A SUMMARY OF ECOLOGICAL DATA AND FISHING ACTIVITIES IN THE AREA OF THE GWAXDLALA/NALAXDLALA (LULL/HOEYA) MARINE REFUGE

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A SUMMARY OF ECOLOGICAL DATA AND FISHING ACTIVITIES IN THE AREA OF THE GWAXDLALA/NALAXDLALA (LULL/HOEYA) MARINE REFUGE

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIX FIGURES

ABSTRACT

Davies, S.C., Boutillier, J., Jackson, J., Nephin, J. 2024. A summary of ecological data and fishing activities in the area of the Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya) Marine Refuge. Can. Tech. Rep. Fish. Aquat. Sci. 3594: vi + 30 p.

In 2023 the area surrounding the Hoeya Head Sill in Knight Inlet was designated the Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya) Marine Refuge. This area is within the marine portion of the Gwa̲xdlala/Nala̲xdlala Indigenous Protected and Conserved Area declared by the Mamalilikulla First Nation in 2021. The shallow sill contains unique geomorphological and oceanographic features that contribute to the high biodiversity observed in the area, including rare and unique species normally found at much greater depths. The designation of this area as an Indigenous Protected and Conserved Area and a Marine Refuge is a notable step to protect marine life, and their habitats and ecosystems, including unique aggregations of corals and sponges. This technical report provides a summary of scientific data compiled by Science Branch at Fisheries and Oceans Canada on the geology, oceanography, ecology, and fishing activities in the area of the Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya) Marine Refuge.

RÉSUMÉ

Davies, S.C., Boutillier, J., Jackson, J., Nephin, J. 2024. A summary of ecological data and fishing activities in the area of the Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya) Marine Refuge. Can. Tech. Rep. Fish. Aquat. Sci. 3594: vi + 30 p.

En 2023, la zone entourant le seuil du cap Hoeya dans le bras Knight a été désignée refuge marin Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya). Cette zone se trouve dans la partie marine de l’aire protégée et de conservation autochtone Gwa̲xdlala/Nala̲xdlala, qui a été établie par la Première Nation Mamalilikulla en 2021. Le seuil peu profond présente des caractéristiques géomorphologiques et océanographiques uniques qui contribuent à la grande biodiversité observée dans la région, y compris des espèces rares et uniques normalement présentes à des profondeurs beaucoup plus grandes. La désignation de cette zone à titre d’aire protégée et de conservation autochtone, et de refuge marin représente une étape importante pour la protection des organismes marins, ainsi que des habitats et des écosystèmes qu’ils fréquentent, y compris les regroupements uniques de coraux et d’éponges. Le présent rapport technique fournit un résumé des données scientifiques compilées par les Sciences de Pêches et Océans Canada concernant la géologie, l’océanographie, l’écologie et les activités de pêche dans la région du refuge marin Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya).

PURPOSE

The Hoeya Head Sill is a unique geomorphological and oceanographic feature in Knight Inlet with high biological diversity. The sill is encompassed within the Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya) Marine Refuge, hereafter referred to as the MR, and was designated in 2023 (Figure 1). Additionally, this marine refuge is contained within the marine portion of the Gwa̲xdlala/Nala̲xdlala Indigenous Protected and Conserved Area, declared by the Mamalilikulla First Nation in 2021.

An overview of the Gwa̲xdlala/Nala̲xdlala (Lull/Hoeya) Marine Refuge can be found at https://www.dfo-mpo.gc.ca/oceans/oecm-amcepz/refuges/lull-hoeya-eng.html. The conservation objective is the protection of corals and sponges on the shallow sill; all fishing activities are prohibited within the marine refuge. The purpose of this document is to summarise and share information on the area that has been collected, compiled, and analysed by DFO Science (Fisheries and Oceans Canada).

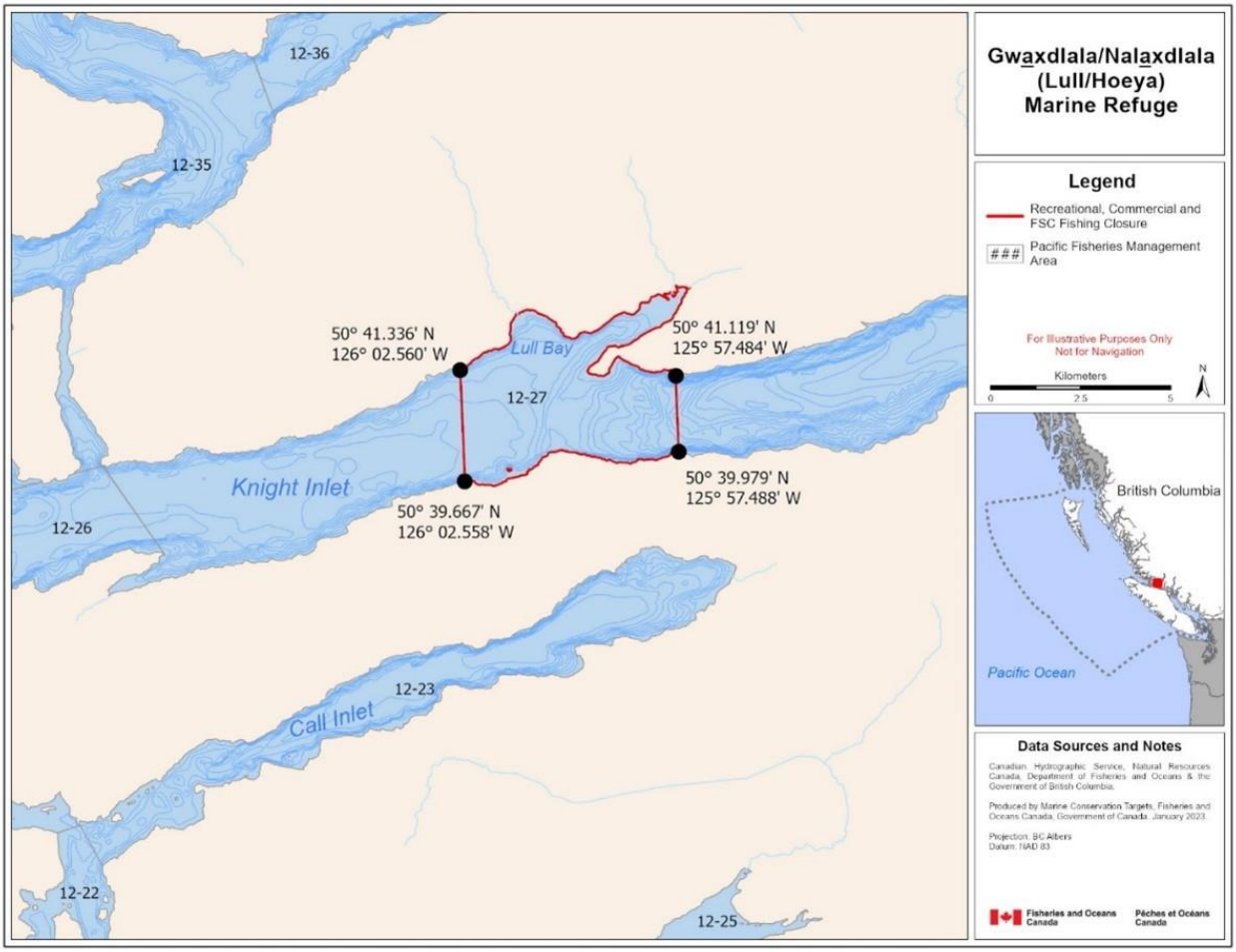

Figure 1. Location of Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge in Knight Inlet, BC.

LIMITATIONS

The information summarised here represents scientific data collected and compiled by DFO, but there are several limitations and gaps:

- The geographic focus of this document is the Hoeya Head Sill and adjacent area, not the entire Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge.
- This is not an exhaustive compilation of available data. Local and traditional knowledge from First Nations, as well as work completed in this area by other investigators are not included. For example, in recent years the Mamalilikulla First Nation and Hakai Institute have undertaken SCUBA and eDNA surveys in the Hoeya Head Sill (Prentice et al. 2023).
- Some species identification of rare or unique species is ongoing, or not completed.

- Fishing activities are described for the Pacific Fisheries Management Area (PFMA) 12-27, not solely within the MR. Data privacy rules prevent the publication of fishing data within a geographical area of this size. However, an internal analysis comparing fishing activities within the entire PFMA 12-27 to those within the MR found the frequency, gear types used, and species caught within the MR was consistent with fishing activities for the entire PFMA 12-27[1].
- This document has not been externally peer-reviewed.

DATA SOURCES

GEOLOGICAL

Multibeam and other bathymetric data of Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge and the surrounding area were provided by Canadian Hydrographic Services (CHS). Interpretation of backscatter data was provided by Kim Conway at Natural Resources Canada (NRCan) and CHS.

OCEANOGRAPHIC

Temperature, salinity, and oxygen data have been collected in Knight Inlet since 1951 through programs by the University of British Columbia (1951 to 1993), Fisheries and Oceans Canada (1979 to 2022) and Hakai Institute (2019 to 2020).

ECOLOGICAL

Species observations and substrate data were obtained from visual surveys using manned submersibles, remotely operated vehicles (ROV) or SCUBA. In 1981, the PICES submersible explored the sill (University of Victoria, V. Tunnicliffe). In 2010 a DFO ROV survey completed six transects around the sill with a Phantom ROV HD2+2 (Deep Ocean Engineering) (Figure 3). The Phantom ROV surveyed approximately 1 m above the seafloor and captured continuous standard definition video. Video imagery was annotated by J. Boutillier for species and substrate. Species identification completed by J. Boutillier was supported by several taxonomic experts including Merlin Best (DFO); Andy Lamb, Bill Austin, Steven Carnes (Smithsonian Museum of

[1] Boutillier, J. and Davies, S. 2017. Evaluation of Hoeya Head Sill in Knight Inlet, Internal Report to DFO Fisheries Management.

Natural History); Catherine McFadden (Harvey Mudd College); Henry Reiswig (Porifera expert); and Henry Chong (Royal BC Museum). SCUBA observations were provided by biologists Neil McDaniel, Doug Swanston, Pauline Ridings, and Brian Rusch.

FISHERIES

Fishery data were sourced from logbook records for commercial Groundfish and Invertebrate Fisheries, commercial Salmon fishery openings from DFO Fishery Operations System database, and through client survey data from the Sports fishing sector. First Nations fishing information is not included. Fishing activities were summarised from 2000 to 2021.

