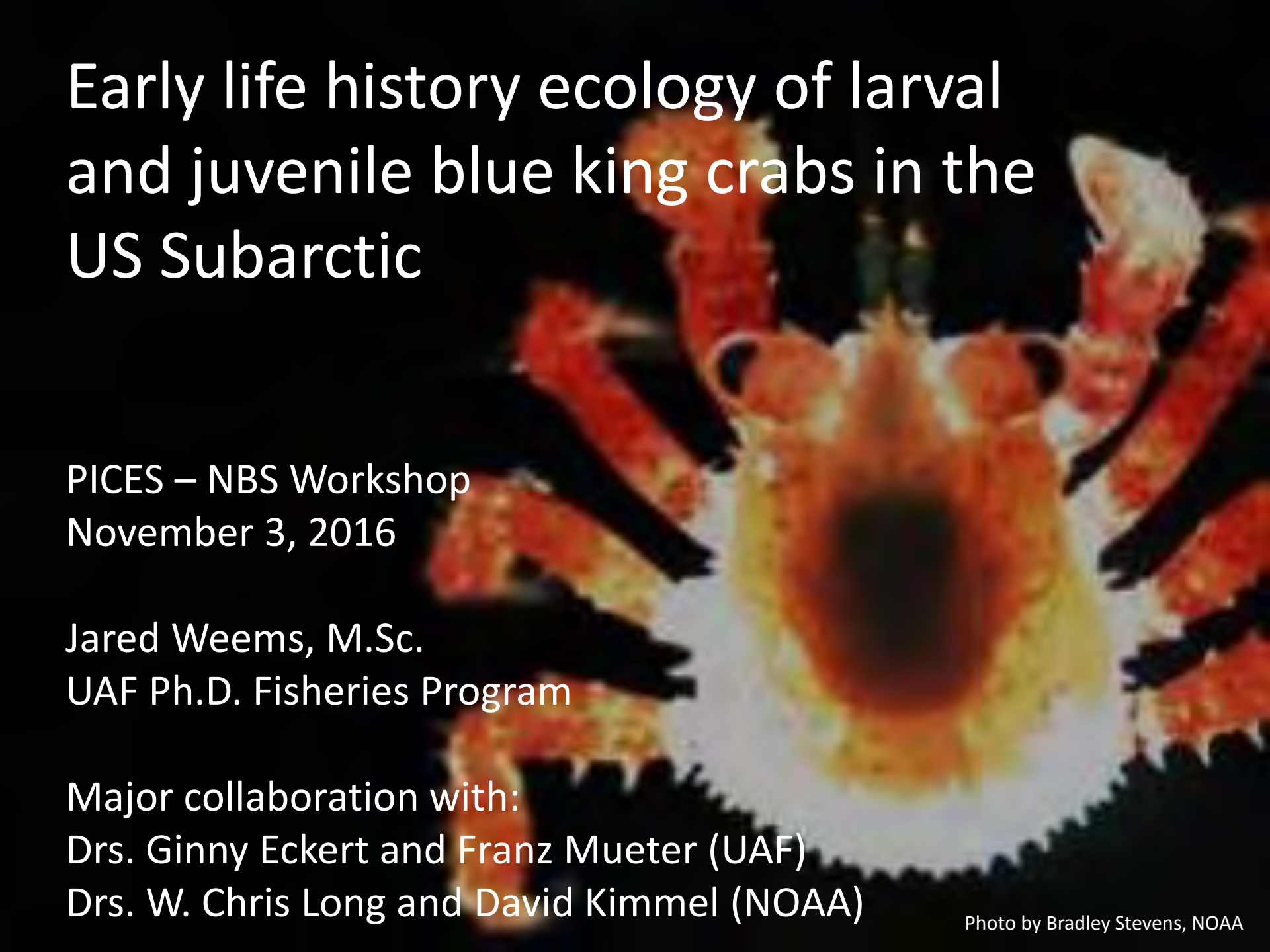
Early life history ecology of larval and juvenile blue king crabs in the US Subarctic



PICES – NBS Workshop
November 3, 2016

Jared Weems, M.Sc.
UAF Ph.D. Fisheries Program

Major collaboration with:
Drs. Ginny Eckert and Franz Mueter (UAF)
Drs. W. Chris Long and David Kimmel (NOAA)

Photo by Bradley Stevens, NOAA

Which is most vulnerable?

Larvae (<1mm)

Adult (>120mm)

Juvenile (~2-10mm)

Photo by Bradley Stevens, NOAA

Why are baby crab important?

Why are Arctic crab of concern?

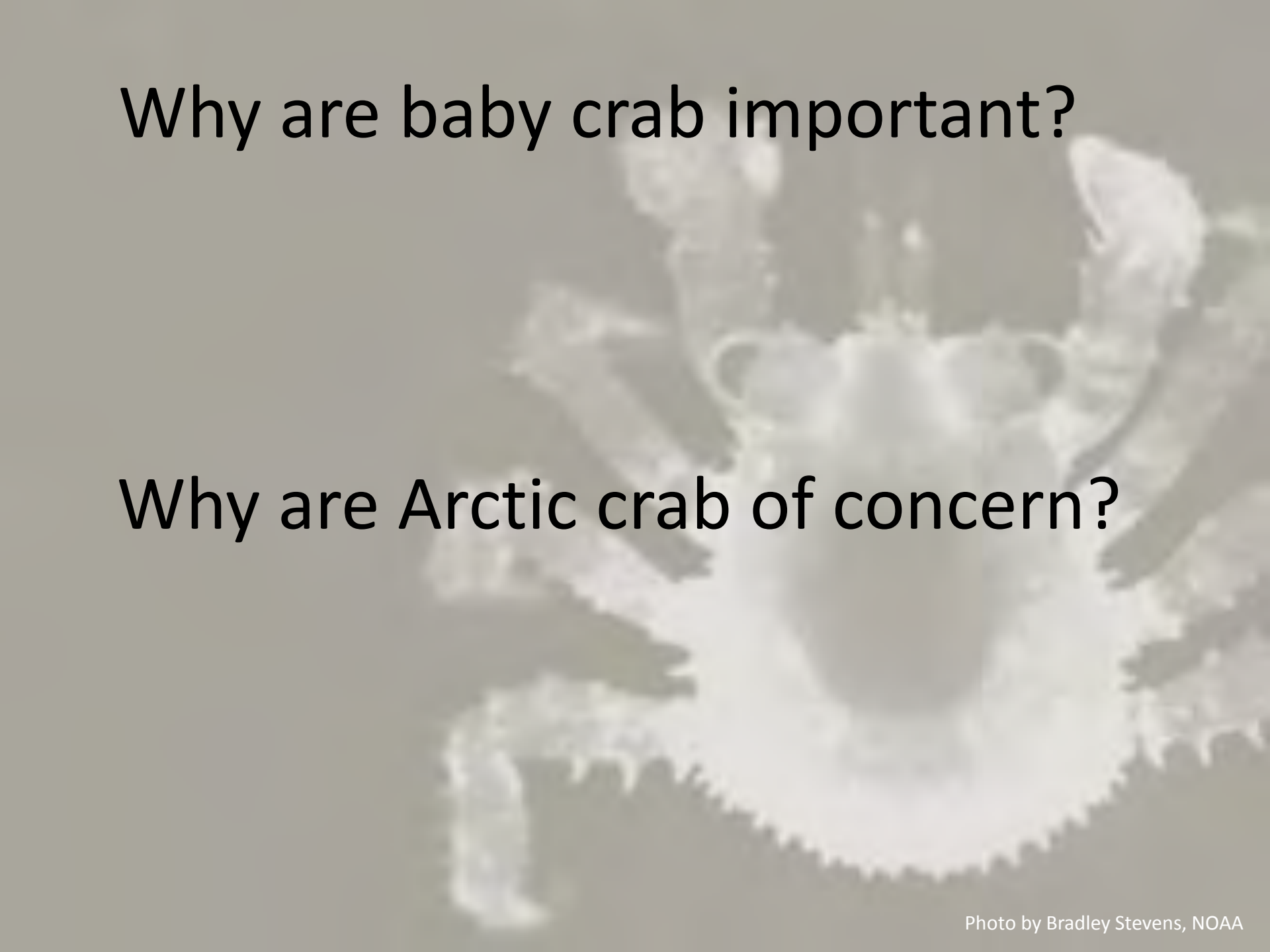


Photo by Bradley Stevens, NOAA

Why are baby crab important?

