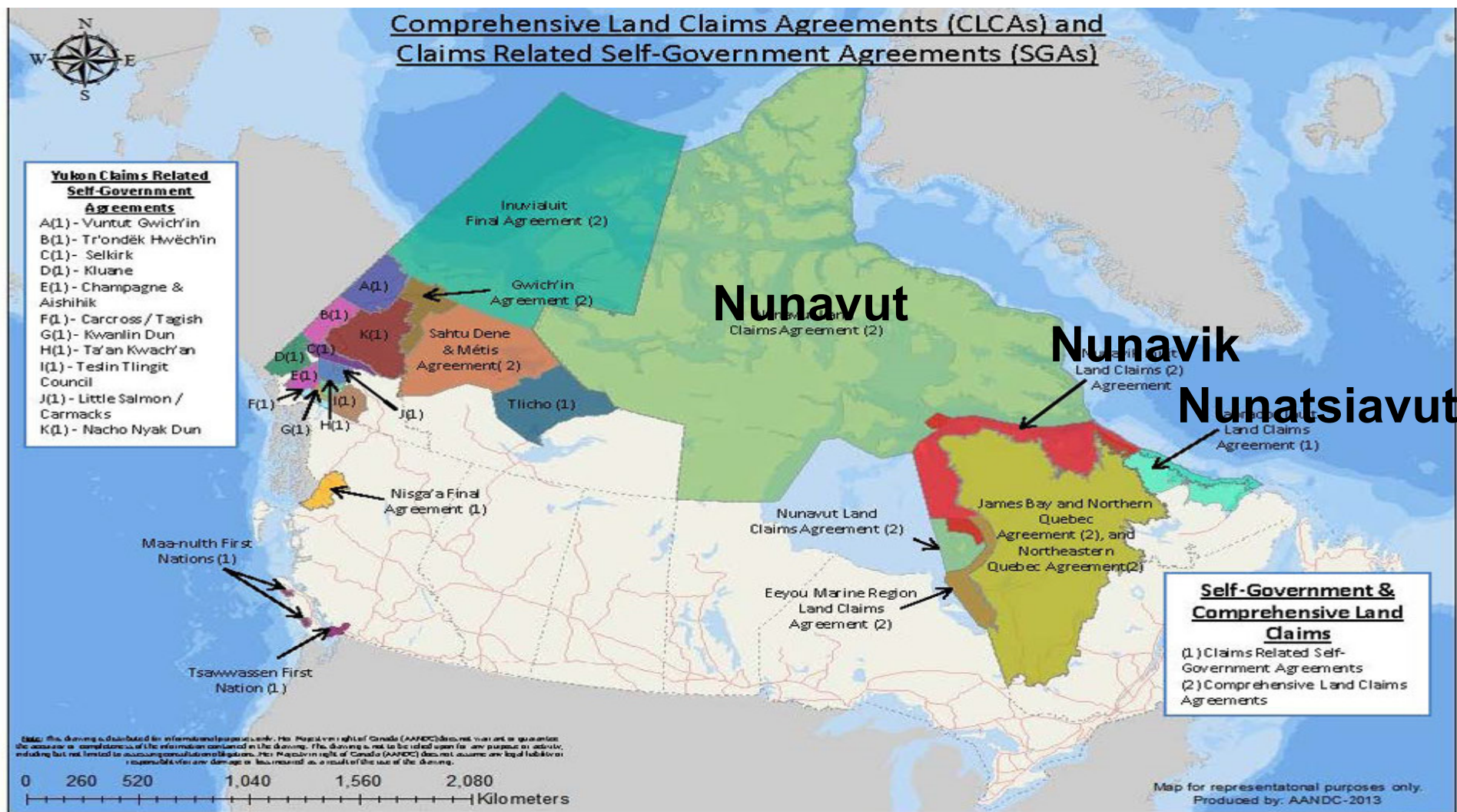


The background of the slide is a photograph of a coastal town, likely in the Arctic region, during sunset or sunrise. The sky is a mix of blue and orange, with soft clouds. The water in the foreground is dark blue with gentle ripples. On the right side, a small town with colorful buildings (red, white, and blue) is visible on a rocky shore. A tall, thin tower or antenna is also visible in the background.

