Parks Canada Parcs Canada

APPENDICES Volume 1: Supporting Reports

Preliminary Assessment of Subtidal Habitat at Thirteen Anchorages in Gulf Islands National Park Reserve of Canada

Prepared for Gulf Islands National Park Reserve
By: Western & Northern Service Centre
November 2011

Canada

APPENDICES VOLUME 1: Supporting Reports

Appendix 1

Subtidal Habitat Assessment for Gulf Islands National Park Reserve: Methods & Definitions

Prepared for Parks Canada by Matthew Drake. May 1st 2011

Appendix 2

Metadata for the Subtidal Habitat Assessment for Gulf Islands National Park Reserve

Prepared for Parks Canada by Matthew Drake. May 1st 2011

Appendix 3

Subtidal Habitat Assessment for Gulf Islands National Park Reserve: Results

Prepared for Parks Canada by Matthew Drake. May 1st 2011

Appendix 1

Subtidal Habitat Assessment for Gulf Islands National Park Reserve: Methods & Definitions

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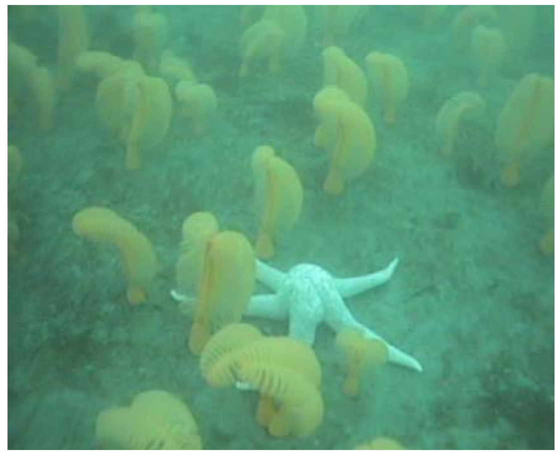
May 1st 2011

Subtidal Habitat Assessment for
Gulf Islands National Park Reserve: Methods & Definitions


Prepared for Parks Canada
Prepared by Matthew Drake

May 1st 2011

Contents

Methods & Definitions

The following document clarifies the methodology and definitions used during the video collection and analysis portion of the Gulf Island National Park Reserve anchorage study. Video footage for this project was collected from December 1st, 2010 to March 25th, 2011. Video from December 2010 was collected using a Video Ray ROV and all video from 2011 was collected using a towed Deep Blue Pro SplashCam. A Sony HDV digital HD videocassette recorder was used in the field to record the underwater footage. The positional information of the boat and camera was recorded using Hypack software.

Hardware Setup

Field Time Calibration

The Sony time stamp was used to match up the time with the Hypack data to obtain the positional information. Please note that when the Sony recording device is unplugged for any period of time, the clock begins to slow down. The Sony device must be calibrated to the laptop with the Hypack program for each field excursion to get the most accurate positional information. To calibrate the Sony device, use the following path, Menu>Others>Clock Set, and set the clock appropriately.

If the Sony device is not calibrated, a calibration factor must be obtained while still in the field. To obtain the calibration factor in the field, record the Sony time and Hypack time (from the same moment) and subtract for the difference between devices (the calibration factor).

No calibration factor was determined in the field for the December 2010 videos, so a round about method was applied to obtain the calibration factor. First the time difference between GeoStamp and the Sony video was determined by playing the video (with visual time stamp) along with the translated audio file (NMEA string) from the GeoStamp. Next, the difference in time between the GeoStamp and Hypack data must be calculated as the Hypack time is based on the laptop it is operating on and GeoStamp records the actual time from the satellites/GPS device. To determine the difference between Hypack and GeoStamp, the two data sets (both with times + positional information) were lined up by positional information. The difference between the two times at the matched positional record was then recorded. The time offset between the Sony time and Hypack time was then determined by adding up the Sony/GeoStamp difference plus the GeoStamp/Hypack difference. This whole process was repeated at several time intervals and the resulting time differences were averaged to obtain the calibration factor.

Video Uploading

All videos were uploaded into a digital format using two Sony playback devices (Sony HDV cassette recorder and a Sony Handy HD Handycam) and the program Windows Movie Maker (see Figure 1). When the videos were recorded in the field the Sony cassette recorder placed a time stamp on the videos that can only be displayed in Sony devices. In order for the Sony time stamp to remain present when uploading the videos into a digital format, a round about method of downloading needs to be applied. To record the time stamp onto the digital video, two Sony devices need to be used. The first plays the cassette tape with the time stamp displayed. This device is then connected to the second Sony device via an A/V cable. The second Sony device is then connected to the computer via an i.Link cable (a.k.a. fire wire or HDV/DV). With this setup the time stamp will be displayed on the uploaded video.

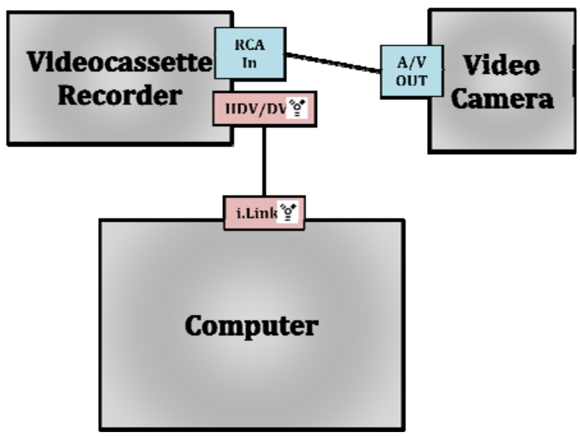


Figure 1. The setup for uploading videocassettes into a digital format (with a time stamp) using two Sony playback devices and Windows Movie Maker (Computer).

Video Analysis Procedures

Discrete vs. Continuous Video Analysis

Video analysis is generally conducted using sections or intervals of the videos (Busby et al., 2005, Jagielo et al., 2003, Collie et al., 2000, Moore et al., 2003) or by conducting a continuous analysis of the video data (Grizzle et al., 2008, Stevens & Connolly, 2003, Malatesta et al., 1992, Sameoto, 2008). As the total area surveyed for each site in this study was relatively small, the video for each site was continuously analysed. Continuous analysis provides the greatest number of data points, which increases the accuracy of the final habitat map.

Originally a program called Video Miner was to be used to analyse the video, but was abandoned as the program setup was not ideal for the information this project was capturing. A standardized Excel spreadsheet was used instead to record information from the video. Every time data was entered into the spreadsheet, the video was paused to help ensure that information would not be missed.

Video Quality and Continuity

To ensure consistency during analysis, all video sections which panned too fast, were blurry, were too far off the bottom or were recorded during a drastic turn were excluded from the analysis.

Analysis Zone

To accurately estimate feature abundances during video analysis, a standardized field of view was established. Standardizing the area analysed in videos requires the selection and dedication of a portion of the screen for use in video analysis. Substrate or organisms are not recorded unless they pass into this dedicated portion of the screen. The two options which are most often used are the horizontal plane created by lasers, and the bottom portion of the screen (Jagielo et al., 2003, Hannah et al. 2010, Jon Martin, SFU, personal correspondence). As the laser references are inconsistent within our videos, or were not present, the bottom two thirds of the video frame were analysed (see Figure 2). To increase the accuracy of data collected during analysis, the bottom of the screen was used over the top portion of the screen. Using the bottom portion of the screen helps optimize video resolution, and reduces errors associated with changing camera angles. Features were counted when they entered the analysis zone. Categories (see Category & Data Definitions below) were considered to have ended once they exited the analysis zone.

Figure 2. A diagram illustrating the analysis zone. The bottom 2/3 of the screen was used during analysis of the video. The top 1/3 of the screen was not used (greyed area).

Using figure 2 as an example for video analysis, there is a fine grain substrate with brown mat, dense orange sea pen (*Ptilosarcus* gurneyi) coverage and three stripped nudibranch (*Arminia californica*).

Please note that due to the video collection method, the data collected is of a semi qualitative nature. The video did not always remain the same distance from the bottom, the camera angle was not always constant, and the direction of travel was sometimes at an angle. When the camera traveled at an (acceptable) angle the analysis zone was adjusted accordingly.

Category Definitions

Substrate

Many different subtidal substrate classification schemes are used, some of which are detailed (Greene et al., 1999, Valentine et al, 2005, Sameoto et al., 2008, Connor et al., 2003) and others which are more simplistic (Canadian Hydrographic Service, 2011). The more complex schemes include details such as texture, roughness, and currents, which can be helpful in analysis but are beyond the scope of this study. Only the top layer of substrate was characterized for this study. The designated substrate categories listed below are common to several reports (Greene et al., 1999, Valentine et al., 2005, Sameoto et al., 2008, Connor et al., 2003, Canadian Hydrographic Service, 2011). The definitions of the substrates are based on those of Greene et al. (1999), as they are the most widely used definitions. Due to the video resolution of this survey, some definitions have been modified.

Fine Grain: Mud / Sand / Gravel (0-4mm) (Figure 3)

Sand Waves: Fine grain with rippling structure (Figure 4)

Pebble: 4-64 mm, smaller than a tennis ball (Figure 5)

Cobble: 64 – 256 mm, size roughly between a tennis ball and basketball (Figure 6)

Boulders: >256 mm, roughly larger than a basketball (Figure 7)

Bedrock: a continuous rock formation (Figure 8)

Shell Hash: pieces of shell (Figure 9)

Unknown: Unknown due to high biological cover

When analysing the video the dominant and subdominant substrates in the above categories were recorded by percent cover.

Minor discrepancies may occur between what is called pebble and cobble. When the substrate was borderline pebble or cobble it was difficult to classify as there was no way of measuring, so a best guess approach was applied.

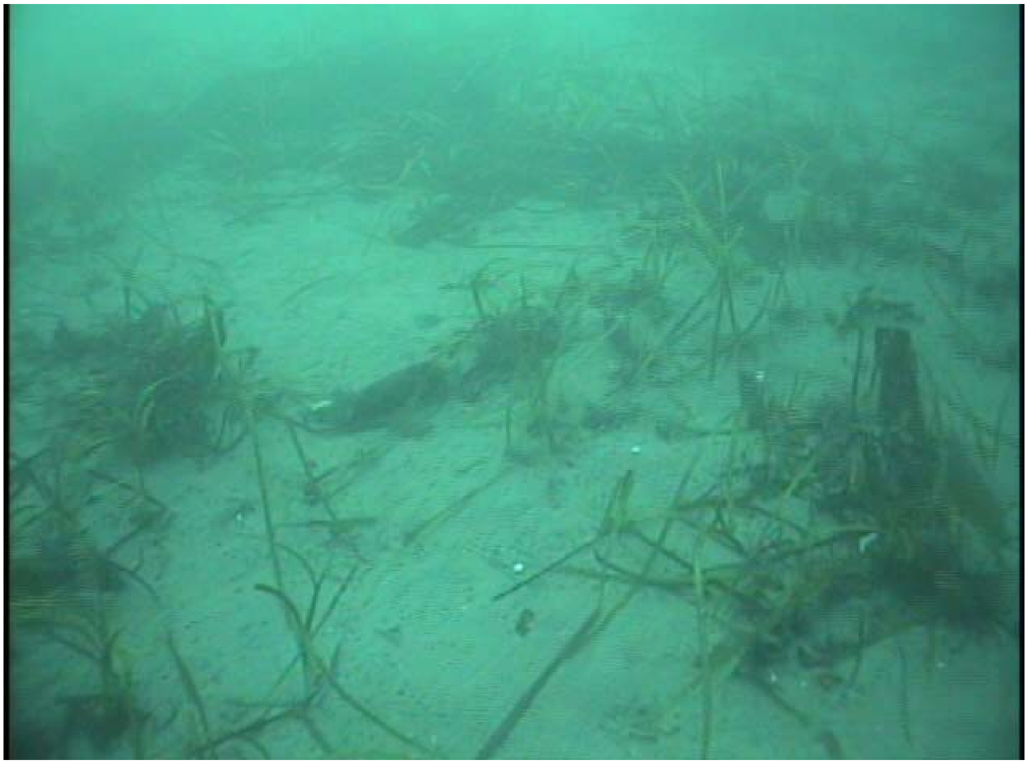


Figure 3. This picture depicts fine grain


Figure 4. This picture depicts sand waves.

Figure 5. This picture depicts shell hash and fine grain.

Figure 6. This picture depicts pebble.


Figure 7. This picture depicts cobble.


Figure 8. This picture depicts boulder.


Figure 9. This picture depicts bedrock.

Flora & Fauna Indicators

Categories for flora and fauna are based on prominent presence and/or sensitivity to anchoring. Prominent or sensitive flora and fauna presence in an area was characterized using several methods. The method depended on the category, which is either coverage (percent cover or occurrence), or count.

Coverage categories occur when the organism is continuously within the analysis zone (see Figure 2). Percent cover was also used for organisms that would be difficult to count and were not considered sensitive (i.e. algae). Occurrence, indicated as present or absent, was used for organisms that were considered sensitive (i.e. eelgrass meadows) or easily countable (i.e. sea urchins). There are three occurrence categories; simple occurrence and two abundance based occurrences. Simple occurrence was used for any organisms that would be hard to count and sensitive (i.e. eelgrass) or, hard to estimate percent coverage or countable but likely not sensitive (i.e. sea urchins and articulated coralline algae). For organisms that were easily countable and possibly sensitive, two abundance categories where applied; sparse and dense. Sparse is when there are two or less organisms continually occurring in the analysis zone. Dense is when there are greater than two organisms continually occurring within the analysis zone (see Figure 2).

When an organism did not continually occur in the analysis zone it was counted. For example, if three orange sea pens occur in the analysis zone, with no other individuals coming into the analysis zone (in top 1/3rd of the screen) then they would simply be counted. If it is a case where there are others coming into the analysis zone immediately after, similar to that in figure 2 (dense orange sea pen coverage), it would become a coverage.

Below is a list of the proposed prominent or sensitive flora and fauna, with the coverage characterization type indicated.

Seagrass

- **Eelgrass** (*Zostera marina*) – Simple occurrence

  Eelgrass is an important habitat component. Horizontally growing rhizomes stabilize the soft sediment, and the vertical blades provide a protected environment for many animals to use as a nursery ground, spawning site, and foraging area.

  As eelgrass creates an important ecosystem, it would be beneficial to further define this category by quality. In regards to anchoring disturbance, it can be difficult to define what is sensitive and what is not. As such, the following classification is for internal purposes only and is based on density.

  Sparse eelgrass: patchy-thin density (Figure 10)
  Dense eelgrass: thin-thick density (Figure 11)

  Eelgrass meadows represented on the maps are characterized by a simple occurrence (Figure 10 & 11) and are not classified by density.

