Status of the Miramichi River estuary gaspereau fishery (1982)

by

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ABSTRACT

Historical catch information for the Miramichi gaspereau fishery shows a drastic decline from a peak of 11,381 tonnes (1952) to levels as low as 119 tonnes (1964). Since 1977, landings showed some improvement but remained in the range of 3343 tonnes (1979) to 1072 tonnes (1982). Commercial catch/net/hour information was combined with biological data from Millbank samples for 1981 and 1982 to assess the current stock status. Age structure of the catch indicates that the 1975 year-class of bluebacks made a strong contribution to the fishery in 1981 and 1982 and probably in 1979 and 1980 as well. This year-class will make only a minor contribution to the fishery in 1983 but there is some indication that the 1978 and 1979 year-classes of alewives may be strong enough to maintain the fishery. Nevertheless, Paloheimo mortality rates calculated at 0.86 and 0.79 for alewives and bluebacks respectively suggest an excessive level of commercial exploitation. Alternative measures for increasing spawning escapement are examined.

RESUME

Les statistiques de prises historiques de gaspareau dans la Miramichi indiquent une diminution dramatique, d'un sommet de 11 381 t (1952) à des niveaux aussi bas que 119 t (1964). Depuis 1977, les débarquements se sont quelque peu améliorés, mais sont demeurés dans la gamme de 3 343 t (1979) à 1 072 t (1982). Dans le but d'évaluer l'état actuel du stock, nous avons combiné les données de prises commerciales/filet/heure avec les données biologiques d'échantillons prélevés à Millbank en 1981 et 1982. La structure par âge des prises indique que la classe d'âge de 1975 de l'alose d'été a contribué significativement à la pêche en 1981 et 1982, et probablement aussi en 1979 et 1980. Cette classe d'âge ne contribuera que très peu à la pêche en 1983, mais on croit, à certains signes, que les classes d'âge de 1978 et 1979 du gaspareau sont suffisamment abondantes pour alimenter cette pêche. Néanmoins, les taux de mortalité de Paloheimo, calculés à 0,86 et 0,79 pour le gaspareau et l'alose d'été respectivement, indiqueraient un niveau d'exploitation commerciale excessif. Nous examinons diverses mesures visant à favoriser l'échappement en vue de la reproduction.

INTRODUCTION

The commercial trap net fishery of the Miramichi River estuary is regarded as the greatest gaspereau fishery in the Gulf Region. However, in 1982 the estimated harvest of 1,142 tonnes was only slightly higher than the 1,043 tonnes harvested in the Margaree River fishery. Since the peak (1952) recorded catch is more than 10 times the 1982 harvest, it is assumed that the fishery is far below its potential annual harvest. Industrial and municipal waste disposal, logging practices, aerial applicaton of insecticides, and overexploitation in the commercial fishery are among the factors which may have contributed to a decline in the fishery. More recently, fishermen have claimed that channel dredging in the estuary has contributed to declining catches.

This paper reviews the status of the Miramichi River gaspereau fishery with emphasis on trends in the fishery characteristics. New information is provided on the biology of the species based on recent data collections.

BACKGROUND

The Miramichi River estuary gaspereau fishery includes catches of alewife *(Alosa pseudoharengus)* and blueback herring *(Alosa aestivalis)* in statistical districts 70, 71, 72 and 73 (Fig. 1). However, harvest in districts 71 and 72 generally exceeds 90% of the total annual landings. Harvest in districts 71 and 72 is also likely to represent harvest of gaspereau produced in either the northwest or southwest Miramichi whereas harvest in districts 70 and 73 may include production from other areas such as Bay du Vin or Baie-Ste-Anne tributaries. Detailed catch-effort data available from logbooks completed by almost all fishermen active in districts 71 and 72 during 1981 and 1982 are therefore considered to represent the fishery. Biological samples collected at Millbank were assumed to be representative of the Miramichi fishery (districts 71 & 72).

The gaspereau fishery in districts 71 and 72 is conducted in the period May 15 to June 15. The number of licences, which peaked at 231 in 1954, has been limited to 35 trap nets or fewer since the early 1970's but, in fact has been close to that level since the mid-1960's. These traps are located approximately as indicated on the attached map (Fig. 1). The 1982 fishery continued to operate seven days per week, contrary to a recommendation from the Research Branch for a return to two-day-per-week closure which was in effect prior to 1979.

Detailed catch-effort data reported through a voluntary logbook system was considered to be sufficiently reliable for general use in 1981 and 1982. Fishing effort is recorded in hours per day and catch in kilograms per day for each net. The detailed information by fisherman is confidential.

Fish for biological sampling were collected from the experimental trap net operated at Millbank by Fisheries and Oceans personnel. In both 1981 and 1982, approximately 50 fish were collected twice each week. Each fresh specimen was measured to the nearest mm fork length and total length and weighed to the nearest gram using an electronic balance. Sex and state of maturity were determined by examining dissected gonads and species was identified by examining the colour of the peritoneal lining. The peritoneum in alewives was considered to vary from pink to pearly-grey while it was sooty-black in blueback (Scott and Crossman, 1973). A sample consisting of 6 - 8 non-regenerated scales was collected from an area below the dorsal fin and extending above and below the lateral line; these were field mounted on acetate slides. Regenerated scales could usually be identified by visual inspection. Age of each specimen was subsequently determined in two independent readings by examining scales at a magnification of 25X and applying the criteria established by Cating (1953) (Rothschild, 1963). Where there was disagreement between the two age determinations a third reading was made and the age common to two readings was accepted.

Data on mean fish size, species composition and age structure from samples collected at Millbank were applied to the daily catch records as reported in logbooks for a detailed examination of the commercial catch in 1981 and 1982.

RESULTS & DISCUSSION

The number of fishing licences for gaspereau on the Miramichi varied from 220 in 1950 down to 163 in 1951 then to a maximum level of 231 in 1954 followed by a steady decline, reaching a minimum of 23 in 1969 (Fig. 2, Table 1). Between 1975 and 1982, the number of licences has been limited to 35 or fewer trap nets. Unfortunately, the number of licences issued per year may not be a good measure of annual fishing effort because of differences in gear type and fishing season, changes in gear design, and gear location, variable fishing effort by individual fishermen and differences in run timing. The 1979 regulation change allowing a seven-day-per-week fishery may alone account for a 40% increase in fishing effort.

The catch statistics also show large annual fluctuations with a severe decline particularly apparent following the maximum recorded catch of 11,381 tonnes in 1952 to a low level of 119 tonnes in 1964 (Fig. 2, Table 1). The decline in catch preceeds the decline in numbers of licences and it is assumed that fishermen were leaving the fishery in response to a declining catch per net. This is supported by the general trend toward declining catches per net from 1952 until 1961 (Fig. 3, Table 1). After 1961 however, the general trend is toward an annual increase in catch per net, although some poor catches such as that in

1975 have been noted. Prior to the limit on the number of nets in 1975, the mean annual catch per net was 18.5 tonnes. Including even the poor return in 1975, the mean annual catch per net in the eight years following the restriction increased to 50.8 tonnes. The decline in catch per net to 41.5 tonnes in 1981 and 31.5 tonnes in 1982 (Fig. 3, Table 1) is disappointing, but these values remain well above the mean annual pre-restriction levels of 18.5 tonnes or the 33 year mean annual catch of 26.3 tonnes per net.

Most nets are set at the opening of the season although some fishermen may delay until significant numbers of fish appear in the estuary. Daily fishing effort then remains relatively constant until the end of the season. This pattern was apparent from logbook reports in both 1981 (Fig. 4, Table 2) and 1982 (Fig. 5, Table 3). Because effort is stable, fluctuations in daily catch per net hour in both 1981 (Fig. 6, Table 4) and in 1982 (Fig. 7, Table 5) are nearly identical to the daily pattern of total catch for these years (Fig. 8, Fig. 9). Although logbook returns for 1981 were incomplete (19 of 27 fishermen reported), the average catch of 94.8 kg/hr is useful for comparison with the 1982 value of only 49.6 kg/hr. This trend was checked by comparing the catch per hour for 17 fishermen who returned logbooks in both years. The results were similar with a decline from 98.2 kg/hr in 1981 to 51.2 in 1982. This represents nearly a 50% drop in catch per hour compared to an approximate 25% drop in the catch per net between the two years.

In 1981, mean weight of alewives declined from an average of 373 g near the beginning of the harvest on May 15 to only about 184 g at the end of the harvest in late June (Table 6). When weighted by numbers, the mean weight of alewives was 295.9 g. Similarily, the mean weight of blueback herring declined from approximately 427 g at the start of the run to 232 g at the end (Table 6). Mean weight of blueback herring was 332.6 g. The decrease in mean fish size with time is a reflection of changes in age structure of the catch with older and, therefore, larger fish arriving earlier.

When the daily catch was proportioned by species, it became apparent that in 1981, alewives (Fig. 10, Table 6) began contributing to the fishery about 10 to 12 days earlier than blueback (Fig. 11, Table 6) but that the blueback quickly overtook the alewives in total contribution to the fishery. Catch, in total numbers of gaspereau per day, is a blend of the two species and shows (Fig. 12) a near normal distribution. It is estimated that the 1981 gaspereau fishery harvested 1,067,700 alewives or 24.5% of the total number, compared to 3,289,700 blueback representing the remaining 75.5%. Harvest by weight was 315,976 kg or 22.4% of the total as alewives and 1,094,265 kg or 77.6% as blueback. This contribution by blueback herring was surprisingly high and is in sharp contrast to the 1981 gaspereau fishery in the Margaree which was estimated to be comprised of 92% alewives by weight. (R. Crawford, pers. comm., N.S. Dept. of Fisheries, Halifax, Nova Scotia)

An examination of the 1981 age structure by species indicated that alewives (Fig. 13, Table 7) were well represented in ages 4, 5, 6 & 7 with very few fish at age 3. Bluebacks (Fig. 13, Table 8) showed an even greater age distribution with good catches at ages 4 through 9. The gaspereau fishery as a whole was heavily dependent on age 6 blueback herring.

In the 1982 fishery, the size of alewives again declined through the run with an average weight of 356 g near the beginning and 165 g at the end (Table 9). Mean weight through the whole run was 312 g which is an increase from 1981. Average size of bluebacks also declined from about 400 g at the start of the season to 226 g at the end with a season average of 323 g. This mean weight represents a decrease from 1981, but again, the average size of bluebacks during the season was greater than that for alewives. Although the alewives (Fig. 14, Table 9) again arrived in the fishery in small numbers a few days ahead of the blueback (Fig. 15, Table 9), the bulk of the numbers arrived during a peak in the blueback harvest. Consequently, the 1982 alewife harvest in particular (Fig. 14) and the gaspereau fishery in general (Fig. 16) were concentrated into only about five days. Of the total 1982 landings, 73% was taken in the six days between May 31 and June 5, inclusive. Although alewives made a slightly greater contribution to the 1982 fishery and represented 39% by both weight and numbers (1,379,200 and 426,822 kg, Table 9), the blueback herring again supported the bulk of the fishery.

More alewives were harvested in 1982 than in 1981. The age structure (Fig. 17, Table 10) also showed a marked shift toward a heavy dependence on age 3. Age 3 and age 4 combined accounted for more than 80% of the alewife harvest with only small numbers of age 5, 6 and older. Since recruitment to the fishery is considered to be highly incomplete for age 3 and age 4, this could be an indication that the 1979 and 1978 year-classes are exceptionally strong and will make a greater contribution to the fishery in 1983. This would suggest that some improvement might be expected in the 1983 alewife fishery.

In contrast to the alewives, the 1982 harvest of bluebacks showed a decline from the 1981 level. Again the bluebacks showed a wide age distribution with ages 4, 5, 6 and 7 each contributing strongly and some fish at age 3, 8, 9, and 10 (Fig. 17, Table 11). Nevertheless, the 1975 year-class which supported the bulk of the fishery at age 6 in 1981 continued to show a strong but declining contribution to the 1982 fishery at age 7. This year-class can not be expected to produce large numbers of fish for harvest in 1983 and the decline may offset any anticipated increase in the harvest of alewives.

The history of low annual catches of gaspereau in the Miramichi since about 1957 compared to earlier landings suggests that the population has been greatly depleted for an extended period of time. In contrast, there is some belief that the low catch in the 1960's and early 1970's was a consequence of poor market conditions rather than population depletion. Improved landings after 1976 could therefore be a reflection of improved markets or increased numbers of fish or both. However, if the improved catch is a result of improved markets, then

failure to show a correlation between annual catches at Millbank and in the commercial fishery (Table 12) may be ignored. The consistent decline in catches at Millbank may indeed be a true index of declining abundance. When fitted to an exponential curve, the data can be used to predict a 1983 Millbank catch of only 24,807 gaspereau. This speculative decline in abundance is consistent with the observed 50% drop in catch per net hour from 1981 to 1982. Paloheimo mortality rates, calculated for alewives and bluebacks to be 0.86 and 0.79 respectively (Table 13), are a further indication of high commercial exploitation.

There are currently insufficient biological data to prove that recent increases in harvest of gaspereau on the Miramichi will contribute to further declines in future harvest. Nevertheless the long term depression of the fishery does indicate that spawning escapement may be inadequate and that any increase in the level of exploitation should be avoided. In the near future, some action may be required to temporarily reduce harvest in order to improve and possibly even to maintain future harvest on the long term.

RECOMMENDATIONS

1. The number of gaspereau licences should be limited to not more than 35 in 1983. Any increase in nets would contribute to a further decline in catch per net unless stocks also begin to increase. If catch continues to decline then consideration could be given to reducing the number of nets possibly through attrition.

NOTE: The above recommendation assumes that the catch per net is at or below levels which are socially and economically desirable in the fishery. If lower levels are acceptable, then more nets could be licenced, provided that other measures are taken to limit harvest.

