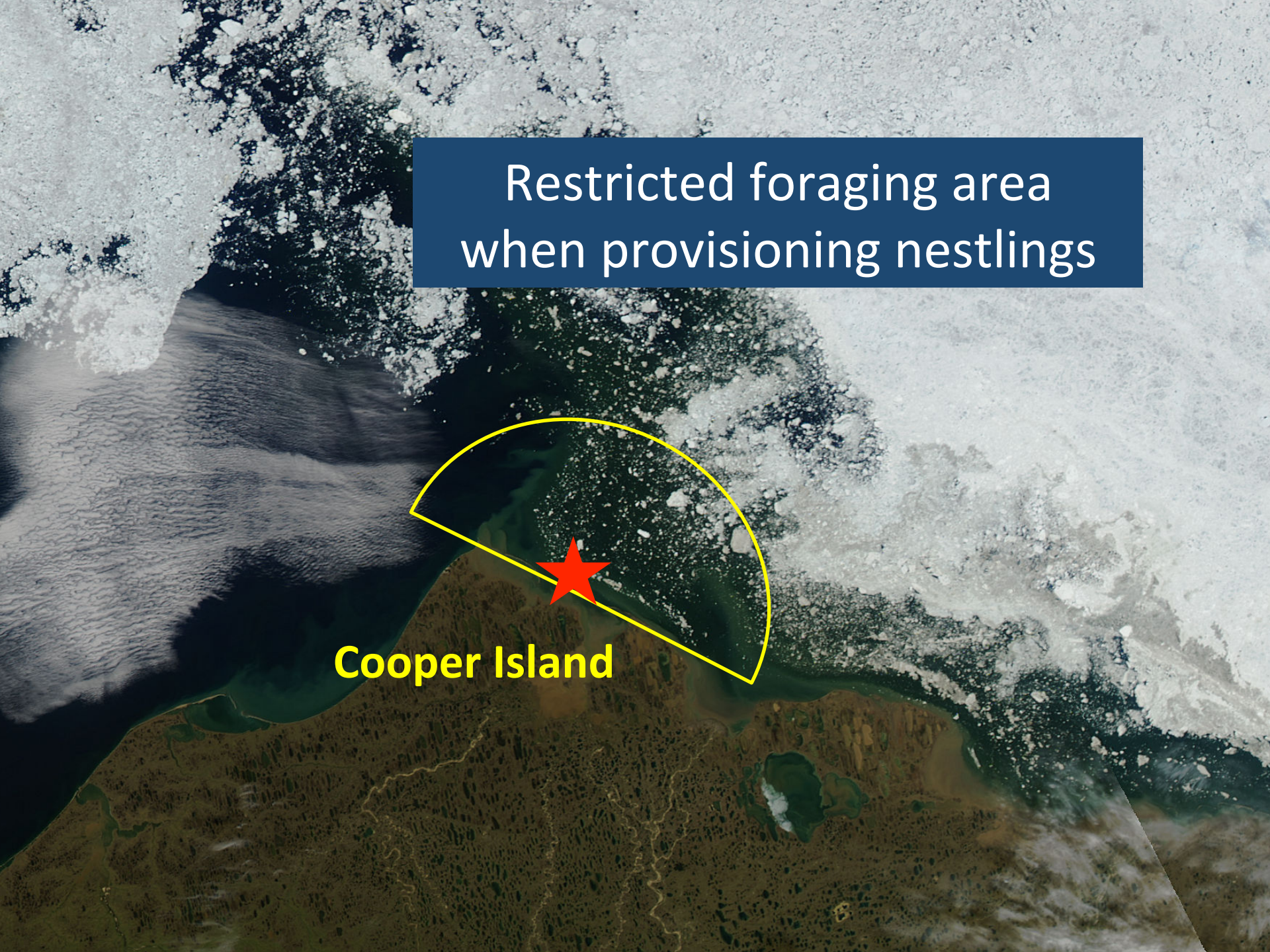
September

Arctic Cod

Black Guillemot Breeding Chronology in the Alaskan Arctic




June and early July

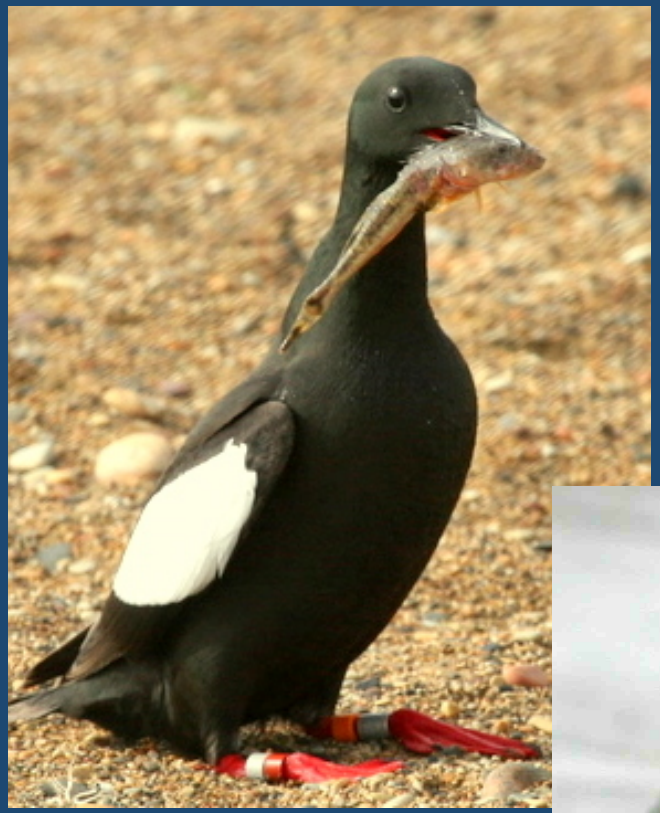

Restricted foraging area
when provisioning nestlings
Cooper Island

Direct observations and images from SLR with telephoto lens

Motion-sensitive cameras at nest sites

Switch to sculpin in 2003

Sculpin are less preferred by both adult and nestling guillemots



Four-horned Sculpin
demersal


M-09

Decadal shift in prey

1975- 2002

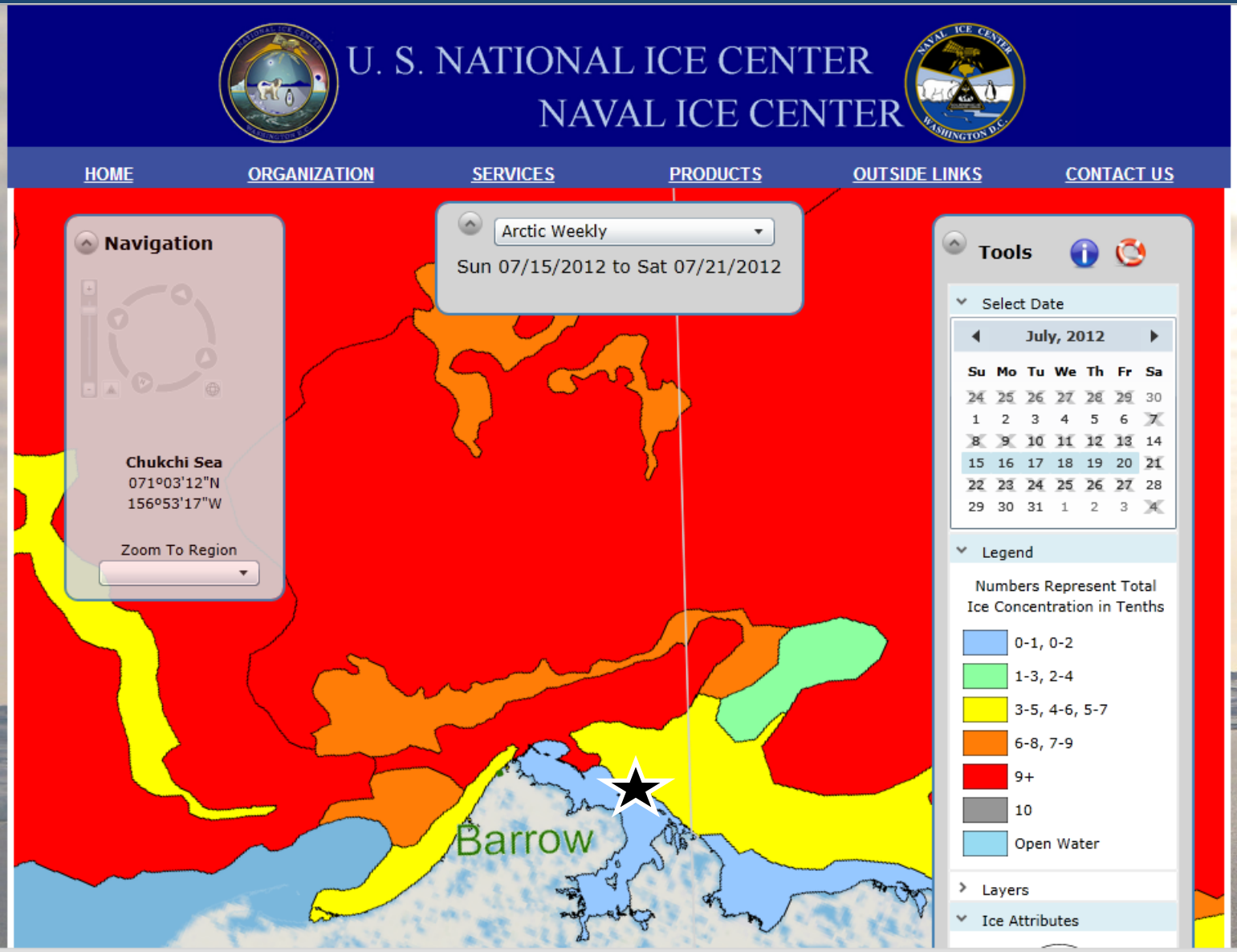
Arctic Cod primary prey fed to nestlings

