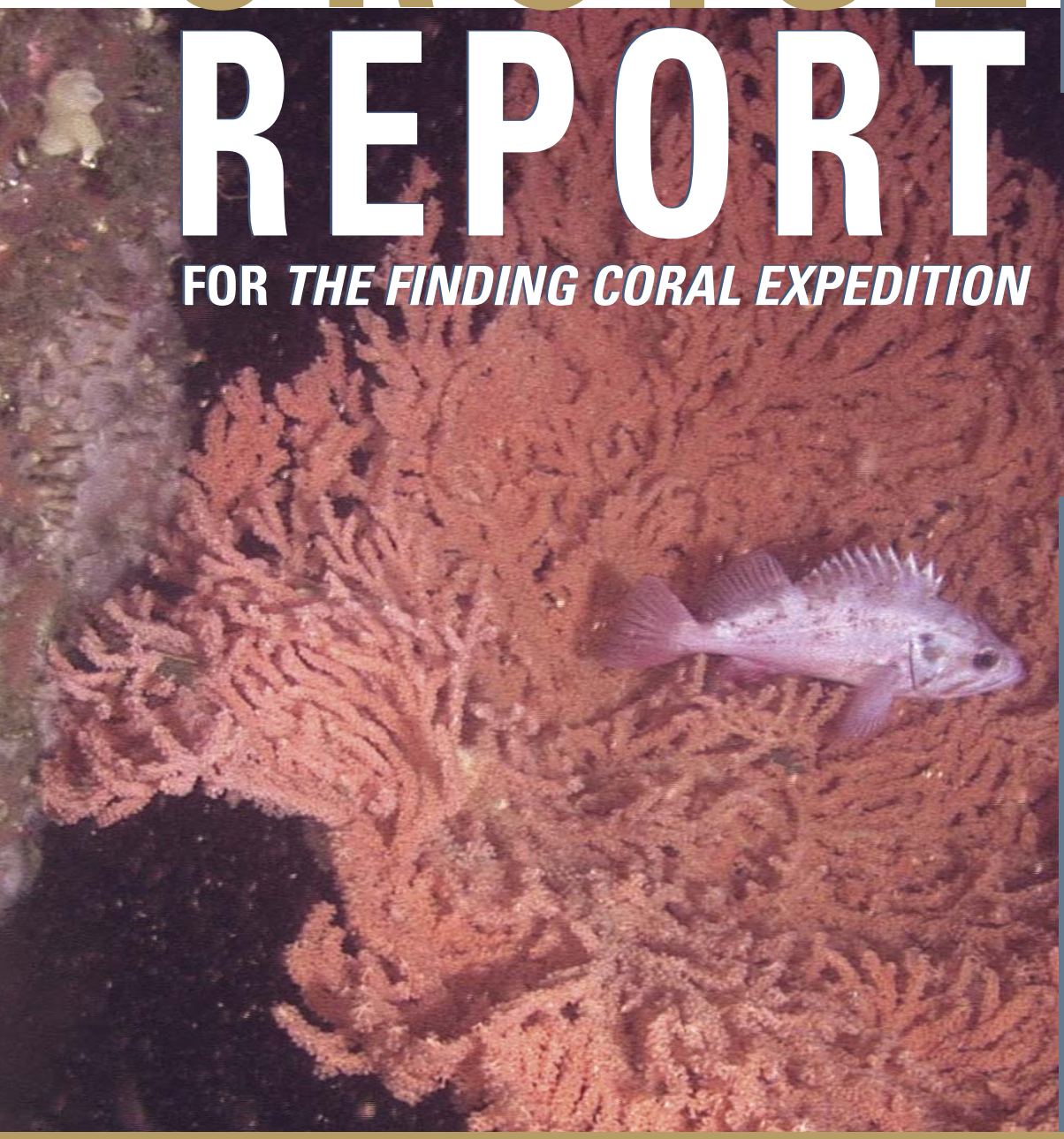
CRUISE REPORT

FOR *THE FINDING CORAL EXPEDITION*



LIVING OCEANS SOCIETY

Healthy Oceans, Healthy Communities

R/V Cape Flattery

June 8th – 23rd, 2009

Living Oceans Society
PO Box 320
Sointula, BC
V0N 3E0
Canada

February 2010

finding CORAL

Report Availability

Electronic copies of this report can be downloaded at **www.livingoceans.org/files/PDF/sustainable_fishing/cruise_report.pdf** or mailed copies requested from the address below.

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Paragorgia polyps photographed in the shipboard lab.

Introduction and Objectives

From June 8th to 23rd, 2009, Living Oceans Society led and funded a survey to explore the distribution, ecology and possible human impacts on temperate coral communities off the Northwest coast of British Columbia. This survey, the "Finding Coral Expedition", stretched from Goose Trough in Queen Charlotte Sound northward through Hecate Strait to Portland Inlet and Dundas Island (Figure 1). The scientific objectives of the survey were:

- documentation of species richness and abundance of deep sea corals in the areas surveyed
- documentation of occurrence of deep sea corals for subsequent distribution models
- identification of fish and invertebrates associated with deep sea corals
- documentation and identification of habitat perturbations in areas with coral records

An additional and equally important objective of the expedition was to educate and raise awareness of the importance of British Columbia's deep sea corals and the need to protect them from destructive fishing methods. Outreach activites under this objective included a press conference on World Oceans Day (June 8 '09), a two-day visit June 17th and 18th by representatives of the media (CBC and *Globe & Mail*), the Fisheries Guardian for the Haida Nation, Parks Canada, and Fisheries and Oceans Canada (DFO), as well as a vessel tour June 18th for the senior class of the North Vancouver Waldorf School. Further, a website entitled "Finding Coral" (http://findingcoral.com) was created and maintained with daily updates that included videos, photos, maps, and dispatches.

Below we provide a brief background on deep sea corals (ecology, significance, threats, and protection status) and the need for this research project in British Columbia. This is followed by a description of the material and methods used for the expedition. Finally, preliminary findings from the Finding Coral Expedition are presented.

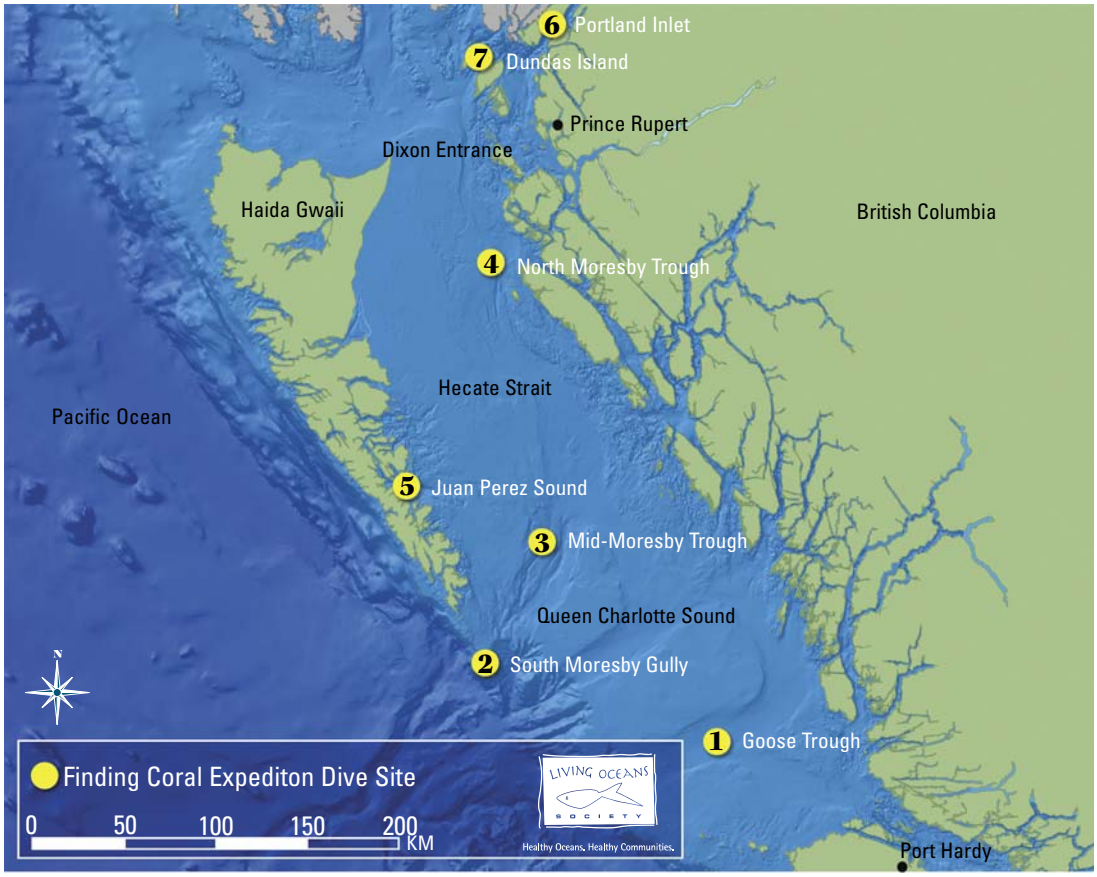

Figure 1

Map of submersible dive sites during the Finding Coral Expedition.

Background

Deep Sea Coral Ecology

Deep sea corals are generally found in the world's oceans on continental shelves, slopes, seamounts, offshore submarine banks and carbonate mounds where the water temperature ranges from 4 - 13°C (Freiwald et al. 2004). The geographic distribution of gorgonians is thought to be cosmopolitan with a vertical range exceeding 5,800 meters (Cairns and Bayer, 2009). As the temperatures appropriate for these species usually occur in deep sea, these corals are often referred to as deep sea or cold water corals (Morgan et al. 2006). For the purposes of this report, we will use the term 'deep sea corals'. Deep sea corals belong to several taxonomic groups within the Phylum Cnidaria. These include stony cup corals (Order: Scleractinia), gorgonian corals (Order: Gorgonacea) black corals (Order: Antipatharia) hydrocorals (Order: Stylasterina), true soft corals (Order: Alcyonacea), and sea whips and sea pens (Order: Pennatulacea). Species of deep sea corals may live as single polyps as is the case with stony cup corals or can consist of a colony of many polyps sharing a common skeleton as is the case with gorgonians.

Deep sea coral species lack the endosymbiotic photosynthetic zooxanthella found in coral species of the sunlit tropical oceans. Deep sea corals are suspension feeders that exclusively rely on capturing prey like planktonic organisms from the water column by means of their tentacles. Like their tropical coral counterparts they are sessile. Thus, they are found in areas where strong currents, and high primary and secondary productivity provide steady nutrient supply. Many species of deep sea corals orient perpendicular to the current to maximize the surface area of polyps exposed to the current, thereby maximizing feeding opportunities. Most deep sea corals, like the gorgonians, cup corals, and hydrocorals attach to hard rocky substrate, whereas sea whips and sea pens generally occur on loose substrate. Although additional research is needed on reproductive modes for some species, they reproduce either by sexual or asexual means or both.

