A preliminary assessment of the American Bar/Surf clam, Spisula solidissima, in Prince Edward Island, 1984

by

Thomas W. Sephton and Clair F. Bryan
Department of Fisheries and Oceans
Fisheries Research Branch, Gulf Region
Invertebrate Research Section
Fisheries Research Unit
University of Prince Edward Island
Charlottetown, P.E.I. C1A 4P3

ABSTRACT

Exploited and unexploited bar clam areas were sampled with a hydraulic clam dredge in P.E.I.. Standing stock and biomass (dry weight) were estimated and high and low density clam beds were identified. High density patches were contiguous with low density ones. Densities ranged from 0.2 to 1.18 ind. m^{-2}, with highest densities occurring in Hillsborough Bay and Cardigan Bay. The size-frequency distribution indicated that about 90% of all clams collected were of legal fishing size and that most populations were composed of older clams.

RESUME

Des prélévements ont été réalisés, dans l'Ile du Prince-Edouard, sur des zones à palourdes. Densité et biomasse (poids sec) ont été estimées et des bancs de palourdes à haute et faible densité ont été identifiés. Les aires de forte et faible densité sont contigues. Les densités varient de 0.2 à 1.18 individua m^{-2}, les plus fortes densités étant observées dans les baies de Hillsborough et Cardigan. Les distributions de fréquence de taille indiquent qu'environ 90% des palourdes recoltées ont la taille légale autorisée pour la pêche et que la plupart des populations est composée de palourdes âgées.

INTRODUCTION

The DFO P.E.I. Resource Development and Protection Branches, P.E.I. Department of Fisheries, and Shellfishermen organizations have expressed interest in the P.E.I. bar/surf clam (Spisula solidissima) fishery from both management and enhancement viewpoints. Current management strategies are limited in their depth and scope because most of the biological information for the species pertains to research done within its main distributional area off the U.S. eastern seaboard (cf. Ropes 1980), and this information may not be entirely applicable to the Gulf Region (Robert 1981). Consequently, the commercial fishery is curtailed as a conservation measure until data are obtained for population modeling to develop management strategies for the future commercial exploitation of bar clams. This is brought about by an increased interest in the near shore and intertidal fishery from seasonal fisherman and resident clam diggers brought about by the increased demand (40% higher than 1983) and prices for bar clams (Table 1). In 1984, 16 restricted (area) commercial licenses were issued in P.E.I. and they landed approximately 742 MT (live weight in the shell) (@ 20¢ lb^{-1}), for a total landed value of $327,000. As there are no restrictions on hand picking of clams, it is difficult to estimate the value of landings from this fishery even though many are sold to packers (@ 22¢ lb^{-1}) and retailers (50-70¢ lb^{-1}). There are no official landings available for N.B. and N.S. and the fishery appears less active than that on P.E.I.

In 1984 a stock assessment of the bar clam resource was conducted in selected areas around P.E.I. to provide the basic data required to conduct future research on the population dynamics and production of the species. This is a preliminary assessment of the status of bar clam stocks (standing stock and biomass) in commercially exploited and unexploited areas.

MATERIALS & METHODS

Sampling sites were chosen in commercially exploited areas along the North Shore from Hog Island to Rustico and at Hillsborough Bay, and unexploited areas at Cape Egmont and Cardigan Bay as shown in Fig. 1. In the late summer and fall of 1984, bar clams were sampled in the subtidal areas (near-shore) (water depths 1.75 to 7.75 m) with a towed hydraulic clam dredge. The dredge had a fishing width of 68 cm and sampled to a

depth of 25 cm in most substrates. A hydraulic pressure of 345 Kpa (50 $lbin^{-2}$) was maintained at the manifold head of the dredge. The dredge was towed for 5 minutes and Loran C coordinates were used to plot the location. The dredge retained clams larger than 30 mm while the legal limit in P.E.I. is 50 mm. Bay clam samples were returned to the laboratory, enumerated and maximum anterior-posterior length was measured with vernier calipers to the nearest mm.

Dry weight:length regression equations (ℓn weight (g) = a + b ℓn length (cm)) were established to estimate individual dry weight and ultimately dry weight biomass. Clams were selected from 1.5 cm size groupings and maximum anterior-posterior length measured. The clam tissue was dried at 60°C for 120 hrs and weighed. The regression equations for the major areas (Appendix 1) were not statistically different ($\alpha = 0.05$) from one another (students "t" test for slopes, Sokal and Rohlf 1981) and a general regression equation was used to estimate individual dry weight, ℓn W = 4.550+2.817 ℓnL (r^2 = 0.9910 n = 300).

Each tow was plotted on a map, the length measured, and the area of each tow and the total area sampled were calculated. The average standing stock (ind.$^{-2}$) and biomass (dry weight) (gm^{-2}) for each tow was calculated and plotted. Contour maps of the beds were drawn by hand and exclude those tows with no clams. The average standing stock and biomass was estimated for each bed based on the estimates delineated by the bed limits. The surface area of each bed was measured with a compensating polar planimeter.

The size-frequency distribution histograms of clams grouped into 10 mm size intervals were graphed for each area. An aging-chondrophore ring reading study for each area has not been completed at this time. Consequently, an approximate von Bertalanffy growth curve was taken from Caddy and Billard (1976) and Robert (1981) and the age scale superimposed on the length axis of the histograms.

RESULTS

The sampling data were variable with patches of high density interspersed with low density patches. An arbitrary decision was used to indicate high (>0.15m^{-2}) and low (<00.15m^{-2}) density beds as shown on Figs. 2 - 5. Generally, clams were abundant in unsheltered sandy substrate (<0.5% silt/clay content) with little or no rock and eel grass. Diver observations indicated that the hydraulic dredge was a relatively efficient sampler (∿80%) in most substrates.

Hillsborough Bay

There were two high density beds surrounded by low ones and Bed G2 is commercially exploited (Fig. 2). Bed G2 had the largest standing stock (1.18m^{-2}) of all sample locations in P.E.I. and the second largest biomass (7.56gm^{-2}) (Table 2 and 3). The total estimated abundance of clams for all beds was 668,400 clams and 6.53 MT (dry weight). The size-frequency histogram showed a broad distribution of clams with the majority occurring between the 8 and 15 cm size intervals (Fig. 6). 97% were larger than the legal size limit (>50mm) and 87% were larger than the usual size recruited into the fishery (>75mm, Robert 1981). Few young clams were collected.

