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Aerial Survey of Herring Gillnets in the Southern Gulf of St. Lawrence

by

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Abstract

An aerial survey to monitor the distribution and intensity of inshore herring fishing gear in the southern Gulf of St. Lawrence was carried out in May 1980. A single engine aircraft flying at altitude of 3000 ft and equipped with aerial camera was used. The survey comprised six main fisheries which required 40 hours flight and 750 pictures.

The intensity of fishing gear varied widely from as low as 10 standard nets (.27 km in length) in Neguac area to as high as 2252 nets (61.7 km) near Escuminac. Both the distribution of gillnets and fishing intensity, in terms of number and length of nets set, varied during the survey period. Among the six fisheries surveyed, Escuminac and Caraquet fisheries were the largest. Fishing effort averaged 36.3 km per day and 18.6 km per day for the two fisheries respectively.

The survey has shown that aerial photographic surveys provide a reliable method of monitoring inshore herring fishing gear. The method is relatively easy, less time consuming, and cheaper than other conventional methods of surveying gillnet fishing effort.

Résumé

On a effectué en mai 1980 un relevé aérien de la distribution et de l'intensité de la pêche côtière au hareng dans le sud du golfe du Saint-Laurent. On s'est servi d'un aéronef monomoteur volant à une altitude de 3 000 pi et équipé d'une caméra pour photographie aérienne. Le relevé couvrit six principales pêcheries, ce qui demanda 40 heures de vol et la prise de 750 photos.

L'intensité de la pêche variait beaucoup d'un endroit à l'autre: d'un minimum de 10 filets standards (,27 km de long) dans la région de Néguac à un maximum de 2 252 filets (61,7 km de long) près d'Escuminac. La distribution des filets maillants et l'intensité de la pêche, en termes de nombre et de longueur des filets mis à l'eau, ont toutes deux varié au cours du relevé. Parmi les six pêcheries étudiées, celles d'Escuminac et de Caraquet étaient les plus intensives. L'effort de pêche dans ces deux régions était en moyenne de 36,3 km et de 18,6 km par jour respectivement.

Le relevé a démontré que la photographie aérienne était une méthode fiable de surveillance des engins de pêche côtière. Elle est relativement facile, requiert moins de temps et est moins dispendieuse que les méthodes conventionnelles de surveillance de l'effort de pêche aux filets maillants.

Introduction

The lack of a reliable index of abundance for inshore herring fisheries is one of the problems facing herring stock assessments in the southern Gulf of St. Lawrence region. At present only catch-per-unit effort data from the purse seine fishery are used to calculate indices of abundance. These indices are subject to bias which is difficult to assess, and may not be sensitive enough to detect significant changes in herring population size.

Because of the large numbers of small boats involved in the widely dispersed inshore herring fisheries and the absence of logbooks, fishing effort data in terms of number of nets fished or even number of fishing trips made are lacking. The urgent need for estimates of fishing effort for the inshore fisheries has been recognized. Two projects, namely re-examination of historical purchase slip data and an aerial survey of inshore fishing gear distribution were initiated in an attempt to obtain a more accurate estimate of inshore fishing effort. Results of the latter project are the subject of this report.

A pilot project which used aerial surveys to monitor the distribution and density/km^2 of herring gillnets in the southern Gulf of St. Lawrence was carried out in May, 1979. The survey was conducted in Miramichi Bay, N. B., an area which supports a major inshore spring herring fishery. A set of 50 aerial photographs covering a 16 km stretch of shore from Bay du Vin to Point Escuminac was taken at altitudes of 6,000 ft. and 3,000 ft. Photographs taken at the latter altitude (scale: 1/6000) were more suitable for identification and measurement of herring gillnets.

Materials and Methods

A single-engine PA-22 "150" Piper Tri-Pacer was chartered for the aerial photographic survey. The aircraft was equipped with a K17B aerial camera with 6" focal length and a yellow filter (minus blue). The camera mount was adjustable for tilt and drift angle, and Tri-X aerographic 2403, Estar base, 10" format film was used.

Cruising speed was 100 knots (185.3 km/hr). Photographs were taken so as to overlap by $\sim$ 35% each. Variations in scale due to altitude changes were within a range of $\pm$ 5%. Scale was checked by measuring a land mass of known dimensions on the photographs.

Initially, sun glare reflected from the water surface created some problems as it tended to conceal the nets. This problem was largely overcome by conducting the survey flights near midday when the angle between the sun and water surface was most acute. The timing of the flights was not as critical on overcast days. The flights were made along the southern coast of the Gulf of St. Lawrence, and the northeast and northwest coast of Prince Edward Island (Figure 1) between May 4 and May 31 (Table 1). Flight duration ranged from 2.7 hr to 6.8 h/trip for a total of 38.6 h.

Mapping of the distribution of nets was accomplished by fitting all photographs taken during a survey flight together to form a composite picture, with the aid of the shore-line landmarks and consecutive numbers on the photographs and cruise track. Gillnets were carefully high-lighted with an erasable wax pencil, a transparent acrylic sheet was laid over the photo-mosaic, and nets and shoreline were carefully traced on the transparency with a fine tipped felt marker.

Net tracings on the transparent sheets were measured by two methods initially: by digitizer, a computer-linked tracing board that records the lengths of objects traced with a special cursor, and by opsciometer, a map measurement gauge. To compare accuracy of the two methods, a few photographs were measured by both methods. As the differences between mean measurements were insignificant, and since the digitizer was located in St. Andrew's, N. B., most measurements were made by the opsciometer.

Results

Identification of herring gillnets from the photographs was not difficult. As gillnets were supported in water by a series of floats, usually equally spaced along the head line, floats appeared as a series of dots in almost straight lines or gentle curves (Figure 3). Lobster trap floats were numerous in some areas, but were easily distinguished from gillnets.

Prior to the start of the aerial surveys, interviews were held with experienced local fishermen to determine the probable locations of inshore herring fishing activity. One of the objectives of the first survey (May 4, 1980) was to determine the distribution of fishing boats and gillnets along the coast for subsequent flights.

Major concentrations of gillnets were found in six areas: Caraquet, Neguac, Escuminac, Kouchibouguac, Shediac and northern P.E.I. (Figure 4). There were reports that some fishing activities during spring occur near the southern end of P.E.I. and Georges Bay, N. S., but these are minor fisheries and due to flight time limitations were not systematically surveyed.

The schedule of air flights and flight times are presented in Table 2. Four to five flights were made in each of the six major fishing areas, between 4 May and 31 May, 1980. Flights were originally scheduled twice per week, but due to weather conditions the schedule could not be followed completely. Nevertheless, flights were made to ensure that peak fishing periods were covered in all areas surveyed.

Caraquet

Flights over Caraquet area covered a stretch of coast approximately 100 km long and 2 km wide from Belloni Pt. (District 64) to Miscou/Shippegan Is. (District 66) (Figures 5-8). Gillnets were scattered along the coast in four concentrations (Figure 5-6) at Belloni-Janeville, Janeville-Grande Anse, Blue Cove and Maisonette-Pt. de Blanchard.

Contrary to observations in past years, when heavy fishing was concentrated between Caraquet Is. and Shippegan Is., the aerial survey did not show any major concentrations of nets in this area. Most gillnet concentrations were in the western part of the surveyed area. On 15 May all gillnets observed were in the Janeville area. On 17 May two concentrations of nets were observed near Blue Cove and near Grindstone. On 31 May, the concentration of nets expanded from Grindstone westwards to Belloni Pt.

Both the distribution of gillnets and fishing intensity, in terms of number of nets set, varied during the survey period (Table 2). At Belloni Pt., the the number of standard nets decreased from 523 on 15 May to 185 nets on 22 May and then increased to 489 nets on 31 May. In the Janeville area the change in net intensity followed the same trend as at Belloni Pt., although there were fewer nets. In Blue Cove, the number of nets varied slightly (from 363 to 385 nets) during the survey. In Maisonette, the number of nets decreased from 47 on 23 May to 11 on 31 May.

In total, the number of nets in the area increased from 523 at the start of the survey to 1,013 at the end of the survey, with an average of 678.5 standard nets set per day (Table 3). The total length of gillnets set ranged from 14.3 km to 27.8 km during the survey period, with an average of 18.6 km of nets set per day.

Neguac/Burnt Church

The major spring herring fishery in the southern Gulf is, at present, located in the outer Miramichi Bay, particularly along the southern shore near Escuminac. The northern shore of inner Miramichi Bay supports a small fishery near Neguac/Burnt Church (Figures 9-12). Four flights were made over the Neguac area between 15 and 31 May. Concentrations of nets were observed in two areas on 15 May and 20 May; the larger concentration off Burnt Church, and the other off Neguac. On 23 May and 31 May, there were no herring nets off Neguac, although the concentrations near Burnt Church remained. Number of nets observed was small (Table 3), ranging from 149 standard nets on 15 May to only 10 nets on 31 May, with an average of 97.8 nets per day. Length of nets set ranged from 4.1 km to 0.3 km with an average of 2.7 km per day.

Escuminac

The Escuminac herring fishery is by far the largest in the southern Gulf of St. Lawrence. Five flights were made over Escuminac between 4 and 31 May (Figure 13-17). The fishing gear was distributed mainly in a strip approximately 20 km long from Pt. Escuminac east to Fox Is., with a width of up to 4 km from shore. The area of greatest concentration was near Escuminac wharf, with the highest fishing intensity observed on 4 May and 17 May. On 4 May, in the centre of the concentration, it was estimated that 1,086 standard nets (total length 29.8 km) were set in an area of 7 square kilometers. On 17 May, the number of nets was 1,174 (total length 32.2 km) in 8 square kilometers of water.

Fishing intensity decreased steadily throughout the season from 2,252 nets to 715 nets by the end of May, with an average of 1,324 nets set per day. In terms of length, fishing effort was estimated to be 61.7 km on 4 May and 19.6 km on 31 May, with an average of 36.3 km per day (Table 3). This fishing effort was the highest observed among all fisheries, with the number of gillnets in the Escuminac area in the early part of the season higher than in all other areas combined.

Kouchibouguac

The aerial survey covered about 50 km of coast between Kouchibouguac Beach and Dune de Buctouche. Five flights were made between 11 May and 31 May. Distribution of nets was uneven, and in most locations sparse (Figures 18-22). In terms of fishing effort, Kouchibouguac was the second smallest fishery after Neguac.

The greatest concentration of fishing nets throughout the fishing season was in District 76. Throughout the survey period, the number of nets set ranged from 85 to 442, with an average of 229.6 nets set per day. In terms of length, this is equivalent to a range of 2.3 km to 12.1 km, with an average of 6.3 kg per day. During the survey, the distribution of nets near Dune de Buctouche, shifted from north to south.

Shediac

Figure 23-27 show the distribution and density of gillnets in the Shediac area during 5 flights made between 11 May and 31 May. The flights covered a stretch of coast approximately 65 km long and 2 km wide, from Dixon Pt. in the north to Johnson Pt. in the south. The heaviest concentration of nets throughout the survey was near Pointe aux Renards, on 18 May. Of the three fishing districts surveyed, District 77 had the highest concentration of nets (Table 2). On 11 May, the fishing nets were distributed mainly between Shediac and Fagan Pt. On 18 May, the distribution of nets extended further north to Cocagne Is. and south to Johnson Pt. On 23 May, a further northward extension of the fishing area toward Dune de Buctouche was observed (Figure 22). The net distribution remained about the same during the rest of the survey period (Figures 24-26).

Intensity of fishing effort varied markedly during the survey in terms of the number of nets set. The number of nets increased from 204 on 11 May to 720 on 20 May, and then decreased to 116 on 31 May, with an average number of 377.0 nets set per day (Table 3). The length of nets set ranged from 3.2 km to 19.7 km, with an average of 10.3 km per day.

North Prince Edward Island

The spring herring fishery was concentrated mainly off North Pt., P.E.I. (Figures 28-31). Four flights were made between 11 May and 31 May, along a section of coast approximately 40 km long and 2 km wide. The survey included both the northeast and northwest coasts (District 92 and 82 respectively). By far the largest concentration of nets was located on the northeast coast (Table 2). On both coasts combined, the average number of nets set was 448.8 nets per day, or 12.3 km of nets per day (Table 3).

The number of nets along the northeast coast decreased sharply from 700 nets on 11 May to 338 nets on 18 May and then to 234 nets on 31 May. On the northeast coast the number of nets ranged from 22 on 11 May to 69 nets on 31 May, with no obvious trend in number set.

Discussion

The present report has shown that aerial photographic surveys provide a reliable method of monitoring inshore herring fishing gear in the southern Gulf of St. Lawrence. This method is relatively easy, time saving and probably cheaper than other conventional methods of surveying fishing effort. The method is particularly useful in situations similar to that of inshore herring where fishing gear is widely dispersed, and its enumeration by other means is practically impossible. Advantages of the aerial survey are the ability to monitor both intensity and distribution of fishing gear throughout the fishing season.

The survey has shown that the intensity of fishing effort in terms of number of nets per unit area, or net measurements (length in kilometers) varies during the fishing season. Moreover, the length of individual nets varied in space and time. These variations could be expected, since the fishermen change the number of nets in each fishing set depending on the size of fish schools observed, and their expected catches. Estimates of fishing effort by conventional methods, e.g. number of boats, fishermen or fishing trips are less reliable since they do not reflect these variations.

The intensity of fishing effort varied widely from as low as 10 standard nets (0.27 km) in the Neguac area to as high as 2,252 nets (61.7 km) near Escuminac. The magnitude of fishing intensity in the latter area can be more strongly appreciated in view of the small size of the fishing area (approximately 10 km^2).

Spatial and temporal variations in net distribution provide useful information not only for monitoring of fishing effort, but also for the monitoring of fish movements. On the assumption that fishermen set their nets in the path of fish during their migration to spawning grounds, a general idea of the migratory route could be formulated.

Table 1. Flight schedule for aerial photographic survey of herring gillnets in the southern Gulf of St. Lawrence, May 1980.