2. Although current levels of spawning escapement are not known, declining catches suggest that spawning escapement may be inadequate to maintain stocks. Action may be required to improve escapement. Two alternatives have been examined for consideration by fisheries managers.

a) It has often been suggested that the two-day-per-week closure (Saturday and Sunday) which was in effect prior to 1979 should be re-instituted. If this had been in effect in 1981 and 1982, and assuming that fish which were caught on weekends would then have escaped to spawn, then the increase in spawning escapement can be calculated from examination of Table 6 and Table 9. The results (Table 14) indicate that landings would have been reduced by 27% (381,800 kg) in 1981 and by 11% (118,900 kg) in 1982. In 1981, the alewife and blueback herring harvest would have both decreased by 27% thus allowing additional escapement of 283,000 alewives and 903,000 blueback herring. In 1982, the reduction in harvest would have been only 9% for alewives and 13% for blueback herring. Spawning escapement would, therefore, have increased by 120,000 for alewives and 278,000 for blueback herring. This option was recommended for 1982 but not implemented.

b) A second alternative considered is to delay the season opening until June 1. Again the potential effects of this action can be determined for 1981 and 1982 by examination of Table 6 and Table 9. The results (Table 14) show that overall reduction in harvest would have been about 25% in 1981 and 14% in 1982. The reduction is similar to that achieved by weekend closures. However, when examined by species, it appears that alewife harvest would have been reduced 50% thus allowing an additional 539,000 spawners to ascend the river in 1981 and by 22% for an increase of 303,000 spawners in 1982. Compensating for this is the more modest reduction in blueback herring harvest estimated at 14% in 1981 and 6% in 1982. Consequently, spawning escapement of this species would have increased by 458,000 in 1981 and by 119,000 in 1982.

Since the early run of fish and, consequently, the alewife population is subject to the heaviest fishing pressure and appears to be in the greatest danger of severe overharvest, the second option of a delayed fishing season is biologically more desirable. It is probable that escapement will increase nearly as predicted yet harvest may be reduced less than estimated since at least some of the post-spawning gaspereau will be taken in the June fishery. Fishermen may be reluctant to accept this option fearing that they will miss the run almost entirely.

3. It is recommended that biological sampling be maintained in 1983 at levels at least equal to that of 1982. Detailed information on landings is also essential to proper stock assessment and it is hoped that logbook reporting can be maintained and preferably expanded to other areas. Consideration should be given by managers, to mandatory logbook reporting. At present, biological and harvest data are inadequate or insufficient to permit the use of sophisticated modelling techniques for stock predictions.

Related factors such as the influence of dredging, the impact of by-catch in mackerel and herring nets, and the influence of market conditions including over-the-side sales should be examined.

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Fishery officers Wayne Olsen and Bill Scott with the Protection and Regulation Branch provided historical and current information on the number and location of commercial traps. Réjean Hébert, statistical officer with the Resource Allocation and Development Branch also supplied historical catch and effort information. The Department's secretarial and word processing staff was required to prepare numerous drafts of tables and text.

Most commercial gaspereau fishermen in statistical districts 71 and 72 are now participating in the voluntary gaspereau logbook program used in the stock assessment.

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TABLE 1. Annual catch statistics and number of fishing licences for the Miramichi River, N.B., gaspereau fishery.

	Districts 71 and 72			Dist. 70 to 73
Year	Catch (mt)	No. Licences	Catch/licence	Catch (mt)
1950	4952	220	22.51	5311
1951	8014	163	49.17	8163
1952	11381	180	63.23	11608
1953	8026	178	45.09	8095
1954	4649	231	20.13	4859
1955	3413	181	18.86	3648
1956	3009	166	18.13	3327
1957	884	135	6.55	1056
1958	816	120	6.80	871
1959	1596	108	14.78	1716
1960	716	120	5.97	786
1961	161	109	1.48	199
1962	733	67	10.94	875
1963	543	66	8.23	617
1964	119	37	3.22	128
1965	425	36	11.81	501
1966	746	41	18.20	875
1967	532	34	15.65	677
1968	436	27	16.15	567
1969	175	23	7.61	237
1970	874	28	31.21	969
1971	469	37	12.68	555
1972	468	26	18.00	592
1973	967	35	27.63	1012
1974	271	35	7.74	415
1975	141	34	4.15	219
1976	406	34	11.94	483
1977	2240	34	65.88	2385
1978	1434	34	42.18	1587
1979	3343	34	98.32	3622
1980	3767	34	110.79	3948
1981	1410	34	41.47	1503
1982	1072	34	31.53	1142

TABLE 2. Summary of daily fishing effort (hours) by all traps reporting in logbooks for districts 71 and 72, Miramichi River gaspereau fishery, 1981.

DATE	DISTRICT	CPUE (KG/HOUR)						
		MON	TUES	WED	THURS	FRI	SAT	SUN
May 11-17	71	0	0	0	0	24	52	64
	72	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	24	52	64
May 18-24	71	192	192	192	216	212	168	144
	72	66	22	22	66	68	22	138
	TOTAL	258	214	214	282	280	190	282
May 25-31	71	264	246	241	262	256	239	215
	72	282	282	284	246	286	282	284
	TOTAL	546	528	525	508	542	521	499
June 01-07	71	238	234	234	232	214	190	220
	72	332	332	332	332	332	332	332
	TOTAL	570	566	566	564	546	522	552
June 08-14	71	230	226	224	222	221	234	216
	72	332	332	288	332	332	332	240
	TOTAL	562	558	512	554	553	566	456
June 15-21	71	153	46	46	46	40	36	24
	72	178	0	0	0	0	0	0
	TOTAL	331	46	46	46	40	36	24
June 22-28	71	39	24	24	24	24	24	24
	72	0	0	0	0	0	0	0
	TOTAL	39	24	24	24	24	24	24

TABLE 3 Summary of daily fishing effort (hours) by all traps reporting in logbooks for districts 71 and 72, Miramichi River gaspereau fishery, 1982.

		CPUE (KG/HOUR)						
DATE	DISTRICT	MON	TUES	WED	THURS	FRI	SAT	SUN
May 17-23	71	120	336	360	384	408	432	432
	72	48	48	96	240	240	240	240
	TOTAL	168	384	456	624	648	672	672
May 24-30	71	408	408	408	408	408	456	504
	72	312	312	312	312	312	312	312
	TOTAL	720	720	720	720	720	768	816
May 31-June 06	71	528	528	528	528	528	504	504
	72	312	312	312	312	312	312	312
	TOTAL	840	840	840	840	840	816	816
June 07-13	71	528	504	504	504	504	504	504
	72	312	312	312	312	312	312	264
	TOTAL	840	816	816	816	816	816	768
June 14-20	71	456	404	120	120	96	96	96
	72	48	48	0	0	0	0	0
	TOTAL	504	452	120	120	96	96	96
June 21-27	71	72	48	48	48	48	0	0
	72	0	0	0	0	0	0	0
	TOTAL	72	48	48	48	48	0	0

TABLE 4. Summary of daily catch per unit effort (kg/hour), Miramichi River gaspereau fishery, districts 71 and 72, 1981. Values are based on gaspereau catch and effort logbook returns.

		CPUE (KG/HOUR)						
DATE	DISTRICT	MON	TUES	WED	THURS	FRI	SAT	SUN
May 11-17	71	0.00	0.00	0.00	0.00	66.17	28.35	18.61
	72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	0.00	0.00	0.00	0.00	66.17	28.35	18.61
May 18-24	71	43.41	16.66	9.19	45.10	36.11	65.54	77.57
	72	0.00	15.46	0.00	42.11	10.00	0.00	35.33
	TOTAL	32.31	16.54	8.24	44.40	29.77	57.95	56.90
May 25-31	71	43.97	43.37	18.01	77.82	146.73	123.40	83.21
	72	59.71	53.65	72.87	21.20	58.29	83.64	102.97
	TOTAL	52.10	48.86	47.69	50.40	100.06	101.88	94.46
June 01-07	71	156.31	198.07	134.98	136.35	239.43	179.86	128.89
	72	144.18	201.70	211.16	81.64	144.21	181.97	197.72
	TOTAL	149.24	200.20	179.66	103.78	181.53	181.21	169.12
June 08-14	71	142.63	42.90	113.20	34.22	63.17	54.52	36.49
	72	281.64	103.02	8.66	95.24	111.17	35.88	24.57
	TOTAL	224.75	78.67	54.40	70.79	91.99	43.59	30.22
June 15-21	71	42.99	32.74	23.67	16.76	14.18	13.22	14.17
	72	50.01	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	46.76	32.74	23.67	16.76	14.18	13.22	14.17
June 22-28	71	33.64	7.42	7.42	7.42	7.42	7.42	7.42
	72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	33.64	7.42	7.42	7.42	7.42	7.42	7.42

TABLE 5. Summary of daily catch per unit effort (kg/hour), Miramichi River gaspereau fishery, districts 71 and 72, 1982. Values are based on gaspereau catch and effort logbook returns.

		CPUE (KG/HOUR)						
DATE	DISTRICT	MON	TUES	WED	THURS	FRI	SAT	SUN
May 17-23	71	0.00	15.23	9.61	9.60	5.21	4.23	0.66
	72	0.00	0.00	7.68	2.05	0.00	2.61	0.00
	TOTAL	0.00	15.23	9.20	6.69	3.28	3.66	0.42
May 24-30	71	0.56	7.85	10.98	5.98	4.08	6.09	34.31
	72	2.10	0.00	0.33	0.55	0.36	0.05	0.00
	TOTAL	1.22	4.45	6.36	3.63	2.12	3.64	21.19
May 31-June 06	71	184.17	360.39	274.36	155.37	79.90	64.35	26.55
	72	2.23	200.27	229.89	118.49	94.14	63.79	0.00
	TOTAL	116.59	300.91	257.84	141.67	85.19	64.14	16.40
June 07-13	71	51.76	42.94	37.73	40.68	30.19	19.07	25.85
	72	112.49	33.98	22.90	14.18	33.80	20.35	0.00
	TOTAL	74.32	39.52	32.06	30.55	31.56	19.56	16.97
June 14-20	71	14.17	33.89	10.39	4.25	14.77	5.31	8.87
	72	51.98	18.90	0.00	0.00	0.00	0.00	0.00
	TOTAL	17.77	32.30	10.39	4.25	14.77	5.31	8.87
June 21-27	71	11.82	0.00	17.73	0.00	9.46	0.00	0.00
	72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	11.82	0.00	17.73	0.00	9.46	0.00	0.00

TABLE 6. Estimated commercial catch of alewife and blueback herring in Miramichi River fishery (Districts 71 and 72), 1981.

Date	Total Catch (Kg)	Alewife No. (x1000)	Alewife wt. (Kg)	Alewife mean wt. (g)	Blueback No. (x1000)	Blueback wt. (Kg)	Blueback mean wt. (g)
May 15	1696	4.6	1696	373.0	0.0	-	-
16	1575	4.2	1555	373.0	0.05	20	427.0
17	1272	3.4	1256	373.0	0.05	16	427.0
18	8904	23.6	8792	373.0	0.3	112	427.0
19	3780	9.9	3685	372.7	0.2	95	427.0
20	1884	5.0	1788	359.3	0.2	96	427.0
21	13374	35.6	12317	345.9	2.5	1057	427.0
22	8904	25.8	8426	326.2	1.2	478	411.4
23	11762	34.1	11131	326.2	1.5	631	411.4
24	17140	49.7	16221	326.2	2.2	919	411.4
25	30388	88.2	28758	326.2	4.0	1630	411.4
26	27555	87.4	26784	306.4	1.9	771	411.4
27	26742	49.8	14761	296.4	29.1	11981	411.4
28	27350	21.2	6074	286.3	53.8	21276	395.8
29	57933	33.7	10027	297.4	126.8	47906	377.7
30	56699	33.0	9814	297.4	124.1	46885	377.7
31	50350	29.3	8715	297.4	110.2	41635	377.7
June 1	90870	52.9	15728	297.4	199.0	75142	377.7
02	121039	46.7	14404	308.5	296.6	106635	359.5
03	108625	56.2	16848	300.0	257.6	91777	356.3
04	62743	41.1	11965	291.5	143.9	50778	353.0
05	105875	58.1	15319	263.8	275.7	90556	328.5
06	101040	55.4	14619	263.8	263.1	86421	328.5
07	99721	54.7	14429	263.8	259.6	85292	328.5
08	134921	74.0	19522	263.8	351.3	115399	328.5
09	46898	19.8	4682	236.0	138.9	42216	304.0
10	29750	9.0	2050	229.0	96.4	27700	287.5
11	41891	6.9	1522	222.0	149.0	40369	271.0
12	54338	24.7	5926	239.5	181.5	48412	266.8
13	26353	12.0	2874	239.5	88.0	23479	266.8
14	14718	6.7	1605	239.5	49.2	13113	266.8
15	16535	7.5	1803	239.5	55.2	14732	266.8
16	1609	1.2	310	257.0	5.0	1299	262.6
17	1163	0.6	152	244.0	3.9	1011	261.2
18	824	0.3	61	231.0	2.9	763	259.7
19	606	0.3	59	230.9	2.2	547	244.2
20	509	0.2	49	230.9	1.9	460	244.2
21	363	0.2	35	230.9	1.3	328	244.2
22	1402	0.6	136	230.9	5.2	1266	244.2
23	190	0.1	19	230.9	0.7	171	244.2
24	190	0.1	23	230.7	0.7	167	228.6
25	190	0.1	9	183.6	0.8	181	232.3
26	190	0.1	9	183.6	0.8	181	232.3
27	190	0.1	9	183.6	0.8	181	232.3
28	190	0.1	9	183.6	0.8	181	232.3
Totals	1410241	1067.7	315976		3289.7	1094265	
Mean				295.9			332.6
%	100	24.5	22.4		75.5	77.6	

TABLE 7. Estimated number of alewives at age, by day, 1981 Miramichi River commercial fishery.

