DIVERSITY OF MARINE BENTHIC COMMUNITIES FROM NEARSHORE ENVIRONMENTS ON THE LABRADOR AND NEWFOUNDLAND COASTS

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BY

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ABSTRACT:

The structure and species diversity of benthic communities were examined from samples collected by SCUBA and Shipek grab from sand bottoms on the Labrador coast and in Conception Bay Newfoundland. The effects of the physical environment on the benthic community were studied using the factors of depth, distance offshore, substrate type, substrate diversity and exposure to open water.

Two communities were found in the areas surveyed; one on finer sands in protected environments characterized by *Prionospio steenstrupi* and *Pectinaria granulata* and one on coarser sands in more exposed environments characterized by *Diastylis* sp. and *Nephtys longosetosa*. Three species found in Labrador, *Laonome kröyeri*, *Amphiophiura convexa* and *Onisimus affinis* were new records for the Labrador coast.

Species diversity was found to be greatest at medium exposures, where heterogeneity of the environment was greatest and on substrates with the greatest diversity of grain sizes. Variations in numbers of species between Newfoundland and Labrador and between sites with similar physical conditions was found to be due to non-burrowing species. Attempts were made to explain differences in number of species for sites on the Labrador coast and between Newfoundland and Labrador sites on the basis of differences in exposure, substrate conditions and predation.

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I would like to thank the following for assistance in identification: Diana Laubitz and Judith Fournier from the Canadian Aquatic Identification Centre at the National Museum in Ottawa for verification and identification of ophiuroids and polychaetes; Dr. D.H. Steele for verification and identification of amphipods; Leonard and Monique Vassallo for moral support and for assistance with amphipods and molluscs.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Number Page

Number Page

INTRODUCTION:

The objective of this study was to examine the relationship between species diversity of benthic communities on the Labrador coast and the physical characteristics of the near shore environment. A qualitative and quantitative survey was made of the animals from benthic samples collected in near shore environments, to determine the structure and species diversity of the benthic communities. A survey was also made of the benthic community from a near shore environment in Conception Bay, Newfoundland to compare with the benthic communities from Labrador.

Marine benthic communities, first described by Petersen (1913) are named by the dominant species in terms of numbers and/or weight and a review and description of the characteristic Petersen-type communities for various parts of the world has been provided by Thorson (1957). Stephensen *et al.* (1972) showed that Petersen-type communities could be determined by computer analysis of data based on numbers or weight but not both. In this survey, communities were determined from a computer analysis of the data based on the numbers of organisms present rather than weight. Sanders *et al.* (1965) discuss the difficulties in comparing samples on the basis of biomass measurements.

Sanders (1968) stresses that species diversity is one of the major features of animal communities and is affected by both the physical and biological parameters in the environment. Spatial heterogeneity has been shown to affect species diversity as the more complex physical environments tend to support more species than do simpler environments. McArthur *et al.* (1966) demonstrated with bird communities that bird species diversity increases as habitat diversity increases. In the same way with benthic communities, Sanders *et al.* (1965) found that sand bottom faunas are more diverse than mud bottom faunas due to the greater variety of microhabitats. Species diversity is also affected by stress in the environment and Sanders (1968) in his stability-time hypothesis discusses how increasing gradients of physical stress on a community result in a more physically controlled community with lower species diversity. Diversity has also been shown to change with latitude and Thorson (1957) discusses how the number of species of benthic epifauna increases from the Arctic to the tropics.

In this study abiotic physical parameters were measured at sites from Nain Labrador south to Conception Bay, Newfoundland. Substrate diversity (the variation in grain sizes present in the sediment) was measured to provide a measure of habitat diversity. Exposure of sites to open water was measured to provide an estimate of physical stress from wave-energy levels. In benthic studies other workers have also measured organic content of the sediment which can affect the distribution of some benthic animals (e.g. Bader, 1954) and chemical parameters which have been shown to have some effect on the species variation of the benthos (e.g. Green, 1971). Wildish (1977) discusses the biotic factors involved in controlling marine sublittoral macrofauna. The effects of depth, distance offshore and substrate type were also examined in this study to determine how they affect species diversity.

MATERIALS AND METHODS:

Collections of benthic organisms from Labrador were made from a ninety foot vessel the 'Regina B' (see Figure 1) during a six week period from August 14 to September 20, 1977. Fourteen sites were selected while working progressively northward along the Labrador coast from Cartwright to Nain (see Figure 2). These sites were selected so as to include the representative coastal environments including protected and exposed areas.

Sites were sampled using SCUBA and a Shipek grab sampler from the vessel. A total of fourty-four Shipek grab samples and ninety-one samples taken by SCUBA were collected along the Labrador coast and twenty-eight samples were taken by SCUBA in Conception Bay Newfoundland (see Figure 2). The methods of sampling and numbers of samples taken at each site and subsite are shown in Appendix F.

I SAMPLING TECHNIQUES:

All Shipek grab samples were taken from the vessel (see Figure 3). The ship's position was determined using radar and depth was determined using the ship's echo sounder. Hauls more than half full were kept for quantitative analysis and the samples were stored in plastic bags on deck until they were sorted within twelve hours.

For near shore sampling, a dive line marked at 10 m intervals was set up from shore to a depth of 10 to 30 m depending on the site. Using SCUBA and a Zodiac boat, samples were taken along the dive line using a plastic bucket with the same dimensions as the Shipek

Figure 1. The M.V. 'Regina B'

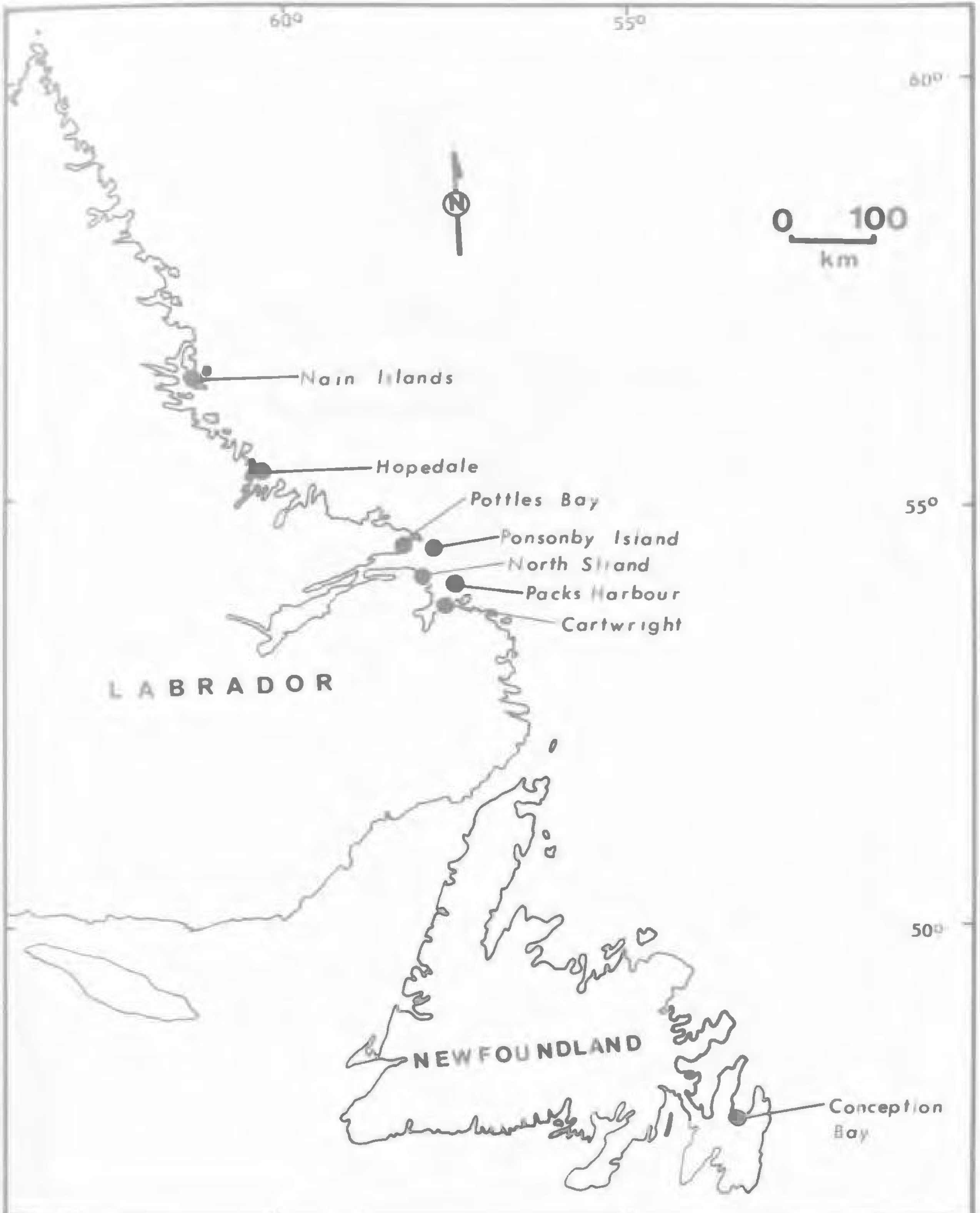
A. Stern view

B. Bow view


A
REGINA B
ST JOHNS NFLD


B

Figure 2. Map of sampling sites in Newfoundland and Labrador.



60°
55°
60°
55°
50°
0 100
km
Nain Islands
Hopedale
Pottles Bay
Ponsonby Island
North Strand
Packs Harbour
Cartwright
LABRADOR
NEWFOUNDLAND
Conception Bay

Figure 3. Shipek grab sampler

A. Sampler about to be lowered

B. Retrieval of sample.

A

B

bucket (.04 m^2). Sampling spots were selected only at markers on the dive line to reduce subjective selection as much as possible. Samples were taken so that half the bucket was filled so as to be comparable to a Shipek sample (see Figure 4). Samples were emptied into plastic bags, tied and brought to the Zodiac (see Figure 5). At each station, depth as determined with a diver's depth gauge and distance offshore along the dive line were recorded.

From each sample a representative subsample of the sediment was taken for grain size analysis. Volume of the subsample was 100 to 200 ml varying with the type of substrate. The samples were then washed with sea water (see Figure 5) and all specimens retained by a 1 mm mesh sieve were hand picked (see Figure 6) and bagged in whirlpak bags. All grab samples were sorted within twelve hours of sampling. Samples were preserved in 10% formalin and returned to the laboratory for identification.

All specimens were identified to species where possible and the numbers of individuals of each species recorded for each sample. Ophiuroids were identified at the Canadian Aquatic Identification Center in the National Museum and representatives of each species of polychaete were sent to the Identification Center for verification and examples of each species were kept as reference for future identifications. At Memorial University amphipods were identified or confirmed by Dr. D.H. Steele and molluscs were identified or confirmed by M. Vassallo.

Figure 4. Scuba Sampling

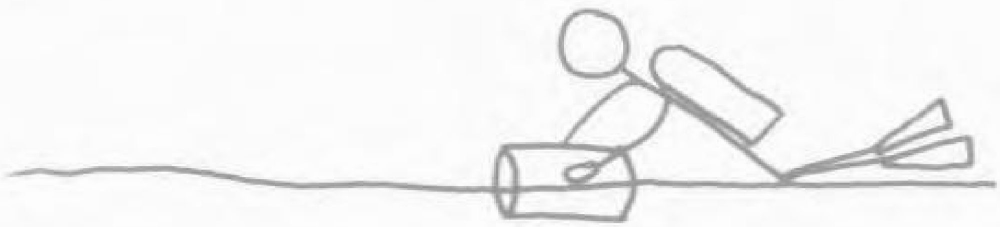
A. Diver pushing sampler into sediment

B. Diver filling sample to same depth as Shipek grab

C. Diver removing sample from sediment

A

B



C

Figure 5.

A. retrieving SCUBA sample

B. washing sediment from sample


A
B

II ANALYSIS:

The species of benthic invertebrates collected at the sampling stations were analyzed using cluster analysis (described by Field and McFarlane, 1968) of species to determine community structure and of stations to determine the similarity of sampling locations. For the Labrador samples, analysis was done using one hundred samples and those species which were found in five or more samples. For Conception Bay in insular Newfoundland, cluster analysis was done on twenty-eight samples and twenty-one of the most abundant species.

Measures of similarity were computed using the coefficient of Czekanowski:

$$C = \frac{2W}{a + b}$$ (described by Bray and Curtis, 1957)

where a = sum of quantitative measures of species in one sample ($\sum_{i=1}^{n} \ln (X + 1)$, where X = abundance value for species i)

b = sum of measures of species in a second sample

W = sum of lesser values for only those species which are in common between the two samples.

C has a resemblance value ranging from 0 to 1 so that a value of 1 indicates two samples are identical in all respects.

Analyses were made using the similarity coefficient on the logarithm of the numbers of specimens of each species. This method tends to scale down the weighting given to abundant species in the sample (Field and McFarlane, 1968). In order to use the Czekanowski coefficient's property of ignoring (0 - 0) matches, ln (X + 1) was calculated where X = abundance value, so that when X = 0, the logarithm also equals 0 (Field and McFarlane, 1968). Dendograms were determined by computer using the unweighted group average method of clustering (Sokal and Sneath, 1963).

Species diversity for each station was determined using Shannon's Index:

$$S = -\sum_{i=1}^{s} \left(\frac{n_i}{N} \log_2 \frac{n_i}{N} \right)$$ (described by Pielou, 1966)

where N = number of individuals in a sample

n_i = number of individuals of i^{th} species

S = number of species in the sample.

Diversity is a measure of the degree of uncertainty attached to the specific identity of any randomly selected individual (Pielou, 1966). The greater the number of species, and the more equal their proportion, the greater the uncertainty and hence the diversity. Shannon's Index is a useful measure of diversity as it measures both equitability and richness components of diversity and as such varies with both the number of species and with the relative abundance of each species (Sanders, 1968).

III EXPOSURE:

Due to the irregular nature of the coastline, many of the fjords and bays are relatively sheltered whereas other areas are exposed to high wave energy levels. To determine the amount of exposure at each sampling site, Baardseth's exposure index (Baardseth, 1970) was used.

This index is a measure of the sector of open water that faces a shore which is expected to be correlated with the amount of exposure (Baardseth, 1970). A transparent disc with a circle divided into thirty-six equal sectors is placed upon the chart with its center in the location of the sampling site. The radius of the sector used was 6 cm corresponding to 3 km in the field (scale of 1:50,000). The sectors containing sea only are counted as open and those with land as closed. The exposure index is then defined as the number of open sectors from the center of the disc (Baardseth, 1970). The choice of the radius is arbitrary but must distinguish between various degrees of exposure inside protected bays as well as outside them. The choice of 3 km seemed to be suitable for most of the island and fjord type coast of Labrador.

IV SPECIES-AREA CURVES:

To determine whether or not enough samples were taken at any one sampling site, species-area curves were drawn. The cumulative number of species was plotted on the ordinate against the area so far examined at any one site. The area is determined by samples progressively added at random until all the samples at a site have been used. If all the species at the site have been sampled, the species-area curve will rise to the value of the total number of species and then stop. The point at which the curve levels off indicates the number of samples required to sample all the species at that site. Species-area curves were drawn for sites with varying substrate conditions and for separate taxonomic groups at sites with similar substrate conditions.

As well as counting the number of species accumulated by adding samples picked at random, the samples can be picked by starting at some point in the interior of the area and progressively adding those samples within a steadily expanding area centered on the point. From the shape of these species-area curves one can determine if the sample is large enough for the number of species to be estimated and whether the area contains a homogeneous or non-homogeneous community (Pielou, 1966). Both types of curves were constructed for one site in Labrador from which the largest area (twenty-one samples) had been sampled. To construct the curve for samples taken over an expanding area, samples were added in order from the middle sample taken on the dive line and alternately adding samples as they were taken offshore and towards shore from the middle sample. The number of species for the area is estimable if the curve for samples taken at random levels off. The community is homogeneous if the curves for both samples taken at random and samples taken over an expanding area level off, and non-homogeneous if the curve for samples taken over an expanding area rises continuously (Pielou, 1966).

V SEDIMENT ANALYSIS:

The sediment subsamples from each grab were analyzed for particle size by the Geological Survey of Canada. Percent sediment by weight was determined for each of the following sediment size ranges:

TABLE 1: Sediment size classes for sediment analysis

Size in Millimeters	Class	
> 2.0	gravel	(G)
1.0 - 2.0	very coarse sand	(VCS)
.50 - 1.0	coarse sand	(CS)
.25 - .50	medium sand	(MS)
.12 - .25	fine sand	(FS)
.063 - .12	very fine sand	(VFS)
.004 - .063	silt	(S)
.001 - .004	clay	(C)

For each sample, substrate diversity was determined using Shannon's index based on the percent by weight of sediment in each of the eight size classes. The sediment of each sample was classified according to the most abundant size class present, which corresponds to the mode in a frequency distribution of grain sizes (see Figure 7a). Where the mode of the distribution occurred between two grain size categories, the sediment was classified according to both grain sizes (see Figure 7b). If there were two peaks or two modes in the grain size frequency distribution (Figure 7c) the sediment was classified by the grain sizes of both peaks.

VI REGRESSION ANALYSIS:

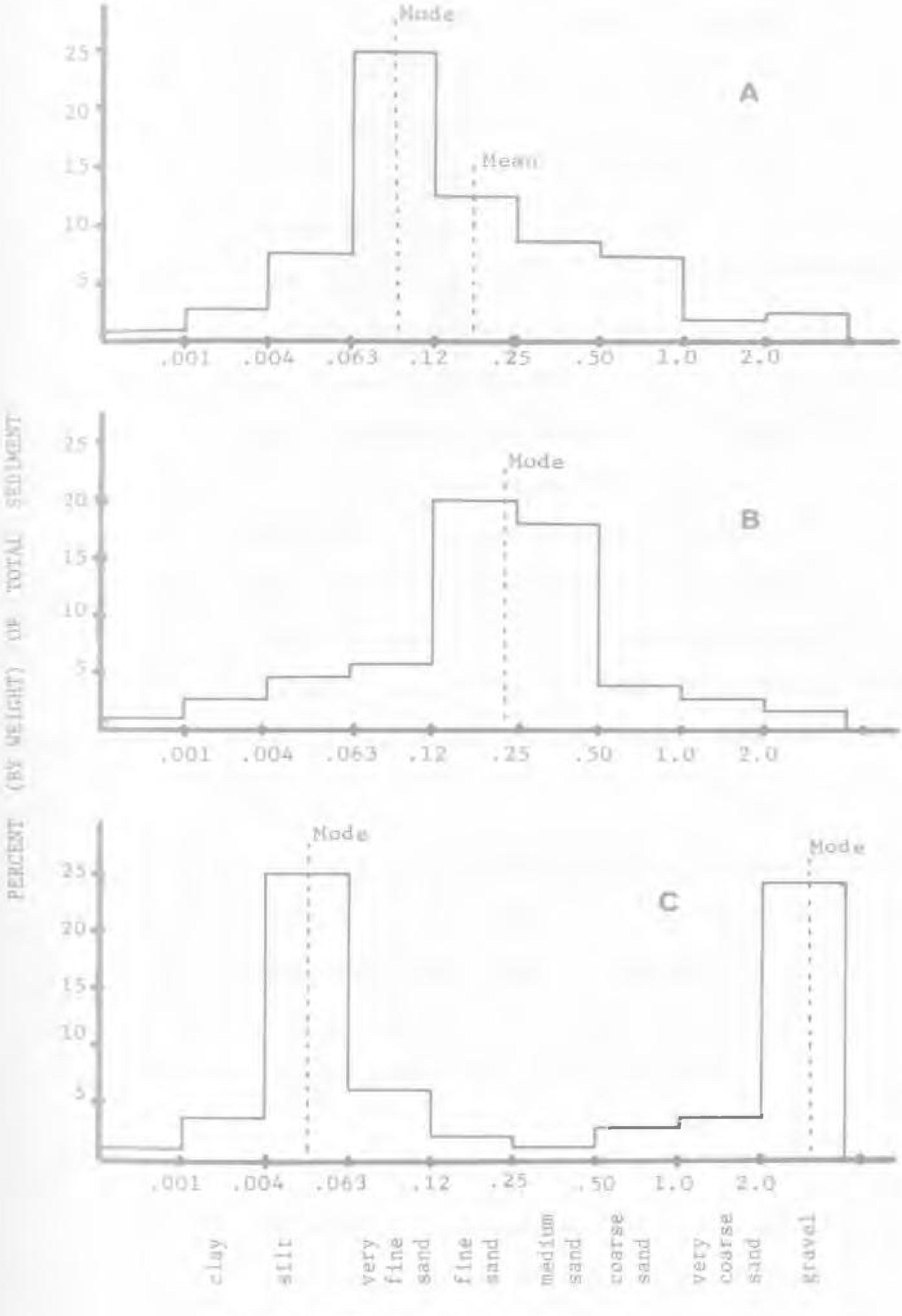
To determine the effects of exposure, depth, distance offshore and substrate on the infaunal community, stepwise multiple regression

Figure 7. Frequency distribution of sediment grain sizes used to classify substrate types.

A. one grain size used to classify substrate

B. two grain sizes used to classify substrate

C. two grain sizes used to classify substrate.


A
B
C
Mode
Mean
Mode
Mode
Mode
25
20
15
10
5
.001
.004
.063
.12
.25
.50
1.0
2.0
PERCENT (BY WEIGHT) OF TOTAL SEDIMENT
clay
silt
very fine sand
fine sand
medium sand
coarse sand
very coarse sand
gravel
GRAIN SIZE IN MILLIMETERS

was used (Statistical Package for the Social Sciences program) with species diversity and numbers of individuals in each sample as the dependent variables. A fifth independent variable, exposure divided by depth was added as it was expected that exposure would have a greater influence on the benthos of shallow areas than on the benthos in deeper areas. The regression program calculates coefficients of correlation between all pairs of variables and those variables which were significantly correlated were determined using the t test ($p<.05$). Stepwise regression rearranges the order of the independent variables in a regression function to correspond to their relative contribution to the regression sum of squares (Smillie, 1966). Variables are introduced into the regression function according to the order in which the largest proportion of the remaining variation is accounted for (Smillie, 1966). The F test ($p<.05$) was used to test whether variables contribute significantly to the regression sum of squares.

For the regression analysis, only samples from the Labrador sites were used. Depth and exposure were only used as variables for near shore samples taken by SCUBA where they would be expected to have an effect. Substrate diversity was used in the regression analysis for all samples including the Shipek grabs from deeper waters.

AREAS SURVEYED:

The survey was made from Nain, Labrador south to Conception Bay Newfoundland (Figure 2). The location of sampling stations for each site and degree of exposure to open water are shown in Figures 8 to 18.

I Cartwright (Figure 8) Lat. 53°35' Long. 57°15'

Two dive lines were set out near Cartwright, the first to 340 m from shore in a protected bay and the second to 90 m from a more exposed rocky shore. Four SCUBA samples were taken from the first site (CW1) on 21 August, 1977 in sand and mud and five SCUBA samples taken from the second site (CW2) on 22 August, 1977, in sand and gravel. Depths of sampling stations ranged from 1 to 15 m at CW1 and from 1 to 7 m at CW2.

II Pack's Harbour (Figure 9) Lat. 53°45' Long. 57°15'

Four samples were taken along a 120 m dive line in Pack's Harbour (PH) on 26 August, 1977. The harbour is very well protected and shallow with a mud bottom and a rocky shore. Samples were taken from 1 to 6 m in depth.

III North Strand (Figure 10) Lat. 53°55' Long. 57°30'

The North Strand is a 25 km stretch of sand beach just south of Hamilton Inlet and is exposed to constant wave action from the north and east. The bottom was consistent throughout the areas sampled and was well sorted sand. Four SCUBA samples (PNS) were taken along a 870 m dive line from 5 to 13 m in depth on 25 August, 1977. Twenty-six Shipek grabs (NS1) were taken from the vessel following a path parallel to shore as shown in Figure 10. These were taken from 23 to 25 August,

Figure 8. Collection sites near Cartwright, showing sectors facing open water used to determine exposure index.

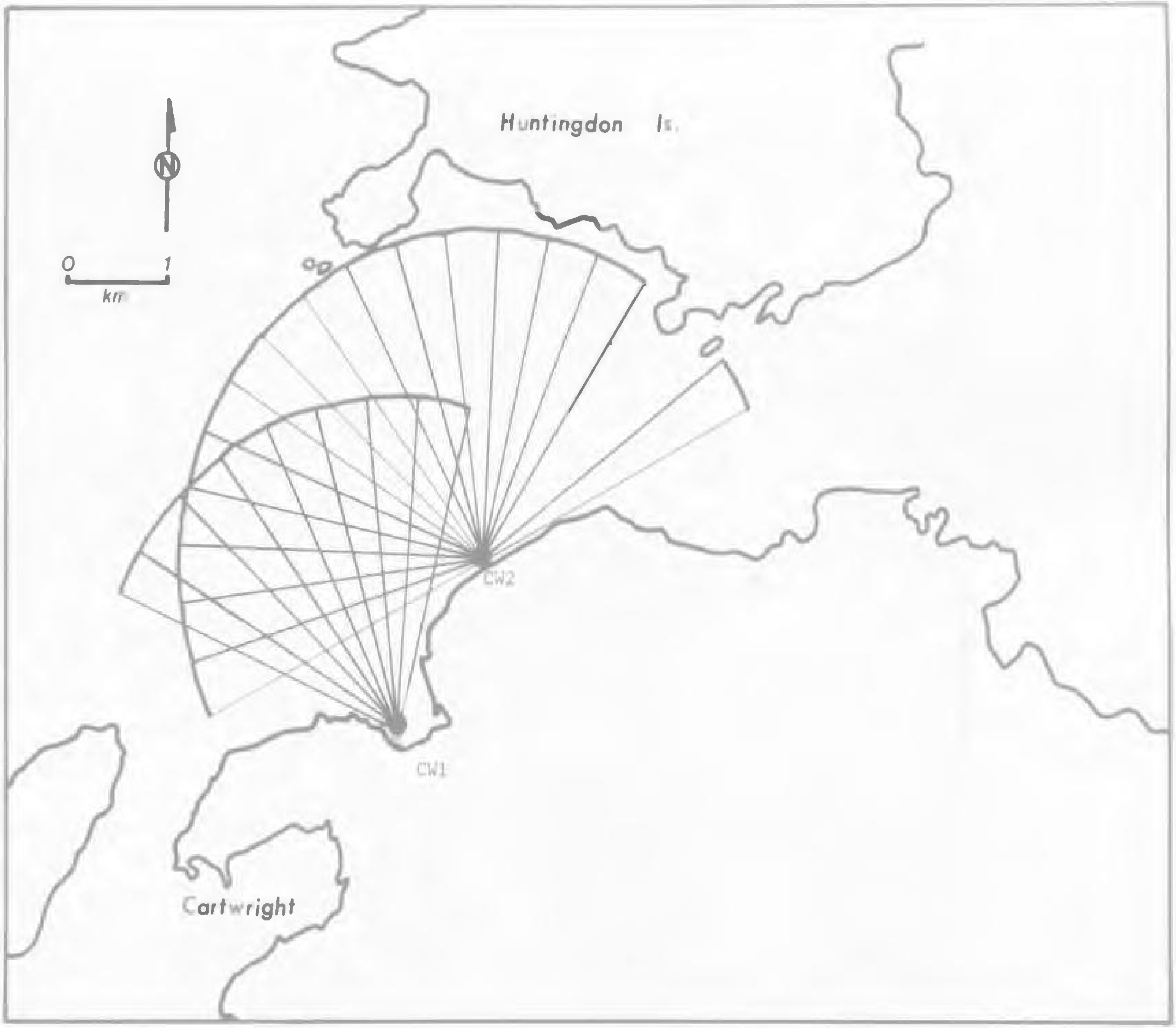
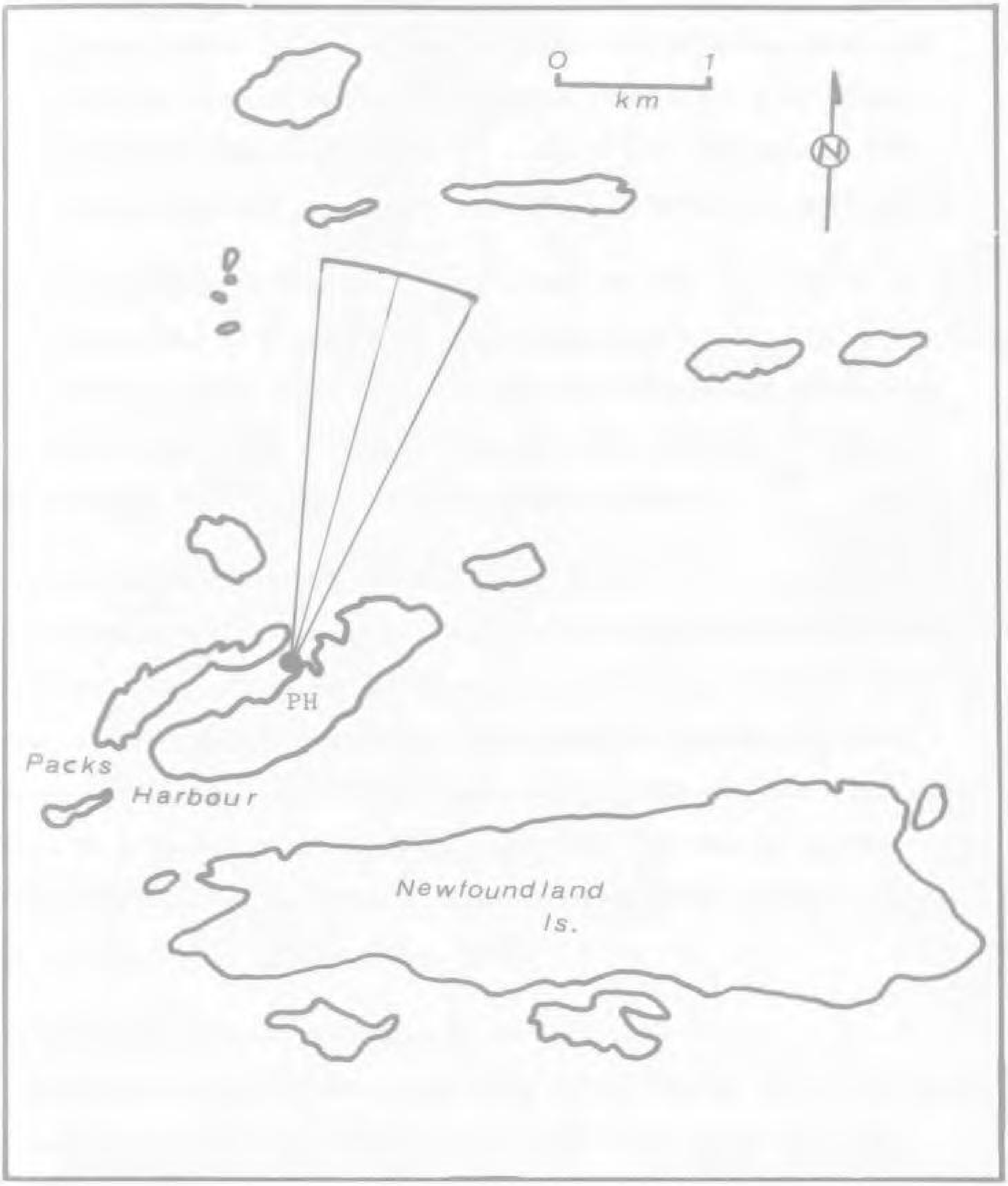

Huntingdon Is.
N
0
1
km
CW2
CW1
Cartwright

Figure 9. Collection site at Pack's Harbour.

