A Collaborative Science-based Approach to AIS Monitoring on the North Coast

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Definition

- Government of Canada (2004) defines invasive alien species as:

  "those harmful alien species whose introduction or spread threatens the environment, the economy or society, including human health"

So What Are AIS?

- Aquatic Invasive Species (AIS)
  - species not native to the ecosystem in which they are found
  - often arrive in new locations as a result of human-mediated movement, both intentional (e.g., direct release of bass in BC lakes) or unintentional (e.g., hitchhikers on recreational boats or personal gear)

How Do AIS Get Here?

- Primary AIS Vectors
  - Introduce AIS from foreign locations
  - E.g.: international shipping, aquaculture

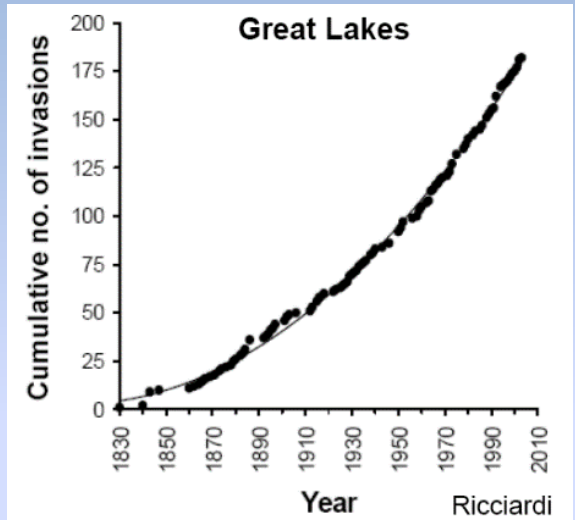
- Secondary AIS Vectors
  - Re-distribute AIS regionally/locally (spread)
  - E.g.: recreational boats, domestic shipping

Why Are We Concerned About AIS?

- AIS can result in the loss of native biodiversity
- AIS can pose significant biological and socio-economic risks, including significant risks to sustainable fisheries and aquaculture (i.e., tunicates and shellfish aquaculture)
- AIS and their impacts may be exacerbated by climate change

Why Are We Concerned About AIS?

- AIS continue to be re-distributed globally at alarming rates
- Many potential vectors and pathways for AIS, very few of which have any regulations
- Preventing all introductions of AIS is not possible
- Monitoring becomes essential



The Need for Collaboration

- No single agency or organization has the resources to undertake post-border AIS prevention/management alone

- Collaborations are essential to monitor for AIS given BC's large, complex coastline

Port of Prince Rupert
Aquatic Invasive Species Program

Collaboration to establish an early detection program for the Prince Rupert harbour

A multi-stakeholder working group that includes representatives of local First Nations was established to provide guidance on the implementation of the program

Initial Collaborations

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LINKING A WORLD OF OPPORTUNITY

coast mountain college

Fisheries and Oceans Canada
Pêches et Océans Canada

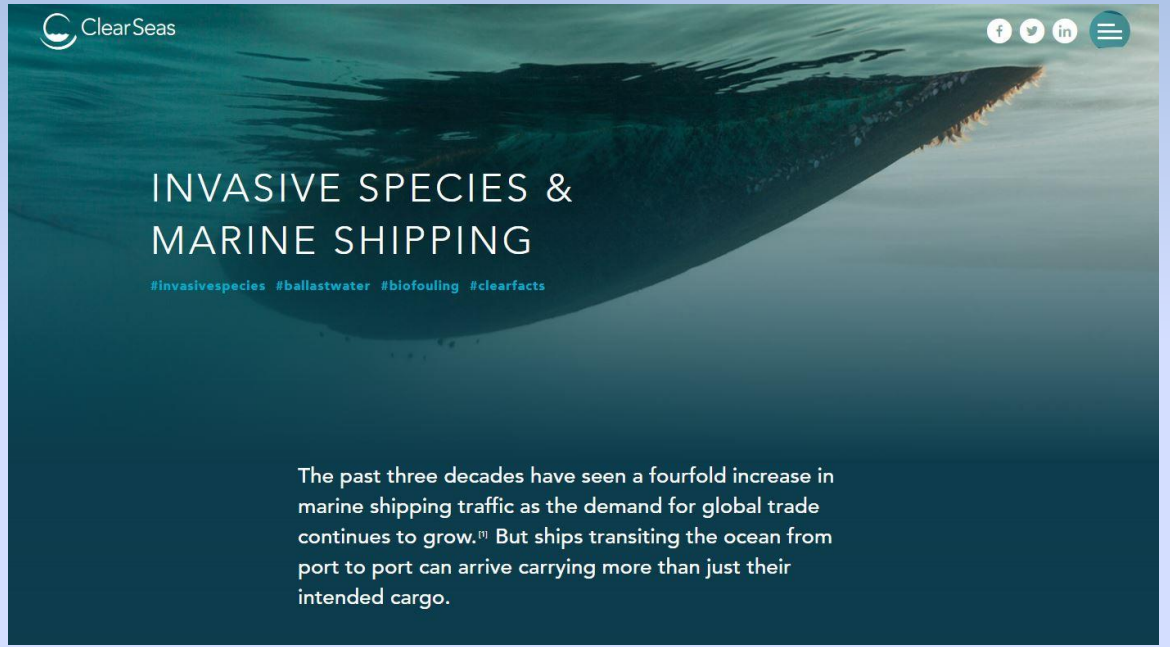
SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER
1965–2015

