British Columbia Faunistic Survey: Subtidal and Deepwater Megafauna of the Strait of Georgia

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Fisheries and Marine Service

Manuscript Report 1488

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BRITISH COLUMBIA FAUNISTIC SURVEY:

SUBTIDAL AND DEEPWATER MEGAFAUNA OF THE STRAIT OF GEORGIA

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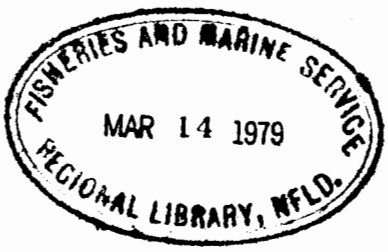

ABSTRACT

Bernard, F. R. 1978. British Columbia faunistic survey: subtidal and deepwater megafauna of the Strait of Georgia. Fish. Mar. Serv. MS Rep. 1488: 41p.

A list of the macroinvertebrates collected from 315 stations occupied in the Strait of Georgia below 10 m comprised 481 species, not including numerous unidentified taxa of bryozoa and compound tunicates. The inventory resulted in the identification of six major communities, primarily dependent on particle size and secondarily on depth.

Key words: Benthos, invertebrates, communities, marine infauna, Strait of Georgia.

RÉSUMÉ

Bernard, F. R. 1978. British Columbia faunistic survey: subtidal and deepwater megafauna of the Strait of Georgia. Fish. Mar. Serv. MS Rep. 1488: 41p.

Le rapport dresse la liste de 481 espèces de macro-invertébrés péchés dans 315 stations, à plus de 10 m de prodondeur, dans le détroit de Géorgie, ce qui ne comprend pas les nombreux bryozoaires et tuniciers coloniaux qui n'ont pu être classés. L'inventaire fait état de six principales communautés différenciées, premièrement, d'apres la granulométrie des particules, et, deuxièmement, d'aprés la profondeur.

Mots clefs: Benthos; invertébrés; communautés; endofaune marine; détroit de Géorgie.

INTRODUCTION

Identifications of numerous benthic invertebrates, collected from more than 300 stations occupied in the Strait of Georgia were used to compile an inventory and preliminary classification of the major communities occurring from approximately 10 m below low water to the deepest regions of the Strait.

The majority of stations were part of the subtidal clam and scallop resources survey (Quayle 1961, 1963) and otters were part of the British Columbia faunistic survey (Bernard et al. 1967, 1968, 1970, 1973). Some stations taken during unrelated investigations, account for the near-random coverage (Fig. 1).

Samples were taken with a variety of quantitative and qualitative apparatus (Bernard et al. 1967), but results showed that dredges, either trawl type or the naturalist dredge and its modifications, to be most effective for delimiting the major communities. Grab type quantitative samplers are meaningful within a given substrate condition and useful for refining spatial distributions determined initially by dredge or trawl sampling.

Samples containing a large quantity of mud and sand, were passed through a series of sieves. Large, readily identifiable organisms were noted in the field, while smaller organisms and those retained by a 1-mm mesh, were fixed in formaldehyde and stored in isopropyl alcohol for later identification. When possible expert assistance was obtained for identification. Among those who contributed to the faunal list were T. B. Butler and J. F. L. Hart (Crustacea); C. Berkeley, R. Gustus, and K. D. Hobson (Polychaeta). Certain entire groups of the collection were identified and published by Austin and Haylock 1973 (Ophiuroids); Bernard 1967, 1970, 1971 (Molluscs and brachiopods); Lambert 1978 (Asteroids).

Four hundred and eighty-one species were present, not counting several genera and numerous species of bryozoa and compound tunicates. This represented the most extensive list of the local benthic fauna since the check-list compiled from the literature by Clemens (1933).

PHYSICAL ENVIRONMENT

The Strait of Georgia lies between the mainland of British Columbia and Vancouver Island. It is a submerged topography with much deposition, originally of glacial origin, but now riverine, dominated by the large outflow from the Fraser River. The western shores of the Strait are shallow with some sandy beaches. The eastern shores are steep, with headlands, deep fjords and few beaches, except in the region of the Fraser River.

The Strait is generally less than 200-m deep, but a number of basins more than 300-m deep exist (Fig. 2). Quadra, Malaspina, Hornby, Ballenas Basins were recognized by Cockbain (1963b), but the last two were included with the

Gabriola Basin by Westrheim (1974) and are so considered in this report (Fig. 2). The basins are floored mainly by clay and silt, with local regions of sandy silt. The floors are generally uniform with numerous suitable trawling areas (Westrheim 1974), though a small number of depressions to about 450 m exist. There is no correlation between sediment grain size and depth (Cockbain 1963b), through the finest materials usually occupy the deeper zones.

The salient feature of the southern portion of the strait is the Fraser River Delta, which consists of sediments over 100 ft in thickness (Cockbain 1963a) actively extending westwards (Matthews and Shepard 1962) with localized zones of retreat (Luternauer and Murray 1973).

Between Texada Island and Vancouver Island is a region of coarser sediments, with patches of gravel and cobbles. The area between the mainland and Gabriola Basin features a number of banks, the largest being Halibut Bank, composed chiefly of sandy sediments unmixed with silt. To the south, adjacent to the Gulf Islands, the bottom is frequently of mixed sand and mud, while the narrow passages are floored with gravel and cobbles.

COMMUNITIES: CONCEPT AND TREATMENT

Communities are determined by environmental factors, so any change in the ambient regime, or its annual fluctuations, will be followed by an alteration in the proportional representation of its constituent species. A satisfactory system for delimitation of major biotic joint occurrences, must include the environment conditions. This is particularly applicable in the case of burrowing and interstitial faunas, where substrate particle size may be the dominant determining factor (Jones 1950).

Early views considered the sea bottom fauna to occupy zones that could be subdivided into smaller units corresponding to individual populations. The integral community concept, as distinct from zonal occurrence was pioneered by Petersen (1913), but early in the development of ecological theory Gleason (1925) recognized the essential individuality of the spatial distribution of a species. This interpretation met with strong opposition from the community school of ecology, and so entrenched became this view that its basically hypothetical nature was obscured until Whittaker (1956) designated it the community-unit theory.

There is little evidence that animal assemblages function as units. In fact communities are the product of the interactions of the distribution patterns of individual species, which are ultimately based on physiological tolerance ranges. In this situation, abrupt discontinuities between adjacent communities are not to be expected. The concept of the community without distinct boundaries is now well established, largely by the work of forest ecologists (Whittaker 1967).