	May 1980									
Date	4	11	15	17	18	20	22	23	28	31
Area										
Caraquet			x	x			x			x
Neguac			x			x		x		x
Escuminac	x			x			x		x	x
Kouchibouguac		x				x		x	x	x
Shediac		x			x			x	x	x
N. P.E.I.		x			x			x		x
Flying Hours	2.7	3.8	2.9	3.5	3.7	2.8	3.6	3.9	4.9	6.8

Table 2. Number and length of herring gillnets along the southern coast of Gulf of St. Lawrence during May, 1980 aerial surveys.

Location	Fishery District	Date	Number of observed nets	Number of standard[a] nets	Length o nets (km
Caraquet Area					
Belloni Pt. - Janeville	64-65	May 15	119	523	14.330
		May 22	56	185	5.069
		May 31	139	489	13.399
Janeville - Grande Anse	65	May 17	47	145	3.973
		May 22	16	53	1.452
		May 31	39	137	3.754
Blue Cove	65	May 17	125	385	10.302
		May 22	110	363	9.946
		May 31	107	376	10.302
Maisonette - Pt. Blanchard	65	May 22	14	47	1.288
		May 31	3	11	.301
Neguac Area	70	May 15	43	149	4.083
		May 20	37	128	3.507
		May 23	30	104	2.850
		May 31	3	10	.274
Escuminac Area	73-75	May 4	623	2,252	61.705
		May 17	679	2,092	57.321
		May 22	189	814	22.304
		May 28	161	747	20.468
		May 31	150	715	19.591
Kouchibouguac Area	75	May 11	10	35	.959
		May 20	13	49	1.343
		May 23	7	28	.767
		May 28	12	49	1.342
		May 31	2	9	.247
	76	May 11	30	105	2.877
		May 20	46	172	4.713
		May 23	98	390	10.686
		May 28	39	164	4.494
		May 31	18	76	2.082
	77	May 23	6	24	.658
		May 28	11	47	1.288

Table 2. (continued)

Location	Fishery District	Date	Number of observed nets	Number of standard nets	Length o nets (km
Shediac Area	77	May 18	112	380	10.412
		May 23	162	362	9.919
		May 28	57	505	13.837
		May 31	23	74	2.028
	78	May 11	68	204	5.590
		May 18	147	320	8.768
		May 23	35	120	3.288
		May 28	44	158	4.329
		May 31	13	42	1.151
	80	May 18	8	20	.548
North P.E.I.	82	May 11	5	22	.603
		May 18	18	71	1.945
		May 23	7	29	.795
		May 31	15	69	1.891
	92	May 11	160	700	19.180
		May 18	86	336	9.261
		May 23	71	332	9.097
		May 31	51	234	6.412

[a] Based on interviews with fishermen the length of a standard herring gillnet is 27.4 m (90 ft). Several of these nets are usually joined to form a "string".

Table 3. Average number and length of herring gillnets per day in six areas of major fishing effort along the southern coast of the Gulf of St. Lawrence, 1980.

Area	Number of observed nets	Number of standard nets[1]	Length of nets (km)
Caraquet	193.8	678.5	18.591
Nequac	28.3	97.8	2.678
Escuminac	360.4	1324.0	36.278
Kouchibouguac	58.4	229.6	6.291
Shediac	133.8	377.0	10.330
North P.E.I.	103.3	448.8	12.296

[1] A standard net is 27.4 m (90 ft) long.

Figure Legends

Figure 1. Map of S. Gulf of St. Lawrence showing fishing districts.

Figure 2. Statistics and length/frequency distribution of herring gillnets as produced by computer digitizer.

Figure 3. Aerial photograph showing herring gillnets.

Figure 4. Map of S. Gulf of St. Lawrence showing six areas covered by aerial survey during May, 1980.

Figures 5-8. Distribution and density of herring gillnets in Caraquet area.

Figures 9-12. Distribution and density of herring gillnets in Neguac area.

Figures 13-17. Distribution and density of herring gillnets in Escuminac area.

Figures 18-22. Distribution and density of herring gillnets in Kouchibouguac area.

Figures 23-27. Distribution and density of herring gillnets in Shediac area.

Figures 28-31. Distribution and density of herring gillnets in N. Prince Edward Island area.

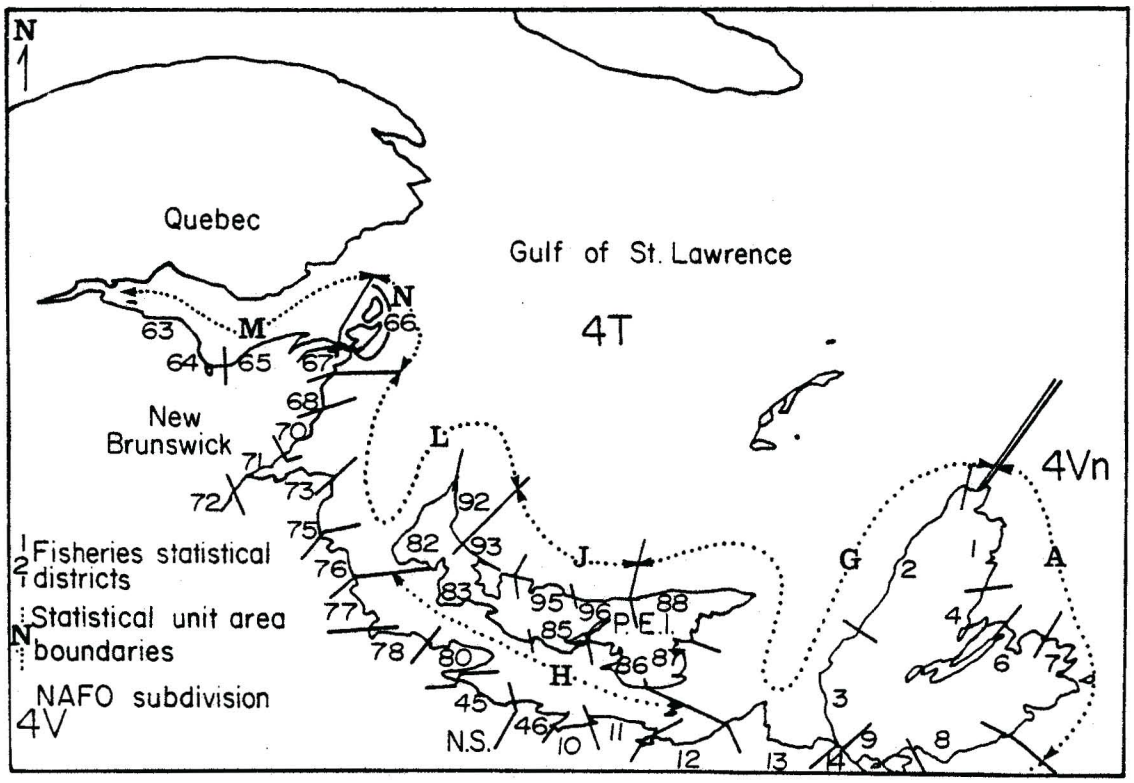

Figure 1. Map of S. Gulf of St. Lawrence showing fishing districts.

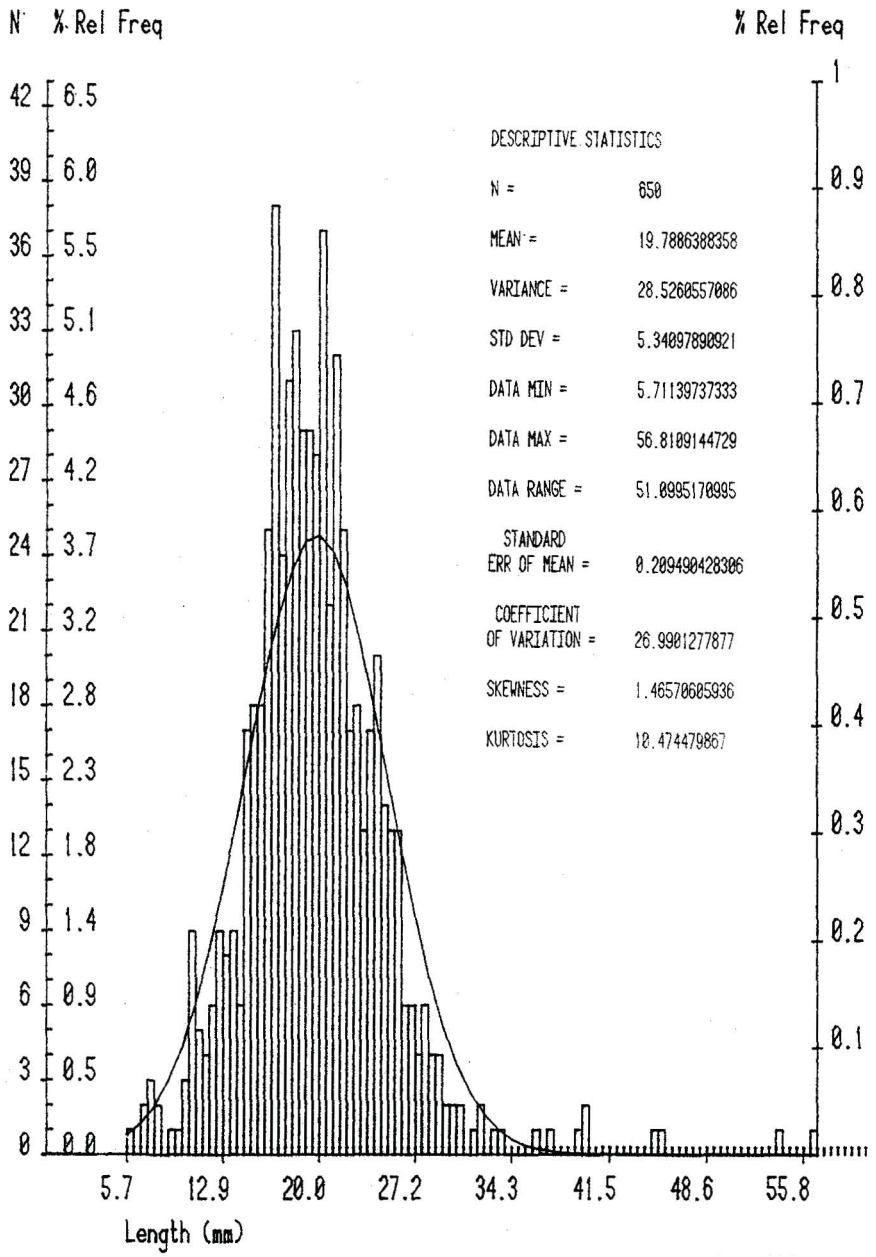

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Figure 3. Aerial photograph showing herring gill nets.

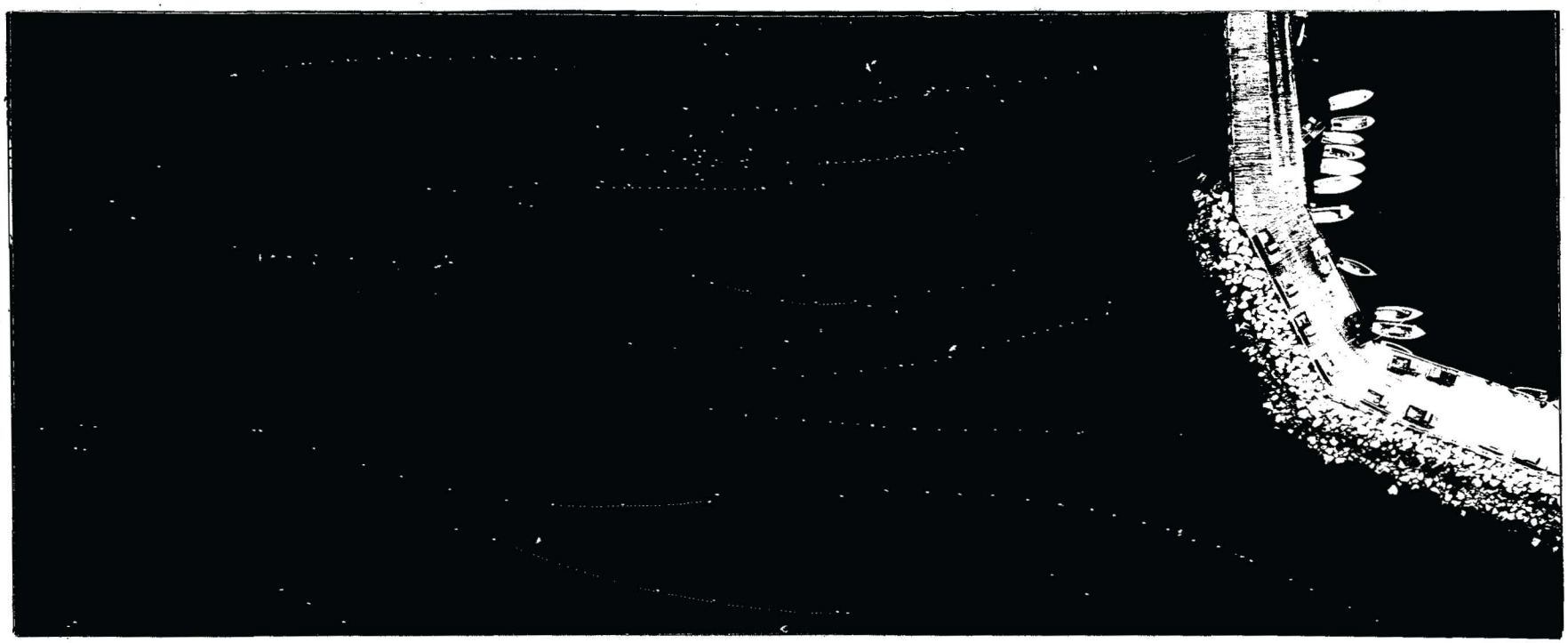


Figure 3. Aerial photograph showing herring gill nets.