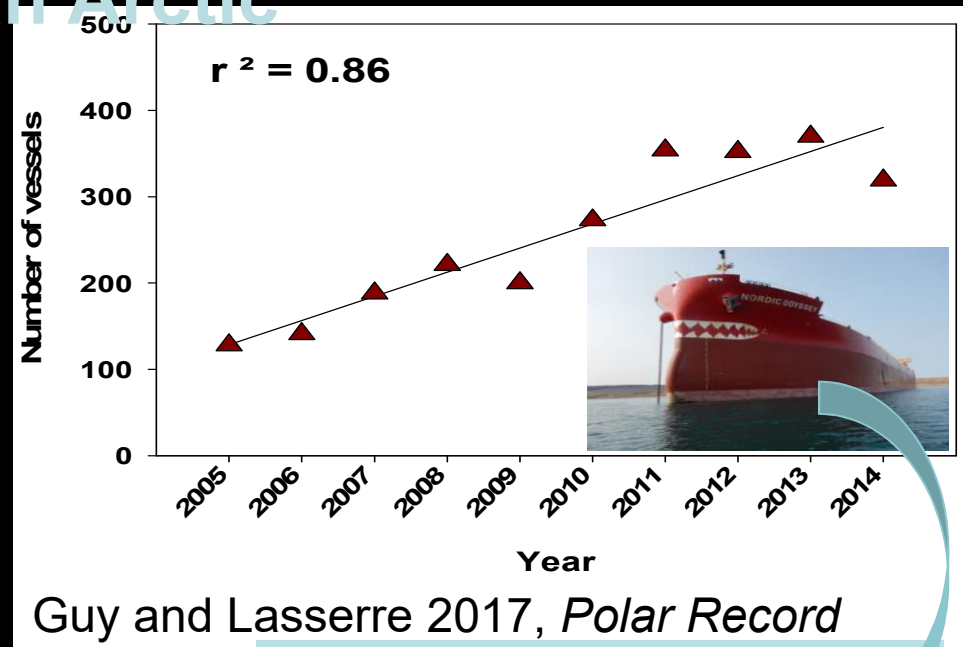
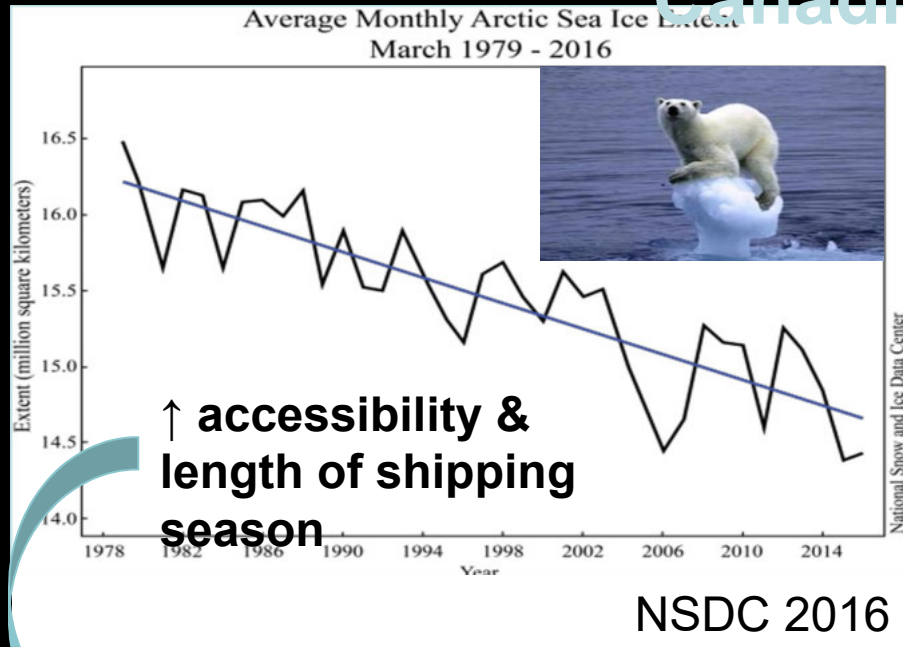
Putting new genetic monitoring tools into practice: engaging northern communities in the collection of coastal biodiversity information

