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LONG TERM MONITORING OF THE INTERTIDAL COMMUNITIES WITHIN
THE GULF OF THE FARALLONES NATIONAL MARINE SANCTUARY:
SOUTH FARALLON ISLANDS

ANNUAL REPORT: 1996

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ABSTRACT

The Gulf of the Farallones National Marine Sanctuary (GFNMS) terrestrial boundary is the mean high tide mark. Estuarine and marine intertidal communities are essential components contributing to the productivity of the Gulf of the Farallones. Long term monitoring of the intertidal areas within the Sanctuary are essential for the protection and management of Sanctuary resources. Previous to this project, the most recent survey of these intertidal areas was reported in 1979 (CSWRCB) and prior to that, in 1892 (Blankinship). The objectives of this monitoring project are to: 1) establish photo and point quadrats around the South Farallon Islands; 2) develop an intertidal species inventory list for sessile organisms; 3) determine percent cover of algal groups within the quadrats; 4) complete a general characterization of the island's intertidal areas; and 5) provide a baseline of data that may enable NOAA to determine damage to intertidal resources in the event of a human-caused perturbation, such as an oil spill. Twenty-four quadrats, each with an associated randomly selected quadrat, have been established around the South Farallon Islands. The quadrats are in areas of distinct zonation containing mussel and sea anemone communities, high and mid-algal assemblages and where trampling by pinnipeds is common. Predominant algal genera include: *Mazzaella*, *Mastocarpus*, *Ulva*, *Corallina*, *Ceramium*, *Cladophora*, *Cryptopleura*, *Prionitis*, *Endocladia*, *Egregia*, *Alaria*, and *Gelidium*. Predominant invertebrate genera include: *Mytilus*, *Anthopleura*, *Balanus*, *Tetraclita*, and *Ophlitaspongia*. The range of mean annual percent cover is from 122 to 252%. Rock (unoccupied space) occurred in nine permanent quadrats, >1 to 8% mean annual cover. Algal species within the Order Fucales were not found on the islands, during 1996.

INTRODUCTION

Marine littoral communities occupy hard and sandy coastal substrates. These habitats are regarded as trophically open ecosystems in which energy and materials are regularly imported and exported. The daily changes of the tidal cycle, in conjunction with other environmental factors such as: wave action, insolation, and desiccation, broadly define the distribution and abundance of intertidal species particularly at the limits of their distribution. Zonation is often conspicuous and readily definable. Because the intertidal areas are accessible, easily observed, and are known to be vulnerable to oil spill events (Foster et al. 1986), a long term monitoring project of the intertidal areas within the Sanctuary is necessary for GFNMS management and resource protection.

The Sanctuary must document the density and diversity of the organisms in the intertidal areas of the GFNMS in the event of a natural or human-induced catastrophic perturbation. This Sanctuary has experienced several large scale perturbations. In 1984, the tanker vessel Puerto Rican exploded, broke apart and sank 12 miles off the South Farallon Islands, Farallon National Wildlife Refuge. Over 1.4 million gallons of oil were discharged into the Sanctuary and killed at

least 3000 birds. In 1986 the barge Apex Houston spilled oil which killed an estimated 10,000 birds. Also in 1986 a large salt barge ran aground at Duxbury Reef. The area of intertidal habitat that was impacted because of this wreck is unknown. Because these types of disasters will continue, we have developed a long term monitoring program to assess the intertidal areas and provide a baseline of data to aid in determining resource risk and assessment.

The terrestrial boundary for the GFNMS is at the mean high tide level. There are over 160 km of shoreline within the GFNMS and more estuarine acreage than in all of the west coast National Estuarine Research Reserves combined. The estuarine and marine littoral communities are essential to the productivity of the Gulf of the Farallones. Recent monitoring of intertidal communities include projects along northern California (Kinnetic Laboratories 1992), southern California (Richards and Davis 1988; Sousa 1984), Gordon L. Chan (1965-1992, pers. comm.) at Duxbury Reef just north of Bolinas Lagoon, Golden Gate National Recreation Area, within the Point Reyes National Seashore, central California from Cape Mendocino south to San Luis Obispo (Sean Connolly, Stanford University), and at seven locations within the boundaries of the GFNMS and Monterey Bay National Marine Sanctuary, between Bodega Head and Point Año Nuevo conducted by the GFNMS.

The information from this project is comparable to on-going intertidal monitoring within the Channel Islands National Park, GFNMS and MBNMS, Point Reyes National Seashore and Golden Gate National Recreation Area and will be available to researchers and seashore educators. The Monterey Bay and Olympic Coast National Marine Sanctuaries plan to conduct comparable, long term monitoring efforts in the intertidal areas within those Sanctuaries. NOAA HazMat and Natural Resource Damage Assessment require the assessment and archival of this data for rapid response and legal defense.

This type of project assists in the education of local university students and educates individuals to the importance of the intertidal communities by involving them in the assessment and stewardship of these important areas. This project is developing the foundation for all Sanctuary work needed to fulfill the GFNMS Management Plan.

METHODS

Point quadrats and photo quadrats have been established at six locations around the South Farallon Islands (SEFI) (Figure 1). At each site, at least three replicate and three randomly selected quadrats were established in middle and high algal zones. The locations selected for monitoring are accessible, have distinct zonation, and are exposed to waves generated from all directions around the island. Some locations are also known to be used as haul-out areas for pinnipeds, thus allowing us to monitor the effects of trampling and waste products. Each quadrat is 30 x 50 cm and is maintained and assessed one to three times, annually. During each visit a photographic slide is taken of the quadrat. Kodachrome 200 and flash at f-stop 5.6 are used for all photographic

documentation. Point assessments are also conducted during each visit; 50 randomly selected points within each quadrat are assessed, as described by Foster et al. (1991). All algal and sessile invertebrate species under the point of contact are recorded. Multiple layers of the same species (taxon) under a single point are tallied only once. Point contact assessment reduces observer bias where densely branched species occur. Species which are not identified in the field are collected from outside the quadrat and identified in the laboratory. Identifications are based on Kozloff (1973), Abbott and Hollenberg (1987), Smith and Carlton (1975), and Dawson and Foster (1966). Point quadrat assessments are entered into Excel® spreadsheet and tallied for percent cover, percent rock or bare space in each quadrat, and number and percentage of dead animals and plants, respectively. Voucher specimens of collected algal species are pressed and archived at the GFNMS offices.

RESULTS AND DISCUSSION

The intertidal areas of the island are highly productive and diverse. Table 1 lists the species found during the surveys and assessments of the quadrats. Table 1 also lists which species were not found by Blankinship and Keeler (1892) and species which have been collected and archived by the GFNMS. We have documented 124 intertidal plant species and 47 species of intertidal invertebrates; 46 species of plants and animals had not been previously reported at SEFI.

Table 2 lists the species documented, using point assessment at each quadrat. Percent cover is noted in Figure 1 for predominant species, i.e. species found year round or at mean percent cover > 20% and percent rock (bare space). Figures 2 through 7 are detailed maps of each survey area, indicating position of permanent quadrats from mean zero tide and zonation and exposure for each quadrat. These maps were developed during February 1996 and 1997 surveys and include quadrats that were established during February 1997. Quadrats were added to better assess the species in each zonation, at each location. Quadrat number 101 was added in the high intertidal zone at Blow Hole Peninsula. Number 102 was added at the high zone at Mussel Flat. Number 103 was added to Dead Sea Lion Flat area in the low zone. This quadrat is in a partial sanded-in habitat. During the February 1997 survey Quadrats number 104 (high zonation) and 105 (middle zonation) were added at Drunk Uncle Islet and are not discussed in this report. Tables 3 - 14 list the species found during each survey at each site around the islands, the percent of rock and the number of and percent of dead animals and plants found during each survey, respectively.

An overall survey of the inaccessible intertidal areas of the South and Middle Farallon Islands were conducted during November 1996. This survey was performed from a Boston Whaler. Observations were made from approximately 15 to 150 m offshore. *Corallina*, *Mazzaella*, *Mytilus*, *Egredia*, *Alaria* and *Pollicipes* were the predominant algal and invertebrate taxa around both South Farallon Islands (Table 15 and Figure 8). *Cryptopleura* appears to be more prevalent on Southeast Farallon Island than on West End Island. *Balanus nubilus* are

predominantly found in areas of high energy on islets, Sugarloaf, Sea Lion Islet, the small islet off of Indian Head and on Saddle Rock.

Middle Farallon Island [approximately 0.2 hectare (1,800 m²)] was surveyed from 50 feet offshore, on 24 November 1997; tide was approximately +0.5'. The entire island was covered with *Hildenbrandia*, *Ulva*, *Pollicipes*, and *Balanus nubilus*. Brown Pelicans, Brandt's Cormorants, Western Gulls and Pelagic Cormorants were resting on the peak of the rock. A total of 43 seabirds were counted.

Blow Hole Peninsula

Quadrats number 1, 2, 3 and 101 occur at Blow Hole Peninsula (Figure 2). Quadrats 1 -3 are in the middle intertidal zone and 101 is in the high intertidal zone. This area faces east and receives waves predominantly from the east and northeast. The quadrats are in a semiexposed habitat, meaning they receive high wave action but submerged rocks diminish wave impact prior to reaching the sampling area. Tables 2, 3, and 4 list the plant and animal species found within the permanent and randomly selected quadrats sampled during 1996. Mean annual percent cover for the permanent quadrats range from 152 - 252%. Mean annual percent cover for the randomly selected quadrats in the high intertidal zone was 122%, for the middle intertidal zone was 218%. The low intertidal zone was not assessed during 1996. Figure 1 list predominant species found in each zone, i.e. species which occur at $\geq 20\%$ mean annual cover or have been documented in a quadrat during each 1996 survey (February, August and December).

Dead Sea Lion Flat, Fisherman's Bay

Quadrats number 4, 5, 6 and 103 are located in this area (Figure 3). Quadrat 103 is in the low intertidal zone; Quadrats 4 and 5 are in the middle intertidal zone; Quadrat 6 is in the high intertidal zone. This area faces east and receives waves predominantly from the east and northeast. The quadrats are in a semiexposed and exposed area, receiving moderate wave action. Tables 2, 5 and 6 list the plant and animal species found within the permanent and randomly selected quadrats sampled during 1996. Mean annual percent cover for the permanent quadrats range from 152 - 201%. Mean annual percent cover for the randomly selected quadrats in the high intertidal zone was 168%, for the middle intertidal zone was 193%, and 152% for the low intertidal zone. Figure 1 list predominant species found in each zone, during each 1996 surveys.

Drunk Uncle Islet

Quadrats number 7, 8 and 9 are located in this area (Figure 4) and are palced in the low intertidal zone. This area faces north and receives waves predominantly from the north and northwest.

Quadrat 7 is along a gulch and is semiprotected. Quadrats 8 and 9 are exposed and receives a large amount of wave action. The epoxy which delineates these quadrats is often missing due to the high wave action. Tables 2, 7 and 8 list the plant and animal species found within the quadrats sampled during 1996. Mean annual percent cover for the permanent quadrats range from 184 - 214%. Mean annual percent cover for the randomly selected quadrats in the high intertidal zone was 140%; the middle zone was 192%; and the low intertidal zone had a mean annual percent cover of 208%. Figure 1 list predominant species found in each zone during 1996 surveys. Assessment of Quadrat 8 was discontinued during 1996 due to difficulty in maintaining permanent markers and unsafe conditions during assessment.

Raven's Cliff

Quadrats number 10 - 15 are located in this area (Figure 5). Quadrat 13 is in the high intertidal zone; Quadrats 10, 14 and 15 are in the middle intertidal zone; Quadrats 11 and 12 are in the low intertidal zone. This area faces south and receives waves predominantly from the south, southwest, southeast and northwest. Quadrats 11, 12, 14 and 15 are semiprotected. Quadrats 10 and 13 are exposed and a surge channel pours into the center of these quadrats and consequently has a scoured crevice in them. Tables 2, 9 and 10 list the plant and animal species found within the quadrats sampled during 1996. Mean annual percent cover for the permanent quadrats range from 192 - 246%. Mean annual percent cover for the randomly selected quadrats in the high intertidal zone was 175% and the middle intertidal zone had a mean annual percent cover of 198%. Figure 1 list predominant species found in each zone during 1996 surveys.