GEOLOGICAL OVERVIEW

Knight Inlet is a 105 km long inlet with an average width of about three km, making it one of the longest inlets on the mainland coast of British Columbia (BC) (Farmer and Smith 1980). This fjord has an average depth of 295 m and a maximum depth of 540 m (Pickard 1961). Figure 2 illustrates the depth profile of Knight Inlet and identifies the location of the Hoeya Head Sill. Geologically, the Hoeya Head Sill is a topographic irregularity left by retreating glacial deposits (Kim Conway, NRCan, Sidney, BC, personal communication, 2017). Multibeam surveys provided detailed bathymetry for the Hoeya Head Sill area of the MR and depict the sill rising up to a depth of ~ 70 m east of Lull Bay at Hoeya Head (Figure 3). Video imagery collected on the 2010 DFO ROV survey characterize the different substrate types found on the Hoeya Head Sill. Shallow ROV transects (Dives 84 – 87, with a depth range between 50 – 150 m) were dominated by coarser materials, such as boulders, cobble, gravel and small amounts of sand. While deeper ROV transects (Dives 88 & 89, that extended to 228 m) encountered mud or mud with boulders (Figure 3). Vertical relief along the ROV transects also varied from flat and rolling seafloor to steep sections with a vertical relief greater than 2 m within the field of view of the ROV.

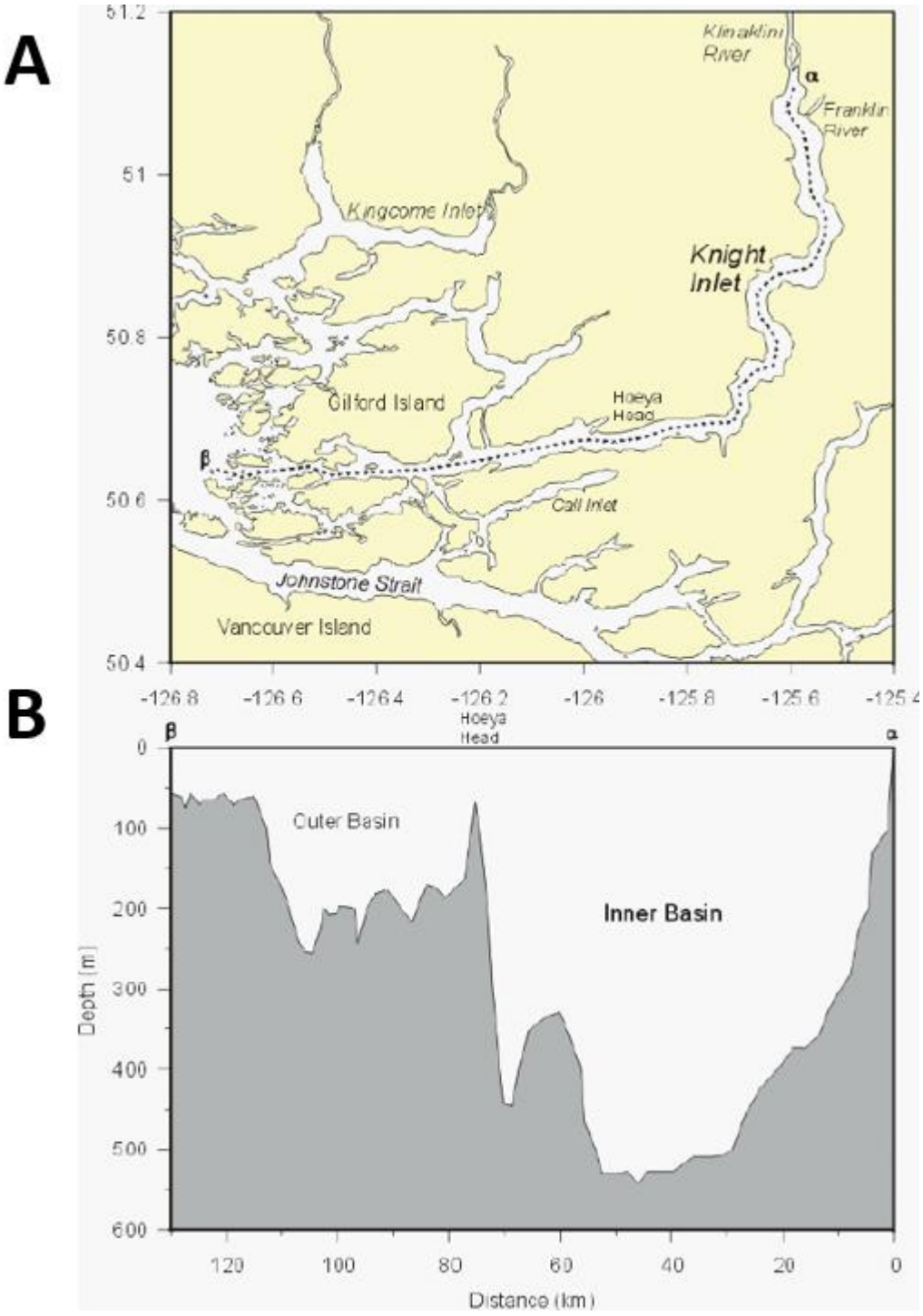

Figure 2. Map of Knight Inlet, British Columbia (A) and its corresponding depth profile (B), both images identify the location of Hoeya Head Sill (DFO 2009). The shallow Outer Basin is west (or seaward) of the Hoeya Head Sill while the deep Inner Basin is northeast (or landward) to the sill.

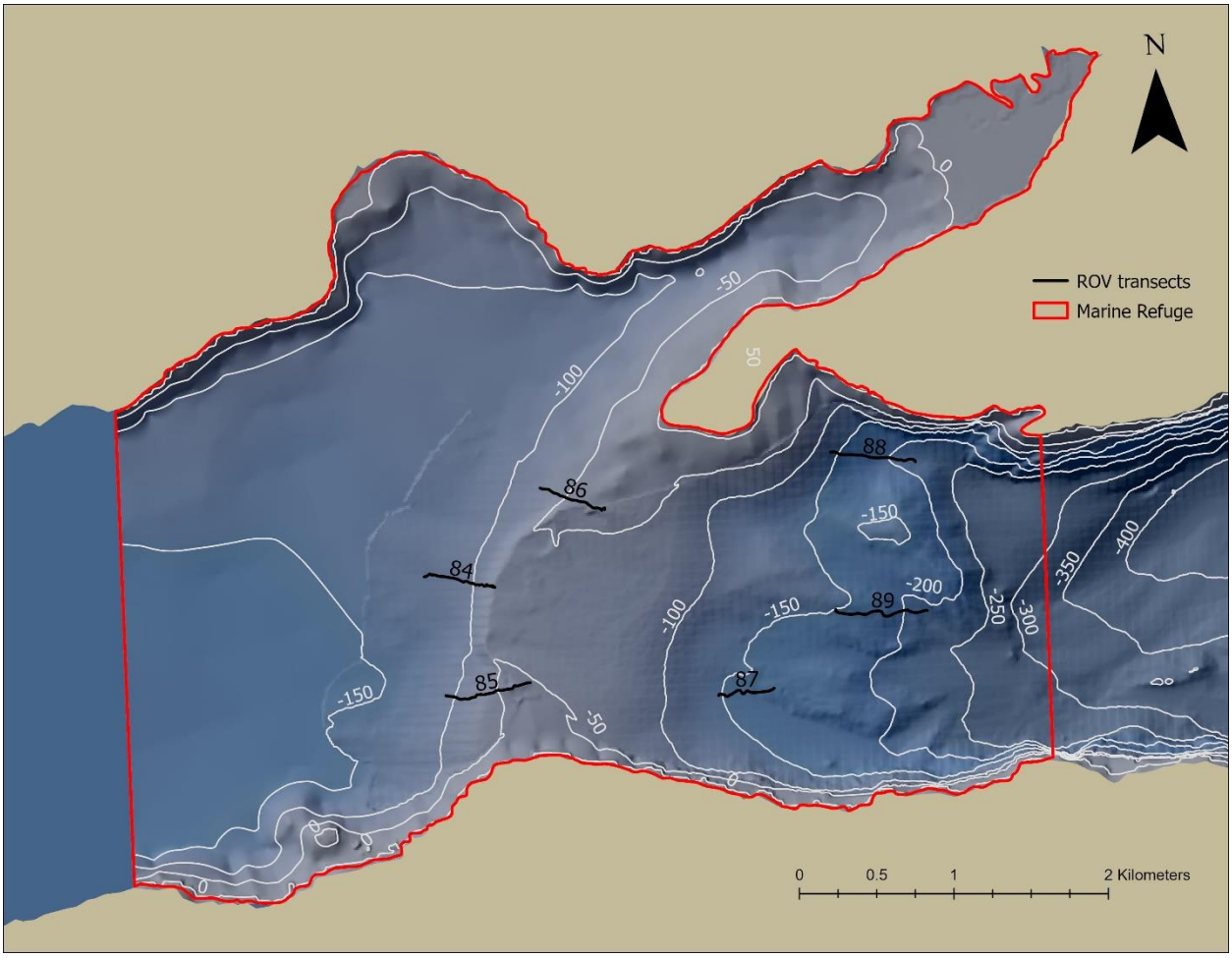

Figure 3. Map of Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge with transect locations from the 2010 DFO ROV survey. Multibeam bathymetry (Kung 2021) illustrates change in depth across the sill. Basemap source: Canadian Hydrographic Service.

OCEANOGRAPHIC OVERVIEW

Temperature, salinity, and oxygen data have been collected from several stations in Knight Inlet since 1951. Data from Station KN3 (50.67 °N, 126.07°W) are included in this report as this station is located approximately 2 km seaward of MR. KN3 sits in about 200 m of water (Pickard 1961) and has been sampled 100 times since 1951 (Figure 4). See Jackson et al. (2021) for detailed information on data collection.

Following Farmer and Freeland (1983) and Jackson et al. (2021), three water types were defined to examine the temperature, salinity, and oxygen at station KN3. These water types were surface (potential density relative to surface pressure of less than 1022.5 kgm-3), intermediate (from the

base of surface layer to 65 m) and deep (from 66 to 200 m bottom). There is significant seasonal variation of water properties throughout the water column, which normally dominates interannual variation. Plots of the monthly average using data from 1951 to 2022, when available, were created to examine the seasonal cycle in each water type (Figure 4); only months where data were collected in at least 3 separate years were plotted. To examine interannual variability, all data collected from 1951 to 2022 were plotted in each water type (Figure 5).

