THE BIOLOGY OF ANADROMOUS SALVELINUS FONTINALIS (MITCHILL, 1815) AND SALMO TRUTTA LINNAEUS, 1758 IN RIVER SYSTEMS FLOWING INTO PLACENTIA BAY AND ST. MARY'S BAY, NEWFOUNDLAND

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by

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A Thesis submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

Department of Biology
Memorial University of Newfoundland
October 1982

St. John's Newfoundland

ABSTRACT

The biology of anadromous brook trout (indigenous) and brown trout (introduced) was studied for several river systems flowing into Placentia and St. Mary's Bays, Newfoundland. Outward movements of brook trout were observed from April to June; inward movements occurred in July-August. Movements between fresh and salt water in Northeast and Southeast Arms, Placentia appear to occur throughout the year. Outward movements of brown trout occurred concurrently with brook trout (North Harbour River, S.M.B.) while inward movements were observed from July through September. Smolt age of brook trout ranged from 1.+ to 7.+ years and that of brown trout from 1.+ to 8.+ years. Modal smolt age of brook trout ranged from 2.+ to 4.+ while for brown trout it was 2.+ to 3.+. The great majority of all samples for both species were comprised of smolt/post-smolt. It is possible that specimens of brown trout with a history of sea life leave North Harbour River, S.M.B. in a discrete run prior to the one observed in April-May which was comprised almost exclusively of smolt. There was some indication that homing occurs to Southeast River and its tributary Beaver River for brook trout.

Growth in freshwater was slower than previously reported for the freshwater form of each species in lakes on the Avalon Peninsula. Growth in freshwater and salt water was slower than that reported for anadromous populations elsewhere in North America (brook trout) and in Europe (brown trout). The slow growth of brown trout in salt water could partially result from the relatively small portion of the yearly increment attained during the winter with temperature being the

dominant determining factor. Newfoundland populations overwintering in estuarine and coastal areas likely experience temperatures of 0°C and less compared with 5-6°C for certain European populations. There was a dramatic increase in growth rate in salt water compared with freshwater for both species; also there was a tendency towards attainment of a greater ultimate size the younger the smolt age.

All age groups of smolt on North Harbour River, S.M.B. were significantly smaller than observed for the other areas. This appears to be the result of overwintering in flowing water on that river as opposed to lakes for the others. Lakes afford better temperature and feeding regimes as well as more living space. Based on the fact that the growth increment attained at the end of the growing season for parr remaining in North Harbour River, S.M.B. is similar to that of the other areas, it does not appear that the size difference in smolt has an adaptive basis but rather reflects a homeostatic compensatory response to temporal environmental conditions.

While size has been reported to be an important factor in smoltification and the development of salinity tolerance, it is not the only one. Smolt in the present study were substantially smaller than those reported in the literature as suffering high mortality upon direct transfer to seawater. These phenomena appear to be the result of a synergistic process involving several variables such as temperature, photoperiod, water level and living space.

Except for some differences in percent occurrence of items in gut contents, the food of brook trout and brown trout were similar in both fresh and salt water.

Spawning time varied with area for brook trout (first three weeks in October for North Harbour River, S.M.B, and first three weeks in November for Southeast River); no spawning concentrations of brown trout were located. Sex ratio was significantly in favor of females for brook trout in virtually all cases; no significance and no consistent trend in favor of either sex was found for brown trout. Age at first maturity for brook trout was 2^+ for both sexes; for brown trout it was 2^+ for males and 3^+ for females. The percentage of brook trout males reaching maturity in a given age group was higher than than of females in the majority of cases; there was no consistent trend for brown trout. For both species there was a tendency for a lower percentage of anadromous fish to reach maturity in a given age group than reported for their counterparts in freshwater. Both sexes of brook trout appear to be alternate spawners; there was evidence for the same for female brown trout. For brook trout, parr and specimens with a sea history spawn together; kelts of each sex showed evidence of spawning as parr. Male brown trout can spawn as parr.

Reproduction in anadromous brook trout and brown trout is spread over the maximum number of years. Delay of maturity until a larger size is attained probably results in a higher reproductive effort and juvenile survival. Atlantic salmon cohabiting the same rivers are more r-selected in that the overall life span is shorter and they probably produce a higher reproductive effort. Salmon are consecutive spawners as opposed to alternate spawners.

