



# The Offshore Marine Fishes Project

**Presented by: Andrew Majewski** on behalf of **Jim Reist (lead PI)** and project collaborators from DFO and the universities of Laval, Québec in Rimouski, Waterloo and Manitoba

**BREA Final Results Forum**

**Inuvik, 25 February 2015**

Photo credit: Laure deMontety, UQAR

# The Team

- Funding: BREA, ESRF, IGC, DFO (multiple internal sources) & ArcticNet.
- MFP PIs (DFO): J. Reist, A. Majewski, W. Walkusz, C. Michel & B. Williams.
- University Linkages: Waterloo (M. Power, H. Swanson); Quebec at Rimouski (P. Archambault); Laval (L. Fortier); Manitoba – Biological Sciences (J. Treberg, M. Docker); Manitoba – Centre for Earth Observation (G. Stern); (NSERC leverage).
- Coastal Linkages: DFO (L. Loseto); UofM (G. Anderson, N. Halden, G. Davoren),

2012



2013

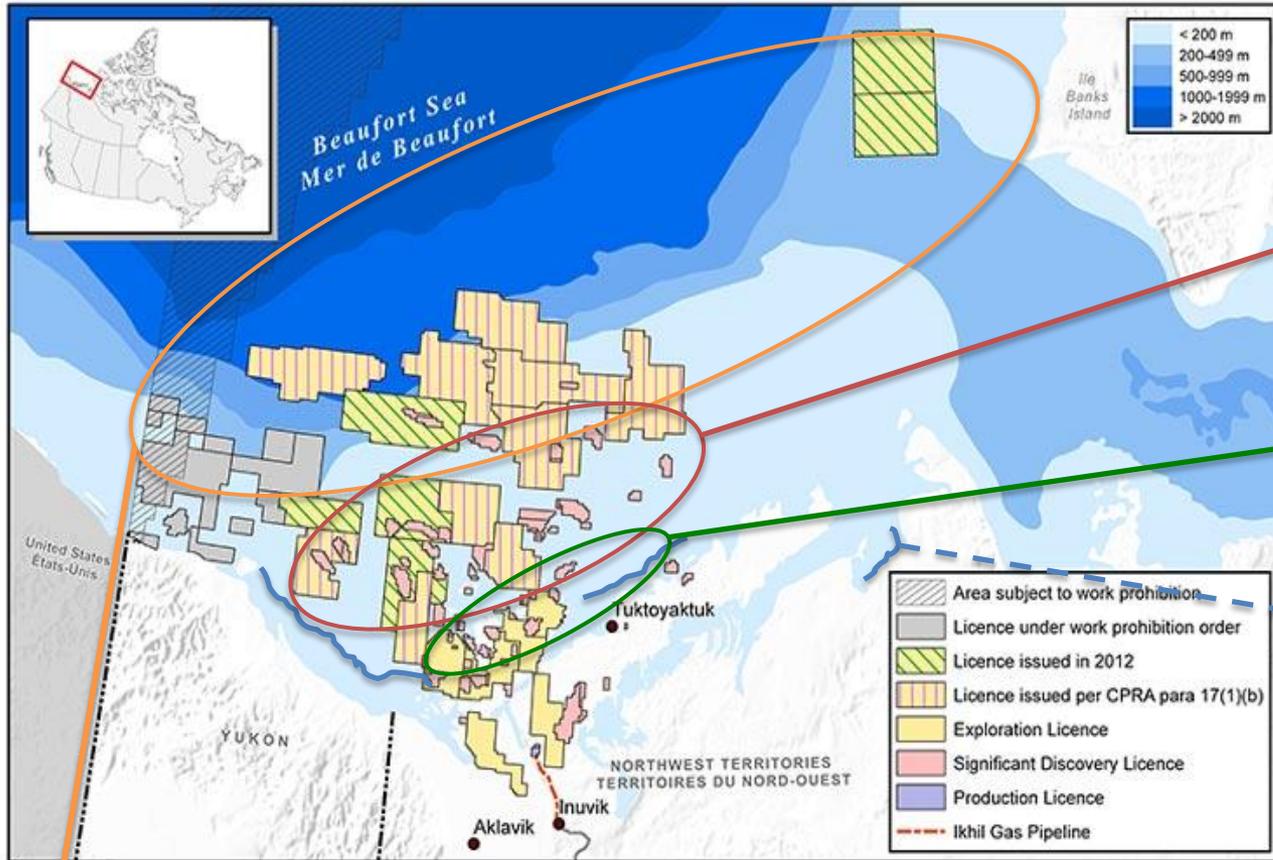
**Government of Canada, co-management partners, many university partners, field crews, ships crew and owners of the *F/V Frosti***



2014



# Canadian Beaufort Sea Bathymetry, Leases & Previous Fish Studies



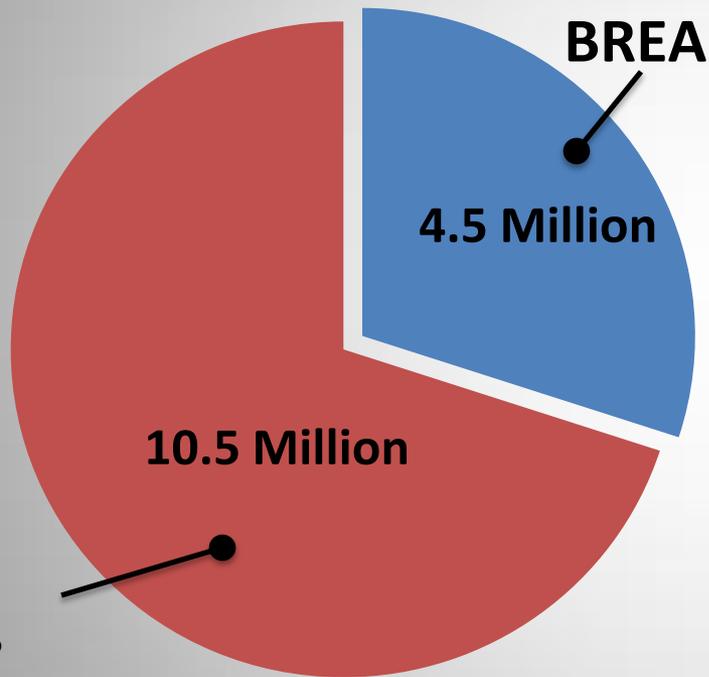
## Fish Research in Area

- 2003-2009 – **Northern Coastal Marine Studies** (5-150m on shelf)
- 1984-1987 – **Northern Oil & Gas Action Program** Marine Studies (10-100m on shelf)
- 1970-present – **nearshore & coastal (0-5m) assessments** of anadromous & marine fish communities

**Priority Research Gap:** persistent summer sea ice & absence of suitable vessel precluded work on **offshore deepwater fishes**, their biodiversity & ecological relationships especially in deep waters – **BREA Marine Fishes Project** (2011-2015) designed to fill gap.

# Tier 1 Gap Identified for BREA: **Presence & Relevance of Fishes in Deepwater Areas?**

- Project approved (Sept 2011) by BREA - 4500k over 5 years (to March 2015)



Total = 15 Million

## Project Linkages

- Multi-disciplinary ecosystem study with **two major themes**:
  - **Offshore Fishes**: diversity, habitat associations & ecosystem roles
  - **Coastal Fishes**: linkages among sub-ecosystems
- Linked directly with the following BREA projects:
  - Baselines and potential effects of mercury and hydrocarbons in Beaufort sediments and biota (Stern, U. Manitoba)
  - Active acoustic mapping of fish (Fortier, U. of Laval)
  - Regional coastal monitoring program (Loseto, DFO)
- Linked with other ArcticNet projects and US (BOEM) work in Beaufort

Completely new research - first-ever systematic sampling to 1500m depth

# Relevance

## Why study marine fish diversity and their habitats?

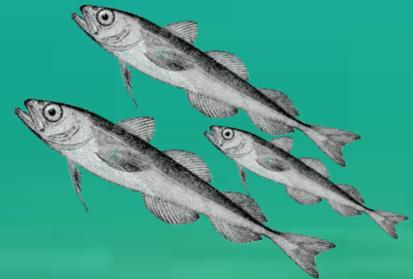
- 1) Allows prediction of what fishes live in an area or habitat
- 2) Provides baselines from which to gauge changes, supporting:

- **Project and mitigation planning**
- **Environmental assessment and regulatory review**
- **Conservation initiatives and monitoring**
  - Ecologically and Biologically Significant Areas (EBSA)
  - Marine Protected Areas (MPA)
- **Ecosystem studies**
  - How do species interact with each other and their habitats?
  - Food-web and energy pathways i.e., who eats who, and where?

