

From Coastal Temperate, High-Arctic to Deep-Sea Habitats: Seafloor Imagery and Environmental Monitoring Using Cabled Observatories to Track Ecosystem Function, Biodiversity and Benthic-Pelagic Coupling

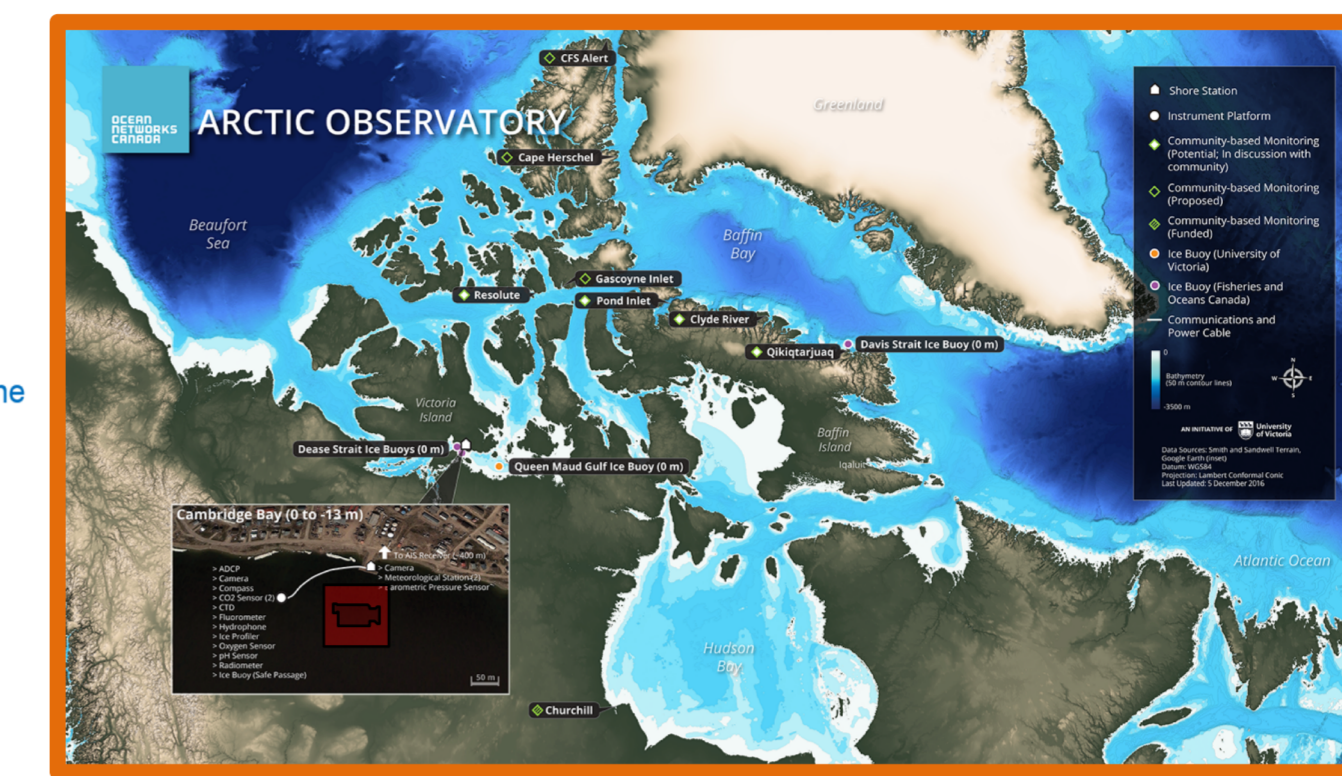
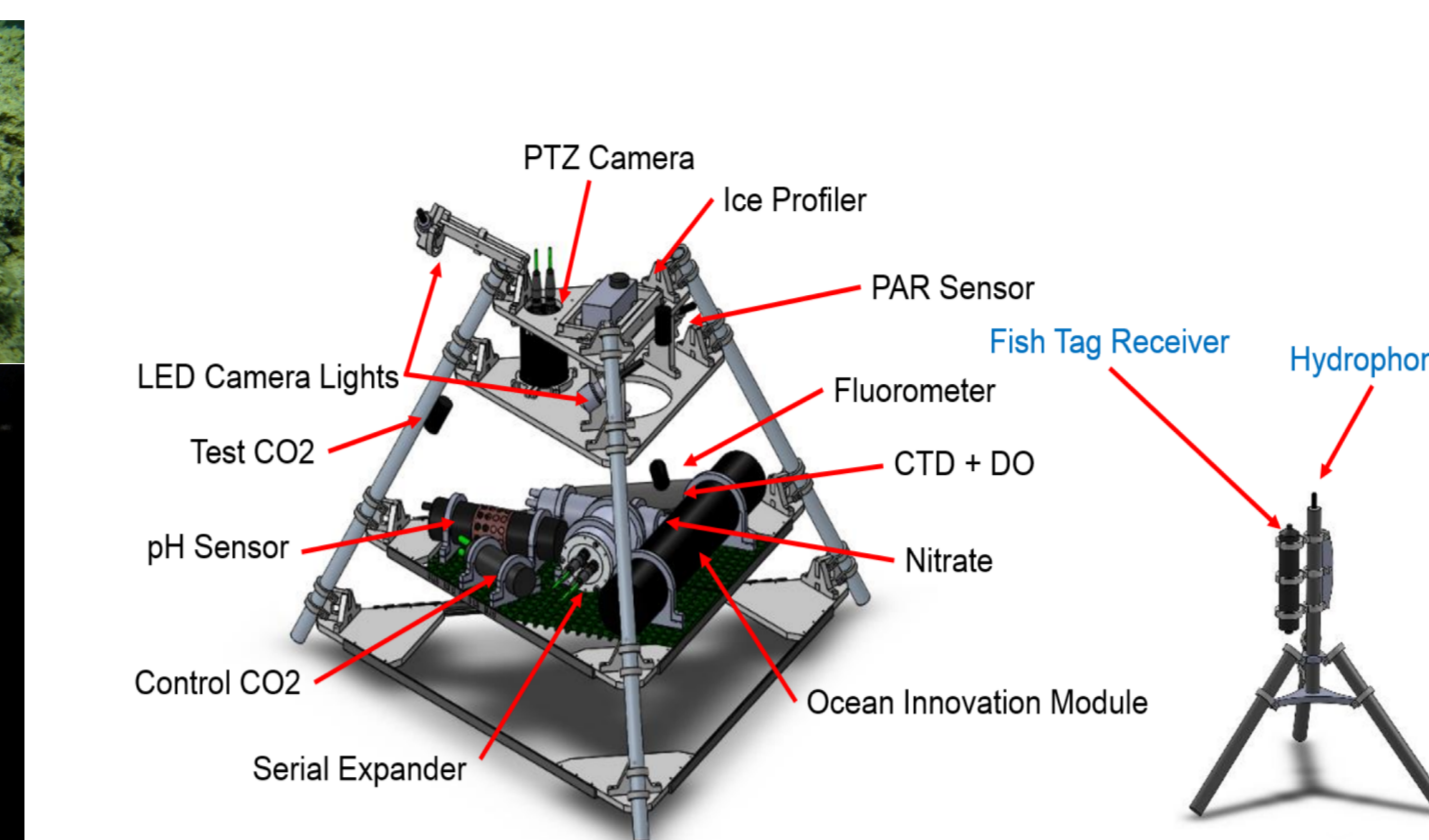
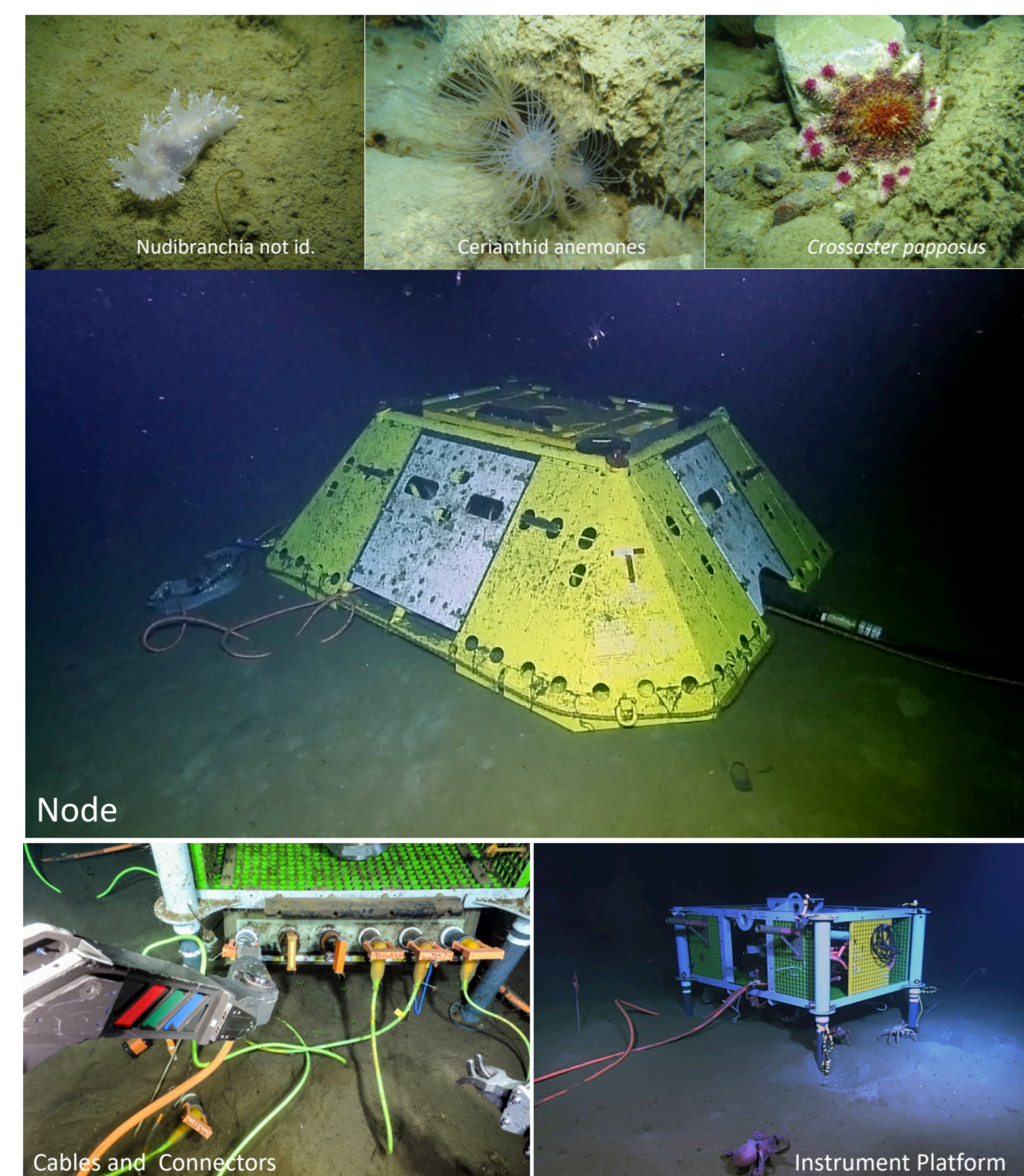
Fabio C. De Leo^{1,2} (fdeleo@uvic.ca), Lu Guan¹, Francis Juanes^{2,3}, Xavier Mouy³, Jacopo Aguzzi⁴