Egmont

A low density bed, that ran parallel to the shoreline, was found near Mount Carmel (Fig. 3). It had a relatively low standing stock (0.14m^{-2}) and biomass (0.03gm^{-2}) and an estimated total abundance of 369,600 clams and 3.32 MT (dry weight) (Table 2 and 3). There were three peaks in the size-frequency distribution of clams occurring at 5 - 6 cm, 10 - 11 cm and 13 - 14 cm size intervals (Fig. 6). 82% of the clams collected were larger than 50 mm and 70% were of recruitment size. Adverse weather conditions prevented a more extensive sampling program at this location.

North Shore

The beds were parallel to the coastline and high density beds were contiguous with low density ones (Fig. 4). There were very high density patches of clams within the high density strips, in particular at Profits Point and New London Bay (Bed 1) where clams were dredged commercially.

Beds 1 and 3 had the largest standing stocks ($0.30m^{-2}$, $0.30m^{-2}$) and biomass ($2.33gm^{-2}$, $2.29gm^{-2}$) (Table 2 and 3). There was a total of 11,519,100 clams and 99 MT (dry weight) over all beds. The size-frequency histogram showed a broad distribution of clams, with most occurring between 7 and 15 cm size intervals (Fig. 7). 91% were larger than 50 mm and 78% were of recruitment size.

Cardigan Bay

Eight clam beds were delineated in Cardigan Bay, with 4 high density beds separated by low density ones (Fig. 5). Beds P1 and B2 had standing stocks and biomasses of $0.48m^{-2}$ and $0.44gm^{-2}$ and $8.89gm^{-2}$ respectively (Table 2 and 3). These two beds were the second and third densest of all beds sampled in P.E.I.. Bed B2 is fished commercially on an occasional basis. The total estimated abundance of all beds was 622,500 clams and 9.05 MT (dry weight). The size-frequency histogram showed a skewed distribution, with a peak between the 14 and 17 cm intervals (Fig. 7). Some young clams were collected. 94% of the clams were larger than the legal size and 87% were of recruitment size.

DISCUSSION

This study was designed to be a preliminary quantitative assessment of the standing stock and biomass of bar clams to obtain a data base for future research. The distribution pattern and patchiness of the standing stock and biomass estimates were typical of bivalve molluscs (Conan 1984, Worms 1984) and it was difficult to delineate clam bed boundaries. Beds with the largest standing stocks are being commercially exploited at moderate levels and our data indicates these beds have standing stocks greater than $0.35m^{-2}$. There are no quantitative data for inshore areas in P.E.I. for comparative purposes. The density estimates are lower than those reported by Caddy and Billard (1976) at Buctouche, N.B. ($1.0m^{-2}$) and are similar to those reported by Bernier and Poirier (1979) at Iles-de-la-Madelaine ($0.50m^{-2}$). Robert (1981) conducted the only quantitative study in P.E.I. but examined the intertidal beds in the vicinity of Mount Carmel. She obtained larger estimates of standing stock ($1.25m^{-2}$) than were found subtidally in this study, but the intertidal beds were smaller in surface area.

The size-frequency distributions indicated that about 90% of all clams collected were of legal fishing size and that most populations were composed of older clams. The absence of younger clams in samples, with the exception of Egmont, may be due to sampling error and requires further study. It is possible that younger clams are located intertidally as Robert (1981) found that 50% of the clams sampled in intertidal beds were of pre-recruit size class. Her size-frequency distributions exhibited the typical skewed curve towards the younger size classes.

Age at recruitment into the fishery appears to be at 3 - 5 years (Caddy and Billard 1976, Robert 1981). However, a detailed aging study (chondrophore ring-reading) of clams from all areas sampled in this study will be performed to give more insight into determining the age as well as the growth rates between areas. Combined with studies on population dynamics, this will permit production to be modelled and an attempt will be made to predict the effects of pulse and steady-state fishing pressure on the fishery. A study of the reproductive cycle of bar clams is presently underway and will provide information on the extent and duration of reproduction as well as the age of maturity.

Little information is available on the commercial fishery except for annual harvest statistics (Table 1). It is suggested that a log-book program, similar to that proposed for scallops, be initiated in order to gather information to estimate fishing pressure, CPUE, extent and periodicity of fishing effort. It is suspected that there may be an increase in fishing effort with the increased demand and prices of bar clams and the increased activity of other seasonal fishermen.

LITERATURE CITED

Bernier, L. and L. Poirier. 1979. Evaluation sommaire du stock des mactres de l'Atlantique, Spisula solidissima Dillwyn, des Iles-de-la-Madeleine. M.I.C., Dir. Gen. Peches marit., Dir. Rech., Cah. Inf. 92, 42p.

Caddy, J.F. and A.R. Billard. 1976. A first estimate of production from an unexploited population of the bar clam, Spisula solidissima. Fish. Mar. Serv. Res. Dev., Tech. Rep. 648, 13p.

Conan, G.Y. 1984. Do assumptions commonly used for modelling populations of finfish apply to shellfish species. ICES Doc. C.M. 1984/K:49, 20p.

Robert, G. 1981. Dynamics of an unexploited population of bar clam, Spisula solidissima. Can. MS Rep. Fish. Aqua. Sci. 1607:12p.

Ropes, J.W. 1980. Biological and fisheries data on Atlantic surf clam, Spisula solidissima (Dillwyn). U.S. Nat. Mar. Fish. Serv. Tech. Rep. Ser. No. 24, 88p.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry. 2nd Ed. W.H. Freeman & Co., San Francisco, 859p.

Worms, J. 1984. Scallop biomass and density estimates in the Southern Gulf of St. Lawrence. CAFSAC Res. Doc. 84/90, 26p.

TABLE 1. Commercial landings (live weight including shell) of bar clams for P.E.I. from 1979 to 1984. The estimated dollar value (10^3) is shown. Partial statistics for N.B. and N.S. are also shown.

P.E.I.	Total Commercial Landings (MT)	$ Value (10^3)
1979	231.5	71
1980	221.8	64
1981	217.6	96
1982	311.0	144
1983	428.6	189
1984	742.2	327
N.B.		
1982	36.7	25
1983	18.1	12
N.S.		
1983	2.0	2

TABLE 2 - Average standing stock (ind m^{-2} ± SD) and estimated total abundance of clams on beds located around P.E.I. The locations of the beds are shown on Fig. 1-5. The bed area, number of tows, total area of tows and the sampling intensity are also shown.