# Relevance

## Are offshore marine fishes important?

- 60 of 68 marine fishes known to occur in the Canadian Beaufort Sea live on the bottom
- Ecological roles of most offshore marine fishes are poorly understood
- Is **Arctic Cod** (*Boreogadus saida*) the only marine fish of ecological relevance?



**Knowledge of the types of fishes, and how they interact with each other and their habitats, will provide context for understanding ecosystem roles**

# Project Goals

Establish baselines for diversity, relative abundances and distributions of offshore marine fishes of the Canadian Beaufort Sea

- What types of fishes are there?
- How many are there?
- Where do they live?

Determine the community structure and habitat associations of marine fishes

- Which fishes live together?
- Which habitat(s) do they live in?

Understand the ecosystem linkages of marine fishes and energy pathways within and amongst habitats

- Who eats who?
- Do the fishes move amongst the different habitats?

# BREA Marine Fishes Sampling 2012 - 2014

2012: ~4 weeks in southern Canadian Beaufort Sea (+5 weeks transit to/from area) – 1000m

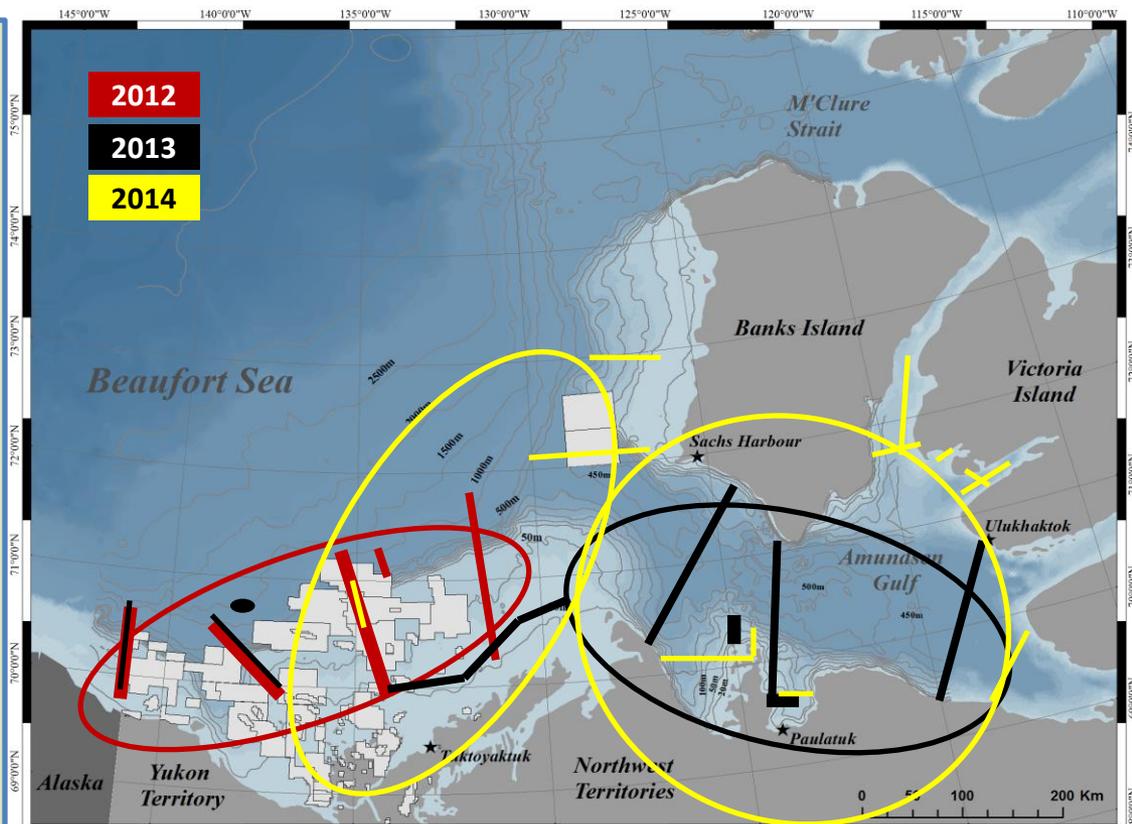
- Shelf & slope lease areas
- Transboundary collaboration

2013: ~6 weeks in eastern Beaufort Sea, Amundsen Gulf & Darnley Bay – 1500m

- Darnley Bay Area of Interest
- Interannual variability
- Deepwater focus
- Transboundary collaboration

2014: ~6 weeks in central Beaufort shelf and slope, Banks Is. and Amundsen Gulf – 2000 m

- Interannual variability
- Southwest Banks Island lease area
- Darnley Bay Area of Interest
- Bays and straits in Amundsen Gulf



F/V *Frosti* (1979)



- Home Port: Steveston, B.C.
- Length: 40 m, Beam: 8 m, Draft: 5 m
- Horsepower: 1200, Gross Tonnage: 454
- Retrofitted: side crane, wet/dry labs, hydroacoustics system, deep-water equipment (2014)
- Accommodation: 8 science crew, 6 ship crew