Brown trout introduced to Newfoundland were mainly British and were of the freshwater form. They have since become anadromous in

Newfoundland waters. Growth rate in freshwater and salt water is lower than that published for British anadromous populations (as already pointed out) and age at first maturity and longevity are greater. Alternate spawning is exhibited instead of consecutive spawning. Differences in exploitation between Newfoundland and Great Britain over the years could compound any assumptions based on life history theory predictions.

Since their introduction in the 1880's through early 1900's, the spread of brown trout (colonization by means of the sea) was rather slow. This could be the result of a combination of the following factors: (1) straying rate, (2) slow growth and hence low egg deposition potential, and (3) the fact that a relatively large number of specimens of both sexes may not mature after entering a river. For one of the rivers studied, the establishment of a population of brown trout has been to the detriment of brook trout. It is not possible in light of present data to say if resource competition in freshwater has contributed to an observed decline in numbers of anadromous brook trout concomitant with an increase in numbers of brown trout on that river. However, there is evidence to suggest that a combination of greater vulnerability to angling on the part of brook trout, angler preference and adjustments in the length and timing of the licenced angling season have in part brought about this result.

ACKNOWLEDGEMENTS

The author was deeply saddened by the untimely death of his supervisor, Dr. C. W. Andrews whose enthusiasm for the study, support and guidance served as an inspiration. Dr. J. M. Green assumed the duties of supervisor for which the author is sincerely grateful. The criticisms and suggestions of Drs. D. H. Steele and L. W. Crim are greatly appreciated.

Field work and the processing of samples in the laboratory would not have been possible without the assistance of E. L. Dalley, J. P. O'Brien, E. G. Dawe and especially H. J. Drew.

Special thanks are extended to several personnel of the Dept. of Fisheries and Oceans, namely F. A. (Fred) Day, A. J. (Art) O'Keefe, A. Pittman, W. Davis and R. Didham for invaluable information pertaining to the various river systems during the field work phase. Counting fence and spawning survey data for Come By Chance River were kindly supplied by Mr. R. J. Wiseman and B. LeDrew. Mr. T. R. Porter provided the information on the spawning history of Atlantic salmon. Mr. A. M. Fleming deserves special mention for allowing use of the Dept. of Fisheries and Oceans facilities at North Harbour, St. Mary's Bay.

Dr. D. H. Steele identified the marine crustaceans encountered in food analysis and Mr. G. Driscoll identified the polychaetes and marine molluscs.

The author is grateful to Mr. Roy Ficken, Dept. of Biology, Memorial University of Newfoundland for photography; thanks are also extended to the technical staff of the Dept. of Biology, in particular

Mr. E. T. Fitzgerald and Mr. C. Cantwell. Dr. J. Rice (Dept. of Biology) and Dr. J. Strawbridge (Dept. of Psychology) provided advice during the statistical analysis of samples.

This study formed part of an overall ecological assessment of river systems flowing into Placentia Bay (later extended to St. Mary's Bay in the case of anadromous trout) undertaken by the Faculty of Science, Memorial University of Newfoundland (Dr. W. D. Machin, Dean) in 1974 and carried out under the direction of the late Dr. G. W. Andrews. The Faculty of Science provided most of the financial assistance. Additional support came from the Freshwater and Anadromous Fisheries Management Program, Dept. of Fisheries and Oceans, St. John's.

The author is grateful to Mrs. Mary Freake for typing the majority of the tables and appendices and to Mrs. Karen Harding, Dept. of Fisheries and Oceans, for typing the remainder of the manuscript and operation of the word processor.

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INTRODUCTION

The brook trout (Salvelinus fontinalis (Mitchill, 1815)) is indigenous to insular Newfoundland. The brown trout (Salmo trutta Linnaeus 1758) was introduced to certain waters on the Avalon Peninsula from Europe beginning in the 1880's and continuing through the early 1900's (Frost 1940; Scott and Crossman 1964; Andrews 1965). Wilder (1952) examined the systematic status of the anadromous form versus the freshwater form of brook trout for Moser River, Nova Scotia and concluded that the two constitute a single taxonomic unit for that river. According to Power (1980), the findings of Wilder have been extended to include all populations of brook trout. The freshwater and anadromous forms of the brown trout were once considered by certain authorities to constitute separate species (Trewavas 1953); however, both are now recognized as a single species (Scott and Crossman 1964; MacCrimmon and Marshall 1968; Wheeler 1969; Campbell 1977).

