Fisheries and Oceans Science | Pêches et Océans Sciences

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Research Document 2000/040 | **Document de recherche 2000/040**

Status of Atlantic Salmon (*Salmo salar* L.) in Gander River, Notre Dame Bay (SFA 4), Newfoundland, 1999

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ISSN 1480-4883
Ottawa, 2000

Canada

Abstract

The status of Atlantic salmon in Gander River in 1999 was determined using counts of small and large salmon from a counting fence located on the main stem just above head of tide, recreational fishery data, and biological characteristics information. Total returns of small salmon in 1999 were similar in magnitude to 1998, maintaining a marked improvement over 1997, in which year the lowest returns of the commercial salmon fishery moratorium period occurred. Returns of large salmon in 1999 were the highest on record, as was the proportion of large salmon. Conservation egg requirement was exceeded in 1999 (121%). High water temperatures and low water levels were encountered early in 1999 compared to previous years, both at the counting fence and at the fishway in Salmon Brook tributary. The majority of returns to Salmon Brook occurred after the onset of increasing water levels in mid-August.

Résumé

L'état du saumon de l'Atlantique de la rivière Gander en 1999 a été déterminé à partir du nombre de petits et grands saumons dénombrés à une barrière de comptage située sur le cours principal de la rivière, juste en amont de la ligne de la marée; on a aussi utilisé des données de pêches récréatives et des renseignements sur les caractéristiques biologiques. Les remontées totales de petits saumons en 1999 étaient semblables à celles de 1998 en ampleur, maintenant une amélioration marquée par rapport à 1997, année des plus faibles remontées de la période du moratoire sur la pêche commerciale au saumon. Les remontées de grands saumons en 1999 étaient les plus élevées enregistrées, comme l'était la proportion du grand saumon. Les besoins en conservation des oeufs ont été dépassés en 1999 (121 %). Des températures élevées et de faibles niveaux d'eau ont été enregistrés au début de l'année 1999, comparativement aux années précédentes, à la barrière de comptage et à la passe à poisson dans le tributaire de Salmon Brook. La majorité des remontées vers le Salmon Brook sont survenues après le début de l'augmentation du niveau d'eau vers la mi-août.

Introduction

The Gander River, with a drainage area of 6,398 km^2 (Porter *et al.* 1974), is the third largest in insular Newfoundland. The river is located in Salmon Fishing Area (SFA) 4 (Notre Dame Bay) (Fig. 1). In addition to being one of the most important Atlantic salmon angling rivers in insular Newfoundland, the river has historically supported a relatively large angler guiding and outfitting industry.

In response to concerns from angler groups that returns to the river were declining, the Department of Fisheries and Oceans in cooperation with the Gander Rod and Gun Club and the Gander Bay-Hamilton Sound Development Association, initiated a 3-year study to determine the status of the Gander River Atlantic salmon population in 1989. The results of this study (O'Connell and Ash MS 1992) showed that for the period 1989-91, Gander River received only 36-44% of its conservation egg requirement. As a result of the implementation of the commercial Atlantic salmon fishery moratorium in 1992 (see below), the project has continued in order to measure the impacts of this measure on adult returns and stock rebuilding.

In this paper, we examine the status of Atlantic salmon in Gander River in 1999, the eighth year of the commercial salmon fishery moratorium. Counts obtained from a counting fence are used in conjunction with recreational fishery data and biological characteristics data to calculate total river returns and egg deposition. Status of stock is evaluated against a conservation egg requirement (calculated in terms of fluvial and lacustrine habitats) derived for Gander River. Other information available in this document includes life-history characteristics of large salmon sampled in Gander River since 1978 and water temperature and water level data since 1989 for the main stem in the vicinity of the counting fence and since 1985 for Salmon Brook tributary.

Management Measures, Past and Present

The introduction of the commercial Atlantic salmon fishery moratorium in insular Newfoundland in 1992 followed a major management plan introduced in 1984 (O'Connell *et al.* 1992a; May 1993), which was modified in 1990 and 1991 to include a commercial fishery quota in each SFA (O'Connell *et al.* MS 1992b). Elements of this management regime continued into the moratorium years. The moratorium placed on the Northern Cod Fishery in 1992, which should have eliminated by-catch of Atlantic salmon in cod fishing gear in SFAs 1-9, was interrupted in 1999 with a limited commercial fishery (total allowable catch of 9000 t) (Anon 1999a). This fishery was prosecuted with fixed gear (gillnets) and did not involve the use of cod traps, which historically accounted for the major portion of Atlantic salmon by-catch. There was a small index cod fishery in this area in September-October in 1998, which is mainly outside the migration period of June-early September for most Atlantic salmon destined for insular Newfoundland rivers.

A quota on the number of fish that could be retained in the Atlantic salmon recreational fishery was introduced in each SFA in 1992 and 1993. The quota was assigned for each SFA as a whole as opposed to individual river quotas. Only hook-and-release fishing was permitted after the quota was caught. Recreational fishery quotas were eliminated in 1994. In place of quotas, for insular Newfoundland, the season bag limit for retained small salmon was lowered from eight to

six fish, three to be caught prior to July 31 and three after that date. Hook-and-release fishing only was permitted after the bag limit of three was reached in each time period. These measures remained in effect in 1995-97. Returns of small salmon to many rivers in insular Newfoundland in 1997 were substantially lower than expected (Dempson *et al.* MS 1998; O'Connell *et al.* MS 1998a). As a result of this and uncertainties regarding levels of future returns, the management plan for 1998 was much more conservative than for previous years. The season bag limit for the retention of small salmon in 1998 was reduced to one, pending the results of an in-season review. As a result of the findings of the in-season review, anglers were allowed to additionally retain three small salmon from July 4 until the end of the angling season. Beginning on July 8, 1998, only the use of barbless hooks was permitted. As in previous years, retention of large salmon was not permitted in insular Newfoundland.

A three-year management plan was implemented in 1999, a significant component of which was the introduction of a River Classification System for insular Newfoundland, used to develop retention levels based on the health of individual stocks, without jeopardising conservation goals. This was a major departure from previous years when stocks were managed on a global basis. Details of the three-year plan are provided in Anon. (1999b). Under this classification system, Gander River is designated as Class I. Rivers in this class fit the following criteria: are large rivers where conservation requirements have been met on average since 1992 (the first year of the commercial salmon fishing moratorium); are rivers that support large populations of Atlantic salmon (>15,000); main stems are not as subject to fluctuations in environmental conditions such as low water levels and high water temperatures as smaller rivers and hence are exempt from protocols regulating angling closures for environmental reasons. Even though the entire Gander River (including tributaries) was exempt from environmental protocols in 1999, all tributaries (except the main stems of Northwest Gander and Southwest Gander tributaries) were closed from July 23 to August 16; the main stems of Northwest Gander and Southwest Gander tributaries were closed during August 5-12. The retention limit for small salmon in Class I rivers is set at 6 fish, without the July 31 season split. The daily hook-and-release limit for Class I rivers is four fish, up from two in 1998.

Following consultations with the Gander River Management Association, the management plan for Gander River for 1999 was subsequently modified from that set out in Anon. (1999b). Instead of the allocated up-front retention limit of six small salmon as defined for Class I rivers in general, only four were available at the beginning of the season for Gander River. The remaining two fish were allocated following an in-season review in mid-July, when it was projected that the conservation spawning requirement would be met. Other measures pertaining to Gander River were as follows: a) all waters above Dead Wolf Falls (newly accessible to anadromous Atlantic salmon) on Dead Wolf Brook (a tributary of Southwest Gander River) and all waters above Great Gull Falls on Great Gull River (a tributary of Northwest Gander River) were restricted to hook-and-release fishing only, and b) to reduce crowding in the area from Glenwood Bridge to and including Pat's Pool, and on First Pond Bar, the daily hook-and-release limit in these two areas was lowered to two fish, with no change in retention limit.

As was the case for the period 1995-98, there was a fall hook-and-release fishery in the main stem of Gander River below Gander Lake in 1999 (September 8-October 7).

Methods

Recreational fishery data and counts of adult salmon in 1999 were compared to two pre-salmon moratorium means (1984-89 and 1986-91). The 1984-89 mean corresponds to years under the major management changes in the commercial fishery in the Newfoundland Region, cited above. The 1986-91 mean incorporates the quota years of 1990 and 1991. The mix of management measures in effect during 1984-89 on the one hand and the imposition of commercial quotas in 1990 and 1991 on the other, should be kept in mind when making evaluations based on the 1986-91 mean. Recreational fishery data in 1999 were also compared to the moratorium mean for 1992-96 (see discussion of the License Stub Return System below) while counts of adult salmon were compared to the mean for 1992-98.

Adult salmon and smolt counting equipment

The location of the counting fence is shown in Fig. 1. Counts of adult Atlantic salmon were obtained with a positive image closed-circuit television (CCTV) system, which was operated in the boat passage in the counting fence, and by viewing VTR tapes. Visual counts were simultaneously conducted in the boat passage in order to categorise fish as small (< 63 cm) or large (≥63 cm) salmon. Counts were also obtained with a conventional adult trap installed in the counting fence. Counts for the Salmon Brook tributary (Fig. 1) were obtained with a conventional adult trap installed in the fishway. Counts of smolts were obtained with conventional traps installed in the counting fence. From 1989 to 1992 a single smolt trap was used, but beginning in 1993, a second trap was added. These traps were installed for the purpose of releasing smolts and kelts migrating downstream during the upstream adult counting period; therefore counts are partial and account for a small portion of the total number of smolts and kelts leaving the river each year.

Recreational fishery data

Prior to 1997, catch and effort data for each river were collected by Department of Fisheries and Oceans (DFO) River Guardians and processed by DFO Science Branch staff, according to procedures outlined in Ash and O'Connell (1987). Rivers with counting facilities had information separated above and below the counting facilities. Data for 1997-99 were derived from the License Stub Return System (see O'Connell *et al.* (MS 1998b) for a description of methodology). Data for 1999 are preliminary at this stage. It was not possible to apportion information above and below the counting fence with the License Stub. In 1997, catch and effort information was apportioned above and below the counting fence by applying the mean proportion for above and below for the period 1993-96 to the estimate for the entire river from the License Stub Return. In 1998 and 1999 angling data for the area below the counting fence, were provided by River Guardians.

The License Stub Return System for collecting recreational fishery data represents a complete departure from the previous DFO River Guardian method. Details of a comparison of stub data with DFO River Guardian data, for rivers in insular Newfoundland for 1994-96, are provided in O'Connell *et al.* (MS 1998b). Overall, estimates of released small and large salmon from the stub were substantially higher than estimates from River Guardians, while the two

methods were closer with respect to estimates of small salmon retained. This has to be kept in mind when comparing catches in 1997-99 with previous years. There is evidence that effort expenditure was under-reported by the stub method and hence this information will not be used in the present document for 1997-99. Analyses are currently being carried out to adjust for under-reporting. The stub estimate for the number of large salmon released for 1997 is incomplete.

Biological characteristics

Biological characteristics information on adult Atlantic salmon in Gander River was obtained primarily by sampling recreational catches, and since 1996, also by sampling fish captured in an estuarial trap and in the counting fence trap. Information used in the calculation of egg deposition (mean weight and proportion female) for fish < 63 cm in fork length (small salmon) is shown in Table 1. Because the sample sizes for weight and proportion female in 1987, were small, the means for the pre-moratorium years 1984-91 were used to calculate egg deposition in that year; similarly, the means for the moratorium period 1992-98 were used for 1998.

A mean weight of 3.13 kg and a proportion of female value of 0.77 (O'Connell *et al.* MS 1997) was used to calculate egg deposition for fish ≥ 63 cm in fork length (large salmon) for all years.

A mean relative fecundity value of 1,752 eggs/kg derived for Gander River (O'Connell *et al.* MS 1998c) was used for both small and large salmon in 1998.

Biological characteristics of smolts were obtained by sampling mortalities incurred during counting operations each year.

Condition was examined using Fulton's condition factor (K) as follows:

$$K = W \times C / L^3 \qquad (1)$$

where,

W = weight (gm for smolts; kg for adults)
C = 100 (for smolts); 100000 (for adults)
F = fork length (cm)

Total river returns, spawning escapement, and egg deposition

Calculations were performed for small and large salmon separately. Total egg deposition was obtained by summing depositions for small and large salmon.

Total river returns

Total river returns (TRR) were calculated as follows:

$$TRR = RC_b + C + HRM_b \qquad (2)$$

where,

RC_b = recreational catch below counting fence
C = count of fish at counting fence
HRM_b = hook-and-release mortalities (10% of hook-and-release fish) below counting fence

A partial count of small and large salmon was obtained at the counting fence in 1992. High water levels caused a delay in counting fence installation until July 1. During the period of delay, fish were counted upriver at the Salmon Brook fishway and also there were some angling catches. The numbers of small and large salmon entering Gander River prior to July 1 in 1989 and 1990 represented on average 4.8% and 7.5% of the total counts. The total counts of small and large salmon for 1992 were adjusted using these percentages and daily counts estimated as the the product of the average proportion of total count (for 1989-90) on a daily basis and estimated total count. Information for 1991 was not used because in that year timing of adult migration was later than in 1989 and 1990 (O'Connell and Ash MS 1992). A similar approach was used to adjust the counts of small and large salmon at the Salmon Brook fishway in 1990. In that year, counts were not obtained during the last two weeks of the run prior to the cessation of counting operations because of extremely low water conditions. The average percentage of small and large salmon counted at the fishway up to August 16 during the period 1984-91 (exclusive of 1987) was 95 and 90.

Spawning escapement

Spawning escapement (SE) was calculated as follows:

$$SE = TRR - RC_t - HRM_t \quad (3)$$

where,

RC_t = total recreational catch
HRM_t = total hook-and-release mortalities (10% of hook-and-release fish)

Egg deposition

Egg deposition (ED) was calculated as follows:

$$ED = SE \times PF \times RF \times MW \quad (4)$$

where,

SE = number of spawners
PF = proportion of females
RF = relative fecundity (No. eggs/kg)
MW = mean weight of females

The phenomenon of atresia occurs in Atlantic salmon in insular Newfoundland (O'Connell and Dempson MS 1997). Since the egg deposition calculations above were based on eggs in early stages of development, they should be regarded as potential egg depositions.

Conservation egg deposition and spawner requirements

Conservation egg deposition and spawner requirements for Gander River, were developed by O'Connell and Dempson (MS 1991). The egg requirement for classical fluvial parr rearing habitat (Elson 1957) was 240 eggs/100 m^2 (Elson 1975); the requirement for lacustrine habitat was 368 eggs/ha (O'Connell and Dempson 1995). **It should be noted that Gander Lake was not included in the calculation of the egg deposition requirement. Also, habitat areas newly accessible to anadromous Atlantic salmon above Big Dead Wolf Falls located on Dead Wolf Brook (Southwest Gander River) have not been included.**

Accessible rearing habitat and conservation egg and spawner requirements in terms of fluvial and lacustrine habitats were as follows:

	Lacustrine	**Fluvial**	**Total**
Accessible habitat	21488 ha	159560 units	
Eggs (No. x 10^6)	7.917	38.294	46.211
Small salmon (No.)	3739	18089	21828

The adult conservation spawning requirement was calculated in terms of small salmon only. Egg deposition from large salmon was considered as a buffer.

Net marks

Since 1994, adult salmon entering the adult trap installed in the counting fence have been examined for the incidence of net marks.

Environmental data

Water temperatures were measured at the counting fence with a Hugrun Seamon digital thermograph. At the fishway in Salmon Brook tributary, temperatures were measured with a Ryan TempMentor digital thermograph in 1985-90 and with the Hugrun Seamon digital thermograph in 1991-99. Water levels were measured near the counting fence each year over a permanent benchmark installed in the river.

Results

Recreational fishery

Catch and effort data are presented in Appendix 1. Catches for all years prior to 1992 represent retained catch for the entire angling season. Total catch for 1999 (retained plus released fish) is compared to years prior to 1992 and 1992-96 (1997 and 1998 data were derived from the

License Stub Return System, as seen above, and hence were not included in the means). There was no estimate of released fish during the period of retention of catch in 1992, which could impact on comparisons. The total number of fish retained in 1999 is also shown. Calculation of catch per unit of effort (CPUE) in terms of retained fish only was not possible since effort figures apply to both retained and released fish collectively. For reasons pointed out above, effort and CPUE information were not available for 1997-99.

Total catch of small salmon (retained plus released fish) in 1999 decreased from 1998 (38%) but was similar to the 1992-96 mean (2%). The number of small salmon retained decreased from that of 1998 (19%) and was also similar to the 1992-96 mean (1%). The number of small salmon released in 1999 decreased from 1998 (61%) and the 1992-96 mean (8%); the number of large salmon released decreased by 26% from 1998 but remained above the mean for 1992-96 (295%).

Forty-one small salmon and 10 large salmon were released in the 1999 fall hook-and-release fishery. In 1998, 26 small salmon and 2 large salmon were released. Thirty-eight small and 3 large salmon were released in 1997; effort expenditure was 100 rod days. In 1996, 128 small and 17 large salmon were released; effort expended was 231 rod days. In 1995, 30 small and 9 large salmon were released with an effort expenditure of 158 rod days.

Biological characteristics

Smolts

Mean fork length, mean weight, mean smolt age, and mean condition factor for smolts sampled at the counting fence during 1989-99 are presented in Fig. 2. No data were available for 1997 and 1998. These parameters were relatively stable over time, with the most pronounced fluctuations being exhibited by mean smolt age and mean condition. Mean smolt age as determined from virgin grilse (1992-99) was more stable over time (Fig. 3). Modal smolt age as determined from smolt samples (Fig. 4) in 1989-99 and from virgin grilse samples (Fig. 5) in 1992-99 was 4+ years.

Adults

The percentage of repeat spawning grilse in the small salmon component in 1999 was the highest recorded since 1984 (Table 1). The overall average percentage for the moratorium period (1992-99) was substantially higher than for the pre-moratorium period (1984-91), due mainly to the influence of the values for 1997 and 1999. Average length and weight of small salmon during the moratorium years was also higher than for pre-moratorium years, while the reverse was true for percentage of female.

Mean fork length, mean weight, mean smolt age, and mean condition factor for virgin grilse for the moratorium years are presented in Fig. 3. There were minor fluctuations over time in these parameters, with values for 1999 being on the higher side.

The numbers and percentages of the various life-history groupings comprising the large salmon component of returns to Gander River since 1978 are presented by individual year and for years combined in Table 2. Overall, the dominant group was consecutive spawning grilse followed by alternate spawning grilse, virgin grilse, and virgin large salmon (a minor component). These groups are broken out in terms of freshwater residence (smolt age), virgin sea life, and spawning history, as denoted by notation, for all years combined, in Table 3. With respect to the notation, the number to the left of the first period is the smolt age, and everything to the right is sea life. The first number to the right of the first period is the virgin sea life while SM denotes a spawning mark. Among consecutive spawners, the number of spawnings ranged from one to five. Some of the alternate spawners later adopted a consecutive spawning strategy (e.g., 3.1.SM.1.**SM.SM**; 4.1.SM.1.**SM.SM**). The virgins were 2-sea-winter fish.

Counts at counting fence and fishway

Smolts

Numbers of smolts counted at the counting fence each year since 1989 are shown in Table 4. Coincident with the installation of the second trap in 1992, there was a large increase in the total number of smolts counted. The number of smolts counted each year depended on when the counting fence was installed, which in turn depended on water levels. By the time the counting fence was installed, smolt runs usually had already been in progress to varying degrees, subject to variations in annual run timing. Therefore, it is felt that these counts have limited value as annual indicators of the total numbers of smolts leaving the river. With these constraints in mind, annual run timing of smolts through the traps is presented in Fig. 6. Latest median run timing (day of the year) occurred in 1992 while the earliest was in 1995. Median timing for 1999 was similar to that of 1998 which in turn was the third earliest. While the date when first smolts were encountered each year was a function of when the fence was installed, the timeframe of adult counting permitted the determination of when the last smolts left the river for the season. Small numbers of smolts continued to leave the river well into August in six of the ten years of counts, and in 1991, a few smolts were counted on September 3. The earliest date for observing the last smolts was July 17, 1996.

Adults

Counts of small and large salmon for the Gander River counting fence for the period 1989-99 are shown in Table 4. The count of small salmon in 1999 was similar to that of 1998 (-1%) and the moratorium mean for 1992-98 (-6%) but was well above the pre-moratorium mean for 1989-91 (155%). The count of large salmon was the highest on record. Daily counts of small salmon in 1999 were characterised by two distinct peaks, one occurring in early July and the other around mid-July (Fig. 7). The peak count for large salmon occurred between the second and third week of July, earlier than in 1998, which in turn was earlier than in 1997. The median daily count of small salmon in 1999 occurred approximately ten days later than in 1998, in which year the earliest run timing of the moratorium period was recorded (Fig. 8). The median for large salmon in 1998 occurred during the third week of July as opposed to early August in 1997 (the latest of the moratorium years). The median for large salmon in 1999 occurred around mid-July, the earliest since 1996. There were only a few days between medians for small and large salmon in 1999; the

highest number of days between medians occurred in 1998 and 1997, in that order, and in 1992 and 1993, the medians coincided.

Counts of small and large salmon for the fishway located in Salmon Brook tributary for the period 1974-99 are shown in Table 5 and Fig. 9. The count of small salmon in 1999 decreased from that of 1998 (15%), was similar to the 1984-89 (3%) and 1992-98 (-3%) means, and increased over the 1986-91 mean (54%). The count of large salmon was similar to that of 1998, the highest on record, and increased over the means (523, 948, and 26%, respectively). The peak daily counts of both small and large salmon in Salmon Brook occurred in mid-August (Fig. 10), as did the medians (Fig. 11).

Total river returns, spawning escapement, and percentage of conservation requirement achieved

Total river returns, spawning escapement, potential egg deposition, and percentage of conservation requirement achieved for Gander River in 1989-99 are presented in Table 6. Total returns of small salmon in 1999 (see also Fig. 12) were similar to 1998 (-2%) and the moratorium mean for 1992-98 (-6%). Total returns of large salmon in 1999 were the highest on record. The percentage of conservation egg requirement achieved for 1989-99 is also shown in Fig. 13. Less than 50% of conservation requirement was achieved for small salmon in terms of egg deposition prior to the moratorium. Conservation egg requirement was exceeded in 1999. During the moratorium years, in addition to 1999, conservation egg requirement was achieved in 1992, 1993, 1996 and 1998, although the years 1994 and 1995 were close to requirement at 91 and 95%. The conservation requirement in terms of small salmon was met only in 1993. The highest proportionate contribution to total egg deposition by large salmon occurred in 1999 while the lowest was in 1995.