Building Additional First Nations Collaborations

- Lax Kw’alaams (plates started in 2018)
- Metlakatla (plates started in 2019)
- Now engaging additional First Nations south of Port of Prince Rupert (and linkages to other DFO AIS Monitoring programs)

Incentives and Support

GREEN MARINE



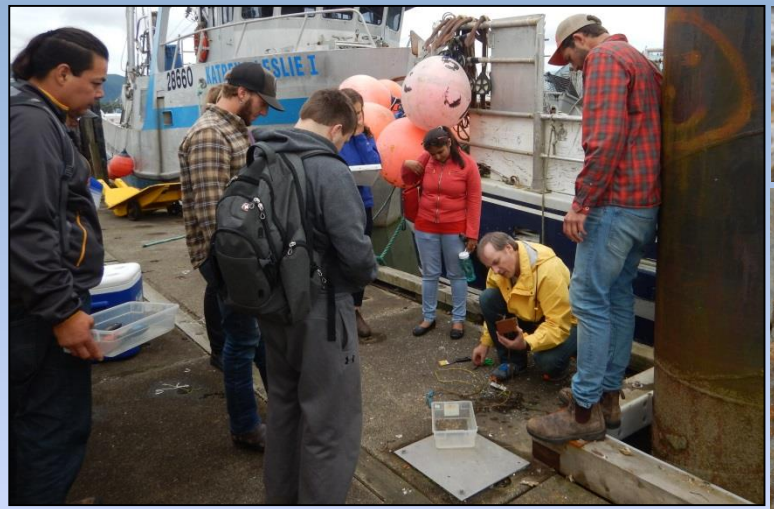
Port of Prince Rupert
Aquatic Invasive Species Program

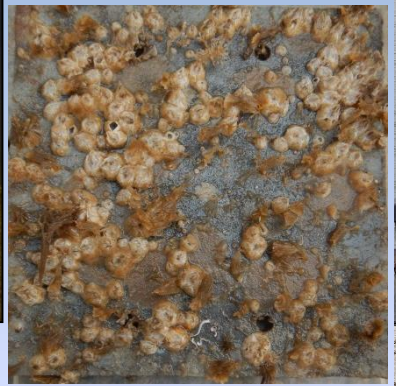
The program, established in 2012, functions around three major elements:

- PlateWatch Program (tunicates and fouling species)
- Green Crab monitoring
- Plankton sampling

Settlement Plates

- Allows passive monitoring for the presence of invasive tunicates and other fouling organisms
- Involved college and middle school students in deploying and retrieving plates as well an lab analysis
- Initially started with four sites and since has expanded to other areas
- Plates hang at about 1m for 3-4 months over summer growing season and then processed in the lab





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Site Prince Rupert Plate #201709 07
Location
Collector
Date 2017 Sept


Site Prince Rupert Plate #201709 2807
Location Fairview Marina
Collector
Date 2017 Sept


Site Prince Rupert Plate #201709 2902
Location Rushbrook
Collector
Date 2017 Sept

A “New” AIS Vector

- On March 11, 2011 a Magnitude 9.0 earthquake hit off Honshu, Japan
  - Ensuing tsunami wave
  - 40 m high
  - inundated 542 sq km

- Estimated 5 million tons of Japan tsunami marine debris (JTMD) washed into the Pacific Ocean

2015 PICES ADRIFT project

- PICES project looking at potential impacts of AIS from Japanese Tsunami Marine Debris
  - Core areas of interest in the north
  - Prince Rupert: 100 plates
  - Haida Gwaii/Gwaii Haanas: 40
  - Also, Ucluelet/Tofino: 50

