Department of Fisheries and Oceans Canadian Stock Assessment Secretariat Research Document 97/75

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Ministère des pêches et océans Secrétariat canadien pour l'évaluation des stocks Document de recherche 97/75

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The gaspereau fisheries (Alosa pseudoharengus and A. aestivalis) of the Miramichi River with updates on the fisheries of the Pokemouche, Tracadie and Richibucto rivers of Gulf New Brunswick

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ABSTRACT

The gaspereau (*Alosa aestivalis*, Blueback herring; *Alosa pseudoharengus*, Alewife) fisheries are regulated by license and season restrictions. Gaspereau landings in Gulf New Brunswick in 1995 and 1996 were down from the previous 5-year average.Target fishing mortalities for gaspereau are between 0.4 and 0.5. Estimated returns of alewife to the Miramichi River increased from about 3 million fish in 1982 to 8 million fish since 1991. Bleuback herring abundance peaked in 1987 and 1988 at about 15 million fish but has since declined to about 6 million fish since 1990. Exploitaiton rates on alewife were generally higher than on blueback herring. The fishing mortality rates exceeded the target levels for alewife and have oscillated around the target levels for blueback herring. Alewife and to a lesser extent blueback herring are harvested primarily at the recruit stage.

RESUME

Les pêches au gaspareau (*Alosa aestivalis*, Alose d'été; *Alosa pseudoharengus*, Gaspareau) sont gérées par des contraintes de permis et de saisons. Les débarquements de gaspareau provenant du sud du Golfe du Saint-Laurent en 1995 et 1996 étaient inférieurs à la moyenne des cinq années précédentes. Les taux de mortalité de pêche cibles pour le gaspareau se situent entre 0.4 et 0.5. Les retours de gaspareau à la rivière Miramichi sont passés d'environ trois millions de poissons en 1982 à huit millions de poissons depuis 1991. L'abondance de l'alose d'été était maximum en 1987 et 1988 à près de 15 millions de poissons mais a diminué à près de huit millions de poissons depuis 1990. Les taux d'exploitaiton du gaspareau sont générallement supérieurs à ceux de l'alose d'été. Les taux d'exploitation dépassaient les niveaux cibles pour le gaspareau et ont fluctué autour du niveau cible pour l'alose d'été. Les deux espèces, mais surtout le gaspareau, sont exploitées majoritairement au stage de nouvelles recrues.

INTRODUCTION

There are three species of anadromous clupeids which utilize the numerous rivers in the Gulf of St. Lawrence for spawning: the American shad (*Alosa sapidissima*), the alewife (*Alosa pseudoharengus*) and the blueback herring (*Alosa aestivalis*). All three species are fished commercially throughout the Gulf of St. Lawrence (Chaput and LeBlanc 1991); the alewife and the blueback herring are reported in the landings under the common name gaspereau. Gaspereau landings in the Gulf rivers of the Maritime provinces peaked in the mid-1950's with reported landings of over 14,600 t in 1952 and declined rapidly afterwards to a low of 920 t in 1969 (LeBlanc and Chaput 1991). Since then, catches peaked at just under 7,100 t in 1980 and have averaged over 5,000 t since 1978 (Chaput 1995).

Both alewife and blueback herring spawn in all the rivers of the Gulf shore of the Maritimes (Chaput and LeBlanc 1991) but the relative abundance of each species varies with the river. For example, alewife represent more than 95% of the spawning run of gaspereau to the Margaree River whereas in the Miramichi River, blueback herring are equally and frequently more abundant than alewife (Chaput and LeBlanc 1991). The alewife migration occurs about ten days to two weeks before the blueback herring migration and gaspereau arrive progressively later in the spring in an east to west direction (Chadwick and Claytor 1991; Chaput and LeBlanc 1991). Gaspereau overwinter outside the Gulf of St. Lawrence.

Annual assessments of the Miramichi River gaspereau fishery have been prepared since 1983 (Alexander and Vromans 1983 to 1988, Chaput and LeBlanc 1989, LeBlanc et al. 1990). A bi-annual assessment was presented for the 1991 and 1992 fisheries (Mowbray et al. 1993) and the 1993 and 1994 fisheries were assessed and summarized in Anon. (1995). Other rivers have been studied and assessed intermittently since the 1970's: Pokemouche River (district 67) and Tracadie River (district 68) in 1974,–1989, 1990, and 1994 (Peppar and Pickard 1976; LeBlanc et al.1991; Anon. 1995), Richibucto River (district 76) in 1989, 1990, and 1994 (LeBlanc et al. 1991; Anon. 1995), and the Kouchibouguac River and Black River (district 75) for 1989 to 1993 (Tremblay et al. 1994).

The assessment of the gasperau fishery of the Mriamichi River has in the past highlighted the following considerations for management:

- 1 the gaspereau fishery historically opened May 15 and closed June 15. As a consequence, alewife were exploited more intensely than blueback herring because the alewife migration begins in mid-May whereas the blueback herring migrate to the Miramichi from late May through June.
- 2 bycatch of striped bass early in the season and bycatch of Atlantic salmon at the end of the season has constrained the opening and closing periods.

New management considerations are:

- 1 introduction of four new trapnet licenses to the Eel Ground First Nation (two in the Northwest Branch of the Miramichi and two in the Southwest Branch of the Miramichi) when there was a freeze on other commercial license issuance.
- 2 prohibition of the sale of wild striped bass originating as bycatch from estuarine commercial fisheries including the gaspereau fishery.

