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Salmonid returns to Southwest Brook (Paradise River) and Muddy Bay Brook, Labrador in 2002-2004

Retours de salmonidés dans le ruisseau Southwest (rivière Paradise) et dans le ruisseau Muddy Bay, au Labrador, de 2002 à 2004

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Abstract

In collaboration with the Eagle River Development Association, fish counting projects were operated from 2002-2004 on Southwest Brook (Paradise River) and Muddy Bay Brook, Labrador. The numbers, and types, of salmonids entering Southwest and Muddy Bay brooks were enumerated using a trap installed in a portable fish counting fence. Southwest Brook has Atlantic salmon, trout and suckers present. Over the period of 2002 to 2004 the total returns to Southwest Brook ranged from 158-615 small salmon, 16-54 large salmon, 186-280 trout, and 5-34 suckers. Muddy Bay Brook has Atlantic salmon, Arctic Charr, trout and suckers present. Over the period of 2002 to 2004 the total returns to Muddy Bay Brook ranged from 106-454 small salmon, 11-31 large salmon, 2,966–3,591 small charr, 1,061-3,912 large charr, 33-196 trout, and 0-2 suckers. Biological data were collected from randomly sampled fish when conditions were suitable. Furthermore, environmental data such as weather, air and water temperature, and relative water level were collected at each site daily.

Résumé

En collaboration avec l'Eagle River Development Association, des projets de dénombrement des poissons ont été entrepris entre 2002 et 2004 dans le ruisseau Southwest (rivière Paradise) et dans le ruisseau Muddy Bay, au Labrador. Le nombre et le genre de salmonidés qui entrent dans les ruisseaux Southwest et Muddy Bay ont été déterminés au moyen d'un piège à poisson aménagé dans une barrière de dénombrement portable. Dans le ruisseau Southwest, on trouve des saumons atlantiques, des truites et des meuniers. De 2002 à 2004, le nombre total de retours dans le ruisseau Southwest a varié entre 158 et 615 petits saumons, 16 et 54 gros saumons, 186 et 280 truites, ainsi que 5 et 34 meuniers. Dans le ruisseau Muddy Bay, il y a des saumons atlantiques, des ombles chevaliers, des truites et des meuniers. Entre 2002 et 2004, les retours totalisaient entre 106 et 454 petits saumons, 11 et 31 gros saumons, 2 966 et 3 591 petits ombles, 1 061 et 3 912 gros ombles, 33 et 196 truites et 0 et 2 meuniers. Des données biologiques ont été consignées à l'aide d'échantillons de poissons prélevés au hasard quand les conditions étaient favorables. De plus, des données environnementales, telles que les conditions météorologiques, la température de l'air et de l'eau et le niveau d'eau relatif ont été recueillies quotidiennement, à chaque endroit.

INTRODUCTION

Labrador forms the northeastern edge of the North American continent and, covering an area of 293,000 km^2, comprises 3% of Canada's total land mass. The linear distance from the Quebec border at Blanc Sablon to the northern most point at Cape Chidley is 1,125 km (Fig. 1). Labrador contains vast areas of freshwater found in the many streams, rivers and lakes dotting the landscape. In spite of its size and importance from a natural resource perspective, little is known about the fish species, their abundance and distribution in Labrador.

Paradise River flows northeasterly, entering Sandwich Bay approximately 20 km southeast of the community of Cartwright. Paradise River has a drainage area of 5,778 km^2; the total length of the main stem and tributaries is 3,373 km with a basin relief of 485 m (Anderson 1985). The headwaters, located about 130 km from the river mouth on the Labrador Plateau, consist of a maze of small ponds and bogs (Murphy 1971). Mature stands of black spruce and balsam fir line the banks of the river (Anderson 1985). Murphy (1971) reported two partial barriers to fish migration on two tributaries but none on the main stem. In 1998, an assessment project was initiated on Paradise River and repeated again in 1999 (Reddin et al. 2000). Fish species reported for Paradise River include Atlantic salmon as well as resident and migratory brook trout, white suckers, eels, and sticklebacks (Anderson 1985). Before the construction of the Trans Labrador Highway, Paradise River was not a scheduled river and thus there are no angling catch statistics available for it; although, local residents reported very little angling activity on the river. However, in expectation of increasing interest due to the opening of the Trans Labrador Highway in 2003, this river is now a scheduled salmon river. In 1971, Murphy (1971) surveyed the rivers in Sandwich Bay and reported that 56,425 parr-rearing units (100 m^2) are available on Paradise River. Murphy (1971) reported that it is potentially capable of producing about 17,000 adult Atlantic salmon. The salmon produced by Paradise River contributed to the local commercial fishery in Sandwich Bay as well as in other parts of the province and possibly west Greenland (Pratt et al. 1974). Southwest Brook is a tributary of Paradise River. The Southwest Brook counting fence is located approximately 75 meters downstream of the Trans Labrador Highway.

Muddy Bay Brook, also known as Dykes River, flows northeasterly, entering Sandwich Bay about 8 km south of Cartwright. Muddy Bay Brook, with drainage area of 344 km^2 is fed by 11 tributaries and the entire system is dotted with small ponds and lakes. The lower sections of the river meander through flat bog land dotted with clumps of spruce trees onto a muddy tidal flat at its mouth. Although there is an increase in gradient beginning at a point 6 km from the mouth, there is only one complete barrier to fish migration located on Rat Pond Brook, a couple of kilometers from its confluence with the main stem of the river. Peet (1971) reported that the upper river flows through a hilly, well-wooded area and that sections of excellent spawning gravel are located 10 km from the mouth. The upper reaches of the main stem consist of an 18 km-long string of lakes that are dominated by Muddy Bay Pond that borders on the Northwest Tributary of Sand Hill River. The common indigenous fish species reported in Muddy Bay Brook by Peet (1971) are Atlantic salmon, brook trout, and Arctic charr. Peet also reported that the river probably supports a good run of fish, most probably sea-run brook trout and Arctic charr, with a smaller run of Atlantic salmon.

The main focus of this project, conducted in collaboration with Eagle River Development

Association, was to inventory the populations of salmonids in two southern Labrador rivers in the presence of aboriginal fisheries for food, social and ceremonial (FSC) purposes and angling. A long-term goal is to monitor changes that are anticipated for this area due to the construction of the Trans Labrador Highway.

DESCRIPTION OF FISHERIES

In the past, there have been several fisheries exploiting the Atlantic salmon of Paradise River, viz. anglers in the river, and also commercial fishers in the estuary, Sandwich Bay area, other parts of Labrador, the northeast coast of the island of Newfoundland and west Greenland. In response to the Supreme Court of Canada's decision interpreting Section 35 of the Constitution Act of 1982, the Department of Fisheries and Oceans provided resource access to Aboriginal groups for food, social and ceremonial purposes (FSC). Since 2000, fisheries for food, social, and ceremonial purposes were established for residents and members of aboriginal groups in the Sandwich Bay area. Some salmon are also caught as a bycatch in non-salmon gear, although it is mandatory to release them, any associated mortalities are unknown.

In the angling fishery, in 1992 and 1993, a quota on the number of fish that could be retained was introduced in each SFA. The quota was assigned for an entire SFA and was not administered on an individual river basis. Only hook-and-release fishing was permitted after the quota was caught. In 1994, quotas for the angling fishery were eliminated. In place of quotas, for Labrador, the season bag limit for retained salmon was lowered from eight to six fish, only two of which could be large salmon. In 1995 and 1996, the season bag limit for the angling fishery remained at six fish but only one large salmon could be retained. In 1999-2001, the angling fishery was restricted to a seasonal limit of four salmon retained, one of which could be large, and four salmon could be hooked-and-released daily. Beginning in 2002, the recreational salmon fishery for all Labrador rivers opened on 15 June and closed on 15 September. Anglers could retain four salmon for the season; other scheduled salmon rivers in southern Labrador were given a Class III designation, with a seasonal retention limit of two small salmon and no large salmon. The lower retention limit for some rivers in southern Labrador was implemented as a precautionary measure to prevent increased fishing mortality expected as a result of increased accessibility via the Trans Labrador Highway. Rivers without direct access from the highway remained at a seasonal limit of four salmon.

In 1992, several major changes were introduced to the management of Atlantic salmon in Newfoundland and Labrador. A five-year moratorium was placed on commercial salmon fishing in the island portion of the province, for the Labrador commercial fishery the quotas first introduced in 1990 were reduced, and a voluntary retirement of commercial salmon licences was instituted for all of the province. In 1998, the commercial fishery in Labrador was closed and fishermen were offered a buyout which most accepted. The west Greenland commercial salmon fishery closed for the 1993 and 1994 fishing seasons but was opened again in 1995-98. In 1999, there was a local use salmon fishery at Greenland and the commercial fishery closed. Commercial fishing was instituted again in 2000-2001 and it was again closed in 2002-2003. Some Paradise River multi-sea-winter salmon may be caught in the Greenland fishery similar to other Labrador stocks (Pratt et al. 1974).

METHODS

COUNTING FENCE

A counting fence was utilised to assess the numbers of upstream migrating salmonids entering Southwest and Muddy Bay brooks. The counting fence on Southwest Brook (a tributary of Paradise River) was located approximately 0.5 km upstream from its confluence with Paradise River and has been operated for five years, viz. 1998-99, 2001-2004. The counting fence at Muddy Bay Brook was located approximately 1.7 km from its confluence with the sea and has been in operation since 2002. The same sites were used for all years; although, the installation and removal times were different. Both counting fences consisted of 3 meter-long sections which were installed according to the description in Anderson and McDonald (1978). The fence was constructed of conduit and channel iron, supported by steel posts and 5 cm x 15 cm wooden supports similar to other portable counting fences used in Newfoundland and Labrador. The fence was operated with every conduit in place so that smaller sea trout and Arctic charr could be included in the total returns. The counting fence on Southwest Brook was operated from 22 June to 28 September, 2002; 17 June to 8 September, 2003, except for the period of 9-13 July when it was out of operation due to a high water event; and 26 June to 7 September, 2004. The counting fence on Muddy Bay Brook was operated from 22 June to 25 September, 2002; 21 June to 8 September, 2003, except for the period of 9-13 July and 27 August to 1 September when it was out of operation due to high water events; and 25 June to 6 September, 2004.

In 2002, both fences were installed in time to count the entire run. In 2003, due to funding restrictions, the counting fence at Muddy Bay Brook was installed too late to count the entire run. The 2003 count was adjusted using distributional data from total returns at Southwest Brook and Sand Hill River so that the 2003 count, as best as possible, reflects the entire run into the river in that year. Prior to the installation in 2003, salmon returns at Muddy Bay Brook were adjusted proportionately to returns in the same period at Southwest Brook. The returns for the two periods when the fence was out of operation due to high water were corrected by the proportional distribution of fish at Sand Hill River for 3 days prior to and 3 days after the fence was out of operation. In 2004, similar to 2002, both fences were installed in time to count the entire run and high water events were not experienced; therefore, there was no need for adjustments in those years.

Once the counting fence was completely installed and operational, enumeration began by manually counting and then releasing the fish to the upstream side of the trap. Distinction between large and small salmon and charr was made by comparison to a known measure placed on the bottom of the fish trap. Large salmon were defined as those with a fork length equal to or greater then 63 cm and small salmon were those less than 63 cm. For Arctic charr, large charr were defined as those with a fork length equal to or greater then 40 cm and small charr were those less than 40 cm. All other fish species encountered in the trap were also enumerated.

BIOLOGICAL CHARACTERISTICS

Biological characteristics of randomly sampled Atlantic salmon were recorded at the Southwest Brook counting fence and samples of Atlantic salmon and Arctic charr were recorded at the Muddy Bay Brook counting fences. Fork lengths were measured and scale samples were taken from salmon to determine the river and sea-age.

ENVIRONMENTAL DATA

During field operations, environmental data were collected at both fence sites. Data collected included water temperature, relative water level, air temperatrure, percent cloud cover, and a weather comment. Water temperatures were also recorded throughout the summer using thermographs that were placed near the fence sites. The thermographs are set to record temperatures every hour. Water levels were determined by placing a meter stick in the same fixed position in the river each year. Air temperatures were also recorded daily from an air thermograph that was placed inside the trap.

RESULTS

COUNTING FENCE

Tables 1a and 1b provide the daily count of fish migrating upstream through the Southwest Brook and Muddy Bay Brook counting fences in 2002. At Southwest Brook, there were 235 small and 34 large salmon that passed through the fence. Other fish counted were 248 brook trout, and 29 suckers. At Muddy Bay Brook, there were 106 small and 11 large salmon, 3,591 small and 1,061 large charr, 196 brook trout and 2 suckers.

Tables 2a and 2b provide the daily count of fish migrating upstream through the Southwest Brook and Muddy Bay Brook counting fences in 2003. At Southwest Brook, there were 158 small salmon and 16 large salmon that passed through the fence. These returns include an adjustment of 6 small salmon for 9-13 July when the fence was out of operation due to high water. All adjustments are highlighted in the tables as bold and italics. Other fish counted were 280 brook trout which was adjusted by 10 fish. At Muddy Bay Brook, there were 394 small salmon and 31 large salmon counted including adjustments of 45 small and 4 large salmon for 21-29 June, 9-13 July, and 27 August – 1 September, prior to fence installation and when the fence was out of operation due to high water. Other fish counted were 99 brook trout adjusted by 9 fish, 2,966 small and 1,345 large charr which were also adjusted for high water events by 58 and 66 fish, respectively.

Tables 3a and 3b provide the daily count of fish migrating upstream through the Southwest Brook and Muddy Bay Brook counting fences in 2004. Returns for Southwest Brook, were 615 small and 54 large salmon, 185 brook trout, 1 sea trout and 34 suckers. At Muddy Bay Brook, 454 small and 28 large salmon, 3,263 small and 3,912 large charr and 33 brook trout were counted.