Date	Age 2	3	4	5	6	7	8	9	10	11
May 15	-	-	518	414	1446	1960	209	-	-	-
16	-	-	475	379	1326	1797	192	-	-	-
17	-	-	384	306	1071	1452	155	-	-	-
18	-	-	2687	2145	7496	10159	1084	-	-	-
19	-	-	1127	900	3144	4261	455	-	-	-
20	-	174	861	518	1369	1652	348	55	-	-
21	-	2493	8297	4131	8297	8261	3312	819	-	-
22	-	1188	7801	4314	5528	5502	1214	284	-	-
23	-	1570	10305	5699	7303	7268	1604	375	-	-
24	-	2287	15018	8304	10642	10592	2337	547	-	-
25	-	4055	26625	14723	18867	18779	4144	970	-	-
26	-	1923	32343	18969	17133	17046	-	-	-	-
27	-	4382	18825	7321	8715	8665	-	1892	-	-
28	-	3267	8169	1634	3267	3267	-	1612	-	-
29	-	2596	14936	1281	8227	5395	-	1281	-	-
30	-	2541	14618	1254	8052	5280	-	1254	-	-
31	-	2256	12981	1114	7150	4688	-	1114	-	-
June 1	-	4072	23428	2010	12904	8461	-	2010	-	-
02	-	-	23345	-	15548	7797	-	-	-	-
03	-	-	22464	-	20611	13085	-	-	-	-
04	-	-	12314	-	16418	12314	-	-	-	-
05	-	-	8711	14518	26132	8711	-	-	-	-
06	-	-	8313	13855	24938	8313	-	-	-	-
07	-	-	8204	13674	24613	8204	-	-	-	-
08	-	-	11100	18500	33300	11100	-	-	-	-
09	-	-	-	9919	9919	-	-	-	-	-
10	-	-	4476	2238	2238	-	-	-	-	-
11	-	-	6856	-	-	-	-	-	-	-
12	-	1386	15119	2747	1361	4132	-	-	-	-
13	-	672	7332	1332	660	2004	-	-	-	-
14	-	375	4095	744	369	1119	-	-	-	-
15	-	421	4601	836	414	1258	-	-	-	-
16	-	134	268	268	134	403	-	-	-	-
June 17	-	348	69	69	34	104	-	-	-	-
18	-	263	-	-	-	-	-	-	-	-
19	-	148	42	21	42	-	-	-	-	-
20	-	125	36	18	36	-	-	-	-	-
21	-	89	25	13	25	-	-	-	-	-
22	-	344	98	50	98	-	-	-	-	-
23	-	47	13	7	13	-	-	-	-	-
24	-	17	34	17	34	-	-	-	-	-
25	-	17	21	4	8	-	-	-	-	-
26	-	17	21	4	8	-	-	-	-	-
27	-	17	21	4	8	-	-	-	-	-
28	-	17	21	4	8	-	-	-	-	-
TOTAL *	0	37,241	336,997	154,258	308,906	203,029	15,054	12,213	0	0
%	0.00	3.49	31.56	14.45	28.93	19.02	1.41	1.14	0.00	0.00

* Total Catch (all ages) = 1,067,698 fish

TABLE 8. Estimated numbers of blueback herring at age, by day, 1981 Miramichi River gaspereau commercial fishery.

Date	Age 2	3	4	5	6	7	8	9	10	11
May 15	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	46	-	-	-	-	-
17	-	-	-	-	37	-	-	-	-	-
18	-	-	-	-	262	-	-	-	-	-
19	-	-	-	-	222	-	-	-	-	-
20	-	-	-	37	149	-	37	-	-	-
21	-	-	-	825	825	-	825	-	-	-
22	-	-	-	194	773	-	194	-	-	-
23	-	-	-	256	1021	-	256	-	-	-
24	-	-	-	373	1488	-	373	-	-	-
25	-	-	-	661	2638	-	662	-	-	-
26	-	-	-	-	1875	-	-	-	-	-
27	-	-	-	2650	23386	1777	1311	-	-	-
28	-	-	-	9783	32575	6504	4892	-	-	-
29	-	-	-	19913	71789	15981	17503	1649	-	-
30	-	-	-	19489	70260	15641	17130	1614	-	-
31	-	-	-	17307	62392	13889	15212	1433	-	-
June 1	-	-	-	31235	112604	25067	27455	2586	-	-
02	-	-	-	39154	156023	39154	54578	7712	-	-
03	-	-	7470	28077	148625	31683	31168	10561	-	-
04	-	-	8199	12371	90480	16399	8199	8199	-	-
05	-	-	18359	28862	169149	22798	18359	18139	-	-
06	-	-	17521	27544	161424	21756	17521	17310	-	-
07	-	-	17292	27185	159316	21472	17292	17084	-	-
08	-	-	23396	36780	215553	29052	23396	23115	-	-
09	-	-	9929	16525	82627	6666	9929	9860	-	3333
10	-	-	10020	18884	49427	8864	3468	4528	-	1156
June 11	-	-	20259	40667	64352	20259	-	3426	-	-
12	-	4899	27037	41916	73489	22137	7440	4536	-	-
13	-	2376	13112	20328	35641	10736	3608	2200	-	-
14	-	1327	7323	11353	19905	5996	2015	1229	-	-
15	-	1491	8227	12755	22362	6736	2264	1380	-	-
16	-	267	804	935	1870	534	403	134	-	-
17	-	147	1002	754	1161	422	244	139	-	-
18	-	65	1046	588	652	326	131	131	-	-
19	-	103	843	484	379	229	155	49	-	-
20	-	87	708	407	318	192	130	41	-	-
21	-	62	504	290	227	137	93	30	-	-
22	-	238	1949	1120	876	529	358	114	-	-
23	-	32	264	152	119	72	48	15	-	-
24	-	51	288	170	85	68	68	-	-	-
25	-	44	234	188	174	85	37	16	-	-
26	-	44	234	188	174	85	37	16	-	-
27	-	44	234	188	174	85	37	16	-	-
28	-	44	234	188	174	85	37	16	-	-
TOTAL *	0	11321	196488	470776	1837098	345416	286865	137278	0	4489
%	0.00	0.34	5.97	14.31	55.84	10.50	8.72	4.17	0.00	0.14

* Total Catch (all ages) = 3,289,731 fish

TABLE 9. Estimated commercial catch of alewife and blueback herring in Miramichi River fishery (district 71 and 72), 1982.

Date	Total Catch Kg	Alewife No. X 1000	Alewife wt Kg	Alewife mean wt (g)	Blueback No. X 1000	Blueback wt Kg	Blueback mean wt (g)
May 18	5118	14.4	5118	356	0.0	0	
19	4196	11.4	4007	353	0.5	189	400
20	4177	10.9	3799	350	0.9	378	400
21	2127	5.6	1876	337	0.6	251	406
22	2459	6.4	2169	337	0.7	290	406
23	284	0.7	250	337	0.1	34	406
24	881	2.3	750	323	0.3	131	412
25	3201	8.5	2862	335	0.8	339	412
26	4581	12.2	4095	335	1.2	486	412
27	2610	7.0	2438	346	0.4	172	412
28	1779	4.9	1488	301	0.7	291	412
29	2792	6.2	2021	327	2.0	771	391
30	17293	38.3	12515	327	12.2	4778	391
31	97937	174.5	61612	353	98.2	36325	370
June 1	252767	382.3	120817	316	361.5	131950	365
2	216586	327.6	103523	316	309.8	113062	365
3	119005	140.8	39281	279	222.1	79724	359
4	71555	69.4	18589	268	166.6	52966	318
5	52334	50.7	13595	268	121.8	38738	318
6	13381	13.0	3476	268	31.1	9905	318
7	62426	45.7	11753	257	182.9	50672	277
8	32246	15.4	3615	235	101.2	28631	283
9	26159	12.5	2933	235	82.1	23226	283
10	24925	5.6	1317	235	81.9	23594	288
11	25753	4.1	960	235	93.2	24793	266
12	15960	2.5	595	235	57.8	15365	266
13	13030	2.1	486	235	47.2	12544	266
14	8958	0.7	173	235	36.0	8785	244
15	14600	0.6	141	235	59.3	14459	244
16	1247	0.1	12	235	5.1	1235	244
17	510	0.0	0		2.1	510	243
18	1418	0.4	100	235	5.7	1318	232
19	510	0.2	36	235	2.0	474	232
20	851	0.3	60	235	3.4	791	232
21	851	0.5	115	212	3.3	736	221
22	0	0.0	0		0.0	0	
23	851	0.5	109	199	3.4	742	221
24	0	0.0	0		0.0	0	
25	454	0.8	136	165	1.4	318	226
Totals	1105812	1379.2	426822		2099.4	678973	
Mean				312			323
%	100	39	39		61	61	

TABLE 10. Estimated number of alewives at age, by day, 1982 Miramichi River commercial fishery.

Date	Age 2	3	4	5	6	7	8	9	10	11
May 18	-	2386	6886	906	2401	589	604	604	-	-
19	-	1805	6175	727	1317	602	363	238	-	125
20	-	1650	6611	706	706	706	239	-	-	239
21	-	802	3468	434	501	245	61	-	-	61
22	-	927	4009	502	579	283	71	-	-	71
23	-	107	463	58	67	33	8	-	-	8
24	-	316	1477	211	265	53	-	-	-	-
25	-	1836	4476	641	991	350	256	-	-	-
26	-	2626	6403	915	1416	500	365	-	-	-
27	-	2071	2902	415	830	415	415	-	-	-
28	-	529	2121	707	885	351	351	-	-	-
29	-	809	3158	636	847	315	414	-	-	-
30	-	5014	19558	3942	5243	1952	2564	-	-	-
31	-	27227	103675	10996	16406	5410	10995	-	-	-
June 1	-	120435	194225	32116	17970	5735	11852	-	-	-
02	-	103196	166424	27519	15397	4914	10156	-	-	-
03	-	66735	59273	14783	-	-	-	-	-	-
04	-	40715	21571	3676	3468	-	-	-	-	-
05	-	29778	15777	2689	2536	-	-	-	-	-
06	-	7614	4034	687	649	-	-	-	-	-
07	-	32013	9147	-	4573	-	-	-	-	-
08	-	7954	4108	-	769	2569	-	-	-	-
09	-	6453	3332	-	624	2084	-	-	-	-
10	-	1867	1867	-	-	1867	-	-	-	-
11	-	682	2725	-	-	682	-	-	-	-
12	-	423	1690	-	-	423	-	-	-	-
June 13	-	345	1379	-	-	345	-	-	-	-
14	-	-	735	-	-	-	-	-	-	-
15	-	300	300	-	-	-	-	-	-	-
16	-	26	26	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-
18	-	214	214	-	-	-	-	-	-	-
19	-	77	77	-	-	-	-	-	-	-
20	-	129	129	-	-	-	-	-	-	-
21	-	542	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-
23	78	391	78	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-
25	421	287	118	-	-	-	-	-	-	-
TOTAL *	499	468,281	658,608	103,266	78,440	30,423	38,714	842	0	504
%	1.04	33.94	47.74	7.49	5.69	2.21	2.81	0.06	0.00	0.04

* Total Catch (all ages) = 1,379,577 fish

TABLE 11. Estimated numbers of blueback herring at age, by day, 1982 Miramichi River commercial fishery.

Date	Age 2	3	4	5	6	7	8	9	10	11
May 18	-	-	-	-	-	-	-	-	-	-
19	-	-	118	-	118	118	118	-	-	-
20	-	-	236	-	236	236	236	-	-	-
21	-	-	77	-	129	232	77	51	51	-
22	-	-	89	-	149	268	89	59	59	-
23	-	-	10	-	17	31	10	7	7	-
24	-	-	-	-	53	159	-	53	53	-
25	-	-	-	-	69	206	412	68	68	-
26	-	-	-	-	99	295	590	98	98	-
27	-	-	-	-	-	-	418	-	-	-
28	-	-	-	177	-	353	177	-	-	-
29	-	-	55	355	55	1206	247	55	-	-
30	-	-	342	2199	342	7466	1527	342	-	-
31	-	-	5498	10898	5498	70884	-	5399	-	-
June 1	-	5784	28197	74470	33981	184730	12291	22052	-	-
02	-	4956	24161	63811	29117	158287	10532	18895	-	-
03	-	7328	22207	66622	29536	66622	14879	14879	-	-
04	-	2665	45804	54132	21486	31313	5497	5663	-	-
05	-	1949	33500	39591	15715	22902	4142	4020	-	-
06	-	498	8565	10123	4018	5856	1028	1059	-	-
07	-	-	82320	64027	22867	13720	-	-	-	-
08	-	-	35409	38444	17806	9510	-	-	-	-
09	-	-	28725	31187	14444	7715	-	-	-	-
June 10	-	-	20481	33506	18596	9339	-	-	-	-
11	-	1957	25911	39053	14354	10998	932	-	-	-
12	-	1213	16058	24203	8896	6816	578	-	-	-
13	-	990	13110	19759	7262	5565	472	-	-	-
14	-	1476	11018	15446	2952	4393	720	-	-	-
15	-	1837	14992	28682	4207	6578	1778	593	593	-
16	-	157	1280	2450	359	562	152	51	51	-
17	-	42	420	1133	126	210	84	42	42	-
18	-	256	1755	2192	369	613	182	256	57	-
19	-	92	631	789	133	221	65	92	20	-
20	-	153	1053	1315	222	368	109	153	34	-
21	-	233	1392	776	233	386	77	233	-	-
22	-	-	-	-	-	-	-	-	-	-
23	-	195	1484	977	275	272	37	118	-	-
23	-	-	-	-	-	-	-	-	-	-
25	-	139	607	422	100	138	-	-	-	-
TOTAL *	0	31,920	425,505	626,739	253,819	628,568	57,456	74,238	1,133	0
%	0	1.52	20.27	29.85	12.09	29.94	2.74	3.54	0.05	0

* Total Catch (all ages) = 2,099,378 fish

Table 12. Annual catch of gaspereau in the Millbank experimental trap (N=number) and in the commercial fishery (T=tonnes) in districts 71 and 72 (1977-1982). Correlation coefficients (r) and regression coefficients a and b are shown for selected correlations as indicated.