- Alaskan king crab fisheries = BIG $$$
- Most vulnerable life stages
- Pelagic and benthic environments

Why are Arctic crab of concern?

Photo by Bradley Stevens, NOAA

Why are baby crab important?

- Alaskan king crab fisheries = BIG $$$
- Most vulnerable life stages
- Pelagic and benthic environments

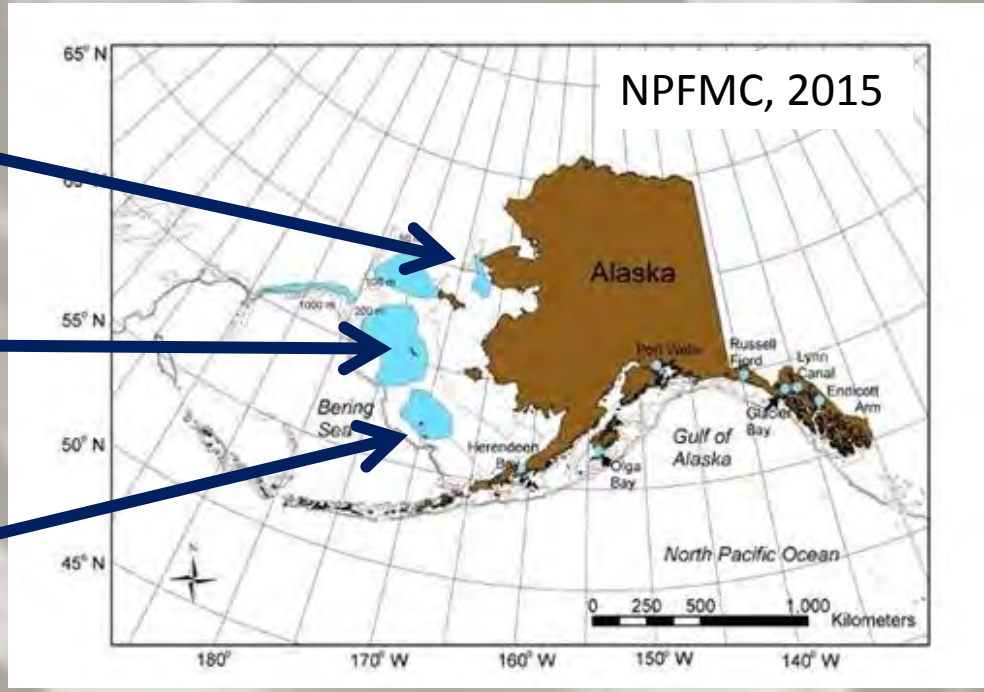
Why are Arctic crab of concern?

- Arctic Fisheries Management Plan (FMP)
  - Fish AND CRAB
- Relatively unknown, pristine resource potential
- Climate change and shifting populations?

Photo by Bradley Stevens, NOAA

Why study blue king crab?

- *Paralithodes platypus*
  - St. Lawrence / King / Little Diomede Islands
    - Subsistence harvests.
  - St. Matthews Island Stock
    - Max harvest of 9 million pounds in 1984.
  - Pribilof Islands Stock
    - Max harvest of 11 million pounds in 1981.



- Pribilof Islands stock was last harvested in 1999, declared overfished in 2002, and has not recovered to harvestable levels.
- St. Matt's stock declared overfished in 1999, and has (semi) recovered since 2008 at annual harvests of ~0.5-1.5 million pounds

Photo by Bradley Stevens, NOAA

Study Objective #1

- Are Pribilof Island blue king crab juveniles a bottleneck in stock recruitment processes?

Study Objective #2

- Will blue king crab populations contract with climate change?

Photo by Bradley Stevens, NOAA

Study Objective #1

- Are Pribilof Island blue king crab juveniles a bottleneck in stock recruitment processes?
  1. Supply - Are there enough?
  2. Essential habitat - Has it changed over time?
  3. Predation pressure - New predators, RKC?

Study Objective #2

- Will blue king crab populations contract with climate change?

Photo by Bradley Stevens, NOAA

Study Objective #1

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Study Objective #2

- Will blue king crab populations contract with climate change?
  1. Supply and advection – Biogeographic range?
  2. Essential habitat - Pelagic water mass associations?
  3. Essential habitat - Proper benthic habitat in north?

Photo by Bradley Stevens, NOAA

Study Objective #1

- Are Pribilof Island blue king crab juveniles a bottleneck in stock recruitment processes?

