Recent Changes in Fishing Effort and Catch Rates of Inshore Herring Fisheries in the Southern Gulf of St. Lawrence

by

S. N. Messieh
Fisheries Research Branch
Department of Fisheries and Oceans
Gulf Region
P.O. Box 5030
Moncton, NB E1C 9B6

ABSTRACT

Estimates of fishing effort and catch rates of the inshore herring fisheries in the southern Gulf of St. Lawrence for the period 1973 to 1983 are presented. These estimates are based on analysis of herring landings and fishing trips available from purchase slip records. Also, presented are fishing effort estimates from aerial photographic surveys conducted during spring herring fisheries in 1980, 1981 and 1983.

Monthly fishing effort and catch rates for five main inshore herring fisheries were compared. These comparisons showed that fishing effort in Escuminac spring fishery, and in Caraquet and Pictou fall fisheries were highest among all inshore fisheries. In total, fishing effort trend decreased from 1973 to 1977, steadily increased until 1981, then dropped slightly in 1982, and increased again in 1983. As would be expected, catch rates were inversely related to fishing effort in most years.

In spring fisheries, average fishing effort ranged between 908 fishing trips in 1977 and 3,657 trips in 1983. Catch rates ranged between .92 mt/trip in 1981 and 2.22 mt/trip in 1978. In fall fisheries, average fishing effort ranged between 610 trips in 1977 and 3,061 trips in 1982. Meanwhile, catch rates ranged between 1.45 mt/trip in 1980 and 3.63 mt/trip in 1975.

Fishing effort estimates based on three years data of aerial photographic surveys showed an increase in number of fishing nets from 1980 to 1981, then a decrease in 1983. This decrease, however, does not correspond to the increase in number of fishing trips shown on the 1983 purchase slips. Causes of this anomaly would require further investigation.

RESUME

La présent document contient des estimations de l'effort de pêche et des taux de capture de la pêche côtière du hareng dans le sud du golfe du Saint-Laurent de 1973 à 1983. Elles reposent sur une analyse des débarquements et des voyages de pêche indiqués sur les bordereaux d'achat. Des estimations de l'effort de pêche découlant de relevés photographiques aériens menés pendant les opérations de pêche de printemps 1980, 1981 et 1983 sont également présentées.

Nous comparons l'effort et les taux de capture mensuels de cinq principales pêcheries côtières de hareng. Ces comparaisons démontrent que l'effort de pêche de printemps à Escuminac et celui de la pêche d'automne à Caraquet et à Pictou sont les plus élevés de tous. Dans l'ensemble, l'effort de pêche a eu tendance à diminuer de 1973 à 1977, à augmenter régulièrement jusqu'en 1981, pour diminuer légèrement en 1982 et finalement augmenter de nouveau en 1983. Comme on pouvait s'y attendre, les taux de capture ont été généralement en relation inverse de l'effort de pêche.

Dans la pêche de printemps, l'effort de pêche moyen a été compris entre 908 sorties en 1977 et 3, 657 en 1983. Les taux de capture ont varié de 0,92 t/voyage en 1981 à 2,22 t/voyage en 1978. En automne, l'effort de pêche a été de 610 sorties en 1977 et 3,061 en 1982. Dans le même temps, les taux de capture ont été compris entre 1,45 t/voyage en 1980 et 3,63 t/voyage en 1975.

Les estimations de l'effort de pêche découlant de trois années de relevés photographiques aériens indiquent une augmentation du nombre de filets de 1980 à 1981 et une diminution en 1983. Cette dernière, cependant, ne correspond pas à l'augmentation des voyages de pêche qui apparaît sur les bordereaux d'achat de 1983. Il faudra rechercher la cause de cette anomalie.

INTRODUCTION

The inshore herring fisheries constitute a major component of fisheries in the Southern Gulf of St. Lawrence. These fisheries were sustained for many years, and a long-term average of about 30,000 mt was landed each year (Figure 1). The inshore Gulf herring are mainly caught by set-nets in spring and drift-nets in fall. In some reports, both gears are collectively called gillnets.

Although catch statistics of herring fisheries in the Southern Gulf are available since 1933 (Tibbo, Messieh and Burnett 1969), fishing effort and catch-per-unit-effort are only available for recent years. Messieh (1981) estimated the fishing effort and CPUE for the inshore fisheries for the period 1973 to 1980 by analysis of purchase slips data. The present report includes an update for these estimates and a complete data base for the fishing effort and catch rates from 1973 to 1983. Also included are estimates of fishing effort based on aerial photographic surveys conducted during spring herring fisheries in 1980, 1981 and 1983.

RESULTS

Fishing Effort and CPUE as Inferred from Purchase Slips Data

Monthly fishing effort and CPUE estimates in 1973 through 1983 for the main fisheries in the Southern Gulf are presented in Tables 1-5. Fishery districts referred to in this report are shown in Figure 2. A summary of Annual fishing effort and CPUE for the five areas is included in Table 6.

In earlier years, total E could differ from sum of monthly E (Tables 1-5). This discrepancy arises from the use of two different data sets, one set based on reported catch statistics, and the other set from purchase slips available in the Public Archives (Messieh, 1981). Small monthly landings were sometimes not recorded, or misplaced to other fishery districts. The differences, however, would not largely affect CPUE estimates or their trends.

Caraquet Fishery

This fishery is one of two largest inshore herring fisheries in the Southern Gulf. Monthly estimates of fishing effort (Table 1: Figures 3 and 4) show that spring and fall fisheries are equally important to this area. The spring fishery usually starts in May. In some years it starts in April, as soon as ice melts. In recent years (1979-1983) the fishery started earlier than previous years, but fishing effort was low ranging from 1-62 fishing trips in the early part of season.

In the spring fishery, fishing effort ranged between 67 fishing trips in 1977 and 704 trips in 1983 (Table 7). CPUE ranged between 0.75 mt/trip in 1981 and 4.33 mt/trip in 1978. CPUE was higher in fall than in spring, ranging between 1.78 in 1980 and 6.76 in 1975 (Table 8).

In summer (July), fishing effort was much less than in spring and fall, particularly in the earlier years of observations. Since 1980, fishing trips increased during summer (200-432 trips). This increase in fishing effort during July probably reflects the recent change in fishing practices where fishermen set their nets further offshore than in the traditional near-shore fishing grounds.

Escuminac Fishery

Except for the last three years, the Escuminac fishery was the largest inshore fishery in the Southern Gulf in terms of landings and fishing effort. As in Caraquet, peak fishing effort of the spring fishery is in May. Fishing trips during May ranged between 469 in 1977 and 1,607 in 1979, (Table 2). During the same month, CPUE ranged between 0.88 mt/trip in 1981 and 2.76 mt/trip in 1983. In June, fishing effort sharply declined in most of the years. In earlier years, the spring fishery was prolonged and relatively high fishing effort was carried out in June. For example, number of fishing trips during June was 245,225 and 199 in 1974, 1975 and 1976, respectively (Table 2). In contrast, a range of only 23 to 90 trips was carried out during the same month in more recent years.

The fall fishery in Escuminac at present is much limited than in spring. Except for earlier years (1973 - 1975), fishing effort ranged between 2 - 81 trips in August, and 16 - 71 trips in September (Table 2). CPUE in fall fishery fluctuated over the years from as low as 0.23 mt/trip in September 1983 to as high as 8.71 mt/trip in August 1979 (Table 2; Figure 3).

Shediac Fishery

This is mainly a spring and summer fishery (Table 3). Average fishing effort in spring ranged between 140 trips in 1977 and 910 trips in 1983. CPUE ranged between 0.24 in 1976 and 1.28 in 1982 (Table 7). The spring fishery in Shediac is developing fast, and recent fishing effort more than doubled in the last two years. The summer fishery in July was active in 1973 and 1974, but in recent years fishing effort dropped to less than 20% of total effort.

Pictou Fishery

The Pictou herring fishery is predominantly a summer-fall fishery which starts in late July and practically ends in September (Table 4). In the past three years, spring fishing was conducted, but was of minor importance. Maximum fishing effort was in August, ranging between 36 trips in 1977 and 1,040 trips in 1980. During that month, CPUE ranged between 0.49 mt/trip in 1980 and 1.86 mt/trip in 1973.

In the fall fishery, the average fishing effort largely increased in the past five years. The largest year was in 1982 where 1,542 trips were carried out, compared to 464 trips in 1973 (Table 8). During these years, CPUE slightly fluctuated between 0.74 low in 1982 and 1.55 high in 1973 (Figure 4).

North P.E.I. Fishery

The fishery in North P.E.I. extends from spring to fall (Table 5). However, the spring fishery was more dominant in all years. Fishing effort in spring ranged between 155 trips in 1977 and 661 trips in 1983. CPUE ranged between 0.36 mt/trip in 1974 and 1.76 mt/trip in 1983 (Table 7). The summer fishery in July is relatively small. Except for 1980 where 169 trips were made, fishing effort ranged between one trip in 1982 and 63 trips in 1983.

In the fall fishery (August and September), fishing effort ranged between 29 trips in 1978 and 264 in 1983. CPUE ranged between 0.21 mt/trip in 1974 and 5.28 mt/trip in 1982 (Table 8). A gradual increase in CPUE was observed in 1974 through 1979, followed by a sharp increase until 1982 (Figures 3 and 4).

Relationship between Effort and CPUE

As would be expected, an inverse relationship between fishing effort and CPUE was observed in all years of observation except in 1973 and 1983 (Figure 5). To better investigate these relationships, data were analyzed for spring and fall fisheries separately. Results are shown in Figures 6 and 7. In both fisheries, the inverse relationships between fishing effort and CPUE were well demonstrated.

Fishing Effort Estimates from Aerial Surveys

Aerial surveys of gillnets in spring herring fisheries in the Southern Gulf were carried out in 1980, 1981 and 1983. Results of the 1980 survey were documented by Messieh and MacPherson (1981).

The intensity and distribution of gillnets during peak fishing season in 5 of the major inshore fisheries are shown in Figures 8-12. A summary of fishing effort estimates is presented in Table 9 and Figures 13-15. Fishing effort estimates are expressed in terms of number of standard nets multiplied by number of days fished during the fishing season. A standard net of 27.4 m long (90 ft.) was used to compensate for the varying sizes of nets being operated. Usually, fishermen use a set of nets consisting of different numbers of nets depending on the availability of fish during the season.

In Figures 13-15 it is shown that fishing intensity varied between years and localities. However, fishing distribution varied a little during the three years of observation. The similarity of fishing distribution reflects the consistancy of fish behaviour from year to year, where fish move to the same spawning grounds year after year. Indeed, the distribution of herring gillnets during spring fisheries has proven to be a reliable source of locating the spawning grounds during the spawning bed surveys.

DISCUSSION

Estimates of fishing effort and CPUE based on purchase slips data have been used in the past two herring assessments (Cleary 1983). Comparison of these estimates with CPUE from purse-seiners and the reliability of catch rates based on these estimates were discussed in CAFSAC.