**Maya Gold presenting for
Kimberly Howland**

Arctic Region, Fisheries and Oceans Canada (DFO)



Changing ice conditions and shipping activity in Canadian Arctic



Coastal impacts:

- oil, spills
- noise, strikes
- species introductions

Glomsrød & Aslaksen 2006, Arctic Council 2009, Walther *et al.* 2009, Hoegh-Guldberg

Aquatic Introductions

- Commercial shipping: main vector for aquatic introductions in Canadian **coastal and Great Lakes waters** and of greatest concern in Arctic
- Species typically **coastal or estuarine**, lower trophic

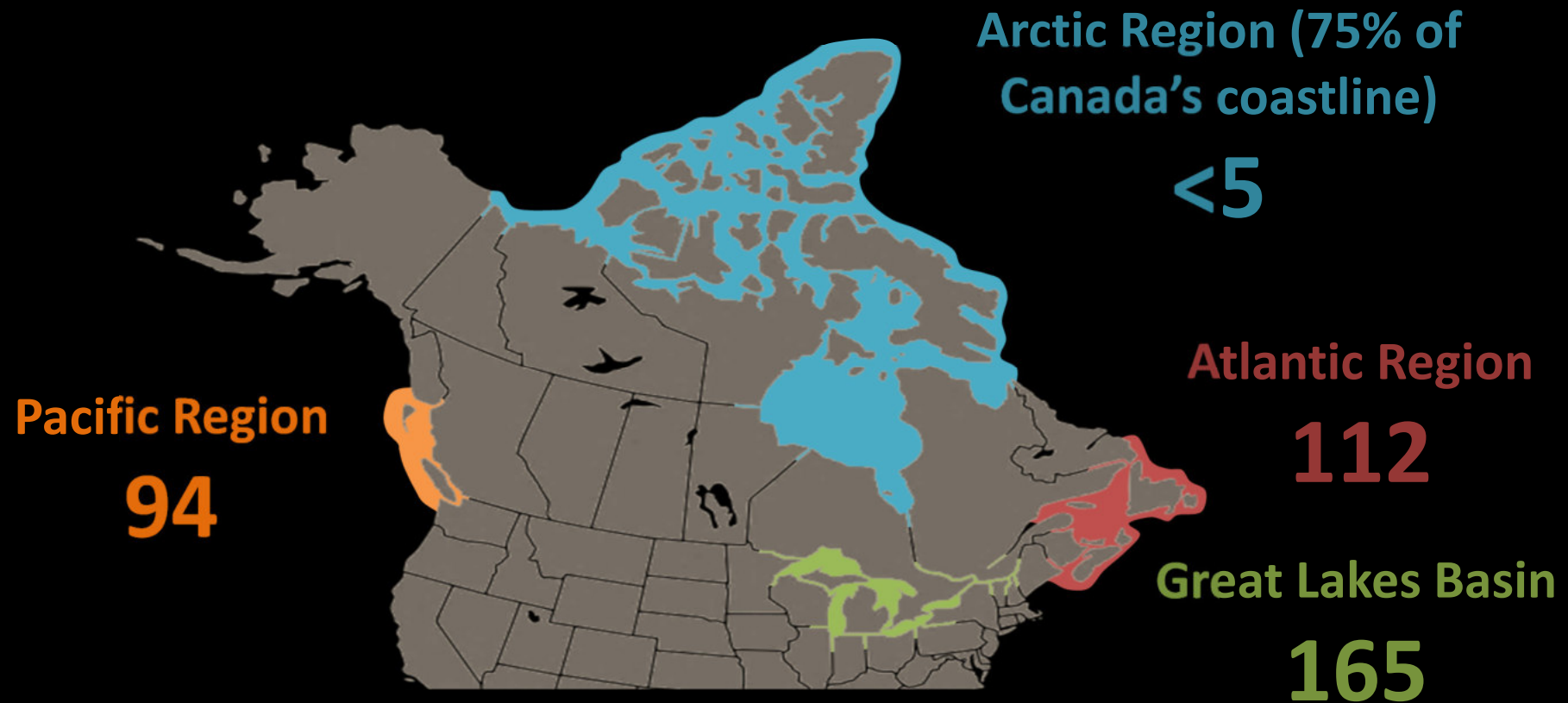


Green Crab



DFO 2004, Clavero & Berthou 2005, Lawler 2006, SERC 2014

Status of aquatic introductions in Canada



Ricciardi 2006, Mathieson et al. 2010, Adams et al. 2014, Linley et al. 2014

Increasing awareness in Arctic:

HOW THE **POLAR** CODE PROTECTS THE ENVIRONMENT

Implemented
2017

OIL



DISCHARGES
Discharge into the sea of oil or oily mixtures from any ship is prohibited



STRUCTURE
Double hull and double bottom required for all oil tankers, including those less than 5,000dwt (A/B ships constructed on or after 1 January 2017)



HEAVY FUEL OIL
Heavy fuel oil is banned in the Antarctic (under MARPOL). Ships are encouraged not to use or carry heavy fuel oil in the Arctic



LUBRICANTS
Consider using non-toxic biodegradable lubricants or water-based systems in lubricated components outside the underwater hull with direct seawater interfaces

INVASIVE SPECIES

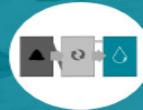


INVASIVE AQUATIC SPECIES
Measures to be taken to minimize the risk of invasive aquatic species through ships' ballast water and biofouling

SEWAGE



DISCHARGES I
