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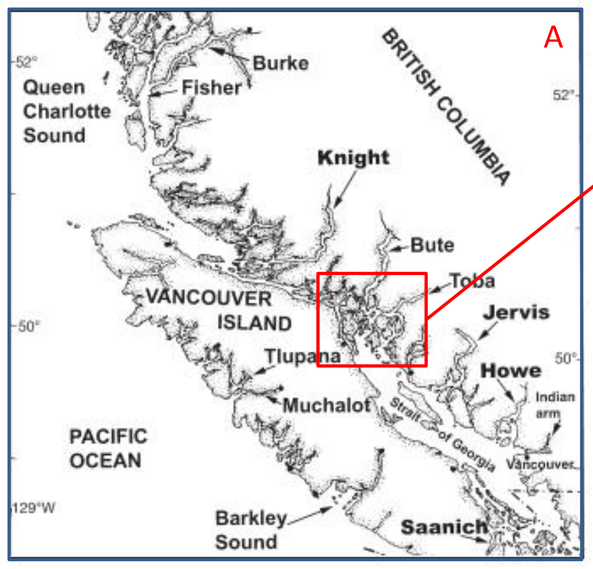
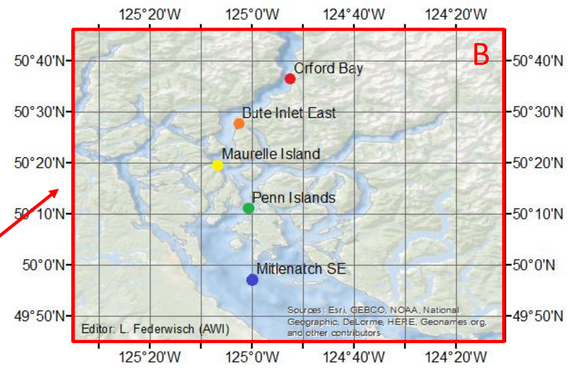
Environmental and biological controls of glass sponges around the Discovery Islands, British Columbia, Canada

Introduction & Objective

Glass sponges (Porifera, Hexactinellida) are characteristically deep water animals, and they are mostly found in depth range of 300-600 m[1]. In only few locations worldwide, including coastal waters of the northeast Pacific, they are found in shallower waters[3]. Glass sponges have significant ecological roles in constructing benthic habitats[4]. Because of their spiky texture and questionable palatability they seem an unlikely prey. However there are reports of predation of glass sponges by sea stars (incl. *Ceramaster* sp) and dorid nudibranchs[5,6]. This research aims to investigate reasons for the occurrence of glass sponges around the Discovery Islands by evaluating impacts of environmental and biological factors.

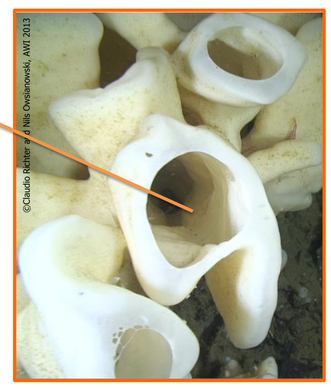


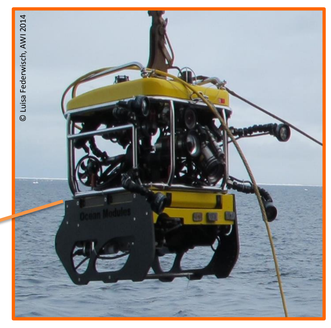


Maps of the study area. (A) BC fjords where, presence of glass sponges was reported (map taken from Leys et al. 2004) [2], (B) our studied area around the Discovery Islands. Stations are colored in rainbow color code; red-blue indicates inshore to offshore location of stations.