Net marks

The numbers of small and large salmon examined for net marks and the numbers and percentages bearing net marks in 1994-99 were as follows:

Year	Small salmon (No.)			Large salmon (No.)			Total (No.)		
	Examined	Marked	%	Examined	Marked	%	Examined	Marked	%
1994	223	36	16.1	10	1	10.0	233	37	15.9
1995	233	16	6.9	13	6	46.1	246	22	8.9
1996	407	52	12.8	34	2	5.9	441	54	12.2
1997	162	27	16.7	33	4	12.1	195	31	15.9
1998							2064	59	2.9
1999	958	37	3.9	167	22	1.3	1125	59	5.2

The highest percentage of small salmon with net marks occurred in 1997, while for large salmon it occurred in 1995. For small and large salmon combined (total), the incidence in 1997 was the same as in 1994, the highest of the five years, while that of 1999 was the second lowest.

Environmental conditions

Maximum and minimum daily water temperatures (°C) for the counting fence and recorded at the fishway in Salmon Brook are presented in Appendices 2 and 3 and Figs. 14 and 15 and daily mean water levels (cm) in Appendices 4 and 5 and Figs. 16 and 17. Maximum daily water temperatures in 1999 reached and exceeded 20 °C at the counting fence for much of the period beginning in the third week of June (compared to early July in 1998) until around the third week in August and there were some occurrences in late August and early September; the highest temperature encountered was 24.3 °C, recorded on August 3. Minimum temperatures of 20 °C or above were consistently recorded for the first three weeks of August. Maximum water temperatures exceeding 20 °C were recorded at the Salmon Brook fishway from mid-June until the third week of August; the highest temperature (27.4 °C) occurred on August 2. Minimum daily temperatures at or above 20 °C occurred for a few days at a time throughout the summer but there was no consistent long sustained period such as recorded for the counting fence on the main stem. Water levels were generally low at the counting fence, especially from early July onwards; the lowest mean value was encountered on August 12. In Salmon Brook, low water levels persisted from late June until mid-August with the lowest mean level experienced on August 3 and 4.

Discussion

Total returns of small salmon to Gander River in 1999 were similar to those in 1998, which year in turn showed a marked improvement over 1997. Beginning in 1997, it was anticipated that there would be a substantial increase in returns of small salmon, resulting from the greatly increased egg deposition levels starting with the commercial salmon fishery moratorium in 1992 (Table 6). The lower than expected returns for Gander River in 1997 was consistent with observations for other rivers with counting facilities in insular Newfoundland, particularly on the Northern Peninsula and northeast and east coasts. For detailed analyses examining possible reasons for the overall low returns of small salmon in insular Newfoundland in 1997, which includes information and discussion for Gander River, see Dempson *et al.* (MS 1998) and O'Connell *et al.* (MS 1998a). While total returns of small salmon for Gander River in 1998 and 1999 improved over numbers recorded in 1997, they remained average for the moratorium period. It is unfortunate that smolt data cannot be used as indicative of smolt production from Gander River, for reasons discussed above. For other rivers distributed throughout insular Newfoundland, where there are complete smolt and adult counts, there are indications that continuing low smolt-to-adult (sea) survival (O'Connell *et al.* MS 2000) may have played a major role in the levels of small salmon returns in recent years.

Conservation requirement in terms of small salmon was met on only one occasion during the moratorium years. It is quite evident from Table 3 that large salmon emanating from many spawnings, as exhibited by their smolt ages and highly variable spawning histories, contribute to egg deposition in any given year. During a period of low survival of virgin fish such as appears to

be the case in recent years, the value of the contribution of large salmon in achieving conservation egg deposition requirement cannot be underestimated.

The incidence of net marks in 1999 was the second lowest of the moratorium years. The occurrence of net marks was likely the result of encounters with illegal and legal fishing gear in coastal waters and illegal gear in the river below the counting fence. It is not possible to accurately estimate the extent of such removals. Therefore total returns considered in the context of being equivalent to total production during the moratorium have to be regarded as minimum values.

Cautions associated with the parameter values used to calculate the conservation egg requirement have been discussed previously by O'Connell and Dempson (1995) and will not be dealt with here.

High water temperatures and low water levels could have played a role in the timing of entry of fish into the main stem of the river in 1999. Entry into Salmon Brook was impeded, with the bulk of small (63%) and large (80%) salmon entering this tributary (Figs. 10 and 11) after water levels increased in mid-August (Figs. 15 and 17).

Acknowledgement

The operation of the counting fence in Gander River in 1999 was carried out as a Joint Project between DFO and the Gander River Management Association.

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Table 1. Biological characteristics data for female small salmon and with sexes combined plus unsexed fish by year and for pre-moratorium (1984-91) and moratorium (1992-99) periods for Gander River (SFA 4), Newfoundland. WW = whole weight (kg); FL = fork length (cm); RS = repeat spawning grilse.

	Sexes combined plus unsexed							Females						%	
Year	$\bar{X}$ WW	SD	N	$\bar{X}$ FL	SD	N	% RS year of return	$\bar{X}$ WW	SD	N	$\bar{X}$ FL	SD	N	Female	N
1984	1.54	0.35	109	51.3	3.80	109	2.8	1.54	0.39	71	51.1	3.89	71	65	71
1985	1.62	0.33	111	51.0	3.66	113	1.8	1.63	0.34	82	51.0	3.59	84	74	84
1986	1.61	0.35	51	52.1	3.27	51	11.8	1.76	0.30	32	53.1	2.90	32	82	32
1987	1.49	0.37	19	50.6	3.50	19	0.0	1.47	0.40	15	49.8	3.45	15	79	15
1988	1.63	0.33	40	52.6	3.56	40	5.0	1.61	0.33	33	52.4	3.74	33	83	33
1989	1.60	0.38	187	52.8	4.11	186	9.4	1.66	0.39	89	53.5	4.13	88	83	89
1990	1.80	0.47	245	53.7	4.07	245	5.4	1.84	0.48	170	54.0	4.24	170	73	170
1991	1.70	0.46	142	52.8	3.93	141	0.7	1.66	0.47	110	52.3	3.90	109	85	110
1992	1.80	0.44	149	54.3	3.80	172	0.0	1.78	0.44	87	54.6	4.02	108	65	109
1993	1.86	0.41	144	55.1	3.98	145	5.6	1.85	0.39	73	55.0	3.28	73	70	73
1994	1.75	0.49	196	53.6	4.18	196	7.5	1.83	0.46	101	54.1	4.25	101	73	101
1995	1.73	0.51	76	52.5	4.73	73	2.7	1.72	0.51	48	52.1	5.13	46	66	48
1996	1.95	0.57	105	54.6	4.40	120	5.9	1.95	0.56	68	54.6	4.35	71	70	71
1997	1.65	0.44	27	54.2	4.67	212	27.0	1.68	0.48	17	54.4	3.94	20	72	20
1998	1.83	0.44	20	53.3	4.40	217	2.5	1.87	0.47	15	54.8	5.15	15	83	15
1999	1.94	0.50	51	55.6	3.96	333	30.0	1.90	0.48	34	55.5	3.88	35	66	35
Pre-moratorium 1984-91	1.66	0.42	904	52.5	4.01	904	4.9	1.69	0.43	602	52.6	4.10	602	77	604
Moratorium 1992-99	1.82	0.48	768	54.4	4.31	1468	12.6	1.84	0.47	443	54.4	4.22	469	69	472

Table 2. Number and percentage (in parentheses) of life-history groups in the large salmon category (>= 63 cm fork length) for Gander River, 1978-99.

Year	VG	CSG	ASG	VLS
1978			1(100.0)	
1980	2(66.7)	1(33.3)		
1981		1(100.0)		
1982	2(40.0)	2(40.0)		1(20.0)
1988	1(100.0)			
1989		2(100.0)		
1990	5(100.0)			
1991	1(100.0)			
1993		5(71.4)	2(28.6)	
1994	5(71.4)	1(14.3)	1(14.3)	
1995			9(90.0)	1(10.0)
1996		1(100.0)		
1997	1(2.6)	32(84.2)	5(13.2)	
1998	1(8.3)	7(58.3)	3(25.0)	1(8.3)
1999	1(1.3)	71(92.2)	5(6.5)	
Total	19(11.1)	123(71.9)	26(15.2)	3(1.8)

VG = virgin grilse; CSG = consecutive spawning grilse;
ASG = alternate spawning grilse; VLS = virgin large salmon

Table 3. Life-history groups by percentage notation for large salmon (>= 63 cm) for Gander River and corresponding length and weight information. Data are for years combined, 1978-99.

Life-history group	Notation	Notation		Fork length (cm)					Whole weight (kg)				
		N	Percent	Min.	Max.	Mean	SD	N	Min.	Max.	Mean	SD	N
Virgin grilse	3.1	5	26.3	63.0	65.2	63.8	0.82	5	2.80	3.30	3.10	0.26	3
	4.1	14	73.7	63.0	65.0	63.6	0.78	14	2.30	3.50	2.83	0.34	14
Consecutive spawning grilse	3.1.SM	15	12.2	63.0	68.9	65.5	2.19	15	2.15	3.00	2.64	0.39	4
	3.1.SM.SM	7	5.7	63.0	82.6	68.6	6.71	7	3.10	7.71	5.30	2.31	3
	3.1.SM.SM.SM	6	4.9	65.5	83.5	70.8	6.55	6					
	3.1.SM.SM.SM.SM	3	2.4	67.5	72.3	70.3	2.48	3			4.54		1
	4.1.SM	27	22.0	63.0	69.8	65.8	2.30	27	2.38	4.50	3.12	0.75	6
	4.1.SM.SM	25	20.3	63.0	78.1	67.4	4.46	25	2.40	3.00	2.71	0.24	4
	4.1.SM.SM.SM	19	15.4	64.4	82.8	72.2	5.34	19					
	4.1.SM.SM.SM.SM	6	4.9	64.8	75.5	71.6	4.34	6					
	4.1.SM.SM.SM.SM.SM	1	1.9			73.5		1					
	5.1.SM	5	4.1	63.4	66.7	64.5	1.29	5					
	5.1.SM.SM	5	4.1	63.1	71.5	66.7	3.35	5					
	5.1.SM.SM.SM	3	2.4	68.0	71.2	69.6	1.60	3					
	5.1.SM.SM.SM.SM	1	1.9			70.8		1					
Alternate spawning grilse	2.1.SM.1.SM	1	3.8			71.6		1					
	3.1.SM.1	8	30.8	68.7	80.0	75.2	4.21	8	3.33	5.90	4.85	1.00	7
	3.1.SM.1.SM	2	7.7	86.0	92.0	89.0	0.04	2			6.20		1
	3.1.SM.1.SM.SM	1	3.8			90.0		1					
	4.1.SM.1	12	46.2	63.0	81.1	73.0	5.62	12	2.50	5.47	4.12	1.04	7
	4.1.SM.1.SM.SM	1	3.8			72.0		1			3.70		1
	4.1.SM.1.SM.1	1	3.8			78.0		1					
Virgin large salmon	3.2	2	66.7	75.0	75.5	75.3	0.04	2			4.65		1
	4.2	1	33.3			76.0		1			4.90		1

Table 4. Counts of Atlantic salmon smolts and adults at the Gander River counting fence, 1989-99. Adjusted counts are bold and in italics.

	Smolts	Adults	
Year		Small	Large
1989	12556	7743	473
1990	19777	7520	508
1991	12973	6445	670
1992	11104	***18179***	***4162***
1993	29913	25905	1734
1994	49109	18080	1072
1995	59370	22002	1121
1996	99149	23665	1753
1997	35873	10476	1883
1998	6860	18742	3649
1999	12197	18461	4815
$\bar{X}$ 86-91		7236	550
95% LCL		5512	289
95% UCL		8960	811
N		3	3
$\bar{X}$ 92-98		19578	2196
95% LCL		14949	1070
95% UCL		24208	3323
N		7	7

Table 5. Counts of small and large salmon at Salmon Brook fishway, 1974-99. Partial counts are in parentheses and are not included in the means. Adjusted counts are bold and in italics.

Year	Small salmon	Large salmon
1974	857	9
1975		
1976		
1977		
1978	755	52
1979	(404)	(6)
1980	997	15
1981	2459	33
1982	1425	18
1983	978	12
1984	1081	38
1985	1663	26
1986	1064	12
1987	493	9
1988	1562	24
1989	596	24
1990	***345***	***8***
1991	245	2
1992	1168	101
1993	1560	87
1994	968	83
1995	1600	125
1996	946	112
1997	465	119
1998	1295	141
1999	1105	138
$\bar{X}$ 84-89	1077	22
95% LCL	573	11
95% UCL	1580	33
N	6	6
$\bar{X}$ 86-91	718	13
95% LCL	191	4
95% UCL	1244	23
N	6	6
$\bar{X}$ 92-98	1143	110
95% LCL	778	90
95% UCL	1508	129
N	7	7

Table 6. Total river returns, spawning escapements, and percentage of conservation requirement achieved in terms of small salmon and eggs for Gander River, 1989-99.

Year	Total returns (No.)		Prop.	Spawning escapement (No.)		Egg deposition (Millions)		% cons. req. achieved		Eggs per
	Small	Large	Large	Small	Large	Small	Large	Small	Eggs	100 sq. m
1989	7743	473	0.058	6570	473	18.005	2.264	30.1	44	127
1990	7740	508	0.062	6585	508	15.381	2.126	30.2	38	110
1991	6745	670	0.090	5565	670	13.757	2.825	25.5	36	104
1992	18179	4162	0.186	17143	4162	36.317	18.343	78.5	118	343
1993	26205	1734	0.062	24739	1725	52.477	6.800	113.3	128	372
1994	18273	1072	0.055	16106	1068	37.697	4.504	73.8	91	264
1995	22266	1121	0.048	19606	1114	38.994	4.696	89.8	95	274
1996	23946	1753	0.068	20822	1746	49.796	7.362	95.4	124	358
1997	10599	1883	0.151	9437	1864	20.877	7.861	43.2	62	180
1998	18805	3649	0.163	16044	3619	35.494	15.262	73.5	110	318
1999*	18491	4822	0.207	16337	4800	35.893	20.241	74.8	121	352

*Preliminary

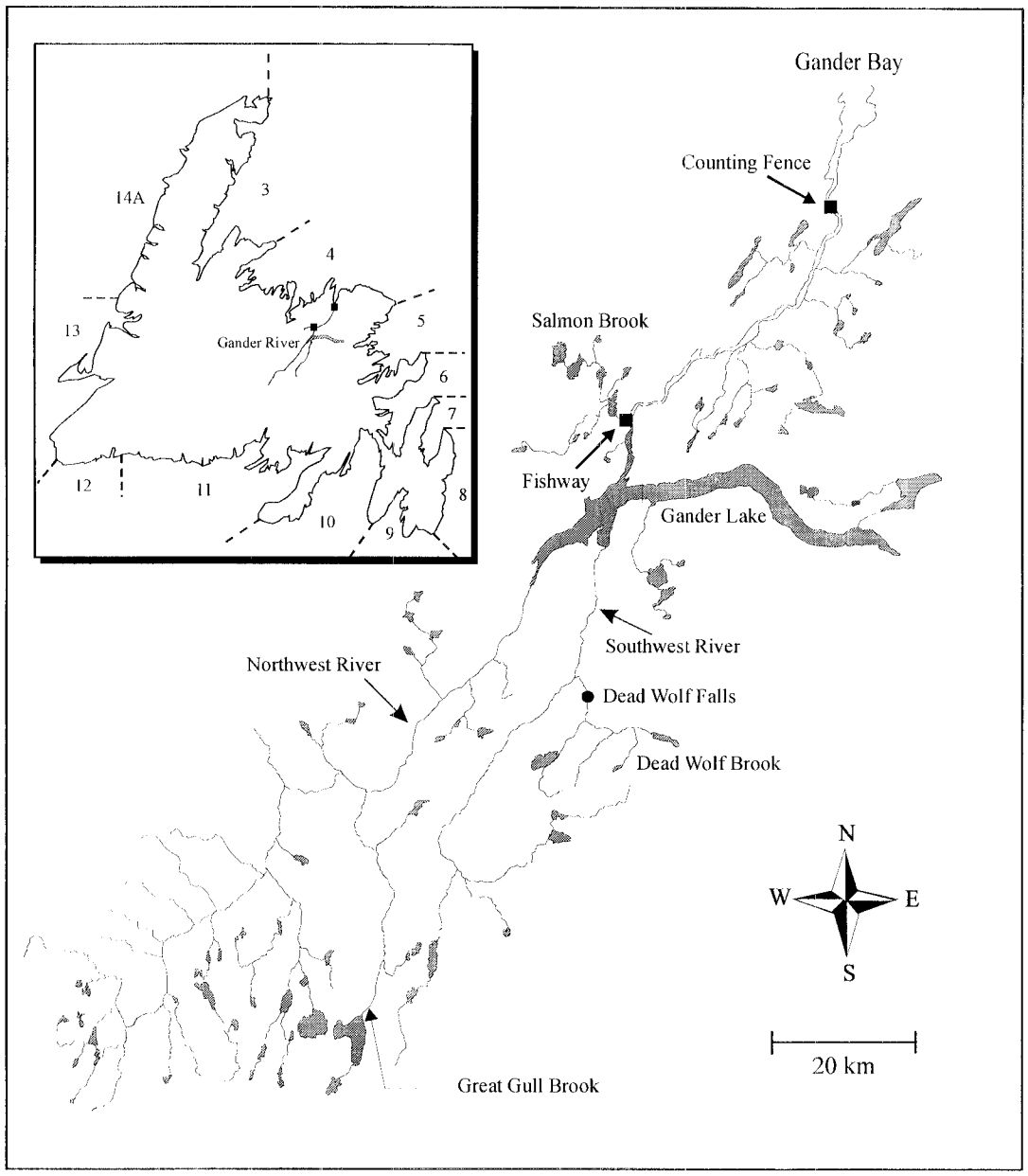

Fig. 1. Map showing the Gander River watershed and location of the counting fence in the lower river, the fishway in Salmon Brook, and the falls on Dead Wolf Brook. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Gander River.

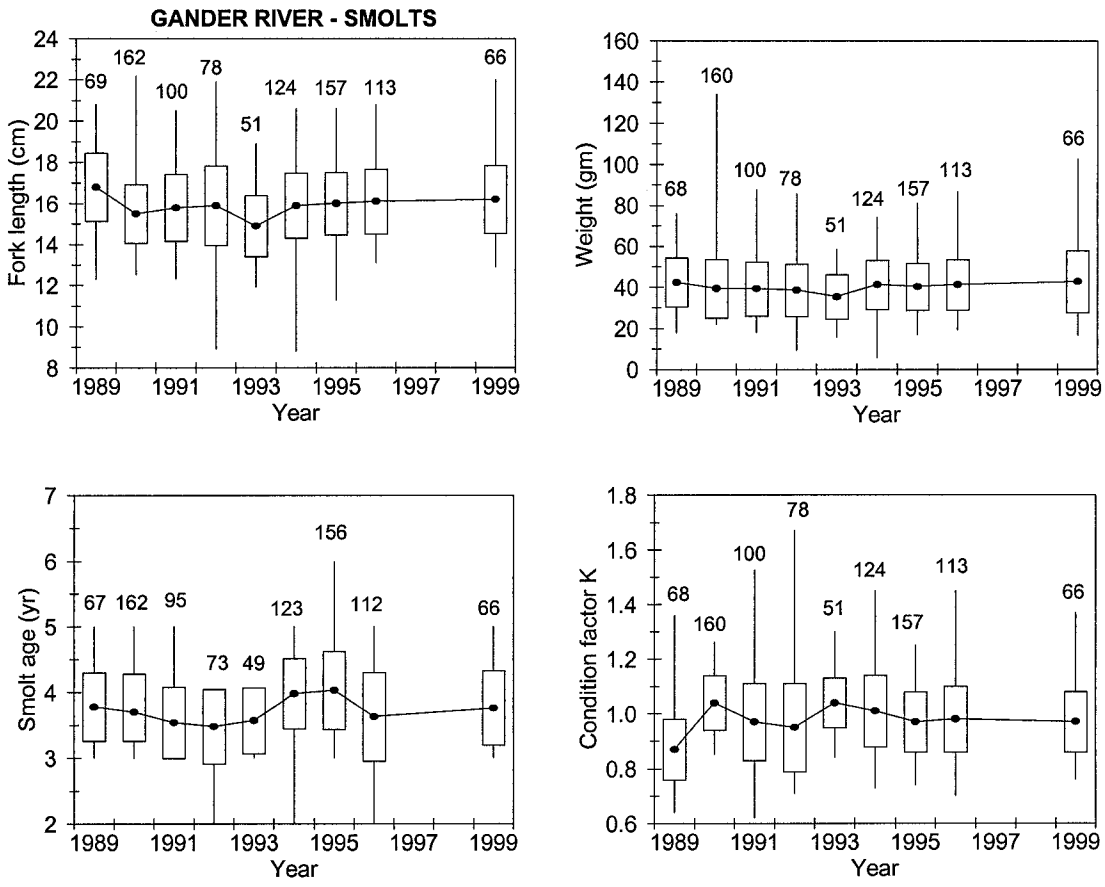

Fig. 2. Mean fork length, mean weight, mean smolt age, and mean condition factor for smolts from Gander River, 1989-99. The rectangle around each point denotes the standard deviation; the vertical line is the range; the number above the vertical line is the sample size.

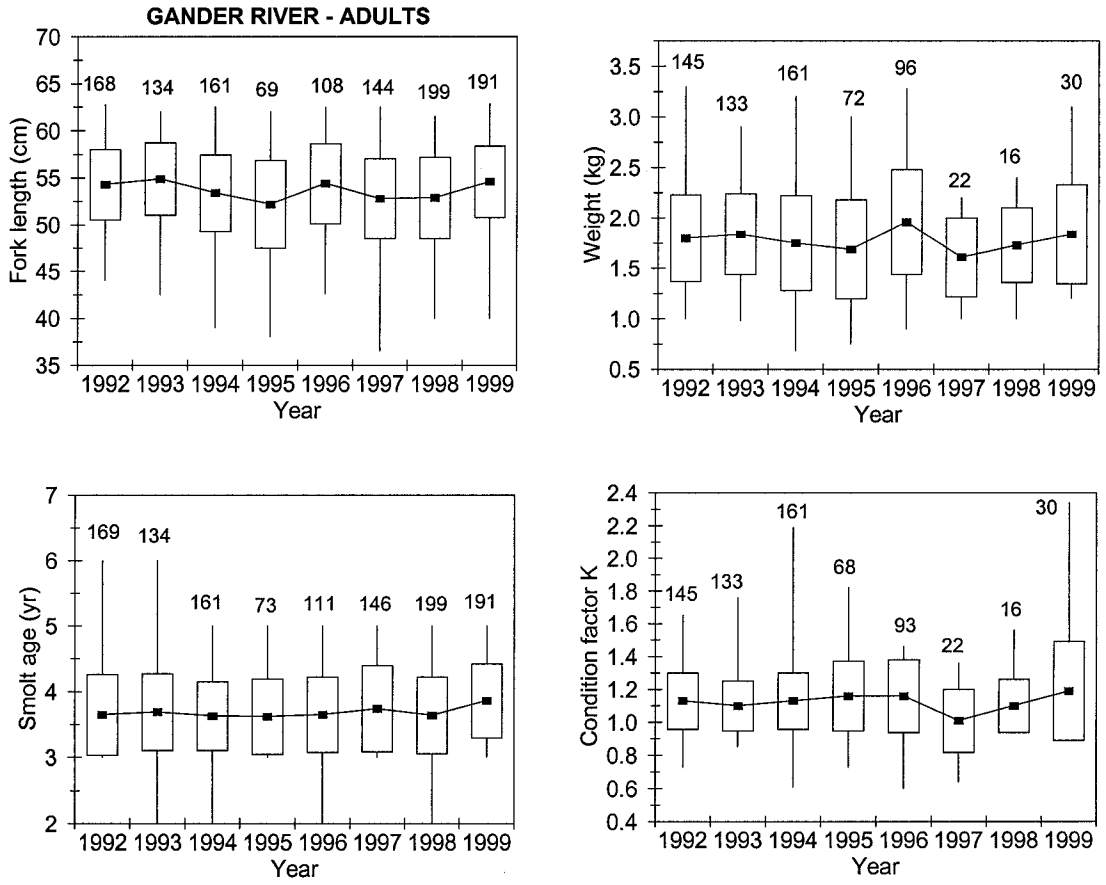

Fig. 3. Mean fork length, mean weight, mean smolt age, and condition factor for virgin grilse from Gander River, 1992-99. The rectangle around each point denotes the standard deviation; the vertical line is the range; the number above the vertical line is the sample size.