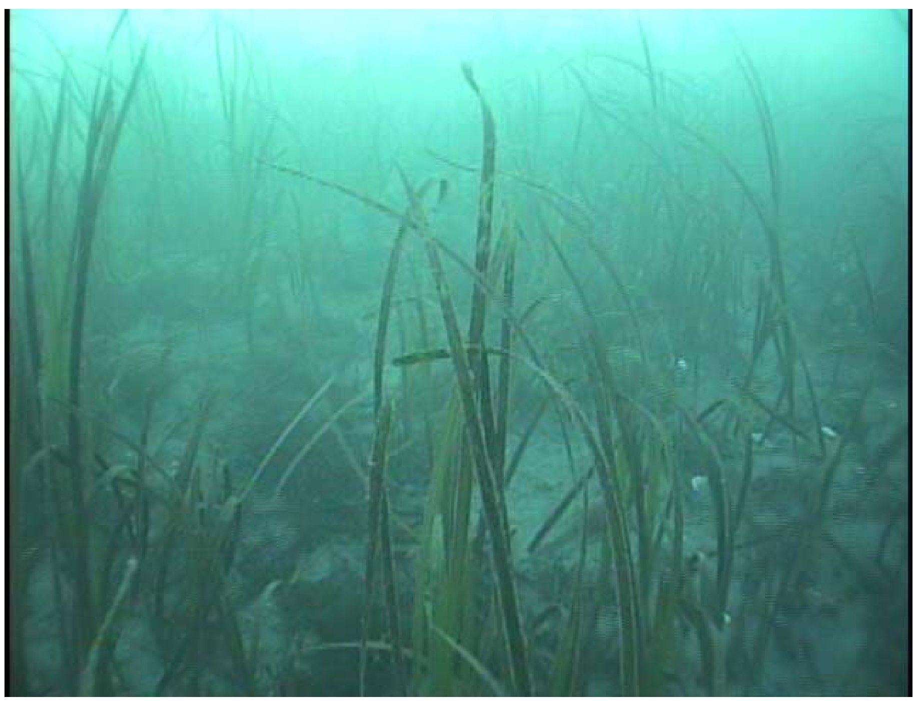


Figure 10. Sparse eelgrass meadow, but for mapping purposes is considered a simple occurrence.

Figure 11. Dense eelgrass meadow, but for mapping purposes is considered a simple occurrence.

- **Surfgrass** – Simple occurrence

  The identity of this plant was based on its associated substrate type and exposure level, so there is a possibility that this is not surfgrass, but eelgrass. This category (surfgrass) does not occur very frequently (only at a couple of sites).

  With the identity of this category potentially being eelgrass, the same characterization as eelgrass was used (simple occurrence).

Algae

- ***Ulva* sp**.- Percent cover

  Ulva is a broad leafed seaweed, growing upwards of one meter in length (Druehl, 2000), and occurring in the mid-intertidal to shallow subtidal (Lamb & Hanby, 2005). *Ulva* flourishes in rich nutrient conditions and can create green tides when highly abundant (Druehl, 2000). *Ulva* is a two cell layer thick seaweed (Druehl, 2005) that attaches to hard substrates. It is seasonally abundant, declining over the winter (Price, 1982).

  Ulva can influence the biotic structure of a localized area in several ways. Mats of *Ulva* can have many animals (oligochaetes, polychaetes, amphipods, crabs) associated with them at various stages of the *Ulva* life cycle (Price, 1982). Blooms of *Ulva* have been shown to exhibit allelopathic qualities by limiting the development of some algae and invertebrate species (Nelson et al., 2003).

  Ulva would be very difficult to count individually so it was characterized using a percent coverage (Figure 12).

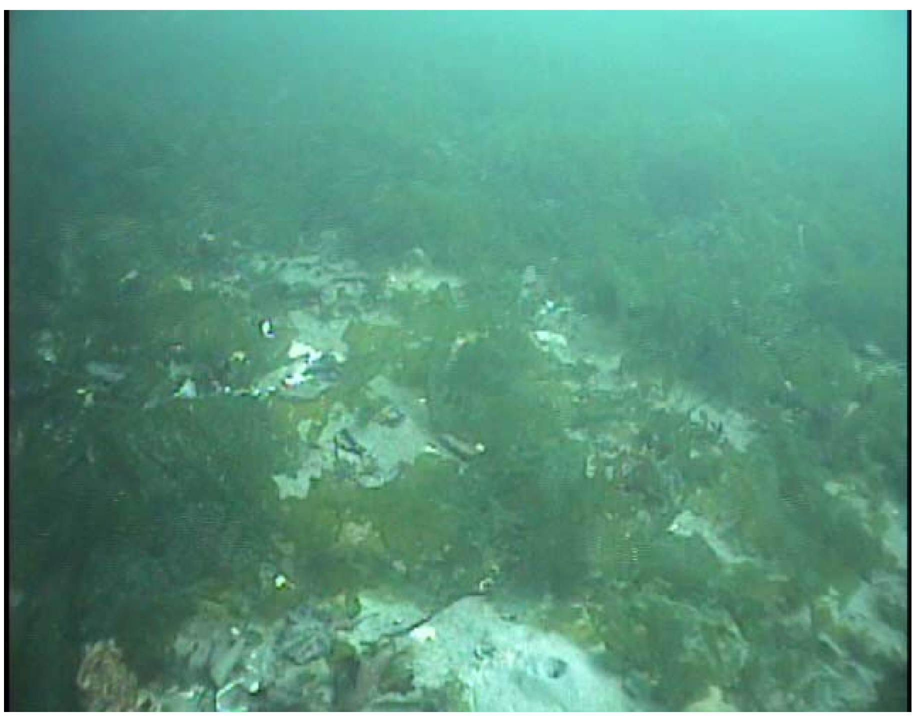


Figure 12. Seventy five percent sea lettuce coverage.

- **Kelp stipes** – Simple occurrence

  Kelp stipes can indicate where kelp forest or understory areas occur when outside the growing season. As many kelps are annual (Druehl, 2000), their visibility during winter and early spring is likely diminished, though some indications will likely remain throughout the year.

  Kelp forests have important ecological roles, providing a large three dimensional environment and creating niches for various species. Kelp provides protection, spawning, and rearing areas for many animals, and protects the shoreline from erosion. The net annual productivity of kelp forests surpasses that of many terrestrial forests.

  Some kelp is highly seasonal in terms of its presences and density, making a percent coverage estimate difficult. Kelp stipe presence was used to record information for this study (Figure 13 & 14).

Figure 13. Degraded kelp stipes without foliage.

Figure 14. Kelp stipes with foliage.

- ***Laminaria saccharina*** – Simple occurrence

  This species of *Laminaria* tends to be very large (3 m long) (Lamb & Hanby 2005), and can be fairly abundant in areas. As this algae is easily countable but likely not sensitive to anchoring, it was characterized by simple occurrence (Figure 15).

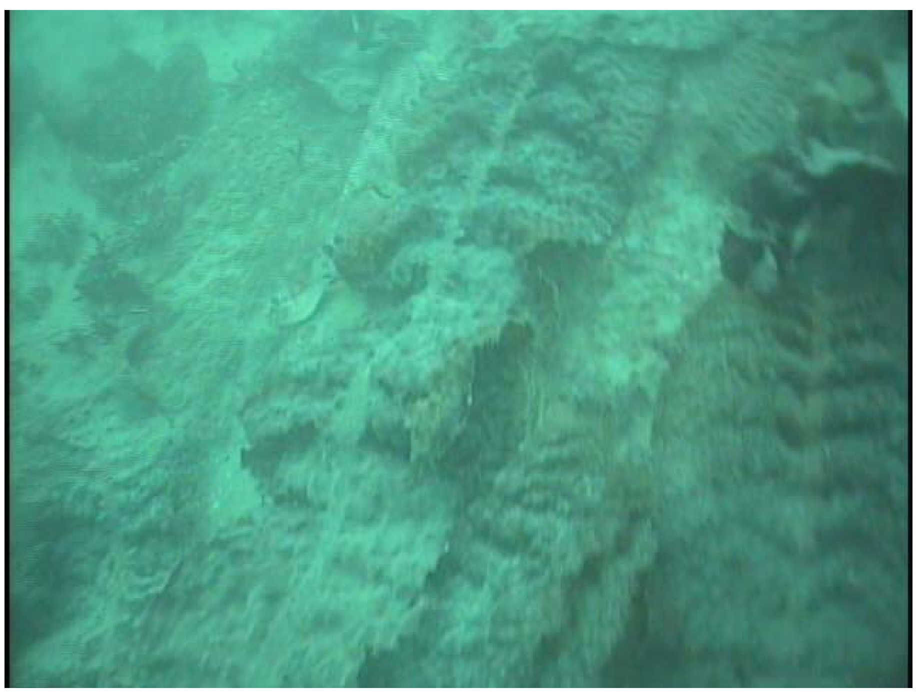


Figure 15. Simple occurrence of *Laminaria*.

- ***Sargassum*** sp. – Simple Occurrence

  The *Sargassum* species commonly encountered locally (*S. muticum*) is considered an introduced species from Japan, which likely came over with oyster spat as early as 1902 (Druehl, 2003). It usually reaches lengths of one to three metres, and commonly forms dense beds in areas sheltered by waves (Druehl, 2003).

  Within the study sites *Sargassum* was only encountered in cobble to bedrock substrate types. Anchoring could possibly positively or negatively affect this introduced species. A positive effect would be damaging the algae and thus affecting its survival. The negative effect is that boating may act as a transportation vector for *Sargassum* if any plant material remains on retrieved anchors.

  With this category having questionable sensitivity to anchoring and being hard to count, a simple occurrence characterization was used (Figure 16).

Figure 16. A simple occurrence of *Sargassum* algae.

- **Articulated Coralline** – Simple Occurrence

  The articulated coralline category is a general grouping of all the articulated coralline algae likely to be encountered, as species identification from video is not possible. Common genera include *Bossiella, Corallina, Serraticardia, and Calliarthron*.

  Articulated corallines are associated with hard substrates and are vertically orientated with a somewhat rigid structure due to calcium carbonate deposits (Lamb & Hanby, 2005). The reported growth rates of articulated corallines are slow (Druehl, 2000, Goldberg & Foster, 2002). Articulated corallines have a diversity of animals that associate with them (as referenced in Konar & Foster, 1992), and have the ability to inhibit local recruitment of other algae (Reed & Foster, 1984).

  As this group of algae may be sensitive to anchoring due to their rigid structure, but are hard to distinguish as individuals, a simple occurrence characterization was used (Figure 17).

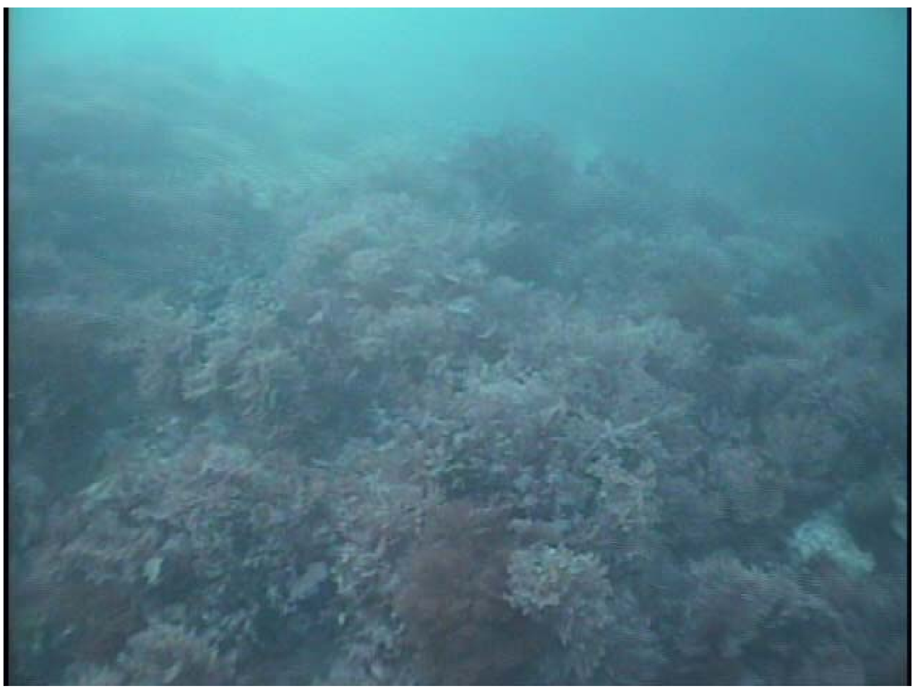


Figure 17. Simple occurrence of articulated coralline algae.

- **Unknown Algae** - Percent cover

  Discerning the identity of some seaweed was difficult due to video resolution. Unidentified seaweed mats were classified based on their colour (red, green, brown), if possible (Figure 18).

  Unidentified seaweed mats or beds are likely to be associated with a hard substrate, unless they are unattached wracks of seaweed. A seaweed mat or bed is similar in nature to the understory of a terrestrial forest. It plays an important role in creating habitat complexity, and increased habitat complexity is linked to greater niche space.

  As the sensitivity of unidentifiable algae is not clear and most algae are hard to count, a percent coverage characterization was used.

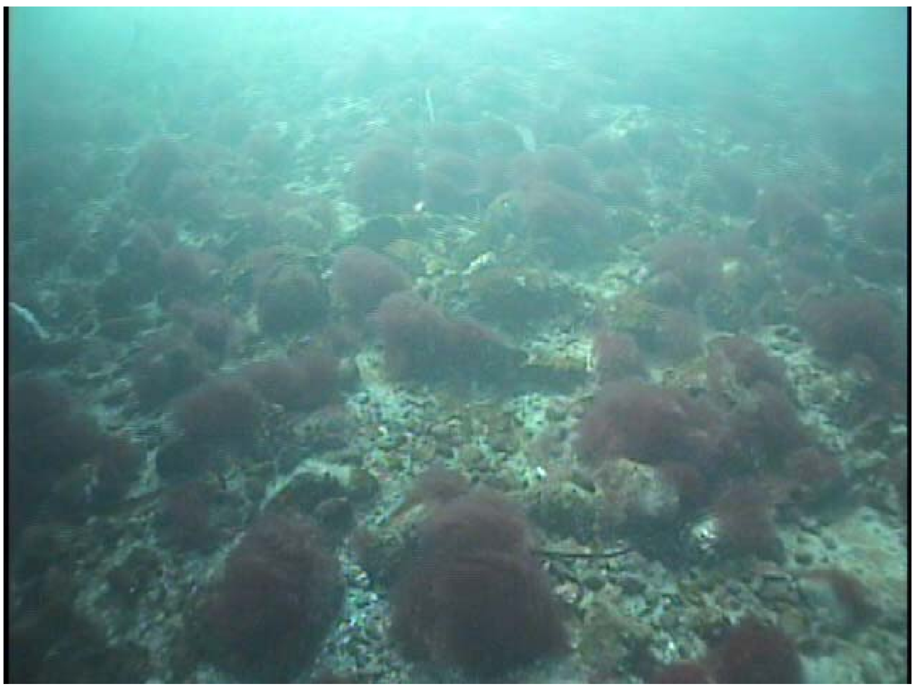


Figure 18. Unknown red algae.

