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Evaluation of the Gaspereau Fishery in the Miramichi River and Estuary, 1988

by

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ABSTRACT

Landings of gaspereau from districts 71 and 72 in 1988 were 1,357 tons, of which 64% were Alosa aestivalis (blueback herring) and 36% Alosa pseudoharengus (alewife). Of the alewife catch, 42% was composed of age 4 fish followed by age 5 and age 3 respectively. First time spawners comprised 52% of the alewife catch. Blueback catch was dominated by the 1983 year class (age 5) followed by the 1984 year class with first time spawners comprising only 33% of total blueback catch. Sequential population analysis was performed by species, grouped by age of recruitment under Type I fisheries assumptions. Calibration of the model was performed by comparing the relationship of population number with the abundance index from Millbank counts for various age combinations. Reliable terminal F values could not be obtained. Based on the abundance index values, the 1984 and 1985 year class recruitment was lower than the 1983 year class and reduced landings of gaspereau in 1989 are expected unless the 1986 year class recruitment is exceptionally high.

RESUME

Les débarquements de gaspareau pour les districts 71 et 72 ont atteint un niveau de 1,357 tonnes en 1988, dont 64% Alosa aestivalis (l'alose d'été) et 36% Alosa pseudoharengus (le gaspareau proprement dit). Les prises de A. pseudoharengus se composaient principalement de poissons d'âge 4 (42%) suivit de poissons âgés de 5 et 3 ans; 52% des prises était de nouvelles recrues. Par contre, les captures en 1988 de A. aestivalis étaient composeés surtout de poissons d'âge 5 (64%) suivit de ceux d'âge 4. Cependant, les nouvelles recrues ont contribué à 33% des débarquements seulement. Une analyse séquentielle de population a été éffectuée par espèce et par âge de recrutement selon les hypothèses d'un modèle de pêche de type I. L'analyse des cohortes a été étalonnée par comparaison d'effectifs de divers âges avec l'abondance correspondante dans le filet-trappe de Millbank. La régression était faible et on n'a pas pu arriver à un taux de mortalité de pêche fiable. Les effectifs d'indice d'abondance par âge indiqueraient que le recrutement des classes de 1984 et 1985 a été faible relatif à celui de 1983 et que l'on pourrait s'attendre à de plus faibles débarquements en 1989 qu'auparavant à moins que le recrutement de 1986 soit exceptionnel.

INTRODUCTION

The 1988 CAFSAC Advisory Document for the gaspereau fishery of District 71 and 72 did not use Sequential Population Analysis (SPA) results to project yield because of two concerns: 1) the natural mortality value of 0.2 had not been validated, and 2) Millbank trap may not be representative of the fishery.

This document describes the 1988 gaspereau fishery of Districts 71 and 72 and details sampling and analysis methodology for the gaspereau fishery in the Miramichi River, particularly:

1) an alternate method of calculating the catch at age than that used in previous gaspereau assessments,

2) an abundance index based upon counts at the Millbank index trap,

3) a cohort analysis model based on Type I fishery assumptions,

4) use of the new cohort model and incorporation of estimated values of 'non-fishing' mortality rates.

BACKGROUND

Annual assessments of the gaspereau fishery in the Miramichi River have been presented since 1983 (Alexander and Vromans 1983, 1984, 1985, 1986, 1987, 1988). The fishing season extends from May 15 to June 15 except for fishermen in the Napan Bay area whose season closes June 30. Prior to 1979, the fishery was regulated by a two-day per week closure. During 1980 through 1986, fishing was conducted seven days a week in spite of provisions in the regulations for a closed time of Saturday morning to Monday morning in the 1984, 1985 and 1986 seasons. In 1987 and 1988, a one day per week closure was enforced during the period from 12:00 hours on Saturday till 18:00 hours on Sunday (i.e. nets had to be tied up, out of the water for those time periods).

Estimated landings of gaspereau from District 71 and 72 in 1988 were 1357 metric tons, which included an over the side sale of 652 tons. This value was substantially less than 1987 landings but was close to the 5 year mean from these districts, and is within the 95% confidence intervals of the historical and 5 year estimates (Table 1). The districts 71 and 72 fisheries remain the dominant gaspereau fishery in Gulf New Brunswick (Table 2). Gulf New Brunswick landings have constituted almost 60% of the total gaspereau landings of the Gulf Region.

STOCK DESCRIPTION PARAMETERS

Detailed Sampling

Random samples for detailed analysis were obtained from the index trapnet operated out of Millbank by DFO. Numbers of gaspereau per sample and estimated counts of gaspereau in the Millbank trap are presented in Table 3. Proportions of fish sampled to fish counted has been constant since 1982, ranging between 1.70 to 3.45% of catch. Samples were processed for fork length (mm), whole weight (g), species, sex, maturity (as immature, spawning, spent) and scales were collected for estimating total age and age of first spawning. The gaspereau fishery of districts 71 and 72 exploits two species, alewife (Alosa pseudoharengus) and blueback herring (Alosa aestivalis) and these were identified primarily on the basis of colouration of the peritoneum and verified against scale markings as described by MacLellan et al. (1981). Disagreement in species identification using both techniques was negligible. Ages were determined according to the criteria described by Cating (1953).

Logbooks

Voluntary daily catch and effort logbooks were obtained from gaspereau fishermen in districts 71 and 72. A sample form is presented in Figure 1. Data extracted from the logbook forms included date, catch and hours gear fished. Incomplete information either as missing effort or ambiguous date and catch data were eliminated prior to analysis. As in the 1987 assessment (Alexander and Vromans 1988), days with recorded effort but zero catch were not used in the calculations of catch per unit effort.

Logbooks were returned by 13 fishermen in 1988, 9 from district 71 and 4 from district 72, which necessitated the use of a conversion factor of 1.963 for estimating total effort (Table 4). This conversion factor is similar to the two previous years, 11 logbooks were returned in 1987 and 13 in 1986. The maximum daily landing of gaspereau for district 71, was recorded on June 9, whereas district 72 maximum catch was recorded on June 1. Combined district maximum catch was recorded on June 10 (11.14% of total logbook catch) which is similar to most other years, maximum catch days ranging between May 28 (1984) and June 13 (1985) (Table 5).

Proportions of species in the landings were estimated to be 36% alewife (488.6 tons) to 64% (868.5 tons) bluebacks based upon daily species composition of gaspereau at Millbank. Proportions have fluctuated back and forth in previous years and this estimated blueback contribution is the highest after 1985 (Table 5). Maximum catch of alewife was estimated to have occurred on June 1 (6.48% of alewife catch) and maximum blueback catch was estimated for June 10 (10.36% of blueback catch) (Table 5).

Catch at Age

Catch at age matrices were recalculated for all years because the cohort analysis procedure described later in this document was performed on catch matrices by age of recruitment. Previously calculated catch matrices did not provide the flexibility to extract this information directly. All logbook and biological data for 1982 to 1987 were reanalysed using SAS procedures. Changes in catch at age, all recruitment ages combined, were noted between previously calculated matrices and those presented in this document (Table 6a and 6b). Discrepancies arise in part from the method of decomposing logbook reported landings for days which did not have detailed sample information. In previous years, age and species composition of catches for those particular days were obtained using a mean age and species composition of the sample days prior to and after the dates in question. In this document, landings from unsampled days were allocated backwards to the previous sample day.

There are several reasons why the catches on days without samples were weighted by samples in the previous sampling day. First, samples were obtained from Millbank trap which is located midway between low river and midriver fishing zones on the opposite shore to the vast majority of trapnets (Figure 2). Second, gaspereau entering the Miramichi estuary are on a spawning migration upstream and it is clear that they are not distributed randomly by species and age group within the fishing zone during the fishery. Changes in age composition of alewife over the duration of the migration have been noted (Figure 3). Previous spawner alewife enter the estuary and ascend the river in the early part of the run with virgin spawners ascending throughout the run. A similar pattern was noted for blueback herring sampled at Millbank (Figure 4). This change in age composition supports the backward allocation of logbook catches onto previous day catch.

1988 Catch at Age

The 1984 year class of alewife was the major contributor to the alewife landings followed closely by the 1983 year class and the 1985 year class (Table 7a). In 1988 no single year class contributed to more than 42% by number to the alewife landings which contrasts with previous years single cohort contributions of 52.7 to 72.9% (Table 7a). Nonetheless, 52% of the alewife catch consisted of first time spawners of which almost half was of the 1985 cohort and the other half the 1984 cohort.

Blueback herring catch was dominated by the 1983 year class (64% of landings by number) followed by the 1984 year class (31%) (Table 7b). First time spawners (FSP), dominated by the 1984 year class (75% of FSP), contributed in numbers to only 33% of the blueback landings in 1988, the lowest proportion since 1982 (Table 7b).

The proportion of first time spawners by age group in the catches has been relatively constant. Alewife are fully recruited at age 5, whereas blueback full recruitment occurs one year later, at age 6 (Table 8).

Weight at Age Matrix

The weight at age matrices for blueback herring and alewife are presented in Tables 9a and 9b. Weight at age was calculated using the measured weights of individual fish. Mean weight at age vectors were calculated using the mean of years 1982 to 1988. Alewife are heavier at age than blueback.

Abundance Index

In terms of overall apparent abundance of gaspereau, the catch rates calculated from logbook catch and effort data, suggest that in 1988 gaspereau were as abundant as in 1981, much less abundant than in 1987 and 1985 yet well above the remaining years (Table 4).

An alternate abundance index was calculated this year to provide an estimate of species and year class abundance independant of commercial catch rates. Species and age composition using the samples and counts of gaspereau at Millbank trapnet are provided in Tables 10a and 10b. The data collected at Millbank were considered to be more reliable than catch rate information from logbooks. The primary reason is that Millbank has been sampled directly for species and age composition and it was possible to calculate an age-structured abundance index for each species. By contrast, in previous years, commercial catch rates for both species and all age groups were inferred from Millbank samples. Secondly, the catchability of the Millbank trap is probably more constant over time than is that of the commercial gear since Millbank is an index trap. The interval comprising the 5% to 95% catch for each species was used to standardize the index between years.

Counts and sampling from the Millbank trap provide quite a different impression of the species composition in the Miramichi than would be implied from the fishery (Figure 5). The catches at Millbank have been dominated by bluebacks in all years, alewife proportion never exceeding more than 35% (Table 11). The proportion of first time spawning alewife in the Millbank counts and as estimated in the fishery are similar (Tables 7a,b and 11) although for blueback FSP proportions are higher in the Millbank counts than the fishery in all years. Millbank counts extend to June 30 whereas the fishery essentially finishes June 15.

NATURAL MORTALITY

The general consensus has always been that gaspereau natural mortality is higher than M = 0.2. As discussed by Chaput and Alexander (1989), natural mortality, in the classic sense, is not calculable at the present time for alewife. An alternate term, 'composite mortality' defined as the sum of the natural mortality components both at sea and during the spawning migrations in freshwater and the mortality component associated with fisheries at sea, i.e. non inriver fisheries, has been calculated as Mc = 0.44 for alewife during the first spawning migration and Mc = 1.05 for subsequent spawning years. Mortality of non-recruited alewife was assumed to be 0.2. These values have been subsequently used in the cohort model discussed below.

An estimate of blueback composite mortality is not available and values equal to those for alewife were used.

COHORT ANALYSIS

In past assessments, SPA was utilized to generate population numbers before the fishery. The most widely used cohort analysis procedure (Pope 1972) is usable at least up to M = 0.3. These simulations assume a Type II fishery, defined by Ricker as one in which the natural mortality occurs simultaneously with the fishing mortality. Under these assumptions, values of Mc utilised in this document render such models unusable.

An alternate point of view is to consider the gaspereau fishery as one which exploits fish under Type I assumptions, i.e. the natural mortality occurs at a time of year other than the fishing season and the population decreases during the fishing season as a result of catch removals only. For convenience, the biological year begins when the fishing commences and natural mortality occurs after fishing ends (Ricker 1975: p. 10-11). Gaspereau fisheries can be justifiably considered as Type I fisheries. The fishery occurs over a short time interval, in most years 80% of the catch is landed within 20 days. In addition gaspereau pass through the fishery on their upstream migration and spawning mortality occurs after they have passed through the fishing zone.