¹Ocean Networks Canada, University of Victoria, Canada, ²Department of Biology, University of Victoria, ³School of Earth and Ocean Sciences, University of Victoria, ⁴Institut de Ciències del Mar, ICM-CSIC, Barcelona



Summary

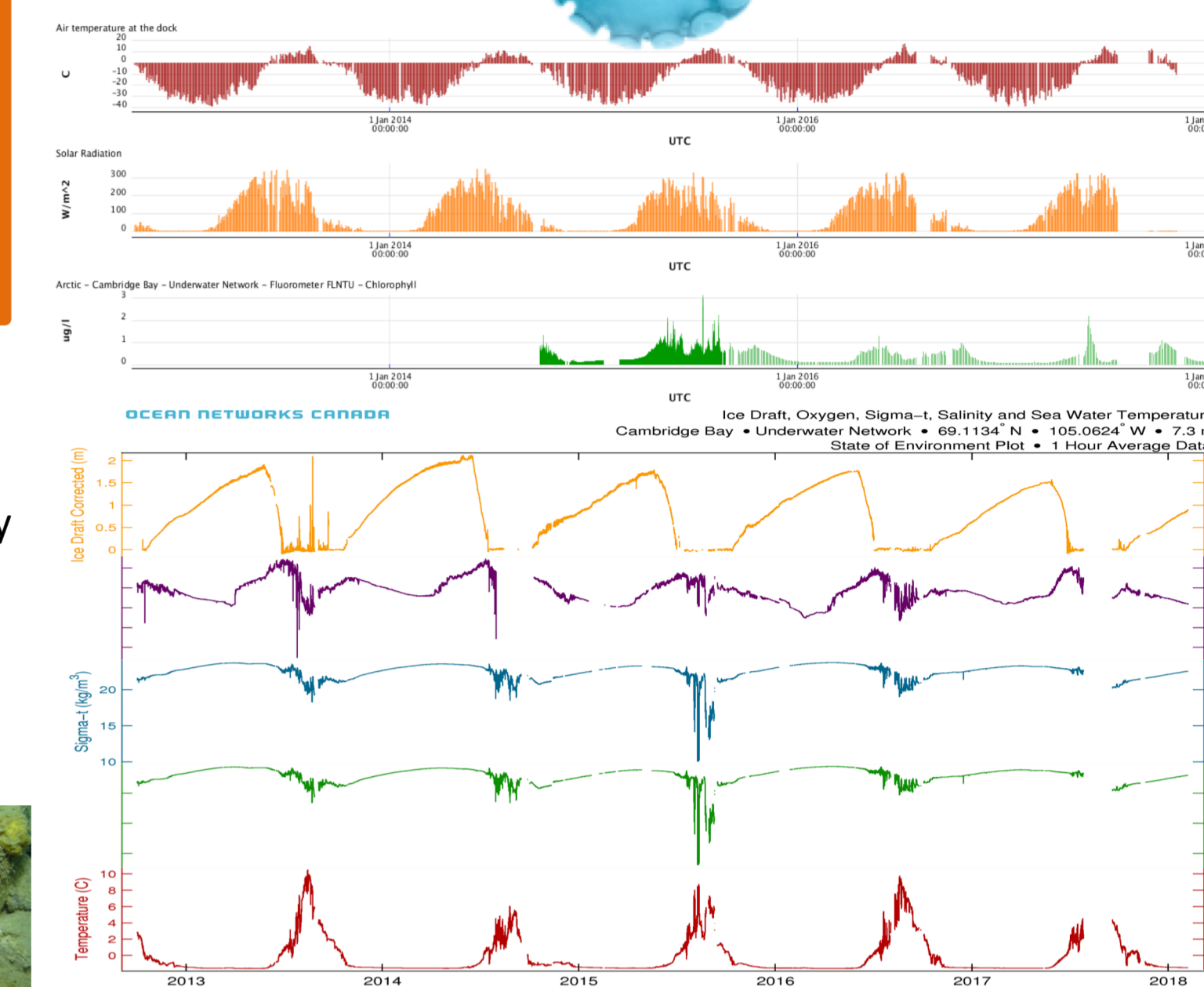
Cabled observatories provide a permanent presence in the ocean, enabling discovery and tracking of previously unseen faunal behaviour and long-term changes in biodiversity and ecosystem function. Ocean Networks Canada (ONC) operates large seafloor cabled observatory networks in the NE Pacific and in the Arctic. The seafloor network of 850+ km of backbone cables connects > 50 instrumented sites (>400 oceanographic instruments, >5,000 sensors), in habitats ranging from temperate coastal fjords and rocky subtidal reefs, ice-covered Arctic bays, to deep-sea canyons, cold seeps, abyssal plains and hydrothermal vents. Here we provide an overview of how fixed-point seafloor video and acoustic imagery, combined with multi-parameter environmental monitoring, can be used to investigate seasonal and inter-annual changes in benthic and benthic-pelagic ecosystems related to: atmospheric and astronomic forcing, carbon flux from the upper ocean, seasonal productivity and sea-ice dynamics, and changes in coastal soundscape. We present snapshot results from recent past and ongoing research projects using imagery of ONC's cabled observatories in the NE Pacific (NEPTUNE and VENUS), and the Cambridge Bay observatory in the Canadian Arctic.