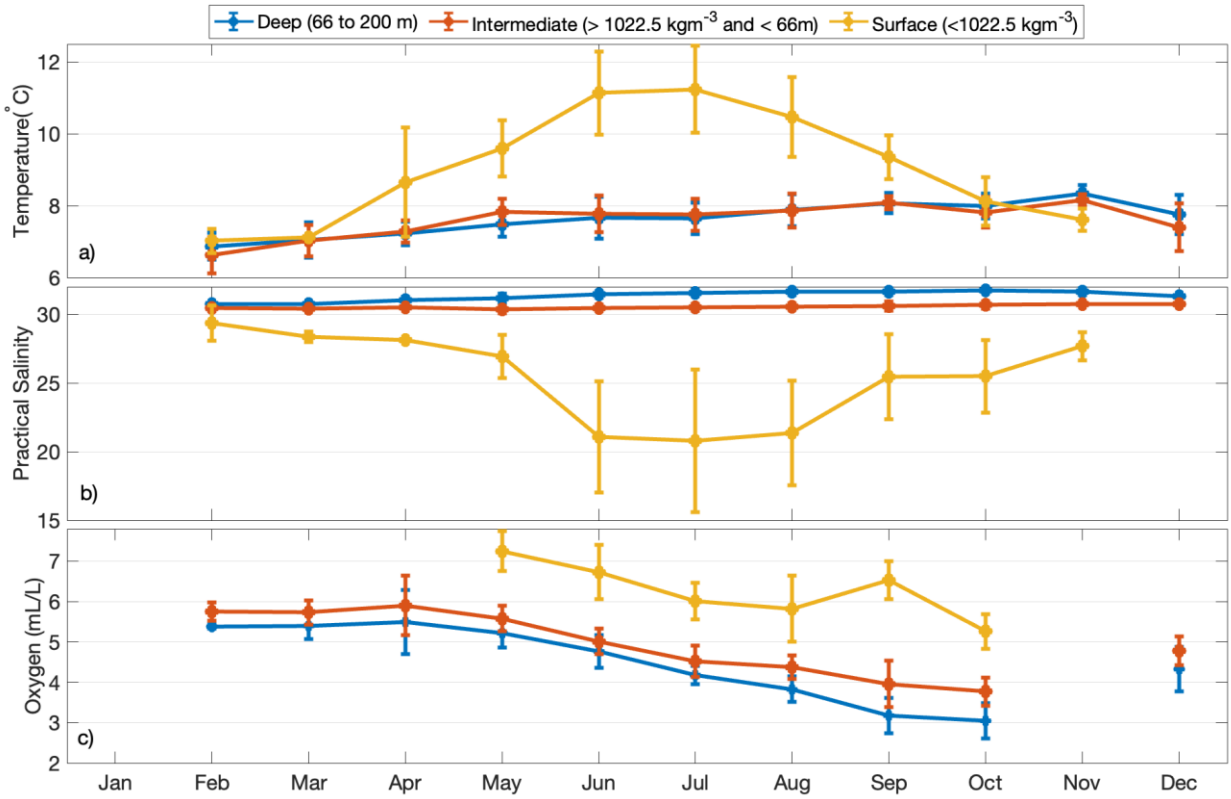

Figure 4. The monthly average of surface, intermediate, and deep water a) temperature, b) practical salinity, and c) oxygen at station KN3 in Knight Inlet. Data from 1951 to 2022 were used to calculate the average when data were available in that month for at least 3 separate years. Error bars represent the standard deviation.

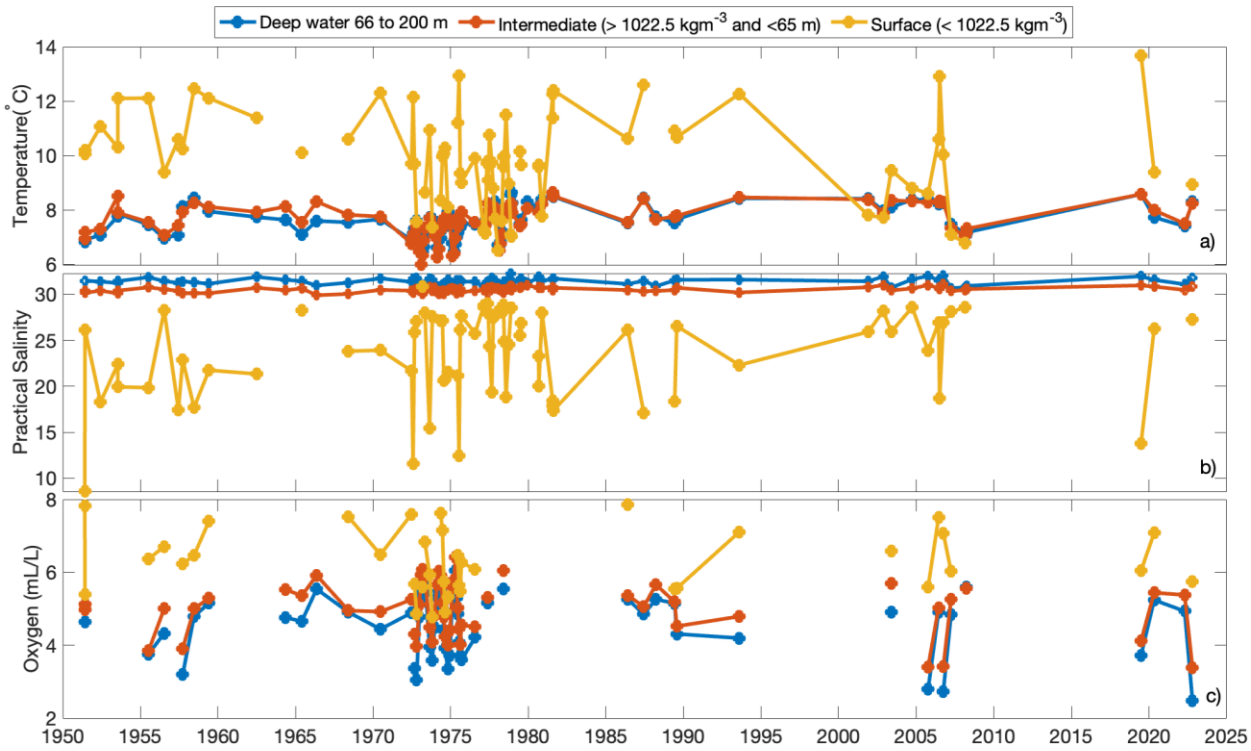

Figure 5. The average a) temperature, b) practical salinity, and c) oxygen in each water type per year using all data collected from 1951 to 2022.

In general, intermediate and deep water properties were similar at station KN3, suggesting that similar processes control these water types. Surface water was much warmer, fresher, and more oxygenated than intermediate or deep water (Figure 4 and 5). Surface waters were on average warmest and freshest in July and had most oxygen in May. Intermediate and deep waters were warmest and had the least amount of oxygen in the fall.

From 1951 to 2020, deep waters located 20 km landward from Hoeya Head Sill at station KN7 warmed by 1.2°C, became 0.1 units saltier, and lost 0.4 mLL-1 oxygen (Jackson et al. 2021). At station KN3 a similar trend was observed, the warmest surface waters were observed in 2019 and the lowest oxygen concentrations in deep and intermediate waters were observed in 2022. These observations are part of a larger warming trend across fjords of southern BC (Jackson et al. 2021).

ECOLOGICAL OVERVIEW

The shallow rise of the Hoeya Head Sill modifies the movement of water in the area during tidal cycles. Internal waves within the water column are created by density differences between the

fresh surface water and deeper salt water (Thomson 1981). This tidal mixing supports a productive and diverse biological community relative to the surrounding waters in Knight Inlet including over 40 species of corals and sponges. Many of the corals encountered are unique or rare in BC, with only a small number of documented observations (Boutillier et al. 2019). These aggregations of corals and sponges create three-dimensional structures, or biogenic habitat, that influence the occurrence and abundance of fish and invertebrate species, both directly and indirectly (DFO 2010a, 2021). Their presence on the sill supports the settlement of low mobility species (e.g. bivalves and sea stars), provide protective habitat for numerous benthic species (e.g. rockfish, crabs and sculpins) which are, at the same time, food sources to a variety of marine life found on the sill (e.g. Lingcod and Giant Pacific Octopus). These aggregations of corals and sponges have been documented to recover slowly after disturbance, and are thus sensitive to both human activities and/or natural events (DFO 2010a). For these reasons, the Hoeya Head Sill was recommended as an Ecologically and Biologically Significant Area (EBSA) (DFO 2006a, Rubidge et al. 2020) and also identified by First Nations and the Province of BC as an area within the Protection Management Zone (PMZ) of the North Vancouver Island Marine Plan (Marine Planning Partnership Initiative 2015).

The *Primnoa pacifica* coral is the most abundant and largest of the biogenic habitat-forming species on the sill and contributes to the high rugosity of the area. The occurrence of such high densities of Primnoa is rare along the BC coast. This species was documented on the 2010 DFO ROV survey at depths between 35 – 159 m, shallower than most other BC observations (Boutillier et al. 2019). Other habitat-forming species observed on the sill include glass sponges, stony corals, and a rare observation of a reef-building scleractinia, which was observed on the 1981 PICES submersible survey (Boutillier et al. 2019) and thought to be observed again on the 2010 DFO ROV survey.

Several species found in the Hoeya Head Sill are considered rare and unique:

Incrustatus n. sp A new species of coral currently undergoing description by C. McFadden. The genetic analysis indicates this would be the first species of this genus described in the North Pacific.

Hymetrochota sp A new sponge record for North Pacific from McDaniel and Swanston (2013) and identified by W. Austin.

Reef-building scleractinia Initial identification of the reef-building stony coral, found by V. Tunnicliffe in 1981 and identified by J. Wells, was *Solenosmilia variabilis* (the only record of this species in BC (Boutillier et al. 2019). More observations of what was thought to be the same coral species were made by DFO in 2010 (unpublished data), but it was later hypothesised that these observations were of *Desmophyllum pertusum* (previously known as *Lophelia pertusa*). This 2010 identification remains unverified (Boutillier et al. 2019, Conway et al. 2007).

However, the hypothesis is based on a subsequent sample from BC waters that was confirmed to be *Desmophyllum pertusum* (Austin 1985 (updated 2008)).