Brown trout introduced into insular Newfoundland were predominantly British and consisted of the freshwater form (mainly the Loch Leven variety) (Frost 1940; Scott and Crossman 1964; Andrews 1965). Since their introduction, they have spread by way of the sea to the southern part of the Bonavista Peninsula and the eastern side of the Burin Peninsula (Andrews 1965). In recent years, there have been unconfirmed reports of the species being found as far north as Notre Dame Bay. Nelson (1965) reported that in North America as a whole, introductions of brown trout have often led to the exclusion of brook trout in running waters. According to Nyman (1970), this is also occurring on the Avalon Peninsula. Integral to an understanding of the impact of colonizing brown trout on anadromous populations brook trout in Newfoundland is a knowledge of the life history strategy of each species, something which has been dealt with only vaguely in the past (see below). This investigation therefore addresses the following questions:

- considering the origin of Newfoundland anadromous brown trout and the high degree of plasticity attributed to the species (Ferguson and Mason 1981), are there differences in the more salient life history features between Newfoundland waters and those published in the literature for British waters?
- if so, given fundamental differences in climate between Newfoundland and Great Britain, are they along the lines predicted by life history theory (Murphy 1966; Schaffer 1974; Stearns 1976, 1977)?
- how does the life history strategy of anadromous brown trout relate to its rate of range extension in Newfoundland both in terms of environmental conditions and degree of similarity to that of anadromous brook trout and also Atlantic salmon with which colonizing populations might have to compete?

Nyman (1970) identified differential angling mortality as being a factor operating to the detriment of brook trout in Waterford River, St. John's. Lear and Day (1977) noted an increase in the numbers of anadromous brown trout concomitant with a decrease in the numbers of anadromous brook trout for North Harbour River, St. Mary's Bay. The present study examines this situation in the context of differential angling mortality for that river as well as in relation to angler preference, angling regulations and possible resource competition.

During the initial stages of this investigation, it was noticed that brook trout smolt on North Harbour River, St. Mary's Bay, were substantially smaller than those of other areas. Brown trout smolt were located only on North Harbour River and they were of the same size range as brook trout smolt. Carscadden and Leggett (1975) reported intraspecific variation in adaptation of life history traits to different environmental conditions on a local scale similar to that occurring on a latitudinal basis. More recently, Riddell and Leggett (1981) related differences in body morphology and movements to environmental differences. Based on known environmental differences between North Harbour River and the remaining systems, smolt were studied to determine if there was evidence of an adaptive basis for the observed size difference. Also, life history traits were examined for differences.

Although part and parcel of the above, a sub-objective of this study was to document the various aspects of the biology of anadromous brook trout and brown trout in insular Newfoundland and make comparisons with populations elsewhere. Such information is required for proper management of these stocks.

LITERATURE REVIEW

The biology of the freshwater form of the brook trout in insular Newfoundland has been dealt with in varying detail by several authors (Frost 1940; Scott and Crossman 1964; Wiseman 1969, 1970, 1971, 1972, 1973; Lee 1971; Wiseman and Whelan 1974; Dalley 1975; Whelan and Wiseman 1975, 1977; Morry and Cole 1977). By comparison, the anadromous form has received much less attention. Knowledge of movements between fresh and salt water for Little Codroy River (Murray 1968) and North Harbour River, St. Mary's Bay (Lear and Day 1977) has been obtained in connection with detailed studies of other salmonid species, namely Atlantic salmon (Salmo salar Linnaeus 1758) for the former river and pink salmon (Oncorhynchus gorbuscha (Walbaum) 1972)[1] for the latter. Scott and Crossman (1964) examined aspects of the life history and biology of anadromous brook trout from Olivers Brook, Picadilly Bay and Little Codroy River as did Wiseman (1969) for Indian River; however, both these studies suffered from extremely small sample sizes.