Deep sea corals are slow-growing, fragile, and long-lived. Some colonies of gorgonians (e.g. *Primnoa* and *Paragorgia*) can grow several meters in width and height and have been documented to live for hundreds of years (Andrews et al. 2002); other gorgonians (e.g., *Leiopathes*) live more than 4,265 years (Roark et al. 2009).

Deep sea corals are ecologically important because they provide habitat for numerous species of invertebrates and fish (Freese et al. 1999, Krieger and Wing 2002, D'Onghia et al. 2009). Some deep sea coral habitats are spawning areas for rockfish and can serve as nurseries for demersal species (D'Onghia et al. 2009). Habitat forming deep sea corals are those families of octocorals, hexacorals and hydrocorals with a majority of species found deeper than 200 m, exhibiting

complex branching morphology and are of sufficient size to serve as substrata or refugia for associated species (Etnoyer and Morgan 2006). In the Northeast Pacific Ocean, eight families have been identified as habitat formers, including hexacorals of the families Antipathidae, Oculinidae and Caryophyllidae; octocorals of the families Corallidae, Isididae, Paragorgiidae and Primnoidae, and hydrocorals in the family Stylasteridae (Bayer and Cairns 2009).

Most surveys of deep-sea corals in the Northeast Pacific Ocean have been conducted in Alaska (Heifetz et al. 2005, Stone 2006) and Washington/Oregon (Branco et al. 2007). Comparatively less research has been conducted on deep sea coral species in British Columbia. Jamieson (2008) approximated a total of five orders, 24 families and 61 coral species that have been observed in B.C. based on survey data, trawl fishery by-catch data and collections (museum and personal) (Jamieson et al 2006, 2007). An additional order, three families and 50 species may exist in B.C. based on research in adjacent areas (Jamieson et al. 2006). Most information on the distribution of B.C. corals comes from trawl fishery by-catch data. Deep sea coral species documented as by-catch include gorgonians such as *Primnoa* (red tree coral), *Paragorgia* (bubblegum coral), and *Isidella* (bamboo coral), pennatulaceans, such as orange sea pens, and the stylasterid hydrocorals.

Threats to Deep Sea Corals

Because they are long-lived, fragile and slow growing, deep sea corals are susceptible to physical damage. Causes of such damage may come from human activity. Bottom contact fisheries, including longline and bottom trawl, represent the most widespread threat to remaining aggregations of large habitat forming deep sea corals in B.C. Bottom trawling has impacted large areas of the sea floor in B.C., in areas that may have historically harboured deep sea coral ecosystems but do not appear to now. In untrawlable areas of rocky substrate where examples of intact deep sea coral communities remain, the greatest present threat is the longline fishery. Additional threats to deep sea corals include dumping, exploration for and extraction of hydrocarbons and minerals, and cable and pipeline placement and maintenance. Global climate change and ocean acidification may pose substantial challenges to deep sea coral survival (Guinotte et al. 2006, Roberts et al. 2006).

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Materials and Methods

Study Area and Site Selection

The study area was located off the west coast of British Columbia (BC) near Haida Gwaii (Queen Charlotte Islands). The survey extended from Goose Trough, Queen Charlotte Sound, through Hecate Strait and north to Portland Inlet and Dundas Island near the Alaska border in Dixon Entrance (Figure 1). Prior to departure a list of possible dive sites were selected based on Canadian Marine Multibeam Bathymetric Data provided by Natural Resources Canada (NRCan) , LOS analysis of trawl observer by-catch data from 1996-2002 (Ardron, 2005), DFO groundfish multispecies survey data (trawl, hook and line, and trap), substrate type, benthic complexity, weather buoy data and tidal speeds. Additionally, a mathematical model of deep sea coral distribution in British Columbia was considered (Finney et al. 2008). Potential dive sites identified during pre-cruise planning included: Goose Trough, South Moresby Gully, Mid-Moresby Trough, McHarg Bank, Learmonth Bank, North Moresby Trough, Mitchell's Trough, Flatfish Bank and Stewart Passage (Figure 2). Operationally the science team chose dive sites using the above information but also considered currents, local tides, sea state, and weather conditions.

Submersibles: *DeepWorker* and *Aquarius*

To address the four science objectives, two *DeepWorker 2000*, one-person submersibles manufactured by Nuytco Research Ltd. were used. They are named *DeepWorker 6* and *DeepWorker 7*. The *DeepWorker* is capable of diving to a maximum depth of 600m and has a maximum speed of two knots (Appendix 1). Each *DeepWorker* was equipped with a five-function manipulator arm, collection basket, Newtcam High Definition Video System, Novia 80 GB Hard Disc HD Video Recording System, two 200 Watt HMI Lights (colour temperature 56000) imagenex 881A Sonar ("forward looking scanning sonar"), and a laser scaling device for measuring distance and aiming the camera. The parallel laser beams were set 20cm apart. This equipment allowed for video documentation and specimen collection. An advantage of the *DeepWorker*, compared to ROVs and most other submersibles, is the dome that allowed scientists to make 360 degree *in situ* observations.

For outreach activities, the three person submersible *Aquarius* was used (Appendix 2). This allowed for two observers to accompany the *Aquarius* pilot, Jeff Heaton. The Aquarius is capable of diving to a maximum depth of 304.8 meters at speeds ranging from 2-3 knots. Five dives were

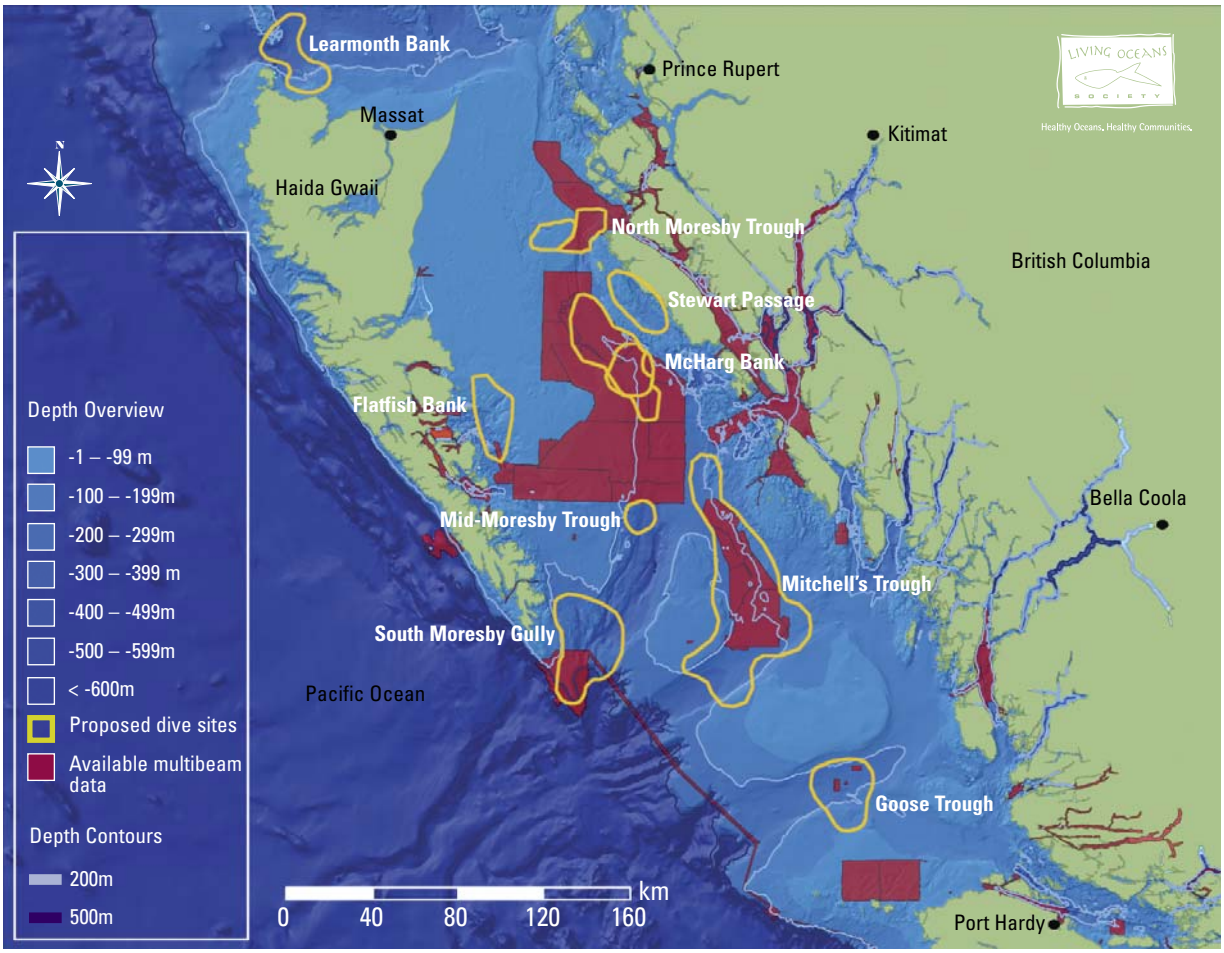

Figure 2

Map of potential dive sites chosen during pre-cruise planning.

made with *Aquarius*, each one in Juan Perez Sound. During four of these dives, a *DeepWorker* accompanied *Aquarius*.

Tracking and Navigation

During all dives, the submersibles were acoustically tracked with the Link-Quest 1500 HA® (High Accuracy) USBL (Ultra Short Baseline System) and 1505B Subsea Transponders (Appendix 3). The integrated navigation package used was Fugro Pelagos™ WinFrog® (Appendix 4). WinFrog was the interface software used to connect the Subsea positional data from the USBL system (Link-Quest), the GPS position of the ship with the ship's heading to simultaneously display a real world position of the ship and the submersibles on the multibeam bathymetric data (NRCan) from the survey area. Communications between the navigator and each submersible pilot were maintained at all times and allowed for instructions or events to be communicated regarding positioning, task, observations and life support readings.

Protocols

The protocols for video documentation (transect and ad hoc), collection of specimen, still photography and preservation were adapted from Etnoyer et al. (2006). At each site, transects of 200 m were conducted. Transects proceeded one after the other with an approximate 200 m transit in between. Generally, transects were oriented into the current and followed the slope upwards. When transects were not in progress, voucher specimens were video documented and collected for morphological and genetic species identification.