Figure 10. Collection site for SCUBA samples at North Strand and path of vessel for Shipek grab samples.


0
1
km
N
PH
Packs
Harbour
Newfoundland
Is.

1977 in depths of 15 to 45 m.

IV Ponsonby Island (Figure 11) Lat. 54 20' Long. 57 35'

Ponsonby Island is a bare rocky island off Hamilton Inlet and a 145 m dive line was set up on the southern exposure. Four SCUBA samples (PI) were taken from depths of 3 to 16 m on 18 August, 1977. The bottom was rocky and grabs were taken from gravel and pebbly sand.

V Pottle's Bay (Figure 12) Lat. 54 20' Long. 57 50'

Pottle's Bay is a long well protected fjord just north of Hamilton Inlet. It has a rocky shore with some gravel beaches and the bottom is soft muddy sand. Six SCUBA samples (PB) were taken on 17 August, 1977 from depths of 2 to 11 m along a 170 dive line.

VI Hopedale (Figure 13) Lat. 55 15' Long. 60 15'

Two dive profiles, each 150 m in length were set off the rocky shores of Anniuwaktook Island at Hopedale. The bottom at both sites was quite diverse with a mixture of sand, mud and gravel; coraline algae were very common in the sediment. Nine SCUBA samples were taken from 8 to 20 m in depth at the first site (HOP-1 to HOP-9) on 17 September, 1977 and eight samples from 5 to 7 m at the second site (HOP-14 to HOP-21) on 18 September, 1977.

VII Nain Islands (Figure 14) Lat. 56 20' Long. 61 30'

The Nain area was characterized by rocky islands with some small gravel beaches. Eighteen Shipek grab samples were taken from the

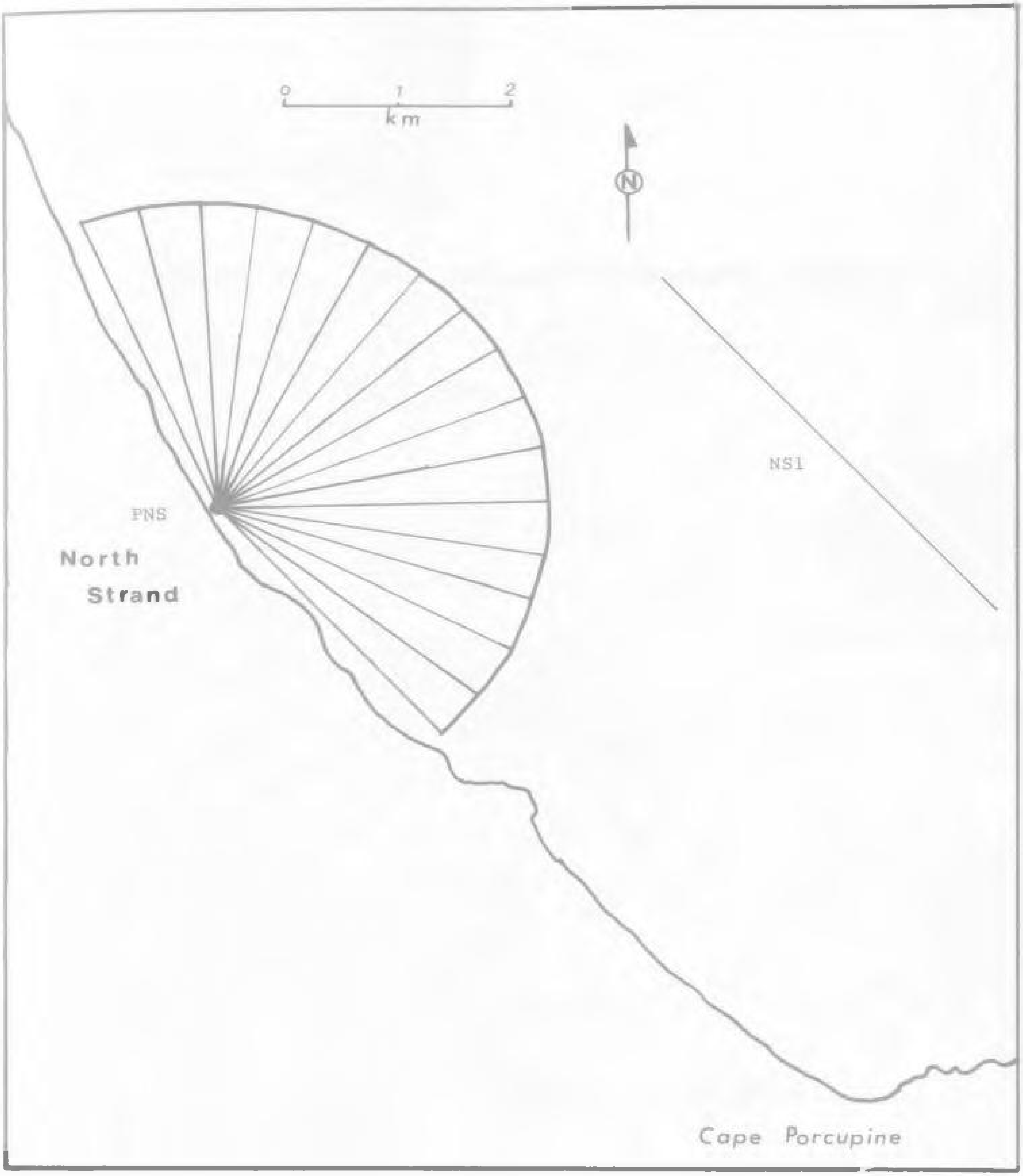

0
1
2
km
N
NS1
PNS
North Strand
Cape Porcupine

Figure 11. Collection site at Ponsonby Island.

0
1
km
Mundy
Is.
N
Ponsonby
PI
Is.

Figure 12. Collection site in Pottle's Bay.

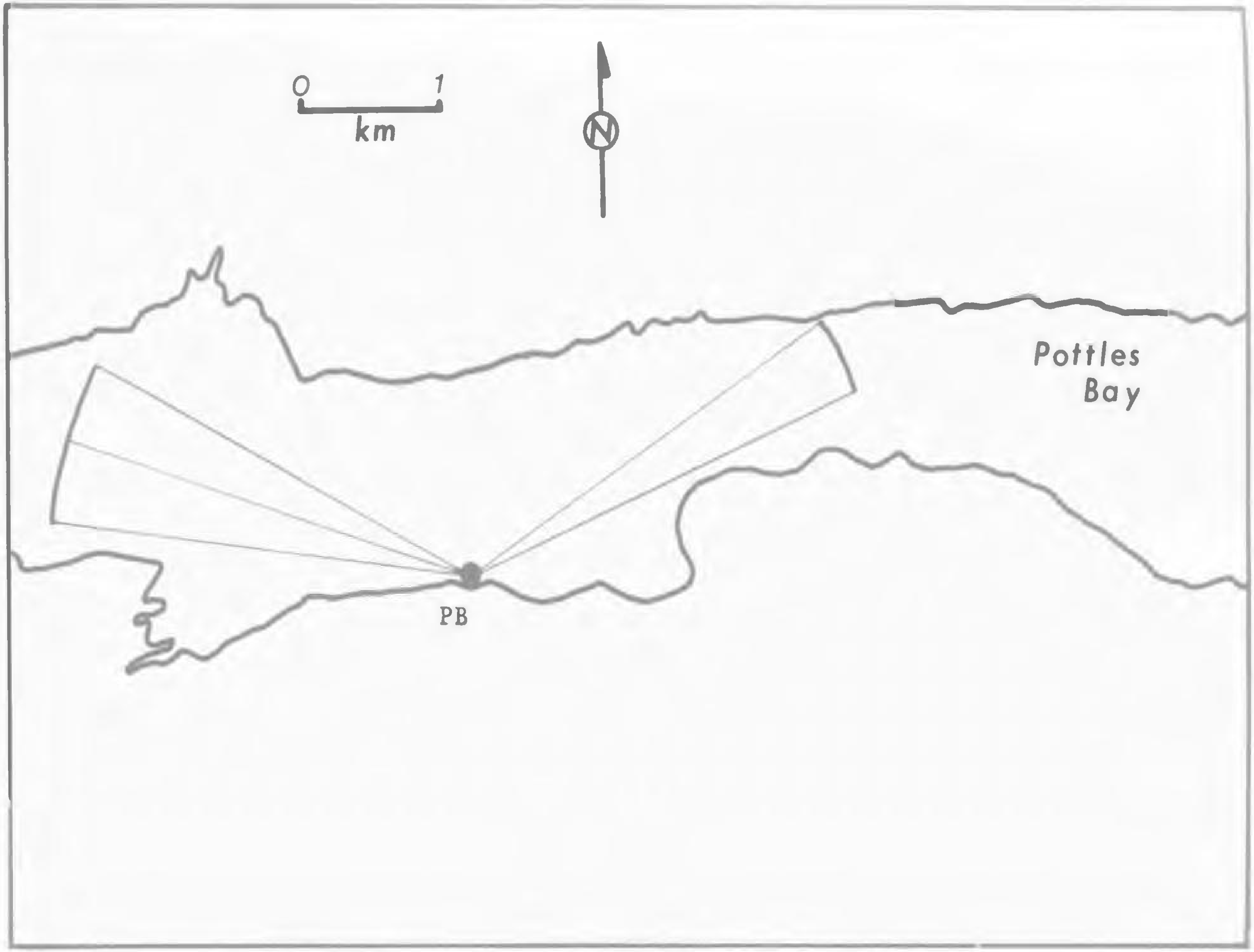
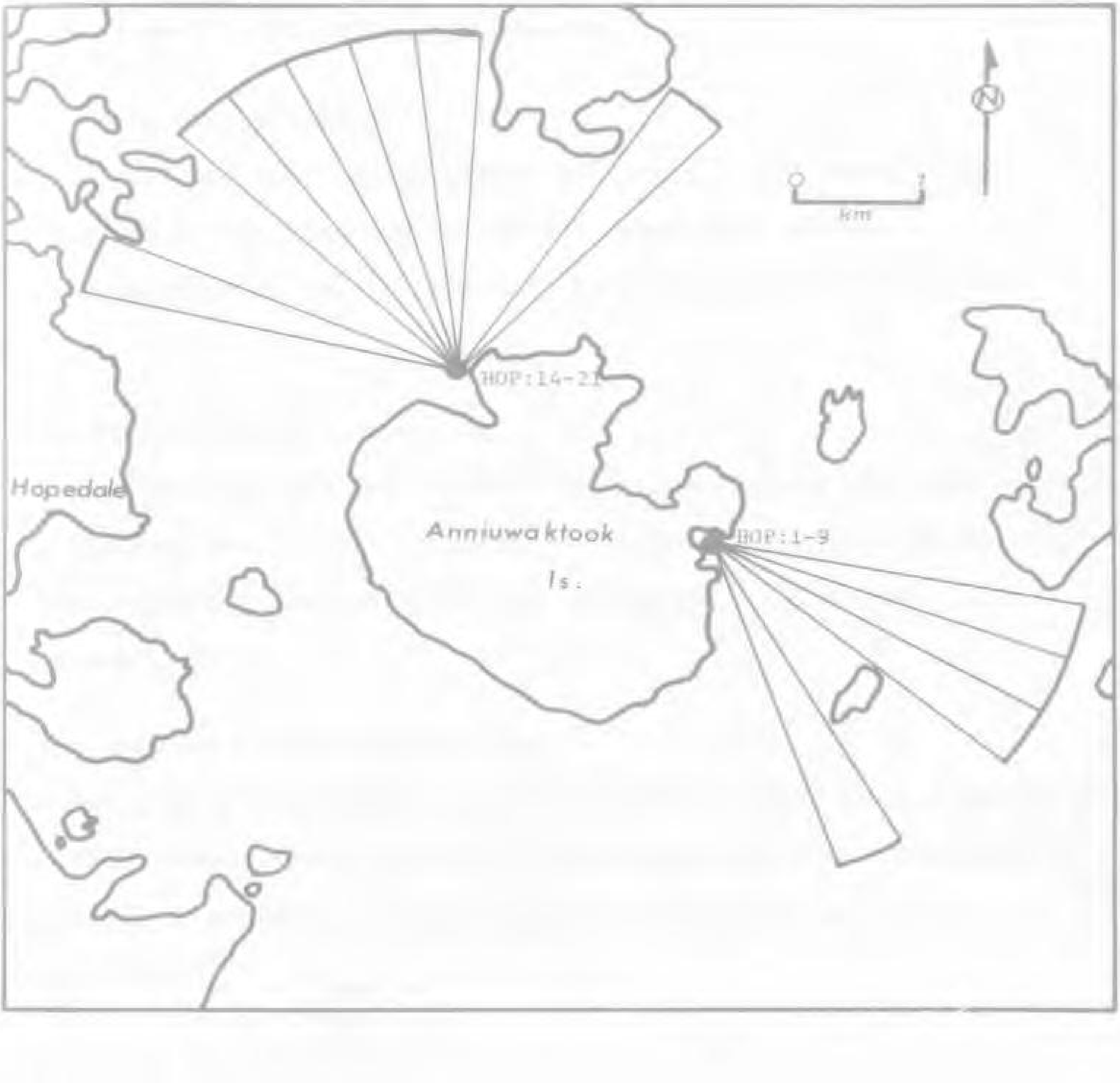

0
1
km
N
Pottles
Bay
PB

Figure 13. Collection sites near Hopedale.



N
km
HOP:14-21
Hopedale
Anniuwaktook
Is.
HOP:1-9

vessel along three profiles as shown in Figure 14 from the 5 to 13 September, 1977. Six hauls were taken from the first site (SHR1) from 42 to 62 m, eight hauls from the second site (SHR2) from 20 to 80 m and four hauls from the third site (SHR3) from 19 to 100 m in depth. The bottom was quite variable, being mostly sand with varying amounts of mud and gravel in the different samples.

a) Meta Cove (Figure 15)

Meta Cove had a protected gravel beach and a soft muddy sand bottom. A 100 m dive line was set up and twenty-one samples taken by SCUBA (SAR3-1 to 22) from 2 to 16 m in depth on 6 September, 1977.

b) Rhodes Island (Figure 15)

A dive line was set out to 200 m off Rhodes Island and seven SCUBA samples (SAR3-31 to 37) were taken from 1 to 9 m in depth on 13 September, 1977. The shore was a sandy beach and the bottom type was sand with some mud and gravel.

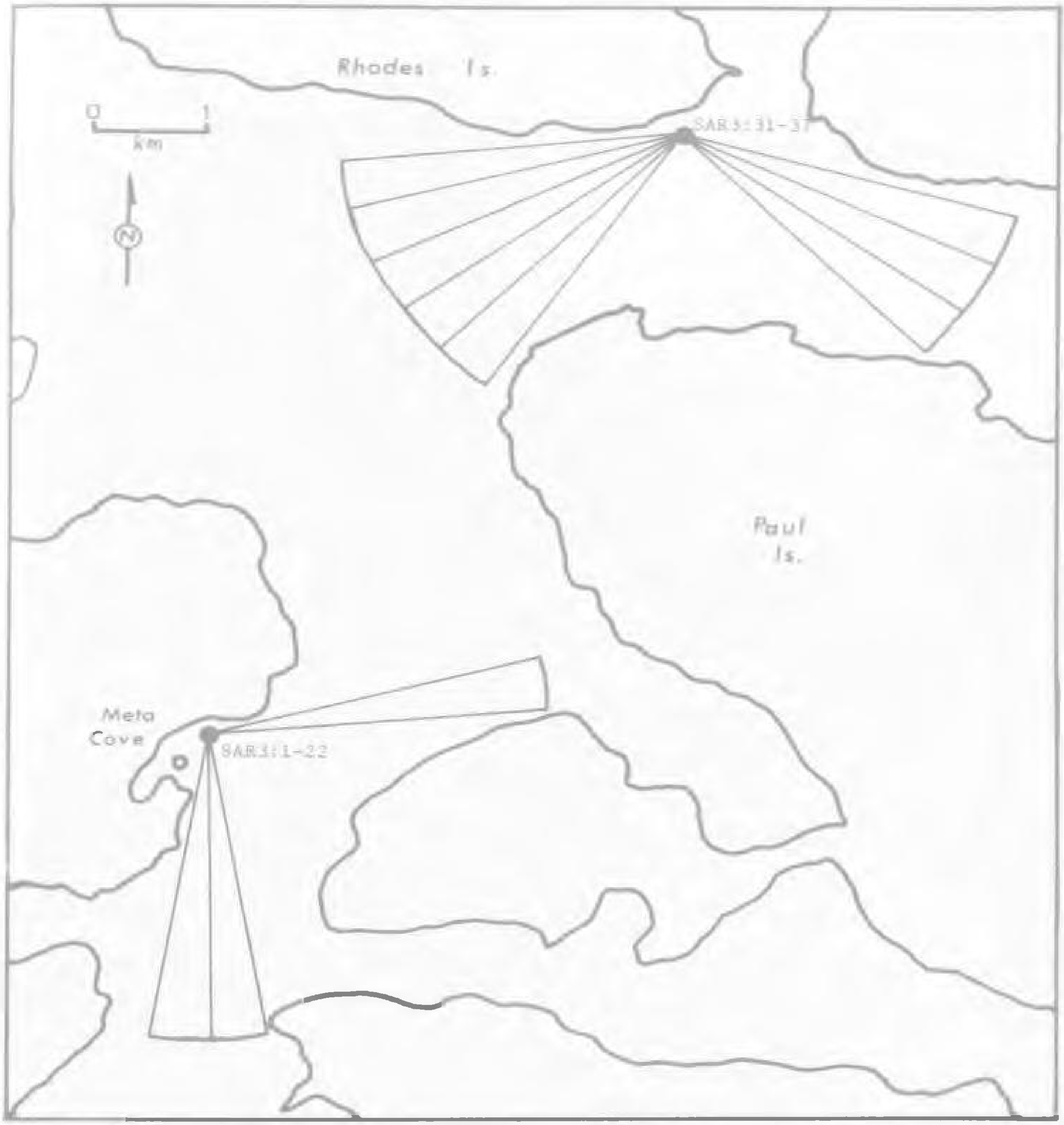
c) Hillsbury Island (Figure 16)

A 160 m dive line was set out off Hillsbury Island from a gravel beach. The bottom type was sand with some gravel and mud. Six SCUBA samples (SAR3-25 to 30) were taken from 3 to 18 m in depth on 11 September, 1977.

FIGURE 14. Paths of vessel for collection of Shipek grab samples near Nain.

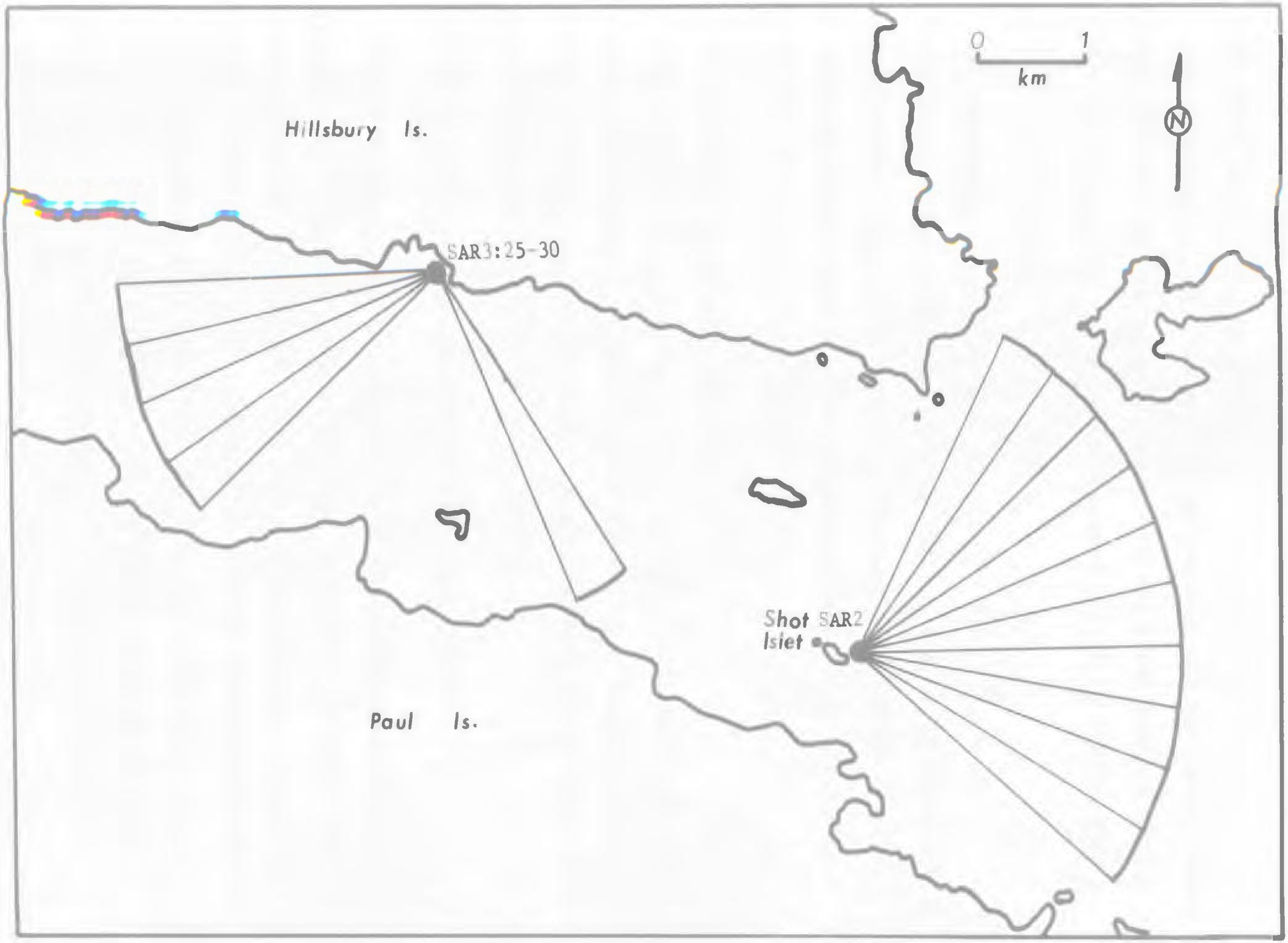

South
Aulatsivik
Is.
N
0
5
km
Dog
Is.
SHR3
Rhodes Is.
Hillsbury
Is.
SHR2
SHR1
Paul
Is.

Figure 15. Collection sites from Meta Cove and Rhodes Island (Nain Islands).



Rhodes Is.
0 1
km
N
SAR3:31-37
Paul Is.
Meta Cove
SAR3:1-22

Figure 16. Collection sites from Hillsbury Island and Shot Islet (Nain Islands).



Hillsbury Is.
SAR3:25-30
0
1
km
N
Shot
Islet
SAR2
Paul Is.

d) Shot Islet (Figure 16)

Shot Islet is a small island and the bottom type was mainly rock. A dive line was set out to 60 m in length and two SCUBA samples (SAR2) were taken at 10 and 13 m in depth from pebble bottom on 5 September, 1977.

e) Siurakuluk Island (Figure 17)

A dive line 440 m in length was set out from a sandy beach on Siurakuluk Island. The bottom type was sand and large boulders were common close to shore. Seven SCUBA samples (SAR1-1 to 7) were taken in depths of 4 to 10 m on 3 September, 1977.

f) East Red Island (Figure 17)

A 280 m dive line was set out from a small sandy beach on East Red Island. The bottom type was sand with some large boulders and evidence of ice scouring. Four SCUBA samples (SAR1-8 to 11) were taken from 9 to 19 m in depth on 4 September, 1977.