The initial attempt to describe benthic assemblages in the northeastern Pacific was by Shelford and Towler (1925), continued by Shelford (1935). Wismer and Swanson (1935) carried out a limited survey off Friday Harbor, Washington and Lie (1968) published the results of a quantitative

sampling of eight stations in Puget Sound, however, sites unsuitable for grab sampling apparatus were avoided. Ellis (1967) recorded the sedimental infauna of Satellite Channel, Vancouver Island.

Statistical methods for delimiting assemblages are currently receiving much attention by ecologists. This phenomenon is mainly attributable to easy availability of computers and readymade soft-ware programs with resulting convenience of data manipulation, rather than any intrinsic value for the solving of biological problems. In this study the use of complex statistical methods, such as cluster analysis, to combine stations sharing a high percentage of species, were not practical due to the numerous rare species involved. Even a statistical program based on the normally expected species (Grassle and Smith 1976) which is sensitive to the less common components, required a preliminary selection of "significant" species, thereby largely invalidating any impartial weighing. It was concluded that simple comparison, based on depth and substrate type, resulted in an ordering of stations by species assemblage essentially in agreement with the statistical methods.

The principal factor governing the distribution of benthic organisms is the size and type of the substrate particles. Sediment types are of course the result of the predominating water current regimes and the degree of exposure. The close correlation of particle size with biotic assemblage present is reflected in the summary of dominant species (Table 1) where the decreased particle variability with increasing depth results in a more limited fauna. Varied assemblages are present in areas of mixed sediments and rock, furnishing wide ecotypic niches. A prime example of this is Halibut Bank, which supports many faunal organisms not present in the more limited benthic environments. An example of the association of an organism with particle size is the case of the holothuroid Paracaudina chilensis, an organism characteristic of the deepest regions of the Strait, but it is present in comparatively shallow water where fine silts are deposited by the Fraser River Plume.

Abiotic factors other than particle size are functional chiefly as constraints to distribution in the shallowest zones only. These include salinity, oxygen concentration, temperature, and the presence or absence of attached macrophytes.

Salinity has a direct effect in estuarine zones, but only the Fraser River modifies the deeper reaches of the Strait. This effect is most marked at the face of the river delta, but some effects are evident across the Strait, among the Gulf Islands.

Oxygen concentration appears to be generally adequate in shallower portions of the Strait, but is important in deeper parts and also fjords, which may act as accumulators of plant debris, particularly bark. The decomposition of these materials may so reduce oxygen tension to effectively exclude much of the biota, though the anoxic condition of the majority of fjords is attributable to hydrology. Some organisms, particularly the clams Compsomyax and Solemya and polychaete worms belonging to the genera Maldane and Capitella, are specially adapted to reduced oxygen, and, though characteristic of deep water, may be found in 20 m or little more, where logging activity has resulted in debris accumulation.

Temperature appears to have little effect 10 m below the surface as diurnal and annual fluctuations are small, except in shallow inlets and bays that display seasonal migration of organisms from deeper waters.

The presence of macrophytes is an important factor determining the type of fauna present. This is in a great measure due to the type of substrate permitting anchorage of the plants which also furnishes a habitat for epiphytic and nestling organisms not found in claustic environments. Indirect factors, as the production of exudates and detritus feeding local biota, and the sheltering effect of the fronds, allowing establishment, of a wide array of delicate epibenthic and attached organisms.

Some organisms appear self-limiting in distributing and absent from many apparently ideal areas. Such a situation is found in the large scallop Patinopecten cauvinus which is present in small numbers in isolated portions of the Gulf Islands (Trincomali Channel, Horuston Passage, and Plumper Sound) and also the Sand Heads off the mouth of the Fraser River, but is absent from the rest of the Strait. A map, showing distribution of major community types is given in Fig. 3.

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Table 1. Summary of dominant organisms by depth and substrate type.

Mud/silt	Sand	Gravel	Rock/cobbles
	20-100 meters		
Acila castrensis	Amphiura polycantha	Glycymeris subobsoleta	Cancer oregonensis
Aphrodita japonica	Astarte alaskensis	Mysella tumida	Chlamys rubida
Brisaster latifrons	Henricia leviuscula		Fusitriton oregonensis
Compsomyax subdiaphana	Miodontiscus prolongata		Henricia leviuscula
Glycera capitata	Nemocardium centifilosum		Metridium senile
Luidia foliata	Pectinaria californiensis		Placiphorella velata
Maldane glebifex	Psephidia lordi		
Pachycerianthus fimbriatus	Stylatula elongata		
Pandora filosa			
Sternaspis fossor			
Tachyrhynchus lacteolus			
	100-200 meters		
Acila castrensis	Munida quadrispina	Glycymeris subobsoleta	Aphrocallistes vastus
Aphrodita japonica	Pectinaria californiensis	Munida quadrispina	Fusitriton oregonensis
Arhynchite pugettensis	Spirontocaris holmsei		Lepidopleurus cancellatus
Brisaster latifrons	Stylatula elongata		Staurocalyptus dowlingi
Cidarina cidaris			
Compsomyax subdiaphana			
Glycinde armigera			
Glycera capittata			
Lucina tenuisculpta			
Pandora filosa			
Sternaspis fossor			
Thyasira gouldii			
Travisia pupa			

Table 1 (cont'd)

Mud/silt	Sand	Gravel	Rock/cobbles
	200-300 meters		
Acila castrensis	Pectinaria californiensis		Aphrocallistes vastus
Arhynchite pugettensis			
Brisaster latifrons			
Compsomyax subdiaphana			
Cidarina cidaris			
Crangon communis			
Glycera capittata			
Lucinoma annulata			
Macoma brota			
Onuphis iredescens			
Paracaudina chilensis			
Solemya sp.			
Thyasira disjuncta			
Thyasira gouldii			
Travisia pupa			
	300-400 meters		
Aphrodita minuta	Dentalium rectius		
Arhynchite pugettensis			
Brada villosa			
Brisaster latifrons			
Echiura spp.			
Lucinoma annulata			
Osteocella septrionalis			
Pachycerianthus fimbriatus			
Paracaudina chilensis			
Pasiphaea pacifica			
Sipuncula spp.			
Solemya sp.			
Thyasira disjuncta			
Travisia pupa			

SYSTEMATIC LIST OF SUBTIDAL INVERTEBRATES COLLECTED IN THE STRAIT OF GEORGIA WITH DEPTH RANGES IN METERS

PHYLUM PORIFERA

CLASS CALCAREA

Leucosolenia sp.	68

CLASS HEXACTINELLIDA

Aphrocallistes vastus Schulze	65-293
Rhodocalyptus dawsoni (Lambe)	65-275
Staurocalyptus dowlingii (Lambe)	132-185