- Project helped solidify AIS Plate Monitoring in Prince Rupert area

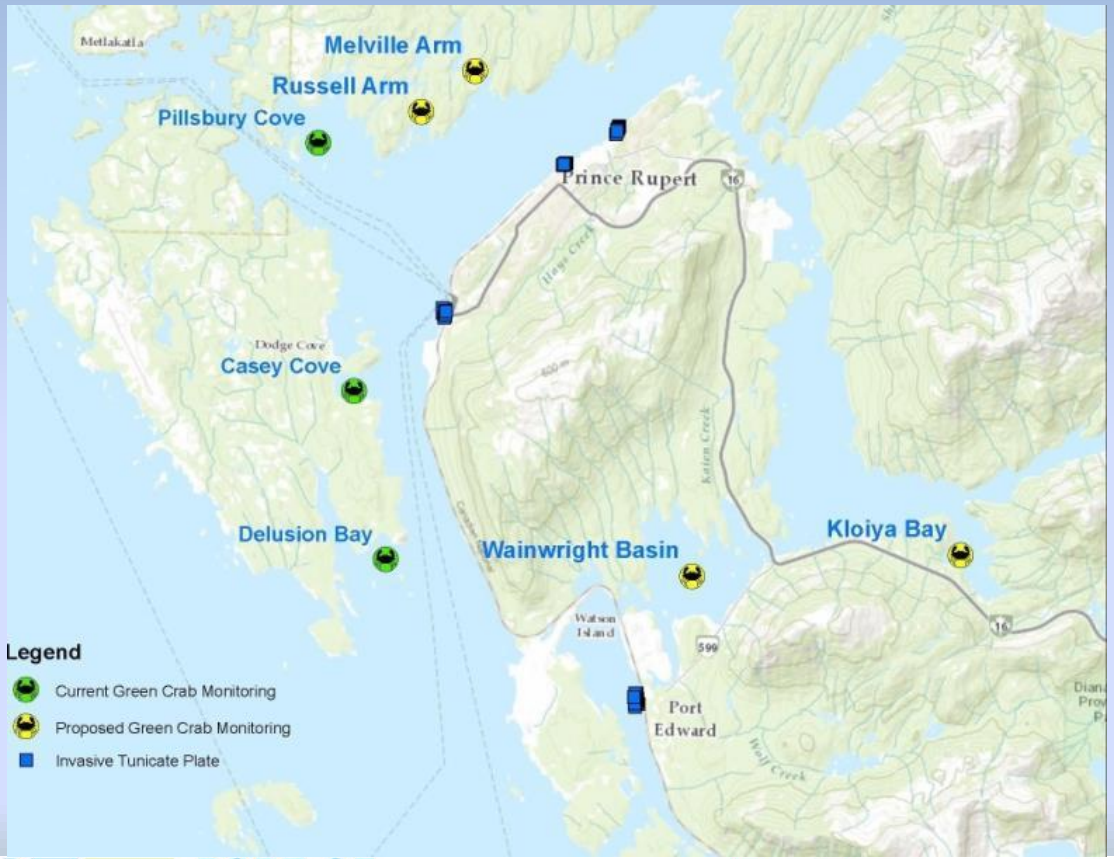
Green Crab (*Carcinus maenas*) in BC

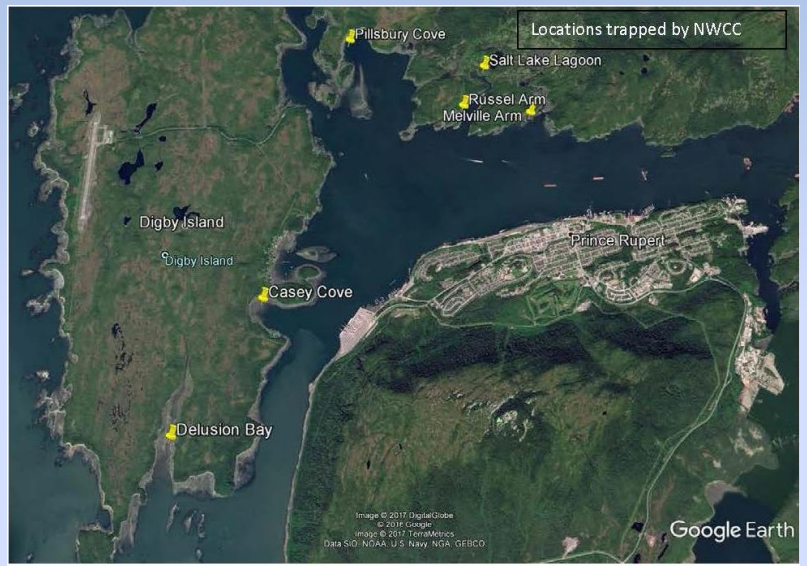
- Arrived on the West Coast of North America in 1989 (San Francisco Bay in packing material)
- Slowly expanded northward into Pacific Northwest
- Arrived in BC through larval transport during 1998/99 El Nino and spreading north
- Not yet detected from Prince Rupert area so monitoring for early detection is critical

Prince Rupert Green Crab

- Began data collection in 2015
- Training and sampling protocol provided by DFO:
  - Fukui folding fish traps
  - Frozen herring bait
  - Traps set in strings of 6 on groundlines with 10m spacing
  - Generally set in the intertidal zone at depth of approximately -1m
- Working with CMC to continue sampling

Prince Rupert Green Crab





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Plankton Sampling

- Began data collection in 2016
- Training and sampling protocol provided by DFO
  - 250 um mesh net
  - vertical tows quarterly