Cnidarians

- **Orange sea pen** (*Ptilosarcus gurneyi*) – Abundance

  P. gurneyi is found in soft sediment (Lamb& Hanby, 2005), and is a long lived invertebrate, living upwards of 15 years or more (Birkeland, 1974). *P. gurneyi* becomes sexually mature at age 5 or 6 (Birkeland, 1974), and has a relatively unpredictable recruitment success (Birkeland, 1974). Individuals may have the capacity to burrow into the sediment when threatened (Weightman & Arsenault, 2002).

  As orange sea pens were easily countable and are possibly sensitive to anchoring, they were characterized with abundance categories (Figure 19 & 20). In addition to adult sea pens being encountered, juveniles were also observed, and were recorded along with adults. A note was made in the comments column of the related data set (*Biotic_Substrate* or *Counts* datasets) if there were juveniles present. Most juveniles were difficult to see, so it is likely they are underrepresented.

Figure 19. Sparse orange sea pens.

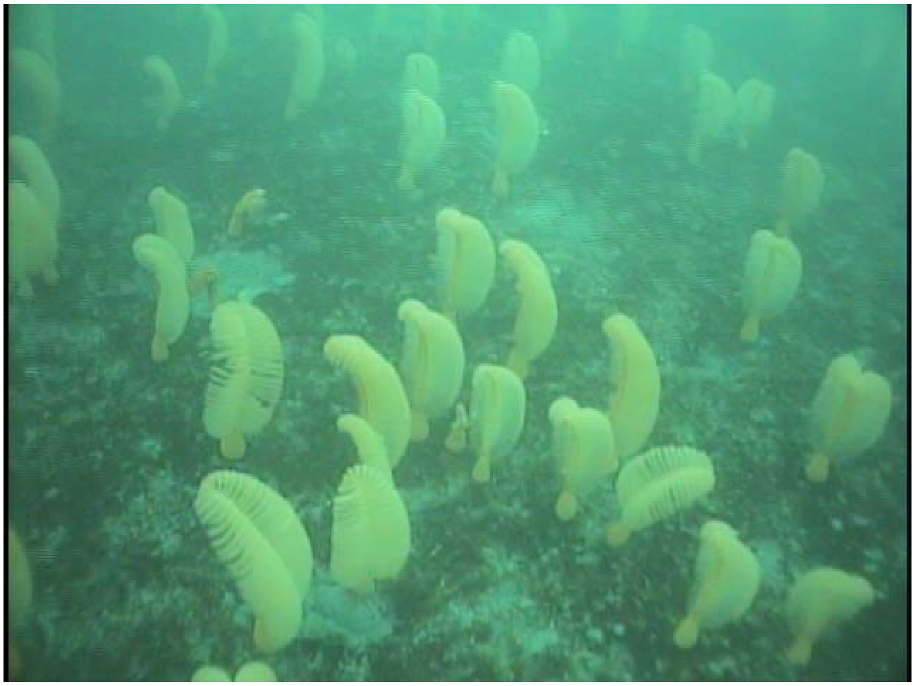


Figure 20. Dense orange sea pens.

- **Tall Plumose Anemone** *(Metridium farcimen)* - Abundance

  M. farcimen are associated with hard substrate, or mixed substrate, provided a hard substrate is present. These anemones can reach heights of over one meter (Lamb & Hanby, 2005). *M. farcimen* are difficult to remove from their substrate and a forced removal would likely cause damage to the animal.

  Tall plumose anemones are frequently found associated with dominantly hard substrate, but they can still occur where there is sparse hard substrate (Figure 22).

  These anemones are easily countable and may be sensitive so were characterized with abundance categories (Figure 22 & 23).

Figure 22. Sparse tall plumose anemones.

Figure 23. Dense tall plumose anemones.

- **Tube-Dwelling Anemone** *(Pachycerianthus fimbriatus*) – Abundance

  P. fimbriatus (Figure 21) can be found abundantly in soft substrate, where tube lengths can reach one meter (Lamb & Hanby, 2005) and act as a sediment stabilizer (Nybakken & Bertness, 2005). The stiff tube of *P. fimbriatu* is often found partially above the substrate. *P. fimbriatus* is the primary prey for *Dendronotis iris* (Giant Nudibranch) which lays its eggs adjacent to *P. fimbriatus* tubes (Lamb & Hanby, 2005). If *P. fimbriatus* becomes uprooted and its tube is severely damaged, it can form new tube layers to raise its oral disc off the sea floor to feed (Arai, 1971). *P. fimbriatus* has not been documented burrowing but it has been observed to partially resettle into soft substrate after several days (Arai, 1971).

  Tube-dwelling anemones, when visible, were easily countable and may be sensitive species, which is why they were characterized with abundance categories. They are likely under represented as they can be difficult to see in the videos.

Figure 21. A single tube-dwelling anemone. This anemone would not be recorded as a coverage but as a count (of one).

- **Branching hydroid** – Simple occurrence

  Without a sample of the hydroid it was not possible to identify this hydroid to species (Figure 24). It only occurred at one site (Winter Cove) in very active water (high current) and on boulder and bedrock substrate.

  Branching hydroids are likely not sensitive to anchoring (because of their habitat), but due to the video quality it was hard to estimate the percent cover so a simple occurrence characterization was used.

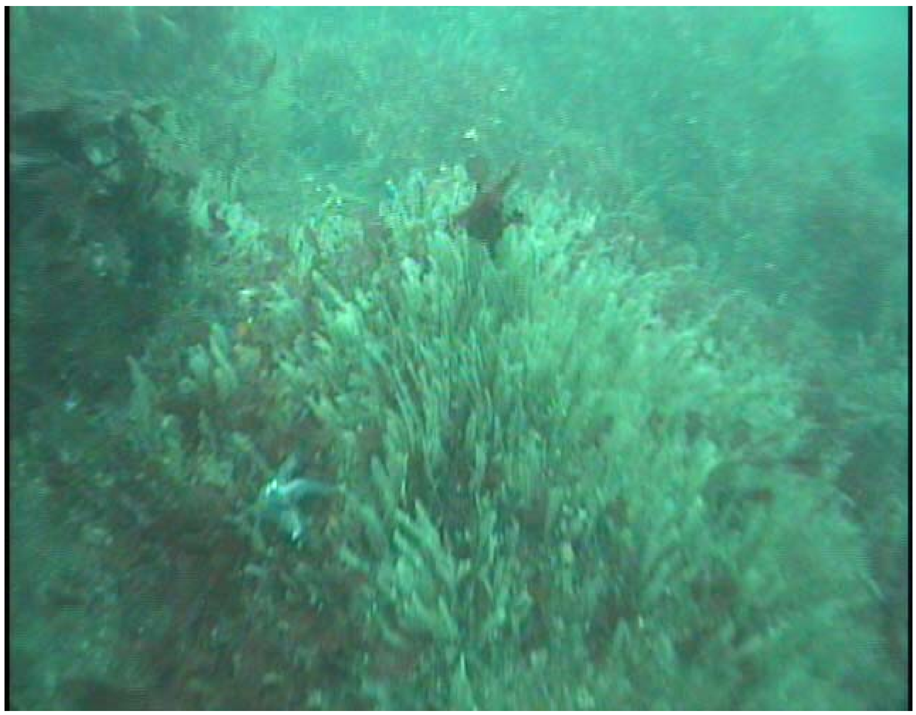


Figure 24. A simple occurrence of branching hydroids at Winter Cove.

- **Cup Coral** – Simple occurrence

  This animal associates with hard surfaces, and is fairly small. For this study it was only encountered at one site (Richardson Bay), in a single area. Due to their small size they may be under represented in this survey.

  As it was difficult to count the cup corals, they were characterized using simple occurrence.

Bivalves

There were several types of siphons encountered, and their identity was determined to the best of my ability but further confirmation or investigation should be sought.

All siphons are likely under represented as only siphons that where visible and not retracted were counted.

- **Geoduck siphons** - Abundance
  These siphons (Figure 25) were only noticed at James Bay. The siphons were characterized using abundance as they were easily countable, but their sensitivity was unknown due to their questionable identity.

Figure 25. Possible geoduck siphon occurring at James Bay. This is not a coverage category, but was recorded as a count.

- **Rough Piddock siphons** – Abundance

  These siphons (Figure 26) were only noticed at Winter Cove. The siphons were characterized using abundance as they were easily countable, but their sensitivity was unknown due to their questionable identity.

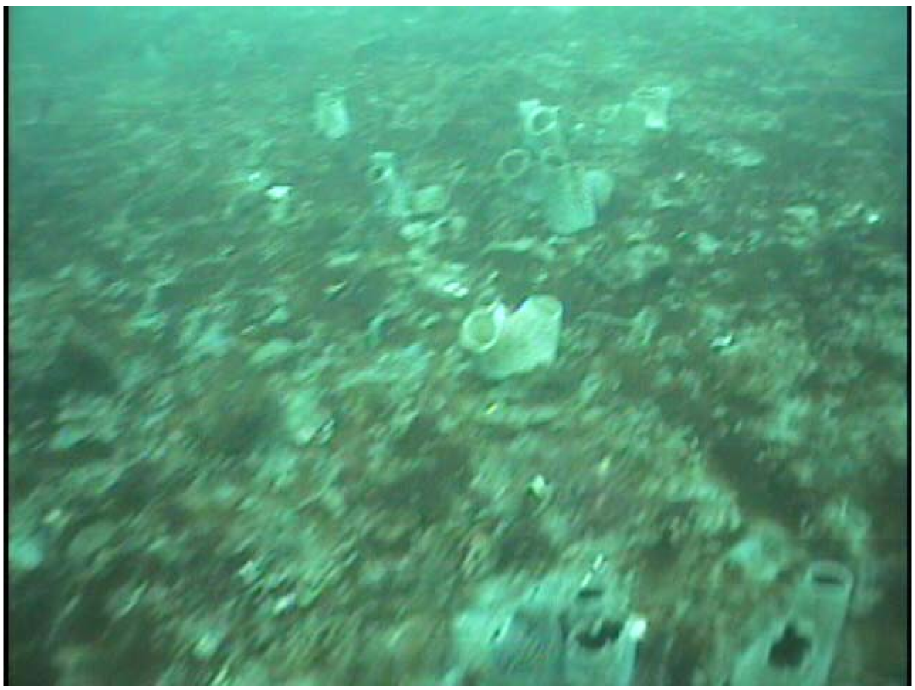


Figure 26. Possible sparse rough piddock siphons occurring at Winter Cove.

- **Possible small white siphons** – Occurrence

  These possible siphons (Figure 27) occurred in large densities only at Winter Cove. With this organism's true identity unknown, and the difficulty associated with counting them, these features were recorded using a simple occurrence.

Figure 27. Simple occurrence of possible small white siphons occurring at Winter Cove.

Crustaceans

- **Giant Acorn Barnacle** – Simple occurrence

  Giant acorn barnacles are found attached to hard substrates, and were only seen at one site (James Bay) during this study. It is possible that due to their small size and colour they have been under represented.

  As this animal was only seen at one site in a very small area it was only characterized by simple occurrence.

Echinoderms

- **Brittle Stars** – Simple occurrence

  This category only occurs at a very specific location in Richardson Bay, on fine grain substrate. It is very likely however that brittle stars have been under represented as they are a fairly small, and slender animals with dull colouration.

  Due to the difficulty in counting the brittle stars a simple occurrence characterization was used.

- **Sea Urchins** (*Strongylocentrotus* sp.) – Simple occurrence

  Some sea urchins are suggested as having a long life expectancy (red sea urchins), and significant influence on the surrounding environment due to their grazing activity.

  Sea urchins are generally associated with hard substrate (boulder or bedrock), but they can be found in pebble or cobble areas, which are more suitable anchoring substrate (Figure 28). This makes their sensitivity to anchoring questionable. If an anchor were to drop on a sea urchin it would undoubtedly cause significant damage due to the urchin's fragile calcium carbonate test.

  As sea urchins are easy to count but their sensitivity is debatable, they were characterized with simple occurrence coverage (Figure 28 & 29). During the analysis two types of sea urchins were encountered: red (*S. fransciscanus*) (Figure 28) and green sea urchins (*S. droebachiensis*) (Figure 29). Occurrences were labeled by species.

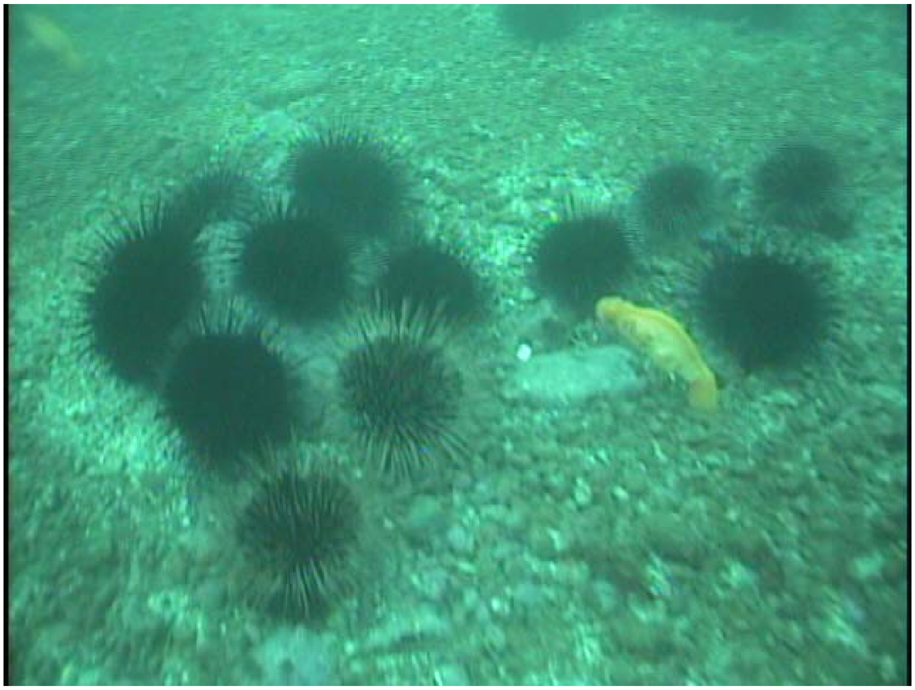


Figure 28. A simple occurrence of red sea urchins, in a pebbly environment.