Submersible dives were conducted off the vessel, *R/V Cape Flattery*, a 56.7 m research vessel. The submersibles were launched and recovered using a boom crane, operated by the Nuytco Operations Team and *Cape Flattery* crew. Once launched, the two *DeepWorkers*, piloted by members of the science team, descended to the ocean floor transect starting point while guided by the topside navigator and dive supervisor. Once the submersible was on station at the start of a transect and both the topside navigator and pilot had recorded the position and depth of the submersible, the pilots commenced a transect following an agreed upon compass heading. A science team member (topside support scientist) recorded and logged pertinent findings of the pilot with respective latitudes, longitudes and depths. The scientist/pilot was then given a new compass heading and transited 200 m before commencing another transect. This was repeated until the dive was terminated. Typical dive times were 3-5 hours.

After recovery of the *DeepWorker*, piloting scientists were interviewed by topside support scientists regarding significant findings, digital video files were copied for archival purposes, and specimens were processed.

Approximately 1.5 Terabytes of video footage were collected over the course of the expedition. All video footage was immediately copied onto two 6 Terabyte NAS Raid Hard Drives. Footage from each dive was named using the protocol:

LOS2009-Dive Site-Sub#-Dive#

For example: *LOS2009-SMoresby-DW6-1* would be *DeepWorker 6* on its first dive at the South Moresby site.

To rapidly obtain some preliminary data, each pilot reviewed the footage from his/her dive and recorded coral findings, megafauna, and other significant observations on a video log. This data, combined with the support scientist log for each site, was used to complete a spreadsheet

indicating presence or absence of species and bottom types observed during the dive. Observations of the scientist not recorded on video were included in the spreadsheet.

A more in depth review and quantification of specimens on the videos is in progress. In order to score the tapes, a number of randomly-selected, non-overlapping quadrats from within each transect are selected to quantify the species present.

Collected specimens were immediately placed into glass aquaria filled with seawater chilled to approximately 7°C. All specimens collected by one submarine on one dive were placed in the same aquarium. Specimens were then examined by members of the scientific team for preliminary identification using manuals and taxonomic keys (Table 1). High resolution photos were taken of specimens of particular interest (Figure 13). Samples were then collected from specimens of interest. Each sample received a unique identifying code, via a waterproof label, that followed the pattern:

LOS2009-Dive Site-Sub # - Dive # - Specimen # - Specimen ID (often tentative)

For example, a sample named *LOS2009-JPerez-DW7-2-1 Primnoa* was taken from a colony, likely of the genus *Primnoa*, collected at the Juan Perez dive site by *DeepWorker 7*, on its second dive at Juan Perez.

All relevant information for each specimen was written on a hard copy specimen log, and the information from this log was then transferred to a spreadsheet that recorded all relevant information for each specimen collected during the expedition.

Deep sea coral samples were collected for the purposes of species identification (ethanol), DNA analysis (ethanol), reproductive histology (10% formalin), and museum storage/display (dry).

Sample dispositions

All species ID samples were sent to Dr. Stephen Cairns of the Department of Invertebrate Zoology in the Smithsonian National Museum of Natural History for identification, and will be deeded to that institution. DNA samples were sent to Dr. Amy Baco-Taylor at Florida State University, reproductive histology samples were sent to Dr. Sandra Brooke at Marine Conservation Biology Institute, and dry samples will be gifted to the Royal British Columbia Museum in Victoria, B.C. *The preliminary findings discussed in this report have not yet been verified by these taxonomic experts.*

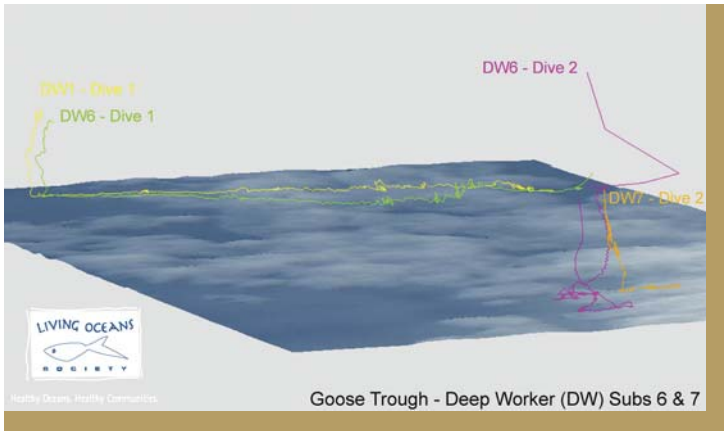

Figure 3

Transect Map from Goose Trough.

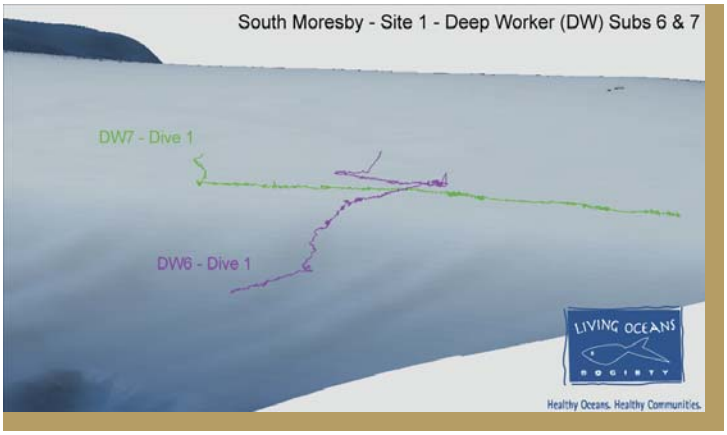

Figure 4

Transect Map from South Moresby Site I.

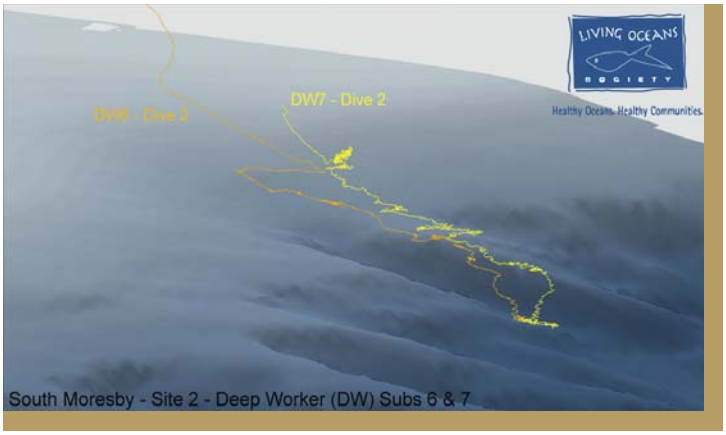

Figure 5

Transect Map from South Moresby Site II.

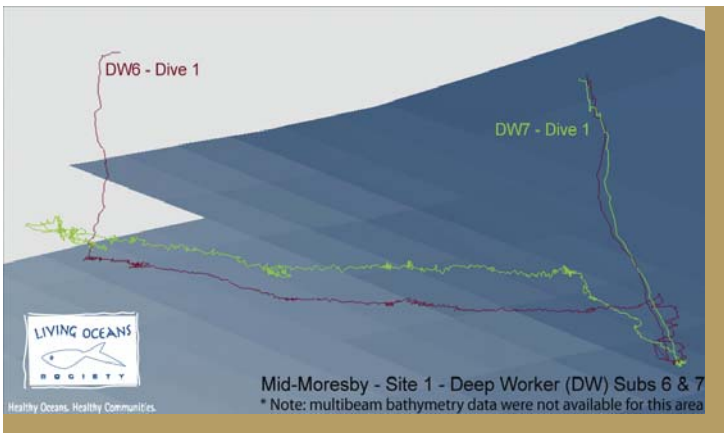

Figure 6

Transect Map from Mid-Moresby Site I.

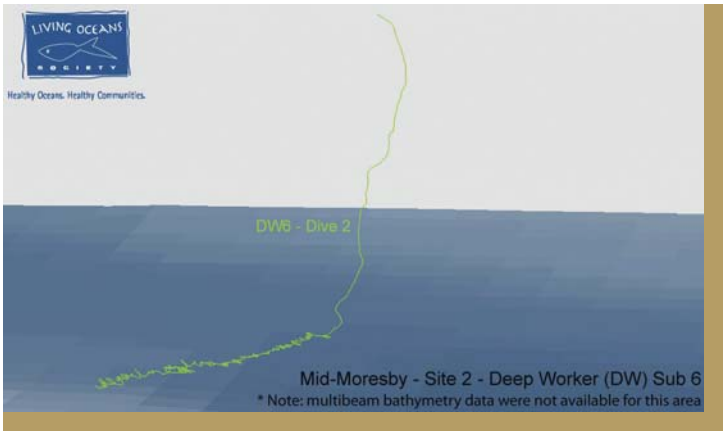

Figure 7

Transect Map from Mid-Moresby Site II.

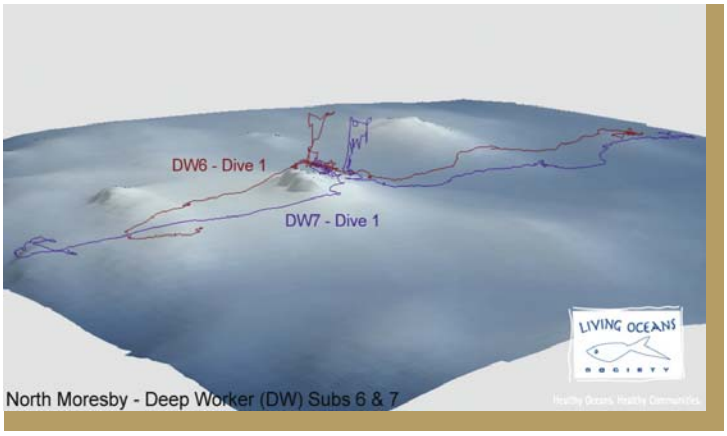

Figure 8

Transect Map from North Moresby.

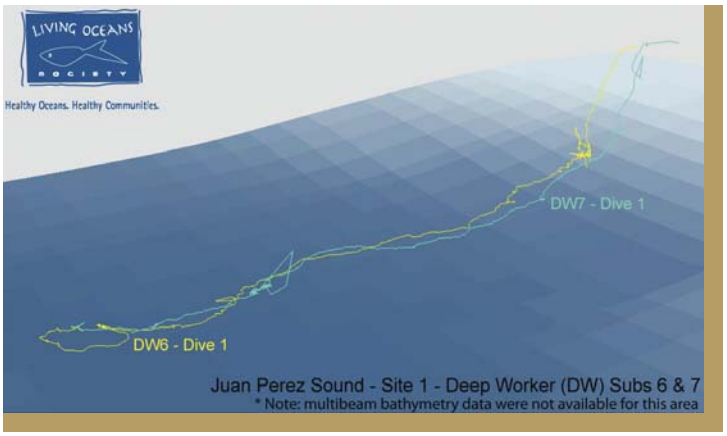

Figure 9

Transect Map from Juan Perez Sound Site I .

