DFO Atlantic Fisheries
Research Document 96/109

MPO Pêches de l'Atlantique
Document de recherche 96/109

Anadromous rainbow smelt (*Osmerus mordax* Mitchill) from the Gulf of St. Lawrence - update of fishery and preliminary status of stock

by

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ABSTRACT

Anadromous rainbow smelt (*Osmerus mordax*) is extensively fished commercially in Gulf New Brunswick, Gulf Nova Scotia and Prince Edward Island. The smelt fishery is a low capital investment, high return fishery which is localized in importance. The commercial fishery is regulated by season, gear, and license restrictions. The Gulf New Brunswick fishery is the largest, representing 76% of the total landings in the statistical districts of the Gulf of St. Lawrence. The maximum landing was recorded in 1932 at 3840 t and the long-term median landing is just over 2000 t annually. The fishery occurs in the fall (Oct. to Dec.) and winter (Jan. to March). The winter fishery is more important. The fishery is dependent upon two age-classes, age 2 and 3 years. Reduced abundance can not be directly inferred from the historical trend of decreased landings. Commercial fishers have indicated that the landings data are inaccurate and severely underestimate the harvests. Fishers attributed the poor fishery in the fall of 1994 to unusually warm water temperatures. Under current season restrictions, there is a substantial portion of the smelt stock which is not available to the fishery. It is unlikely that the present fishing levels in Miramichi Bay are over-exploiting the resource but the stocks in smaller bays may currently be exploited at substantially higher levels.

RÉSUMÉ

L'éperlan arc-en-ciel (*Osmerus mordax* Mitchill) a fait l'objet d'un exploitation commercial à travers les régions du Golfe Nouveau-Brunswick, Golfe Nouvelle-Écosse et l'Île du Prince-Edouard. Cette pêcherie nécessite un investissement capital minimal mais produit un rendement élevé d'une importance localisée. La pêche commerciale est réglementée par des restrictions de saisons, d'engin de pêche et de quantité de permis issus. La pêcherie du Golfe Nouveau-Brunswick est la plus importante et représente 76% des débarquements du sud du Golfe du Saint-Laurent. Le débarquement annuel maximum de 3 840 t a été enregistré en 1932 et la médiane des débarquements annuels depuis 1917 se situe à juste au-dessus de 2 000 t. La pêche se poursuit à l'automne (octobre à décembre) ainsi que durant l'hiver (janvier à mars) mais la pêcherie d'hiver est la plus importante. Les captures sont composés principalement de poissons âgés de deux et trois ans. On ne peut pas conclure que la tendance à la diminution des débarquements représente une diminution de l'abondance de l'espèce. Les pêcheurs ont indiqué que la base de données statistiques est incomplète et les débarquements sont sévèrement sous-estimés. Les pêcheurs étaient de l'opinion que des températures d'eaux supérieures à la normale ont contribué aux faibles débarquements enregistrée à l'automne 1994. Une grande proportion de la population d'éperlan n'est pas exploitée due à la présente réglementation qui limite la saison de pêche. Il est peux probable que le présent niveau de pêche dans la Baie de Miramichi sur-exploite la ressource mais les populations dans les estuaires de tailles inférieures à la Miramichi sont sans doute exploitées à des niveaux élevés.

INTRODUCTION

Anadromous rainbow smelt (*Osmerus mordax*), abundant throughout the Atlantic provinces and Quebec (Scott and Scott 1989), has been extensively fished commercially and recreationally throughout Gulf New Brunswick (Gulf NB) and Gulf Nova Scotia (Gulf NS) and Prince Edward Island (PEI) since the turn of the century (McKenzie 1964). Until the mid 1960's, the commercial fishery of Miramichi Bay was the largest smelt fishery in eastern Canada (Chaput 1995). The smelt population and the fishery of Miramichi Bay was studied and described in detail by McKenzie (1964) and the following points are particularly important:

- smelt spawn in the early spring in the low gradient tributaries of both branches and the main stem of the Miramichi,

- smelt leave the estuary and are found outside the bay in the summer and early fall,

- smelt do not migrate far from their natal streams and distinct populations may be found in individual bays (Fréchette et al. 1983),

- the fishery only exploited part of the stock because a large component of the population only moved into the inner bay after the fishery closed,

- there was a decreased fishing effort, -85% in the Miramichi Bay fishery between 1931 and 1963, and

- smelt are not long lived, maximum age recorded in the Miramichi samples was 7 years while the modal age in the fishery was 2 and 3 years.

Smelt are a comparatively small fish with modal fork lengths of about 13 to 15 cm in the spawning population (McKenzie 1964, Chaput 1995). In the Miramichi River, smelt have been estimated to make up the largest part of the anadromous fish spawning biomass (more than 50% and in the order of 10,000 t) and are the most abundant anadromous fish (100 to 300 million individuals) migrating into the river (Chaput 1995). Smelt larvae were the most abundant species in the Miramichi estuary in 1992 (Locke and Courtenay 1995).

The smelt fishery is a low capital investment, high return fishery which is localized in importance (McKenzie 1964, Chaput and LeBlanc 1991). Because of this, it has not attracted a large amount of research or assessment - for the most part, there have not been any requests from the industry to provide a stock assessment of this resource. With recent significant declines in the major groundfish stocks throughout eastern Canada, these coastal fisheries have the potential to become more heavily exploited.

The objectives of this document are:

1 - to present the landings of the smelt fishery from the Gulf of St. Lawrence, maritime provinces with emphasis on the Miramichi River and southeast Gulf New Brunswick districts,

2 - to present updated information on the size and age of smelt in the 1989 to 1991 fishery and compare it to the early 1960's data (McKenzie 1964), and

3 - to determine with industry the information and knowledge gaps which exist in the current databases and recommend how these problems can be remedied.

This document addresses in particular the smelt populations and fishery of Miramichi Bay and southeast New Brunswick (Fig. 1). Data from the Chaleur Bay smelt fishery and smelt populations are presented in d'Amours et al. (1994).

DESCRIPTION OF FISHERIES

Management:

The commercial smelt fisheries are regulated by season, gear and license restrictions. In Gulf New Brunswick, the commercial smelt fishery opens October 15 and closes at the end of February. Variation orders have been used to prolong the fishery into March. In recent years, when season extensions have not been granted, it was because of poor markets, and/or poor landings.