CLASS DEMOSPONGIA

Aplysilla polyraphis de Laubenfels	
Biemma rhadia de Laubenfels	113
Cliona celata Grant	55-113
Esperiopsis originalis de Laubenfels	18-163
Geodia mesotriaena (Fleming)	26-265
Halichondria panicea (Pallas)	9-68
Iophon pattersoni (Bowerbank)	65-82
Mycale adhaerens (Lambe)	26-90
Myxilla incrustans (Esper)	55-92
Ophlitaspongia pennata (Lambe)	9
Podotuberculum hoffmanni Bakus	113
Polymastia cf. pachymastia de Laubenfels	55-113
Stylissa stipitata de Laubenfels	68
Xestospongia vanilla (de Laubenfels)	132

PHYLUM CNIDARIA

CLASS HYDROZOA

Order Gymnoblastea

Corymorpha cf. palma Torrey	9
Eudendrium californicum Torrey	9

Order Calyptoblastea

Abietinaria spp.	36-162
Aglaophenia inconspicua Torrey	20-168
Gonothyraea clarki (Marktanner-Turneretshev)	
Halecium cf. labrosum Alder.	36-82
Obelia dichotoma (Linné)	41-82
dubia Nutting	9-90
longissima (Pallas)	22
Stegopoma plicatile (Sars)	36-185

Order Hydrocorallina

Allopora porphyra (Fisher)	59-117
verrilli	36-156

CLASS SCYPHOZOA

Order Stauromedusae

Haliclystus auricula (Rathke)	7-55

CLASS ANTHOZOA

Subclass Octocorallia

Order Pennatulacea

Balticina septentrionalis (Gray)	218-370
Ptilosarcus gurneyi (Gray)	18-185
Stylatula elongata (Gabb)	19-159
Virgularia sp.	66

Order Stolonifera

Clavularia sp.	18

Order Gorgonacea

Paragorgonea arborea (Linné)	68
pacifica (Kukenthal)	165-201

Order Alcyonaria

Germesia rubiformis (Pallas)	220
Primnoa willeyi Hickson	197

Subclass Cerianthipatharia

Order Ceriantharia

Pachycerianthus fimbriatus (McMurrich)	55-326

Subclass Zoantharia

Order Zoanthiniaria

Epizoanthus scotinus Wood	23-135

Order Scleractinia

Balanophyllia elegans Verrill	41-92
Caryophyllia alaskensis Vaughan	36

Order Actiniaria

Anthopleura artemisia (Pickering)	36-132
xanthogrammica (Brandt)	9-40
Metridium senile (Linné)	27-113
Tealia crassicornis (Müller)	20-135

PHYLUM PLATYHELMINTHES

CLASS TURBELLARIA

Order Polycladia

Kaburakia excelsa Boch
Pseudoceros canadensis Hyman

PHYLUM NEMERTEA

Cerebratulus montogmeryi Coe	59-326
Paranemertes peregrina Coe	20-289
Tubulanus polymorphus Renier	20-207
Tubulaxia spp.	18-82

PHYLUM ECTOPROCTA

CLASS GYMNOLAEMATA

Order Ctenostomata

Clavopora occidentalis (Fewkes)	

Order Cyclostomata

Disporella sp.	55
Heteropora pacifica Borg	90
Lichenopora verrucaria (Fabricius)	46-284

Order Cheilostomata

Alderina brevispina (O'Donoghue & O'Donoghue)	
Membranipora membranacea (Linné)	21-65
serrilamella Osburn	117
Microporina borealis (Bush)	55
Mucronella sp.	18
Myriozoum tenue	113
Phidolopora pacifica (Robertson)	
Schizoporella sp.	113
Scrupocellaria diegensis (Smith)	165-326

PHYLUM ANNELIDA

CLASS POLYCHAETA

Subclass Errantia

Family Aphroditidae

Aphrodita japonica Marenzeller	10-275
longipalpa Essenberg	115
parva Moore	35-275

Family Glyceridae

Glycera capitata Oersted	35-265
robusta Ehlers	42-400
tesselata Grube	75-220

Family Goniadidae

Glycinde armigera Moore	40-399
Gonaida annulata Moore	81-289
maculata Oersted	

Family Lumbrineridae

Lumbrinereis luti Berkeley & Berkeley	40-289

Family Nephtyidae

Nephtys caeca (Fabricius)	7-289
punctata Hartman	35-326
rickettsi Hartman	45-274

Family Nereidae

Micronereis nanaimoensis Berkeley & Berkeley	
Nereis pelagica Linné	52
zonata Malmgren	384-439
Platynereis bicanaliculata	27-113

Family Onuphidae

Diopatra ornata Moore	110-159
Onuphis iridescens (Johnson)	165-439

Family Polynoidea

Antioella macrolepida (Moore)	7-60
Arctonoe pulchra (Johnson)	55--82
Eunoe oerstedi Malmgren	90-159
sp.	100-131
Gattyana cf. cirrosa (Pallas)	7-174
Harmothoe fragilis Moore	61-110
sp.	108-289
Hesperonoe complanata (Johnson)	7-292
Lepidasthenia longicirrata Berkeley	238-293
Lepidonotus squamatus (Linné)	289-394

Family Syllidae

Pionosyllis gigantea Moore	110-220
Syllis harti Berkeley & Berkeley	113

Subclass Sedentaria

Family Ampharetidae

Amphicteis mucronata Moore	65-439
scaphobranchiata Moore	121-296
Artacama conifera Moore	26-278
Asabellides lineata (Berkeley & Berkeley)	70-163
Asychis similis (Moore)	220-319
Melinna cristata (Sars)	58-137

Family Chaetopteridae

Mesochaetopterus taylori Potts	137-293
Spiochaetopterus costarum (Claparede)	31-357

Family Cirratulidae

Chaetozone setosa Malmgren	45-289
Dodecaceria fewkesi Berkeley & Berkeley	82

Family Flabelligeridae

Brada villosa (Rathke)	130-421

Family Maldanidae

Clymenura columbiana (Berkeley)	113
Maldane glebifex Grube	27-174
Maldanella robusta Moore	26
Nicomache lumbricalis (Fabricius)	60-278
Praxillella gracilis (Sars)	242
pacifica Berkeley	238

Family Opheliidae

Armandia brevis (Moore)	207
Travisia pupa Moore	35-397

Family Pectinariidae

Pectinaria californiensis Hartman	9-357

Family Sabellidae

Branchiomma burrardum Berkeley	38-265
Sabella crassicornis Sars	9-166

Family Sabellariidae

Idanthyrsus armatus Kinberg	108-174

Family Sepulidae

Crucigera irregularis Bush	65-275
Protula pacifica Pixell	60-174
Serpula vermicularis Linné	36-132
Spirorbis medius Pixell	326
spirilum (Linné)	37-326