Coastal Arctic – 7 m

Research questions include:

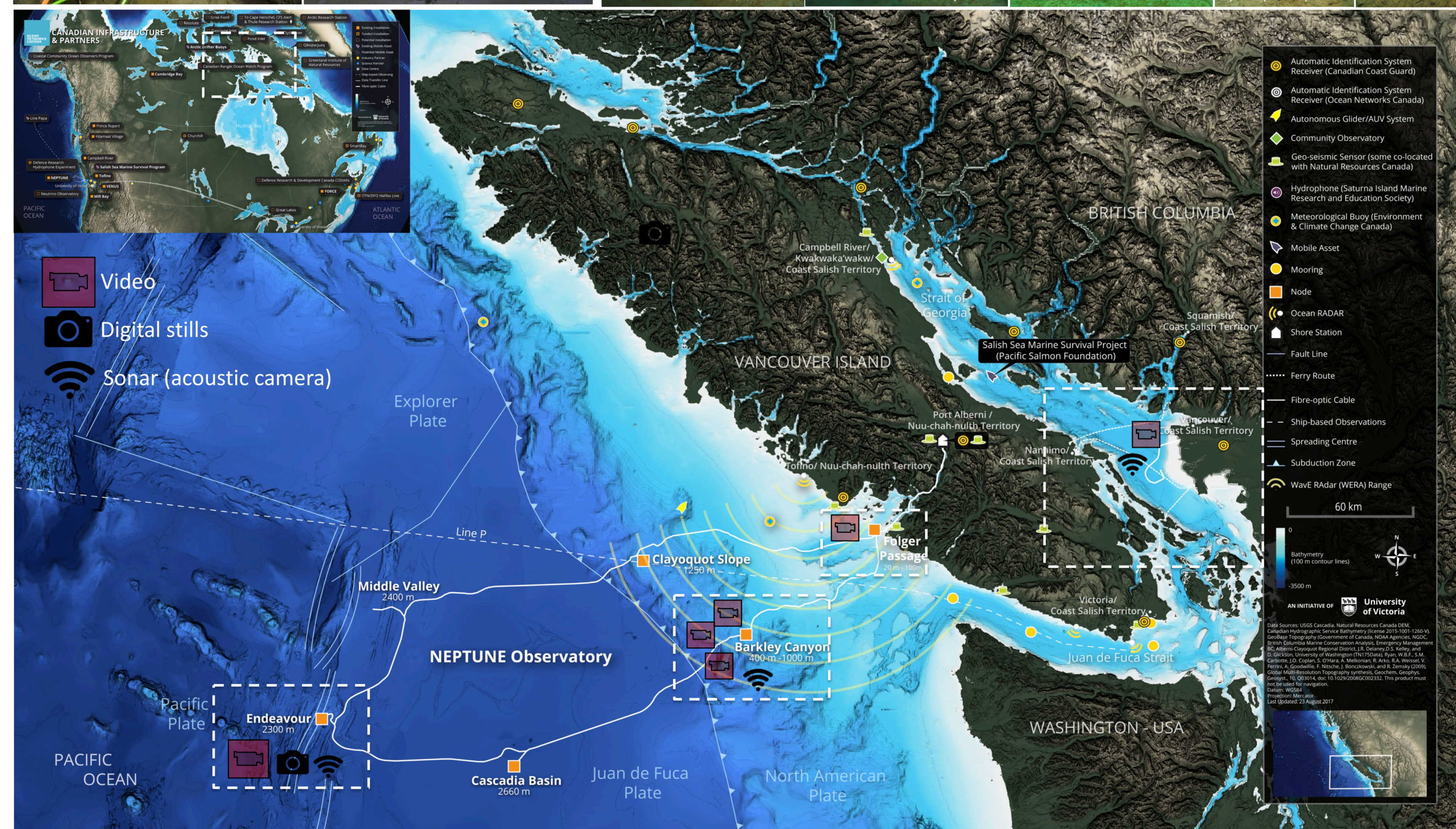
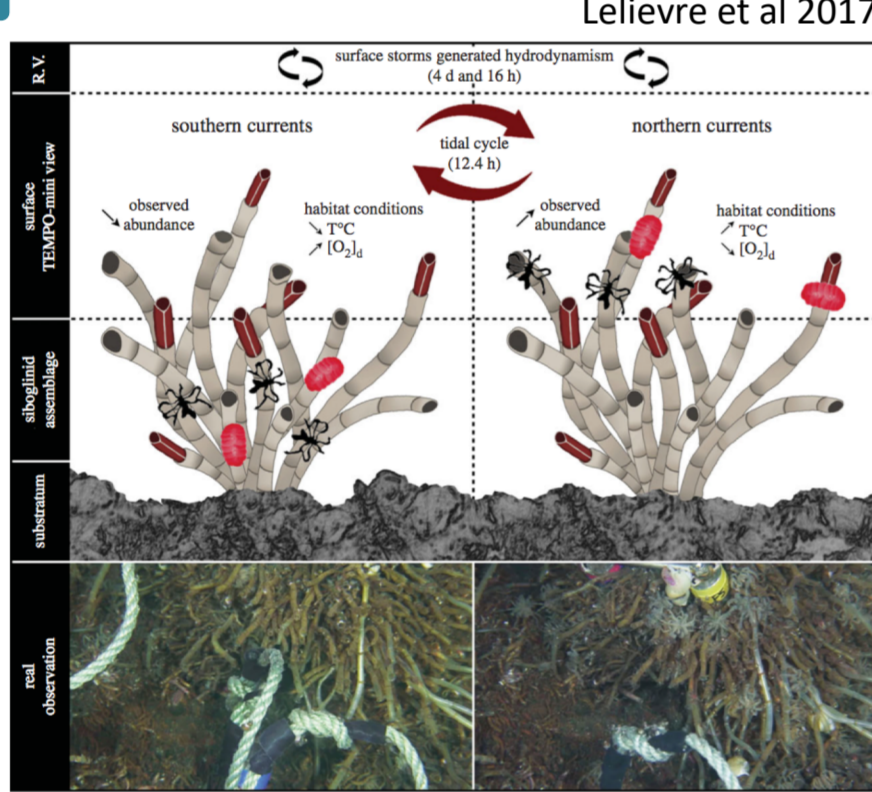
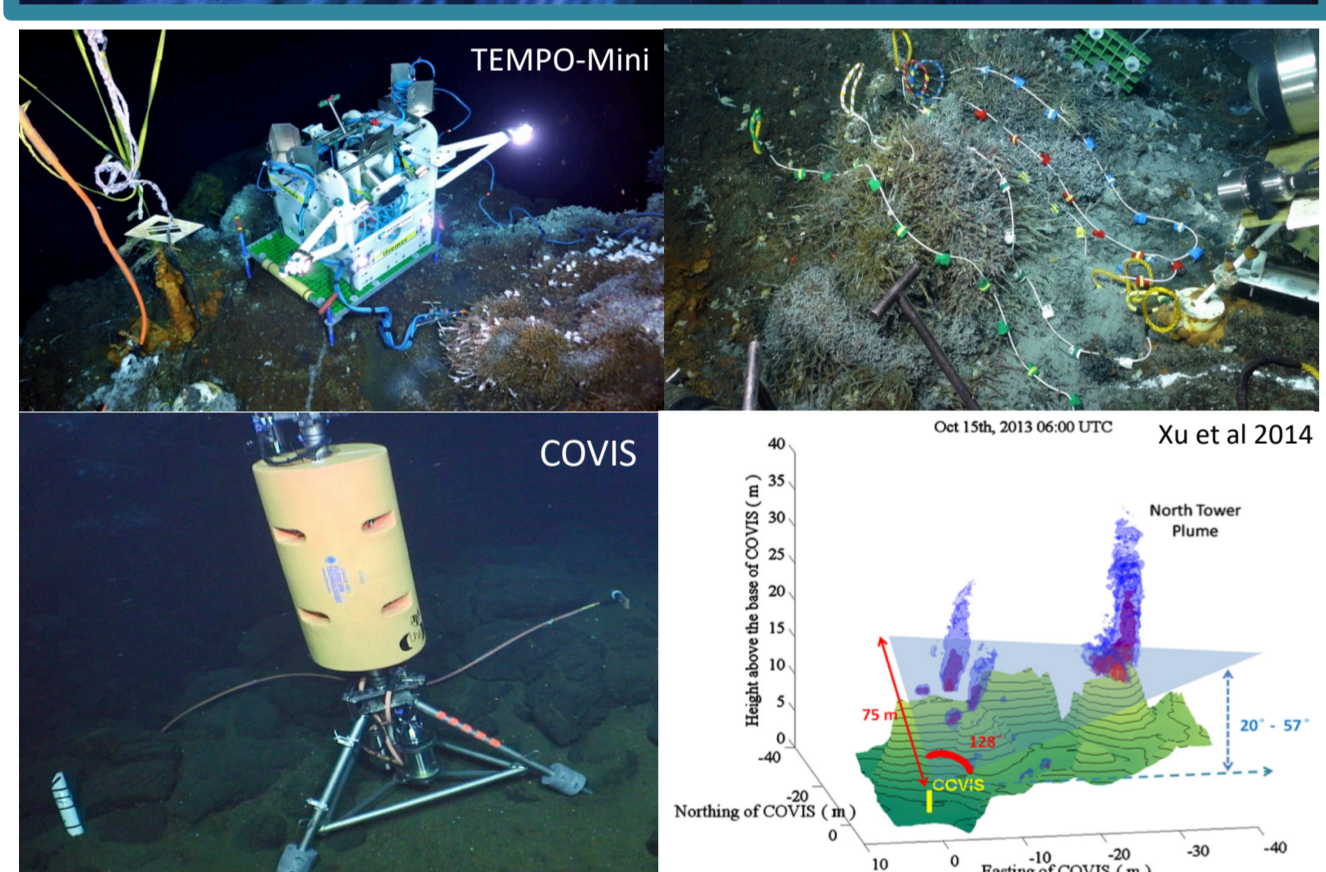
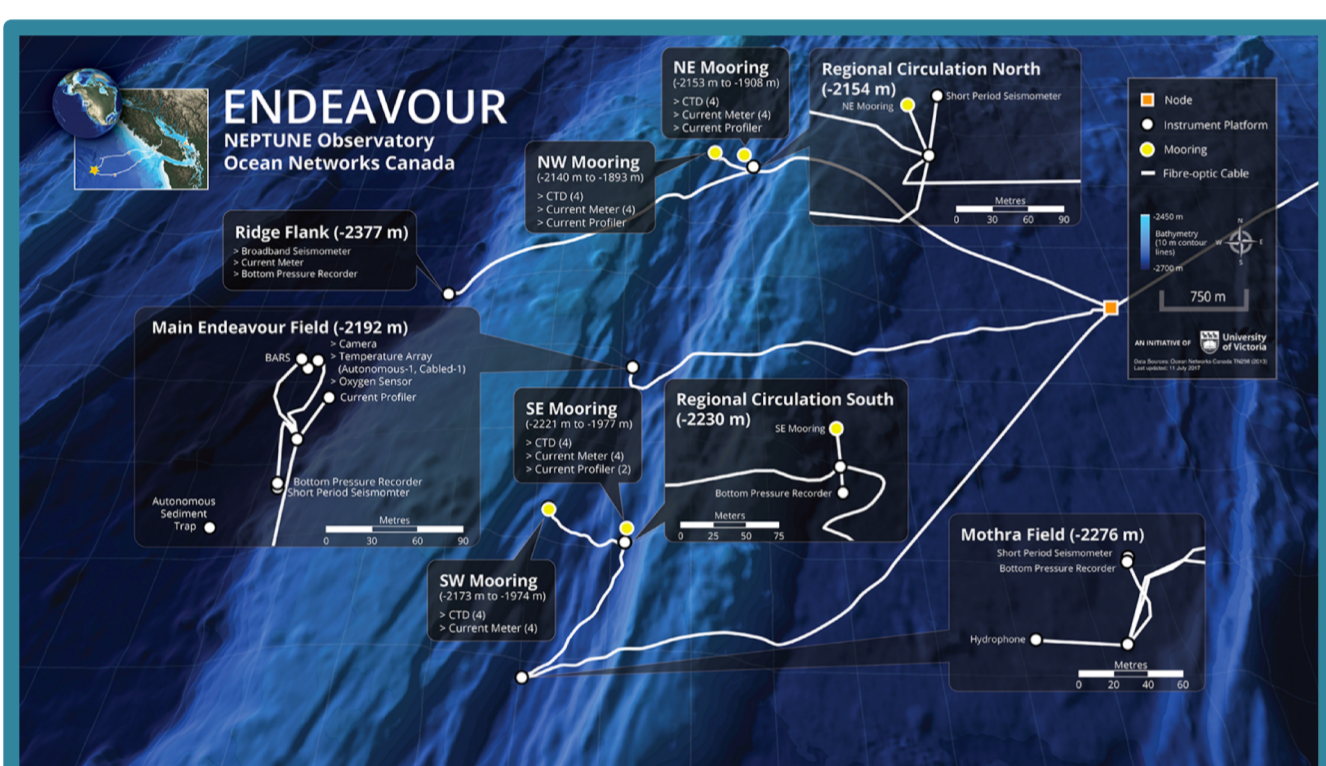
- Seasonal and inter-annual variability in benthic community structure related to primary productivity and sea-ice coverage dynamics;
- Combined imagery and fish tag receiver data to study Arctic char (*Salvelinus alpinus*) population dynamics.