Comparison of salmon returns at Southwest Brook in 1998-99 and 2001-2004 are shown in Figure 2. The returns of small salmon declined substantially from 1999 to 2003 (no count in 2000). Between 2002 - 2003 returns of small salmon declined by 33%. Returns of large salmon also declined from 1999 to 2003 but increased slightly from 2001 to 2002. Large salmon declined by 53% from 2002 to 2003. In 2004, however, returns for both small and large salmon increased over all years, with returns of small salmon to Southwest Brook from 2003 to 2004 increasing by 389%, and large salmon by 338%. The year 1999 had the highest returns prior to 2004. In 2004, there was an increase of 186% for small salmon and 126% for large salmon over returns in 1999. In 2004, both small salmon and large salmon returns increased over the mean for 1998 - 2003 (excluding 2000 – no count taken). Small salmon returns increased by 266% over the mean and the large salmon returns increased by 209% over the mean.

Comparison of salmon returns at Muddy Bay Brook which has three years of data, 2002-2004, are shown in Figure 3. Returns of small salmon increased substantially from 106 in 2002 to 394 in 2003, increasing by 372%. In 2004 there was another increase of small salmon from 394 to 454, an increase of 115% over 2003 returns. Large salmon increased from 11 in 2002 to 31 in 2003 (282%). In 2004 there was a decrease of 10% in the number of large salmon from 2003. However, compared to 2002, the number of large salmon increased by 255% in 2004.

Muddy Bay Brook also has a substantial charr population. Returns of small charr declined from 3,591 fish returning in 2002 to 2,966 in 2003, a decline of 17% (Fig. 4). In 2004, the number of small charr increased 10 % over 2003 from 2,966 to 3,262. However, small charr returns in 2004 were not greater than the 2002 count. On the other hand, returns of large charr increased from 1,061 in 2002 to 1,345 in 2003, an increase of 27%. In 2004 there was another increase in the number of large charr over 2002 and 2003 returns. The number of large charr increased from 1,345 in 2003 to 3,912 in 2004 an increase of 191%.

During counting fence operations, a number of other observations were made on angling activity and presence of potential predators of salmonids. Three species of seals(ranger, grey, and bearded) were observed frequently in the main stem of Paradise River and were sometimes seen as far upstream as the trap in the counting fence. No seals were observed at Muddy Bay Brook. Bears were observed at both brooks on a couple of occasions feeding on fish. Other potential predators such as otters, eagles and fish hawks were also frequently noted.

BIOLOGICAL CHARACTERISTICS

The biological characteristics of randomly sampled small and large salmon from Southwest Brook and small and large salmon and charr from Muddy Bay Brook for the summers of 2002 to 2004 are provided in Table 4, 5a and 5b, respectively. The biological characteristics for salmon include fork length (cm), river age (%), and sea-age (%). The biological characteristics for charr

include the fork length (cm).

The mean fork length of the small salmon for Southwest Brook ranged between 55 cm and 56 cm with standard deviations of between 2.71 to 3.61. The mean fork length of the large salmon ranged between 68 cm and 72 cm with the standard deviation ranging between 4.62 to 6.47. The minimum fork length over the three years was 43 cm and the maximum was 81cm.

Of the fish sampled for river age in 2002, the majority of the small fish (n=65) were river age 4 (43%) and 5 (48%) and the majority of the large fish were river age 4 (80%). In 2003 of the small (n=49) and large (n=10) fish sampled the majority of small salmon (39%) and large salmon (50%) were river age 5. Furthermore, of the small fish sampled there were fish from river age 3 (2%) to river age 7 (6%). In 2004, the majority of the small fish sampled were river age 4 (n=89, 55%) and large fish sampled were river age 5 (n=3, 67%).

In 2002, most of the small fish (n=74) were sea-age 1 (97%) with the remaining being previous spawners (3%). The large fish (n=8) were sea-age 1 (25%), sea-age 2 (38 %) and also previous spawners (38%). In 2003, again most of the small (n=64) fish were of sea-age 1 (97%) with the remaining being previous spawners (3%). The majority of the large fish were sea-age 2 (62%) followed by 23% previous spawners and 15% of sea-age 1 fish. In 2004, of the 94 small salmon sampled all were sea-age 1. The majority of the large salmon were sea-age 2 (67%) the remaining fish sampled were sea-age 1 (33%) with no previous spawners.

The mean fork length of the small salmon for all years for Muddy Bay Brook was 55 cm with the standard deviations ranging between 2.74 and 3.10. The mean fork length of the large salmon ranged between 70 cm and 76 cm with the standard deviation ranging between 0.55 and 6.68. The minimum fork length over the three years was 45 cm and the maximum was 84 cm.

Of the fish sampled in 2002, the majority of the small fish (n=68) were river age 5 (50%); however, fish sampled were from river ages 3 to 6. The majority of large fish (n=3) were river age 4 (67%) followed by river age 5 (33%). In 2003, the majority of the small fish sampled were of river age 4, 5, and 6; however, some fish sampled were of river age 3 (3%) and river age 7 (1%). The large fish sampled (n=4) were all river age 4. In 2004, the majority of the small fish were river age 4 and 5 with an overall range from river age 2 - 7. The majority of the large fish (n=11) were river age 3 (45%) with an overall from river age 3 - 6.

In 2002, all of the small fish (n=78) were sea-age 1 and the majority of the large fish (67%) were previous spawners, while all other fish were sea-age 2. In 2003, a majority of the small fish (99%) and large fish (80%) were sea-age 1 with all other fish being sea-age 2. In 2004, again all of the small fish (n=131)were of sea-age 1, whereas, the large fish (n=13) were of sea-ages 1 and 2.

The mean fork length of the small charr for all years was between 33 cm and 35 cm with standard deviations ranging between 2.90 cm and 3.53 cm. The mean fork length of large charr ranged between 43 cm and 47 cm with the standard deviation ranging between 3.46 cm and 5.98 cm. The minimum fork length over the three years was 26 cm and the maximum was 64 cm.

ENVIRONMENTAL CONDITIONS

The environmental data for Southwest Brook for the years 2002, 2003 and 2004 are provided in Table 6 and Figure 7a, 8a, and 9a, respectively. The lowest daily mean water temperature at Southwest Brook over the three year period was 9.5°C which occurred in 2003 and the highest was 21.3°C in 2002. The mean of the mean daily water temperatures for the three year period was 15.9°C. The mean daily morning and evening relative water level showed the greatest increase in 2002 with a difference between the minimum and maximum being 558 mm. In 2002 there was a high water event which occurred in September of 2002. The lowest daily mean air temperature at Southwest Brook (5.7°C) over the three year period occurred in 2004 and the highest (23.3°C) in 2002. The mean of the mean daily air temperatures for the three year period was 14.4°C.

Table 7 and Figures 7b, 8b, and 9b provide the environmental data for Muddy Bay Brook for the years 2002, 2003 and 2004, respectively. The lowest (5.4°C) and the highest (21.6°C) daily mean water temperature at Muddy Bay Brook over the three year period occurred in 2002. The mean for the three year period was 15.8°C. The mean daily morning and evening relative water levels showed the greatest increase in 2002 with a difference between the minimum and maximum of 1130 mm. In 2002, there was a high water event which occurred in September. Over the three year period, the lowest (2.9°C) and highest (23.6°C) daily mean air temperature was experienced at Southwest Brook in 2002. The mean of the mean daily air temperatures for the three year period was 13.5°C.

DISCUSSION

In 2002-2004, total returns at the trap at Southwest Brook were 269, 174 and 669 salmon plus trout and suckers. In 2002-2004, total returns at the trap at Muddy Bay Brook were117 salmon and 4,652 charr, 425 salmon and 4,311 charr, and 482 salmon and 7,175 charr plus some trout annually. Since these returns include estimates for high water events and angling where known, these data are the total returns to the river and are considered to be complete. For Southwest Brook, comparable return information is also available for 1998-1999 and 2001-2002 and as such the time series indicated that returns were declining to Southwest Brook up to 2004 when they increased substantially over average total returns of 231 small salmon and 26 large salmon, 1998-2002. Returns of salmon to Muddy Bay Brook have increased annually since 2002. Returns to both Southwest and Muddy Bay brooks are the highest in the time series of both rivers. Returns of Arctic charr to Muddy Bay Brook indicate that the harvestable component, viz. the large charr, has increased annually from 1,061 in 2002 to 3,911 in 2004. Also, the numbers of small or juvenile charr have remained steady over the three years averaging 3,273 per year.

Anderson (1985) considers that Southwest Brook is capable of producing circa. 1,128 salmon annually and Muddy Bay Brook 916 by prorating from drainage area as no survey information is available for Muddy Bay Brook (Reddin et al. 2004). If about 1,000 salmon are appropriate values for production capabilities of both rivers, then average returns of 326 for Southwest and 341 for Muddy Bay brooks in 2002-2004 are well below. The much higher returns of 669 and 482 salmon recorded in 2004 remain less then half of full production values. However, it should be kept in mind that total returns of salmon to Southwest and Muddy Bay brooks are not equivalent to

total production, as some salmon produced at these rivers would have been taken in the food fishery in Sandwich Bay. In recent years, as a result of the closure of the commercial fishery, a higher proportion of the total population would be found in freshwater which should be of benefit to the spawning population and ultimately future returns. Food fishery landings are available from logbooks from both Resident fishers in 2002-2003 and Resident and Métis Nation fishers in 2004 (Reddin et al. 2004). Total landings from both fisheries in Sandwich Bay are shown in the text table that follows:

	Salmon		**Charr**		**Trout**	
	Numbers	**Weight, kg**	**Numbers**	**Weight, kg**	**Numbers**	**Weight, kg**
2002	788	1,734	3,029	2,842	3,251	2,430
2003	806	1,751	1,646	1,801	2,447	1,684
2004	1,297	3,417	2,038	2,241	2,225	1,850

The highest landings of salmon occurred in 2004 and of charr and trout in 2002. Without the information from the counting fences, it would have been tempting to attribute the lower landings of charr in 2003-2004 to landings in the food fishery but in fact 2004 was the best year of the three years for which data are available at Muddy Bay Brook. Main river for charr production in Sandwich Bay is Muddy Bay Brook whereas salmon and trout come from at least six rivers in the bay. Also, because the town of Cartwright is very close to Muddy Bay Brook, the majority of the food fishery takes place near to as well as in this bay.

For most rivers in Eastern Canada, the returns when converted to egg deposition can be put into a conservation perspective (CSAS 2005). For Southwest and Muddy Bay brooks, conservation requirements in terms of habitat area are not yet available but are being developed as projects progress in Labrador. Some consideration should be given to verifying and if necessary refining for Labrador rivers, the applicability of the standard conservation requirement for Eastern Canada of 240 eggs per 100 m2 of parr-rearing habitat. This standard conservation requirement was derived from salmon rivers in the southern range of their distribution (Chaput 1997) and there is concern for its relevance for rivers in Labrador. Possibly, lower conservation requirements for Labrador rivers compared to the rivers from which the standard conservation requirements were developed could arise from the underlying geology, climate and the presence of other salmonids, i.e. sea trout and charr that are absent to the south. On the other hand, Labrador rivers due to their isolation remain relatively pristine and unpolluted compared to some more southerly rivers. Fish stocks and in particular salmonids, which require clean and relatively cool water, should benefit from this isolation. It is recommended that the total returns be repeated in 2005 along with research directed at measuring the available habitat and furthering the collection of information on species distribution.

In the absence of suitable conservation requirements, an alternate means by which comparisons of salmon abundance can be made is to scale numbers of salmon and other salmonids returning to the river relative to the watershed drainage area. Thus, for Southwest and Muddy Bay brooks comparisons of the numbers of returning salmon versus those of other rivers in Labrador where total returns are also known are relevant. In doing this for 2002-2004 values, Southwest Brook has a range of values from 0.45-1.74 salmon per km^2, while Muddy Bay Brook has from 0.55-2.26

salmon per km^2. These values compared to 0.65-1.77 for English River and 3.21-4.08 for Sand Hill River. Sand Hill River, also in southern Labrador, was assessed from 1994 to 1996 during the commercial fishery and had a range of values 2.52-3.23 salmon per km^2. In contrast, two rivers on the northern peninsula of Newfoundland, viz. Torrent River and Western Arm Brook have corresponding conservation requirements in the range of 1.1 to 2.0 salmon per km^2 of drainage. Actual returns for these rivers are above conservation requirements, ranging from 7 to 10 salmon per km^2. These comparisons suggest that returns of salmon to Southwest and Muddy Bay brooks are low relative to Sand Hill River and other rivers on the Island of Newfoundland.

Muddy Bay Brook is not unusual for a Labrador river in that it has substantial stocks of sea trout and Arctic charr as well as salmon. In terms of total salmonids, including sea trout and charr, the number of fish per unit drainage area for Muddy Bay Brook increases to 22-36 fish per km^2, 2002-2004 while Southwest Brook which has no charr but does have trout increases to 1.16-2.22. Fraser River measured in the 1970s had 2.3 while Ikarut River and Reid Brook, all rivers in northern Labrador, had values of 5.9 and 5.1 per km^2, respectively (B. Dempson, pers. comm.). Comparison of these values to Muddy Bay and Southwest brooks in 2002-2004 suggests that overall returns were satisfactory in 2004; although lower in 2002-2003. In addition to fishing mortality, there are a number of potential causes of low returns some of which are unique to Labrador rivers. One such possibility is predation by seals. Ranger seals (Phoca vitulina), grey seals (Halichoerus grypus) and harp seals (Phoca groenlandica) occur in Sandwich Bay and in the estuaries of Muddy Bay and Southwest brooks. It may be that predation by seals and other sources of natural mortality in addition to exploitation are keeping the salmon populations lower then what they potentially could be.

In conclusion, this paper summarizes the available information on the salmonid populations in Southwest Brook (Paradise River) and Muddy Bay Brook, Labrador. Returns of salmonids to rivers in southern Labrador should continue to be monitored for conservation purposes, and furthermore as a comparison of salmonid populations before and after the construction of the Trans Labrador Highway. Analysis of future returns of all salmonids in relation to the ongoing food fisheries in Labrador are also very important.