Anthothela pacifica A rare coral species with very unique habitat needs. Lamb and Hanby (2005) have documented its occurrence in other high current locations in BC.

Plakina atka A sponge species with a potential range extension into southern BC.

Solaster n. sp A new species of sea star found by N. McDaniel and D. Swanston using SCUBA and identified by R. Clark as an undescribed species.

Alcyonium sp At least two species of Alcyonium corals observed by biologists using SCUBA that need further identification: one from N. McDaniel and D. Swanston and the other from P. Ridings and B. Rusch. At least one of these appears to be a new species.

SPECIES RECORDS

Over 200 species have been observed at the Hoeya Head Sill from six data sources. The species observed span ten major taxonomic groups; Algae, Porifera, Cnidaria, Polychaeta, Bryozoa, Brachiopoda, Mollusca, Arthropoda, Echinodermata, and Chordata. Table 1 contains a list of the species (or species groups) that have been documented in the shallow sill ecosystem.

The most observed species from the 2010 DFO ROV survey included Pandalid Shrimp (family Pandalidae), Spot Prawn (*Pandalus platyceros*), Red tree coral (*Primnoa pacifica*), Crinoids (*Florometra serratissima*), Demosponges, Pale Sea Urchin (*Strongylocentrotus pallidus*), Walleye Pollock (*Gadus chalcogrammus*), Quillback Rockfish (*Sebastes maliger*), Stylaster hydrocorals (family Stylasteridae), and Spotted Ratfish (*Hydrolagus colliei*). See the appendix for maps showing the distribution of the common species observed on the 2010 DFO ROV survey.

Table 1. Species list for Hoeya Head Sill compiled from several different sources (Data source by number: 1=McDaniel And Swanston; 2=DFO ROV; 3=Ridings And Rusch; 4=Tunnicliffe; 5=McFadden; 6=Reiswig)

	TAXA	COMMON NAME	SOURCE	COMMENTS
ALGAE	*Rhodomelaceae*	Filamentous red algae	1	
	Clathromorphum spp.	Crustose coralline algae	1	
	Opuntiella californica	Prickly pear seaweed	1	
	Callophyllis sp.	Beautiful leaf seaweed	1	
	Desmarestia sp.	Thin acid kelp	1	
	Fucus distichus	Rockweed	1	
	Alaria marginata	Broad winged-kelp	1	

	TAXA	COMMON NAME	SOURCE	COMMENTS
	Agarum fimbriatum	Fringed sea colander kelp	1	
	Laminaria sinclairii	Dense-clumped kelp	1	
	Nereocystis luetkeana	Bull kelp	1	
	Saccharina latissima	Sugar wrack kelp	1	
	Codium setchellii	Spongy cushion	1	
	Ulva sp.	Sea lettuce	1	
PORIFERA	*Leucosolenia*	Calcarious sponge	2	
	Sycandra cf. Utriculus	Leather bag sponge	1	
	Class Demospongiae	Demosponge	1	
	Amphilectus digitatus infundibulus	Flabby bowl sponge	1,3,6	*Was Neoesperiopsis infundibulus
	Halichondria (Eumastia) sitiens	Green-tinged sponge	1	Sp. not in Austin
	Hymenancora n. Sp	Sponge	2	Arndtanchora is jr. Synonym Austin uses
	Hymetrochota n.sp.	Sponge	1	Two known sp. From Azores
	Iophon lamella	White reticulated sponge	1	*jr synonym is Iophon chelifer
	Isodictya rigida	Orange finger sponge	2	
	Lissodendoryx sp.	Sponge	2	
	Lycopodina occidentalis	Pipe cleaner sponge	1	*was Asbestopluma occidentalis
	Cf. Oceanopea sp.	Lobate sponge	2,6	H.R. ID
	Mycale adhaerens	Sponge on scallop	1	
	Neoesperiopsis digitata	Sponge	2	
	Phakellia sp	Sponge	2,6	
	Poecillastra japonica	Sponge	2	
	Reniera sp.	Sponge	2	
	Semisuberites cribrosa	Funnel sponge	1	
	Suberites latus	Hermit crab sponge	2	
	Weberella n.sp.	Sponge	1	See Austin et al. (2014)
	Halisarcidae sp.	Sponge	1	
	Raspailiidae sp.	Sponge	2	2 known species in BC
	Class Hexactinellida	Glass sponge	1	
	Aphrocallistes vastus	Cloud sponge	1,2	
	Farrea	Glass sponge	2	ID H.R.
	Rhabdocalyptus sp	Boot sponge	2	
	Rhabdocalyptus dawsoni	Sharp-lipped boot sponge	1,2,6	ID H.R.
	Plakina atka	Brain sponge	1	

	TAXA	COMMON NAME	SOURCE	COMMENTS
CNIDARIA	*Actinaria*	Anemones	2	At least 1 if not 2 other deep-water sp.
	Cribrinopsis fernaldi	Crimson anemone	1,2	
	Urticina	Anemone	1	
	Urticina crassicornis	Painted anemone	1	
	Stomphia coccinea	Spotted swimming anemone	1	
	Stomphia didemon	Swimming anemone	1	
	Metridium farcimen	Giant plumose anemone	1,2	
	Pachycerianthus fimbriatus	Tube dwelling anemone	1,2	
	Epizoanthus scotinus	Orange zoanthid	1,2	
Soft coral	*Anthothela pacifica*	Dwarf white gorgonian	1	
	Incrustatus n. Sp.	Road map soft coral	1,5	Mcfadden: potentially first record of this genus in N. Pacific
	Primnoa pacifica	Red tree	1,2,3	
	Alcyonium sp.	Red soft coral	1	Yet to be identified
	Alcyonium sp.	White soft coral	3	Yet to be identified
Pennatulacea	*Halipteris willemoesi*	Sea whip	2	
	Ptilosarcus gurneyi	Orange sea pen	1	
	Virgularia tuberculata	White sea pen	2	
Stony coral	*Lophelia pertusa*	Reef building coral	2,4	Confirmation by M. Best. *now Desmophyllum pertusum
	Balanophyllia elegans	Orange cup coral	1	
Hydrocorals	*Stylasteridae*	Hydrocoral	1	
	Stylantheca	Encrusting hydrocoral	2	
	Stylaster	Erect hydrocoral	2,3	
	Stylaster verrillii	Branching pink hydrocoral	1	
Other hydroids	*Ectopleura marina*	Solitary pink-mouth hydroid	2	
	Aglaophenia	Ostrich plume hydroids	1,2	
	Grammaria	Spindly embedded hydroid	1	
	Lafoea dumosa	Muff hydroid	1	
	Plumularia	Delicate plume hydroid	1	
	Thuiaria	Embedded sea fir hydroid	1	
	Thuiaria thuja	Bottlebrush hydroid	1	
POLYCHAETA	*Halosydna brevisetosa*	Eighteen-scaled worm	1	
	Canalipalpata	Sabelloid-spionoid tubeworms	2	

	TAXA	COMMON NAME	SOURCE	COMMENTS
	Chone aurantiaca	Orange feather-duster	1	
	Eudistylia catharinae	Roll-top feather-duster	1	
	Megalomma splendida	Twin-eyed feather-duster	1	
	Myxicola infundibulum	Slime-tube feather-duster	1	
	Parasabella media	Parasol feather-duster	1	
	Serpulidae	Calcareous tubeworms	2	
	Protula pacifica	White-crowned calcareous tubeworm	1	
	Serpula columbiana	Red trumpet calcareous tubeworm	1	
BRYOZOA	*Microporella borealis*	Stick bryozoan	1,2	
	Schizoporella japonica	Orange encrusting bryozan	1	
BRACHIOPODA	*Brachiopoda*	Lampshells sp.	2	
	Hemithiris psittacea	Black lamp shell	1	
	Laqueus vancouveriensis	California lamp shell	1	
	Terebratalia transversa	Tansverse lamp shell	1	
	Terebratulina unguicula	Snake's head lamp shell	1	
MOLLUSCA	*Chlamys sp.*	Scallop	2	
	Chlamys hastata	Spiny pink scallop	1	
	Clinocardium nuttallii	Nuttall's cockle	1	
	Hiatella arctica	Arctic nestler	1	
	Modiolus rectus	Straight horsemussel	1	
	Mya truncata	Truncated softshell clam	1	
	Saxidomus gigantea	Washington butter clam	1	
	Enteroctopus dofleini	Giant Pacific octopus	1,2	
	Gastropoda	Snails and slugs	2	
	Bathybembix bairdii	Baird's margarite	1	
	Calliostoma variegatum	Variable topsnail	1	
	Diodora aspera	Rough keyhole limpet	1	
	Trichotropis cancellata	Checkered hairysnail	1	
	Fusitriton oregonensis	Oregon triton	1,2	
	Ceratostoma foliatum	Leafy hornmouth	1	
	Amphissa columbiana	Wrinkled dogwinkle	1	
	Nipponotrophon stuarti	Winged trophon	1	
	Nucella lamellosa	Wrinkled dogwinkle	1	
	Ocinebrina interfossa	Sculptured rocksnail	1	
	Onchidoris bilamellata	Barnacle-eating nudibranch	1	
	Triopha catalinae	Clown nudibranch	1	
	Melibe leonina	Hooded nudibranch	2	
	Tochuina	Orange-peel nudibranch	1	
	Tritonia sp.	Pink tritonai	1	
	Tritonia festiva	Diamonback nudibranch	1	
	Chitonida	Chitons		
	Cryptochiton stelleri	Giant Pacific chiton	1	