Family Spionidae

Laonice cirrata (Sars)	201-275
Polydora caulleryi Mesnil	35-289
Spiophanes berkleyorum Pettibone	95

Family Steraspidae

Sternaspis fossor Stimpson	13-439

Family Terebellidae

Neoamphitrite robusta (Johnson)	108-399
Pista moorei Berkeley & Berkeley	113
Scionella japonica Moore	207-434
Terebellides stroemi Sars	65-218

PHYLUM SIPUNCULIDA

Golfingia cf. margaritacea (Sars)	174-393
Phascolosoma agassizii Keferstein	150-329
Themiste sp.	278

PHYLUM ECHIURA

Arhynchite pugettensis Fisher	42-375
Echiurus alaskanus Fisher	256-370
Nellobia eusoma Fisher	220

PHYLUM BRACHIOPODA

CLASS INARTICULATA

Family Craniidae

Crania californica Berry	32-92

CLASS ARTICULATA

Family Cancellothyrididae

Terebratulina unguicula (Carpenter)	20-166

Family Dallinidae

Laqueus californianus (Koch)	18-399
Terebratalia transversa (Sowerby)	18-174

Family Hemithyrididae

Hemithiris psittacea (Dillwyn)	92-421

PHYLUM MOLLUSCA

CLASS AMPHINEURA

Order Neoloricata

Family Acanthochitonidae

Cryptochiton stelleri (Middendorff)	9-20

Family Ischnochitonidae

Ischnochiton interstinctus (Gould)	55
retiporosus Carpenter	26
Lepidizona mertensii (Middendorff)	45-59
Tonicella lineata Wood	20-102
submarmorea (Middendorff)	35-74

Family Lepidopleuridae

Lepidopleurus belknapi (Dall)	90-220
cancellatus (Sowerby)	23-162

Family Mopaliidae

Mopalia imporcata Carpenter	9-59
lignosa (Gould)	9-37
Placiphorella velata Dall	23-174

CLASS GASTROPODA

Order Archaeogastropoda

Suborder Docoglossa

Family Cocculinidae

Cocculina agassizii Dall	289

Family Fissurellidae

Diodora aspera (Eschscholtz)	82
Puncturella cucullata (Gould)	18-45
galathea (Gould)	55-82
multistriata Dall	36

Family Lepetidae

Cryptobranchia concentrica (Middendorff)	9-82
Lepeta caeca (Muller)	55-185

Suborder Trochina

Family Trochidae

Calliostoma canaliculatum (Ligtfoot)	20-82
ligatum (Gould)	35-65
Cidarina cidaris (Adams)	55-278
Margarites pupillus (Gould)	55-185
Solariella obscura (Couthouy)	45-82
peramabilis Carpenter	26-132

Family Turbinidae

Homalopoma luridum (Dall)	9-55

Order Mesogastropoda

Suborder Taenioglossa

Family Caecidae

Caecum crebricinctum Carpenter	37-82
Fartulum cf. occidentale Bartsch	26

Family Cerithiidae

Cerithiopsis truncata Dall	161
Bittium eschrichtii (Middendorff)	9-36

Family Cymatiidae

Fusitriton oregonensis (Redfield)	10-166

Family Naticidae

Natica clausa Broderip & Sowerby	110-117
Polinices lewisii (Gould)	9-26
pallidus Broderip & Sowerby	12-414

Family Tornidae

Vitrinella columbiana (Bartsch)

Family Trichotropididae

Trichotropis cancellata Hinds	18-146

Family Hipponicidae

Hipponix antiquatus (Linné)	9

Family Calyptraeidae

Crepidula adunca Sowerby	37

Family Turritellidae

Tachyrhynchus lacteolus (Carpenter)	14-152

Suborder Ptenoglossa

Family Epitoniidae

Epitonium indianorum (Carpenter)	27-220

Suborder Gymnoglossa

Family Eulimidae

Balcis micans (Carpenter)	55
Balcis spp.	9-60

Suborder Stenoglossa

Family Buccinidae

Buccinum tenue (Gray)	55-146

Family Columbellidae

Amphissa columbiana Dall	26-146
versicolor Dall	26-55
Mitrella carinata (Hinds)	9-22
gouldi (Carpenter)	14-146

Family Muricidae

Ceratostoma foliata (Gmelin)	55-59
Ocenebra tenuisculptus (Carpenter)	9-26
Trophonopsis lasius (Dall)	161-256

Family Nassariidae

Nassarius mendicus (Gould)	14-146

Family Neptuneidae

Colus spp.	121-397
Neptunea amianta (Dall)	218-243
tabulata (Baird)	174-256
Searlesia dira (Reeve)	65

Family Olividae

Thais lamellosa (Gmelin)	9-113

Family Turridae

Ophiodermella incisa (Carpenter)	26-45

Subclass Opisthobranchiata

Order Cephalaspidea

Family Acteocinidae

Acteocina eximia (Baird)	26-132
culcitella (Gould)	9-174
Cylichna attonsa Carpenter	15-82

Order Tectibranchia

Family Acteonidae

Acteon punctocaelatus (Carpenter)	9-59

Family Atydae

Haminoes virescens (Soweroy)	9-18
vesicula (Gould)	9-15

Family Gastropteridae

Gastropteron pacificum Bergh	82-117

Family Pyramidellidae

Odostomia columbiana Dall & Bartsch	26
Turbonilla lordi (E.A. Smith)	14-73
Turbonilla spp.	26-82

Order Acoela

Suborder Nudibranchiata

Family Aeolidiidae

Aeolidia papillosa (Linné)	9
Hermissenda crassicornis (Eschsholtz)	7-9

Family Arminidae

Armina californica (Cooper)	55-326

Family Dendronotidae

Dendromotus frondosus (Ascanius)	9-82
iris Cooper	21-90

Family Dironidae

Dirona albolineata MacFarland	18-90

Family Doridiidae

Anisodoris nobilis (MacFarland)	65
Cadlina flavomaculata MacFarland	9-36
Diaulula cf. sandiegensis (Cooper)	9
Rostanga pulchra MacFarland	27-30

Family Fimbriidae

Melibe leonina (Gould)	26-68

Family Flabellinidae

Coryphella fusca O'Donoghue	45

Family Onchidoriididae

Acanthodoris cf. pilosa (Abildgaard)	18-90

CLASS BIVALVIA

Subclass Paleotaxodonta

Order Nuculanidae

Family Nuculanidae

Nuculana cellulita (Dall)	18
hamata (Carpenter)	90-174
minuta Fabricius	26-172
pernula (Müller)	73-278
Yoldia limatula (Say)	74-265
martyria Dall	108-393
scissurata Dall	36-397
thraciaeformis (Storer)	37-414

