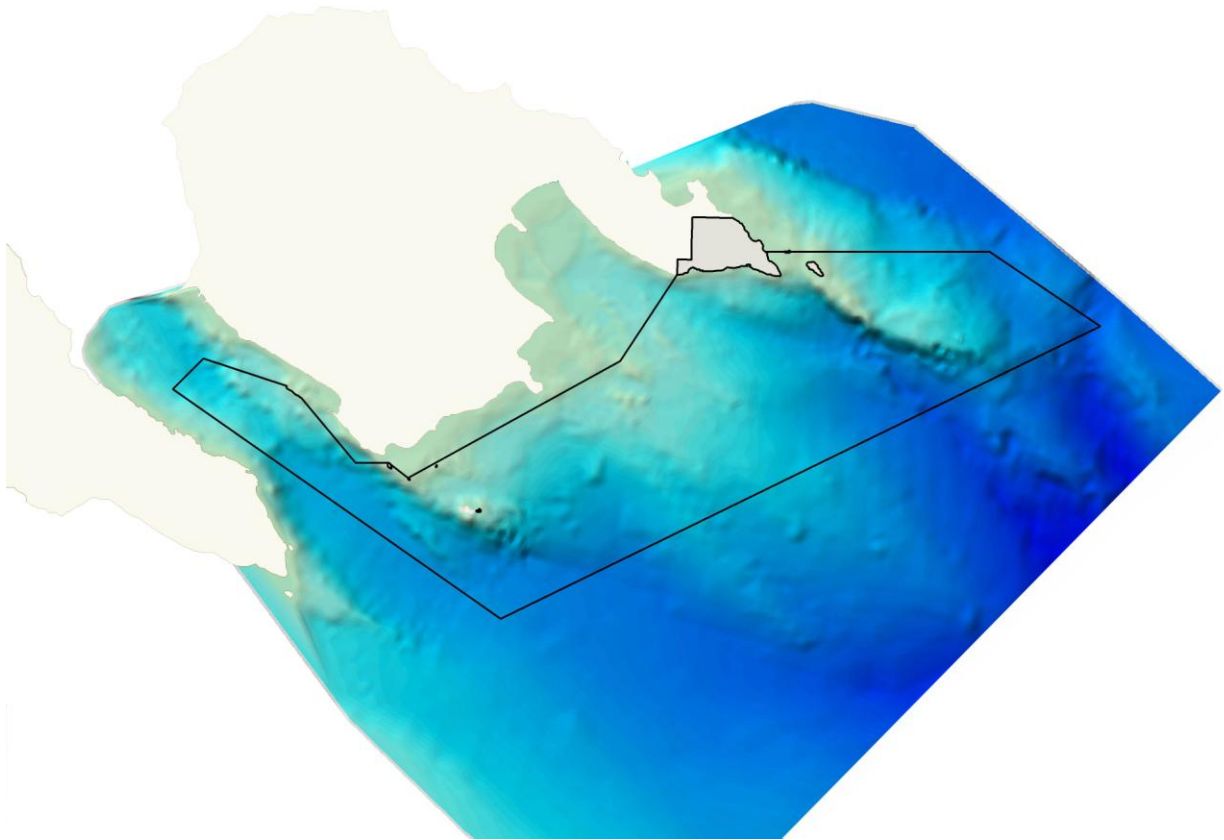


# HELLIWELL PROVINCIAL PARK SUBTIDAL ECOSYSTEM BASED PLANNING



Submitted to

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by

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# Helliwell Provincial Park Subtidal Ecosystem Based Planning

## 1 Introduction

This report is a companion to the report *Helliwell Provincial Park Ecosystem Planning Project* (Balke *et al.* March 2001) that provided the information necessary to produce an ecosystem based management plan for the terrestrial and intertidal portions of Helliwell Provincial Park. The focus of this report is to define and map the subtidal marine management zones based on an ecosystem approach and identify management actions and issues for each habitat. No new field work was done for this project however existing, previously unprocessed, data on marine substrate and depth were retrieved and incorporated into digital map layers for this project. Management issues specific to a subtidal management zone are discussed in the description of each zone. Most generic management issues including impacts of fishing and disturbance of marine wildlife, that could apply to all management zones, were reviewed in Balke *et al.* 2001 and are not reiterated here.

Section 2 below describes the mapping and classification of the subtidal portions of Helliwell Provincial Park at a map scale of 1:30,000. This map scale is dictated by the smallest scale of the resource layers used define management units, in this instance, depth. Maps of the marine habitat features and derived management zones are provided in Appendix B – Map Atlas and as ArcView shape files and JPEG and Adobe graphic files on the accompanying CD.

Section 4 of this report summarizes the main issues and management prescriptions for each of the identified subtidal management zones. The main management prescriptions include:

- ❑ Complete subtidal substrate surveys for the park area and re-survey steep slope areas.
- ❑ Incorporate eelgrass beds along SW Hornby Island into the park.
- ❑ Instigate a system of volunteer surveys for monitoring populations of reef fish and invertebrate.
- ❑ Undertake remote camera or submersible surveys of deep mobile sediment zones to determine the extent of benthic epifauna.
- ❑ Work with DFO to monitor and/or close fisheries within the park that impact on the benthic biota.
- ❑ Work with the local dive operators to develop a “Diving Code” within the park.
- ❑ Work with the Canadian Coast Guard to prohibit anchoring in sensitive high diversity habitats and place mooring buoys in strategic locations as an alternative to anchoring.

## 2 Mapping of Marine Habitats Features of Helliwell Provincial Park

While terrestrial ecosystem mapping has recently been standardized in BC (TEM mapping) there are no such standards currently existing for the subtidal marine habitats. A RIC discussion paper on mapping and classification of subtidal marine habitats recommended that at a minimum a subtidal mapping system should incorporate depth, substrate/sediment, bottom complexity/slope, energy (wind and tidal generated currents), estuarine processes and water quality (Booth *et al.* 1995). Water quality information is not currently available for Helliwell Provincial Park, however it is unlikely that large horizontal variations in water quality parameters (temperature, salinity, turbidity) are present. Estuarine processes, other than the large-scale seasonal freshwater discharge associated with the Fraser River, are not a factor within the park boundaries. It was also recommended that “structural” biota, that itself can form a habitat for other organisms, should be included in a subtidal classification system (*ibid.*). Such structural biota includes canopy kelp beds, eelgrass meadows and biological reefs (coral, sponges). Biological data can also be used to validate the classification system.

