

Submarine islands of benthic biodiversity within and adjacent to an offshore transitional area

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& Tammy Norgard

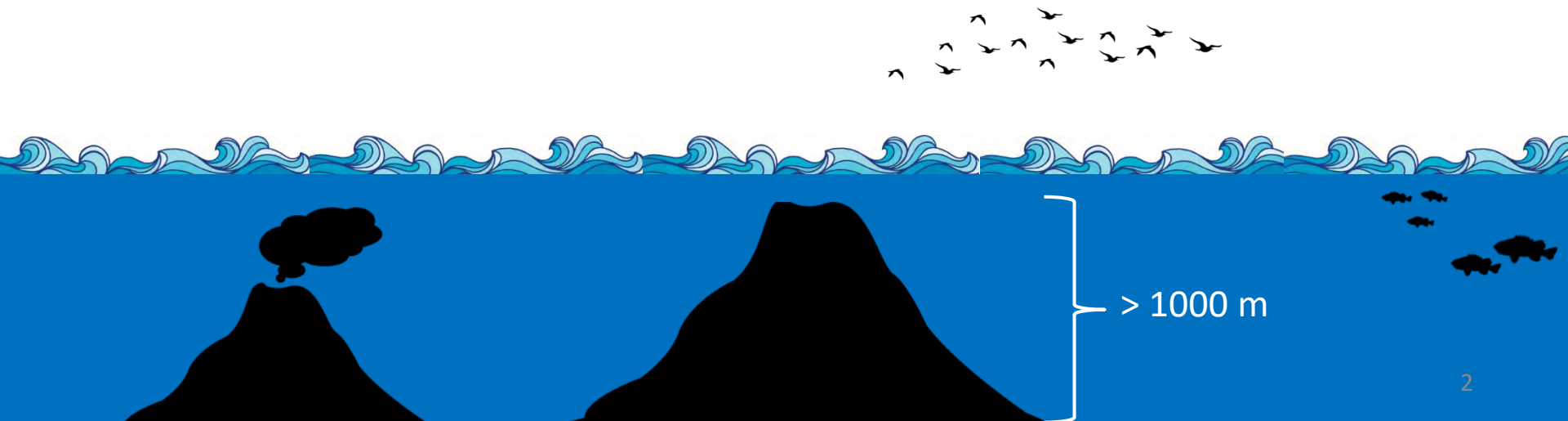
Marine Spatial Ecology & Analysis Section,
Fisheries and Oceans Science Division

International Symposium: Understanding Changes in
Transitional Areas of the Pacific Ocean
24th April 2018

Seamount 101

Underwater volcanic mountain

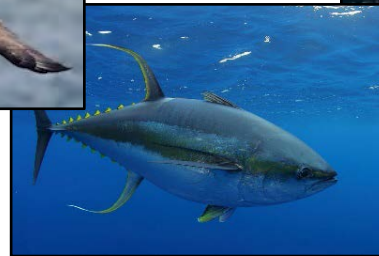
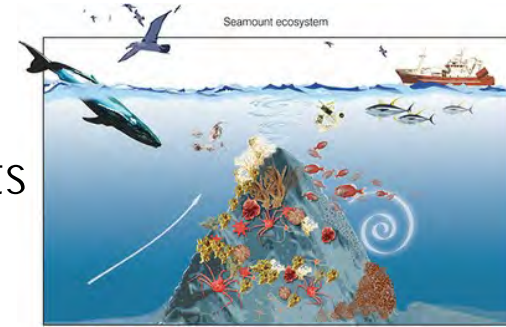
- “A large, isolated elevation characteristically of **conical** form” (Bouma 1990)
- Active or extinct volcanic activity
- Exceed **1000 m** above the surrounding seafloor (US Board of Geographic Names 1981)





Offshore oases of life & a hotspot of biological diversity

- **high productivity**
- eddies & cones **concentrate local productivity** while pulling in productivity from elsewhere, acts as a **barrier & traps** prey
- boosts productivity throughout the **food web****
 - feeding grounds for seabirds, whales, pelagic fish, vertical migration of productivity to the seafloor of the seamount **extends in 4-D
- hard substrate and **complex 3-D** structures → deep-sea corals, sponges, rockfish, etc.
- **refuge** for a subset of species found on the continental slope