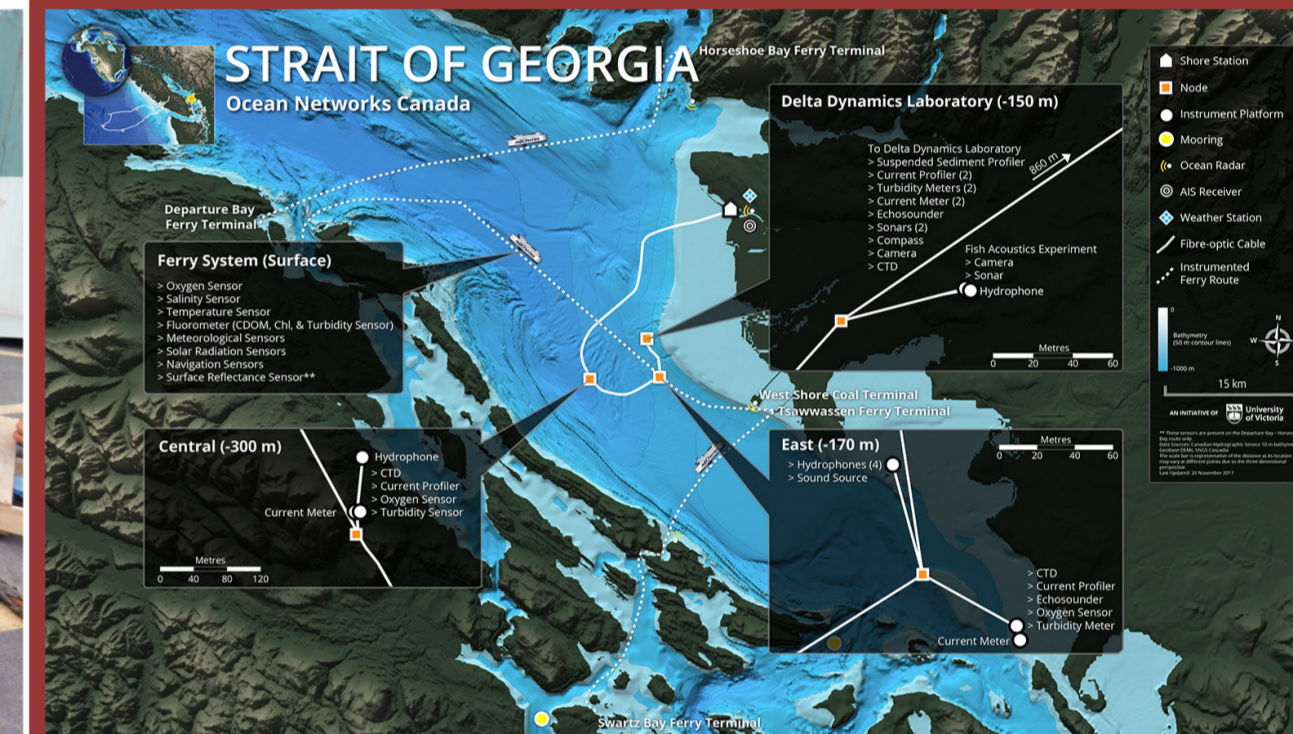
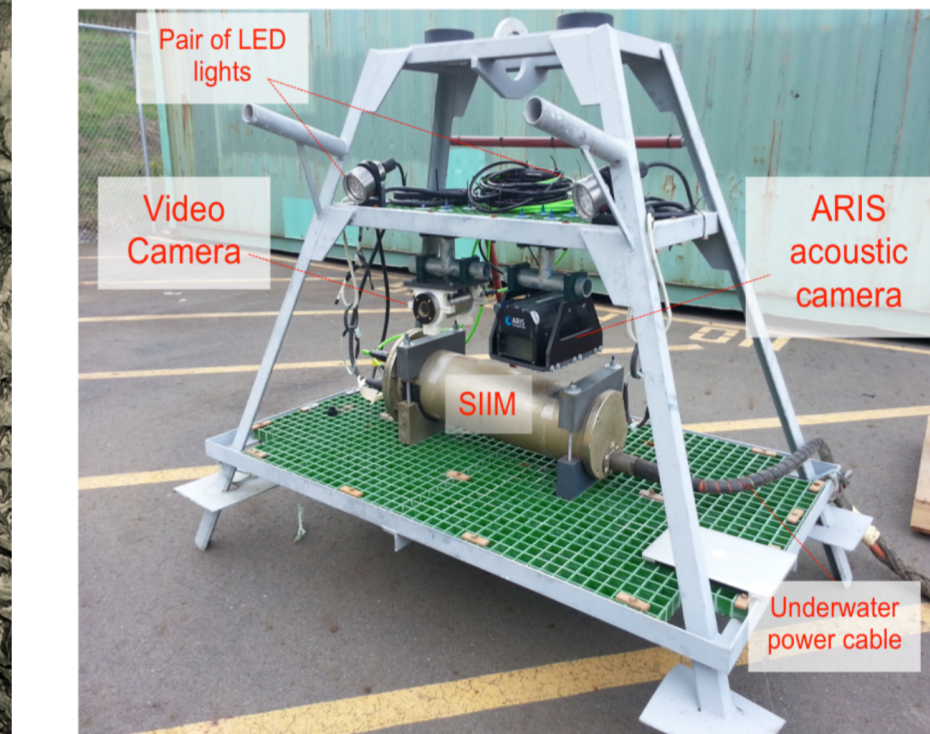
Hydrothermal Vent - 2300 m