The development of a management classification system is also somewhat dependent on the available data. Information available for classification, mapping and verification of subtidal habitats in the Helliwell Park area included bathymetry, marine substrates, and eelgrass beds. Three data layers were derived from the bathymetry data: depth class, slope class and a measure of sea bed topographic complexity. In addition there was some information on tidal currents from CHS charts and the presence of “waves” or bedforms in deeper regions with sandy-Gravel substrate. The influence of wind and wave generated currents on the benthos were taken to be a function of bottom depth. Canopy kelp beds were identified as a habitat feature but not were included as a habitat feature as they no longer occur in the area encompassed by Helliwell Provincial Park.

Each of the data layers representing marine habitat features has inherent strengths and weaknesses that need to be considered when combining them to obtain management zones for the park. Each marine feature data layer is discussed separately below.

### 2.1 Bathymetry

The bathymetry for Helliwell Park was digitized as spot depth from four CHS field sheets (Table 1). A total of 4185 points were digitized from the relevant portions of the four field sheets.

**Table 1: Canadian Hydrographic Service field sheets used to map spot depths for subtidal regions of Helliwell Provincial Park.**

Sheet number	Year surveyed	Location
2281 L	1969	Sangster Island to Hornby Island
2283 L	1970	Sisters Islets to Texada Island
1125 L	1971	Baynes Sound and Lambert Channel
1122 L	1971	Hornby Island to Little River

All soundings on the field sheets were in fathoms (feet and fathoms under 15 fathoms depth). These were converted to meters for this project. The field sheets were all georeferenced using a UTM projection (Zone 10) and the NAD 27 datum (ellipsoid measure). The map scale for all

field sheets was 1:30,000. The shoreline on these field sheets was taken from aerial photography and the sounding positions were referenced by mini-fix using the hyperbolic or range-and-bearing mode from surveyed monuments. The spacing of spot depth varied from 200 m in offshore areas to about 50 m in nearshore areas and around Flora Islets. At a map scale of 1:30,000, 1 mm on the map is equivalent to 30 m in the real world. The horizontal accuracy of the of spot depth points is therefore expected to be around 30 m and the accuracy of the extrapolated depth polygons in the range of 30 to 100 m.

When digitizing the spot depths it was noted that some inconsistencies were observed in areas where field sheets overlapped. In such a case the points were dropped if they occurred on a field sheet edge (while the retained points were nearer the centre of the other field sheet). Data collected from more densely spaced points were retained over points that were collected with a wider spacing. This “weeding” of points was done to ensure that complexity of bottom topography was not inferred where it did not definitely exist. From the field sheet spot data three derived map layers were created. These are described below.

### 2.1.1 Depth Classes

Polygons of bottom depth were interpolated by contouring the spot depth points to achieve prescribed intervals of depth (Table 2; Map 1). The subtidal intervals were selected from what is known of the depth distribution of marine plant and animals in the park. These are primarily influenced by available light and currents.

**Table 2: Depth classes used to define subtidal marine habitats.**

Depth Class	Depth Range (m)	Light	Dominant Energy
1	0 (Drying banks)	High	Waves
2	0-10	High	Waves
3	10-20	Moderate	Waves and Tidal Currents
4	20-50	Low	Tidal Currents
5	<50	Virtually absent	Tidal Currents

### 2.1.2 Slope Classes

A number of marine species occurring in the marine waters of Helliwell Provincial Park are known to prefer habitats near or on steep slopes. These include a range of fish and invertebrate species, notable examples being Cloud and Chimney sponges, Six-gilled sharks, Crimson anemones and several rockfish species (see Appendix A “Marine Species of Helliwell Provincial Park Associated with Vertical Habitats”). The slope of the bottom was calculated from a TIN created from the spot depths. From this, four classes of slope were identified (Table 3; Map 2).

**Table 3: Slope classes used to define subtidal marine habitats.**

Slope (degrees)	Description
0-10	Flat
10-20	Gentle slope
20-40	Steep slope
>40	Cliffs (Vertical)

### 2.1.3 Topographic Complexity of the Sea Floor

It was felt that topographically complex habitats would offer more niches for organisms and as such could host greater species and community diversity, and perhaps resilience, than less complex habitats. It is also speculated that in areas of higher wave energy, the protection afforded in regions of greater complexity may confer sufficient advantage to allow marine plants and invertebrates to resist displacement by storms.

The measure used to indicate bottom complexity was an exaggerated slope of slope or second derivative function of depth over a given unit of area. The method used to indicate the physical complexity of the sea bed follows that of Ardron *et al.* (2001). This method was developed for a large area at a smaller scale, however by adapting the grid size and radius for calculating density the method can be equally well applied to a small area at a larger scale.

The TIN of the spot depths taken from the CHS field sheets was converted to a 10 m grid and exaggerated by a factor of 20 times. The slope of slope of exaggerated depth was divided into 5 equal interval classes. The lowest 3 classes were set to a null value while the top 2 classes were assigned a weighting value of 1 or 2, with 2 representing the highest value. The grid cells were then converted to points, and a kernel density function was used to create a grid of areas of high complexity. A 300 m outer radius was used to calculate density. The densities were calculated as the weighted number of points per km<sup>2</sup> and then normalized to values of 1 to 100. Areas were then assigned to one of 6 complexity classes based on the normalized complexity value (Map 3).

**Table 4: Classes used for topographic complexity of the sea bed**

Class	Normalized Complexity Value	Topographic Complexity
0	0	None
1	1-25	Very Low
2	26-50	Low
3	51-75	Moderate
4	76-90	High
5	90-100	Very High

## 2.2 Marine Substrate

Marine Substrate was mapped from a side-scan sonar survey completed in 1997. The survey covered approximately 70 km<sup>2</sup> of seabed including most, but not all, of the marine portion of Helliwell Park. Almost 45 km<sup>2</sup> of the area mapped for marine substrate lay outside the park boundaries to the south and southeast. Most nearshore areas, the region north of Ford Cove in Lambert Channel and the region northeast of Flora Islet, were not surveyed. The analog sonograms from the survey were plotted by Coastal and Ocean Resources Inc (CORI) at a scale of 1:5000. CORI identified and mapped eight substrate types and three bedform modifiers. These are listed in descending order of mobility in Table 5 below. Substrate polygons were digitized by Jacqueline Booth and Associates and imported into ArcView for analysis (Map 4). A total 161 separate polygons were mapped with the smallest polygon of 470 m<sup>2</sup> and the largest 15.1 km<sup>2</sup>. Area statistics were calculated both for all areas covered by the sidescan sonar survey and for just those areas surveyed that fall within the park boundaries (Table 5).