No discharge of sewage in polar waters allowed (except under specific circumstances)



TREATMENT PLANTS
Discharge is permitted if ship has an approved sewage treatment plant, and discharges treated sewage as far as practicable from the nearest land, any fast ice, ice shelf, or areas of specified ice concentration



DISCHARGES II
• Sewage not comminuted or disinfected can be discharged at a distance of more than 12nm from any ice shelf or fast ice
• Comminuted and disinfected sewage can be discharged more than 3nm from any ice shelf or fast ice

GARBAGE



PLASTICS
All disposal of plastics prohibited (under MARPOL)



FOOD WASTES I
Discharge of food wastes onto the ice is prohibited



FOOD WASTES II
Food wastes which have been comminuted or ground (no greater than 25mm) can be discharged only when ship is not less than 12nm from the nearest land, nearest ice shelf, or nearest fast ice



ANIMAL CARCASSES
Discharge of animal carcasses is prohibited



CARGO RESIDUES
Cargo residues, cleaning agents or additives in hold washing water may only be discharged if they are not harmful to the marine environment; both departure and destination ports are within Arctic waters; and there are no adequate reception facilities at those ports. The same requirements apply to Antarctic area under MARPOL

BACKGROUND INFO

- THE INTERNATIONAL CODE FOR SHIPS OPERATING IN POLAR WATERS WILL ENTER INTO FORCE ON 1 JANUARY 2017
- IT APPLIES TO SHIPS OPERATING IN ARCTIC AND ANTARCTIC WATERS: ADDITIONAL TO EXISTING MARPOL REQUIREMENTS
- IT PROVIDES FOR SAFE SHIP OPERATION AND PROTECTS THE ENVIRONMENT BY ADDRESSING THE UNIQUE RISKS PRESENT IN POLAR WATERS BUT NOT COVERED BY OTHER INSTRUMENTS