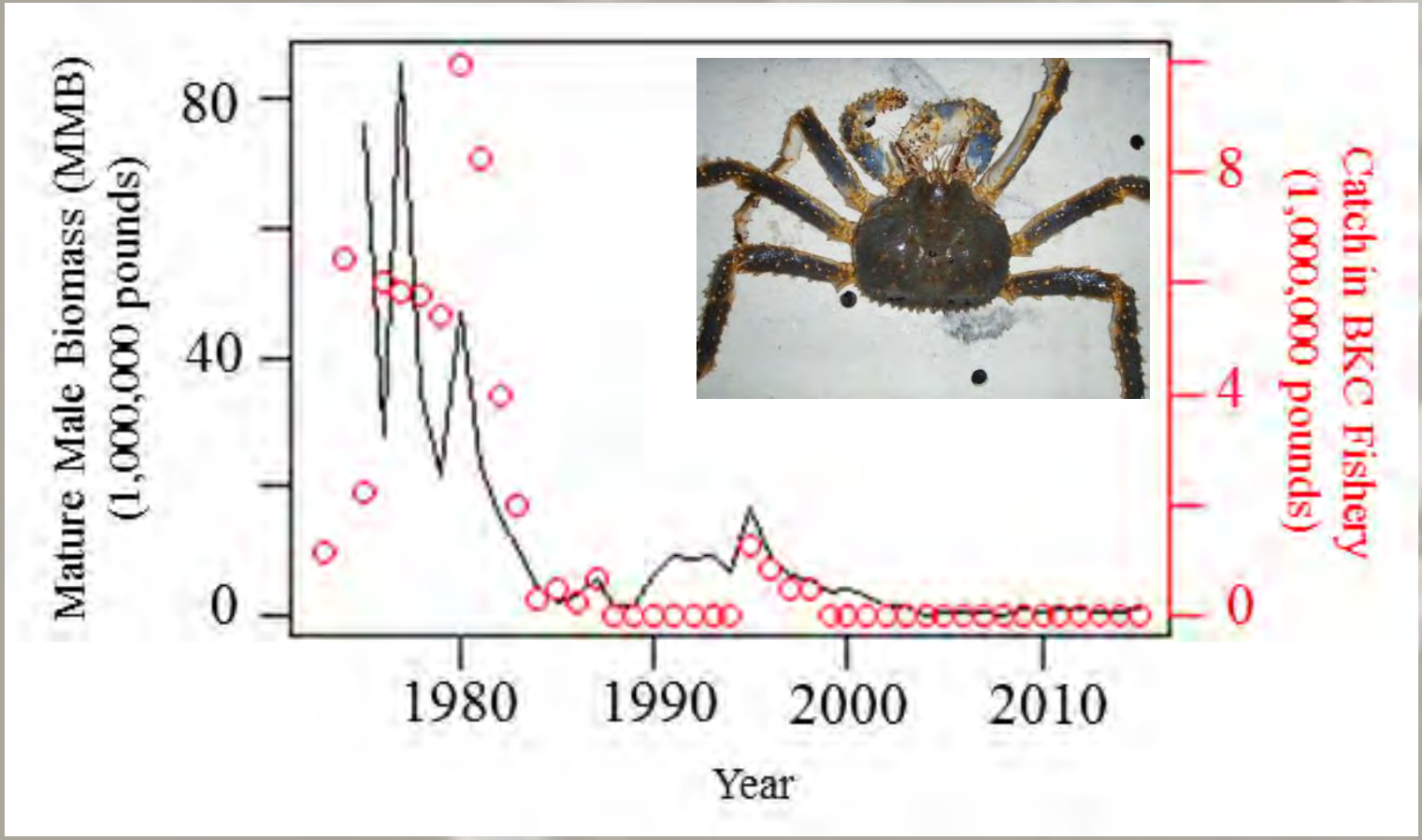


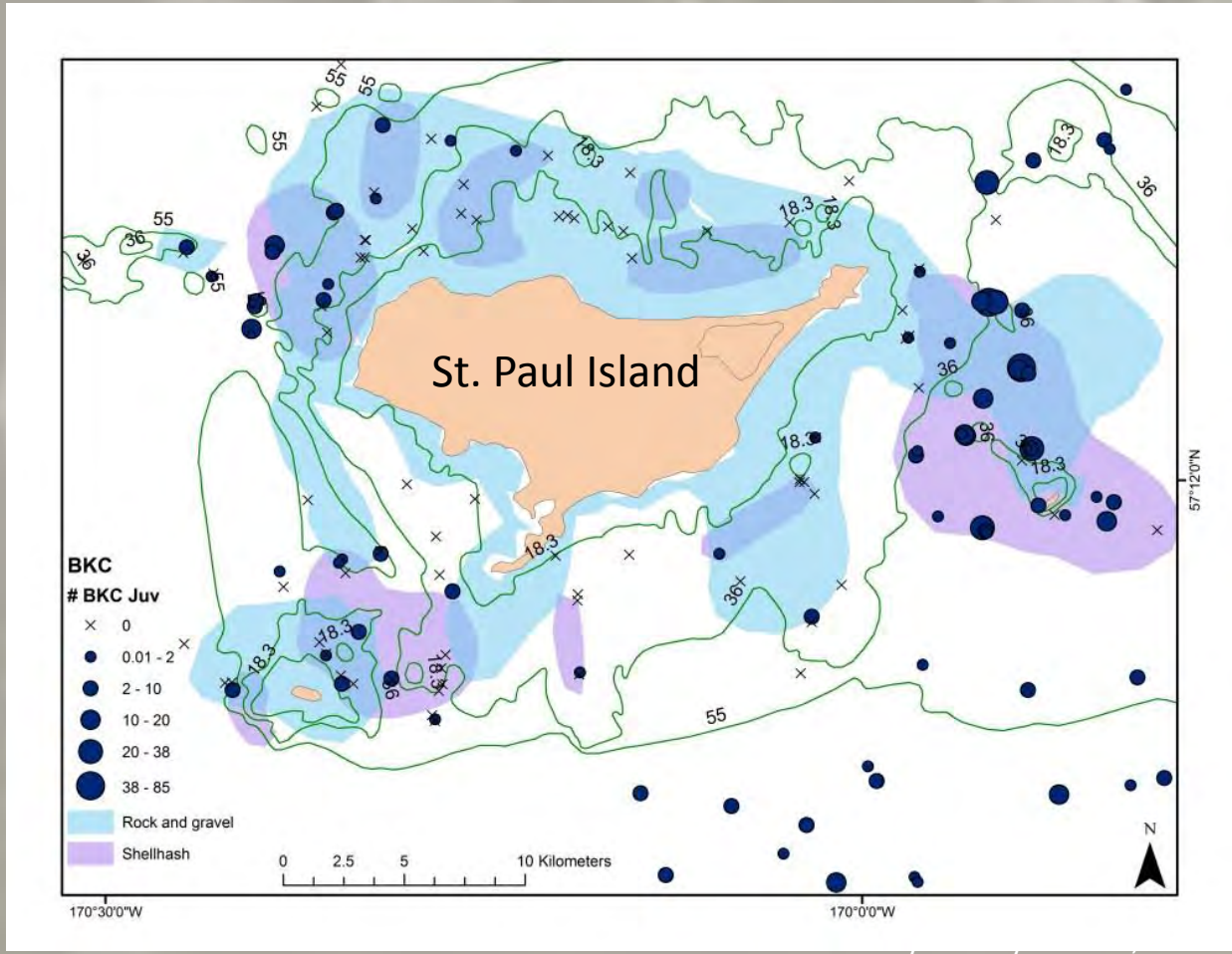
Photo by Bradley Stevens, NOAA

Objective #1

- Historical Perspective
  - Armstrong et al. 1987 – OCSEAP study

- Long et al. recovered data (NPRB 1321)

- Purple Habitat
  - Shellhash (preferred)
- Blue Habitat
  - Rock / Gravel (Ok)



Objective #1 – Sampling Plan

1) Supply
    1) Determine nearshore abundance and distribution of juvenile blue king crab through dive surveys
    2) Assess glaucothoe settlement using collection bags


Photo by Chris Long, NOAA


Photo by Chris Millbern

Photo by Bradley Stevens, NOAA

Objective #1 – Sampling Plan

2) Essential habitat
    1) Drop cameras to confirm habitat
    2) Survey nearshore habitat during dive surveys

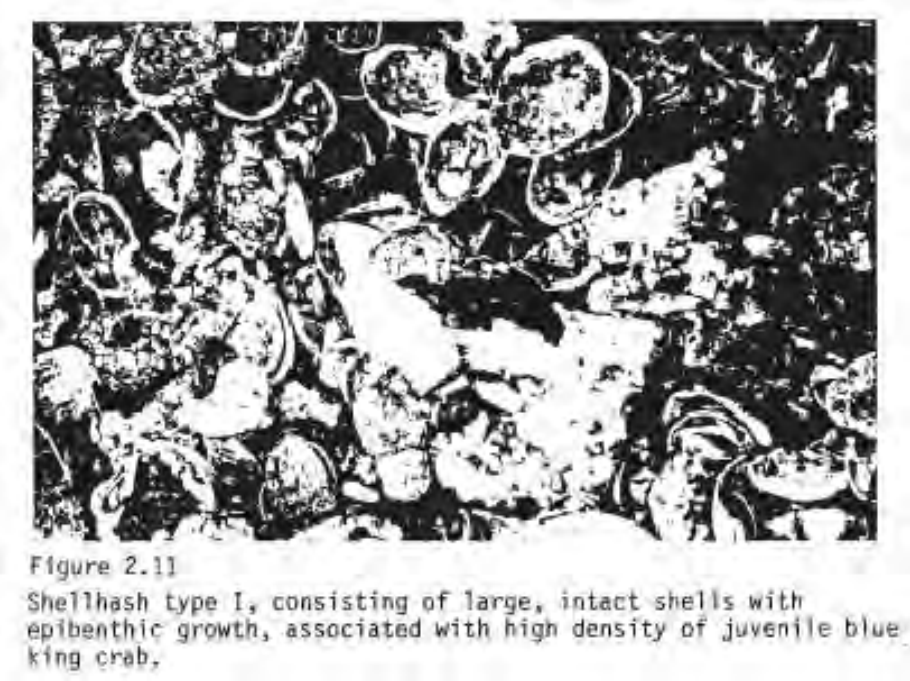


Figure 2.11
Shellhash type I, consisting of large, intact shells with epibenthic growth, associated with high density of juvenile blue king crab.

