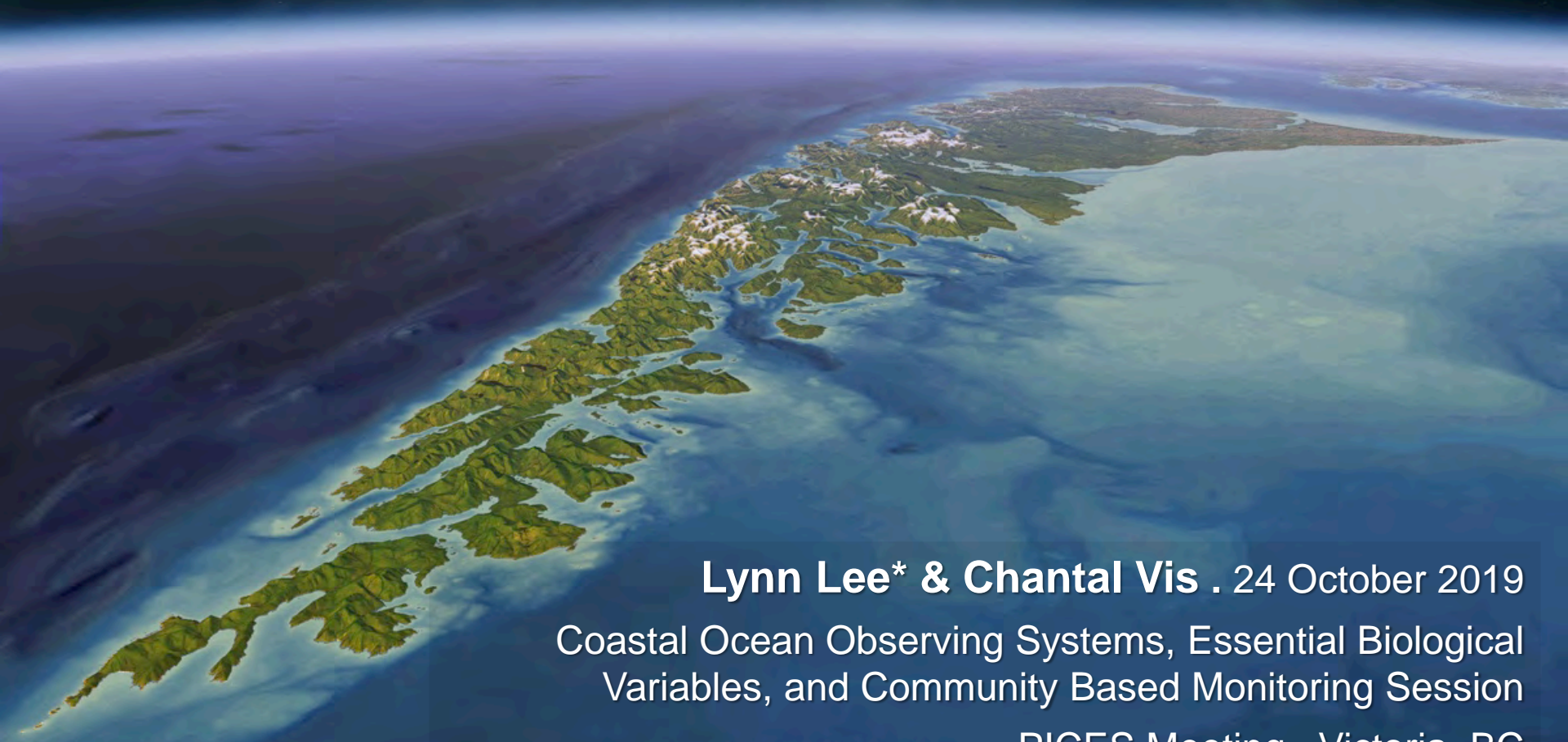


Establishing a long-term marine monitoring program for Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site



Lynn Lee* & Chantal Vis . 24 October 2019

Coastal Ocean Observing Systems, Essential Biological
Variables, and Community Based Monitoring Session

PICES Meeting . Victoria, BC

Parks Canada's Network of Protected Heritage Areas

Marine Regions

- Pacific Ocean**
1. Hecate Strait
 2. Queen Charlotte Shelf
 3. Queen Charlotte Sound
 4. Vancouver Island Shelf
 5. Strait of Georgia

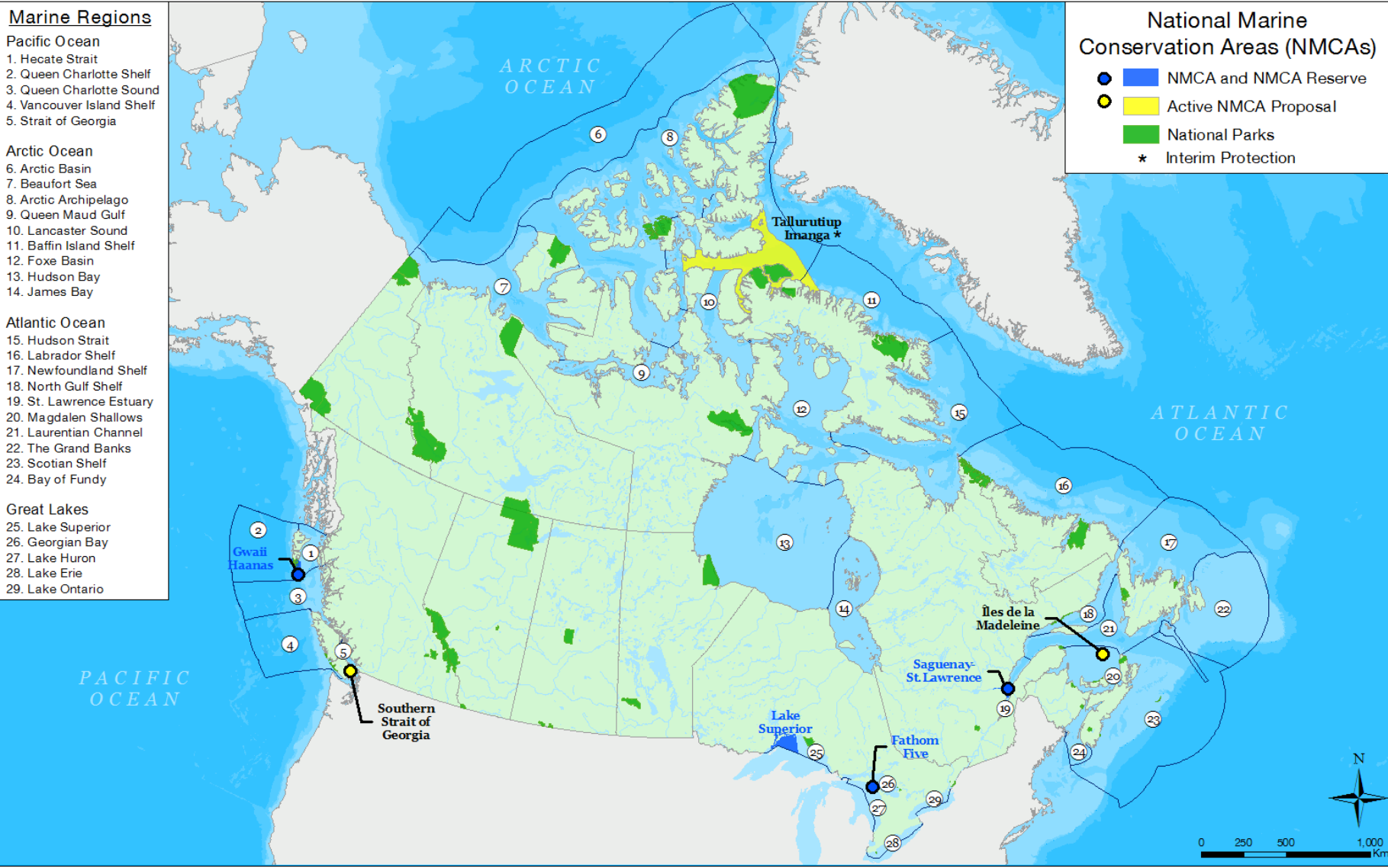
- Arctic Ocean**
6. Arctic Basin
 7. Beaufort Sea
 8. Arctic Archipelago
 9. Queen Maud Gulf
 10. Lancaster Sound
 11. Baffin Island Shelf
 12. Foxe Basin
 13. Hudson Bay
 14. James Bay

- Atlantic Ocean**
15. Hudson Strait
 16. Labrador Shelf
 17. Newfoundland Shelf
 18. North Gulf Shelf
 19. St. Lawrence Estuary
 20. Magdalen Shallows
 21. Laurentian Channel
 22. The Grand Banks
 23. Scotian Shelf
 24. Bay of Fundy

- Great Lakes**
25. Lake Superior
 26. Georgian Bay
 27. Lake Huron
 28. Lake Erie
 29. Lake Ontario

National Marine Conservation Areas (NMCAs)

- NMCA and NMCA Reserve
- Active NMCA Proposal
- National Parks
- * Interim Protection



Parks Parcs

2018



Parks Canada's Network of Protected Heritage Areas

Marine Regions

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1. Hecate Strait
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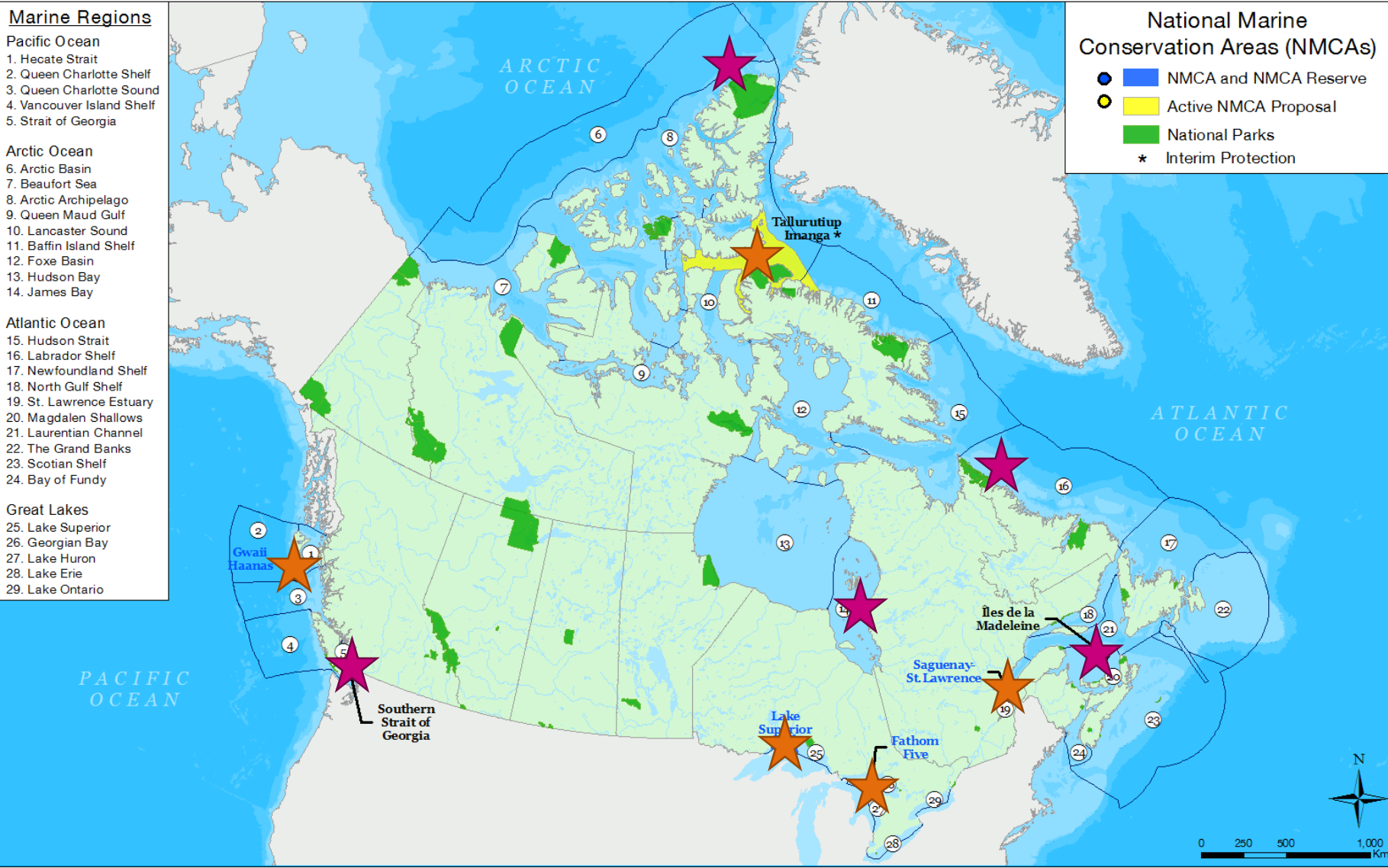
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National Marine Conservation Areas (NMCAs)

- NMCA and NMCA Reserve
- Active NMCA Proposal
- National Parks
- Interim Protection