2003- 2013

(with exception of 2006)
Reduction and seasonal disappearance of Arctic Cod

Sculpin become primary prey

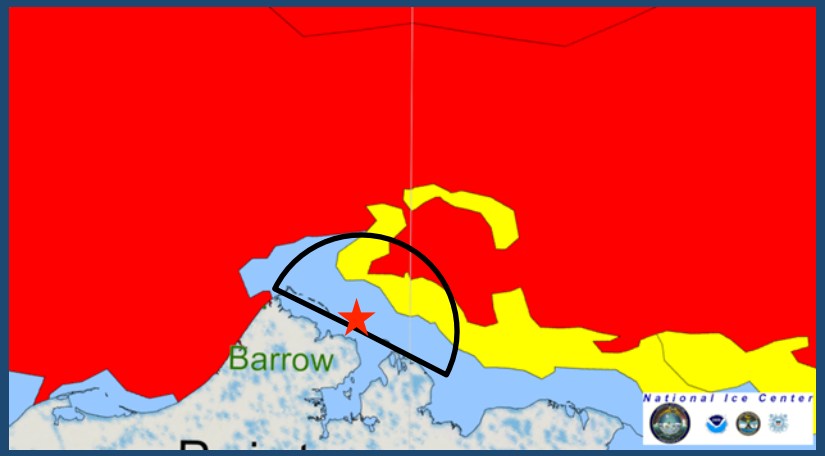
Distance to nearest ice



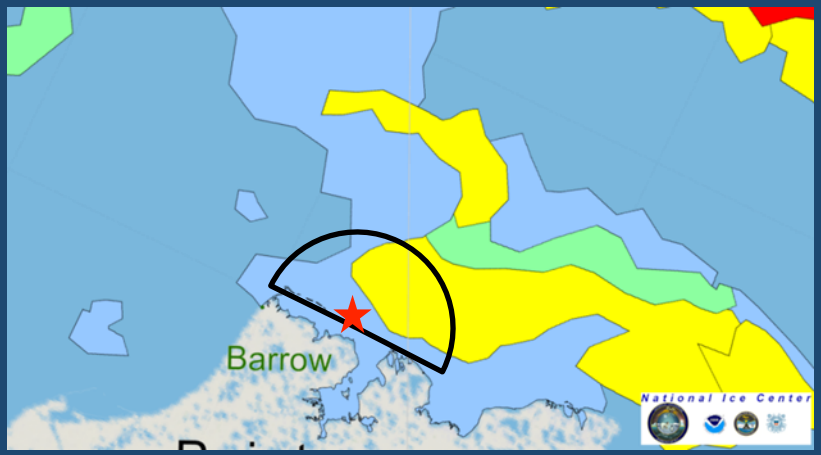
1 AUGUST

Early growth with some hatching

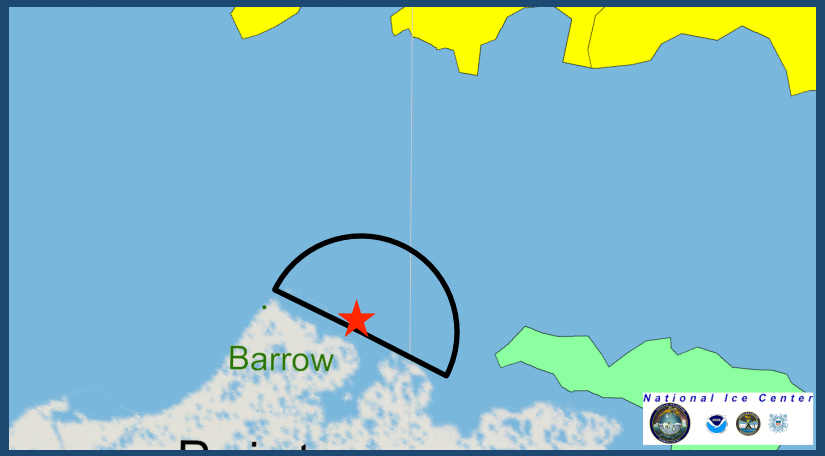
2006

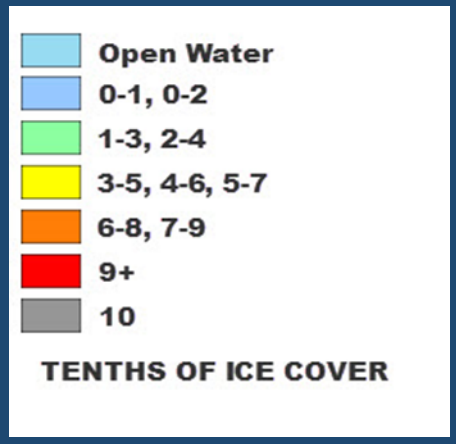


2007



2011

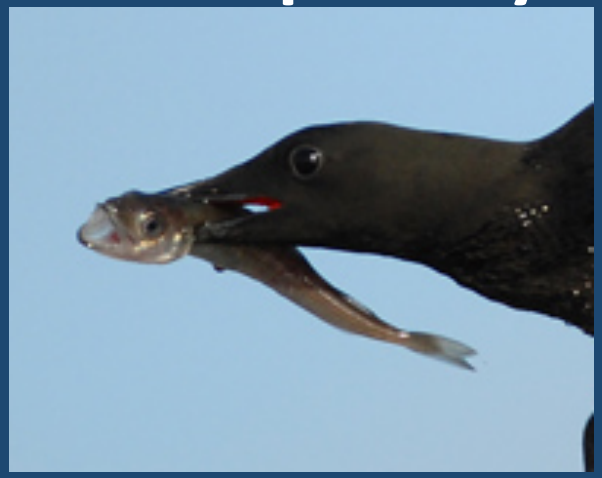




Typical prey selection for parent guillemots provisioning nestlings 1975-2002

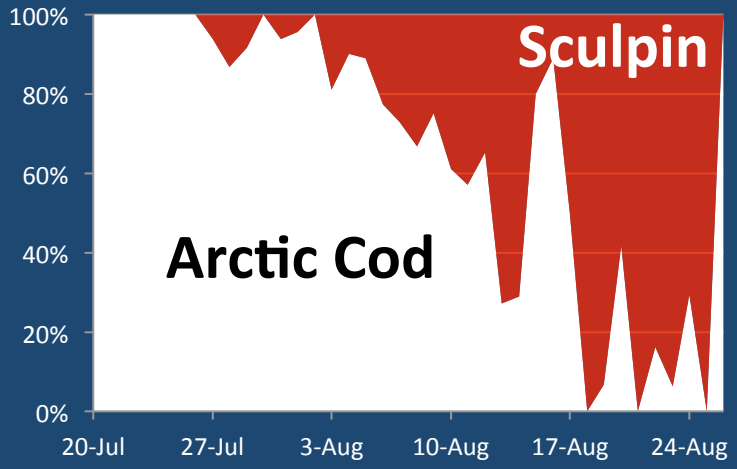