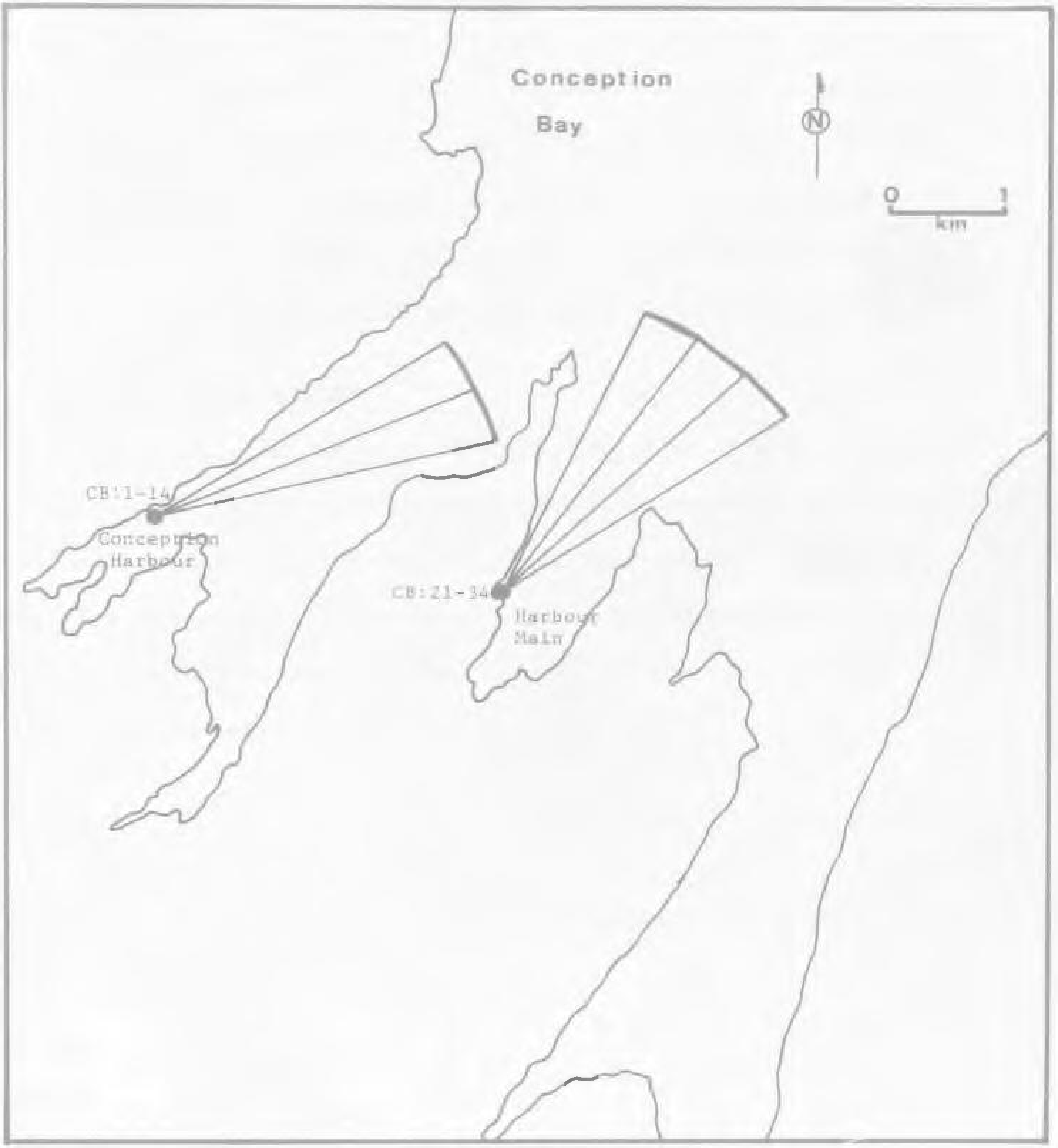
VIII Conception Bay (Figure 18) Lat. 47°30' Long. 53°20'

Two dive sites were selected in well protected bays at the west end of Conception Bay Newfoundland. The coast is similar to that of the Nain area with rocky shores and scattered gravel beaches. Fourteen SCUBA samples (CB-1 to 14) were taken at Conception Harbour on 7 March, 1978 from depths of 5 to 7 m and the substrate was soft muddy sand. At Harbour Main, fourteen SCUBA samples (CB-21 to 34) were taken on 31 August, 1978 from a small gravel beach at depths of 3 to 11 m.

Figure 17. Collection sites from Siurakuluk Island and East Red Island (Nain Islands).

0
1
km
N
Siurakuluk Is.
SAR1:1-7
SAR1:8-11
East Red Is.

Figure 18. Collection sites in Conception Bay Newfoundland.



Conception
Bay
N
0 1
km
CB:1-14
Conception
Harbour
CB:21-34
Harbour
Main

RESULTS:

I SEDIMENT COMPOSITION

The substrate type and diversity for each sediment sample is given in Appendix E. The dominant sediment type was sand at all sites with finer sands at protected sites and coarser sands at more exposed sites. Fine to very fine sand were the dominant sediment types at the Nain Islands and at the Conception Bay sites. Medium to fine sand predominated the exposed North Strand coast and medium sand and gravel at the more exposed sites near Cartwright and Hopedale.

II COMPOSITION OF GRAB SAMPLES:

A total of one hundred and eighty-eight species were collected in grab samples from seventeen sites along the Labrador coast. From two sites in Conception Bay, Newfoundland, forty-one species were collected including five species not found in the Labrador collections. Table 2 shows the percent of species and individuals in the major taxonomic groups found in the samples.

TABLE 2: Percentages of species and numbers in the taxonomic groups for Labrador and Newfoundland samples.

	Percent of Species		Percent of Individuals	
Group	Labrador	Newfoundland	Labrador	Newfoundland
Annelids	30.7	52.3	56.3	79.6
Amphipods	17.6	11.4	19.4	5.1
Pelecypods	10.8	18.2	11.9	6.0
Gastropods	18.2	2.3	3.2	0.4
Echinoderms	8.0	4.5	1.9	0.3
Others	14.8	11.3	7.1	3.0

Polychaetous annelids made up the largest percent of both numbers and species found in the samples. Amphipods, pelecypods and gastropods made up most of the remaining groups of the infauna. A list of all species is included in Appendix D.

Three species from the Labrador samples were new records for the collecting area. The annelid *Laonome kröyeri* was a new record for eastern North America and the echinoid *Amphiophiura convexa* and the amphipod *Onisimus affinis* were new records for Labrador. *Amphiophiura convexa* has been found in the northern North Atlantic in deep water and off Baffin Island (Diana R. Laubitz, pers. comm.) *Onisimus affinis* is a circumpolar species being common in the Arctic and having been found south to Ungava Bay (Dunbar, 1954) and has not been recorded from the Labrador coast (D.H. Steele, pers. comm.). *Laonome kröyeri* was only found south of Hamilton Inlet in four samples from Cartwright and Pack's Harbour from 4 to 6 meters in depth and in a very fine sand bottom. *Onisimus affinis* was found at Ponsonby Island at 11 meters on a cobble bottom. *Amphiophiura convexa* was more common in the areas sampled, occurring in eighteen samples from Cartwright to Hopedale in depths of 7 to 60 meters and in substrates of fine and medium sand.

The average density of benthic organisms from the Labrador samples was 1,028 per square meter and for the Newfoundland samples, 1,105 organisms per square meter. Density varied with the different substrates sampled as shown in Table 3. The largest number of individuals was found in the finest grained substrate (very fine sand) with less in substrates of larger grain size. Fewer organisms were also found on substrates with the lowest diversity of grain sizes. Fine sand with diversity less than 2.0 had significantly fewer organisms than fine sand with diversity greater than 2.0 (t test, $p<.05$). However the density of benthic organisms from Conception Bay Newfoundland was not significantly different (t test, $p>.05$) from the density of organisms from Labrador in the same substrate type (fine sand, diversity (Shannon's Index) > 2.0). The density on fine sand (diversity > 2.0) was significantly different from that on very fine and that on medium sand, but not significantly different from the density on sand with gravel (t test, $p<.05$).

TABLE 3: Mean density of infauna from different substrates.

Substrate	Number samples	Mean density (per sq m)	Standard deviation
very fine sand	12	1800	90.8
fine sand (diversity>2.0)	25	1422	35.4
fine sand (diversity<2.0)	19	415	21.8
fine sand, Nfld. (diversity>2.0)	14	1105	55.8
medium sand	11	795	31.6
sand and gravel	26	990	30.5

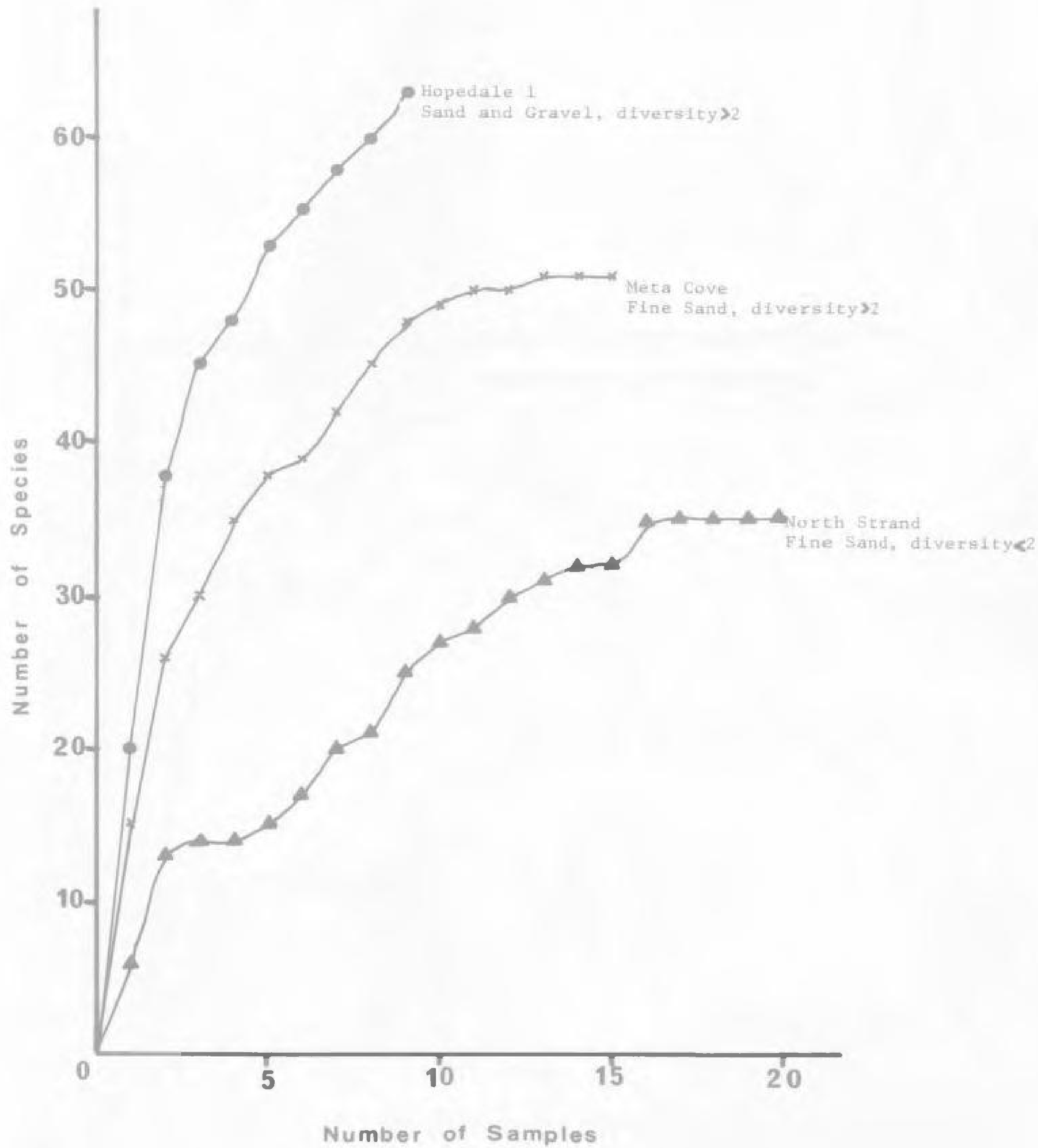
III SPECIES-AREA CURVES:

To determine whether or not enough samples have been taken in an area, a species-area curve can be drawn. Figure 19 shows the species-area curves for grab samples from several sites with varying substrates. Twelve to fifteen hauls (.04 m^2) were required to collect most of the species at any one site. After fifteen hauls, the species-area curves have levelled off. The largest number of species occurred in sediments with the largest grain sizes where there was a mixture of both sand and gravel (Figure 19). From two sites with substrates of fine sand, the largest number of species was found at the site with the greatest diversity of grains sizes (substrate diversity > 2.0). Similar results were found when species-area curves were drawn for only the species of polychaetes (Figure 20). Twelve to fifteen hauls collect most of the species of polychaetes and the largest number of species occur in the more diverse substrate types.

Figure 21 shows species-area curves (collector's curves) for samples taken at Meta Cove Labrador. Both the curves from samples taken at random and for samples taken over an expanding area level off. This indicates that the total number of species for the area is estimable and that the area contains a homogeneous community (Pielou, 1977).

In Figures 22 to 24, species-area curves are shown for five sites from Labrador and two sites in Newfoundland that had similar substrates of fine sand. All of these sites were from relatively

Figure 19. Species-area curves for samples from different substrates in Labrador.



Hopedale 1
Sand and Gravel, diversity>2
Meta Cove
Fine Sand, diversity>2
North Strand
Fine Sand, diversity<2
Number of Species
Number of Samples
60
50
40
30
20
10
0
5
10
15
20

Figure 20. Species-area curves for polychaetes from different substrates in Labrador.

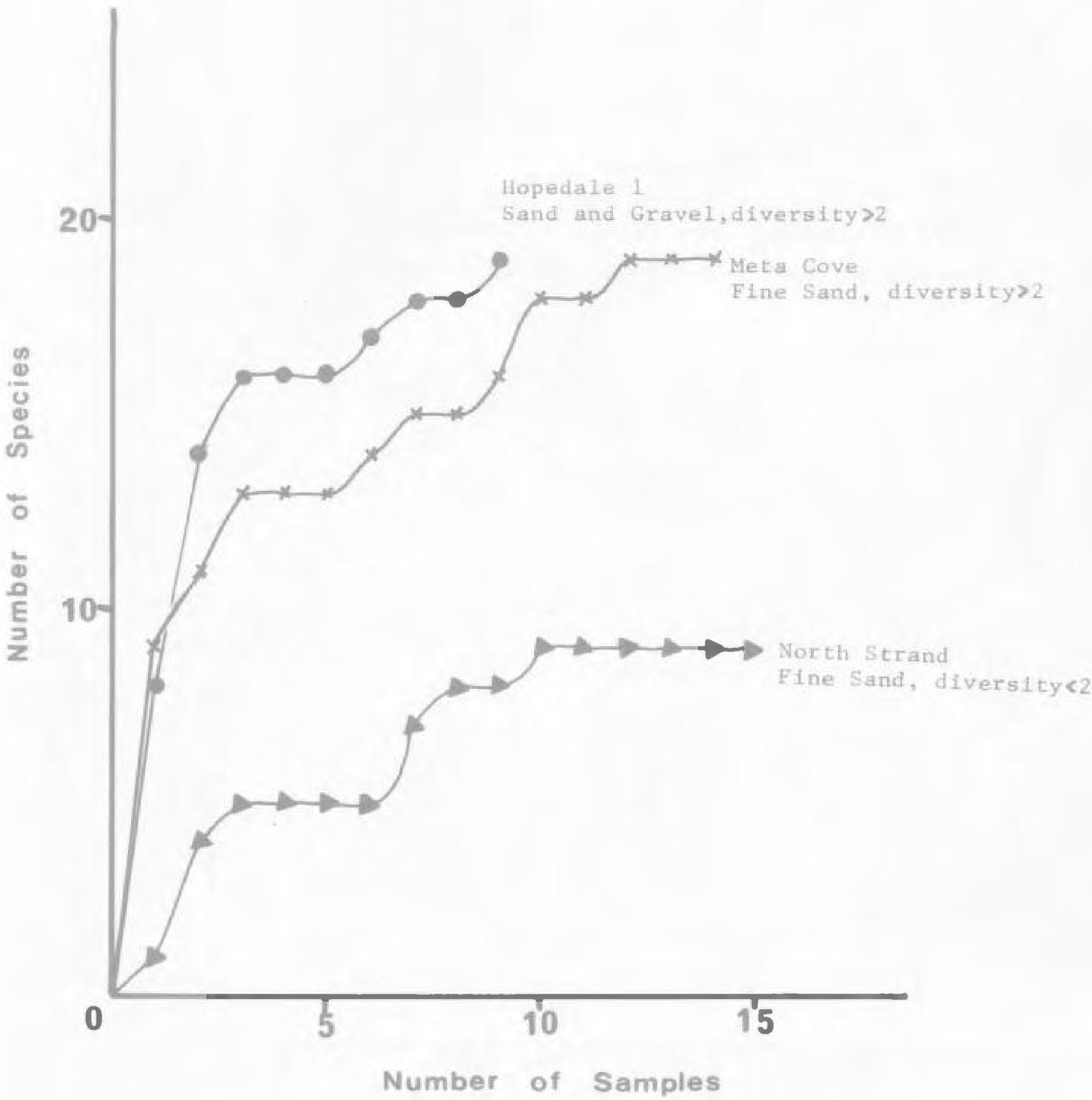

Hopedale 1
Sand and Gravel,diversity>2
Meta Cove
Fine Sand, diversity>2
North Strand
Fine Sand, diversity<2
Number of Species
20
10
0
5
10
15
Number of Samples

Figure 21. Species-area curves for samples at Meta Cove taken at random and over an expanding area.

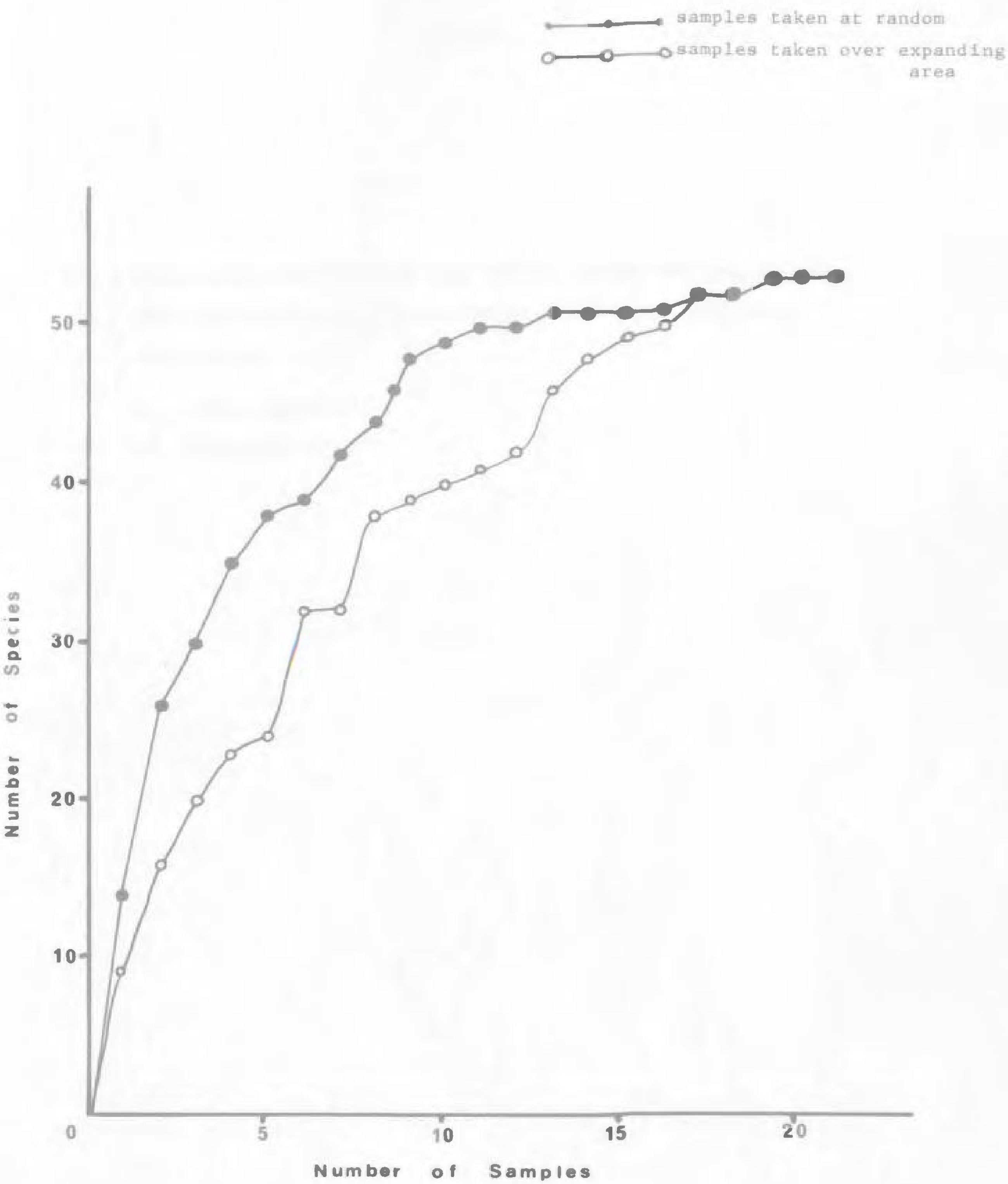
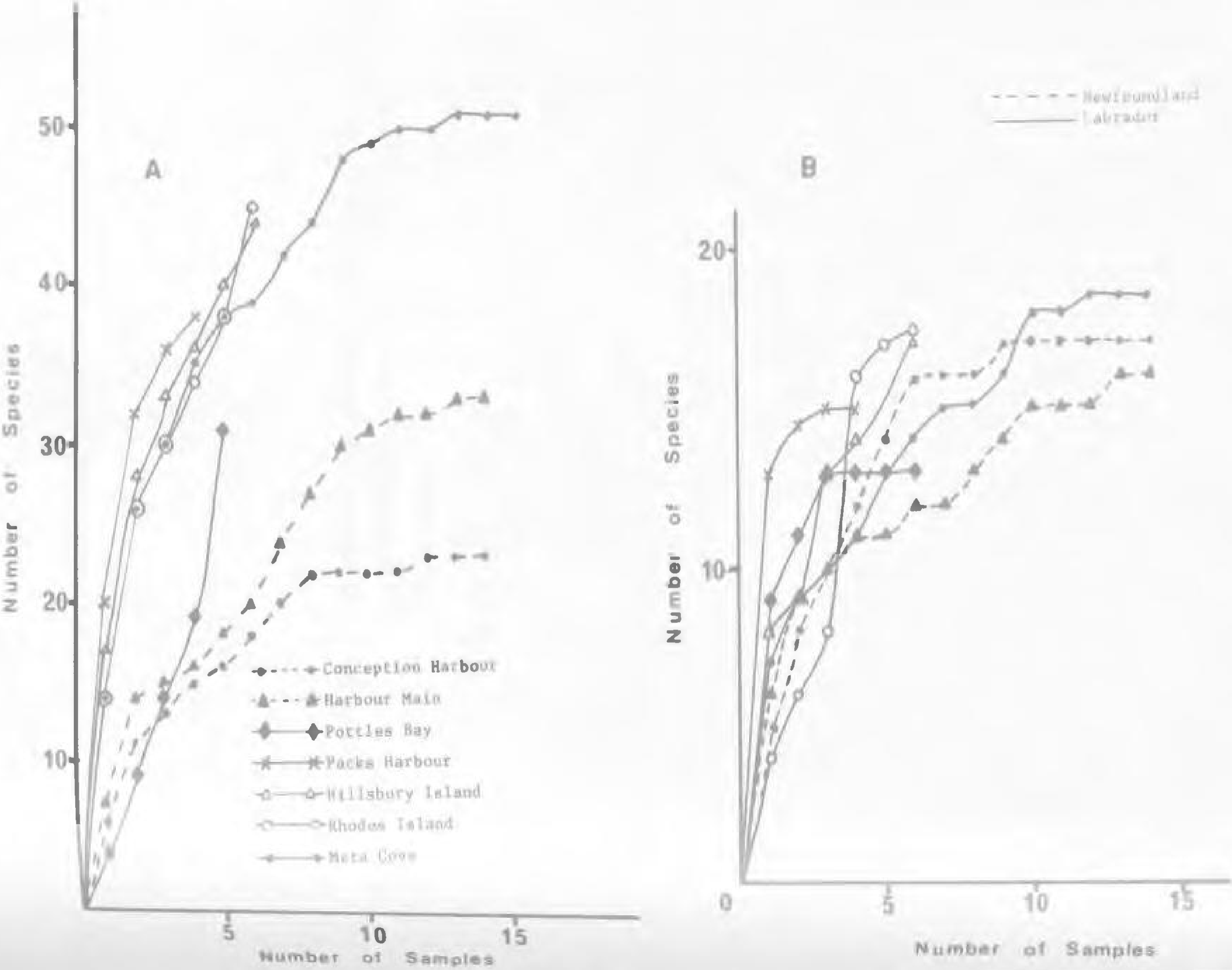

samples taken at random
samples taken over expanding area
Number of Species
Number of Samples
0
5
10
15
20
10
20
30
40
50

Figure 22. Species-area curves for sites from Newfoundland and Labrador with substrates of fine and very fine sand.

A. all species

B. Polychaetes

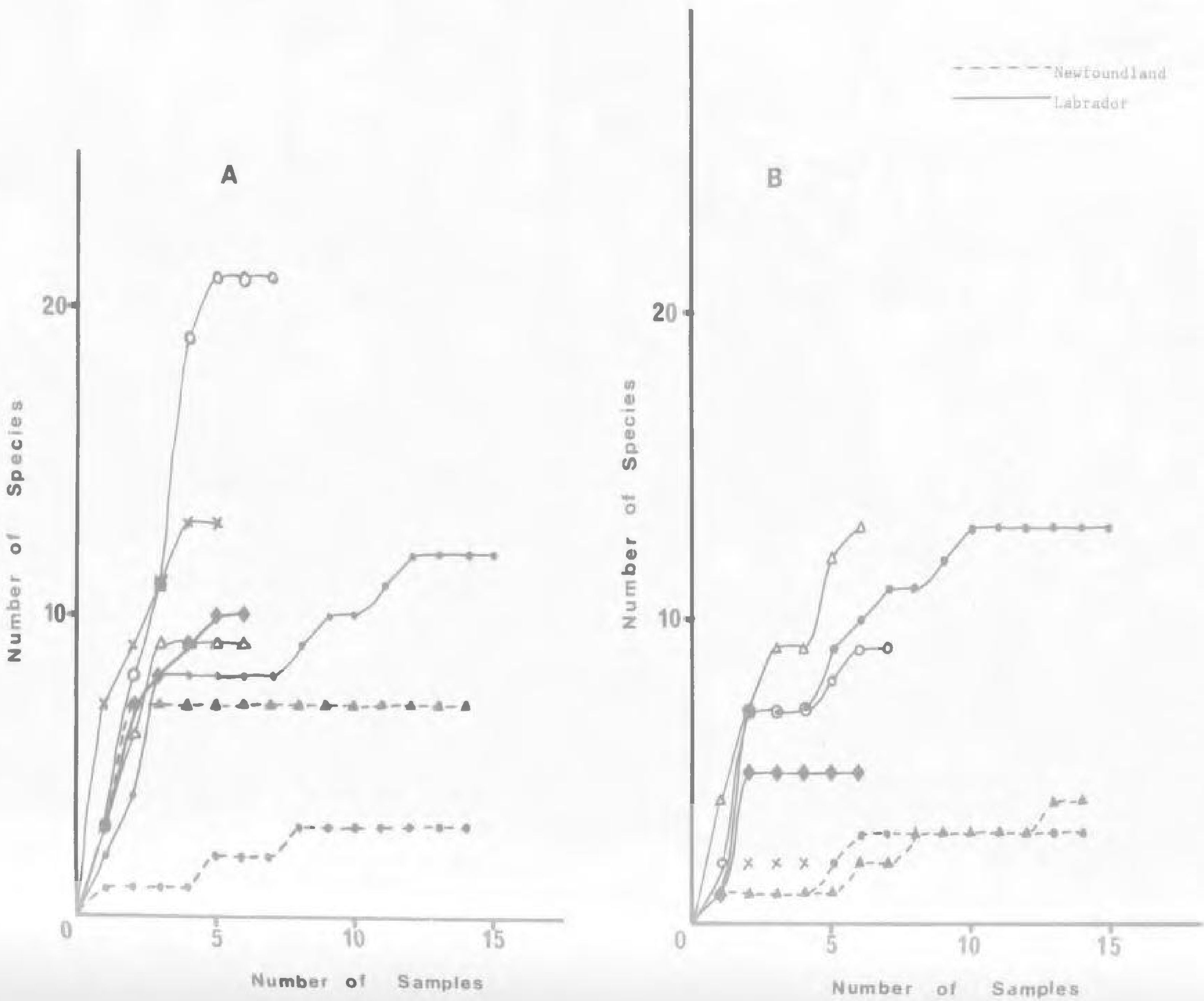


A
B
Number of Species
Number of Samples
Conception Harbour
Harbour Main
Pottles Bay
Packs Harbour
Hillsbury Island
Rhodes Island
Newfoundland
Labrador

Figure 23. Species-area curves for sites from Newfoundland and Labrador with substrates of fine and very fine sand.