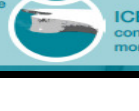
DEFINITIONS



SHIP CATEGORIES
Three categories of ship designed to operate in polar waters in:
A) at least medium first-year ice
B) at least thin first-year ice
C) open waters/ice conditions less severe than A and B



FAST ICE: Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs



ICE SHELF: A floating ice sheet of considerable thickness showing 2 to 50m or more above sea-level, attached to the coast

CHEMICALS

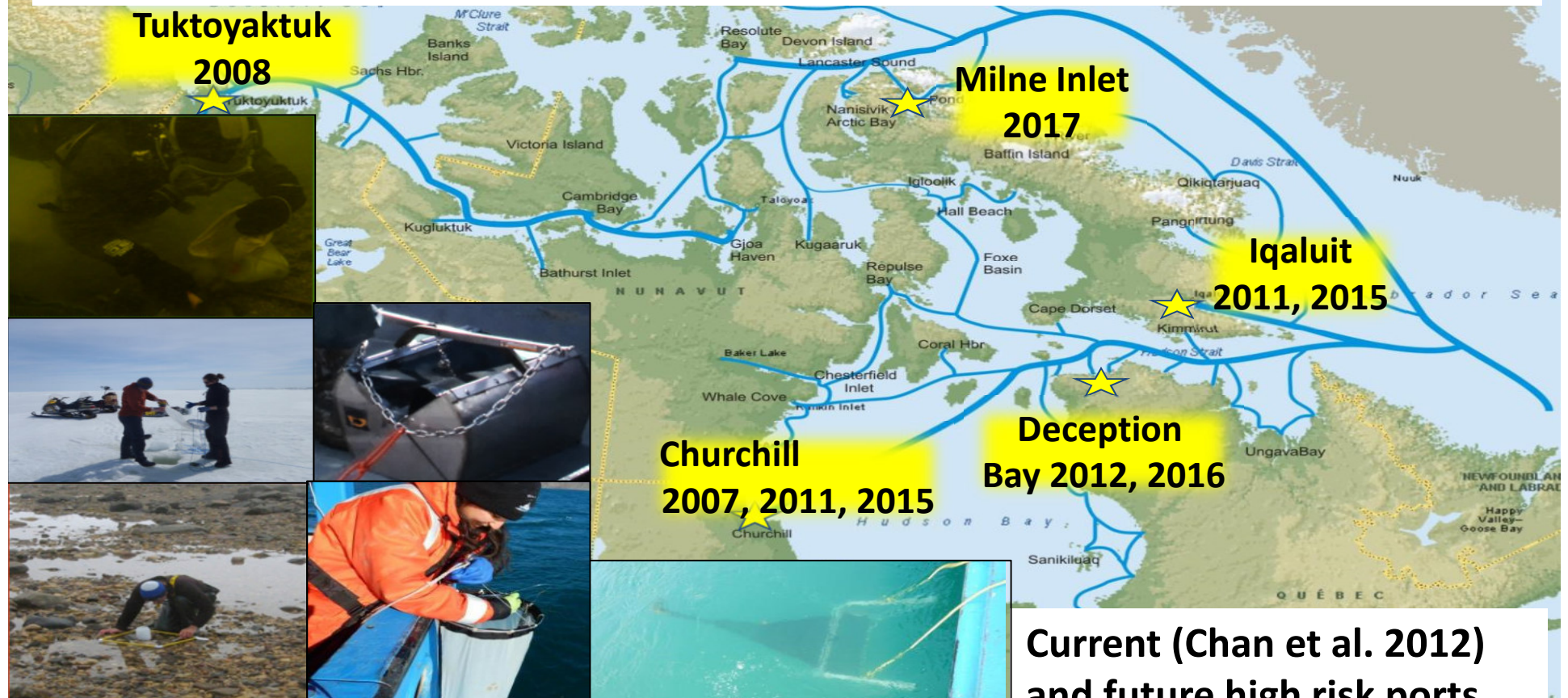


DISCHARGES
Discharge of noxious liquid substances (NLS) or mixtures containing NLS is prohibited in polar waters