Percent of observed fish per day

Percent of observed fish per day

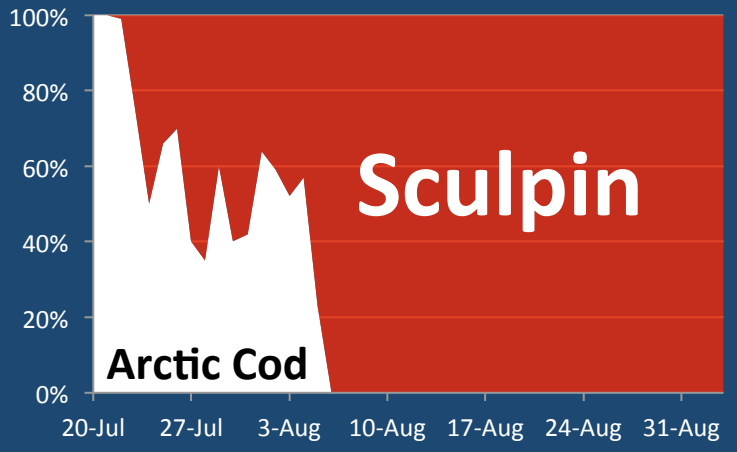


2006

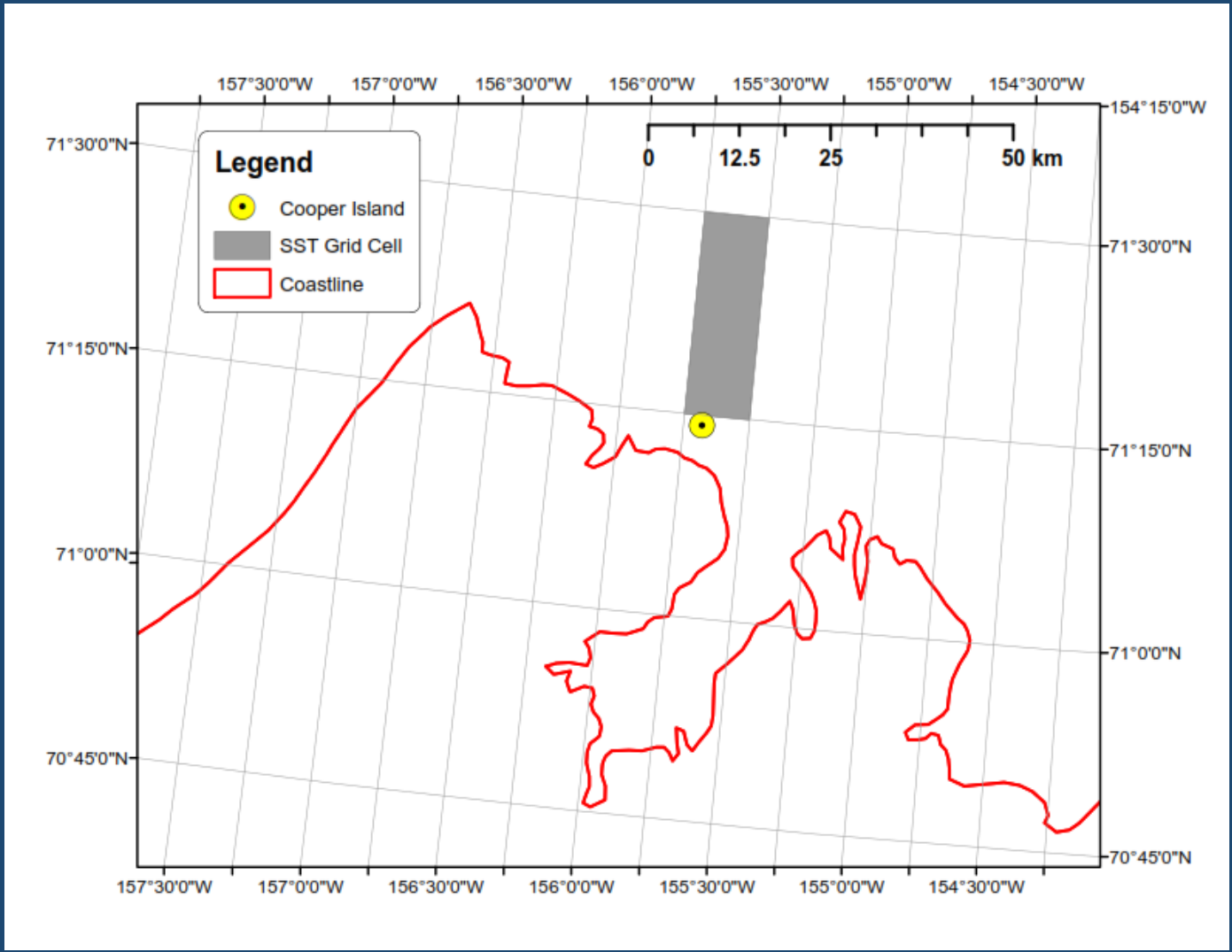
2007



2011



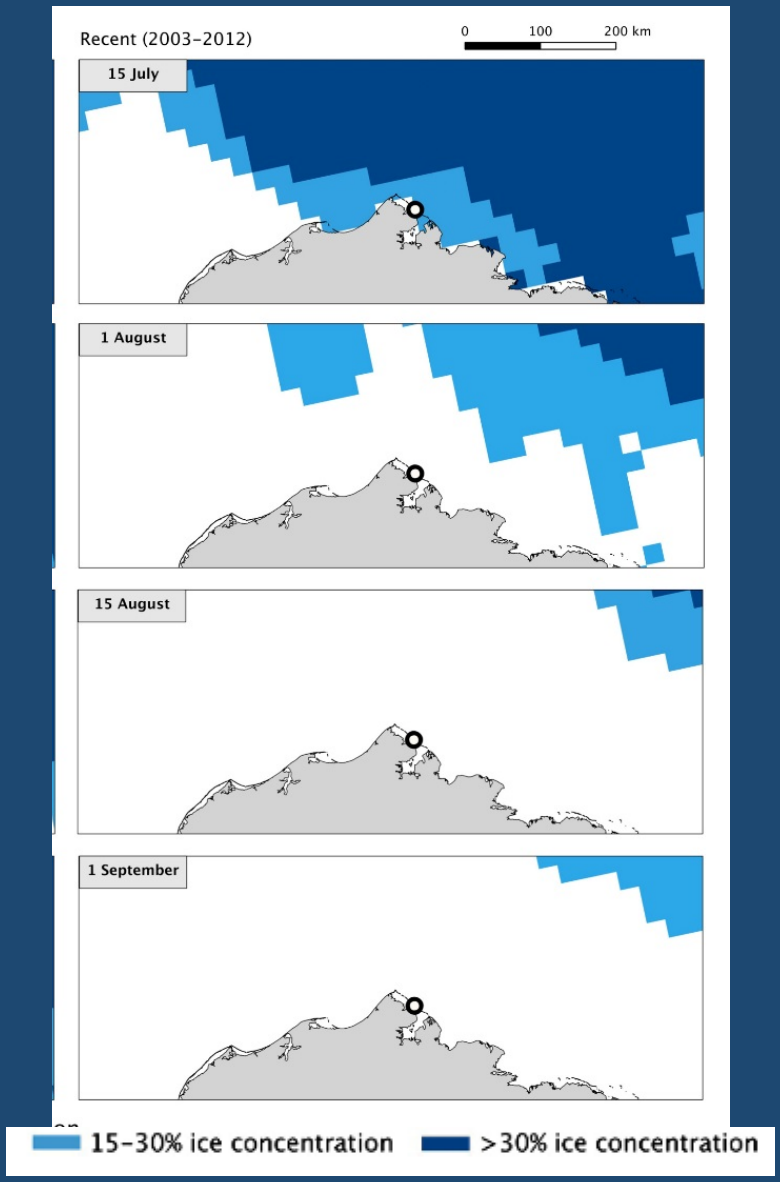
AVHRR*-derived SST



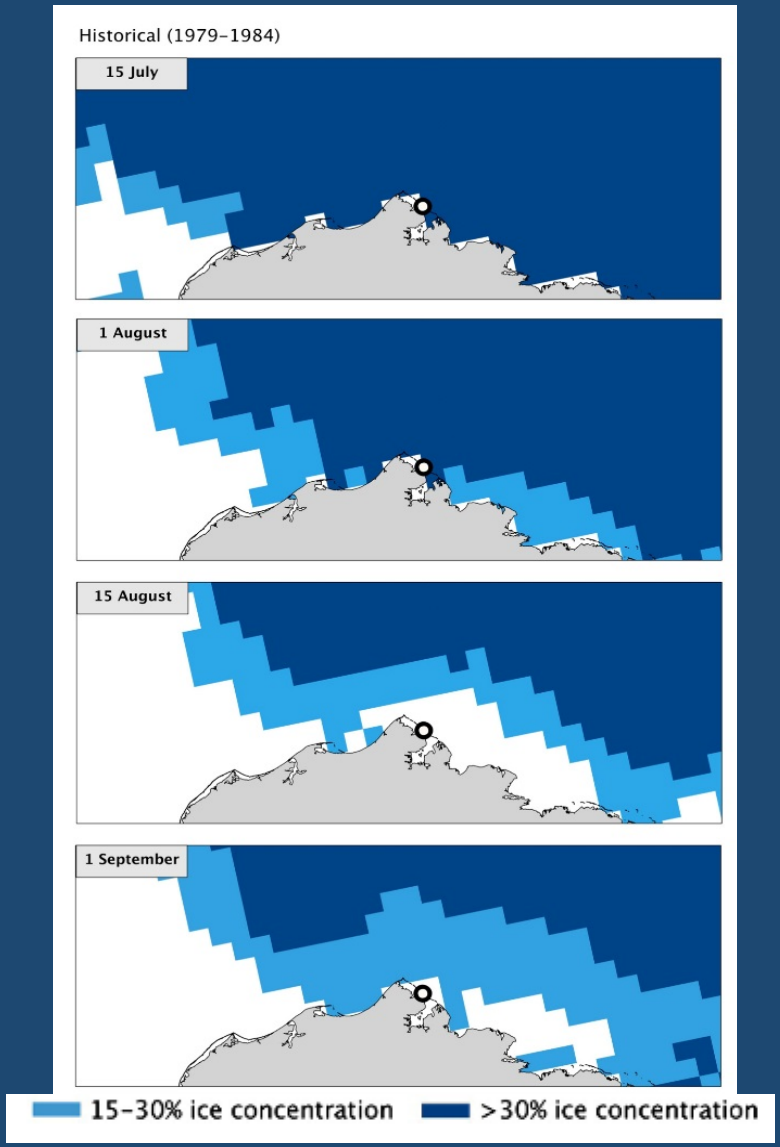
***Advanced Very High Resolution Radiometer**

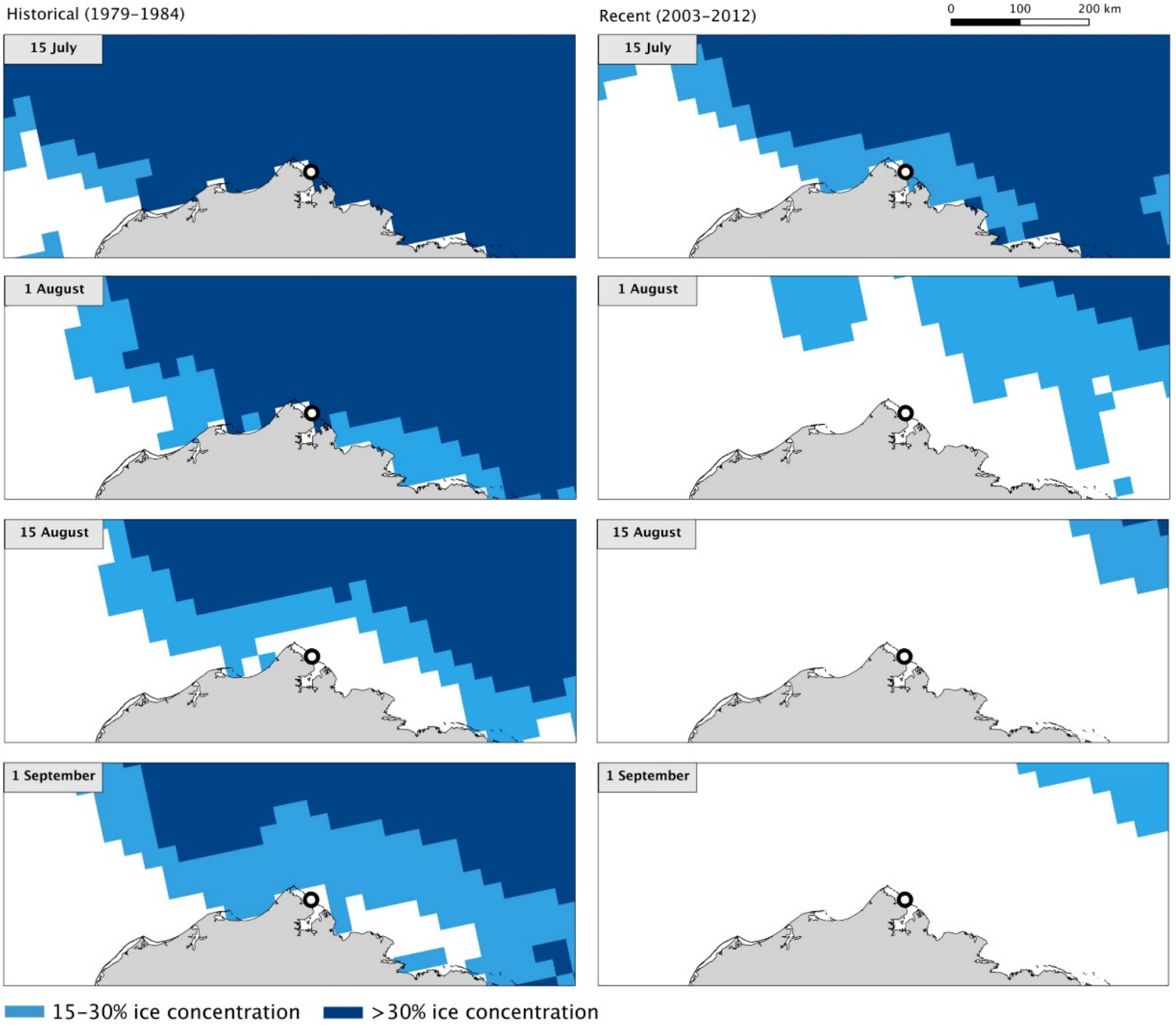
Pathfinder AVHRR data (1981-2005) and operational AVHRR data (2006-2012), provided by NOAA's National Climate Data Center (NCDC).

Sea ice during guillemot nestling period in recent decade (2003-2012)