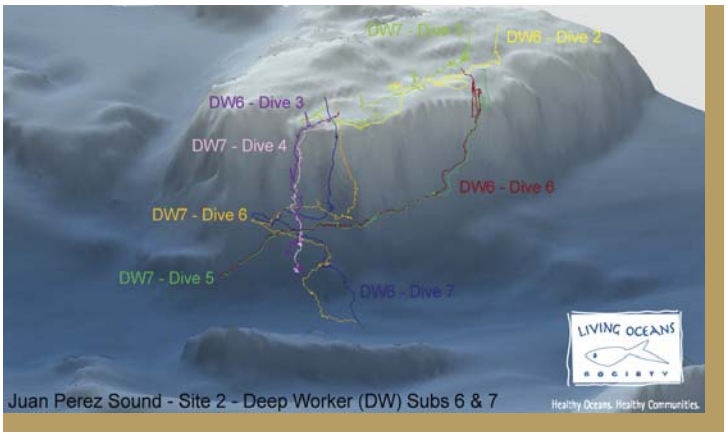

Figure 10

Juan Perez Sound Site II.

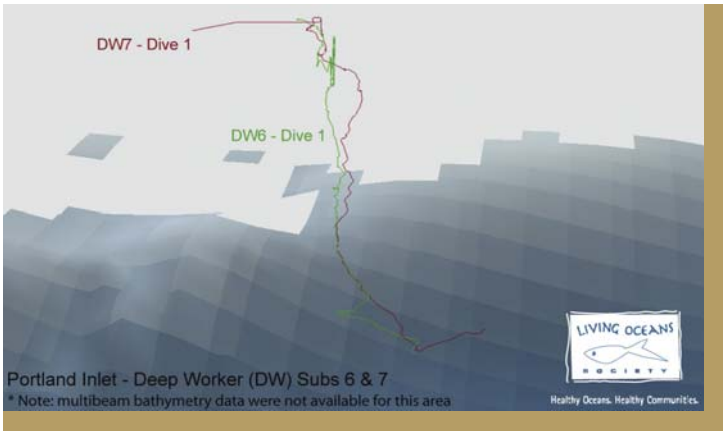

Figure 11

Portland Inlet

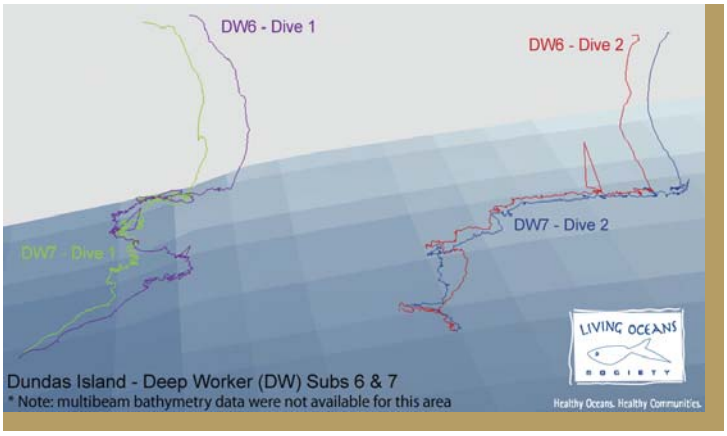

Figure 12

Dundas Island.

Table 1

Reference material used to identify fish and invertebrates during the survey.

Title	*Authors*	*Publisher*
Guide to Northeast Pacific Rockfish-Genera *Sebastes* and *Sebastlobus*	*Donald E. Kramer* and *Victoria M. O'Connell*	Alaska Sea Grant College Program – Marine Advisory Bulletin no. 25
Northeast Pacific Flatfishes – Family *Bothidae* and *Pleuronectidae*	*Donald E. Kramer, William H. Brass, Brian C. Paust* and *Barry E. Bracken*	Alaska Sea Grant College Program – Marine Advisory Bulletin no. 47
Guide to Marine Mammals of Alaska	*Kate Wynne* and *Pieter Folkens*	Alaska Sea Grant College Program – Marine Advisory Bulletin no. 44
Field Guide to Sharks, Skate and Ratfish of Alaska	*Duane E. Stevenson, James W. Orr, Gerald R. Hoff* and *John D. McEachran*	Alaska Sea Grant College Program
Fishes of Alaska	*Catherine W. Mecklenburg, T. Anthony Mecklenburg* and *Lyman K. Thorsteinson*	American Fisheries Society – Bethesda, Maryland
A Practical Guide To The Identification Of Commercial Groundfish Species Of British Columbia	*Donna Grant, Michael Gjernes* and *Nev Venables*	Archipelago Marine Research
The Beachcombers Guide to Seashore life in the Pacific Northwest	*J Duane Sept*	Harbour Publishing
Pacific Seaweeds	*Louis Druehl*	Harbour Publishing
Shells and Shellfish of the Pacific Northwest – A field Guide	*Rick M. Harbo*	Harbour Publishing
Whelks to Whales coastal marine life of the Pacific Northwest	*Rick M. Harbo*	Harbour Publishing
Coastal Fishes of the Pacific Northwest	*Andy Lamb* and *Phil Edgell*	Harbour Publishing
Pacific Coast Crabs and Shrimp	*Gregory C. Jensen*	Sea Challengers, Monterey
Pacific Coast Nudibrachs	*David W. Behrens*	Sea Challengers, Monterey
Pacific Coast Pelagic Inverterates	*David Wrobel* and *Claudia Mills*	Sea Challengers, Monterey
Guide to Marine Invertebrates	*Daniel W. Gotshall*	Sea Challengers, Monterey
A Field Guide to Pacific Coast Fishes: North America	*William N. Eschmeyer, Earl S. Herald, Roger Tory Peterson, Katherine P. Smith,* and *Howard E. Hammann*	Peterson Field Guides, Houghton Mifflin Company, New York

Table 1

continued

Title	*Authors*	*Publisher*
Brittle Stars, Sea Urchins and Feather Stars of British Columbia, Southeast Alaska and Puget Sound	*Philip Lambert* and *William C. Austin*	Royal BC Museum Handbook
Sea Cucumbers of British Columbia, Southeast Alaska and Puget Sound	*Philip Lambert*	Royal BC Museum Handbook co-published with UBC Press
Crabs and Their Relatives of British Columbia	*Josephine F.L Hart*	Royal BC Museum Handbook – Handbook 40
Sea Stars of British Columbia, Southeast Alaska and Puget Sound	*Philip Lambert*	Royal BC Museum Handbook co-published with UBC Press
Invertebrate Zoology	*Edward E. Rupert* and *Robert D. Barnes*	Saunders College Publishing
Shrimps of the Pacific Coast of Canada	*T. H. Butler*	Canadian Bulletin of Fisheries and Aquatic Science 202
Pacific Fishes of Canada	*JL Hart*	CJFAS Bulletin 180
The Rockfishes of the Northeast Pacific	*Milton S. Love, Mary Yoklavich* and *Lyman Thorsteinson*	University of California Press
Marine Invertebrates of the Pacific Northwest	*Eugene N. Kozloff*	University of Washington Press, Seattle
Filed Guide to the Benthic Marine Invertebrates of Alaska's Shelf and Upper Slope: Volume 1 Sponges to Gastropods	*Roger N. Clark*	NOAA/NMFS/AFSC/ Race Division working document
Filed Guide to the Benthic Marine Invertebrates of Alaska's Shelf and Upper Slope: Volume 2 Bivalves to Tunicates	*Roger N. Clark*	NOAA/NMFS/AFSC/ Race Division working document
Guide to Rockfishes (*Scorpaenidae*) of the *Genera Sebastes*, *Sebastolobus*, and *Adelosebastes* of the Northeast Pacific Ocean, Second Edition	*James Wilder Orr, Michael A. Brown* and *David C. Baker*	NOAA Tech. Memo. NMFS-AFSC-117, 47 p
A Working Field Guide to Trawl-Caught Animals Volume 1 (Fishes)	*based on D. W. Kessler's Alaska's Saltwater Fishes And Other Sea Life*	NOAA/NMFS/AFSC/ Race Division working document
A Field Guide to Alaskan Corals	*B. L. Wing* and *D. R. Barnard*	NOAA Tech. Memo. NMFS-AFSC-146, 67 p

Figure 13

Example of photo taken in the lab: several dried specimens of *Primnoa pacifica.*

Figure 14

Colonies of *Primnoa sp.* Photographed at a depth of 943 ft in Juan Perez Sound.

Preliminary Findings

Sites Assessed and Sampling Effort

A total of 30 scientific dives were completed at seven localities (Figure 1). Within Juan Perez Sound, two dive sites were visited including the terminal moraine and a large reef structure south of Crombie Point on Ramsey Island. Given the geomorphic differences between these two sites, data collected at either one have been treated seperately. Thus eight sites are referred to throughout this section. At each site, between two and fourteen 200 m video transects were completed with either a vertical or horizontal orientation (Table 2). A total of 110 specimens were collected at depths ranging from 30 to 439 m. Eight dives were conducted for outreach purposes (Table 3) and their outcomes are not included in the present document.

Deep Sea Corals

Approximately 16 species of deep sea corals were observed at seven of the sites surveyed, or 87.5% (Table 4 and Figure 14). A total of 19 specimens of deep sea corals were collected from four of the sites (Table 5). The number of potential species observed per site ranged from one at Goose Trough to 11 at South Morsbey Gully and Juan Perez Sound. No coral species were observed at the terminal moraine in Juan Perez Sound. The largest colonies observed were red-tree corals (*Primnoa sp.*) in Juan Perez Sound, at Dundas Island and Portland Inlet. Some of them exceeded 1.5 m height and 2 m width (Figure 15). *Stylaster sp*. was the most commonly encountered deep sea coral. Other observed cold water coral taxa included *Paragorgia sp*. (Figure 16), *Swiftia sp*., and *Isidella sp*. (Figure 17) *Anthomastus sp*. was the least observed cold water coral, and was only noted at Portland Inlet.