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Table 1a. Daily returns of upstream migrating Atlantic Salmon, Trout & Suckers at Southwest Brook, 2002

Date	Number of Fish			
	Atlantic salmon			
	Large	Small	Trout	Sucker
22-Jun	1	0	0	0
23-Jun	0	0	2	2
24-Jun	0	0	0	5
25-Jun	0	0	0	3
26-Jun	0	0	1	1
27-Jun	0	0	0	4
28-Jun	1	1	0	0
29-Jun	0	0	0	1
30-Jun	0	0	0	2
1-Jul	0	0	0	1
2-Jul	0	0	0	0
3-Jul	1	1	0	2
4-Jul	2	0	0	1
5-Jul	0	9	0	0
6-Jul	0	10	0	0
7-Jul	0	1	0	0
8-Jul	0	6	0	0
9-Jul	0	9	0	0
10-Jul	1	30	0	1
11-Jul	1	10	0	0
12-Jul	1	4	0	0
13-Jul	0	2	0	0
14-Jul	1	10	0	0
15-Jul	0	7	0	0
16-Jul	0	9	0	1
17-Jul	2	4	1	0
18-Jul	1	6	0	0
19-Jul	3	23	0	0
20-Jul	0	0	1	0
21-Jul	1	1	0	1
22-Jul	0	0	1	0
23-Jul	3	7	2	0
24-Jul	2	8	7	0
25-Jul	0	6	8	0
26-Jul	1	19	3	0
27-Jul	0	0	0	0
28-Jul	0	0	0	0
29-Jul	2	3	3	0
30-Jul	0	0	0	0
31-Jul	0	0	0	0
1-Aug	1	0	1	0
2-Aug	0	0	15	0
3-Aug	0	1	4	0
4-Aug	0	1	8	0
5-Aug	0	5	1	0
6-Aug	0	2	6	0
7-Aug	0	0	18	0

Table 1a cont'd (Southwest Brook 2002)

Date	Number of Fish			
	Atlantic salmon			
	Large	Small	Trout	Sucker
8-Aug	0	5	14	0
9-Aug	0	8	13	0
10-Aug	0	1	5	0
11-Aug	0	0	2	0
12-Aug	1	3	13	0
13-Aug	0	4	15	0
14-Aug	0	0	8	0
15-Aug	0	8	9	0
16-Aug	2	1	17	0
17-Aug	0	1	1	0
18-Aug	0	1	1	0
19-Aug	1	0	6	0
20-Aug	0	0	0	0
21-Aug	1	2	3	0
22-Aug	1	0	7	0
23-Aug	3	2	7	0
24-Aug	0	0	16	0
25-Aug	0	0	5	0
26-Aug	0	0	4	0
27-Aug	0	0	0	0
28-Aug	0	0	0	0
29-Aug	0	0	0	0
30-Aug	0	0	0	0
31-Aug	0	0	1	0
1-Sep	0	0	0	0
2-Sep	0	1	3	0
3-Sep	0	0	5	0
4-Sep	0	0	0	0
5-Sep	0	1	0	0
6-Sep	0	0	0	0
7-Sep	0	2	8	0
8-Sep	0	0	0	0
9-Sep	0	0	0	0
10-Sep	0	0	0	0
11-Sep	0	0	1	0
12-Sep	0	0	2	0
13-Sep	0	0	0	0
14-Sep	0	0	0	0
15-Sep	0	0	0	0
16-Sep	0	0	0	0
17-Sep	0	0	0	0
18-Sep	0	0	0	0
19-Sep	0	0	0	1
20-Sep	0	0	0	0
21-Sep	0	0	0	0
22-Sep	0	0	0	1
23-Sep	0	0	0	0
24-Sep	0	0	0	0
25-Sep	0	0	0	0
26-Sep	0	0	0	1
27-Sep	0	0	0	1
28-Sep	0	0	0	0
Total	34	235	248	29

Table 1b. Daily returns of upstream migrating Atlantic salmon, trout, suckers and charr at Muddy Bay Brook, 2002.

Date	Number of Fish						
	Atlantic salmon		Trout		Sucker	Arctic charr	
	Large	Small	Resident	Sea		Large	Small
22-Jun	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0
2-Jul	0	0	0	0	0	0	0
3-Jul	0	0	0	0	0	0	0
4-Jul	0	0	0	0	0	0	0
5-Jul	0	1	1	0	0	0	0
6-Jul	0	3	0	0	0	0	0
7-Jul	0	2	0	0	0	0	0
8-Jul	0	5	0	0	0	0	0
9-Jul	0	11	0	0	0	0	0
10-Jul	0	10	5	0	0	0	0
11-Jul	0	3	0	0	0	0	0
12-Jul	0	4	0	0	0	0	0
13-Jul	0	6	1	0	0	0	0
14-Jul	1	23	0	0	0	0	0
15-Jul	0	3	0	1	0	0	0
16-Jul	0	4	0	0	0	0	0
17-Jul	1	1	1	0	0	0	0
18-Jul	1	1	0	0	0	0	0
19-Jul	1	0	0	0	0	0	0
20-Jul	0	1	4	0	0	2	0
21-Jul	0	0	0	0	0	25	0
22-Jul	0	0	0	0	0	0	0
23-Jul	0	1	0	0	0	3	0
24-Jul	0	0	4	31	0	54	35
25-Jul	0	0	0	15	0	32	52
26-Jul	0	0	35	0	0	1	100
27-Jul	0	0	0	0	0	1	10
28-Jul	0	0	0	0	0	10	17
29-Jul	0	0	0	2	0	4	5
30-Jul	0	2	6	0	0	12	52
31-Jul	0	0	79	0	0	157	384
1-Aug	0	0	0	0	0	110	111
2-Aug	0	0	0	2	0	110	88
3-Aug	0	3	1	2	0	214	457
4-Aug	0	0	1	0	0	54	268
5-Aug	0	0	0	0	0	30	181
6-Aug	0	1	0	0	1	65	367

Table 1b Cont'd (Muddy Bay Brook 2002)

Date	Number of Fish						
	Atlantic salmon		Trout		Sucker	Arctic Charr	
	Large	Small	Resident	Sea		Large	Small
7-Aug	0	1	0	0	0	5	58
8-Aug	5	9	0	0	0	27	124
9-Aug	0	3	0	0	0	22	202
10-Aug	0	1	0	0	0	18	142
11-Aug	0	0	0	0	1	47	215
12-Aug	0	0	0	0	0	9	118
13-Aug	0	1	0	0	0	4	100
14-Aug	0	0	1	0	0	27	113
15-Aug	0	0	1	0	0	4	115
16-Aug	0	0	0	0	0	1	29
17-Aug	0	0	0	0	0	1	15
18-Aug	0	0	0	0	0	4	54
19-Aug	0	0	0	0	0	5	108
20-Aug	0	0	1	0	0	0	15
21-Aug	1	1	0	0	0	1	34
22-Aug	0	0	0	0	0	1	12
23-Aug	0	1	0	0	0	0	5
24-Aug	1	2	0	2	0	1	2
25-Aug	0	0	0	0	0	0	2
26-Aug	0	0	0	0	0	0	1
27-Aug	0	0	0	0	0	0	0
28-Aug	0	0	0	0	0	0	0
29-Aug	0	0	0	0	0	0	0
30-Aug	0	0	0	0	0	0	0
31-Aug	0	0	0	0	0	0	0
1-Sep	0	0	0	0	0	0	0
2-Sep	0	0	0	0	0	0	0
3-Sep	0	0	0	0	0	0	0
4-Sep	0	0	0	0	0	0	0
5-Sep	0	0	0	0	0	0	0
6-Sep	0	0	0	0	0	0	0
7-Sep	0	2	0	0	0	0	0
8-Sep	0	0	0	0	0	0	0
9-Sep	0	0	0	0	0	0	0
10-Sep	0	0	0	0	0	0	0
11-Sep	0	0	0	0	0	0	0
12-Sep	0	0	0	0	0	0	0
13-Sep	0	0	0	0	0	0	0
14-Sep	0	0	0	0	0	0	0
15-Sep	0	0	0	0	0	0	0
16-Sep	0	0	0	0	0	0	0
17-Sep	0	0	0	0	0	0	0
18-Sep	0	0	0	0	0	0	0
19-Sep	0	0	0	0	0	0	0
20-Sep	0	0	0	0	0	0	0
21-Sep	0	0	0	0	0	0	0
22-Sep	0	0	0	0	0	0	0
23-Sep	0	0	0	0	0	0	0
24-Sep	0	0	0	0	0	0	0
25-Sep	0	0	0	0	0	0	0
Total	11	106	141	55	2	1061	3591

Table 2a. Daily returns of upstream migrating Atlantic salmon, trout, and suckers at Southwest Brook, 2003.

Date	Number of Fish			
	Atlantic Salmon		Trout	Sucker
	Large	Small		
17-Jun	0	0	0	0
18-Jun	0	0	0	0
19-Jun	0	0	0	0
20-Jun	0	0	0	0
21-Jun	0	0	0	0
22-Jun	0	0	0	0
23-Jun	0	0	0	0
24-Jun	0	0	0	3
25-Jun	0	0	0	1
26-Jun	1	1	0	0
27-Jun	0	2	0	0
28-Jun	0	2	0	0
29-Jun	0	0	0	0
30-Jun	0	3	0	0
1-Jul	0	0	0	0
2-Jul	0	1	0	0
3-Jul	0	0	0	0
4-Jul	0	3	0	0
5-Jul	2	5	0	0
6-Jul	0	0	0	0
7-Jul	0	2	0	0
8-Jul	1	6	1	0
9-Jul	***0***	***2***	***2***	***0***
10-Jul	***0***	***1***	***2***	***0***
11-Jul	***0***	***1***	***2***	***0***
12-Jul	***0***	***1***	***2***	***0***
13-Jul	***0***	***1***	***2***	***0***
14-Jul	0	0	6	0
15-Jul	0	4	1	0
16-Jul	1	0	2	0
17-Jul	2	8	2	0
18-Jul	0	9	5	0
19-Jul	0	15	21	0
20-Jul	1	19	12	0
21-Jul	0	3	13	0
22-Jul	0	6	18	0
23-Jul	0	5	20	0
24-Jul	0	2	2	0
25-Jul	0	2	3	0
26-Jul	0	0	18	0
27-Jul	0	6	18	0
28-Jul	0	1	20	0
29-Jul	0	1	14	0

Table 2a Cont'd (Southwest Brook 2003)

Date	Number of Fish			
	Atlantic salmon		Trout	Sucker
	Large	Small		
30-Jul	2	8	18	0
31-Jul	1		28	0
1-Aug	0	4	5	0
2-Aug	1	8	9	1
3-Aug	0	0	8	0
4-Aug	0	0	3	0
5-Aug	0	0	11	0
6-Aug	0	0	3	0
7-Aug	0	0	0	0
8-Aug	0	1	1	0
9-Aug	0	0	0	0
10-Aug	0	2	6	0
11-Aug	0	0	0	0
12-Aug	0	0	0	0
13-Aug	0	0	0	0
14-Aug	0	0	0	0
15-Aug	0	0	0	0
16-Aug	0	0	0	0
17-Aug	0	2	0	0
18-Aug	0	0	1	0
19-Aug	0	0	1	0
20-Aug	0	0	1	0
21-Aug	0	2	1	0
22-Aug	0	0	0	0
23-Aug	0	0	0	0
24-Aug	0	2	0	0
25-Aug	0	1	0	0
26-Aug	3	4	0	0
27-Aug	0	0	0	0
28-Aug	0	0	0	0
29-Aug	0	0	0	0
30-Aug	0	0	0	0
31-Aug	0	0	0	0
1-Sep	0	0	0	0
2-Sep	0	0	0	0
3-Sep	0	1	0	0
4-Sep	0	0	0	0
5-Sep	0	0	0	0
6-Sep	0	0	0	0
7-Sep	0	0	0	0
8-Sep	0	0	0	0
Total	**16**	**158**	**280**	**5**

Table 2b. Daily returns of upstream migrating Atlantic salmon, trout, suckers and charr at Muddy Bay Brook, 2003.

Date	Number of Fish						
	Atlantic salmon		Trout		Sucker	Arctic charr	
	Large	Small	Resident	Sea		Large	Small
21-Jun	***0***	***3***	***0***	0	0	***0***	***0***
22-Jun	***0***	***3***	***0***	0	0	***0***	***0***
23-Jun	***0***	***3***	***0***	0	0	***0***	***0***
24-Jun	***0***	***3***	***0***	0	0	***0***	***0***
25-Jun	***0***	***3***	***0***	0	0	***0***	***0***
26-Jun	***0***	***3***	***0***	0	0	***0***	***0***
27-Jun	***0***	***3***	***0***	0	0	***0***	***0***
28-Jun	***0***	***3***	***0***	0	0	***0***	***0***
29-Jun	***0***	***3***	***0***	0	0	***0***	***0***
30-Jun	0	0	0	0	0	0	0
1-Jul	1	5	0	0	0	0	0
2-Jul	0	6	0	0	0	0	0
3-Jul	0	15	0	0	0	0	0
4-Jul	1	12	2	0	0	0	0
5-Jul	1	16	5	0	0	0	0
6-Jul	2	20		0	0	9	1
7-Jul	2	17	1	0	0	1	0
8-Jul	0	2	0	0	0	0	0
9-Jul	***1***	***4***	***2***	0	0	***13***	***12***
10-Jul	***1***	***4***	***2***	0	0	***13***	***12***
11-Jul	***1***	***4***	***2***	0	0	***13***	***12***
12-Jul	***1***	***4***	***2***	0	0	***13***	***12***
13-Jul	***1***	***4***	***2***	0	0	***13***	***12***
14-Jul	0	0	0	0	0	4	8
15-Jul	1	10	7	0	0	60	57
16-Jul	0	10	3	0	0	5	3
17-Jul	0	16	6	0	0	103	91
18-Jul	0	18	8	0	0	144	312
19-Jul	2	16	13	0	0	168	227
20-Jul	1	10	25	0	0	195	260
21-Jul	2	22	0	0	0	143	234
22-Jul	2	13	0	0	0	98	146
23-Jul	2	7	2	0	1	34	251
24-Jul	0	8	0	0	0	74	333
25-Jul	1	13	3	0	0	77	172
26-Jul	0	8	1	0	0	82	407
27-Jul	0	5	1	0	0	14	54
28-Jul	0	3	3	0	0	19	71
29-Jul	2	15	1	0	0	7	31
30-Jul	0	4	0	0	0	1	4

Table 2b Cont'd (Muddy Bay Brook 2003)