# Habitat and Foodweb Components

Sampling aboard the F/V Frosti

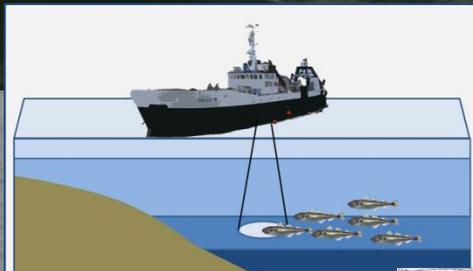


Fish and Epifauna

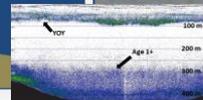


Zooplankton

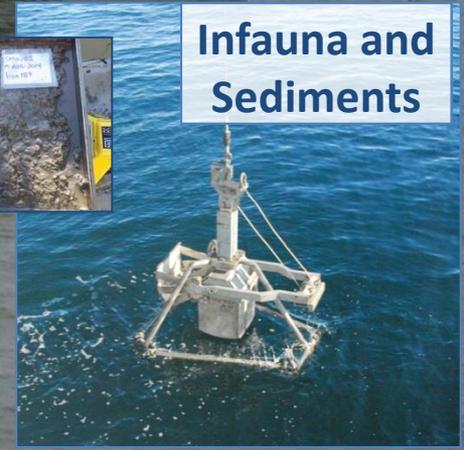
Oceanography and Marine Productivity



Hydroacoustics



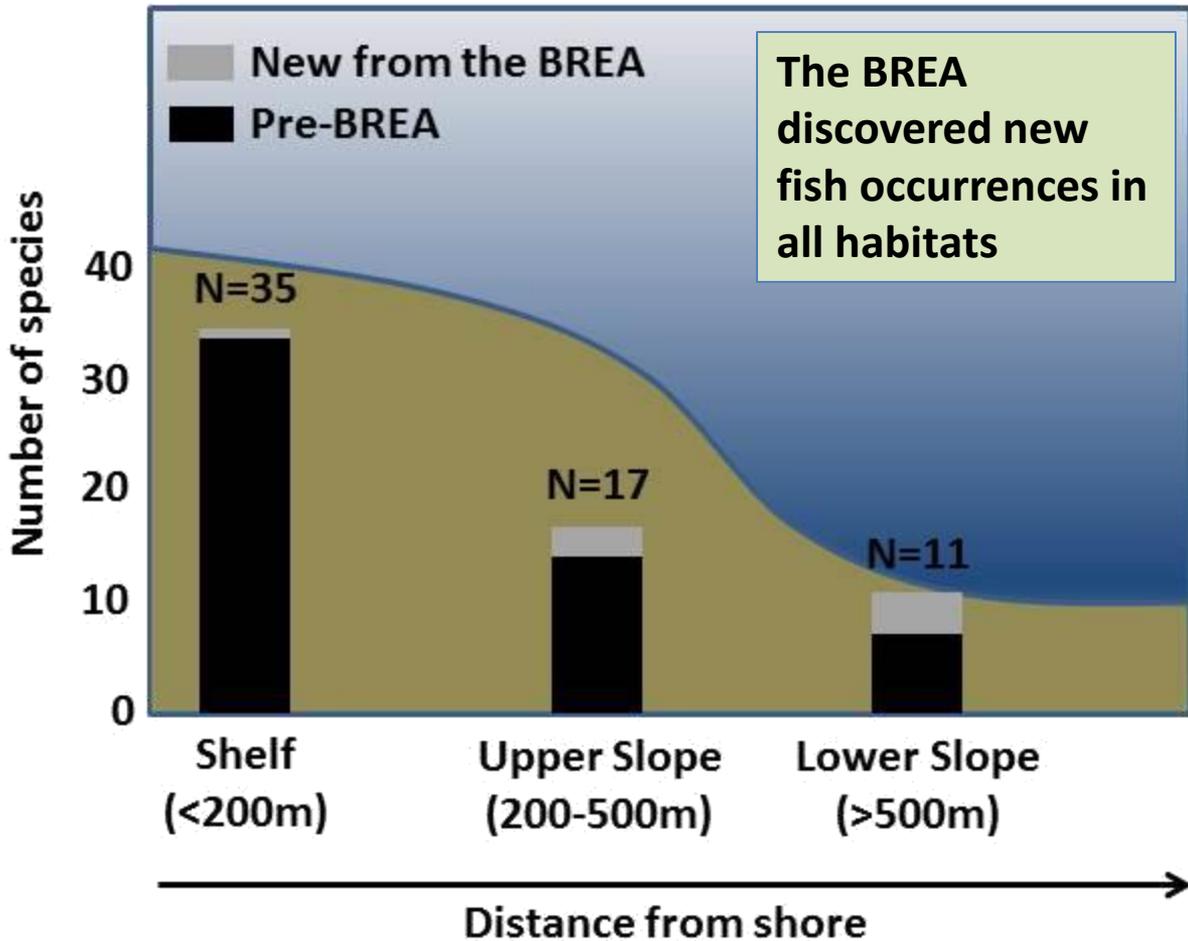
Infauna and Sediments



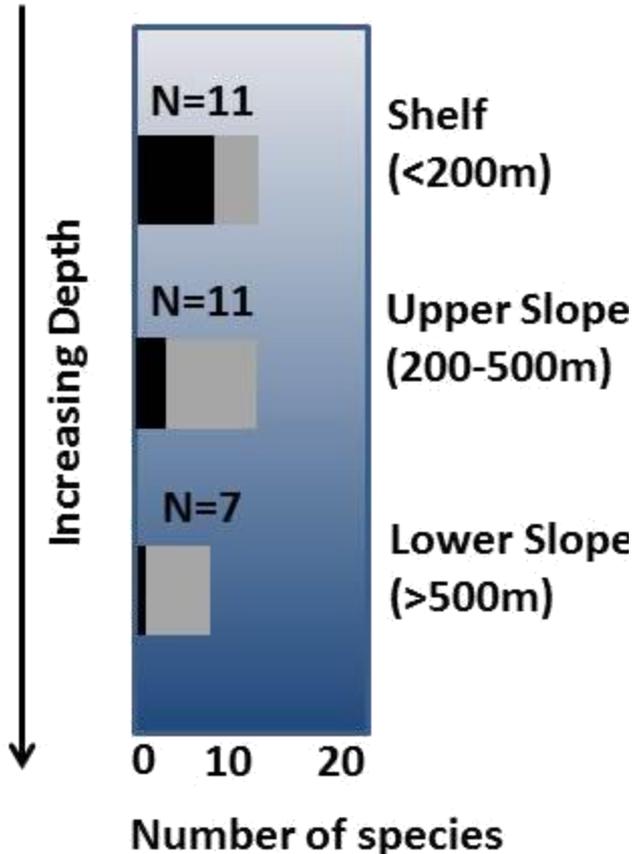
# Baselines – Marine Fish Diversity

## Marine fishes known to the Beaufort Sea before and after BREA

### Bottom Fishes



### Water-column Fishes



# Baselines: New Marine Fish Occurrences, 2012 & 2013

Docked Snailfish (*Lethotremus muticus*)



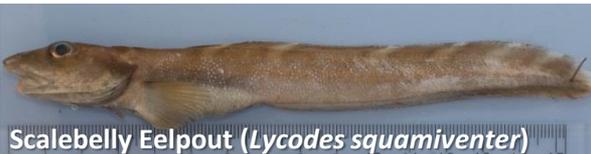
Polar Sculpin (*Cottunculus microps*)



Doubleline Eelpout (*Lycodes eudipleurostictus*)



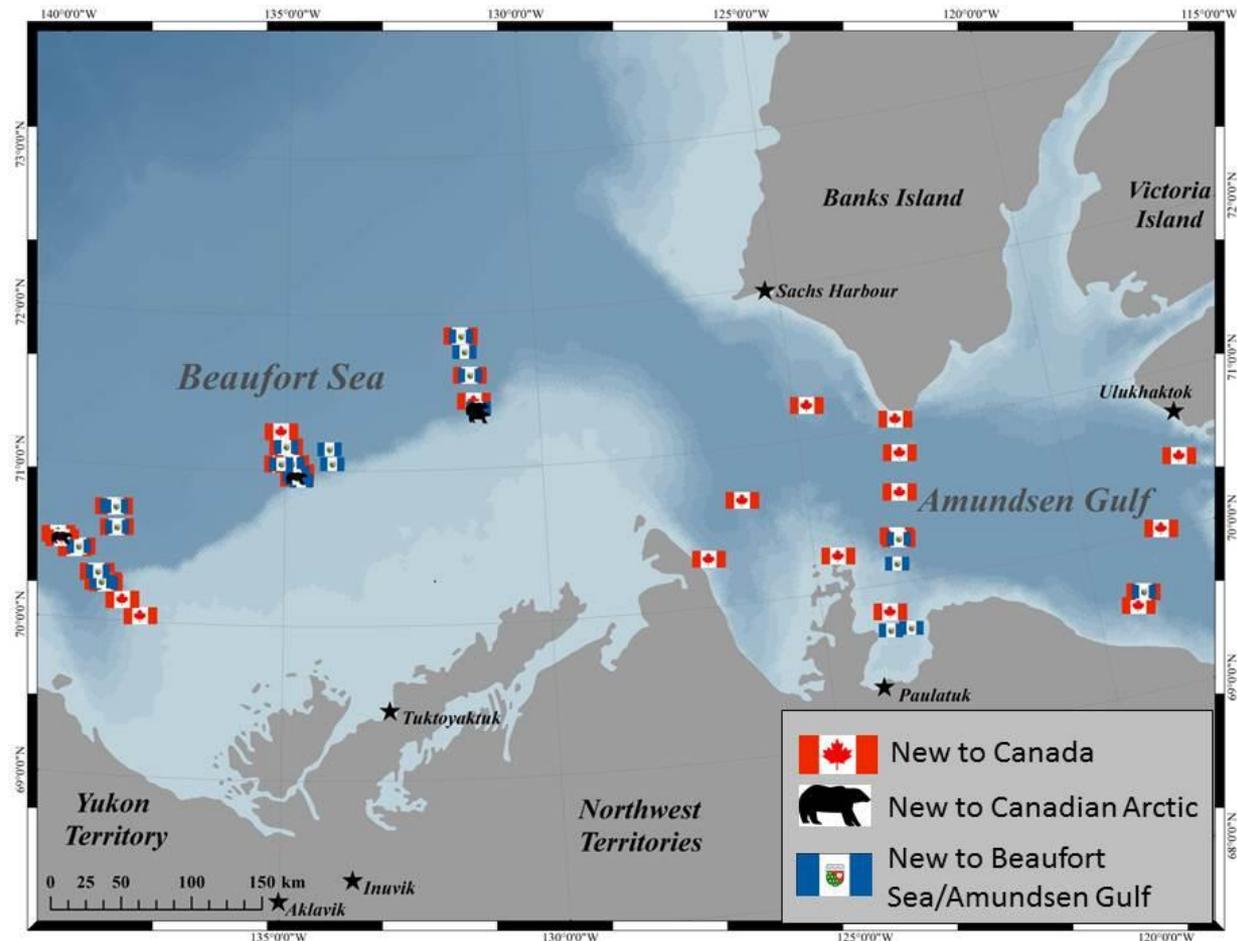
Scalebelly Eelpout (*Lycodes squamiventer*)



Archer Eelpout (*Lycodes sagittarius*)