Research topics include:

- Short and long-term vent fauna responses to vent fluid dynamics and astronomic and atmospheric variability;
- Vent plume geochemistry, mass and heat flow associated tectonics and seismic activity.

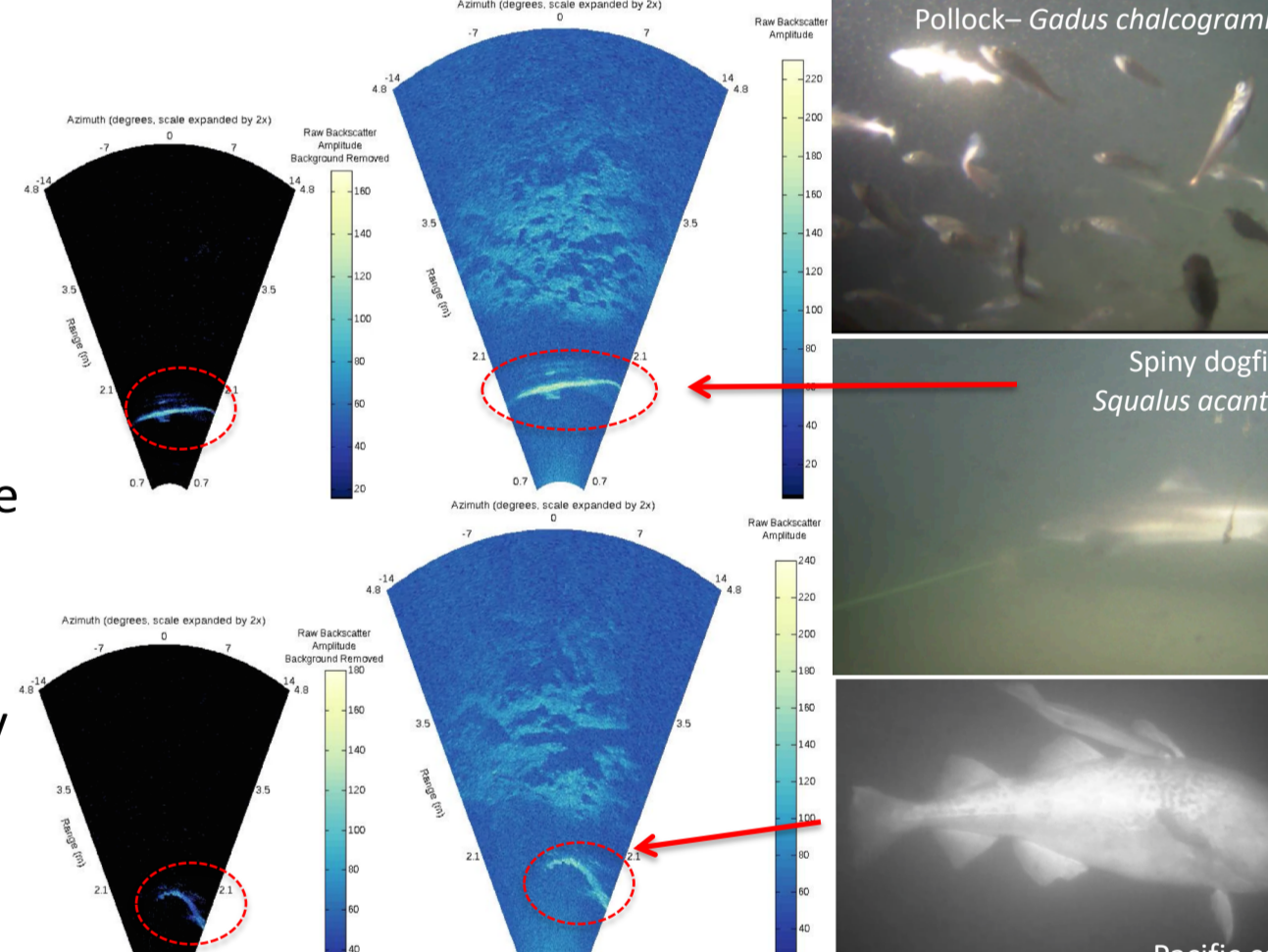


Estuarine/Delta front – 150 m



Research questions include:

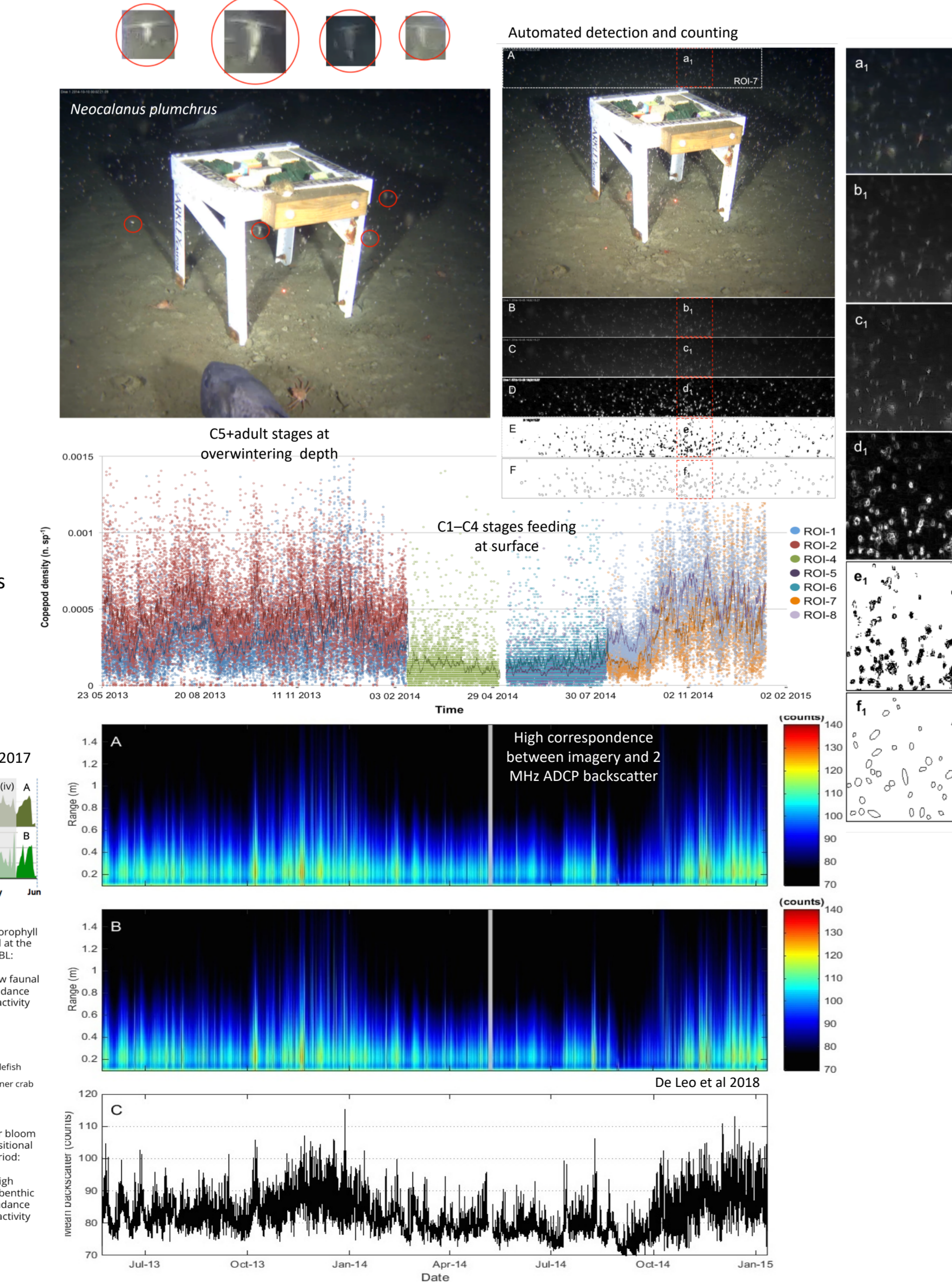
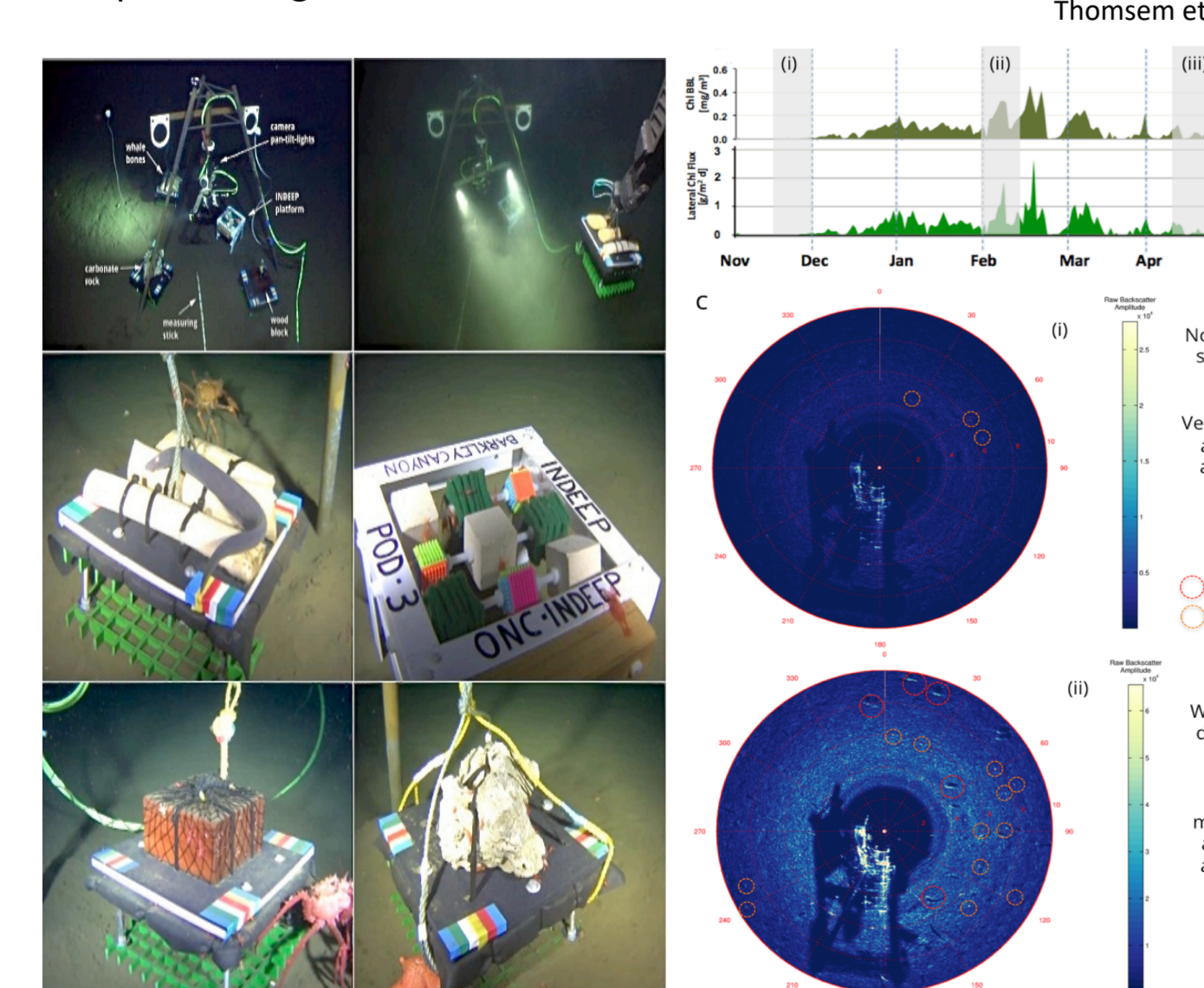
- Identify and characterize the types of sounds the multiple species of fish produce in the Strait of Georgia;
- Assess changes of fish behavior due to changes in underwater noise levels;
- Infer fish abundance and taxonomy from automated detections of acoustic imagery and hydrophone spectrograms.