Year	1977	1978	1979	1980	1981	1982
Millbank(N)	173,632	126,581	103,946	74,819	43,551	34,164
Commercial(T)	2,240	1,434	3,343	3,767	1,410	1,072

Regression type	Exponential	Linear
Variable X	Millbank catch	Millbank catch
Variable Y	Year	Commercial catch
r	0.99	0.22
a	24,807	69,076
b	0.33	10.72

TABLE 13. Estimates of catch at age for alewife and blueback herring in the 1981 and 1982 gaspereau fishery in the Miramichi River estuary. Instantaneous mortality (Z), annual mortality (A), and annual survival (S) are estimated using Paloheimo's catch effort method.

Alewife

Age	Catch 1981	Catch 1982	Catch/hr 1981	Catch/hr 1982
3	37241	468281	2.67	21.21
4	336997	658608	24.19	29.83
5	154258	103266	11.07	4.68
6	308906	78440	22.18	3.55
7	203029	30423	14.57	1.38
8	15054	38714	1.08	1.75
9	12213	842	0.88	0.04
			5-8	6-9
			48.90	6.72

1981 Effort 13930 hrs $\frac{6\text{-}9}{5\text{-}8} = 0.14$ $Z = 1.98$ $S = 0.1381$ $A = 0.8619$
1982 Effort 22076 hrs

Blueback Herring

Age	Catch 1981	Catch 1982	Catch/hr 1981	Catch/hr 1982
3	11321	31920	0.81	1.45
4	196488	425505	14.11	19.27
5	470776	626739	33.80	28.39
6	1837098	253819	131.88	11.50
7	345416	628568	24.80	28.47
8	286865	57456	20.59	2.60
9	137278	74238	9.85	3.36
10		1138		0.05
			5-9	6-10

1981 Effort 13930 hrs $\frac{6\text{-}10}{5\text{-}9} = 0.21$ $Z = 1.57$ $S = 0.2080$ $A = 0.7920$
1982 Effort 22076 hrs

TABLE 14. Estimates of hypothetical increase in spawning escapement for alewife and blueback herring and the impact on the fishery from: A. week-end fishing closure and B. delayed season opening to June 1.

Option	Year	Increased Escapement				Loss to Fishery	
		Alewives		Blueback			
		N (X1000)	Harvest Reduction %	N (X1000)	Harvest Reduction %	kg (X1000)	Reduction %
A	1981	283.1	27	902.8	27	381.9	27
	1982	120.4	9	278.3	13	118.9	11
B	1981	538.5	50	458.1	14	347.3	25
	1982	303.3	22	118.6	6	149.4	14

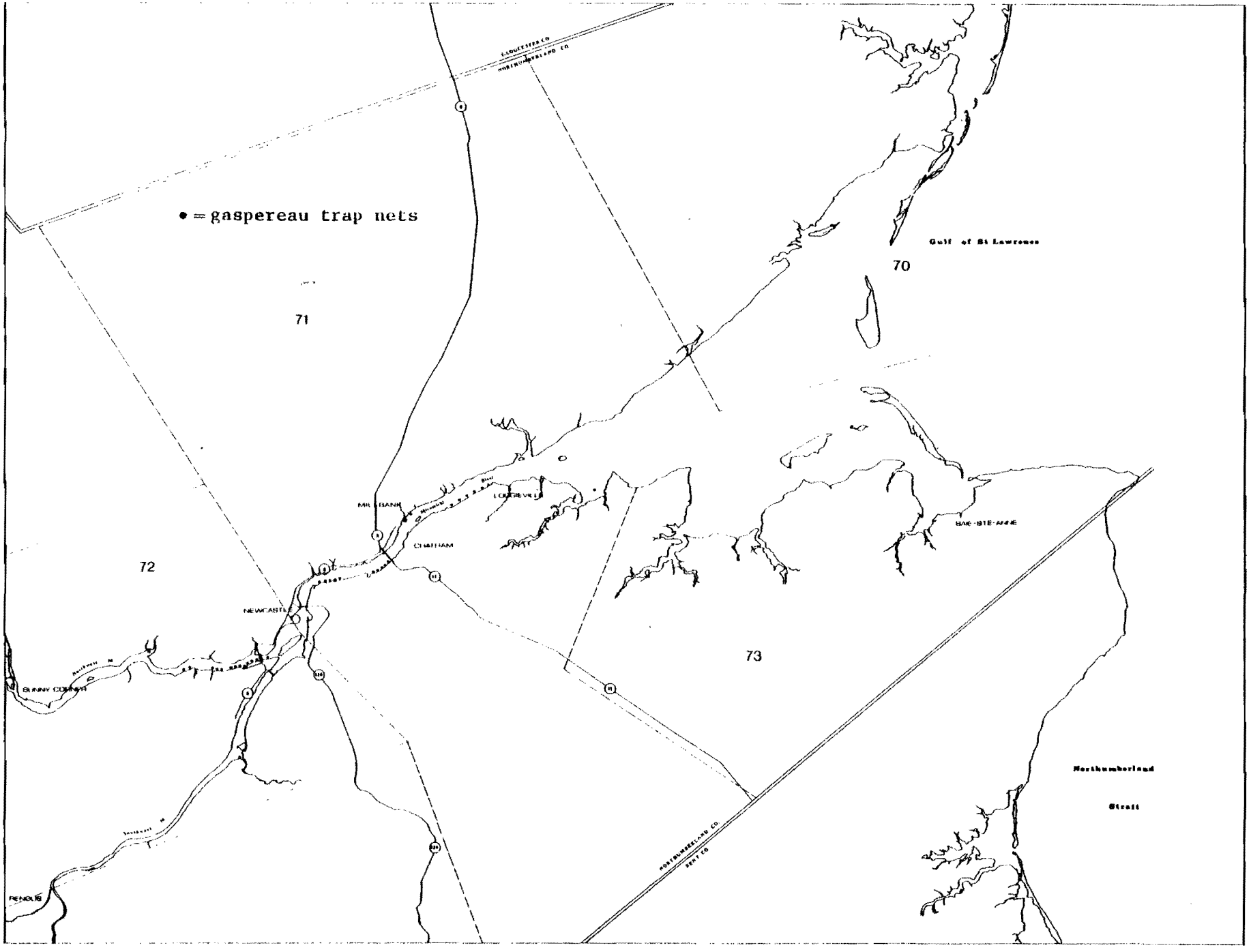

Fig. 1. Map of Miramichi estuary showing boundaries of statistical districts, location of commercial gaspereau traps and location of Millbank trap site.

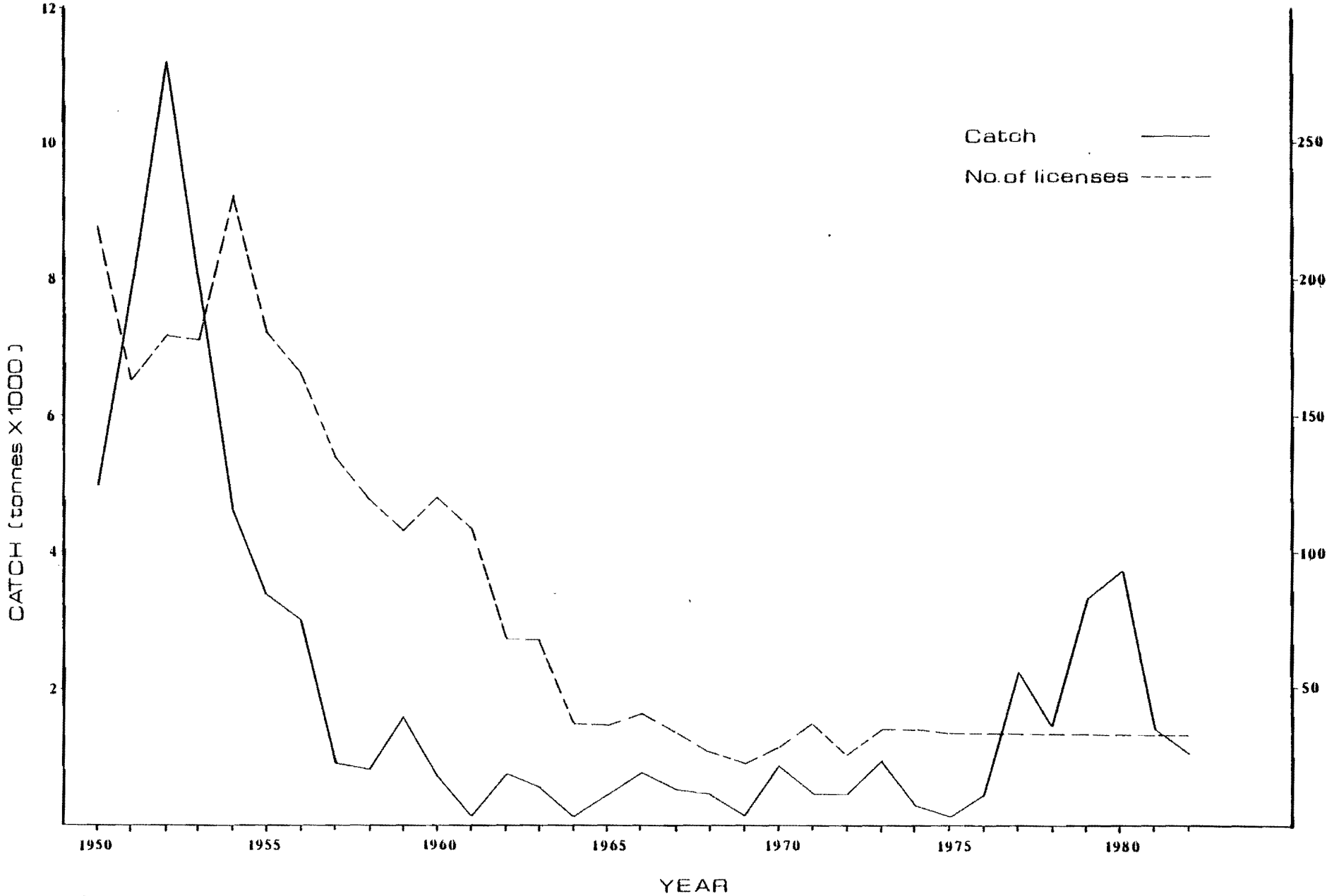

Fig. 2 Number of gaspereau fishing licenses and annual gaspereau catch (mt) in the Miramichi estuary (districts 71 & 72 combined).

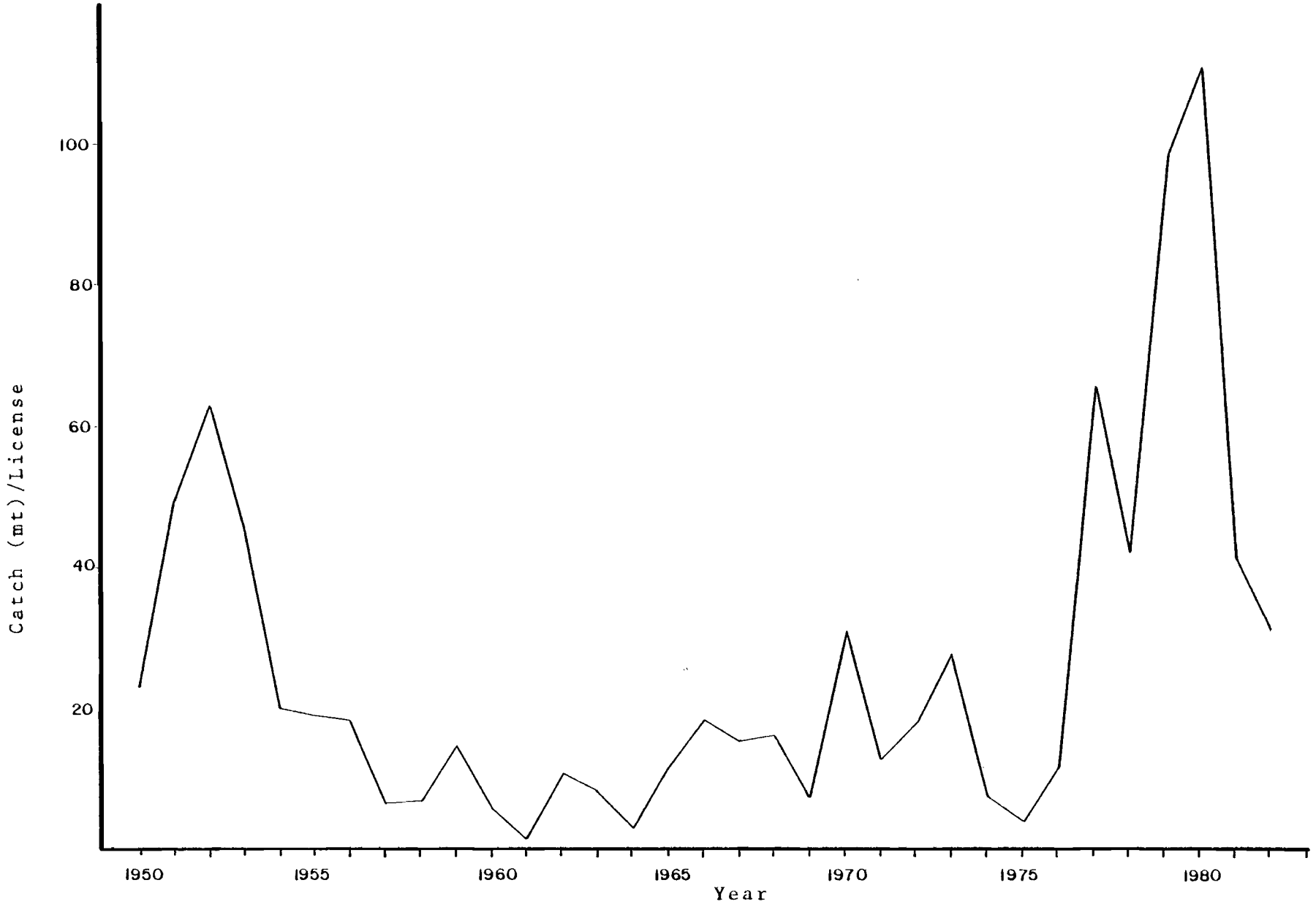

Fig. 3 Annual catch (mt) per license in the Miramichi River gaspereau fishery (districts 71 & 72 combined).