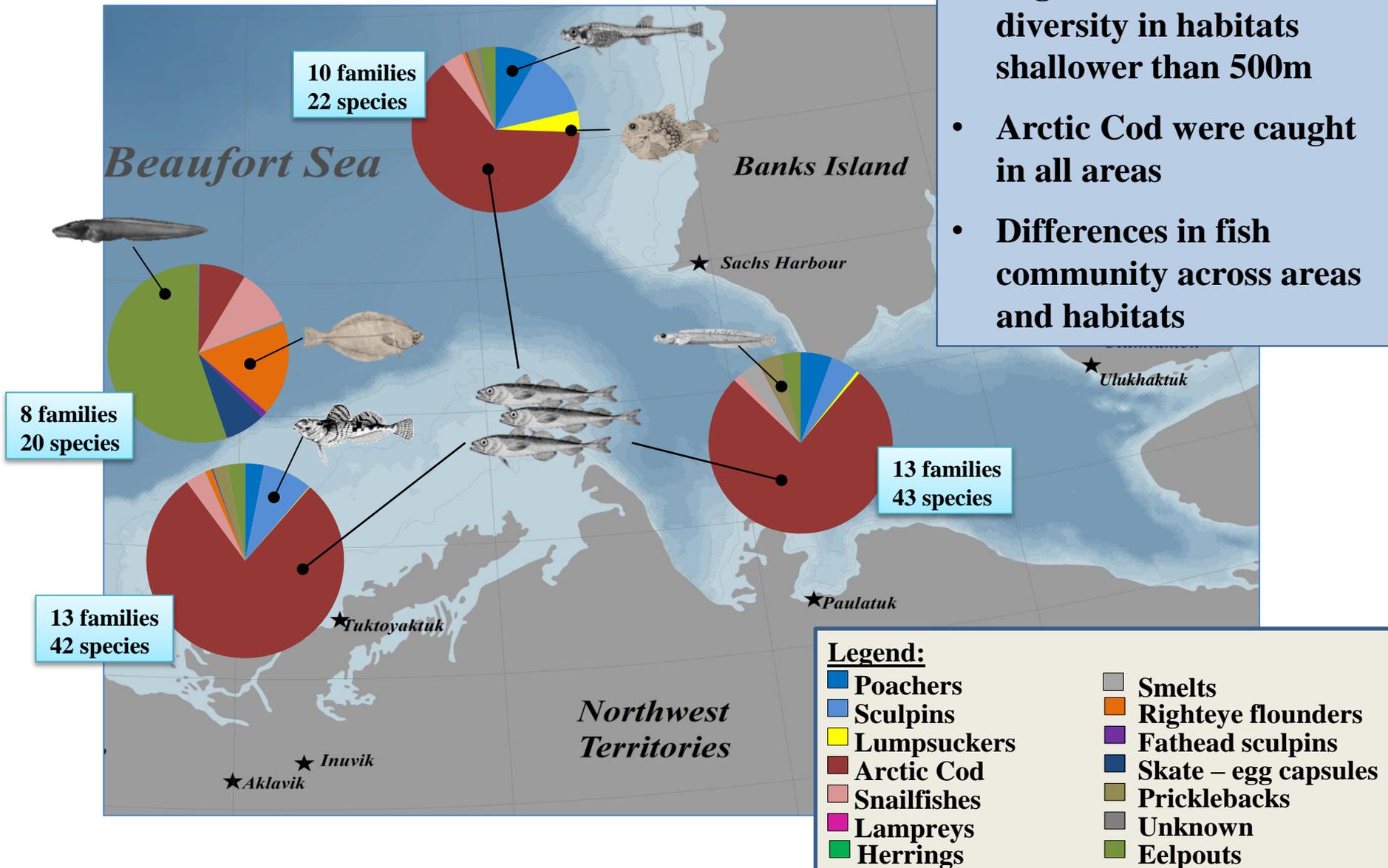
All Photos by S. Atchison, DFO



New species likely represent both:

- Changes in fish distributions because of climate change and,
- Fish that were there but hadn't been sampled yet

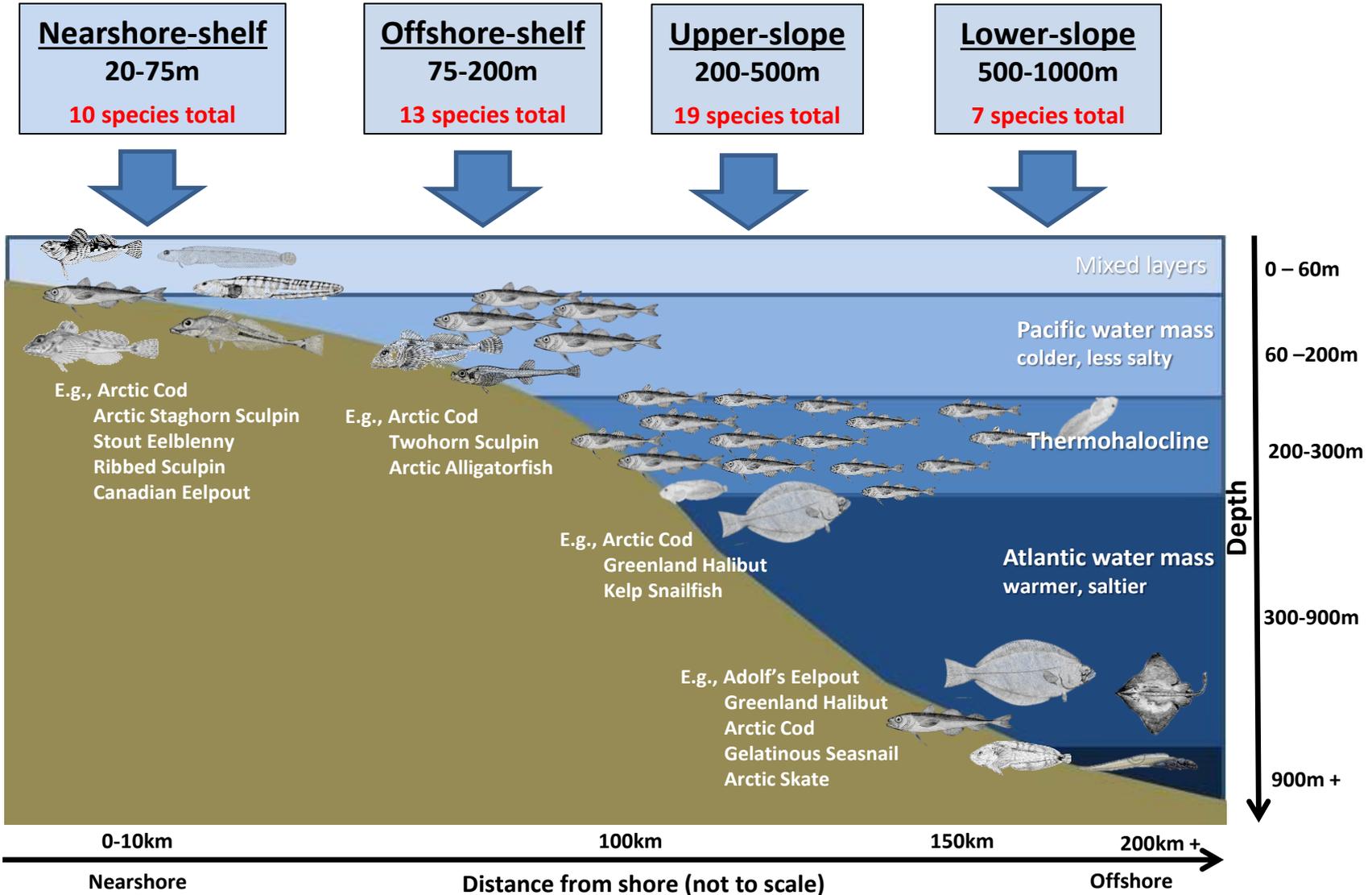
# Baselines: Bottom Fish Diversity & Abundances



- Highest bottom fish diversity in habitats shallower than 500m
- Arctic Cod were caught in all areas
- Differences in fish community across areas and habitats