Family Nuculidae

Nucula cf. tenuis (Montagu)	
Truncacila castrensis (Hinds)	14-414

Subclass Cryptodonta

Order Solemyoidea

Family Solemya

Solemya sp.	42-439

Subclass Pteriomorphia

Order Arcoidea

Family Glycymerididae

Glycymeris subobsoleta (Carpenter)	9-150

Order Mytiloidea

Family Mytilidae

Megacrenela decussata (Montagu)	35-92
Modiolus cf. modiolus (Linné)	10-110
rectus (Conrad)	142
Musculus niger (Gray)	42-65
Solamen columbianum (Dall)	73-166

Order Pteroida

Family Anomiidae

Pododesmus macroschisma (Deshayes)	14-82

Family Pectinidae

Chlamys hastata (Sowerby)	10-172
Chlamys pugetensis Oldroyd	45-289
rubida (Hinds)	14-185
Cyclopecten vancouverensis (Whiteaves)	26-293
Patinopecten caurinus (Gould)	14-52
Propeamussium alaskensis (Dall)	65-243

Subclass Heterodonta

Order Veneroida

Family Astartidae

Astarte alaskensis Dall	27-55
compacta Carpenter	26
esquimalti (Baird)	18-174

Family Cardiidae

Clinocardium californiense (Deshayes)	9-110
nuttallii (Conrad)	10-18
Nemocardium centifilosum (Carpenter)	18-265
Serripes groenlandicus Bruguiere	14-35

Family Carditidae

Cardita paucicostata Krause	58-154
ventricosa Gould	18-82
Miodontiscus prolongata (Carpenter)	18-90

Famiy Kelliidae

Kellia suborbicularis (Montagu)	26-82
Mysella tumida (Carpenter)	9-115

Family Leptonidae

Lasaea cistula Keen	18

Family Lucinidae

Lucinoma annulata (Reeve)	42-414
Parvilucina tenuisculpta (Carpenter)	40-293

Family Mactridae

Spisula falcata (Gould)	18
Tresus nuttallii (Conrad)	18

Family Semelidae

Semele rubropicta Dall	36

Family Solenidae

Siliqua lucida Hertlein	10
Solen sicareus Gould	12-19

Family Tellinidae

Macoma alaskana Dall	
brota Dall	100-201
calcarea (Gmelin)	102-132
carlottensis Whiteaves	18-265
elimata Dunnill & Coan	61-278
expansa Carpenter	73
inconspicua (Broderip & Sowerby)	110-275
lipara Dall	110-275
nasuta (Conrad)	9-18
Tellina buttoni Dall	18-73
salmonea (Carpenter)	9-154

Family Thyasiridae

Axinopsida serricata (Carpenter)	14-242
Axinulus ferruginosus (Forbes)	161-293
Tyasira bisecta (Conrad)	265
disjuncta (Gabb)	68-414
gouldii (Philippi)	66-384

Family Ungulinidae

Diplodonta orbellus (Gould)	9-26

Suborder Venerina

Family Kelliellidae

Turtonia minuta (Fabricius)	40

Family Veneridae

Compsomyax subdiaphana (Carpenter)	15-421
Humilaria kennerlyi (Reeve)	35-110
Psephidia lordi (Baird)	9-150
Saxidomus giganteus Deshayes	18-40
Transenella tantilla (Gould)	9-55

Order Myoida

Family Myoida

Cryptomya californica (Conrad)	40-357
Hiatella arctica (Linné)	18-262
pholadis (Linné)	26
Mya truncata (Linné)	19
Panope generosa (Gould)	18-55

Family Pholadidae

Bankia setacea Tryon	18-161
Xylophaga washingtonia Bartsch	121-421

Subclass Anomalodesmata

Order Pholadomyoida

Family Lyonsiidae

Entodesma saxicola Baird	32-113
Lyonsia californica Conrad	18-42

Family Pandoridae

Pandora filosa (Carpenter)	35-265
grandis Dall	42-156
punctata Conrad	9-55

Order Setibranchoidea

Family Cuspidariidae

Cardiomya californica (Dall)	14-275
pectinata (Carpenter)	23-172
oldroydi Dall in Olroyd	27-172
planetica (Dall)	256-370

CLASS SCAPHOPODA

Family Dentaliidae

Dentalium rectius Carpenter	121-414

CLASS CEPHALOPODA

Order Sepiodidae

Family Sepiodidae

Rossia pacifica Berry	27-344

Order Octopoda

Family Octopodidae

Octopus dofleini (Wulker)	23-344

PHYLUM ECHINODERMATA

CLASS CRINOIDEA

Order Comutulidae

Family Antedoinidae

Florometra serratissima (Clarke)	30-163

CLASS OPHIUROIDEA

Order Euryalae

Family Asteronychidae

Asteronyx loveni Muller & Troschel	18-65

Family Gorgonocephalidae

Gorgonocephalus eucnemis Muller & Troschel	40-65

Order Ophiurae

Family Amphiuridae

Axiognathus pugetana (Lyman)	18-117
squamata (delle Chiaje)	9-150
Amphiodia digitata Nielsen	26-262
occidentlis (Lyman)	40-146
periercta Clark	26-68
psara Clark	37
urtica (Lyman)	18-131
Amphioplus hexacanthus Clark	27-162
macraspis (Clarke)	117
strongyloplax (Clarke)	40-185
Amphiura diomedeae Lütken & Mortensen	91-262
polyacantha Lütken & Mortensen	20-156
seminuda Lütken & Mortensen	113

Family Ophiacanthidae

Ophiopholis aculeata (Linné)	18-185
bakeri McClendon	30-152
japonica (Lyman)	113
kennerlyi (Lyman)	35-159
longispina Clark	113

Family Ophiocomidae

Ophiopsila californica Clark	27-58
Ophiopteris papillosa (Lyman)	41-185

Family Ophiolepididae

Amphiophiura ponderosa (Lyman)	81
superba Lütken & Mortensen	81
Ophiocten hastatum Lyman	37
Ophiura cryptolepas Clark	26
leptoctenia Clark	26-165
luetkeni (Lyman)	14-156
sarsi Lütken	14-159