Aspects of the biology of the freshwater form of brown trout in Newfoundland have been studied by Scott and Crossman (1964), Liew (1969), Lee (1971), Wiseman (1971, 1972, 1973) and Wiseman and Whelan (1974). Very little has been done with respect to the anadromous form. Williamson (1963) reported on record specimens angled at Witless Bay, Scott and Crossman (1964) treated the form very briefly and Lear and Day (1977) observed movements on North Harbour River, St. Mary's Bay.

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[1]An unsuccessful attempt was made between 1958 and 1966 to establish a run of pink salmon on North Harbour River, S.M.B. by transplants of eyed eggs from British Columbia (Lear 1975).

STUDY AREA

Fig. 1 shows the general area studied in the context of insular Newfoundland and the various river systems in relation to Placentia and St. Mary's Bays. Each system is shown in greater detail in Figs. 2-7. In keeping with the objectives outlined above, these rivers were chosen for the following reasons: (1) the occurrence of sympatric populations of brook trout and brown trout, (2) comparison of the two contrasting environments referred to above was possible (see below) and (3) in order to adequately document the life history and biology of each species, it was necessary to study as many rivers as possible. Beaver River was chosen because it was the least exploited.

Physical and Chemical Conditions

Detailed data for each system on the geomorphological characteristics of drainage basin, physical characteristics of river channel, water chemistry, obstruction locations, angler accessibility, etc. can be found in Porter et al. (1974). Temperature, water level and water chemistry data for several consecutive years for North Harbour River, S.M.B. are available in Lear and Day (1977). North Harbour River, S.M.B. differs from the other rivers by a relative lack of standing water habitat (lakes and ponds) accessible to migrating salmonids. Lakes on Cataract River tributary are upstream from an impassible falls, the one on Saddle Brook is at the end of an intermittent stream and those on Collins Brook are periodically inaccessible due to beaver dams. There are only three freely accessible lakes, all of which are small compared to some on the other systems (one forms the headwaters of the main stem and the remaining two the headwaters of the Soldiers River tributary). The relatively low overall number of lakes plus the fact

Fig. 1. Map showing the study area in the context of insular Newfoundland and each system in relation to Placentia and St. Mary's Bays.

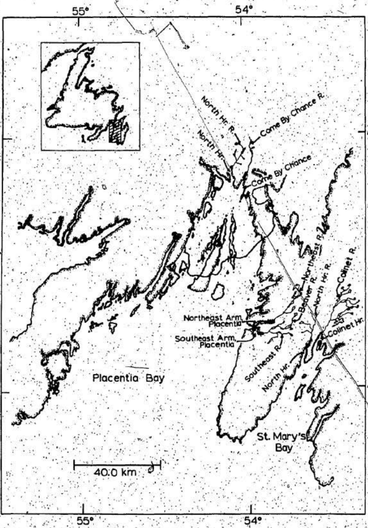

55°
54°
48°
47°
North Hr. R.
North Hr.
Come By Chance R.
Come By Chance
Northeast R.
Beaver R.
North Hr. R.
Colinet R.
Northeast Arm, Placentia
Southeast Arm, Placentia
Colinet Hr.
Southeast R.
North Hr.
Placentia Bay
St. Mary's Bay
40.0 km

Fig. 2. Detailed map of North Harbour River, St. Mary's Bay showing sampling station locations and gear type. R.S. = River Set.

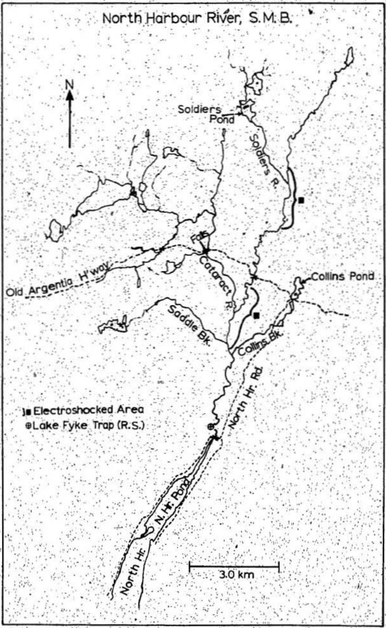

North Harbour River, S.M.B.
N
Soldiers Pond
Soldiers R.
Falls
Old Argentia H'way
Cataract R.
Collins Pond
Saddle Bk.
Collins Bk.
North Hr. Rd.
■ Electroshocked Area
⊕ Lake Fyke Trap (R.S.)
N. Hr. Pond
North Hr.
3.0 km

Fig. 3. Detailed map of Southeast River and its tributary Beaver River as well as the Southeast Arm of Placentia. Shown also are sampling station locations and gear type. L.S. = Lake Set; R.S. = River Set.