Date	Number of Fish						
	Atlantic salmon		Trout		Sucker	Arctic charr	
	Large	Small	Resident	Sea		Large	Small
31-Jul	0	5	3	0	0	4	14
1-Aug	0	1	0	0	0	10	21
2-Aug	1	4	3	0	0	0	18
3-Aug	0	2	0	0	0	7	33
4-Aug	0	5	0	0	0	2	29
5-Aug	1	5	0	0	0	1	3
6-Aug	0	1	1	0	0	2	11
7-Aug	1	5	0	0	0	2	14
8-Aug	0	3	0	0	0	2	19
9-Aug	0	3	0	0	0	5	13
10-Aug	0	2	0	0	0	2	35
11-Aug	0	4	0	0	0	0	2
12-Aug	2	7	0	0	0	2	4
13-Aug	0	0	0	0	0	2	14
14-Aug	0	3	0	0	0	0	3
15-Aug	0	4	0	0	0	0	13
16-Aug	0	0	0	0	0	0	0
17-Aug	0	6	0	0	0	0	0
18-Aug	0	4	0	0	0	0	0
19-Aug	0	0	1	0	0	0	0
20-Aug	0	2	0	0	0	0	0
21-Aug	0	2	0	0	0	0	0
22-Aug	0	1	0	0	0	0	0
23-Aug	0	1	1	0	0	0	0
24-Aug	0	1	0	0	0	0	0
25-Aug	0	5	0	0	0	0	0
26-Aug	2	2	0	0	0	0	0
27-Aug	***0***	***0***	***0***	0	0	***0***	***0***
28-Aug	***0***	***0***	***0***	0	0	***0***	***0***
29-Aug	***0***	***0***	***0***	0	0	***0***	***0***
30-Aug	***0***	***0***	***0***	0	0	***0***	***0***
31-Aug	***0***	***0***	***0***	0	0	***0***	***0***
1-Sep	***0***	***0***	***0***	0	0	***0***	***0***
2-Sep	0	0	0	0	0	0	0
3-Sep	0	0	0	0	0	0	0
4-Sep	0	0	0	0	0	0	0
5-Sep	0	0	0	0	0	0	0
6-Sep	0	0	0	0	1	0	0
7-Sep	0	0	0	0	0	0	0
8-Sep	0	0	0	0	0	0	0
Total	**31**	**394**	**99**	**0**	**2**	**1345**	**2966**

Table 3a. Daily returns of upstream migrating Atlantic salmon, Trout, & Suckers at Southwest Brook, 2004.

Date	Number of Fish				
	Atlantic Salmon		Trout		Sucker
	Large	Small	Resident	Sea	
26-Jun	0	1	0	0	0
27-Jun	0	1	0	0	5
28-Jun	1	5	0	0	0
29-Jun	0	21	0	0	0
30-Jun	0	9	0	0	4
1-Jul	2	33	0	0	9
2-Jul	1	22	0	0	7
3-Jul	3	36	0	0	5
4-Jul	3	36	0	0	1
5-Jul	1	32	0	0	1
6-Jul	0	6	0	0	0
7-Jul	0	33	0	0	0
8-Jul	1	20	1	0	2
9-Jul	0	13	0	0	0
10-Jul	0	13	0	0	0
11-Jul	1	16	0	0	0
12-Jul	2	26	0	0	0
13-Jul	3	30	0	0	0
14-Jul	7	33	0	0	0
15-Jul	3	51	3	0	0
16-Jul	2	24	0	0	0
17-Jul	2	23	1	0	0
18-Jul	5	17	1	0	0
19-Jul	5	25	0	0	0
20-Jul	2	3	1	0	0
21-Jul	1	8	0	0	0
22-Jul	0	11	2	0	0
23-Jul	0	10	0	0	0
24-Jul	2	10	0	0	0
25-Jul	1	0	3	0	0
26-Jul	0	0	3	0	0
27-Jul	0	4	0	0	0
28-Jul	0	0	3	0	0
29-Jul	0	0	1	0	0
30-Jul	0	2	13	0	0
31-Jul	0	2	3	0	0
1-Aug	1	10	8	0	0
2-Aug	1	6	18	0	0
3-Aug	0	0	15	0	0
4-Aug	2	3	6	0	0
5-Aug	0	6	7	0	0
6-Aug	0	0	1	0	0
7-Aug	0	1	0	0	0

Table 3a Cont'd (Southwest Brook, 2004)

Date	Number of Fish				
	Atlantic salmon		Trout		Sucker
	Large	Small	Resident	Sea	
8-Aug	0	0	1	0	0
9-Aug	0	1	1	0	0
10-Aug	0	0	20	0	0
11-Aug	0	2	14	0	0
12-Aug	0	1	2	0	0
13-Aug	0	4	5	0	0
14-Aug	0	0	2	0	0
15-Aug	0	0	4	0	0
16-Aug	0	0	9	0	0
17-Aug	0	0	2	0	0
18-Aug	2	1	4	0	0
19-Aug	0	0	0	0	0
20-Aug	0	0	2	0	0
21-Aug	0	0	0	0	0
22-Aug	0	0	0	0	0
23-Aug	0	0	0	0	0
24-Aug	0	0	2	0	0
25-Aug	0	1	0	0	0
26-Aug	0	0	0	0	0
27-Aug	0	0	3	0	0
28-Aug	0	0	20	0	0
29-Aug	0	3	0	0	0
30-Aug	0	0	0	0	0
31-Aug	0	0	0	0	0
1-Sep	0	0	2	1	0
2-Sep	0	0	1	0	0
3-Sep	0	0	1	0	0
4-Sep	0	0	0	0	0
5-Sep	0	0	0	0	0
6-Sep	0	0	0	0	0
7-Sep	0	0	0	0	0
Total	**54**	**615**	**185**	**1**	**34**

Table 3b. Daily returns of upstream migrating Atlantic Salmon, Trout, Suckers & Charr at Muddy Bay Brook, 2004.

Date	Number of Fish						
	Atlantic salmon		Trout		Sucker	Artic charr	
	Large	Small	Resident	Sea		Large	Small
25-Jun	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0
27-Jun	1	5	0	0	0	0	0
28-Jun	0	1	0	0	0	0	0
29-Jun	2	7	0	0	0	0	0
30-Jun	1	15	0	0	0	0	0
1-Jul	1	24	0	0	0	0	0
2-Jul	0	20	0	0	0	0	0
3-Jul	2	24	0	0	0	0	0
4-Jul	1	1	0	0	0	0	0
5-Jul	1	18	1	0	0	0	0
6-Jul	1	31	1	0	0	0	0
7-Jul	6	36	2	0	0	0	0
8-Jul	3	25	5	0	0	0	0
9-Jul	2	18	6	0	0	0	0
10-Jul	2	12	1	0	0	0	0
11-Jul	0	27	2	0	0	0	0
12-Jul	0	28	2	0	0	0	0
13-Jul	1	24	0	0	0	0	0
14-Jul	2	17	2	0	0	0	0
15-Jul	0	23	5	0	0	0	0
16-Jul	0	5	0	0	0	0	0
17-Jul	0	7	0	0	0	0	0
18-Jul	0	1	1	0	0	0	1
19-Jul	0	6	0	0	0	0	0
20-Jul	0	6	0	0	0	0	0
21-Jul	0	13	0	0	0	0	0
22-Jul	0	8	0	0	0	36	62
23-Jul	0	4	0	0	0	70	46
24-Jul	0	6	2	0	0	2	5
25-Jul	0	5	2	0	0	476	1087
26-Jul	0	4	0	0	0	976	412
27-Jul	0	1	0	0	0	769	316
28-Jul	0	2	0	0	0	420	203
29-Jul	0	1	1	0	0	197	80
30-Jul	0	5	0	0	0	174	102
31-Jul	0	4	0	0	0	196	116
1-Aug	0	1	0	0	0	63	25
2-Aug	0	2	0	0	0	57	48

Table 3b. Cont'd (Muddy Bay Brook, 2004)

Date	Number of Fish						
	Atlantic salmon		Trout		Sucker	Artic charr	
	Large	Small	Resident	Sea		Large	Small
3-Aug	0	0	0	0	0	113	67
4-Aug	0	2	0	0	0	41	42
5-Aug	1	6	0	0	0	133	94
6-Aug	1	1	0	0	0	35	35
7-Aug	0	0	0	0	0	52	70
8-Aug	0	0	0	0	0	9	34
9-Aug	0	1	0	0	0	35	84
10-Aug	0	1	0	0	0	15	54
11-Aug	0	0	0	0	0	19	52
12-Aug	0	0	0	0	0	9	13
13-Aug	0	0	0	0	0	3	27
14-Aug	0	0	0	0	0	4	65
15-Aug	0	1	0	0	0	3	21
16-Aug	0	0	0	0	0	1	12
17-Aug	0	1	0	0	0	1	15
18-Aug	0	0	0	0	0	0	36
19-Aug	0	2	0	0	0	1	0
20-Aug	0	0	0	0	0	2	20
21-Aug	0	0	0	0	0	0	13
22-Aug	0	1	0	0	0	0	4
23-Aug	0	0	0	0	0	0	0
24-Aug	0	0	0	0	0	0	0
25-Aug	0	0	0	0	0	0	0
26-Aug	0	0	0	0	0	0	0
27-Aug	0	0	0	0	0	0	2
28-Aug	0	0	0	0	0	0	0
29-Aug	0	1	0	0	0	0	0
30-Aug	0	0	0	0	0	0	0
31-Aug	0	0	0	0	0	0	0
1-Sep	0	0	0	0	0	0	0
2-Sep	0	0	0	0	0	0	0
3-Sep	0	0	0	0	0	0	0
4-Sep	0	0	0	0	0	0	0
5-Sep	0	0	0	0	0	0	0
6-Sep	0	0	0	0	0	0	0
Total	**28**	**454**	**33**	**0**	**0**	**3912**	**3263**

Table 4a. The Biological Characteristics for small and large salmon at Southwest Brook (Paradise River) from 2002 to 2004. (n=sample size, PS=previous spawners)

Year	Size	FORK LENGTH (cm)					RIVER AGE (%)						SEA AGE (%)			
		n	Mean	SD	Min	Max	3	4	5	6	7	n	1	2	PS	n
2002	**Small**	77	55	2.71	50	62	6	43	48	3	0	65	97	0	3	74
	Large	8	72	6.47	63	81	0	80	20	0	0	5	25	38	38	8
2003	**Small**	64	56	3.01	50	62	2	20	39	33	6	49	97	0	3	64
	Large	13	71	5.16	63	78	0	10	50	40	0	10	15	62	23	13
2004	**Small**	95	56	3.61	43	62	7	55	35	3	0	89	100	0	0	94
	Large	3	68	4.62	63	71	0	33	67	0	0	3	33	67	0	3

Table 5a. The Biological Characteristics for small and large salmon at Muddy Bay Brook from 2002 to 2004. (n=sample size, PS=previous spawners)

Year	Size	FORK LENGTH (cm)					RIVER AGE (%)							SEA AGE (%)			
		n	Mean	SD	Min	Max	2	3	4	5	6	7	n	1	2	PS	n
2002	**Small**	79	55	2.74	47	61	0	1	29	50	19	0	68	100	0	0	78
	Large	7	76	6.68	64	84	0	0	67	33	0	0	3	0	33	67	6
2003	**Small**	151	55	3.10	48	62	0	2	32	33	31	1	121	99	1	0	149
	Large	5	76	0.55	75	76	0	0	100	0	0	0	4	80	20	0	5
2004	**Small**	132	55	3.04	45	62	1	18	44	32	5	1	117	100	0	0	131
	Large	13	70	4.47	63	76	0	45	27	9	18	0	11	46	54	0	13

Table 5b. The Biological Characteristics for small and large charr at Muddy Bay Brook from 2002 to 2004. (n=sample size)

Year	Size	FORK LENGTH (cm)				
		n	Mean	SD	Min	Max
2002	**Small**	193	33	3.33	26	39
	Large	83	47	5.98	40	64
2003	**Small**	109	35	2.90	28	39
	Large	92	45	4.39	40	60
2004	**Small**	85	35	3.53	27	39
	Large	76	43	3.46	40	58

Table 6. The minimum, maximum and mean daily mean water temperature (°C), daily mean morning and evening relative water level (mm), and daily mean air temperature (°C) at Southwest Brook (Paradise River), Labrador for 2002 to 2004.

	Water Temperature (°C)			Water Level (mm)			Air Temperature (°C)		
YEAR	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
2002	10.6	21.3	15.9	392	950	548	8.8	23.3	14.3
2003	9.5	20.6	15.2	419	910	645	7.7	20.6	13.7
2004	10.2	20.5	16.5	333	807	506	5.7	13.2	15.2

Table 7. The minimum, maximum and mean daily mean water temperature (°C), daily mean morning and evening relative water level (mm), and daily mean air temperature (°C) at Muddy Bay Brook, Labrador for 2002 to 2004.