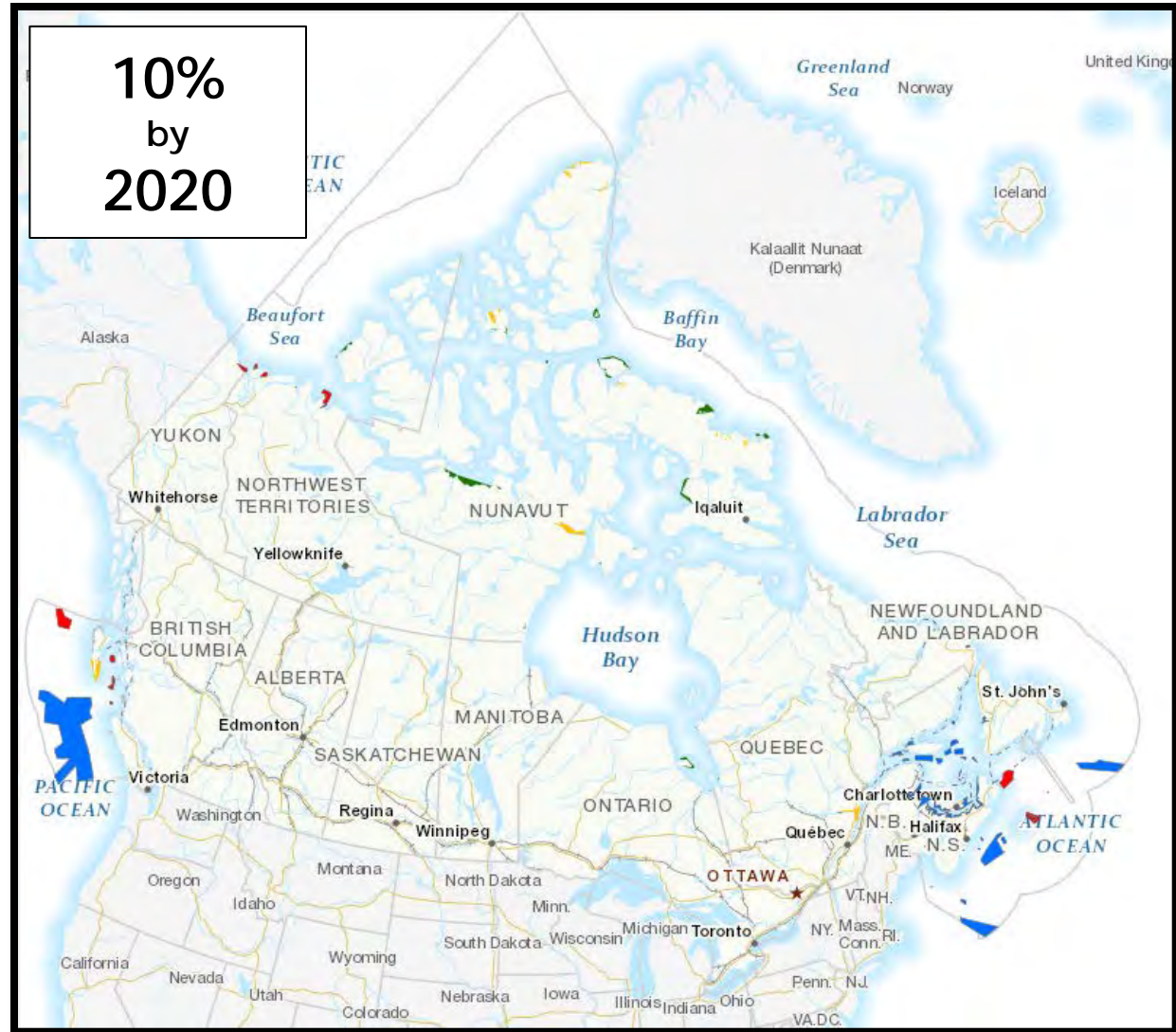


Seamounts protection

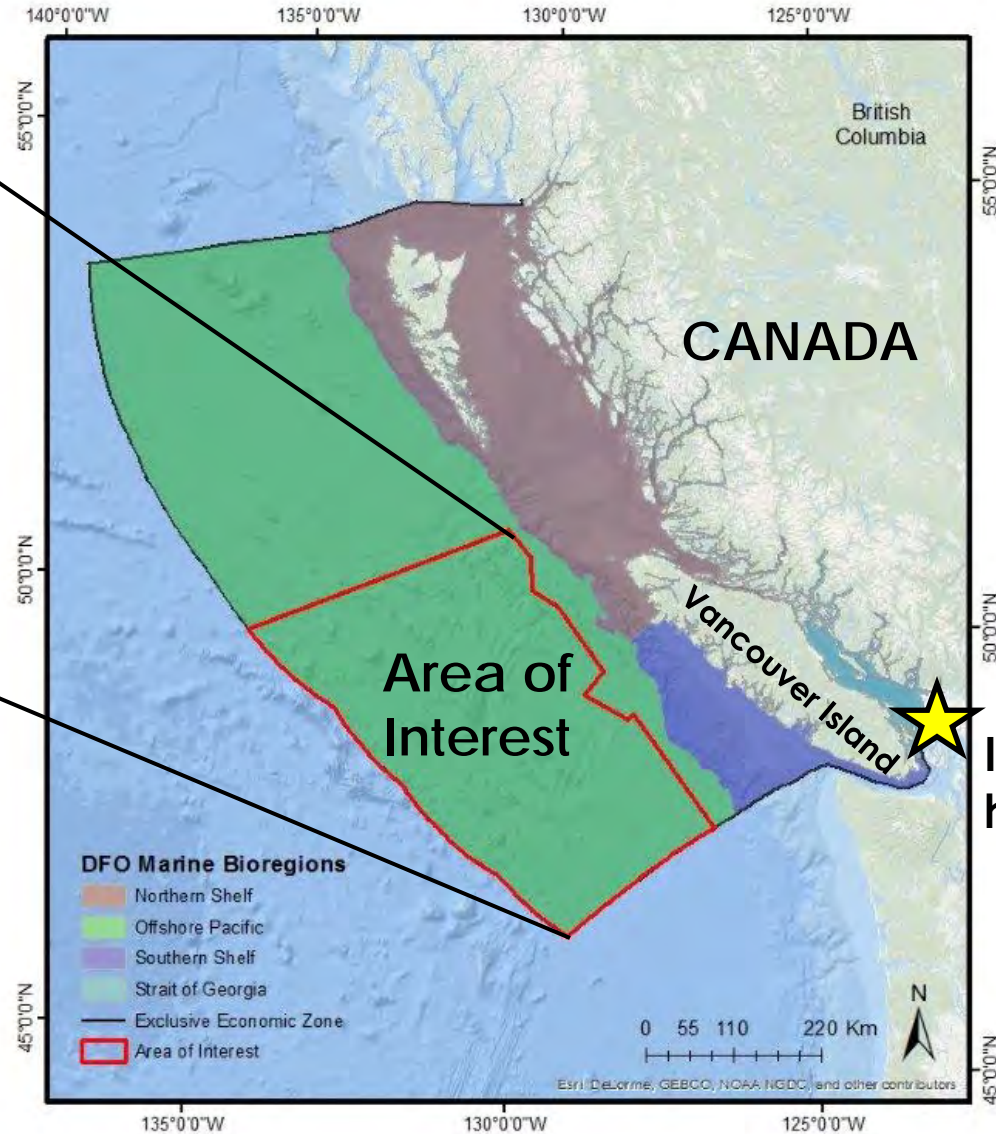
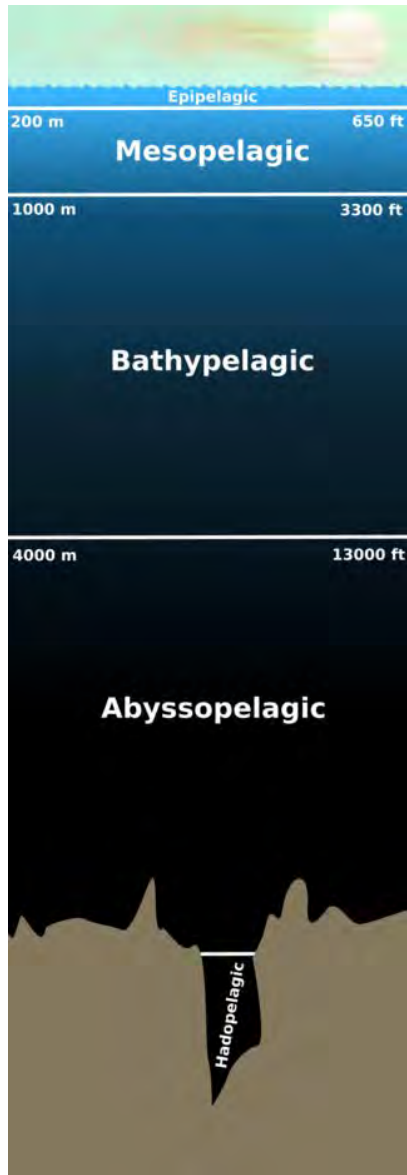