The cohort model utilized in this document uses a modification of the catch equations documented by Rivard (1982) for which:

1) population numbers of the last age group are considered equal to the catch, since fishing is complete and there are no survivors beyond that age. Oldest age F's are irrelevant.

2) population numbers refer to numbers just prior to the beginning of the fishery.

The equation for previous year numbers is:

$$N_1 = N_2 e^m + C_1 \qquad \text{(Ricker 1975: p. 198).}$$

The composite mortality rate used in this analysis varies with spawning frequency rather than directly with age. Consequently, cohort analysis of alewife and blueback was performed by age of recruitment. This type of analysis eliminates the requirement of a partial recruitment vector since in each simulation, all the fish included are fully recruited to the fishery. Two groups were analysed for alewife, age 3 recruits and age 4 recruits, whereas groups corresponding to recruitment ages 3, 4 and 5 were used for blueback. Although in the past, alewife and blueback have been aged as 2 and 6 year old recruits, the proportions are very low, their presence in the fishery has been inconsistent and they are not considered further (Tables 7a,b).

Initial values of recent year F's were input as 1.0, corresponding to values for full recruitment. The terminal F values were determined iteratively by regressing population numbers at F against indices of abundance (intercept through the origin) and selecting the F which maximized R-square and reduced the residual sum of squares of the previous three years. A final cohort analysis was performed using the selected terminal F to generate estimated population numbers at the beginning of the fishery. A summary of the regression analyses using several abundance indices is presented in Table 12.

The abundance index/cohort analysis relationship could not be calibrated appropriately as evidenced by differences in the best terminal F by recruitement age group (Table 12). The short time series and variations in timing of gaspereau abundance in the fishery relative to Millbank trap, which monitors gaspereau movements after the fishery has ended, undoubtedly contributed variance to the data set. Terminal F of alewife in 1988, age 3 recruits, was estimated at 0.60 and 0.20 for age 4 recruits. Blueback terminal F values were 0.14 for age 3 recruits, 0.13 for age 4 and 0.46 for age 5 recruits. Population numbers by recruit age and the estimated F matrices are presented in Table 13a,b. Fishing mortality was higher on alewife than blueback in all years which is a reflection of the run timing and relatively more fishing effort exerted on the alewife relative to blueback.

Estimates of F were calculated from Paloheimo 'Z' values based on the abundance index from Millbank trap (Table 14). Negative F values i.e. increases in abundance of cohort with age, were noted in all recruitment age matrices which suggested that sampling procedures should be reexamined. F values of cohort and Paloheimo methods were high on the older previous spawner groups, but low on new recruits and first time previous spawners.

YIELD PER RECRUIT - $F_{0.1}$

A yield per recruit analysis by the method of Thompson and Bell (Rivard 1982) was performed for alewife and blueback by age of recruitment, using the Mc values mentioned previously. The results are summarized below:

Alewife Recruited age	$F_{0.1}$	Yield per Recruit	Avg. Weight	Age Interval of Estimate
	Mc = 0.44, 1.05 (this report)			
3	1.34	0.162	0.225	3 to 7
4	1.42	0.202	0.276	4 to 8
	M = 0.2 (previous natural mortality value)			
3	0.51	0.178	0.255	3 to 7
4	0.54	0.213	0.300	4 to 8

Blueback Recruited age	$F_{0.1}$	Yield per Recruit	Avg. Weight	Age Interval of Estimate
	Mc = 0.44, 1.05 (this report)			
3	1.34	0.123	0.170	3 to 7
4	1.34	0.147	0.204	4 to 8
5	1.36	0.178	0.246	5 to 9
	M = 0.2 (previous natural mortality value)			
3	0.48	0.135	0.197	3 to 7
4	0.49	0.162	0.235	4 to 8
5	0.52	0.194	0.277	5 to 9

The $F_{0.1}$ value of F calculated using the variable composite mortality is substantially higher than that estimated with constant M = 0.2. This would indicate that for the younger age groups, both alewife and blueback, the fishing mortality has not been excessive although it has been exceeded for some repeat spawner age groups. Mean F by recruit age group indicates that $F_{0.1}$ was exceeded for age 4 recruited alewife in 1983 and for blueback recruitment age 5 in 1987 (Table 13a,b).

PROJECTIONS

The difficulties encountered with the calibration of the terminal F in the cohort analysis make projections of future harvest inappropriate. However, the catch of alewife in 1988 was down from that in 1987, as a result of the reduced contribution of the 1983 year class and a 1984 year class which is much smaller than the 1983 cohort. Indications are that the 1985 year class will not be a strong contributor either, therefore catches of alewife in 1989 are anticipated to be less than in 1988, unless the 1986 cohort recruitment at age 3 is unusually strong.

Blueback catches in 1988 were down from 1987, these having been sustained in the past three years by the exceptionally strong 1983 cohort. Recruitment strengths of the 1984 and 1985 cohorts have been substantially less than the 1983 cohort. The 1985 cohort appears to be very weak, unless the estimated F for the 3 year old blueback recruits in 1988 is too high, which at F = 0.14 is doubtful. Low catches of the 1985 cohort may also be a consequence of delayed movement of these individuals into the Miramichi, although the abundance index of this recruitment group is the lowest estimated to date, 0.94 compared to 11.9 to 328.6 in previous years (Table 10b). Consequently, catch of gaspereau in the Miramichi districts 71 and 72 is expected to go down in 1989. Such troughs in catches have occurred before. Presently regulated weekly closed periods should be continued.

MILLBANK / COMMERCIAL GEAR COMPARISON

In a preliminary analysis of Millbank selectivity, a commercial trapnet downstream of the Millbank trap was sampled on 12 different days between May 24 and June 9. It should be noted that the majority of commercial trapnets are on the opposite shore and above Millbank. Therefore, this trap may not be representative of the fishery either. Length frequencies, species and sex were recorded daily from approximately 200 gaspereau from which a length stratified subsample was aged.

Estimates of catch at age, species composition and length frequencies were obtained by weighting the detailed sample by daily catch, for the commercial net, and by daily counts, for Millbank. Estimates of catch at age when no detailed sample was collected, were obtained by taking the mean of the numbers at age for the sample dates before and after the unsampled day.

The Millbank trap and the commercial trap caught nearly identical sizes of gaspereau. The commercial trap had caught one smaller length group than Millbank although this difference is probably attributable to the larger number of lengths measured from the commercial trapnet (Figure 6). In the 1987 gaspereau assessment, it had been indicated that Millbank was catching smaller gaspereau than the commercial trapnet sampled (Alexander and Vromans 1988).

Over the time period sampled, the commercial trapnet catch was estimated to be composed of 53% blueback herring in contrast to the Millbank trap which had an estimated catch proportion of 42% (Table 15). These proportions were significantly different ($P<0.001$; test of proportions, Sokal and Rohlf 1969: p. 607). The proportions of virgin to previous spawners by species were also significantly different (Table 15). In terms of the age composition by species, the two traps sampled different age classes (Kolmogorov-Smirnov test, $P<0.01$) (Table 15). The dominant blueback cohort in both traps was the 1983 year class (five year old previous spawner recruited at age 4). The dominant alewife cohort was the 1984 year class although samples from Millbank estimated a larger proportion of first time spawner four year olds while the commercial trapnet had a larger proportion of repeat spawner four year olds (Table 15, Figure 7).

This analysis indicates that the Millbank trap had selected different gaspereau from the commercial trap directly downstream, although size was not a factor. Age composition and species proportions are most different between the nets, although different sampling methods would affect the results. The commercial trapnet catchability was substantially higher than the Millbank trapnet, it captured over 25 times more gaspereau (by number).

It cannot be concluded from this that Millbank was not representative of the fishery; comparisons of two commercial nets could just have easily produced similar results. It does, however, indicate that the sampling for length, species and age samples should be spread out over as many fishermen and areas as possible, rather than relying exclusively upon samples from the Millbank trap to represent the fishery.

DIRECTION FOR THE FUTURE

The gaspereau fishery is difficult to assess because two species contribute to the landings (these are not differentiated at points of landing) and the timing of the species migrations and age distribution varies within a particular year. Present fishing pressures on the alewife of the Miramichi are higher than on blueback, but have been below $F_{0.1}$ values. Current management strategy, which incorporates closures each week should be maintained. A fishing season which closes on June 15 does not reduce the exploitation on alewife. If the pattern of age segregation of blueback within the spawning migration that was noted in the Millbank samples holds true for the fishery, then the June 15 closure exploits the previous spawner groups more intensively, which may have contributed to the reduced numbers of these older individuals in recent years. This reduction in the number of age classes in samples collected is disconcerting and is perhaps an artifact of current sampling methods. Given the concerns which have been documented in this assessment regarding changes in species and age composition with time, and the representativeness of Millbank sampling with regards to catches in the fishery, a verification of the appropriateness of the current sampling procedures should be undertaken. This would require sampling the commercial fishery directly, preferrably by fishing zones. The absence of older, less abundant age groups in samples should be substantiated by undertaking a two-phase sampling program, large (500 +) length frequency samples and length stratified sampling for species, sex, age.

The cohort analysis model described in this document provides a better representation of the gaspereau/fishery relationship than the one previously utilised. The time series is presently too short to permit reliable tuning of the terminal F values. The Millbank abundance index is an ideal independent estimator of abundance and species composition and should be maintained. Alternate estimates could be developed from more detailed analyses of logbook data from the various river zones.

Recruitment estimation remains a problem. Reliable cohort analysis could provide some estimate of spawning escapement and an escapement/recruitment relationship explored.

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LITERATURE CITED

Alexander, D.R. and A.H. Vromans. 1983. Status of the Miramichi River gaspereau fishery (1982). CAFSAC Res. Doc. 83/37. 40 p.

Alexander, D.R. and A.H. Vromans. 1984. Status of the Miramichi River gaspereau fishery (1983). CAFSAC Res. Doc. 84/23. 23 p.

Alexander, D.R. and A.H. Vromans. 1985. Status of the Miramichi River gaspereau fishery (1984). CAFSAC Res. Doc. 85/92. 25 p.

Alexander, D.R. and A.H. Vromans. 1986. Status of the Miramichi River gaspereau fishery (1985). CAFSAC Res. Doc. 86/36. 25 p.

Alexander, D.R. and A.H. Vromans. 1987. Status of the Miramichi River gaspereau fishery (1986). CAFSAC Res. Doc. 87/15. 21 p.

Alexander, D.R. and A.H. Vromans. 1988. Status of the Miramichi River fishery (1987) for alewife (Alosa pseudoharengus) and blueback herring (Alosa aestivalis). CAFSAC Res. Doc. 88/27. 30 p.

Cating, J.P. 1953. Determining age of Altantic shad from their scales. U.S. Fish and Wildlife Ser., Fish. Bull. 54 (85): 187-199.

Chaput, G.J. and D.R. Alexander. 1989. Mortality rates of alewife in the southern Gulf of St. Lawrence. CAFSAC Res. Doc. in preparation.

Jones, R. 1981. The use of length composition data in fish stock assessments (with notes on VPA and cohort analysis). FAO Fisheries Circular No. 734. 60 p.

MacLellan, P., G.E. Newsome and P.A. Dill. 1981. Discrimination by external features between alewife (Alosa pseudoharengus) and blueback herring (A. aestivalis). Can. J. Fish. Aquat. Sci. 38: 544-546.

Pope, J.G. 1972. An investigation of accuracy of virtual population analysis using cohort analysis. Res. Bull. Int. Comm. Northwest Atl. Fish., 9, 65-74. (In D.H. Cushing (Ed.)> Key Papers on Fish Populations. IRL Press, Washington.

Ricker, W.E. 1975. Computation and interpretation of biological statistics in fish populations. Bull. Fish. Res. Board Can. No. 191: 382 p.

Rivard, D. 1982. APL programs for stock assessment. Can Tech. Rep. Fish. Aquat. Sci. No. 1091. 146 p.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Bull. Fish. Res. Board Can. No. 184. 966 p.