- Can identify potential AIS not encountered by plates or trapping

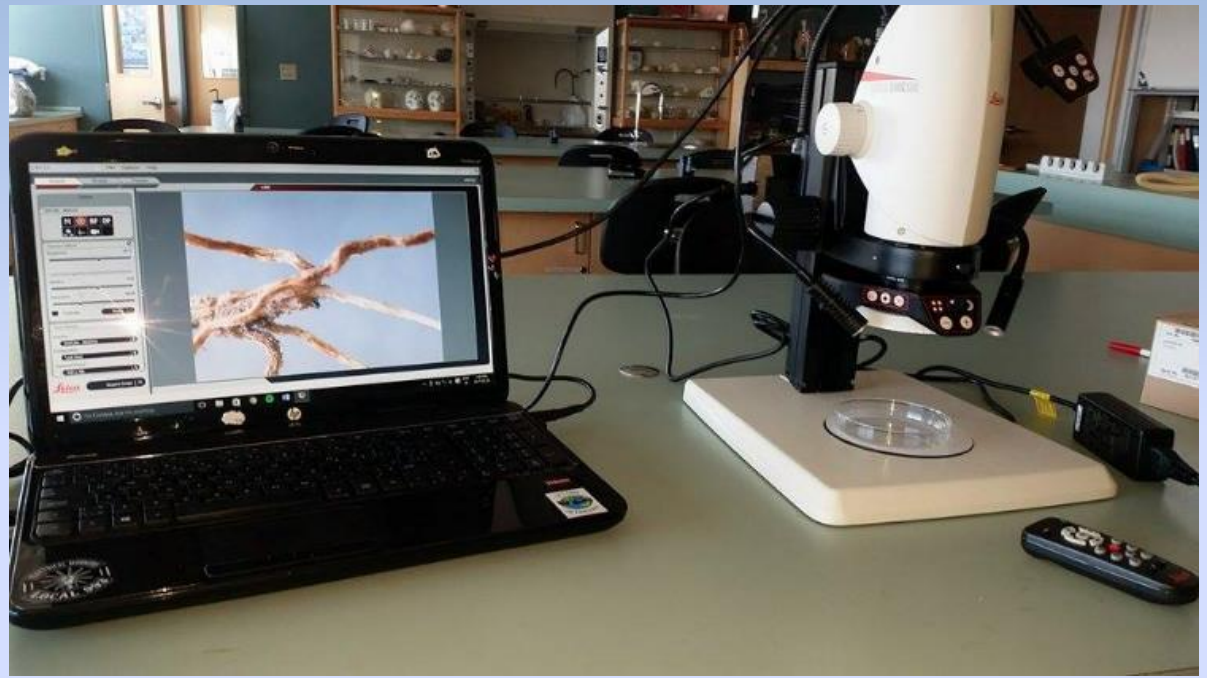
- Quarterly sampling using Port vessel

Student Engagement

- Use of program to educate children on importance of monitoring and ecosystem management

- Partnership with CMC to incorporate AIS monitoring into Applied Coastal Ecology Program providing students with valuable field work and lab experience

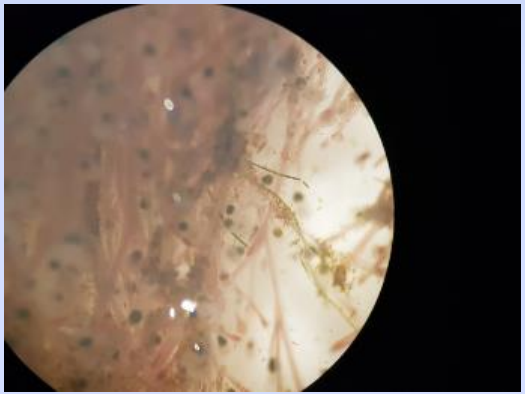
New Technology



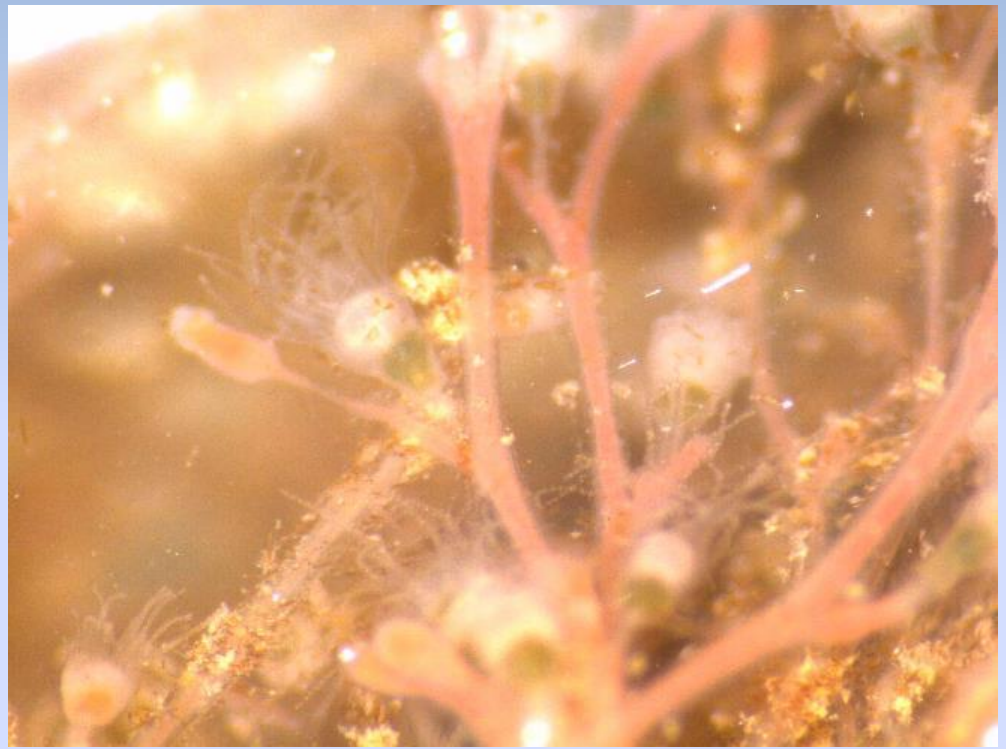
NWCC has acquired a new microscope to be used for the program.