The validity of purse-seine catch rates as population abundance indices was often questioned (Powles 1981). The problems involved in these estimates which reduce their reliability as abundance index are the schooling behaviour of herring, fleet distribution, changing searching capabilities etc.

Cleary (1983) modified inshore catch rates estimates by Messieh (1981) to take into account the number of nets fished per trip. Catch rates were calculated as total landings divided by the total number of successful trips times the number of nets per trip. The adjusted catch rates used by Cleary for tuning the cohort analysis are compared with the unadjusted catch rates for both spring and fall fisheries (Table 10 and Figure 16). The comparison showed a remarkable agreement in trends in catch rates of the two sets of data. The agreement was well demonstrated in both fisheries, but better agreement was shown in the spring fishery. These results provide a supporting evidence of the reliability of catch rates based on purchase slips data even without having access to the number of nets per trip. It is recommended that analysis of purchase slips should be continued on a regular basis.

Fishing effort estimates based on three years data of aerial photographic surveys showed an increase in number of fishing nets from 1980 to 1981, and a decrease in 1983. This decrease, however, does not correspond to the increase in number of fishing trips shown on the 1983 purchase slips. Causes of this anomaly would require further investigation.

Aerial surveys obviously provide the most direct estimates of number and size of nets engaged in actual fishing throughout the season. Several years of observations would be needed to assess the use and reliability of the aerial surveys in estimating fishing effort of spring herring fisheries. However, it would require more funding if these surveys are to be conducted on a routine annual basis.

In case of absence of aerial surveys, the catch rate estimates based on purchase slips data would be an adequate source of abundance indices. For fine tuning of these estimates, care should be taken to include not only number of nets but also their size. In future, it would be useful if an agreement with fishermen could be reached to include number and size of fishing gear as on the purchase slip forms.

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Table 1. Fishing effort and catch-per-unit-effort of inshore herring fishery in Caraquet (Fish. Dis. 65, 66, 67), 1973-83

Year	April		May		June		July		August		September		October		November		All Year*	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	-	-	2.20	413	4.95	256	1.09	35	2.16	593	4.26	247	1.36	15	-	-	2.49	1832
1974	-	-	2.49	355	1.28	137	2.06	58	2.94	95	7.99	173	7.10	7	-	-	4.21	689
1975	-	-	1.83	46	0.58	192	0.48	25	7.16	170	6.12	107	8.25	3	-	-	4.48	472
1976	-	-	3.20	94	0.92	262	0.52	20	4.37	143	6.36	98	2.34	30	-	-	4.28	495
1977	-	-	4.04	63	1.87	4	1.59	16	7.55	181	2.58	202	0.29	40	-	-	5.02	438
1978	-	-	3.83	107	8.16	14	2.01	54	4.27	401	3.22	38	1.77	9	-	-	4.02	623
1979	1.22	5	1.39	163	3.29	60	0.60	65	1.50	129	3.01	313	1.44	181	-	-	2.01	916
1980	4.83	2	3.29	163	0.36	54	0.31	200	1.84	329	1.66	167	1.62	68	-	-	1.65	985
1981	0.71	62	0.83	277	0.52	104	0.41	432	1.91	1149	2.94	613	1.33	116	0.92	26	1.69	2779
1982	0.93	52	1.61	405	1.03	104	0.55	241	2.65	769	5.53	683	0.43	7	-	-	2.99	2261
1983	0.52	1	1.41	540	1.86	164	0.73	353	5.21	975	3.35	309	0.08	26	-	-	3.14	2368

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

* = Total E could differ from sum of monthly E (see text).

Table 2. Fishing effort and catch-per-unit-effort of inshore herring fishery in Escuminac (Fish. Dist. 73, 75), 1973-83

Year	April		May		June		July		August		September		October		November		All Year	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	-	-	2.03	1416	1.55	55	0.30	11	2.71	402	3.77	354	3.43	7	-	-	2.43	2232
1974	-	-	1.69	1191	1.05	245	0.05	7	3.07	67	4.05	124	-	-	-	-	1.86	1603
1975	-	-	1.63	810	1.51	225	-	-	3.76	71	4.98	152	-	-	-	-	2.21	1215
1976	1.84	5	2.14	1019	0.25	199	-	-	8.22	2	7.42	71	-	-	-	-	2.44	1249
1977	-	-	2.42	469	1.44	77	-	-	3.55	16	-	-	-	-	-	-	2.57	572
1978	.68	2	2.60	1145	3.97	59	0.12	12	2.05	20	5.45	39	1.36	1	-	-	2.99	1278
1979	2.05	6	1.63	1607	3.32	50	2.10	3	5.15	22	8.71	35	-	-	-	-	1.87	1723
1980	0.44	7	1.20	1128	0.47	46	0.17	92	5.02	55	5.66	65	-	-	-	-	1.46	1393
1981	1.21	180	0.88	1066	0.34	23	0.10	7	3.71	81	6.48	66	0.57	2	-	-	1.33	1425
1982	1.04	3	2.49	637	0.31	50	0.15	49	1.15	16	1.31	28	0.57	2	-	-	2.13	785
1983	-	-	2.76	1218	0.44	90	0.78	122	0.96	47	0.23	16	-	-	-	-	2.36	1493

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 3. Fishing effort and catch-per-unit-effort of inshore herring fishery in Shediac (Fish. Dist. 78, 80), 1973-83

Year	April		May		June		July		August		September		October		November		All Year	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	-	-	1.55	2	0.85	352	0.98	237	-	-	-	-	-	-	-	-	1.09	532
1974	0.40	1	0.41	582	0.69	182	0.26	214	-	-	-	-	-	-	-	-	0.49	906
1975	-	-	0.83	111	0.54	78	0.22	49	0.09	-	-	-	-	-	-	-	0.78	187
1976	0.96	55	0.23	443	0.85	10	0.33	38	-	-	-	-	-	-	-	-	0.53	489
1977	-	-	1.12	101	0.41	39	0.20	14	-	-	-	-	2.46	50	-	-	1.28	204
1978	0.67	9	1.12	307	3.40	14	1.19	52	-	-	-	-	-	-	-	-	1.18	382
1979	1.0	35	0.59	401	0.53	14	2.55	18	-	-	0.06	1	-	-	-	-	0.70	469
1980	0.70	24	0.64	691	0.57	105	0.65	37	-	-	-	-	-	-	-	-	0.63	857
1981	0.84	18	1.17	330	1.25	88	1.02	64	-	-	-	-	-	-	-	-	1.15	500
1982	1.24	43	1.42	314	1.14	298	1.25	27	-	-	-	-	-	-	-	-	1.28	682
1983	-	-	0.99	628	0.89	282	1.23	31	-	-	-	-	-	-	-	-	0.97	941

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 4. Fishing effort and catch-per-unit-effort of inshore herring fishery in Pictou (Fish. Dist. 11), 1973-83

Year	April		May		June		July		August		September		October		November		All Year	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	-	-	-	-	-	-	0.87	19	1.86	210	1.29	254	1.97	8	-	-	1.65	455
1974	-	-	-	-	-	-	0.49	41	0.88	260	1.25	80	-	-	-	-	0.91	384
1975	-	-	-	-	-	-	1.58	22	1.07	201	1.58	129	-	-	-	-	1.02	443
1976	-	-	-	-	-	-	0.71	103	0.73	154	1.31	183	0.99	14	-	-	0.97	454
1977	-	-	-	-	-	-	0.81	46	1.30	36	1.21	142	-	-	-	-	1.14	224
1978	-	-	-	-	-	-	0.59	70	1.00	138	1.19	51	-	-	-	-	0.93	259
1979	-	-	-	-	-	-	1.01	173	1.11	409	0.83	345	0.29	3	-	-	0.98	930
1980	-	-	-	-	-	-	0.44	339	0.49	1040	0.92	252	1.43	3	-	-	0.55	1634
1981	1.84	1	2.37	2	7.70	10	0.94	298	1.10	579	1.24	294	1.16	2	-	1	1.18	1187
1982	-	-	10.90	5	2.27	1	1.28	121	0.76	785	0.72	757	-	-	-	-	0.81	1669
1983	-	-	0.59	67	0.97	7	0.84	93	1.15	548	1.87	200	1.36	1	-	-	1.23	916

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 5. Fishing effort and catch-per-unit-effort of inshore herring fishery in North PEI (Fish. Dist. 82, 92), 1973-83

Month	April		May		June		July		August		September		October		November		All Year	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	-	-	1.26	78	0.73	106	1.02	22	-	-	-	-	-	-	-	-	0.91	301
1974	-	-	0.40	223	0.32	204	0.42	26	0.06	80	0.55	33	-	-	-	-	0.35	593
1975	-	-	1.24	253	0.29	92	0.36	12	0.23	36	0.26	52	-	-	-	-	0.97	415
1976	-	-	0.60	142	0.13	41	0.15	19	-	-	0.44	40	0.35	11	-	-	0.41	349
1977	-	-	0.54	155	-	-	0.35	20	0.11	2	0.23	31	-	-	-	-	0.61	220
1978	0.98	4	1.31	250	0.26	127	0.23	40	0.24	15	0.54	14	0.92	18	-	-	0.81	498
1979	1.40	8	1.80	192	0.33	83	0.11	22	0.24	26	1.42	45	0.32	1	-	-	1.18	377
1980	0.66	8	0.88	227	2.00	9	0.10	169	2.40	51	2.91	68	0.89	16	-	-	1.05	548
1981	2.72	73	1.22	324	0.31	254	0.21	58	3.18	138	3.32	93	0.94	16	-	-	1.51	956
1982	0.47	1	3.13	220	0.18	235	0.14	1	4.66	16	6.69	7	-	-	-	-	1.77	480
1983	-	-	2.01	465	1.18	196	0.41	63	4.33	152	3.00	112	0.06	2	-	-	2.21	990

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 6 Annual fishing effort and average catch-per-unit-effort of major inshore herring fisheries in the southern Gulf of St. Lawrence, 1973-83.

Year	Caraquet		Escuminac		Shediac		Pictou		North PEI		Total	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	2.49	1832	2.43	2232	1.09	532	1.65	455	0.91	301	2.17	5352
1974	4.21	689	1.86	1603	0.49	906	0.91	384	0.35	593	1.65	4175
1975	4.48	472	2.21	1215	0.78	187	1.02	443	0.97	415	2.21	2732
1976	4.28	495	2.44	1249	0.53	489	0.97	454	0.41	349	1.98	3036
1977	5.02	438	2.57	572	1.28	204	1.14	224	0.61	220	2.61	1658
1978	4.02	623	2.99	1278	1.18	382	0.93	259	0.81	498	2.16	3040
1979	2.01	916	1.87	1723	0.70	469	0.98	930	1.18	377	1.51	4415
1980	1.65	985	1.46	1393	0.63	857	0.55	1634	1.05	548	1.00	5417
1981	1.69	2779	1.33	1425	1.15	500	1.18	1187	1.51	956	1.46	6847
1982	2.99	2261	2.13	785	1.28	682	0.81	1669	1.77	480	1.96	5877
1983	3.14	2368	2.36	1493	0.97	941	1.23	916	2.21	990	2.26	6708

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 7 Fishing effort and catch-per-unit-effort of inshore spring herring fishery in the southern Gulf, 1973-83.