LOCATION	BED NO.	BED AREA ha	BED AREA m^2	NO. OF TOWS	TOTAL AREA OF TOWS (m^2)	SAMPLING INTENSITY (%)	STANDING STOCK ind m^{-2} ($\bar{x}$ ± SD)	ESTIMATED TOTAL ABUNDANCE OF BED
North Shore - Cavendish	1	244	2,440,000	17	1530.00	0.0627	0.30±0.15	732,000
Cavendish, New London, Malpeque, Hog Island	2	4578	45,780,000	30	2909.72	0.0064	0.07±0.06	3,204,600
New London, Malpeque, Hog Is.	3	2107	21,070,000	22	1940.75	0.0092	0.30±0.16	6,321,000
Malpeque, Hog Island	4	1195	11,950,000	18	1622.61	0.0136	0.07±0.04	836,500
Hog Island	5	62	620,000	5	456.73	0.0737	0.22±0.11	136,400
Rustico	6	481	4,810,000	14	1445.85	0.0301	0.06±0.05	288,600
Cardigan Bay - Panmure Island	P1	35	350,000	8	870.94	0.2488	0.48±0.31	168,000
Panmure Island	P2	65	650,000	5	427.00	0.0657	0.02±0.01	13,000
Panmure Island	P3	69	690,000	15	1710.18	0.2479	0.07±0.05	48,300
Panmure Island	P4	6	60,000	2	287.22	0.4787	0.26±0.06	15,600
Boughton Island	B1	474	4,740,000	27	2297.04	0.0485	0.04±0.04	189,600
Boughton Island	B2	23	230,000	9	1027.65	0.4468	0.44±0.19	101,200
Boughton Island	B3	35	350,000	4	336.09	0.0960	0.17±0.05	59,500
Boughton Island	B4	39	390,000	6	584.46	0.1499	0.07±0.04	27,300
Hillsboro Bay - Governor's Island	G1	75	750,000	3	193.29	0.0258	0.05±0.02	37,500
Governor's Island	G2	34	340,000	6	331.78	0.0976	1.18±0.95	401,200
St. Peter's Bay	S1	317	3,170,000	11	995.97	0.0314	0.04±0.05	126,800
St. Peter's Bay	S2	49	490,000	11	960.23	0.1960	0.21±0.09	102,900
Egmont Bay - Egmont Bay	E1	264	2,640,000	11	793.77	0.0301	0.14±0.07	369,600

TABLE 3 - The average dry weight biomass (gm^{-2} ± SD) and estimated total biomass (MT) on beds located around P.E.I. The locations of the beds are shown in Fig. 1-5. The bed area, number of tows, total area of tows and the sampling intensity are also shown.

	LOCATION	BED NO.	BED AREA ha	BED AREA m^2	NO. OF TOWS	TOTAL AREA OF TOWS (m^2)	SAMPLING INTENSITY (%)	BIOMASS gm^{-2} (dry weight) ($\bar{x}$ ± SD)	ESTIMATED TOTAL BIOMASS OF BED (MT)
North Shore -	Cavendish	1	244	2,440,000	16	1501.44	0.0615	2.3272±1.3343	5.68
	Cavendish, New London, Malpeque, Hog Island	2	4578	45,780,000	20	2548.61	0.0056	0.7029±0.5585	32.18
	New London, Malpeque, Hog Is.	3	2107	21,070,000	18	1451.70	0.0069	2.2945±1.5711	48.35
	Malpeque, Hog Island	4	1195	11,950,000	14	1281.89	0.0107	0.7440±0.3818	8.89
	Hog Island	5	62	620,000	5	456.73	0.0737	2.0623±1.1723	1.28
	Rustico	6	481	4,810,000	13	1445.85	0.0301	0.5448±0.4661	2.62
Cardigan Bay -	Panmure Island	P1	35	350,000	8	870.94	0.2488	4.1109±2.3628	1.44
	Panmure Island	P2	65	650,000	5	427.00	0.0657	0.1253±0.1137	0.08
	Panmure Island	P3	69	690,000	13	1470.47	0.2131	1.4706±1.1815	1.02
	Panmure Island	P4	6	60,000	2	287.22	0.4787	3.8361±0.7832	0.23
	Boughton Island	B1	474	4,740,000	27	2297.04	0.0485	0.6233±0.9013	2.95
	Boughton Island	B2	23	230,000	7	467.16	0.2031	8.8927±3.1720	2.05
	Boughton Island	B3	35	350,000	4	336.09	0.0960	3.0198±1.0912	1.06
	Boughton Island	B4	39	390,000	6	584.46	0.1499	0.5713±0.7422	0.22
Hillsboro Bay -	Governor's Island	G1	75	750,000	2	103.11	0.0138	0.4735±0.2272	0.36
	Governor's Island	G2	34	340,000	6	331.78	0.0976	7.5566±7.0066	2.57
	St. Peter's Island	S1	317	3,170,000	10	995.97	0.0314	0.6881±0.8568	2.18
	St. Peter's Island	S2	49	490,000	11	960.03	0.1960	2.8962±1.3470	1.42
Egmont Bay -	Egmont Bay	E1	264	2,640,000	10	793.47	0.0301	1.2176±0.8284	3.22

Fig. 1. Location of sampling areas around P.E.I..