	TAXA	COMMON NAME	SOURCE	COMMENTS
	Lepidozona mertensii	Merten's chiton	1	
ARTHROPODA	*Ericthonius rubricornis*	Tube dwelling sea flea	1	
	Brachyura (infraorder)	Crabs unkwn.	2	Unidentified
	Cancer productus	Red rock crab	1	
	Metacarcinus magister	Dungeness crab	1,3	
	Chorilia longipes	Red-clawed crab	1	
	Pugettia sp.		2	
	Pugettia gracilis	Graceful decorator crab	1	
	Acantholithodes hispidus	Hairy-spined crab	1	
	Cryptolithodes typicus	Butterfly crab	1	
	Lopholithodes foraminatus	Brown box crab	1,2	
	Lopholithodes mandtii	Puget Sound King crab	1	
	Phyllolithodes papillosus	Heart crab	1	
	Rhinolithodes wosnessenskii	Rhinoceros crab	1	
	Munida quadrispina	Galatheid crab	1	
	Chionoecetes bairdi	Tanner crab	2	
	Hyas lyratus	Pacific lyre crab	1	
	Elassochirus gilli	Orange hermit crab	1	
	Elassochirus tenuimanus	Widehand hermit crab	1	
	Pagurus armatus	Blackeyed hermit crab	1	
	Pagurus beringanus	Bering hermit crab	1	
	Eualus townsendi	Townsend's eualid	1	
	Heptacarpus decorus	Elegant coastal shrimp	1	
	Heptacarpus kincaidi	Kincaid's shrimp	1	
	Lebbeus grandimanus	Candy stripe shrimp	1	
	Pandalopsis dispar	Sidestripe shrimp	2	
	Pandalus sp.	Pandalus shrimp unk.	1,2	
	Pandalus borealis	Spiny pink shrimp	1	
	Pandalus danae	Coonstripe shrimp	1	
	Pandalus platyceros	Spot prawn	2	
	Euphausia pacifica	Pacific euphausiid	2	
	Balanus glandula	Common acorn barnacle	1	
	Balanus nubilus	Giant acorn barnacle	1	
	Balanus rostratus	Rostrate barnacle	1	
ECHINODERMATA	*Evasterias troschelii*	Mottled star	1	
	Leptasterias alaskensis	Alaskan 6-armed star	2	
	Pycnopodia helianthoides	Sunflower star	1,2	
	Gephyreaster swifti	Gunpowder star	1	
	Henricia	Henricia	2	
	Henricia leviuscula	Blood star	1	
	Dermasterias imbricata	Leather star	2	
	Ceramaster patagonicus	Cookie star	1,2	
	Hippasteria phrygiana	Spiny red star	1,2	Previous name was *H. Spinosa*
	Mediaster aequalis	Vermilion star	1,2	

	TAXA	COMMON NAME	SOURCE	COMMENTS
	Crossaster papposus	Rose star	1,2	
	Solaster	Sun star	1	
	Solaster dawsoni	Morning sun star	1	
	Solaster endeca	Northern sun star	1	
	Pteraster militaris	Wrinkled star	1	
	Pteraster tesselatus	Slime star	1	
	Florometra serratissima	Common feather star	1,2	
	Strongylocentrotus droebachiensis	Green sea urchin	1	
	Strongylocentrotus pallidus	White sea urchin	1,2	
	Parastichopus californicus	Giant sea cucumber	1,2	
	Cucumaria miniata	Red sea cucumber	1	
	Psolus chitonoides	Creeping pedal sea cucumber	1	
	Gorgonocephalus eucnemis	Basket star	1,2	
	Ophiopholis aculeata	Daisy brittle star	1	
CHORDATA	*Gadus chalcogrammus*	Walleye pollock	2	
	Microgadus proximus	Pacific tomcod	1	
	Aulorhynchus flavidus	Tubesnout	1	
	Ronquilus jordani	Northern ronquil	1	
	Embiotoca lateralis	Striped seaperch	3	
	Ptilichthys goodei	Quillfish	1	
	Stichaeidae	Pricklebacks	2	
	Chirolophis decoratus	Decorated warbonnet	1	
	Lumpenus sagitta	Snake prickleback	1	
	Poroclinus rothrocki	Whitebarred prickleback	2	
	Zoarcidae	Eelpouts	2	
	Pleuronectiformes	Flatfishes unk. Sp.	2	
	Glyptocephalus zachirus	Rex sole	2	
	Hippoglossoides elassodon	Flathead sole	2	
	Lepidopsetta bilineata	Rock sole	1	
	Lyopsetta exilis	Slender sole	2	
	Parophrys vetulus	English sole	1	
	Platichthys stellatus	Starry flounder	1	
	Pleuronichthys coenosus	C-O sole	1	
	Agonopsis vulsa	Northern spearnose poacher	1	
	Podothecus accipenserinus	Sturgeon poacher	1	
	Erilepis zonifer	Skilfish	2	
	Cottidae	Sculpins	2	
	Artedius harringtoni	Scalyhead sculpin	1	
	Enophrys bison	Buffalo sculpin	1	
	Enophrys lucasi	Leister sculpin	1	

	TAXA	COMMON NAME	SOURCE	COMMENTS
	Hemilepidotus hemilepidotus	Red Irish lord	1	
	Jordania zonope	Longfin sculpin	1	
	Myoxocephalus polyacanthocephalus	Great sculpin	1	
	Triglops pingelii	Ribbed sculpin	1	
	Hemitripterus bolini	Bigmouth sculpin	1	
	Nautichthys oculofasciatus	Sailfin sculpin	1	
	Hexagrammos decagrammus	Kelp greenling	1,2	
	Hexagrammos stelleri	Whitespotted greenling	1	
	Ophiodon elongatus	Lingcod	1,2,3	
	Liparis dennyi	Marbled snailfish	1	
	Rhamphocottus richardsonii	Grunt sculpin	1	
	Sebastes caurinus	Copper rockfish	1,2	
	Sebastes ciliatus	Dark rockfish	1	
	Sebastes emphaeus	Puget Sound rockfish	1	
	Sebastes flavidus	Yellowtail rockfish	3	
	Sebastes maliger	Quillback rockfish	1,2,3	
	Sebastes melanops	Black rockfish	1	
	Sebastes ruberrimus	Yelloweye rockfish	2	
Elasmobranchii	*Raja rhina*	Longnose skate	2	
	Squalus suckleyi	Pacific spiny dogfish	2	
	Hydrolagus colliei	Spotted ratfish	2	
	Ascidiacea (Class)	Tunicates	2	
	Didemnum sp.	Compound tunicate	1	
	Didemnum carnulentum	Pacific white crust	1	
	Cystodytes sp.	Compound tunicate	1	
	Ascidia paratropa	Glassy tunicate	1	
	Corella willmeriana	Transparent tunicate	1	
	Pyura haustor	Warty tunicate	1	
	Cnemidocarpa finmarkiensis	Broadbase tunicate	1	
Mammalia	*Eumetopias jubatus*	Steller sea lion	1	
	Phoca vitulina	Pacific harbour seal	1	
	Megaptera novaeangliae	Humpback whale	1	
	Lagenorhynchus obliquidens	Pacific white-sided dolphin	1	

FISHING ACTIVITIES

The Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge is completely contained within the Pacific Fisheries Management Area (PFMA) 12-27 (Figure 6). On February 14th, 2023, the MR was closed to all fishing activity. This closure is defined as:

> "*that portion of Subarea 12-27 that lies inside a line that begins at 50° 41.336' N, 126° 02.560' W, then easterly following the shoreline into Lull Bay, then following the shoreline to 50° 41.119' N, 125° 57.484' W, then southerly to 50° 39.979' N, 125° 57.488' W, then westerly following the shoreline to 50° 39.667' N, 126° 02.558' W, then northerly to the beginning point".*

The closure protects the high biological diversity found within the MR and the known occurrences of corals and sponges. Impacts from fishing activities on benthic habitats have been assessed in previous national DFO Science Advisory processes (DFO 2006b, 2010b). These activities can harm biogenic habitats either directly (e.g. removal or damage) or indirectly (e.g. smothering by sedimentation) (DFO 2010a). The extent of harm is dependent on the gear type utilized, the footprint of the gear deployed, the frequency of fishing activities, as well as the vulnerability of the habitat where these activities take place (DFO 2006b, 2010a, 2010b).

Historic fishing data were reviewed for both the entire PFMA 12-27 and MR. The frequency, gear types used, and species caught within the MR was consistent with fishing activities for the entire PFMA 12-27[2]. Fishing gear utilized within PFMA 12-27 included mobile gear (beam trawl, seine nets, and trolling gear) and non-mobile gear (hook and line, or longline gear, trap gear, and gill nets). A description of the recorded species caught by each fishery are summarized below and Table 2 illustrates the frequency, or number of years between 2000 and 2021, where fishing activities &/or openings took place.

[2] Boutillier, J. and Davies, S. 2017. Evaluation of Hoeya Head Sill in Knight Inlet, Internal Report to DFO Fisheries Management.

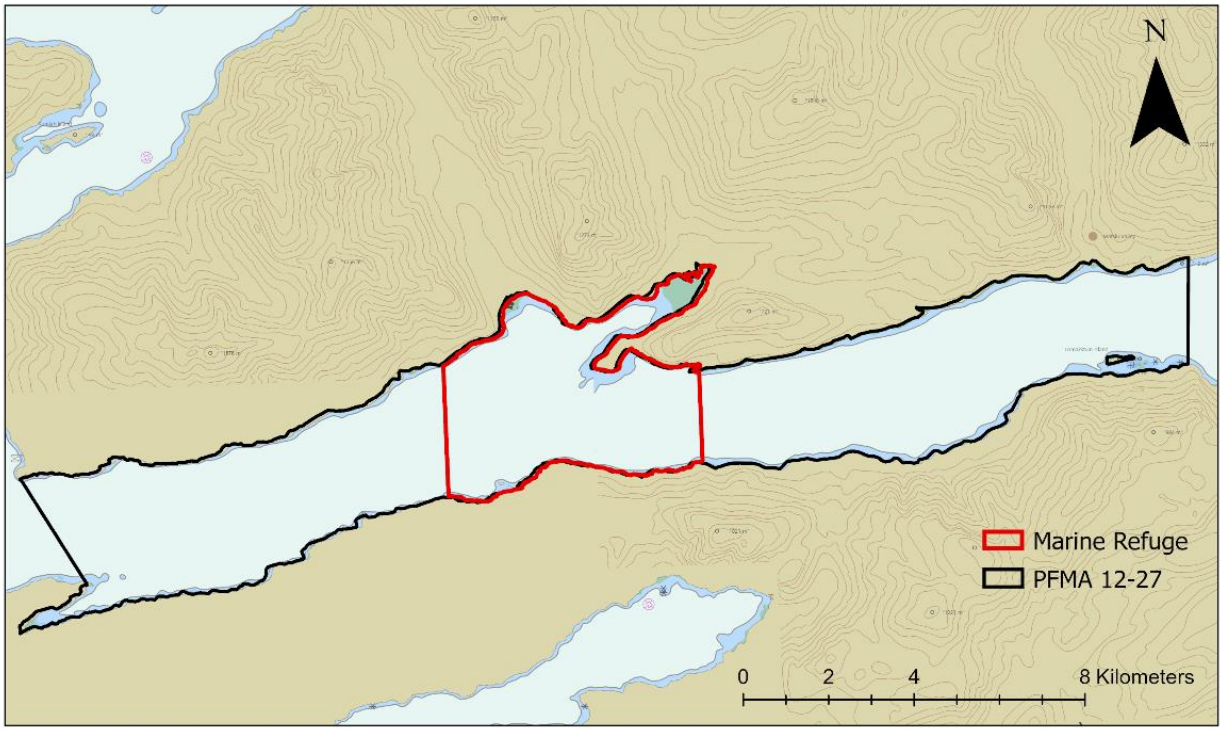

Figure 6. Boundaries of the Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge and Pacific Fisheries Management Area (PFMA) 12-27. Basemap source: Canadian Hydrographic Service.