Convention on Biological Diversity

AICHI BIODIVERSITY TARGETS

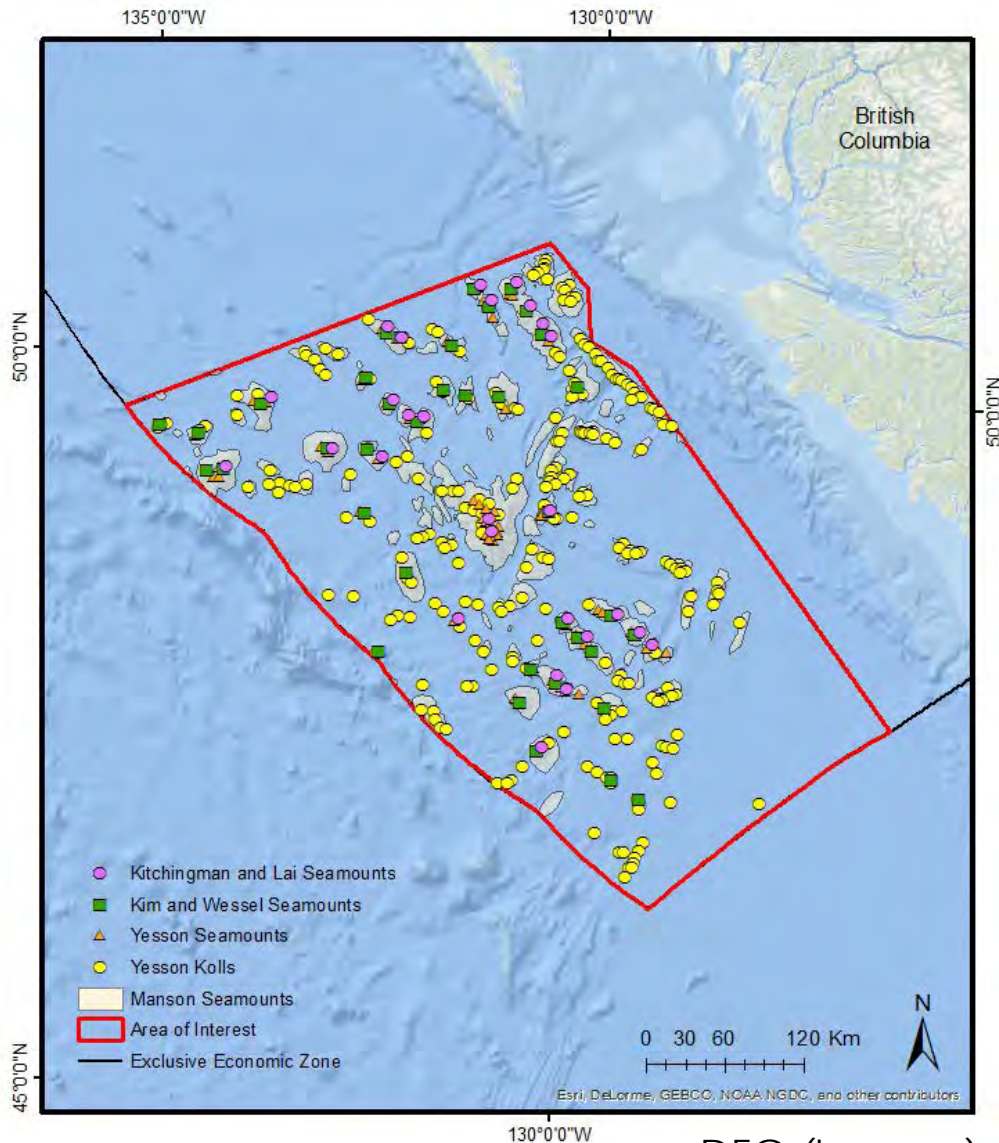


140,000 km² or 420,000 km³



DFO (in press)

Seamounts protection



DFO (in press)