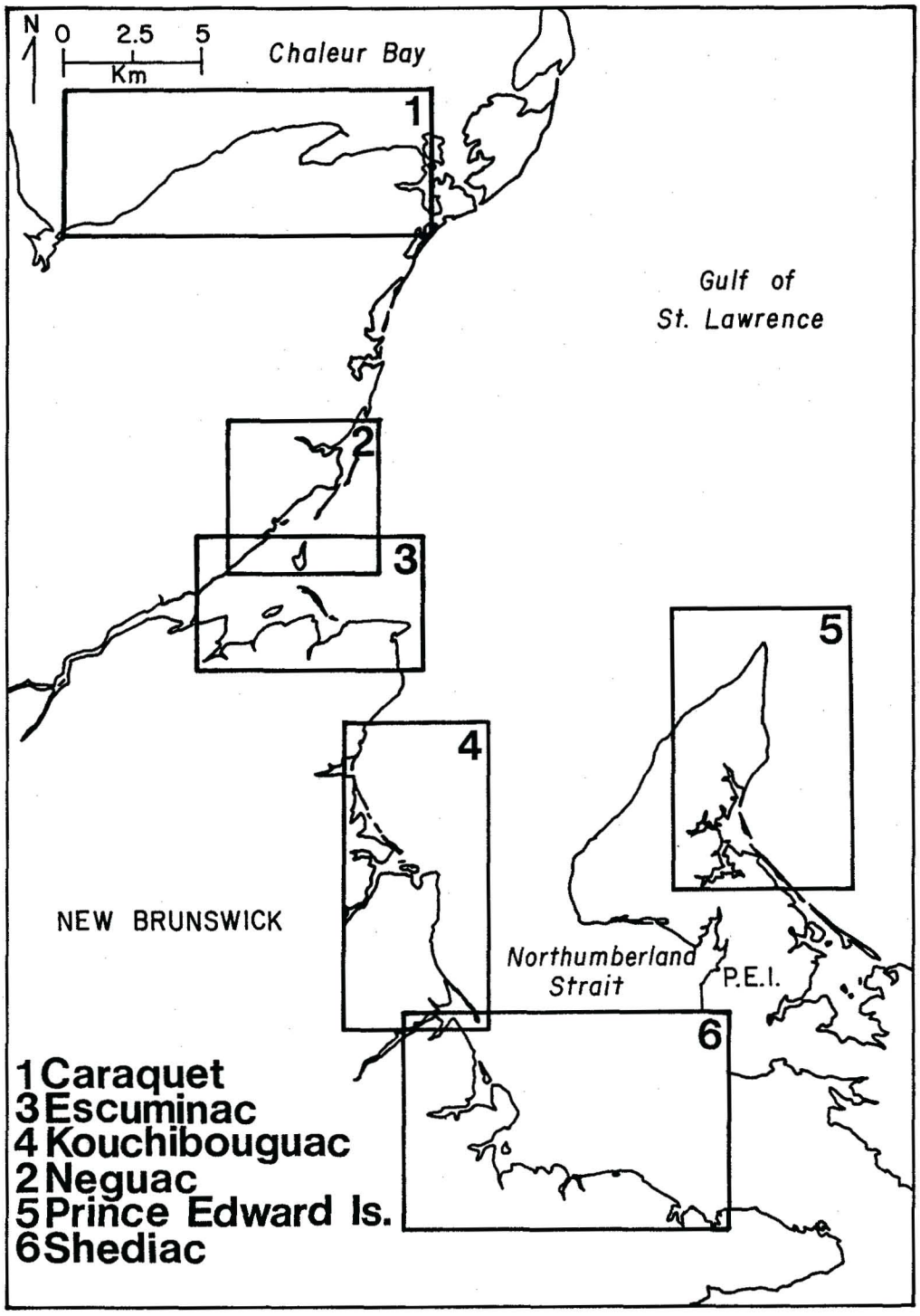


Figure 4. Map of S. Gulf of St. Lawrence showing six areas covered by aerial survey during May, 1980.

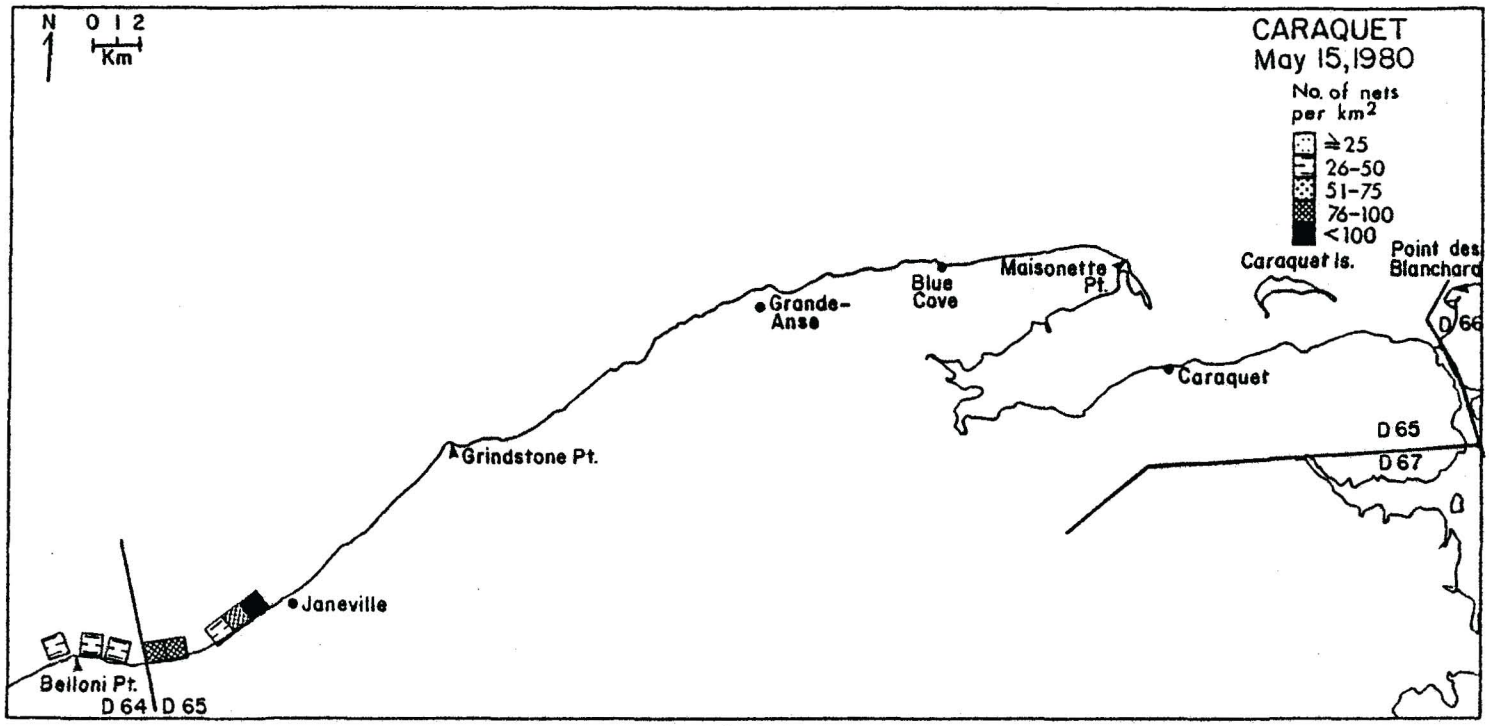


Fig. 5

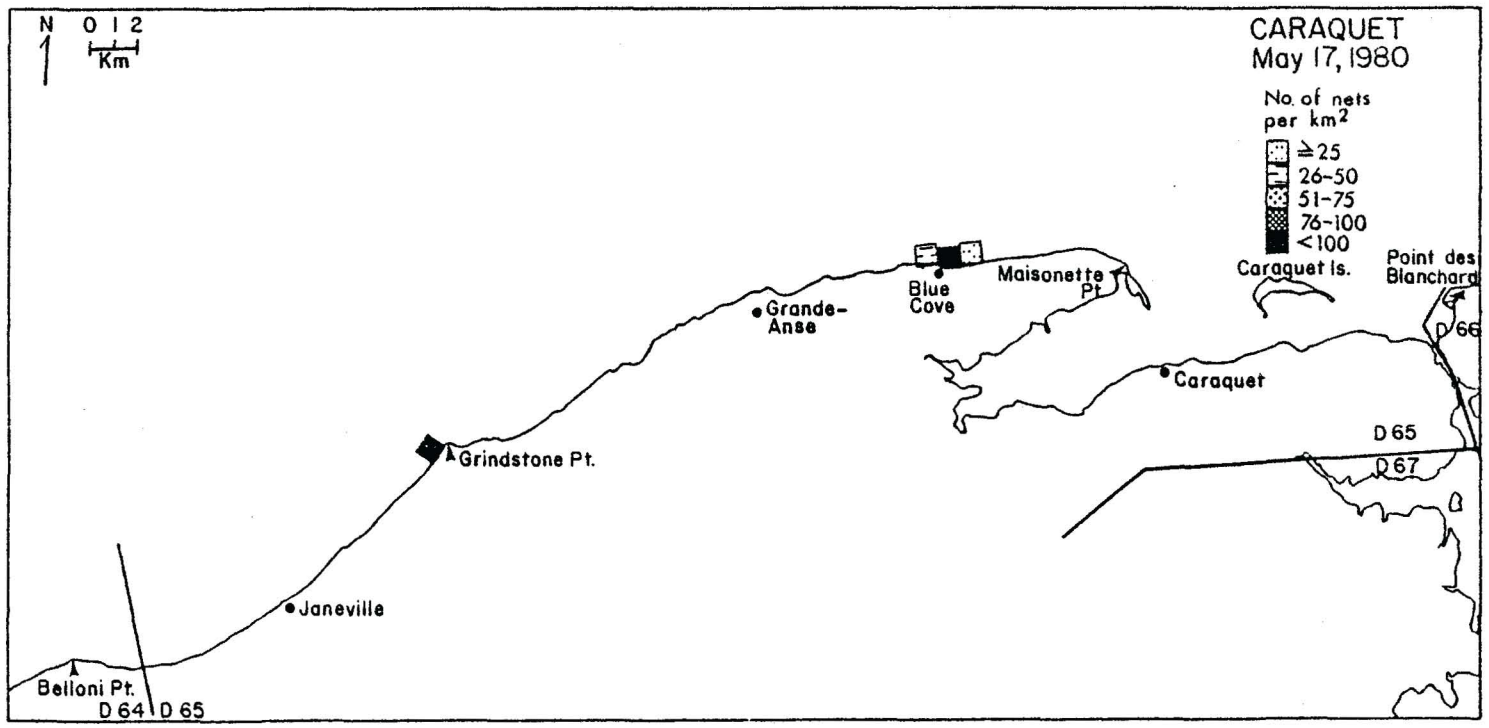


Fig. 6

Figures 5-8. Distribution and density of herring gillnets in Caraquet area.

