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Status of Atlantic salmon (*Salmo salar* L.) in Gander River, Notre Dame Bay (SFA 4), Newfoundland, 2000

État du saumon atlantique (*Salmo salar* L.) de la rivière Gander, baie Notre Dame (ZPS 4), Terre-Neuve, en 2000

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Abstract

For the first time since the inception of the Gander River project in 1989, the counting fence did not operate in 2000. As an alternative to using absolute counts obtained from the counting fence for determining status of stock, estimates of total returns were based on relationships between counts at the fishway in Salmon Brook tributary and total returns to the counting fence during 1989-1999. Estimates were provided by means of a regression method and a simulation method using a nonparametric bootstrap re-sampling technique. Estimates from both methods were more or less similar. Total returns of small salmon in 2000 were the second lowest (lowest was in 1997) of the moratorium years (25% and 24% below 1999 for the regression and simulation methods; 29% and 28% below the 1992-1999 mean); estimated returns of large salmon were well below the record high for 1999 (62% and 58%) and below the mean for 1992-1999 (27% and 19%). The regression estimate for percentage of conservation egg requirement achieved was 83 compared to 87 for simulation, the second lowest of the moratorium years. There was a high degree of uncertainty around estimates for both methods. The percentage of conservation egg requirement achieved in Salmon Brook tributary in 2000 (86%) was also the second lowest of the moratorium years. The potential impacts of the retention of large salmon in the recreational fishery, on stock composition and egg deposition, are discussed.

Résumé

Pour la première fois depuis la mise en œuvre du projet de la rivière Gander, en 1989, la barrière de dénombrement n'a pas été utilisée en 2000. Au lieu d'utiliser les chiffres absolus obtenus grâce à la barrière de dénombrement pour déterminer l'état du stock, on a fait des estimations des remontes totales d'après les relations entre les dénombrements à la passe migratoire du ruisseau Salmon et les remontes totales à la barrière de dénombrement de 1989 à 1999. Les estimations ont été établies en utilisant une méthode de régression et une méthode de simulation ayant recours à une technique « bootstrap » de rééchantillonnage non paramétrique. Les estimations d'après les deux méthodes étaient plus ou moins semblables. Les remontes totales de petits saumons en l'an 2000 ont été les deuxièmes moins élevées (les moins élevées ont été en 1997) de la période du moratoire (25 % et 24 % de moins qu'en 1999 d'après les méthodes de régression et de simulation; de 29 % et de 28 % inférieurs à la moyenne pour 1992-1999); les remontes estimatives de gros saumons ont été nettement inférieures au record atteint en 1999 (62 % et 58 %) et sous la moyenne pour 1992-1999 (27 % et 19 %). L'estimation par la méthode de régression en ce qui concerne le pourcentage de l'objectif de ponte de conservation atteint a été de 83 % alors que l'estimation par la méthode de simulation était de 87 %, le deuxième chiffre le plus bas pour la période du moratoire. Le degré d'incertitude pour les deux méthodes était très élevé. Le pourcentage de l'objectif de ponte atteint dans le ruisseau Salmon en l'an 2000 (86 %) a été également le deuxième plus faible de la période du moratoire. Les incidences potentielles de la rétention de grands saumons dans le cadre de la pêche récréative sur la composition des stocks et la ponte sont examinées dans ce document.

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 1989-1991, 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 2000, the ninth year of the commercial salmon fishery moratorium. For the first time since the inception of the Gander River project, the counting fence ceased to operate in 2000. Consequently, total river returns were estimated from relationships between counts at the fishway in Salmon Brook tributary and total returns to the counting fence during 1989-1999. The precision and utility of this approach in determining egg deposition is examined. Egg deposition in Salmon Brook tributary since 1989 is included for the first time. Status of stock is evaluated against conservation egg requirements (calculated in terms of fluvial and lacustrine habitats) derived for the entire Gander River and Salmon Brook. Other information available in this document includes water temperature and water level data since 1989 for the main stem in the vicinity of the counting fence and the fishway in Salmon Brook since 1985. The potential impacts of retaining large salmon in the recreational fishery on egg deposition and stock composition are also examined. In this connection, life-history characteristics of large salmon sampled in Gander River since 1978 and run timing information for small and large salmon at the counting fence for the period 1992-1999, are included.

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, continued in 2000. 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. In 1999, there was a limited commercial fishery for cod with a total allowable catch (TAC) of 9000 t (Anon. 1999a). In 2000, there was a TAC of 7000 t allocated to an index fishery (CSAS 2001).

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 1995-1997. 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. There was a daily hook-and-release limit of two fish. Beginning on July 8, 1998, only the use of barbless hooks was permitted. As in previous years, the retention of large salmon was not permitted in insular Newfoundland in 2000.

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) and these changes were continued in 2000. 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 Brook (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. Also in 2000, the Northwest Gander and Southwest Gander tributaries were no longer exempt from the environmental protocols.

An in-season review of returns to rivers in SFA 4 was conducted in late July of 2000. This was prompted by very low returns to counting facilities in Exploits River and Campbellton River and general reports of poor catches by anglers. Significant positive regressions between Gander River and Exploits River and Gander River and Campbellton River for returns of small salmon, suggested that returns to Gander River were also low. Even though the count of small salmon at Salmon Brook was also low up to that point, judging from past experience, low water levels prevalent at the time would have prevented fish from entering the fishway. Hence this count was not used as the prime consideration for the conclusion of low returns to Gander River in general. The retention limit for small salmon was therefore reduced to two for the remainder of the angling season.

As was the case for the period 1995-1999, there was a fall hook-and-release fishery in the main stem of Gander River below Gander Lake in 2000 (September 8-October 7).

Methods

Recreational fishery data and counts of adult salmon in 2000 were compared to two pre-salmon moratorium means (1984-1989 and 1986-1991). The 1984-1989 mean corresponds to years under the major management changes in the commercial fishery in the Newfoundland Region, cited above. The 1986-1991 mean incorporates the quota years of 1990 and 1991. The mix of management measures in effect during 1984-1989 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 1986-1991 mean. Recreational fishery data in 2000 were also compared to the moratorium means for 1992-1996 and 1997-1999 (see discussion of the License Stub Return System below) while counts of adult salmon were compared to the mean for 1992-1999.

Adult salmon counting equipment

Adult salmon were counted in Salmon Brook by means of a conventional wooden trap installed in the fishway. In 2000, for the first time, a solar powered (40 watt Solarex Solar Panel supplying a 12 volt marine battery) underwater video camera (MW-150 Mini Sea View) was installed in the trap, connected to a 13 cm AC-DC monitor (running off the same solar panel and 12 volt battery). This equipment was used to monitor the movement of fish into and out of the trap. By viewing the monitor every one-half hour, fish were cleared through the trap as soon as sufficient numbers accumulated. Previously, the trap was checked at four or more pre-determined intervals throughout the day. Observations elsewhere showed that adult salmon move freely into and out of the trap between trap-check intervals. In this regard, the goal of monitoring by video was to facilitate the passage of fish through the trap.

Recreational fishery data

Prior to 1997, catch and effort data 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). Information was also provided for above and below the counting fence and the section of Salmon Brook above the fishway. Data for 1997-2000 were derived from the License Stub Return System (see O'Connell *et al.* MS 1998b for a description of the methodology). Data for 2000 are preliminary at this stage. It was not possible to determine catch and effort above and below counting facilities with the License Stub Return, nor was it possible to obtain angling information specific to Salmon Brook. Data for Salmon Brook for 1997-2000 were estimated by applying the ratio of average catch and effort above the fishway to that for the entire river during 1993-1996, to the License Stub Return estimates for the entire river.

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 insular Newfoundland rivers for 1994-1996, 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 1997-2000 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. Analyses are currently being carried out to adjust for under-reporting.

Biological characteristics

Biological characteristics information on adult Atlantic salmon in Gander River was obtained primarily by sampling recreational catches and 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 both the entire river and for Salmon Brook 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 1984-1991 were used to calculate egg deposition in that year; similarly, the means for the moratorium period 1992-1998 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 1997a) was used to calculate egg deposition for fish ≥ 63 cm in fork length (large salmon) for all years for the entire river and for Salmon Brook.

A mean relative fecundity value of 1,752 eggs/kg derived for Gander River (O'Connell *et al.* MS 1998c) was used in the calculation of egg deposition for both small and large salmon in 1994-1999, and for the regression method used in 2000 (see below). Prior to that, where sample sizes warranted, year-specific values presented in O'Connell *et al.* (MS 1997b) were used.

Condition of virgin grilse 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 = 100000
F = fork length (cm)

Total river returns

Total river returns (TRR) of small salmon for the entire river in 2000 were estimated by two methods. The first method used the relationship (Fig. 2) between total returns to the counting fence and counts at Salmon Brook for 1989-1999 and solving for the count at Salmon Brook in 2000. The second estimate was obtained by a non-parametric bootstrap procedure in Microsoft Excel using the @Risk (Palisade Corp. 2000), version 4 add-in. The input variable was the count at Salmon Brook in 2000 divided by the ratio of the count at Salmon Brook to total returns at the counting fence for the years 1989-1999, and re-sampling ratios from individual years until convergence was achieved.

Total river returns of large salmon in 2000 were estimated by applying the mean proportion of large salmon in total returns to the counting fence during the moratorium years 1992-1999 to the estimate and 95% confidence limits of total returns of small salmon obtained by the regression relationship in Fig. 2. Proportions were re-sampled from individual years during 1992-1999 in the bootstrap procedure.

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 product of the average proportion of total count (for 1989-1990) 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 1984-1991 (exclusive of 1987) was 95 and 90.

Spawning escapement

Spawning escapement (SE) was calculated as follows:

$$SE = TRR - RC_t \text{ or } RC_a - HRM_t \qquad (2)$$

where,

RC_t = total river retained recreational catch
RC_a = retained recreational catch above the fishway in Salmon Brook
HRM_t = total hook-and-release mortalities (10% of hook-and-release fish) .

Egg deposition

Egg deposition (ED) was calculated as follows:

$$ED = SE \times PF \times RF \times MW \quad (3)$$

where,

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

Calculations were performed for small and large salmon separately. Total egg deposition was obtained by summing depositions for small and large salmon. Bootstrap estimates of egg deposition for the entire river used relative fecundity values re-sampled from individual years (where $N \geq 20$) for the period 1984-1993 presented in O'Connell *et al.* (MS 1997b). The other parameters used for egg deposition estimates for the entire river and Salmon Brook for both the regression and bootstrap methods were the point estimates referred to above.

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 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 for all of Gander River and Salmon Brook were as follows:

Gander River – Total	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

Salmon Brook	Lacustrine	Fluvial	Total
Accessible habitat	1585 ha	7221 units	
Eggs (No. x 10^6)	0.583	1.733	2.316
Small salmon (No.)	275	819	1094

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

During 1994-1999, adult salmon entering the adult trap installed in the counting fence were examined for the incidence of net marks. Information on net-scarring was compiled for Salmon Brook in 2000 and compared to that for the counting fence.

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 1985-1990 and with the Hugrun Seamon digital thermograph in 1991-1999. Water levels were measured near the counting fence and near the fishway in Salmon Brook each year over a permanent benchmarks 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 2000 (retained plus released fish) is compared to years prior to 1992 and the 1992-1996 and 1997-1999 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 2000 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 1997-2000.

Total catch of small salmon (retained plus released fish) in 2000 decreased from that of 1999 (47%) and the 1992-1996 (34%) and 1997-1999 (44%) means. The number of small salmon retained also decreased (51, 37, and 38%, respectively). The number of small salmon released in 2000 decreased from 1999 (39%) and the 1992-1996 (31%) and 1997-1999 (54%) means; the number of large salmon released also declined from 1999 (64%) and the 1997-1999 mean (62%) but increased over the 1992-1996 mean (71%).

Forty-six small and 5 large salmon were released in the 2000 fall hook-and-release fishery compared to 45 and 10 in 1999. 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

The percentage of repeat spawning grilse in the small salmon component in 2000 decreased from the record high in 1999 (Table 1). The overall average percentage for the moratorium period (1992-2000) however, remained higher than for the pre-moratorium period (1984-1991). Average length and weight of small salmon during the moratorium years were 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 and 2000 being on the higher side. Modal smolt age for Gander River virgin grilse during the period 1992-2000 has been consistently 4+ years (Fig. 4).

As part of the analysis of the implications of the retention of large salmon in the recreational fishery, Table 2 presents the numbers and percentages of the various life-history groupings comprising the large salmon component of returns to Gander River since 1978, by individual year and for years combined. 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 the Salmon Brook fishway

Counts of small and large salmon for the fishway located in Salmon Brook tributary for the period 1974-2000 are shown in Table 4 and Fig. 5. The count of small salmon in 2000 decreased from that of 1999 (33%) and the 1984-1989 (31%) and 1992-1999 (35%) means and was similar to the 1986-1991 (3%) mean. The count of large salmon decreased from 1999 (56%) and the 1992-1999 mean (46%) but remained above the 1984-1989 (175%) and 1986-1991 (363%) means. Daily counts of small and salmon showed two distinct peaks, one around the first week of July and the other in the third week of August (Fig. 6a). Peaks for large salmon were not as distinct but fell within the modes for small salmon, and later than small salmon in the case of the first mode. The median count for small salmon occurred in early July and that of large salmon in mid-July (Fig. 7a).). No fish entered the fishway from late July to around mid-August.

Run timing through the Counting Fence, 1992-1999

In connection with the evaluation of the potential impacts of the retention of large salmon in the recreational fishery, run timing of both small and large salmon through the counting fence for the period 1992-1999 is shown in Figs. 6b and 7b. Annual variability in the timing of peaks and medians of both size components is quite evident as well as variability in the number of days separating the medians for small and large salmon.

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

Total river returns of small and large salmon, spawning escapement, potential egg deposition, and percentage of conservation requirement achieved for the entire Gander River and Salmon Brook tributary in 1989-2000 are presented in Tables 5 and 6 (see also Fig. 8 for total river returns for the entire Gander River).