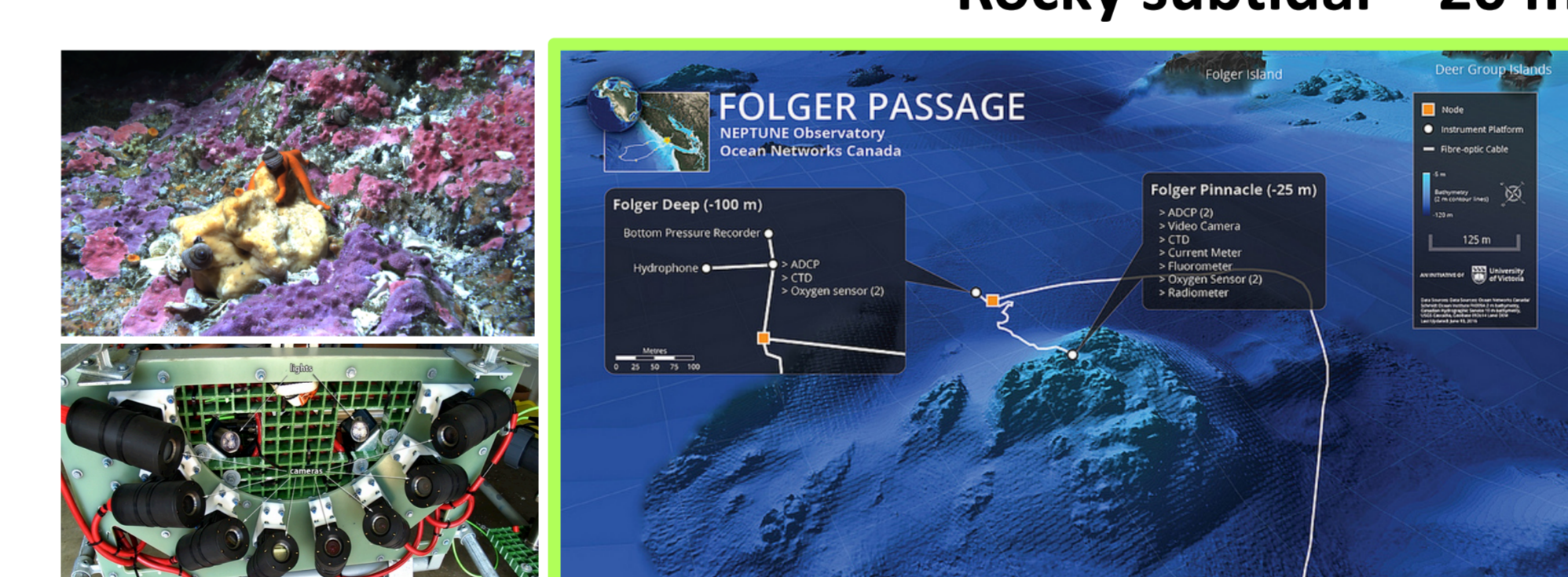
Submarine Canyon – 400 - 1000 m



- Benthic community responses to surface ocean circulation, primary productivity, and carbon flux to depth;
- Faunal biorhythms related to diel and tidal periodicities and seasonal environmental variability, including of commercially important species (e.g., sablefish *Anoplopoma fimbria*);
- Seasonal and inter-annual variability in deep overwintering migration of calanoid copepods (*Neocalanus* spp.);
- Benthic faunal colonization and succession experiments on artificially implanted organic substrates.