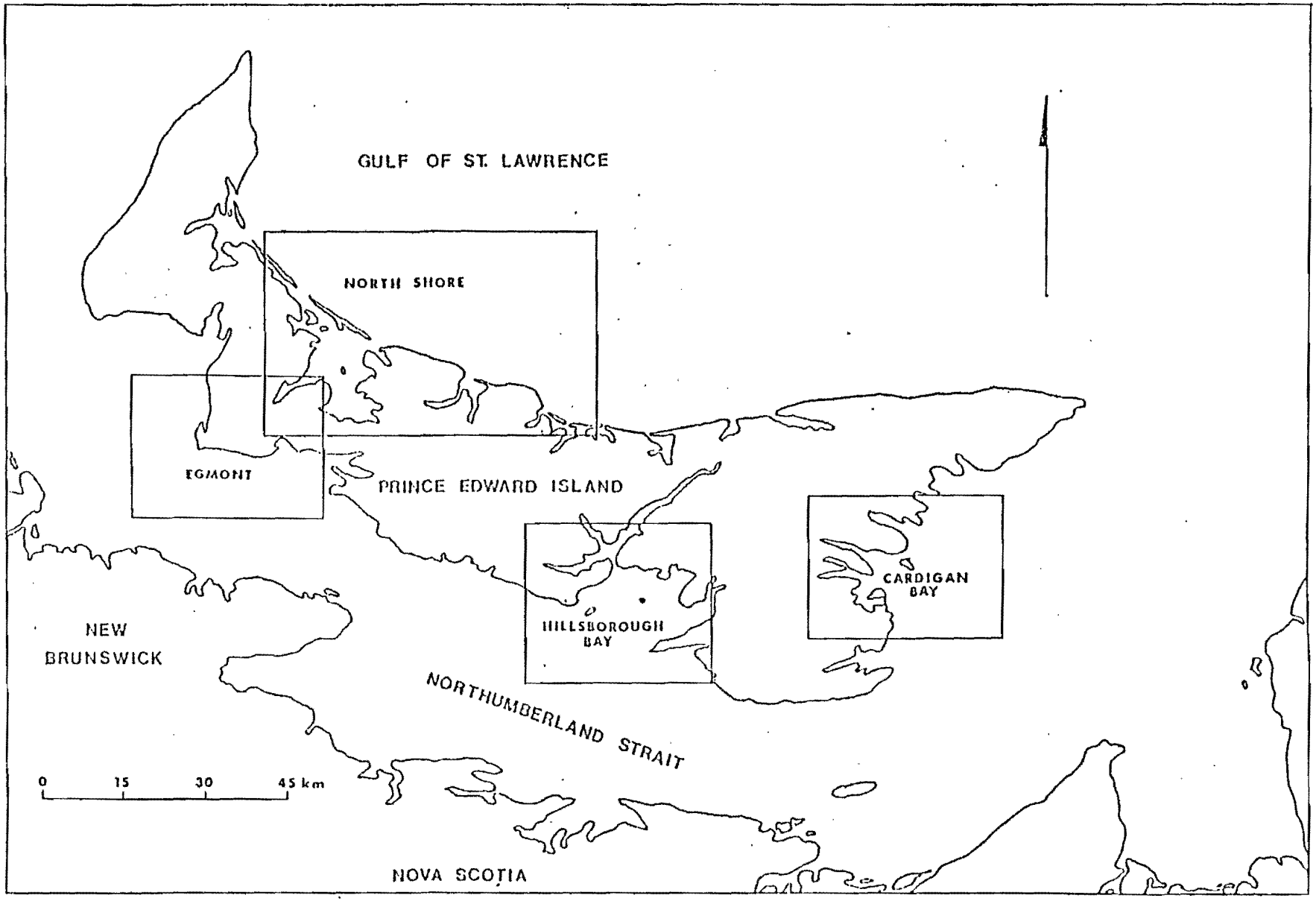


Fig. 2. Location of low and high density bar clam beds in Hillsborough Bay. Bed numbers correspond to those shown in Table 2.

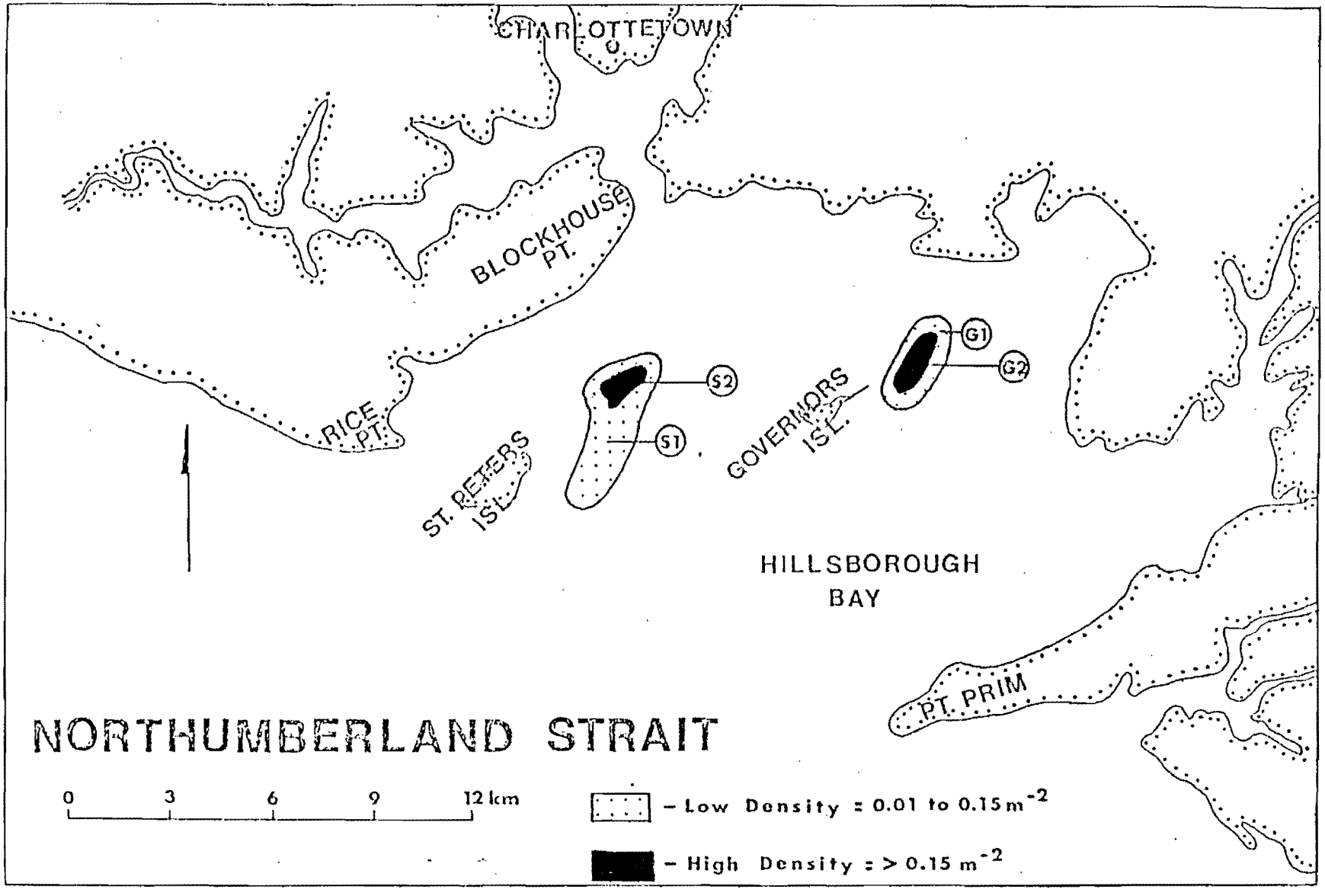


Fig. 3. Location of the bar clam bed in the vicinity of Cape Egmont. Bed number corresponds to that shown in Table 2.