Estimated total returns (and confidence estimates) of small and large salmon to the entire Gander River in 2000 obtained by both computational methods were as follows:

Method	**Estimates (No.)**	**Small Salmon**	**Large Salmon**
Regression	**Predicted**	13872	1847
	Lower 95% CL	8613	1147
	Upper 95% CL	22341	2975
Simulation	**Estimated mean**	14041	2034
	5th percentile	9640	601
	95th percentile	20428	4345

The estimate of 14041 small salmon derived from simulation was very close (only 1.4% higher) to the 13872 calculated from the regression. The simulation estimate for large salmon (2034) was 10% higher than the regression estimate (1847). Confidence estimates were wide for both methods. Estimated returns of small salmon in 2000, regardless of method used, were the second lowest of the moratorium years (25% and 24% below 1999 for the regression and simulation methods; 29% and 28% below the 1992-1999 mean); estimated returns of large salmon were well below the record high for 1999 (62% and 58%) and below the average for 1992-1999 (27% and 19%).

Estimates of egg deposition (and confidence estimates) for small and large salmon for the entire Gander River in 2000 derived from each method were as follows:

Method	Estimates (x 10^6)	Small Salmon	Large Salmon
Regression	**Predicted**	30.734	7.758
	Lower 95% CL	17.820	4.802
	Upper 95% CL	51.531	12.520
Simulation	**Estimated mean**	31.504	8.683
	5th percentile	20.191	2.499
	95th percentile	48.894	18.814

Just as observed for total returns, egg deposition estimated by each method was similar for small salmon (simulation results just 2.5% higher than that of regression) while the difference between methods was greater (11.9% higher for simulation over regression) for large salmon. Again, confidence estimates were wide for both methods.

The regression estimate for percentage of conservation egg requirement achieved for the entire Gander River in 2000 was 83. This compares to 87% (5th percentile = 52%; 95th percentile = 136%) for the simulation method (Fig. 9). Less than 50% of conservation egg requirement was achieved prior to the moratorium. Conservation egg requirement was not met in 2000 and was the second lowest of the moratorium years. During the moratorium years, conservation egg requirement was achieved in 1992, 1993, 1996, 1998, and 1999. The percentage of conservation requirement in terms of small salmon achieved in 2000 was 57.3 for the regression method and 58.1 for the simulation method. The conservation requirement in terms of small salmon was met only in 1993.

The percentage of conservation egg requirement achieved in 2000 for Salmon Brook tributary was the second lowest of the moratorium years (Table 6). Conservation egg requirement was achieved in all moratorium years except 1997 and 2000. The level of conservation requirement achieved in terms of small salmon in 2000 was also the second lowest of the moratorium years (requirement was not met in 1994, 1996, 1997, and 2000).

Comparison of estimated total returns of small salmon with actual returns

The results of a sensitivity analysis (rank order correlation between values of the output variable and values of the input variables) on the relative influence of the three input parameters on the simulated output for percentage of conservation egg requirement achieved is presented in Fig. 10. The most influential variable was the ratio of counts of small salmon at Salmon Brook to total returns of small salmon to the counting fence, followed by the proportion of large salmon at the counting fence, and relative fecundity (eggs/kg). Estimates of total returns of small salmon as well as confidence estimates by each method for the period 1989-1999 are compared with actual total returns in Fig. 11. Estimates by both methods tracked actual values fairly well with regression results being closer to the actual for some years and simulation results closer for others; the direction of change from actual was generally the same for both methods. Further comparisons of estimated values with actual values involved removing the regression pair or ratio in the case of simulation from the analysis for a given year and calculating total returns for that year from the count at Salmon Brook. The performance of the regression method in this regard was tighter than that of simulation, with estimates for 9 out of 11 years being within ±20% of actual values compared to 5 out of 11 for simulation (Fig. 12). Deviations from actual for the simulation method were generally wider than for the regression method while direction of change between methods was different for three years (1990, 1993, and 1994).

Net marks

The numbers of small and large salmon examined for net marks and the numbers and percentages bearing net marks in 1994-1999 for the Gander River counting fence and in 2000 for the Salmon Brook fishway 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
2000[1]	741	26	3.5	53	5	9.4	794	31	3.9

[1]Salmon Brook fishway

The highest percentage of small salmon with net marks at the counting fence 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 six years, while that of 1999 was the second lowest. The overall incidence of net-marked small salmon at Salmon Brook in 2000 was comparable to the lower values observed for the counting fence while that of large salmon increased substantially over the low observed at the counting fence in 1999. The incidence for small and large salmon combined in 2000 was on the low side compared to the counting fence.

Environmental conditions

Maximum and minimum daily water temperatures (°C) for the counting fence (1989-1999) and recorded at the fishway in Salmon Brook are presented in Appendices 2 and 3 and Figs. 13 and 14 and daily mean water levels (cm) in Appendices 4 and 5 and Figs. 15 and 16. Maximum water temperatures exceeding 20 °C were recorded at the Salmon Brook fishway from around mid-June through August; the highest temperature (27.1 °C) occurred on August 7. Minimum daily temperatures at or above 20 °C occurred for several days at a time throughout July and August. Low water levels persisted from late July until mid-August with the lowest mean level experienced on both August 7 and 9.

Potential impacts of the retention of large salmon in the recreational fishery

As seen above, the great majority of large salmon in Gander River are repeat spawning grilse, hence the management measure of no retention of catch as a means of protecting the virgin multi-sea-winter stock component does not apply here. Using the default biological characteristics for large salmon and average values for the moratorium years for small salmon, large salmon contribute 5484 eggs per female compared to 3241 for small salmon, for a ratio of 1.7:1. The ratio in terms of eggs per fish (i.e., adjusting for sex ratio) is 1.9:1, and in the context of egg-laying potential, one large salmon is nearly equivalent to two small salmon. As a group, large salmon have contributed between 11 (in 1994) and 37% (in 1999) of total egg deposition during the moratorium years. Table 7 shows the percentage of total conservation egg requirement achieved after assumed 5, 10, and 15% exploitation rates on large salmon, compared to no retention, for the moratorium period 1992-1999. Compared to no retention, an exploitation rate of 5% resulted in decreases in percentage of conservation requirement achieved of 0-2%; at 15% exploitation, the range was 1-7%.

Discussion

Estimated total returns of small salmon to Gander River in 2000 were the second lowest of the moratorium years, the lowest being in 1997. The low returns for Gander River in 2000 were consistent with observations for other rivers with counting facilities (Exploits River and Campbellton River) in SFA 4 (O'Connell *et al.* MS 2001). Beginning in 1997, it was anticipated that there would be a substantial increase in returns of small salmon to Gander River, resulting from the greatly increased egg deposition levels starting with the commercial fishery moratorium in 1992 (Table 5). So far this has failed to materialise. Low smolt-to-adult (sea) survival may have played a role in the low returns to Gander River in 2000. Sea survival for small salmon (repeat spawners included) returning to Campbellton River in 2000 decreased by 38% from 1999 and was the second lowest (the lowest was in 1997) since 1993 (Downton *et al.* MS 2001; O'Connell *et al.* MS 2001).

There was obviously at lot of variability around estimates derived from both the regression and simulation methods. The simulation method likely incorporated more variability into the estimate of percentage of conservation egg requirement achieved as a result of re-sampling from three input variables, while point estimates were used for all variables in the regression model.

Simulation therefore appears to be a more appropriate expression of uncertainty. The levels of uncertainty encountered in these analyses certainly underscore the fact that there is no substitute for absolute counts.

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 small salmon, such as appears to be the case in recent years, the value of the contribution of large salmon in achieving conservation egg requirement cannot be underestimated. In years when conservation egg requirement was achieved, if one took the extreme case and removed all large salmon, the requirement would have been met only in 1993 and 1996. The range of assumed exploitation rates used above for large salmon is consistent with that observed for small salmon for Gander River. If the assumed exploitation rates for large salmon are reasonable, then the above analysis suggests the resultant level of retention of large salmon would have a minimal impact on egg deposition. Attempts to adjust the exploitation rate of large salmon by targeting specific dates for the fishery would be difficult given the annual variability in run timing.

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.

Entry into the Salmon Brook fishway in 2000 was impeded from mid-late July until around mid-August as a result of low water levels. During the period August 3-18, no fish entered the fishway.

Acknowledgements

The collection of biological characteristics data for Gander River in 2000 was carried out as a Joint Project between DFO and the Gander River Management Association. Adult counts at the Salmon Brook fishway were obtained through contractual arrangements with the Salmonid Association of Eastern Newfoundland and funding provided by DFO.

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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 (1984-1991) and moratorium (1992-2000) 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
2000	1.96	0.59	121	54.4	4.44	128	5.5	1.92	0.58	83	54.1	4.25	82	73	83
Pre-moratorium 1984-1991	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 1992-2000	1.84	0.49	889	54.4	4.32	1596	12.0	1.85	0.49	526	54.3	4.22	551	70	555

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 small and large salmon at the Gander River counting fence 1989-1999 and Salmon Brook fishway, 1974-2000. Partial counts are in parentheses and are not included in the means. Adjusted counts are bold and in italics.

	Gander River (counting fence)		Salmon Brook (fishway)	
Year	Small salmon	Large salmon	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	7743	473	596	24
1990	7520	508	***345***	***8***
1991	6445	670	245	2
1992	***18179***	***4162***	1168	101
1993	25905	1734	1560	87
1994	18080	1072	968	83
1995	22002	1121	1600	125
1996	23665	1753	946	112
1997	10476	1883	465	119
1998	18742	3649	1295	141
1999	18461	4815	1105	138
2000			742	61
$\bar{X}$ 84-89			1077	22
95% LCL			573	11
95% UCL			1580	33
N			6	6
$\bar{X}$ 86-91	7236	550	718	13
95% LCL	5512	289	191	4
95% UCL	8960	811	1244	23
N	3	3	6	6
$\bar{X}$ 92-99	19439	2524	1138	113
95% LCL	15549	1304	832	95
95% UCL	23328	3744	1444	131
N	8	8	8	8

Table 5. Total river returns, spawning escapements, and percentage of conservation requirement achieved in terms of small salmon and eggs for the entire Gander River, 1989-2000.

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	15776	4795	34.660	20.221	72.3	119	344
2000*	13872	1847	0.118	12516	1837	30.734	7.758	57.3	83	241
2000**	14041	2034	0.127	12685	2024	31.504	8.683	58.1	87	252

*Regression results
**Simulation results
2000 data are preliminary

Table 6. Fishway counts, spawning escapements, and percentage of conservation requirement achieved in terms of small salmon and eggs for Salmon Brook tributary, 1989-2000.

Year	Fishway Count (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	596	24	0.039	596	24	1.633	0.115	54.5	75	242
1990	345	8	0.023	344	8	0.804	0.033	31.4	36	116
1991	245	2	0.008	230	2	0.569	0.008	21.0	25	80
1992	1168	101	0.080	1111	101	2.354	0.445	101.6	121	388
1993	1560	87	0.053	1534	87	3.254	0.343	140.2	155	498
1994	968	83	0.079	933	83	2.185	0.350	85.3	109	351
1995	1600	125	0.072	1521	125	3.024	0.526	139.0	153	492
1996	946	112	0.106	848	112	2.028	0.471	77.5	108	346
1997	465	119	0.204	436	119	0.964	0.500	39.8	63	203
1998	1295	141	0.098	1226	140	2.712	0.592	112.1	143	458
1999	1105	138	0.111	1035	137	2.274	0.579	94.6	123	395
2000*	742	61	0.076	707	61	1.736	0.256	64.6	86	276

*Preliminary

Table 7. Percent of conservation egg requirement achieved after assumed 5, 10, and 15% exploitation rates on large salmon (retained) compared to no (0%) exploitation for Gander River, 1992-1999, and the respective decreases from 0% exploitation.

Year	Exploitation Rate						
	0%	5%		10%		15%	
	Egg Dep.	Egg Dep.	Decrease	Egg Dep.	Decrease	Egg Dep.	Decrease
1992	118	116	2	114	4	113	5
1993	128	127	1	127	1	126	2
1994	91	91	0	90	1	90	1
1995	95	94	1	94	1	93	2
1996	124	123	1	122	2	121	3
1997	62	61	1	60	2	60	2
1998	110	108	2	107	3	105	5
1999	119	117	2	114	5	112	7

