SHIFTS IN THE SEABIRD COMMUNITY OF THE CHUKCHI SEA OVER FOUR DECADES: A SEA CHANGE IN STRUCTURE?

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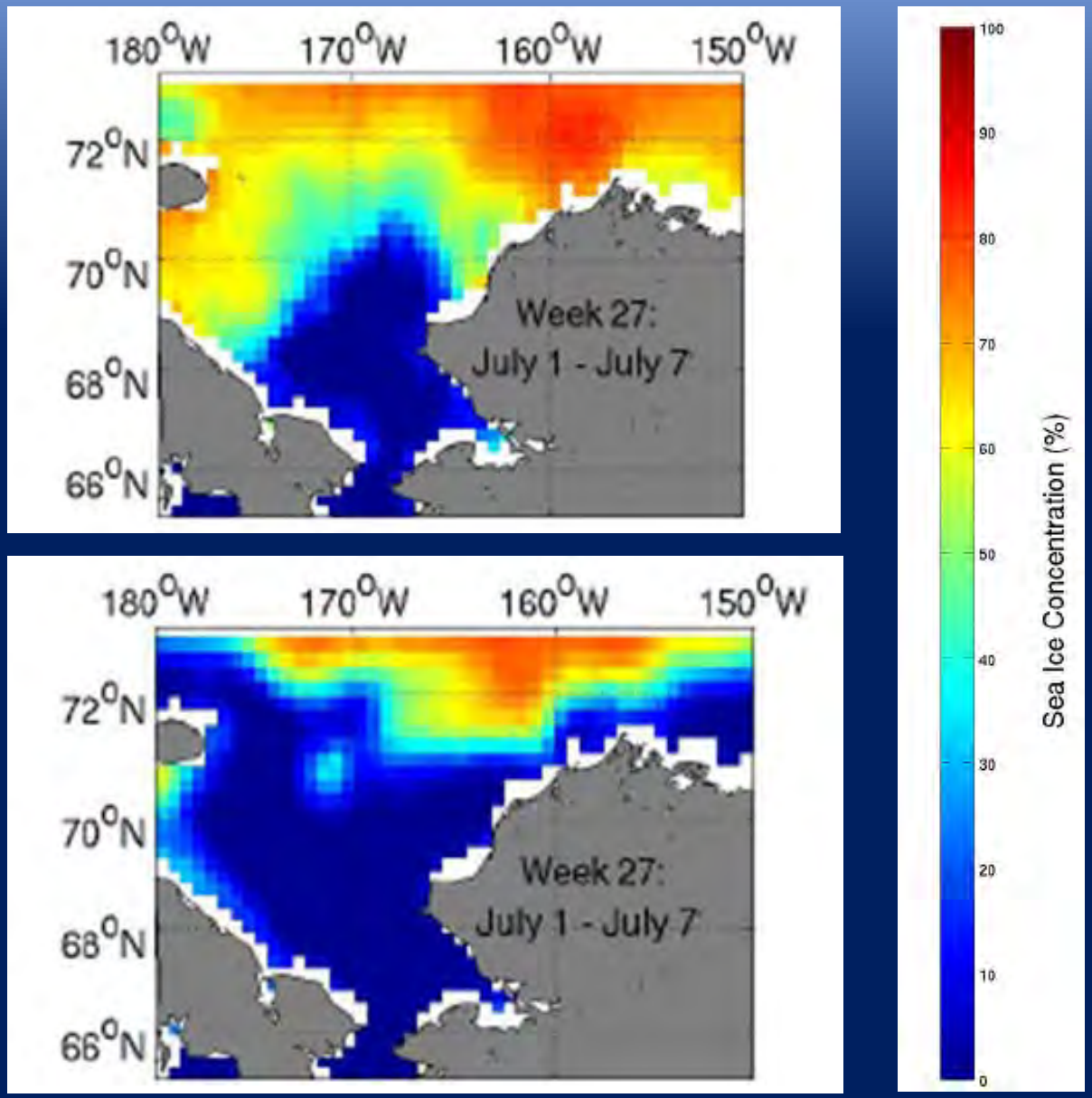
Ocean Sciences Meeting
26 February 2014
Honolulu, HI