There is less historical information on the status of gaspereau in rivers other than the Miramichi. On the basis of the distribution of age classes in the gaspereau fisheries of the other smaller river systems of Gulf New Brunswick, it appears that the fishery exploitation has been more intensive than on the Miramichi River.

The following document provides a description of the 1995 and 1996 fisheries of the Miramichi – River in terms of the harvests, species composition, and age distribution in the catches. Catch and effort data from logbook reports provide an indication of the relative abundance of the spawning populations. The logbook data are also used to describe the timing of the spawing migrations between years. Similar data are analyzed for the 1995 and 1996 fisheries of the Richibucto River and compared to findings from previous years.

DESCRIPTION OF FISHERIES

The gaspereau fisheries are regulated by license and season. There is a freeze on new ______ commercial licenses in Gulf New Brunswick. The seasons in 1993 to 1996 varied by district and river (Fig. 1).

Districts 67 & 68 (Gloucester Co.) - May 24 to June 30 with weekend closures from 12:00 noon Saturday to 18:00 Sunday with the following exceptions:

- Pokemouche River (district 67) open last two weekends of June
- Grande Rivière Tracadie (district 68) June 1 to 30, (extended to July 7 in 1993) open last two weekends of June.

Districts 70 to 73 (Northumberland Co.) - May 15 to June 30 with weekend closures as above throughout the season except for the following:

Miramichi River and Northwest Miramichi (districts 71 and 72) - May 15 to June 15 for 1993 and 1994 (extended to June 19 in 1993 and June 18 in 1994) with weekend closures as above in May, seven days per week fishing in June. In 1995 and 1996, the fishing ______ season was May 20 to June 20 with weekend closures in May and the first weekend in June, fishing open in the last two weekends of the season.

Districts 75 to 80 - June 1 to 30 with weekend closures as above with exception for the following: \equiv

- Kouchibouguac, Kouchibouguacis, Bouctouche and Shédiac no weekend closures,
- Richibucto and St. Charles May 20 to June 25 with weekend closures but open last two weekends of fishing in June.

Landings

Landings are available from purchase slip and supplementary 'B' forms compiled by Statistics Branch of DFO. Purchase slips are completed by buyers. Supplementary 'B' forms are completed by DFO field officers monthly and are estimates of the catch of gaspereau which was used locally for bait or other purposes. These catches are not sold to buyers and would not normally be recorded in the purchase slip database. Between 1978 and 1987, the proportion of the total reported landings compiled by Statistics Branch which were transcribed from purchase slips averaged 88% for the Miramichi River fishery and 72% for the southeast New Brunswick districts (Chaput and LeBlanc 1991).

A second source of catch data is the voluntary logbook program. Daily catch and effort logbooks are completed by varying numbers of fishers in any year - the largest participation is from the Miramichi River fishery.

Since 1991, landings have been compiled the "Spring herring and gaspereau coordination committee". Monitors would obtain the catch values from the buyers on a daily basis or every second day.

Landings compiled by the "Spring herring and gaspereau coordination committee" are compared to Statistics Branch compilations in Table 2. The catches compiled by the coordination committee were frequently different from the DFO compiled landings; generally DFO catches were less than the coordination committee values. The landings in 1994 for Miramichi River and Richibucto were 25% higher in the coordination committee values compared to DFO. Fishers from Pokemouche River and the Miramichi River reported that catches were up in 1994 relative to 1993 while those from Richibucto reported that catches were up in 1994 (Anon. 1995). The purchase slip data from Richibucto correspond with this view from the fishers. For the Miramichi, this view is consistent with the coordination committee estimate but not the DFO value (Table 2). Coordination committee values and purchase slip data show similar trends for 1995 and 1996 in all the rivers. The landings data are very similar between the two data collection methods for the Pokemouche and Tracadie rivers. The coordination committee estimates are higher than the purchase slip data for the Miramichi but the purchase slip data are higher for the Richibucto River (Table 2). There is no obvious explanation for the discrepancy. The purchase slip data were used in the assessment for estimating the catch at age from the fisheries.

TARGET

The management of the gaspereau fishery has in the past been based on ensuring that the overall fishing mortality does not exceed the yield per recruit value at $F_{0.1}$. The $F_{0.1}$ value for gaspereau has been determined to be F=1.05 for alewife and F=1.01 for blueback herring (LeBlanc et al. 1991). This translates to fishing mortalities which remove about 65% of the spawning population in a given year. This high value stems from an estimate of the high natural mortality for mature spawning gaspereau of M=0.44 for first time spawners and M=1.05 for all subsequent spawning years (Chaput and Alexander 1989).

Chaput et al. (1997) review the derivation of target fishing mortalities for gaspereau and suggest_that target F should be reduced below those derived from $F_{0,1}$ objectives. Walters and Pearse (1996) suggest that F_{opt} (defined as the optimum fishing rate based on the long-term objective of maximizing a logarithmically risk-averse function of catch) is less than two-thirds $F_{0,1}$ of harvestable fish. It has also been suggested that given the uncertainty of estimating and forecasting stock size, the fishing mortality should remain below M (Walters and Maguire 1996).