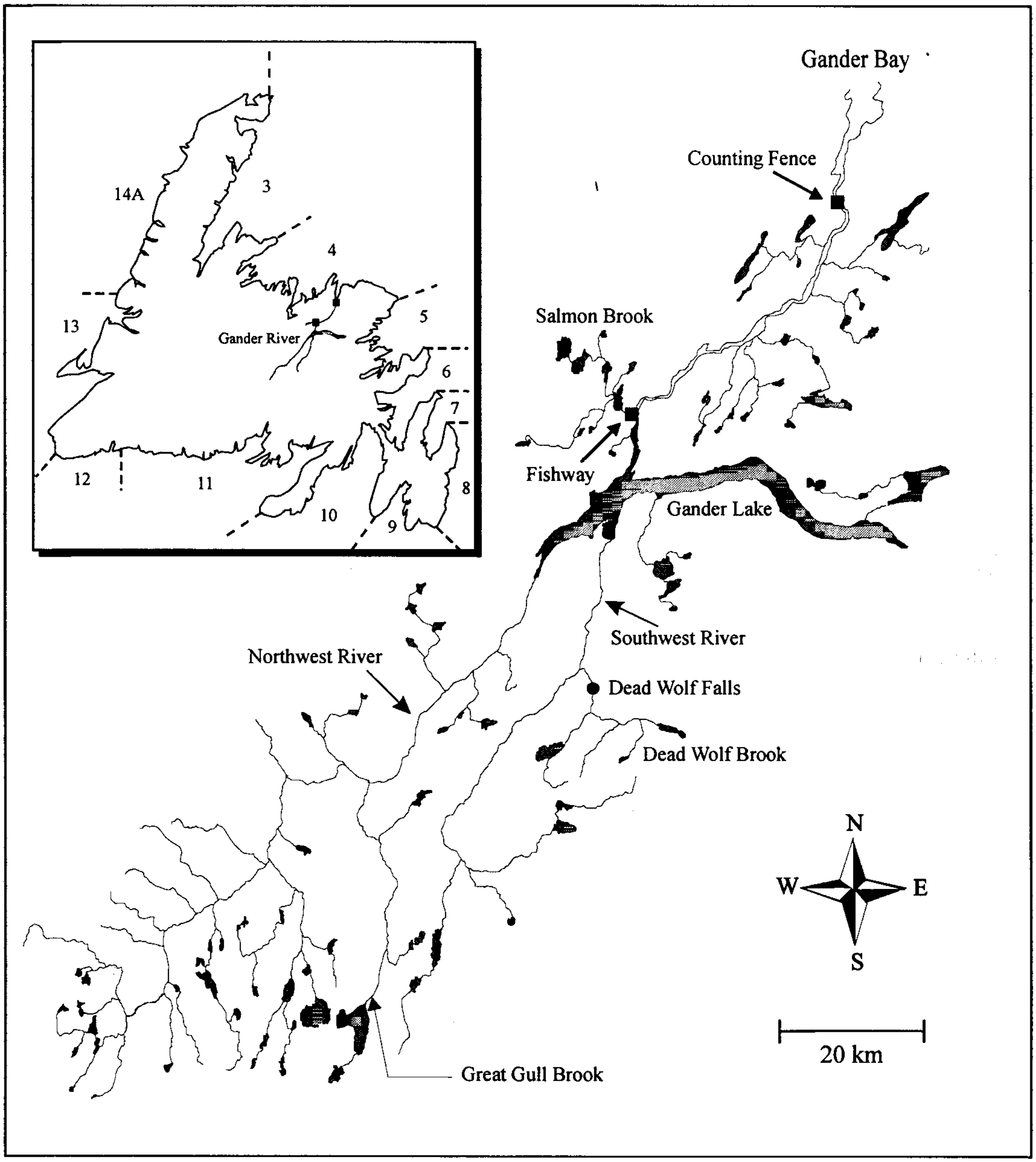


Fig. 1. Map showing the Gander River watershed and location of the counting fence in the lower river, the fishway in Salmon Brook, and the falls on Dead Wolf Brook. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Gander River.

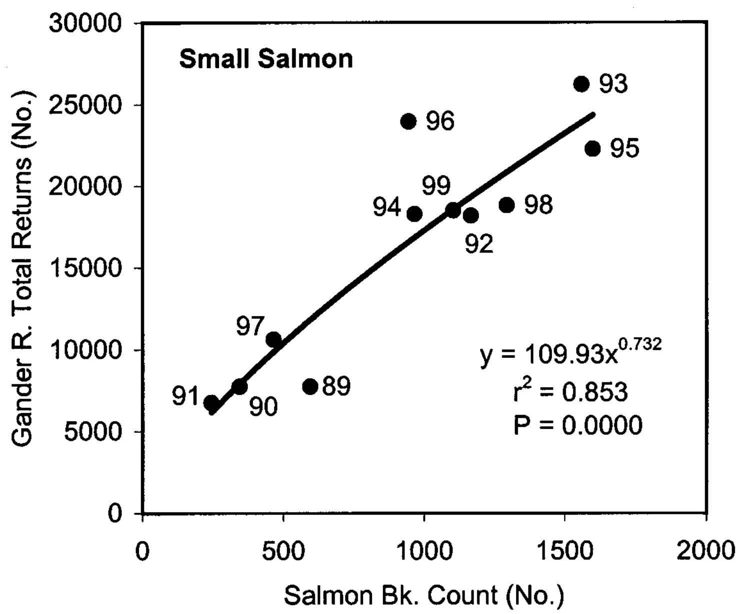


Fig. 2. Regression of total returns of small salmon at the counting fence on counts of small salmon at the fishway in Salmon Brook, 1989-1999.

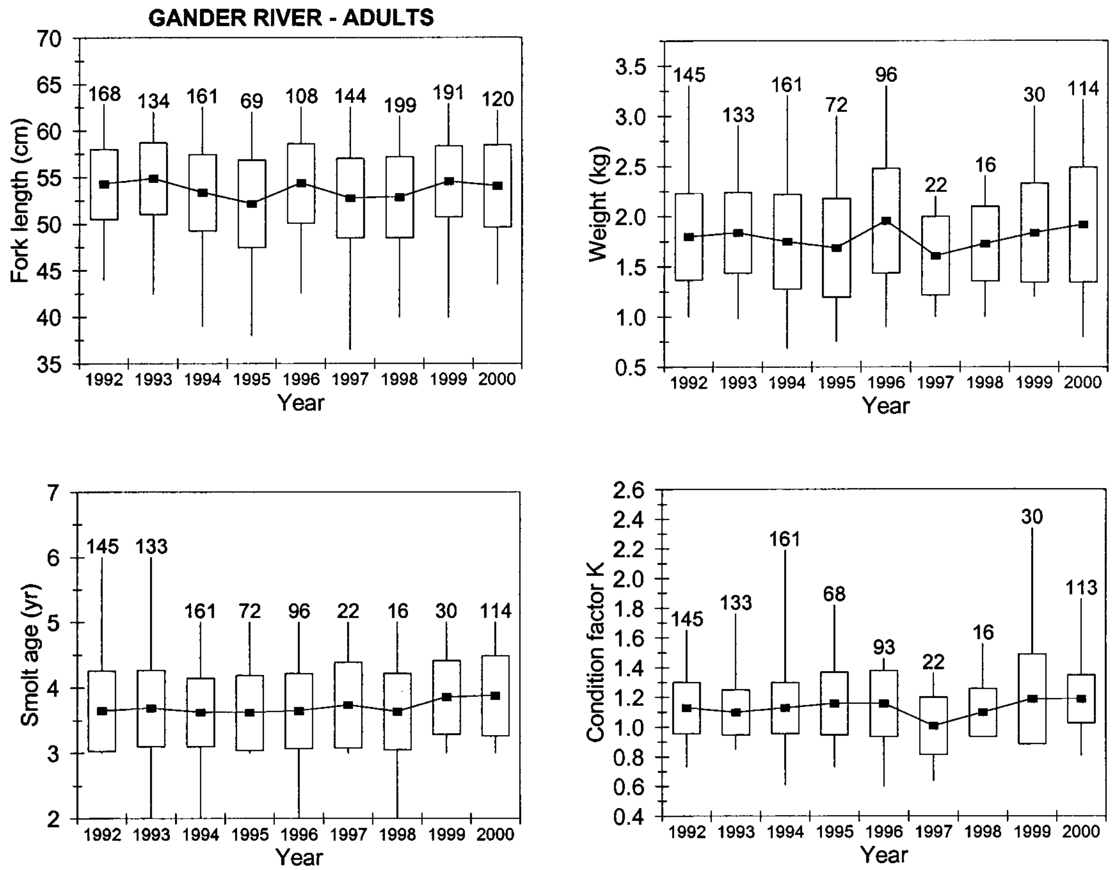


Fig. 3. Mean fork length, mean weight, mean smolt age, and condition factor for virgin grilse from Gander River, 1992-2000. The rectangle around each point denotes the standard deviation; the vertical line is the range; the number above the vertical line is the sample size.

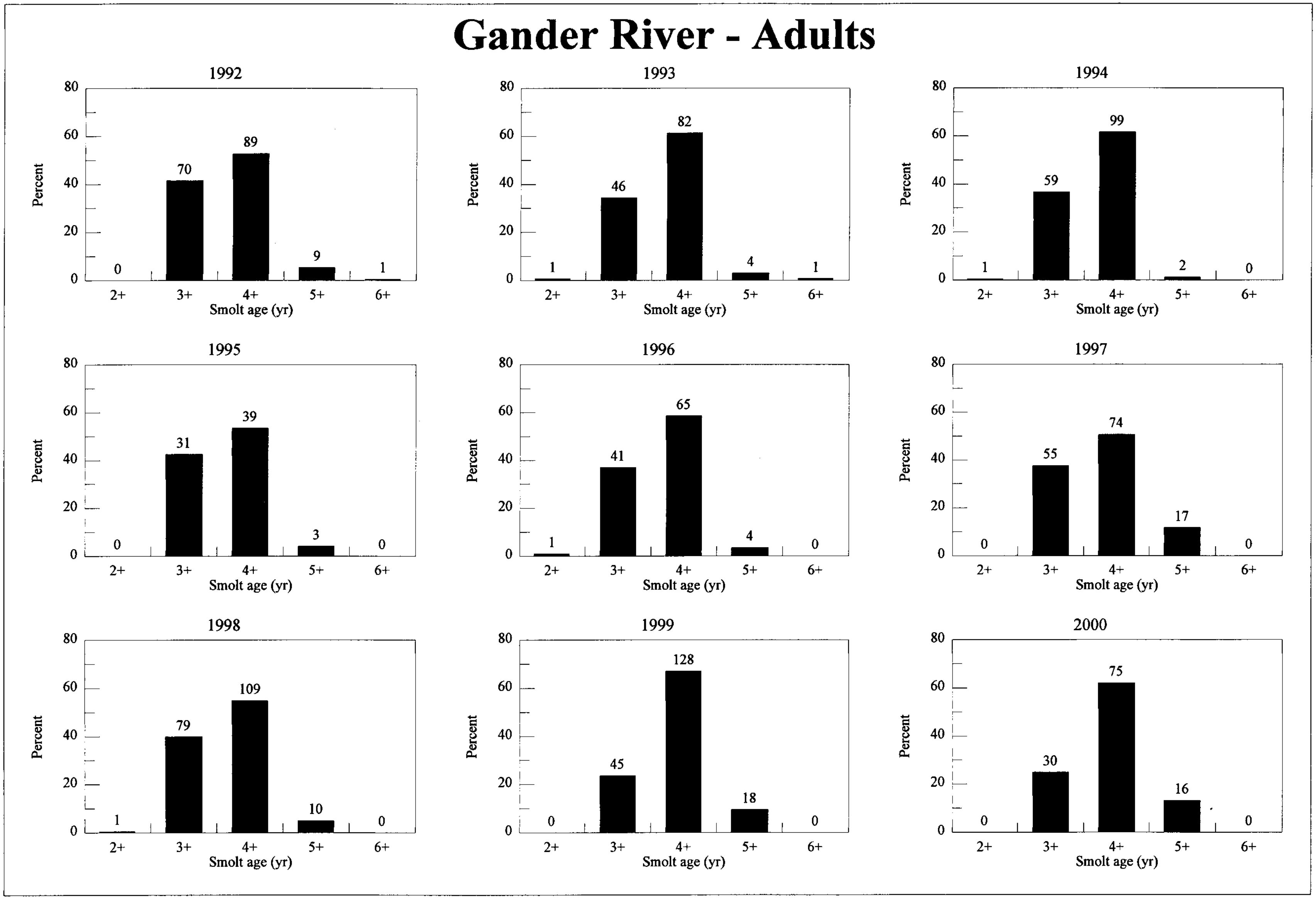


Fig. 4. Smolt age composition for virgin grilse from Gander River, 1992-2000. The number above each bar denotes sample size.

Gander River (Salmon Brook)
Fishway

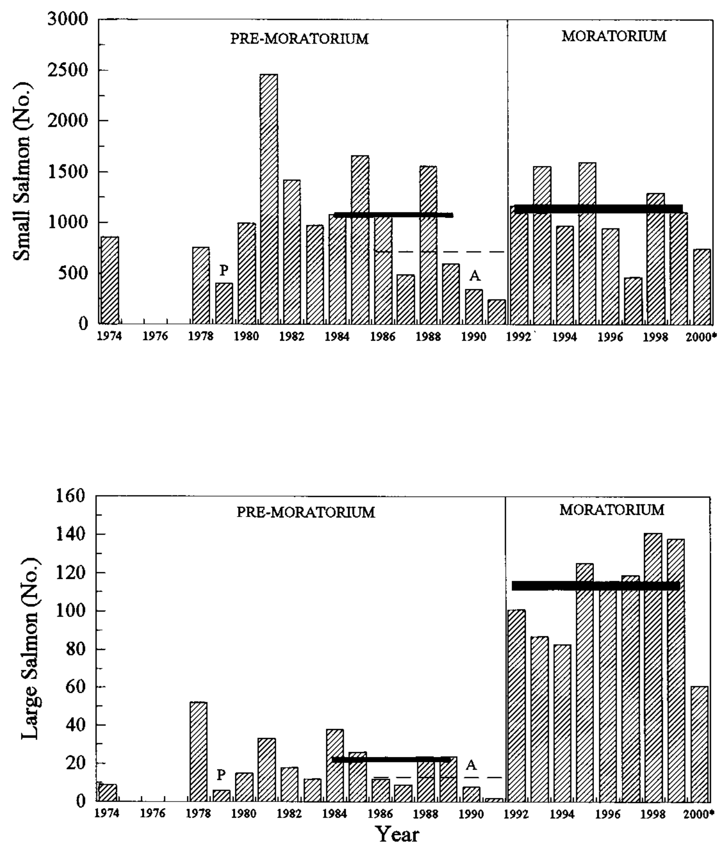


Fig. 5. Counts of small and large salmon at the fishway in Salmon Brook (SFA 4), 1984-2000. The thin solid horizontal line represents the 1984-1989 mean, the broken line the 1986-1991 mean, and the thick solid line the 1992-1999 mean. A=adjusted count; P=partial count, not included in the means.