	Water Temperature (°C)			Water Level (mm)			Air Temperature (°C)		
YEAR	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
2002	5.4	21.6	14.7	270	1400	435	2.9	23.6	12.4
2003	10.1	20.8	15.4	295	805	499	5.8	20.7	13.2
2004	11.0	21.1	17.2	280	760	411	6.2	22.2	15.0

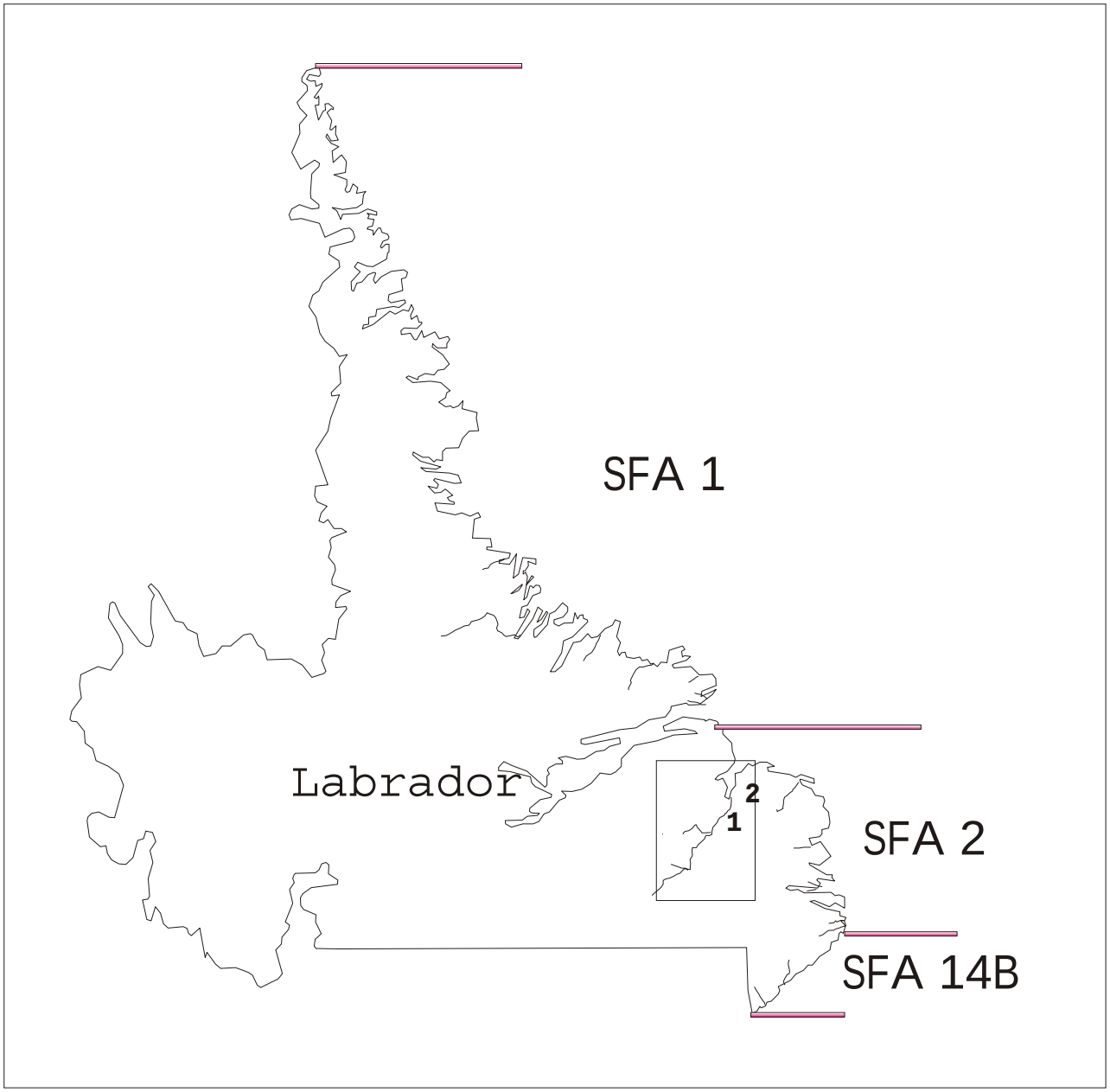

Figure 1. Location map depicting Labrador, Salmon Fishing Areas (SFAs) with Southwest Brook(1) and Muddy Bay Brook (2).

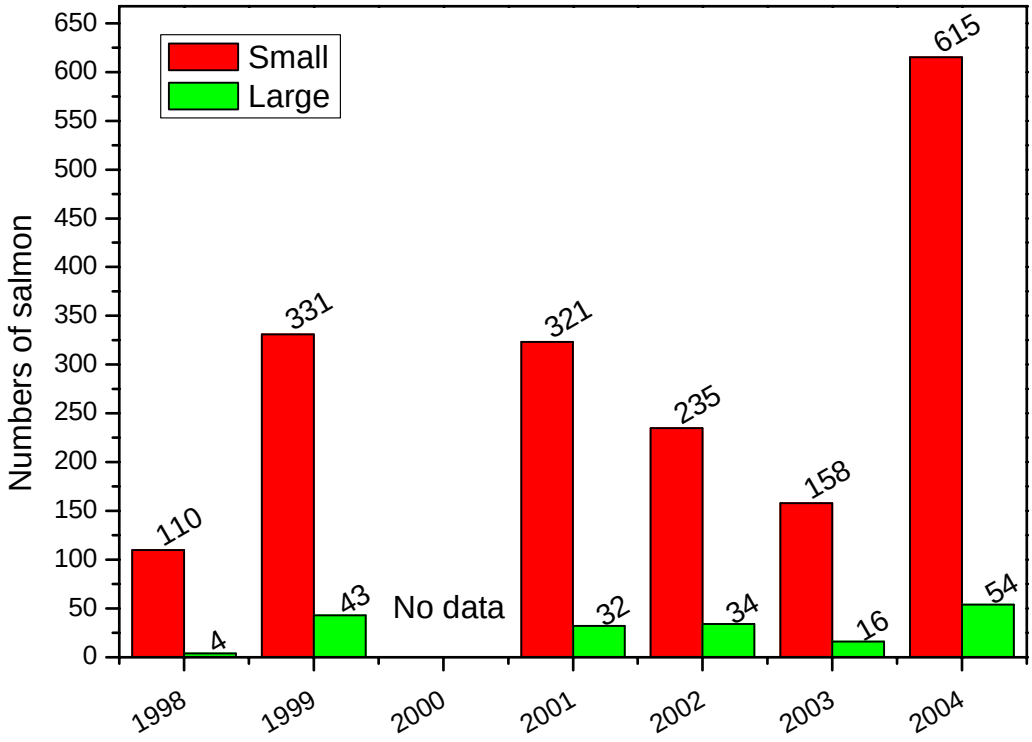

Figure 2. Annual returns of Atlantic salmon to Southwest Brook (Paradise River), Labrador.

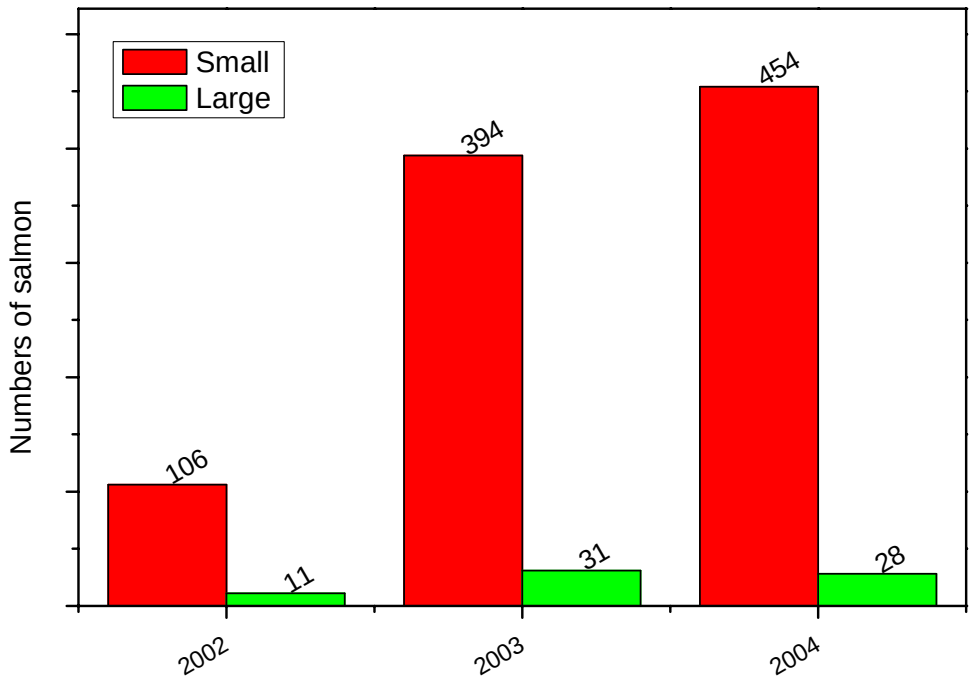

Figure 3a. Annual returns of Atlantic salmon to Muddy Bay Brook, Labrador.

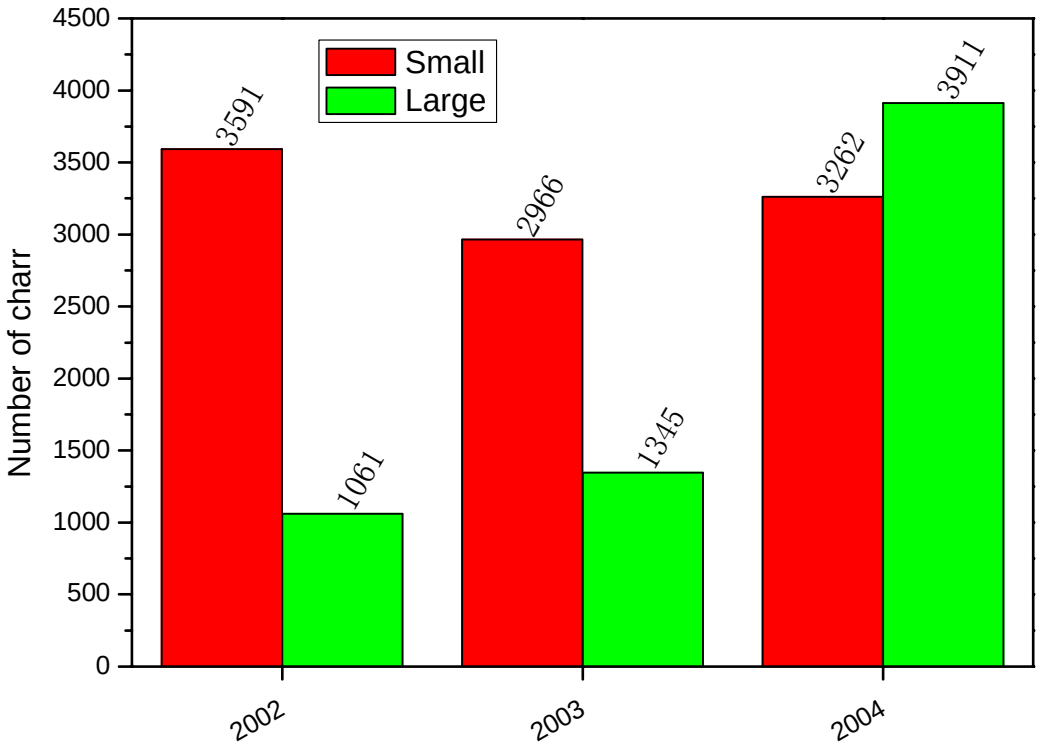

Figure 3b. Annual returns of Arctic charr to Muddy Bay Brook, Labrador.

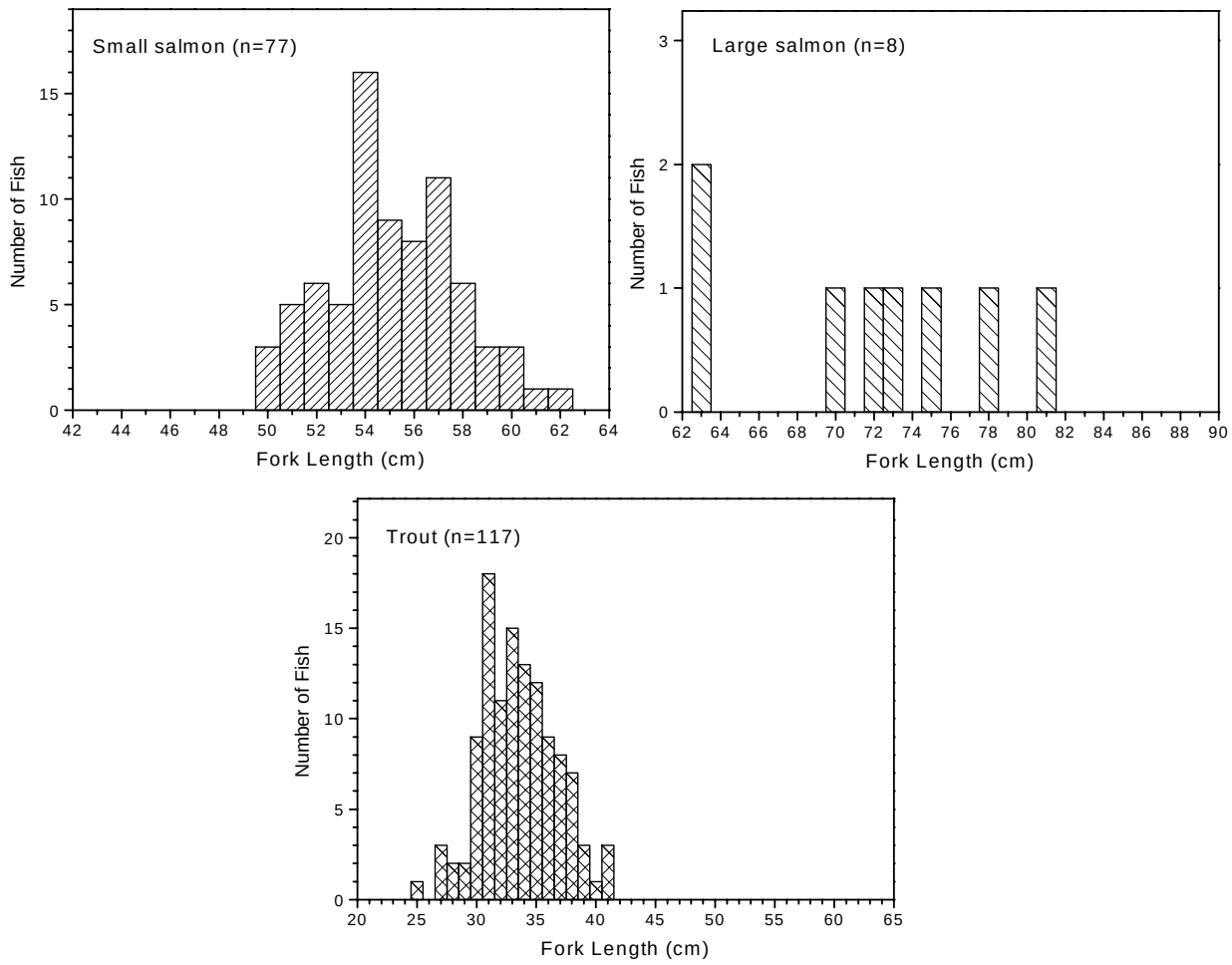

Figure 4a. Fork length frequency distributions for small salmon, large salmon and trout from Southwest Brook (Paradise River), Labrador in 2002.