Year	Caraquet		Escuminac		Shediac		Pictou		North PEI		Total	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	3.25	669	2.01	1471	0.85	354	-	-	0.95	184	2.09	2678
1974	2.15	492	1.58	1436	0.45	764	-	-	0.36	427	1.23	3119
1975	0.82	238	1.60	1035	0.71	189	-	-	0.99	345	1.29	1807
1976	1.52	356	1.83	1218	0.24	453	-	-	0.49	183	1.34	2210
1977	3.91	67	2.28	546	0.92	140	-	-	0.54	155	1.89	908
1978	4.33	121	2.67	1204	1.22	321	-	-	0.96	377	2.22	2023
1979	1.90	223	1.68	1657	0.59	415	-	-	1.36	275	1.49	2570
1980	2.56	217	1.17	1174	0.63	796	-	-	0.92	236	1.09	2423
1981	0.75	381	0.87	1089	1.19	418	6.81	12	0.82	578	0.92	2478
1982	1.49	509	2.33	687	1.28	612	9.46	6	1.61	455	1.73	2269
1983	1.51	704	2.60	1308	0.96	910	0.63	74	1.76	661	1.79	3657

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 8 Fishing effort and catch-per-unit-effort of inshore fall herring fishery in the southern Gulf, 1973-83.

Year	Caraquet		Escuminac		Shediac		Pictou		North PEI		Total	
	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E	C/E	E
1973	2.78	840	3.21	756	-	-	1.55	464	-	-	2.66	2060
1974	6.20	268	3.71	191	-	-	0.97	340	0.21	113	2.99	912
1975	6.76	277	4.59	223	0.09	1	1.27	330	0.25	88	3.63	919
1976	5.18	241	7.44	73	-	-	1.04	337	0.44	40	3.13	691
1977	4.93	383	3.55	16	-	-	1.23	178	0.22	33	3.56	610
1978	4.18	439	4.30	59	-	-	1.05	189	0.38	29	3.21	716
1979	2.57	442	7.34	57	0.06	1	0.98	754	0.99	71	1.78	1325
1980	1.78	496	5.37	120	-	-	0.85	1292	2.69	119	1.45	2027
1981	2.27	1762	4.95	147	-	-	1.15	873	3.24	231	2.15	3013
1982	4.00	1452	1.25	44	-	-	0.74	1542	5.28	23	2.33	3061
1983	4.76	1284	0.77	63	-	-	1.34	748	3.77	264	3.45	2359

E = Number of successful fishing trips; C/E = Catch (mt) per successful trip.

Table 9 Fishing effort estimates of spring inshore herring fisheries in 1980-83*, as inferred from aerial surveys.

Fishery	Number of standard nets** X days fished during fishing season		
	1980	1981	1983
Caraquet	10,864	10,824	6,143
Escuminac	49,770	70,200	37,263
Kouchibouguac	4,600	8,580	5,724
Shediac	7,540	21,714	10,086
North PEI	8,980	9,480	5,687
Total	81,754	120,798	64,903

*No aerial survey in 1982
**A standard net is 27.4m (90 ft)

Table 10 Comparison of CPUE estimated from purchase slips data and adjusted CPUE used for tuning the cohort analysis.

Year	Spring Fishery		Fall Fishery	
	unadjusted*	adjusted**	unadjusted*	adjusted**
1973	2.09	.093	2.66	.381
1974	1.23	.057	2.99	.728
1975	1.29	.057	3.63	.889
1976	1.34	.061	3.13	.591
1977	1.89	.075	3.56	.478
1978	2.22	.077	3.21	.360
1979	1.49	.046	1.78	.185
1980	1.09	.041	1.45	.133
1981	.92	.036	2.15	.182
1982	1.73	.064	2.33	.343
1983	1.79	-	3.45	-

*Catch in metric tons per successful fishing trip.
**From Cleary (1983). Calculated as total inshore landings divided by number of successful trips times number of nets per trip.

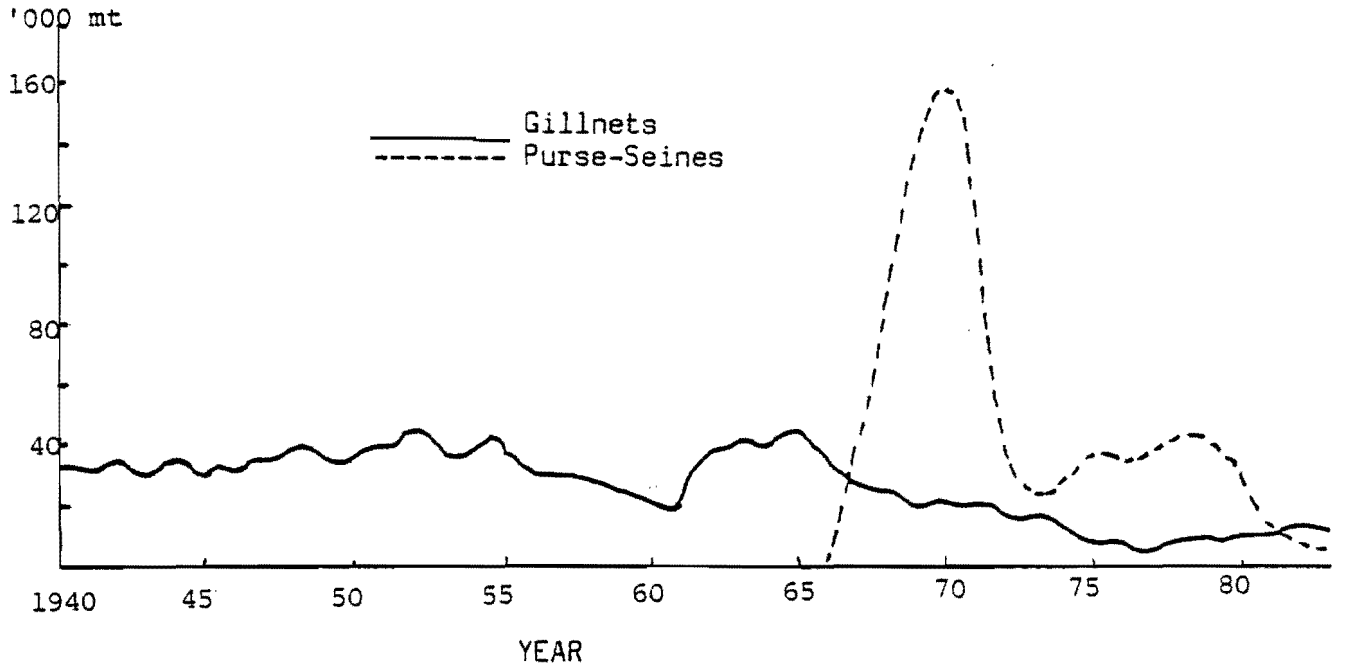

Figure 1. Herring landings in 4T, Gulf of St. Lawrence, 1940-1983.

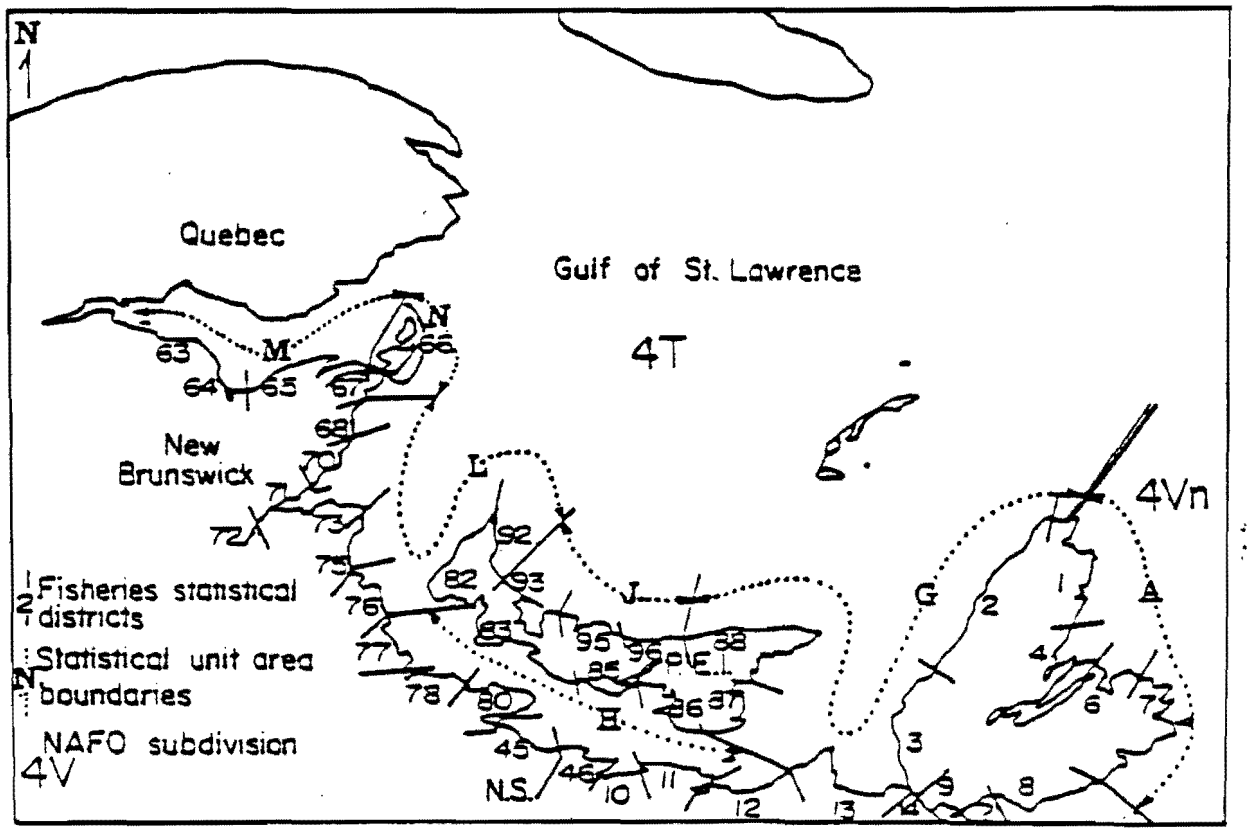

Figure 2. Map of South Gulf of St. Lawrence showing fishing districts.