Method

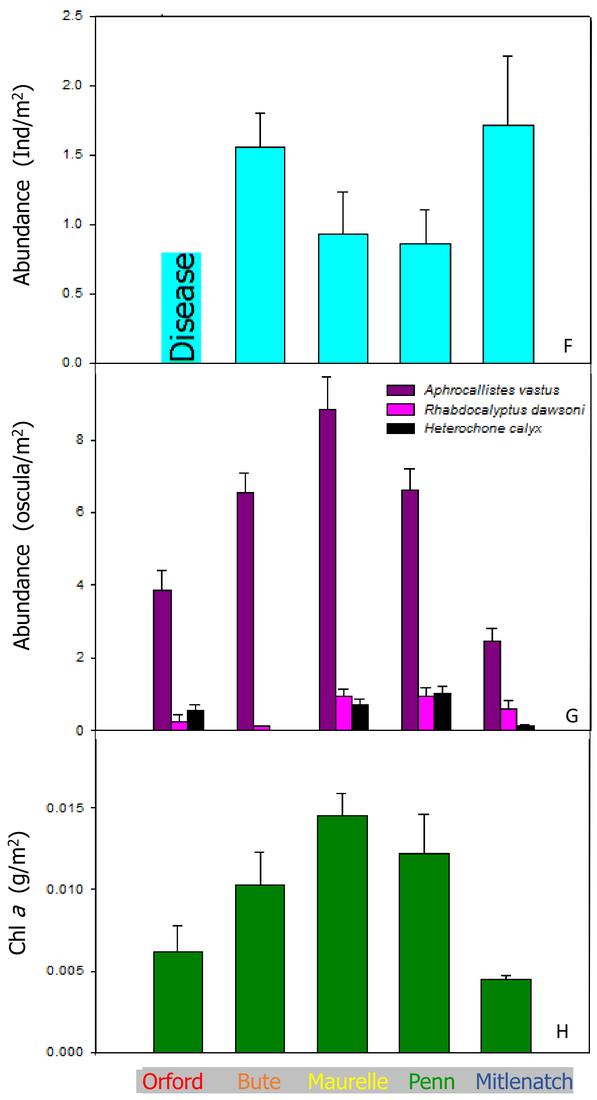
Remotely Operated Vehicle (ROV) was used to map the distribution of glass sponges and other benthic biota at the five stations of Orford Bay, Bute Inlet East, Maurelle Island, Penn Islands, and Mitlenatch Island in the Discovery Islands archipelago. Data from altimeter which was mounted on a camera (measuring its distance to the substrate) was used to calculate the area, and data for temperature, oxygen, salinity and Chl *a* were obtained from CTD measurements. Individual sponge oscula, were counted as a water processing units, as it is very difficult to determine individuals in the abundance of oscula from a glass sponge[3].





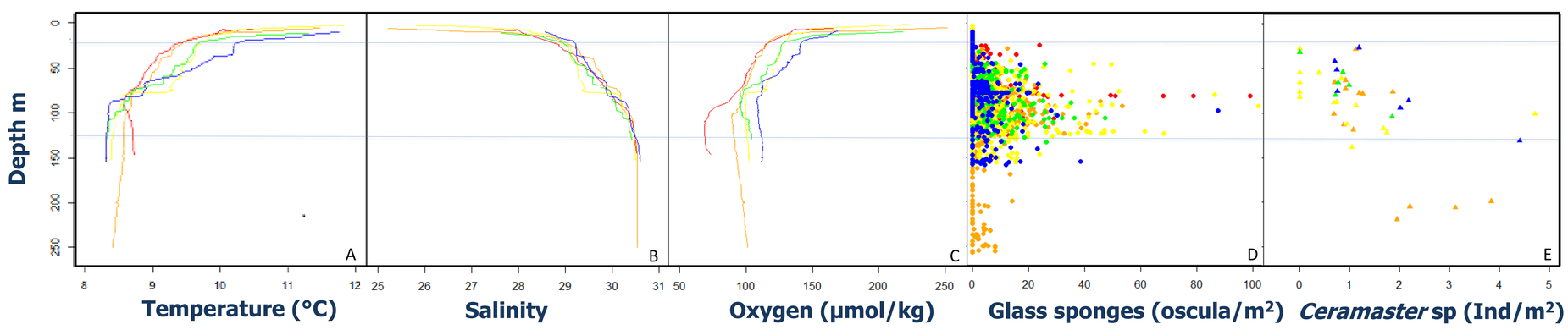
Stations coordinates, depth, and area information