Low Arch

Quadrats number 16, 17 and 18 are located in this area (Figure 6). Quadrats 16 and 17 are in the middle intertidal zone and 18 is in the high intertidal zone. This area faces south and receives waves predominantly from the south, west and southwest. The quadrats are in a semiexposed area, receiving moderate to intense wave action and are occasionally used by California sea lions as a haul-out area. Tables 2, 11 and 12 list the plant and animal species found within the permanent and randomly selected quadrats sampled during 1996. Mean annual percent cover for the permanent quadrats range from 175 - 199%. Mean annual percent cover for the randomly selected quadrats in the high intertidal zone was 125%, for the middle intertidal zone was 196%, and 206% for the low intertidal zone. Figure 1 list predominant species found in each zone during 1996 surveys.

Mussel Flat

Quadrats number 19, 20, 22 and 102 are located in this area (Figure 7). Quadrat 103 is in the high intertidal zone; Quadrats 19 and 20 are in the middle intertidal zone; Quadrat 22 is in the low intertidal zone. This area is a gulch and receives waves predominantly from the south, west and southwest. The quadrats are in a protected area, receiving minimal wave action. Quadrats 19, 20 and 22 are on a vertical wall which faces the sun from sunrise to approximately 1500 to 1700 hours. Tables 2, 13 and 14 list the plant and animal species found within the permanent and randomly selected quadrats sampled during 1996. Mean annual percent cover for the permanent quadrats range from 135 - 189%. Mean annual percent cover for the randomly selected quadrats in the high intertidal zone was 172%, for the middle intertidal zone was 195%, and 194% for the low intertidal zone. Figure 1 list predominant species found in each zone during 1996 surveys.

SUMMARY

Corallina vancouveriensis, *Mazzaella* sp. and *Mytilus californianus* are found at most areas of the South Farallon Islands. All quadrats had a mean annual percent cover of at least 122%. The areas of highest percent cover is at the middle zone at Blow Hole Peninsula. Highest diversity are at Quadrats 4, 5, 6 and 103 near Dead Sea Lion Flat. The quadrats at Drunk Uncle Islet, Quadrats 7-9 have the most diverse sessile invertebrate fauna. Quadrats in low and middle intertidal zones have higher mean annual percent cover than those in the high intertidal zone, but all quadrats in the high intertidal zone were above 122% mean annual cover, indicating high growth and productivity year round in all island intertidal zones.

Two algal species commonly found on the mainland, *Fucus distichus* and *Pelvetiopsis limitata* have not been found on the South Farallon Islands. Fucals such as *F. distichus* and *P. fastigiata*, have been found in previous years on Southeast Farallon Island (Blankinship and Keeler 1892, CSWRCB 1979). Surveys during 1996 did not find fucals anywhere on the islands, including Middle Farallon Island.

Corallines are highly susceptible to the effects of diesel, sea lion urine and feces, and trampling, causing bleaching and die-off. The West End quadrats, where *Corallina vancouveriensis* mean annual percent cover can be >50% in the high intertidal zone and nearly 100% in the low and middle intertidal zones, will be important areas to use either as a control or monitor the effects and recovery of the intertidal zone after an oil or diesel spill, due to the high number of plants sensitive to hydrocarbon products (Thursby et al. 1993).

We will continue to monitor these areas on the South Farallon Islands, to obtain a ten year baseline, quantify seasonal abundance, and determine which areas are similar. While this is being done SEFI can be used to support base line studies of mainland areas with similar algal

assemblages. Stratified randomly selected quadrats have been incorporated into the monitoring sites. This enables us to get a general overview of these areas, from the waterline up to the nearest high point or to where the algae no longer grow. In the event of oiling it will be these highest areas which will be most acutely affected.

During 1997 we will analyze the baseline data set to determine adequate sample size needed to detect a change of 10, 25 and 50% in percent cover for each area and each zone within each area.

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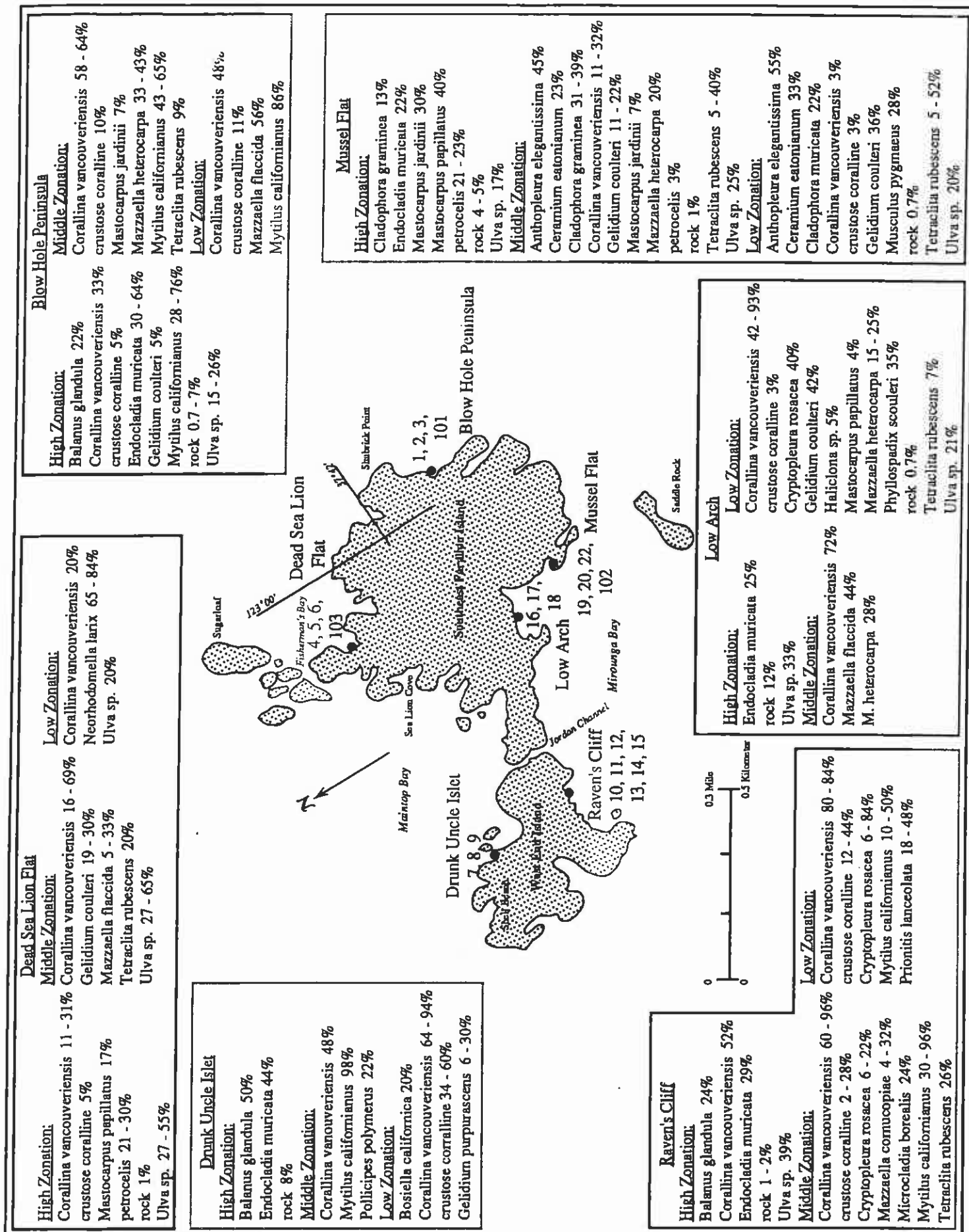
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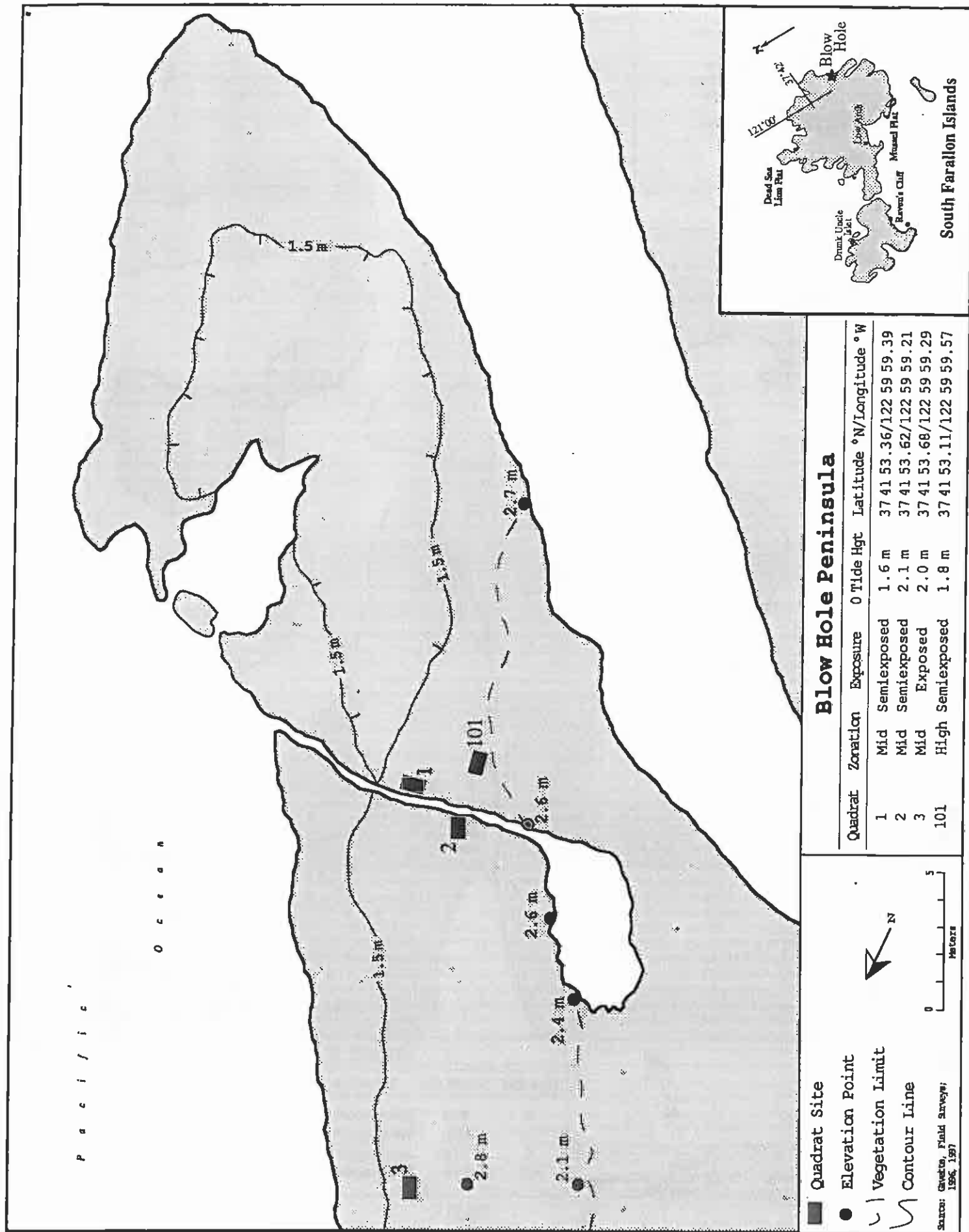
- Figure 1. Location of sampling sites. Percent cover for predominant species ($\geq 20\%$ percent cover), persistent species (species found in permanent quadrats year round), and percent cover of rock or bare space.
- Figure 2. Map of sample site at Blow Hole Peninsula.
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- Table 11. Percent cover for plants and animals found in permanent quadrats, at Low Arch.
- Table 12. Percent cover for plants and animals found in random quadrats, at Low Arch.