Image from Armstrong et al. 1987

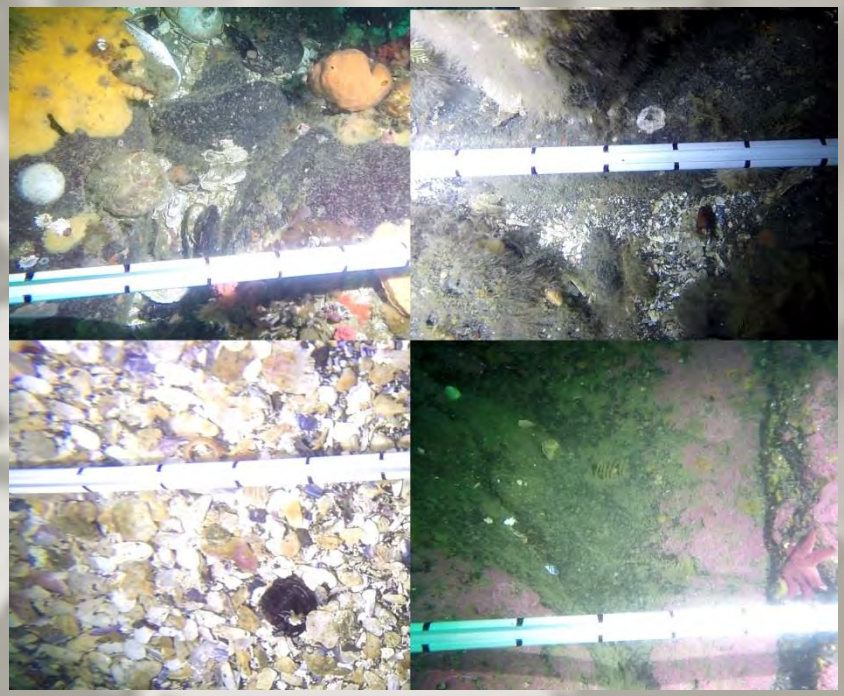


Photo by Jared Weems

Photo by Bradley Stevens, NOAA

Objective #1 – Sampling Plan

3) Predation pressure
    1) Assess the juvenile fish abundance in nearshore during dive surveys
    2) Collect juvenile fish for stomach content analysis
    3) Assess predation pressure through crab tethering experiments


Photo by Chris Long, NOAA


Photo by Jared Weem


Photo by Chris Millbern

OAA

Objective #1 – Preliminary Results

1) Juvenile Crab Abundance and Distribution

- 2016 pilot study
- Goal: Test megalopae collector bags
- Sandy bottom habitat (not ideal)