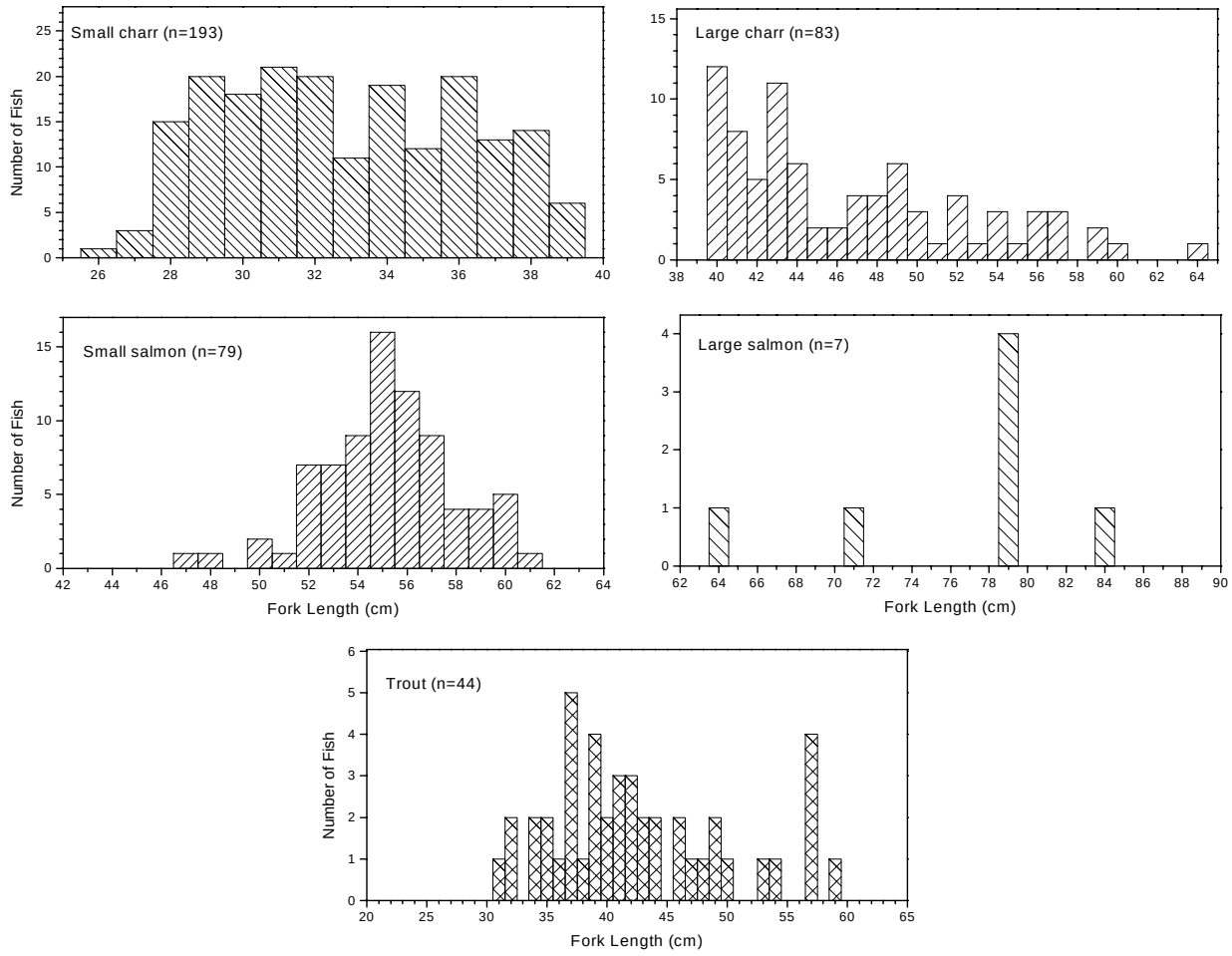

Figure 4b. Fork length frequency distributions for small charr, large char, small salmon, large salmon and trout from Muddy Bay Brook, Labrador in 2002.

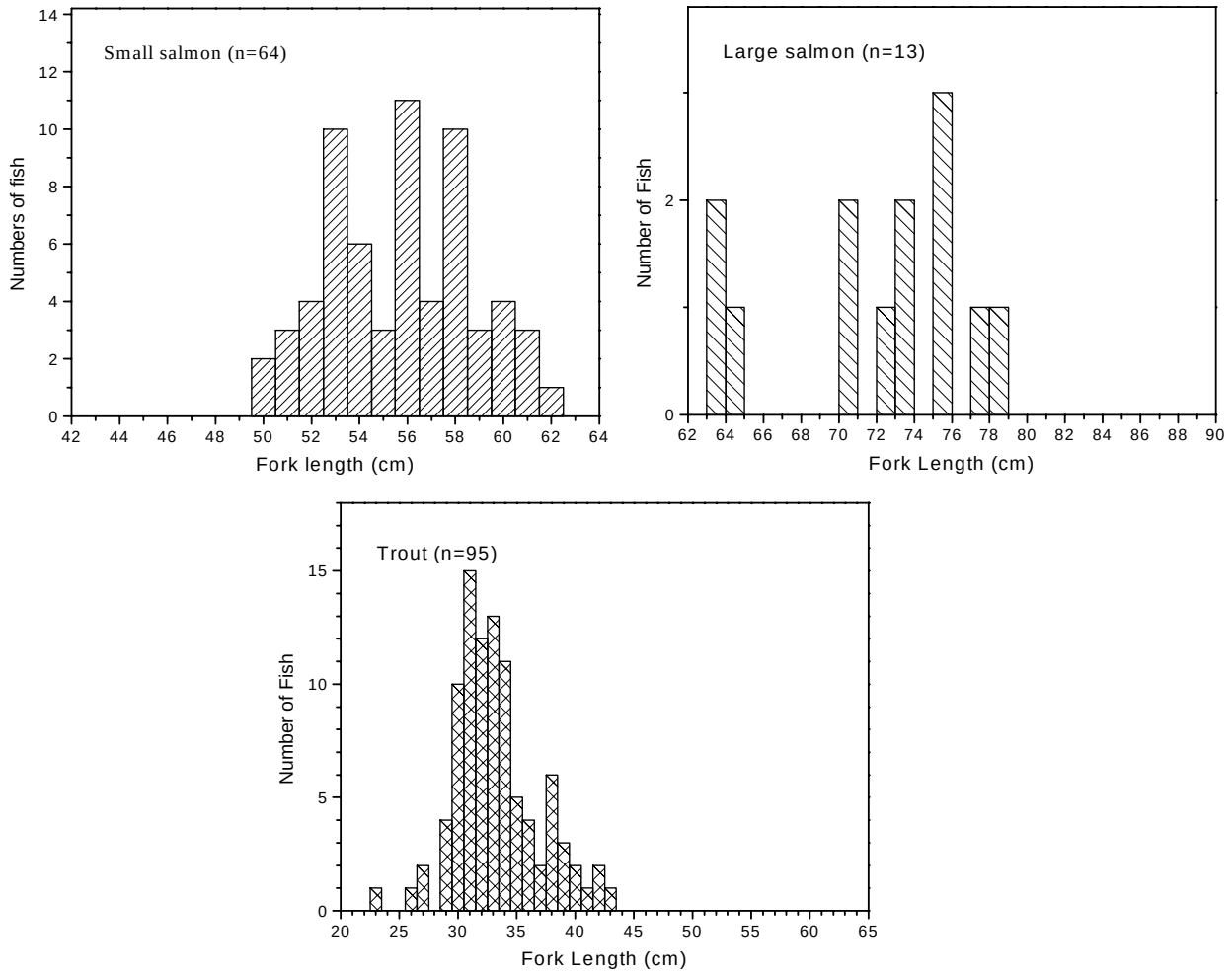

Figure 5a. Fork length frequency distributions for small salmon, large salmon and trout from Southwest Brook (Paradise River), Labrador in 2003.

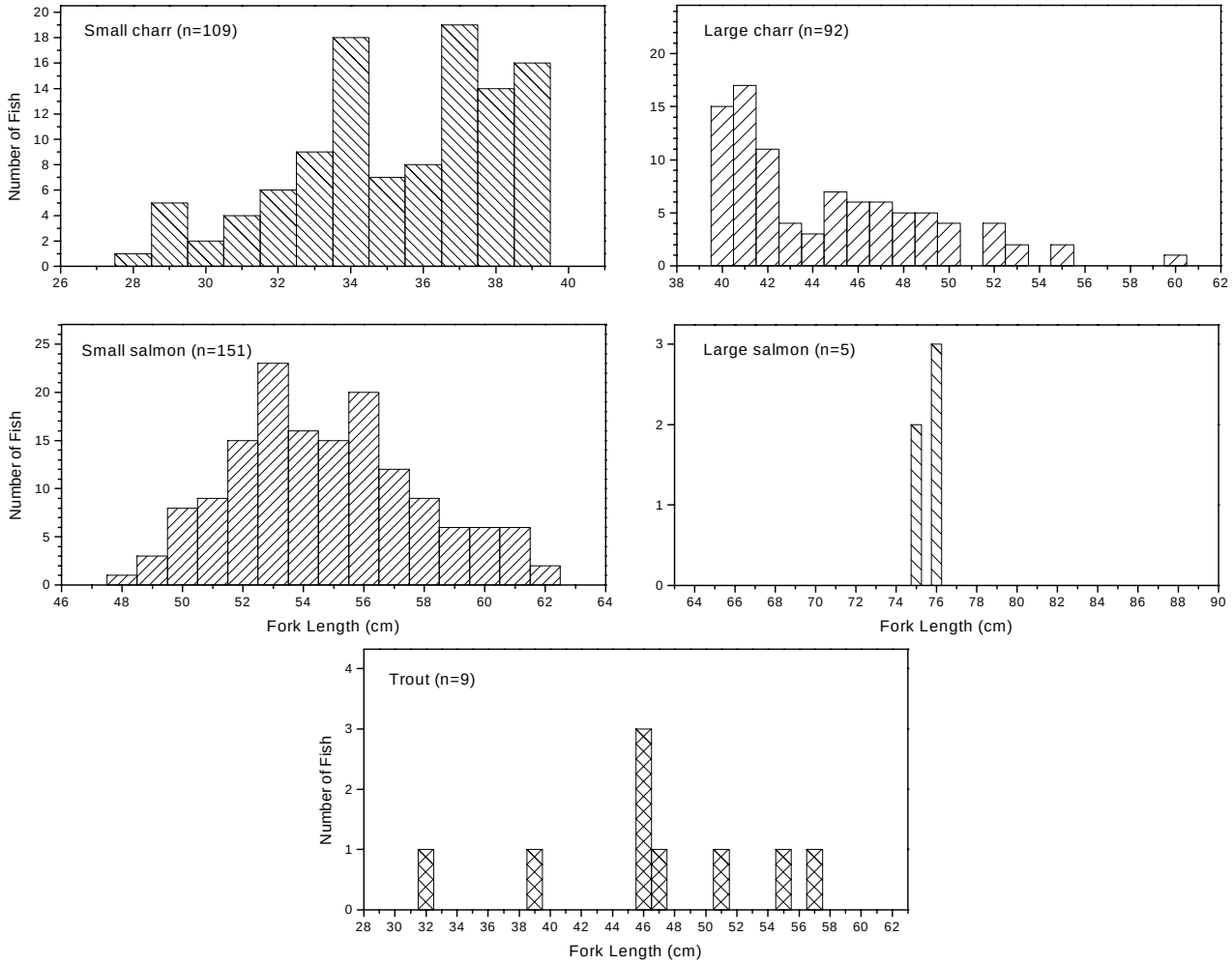

Figure 5b. Fork length frequency distributions for small charr, large charr, small salmon large salmon and trout from Muddy Bay Brook, Labrador in 2003.

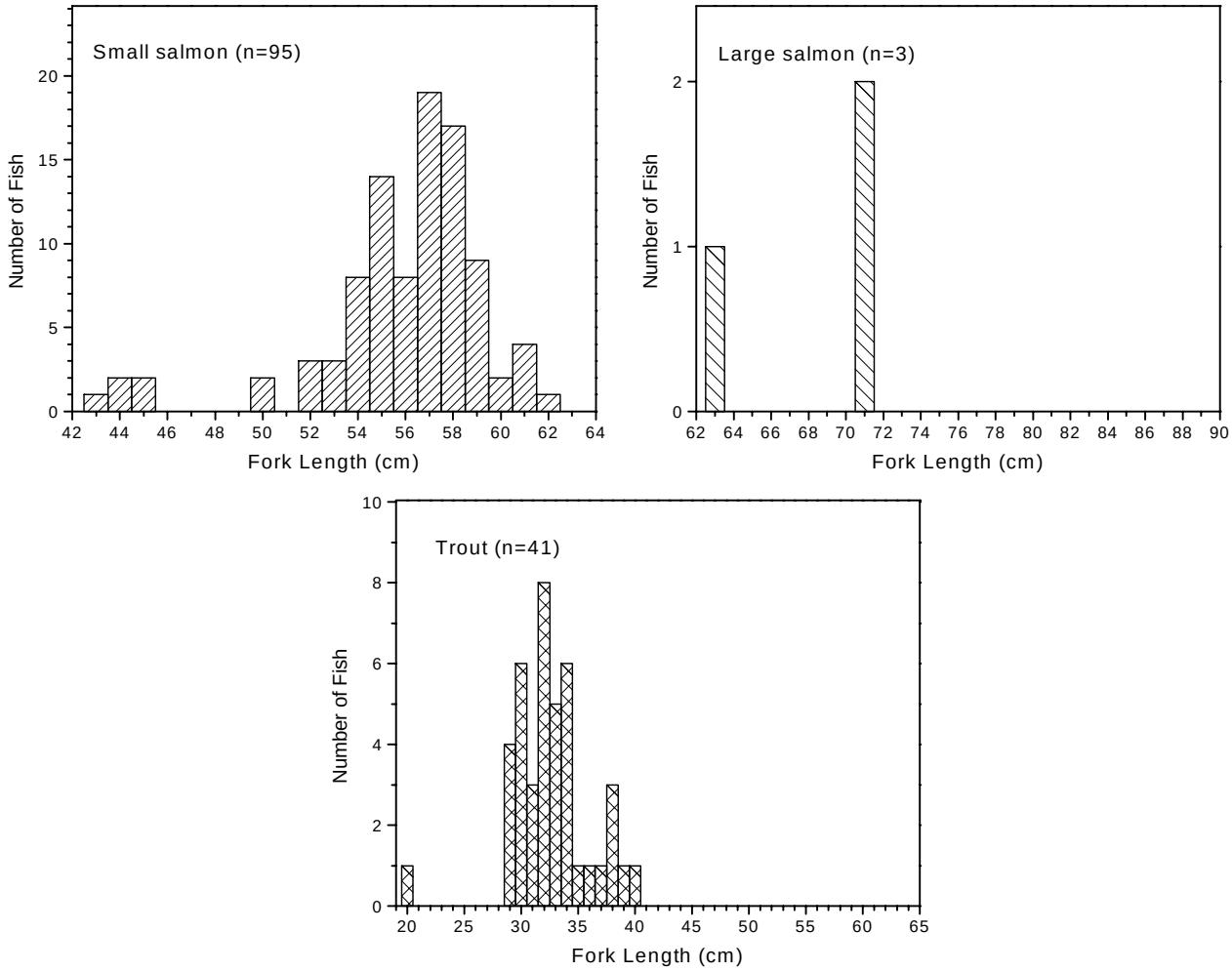

Figure 6a. Fork length frequency distributions for small salmon, large salmon and trout from Southwest Brook (Paradise River), Labrador in 2004.