General indicators of natural mortality based on the longevity of the species (Hoenig 1981) and on life history invariants (Jensen 1996) provide indications that M is in the order of 0.4 rather than 0.2. At a maximum spawning age of eleven years for alewife and twelve years for blueback herring, the empirical relationship derived by Hoening (1981) indicated that M was in the order of 0.4. Jensen (1996) reviewed three life history relations called the Beverton and Holt invariants, one of which provides an indication of the natural mortality on the basis of the age at maturity (M x m = C1; where M = natural mortality, m = age at maturity, and C1 = 1.65 or 2). The age at maturity of alewife in the Miramichi River is similar to that of the Margaree River (based on the proportion of the recruitment to the river which matures at age 3 years versus 4 years) at 3.35 years. Blueback herring are older at maturity than alewife, 3.95 years. This gives an estimate of M = 0.49 for alewife and M = 0.42 for blueback herring. The target fishing mortalities for Miramichi alewife should therefore be in the order of 0.4 to 0.5 for alewife and 0.4 for blueback herring.

ASSESSMENT DATA

The data used in the assessment of the Miramichi River include logbook reports from individual fishers, two-stage stratified sampling for age composition and derivation of the catch at age, and sampling at index trapnets in each of the Northwest and Southwest branches of the Miramichi River. Only two-stage stratified sampling for age composition and catch-at-age were conducted for the Richibucto River in 1994 to 1996 and for the Pokemouch and Tracadie rivers in 1994.

Fishery logbooks are used to make inferences on timing of the catch and in the past have been used as an abundance index (Mowbray et al. MS1993). Logbook data are available from the Miramichi for 1982 to 1996. Logbook data from other rivers have not been available in recent years.

Commercial sampling followed a similar procedure to that used since 1989 (LeBlanc and Chaput MS1990). Sampling was conducted weekly at the three main landing locations: twice a week at the Loggieville wharf, three times a week at the Chatham wharf and three times per week at the Newcastle

wharf (Fig. 1; Table 3). A sample of about 70 kg was obtained from an individual fisher's catch. Lengths were obtained by species (alewife and blueback herring). Two fish per half centimetre length group of each species were kept for detailed analysis (length, weight, species, sex, maturity, gonad weight of females, scales collected for ageing). Scales were interpreted for total age and age of first spawning. For the other rivers sampled in 1994 to 1996, two-stage sampling was conducted twice per week but gaspereau were not identified to species in the first phase of sampling. Fish were kept for detailed sampling using the following protocols: three fish for every 5 mm fork length group up to 280 mm and 5 fish for every 5 mm group for fish longer than 280 mm.

When detailed samples were frozen prior to analysis, fresh fish lengths were estimated from frozen lengths using the following relationship (Chaput MS1993): adjusted length (mm) = 1.0143 X frozen length (mm) + 4.557

Scales for age determination were collected preferentially from the left side, midway between the dorsal fin and the ventral scutes. Species (alewife, *Alosa pseudoharengus*; blueback herring, *Alosa aestivalis*) were identified on the basis of the external appearance and the peritoneum colour (Scott and Crossman 1973). The peritoneal lining of alewife tends to be pale to dusky whereas the lining of the body cavity of blueback herring is sooty to black.

The catch-at-age of alewife and blueback herring was derived from age-length keys (Table 3) applied to length sampling vectors. Length vectors within each group were weighted by the reported logbook catch for that period or by the daily landings from the area as recorded on purchase slips. Logbooks were used preferentially to purchase slips when available. Catch-at-age was first derived for each area, summed and adjusted for the total harvests from the river.

The catch-at-age for the other rivers was determined using one age-length key per river applied to the length frequency samples from the fishery. The catch-at-age for these rivers was not weighted by the landings but provides an indication of the relative age structure in the catch. Proportions of alewife and blueback herring in the fishery are determined from the proportions in the length samples.

Annual counts of gaspereau are available from the DFO index trapnet at Millbank (up to 1992) and from the index trapnets in the Southwest and Northwest branches for 1992 to 1995. A trapnet was also operated in the Southwest Miramichi at Millerton, about 10 km above the confluence of the two branches of the river, in 1995 and 1996. These data provide an indication of the relative abundance of gaspereau, timing of the run and proportion of total run available to the fishery. Sampling for length and species composition was conducted at the index trapnets in 1995 and 1996.

ASSESSMENT RESULTS

Miramichi River

Estimation of Stock Parameters

Alewife return to the Miramichi at least ten days before blueback herring. In 1994, the catches were exclusively alewife until June 3. By June 8, blueback herring made up 35% of the catch and by June 16, blueback herring made up about 60% of the catch. A similar pattern was observed in 1993;

100% alewife up to June 4 decreasing to 60% alewife by June 15. Blueback herring were first observed in the catches at Loggieville on June 1 in 1995 and 1996 (Fig. 2). The proportions alewife over the season were similar in the catches from Loggieville and Chatham but blueback showed up about two days later in the Newcastle fishery which is farthest upstream (Fig. 2). The daily proportions are also more variable in Newcastle and in 1996, the proportion alewife was higher than at the other two locations until the very end of the fishery, June 15 to 20.