Photos by Jared Weems

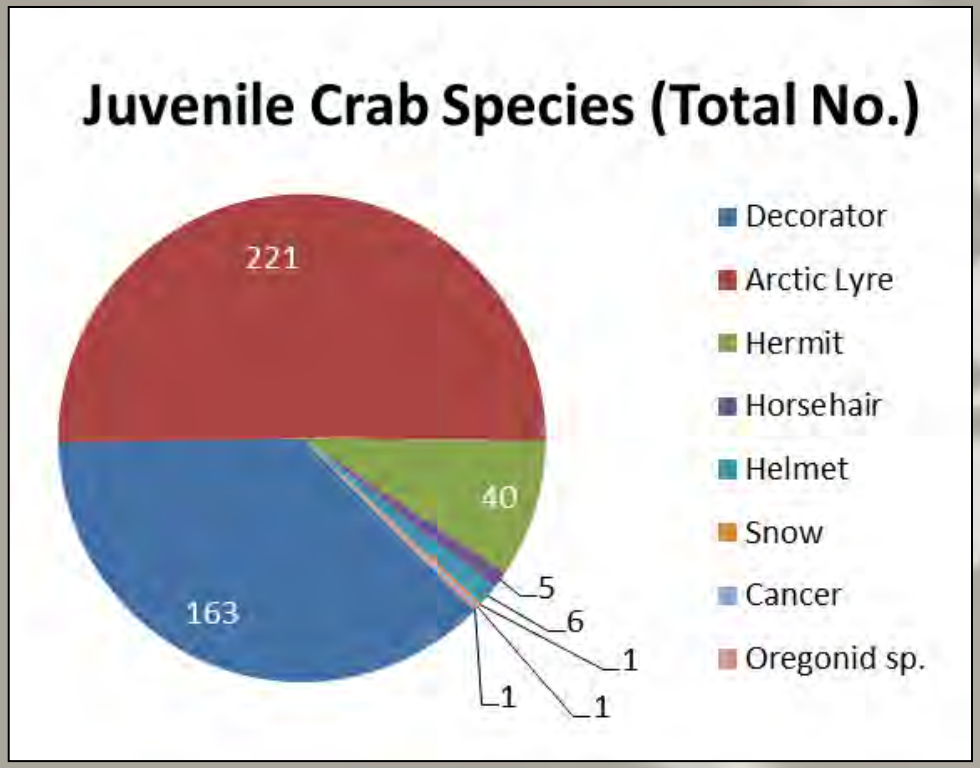


Photo by Chris Millbern

Objective #1 – Preliminary Results

2) Essential Habitat

- Habitat scouting via SCUBA
- Drop camera surveys

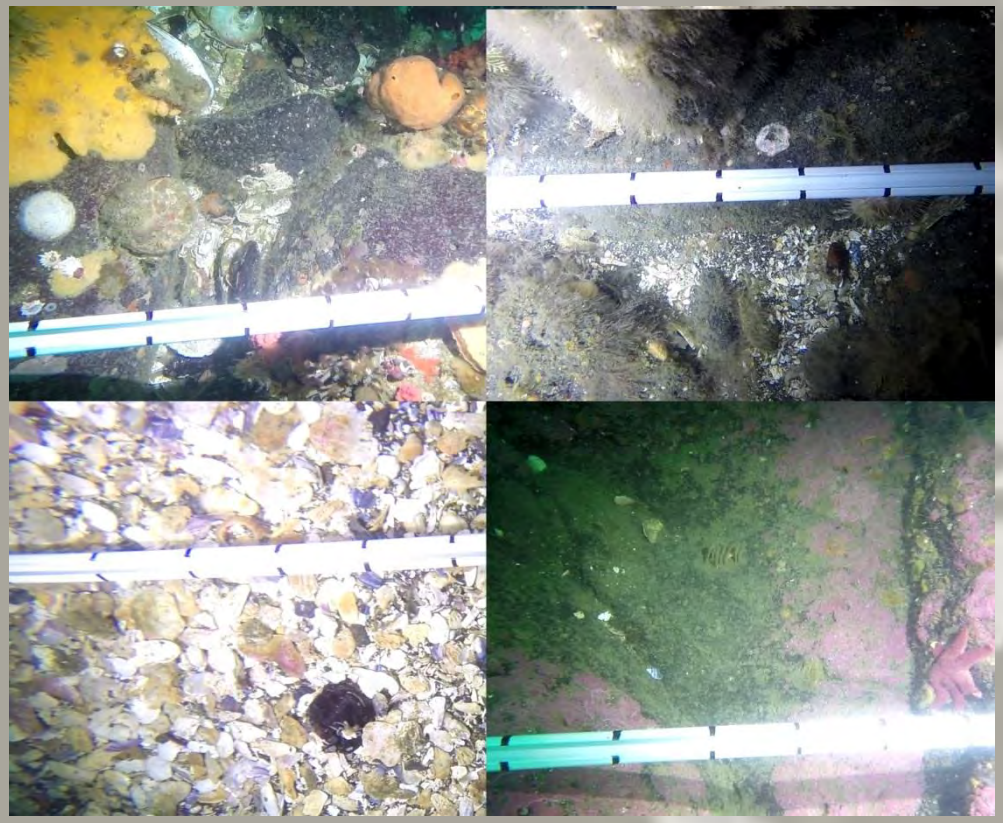
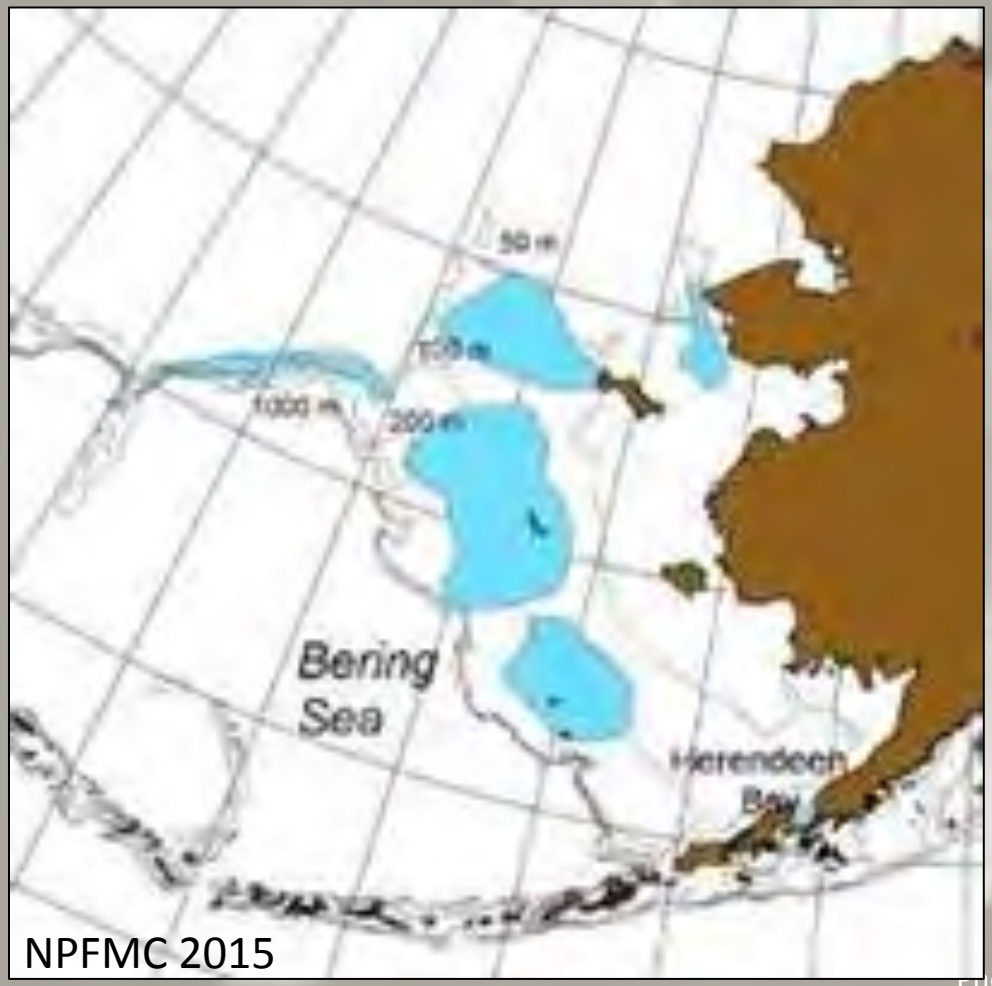


Photo by Jared Weems

Photo by Chris Millbern

Study Objective #2

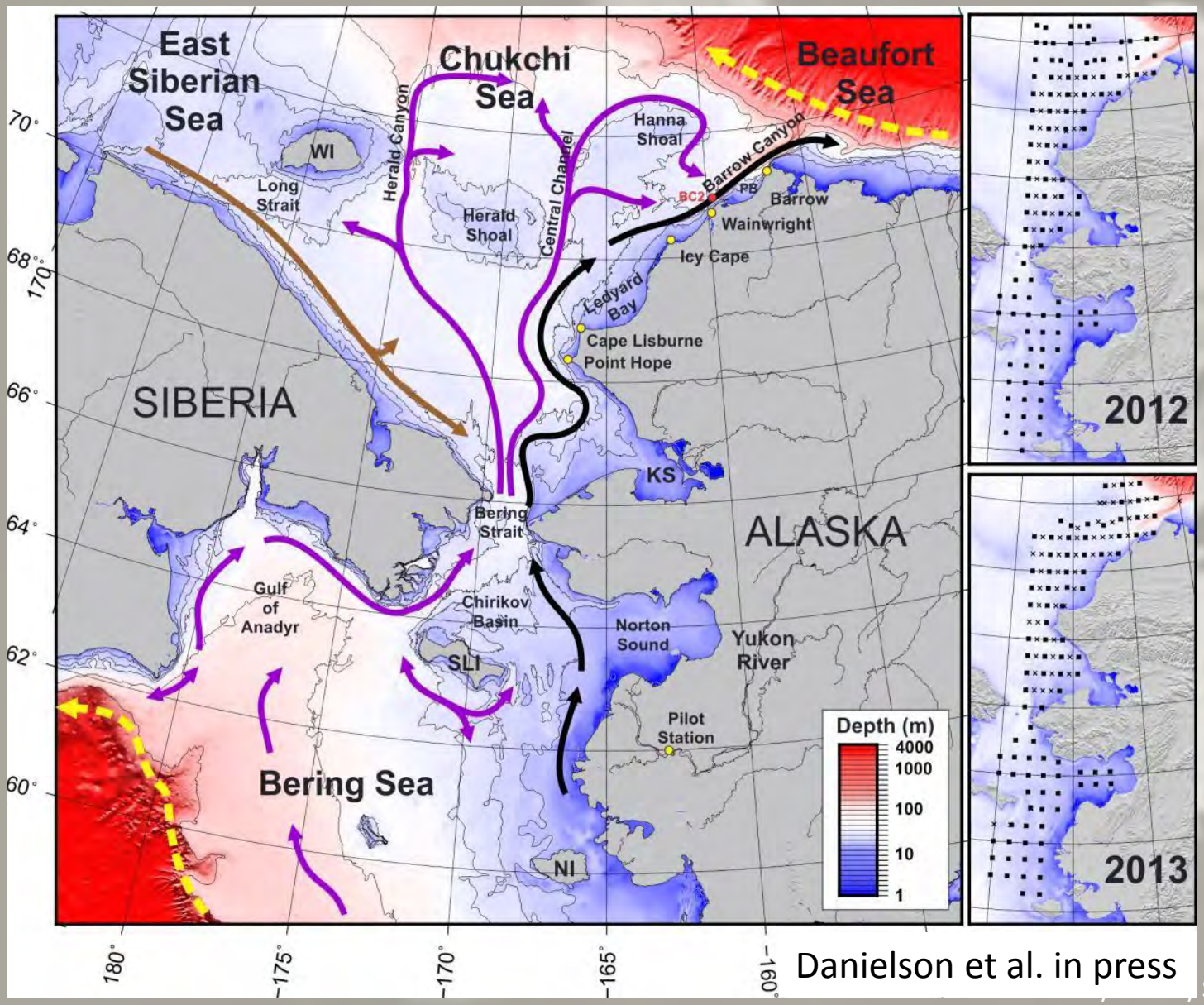
- Will blue king crab populations contract with climate change?