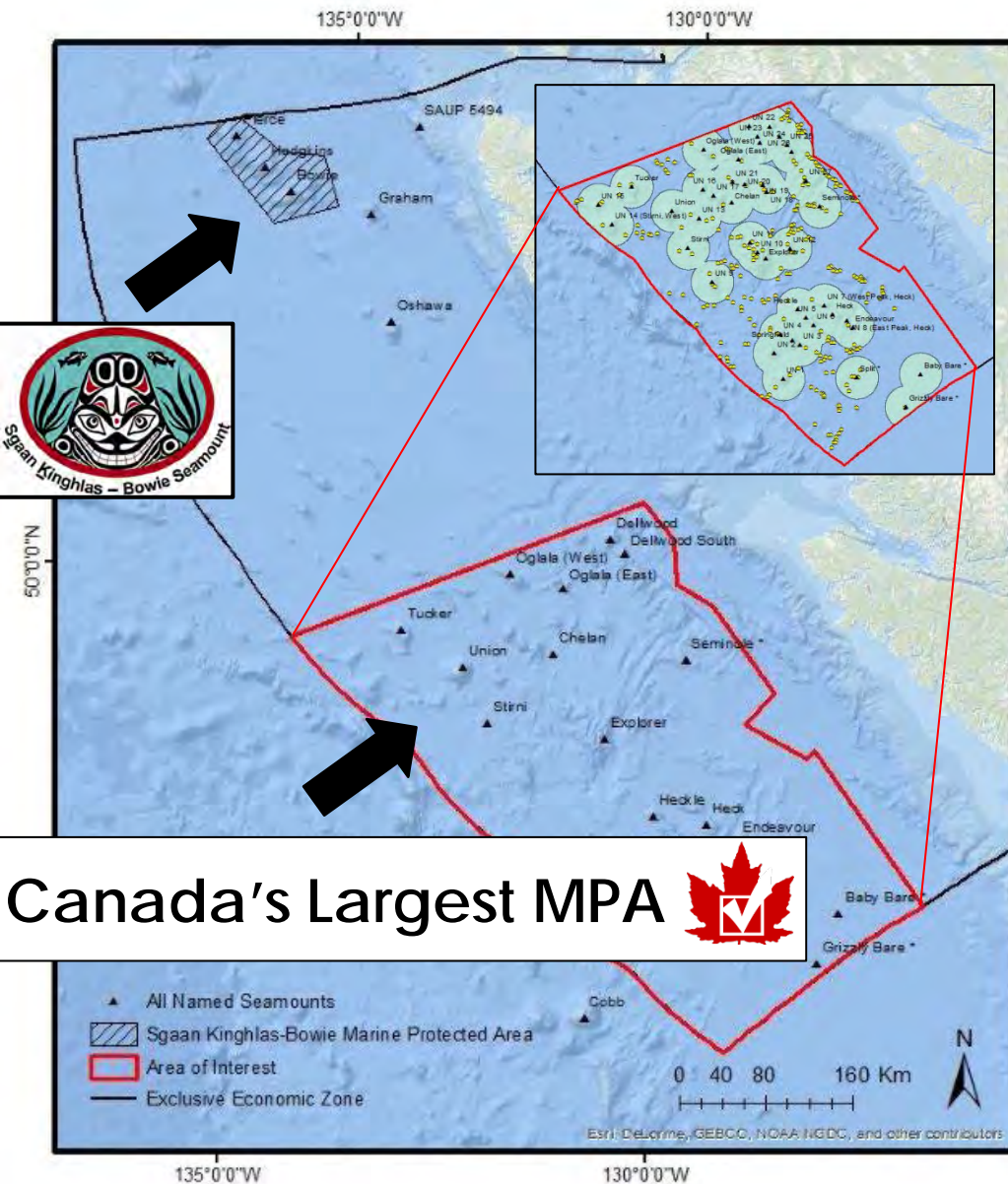
19 known seamounts,

27 Predicted seamounts:

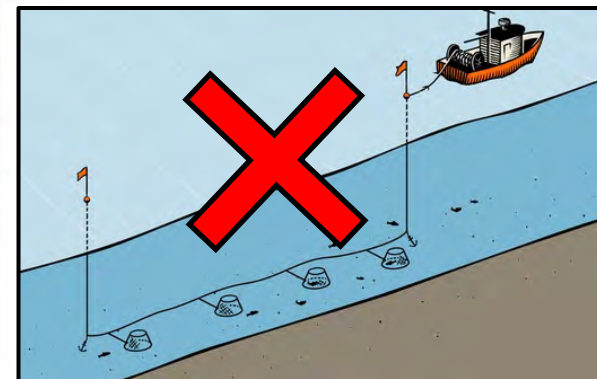
1. Kitchingman and Lai (2004) (purple circles),
2. Manson (2009) (beige polygons),
3. Kim and Wessel (2011) (green squares),
4. Yesson et al. (2011) (orange triangles for seamounts and yellow circles for knolls)

- **Imposed rule:** >1000 m elevation over 20 km (Yesson et al. 2011)

Seamounts protection



- **46:** a network of 40 seamounts (south) + 6 seamounts (north) within Canada's EEZ
- **All** known Canadian seamounts
 - none in the Canadian Arctic or Atlantic
- Early 2018: **No bottom-contact seamount fishing**



DFO (in press)

Knowledge gap

- **Baseline** information for individual seamounts:
 - multibeam bathymetry maps
 - visual surveys
 - species composition
 - influence of the “seamount effect” over space and time

Difficult tasked: creating managements and monitoring plans for the soon-to-be 43 protected offshore seamounts

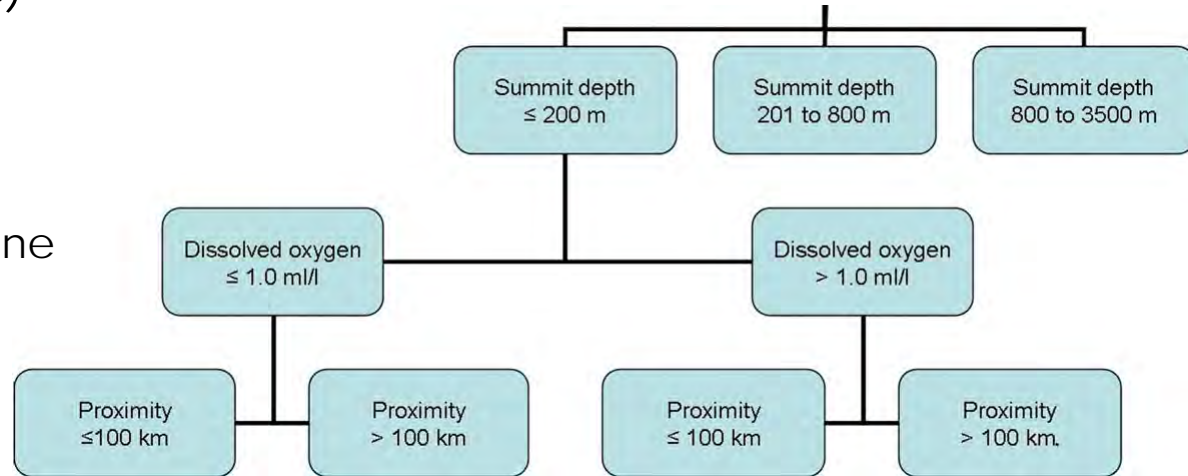


Seamounts classification

A network of diverse seamounts (DFO, in press)

- contains **5 different classes** of seamounts
 - based on depth, proximity, & oxygen alone (Clark et al. 2007)