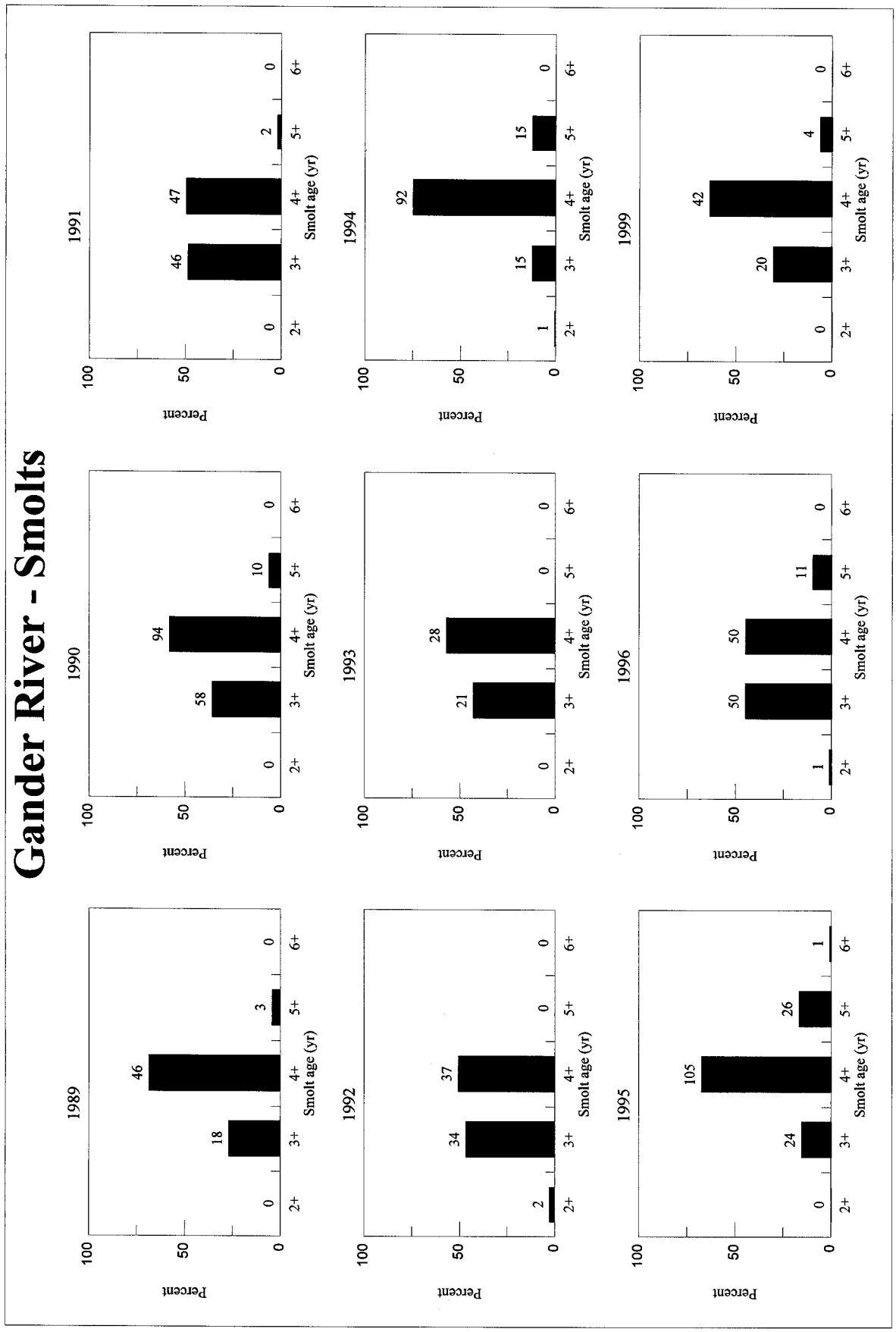

Fig. 4. Age composition for smolts from Gander River, 1989 - 99. The number above each bar denotes sample size.

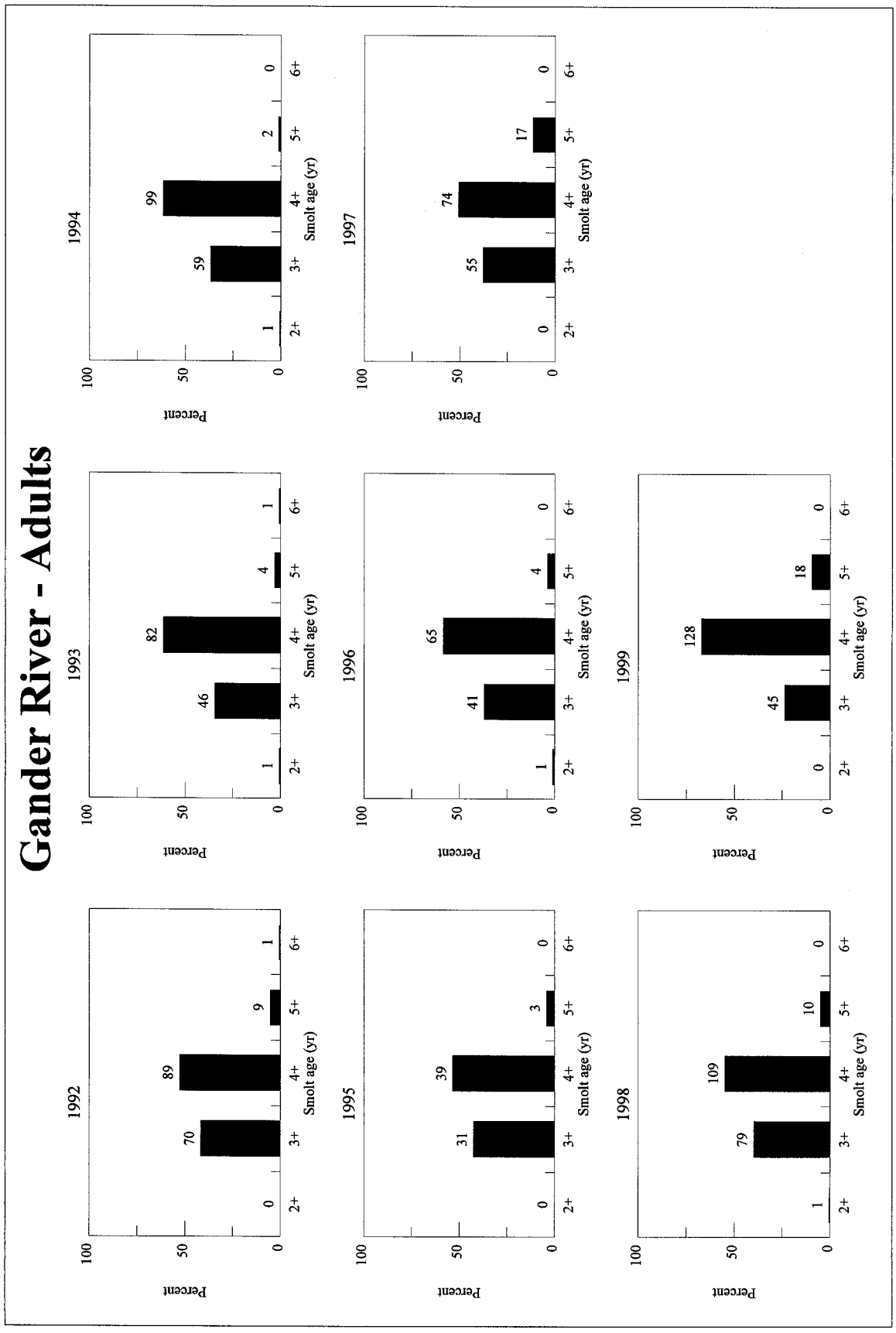

Fig. 5. Smolt age composition for virgin grilse from Gander River, 1992-99. The number above each bar denotes sample size.

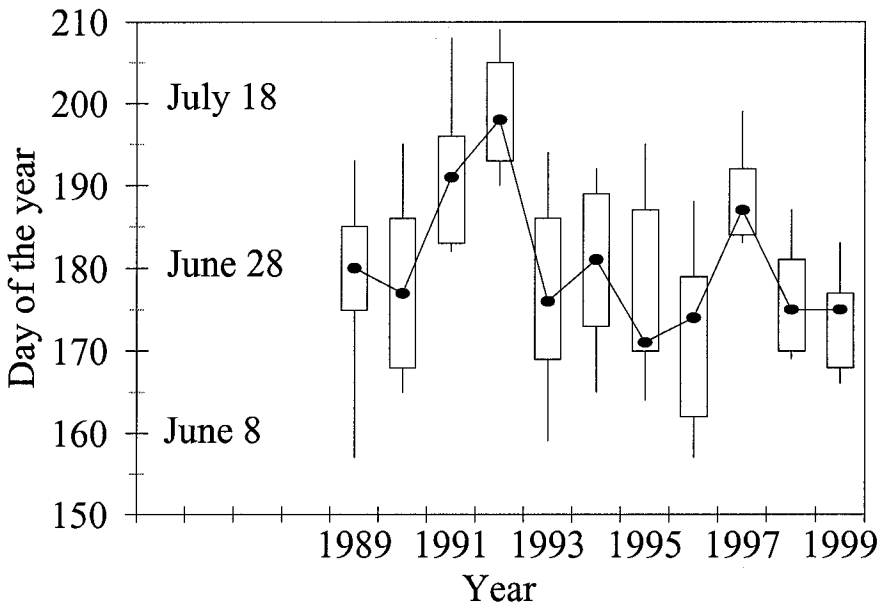

Fig. 6. Annual variation in smolt run timing for Gander River, 1989-99. Vertical lines represent the 10th and 90th percentiles, rectangles are the 25th and 75th percentiles, and the point within each rectangle is the median.

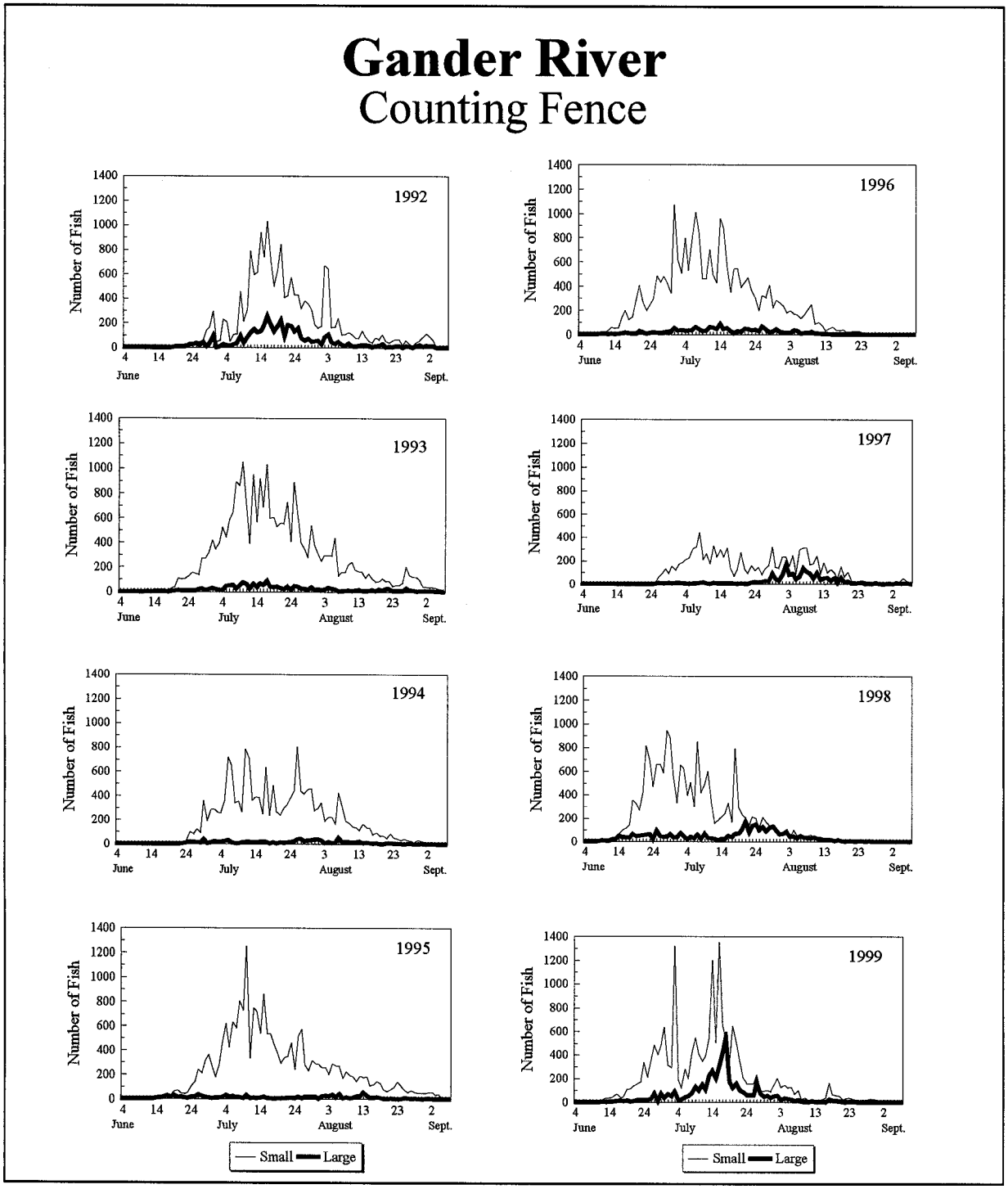

Fig. 7. Daily counts of small and large salmon at the Gander River counting fence, during the moratorium years, 1992-99.

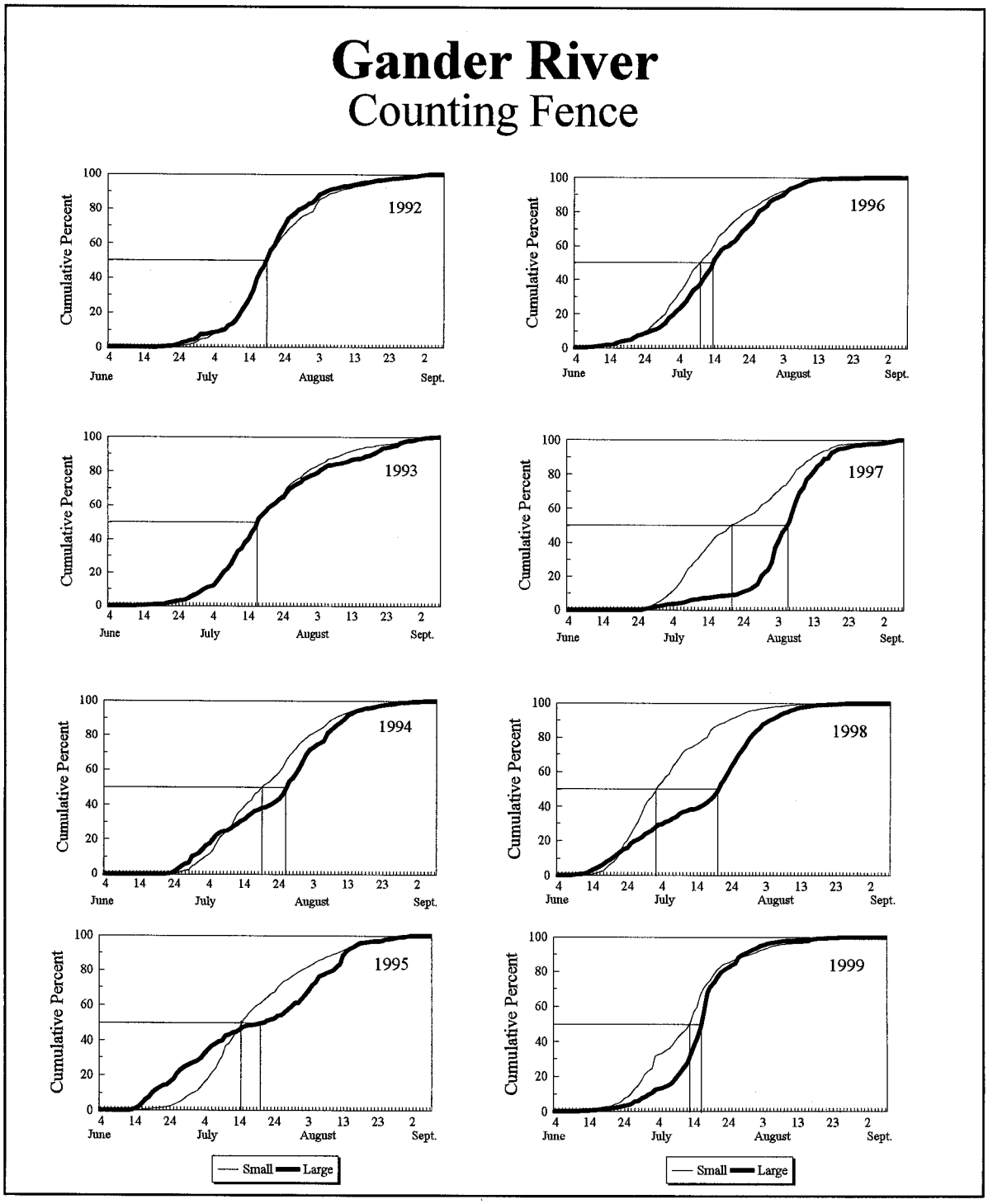

Fig. 8. Daily cumulative percent of small and large salmon at the Gander River counting fence, during the moratorium years, 1992-99. Dates of median counts are also shown.

Gander River (Salmon Brook)

Fishway Count

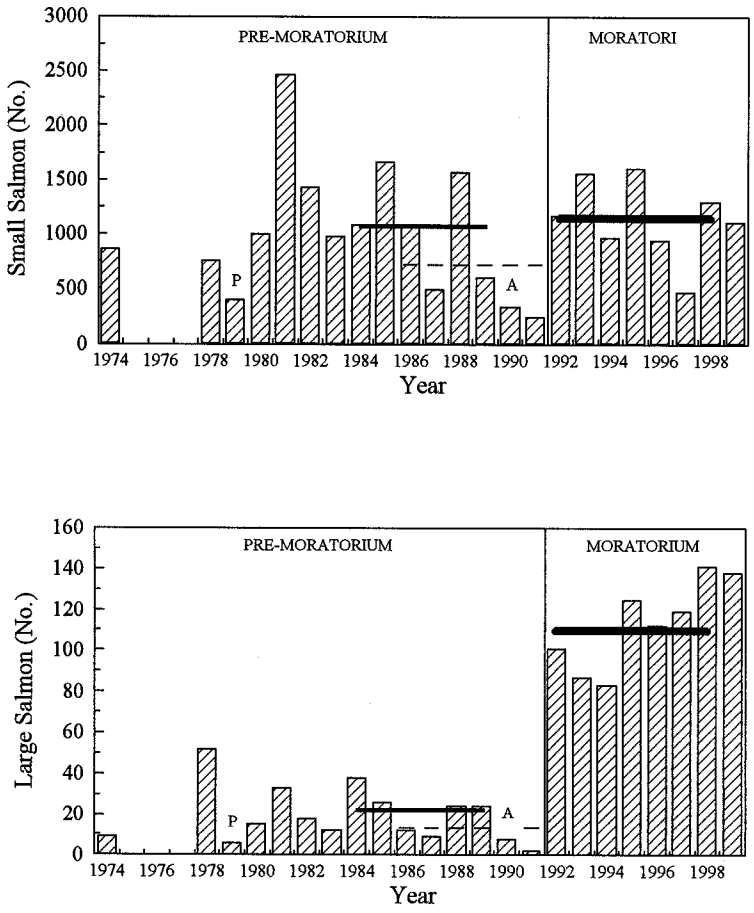

Fig. 9. Counts of small and large salmon at the fishway in Salmon Brook (SFA 4), 1984-99. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean, and the thick solid line the 1992-98 mean. A=adjusted count; P=partial count, not included in the means.