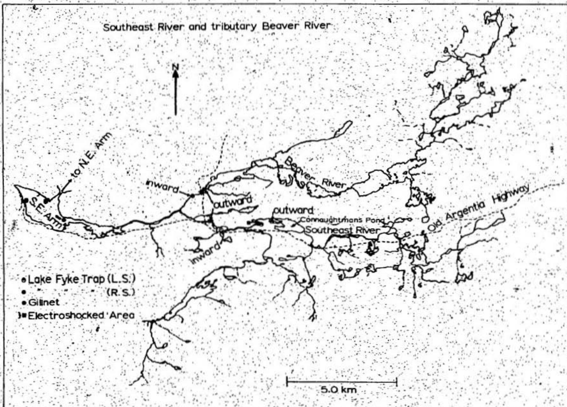

Southeast River and tributary Beaver River
N
to N.E. Arm
S.E. Arm
inward
outward
outward
inward
Beaver River
Connaughtmans Pond
Southeast River
Old Argentia Highway
Lake Fyke Trap (L.S.)
" " " (R.S.)
Gillnet
Electroshocked Area
5.0 km

Fig. 4. Detailed map of Northeast River and part of the Northeast Arm of Placentia. Shown also are sampling station locations and gear type. L.S. = Lake Set.

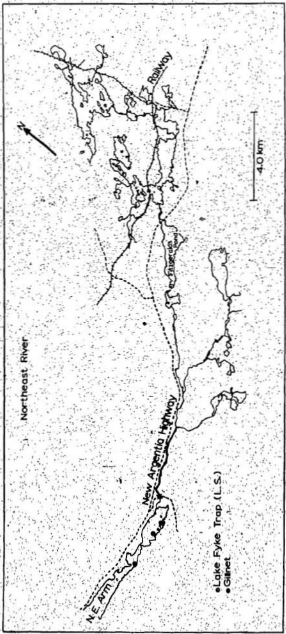

Northeast River
Railway
N
4.0 km
Fitzgeralds Pond
New Argentia Highway
N.E. Arm
Lake Fyke Trap (L.S.)
Gillnet

Fig. 5. Detailed map of Come By Chance River showing sampling station locations and gear type. R.S. = River Set.

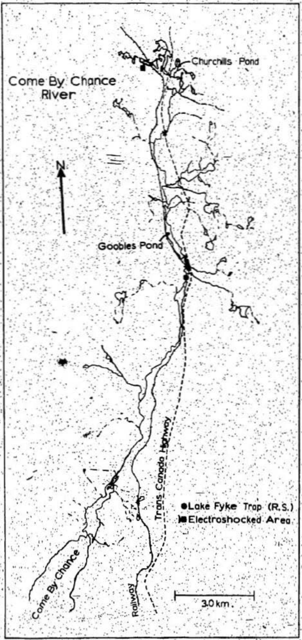

Come By Chance
River
Churchills Pond
N
Goobles Pond
Trans Canada Highway
Lake Fyke Trap (R.S.)
Electroshocked Area
Come By Chance
Railway
3.0 km

Fig. 6. Detailed map of North Harbour River, Placentia Bay showing area angled.