Family Ophionereidae

Ophionereis eurybrachplax Clark	26-117

Family Ophiothricidae

Ophiothrix spiculata Le Conte	17-146

CLASS ASTEROIDEA

Order Phanerozonia

Family Asteropidae

Dermasterias imbricata (Grube)	10-59

Family Astropectinidae

Leptychaster pacificus Fischer	110-275

Family Goniasteridae

Ceramaster patagonicus (Sladen)	102-293
Hippasteria spinosa Verrill	19-161
Mediaster aequalis Stmpson	35-275
Pseudarchaster parellii (Duben & Koren)	121

Order Spinulosa

Family Echinasteridae

Henricia leviuscula (Stimpson)	18-82
longispina Fischer	90-220

Family Solasteridae

Crossaster papposus (Linné)	18-82
Solaster dawsoni Verrill	18-163
stimpsoni Verrill	27-35
Pteraster tesselatus Ives	40-90

Order Forcipulata

Family Asteridae

Evasterias troschelii (Stimpson)	18-174
Orthasterias koehleri (de Loriol)	37-65
Pisaster brevispinus (Stimpson)	12-55
ochraceus (Brandt)	9

CLASS ECHINOIDEA

Order Centrechinoida

Family Strongylocentrotidae

Allocentrotus fragilis (Jackson)	384
Stronglylocentrotus drobachiensis Müller	55-113
franciscanus (Agassiz)	18-117
pallidus (G. Sars)	113

Order Clypeastroida

Family Dendrasteridae

Dendraster exentricus (Eschscholtz)	18

Order Spatangoida

Family Hemiasteridae

Brisaster latifrons (Agassiz)	34-414

CLASS HOLOTHURIOIDEA

Order Aspidochirota

Family Holothuriidae

Parastichopus californicus (Stimpson)	14-146

Order Dendrochirota

Family Cucumariidae

Cucumaria fallax	73
miniata (Brandt)	23-99
piperata (Stimpson)	18-146
Eupentacta pseudoquiquesemita Deichmann	55
quinquesemita (Selenka)	18-90
Pentamera populifer (Stimpson)	41-265
Psolidium bullatum Oshima	36-201
Psolus chitonoides (Clark)	59-262

Order Apoda

Family Synaptidae

Chiridota sp.	22-414
Leptosynapta spp.	9-265
Molpadia intermedia (Ludwig)	9-180

Order Molpadida

Family Molpadidae

Paracaudina chilensis (J. Müller)	42-414

PHYLUM ARTHROPODA

Subphylum Chelicerata

CLASS PYCNOGONIDAE

Family Nymphonidae

Nymphon pixellae Scott	66-274

Family Phoxichilidiidae

Phoxichilidium femoratum (Rathke)	18-37

Subphylum Mandibulata

CLASS CRUSTACEA

Subclass Cirripedia

Order Thoraciae

Family Balanidae

Balanus crenatus Bruguière	20-90
glandula Darwin	27-37
nubilus Darwin	18-90

Family Chthamalidae

Chthamalus dalli Pilsbry	9-42

Family Scalpellidae

Scalpellum columbianum Pilsbry	102-399

Subclass Malacostraca

Order Cumacea

Family Diastylidae

Diastylis alaskensis Calman	20
bidentata Calman	9-130
pellucida Hart 40-130	37-59
Diastylopsis cf. dawsoni (Smith)	55
Leptostylis villosa (Sars)	40-90

Family Lampropidae

Hemilamprops sp.	19
Lamprops cf. quadriplicata (Smith)	40-59

Family Leuconidae

Eudorella pacifica Hart	22-140
Eudorellopsis biplicata Calman	37
Leucon fulvus (Sars)	9-274
sp.	20-110

Family Nannastacidae

Campylaspis sp.	10-113
Cumella vulgaris Hart	18

Order Amphipoda

Suborder Caprellidea

Family Caprellidae

Caprella equilibra Say	25-68
sp.	9-32

Suborder Gammaridea

Family Ampeliscidae

Ampelisca spp.	45-289

Family Ampithoidae

Ampithoe humeralis Stimpson	10-15

Family Aoridae

Aoroides columbiae Walker	20-68

Family Corophiidae

Corophium spinicorne Stimpson	9

Family Gammaridae

Anisogammarus remellus (Weckel)	36
Maera sp.	82
Melita sp.	45-174

Family Lysianasiidae

Orchoneme sp.	14-172

Family Phoxocephalidae

Heterophorus spp.	52-117
Paraphorus oculatus (Sars)	17-137

Family Talitridae

Orchestoidea (?) sp.	18
Parallorchestes ochotensis (Brandt)	15

Order Isopoda

Family Anthuridae

Cyathura carinata (Kroyer)	45-68

Family Limnoriidae

Limnoria lignorum Rathke	35-40

Order Decapoda

Suborder Natantia

Family Crangonidae

Crangon communis Rathbun	36-414
munita Dana	82-117
Sclerocrangon alata Rathbun	102

Family Hippolytidae

Eualus avinus (Rathbun)	14-152
berkelyorum Butler	108-166
macrophthalmus (Rathbun)	165-414
pusiolus (Kroyer)	68-82
townsendi (Rathbun)	110-180
Heptacarpus brevirostris (Dana)	65-132
decorus (Rathbun)	131
flexus (Rathbun)	92-185
moseri (Rathbun)	58
Spirontocaris holmsei Holthuis	46-322
spinus (Sowerby)	36

Family Pandalidae

Pandalus goniurus Stimpson	58
hypsinotus Brandt	36-40
jordani Rathbun	73-162
platyceros Brandt	36
stenolepsis Rathbun	55

Family Peneidea

Pasiphaea pacifica Rathbun	152-399

Suborder Reptantia

Family Canceridae

Cancer gracilis Dana	22-82
magister Dana	12-50
oregonensis (Dana)	26-101
productus Randall	9-59

Family Diogenidae

Paguristes turgidus (Stimpson)	36-110

Family Galatheidae

Munida quadrispina Benedict	55-293

Family Lithodidae

Acantholithodes hispidus (Stimpson)	20-102
Hapalogaster mertensii Brandt	113
Lopholithodes foraminatus (Stimpson)	55-185
Phyllolithodes papillosus Brandt	23-159
Rhinolithodes wosnessenskii Brandt	18-163

Family Maiidae

Chionoecetes bairdi Rathbun	38-40
Chorilia longipes Dana	22-414
Hyas lyratus Dana	37-55
Oregonia gracilis Dana	22-146
Pugettia producta Randall	12-30
Scyra acutifrons Dana	64-65