In 1995 and 1996, the opening of the fishery was delayed to May 20 and extended to June 20. The expectation of this change was that more blueback would be harvested. Before 1990, the catch of gaspereau was composed of 24% to 71% alewife by number with a median proportion of 46% (Tables 4 and 5). Between 1990 and 1994, the proportion alewife in the total harvests varied minimally between 62% and 77%. In 1995, the proportion alewife dropped to 37% but rose to 53% in 1996, values more typical of the pre-1990 period. The higher catch of alewife relative to blueback herring in 1990 to 1994 was attributed to the delayed migration of gaspereau in those years and the closure of the fishery on June 15, soon after the start of the blueback migration.

First time spawners have generally dominated the harvests of alewife in the Miramichi fishery. The proportions of first time spawners in the harvests have varied between 0.37 and 0.87 with a median of 0.72 for 1982 to 1996 (Table 4; Fig. 3). The 1991 year-class was the most abundant cohort in both the 1995 and 1996 fisheries representing 65% and 45% of the total alewife harvests. In general, four year old fish are the dominant age group in the harvests (11 of 15 years) with three year olds as the second most dominant age group (3 of 15 years). In 1996, for the first time, five year old fish were the dominant age group (Table 4; Fig. 3).

First time spawners made up smaller proportions of the blueback herring harvests; varying between 0.17 and 0.71 with a median value of 0.48 during the 1982 to 1996 fisheries (Table 5; Fig. 4). During 1994 and 1995, it was estimated that 71% of the blueback herring harvests were first time spawners but the proportion declined to 48% in 1996 (Table 5). The 1991 year-class was the dominant cohort in the 1995 and 1996 fisheries representing 59% and 67% of the total harvests. Four year old blueback are generally expected to be the dominant age group in the harvests (8 of 15 years) but five year olds (4 of 15 years), six year olds (2 of 15 years) and even seven years olds have been the dominant age group since 1982 (Table 5).

Previous spawner/older gaspereau tend to return to the river before new recruits. This pattern has been consistent every year and is most noticeable in the change in lengths over the duration of the fishery. Gaspereau (species combined) lengths decreased progressively over time in the Miramichi (Fig. 5). Large fish (median fork length of 280 mm) were observed at the start of the fishery in 1991 and 1995 but in the other years, gaspereau at the start of the season were between 260 and 270 mm median length. Fork lengths by the close of the fishery between 1991 and 1996 were consistently about 250 mm (Fig. 5). By species, alewife and blueback herring lengths decreased progressively over the season (Fig. 6). In 1994 and 1995, blueback herring were generally smaller than alewife at the start and end of the seaons but blueback herring were of similar size in 1993 and 1996 (Fig. 6).

Abundance of gaspereau

Catch rates (kg per trapnet per day) from logbooks are used as an indication of the abundance of gaspereau in the Miramichi River. Catch rates in 1992 and 1993 were about twice the values from 1994

and in previous years. Catch rates in 1996 were the lowest observed since 1984 (Fig. 7). In 1996, there were no days when the average harvest was greater than 5000 kg per trapnet per day and in most days, harvests were less than 2500 kg per trapnet per day. Between 1987 and 1993, there were numerous days when catch rates exceeded 5000 kg per trapnet per day (Fig. 7).

Research indices of abundance

Catches of gaspereau at Millbank and at the trapnets in each branch of the Miramichi provide alternative indicators of abundance over time. Abundance of gaspereau in the Miramichi was high during 1976 to 1980, decreased and stayed relatively constant from 1981 to 1988 and declined again in 1989 to 1991 (Table 6). Counts for seven years from the Northwest index trapnet suggest that abundance was extremely variable over time but that gaspereau were very abundant in 1992 but much less abundant in 1987 and 1994. At the Southwest index trapnet, abundance was high in 1985, 1987 and 1995. The 1996 count of gaspereau at the Millerton trapnet (about 10 km upstream of the Enclosure trapnet) was less than half the 1995 count, a proportion which was similar to the harvest decline from the commercial fishery for those two years (Table 6).

Timing of the fishery

Catches in the fishery since 1990 have occurred later than what was considered normal in the 1980's with only 50% of the logbook catch recorded landed by June 12 in all three fishing areas (day 163; Fig. 8). The timing of the landings in 1993 to 1996 are among the latest; this would have been expected since the fishery closure dates were later in those three years (June 19 in 1993, June 18 in 1994, June 20 in 1995 and 1996). The delayed catches since 1990 occurred in all three areas, Loggieville, Chatham and Newcastle (Fig. 8).

Delayed migration of gaspereau was not as evident at the DFO Millbank trapnet, in terms of when 50% of the gaspereau were counted but the first part of the run was later in 1990 to 1992 and in 1985 than all other years. This is true whether looking at the entire run of gaspereau or only that portion of the run up to and including June 20 (Fig. 9). Catches at the DFO index trapnet in the Northwest Miramichi indicate that the gaspereau migrations of 1992 to 1995 were later than those of 1985 to 1987 by about ten days, similar to the logbook catch data for those years. Even the 1985 migration, a late year in the commercial fishery, is earlier than 1992 to 1995. The 1996 run was earlier than in 1995 (Fig. 9).

The fishery had access to variable proportions of the total gaspereau spawning migration. Only about 60% of the total gaspereau counted at Millbank were counted during the gaspereau fishing season and in some years, as little as 10% to as much as 50% of the gaspereau run was counted after the closure of the fishery (June 15 most years). In 1995, over half of the annual count of gaspereau occurred after June 20 when the fishery closed. In 1996, based on the counts at the upper trapnet in the Southwest Miramichi, the fishery had access to over 75% of the gaspereau migration (Fig. 9).