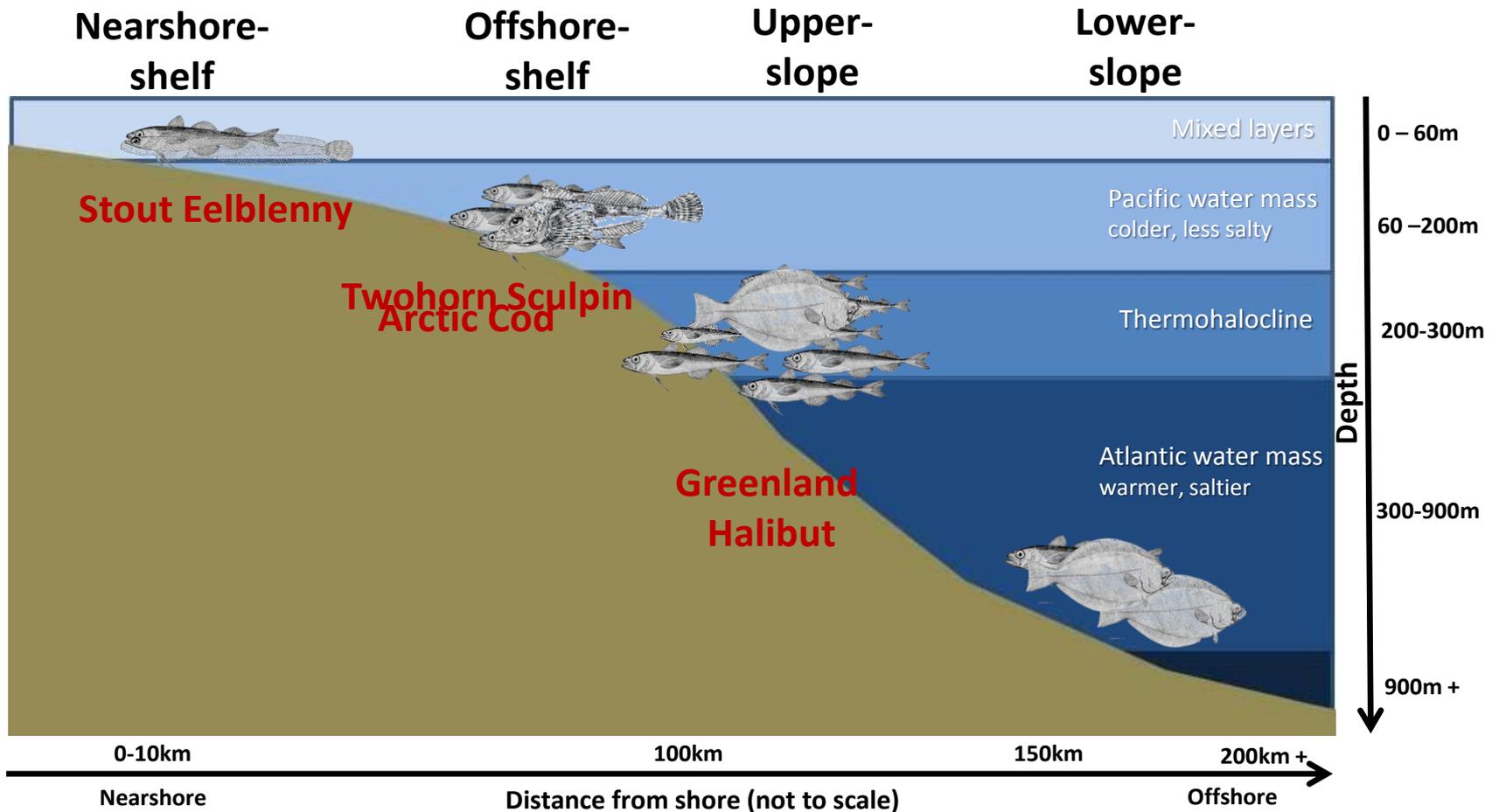
# Habitat Associations: Bottom Fishes

Four distinct fish groups occupy different habitats on the shelf and slope

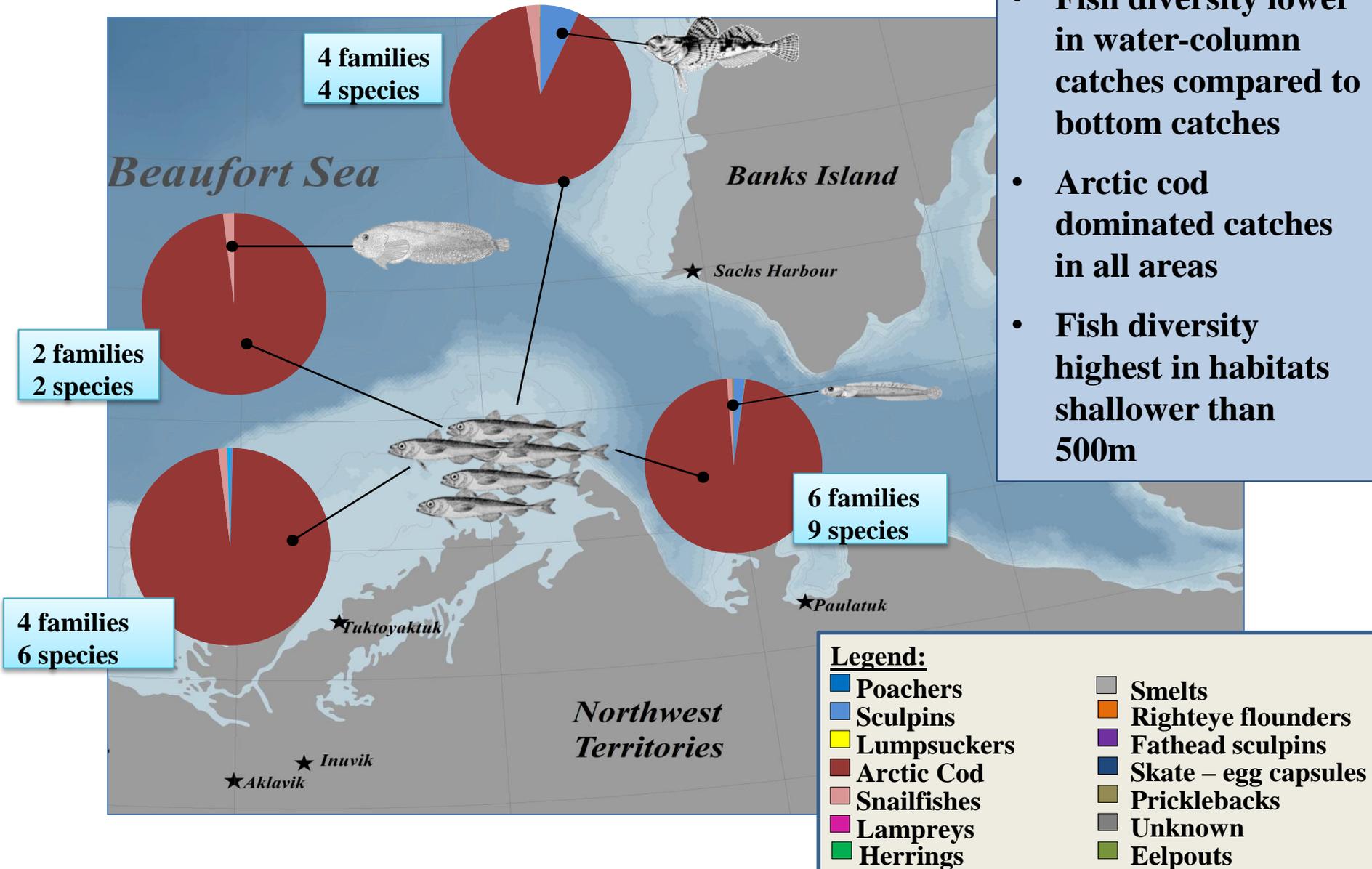


# Habitat Associations: Bottom Fishes

- Arctic Cod was found in all groups and habitats
- Other fishes characterized only one or two groups, and occupied narrower ranges of habitats