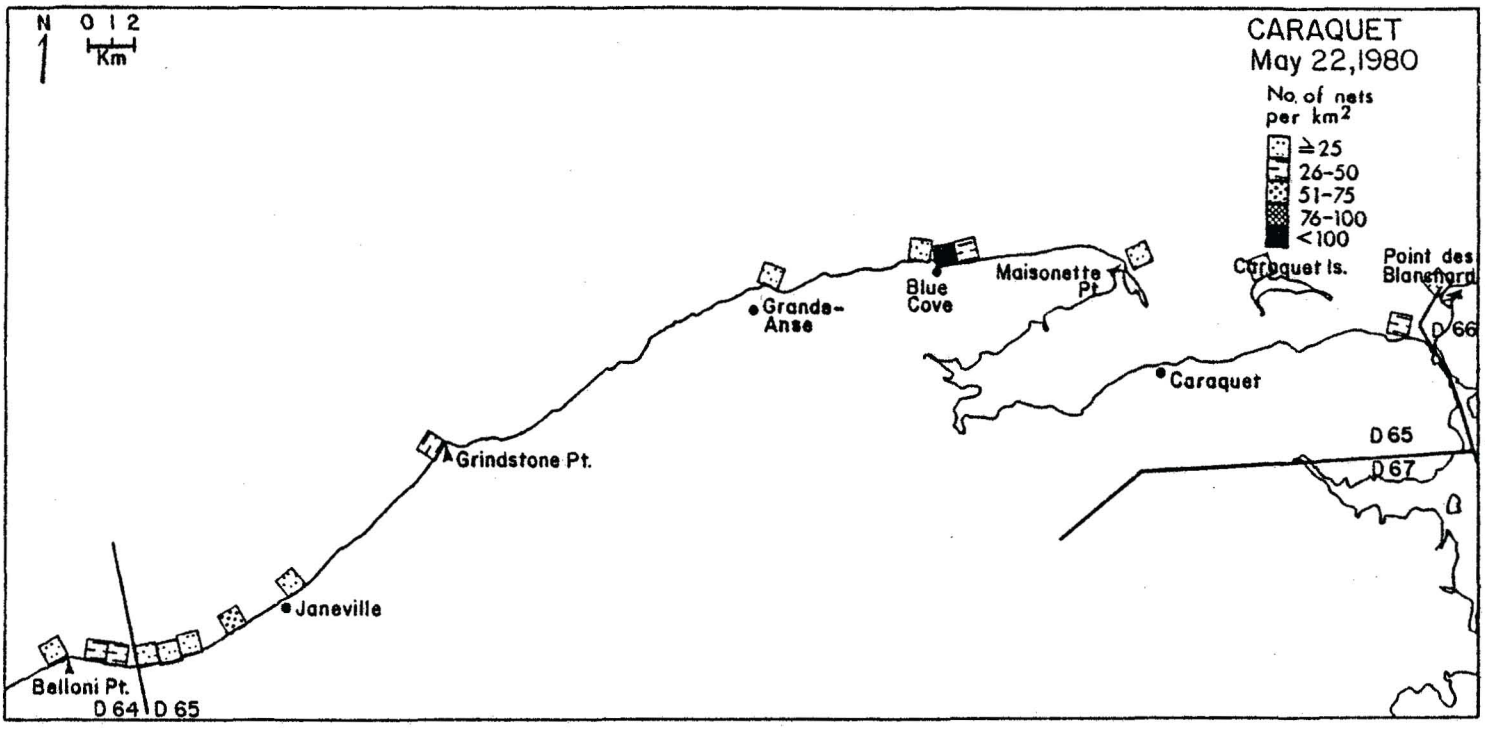
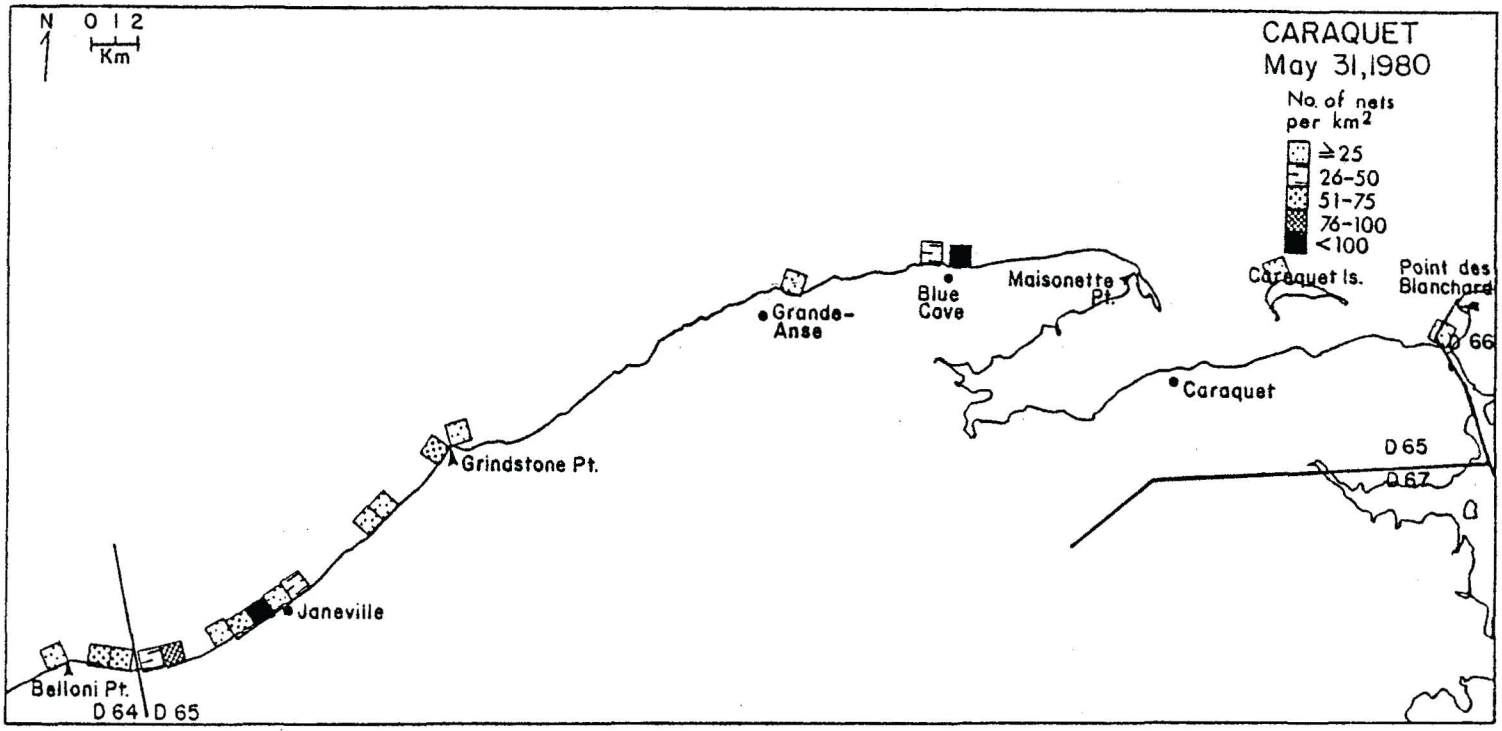

N
0 1 2
Km
CARAQUET
May 22,1980
No. of nets
per km²
≥25
26-50
51-75
76-100
<100
Caraquet Is.
Point des
Blanchard
Maisonette
Pt.
Blue
Cove
Grande-
Anse
D 66
Caraquet
D 65
D 67
Grindstone Pt.
Janeville
Belloni Pt.
D 64
D 65

Fig. 7


N
0 1 2
Km
CARAQUET
May 31,1980
No. of nets
per km²
≥25
26-50
51-75
76-100
<100
Caraquet Is.
Point des
Blanchard
Maisonette
Pt.
Blue
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Caraquet
D 65
D 67
Grindstone Pt.
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Belloni Pt.
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D 65

Fig. 8

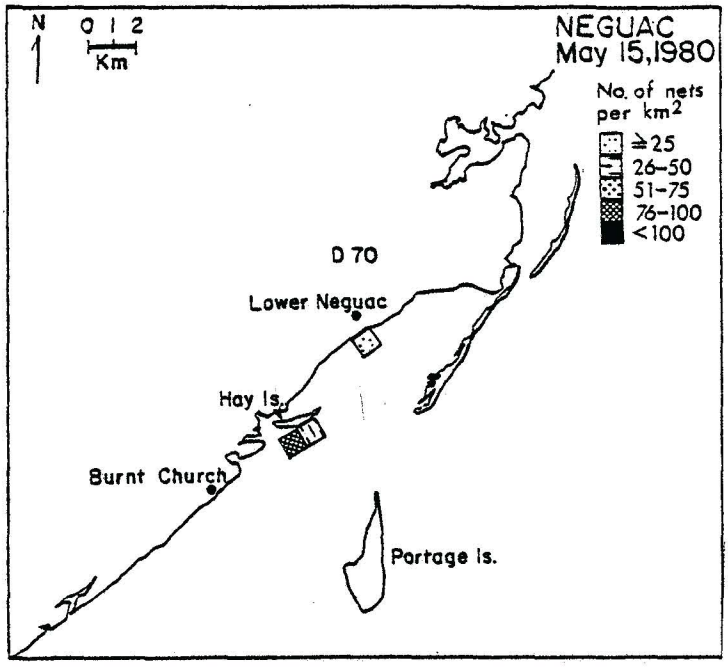

Fig. 9

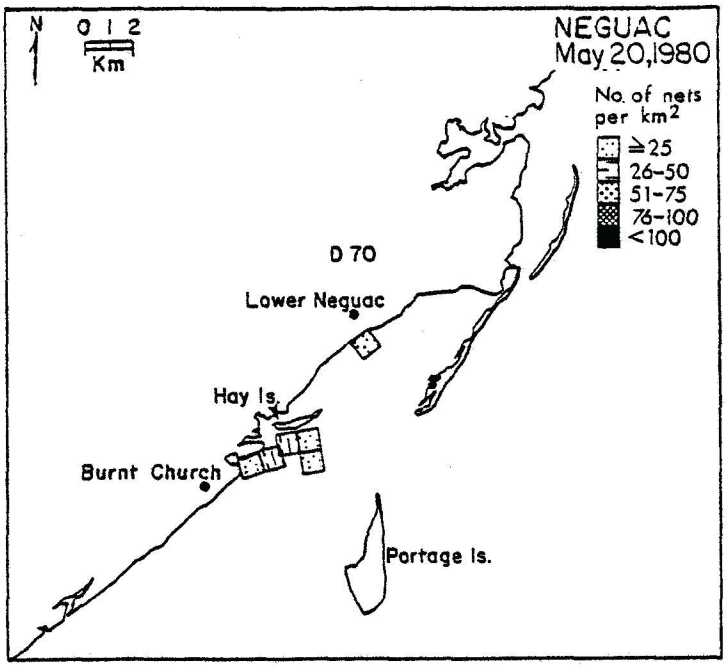

Fig. 10

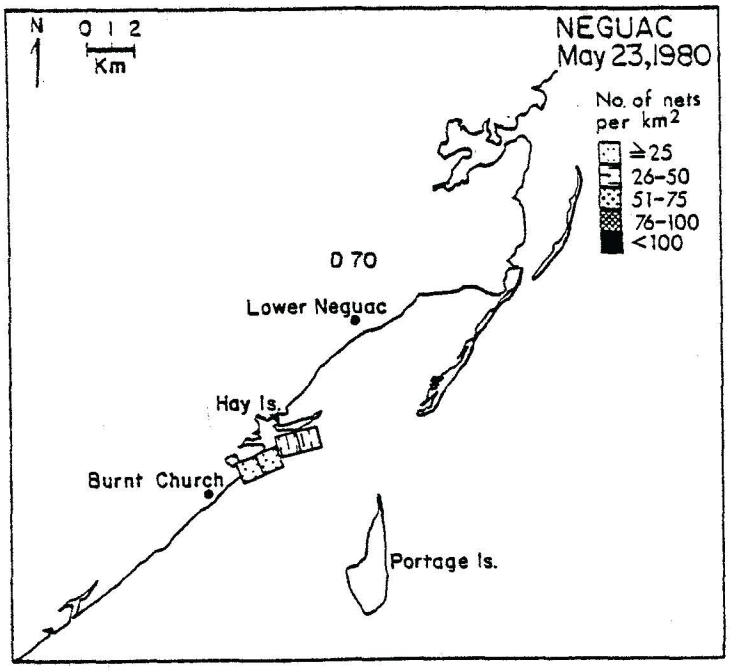

Fig. 11

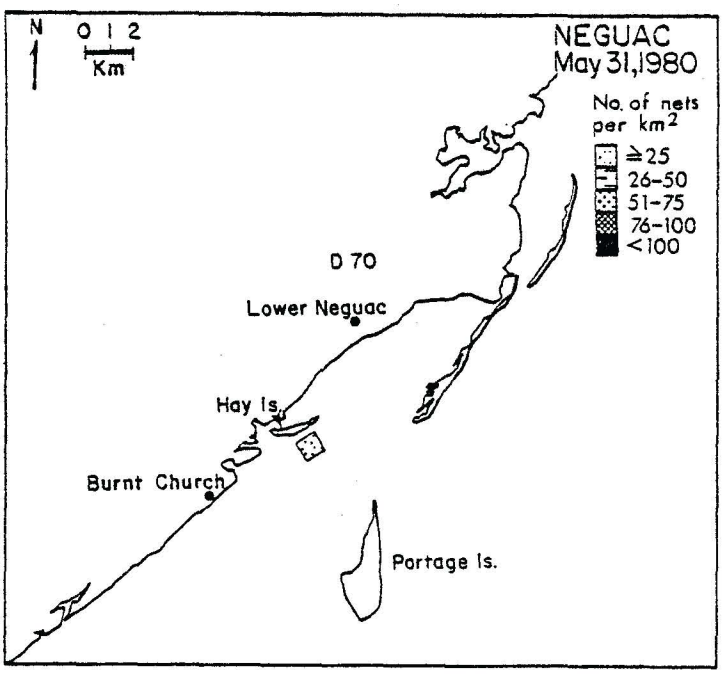

Fig. 12

Figures 9-12. Distribution and density of herring gillnets in Neguac area.