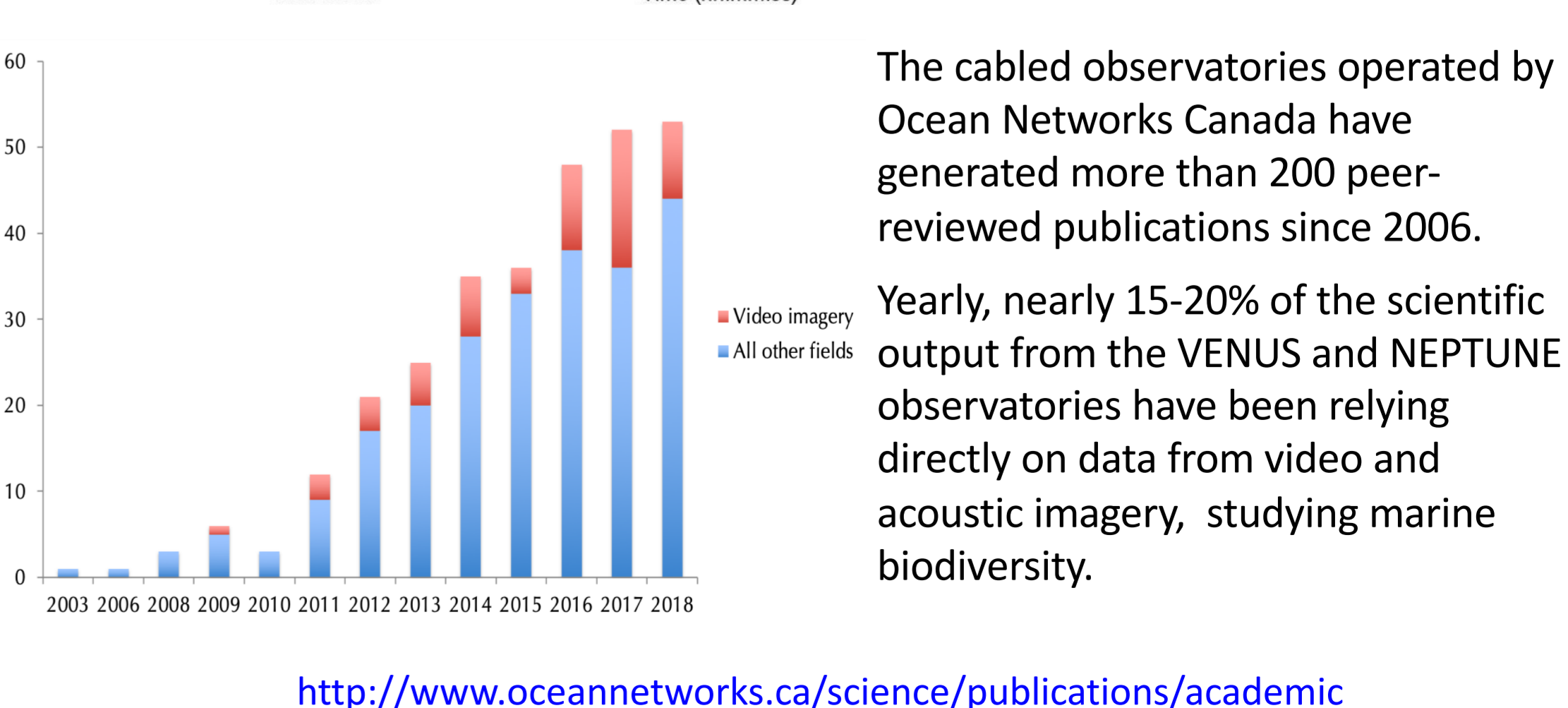
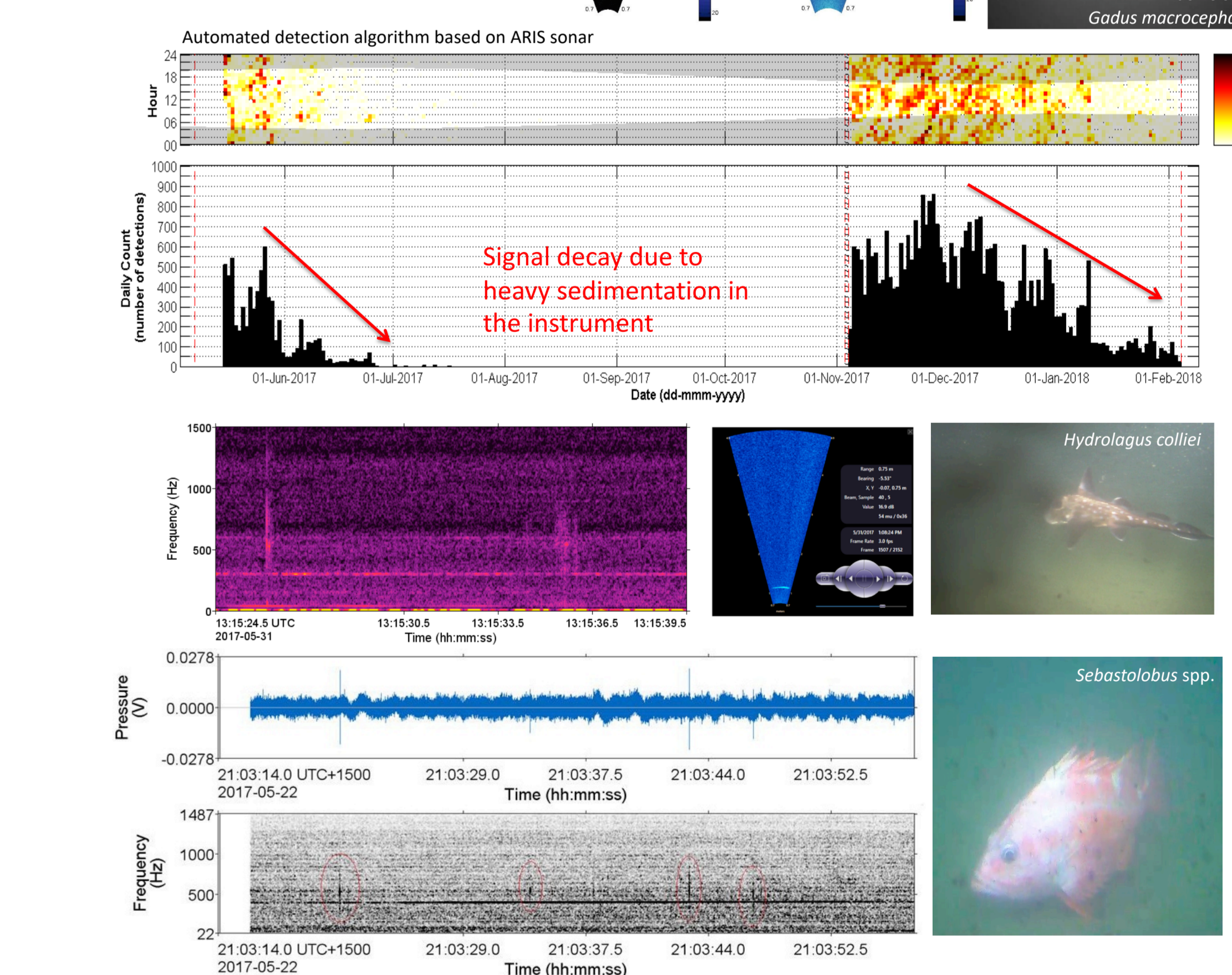
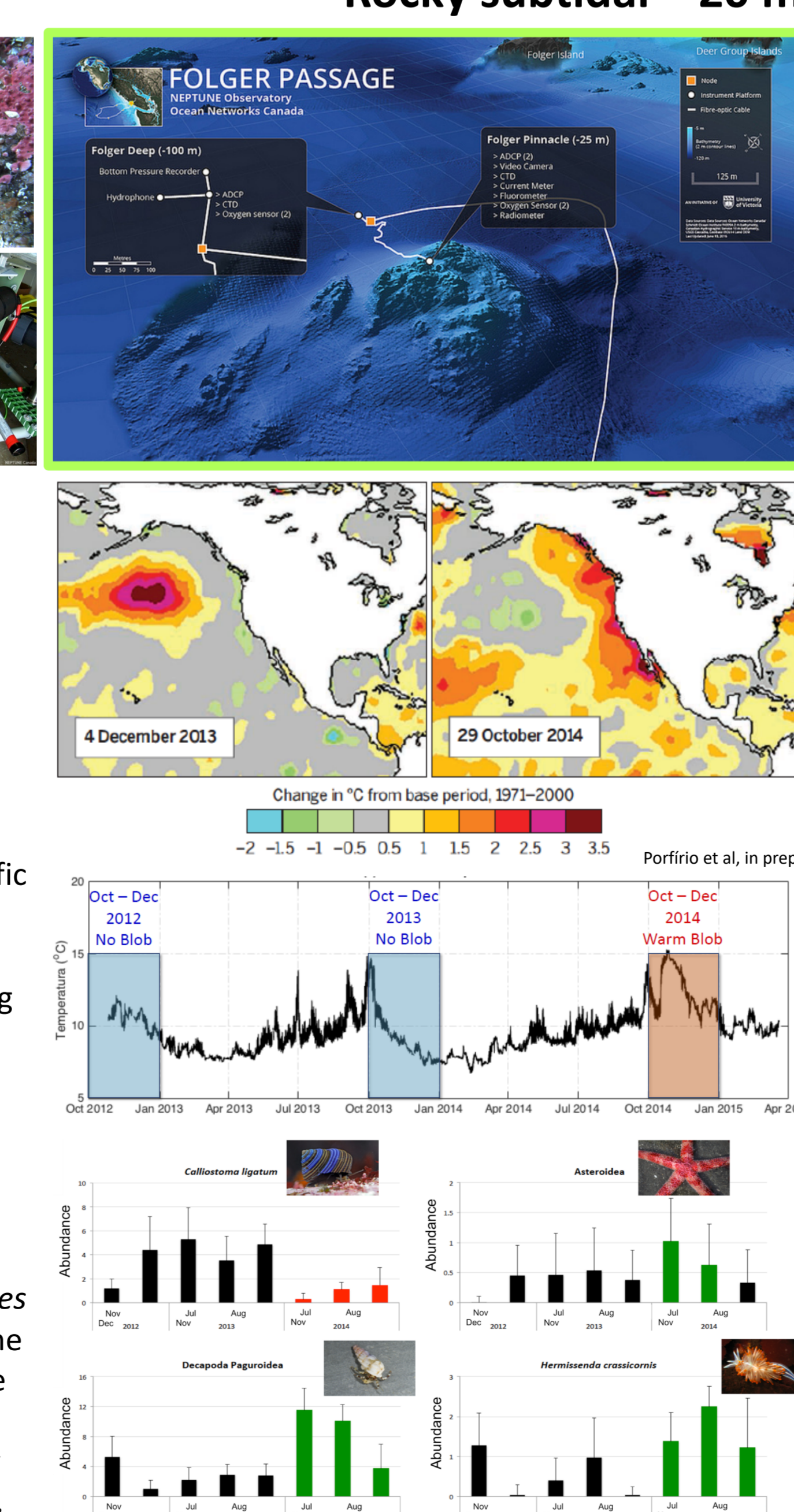


Rocky subtidal – 20 m



Research questions:

- Seasonal and inter-annual variability in benthic community structure related to coastal productivity;
- Recent study demonstrated the effects of the NE Pacific 'Warm Blob' sea-surface temperature anomaly in structuring of benthic communities, with replacement of detritivore by carnivores species;
- Changes in demersal (*Suberites coccineus*) body volume in response to surface storms, productivity/turbidity and dissolved oxygen.



The cabled observatories operated by Ocean Networks Canada have generated more than 200 peer-reviewed publications since 2006. Yearly, nearly 15-20% of the scientific output from the VENUS and NEPTUNE observatories have been relying directly on data from video and acoustic imagery, studying marine biodiversity.

<http://www.oceannetworks.ca/science/publications/academic>