**Table 5: Summary of side-scan sonar substrate classification for subtidal areas surveyed in the region of Helliwell Provincial Park**

Substrate	Description	all areas mapped			areas within park	
		# polygons	Area (km <sup>2</sup> )	% Area	Area (km <sup>2</sup> )	% Area
Bedrock	Bedrock; may contain intermittent veneer of gravel or sand	25	3.0	4%	2.1	8.3%
sandy Gravel	>50% Gravel with sand; gravel may include pebbles, cobbles, boulders	27	10.0	14%	5.5	21.6%
gravelly Sand	>50% sand with gravel (pebble, cobble, boulder)	66	19.0	27%	6.2	24.3%
Sand	>90% sand; likely some gravel and mud pockets	21	22.8	32%	9.6	37.8%
muddy Sand	>50% sand with some mud; no large pockets of gravel	3	0.05	0%	0.05	1.2%
gravelly sandy Mud	mostly Mud (>50%) with some sand and some gravel	5	0.7	1%	0.6	2.24%
fine Sand/Mud	a mixture of sand and mud	4	14.2	20%	0.4	1.4%
sandy Mud	>50% Mud with sand; little gravel	10	0.5	1%	0.5	1.9%
<b>TOTALS:</b>		<b>161</b>	<b>70.3</b>	<b>100%</b>	<b>25.5</b>	<b>100%</b>

It was discovered that in many instances mobile sediments were mapped in areas of steep slope. After discussions with Brian Bornhold of CORI, it was decided that this error is caused by the difficulty in interpreting side-scan sonar in the areas of high slope when depth is not collected concurrently. As there was no systematic way to correct the sediment classification map it was left as provided by CORI. However, sediments in areas of steep slope were not used in the delineation of management zones.

### 2.2.1 Substrate Classes

The substrate and its overlying sediments shape marine benthic habitats and are a significant factor in determining the species present. The substrates that were identified and mapped by CORI were divided into three classes based on the mobility of the substrate.

#### 2.2.1.1 Immobile Substrates

Bedrock and boulder/cobble substrates provide a fixed, stable surface that supports epibenthos. The more or less permanent nature of these immobile substrates supports long-lived epibenthic species such as the cloud and boot sponges which themselves provide a habitat for small fish and invertebrates. In the shallower, photic depths, algal growth is richest on these hard substrates and adds to the physical complexity of the habitat.

#### 2.2.1.2 Mobile Substrates Primarily Composed of Sand and/or Gravel

Habitats with sand and/or gravel substrates tend to be dominated by infauna although some epifaunal species may be present as well as bottom dwelling fish and invertebrates. At all depths within the park the mobile sand and sandy-gravel substrates are most likely colonized by small crustaceans, polychaetes and molluscs which are adapted to the changing hydrography and substratum; they are able to reburrow rapidly following being washed-out of the sediment during storms (Vanosmael *et al.* 1982). For example, the worms such as the polychaete *Nephtys* and

nemertean *Cerebratulus*, are adapted to burrowing in mobile sands and are typical members of the community in these habitats. These communities are probably shaped by more by the physical environment rather than by biological forces such as competition and predation. The density of individuals and species richness is often highest in the coarsest grades of mobile sediments, mainly due to large numbers of interstitial polychaetes (Vanosmael *et al.* 1982). Due to the continual sediment disturbance by wind and wave generated currents in shallower regions (<20 m), the community may have a large opportunistic component with species such as the polychaete *Chaetozone* and may be prevented from reaching a climax community.

#### 2.2.1.3 Mobile Substrates Primarily Composed of Mud

Sediments that include mud are rare within the park boundaries. Two large areas of fine sand and mud are located to the south of the park boundary in water depths of over 100 metres. Only small portions of these very soft sediments are located within the park boundaries, primarily at depths of greater than 50 meters. These are likely low currents areas where suspended sediment deposition dominates. Diversity of benthic infauna is expected to be lower in these areas than in the Sand/Gravel substrates.

### **2.3 Currents and Waves**

The main sources of abiotic disturbance in the region are wave-generated turbulence, and currents generated by tides, winds or waves. Very large storm waves can affect the seabed at maximum depths of about 30-40 m, with increased current velocities at 60-70 m (Hall 1994), perhaps even deeper. On a provincial scale the Strait of Georgia is considered to have low to moderate wave exposure. Storms with winds of 35 knots will cause wave-induced currents of greater than 0.5 m/s (current threshold velocity of sand) only in waters less than 20 m (CORI 2001). Species living in these depths are typically adapted to resisting these events or recovering quickly. Wave energy was therefore not considered to be a separate variable in the classification of the subtidal ecosystem but was taken into account by the inclusion of depth as a factor (see section 2.1.1).

Nearshore tidal currents can resuspend and remove all but the largest sediment particles, leaving bottoms of boulders, cobbles, or pebbles. In deeper waters offshore, currents are rarely strong enough to remove even fine, silt-sized particles. Two areas of higher tidal currents are indicated on CHS chart 3527 for two portions of the park: Lambert Channel, and the waters to the west of Flora Islet. The presence of bedforms on sandy-gravel substrates in two areas, south of Chrome Island (35m – 65m depth) and south of Flora Islet (50m - 125m depth), possibly indicate the presence of these tidal currents. In general however, CHS has not recorded strong tidal currents in the region and they were therefore not included as a factor in classification of the subtidal regions of the park.

### **2.4 Eelgrass**

The predominant eelgrass species in the Hornby Island area is *Zostera marina*, although the exotic species *Z. japonica* is becoming more common in the Strait of Georgia. Eelgrass beds were mapped from anecdotal information provided by Amanda Heath of Hornby Island Diving.

The only beds in the vicinity of Helliwell Park are located along the southeast shore of Hornby Island in the area of Ford Cove (Map 5). The beds do not lie within the Park boundary but are in the region between the park boundary and the shore. Both areas of possible and known eelgrass beds were included. As the beds were mapped from anecdotal information, the 10 m depth contour was used to delineate the seaward boundary of the beds. Sediments were not mapped for this region however it is known that preferred habitat is sandy to muddy substrata and sheltered environments, such as enclosed bays or coastal areas with a gentle longshore current and tidal flux.