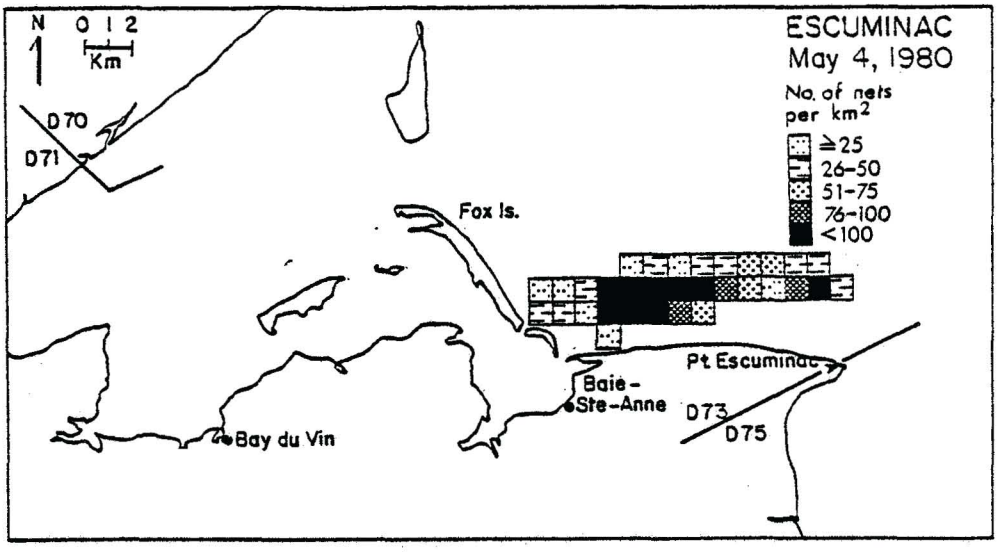

Fig. 13

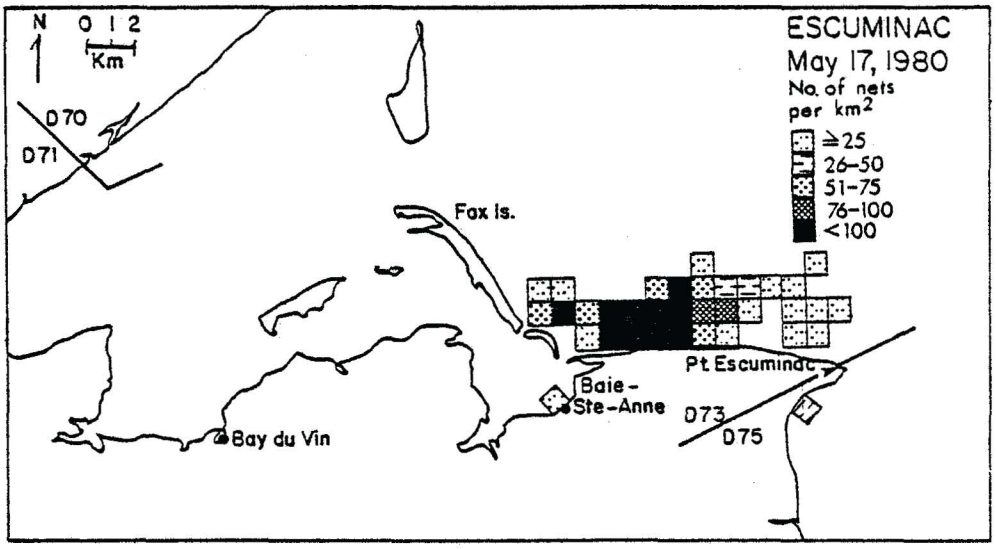

Fig. 14

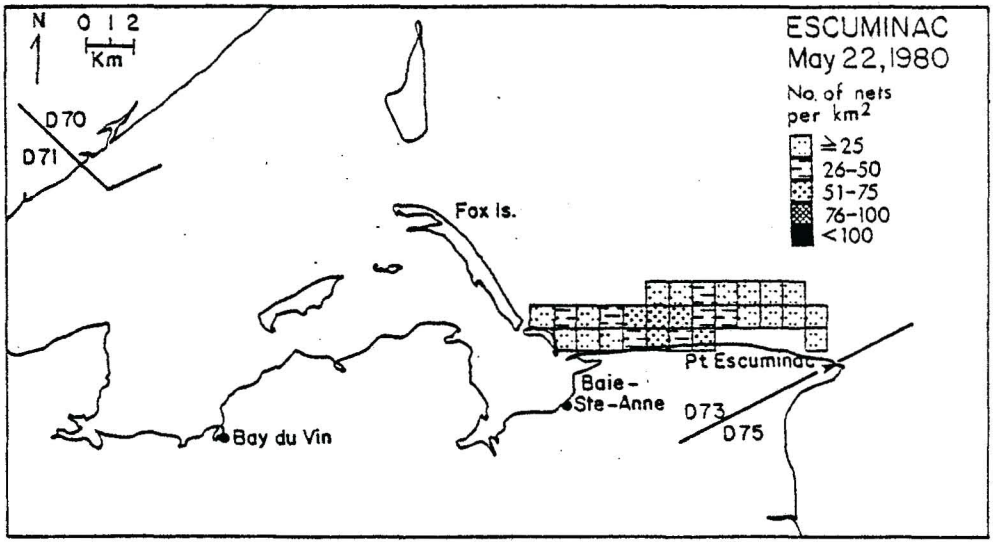

Fig. 15

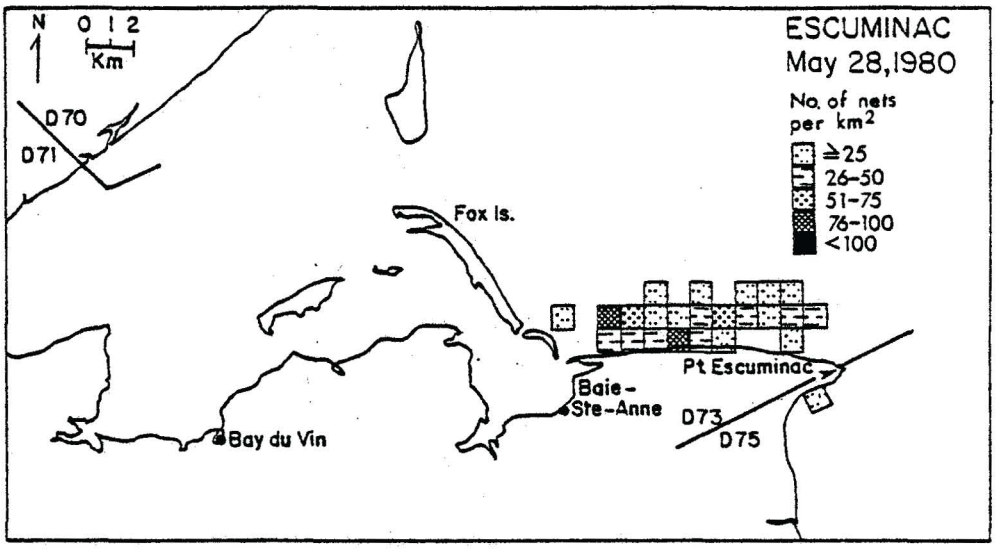

Fig. 16

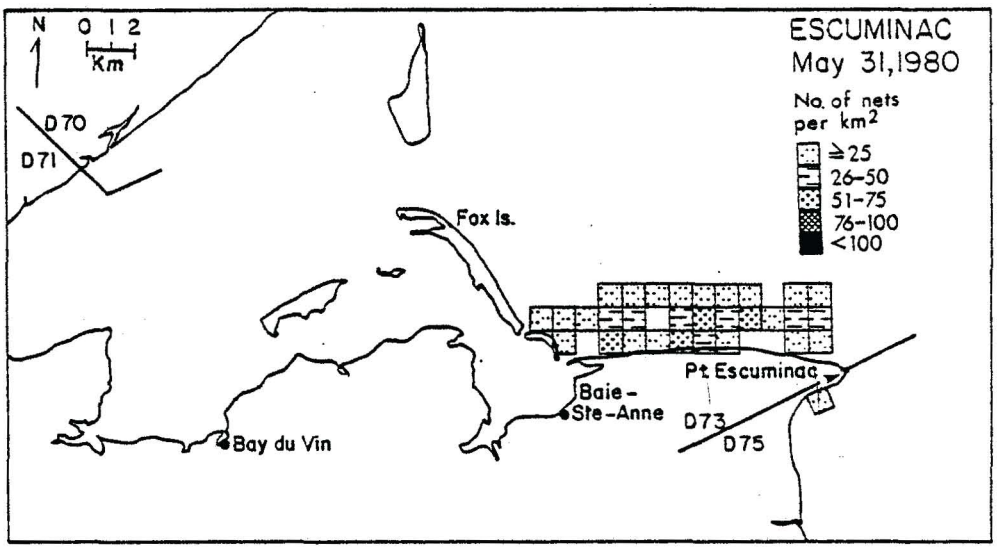

Fig. 17

Figures 13-17. Distribution and density of herring gillnets in Escuminac area.

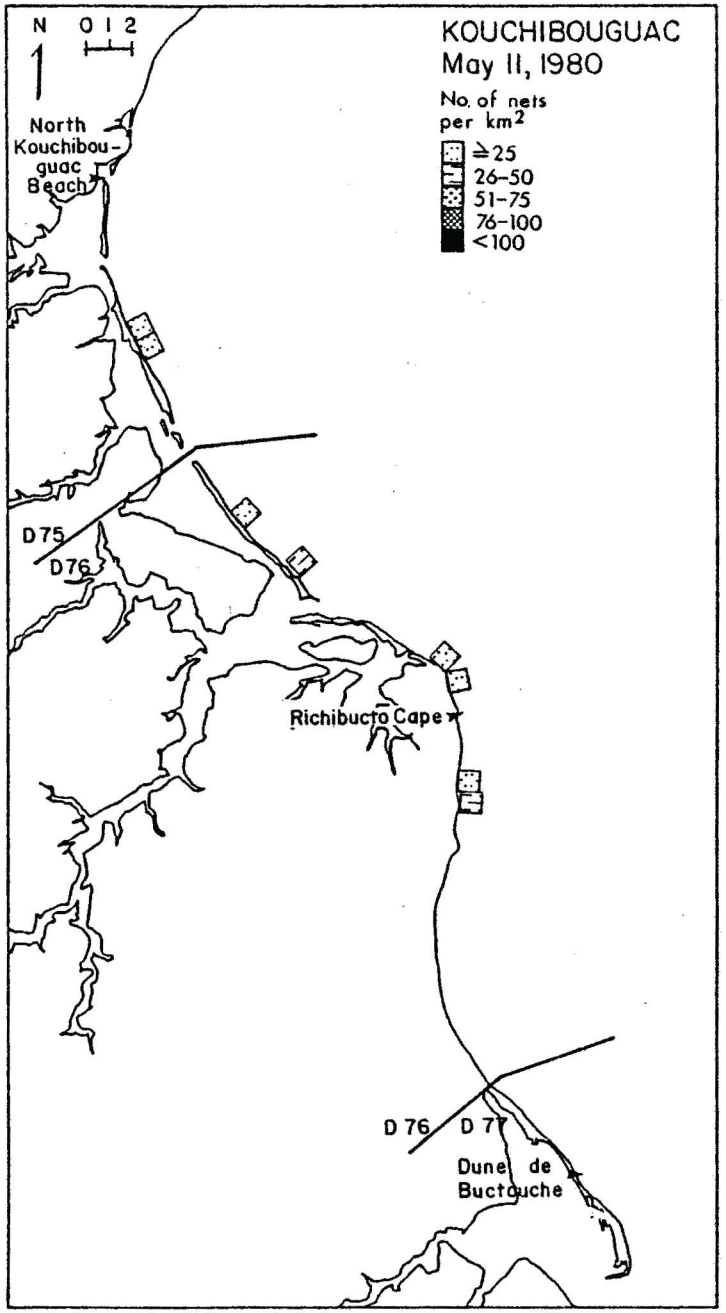
N 0 1 2
1
KOUCHIBOUGUAC
May 11, 1980
No. of nets per km²
≧25
26-50
51-75
76-100
<100
North Kouchibouguac Beach
D75
D76
Richibucto Cape
D 76
D 77
Dune de Buctouche

Fig. 18

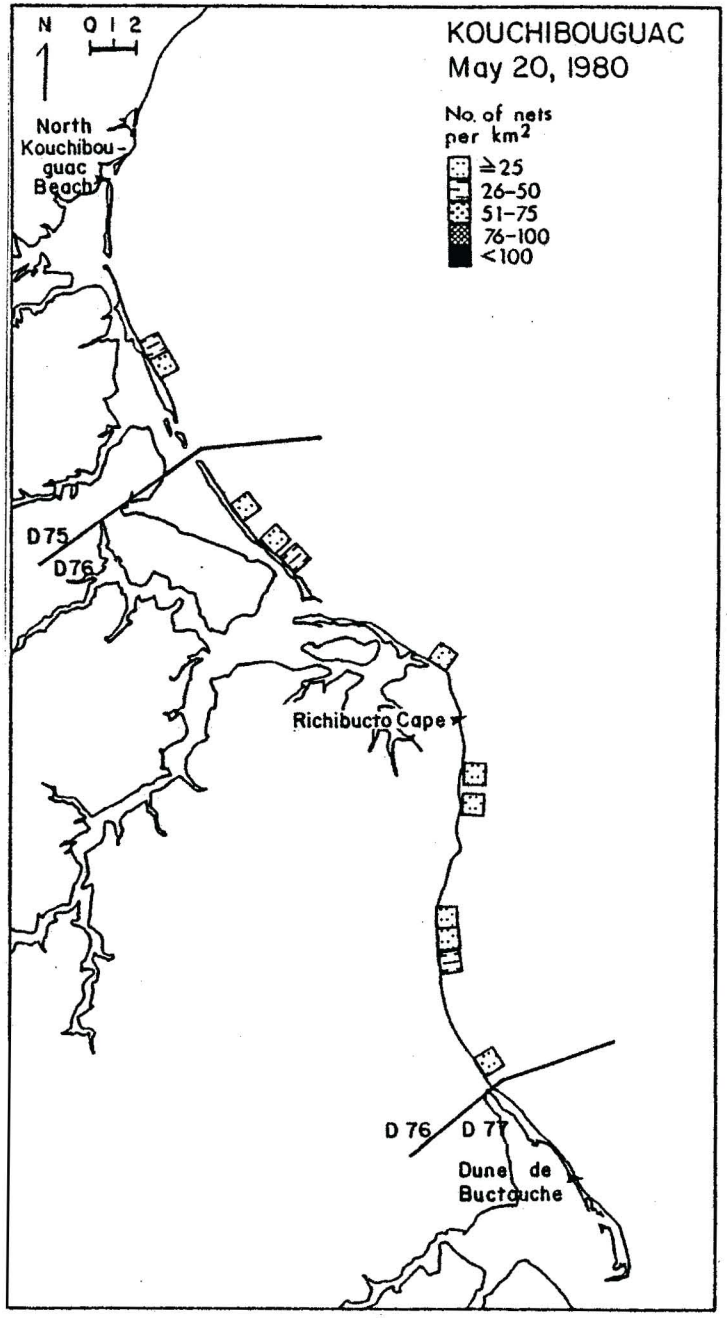
N 0 1 2
1
KOUCHIBOUGUAC
May 20, 1980
No. of nets per km²
≧25
26-50
51-75
76-100
<100
North Kouchibouguac Beach
D75
D76
Richibucto Cape
D 76
D 77
Dune de Buctouche