Diversity of Connected People & Places



Diversity of Connected People & Places



Ecosystems

Knowledge

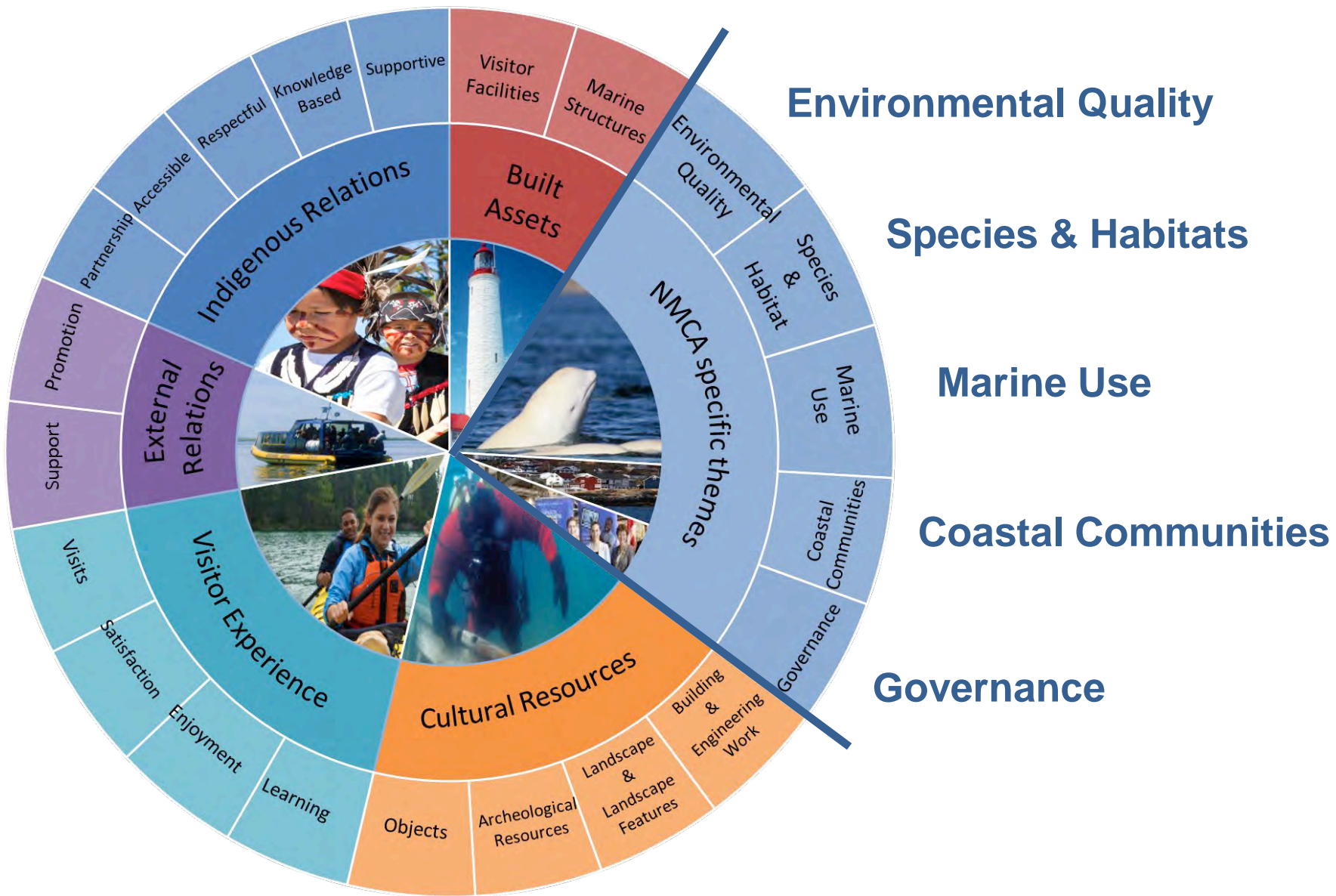
Visitor
experience

Sustainable
use

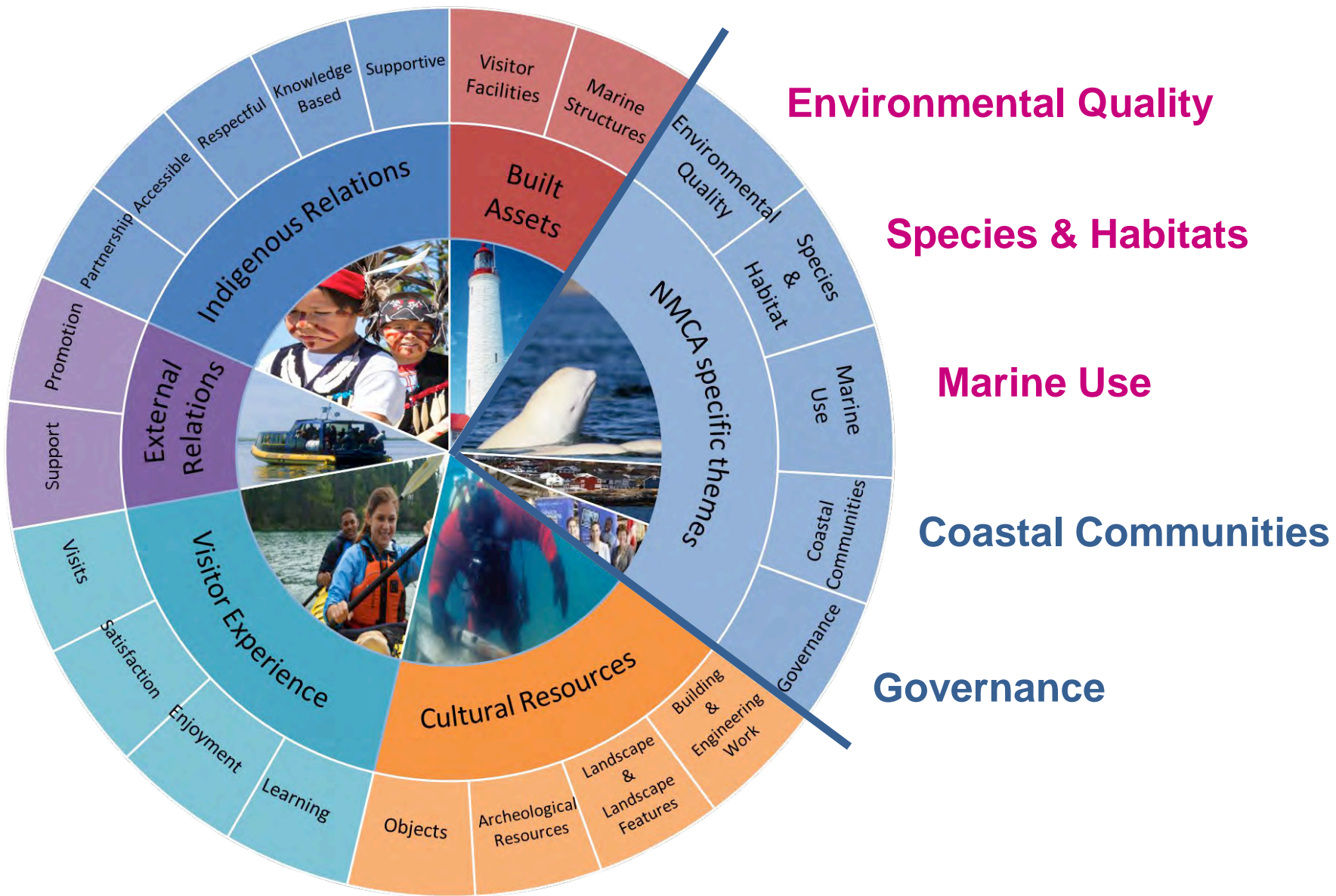
Coastal
communities

Culture

5 Themes for Marine Monitoring



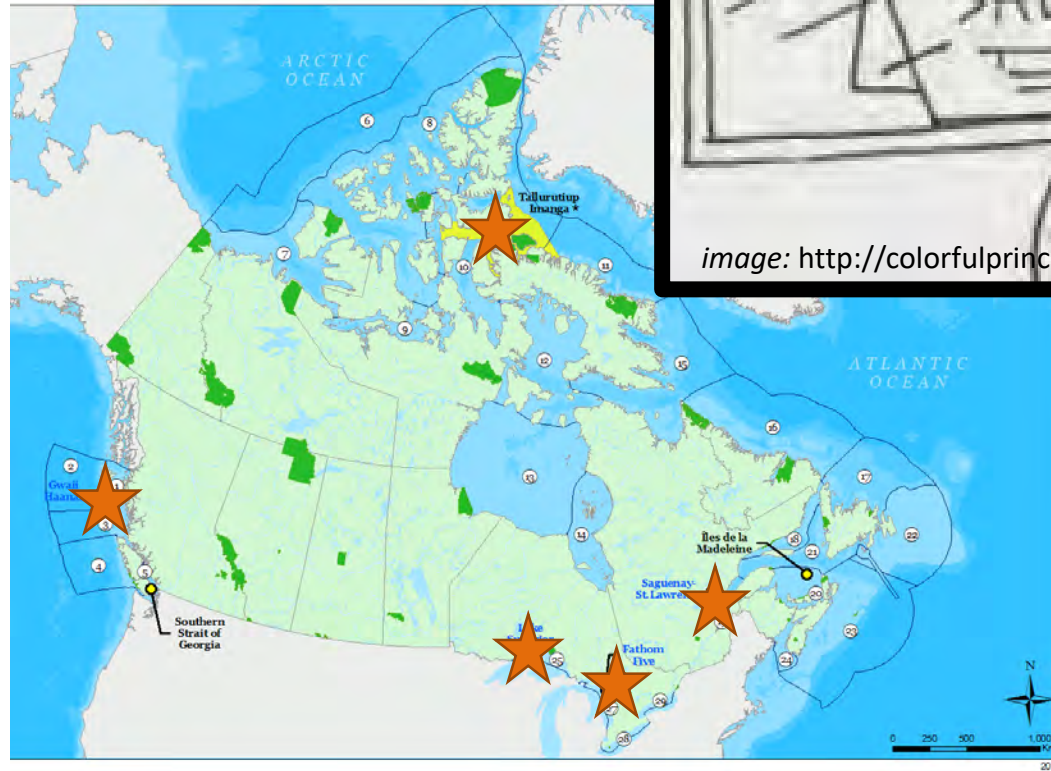
5 Themes for Marine Monitoring



National Marine Monitoring Framework

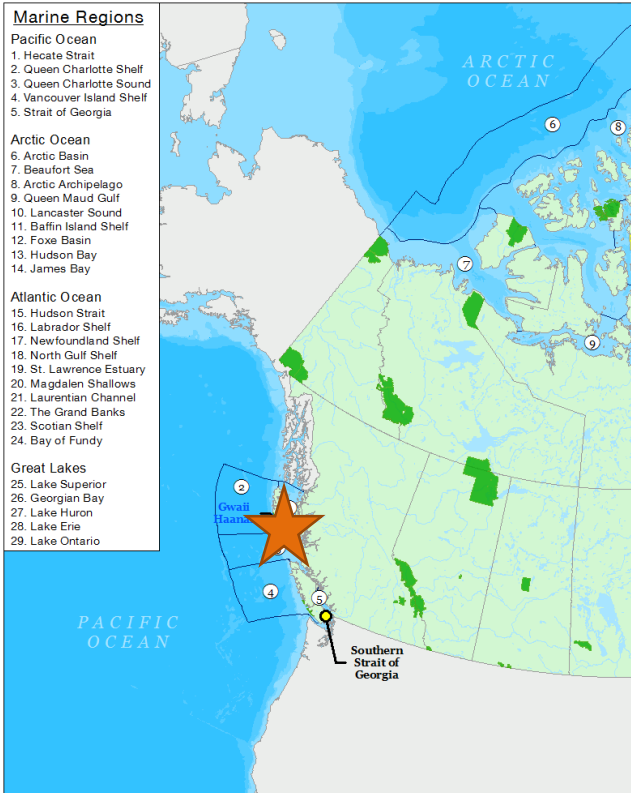
The Challenge & Opportunity...

Integrated place-based monitoring program

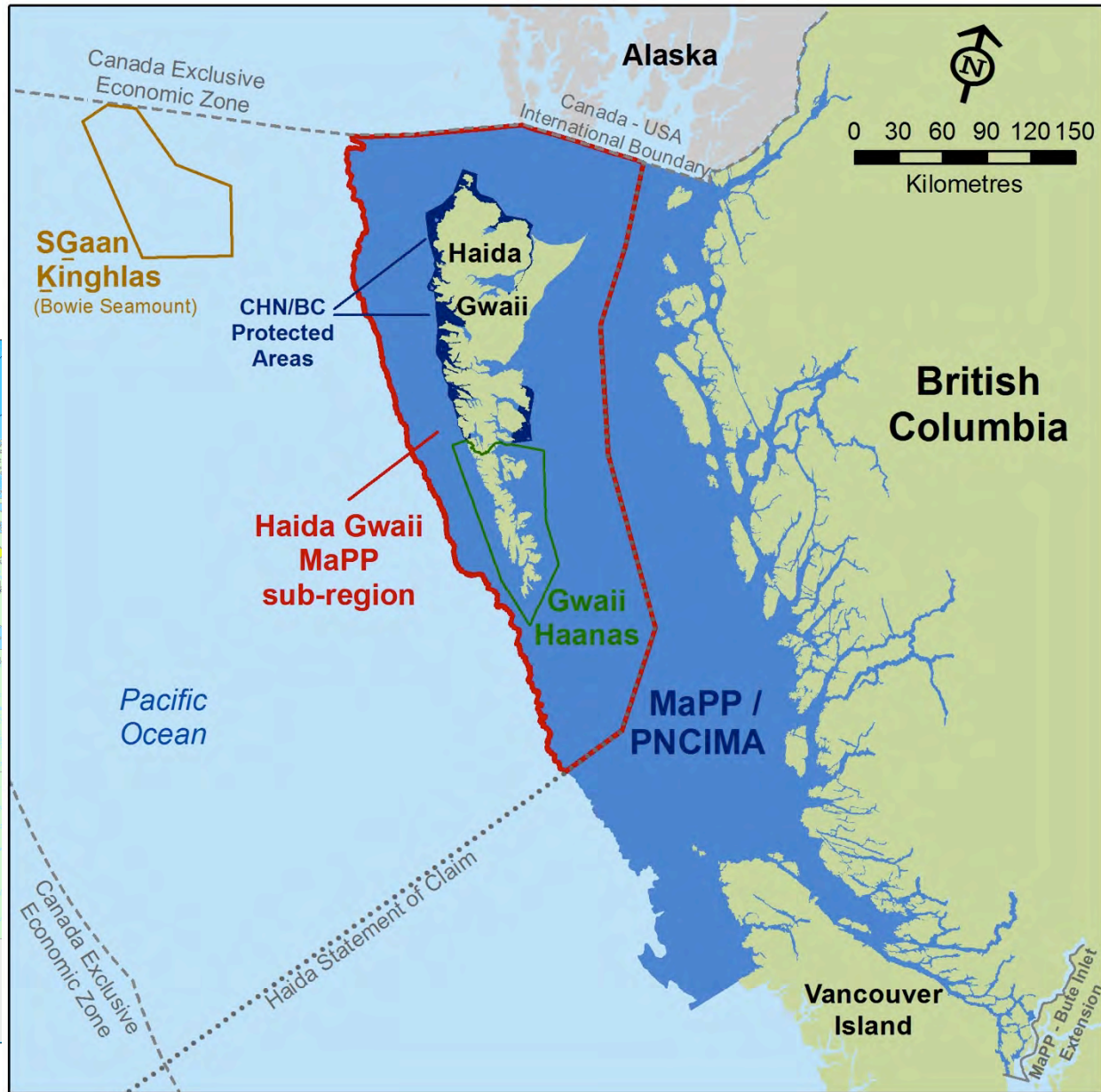


Consistent, yet flexible monitoring framework to fit diversity of sites

Experience from Gwaii Haanas



Parks Canada Parks Canada

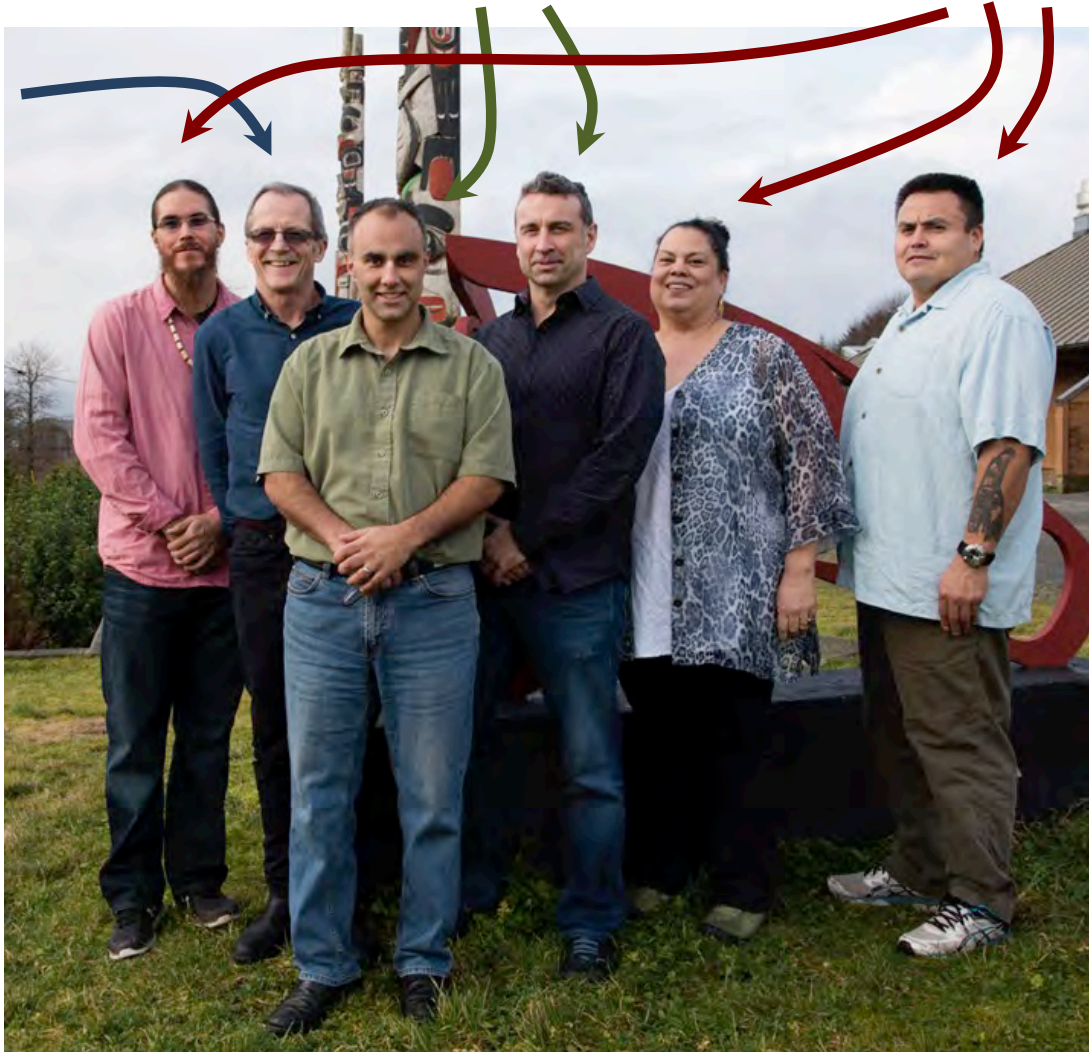


Gwaii Haanas Archipelago Management Board

**Fisheries
and Oceans
Canada**

Parks Canada

Haida Nation

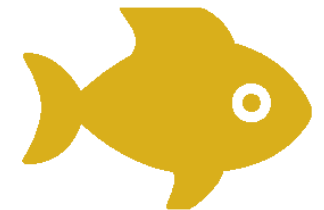
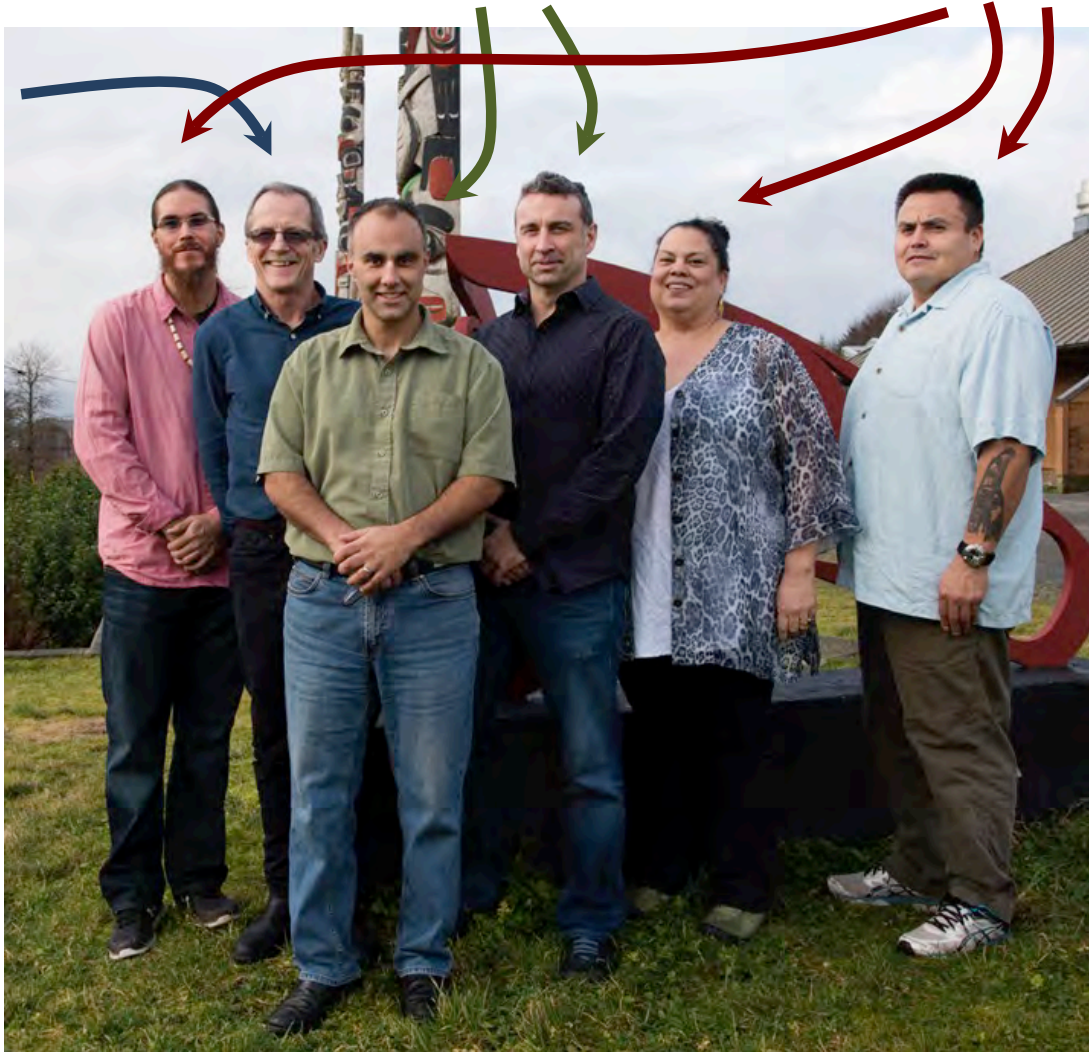


Gwaii Haanas Archipelago Management Board

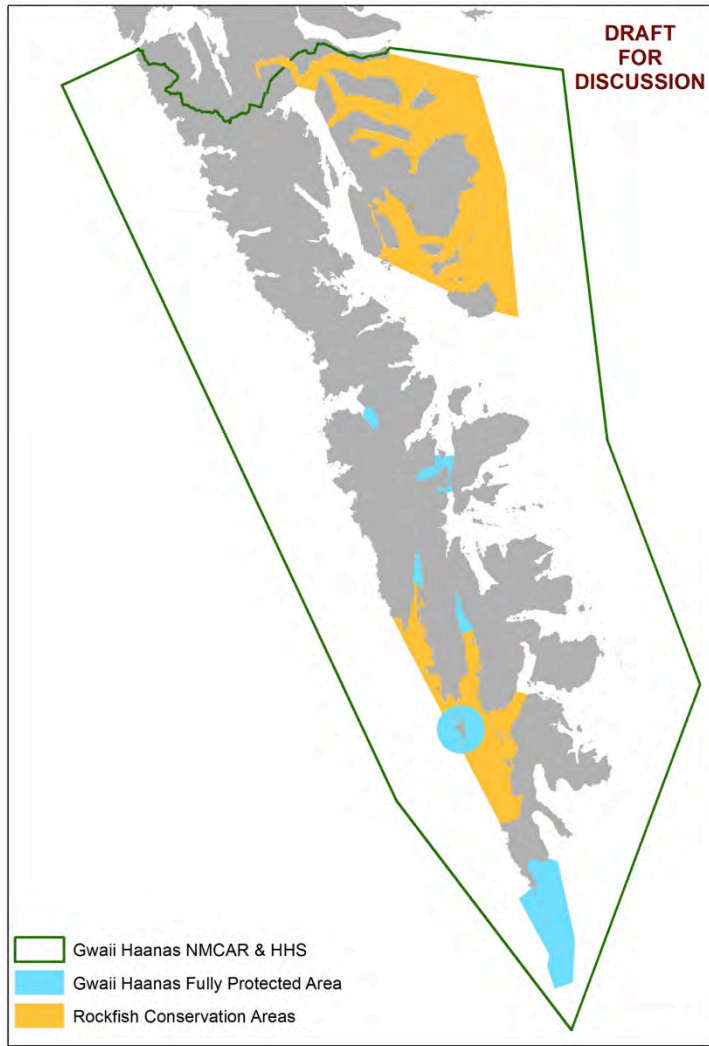
Fisheries
and Oceans
Canada

Parks Canada

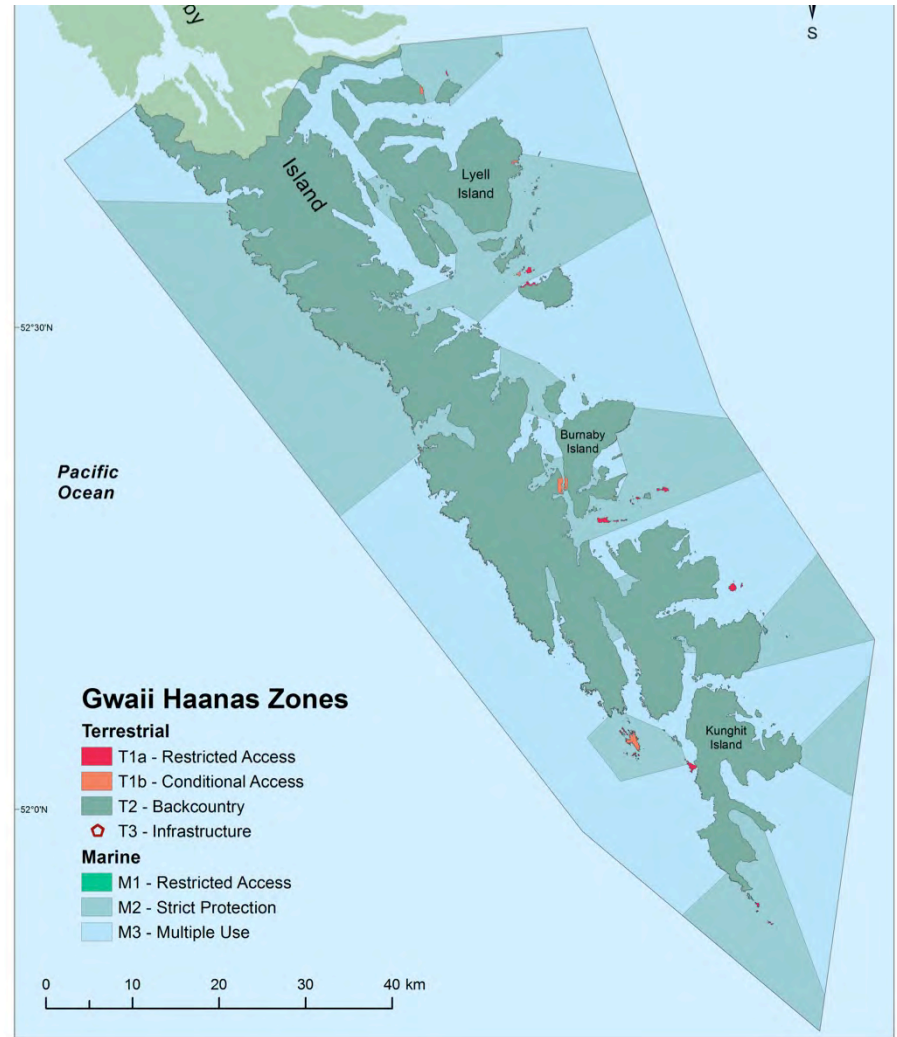
Haida Nation



Spatial Zoning



Previous



Final LSP Nov 2018

LSP

MM

SAR

CoRe

EBM

Ecological, Cultural, Social, Economic, Governance & Management Objectives & Targets