Figure 29. A simple occurrence of green sea urchins.

Other Categories

- **Mounding Infaunal Animals** – Abundance

  Many animals create mounds, such as lugworms, various other polychaetes, and *Upogebia pugettensis* (mud shrimp). The identity of any infaunal animals which create the mounds observed in this study cannot be determined by video analysis. To accurately identify infaunal animals, a sediment grab would be required.

  Sediment reworking changes the micro topography of the bottom, which can alter near-bed hydrodynamics (Reise, 2002). The associated tunnels and reworking can also increase the flux rates of nutrients and other materials between the sediment-water interface (Reise, 2002). Lugworms (a mounding animal) have been shown to both positively and negatively affect the local biota (Reise, 1983, Flach, 1992).

  As mounds can be counted and their sensitivity is questionable, an abundance based characterization was used (Figure 31). Please note that only large mounds were considered for this category. This category is also likely under represented as it was difficult to identify what was a mound, or if any were even present due to the resolution of the video.

Figure 31. Dense mounding infaunal animal activity.

- **Possible tunicate** – Simple occurrence

  There was a frequently occurring, odd looking jelly like organism (Figure 30) encountered at Winter Cove, which could possibly be a type of tunicate. It appears to occur mostly on fine grain substrate.

  As the identity of this organism is very questionable without a sample, and the organism is hard to count, and occurs in suitable anchoring substrate, it was categorized as a simple occurrence (Figure 30).

Figure 30. A simple occurrence of a possible un-known tunicate at Winter Cove

- **Brown mat** – Simple occurrence

  At all of the sites (to differing extents) there is a fine brown layer (Figure 32 & 33) that occurs on fine grain substrate. The identity of this brown mat is unknown at this point - it could potentially be a bacteria, algae, or even diatoms.

  Due to the unknown identity of this substance and the difficulty involved in estimating percent cover, a simple occurrence characterization was used (Figure 32 & 33).

  Please note that the coverage of this category is likely under represented. Under certain conditions it becomes very difficult to detect its presence (low light, deeper water). The certainty that all brown mats were the same thing at all the different sites is also questionable.

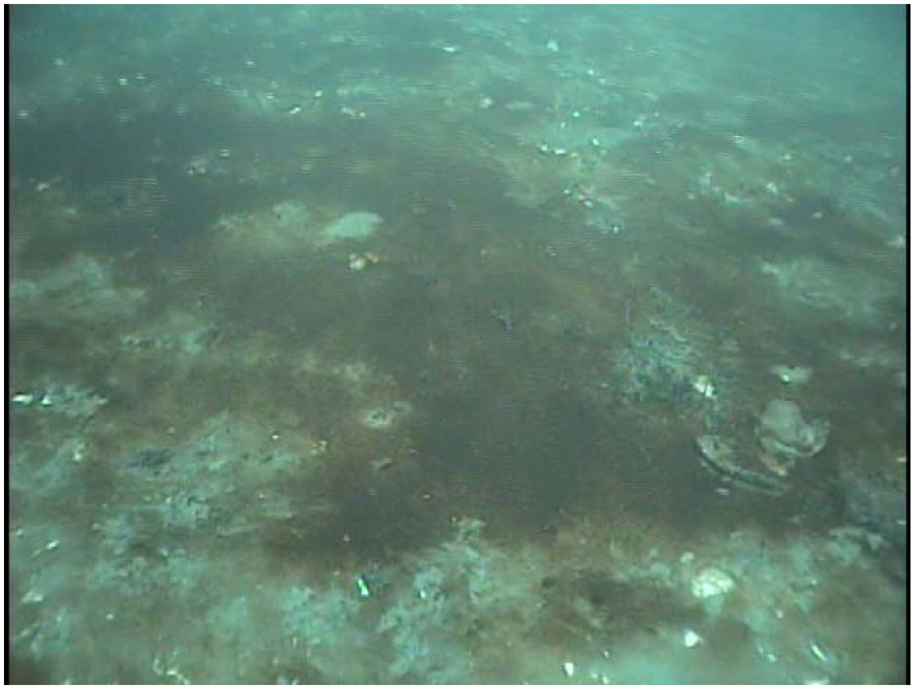


Figure 32. Simple occurrence of brown mat.

Figure 33. Questionable simple occurrence of brown mat.

- **Generic**

  Any substrate that does not have an identifiable associated organism or is bare will be defined as generic.

Non Category Species - Count

All other organisms that are not part of the flora, fauna indicator groups were enumerated as they are encountered and identified to their lowest possible taxa group. Only larger organisms like an adult red rock crab or a medium sized sunflower star were easily identifiable to species due to video resolution.

Anthropogenic Characteristics

All garbage encountered was identified and counted as it was encountered. Objects that consistently appeared (i.e., bottles, crab traps, rope) were identified and labeled, and for all occurrences of rope a screen direction was noted. All crab traps encountered were identified as being old (Figure 34) or clean (Figure 35). Old traps are likely abandoned and pose potential ghost trapping threats, whereas clean crab traps are likely still in use by fishermen. More obscure objects were labeled based on their size (small & large) and if possible, with their identity (i.e. recycling box, dip net) (Figure 36, 37 & 38).

Figure 34. An old crab trap, which has been abandoned, but likely not acting as a ghost trap.

Figure 35. An active crab trap likely still in use, with six Dungeness crabs inside.

Figure 36. A discarded recycling box.

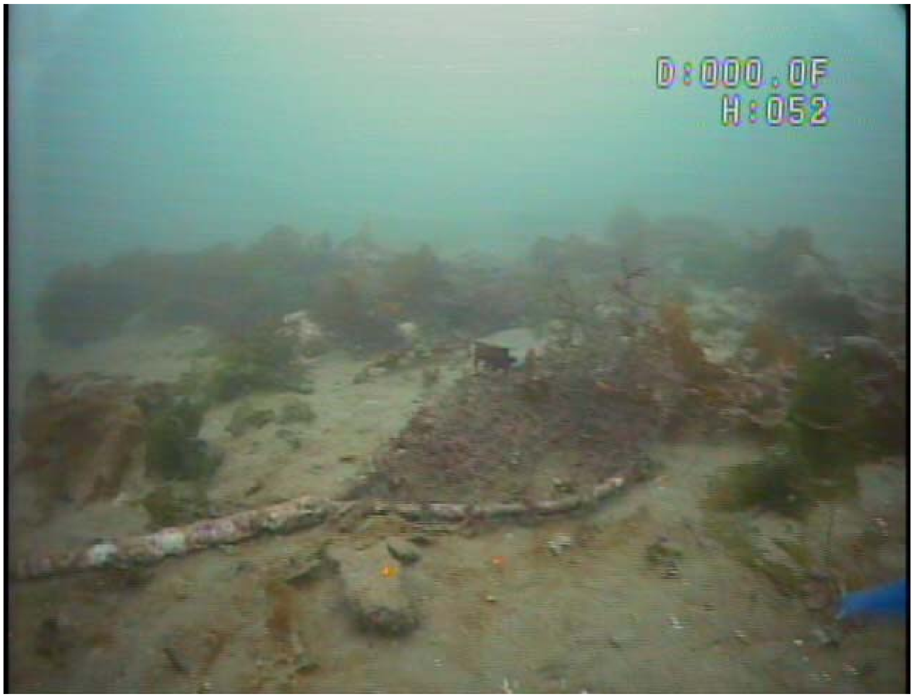


Figure 37. A discarded dip net.

Figure 38. Discarded bags of cement.

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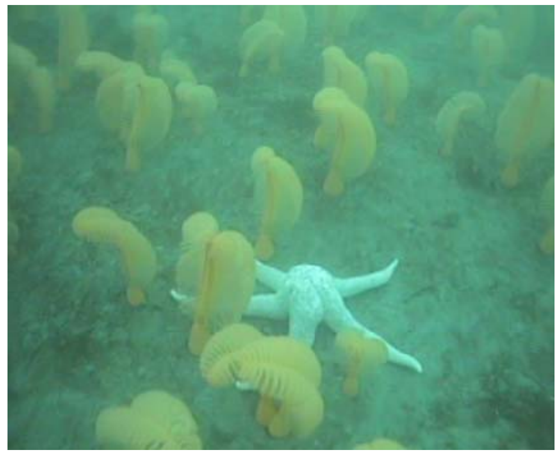
Appendix 2

Metadata for the Subtidal Habitat Assessment for Gulf Islands National Park Reserve

Prepared for Parks Canada
Prepared by Matthew Drake
May 1st 2011

Metadata for the Subtidal Habitat Assessment for Gulf Islands National Park Reserve



Prepared for Parks Canada
Prepared by Matthew Drake

May 1st 2011

Table of Contents

General

Site names

All sites are named based on the body of water (bay, cove, harbour) they occur in. If a named water reference does not exist at the survey location, then an adjacent land mass (island, point, spit, park) is used. A two letter code was assigned to each site to simplify data processing (see VideoCatalogue.xlsx) and is based on the first two letters occurring in the site name. When two sites have the same first two letters, one of the conflicting sites was coded using the first and third letters of the site name. There are two exceptions to the above rules; Royal Cove (RC) and Otter Bay & Roesland (OR).

Time formats (S, H, V, Vs)

There are several different time formats that occur within the datasets. The time formats differ due to the different software and hardware used during the data gathering phase.

S_time: This refers to the time stamp observed on the video footage created by the Sony HDV video cassette recorder.

H_time: This refers to the time that Hypack records with the positional data. The discrepancies between *H time* and *S_time* result from the Hypack recordings not being calibrated to the Sony HDV video cassette recorder in the field. To find the corresponding data based on the *H_time* when watching the videos, a date-specific calibration factor must be applied to the *S_time* (see *VideoCatalogue.xlsx*).

V_time: This time refers to the elapsed playing time (minutes) of the cassette tapes. The *V time* starts at the beginning of the tape playback. *V_time* cannot be used when viewing the uploaded digital video, as the digital videos often have 'dead air' time before the video actually starts. To determine the *V_time* for an uploaded video simply subtract the 'dead air' time.

Vs_time: This is the most commonly used time format. It refers to the seconds that have elapsed while playing the cassette tapes and is utilized in the unique identifier (see below). The *Vs_time* starts at the beginning of the tape playback. *Vs_time* cannot be used when viewing the uploaded digital video, as the digital videos often have 'dead air' time before the video actually starts. To determine the

Vs_time for an uploaded video simply subtract the 'dead air time'.

Video Feed

A feed refers to a continuous portion of video, such as one deployment of the camera. As several feeds may exist on one video, this descriptor refers to a particular start and stop time within a video.

Unique Identifier (Key)

All temporal and spatially related data points have a unique identifier (Key) that describes the site code, video number, video feed, and video time (*Vs_time*). For example, PR14-333 describes Princess Bay, video 1, feed 4, at elapsed video time 333 seconds.

Positional Information

This data originates from the Hypack output files (.out extensions). Portions of some sites do not have associated Hypack files (the software was not working) so waypoints were taken instead. For cases where waypoints were used, positional points (one per second) were calculated between the two waypoints using ArcMap with the assumption that the boat was traveling a constant speed. The origin of the positional information (Hypack or waypoint) is contained within the column *Origin* in *PositionalData.xlsx* .

Please note that the positional data from December describes the location of the ROV, while subsequent dates only show the positional data for the boat. The change in positional information was due to a change in the equipment being used (ROV vs. tow-behind camera). The accuracy of the positional information from the tow-behind camera will decrease with depth.

Please also note that the attribute data from the video may not line up exactly with the positional information from the Hypack system. As the two datasets were merged using time, some minor rounding errors may have occurred, though the data will not be off by more than a few seconds, if at all.

There are also limitations of the Hypack data as it is positional information obtained from a GPS device. When the GPS device does not receive a new signal, the old signal is repeated until a new one is received, so there will be data points that will occasionally overlap.

Definitions & Catalogues

Definitions.xlsx

This document contains all of the codes and definitions for the sites, substrate, biotic categories, and count data. The worksheets contained within the document are as follows:

Sites: This worksheet lists all of the site names, their associated two digit code and any additional notes related to the naming of the sites.

Substrate: This worksheet lists and defines all of the characterized substrate types and lists the associated code for each substrate type.

Biotic: This worksheet lists and defines all of the continuously occurring biotic categories and lists their associated data codes. Some species identifications are still in question and are awaiting a second opinion from experts. These questionable species are indicated with a '?' in this worksheet.

Count: This worksheet lists all of the codes for the different organisms and anthropogenic objects encountered that are not covered under the biotic coverage category. Entries in this dataset refer to non-continuous features (i.e. a single sea pen in the whole data frame, versus several sea pens in continuous frames). All organisms have both common and scientific names listed. Some species identifications are still in question and are awaiting a second opinion from experts. These questionable species are indicated with a '?' in this worksheet.

References: This worksheet gives references for the books used to identify the various animals encountered while analysing the videos.

VideoCatalogue.xlsx

This document contains information on the amount of video, the video time series and calibration factors between the different time references. The worksheets contained within the document are as follows:

Video_Amount: This worksheet contains the total duration of each video and the total amount of video coverage for each site.

Time_Series: This worksheet contains the elapsed time in all time formats (S, H, V, Vs) broken down by site, video, and feed. Please note that RC4 and PM4 are on the same cassette tape, so the PM4 video time (*V* and *Vs_time*) does not start at zero. Please also note that the video time (*V_time*) on RC2 strangely resets its self mid tape, so a zero time is recorded twice for this tape.

Time_Adjustment: This worksheet lists the differences between the Sony (*S_time*) and Hypack (*H_time*) time by each survey date. The times listed in this worksheet need to be added to the Sony time (*S_time*) to convert it into Hypack time (*H_time*).

PictureCatalogue.xlsx

This workbook is a catalogue of all the pictures taken using the Sony cassette recorder while analysing the videos. The document lists the site of origin for each picture and gives descriptions of the picture content (garbage, animals, substrate and biotic categories).

All of the pictures have references for the site that they were collected at, but only some are geo-referenced using the unique identifier. Originally the pictures were only captured to illustrate the different substrate and biotic categories (and were not geo-referenced). Subsequent pictures were associated with a unique identifier to geo-reference the pictures for use in an interactive map.

Two worksheets are contained within this document:

All: This worksheet contains all available pictures with their related data.