Fig. 19

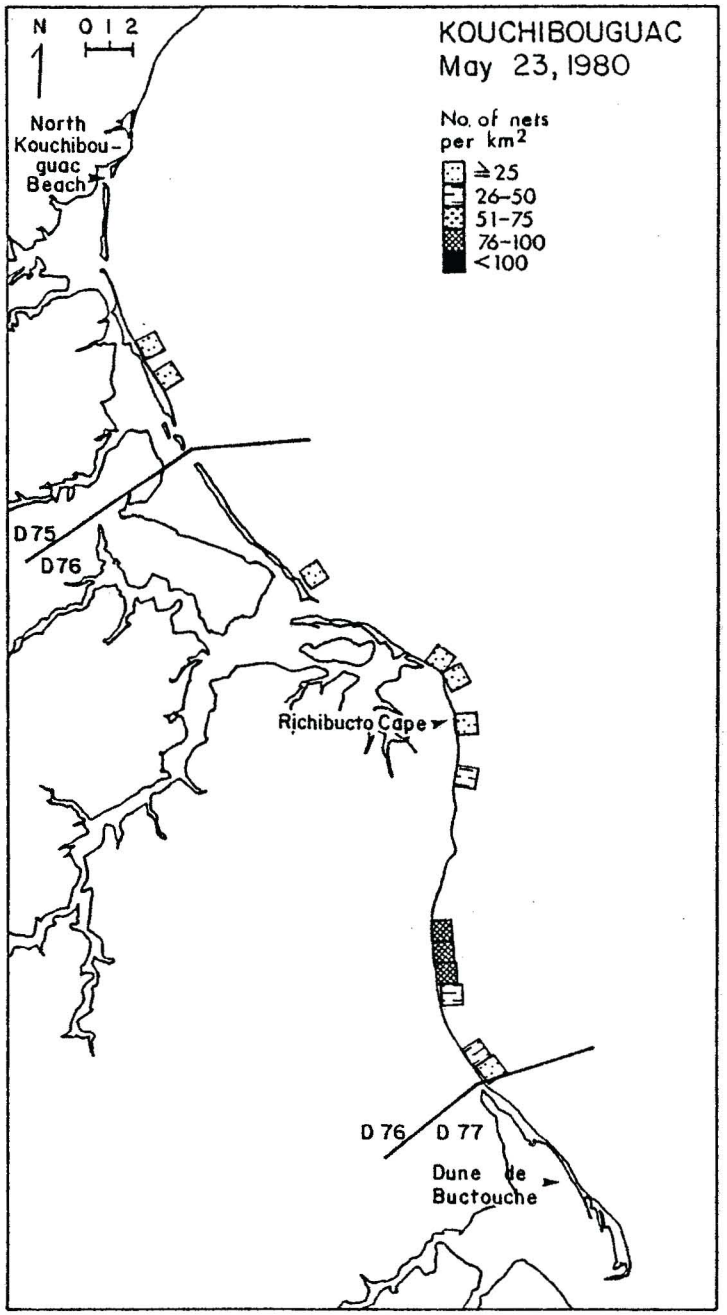
N 0 1 2
KOUCHIBOUGUAC
May 23, 1980
No. of nets per km²
≧25
26-50
51-75
76-100
<100
North Kouchibou-guac Beach
D75
D76
Richibucto Cape
D 76
D 77
Dune de Buctouche

Fig. 20

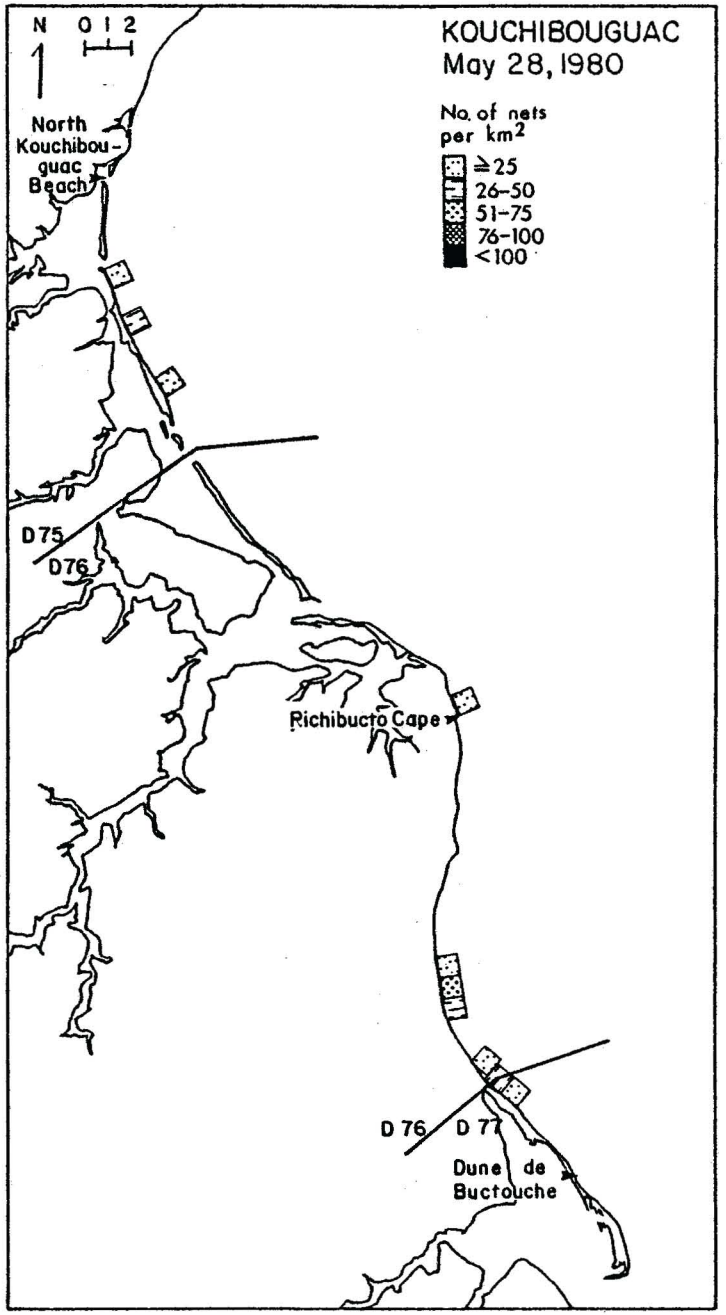
N 0 1 2
KOUCHIBOUGUAC
May 28, 1980
No. of nets per km²
≧25
26-50
51-75
76-100
<100
North Kouchibou-guac Beach
D75
D76
Richibucto Cape
D 76
D 77
Dune de Buctouche

Fig. 21

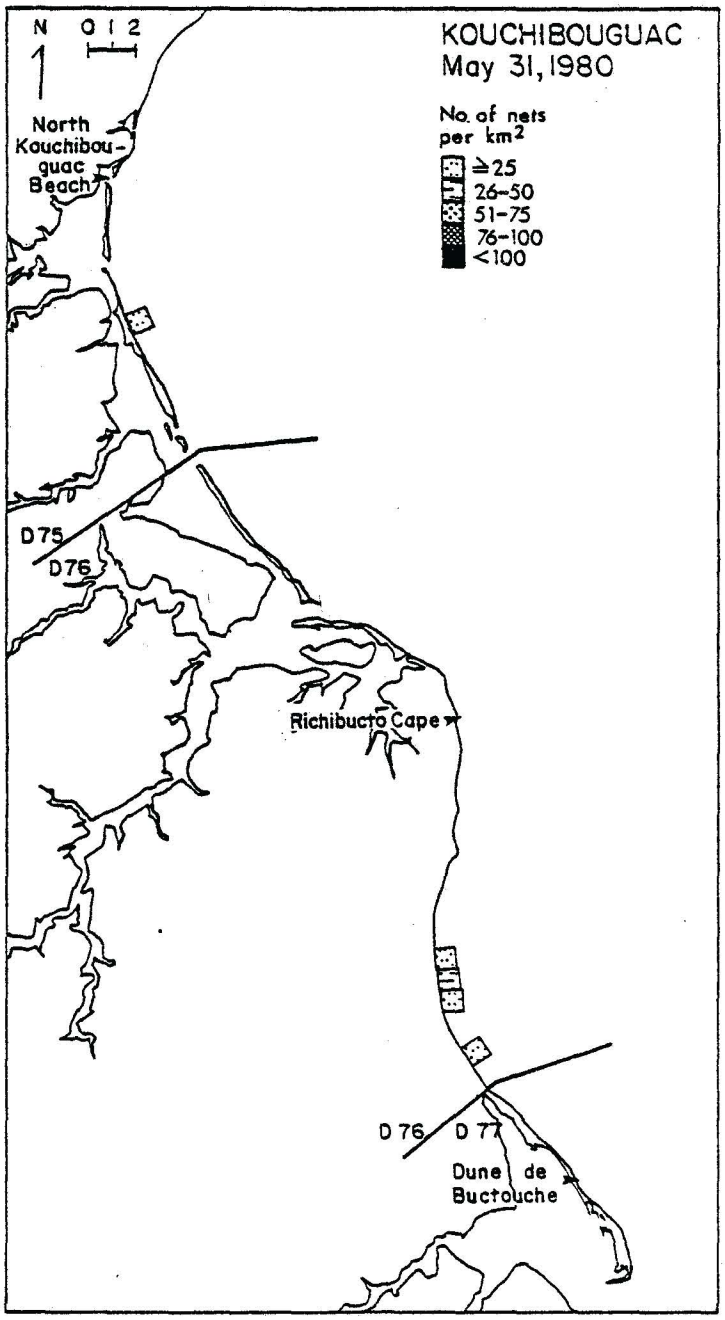

Fig. 22

Figures 18-22. Distribution and density of herring gillnets in Kouc ibou uac area.

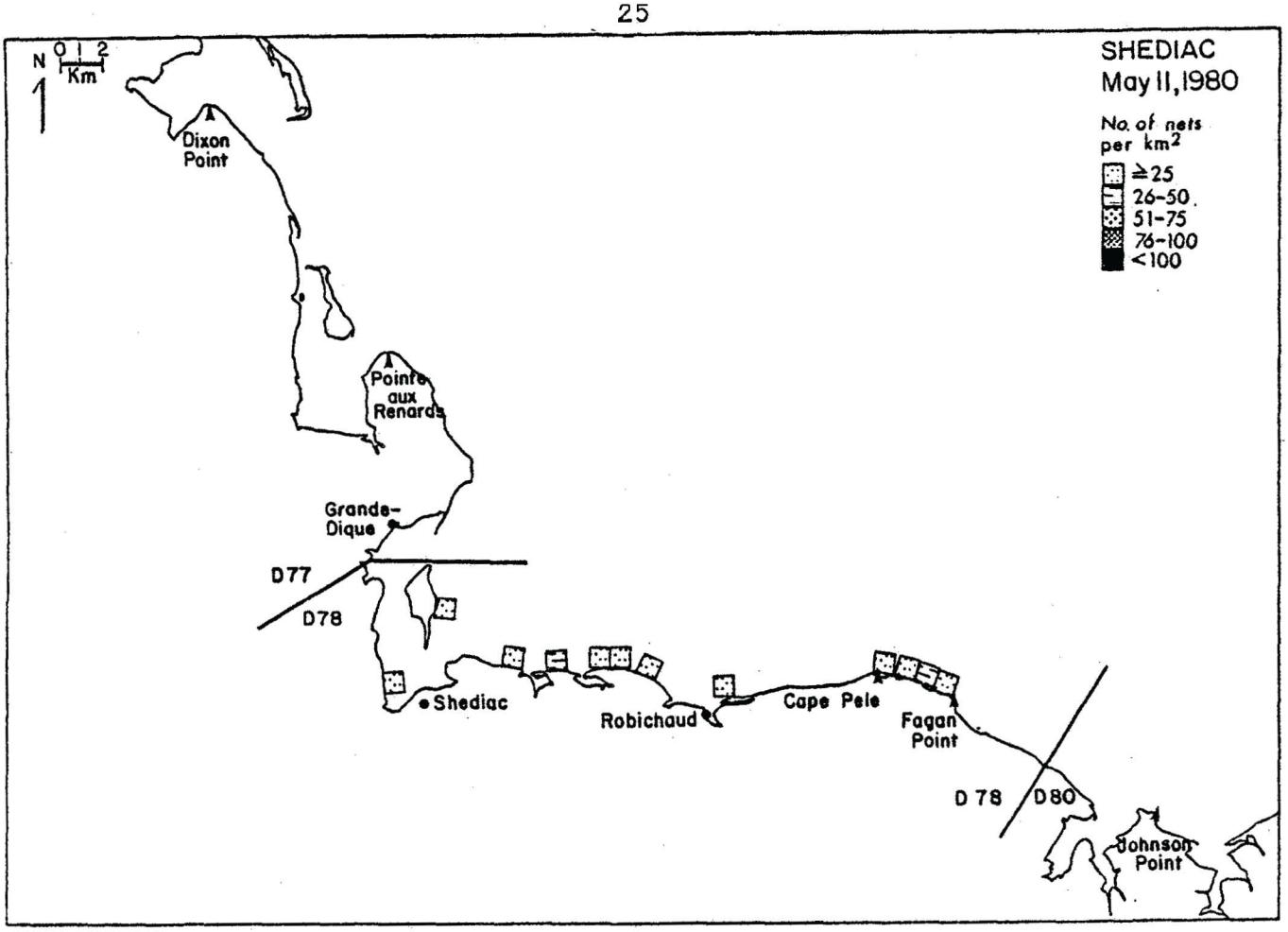
N
0 1 2
Km
SHEDIAC
May 11, 1980
No. of nets per km²
≥25
26-50
51-75
76-100
<100
Dixon Point
Pointe aux Renards
Grande-Dique
D77
D78
Shediac
Robichaud
Cape Pele
Fagan Point
D 78
D80
Johnson Point