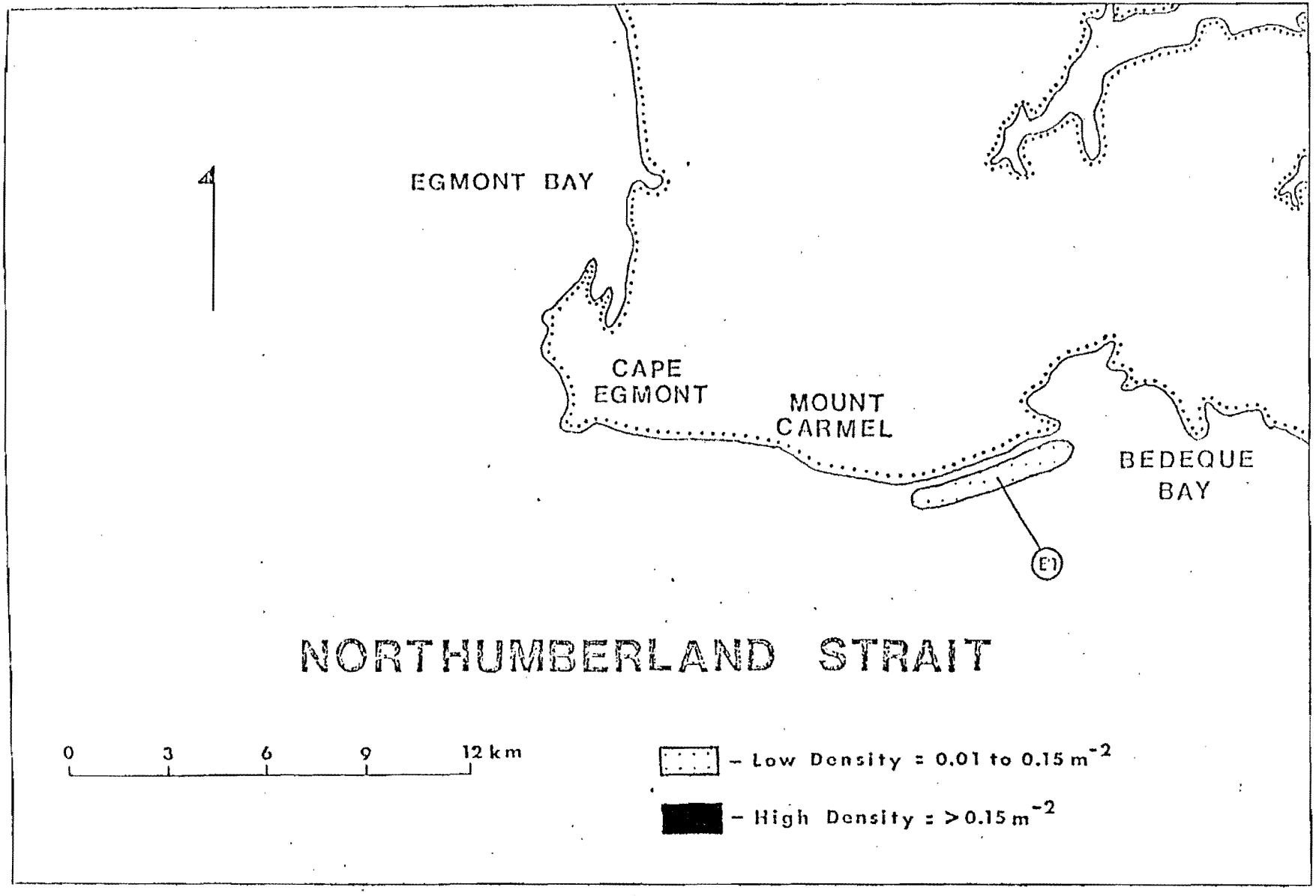


Fig. 4. Location of low and high density bar clam beds along the North Shore of P.E.I. from Hog Island to Rustico. Bed numbers correspond to that shown in Table 2.