- Arctic changing rapidly, unique flora & fauna vulnerable to invasion, limited invasions > a **unique opportunity to be proactive**
- Priority actions & guidance to be undertaken by Arctic Council, Arctic States & partners to protect Arctic region from impacts of IAS
- **Emphasis on role of local indigenous peoples- community based monitoring**

Early detection: Characterizing baseline coastal biodiversity in ports





Polar Knowledge
Canada

Savoir polaire
Canada

ArcticNet



Fisheries and Oceans
Canada

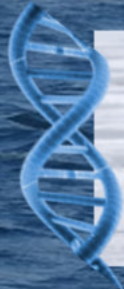
Pêches et Océans
Canada

“biodiversity shifts and early detection of aquatic invasive species (AIS) in the Canadian Arctic: preparing for impacts of climate change and associated increases in shipping activity”

“Monitoring marine biodiversity with eDNA; a new cost-effective method to track rapid Arctic changes”



Genetic Tools: Environmental DNA (eDNA)



- Genetic material in environment
- Easy to collect (water, sediments)
- Improved baseline – detecting difficult to sample species
- Screening for taxa of interest (e.g.,

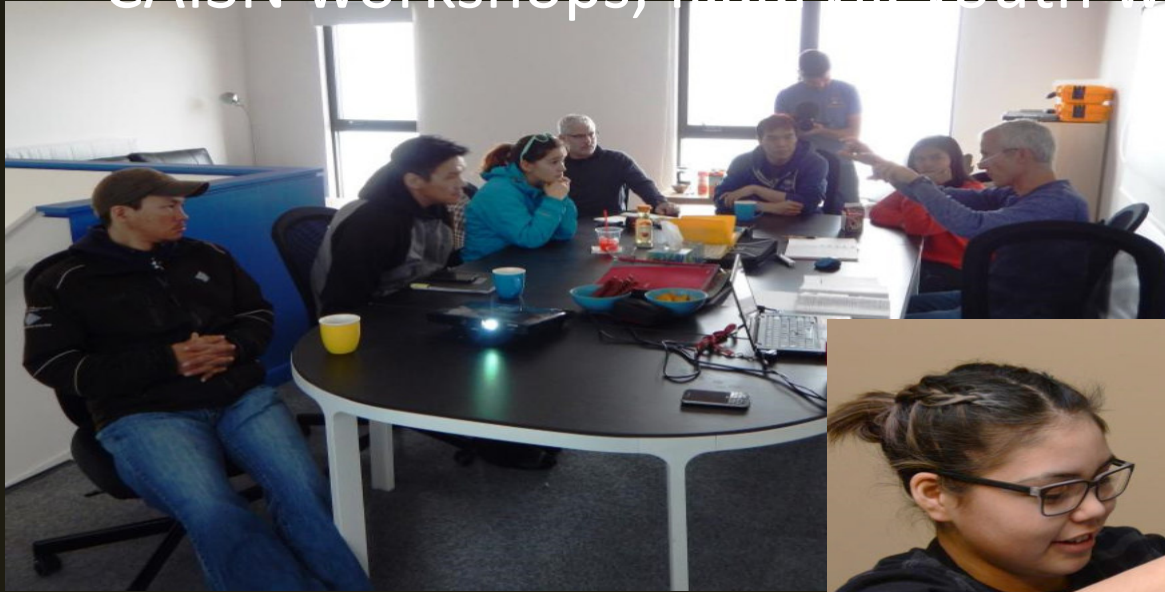
Development of genetic tools (eDNA metabarcoding)

- Incorporated into port surveys, testing how eDNA is distributed (time, space) in Arctic marine environment:
 - Syringe filtration method (user-friendly)
 - Correspondence with standard port sampling methods
 - Effects of depth, proximity from shore, season, tides
 - eDNA recovery from water vs sediments