Fig. 23

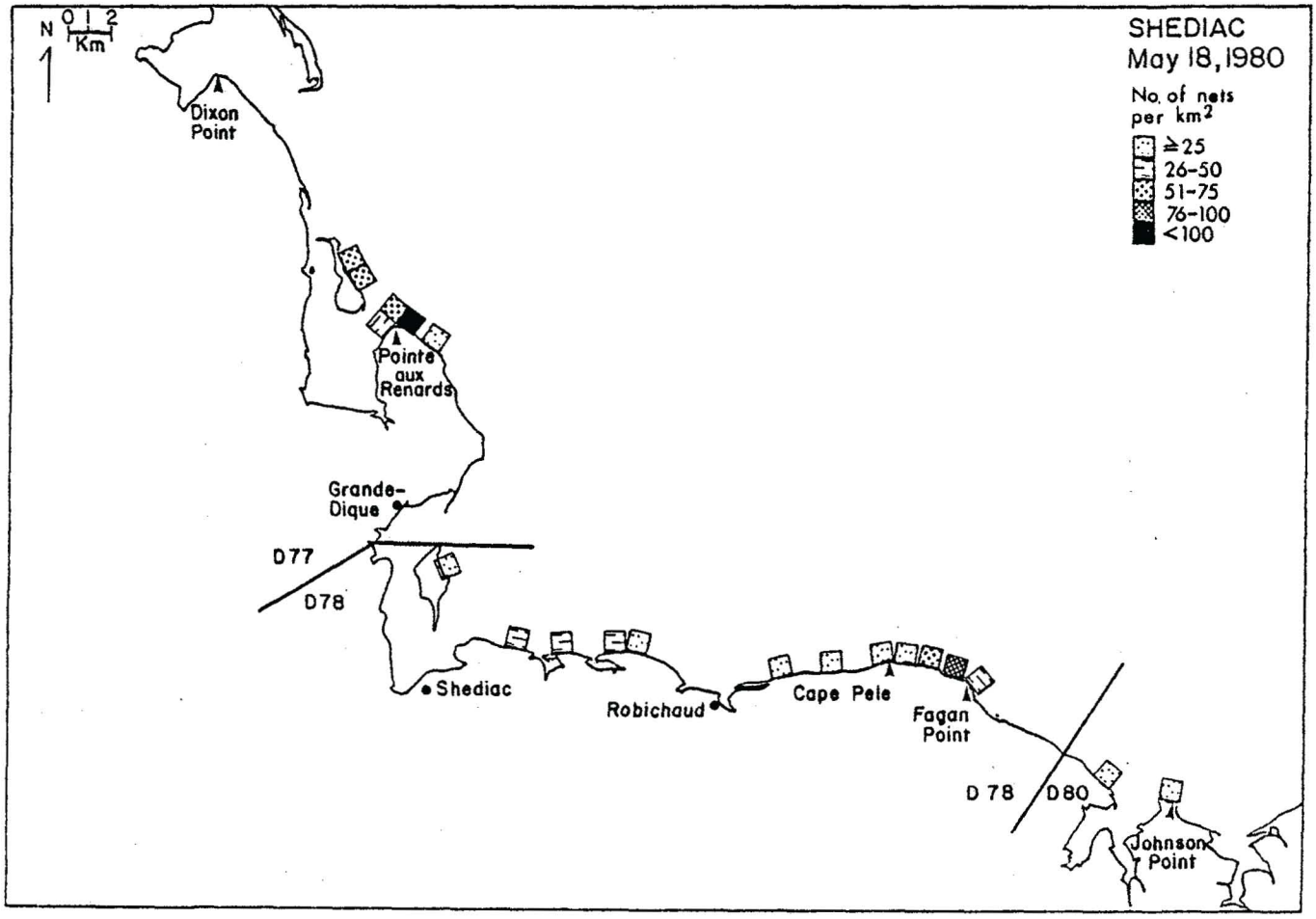
N
0 1 2
Km
SHEDIAC
May 18, 1980
No. of nets per km²
≥25
26-50
51-75
76-100
<100
Dixon Point
Pointe aux Renards
Grande-Dique
D77
D78
Shediac
Robichaud
Cape Pele
Fagan Point
D 78
D80
Johnson Point

Fig 24

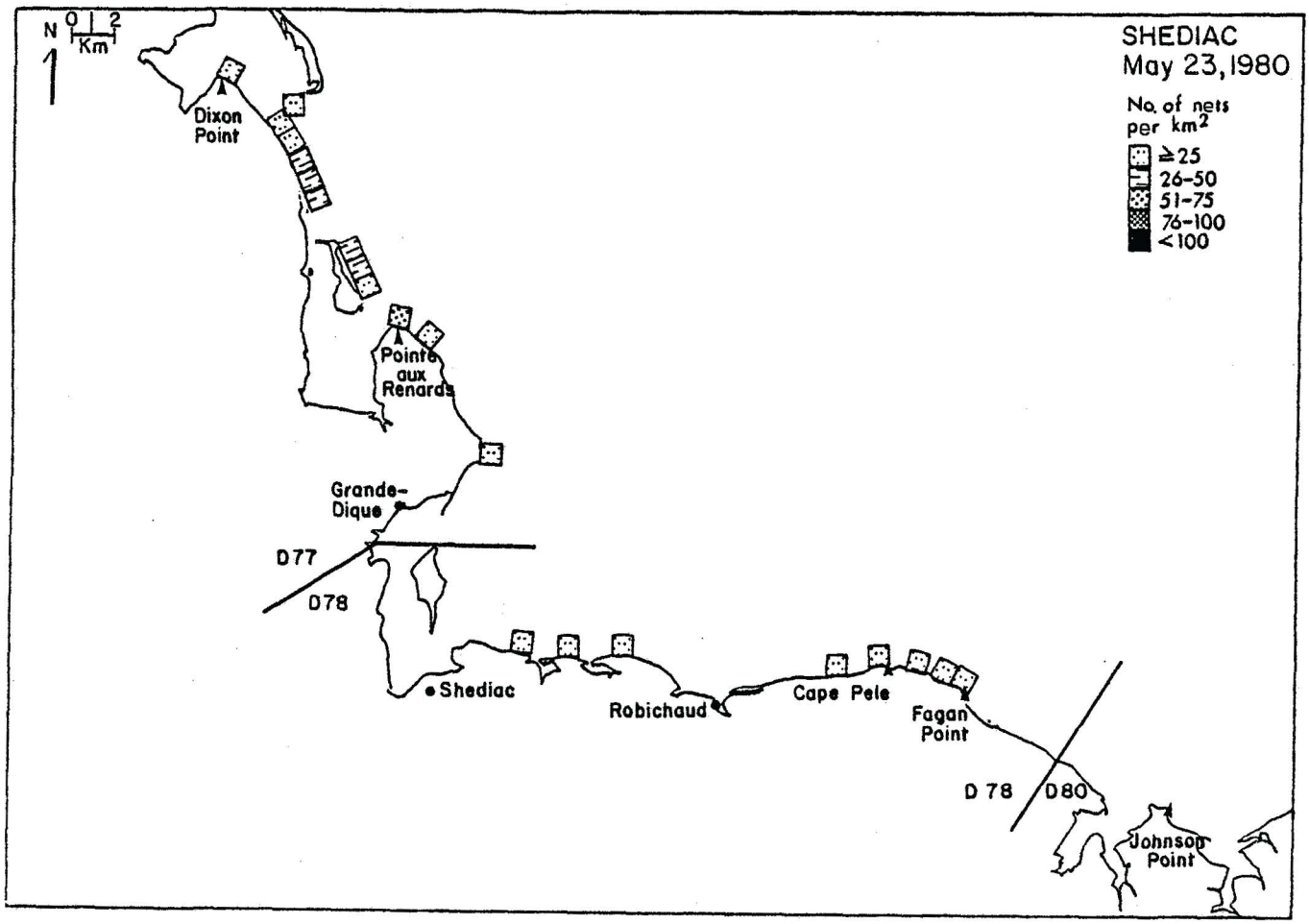
N
0 1 2
Km
SHEDIAC
May 23, 1980
No. of nets per km²
≥25
26-50
51-75
76-100
<100
Dixon Point
Pointe aux Renards
Grande-Dique
D77
D78
Shediac
Robichaud
Cape Pele
Fagan Point
D 78
D80
Johnson Point

Fig. 25

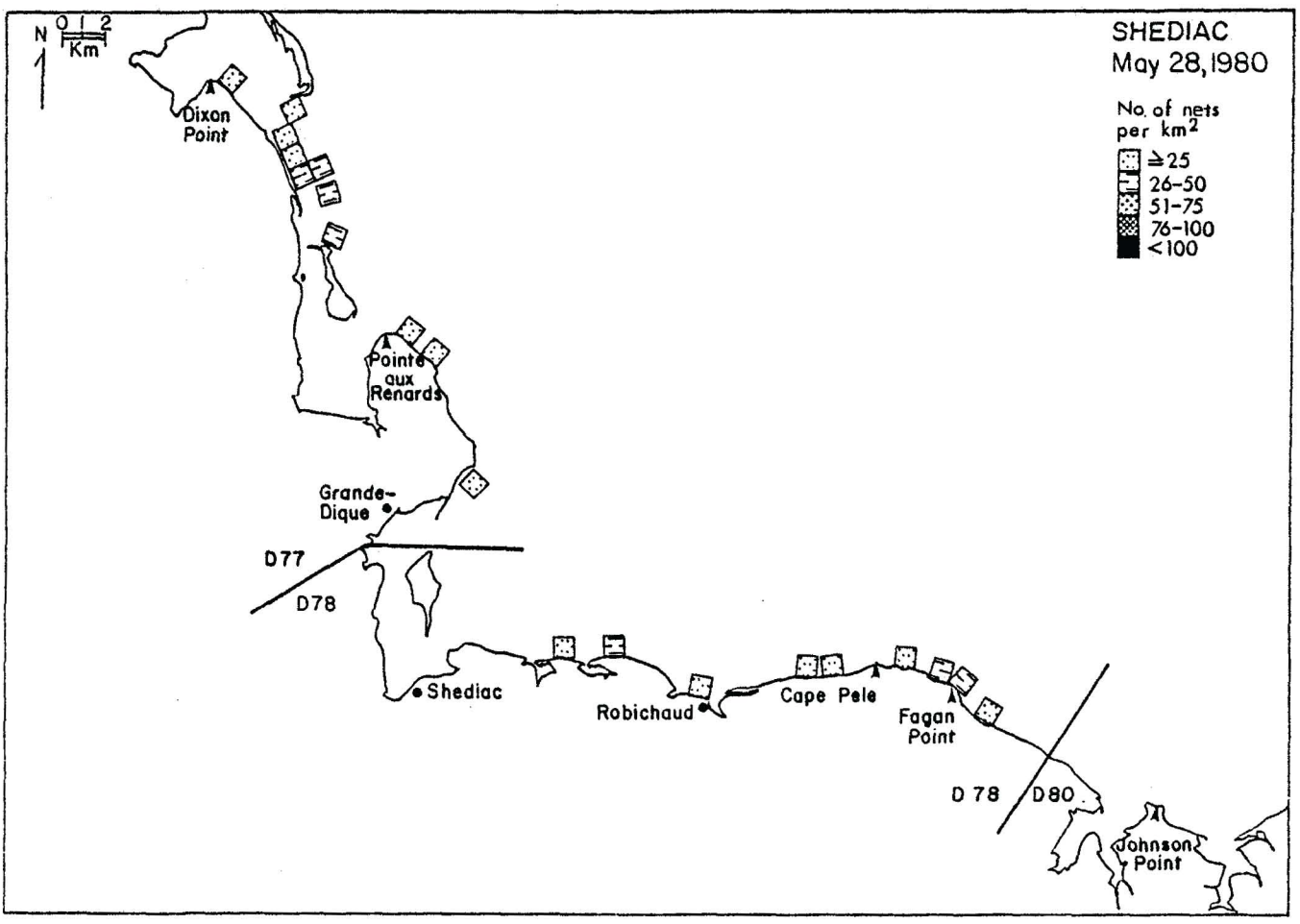
N
0 1 2
Km
SHEDIAC
May 28, 1980
No. of nets per km²
≥25
26-50
51-75
76-100
<100
Dixon Point
Pointe aux Renards
Grande-Dique
D77
D78
Shediac
Robichaud
Cape Pele
Fagan Point
D 78
D80
Johnson Point

Fig. 26

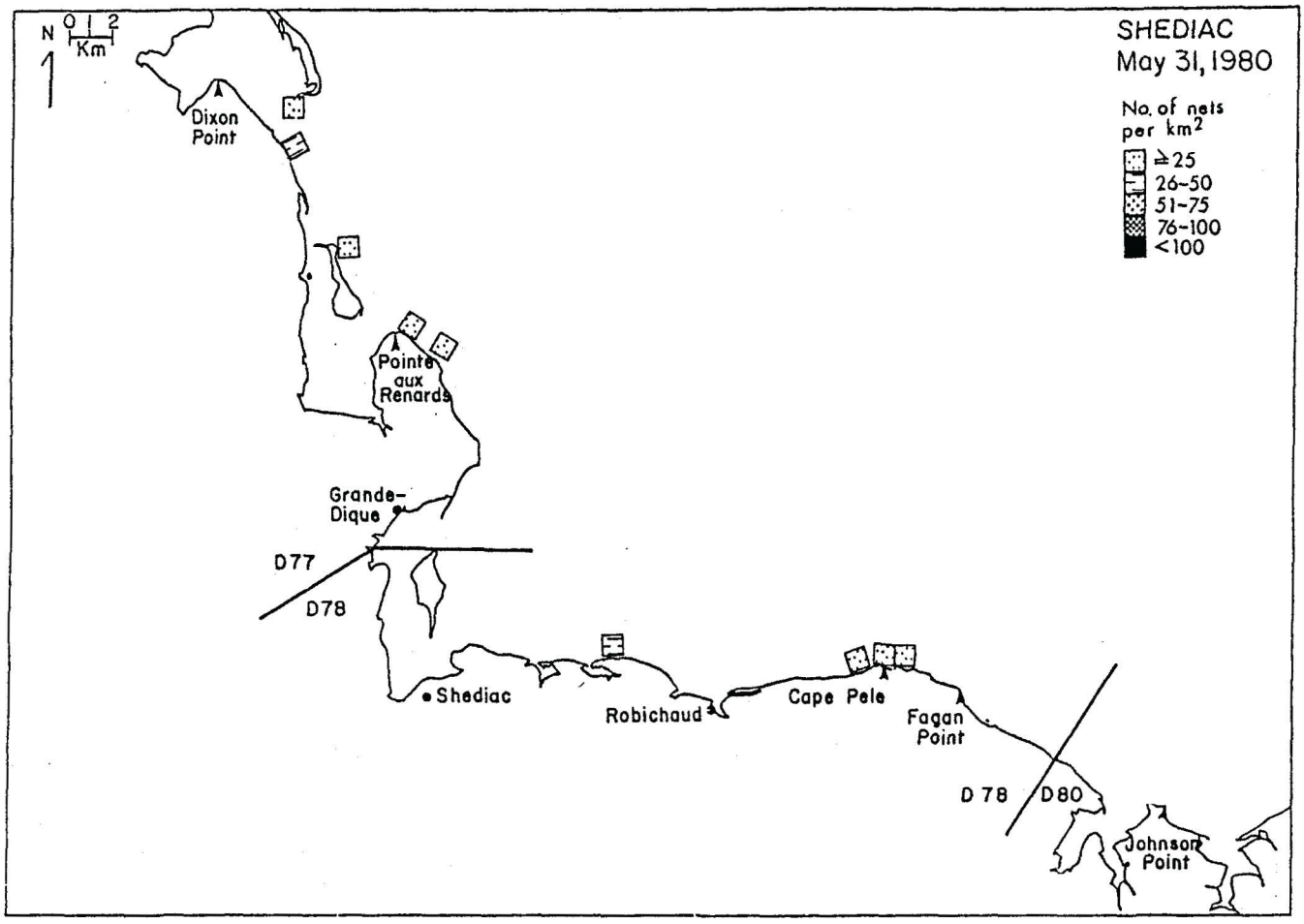

Fig. 27

Figures 23-27. Distribution and density of herring gillnets in Shediac area.