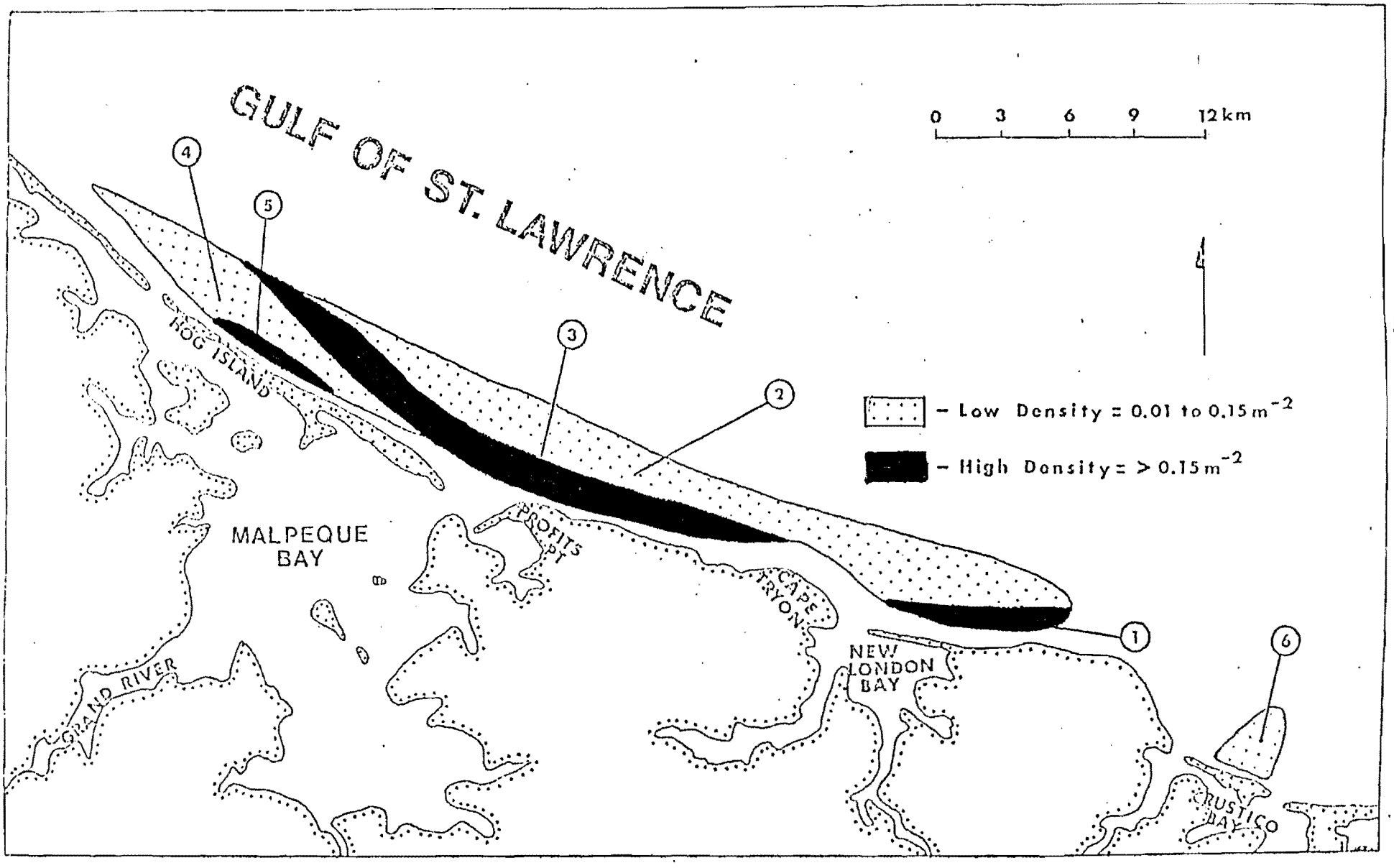


Fig. 5. Location of low and high density bar clam beds in Cardigan Bay. Bed numbers