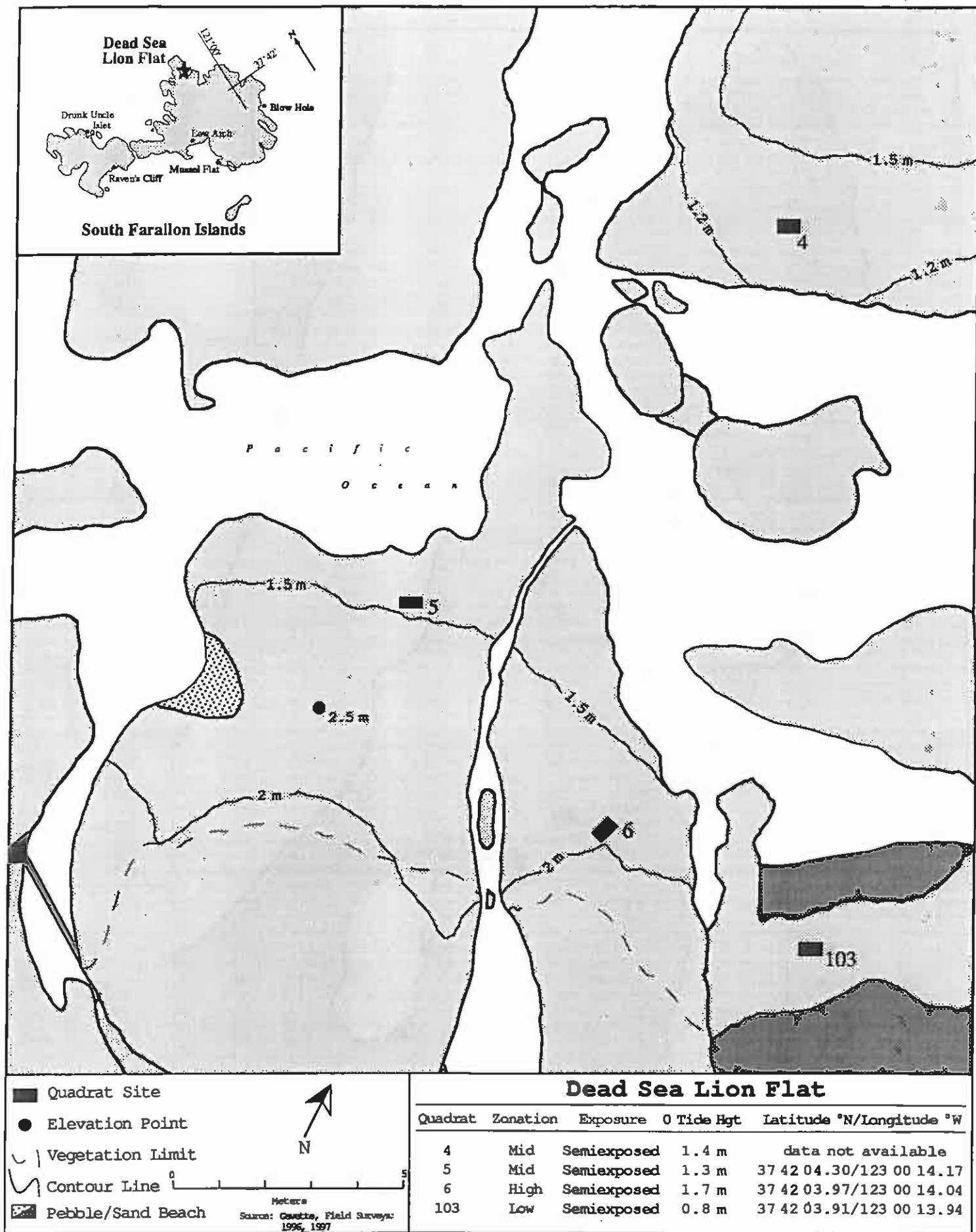
Table 13. Percent cover for plants and animals found in permanent quadrats, at Mussel Flat.

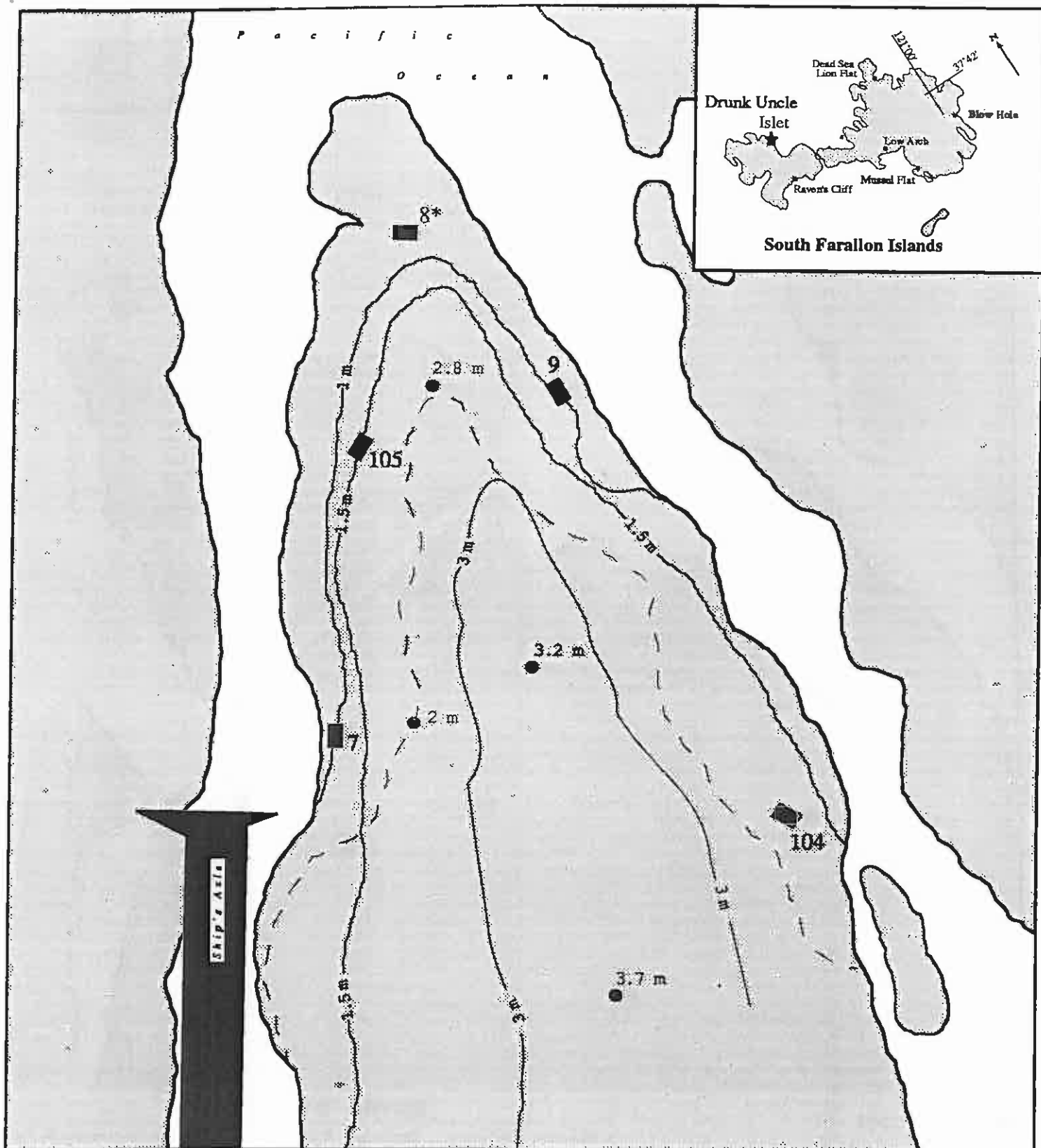
Table 14. Percent cover for plants and animals found in random quadrats, at Mussel Flat.

Table 15. Dominant algal and invertebrate Genera observed during 1996 island survey at specified locations.









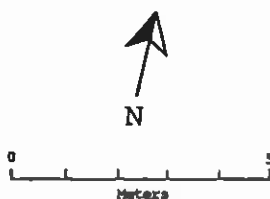
■ Quadrat Site

● Elevation Point

--- Vegetation Limit

--- Contour Line

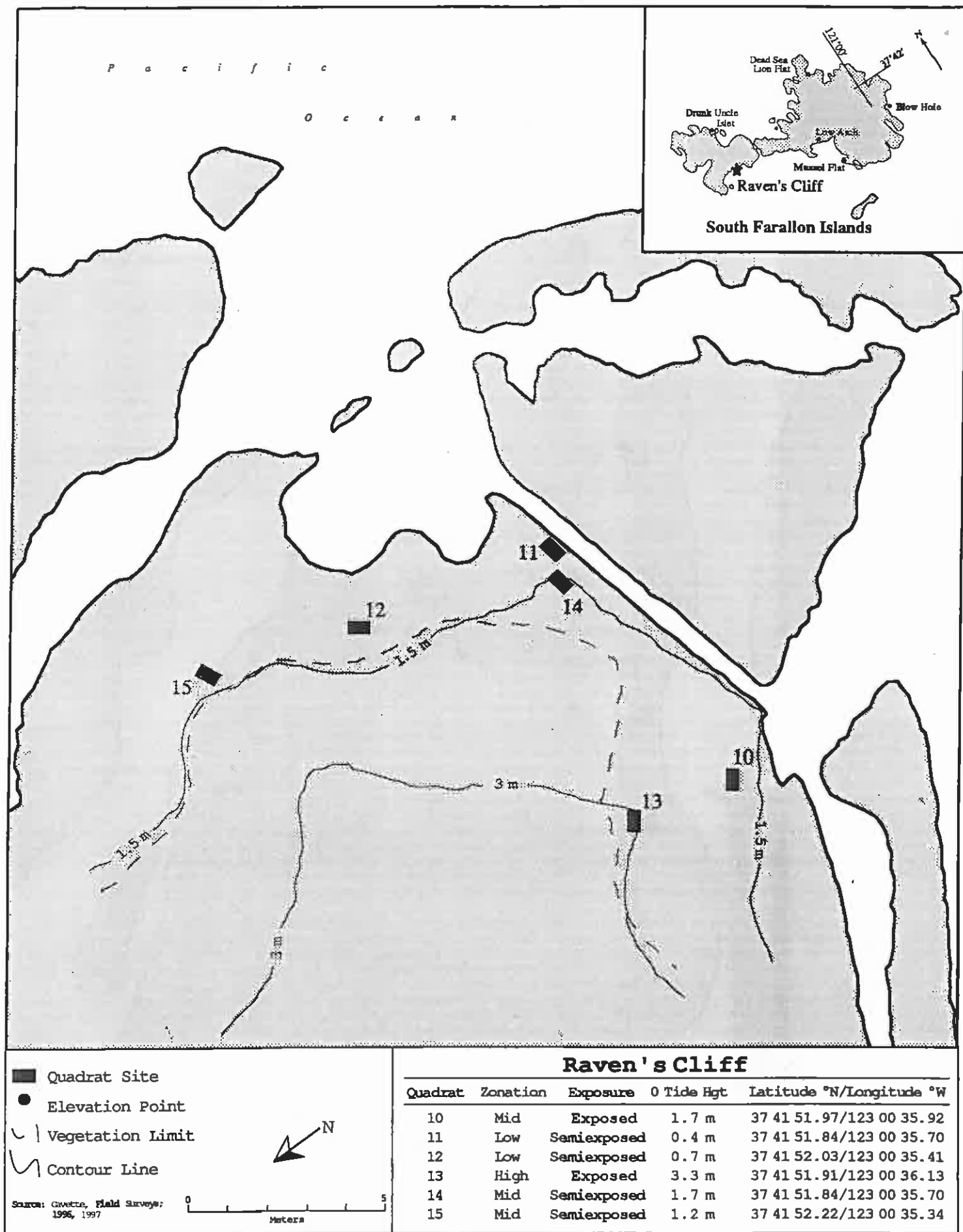
Source: Gavette, Field Surveys:
1996, 1997