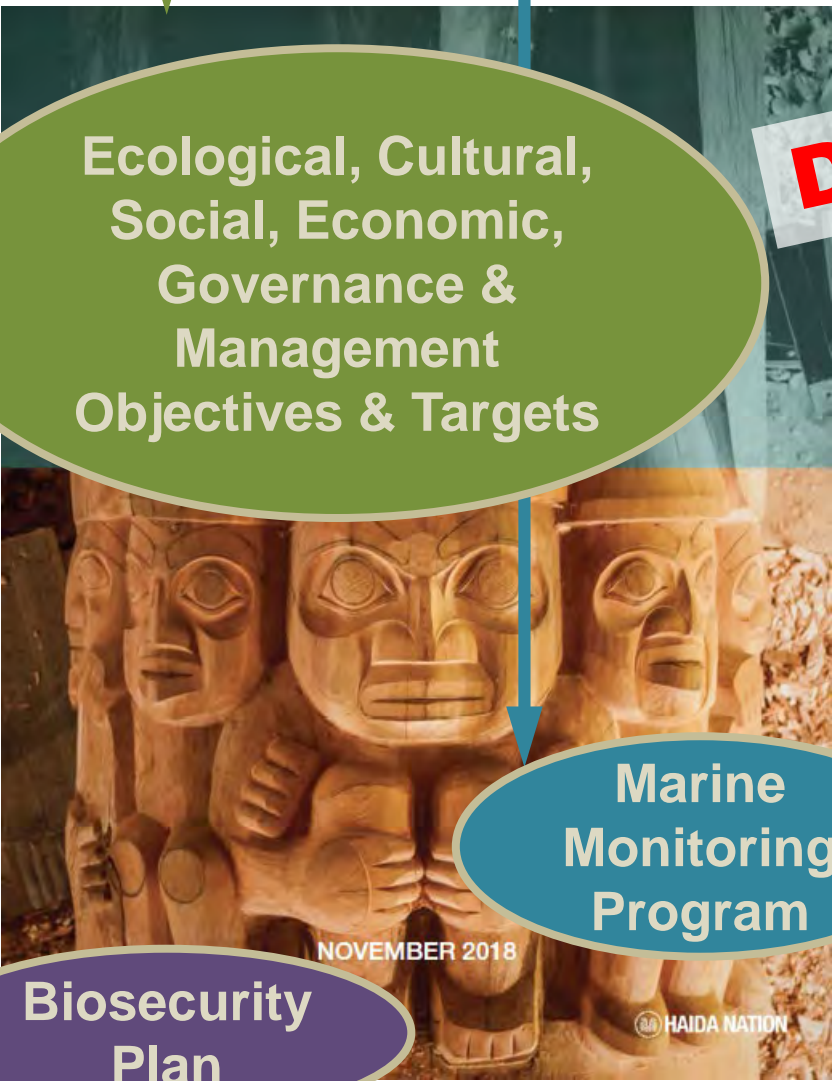
Marine Monitoring Program

Biosecurity Plan

Drivers

Conservation & Restoration

Ecosystem Based Management



LSP

MM

SAR

CoRe

EBM

Environmental Quality Pressures

Species & Habitats

Marine Use Pressures

ECVs

Ecological & Biological EOVs

LSP

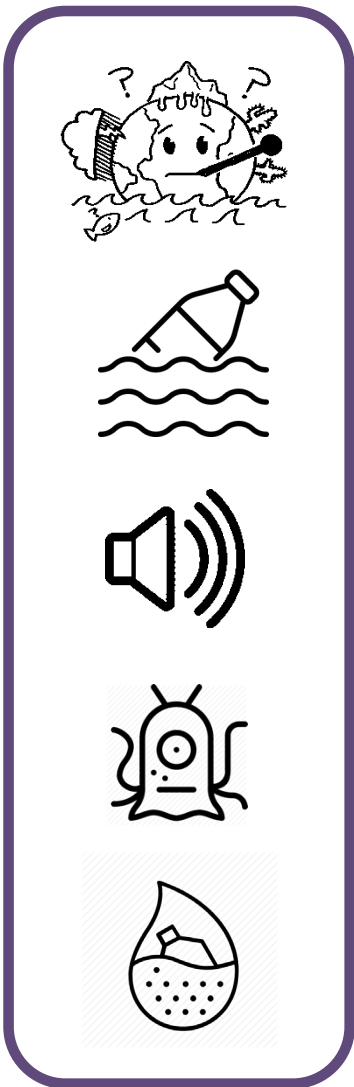
MM

SAR

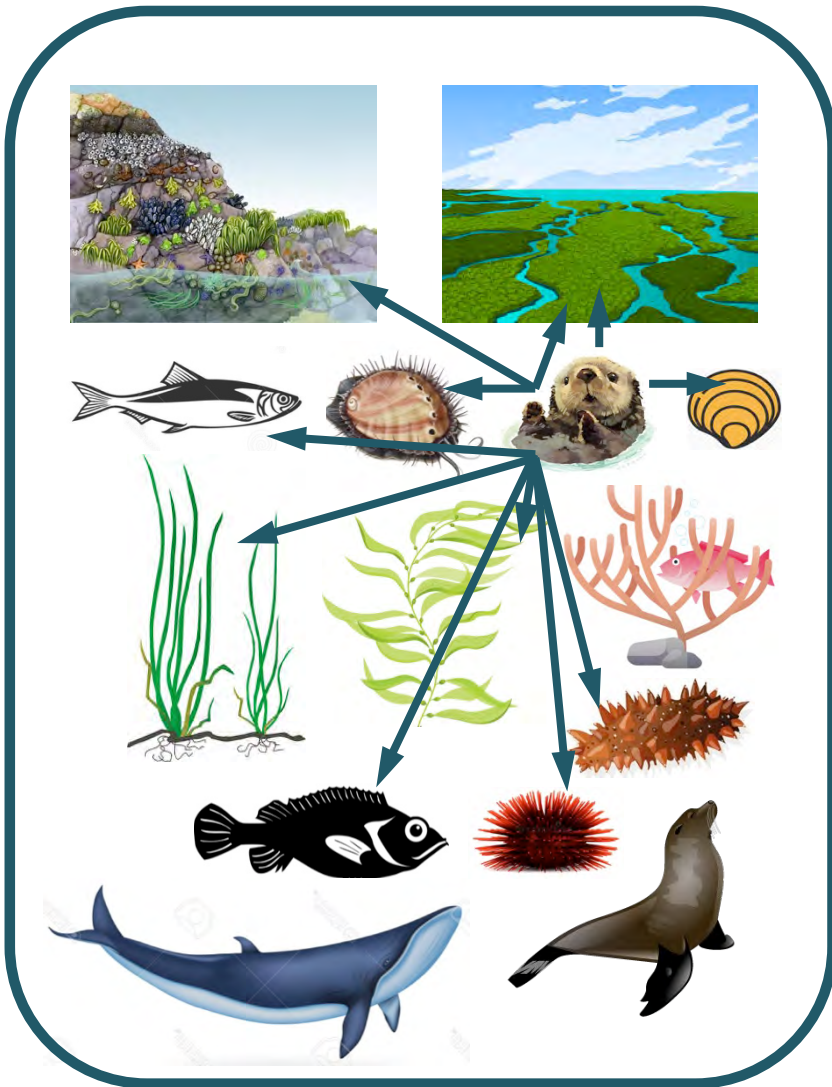
CoRe

EBM

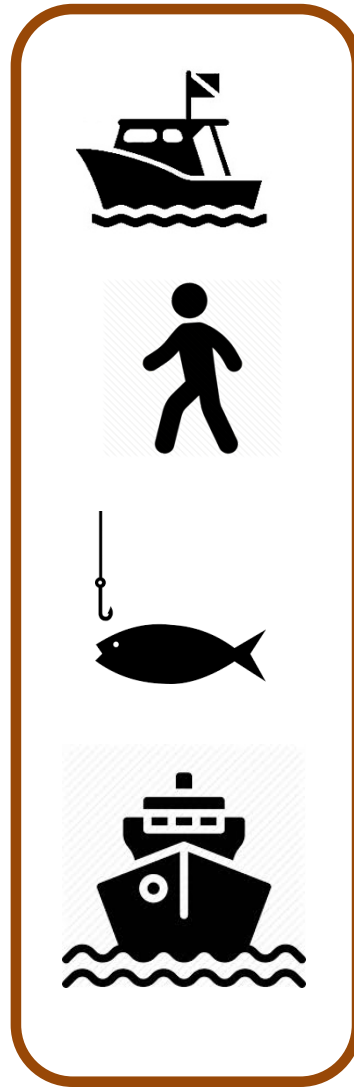
Environmental quality



Species & Habitats



Marine use



LSP

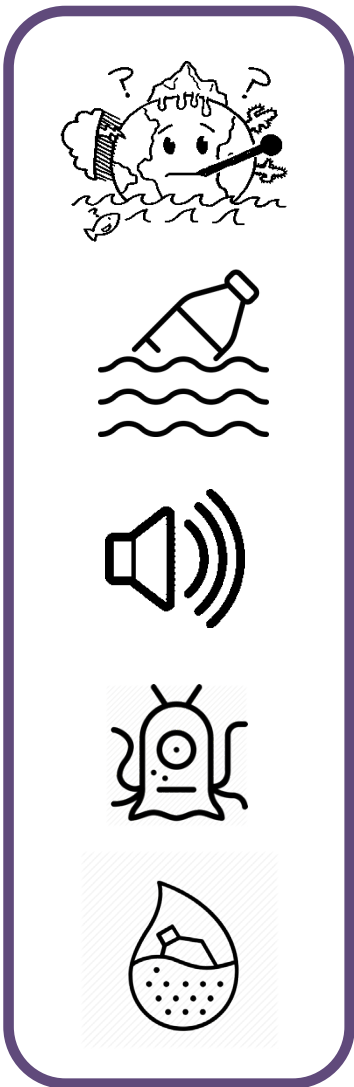
MM

SAR

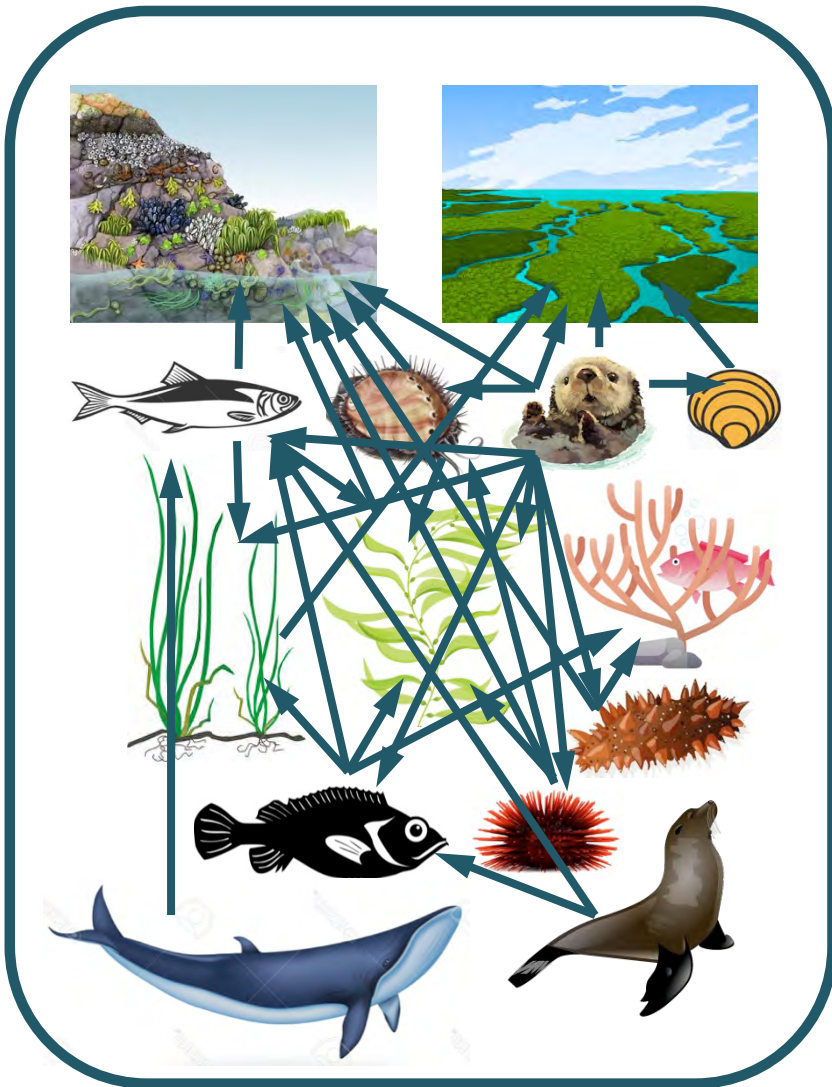
CoRe

EBM

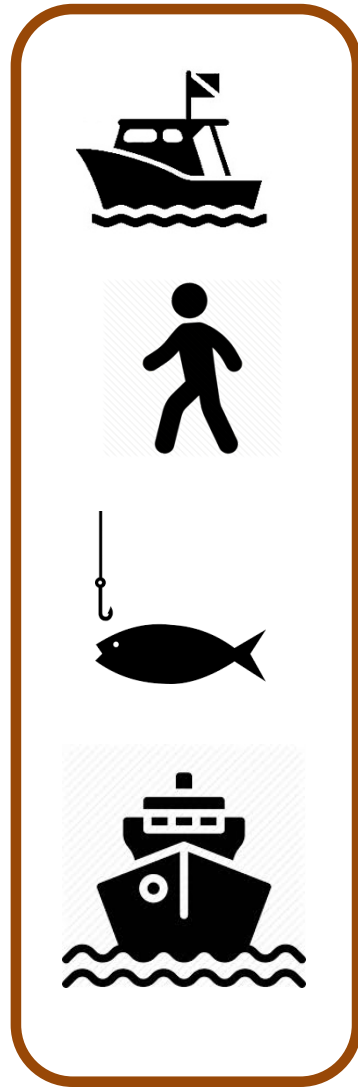
Environmental quality



Species & Habitats



Marine use



LSP

MM

SAR

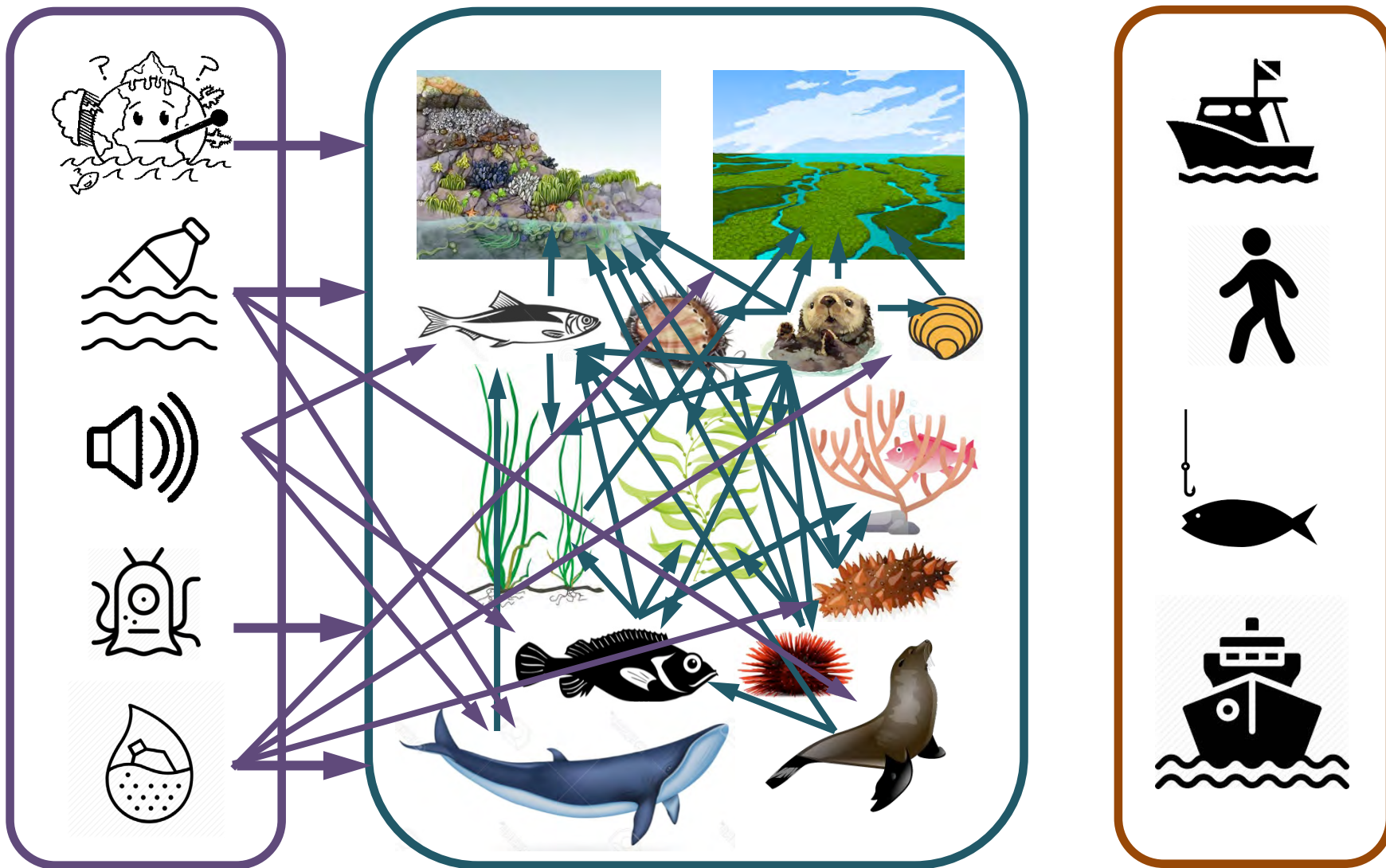
CoRe

EBM

Environmental
quality

Species & Habitats

Marine use



LSP

MM

SAR

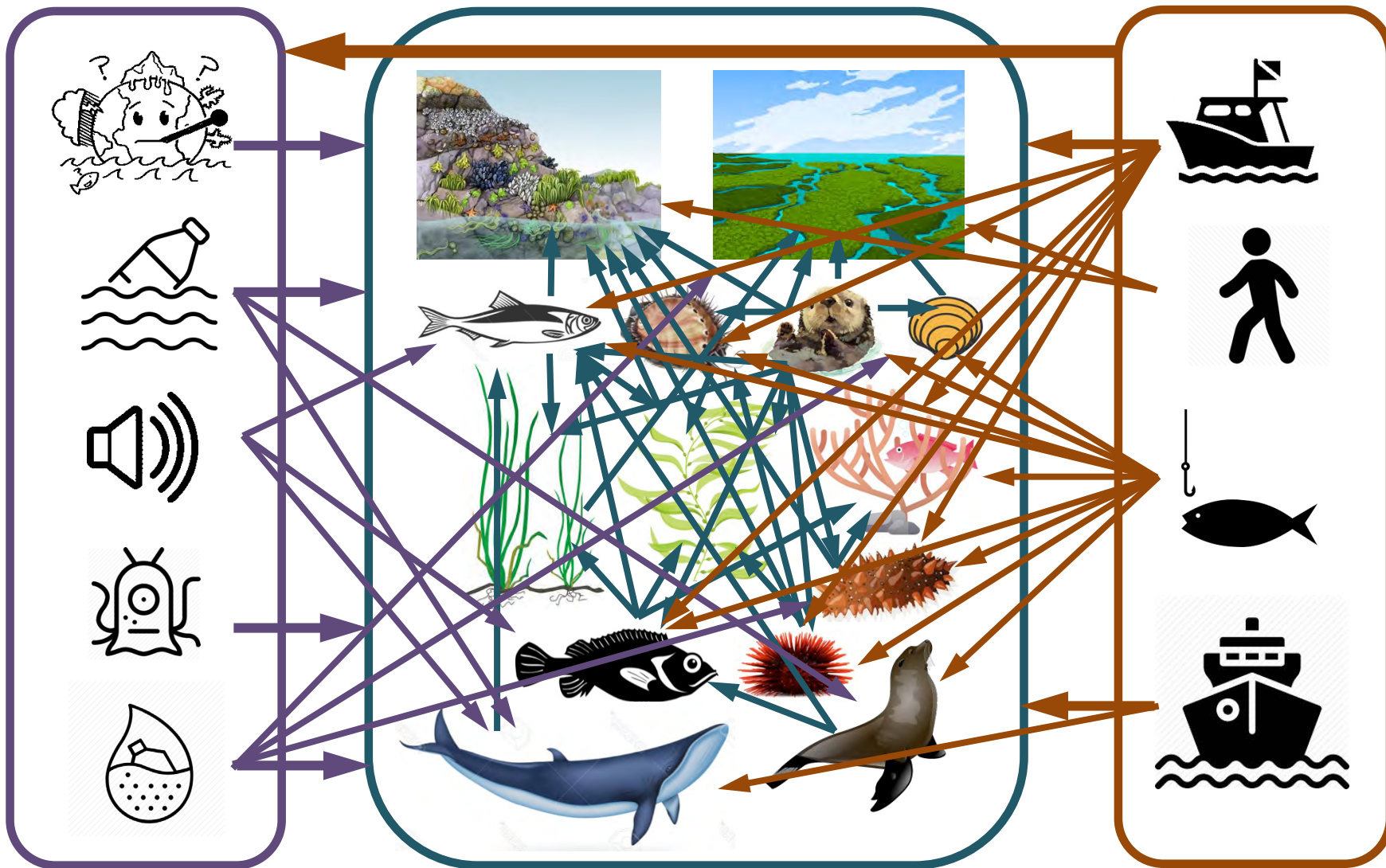
CoRe

EBM

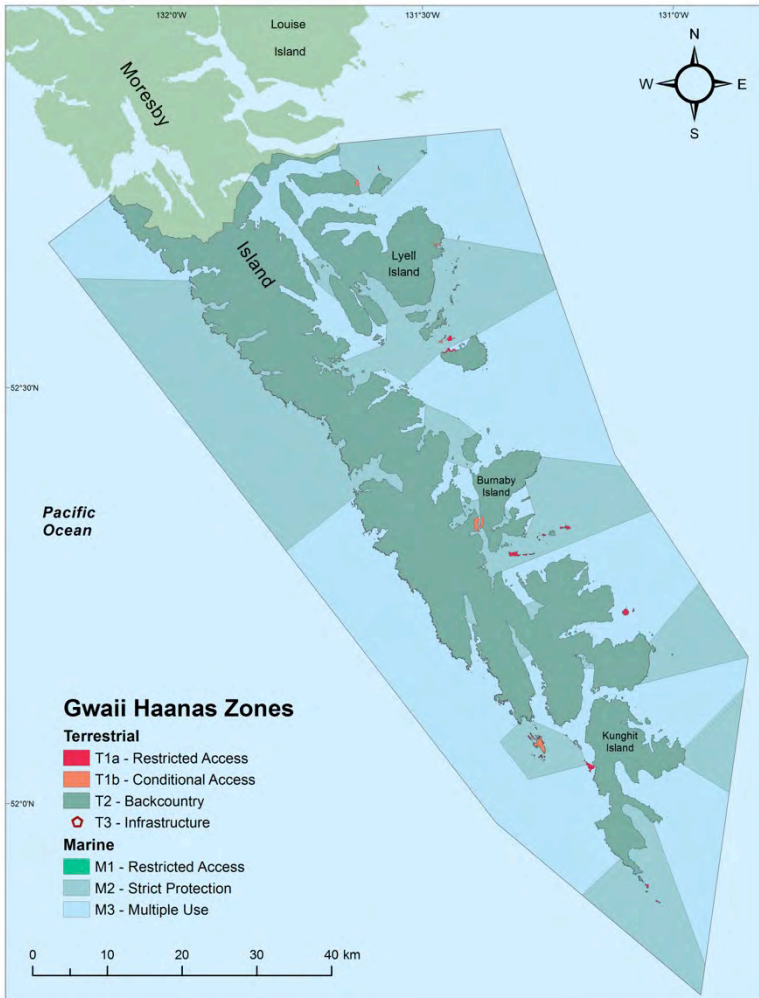
Environmental
quality

Species & Habitats

Marine use

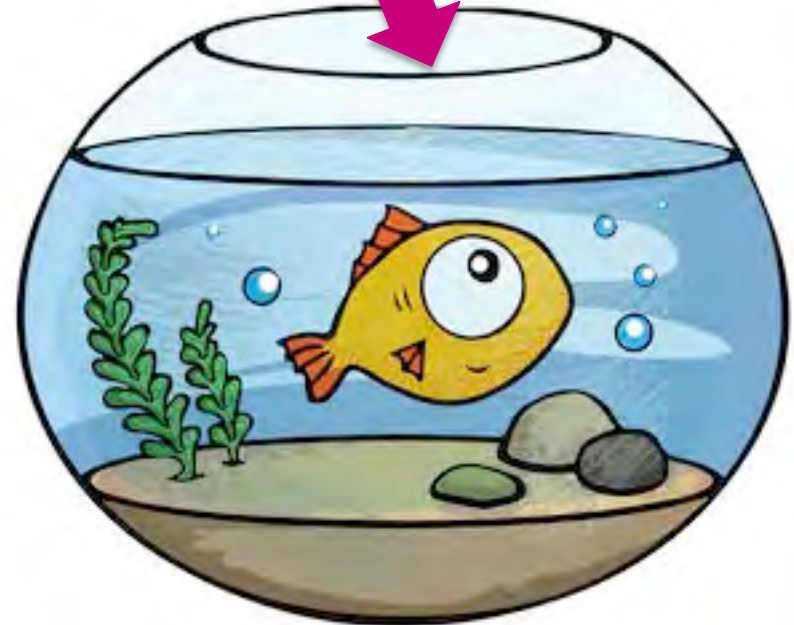


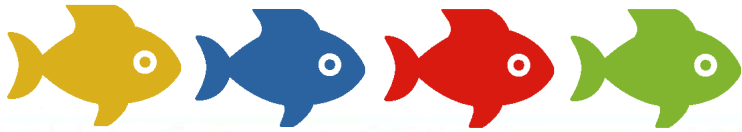
How We are a Fishbowl



5 stories

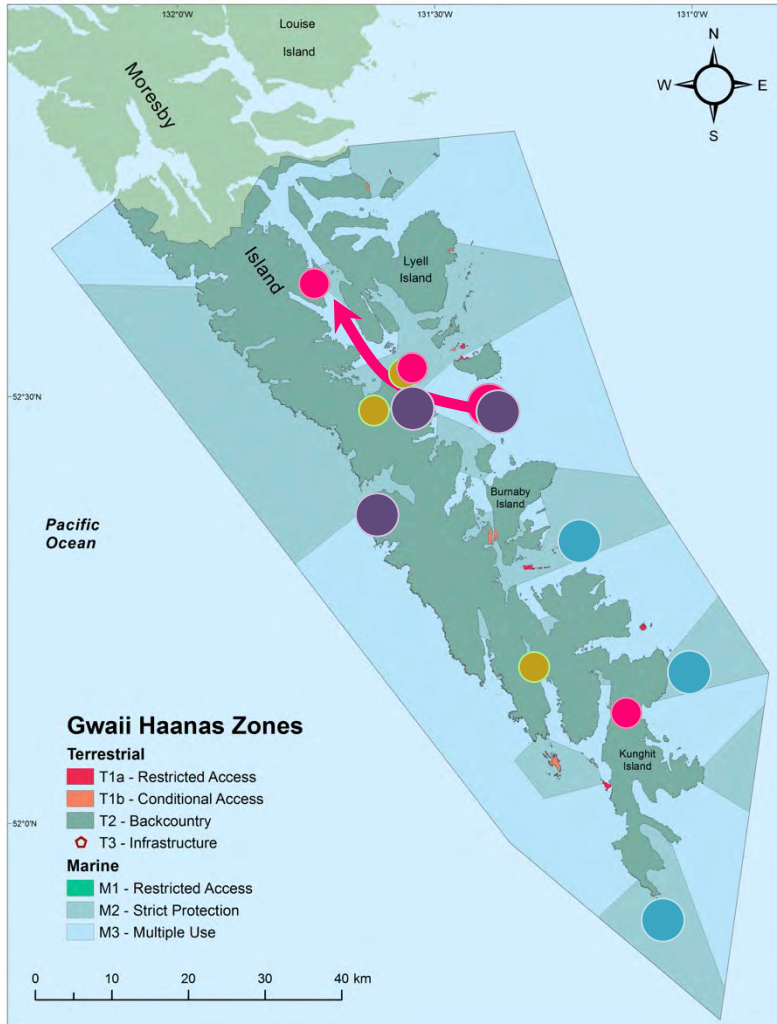
- Ocean condition
- Invasive species