New Technology in Action

Alternate Skein – Red Seaweed

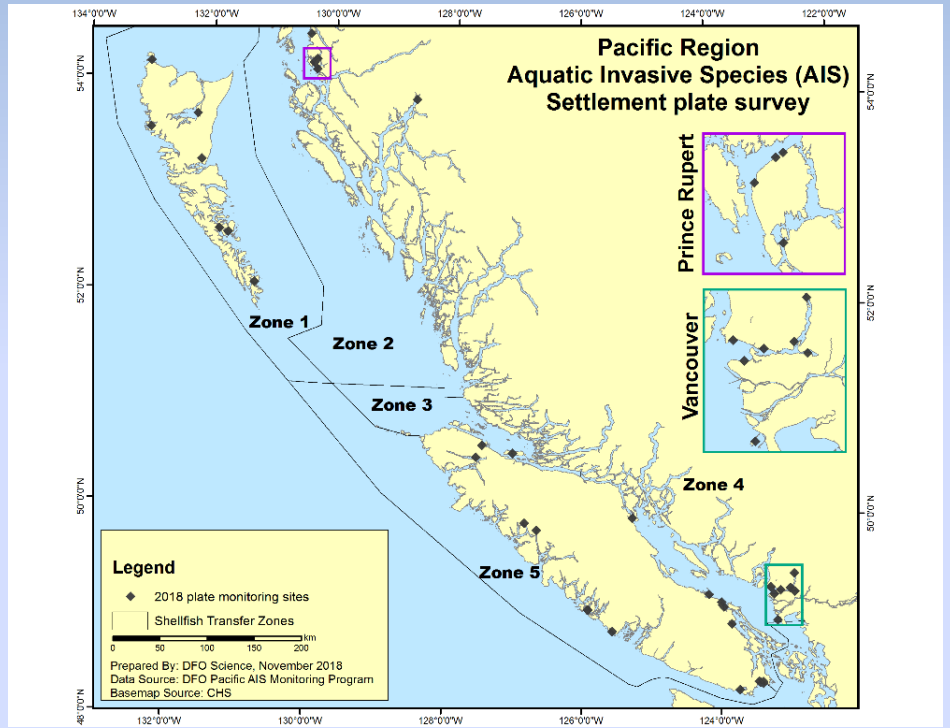


Red Seaweed – Old Scope

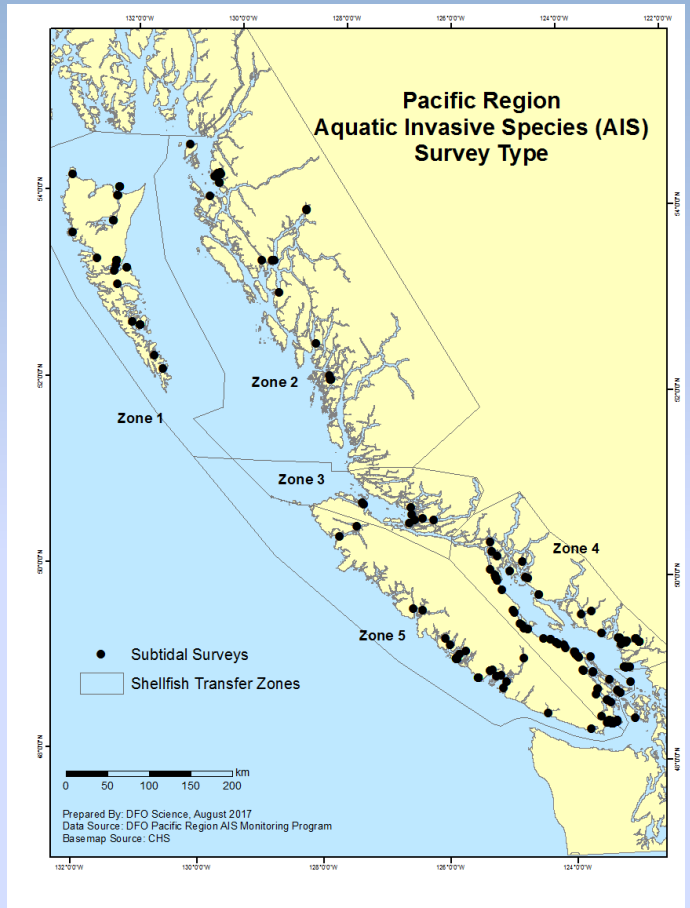