Sokal, R.R. and F.J. Rohlf. 1969. Biometry. The principles and practice of statistics in biological research. W.H. Freeman and Co. San Francisco.

Table 1. Annual landings for the Miramichi River gaspereau fishery (districts 71 and 72).

YEAR	LANDINGS (mt)
1950	4,952
1951	8,014
1952	11,381
1953	8,026
1954	4,649
1955	3,413
1956	3,009
1957	884
1958	816
1959	1,596
1960	716
1961	161
1962	733
1963	543
1964	119
1965	425
1966	746
1967	532
1968	436
1969	175
1970	874
1971	469
1972	468
1973	967
1974	271
1975	141
1976	406
1977	2,240
1978	1,434
1979	3,343
1980	3,767
1981	1,410
1982	1,278
1983	1,088
1984	665
1985	1,857
1986	1,154
1987	2,145
1988	1,357
Means (95% C.I.)	
Historical	1,981.7 (1,161.3 - 2,802.0)
10 Year	1,814.1 (1,390.8 - 2,237.4)
5 Year	1,381.8 (631.7 - 2,131.9)

Table 2. Landings of gaspereau from the southern Gulf of St. Lawrence, 1978 to 1987. Data summarized from purchase slip and Supplementary 'B' slips collated by Statistics Branch, DFO.

	New Brunswick Statistical Districts						Total Landings (metric tons)			
Year	63-65	66-70	71-72	73-75	76	77-80	NB	NS	PEI	Gulf
1978	0.9	781.0	1433.7	200.0	566.4	102.1	3084.1	1911.0	104.2	5099.4
1979	33.2	413.4	3343.1	343.4	212.8	62.9	4408.7	2023.4	405.3	6837.4
1980	105.0	237.3	3767.2	218.5	237.0	111.0	4676.0	2167.4	253.2	7096.5
1981	320.3	128.4	1410.9	143.2	564.3	140.9	2708.0	1653.5	258.8	4620.3
1982	45.2	149.6	1277.6	193.4	314.1	13.8	1993.7	1663.6	132.9	3790.2
1983	9.3	226.2	1087.9	123.2	392.3	61.8	1900.6	779.8	36.4	2716.9
1984	0.0	205.2	666.1	196.5	506.5	142.5	1716.9	1052.4	87.9	2857.2
1985	5.0	465.4	1341.9	136.5	1427.4	193.0	3569.2	3203.3	238.4	7010.9
1986	0.0	293.6	1171.4	45.5	398.1	352.7	2261.3	974.3	463.6	3699.2
1987	0.0	620.4	2208.7	141.0	1152.2	296.8	4419.2	2558.6	364.2	7342.0
Mean	51.9	352.1	1770.9	174.1	577.1	147.7	3073.8	1798.7	234.5	5107.0

Table 3. Counts of gaspereau and number sampled daily from Millbank trapnet, 1982 to 1988. (Dot indicates days when trap was not fished or samples not collected.)

		1982		1983		1984		1985		1986		1987		1988	
		Count	Sample	Count	Sample	Count	Sample	Count	Sample	Count	Sample	Count	Sample	Count	Sample
May	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	9	.	.	0	.	.	.	.	.	.	.	.	.	.	.
	10	0	.	0	.	.	.	.	.	.	.	.	.	.	.
	11	0	.	0	.	.	.	.	.	.	.	.	.	.	.
	12	0	.	9	.	0	.	.	.	.	.	.	.	.	.
	13	0	.	3	.	.	.	.	.	6	.	.	.	.	.
	14	0	.	.	.	0	.	0	.	5	.	.	.	.	.
	15	.	.	.	.	0	.	0	.	150	20	1	.	.	.
	16	.	.	34	20	0	.	0	.	88	20	.	.	0	.
	17	50	18	30	20	1	.	0	.	.	.	.	.	0	.
	18	264	.	275	.	0	.	.	.	135	7	.	.	1	.
	19	325	.	116	19	.	.	0	.	.	.	1519	50	0	.
	20	249	50	166	20	0	.	0	.	368	18	826	29	0	.
	21	90	.	438	34	.	.	0	.	80	20	223	20	0	.
	22	50	.	3685	50	88	21	0	.	364	35	343	20	48	.
	23	21	.	393	35	920	35	0	.	1053	36	422	30	133	20
	24	76	50	837	34	415	35	0	.	.	.	114	20	105	20
	25	17	.	289	.	497	35	1	.	.	.	290	40	667	34
	26	23	.	237	20	800	35	0	.	270	20	83	.	555	35
	27	18	18	722	34	1191	49	4	.	288	20	1620	50	1425	35
	28	32	32	381	34	355	35	85	.	129	20	217	35	357	35
	29	20	.	693	35	329	35	63	.	730	.	103	20	808	35
	30	136	.	1367	50	463	35	611	25	1509	50	306	31	378	35
	31	2470	50	422	35	34	19	867	35	1992	49	281	20	401	34
June	1	2639	.	854	33	424	20	220	20	970	25	54	20	1390	50
	2	1513	.	608	35	19	19	29	15	883	35	264	20	1855	49
	3	2250	49	1440	46	230	20	564	24	911	33	1766	50	497	35
	4	1542	.	836	35	408	35	640	39	257	19	2846	50	433	20
	5	648	.	1220	45	388	34	1970	35	770	35	1397	50	687	34
	6	948	.	4063	50	734	35	2244	.	1580	50	1174	35	887	35
	7	3076	40	2340	50	820	33	1565	20	1464	49	1556	50	1392	50
	8	2330	.	2515	50	926	35	2285	49	866	28	935	35	753	35
	9	2704	.	1823	45	920	35	1250	.	2400	.	3492	.	1140	20
	10	3830	47	2903	50	511	35	5748	47	152	.	2275	.	5742	50
	11	860	.	2037	49	5180	50	6625	98	750	50	660	35	2874	50
	12	2007	.	4237	50	5727	69	3320	.	1712	47	298	25	7455	50
	13	1215	.	537	35	4032	50	2005	50	691	33	1197	49	2490	50
	14	743	50	172	18	2127	49	2740	37	3145	35	2150	50	5100	50
	15	210	.	442	36	3620	49	1680	20	4885	90	345	35	3975	50
	16	606	.	3846	48	975	34	1490	50	1560	.	964	35	1470	.
	17	532	50	2587	50	180	20	2075	48	1668	47	757	36	2545	35
	18	492	.	3243	50	497	19	4320	28	2401	35	970	35	337	20
	19	175	.	659	34	537	35	2300	47	1025	50	1153	.	935	25
	20	.	.	954	32	429	35	920	26	1129	54	2023	35	511	30
	21	680	50	1185	47	837	33	3185	48	786	.	1260	35	488	.
	22	603	.	1117	49	528	37	1166	50	281	20	1102	50	585	.
	23	95	.	1721	47	733	34	2166	45	295	20	1155	.	420	34
	24	110	50	430	34	507	34	2090	49	282	.	667	34	297	19
	25	142	.	207	19	272	21	730	30	267	20	1092	.	298	20
	26	118	.	219	18	267	20	.	.	888	33	368	.	198	19
	27	108	.	340	18	257	21	1500	50	215	20	189	.	192	20
	28	80	50	19	.	219	21	1950	.	423	25	38	.	275	20
	29	52	.	143	20	237	19	503	23	22	.	119	.	37	20
	30	15	.	37	19	187	20	450	.	8	.	17	.	40	.
Total		34,164	604	52,831	1,552	37,821	1,305	59,361	1,008	39,853	1,168	38,631	1,129	50,175	1,173
% sampled			1.77		2.94		3.45		1.70		2.93		2.92		2.34

Table 4. Miramichi River catches reported through data from purchase slips and Supp 'B' slips collated by Statistics Branch DFO and through voluntary logbooks, 1981 to 1988, with resultant conversion factor and CPUE estimates.

	1981	1982	1983	1984	1985	1986	1987	1988
Total landings (mt) A	1410.9	1277.6	1087.9	666.1	*1857.4	1171.4	2208.7	1357.1
Logbook catches (mt) B	1322.9	1108.4	829.2	612.2	1496	609.6	1077.3	691.3
Logbook effort (hrs)	12308	13148	14894	8857	10507	7450	7572	6166
Conversion factor A/B	1.067	1.153	1.312	1.088	1.242	1.922	2.050	1.963
Total effort (hrs)	13127	15155	19541	9637	13045	14316	15524	12105
CPUE (kg/hr)	107.5	84.3	55.7	69.1	142.4	81.8	142.3	112.1

* 1985 landings total used was one by Science Branch since Statistics Branch estimate was lower than logbook catches reported for that year.

Table 5. Miramichi River alewife and blueback herring daily percentage of total logbook catch (1982–1988).

MM	DD	1982		1983		1984		1985		1986		1987		1988	
		Alewife	Blueback	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback
May	15	–	–	–	–	–	–	–	–	0.12	0.00	–	–	–	–
	16	–	–	0.02	0.00	0.13	0.00	–	–	0.41	0.00	–	–	0.03	0.00
	17	–	–	0.02	0.00	0.06	0.00	–	–	0.63	0.00	–	–	0.03	0.00
	18	0.46	0.00	0.15	0.00	0.00	0.00	–	–	0.00	0.00	0.82	0.00	0.05	0.00
	19	0.38	0.00	0.17	0.00	0.06	0.00	–	–	1.46	0.00	1.29	0.00	0.05	0.00
	20	0.35	0.03	0.09	0.02	0.00	0.00	–	–	0.91	0.00	0.66	0.00	0.00	0.00
	21	0.18	0.01	1.00	0.00	0.80	0.00	–	–	2.30	0.00	0.49	0.00	0.05	0.00
	22	0.21	0.02	2.16	0.06	1.36	0.00	–	–	4.32	0.00	0.56	0.00	0.00	0.00
	23	0.02	0.00	5.02	0.00	1.55	0.00	–	–	2.36	0.00	0.41	0.00	0.66	0.00
	24	0.07	0.01	3.61	0.00	0.93	0.00	–	–	1.11	0.00	0.00	0.00	1.21	0.00
	25	0.25	0.04	2.81	0.00	5.78	0.00	–	–	0.20	0.00	0.93	0.00	1.04	0.00
	26	0.36	0.06	2.23	0.14	8.61	0.15	0.02	0.00	0.43	0.00	1.74	0.00	1.40	0.00
	27	0.22	0.02	1.37	1.44	9.10	0.00	0.49	0.00	0.49	0.00	3.28	0.00	3.50	0.00
	28	0.14	0.02	1.12	0.29	9.35	0.00	0.18	0.00	4.56	0.00	5.71	0.00	3.87	0.00
	29	0.22	0.03	1.86	0.18	5.49	0.12	1.08	0.00	6.72	0.00	5.05	0.50	0.00	0.00
	30	1.37	0.19	1.94	1.09	4.48	0.21	1.03	0.00	7.26	0.61	2.22	0.00	1.83	0.00
	31	5.61	3.25	2.15	0.37	2.62	0.17	1.21	0.00	6.67	0.37	0.00	0.00	2.80	0.65
June	1	14.47	8.38	2.68	0.45	3.14	0.14	1.09	0.00	5.47	0.26	3.35	2.66	6.48	0.92
	2	12.40	7.18	1.25	1.81	2.18	0.37	0.33	0.02	4.62	1.01	1.57	3.93	1.70	1.79
	3	3.89	6.87	1.80	3.74	1.08	0.66	2.11	0.32	3.31	1.38	5.78	0.96	3.33	0.49
	4	2.34	4.13	1.31	4.28	1.58	0.80	4.90	0.76	1.56	2.03	4.11	2.69	1.30	1.44
	5	1.71	3.02	3.19	2.54	1.22	3.93	3.63	1.63	3.05	1.53	2.92	4.07	0.00	0.00
	6	0.44	0.77	1.81	2.76	0.55	3.36	2.62	1.18	1.12	5.57	1.70	3.28	0.61	5.66
	7	1.21	4.43	0.71	3.03	2.22	4.91	0.25	5.99	0.78	3.90	0.00	0.00	0.63	4.10
	8	0.63	2.29	1.84	5.17	2.94	4.16	0.98	5.58	0.58	2.47	3.08	6.78	2.13	4.77
	9	0.51	1.86	1.87	4.56	0.86	1.96	0.45	2.56	0.46	1.97	2.61	5.74	1.62	7.69
	10	0.17	2.08	1.91	6.11	4.81	4.38	0.37	4.85	0.42	1.79	1.84	4.06	0.78	10.36
	11	0.18	2.15	0.65	4.61	1.52	1.97	0.47	4.39	1.00	3.41	0.39	5.35	0.00	6.25
	12	0.11	1.36	0.31	3.46	0.02	0.07	0.82	7.64	0.37	1.68	0.19	3.56	0.00	0.00
	13	0.09	1.09	1.51	1.65	0.02	0.09	0.88	9.32	0.30	2.09	0.28	3.67	0.33	4.24
	14	0.02	0.79	0.65	1.55	0.00	0.00	0.70	9.41	0.40	3.12	0.00	0.00	0.15	6.94
	15	0.03	1.29	0.28	2.07	0.01	0.10	0.59	7.59	0.05	0.55	0.01	0.13	0.52	6.63
	16	0.00	0.11	0.00	0.09	–	–	1.65	5.29	0.06	0.70	0.00	0.23	0.02	0.23
	17	0.00	0.05	0.00	0.10	–	–	0.32	3.25	0.10	0.46	0.00	0.21	0.00	0.29
	18	0.00	0.13	0.03	0.06	–	–	0.30	3.50	0.04	0.28	0.03	0.11	0.00	0.41
	19	0.00	0.05	0.00	0.01	–	–	0.02	0.17	0.08	0.16	0.03	0.11	0.00	0.00
	20	0.00	0.08	0.03	0.17	–	–	0.00	0.06	0.02	0.16	0.01	0.05	0.00	0.21
	21	0.01	0.07	0.00	0.02	–	–	–	–	0.04	0.28	0.00	0.00	0.00	0.20
	22	0.00	0.00	0.02	0.07	–	–	–	–	0.00	0.01	0.01	0.19	0.00	0.22
	23	0.01	0.07	0.00	0.03	–	–	–	–	0.01	0.25	0.01	0.15	0.01	0.27
	24	0.00	0.00	0.02	0.08	–	–	–	–	0.00	0.08	0.01	0.13	0.01	0.12
	25	0.01	0.04	0.01	0.07	–	–	–	–	0.00	0.06	0.01	0.17	0.00	0.04
	26	–	–	0.00	0.00	–	–	–	–	–	–	0.01	0.18	–	–
	27	–	–	0.05	0.06	–	–	–	–	–	–	–	–	–	–
	28	–	–	0.01	0.01	–	–	–	–	–	–	–	–	–	–
	29	–	–	0.01	0.04	–	–	–	–	–	–	–	–	–	–
	30	–	–	0.01	0.06	–	–	–	–	–	–	–	–	–	–
July	1	–	–	0.00	0.03	–	–	–	–	–	–	–	–	–	–
	2	–	–	0.00	0.01	–	–	–	–	–	–	–	–	–	–
TOTAL	%	48.06	51.94	47.69	52.31	72.44	27.56	26.49	73.51	63.82	36.18	51.10	48.90	36.10	63.90