- Eelgrass
- Kelp
- Abalone





Ocean condition

- Mooring buoy
- Tidbits for SST
- TSG on Gwaii Haanas II



Pollution Tracker

Ocean noise & Cetacean use

- Hydrophones
- Cetacean Sightings

Pinnipeds & Sea otters

- Sea lions
- Harbour seals

LSP

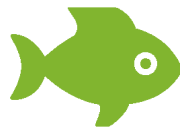
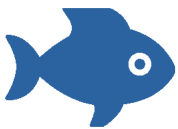
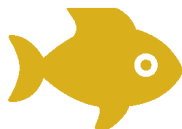
MM

SAR

CoRe

EBM

**Hakai
Institute &
academia**



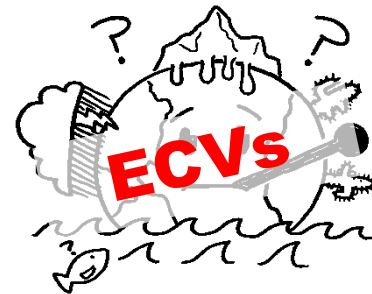
Ocean Condition

(1) Nearshore temperature sensors
Summer 2016 - present

(2) Juan Perez Sound mooring buoy with DFO
Summer 2017-2021

(3) Ocean Condition Compilation & Expert Workshop
Feb 2019

(4) Purchase ocean pH sensor & CTD (sonde)
March 2019



(5) RV DT cruise with CTD
Jun/Jul 2019



(1) Good data for some sites; other sites blown out over winter

(2) Good data Conductivity, temperature & depth + currents (2017) + ocean noise & cetacean calls (2018)

(3) Recommended indicators & metrics for ocean condition monitoring

(4) pH sensors deployed on JPS mooring buoy
Data expected summer 2020

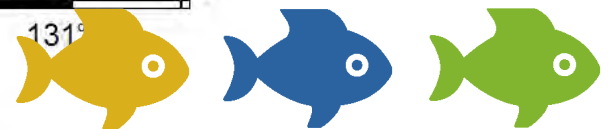
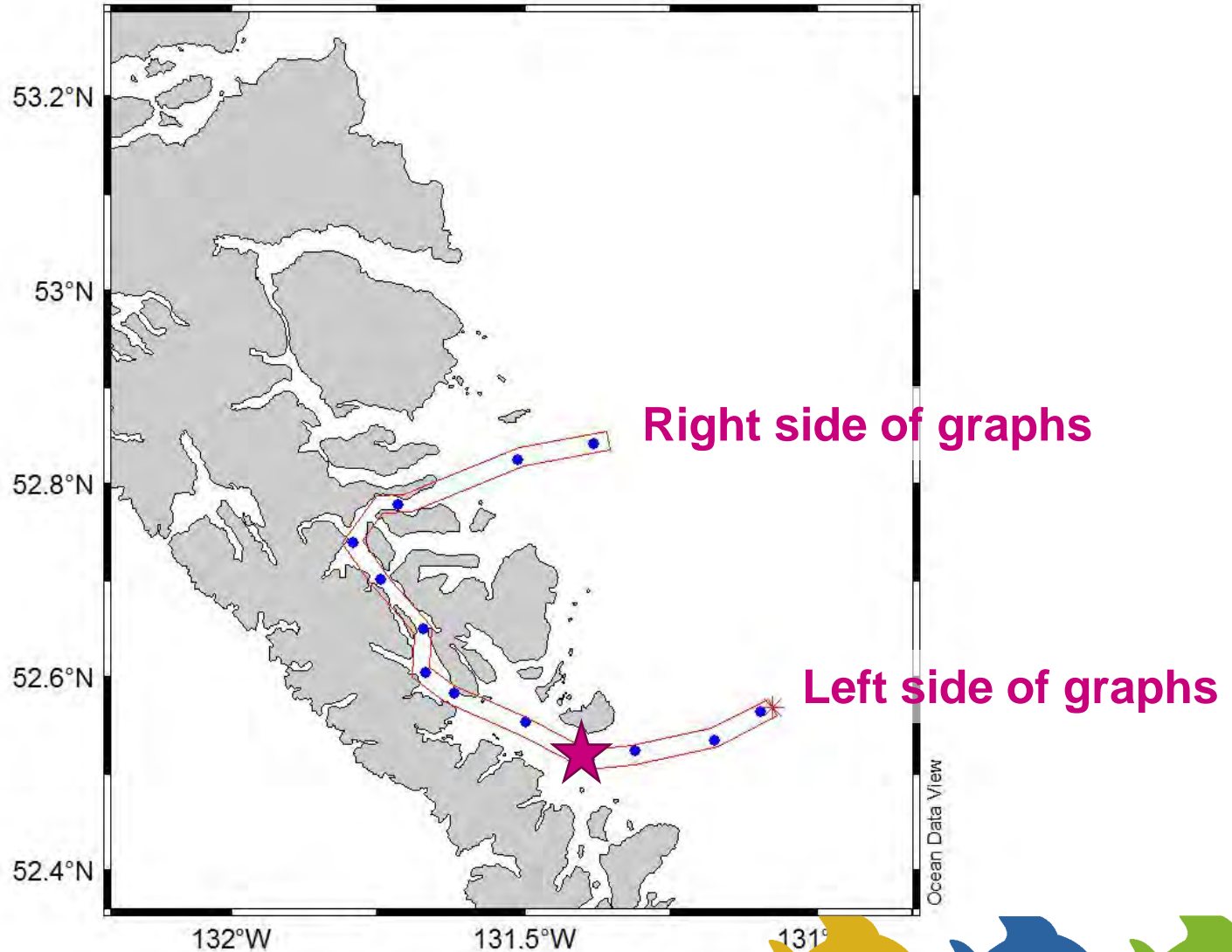
Satellite imagery