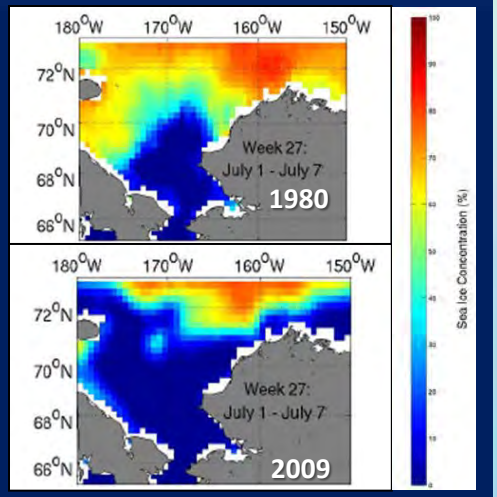
SEA ICE TIMING

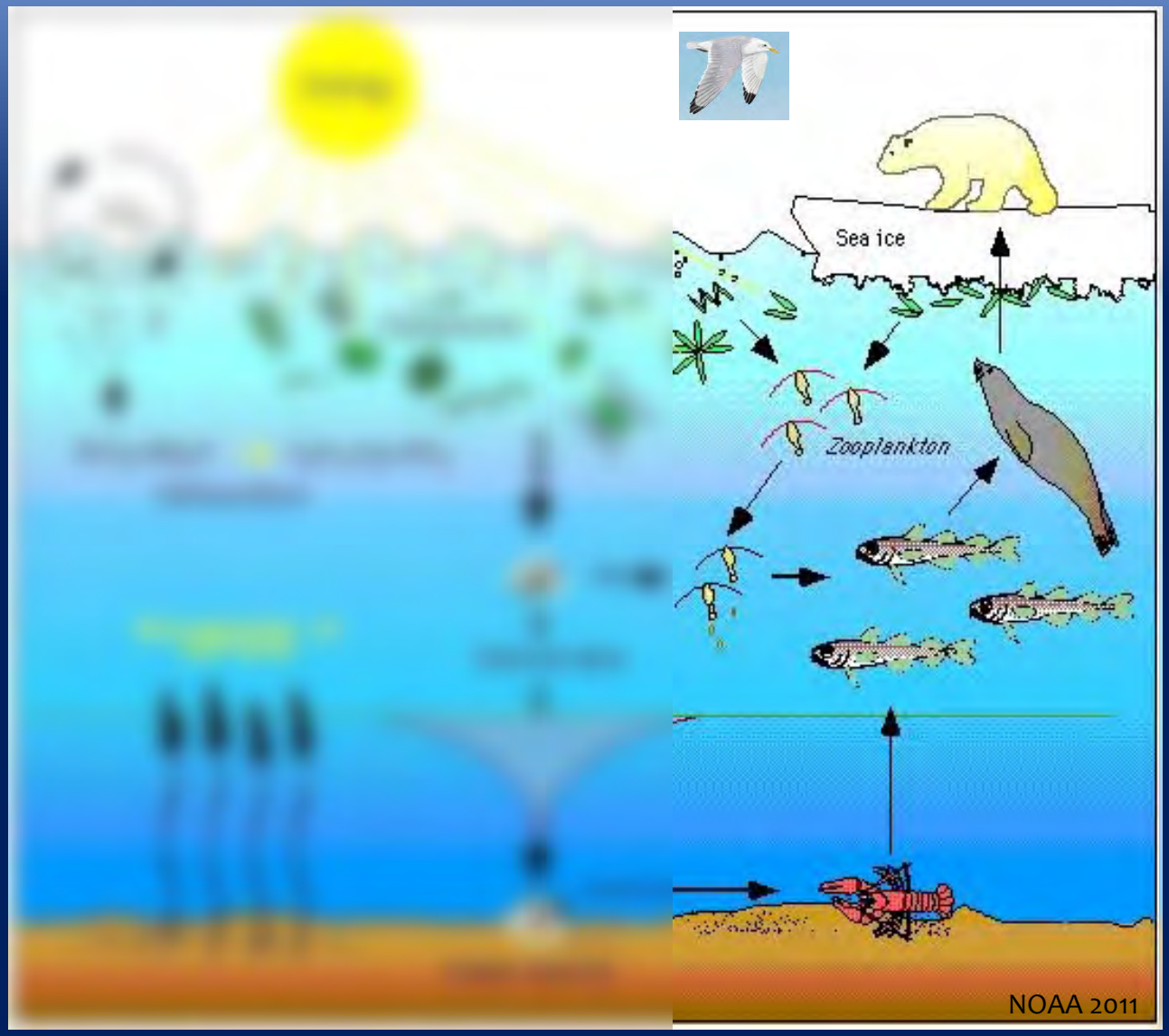
1980

2009



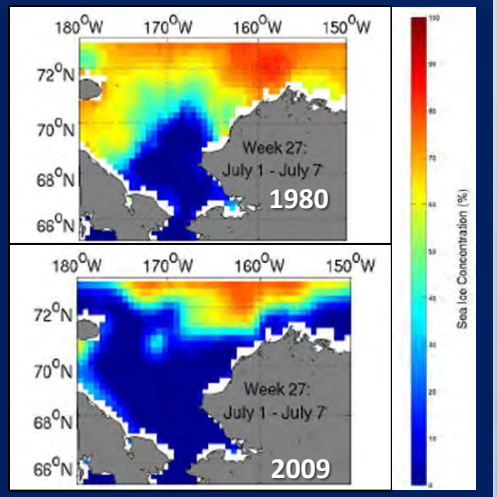
CLIMATE CHANGE PREDICTIONS

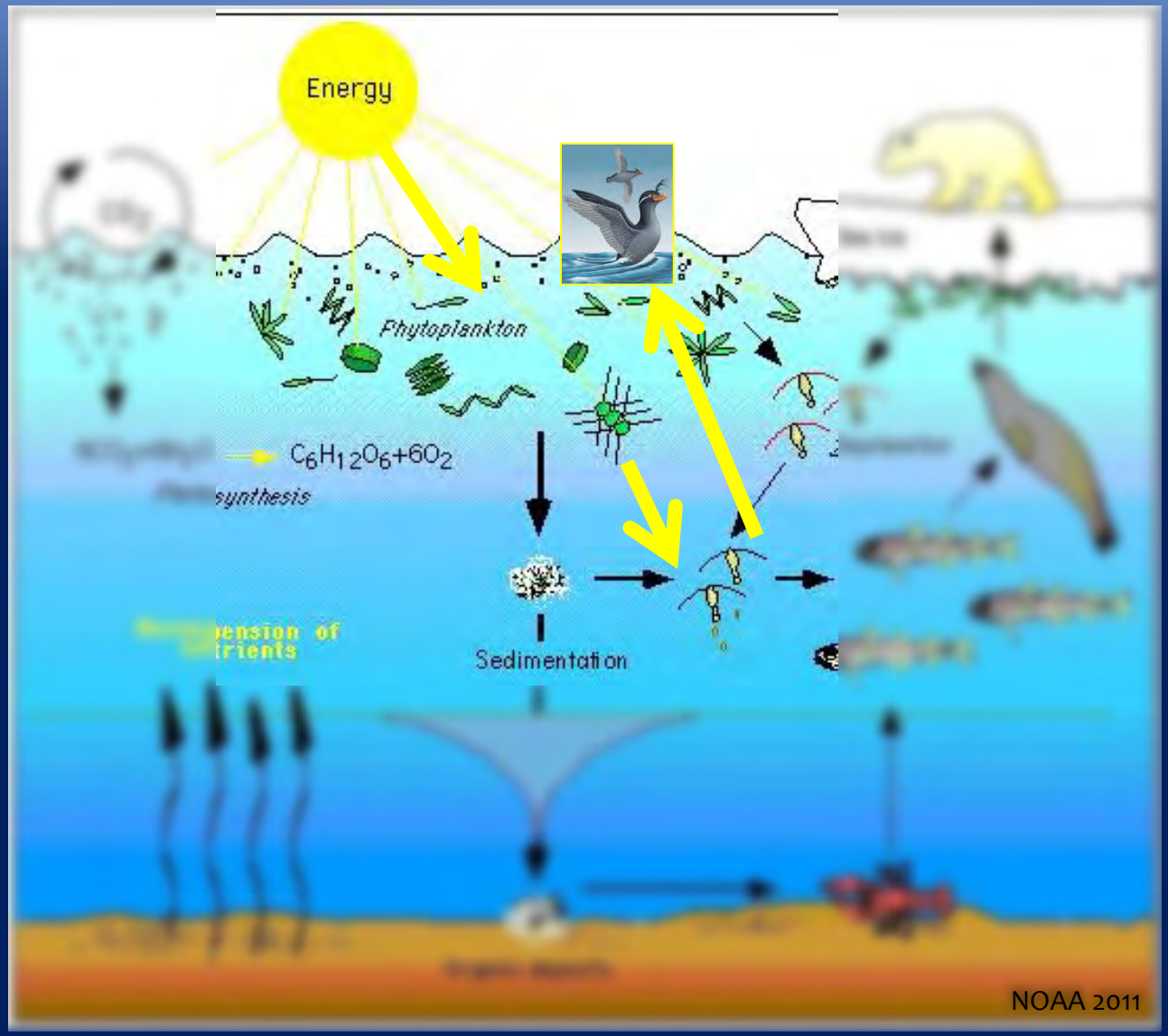




NOAA 2011

CLIMATE CHANGE PREDICTIONS

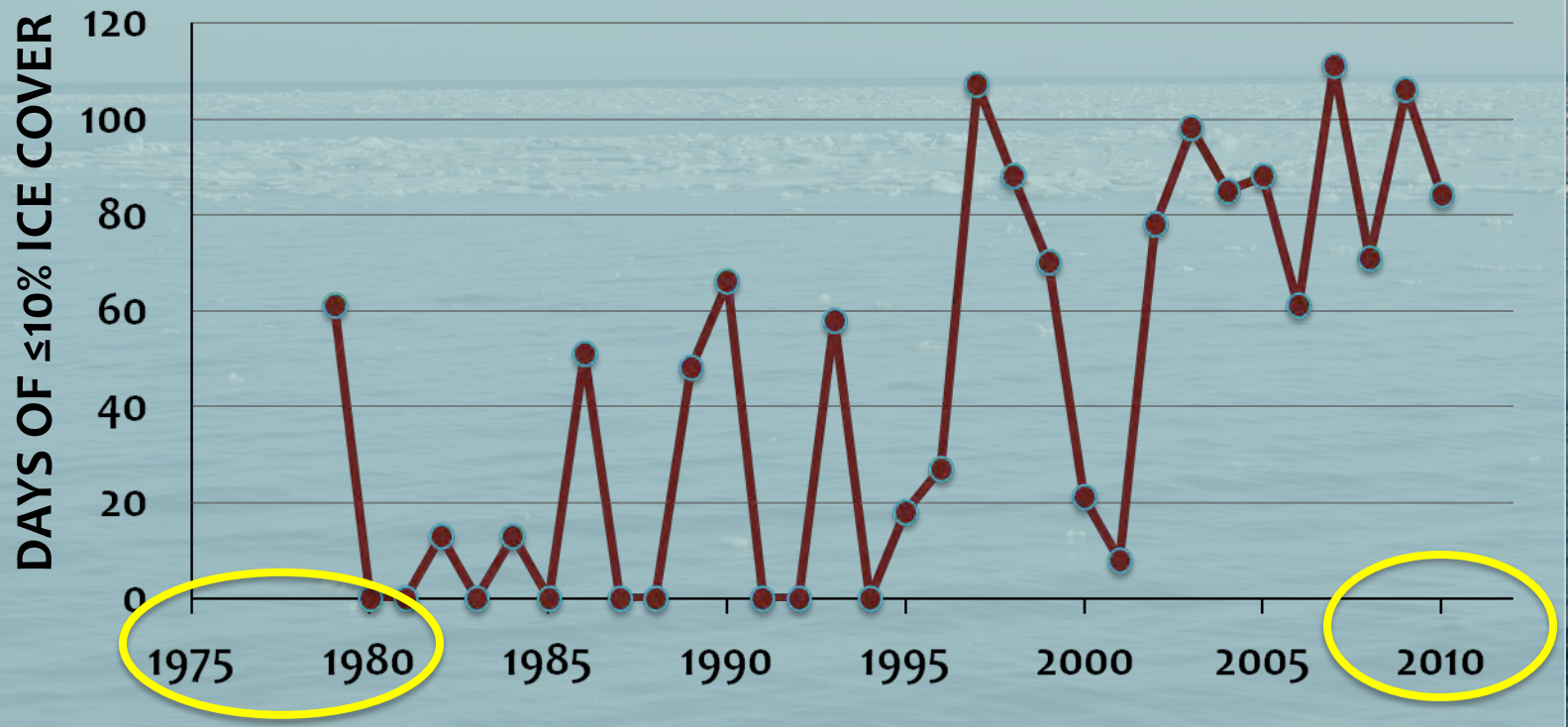




NOAA 2011

HABITAT CHANGE

Ice-free days 72–73°N



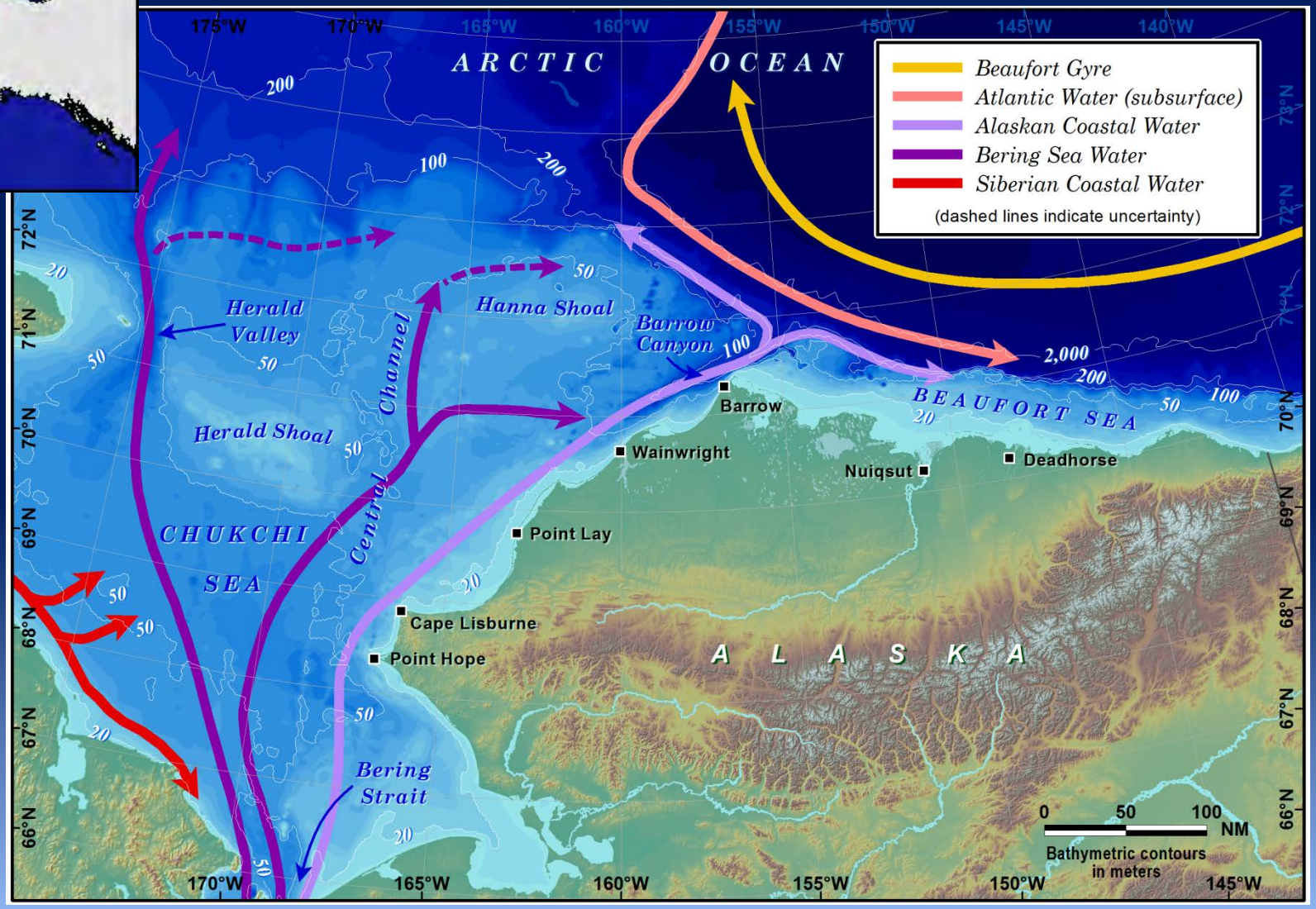
QUESTIONS

- Changes in seabird community (nMDS)?
  - Community composition
  - Species diversity
  - Foraging guilds

- Changes in abundance (birds km^{-2}; GLM)?
  - By foraging guild
  - By region

- Other changes in marine environment?