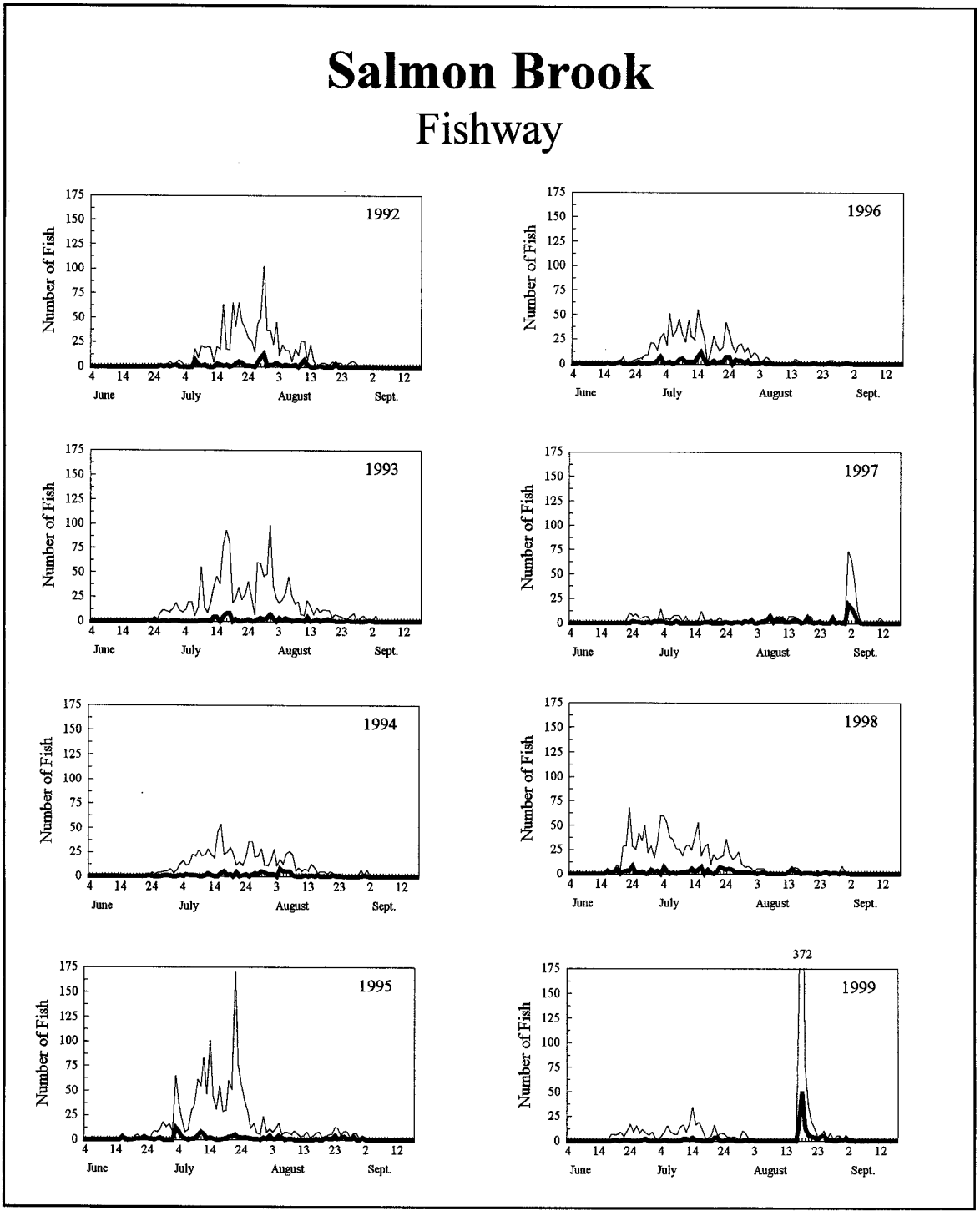

Fig. 10. Daily counts of small and large salmon at the Salmon Brook fishway, during the moratorium years, 1992-99.

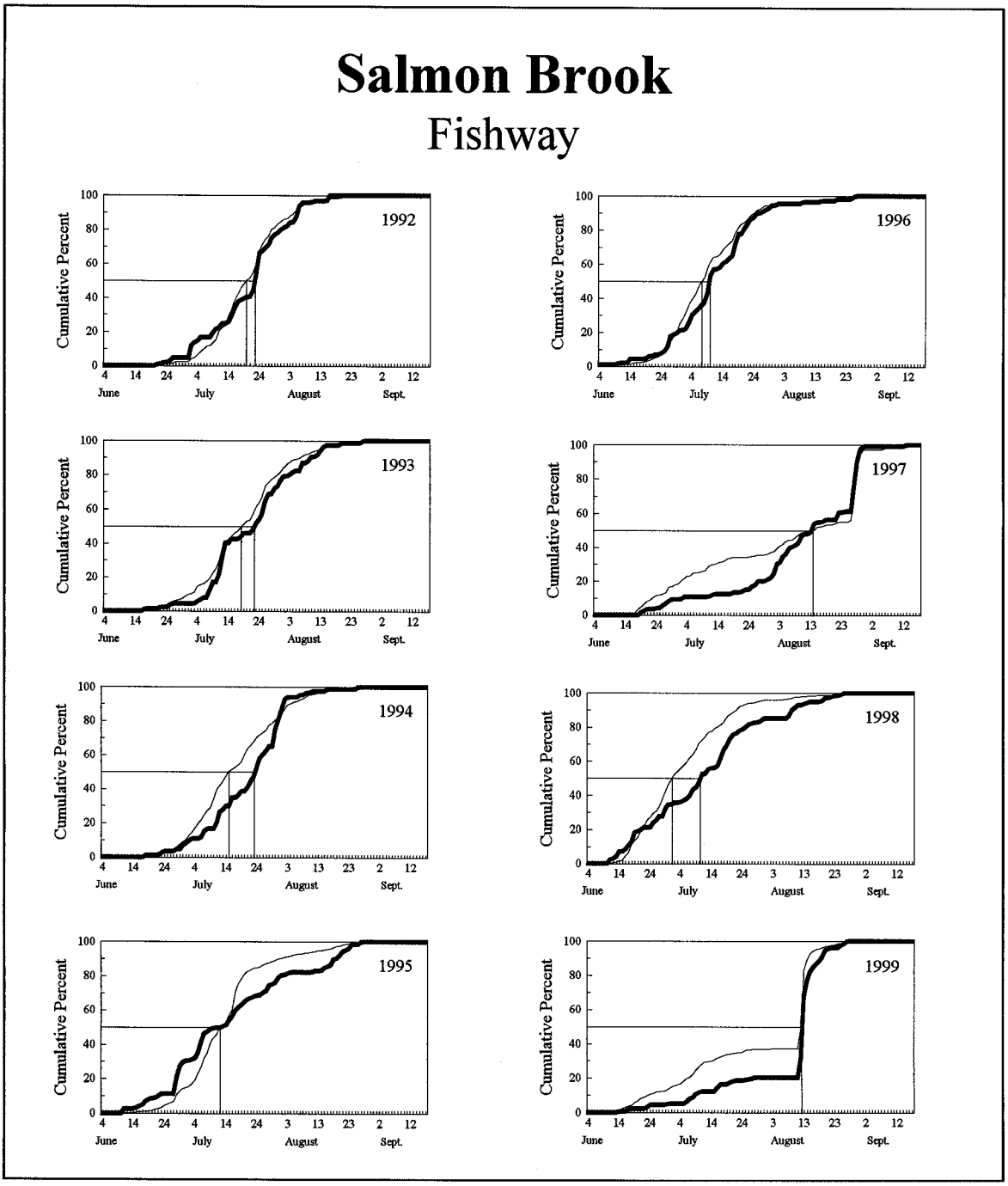

Fig. 11. Daily cumulative percent of small and large salmon at the Salmon Brook fishway, during the moratorium years, 1992-99. Dates of median counts are also shown.

Gander River
Total Returns

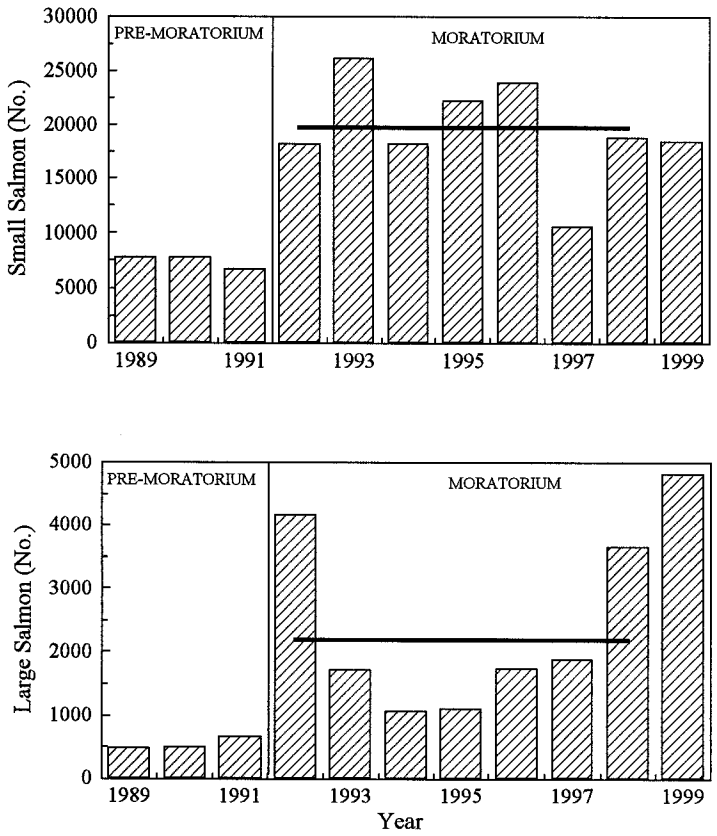

Fig. 12. Total returns of small and large salmon to Gander River (SFA 4), 1989-99. The solid horizontal line represents the 1992-98 mean.

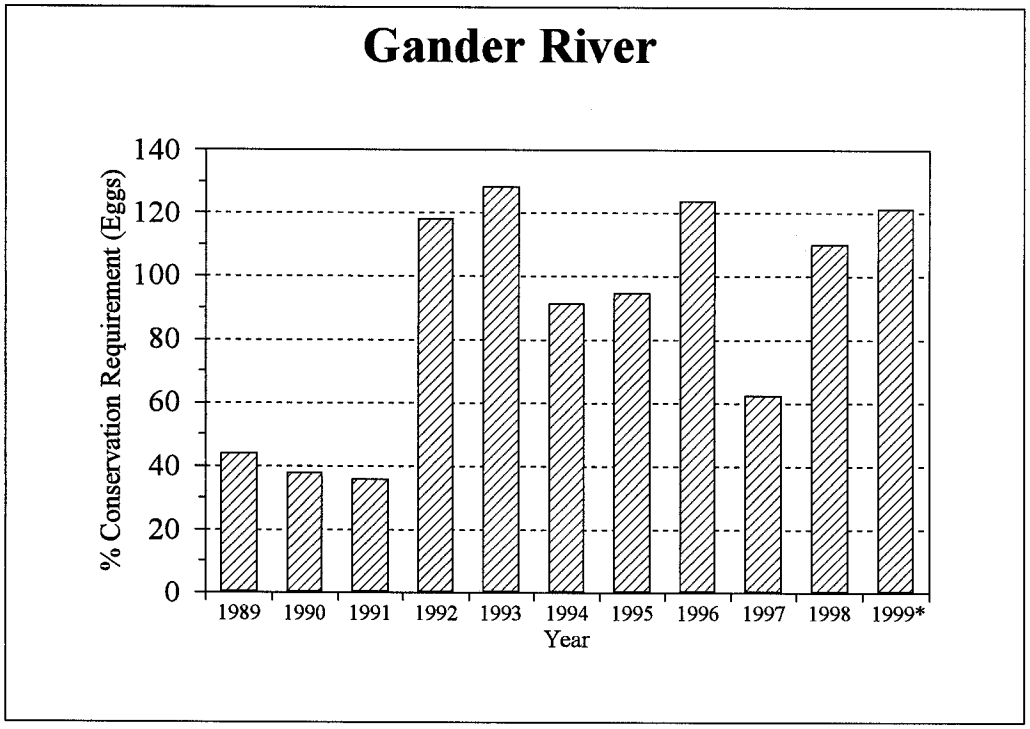

Fig. 13. Percentage conservation egg requirement achieved for Gander River, 1989-99. Asterisk denotes preliminary.

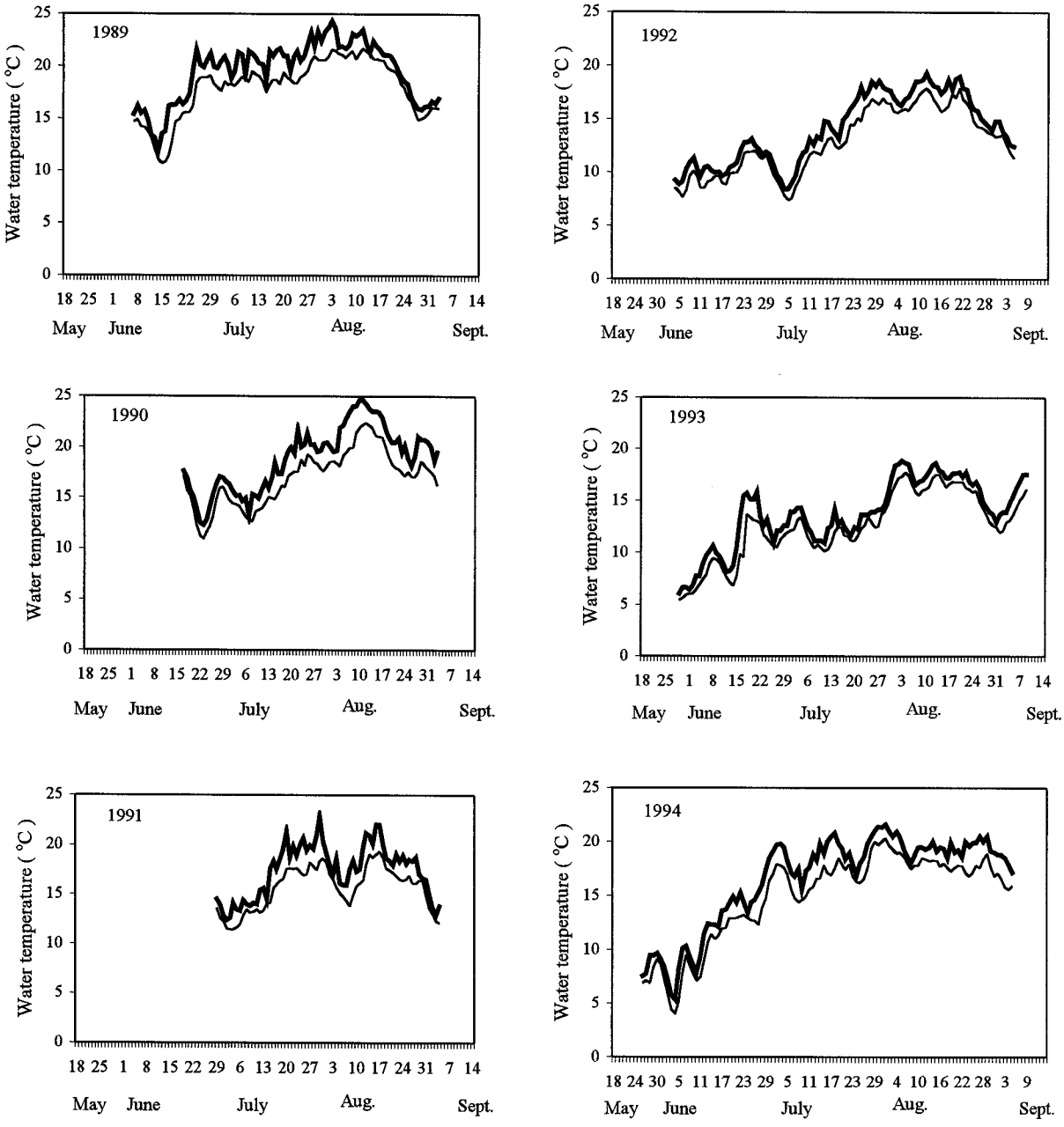

Fig. 14. Daily maximum and minimum water temperatures (°C) for Gander River, measured at the counting fence, 1989-99.

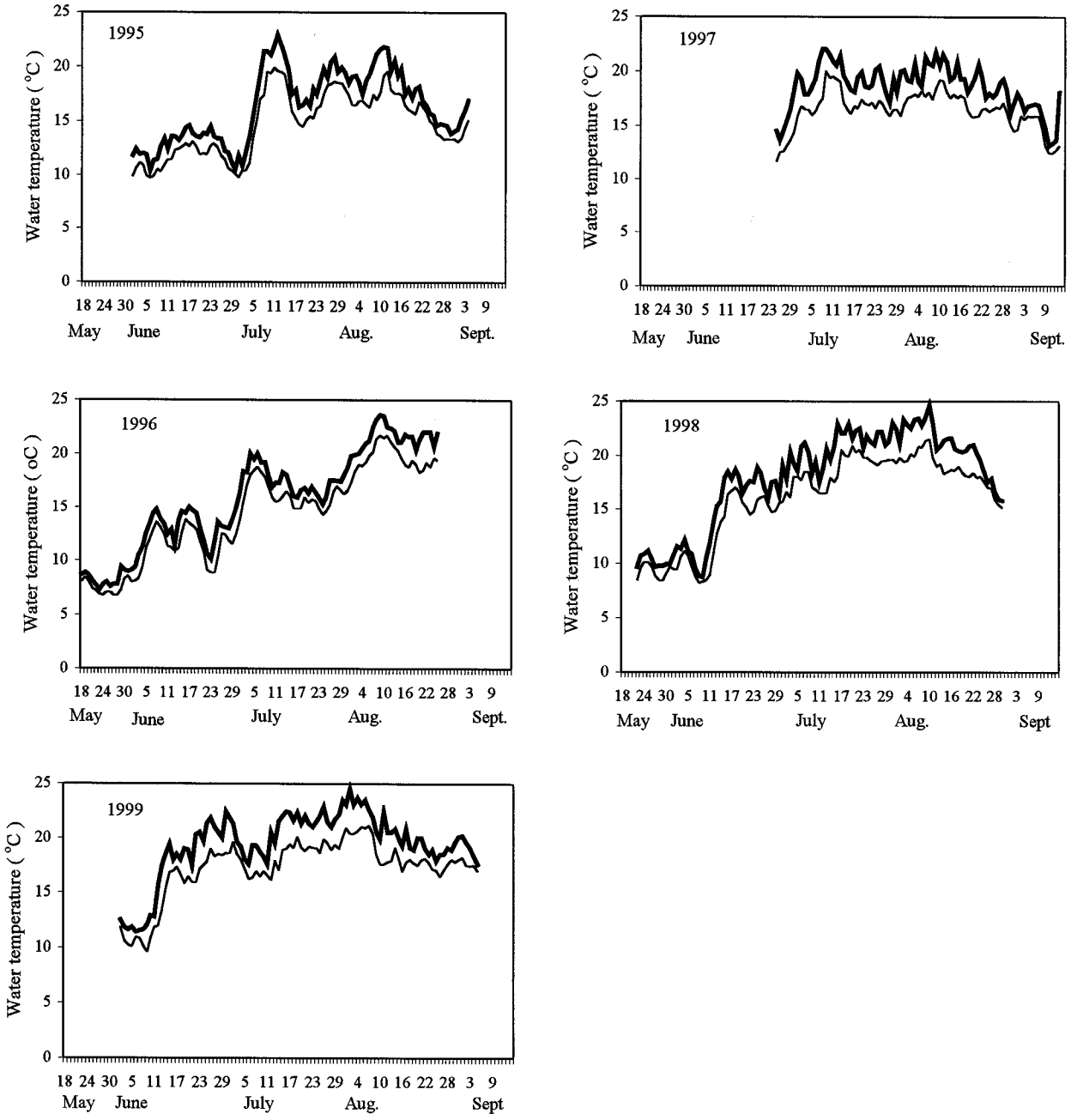
1995
1997
1996
1998
1999
Water temperature (°C)
Water temperature (oC)
0
5
10
15
20
25
18 24 30 5 11 17 23 29 5 11 17 23 29 4 10 16 22 28 3 9
May June July Aug. Sept.
Sept

Fig. 14 (cont'd)

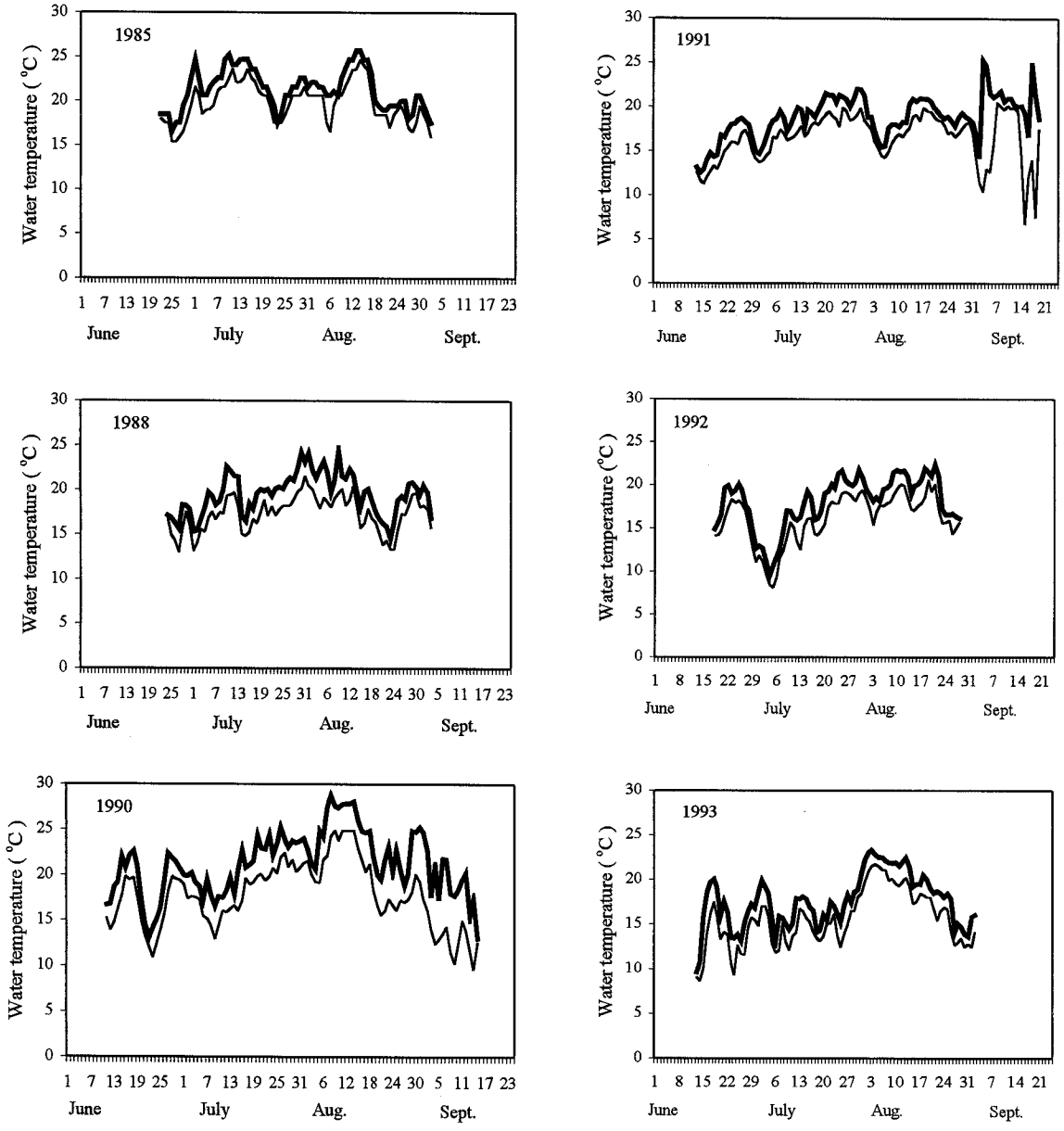

Fig. 15. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook, 1985-99.