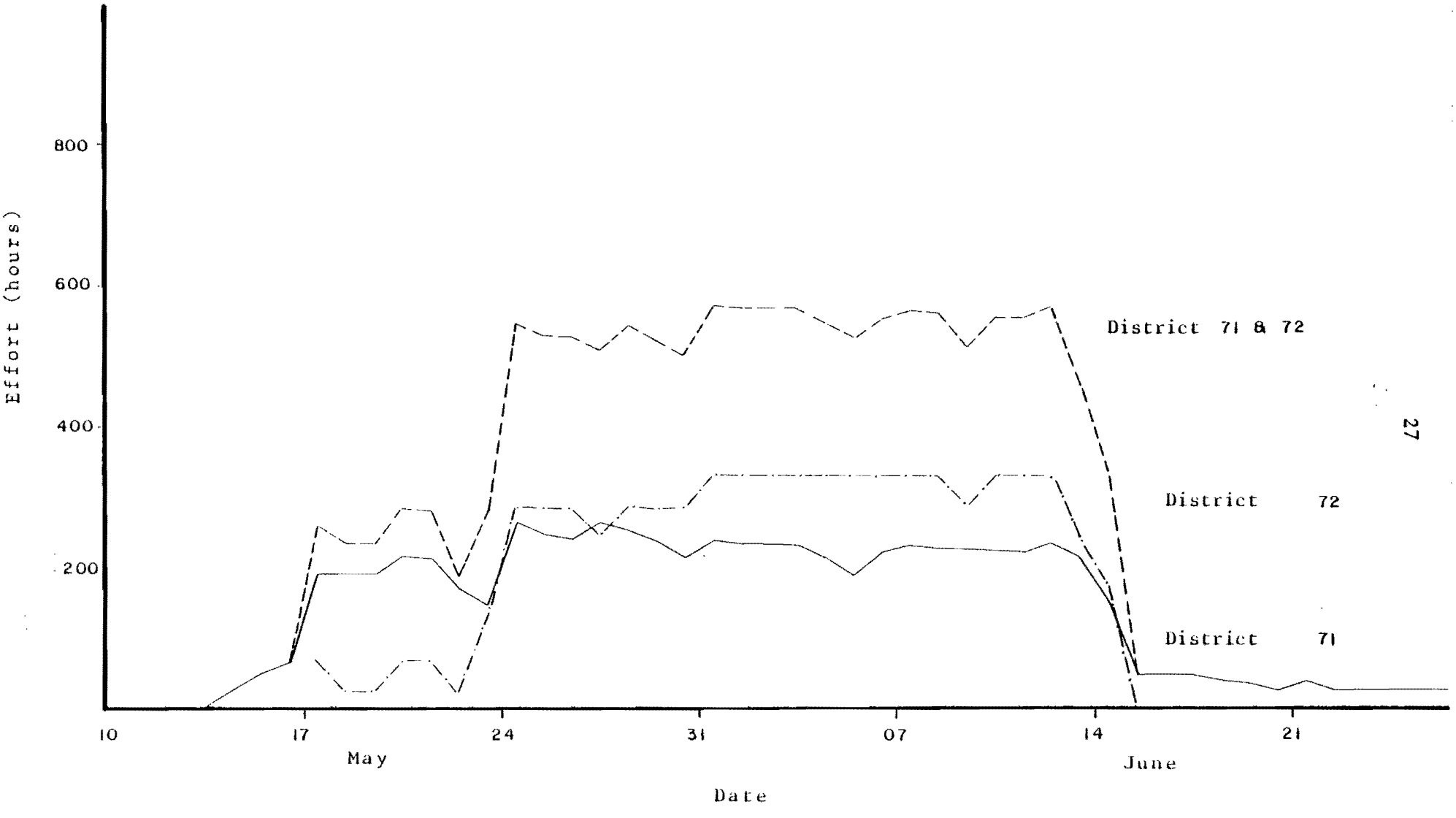

Fig. 4 Daily fishing effort (trap hours) by gaspereau traps in the Miramichi River estuary (districts 71 & 72), 1981.

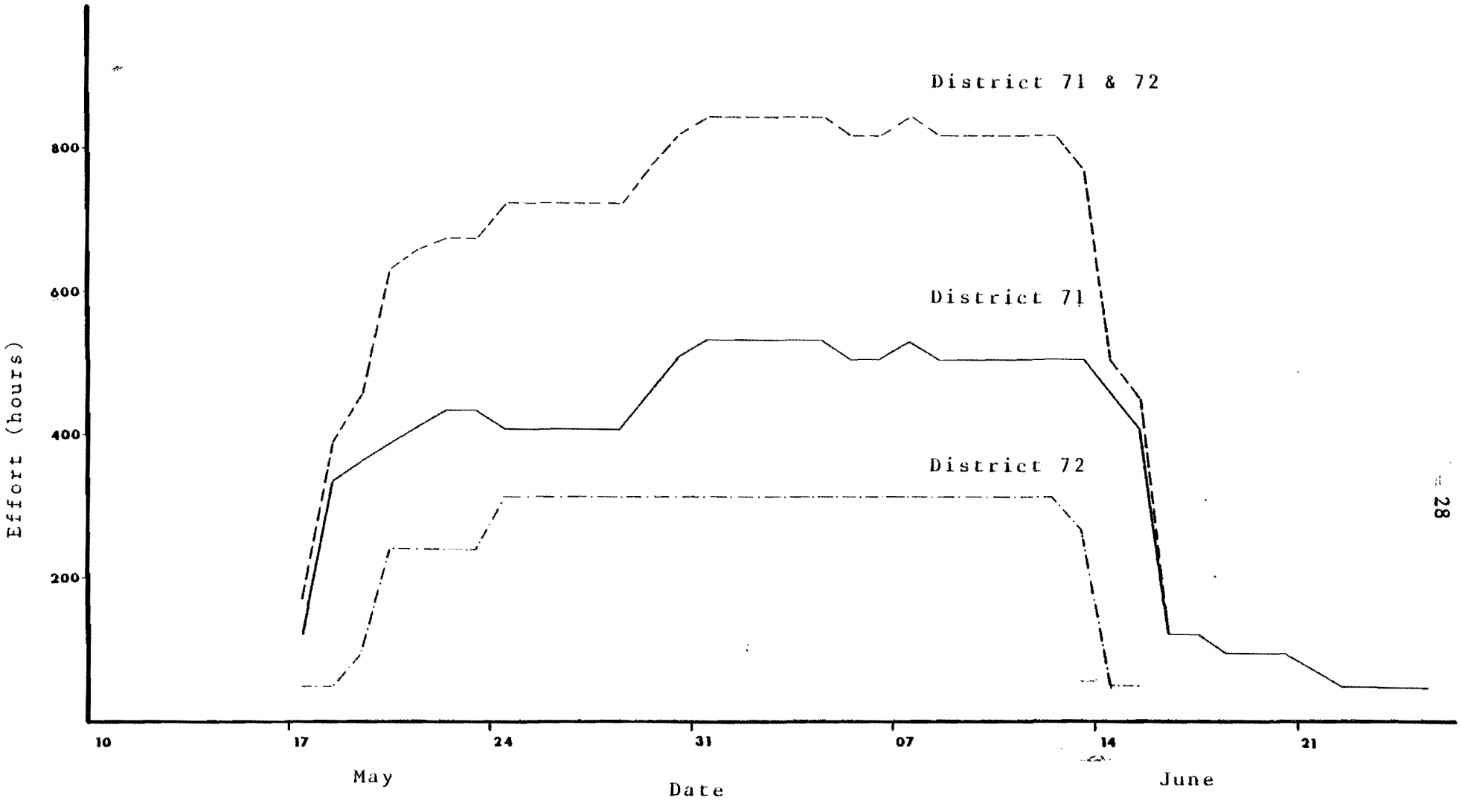

Fig. 5 Daily fishing effort (trap hours) by gaspereau traps in the Miramichi River estuary (districts 71 & 72), 1982.

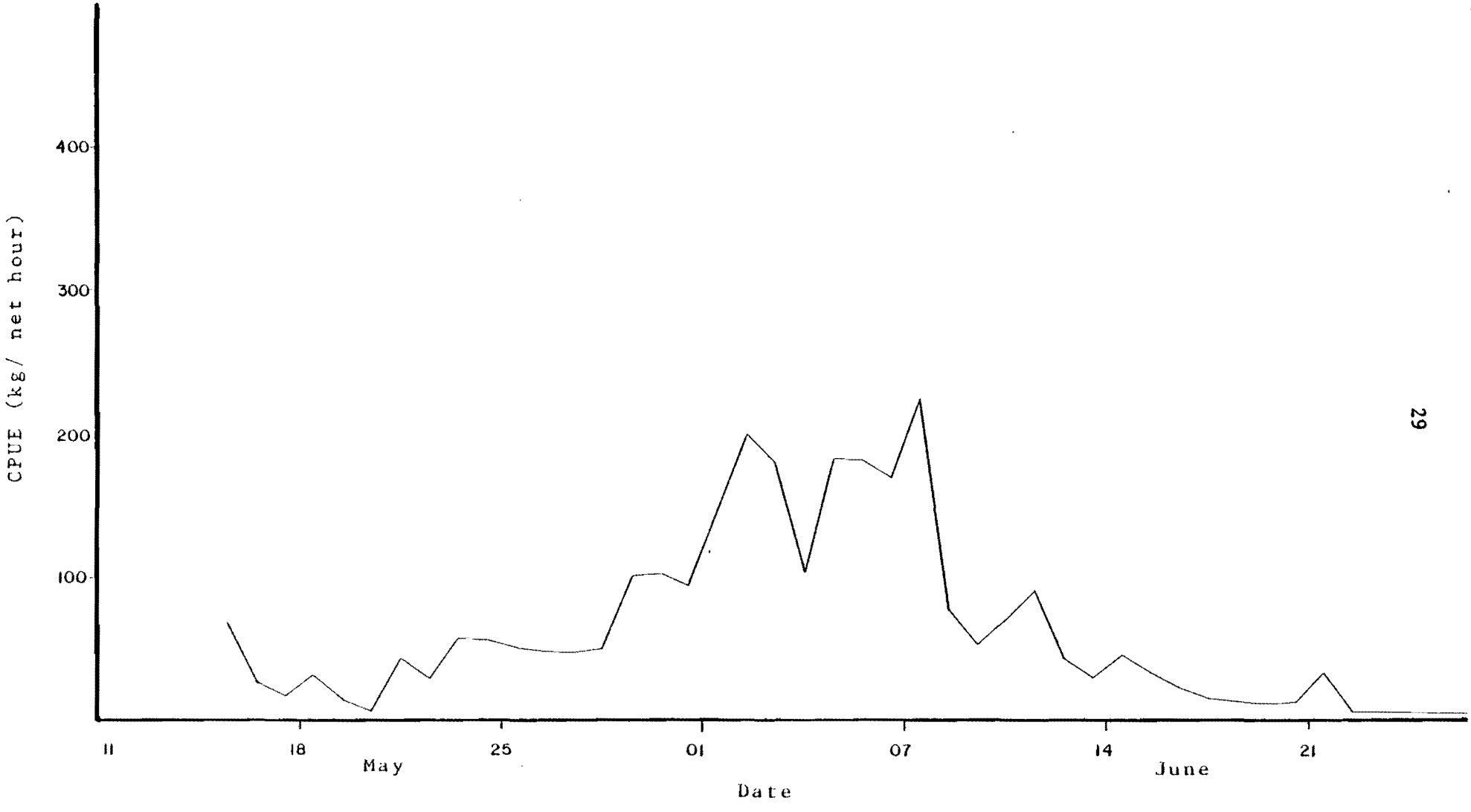

Fig. 6 Daily catch per unit effort (kg/trap hour) for gaspereau traps in the Miramichi River estuary (districts 71 & 72), 1981.