## **2.5 Canopy Kelp beds**

Canopy kelp beds are an important habitat and food source for many marine organisms. The Hornby Island area does not support the giant kelp, *Macrocystis integrifolia*, which is limited to areas where there is little variation in seasonal water temperature and salinity, or areas where the low salinity periods coincide with low water temperatures (Druehl 1978). The bull kelp, *Nereocystis luetkeana*, has been reported from the region of the park but is reported to have disappeared in the late 1990s (Amanda Heath, Hornby Island Diving, pers. comm.). Canopy kelp beds are not indicated on the nautical charts for the region but smaller beds were often not mapped.

The reason(s) for the disappearance of bull kelp in the Helliwell area has not been documented. Kelp forests are dynamic ecosystems, vulnerable to natural fluctuations caused by the varying abundance of associated species, storms, and oceanographic conditions like El Niño events (Tegner *et al.* 1997). Bull kelp is an annual species that recruits opportunistically to disturbed areas. Recruitment occurs primarily during the spring and mortality of new recruits is very high (Foreman 1984). This annual cycle tends to result in pronounced seasonal changes in bed density and biomass which increases during the summer until autumn storms remove entire plants and eventually the entire bull kelp bed. The growth of the kelp canopy is influenced by both the upper surface water temperature (Tegner 1996) and the availability of nutrients, particularly nitrate. Off the California coast, a substantial drop in kelp abundance and number of stipes has been confirmed and linked to warming since 1990 (Smith and Kaufmann 1999). In British Columbia the kelp biomass in Johnstone Straits decreased in 1981 when water temperatures and salinity returned to normal after 6 years of below normal values (Foreman 1984). While *Nereocystis* can tolerate a wide variety of temperatures, it can be limited to the availability of inorganic nitrogen (Foreman 1984), which in turn is influenced by temperature. Sea urchin predation has also been linked to disappearance of canopy kelp beds (Mann and Breen 1972).

### 3 Derivation of Ecosystem Based Subtidal Management Zones

Once all subtidal habitat features were mapped, they were overlaid and combined to form polygons with attributes for each habitat feature. Subtidal management zones were then derived on an ecosystem basis. Areas with similar physical processes, species communities and potential impacts from anthropogenic sources were combined. The nearshore areas adjacent to the park were included in this analysis because of their potential importance as a source of recruitment to offshore populations. The system used to derive management zones was hierarchical with features analysed in the following order:

1. Eelgrass beds (present only outside park boundary)
2. Slope (high slopes of >20 degrees)
3. Physical complexity of the sea bottom (areas of highest complexity)
4. Depth (0-10m, 10-20m, 20-50m >50m)
5. Substrate (rock, sand/gravel, mud)

A total of 12 ecosystem based management units were derived based on these features (Table 6; Map 6). By far the largest area of the subtidal regions of the park is classified as Zone SGD – flat, deep areas (>20 m) with sand and/or gravel bottom sediments. The smallest area is that where the eelgrass beds are located (Zone E). The areas of low slope and physical complexity of the bottom where substrate was not surveyed (Zones UvD, UD, US, UP), should be incorporated into one of the other subtidal management zones once the substrates have been mapped.

**Table 6: Classification of subtidal management zones for Helliwell Provincial Park.**

Eelgrass	Slope	Bottom complexity	Depth	Substrate(s)	Zone	Area (Ha)
Present	n/a	n/a	<10	n/a	E	10.67
Absent	>20°	n/a	n/a	n/a	RHD	106.75
	n/a	high	n/a	n/a		
	<20°	low	>20	Rock	RD	114.75
			10-20		RS	96.94
			<10		RP	53.69
			>20	sandy-Gravel, gravelly-Sand Sand, muddy-Sand	SGD	1993.62
			≤20	sandy-Gravel, gravelly-Sand Sand, muddy-Sand	SGS	340.77
			>20	gravelly-sandy-Mud, sandy-Mud	MD	141.49
			>50	Unknown	UvD	207.79
			20-50		UD	171.45
			10-20		US	65.13
≤10	UP	379.31				

The acronym for each zone is based on the substrate (R–rock, SG-sand/gravel, M-mud, U-unknown) and depth (vD-very deep >50m, D-deep >20 m, S-shallow 10-20 m, P-photic <10 m). In addition there are two special zones; “Zone E” named for Eelgrass and “Zone RHD” named for Rocky with assumed High (biological) Diversity. The ecological importance and potential anthropogenic disturbances for each of these zones is discussed below.

### 3.1 Zone E – Eelgrass beds

Both *Z. marina* and *Z. japonica* are perennial species. The depth to which eelgrass will grow depends on the available light. Increases in turbidity are a commonly cited factor in the decline of eelgrass beds, particularly those of *Z. marina* (e.g. Giesen *et al.* 1990a, b). While high nutrient levels may stimulate growth of eelgrass it can also limit their growth if they lead to high levels of phytoplankton which will limit the available light. Under typical conditions in the Straits of Georgia *Zostera* will grow from the lower intertidal to a depth of 4 m.

Eelgrass meadows are considered to be the most productive of shallow, sedimentary environments. Eelgrass primary production supports a rich, resident fauna and as a result, the beds are used as refuge and nursery areas by many species, including commercial fish species. A list of species recorded from the eelgrass beds along the southwest coast of Hornby Island is presented in Table 7.