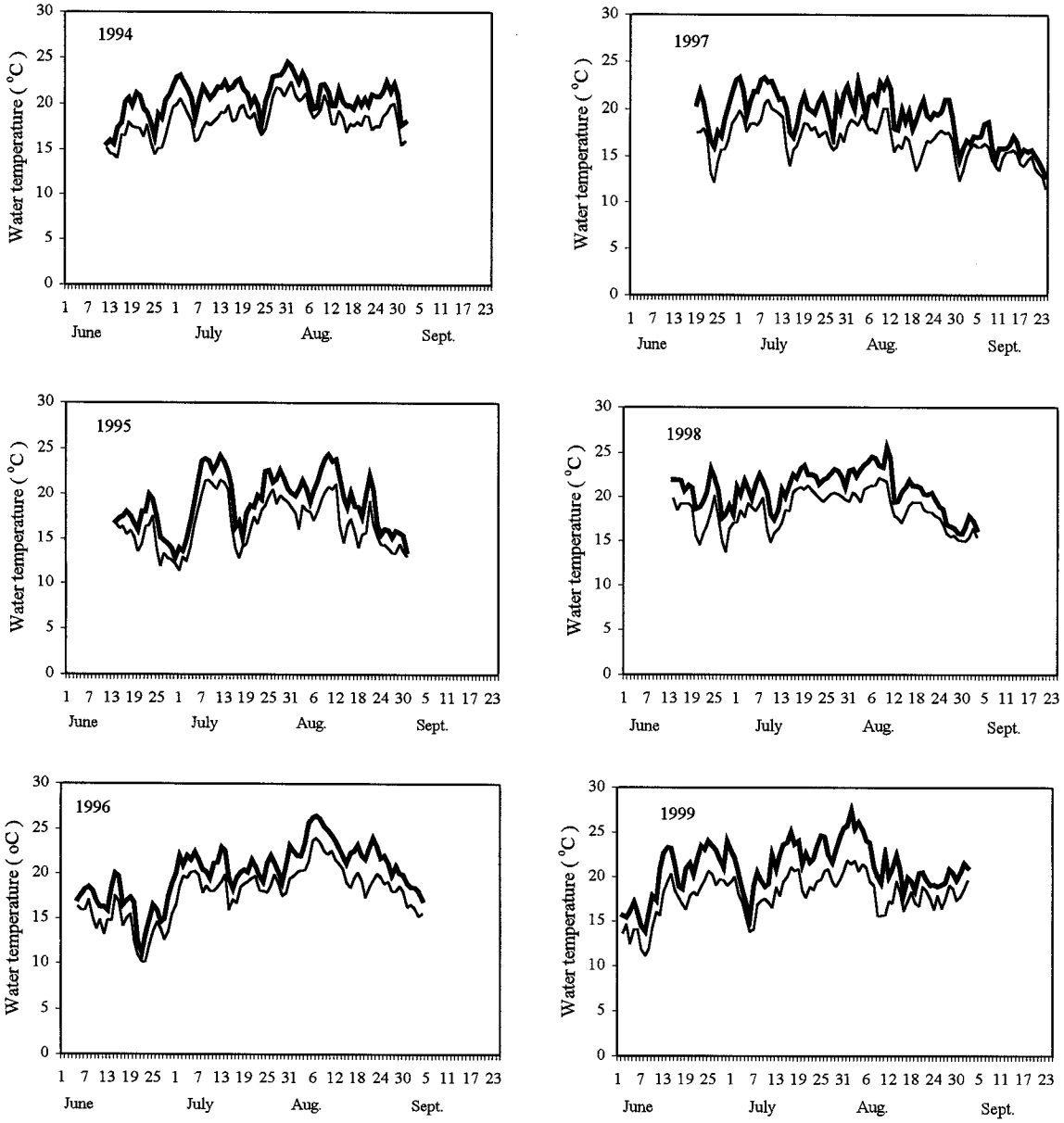
1994
1997
1995
1998
1996
1999
Water temperature (°C)
Water temperature (oC)
0 5 10 15 20 25 30
1 7 13 19 25 1 7 13 19 25 31 6 12 18 24 30 5 11 17 23
June
July
Aug.
Sept.

Fig. 15 (cont'd)

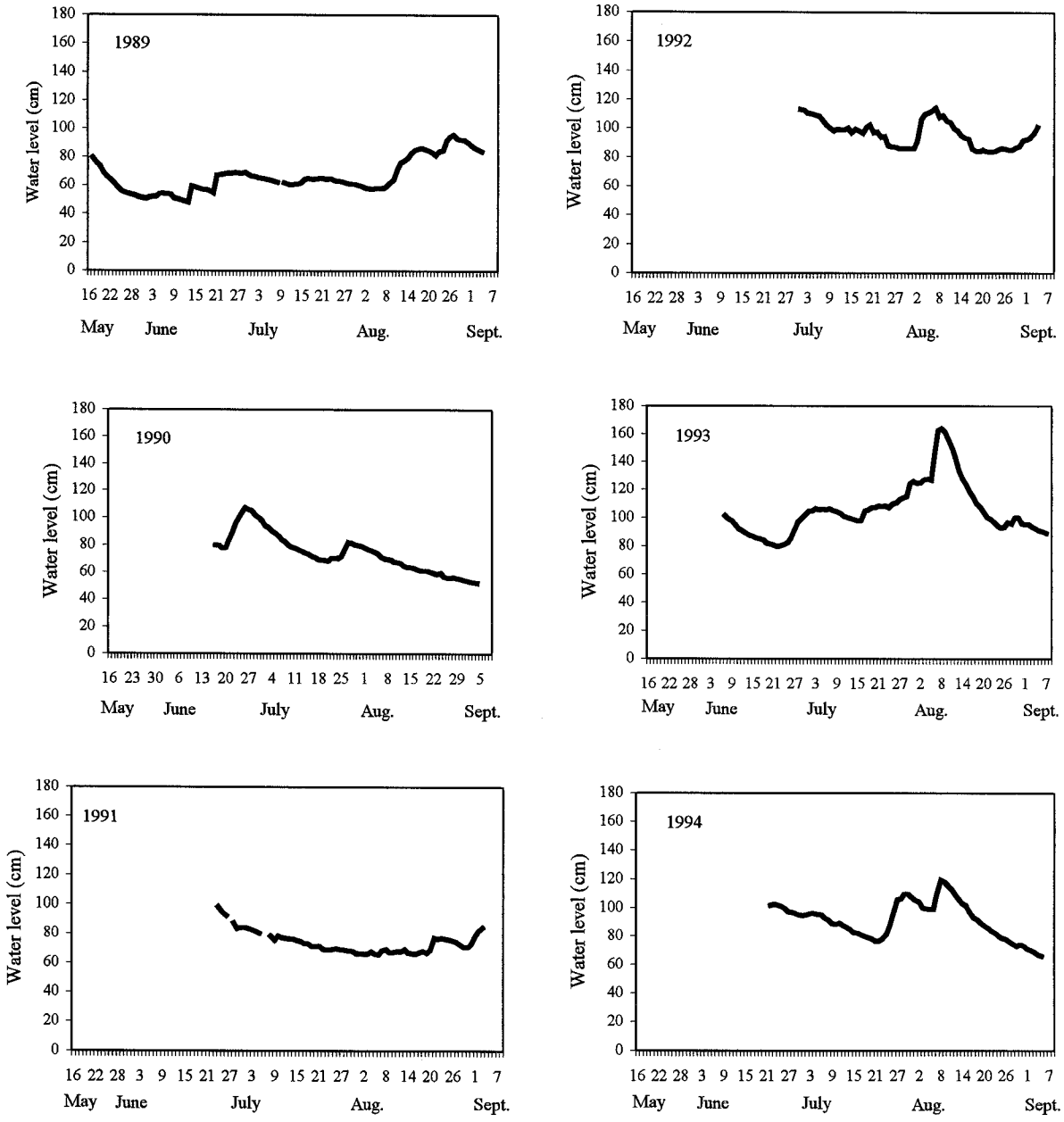

Fig. 16. Mean daily water levels (cm) for Gander River, measured near the counting fence, 1989-99.

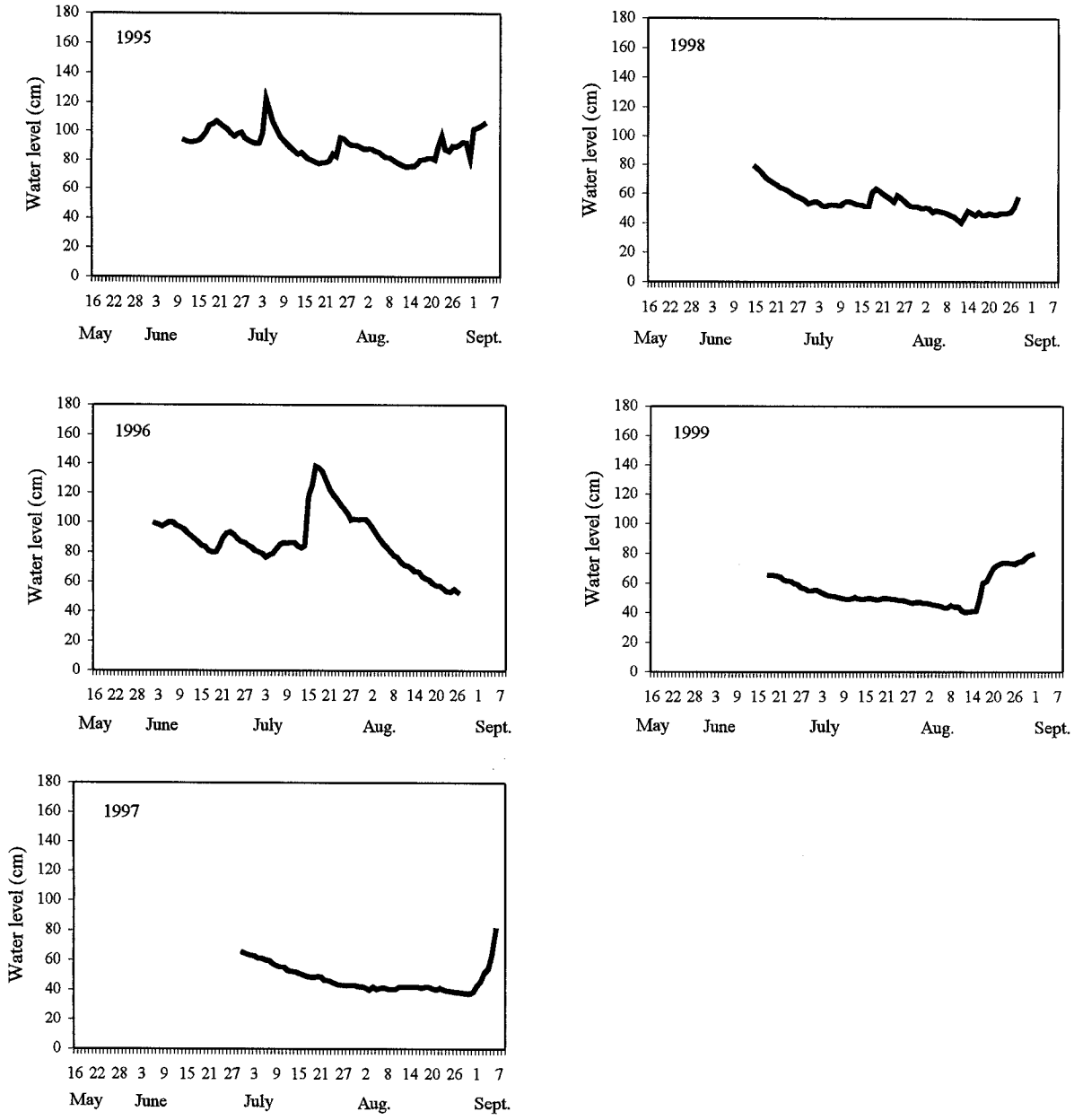
1995
1998
1996
1999
1997
Water level (cm)
0 20 40 60 80 100 120 140 160 180
16 22 28 3 9 15 21 27 3 9 15 21 27 2 8 14 20 26 1 7
May June July Aug. Sept.

Fig. 16 (cont'd)

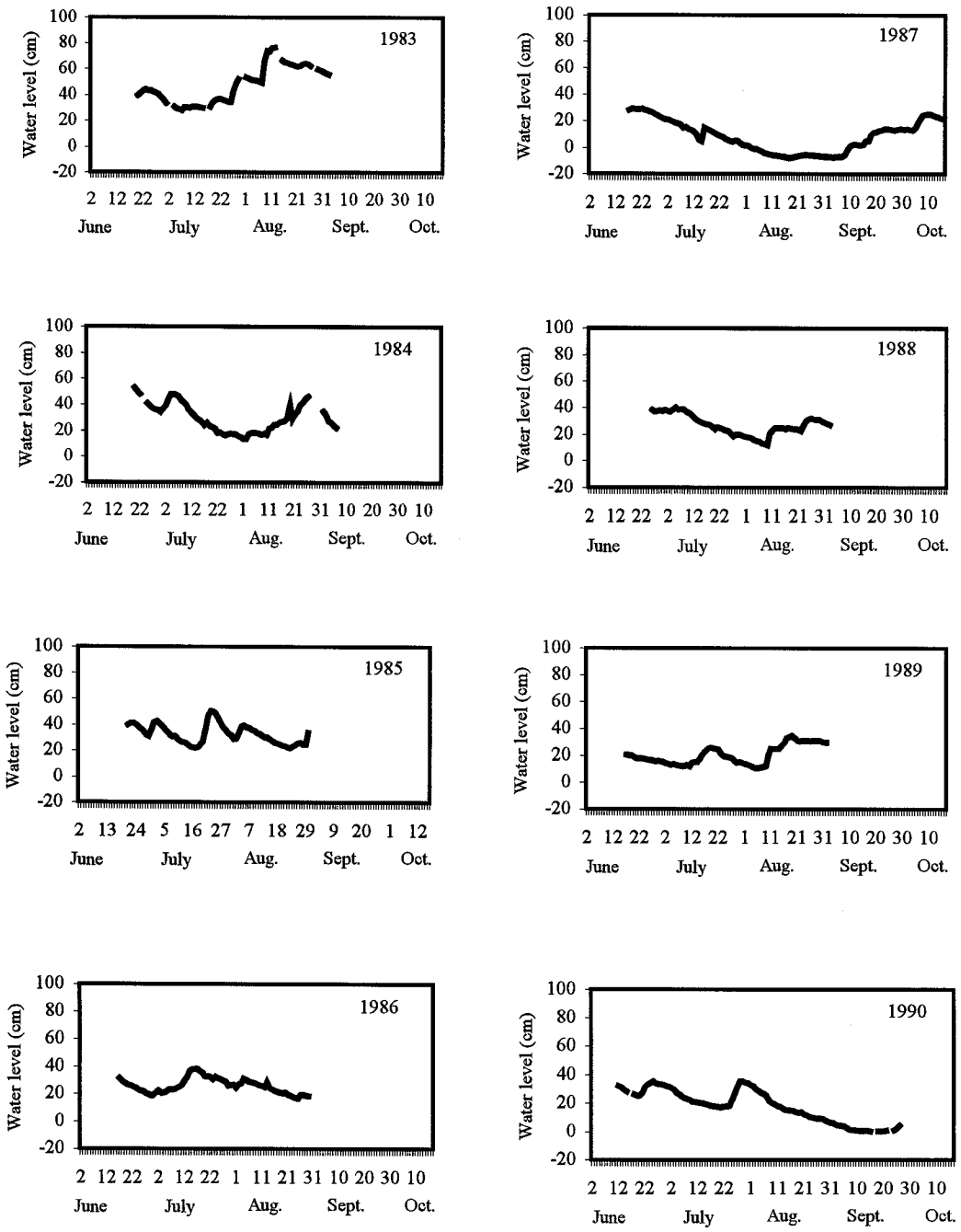

Fig. 17. Mean daily water levels (cm) measured near the fishway in Salmon Brook, 1983-99.

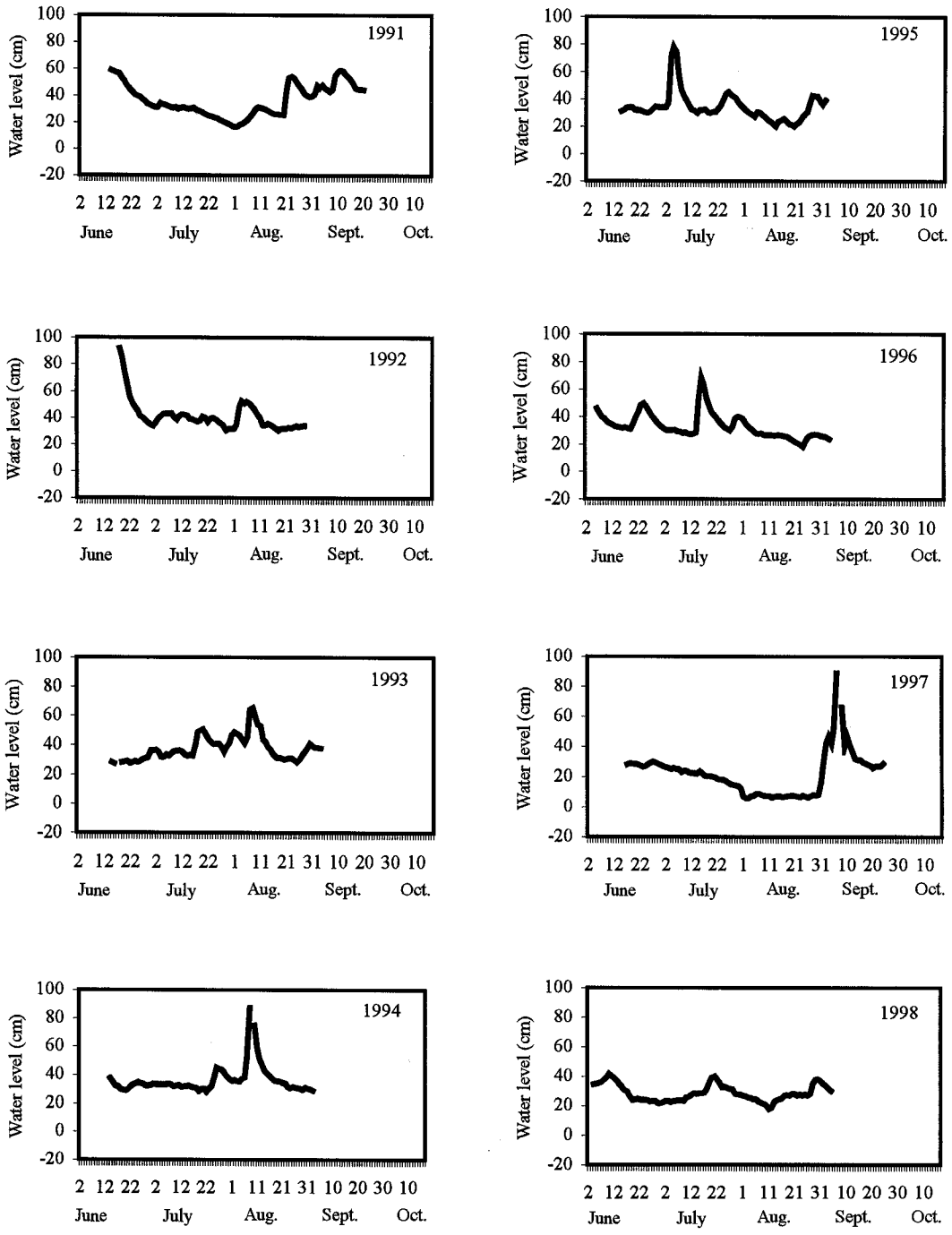
1991
1995
1992
1996
1993
1997
1994
1998
Water level (cm)
100
80
60
40
20
0
-20
2 12 22 2 12 22 1 11 21 31 10 20 30 10
June July Aug. Sept. Oct.

Fig. 17 (cont'd)

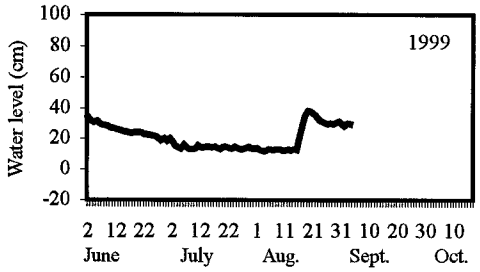
100
80
60
40
20
0
-20
Water level (cm)
1999
2 12 22 2 12 22 1 11 21 31 10 20 30 10
June July Aug. Sept. Oct.

Fig. 17 (cont'd)

Appendix 1. Atlantic salmon recreational fishery catch and effort data for Gander River, Notre Dame Bay (SFA 4), 1974-99. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	5153	2270	.	2270	19	.	19	2289	.	2289	0.44
1975	6670	2976	.	2976	38	.	38	3014	.	3014	0.45
1976	6633	2374	.	2374	132	.	132	2506	.	2506	0.38
1977	6939	2269	.	2269	927	.	927	3196	.	3196	0.46
1978	8322	3332	.	3332	389	.	389	3721	.	3721	0.45
1979	7217	4199	.	4199	318	.	318	4517	.	4517	0.63
1980	6384	2664	.	2664	268	.	268	2932	.	2932	0.46
1981	10643	4578	.	4578	249	.	249	4827	.	4827	0.45
1982	8026	2176	.	2176	205	.	205	2381	.	2381	0.30
1983	6934	2033	.	2033	239	.	239	2272	.	2272	0.33
1984	7590	2028	.	2028	13	.	13	2041	.	2041	0.27
1985	10207	3358	.	3358	*	.	0	3358	.	3358	0.33
1986	9740	2361	.	2361	*	.	0	2361	.	2361	0.24
1987	6384	1444	.	1444	*	.	0	1444	.	1444	0.23
1988	7943	2686	.	2686	*	.	0	2686	.	2686	0.34
1989	6290	1173	.	1173	*	.	0	1173	.	1173	0.19
1990	7118	1155	.	1155	*	.	0	1155	.	1155	0.16
1991	5853	1180	.	1180	*	.	0	1180	.	1180	0.20
1992	6273	1268	525	1793	*	3	3	1268	528	1796	0.29
1993	9073	1271	1950	3221	*	92	92	1271	2042	3313	0.37
1994	11287	2122	448	2570	*	39	39	2122	487	2609	0.23
1995	12215	2598	612	3210	*	74	74	2598	686	3284	0.27
1996	12347	2974	1153	4127	*	73	73	2974	1226	4200	0.34
1997**		1061	1007	2068	*	189***	189	1061	1196	2257	
1998**		2543	2179	4722	*	298	298	2543	2477	5020	
1999**		2068	859	2927	*	222	222	2068	1081	3149	
84-89 $\bar{X}$	8354.0	2321.2	.	2321.2	.	.	.	2323.8	.	2323.8	0.28
95% CL	1998.7	1003.6	.	1003.6	.	.	.	1002.1	.	1002.1	0.07
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	7388.8	1711.0	.	1711.0	.	.	.	1711.0	.	1711.0	0.23
95% CL	1910.7	931.9	.	931.9	.	.	.	931.9	.	931.9	0.09
N	5	5	0	5	0	0	0	5	0	5	5
92-96 $\bar{X}$	10239.0	2046.6	937.6	2984.2	.	56.2	56.2	2046.6	993.8	3040.4	0.30
95% CL	3197.5	957.1	782.1	1075.8	.	43.9	43.9	957.1	814.4	1112.6	0.07
N	5	5	5	5	0	5	5	5	5	5	5

1987 DATA NOT INCLUDED IN MEAN.

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 - 1996 AND ON RETAINED FISH ONLY PRIOR TO 1992.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA WERE OBTAINED FROM THE LICENSE STUB RETURN (1999 DATA ARE PRELIMINARY).