Education & outreach in high risk locations

- CAISN workshops, Ikaarvik youth workshops

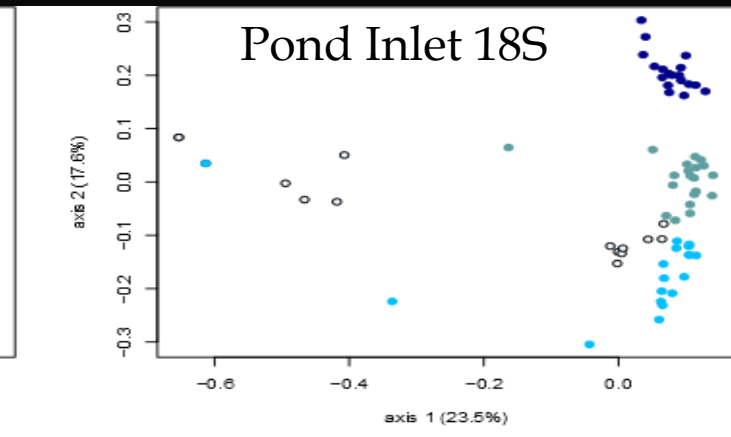
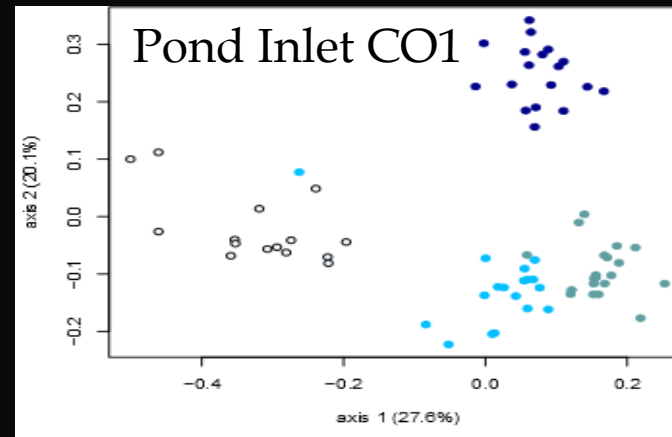


Hands-on experience (genetic tools & standard sampling approaches)