**Table 7: Species recorded from eelgrass beds along the SW shore of Hornby Island**

Species Group	Common Name	Latin Name
Bivalve	Horse clam, gaper clam	<i>Tresus sp.</i>
	Nuttall's cockle	<i>Clinocardium nuttallii</i>
Snail	Lewis's moonshell	<i>Euspira lewisii (Polinices lewisii)</i>
Nudibranch	Giant nudibranch, spanish dancer	<i>Dendronotus iris</i>
	Hooded nudibranch	<i>Melibe leonina</i>
Sea cucumber	California sea cucumber	<i>Paraschichopus californicus</i>
Sea Star	Short-spined pisaster	<i>Pisaster brevispinus</i>
	Sunflower star	<i>Pycnopodia helianthoides</i>
Shrimp	Coonstripe shrimp, dock shrimp	<i>Pandalus danae</i>
	Stiletto shrimp	<i>Heptacarpus stylus</i>
Crab	Graceful decorator crab	<i>Oregonia gracilis</i>
	Graceful kelp crab	<i>Pugettia gracilis</i>
	Longhorn decorator crab	<i>Chorilia longipes</i>
	Northern kelp crab	<i>Pugettia producta</i>
	Red rock crab	<i>Cancer productus</i>
	Bering hermit	<i>Pagurus beringanus</i>
Fish	C-O Sole	<i>Pleuronichthys coenosus</i>
	Pacific spiny lump sucker	<i>Eumicrotremus orbis</i>
	Pile perch	<i>Rhacochilus vacca</i>
	Sailfin sculpin	<i>Nautichthys oculo-fasciatus</i>
	Shiner perch	<i>Cymatogaster aggregata</i>
	Speckled sanddab	<i>Citharichthys stigmaeus</i>
	Striped seaperch	<i>Ebmiotoca lateralis</i>
	Tube snout	<i>Aulorhynchus flavidus</i>

Dense meadows of eelgrass results in increase rates of sedimentation, and the rhizome and root networks bind the substratum together, thereby reducing sediment erosion. The roots also allow oxygen to penetrate into otherwise impermeable sediments. The penetration of *Zostera* roots into

the sediment aerates the upper layers and provides a more favourable habitat for burrowing animals. The plants also contribute to a detrital pathway that is important in transferring the primary production of the meadow to higher trophic levels. The physical structure afforded by the plants also provides a refuge from predation for juvenile stages of commercially important species.

Given the contribution of eelgrass meadows to fisheries production and the maintenance of water quality in coastal waters, management policies should be established to protect and restore them. While the Federal fish habitat protection policies are intended to produce no net loss of productive habitats (including eelgrass meadows) in Canadian waters, it would be advantageous if the marine boundaries of Helliwell Provincial Park could be extended to include these beds. A shellfish lease and the marina at Ford Cove could both potentially impact these eelgrass beds that are undoubtedly important to recruitment and productivity of the existing marine park. Ford Cove is in close enough proximity to the eelgrass beds that sedimentation from dredging of this harbour could impact on the park. Disposal of dredged material is also a potential impact. Dredging activity requires a permit which can be denied if the impacts are considered unacceptable.

As the present eelgrass beds have only been mapped from anecdotal information, a more detailed survey of these beds is recommended. This survey should be done using GPS technology to map the exact extent of the beds combined with quadrat studies to determine the density (health) of the beds.

### **3.2 Zone RHD – Areas with steep slopes or a topographically complex sea bed**

Analysis of the map of areas of Zone RHD which are characterized by having steep slopes or a topographic complex sea bed indicated a strong correlation with identified dive areas. These areas typically have a greater number of niches for macro epibenthos which in turn attracts a higher density and diversity of fish species. Similarly the steep rock walls south of Flora Islet, south of Norris Rocks and near Toby Islet/Heron Rocks are all reported to support a rich fish and epibenthic macro-invertebrate fauna (Balke *et al.* 2001). The Flora Islet and Norris Rocks areas are areas where six-gilled sharks have been reported and delicate cloud and chimney sponges are found on the wall at Flora Islet (*ibid.*). The rich marine life supported by these habitats also attracts divers and commercial and sport fishermen. It is recommended that these areas be given special consideration with respect to the following potential anthropogenic impacts.

#### *1. Physical damage to delicate macro-invertebrates by fishing gear*

These areas tend to be avoided by trawl gear as it tends to “hang up” on the rough bottoms. Prawn fishermen are known to try to place their traps as close as possible to the rock wall at Flora Islet (Amanda Heath, pers. comm., 2000). Divers have reported seeing some damage to sessile invertebrates such as cloud sponges, probably caused by this practice (*ibid.*). DFO should be asked to place buffers around these zones to protect these fragile epifauna.

#### *2. Physical damage to delicate macro-invertebrates by anchoring*

These areas tend to support an abundant and diverse fish population including highly prized sport fish such as lingcod and rockfish. The abundant fish and epibenthic invertebrate life also attracts divers to these areas. Both user groups often anchor their boats in close proximity to these sites while fishing or diving. There is a potential for damaging the more

delicate sessile invertebrate fauna every time an anchor is dropped. An alternative would be to place mooring buoys in strategic locations and prohibit anchoring in these regions. The mooring buoys should be placed with the assistance of divers in order to avoid physical damage to the benthos.

3. *Physical damage to delicate macro-invertebrates by divers*

Divers can cause damage to delicate epibenthic macro-invertebrates intentionally or unintentionally. The local dive operator, Hornby Island Diving, works with clients to minimize these impacts however dive areas should be monitored to ensure that non-supervised divers are not impacting on the biota.

A volunteer based benthic monitoring program such as the DFO “Reefkeepers” or the Reef Environmental Education Foundation projects the “REEF Fish Survey Project” and “Living REEF Project” should be supported in representative sections of this zone to monitor changes in the biota. Web links to these two programs are provided below. Deeper areas (>20 m) should be surveyed using remote cameras or submersibles. Any future deployment of submersibles in this region should incorporate baseline reconnaissance of the biota in all areas that they intend to operate.

"Reefkeepers' Guide For Monitoring Subtidal Habitats of Canada's Pacific Waters":  
<http://www.pac.dfo-mpo.gc.ca/sci/protocol/reefkeepers/Objectives/default.htm>

“REEF Fish Survey Project” and “Living REEF Project”:  
<http://www.reef.org/data/surveyproject.htm>

### **3.3 Zone RD – Topographically simple, low slope areas with rocky substrates and waters depths of greater than 20 m**

These deep rock areas are below the photic zone but likely support a community of benthic epifauna and fishes similar but perhaps less diverse than that of the more topographically complex benthic habitats in Zone RHD. These areas are outside of the range of severe wind or wave-generated currents but would still have enough water flow to keep sediments from depositing and supply filter-feeding benthos with sufficient food. Anthropogenic disturbances to these habitats are similar to those of Zone RHD habitats although the impacts are possible less, due to lower diversity and abundance of organisms. In general, rock bottom habitats are not extensive within the park boundaries<sup>1</sup> and tend to border the Zone RHD habitats. It is recommended that these areas be managed as a buffer zone around Zone RHD habitats. Areas in this zone are best surveyed using remote cameras, as the depths would require decompression diving by divers.