Other Organisms

Numerous species of fish were documented during the dives, including twenty species of rockfish (Table 6) and many commercially important non-rockfish species (Table 7). Red tree corals (*Primnoa sp.*) were found to be a common refugium for rockfish—mainly sharpchin rockfish (*Sebastes zacentrus*). Invertebrates were noted at all sites (Tables 8-12) and were often found in association with deep sea corals. Several species were observed in direct associations with the coral colonies. The southern spiny star (*Hippasteria spinosa*) and the orange peel nudibranch (*Tochuina tetraquetra*) were observed feeding on *Primnoa* in Juan Perez Sound, and at Dundas

Figure 15

DeepWorker 6 collecting sample of *Primnoa sp*. in Juan Perez Sound.

Figure 16

Paragorgia sp. at Juan Perez dive site.

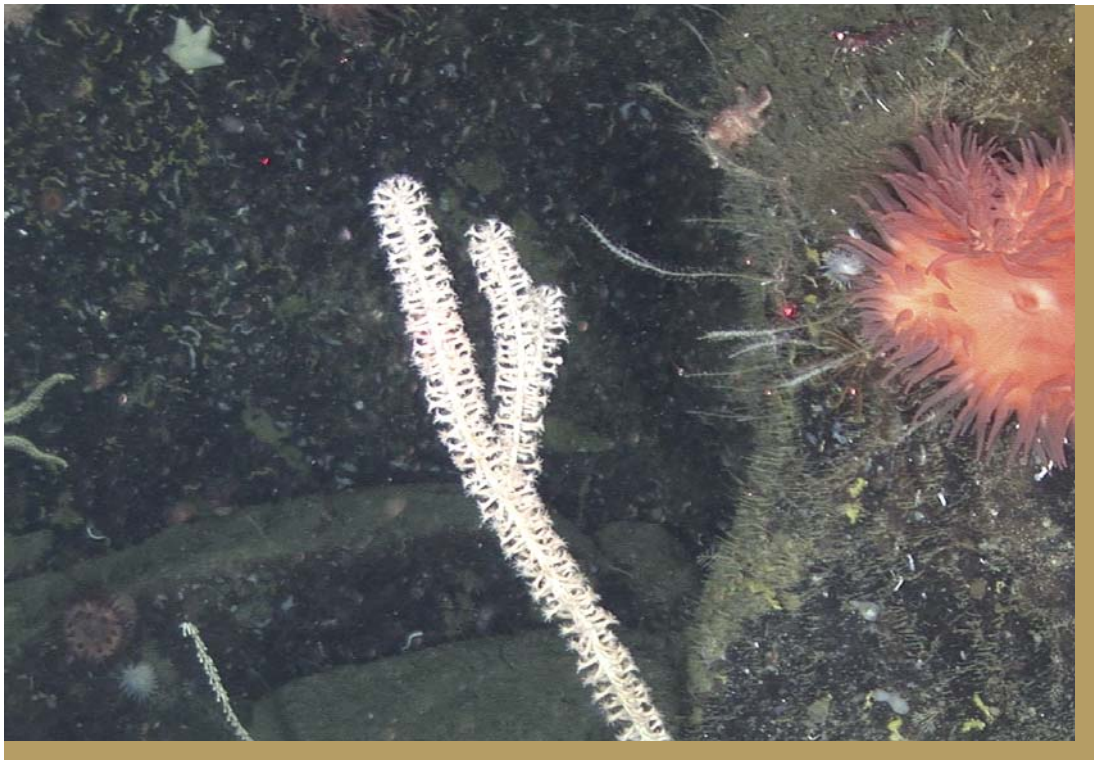

Figure 17

Isidella coral at South Moresby dive site.

Table 2

Summary of dives made for scientific purposes by the *DeepWorkers* (DW6 and DW7). The symbol (~) denotes an approximation.

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Goose Trough	10 June 09	DW6	J. Lash	N 51° 19.676 W 128° 56.9323	220 - 243	2 vertical
	10 June 09	DW7	L. Morgan	N 51° 19.6745 W 128° 56.9656	216 - 247	0
	10 June 09	DW6	S. McKenna	N 51° 18.7 W 128° 56.555	~ 230 - 238	1 vertical
	10 June 09	DW7	G. Workman	N 51° 18.74 W 128° 56.45	227 - 240	0

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
South Moresby Gully	11 June 09	DW6	M. Reuscher	N 51° 42.1185 W 130° 46.383	273 - 427	4 vertical
	11 June 09	DW7	T. Shirley	N 51° 42.0303 W 130° 45.0341	229 - 292	4 vertical
	12 June 09	DW6	J. Lash	N 51° 45.39 W 130° 43.64	353 - 514	3 vertical
	12 June 09	DW7	L. Morgan	N 51° 45.38 W 130° 43.62	347 - 524	3 vertical

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Mid- Moresby Trough	13 June 09	DW6	S. McKenna	N 52° 17.66 W 130° 20.43	296 - 360	2 vertical
	13 June 09	DW7	G. Workman	N52° 17.66 W130°.20.43	302 - 366	2 vertical
	13 June 09	DW6	M. Reuscher	N 52° 14.47 W 130° 22.20	119 - 122	2 vertical
	13 June 09	DW7	T. Shirley	N 52° 14.47 W 130° 22.20	Dive aborted 387	0

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
North Moresby Trough	14 June 09	DW6	J. Lash	N 53° 38.3699 W 130° 48.7797	101 - 149	3 vertical
	14 June 09	DW7	L. Morgan	N 53° 38.3730 W 130° 43.7915	107 - 156	3 vertical

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Juan Perez Terminal Moraine	15 June 09	DW6	S. McKenna	N 52° 31.5888 W 131°.14.5044	212 - 279	2 vertical
	15 June 09	DW7	G. Workman	N 52° 31.5873 W 131° 14.5366	211 – 282	2 vertical

Table 2

continued

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Juan Perez	16 June 09	DW6	J. Lash	N52° 31.5040 W131° 23.3705	69 – 86	2 vertical
	16 June 09	DW7	L. Morgan	N52 ° 31.5086 W131° 23.3480	65 – 92	2 vertical
	16 June 09	DW6	S. McKenna	N 52° 31.37 W 131° 23.14	84 – 322	1 vertical
	16 June 09	DW7	G. Workman	N 52° 31.37 W 131° 23.14	88 – 326	1 vertical

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Portland	18 June 09	DW6	M. Reuscher	N 54° 48.24 W 130° 19.96	51 - 429	1 vertical
	18 June 09	DW7	T. Shirley	N 54° 48.24 W 130° 19.96	55 - 428	1 vertical

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Dundas Island	19 June 09	DW6	J. Lash	N 54° 38.002 130° 57.2830	152 – 430	0
	19 June 09	DW7	L. Morgan	N 54° 38.000 W 130° 57.2830	179 - 280	0
	19 June 09	DW6	S. McKenna	N 54° 37.8812 W 130° 57.2461	163 - 252	1 horizontal
	19 June 09	DW7	G. Workman	N 54° 37 9774 W 130° 56.9414	158 - 250	1 horizontal

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*	*# Transects with orientation*
Juan Perez Sound	20 June 09	DW6	M. Reuscher	N 52° 31.4177 W 131° 23.2356	36 - 328	1 horizontal
	20 June 09	DW7	T. Shirley	N 52° 31.4177 W 131° 23.2356	81 - 330	1 horizontal
	20 June 09	DW6	J. Lash	N 52° 31.25 W 131° 23.13	94 - 369	1 horizontal
	20 June 09	DW7	L. Morgan	N 52° 31.312 W W 131° 23.08	160 - 363	1 horizontal

Island. A few invetebrates were found on or with the coral specimens collected and not noted until post-dive examination. These included crinoids (*Florometra asperrima*) and shrimp on *Primnoa* specimens collected at Juan Perez Sound; shrimp on *Paragorgia* samples collected from Juan Perez Sound. Hydroid colonies were the most common symbionts of *Primnoa*, brittle stars the most common symbionts of the hydrocorals and were also found with *Swiftia sp*. at South Moresby Gully. Several species of sponges within the class Hexactinellida were observed in six of the sites (Table 11). The only dive sites for which sponges were not noted was Mid-Moresby Trough.

Anthropogenic Activity

Possible evidence of trawling was recorded at four of eight sites. What appeard to be trawl tracks were observed in South Moresby Gully, Juan Perez Sound, and at Goose Trough. Numerous old and fresh trawl tracks were observed at Mid-Moresby Gully. Evidence of longlining activity was noted at Dundas.

Derelict fishing gear and debris were observed at four of the eight (or 50%) sites assess. This included several pieces of trawl wire at Mid-Moresby Trough and South Moresby Gully; fishing line or a down rigger cable at Dundas Island and in Juan Perez sound; and longline groundline, gangion and snaps at Juan Perez Sound and Dundas Island.

Table 3

Summary of dives made for outreach purposes by *Aquarius* (AQ) and *DeepWorker* (DW6 or DW7). The symbol (~) denotes an approximation.

Site	*Date*	*Submersible*	*Pilot/Scientist*	*Latitude and Longitude*	*Depth range (meters)*
Juan Perez Sound	15 June 09	AQ	J. Heaton	N 52° 31.16 W 131° 26.33	20-32
	15 June 09	DW7	T. Shirley	N 52° 34.18 W 131° 26.31	30-34
	17 June 09	AQ	J. Heaton	N 52° 33.2869 W 131° 26.6763	61-91
	17 June 09	DW6	J. Lash	N 52° 33.2896 W 131° 26.6763	67-90
	17 June 09	AQ	J. Heaton	N 52° 33.52 W 131° 27.09	~ 40-90
	17 June 09	AQ	J. Heaton	N 52° 33.55 W 131° 27.01	40-90
	17 June 09	AQ	J. Heaton	N 52° 45.39 W 131° 43.64	~ 40-90
	17 June 09	DW6	M. Reuscher	N 52° 33.55 W 131° 27.02	40-92

Table 4

Deep-sea corals observed by site.

Scientific names (taxonomic class or species) are listed with common names in parentheses. In some cases only broad taxonomic or common names for the species are listed. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of observation.