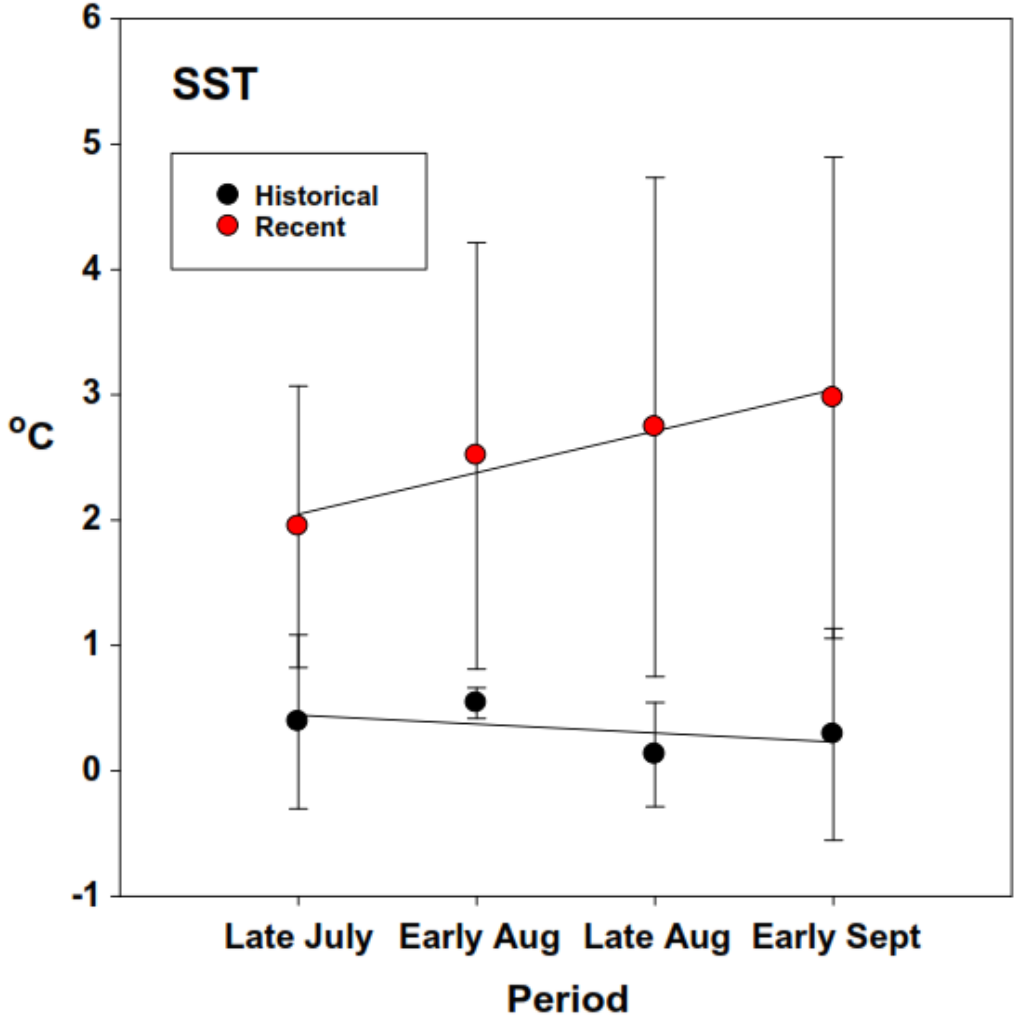


Sea ice during guillemot nestling period in historic decade (1979-1984)

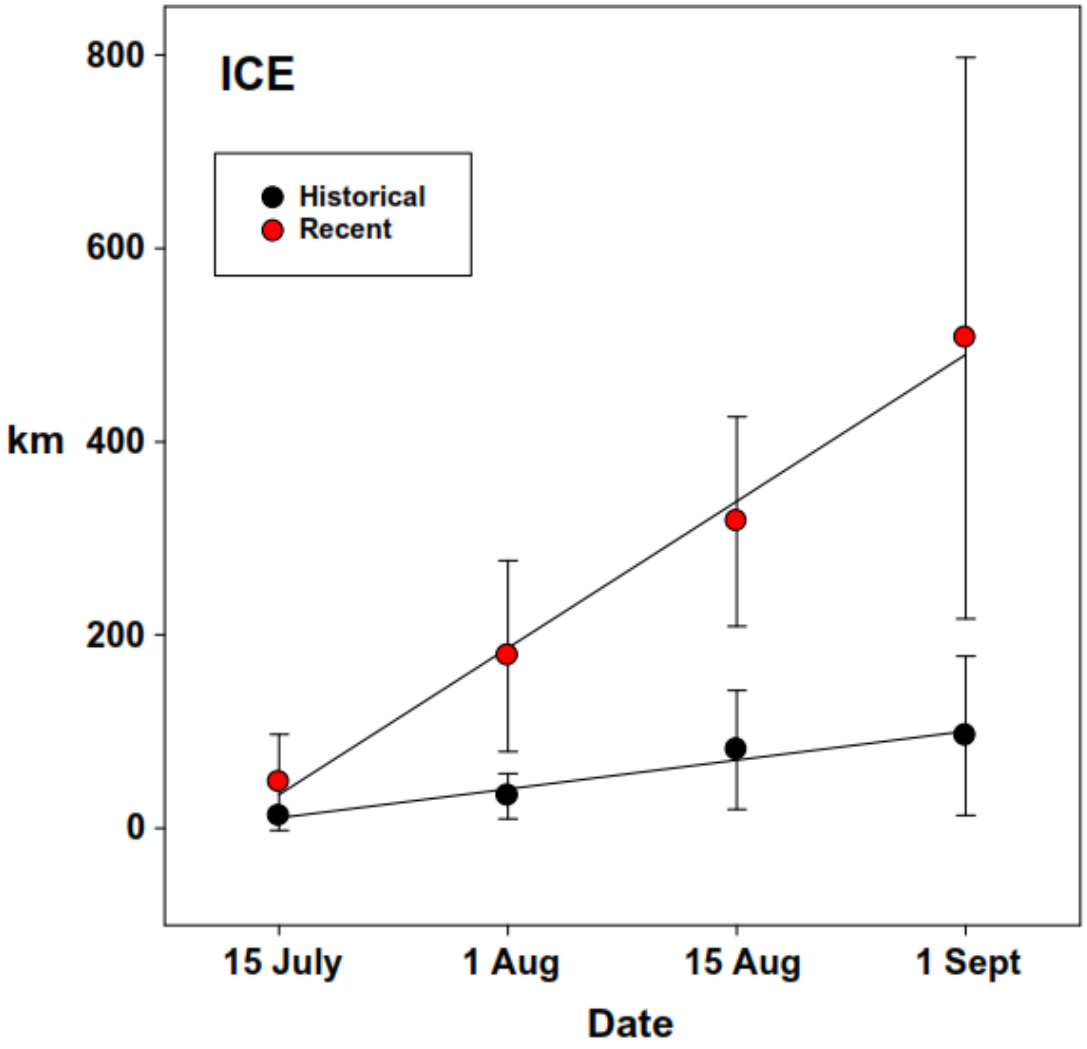



Historical (1979–1984)
Recent (2003–2012)
0
100
200 km
15 July
15 July
1 August
1 August
15 August
15 August
1 September
1 September
15–30% ice concentration
>30% ice concentration

SST North of Cooper Island for Historical (1975-84) and Recent (2003-2012) Decades



Distance to 30% sea ice from Cooper Island for Historical (1975-84) and Recent (2003-2012) Decades




on ice that may not be here in a hundred years
George Divoky, Ph.D., Researcher, Institute of Arctic Biology, University of Alaska
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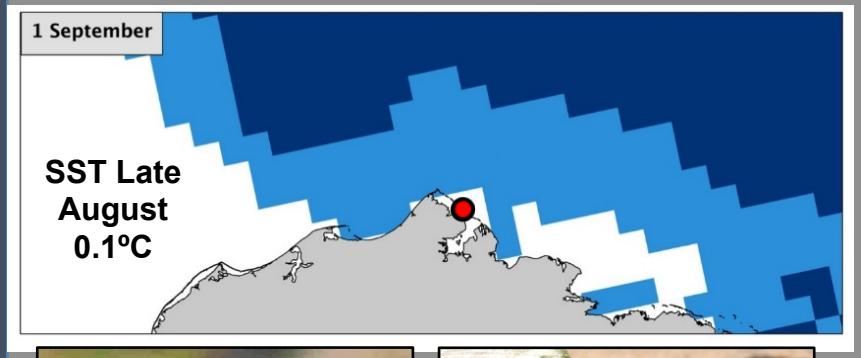
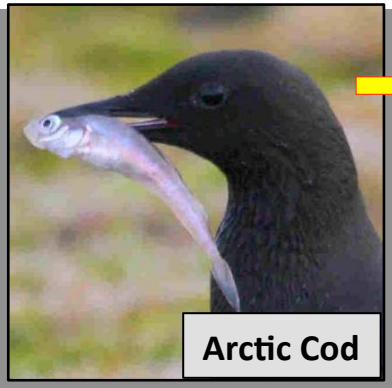
1979-1984