- workshops & on the job



Pond Inlet 2017 - Seasonal variability in eDNA

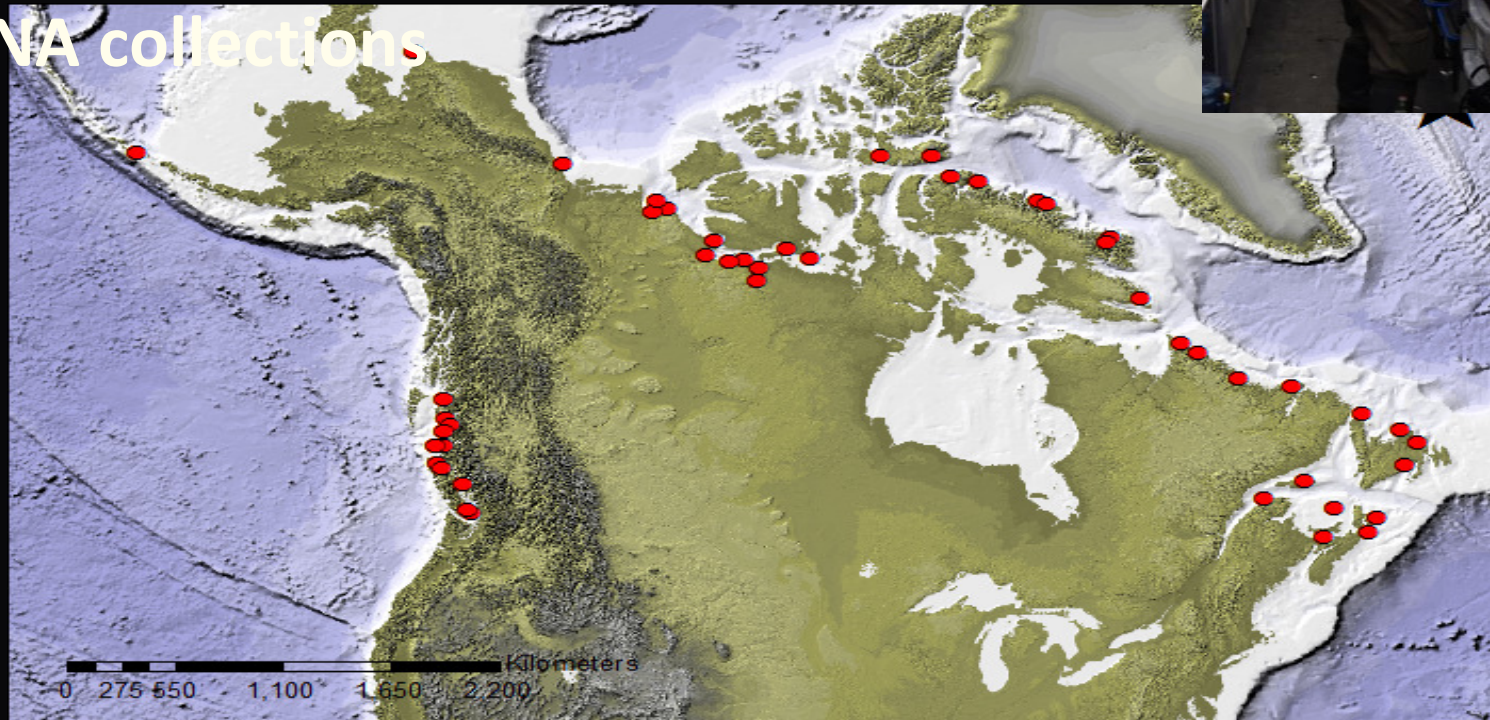




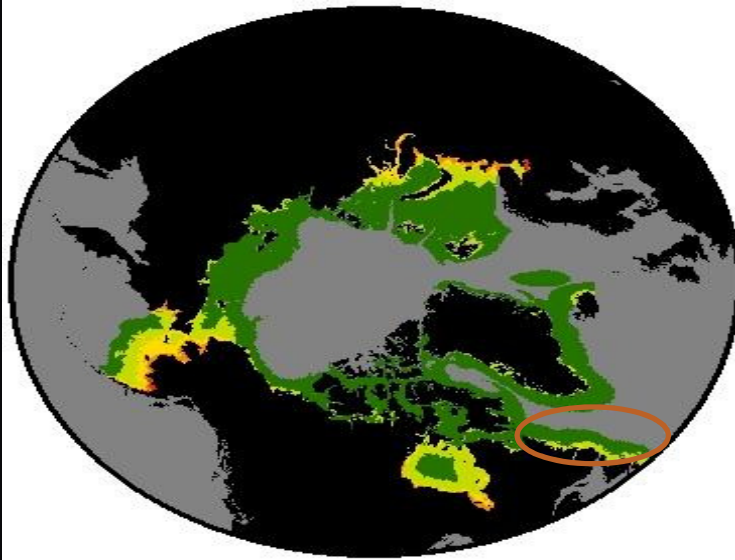
Mentorship – benefits:

- Training of youth with fellow Inuit
- Building skills of mentors

Extending coverage and characterization of coastal biodiversity: C3/Students on Ice, shore-based coastal eDNA collections



45 sites (2 reps + control/site), off shore (project 12) > complementary



Future work:

- Extending coverage into Nain, Labrador, a hotspot/ area of concern
- Extending research to additional areas of concern identified in Pond/Milne Inlet – community-led funding/design
- Oceans Protection Plan Coastal Baseline - Iqaluit





Questions?

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