GPS: This worksheet contains only those pictures in the *All* worksheet that are geo-referenced.

Finalized Datasets

Biotic_Substrate.xlsx/.shp

This dataset has all of the continuous biotic and substrate data used to make portions of the maps. This dataset also contains the video coverage data.

For the substrate data, two categories were recorded; dominant substrate (with percent cover) and subdominant substrate (with percent cover). Please note that a second (or third) sub-dominate substrate component may be present in some areas, but was not recorded. Minor discrepancies may also occur between what is called pebble and cobble. When the substrate was border line pebble or cobble it was difficult to classify as there was no way of measuring, so a best guess approach was applied.

For all category codes and definitions see *Definitions.xlsx* document. All positional information was obtained from the Hypack track line output positional files.

Within the biotic category data there are several types of data recorded. Some biotic features are recorded using presence or absence of a feature (or as a high or low abundance occurrence), while other biotic features are recorded with an estimated percent coverage. To determine which biotic features are measured using occurrence, or percent cover categories see *Definitions.xlsx* or *GINPR_Anchorage_Methods_Definitions.docx* documents. Any absence/occurrence biotic data have a zero in the percent coverage column. Count data for biotic features (non-continuous) is stored in the *Counts.xlsx* workbook.

Error checking and quality control was largely done in the *Biotic_Substrate.xlsx/.shp* files and may not be updated in the original source data (files ending in *_video.xlsx*).

Counts.xlsx/.shp

This document contains all of the positional information and amounts (counts) of non-continuous garbage and animals. This data is not represented in the *Biotic_Substrate.xlsx/.shp* data set.

For all category codes and definitions see *Definitions.xlsx* document. All positional information was obtained from Hypack track line output positional files.

There are two comment columns (L & D) in this document. *L_comments* are concise and were created as labels for mapping. *D_comments* provide general information and descriptions and are not suitable for labelling.

For all occurrences of rope, a screen direction is noted in the comments section. The top of the screen is considered North (N), the bottom South (S), the left West (W), and the right East (E).

For all noted schools of fish in this data, there are no estimations of the number of fish present in the school, just simply an indication of their presence. This is also applicable to any entries for the hooded nudibranch as these nudibranchs would frequently occur in eelgrass meadows in fairly abundant amounts.

It should be noted that for some of the sites there are noticeable overlaps in the survey tracks. For sites with overlaying survey tracks the counts of some features may be slightly skewed due to possible replication.

Error checking and quality control was largely done in the *Counts.xlsx/.shp* files and may not be updated in the original source data (files ending in *_video.xlsx*).

GIS Information

Data Layers (Layer & Shapefiles)

Video Coverage

This layer file depicts the coverage for all of the useful (on the bottom) video. The shape file used for this layer is *Biotic_Substrate.shp*. The fields used for this layer file are *X_Long* and *Y_Lat*.

Substrate

This layer file shows all the substrate types that have a coverage of twenty five percent or greater. The shapefile used for this layer is *Biotic_Substrate.shp*. The field used for this layer file is *Substrate25*.

Sensitive Species

This layer file depicts the coverage of all the biotic categories defined as being sensitive to anchoring (eelgrass, sea pens, and anemones). The shapefiles used for this layer are *Biotic_Substrate.shp* and *Counts.shp.* The fields used for this layer file are *Sensitive* (*Biotic_Substrate.shp*) and *species_id* (*Count.shp*), with appropriate filters applied to *species_id*.

Algae

This layer files shows the coverage of all algae that are described under the coverage categories. The shapefile used for this layer is *Biotic_Substrate.shp*. The field used for this layer file is *OtherBiotic*, with an appropriate filter to only select algae.

Other Invertebrate Count

This layer file shows the coverage of all the other invertebrates not considered sensitive that are described under the coverage categories. Species occurring only in the species count data are not depicted. The shapefile used for this layer is *Counts.shp*. The field used for this layer file is *species_id*, with the appropriate filter to select the desired species.

Other Invertebrate Coverage

This layer file shows the coverage of all the other invertebrates not considered sensitive that are described under the coverage categories. The shapefile used for this layer is *Biotic_Substrate.shp*. The field used for this layer file is *OtherBiotic*, with an appropriate filter to only select non-sensitive invertebrates.

Garbage

The locations of all anthropogenic objects encountered are depicted here (layer file) by their identity and amount. Note that uncommon objects were either labelled as a large or small object in the *Common_name* column, with a more descriptive name in the *L_comment* column. The shapefile used for this layer is *Counts.shp*. The field used for this layer file is *Common_name*.

Study Areas

This shapefile contains the modified versions of the original study area polygons. They have been modified to encapsulate all of the areas covered by the survey. Some study site polygons were reduced as only a portion of the site was surveyed (D'Arcy, Narvaez, & Richardson), while the remaining polygons were adjusted so all of the track lines fell within the polygons. One polygon (Royal Cove) was created as this site was not included within the original study areas.

Digitized Eelgrass Orthos

This shapefile file indicates where there is a high likelihood of eelgrass meadows. The information is based on digitised orthophotos. Images used were from 2004, 2005, 2007, and 2010. These potential eelgrass areas have not been ground-truthed. The author of this shapefile is Jason Winchester, Parks Canada.

Maps

The workbooks are setup based on the size of the map printed (8x11 or 11x17). All of the 11x17 maps have a survey track for the surveyed areas not represented by the layer of interest. Within the workbooks, individual bookmarks were created for each site.

Video Coverage (8x11)

This map depicts all of the usable on-bottom video footage. The layer/shapefiles used in this map are *Study Area* and *Video Coverage*. This map was created using the *GINPR_Anchorages_8x11.mxd*.

Substrate (11x17)

This map depicts all of the dominant substrate types. The layer file used in this map is *Substrate*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Eelgrass (11x17)

This map depicts the locations of eelgrass meadows. The layer file used in this map is *SensitiveSpecies*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Sea Pens (11x17)

This map depicts the locations of all sea pens. For sea pens referred to in a singular context (ie. Sea Pen), it implies a non continuous occurrence of sea pens. The layer file used in this map is *SensitiveSpecies*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Anemones (11x17)

This map depicts the locations of sea anemones. For anemones referred to in a singular context (ie. Anemone), it implies a non continuous occurrence of anemones. The layer file used in this map is *SensitiveSpecies*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Algae (11x17)

This map shows the coverage of all the algae that are described under the coverage categories. The layer file used in this map was *Algae*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Invertebrate Coverage (11x17)

This map depicts invertebrates that are not considered sensitive and are described under the coverage categories. Species occurring only in the species count data are not depicted. The layer files used in this map were *OtherInvertatbrateCoverage* & *OtherInvertabrateCount*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Garbage (11x17)

This map depicts all of the objects considered garbage. The layer file used in this map is *Garbage*. This map was created using the *GINPR_Anchorages_11x17.mxd*.

Raw Data

This section contains information on the original data. Corrected and finalized datasets were created from the raw data.

Video Analysis Folder (files ending in *_video.xlsx*)

These are the original data collected while analysing the videos. The naming of each document describes the site code and the video. Within each document, substrate, biotic categories, count species and garbage are listed with a unique identifier (key) but are not geo-referenced.

If there is a need to come back to this data and a discrepancy between this data and the finalized datasets (*Biotic_Substrate.xlsx/.shp* or *Counts.xlsx/.shp*) is found, the finalized data is correct. Error checking and quality control was largely done in the finalized data sets and may not be updated in the original source data (files ending in *_video.xlsx*).

Hypack Output Folder

This folder contains all of the original output files that Hypack created using the ToughBook (C:\HYPACK 2008\Projects\Dougs test utm):

Track Line Folder:

This folder includes all of the .out extension files that contain the spatial and temporal data for the survey tracks. These files can be imported into Excel or Access for further use. Almost all of the positional information used in the finalized datasets originates from these files. The exception was if Hypack was not working, and waypoints were used (see *Positional Information* above).

Please note that the times in this data (*H_time*) do not directly line up with the video time stamps (*S_time*). For further explanation see the *Time formats (S, H, V, Vs)* section above.

Target Data:

This data (*HypackTargetData.tgt*) is the on-site point specific data created in Hypack, such as the location of cement bags.

This data is very rough and has not been edited, and there are likely slight positional discrepancies between this data and the finalized datasets, which would be the result of how the target data was created. Points that are entered into this data are created by indicating with the position of the mouse where an object or event is to be noted. This method is just a rough estimate of an object or event's position.

Regardless of the moderate inaccuracy of this data, it is helpful as a rough data truthing source to ensure finalised datasets have been assembled correctly.

Sensus

This dataset contains all depth and temperature data obtained using the Sensus Ultra and Sensus Pro devices for all surveys performed in 2011, and excludes videos 1 to 3 for PR, RU, and RC (which were completed in 2010).

Please note that this data may be off by as much as a minute due to the way in which the data is download (the program rounds the start time to the nearest minute).

Digital Videos

These are all of the digital videos of the original cassette tapes which were created using the program Windows Movie Maker. The resolution of these videos is worse than that of the cassette tapes, so the digital videos were not analysed and were only used for quick checks of the video if an issue needed to be resolved. Please note that not all of the digital videos have the same *V_time* as the cassette tapes as there is a blue screen of undetermined length at the start of some of the digital videos. To adjust for this, simply add the time the blue screen is present on a certain digital video to calculate the proper *V_time*.

Filing system

There are two locations for data (G drive and GIS network). The rationale behind creating two sources was for ease of access. The locations and filing system for all documents are as follows.

G:\Common\GulfIslands\VideoAnalysis
Metadata.docx

\Final_Products
SiteResults.docx
Methods_Definitions.docx
PictureCatalogue.xlsx

\Data
VideoCatalogue.xlsx
Definitions.xlsx
PositionalData.xlsx
Biotic_Substrate.xlsx
Counts.xlsx

\Maps
MapKey.xslx
\Sitename
Video Coverage
Substrate
Eelgrass
Sea Pens
Anemones
Algae
Invertebrate Coverage
Garbage

\Raw_Data
\HypackOutput
HypacTargetData.tgt

\TrackLines

All .out file extensions

\VideoAnalysis

Sitenamehere_video.xlsx

Sensus

Sensus.xlsx

GIS drive (\\van-map2\Projects\GulfIslands\MarineBoating)

\Maps

GINPR_Anchorages_8x11.mxd
GINPR_Anchorages_11x17.mxd

\Shapefiles

Algae.lyr
Biotic_Substrate.shp
Counts.shp
DigitizedEelgrass_Orthophotos.shp
Garbage.lyr
OtherInvertebrateCount.lyr
OtherInvertebrateCoverage.lyr
SensitiveSpecies.lyr
Study_Areas.shp
Substrate.lyr
VideoCoverage.lyr

Appendix 3

Subtidal Habitat Assessment for Gulf Islands National Park Reserve: Results

Prepared for Parks Canada
Prepared by Matthew Drake
May 1st 2011

Subtidal Habitat Assessment for Gulf Islands National Park Reserve: Results

Prepared for Parks Canada
Prepared by Matthew Drake

May 1st 2011

Contents

Gulf Islands National Park Reserve Forward

The following document outlines some of the results found during the video analysis for the subtidal habitat assessment of the Gulf Islands National Park Reserve. The intent of this project was to identify any potentially sensitive areas that might be affected by frequent anchoring activity. Video data was collected in the field from December 1st, 2010 to March 25th, 2011 and was then analyzed and mapped at the Parks Canada Western Service Centre. For a description of the methodology and definitions used in this project, please see the *Subtidal Habitat Assessment for Gulf Islands National Park Reserve: Methods & Definitions* document.

The total area of all 13 study sites for the Gulf Islands National Park Reserve anchorage study is 3.34 Km^2 (Appendix A). Approximately 24 hours of video footage was recorded for this study, of which roughly 20.5 hours were used and mapped (Appendix A). The largest site surveyed (in terms of area) was Sidney Spit (~1.43 Km^2), and it had the second longest video coverage (2:28:22) after Bennet Bay (2:32:19) (Appendix A). The smallest site surveyed (in terms of area) was Richardson Bay (0.03 Km^2), and Narvaez, which is of similar size (0.04 Km^2), had the least amount of video footage (0:33:18) (Appendix A).

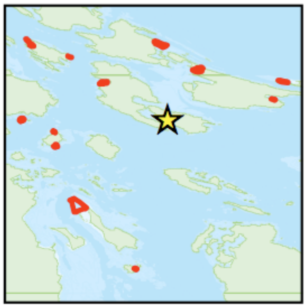
Eelgrass meadows are seen in some capacity at eleven of the thirteen sites. Orange sea pen gardens are not as prevalent as eelgrass meadows but do occur at six of the surveyed sites.

Three invertebrates that were regularly encountered throughout the study area are Dungeness crabs (n=400), pink sea stars (n=399), and sunflower stars (n=364) (Appendix C). A large majority of Dungeness crabs were seen at Sidney Spit (n=201) (Appendix C). Bennet Bay has the most pink sea stars (n=162) and North Russell Island has the most sunflower stars (n=104) (Appendix C). The greatest species richness occurs at Bennet Bay (*S*=23), with North Russell (*S*=22), and Winter Cove (*S*=21) close behind.

Species richness (*S*) is used throughout this document, and is defined as a count of the number of different species occurring. For the purposes of this report, only animals were considered for species richness (not plants), as much of the seaweed encountered was unidentifiable.

Most sites have some form of garbage (except D'Arcy), with bottles (n=397) being the most common object observed (Appendix B). Royal Cove has the most bottles present (n=182) followed by Bennet Bay (n=72) (Appendix B). Some of the more obscure objects encountered were bags of cement at North Russell Island, a thigh master at Sidney Spit, an umbrella at Bennett Bay, and lawn chairs at both Reef Harbour and James Bay.