Fishery	Fishing Districts Included
Caraquet	65, 66, 67
Escuminac	73, 75
Shediac	78, 80
Pictou	11
North PEI	82, 92

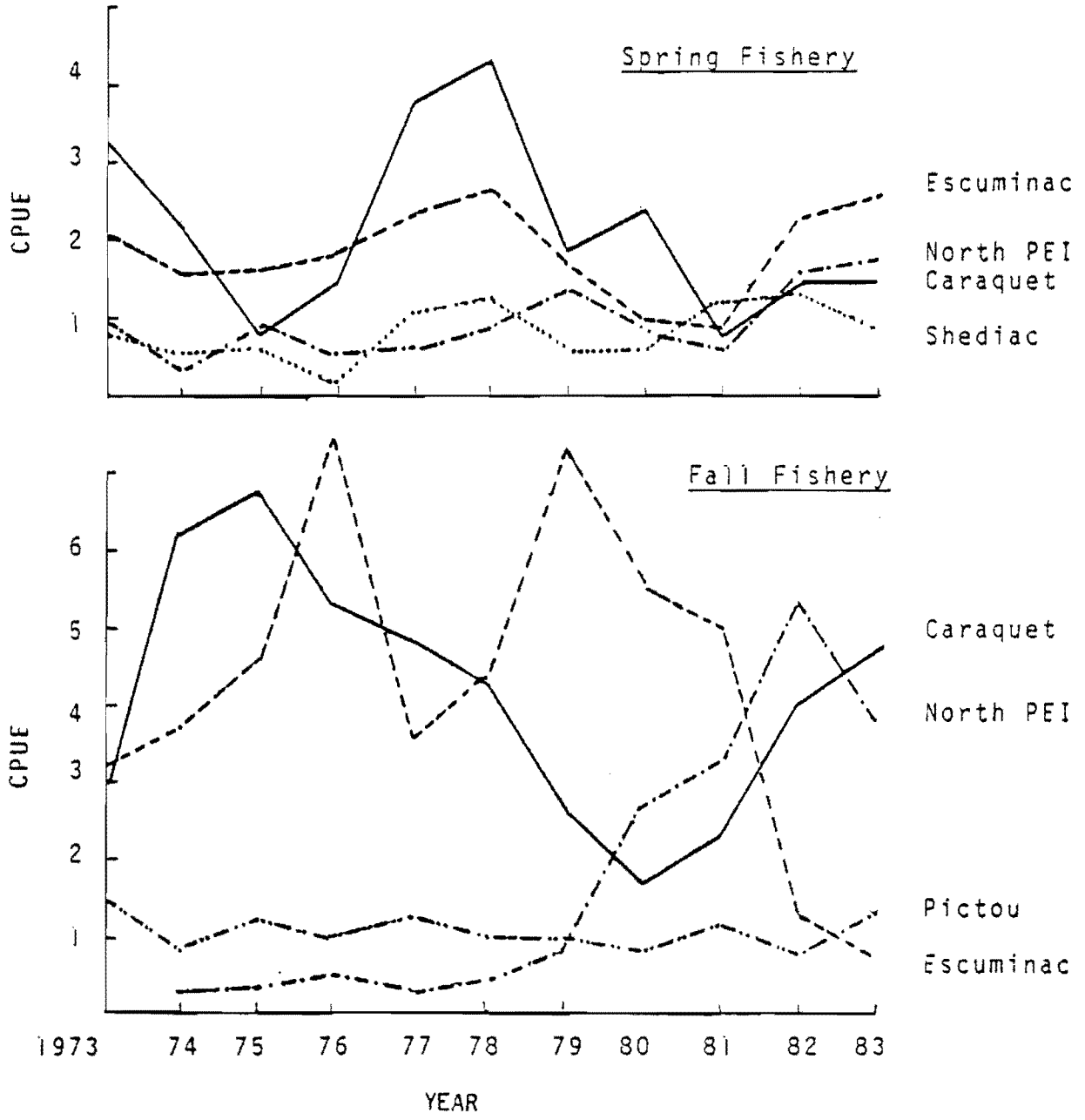

Figure 3. Catch-per-unit-effort of spring and fall herring fisheries separated by fishing areas.

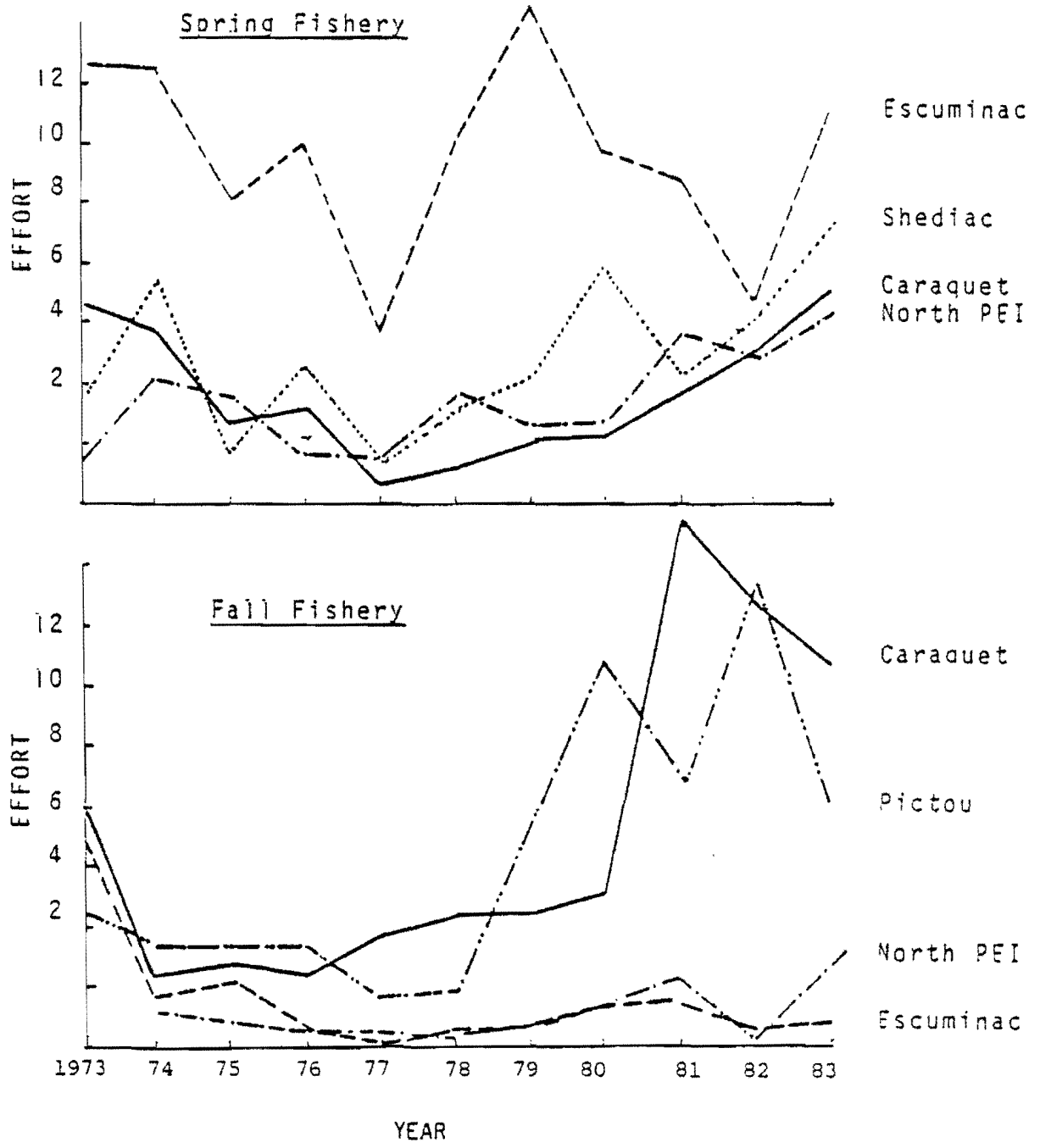

Figure 4. Fishing effort of spring and fall herring fisheries separated by fishing areas.

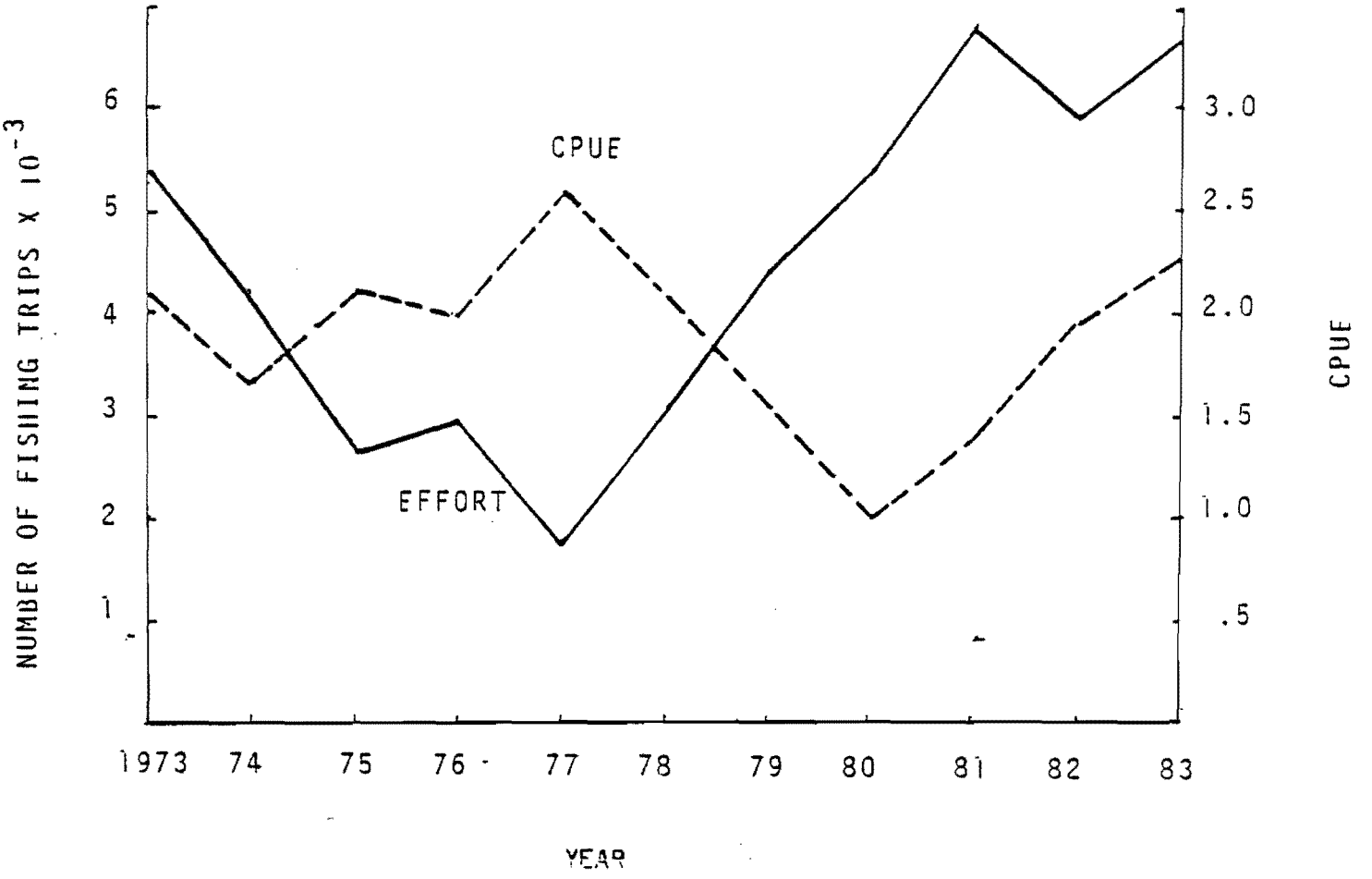

Figure 5. Fishing effort and catch-per-unit-effort of inshore herring fisheries in the southern Gulf, 1973-1983.