GROUNDFISH (LONGLINE) HOOK AND LINE FISHERY

The Groundfish hook and line fisheries are managed using species specific coast-wide quotas (Fisheries and Oceans Canada 2023a). Over the last 21 years, the Groundfish hook and line fisheries have occurred in PFMA 12-27 in 2000, 2006, 2008, 2009, 2015, 2016, and 2017 respectively (Table 2). The range of days fished per year was between one and five. The target species for these fisheries were North Pacific Spiny Dogfish (*Squalus suckleyi*) and Pacific Halibut (*Hippoglossus stenolepis*). The total retained catch within PFMA 12-27 over the seven years that the fishery took place also included Sablefish (*Anoplopoma fimbria*), Yelloweye Rockfish (*Sebastes ruberrimus*), Canary Rockfish (*Sebastes pinniger*), Pacific Cod (*Gadus macrocephalus*), Big Skate (*Beringraja binoculata*), Longnose Skate (*Raja rhina*), Bluntnose Sixgill Shark (*Hexanchus griseus*), Quillback Rockfish (*Sebastes maliger*), Lingcod (*Ophiodon elongatus*), Spotted Ratfish (*Hydrolagus colliei*), Greenlings (*Hexagrammidae*), Flatfishes (*Pleuronectiformes*), English Sole (*Parophrys vetulus*), and Arrowtooth Flounder (*Atheresthes stomias*).

PRAWN BY TRAP FISHERY

The commercial Prawn fishery for Spot Prawn (*Pandalus platyceros*) starts each year in May and proceeds until the minimal female spawner index is obtained (Fisheries and Oceans Canada 2023b). The female spawner index data is gathered in-season by at-sea observers sampling the commercial catch. Once the seasonal index is observed, the fishery is closed until May of the following year. Closures are usually made on an Area or Sub-area bases. Between 2000 and 2021, the Prawn industry consistently fished in PFMA 12-27 (Table 2). Over the 21 years, fishing activities were conducted on average for 39 days per year.

SHRIMP BY TRAWL FISHERY

The shrimp trawl fishery quota is established for "Area 12-Inside" (Fisheries and Oceans Canada 2023c). Area 12-inside also includes PMFAs 12-23, 12-26 to 12-35 and 12-37 to 12-47. Annual quotas for Area 12-Inside are set separately for Sidestripe shrimp (*Pandalopsis dispar*), Humpback shrimp (*Pandalus hypsinotus*) and other Pandalid shrimps including two species of Pink shrimp (*Pandalus borealis* and *Pandalus jordani*). The annual quota for Area 12-Inside is set on a "Shrimp Year" which runs from May of one year to the end March of the next. Small proportions of the Sidestripe shrimp and other Pandalid shrimp species quotas for the "Area 12-Inside" shrimp trawl fisheries have been fished periodically in PMFA 12-27. Between 2000 and 2021 there were sixteen "Shrimp Years" where the shrimp trawl fishery occurred in PFMA 12-27 (Table 2), with the number of fishing days ranging from one to 26 per year.

CRAB BY TRAP FISHERY

The commercial crab fishery for Dungeness crab (*Metacarcinus magister*) is managed using retention restrictions for sex and size (Fisheries and Oceans Canada 2023d). Seasonal closures for soft-shell period were not implemented in the area. Between 2000 and 2021, the crab fishery consistently fished every year in PFMA 12-27 (Table 2).

SALMON COMMERCIAL FISHERIES

Commercial Pacific Salmon fisheries are managed using quotas specific to species, gear, and area (Fisheries and Oceans Canada 2023e). A review of the Commercial Salmon fisheries

indicates that there were openings for both the seine and gillnet fishery in 2000, 2001, and 2009, while the troll fishery was open in 2003 and 2004 (Table 2). Commercial salmon fishery openings in PMFA 12-27 ranged from one to 13 days per year.

Table 2. Summary by year of fisheries that reported activities or openings within Pacific Fisheries Management Area 12-27

	Groundfish Hook And Line	Prawn by Trap	Shrimp by Trawl*	Crab by Trap	Salmon Seine	Salmon Gillnet	Salmon Troll
2000		X	X	X	X	X	
2001		X	X	X	X	X	
2002		X	X	X			
2003		X		X			X
2004		X		X			X
2005		X	X	X			
2006	X	X	X	X			
2007		X	X	X			
2008	X	X	X	X			
2009	X	X	X	X	X	X	
2010		X	X	X			
2011		X	X	X			
2012		X		X			
2013		X		X			
2014		X	X	X			
2015		X	X	X			
2016	X	X	X	X			
2017	X	X	X	X			
2018		X	X	X			
2019		X	X	X			
2020		X		X			
2021		X		X			

***** Shrimp by Trawl is reported by Shrimp Season (May 1st to March 31st) rather than by calendar year.

SALMON SPORT FISHERIES

There are no data available from the sport fishery in PFMA 12-27. However, there are sports fishing lodges approximately 30 km away from the MR, in Clio Channel, and there have been incidental reports of halibut jigging and salmon trolling occurring in PMFA 12-27 including in

the area around the Hoeya Head Sill (Pieter Van Will, DFO, Campbell River, BC, personal communication, 2017). Lost recreational gear has also been documented during SCUBA dives on the sill (Figure 7).

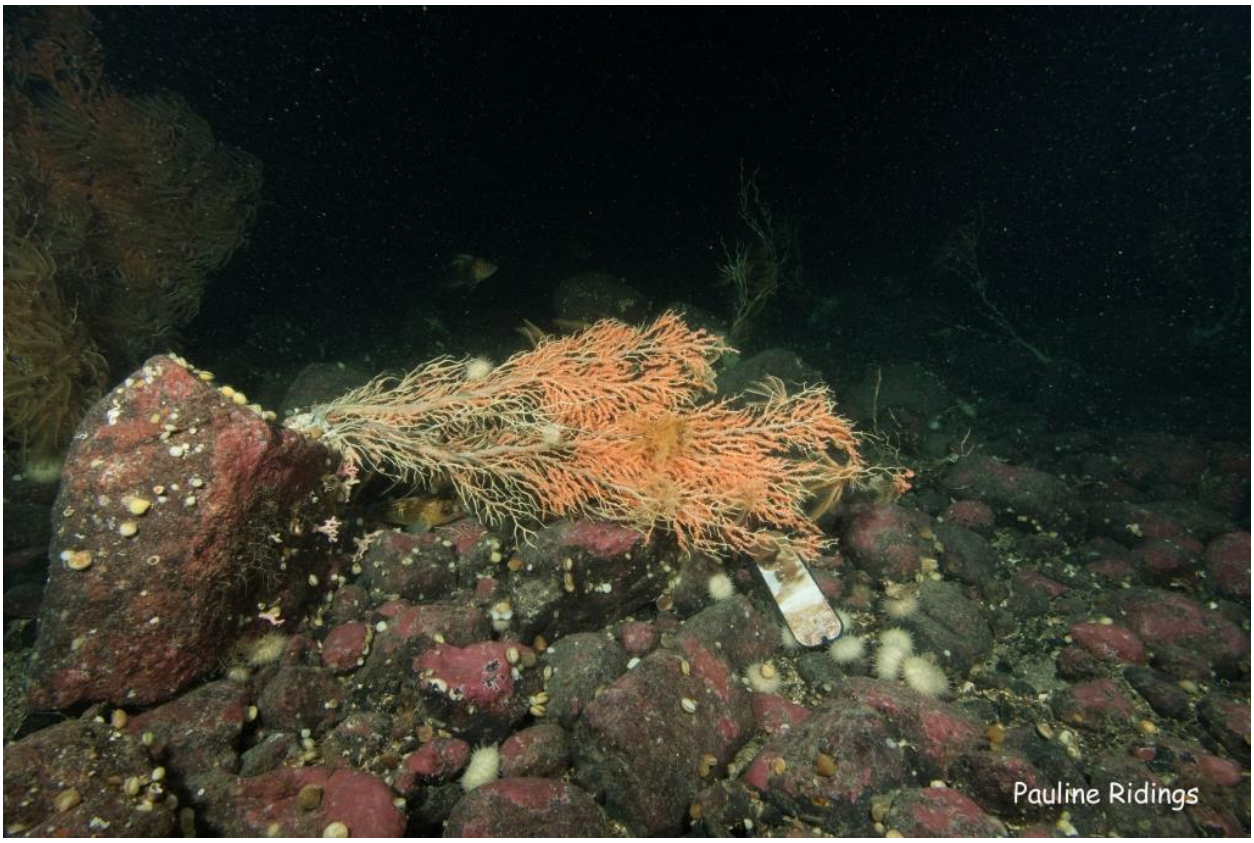

Figure 7. Lost sport fishing troll gear amongst *Primnoa* corals on rocky substrate, Hoeya Head Sill, Knight Inlet, British Columbia.

GHOST GEAR

Observations of fishing gear and impacted biogenic habitat withing the Hoeya Head Sill were noted on three of the six ROV dives completed during the 2010 DFO ROV survey (Table 3). These included longline gear and either broken or dead *Primnoa pacifica* consistent with impact from mobile fishing gear.

Table 3. Observations of fishing gear and/or impacted fauna on the Hoeya Head Sill noted during the 2010 DFO ROV survey and consistent with impact from mobile fishing gear. See Figure 3 for transect locations.