State of the Stock

Backward cohort summation provides a reconstruction of the runs of gaspereau to the Miramichi River for 1982 to 1994. Under the assumption of M = 0.4, the returns of alewife to the Miramichi River have been increasing from about 3 million fish in 1982 to about 8 million fish since 1991 (Fig. 10). Blueback herring abundance peaked in 1987 and 1988 at about 15 million fish but has declined to about

6 million fish since 1990. The spawning escapement has followed a similar trend to the returns but with alewife escapement declining to less than 2 million fish in 1993 and 1994 (Fig. 10). Blueback herring escapement has been about 3 million fish since 1990. Annual exploitation rates have fluctuated between 0.4 and 0.75 for alewife, 0.15 and 0.6 for blueback herring. In all years except 1985, the exploitation rates on alewife have been higher than on blueback herring.

The estimated exploitation rates in 1993 and 1994 exceeded the target exploitation rates for alewife under the assumption of a natural mortality rate of 0.4. Exploitation rates on blueback herring in 1993 equalled the target exploitation rate but exceeded the target rate in 1994. Both alewife and blueback herring exploitation rates for 1982 to 1994 are higher than those estimated from cohort analysis by LeBlanc et al. (MS1991) for the 1982 to 1990 fisheries.Previous assessments indicated that the fishing mortality on alewife was much higher than on blueback herring. This would be even more relevant since 1990 because of the delayed migrations. In the 1980's, alewife were harvested in large part in May while blueback herring were captured in June. There were generally fewer age-classes in the alewife spawning run compared to the blueback herring which would be indicative of higher exploitation on the alewife. Since 1994, however, there have been five age-classes in the blueback herring run, similar to alewife. The fishery also harvests a higher proportion of new recruit alewife relative to new recruit blueback herring.The proportion new recruit blueback in 1994 and 1995 was among the highest observed although lower than the proportion new recruits in the alewife catches (Tables 4 and 5).

In the 1995 gaspereau migration, the fishery harvested alewife and blueback herring disproportionately to the relative size of the runs. Alewife comprised 37% of the total harvests (by number) but for the entire gaspereau migration, alewife constituted but 15% of the total gaspereau in the river. The estimates for the total run are based on counts and samples at the Southwest Enclosure and Northwest Enclosure trapnets. Alewife were exploited in direct proportion to their abundance at size (fork length) but larger blueback herring were exploited more heavily than the smaller, younger aged fish (Fig. 11).

Richibucto, Tracadie and Pokemouche Rivers

The harvest of 304 t from the Richibucto River in 1995 were the lowest recorded in the 1981 to 1996 time series for this river (Table 2). The 1996 harvest of 469 t represented a 15% decline from the previous five-year mean harvest. Alewife have been the dominant component of the harvests, varying between 70% and 96% in the five years sampled (Fig. 12). There were generally only four age classes in the annual harvests and no alewife older than six years old have ever been sampled (Fig. 12). Three and four year old alewife are the dominant age groups in the harvests. Blueback herring, although less abundant in the catches, are represented by more age groups than alewife; seven and eight year old blueback have been sampled from this river. As in the Miramichi River, alewife and blueback herring catches are comprised mostly of new recruits.

The harvests of gaspereau from the Pokemouche and Tracadie rivers declined in 1995 and 1996. The 1996 harvests are the lowest observed since the early 1980's (Table 2). In both the Pokemouche and Tracadie rivers, greater than 90% of the harvest are alewife (Fig. 13). The harvests of alewife tend to be comprised of very high proportions new recruits (59% to 88%) (Fig. 13). Only three age-classes were present in the alewife catches from the Pokemouche and Tracadie rivers with the catches dominated by three or four year old fish. No alewife older than 6 years were sampled from these fisheries.

In these Gulf New Brunswick rivers, the age distribution in the catches, the absence of alewife older than 6 years old and the more abundant age groups in the blueback catches indicate that the status of the gaspereau stocks is similar to that of the Miramichi River; exploitation rates are presumed to be above target levels.

FUTURE PROSPECTS

For the Miramichi River fishery, the 1991 year-class appears to be strong but the 1992 year-class is weak. The incoming 1993 year-class appears to be average. The exploitation rates in 1995 and 1996 were not estimated but based on the catch rates from logbooks and counts of gaspereau at the Southwest Miramichi index trapnet, the abundance in 1996 was less than in the 1990's. Blueback herring are declining in abundance. The 1992 year-class appears weak (based on catches at three and four years old). Because both alewife and blueback herring in this fishery are harvested primarily at the recruit stage, there are no reliable indicators of incoming year-class strength.

For the other rivers, exploitation rates are presumed to be higher than in the Miramichi and the prospects are not expected to be any more positive than for the Miramichi.

MANAGEMENT CONSIDERATIONS

Exploitation rates estimated from backward cohort summation for the 1982 to 1994 Miramichi fisheries generally exceeded the target fishing levels. The freeze on licenses should be continued. Of the 34 trapnets licensed for the Miramichi River, 15 are located in the Northwest Branch of the river. The Southwest Miramichi gaspereau are exploited only when passing through the main Miramichi River. There is no evidence to indicate that the stocks of gaspereau are distinct in the two branches but gaspereau do show strong affinity to their natal river and this would be the appropriate assumption to make for the Miramichi. Some effort should be displaced from the Northwest Miramichi downriver where the mixed runs can be exploited or into the Southwest Miramichi to relieve some pressure from the Northwest run. The weekend closures in May should be maintained to reduce the exploitation rate on the alewife. If exploitation rates on blueback herring rise above recent years'levels, then weekend closures in June should be reconsidered.