Salmon Brook

Fishway

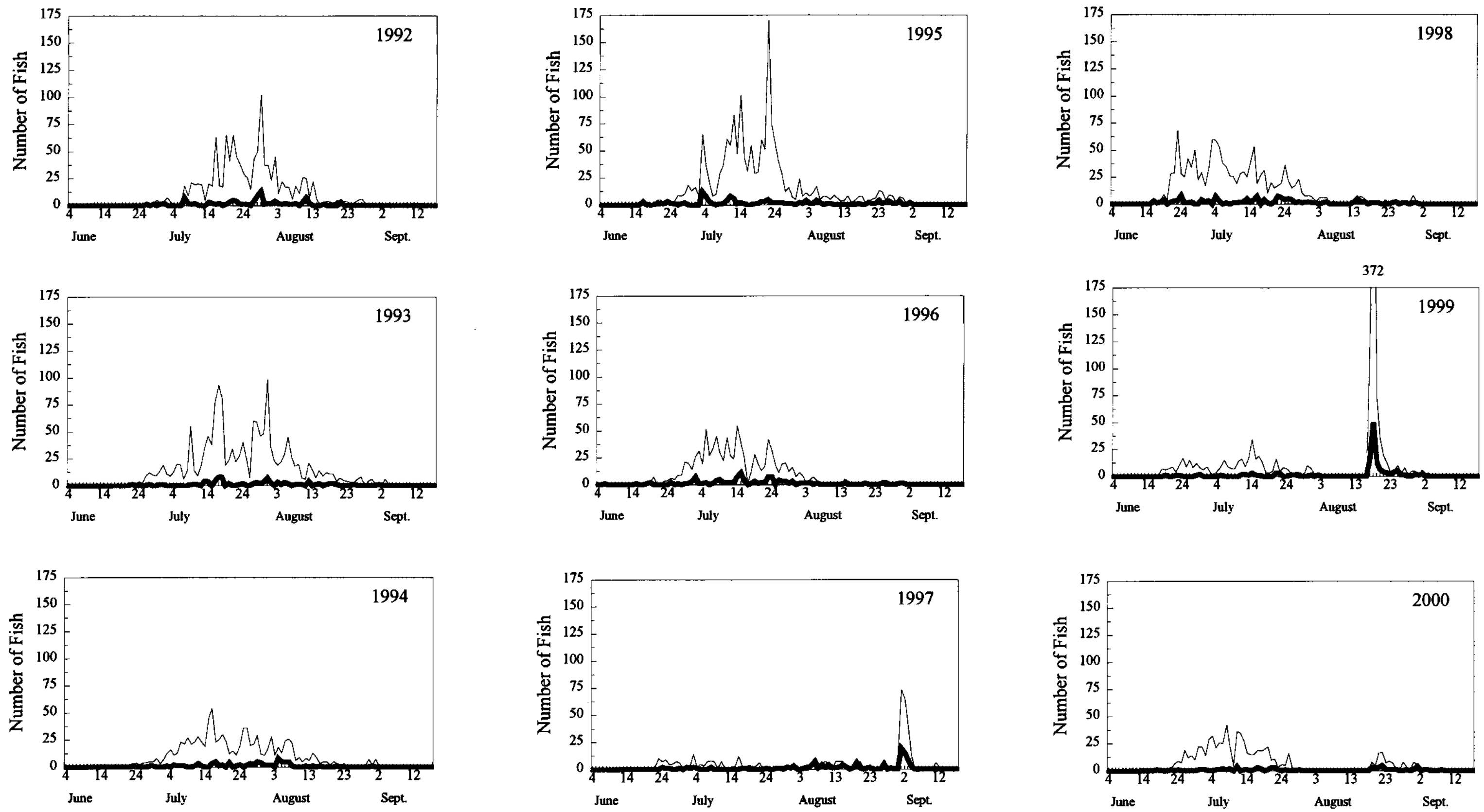


Fig. 6a. Daily counts of small and large salmon at the Salmon Brook fishway, during the moratorium years, 1992-2000.

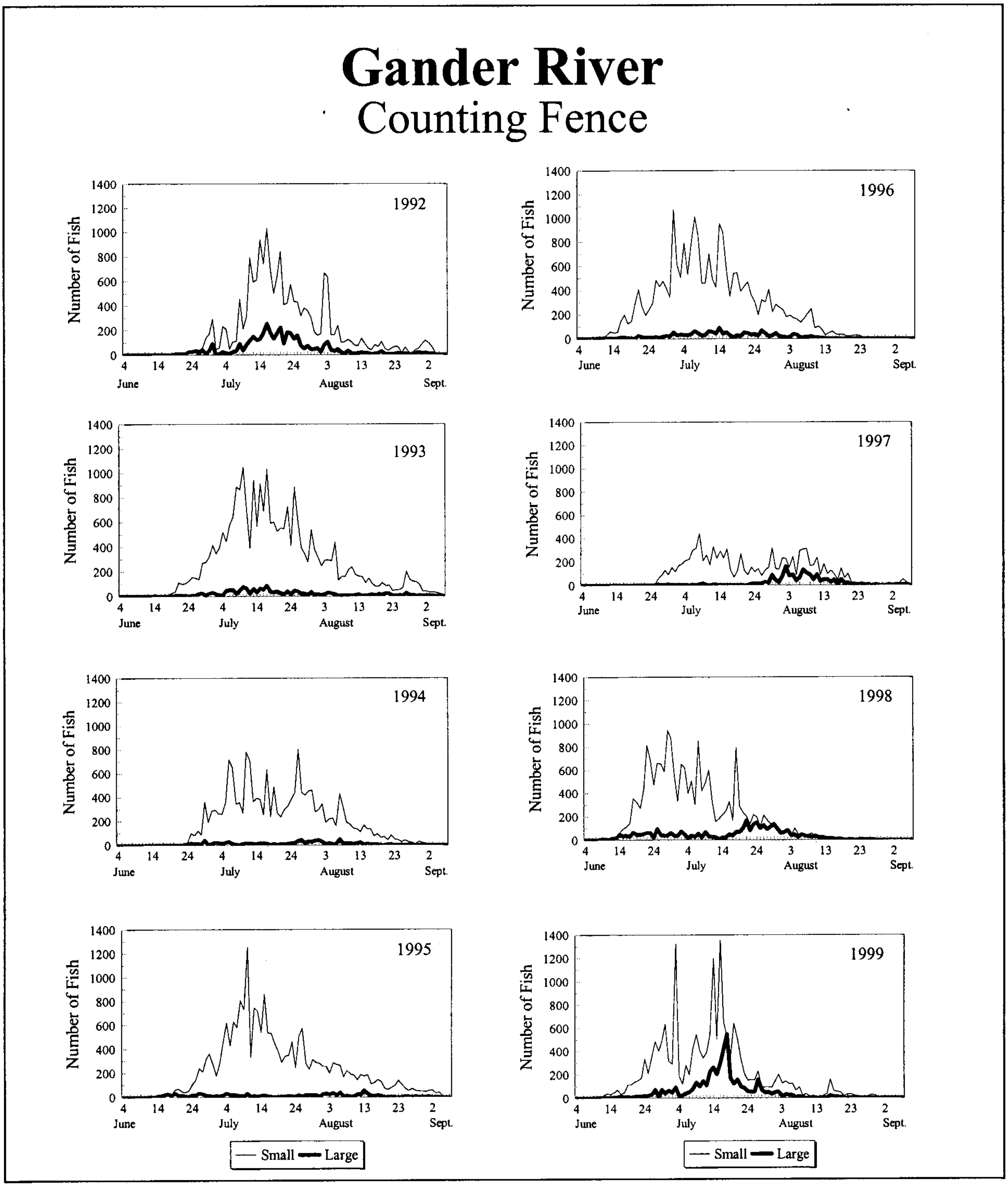


Fig. 6b. Daily counts of small and large salmon at the Gander River counting fence, during the moratorium years, 1992-1999.

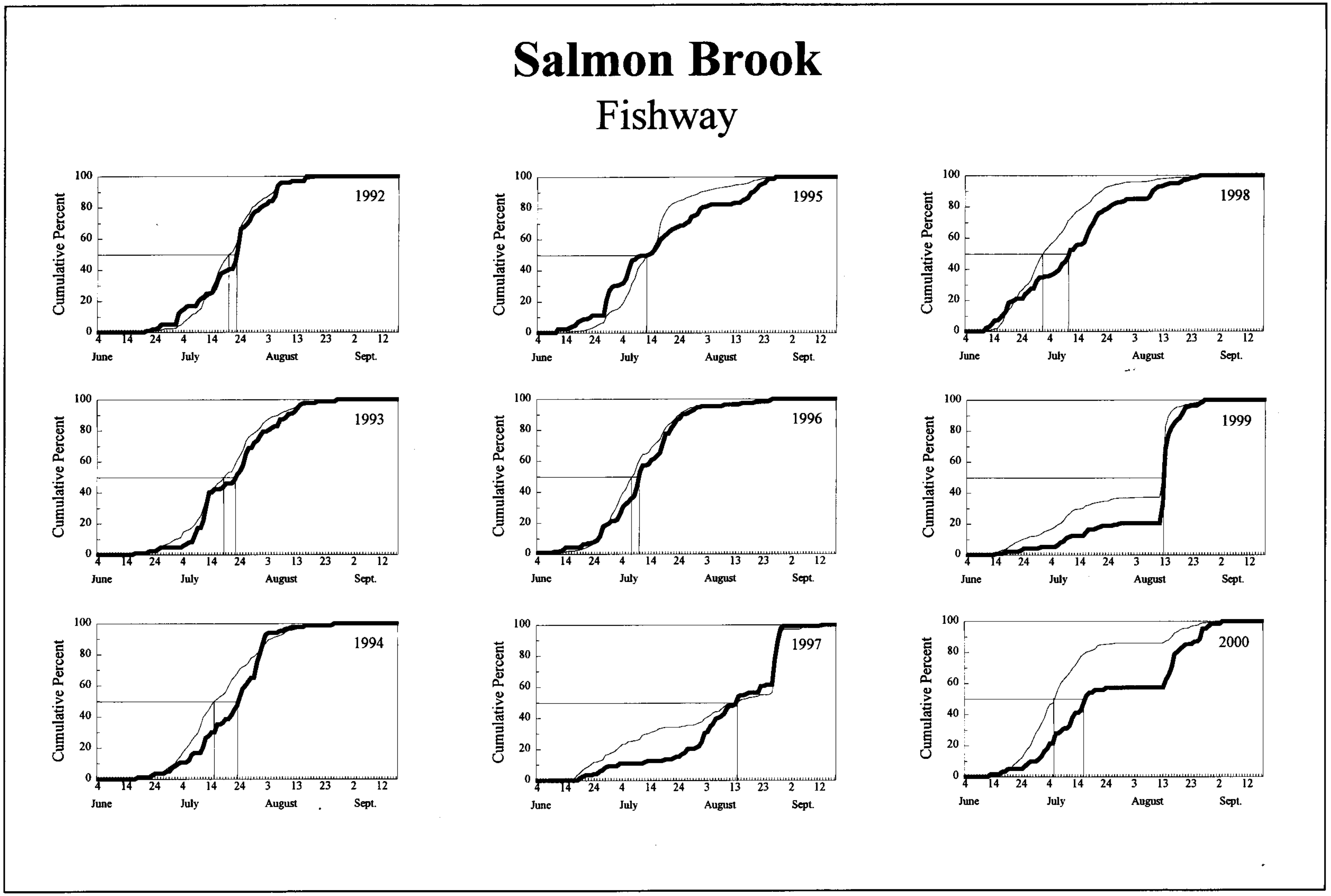


Fig. 7a. Daily cumulative percent of small and large salmon at the Salmon Brook fishway, during the moratorium years, 1992-2000. Dates of median counts are also shown.

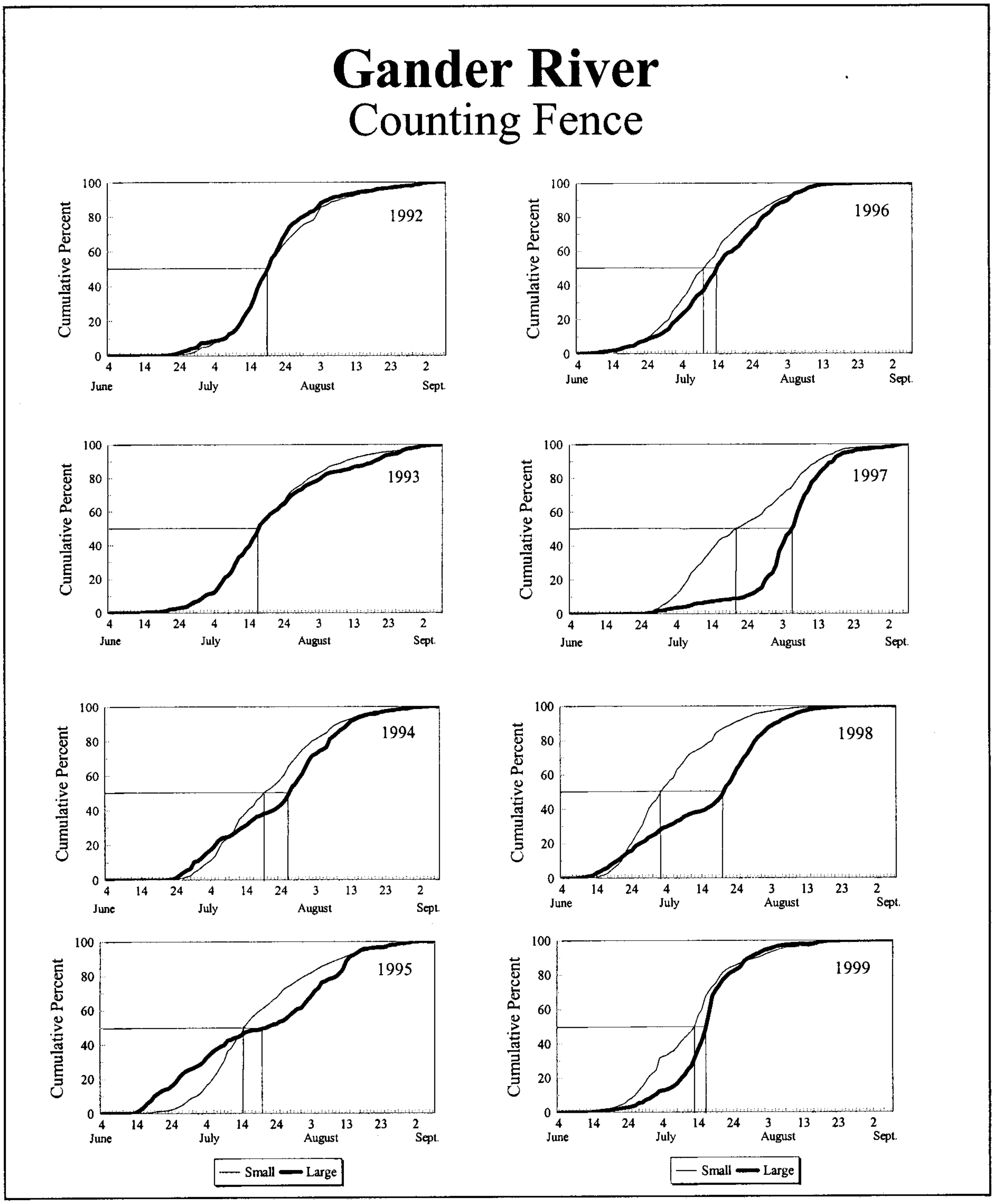


Fig. 7b. Daily cumulative percent of small and large salmon at the Gander River counting fence, during the moratorium years, 1992-1999. Dates of median counts are also shown.