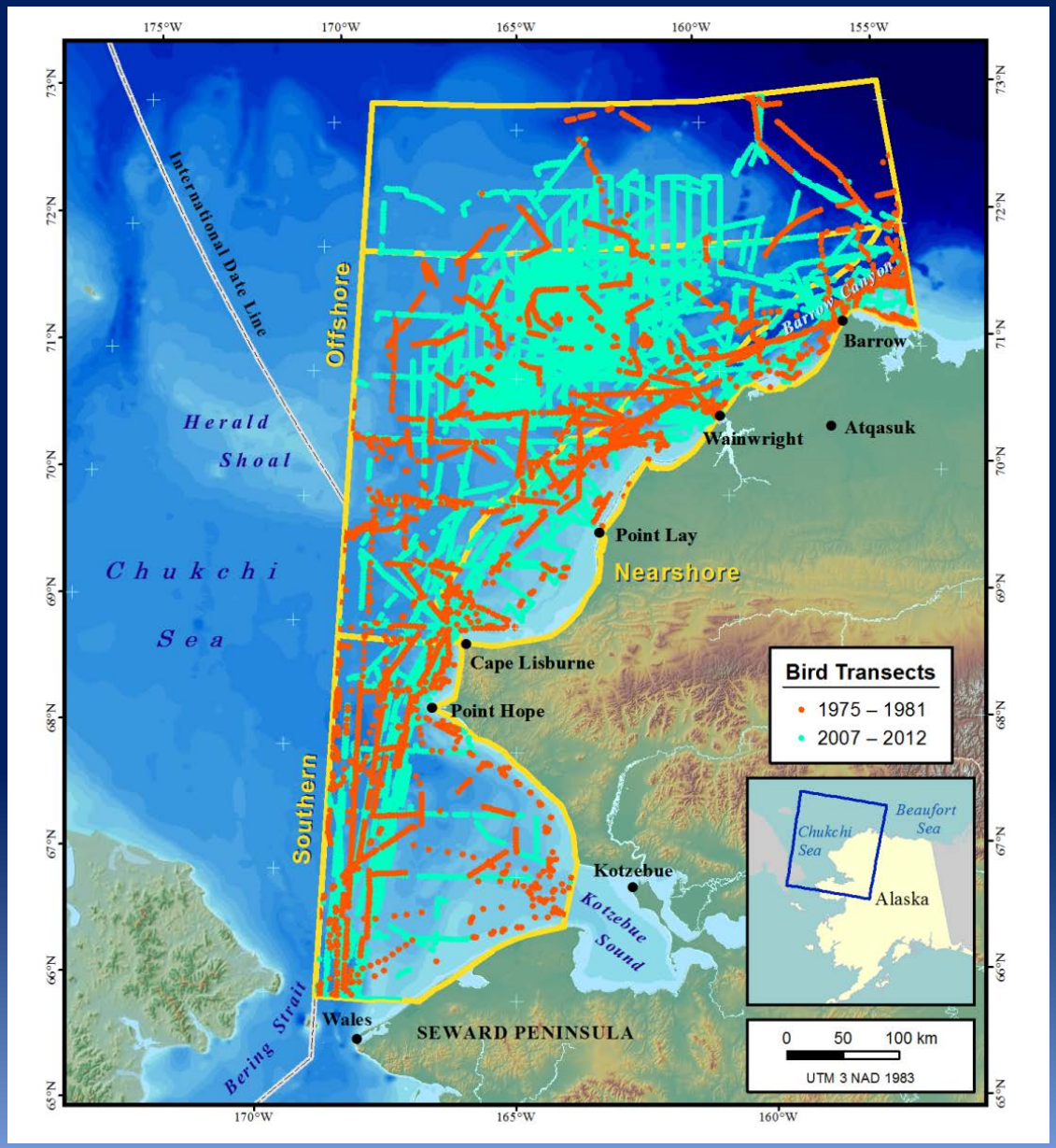
CURRENTS & BATHYMETRY



STUDY AREA

175°W
170°W
165°W
160°W
155°W
73°N
72°N
71°N
70°N
69°N
68°N
67°N
66°N
65°N
Northern
International Date Line
Offshore
Barrow Canyon
Barrow
Wainwright
Atqasuk
Herald
Shoal
Point Lay
Nearshore
Chukchi
Sea
Cape Lisburne
Point Hope
Southern
Kotzebue
Kotzebue
Sound
Bering Strait
Wales
SEWARD PENINSULA
0 50 100 km
UTM 3 NAD 1983

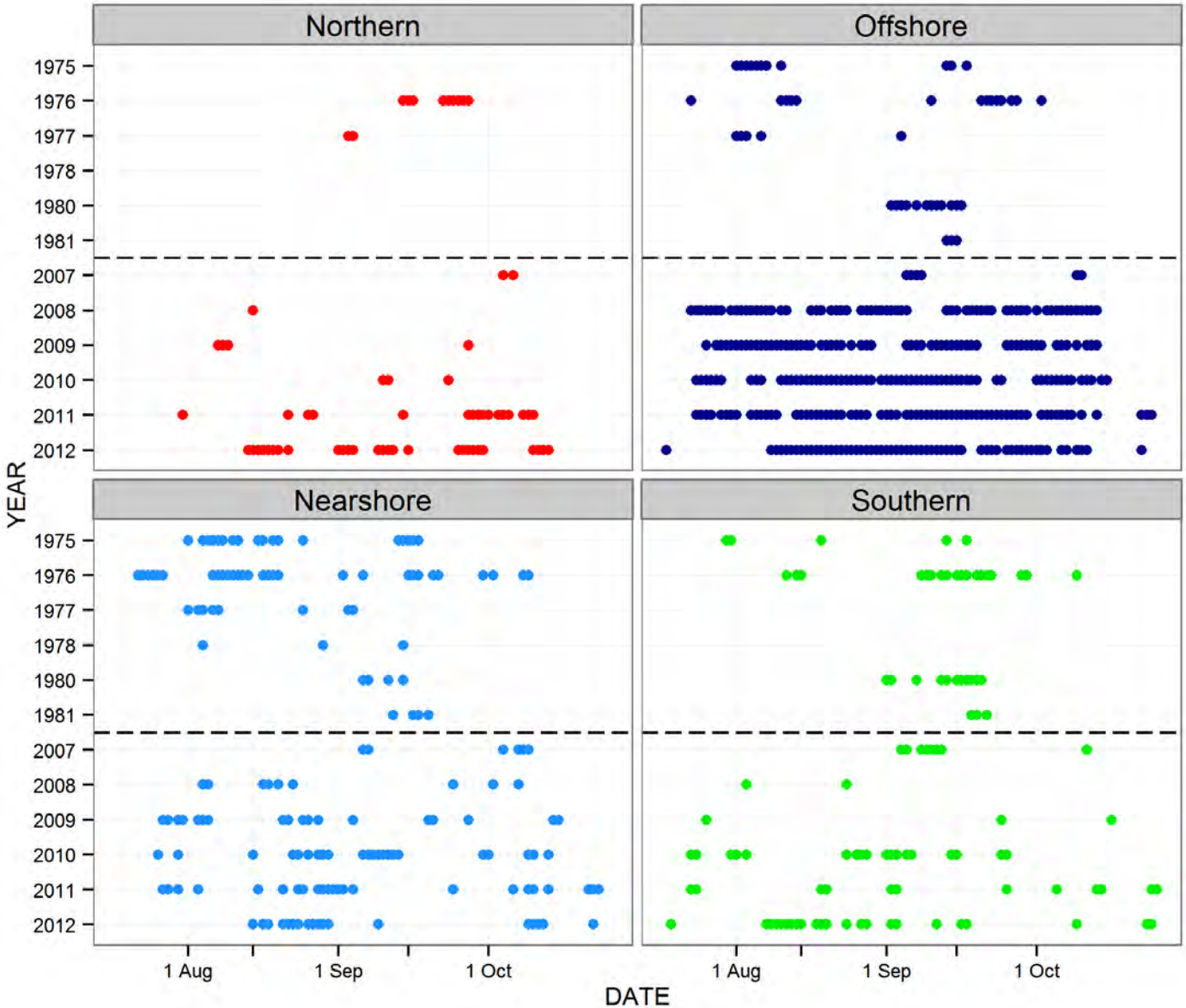
SEABIRD SAMPLING



CONTRIBUTING PROJECTS

- OCSEAP 1975–1981 (NOAA/MMS)
- CSESP 2008–2012 (ConocoPhillips, Shell, Statoil)
- AKMAP 2010–2011 (AK DEC, Shell)
- USFWS 2007–2012
- SSM/I 1979–2011 (NASA)