### **3.4 Zone RS – Topographically simple, low slope areas with rocky substrates and waters depths of 10 – 20 m**

These hard, immobile substrate habitats are in the lower reaches of the photic zone but are still able to support red algal species or the deeper growing brown algae such as *Agarum fimriatum*.

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<sup>1</sup> The total of class RD, RS and RP habitats in the park and adjacent coastal areas is 265.38 Ha or 7.2% of the area.

These depths are below the foraging ability of marine bird species and are never exposed at low tide. As with the deeper, non-photic Zone RD habitats it is recommended that these areas be maintained as a buffer around the Zone RHD habitats.

### **3.5 Zone RP – Topographically simple, low slope areas with rocky substrates and waters depths of less than 10 m**

These flat rock areas are rich in marine algae and in the shallower depths (<4 m) are the prime feeding grounds and low tide loafing areas for Harlequin ducks. Seals and sea lions also haul out in on exposed portions of these areas at low tide. Areas of this zone are located along the shoreline of the terrestrial portions of the park on St. John Point and surround the exposed reefs at Flora Islet, Norris Rocks and Nash Bank. Disturbance to marine birds and mammals is the main management issue in these areas. These regions are not typically fished by trawl or dredge. Dive fisheries for urchins, sea cucumber, abalone and rock scallop occurred here at one time but are no longer active. Abalone fisheries are closed coastwide in BC.

### **3.6 Zone SGD – Topographically simple, low slope areas with sand and/or gravel bottom sediments and waters depths of greater than 20 m**

In the deeper areas (>30 m) with mobile sediment, epibenthic species such the sea pen *Ptilosarcus gurneyi* may extend several feet above the sediment interface; a bulbous foot buried in the substrate holds the stalk in place and if disturbed the sea pens can retract into the substrate. Sea pens are not immune to disturbance however; whole animals and detached plumes of *Ptilosarcus* have been recorded as a trawl bycatch (SCMAIT 1998). Like wise, tube dwelling anemones that have a similar ability to retract below the substrate surface still may be impacted by bottom trawl gear. Sea whips (*Balticina septentrionalis*) grow very slowly but are long lived and they can reach 4 feet or more in height and cannot retract into the sediment. Epibenthic species such as sea whips and sea pens provide shelter for young fishes and other more mobile invertebrates such as nudibranchs; removing these sessile epibenthic species can therefore affect other mobile species that might not be directly impacted by physical impacts.

Local dive operator, Hornby Island Diving, reported sea whips as an uncommon species in the Helliwell Park area. The only recorded sightings in the Helliwell region were at depths of 100 feet (~30 m) the area of Barney's Reef in Lambert Channel (Balke *et al.* 2001). In contrast, recent towed video surveys of the seabed near Parksville showed high densities of sea whips in 20-40m water depths associated with sand bottoms (CORI 2001). As divers do not typically frequent these types of habitats, it is possible that extensive sea whip beds could have been overlooked in the Helliwell Park region. It is recommended that a remote camera be used to survey these Zone SGD habitats in the subtidal regions of Helliwell Provincial Park. If extensive beds of epibenthic macro-invertebrates such as sea pens or sea whips are found to be present, it is recommended that the local trawl fisheries for pink scallops<sup>2</sup>, shrimp and cod be monitored for bycatch. The shrimp trawl fishery does not appear to have significant amounts of bycatch of benthic invertebrates (Hay *et al.* 1999) however it is possible that species such as sea pens or sea whips may be damaged but still not show up in the trawl. If extensive epifaunal invertebrate beds

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<sup>2</sup> Note that the management plan has suspended scallop trawl fisheries for the current year pending better stock assessment (DFO 2001 Pink and Spiny Scallop Dive Fishery management Plan)

are observed within this zone, it is recommended that DFO be requested to close the sensitive areas to trawl fisheries or require a modification of fishing methods to keep gear off the bottom.

### **3.7 Zone SGS – Topographically simple, low slope areas with sand and/or gravel bottom sediments and waters depths of less than 20 m**

In the shallower areas (<20 m) of Tribune Bay and along Norman Point in areas of sand, gravelly-sand and sandy-gravel, there is a geoduck/horse clam population that supports an active fishery<sup>3</sup>. Geoducks have been harvested in DFO statistical Area 14 (Hornby Island to Comox Area) since 1976. Geoducks may occur at depths of up to 110 m (Hand 1998) however harvesting only occurs in depths of up to about 20 m. The 2001-2002 quota for the coastal areas of all of Hornby Island is 52,000 lb. Incidental mortality of juvenile geoducks is a concern in the fishery. Other ecological impacts are thought to be minor (Washington State 2000, Breen and Shields 1983) however there is considerable disruption of the top 2-3 feet of sediment. BC Parks could approach DFO and request that the small area of active geoduck fishing within the park be closed to geoduck fishing as a precautionary measure.

### **3.8 Zone MD – Topographically simple, low slope areas with bottom sediments dominated by mud and waters depths of greater than 20 m**

These deep, soft sediment habitats tend to be the least diverse of all habitats in the subtidal regions of Helliwell Provincial Park. Benthic epifaunal and infaunal communities are dominated by species such as sea cucumbers, clams, heart urchins, polychaetes and brittle stars in 50-300 m depths in the Strait of Georgia (Lambert 1994). Ellis (1970) identified a complex of *Amphiura* (brittle star) and *Maldane-Ophiura* (polychaete-brittle star) communities as dominating the level-bottom plains occupying extensive areas of fine grained sediment through the trough of the Strait of Georgia at depths below 50 m (164 ft). Deepwater mud substrates generally supported low abundance/low diversity assemblages of epibenthic marine life. Those species which have been recorded from this habitat are listed below in Table 8. The commercial shrimp trawl does operate within this zone. Disturbance of bottom fauna should be monitored via baseline surveys of the biota and monitoring of bycatch.

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<sup>3</sup> It should be noted that the areas mapped from anecdotal interviews of local residents and fishery officers for this fishery in Balke *et al.* (2001) should be adjusted to reflect the known depth and substrate preferences of these species.