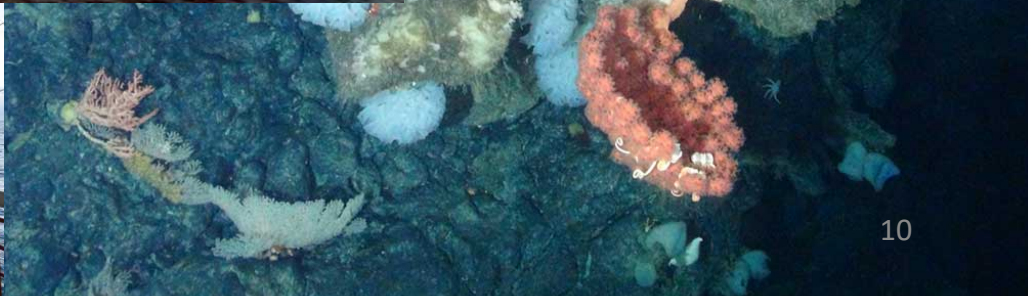
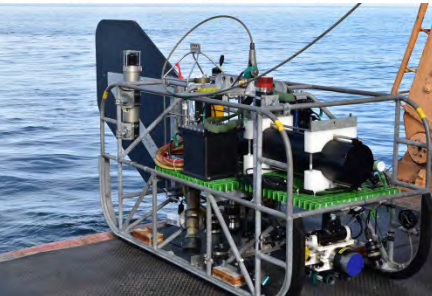
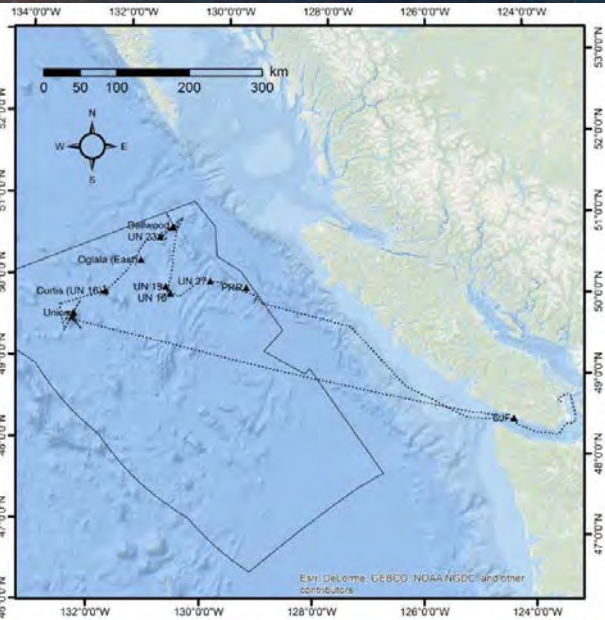
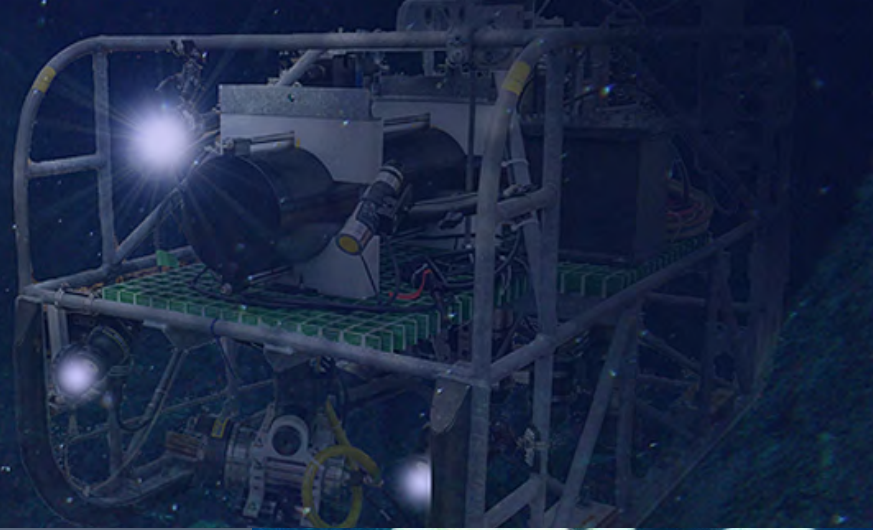
A global seamount classification to aid the scientific design of marine protected area networks
 Malcolm R. Clark^{a,*}, Les Watling^b, Ashley A. Rowden^a, John M. Guinotte^c, Craig R. Smith^b
^aNational Institute of Water & Atmospheric Research, Wellington, New Zealand
^bUniversity of Hawaii at Manoa, Honolulu, USA
^cMarine Conservation Biology Institute, Bellevue, USA