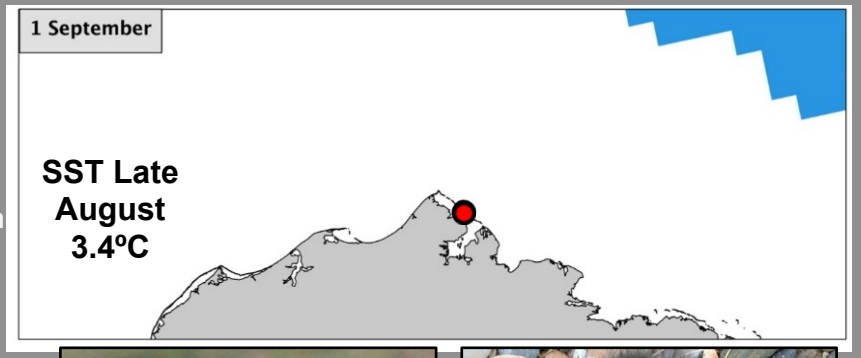
Cooper Island

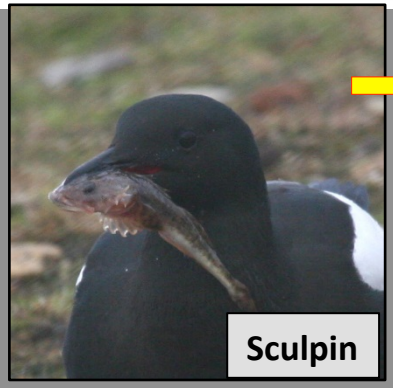
Ice concentration

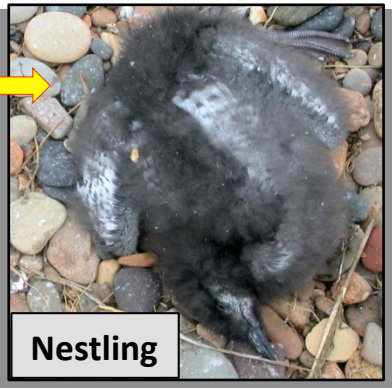
15-30%

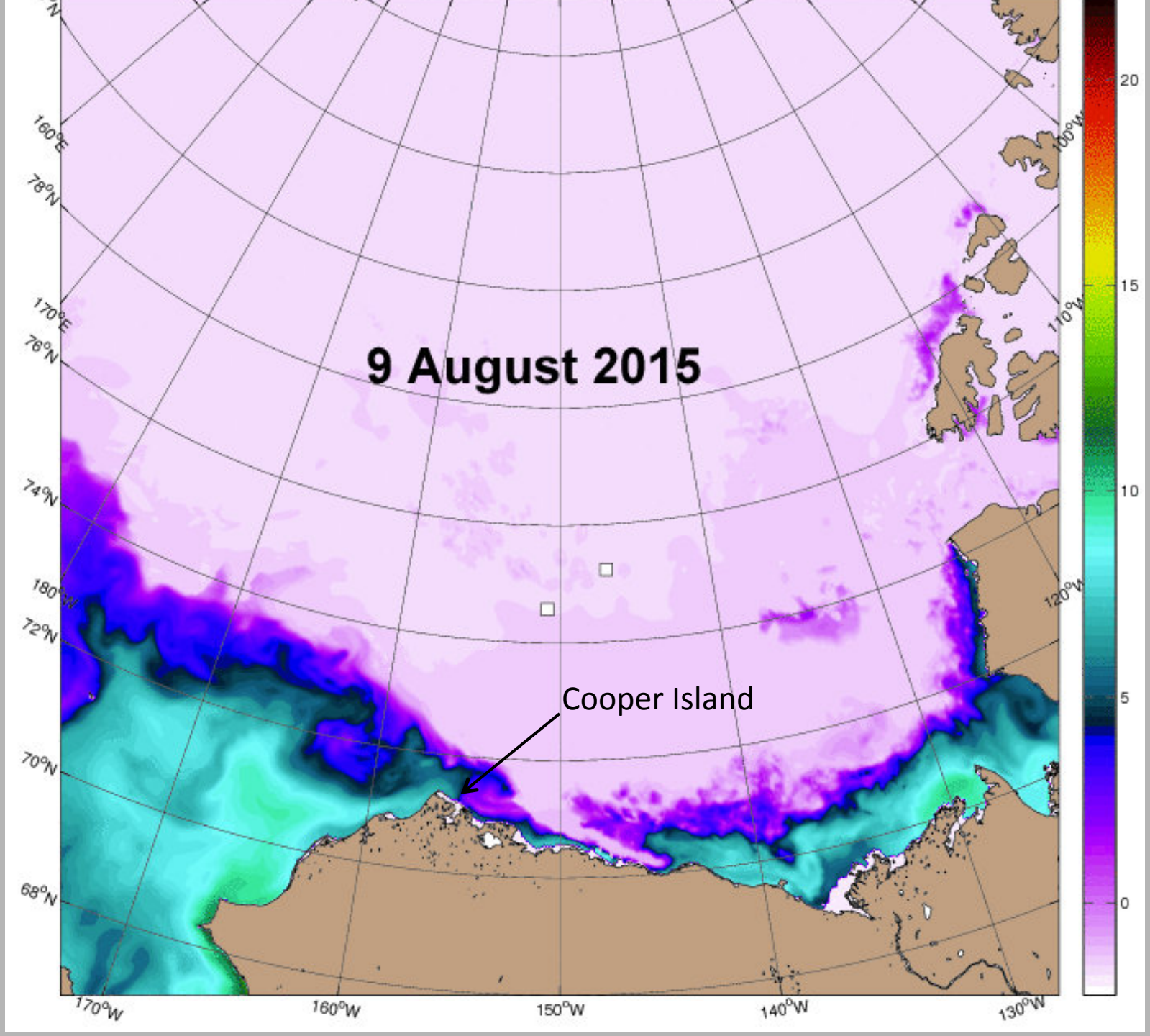
>30%

2003-2012

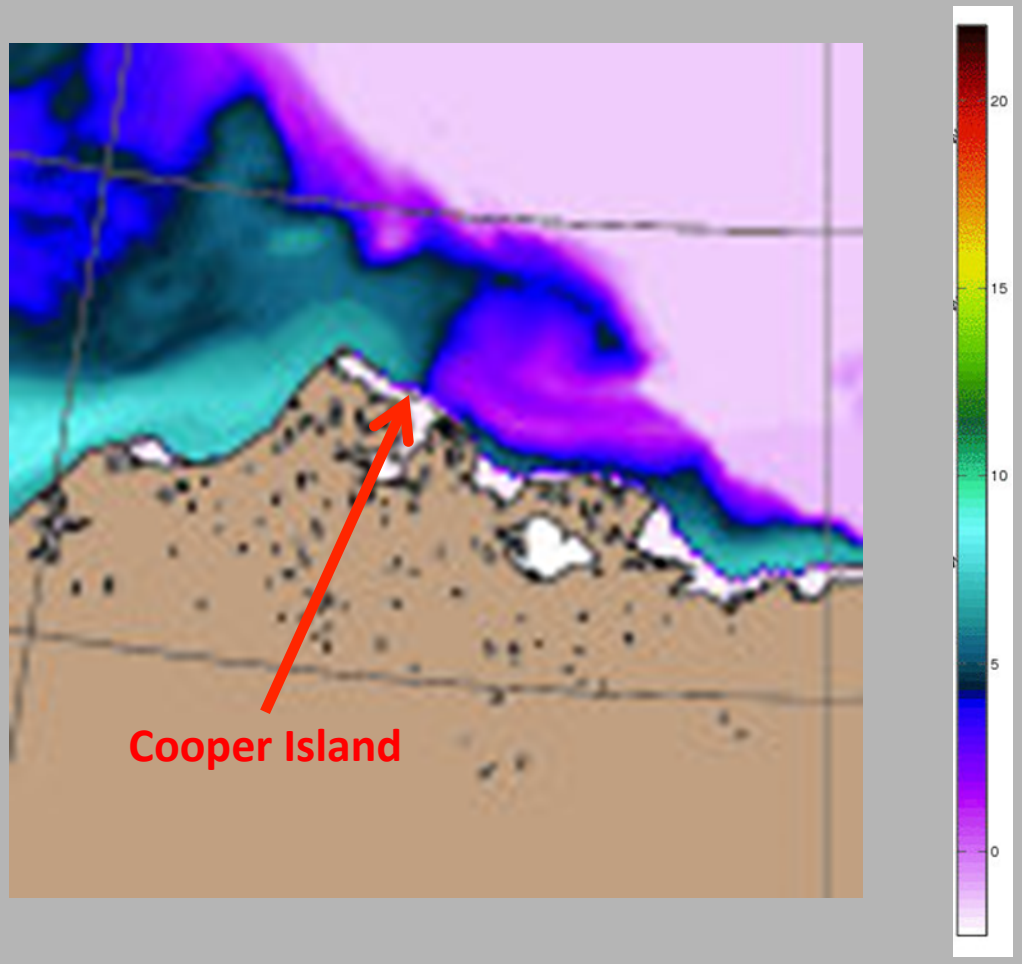




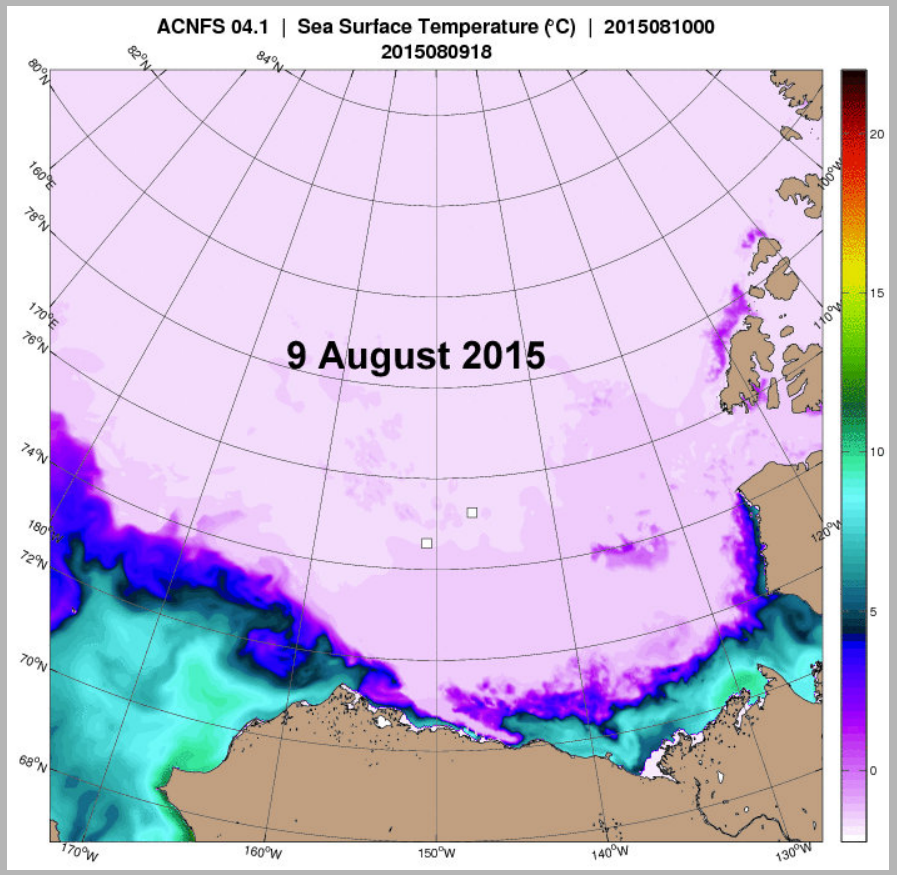


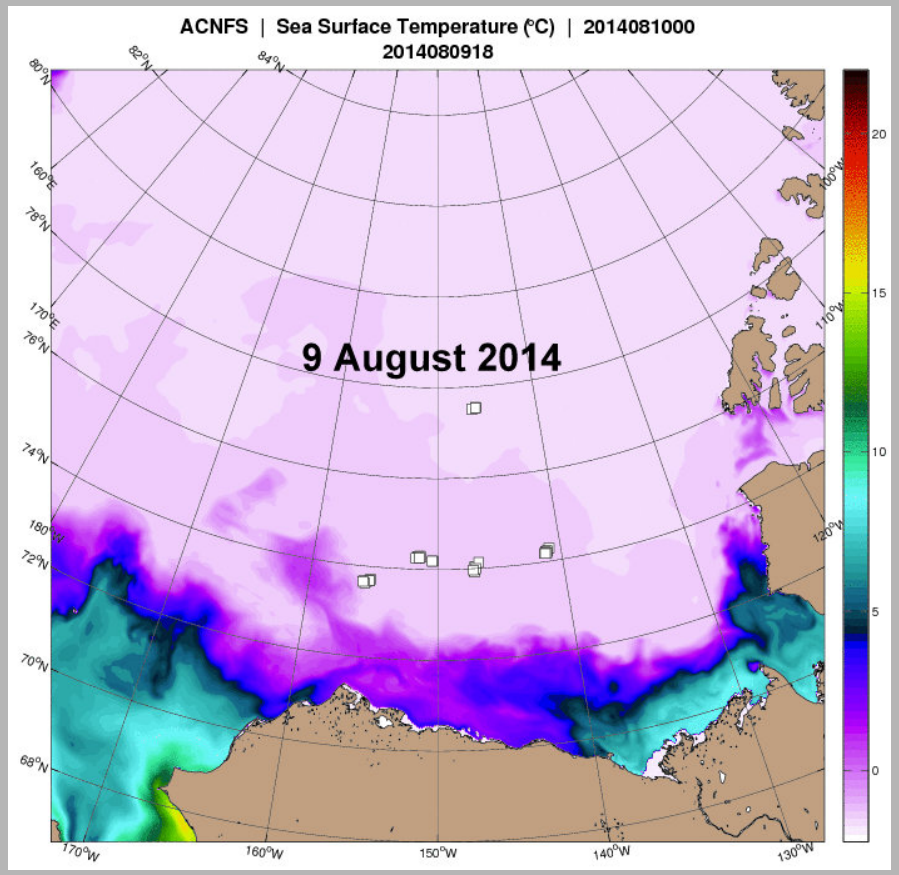

9 August 2015
Cooper Island
160°E
78°N
170°E
76°N
74°N
180°W
72°N
70°N
68°N
170°W
160°W
150°W
140°W
130°W
110°W
120°W
100°W
20
15
10
5
0

Cooper Island was directly south of a frontal zone with warm (>6C°) to the west and cold (<5C°) to the east.