Table 6 (a). Alewife catch-at-age (numbers of fish) in the Miramichi River gaspereau fishery, 1981-1988 (percentage indicates difference with previous data).

Numbers of alewife	Year							
Total Age	1981*	1982	1983	1984	1985	1986	1987	1988
2	0	88	3,372	442	0	0	0	0
3	38,619	476,996	651,448	1,070,590	767,926	2,345,873	644,357	456,578
4	317,258	999,915	1,016,450	702,197	1,073,946	585,936	2,849,127	766,385
5	147,714	131,089	116,524	131,234	170,067	271,506	645,671	577,356
6	304,056	150,259	55,690	41,649	0	16,014	194,130	42,492
7	217,214	54,344	27,508	0	0	0	24,679	2,061
8	14,696	83,846	33,957	0	0	0	0	0
9	12,494	0	12,277	4,141	0	0	0	0
10	0	0	744	0	0	0	0	0
11	0	631	6,281	0	0	0	0	0
2+	1,052,051	1,897,167	1,924,250	1,950,252	2,011,940	3,219,329	4,357,965	1,844,872
Percent change (1989-1988 / 1988)								
2	.	-75.8	-9.3	7.5	0.0	0.0	0.0	.
3	.	-5.0	4.7	1.4	7.0	0.5	-0.1	.
4	.	29.2	5.4	3.3	12.4	3.4	4.6	.
5	.	13.8	4.1	8.6	-12.8	15.0	9.3	.
6	.	52.9	5.9	8.0	0.0	53.6	6.1	.
7	.	50.9	7.4	0.0	0.0	0.0	2.0	.
8	.	66.4	2.8	0.0	0.0	0.0	0.0	.
9	.	0.0	4.7	11.0	0.0	0.0	0.0	.
10	.	0.0	-1.3	0.0	0.0	0.0	0.0	.
11	.	3.4	-3.2	0.0	0.0	0.0	0.0	.
% on total	.	19.3	5.0	2.7	7.7	2.3	4.6	.

* 1981 historical data provided by Scotia-Fundy region

Table 6 (b). Blueback catch-at-age (numbers of fish) in the Miramichi River gaspereau fishery, 1981-1988 (percentage indicates difference with previous data).

Numbers of blueback	Year							
Total Age	1981*	1982	1983	1984	1985	1986	1987	1988
2	0	0	152	0	0	8,896	0	0
3	10,586	24,844	56,029	51,449	389,827	544,932	191,827	1,248
4	194,411	410,962	1,045,600	371,523	4,049,729	345,012	4,012,852	1,195,308
5	476,165	592,099	625,478	176,920	1,268,529	824,050	230,505	2,433,102
6	1,830,828	253,782	244,428	89,563	415,653	181,677	536,803	108,918
7	344,686	767,332	69,196	39,630	110,747	15,875	205,493	76,244
8	289,803	45,393	161,470	38,506	11,866	15,117	42,683	5,324
9	136,676	78,880	14,971	15,723	124,287	910	0	0
10	0	904	30,164	3,835	0	5,502	0	0
11	19,287	0	264	0	0	0	0	0
12	0	0	0	4,235	22,048	0	0	0
2+	3,302,442	2,174,197	2,247,751	791,382	6,392,686	1,941,971	5,220,163	3,820,145
Percent change (1989-1988 / 1988)								
2	.	0.0	-6.5	0.0	0.0	7.1	0.0	.
3	.	-38.3	1.0	0.2	5.9	-2.2	-1.7	.
4	.	-18.8	-0.3	14.4	7.5	7.0	-3.4	.
5	.	-20.7	-0.0	20.4	5.2	0.6	-14.4	.
6	.	-16.2	-1.2	17.3	2.9	-1.2	-2.3	.
7	.	11.8	1.1	16.9	0.5	-0.5	0.9	.
8	.	-34.3	1.2	51.1	40.9	-15.7	1.8	.
9	.	-8.5	-2.0	21.6	9.3	22.5	0.0	.
10	.	-41.6	0.9	5.7	0.0	2.3	0.0	.
11	.	0.0	-9.3	0.0	0.0	0.0	0.0	.
12	.	0.0	0.0	104.2	-11.3	0.0	0.0	.
% on total	.	-10.4	-0.2	16.8	6.5	0.5	-3.6	.

* 1981 historical data provided by Scotia-Fundy region

Table 7 (a). Miramichi River alewife catch at age matrix (numbers of fish) factored on total landings (1982-1988). FSP = first time spawners.

Numbers of alewife	Year						
Total Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 2							
2	88	3,372	442	0	0	0	0
3	0	2,998	0	0	0	0	0
4	0	0	2,914	0	0	0	0
5	0	0	0	0	0	0	1,584
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
Recruited at age 3							
3	476,996	648,450	1,070,590	767,926	2,345,873	644,357	456,578
4	512,276	234,132	146,091	386,590	286,470	1,440,508	320,843
5	609	32,675	68,132	56,831	151,799	242,523	290,290
6	6,892	0	16,625	0	0	66,394	21,811
7	3,522	0	0	0	0	0	0
8	0	8,203	0	0	0	0	0
9	0	1,156	4,141	0	0	0	0
10	0	191	0	0	0	0	0
11	631	0	0	0	0	0	0
Recruited at age 4							
4	487,639	782,317	553,192	687,357	299,466	1,408,619	445,542
5	130,479	62,669	63,102	113,236	118,662	391,723	221,913
6	143,367	39,749	24,958	0	16,014	122,139	15,357
7	43,161	16,464	0	0	0	24,679	2,061
8	81,564	22,757	0	0	0	0	0
9	0	11,090	0	0	0	0	0
10	0	289	0	0	0	0	0
11	0	6,281	0	0	0	0	0
Recruited at age 5							
5	0	21,180	0	0	1,046	11,426	63,569
6	0	15,941	65	0	0	5,598	5,324
7	7,661	5,730	0	0	0	0	0
8	2,282	2,971	0	0	0	0	0
9	0	31	0	0	0	0	0
10	0	264	0	0	0	0	0
Recruited at age 6							
6	0	0	0	0	0	0	0
7	0	5,314	0	0	0	0	0
8	0	27	0	0	0	0	0
Total	1,897,166	1,924,250	1,950,252	2,011,940	3,219,329	4,357,965	1,844,872
Dominant Cohort	1978	1979	1981	1981	1983	1983	1984
%	52.7	52.8	54.9	53.4	72.9	65.4	41.5
% FSP	50.9	75.6	83.3	72.3	82.2	47.4	52.3

Table 7 (b). Miramichi River blueback herring catch at age matrix (numbers of fish) factored total landings (1982-1988). FSP = first time spawners.

Numbers of blueback	Year						
Total Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 2							
2	0	152	0	0	8,896	0	0
3	0	0	0	45,286	4,041	441	0
4	156	3,348	8,928	458,701	10,745	0	0
5	38,979	0	65	61,651	0	0	0
6	38,530	0	0	0	0	0	0
7	38,530	0	0	0	0	0	0
8	0	2,971	0	0	0	0	0
Recruited at age 3							
3	24,844	56,029	51,449	344,541	540,890	191,386	1,248
4	331	56,345	46,033	651,074	115,960	827,750	215,652
5	104,330	24,476	19,005	238,591	112,724	30,711	343,476
6	57,735	22,581	132	83,989	7,486	26,879	0
7	245,140	0	5,692	6,269	635	0	11,064
8	295	9,110	6,437	0	4,890	0	0
9	156	0	3,573	53,698	910	0	0
10	295	0	0	0	5,502	0	0
11	0	0	0	0	0	0	0
12	0	0	0	22,048	0	0	0
Recruited at age 4							
4	410,476	985,907	316,563	2,939,955	218,307	3,185,102	979,655
5	269,938	320,701	115,687	791,462	680,984	146,913	1,798,346
6	113,298	96,567	85,019	284,856	149,370	495,935	82,493
7	346,806	20,837	9,861	57,964	15,240	173,138	65,180
8	25,609	115,083	25,692	11,866	10,227	0	5,324
9	59,235	14,860	10,110	48,540	0	0	0
10	0	23,796	3,835	0	0	0	0
11	0	264	0	0	0	0	0
12	0	0	4,235	0	0	0	0
Recruited at age 5							
5	178,851	280,301	42,162	176,825	30,342	52,881	291,281
6	44,219	113,850	4,412	46,808	24,821	13,989	26,425
7	129,543	35,305	24,077	46,514	0	32,355	0
8	19,490	34,208	6,377	0	0	42,683	0
9	19,490	111	2,040	22,048	0	0	0
10	609	6,368	0	0	0	0	0
Recruited at age 6							
6	0	11,430	0	0	0	0	0
7	7,313	13,054	0	0	0	0	0
8	0	98	0	0	0	0	0
Total	2,174,197	2,247,751	791,382	6,392,686	1,941,971	5,220,163	3,820,145
Dominant Cohort	1975	1979	1980	1981	1981	1983	1983
(%)	35.3	46.5	46.9	63.3	42.4	76.9	63.7
% FSP	28.2	59.3	51.8	54.1	41.1	65.7	33.3

Table 8. Percentage of first time spawners at age for alewife and blueback herring in the Miramichi River gaspereau fishery (1982-1988).