A. Molluscs

B. Amphipods.

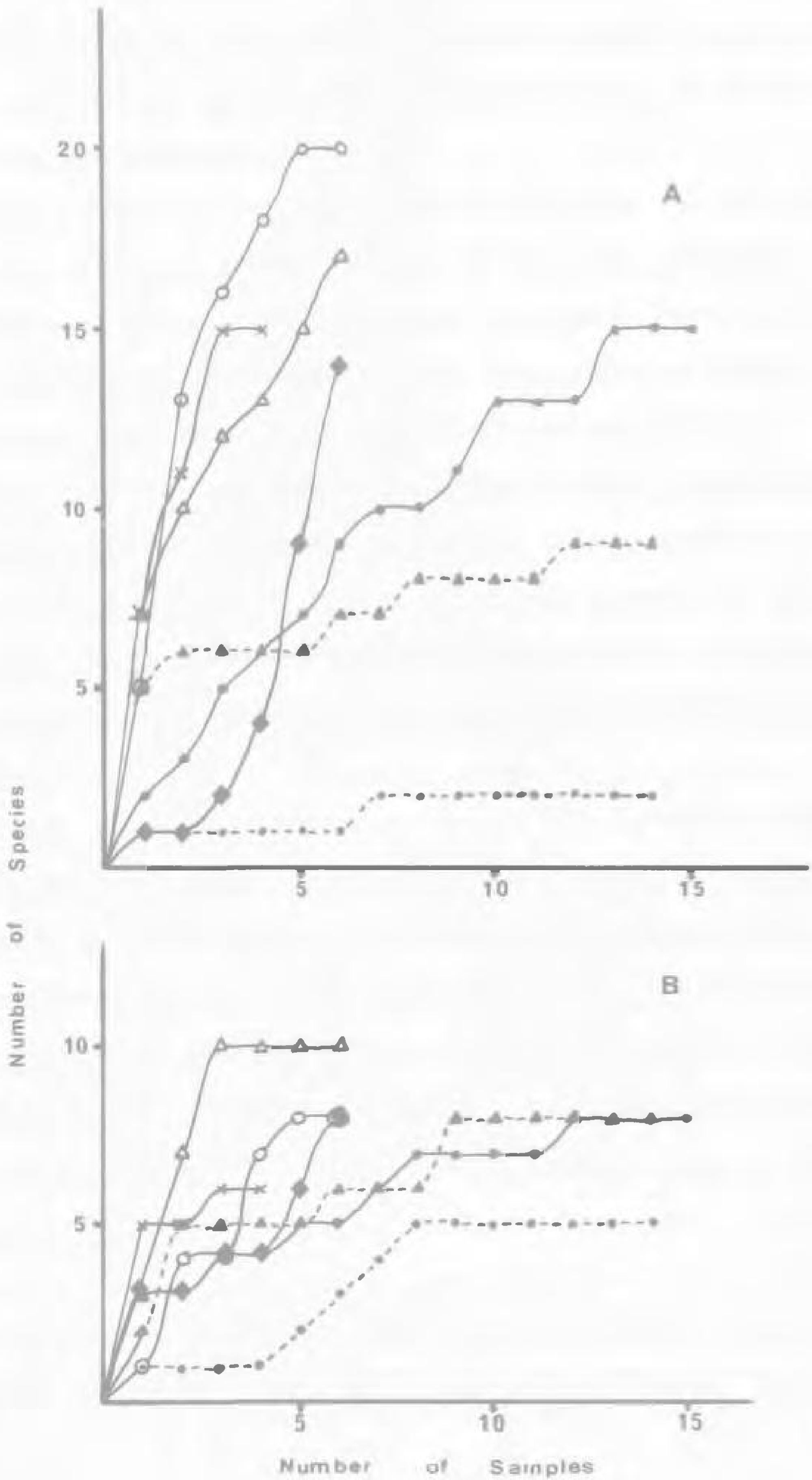


A
B
Number of Species
Number of Samples
0
5
10
15
20
Newfoundland
Labrador

Figure 24. Species-area curves for sites from Newfoundland and Labrador with substrates of fine and very fine sand.

A. nonburrowing species

B. burrowing species other than polychaetes.



A
B
20
15
10
5
5
10
15
Number of Species
Number of Samples

protected areas with exposure indices less than eight. The range in latitude is from 47°25' for the two Newfoundland sites to 56°30' for the sites from Nain, Labrador.

The total number of species collected is higher for the Labrador sites than for the sites in Newfoundland (Figure 22). However, comparing the species-area curves for the same sites where only the polychaete species are considered (Figure 22B), there is little difference between sites or between Newfoundland and Labrador. Species-area curves for the same sites using molluscs (Figure 23A) and amphipods (Figure 23B) show that there is a large amount of variation in the total number of species between sites, with the greatest variation in species-area curves for molluscs. Newfoundland sites had fewer species of both molluscs and amphipods than did the Labrador sites.

Figure 24 shows species-area curves for all species other than polychaetes, with burrowing species separated from non-burrowing species. Most of the variation in the number of species between sites is accounted for by non-burrowing species (Figure 24A) and the largest number of these species is found at the Labrador sites. For burrowing species there is less difference between sites in the species-area curves as shown in Figure 24B.

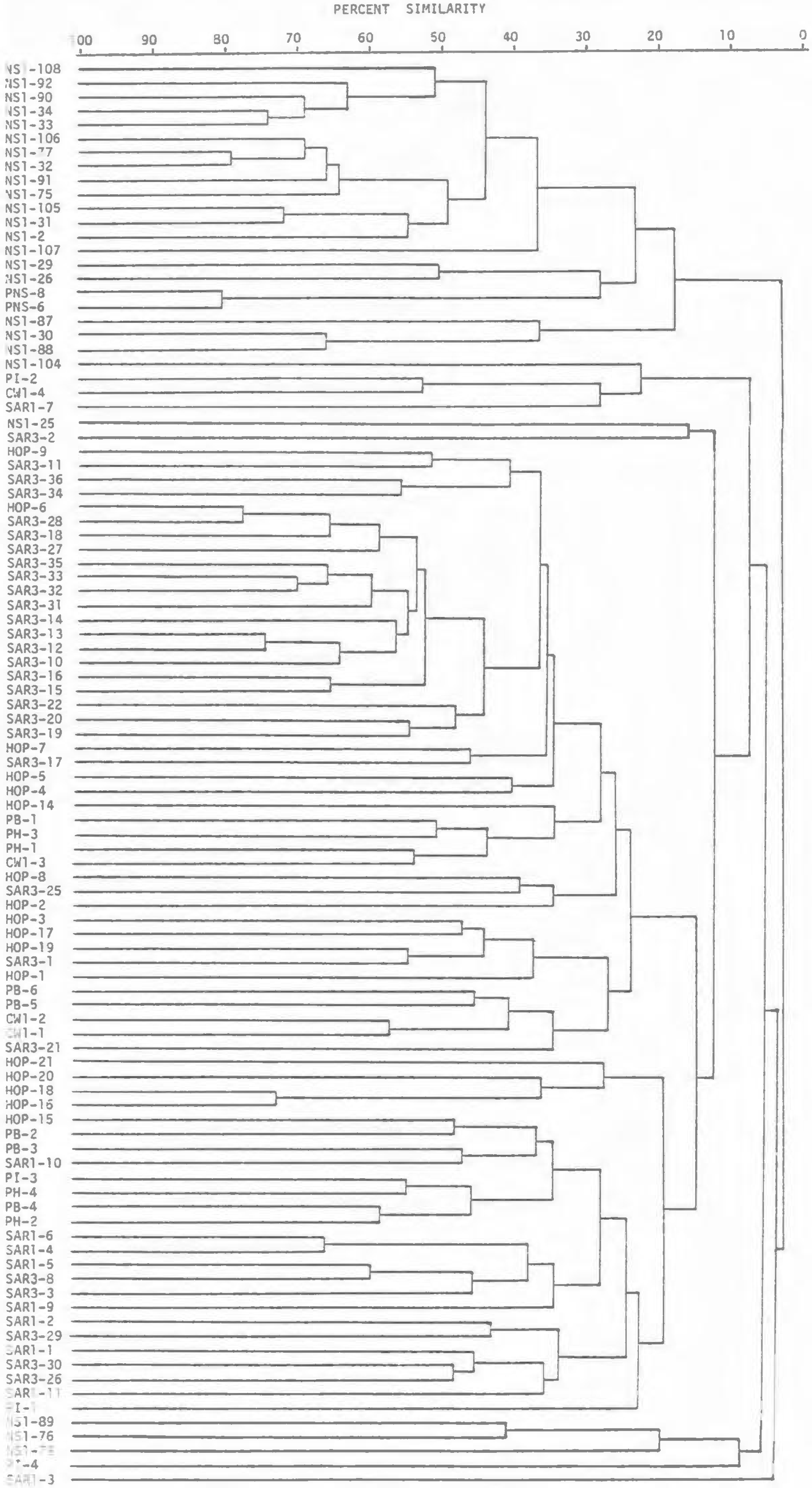
IV CLUSTER ANALYSIS:

The results of cluster analysis on one hundred and five samples from Labrador and twenty-eight samples from Conception Bay are shown in the dendograms of Figures 25 and 26, respectively. The level at which two branches join in the dendogram is the similarity coefficient for two samples or groups of samples based on the unweighted pair-group method (Sokal and Sneath, 1963). For all the sampling sites, the species and numbers collected in each sample are presented in Appendix E.

Two major groups of similar samples were found in the Labrador collection, one group of thirteen samples from the North Strand (NS1-108 to NS1-2) and a second group of seventeen samples from Nain including one sample from Hopedale (HOP-6 to SAR3-19, Figure 25). The groups form separate aggregations from other samples at the forty percent level of similarity. Most of the samples from Conception Bay were grouped at the forty percent level of similarity and all of the samples from one site, Conception Harbour, were grouped together at the forty percent level.

Analysis of species associations through cluster analysis for sixty-three species from Labrador and for twenty-one species collected in Conception Bay are shown in Figures 27 and 28, respectively. Two species associations from the Labrador samples can be found that are associated with the two groups of similar samples. The first is a community of *Turtonia minuta*, *Diastylis* sp., *Nephtys longosetosa*, *Stegophiura stuwitzii* and *Ampharete arctica*. These are associated with the group of samples NS1-108 to NS1-2 (Figure 25) from the sample analyses which were from a substrate of fine and medium sand and with

Figure 25. Dendogram resulting from unweighted group average clustering showing similarities among samples from Labrador.


PERCENT SIMILARITY
100 90 80 70 60 50 40 30 20 10 0
NS1-108
NS1-92
NS1-90
NS1-34
NS1-33
NS1-106
NS1-77
NS1-32
NS1-91
NS1-75
NS1-105
NS1-31
NS1-2
NS1-107
NS1-29
NS1-26
PNS-8
PNS-6
NS1-87
NS1-30
NS1-88
NS1-104
PI-2
CW1-4
SAR1-7
NS1-25
SAR3-2
HOP-9
SAR3-11
SAR3-36
SAR3-34
HOP-6
SAR3-28
SAR3-18
SAR3-27
SAR3-35
SAR3-33
SAR3-32
SAR3-31
SAR3-14
SAR3-13
SAR3-12
SAR3-10
SAR3-16
SAR3-15
SAR3-22
SAR3-20
SAR3-19
HOP-7
SAR3-17
HOP-5
HOP-4
HOP-14
PB-1
PH-3
PH-1
CW1-3
HOP-8
SAR3-25
HOP-2
HOP-3
HOP-17
HOP-19
SAR3-1
HOP-1
PB-6
PB-5
CW1-2
CW1-1
SAR3-21
HOP-21
HOP-20
HOP-18
HOP-16
HOP-15
PB-2
PB-3
SAR1-10
PI-3
PH-4
PB-4
PH-2
SAR1-6
SAR1-4
SAR1-5
SAR3-8
SAR3-3
SAR1-9
SAR1-2
SAR3-29
SAR1-1
SAR3-30
SAR3-26
SAR1-11
PI-1
NS1-89
NS1-76
NS1-78
PI-4
SAR1-3

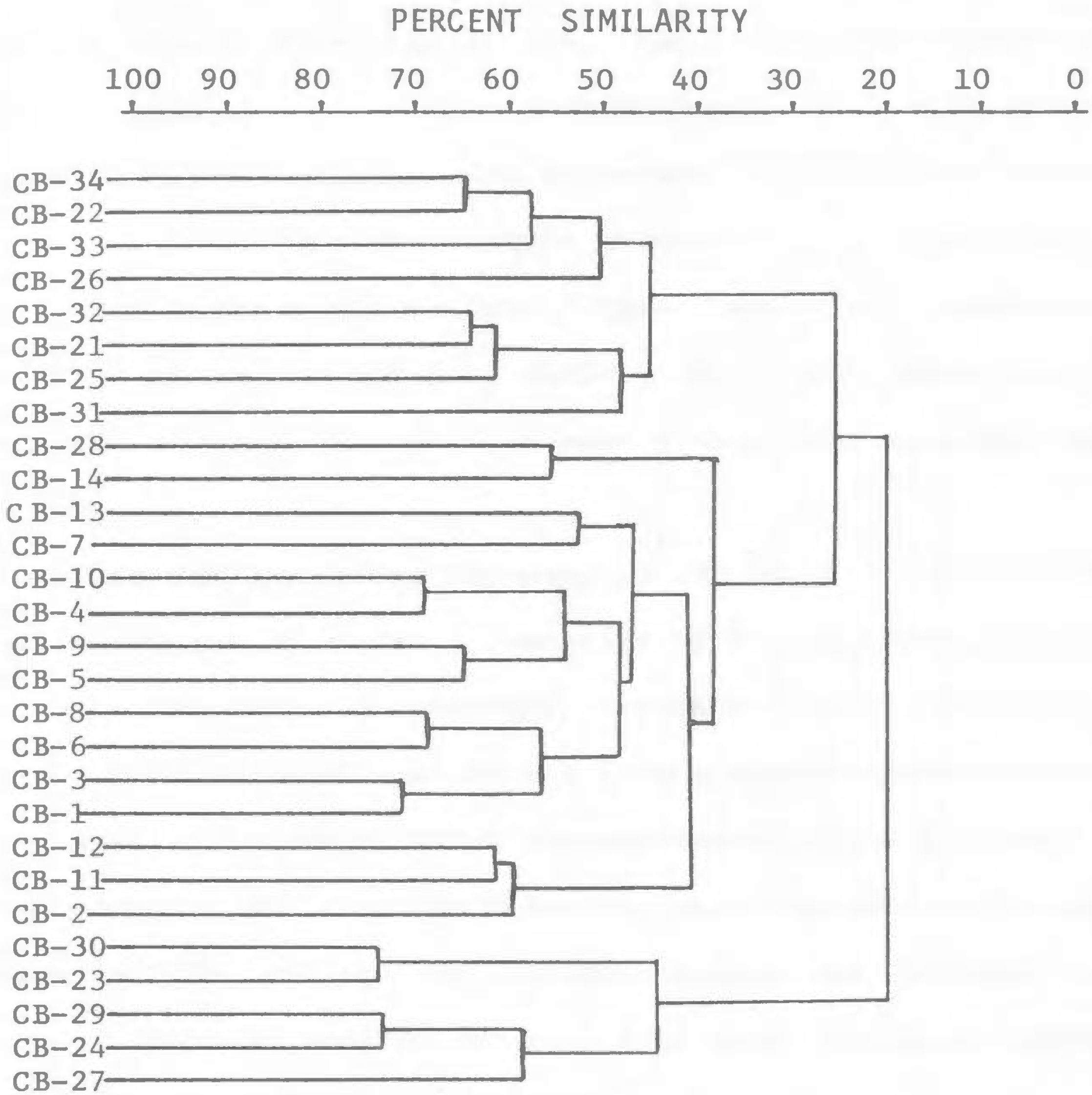


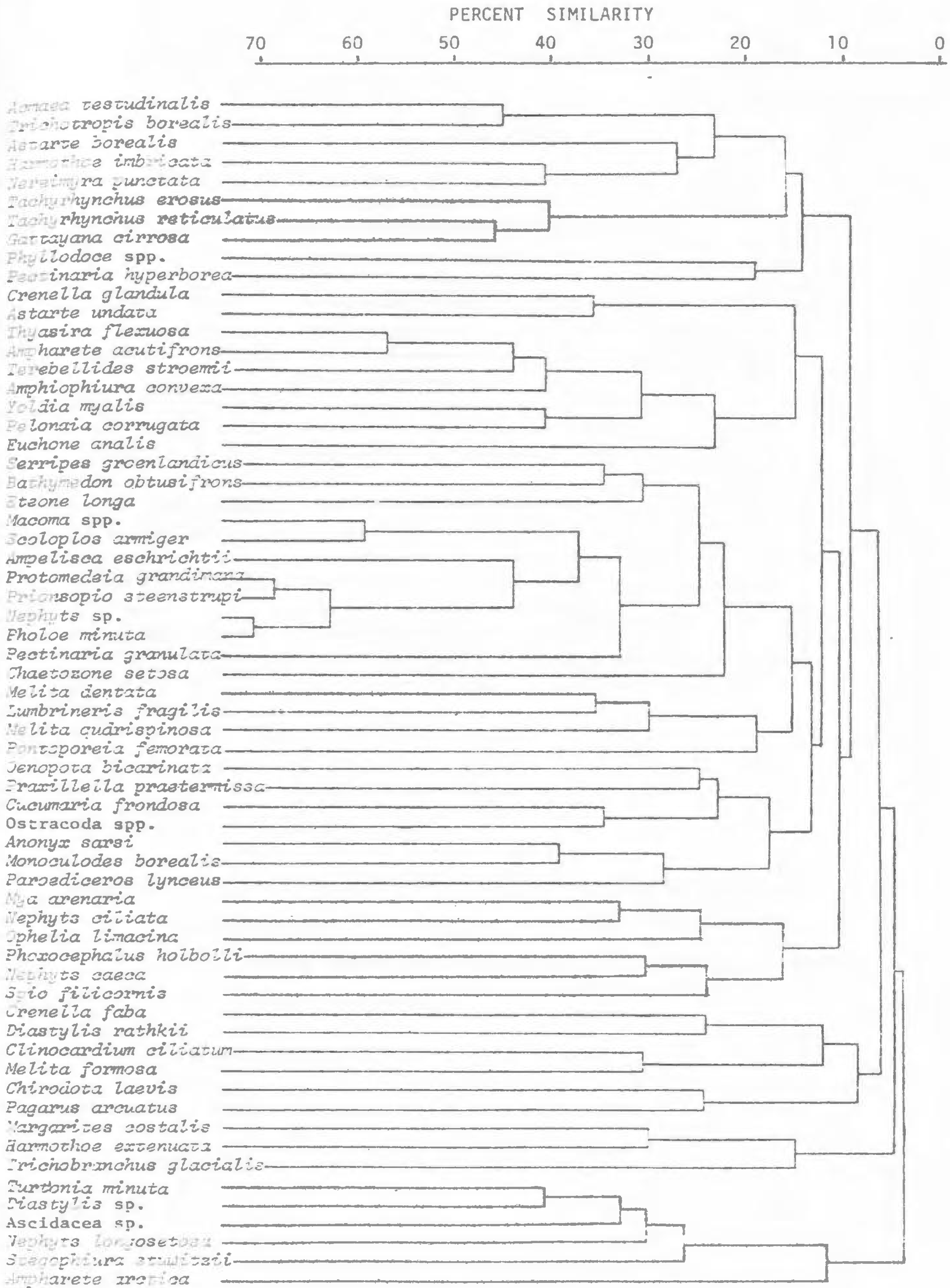
Figure 26. Dendogram resulting from unweighted group average clustering showing similarities among samples from Conception Bay Newfoundland.

a mean substrate diversity of 1.6. The second species association forms a community of *Serripes groenlandicus*, *Bathymedon obtusifrons*, *Eteone longa*, *Macoma* spp., *Scoloplos armiger*, *Ampelisca eschrichtii*, *Protomedia grandimana*, *Prionospio steenstrupi*, *Nephtys* spp., *Pholoë minuta* and *Pectinaria granulata*. This community is associated with the group of samples HOP-6 to SAR3-19 (Figure 25) which were from a substrate of very fine and fine sand with a mean substrate density of 2.55.

From the Conception Bay samples the association of common species (Figure 28) forms a community of *Phoxocephalus holbolli*, *Spio* sp., *Prionospio steenstrupi*, *Pectinaria granulata* and *Eteone longa*. This group of species was from a similar substrate to that associated with samples HOP-6 through SAR3-19 from Labrador. From the Conception Bay site the substrate was fine sand with a substrate diversity 2.56, and for the Labrador samples the substrate was fine sand for fourteen samples and very fine sand for three samples with a mean substrate diversity of 2.55.

Table 4 shows the species from the similar Labrador and Newfoundland communities which are common to both areas and those which are common to only one area. Most of these species have known distributions from the Arctic to south of Newfoundland. *Serripes groenlandicus* which was only found in the Labrador community has a distribution from the Arctic to Cape Cod but is very common in cold waters and uncommon in its southern range (Abbott, 1974). *Bathymedon obtusifrons* was only found in Labrador, and Newfoundland is near the

Figure 27. Dendogram resulting from unweighted group average clustering showing similarities among species collected in Labrador.


PERCENT SIMILARITY
70
60
50
40
30
20
10
0
testudinalis
tropis borealis
Astarte borealis
e imbricata
ra punctata
rhynchus erosus
rhynchus reticulatus
Gattyana cirrosa
Phyllodoce spp.
Pectinaria hyperborea
Crenella glandula
Astarte undata
Thyasira flexuosa
Ampharete acutifrons
Terebellides stroemii
Amphiophiura convexa
Yoldia myalis
Pelonaia corrugata
Euchone analis
Serripes groenlandicus
Bathymedon obtusifrons
Eteone longa
Macoma spp.
Scoloplos armiger
Ampelisca eschrichtii
Protomedeia grandimana
Prionospio steenstrupi
Nephtys sp.
Pholoe minuta
Pectinaria granulata
Chaetozone setosa
Melita dentata
Lumbrineris fragilis
Melita cudrispinosa
Pontoporeia femorata
Oenopota bicarinata
Praxillella praetermissa
Cucumaria frondosa
Ostracoda spp.
Anonyx sarsi
Monoculodes borealis
Paroediceros lynceus
Mya arenaria
Nephtys ciliata
Ophelia limacina
Phoxocephalus holbolli
Nephtys caeca
Spio filicornis
Crenella faba
Diastylis rathkii
Clinocardium ciliatum
Melita formosa
Chirodota laevis
Pagarus arcuatus
Margarites costalis
Harmothoe extenuata
Trichobranchus glacialis
Turtonia minuta
Diastylis sp.
Ascidacea sp.
Nephtys longosetosa
Stegophiura
Ampharete

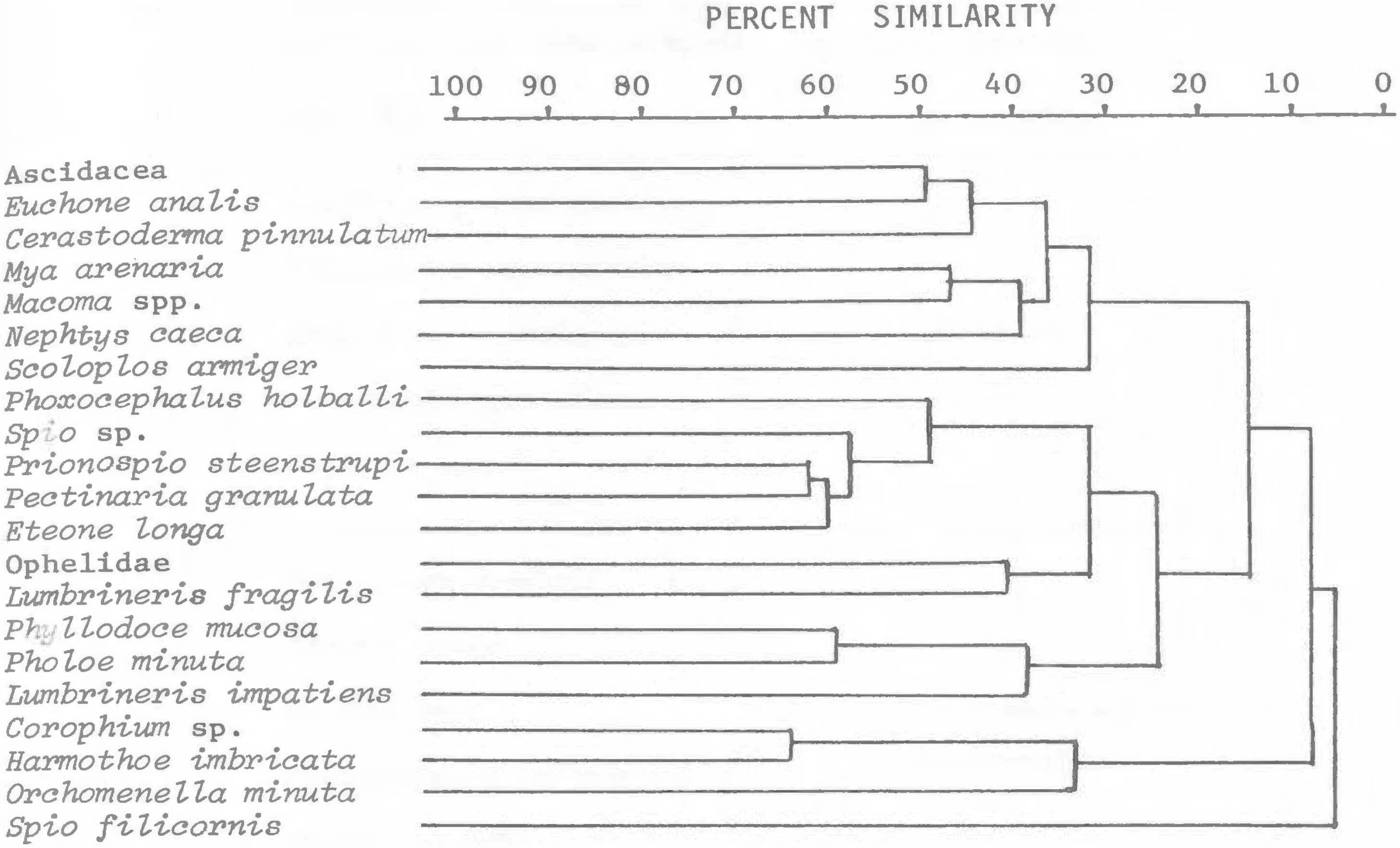


Figure 28. Dendogram resulting from unweighted group average clustering showing similarities among species collected in Conception Bay Newfoundland.

TABLE 4. Occurrence of common species from two communities on fine sand from Labrador and Newfoundland.

SPECIES	OCCURRENCE
Serripes groenlandicus	
Bathymedon obtusifrons	
Ampelisca eschrichtii	Labrador
Protomedia grandimana	
Nephyts spp.	
Scoloplos armiger	
Eteone longa	
Macoma spp.	Labrador and Newfoundland
Prionospio steenstrupi	
Pholoe minuta	
Pectinaria granulata	
Phoxocephalus holbolli	Newfoundland
Spio sp.	

southern limit of its known distribution from the Arctic to the Gulf of St. Lawrence (Bousfield, 1973). In the same way, *Ampelisca eschrichtii* which was only found in Labrador is more common in northern waters than in the southern part of its range, being found in the Arctic and subarctic waters with its range extending south to the Bay of Fundy (Dunbar, 1954). *Protomedia grandimana* is also a northern species and in North America is found in Baffin Bay, with Labrador being the southern limit of its distribution (Stephensen, 1933).