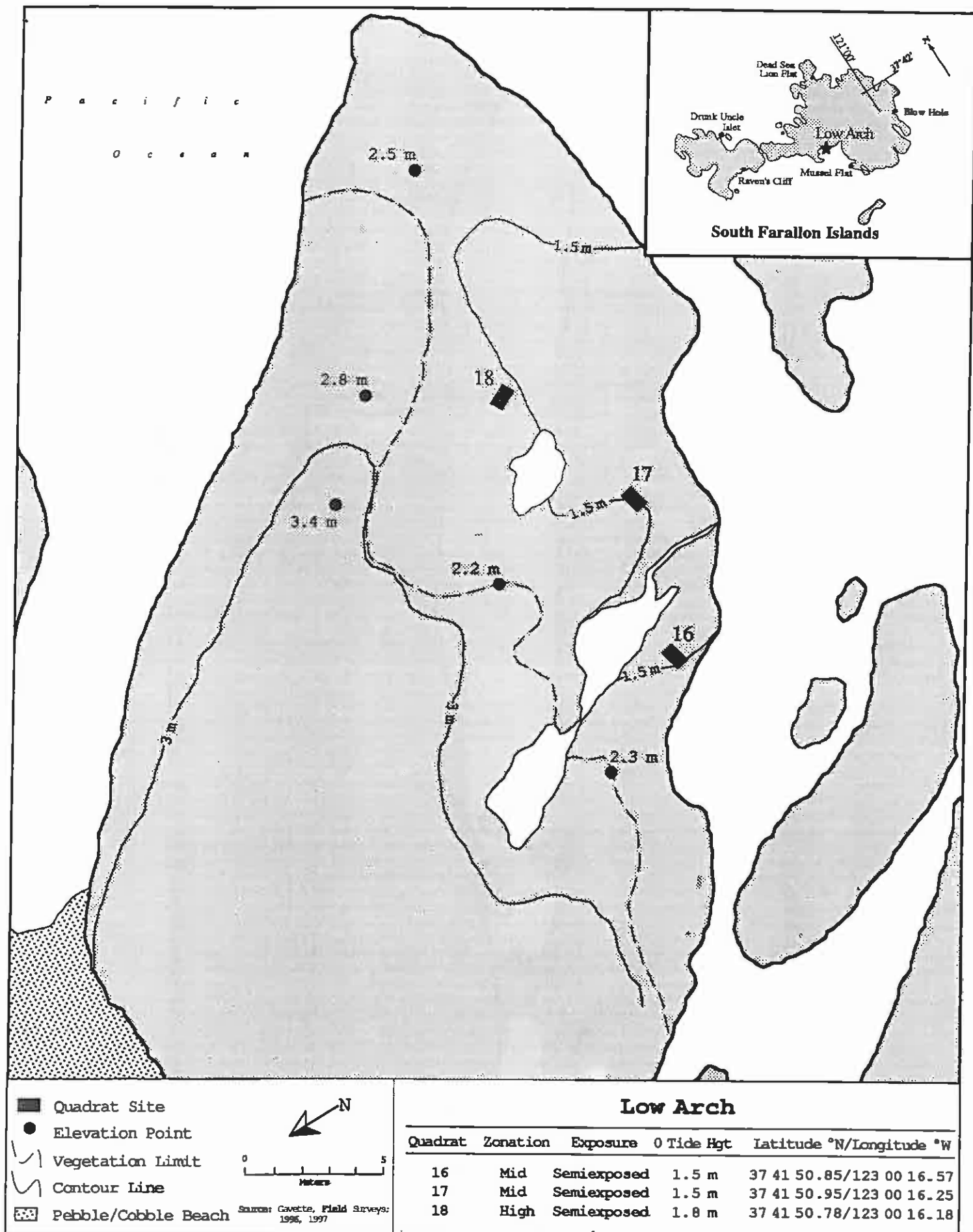


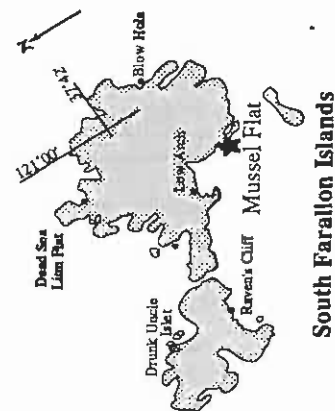
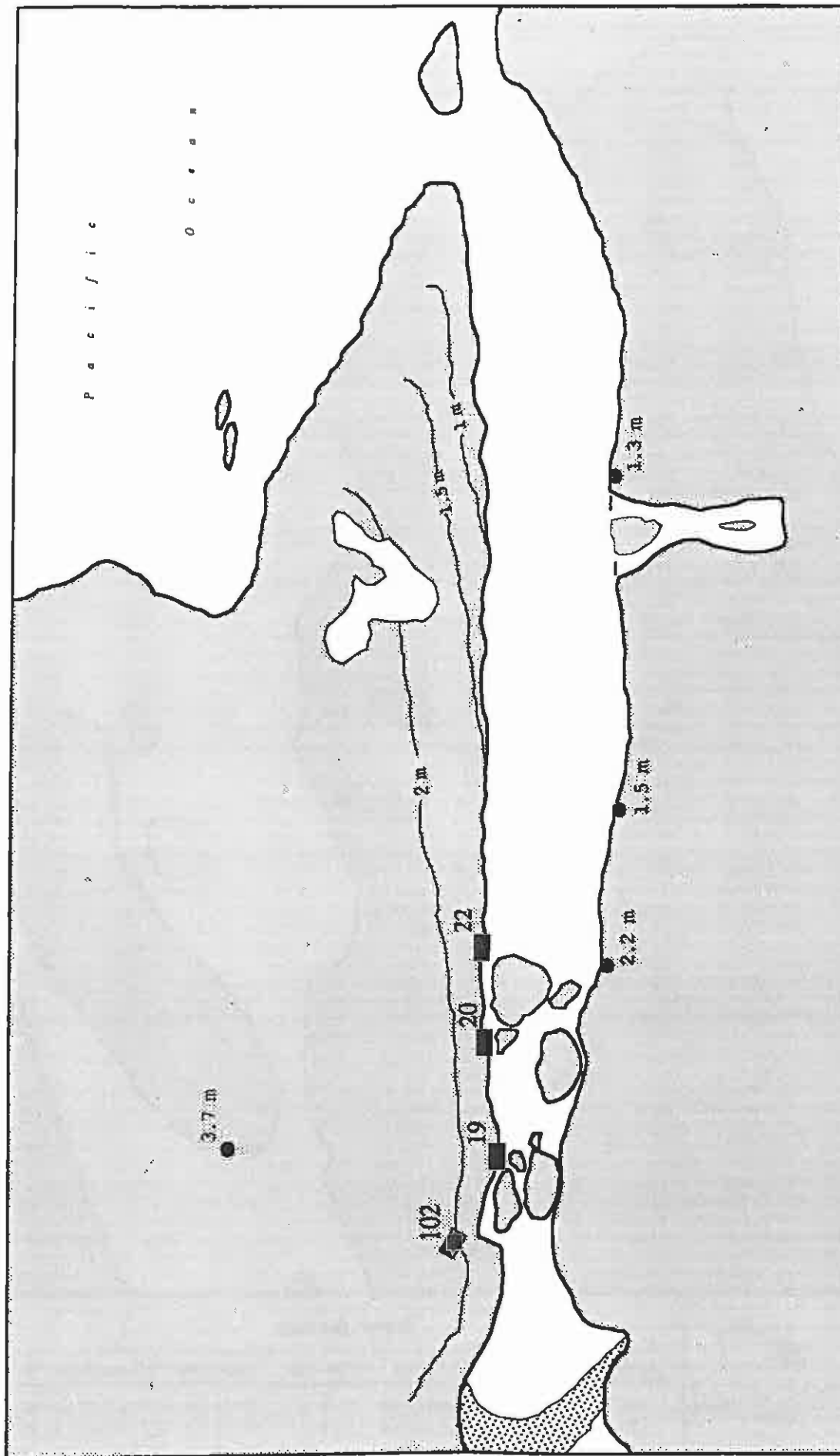
Drunk Uncle Islet

Quadrat	Zonation	Exposure	0 Tide Hgt	Latitude °N/Longitude °W
7	Low	Semiexposed	0.7 m	37 41 59.65/123 00 39.89
8*	Low	Exposed	0.8 m	37 41 59.94/123 00 39.68
9	Low	Exposed	0.7 m	37 41 59.89/123 00 39.58
104	High	Semiexposed	2.1 m	37 41 59.54/123 00 39.49
105	Mid	Semiexposed	1.5 m	37 41 59.82/123 00 39.80

8* - Last survey Feb. '96; removed from monitoring program due to high surge





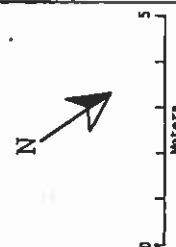


Mussel Flat

Quadrat	Zonation	Exposure	0 Tide Hgt *	Latitude °N	Longitude °W
19	Mid	Protected	0.3 m	37 41 47.74	123 00 12.44
20	Mid	Protected	0.4 m	37 41 47.80	123 00 12.60
22	Low	Protected	0.5 m	37 41 47.86	123 00 12.67
102	High	Protected	2.0 m	37 41 47.63	123 00 12.53

*Quadrats 19, 20, 22 on vertical wall

- Quadrat Site
- Elevation Point
- Contour Line
- ▨ Pebble Beach



Sources: Gazetteer, Field Surveys;
1986, 1997

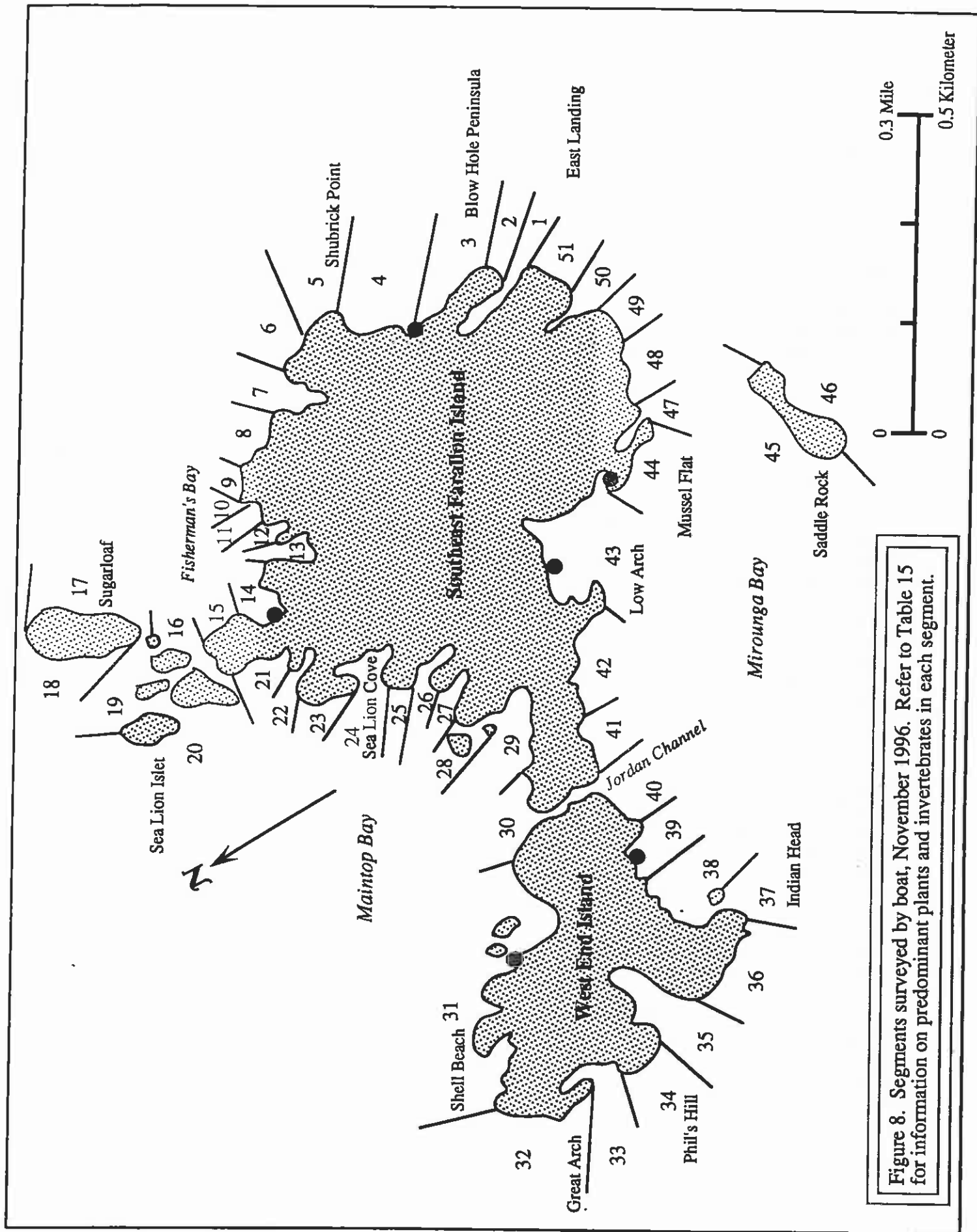


Table 1. List of plants and animals found at the South Farallon Islands, August 1992 through December 1996.

*Denotes voucher specimen collected.

†Denotes species not found in Water Quality Monitoring Report 79-13; 1979.