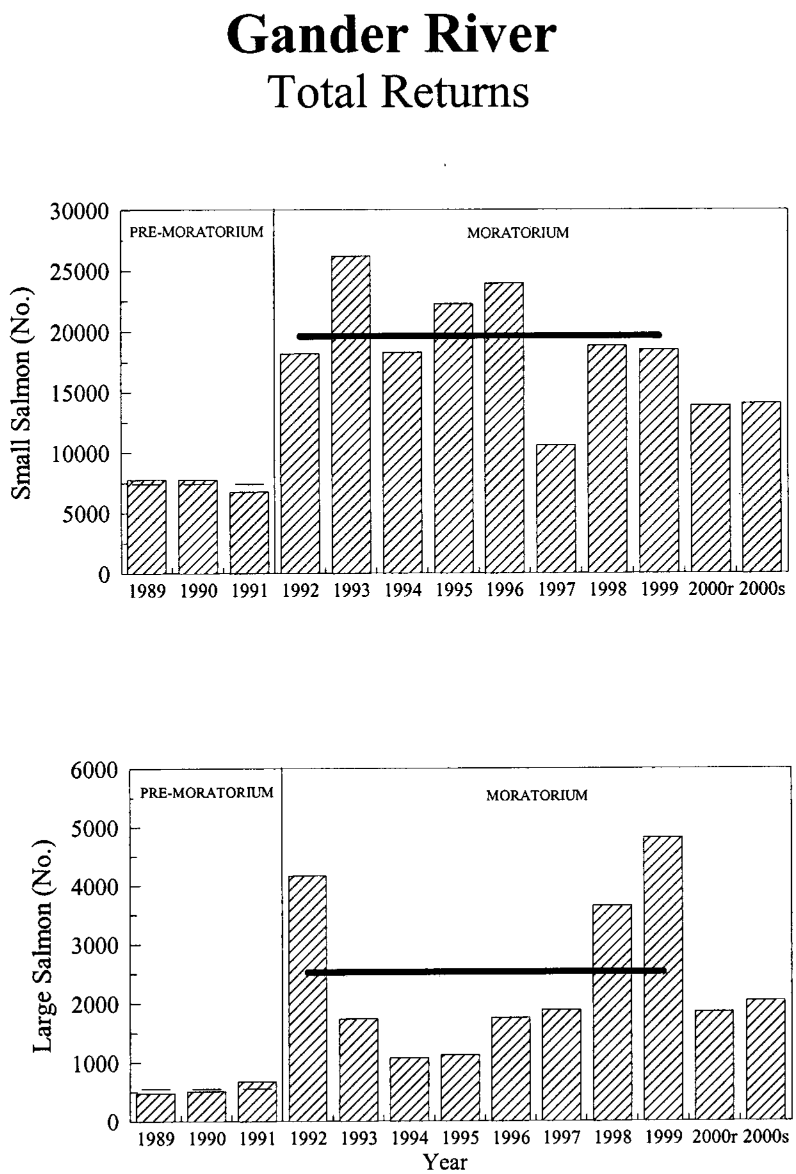


Fig. 8. Total returns of small and large salmon to Gander River (SFA 4), 1989-2000. The broken line represents the 1989-1991 mean, and the solid line the 1992-1999 mean. Subscript r = regression method and subscript s = simulation method.

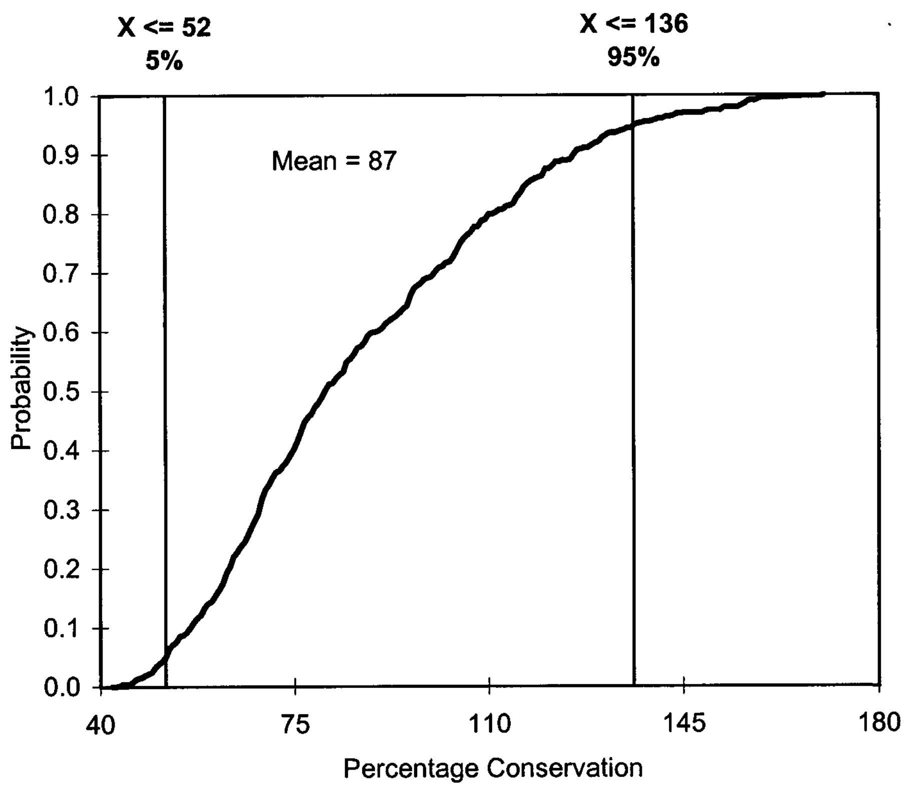


Fig. 9. Simulation results for percentage of conservation egg requirement achieved for the entire Gander River in 2000.

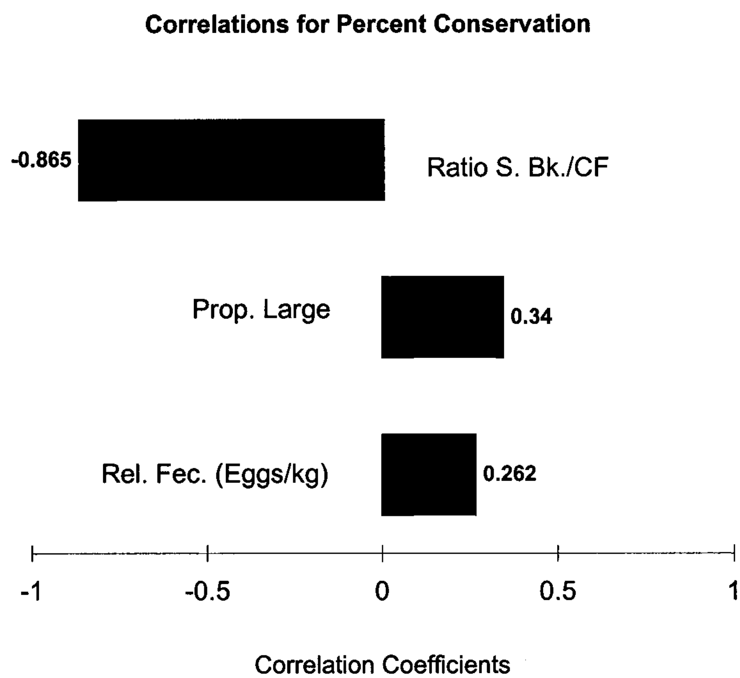


Fig. 10. Results of sensitivity analysis on the three input parameters comparing relative influence on output for percentage of conservation egg requirement achieved for the entire Gander River in 2000.

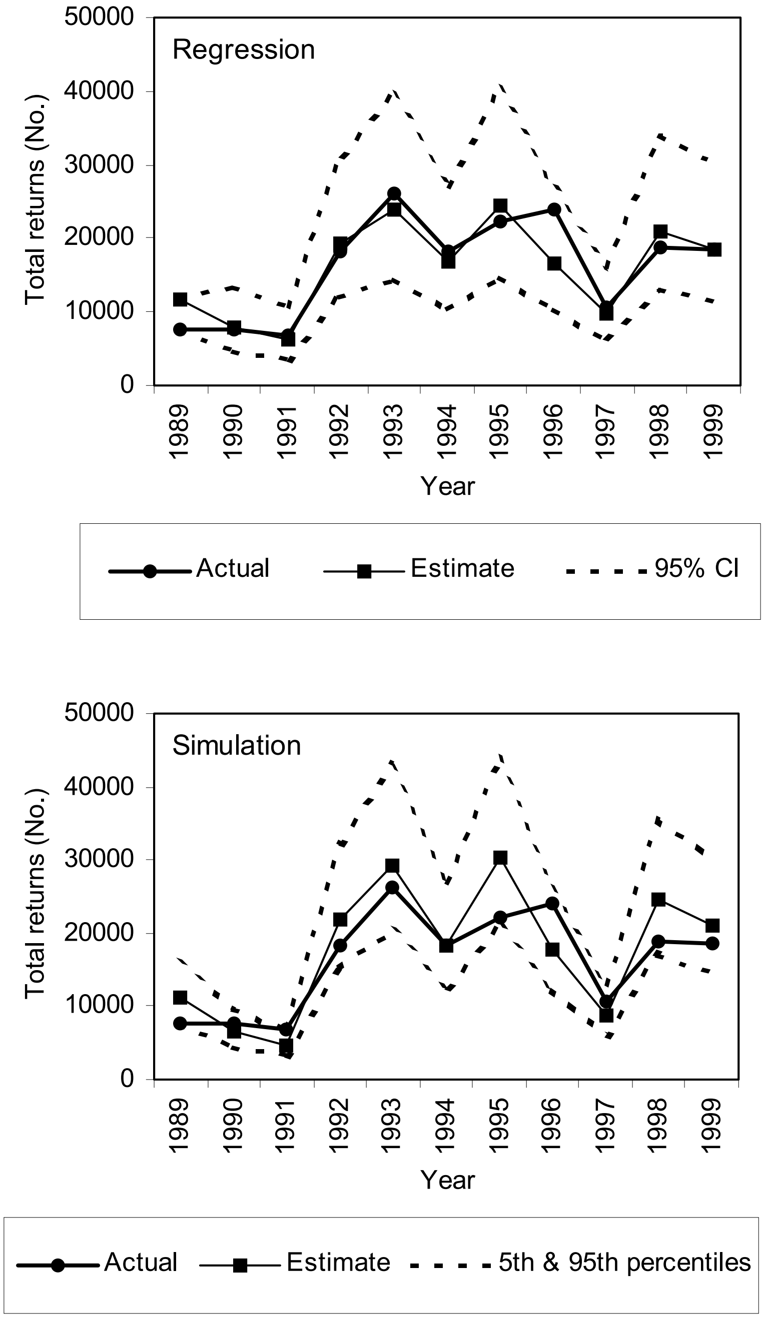


Fig. 11. Comparison of estimated total returns of small salmon by the regression and simulation methods to actual total returns for the entire Gander River, 1989-1999.

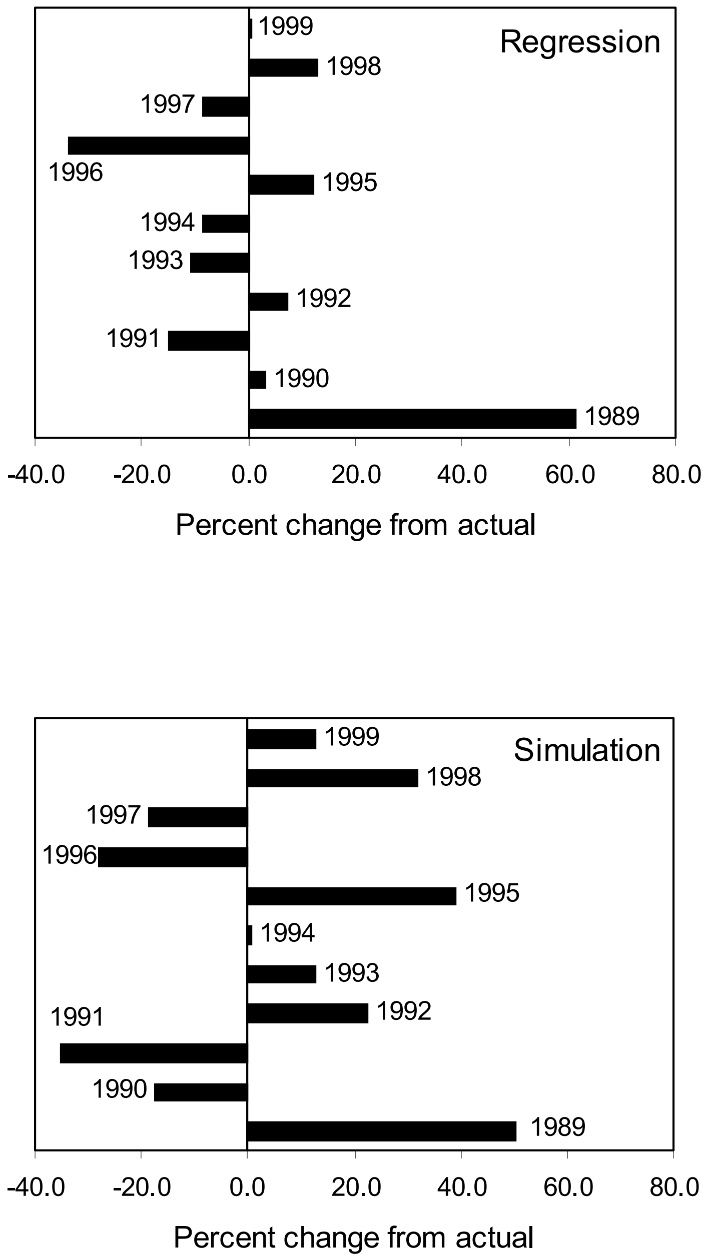


Fig. 12. Comparison of regression and simulation estimates of total returns of small salmon for the entire Gander River each year with the actual when input data (regression pair or ratio) for that year were removed from the analysis (see text).