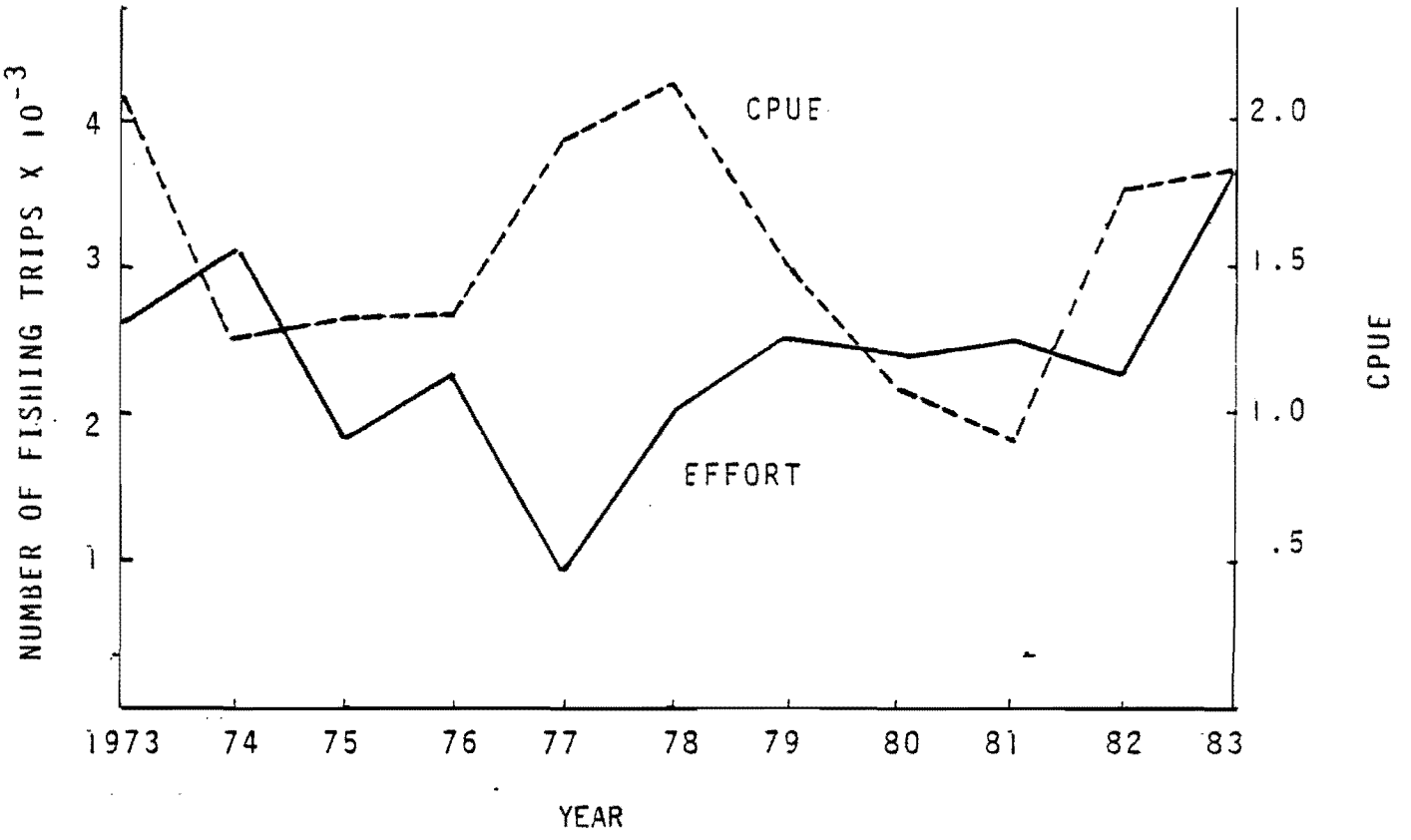

Figure 6. Fishing effort and catch-per-unit-effort of inshore spring herring fisheries (May-June) in the southern Gulf, 1973-1983.

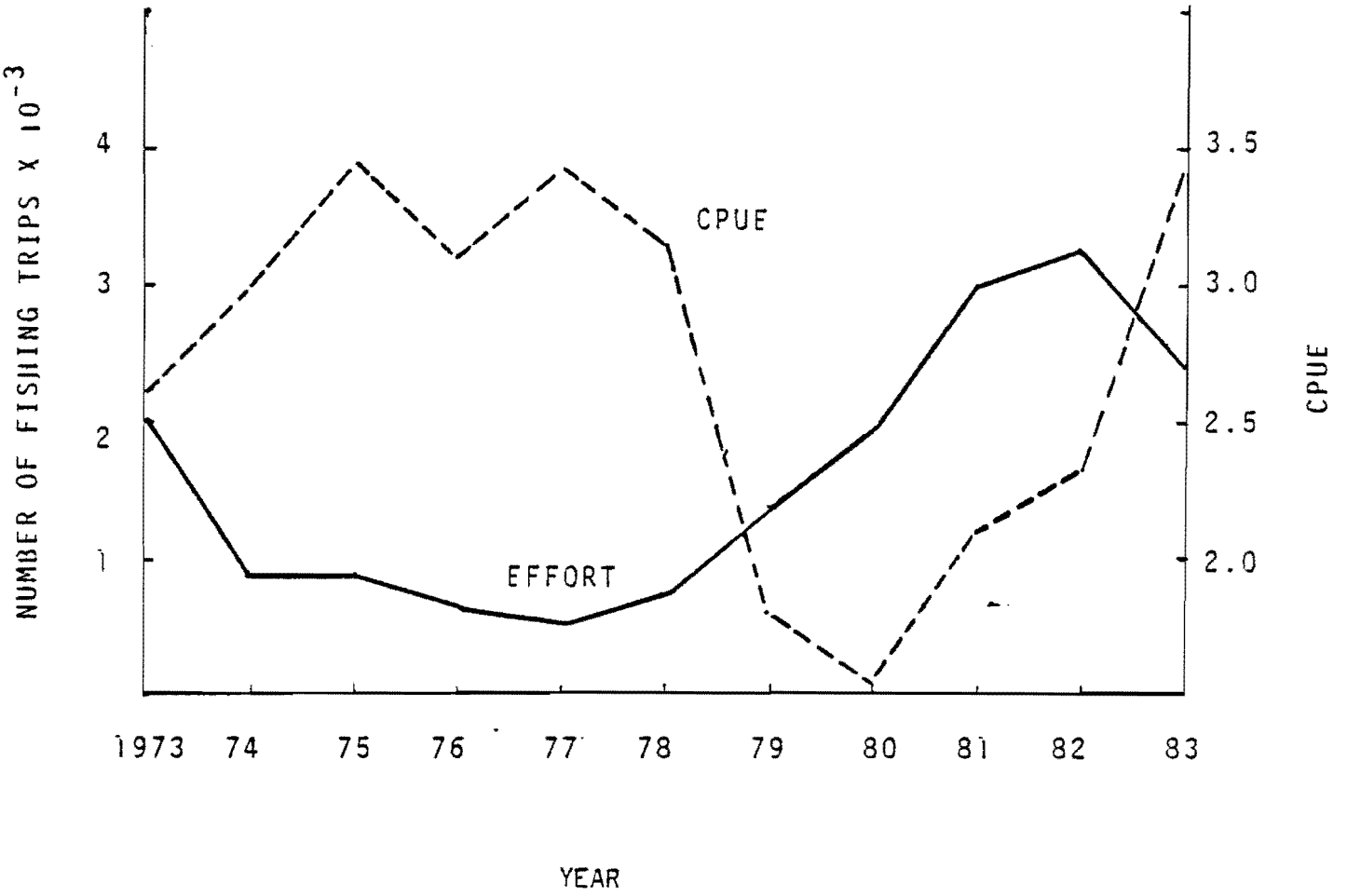

Figure 7. Fishing effort and catch-per-unit-effort of inshore fall herring fisheries (August-September) in the southern Gulf, 1973-1983.

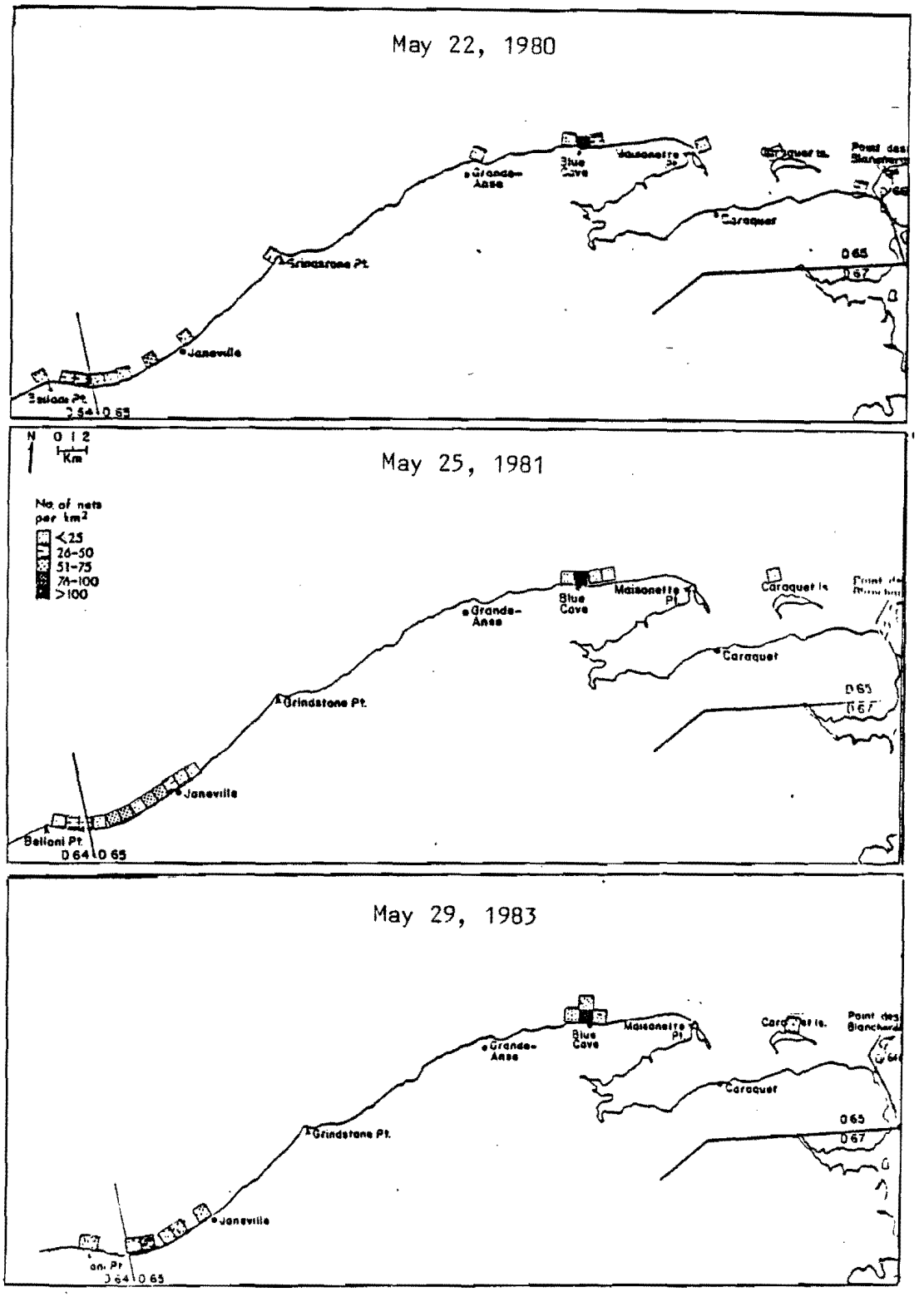

Figure 8: Distribution and intensity of herring gillnets in Caraquet fishery as revealed by aerial surveys in 1980, 1981 and 1983.