**Table 8: Mobile macro-fauna recorded from depths of > 50 m on mud substrates in Helliwell Provincial Park.**

Group	Common Name	Latin Name	Abundance Notes
Cephalopods	Stubby squid	<i>Rossia pacifica</i>	Observed from submersibles only.
Cephalopods	Smooth-skinned octopus	<i>Lyoderma</i> sp. (?)	Observed from submersibles only
Crabs	Tanner crab, snow crab	<i>Chionocetes bairdi</i>	Observed from submersibles only
Crabs	Box crab	<i>Lopholithodes forminatus</i>	Caught in prawn traps
Crabs	Squat lobster	<i>Munida quadrispina</i>	Common
Sea Stars	Mottled star	<i>Evasterias troschelii</i>	Common
Sponges	Aggregated vase sponge	<i>Polymastia pacifica</i>	One sighting only, Flora
Fishes	Slender sole	<i>Lyopsetta exilis</i>	Observed from submersible
Fishes	Greenstripe rockfish	<i>Sebastes elongatus</i>	Observed from submersibles only.
Fishes	Spiny dogfish	<i>Squalus acanthias</i>	Locally fairly numerous

The species composition of Zone MD habitats would best be determined by a series of grab samples supplemented by remotely operated cameras. Shrimp trawl fisheries should be monitored for bycatch.

### **3.9 Zones UvD, UD, US, UP - Topographically simple, low slope areas with unknown substrates**

These subtidal Zones were included to identify areas where further study is needed. Areas classed as Zone UP (<10 m) and Zone US (10-20 m) are mostly nearshore and outside of the park boundaries. The deeper areas (Zones UvD and UD) in Lambert Channel and to the NE of Flora Islet are likely similar to the adjacent habitats that have been surveyed for sediment with sand or gravel sediments dominating in deeper areas and rock substrates in the regions identified as dive areas (Balke *et al.* 2001). Any future scan-scan sonar surveys in the region to fill in this data gap should re-survey the areas of steep slope around Flora Islet and Norris Rocks. All side-scan sonar surveys should have concurrent depth measurements taken to overcome the problem of inaccurate sediment classification in areas of high slope.

## **4 Summary of Issues and Management Prescriptions by Zone**

### **4.1 Zone E: Eelgrass beds**

#### **Issues**

1. Eelgrass beds are a highly productive ecosystem that provides nursery areas for many marine species.
2. Eelgrass beds are important in reducing sediment erosion and the roots allow oxygen to penetrate into otherwise impermeable sediments.
3. The eelgrass beds in the region of Helliwell Provincial Park are currently not included in the park.
4. The density and extent of eelgrass beds in the region of Helliwell Provincial Park are currently not well surveyed.

#### **Management Prescriptions**

1. BC Parks should consider including the eelgrass beds within the park boundary.
2. The density and extent of the eelgrass beds should be determined as a baseline. The survey should incorporate DFO CSIM standards using GPS positioning and representative quadrat sampling. The Comox Valley Project Watershed Society<sup>4</sup> has completed CSIM projects in the Comox-Strathcona Regional District (Don Chamberlain, pers. comm.) and could possibly assist BC Parks with this survey.

### **4.2 Zone RHD – Areas with steep slopes or a topographically complex sea bed**

#### **Issues**

1. This zone is thought to support the highest density and diversity of fish and invertebrate species. In shallower areas the algal cover is also rich.
2. Many of the invertebrate species are fragile epifauna that can be easily damaged by fishing gear, anchoring or physical contact with divers.
3. The drop off around Flora is a favourite area for the prawn trap fishery.
4. Hornby Island Diving has been keeping a species list for some of these habitats. There has not however been a systematic method of tracking changes in the biota.
5. Substrate mapping in areas of high slope are considered to be unreliable as depth measurements were not collected concurrently.

#### **Management Prescriptions**

1. BC Parks should ask DFO to close these areas to all bottom trawl and trap fisheries.
2. BC Parks should consider working with the Canadian Coast Guard to prohibit anchoring in these areas and instead place mooring buoys in strategic locations for use by sport divers.

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<sup>4</sup> Mailing Address: Comox Valley Project Watershed Society  
Box 3007, Courtenay, BC V9N 5N3 ph: 250-339-1619 fax: 250-339-9619

Care should be taken not to place these in areas that will encourage their use by recreational fishermen (e.g. rockfish or ling cod hot spots) as this could lead to local over fishing.

3. BC Parks should work with local diver operators to develop a “Diving Code” within the park that encourages divers not to take and marine organisms and to take care to avoid damaging fragile epibenthic species such as Cloud and Chimney sponges.
4. BC Parks should work with local dive operators to establish a volunteer subtidal marine monitoring program such as the DFO “Reefkeepers” Program or Reef Environmental Education Foundation’s “REEF Fish Survey Project” and “Living REEF Project”.
5. The presence and absence of canopy kelp beds in this zone should be monitored annually.
6. Deeper areas (>20 m) should be surveyed using remote cameras or submersibles.
7. Any future deployment of submersibles in this region should incorporate baseline reconnaissance of the biota in all areas that they intend to operate.
8. Substrates should be re-surveyed in the areas of steep slope around Flora Islet and Norris Rocks. All side-scan sonar surveys should have concurrent depth measurements taken to overcome the problem of inaccurate sediment classification in areas of high slope.

#### **4.3 Zone RD – Topographically simple, low slope areas with rocky substrates and waters depths of greater than 20 m**

##### **Issues**

1. This zone likely supports a community of benthic epifauna and fishes similar but perhaps less diverse than that of the more topographically complex benthic habitats in Zone RHD.
2. This zone tends to border the Zone RHD habitats.

##### **Management Prescriptions**

1. It is recommended that these areas be managed as a buffer zone around Zone RHD habitats.
2. Areas in this zone are best surveyed using remote cameras or submersibles, as the depths would require decompression diving by divers.

#### **4.4 Zone RS – Topographically simple, low slope areas with rocky substrates and waters depths of 10 – 20 m**

##### **Issues**

1. These habitats support red algal species and the deeper growing brown algae such as *Agarum fimriatum*.
2. This zone likely supports a community of benthic epifauna and fishes similar but perhaps less diverse than that of the more topographically complex benthic habitats in Zone RHD.
3. This zone tends to border the Zone RHD habitats.

##### **Management Prescriptions**

1. It is recommended that these areas be managed as a buffer zone around Zone RHD habitats. All management prescriptions which apply to zone RHD (section 4.2) should be extended into these buffer areas.
2. Areas in this zone should be included in the volunteer diver surveys (see section 4.2).