Effort is restricted by license. In Gulf NB, there were 859 smelt licenses issued in 1988, Gulf NS had 150 licenses and PEI had 419 licenses for fishing with boxnets, bagnets and gillnets (Cairns 1989, McKenzie 1964). Almost half of the licenses in Gulf NB are issued in districts 66 to 73 (Fig. 1), 25% are for the Miramichi Bay districts (70 to 73).

Landings

Landings, summarized from purchase slip data, for the statistical districts in Gulf NB, Gulf NS and PEI for 1917 to 1994 are summarized in Table 1. During 1989 to 1993, smelt landings from the Miramichi River districts (70-73) averaged 304 t with the highest catch since 1917 occurring in 1924 at 1624 t (Table 1).

The fishery occurs in the fall (open water) and winter (under the ice) and although these are recorded as having occurred in different calendar years, the winter and preceding fall fishery is the more appropriate aggregation of the data. The winter fishery contributes the largest share of the season's catch in the central and southeast New Brunswick districts but the fall fishery is a significant proportion (>25%) of the catch in the southeast New Brunswick districts (Fig. 2). In Miramichi Bay, the fall fishery was generally less than 10% of the catch before 1980 but since 1981, there have been large fluctuations and the fall fishery now contributes between 15 to 20% of the landings (Fig. 3).

The fall 1994 fishery in Gulf NB was poor; landings were 50% below the previous five-year average and 34% of the previous ten-year average (Table 2). A poor fishery in the fall of 1994 was attributed to unusually warm water temperatures although poor fall fisheries had occurred in the past as well (Appendix 1).

TARGET

A conservation target exploitation rate or spawning stock biomass has not been defined for smelt.

FISHERIES DATA

Samples from the commercial catches were obtained twice per month in the 1989 to 1991 fisheries. Selected fishermen kept samples of between 25 and 50 fish every 15 days in three main areas of the province: Northeast - Tracadie River, Central - Neguac and Loggieville area, and southeast - Richibucto and Shediac Bay. All fish were measured for fork length, and a subsample by length was sampled in detail for length, weight, sex, gonad weight, and scales were collected for ageing.

A catch-at-age was determined using age-length keys (one per area by fall and winter) and applied to the length frequency samples from the fishery. Length samples were not prorated by the

landings and the catch-at-age matrices were calculated as the proportion-at-age in each of the fisheries and seasons.

Logbooks were completed by a select group of volunteers in each of the three main areas during the 1989 to 1991 fisheries. Daily catches of smelt and the number and type of nets fished were recorded. The catch and effort data were used to calculate a catch per unit of effort (kg of smelt per net day of fishing) assuming that this CPUE index would be representative of the stock size and/or availability in each area and season.

RESEARCH DATA

Length and detail sample of post-spawning smelt were obtained at the Bartholomew River counting fence in May 1989. Incomplete counts of smelts passing downstream through the Bartholomew fence were obtained in 1988 and 1989. The counts are incomplete because the fence was installed in order to enumerate Atlantic salmon smolts and the spawning migration of smelt was occurring while the fence was being installed (R. Pickard, DFO, pers. comm.).

ASSESSMENT RESULTS

Age and size composition

In the Miramichi Bay (Loggieville and Neguac) samples, the fork length of smelt in the fishery increased from the fall to the winter in both 1989 to 1990 and 1990 to 1991 (Fig. 4). Only in the Tracadie River samples (district 68) did size decrease over the period of the fishery. The increased size of smelt in the Loggieville samples corresponded to higher catches of older smelt as the season evolved; in the fall of 1989, catches were mostly composed of 2 year old smelt, whereas in the winter of 1990, 2 and 3 year old smelt were abundant in the catch (Fig. 5). Females were significantly longer at age than males in both the fall and winter samples but size was similar between the two sampling seasons (Table 3). This was consistent for ages 2 to 5 years. These findings contrast with those of McKenzie (1964) who reported a noticeable decline in the size of the smelt during the course of the annual fishery, in part attributed to an increase in the proportion of younger fish but also from a decrease in the length and weight of fish within an age group.

In all the areas samples, age 2 and 3 year old smelt were dominant in the catches. The oldest smelt sampled were five years old (Fig. 5). Males were dominant in the younger age groups but sex ratios were more equilibrated or skewed towards females for the 4 and 5 year old smelt. This pattern was consistent in both the fall and winter samples.

	Age group (years)			
Season	2	3	4	5
Fall	43 (N=230)	40 (N=179)	50 (N=79)	44 (N=10)
Winter	36 (N=342)	43 (N=329)	58 (N=122)	91 (N=23)

Skewed ratios towards males were also reported by McKenzie (1964) in sampling from the Miramichi River fishery, with females being predominant (54%) in the age 5 years and older fish.

Composition of the spawning run

In the samples of downstream migrating smelt at Bartholomew River counting fence in May of 1989 (Fig. 6) males outnumbered females by 3 to 1. The female component was slightly older than the males with age 3 and 4 smelt being relatively more abundant in the female group than in the males.

	Age group (years)			
	2	3	4	5
% female	21 (N=134)	25 (N=178)	28 (N=69)	31 (N=13)

In samples of post-spawning smelt from the Black River counting fence (Kouchibouguac National Park, district 75), the modal length of smelt was 14 cm (1989 to 1992) and age 2 to 4 smelt were the most abundant (Delaney et al. 1993). Sex ratios of the spawning run of smelt were skewed towards males (66% to 78%) in 3 of the 4 years sampled.

The predominance of males in the samples of downstream moving, post-spawning smelt, probably results from the extended duration of males relative to females on the spawning grounds (McKenzie 1964).

Abundance indices of smelt

Catch rates of the commercial fisheries vary by month, season and area (Table 4). In the winter of 1991, the catch rates in the Miramichi were higher than in the other areas. Fall catch rates also tend to be higher in the Miramichi but were generally less than catch rates in the winter. For the Miramichi districts, the catch rates reported by the fishers in 1989 to 1991 (16.2 to 66.9 kg per net per day) are higher those reported by McKenzie for the 1951 to 1963 period (2.2 to 12.4 kg per net per day).