Plants:

Acrochaetium sp.* (microalgae)
*Ahnfeltia plicata**†
Ahnfeltiopsis leptophyllus (*Gymnogonrus leptophyllus*)*
Ahnfeltiopsis linearis (*Gymnogonrus linearis*)*
*Alaria marginata**
*Bornetia californica**
*Bossiella californica**
Bossiella orbigniana ssp. *dichotoma**
Bossiella orbigniana ssp. *orbigniana*†
*Botryoglossum farlowianum**
Botryoglossum farlowianum var. *anomalum*
*Branchioglossum undulatum**†
*Bryopsis corticulans**
*Calliarthron tuberculosum**†
Callithamnion pikeanum†
*Callophyllis crenulata**†
*Ceramium eatonianum** (microalgae)
*Ceramium pikeanum** (microalgae)
Chondracanthus harveyanus (*Gigartina harveyana*)*†
Chondracanthus spinosus (*Gigartina spinosa*)*
Cladophora graminea
Cladophora sp.*
*Codium fragile**
Corallina vancouveriensis
*Costaria costata**
 crustose coralline
Cryptopleura corallinara†
*Cryptopleura lobulifera**
*Cryptopleura rosacea**
*Cryptopleura violacea**
*Delesseria decipiens**
*Desmarestia ligulata**
*Dictyoneurum californicum**
Dilsea californica
*Egregia menziesii**
*Endocladia muricata**
Enteromorpha intestinalis
*Erythrocladia subintegra** (microalgae)
*Erythrophyllum delesserioides**
*Erythrotrichia carnea** (microalgae)
*Erythrotrichia pulvinata** (microalgae)
*Farlowia compressa**
*Farlowia conferta**†
*Farlowia mollis**†
*Fauchea fryeana**†

Table 1 continued.

*Fauchea lanciniata**†
Gastroclonium subarticulatum (*Gastroclonium coulteri*)*
*Gelidium coulteri**†
*Gelidium purpurascens**
*Gelidium pusillum**†
*Gelidium robustum**
*Gigartina exasperata**
Gigartina volans
*Gracilaria sjoestedtii**
*Gracilariophila oryzoides**† (parasitic)
*Grateloupia doryphora**
*Grateloupia filicina**†
Halicystis ovalis (gametangial stage of *Derbesia marina*)*
Hildenbrandia sp.
Hymenena flabelligera†
*Hymenena multiloba**
*Iridaea cornucopiae**†
*Janczewskia gardneri**†
Laminaria dientigra (*Laminaria setchellii*)
*Laminaria ephemera**†
*Leathesia difformis**
Lithophyllum sp.†
Lithothamnium sp.†
*Lithothrix aspergillum**
*Mastocarpus canaliculata**
*Mastocarpus jordinii**
Mastocarpus papillatus
Mazzaella flaccida (*Iridaea flaccida*)
Mazzaella heterocarpa (*Iridaea heterocarpa*)*
Mazzaella lineare (*Iridaea lineare*)
Mazzaella splendens (*Iridaea cordata*† and *Iridaea splendens*)*
*Melanosiphon intestinalis** (microalgae)
*Melobesia marginata** (epiphytic)
*Melobesia mediocris** (epiphytic)
Membranoptera dimorpha
*Microcladia borealis**
*Microcladia coulteri**
*Myriogramme spectabilis**†
Myriogramme variegata†
*Neoptilota hypnoides**†
*Neorhodomela larix**†
Nitophyllum sp.
Odonthalia floccosa
*Opuntiella californica**
Osmundea spectabilis (*Laurencia spectabilis*)*
*Petalonia fascia**†
Petrocelis franciscana
Peyssonellia meridionalis
*Phycodrys setchellii**†
Phyllospadix scouleri
*Pikea californica**

Table 1 continued.

Pikea robusta*†
Piloyella sp. (microalgae)
Plocamium cartilagineum*
Plocamium oregonum*
Plocamium pacificum
Plocamium violaceum*
Polyneura latissima*
Polysiphonia hendryi*†
Porphyra lanceolata*
Porphyra nereocystis (epiphytic on Nereocystis)*
Porphyra perforata*
Postelsia palmaeformis*†
Prionitis cornea*†
Prionitis lanceolata*
Prionitis linearis*
Prionitis lyallii
Pseudogloiophloea confusa
Pterocladia capillacea†
Pterosiphonia baileyi*
Ralfsia sp.†
Rhodoglossum affine*†
Rhodymenia californica*
Rhodymenia pacifica*
Rhodymenia rhizoides
Sarcodiotheca gaudichaudii (Neoagardhiella baileyi)*
Scytosiphon lomentaria*†
Smithora naiadum* (epiphytic)
Spongomorpha coalita*
Spongonema tomentosum* (microalgae)
Ulothrix laetevirens*†
Ulva angusta*
Ulva taeniata*
Urospora sp.†

Invertebrates:

Amphipods
Anisodoris nobilis†
Annelid
Anthopleura elegantissima
Anthopleura xanthogrammica
Aplahenia sp.
Aplysilla glacialis
Aplysilla polyraphis
Ascidian
Balanus glandula†
Balanus nubilus
Bryozoan
Collisella scabra
Epiactis prolifera

Table 1 continued.

Haliclona permollis
Haliclona sp.(beige)
Haliclona sp. (lavender)
Haliotis cracherodii
Haliotis rufescens
Hermisenda crassicornis
Hopkinsia rosacea†
Hydrozoans
Katharina tunicata
Leptasterias hexactis
Littorina keenae
Littorina sitkana
Littorina scutulata
Lottia digitalis (*Collisella digitalis*)
Lottia gigantea
Lottia pelta (*Collisella pelta*)
Lottia strigatella (*Collisella paradigitalis*)
Lipdochitona dentiens
Mopalia ciliata
Musculus pygmaeus
Mytilus californianus
Nematode
Nucella emarginata
Nuttallina californica
Ophlitaspongia pennata
Pachygrapsus crassipes
Pisaster ochraceus
Phyllochaetopterus prolifica†
Pollicipes polymerus
Pugettia producta
Pycnoclavella stanleyi
Semibalanus cariosus
Serpula vermicularis
Strongylocentrotus droebachiensis
Strongylocentrotus franciscanus
Strongylocentrotus purpuratus
Tetraclita rubescens†
Triopha catalinae
Tubulanus sexlineatus
Tubularia crocea†
Urticina crassicornis†
Urticina lofotensis†

Table 2. Species found in quadrats at each location, 1996.

Blow Hole Peninsula

Plants

Callithamnion pikeanum
 Ceramium eatonianum
 Cladophora graminea
 Corallina vancouveriensis
 crustose coralline
 Cryptopleura rosacea
 diatom
 Endocladia muricata
 Egregia menziesii
 Gastroclonium coulteri
 Gelidium coulteri
 Hildenbrandia occidentalis
 H. prototypus
 Mazzaella flaccida
 M. heterocarpa
 Mastocarpus canaliculata
 M. jardinii
 M. papillatus
 Microcladia borealis
 petrocelis
 Porphyra sp.
 Prionitis lanceolata
 Pterocladia capillacea
 Rhodoglossum affine
 Ulva sp.

Invertebrates

Balanus glandula
 C. scabra
 Haliclona sp.
 Katharina tunicata
 Littorina keenae
 Lottia digitalis
 L. gigantea
 Mytilus californianus
 Nucella canaliculata
 Nuttallina californica
 Pollicipes polymerus
 Tetracrita rubescens
 Tubularia crocea

Dead Sea Lion Flat

Plants

Ahnfeltiopsis linearis
 Bosiella californica
 Bryopsis corticulans
 Ceramium eatonianum
 Cladophora graminea
 Corallina vancouveriensis
 crustose coralline
 Cryptopleura rosacea
 C. violacea
 diatom
 Egregia menziesii
 Farlowia mollis
 Gastroclonium coulteri
 Gelidium coulteri
 Hildenbrandia prototypus
 Mazzaella flaccida
 M. heterocarpa
 M. splendens

Invertebrates

Anthopleura elegantissima
 Balanus glandula
 Collisella scabra
 Littorina keenae
 Lottia digitalis
 Musculus pygmaeus
 Mytilus californianus
 Nucella emarginata
 Pisaster ochraceus
 Tetracrita rubescens
 Tubularia crocea

Dead Sea Lion Flat (continued)

Plants con't.

Mastocarpus canaliculata
M. jardinii
M. papillatus
Melobesia marginata
Microcladia borealis
M. coulteri
Neorhodomela larix
petrocelis
Phyllospadix scouleri
Plocamium sp.
Polysiphonia sp.
Porphyra sp.
Prionitis lanceolata
Rhodoglossum affine
Ulva sp.

Mussel Flat

Plants

Ceramium eatonianum
Cladophora graminea
Corallina vancouveriensis
crustose coralline
Endocladia muricata
Gelidium coulteri
Hildenbrandia prototypus
Mastocarpus canaliculata
M. jardinii
M. papillatus
Mazzaella flaccida
M. heterocarpa
Microcladia borealis
M. coulteri
petrocelis
Porphyra sp.
Prionitis lanceolata
Ulva sp.

Low Arch

Plants

Cladophora graminea
Corallina vancouveriensis
crustose coralline
Cryptopleura rosacea
diatom
Egregia menziesii

Invertebrates

Anthopleura elegantissima
Collisella scabra
Lottia digitalis
Musculus pygmaeus
Pollicipes polymerus
Tetracita rubescens

Invertebrates

Balanus glandula
Haliclona sp.
Katharina tunicata
Littorina scutulata
Lottia digitalis
Musculus pygmaeus

Low Arch (continued)

Plants (con't.)

Endocladia muricata
Gastroclonium coulteri
Gelidium coulteri
Mazzaella flaccida
M. heterocarpa
M. splendens
Lithophyllum sp.
Mastocarpus jardinii
M. papillatus
Microcladia borealis
M. coulteri
petrocelis
Phyllospadix scouleri
Porphyra sp.
Prionitis lanceolata
Ulva sp.

Raven's Cliff

Plants

Corallina vancouveriensis
crustose coralline
Cryptopleura rosacea
Endocladia muricata
Egregia menziesii
Gelidium purpurascens
Laurencia spectabilis
Mastocarpus jardinii
M. papillatus
Mazzaella flaccida
M. heterocarpa
M. splendens
Microcladia borealis
M. coulteri
petrocelis
Phyllospadix scouleri
Porphyra sp.
Prionitis lanceolata
Rhodoglossum affine
Ulva sp.

Drunk Uncle Islet

Plants

Bosiella californica
Corallina vancouveriensis
crustose coralline

Invertebrates (con't.)

Mytilus californianus
Nucella emarginata
Ophlitaspongia pennata
Pollicipes polymerus
Strongylocentrotus purpuratus
Tetraclita rubescens

Invertebrates

Balanus glandula
Collisella scabra
Mytilus californianus
Littorina keenae
Lottia digitalis
Ophlitaspongia pennata
Pollicipes polymerus
Strongylocentrotus purpuratus
Tetraclita rubescens

Invertebrates

Anthopleura elegantissima
A. xanthogrammica
Balanus glandula

Drunk Uncle Islet (continued)

Plants (con't.)

Cryptopleura rosacea
Endocladia muricata
Gelidium purpurascens
Mastocarpus papillatus
Mazzaella heterocarpa
petrocelis
Prionitis lanceolata

Invertebrates (con't.)

Collisella scabra
Haliclona sp.
Littorina scutulata
Mytilus californianus
Nucella emarginata
Ophlitaspongia pennata
Pisaster ochraceus
Pollicipes polymerus
Semibalanus cariosus
Strongylocentrotus purpuratus
Tetraclita rubescens

Table 3. Percent cover for plants and animals found in permanent quadrats, Blow Hole Peninsula.