Red Seaweed (Hydrazoa) – New Scope

BC AIS Monitoring



2018 only



All years

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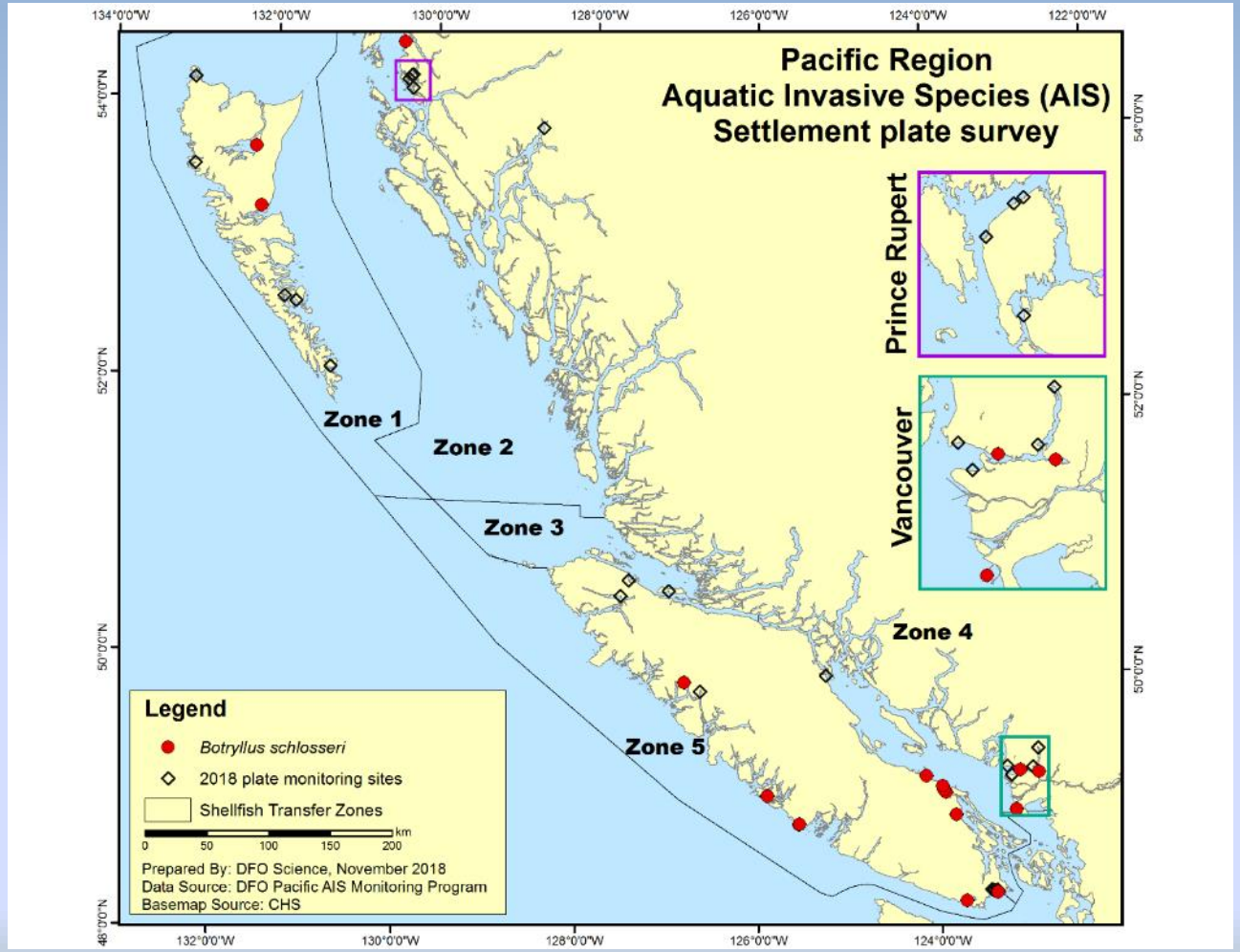
Botryllus schlosseri