RESEARCH RECOMMENDATIONS

Presently, no estimates of fishing mortality are available. Methods to assess trends in fishing mortality over time such as those dealing with abundance at length (Sinclair et al. 1993) should be considered.

There is no evidence of distinct runs between the Northwest and Southwest Miramichi. Species composition between the two branches has not been examined but indications from the index trapnets near the confluence of the two branches suggest there is little difference in species composition at that point in the river. Sampling from trapnets further upriver should be considered to address this question. Sampling at the DFO index trapnets should be conducted to more appropriately decompose the spawning

run into alewife and blueback herring. Sampling at these trapnets would provide a more complete description of the gaspereau spawning populations because the fishery closes part way through the run.

Logbooks provide useful data regarding timing and abundance over time. These should be distributed to more rivers. Fishers indicated that participation would improve if the only information requested was effort and catch of clupeids.

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		New B	runswick Stat	istical Districts	Southern Gulf					
Year	63-65	66-70	71-72	73-75	76	77-80	NB	NS	PEI	Total
1978	1	781	1434	200	566	102	3084	1911	104	5099
1979	33	413	3343	343	213	63	4409	2023	405	6837
1980	105	237	3767	219	237	111	4676	2167	253	7097
1981	320	128	1411	143	564	141	2708	1653	259	4620
1982	45	150	1278	193	314	14	1994	1664	133	3790
1983	9	226	1088	123	392	62	1901	780	36	2717
1984		205	666	197	507	143	1717	1052	88	2857
1985	5	465	1342	136	1427	193	3569	3203	238	7011
1986	-	294	1171	45	398	353	2261	974	464	3699
1987		620	2209	141	1152	297	4419	2559	364	7342
1988		481	1888	269	902	174	3714	2835	233	6782
1989	8	630	1682	432	803	127	3681	2116	132	5929
1990		376	1634	326	719	141	3196	1493	84	4773
1991		462	2028	239	588	267	3584	1070	87	4743
1992		539	2451	54	397	13	3454	772	318	4544
1993		521	1971	89	754	238	3573	951	198	4722
1994		521	1935	83	574	133	3246	465	95	3806
1995		343	2335	39	444	70	3230	188	34	3452
1996	0	119	1150	37	469	152	1927	170	53	2150
Mean (90-94)	0	484	2004	158	606	158	3411	950	156	4518
Mean (91-95)	0	477	2144	101	551	144	3418	689	146	4253
1995 - Mean/Mean		-29%	17%	-75%	-27%	-56%	-5%	-80%	-78%	-24%
1996 - Mean/Mean		-75%	-46%	-64%	-15%	6%	-44%	-75%	-64%	-49%

Table 1. Landings (tons) of gaspereau from Gulf Region, 1978 to 1996. Data summarized from purchase slip and supplementary 'B' slips collated by Statistics Branch, DFO. The year - mean / mean is the percent change for the year from the previous 5-year mean.

* 1985 landings for districts 71-72 as per Statistics Branch data are lower than the Science Branch for that year . no landings recorded; 0 means landings less than 0.5 t

Table 2. Landings (t) of gaspereau by river system based on Statistics Branch (P-slip), values obtained by "spring herring and gaspereat	u coordination
committee" (Coord.), and as cumulated from logbook reports (Logbook). Not all fishers completed logbooks in any given year.	

	Pokemouche		Tracadie		Miramichi			Richibouctou	
Year	P-Slip	Coord.	P-Slip	Coord.	P-Slip	Coord.	Logbook	P-Slip	Coord.
1981	43		47		1411		1323	564	
1982	74		29		1278		1108	314	
1983	35		72		1088		829	392	
1984	127		78		666		612	507	
1985	387		79		1857		1496	1427	
1986	273		21		1171		610	396	
1987	519		74		2209		1077	1149	
1988	393		85		1888		691	903	
1989	442		187		1682		1175	803	
1990	291		85	170	1789		1148	720	
1991	337		125	125	2028		1009	589	
1992	431	682	108	71	2451	1917	827	397	
1993	387	182	134	40	1971	1909	1799	754	1133
1994	376		145		1935	2553	1091	574	799
1995	233	227	110	115	2335	2788	552	304	174
1996	52	54	47	45	1150	1356	562	469	397
Mean									
1992-1996	296		109		1968	2105	966	499	
								· · · · · · · · · · · · · · · · · · ·	