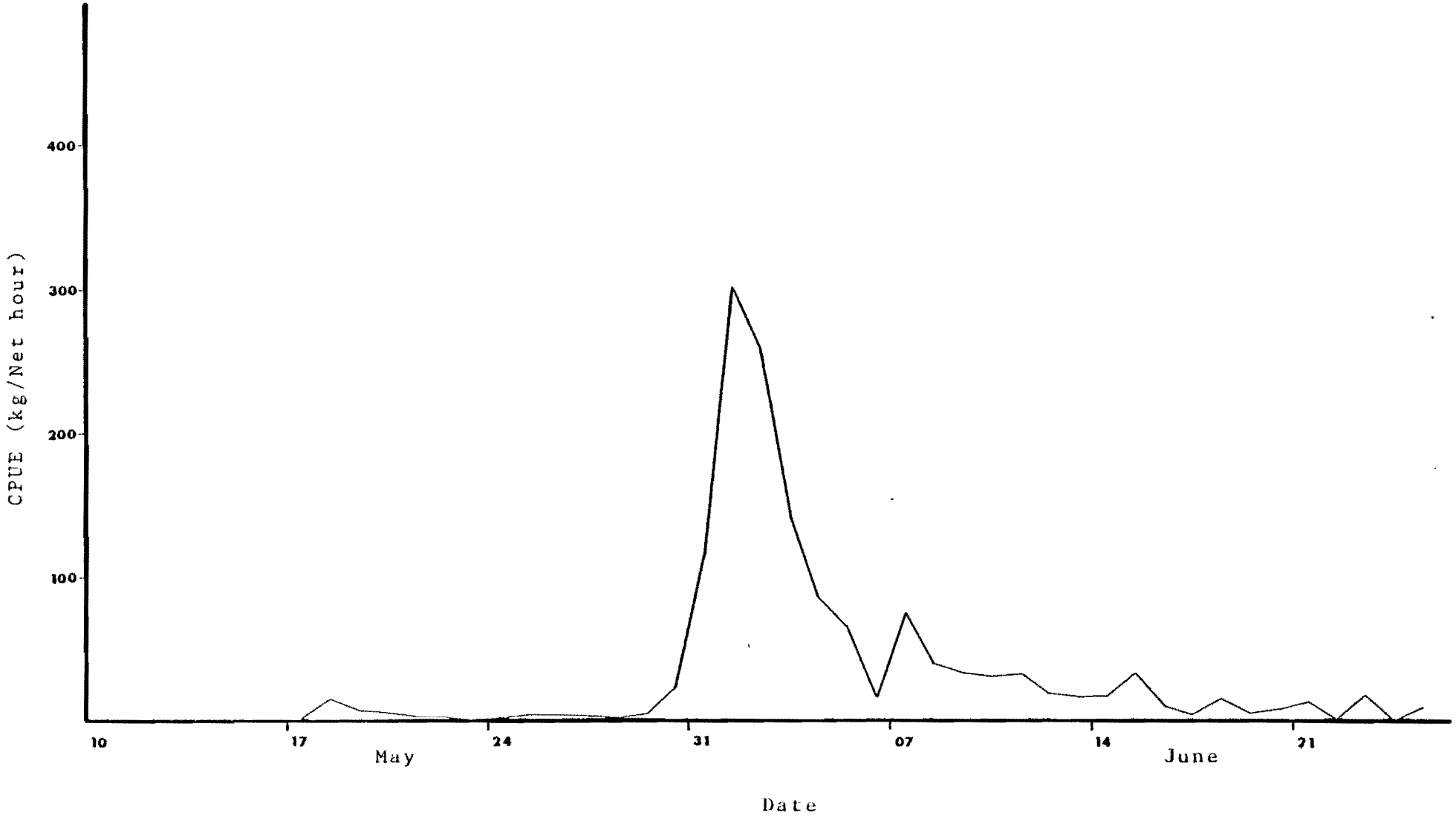

Fig. 7 Daily catch per unit effort (kg/trap hour) for gaspereau traps set in the Miramichi River estuary (districts 71 & 72), 1982.

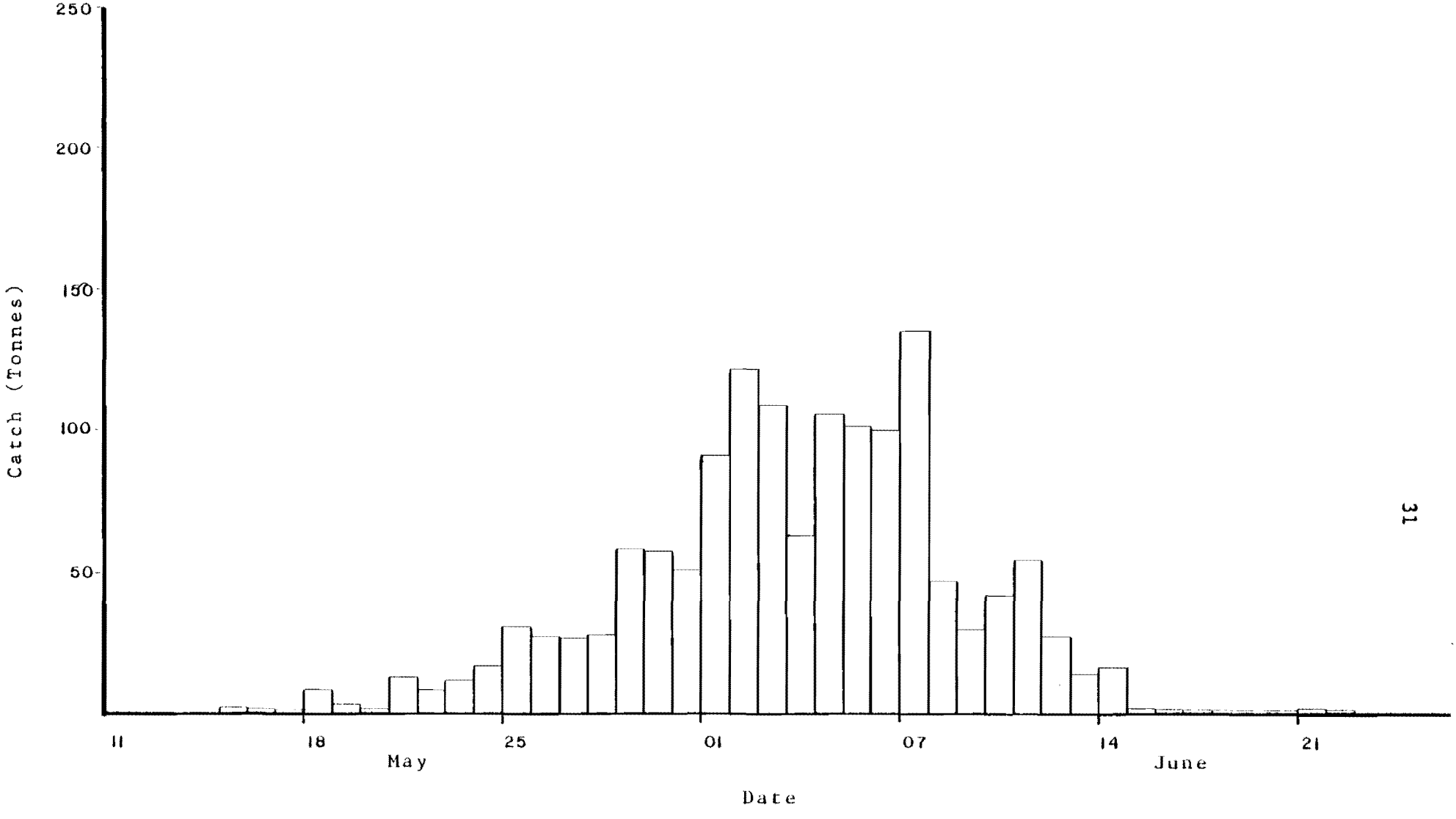

Fig. 8 Estimated catch (mt) of gaspereau per day in the Miramichi River estuary (districts 71 & 72), 1981.

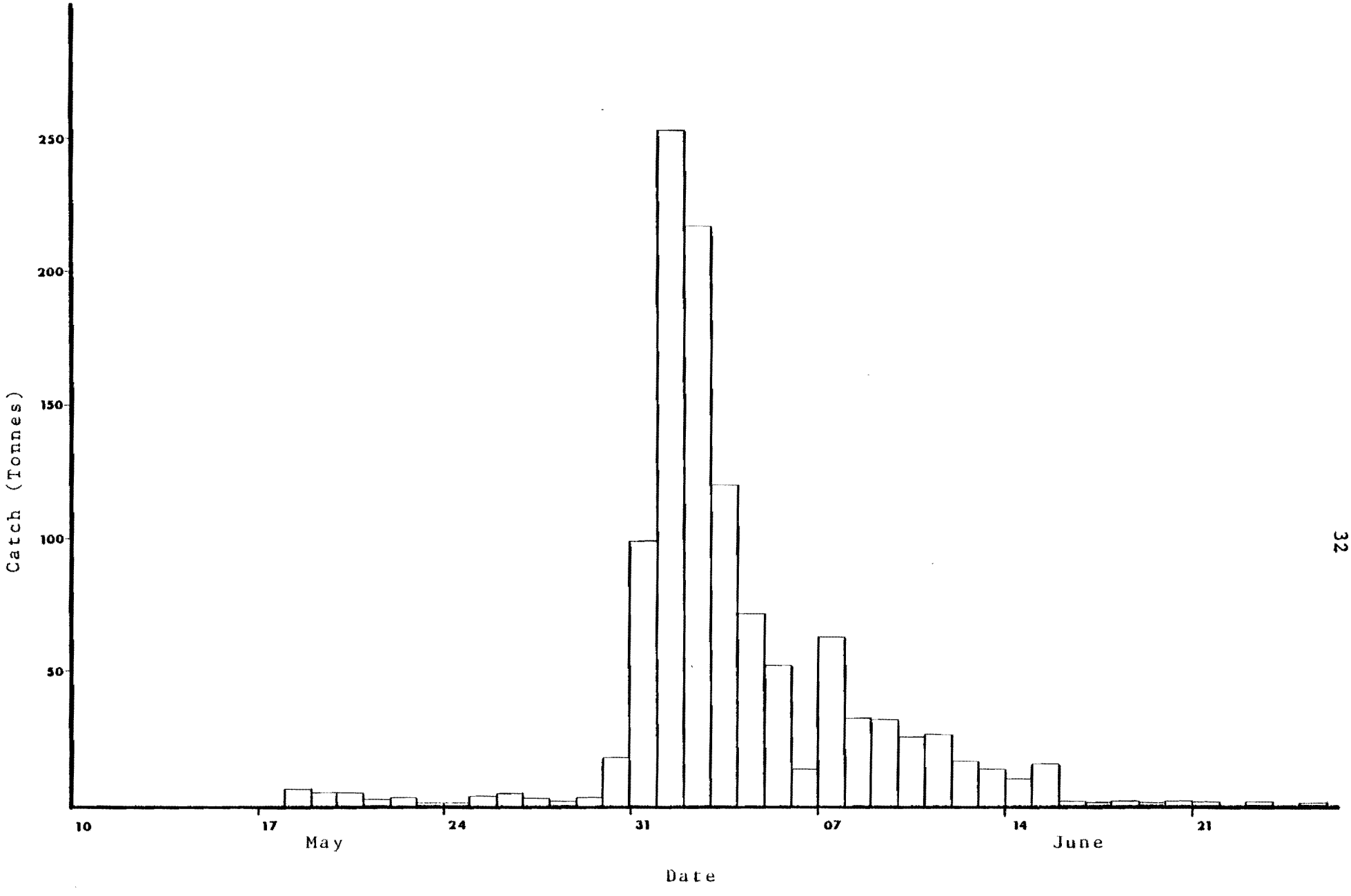

Fig. 9 Estimated catch (mt) of gaspereau per day in the Miramichi River estuary (districts 71 & 72), 1982.

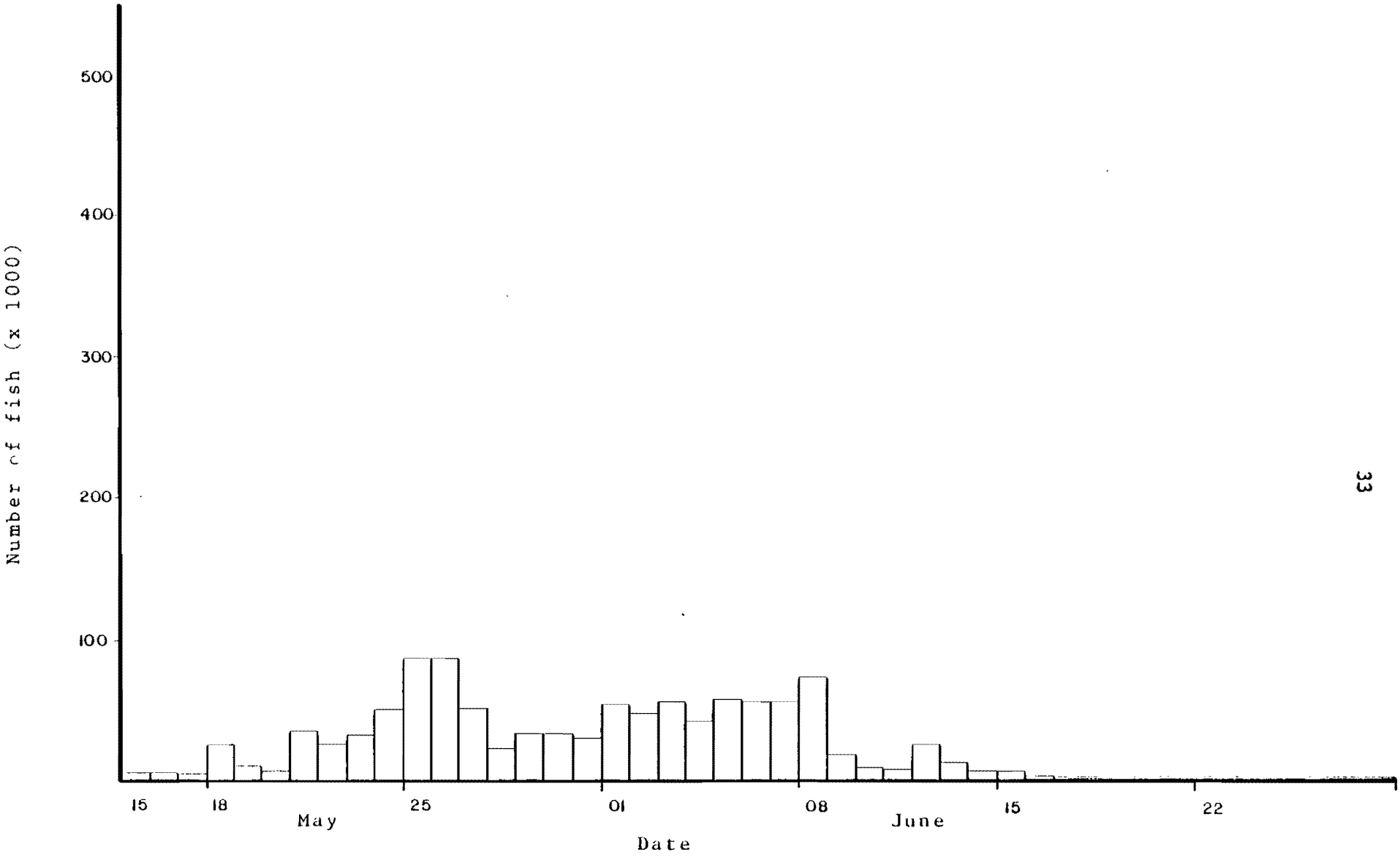

Fig. 10 Estimated number of alewives caught per day in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1981.