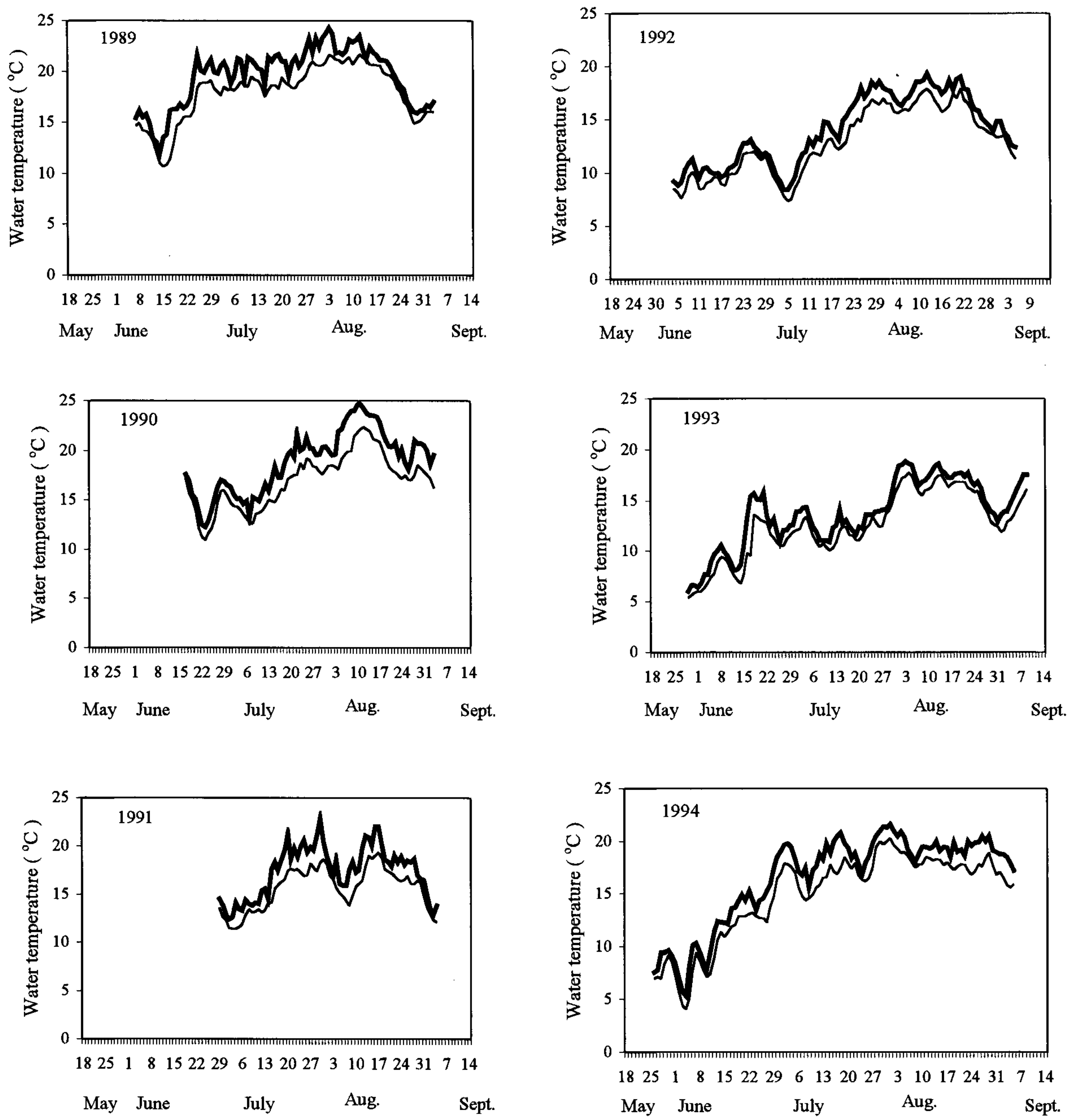


Fig. 13. Daily maximum and minimum water temperatures (°C) for Gander River, measured at the counting fence, 1989-99.

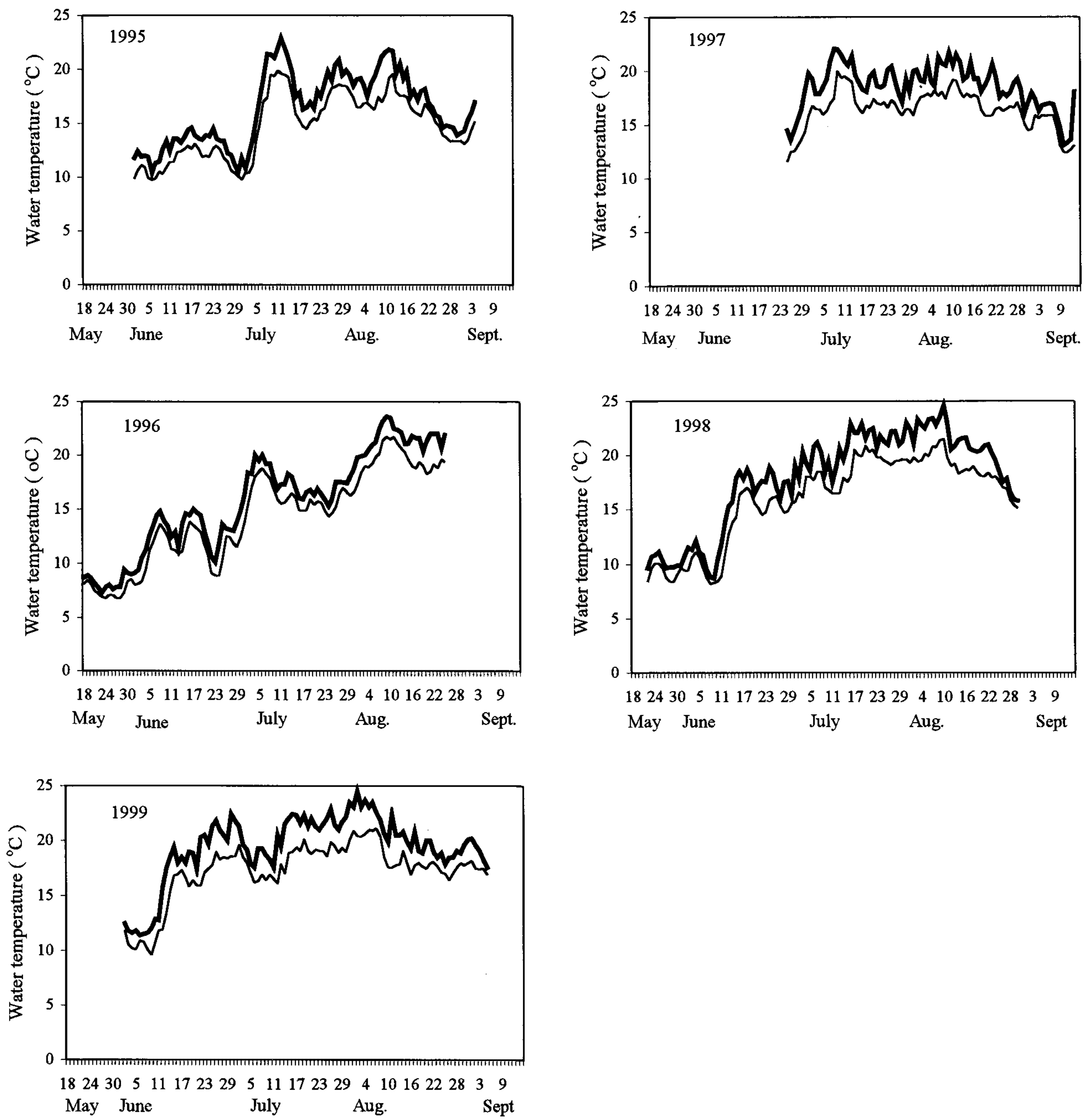

1995
Water temperature (°C)
0
5
10
15
20
25
18 24 30 5 11 17 23 29 5 11 17 23 29 4 10 16 22 28 3 9
May June July Aug. Sept.
1997
Water temperature (°C)
18 24 30 5 11 17 23 29 5 11 17 23 29 4 10 16 22 28 3 9
May June July Aug. Sept.
1996
Water temperature (oC)
18 24 30 5 11 17 23 29 5 11 17 23 29 4 10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

Fig. 13 (cont'd)

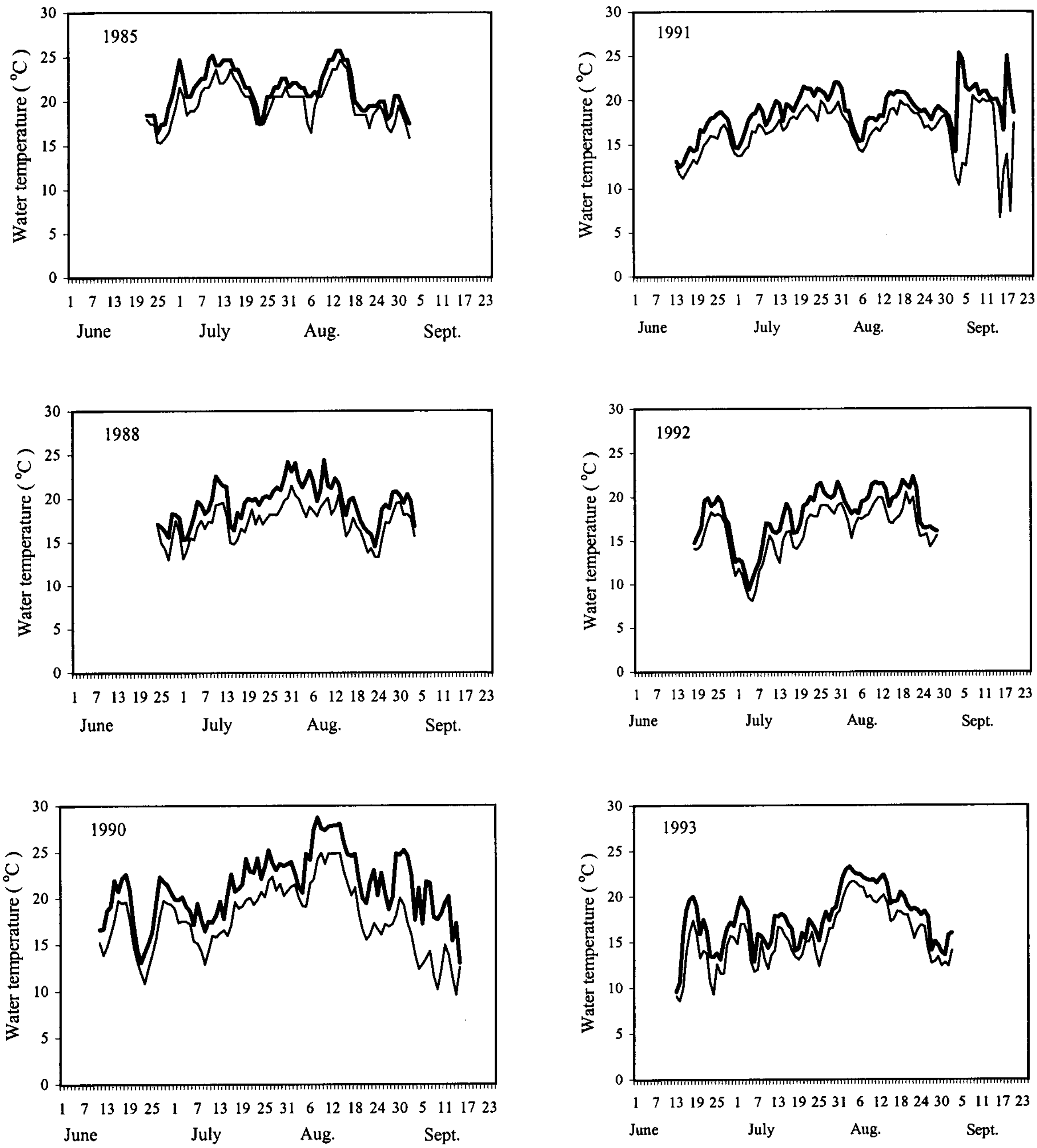


Fig. 14. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook, 1985-2000.