correspond to that shown in Table 2.

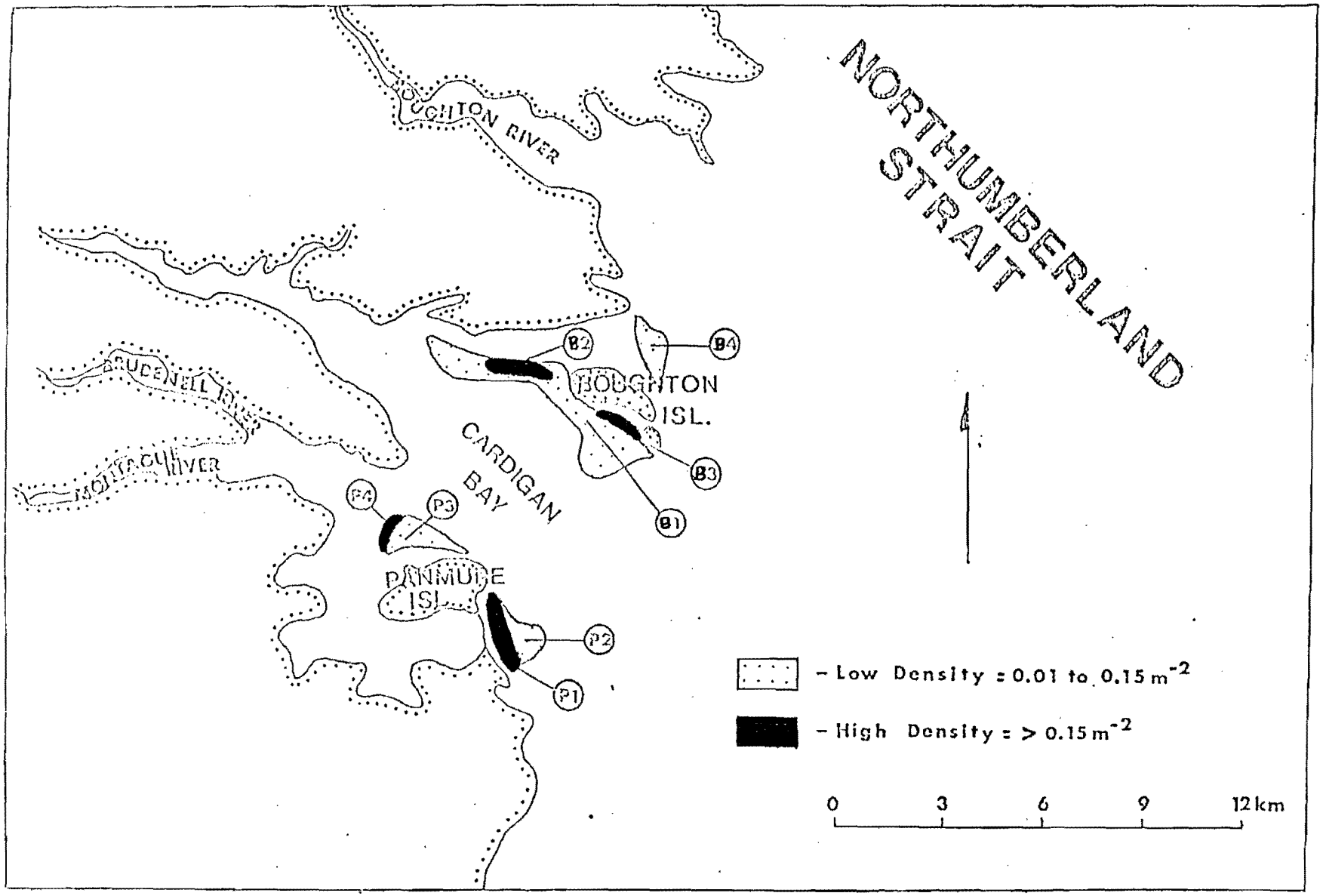
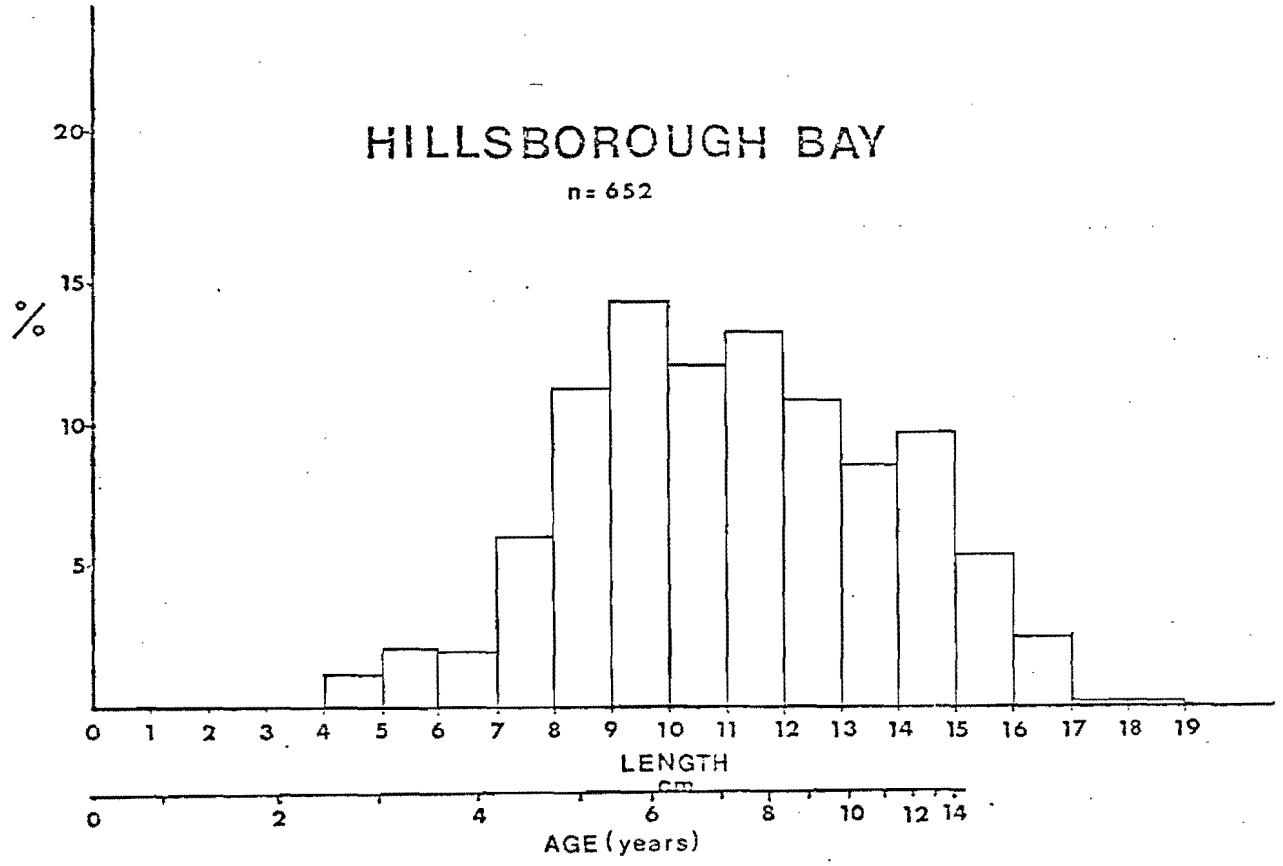