SAR AP \$

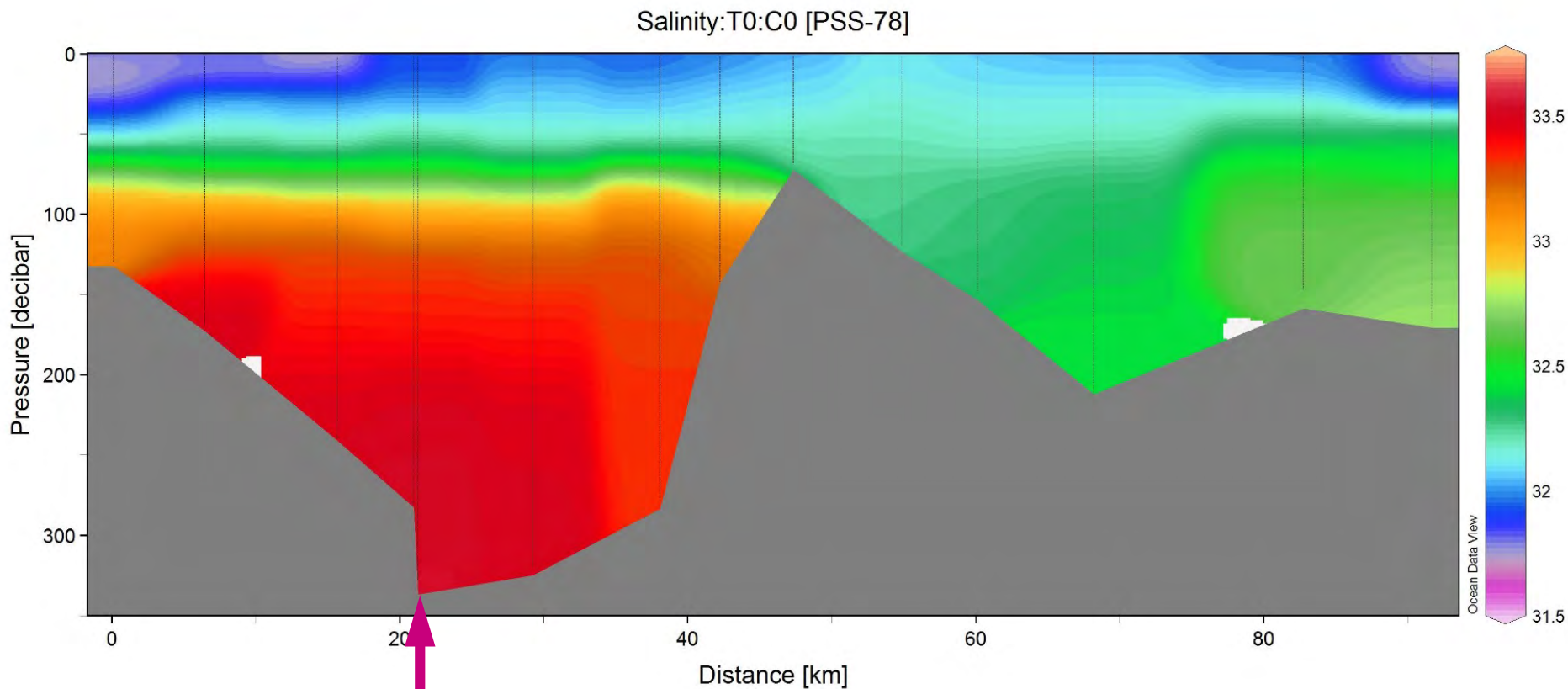
SAR AP \$

CTD profiles around Lyell Island

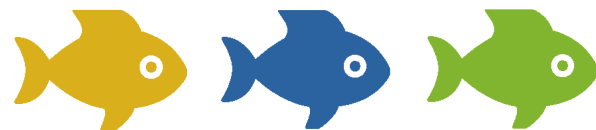
August 2018 - south to north clockwise



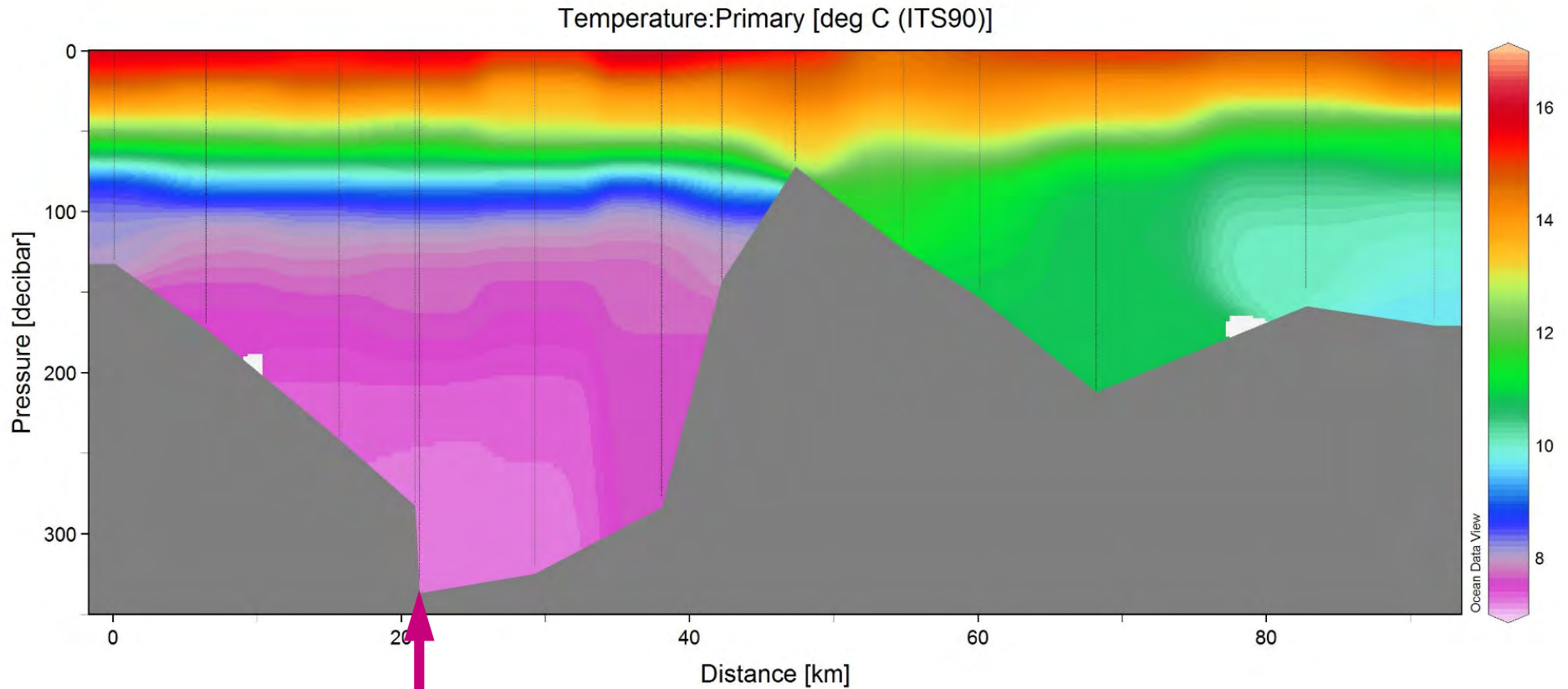
Salinity – Aug 2018



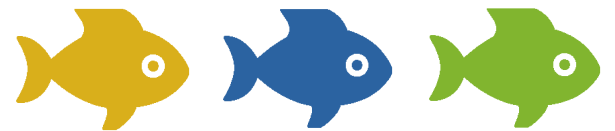
**Mooring location
365 m depth**



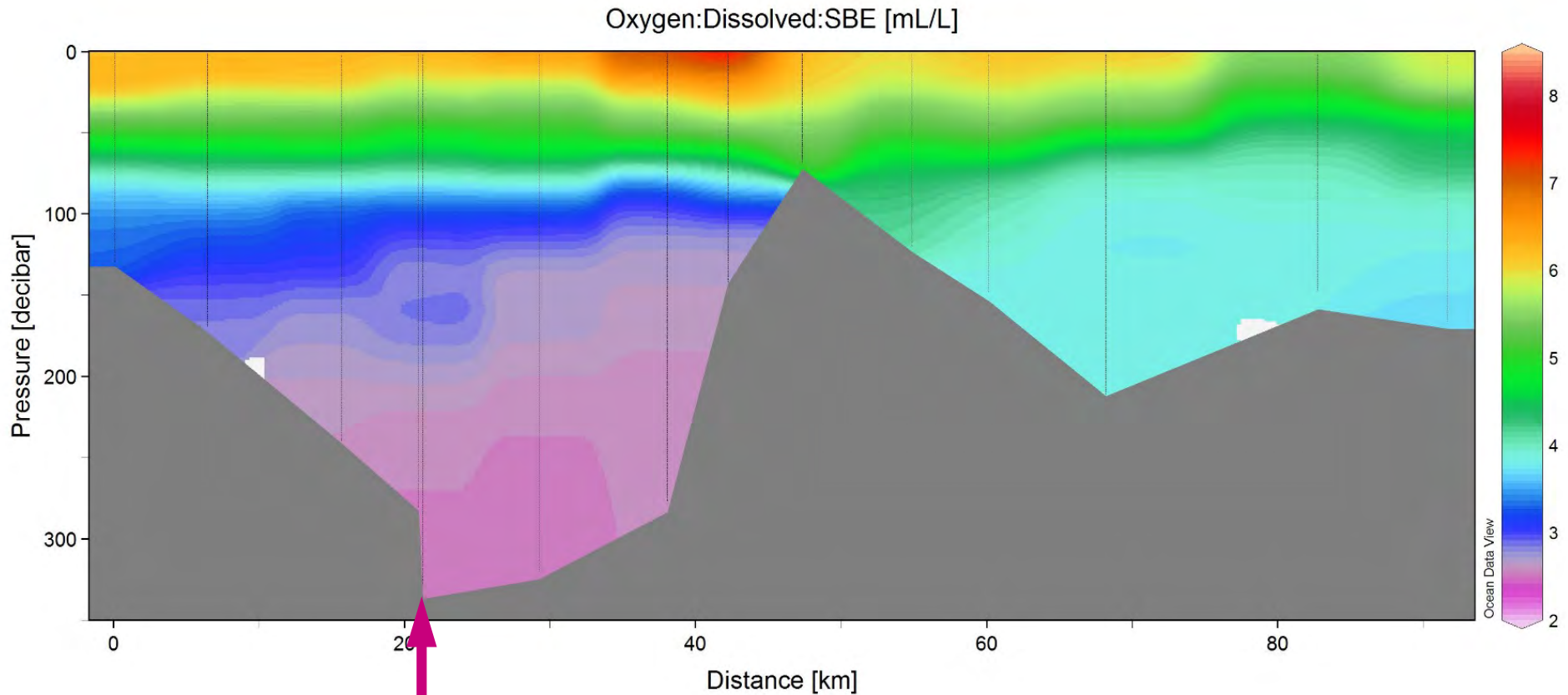
Temperature – Aug 2018



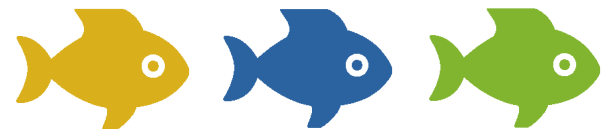
**Mooring location
365 m depth**



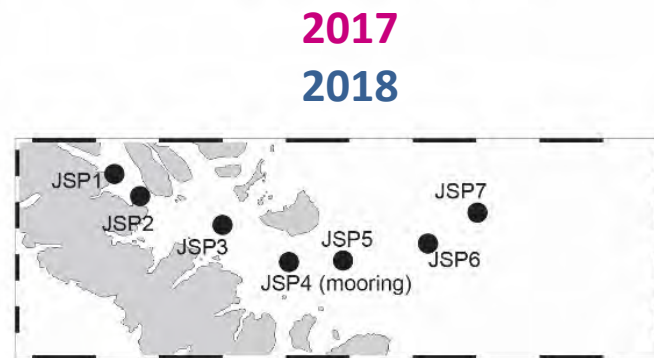
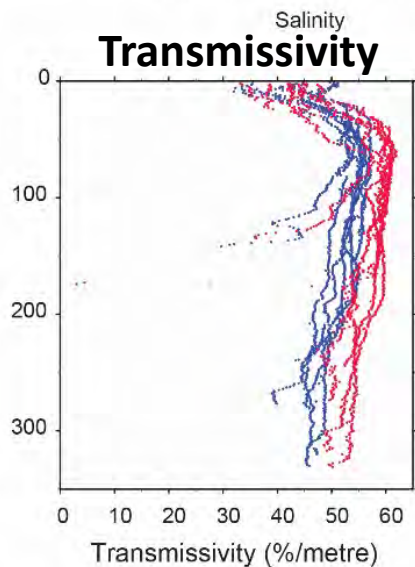
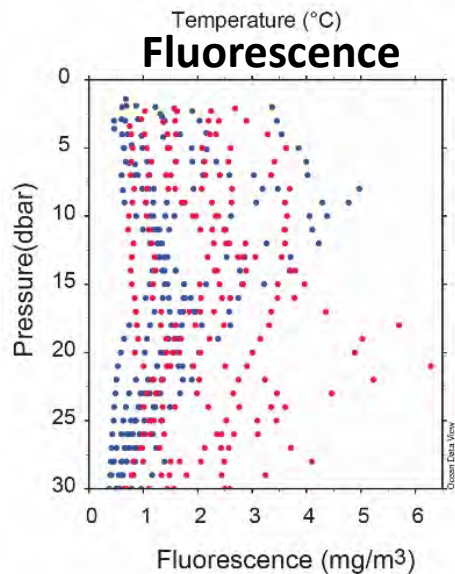
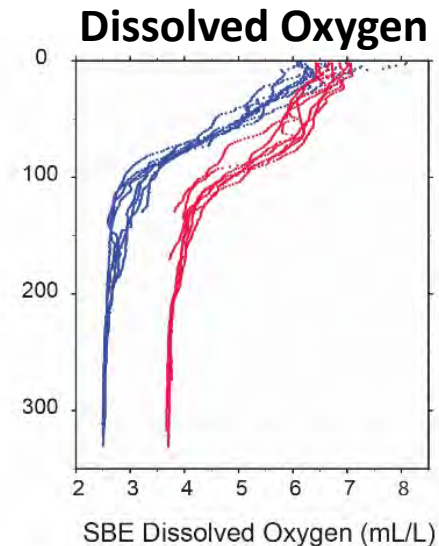
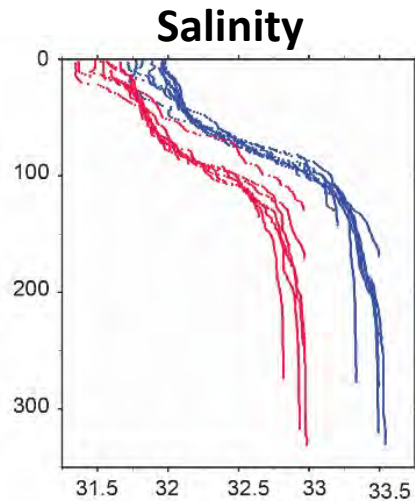
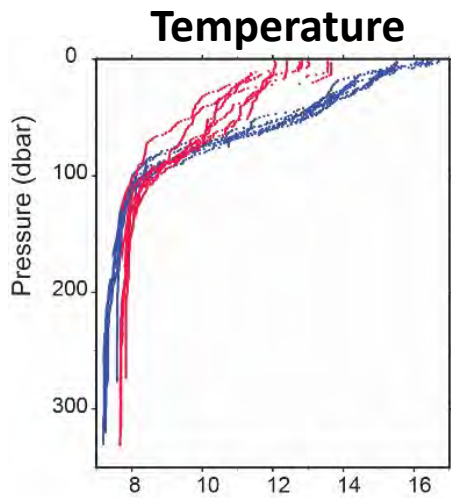
Dissolved Oxygen – Aug 2018



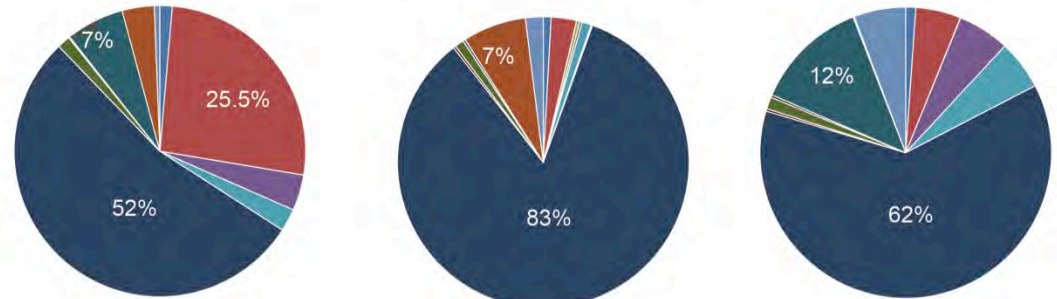
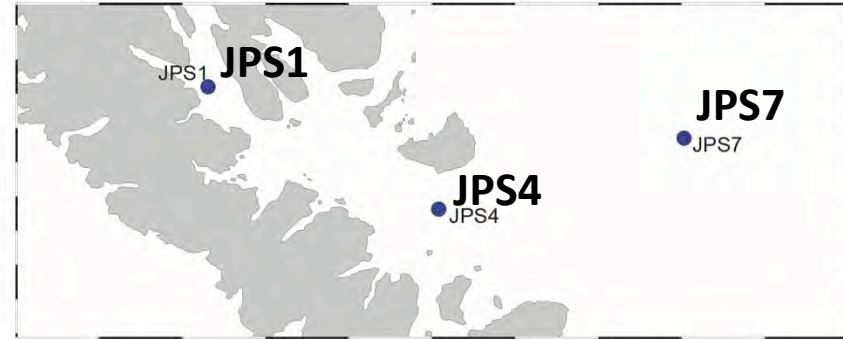
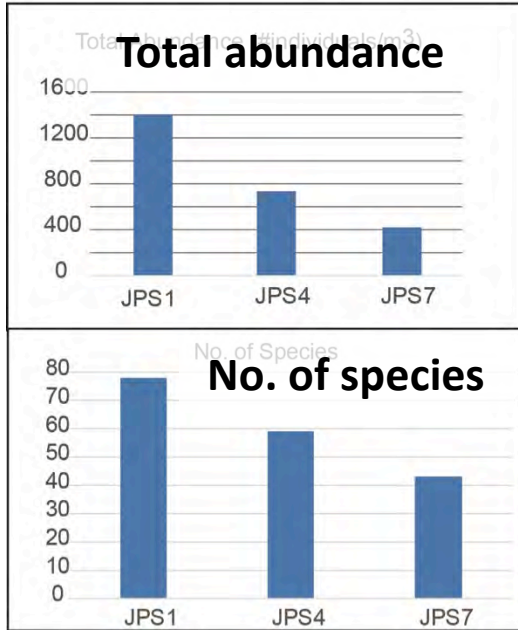
**Mooring location
365 m depth**



Summer 2017 & 2018

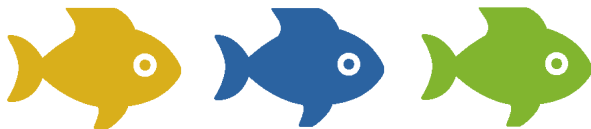
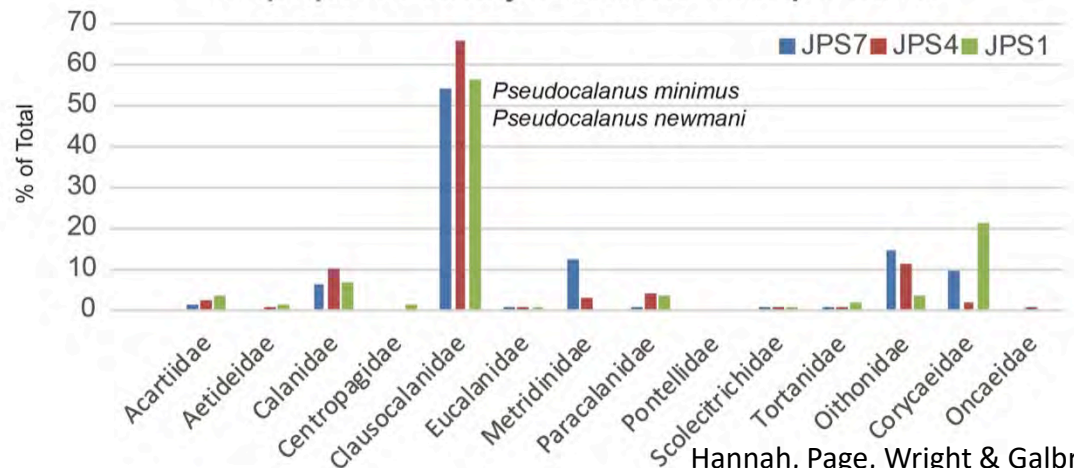


Zooplankton in Summer 2017



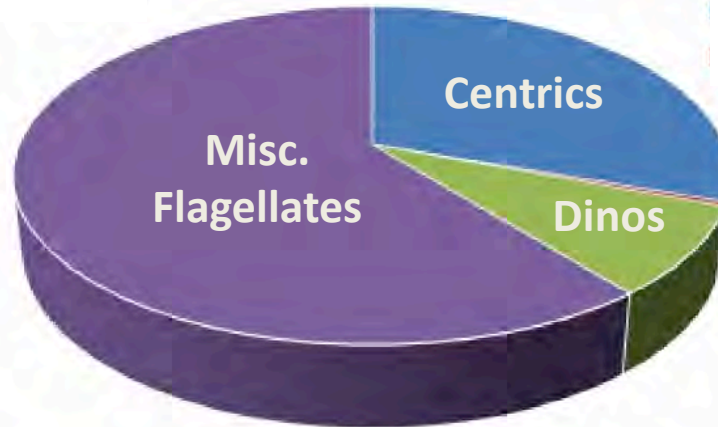
- Polychaeta
- Fish
- Euphausiids
- Amphipods
- Chaetognaths
- Copepods
- Urochordata
- Squishies
- Branchiopoda
- Decapod
- Isopod/Mysid
- Barnacle Larvae
- Molluscs

Copepod Family Percent Composition

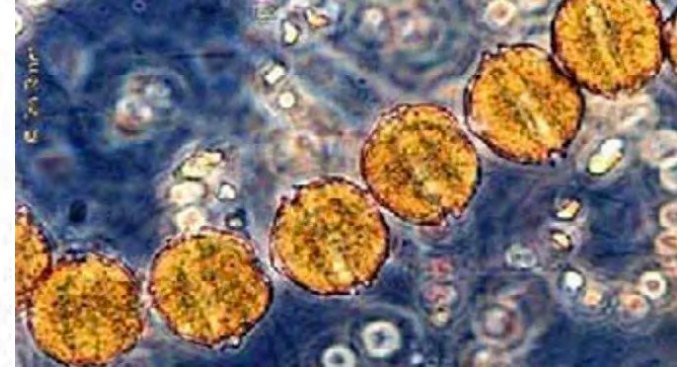


Phytoplankton in Summer 2017

JPS4 Outer

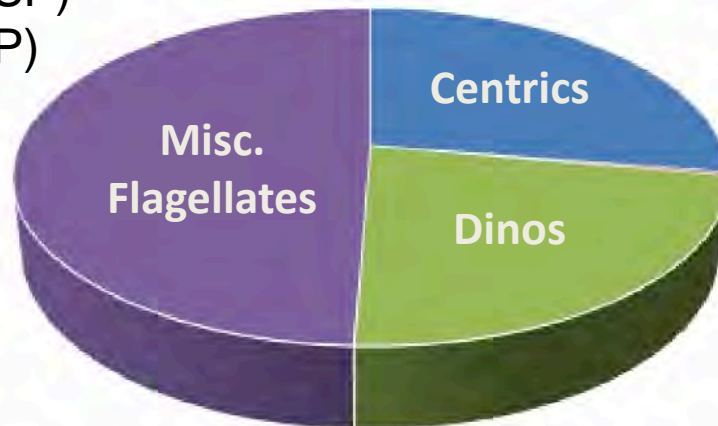


Alexandrium (PSP)

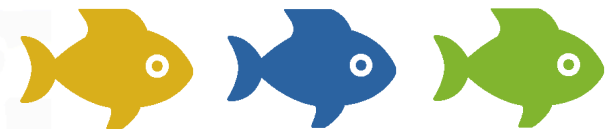
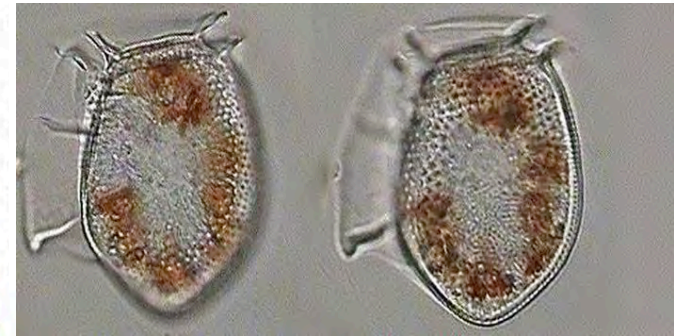


- # of cells in JPS1 > JPS4 by 42 %
- Lots of miscellaneous flagellates
- Dinoflagellates JPS1 > JPS4 directly related to increase in Alexandrium (PSP) & Dinophysis (DSP)

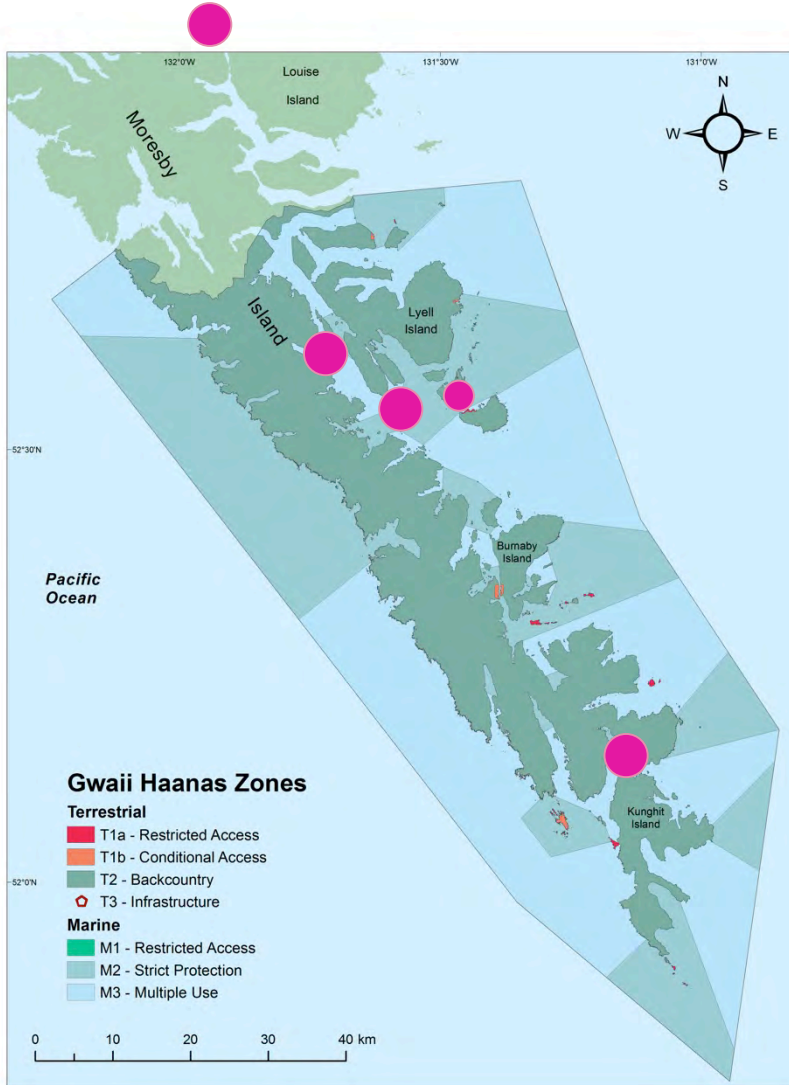
JPS1 Inner



Dinophysis (DSP)



Invasive Species Settlement Plates



Invasive Species Settlement Plates



Masset 2015



Masset 2017

Invasive Species Settlement Plates



2015



2017

Site Haida Gwaii Plate #201709 3101
 Location Masset
 Collector JJ Date 2017 Sept 11

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0.46	0.31	0.31	-0.05	-0.57	-0.96	-0.78	-0.10	-0.79	-0.60	0.24	0.36	1.21	0.97	-0.04