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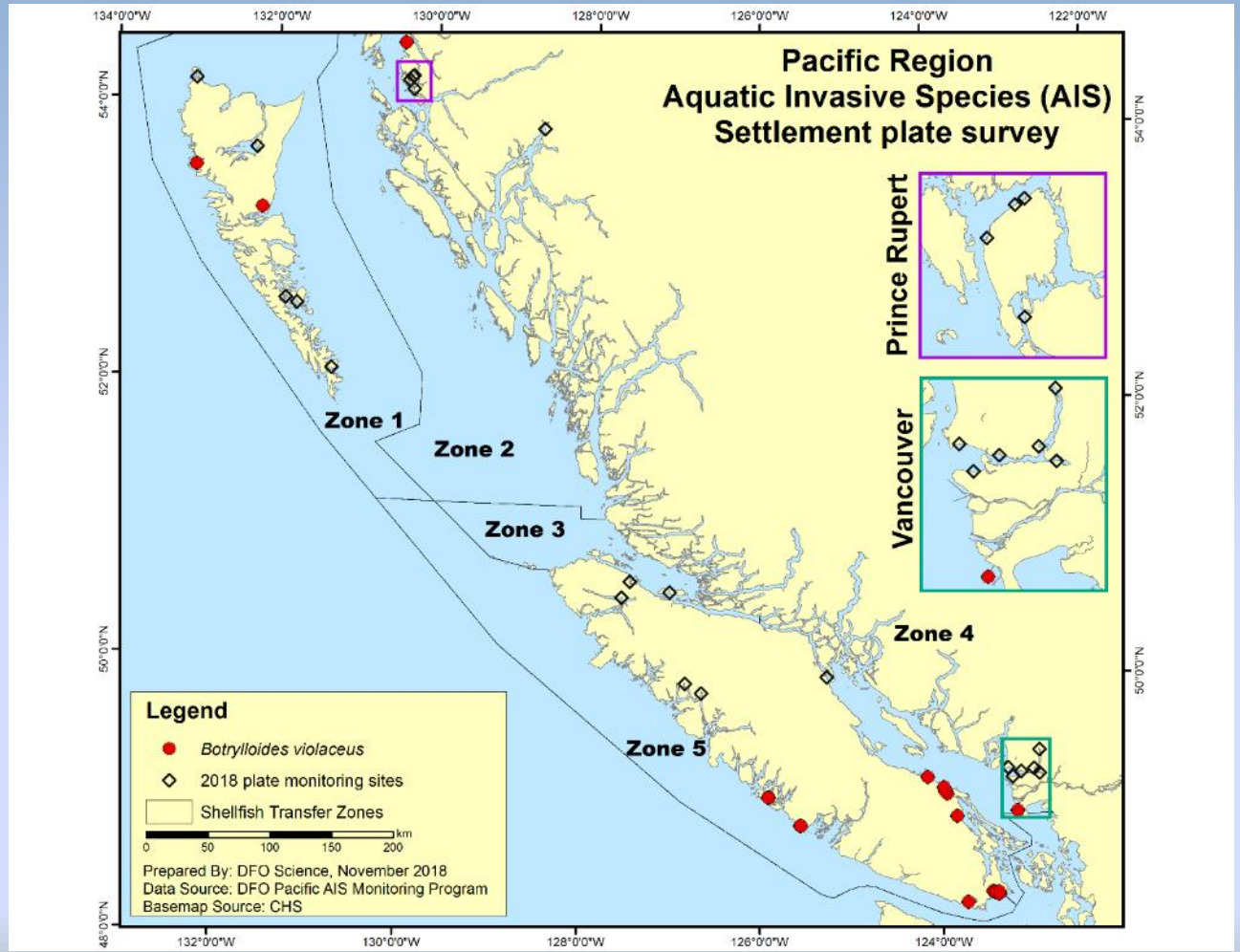
Botrylloides violaceus



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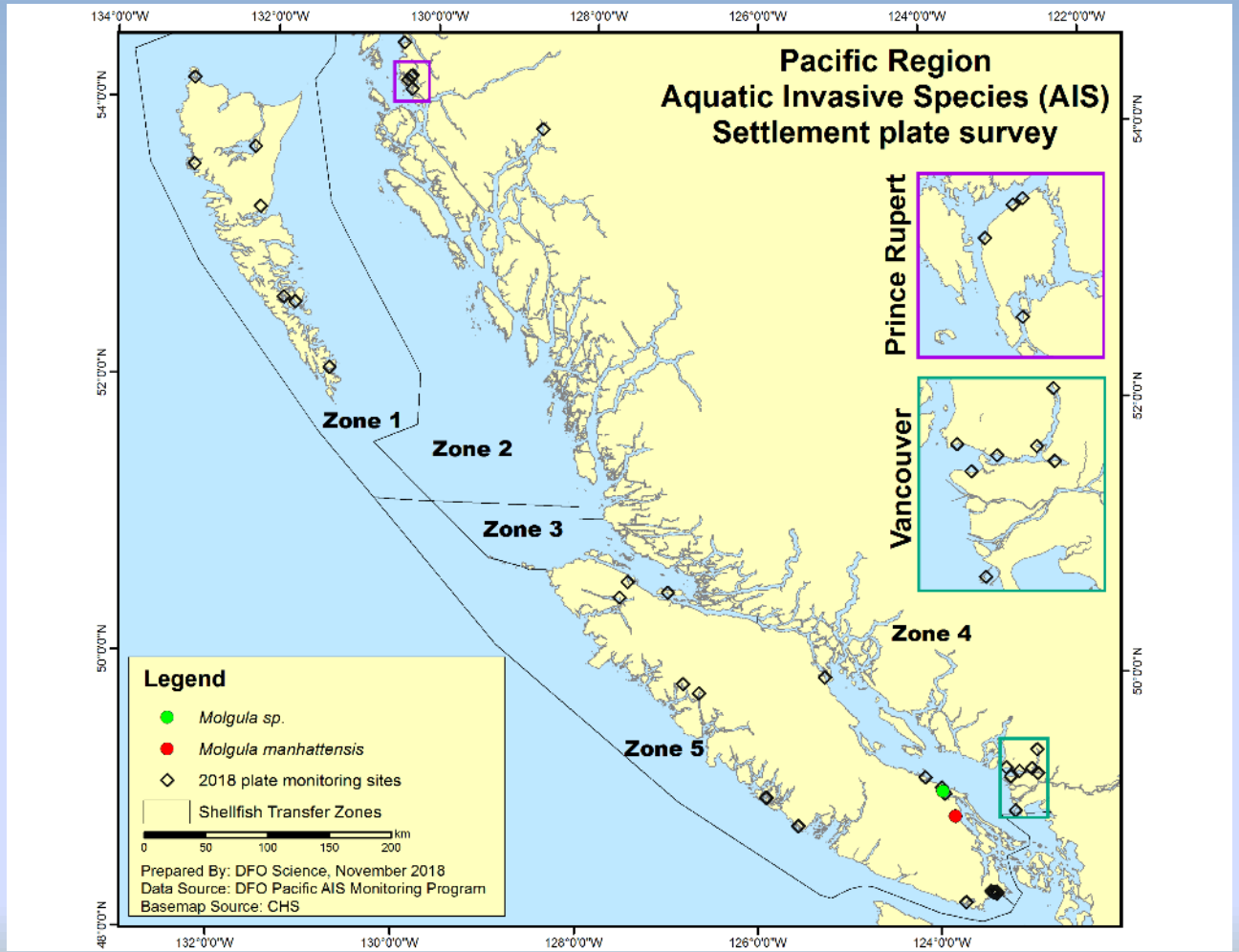
Molgula manhattensis