TRANSECT	GEAR TYPE	OBSERVABLE IMPACT
84		Broken *Primnoa*
84	Longline fishing gear	
85		Broken and dead *Primnoa*
85		Dead *Primnoa*
85		Dead *Primnoa* covered with *Florometra*
86		Dead, knocked over *Primnoa*
86		Dead, knocked over *Primnoa*
86		Dead, knocked over *Primnoa*
87		Dead *Primnoa*
87		*Primnoa* remains
87		*Primnoa* remains
87		Dead *Primnoa*

UNCERTAINITIES AND KNOWLEDGE GAPS

While small in size, the Gwaxdlala/Nalaxdlala (Lull/Hoeya) Marine Refuge represents an area of high biodiversity and unique geological features along the BC coastline. Previous work by DFO and other investigators have only explored a small portion of the MR, and concentrated mostly on the Hoeya Head Sill itself. This technical report is not an exhaustive compilation of available data in the area. In addition, knowledge gaps exist in the community structure of the waters surrounding the sill, as well as in the nearshore and estuarine habitats.

Taxonomic expertise to identify rare and unique coral and sponge species encountered on the Hoeya Head Sill is limited. Some observations collected to date represent new species that need to be formally described and catalogued. While other observations are either rare or represent range extensions into BC waters and can be challenging to confirm the identification of.

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REFERENCES

Austin, W.C. 1985 (updated 2008). An annotated checklist of marine invertebrates in the cold temperate northeast Pacific. Khoyatan Marine Laboratory.

Austin, W.C., Ott, B.S., Reiswig, H.M., Romagosa, P. and McDaniel, N.G. 2014. Taxonomic review of Hadromerida (Porifera, Demospongiae) from British Columbia, Canada, and adjacent waters, with the description of nine new species. Zootaxa **3823**(1): 1–84-81–84.

Boutillier, P.D.G., Boutillier, J.A. and Gillespie, G.E. 2019. British Columbia Corals: A Synopsis of Information on their Taxonomy, Occurrences, Distribution, Threats and General Status. Can. Tech. Rep. Fish. Aquat. Sci. (3322): vii + 260 p.

Conway, K., Barrie, J., Hill, P., Austin, W. and Picard, K. 2007. Mapping sensitive benthic habitats in the Strait of Georgia, coastal British Columbia: deep-water sponge and coral reefs. Geol Surv Can **2**: 1-6.

DFO. 2006a. Identification of ecologically significant species and community properties. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/041, pp.

DFO. 2006b. Impacts of Trawl Gears and Scallop Dredges on Benthic Habitats, Populations and Communities. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/025, pp. 13

DFO. 2009. Annual averaged deep water properties for inlets. Available from https://www.pac.dfo-mpo.gc.ca/science/oceans/bc-inlets-mer-de-bras-cb/water-prop-eau-eng.html [accessed 2019].

DFO. 2010a. Occurrence, susceptibility to fishing, and ecological function of corals, sponges, and hydrothermal vents in Canadian waters. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/041, pp. 54

DFO. 2010b. Potential impacts of fishing gears (excluding mobile bottom-contacting gears) on marine habitats and communities. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/003, pp. 24

DFO. 2021. A National Monitoring Framework for Coral and Sponge Areas Identified as Other Effective Area-Based Conservation Measures. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/048, pp. 23

Farmer, D.M. and Smith, J.D. 1980. Tidal interaction of stratified flow with a sill in Knight Inlet. Deep Sea Research Part A. Oceanographic Research Papers **27**(3): 239-254. https://doi.org/10.1016/0198-0149(80)90015-1.

Farmer, D.M. and Freeland, H.J. 1983. The physical oceanography of Fjords. Progress in Oceanography **12**(2): 147-219. https://doi.org/10.1016/0079-6611(83)90004-6.

Fisheries and Oceans Canada. 2023a. Groundfish Integrated Fisheries Management Plan 2023/24. pp. 367

Fisheries and Oceans Canada. 2023b. Prawn and Shrimp by Trap Fisheries Management Plan 2023/24. pp. 176

Fisheries and Oceans Canada. 2023c. Shrimp Trawl Fisheries Management Plan 2023/24. pp. 215

Fisheries and Oceans Canada. 2023d. Crab by Trap Fisheries Management Plan 2023/24. pp. 315

Fisheries and Oceans Canada. 2023e. Southern Salmon Integrated Fisheries Management Plan 2023/24. pp. 639

Jackson, J.M., Bianucci, L., Hannah, C.G., Carmack, E.C. and Barrette, J. 2021. Deep Waters in British Columbia Mainland Fjords Show Rapid Warming and Deoxygenation From 1951 to 2020. Geophysical Research Letters **48**(3): e2020GL091094. https://doi.org/10.1029/2020GL091094.

Kung, R. 2021. Canada west coast topo-bathymetric digital elevation model. Available from https://open.canada.ca/data/en/dataset/e6e11b99-f0cc-44f7-f5eb-3b995fb1637e [accessed 2022].

Lamb, A. and Hanby, B.P. 2005. Marine life of the Pacific Northwest: a photographic encyclopedia of invertebrates, seaweeds and selected fishes. Harbour Publishing.

Marine Planning Partnership Initiative. 2015. North Vancouver Island Marine Plan. ISBN: 978-0-7726-6884-4. pp. vii + 153

McDaniel, N. and Swanston, D. 2013. Observations on the Gorgonian Coral Primnoa pacifica at the Knight Inlet sill, British Columbia 2008 to 2013. Available from https://www.neilmcdaniel.com/assets/observations-on-primnoa,-may-1-13.pdf [accessed April 2017].

Pickard, G.L. 1961. Oceanographic Features of Inlets in the British Columbia Mainland Coast. Journal of the Fisheries Research Board of Canada **18**(6): 907-999. 10.1139/f61-062.

Prentice, C., Olson, A.M., Meagher Robinson, K., Clemente-Carvalho, R., Hall, K., Monteith, Z.L., Morien, E., Pontier, O., Hessing-Lewis, M., Kellogg, C. and Lemay, M. 2023. Biodiversity Surveys of the Gwaxdlala/Nalaxdlala Indigenous Protected and Conserved Area (IPCA) in Knight Inlet, British Columbia (v1.0). Hakai Institute

Rubidge, E., Jeffery, S., Gregr, E.J., Gale, K.S.P. and Frid, A. 2020. Assessment of nearshore features in the Northern Shelf Bioregion against criteria for determining Ecologically and Biologically Significant Areas (EBSAs). DFO. Can. Sci. Advis. Sec. Res. Doc. 2020/023, pp. vii + 68 p.

Thomson, R.E. 1981. Oceanography of the British Columbia coast. Can. Spec. Pub. Fish. Aquat. Sci. 56, pp. xii + 291

APPENDIX

Maps of aggregated species richness and species abundances of commonly observed species from the 2010 DFO ROV survey on the Hoeya Head Sill. Each grid cell represents 50 linear meters along the ROV transect. The black polygon on the maps below denotes the 100 m depth contour.

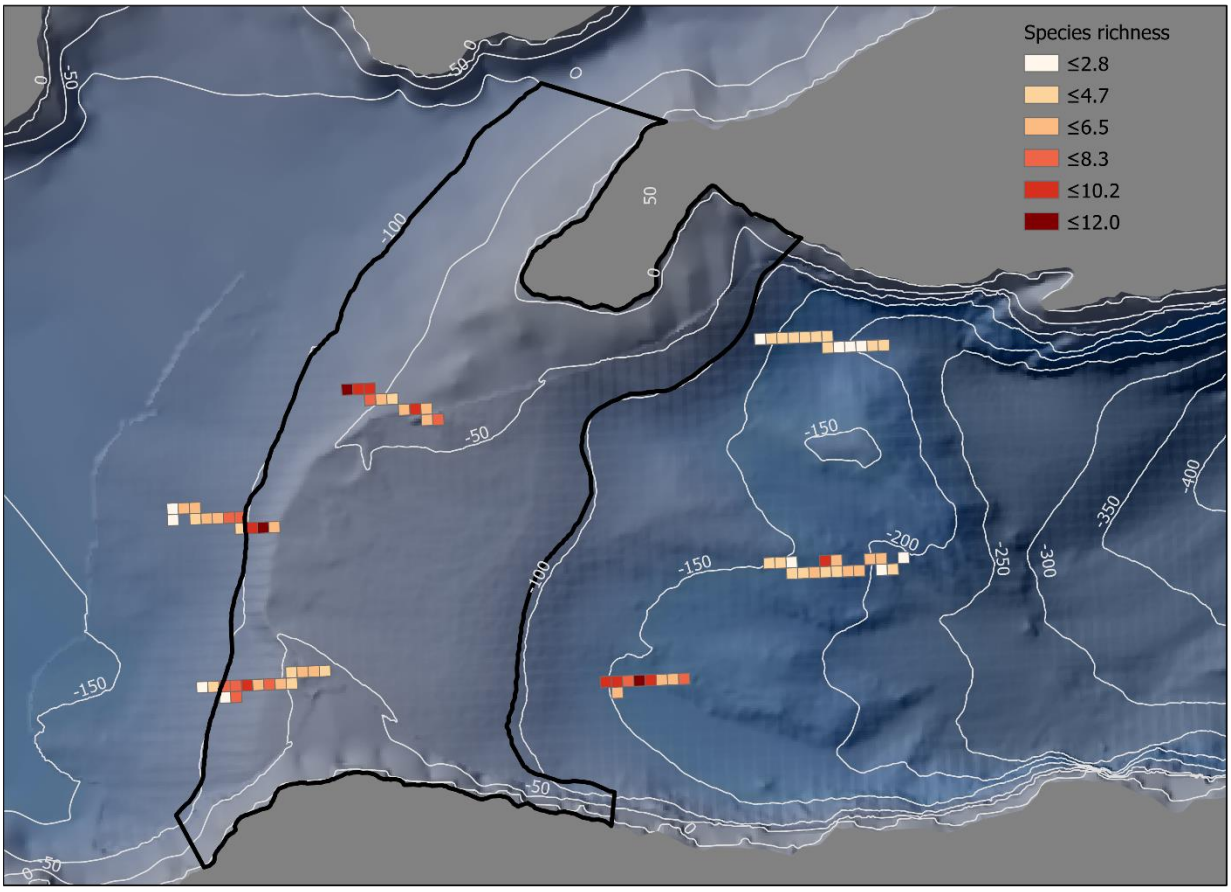

Figure A - 1. Species richness along each transect from the 2010 DFO ROV dives.