Eelgrass Meadow Sampling 2001-2019

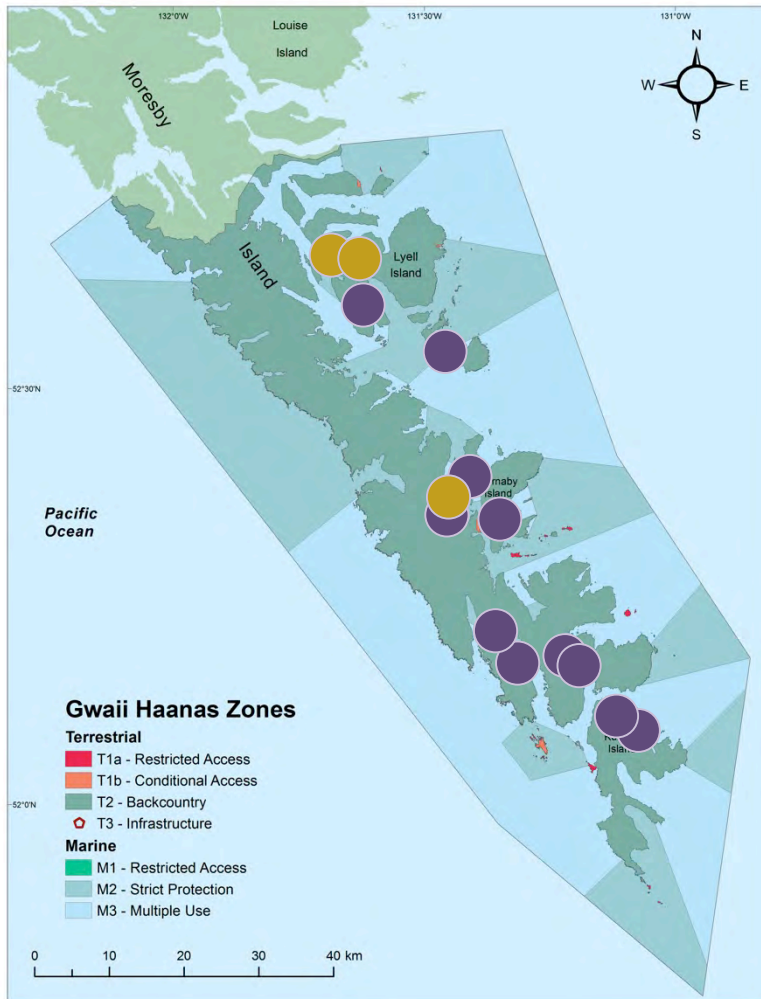
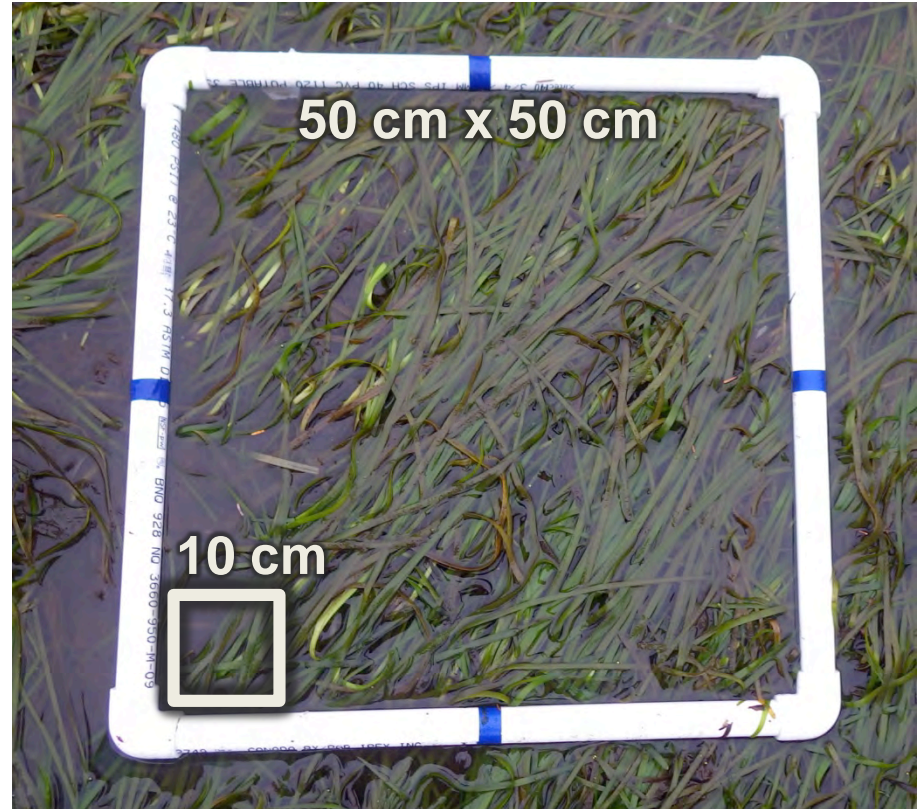
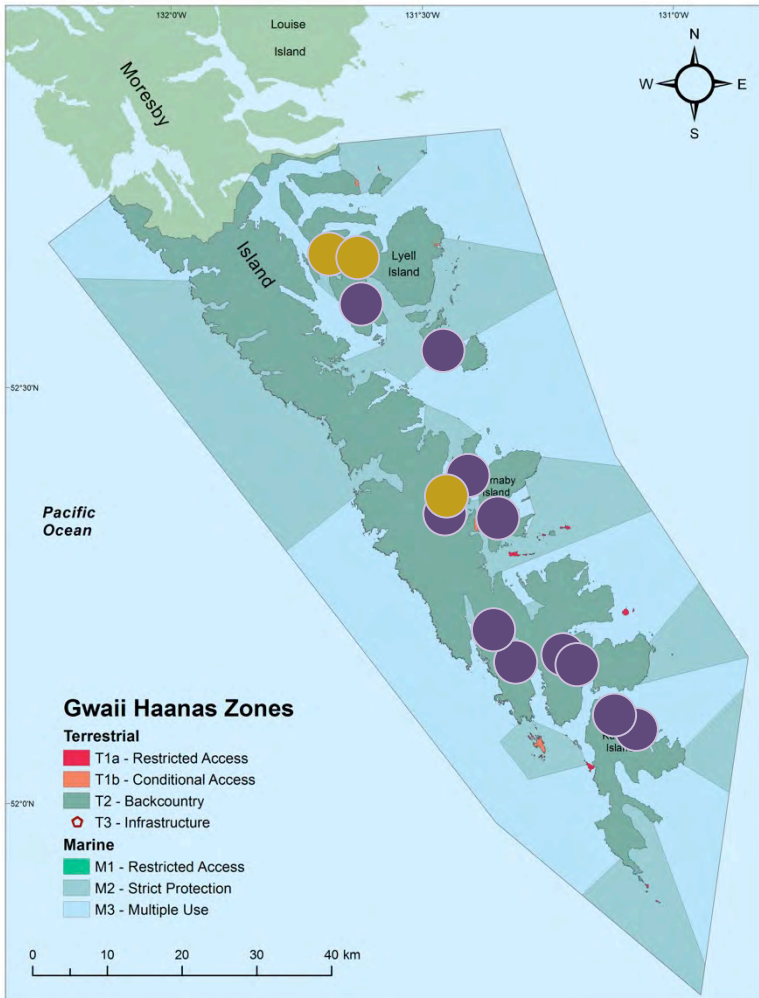


photo: Gwaii Haanas

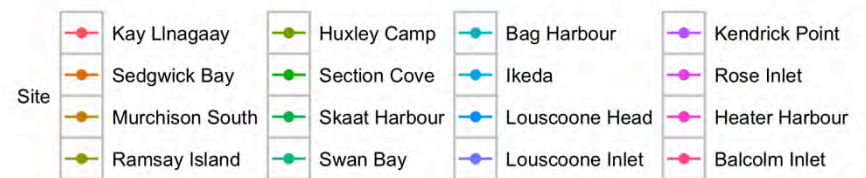
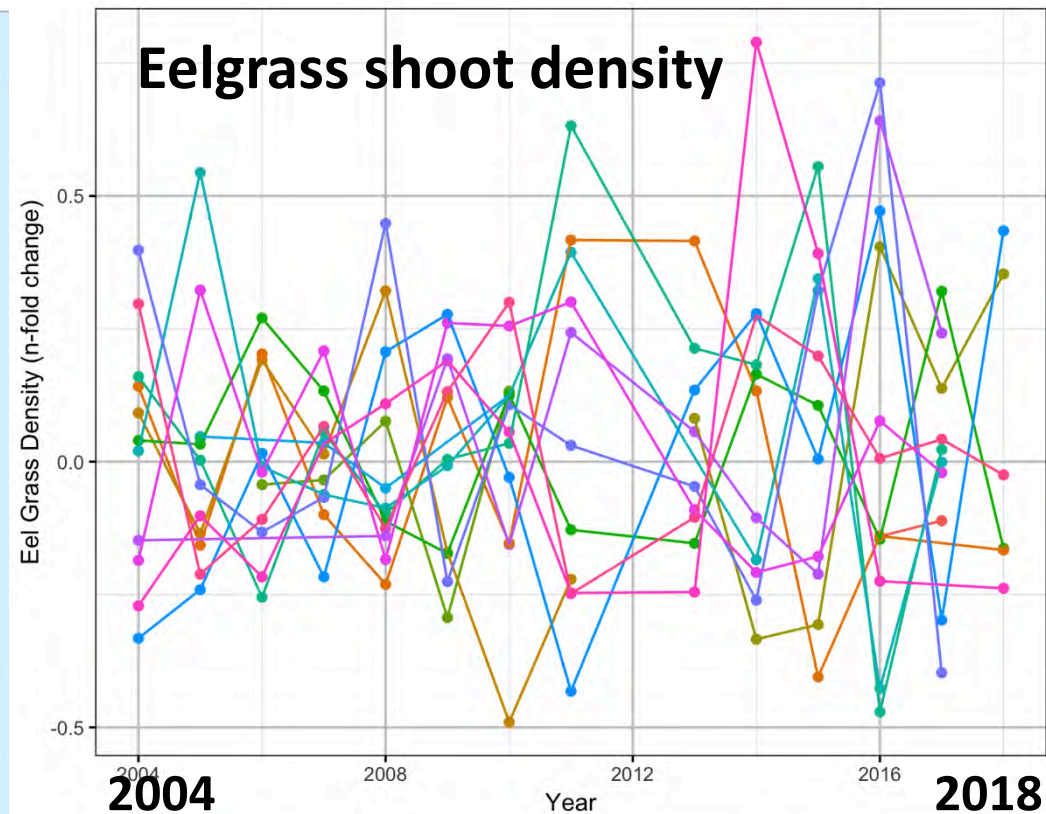
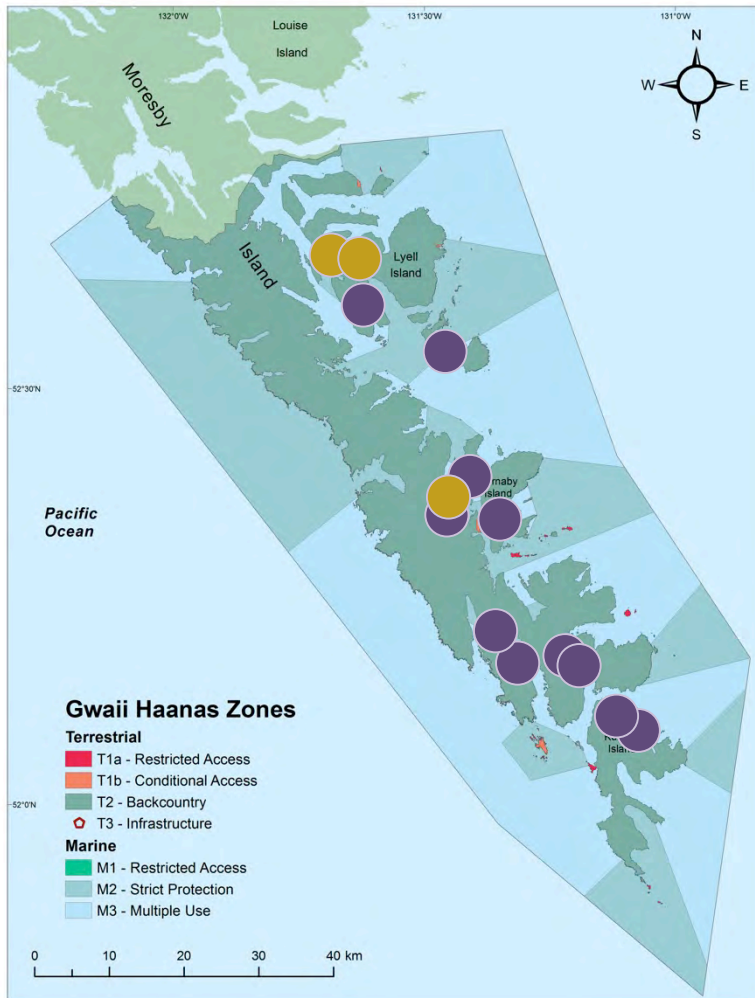
- Fish diversity & abundance
- Eelgrass shoot density & biomass
- Epiphyte biomass

Eelgrass Meadow Sampling

Eelgrass shoot density

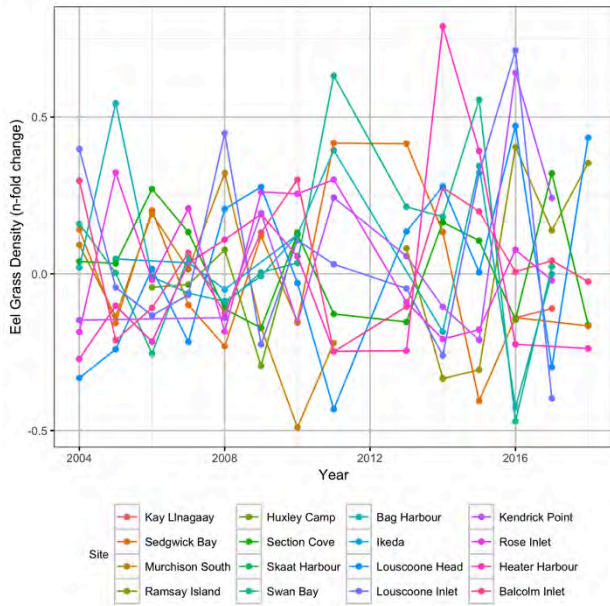


Eelgrass Meadow Sampling

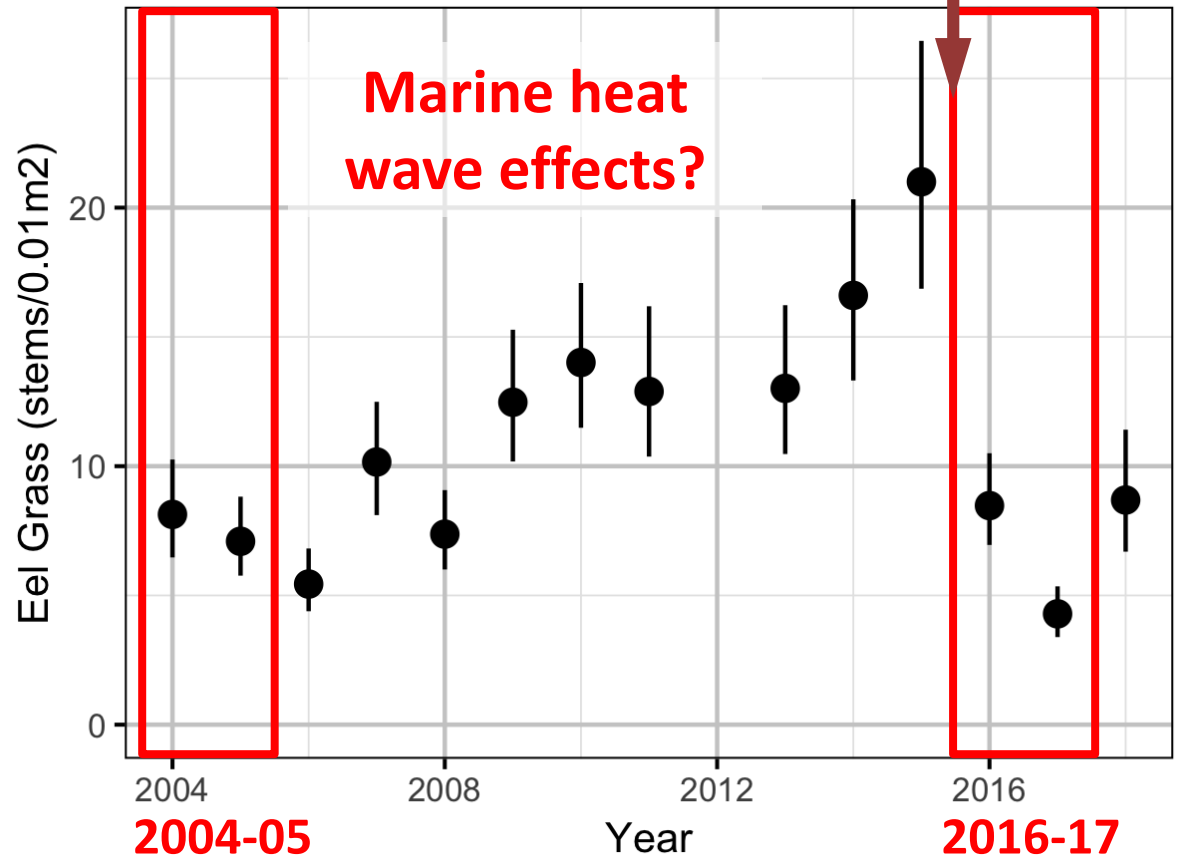


Eelgrass Meadow Sampling

New marine ecologist?

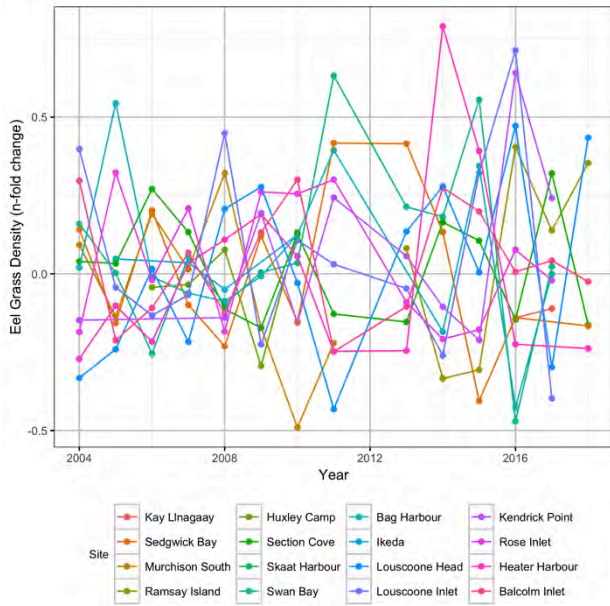


Eelgrass shoot density

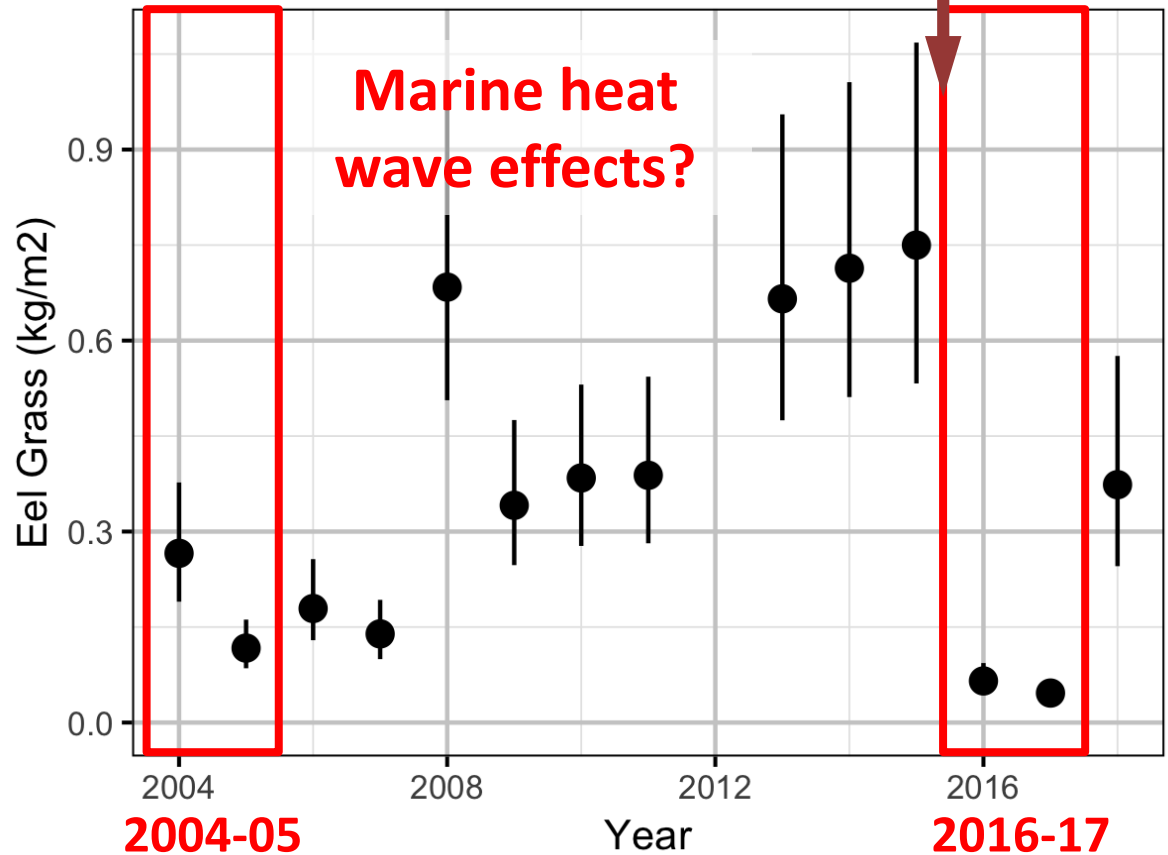


Eelgrass Meadow Sampling

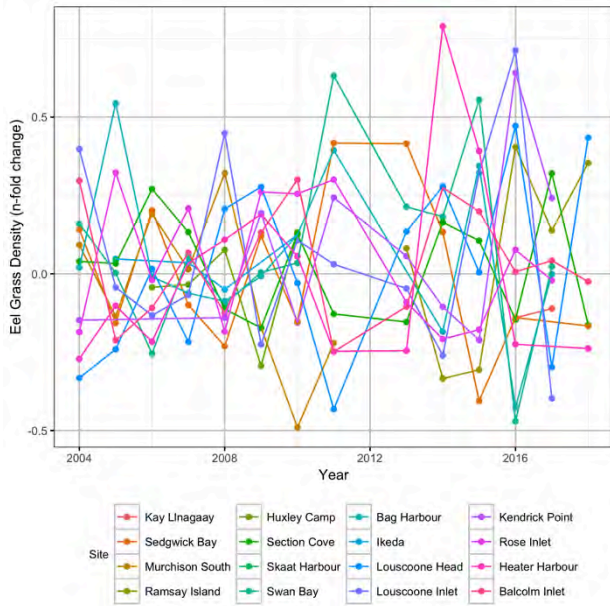
New marine ecologist?