In 1988, the Bartholomew River counting fence was operational on May 5 and more than 260,000 smelts were counted through the downstream trap. In 1989, the fence was operational on May 20 and over 121,000 smelt were counted moving downstream. These counts are considered incomplete because smelt were observed moving downstream before the fence was operational in both years (Russell Pickard, DFO, pers. comm.). With more than 60 spawning brooks and streams in the Miramichi River (McKenzie 1964), we would expect the spawning stock of smelt to be in the order of 10's to 100's of million fish.

Status of the stock

Reduced abundance can not be directly inferred from the trend of decreased landings since 1917. There have been large declines in licensed effort in Miramichi Bay since the 1940's (McKenzie 1964). Indications from the catch rates during 1989 to 1991 would suggest that abundance is higher

now than in the 1950 to 1960's. But high catch rates do not imply high abundance, especially if effort over the time series also varies. The fishery has been in the past and is presently dependent on two age-classes, 2 and 3 year old smelt.

During 1946-1947, there were more than 2400 trapnet licenses and the exploitation rate on the entire Miramichi stock was less than 5% (McKenzie 1964). The low overall exploitation rate was a consequence of a large component which remained outside the bay and moved upstream towards the spawning grounds after the fishery closed. At that time, the total stock of smelt in the Miramichi was estimated at more than 375 million fish (McKenzie 1964). The exploitation rate on fish available to the fishery was as high as 74% within Miramichi Bay (McKenzie 1964).

It is unlikely that the present fishing levels (jut over 220 licenses in Miramichi Bay) are over-exploiting the overall resource: potential gear effort is about 10% of the effort during the first half of this century. Under current season restrictions, there is a substantial portion of the smelt stock which is not available to the fishery (McKenzie 1964) although the exploitation rate on smelt within the bay during the fishing season could conceivably also be very high. Commercial fishers feel that the fishing exploitation may be substantially higher in the smaller bays and rivers throughout the southern Gulf of St. Lawrence relative to that of Miramichi Bay.

ECOLOGICAL CONSIDERATIONS

During the science workshop in January 1995, the fishers were concerned about changes in accessibility and water quality of the spawning streams. McKenzie (1964) had indicated that remedial measures should be taken to alleviate natural and artificial obstructions to migration thereby increasing the spawning habitat and post-spawning survival of spawners.

FUTURE PROSPECTS

Forecasting future recruitment is difficult. McKenzie (1964) indicated that there was no apparent relationship between larval abundance and yield of the year-class since four of the five strong year-classes resulted from poor larval abundance estimates. Smelt have been frequently sampled during the annual (1988 to 1995) July juvenile groundfish survey in NAFO Division 4Tl (Shediac Valley, outside Miramichi Bay) (Mark Hanson, DFO Science, pers. comm.). The survey data could provide an indication of the age-classes, size and abundance of smelt which would be available to the fall and winter fisheries.

RESEARCH RECOMMENDATIONS

1 - The user groups expressed concern that the purchase slip landings data being used by DFO are inaccurate and severely underestimate the actual landings in all the statistical districts. There was also concern expressed that the district for which the landings are recorded are not necessarily the district where the smelt were caught. Although logbooks may provide an indication of the catch and effort of the participants, it was unlikely that all the fishers would complete these accurately. It was decided at the science workshop that a committee of fishers would meet monthly to collate the catches by all individuals in their area. These data should be a better indication of the true landings than the purchase slip and local sales estimates currently compiled by DFO. This was initiated in January 1995.

2 -The fishery should be sampled as was done in 1989 to 1991. Coverage should be extended to fishers fishing different locations within the same area because catches and sizes of smelt can vary spatially as well as temporally.

3 - The catch data from the 4Tl juvenile groundfish surveys conducted in July should be analyzed and compared to landings in the Miramichi Bay, southeast New Brunswick areas to determine if abundance of smelt in the survey can be used to predict landings (i.e. abundance).

Minutes from the peer review conducted in February 1995 are presented in the report edited by Science Branch (1995).

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Table 1. Annual (calendar year) landings of smelt (metric tons) from the statistical districts in Gulf New Brunswick, Gulf Nova Scotia and Prince Edward Island for 1917 to 1994. Data for 1917 to 1988 from LeBlanc and Chaput (1991). Data for 1989 to 1994 from Statistics Branch, Department of Fisheries and Oceans, Moncton. A period indicates no landings were registered.