			Log	gieville	C	hatham	Newcastle				
Year	Month	Day	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback			
1995	May	30	0	0	0	0	19	0			
		31	0	0	161	5	0	0			
	June	1	0	0	0	0	151	0			
		3	0	0	0	0	0	0			
		4	0	0	0	0	0	0			
		5	168	5	0	0	0	0			
		5	0	0	0	0	198				
		/	133	42	183	34	102	20			
		0		0	21	202	102	30			
		9		257		202	47	161			
		10	0	257	42	160	47				
		12			42	100	129	87			
		13	100		71		0	0			
		14	100		, ,		115	- 126			
		15	73	XAD	94	42	0	0			
		16		0	o	0	88	219			
		17	112	107	96	160	0	0			
		18	o	0	Ó	0	109	194			
		19	108	147	103	117	72	203			
		20	0	0	0	0	0	0			
		21	0	0	44	190	0	0			
1006	Mov	20		0		0	102	1			
1990	iviay	29		0		0	192	, l			
		31		0	0	0	122	0			
	June	1	217	2	0	0		ů o			
	ouno	5		0	0		203				
		6		o	ō	o	182	6			
		7	154	38	162	22	0	o			
		8	0	0	0	0	198	25			
		9	158	23		45	0	0			
		10	O	0	0	0	162	40			
		11		<i></i>	0	0	0	- 0			
		12	0	0	9	0	<u>/////////////////////////////////////</u>	107			
		13	33	194	59		0	0			
		14	0	0	0	0	104	<u> </u>			
		16	0	0	0	0	0	0			
		17	64	152	58	106	0	0			
		18	0	0	0	0	57	149			
		19	44	182	44	156		0			
		20	0	0	0	U O	60	192			
		21	66	224				216			
		22	<u> </u>			U	70[210			

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Table 3. Species composition and number of fish measured by sampling date and location of the Miramichi River, 1995 and 1996. Rectangles define samples combined for age-length keys. Shaded samples indicate key overlap.

				Numbers	of alewife (X	1000)										
ge.FSP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	
2.2 tal 2	0 0	3 3	0 0		•			1 1	3 3	•		•	•	•	7 7	
3.2 3.3 otal 3	477 477	3 648 651	1071 1071	768 768	2346 2346	644 644	635 635	214 214	3833 3833	2335 2335	538 538	1158 1158	657 657	16 16	983 983	
4.2 4.3 4.4 ptal 4	512 488 1000	234 782 1016	3 146 553 702	387 687 1074	286 299 586	1441 1409 2849	447 620 1067	372 777 1149	26 254 281	371 2242 2613	912 1014 1925	497 1646 2143	414 4614 5028	103 2689 2792	16 262 278	
5.2 5.3 5.4 5.5 otal 5	1 130 131	33 63 21 117	68 63 131	57 113 170	152 119 1 272	243 392 11 646	2 404 309 88 804	389 553 29 971	151 295 25 471	41 106 64 212	317 295 26 638	724 859 423 2005	213 60 94 368	192 738 388 1318	81 597 546 1224	
6.3 6.4 6.5 6.6	7 143	40 16	17 25 0		16	66 122 6	30 21 7	146 217 32	58 113 9	43 79 8	23 22	121 344 102 114	10 164 13 4	9 72 25	44 128 67 17	
otal 6	150	56	42	•	16	194	59	395	180	130	45	680	190	106	256	
7.3 7,4 7.5 7.6	4 43 8	16 6 5	•	•	•	25	3	1 2 4	16 26 12	14 6	8	•	44 8 90	2 26 10 1	1	
7.7 otal 7	54	28		•		25	3	6	55	21	14		6 149	39	5	
8.3 8.4 8.5	82 2	8 23 3		,				0 0	2 1		1		•	6	• • •	
otal 8	84	34					•	0	4	•	i		•	6		
9.3 9.4 9.5 otal 9	• • •	1 11 0 12	4 · : 4	: : :		• • •		.	•			78 78 78	•	•	•	
10.3 10.4 10.5 otal 10		0 0 0 1			•	•	•	•			•				•	
11.3 11.4 otel 11	1	6	•		•				•		•					
otal	1,897	1,924	1,950	2,012	3,219	4,358	2,568	2,735	4,825	5,311	3,162	6,064	6,392	4,277	2,753	
ominant ohort of Total	1978	1979.1	1981.1	1981.1	1983.1 73%	1983.1	1984.1	1985	1987 79%	1987 49%	1988 61%	1989	1990 79%	1991 65%	1991 44%	
FSP	51%	76%	83%	72%	82%	47%	52%	37%	85%	87%	50%	55%	84%	72%	66%	
of total gas	spereau harv	est (by numl	ber)													
lewite	47%	46%	71%	24%	62%	45%	33%	38%	63%	66%	62%	77%	62%	37%	53%	

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Table 4. Alewife catch-at-age (number of fish X 1000) from the Miramichi River fishery, 1982 to 1996. FSP = first time spawners.