	Goose Trough ***n = 4***	***South Moresby Gully*** ***n = 4***	***Mid-Moresby Trough*** ***n = 4***	***North Moresby Trough*** ***n = 2***	***Juan Perez Sound (Terminal Moraine)*** ***n = 2***	***Juan Perez Sound*** ***n = 8***	***Portland Inleta*** ***n = 2***	***Dundas Island*** ***n = 4***
Octocorals								
Anthomastus sp	0	0	0	0	0	0	1	0
Arthrogorgia sp. (scaled gorgonian)		1	1	0	0	?	0	0
Isidella sp. (bamboo)	0	1	0	0	0	0	0	0
Lepidisis sp. (solitary bamboo)	0	?	0	0	0	0	0	0
Paragorgia sp. (bubblegum coral)	1	1	?	0	0	1	1	1
Primnoa sp 1 (red tree coral)	0	0	0	0	0	1	1	1
Primnoa sp 2 (red tree coral	0	0	0	0	0	1	0	0
c.f. *Ptilosarcus sp* (sea pen)	0	0	0	1	0	0	0	0
Sea whip	0	0	0	1	0	1	0	0
Swiftia beringi	0	1	0	0	0	0	0	0
Swiftia sp.	0	1	0	0	0	?	1	0
Hydrocorals								
Hydrocoral (pink)	0	1	?	?	0	1	?	1
Stylaster sp.	0	1	1	?	0	1	1	1
Scleractinian corals								
Balanophyllia elegans (orange cup coral)	0	1	0	0	0	1	0	?
Caryophyllia alaskensis (brown cup coral)	0	1	0	0	0	?	0	0
Desmophyllum dianthus (giant cup coral)	0	1	0	0	0	?	0	0

c.f. ~ compared with

[a] ~ Extremely poor visibility

Table 5

Summary of deep-sea coral specimens collected by site with date, depth, species identification, and samples taken.

Site	Date	Sub #	Dive #	Latitude and Longitude	Depth (meters)	Specimen collected	Samples: Species ID	Samples: DNA	Samples: Repro	Samples: Dry
South Moresby	11 June 2009	DW 6	1	N 51° 42.39 W 130° 45.15	284	*Swiftia sp., beringi?*	x	0021		x
	12 June 2009	DW 6	2	N 51° 45.3 W 130° 44.3	380	*Stylaster* (white)		0024		
	12 June 2009	DW 7	2	N 51° 45.44 W 130° 44.4	346	*Primnoa pacifica*	x	0025		x
	12 June 2009	DW 7	2	N 51° 45.44 W 130° 44.4	346	*Stylaster campylecus parageus*	x	0026		x
	12 June 2009	DW 7	2	N 51° 45.44 W 130° 44.4	346	*Caryophyllia sp.*				x
	12 June 2009	DW 6	2	N 51° 42.1185 W 130° 46.383	380	*Paragorgia sp.* (dead and broken)				x
	12 June 2009	DW 6	2	N 51° 45.3 W 130° 44.0	439	*Isidella sp.*	x		x	x
Dundas Island	19 June 2009	DW 6	1	N 54° 37.92 W 130° 57.07	247	*Primnoa pacifica*	x	0044	x	x
	19 June 2009	DW 7	1	N 54° 37.94 W 130° 57.05	243	*Primnoa pacifica*	x	0045	x	x
	19 June 2009	DW 6	1	N 54° 37.92 W 130° 57.07	247	*Primnoa sp.*			x	
	19 June 2009	DW 6	1	N 54° 37.92 W 130° 57.07	247	*Primnoa sp.*			x	
	19 June 2009	DW 6	1	N 54° 37.92 W 130° 57.07	247	*Primnoa pacifica*	x	x	x	x
Mid- Moresby	13 June 2009	DW 6	1	N 52° 27.03 W 130° 20.74	296	*Stylaster sp.*		0027		x
Juan Perez Sound	15 June 2009	DW 7	1	N 52° 32 W 131° 14	274	*Stylaster sp., 1*		0037		
	15 June 2009	DW 7	1	N 52° 32 W 131° 14	274	*Stylaster sp., 2*		0038		
	16 June 2009	DW 7	4	N 52° 31.32 W 131° 23.30	320	*Primnoa pacifica*	x	0039	x	x
	16 June 2009	DW 7	4	N 52° 31.32 W 131° 23.30	320	*Primnoa pacifica*	x	0040	x	x
	20 June 2009	DW 6	7	N 52° 31.36 W 131° 23.26	352	*Primnoa pacifica*	x		x	x
	20 June 2009	DW 7	6	N 52° 31.43 W 131° 23.26	198	*Paragorgia sp.*	x	x	x	x

Table 6

Species of rockfish observed by site.

Scientific names are listed with common names in parentheses. The distinction between observations of adults and juveniles of the same fish species is made by a separate row and written before the common name. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of observation and was not counted in species total.

Species name (common name)	***Goose Trough***	***South Moresby Gully***	***Mid-Moresby Trough***	***North Moresby Trough***	***Juan Perez Sound (Terminal Moraine)***	***Juan Perez Sound***	***Portland Inleta***	***Dundas Island***
Rockfish	***n = 4***	***n = 4***	***n = 4***	***n = 2***	***n = 2***	***n = 8***	***n = 2***	***n = 4***
Sebastes aleutians (Rougheye)	1	1	0	0	0	0	0	0
Sebastes alutus (Pacific Ocean Perch)	1	0	1	0	0	0	0	0
Sebastes babcocki (Adult Redbanded)	1	1	1	0	0	1	0	1
S. babcocki juvenile (Juvenile Redbanded)	1	0	1	0	0	1	0	1
Sebastes borealis (Shortraker)	1	1	1	0	0	?	0	1
Sebastes caurinus (Cooper)	0	0	0	0	0	1	0	0
Sebastes crameri (Dark blotched)	0	0	0	0	0	0	0	0
Sebastes elongatus (Greenstriped)	0	0	0	0	0	0	0	0
Sebastes flavidus (Yellowtail)	1	0	0	0	0	1	0	0
Sebastes helvomaculatus (Rosethorn)	1	0	0	0	0	0	0	0
Sebastes maliger (Quillback)	0	0	0	1	0	0	0	0
Sebastes melanosticus (Blackspotted)	0	0	1	0	0	1	0	0
S. melanosticus juvenile (Blackspotted)	0	0	0	0	0	0	0	1
Sebastes nebulosus (China)	0	0	0	0	0	1	0	0
Sebastes nigrocinctus (Tiger)	0	0	0	1	1	1	0	0
Sebastes paucispinis (Boacaccio)	0	0	0	0	0	1	0	0
Sebastes reedi (Yellowmouth)	1	0	0	0	0	0	0	0
Sebastes rubermimus (Yelloweye)	0	0	0	1	0	1	0	0

[a] Extremely poor visibility [b] Gravid females observed

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Table 6

Species of rockfish observed by site. **(continued)**

Species name (common name)	*Goose Trough*	*South Moresby Gully*	*Mid-Moresby Trough*	*North Moresby Trough*	*Juan Perez Sound (Terminal Moraine)*	*Juan Perez Sound*	*Portland Inleta*	*Dundas Island*
Rockfish	***n = 4***	***n = 4***	***n = 4***	***n = 2***	***n = 2***	***n = 8***	***n = 2***	***n = 4***
S. rubermimus juvenile (Yellow eye)	0	0	0	1	0	0	0	0
Sebastes wilsoni (Pygmy)	0	0	0	0	0	1b	0	0
Sebastes zacentrus (Sharpchin)	1	0	0	0	1	0	0	0
Sebastolobus alacanus (Shortspine thornyhead)	1	0	1	0	0	0	0	1
Sebastolobus altivelis (Longspine thornyhead)	0	1	0	0	0	0	0	0
Total number of Rockfish species observed	***9***	***4***	***5***	***3***	***2***	***9***	***0***	***4***

[a] Extremely poor visibility [b] Gravid females observed

Table 7

Other species of fish (non-rockfish) observed by site.

Scientific names are listed with common names in parentheses. In case where taxonomic identity could not be resolved to species level, family or suborder level was used. The distinction between observations of adults and juveniles of the same fish species is made by a separate row and written before the common name. The site names with the number (n) of dives by the submersible, DeepWorker for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed.

Species Name (common name)	*Goose Trough* *n = 4*	*South Morsby Gully* *n = 4*	*Mid-Moresby Trough* *n = 4*	*North Moresby Trough* *n = 2*	*Juan Perez Sound (Terminal Moraine)* *n = 2*	*Juan Perez Sound* *n = 8*	*Portland Inleta* *n = 2*	*Dundas Island* *n = 4*
Anoplopoma fimbria (Sablefish)	0	1	1	0	1	0	0	0
A. fimbria (Juvenile Sablefish)	0	0	0	0	1	0	0	0
Atheresthes stomias (Arrowtooth flounder)	1	1	1	?	1	0	0	0
Bathyraja aleutica (Aleutian skate)	0	0	1	0	0	0	0	0
Bathyraja interrupta (Sandpaper skate)	0	?	0	0	0	0	0	1
Clupea harengus pallasi (Pacific herring)	0	0	0	0	1	1 school	0	0
Embassichthys bathybius (Deepsea sole)	0	?	0	0	0	0	0	0
Eptatretus deani (Black hagfish)	0	1	1	0	0	0	0	0
Gadus macrocephalus (Pacific Cod)	0	0	0	0	0	0	0	0
Glyptocephalus zachirus (Rex sole)	1	0	1	?	0	1	0	0
Hippoglossus stenolepis (Pacific halibut)	0	1	1	1	1	0	0	0
Hydrolagus colliei (Spotted ratfish)	1	1	1	1	1	1	1	1
Microstomas pacificus (Dover sole)	1	1	1	?	1	0	0	0
Ophiodon elongatus (Ling cod)	1	0	0	1	1	0	0	0
Raja binoculata (Big skate)	1	0	0	0	1	0	0	0
Raja rhina (Longnose skate)	1	1	0	0	1	0	0	0
Squalus acanthias (Spiny dogfish)	0	0	0	0	1	0	0	0

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Table 7

Other species of fish (non-rockfish) observed by site. **(continued)**

Species Name (common name)	*Goose Trough* *n = 4*	*South Morsby Gully* *n = 4*	*Mid-Moresby Trough* *n = 4*	*North Moresby Trough* *n = 2*	*Juan Perez Sound (Terminal Moraine)* *n = 2*	*Juan Perez Sound* *n = 8*	*Portland Inleta* *n = 2*	*Dundas Island* *n = 4*
Theragra chalcogramma (Walleye Pollock)	0	0	0	0	1	0	0	0
Family name (common name)	0	0	0	0	0	0	0	0
Family Agonidae (Poachers)	1	1	1	1	0	0	0	0
Family Cottidae (Sculpin)	0	0	1	1	1	0	0	0

Table 8

Species of echinoderms observed by site.

Scientific names (taxonomic class or species) are listed with common names in parentheses. In some cases, common names were not available. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of observation and was not counted in species total.