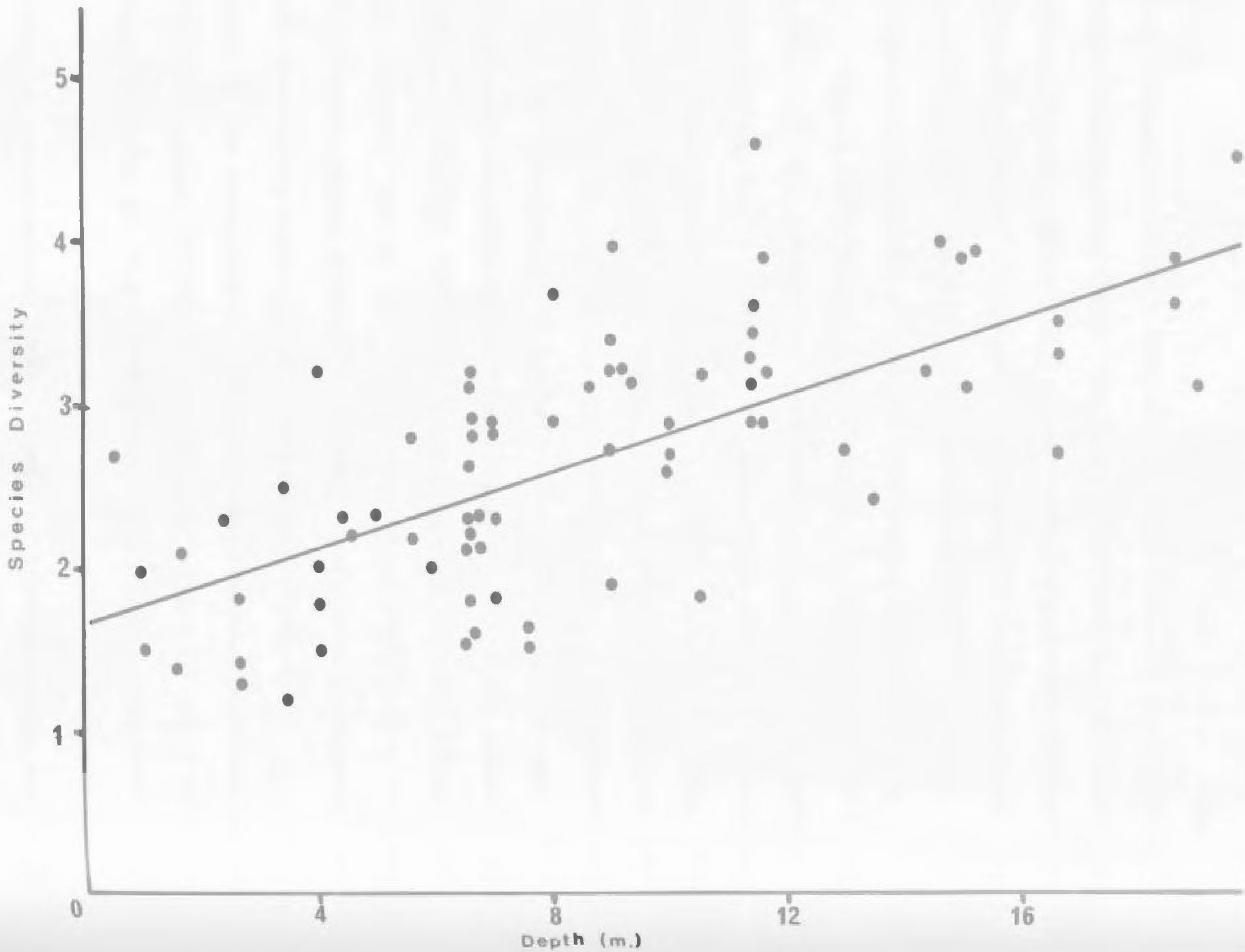
Phoxocephalus holbolli which was common in the Newfoundland community was also found in Labrador but was not as abundant. This species has a range from boreal waters south to Long Island Sound (Bousfield, 1973) and Labrador is near the northern limit of its distribution. The species common to both the Labrador and Newfoundland communities all have known distributions from the Arctic to southern waters in the Atlantic (Pettibone, 1954, 1956, Grainger, 1954).

V REGRESSION ANALYSES:

For each sample, the species composition, depth, distance offshore, numbers of individuals, substrate type, substrate diversity and species diversity are shown in Appendix E. The mean values of species diversity for all sampling sites are shown in Appendix A. Correlation coefficients from the regression analyses for all pairs of variables are shown in Appendix B, and those correlations which are significantly different from 0 at $P<.05$ are underlined.

For near-shore samples taken by SCUBA, species diversity showed a positive correlation with depth (Figure 29) but distance offshore was not significantly correlated with species diversity (t test, $p>.05$). Species diversity was also found to have a significant positive correlation with substrate diversity (t test, $p<.05$). Figure 30 shows mean

Figure 29. Graph showing relationship between depth of sampling and species diversity for SCUBA samples from Labrador.



Species Diversity
5
4
3
2
1
0
4
8
12
16
Depth (m.)

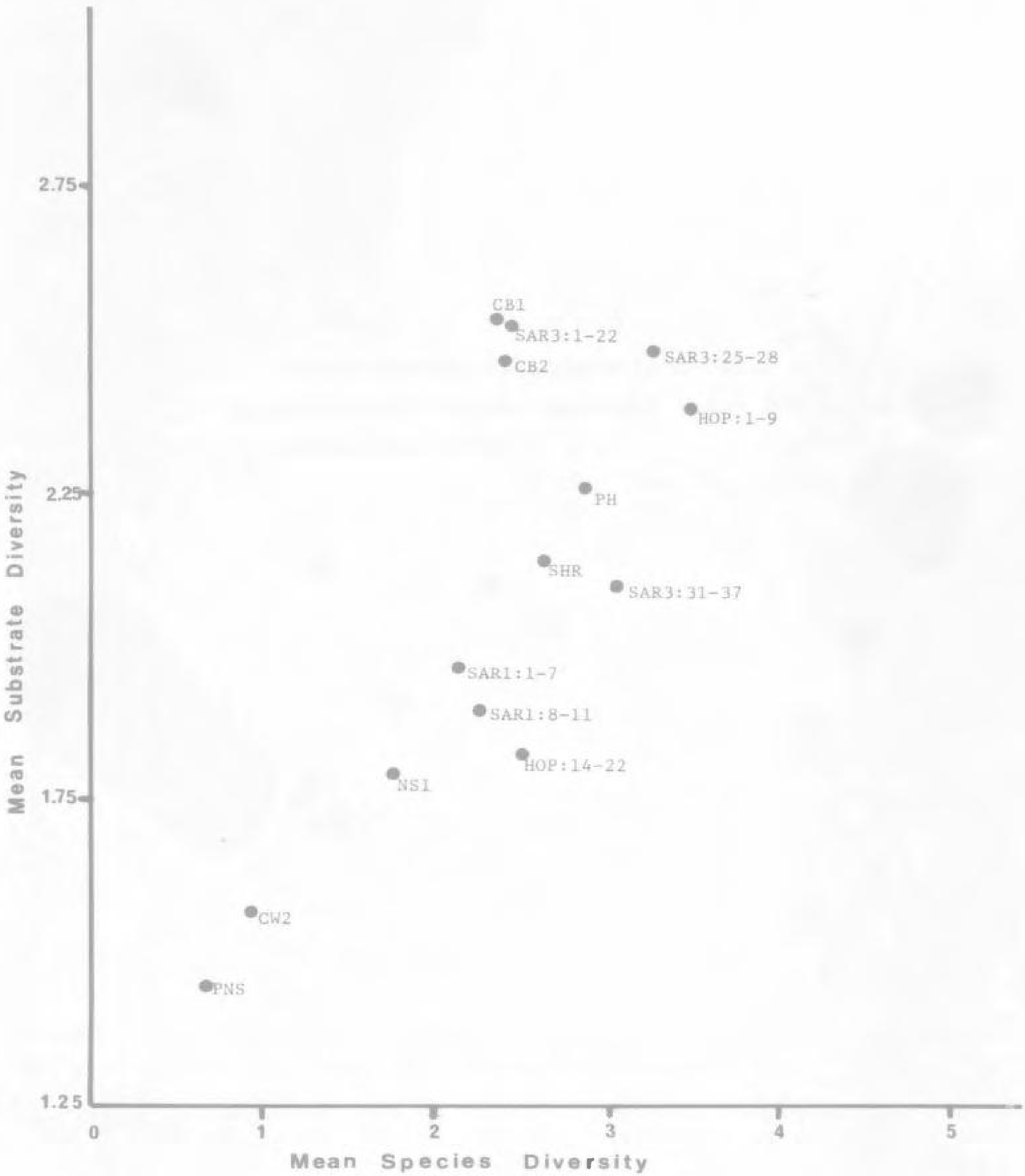
substrate diversity plotted against mean species diversity for each sampling site.

Exposure as determined from Figures 8 to 18 varied from an index of 2 for protected bays to 16 for exposed coastline. The relationship between exposure and species diversity can be seen in Figure 31. Mean species diversity for each site is plotted against the exposure at that site. Species diversity showed a significant negative correlation with exposure (t test, $p<.05$), however diversity tends to be highest at medium exposure values of 4 and 5 and decreases as exposure increases or decreases from these values (see Figure 31).

The correlations between numbers of individuals and each of the independent variables were not as high as the correlations with species diversity (Appendix B). Numbers of individuals showed a significant positive correlation with substrate diversity and a significant negative correlation with exposure and exposure divided by depth (t test, $p<.05$). Number of individuals was not significantly correlated with depth or distance offshore (t test, $p>.05$).

Several of the independent variables showed significant correlations with other independent variables (Appendix B). Figure 32 shows the relationship of exposure and substrate diversity. There was a significant negative correlation (t test, $p<.05$) between substrate diversity and exposure to open water. Substrate diversity also had a significant negative correlation with distance offshore (t test, $p<.05$).

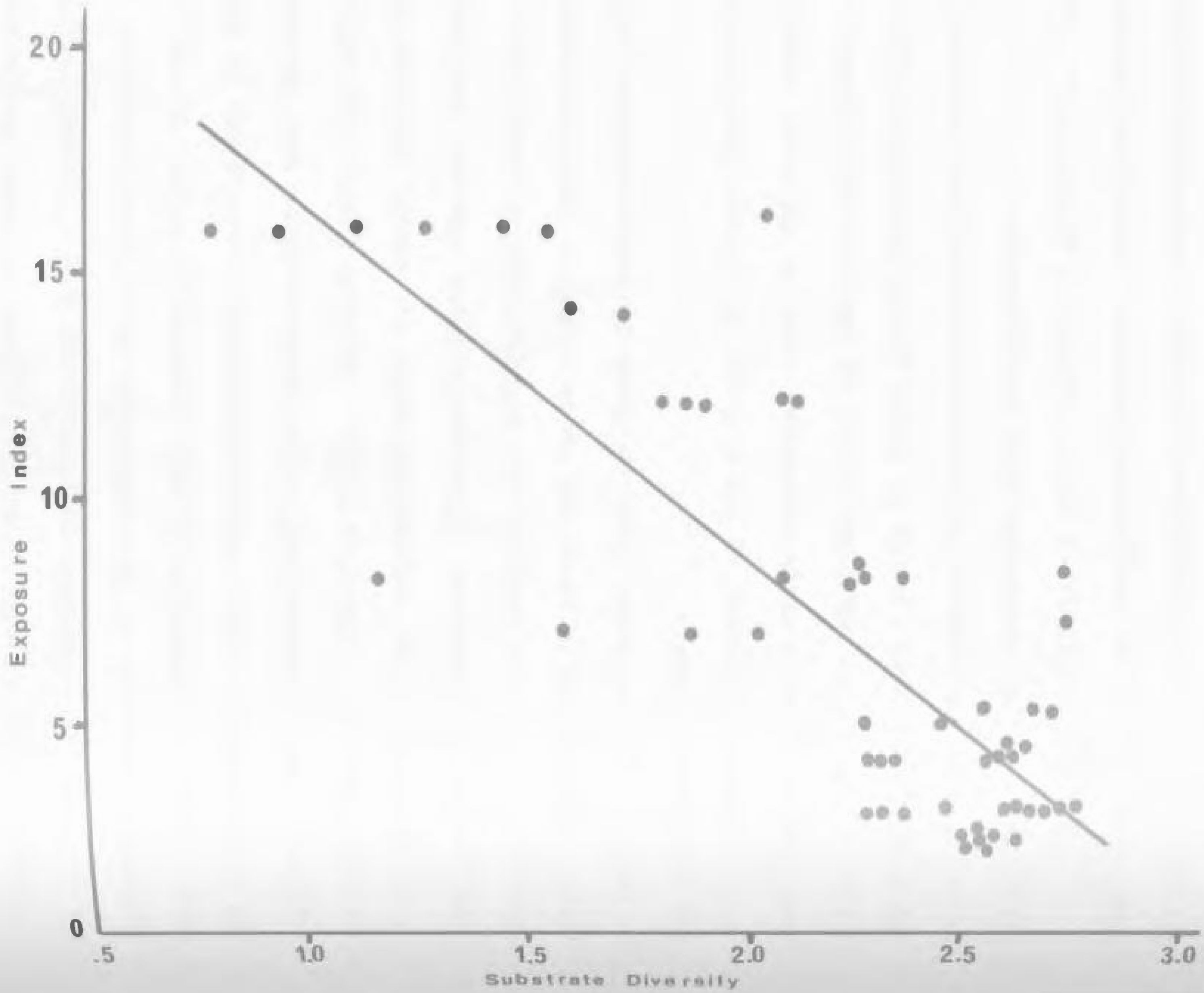
Figure 30. Graph showing relationship between mean substrate diversity and mean species diversity at each collecting site.



Mean Substrate Diversity
2.75
2.25
1.75
1.25
CB1
SAR3:1-22
CB2
SAR3:25-28
HOP:1-9
PH
SHR
SAR3:31-37
SAR1:1-7
SAR1:8-11
HOP:14-22
NS1
CW2
PNS
0
1
2
3
4
5
Mean Species Diversity

Figure 31. Graph showing relationship between mean species diversity and the exposure index for each collecting site.

Figure 32. Graph showing relationship between substrate diversity and exposure for samples from Labrador.



Exposure Index
20
15
10
5
0
.5
1.0
1.5
2.0
2.5
3.0
Substrate Diversity

To determine how much of the variance in species diversity and in numbers of individuals could be explained in terms of the factors measured, stepwise multiple regression was used. Stepwise regression rearranges the order of the independent variables to correspond to their relative contribution to the regression function and will only add those variables which have a significant contribution to the regression sum of squares once other variables have been introduced into the regression (Smillie, 1966). Appendix C shows the analysis of variance tables for species diversity and numbers in terms of depth, substrate diversity, distance offshore, exposure and exposure divided by depth. In Table 5, the variance contributed to the stepwise regression is shown for those variables which are significant at the five percent level, and the total variance accounted for by the regression is shown.

Fifty-three percent of the variance in species diversity can be explained in terms of three variables: depth is the most significant variable followed by substrate diversity and distance offshore. Exposure and exposure divided by depth do not contribute significantly to determining the variance in species diversity once the other variables have been introduced into the regression.

Using only those sites where exposure is greater than 3 such that there is a linear relationship between exposure and species diversity (Figure 31), sixty-nine percent of the variance can be explained in terms of three variables. Exposure is the most important

Table 5: Variance contributed by each significant variable (F test, $p<.05$) in the stepwise multiple regression (S=significant, N=not significant).

INDEPENDENT VARIABLES	DEPENDENT VARIABLES			
	ALL SITES		WHERE EXPOSURE >3	
	SPECIES DIVERSITY	NUMBER INDIVIDUALS	SPECIES DIVERSITY	NUMBER INDIVIDUALS
DEPTH	S 31%	N	S 10%	S 7%
DISTANCE OFFSHORE	S 2%	N	N	N
EXPOSURE	N	N	S 57%	S 20%
EXPOSURE/ DEPTH	N	S 6%	N	S 6%
SUBSTRATE DIVERSITY	S 20%	N	S 2%	N
AMOUNT OF VARIANCE ACCOUNTED FOR	53%	6%	69%	33%

variable followed by depth and substrate diversity. Distance offshore and exposure divided by depth do not contribute any further significant reduction in variance to species diversity (F test, p>.05).

With numbers of individuals, exposure divided by depth explains six percent of the variance and the other variables do not contribute any further significant reduction in variance at p<.05. However, using only those samples where exposure is greater than 3, the category numbers of individuals has thirty-three percent of its variance explained in terms of exposure, depth and exposure divided by depth (Table 5). Substrate diversity and distance offshore do not add any significant contribution to explaining the variation in numbers (F test, p>.05).

DISCUSSION:

All of the quantitative benthos samples from Labrador and Newfoundland were collected by quantitative samplers, namely Shipek grabs from the vessel and a plastic sampler for SCUBA samples. Depending on the substrate type and the operator, grabs penetrate to variable depths and can give variable quantitative data. Ellis (1960) found that as the volume of substrate increased with grab sampling, the number of animals per haul increased. To reduce variation in the results, any grabs that were less than half full were not used for quantitative data.

In the present study, all shallow near shore samples were taken by SCUBA for these areas were not accessible by the vessel. Using SCUBA the diver can see the substrate before sampling and avoid large rocks or boulders that would affect the penetration of a sampler operated from a vessel. Each sample taken by SCUBA can be taken to the same depth in the substrate and so give the same size of sample to provide comparable results from quantitative analysis.

Many of the grabs that were taken in deeper water from the vessel using the Shipek grab sampler were less than half full and could not be used for quantitative data. The Shipek grab is one of the most reliable samplers for bottom samples although it gives a small sample (Holme and McIntyre, 1971).

For quantitative analysis, numbers of individuals was used rather than biomass. Sanders *et al.* (1965) and Field and McFarlane (1968) discuss the advantages of using numbers rather than weight in benthos studies due to the difficulty in comparison of samples from biomass measurements. The presence or absence of large rare animals in a sample can affect the biomass to a large degree, especially when the area sampled is small. Also if wet weight is to be used so that the specimens need not be destroyed, the bulk of weight may be accounted for by inorganic calcium carbonate present in molluscs, and echinoderms rather than organic biomass (Sanders *et al.* 1965).

I
BENTHIC COMMUNITIES:

The marine level bottom community and the types of species associations found in different environments have been described by Thorson (1957). Ellis (1960) also found that marine infauna species from Arctic North America associate in such a way that similar faunas are found under similar environmental conditions. Cluster analysis is a very useful technique in delineating these species associations and their distributions and several authors have used this technique to analyse the distribution of coastal marine benthos (Field, 1970). From the Labrador samples, two groups of species were found using cluster analysis and these communities were found to be associated with two types of environments.

A community from the North Strand, south of Hamilton Inlet was characterized by *Diastylis* and *Nephtys longosetosa*. This community was associated with an exposed coastline and a substrate of fine and medium sand with a low diversity of grain sizes. The other community characterized by *Prionospio steenstrupi*, *Protomedia grandimana* and *Nephtys* was found in more protected bays and in substrates of very fine or fine sand with a high diversity of grain sizes.

Although Thorson (1957) stresses that very mobile animals such as *Diastylis* should be avoided as characterizing species, the North Strand had a very sparse fauna, and *Diastylis* and *Nephtys* were the only species common in all samples. Thorson (1957) also says that the characteristics of a level-bottom community must be based upon more than one species.

Thorson (1966) discusses the parallels of marine level bottom communities from the same sediment at the same depth but from different latitudes. Thus from a similar environment in Newfoundland as that of a community in Labrador one would expect to find a similar species association. The community found in Conception Bay Newfoundland was dominated by *Prionospio* *steenstrupi* and *Pectinaria granulata* and that in Labrador by *Prionospio steenstrupi*, *Protomedia grandimana* and *Nephtys*. A comparison of the species composition of these communities showed that most of the common species found in either community were present in both areas. The species that were found in Labrador and not in Newfoundland are species with more northerly ranges in the North Atlantic and the species found in Newfoundland and not in Labrador have more southerly ranges.

Thorson (1957) describes level-bottom communities from various parts of the world. His *Macoma calcarea* community (Thorson, 1957) from the East Greenland fjords in subtidal waters to 50 to 60 m is the closest community geographically (of those described) to the Labrador and Newfoundland sites. Thorson's community was characterized by *Macoma calcarea*, *Mya truncata*, *Cardium ciliatum*, *Cardium (=Serripes) groenlandicus*, *Ophiocten sericeum*, *Pectinaria granulata* and *Astarte borealis*. *Macoma* tends to be dominant in this community where there is mainly mud and silt in the substrate, and increasing amounts of sand lead to the dominance of *Cardium (=Serripes)* (Thorson, 1957). The community from Labrador and Newfoundland from substrates of fine and very fine sand is similar to Thorson's *Macoma* community. Two species from the *Macoma* community, *Serripes groenlandicus* and *Pectinaria granulata* and one genus, *Macoma*, were found as characteristic animals in the Labrador community and *Pectinaria granulata* was also found as a characteristic species in the Newfoundland community. Of the other animals in Thorson's community, *Mya* and *Astarte* were also present in the Labrador and Newfoundland community, although not as characteristic species. The community from the more exposed coastline of Labrador, from fine and medium sand does not parallel any of these described by Thorson.

Due to the small area of the samplers used in this study (.04 m^2), many of the larger and more widespread species such as the larger pelecypods *Macoma, Mya, Astarte* and *Serripes* would not be as common as with Thorson's samples using a larger grab (.1 m^2). The smaller grab may also miss deeply burrowing species such as *Mya*. Using numbers rather than weight in the analysis, the larger species are not emphasized as much as in Thorson's community where the community is based on dominant species by both numbers and weight.

Many of the species found in the Labrador and Newfoundland community were also found as abundant species in the sand bottom communities from Baffin Island described by Ellis (1960). *Pholoë minuta, Pectinaria granulata, Astarte* and *Serripes* were found in Ellis' Arctic *Macoma* community and also in the Labrador and Newfoundland communities.

Species which are restricted to either sheltered or exposed areas can be used as "indicator species" of these conditions (Field and McFarlane, 1968). *Diastylis* is the best indicator of the exposed coastline from the Labrador samples as it is restricted to those sites where the exposure index is high (greater than 14). *Stegophiura stuwitzii* although not as common as *Diastylis* is also an indicator of high exposures as it is restricted to the exposed sites. For the Labrador coast, *Prionospio steenstrupi* and *Protomedia grandimana* are the best indicators of sheltered environments. Both species were abundant at sites with low exposure indices and neither were found at sites where the exposure index was greater than 8. *Prionospio steenstrupi* was also abundant at the sheltered sites in Conception Bay.

Comparing the environments of the Newfoundland and Labrador coasts, one would expect a similarity in marine life. Labrador and Newfoundland both lie in the subarctic marine zone and are characterized by the so called 'boreo-arctic' species found normally in temperate waters, subarctic mixed water and pure Arctic waters (Dunbar, 1968). The Labrador coast represents the eastern rim of the resistant Canadian Shield and Newfoundland is the most northerly part of the Appalachian mountain system, and in both regions the scouring of Pleistocene glaciers has left indented fjord coasts with rocky shores and few beaches (Owens, 1977). The presence of ice for up to 7 months each year, high wave-energy levels in winter and fall and summer fogs combine to give the coastal environment its character (Owens, 1977). The salinity is similar for the areas studied but the water temperature reaches higher summer maxima in Newfoundland than in Labrador.

Temperature seems to be the main factor that differentiates the Nain sampling sites from the Conception Bay site. The maximum surface temperature in Labrador ranges from 4°C in Nain to 6°C in Cartwright (Dunbar, 1951) while in Conception Bay summer temperatures reach 14°C (Steele, 1974). Winter conditions are similar in both areas although the Labrador coast would have more ice and more ice scouring. However a 10°C difference in maximum summer water temperatures and a geographic separation of 1100 kilometers between the two areas would account for differences in the species composition of the fauna. Species restricted to colder waters such as *Serripes groenlandicus* are found in Labrador and not in Newfoundland, while species requiring warmer temperatures for spawning such as *Littorina littorea* occur in Newfoundland and not in Labrador.

II
SPECIES DIVERSITY:

In the present study, within habitat species diversity was measured for each sample. This measures the evenness and richness of species in repeated sampling within a homogeneous community. Species diversity should be greatest where 1) there is the greatest amount of overlap between species and 2) the greatest number of niches is available. Generally, local diversity or within habitat diversity is highest in the more structurally diverse habitats (e.g. Spight, 1977).

Substrate diversity was found to be a significant factor in its effect on within habitat species diversity. As the number of size classes in the substrate increased so did species diversity. The more diverse substrate has more potential niches for the species to occupy and could account for the increase in species diversity.

In the same way that within habitat diversity increases, it is expected that there will be more species in a region, and between habitat diversity will increase, where there are more ecological niches (Connell and Orias, 1964). MacArthur *et al.* (1966) found that bird species diversity in different areas was highest where foliage height diversity was highest. From the species-area curve (Fig. 18), it can be seen that the between habitat diversity, measured by number of species, is greatest on substrates with the greatest diversity of grain sizes, and species diversity was also greater on bottoms with both sand and gravel than on bottoms with just sand. Larger grain sizes would provide more habitats for small benthic organisms to settle on or crawl into. In the same way, the more variation in grain sizes, the more complex the environment and the more habitats that are available for the different species to occupy.

As well as availability of niches, the number of species in an area is affected by environmental fluctuations. When physiological stress is increased by unfavourable physical conditions, the community changes from a biologically accommodated to a physically controlled community and the number of species diminishes (Sanders, 1968). In shallow near shore waters, wave action and currents could be a physiological stress to the benthos, especially in an environment such as the Labrador, Newfoundland coast where wave-energy levels are high. Exposure to open water was measured for each sampling site to determine the effect of wave action and currents on the community structure and its species diversity.

Species diversity was found to be highest at intermediate levels of exposure and decreased as exposure increased. A site with very high exposure to waves may have an unstable bottom in which many species of the infauna may have difficulty in maintaining position or in feeding. However sites with very low exposure indices had lower species diversity than did sites with medium exposure indices. Low species diversity in areas of low exposure to waves may be a result of poorer food supply. Currents and wave action would help to supply food to filter and deposit feeders of the infauna as well as replenish the oxygen and remove unwanted metabolites. Sites with low exposure indices would also be associated with a more stable environment in terms of fluctuation in wave levels and currents. Connell (1978) found that high diversity in tropical rain forests and coral reefs is maintained only in a non equilibrium state. Johnson (1970) described marine benthic communities as being in various stages of succession and suggested that the continual occurrence of small scale disturbances would keep the community at an intermediate stage of succession at which species diversity is highest.

Intermediate environmental conditions often support the largest number of species as the more specialized or extreme the habitat, the poorer in species but the richer in individuals will be the community (Ekman, 1953). Physical disturbances allow competitively inferior opportunists to be maintained in a system and can switch a system from one in which competitive exclusion would lead to reduced richness to one where disturbance mediated competitive coexistence occurs (Menge and Sutherland, 1976). However diversity may be reduced if the disturbance is more frequent and widespread and the community may be physically controlled (e.g. Dayton, 1971).

The uppermost layer of the level bottom which is the result of recent sedimentation varies in relation to the movement of the water (Thorson, 1957). For the Labrador coast, sites with high exposure indices had the lowest diversity of grain size in the sediment. Buchanan (1963) found a poor correlation between grade of sediment and the qualitative nature of the animal association and suggested that the bottom sediment serves little more than a supporting function. The more relevant ecological factors may be found in the quality of the suspended matter together with the speed and nature of its flow over the bottom (Buchanan, 1963). Marzolf (1965) suggested that the indirect effect of environmental factors may be more than once removed from the observed correlation, for example there may be a strong correlation with sediment size and only a moderate correlation with current velocity upon which sediment size depends. Exposure was found to be significantly correlated with both species diversity and substrate diversity and thus would have some effect on the relationship between substrate diversity and species diversity.