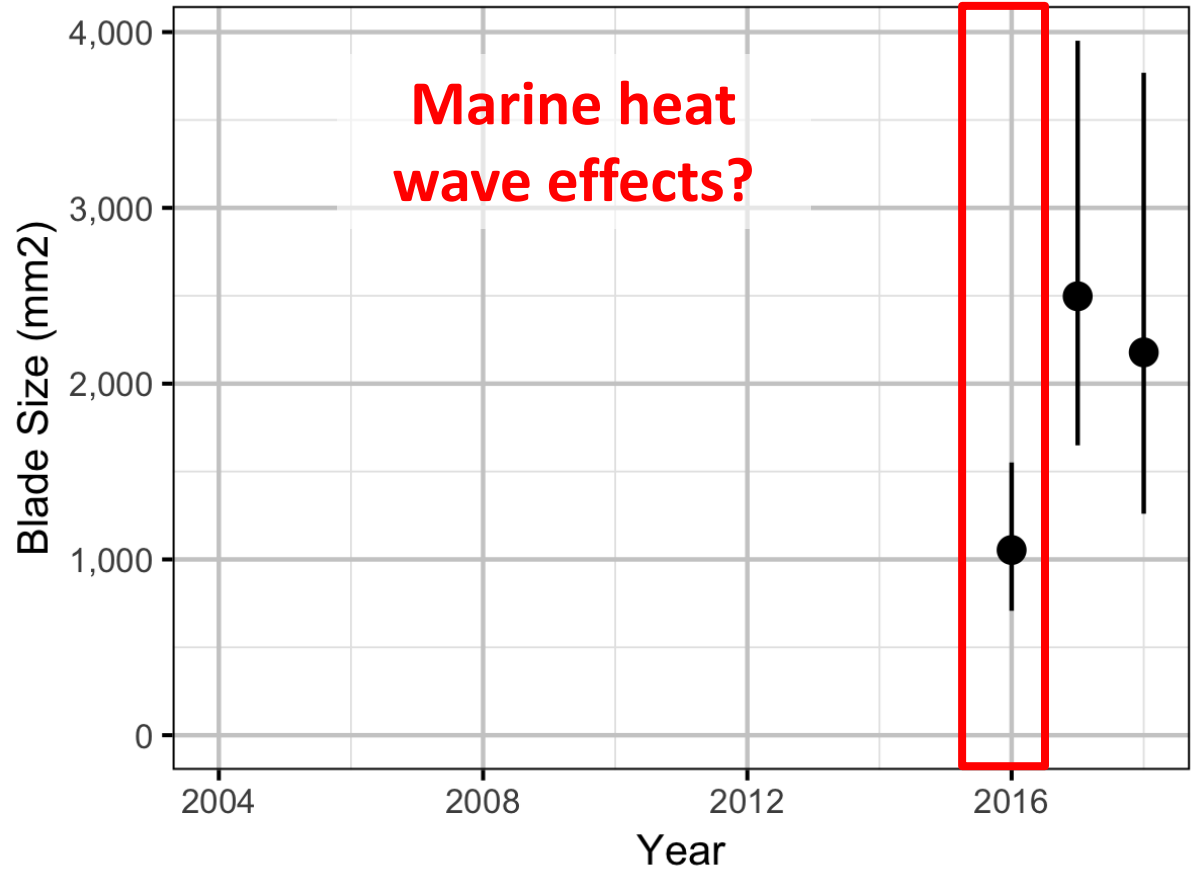
Eelgrass shoot biomass



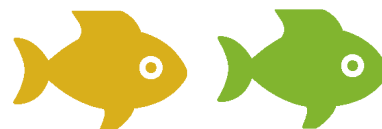
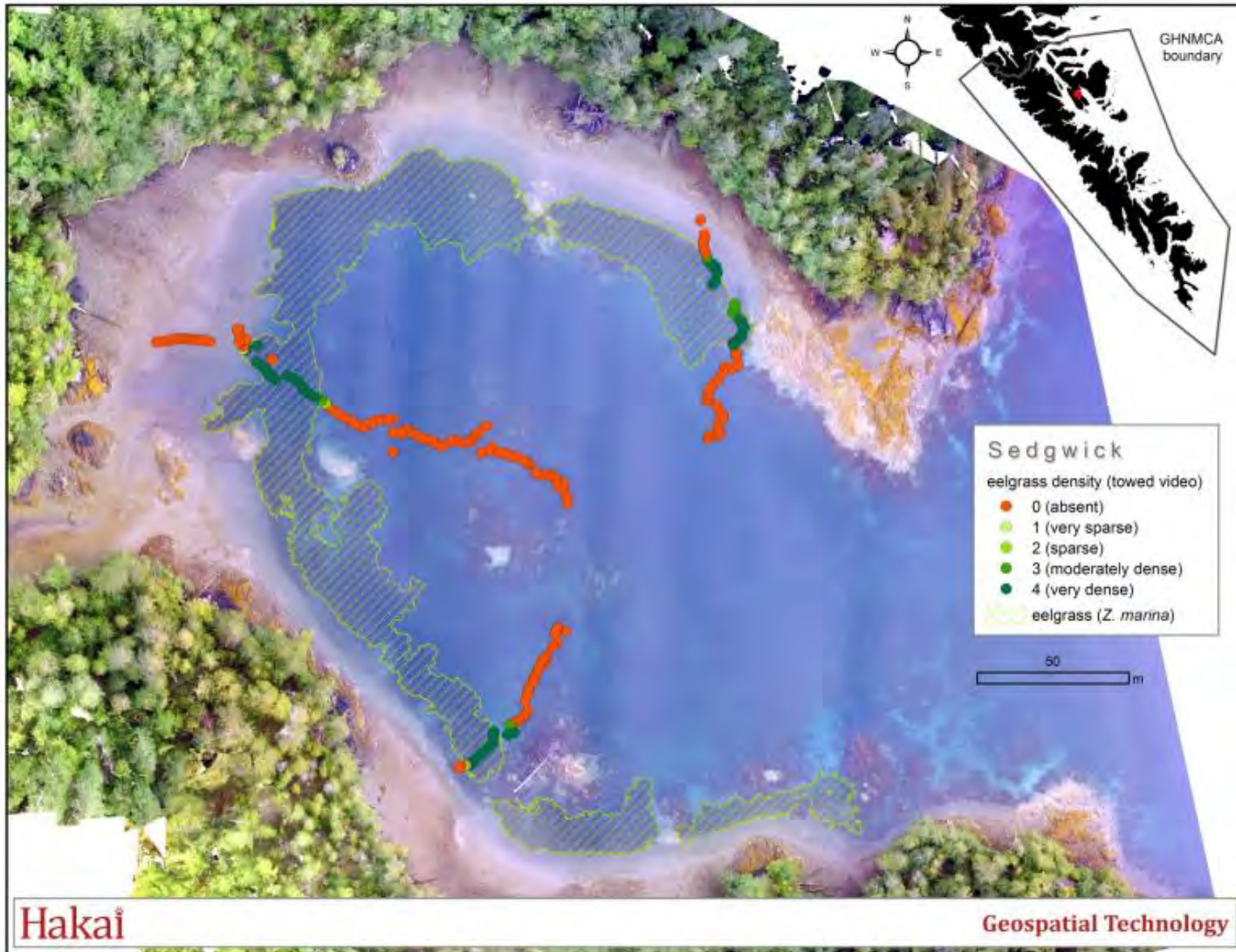
Eelgrass Meadow Sampling



Mean maximum blade width/shoot



Eelgrass Meadow Mapping 2016-18



Eelgrass Meadow Mapping 2016-18

2018



2017



2016



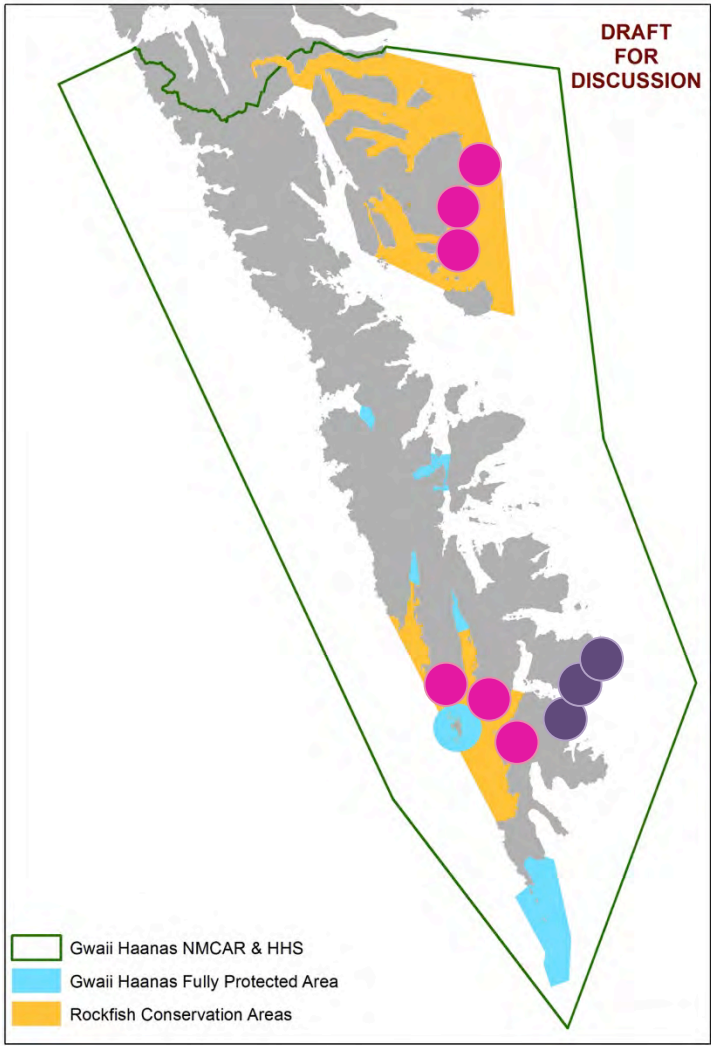
Kelp Forests

- Kelp density & biomass
- Kelp canopy
- All kelp cover
- Fishes
- Invertebrates
- Other metrics

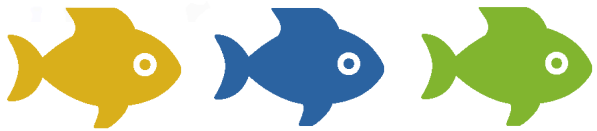
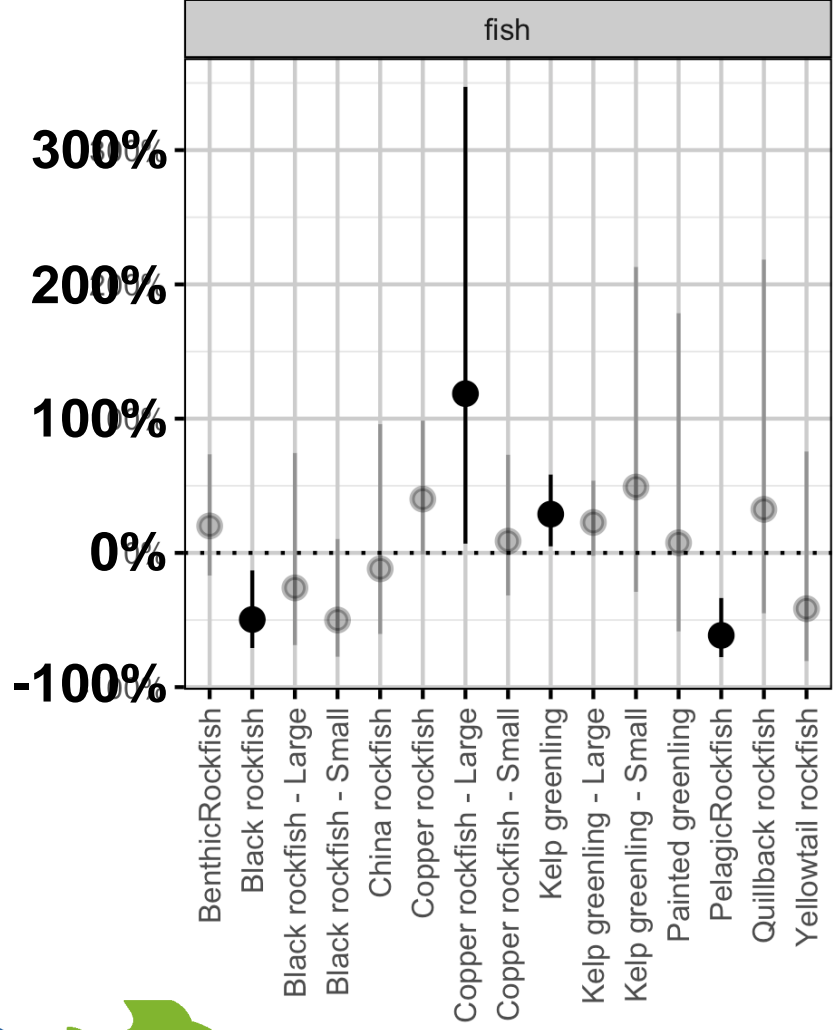
photos: Ryan Miller/millermarine.ca

Kelp Forest Fishes

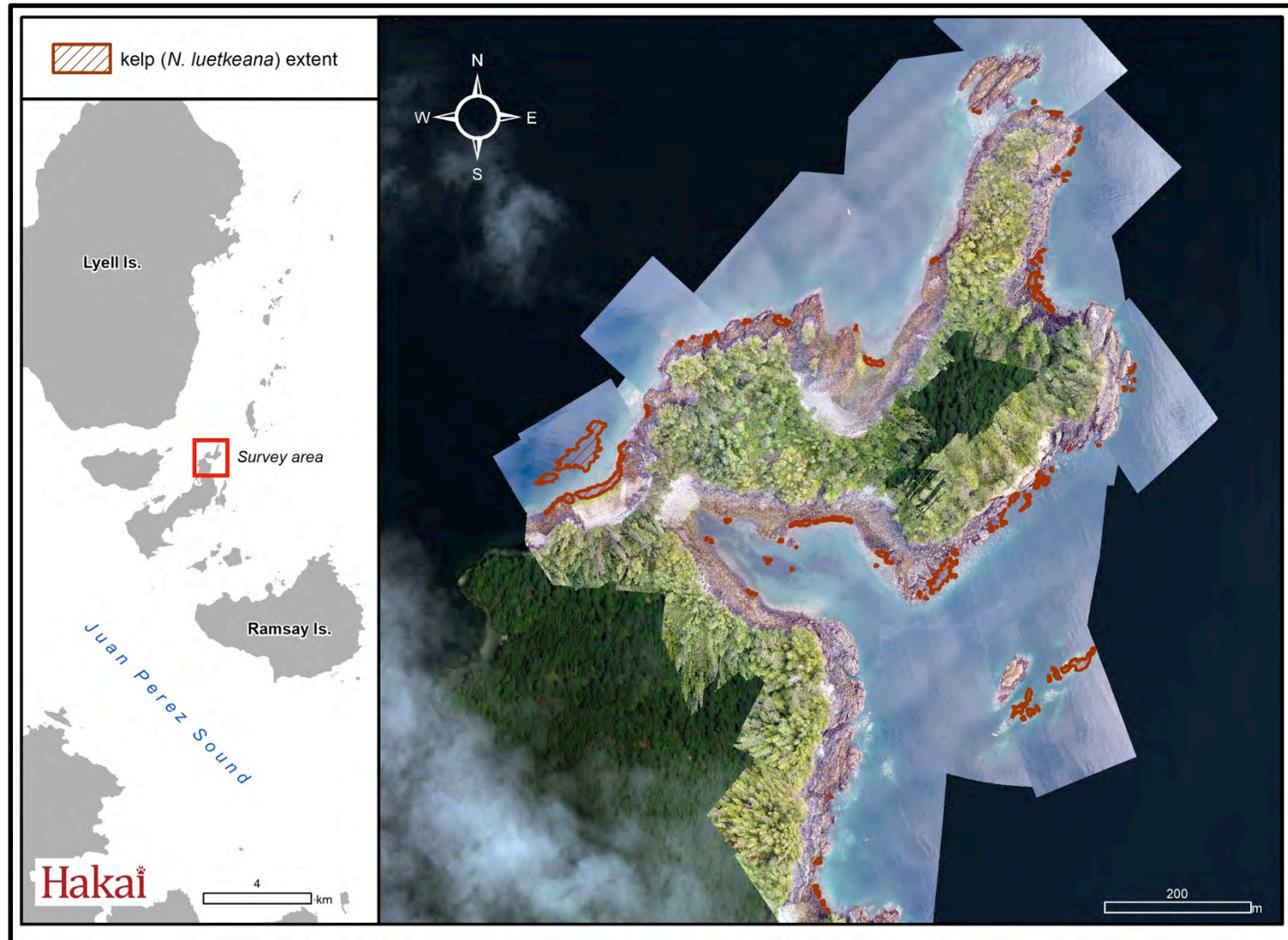
2009-13 SCUBA surveys



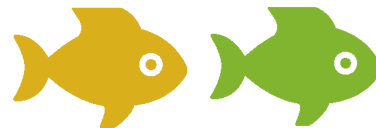
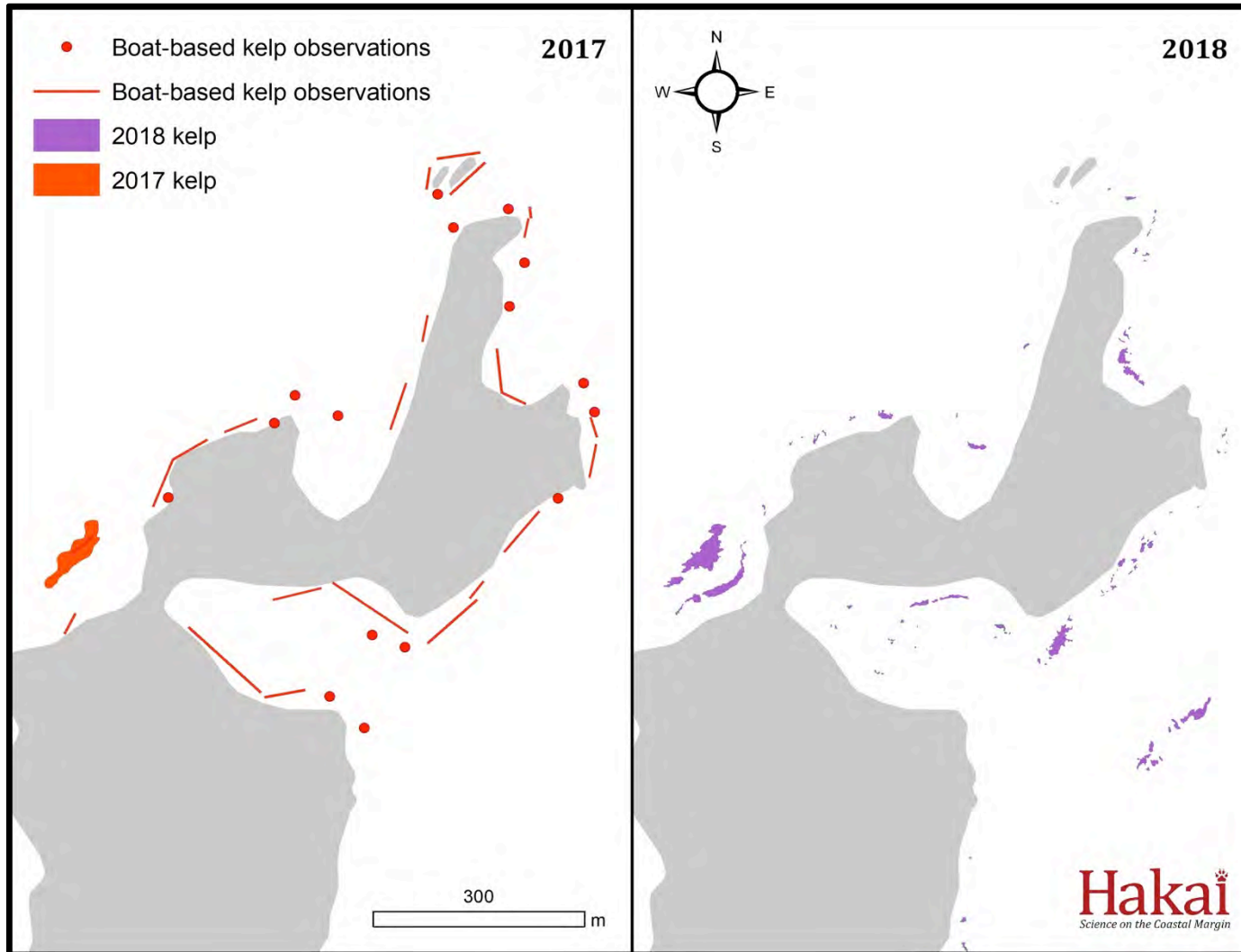
Effect of rockfish protection



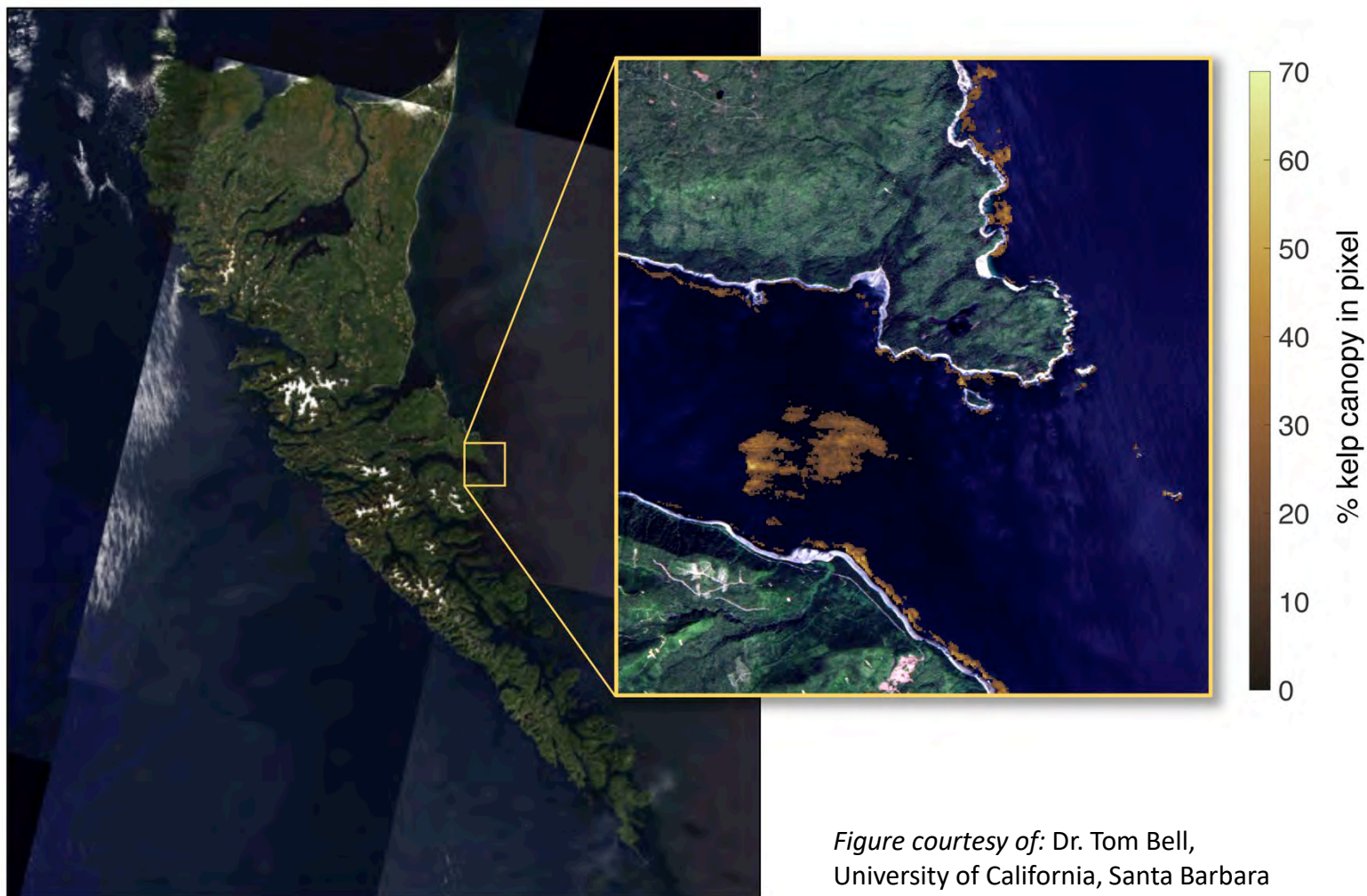
Kelp Canopy Mapping . UAT (drone) imagery