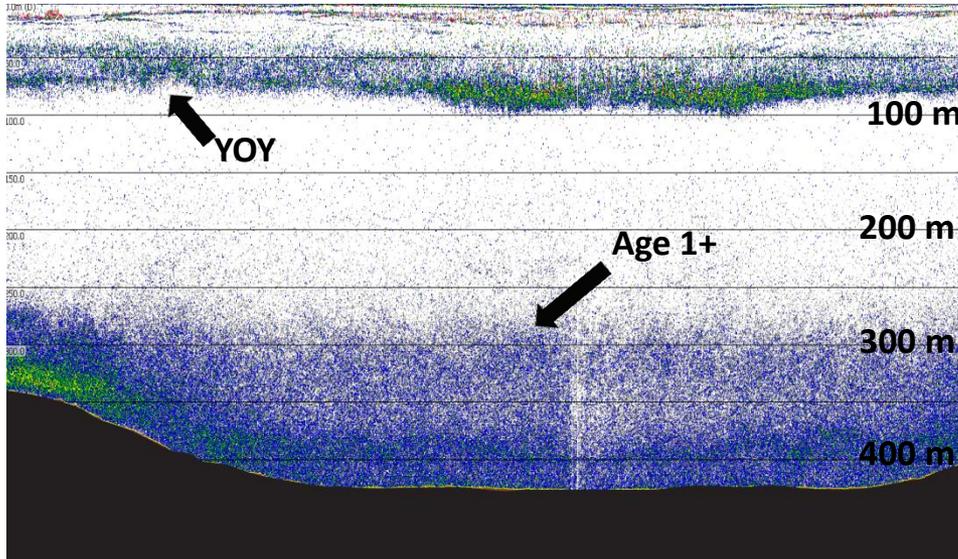


# Baselines: Water-column Fish Diversity & Abundances



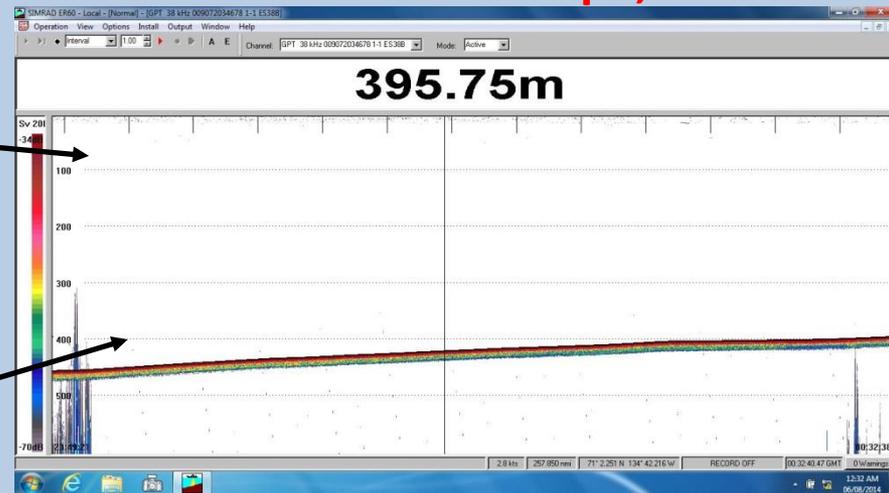
# Habitat Associations: Water-column Fishes

**2012 & 2013**



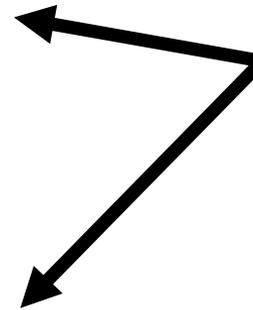
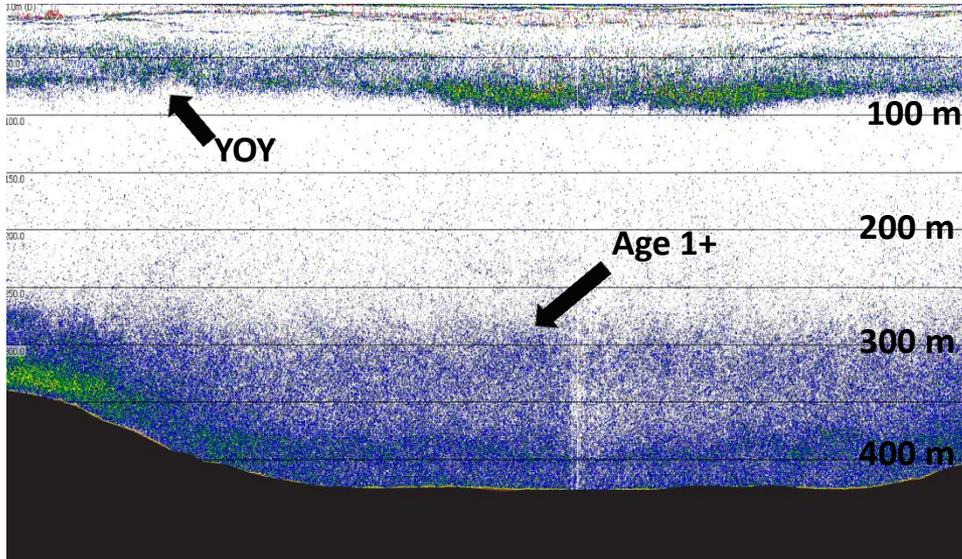
**Beaufort Shelf & Slope, 2014**

- Less fish at the surface than in previous years
- Bottom layer not present in 2014
  - Mainly large Arctic Cod in bottom catches; 1yo in water-column catches
  - Less age 2 and 3 Arctic Cod compared to past years



# Habitat Associations: Water-column Fishes

2012 & 2013

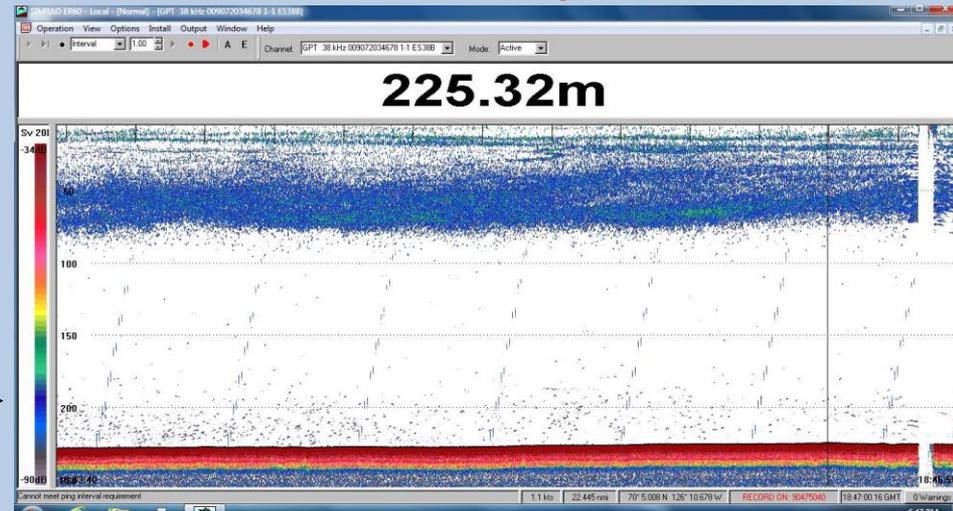


Franklin Bay 2014

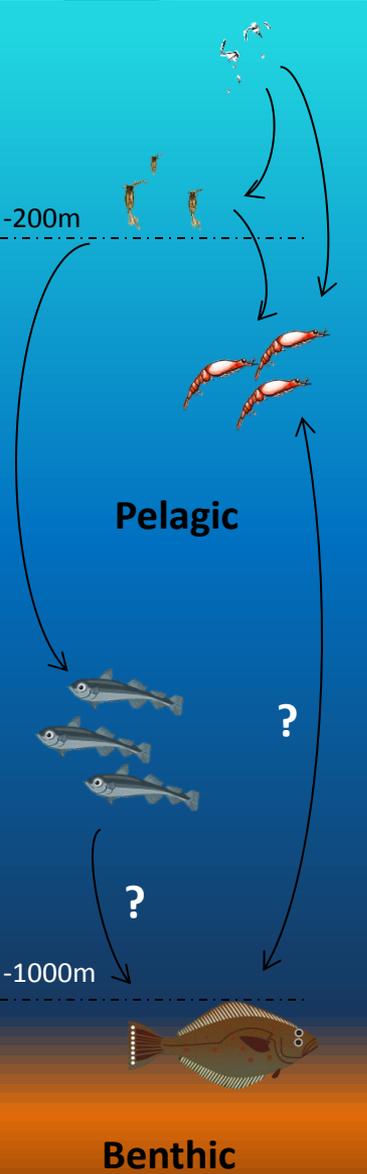
High fish numbers at surface in bays  
in Amundsen Gulf