	Statistical districts of NB Gulf															Gulf Nova Scotia	Gulf P.E.I.
Year	63	64	65	66	67	68	70	71	72	73	75	76	77	78	80 Total	Total	Total
1917	145	20	55	91	.	91	.	785	.	394	.	293	327	185	133 2519	106	291
1918	175	.	80	109	65	77	.	137	683	134	.	291	307	139	973 3170	158	293
1919	226	2	54	73	35	42	704	225	.	251	271	151	85	138	188 2444	224	390
1920	138	6	89	20	.	120	.	653	.	414	.	150	140	46	36 1813	94	495
1921	307	20	.	173	73	68	.	1102	.	466	.	261	234	104	10 2817	150	476
1922	335	36	174	91	.	106	.	1131	.	394	.	233	216	119	9 2844	141	429
1923	179	11	75	35	.	84	.	804	.	212	.	172	260	117	9 1955	126	444
1924	274	16	156	64	.	27	.	1062	.	564	.	217	314	174	26 2894	212	648
1925	183	8	113	35	.	32	.	787	.	438	.	205	220	63	19 2103	172	799
1926	427	24	109	48	.	74	.	895	.	443	.	185	213	189	77 2683	283	699
1927	393	17	96	56	.	17	.	645	.	332	.	173	239	.	122 2088	192	678
1928	237	16	179	82	25	47	708	485	.	400	22	158	258	48	35 2701	183	596
1929	244	40	182	175	210	25	80	280	.	440	32	104	169	27	40 2046	182	431
1930	103	58	38	102	170	26	.	576	.	274	1	115	154	.	118 1735	207	354
1931	286	20	42	130	119	30	471	282	.	324	.	128	183	.	114 2129	201	342
1932	1075	21	39	103	123	28	420	422	.	501	.	101	153	.	112 3097	274	469
1933	398	23	36	131	107	75	548	230	.	483	.	113	160	.	69 2372	214	418
1934	126	.	19	76	119	75	387	224	.	303	15	111	117	.	91 1664	163	374
1935	256	35	226	105	.	108	490	232	.	346	17	159	241	.	166 2383	131	455
1936	177	51	438	103	.	70	460	492	.	405	18	197	313	.	170 2893	157	538
1937	176	36	141	101	.	141	400	138	.	311	20	155	192	.	126 1937	178	404
1938	185	16	139	150	.	91	427	197	.	264	9	137	231	.	128 1976	140	436
1939	248	50	173	117	.	90	508	178	.	272	6	136	187	.	75 2041	168	441
1940	100	77	170	114	.	114	555	167	.	446	9	218	363	.	151 2484	207	482
1941	248	23	90	66	.	82	363	302	.	354	2	183	315	.	102 2128	160	392
1942	177	49	181	108	.	77	368	325	.	324	5	190	356	.	190 2350	121	254
1943	120	18	63	63	.	77	195	128	.	253	9	182	257	.	229 1595	223	327
1944	170	121	123	112	.	78	336	133	.	255	4	199	237	.	207 1974	265	488
1945	95	26	139	141	.	85	360	146	.	246	7	159	198	.	175 1777	202	535
1946	159	23	113	83	.	75	190	113	.	146	7	141	132	.	124 1307	148	560
1947	123	23	105	64	26	82	218	97	.	195	19	121	182	141	. 1394	167	486
1948	178	40	115	67	54	96	433	371	.	290	55	150	219	67	65 2200	131	531
1949	202	41	155	78	35	72	449	128	.	233	41	94	215	53	49 1845	155	450
1950	132	20	150	119	47	65	302	77	.	168	58	138	246	116	123 1758	290	517
1951	199	25	116	64	43	43	269	327	.	353	37	91	196	60	72 1894	175	386
1952	101	9	66	40	49	36	215	85	.	98	35	79	129	49	40 1031	107	282
1953	115	9	114	77	58	87	432	110	.	218	27	93	194	72	100 1706	149	404
1954	62	14	85	75	62	40	226	156	.	188	22	69	123	78	81 1281	113	329
1955	77	24	156	104	32	89	275	383	.	280	62	89	154	76	58 1859	89	303
1956	55	17	124	90	39	45	247	141	.	144	24	79	105	44	76 1230	129	442
1957	21	16	87	74	35	36	94	68	.	48	11	50	39	27	45 650	108	222
1958	48	25	100	59	71	42	203	92	.	119	30	112	109	36	63 1110	119	368
1959	38	14	55	37	30	28	119	51	1	99	20	95	60	40	55 741	177	327
1960	30	11	37	51	52	60	121	68	1	83	36	60	56	30	61 758	135	291
1961	9	20	43	27	36	26	65	36	.	43	10	105	51	32	50 552	69	134
1962	20	10	58	80	33	33	94	37	2	54	22	108	92	76	36 755	74	130
1963	64	23	43	37	33	21	168	50	9	65	41	119	104	138	18 931	47	155
1964	94	10	49	80	74	50	211	86	2	116	40	167	98	66	28 1171	88	222
1965	119	16	81	61	70	88	193	106	2	141	60	211	97	52	55 1350	78	210
1966	148	15	56	60	67	49	186	120	3	108	28	178	81	35	61 1194	86	287
1967	57	23	27	31	40	40	192	75	4	109	37	130	81	75	48 971	61	198
1968	27	6	41	46	47	43	178	39	1	114	34	102	104	64	25 870	194	216
1969	42	64	75	50	47	36	249	122	0	96	27	162	117	105	24 1215	156	283
1970	74	12	82	27	40	38	145	112	.	105	47	83	145	64	53 1026	296	224
1971	27	9	67	8	21	33	152	61	.	55	33	61	74	57	17 674	111	227
1972	40	6	29	9	71	27	95	16	.	35	35	90	90	41	21 605	102	325
1973	98	6	37	25	23	27	120	33	.	42	18	39	69	29	25 592	83	372
1974	83	9	28	22	7	47	162	75	.	60	26	51	88	75	29 761	105	335
1975	27	23	15	30	85	60	139	42	.	141	13	77	109	61	23 843	104	460
1976	32	9	12	23	83	88	306	52	.	117	22	115	162	158	21 1200	71	569
1977	34	13	1	16	98	123	426	71	.	122	10	39	100	104	20 1175	60	456
1978	36	2	28	13	105	145	186	105	.	137	30	43	109	186	15 1138	46	401
1979	72	7	50	4	27	177	186	124	.	137	19	106	201	233	66 1409	85	559
1980	102	18	24	23	51	198	229	194	.	152	10	123	303	31	90 1548	28	413
1981	36	9	5	19	77	181	332	327	.	135	33	31	181	88	21 1475	57	324
1982	41	11	3	14	10	165	293	413	.	221	45	134	565	6	13 1934	28	299
1983	.	6	2	26	28	107	90	85	.	82	22	85	101	12	6 653	8	262
1984	.	7	13	29	19	127	71	85	.	79	19	126	68	8	21 673	23	244
1985	2	3	13	23	17	62	79	102	.	80	33	156	40	9	16 635	20	118
1986	.	9	14	39	49	96	134	220	.	28	25	277	623	12	18 1543	34	704
1987	.	9	75	37	38	66	94	160	.	26	35	331	610	4	18 1502	25	150
1988	2	6	82	37	25	40	113	127	.	96	46	269	386	6	14 1247	67	219
1989	12	5	31	32	76	24	220	130	.	137	35	282	103	6	10 1100	34	104
1990	13	2	29	40	37	60	199	94	.	82	11	155	72	6	10 810	34	85
1991	54	10	60	33	23	16	135	70	.	128	13	199	61	5	7 812	54	158
1992	20	13	55	81	32	41	85	43	.	29	8	208	87	4	7 713	60	194
1993	10	8	59	91	63	10	100	41	.	27	8	215	87	3	7 728	49	180
1994	51	19	28	77	30	23	150	15	.	99	21	253	105	17	11 899	61	254

Table 2. Landings (tons) of smelt as recorded by Statistics Branch of the Department of Fisheries and Oceans, Moncton.