The benthic infauna is most fully developed below the intertidal zone (Thorson, 1957). Below the intertidal zone the infauna is constantly submerged so that the most important environmental factors affecting the organisms are currents, substrate and food. For the near shore sites in Labrador, species diversity was found to be positively correlated with depth. The infauna from shallow waters would be influenced by wave action to a much greater extent than the infauna in deeper waters. The effect of exposure in reducing species diversity is more pronounced for shallow samples than for deep samples. The infauna in deeper waters would have a more stable bottom and less stress from current and wave action.

Distance offshore at near shore sites is also associated with an increase in species diversity and is also associated with an increase in depth. However the correlation of species diversity with distance offshore was not significant (t test, $p>.05$). Variations in slope offshore between the different sites and the irregular nature of the bottom in many of the areas sampled would account for a poor relationship between distance offshore and depth or species diversity.

The environmental factors measured which have been shown to affect the community are in most cases not independent of each other. The factors may also be affected by other factors that were not measured and yet have a significant effect on the community. For example Bader (1954) found that the organic content and its state of decomposition were the primary factors in controlling the distribution of sediment dwelling pelecypods whereas the physical characteristics of the sediments and depth were secondary in importance.

Combining all the factors measured, depth, substrate diversity and distance offshore together are all significant in explaining the variance in species diversity in a multiple regression analysis. Other variables which are significantly correlated to species diversity do not contribute any further reduction to the variance in species diversity as they may be correlated with another independent variable. Exposure is highly correlated with substrate diversity (Fig. 33) and was not significant in explaining any variance in species diversity once substrate diversity was used in the multiple regression function (see Table 5). However exposure was found to be the most important factor affecting species diversity for unprotected sites (exposure >3) and depth and substrate diversity were also significant factors.

Using number of individuals as the dependent variable, only one variable, exposure divided by depth is significant in the regression function and very little variance in numbers is accounted for. Using only those sites which have exposure indices greater than 3, more variance can be accounted for in numbers of individuals, and exposure and depth are both significant factors. However only 33 percent of the variance in numbers can be accounted for whereas 69 percent of the variance in species diversity can be explained by the variables measured (Table 4). Density may not be as predictable as species diversity in looking at communities and Sanders (1968) stresses that diversity is one of the major features of animal communities. However there may be other factors more important than the ones measured in controlling density. Organic content of the substrate would be expected to be more important in determining numbers than other factors, as there is a close correlation between density of the benthos and organic content of the sediments (e.g. Bader, 1954).

Species-area curves may either follow a log series distribution and rise continously or may be negative binomial and after rising at first reach a maximum and then decrease to a zero rate of increase (Pielou, 1977). The species-area curves (e.g. Figs. 18, 19, 20) show that the number of species at any one site is estimable and after fifteen samples the curves have levelled off. However, if there is still an appreciable proportion of singletons when all the area has been examined, the community may occupy a larger area than that examined or the community is not homogeneous and is a chance assemblage of immigrant species (Pielou, 1977). Taking species area curves as in Figure 20, with samples taken a) at random and b) in a set pattern over an expanding area, one can determine if the community is homogeneous. In Figure 20 both the curves for samples taken at random and over an expanding area level off although the curve for samples taken over an expanding area rises more slowly and levels off later. This indicates that the number of species for the area is estimable and that the area contains a homogeneous community with the area sampled being a small part of a larger area occupied by the community concerned (Pielou, 1977). A species area curve for samples taken over an expanding area that rises continuously would indicate that the community is not homogeneous (Pielou, 1977).

The number of species of aquatic invertebrates increases enormously from the Arctic towards the tropics and this increase is very pronounced in the epifauna while the number of infaunal species seems to be roughly the same in Arctic as in temporal or tropical seas (Thorson, 1957). Species-area curves for polychaetes and other burrowing species (Figs. 21 and 25B) for different sites from Labrador to Newfoundland with similar physical conditions show that this trend does apply for the infauna. The constantly submerged infauna are associated with a level bottom and are exposed to nearly the same types of environmental conditions in all seas so that temperature is the only physical factor that is really different (Thorson, 1957).

The species-area curves for non-burrowing species (Figs. 23, 24 and 25A) show that there is much more variation between sites with similar physical conditions and that the lowest number of species was found in Newfoundland. This trend is opposite to what would be expected as Labrador is at a more northern latitude than Newfoundland. Spight (1977) found that there were not more species of prosobranch gastropods in tropical beach quadrats than in temperate beaches and that differences in diversity were due to structure-diversity relationships. As the physical environment was similar for the seven sites compared in Figures 23, 24 and 25A, differences in the numbers of non-burrowing species could be due to interactions within the community.

Competition (e.g., Menge and Sutherland, 1976) and predation (e.g., Merge and Sutherland, 1976, Spight 1977) can affect species diversity and the intensity of competition or predation seems to be what is important. Whereas competition can decrease species diversity through competitive exclusion (Connell, 1978), competition on a less intense scale will increase diversity through biological accommodation (Menge and Menge, 1974). In the same way intense predation can decrease diversity by intense grazing (e.g. Paine and Vadas, 1969) whereas moderate predation increases diversity by reducing competitive exclusion (Menge and Sutherland, 1976).

The presence of large schools of the cunner, *Tautogolabrus adspersus* at the Newfoundland sites could account for a reduction in the number of non-burrowing benthic species in the area. The cunner was not found at Labrador sites and has a distribution from Chesapeake Bay to northern Newfoundland (Leim and Scott, 1966). Cunners feed principally on molluscs and crustaceans (Leim and Scott, 1966) and large numbers of molluscs and crustaceans have been found in the stomachs of cunners from Conception Bay (J.M. Green, pers. comm.).

The effects of predation and competition on species diversity are not independent of other factors. When predation is intense, hiding places will be at a premium. However, the more complex environment will have more hiding places than a uniform bottom. Intense predation may increase species diversity on a cobble bottom where the underside of stones and crevices in stones provide different types of habitats (Spight, 1977) whereas predators may reduce species diversity on uniform sand bottoms where hiding places are rare for non-burrowers.

SUMMARY:

Two benthic communities were found in the areas surveyed. A community from Labrador in protected coastal areas with a substrate of fine - very fine sand was similar to a community from Newfoundland associated with the same physical conditions. Species differences from these two areas were accounted for by species with ranges that did not extend further south than Labrador for the Labrador community and species with ranges not extending further north than Newfoundland for the Newfoundland community. This community characterized by *Prionsopio steenstrupi* and *Pectinaria granulata* shows similar community structure to Thorson's Arctic *Macoma* community. A second community from Labrador was associated with more exposed areas and a substrate of fine and medium sand. This community characterized by *Diastylis* sp. and *Nephtys longosetosa* did not parallel any of Thorson's communities.

Three species found in Labrador, *Laonome kröyeri*, *Amphiophiura convexa* and *Onisimus affinis* were new records for the Labrador coast.

Species diversity of the benthos was found to be greatest where heterogeneity of the environment was greatest. Diversity was high on substrates with the greatest diversity of grain sizes and low where the substrate was constant with few grain sizes present. Diversity was highest where exposure levels were medium, and low where exposure to waves was high or where the exposure was very low. Depth and distance offshore were less significant factors than substrate and exposure in their effects on species diversity. Diversity tended to increase with

depth and distance offshore and was low in very shallow near-shore areas.

More species of benthos were found at Labrador sites than at the Newfoundland sites. However, there was very little difference in the numbers of burrowing species between the two areas or between sites. Variations in numbers of species between sites with similar physical conditions was due to non-burrowing species. Fewer species of epifauna in the Newfoundland sites as compared to similar Labrador sites may be due to predation by inshore fish species.

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APPENDIX A

Mean species diversity values for all sampling sites.

LOCATION	NUMBER SAMPLES	MEAN SPECIES DIVERSITY	STANDARD DEVIATION
Conception Harbour (CB:1-14)	14	2.34	.56
Harbour Main (CB:21-34)	14	2.37	.75
Meta Cove (SAR3:1-22)	21	2.40	.87
Pack's Harbour (PH)	4	2.85	.96
Pottle's Bay (PB)	6	2.60	1.30
Hopedale 1 (HOP:1-9)	9	3.48	.66
Hopedale 2 (HOP:14-21)	8	2.54	.69
Rhodes Is. (SAR3:31-37)	7	2.09	.48
Hillsbury Is. (SAR3:25-30)	6	2.49	.19
Cartwright 1 (CW1)	4	2.85	.78
Cartwright 2 (CW2)	5	1.56	.70
Shot Islet (SAR2)	2	2.40	.14
Ponsonby Is. (PI)	4	2.30	.73
East Red Is. (SAR1:8-11)	4	2.30	.63
Siurakuluk Is. (SAR1:1-7)	7	2.13	.70
North Strand (PNS)	4	0.73	.83
Shipeks from North Strand (NS1)	26	1.79	.78
Shipeks from Nain (SHR)	18	2.62	.72
Total	149	2.31	.92

Legend for APPENDICES B and C:

NUMB -	number of individuals
SPESD -	species diversity
SUBSD -	substrate diversity
EXPOS-	exposure index
DEPTH -	depth in meters
EXPD -	exposure index divided by depth
DIST -	distance offshore in meters

APPENDIX B

Correlation coefficients for factors used in regression analysis.

Lower triangle: correlation coefficients
Upper triangle: number of cases for correlation.

a) Species diversity

	SPESD	SUBSD	EXPOS	DEPTH	EXPD	DIST
SPESD	121.	121.	86.	86.	86.	85.
SUBSD	0.53714	121.	86.	86.	86.	85.
EXPOS	-0.43845	-0.68505	86.	86.	86.	85.
DEPTH	0.55676	0.18152	-0.13150	86.	86.	85.
EXPD	-0.40986	-0.35125	0.51319	-0.47956	86.	85.
DIST	-0.19186	-0.39260	0.62878	0.24017	0.02453	85.

b) Species diversity where exposure index >3

	SPESD	SUBSD	EXPOS	DEPTH	EXPD	DIST
SPESD	121.	121.	51.	86.	51.	85.
SUBSD	0.53714	121.	51.	86.	51.	85.
EXPOS	-0.75280	-0.55065	51.	51.	51.	50.
DEPTH	0.55676	0.18152	-0.35327	86.	51.	85.
EXPD	-0.48653	-0.23902	0.43286	-0.62630	51.	50.
DIST	-0.19186	-0.39260	0.52819	0.24017	-0.11979	85.

c) Number of individuals

	NUMB	SUBSD	EXPOS	DEPTH	EXPD	DIST
NUMB	121.	121.	86.	86.	86.	85.
SUBSD	0.24217	121.	86.	86.	86.	85.
EXPOS	-0.23264	-0.68505	86.	86.	86.	85.
DEPTH	0.08060	0.18152	-0.13150	86.	86.	85.
EXPD	-0.24523	-0.35125	0.51319	-0.47956	86.	85.
DIST	-0.14242	-0.39260	0.62878	0.24017	0.02453	85.

d) Number of individuals where exposure index > 3

	NUMB	SUBSD	EXPOS	DEPTH	EXPD	DIST
NUMB	121.	121.	51.	86.	51.	85.
SUBSD	0.24217	121.	51.	86.	51.	85.
EXPOS	-0.44194	-0.55065	51.	51.	51.	50.
DEPTH	0.08060	0.18152	-0.35327	86.	51.	85.
EXPD	-0.41446	-0.23902	0.43286	-0.62630	51.	50.
DIST	-0.14242	-0.39260	0.52819	0.24017	-0.11979	85.

(underlined coefficients are significantly different from 0, t test, $p < .05$).

APPENDIX C

Analysis of variance summary table for multiple regression analysis.

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
SPESD	DEPTH	0.55676	0.30998	0.30998	0.55676	0.03478	0.51787
	SUBSD	0.71177	0.50662	0.19664	0.53714	0.65971	0.36541
	DIST	0.72725	0.52890	0.02228	-0.19186	-0.00100	-0.17207
	EXPOS	0.72765	0.52948	0.00058	-0.40986	-0.02806	-0.02894
	(constant)					0.18043	
SPESD where exposure >3	EXPOS	0.75280	0.56671	0.56671	-0.75280	-0.13287	-0.64830
	DEPTH	0.81446	0.66334	0.09663	0.55676	0.01813	0.26994
	SUBSD	0.82853	0.68647	0.02313	0.53714	0.37179	0.20593
	DIST	0.83648	0.69970	0.01324	-0.19186	0.00099	0.17051
	EXPD	0.83682	0.70027	0.00057	-0.48653	0.02581	0.03280
	(constant)					2.16006	
NUMB	EXPD	0.24523	0.06014	0.06014	-0.24523	-10.7262	-0.22697
	SUBSD	0.29650	0.08791	0.02777	0.24217	14.7861	0.16804
	DIST	0.30575	0.09348	0.00557	-0.14242	-0.02880	-0.10205
	EXPOS	0.30725	0.09440	0.00092	-0.23264	0.55380	0.05966
	DEPTH	0.30803	0.09488	0.00048	0.08060	-0.08641	-0.02639
	(constant)					15.2133	
NUMB where exposure >3	EXPOS	0.44194	0.19531	0.19531	-0.44194	-4.68162	-0.46869
	EXPD	0.50655	0.25659	0.06128	-0.41446	-16.9978	-0.44314
	DEPTH	0.57189	0.32705	0.07046	0.08060	-1.30297	-0.39797
	DIST	0.58111	0.33769	0.01064	-0.14242	0.04166	0.14764
	(constant)					122.770	

APPENDIX D

List of species, collection sites and depth ranges of collections.

Polychaetes:

Pholoë minuta (Fabricius). Pottle's Bay, Cartwright, Pack's Harbour, Nain, Conception Bay. 4-16 m.

Nereimyra punctata (Muller). Ponsonby Is., North Strand, Hopedale, Nain. 6-31m.

Pectinaria granulata (Linne). Cartwright, Pack's Harbour, Ponsonby Is., Hopedale, Pottle's Bay, Nain, Conception Bay. 1-56 m.

Pectinaria hyperborea (Malmgren). Pottle's Bay, Nain. 5-16 m.

Harmothoë imbricata(Linne). North Strand, Pack's Harbour, Ponsonby Is., Hopedale, Nain, Conception Bay. 3-62 m.

Harmothoë extenuata (Grube). North Strand, Hopedale, Nain. 7-53 m.

Gattayana cirrosa (Pallas). Hopedale, Nain. 7-62 m.

Ampharete acutifrons (Grube). Cartwright, Pack's Harbour, Hopedale, Nain. 5-50 m.

Ampharete arctica(Malmgren). Nain, North Strand. 9-40 m.

Glycera capitata (Oersted). Cartwright, Hopedale, Nain. 6-36 m.

Goniada maculata(Oersted). Cartwright, Nain, Conception Bay. 11-17 m.

Chaetozone setosa (Malmgren). North Strand, Pottle's Bay, Ponsonby Is., Cartwright, Nain. 1-18 m.

Nephtys spp. (juv.). Cartwright,Pack's Harbour, Pottle's Bay, Hopedale, Nain. 4-60 m.

Nephtys discors (Ehlers). Pack's Harbour, Hopedale, Nain. 6-9 m.

Nephtys ciliata(Muller). Cartwright, Pottle's Bay, Hopedale, Nain, Conception Bay. 4-90 m.

Nephtys caeca(Fabricius). North Strand, Hopedale, Nain, Conception Bay. 3-27 m.

Nephtys longosetosa (Oersted). North Strand, Pottle's Bay, Pack's Harbour, Hopedale, Nain. 3-42 m.

Nephtys paradoxa(Malm). Nain. 50-90 m.

Pherusa plumosa (Muller). Hopedale, Nain. 13-96 m.

Travisia forbesii (Johnston). North Strand, Nain. 1-27 m.

Scalibregma inflatum (Rathke). Pottle's Bay, Nain. 10-60 m.

Flabelligera affinis (Sars). Nain. 90m.

Scoloplos armiger (Muller). Cartwright, Pack's Harbour, North Strand, Pottle's Bay, Nain, Conception Bay. 1-56 m.

Naineris quadricuspida (Fabricius). Ponsonby Is. 3 m.

Terebellides stoëmii (Sars). Cartwright, Pack's Harbour, Pottle's Bay, Hopedale, Nain. 6-56 m.

Nicolea venustula (Montagu). Nain. 6-10 m.

Polycirrus medusa (Grube). Hopedale, Nain. 7-9 m.

Thelepus cincinnatus (Fabricius). Hopedale, Nain. 11-62 m.

Leana abranchiata (Malmgren). Nain. 16 m.

Trichobranchus glacialis (Malmgren). North Strand, Hopedale, Nain. 7-31 m.

Capitella capitata (Fabricius). Ponsonby Is., Cartwright. 1-16 m.

Nereis pelagica (Linne). Hopedale, Nain. 11-20 m.

Lumbrineris fragilis (Muller). Cartwright, Hopedale,Nain, Conception Bay. 4-96 m.

Lumbrineris impatiens (Claparede). Nain, Conception Bay. 5-11 m.

Phyllodoce spp. (*maculata*(Linne),*mucosa*(Oersted),*arenae*(Webster)). Cartwright, Pack's Harbour, Pottle's Bay, Hopedale, Nain, Conception Bay. 1-16 m.

Eteone longa (Fabricius). North Strand, Cartwright, Pottle's Bay, Pack's Harbour, Ponsonby Is., Nain, Conception Bay. 1-96 m.

Prionospio steenstrupi (Malmgren). North Strand, Cartwright, Pack's Harbour, Hopedale, Nain, Conception Bay. 1-96 m.

Spio filicornis (Muller). Noth Strand, Pottle's Bay, Ponsonby Is., Pack's Harbour, Cartwright, Nain, Conception Bay. 1-31 m.

Ophelia limacina (Rathke). Ponsonby Is., Hopedale, Nain. 3-33 m.

Spirorbis spirillum (Linne). Ponsonby Is., North Strand, Nain. 11-31 m.

Spirorbis granulatus (Linne). Ponsonby Is. 12 m.

Nicomache sp. Nain. 10-90 m.

Praxillella praetermissa (Malmgren). Cartwright, Pottle's Bay, Hopedale, Nain.1-18m.

Rhodine loveni (Malmgren). Cartwright, Nain. 11-50 m.

Eumida sanguinea (Oersted). Nain. 36 m.

Euchone analis (Krøyeri). Cartwright, Pack's Harbour, Pottle's Bay, Hopedale, Nain, Cartwright. 3-18 m.

Chone infundibuliformis (Kroyeri). North Strand, Pack's Harbour, Nain. 6-18 m.

Laonome kröyeri (Malmgren). Cartwright, Pack's Harbour. 4-6 m.

Owenia fusiformis (Delle Chiaje). Nain. 19 m.

Diplocirrus hirsutus (Hansen). Cartwright. 15 m.

Pygospio elegans (Claparede). North Strand. 27 m.

Apistobranchus sp. Conception Bay. 5 m.

Euphrosine sp. Conception Bay. 5 m.

Amphipods:

Gammarus oceanicus (Segerstale). Cartwright, Nain. 1-2 m.

Pontoporeia affinis (Lindstrom). Nain.1-3 m.

Pontoporeia femorata (Krøyer). Hopedale, Nain. 6-8 m.

Arrhis phyllonyx (M.Sars). North Stand. 45 m.

Monoculodes latimanus (Goes). North Strand, Hopedale, Nain. 10-44 m.

Monoculodes borealis (Boeck). Hopedale, Nain. 3-19 m.

Monoculopsis longicornis (Boeck). Nain. 3 m.

Paroediceros lynceus (M.Sars). Hopedale, Nain. 5-19 m.

Unicola irrorata (Say). Ponsonby Is. 16 m.

Ischyrocerus anguipes (Krøyer). Nain. 33m.

Phoxocephalus holbolli (Krøyer). Nain, Conception Bay. 3-19 m.

Caprella septentrionalis (Krøyer). Ponsonby Is. 3 m.

Byblis gaimardi (Krøyer). Cartwright, Nain. 7-18 m.

Byblis sp. Cartwright, Nain. 15-90 m.

Protomedeia fasciata (Krøyer). Pack's Harbour. 4 m.

Protomedeia grandimana (Bruggen). Hopedale, Nain. 3-60 m.

Ampelisca macrocephala (Lilljeborgi). Cartwright. 5 m.

Ampelisca eschrichti (Krøyer). Pottle's Bay, Hopedale, North Strand, Nain. 4-90 m.

Goesia depressa (Goes). Cartwright. 9-15 m.

Oediceros saginatus (Krøyer). Cartwright, Nain. 1 m.

Bathymedon obtusifrons (Hansen). Pack's Harbour, Pottle's Bay, Hopedale, Nain, 4-82 m.

Melita quadrispinosa (Vosseler). North Strand, Hopedale, Nain. 8-15 m.

Melita dentata (Krøyer). North Strand, Hopedale, Nain. 8-15 m.

Melita formosa (Murdoch). North Strand, Hopedale, Pottle's Bay, Nain. 11-60 m.

Stenothoe brevicornis (Sars). Nain. 22 m.

Pontogeneia inermis (Krøyer). Nain, Conception Bay. 5-62 m.

Corophium sp. Hopedale,Nain, Conception Bay. 9-11 m.

Parapleustes sp. Nain. 3-60 m.

Acanthostephia sp. North Strand. 23 m.

Anonyx sarsi (Steele & Brunel). Ponsonby Is., Hopedale, Nain. 3-18 m.

Anonyx lilljeborgi (Boeck). Ponsonby Is., Hopedale, Nain. 3-18 m.

Anonyx ochoticus (Gurjanova). Nain. 19-58 m.

Anonyx nugax (Phipps). Nain. 18 m.

Orchomenella minuta (Krøyer). Ponsonby Is., Nain, Conception Bay. 1-101 m.

Hippomedon propinquus (Sars). Nain. 9-19 m.

Onesimus plautus (Krøyer). Nain. 9-83 m.

Onesimus affinis (Hansen). Ponsonby Is. 11 m.

Onesimus edwardsi (Krøyer). Nain, Ponsonby Is. 3-60 m.

Uristes sp. Nain. 56 m.

Pseudalibrotus littoralis (Krøyer). Nain. 2 m.

Decapods:

Hyas araneus (Linnaeus). Ponsonby Is., Hopedale, Nain. 1-36 m.

Pagurus arcuatus (Squires). North Strand, Pottle's Bay, Ponsonby Is., Nain, 3-18m.

Pagurus pubescens (Krøyer). Nain. 22-56 m.

Cirriped: *Balanus* spp. North Strand, Ponsonby Is., Hopedale, Nain, Pack's Harbour 2-22 m.

Pycnogonida: North Strand, Nain. 19-36 m.

Cumacea:

Diastylis sp. Hopedale, Pack's Harbour, North Strand, Nain, Conception Bay. 4-44m.

Diastylis rathkii (Krøyer). Pottle's Bay, North Strand, Nain. 6-44 m.

Leucon nasicus (Krøyer). Pottle's Bay, Nain. 11-82 m.

Eudorella emarginata (Krøyer). Pottle's Bay, Nain. 6-10 m.

Leptognathia gracialis (Krøyer). North Strand. 27 m.

Ostracoda: Cartwright, Hopedale, North Strand, Nain. 9-60 m.

Insecta: North Strand. 19 m.

Isopoda:

Edotea montosa (Stimpson). Conception Bay. 7-11 m.

Echinodermata:

Echinarachnius parma (Lamarck). Conception Bay. 7 m.

Strongylocentrotus drobachiensis (Muller). Nain, Conception Bay. 1-11 m.

Ophiacantha bidentata (Retzius). Nain. 19-102 m.

Ophiopholis aculeata (Linnaeus). Hopedale, Nain. 7-19 m.

Ophiura robusta (Ayres). Nain. 19-20 m.

Amphiophiura convexa (Lyman). Pottle's Bay, Hopedale, Pack's Harbour, Cartwright, North Strand, Nain. 6-60 m.

Stegophiura stuwitzii (Lutken). North Strand. 19-31 m.

Solaster papposus (Linnaeus). Nain. 19 m.

Leptasterias sp. Nain. 19 m.

Psolus fabricii (Duben & Koren). Nain. 21-56 m.

Psolus phantapus (Strussenfeldt). Nain. 47 m.

Cucumaria frondosa (Gunnerus). Pottle's Bay, Cartwright, Hopedale,Nain. 6-19 m.

Pentamera calcigera (Fabricius). Nain. 9 m.

Chiridota laevis (Fabricius). Pack's Harbour, Hopedale, Nain. 4-13 m.

Porifera:

Lissodendoryx indistincta (Fristedt). Nain. 19 m.

Grantia ciliata (Fabricius). Nain. 62 m.

Ectoprocta: Nain. 19-62 m.

Larvacea: Nain. 102 m.

Ctenophora: Pottle's Bay, North Strand. 10-40 m.

Ascidacea: sp. Cartwright, North Strand, Nain, Conception Bay. 8-60 m.

Pelonaia corrugata (Forbes& Goodsir). Ponsonby Is., Cartwright, Hopedale, Nain, Pack's Harbour. 6-80 m.

Actinaria: Ponsonby Is., Nain. 2-16 m.

Oligochaeta: Cartwright, Nain. 5-50 m.

Nemertea: Nain. 19 m.

Gastropod Molluscs:

Boreotrophon fabricii (Muller). Nain. 46-56 m.

Boreotrophon clathratus (Linne). North Strand. 18 m.

Oenopota bicarinata (Couthouy). Cartwright, Hopedale, North Strand, Nain. 2-19 m.

Oenopota incisula (Verill). Hopedale, Nain. 3-25 m.

Oenopota pyramidalis(Strom). Pack's Harbour, North Strand, Nain. 6-18 m.

Oenopota elegans (Muller). Hopedale, Nain. 4-13 m.

Oenopota turricula (Montagu). North Strand, Nain. 5-40 m.

Oenopota hapularia (Couthouy). Pack's Harbour, Nain. 2-6 m.

Oenopota sp. Hopedale, Nain. 1-11 m.

Buccinum undatum (Linne). Pack's Harbour, Nain. 4-90 m.

Buccinum tenue (Gray). Nain. 15-50 m.

Buccinum sp. Nain. 2m.

Tachyrhynchus reticulatus (Mighels & Adams). Hopedale, Nain. 7-62 m.

Tachyrhynchus erosus (Couthouy). Hopedale, Nain. 3-14 m.

Lunatia pallida (Broderip & Sowerby). Nain. 9-62 m.

Trichotropis borealis (Broderip & Sowerby). Nain. 9-56 m.

Margarites costalis (Gould). North Strand, Hopedale, Nain. 7-50 m.

Margarites olivaceus (Brown). Nain. 60 m.

Margarites helicinus (Phipps). Ponsonby Is. 3 m.

Littorina saxitalis (Olivi). Cartwright, Hopedale, Pack's Harbour. 1-7 m.

Littorina littorea (Linne). Conception Bay. 5 m.

Lacuna vincta (Montagu). Pack's Harbour. 1 m.

Haminoea solitaria (Say). North Strand. 18-40 m.

Cingula arenaria (Mighels & Adams). Hopedale. 11-20 m.

Solariella varicosa (Mighels & Adams). Cartwright. 15 m.

Admete couthouyi (Jay). Pottle's Bay, Nain. 9-10 m.

Cylichna alba (Brown). Pottle's Bay, North Strand, Nain. 11-80 m.

Natica clausa (Broderip & Sowerby). Nain. 15 m.

Hydrobia totteni (Morison). Nain. 10 m.

Diaphana minuta (Brown). Cartwright. 9 m.

Retusa obtusa (Montagu). Pack's Harbour. 6 m.

Philine quadrata (S. Wood). Nain. 10 m.

Philine sp. Cartwright. 15 m.