***PARTIAL

Appendix 2a. Maximum and minumim water temperatures (°C) measured at the counting fence in Gander River for the month of May, 1989-99.

Year		Date													
		18	19	20	21	22	23	24	25	26	27	28	29	30	31
1989	Max.														
	Min.														
1990	Max.														
	Min.														
1991	Max.														
	Min.														
1992	Max.														
	Min.														
1993	Max.												6.0	6.6	6.6
	Min.												5.4	5.6	5.9
1994	Max.									7.5	7.7	9.4	9.4	9.6	9.1
	Min.									6.9	7.1	6.9	8.3	9.1	8.6
1995	Max.														
	Min.														
1996	Max.	8.7	8.9	8.6	8.1	7.7	7.3	7.8	8.0	7.6	7.8	7.8	9.4	9.1	9.0
	Min.	8.1	8.4	8.1	7.4	7.2	6.9	6.8	7.1	7.1	6.8	6.8	7.3	8.3	8.5
1997	Max.														
	Min.														
1998	Max.					9.6	10.7	10.8	11.1	10.3	9.6	9.7	9.7	9.9	9.9
	Min.					8.4	9.6	10.1	10.1	9.6	8.8	8.4	8.4	9.0	9.6
1999	Max.														
	Min.														

Appendix 2b. Maximum and minimum water temperatures (°C) measured at the Gander River counting fence for the month of June, 1989-99.

Year		Date																												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1989	Max.							15.4	16.2	15.5	15.8	14.9	13.4	13.1	12.0	13.5	13.8	16.2	16.3	16.3	16.8	16.4	16.7	17.4	19.7	21.6	20.1	19.9	20.6	21.2	19.9
	Min.							14.7	14.9	14.2	14.2	13.8	13.2	12.1	11.0	10.7	10.8	11.4	12.8	14.7	14.9	15.5	15.6	15.6	16.2	18.4	18.9	18.9	18.9	19.1	18.3
1990	Max.																	17.6	16.9	15.6	15.1	13.9	12.5	12.3	12.8	13.9	15.3	16.3	17.0	16.9	16.5
	Min.																	17.1	15.7	15.1	14.0	12.3	11.3	10.9	11.6	12.1	13.1	14.8	15.9	16.0	15.4
1991	Max.																													14.5	13.9
	Min.																													13.6	12.6
1992	Max.				9.2	8.8	9.1	10.3	10.9	11.3	10.3	9.6	10.4	10.5	10.1	9.9	10.0	9.6	9.8	10.4	10.6	10.9	12.1	12.8	12.8	13.1	12.5	12.1	11.7	11.9	11.6
	Min.				8.5	8.1	7.6	8.3	9.6	10.1	9.6	8.5	8.5	9.1	9.2	9.6	9.6	8.9	8.8	9.8	9.9	9.9	10.6	11.8	11.9	11.9	12.0	11.5	11.2	11.6	10.7
1993	Max.	6.4	6.8	7.7	7.7	8.9	9.7	10.1	10.6	9.9	9.6	8.9	8.1	8.2	8.7	10.5	13.3	15.4	15.7	15.1	15.1	15.8	13.4	12.6	13.2	12.0	10.9	12.1	12.1	12.6	12.6
	Min.	6.0	6.0	6.4	6.9	7.4	7.8	8.9	9.4	9.3	9.0	8.2	7.6	7.1	6.8	7.7	9.8	9.6	13.6	13.4	13.1	13.0	12.8	11.7	11.3	10.9	10.6	10.5	11.2	11.6	11.9
1994	Max.	8.4	7.1	5.7	5.3	8.1	10.1	10.3	9.4	8.5	7.9	9.4	11.4	12.4	12.3	12.3	12.1	13.6	13.7	14.3	14.9	14.4	15.3	14.4	13.4	14.4	14.6	15.3	15.9	17.4	18.5
	Min.	7.3	5.8	4.4	4.0	5.1	7.8	9.4	8.6	7.7	7.1	7.4	8.9	10.6	11.4	10.9	11.3	11.9	12.0	12.9	12.9	12.9	13.1	13.2	12.9	12.7	12.7	12.3	13.8	14.7	16.4
1995	Max.	11.8	12.4	11.9	12.0	11.9	10.4	11.3	11.4	12.6	13.4	12.4	13.6	13.6	13.2	13.7	14.4	14.6	13.9	13.6	13.5	13.9	13.8	14.5	13.6	13.4	13.4	12.2	12.1	11.2	10.5
	Min.	9.8	10.6	11.1	10.9	9.9	9.7	9.8	10.5	10.3	10.9	11.4	11.4	12.3	12.4	12.6	12.9	12.6	13.1	12.6	11.9	12.0	11.9	12.7	12.9	12.5	11.8	11.4	10.6	10.4	10.1
1996	Max.	9.1	9.4	10.5	11.2	12.6	13.4	14.4	14.8	13.9	13.4	12.4	12.9	11.4	13.7	14.6	14.4	15.0	14.7	14.4	13.1	11.8	10.6	10.1	11.8	13.6	13.2	13.1	13.0	13.8	14.9
	Min.	8.0	8.1	8.3	9.4	11.2	11.9	12.9	13.6	13.1	12.4	11.3	11.2	10.9	11.1	12.6	13.8	13.5	13.2	12.9	11.8	10.8	9.1	8.9	8.9	10.3	12.5	12.4	11.8	11.5	12.4
1997	Max.																									14.5	13.6	14.6	15.5	16.4	18.3
	Min.																									11.6	12.5	12.6	13.1	13.6	14.4
1998	Max.	10.8	11.5	11.3	12.1	11.1	10.8	9.5	8.8	8.7	10.4	11.8	13.9	15.3	15.7	17.9	18.5	17.8	18.7	18.0	16.5	17.2	17.6	17.5	18.9	18.4	16.9	16.1	17.5	17.6	16.3
	Min.	9.4	9.4	10.6	11.1	10.7	9.6	8.8	8.2	8.3	8.4	8.9	11.0	12.7	13.8	14.3	16.4	16.7	17.0	16.6	15.6	15.1	14.5	14.7	15.9	16.1	16.2	15.3	14.7	14.8	15.6
1999	Max.		12.5	11.8	11.6	11.8	11.4	11.5	11.6	12.0	12.9	12.8	15.6	17.4	18.5	19.4	18.0	18.5	18.0	19.0	18.9	17.4	20.3	20.5	19.7	21.3	21.8	21.0	20.5	20.0	22.4
	Min.		11.8	10.6	10.2	10.1	10.9	10.8	10.1	9.6	10.8	11.8	11.9	13.4	15.4	16.8	16.9	17.3	16.6	15.8	16.4	15.9	15.9	17.1	17.5	17.8	19.0	18.3	18.5	18.4	18.6

Appendix 2c. Maximum and minimum water temperatures (°C) measured at the Gander River counting fence for the month of July, 1989-99.

Year		Date																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1989	Max.	19.8	20.5	20.9	20.2	18.8	19.5	21.3	21.1	19.1	21.4	21.2	20.8	20.3	20.2	18.6	21.4	21.0	21.5	21.7	21.0	21.0	19.5	20.9	21.4	20.5	21.0	22.1	23.2	21.9	23.3	22.4
	Min.	18.0	17.6	18.5	18.2	18.3	18.1	18.5	19.0	18.7	18.5	19.5	19.2	19.1	18.5	17.5	18.2	18.7	18.7	18.3	19.4	18.9	18.7	18.4	18.4	19.0	19.2	19.6	20.5	21.0	20.6	20.6
1990	Max.	16.3	15.6	15.1	15.2	14.6	14.9	13.1	15.3	15.1	14.9	15.8	16.6	15.9	16.9	18.4	17.3	17.3	18.7	19.6	19.9	19.3	21.7	20.0	20.2	21.3	20.2	20.2	19.5	19.6	20.3	20.4
	Min.	14.7	14.4	14.3	14.1	13.6	13.1	12.8	12.6	13.6	13.7	13.9	14.4	15.0	14.9	14.8	15.4	16.1	16.0	17.1	17.3	17.5	17.5	18.7	18.1	19.2	19.0	18.4	18.3	17.8	17.6	18.1
1991	Max.	12.8	12.4	12.6	14.1	13.4	13.3	14.4	14.0	13.8	14.1	14.0	15.4	15.6	14.5	17.6	18.3	17.5	18.5	19.5	21.3	18.7	19.8	18.9	19.9	20.6	19.4	19.9	19.6	21.0	22.9	20.4
	Min.	12.3	11.5	11.4	11.4	11.6	11.9	12.8	13.4	13.1	13.2	13.4	13.1	13.3	14.1	14.1	15.6	15.9	16.3	16.5	17.5	17.6	17.5	17.6	17.3	16.9	17.0	18.2	17.8	17.4	18.3	18.6
1992	Max.	10.6	9.7	9.2	8.4	8.4	8.9	9.6	11.0	11.8	12.0	13.1	12.6	13.3	13.1	14.8	14.7	14.0	13.6	13.1	14.9	15.3	16.0	16.4	17.0	18.0	17.1	17.6	18.5	18.1	18.6	18.0
	Min.	9.7	9.2	8.5	7.8	7.3	7.5	8.6	9.2	10.2	10.9	11.6	11.9	11.8	11.6	12.4	13.1	13.2	12.4	12.2	12.6	12.9	14.5	14.4	15.1	14.8	16.1	16.3	16.9	16.6	16.4	17.0
1993	Max.	13.9	13.9	14.3	14.3	13.3	12.4	11.9	11.1	11.1	11.1	10.9	12.3	12.6	14.1	12.7	13.1	12.5	12.0	11.7	12.4	12.2	13.6	13.6	13.6	13.9	13.9	14.1	14.1	14.6	15.8	17.3
	Min.	12.1	12.2	13.1	13.4	12.5	11.5	10.9	10.4	10.8	10.4	10.1	10.3	10.9	12.0	12.4	12.4	11.6	11.6	11.1	11.1	11.6	12.3	12.6	13.4	12.9	12.4	12.5	13.7	14.0	14.7	15.8
1994	Max.	19.1	19.7	19.8	19.5	18.3	17.1	16.8	17.5	15.6	17.3	17.6	18.8	18.3	19.8	18.9	20.0	20.5	20.8	19.8	19.4	18.4	18.9	17.9	16.9	18.0	18.6	19.8	20.5	21.0	21.4	21.3
	Min.	17.0	17.9	17.8	17.6	17.0	15.6	14.8	14.4	14.6	14.9	15.6	15.8	16.6	16.6	17.8	17.1	16.9	17.5	18.5	17.9	17.4	17.9	16.8	16.3	16.2	16.6	17.5	19.4	20.0	19.7	20.0
1995	Max.	11.8	10.8	12.1	13.6	15.4	17.5	19.2	21.4	21.4	21.1	21.9	22.9	21.9	21.0	19.7	17.5	17.9	16.3	16.5	17.0	16.4	18.0	17.5	18.7	19.8	19.0	20.4	20.9	19.5	19.9	19.5
	Min.	9.7	10.4	10.4	11.1	13.4	15.1	17.1	17.4	19.5	19.4	19.9	19.6	19.5	19.3	17.6	15.9	15.3	14.7	14.5	15.1	15.5	15.3	16.2	16.4	17.5	18.3	18.4	18.6	18.5	18.5	18.0
1996	Max.	16.4	18.4	18.3	20.0	19.5	20.0	19.2	19.2	17.9	16.9	17.3	17.3	18.3	18.0	16.9	16.0	15.9	16.6	16.8	16.3	16.9	16.4	15.9	15.3	15.9	17.5	17.5	17.5	17.4	18.0	18.8
	Min.	13.8	15.4	17.1	18.0	18.5	18.8	18.3	17.8	16.9	15.9	15.5	15.6	16.0	16.5	16.0	14.9	14.9	14.9	15.9	15.4	15.7	15.6	14.9	14.3	14.6	15.2	16.5	17.0	16.6	16.2	16.6
1997	Max.	19.8	19.3	17.9	17.9	18.5	19.3	20.9	22.0	22.0	21.5	20.9	20.5	21.4	19.6	18.9	18.3	18.1	19.5	19.9	18.6	18.5	18.7	20.1	20.4	19.2	17.9	17.1	19.3	18.1	20.0	20.1
	Min.	15.8	16.8	16.5	16.5	16.0	16.3	17.0	17.5	20.0	19.4	19.5	19.3	19.0	17.1	16.5	16.1	16.8	16.6	17.4	17.0	16.9	17.1	16.6	17.3	17.0	16.3	15.9	16.5	16.5	15.9	16.9
1998	Max.	19.1	17.8	20.3	19.3	18.6	20.8	21.2	20.3	18.4	19.4	17.5	18.9	20.6	19.6	20.9	22.9	22.1	22.1	22.9	21.6	22.3	22.5	20.7	21.8	21.3	21.0	22.2	22.2	21.0	21.3	23.0
	Min.	15.7	16.6	16.1	18.0	18.0	17.7	18.5	18.5	17.0	16.8	16.5	16.5	16.5	17.9	17.5	18.0	20.5	20.0	19.9	20.9	20.3	20.5	19.8	19.8	19.5	19.3	19.1	19.5	19.5	19.6	19.6
1999	Max.	21.8	21.3	19.6	19.2	18.0	17.6	19.3	19.3	18.7	18.3	17.6	20.5	19.5	21.5	22.0	22.4	22.3	21.6	22.3	21.3	22.0	21.3	21.0	21.5	22.0	22.9	21.4	21.0	21.7	22.1	23.5
	Min.	18.6	19.6	18.5	18.0	17.1	16.2	16.3	16.9	16.4	16.9	16.5	16.1	17.9	17.0	18.9	19.0	19.4	19.1	20.1	19.1	18.8	19.2	19.1	19.1	18.6	19.9	19.5	18.9	19.4	19.0	20.1

Appendix 2d. Maximum and minimum water temperatures (°C) measured at the Gander River counting fence for the month of August, 1989-99.

Year		Date																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1989	Max.	23.3	23.7	24.3	23.7	21.8	21.9	21.7	22.0	23.1	22.9	23.1	23.5	22.1	21.3	22.4	21.9	21.6	21.1	21.1	21.0	20.5	19.8	19.1	18.6	18.3	17.1	16.5	16.0	15.9	16.2	16.2
	Min.	20.6	20.9	21.6	21.5	21.2	21.1	20.8	21.2	21.4	20.7	21.2	21.7	21.4	21.2	20.7	20.7	20.6	20.6	19.9	19.7	19.6	19.3	18.4	18.0	17.1	16.7	15.8	14.9	15.0	15.2	15.6
1990	Max.	20.0	19.5	19.6	21.9	22.1	22.9	23.5	24.0	24.0	24.6	24.6	24.2	23.7	23.5	23.5	23.4	22.9	21.7	21.0	20.4	20.4	20.8	19.4	20.1	18.8	18.1	19.0	21.0	20.7	20.7	20.5
	Min.	18.5	18.5	18.3	18.1	19.1	19.5	19.9	19.9	21.4	21.8	22.2	22.3	22.1	21.9	21.1	21.0	20.9	20.0	19.1	18.3	17.9	17.8	17.4	17.1	17.5	17.0	17.0	17.5	18.5	18.2	17.8
1991	Max.	19.1	18.0	17.0	18.6	16.1	15.9	15.9	17.5	18.4	17.3	17.5	19.8	21.1	20.9	20.1	22.0	22.0	20.1	18.6	18.4	17.9	19.0	18.3	18.9	18.1	18.5	18.3	18.7	17.0	16.6	16.5
	Min.	18.2	17.0	16.5	15.7	15.1	14.8	14.3	13.8	14.9	15.8	16.1	16.4	17.9	19.0	18.7	19.0	19.3	18.8	17.6	17.4	17.2	16.9	16.5	16.4	16.5	16.9	16.1	16.1	16.4	16.3	14.9
1992	Max.	17.8	17.7	17.0	16.5	16.3	16.9	17.1	17.8	18.5	18.5	18.7	19.3	18.5	18.1	18.0	17.4	17.8	18.7	17.8	18.8	19.0	17.9	17.8	16.6	15.9	15.8	15.1	14.7	14.4	13.9	14.8
	Min.	16.5	16.5	15.7	15.6	15.8	16.0	15.8	16.4	16.7	17.3	17.7	17.9	17.5	16.8	16.3	15.7	15.9	16.3	17.4	17.0	17.9	16.9	16.5	16.0	14.8	14.3	14.2	14.0	13.7	13.6	13.3
1993	Max.	18.4	18.5	18.8	18.6	18.5	17.4	16.5	16.8	16.9	17.3	17.8	18.4	18.6	17.9	17.7	17.2	17.2	17.6	17.6	17.7	17.3	17.7	16.8	16.5	16.8	16.2	14.9	14.4	13.9	13.7	12.9
	Min.	16.5	17.2	17.3	17.7	17.4	16.5	15.8	15.5	16.0	16.1	16.3	17.1	17.5	17.5	16.9	16.3	16.6	16.8	16.8	16.8	16.8	16.2	16.1	15.8	15.9	14.9	14.3	13.7	12.9	12.6	12.5
1994	Max.	21.6	20.9	20.5	20.9	20.4	19.2	18.6	18.0	18.8	19.5	19.5	19.3	19.5	20.0	19.1	19.5	19.4	18.5	19.9	19.0	19.2	18.6	20.0	19.6	19.9	19.9	20.5	20.0	20.5	19.1	19.0
	Min.	20.3	19.6	19.3	18.9	19.0	18.6	18.0	17.5	17.8	17.8	18.5	18.4	18.2	18.3	18.3	17.7	18.0	17.6	17.3	17.6	17.8	17.8	17.2	16.8	17.2	17.8	17.6	18.4	18.9	17.7	16.8
1995	Max.	18.5	19.1	19.2	18.5	17.5	18.8	19.3	20.3	21.2	21.6	21.8	21.7	19.6	20.5	19.2	19.8	17.5	18.0	17.2	18.0	18.2	16.9	16.5	15.8	15.6	14.6	14.8	14.7	14.6	13.9	14.1
	Min.	17.4	16.5	16.5	16.9	16.9	16.5	16.3	17.5	17.0	17.7	19.2	19.6	17.9	17.6	17.6	17.5	16.5	16.1	15.9	15.7	16.8	16.4	15.9	15.1	14.7	13.9	13.7	13.3	13.4	13.4	13.4
1996	Max.	19.8	19.9	20.0	20.5	21.0	21.2	22.5	23.2	23.6	23.5	22.5	22.4	22.2	21.1	21.1	21.8	21.6	21.6	20.4	21.3	22.0	22.0	22.0	20.7	21.9						
	Min.	17.3	18.4	19.0	18.9	19.2	19.8	20.2	21.4	21.7	21.5	21.7	21.1	20.7	20.3	19.6	19.0	18.8	19.4	19.0	18.3	18.5	19.2	18.8	19.6	19.4						
1997	Max.	19.1	19.0	20.7	19.0	18.6	21.3	20.7	20.5	21.7	20.5	21.5	20.8	19.2	19.5	20.8	19.3	19.3	18.1	18.7	19.4	20.6	19.5	17.6	18.0	17.7	18.0	18.9	19.3	18.4	16.1	17.0
	Min.	17.6	17.7	17.9	17.7	18.2	17.7	18.1	17.4	18.4	19.2	19.1	18.1	17.6	17.9	17.6	17.8	17.6	16.4	15.8	15.8	15.9	16.5	16.6	16.3	16.5	16.7	16.6	17.1	16.3	15.1	14.5
1998	Max.	22.4	21.1	23.3	22.8	22.5	23.3	23.4	22.8	23.5	24.6	23.0	20.5	20.9	21.4	21.6	21.6	20.6	20.4	20.3	20.4	20.9	21.0	20.2	19.5	18.4	17.5	17.8	16.6	15.9	15.8	
	Min.	19.3	19.8	19.4	19.5	20.1	19.9	20.8	20.7	21.4	21.5	19.8	19.0	19.2	18.3	18.5	18.7	18.6	19.0	18.4	18.1	18.0	18.4	17.9	18.0	17.5	17.0	16.9	15.9	15.4	15.1	
1999	Max.	23.1	24.5	23.1	23.7	23.1	23.5	22.6	21.9	20.6	19.9	22.4	20.5	20.5	20.8	19.9	19.3	20.8	19.1	18.9	20.0	20.0	19.0	18.5	18.9	17.9	18.5	18.5	19.1	18.9	19.6	20.1
	Min.	20.9	20.4	20.4	20.6	21.0	20.9	21.1	20.4	18.5	17.6	17.6	17.8	17.9	19.1	18.0	16.9	17.8	18.0	17.7	17.5	18.0	18.1	17.7	17.1	17.0	16.4	17.0	17.6	18.0	17.8	18.0

Appendix 2e. Maximum and minumim water temperatures (°C) measured at the counting fence in Gander River for the month of September, 1989-99.

Year		Date													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1989	Max.	16.7	16.5	17.0											
	Min.	16.1	16.1	16.0											
1990	Max.	20.0	18.6	19.5											
	Min.	17.5	17.1	16.2											
1991	Max.	14.9	13.6	12.9	13.8										
	Min.	13.6	13.0	12.3	12.1										
1992	Max.	14.8	13.8	13.4	12.6	12.4									
	Min.	13.4	13.5	12.6	11.9	11.3									
1993	Max.	13.6	13.9	13.9	14.7	15.4	16.2	16.8	17.5	17.5					
	Min.	11.9	12.1	12.9	13.1	13.6	14.3	15.0	15.4	16.1					
1994	Max.	18.8	18.8	18.5	17.9	17.2									
	Min.	17.1	16.6	15.8	15.6	15.9									
1995	Max.	14.3	15.3	16.0	17.0										
	Min.	13.1	13.4	14.4	15.2										
1996	Max.														
	Min.														
1997	Max.	18.0	17.4	16.3	16.8	16.9	17.0	16.9	15.9	14.8	13.1	13.3	13.6	18.1	
	Min.	14.6	15.9	15.6	15.9	15.8	15.9	15.9	14.8	13.1	12.4	12.4	12.7	13.1	
1998	Max.														
	Min.														
1999	Max.	20.2	19.6	19.1	18.3	17.6									
	Min.	18.2	17.5	17.4	17.5	16.9									

Appendix 3a. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of June, 1985-99.