		Districts 63 to 68			Districts 70 to 73			Districts 75 to 80			Gulf New Brunswick		
Fall	Winter	Fall	Winter	Total	Fall	Winter	Total	Fall	Winter	Total	Fall	Winter	Total
1967	1968	.	96	.	.	300	.	.	110	.	.	506	.
1968	1969	94	219	313	32	458	490	210	252	462	337	929	1265
1969	1970	65	164	229	9	339	348	179	207	386	253	710	963
1970	1971	88	120	208	21	245	266	183	164	347	292	529	821
1971	1972	36	124	160	22	116	138	75	170	245	133	410	543
1972	1973	43	172	214	31	190	222	106	100	205	180	462	641
1973	1974	33	171	204	4	283	287	81	167	248	118	621	739
1974	1975	21	175	196	10	307	317	100	145	244	130	627	757
1975	1976	56	197	253	15	453	468	128	373	501	199	1023	1222
1976	1977	49	208	257	21	595	616	104	131	235	174	934	1107
1977	1978	72	219	290	23	406	429	140	128	268	235	752	986
1978	1979	88	223	311	22	406	428	252	198	450	362	827	1188
1979	1980	96	296	392	42	539	580	416	382	798	553	1217	1770
1980	1981	103	259	362	36	741	777	172	121	293	310	1121	1432
1981	1982	51	192	243	53	874	927	233	581	814	337	1647	1984
1982	1983	48	113	161	53	196	250	181	102	283	283	411	694
1983	1984	52	157	209	59	214	273	125	195	320	236	566	802
1984	1985	37	49	86	21	197	217	44	126	170	102	372	474
1985	1986	71	111	182	64	312	376	124	229	353	259	651	911
1986	1987	96	166	262	70	258	327	691	440	1132	857	864	1721
1987	1988	52	98	150	21	262	283	556	469	1026	629	830	1459
1988	1989	89	92	181	73	669	743	251	306	557	413	1068	1481
1989	1990	82	75	157	21	352	373	128	196	324	232	623	854
1990	1991	102	140	243	21	287	308	122	194	316	245	622	867
1991	1992	54	132	186	43	143	186	88	216	304	185	491	677
1992	1993	109	150	259	15	136	151	129	182	311	252	469	721
1993	1994	90	130	240	32	217	248	137	232	369	259	578	858
1994	1995	98	.	.	47	.	.	174	.	.	319	.	.
Averages													
89-93	.	88	118	217	26	317	253	121	219	325	235	654	795
84-93	.	78	117	195	38	283	321	227	256	486	343	655	1002

Table 3. Analysis of season and sex effects by age (years) on fork length (mm) of smelt sampled from the commercial catches in October 1989 to March 1991 from the Miramichi Bay area. Fall represents the October to December samples, Winter represents the January to March samples. C.V. is the coefficient of variation, N is the sample size. P-values for the season effect, sex effect and the interaction between sex and season.

		Male				Female			Season
Age	Season	Mean	C.V.	N		Mean	C.V.	N	
2	Fall	148	9%	100		141	9%	130	P>0.50
	Winter	145	8%	120		143	9%	214	
	Sex / Interaction				P<0.001				P>0.05
3	Fall	178	7%	72		171	6%	107	P>0.30
	Winter	177	7%	139		170	6%	188	
	Sex / Interaction				P<0.001				P>0.80
4	Fall	200	6%	39		190	6%	39	P>0.60
	Winter	198	5%	71		189	7%	51	
	Sex / Interaction				P<0.001				P>0.60
5	Fall	227	4%	4		211	3%	5	P>0.30
	Winter	223	6%	20		206	3%	2	
	Sex / Interaction				P<0.01				P>0.30

Table 4. Catch per effort in the smelt fisheries of northeast, central and southeast New Brunswick estimated from logbook reports, 1989 to 1991.

MEAN CATCH PER EFFORT (KGS PER box NET PER DAY) BY AREA AND MONTH, NEW BRUNSWICK SMELT LOGBOOK RETURNS 1989-1991.

AREA NORTHEAST (District 68)

	YY					
	89		90		91	
	N	MEAN	N	MEAN	N	MEAN
Month						
1	.	.	63	15.3	65	12.3
2	.	.	56	20.5	55	8.0
3	.	.	8	15.9	13	15.5
11	3	64.2	.	.	.	.
12	47	14.9	8	13.6	.	.

AREA CENTRAL (Districts 70 to 73)

	YY					
	89		90		91	
	N	MEAN	N	MEAN	N	MEAN
Month						
1	.	.	80	11.0	53	16.2
2	.	.	72	16.5	59	25.1
3	.	.	10	37.5	17	66.9
10	53	30.4	30	17.0	.	.
11	76	40.3	49	19.6	.	.
12	54	21.4	21	32.9	.	.

AREA SOUTHEAST (Districts 75-80)

	YY					
	89		90		91	
	N	MEAN	N	MEAN	N	MEAN
Month						
1	.	.	43	21.0	29	12.6
2	.	.	23	24.2	19	4.7
3	.	.	3	15.9	3	4.5
10	19	16.1	25	11.0	.	.
11	40	11.7	21	9.5	.	.
12	32	18.9	1	18.2	.	.