Quadrat Number = Q1

Description: Blow Hole Peninsula, high middle zonation, semiexposed
n = 3

	11/22/96	8/28/96	2/13/98	Mean Annual % Cover
<i>Balanus glandula</i>		1		0.7
<i>Ceramium satonianum</i>	4		1	3.3
<i>Cladophora graminea</i>	5	6		7.3
<i>Corallina vancouveriensis</i>	19	11	20	33.3
crustose coralline	1	1	6	5.3
<i>Cryptopleura rosacea</i>	1			0.7
diatom	1			0.7
<i>Gastrodium coulteri</i>	5	1		1.0
<i>Gelidium coulteri</i>	1	3	3	2.7
<i>Hildenbrandia occidentalis</i>	2			1.3
<i>Hildenbrandia prototypus</i>	2		1	2.0
<i>Mazzaella flaccida</i>		30	17	31.3
<i>Mazzaella heterocarpa</i>	20			13.3
<i>Lottia gigantea</i>			2	1.3
<i>Mastocarpus canaliculata</i>		2		1.3
<i>Mastocarpus jardinii</i>	3		1	2.7
<i>Microcladia borealis</i>			1	0.7
<i>Mytilus californianus</i>	31	45	38	76.0
<i>Nuttallina californica</i>	2			1.3
<i>Petrocelis</i>			1	0.7
<i>Porphyra</i> sp.	5	22		18.0
<i>Pterocladia capillacea</i>	11			7.3
rock	1			0.7
<i>Tetraclitia rubescens</i>	3			2.0
<i>Tubularia crocea</i>				0.0
<i>Ulva</i> sp.	9	7	8	14.7
Total Percent Cover	252	258	194	235
# dead inverte	5	0	0	
% dead plants	0	0	0	

Quadrat Number Q2

Description: Blow Hole Peninsula, low middle zonation, semiexposed
n = 3

	11/22/96	8/20/96	2/13/98	Mean Annual % Cover
<i>Balanus glandula</i>	2		1	2.0
<i>Corallina vancouveriensis</i>	18	32	22	48.0
crustose coralline	6	5	8	11.3
<i>Cryptopleura rosacea</i>		3	2	3.3
diatom	11			7.3
<i>Hildenbrandia occidentalis</i>	1			0.7
<i>Hildenbrandia prototypus</i>	1			0.7
<i>Mazzaella flaccida</i>			31	20.7
<i>Mazzaella heterocarpa</i>	37	47		56.0
<i>Mytilus californianus</i>	40	46	43	86.0
<i>Nuttallina californica</i>	1			0.7
<i>Pollicipes polymerus</i>		2	1	2.0
<i>Prionitis lanceolata</i>		1		0.7
<i>Pterocladia capillacea</i>	1			0.7
<i>Tetraclitia rubescens</i>	1		1	4.0
<i>Ulva</i> sp.	2	10		8.0
Total Percent Cover	242	300	214	252
# dead inverte	5	0	0	
% dead plants	0	0	0	

Quadrat Number = 101

Description: Blow Hole Peninsula, high zonation, semiexposed
n = 2

	11/22/96	8/28/96	Mean Annual % Cover
<i>Balanus glandula</i>	6	5	11.0
<i>Cladophora graminea</i>	1		1.0
<i>Corallina vancouveriensis</i>	1	3	4.0
crustose coralline	6	4	10.0
<i>Lottia digitalis</i>		1	1.0
<i>Endocladia muricata</i>	35	29	84.0
<i>Hildenbrandia occidentalis</i>	19		19.0
<i>Littorina keenae</i>	1		1.0
<i>Lottia gigantea</i>	1		1.0
<i>Mastocarpus jardinii</i>	4	4	8.0
<i>Mastocarpus papillatus</i>		1	1.0
<i>Mytilus californianus</i>	8	20	28.0
<i>Porphyra</i>		2	2.0
<i>Pterocladia capillacea</i>	1		1.0
rock	3	4	7.0
Total Percent Cover	166	138	152
# dead animals	2	0	
% dead plants	5	5	

Quadrat Number: Q3

Description: Blowhole Peninsula, high-middle zonation, exposed
n = 3

	11/22/96	8/28/96	2/13/98	Mean Annual % Cover
<i>Corallina vancouveriensis</i>	32	20	35	58.0
crustose coralline	11	3	1	10.0
<i>Collisella scabra</i>			1	0.7
diatom	4			2.7
<i>Endocladia muricata</i>		3	1	2.7
<i>Gelidium coulteri</i>	3	2		3.3
<i>Mazzaella flaccida</i>		8	11	12.7
<i>Mazzaella heterocarpa</i>	24		2	17.3
<i>Katharina tunicata</i>			1	0.7
<i>Mastocarpus papillatus</i>		6		4.0
<i>Mastocarpus jardinii</i>	5	1	4	8.7
<i>Mytilus californianus</i>	33	33	32	85.3
<i>Porphyra</i> sp.		6		4.0
<i>Pollicipes polymerus</i>			1	0.7
<i>Pterocladia capillacea</i>	1			0.7
<i>Tetraclitia rubescens</i>	4	3	7	9.3
<i>Ulva</i> sp.	1	14		10.0
Total Percent Cover	238	198	192	208.7
# dead inverte	0	0	0	
% dead plants	1	1	0	

Table 4. Percent cover for plants and animals found in randomly selected quadrats at Blow Hole Peninsula.

Area: Blow Hole Peninsula

Description: high zonation, quadrats randomly selected
n = 3

	8/28/96	2/13/96	2/13/96	Mean Annual % Cover
Balanus glandula	17	11	5	22.0
Callithamnion pikeanum			2	1.3
Cladophora graminea	2			1.3
Corallina vancouveriensis		4		2.7
crustose coralline			5	3.3
Lottia digitalis	1	1		1.3
Collisella scabra	2			1.3
Endocladia muricata	5	40		30.0
Hildenbrandia prototypus	6	1		4.7
Mazzaella heterocarpa		5		3.3
Mastocarpus jardinii		3	1	2.7
Mastocarpus papillatus	3			2.0
Mytilus californianus	1	9	3	8.0
Nucella canaliculata	1	2		0.7
Petrocelis	8			2.0
Porphyra sp.		1		5.3
Pollicipes polymerus				0.7
rock	3		13	10.7
Tetracilita rubescens	5			3.3
Ulva sp.	22		17	26.0
Total Percent Cover	146	154	66	122.0
# dead inverts	1	0	0	
% dead plants	0	0	0	

Area: Blowhole Peninsula

Description: middle zonation, quadrats randomly selected
n = 2

	8/28/96	2/13/96	Mean Annual % Cover
Balanus glandula	7		7
Corallina vancouveriensis	26	38	64
crustose coralline	3	6	9
Lottia digitalis	2		2
Cryptopleura rosacea		15	15
Endocladia muricata	6		6
Haliclona (biege)	4		4
Hildenbrandia occidentalis		1	1
Hildenbrandia prototypus	2		2
Mazzaella flaccida		9	9
Mazzaella heterocarpa	43		43
Katharina tunicata		1	1
Mastocarpus jardinii	1		1
Mastocarpus papillatus	5		5
Mytilus californianus		43	43
Nucella canaliculata	2		2
Petrocelis	3		3
Porphyra sp.	1		1
Total Percent Cover	210	226	218
no. dead inverts	0	0	
% dead plants	10	0	

Table 5. Percent cover for plants and animals found in permanent quadrats, Dead Sea Lion Flat.

Quadrat Number = Q4

Description: Dead Sea Lion Flat,
low middle zonation, semisexposed,
often has plinnipeds hauled out at
low tide
n = 3

	11/23/96	8/29/96	2/18/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>			3	2.0
<i>Balanus glandula</i>			1	0.7
<i>Bryopsis corticulans</i>			2	1.3
<i>Ceramium eatonlanium</i>	2			1.3
<i>Cladophora graminea</i>	1		2	2.0
<i>Corallina vancouveriensis</i>	35	32	36	68.7
crustose coralline	1	2	8	6.0
<i>Gastrodium coulteri</i>		8	6	9.3
<i>Gelidium coulteri</i>	10	10	8	18.7
<i>Mazzaella flaccida</i>	25	22	2	32.7
<i>Mazzaella heterocarpa</i>	9		17	17.3
<i>Mastocarpus jardini</i>			1	0.7
<i>Mastocarpus papillatus</i>	3	4		4.7
<i>Microcladia borealis</i>			2	1.3
<i>Mytilus californianus</i>	1			0.7
<i>Petrocella</i>	5	3		5.3
<i>Rhodoglossum affine</i>		2		1.3
<i>Ulva</i> sp.	17	22	2	27.3
Total Percent Cover	218	216	170	201.3
# dead inverts	0	0	0	
% dead plants	0	1	35	

Quadrat Number = Q8

Description: Dead Sea Lion Flat,
high zonation, semisexposed
n = 3

	11/23/96	8/29/96	2/18/96	Mean Annual % Cover
<i>Balanus glandula</i>	2		11	8.7
<i>Ceramium eatonlanium</i>			10	6.7
<i>Corallina vancouveriensis</i>	2	1	14	11.3
crustose coralline	1	1	8	5.3
<i>Lottia digitalis</i>			1	0.7
diatom		6		4.0
<i>Gelidium coulteri</i>	1		8	6.0
<i>Mazzaella flaccida</i>	1		2	2.0
<i>Mazzaella heterocarpa</i>	1			0.7
<i>Littorina keenae</i>		1		0.7
<i>Mastocarpus jardini</i>		2		1.3
<i>Mastocarpus papillatus</i>	5	2	18	16.7
<i>Musculus pygmaeus</i>	4	4		5.3
<i>Nucella emarginata</i>	1			0.7
<i>Petrocella</i>	18	5		21.3
<i>Prionitis lanceolata</i>			1	0.7
<i>Rhodoglossum affine</i>	3			2.0
rock	1		1	1.3
<i>Tetractia rubescens</i>	2	3		3.3
<i>Ulva</i> sp.	28	50	5	55.3
Total Percent Cover	138	150	170	152.7
# dead inverts	0	1	0	
% dead plants	0	1	1	

Quadrat Number = Q5

Description: Dead Sea Lion
Flat, middle zonation,
semisexposed
n = 3

	11/23/96	8/29/96	2/18/96	Mean Annual % Cover
<i>Balanus glandula</i>	1	1	3	3.3
<i>Ceramium eatonlanium</i>			24	18.0
<i>Corallina vancouveriensis</i>	28	13	25	42.7
crustose coralline	2		4	4.0
<i>Egregia menziesii</i>			2	1.3
<i>Gelidium coulteri</i>	1	2		2.0
<i>Mazzaella flaccida</i>	3	2	3	5.3
<i>Mazzaella heterocarpa</i>	14		5	12.7
<i>Mastocarpus jardini</i>			2	1.3
<i>Mastocarpus papillatus</i>	4	5		6.0
<i>Petrocella</i>	4			2.7
<i>Porphyra</i> sp.	1			0.7
<i>Rhodoglossum affine</i>		7		4.7
<i>Tetractia rubescens</i>	7	12	11	20.0
<i>Tubularia crocea</i>				0.0
<i>Ulva</i> sp.	28	47	24	64.7
Total Percent Cover	178	178	206	187.3
# dead inverts	0	0	0	
% dead plants	0	1	0	

Quadrat Number = Q103

Description: Dead Sea Lion
Flat, low zonation,
semisexposed, sanded in area
n = 2

	11/23/96	8/29/96	Mean Annual % Cover
<i>Ahnfeltiopsis linearis</i>		4	4
<i>Anthopleura elegantissima</i>	1		1
<i>Corallina vancouveriensis</i>		1	1
<i>Cryptopleura violacea</i>	1		1
<i>Egregia menziesii</i>	18	1	19
<i>Farlowia mollis</i>	2		2
<i>Mastocarpus papillatus</i>	1	10	11
<i>Neorhodomela larix</i>	46	38	84
<i>Plocamium</i> sp.		2	2
<i>Polysiphonia</i> sp.		2	2
<i>Prionitis lanceolata</i>		1	1
rock/sand	1		1
<i>Ulva</i> sp.	27	41	88
Total Percent Cover	192	200	198
# dead animals	0	0	
% dead plants	0	0	

Table 6. Percent cover for plants and animals found in randomly selected quadrats at Dead Sea Lion Flat.