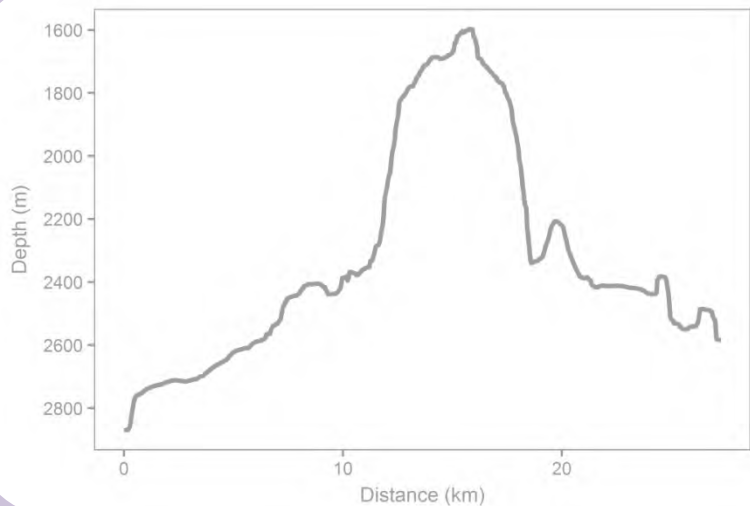
No.	Seamount	Feature class	In Ban et al. 2016	Summit depth (m)	Est. base depth (m)	Est. elevation (m)	Est. temp. at summit (°C)	Est. [O ₂] at summit (mL/L)	Lat.	Long.	Proximity to nearest seamount (km)	Proximity to base of the continental slope (km)	Seamount class (Clark et al. 2011)	Location predicted by:	Associated with:
Named seamounts within the Offshore Pacific Area of Interest															
1	Chelan Seamount	Seamount	Y	1459	3050	1591	2.4	0.6	49.75	-131.53	28	44	2	KL, M, KW, Y	Chelan Seamount (chain)
2	Dellwood Seamount	Seamount	Y	300	2659	2359	2.9	0.5	50.73	-130.9	19	on slope	3	KL, M, KW, Y	Dellwood Seamount Chain
3	Dellwood South Seamount	Seamount	Y	1218	2629	1411	2.6	0.5	50.6	-130.72	16	on slope	2	KL, M, KW, Y	Dellwood Seamount Chain
4	Endeavor Seamount	Seamount	N ²	1707	2900	1193	2.1	1.2	48.27	-129.08	13	on slope	1	M, Y	na
5	Explorer Seamount	Seamount	Y	830	3300	2470	3.6	0.4	49.07	-130.93	14	17	2	KL, M, KW, Y	Explorer Seamount (complex)
6	Heck Seamount	Seamount	Y	1100	2700	1600	3.2	0.4	48.42	-129.47	18	on slope	2	KL, M, KW, Y	Heck Seamount (chain)
7	Heckle Seamount	Seamount	N ²	1400	2800	1400	2.5	0.6	48.47	-130.13	16	on slope	2	KL, M, KW, Y	Heckle Seamount Chain
8	Oglala Seamount (West)	Seamount	N ²	1600	3069	1469	2.2	0.9	50.38	-132.17	41	91	2	KL, M, KW, Y	na
9	Oglala Seamount (East)	Seamount	Y	1372	3000	1628-1200	2.6	0.5	50.3	-131.47	32	41	2	M, KW, Y	na



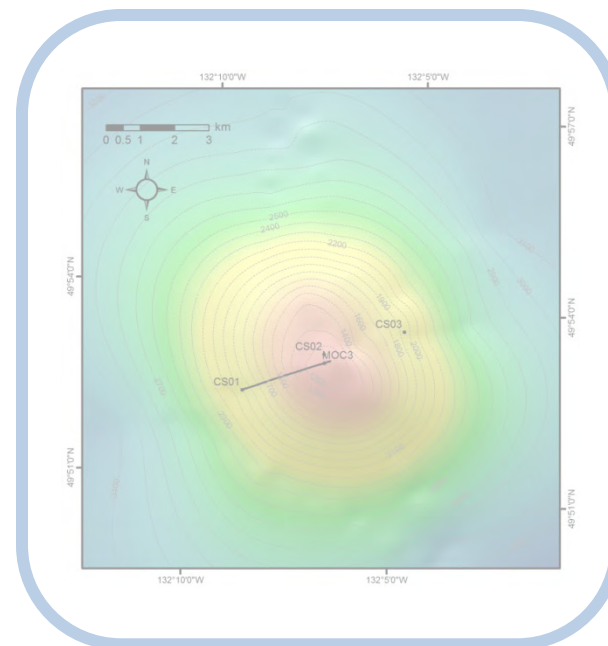
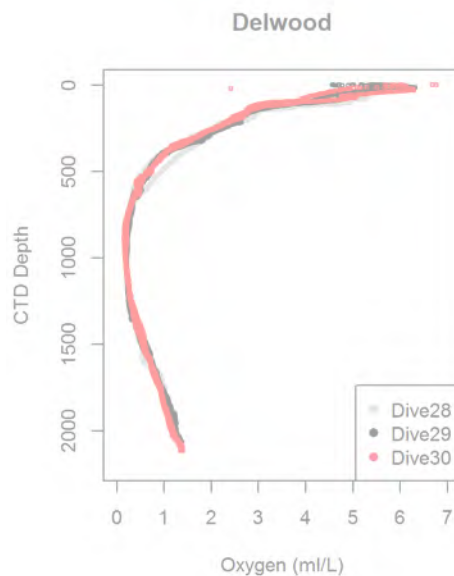
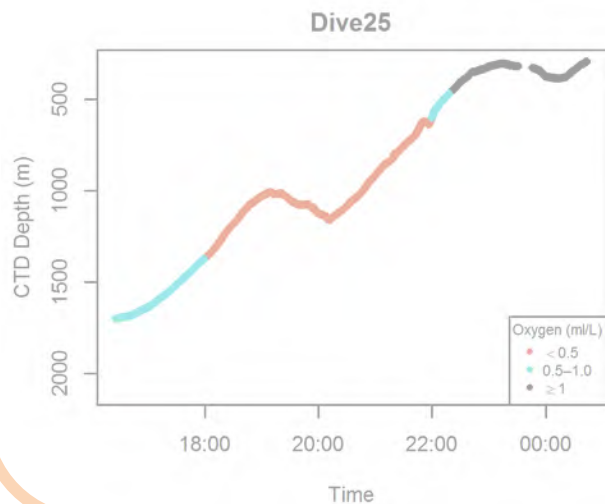
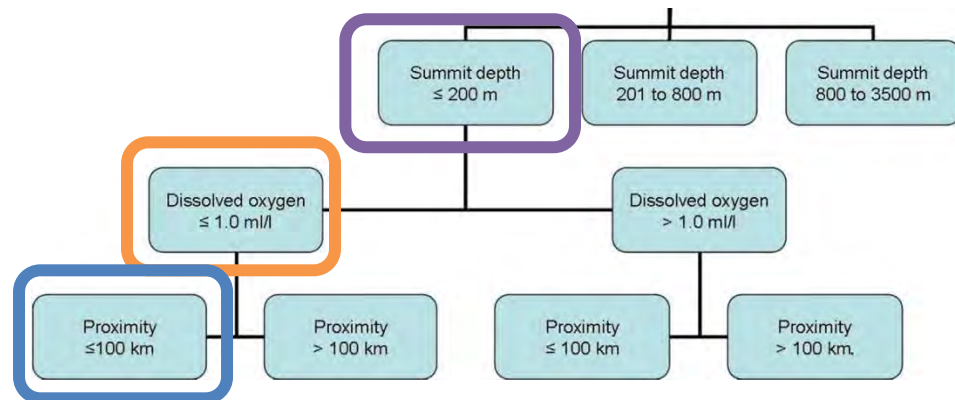
Exploring the AOI