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#### **4.5 Zone RP – Topographically simple, low slope areas with rocky substrates and waters depths of less than 10 m**

##### **Issues**

1. These areas are rich in marine algae and support epibenthic marine invertebrates and shallow water fishes.
2. In the shallower depths (<4 m) this zone is the prime feeding ground and low tide loafing area for Harlequin ducks. These birds are sensitive to disturbance by dogs and humans along the shore or approaching the shore by boat.
3. Seals and sea lions haul out in on exposed portions of these areas at low tide. These species will leave the haul out when disturbed by humans or dogs along the shore or approaching the shore by boat.

##### **Management Prescriptions**

1. See Balke et al. 2001 (page 83) for management prescriptions concerning management of access to prevent disturbance to marine mammals and birds.
2. It is recommended that these areas be managed as a buffer zone around Zone RHD habitats. All management prescriptions which apply to zone RHD (section 4.2) should be extended into these buffer areas.
3. Areas in this zone should be included in the volunteer diver surveys (see section 4.2).

#### **4.6 Zone SGD – Topographically simple, low slope areas with sand and/or gravel bottom sediments and waters depths of greater than 20 m**

##### **Issues**

1. The benthic communities possibly include dense beds of epifaunal species such as the sea pens or sea whips. Extensive areas of sea whips have been recorded in similar habitats off Parksville. These species provide shelter for other mobile benthic species.
2. These epifaunal species have been recorded as a trawl bycatch.

##### **Management Prescriptions**

1. See Balke et al. 2001 (page 83) for management prescriptions concerning management of access to prevent disturbance to marine mammals and birds.
2. It is recommended that a remote camera be used to survey these Zone SGD habitats in the subtidal regions of Helliwell Provincial Park. If extensive beds of epibenthic macro-invertebrates such as sea pens or sea whips are found to be present within this zone, it is recommended that DFO be requested to close the sensitive areas to trawl fisheries or require a modification of fishing methods to keep gear off the bottom

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#### **4.7 Zone SGS – Topographically simple, low slope areas with sand and/or gravel bottom sediments and waters depths of less than 20 m**

##### **Issues**

1. There is a geoduck/horse clam population in this zone that supports an active fishery. This fishery disturbs the top 2-3 feet of the sediments.
2. Incidental mortality of juvenile geoducks is a concern in the fishery.

##### **Management Prescriptions**

1. BC Parks should approach DFO and request that the small area of active geoduck fishing within the park be closed to geoduck fishing as a precautionary measure.

#### **4.8 Zone MD – Topographically simple, low slope areas with bottom sediments dominated by mud and waters depths of greater than 20 m**

##### **Issues**

1. Deepwater mud substrates generally supported low abundance/low diversity assemblages of epibenthic marine life.
2. The biota of this zone has not been surveyed within the park.
3. Commercial shrimp trawls operate within this zone.

##### **Management Prescriptions**

1. A non-intensive survey of the benthic biota this zone should be instigated to obtain baseline data. The species composition of Zone MD habitats would best be determined by a series of grab samples supplemented by remotely operated cameras.
2. DFO should be requested to monitor bycatch of shrimp trawl fisheries within this zone.

#### **4.9 Zones UvD, UD, US, UP - Topographically simple, low slope areas with unknown substrates**

##### **Issues**

1. There is limited information on sea bed substrates for these zones. (only a few spot observations from CHS charts).
2. Areas classed as Zone UP (<10 m) and Zone US (10-20 m) are mostly nearshore and outside of the park boundaries.

##### **Management Prescriptions**

1. The sea bed substrate should be mapped for these areas. All side-scan sonar surveys should have concurrent depth measurements taken to overcome the problem of inaccurate sediment classification in areas of high slope.
2. Once substrate has been mapped fro these areas they should be reclassified into one of the other management zones.

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## Appendix A

### Marine Species of Helliwell Provincial Park Associated with Vertical Habitats

Depth	Common Name	Latin Name
Subtidal 30 - 60'	Giant barnacle	Balanus nubilus
Subtidal 100 - 200'+	Cloud sponge	Aphrocallistes vastus
Subtidal 30 - 100'	Grunt sculpin	Rhamphocottus richardsoni
	Creeping pedal (armoured) sea cucumber	Psolus chitonoides
	Sea peach	Halocynthia aurantium
	Hairy sea squirt	Boltenia villosa
	Sharpnose crab	Scura acutifrons
	Cushion star, slime star	Pteraster tesselatus
	Vermilion star	Mediaster aequalis
Subtidal 30 - 130'+	Black rockfish	Sebastes melanops
	Quillback rockfish	Sebastes maliger
Subtidal 30 - 60'	Painted greenling	Oxylebius pictus
Subtidal 40 - 130'+	Lingcod	Ophiodon elongatus
Subtidal 60 - 130'	Feather star	Florometra serratissima
	Cookie star	Ceramaster patagonicus
	Long ray star	Stylasterias forreri
Subtidal 80 - 130'	Chimney sponge, Boot sponge	Staurocalyptus dowlingi
	Chimney sponge, Boot sponge	Rhabdocalyptus dawsoni
Subtidal 80 - 130'+	Yelloweye rockfish	Sebastes ruberrimus
Subtidal 90'	Rhinoceros crab	Rhinolithodes wosnessenskii
Subtidal 100 - 300'	Spiny lithod crab	Acantholithodes hispidus
Subtidal 30 - 130'	Oregon hairy triton	Fusitriton oregonensis
Subtidal 30 - 60'	Leafy hornmouth snail	Ceratostoma foliatum
Subtidal 30 - 300'	Spot prawn, spot shrimp	Pandalus platyceros
Subtidal 30 - 60'	Heart crab	Phyllolithodes papillosus
Subtidal 30 - 60'	Red dendronotid	Dendronotus rufus
Subtidal 30 - 100'	Zoanthids	Epizoanthus scotinus
Subtidal 30 - 100'	Mosshead warbonnet	Chirolophis nugator
Subtidal 60 - 130'	Crimson anemone	Cribrinopsis fernaldi
Subtidal 60 - 130'	Candy stripe shrimp	Lebbeus grandimanus
Subtidal 60'	Pacific cod	Gadus macrocephalus
Subtidal 90'	Red brotula	Brosmophycis marginata
Subtidal 60 - 130'	Squat lobster	Munida quadrispina
Subtidal 30 - 130'+	Ratfish	Hydrolagus colliei
Subtidal 30 - 900'+	Sixgill shark	Hexanchus griseus
Subtidal 30'	Blade shrimp	Spirontocaris sp

**Appendix B**  
**Map Atlas**