Class or species name (common name)	*Goose Trough* *n = 4*	*South Moresby Gully* *n = 4*	*Mid-Moresby Trough* *n = 4*	*North Moresby Trough* *n = 2*	*Juan Perez Sound (Terminal Moraine)* *n = 2*	*Juan Perez Sound* *n = 8*	*Portland Inleta* *n = 2*	*Dundas Island* *n = 4*
Crinoidea (sea lilies)	1	0	0	0	0	1	0	0
Florometra serratissima	1	0	0	0	0	1	0	0
Asteroidea (starfish or seastars)	1	1	1	0	1	1	1	1
Asterina miniata	0	0	?	0	0	0	0	1
Ceramaster patagonicus	0	0	0	0	1	1	0	0
Crossaster papposus	0	0	0	0	1	1	0	1
Henricia sp	1	0	0	0	0	1	0	1
Henricia leviuscula leviuscula	0	0	0	0	0	1	0	0
Hippasteria sp	0	0	0	0	0	1	0	1
Hippasteria spinosa	0	0	0	0	0	1#feed on Prim	0	0
Luidia foliolata	1	0	0	0	0	0	0	1
Mediaster aequalis	0	0	0	0	0	1	0	1
Orthasterias koehleri	0	0	0	0	1	1	0	1
Pteraster sp	1	0	0	0	0	1	0	0
Pteraster tesselatus	0	1	0	0	1	0	0	0
Pycnopodia helianthoides	0	0	0	0	1	0	0	1
Solaster sp	0	0	1	0	0	0	1	0
Solaster dawsoni	0	0	1	0	0	0	0	0
Ophiuroidea (brittle stars or basket stars)	1	1	1	1	1	1	1	0
Gorgonocephalus eucnemis	0	0	0	0	0	1	0	0
Ophiopholis aculeata	0	0	0	0	0	0	0	0
Ophiopholis bakeri	1	0	0	1	0	0	0	0
Ophiopholis longispina	0	1	0	0	0	0	0	0
Ophiura sarsi	1	0	1	0	1	?	0	0

[a] Extremely poor visibility

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Table 8

Species of echinoderms observed by site. **(continued)**

Class or species name (common name)	*Goose Trough* *n = 4*	*South Moresby Gully* *n = 4*	*Mid-Moresby Trough* *n = 4*	*North Moresby Trough* *n = 2*	*Juan Perez Sound (Terminal Moraine)* *n = 2*	*Juan Perez Sound* *n = 8*	*Portland Inleta* *n = 2*	*Dundas Island* *n = 4*
Ophiuroid sp 1	0	1	0	0	0	0	0	0
Ophiuroid sp 2	0	1	0	0	0	0	0	0
Echinoidea (sea urchins and sand dollars)	0	0	0	0	0	0	0	0
Allocentrus fragilis	0	0	0	0	0	0	0	0
Strongylocentrotus pallidus	0	0	0	0	0	0	0	0
Holothuroidea (sea cucumbers)	0	0	0	0	0	0	0	0
Parastichopus californicus	0	0	0	0	1	0	0	0
Parastichopus leukothele	0	0	0	0	0	1	0	1
Parastichopus sp	0	0	0	0	0	0	0	1

Table 9

Species of crustaceans observed by site.

Scientific names (taxonomic family or species) are listed with common names in parentheses. In some cases only broad taxonomic or common names for organism are listed. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of identification (c.f.).

	Goose Trough *n = 4*	*South Morsby Gully* *n = 4*	*Mid-Moresby Trough* *n = 4*	*North Moresby Trough* *n = 2*	*Juan Perez Sound (Terminal Moraine)* *n = 2*	*Juan Perez Sound* *n = 8*	*Portland Inleta* *n = 2*	*Dundas Island* *n = 4*
Crab								
Acantholithodes hispidus (spiny lithode crab)	1	0	0	0	0	1	0	0
Chorilia longipes (longhorn decorator crab)	0	0	0	1	0	1	0	0
Lithodidae (stone and king crabs)	0	0	0	0	0	1	0	0
Lithodes aequispinus (golden king crab)	0	1	0	0	0	0	0	0
Munida quadrispina (squat lobster)	1	1	0	0	0	0	0	1
Parapagurodes hartae (hermit crab)	0	0	0	0	0	1	0	0
hermit crabs	0	0	1	1	1	0	1	0
decorator crabs	0	0	0	1	0	0	0	0
Shrimp								0
Eualus sp	0	0	0	1	0	0	0	0
Heptacarpus kincaidi (Kincaid coastal shrimp)	0	0	0	0	0	1	0	0
Pandalus dispar	1	0	0	0	1	0	0	0
Pandalus platyceros (spot shrimp)	1	0	0	0	1	0	0	0
Pandalus sp	0	0	0	0	0	1	0	1
Miscellaneous								
Caprellidae (amphipods)	0	1	0	0	0	0	0	0
Copepods	0	1	1	1	0	0	0	0
Euphausiids (krill)	0	0	0	0	0	1	0	0
Isopods	1	0	0	1	0	0	0	0
Mysids	0	0	1	1	0	0	0	0

[a] Extremely poor visibility

Table 10

Species of brachiopods, mollusks, and miscellaneous taxa observed by site.

Scientific names (taxonomic class or species) are listed with common names in parentheses. Miscellaneous organisms are also listed as observed by site. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of observation and was not counted in species total.

	Goose Trough ***n = 4***	***South Morsby Gully*** ***n = 4***	***Mid-Moresby Trough*** ***n = 4***	***North Moresby Trough*** ***n = 2***	***Juan Perez Sound (Terminal Moraine)*** ***n = 2***	***Juan Perez Sound*** ***n = 8***	***Portland Inleta*** ***n = 2***	***Dundas Island*** ***n = 4***
Brachipods								
Laqueus californianus	0	0	1	1	1	1	0	0
Molluscs	1	1	1	0	0			
polyplacophoras (chitons)	0	1	0	0	0	0	0	0
gastropods (snails, clams, mussels)	1	0	0	0	0	1	0	0
Fusitriton oregonensis (hairy fusitron)	1	0	1	0	1	1b	0	1
Trochidae (top snails)	0	0	0	0	0	1	0	0
bivalve field	0	0	0	0	0	1	0	0
nudibranchs (sea slugs)	1	0	0	0	0	1c		
Aldisa tara (Tara's dorid)	0	0	0	0	0	?	0	0
Tochuina tetraquetra (orange peel nudibranch)	0	0	0	0	0	1	0	1
white nudibranch	0	0	0	0	0	1	0	0
cephalopods (squid and octopus)	1	0	0	1	1	1	0	0
Enetroctopus dofelini (Giant Pacific Octopus)	1	0	0	1	0	?	0	0
Rossia pacifica (Stubby squid)	1	0	0	0	1	1	0	0
small squid	0	0	0	0	0	1	0	0
Miscellaneous								
featherdusters	0	0	0	0	0	0	0	0
arrow worms	0	0	0	0	0	1	0	0
bryozoan	0	0	0	0	1	0	0	0
serpulids	1	0	0	1	0	1	0	0
polycheates	0	0	0	1	1	0	0	0

[a] Extremely poor visibility [b] Triton with eggs [c] nudibranch eggs collected

Table 11

Species of sponges observed by site.

Scientific names (taxonomic class or species) are listed with common names in parentheses. In some cases common names were not available. Where species or common name could not be found, a description of the sponge observed is used. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of identification.

Class or species name (common name) ***Sponges***	***Goose Trough*** ***n = 4***	***South Moresby Gully*** ***n = 4***	***Mid-Moresby Trough*** ***n = 4***	***North Moresby Trough*** ***n = 2***	***Juan Perez Sound (Terminal Moraine)*** ***n = 2***	***Juan Perez Sound*** ***n = 8***	***Portland Inleta*** ***n = 2***	***Dundas Island*** ***n = 4***
Hexactinellida (glass sponges)								
Acanthascus sp. (vase sponge)	?	?	0	0	0	0	0	0
Acanthacus (Rhabdocalyptus) dawsoni (sharp lipped boot sponge)	1	1	0	0	0	1	0	1
Acanthacus (Staurocalyptus) dowlingi	1	0	0	0	0	0	0	0
Aphrocallistes vastus (clay pipe cloud sponge)	1	0	0	0	0	0	0	0
Farrea beringiana (Berring lace sponge)	0	0	0	0	0	0	0	1
Farrea occa	0	0	0	0	0	0	1	0
cloud sponge	0	0	0	0	1	1	1	0
yellow cloud sponge	0	1	0	0	0	0	0	0
Demospongiae								
Clathria (Microciona) sp.	0	0	0	0	0	AQ collected	0	0
Plicatellopsis amphispicula	1	0	0	0	0	0	0	0
large brown sponge	0	0	0	0	0	0	1	0

Table 12

Non-coral Cnidarians and Ctenophores observed by site.

Scientific names (taxonomic class or species) are listed with common names in parentheses. The site names with the number (n) of dives by the submersible, *DeepWorker* for scientific purposes are noted. The number one (1) indicates the species was observed while a zero (0) indicates the species was not observed. A question mark (?) indicates uncertainty of observation.

	Goose Trough ***n = 4***	***South Moresby Gully*** ***n = 4***	***Mid-Moresby Trough*** ***n = 4***	***North Moresby Trough*** ***n = 2***	***Juan Perez Sound (Terminal Moraine)*** ***n = 2***	***Juan Perez Sound*** ***n = 8***	***Portland Inleta*** ***n = 2***	***Dundas Island*** ***n = 4***
Hydrozoa (hydroids, anemones and zoanthids)								
Hydroids	0	1	0	0	1	0	0	1
Anemones	0	1	0	1	1	1	1	1
Actinoscyphia sp (anemone)	0	1*	0	0	0	0	0	0
Cribrinopsis fernaldi (crimson anemone)	0	0	0	0	0	1	0	1
Epiactis prolifera (proliferating anemone)	0	0	0	0	0	1	0	0
Liponema brevicovis (pom-pom anemone)	0	1	0	0	0	0	0	1
Metridium farcimen js gigantium (giant plumose anenome)	0	0	0	1	1	1	0	1
burrowing anemones	0	0	0	0	0	0	1	0
snakelock anenome	0	0	0	0	0	1	0	0
little orange anemone	0	0	0	0	0	0	0	1
white anemone	0	1	0	0	0	0	0	0
Zoanthids	0	1	1	1	0	1	0	0
Epizoanthus sp	0	0	0	0	0	1	0	0
Scyphozoa (jelly fish)	0	1	1	1	0	1	0	0
Cyanea capillata (lionsmane jellyfish)	0	0	0	0	0	1	0	0
Periphylla periphylla (red jellyfish)	0	1	1	0	0	0	0	0
Ctenophores (comb jellies)	0	0	0	1	1	0	0	0

* extremely abundant, millions [a] Extremely poor visibility

Significance of Expedition

The Finding Coral Expedition is the first submersible survey in B.C. waters to specifically study deep sea corals. It is also the first time an ENGO has sponsored such an expedition in BC. The survey generated new information on the distribution, abundance, location, depth range and species association of deep sea corals in B.C., particularly *Primnoa pacifica*. The survey included previously unexplored regions in BC, and took in four distinct community assemblages. South Moresby Gully was of interest because brittlestars (*Ophiopholis spp.*) were sufficiently dense to carpet the bottom. The density of these suspension-feeding brittlestars would effectively prevent settlement and recruitment of other taxa.