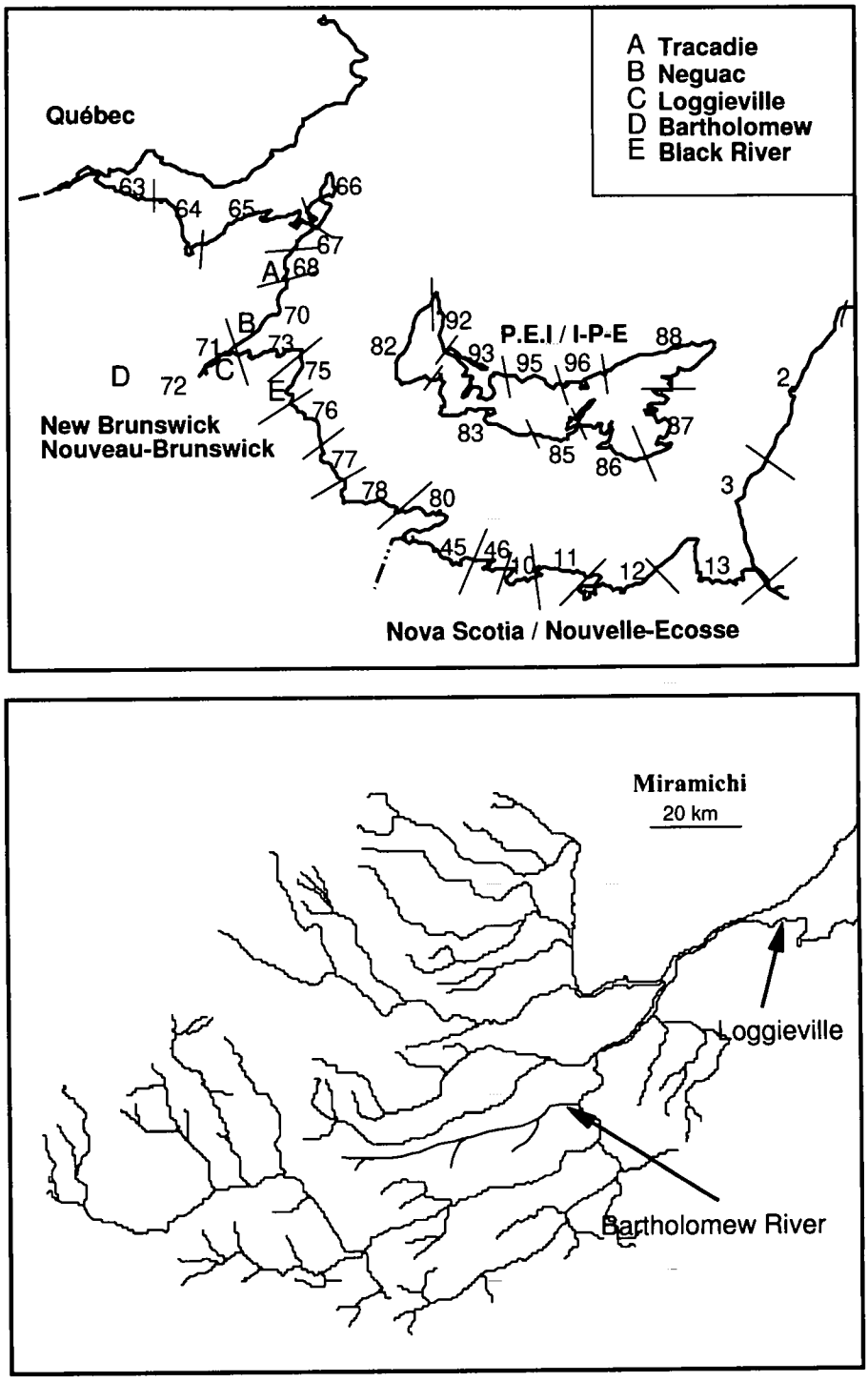


Figure 1. Statistical districts and locations referred to in text.

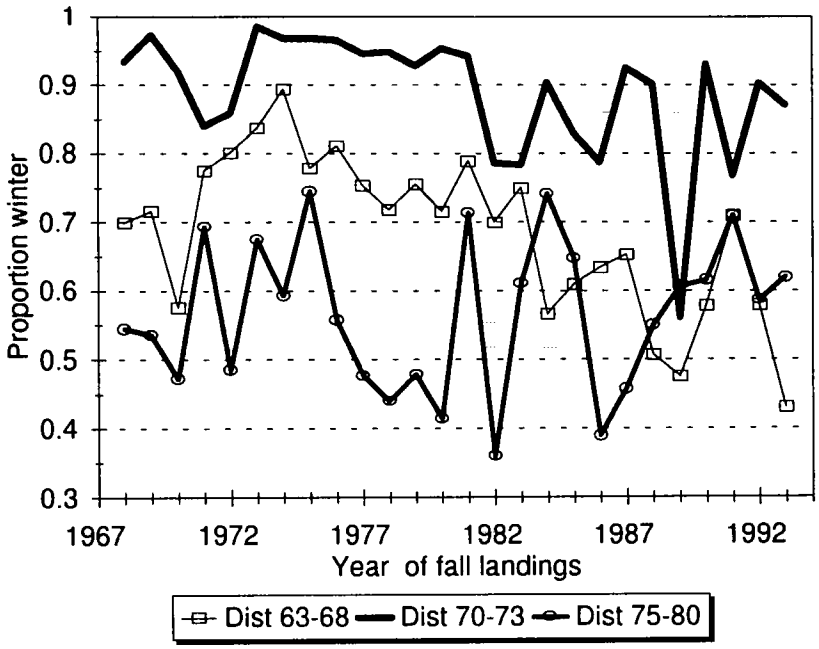


Figure 2. Proportion of the total fall (year i) and winter (year i+1) catch that was reported lan during the winter fishery (January to March), within Gulf New Brunswick.