Year	Age	Alewife	Blueback
1982	3	100.0	100.0
	4	48.8	99.9
	5	0.0	30.2
	6	0.0	0.0
1983	3	99.5	100.0
	4	77.0	94.3
	5	18.2	44.8
	6	0.0	4.7
1984	3	100.0	100.0
	4	78.8	85.2
	5	0.0	23.8
	6	0.0	0.0
1985	3	100.0	88.4
	4	64.0	72.6
	5	0.0	13.9
	6	0.0	0.0
1986	3	100.0	99.3
	4	51.1	63.3
	5	0.4	3.7
	6	0.0	0.0
1987	3	100.0	99.8
	4	49.4	79.4
	5	1.8	22.9
	6	0.0	0.0
1988	3	100.0	100.0
	4	58.1	82.0
	5	11.0	12.0
	6	0.0	0.0
Mean	3	99.9	98.2
	4	61.0	82.4
	5	4.5	21.6
	6	0.0	0.7

Table 9 (a). Mean weight (g) at age for alewife from the Miramichi River fishery, 1982 to 1988. Numbers in parentheses indicate sample size used in estimating mean weight.

Total Age	Recruit Age	Year							Weighted Mean
		1982	1983	1984	1985	1986	1987	1988	
1	1	–	53 (5)	–	–	–	–	–	53
2	2	132 (28)	112 (101)	134 (68)	122 (116)	119 (13)	–	–	122
3	2	–	237 (1)	–	138 (2)	–	–	–	171
	3	249 (73)	225 (226)	213 (372)	211 (135)	208 (354)	218 (94)	231 (103)	217
4	2	–	–	273 (2)	–	–	–	–	273
	3	331 (49)	284 (72)	282 (46)	258 (49)	275 (72)	241 (185)	267 (77)	268
	4	316 (82)	278 (236)	274 (159)	264 (80)	271 (55)	250 (183)	267 (97)	273
5	2	–	–	–	–	–	–	294 (1)	294
	3	269 (1)	350 (21)	325 (19)	274 (6)	311 (24)	294 (30)	288 (61)	304
	4	352 (18)	345 (32)	335 (16)	294 (9)	304 (28)	297 (42)	280 (42)	311
	5	251 (1)	275 (7)	–	–	327 (1)	291 (2)	289 (14)	285
6	2	–	–	–	–	–	–	–	–
	3	371 (5)	–	344 (5)	–	–	305 (12)	355 (3)	332
	4	404 (22)	316 (15)	347 (7)	–	291 (2)	293 (17)	306 (3)	342
	5	–	304 (30	265 (1)	–	–	236 (1)	–	283
	6	–	–	–	–	–	–	268 (1)	268
7	2	–	–	–	–	–	–	–	–
	3	413 (4)	–	–	–	–	–	–	413
	4	395 (5)	417 (9)	–	–	–	312 (2)	542 (1)	405
	5	419 (2)	344 (1)	–	–	–	–	–	394
	6	–	329 (1)	–	–	–	–	–	329
8	2	–	–	–	–	–	–	–	–
	3	457 (1)	383 (3)	–	–	–	–	–	402
	4	514 (6)	382 (7)	–	–	–	–	–	443
	5	413 (1)	438 (1)	–	–	–	–	–	426
	6	–	426 (1)	–	–	–	–	–	426
9	3	–	449 (1)	525 (1)	–	–	–	–	487
	4	554 (2)	417 (4)	–	–	–	–	–	462
	5	–	406 (1)	–	–	–	–	–	406
10	3	–	361 (1)	–	–	–	–	–	361
	4	–	390 (1)	–	–	–	–	–	390
	5	–	293 (1)	–	–	–	–	–	293
11	3	634 (1)	–	–	–	–	–	–	635
	4	–	383 (1)	–	–	–	–	–	384

Recruitment ages combined

	1982	1983	1984	1985	1986	1987	1988	Weighted Mean
1	–	53	–	–	–	–	–	53
2	132	112	134	122	119	–	–	122
3	249	225	213	210	208	218	231	217
4	321	279	276	262	273	245	267	271
5	343	339	329	286	307	296	286	306
6	398	314	340	–	291	296	321	335
7	406	402	–	–	–	312	542	402
8	494	391	–	–	–	–	–	432
9	554	420	525	–	–	–	–	462
10	–	348	–	–	–	–	–	348
11	634	383	–	–	–	–	–	509

Table 9 (b). Mean weight (g) at age for blueback herring in the Miramichi River fishery 1982 to 1988. Numbers in parentheses indicate sample size used in estimating mean weight.

Total Age	Recruit Age	Year 1982	1983	1984	1985	1986	1987	1988	Weighted Mean
2	2	–	107 (9)	–	124 (4)	130 (17)	–	–	122
3	2	–	–	155 (6)	165 (26)	132 (14)	166 (1)	–	154
	3	176 (18)	172 (113)	157 (122)	166 (90)	167 (296)	164 (49)	166 (2)	166
4	2	292 (1)	191 (1)	168 (7)	195 (74)	174 (2)	–	–	193
	3	200 (11)	242 (18)	189 (51)	195 (100)	199 (32)	208 (72)	226 (38)	204
	4	214 (110)	207 (448)	194 (402)	193 (482)	208 (61)	185 (406)	198 (205)	197
5	2	340 (2)	–	290 (1)	203 (8)	–	–	–	236
	3	218 (47)	273 (8)	226 (21)	238 (30)	229 (26)	230 (4)	239 (54)	232
	4	280 (37)	267 (110)	232 (87)	241 (94)	236 (170)	238 (16)	235 (333)	242
	5	233 (51)	251 (91)	237 (49)	229 (29)	227 (8)	201 (6)	226 (70)	236
6	2	343 (1)	–	–	–	–	–	–	343
	3	323 (15)	289 (10)	227 (3)	291 (8)	215 (4)	238 (4)	–	285
	4	356 (13)	311 (26)	298 (32)	288 (27)	277 (32)	245 (36)	282 (16)	287
	5	313 (8)	296 (33)	263 (7)	299 (5)	239 (7)	271 (4)	244 (4)	285
	6	–	260 (3)	–	–	–	–	–	260
7	2	398 (1)	–	–	–	–	–	–	398
	3	349 (17)	–	337 (2)	324 (2)	279 (1)	–	277 (1)	340
	4	368 (26)	372 (8)	340 (7)	287 (8)	310 (5)	285 (6)	298 (9)	335
	5	406 (12)	380 (13)	313 (5)	328 (5)	–	255 (3)	262 (1)	360
	6	328 (2)	447 (2)	–	–	–	–	–	387
8	2	–	409 (1)	–	–	–	–	–	409
	3	303 (1)	441 (5)	332 (5)	299 (1)	305 (1)	–	–	367
	4	385 (7)	371 (40)	409 (11)	395 (2)	394 (2)	–	–	381
	5	439 (1)	363 (12)	424 (2)	287 (1)	–	334 (3)	–	365
	6	–	345 (2)	296 (1)	–	–	–	–	329
9	3	206 (1)	–	490 (1)	376 (4)	327 (1)	–	–	361
	4	364 (6)	391 (4)	372 (8)	401 (3)	–	390 (1)	–	378
	5	416 (1)	356 (2)	429 (1)	414 (2)	–	–	–	397
10	3	318 (1)	–	–	–	356 (1)	–	–	337
	4	–	383 (9)	353 (2)	–	–	–	–	378
	5	370 (2)	432 (2)	–	–	–	–	–	401
11	3	–	–	–	–	–	–	–	–
	4	–	335 (1)	–	–	–	–	–	335
12	3	–	–	–	381 (1)	–	–	–	381
	4	–	–	485 (1)	–	–	–	–	485

Recruitment ages combined

	1982	1983	1984	1985	1986	1987	1988	Weighted Mean
2	–	107	–	124	130	–	–	122
3	176	172	157	166	166	164	166	165
4	213	209	193	194	204	189	202	198
5	242	260	233	237	235	228	234	239
6	333	299	287	290	265	247	274	286
7	369	383	330	305	305	275	293	345
8	382	375	384	344	364	334	–	374
9	351	379	390	393	327	390	–	378
10	353	392	353	–	356	–	–	378
11	–	335	–	–	–	–	–	335
12	–	–	485	381	–	–	–	433

Table 10 (a). Abundance index (number per day) of alewife using counts at Millbank trap (5% to 95% catch interval), 1982 to 1988.

	Year						
Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 2							
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
Recruited at age 3							
3	127.3	203.7	211.9	141.9	340.3	81.4	102.5
4	77.9	67.3	23.9	73.7	32.7	164.6	68.9
5	0.1	7.3	11.2	14.2	14.9	26.82	68.6
6	1.4	0	1.6	0	0	10.69	4.8
7	0.7	0	0	0	0	0	0
8	0	2.3	0	0	0	0	0
9	0	0.4	0.3	0	0	0	0
10	0	0	0	0	0	0	0
11	0.3	0	0	0	0	0	0
Recruited at age 4							
4	103.1	207.7	99.7	141.7	38.3	120.9	100.4
5	23	22.3	8	23.5	16.5	32.9	55.2
6	27.5	13.6	6.4	0	4.8	11.27	2.4
7	6.9	7.1	0	0	0	1.2	0
8	12.1	7.3	0	0	0	0	0
9	0	3.3	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	1.9	0	0	0	0	0
Recruited at age 5							
5	0	3.7	0	0	0.5	2.3	12.5
6	0	2.7	2.6	0	0	0.3	0.5
7	4.2	0.4	0	0	0	0	0
8	0.2	0.7	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
Recruited at age 6							
6	0	0	0	0	0	0	0
7	0	0.9	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0

Table 10 (b). Abundance index (number per day) of blueback using counts at Millbank trap (5% to 95% catch interval), 1982 to 1988.

	Year						
Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 2							
2	0	0	0	0	23.6	0	0
3	0	0	2.7	26.6	11.5	0.4	0
4	0.7	2.2	2.8	143	3.9	0	0
5	11	0	4.5	15.6	0	0	0
6	4.2	0	0	0	0	0	0
7	4.2	0	0	0	0	0	0
Recruited at age 3							
3	11.9	67	108.4	122.4	328.6	87.9	0.94
4	0.7	28	93.3	233.6	37.7	128	94.6
5	11.8	9.1	46.9	92	35.6	7.6	165.6
6	45.2	20.3	10.99	16.3	5.6	9.2	0
7	45.8	0	5.9	3	1.4	0	1.2
8	1.2	1.4	15.3	3.1	0.5	0	0
9	0.7	0	0	13.7	2.3	0	0
10	1.2	0	0	0	2.9	0	0
11	0	0	0	0	0	0	0
12	0	0	0	3.6	0	0	0
Recruited at age 4							
4	305.5	756.1	567.7	1024.2	76.5	756.1	636.9
5	142.8	228.6	171.1	245.7	205.9	15	887.7
6	67.3	48.6	61.6	79.7	35	54.3	45.7
7	81.5	3.7	11.8	20.9	6.8	12.8	35
8	8.9	54.5	8.9	4.6	1.4	0	0
9	12.2	5.6	3	1.4	0	1.4	0
10	0	5.5	0	0	0	0	0
11	0	1.4	0	0	0	0	0
Recruited at age 5							
5	140	181.6	117	78.4	7.6	7.3	191
6	46.1	54.7	14.5	14.5	6.1	5.3	4.4
7	48	10.4	6.1	5.5	0	4.9	1.1
8	5.5	24	1.4	3.1	0	4.7	0
9	5.5	4.7	0	5.7	0	0	0
10	0	4	0	0	0	0	0
Recruited at age 6							
6	0	7.7	0	0	0	0	0
7	9.1	2.3	0	0	0	0	0
8	0	4	0.8	0	0	0	0
9	0	0	0	0	0	0	0

Table 11. Proportion at age and % first time spawners (%FSP) of alewife and blueback herring from the Millbank trap based on the total counts of gaspereau, 1982 to 1988.