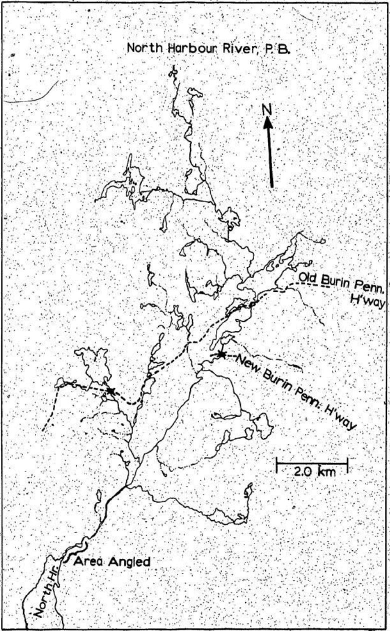
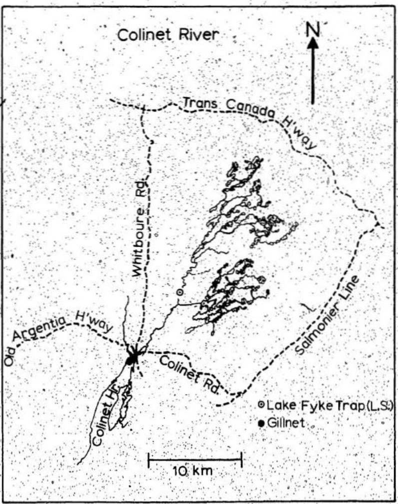

North Harbour River, P. B.
N
Old Burin Penn. H'way
New Burin Penn. H'way
2.0 km
Area Angled
North Hr.

Fig. 7. Detailed map of Colinet River and part of Colinet Harbour showing sampling station locations and gear type. L.S. = Lake Set.


Colinet River
N
Trans Canada H'way
Whitboure Rd.
Old Argentia H'way
Salmonier Line
Colinet Rd.
Colinet Hr.
Lake Fyke Trap (L.S.)
Gillnet
10 km

they are located in the headwaters of the various tributaries results in part in very unstable flow conditions. The extremes of flooding and low water conditions occur to a much greater extent on this river than the others studied.

Very little published information exists on the physical and chemical conditions in the open waters of Placentia Bay and St. Mary's Bay or their inlets and estuaries. Naidu and Cahill (1978) studied mean daily temperatures in Garden Cove (at depths of 3.0 and 6.0 m in summer and 21.0 and 24.0 m in winter) and Little Bay (4.5 and 15.0 m in summer; 16.5 and 27.0 m in winter) in Placentia Bay between March 1976 and March 1977. In Garden Cove, the maximum temperature at 3.0 m occurred in September (16.2°C) and at 6.0 m in August (15.8°C); minimum temperatures occurred in February (1.8°C at 21.0 m and 0.4°C at 24.0 m). In Little Bay, maximum temperatures occurred in September (15.1°C at 4.5 m and 14.1°C at 15.0 m) and minimum temperatures in February (0.0°C at 16.5 m and -1.7°C at 27.0 m). Also in Placentia Bay, Bruce et al. (1981) studied temperature and salinity in Northeast and Southeast Arms, Placentia (the estuaries corresponding to Northeast River and Southeast River in the present study) from June to October 1979. They studied four stations (at 1 m intervals from surface to bottom) in each Arm (extending longitudinally from the vicinity of the river to the mouth of the estuary). There was no definite thermal stratification in either Arm. Surface temperature in Northeast Arm ranged from 20.0 (August 6) to 9.2°C (October 15) while in Southeast Arm, the range was from 19.8 (August 7) to 8.8°C (October 16). Bottom temperature ranged from 19.8 (depth of 17.0 m) to

11.0°C (26.0 m) on August 6 and October 1 respectively in Northeast Arm. In Southeast Arm, the highest bottom temperature occurred on August 7 (18.8°C at 6.0 m) and the lowest on October 16 (10.6°C at 6.0 m). There were no definite haloclines present in Northeast Arm during June and July (salinity was in excess of 25.0 °/oo from surface to bottom; from August to October, haloclines began for most part at the surface and extended downward to approximately 2.0 m (salinities below the haloclines were <25.0 °/oo). In Southeast Arm, Haloclines were found at the station closest to the river in June and July but not the remaining stations which developed same in August-October. Again they extended from the surface to around 2.0 m and salinities below this were in excess of 25.0 °/oo for all stations. Surface salinity in Northeast Arm ranged from 1.9 (station nearest river mouth) to 29.5 °/oo while in Southeast Arm the range was from 0.0 (station nearest river mouth) to 28.2 °/oo.