Pelecypod Molluscs:

Macoma spp. Cartwright, Ponsonby Is., Hopedale, North Strand, Pack's Harbour, Nain, Conception Bay. 1-62 m.

Hiatella arctica (Linne). Ponsonby Is., Hopedale, Nain, Conception Bay. 3-36 m.

Yoldia myalis (Couthouy). North Strand, Pack's Harbour, Hopedale, Nain. 5-60 m.

Nuculana sp. Hopedale, Nain. 11-56 m.

Astarte undata (Dall). Cartwright, Hopedale, North Strand. 5-31 m.

Astarte subequilatera (Sowerby). Cartwright, Hopedale,North Strand, Nain, Conception Bay. 5-62 m.

Astarte borealis (Schumacher). Cartwright, Hopedale,Nain. 5-62 m.

Serripes groenlandicus (Bruguiere). Pack's Harbour, Pottle's Bay, Hopedale, Nain. 6-18 m.

Musculus discors (Linne). Pottle's Bay, Hopedale,Nain. 6-20 m.

Cerastoderma pinnulatum (Conrad). North Strand, Conception Bay. 5-44 m.

Clinocardium ciliatum (Fabricius). Pack's Harbour, Pottle's Bay, Hopedale, Nain. 6-62 m.

Nucula tenuis (Montagu). Hopedale, Nain. 5-82 m.

Mya arenaria (Linne). Pottle's Bay, Hopedale, Nain, Conception Bay. 3-60 m.

Thyasira flexuosa (Montagu). Cartwright, Pack's Harbour, Pottle's Bay, Nain. 5-62 m.

Mytilus edulis (Linne). Pack's Harbour, Pottle's Bay, Ponsonby Is., Conception Bay. 1-62 m.

Crenella glandula (Totten). North Strand, Cartwright, Ponsonby Is., Hopedale, Nain, Conception Bay. 3-31 m.

Turtonia minuta (Dall). Pottle's Bay, North Strand, Pack's Harbour, Hopedale, Nain. 2-36 m.

Cyclocardia borealis (Conrad). North Strand, Nain. 25-56 m.

Lepeta caeca (Muller). Nain. 4-56 m.

Acmaea testudinalis (Muller). Hopedale,Cartwright, Ponsonby Is., Nain. 3-9 m.

Puncturella noachina (Linne). Nain. 22 m.

Polyplacophoran Molluscs:

Tonicella marmorea (Fabricius). Hopedale, Nain. 7-20 m.

Ischnochiton albus (Linne). Hopedale, Nain. 7-56 m.

Tonicella rubra (Linne). Hopedale, Nain. 7-19 m.

Brachiopoda: *Hemithyris psittacea* (Chemnitz). Nain. 13-90 m.

APPENDIX E

TABLES OF QUANTITATIVE DATA FOR BENTHOS FROM EACH SITE WITH SAMPLE INFORMATION.

CW1, CW2: Cartwright (see Fig. 8)

PH: Park's Harbour (see Fig. 9)

NS, PNS: North Strand (see Fig. 10)

SAR2: Shot Islet (see Fig. 16)

PI: Ponsonby Island (see Fig. 11)

PB: Pottle's Bay (see Fig. 12)

HOP: Hopedale (see Fig. 13)

SHR1, SHR2, SHR3: Shipeks from Nain Islands (see Fig. 14)

SAR3:1-22: Meta Cove (see Fig. 15)

SAR3:31-37: Rhodes Island (see Fig. 15)

SAR3:25-30: Hillsbury Island (see Fig. 16)

SAR1:1-7: Siurakuluk Island (see Fig. 17)

SAR1:8-11: East Red Island (see Fig. 17)

CB: Conception Bay (see Fig. 18)

	CW1-1	CW1-2	CW1-3	CW1-4	CW2-1	CW2-2	CW2-3	CW2-4	CW2-5
Pholoe minuta	1	-	2	-	-	-	-	-	-
Pectinaria granulata	-	1	6	-	-	2	-	-	-
Nephtys spp.	3	-	-	-	-	-	-	-	-
Nephtys ciliata	1	-	-	-	-	-	-	-	-
Chaetozone setosa	2	-	3	-	-	-	-	-	-
Eteone longa	-	-	3	1	-	1	3	-	-
Spio filicornis	-	-	-	3	-	-	-	-	-
Fraxillella praetermissa	-	-	1	1	-	-	-	-	-
Ampharete acutifrons	8	-	7	-	-	1	-	-	-
Scoloplos armiger	4	6	8	-	-	2	-	-	-
Travisia forbesaa	-	-	-	-	-	-	1	-	-
Oediceros saginatus	-	-	-	1	-	-	-	-	-
Lumbrineris fragilis	1	-	-	-	-	1	-	-	-
Capitella capitata	-	-	-	-	-	-	-	3	-
Euchone analis	-	-	38	-	-	2	-	-	-
Laonome kroyeri	-	-	13	-	-	15	-	-	-
Terebellides stroemii	12	3	-	-	-	-	-	-	-
Prionscpio steenstrupi	2	-	-	-	-	-	-	-	-
Rhodine loveni	6	-	-	-	-	-	-	-	-
Diplocirrus hirsutus	1	-	-	-	-	-	-	-	-
Phyllodoce sp.	-	-	1	-	-	-	-	-	-
Goniada maculata	1	-	-	-	-	-	-	-	-
Glycera capitata	-	1	-	-	-	-	-	-	-
Oligichaeta	-	-	-	-	1	-	-	-	-
Byblis gaimardi	-	3	-	-	-	-	-	-	-
Byblis spp.	18	-	-	-	-	-	-	-	-
Gammarus oceanicus	-	-	-	-	-	-	-	-	1
Goesia depressa	3	2	-	-	-	-	-	-	-
Ampelisca macrocephala	-	-	1	-	-	-	-	-	-
Leucon nasicus	3	-	-	-	-	-	-	-	-
Cucumaria frondosa	1	2	-	-	-	-	-	-	-
Pelonaia corrugata	3	2	-	-	-	-	-	-	-
Amphiophiura convexa	10	7	-	-	-	-	-	-	-
Ascidacea	2	-	-	-	-	-	-	-	-
Macoma spp.	3	2	7	6	-	-	-	-	-
Astarte borealis	-	-	-	-	5	7	-	-	-
Astunte subequilatera	-	-	5	-	-	-	-	-	-
Mya arenaria	-	-	-	-	-	1	-	-	-
Astarte undata	2	-	1	-	-	-	-	-	-
Thyasira flexuosa	13	11	4	-	-	-	-	-	-
Crenella glandula	1	-	-	-	-	-	-	-	-
Littorina saxitalis	-	-	-	-	-	-	-	-	2
Oenopota bicarinata	-	-	1	-	-	-	-	-	-
Solariella varicosa	1	-	-	-	-	-	-	-	-
Diaphana minuta	-	1	-	-	-	-	-	-	-
Philine sp.	1	-	-	-	-	-	-	-	-
Acmaea testudinalis	-	-	-	-	-	1	-	-	-
Depth (m.)	15	9	5	1	7	5	3	2	1
Number individuals	103	41	101	12	6	33	4	3	3
Number species	25	12	16	5	2	10	2	1	2
Species diversity	3.0	3.8	2.7	1.9	.7	2.2	.8	0	.9
Substrate				FS	MS	MS	MS	G	G
Substrate diversity				1.16	2.06	2.51	1.29	.82	1.14

	PH-1	PH-2	PH-3	PH-4
Pholoe minuta	4	–	13	1
Pectinaria granulata	11	12	33	5
Harmothoe imbricata	–	7	–	2
Ampharete acutifrons	5	–	–	–
Nephtys spp.	4	–	16	–
Nephtys longosetosa	1	–	3	1
Nephtys discors	1	–	–	–
Phyllodoce spp.	–	3	–	1
Scoloplos armiger	13	1	46	–
Terebellides stroemii	2	–	–	–
Eteone longa	3	5	14	1
Prionsopio steenstrupi	1	–	3	–
Spio filicornis	1	–	–	–
Chone infundibuliformis	5	–	–	–
Diplocirrus hirsutus	35	–	–	–
Laonome kroyeri	3	–	1	–
Balanus sp.	–	3	–	–
Bathymedon obtusifrons	–	–	10	–
Protomedeia fasciata	–	–	21	–
Amphiophiura convexa	3	–	–	–
Pelonaia corrugata	6	1	–	–
Chiridota laevis	1	–	–	–
Diastylis sp.	–	–	1	–
Oenopota pyramidalis	2	–	–	–
Oenopota harpularia	1	–	–	–
Buccinum undatum	–	–	1	–
Lacuna vincta	–	2	–	–
Retusa obtusa	5	–	–	–
Littorina saxitalis	–	26	–	–
Macoma spp.	19	–	19	–
Clinocardium ciliatum	1	–	–	–
Serripes groenlandicus	3	–	–	–
Thyasira flexuosa	7	–	–	–
Turtonia minuta	3	–	–	–
Crenella faba	–	–	1	–
Yoldia myalis	3	–	–	–
Mytilus edulis	–	66	–	18
Depth (m.)	7	1	4	7
Number individuals	162	129	182	29
Number species	28	11	14	7
Species diversity	4.0	2.6	3.1	1.7
Substrate	VFS	FS	VFS	FS
Substrate diversity	2.08	2.09	2.31	2.61

	NS1-2	NS1-25	NS1-26	NS1-27	NS1-29	NS1-30	NS1-31	NS1-32	NS1-33	NS1-34	NS1-73	NS1-75	NS1-76	NS1-77	NS1-79	NS1-87	NS1-88	NS1-89	NS1-90	NS1-91	NS1-92	NS1-104	NS1-105	NS1-106	NS1-107	NS1-108
Pholoe minuta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Nereimyra punctata	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
Harmothoe imbricata	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-
Harmothoe extenuata	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetozone setosa	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scoloplos armiger	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Nephtys longosetosa	1	-	1	-	1	-	2	1	1	3	-	1	-	1	-	-	-	-	-	1	3	1	1	-	-	2
Nephtys caeca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Travisia forbesii	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eteone longa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2
Prionospio steenstrupi	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spio filicornis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2
Pygospio elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Spirorbis spirillum	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	8	-	-	-	-	-	-	-	-
Euchone analis	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chone infundibuliformis	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-
Arrhis phyllonyx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Ampelisca eschrichti	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Protomedeia grandimana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Melita dentata	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Melita formosa	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Melita quadrispinosa	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monoculodes latimanus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Orchomenella minuta	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Diastylis rathkii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
Diastylis sp.	2	-	-	1	-	1	3	3	6	5	-	5	-	4	-	1	1	-	6	9	10	-	1	4	16	2
Leptognathia glacialis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Stegophiura stuwitzii	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-	-	-	8	1	6	-	-	-	-	2
Amphiophiura convexa	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	-	3	2	1	1	-
Pycnogonida	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Balanus sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	7	-	-	-	-	-	-	-	-	-	-	-
Ostracoda	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
Ascidacea	-	-	-	-	-	-	1	1	3	-	-	1	-	2	-	-	-	-	-	2	-	-	1	3	-	-
Boreotrophon clathratus	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Oenopota pyramidalis	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Oenopota bicarinata	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Oenopota turricula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Margarites costalis	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-
Haminoea solitaria	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-
Cylichna alba	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macoma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yoldia hyalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Astarte undata	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Cerastoderma pinnulatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astarte subequilatera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Turtonia minuta	-	2	-	-	-	-	-	6	-	-	-	1	-	2	-	-	-	-	-	3	7	-	-	5	-	4
Crenella glandula	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyclocardia borealis	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Trichobranchus glacialis	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-
Depth (m.)	24	18	27	27	25	25	19	21	25	26	33	31	33	13	23	44	33	31	31	27	19	45	39	32	31	26
Number individuals	3	6	3	1	3	1	7	12	13	10	2	12	31	21	12	1	2	17	14	21	28	7	8	14	21	13
Number species	2	4	3	1	3	1	4	5	4	3	2	7	12	8	5	1	2	7	2	10	5	5	7	5	6	6
Species diversity	.9	1.4	1.6	0	1.6	o	2.1	1.9	1.8	1.7	1.0	2.3	2.5	2.2	1.8	0	1.0	2.3	1.0	2.7	2.4	2.1	2.9	2.1	1.3	2.5
Substrate	FS	FS	MS	S	MS	MS	FS	FS	FS	MS	CS	MS	FS	FS		MS	MS		FS	FS	FS	FS	FS	FS	FS	FS
Substrate diversity	196	163	194	260	264	202	119	143	137	154	.50	166	220	141		202	211		152	152	171	149	188	161	192	155

	PNS-5	PNS-6	PNS-7	PNS-8
Nephtys longosetosa	–	1	–	–
Scoloplos armiger	–	–	–	1
Anonyx sarsi	–	–	–	1
Pagurus arcuatus	–	1	–	1
Ascidacea	–	3	–	8
Depth (m.)	5	8	13	13
Number individuals	0	5	0	12
Number species	0	3	0	5
Species diversity	0	1.4	0	1.5
Substrate	MS	FS	CS	FS
Substrate diversity	1.46	.96	1.58	.95

	SAR2-1	SAR2-2
Glycera capitata	4	1
Trichobranchus glacialis	1	–
Spio filicornis	1	–
Ophelia limacina	1	–
Pelonaia corrugata	1	1
Oenopota bicarinata	1	–
Astarte borealis	–	1
Crenella glandula	1	–
Hemithyris psittacea	–	1
Tonicella rubra	–	1
Depth (m.)	10	13
Number individuals	10	5
Number species	7	5
Species diversity	2.5	2.3
Substrate	G	G
Substrate diversity	–	–

	PI-1	PI-2	PI-3	PI-4
Naineris quadricuspida	-	-	-	1
Nereimyra punctata	1	-	-	-
Pectinaria granulata	3	-	6	-
Harmothoe imbricata	-	-	1	20
Chaetozone setosa	-	1	-	-
Nephtys longosetosa	-	1	-	-
Eteone longa	-	2	-	-
Capitella capitata	1	-	-	24
Ophelia limacina	1	2	-	-
Spirorbis spirillum	-	-	120	-
Spirorbis granulatum	-	-	1	-
Phyllodoce spp.	-	-	-	35
Spio filicornis	-	1	-	-
Unicola irrorata	26	-	-	-
Orchomenella minuta	-	1	-	-
Anonyx sarsi	8	-	-	-
Onesimus edwardsi	15	-	-	-
Onesimus affinis	-	-	1	-
Caprella septentrionalis	-	-	-	7
Pagurus arcuatus	1	-	1	2
Hyas araneus	-	-	-	1
Pelonaia corrugata	-	2	-	-
Macoma sp.	-	1	-	-
Margarites helicinus	-	-	-	7
Mytilus edulis	-	-	-	20
Crenella glandula	-	-	-	7
Hiatella arctica	-	-	-	3
Acmaea testudinalis	-	-	-	1
Depth (m.)	16	14	11	4
Number individuals	56	11	130	128
Number species	8	8	6	12
Species diversity	2.6	3.1	.6	2.9

	PB-1	PB-2	PB-3	PB-4	PB-5	PB-6
Pholoe minuta	9	-	-	-	-	2
Pectinaria granulata	10	40	18	8	-	2
Pectinaria hyperborea	27	-	-	-	4	-
Nephtys spp.	17	-	-	-	-	6
Nephtys ciliata	3	2	1	-	2	1
Nephtys longosetosa	1	-	2	-	-	-
Eteone longa	-	-	1	2	-	1
Chaetozone setosa	-	1	-	9	-	-
Scoloplos armiger	6	2	-	-	4	2
Salibregma inflatum	-	-	-	-	1	1
Terebellides stroemii	-	-	-	-	1	2
Spio filicornis	-	1	-	-	-	-
Harmothoe imbricata	-	-	-	1	-	-
Praxillella praetermissa	-	-	-	-	1	1
Euchone analis	6	-	-	-	-	1
Phyllodoce sp.	1	-	-	-	-	-
Bathymedon obtusifrons	-	-	-	-	-	2
Melita dentata	-	-	-	-	-	1
Melita formosa	-	-	-	-	2	-
Ampelisca macrocephala	-	-	-	-	1	-
Anonyx liljeborgi	-	-	-	-	1	-
Ampelisca eschrichti	-	-	-	-	-	1
Diastylis rathkii	-	-	-	-	-	2
Leucon nasicus	-	-	-	-	1	-
Pagurus arcuatus	-	-	-	-	-	1
Eudorella emarginata	-	-	-	-	-	2
Cucumaria frondosa	1	-	-	-	2	1
Amphiophiura convexa	-	-	-	-	1	-
Admete couthoyi	-	-	-	-	-	1
Thyasira flexuosa	-	-	-	-	1	-
Mytilus edulis	-	-	-	32	-	-
Serripes groenlandicus	-	-	-	-	1	1
Cylichna alba	-	-	-	-	1	-
Crenella faba	-	-	-	-	-	3
Macoma spp.	20	-	-	4	4	6
Musculus discors	1	-	-	-	1	-
Mya arenaria	2	1	-	-	-	-
Clinocardium ciliatum	-	-	-	-	1	1
Turtonia minuta	-	-	1	-	-	-
Depth (m.)	7	3	3	2	12	10
Number individuals	104	47	23	56	30	43
Number species	13	6	5	6	18	22
Species diversity	3.1	1.1	1.2	2.2	3.8	4.3

	HOP-1	HOP-2	HOP-3	HOP-4	HOP-5	HOP-6	HOP-7	HOP-8	HOP-9
Pholoe minuta	-	1	1	2	1	9	3	2	2
Nereimyra punctata	2	-	1	-	-	-	-	-	-
Pectinaria granulata	-	1	-	1	-	2	5	2	4
Harmothoe imbricata	1	-	4	-	3	-	1	2	1
Harmothoe extenuata	-	-	2	-	-	-	-	-	-
Gattyana cirrosa	-	2	1	-	-	-	-	-	-
Nephtys longosetosa	-	-	-	-	-	-	8	3	-
Nephtys spp.	2	1	1	1	-	8	-	-	2
Nephtys caeca	-	-	-	-	-	-	-	-	3
Nephtys ciliata	1	1	1	-	-	-	-	-	-
Phyllodoce sp.	1	-	-	-	-	-	-	-	-
Scoloplos armiger	1	-	6	3	5	6	3	1	-
Lumbrineris fragilis	-	1	2	-	5	-	-	1	-
Prionsopio steenstrupi	1	-	1	-	-	7	6	-	5
Ampharete acutifrons	-	-	-	-	-	1	-	-	-
Thelepus cincinnatus	-	-	1	-	-	-	-	-	-
Nereis pelagica	-	-	1	-	-	-	-	-	-
Praxillella praetermissa	-	1	-	-	-	-	-	1	-
Euchone analis	-	1	-	-	-	-	-	-	1
Chaetozone setosa	1	-	-	-	-	-	-	-	-
Pontoporeia femorata	-	-	-	-	-	-	-	2	-
Bathymedon obtusifrons	-	-	-	1	3	-	-	-	-
Paroediceros lynceus	-	-	-	-	1	-	-	-	-
Pontoporeia affinis	-	-	-	-	-	-	-	-	6
Protomedeia grandimana	1	1	-	3	10	12	-	1	1
Monoculodes latimanus	1	-	-	-	-	-	-	-	-
Melita quadrispinosa	-	-	34	-	3	-	-	22	-
Melita dentata	-	1	-	-	1	-	-	1	4
Melita formosa	1	-	-	-	-	-	-	-	-
Anonyx sarsi	-	1	-	2	1	-	-	-	-
Corophium sp.	-	1	-	1	-	-	-	-	-
Diastylis sp.	-	-	-	-	2	-	-	-	-
Pagurus arcuatus	-	-	-	-	-	-	-	-	1
Balanus sp.	-	-	-	-	-	1	-	-	1
Ostracoda	-	5	-	-	2	-	-	-	-
Cucumaria frondosa	-	1	-	-	-	-	-	1	-
Stongylocentrotus drobachiensis	1	1	-	-	-	-	-	-	-
Amphiophiura convexa	-	-	-	-	1	1	-	-	-
Pelonaia corrugata	-	-	-	-	1	1	-	-	-
Chiridota laevis	-	-	1	-	-	-	-	-	-
Oenopota bicarinata	-	-	-	-	1	-	4	-	2
Oenopota sp.	-	2	-	-	-	-	-	-	-
Oenopota elegans	-	-	-	-	-	-	-	1	-
Oenopota incisula	1	1	-	-	-	-	-	-	-
Cingula arenaria	1	-	2	-	-	-	-	-	-
Hiatella arctica	-	-	3	-	-	-	-	-	-
Crenella glandula	1	1	-	-	-	-	-	-	-
Crenella faba	-	-	-	-	-	-	1	-	-
Tachyrhynchus erosus	-	2	-	-	-	-	-	-	-
Tachyrhynchus reticulatus	4	2	2	-	1	-	2	2	-
Trichotropis baorealis	-	-	-	1	-	-	-	-	-
Serripes groenlandicus	-	4	-	-	-	1	-	-	-
Mya arenaria	-	1	-	-	-	-	-	-	-
Macoma spp.	3	2	5	-	-	2	1	-	-
Yoldia myalis	-	1	1	-	1	-	-	-	-
Clinocardium ciliatum	1	1	-	-	-	-	-	-	-
Astarte subequilatera	-	2	-	-	-	-	-	-	-
Turtonia minuta	-	2	-	-	-	-	-	-	-
Nucula tenuis	-	-	-	-	-	-	1	-	-
Nuculana sp.	-	1	1	-	-	-	-	-	-
Tonicella marmorea	1	-	-	-	-	-	-	-	-
Tonicella rubra	-	-	4	-	-	-	-	-	-
Margarites costalis	2	-	-	-	-	-	-	-	-
Ampelisca eschrichti	-	-	-	1	1	1	-	-	1
Monoculodes borealis	-	2	-	2	-	-	-	-	-
Depth (m.)	20	11	12	11	15	15	11	8	8
Number individuals	28	48	74	18	43	52	35	50	34
Number species	20	29	20	11	18	13	11	14	14
Species diversity	4.4	4.5	3.1	2.8	3.9	3.0	3.2	2.8	3.6
Substrate	FSG	FSG	SG	FS	FS	FS	FS	FSG	FSG
Substrate diversity	260	257	213	255	219	228	231	235	263

	HOP-14	HOP-15	HOP-16	HOP-17	HOP-18	HOP-19	HOP-20	HOP-21
Pholoe minuta	4	–	1	–	–	–	–	2
Nereimyra punctata	–	–	6	–	5	–	30	6
Pectinaria granulata	2	8	13	3	8	–	7	1
Harmothoe extenuata	–	–	–	1	–	–	–	–
Harmothoe imbricata	–	–	1	7	–	3	6	4
Gattayana cirrosa	–	–	–	–	–	–	–	1
Glycera capitata	–	–	–	–	1	–	–	–
Nephtys discors	–	1	–	–	–	–	–	2
Nephtys sp.	1	1	–	–	–	–	–	–
Nephtys ciliata	1	–	2	–	2	–	1	–
Nephtys caeca	1	–	–	–	–	–	–	–
Scoloplos armiger	–	3	–	1	–	6	–	–
Lumbrineris fragilis	–	–	–	1	–	2	1	–
Terebellides stroemii	–	–	–	3	1	2	–	–
Ophelia limacina	4	–	4	–	6	–	–	–
Praxillella praetermissa	–	3	–	–	3	–	–	–
Euchone analis	16	–	–	–	1	–	–	–
Trichobranchus glacialis	–	–	–	–	–	1	–	–
Polycirrus medusa	–	–	–	1	–	1	–	–
Pontoporeia femorata	–	1	–	–	–	2	–	–
Protomedeia grandimana	37	–	–	–	2	–	–	–
Melita dentata	–	1	–	–	–	–	–	–
Phoxocephalus holbolli	2	–	–	–	–	–	–	–
Hyas araneus	–	–	–	3	–	2	–	–
Pelonaia corrugata	–	–	–	–	1	–	3	–
Ophiopholis aculeata	–	–	–	1	–	–	–	–
Tachyrhynchus reticulatus	–	–	–	1	–	–	–	–
Margarites costalis	–	–	–	1	–	–	–	–
Littorina saxitalis	–	–	–	1	–	–	–	–
Macoma spp.	1	–	–	3	–	7	1	–
Yoldia myalis	1	–	4	1	1	–	1	–
Hiatella arctica	–	–	–	2	–	–	–	–
Astarte borealis	–	–	46	–	28	–	2	–
Astarte undata	–	–	1	–	–	–	–	–
Crenella glandula	1	–	1	–	–	–	–	–
Crenella faba	1	–	–	–	–	–	–	–
Mya arenaria	–	–	–	–	1	–	–	–
Musculus discors	–	–	–	3	–	–	–	–
Thyasira flexuosa	–	–	1	–	1	–	–	–
Cerastoderma pinnulatum	–	1	–	–	–	–	–	–
Tonicella rubra	–	–	–	3	–	–	–	–
Tonicella marmorea	–	–	–	–	–	–	–	4
Ischnochiton albus	–	–	–	–	–	–	–	2
Acmaea testudinalis	–	–	–	–	–	–	–	1
Depth (m.)	5	7	7	7	7	7	7	7
Number individuals	72	19	80	36	63	26	52	23
Number species	13	8	11	17	14	9	9	9
Species diversity	2.1	2.2	1.7	3.8	2.8	2.8	2.2	2.7
Substrate	CS	SG	G		G	SG	G	G
Substrate diversity	2.03	2.76	1.05		1.89	2.72	1.58	1.65

	SHR3-29	SHR3-32	SHR3-35	SHR3-37	SHR1-45	SHR1-54	SHR1-55	SHR1-56	SHR1-57	SHR1-60
Nereimyra punctata	-	-	-	-	-	-	-	-	-	1
Pectinaria granulata	-	-	-	-	1	-	-	-	-	-
Harmothoe imbricata	-	-	-	3	1	-	-	-	-	-
Harmothoe extenuata	-	-	8	-	-	-	1	-	-	-
Glycera capitata	-	-	-	3	-	-	-	-	-	-
Gattayana cirrosa	-	-	-	-	1	1	-	-	1	1
Nephtys ciliata	1	-	-	-	1	-	-	1	-	-
Nephtys paradoxa	1	-	-	-	-	-	-	-	-	-
Thelepus cincinnatus	-	-	13	4	4	6	-	-	-	-
Eteone longa	-	-	-	-	-	-	-	-	1	-
Lumbrineris fragilis	-	-	-	-	-	1	-	1	1	1
Nereis pelagica	-	-	1	-	-	-	-	-	-	-
Ophelia limacina	-	-	-	1	-	-	-	-	-	-
Nicomache sp.	2	-	-	-	-	-	-	-	-	-
Flabelligera affinis	1	-	-	-	-	-	-	-	-	-
Eumida sanguinea	-	-	-	1	-	-	-	-	-	-
Rhodine loveni	-	-	-	-	-	-	1	-	-	2
Byblis spp.	1	-	-	-	-	1	-	-	1	-
Ampelisca eschrichti	1	-	-	-	-	1	-	-	-	-
Melita dentata	-	-	-	-	-	-	-	1	-	-
Pontogeneia inermis	-	-	-	-	1	-	-	-	-	-
Hyas araneus	-	-	-	1	-	-	-	-	-	-
Balanus spp.	17	-	-	7	10	-	27	20	6	-
Pycnogonida	-	-	-	1	-	-	-	-	-	-
Strongylocentrotus drobachiensis	-	-	1	-	-	-	-	-	-	-
Ophiacantha bidentata	1	2	8	-	-	1	-	-	-	-
Ophiopholis aculeata	-	-	5	-	-	-	-	-	-	-
Ophiura robusta	-	-	3	-	-	-	-	-	-	-
Amphiura sundervalli	-	-	-	-	-	-	1	-	-	-
Solaster papposus	-	-	1	-	-	-	-	-	-	-
Lepasterias sp.	-	-	1	-	-	-	-	-	-	-
Lissodendoryx indistincta	-	-	1	-	-	-	-	-	-	-
Pelonaia corrugata	-	-	-	3	-	-	1	-	-	-
Grantia ciliata	-	-	-	-	1	-	-	-	-	-
Psolus phantapus	-	-	-	-	-	1	-	-	-	-
Larvacea	-	1	-	-	-	-	-	-	-	-
Ectoprocta	-	-	1	-	1	3	-	1	-	-
Oligochaeta	-	-	1	-	-	-	1	-	-	-
Hemithyris psittacea	3	1	-	-	-	-	-	-	-	-
Buccinum undatum	1	-	-	-	-	-	-	-	-	-
Buccinum tenue	-	-	-	-	-	-	-	-	1	-
Hiatella arctica	-	-	1	1	-	-	-	-	-	-
Margarites costalis	-	-	-	1	-	-	-	1	-	-
Lepeta caeca	-	-	-	-	-	1	5	-	-	-
Cyclocardia borealis	-	-	-	-	6	-	-	-	-	2
Nuculana sp.	-	-	-	-	-	2	-	2	1	-
Crenella faba	-	-	-	-	-	1	-	-	-	-
Boreotrophon fabricii	-	-	-	-	-	1	-	-	-	-
Nucula tenuis	-	-	-	-	-	-	1	1	2	-
Astarte undata	-	1	-	-	-	-	-	-	-	-
Astarte subequilatera	-	-	-	-	1	-	-	-	-	-
Astarte borealis	-	-	-	1	2	-	-	-	-	-
Macoma sp.	-	-	-	-	1	-	-	-	-	-
Thyasira flexuosa	-	-	-	-	1	-	-	-	-	-
Musculus discors	-	-	-	-	-	-	-	-	-	-
Tachyrhynchus reticulatus	-	-	-	-	2	1	-	-	2	-
Lunatia pallida	-	-	-	-	1	-	-	-	-	-
Clinocardium ciliatum	-	-	-	-	1	-	-	1	1	-
Tonicella rubra	-	-	2	-	-	-	-	-	-	-
Ischnochiton albus	-	-	1	-	-	-	-	-	-	-
Depth (m.)	90	102	19	36	62	48	50	50	50	42
Number individuals	29	5	52	27	37	21	40	29	18	7
Number species	10	4	15	12	17	13	9	9	10	5
Species diversity	2.0	1.9	3.2	3.1	3.5	3.5	2.3	1.8	2.6	2.0
Substrate	-	FS	FSG	MSG	SG	SG	-	-	-	SG
Substrate diversity	-	2.27	2.60	2.29	1.66	2.22	-	-	-	1.93