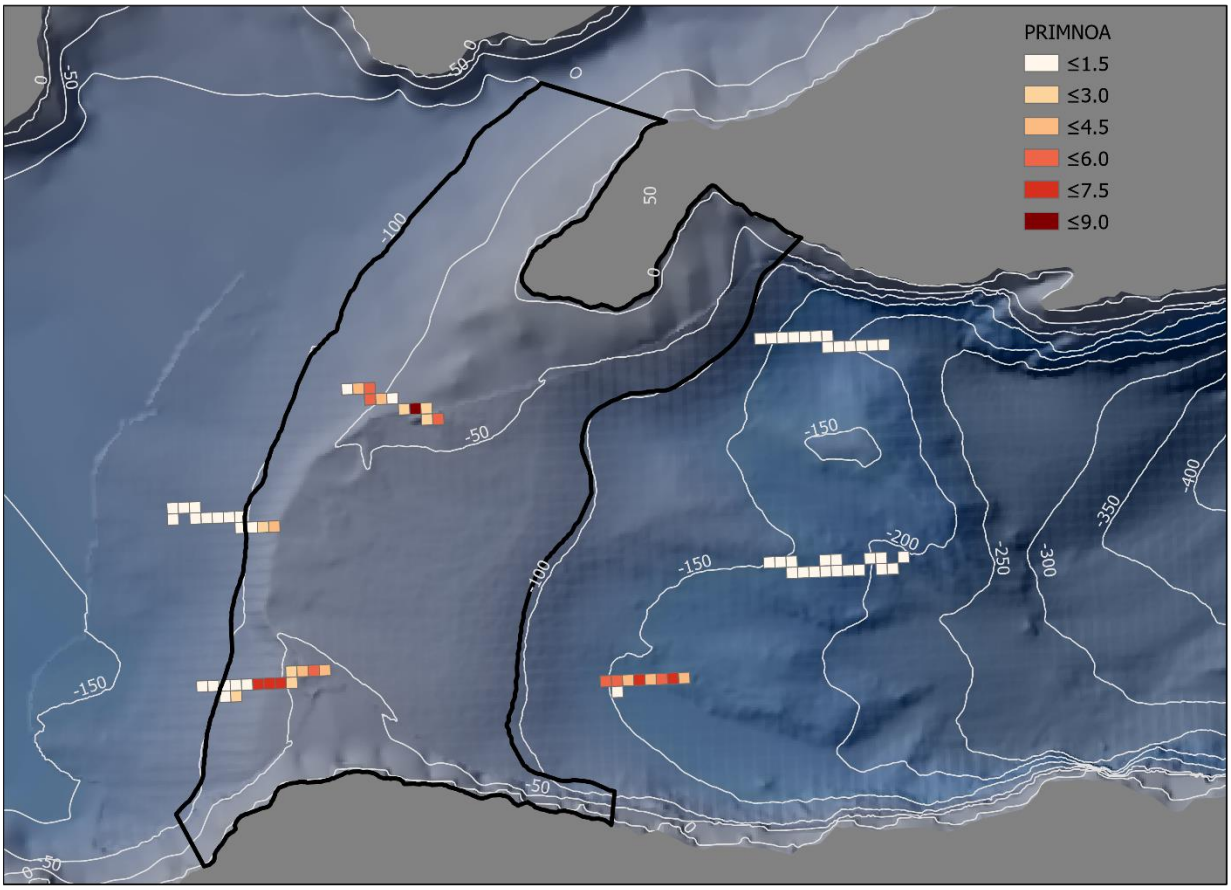

Figure A - 2. Number of observations of *Primnoa pacifica* along each transect from the 2010 DFO ROV dives.

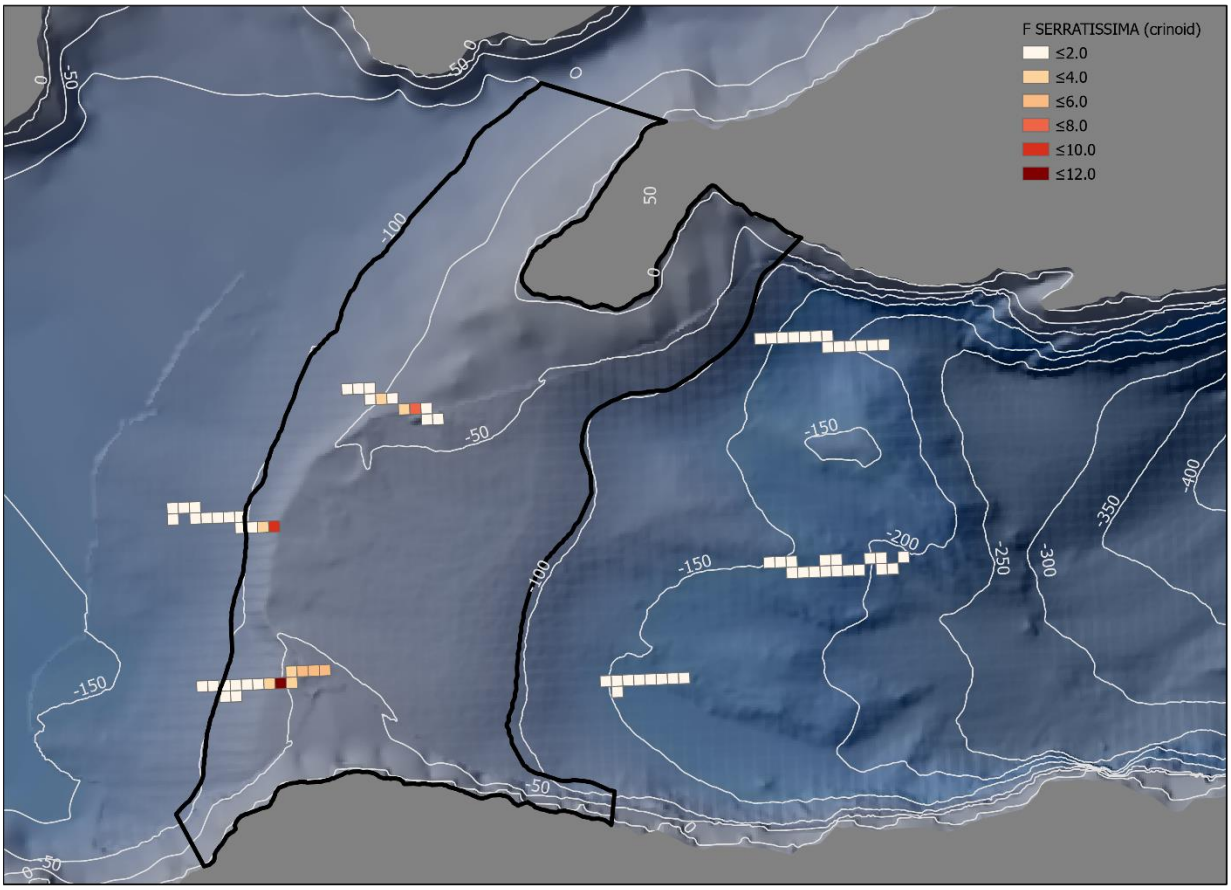

Figure A - 3. Number of observations of crinoids (*Florometra serratissima*) along each transect from the 2010 DFO ROV dives.

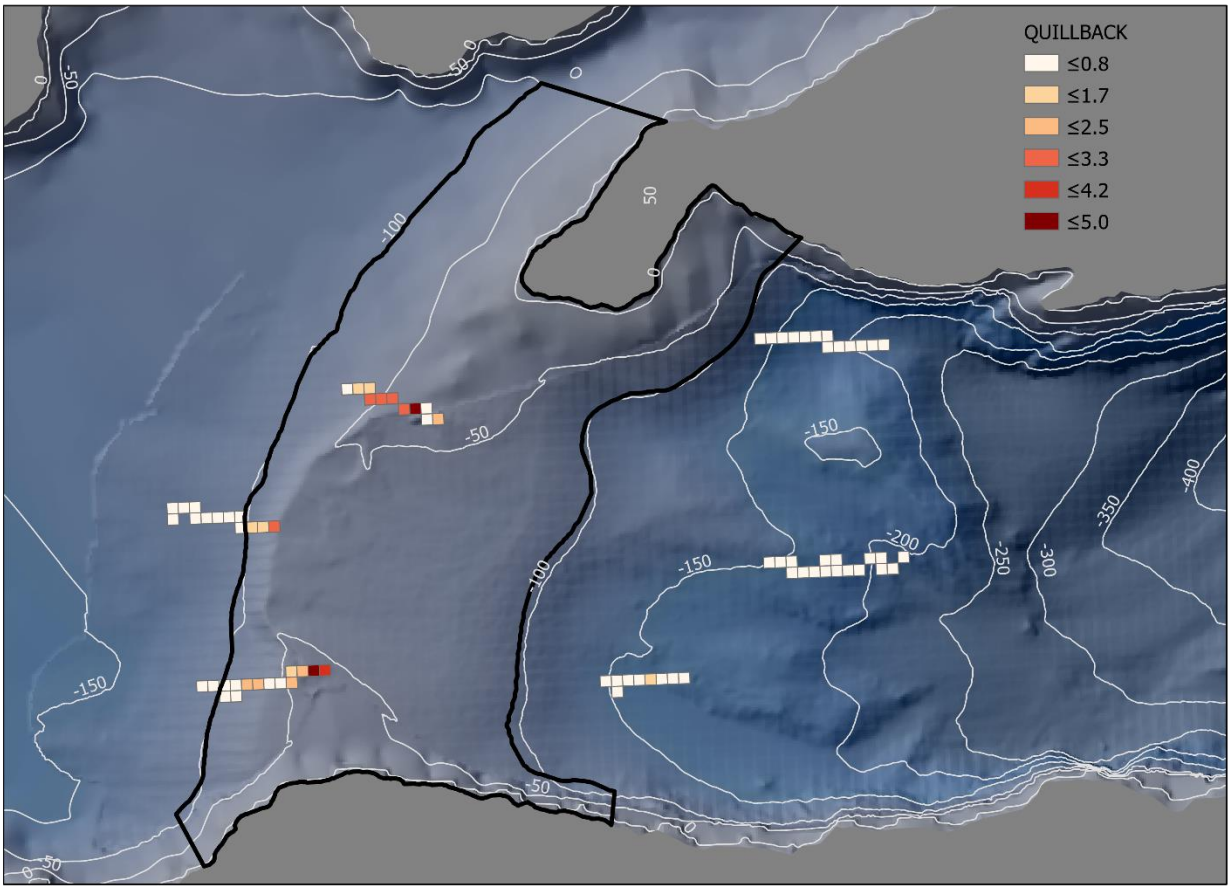

Figure A - 4. Number of observations of quillback rockfish (*Sebastes maliger*) along each transect from the 2010 DFO ROV dives.