Templeman and Fleming (1965) reported a temperature of -1.°C extending from the surface to the bottom (150 m) in the middle of St. Mary's Bay in February 1957. Lear and Day (1977) examined mean monthly surface temperatures from April to October at the mouth of North Harbour estuary, St. Mary's Bay from 1960 to 1974. For any given year, lowest surface temperatures occurred in April (2.96-3.84°C) while the highest occurred in August (11.17-16.44°C). Bottom mean monthly temperatures (depth not specified) were studied from May to October (1960-1969); lowest temperatures occurred in May (0.02-2.50°C) and highest in September (8.40-17.5°C). During the present study, a surface salinity of 22.5 °/oo and a bottom salinity of 24.0 °/oo (depth of 2.0 m) were recorded approximately 1.5 km from the mouth of North Harbour River, S.M.B. in North Harbour Pond on September 21, 1976.

During winter, estuaries in both bays can become ice-covered for varying periods.

Fish Species Present

Brook trout, Atlantic salmon and threespine stickleback (Gasterosteus aculeatus Linnaeus, 1758) are present in all systems studied while brown trout are found in four of them (North Harbour River, S.M.B.; Colinet River, Northeast River, and Come By Chance River). Other species encountered sporadically throughout the present study include rainbow smelt (Osmerus mordax (Mitchill, 1815)) - North Harbour River, S.M.B.; Southeast River, Northeast and Southeast Arms of Placentia, Colinet River, Colinet Harbour and Come By Chance River and American eel (Anguilla rostrata (Le Sueur, 1817)) - North Harbour River, S.M.B.; Southeast River, Beaver River, Northeast River and Come By Chance River. Subject to verification, specimens of what appear to be anadromous Arctic char (Salvelinus alpinus (Linnaeus, 1758)) were taken in Northeast River. Additional species for these rivers reported by Porter et al. (1974) include alewife (Alosa pseudoharengus (Wilson, 1811)) for North Harbour River, S.M.B. and blackspotted stickleback (Gasterosteus wheatlandi Putnam, 1867) and fourspine stickleback (Apeltes quadracus (Mitchill, 1815)) for Come By Chance River. Alewife were taken in Northeast Arm, Placentia and Colinet Harbour in the present study.

Lear (1975) lists the following marine species in descending order of abundance as occurring in North Harbour estuary, St. Mary's Bay: cunner (Tautogolabrus adspersus (Walbaum, 1792)); Atlantic herring (Clupea harengus Linnaeus, 1758); winter flounder (Pseudopleuronectes americanus (Walbaum, 1792)); short-horn sculpin (Myoxocephalus scorpius (Linnaeus, 1758)); Atlantic cod (Gadus morhua Linnaeus, 1758); thorny skate (Raja radiata Donovan, 1807); Atlantic tomcod (Microgadus tomcod (Walbaum, 1792)) and northern wolffish (Anarhichas denticulatus Krøyer, 1884). Bruce et al. (1981) reported cunner and winter flounder in that order as being the dominant forms in Northeast and Southeast Arms, Placentia. Threespine stickleback and rainbow smelt were common in all estuaries in the present study. Spawning capelin (Mallotus villosus (Müller, 1977)) and herring were encountered in the spring.

MATERIALS AND METHODS

Station locations and the type of gear used at each are shown in Figs. 2-7. Sampling periods, number of specimens captured per period and number of gear units are presented in Table 1.

Lake fyke traps (live traps) were constructed of knitted nylon mesh (1.3 cm stretched). The leader (30.5 m long and 1.8 m deep) and two wings (each 9.1 m long and 1.8 m deep) were attached to a main square frame (1.2 m) which was followed by four smaller frames (each 0.6 m) and a trailing cod end. In lakes, the leader was tied and set off perpendicular to the shore (depth of water varied between 1 and 3 m). When set in a river, the body of the trap was placed in a pool of suitable depth with each wing tied to the corresponding river bank and fastened to the substrate with heavy rocks placed side by side. This arrangement completely barred off the river. When the channel width was greater than could be spanned by the wings, the leader was fastened to the side of the main frame and tied to one bank and the opposing wing (sometimes with an added extension of the same material and mesh size) tied to the other (Fig. 8). The trap entrance faced upstream or downstream depending on the direction of trout movement.