Seamounts classification



1st: all were confirmed as seamounts



Transitional zone



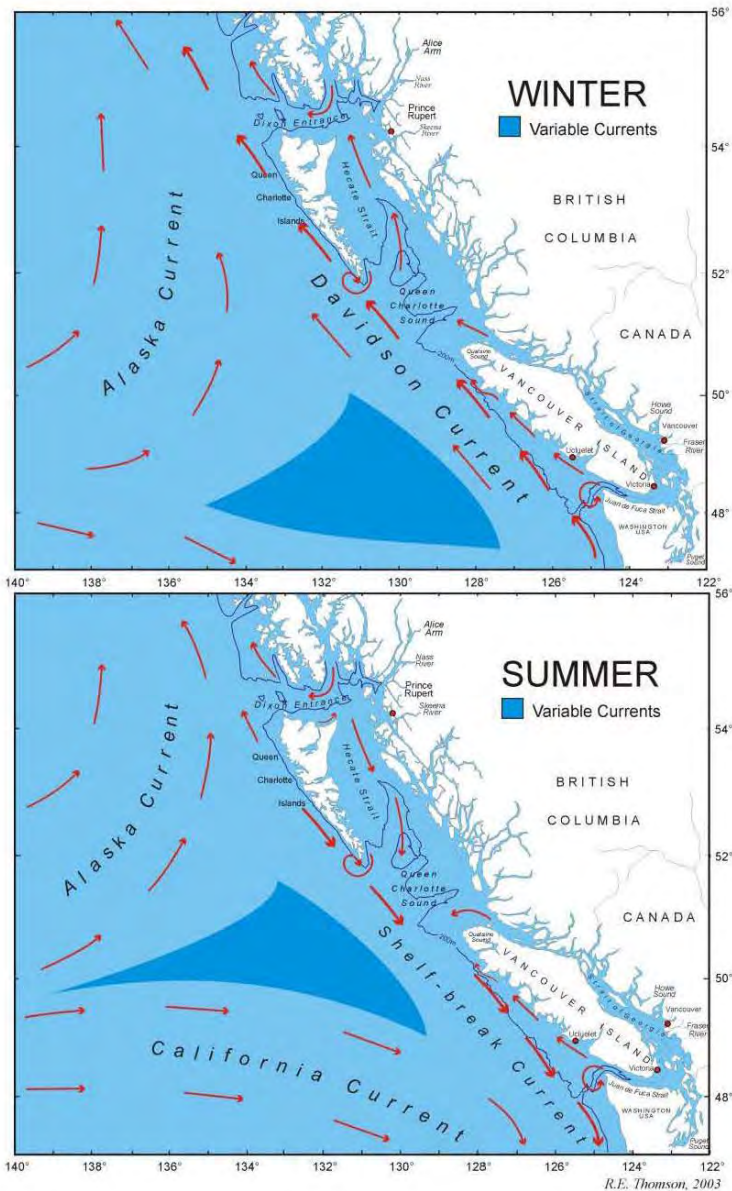
Ground-truthed: 5 classes of seamounts, with oxygen concentration as the prominent variable dividing the network

Surveyed seamounts within and adjacent to the offshore transitional area

- **Bifurcation (split)** of the North Pacific current into the Alaska current & the California current
- **mobile region** of variable currents (south in winter; north in summer)