ROV station	Date	N coordinate	W coordinate	Max. depth (m)	Studied area (m²)
Orford Bay	30.07.2013	50°36'150"	124°52'529"	150	102.05
Bute Inlet East	28.07.2013	50°27'294"	124°02'701"	251	252.27
Maurelle Island	01.08.2013	50°19'246"	124°06'768"	153	270.16
Penn Islands	31.07.2013	50°10'718"	125°00'749"	131	128.65
Mitlenatch Island	22.07.2013	49°56'905"	124°59'870"	155	316.96



Comparison of the mean abundance of sea star *Ceramaster* sp (F), glass sponges (oscula) (G), and Chl *a* (24-130 m). No sea star was seen in Orford station. Chl *a* shows highest value in Maurelle station where glass sponges had highest abundance. There was not any significant difference between the abundance of *Ceramaster* sp in four stations. Abundance of *A. vastus* was significantly higher than the abundance of other glass sponges, and Chl *a* was significantly higher in Maurelle station. Error bars show standard errors.

Environmental parameters: Temperature, Salinity, Oxygen, Chl *a*, and biological parameters: Abundance of glass sponges species and Sea star *Ceramaster* sp



A-C: Vertical profiles of environmental parameters; D and E: Horizontal profiles of glass sponges species and sea star (*Ceramaster* sp) abundance in the water column at the five stations (according to the rainbow color code of red: Orford Bay; orange: Bute Inlet East; yellow: Maurelle Island; green: Penn Islands and blue: Mitlenatch Island) around Discovery Islands. The blue dotted lines show the common depth range of (24-130 m) at the five stations.

Results

- Temperature, salinity, oxygen, Chl *a* range was 8.31-10.21 °C, 28.86-30.52, 68.51-140.75 µmol/kg, and 0.11-0.36 mg/m³ respectively in 24-130 m.
- Highest abundance of glass sponges oscula was seen at Maurelle station.
- Presence of sea star *Ceramaster* sp showed very small correlation with occurrence of all glass sponges and their absence at Orford Bay station might be caused by sea star wasting disease (SSWD).
- Combination effect of depth, oxygen and Chl *a* showed relatively moderate correlation with occurrence of all glass sponges in the whole studied area.

Conclusions

- Occurrence of glass sponges in these areas is probably governed by bottom up control.
- Primary production and flux of food from surface might be a contributing factor.
- Predation does not seem to have big impact on occurrence of glass sponges.

Comparison of correlation coefficients (rho) between environmental, biological parameters and occurrence of glass sponges (24 – 130 m).

Depth, Chl *a*, and oxygen showed higher correlation (bold figures) with occurrence of glass sponges.

Environmental & Biological parameters	Orford Bay station	Bute Inlet East station	Maurelle Island station	Penn Islands station	Mitlenatch Island station
Depth (m)	0.13	0.29	**0.19**	0.21	**0.21**
Temperature (°C)	0.04	0.31	0.17	0.21	0.18
Salinity	0.11	0.31	0.13	0.22	0.17
Density (kg/m³)	0.10	0.31	0.14	0.22	0.17
Oxygen (µmol/kg)	**0.16**	0.30	0.17	0.24	0.17
Chl *a* (mg/m³)	-0.00	**0.33**	0.15	**0.27**	0.17

Comparison of the environmental parameters range for occurrence of glass sponges (24 – 130 m)

Environmental Parameters range	Orford Bay station Mean±SD	Bute Inlet East station Mean±SD	Maurelle Island station Mean±SD	Penn Islands station Mean±SD	Mitlenatch Island station Mean±SD
Depth (m)	67.93±29.14	78.16±26.27	81.45 ±24.64	81.17±26.98	70.50±30.44
Temperature (°C)	8.86±0.21	8.82±0.23	8.93±0.45	8.81±0.43	9.12±0.71
Salinity	29.74±0.51	30.03±0.35	29.79±0.49	29.89±0.41	29.85±0.44
Density (kg/m³)	23.04±0.43	23.27±0.30	23.06±0.45	23.16±0.38	23.08±0.45
Oxygen (µmol/kg)	93.90±15.45	98.25±6.64	109.01±9.28	105.39±9.69	120.63±12.22
Chl *a* (mg/m³)	0.03±0.03	0.07±0.05	0.12±0.10	0.07±0.08	0.04±0.03

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