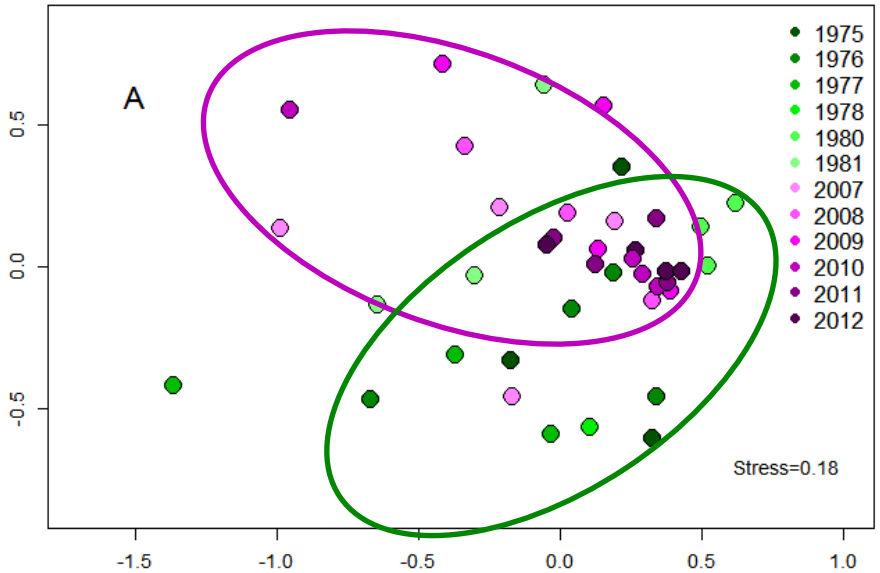
SEABIRD SAMPLING DATES



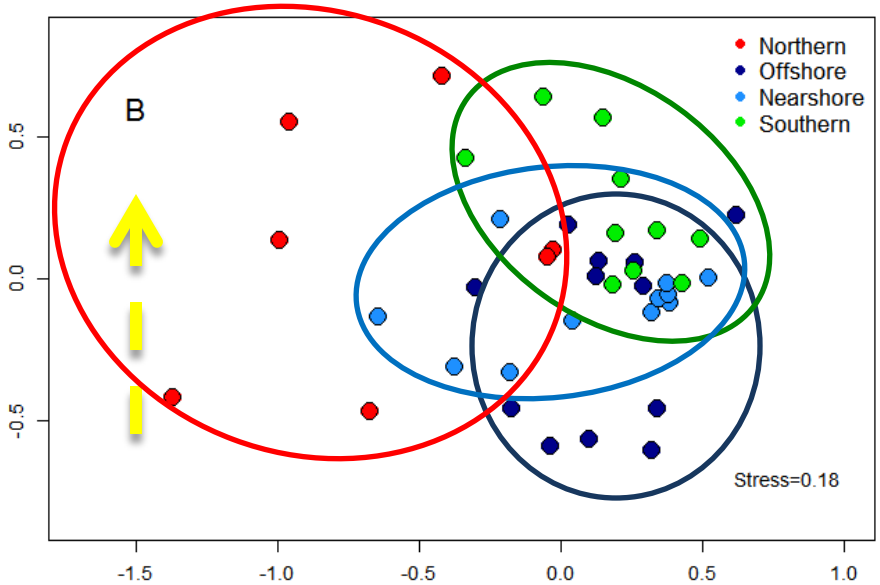
SHIFT IN SEABIRD COMMUNITY

50 species summarized by region-year

BY YEAR

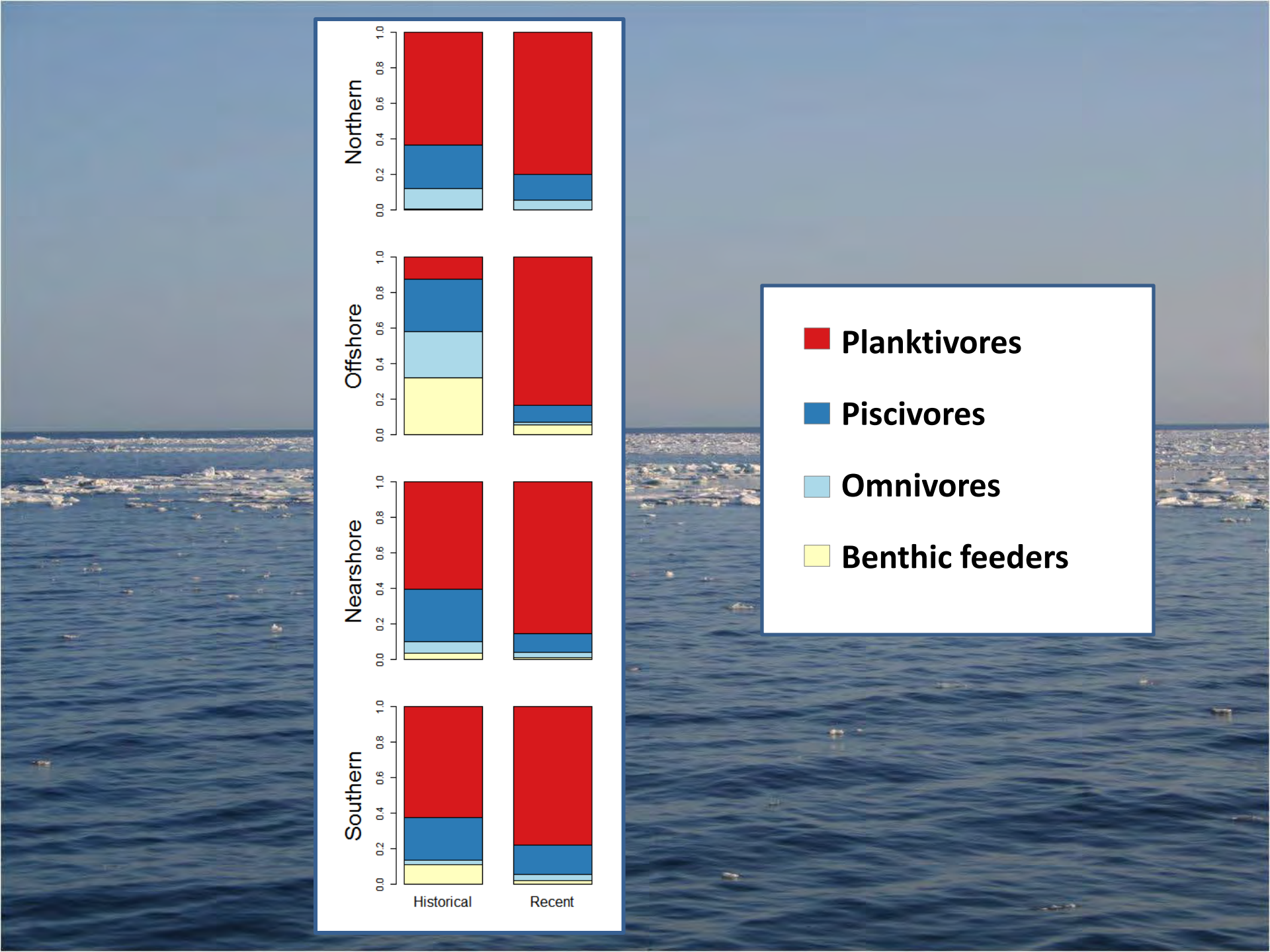


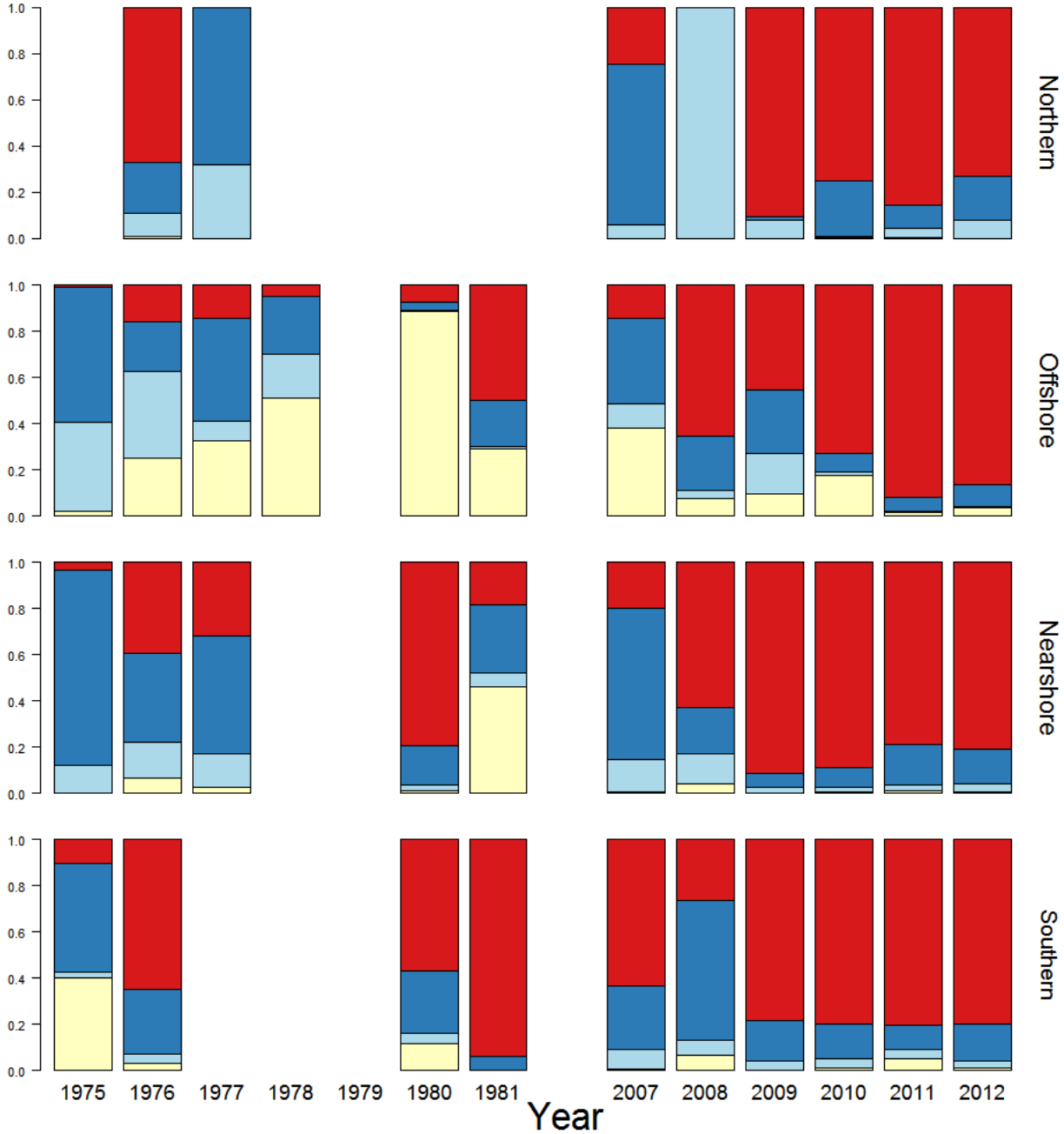
BY REGION



Shift in composition

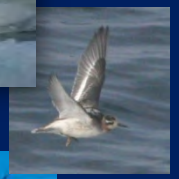
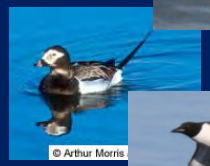
Shift evident in all regions


Northern
Offshore
Nearshore
Southern
0.0
0.2
0.4
0.6
0.8
1.0
Historical
Recent
Planktivores
Piscivores
Omnivores
Benthic feeders



- Planktivores
- Piscivores
- Omnivores
- Benthic feeders

KEY PLAYERS IN COMMON

Rank	Historical	Recent
1	Black-legged Kittiwake	Short-tailed Shearwater
2	Short-tailed Shearwater	Crested Auklet
3	Glaucous Gull	Thick-billed Murre
4	Phalarope spp.	Least Auklet
5	Spectacled Eider	Black-legged Kittiwake
6	Thick-billed Murre	Phalarope spp.
7	Common Eider	Common Murre
8	Long-tailed Duck	Northern Fulmar
9	Black Scoter	Long-tailed Duck
10	King Eider	Glaucous Gull