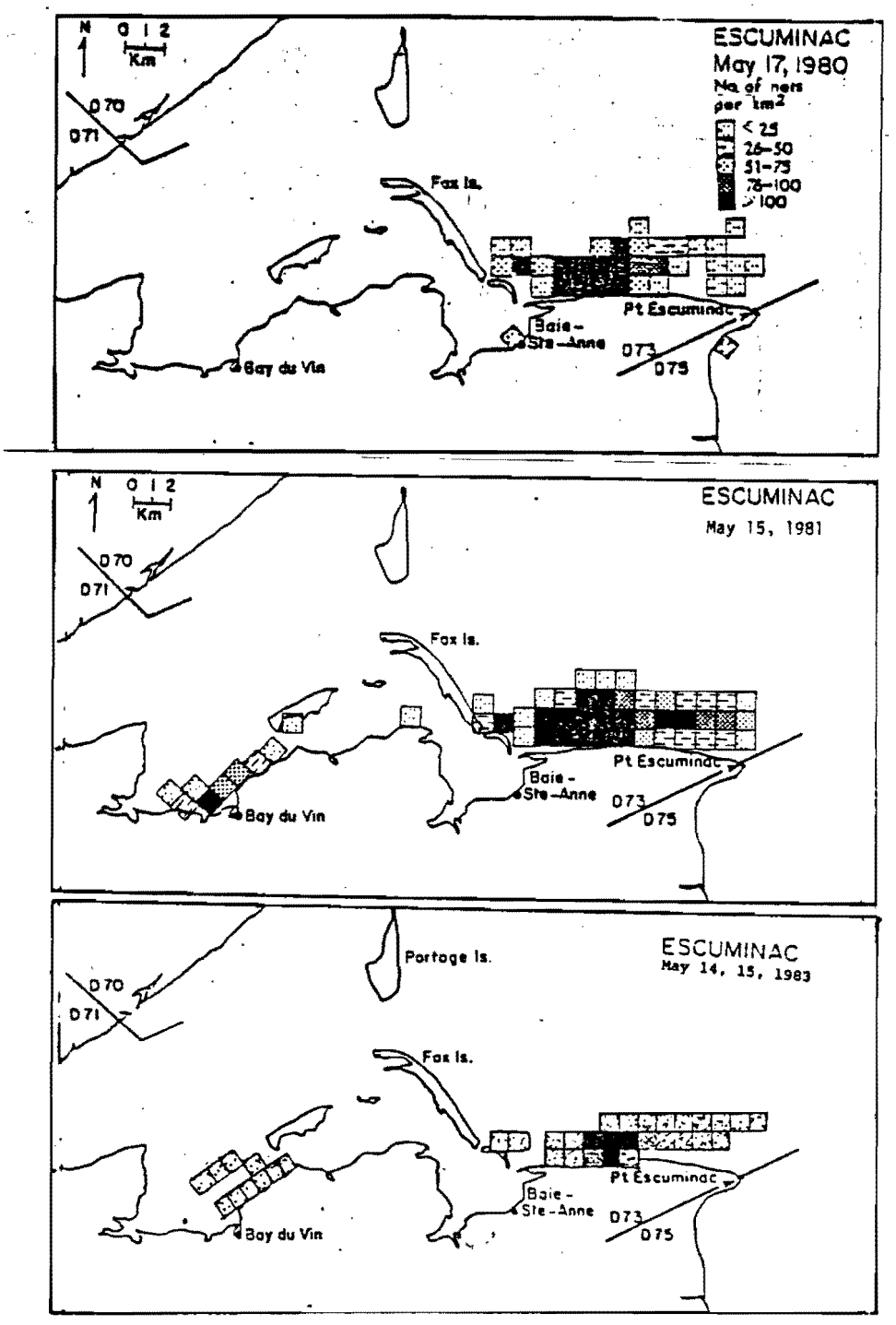

Figure 9: Distribution and intensity of herring gillnets in Escuminac fishery as revealed by aerial surveys in 1980, 1981 and 1983.

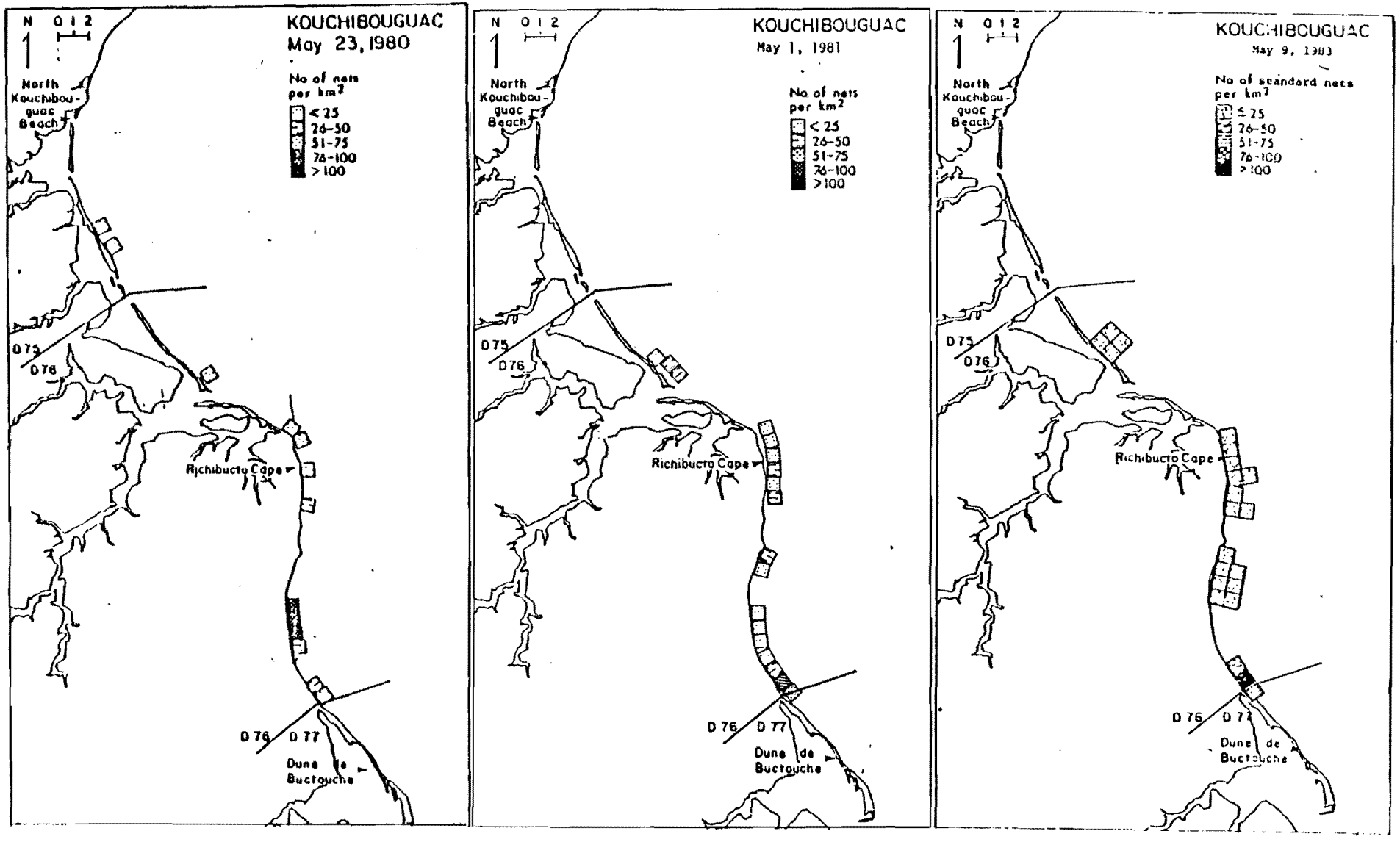

Figure 10: Distribution and intensity of herring gillnets in Kouchibouguac fishery as revealed by aerial surveys in 1980, 1981 and 1983.