Sites



Beaumont

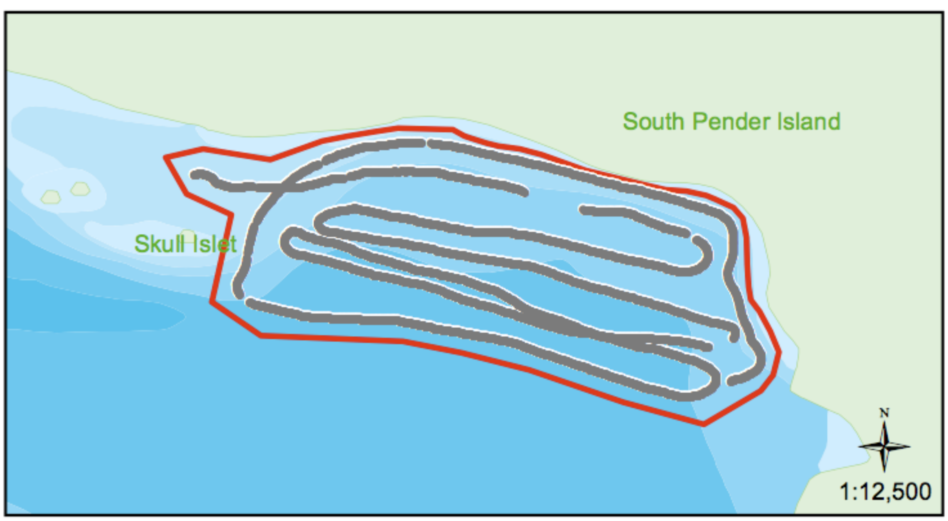
Major Adjacent Land Mass: Pender Island

Survey area: 0.16 Km^2
Total survey time (hh:mm:ss): 1:22:38
Date surveyed: February 10th, 2011

Description:
The substrate for this site is primarily fine grain or some variation of fine grain with another substrate. This site has some of the heaviest and most wide spread brown mat coverage and has very little biotic coverage. While there is kelp stipes in the northwest area of the study site, there is no eelgrass present at this site, which suggests that potential eelgrass based on the orthophotos may be a kelp species, and not eelgrass.

This site has a low species richness (*S*=7), compared to the other sites. The dominant animal at this site is the Dungeness crab (n=33), and with the abundance of dark brown mat at this site you can easily observe the track marks from crab activity.

Beaumont has the second highest count of garbage (n=110) compared to other sites (Appendix B). This site also has the second highest count of bottles (n=73), which is slightly ironic as another piece of garbage found here was a recycling bin (Appendix B).



Bennet Bay

Major Adjacent Land Mass: Mayne Island

Survey area: 0.43 Km^2
Total survey time (hh:mm:ss): 2:32:19
Date surveyed: March 8th & March 17th, 2011

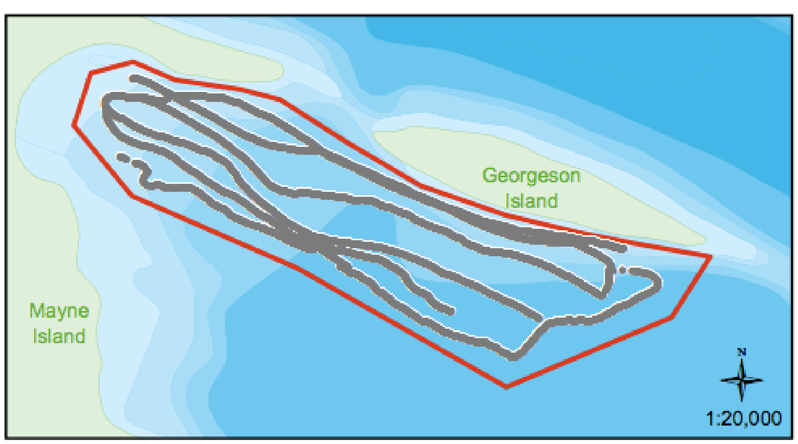
Description:
The substrate of this site is predominantly composed of fine grain material with a moderate amount of brown mat present. There are also some notable areas with pebble and fine grain mixtures.

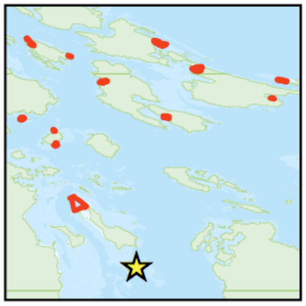
A sizable eelgrass meadow was encountered at the head of the bay. The surveyed eelgrass lines up nicely with the potential eelgrass layer captured from the orthophotos. Many hooded nudibranch were encountered within this eelgrass meadow. Along Georgeson Island there are additional but smaller eelgrass meadows, but they are patchy and less dense than those at the head of the bay.

Prominent orange sea pen gardens, which include juveniles, are widely distributed throughout the bay. Many striped nudibranch and (possibly) *Tritonia* nudibranch were encountered within the gardens and were often seen preying on the sea pens.

Red sea urchins were observed between Georgeson and Mayne Island on potentially suitable anchoring substrate, however, anchoring in this area is unlikely as it is open to direct current. Some algae are present at this site. A noticeable *Sargassum* bed is present along Georgeson Island and *Laminaria* clearly occurs in various locations throughout the bay.

This site has the highest species richness of all the sites (*S*=23). For the size of this site there was a minimal amount of garbage encountered (n=17), where the dominant garbage type is bottles (n=13) (Appendix B).





D'Arcy Island

Major Adjacent Land Mass: D'Arcy Island

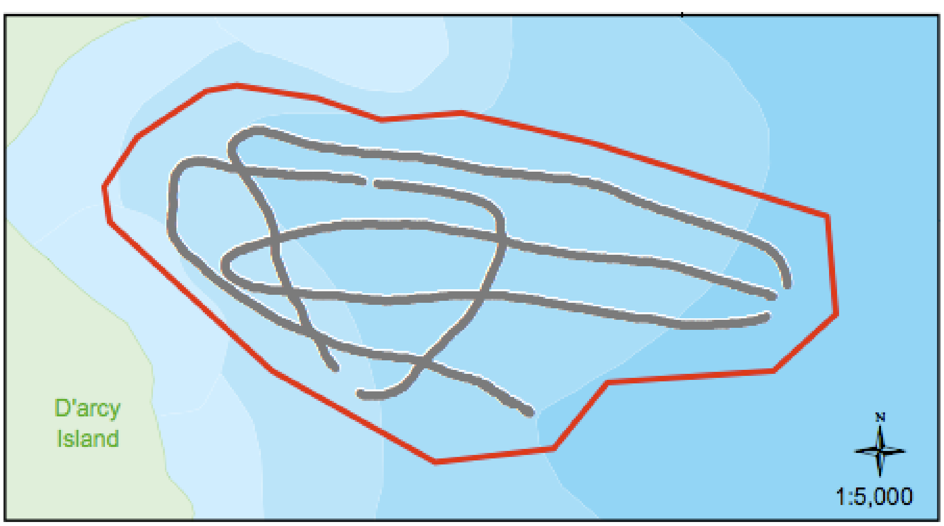
Survey area: 0.04 Km^2
Total survey time (hh:mm:ss): 00:33:46
Date surveyed: February 10th, 2011

Description:
The substrate of this site is dominantly fine grain with a moderate coverage of brown mat. There are a number of other substrate types present, such as small pockets of sand waves, although the waves are dingy from the presence of the brown mat.

Eelgrass meadows were encountered at this site, though it should be noted that the orthophoto estimates for this site do not appear to capture the eelgrass distribution very well. There is a small singular patch of eelgrass that may be surfgrass to the southwest. This seagrass patch was found in small fine grain pockets in amongst the boulders and bedrock. Determining whether this patch of seagrass is surfgrass or eelgrass is difficult without better video resolution or a physical sample. The potential surfgrass at this site was not mapped as surfgrass but rather as eelgrass due to its uncertain identity.

The southwest area (characterized by bedrock and boulder) has a noticeable presence of articulated coralline algae. There were no other notable algae trends nor was there any notable animal presence.

This site is the least diverse area of all the sites in terms of species richness (*S*=2). D'Arcy is also unique in not having any garbage present at the site.



James Bay

Major Adjacent Land Mass: Prevost Island

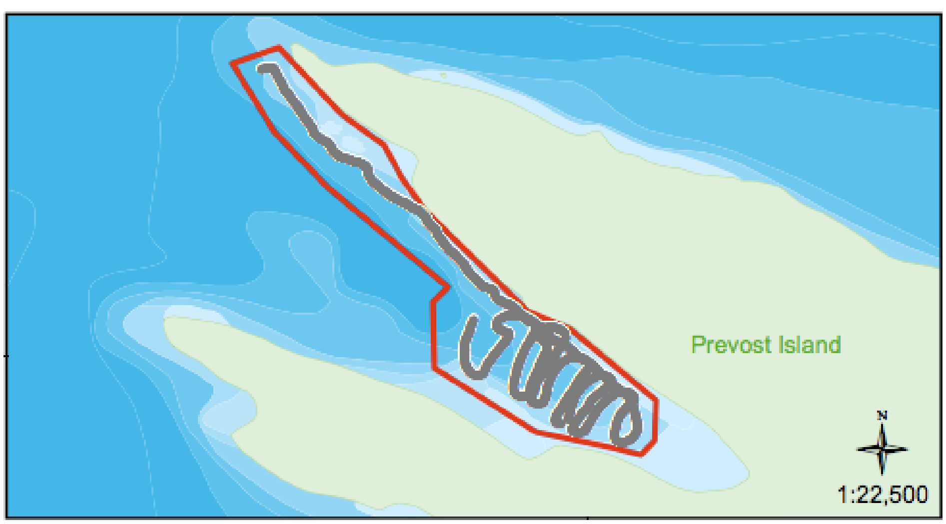
Survey area: 0.18 Km^2
Total survey time (hh:mm:ss): 1:30:21
Date surveyed: March 8th, 2011

Description:
Along Peile Point area there is a mix of steep bedrock and fine grain, which could possibly be fine shell hash, but due to the video resolution it was difficult to tell. Further in the bay it becomes entirely fine grain with moderately distributed brown mat in the shallower portions of the bay.

Orange sea pens, both adults and juveniles, are prominent in the bay at this site. Eelgrass was also encountered in the bay, which seemed to overlap with the orthophoto estimates nicely. Small areas of tube-dwelling anemones are also present here.

Along Peile point there is continuous red sea urchin presence. Along this same point there may also possibly be abalone, but the video resolution was not clear enough to make a proper identification, though the animals had an abalone shaped body. Another animal unique to this site was what could possibly be geoducks. The species richness of this site compared to others is moderate (*S*=7).

This site has a moderate amount of garbage compared to other sites (n=33) (Appendix B). Some of the objects include active crab traps (n=2), but the most frequently occurring object is bottles (n=27) (Appendix B).



Narvaez Bay

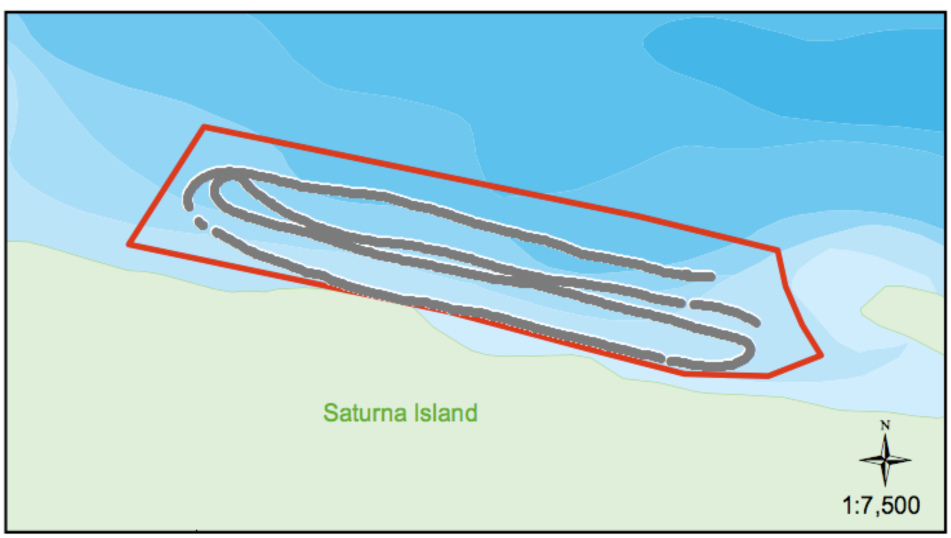
Major Adjacent Land Mass: Saturna Island

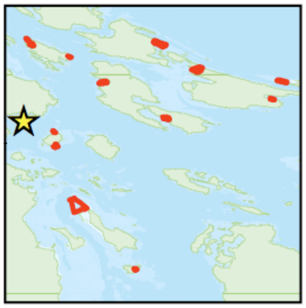
Survey area: 0.04 Km^2
Total survey time (hh:mm:ss): 0:33:18
Date surveyed: February 10^{th}, 2011

Description:
This site is almost entirely composed of a fine grain substrate. There is a moderate distribution of brown mat as well.

With the exception of a moderate eelgrass meadow within the small bay, there are not many potentially sensitive areas at this site. The eelgrass meadow appears to confirm the eelgrass orthophoto suggestions. Within the eelgrass there is an area with heavy infaunal mounding. Elsewhere in the site there are several isolated spots with tube-dwelling anemones. The species richness (*S*=7) for this site is relatively low.

In terms of garbage there is a moderate amount compared to other sites (n=44), most of which is composed of bottles (n=43), largely occurring near the small bay (Appendix B).





North Russell Island

Major Adjacent Land Mass: Russell Island

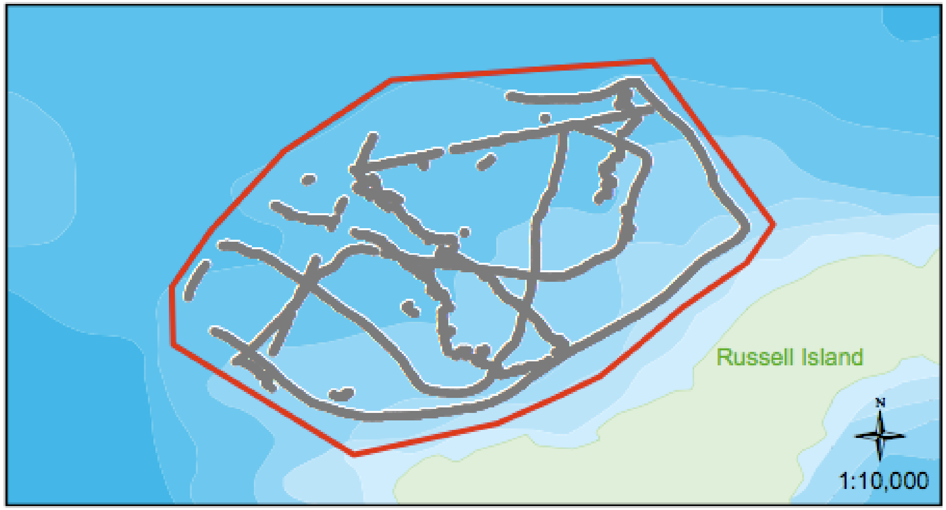
Survey area: 0.15 Km^2
Total survey time (hh:mm:ss): 2:25:58
Date surveyed: December 1st, 2010, February 9th & March 25th, 2011

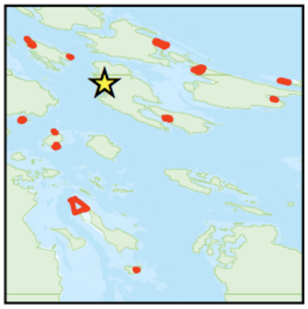
Description:
This site is highly diverse in terms of substrate type (fine grain to bedrock), though the deeper areas do appear to be primarily fine grain. In the shallower areas there is minimal brown mat coverage, though the limited distribution is likely due to the diverse substrates types.