NEW KEY PLAYERS

Rank	Historical	Recent
1	Black-legged Kittiwake	Short-tailed Shearwater
2	Short-tailed Shearwater	Crested Auklet
3	Glaucous Gull	Thick-billed Murre
4	Phalarope spp	Least Auklet
5	Spectacled Eider	Black-legged Kittiwake
6	Thick-billed Murre	Phalarope spp.
7	Common Eider	Common Murre
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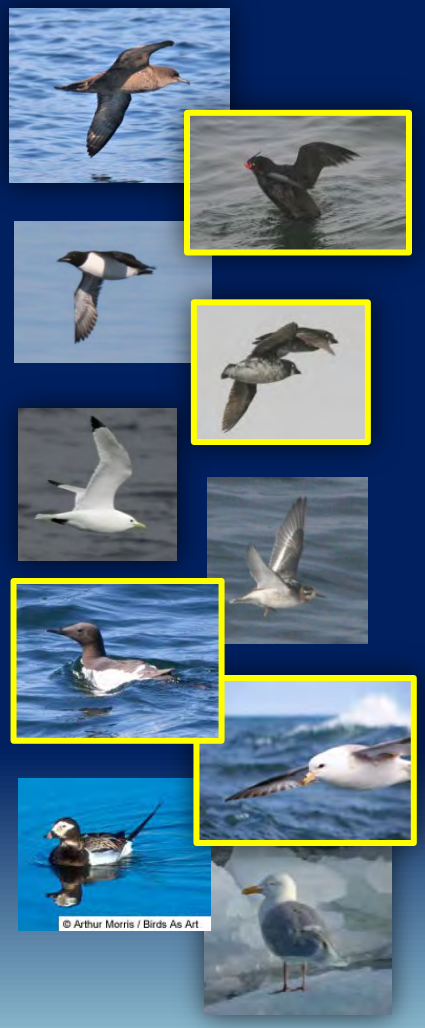
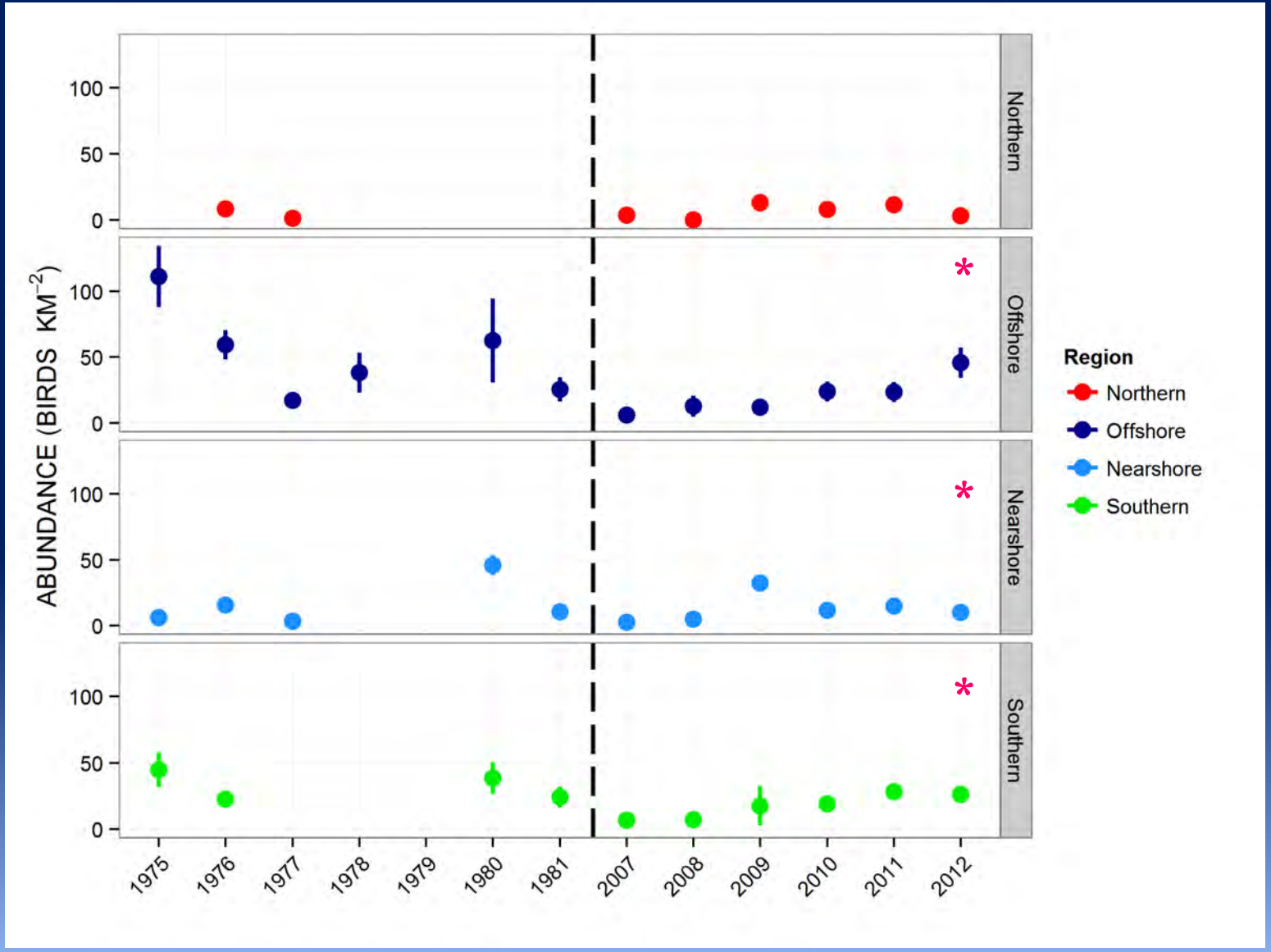
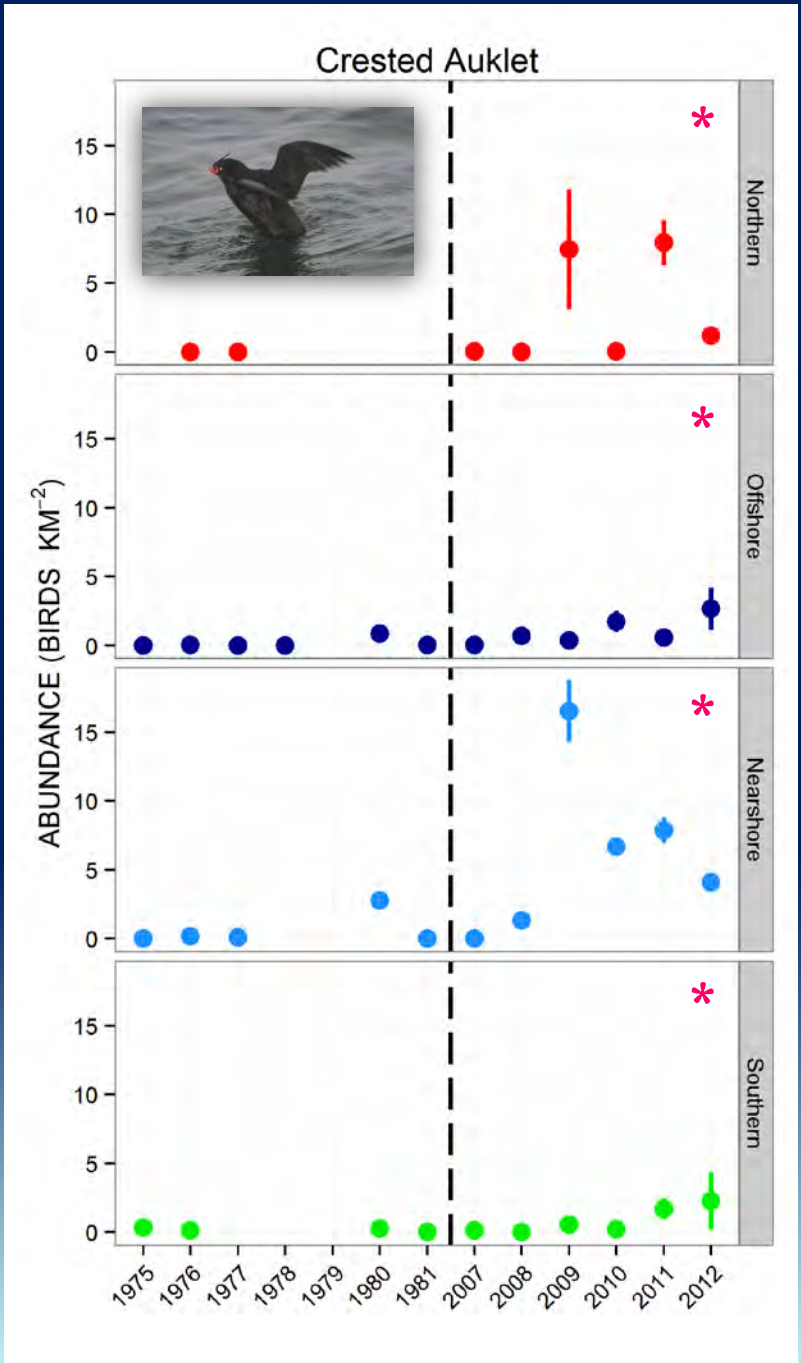
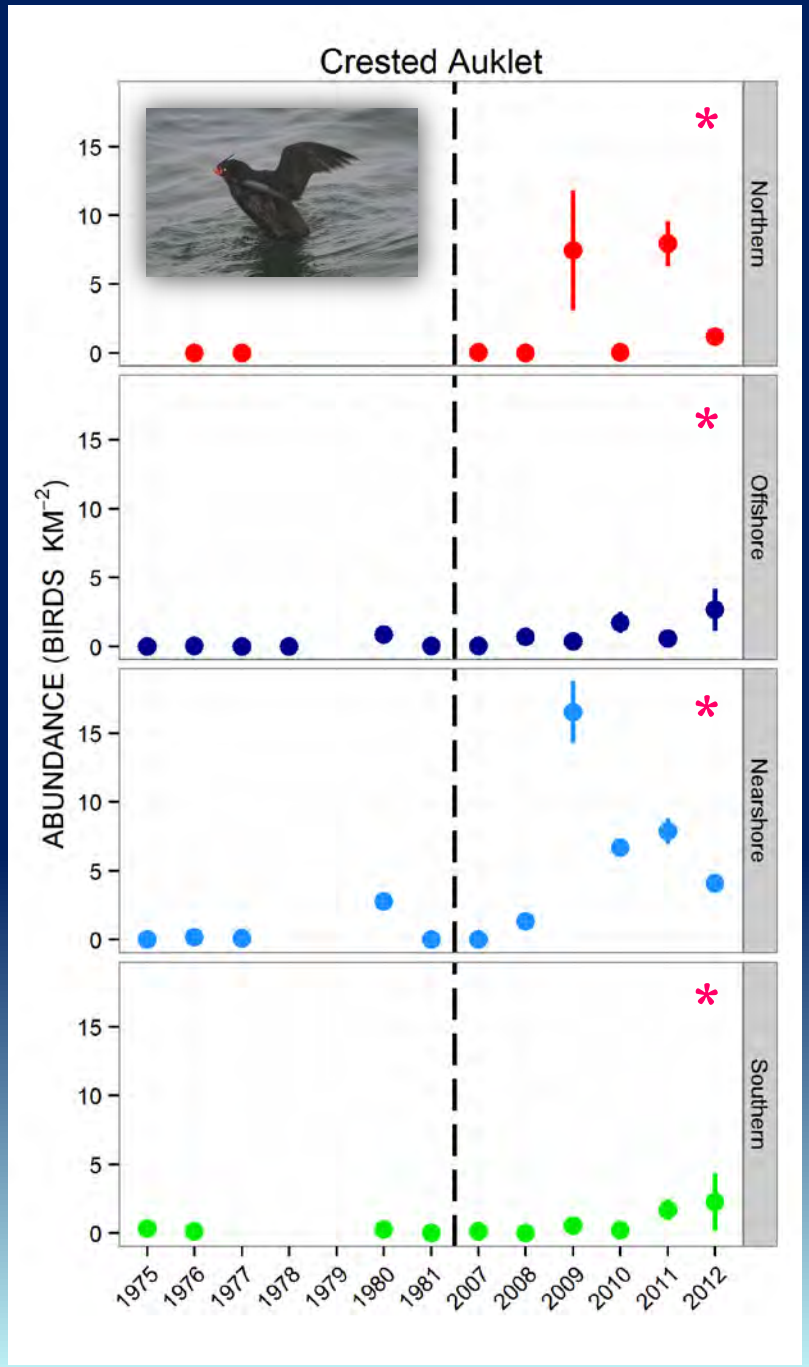
10	King Eider	Glaucous Gull