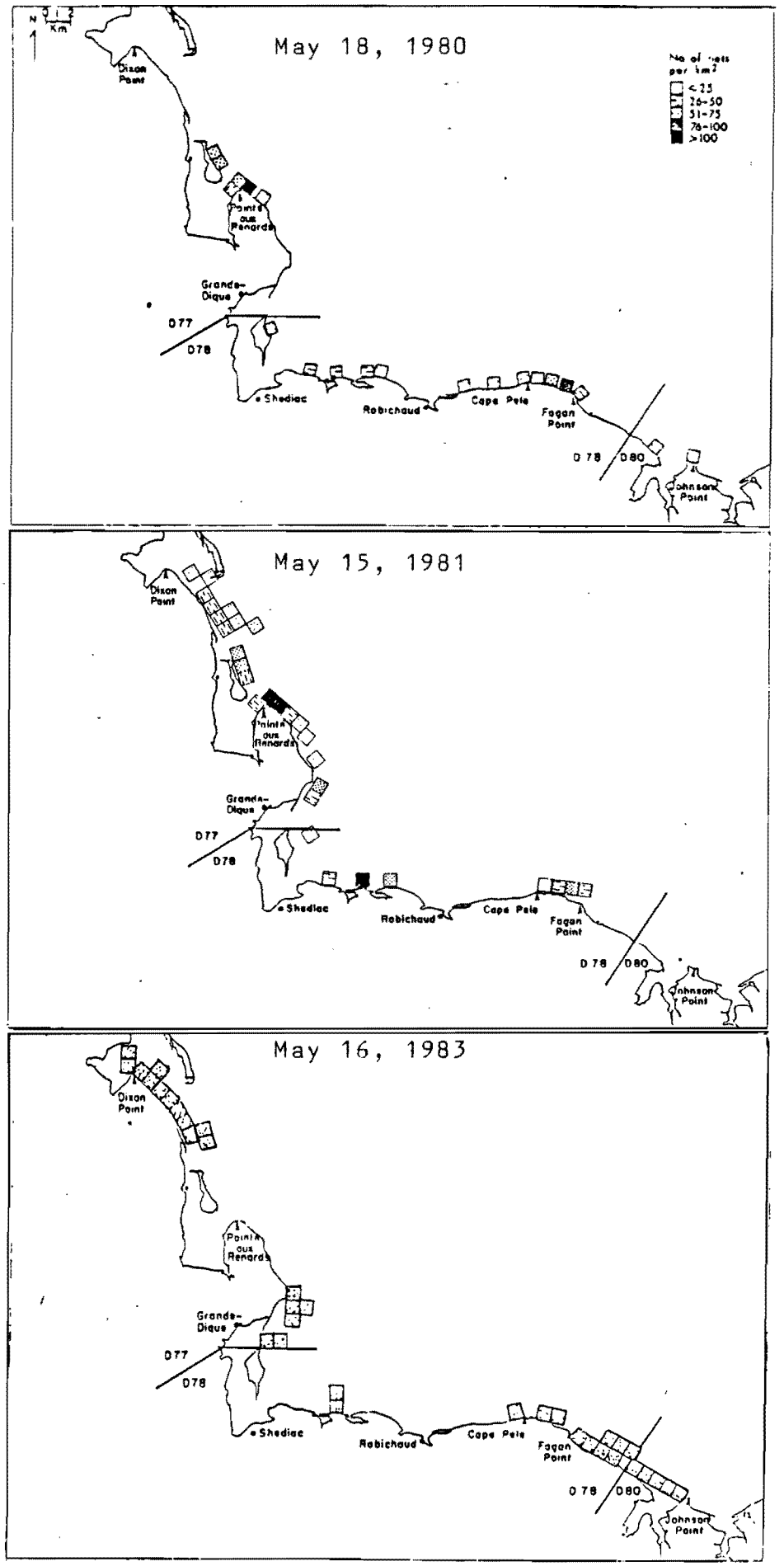

Figure 11: Distribution and intensity of herring gillnets in Shediac fishery as revealed by aerial surveys in 1980 and 1983.

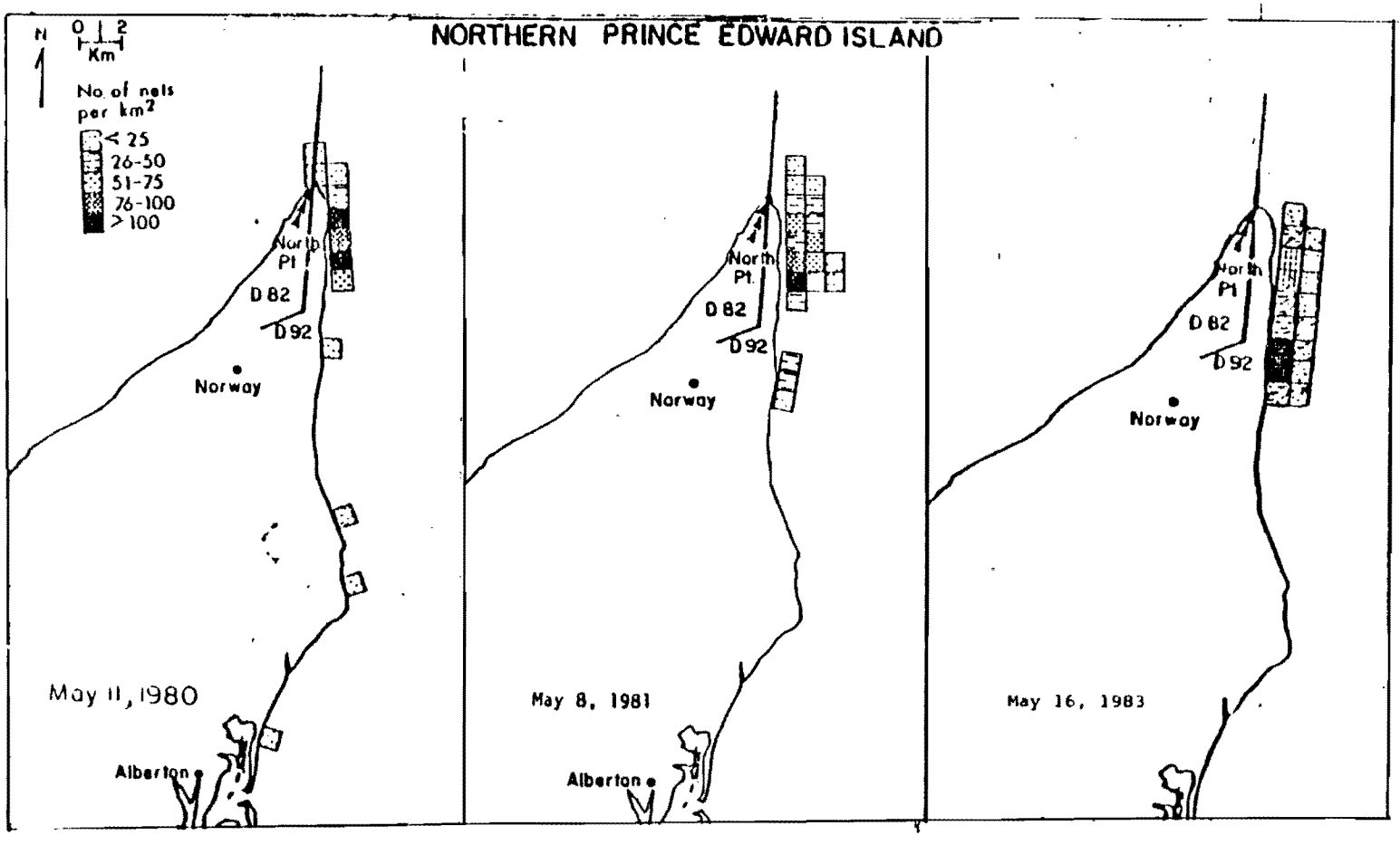

Figure 12: Distribution and intensity of herring gillnets in northern PEI fishery as revealed by aerial surveys in 1980, 1981 and 1983.

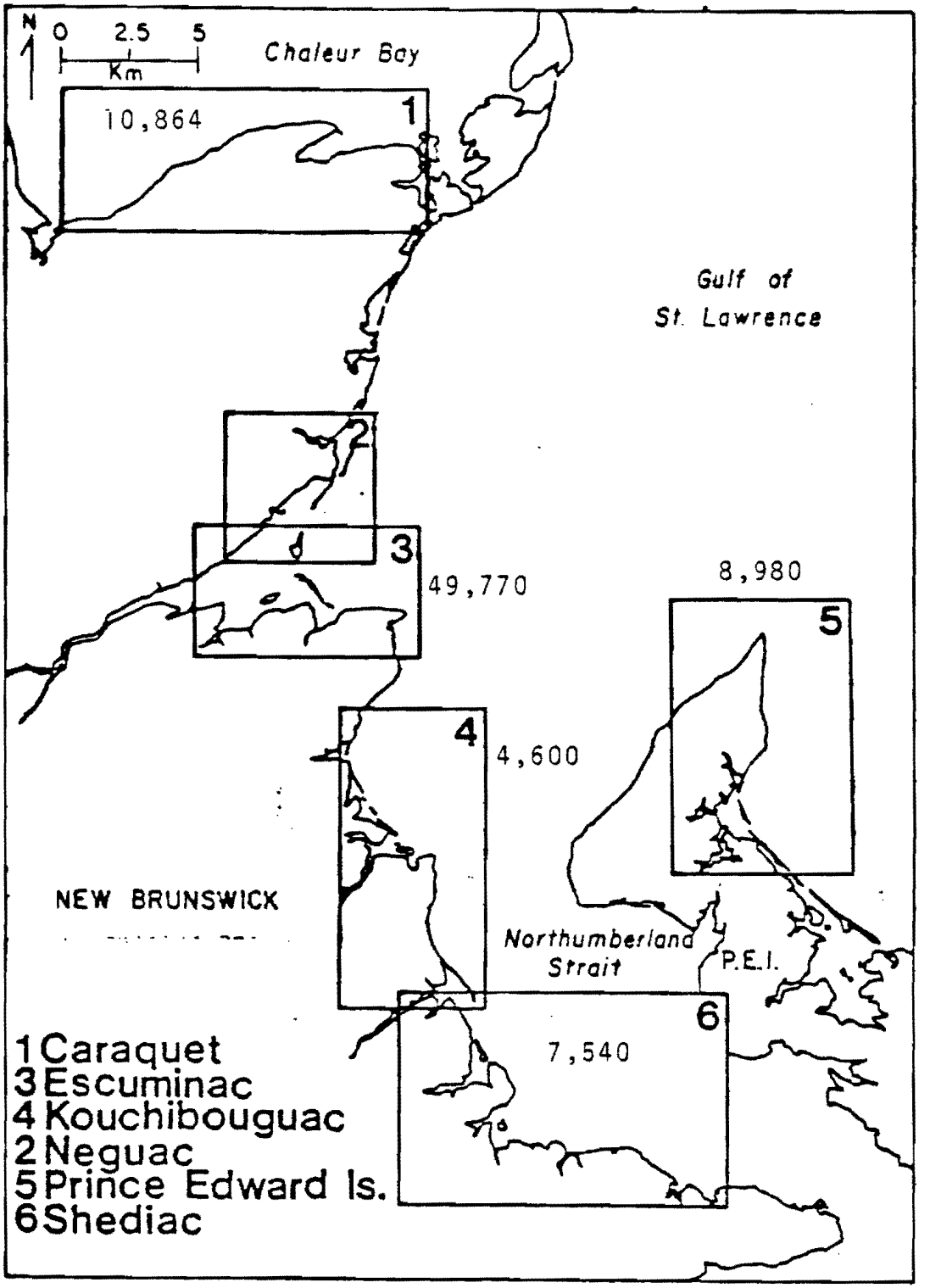

Figure 13. Number of herring net-days fished in the southern Gulf of St. Lawrence estimated from aerial surveys in spring 1980. (1 standard net = 27.4m (90 ft).