Potential sensitive organisms at the site include the white sea pens in one of the deeper areas and the continuous tall plumose anemone coverage. There are no eelgrass meadows present. The orthophoto suggestions are likely representing *Ulva* and some other variations of algae as these types of algae were frequently seen in the shallower water at this site.

This site has the second highest level of species richness (*S*=22) compared to other sites. There appears to be an unusually high amount of Red Rock crab burrowing in a localised area of fine grain sediment in the deep western area of this site.

The amount of garbage encountered at this site was moderate (n=23) (Appendix B) compared to other sites. Several full bags of cement were encountered in the vicinity of the shoreline.





Otter Bay & Roesland

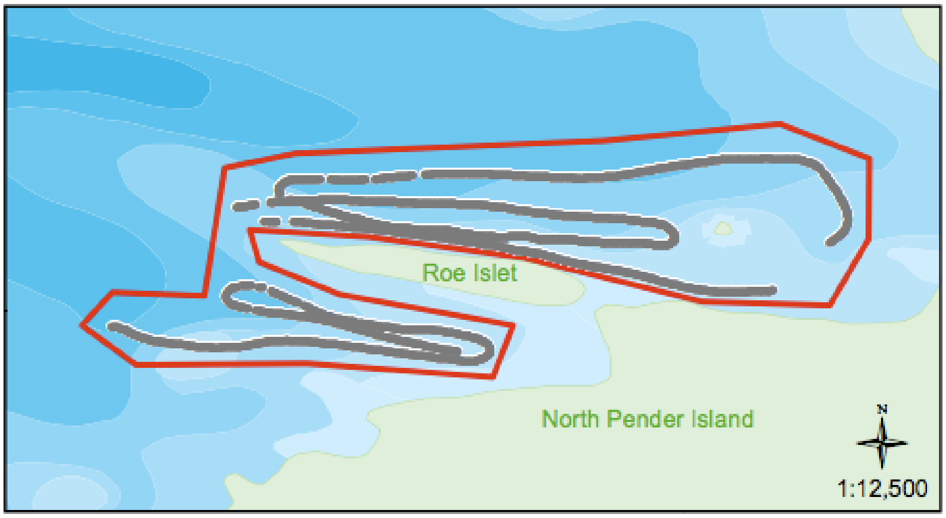
Major Adjacent Land Mass: Pender Island

Survey area: 0.16 Km^2
Total survey time (hh:mm:ss): 0:53:26
Date surveyed: February 9th, 2011

Description:
This site is almost entirely fine grain with some notable spots of shell hash. There is a prominent brown mat coverage on the majority of the fine grain substrate at this site.

Within Otter Bay there is a noticeable abundance of orange sea pens. Some eelgrass was encountered in the west portion of Otter Bay, but due to some video issues the extent of the meadow was likely not entirely captured. The orthophoto analysis for this area might indicate the meadow's full distribution, although that is not likely the case for Ella Bay (the smaller bay). There is a very small patch of eelgrass occurring in Ella Bay but the area is prominently covered by *Ulva*, so it is likely that the orthophoto analysis is depicting *Ulva* coverage in this bay.

This site has a low species richness (*S*=6) compared to the other sites, as well as a low level of garbage (n=8) (Appendix B).



Princess Bay

(Princess Margaret, Tortoise Bay)

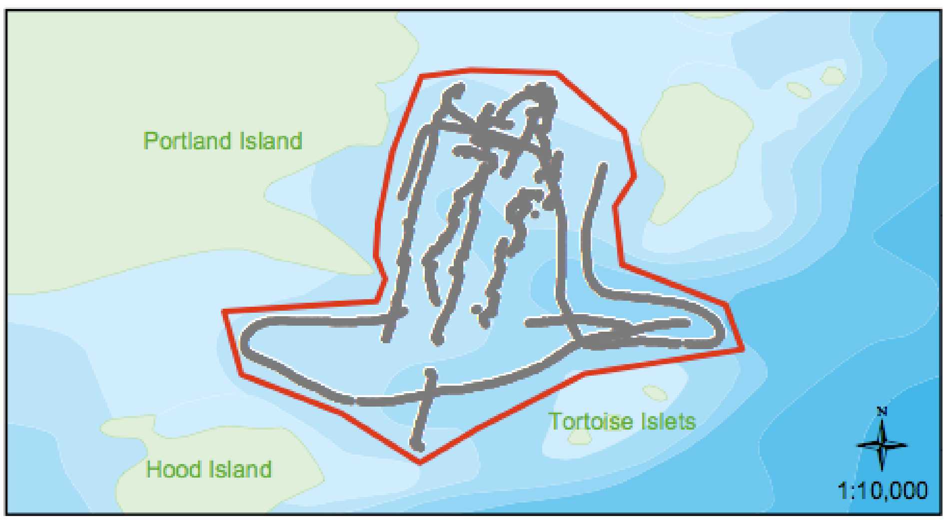
Major Adjacent Land Mass: Portland Island

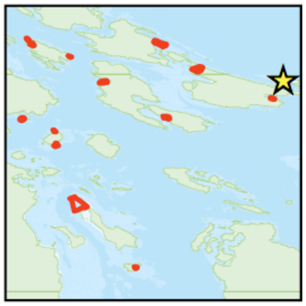
Survey area: 0.09 Km^2
Total survey time (hh:mm:ss): 2:18:57
Date surveyed: December 3rd, 2010 & February 9th, 2011

Description:
This site is predominantly composed of a fine grain substrate with moderate brown mat coverage. Of the biotic components there appears to be two dominate types; eelgrass meadows and *Ulva*. There are two eelgrass meadows of a moderate size occurring within the bay. One confirms the suggestion of eelgrass by orthophotos within the bay. The southwest eelgrass meadow was not documented until this study, likely due to the depth of water in which it occurs.

There is a low species richness (S = 8) at this site compared to other sites, though there was a large school of Tubesnouts (*Pallasina barbata*) occurring in and amongst the eelgrass meadows.

There is a moderate amount of garbage present (n=33) (Appendix B) in the bay. The prominent component of the garbage is bottles (n=24) (Appendix B). One of the more obscure objects is a large metal drum.





Reef Harbour

(Tumbo & Cabbage Island)

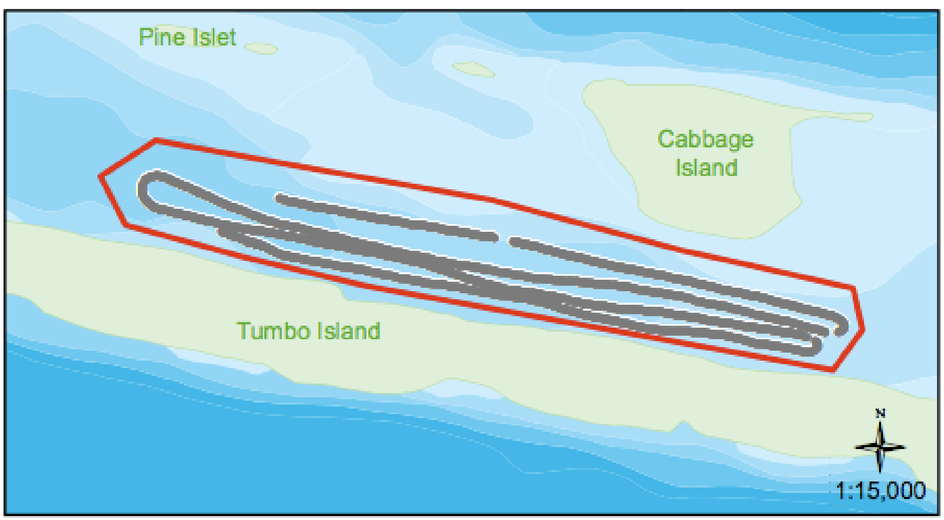
Major Adjacent Land Mass: Tumbo Island

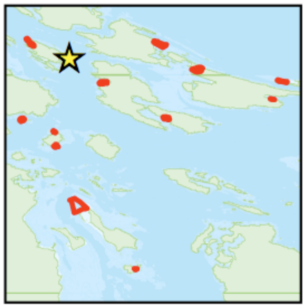
Survey area: 0.15 Km^2
Total survey time (hh:mm:ss): 1:12:49
Date surveyed: February 10th, 2011

Description:
This site is entirely fine grain, except for a very small portion in the southwest corner of the site. There is very prominent brown mat beginning just outside of the eelgrass meadow. The extensive eelgrass meadow encountered here was some of the healthiest observed in all of the surveyed sites. The orthophoto analysis appears to overlap nicely where the eelgrass is, which suggests that there is more eelgrass further in the harbour.

Beyond eelgrass there were not many other organisms encountered. The species richness compared to other sites is low (*S*=5). One of the animals encountered was an oddly located lingcod; it was observed in the middle of uncharacteristic fine grain substrate, just resting.

This site has relatively low amounts of garbage (n=16) (Appendix B). One of the more obscure objects encountered was a lawn chair.





Richardson Bay

(Portlock Point)

Major Adjacent Land Mass: Prevost Island

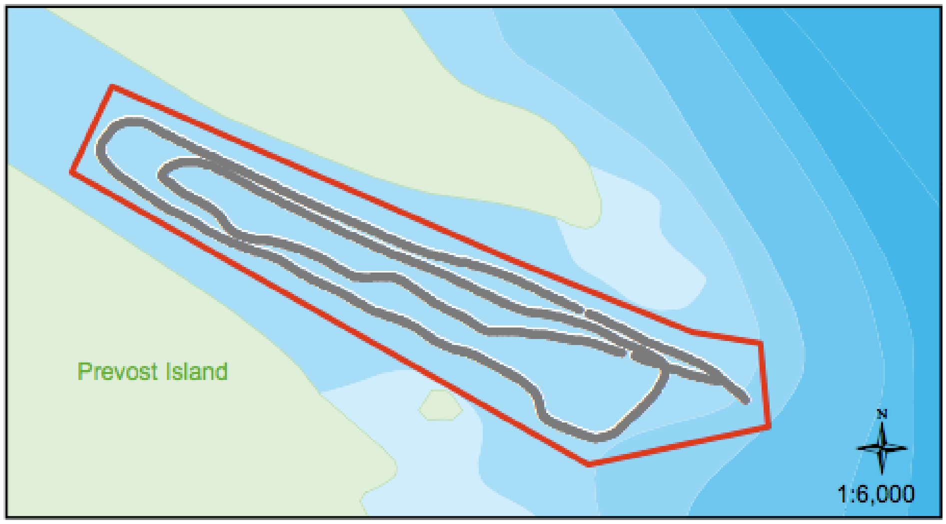
Survey area: 0.03 Km^2
Total survey time (hh:mm:ss): 0:33:42
Date surveyed: March 8th, 2011

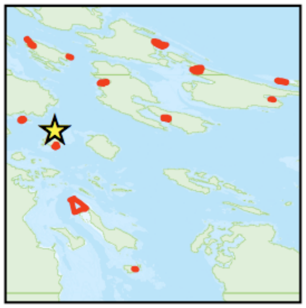
Description:
The substrate at this site is predominantly fine grain with a moderate coverage of brown mat. There are also some isolated areas that have bedrock.

Just outside the bay there is an orange sea pen garden, and just inside the bay there is a small eelgrass meadow. Further in the bay there is primarily *Ulva*, which is likely what the orthophoto analysis is depicting. In addition to the *Ulva* in the bay there is a noticeable presence of infaunal mounding activity. Unique to this site, near the mouth of the bay, an isolated area has brittle stars and cup coral. This site has a fairly diverse abiotic and biotic (*S*=13) make-up for its small size.

This site has a low level of garbage compared to most other sites (n=2) (Appendix B).

It should be noted that while surveying this area, the fine grain substrate was somehow disturbed when we went into the bay, making the waters slightly cloudy. As a result of this, some of the finer details may not have been captured at this site.





Royal Cove

Major Adjacent Land Mass: Portland Island

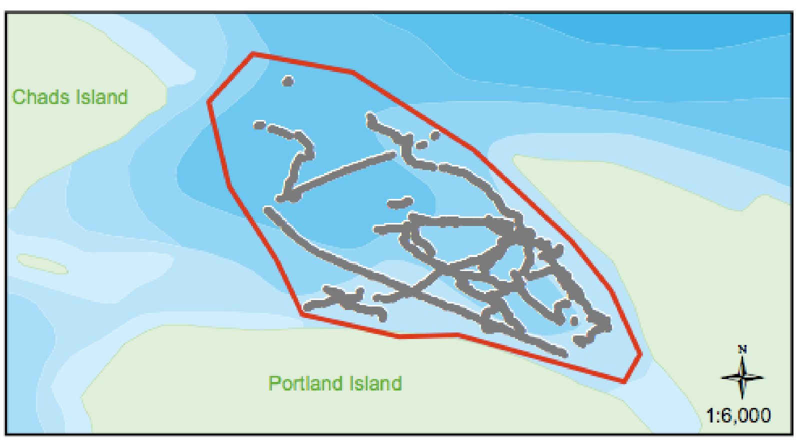
Survey area: 0.04 Km^2
Total survey time (hh:mm:ss): 1:49:50
Date surveyed: December 2nd, 2010 & February 9th, 2011

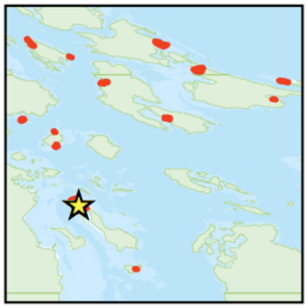
Description:
This site is predominantly fine grain with a moderate brown mat distribution. There is some bedrock closer to the outer shorelines of the cove.

There is eelgrass found at this site but it was fairly low lying eelgrass mixed in with a bunch of other algae types, so it is possible the eelgrass seen here was part of a seaweed wrack. Further into the cove noticeable amounts of *Ulva* were observed and it is likely that it is the *Ulva* that is depicted by the orthophoto polygon at this site.

The species richness (*S*=14) here is moderate compared to the other sites. There is a very high amount of garbage (n=201) (Appendix B), the highest count of all the sites. The majority of the garbage found here is bottles (n=182), which is also the highest bottle count of all the sites (Appendix B). This site also has a notable amount of small objects (n=13) (Appendix B), some of which included a dust pan, a dip net, a sandal, and a roll of duct tape.