Year		Date																												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1985	Max.																						18.5	18.5	18.5	16.5	17.5	17.5	19.5	20.6	22.6
	Min.																						18.0	17.5	17.5	15.4	15.4	15.9	16.5	18.0	19.5
1988	Max.																								17.1	16.8	16.3	15.6	18.3	18.2	17.8
	Min.																								16.9	14.9	14.3	13.0	15.5	17.5	16.1
1990	Max.											16.7	16.7	18.7	19.1	22.0	20.7	22.1	22.6	20.9	17.2	14.5	13.1	14.2	15.2	16.3	19.5	22.3	21.8	21.5	20.7
	Min.											15.2	13.9	14.8	16.2	17.7	19.8	19.5	19.7	17.6	14.9	13.2	12.0	10.9	12.5	13.9	15.7	18.1	19.8	19.5	19.4
1991	Max.													13.1	12.5	12.9	13.9	14.7	14.3	14.5	16.7	16.5	17.4	18.0	18.1	18.5	18.7	18.3	17.9	16.4	14.8
	Min.													12.6	11.6	11.2	11.9	12.6	13.3	12.9	13.8	14.9	15.4	16.0	15.9	15.7	16.9	17.3	16.5	14.9	14.0
1992	Max.																		14.8	15.6	16.5	19.6	19.9	19.0	19.3	20.0	19.4	17.6	17.0	14.7	12.6
	Min.																		14.1	14.1	14.6	16.0	17.3	18.3	17.9	18.1	17.8	17.0	14.9	12.7	11.0
1993	Max.													9.6	10.6	15.9	18.5	19.7	20.0	19.0	15.9	17.5	16.3	13.5	13.4	13.8	13.1	15.2	16.5	17.2	16.8
	Min.													9.1	8.6	10.0	13.9	16.1	17.4	15.9	13.3	14.1	13.8	10.6	9.3	12.6	11.6	11.6	14.7	15.7	15.5
1994	Max.												15.6	16.0	15.6	17.4	17.9	20.1	20.6	19.8	21.1	20.8	19.5	19.1	18.0	16.4	18.9	18.4	20.3	21.0	22.0
	Min.												15.1	14.5	14.4	14.0	16.6	16.5	18.0	17.5	17.4	17.3	16.4	17.7	15.9	14.4	15.1	15.1	16.4	18.2	19.7
1995	Max.														16.8	17.3	17.5	18.0	17.5	16.6	15.9	18.0	18.0	19.9	19.4	17.4	15.1	14.8	14.4	13.9	12.8
	Min.														16.7	16.1	16.3	15.4	15.8	15.1	13.5	14.4	16.3	16.4	17.5	13.8	11.9	13.3	12.7	12.6	12.1
1996	Max.					17.0	17.6	18.2	18.5	18.0	16.9	16.2	16.2	15.8	18.5	20.0	19.7	16.4	16.9	17.3	16.7	12.3	11.1	13.2	14.9	16.4	15.8	14.6	14.9	17.4	18.8
	Min.					16.2	15.9	15.9	17.0	15.0	13.8	14.8	13.2	14.8	14.7	17.5	16.8	14.1	14.9	15.4	12.4	10.9	10.1	10.1	12.1	13.5	14.6	13.8	12.6	13.6	15.4
1997	Max.																			20.5	21.8	20.6	18.5	16.6	15.9	17.6	17.1	19.0	20.3	21.6	23.0
	Min.																			17.5	17.5	18.0	17.0	13.1	12.1	14.3	15.7	15.7	16.7	18.4	19.1
1998	Max.														21.9	21.9	21.8	20.7	21.3	21.0	18.6	18.8	19.5	20.5	23.1	22.1	20.8	17.6	18.0	19.0	18.0
	Min.														19.8	18.5	19.3	19.3	19.3	18.8	15.6	14.5	15.8	16.7	18.3	20.1	17.9	14.9	13.7	16.3	17.0
1999	Max.		15.6	15.4	16.0	17.1	15.9	14.4	13.8	15.9	17.8	17.3	20.8	22.6	23.3	23.2	21.5	18.9	18.6	20.9	21.5	20.3	21.9	23.5	23.1	24.0	23.5	23.0	22.0	21.0	24.0
	Min.		13.6	14.6	12.4	14.1	14.1	11.8	11.1	11.9	14.2	16.0	15.6	18.2	19.4	20.3	18.5	17.6	16.9	16.3	17.8	18.3	17.9	18.9	19.6	20.6	20.3	19.0	19.7	19.6	19.0

Appendix 3b. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of July, 1985-99.

Year		Date																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1985	Max.	24.7	22.6	20.6	20.6	21.6	22.1	22.6	22.6	24.7	25.2	24.1	24.1	24.7	24.7	24.7	23.6	23.6	22.6	21.6	21.6	20.6	19.5	17.5	18.5	20.6	20.6	21.6	21.6	22.6	22.6	21.6
	Min.	21.6	20.6	18.5	19.0	19.0	19.5	21.1	21.6	21.6	22.6	23.6	22.1	22.1	22.6	23.6	22.6	22.1	21.1	20.6	20.6	19.5	17.5	17.5	17.5	18.5	19.5	20.6	20.6	20.6	21.6	20.6
1988	Max.	15.3	15.4	16.6	18.0	19.7	19.3	18.3	18.7	20.0	22.6	22.0	21.5	21.4	17.0	16.4	18.4	17.8	19.6	20.0	19.8	20.0	19.3	20.1	20.3	20.1	20.9	21.3	21.0	22.4	24.2	23.1
	Min.	13.1	14.0	15.5	15.3	16.8	17.5	16.6	17.4	17.3	19.3	19.4	19.6	18.1	15.0	14.8	15.3	16.6	16.2	17.4	18.8	17.1	18.1	17.1	17.7	18.2	18.2	18.2	18.9	19.8	20.1	21.5
1990	Max.	19.9	19.8	20.2	19.1	18.6	17.2	19.4	17.7	16.5	17.5	17.4	18.3	19.7	17.8	20.4	22.7	20.8	21.1	21.5	24.3	22.9	22.8	24.4	22.1	23.4	25.2	23.8	23.1	23.7	23.5	23.7
	Min.	18.9	17.4	17.6	17.5	17.2	15.4	15.2	14.3	12.9	14.4	16.0	15.8	16.3	16.6	16.0	17.1	19.6	18.9	19.2	19.8	20.1	19.3	19.8	20.7	20.1	21.9	22.4	20.8	21.6	20.3	20.8
1991	Max.	14.6	15.4	16.5	17.8	18.4	18.6	19.5	18.8	17.2	17.9	19.0	19.9	19.6	17.7	19.6	19.3	18.8	19.7	20.5	21.5	21.3	21.3	20.5	21.3	21.1	20.8	20.0	20.8	22.0	22.0	21.3
	Min.	13.7	13.8	14.4	14.8	16.5	16.4	17.3	17.0	16.2	16.4	16.6	17.1	17.8	16.6	17.0	17.9	18.2	17.9	18.6	19.1	19.5	18.9	18.6	17.7	19.9	19.5	18.5	18.6	19.1	19.8	18.5
1992	Max.	12.9	12.6	11.1	9.4	10.6	11.7	12.6	14.6	17.0	16.9	16.1	15.9	16.2	17.8	19.2	18.5	15.9	16.0	16.9	19.0	19.2	20.0	19.6	21.3	21.6	20.5	20.1	19.9	20.2	21.7	20.8
	Min.	11.8	11.1	9.6	8.4	8.1	9.3	11.5	12.3	13.9	15.6	15.0	13.4	12.5	15.1	16.0	16.1	14.3	14.1	14.7	15.4	17.4	18.0	17.8	17.8	19.0	19.1	19.0	18.5	18.1	19.0	19.3
1993	Max.	18.5	19.9	19.1	18.5	15.7	12.9	15.9	15.7	15.1	14.4	15.1	17.9	17.8	18.1	17.8	16.9	16.5	14.1	14.3	16.0	15.4	17.5	17.0	16.3	15.2	17.1	18.3	17.4	18.6	18.8	20.6
	Min.	14.8	17.0	17.0	15.9	12.9	11.8	12.0	15.1	13.1	12.1	13.6	14.1	16.7	16.5	15.7	15.2	14.1	13.4	13.1	13.6	15.1	15.1	16.1	13.9	12.4	13.9	15.0	16.5	16.5	18.0	18.4
1994	Max.	22.8	23.0	22.2	21.5	20.6	18.4	20.1	21.8	21.2	20.5	21.0	21.8	21.7	22.4	21.5	21.8	22.4	22.6	21.6	21.1	19.9	20.6	19.8	17.6	20.3	21.4	22.9	23.0	23.1	23.6	24.5
	Min.	19.9	20.5	19.7	18.9	18.1	15.9	16.1	17.3	18.0	17.6	18.0	18.4	19.1	19.0	19.8	18.1	18.3	19.5	19.9	18.6	18.4	19.0	17.5	16.6	17.3	18.9	20.8	21.7	21.6	20.8	21.6
1995	Max.	13.9	13.6	14.8	16.8	18.9	21.1	23.6	23.9	23.6	22.5	23.2	24.2	23.5	22.5	20.8	16.3	16.9	15.1	17.8	18.7	18.5	19.8	19.4	22.5	22.6	21.3	21.6	22.6	21.6	20.6	20.1
	Min.	11.4	12.9	12.4	14.1	16.4	18.1	20.0	21.4	21.5	21.0	20.5	21.5	21.2	20.5	16.4	13.8	12.8	14.1	14.3	16.0	17.4	16.6	18.2	18.7	19.7	20.5	18.9	19.8	19.4	19.1	18.5
1996	Max.	20.0	21.9	20.9	22.0	21.5	22.4	21.5	20.4	20.2	19.5	21.1	21.2	22.9	22.5	19.5	18.3	19.5	20.1	20.4	20.1	21.5	20.8	19.7	19.1	21.2	22.0	21.2	20.1	19.0	21.0	23.1
	Min.	16.4	18.5	19.7	19.5	20.1	20.2	19.9	17.8	18.6	18.0	18.0	18.5	19.1	19.9	15.9	17.1	16.6	18.5	18.8	19.1	19.5	19.7	18.1	18.0	17.9	18.7	19.9	18.9	17.5	17.8	19.5
1997	Max.	23.3	22.0	19.3	20.8	21.8	21.8	23.0	23.3	22.8	22.9	22.0	21.0	21.1	20.1	17.5	17.0	18.3	20.4	21.4	20.1	19.8	19.5	20.7	21.4	20.3	18.8	17.0	21.0	19.8	21.6	22.4
	Min.	19.8	19.1	17.6	18.4	18.5	18.3	18.9	20.5	21.0	20.0	19.8	19.5	19.1	15.8	13.9	15.6	16.1	17.2	18.5	18.4	17.7	18.1	17.0	17.4	17.6	16.4	15.6	15.9	17.4	16.5	18.1
1998	Max.	21.1	20.2	21.8	20.9	19.8	21.5	22.5	21.7	20.5	18.0	17.4	18.5	20.8	20.0	21.4	22.5	22.1	23.2	23.5	22.5	22.5	22.3	21.4	21.9	22.1	22.6	23.1	22.9	22.2	21.1	23.0
	Min.	17.1	18.5	17.7	19.3	18.8	18.4	19.1	19.9	16.3	14.8	15.9	16.3	17.0	18.5	18.4	20.5	20.9	21.1	20.8	21.3	20.7	20.3	19.8	19.5	19.8	20.3	20.4	20.3	20.0	19.7	19.5
1999	Max.	22.9	22.1	20.4	18.4	17.0	15.1	19.0	20.5	19.6	18.9	19.2	22.5	20.9	22.5	23.6	23.9	25.0	23.7	24.0	21.4	22.6	21.6	22.0	23.5	24.6	24.5	22.5	21.6	23.0	24.5	25.5
	Min.	19.4	20.0	18.1	17.0	15.4	13.8	14.1	16.8	17.3	17.5	17.1	16.5	18.8	17.8	19.4	20.0	21.0	20.7	20.8	18.4	17.6	18.9	18.5	19.5	19.7	20.7	20.8	19.4	18.9	19.7	20.6

Appendix 3c. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of August, 1985-99.

Year		Date																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1985	Max.	22.1	22.1	21.6	21.6	20.6	20.6	21.1	20.6	22.6	23.6	24.7	24.7	25.7	25.7	24.7	24.7	23.1	20.0	19.5	19.0	19.0	19.5	19.5	19.5	20.0	20.0	18.0	18.5	20.6	20.6	19.5
	Min.	20.6	20.6	20.6	20.6	17.5	16.5	19.5	20.6	20.6	21.6	22.6	23.6	23.6	24.7	24.1	23.6	20.6	18.5	18.5	18.5	18.5	17.0	18.5	19.0	19.5	18.5	17.0	16.5	17.5	19.5	18.5
1988	Max.	24.1	22.1	21.3	22.2	23.2	21.9	19.7	21.0	24.4	21.5	21.2	22.3	21.7	19.7	18.1	19.8	20.1	18.8	17.5	16.7	16.2	15.9	14.5	16.4	18.8	19.3	18.9	20.7	20.8	20.3	19.5
	Min.	20.4	20.0	18.9	17.9	19.1	18.6	18.0	19.0	19.6	20.1	18.2	18.9	20.4	18.1	15.7	16.3	17.8	16.8	16.3	15.1	13.8	14.3	13.3	13.3	15.4	17.3	17.2	18.3	19.5	19.6	18.1
1990	Max.	24.0	22.7	21.3	20.6	24.8	24.2	27.5	28.7	27.6	27.4	27.8	27.8	27.9	28.1	26.0	24.7	24.6	24.8	22.0	20.0	19.5	21.7	23.0	20.3	22.7	20.5	18.8	20.1	24.8	24.7	25.2
	Min.	21.3	21.5	20.0	19.2	19.1	21.6	22.1	24.2	24.9	23.8	24.9	24.9	24.9	24.9	22.9	21.6	20.3	21.1	18.3	16.6	15.5	16.0	17.3	16.6	16.1	17.2	17.0	17.2	18.2	20.0	19.2
1991	Max.	18.8	18.8	17.3	16.2	15.4	15.5	17.6	18.0	18.0	17.7	18.3	18.2	20.3	20.9	20.6	21.0	20.9	20.9	20.6	19.9	19.4	19.0	18.7	18.9	18.4	17.8	18.8	19.3	18.9	18.6	18.2
	Min.	17.9	17.4	16.1	15.4	14.4	14.2	14.8	15.9	16.5	16.9	16.5	17.2	17.5	18.9	19.1	18.4	19.9	19.5	19.5	18.9	18.5	18.5	17.9	16.9	17.1	16.6	16.9	17.5	18.1	18.3	16.9
1992	Max.	19.5	18.8	18.1	18.5	18.1	19.5	19.6	20.0	21.4	21.7	21.5	21.6	20.9	18.9	19.9	20.0	20.6	21.9	21.4	21.0	22.3	21.0	17.1	16.5	16.5	16.6	16.3	16.1			
	Min.	18.4	17.2	15.3	16.8	17.6	17.5	17.8	18.0	18.8	19.5	20.0	19.9	18.5	17.1	17.0	17.5	17.8	18.6	20.5	19.2	20.0	17.1	15.5	15.6	15.8	14.3	14.9	15.6			
1993	Max.	22.2	23.0	23.3	22.8	22.5	22.5	22.1	21.9	21.8	21.9	21.5	22.0	22.4	21.4	19.2	19.5	19.5	20.5	20.0	19.0	18.5	18.7	18.5	18.0	18.4	17.8	14.1	15.1	14.7	13.9	13.6
	Min.	19.8	20.9	21.5	21.7	21.5	21.1	21.0	19.9	20.1	19.5	19.3	19.8	20.2	19.3	17.3	17.5	18.4	18.3	18.0	18.0	16.7	15.4	16.4	16.9	16.7	14.2	12.7	12.9	13.4	12.4	12.8
1994	Max.	24.1	23.1	22.3	23.3	22.5	21.0	19.5	19.6	22.0	22.1	21.3	19.9	19.9	21.5	20.2	19.8	19.8	19.5	20.5	19.9	20.5	19.9	21.0	20.8	20.8	21.3	22.4	21.3	22.1	20.9	17.7
	Min.	22.4	20.9	20.3	20.5	21.1	19.5	18.5	18.8	19.4	20.9	19.8	17.8	17.8	19.3	18.5	16.9	17.8	17.6	18.0	17.6	18.7	18.6	17.2	17.6	17.5	18.7	19.0	19.9	20.0	18.0	15.5
1995	Max.	19.8	20.5	21.5	20.5	19.1	20.4	21.5	22.9	23.9	24.3	23.6	23.8	21.8	19.6	18.5	20.1	18.6	18.5	17.5	20.0	22.0	20.5	16.5	15.4	16.0	15.9	15.1	15.8	15.6	15.3	13.6
	Min.	17.9	16.0	18.7	18.1	18.0	17.0	18.1	19.3	20.2	20.8	20.5	21.1	16.4	14.5	16.4	17.2	15.6	14.0	15.4	15.6	19.2	16.6	15.2	14.3	14.3	13.9	13.4	13.4	14.4	13.6	13.0
1996	Max.	22.5	22.0	22.0	23.5	25.6	26.2	26.4	26.1	25.3	24.9	24.3	23.7	22.9	21.9	21.1	22.3	22.5	23.2	22.0	21.6	23.0	24.0	23.0	21.7	22.0	21.1	19.8	20.8	20.0	19.9	18.9
	Min.	19.7	20.2	20.3	20.4	21.3	23.7	24.0	23.5	22.6	22.1	22.6	21.6	21.1	20.5	19.0	18.4	19.5	20.1	19.2	17.3	18.5	19.2	20.0	19.6	18.9	19.1	18.0	18.0	18.6	18.0	16.2
1997	Max.	21.0	20.0	22.9	21.0	19.3	21.3	21.5	20.8	22.8	22.2	23.0	22.1	17.9	17.8	19.9	18.7	19.7	17.9	18.9	20.0	20.9	19.3	19.0	19.6	19.4	19.7	21.0	21.0	19.1	16.5	14.6
	Min.	18.9	18.6	18.3	19.4	18.6	17.8	17.9	17.4	18.6	20.1	20.1	17.5	15.4	16.2	15.8	17.1	16.6	15.0	13.4	14.2	15.4	16.6	16.5	16.8	17.4	17.7	17.4	17.5	16.6	14.1	12.3
1998	Max.	23.1	22.3	23.1	23.6	23.9	24.5	24.3	23.5	23.3	25.5	24.3	19.4	19.5	20.5	21.1	21.8	21.2	21.2	21.0	20.3	20.2	20.4	19.7	18.9	18.6	16.8	16.6	16.4	15.9	15.8	16.6
	Min.	20.5	20.1	19.4	20.8	21.1	21.3	21.3	22.1	21.9	21.7	19.5	17.8	17.6	17.0	18.1	19.1	19.4	19.4	19.4	18.5	18.3	18.3	17.8	17.6	16.9	15.8	15.5	15.6	15.1	15.0	14.9
1999	Max.	25.7	27.4	25.4	26.1	25.3	24.1	23.8	21.1	20.0	19.3	22.6	20.0	20.9	22.4	20.8	18.0	19.9	19.5	18.5	20.4	20.5	19.7	19.0	19.1	18.9	19.1	19.3	20.8	20.4	19.6	20.5
	Min.	21.8	21.4	21.8	20.6	21.4	21.0	19.5	19.0	15.6	15.6	15.7	17.2	17.0	19.5	18.3	16.1	17.3	18.3	17.0	16.7	18.9	18.4	17.5	16.3	17.9	16.4	17.4	19.0	18.7	17.3	17.8

Appendix 3d. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of September, 1985-99.

Year		Date																												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1985	Max.	18.5	17.5																												
	Min.	17.5	15.9																												
1988	Max.	20.5	19.7	16.8																											
	Min.	18.2	17.8	15.7																											
1990	Max.	24.6	22.6	17.6	21.1	17.2	21.8	21.7	17.9	17.7	18.3	19.5	20.2	15.4	17.3	13.0															
	Min.	17.3	16.1	13.9	12.4	12.9	13.5	14.3	11.5	10.2	12.3	14.9	13.8	11.5	9.6	12.5															
1991	Max.	16.8	14.2	25.3	24.6	21.5	21.1	21.4	21.8	20.6	21.0	21.0	20.2	20.0	20.1	19.2	16.6	25.0	21.2	18.6											
	Min.	14.2	11.4	10.4	12.9	12.6	15.7	20.5	20.0	19.7	20.1	19.8	19.9	19.5	14.5	6.7	12.0	13.9	7.4	17.4											
1992	Max.																														
	Min.																														
1993	Max.	15.8	16.0																												
	Min.	12.4	14.1																												
1994	Max.	18.0																													
	Min.	16.0																													
1995	Max.																														
	Min.																														
1996	Max.	18.5	18.4	18.0	17.0																										
	Min.	16.5	16.1	15.2	15.5																										
1997	Max.	15.8	16.6	16.3	17.1	17.0	17.1	18.4	18.6	15.9	14.6	15.8	15.8	15.8	16.2	17.1	16.5	15.1	15.7	15.4	15.6	15.0	14.4	13.6	12.7						
	Min.	13.4	14.9	15.8	16.3	15.9	15.9	16.3	16.0	14.6	13.9	13.4	14.8	15.4	15.4	15.6	15.2	14.1	13.9	14.6	14.9	13.6	13.1	12.8	11.4						
1998	Max.	17.8	17.3	16.3																											
	Min.	15.4	16.4	15.4																											
1999	Max.	21.5	21.0																												
	Min.	18.6	19.6																												

Appendix 4. Mean daily water levels (cm) measured near the counting fence in Gander River, 1989-99.