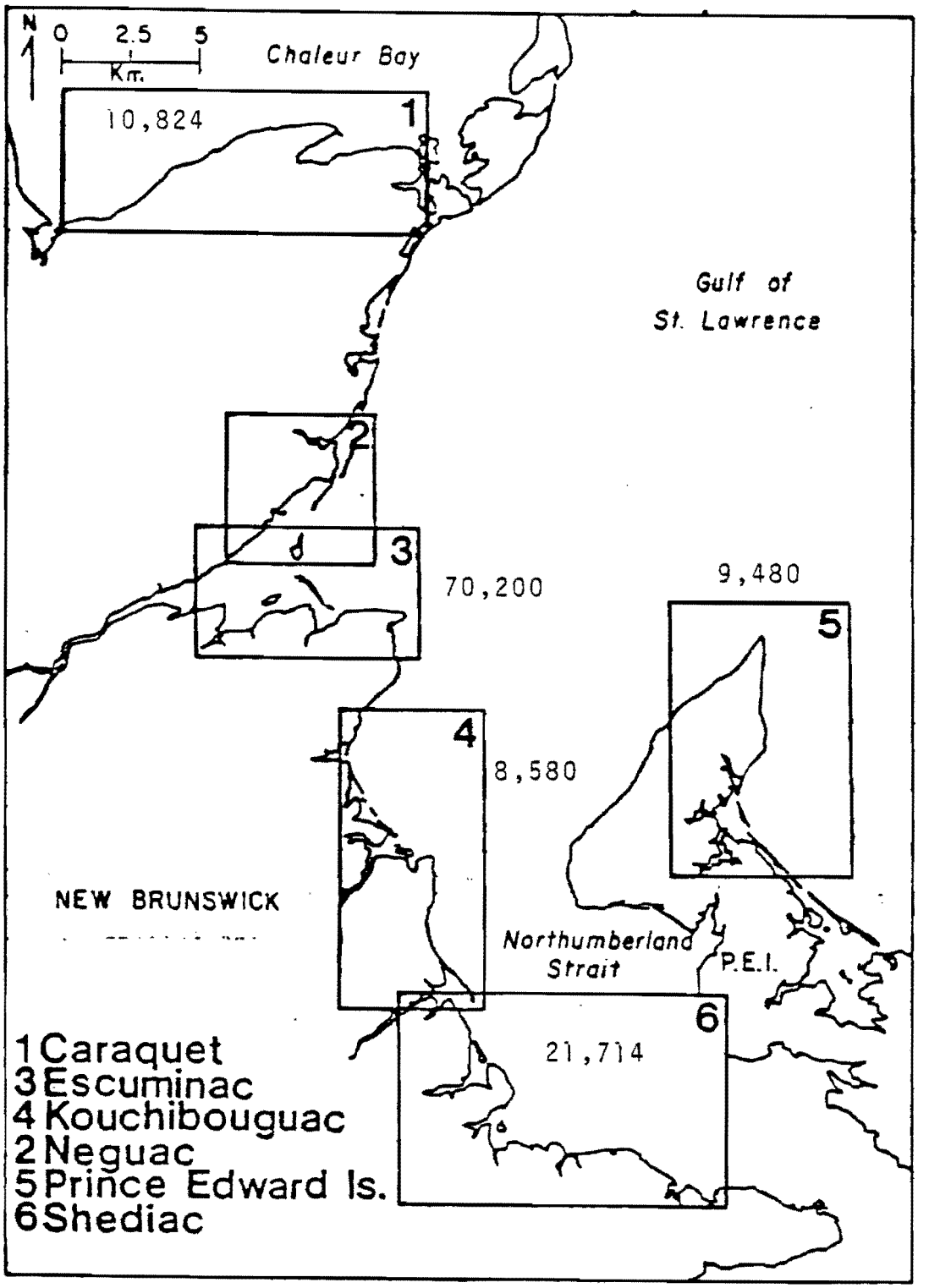

Figure 14. Number of herring net-days fished in the southern Gulf of St. Lawrence estimated from aerial surveys in spring 1981.

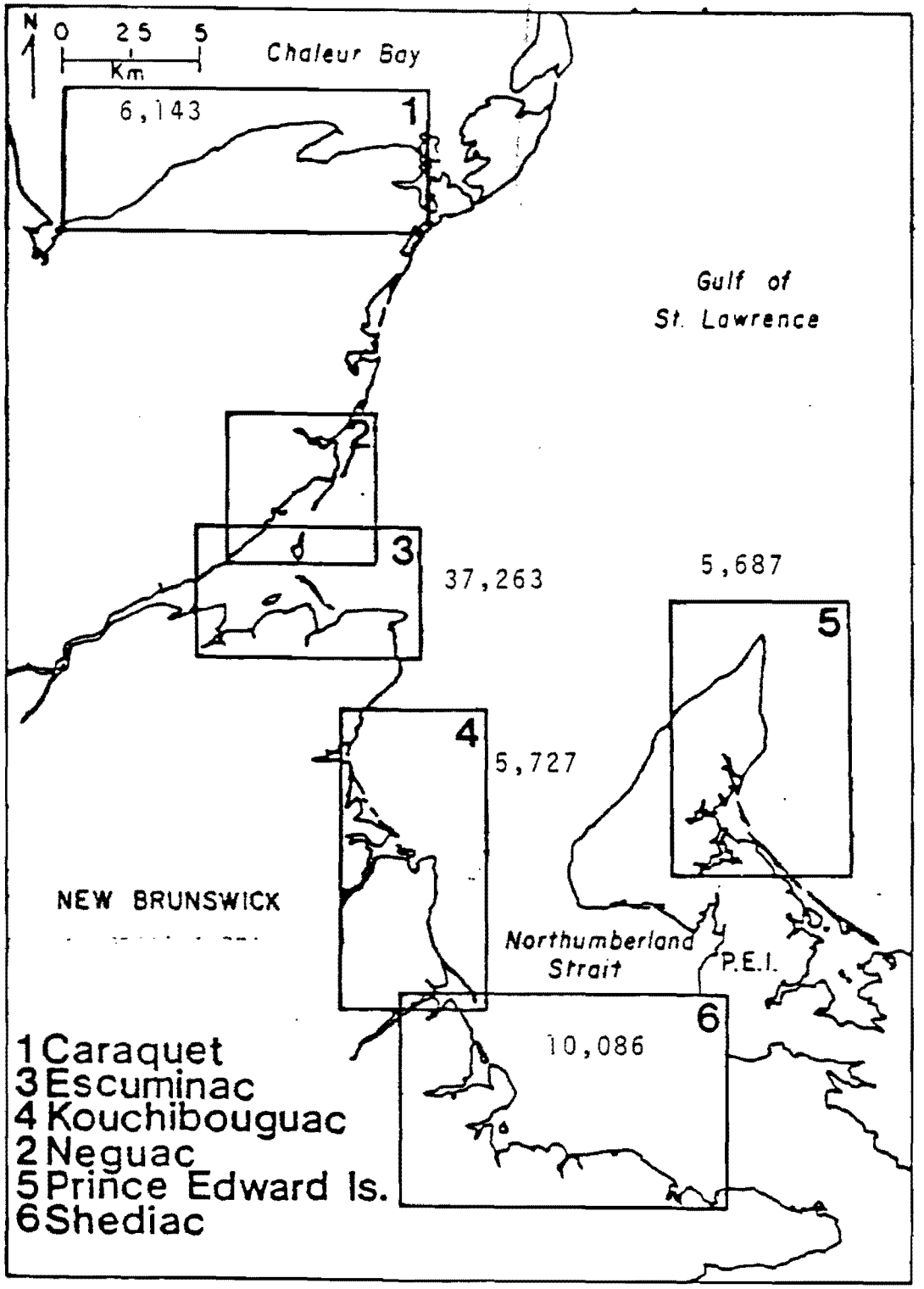

Figure 15. Number of herring net-days fished in the southern Gulf of St. Lawrence estimated from aerial surveys in spring 1983.

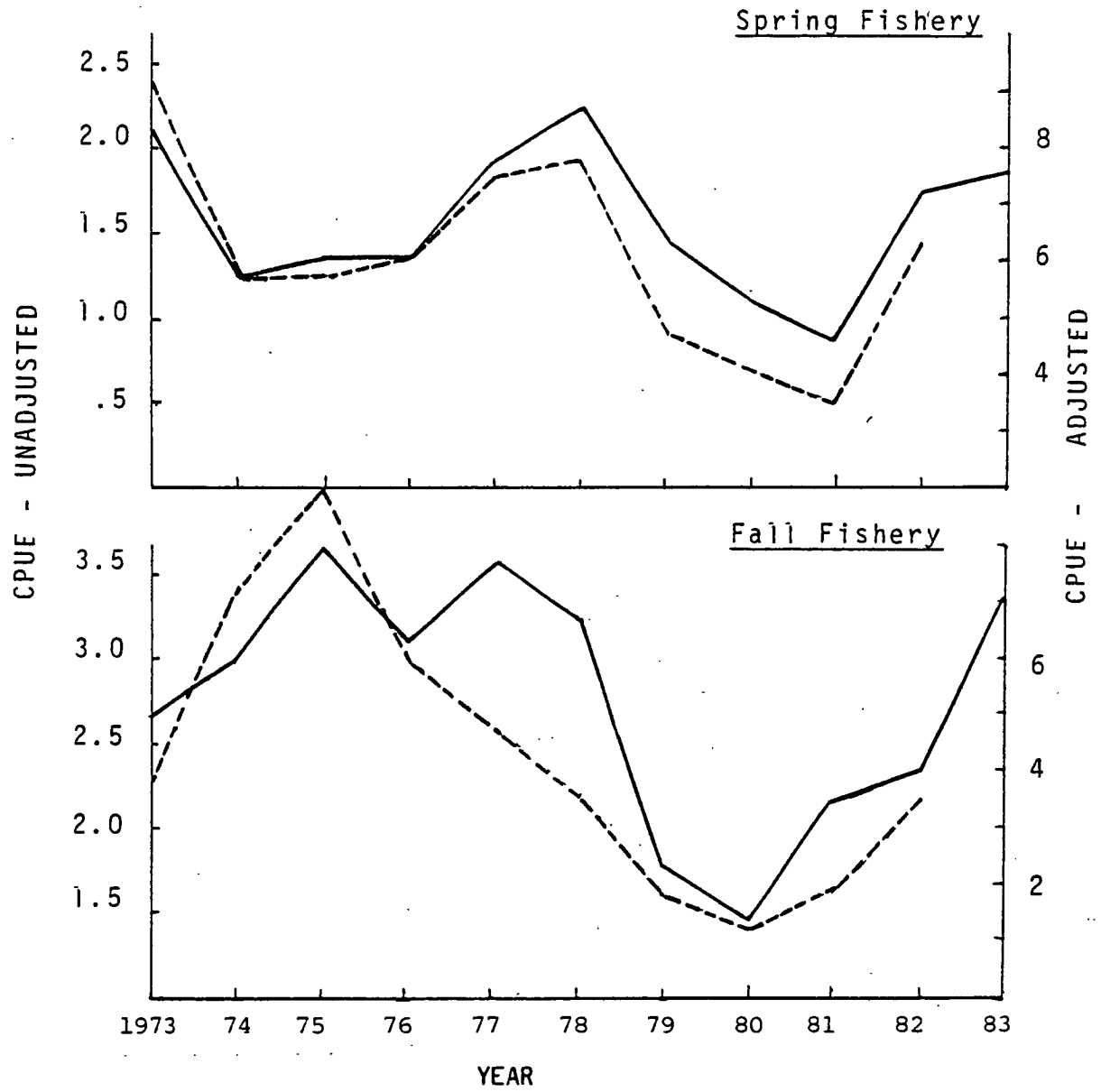

Figure 16. Comparison of adjusted (----) and unadjusted (_____) CPUE estimates for spring and fall inshore herring fisheries in the southern Gulf of St. Lawrence.