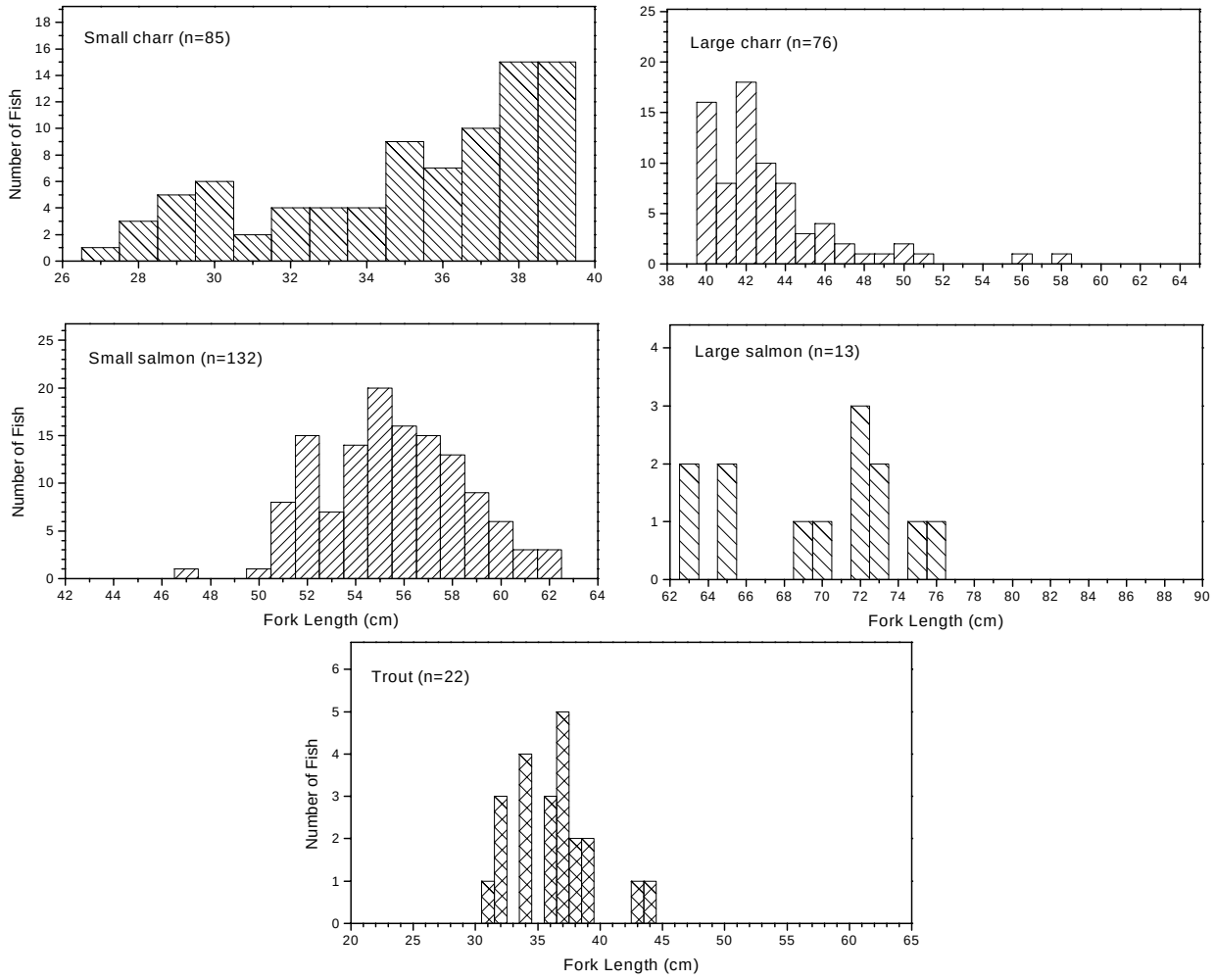

Figure 6b. Fork length frequency distributions for small charr, large charr, small salmon, large salmon and trout from Muddy Bay Brook, Labrador in 2004.

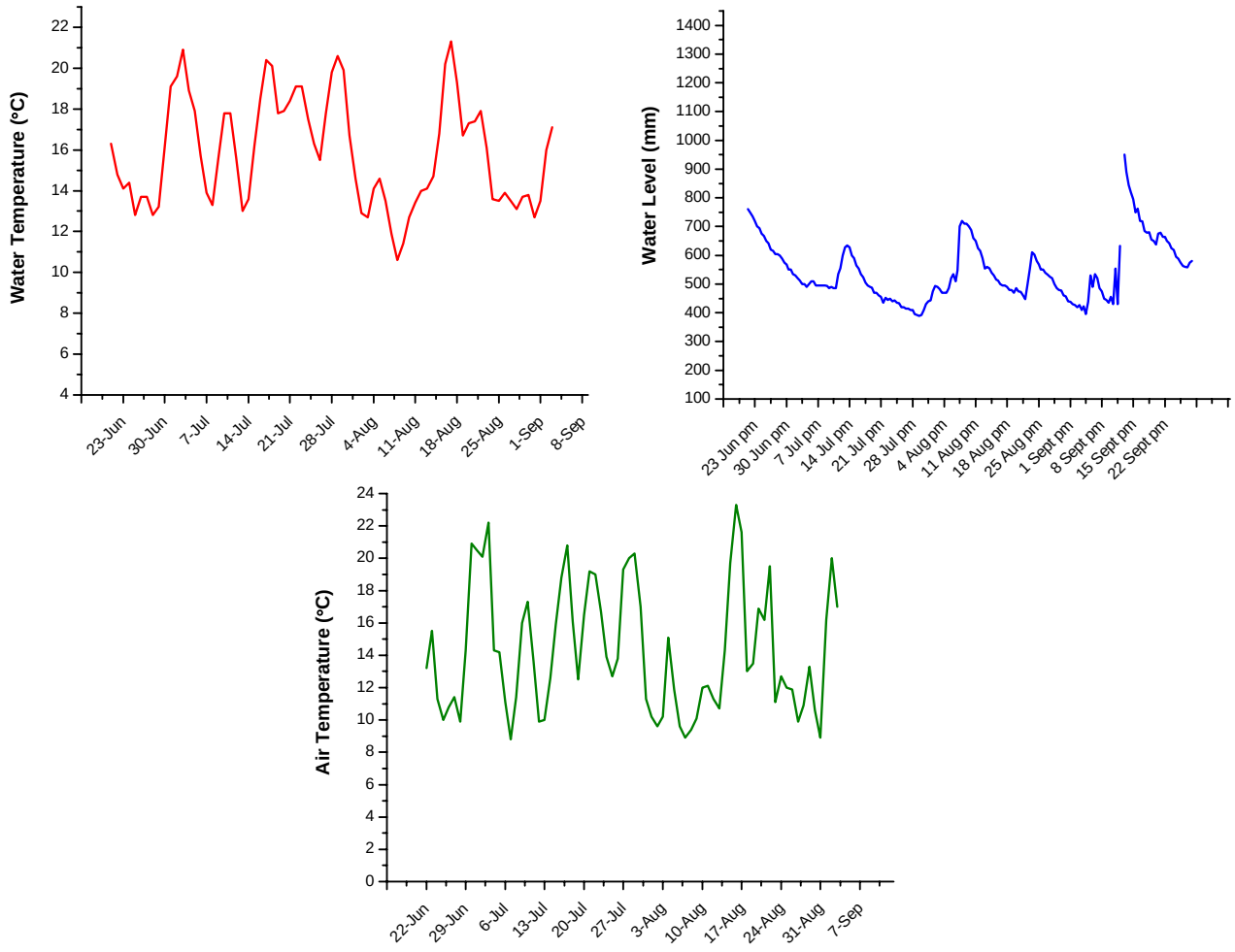

Figure 7a. Mean daily water temperature (°C), mean daily morning (am) and evening (pm) relative water level (mm), and the mean daily air temperature (°C) measurements for Southwest Brook (Paradise River), Labrador in 2002.

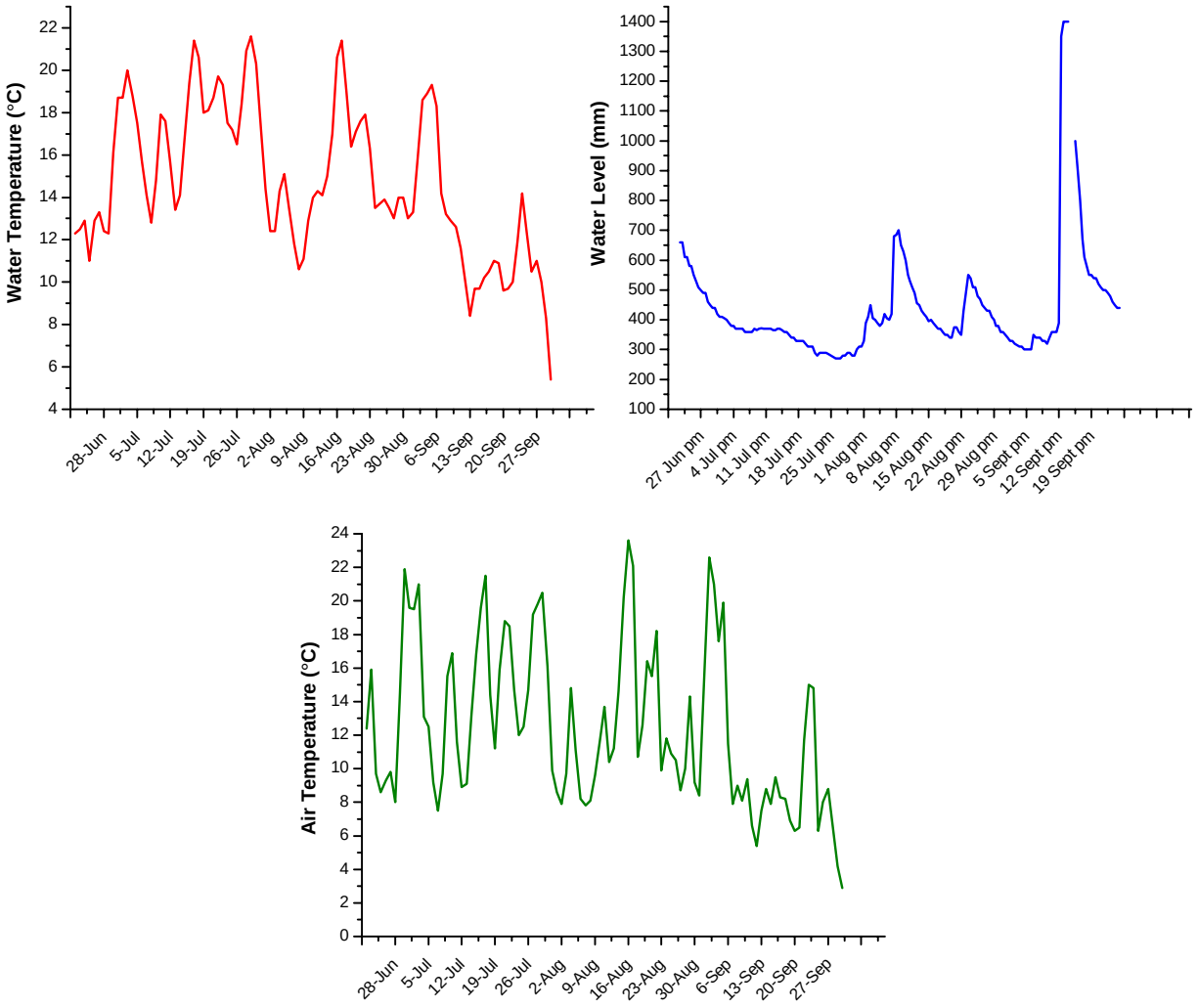

Figure 7b. Mean daily water temperature (°C), mean daily morning (am) and evening (pm) relative water level (mm), and the mean daily air temperature (°C) measurements for Muddy Bay Brook, Labrador in 2002.