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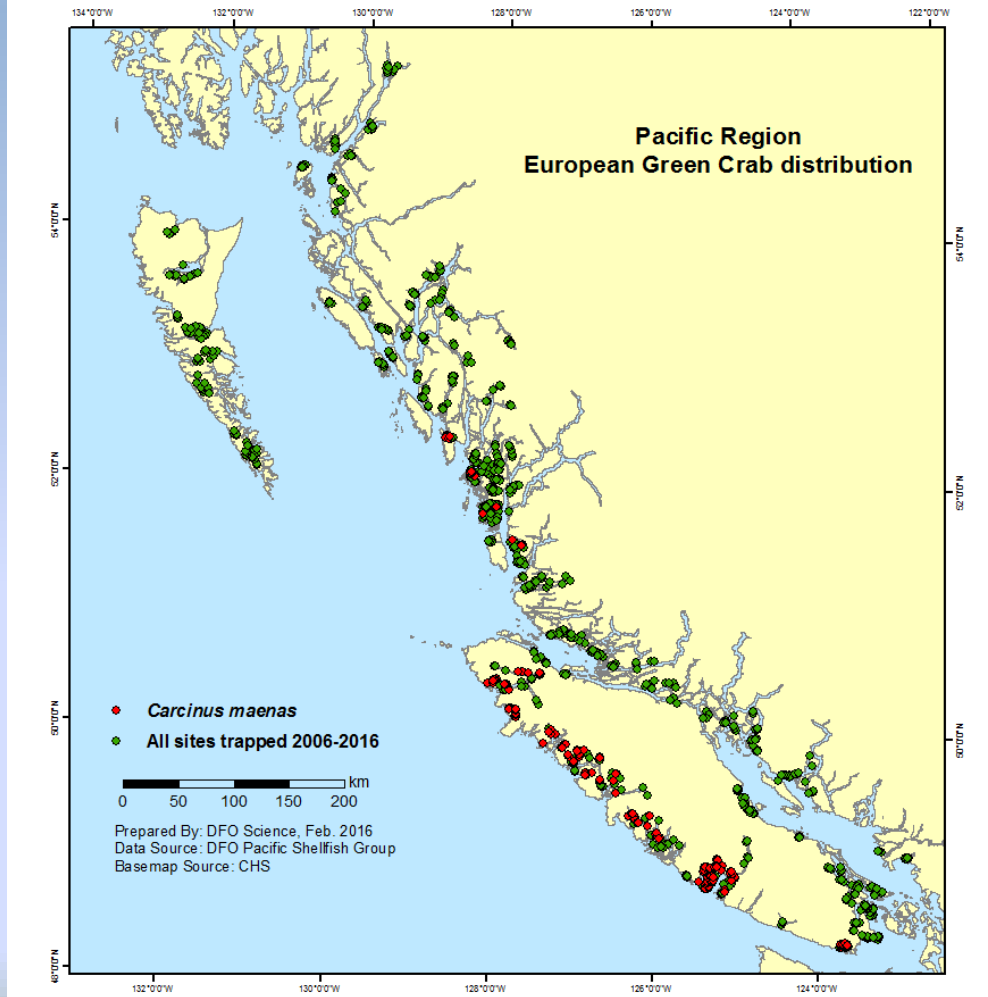
European Green Crab in BC

No adults detected in Port of Prince Rupert waters yet but we are tracking northward spread of this species



AIS Monitoring Tools

- Species identification can be challenging
  - Complicated for early life history stages
  - Considerable taxonomic uncertainty for some groups
  - Existing keys often do not contain AIS
  - Need to differentiate from native species

- Molecular tools offer some promise for AIS detection/ID/monitoring
  - qPCR and Next Generation Sequencing (e.g., 454)
  - e-DNA methodologies

Molecular Tool Limitations (Warning!)

- DNA databases are often incomplete or contain errors
  - Not developed for AIS
  - Taxonomic expertise often questionable
  - Standard genes don't work for all taxa

- However, they do represent a potential cost-effective methodology that could allow greater spatial/temporal coverage compared to existing monitoring techniques

Conclusions

- So far very few AIS detected in Prince Rupert
- Collaborations are essential to undertake longer-term monitoring project like this
- AIS Monitoring is providing important baseline data to be able to compare changes over time
  - E.g., climate change impacts, pollution

Conclusions

- These monitoring programs are relatively low cost and easy to implement
- They also foster capacity building, especially in more remote locations
- Integrated groups like the AIS WG in Prince Rupert provide greater social license

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