NPFMC 2015

Photo by Bradley Stevens, NOAA

Objective #2



Danielson et al. in press

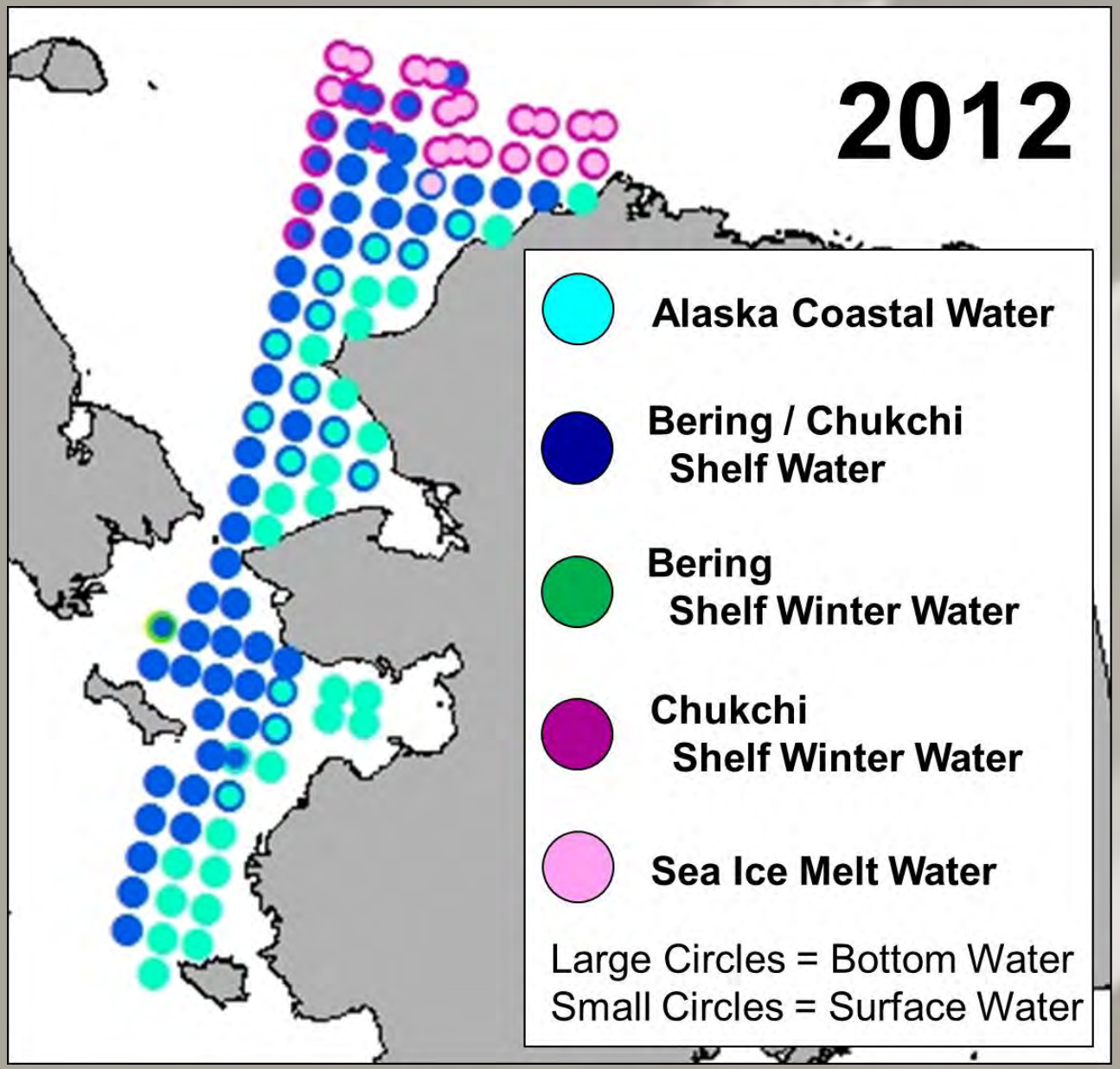
Stevens, NOAA

Objective #2 – Sampling Plan

1) Samples
   - Arctic Eis 2012 and 2013 zooplankton 505µm net
   - Arctic IES Phase II, Arctic IERP 2017 and 2019 zooplankton 505µm net
2) Supply and Advection
   - Late summer (seasonal)
   - CPUE of crab by <u>species and stage</u>
3) Essential Pelagic Habitat
   - Concurrent oceanographic data