Conditions in 2014 (on right) when Arctic Cod was the primary prey during the entire nestling period show more typical oceanographic conditions.

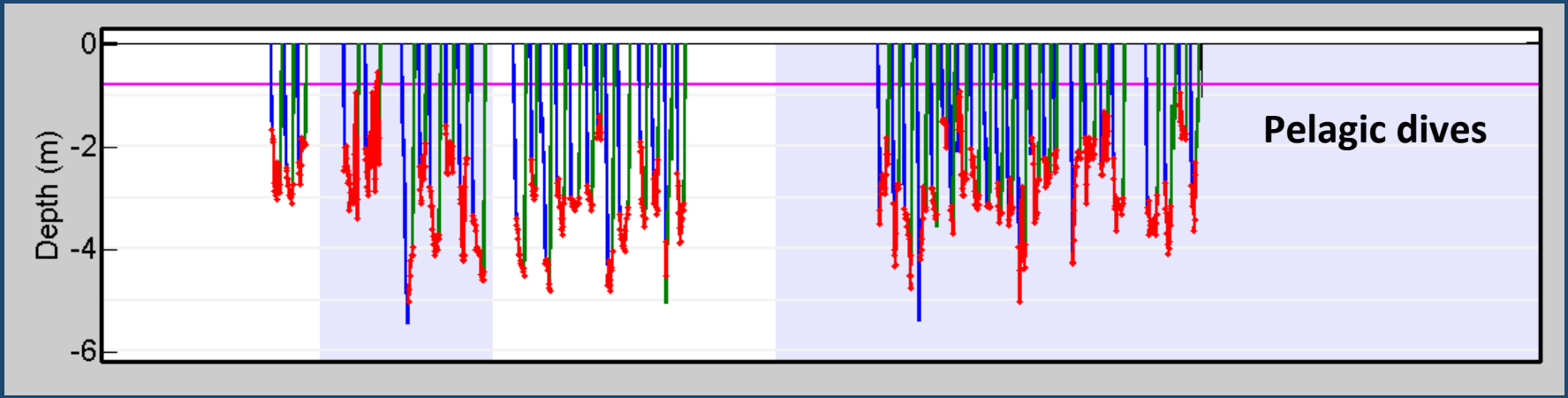




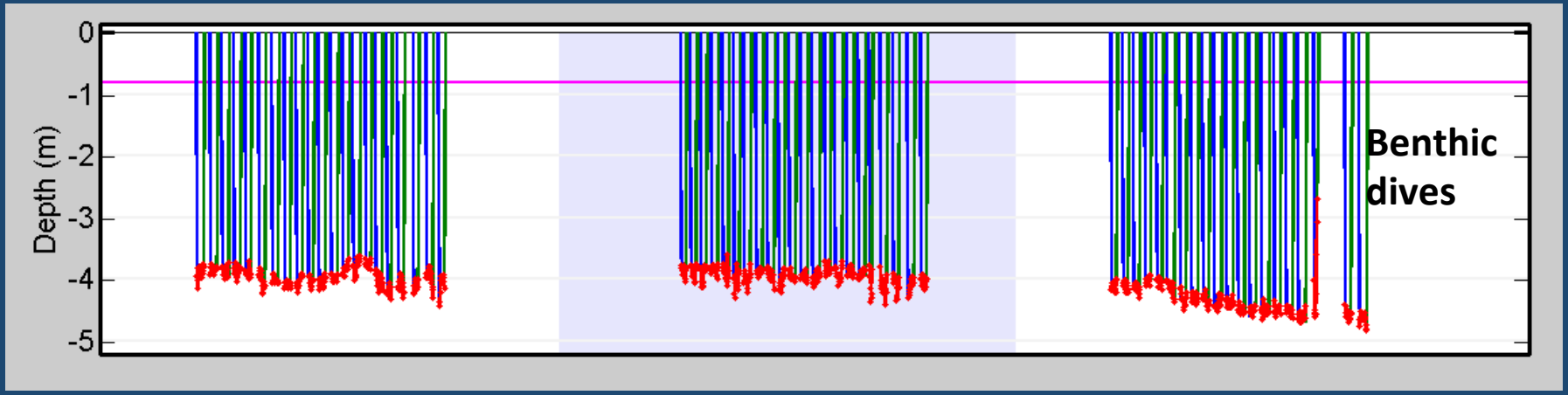
Using temperature and depth loggers to examine diving behavior

Tracking changes in foraging behavior and cod availability during the ice retreat

Ice present and SST< 4C

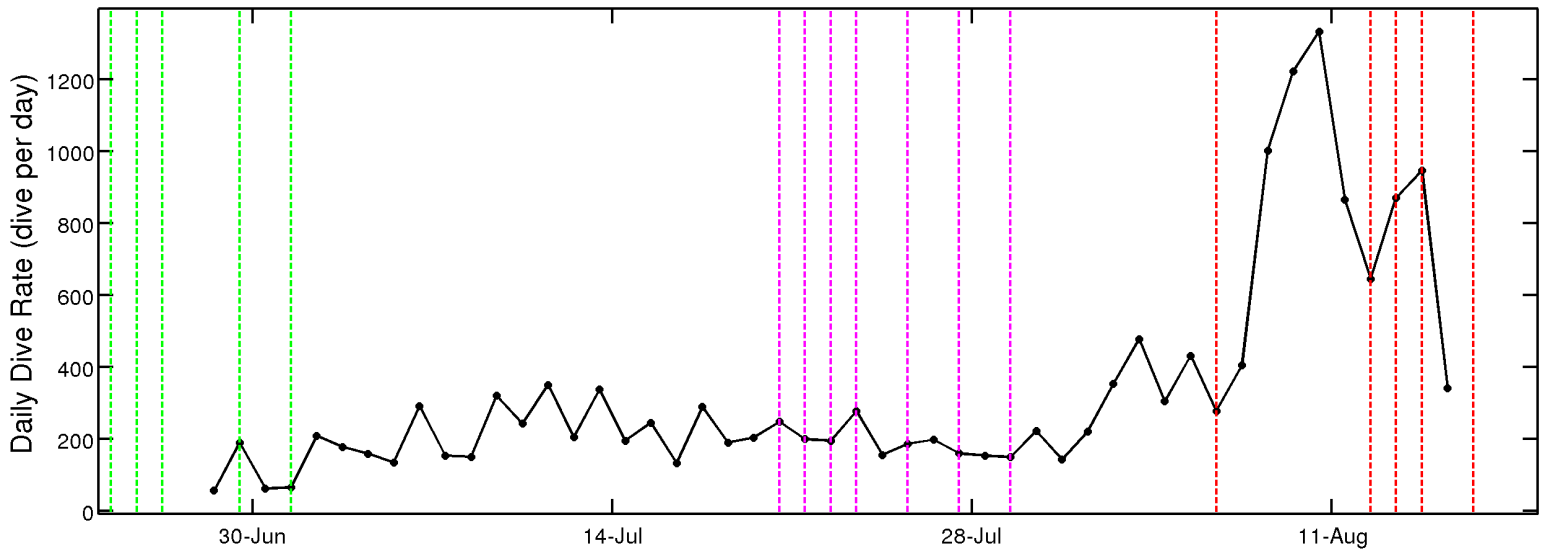


No ice and SST > 4C



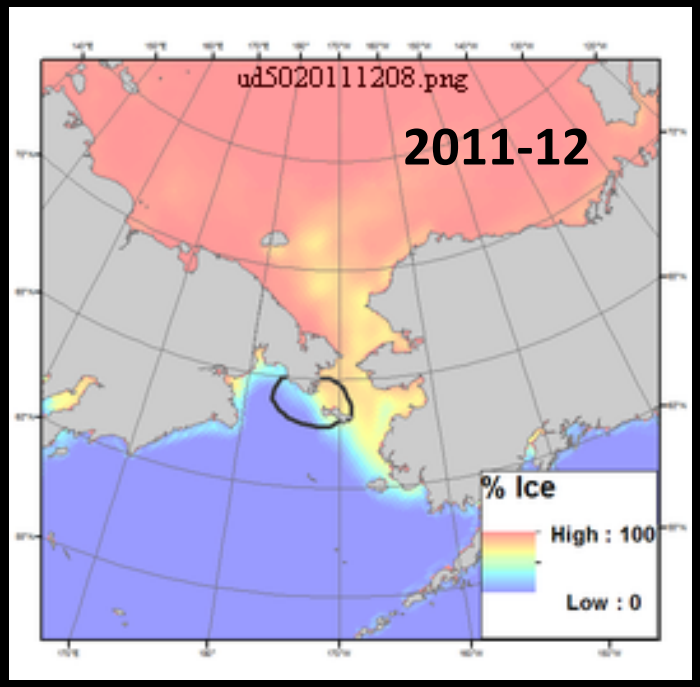
Yann Tremblay

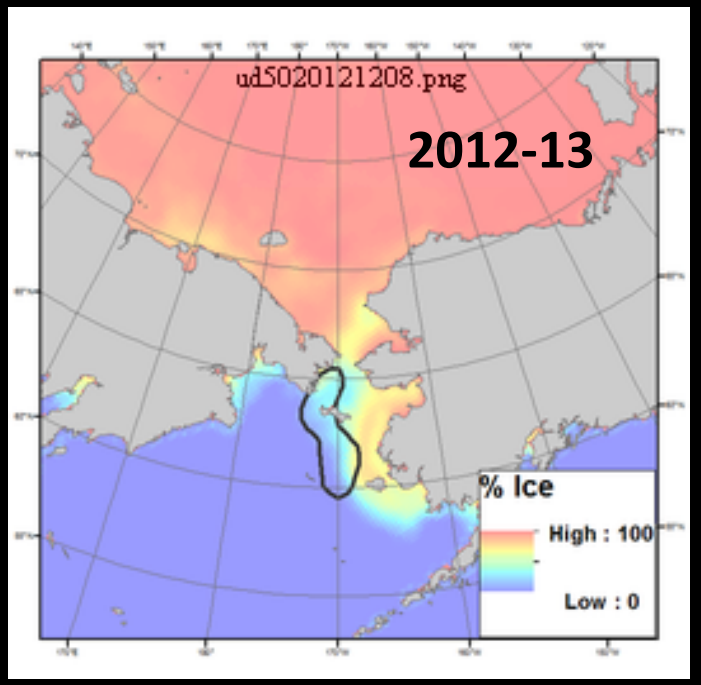
Dramatic increase in dive frequency when Arctic cod no longer available