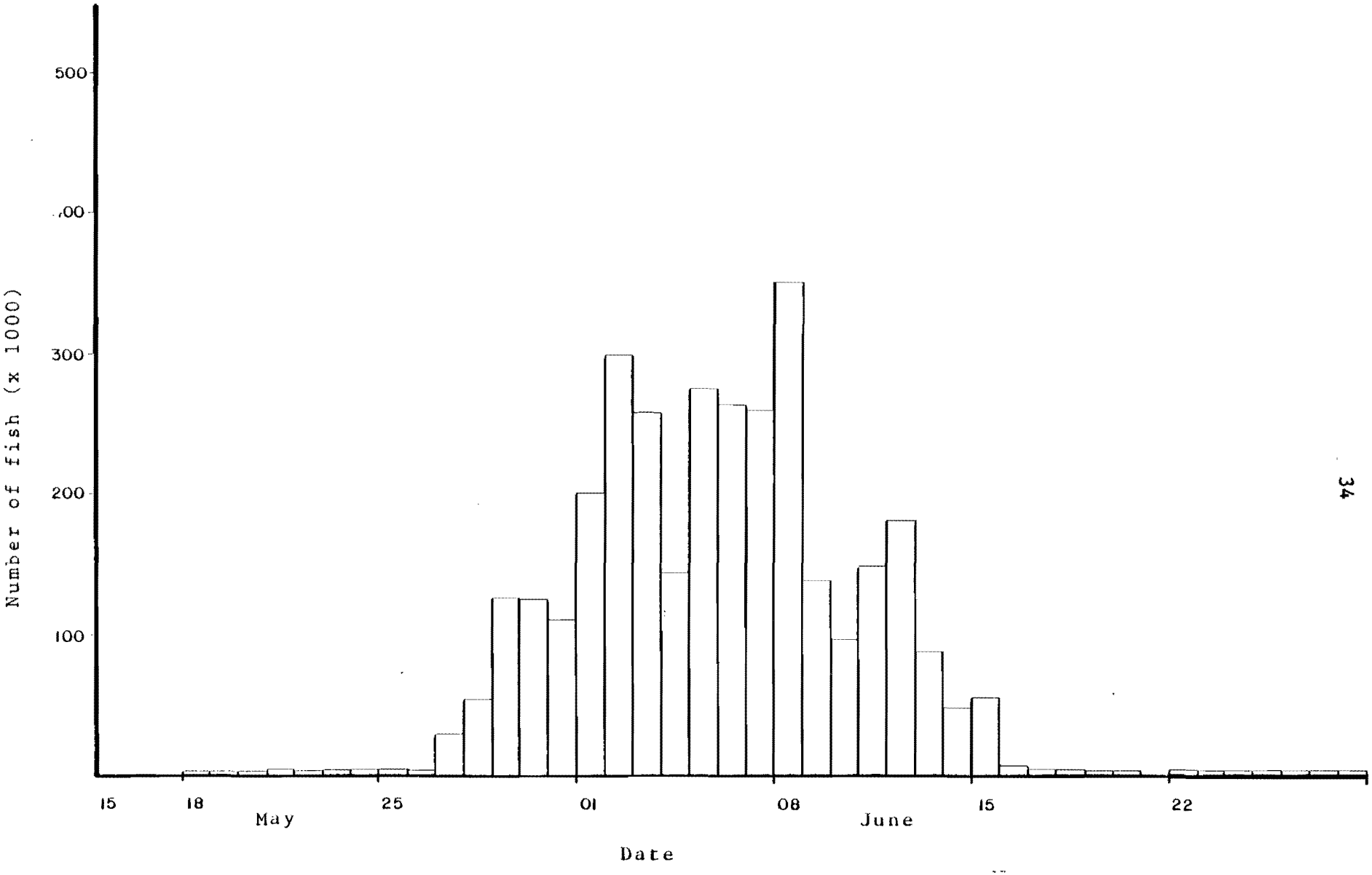

Fig. 11 Estimated number of blueback herring caught per day in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1981.

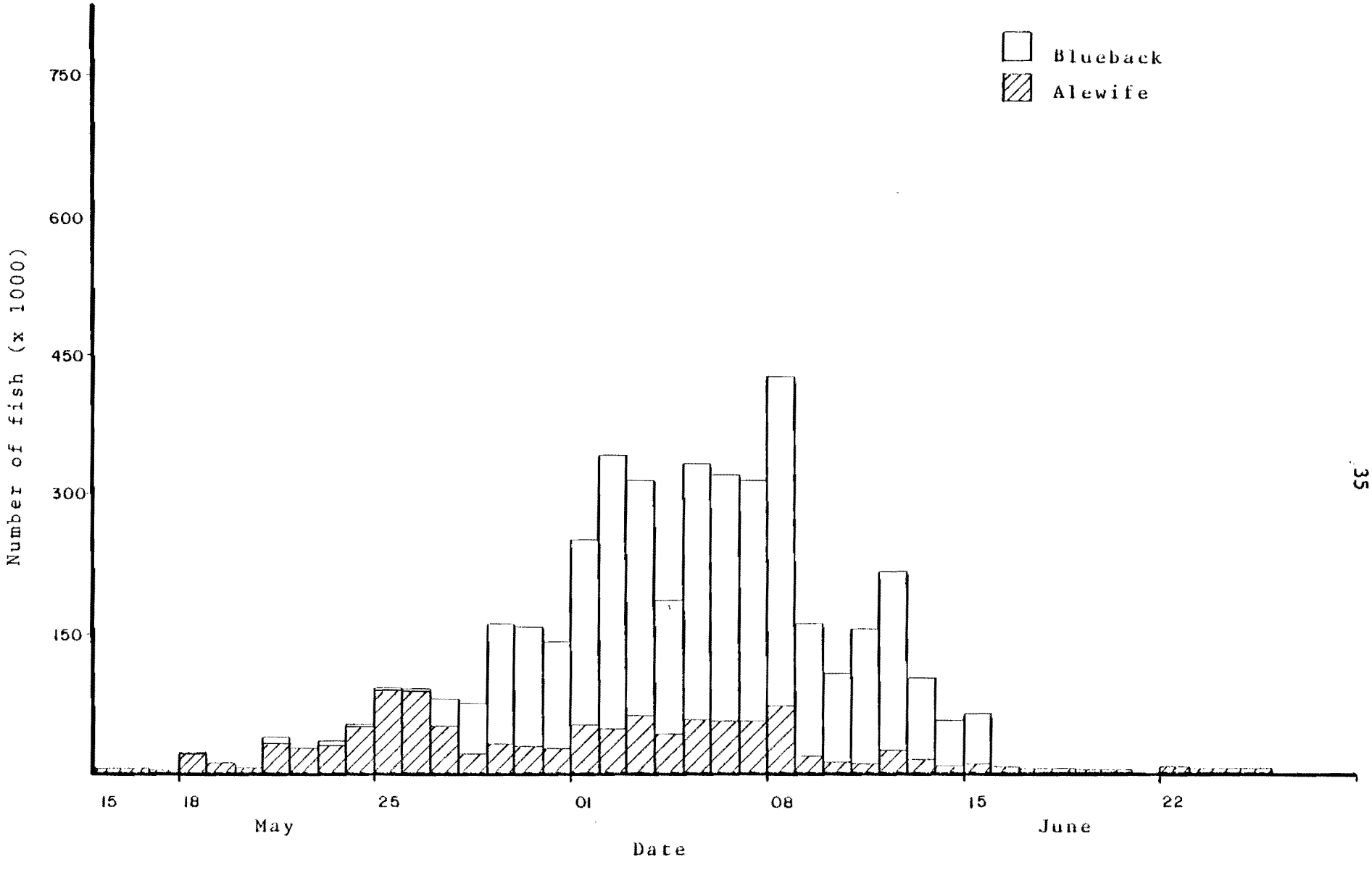

Fig. 12 Estimated number of alewives and blueback herring caught per day in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1981.

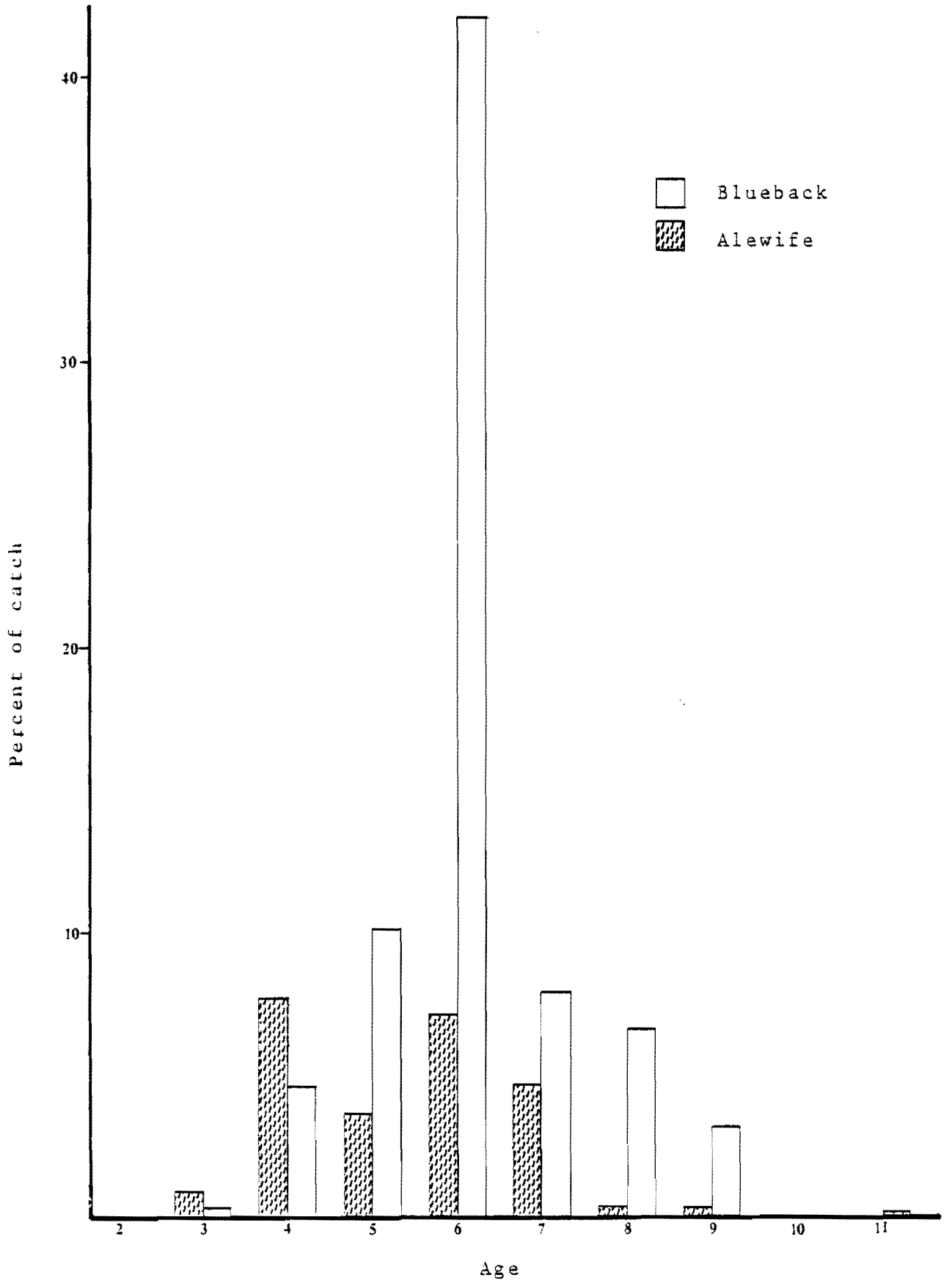

Fig. 13 Catch (percentage of total estimated catch) of alewives and blueback herring, in each age group, in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1981.