Net catches suggest high numbers  
of YOY Arctic Cod

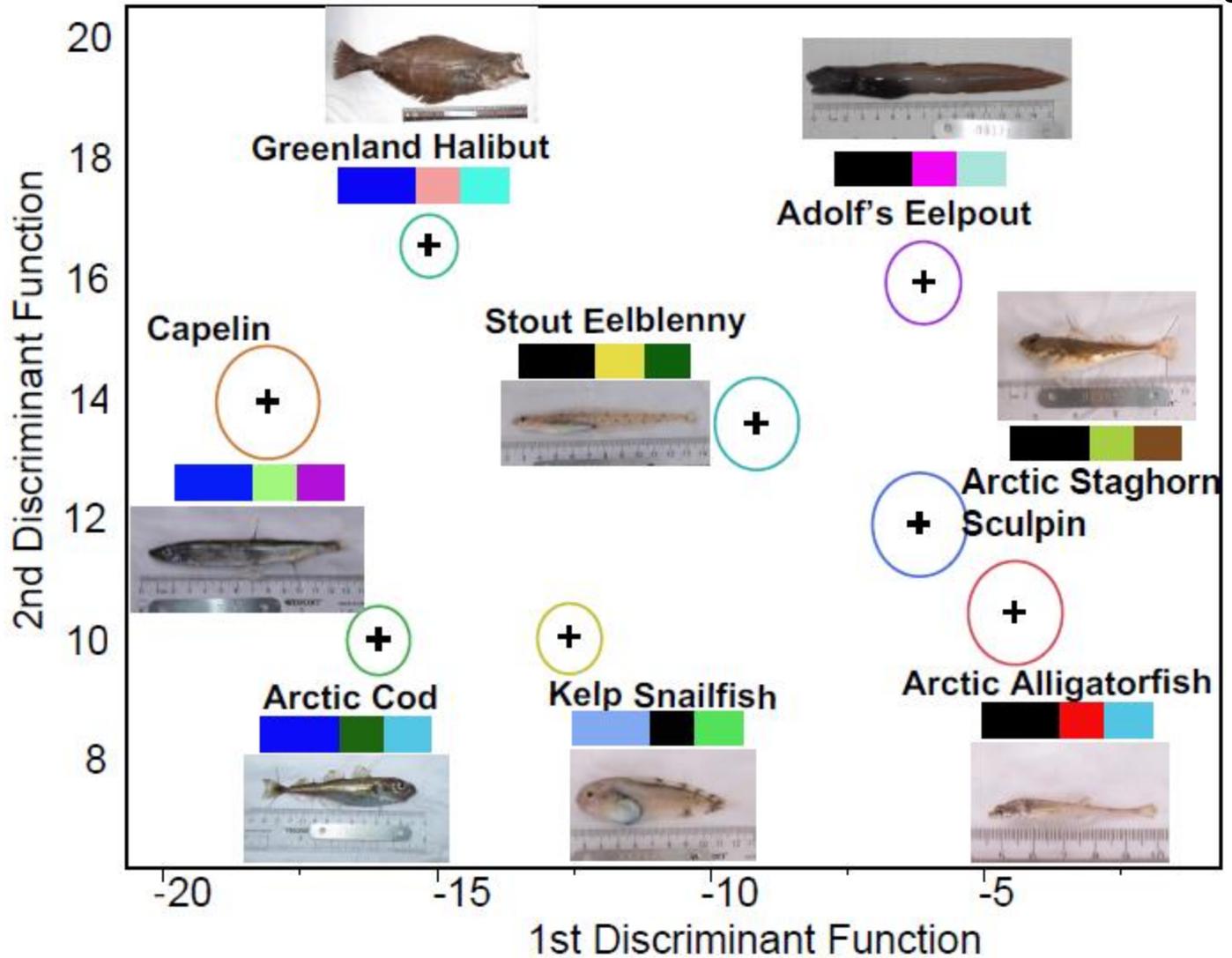
Scattered layer of fishes on bottom



# Water-column and bottom coupling



Water-column feeding  $\longrightarrow$  Bottom feeding



# Energy Pathways

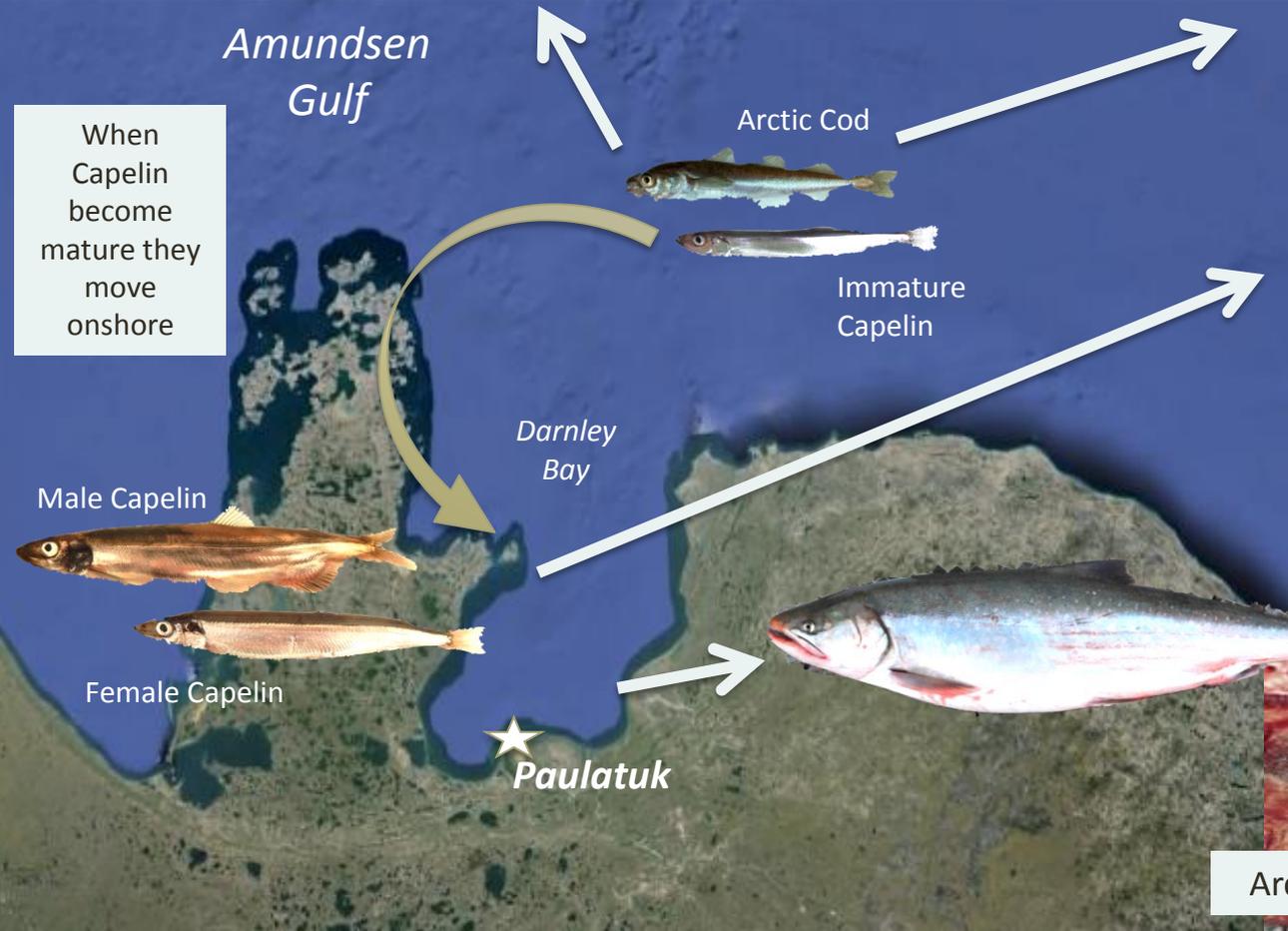
## OFFSHORE: Co-occurring Arctic Cod and Juvenile Capelin

- Capelin and Arctic Cod collected together in benthic trawl (2013)
- Stomach analysis indicate they are feeding on zooplankton (~80% dietary overlap)
- Important habitat for juvenile fishes
- Prey source for pelagic predators (halibut, seals, possibly Beluga)