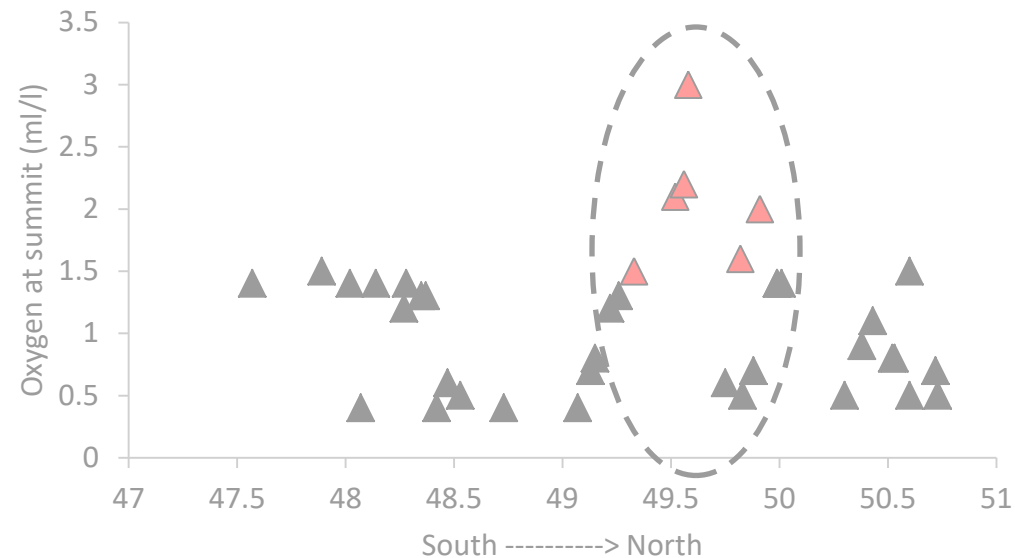
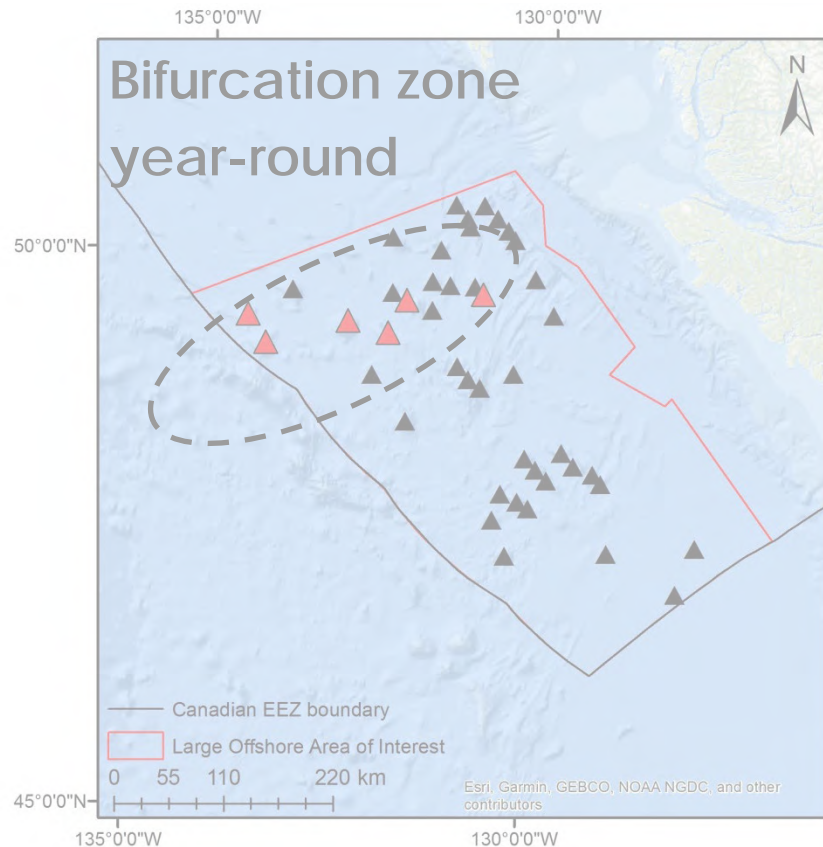
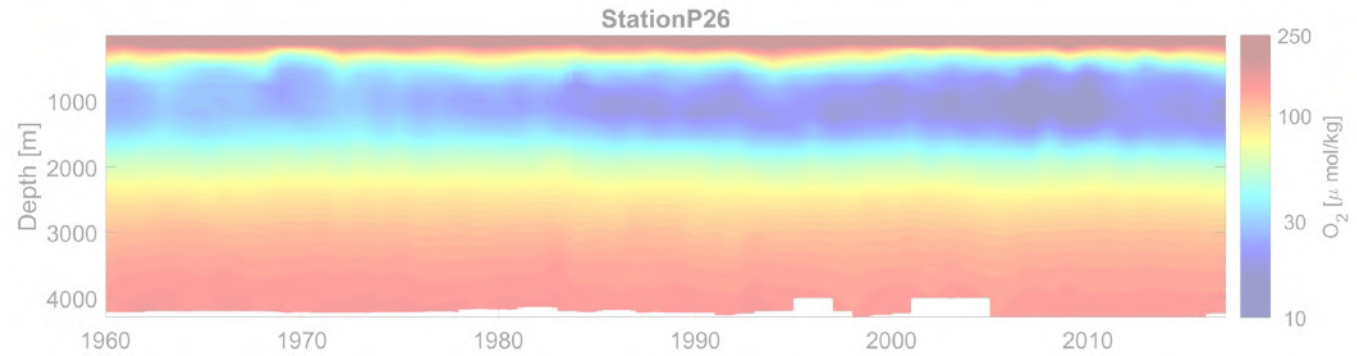


(DFO, in press)



Transitional zone

Naturally occurring oxygen minimum zone (Line P data)



- AOI seamounts with 6 highest [O₂]
- All "Class one" seamounts

Transitional zone

Preliminary analyses of the benthic surveys:

- at the same depths, benthic communities vary between seamounts of different classes based on $[O_2]$
- mechanism unknown
 - grazing of recruits?
 - $[DSi]$?

Appears the bifurcation zone plays a role in diversifying seamount benthic communities within the network

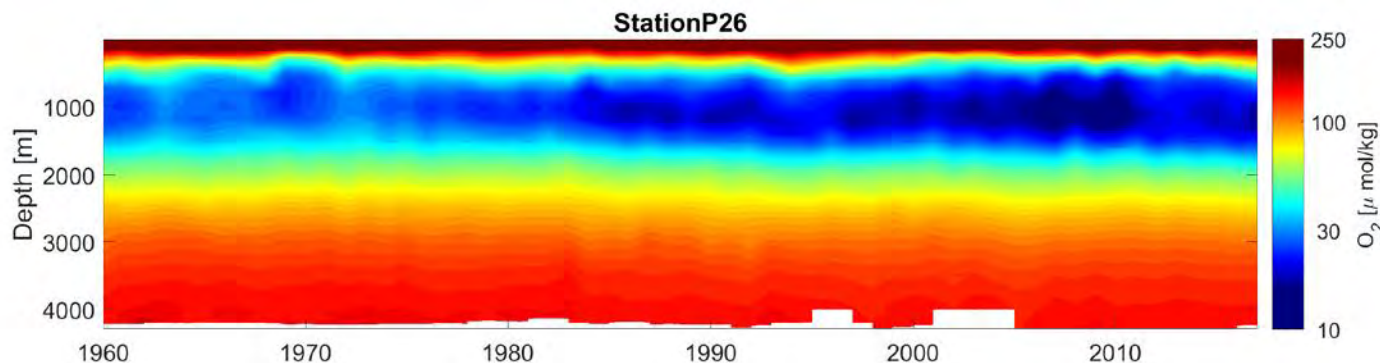




Long-term variability in the Oxygen Minimum Zone in the North East Pacific and potential impacts on seamount communities

Tetjana Ross, Cherisse Du Preez , Debby Ianson, Tammy Norgard and Marie Robert

- Climate change
- OMZ is becoming more O₂ depleted, while expanding shallower and deeper
- Threat to regional diversity among seamounts?



Future expeditions

Offshore Seamounts

- July 2018
- E/V *Nautilus* with ROV *Hercules*
- Major objectives:
 - survey 3 seamounts: Bowie, Dellwood, & Explorer
 - establish long-term monitoring sites



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Seamount summary

- Oases of life
- Prominent features in Canada's Pacific offshore
- Important to Canadian MPAs
- Fisheries and Oceans Canada: using a seamount **classification system to aid with management & monitoring planning**
- Regional **diversity among seamounts** shows correlation with **[O₂]** and the **Bifurcation Zone**
- Ongoing research:
 - ID diversity among seamounts & representative seamounts
 - Set up long-term monitoring sites
 - Predict potential impacts of climate change (expansion of OMZ)



**Thank you for
your attention**