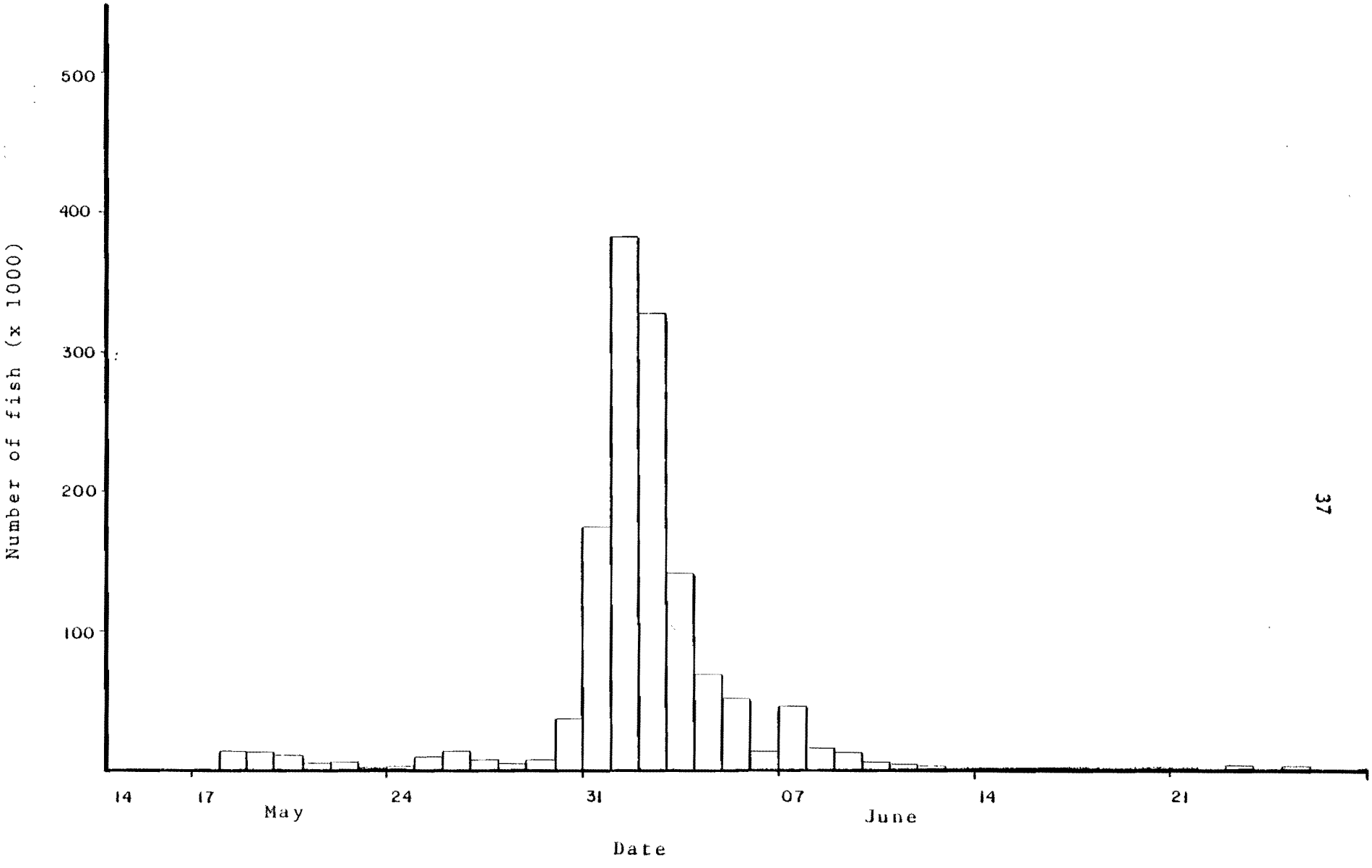

Fig. 14 Estimated number of alewives caught per day in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1982.

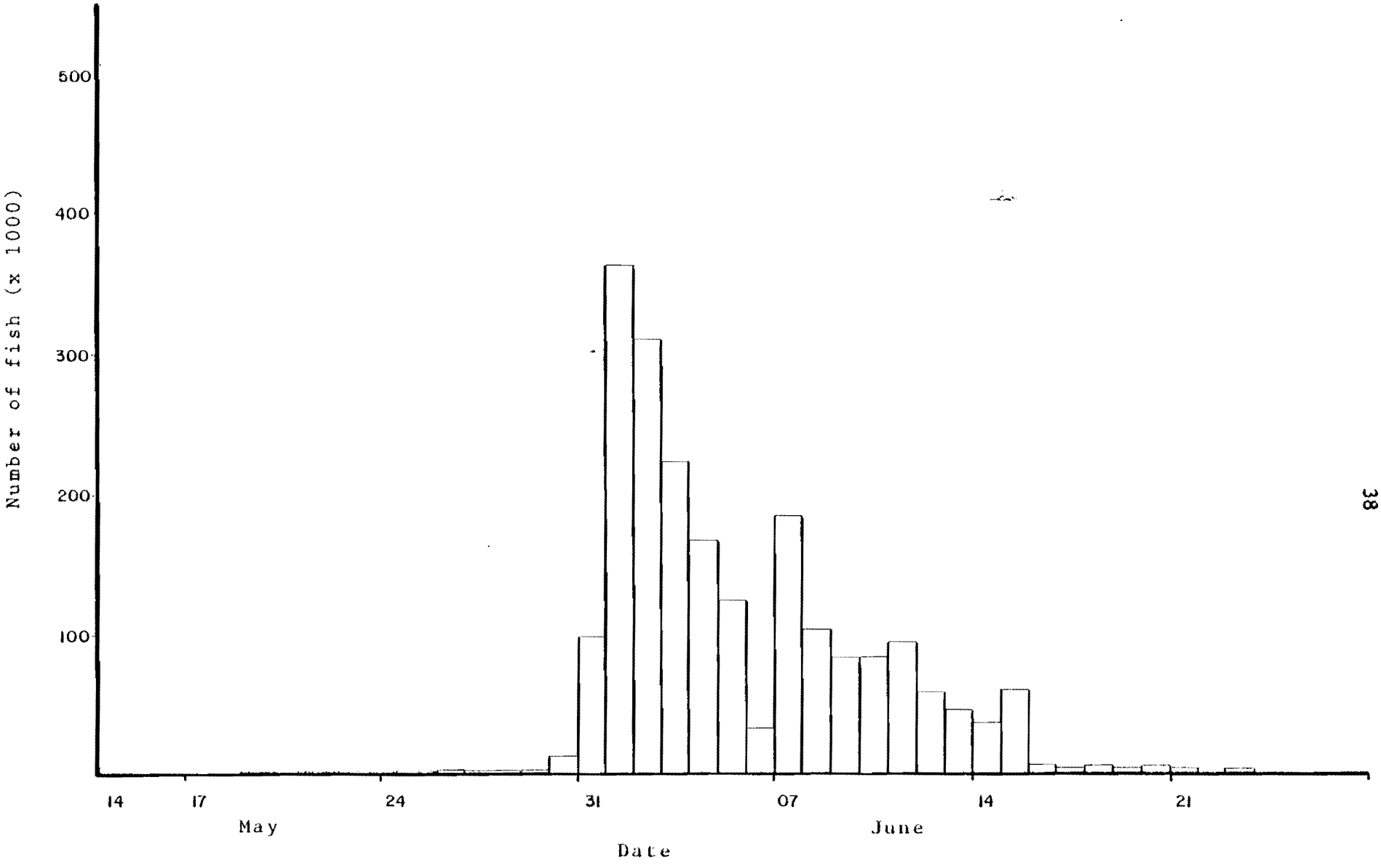

Fig. 15 Estimated number of blueback herring caught per day in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1982.

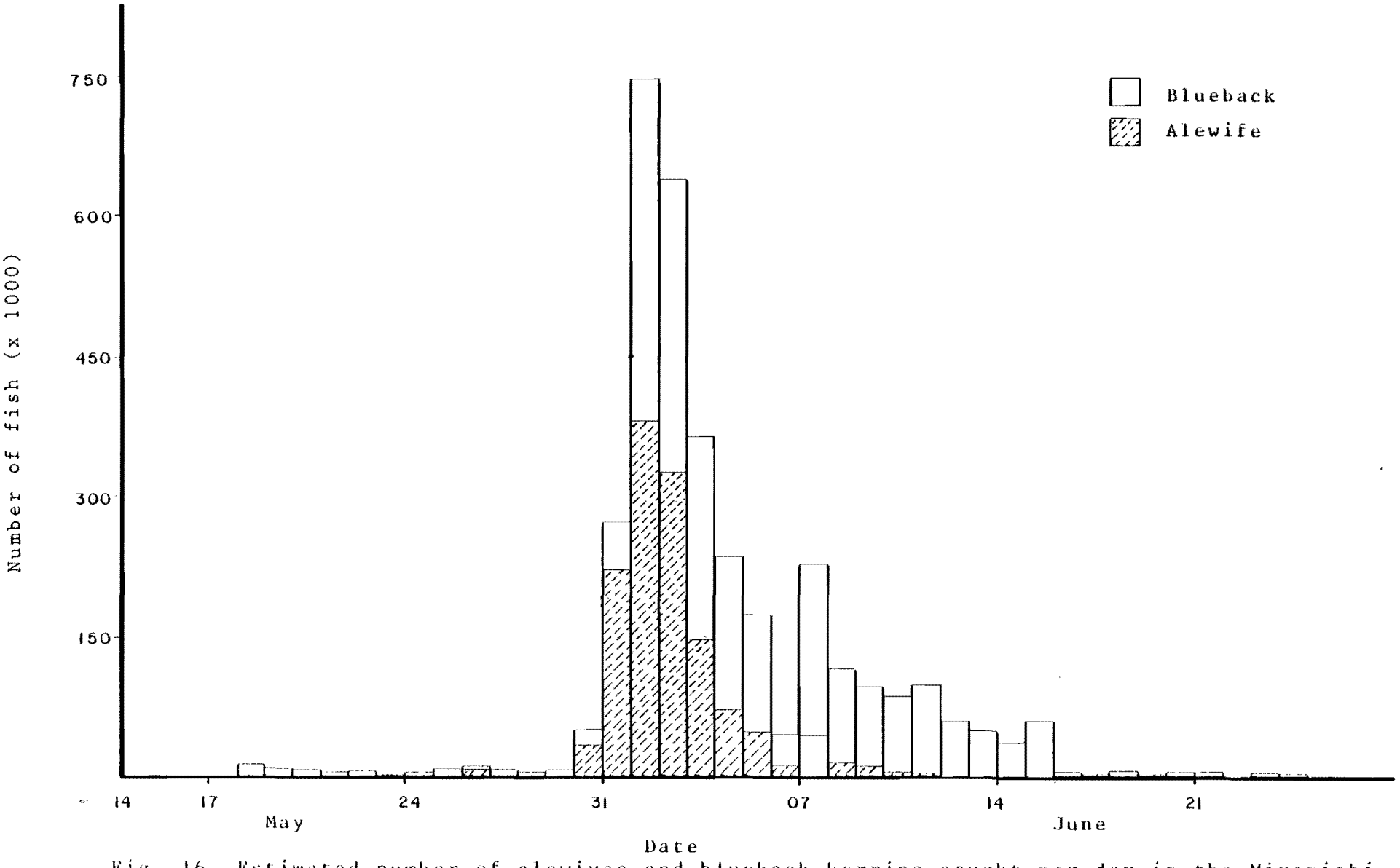

Fig. 16 Estimated number of alewives and blueback herring caught per day in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1982.

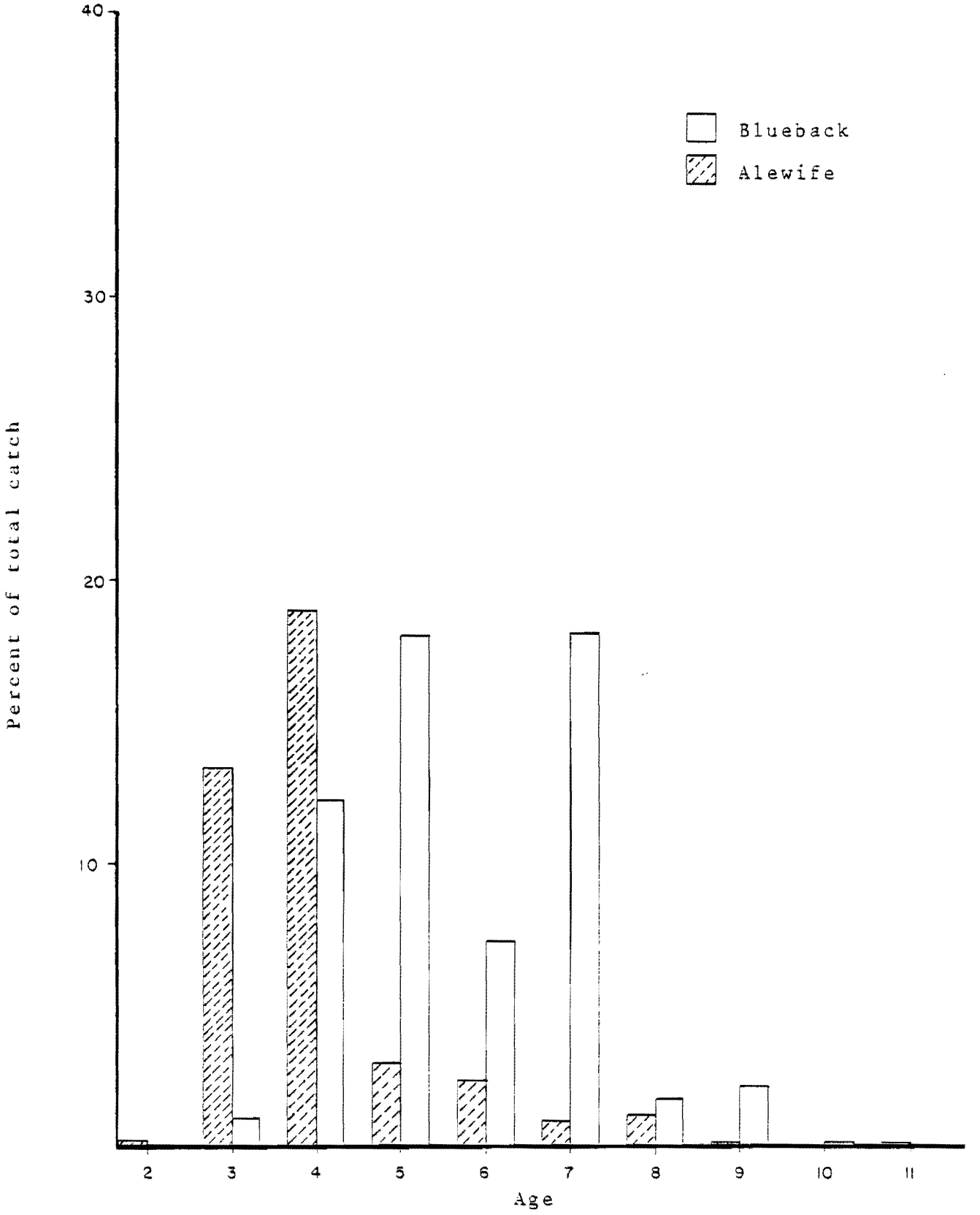

Fig. 17 Catch (percentage of total estimated catch) of alewives and blueback herring, in each age group, in the Miramichi River estuary gaspereau fishery (districts 71 & 72), 1982.