## NEARSHORE: Capelin

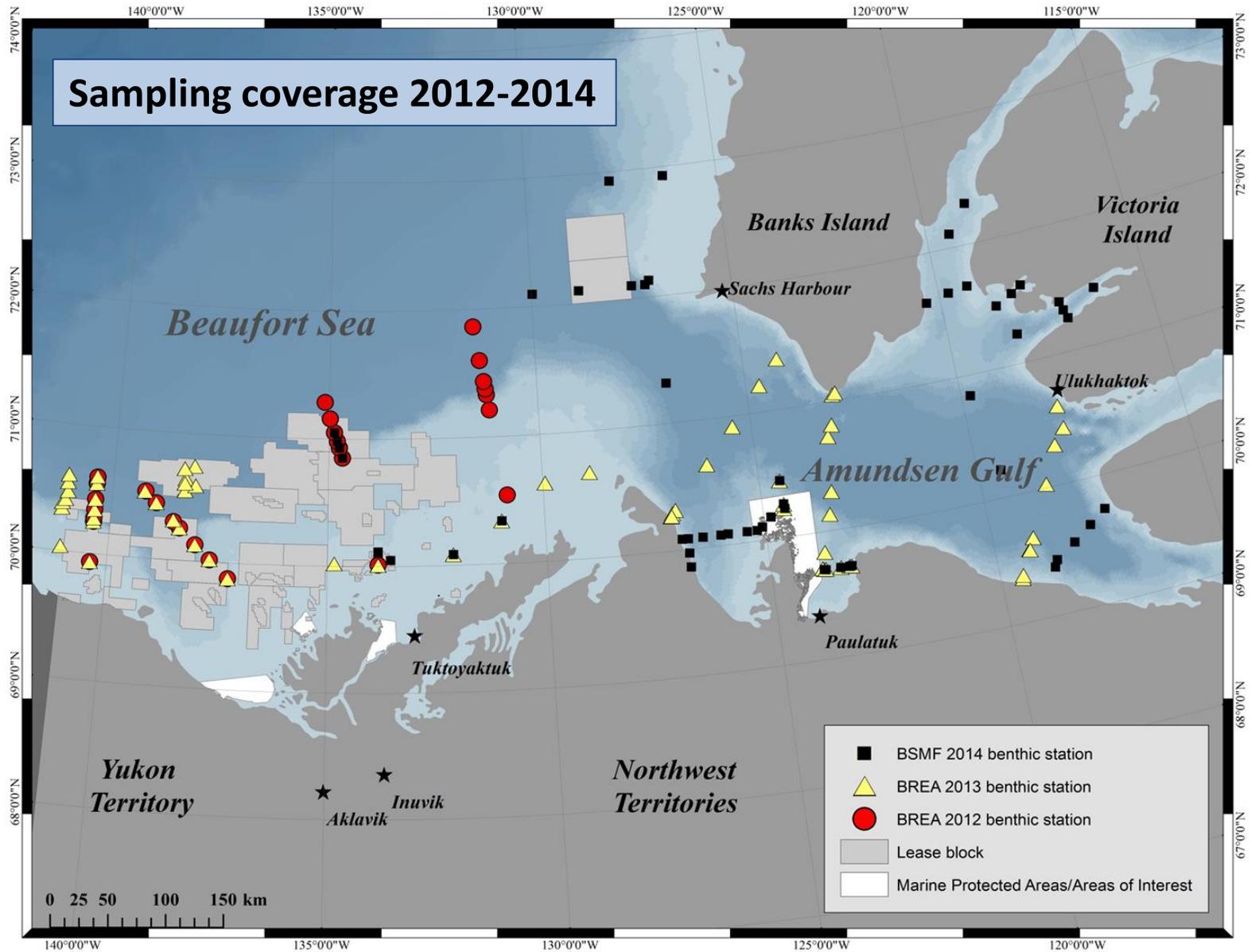
- Capelin spawned in July, 2014
- Nearshore habitat critical for maintaining Capelin population
- Aggregations of Capelin onshore serve as a prey source for coastal predators (Arctic Char, sea birds and possibly Beluga)



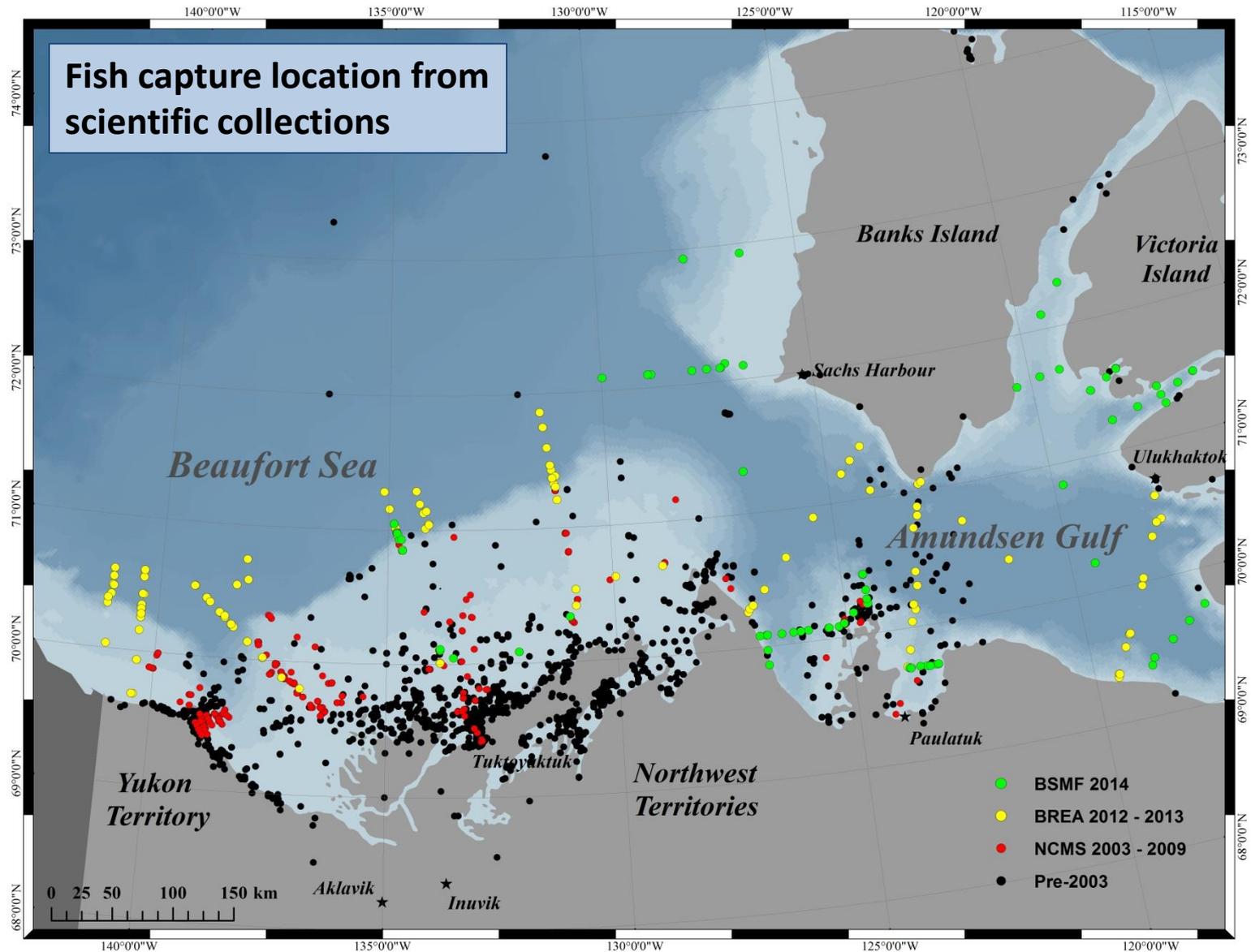
Arctic Char Stomach Contents



# Geographic Coverage



# Geographic Coverage



# Conclusions – New Knowledge

## Knowledge pre-2012

- ~70 fish species – 20 sea-run spp, 52 marine, mostly on shelf
- Relatively few water-column marine species (assumed)
- Relatively more bottom marine species (assumed)
- Offshore fish habitat use unknown
- Arctic Cod important but uncertain numbers & habitats

## New Knowledge

- 16 new marine fishes recorded
- Confirmed low water-column diversity & high bottom diversity
- Linked fishes to habitats
- Fish community differs by habitat/area
- Arctic Cod found everywhere, in particular in slope habitats; high numbers
- Couplings between bottom and water-column habitats, and nearshore and offshore habitats confirmed

### Key Knowledge gaps:

- *Year-to-year differences of fish community and habitats*
- *Importance of unexplored areas such as embayments*

# Next Steps 2014/2015 and beyond...

## Near-term (2014/2015):

- BREAs results forum
- Publication of project reports, communication materials and metadata
  - DFO reports, Polar Data Catalog

## Medium term (2014-2016):

- Analysis and publication of diversity of fishes, other animals and their habitats
- Completion of graduate student projects  
e.g., Arctic Cod energetics, Capelin studies, foodweb structure

## Longer term (2016-):

- Publication of foodweb & energy pathways within and among offshore habitats
- Publication of the energetic links within/among offshore and coastal habitats

**BREA!!!!!!**

A black and white photograph of a fish swimming in an aquarium. The fish is positioned in the lower right quadrant of the frame. Above the fish, a thought bubble contains the text 'AAAAHHHH!!!'. The background shows the dark, curved edge of the aquarium tank and the water surface.

**AAAAHHHH!!!**