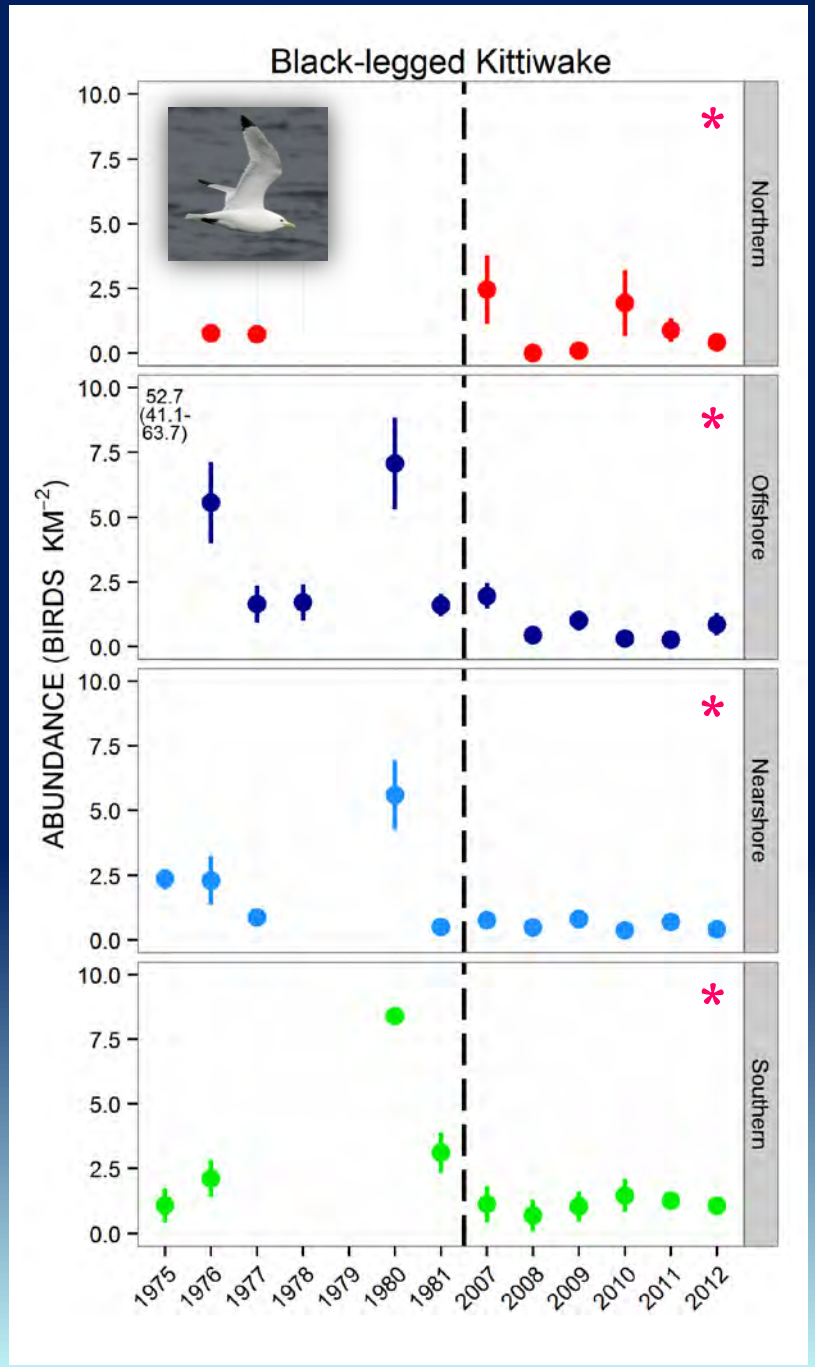


TOTAL ABUNDANCE



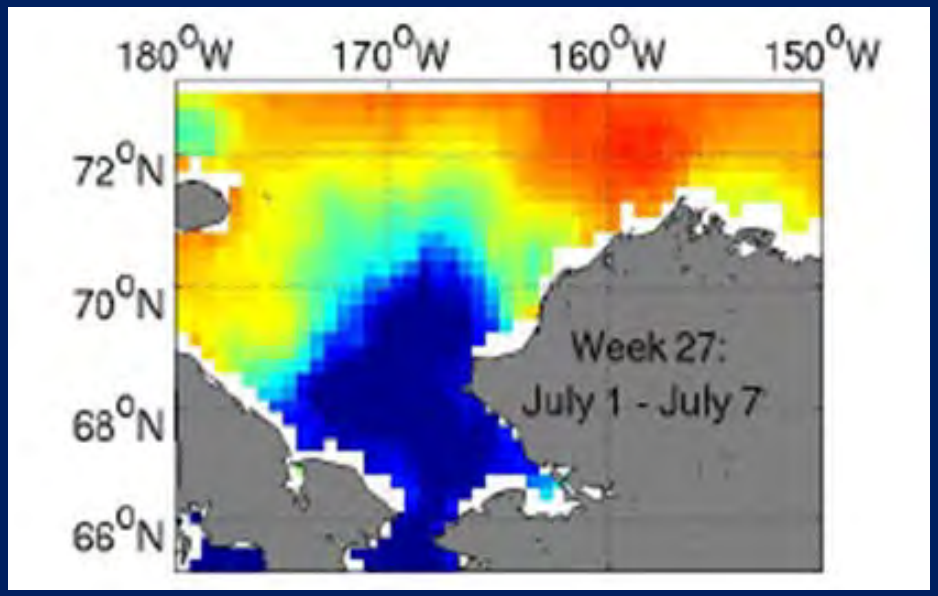

Crested Auklet
ABUNDANCE (BIRDS KM^{-2})
Northern
Offshore
Nearshore
Southern
0
5
10
15
1975
1976
1977
1978
1979
1980
1981
2007
2008
2009
2010
2011
2012
*


Crested Auklet
ABUNDANCE (BIRDS KM^{-2})
Northern
Offshore
Nearshore
Southern
*
0
5
10
15
1975
1976
1977
1978
1979
1980
1981
2007
2008
2009
2010
2011
2012

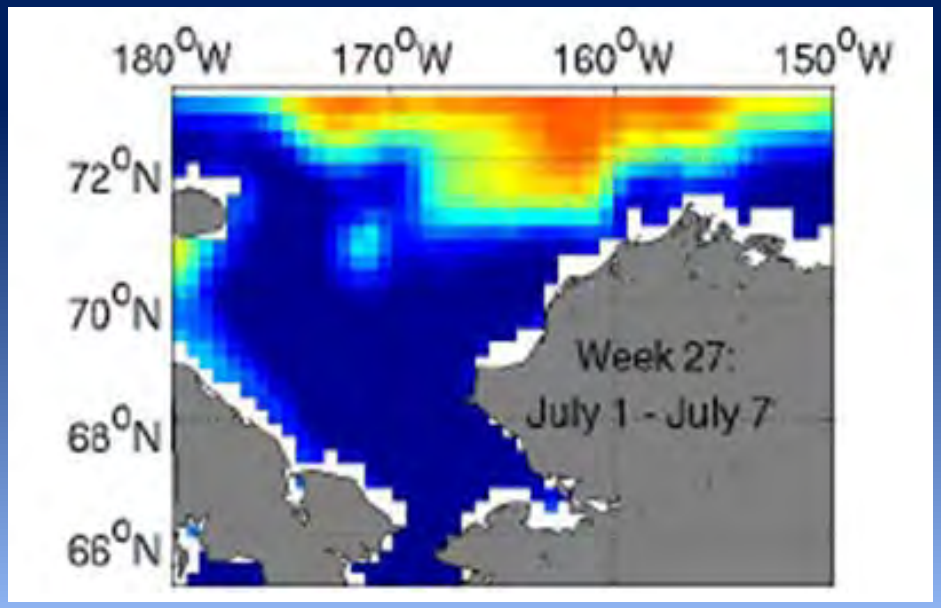

Black-legged Kittiwake
ABUNDANCE (BIRDS KM^{-2})
52.7
(41.1-
63.7)
Northern
Offshore
Nearshore
Southern
*
0.0
2.5
5.0
7.5
10.0
1975
1976
1977
1978
1979
1980
1981
2007
2008
2009
2010
2011
2012