When looking at this site you will notice two of the track lines are fairly straight. Those are the result of using two way points and back filling the positional information. These waypoints were used due to malfunctioning GPS equipment in the field. As a result of this method, the positional accuracy will not be as high as the other positional points depicted.





Sidney Spit

Major Adjacent Land Mass: Sidney Island

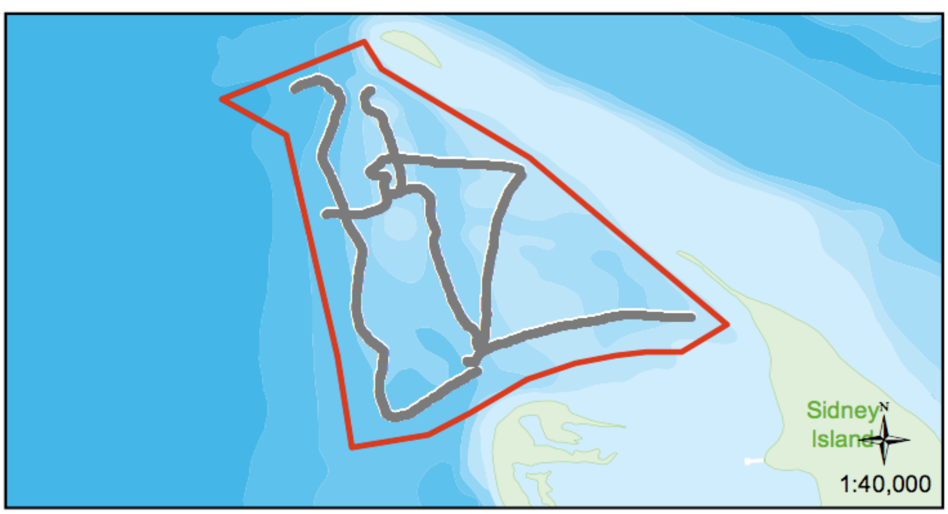
Survey area: 1.43 Km^2
Total survey time (hh:mm:ss): 2:28:22
Date surveyed: March 25th, 2011

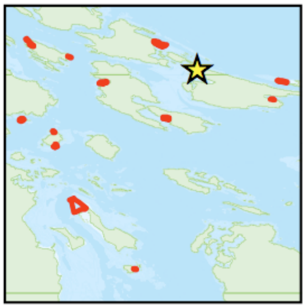
Description:
In the more sheltered areas, the substrate is composed of fine grain and in the more exposed areas (outside of the points) the substrate is composed of sand waves. In the non eelgrass areas the distribution of brown mat is moderate.

Prominent eelgrass meadows were encountered at this site. The orthophoto polygons accurately depict the extent of the eelgrass meadow, as this site has been extensively surveyed for eelgrass before this project. What has not been mapped until this project is the noticeable presence of orange sea pens throughout the area, some of which include juveniles.

Species richness for this area is somewhat low (*S*=7), though large schools of Pacific sand lance were encountered throughout the areas with sand waves.   The most Dungeness crabs of any site (n=201) were encountered here (Appendix C), which is likely due to the habitat suitability of this site.

This site has a moderate amount of garbage present (n=21), with crab traps as the majority of the objects (n=14) (Appendix B). This site has the most crab traps present of any site, which are likely from commercial operations (with some traps still active). One of the more obscure objects encountered here (and in all of the sites) is what looks like a thigh master.





Winter Cove

Major Adjacent Land Mass: Saturna Island

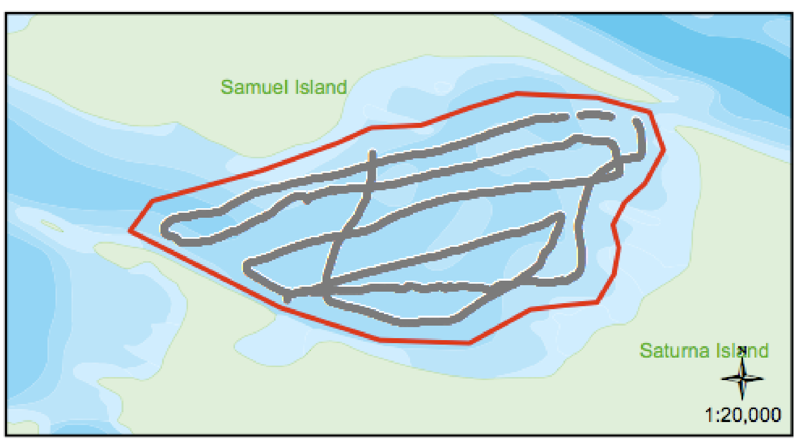
Survey area: 0.44 Km^2
Total survey time (hh:mm:ss): 2:16:22
Date surveyed: March 18th, 2011

Description:
The substrate of this site is predominantly fine grain or some variation of fine grain, with prominent brown mat distribution.

Eelgrass is widely distributed throughout this site, but it is not the healthiest looking eelgrass. The eelgrass tends to be somewhat thin in density, but is continuous in coverage. On the map there are very small patches of surfgrass depicted. As was the case with D'Arcy, this might actually be eelgrass, but the reason it was classified as surfgrass was based on its surrounding substrate (being predominantly rock). Within this site there is also a very prominent level of orange sea pens dispersed along the Saturna Island side of the bay, some of which includes juveniles.

This site has the third highest species richness (*S*=21) among all of the sites. Some of the unique biotic coverage included what are possibly Rough Piddocks, and another possible type of bivalve with a small white siphon. There is another mystery organism that could potentially be a tunicate that is fairly widely distributed in varying densities throughout much of the cove.

For such a large site, the amount of garbage here is fairly low (n=15) (Appendix B). Much like many other sites, the garbage that is here mostly consisted of bottles (n=14) (Appendix B).



Appendix A

The total survey area and times for each site.

Site	Video (h:mm:ss)	Area (Km^2)
Beaumont	1:22:38	0.16
Bennet Bay	2:32:19	0.43
D'Arcy	0:33:46	0.04
James Bay	1:30:21	0.18
Narvaez	0:33:18	0.04
Otter Bay & Roesland	0:53:26	0.16
Princess Bay	2:18:57	0.09
Reef Harbour	1:12:49	0.15
Richardson Bay	0:33:42	0.03
Royal Cove	1:49:50	0.04
Russell Island	2:25:58	0.15
Sidney	2:28:22	1.43
Winter Cove	2:16:22	0.44
Total	20:31:48	3.34

Appendix B

The total amounts (count) of garbage and other objects encountered at each site.

Object Type	Beaumont	Bennet Bay	D'Arcy Island	James Bay	Narvaez Bay	Otter Bay & Roesland	Princess Bay	Royal Cove	Reef Harbour	Richardson Bay	Russel Island	Sidney Spit	Winter Cove	Sum
Bottles	73	13		27	43	3	24	182	4	1	11	2	14	**397**
Cans	12	1				1	2	1	3		1	1		**22**
Small Objects	16			1	1	1	5	13	4		10	1	1	**53**
Large Objects	4	1		1			1	5	3		1			**16**
Abandoned Crab Traps	1	1		2		2						7		**13**
Clean Crab Traps	1	1		2			1					7		**12**
Rope						1			1	1		3		**6**
Mooring Buoy Anchors	3								1					**4**
Sum	**110**	**17**	**0**	**33**	**44**	**8**	**33**	**201**	**16**	**2**	**23**	**21**	**15**	**523**

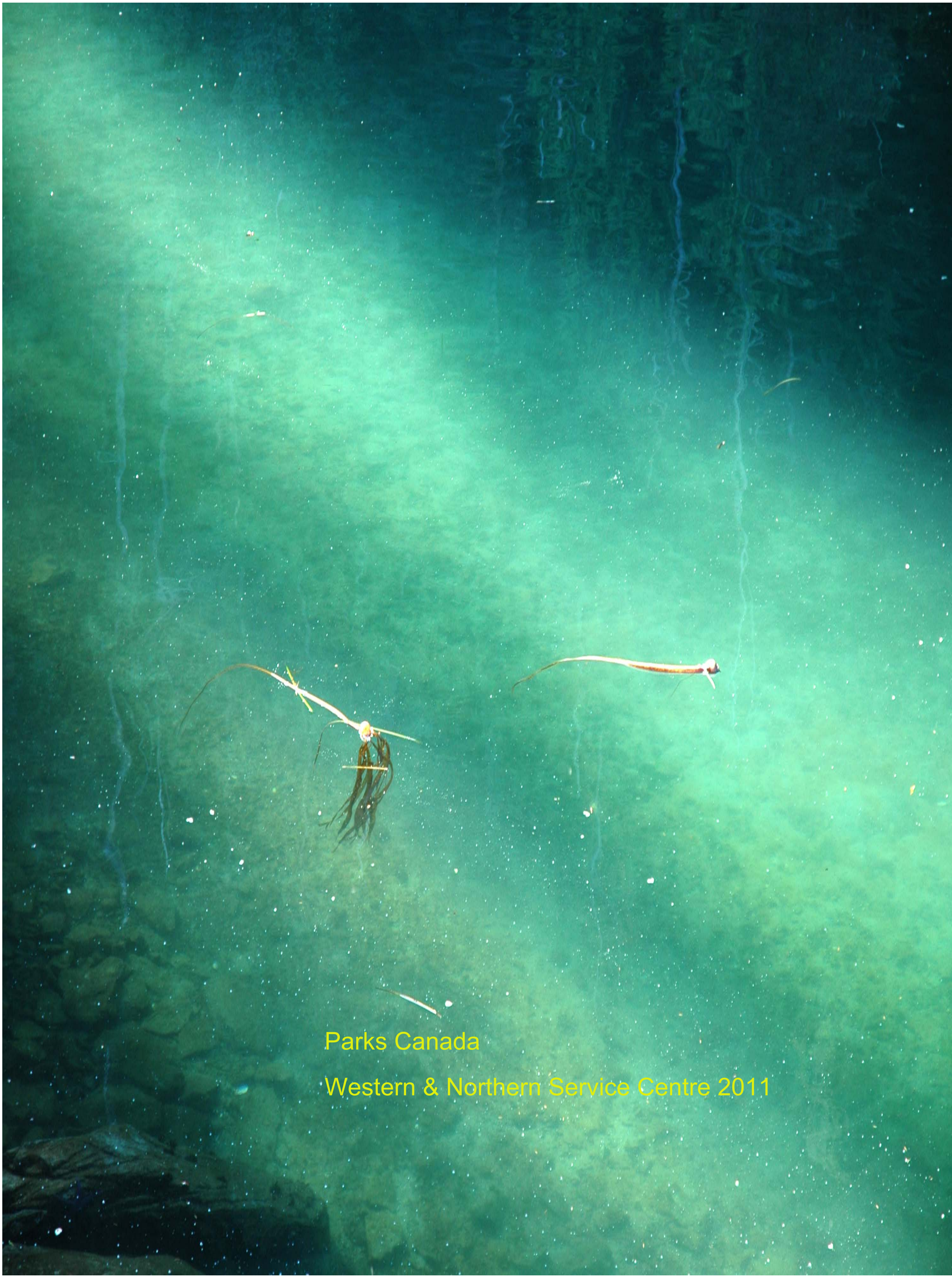
Appendix C

The total amounts of each animal counted by site

Common_Name	Beaumont	Bennet Bay	D'Arcy Island	James Bay	Narvaez Bay	Otter Bay & Roesland	Princess Bay	Royal Cove	Reef Harbour	Richardson Bay	Russel Island	Sidney Spit	Winter Cove	Sum
Cnidarians														
Anemone Unknown	3	5		8	3		1	1		1	3		3	**28**
Tall Plumose Anemone	9	4		16		6			10	1	51		11	**108**
Short Plumose Anemone		2												**2**
Tube-dwelling Anemone	22	6		54	19			3		6	1			**111**
Orange Sea Pen		114		111		39				11		86	58	**419**
White Sea Pen											3			**3**
Annelids														
Spaghetti worm													2	**2**
Molluscs														
Rock Scallop				1	1									**2**
Rough Piddock								1					6	**7**
Pacific Goeduck				8										**8**
Nudibranch Unknown		17								3			2	**22**
Hooded Nudibranch							2							**2**
Frosted Nudibranch		1		1	2			1			12			**17**
Gastropod Snail Unknown											27			**27**
Stripped Nudibranch		55												**55**
Crustaceans														
Unknown Shrimp							3							**3**
Unknown Crab													1	**1**
Unknown Cancer Crab	3	10		7		1			9		5	10	1	**46**
Dungeness Crab	33	47		23	5	19	17	4	37	2	7	201	5	**400**
Red Rock Crab		1					4	20			27		9	**61**
Graceful Crab								2						**2**
Kelp Crab		3												**3**
Echinoderms														
Unknown Sea Cucumber													1	**1**
Giant Sea Cucumber		22		11						23	19		6	**81**
Red Sea Cucumber		31											5	**36**
Sea Lilly										1	1			**2**
Uknown Starfish		15		3	1	1	2	8	3		9	1	28	**71**
Sunflower Star	16	36		48	1	7	3	17	15	5	104	31	81	**364**
Pink Star	3	162		78		2	2	17	18	1	26	1	89	**399**
Leather Star		35		10				2		1	3		18	**69**
Mottled Star	13	5	1	5	1			2			34		12	**73**
Sun star		7						1			3		4	**15**
Blood Star		4	1	2						1			3	**11**
Ochre Star								1					17	**18**
Bat Star											1			**1**
Painted Star		1		3							1			**5**
Cushion Star		1												**1**
Rose Star		1												**1**
Red Sea Urchin		15		7										**22**

Appendix C continued

Common_Name	Beaumont	Bennet Bay	D'Arcy Island	James Bay	Narvaez Bay	Otter Bay & Roesland	Princess Bay	Royal Cove	Reef Harbour	Richardson Bay	Russel Island	Sidney Spit	Winter Cove	Sum
Vertebrates														
Unknown Flatfish								1		1	3			**5**
Starry Flounder											1	3		**4**
Unknown Greenling											2			**2**
Kelp Greenling				3				1			1		3	**8**
White spotted Greenling											2			**2**
Lingcod									1					**1**
Sandlance School														**0**
Tubesnout School														**0**
Unknown Fish											1			**1**
Unknown Fish School														**0**
Copper Rockfish											1			**1**
Sculpin		1										1		**2**
Sum	**68**	**415**	**2**	**213**	**8**	**30**	**28**	**80**	**85**	**37**	**273**	**256**	**288**	**1783**


Parks Canada
Western & Northern Service Centre 2011