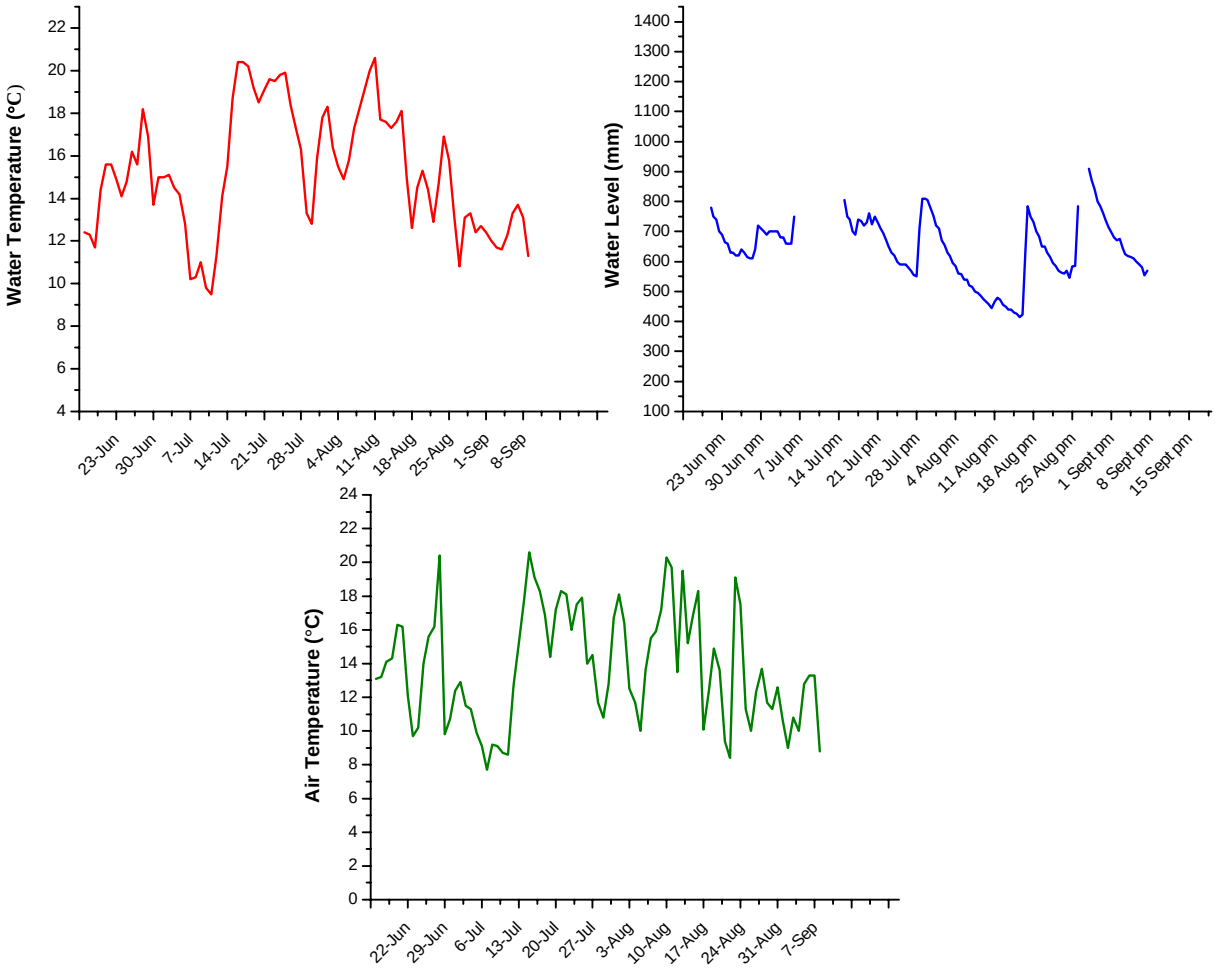

Figure 8a. Mean daily water temperature (°C), mean daily morning (am) and evening (pm) relative water level (mm), and the mean daily air temperature (°C) measurements for Southwest Brook (Paradise River), Labrador in 2003.

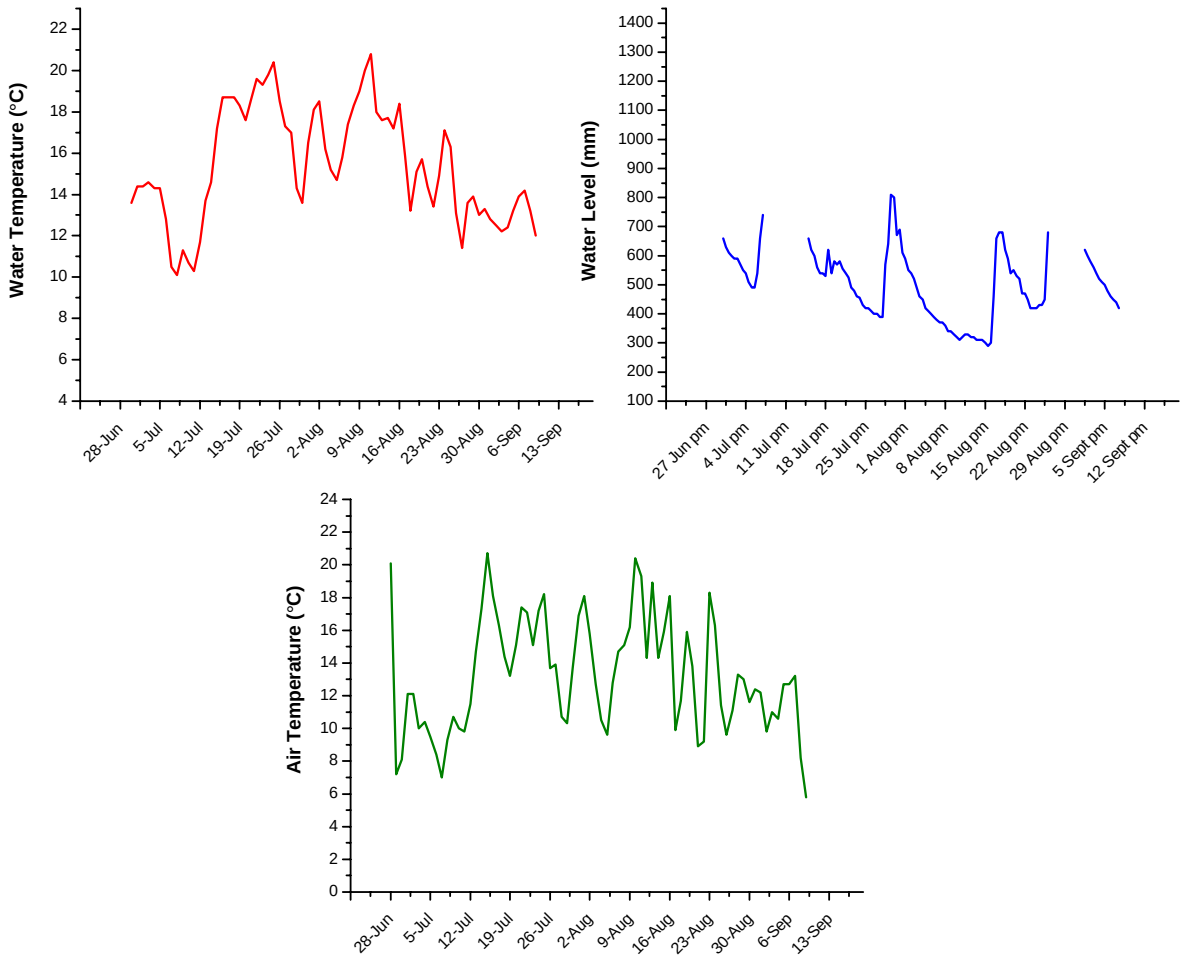

Figure 8b. Mean daily water temperature (°C), mean daily morning (am) and evening (pm) relative water level (mm), and the mean daily air temperature (°C) measurements for Muddy Bay Brook, Labrador in 2003.

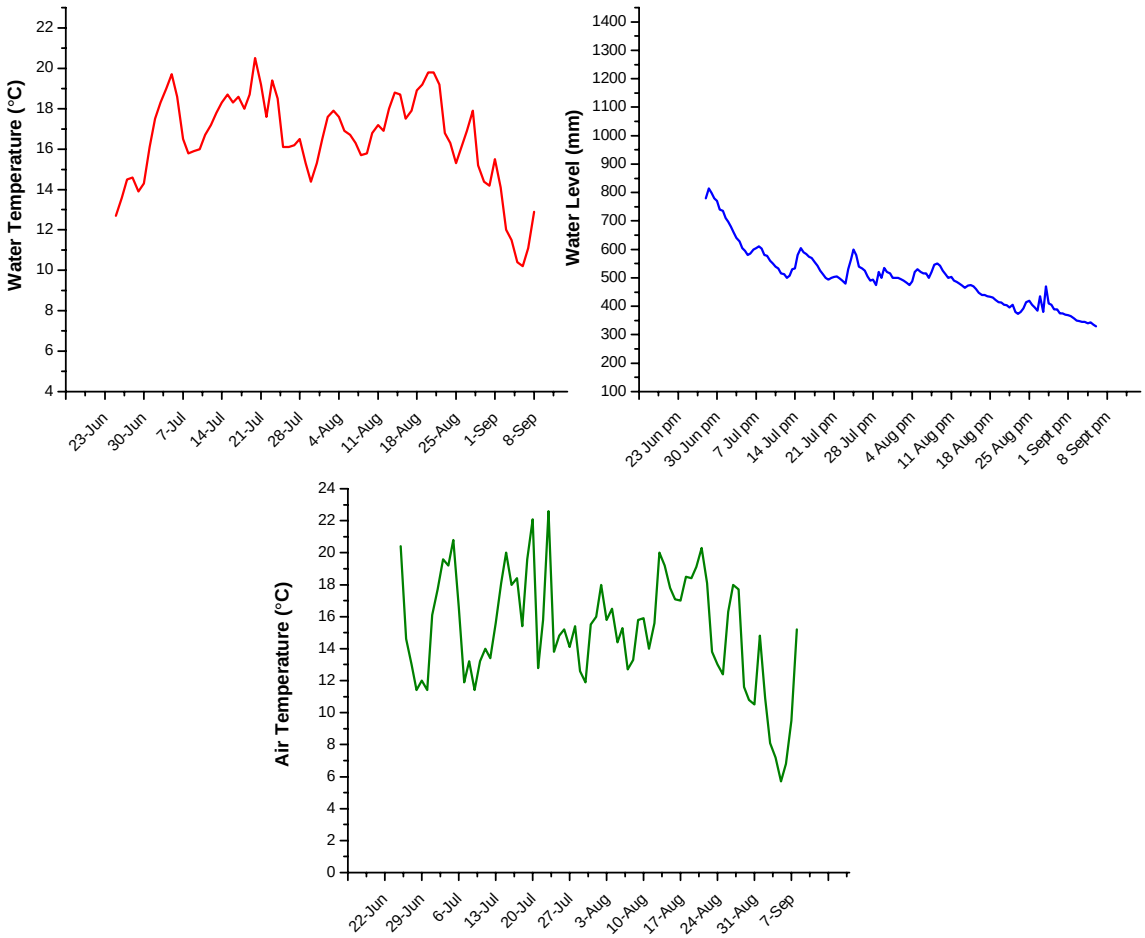

Figure 9a. Mean daily water temperature (°C), mean daily morning (am) and evening (pm) relative water level (mm), and the mean daily air temperature (°C) measurements for Southwest Brook (Paradise River), Labrador in 2004.

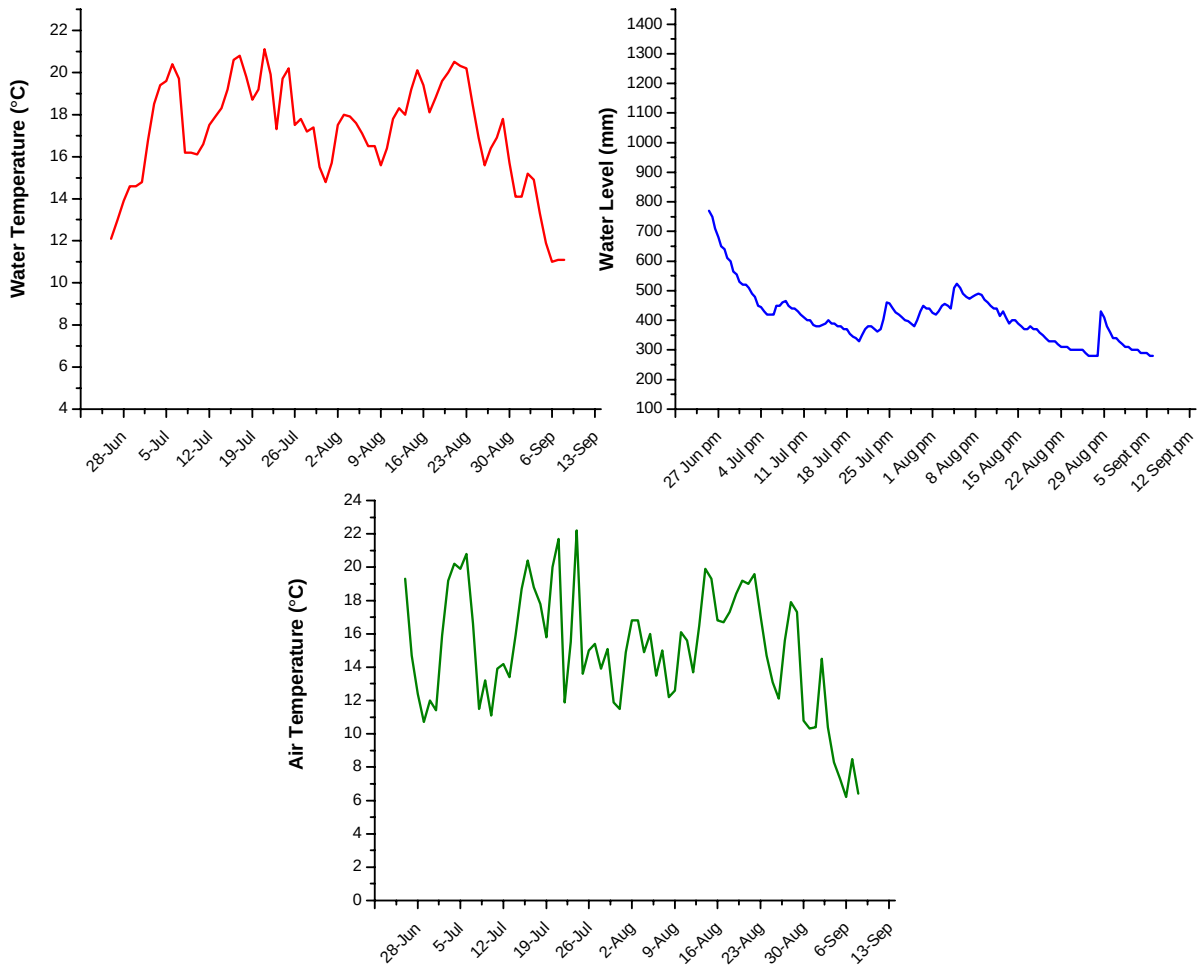

Figure 9b. Mean daily water temperature (°C), mean daily morning (am) and evening (pm) relative water level (mm), and the mean daily air temperature (°C) measurements for Muddy Bay Brook, Labrador in 2004.