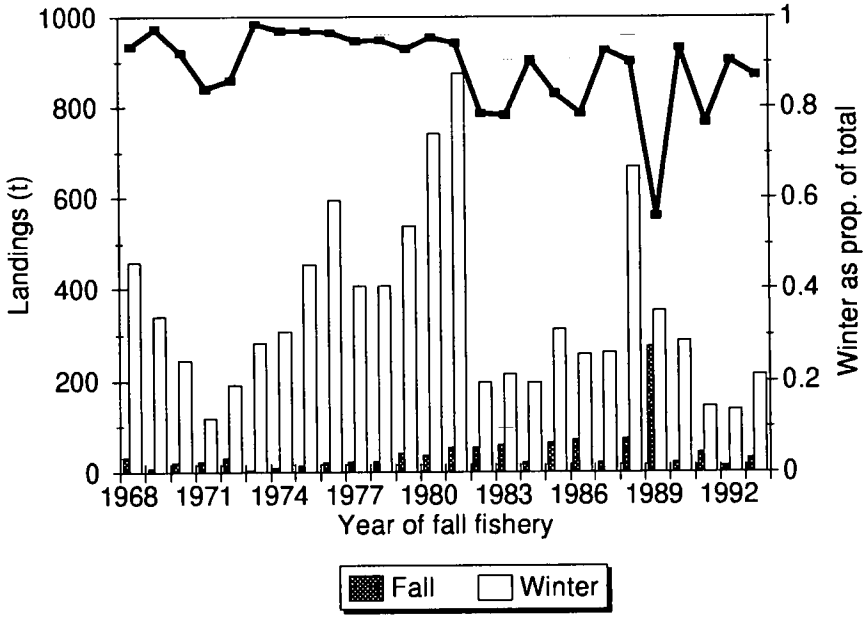
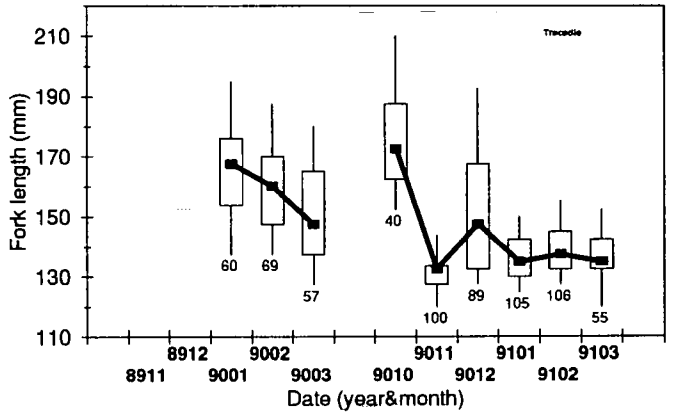
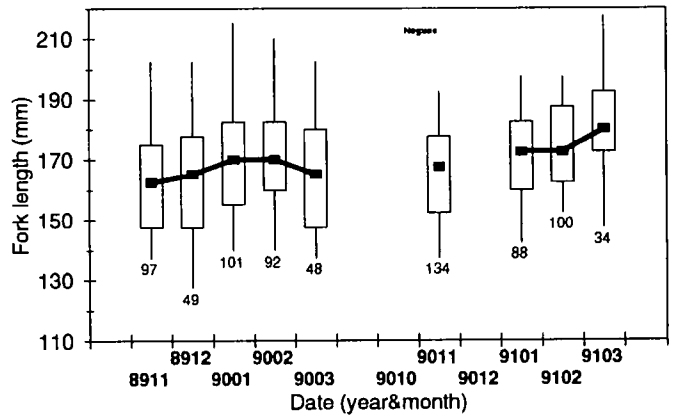


Figure 3. Landings by season (fall year i, winter year i+1) and the proportion of the total landings reported from the winter season (January to March) in the Miramichi Bay smelt fish 1968 to 1993.





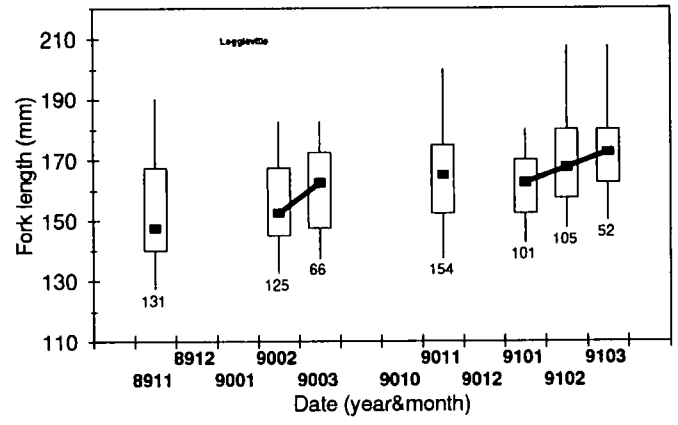
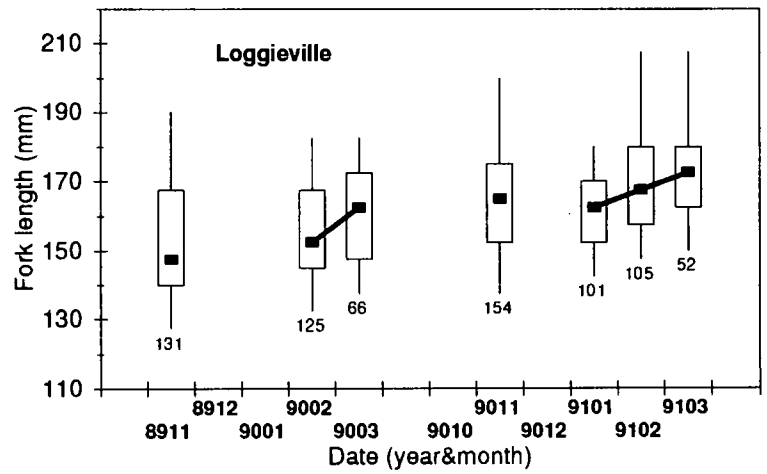


Figure 4. Smelt fork length distributions by month and year sampled from three fishery locations in Gulf New Brunswick, 1989 to 1991. Vertical line represents the 5th to 95th percentile range, the rectangles are the interquartile range, and the solid lines join the median values. The sample size is indicated under each individual plot.



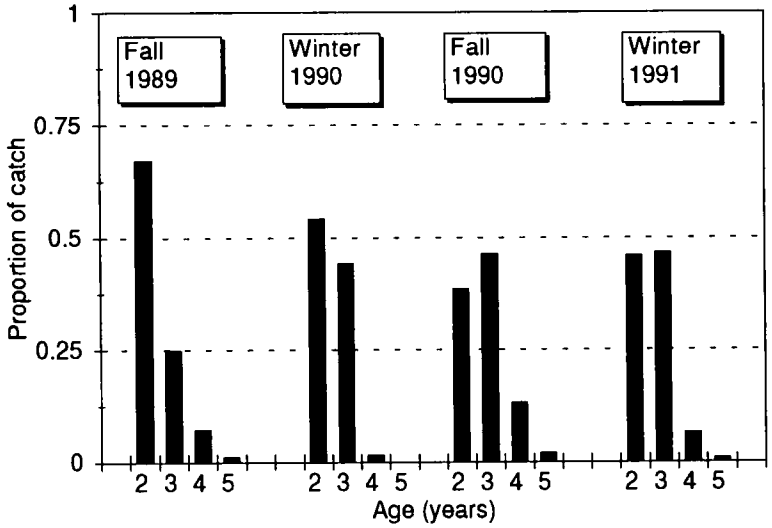


Figure 5. Length distribution and proportion at age of smelt sampled from the Loggieville fishery, 1989 to 1991. Box plots are interpreted as in Figure 4.