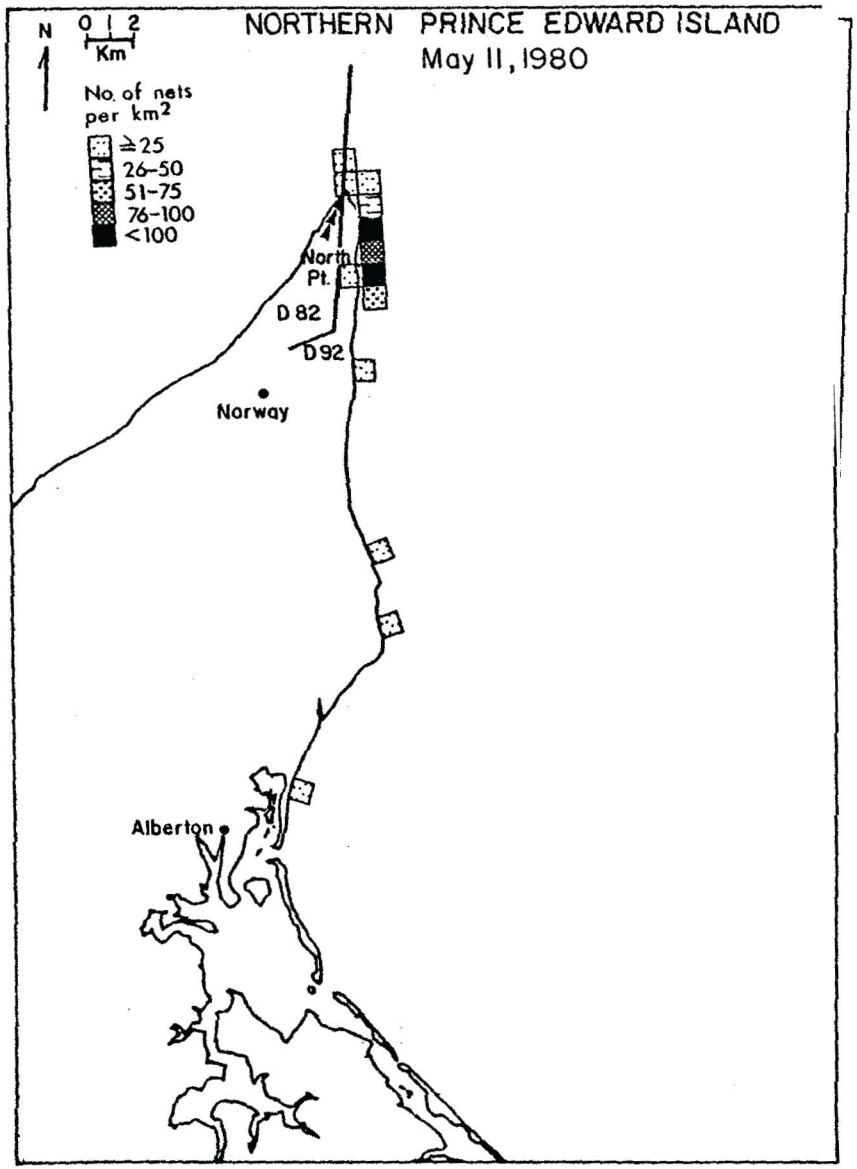
N
0 1 2
Km
NORTHERN PRINCE EDWARD ISLAND
May 11, 1980
No. of nets per km²
≧25
26-50
51-75
76-100
<100
North Pt.
D 82
D 92
Norway
Alberton

Fig. 28

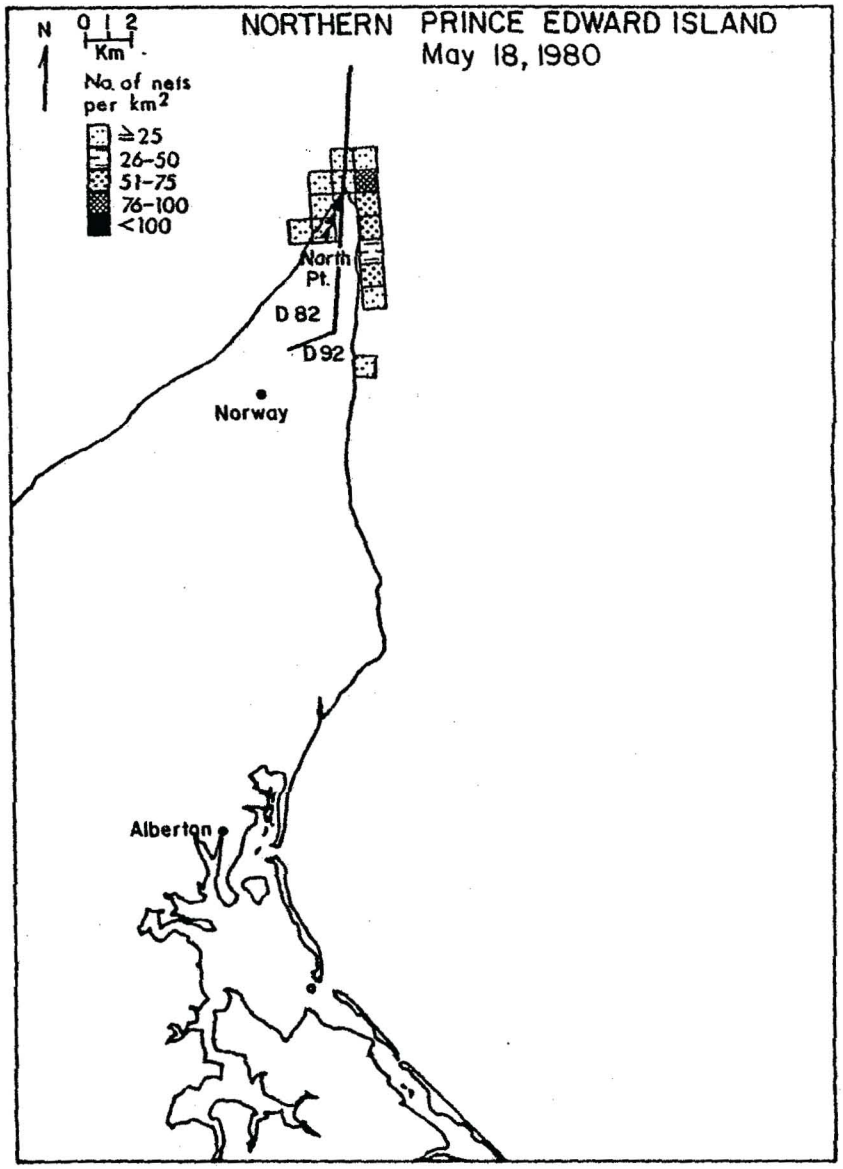
N
0 1 2
Km
NORTHERN PRINCE EDWARD ISLAND
May 18, 1980
No. of nets per km²
≧25
26-50
51-75
76-100
<100
North Pt.
D 82
D 92
Norway
Alberton

Fig. 29

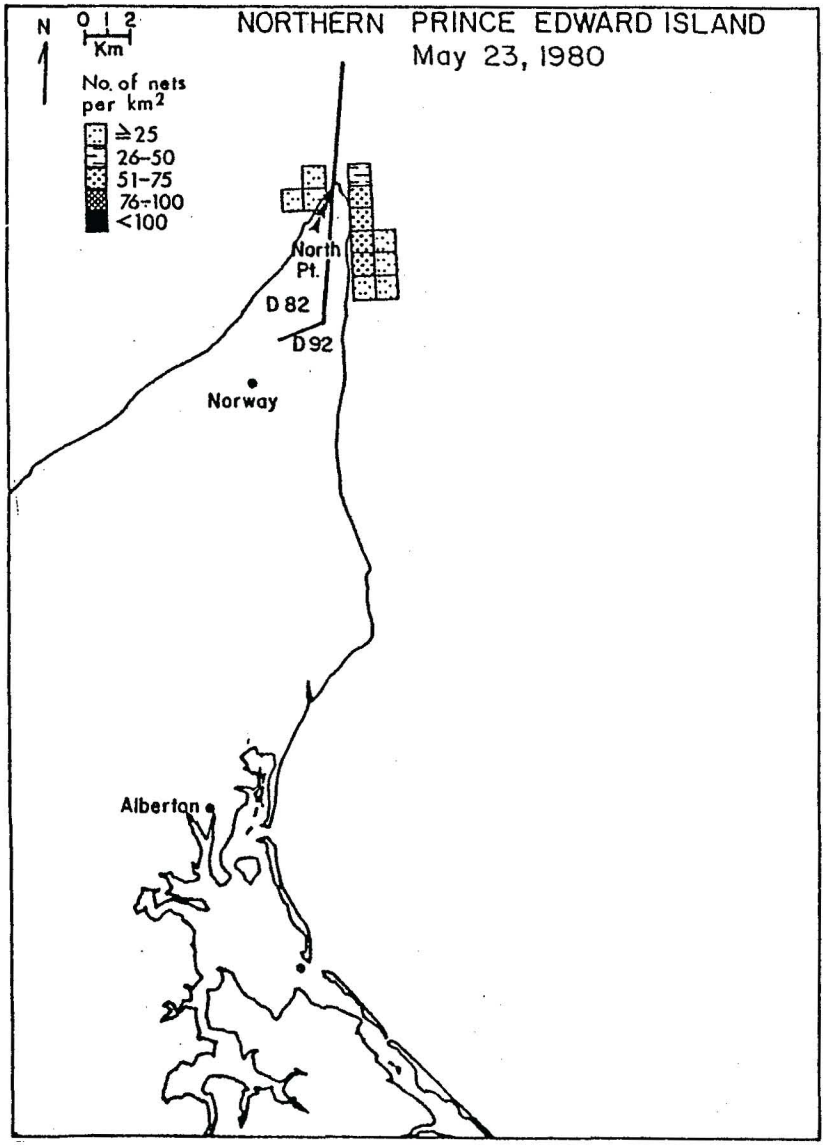

Fig. 30

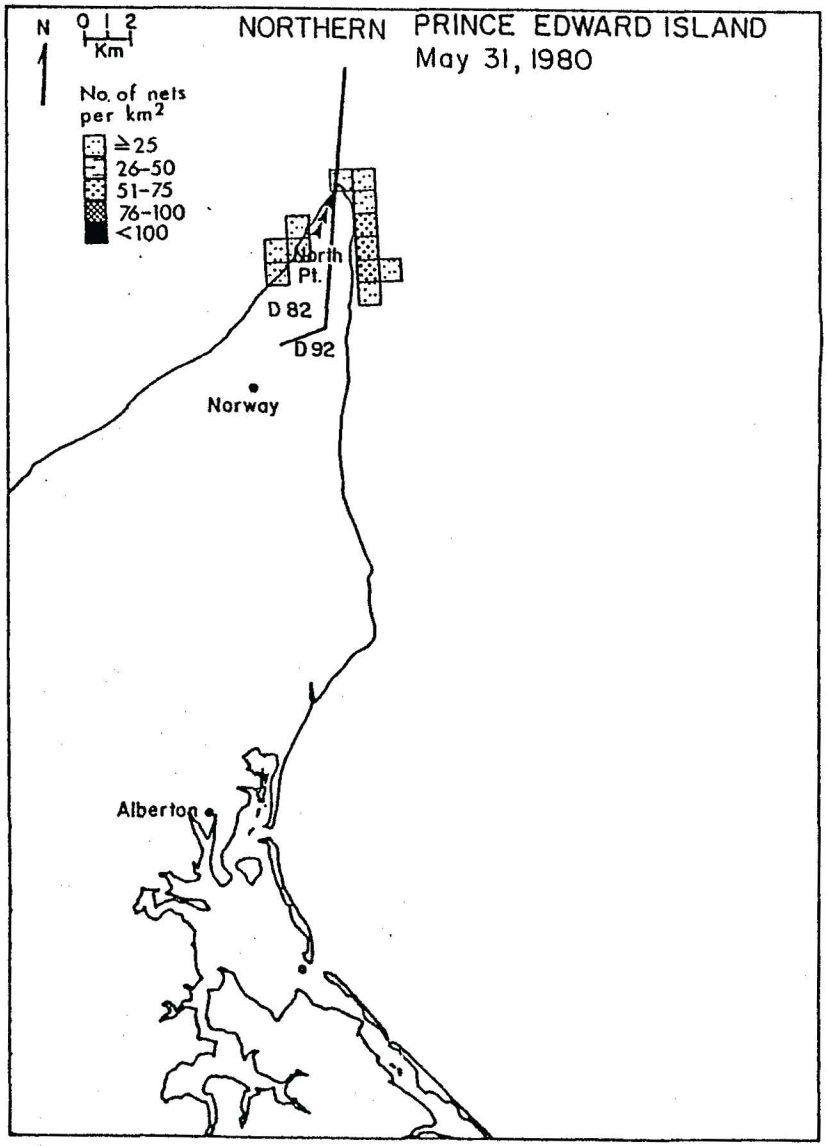

Fig. 31

Figures 28-31. Distribution and density of herring gillnets in N. Prince Edward Island area.