Family Paguridae

Discorsopagurus schmitti (Stevens)	55
Elassochirus tenuimanus (Dana)	36-110
Pagurus alaskensis (Harrington & Griffin)	146
armatus (Dana)	36
beringianus (Benedict)	14-113
capillatus (Benedict)	18-73
dalli (Benedict)	110
hirsutiusculus (Dana)	18-90
kennerlyi (Stimpson)	140
ochotensis Brandt	26-146
setosus (Benedict)	116-265

Family Pinnotheridae

Fabia subquadrata (Dana)	64-65
Pinnixa littoralis Holmes	40-265

Family Porcellanidae

Petrolisthes cinctipes (Randall)	55

Family Xanthidae

Lophopanopeus bellus (Stimpson)	20-68
diegnsis Rathbun	26

PHYLUM CHORDATA

Subphylum Urochordata

CLASS ASCIDIACEA

Family Chelyosomatidae

Chelyosoma productum Stimpson	36
Corella willmeriana Herdman	18-68

Family Cionidae

Ciona intestinalis (Linné)	18-68

Family Halocynthiidae

Boltenia villosa (Stimpson)	18-135
Halocynthia aurantium (Pallas)	20-135
igaboja Oka.	20-68
Pyura haustor (Stimpson)	65-135
mirabilis (von Drasche)	20-135

Family Phallusiidae

Ascidia ceratodes (Huntsman)	18-90
paratropa (Huntsman)	26-162

Family Styellidae

Cnemidocarpa finmarkiensis (Kiaer)	20-82
Styella gibbsii (Stimpson)	36

Compound Ascidians

Several genera	20-162

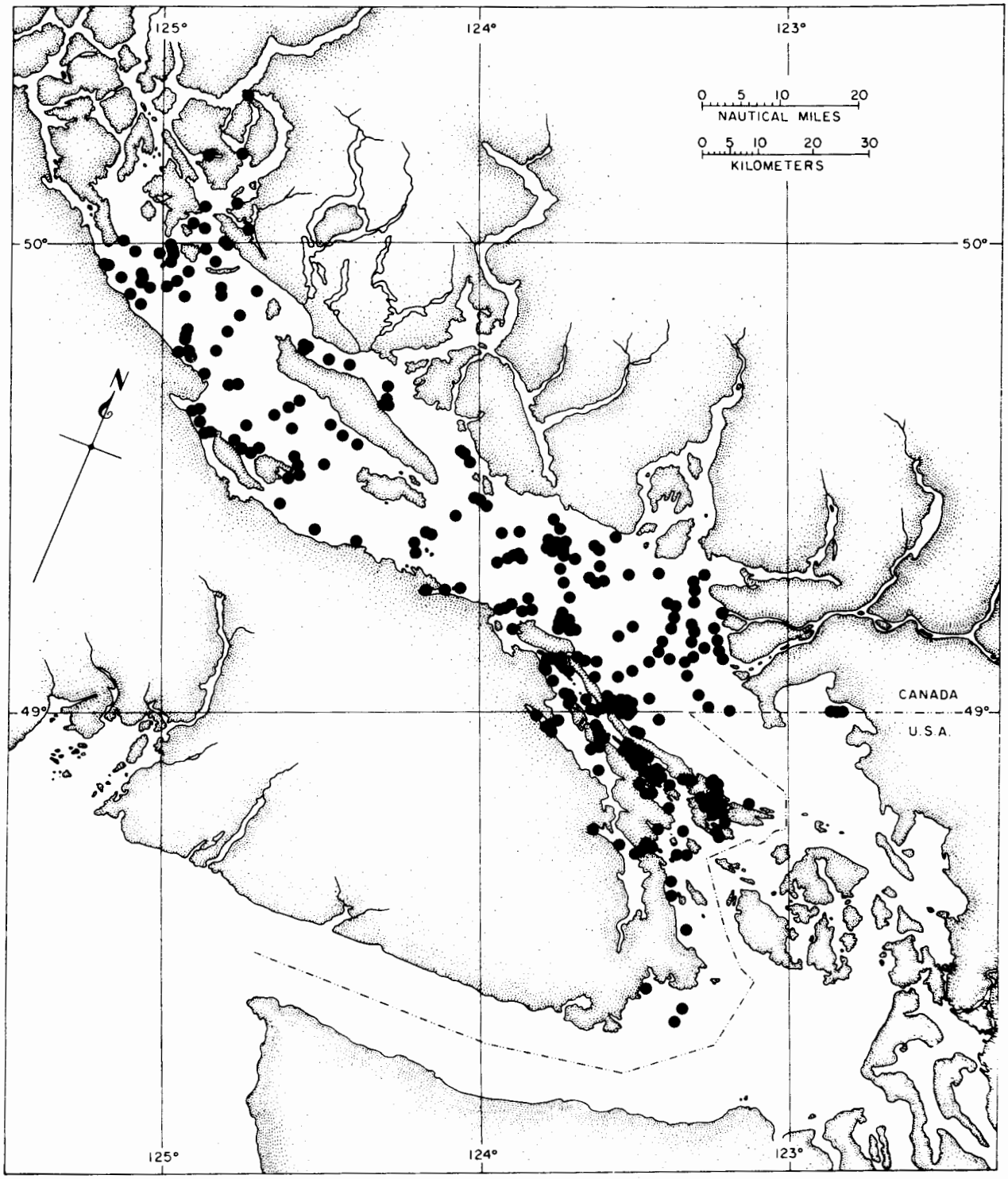

Fig. 1. Map of the Strait of Georgia showing benthic sample stations.