Area: Dead Sea Lion Flat

Description: high zonation,
quadrats are randomly selected,
deposition area
n = 3

	11/23/96	2/18/96	2/18/96	Mean Annual % Cover
<i>Balanus glandula</i>	9		18	16.7
<i>Ceramium estonianum</i>		4		2.7
<i>Cladophora graminea</i>		1		0.7
<i>Corallina vancouveriensis</i>		34	13	31.3
crustose coralline		3	2	3.3
<i>Lottia digitalis</i>	1			0.7
<i>Endocladia muricata</i>	1		1	1.3
<i>Mazzaella heterocarpa</i>		9	2	7.3
<i>Mastocarpus jardinii</i>			6	4.0
<i>Mastocarpus papillatus</i>	15	3		12.0
<i>Microcladia borealis</i>		1		0.7
<i>Musculus pygmaeus</i>		4		2.7
<i>Petrocelis</i>	30	2	13	30.0
<i>Rhodoglossum affine</i>	2		27	19.3
rock		2		1.3
<i>Tetracita rubescens</i>	3	9		8.0
<i>Ulva</i> sp.	14	19	8	27.3
Total Percent Cover	150	178	178	168
# dead inverts	0	1	0	
% dead plants	1	5	35	

Area: Dead Sea Lion Flat

Description: low zonation,
quadrats are randomly selected,
occasional sea lion haul-out
n = 2

	11/23/96	2/18/96	Mean Annual % Cover
<i>Corallina vancouveriensis</i>	20		20
<i>Cryptopleura rosacea</i>	9		9
<i>Cryptopleura violacea</i>	2		2
<i>Egregia menziesii</i>		1	1
<i>Gastroclonium coulteri</i>	1		1
<i>Gelidium coulteri</i>	5		5
<i>Mastocarpus canaliculata</i>		8	8
<i>Melobesia marginata</i>	18		18
<i>Microcladia coulteri</i>		2	2
<i>Neorhodomeia larix</i>	20	45	65
<i>Petrocelis</i>		3	3
<i>Phyllospadix coulteri</i>	19		19
<i>Ulva</i> sp.		1	1
Total Percent Cover	184	120	152
# dead inverts	0	0	
% dead plants	0	0	

Area: Dead Sea Lion Flat

Description: middle zonation,
occasional sea lion haul-out,
moderate wave action,
deposition area
n = 4

	11/23/96	8/29/96	8/29/96	8/29/96	Mean Annual % Cover
<i>Ceramium estonianum</i>		2	1		1.5
<i>Corallina vancouveriensis</i>		5	20	4	15.5
crustose coralline			3		1.5
<i>Colicella scabra</i>	1				0.5
Diatom				2	1
<i>Egregia menziesii</i>		13			8.5
<i>Gastroclonium coulteri</i>		10	5		8.5
<i>Gelidium coulteri</i>	18	21	11	9	29.5
<i>Hildenbrandia prototypus</i>		2	1		1.5
<i>Mazzaella flaccida</i>		19	40	6	32.5
<i>Mastocarpus canaliculata</i>	20	11	18	27	38
<i>Mastocarpus papillatus</i>		12	2	1	7.5
<i>Microcladia borealis</i>			1		0.5
<i>Musculus pygmaeus</i>				1	0.5
<i>Neorhodomeia larix</i>	5	1			3
<i>Petrocelis</i>	10	3			6.5
<i>Pistia ochracea</i>		2			1
<i>Rhodoglossum affine</i>			2	2	2
<i>Ulva</i> sp.	16	20	10	25	35.5
Total Percent Cover	148	242	228	154	193
# dead inverts	0	0	0	0	
% dead plants	0	0	0	0	

Table 7. Percent Cover for plants and animals found in permanent quadrats, Drunk Uncle Islet.

Quadrat Number: Q7

Description: Drunk Uncle Islets,
low zonation, semiexposed,
usually high surf
n = 1

	2/15/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	1	2
<i>Corallina vancouveriensis</i>	40	80
crustose coralline	17	34
<i>Gelidium purpurascens</i>	24	48
<i>Mytilus californianus</i>	7	14
<i>Nucella emarginata</i>	1	2
<i>Ophlitaspongia pennata</i>	2	4
<i>Prionitis lanceolata</i>	6	12
<i>Semibalanus cariosus</i>	1	2
<i>Tetracita rubescens</i>	3	6
Total Percent Cover	204	
# dead inverts	1	
% dead plants	0	

Quadrat Number: Q9

Description: Drunk Uncle Islets,
low zonation, exposed, usually
high surf
n = 1

	2/15/96	Mean Annual % Cover
<i>Corallina vancouveriensis</i>	47	94
crustose coralline	29	58
<i>Gelidium purpurascens</i>	3	6
<i>Haliclona</i> (gold)	2	4
<i>Mytilus californianus</i>	1	2
<i>Ophlitaspongia pennata</i>	5	10
<i>Piaster ochraceus</i>	1	2
<i>Prionitis lanceolata</i>	3	6
<i>Tetracita rubescens</i>	1	2
Total Percent Cover	184	
# dead inverts	0	
% dead plants	0	

Quadrat Number: Q8

Description: Drunk Uncle Islets, low
zonation, exposed, high surf, no longer
to be assessed, last surveyed November
1996
n = 1

	2/15/96	Mean Annual % Cover
<i>Anthopleura xanthogrammica</i>	1	2
<i>Corallina vancouveriensis</i>	45	90
crustose coralline	20	40
<i>Cryptopleura rosacea</i>	8	16
<i>Gelidium purpurascens</i>	15	30
<i>Haliclona</i> (golden)	3	6
<i>Ophlitaspongia pennata</i>	6	12
<i>Prionitis lanceolata</i>	9	18
Total Percent Cover	214	
# dead inverts	0	
% dead plants	0	

Table 8. Percent cover for plants and animals found in randomly selected quadrats at Drunk Uncle Islet.

Area: Drunk Uncle Islet

Description: high zonation,
quadrats are randomly selected
n = 1

	2/15/96	Mean Annual % Cover
<i>Balanus glandula</i>	25	50
<i>Collisella scabra</i>	3	6
<i>Endocladia muricata</i>	22	44
<i>Littorina scutulata</i>	1	2
<i>Mastocarpus papillatus</i>	9	18
<i>Petrocellis</i>	8	16
rock	4	8
<i>Tetracitla rubescens</i>	2	4
Total Percent Cover	140	
no. dead Inverts	0	
% dead plants	0	

Area: Drunk Uncle Islet

Description: low zonation,
quadrats are randomly selected,
high surge year round, high
density of corallines, mussel beds
n = 1

	2/15/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	6	12
<i>Anthopleura xanthogrammica</i>	4	8
<i>Bosliella californica</i>	10	20
<i>Corallina vancouveriensis</i>	32	64
crustose coralline	30	60
<i>Egregia menziesii</i>	6	12
<i>Gelidium purpurascens</i>	11	22
<i>Haliclona</i> (golden)	1	2
<i>Mytilus californianus</i>	2	4
<i>Semibalanus cariosus</i>	1	2
<i>Strongylocentrotus purpuratus</i>	1	2
Total Percent Cover	208	
no. dead Inverts	0	
% dead plants	0	

Area: Drunk Uncle Islet

Description: middle zonation,
high surge area, large amt. of
corallines and mussels, quadrats
randomly selected
n = 1

	2/16/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	6	12
<i>Balanus glandula</i>	1	2
<i>Corallina vancouveriensis</i>	24	48
<i>Collisella scabra</i>	4	8
<i>Mazzaella heterocarpa</i>	1	2
<i>Mytilus californianus</i>	49	98
<i>Pollicipes polymerus</i>	11	22
Total Percent Cover	192	
no. dead Inverts	0	
% dead plants	0	

Table 9. Percent cover for plants and animals found in permanent quadrats, Raven's Cliff.

Quadrat Number: Q10			Quadrat Number: Q11			Quadrat Number: Q12		
Description: Raven's Cliff, middle zonation, exposed, heavy surf			Description: Raven's Cliff, low zonation, semilexposed, heavy surge channel flows on top of this quadrat			Description: Raven's Cliff, low zonation, semilexposed		
n = 1			n = 1			n = 1		
	Mean Annual 2/18/98 % Cover			Mean Annual 2/18/98 % Cover			Mean Annual 2/18/98 % Cover	
Corallina vancouveriensis	30	80	Corallina vancouveriensis	40	80	Corallina vancouveriensis	42	84
crustose coralline	1	2	crustose coralline	22	44	crustose coralline	6	12
Cryptopleura rosacea	11	22	Cryptopleura rosacea	6	12	Cryptopleura rosacea	42	84
Mazzaella heterocarpa	1	2	Gelidium purpurascens	1	2	Laurencia spectabilis	2	4
Mytilus californianus	48	98	Mazzaella comucopias	1	2	Mytilus californianus	5	10
Phyllospadix scouleri	2	4	Laurencia spectabilis	1	2	Ophitasporgia pennala	9	18
Prionitis lanceolata	2	4	Microcladia coulteri	2	4	Prionitis lanceolata	9	18
Ulva sp.	2	4	Mytilus californianus	25	50	Strongylocentrotus purpuratus	3	
Total Percent Cover	194		Prioritis lanceolata	24	48	Total Percent Cover	238	
# dead inverte	5		Tetractia rubescens	1	2	# dead inverte	0	
% dead plants	0		Total Percent Cover	249		% dead plants	0	
			# dead inverte	0				
			% dead plants	0				
Quadrat Number: Q13			Quadrat Number: Q14			Quadrat Number: Q15		
Description: Raven's Cliff, high zonation, exposed, high surf, channel cut is deepening 2/97			Description: Raven's Cliff, middle zonation, semilexposed but often high surf, big storms winter 84-85			Description: Raven's Cliff, middle zonation, semilexposed, but often high surf, big storms winter of 84-85		
n = 1			n = 1			n = 1		
	Mean Annual 2/18/98 % Cover			Mean Annual 2/18/98 % Cover			Mean Annual 2/18/98 % Cover	
Balanus glandula	4	8	Balanus glandula	1	2	Balanus glandula	1	2
Corallina vancouveriensis	28	52	Corallina vancouveriensis	44	88	Corallina vancouveriensis	44	88
crustose coralline	9	18	crustose coralline	1	2	Lotia digitata	1	2
Collisella scabra	1	2	Lotia digitata	1	2	Cryptopleura rosacea	3	6
Mazzaella heterocarpa	4	8	Mazzaella flaccida	3	6	Egrella menziesii	8	12
Littorina keenae	1	2	Mazzaella heterocarpa	2	4	Mazzaella comucopias	2	4
Mastocarpus papiliatus	3	6	Mytilus californianus	48	92	Mazzaella flaccida	2	4
Microcladia borealis	1	2	Total Percent Cover	198		Mazzaella heterocarpa	4	8
Mytilus californianus	5	10	# dead inverte	0		Laurencia spectabilis	2	4
Peucecella	8	16	% dead plants	0		Microcladia borealis	12	24
Porphyra sp.	4	8				Mytilus californianus	15	30
Rhodoglossum affine	5	10				Polydora polymorpha	1	2
rock	1	2				Tetractia rubescens	13	26
Tetractia rubescens	2	4				Ulva sp.	8	16
Ulva sp.	23	46				Total Percent Cover	228	
Total Percent Cover	182					# dead inverte	0	
# dead inverte	1					% dead plants	0	
% dead plants	0							

Table 10. Percent cover for plants and animals found in randomly selected quadrats at Raven's Cliff.

Area: Raven's Cliff random high

Description: high zonation, to assess end of vegetation line go to top of Endocladia, Ulva in high spray zone
n = 2

	2/16/96	2/16/96	Mean Annual % Cover
Balanus glandula	4	20	24
Corallina vancouveriensis	7	5	12
crustose coralline	4		4
Lottia digitalis	3		3
Endocladia muricata	29		29
Mazzaella heterocarpa	3		3
Mastocarpus papillatus	15		15
Mytilus californianus	2		2
Petrocelis	7	1	8
Porphyra sp.		7	7
Rhodoglossum affine	14		14
rock	1		1
Tetracilita rubescens	4	11	15
Ulva sp.	3	36	39
Total Percent Cover	190	160	175
no. dead inverts	1	2	
% dead plants	0	0	

Area: Raven's Cliff

Description: middle zonation, quadrats randomly selected, assess top of vegetation line where Endocladia stops
n = 1

	2/16/96	Mean Annual % Cover
Corallina vancouveriensis	48	96
crustose coralline	14	28
Cryptopleura rosacea	4	8
Mazzaella cornucopiae	16	32
Microcladia borealis	7	14
Ophlitaspongia pennata	2	4
Tetracilita rubescens	7	14
Ulva sp.	1	2
Total Percent Cover	198	
no. dead inverts	0	
% dead plants	0	

Table 11. Percent cover for plants and animals found in permanent quadrats, Low Arch.