Three of the eight localities contained significant numbers of large habitat-forming deep water corals, and all aggregations were composed almost entirely of *Primnoa pacifica*. The highest densities were observed off Crombie Point in Juan Perez Sound, with large aggregations at Dundas Island and Portland Inlet as well.

Observations

Anthropogenic Observations

- Evidence of disturbance by fishing gear was noted at four sites; the site showing the greatest degree of disturbance from fishing activity was Mid-Moresby Trough.

Habitat observations

- Evidence of bottom trawling and disturbance to habitat was documented. The most obvious impacts were recorded at Mid-Moresby Gully, a known trawling ground.
- The role of deep sea corals as habitat for rockfish and invertebrates was documented; our observations agree with prior reports from Alaska and elsewhere.

Survey operations

- Survey design needs to be formalized, sampling effort varied by site, too little quantitative data and too much ad hoc filming.

- *DeepWorkers* were a reliable tool for assessing deepwater sites for deep sea corals having several advantages over Remotely Operated Vehicles (ROVs). The most pronounced being the field of view afforded the pilot. The pilot has an unobstructed 360 x 180 degree view, the large field of view allows the pilot to make and respond to observations very quickly and explore a much larger area than could be directly observed with an ROV having a fixed field of view. The principle advantage of an ROV is the endurance and quantity of quantitative data that can be collected. The *DeepWorkers* were limited to two 4 hour dives per day while some ROVs can, with the appropriate support crew, work 24 hrs per day.

Further analysis of results

The video data and specimens collected during the expedition will be used to examine relationships between species and deep sea coral colonies, the potential effect of substrate type and oceanographic factors on distribution and occurrence of coral and other manuscripts The results will also be used to groundtruth and create distribution models for deep sea corals.

Recommendations for Future Research

- Identify areas in B.C. with the highest conservation value for deep sea corals— this work should include both analytical and field collection activities. Field work should employ a range of tools including submersibles like the DeepWorker, Aquarius or Delta, remotely operated vehicles including the ROPOS, phantom and Seamor ROVs, towed camera arrays, multibeam and sidescan sonar.
- Describe the ecosystem service provided by deep sea corals as both food for predators and as habitat for a host of invertebrate and fish species.
- Describe the habitat requirements of deep sea corals. This data could be used to inform future distributional modeling work and help refine sighting of future coral conservation areas.

Unidentified Sponge in
Portland Inlet

Acknowledgements

Our journey to the bottom of the sea was inspired by great explorers who have introduced us to the mysteries of the ocean and piqued our curiosity. From Jacques Cousteau to Sylvia Earle – thank you for taking us and the rest of the world beneath the surface and into the deep blue sea.

The Finding Coral Expedition could not have happened without the support of many people. Special thanks to the Gordon and Betty Moore Foundation, private donors, and every individual that helped fund this research trip. Without your support we never would have left the dock.

The team at Nuytco played a pivotal role in the Finding Coral Expedition. The wisdom and support from Dr. Phil Nuytten, Jeff Heaton, Mike Reay, and the rest of the crew helped us grasp the logistics involved in chartering a ship, renting subs, and exploring the deep sea.

The scientists who joined the expedition and those that helped us prepare the science strategy ensured that we were gathering data and information that would advance the effort to protect deep sea corals. Tavi and Mark, our videographers, worked long hours helping us share the stories about the deep sea across Canada and around the world. Thank you for lending us you time and energy.

Along the way we had support from staff at Fisheries and Oceans Canada who helped ensure that we had all the information and permits required to make this expedition happen. This trip would not have happened without their assistance.

The crew of the Cape Flattery, the team that put together our computer system, and many other people were instrumental in making this expedition success. I cannot name everyone but you know who you are. Thank you.

Finally, I would like to thank the team at Living Oceans Society. From the Board of Directors who encouraged us to go on this adventure to Dorthea, John, Mary, Geoff, Dorie, Karin, Carrie, James and others who stick handled every obstacle and challenge that came our way. We made it through with much laughter and a few tears. Thanks for all you do for the ocean.

Final thanks to Molly and Dexter Lash-Burrows. Thanks for sharing me with the deep sea. Next time I hope I can bring you with me.

Sincerely,

Jennifer Lash

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Appendix 1

DeepWorker Specifications

• OPERATING DEPTH	600 m (2,000 ft)
• AIR WEIGHT	4,000 lbs
• DIMENSIONS	Length 8 ft Width 5 ft Height 5 ft
• PILOT	One
• PASSENGERS	None
• LIFE SUPPORT	80 hours
• DIVE TIME	6 hours per charge Charge time approximately 6 hours for full charge
• TOTAL POWER CAPACITY	12 KW 2 x 120 V Battery Pods (240 V nominal) 12 VDC @ 500 watts, 24 VDC @ 500 watts
• VIEW PORT	24 inch diameter acrylic, serves as entry hatch
• THRUSTERS	2 x 1 HP Horizontal, 2 x 1 HP Ver-trans
• THRUSTER CONTROL	Foot Controllers

Pressure Hull

- 38 inch sphere attached to 24 inch dia. by 24 inch long cylinder.
  Manufactured of A516 grade 70 steel with 316 stainless steel hatch rings.
  Aluminum alloy hull.

Accessories

- Ritchey Fluxgate Compass
- Imagenex 881A DSP Sonar
- Imagenex Heading Sensor
- Five function manipulator
- Sample collection basket
- Newtcam HD Video System
- Nnovia 80 GB Hard Disc HD Video Recording System with event “Mark” feature and time code feature.
- Laser scaling device for measuring distance and camera aiming.
- 200 Watt HMI Lights x 2, 5600 deg. Color temperature.
- Underwater Telephone: Nuytcom DSP Digital 27 kHz
- On-Board Programmable Logic Controller (PLC) to provide auto depth and altitude functions

Aquarius submersible with *Deepworker 6* and *7* onboard the *R/V Cape Flattery*.

Appendix 2

Aquarius Manned Submersible

• DEPTH	1000 ft
• CREW	1 pilot, 2 observers
• LIFE SUPPORT	240 man hours 3 occupants x 80 hours each
• DIVE DURATION	6 – 8 hours
• WEIGHT	4.5 tons
• PROPULSION	2 horizontal thrusters 2 vertical thrusters.
• SPEED	2 – 3 knots
• SONAR	Imagenex 881A Scanning sonar
• BALLAST	700 cu. ft. of compressed air supplying 3 soft ballast tanks for surface or emergency buoyancy. Total lift 1,325 lbs.
• VIEWING	1 x 40" hemispherical viewing dome forward and 4 x 4 " I.D. view ports in conning tower
• CONTROL SYSTEM	On board PLC (Programmable Logic Controller) providing pilot interface with all on-board systems as well as linear/proportional thrust control with auto depth
• EMERGENCY SYSTEMS	Back-up power for communication systems and life support Manual override for PLC control system. 260 lb. jettisonable weight. Emergency air BIBS (Built in breathing system) connected to ballast air system. Lung powered CO_2 scrubber systems. Emergency strobe light. Emergency radio tracking beacon. VHF radio equipped with emergency distress beacon.

Accessories

- Ritchey Fluxgate Compass
- Multiple laser scaling lights
- Nuytco Newtcam HDV Video System
- 7 Function Hydraulic Manipulator System
- Suction Sampling System
- 27 kHz Nuytcom DSP Acoustic Telephone
- On-board programmable PLC
- Imagenex 881A Scanning Sonar
- 80–100 GB Nnovia Hard Disc video recording unit
- Nuytco Newtliteâ 200 watt (4 heads = 800 watts) and/or 600 watt (2 heads = 1200 watts) HMI lighting system (5600 deg. Color temperature)
- 5.0 mega pixel digital camera (external). Approx 400 frames per dive. Synchronized to 250 watt-second strobe with optional 2 x 80 watt-second slaves.

Optional Equipment

- DVL (Doppler Velocity Logger) recording depth, altitude, distance over ground, salinity, temperature, and bearing.
- Tether for real-time video feed to surface

Appendix 3

TrackLink 1500HA System Specifications

- POSITIONING ACCURACY 0.25 degree (better than 0.5% of slant range)
- SLANT RANGE ACCURACY 0.20 meter
- WORKING RANGE WITH SHIP NOISE
  Up to 1000 meters
- OPERATING BEAMWIDTH 120º to 150º
- TARGETS TRACKED Up to 16
- OPERATING FREQUENCY 31.0 to 43.2 kHz
- TRANSPONDER MAXIMUM DEPTH
  Up to 1500 m
- TRANSCEIVER MAXIMUM DEPTH
  Up to 20 m
- TRANSCEIVER DIMENSION 24 cm x 12.6 cm (diameter)
- TRANSCEIVER WEIGHT OUT OF WATER
  3.5 kg
- TRANSCEIVER WEIGHT IN WATER
  1.2 kg
- TRANSMIT MODE POWER CONSUMPTION
  10 Watts
- RECEIVER MODE POWER CONSUMPTION
  1.6 Watt
- OPERATING TEMPERATURE -2º to 45º C
- STORAGE TEMPERATURE -5º to 75º C
- RS-232 CONFIGURATION 9600 baud, 1 start bit, 1 stop bit, no parity bit, and no flow control
-
  Up to 19200 baud
  http://www.link-quest.com/html/1500ha_sys_spec.htm

Appendix 4

WinFrog Integrated Navigation Software

- Fugro Pelagos provides you with the latest cutting-edge technology in integrated navigation and data management system software.
- WinFrog is a complete Integrated Navigation System (INS). The core program provides you with real-time position and navigation information, and can simultaneously collect data from up to 25 types of devices, including other GPSs and sounders. It also allows you to define multiple vehicles, each having its own devices, names, offsets, tracks and shapes. Data output can be through industry standard NMEA or customized formats. WinFrog consists of several modules which allow the product to be customized to your needs.
  - Long Baseline Acoustic Module
  - GPS Calculations Module
  - Multi-Vehicle Positioning & Telemetry Module
  - Controlled Remote Tug Telemetry Module
  - Cable Management Module
  - Multibeam Module

WinFrog, the most advanced software available today, offers you:

- Multiple graphics windows
- Configurable text windows
- DGPS computations from pseudo-ranges
- Multiple instances of input and output devices
- DXF and comma-delimited data support
- Data sharing with Ethernet, built-in RF network and other Microsoft Windows® applications