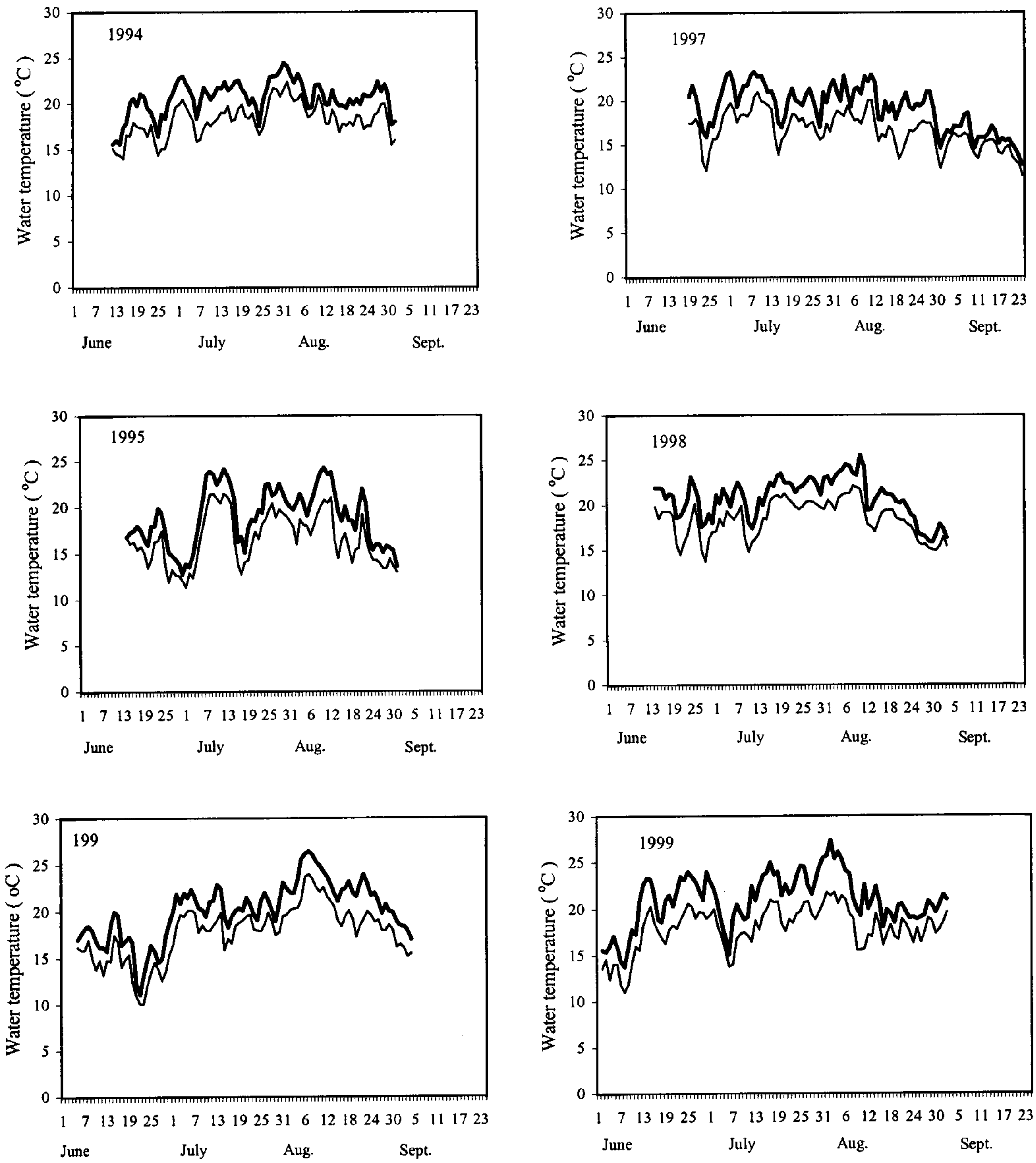

1994
1997
1995
1998
199
1999
Water temperature (°C)
Water temperature (oC)
0
5
10
15
20
25
30
1 7 13 19 25 1 7 13 19 25 31 6 12 18 24 30 5 11 17 23
June
July
Aug.
Sept.

Fig. 14 (cont'd)

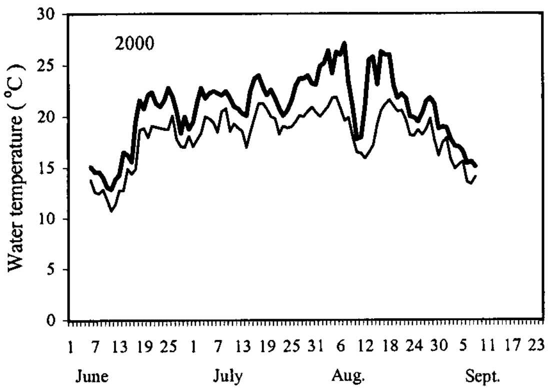

2000
Water temperature (°C)
30
25
20
15
10
5
0
1 7 13 19 25 1 7 13 19 25 31 6 12 18 24 30 5 11 17 23
June
July
Aug.
Sept.

Fig. 14 (cont'd)

Gander River
SFA 4

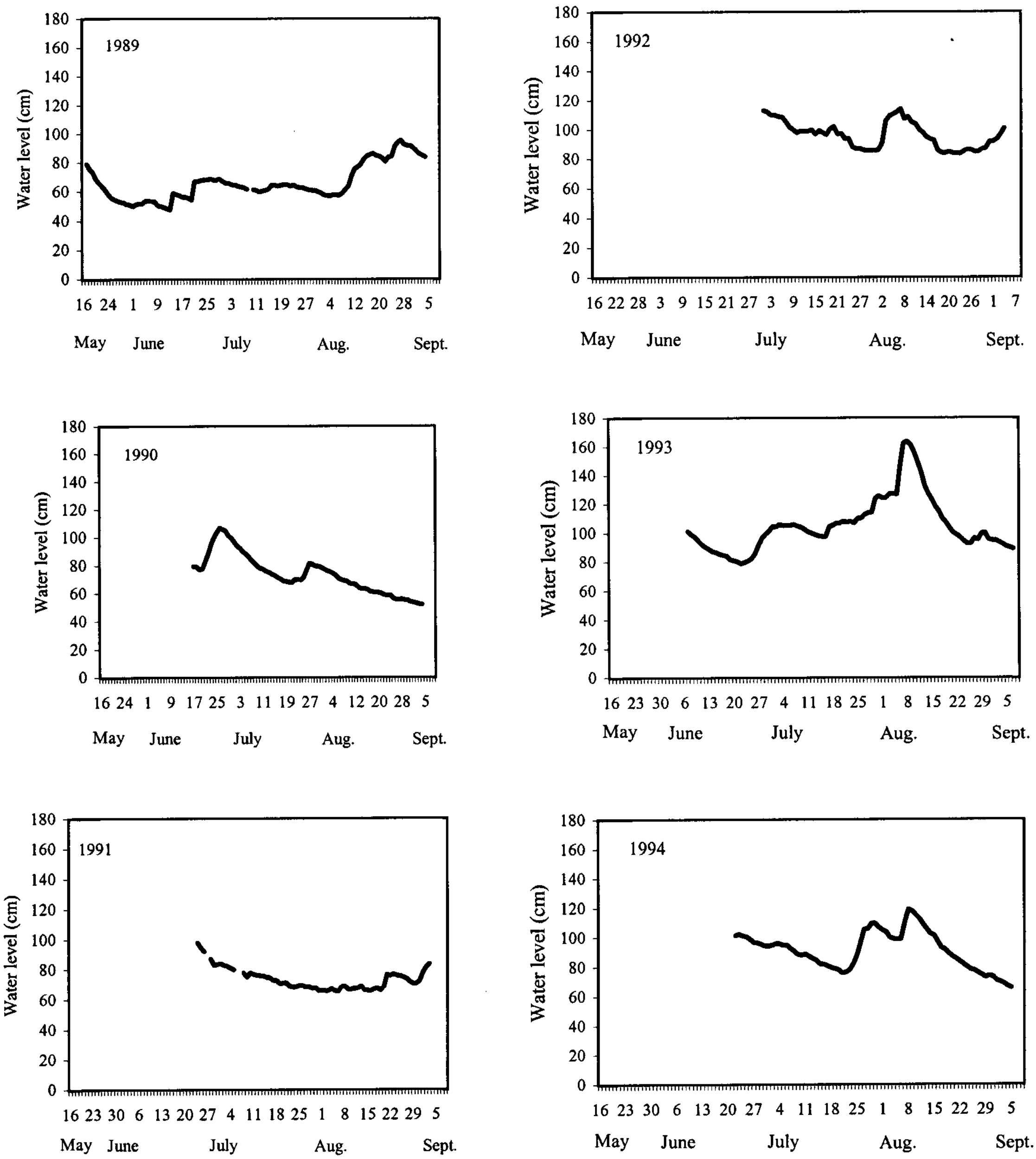


Fig. 15. Mean daily water levels (cm) for Gander River, measured near the counting fence, 1989-99.

Gander River
SFA 4

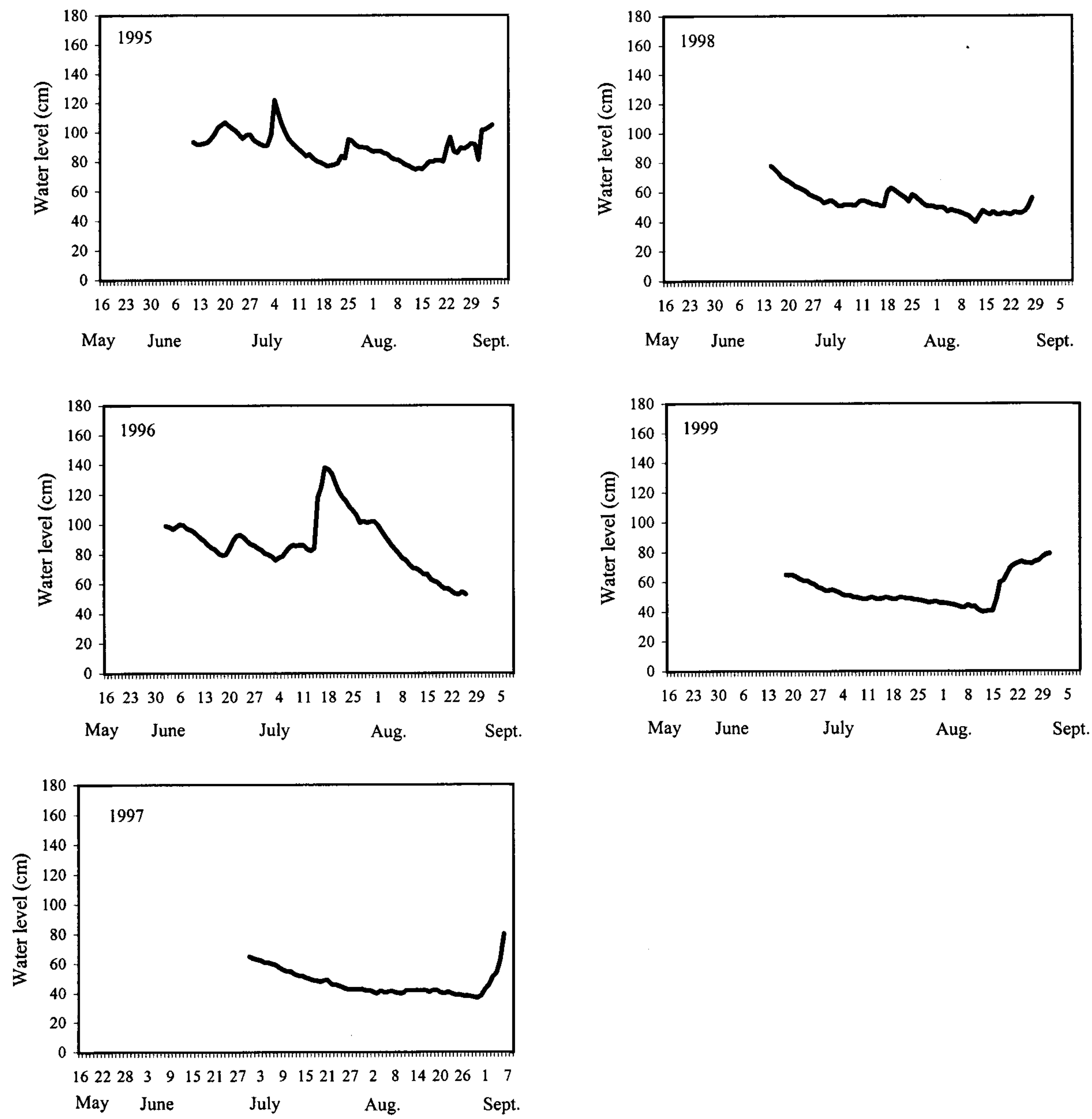


Fig. 15 (cont'd)