Quadrat Number: Q18

Description: Low Arch, low-middle zonation, semiexposed, occasional sea lion haul-out
n = 3

	11/25/98	8/29/98	2/14/98	Mean Annual % Cover
<i>Corallina varcovenerensis</i>	19	10	35	42.7
crustose coralline		1	4	3.3
<i>Lotia digitalis</i>				
<i>Gelidium coulteri</i>	24	25	13	41.3
<i>Halidoria (purple)</i>	4	1	2	4.7
<i>Mazzaella fucoida</i>	21	36		38.0
<i>Mazzaella heterocarpa</i>	23		34	38.0
<i>Katharina lunicata</i>			1	0.7
<i>Mastocarpus jordanii</i>	1			0.7
<i>Mastocarpus papillatus</i>	2	3	1	4.0
<i>Mytilus californianus</i>		1		0.7
<i>Petrocelia</i>			1	0.7
<i>Porphyra</i> sp.	1			0.7
<i>Pollicipes polymerus</i>			1	0.7
<i>Tetractia rubescens</i>	1	9	1	7.3
<i>Ulva</i> sp.	1	21		14.7
Total Percent Cover	194	214	188	198.7
# dead inverts	0	0	1	
% dead plants	0	0	1	

Quadrat Number: Q18

Description: Low Arch, mid-high zonation, semiexposed, occasional sea lion haul-out
n = 3

	11/25/98	8/29/98	2/14/98	Mean Annual % Cover
<i>Balanus glandula</i>			2	1.3
<i>Lotia digitalis</i>			1	0.7
<i>Corallina varcovenerensis</i>	31	19	34	58.0
crustose coralline	3	3		4.0
<i>Egregia menziesii</i>	1			0.7
<i>Endocladia muricata</i>	3		4	4.7
<i>Gelidium coulteri</i>		1		0.7
<i>Mazzaella fucoida</i>	21			14.0
<i>Mazzaella heterocarpa</i>	26	3	8	24.7
<i>Mastocarpus papillatus</i>	2	2		2.7
<i>Microcladia borealis</i>	5			3.3
<i>Mucocuta pygmaea</i>		9		8.0
<i>Mytilus californianus</i>	9		16	16.7
<i>Petrocelia</i>	1			0.7
rock			1	0.7
<i>Tetradia rubescens</i>	5	9	10	16.0
<i>Ulva</i> sp.	6	26		22.7
Total Percent Cover	186	186	150	174.7
# dead inverts	0	0	1	
% dead plants	0	1	1	

Quadrat Number: Q17

Description: Low Arch, low-middle zonation, semiexposed, occasional sea lion haul-out
n = 3

	11/25/98	2/29/98	2/14/98	Mean Annual % Cover
<i>Corallina varcovenerensis</i>	44	49	48	82.7
crustose coralline	1	1	2	2.7
<i>Cryptopleura rosacea</i>	3		17	13.3
<i>Gastrodicium coulteri</i>	1			0.7
<i>Gelidium coulteri</i>	5	3		5.3
<i>Mazzaella fucoida</i>	5			3.3
<i>Mazzaella heterocarpa</i>	14	5	4	15.3
<i>Mastocarpus papillatus</i>		1		0.7
<i>Microcladia borealis</i>	5	4		8.0
<i>Mytilus californianus</i>			4	2.7
<i>Proritis lanceolata</i>			2	1.3
<i>Strongylocentrotus purpuratus</i>	21	32	3	20.0
<i>Ulva</i> sp.				35.3
Total Percent Cover	188	190	158	181.3
# dead inverts	0	0	0	
% dead plants	1	0	0	

Table 12. Percent cover for plants and animals found in randomly selected quadrats at Low Arch.

Area: Low Arch

Description: high zonation, semiexposed, quadrats are randomly selected
n = 8

	11/25/98	11/25/98	8/29/98	2/14/98	2/14/98	2/14/98	Mean Annual % Cover
<i>Balanus glandula</i>	1		1	8	10	2	7.3
<i>Cladophora graminea</i>	7	2		3		4	5.3
<i>Colisella digitalis</i>	1		2				1.0
<i>Corallina vancouverensis</i>	2	5		2		21	10.0
crustose coralline	3	3		3			3.0
diatom			3				1.0
<i>Endocladia muricata</i>	7	29	3	27		8	24.7
<i>Halidona (purple)</i>						1	0.3
<i>Mazzaella flaccida</i>	3	13					5.3
<i>Mazzaella heterocarpa</i>		2				11	4.3
<i>Littorina scutellata</i>	1						0.3
<i>Mastocarpus jardinii</i>				30	2	4	12.0
<i>Mastocarpus papillatus</i>	2	21	8			2	10.3
<i>Microcladia borealis</i>						3	1.0
<i>Petrocelia</i>		1			1	3	1.7
rock	7	3	11	3	7	5	12.0
<i>Tetracida rubescens</i>					1	14	5.0
<i>Ulva sp.</i>	21		30	1	40	8	32.7
Total Percent Cover	98	152	90	148	108	158	125.3
# dead inverts	0	0	0	7	0	0	
% dead plants	0	0	5	0	0	0	

Area: Low Arch

Description: low zonation, quadrats are randomly selected
n = 2

	8/29/98	8/29/98	Mean Annual % Cover
<i>Corallina vancouverensis</i>	38	43	81
crustose coralline	1	5	6
<i>Cryptopleura rosacea</i>	38	1	40
<i>Egregia menziesii</i>		1	1
<i>Halidona (bioge)</i>	1	1	2
<i>Mazzaella cordata</i>	8		8
<i>Mazzaella flaccida</i>	1	1	2
<i>Microcladia coulteri</i>	3		3
<i>Mytilus californianus</i>		1	1
<i>Ophiurospongia penicillata</i>	4		4
<i>Phyllospadix scouleri</i>		35	35
<i>Prionitis lanceolata</i>	1	3	4
<i>Ulva sp.</i>	9	12	21
Total Percent Cover	208	108	208
# dead inverts	0	0	
% dead plants	0	0	

Area: Low Arch

Description: middle zonation, semiexposed, quadrats are randomly selected moderate to high surf, occasional sea lion haul-out
n = 1

	11/25/98	Mean Annual % Cover
<i>Corallina vancouverensis</i>	38	72
crustose coralline	8	18
<i>Gelidium coulteri</i>	2	4
<i>Halidona (purple)</i>	1	2
<i>Mazzaella flaccida</i>	22	44
<i>Mazzaella heterocarpa</i>	14	28
<i>Mastocarpus papillatus</i>	5	10
<i>Microcladia borealis</i>	1	2
<i>Mytilus californianus</i>	1	2
<i>Nucella emarginata</i>	2	4
<i>Tetracida rubescens</i>	2	4
<i>Ulva sp.</i>	4	8
Total Percent Cover	108	
# dead inverts	0	
% dead plants	1	

Table 13. Percent cover for plants and animals found in permanent quadrats, Mussel Flat.

Quadrat Number: Q19

Description: Mussel Flat, low-middle zonation, protected, vertical wall, shady side

n = 2

	11/25/96	8/29/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	3	7	10.0
<i>Ceramium eatonianum</i>	11	6	17.0
<i>Cladophora graminea</i>	13	19	32.0
<i>Corallina vancouveriensis</i>	19	13	32.0
<i>Lottia digitalis</i>		1	1.0
crustose coralline	6	4	10.0
<i>Galidium coulteri</i>	11	11	22.0
<i>Hildenbrandia prototypus</i>		2	2.0
<i>Mazzaella flaccida</i>		2	2.0
<i>Mazzaella heterocarpa</i>		1	1.0
<i>Mastocarpus jardinii</i>	2		2.0
<i>Mastocarpus papillatus</i>		2	2.0
<i>Microcladia borealis</i>	13	6	19.0
<i>Petrocelis</i>	4	1	5.0
<i>Prionitis lanceolata</i>	1		1.0
rock		1	1.0
<i>Tetracita rubescens</i>	10	14	24.0
<i>Ulva</i> sp.	3	4	7.0
Total Percent Cover	192	186	189
# dead inverts	0	0	
% dead plants	0	0	

Quadrat Number = Q102

Description: Mussel Flat, high zonation, protected

n = 2

	11/25/96	8/29/96	Mean Annual % Cover
<i>Cladophora graminea</i>	5	3	8
crustose coralline		5	5
<i>Lottia digitalis</i>		1	1
<i>Endocladia muricata</i>	14	8	22
<i>Galidium coulteri</i>	8		8
<i>Mastocarpus jardinii</i>	30		30
<i>Mastocarpus papillatus</i>		40	40
<i>Petrocelis</i>	12	9	21
rock	3	1	4
<i>Ulva</i> sp.	5	6	11
Total Percent Cover	148	144	146
# dead animals	0	0	
% dead plants	0	10	

Quadrat Number: Q20

Description: Mussel Flat, low-middle zonation, protected, vertical wall, shady side

n = 3

	11/25/96	8/29/96	2/19/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	22	17	29	45.3
<i>Ceramium eatonianum</i>		7	17	16.0
<i>Cladophora graminea</i>	18	22	19	39.3
<i>Corallina vancouveriensis</i>	10	1	5	10.7
<i>Galidium coulteri</i>	3	8	6	11.3
<i>Mazzaella flaccida</i>		6		4.0
<i>Mazzaella heterocarpa</i>		1	1	1.3
<i>Mastocarpus jardinii</i>	5	5	1	7.3
<i>Microcladia borealis</i>	4		8	8.0
<i>Microcladia coulteri</i>			2	1.3
<i>Petrocelis</i>	2	1	1	2.7
<i>Tetracita rubescens</i>	1	3	3	4.7
<i>Ulva</i> sp.	2			1.3
Total Percent Cover	134	142	184	153.3
# dead inverts	0	0	0	
% dead plants	0	0	0	

Quadrat Number: Q22

Description: Mussel Flat, low zonation, protected, vertical wall, shady side

n = 3

	11/25/96	8/29/96	2/19/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	24	32	26	54.7
<i>Ceramium eatonianum</i>	17	13	20	33.3
<i>Cladophora graminea</i>	10	12	11	22.0
<i>Corallina vancouveriensis</i>	1	1	2	2.7
crustose coralline	2	1	1	2.7
<i>Mazzaella flaccida</i>	2	3		3.3
<i>Mastocarpus papillatus</i>			2	1.3
<i>Microcladia borealis</i>			5	3.3
<i>Petrocelis</i>	2		6	5.3
rock	1			0.7
<i>Tetracita rubescens</i>	1	2		2.0
<i>Ulva</i> sp.	2	2	3	4.7
Total Percent Cover	122	132	152	135.3
# dead inverts	0	0	0	
% dead plants	0	0	0	

Table 14. Percent cover for plants and animals found in randomly selected quadrats at Mussel Flat.

Area: Mussel Flat

Description: high zonation,
protected, quadrats
randomly selected

n = 3

	11/25/96	11/25/96	2/19/96	Mean Annual % Cover
<i>Ceramium eatonianum</i>			21	14.0
<i>Cladophora graminea</i>	1	7	12	13.3
<i>Corallina vancouveriensis</i>		3		2.0
<i>Endocladia muricata</i>		17	19	24.0
<i>Gelidium coulteri</i>	8	1		6.0
<i>Mazzaella heterocarpa</i>		10		6.7
<i>Mastocarpus Jardinii</i>	39			26.0
<i>Mastocarpus papillatus</i>		1	24	16.7
<i>Musculus pygmaeus</i>	2			1.3
<i>Petrocelis</i>	16	3	16	23.3
<i>Porphyra</i> sp.		2		1.3
rock	4	4		5.3
<i>Tetracita rubescens</i>		27		18.0
<i>Ulva</i> sp.	1	14	11	17.3
Total Percent Cover	140	170	206	172.0
# dead inverts	0	0	0	
% dead plants	0	0	0	

Area: Mussel Flat

Description: middle zonation,
protected, quadrats are
randomly selected

n = 2

	11/25/96	2/19/96	Mean Annual % Cover
<i>Ceramium eatonianum</i>		23	23
<i>Cladophora graminea</i>	7	24	31
<i>Corallina vancouveriensis</i>	3	9	12
crustose coralline		5	5
<i>Lotia digitalis</i>		3	3
<i>Endocladia muricata</i>	17		17
<i>Gelidium coulteri</i>	1		1
<i>Mazzaella heterocarpa</i>	10	10	20
<i>Mastocarpus Jardinii</i>		2	2
<i>Mastocarpus papillatus</i>	1		1
<i>Microcladia borealis</i>		5	5
<i>Petrocelis</i>	3	5	8
<i>Porphyra</i> sp.	2		2
rock	4	2	6
<i>Tetracita rubescens</i>	27	13	40
<i>Ulva</i> sp.	14	11	25
Total Percent Cover	170	220	195
no. dead inverts	0	0	
% dead plants	0	0	

Area: Mussel Flat

Description: low zonation, quadrats are randomly selected

n = 1

	11/25/96	Mean Annual % Cover
<i>Anthopleura elegantissima</i>	1	2
<i>Ceramium eatonianum</i>	7	14
<i>Cladophora graminea</i>	4	8
<i>Corallina vancouveriensis</i>	1	2
crustose coralline	1	2
<i>Collisella scabra</i>	1	2
<i>Gelidium coulteri</i>	18	36
<i>Mazzaella flaccida</i>	6	12
<i>Microcladia borealis</i>	4	8
<i>Musculus pygmaeus</i>	14	28
<i>Petrocelis</i>	2	4
<i>Pollicipes polymerus</i>	2	4
<i>Tetracita rubescens</i>	26	52
<i>Ulva</i> sp.	10	20
Total Percent Cover	194	
# dead inverts	0	
% dead plants	0	