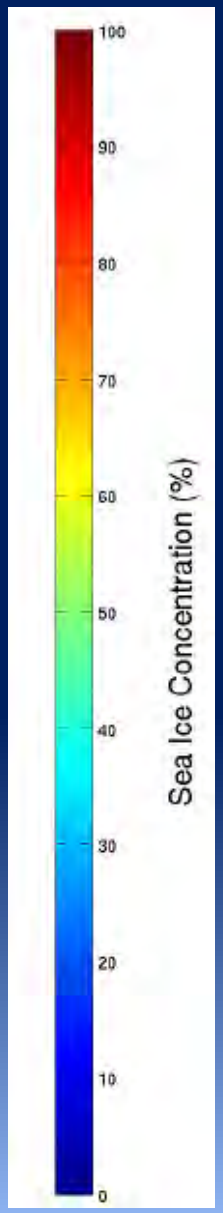
SEA ICE TIMING

1980

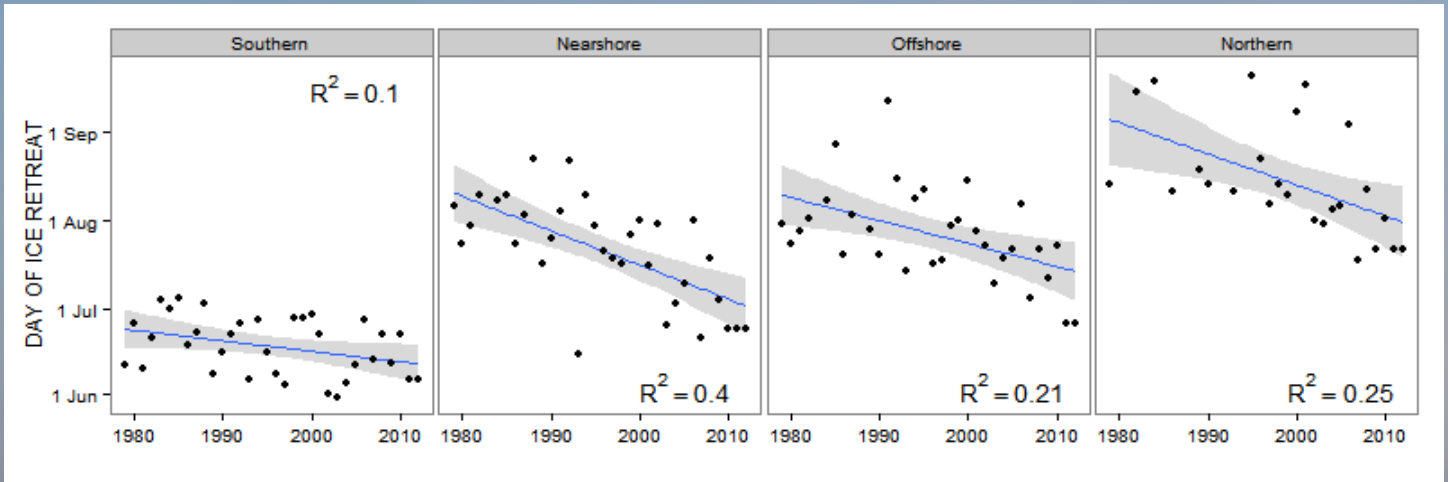


2009

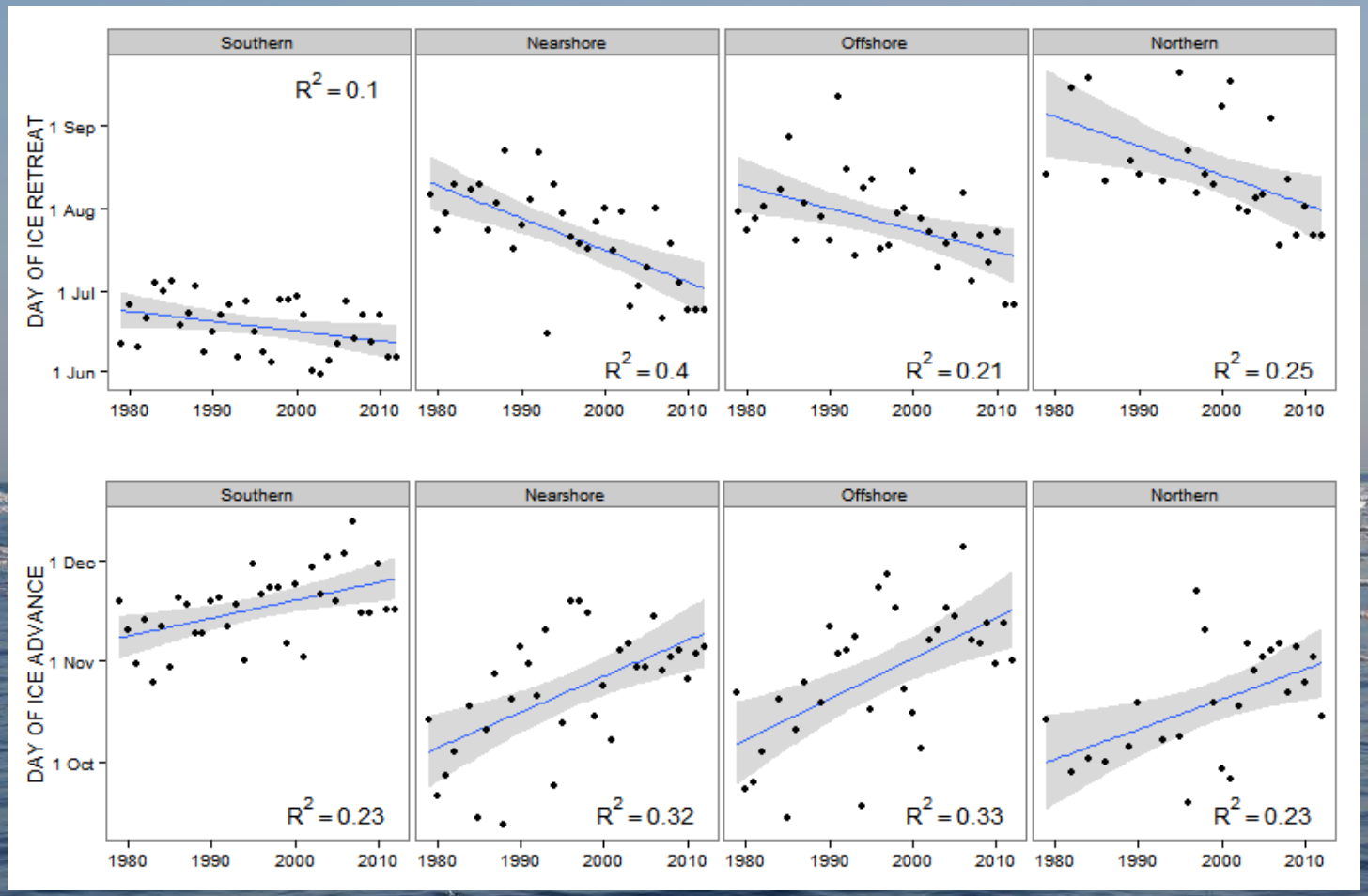


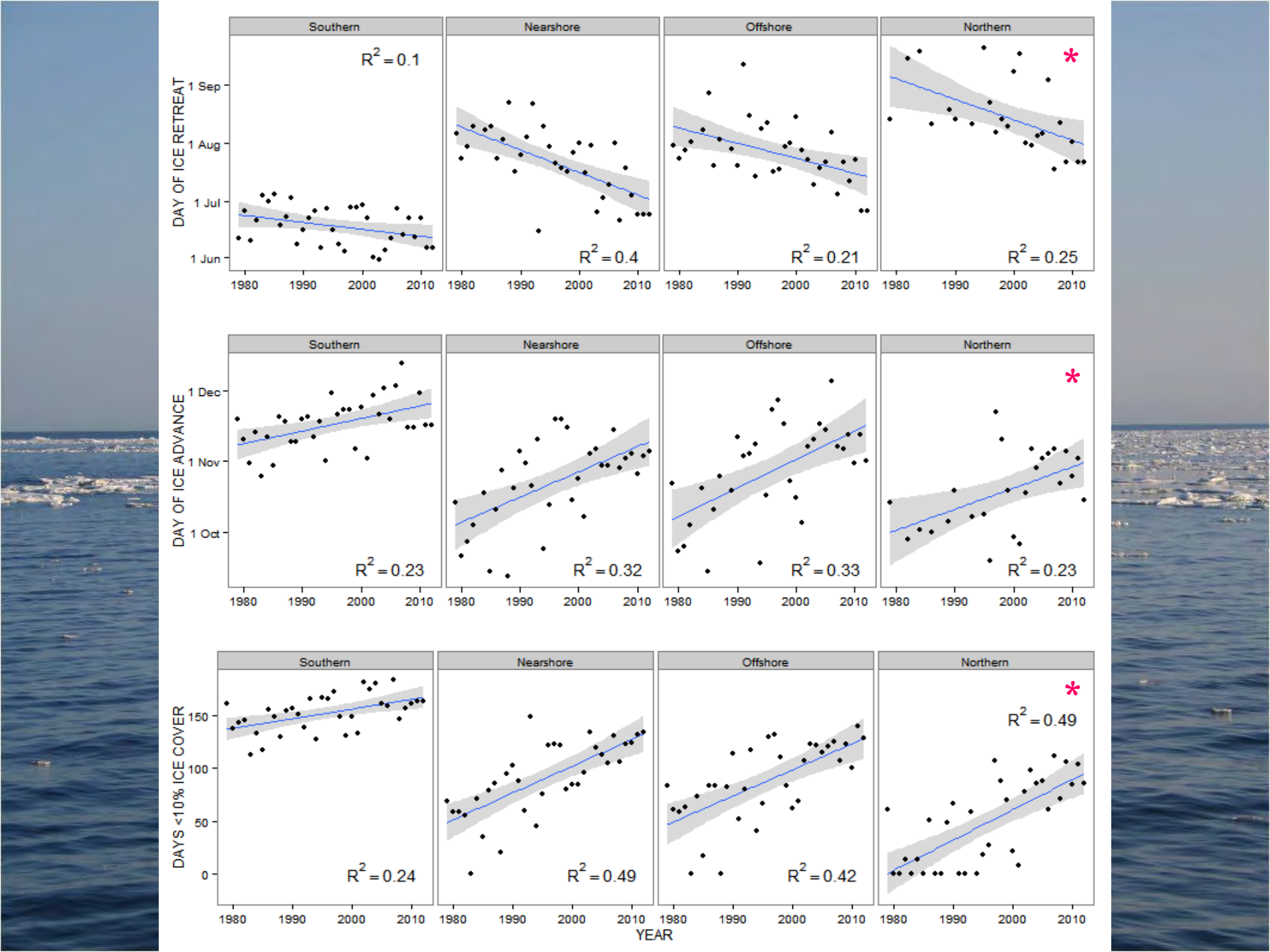


SEA ICE TIMING

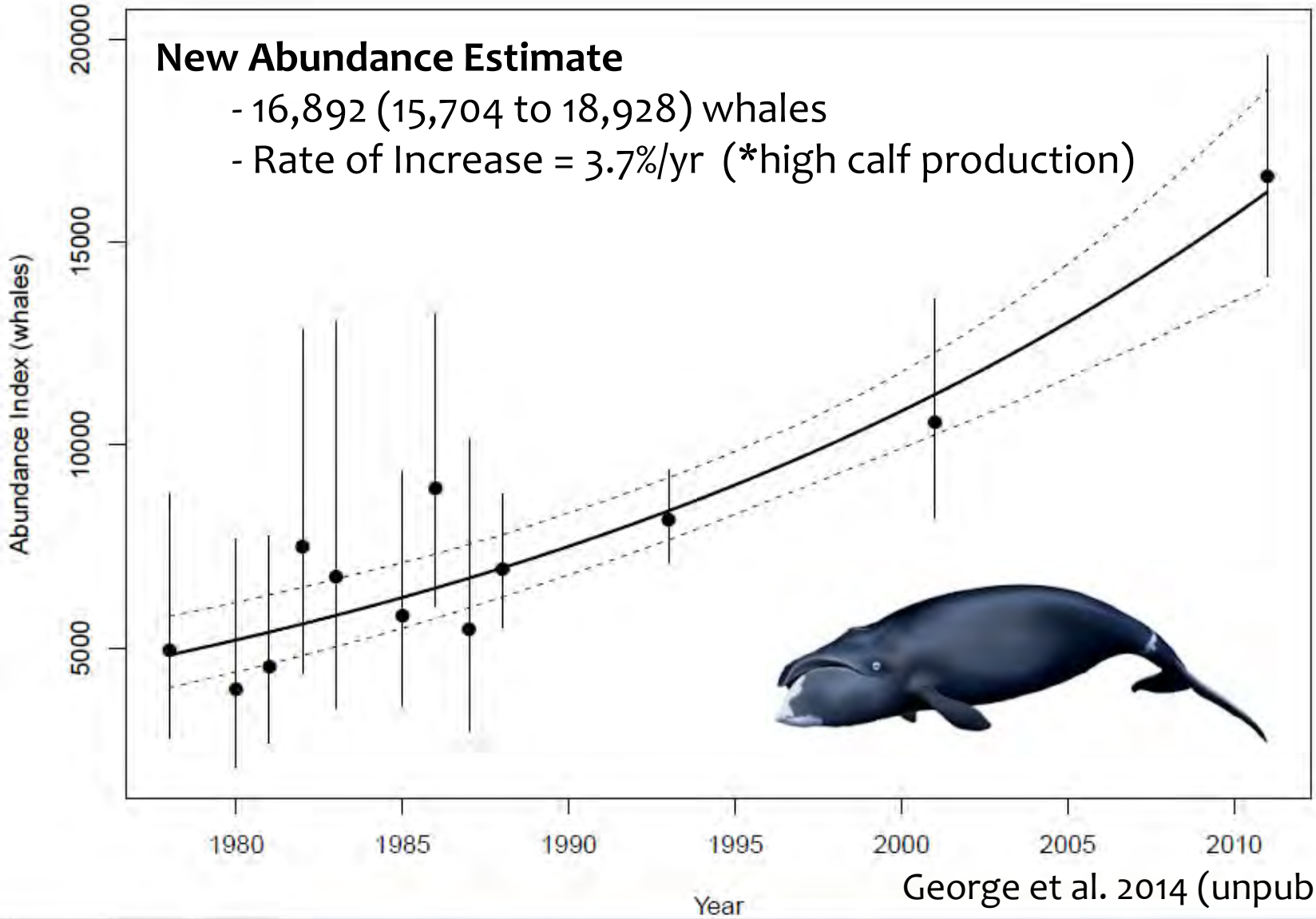


SEA ICE TIMING



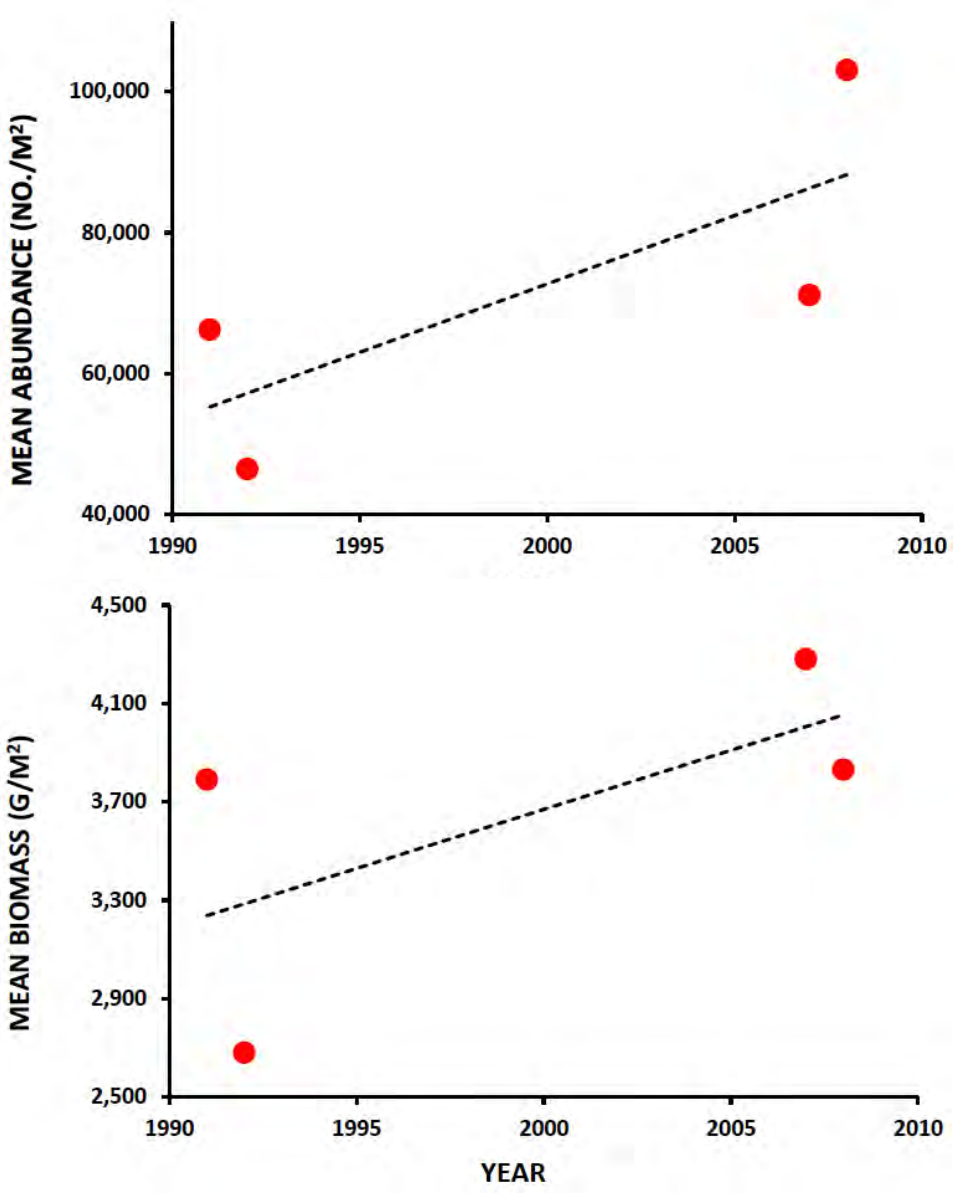

Southern
Nearshore
Offshore
Northern
DAY OF ICE RETREAT
1 Sep
1 Aug
1 Jul
1 Jun
$R^2 = 0.1$
$R^2 = 0.4$
$R^2 = 0.21$
$R^2 = 0.25$
*
DAY OF ICE ADVANCE
1 Dec
1 Nov
1 Oct
$R^2 = 0.23$
$R^2 = 0.32$
$R^2 = 0.33$
$R^2 = 0.23$
*
DAYS <10% ICE COVER
150
100
50
0
$R^2 = 0.24$
$R^2 = 0.49$
$R^2 = 0.42$
$R^2 = 0.49$
*
1980
1990
2000
2010
YEAR

BOWHEAD INCREASE



George et al. 2014 (unpublished)

MESOZOOPLANKTON INCREASE



ABUNDANCE

BIOMASS

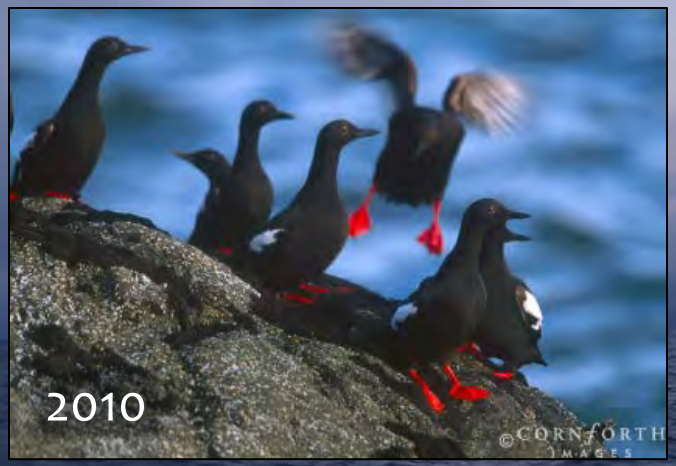
Matsuno et al. 2011.
Polar Biology 34: 1349-1360

EVIDENCE FOR CHANGE…

- Community composition changed: piscivores ⇨ planktivores
  - Abundance of planktivores increased and abundance of piscivores decreased throughout the eastern Chukchi Sea
    - Change in all regions (and Beaufort) suggests an ecosystem-wide shift toward planktivores
      - Earlier ice retreat creating an environment that is more favorable to large zooplankton
        - Forage fish?

ACKNOWLEDGMENTS

- ConocoPhillips, Shell E&P, and Statoil
- John Piatt and Gary Drew, USGS
- OCSEAP
- Peter Winsor, UAF
- Craig George, North Slope Borough
- Crew and support staff of the M/V *Bluefin*, M/V *Westward Wind*, and R/V *Norseman II*
- ABR and USFWS seabird personnel
- Olgoonik Fairweather LLC
- The village of Wainwright

- All photos © Olgoonik Fairweather LLC unless otherwise noted

MEET THE NEW NEIGHBORS