Alewife

	1982		1983		1984		1985		1986		1987		1988	
Age	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP
3	0.33	100	0.37	100	0.58	100	0.36	100	0.76	100	0.18	100	0.24	100
4	0.47	57	0.50	76	0.34	81	0.54	66	0.16	54	0.63	42	0.41	59
5	0.06		0.06	11	0.05		0.10		0.07	2	0.14	4	0.33	9
6	0.07		0.03		0.03		.		0.01		0.05		0.02	
7	0.03		0.01		.		.		.		<.01		.	
8	0.03		0.02		.		.		.		.		.	
9	.		0.01		<.01		.		.		.		.	
10	.		.		.		.		.		.		.	
11	<.01		<.01		.		.		.		.		.	
% FSP	59.9		75.1		85.2		71.8		84.5		45.2		51.7	
% of gaspereau	29.6		34.1		33.4		16.1		33.8		34.5		19.8	

Blueback herring

	1982		1983		1984		1985		1986		1987		1988	
Age	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP	Prop.	%FSP
2	.		.		.		.		0.03	100	.		.	
3	0.01	100	0.04	100	0.09	98	0.07	82	0.43	97	0.08	99	<.01	100
4	0.28	99	0.52	96	0.53	86	0.65	73	0.15	65	0.81	86	0.35	87
5	0.36	35	0.27	43	0.27	34	0.20	18	0.31	3	0.03	24	0.60	15
6	0.15		0.09	6	0.07		0.05		0.06		0.06		0.02	
7	0.17		0.01		0.02		0.01		0.01		0.02		0.02	
8	0.01		0.05		0.02		<.01		<.01		<.01		.	
9	0.02		<.01		<.01		<.01		<.01		<.01		.	
10	<.01		<.01		.		.		.		.		.	
11	.		<.01		.		<.01		.		.		.	
% FSP	41.6		66.4		63.2		56.8		55.0		77.7		40.2	
% of gaspereau	70.4		65.9		66.6		83.9		66.2		65.5		80.2	

Table 12. Regression variables, and best terminal F using the highest R-square and minimum residual.

Abundance Index (Variable X)	Population Estimate (Variable Y)	R square	F	
Alewife				
Recruited at age 3				
Ages 3, 4, 5, 6	Ages 3, 4, 5, 6	0.457	0.60	*
Recruited at age 4				
Age 5	Age 5	0.749	0.20	*
Previous spawners	Previous spawners	0.478	0.25	
Blueback				
Recruited at age 3				
Age 3	Age 3	0.848	0.14	*
Recruited at age 4				
Age 5	Age 5	0.840	0.12	
Previous spawners	Previous spawners	0.712	0.13	*
Recruited at age 5				
Age 5	Age 5	0.720	0.46	*

* denotes value selected for terminal F

Table 13a. Prefishery population numbers of alewife and values of F by recruitment age, estimated from Type 1 cohort analysis.

	Year						
Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 3							
3	1,143,658	1,127,737	3,186,352	2,901,814	7,437,355	1,748,502	1,011,948
4	742,912	429,354	308,677	1,362,627	1,374,301	3,279,099	711,109
5	1,446	80,708	68,315	56,895	341,552	380,673	643,392
6	7,185	293	16,808	64	22	66,401	48,343
7	60,881	102	102	64	22	7	2
8	3,339	20,072	35	35	22	7	2
9	558	1,168	4,153	12	12	7	2
10	4	195	4	4	4	4	2
11	632	1	1	1	1	1	1
3+	1,960,615	1,659,630	3,584,447	4,321,516	9,153,291	5,474,701	2,414,801
Fishing Mortality							
3	0.54	0.86	0.41	0.31	0.38	0.46	0.60
4	1.17	0.79	0.64	0.33	0.23	0.58	0.60
5	0.55	0.52	5.93	6.81	0.59	1.01	0.60
6	3.20	0.01	4.53	0.02	0.05	9.26	0.60
7	0.06	0.01	0.01	0.02	0.05	0.15	0.60
8	0.00	0.53	0.03	0.03	0.05	0.15	0.60
9	0.00	4.66	5.93	0.09	0.09	0.15	0.60
10	0.30	4.22	0.30	0.30	0.30	0.30	0.60
11	1.00	1.00	1.00	1.00	1.00	1.00	0.60
3+	0.77	0.82	0.56	0.40	0.37	0.68	0.60
Population number recruited at age 4							
4	697,478	880,923	1,113,211	1,557,789	1,283,632	3,309,480	2,457,907
5	244,905	135,144	63,505	360,672	560,589	633,838	1,224,223
6	190,708	40,042	25,361	141	86,587	154,647	84,725
7	108,295	16,566	102	141	49	24,696	11,375
8	113,291	22,792	35	35	49	17	6
9	838	11,102	12	12	12	17	6
10	17,953	293	4	4	4	4	6
11	1	6,282	1	1	1	1	1
4+	1,373,469	1,113,144	1,202,231	1,918,795	1,930,923	4,122,700	3,778,249
Fishing Mortality							
4	1.20	2.19	0.69	0.58	0.27	0.55	0.20
5	0.76	0.62	5.06	0.38	0.24	0.96	0.20
6	1.39	4.92	4.14	0.01	0.21	1.56	0.20
7	0.51	5.10	0.01	0.01	0.02	7.36	0.20
8	1.27	6.50	0.03	0.03	0.02	0.06	0.20
9	0.00	6.92	0.09	0.09	0.09	0.06	0.20
10	0.00	4.63	0.30	0.30	0.30	0.30	0.20
11	1.00	1.00	1.00	1.00	1.00	1.00	0.20
4+	1.08	2.27	0.99	0.54	0.26	0.70	0.20

Table 13b. Prefishery population numbers of blueback herring and values of F by recruitment age, estimated from Type 1 cohort analysis.

Age	Year						
	1982	1983	1984	1985	1986	1987	1988
Population number recruited at age 3							
3	1,287,044	1,281,924	4,972,307	660,965	13,491,943	2,754,472	9,560
4	548,204	812,902	789,521	3,169,211	203,788	8,340,949	1,650,720
5	280,486	191,721	264,748	260,174	881,191	30,734	2,629,152
6	1,731,146	61,643	58,525	85,994	7,552	268,915	8
7	300,644	585,589	13,669	20,434	701	23	84,697
8	397	19,422	204,919	2,791	4,956	23	8
9	514,705	35	3,608	69,456	976	23	8
10	307	180,060	12	12	5,514	23	8
11	4	4	63,009	4	4	4	8
12	1	1	1	22,049	1	1	1
3+	4,662,938	3,133,301	6,370,319	4,291,090	14,596,626	11,395,167	4,374,170
Fishing Mortality							
3	0.02	0.05	0.01	0.74	0.04	0.07	0.14
4	0.00	0.07	0.06	0.23	0.84	0.11	0.14
5	0.47	0.14	0.07	2.49	0.14	7.25	0.14
6	0.03	0.46	0.00	3.76	4.75	0.11	0.14
7	1.69	0.00	0.54	0.37	2.37	0.05	0.14
8	1.37	0.63	0.03	0.00	4.33	0.05	0.14
9	0.00	0.03	4.65	1.48	2.70	0.05	0.14
10	3.33	0.00	0.09	0.09	6.22	0.05	0.14
11	0.30	0.30	0.00	0.30	0.30	0.30	0.14
12	1.00	1.00	1.00	1.00	1.00	1.00	0.14
3+	0.16	0.06	0.02	0.54	0.06	0.12	0.14
Population number recruited at age 4							
4	2,393,975	2,623,678	6,109,561	13,506,622	3,683,380	27,878,391	8,663,413
5	908,434	1,277,445	1,054,784	3,730,902	6,805,317	2,231,633	15,903,378
6	1,516,210	223,433	334,800	328,625	1,028,621	2,143,135	729,522
7	758,526	490,931	44,395	87,408	15,316	307,683	576,417
8	99,493	144,076	164,503	12,084	10,303	26	47,082
9	127,271	25,854	10,145	48,575	76	26	9
10	35,350	23,808	3,847	12	12	26	9
11	4	12,370	4	4	4	4	9
12	1	1	4,236	1	1	1	1
4+	5,839,264	4,821,596	7,726,275	17,714,233	11,543,030	32,560,925	25,919,840
Fishing Mortality							
4	0.19	0.47	0.05	0.25	0.06	0.12	0.12
5	0.35	0.29	0.12	0.24	0.11	0.07	0.12
6	0.08	0.57	0.29	2.02	0.16	0.26	0.12
7	0.61	0.04	0.25	1.09	5.32	0.84	0.12
8	0.30	1.60	0.17	4.02	4.92	0.04	0.12
9	0.63	0.86	5.69	7.25	0.01	0.04	0.12
10	0.00	7.68	5.86	0.09	0.09	0.04	0.12
11	0.30	0.02	0.30	0.30	0.30	0.30	0.12
12	1.00	1.00	1.00	1.00	1.00	1.00	0.12
4+	0.25	0.45	0.09	0.30	0.11	0.13	0.12

Table 13b (Cont'd).

Age	Year						
	1982	1983	1984	1985	1986	1987	1988
Population number recruited at age 5							
5	462,618	493,698	656,165	358,968	52,077	164,165	789,989
6	711,800	182,756	137,435	395,440	117,306	13,998	71,670
7	243,992	233,611	24,112	46,549	121,999	32,364	3
8	19,819	40,050	69,395	12	12	42,692	3
9	37,691	115	2,044	22,052	4	4	3
10	610	6,369	1	1	1	1	1
5+	1,476,530	956,599	889,152	823,022	291,399	253,224	861,669
Fishing Mortality							
5	0.49	0.84	0.07	0.68	0.87	0.39	0.46
6	0.06	0.98	0.03	0.13	0.24	7.50	0.46
7	0.76	0.16	6.55	7.21	0.00	8.34	0.46
8	4.10	1.93	0.10	0.09	0.09	8.61	0.46
9	0.73	3.69	6.57	8.95	0.30	0.30	0.46
10	1.00	1.00	1.00	1.00	1.00	1.00	0.46
5+	0.38	0.75	0.25	1.00	0.25	3.18	0.46

Table 14. Between year F as estimated from Paloheimo Z of Millbank catch per unit effort of alewife and blueback, 1982 to 1988. Negative F values indicate that Z was less than Mc allocated to that age group.

Alewife	Year						
Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 3							
3	0.20	1.70	0.62	1.03	0.29	-0.27	
4	1.32	0.74	-0.53	0.55	-0.85	-0.17	
5	3.57	0.47	8.27	8.51	-0.72	0.67	
6	6.19	.	6.33	.	-1.05	8.23	
7	-2.24	.	.	.	.	.	
8	-7.04	0.98	.	.	.	.	
9	.	4.94	4.66	.	.	.	
10	.	.	.	.	.	.	
11	.	.	.	.	.	.	
Recruited at age 4							
4	1.09	2.82	1.01	1.71	-0.29	0.34	
5	-0.52	0.20	7.94	0.54	-0.67	1.57	
6	0.30	8.47	7.71	.	0.34	8.28	
7	-1.11	7.82	.	.	.	6.04	
8	0.25	7.85	.	.	.	.	
9	.	7.05	.	.	.	.	
10	-8.60	.	.	.	.	.	

Blueback	Year						
Age	1982	1983	1984	1985	1986	1987	1988
Recruited at age 3							
3	-1.30	-0.77	-1.21	0.74	0.50	-0.51	
4	-3.61	-1.57	-1.04	0.83	0.55	-1.31	
5	-1.59	-1.24	0.01	1.75	0.30	7.89	
6	9.67	0.19	0.25	1.40	7.58	0.99	
7	2.44	-10.69	-0.41	0.74	6.19	.	
8	6.04	6.19	-0.94	-0.75	5.17	.	
9	5.50	.	.	0.50	6.69	.	
10	6.04	.	.	.	6.92	.	
Recruited at age 4							
4	-0.15	1.05	0.40	1.16	1.19	-0.60	
5	0.03	0.26	-0.29	0.90	0.28	-2.16	
6	1.85	0.37	0.03	1.41	-0.04	-0.61	
7	-0.65	-1.93	-0.11	1.65	7.77	8.41	
8	-0.59	1.85	0.80	7.38	.	.	
9	-0.25	7.58	6.96	6.19	.	6.19	
10	-8.29	7.56	.	.	.	.	
Recruited at age 5							
5	0.50	2.09	1.65	2.11	-0.08	0.07	
6	0.44	1.14	-0.08	8.53	-0.83	0.52	
7	-0.36	0.95	-0.37	7.56	-9.51	7.45	
8	-0.89	9.04	-2.45	6.99	.	7.41	
9	-0.73	7.41	.	7.60	.	.	
10	.	2.95	.	.	.	.	