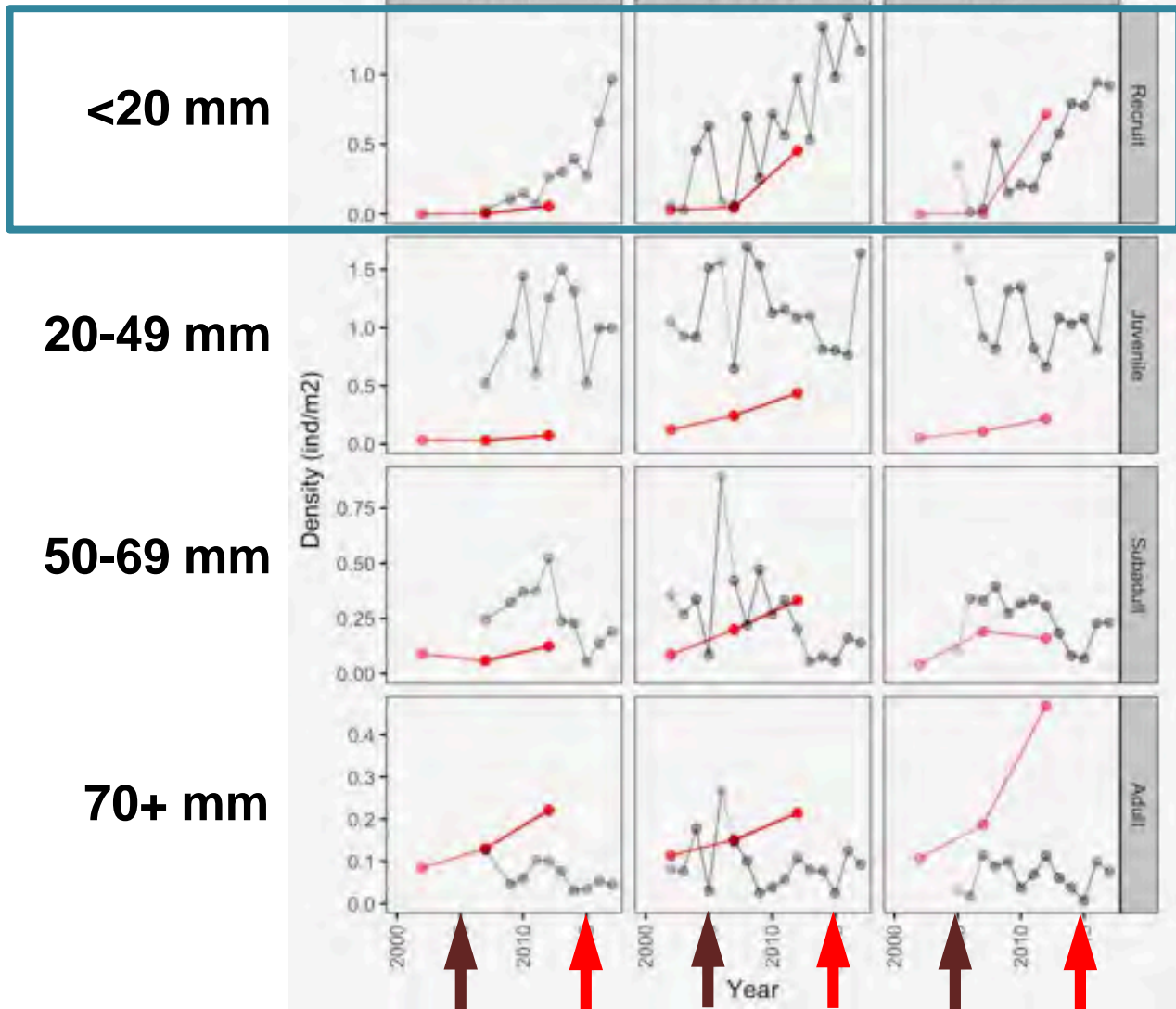
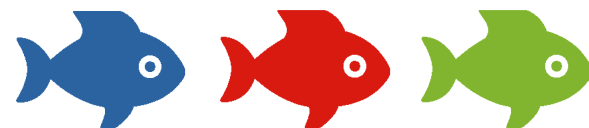
Kelp Canopy Mapping . UAT (drone) imagery



Kelp Canopy Mapping . Satellite imagery



Northern Abalone



abalone photos: Lynn Lee; condo photo: Haida Fisheries

Traditional & Local Knowledge

Deeper understanding of relationships & change

Heiltsuk abalone expert



1940s



1950s



1960s



1970s



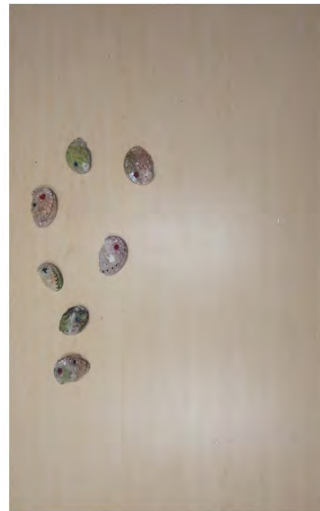
1980s



1970s



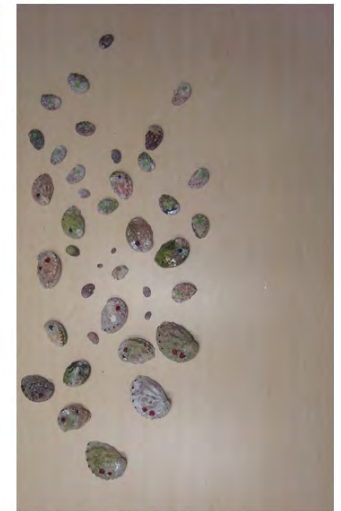
1980s



1990s



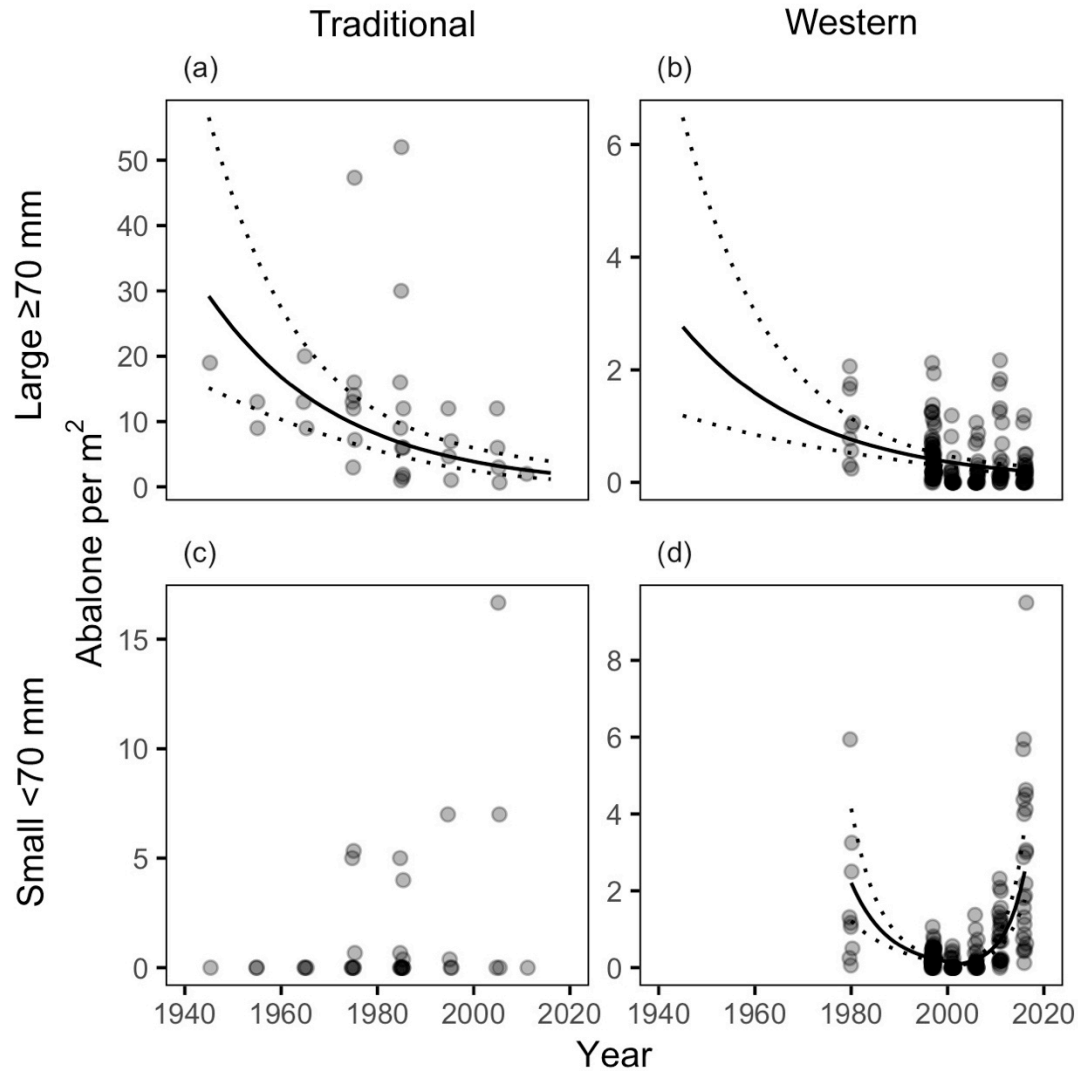
2000s (typical)



2000s (recovering)

Traditional & Local Knowledge

Deeper understanding of relationships & change



LSP

MM

SAR

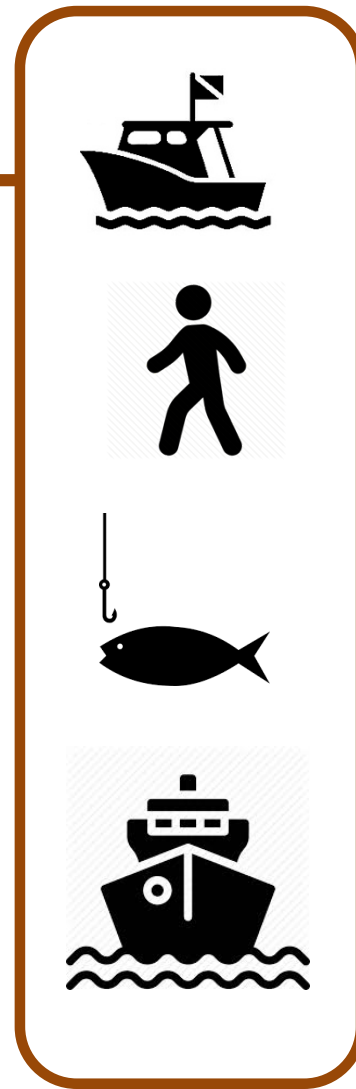
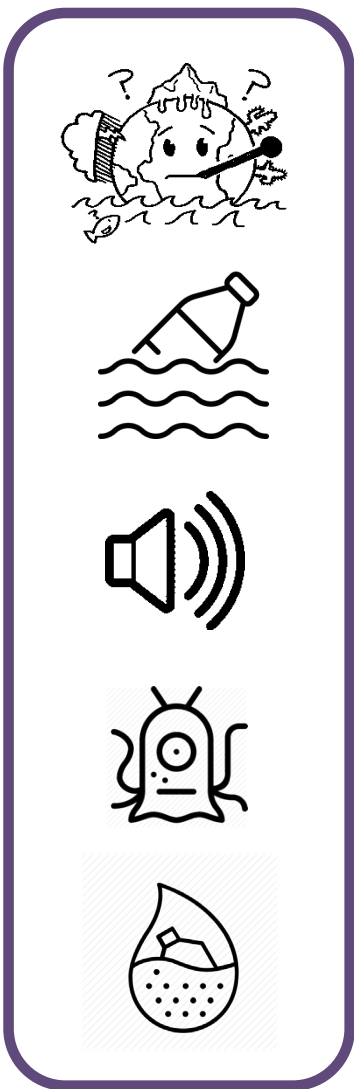
CoRe

EBM

Environmental
quality

Species & Habitats

Marine use



LSP

MM

SAR

CoRe

EBM

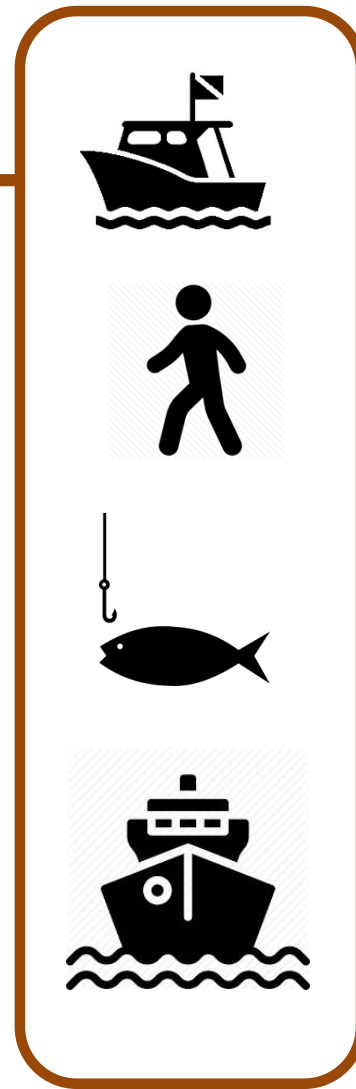
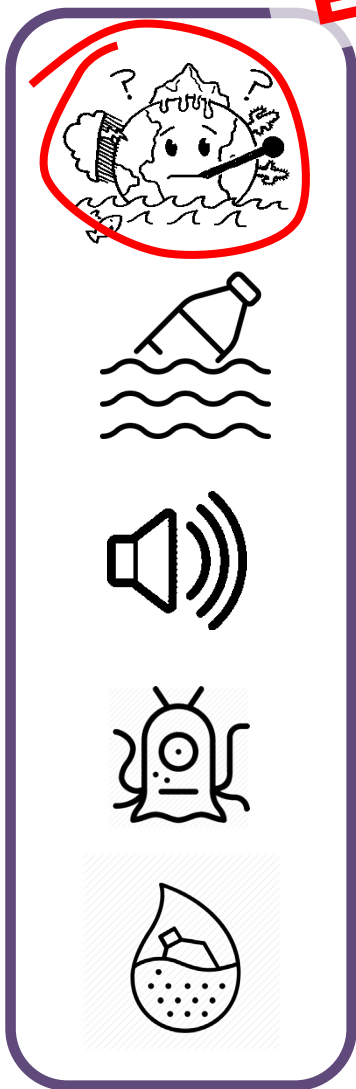
Environmental
quality

ECVs

Species & Habitats

eEOVs

Marine use



LSP

MM

SAR

CoRe

EBM

ECVs

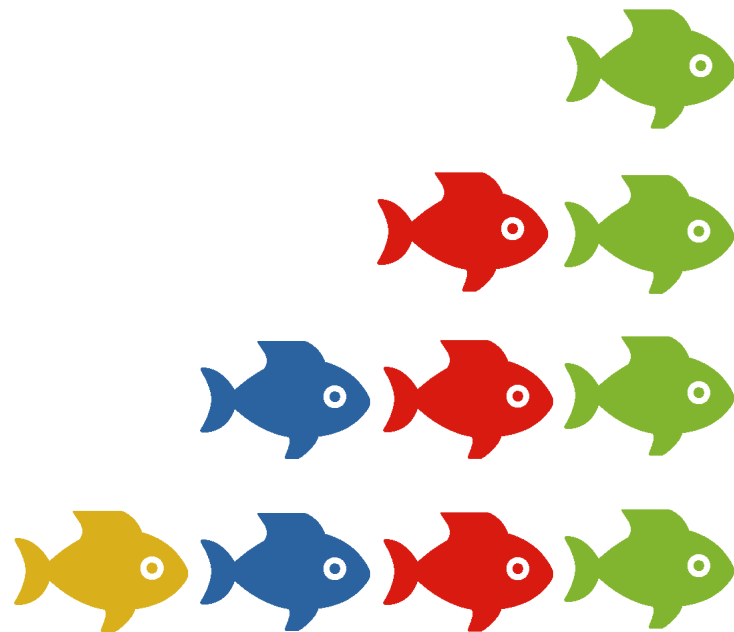


eEOVs



Tiered Monitoring
to address funding, capacity & program sustainability

Honda



Cadillac

LSP

MM

SAR

CoRe

EBM

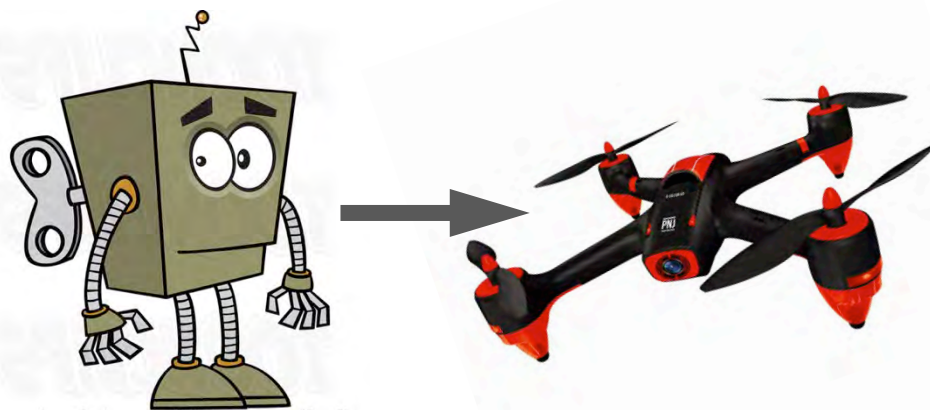
ECVs



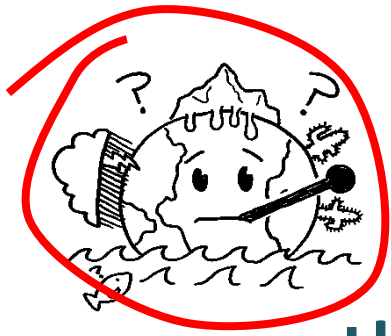
eEOVs



Low to High Tech
to address funding, capacity & program sustainability



How We are a Fishbowl



WHAT?

Unit & Size?

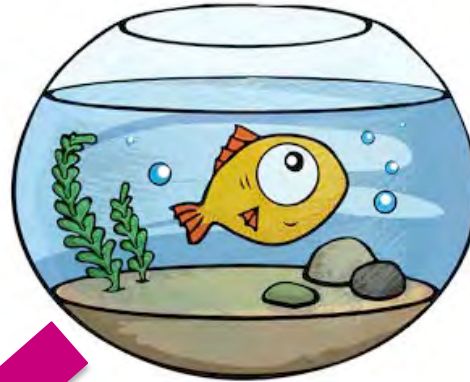
Where?

Replicates?

Timeframe?

Technology?

Protocol?



**Local to Regional
to Global**

**What matters for
integrating metrics
across space & time?**

**How do we
effectively deal
with the data?**





Canada



Fisheries and Oceans
Canada



Hakai
Science on the Coastal Margin



UNIVERSITY
OF OREGON



Gwaii Haanas as a Collaborative Sentinel Site!



Good People Working Together

Canada



HAIDA NATION

Measure things that...

- Matter to people... in places they care about
- Are easy to measure consistently with accessible technology
- Draw on strengths & build capacity in collaborations
- Span across needs & link programs at multiple scales
- Proactively inform anticipated management issues
- Foster flexible, collaborative problem-solving
- Build relationships with good people!

image: Lynn Lee

Also seize opportunities...when a dead whale falls...

Scientists Freak Over Swarm of Octopuses Eating Dead Whale | NowThis

Press esc to exit full screen

NOW

THIS

Elgrass density



EVNautilus

Please, somebody tell Twitter,

Scroll for details

SUBSCRIBE

0:34 / 3:47





Thank you . Haawa

photo: Lynn Lee