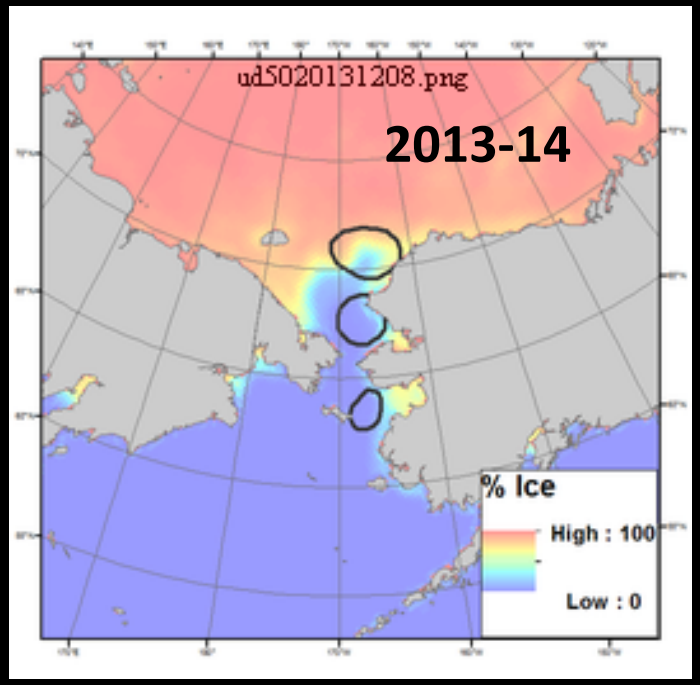


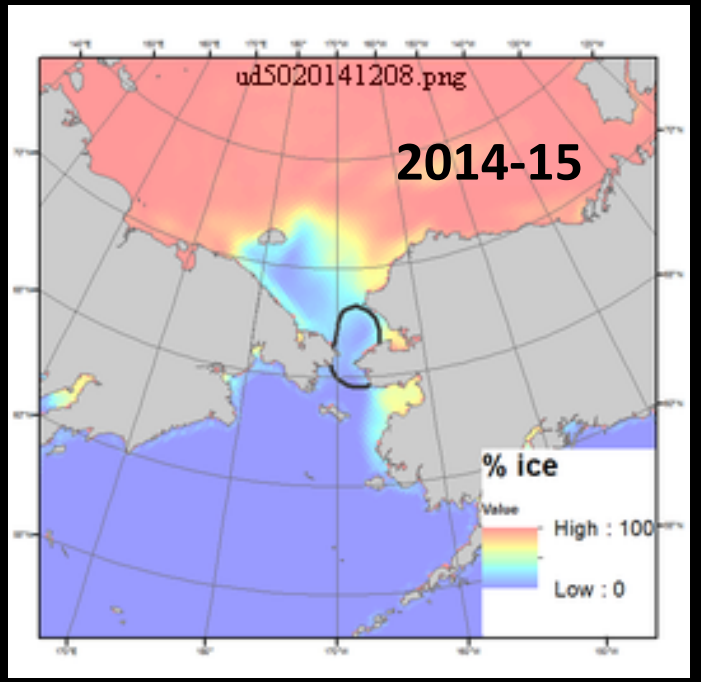
Tracking movements in the nonbreeding season with light-sensitive geolocators