Salmon Brook
SFA 4

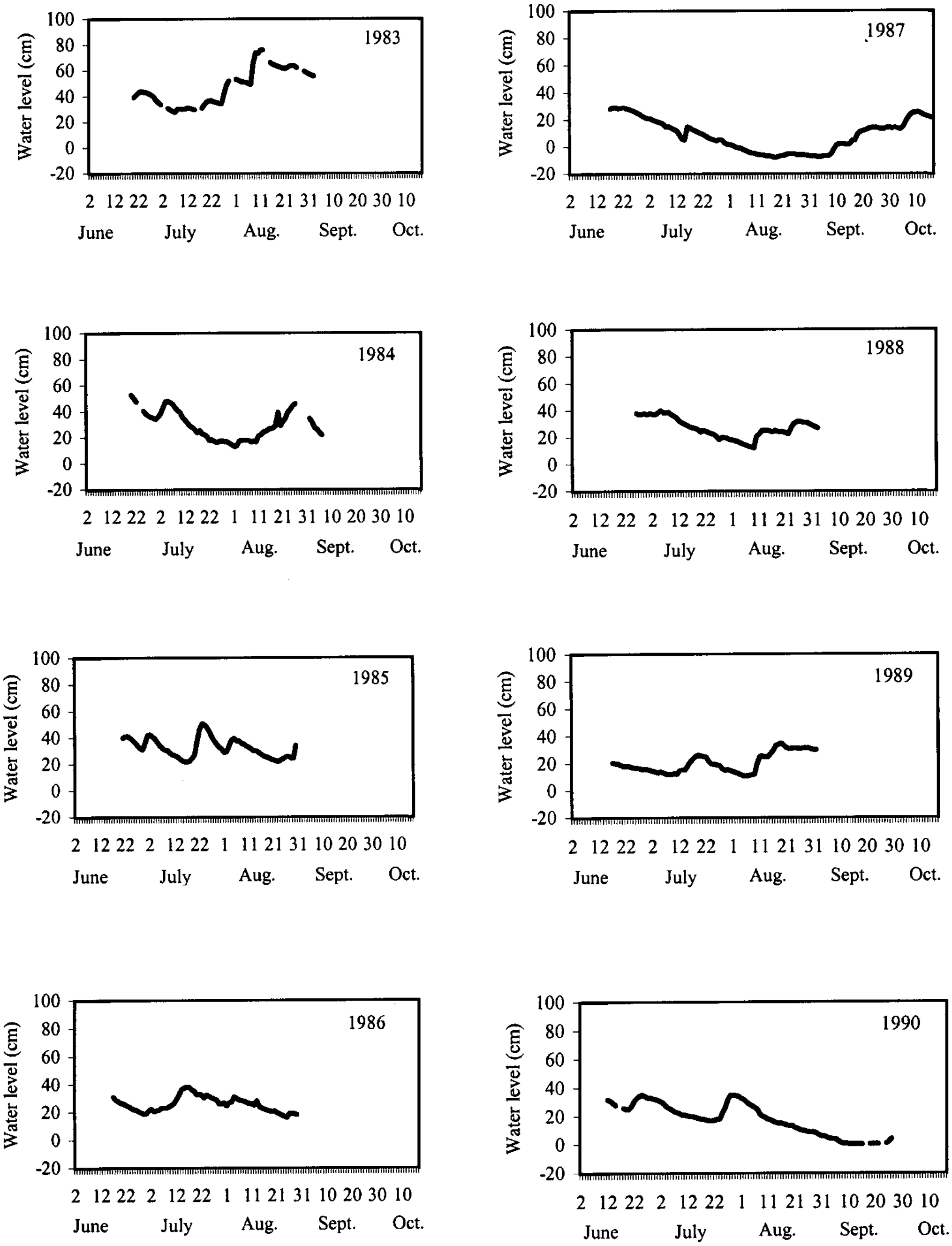


Fig. 16. Mean daily water levels (cm) measured near the fishway in Salmon Brook, 1983-2000.

Salmon Brook
SFA 4

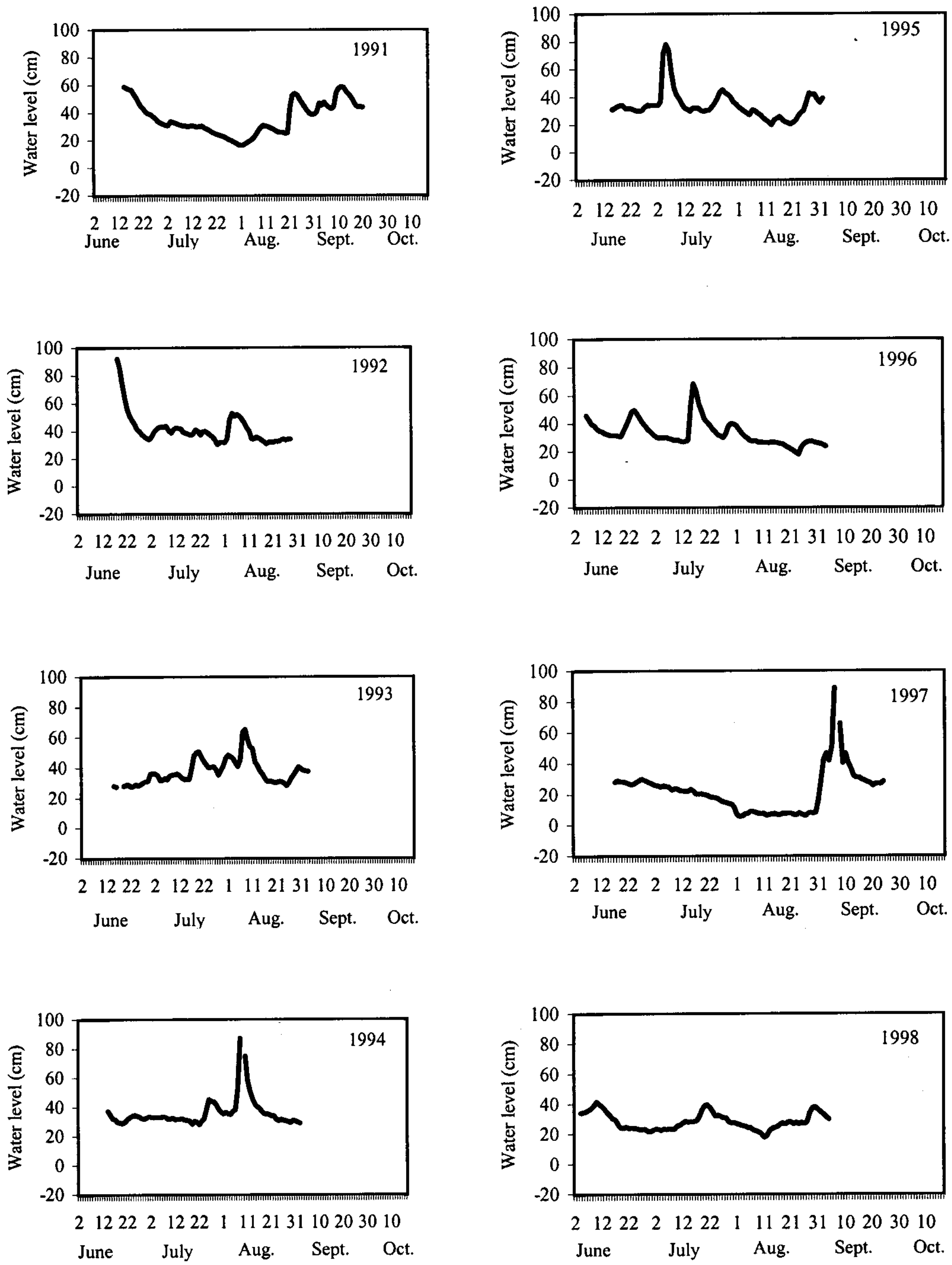
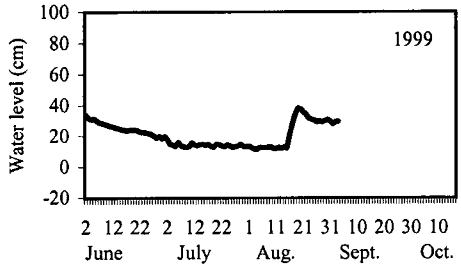


Fig. 16 (cont'd)

Salmon Brook

SFA 4



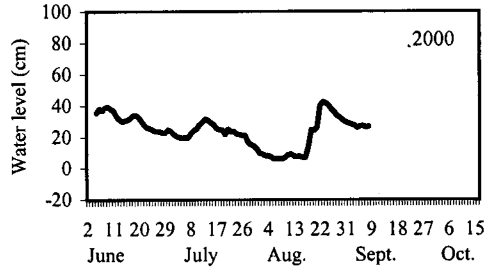


Fig. 16 (cont'd)

Appendix 1. Atlantic salmon recreational fishery catch and effort data for Gander River, Notre Dame Bay (SFA 4), 1974-2000. 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**		2609	1061	3670	*	268	268	2609	1329	3938	
2000**		1291	650	1941	*	96	96	1291	746	2037	
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
97-99 $\bar{X}$		2071.0	1415.7	3486.7	.	251.7	251.7	2071.0	1667.3	3738.3	
95% CL		2174.6	1643.7	3320.2	.	139.9	139.9	2174.6	1749.8	3458.9	
N		3	3	3	0	3	3	3	3	3	

1987 DATA NOT INCLUDED IN MEAN; 1997 LARGE SALMON IS PARTIAL.

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 (2000 DATA ARE PRELIMINARY).

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	16	16	16	15	13	13	12.0	14	14	16	16	16	17	16	17	17	20	22	20	20	21	21	20
	Min.							15	15	14	14	14	13	12	11.0	11	11	11	13	15	15	16	16	16	16	18	19	19	19	19	18
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	21	21	20	19	20	21	21	19	21	21	21	20	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	23	22	23	22
	Min.	18.0	18	19	18	18	18	19	19.0	19	19	20	19	19	19	18	18	19	19	18	19	19	19	18	18	19.0	19	20	21	21.0	21	21
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	24	24	24	22	22	22	22.0	23	23	23	24	22	21	22	22	22	21	21	21.0	21	20	19	19	18	17	17	16.0	16	16	16
	Min.	21	21	22	22	21	21	21	21	21	21	21	22	21	21	21	21	21	21	20	20	20	19	18	18.0	17	17	16	15	15.0	15	16
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.	17	17	17.0											
	Min.	16	16	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, 1985-2000.

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
2000	Max.							15.1	14.6	14.6	14.1	13.1	12.9	13.9	14.3	16.5	16.3	15.6	19.5	21.6	20.8	22.1	22.4	21.3	21.0	21.6	22.8	22.0	20.5	18.4	20.0	18.8
	Min.							13.8	12.6	12.5	12.9	11.9	10.8	11.4	12.8	12.8	14.9	14.4	14.9	18.7	18.9	18.0	19.1	19.0	18.9	18.8	18.8	20.1	17.8	17.1	17.0	18.1

Appendix 3b. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of July, 1985-2000.

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
2000	Max.	19.5	21.4	22.8	21.8	22.3	22.5	22.3	22.1	22.5	21.8	21.0	20.8	20.3	20.1	22.5	23.7	24.0	22.9	22.1	22.6	21.8	20.8	20.1	20.6	21.5	23.0	23.7	23.7	24.0	23.2	23.1
	Min.	17.1	17.8	18.4	20.0	19.8	19.4	18.5	20.5	20.8	18.6	19.3	18.9	18.6	17.0	18.5	19.9	21.3	21.3	20.8	20.0	19.8	18.3	19.1	18.9	19.0	19.5	20.1	20.0	20.5	20.9	20.4

Appendix 3c. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of August, 1985-2000.

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
2000	Max.	24.9	25.2	26.4	24.2	26.3	26.0	27.1	23.3	20.9	17.8	18.0	20.9	25.5	25.8	23.1	26.3	26.0	26.0	23.0	21.8	22.2	21.8	20.0	19.9	19.5	20.3	21.5	21.8	21.2	18.8	19.0
	Min.	20.0	20.5	21.0	21.8	21.9	20.8	19.6	19.9	18.0	16.5	16.4	15.9	16.5	17.2	19.3	20.6	21.2	21.6	21.0	20.5	20.6	19.7	18.2	18.1	18.7	18.2	18.8	19.8	17.7	16.2	17.5

Appendix 3d. Maximum and minimum water temperatures (°C) measured at the fishway in Salmon Brook for the month of September, 1985-2000.

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																												
2000	Max.	18.9	17.8	17.1	17.0	16.6	15.4	15.6	15.1																						
	Min.	17.9	15.8	14.9	15.3	15.6	13.6	13.4	14.1																						

Appendix 4. Mean daily water levels (cm) measured near the counting fence in Gander River, 1989-1999.

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, 1983-2000.

Month	Day	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
June	2																	33.8	
	3																	31.5	
	4																34.2	30.8	
	5																34.5	31.3	35.5
	6														45.7		35.0	29.9	38.2
	7														43.0		36.0	28.8	37.0
	8														39.7		37.3	28.3	39.0
	9														38.7		39.2	28.0	39.2
	10														36.2		41.5	27.0	38.0
	11														35.0		40.0	26.6	36.7
	12								31.8						34.3		38.3	26.1	33.0
	13								30.8						33.0		36.7	25.5	31.5
	14								29.3	59.0			37.3		32.3		34.3	25.0	30.0
	15								27.8	58.2		28.0	34.7	31.2	31.8		32.5	24.3	30.5
	16									57.2		27.5	32.0	32.2	31.7		30.3	24.3	31.0
	17				31.0	28.2		20.3		56.8			31.7	33.5	31.8	28.0	29.7	23.7	32.5
	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	34.0
	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	33.8
	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	32.0
	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	29.5
	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	27.0
	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	25.8
	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	25.4
	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	24.3
	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	23.7
	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	23.7
	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	23.0
	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	22.9
	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	24.7
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	23.8
	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	22.0
	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	20.5
	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	19.9
	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	19.5
	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	19.7
	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	19.6
	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	22.1
	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	24.3
	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	25.2
	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	28.0
	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	29.6
	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	31.6
	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	30.9
	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	29.4
	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	28.1
	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	25.6
	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	24.9
	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	24.9
	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	21.8
	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	25.3
	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	23.6
	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	23.8
	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	21.9
	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	21.8
	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	21.2
	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	21.2
	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	16.7
	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	15.2
	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	14.5
	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	12.5

Appendix 5(cont'd)

Month	Day	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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	9.6
	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	9.3
	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	8.0
	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	8.2
	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	7.5
	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	6.3
	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	6.2
	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	6.5
	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	6.2
	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	7.2
	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	8.8
	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	9.0
	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	7.8
	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	7.6
	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	7.8
	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	7.1
	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	7.0
	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	14.1
	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	24.9
	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	24.4
	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	26.3
	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	40.5
	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	42.5
	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	41.8
	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	40.5
	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	37.9
	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	36.1
	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	33.7
	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	32.6
	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	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	29.8
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	29.0
	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	28.2
	3		27.4			-7.5			4.3	45.3		37.7			23.6	46.7	31.5	29.5	27.8
	4		26.3			-7.5			4.0	47.7						42.0	30.0		26.1
	5		23.7			-7.0			4.0	45.5						52.0			27.2
	6		22.0			-7.0			2.8	44.0						89.0			27.3
	7					-7.0			1.3	43.0									26.5
	8					-5.7			1.0	44.3						66.0			26.9
	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	2000
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													