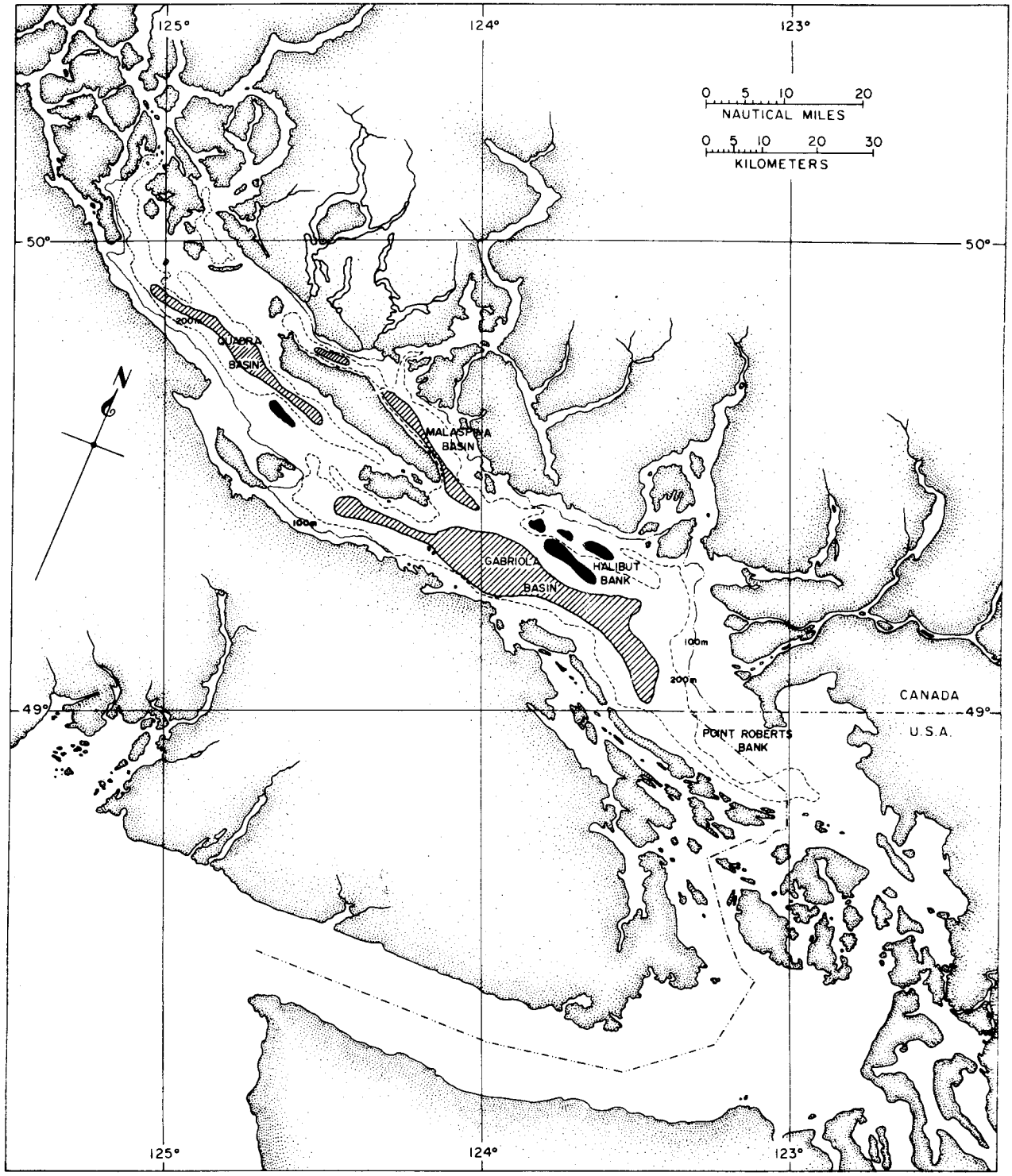

Fig. 2. Map of the Strait of Georgia showing bathymetry.

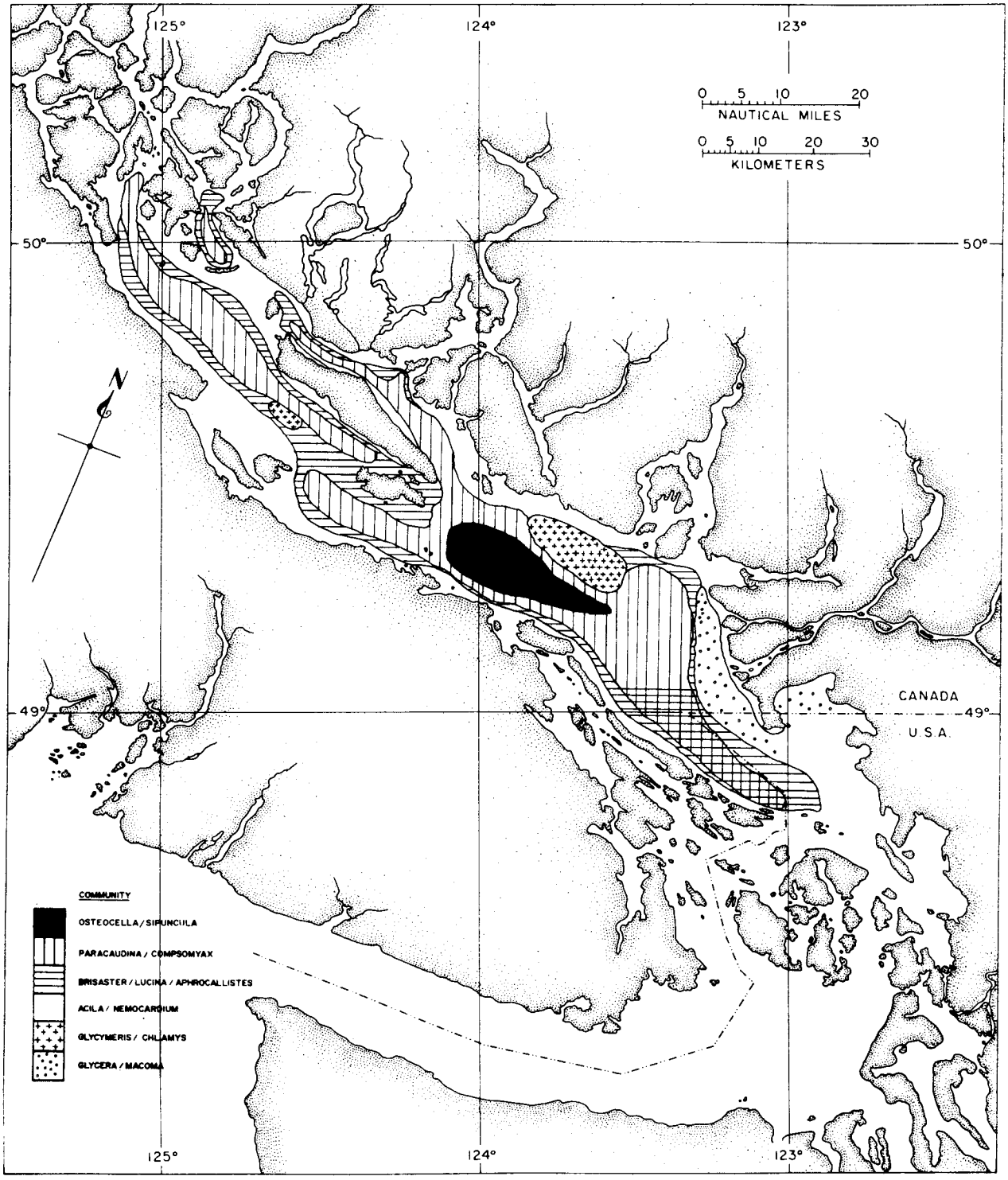

Fig. 3. Map of the Strait of Georgia showing major benthic communities.