8 December

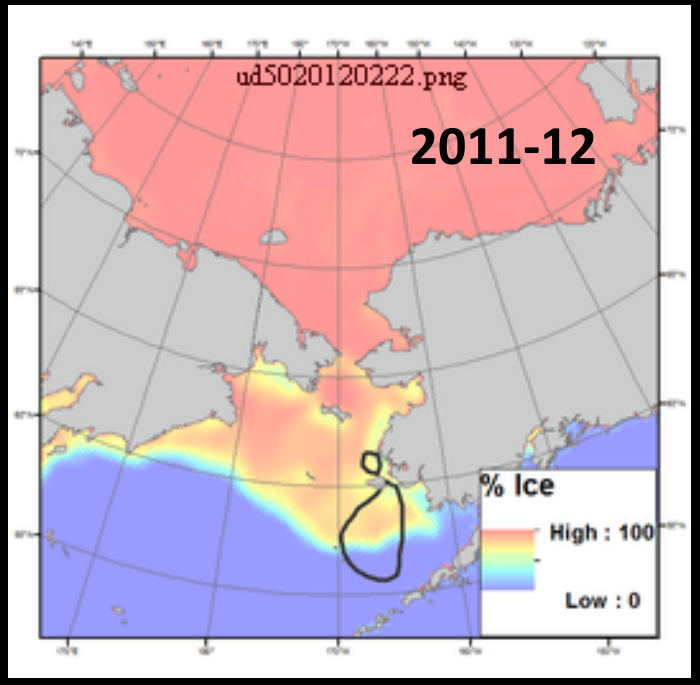

ud5020111208.png
2011-12
% Ice
High : 100
Low : 0

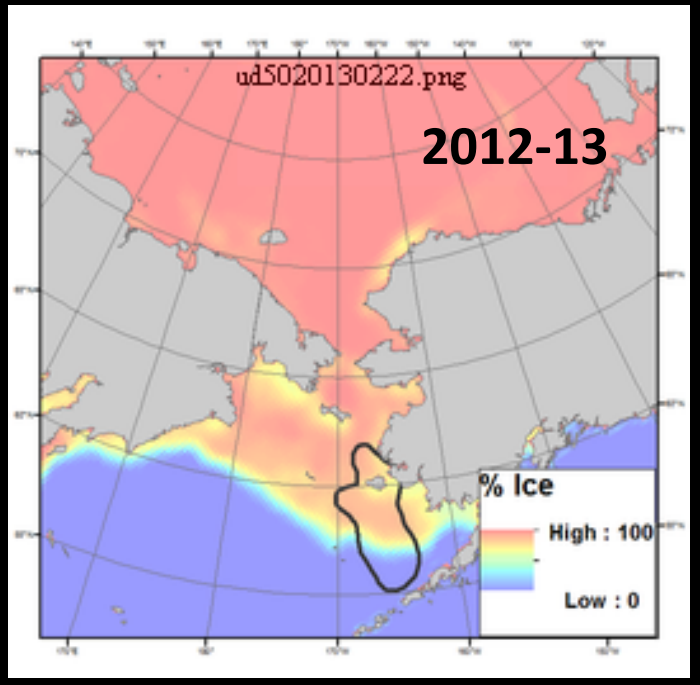

ud5020121208.png
2012-13
% Ice
High : 100
Low : 0

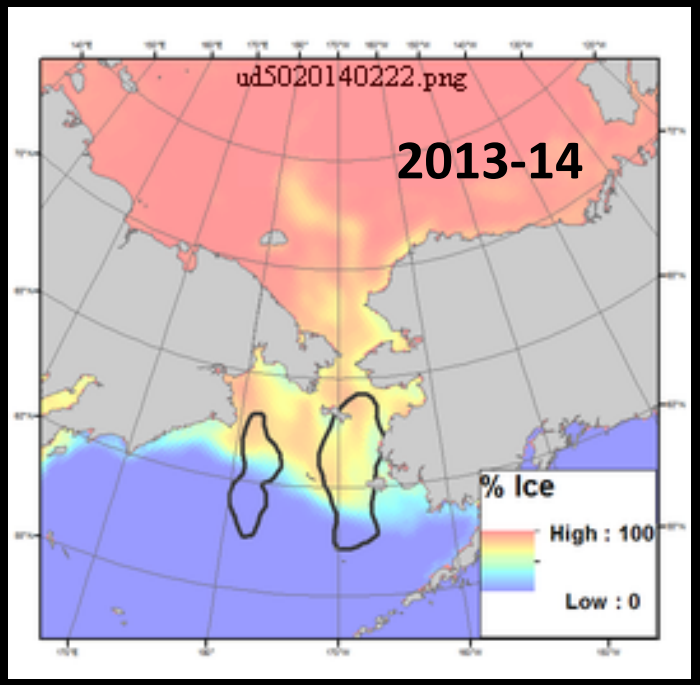

ud5020131208.png
2013-14
% Ice
High : 100
Low : 0

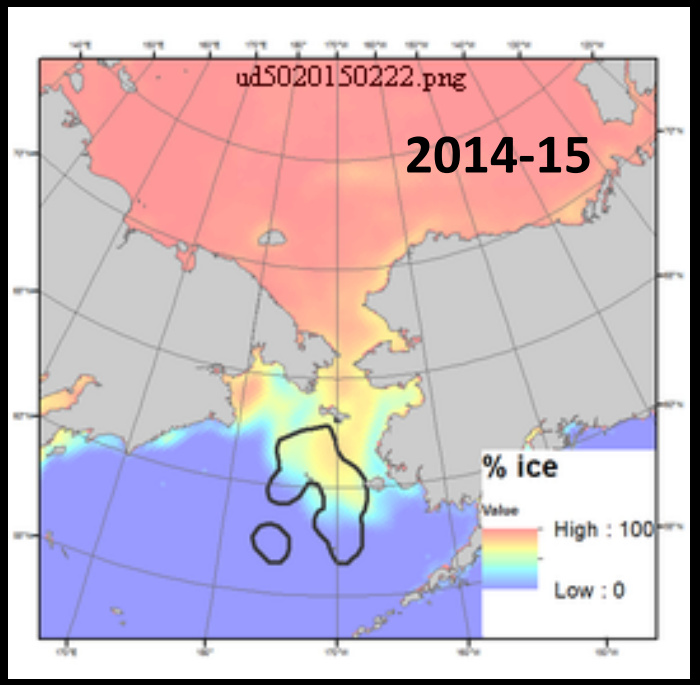

ud5020141208.png
2014-15
% ice
Value
High : 100
Low : 0

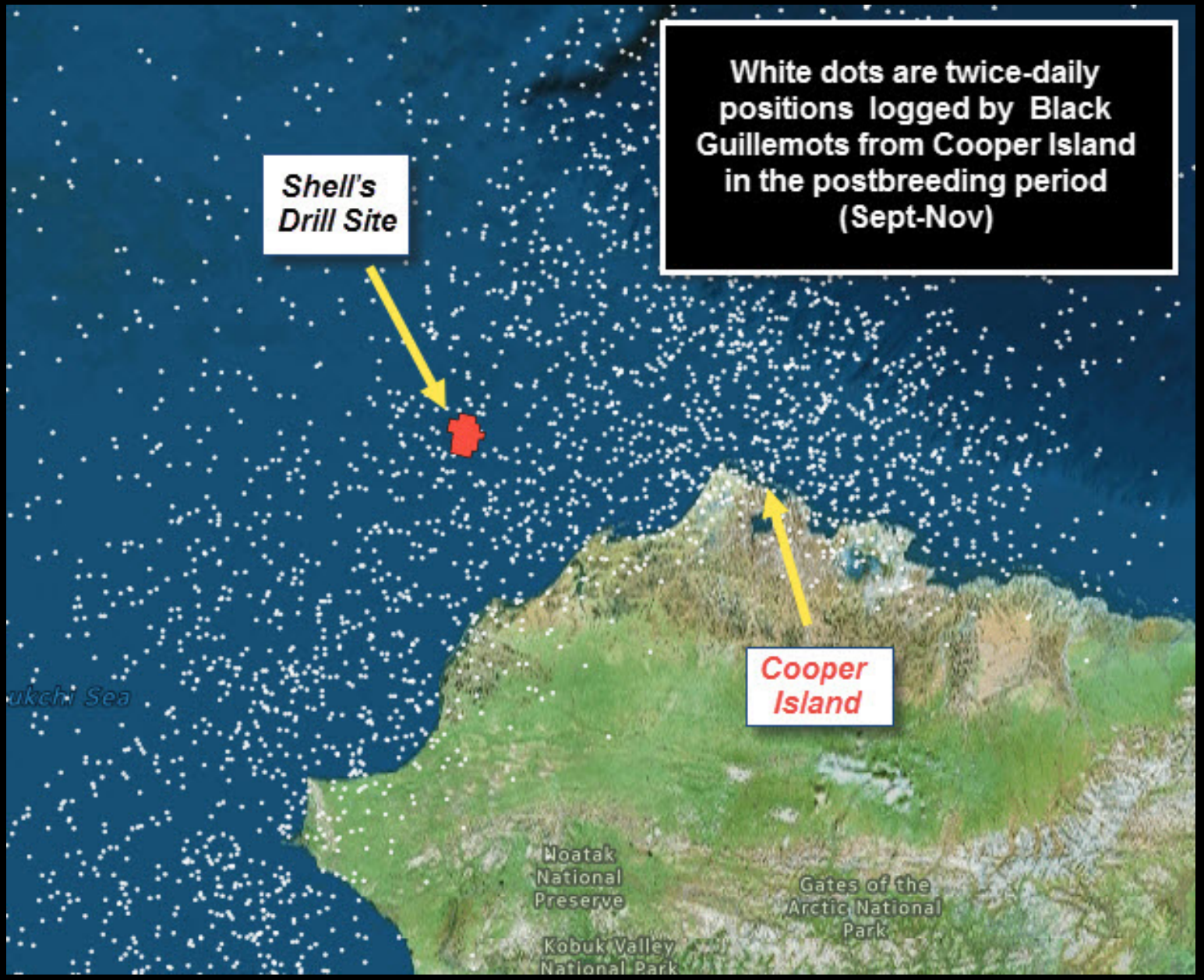
22 February


ud5020120222.png
2011-12
% Ice
High : 100
Low : 0


ud5020130222.png
2012-13
% Ice
High : 100
Low : 0


ud5020140222.png
2013-14
% Ice
High : 100
Low : 0

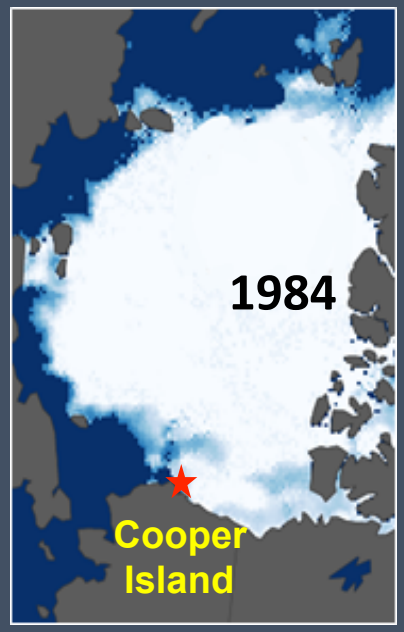

ud5020150222.png
2014-15
% ice
Value
High : 100
Low : 0


White dots are twice-daily positions logged by Black Guillemots from Cooper Island in the postbreeding period (Sept-Nov)
Shell's Drill Site
Cooper Island
Noatak National Preserve
Gates of the Arctic National Park
Kobuk Valley National Park

Wooden nest cases replaced with plastic nest cases in 2011

Thanks for support and encouragement

- Residents of Barrow, Alaska
- North Slope Borough Wildlife Mgmt.
- North Slope Borough SAR
- Barrow Arctic Science Consortium
- SOAR - Synthesis of Arctic Research
- Sue Moore and Lisa Guy
- David Kennedy

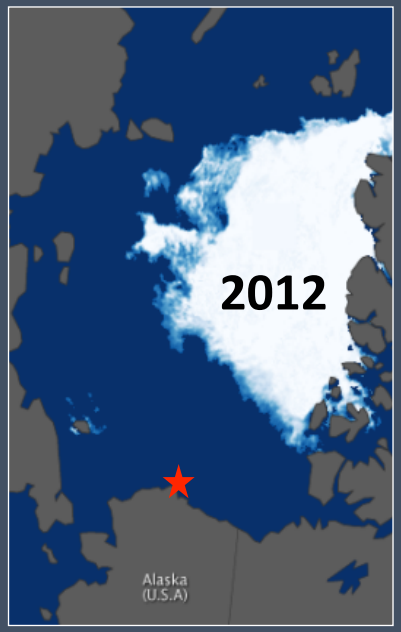


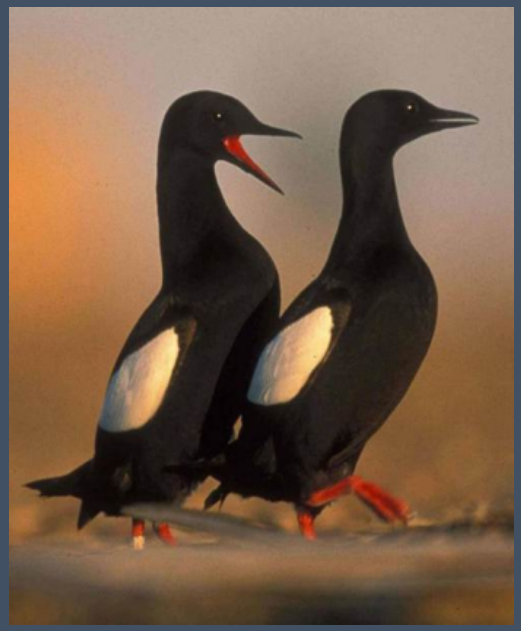
1975 40TH ANNIVERSARY 2015

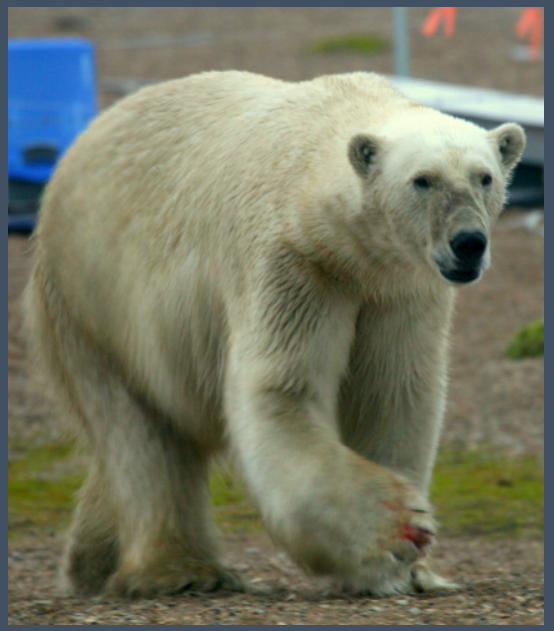
FRIENDS OF

Cooper Island

cooperisland.org







Sea ice was next to Cooper Island all summer until the early 21st Century. Now in late summer It retreats hundreds of miles north while Black Guillemot parents are feeding young.

The loss of sea ice reduces the availability of Arctic Cod, the preferred prey. Guillemot parents now regularly feed their nestlings sculpin. As a result, chick growth and survival has declined, as has the size of the breeding colony.

Loss of sea ice has forced polar bears to seek refuge on Cooper Island, where they ate guillemot eggs and nestlings. The wooden nest boxes used since 1972 were replaced with bear-proof plastic cases in 2012.

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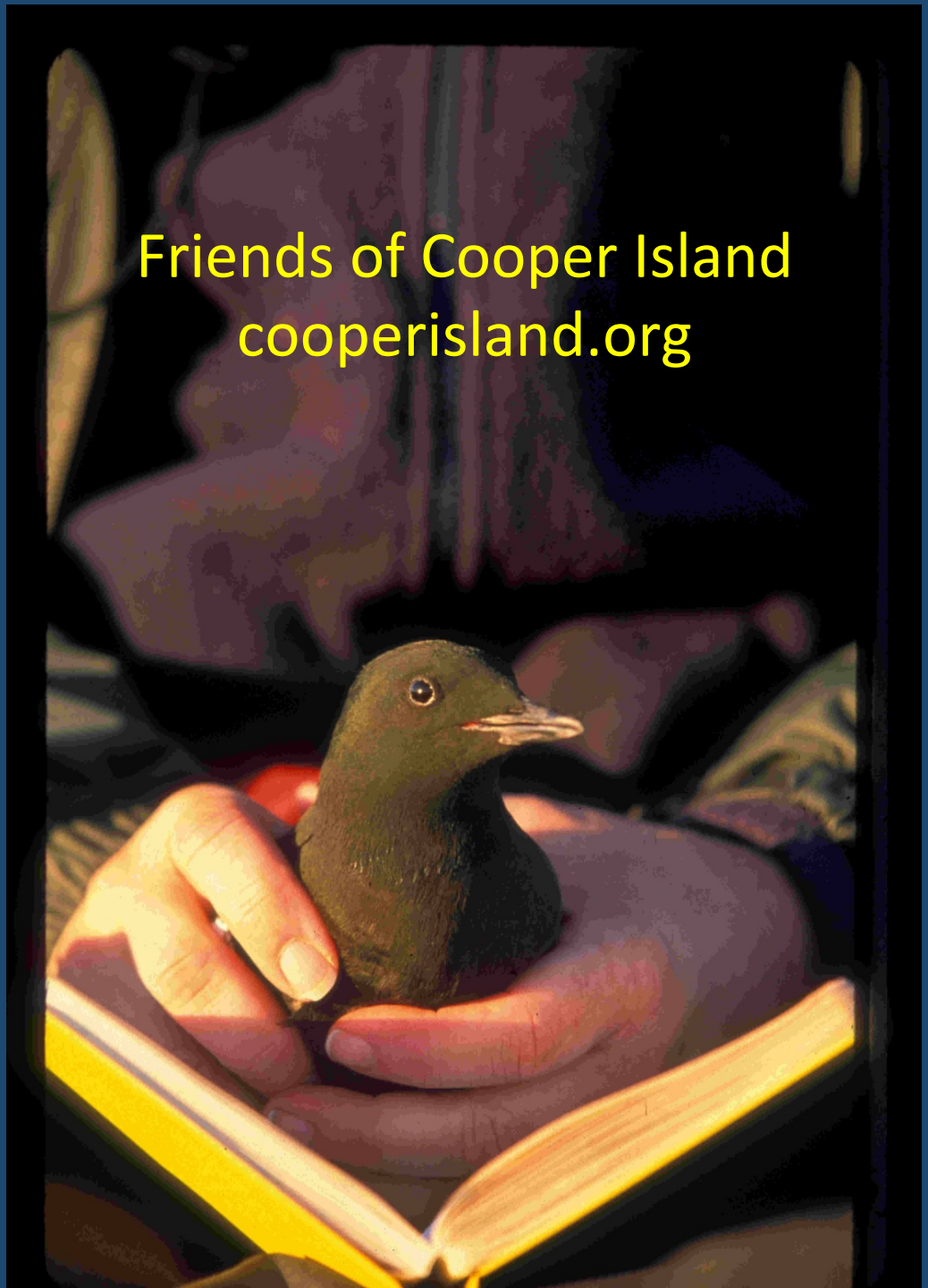
Friends of Cooper Island
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