NOAA

Objective #2 – Preliminary Results

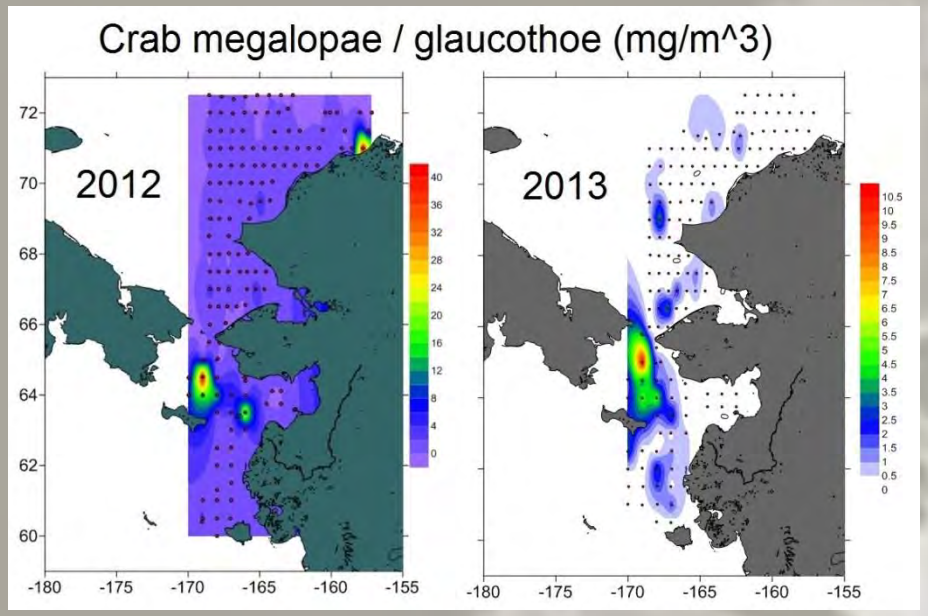


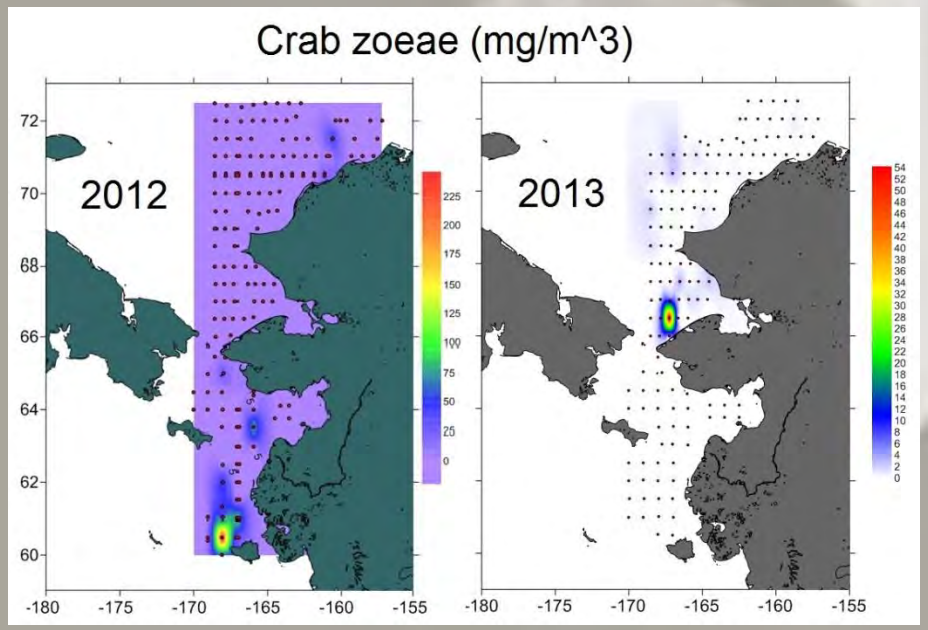
Oceanography and Water Masses

Danielson *et al*. *in press*

Photo by Bradley Stevens, NOAA

Objective #2 – Preliminary Results





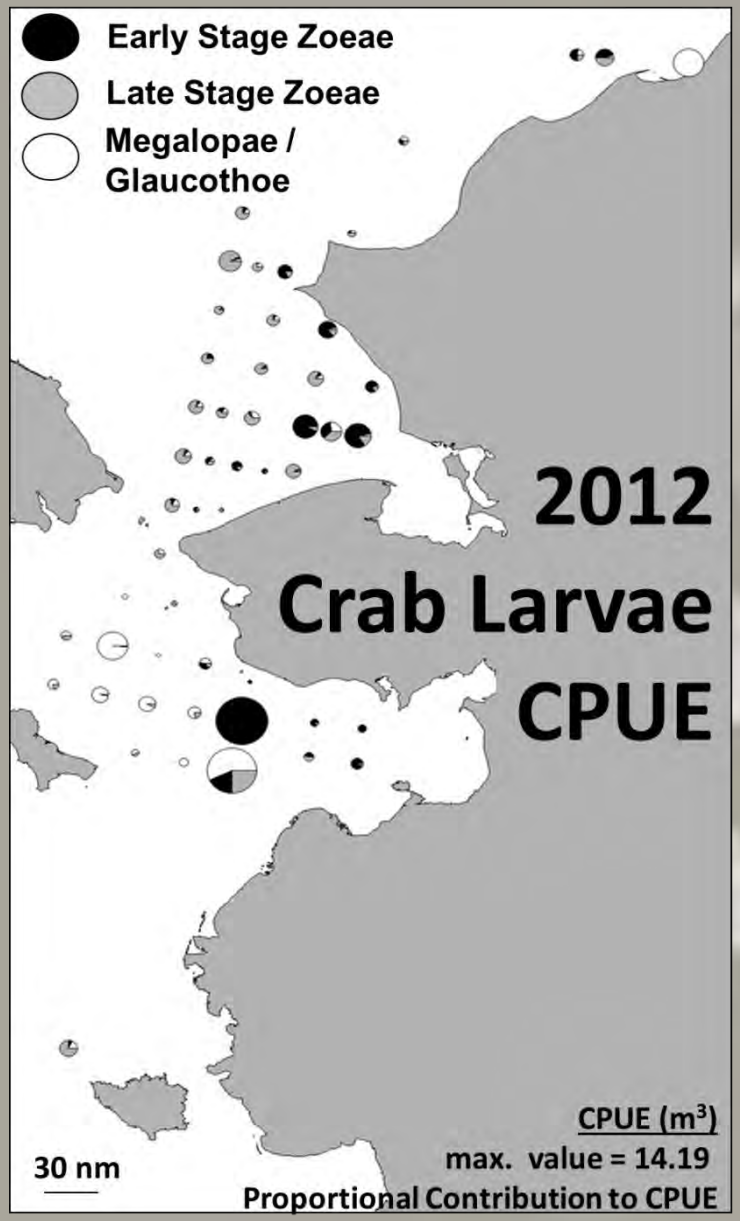
Zooplankton Crab Larvae Distributions and Biomass

Maps courtesy of Alexei Pinchuk.

See Pinchuk and Eisner, *in press* for zooplankton community analysis

Photo by Bradley Stevens, NOAA

Objective #2 – Preliminary Results



Total Crab Larvae
Distribution and CPUE

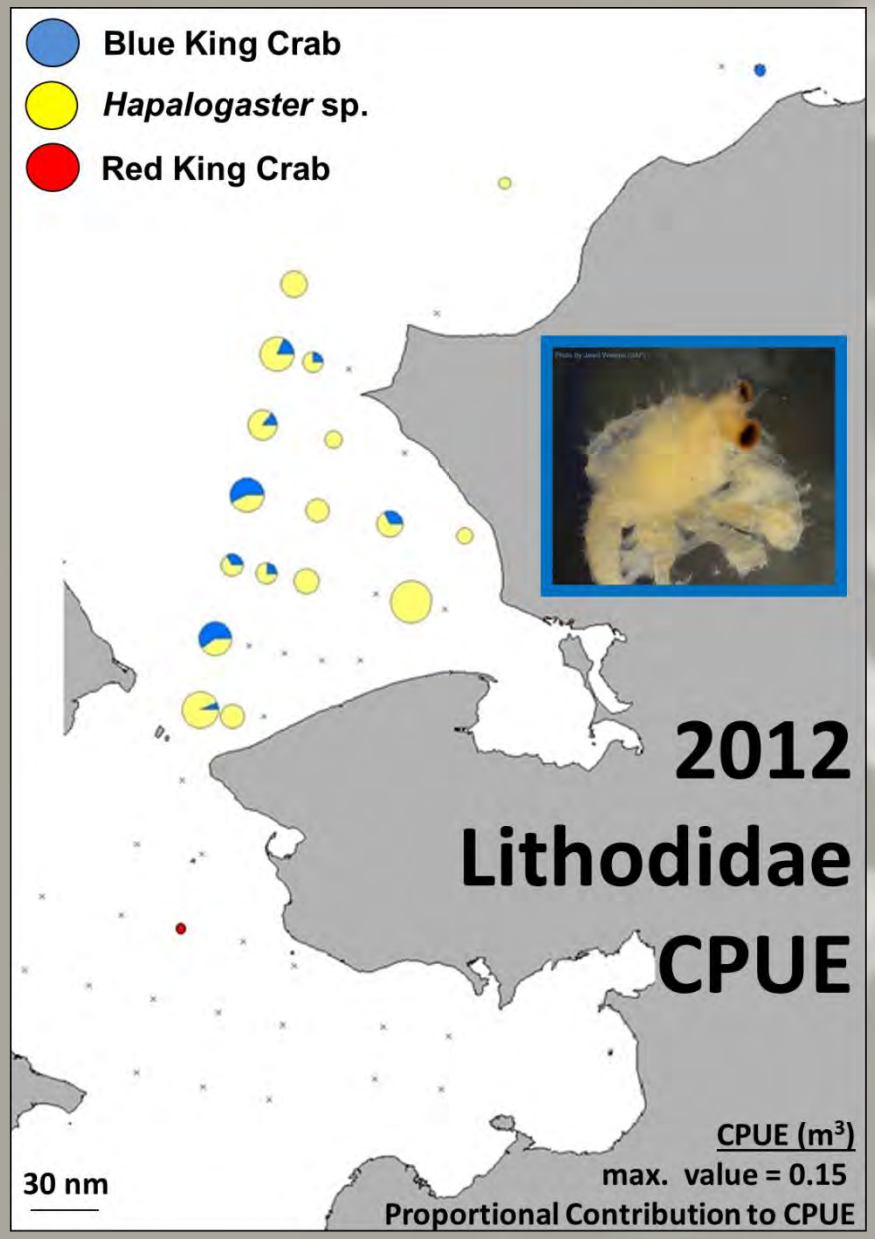
Max CPUE: 14.19 ind. m^3

GLMs suggest:

- Early stages more abundant in surface waters
- Early stages less abundant in bottom waters
- Late stages more abundant in bottom waters

Photo by Bradley Stevens, NOAA

Objective #2 – Preliminary Results



Lithodidae Larvae

Distribution and CPUE

Max CPUE: 0.15 ind. m^3

Low abundance, low biomass

Blue King Crab Count:

Early Stage Zoeae = 2

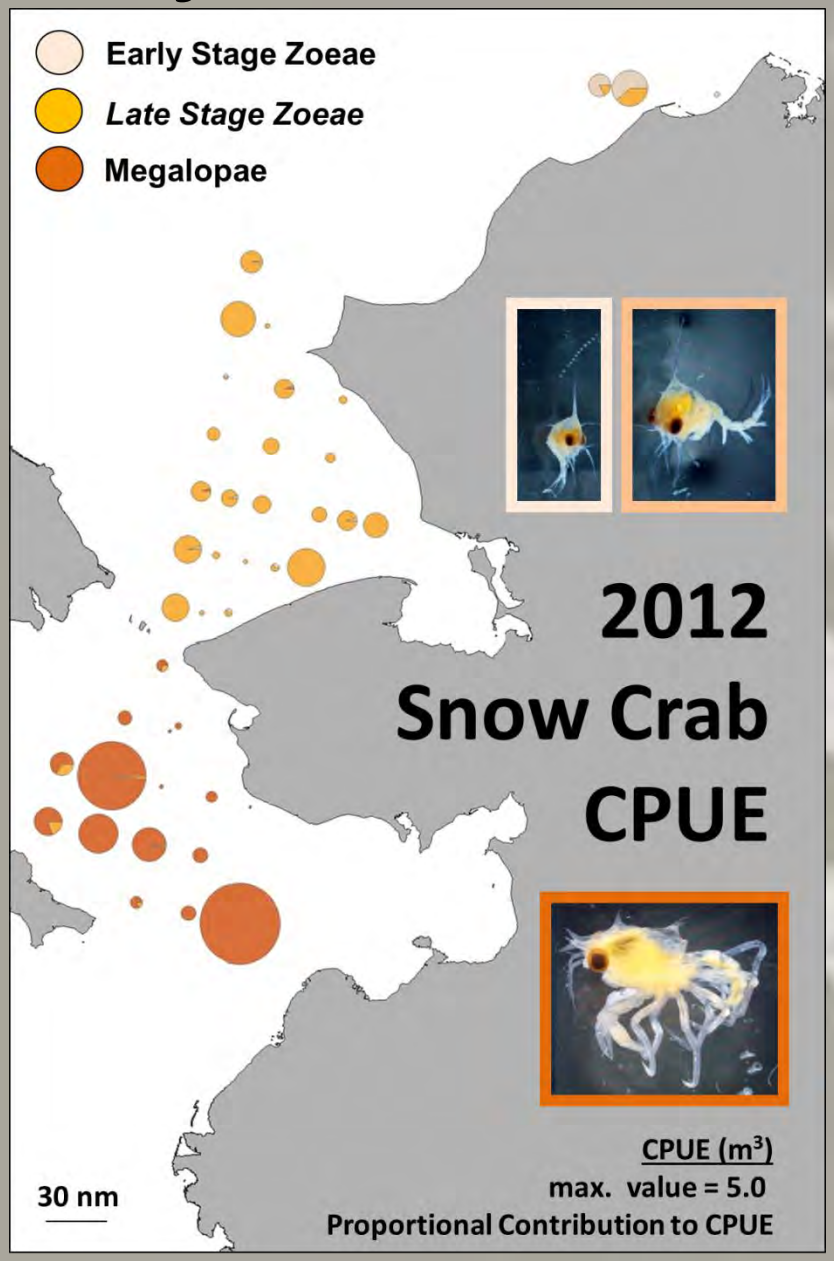
Late Stages Zoeae = 14

Glaucothoe = 4

Date/Time sampling artifact

Photo by Bradley Stevens, NOAA

Objective #2 – Preliminary Results



Snow Crab Larvae
Distribution and CPUE

Max CPUE: 5.0 ind. m^3

Ubiquitous distribution

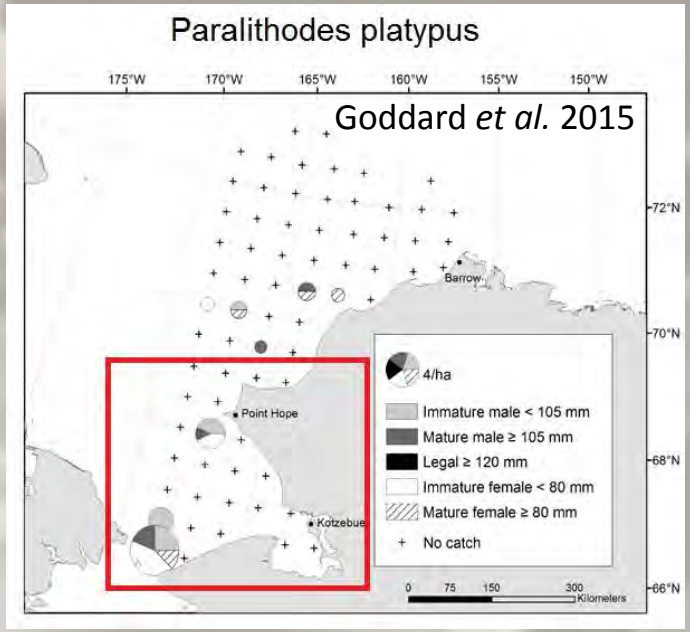
High relative abundance and biomass

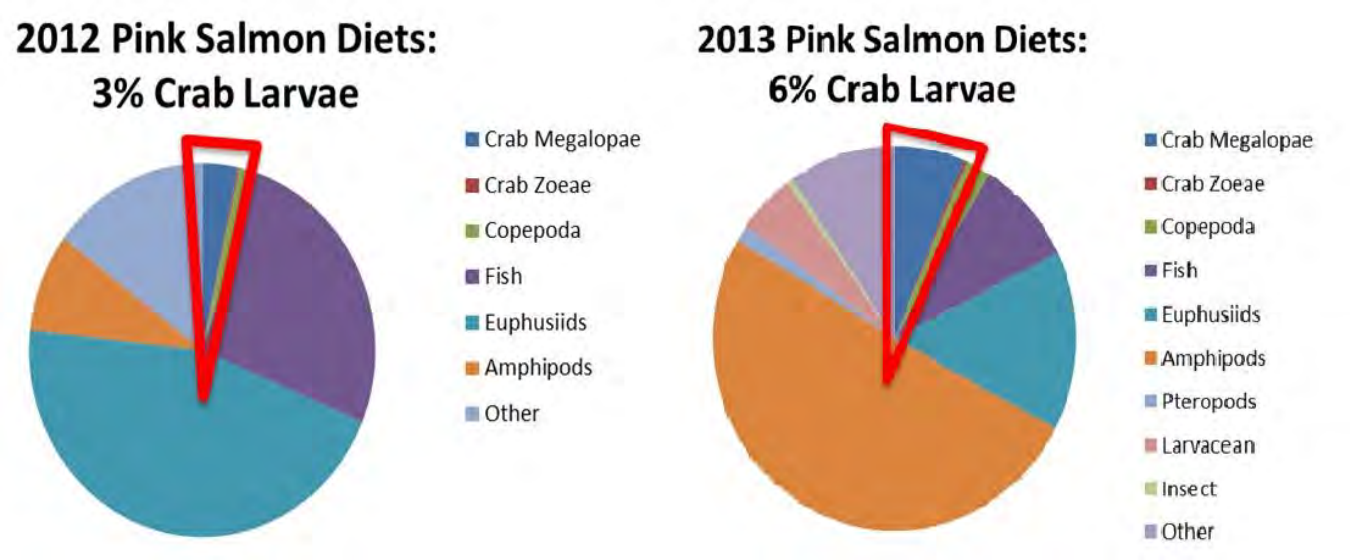
Date/Time sampling artifact

Photo by Bradley Stevens, NOAA

Objective #2 – Future Plans

3) Essential Benthic Habitat
   - Can blue king crab recruit into the Arctic ?
4) Predation Pressure
   - Demersal Fishes
   - Juvenile Salmon





ley Stevens, NOAA

Dissertation Synthesis

- Objective #1 - Are Pribilof Island blue king crab juveniles a bottleneck in stock recruitment processes?
  - **What's wrong with this southern population?**
  - **Will it ever recover and be fishable?**
- Objective #2 – Are blue king crab populations contracting or just overfished? with climate change?
  - **Are Bering Sea populations at risk?**
  - **Can blue king crab retreat to the Arctic?**
  - **Is there suitable habitat in the Chukchi or Beaufort Seas?**

Photo by Bradley Stevens, NOAA

Questions?

Bering Sea Days – 2016

St. Paul Island Schools

References and Figures Cited

- Armstrong, D. A., J. L. Armstrong, R. Palacios, and G. Williams. 1987. “Distribution, abundance, and biology of blue king and Korean hair crabs around the Pribilof Islands: Final Report.” Outer Continental Shelf Environmental Assessment Program (OCSEAP). Research Unit 638. Minerals Management Service. Department of Interior.
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