Month	Day	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
May	**17**	79.3										
	18	75.5										
	19	73.5										
	20	68.8										
	21	66.0										
	22	63.9										
	23	61.4										
	24	58.5										
	25	56.0										
	26	54.8										
	27	54.0										
	28	53.0										
	29	52.8										
	30	51.5										
	31	51.3										
June	**1**	50.3										
	2	51.5							99.0			
	3	52.0							98.4			
	4	52.0							97.0			
	5	53.8							98.6			
	6	54.0							100.0			
	7	53.5				101.2			99.6			
	8	53.5				98.8			97.4			
	9	50.8				97.4			96.5			
	10	50.3				94.5			95.0			
	11	49.5				92.0		93.5	92.6			
	12	48.5				90.5		92.0	90.6			
	13	47.8				89.0		92.0	89.0			
	14	59.0				87.4		92.7	86.3			
	15	58.5				86.7		93.3	84.2		78.0	
	16	57.5				85.5		95.8	83.3		76.0	
	17	56.7	79.5			84.8		99.0	80.5		73.5	
	18	56.6	79.3			84.3		103.5	79.5		70.5	65.0
	19	55.8	77.4			81.7		105.0	80.0		69.0	65.0
	20	54.5	77.8			81.2		107.0	83.8		67.4	64.7
	21	67.0	82.8			80.5		104.8	89.2		66.0	63.7
	22	67.3	88.2			79.1	101.5	103.0	92.5		64.0	62.0
	23	67.8	95.2			79.8	102.3	101.2	93.0		63.1	61.0
	24	68.3	99.8	98.0		81.0	101.3	98.6	91.5		62.0	61.0
	25	68.3	103.8	94.5		82.2	100.6	96.0	89.0		60.5	59.5
	26	68.9	106.8	92.3		85.6	99.0	98.1	86.9		58.3	58.7
	27	68.3	105.8			91.5	96.8	98.8	86.0		57.5	56.5
	28	68.0	105.0	87.3		96.6	96.5	95.0	84.2		56.3	56.0
	29	69.0	101.4	83.0		99.3	95.6	93.4	83.1		55.3	54.3
	30	67.5	99.6	83.8		101.7	94.7	92.0	80.8	65.0	53.0	54.3
July	**1**	66.0	97.0	84.0	113.0	104.4	94.4	91.0	80.0	63.9	53.7	55.0
	2	66.0	94.0	83.0	112.3	104.4	95.0	91.3	78.7	62.9	54.7	54.0
	3	65.0	92.6	82.5	110.0	106.0	96.0	98.3	76.3	62.5	53.3	53.0
	4	65.0	90.0	81.0	110.0	105.2	95.8	122.3	78.0	61.0	51.2	51.5
	5	64.0	88.5	80.0	109.0	105.6	95.0	113.8	78.7	61.0	51.0	51.0
	6	63.7	86.3		108.6	105.3	95.0	106.2	82.0	60.0	52.0	51.0
	7	63.0	83.8		105.7	106.0	92.8	100.5	85.0	59.4	52.0	50.0
	8	62.0	82.0	78.0	102.0	105.0	91.0	95.8	86.1	57.5	51.6	49.7
	9		79.5	75.1	100.0	104.0	88.8	93.0	85.7	56.0	51.3	49.0
	10	61.5	78.3	78.0	98.0	102.7	88.0	90.5	86.2	55.0	53.7	49.0
	11	61.0	77.5	77.0	99.3	100.7	88.8	88.3	86.1	55.0	54.5	49.0
	12	60.0	76.0	76.3	99.0	100.0	87.4	86.4	83.6	53.0	54.0	50.0
	13	60.8	75.1	76.2	99.0	99.0	86.0	84.0	82.4	52.0	53.0	49.0
	14	61.0	74.0	76.0	100.0	98.2	84.8	85.3	84.3	52.0	52.0	49.0
	15	62.0	73.2	74.9	97.0	97.7	82.3	82.5	118.2	50.7	52.0	49.0

Appendix 4 (cont'd)

Month	Day	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
July	**16**	64.5	71.5	74.7	99.3	97.8	82.0	80.4	125.0	50.0	51.0	49.7
	17	64.7	70.4	73.0	98.0	104.4	81.0	79.6	138.0	49.0	51.0	49.1
	18	64.0	69.0	73.0	96.5	105.3	79.8	78.4	137.0	48.5	60.3	48.5
	19	64.5	68.8	71.0	100.7	106.8	79.0	77.0	134.2	48.0	63.0	48.7
	20	65.0	68.3	71.0	102.0	107.0	78.3	77.8	127.8	49.0	61.5	49.7
	21	65.0	68.0	71.4	97.0	108.0	76.0	78.0	122.0	48.7	59.7	49.3
	22	64.0	70.0	69.0	97.3	107.7	76.5	79.0	118.4	46.0	57.8	49.0
	23	64.8	70.2	68.7	93.7	108.0	78.0	84.0	115.9	46.0	56.5	49.0
	24	63.7	69.8	68.6	94.0	107.0	81.5	82.4	111.8	45.0	54.0	48.2
	25	63.0	71.3	69.3	88.0	110.0	87.8	95.3	109.2	44.0	58.3	48.0
	26	63.0	76.5	69.3	87.0	110.3	96.3	94.5	106.1	43.0	57.0	47.7
	27	62.1	81.8	68.5	87.0	112.7	105.6	91.6	101.3	43.0	54.8	47.0
	28	61.4	81.0	68.5	86.0	114.0	105.9	90.1	102.2	42.8	52.5	46.2
	29	61.0	79.8	67.7	86.0	114.5	109.6	90.0	101.2	43.0	51.0	46.7
	30	61.0	79.5	68.0	86.0	124.2	109.6	90.0	101.8	43.0	51.0	47.0
	31	60.0	78.8	66.0	86.0	125.6	106.9	88.3	102.0	42.0	50.6	46.0
August	**1**	59.3	77.7	66.1	86.0	124.3	104.9	87.0	99.7	42.1	49.5	46.0
	2	57.8	76.6	66.0	91.0	124.6	103.8	87.5	96.0	40.9	50.0	45.7
	3	57.4	75.8	66.0	106.0	127.0	100.0	87.5	92.5	40.0	49.7	45.2
	4	57.2	74.8	67.3	109.5	127.2	99.0	86.0	88.8	41.7	47.0	44.7
	5	58.0	73.3	66.0	110.7	126.6	99.0	85.4	85.7	40.5	48.3	44.2
	6	57.8	71.0	65.7	112.0	145.6	99.0	83.0	83.2	41.0	47.3	43.2
	7	57.7	69.8	68.3	114.0	162.5	109.8	81.6	80.3	41.5	47.0	43.0
	8	59.0	69.2	69.0	107.5	163.7	119.0	81.3	77.5	40.5	46.0	44.7
	9	61.8	68.8	67.0	109.0	161.3	118.0	80.0	76.2	40.1	45.0	43.3
	10	64.0	67.0	67.0	105.0	156.0	115.4	78.3	73.0	40.3	44.0	43.7
	11	70.8	67.0	67.7	104.0	149.3	112.6	77.3	70.8	42.0	42.0	41.2
	12	76.0	66.5	67.6	100.0	141.7	109.0	76.0	70.3	42.0	40.0	40.1
	13	77.2	64.2	69.0	98.0	132.8	105.7	74.8	68.9	42.0	44.0	40.2
	14	79.0	63.5	66.5	95.0	127.2	102.5	75.7	66.7	42.0	47.7	40.7
	15	82.8	63.3	66.3	93.5	123.2	101.5	75.0	66.6	42.0	46.0	40.8
	16	84.8	63.0	66.0	92.8	118.2	97.2	77.3	63.3	42.0	45.0	48.5
	17	85.5	61.6	67.2	86.0	114.8	93.2	80.0	62.0	41.0	46.8	59.8
	18	86.3	61.0	67.7	84.3	109.7	92.0	80.0	61.0	42.0	45.0	61.0
	19	85.0	61.0	66.5	84.0	107.3	89.3	81.0	58.6	42.0	45.0	65.7
	20	84.5	60.7	68.5	85.0	103.5	87.3	81.0	57.0	40.6	46.0	70.0
	21	83.2	60.0	76.8	84.0	100.2	85.6	80.0	57.0	40.0	45.5	71.7
	22	80.9	59.0	76.0	84.0	98.8	83.7	89.3	55.0	41.0	45.0	72.7
	23	84.0	58.4	77.0	83.7	96.8	82.0	96.7	53.4	40.0	46.3	73.7
	24	84.3	59.0	76.0	85.0	94.4	80.2	87.0	53.0	39.0	46.0	73.0
	25	91.2	56.6	75.8	86.3	92.7	78.4	86.0	54.9	39.3	46.0	73.0
	26	94.0	55.8	75.0	86.0	93.0	77.8	89.5	53.0	38.5	47.0	72.3
	27	95.7	55.8	74.0	85.0	96.5	76.0	89.0		38.5	50.3	74.0
	28	92.8	56.0	72.0	85.0	95.3	74.7	90.3		38.0	56.0	74.5
	29	92.0	55.3	70.5	86.8	99.8	73.0	92.3		37.4		76.8
	30	91.9	55.0	70.8	87.3	100.0	74.0	91.8		37.0		78.3
	31	90.3	54.0	72.4	91.7	95.5	73.4	81.2		38.7		79.0
September	**1**	88.5	53.6	78.0	92.0	95.0	70.8	101.3		42.8		
	2	86.2	53.0	81.8	93.5	95.0	70.0	102.0		45.7		
	3	85.1	52.3	83.8	96.7	93.5	69.0	103.4		51.2		
	4	84.0	52.0		101.0	92.3	67.0	105.0		53.8		
	5					90.7	66.0			62.6		
	6					90.0				80.0		
	7					89.0						

Appendix 5. Mean daily water levels (cm) measured near the fishway in Salmon Brook, 1983-99.

Month	Day	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
June	2																	33.8
	3																	31.5
	4																34.2	30.8
	5																34.5	31.3
	6														45.7		35.0	29.9
	7														43.0		36.0	28.8
	8														39.7		37.3	28.3
	9														38.7		39.2	28.0
	10														36.2		41.5	27.0
	11														35.0		40.0	26.6
	12								31.8						34.3		38.3	26.1
	13								30.8						33.0		36.7	25.5
	14								29.3	59.0			37.3		32.3		34.3	25.0
	15								27.8	58.2		28.0	34.7	31.2	31.8		32.5	24.3
	16									57.2		27.5	32.0	32.2	31.7		30.3	24.3
	17				31.0	28.2		20.3		56.8			31.7	33.5	31.8	28.0	29.7	23.7
	18				29.0	29.0		20.0	25.8	53.8	92.0		29.8	34.0	31.3	29.0	26.3	24.1
	19				27.8	29.0		19.8	25.0	51.0	85.7	28.0	29.3	34.0	30.8	28.3	24.2	24.1
	20	39.3	52.8		26.8	28.5		18.8	25.0	47.5	73.5	28.5	28.8	32.0	35.0	28.5	24.2	24.0
	21	41.3	50.5	40.0	26.3	28.5		17.8	27.3	44.8	64.0	29.0	29.7	32.0	39.0	28.0	24.8	23.8
	22	43.1	47.7	41.0	25.3	29.0		18.0	30.8	43.0	56.0	27.3	31.7	32.0	43.3	27.3	24.0	22.8
	23	44.0		41.0	24.3	28.3		18.0	33.0	40.5	51.0	28.0	33.0	31.0	48.3	26.5	24.2	22.5
	24	43.4		40.0	23.0	28.0		17.3	34.0	39.7	48.0	29.0	33.8	30.2	49.5	27.0	24.0	22.4
	25	43.3	40.6	38.0	22.2	27.0		16.8	35.2	38.8	45.0	28.2	34.5	30.0	47.2	28.0	23.8	21.9
	26	42.4	38.6	36.5	21.8	26.3	38.0	16.5	34.0	37.3	41.5	29.0	34.0	30.5	44.0	29.2	23.0	21.3
	27	41.6	36.9	34.3	20.7	25.3	37.0	16.3	33.0	35.8	39.8	30.2	33.3	32.7	40.8	30.0	23.2	20.3
	28	40.3	35.9	32.0	19.8	24.3	37.5	15.8	33.0	33.8	37.8	31.0	32.3	34.3	38.8	29.2	23.3	18.9
	29	37.6	35.3	31.1	19.0	22.8	37.7	15.8	32.5	32.8	36.2	31.3	32.0	34.0	36.0	28.5	21.8	20.2
	30	35.8	34.3	36.0	19.0	22.0	37.2	15.5	32.0	32.0	34.8	36.0	32.5	34.0	34.2	27.7	21.8	18.5
July	1	33.8	36.3	41.8	21.2	21.0	38.0	15.0	31.3	31.3	34.2	36.2	33.3	34.0	32.4	26.8	22.6	19.9
	2		38.7	42.4	22.5	21.0	37.3	14.3	30.3	31.0	36.0	36.3	33.0	34.2	30.6	26.0	23.3	18.0
	3		43.5	40.9	20.7	20.0	37.0	13.8	29.2	34.0	39.5	34.8	33.0	36.8	29.9	25.7	23.2	15.0
	4	31.0	47.7	39.1	21.2	19.3	38.3	13.0	27.0	33.3	41.5	31.8	33.0	71.7	30.0	25.0	22.7	14.3
	5	29.6	48.0	36.6	21.7	18.3	40.0	13.8	25.8	32.8	43.0	31.9	33.0	78.2	30.1	25.7	23.4	13.5
	6	28.7	47.2	34.3	23.2	17.8	38.3	13.0	24.8	32.0	43.0	33.3	33.0	74.3	30.2	25.2	23.1	16.2
	7	28.0	46.0	32.3	23.4	16.8	38.7	12.3	23.3	31.3	43.2	32.3	33.5	58.5	29.3	24.9	23.7	14.2
	8	30.5	43.0	30.7	23.0	14.7	38.8	12.0	22.8	30.7	43.5	34.6	33.0	46.5	29.0	23.0	23.5	13.1
	9	30.4	40.7	30.8	24.0	15.0	37.0	12.0	22.0	31.0	40.5	35.5	31.8	41.7	27.9	23.8	23.3	13.0
	10	30.0	39.5	28.8	25.1	13.8	36.0	12.7	21.0	30.0	38.8	35.5	32.0	38.8	28.5	23.8	25.5	13.3
	11	30.6	35.4	27.4	26.4	12.8	34.8	12.2	21.0	30.7	41.2	36.0	32.5	35.0	27.5	22.7	26.0	15.7
	12	31.0	33.5	26.6	29.2	11.8	32.5	14.5	20.3	31.0	42.5	35.1	31.5	32.2	27.2	22.5	27.3	14.3
	13	30.8	31.3	25.8	32.5	9.3	31.0	15.0	20.0	30.3	42.0	33.4	31.8	31.4	27.3	22.2	28.5	14.2
	14	30.4	29.0	24.4	36.2	5.7	29.9	15.0	20.0	30.0	41.8	32.4	31.7	29.8	28.2	22.0	28.2	14.5
	15	29.9	28.0	22.9	37.6	5.0	29.0	18.0	19.3	30.3	39.0	32.8	32.0	32.1	51.6	23.5	28.3	14.7
	16		26.0	22.1	38.0	14.8	28.0	20.8	18.8	30.7	38.7	32.5	31.2	32.2	68.5	22.3	28.3	14.3
	17		23.9	22.0	38.2	13.8	27.3	23.3	18.0	29.0	38.0	40.0	30.9	32.2	63.8	20.3	28.7	14.7
	18	30.9	25.6	22.4	36.5	12.8	26.8	25.0	18.0	28.3	37.2	48.5	30.6	30.2	54.0	20.3	31.3	13.7
	19	34.0	23.0	24.6	35.3	11.8	25.8	26.0	17.3	27.5	38.0	50.0	28.4	30.0	49.0	20.5	35.8	12.9
	20	35.9	22.4	26.8	32.8	10.8	24.0	25.5	17.0	26.3	41.0	50.7	30.3	30.5	43.3	20.0	39.0	14.7
	21	36.9	21.0	36.5	33.0	10.0	25.2	25.0	17.0	25.3	40.0	47.0	30.0	30.6	41.0	19.7	39.7	14.5
	22	36.9	18.0	46.3	32.5	9.0	24.8	24.5	17.5	24.5	37.2	44.3	28.1	33.0	38.9	18.5	37.8	13.8
	23	35.8	18.3	50.3	30.5	8.0	23.7	21.5	18.0	24.0	39.7	42.1	30.5	35.5	36.2	18.2	35.2	13.3
	24	35.4	16.9	50.0	32.5	6.7	23.0	19.5	18.0	23.5	40.0	40.2	31.9	39.0	34.2	18.0	32.2	14.5
	25	34.7	16.3	48.1	31.5	5.7	22.3	19.2	22.7	22.8	38.5	40.7	38.6	43.8	32.0	17.2	32.7	13.7
	26	34.4	17.1	44.4	30.5	5.0	20.7	18.8	26.2	21.7	37.2	40.8	45.1	45.3	31.0	16.0	32.0	12.8
	27	42.1	17.6	40.6	29.8	4.3	18.3	18.3	32.0	20.7	35.8	38.8	44.0	43.1	29.9	15.2	31.0	13.2
	28	48.6	17.0	37.5	29.0	5.3	20.0	15.8	35.0	20.0	33.7	35.2	43.8	41.8	32.7	14.7	31.0	13.7
	29	52.1	17.0	35.0	26.0	5.0	19.8	14.8	35.0	19.0	30.3	38.4	41.6	40.0	38.5	14.2	28.2	14.7
	30		15.8	32.9	26.2	2.8	19.3	15.3	34.5	18.2	32.0	41.1	38.5	36.5	40.1	13.8	27.5	13.3
	31		14.8	31.4	26.7	1.8	18.3	14.8	34.0	16.8	32.0	46.3	36.6	35.0	39.6	11.8	27.7	13.3

Appendix 5(cont'd)

Month	Day	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
August	1	53.3	13.4	28.9	24.5	1.5	18.0	13.8	32.7	16.5	31.7	48.5	35.5	32.8	38.2	7.0	27.0	13.7
	2	52.7	13.5	29.4	27.0	1.0	17.5	13.3	31.7	17.0	34.7	47.5	36.5	31.4	35.4	5.7	26.3	12.6
	3	51.6	17.1	33.8	27.5	0.0	17.0	12.3	29.8	18.2	48.0	46.3	35.4	29.7	32.9	5.8	25.7	11.7
	4	51.2	18.0	38.3	31.0	-1.0	15.8	11.5	28.3	19.2	52.7	43.4	35.0	28.5	31.0	7.3	25.3	11.7
	5	51.1	18.0	39.3	30.0	-1.0	15.0	10.5	27.3	20.2	50.7	41.0	37.3	27.3	29.6	7.5	24.3	12.8
	6	50.3	18.0	37.7	28.7	-2.2	14.3	10.5	26.3	22.0	52.0	45.3	38.0	30.6	27.7	9.0	24.3	12.6
	7	49.2	17.6	37.6	28.5	-3.0	13.3	11.0	25.0	24.2	50.8	63.9	53.1	30.2	27.6	8.8	22.8	12.7
	8	65.4	16.8	35.8	27.8	-4.0	12.8	11.5	21.2	27.3	48.7	65.3	87.3	28.3	27.8	8.2	22.2	12.9
	9	73.9	17.3	35.0	27.0	-4.7	12.0	12.0	20.0	29.7	46.0	58.6		27.0	26.7	7.5	21.5	13.0
	10	73.3	16.8	33.5	26.3	-5.0	20.5	20.0	19.0	31.0	42.3	53.9	75.0	24.8	26.6	7.3	20.3	12.0
	11	76.0	21.3	32.8	26.0	-5.5	22.3	25.0	17.8	30.5	40.0	52.8	58.2	23.3	26.5	7.5	17.8	12.0
	12	76.2	22.2	31.5	25.0	-6.0	25.0	25.0	17.3	30.2	34.3	43.8	51.3	21.8	26.5	6.3	18.7	12.8
	13		24.3	30.1	28.3	-6.0	25.0	24.8	16.3	29.3	34.3	41.7	46.1	20.0	26.3	7.0	22.3	12.3
	14		24.6	30.0	24.0	-6.5	25.0	24.7	15.5	28.3	35.7	38.0	42.4	23.3	26.7	7.2	23.7	13.0
	15	66.3	26.3	28.8	23.0	-7.0	24.8	27.0	15.0	27.3	34.7	36.2	40.4	24.3	26.4	7.3	24.5	12.5
	16	65.0	26.9	27.3	22.3	-7.0	24.0	29.3	15.0	26.3	33.7	33.3	39.3	25.7	26.1	6.7	25.0	21.3
	17	64.3	27.1	26.1	21.5	-7.7	25.0	33.0	14.3	26.0	32.3	31.2	37.1	23.8	25.6	6.8	26.7	28.0
	18	63.6	29.3	25.5	21.0	-8.0	24.3	34.0	13.8	26.0	30.7	31.2	35.5	22.0	25.3	7.5	27.3	34.3
	19	62.9	39.5	24.7	20.5	-7.5	24.0	34.5	13.2	25.3	32.0	31.0	35.4	21.5	24.2	7.5	26.7	38.0
	20	62.0	29.0	23.7	21.0	-7.0	24.0	33.0	13.5	25.5	32.0	30.3	35.0	20.3	22.8	7.7	28.0	37.7
	21	61.7	32.3	23.0	19.8	-6.7	23.3	31.2	12.0	44.0	32.0	30.3	34.1	21.7	21.7	7.3	28.0	35.8
	22	62.3	34.6	22.5	18.8	-6.0	22.5	30.5	11.5	53.0	32.7	31.0	34.0	23.0	20.8	6.8	26.8	34.4
	23	63.5	39.4	22.0	17.8	-5.5	27.0	31.0	10.3	54.0	32.3	30.8	31.3	26.3	19.2	6.7	27.7	31.7
	24	64.0	41.3	23.3	17.0	-5.5	30.0	31.0	10.0	53.0	33.2	29.8	30.7	28.7	18.0	7.8	26.8	31.0
	25	63.7	44.3	24.2	16.5	-5.7	31.3	31.0	9.5	49.7	34.0	28.2	31.5	30.2	22.8	6.8	27.7	30.3
	26	62.4	46.0	25.3	19.2	-6.0	32.0	30.7	9.0	47.0	33.2	30.0	31.0	36.3	25.2	6.0	27.0	29.4
	27			25.8	19.2	-6.0	31.2	31.0	9.0	44.5	34.0	33.3	30.5	42.7	26.7	7.2	28.2	29.8
	28			24.5	18.8	-6.0	31.0	31.0	9.0	41.7	34.0	35.3	30.0	42.0	27.0	8.0	34.3	29.3
	29	59.6		24.4	18.3	-6.3	31.0	31.0	8.0	39.7		38.2	29.3	42.0	27.1	7.8	37.5	30.0
	30	58.4		34.0		-6.5	29.8	30.5	6.8	39.0		40.7	31.0	38.3	26.4	8.2	38.0	30.8
	31	57.4				-7.0	28.8	30.0	6.0	39.2		39.2	30.3	36.0	25.9	16.7	36.5	29.5
September	1	56.6	34.7			-7.0	27.8	30.0	6.0	40.5		38.2	29.8	39.2	25.6	29.7	34.7	28.0
	2	55.7	32.0			-7.0	26.8		5.0	47.0		37.8	29.0		24.8	42.7	33.3	29.7
	3		27.4			-7.5			4.3	45.3		37.7			23.6	46.7	31.5	29.5
	4		26.3			-7.5			4.0	47.7						42.0	30.0	
	5		23.7			-7.0			4.0	45.5						52.0		
	6		22.0			-7.0			2.8	44.0						89.0		
	7					-7.0			1.3	43.0								
	8					-5.7			1.0	44.3						66.0		
	9					-2.0			1.0	54.3						40.3		
	10					1.0			0.5	57.7						46.7		
	11					2.0			0.5	58.7						40.7		
	12					2.0			0.5	58.5						37.0		
	13					2.0			0.5	55.7						32.0		
	14					1.5			0.5	53.8						31.0		
	15					2.0			0.3	51.8						31.0		
	16					4.7				48.7						29.7		
	17					4.7				45.3						29.0		
	18					9.3			0.4	44.3						28.0		
	19					11.0			0.4	44.5						27.5		
	20					11.7			0.4	44.0						25.7		
	21					12.3			0.5							26.8		
	22					13.0										27.0		
	23					14.0										26.8		
	24					14.0			1.0							28.5		
	25					13.8			2.0									
	26					13.5			4.0									
	27					13.0												
	28					13.2												
	29					14.0												
	30					14.0												

Appendix 5(cont'd)

Month	Day	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
October	**1**					13.5												
	2					13.8												
	3					13.5												
	4					13.0												
	5					14.3												
	6					18.3												
	7					21.3												
	8					24.0												
	9					25.0												
	10					25.2												
	11					25.3												
	12					24.3												
	13					23.3												
	14					22.7												
	15					22.0												
	16					21.3												