Table 15. Comparison of estimated catch at age of blueback and alewife from Millbank trapnet and commercial trapnet for corresponding time period.

Age	Recruit at Age	Proportion of Catch		
		Millbank	Commercial	
Blueback				
3	3	0	0.003	
4	3	0.078	0.135	
	4	0.152	0.114	
5	3	0.137	0.184	
	4	0.528	0.516	
	5	0.039	0	
6	3	0	0	
	4	0.033	0.039	
	5	0.004	0	
7	3	0.004	0.001	
	4	0.022	0.005	
	5	0	0.003	
8	3	0	0	
	4	0.002	0	
Alewife				
3	3	0.257	0.262	
4	3	0.178	0.287	
	4	0.222	0.247	
5	2	0.003	0	
5	3	0.161	0.053	
	4	0.117	0.092	
	5	0.037	0.055	
6	3	0.016	0.002	
	4	0.008	0.002	
	5	0.002	0	
Overall Proportions				
Alewife		0.584	0.472	P<0.001
Blueback		0.416	0.528	
Alewife				
Virgin		0.516	0.564	P<0.001
Repeat		0.484	0.436	
Blueback				
Virgin		0.191	0.117	P<0.001
Repeat		0.809	0.883	

Fisheries and Oceans / Pêches et Océans

Gaspereau Catch and Effort Record/ Registre des prises et de l'effort de pêche-gaspareau

Name / Nom (1–20, 21)

Week of / Semaine du ____ to / à ____ (27)

Year / Année 19__ (29)

GEAR USED / AGRES UTILISE (31)

Trap Net / Filet en trappe ☐ Dip Net / Epuisette ☐

Fixed Gill Net / Filet maillant fixe ☐ Drift Net / Filet maillant a derive ☐

Other / Autre _____

NUMBER OF NETS / NOMBRE DE FILETS (33)

Statistical District / District statistique (35)

River System(s) / Reseau fluvial _____ (38)

Fishing Location(s) / Lieu(x) de pêche _____

SPECIES CAUGHT / ESPECES DE POISSON PÊCHÉES	DAILY CATCH/PRISES QUOTIDIENNES							DEPARTMENT USE / RÉSERVÉ AU MINISTÈRE
	MONDAY / LUNDI	TUESDAY / MARDI	WEDNESDAY / MERCREDI	THURSDAY / JEUDI	FRIDAY / VENDREDI	SATURDAY / SAMEDI	SUNDAY / DIMANCHE	
Gaspereau-Kilograms (if pounds specify) / Gaspareau-Kilogrammes (si en livres, précisez)	43	48	53	58	63	68	73	
Striped Bass — Number / Bar d'Amerique — Nombre								
Shad — Number / Alose — Nombre								
Other — Specify (88) / Autre — Précisez								
Number of Hours Net(s) Fished / Nombre d'heures consacrées à la pêche	96	98	100	102	104	106	108	
CATCH DISTRIBUTION-KILOGRAMS/DISTRIBUTION DES PRISES-POIDS EN KILOGRAMMES								
Sold for or Utilized as Bait / Vendues ou utilisées comme appât								
Sold to Fish Plant / Vendues à une usine du poisson								
Sold to Buyer / Vendues à un acheteur								
Self Consumed or Sold Locally / Consommation personnelle ou vendues sur place								

COMMENTS: Note weather and gear damage preventing fishing, etc.

OBSERVATIONS: Indiquez les jours ou vous ne pouvez pêcher à cause du mauvais temps ou d'engins endommagés, etc

GR 130

Figure 1. Sample logbook form used for recording gaspereau catch and effort data.

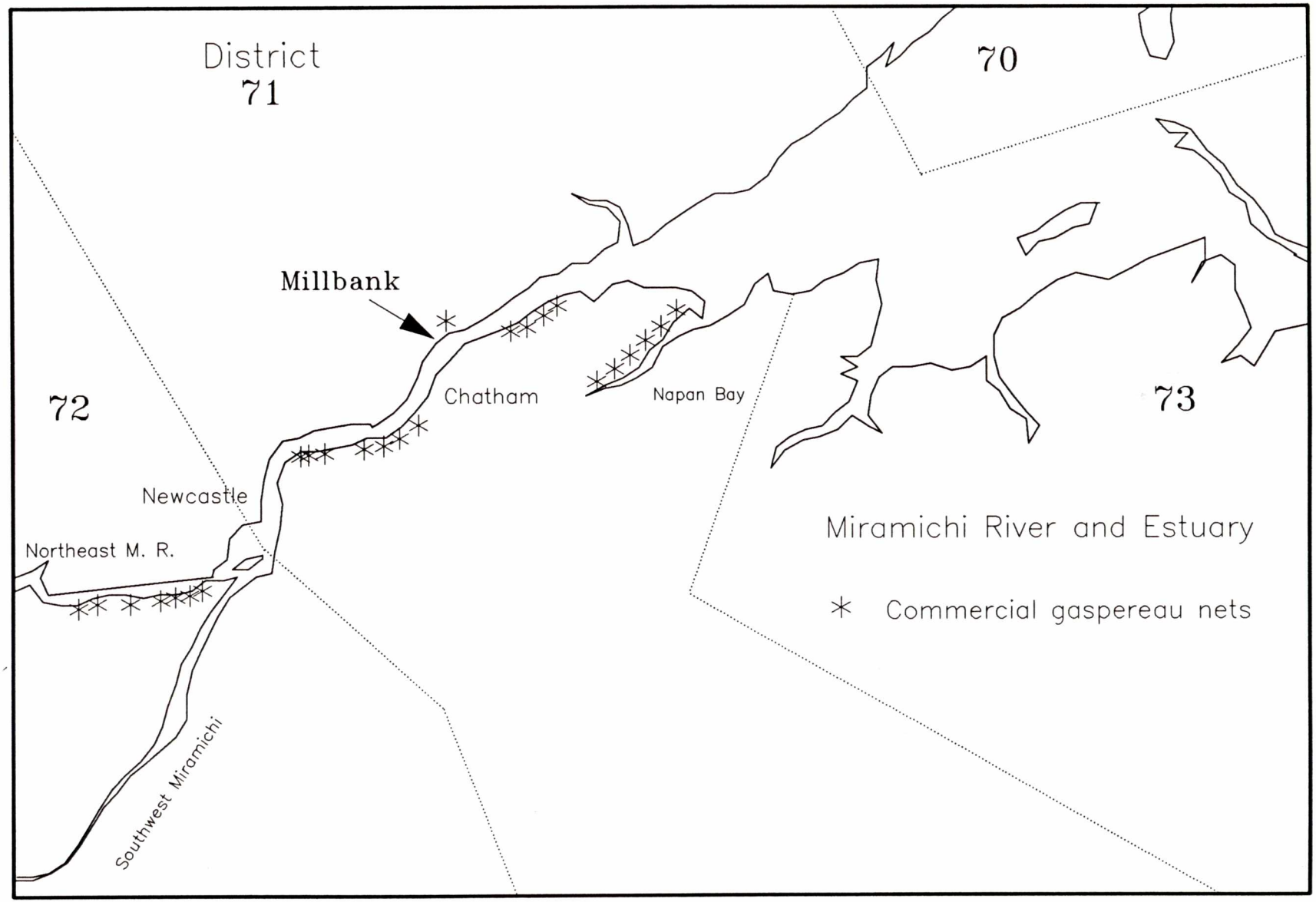

Figure 2. Miramichi River and estuary showing location of Millbank index trap relative to commercial gaspereau trapnets in districts 71 and 72.

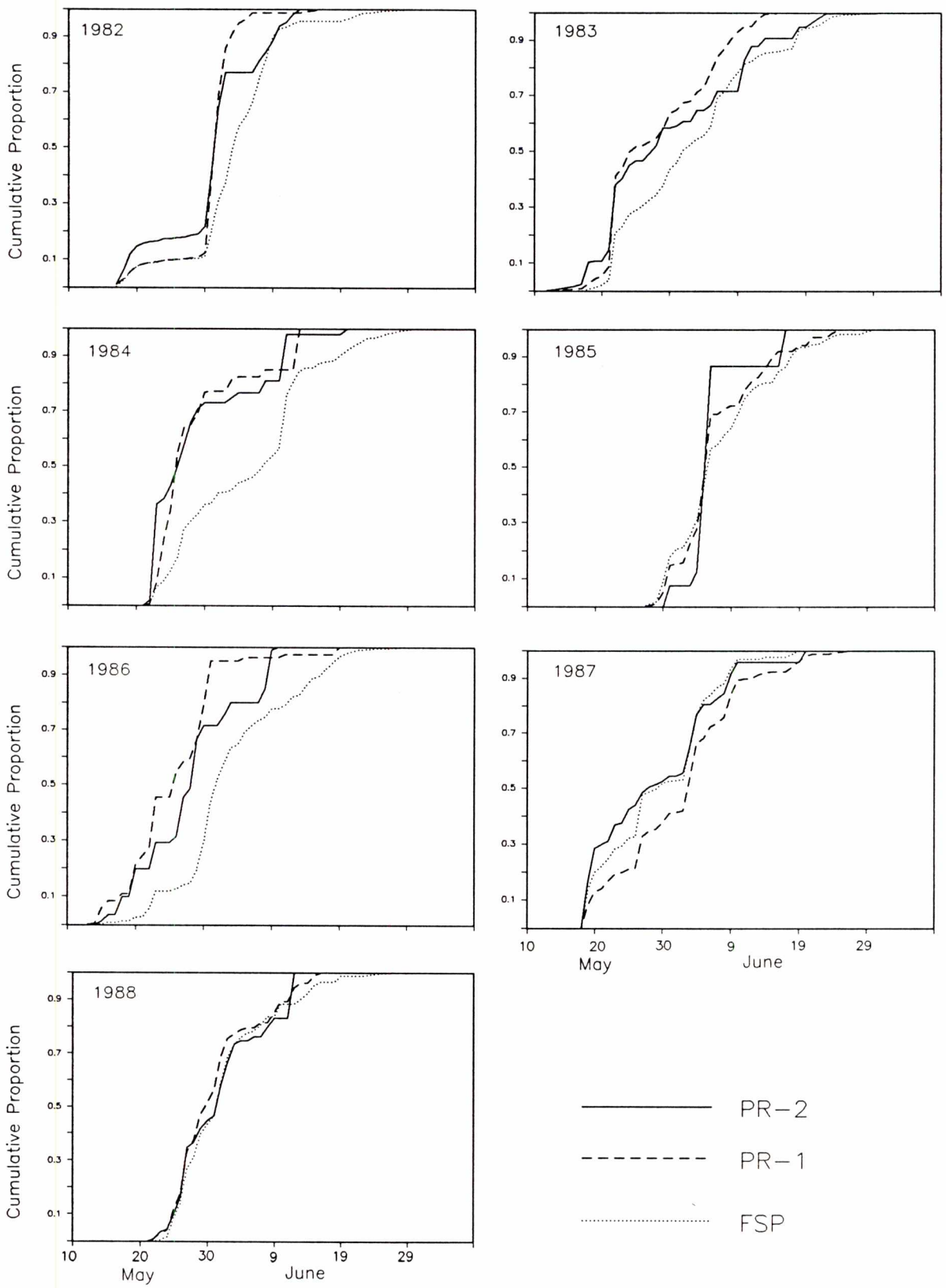

Figure 3. Cumulative counts of alewife, by spawning group, at the Millbank index trap, 1982 to 1988. Legend: FSP = first time spawners, PR-1 = one previous spawning, PR-2 = 2 or more previous spawnings.