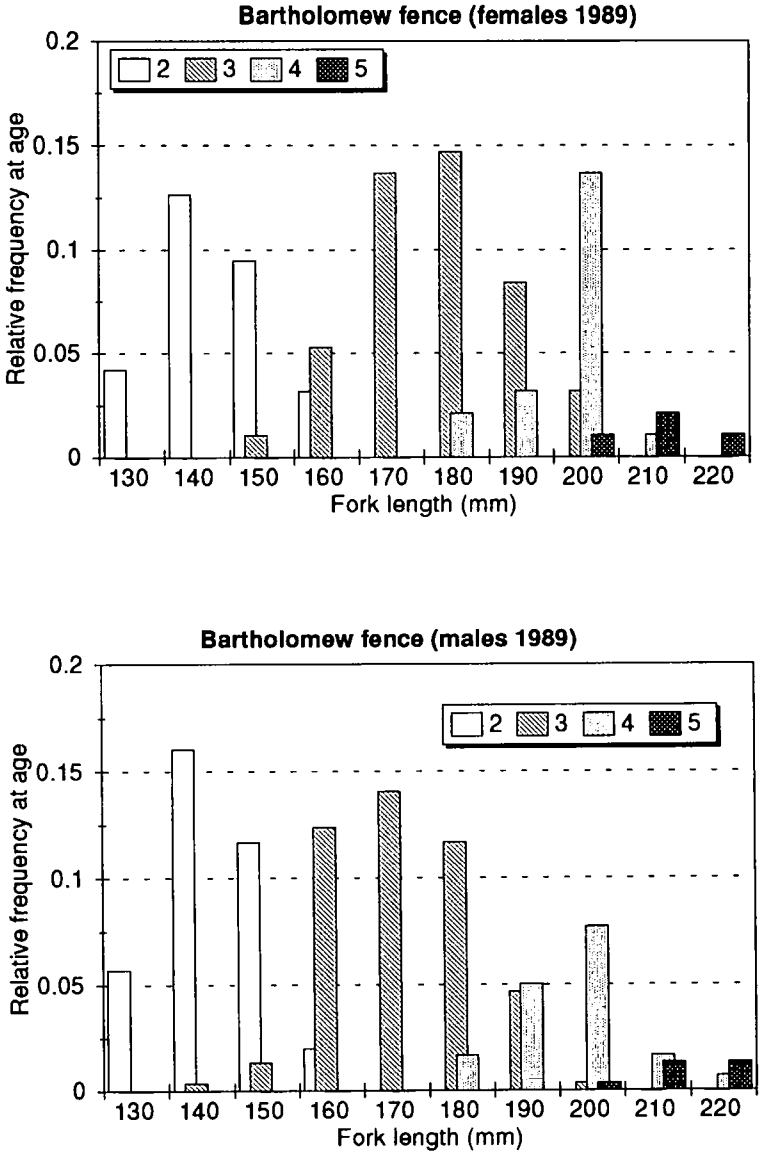


Figure 6. Size distribution by age of male and female smelt sampled from the downstream migrants at the Bartholomew River counting fence in May 1989.

APPENDIX 1. STOCK STATUS WORKSHOP NOTES

Minutes of the science workshop on smelt of central and southeast New Brunswick, January 17, 1995.

1. Landings:

- Purchase Slips do not accurately reflect catch. Fish are often landed in one area and sold in another and sales are often not recorded on the day the catch occurs.
- Discussion on how to collect accurate catch statistics focused on the pros and cons of logbooks and other methods. It was decided that each assessment area would set up a committee of three participants in the fishery to collect and report on statistics once a month. Initially the reporting would be done at a meeting but once the system was in place it could be done by teleconference. Initial contact persons are Miramichi: Ken Clark and Alvin Scott, Richibucto: Jean-Guy Maillet, and Buctouche: Omer Duplessis.
- Logbooks could also be kept by interested individuals, but contact with the individuals should be done in person and on a one on one basis and not by mail or over the phone.

2. Fishery Data:

- In the winter fishery square box nets are used, in the fall fishery a mixture of bag nets and square box nets are used.
- It is important to collect samples, this could best be done by phoning individuals and asking them to keep part of their catch for samples.

3. Abundance:

- Exploitation rate may be lower than indicated by landings because many smelt move into the systems after the fishery is closed.
- It was decided that the major stock areas for abundance assessments from Miramichi south would be the Miramichi, Pt. Sapin to Richibucto, and Buctouche to the Border. Within these areas there could be subareas for sampling and gathering statistics. For example, the Miramichi would have four subareas, North Shore, Chatham, Loggieville, Neguac, and Baie Ste. Anne.
- Miramichi: North Shore Bay - fall fishery catches were down to lowest point but 90% of the fish were of large size. Water temperatures were high this fall and catches are not usually good when temperatures are high. Loggieville - Water temperature was too high in the fall, winter was stable but for the winter fishery catches in Chatham and Loggieville do not reflect abundance. Chatham - fall fishery was low. Baie Ste. Anne - winter was lowest since 1967.
- Richibucto: Dec. to mid. January there were few smelts and they were of a small size.
- Buctouche: catches are increasing and the size of the fish are increasing.
- Low catches in 1994 were the result of poor weather conditions and not low abundance. Fishing is poor right now because of bad ice conditions.

5. Multispecies Interactions

- Seals are increasing in all areas and often damage gear.
- It is difficult to release flounder in the winter and the reason for this measure needs further explanation.

6. Environment

- Cleaning the brooks to make smelt passage easier is needed in some areas.

- Pollution effects need to be considered and someone from MREAC or the Dept. of Environment, or Habitat Research should be invited to the workshop to address these issues next year.

7. Other Considerations

- The workshop should be held as soon as possible after the fishery is over. The first week in April would be suitable.

8: Participants:

Terry Comeau	Trapnetter
Sterling King	Trapnetter
Brian Kelly	Trapnetter
Daryl G. Trevors	Trapnetter
Allison Robichaud	Trapnetter
Alvin Scott	Trapnetter
Jean-Louis Gallant	Richibuctou - Co-op
Jean-Guy Maillet	Trapnetter
Michel McIntyre	Trapnetter
Edmund Drysdale	U.P.M.
Normand Allain	Trapnetter
Gaetan Landry	M.P.A.
Florence Albert	M.P.O. - Tracadie-Sheila
Bernard L. Dubee	N.B.D.N.R.E - Newcastle
Omer Duplessis	Trapnetter
Gérald Poirier	Trapnetter
Marc Gallant	Trapnetter
Ross Claytor	D.F.O. - Science
Gérald Chaput	D.F.O. - Science