Fig. 6. The size-frequency distribution of bar clams collected at Hillsborough Bay and Cape Egmont sample sites. The age scale is taken from Caddy and Billard (1976) and Robert (1981). n = number of clams.



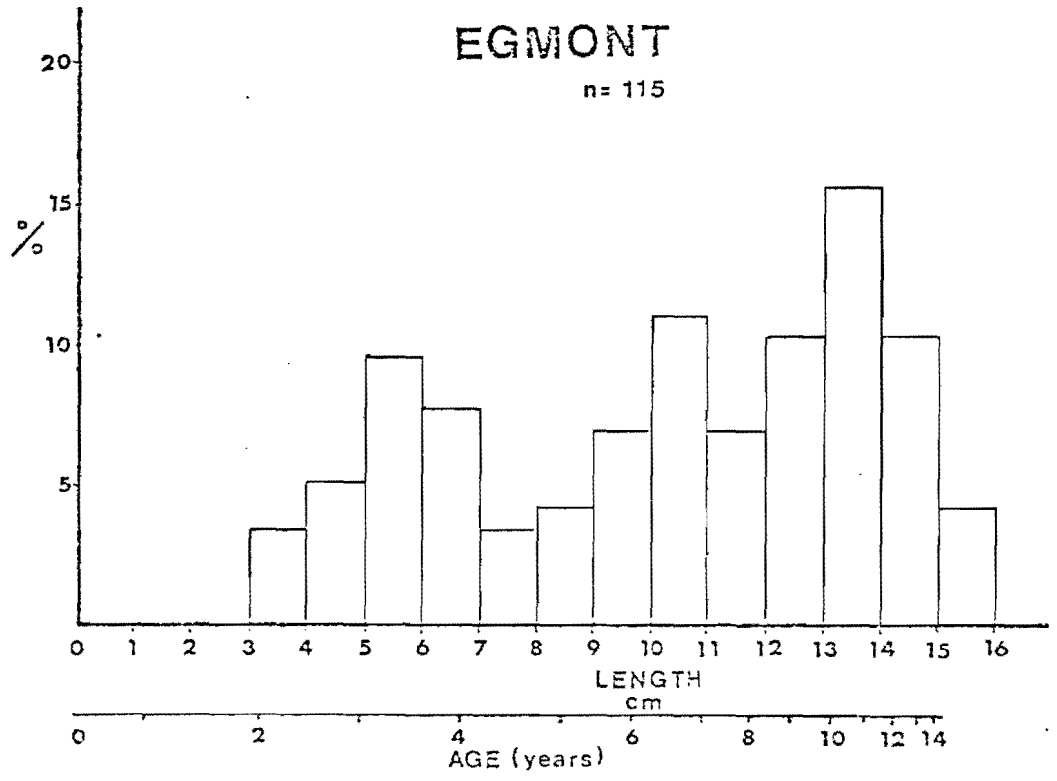
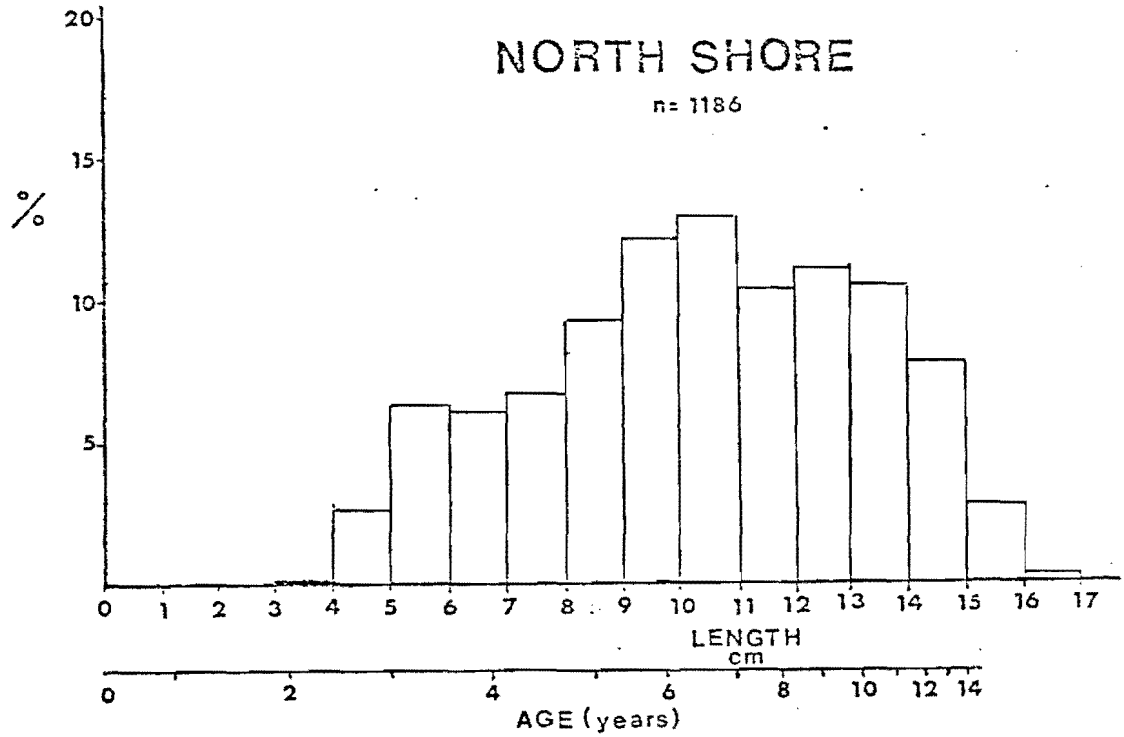
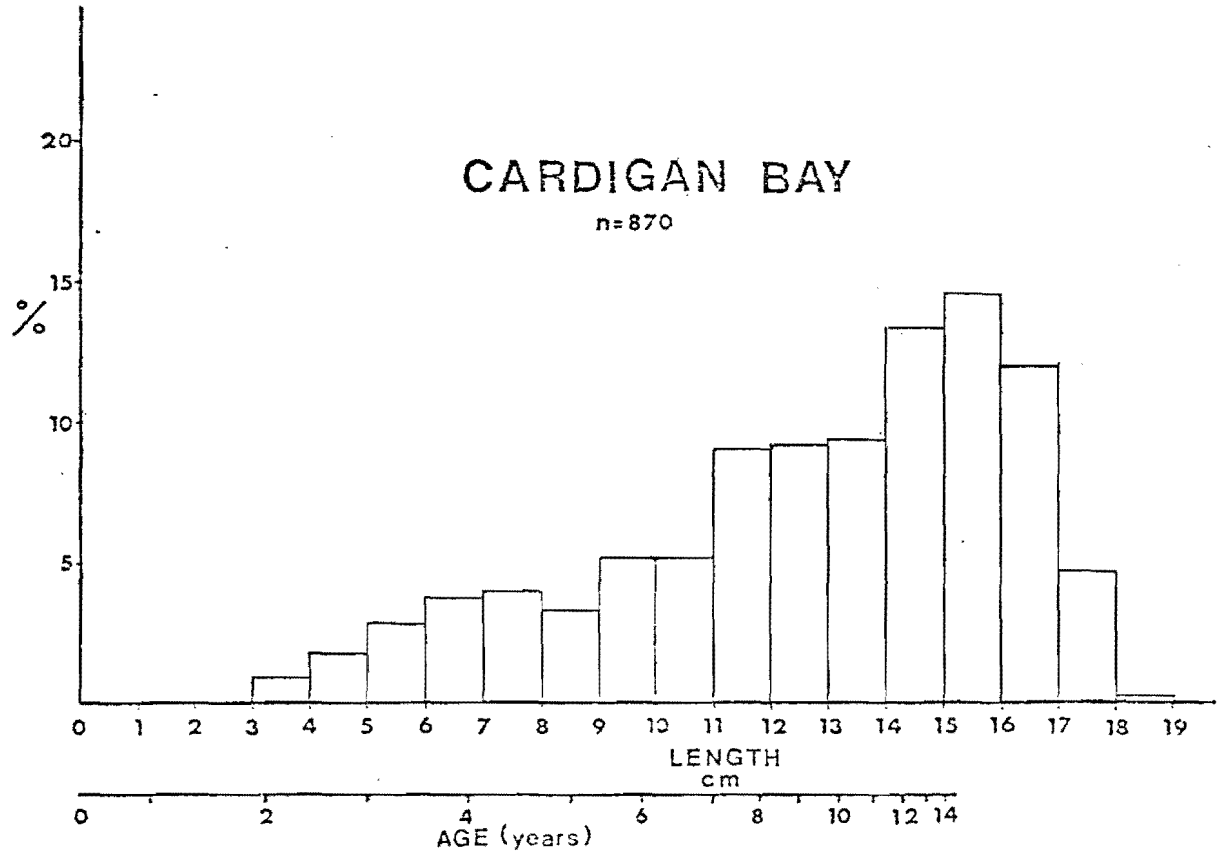


Fig. 7. The size-frequency distribution of bar clams collected at North Shore and Cardigan Bay sample sites. The age scale is taken from Caddy and Billard (1976) and Robert (1981). n = number of clams.





Appendix 1. The parameters for the dry weight:length regression equations ($\ell nW = a+b\ \ell nL$) from different areas in P.E.I. The overall equation parameters are shown. The y-intercept (a), slope (b), correlation coefficient (r^2) and number of samples (n) are shown.

LOCATION	a	b	r^2	n
Hillsborough Bay	-4.5696	2.8219	0.9938	82
Cardigan Bay	-4.5196	2.8106	0.9916	75
North Shore	-4.5556	2.8143	0.9888	80
OVERALL	-4.5503	2.8170	0.9910	300