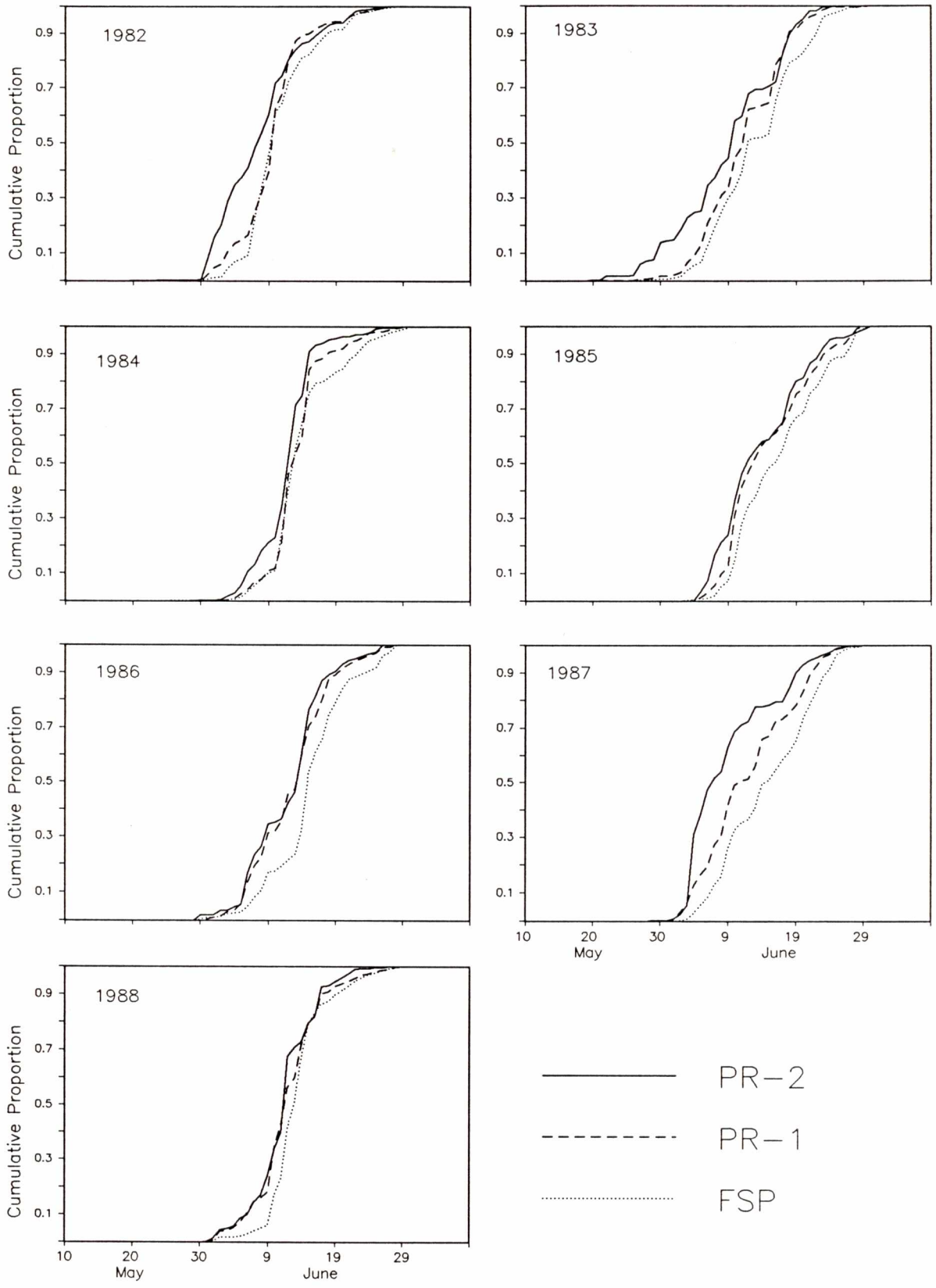

Figure 4. Cumulative counts of blueback herring, by spawning group, at the Millbank index trap, 1982 to 1988. Legend: FSP = first time spawners, PR-1 = one previous spawning, PR-2 = 2 or more previous spawning.

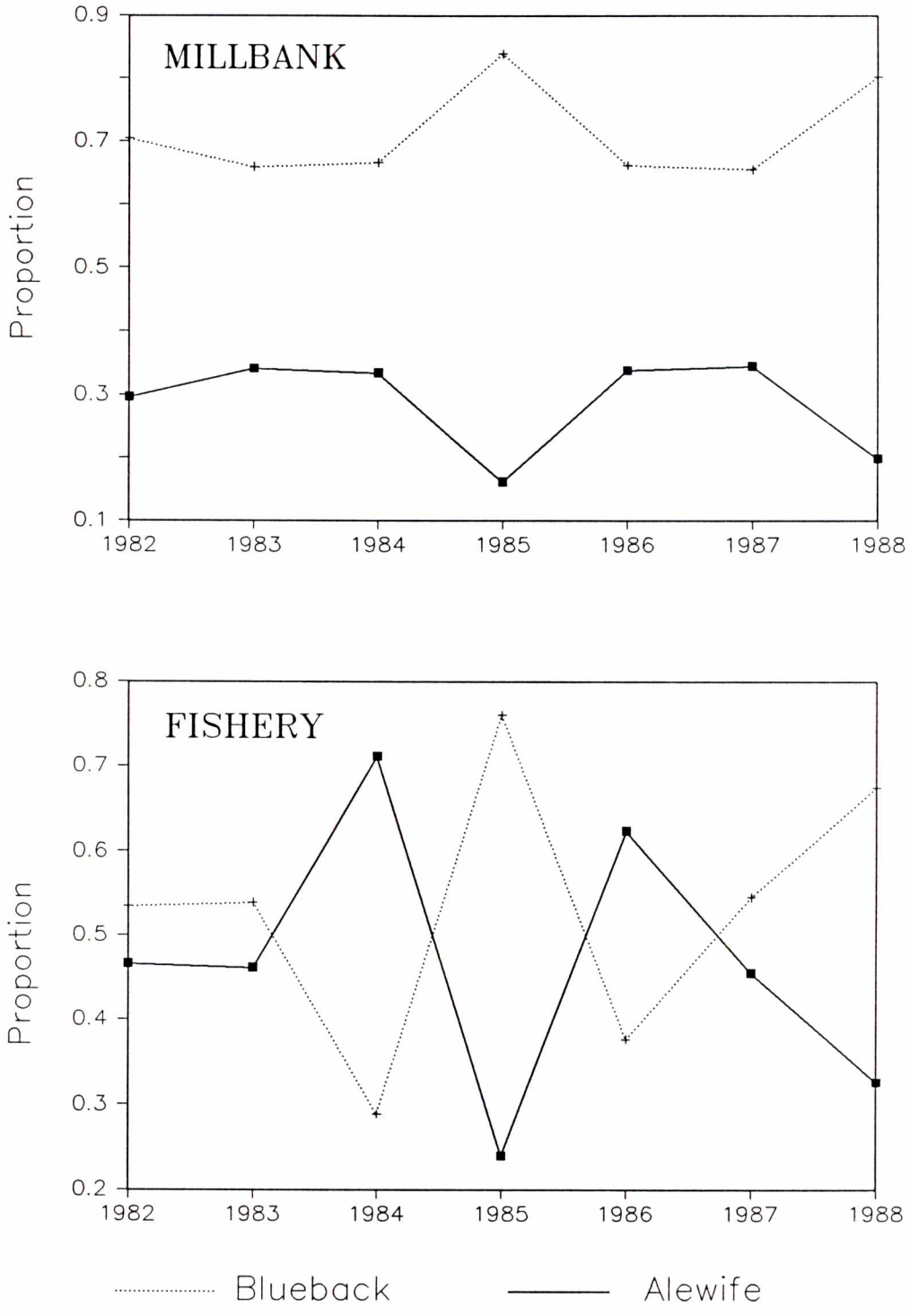

Figure 5. Estimated proportion of alewife and blueback in the commercial fishery and at Millbank trapnet, 1982 to 1988.

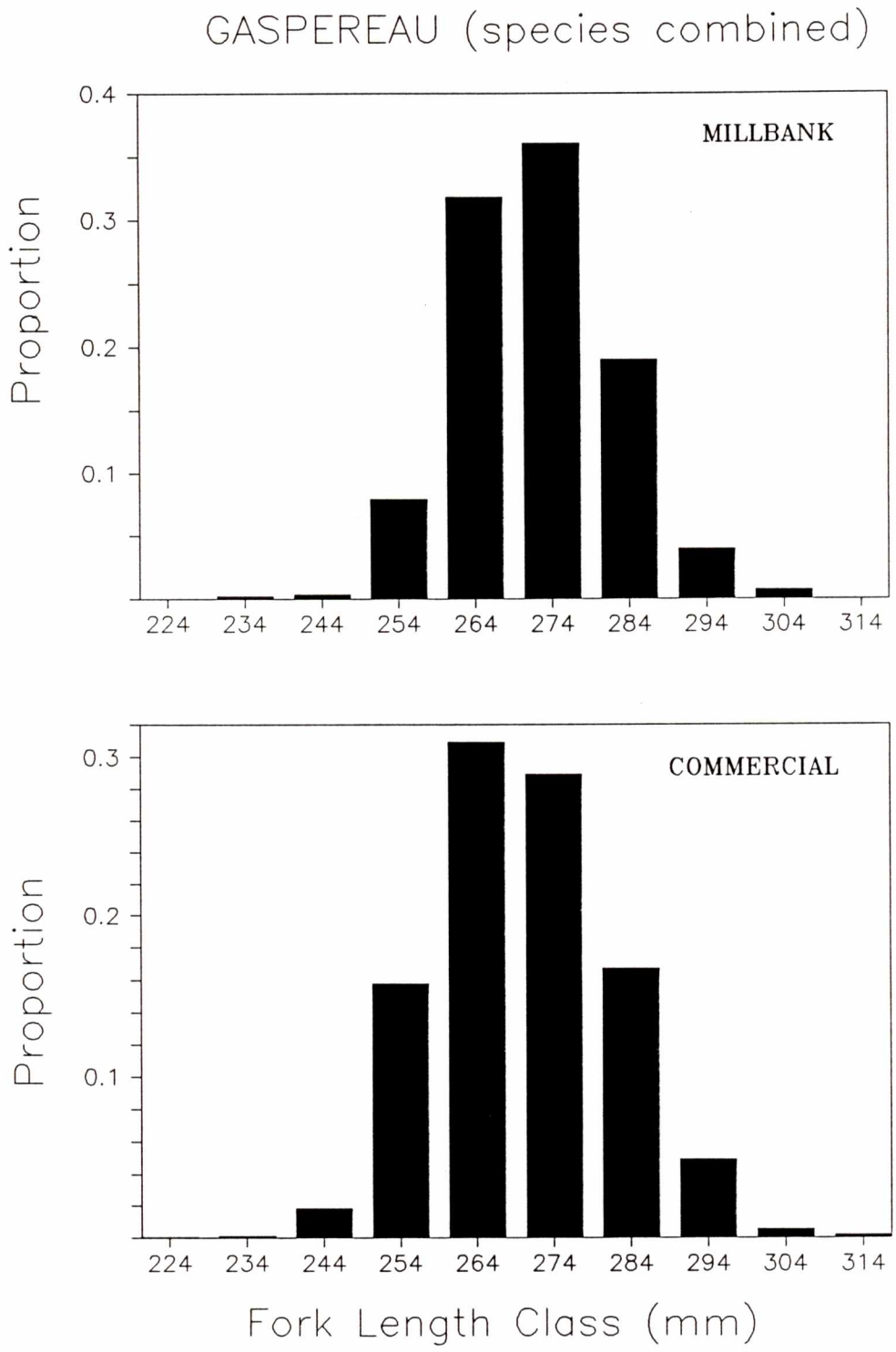

Figure 6. Length frequency of gaspereau sampled from the Millbank trapnet and commercial trapnet, 1988.