Age.FSP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2.2		0			9									
Total 2	,	0	•	•	9	•						•		•
3.2 3.3 Totat 3	25 25	56 56	51 51	45 345 390	4 541 545	0 191 192	2 2	4	416 416	520 520	130 130	47 47	155 155	78 78
4.2	0	3	9	459	11		-							
4.3	0	56 986	46 317	651 2940	116	828 3185	300	2 611	398	35	307	124	90 1805	147
Total 4	411	1046	372	4050	345	4013	1664	613	398	1358	899	295	1895	4321
5.2 5,3	39 104	24	0 19	62 239	113	31	478	98	23	48	178	24		113
5.4	270 179	321 280	116	791 177	681 30	147 53	2503 405	1424 136	583 163	93 106	404	380 297	98 466	1564
Total 5	592	625	177	1269	824	231	3386	1658	769	247	582	700	564	2620
6.2 6.3	39 58	23	o	84	7	27		133	85	51	102			11
6.4	113	97	85	285	149	496	115	1850	789	286	77	233	625	114
6.6	44	114	•	•/	25	14	37	. 64		1		92 7	384	21
Total 6	254	244	90	416	182	537	152	2066	972	337	184	333	1084	237
7.2 7.3	39 245	•	6	6	i	:	15	:	ż	12	48	32		:
7.4	347 130	21 35	10 24	58 ∡7	15	173 32	91	40 7	219 44	212 13	67	61 60	273	79 26
7.6	7	13			•		:	,					13	
7,7 Total 7	767	69	40	111	16	205	106	47	269	237	115	53 206	287	105
8.2	-	3			<u>-</u>									
8.3 8.4	0 26	9 115	6 26	12	10		ż		15	46	7	83	•	7
8.5	19	34	6			43		0	•			43		
8.6 Total 8	45	161	39	12	15	43	7	o	15	46	7	126	•	7
9.3	0		4	54	1									
9.4	59	15	10	49	•	•	•	0	2	•		21	-	•
Total 9	79	15	16	124	1			o	2		•	21		
10.3	0	24	i		6			•		•	•			
10.5	1	6										61		•
Total 10	1	30	4	•	6			•	•	•	·	61	•	•
11.3 11.4													•	
Total 11		ŏ										•		
12.3 12.4				22							•	•		
Total 12			4	22		•	•		•					
Total	2,174	2,248	791	6,393	1,942	5,220	5,317	4,389	2,841	2,746	1,917	1,789	3,984	7,368
Dominant Cohort	1975	1979.1	1980.1	1981,1	1981.1	1983.1	1983.1	1983	1984	1987	1988	1988	1990	1991
(%)	35%	47%	47%	63%	42%	77%	84%	47%	34%	49%	47%	39%	48%	59%
% FSP	28%	59%	52%	54%	41%	66%	33%	17%	34%	71%	38% 	32%	70%	71%
≫ of total gas	pereau harv	est (by numb	(19K		0.007					a . a .	201	128	209/	8294

Table 5. Blueback herring catch-al-age (number of fish X 1000) from the Miramichi River fishery, 1982 to 1996. FSP = first time spawners. 0 indicates less than 500 fish; . indicates no fish caught.

	Estuary	Northwest	South	Southwest				
Year	Millbank	Enclosure	Enclosure	Millerton				
1976	87,839							
1977	183,624			_				
1978	132,761							
1979	112,567							
1980	75,801							
1981	44,071							
1982	35,376							
1983	53,763							
1984	39,332							
1985	65,550	79,118	100,800					
1986	40,536	78,795	94,134					
1987	39,799	29,445	100,305					
1988	50,684							
1989	17,920							
1990	19,868							
1991	23,995							
1992	39,679	136,448	74,746					
1993	•	65,237	39,627					
1994		38,353	66,106					
1995		73.872	125.057	151,325				
1996		,	- ,	72,177				

Table 6. Counts of gaspereau at index trapnets in the Miramichi estuary (Millbank), and in each of the branches for 1976 to 1996. Counts are for the entire migration period.



Figure 1. Statistical districts, rivers and place names referenced in the document.



Figure 2. Proportion alewife in the harvests from the three main fishing areas in the Miramichi River in 1995 and 1996.



Figure 3. Harvest number at age (X 1000) (hatched bars) and first time spawners at age (solid bars) of alewife in the commercial catch of the Miramichi River, 1982 to 1996.



Figure 4. Harvest number at age (X 1000) (hatched bars) and first time spawners at age (solid bars) of blueback herring in the commercial catch of the Miramichi River, 1982 to 1996.



Figure 5. Change in length distributions of gaspereau (species combined) over the season in the Miramichi River, 1991 to 1996. Box plots are interpreted as follows: vertical lines are the 5th to 95th percentile range, rectangles are the interquartile range and solid line and square symbol are median values.



Figure 6. Changes in the length distributions of alewife and blueback herring over the fishing season for 1993 to 1996. Box plots are interpreted as in Figure 5.



Figure 7. Daily catch per unit effort in the Miramichi River gaspereau fishery as derived from logbooks. Catch per effort units are in kg per trapnet per day.



Figure 8. Timing of the gaspereau catches of the Miramichi River by fishing area, 1982 to 1996. Solid line is the median date of landings, rectangles encompass interquartile range (25% to 75% of landings), vertical lines encompass the 5% to 95% range of landings.



Figure 9. Timing of the total counts (upper) and counts to June 20 (lower) of gaspereau at the Millbank trapnet, 1976 to 1992 and at the upriver index trapnets, 1985 to 1996. Box plots are interpreted as in Figure 8.

Millbank gaspereau count, whole year

82

ˈ<mark>84</mark> ˈ Year 86

88

90

92

18-Jul

08-Jul

28-Jun

Date Date

08-Jun

29-May

19-May

76

78







Figure 10. Estimated total returns, escapement and fishing mortality rate by species in the gaspereau fisheries of the Miramichi River, 1982 to 1994. All estimates based on an assumed natural mortality rate of M = 0.4.





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Figure 12. Proportion at age in the alewife and blueback herring catches from the Richibucto River gaspereau fisheries in 1989, 1990 and 1994 to 1996.



Figure 13. Proportion at age in the alewife catches from the Tracadie River and Pokemouche River gaspereau fisheries in 1989, 1990 and 1994.

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