	SHR2-44	SHR2-46	SHR2-48	SHR2-49	SHR2-55	SHR2-56	SHR2-59	SHR2-60
Harmothoe extenuata	2	-	-	-	-	-	2	-
Ampharete acutifrons	-	-	-	-	1	-	-	-
Nephtys sp.	-	-	-	-	2	-	-	-
Nephtys ciliata	1	1	1	1	-	1	-	1
Scoloplos armiger	1	-	-	-	-	-	-	-
Terebellides stroemii	-	1	-	-	-	-	-	-
Scalibregma inflatum	-	-	-	-	2	-	-	-
Thelepus cincinnatus	1	-	-	-	-	-	-	-
Lumbrineris fragilis	4	-	-	1	-	1	-	-
Nereis pelagica	-	-	-	-	-	-	1	-
Spirorbis spirillum	-	-	-	-	-	-	-	13
Byblis spp.	-	-	12	39	26	2	-	-
Ampelisca eschrichti	-	-	-	2	-	3	-	-
Protomedeia grandimana	-	-	-	-	1	-	-	-
Bathymedon obtusifrons	-	-	2	-	-	-	-	1
Melita formosa	-	-	-	-	-	1	-	-
Pontogeneia inermis	-	-	-	-	-	-	-	4
Stenothoe brevicornis	-	-	-	-	-	-	-	1
Monoculodes latimanus	-	-	-	-	-	-	-	1
Anonyx ochoticus	-	1	-	-	-	-	-	-
Parapleustes sp.	-	-	-	-	1	-	-	-
Orchomenella minuta	-	-	-	1	-	-	-	-
Onesimus plautus	-	-	1	-	-	-	-	-
Onesimus edwardsi	-	-	-	-	2	-	-	-
Tristes sp.	-	1	-	-	-	-	-	-
Ischyrocerus anguipes	-	-	-	-	-	-	-	10
Hyas araneus	-	-	-	-	-	-	1	-
Pagurus pubescens	1	-	-	-	-	-	-	1
Balanus spp.	32	-	-	-	-	-	-	10
Ostracoda	-	-	-	-	1	-	-	-
Strongylocentrotus drobachiensis	-	-	-	-	-	-	1	-
Ophiacantha bidentata	-	-	-	1	1	-	-	-
Pectinaria granulata	1	-	-	-	-	-	-	-
Ophiura robusta	-	-	-	-	-	-	1	-
Amphiophiura convexa	-	-	-	-	3	-	-	-
Pelonaia corrugata	1	-	2	1	1	1	-	-
Psolus fabricii	-	1	-	-	-	-	-	1
Ascidacea	-	-	-	-	1	-	-	-
Hemithyris psittacea	1	2	-	-	-	-	-	-
Margarites olivaceus	-	-	-	-	-	1	-	-
Lepeta caeca	2	1	-	-	-	-	-	-
Trichotropis borealis	1	1	-	-	-	-	-	-
Cyclocardia borealis	5	1	-	-	-	-	-	-
Nuculana sp.	1	-	-	-	-	-	-	-
Crenella faba	1	-	-	-	-	-	-	-
Boreotrophon fabricii	-	1	-	-	-	-	-	-
Cylichna alba	-	-	1	-	1	-	-	-
Oenopota incisula	-	-	1	-	-	-	-	-
Nucula tenuis	-	-	2	-	1	1	-	-
Astarte subequilatera	-	2	-	-	-	1	-	-
Yoldia myalis	-	-	-	-	1	-	-	-
Mya arenaria	-	-	-	-	-	1	-	-
Macoma sp.	-	-	-	-	1	-	1	1
Thyasira flexuosa	-	-	-	-	-	4	1	-
Musculus discors	-	-	-	-	-	-	1	-
Puncturella noachina	-	-	-	-	-	-	-	1
Ischnochiton albus	-	1	-	-	-	-	-	-
Depth (m.)	56	56	83	83	60	60	20	22
Number individuals	55	14	22	46	48	19	9	45
Number species	15	12	8	7	17	11	8	12
Species diversity	2,2	3,8	2,5	1,0	2,8	3,2	2,9	2,9
Substrate	S	S	VFS	VFS	VFS	VFS	S,G	S,G
Substrate diversity	2,59	2,59	1,70	1,70	1,78	1,78	2,33	2,33

	SAR3-1	SAR3-2	SAR3-3	SAR3-4	SAR3-6	SAR3-7	SAR3-8	SAR3-9	SAR3-10	SAR3-11	SAR3-12	SAR3-13	SAR3-14	SAR3-15	SAR3-16	SAR3-17	SAR3-18	SAR3-19	SAR3-20	SAR3-21	SAR3-22
Nereimyra punctata	2																				
Pectinaria granulata	1	1	20		10	1	8	7		1		1	2						2		
Pectinaria hyperborea											1										
Harmothoe imbricata	2												1	1		1					
Harmothoe extenuata														1							
Gattayana cirrosa																			1		
Goniada maculata																		1			
Chaetozone setosa	1	4	1						3		1	8			1		1	2	2		
Pholoe minuta		8							9	2	10	18	4			2	5	1	1		
Nephtys spp.		20			1				7	1	11	21	4	13	7	3	3	2	1		2
Nephtys ciliata										1	1		1	1				2			
Nephtys caeca					4			3	3	2											
Nephtys longosetosa		1	1				1														
Scoloplos armiger	10										2	3	1	7	6	9	3	1	5	5	
Terebellides stroemii														1	1					1	
Nicolea venustula											1				1						
Polycirrus medusa																	2				
Trichobranchus glacialis													1			1					
Lumbrineris fragilis	2	1							2			1		3	2	4	2	2	1	3	2
Phyllodoce sp.	1													2							
Eteone longa	1		1				1		1				2	1	2				1		
Spio filicornis			4				24														
Prionospio steenstrupi						12			61	3	75	269	32	37	16	8	12	3	3	3	4
Praxillella praetermissa													1			1	3				
Leana abranchiata	1																				
Pseudalibrotus littoralis				3																	
Pontoporeia affinis			6	29		2															
Pontoporeia femorata		1									2										
Monoculodes latimanus															1						
Paroediceros propinquis													1								
Paroediceros lynceus														1	1						
Protomedeia grandimana	2								3	2	13	18	13	40	4		8	13	12	3	6
Ampelisca eschrichti									1			1	1	6	1		1	4			
Bathymedon obtusifrons									1		1	2	2	2							
Melita quadrispinosa													1					1			
Melita dentata													1	4	3		1	5			
Melita formosa																				2	
Anonyx sarsi																		1	1		
Anonyx liljeborgi										1											
Byblis gaimardi	1																				
Gammarus oceanicus				15																	
Orchomenella minuta				3								1									1
Balanus spp.	4												1	4		6	6	1			
Diastylis rathkii												1									1
Eudorella emarginata											1										
Pagurus arcuatus									1	1											
Amphiophiura convexa																			1		
Pelonaia corrugata																		1		1	
Ascidacea																		1			
Chiridota laevis									1	2		1									
Oenopota elegans					1																
Oenopota bicarinata						1												1			
Oenopota hyperborea						1															
Oenopota sp.			1																		
Buccinum tenue																		2			
Buccinum undatum							1					1									
Margarites costalis													1				1	1			
Tachyrhynchus erosus						1															
Natica clausa																		1			
Nucula tenuis	1																				
Nuculana sp.																		1			
Macoma sp.	1		1											1		1	1	1	1		2
Astarte borealis																		1	1		2
Serripes groenlandica											1	1	1		3				2	1	
Musculus discors													1								
Crenella faba																			1		
Mya arenaria																			1		
Depth (m.)	17	6	2	2	4	3	3	4	4	4	7	7	9	10	11	11	11	15	16	17	17
Number individuals	30	36	35	48	16	18	35	10	93	16	120	347	72	132	49	37	49	49	37	19	20
Number species	14	7	8	4	4	6	5	2	12	10	13	15	20	18	14	11	14	23	17	8	8
Species diversity	3.2	1.9	2.0	1.3	1.4	1.7	1.3	.9	1.9	3.4	2.0	1.4	3.0	2.8	3.1	3.0	3.3	3.8	3.4	2.8	2.8
Substrate	SG	VFS	FS	FS	FS	FS	MS	FS	FS	VFS	FS	VFS	FS	VFS	FS	VFS	FS	VFS	VFS	VFS	FS
Substrate diversity	231	236	262	275	277	230	237	235	235	262	245	229	272	272	269	272	247	267	265	269	274

	SAR3-31	SAR3-32	SAR3-33	SAR3-34	SAR3-35	SAR3-36	SAR3-37
Pholoe minuta	2	32	15	4	11	6	-
Nereimyra punctata	-	-	-	5	-	-	-
Pectinaria granulata	-	-	-	11	-	4	-
Pectinaria hyperborea	-	-	2	2	-	-	-
Harmothoe imbricata	-	1	-	5	2	6	-
Gattyana cirrosa	-	-	-	1	-	-	-
Nephtys spp.	6	17	19	1	4	2	-
Nephtys discors	1	-	-	-	-	-	-
Nephtys ciliata	-	-	-	1	-	-	
Ampharete arctica	-	-	-	-	1	-	-
Eteone longa	-	-	-	-	-	-	1
Scoloplos armiger	-	-	-	1	-	-	-
Lumbrineris fragilis	1	-	1	-	-	1	-
Prionsopio steenstrupi	12	21	35	2	17	3	-
Spio filicornis	-	-	-	-	-	1	1
Praxillella praetermissa	-	1	-	-	-	-	-
Euchone analis	-	-	-	1	-	-	-
Phyllodoce sp	-	-	-	1	-	-	-
Nicolea venustula	-	-	1	1	-	-	-
Polycirrus medusa	-	-	-	3	-	-	-
Anonyx liljeborgi	-	-	-	-	1	-	-
Anonyx sarsi	-	2	-	-	2	-	-
Protomedeia grandimana	17	21	24	4	22	3	-
Monoculodes borealis	-	2	-	-	-	-	-
Ampelisca eschrichti	2	6	5	12	5	4	-
Melita dentata	-	-	-	-	-	4	-
Orchomenella minuta	-	1	2	-	-	-	3
Bathymedon obtusifrons	-	1	4	-	5	-	-
Onesimus plautus	-	-	1	2	-	-	-
Onesimus edwardsi	-	-	-	-	4	-	-
Corophium sp.	-	1	-	-	1	-	-
Pagurus sp.	1	-	-	-	-	-	-
Balanus spp.	-	-	1	19	-	22	-
Ostracoda	3	4	1	-	-	-	-
Amphiophiura convexa	-	1	-	-	-	-	-
Pelonaia corrugata	-	-	2	-	-	-	-
Cucumaria frondosa	-	2	1	-	-	-	-
Pentamera calcigera	-	-	-	-	-	1	-
Oenopota bicarinata	-	3	1	-	-	-	-
Oenopota pyramidalis	-	-	-	-	1	-	-
Oenopota elegans	-	1	-	-	-	-	-
Oenopota sp.	-	-	1	1	-	-	-
Oenopota incisula	1	-	-	-	-	-	-
Buccinum undatum	-	-	-	1	-	1	-
Tachyrhynchus erosus	-	-	-	2	-	-	-
Tachyrhynchus reticulatus	1	-	-	1	-	-	-
Trichotropis borealis	-	2	-	3	1	1	-
Admete couthouyi	-	-	1	-	-	-	-
Macoma spp.	-	1	1	2	-	-	-
Crenella glandula	-	-	1	-	-	-	-
Clinocardium ciliatum	-	-	-	-	1	1	-
Astarte borealis	-	2	-	3	-	1	-
Serripes groenlandicus	1	-	1	-	-	-	-
Yoldia myalis	-	-	-	1	-	1	-
Hiatella arctica	-	-	-	1	-	-	-
Lunatia pallida	-	-	-	1	-	-	-
Tonicella rubra	-	-	-	1	-	-	-
Tonicella marmorea	-	-	-	3	-	-	-
Acmaea testudinalis	-	-	-	4	-	2	-
Depth (m.)	9	9	9	9	9	9	1
Number individuals	48	122	119	97	78	63	5
Number species	12	20	21	31	15	17	3
Species diversity	2.6	3.7	3.1	3.9	3.1	3.3	1.4
Substrate	FS	FS	FS	FS,G	FS	FS,G	FS
Substrate diversity	2.29	2.29	2.36	1.24	2.09	1.72	2.69

	SAR3-25	SAR3-26	SAR3-27	SAR3-28	SAR3-29	SAR3-30
Pholoe minuta	-	-	5	14	1	-
Pectinaria granulata	3	10	1	2	7	6
Pectinaria hyperborea	-	-	-	-	-	1
Harmothoe imbricata	1	-	2	-	-	-
Nereimyra punctata	-	-	1	-	-	-
Nephtys ciliata	-	-	-	-	-	1
Nephtys caeca	-	3	-	1	-	4
Nephtys longosetosa	2	-	-	-	1	-
Nephtus spp.	-	-	19	6	-	-
Ophelia limacina	-	-	-	-	22	-
Phyllodoce spp.	-	-	2	1	1	-
Scoloplos armiger	1	-	8	4	-	-
Lumbrineris fragilis	1	-	-	2	-	-
Prionsopio steenstrupi	1	2	10	8	-	-
Spio filicornis	1	-	2	-	12	1
Praxillella praetermissa	3	1	3	4	-	-
Chone infundibuliformis	-	-	-	1	-	-
Rhodine loveni	-	-	1	-	-	-
Orchomenella minuta	-	-	3	-	2	-
Phoxocephalus holbolli	-	3	1	-	15	6
Monoculopsis longicornis	-	-	-	-	2	-
Protomedeia grandimana	2	2	48	13	22	2
Byblis gaimardi	-	1	-	-	-	-
Monoculodes borealis	-	-	-	-	2	2
Ampelisca eschrichti	5	1	-	3	-	-
Pontogeneia inermis	-	-	-	-	-	1
Bathymedon obtusifrons	1	-	-	-	-	-
Onesimus edwardsi	-	-	3	-	3	3
Paroediceros lynceus	-	-	-	-	-	2
Anonyx sasri	2	-	2	-	1	1
Anonyx nugax	-	5	-	-	-	-
Anonyx liljeborgi	-	-	1	-	-	-
Parapleustes spp.	-	-	-	-	6	2
Pagurus arcuatus	-	1	-	-	-	-
Diastylis sp.	-	-	1	-	7	1
Cucumaria frondosa	1	-	-	-	-	-
Pelonaia corrugata	1	1	-	1	-	-
Amphiophiura convexa	2	-	4	1	-	-
Trichotropis borealis	-	-	1	-	-	-
Oenopota turricula	-	-	-	-	-	1
Oenopota bicarinata	-	1	1	1	1	-
Nucula tenuis	-	-	2	-	-	2
Macoma spp.	-	-	6	4	-	3
Astarte subequilatera	1	-	-	-	-	-
Serripes groenlandicus	1	-	-	-	-	-
Yoldia myalis	2	1	-	1	-	-
Mya arenaria	-	2	-	-	3	-
Thyasira flexuosa	-	1	-	-	-	1
Depth (m.)	18	18	11	11	3	5
Number individuals	31	35	123	67	105	40
Number species	18	15	23	17	17	18
Species diversity	3.8	3.5	2.8	3.5	2.4	3.4
Substrate	FS	FS	FS	FS	CS	FS
Substrate diversity	268	270	229	247	227	254

	SAR1-1	SAR1-2	SAR1-3	SAR1-4	SAR1-5	SAR1-6	SAR1-7
Nephtys ciliata	-	1	1	-	-	-	-
Nereimyra punctata	-	1	-	-	-	-	-
Pectinaria granulata	33	2	-	2	4	3	-
Harmothoe imbricata	-	1	-	-	-	-	-
Neph caeca	4	1	5	3	4	2	-
Glycera capitata	-	3	-	-	-	-	-
Nicomache sp.	1	-	-	-	-	-	-
Spio filicornis	-	12	-	1	8	-	6
Ophelia limacina	-	1	-	-	-	-	-
Phyllodoce sp.	-	-	-	-	1	-	-
Travisia forbesii	-	-	-	-	-	1	-
Eteone longa	-	-	-	-	-	1	-
Chaetozone setosa	-	-	-	-	-	-	2
Praxillella praetermissa	-	-	-	-	-	-	1
Phoxocephalus holbolli	7	-	25	-	-	4	19
Ampelisca eschrichti	4	-	-	-	-	-	-
Protomedia grandimana	1	-	-	-	-	-	-
Orchomenella minuta	1	1	-	-	-	-	-
Bathymedon obtusifrons	-	1	-	-	-	-	-
Paroediceros lynceus	-	2	-	-	-	-	-
Anonyx sarsi	-	1	-	-	-	-	-
Monoculodes borealis	-	-	-	-	1	-	-
Hydrobia totteni	2	-	-	-	-	-	-
Turtonia minuta	3	-	-	-	-	-	-
Lepeta caeca	-	-	-	-	-	-	4
Crenella glandula	1	-	-	-	-	-	-
Astarte borealis	4	-	-	-	-	-	-
Mya arenaria	-	3	2	-	-	-	-
Oenopota bicarinata	-	1	-	-	-	-	-
Macoma sp.	-	1	-	-	-	-	-
Depth (m.)	10	6	7	8	6	5	4
Number individuals	61	32	33	6	18	11	32
Number species	11	15	4	3	5	5	5
Species diversity	2.6	3.4	1.4	1.5	2.1	2.2	1.7
Substrate	CS	MS	MS	CS	CS	MS	MS
Substrate diversity	1.89	2.12	1.82	1.82	2.11	1.91	2.13

	SAR1-8	SAR1-9	SAR1-10	SAR1-11
Pholoe minuta	-	3	1	8
Pectinaria granulata	-	4	25	2
Nephtys sp.	-	1	1	-
Nephtys longosetosa	-	-	4	3
Spio filicornis	-	2	-	-
Pherusa plumosa	-	-	2	-
Scoloplos armiger	-	-	-	1
Phyllodoce sp.	-	1	-	-
Owenia fusiformis	-	-	-	2
Nemertea	-	-	-	1
Ampelisca eschrichti	-	2	6	1
Paroediceros lynceus	3	-	1	1
Monoculodes borealis	1	-	4	1
Phoxocephalus holbolli	-	-	-	2
Protomedeia grandimana	-	-	-	1
Anonyx ochoticus	-	-	-	1
Hippomedon propinquus	1	-	-	1
Onesimus plautus	-	-	-	2
Diastylis sp.	5	18	-	48
Ostracoda	-	-	-	1
Chirodota laevis	-	-	1	-
Pelonaia corrugata	-	-	-	1
Cucumaria frondosa	-	-	-	1
Oenopota turricula	-	-	2	-
Oenopota incisula	-	-	-	1
Oenopota elegans	-	-	1	-
Philine quadrata	-	1	-	-
Turtonia minuta	-	54	-	-
Mya arenaria	-	-	-	9
Yoldia myalis	-	-	-	2
Macoma sp.	-	-	-	3
Crenella faba	-	-	-	2
Thyasira flexuosa	-	-	-	1
Depth (m.)	9	11	13	19
Number individuals	11	86	49	96
Number species	5	9	12	24
Species diversity	1.8	1.7	2.6	3.0
Substrate	FS	FS	FS	FS
Substrate diversity	1.75	1.62	1.97	2.24

	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-7	CB-8	CB-9	CB-10	CB-11	CB-12	CB-13	CB-14
Pholoe minuta	–	1	–	3	1	–	2	–	1	3	1	–	–	–
Pectinaria granulata	5	16	3	5	2	3	3	14	4	5	16	17	5	2
Harmothoe imbricata	1	–	–	–	–	–	1	–	–	–	–	–	–	–
Scoloplos armiger	–	–	–	1	–	2	–	2	–	–	–	–	–	–
Nephtys caeca	–	1	–	–	–	–	2	1	–	–	2	–	1	1
Lumbrineris impatiens	–	–	–	–	–	–	–	–	40	4	–	–	–	1
Lumbrineris fragilis	–	2	–	6	–	–	–	–	–	–	–	–	177	–
Eteone longa	2	–	2	5	4	3	11	1	7	9	–	1	8	4
Prionsopio steenstrupi	3	8	2	4	2	4	1	2	4	2	4	4	3	–
Spio sp.	8	3	3	2	3	6	2	2	2	–	–	–	3	4
Ampharete sp.	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Pherusa plumosa	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Apistobranchus sp.	–	–	4	–	–	–	–	–	–	–	–	1	–	–
Phyllodoce mucosa	–	–	–	2	1	–	–	–	2	3	–	–	–	–
Euphrosine sp.	–	–	–	–	–	4	–	–	–	–	–	–	–	–
Ophelidae	–	–	–	–	–	3	–	3	8	–	–	–	28	–
Euchone analis	–	–	–	–	1	–	–	–	1	–	5	–	–	–
Phoxocephalus holbolli-	–	2	4	5	–	–	6	3	–	3	–	–	5	–
Orchomenella minuta	–	–	–	–	–	1	8	1	–	–	–	–	–	–
Corophium sp.	–	–	–	–	–	–	1	1	–	–	–	–	–	–
Littorina littorea	4	–	–	–	–	–	–	–	–	–	–	–	–	–
Macoma spp.	–	–	–	–	1	–	2	–	1	–	1	–	2	–
Cerastoderma pinnulatum	–	–	–	–	–	–	–	1	–	1	1	–	–	–
Bathymedon obtusifrons	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Depth (m.)	5	5	5	4	4	6	5	4	4	5	4	5	5	5
Number individuals	23	34	18	35	15	27	38	32	70	30	30	23	232	12
Number species	6	8	6	10	8	9	11	12	10	8	7	4	9	5
Species diversity	2.3	2.3	2.5	2.7	2.8	3.0	2.9	2.8	2.2	2.8	2.0	1.1	1.3	2.1
Substrate	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Substrate diversity	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56

	CB-21	CB-22	CB-23	CB-24	CB-25	CB-26	CB-27	CB-28	CB-29	CB-30	CB-31	CB-32	CB-33	CB-34
Pholoe minuta	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Pectinaria granulata	5	14	–	–	2	1	–	1	–	–	8	1	1	1
Harmothoe imbricata	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Scoloplos armiger	–	1	–	–	2	1	1	–	1	–	–	–	3	–
Nephtys caeca	1	4	9	4	1	–	3	2	7	12	–	1	4	5
Nephtys ciliata	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Eteone longa	1	–	–	–	–	–	1	–	–	–	–	–	–	1
Spio filicornis	–	–	–	1	–	–	–	–	–	2	–	1	–	–
Spio spp.	–	–	–	4	–	1	2	1	4	–	–	–	–	–
Goniada maculata	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Phyllodoce mucosa	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Phyllodoce groenlandica	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Phyllodoce sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Terebellid	–	–	–	–	1	–	2	–	–	–	–	–	–	–
Euchone analis	2	8	–	–	11	1	–	–	–	–	6	4	5	1
Ampharete sp.	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Edotea montosa	3	–	–	–	–	2	–	–	–	–	2	–	–	–
Phoxocephalus holbolli	–	–	–	–	–	1	1	–	–	–	–	–	–	–
Corophium sp.	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Pontogeneia inermis	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Monoculodes sp.	1	–	1	–	–	–	–	–	–	–	–	–	–	–
Crenella glandula	1	–	–	–	–	–	–	–	1	–	2	–	–	–
Cerastoderma pinnulatum	4	4	–	–	–	–	–	–	–	–	–	1	1	–
Mya arenaria	–	2	–	1	–	1	–	–	–	–	1	–	8	3
Macoma spp.	–	4	–	1	–	1	–	1	1	–	–	–	1	1
Hiatella arctica	–	1	–	–	–	–	–	1	–	–	–	–	–	–
Mytilus edulis	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Astarte subequilatera	1	–	–	–	–	1	–	–	–	–	–	–	–	–
Diastylis sp.	–	–	–	–	–	–	–	–	–	2	–	–	1	–
Cumacea	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Ascidacea	3	3	–	–	3	3	1	–	–	–	–	1	–	3
Strongylocentrotus drobachiensis	–	–	–	–	–	1	–	–	–	–	–	–	1	–
Echinarachnius parma	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Depth *(m.)*	7	9	3	4	10	11	9	4	5	4	8	9	10	11
Number individuals	25	43	10	11	20	14	11	7	14	17	20	9	28	17
Number species	13	11	2	5	6	11	7	6	5	4	6	6	12	9
Species diversity	3.4	2.9	.5	2.0	2.0	3.3	2.7	2.5	2.0	1.8	2.2	2.3	3.1	2.6
Substrate	FS	FS	VFS	VFS	FS	FS	FS	VFS	FS	FS	VFS	VFS	VFS	VFS
Substrate diversity	246	246	232	232	246	246	246	232	246	246	232	232	232	232

APPENDIX F

Sampling data from each site and subsite.

SITE	SUBSITE	NUMBER OF SAMPLES	
		SCUBA	SHIPEK
CARTWRIGHT	CW1	4	
	CW2	5	
PACK'S HARBOUR (PH)		4	
NORTH STRAND	PNS	4	
	NS1		26
PONSONBY IS. (PI)		4	
POTTLE'S BAY (PB)		6	
HOPEDALE	HOP-1 to 9	9	
	HOP-14to 21	8	
NAIN ISLANDS	Meta Cove SAR3-1to22	21	
	Rhodes Is. SAR3-31to37	7	
	Hillsbury Is. SAR3-25to30	6	
	Shot Islet SAR2	2	
	Siurakuluk Is. SAR1-1to7	7	
	East Red Is. SAR1-8to11	4	
	SHR1		6
	SHR2		8
	SHR3		4
CONCEPTION BAY	Conception Harbour	14	
	Harbour Main	14	
	TOTAL	119	44

5