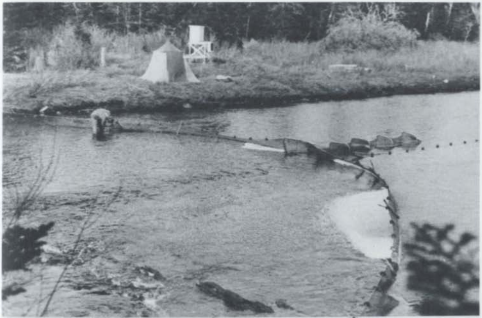
Two gangs of monofilament nylon gillnets were used (one 3-panel and one 5-panel). Individual panels (45.8 m long and 1.8 m deep) consisted of a single mesh size and were arranged in a series from smallest to largest mesh size as follows: 3.8, 5.1 and 7.6 cm for the 3-panel gang with two additional panels of 10.2 and 15.2 cm comprising the 5-panel gang. Nets (bottom set) were tied to the shore and set off perpendicular with the smallest mesh innermost. Depth of water in which the outer panel was set varied between 5 and 10 m.

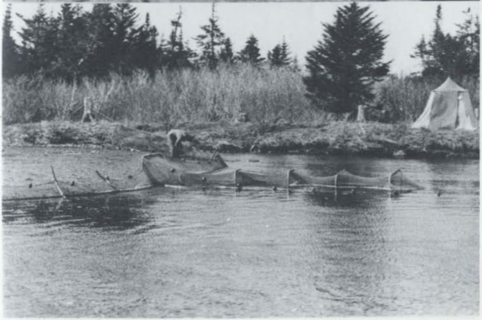
Table 1. Sampling gear, setting and removal dates and number of each species taken for each area.

Area	Date Set	Date Removed	N	Sampling Gear	No. of Gear units
Salvelinus fontinalis					
North Hr. R., S.M.B.					
Outward	May 10	May 15, 1976	282	Lake Fyke Trap (R.S.)	1
Outward	May 17	May 21, 1976	105	Lake Fyke Trap (R.S.)	1
Inward	July 5	July 26, 1976	477	Lake Fyke Trap (R.S.)	1
Outward	Apr. 13	June 1, 1977	121	Lake Fyke Trap (R.S.)	1
Inward	July 8	Aug. 5, 1977	232	Lake Fyke Trap (R.S.)	1
Spawners	Oct. 7–8 & Nov. 1, 1976		56	Electroshocker	1
Beaver R.					
Outward	Apr. 23	May 31, 1977	471	Lake Fyke Trap (R.S.)	1
Inward	July 9	Aug. 5, 1977	579	Lake Fyke Trap (R.S.)	1
Southeast R.					
Outward	Apr. 18	May 31, 1977	202	Lake Fyke Trap (R.S.)	1
Outward	June 1	June 17, 1977	95	Lake Fyke Trap (L.S.)	2
Inward	July 9	Aug. 5, 1977	45	Lake Fyke Trap (L.S.)	1
Spawners	Nov 5–22, 1976		180	Electroshocker	1
Northeast R.					
Outward	June 14	June 16, 1976	102	Lake Fyke Trap (L.S.)	2
Outward	May 3	June 17, 1977	337	Lake Fyke Trap (L.S.)	2
Come By Chance R.					
Inward	July 27	Aug. 6, 1976	37	Lake Fyke Trap (R.S.)	1
Inward	July 11	July 29, 1977	69	Lake Fyke Trap (R.S.)	1
Spawners	Sept. 30– Oct. 11, 1976		123	Electroshocker	1
North Hr. R., P.B.	July 18– July 22, 1977		48	Angler	2
Northeast Arm, Plac.	June 16	June 18, 1975	88	3-Panel Gillnet	1
	June 14	June 17, 1976	107	5-Panel Gillnet	1
	Sept. 2	Sept. 21, 1976	115	3 & 5-Panel Gillnets	1(of each)
	Nov. 2	Nov. 3, 1976	23	5-Panel Gillnet	
	May 11	May 13, 1977	17	3-Panel Gillnet	1
	July 5	July 7, 1977	27	5-Panel Gillnet	1
	Aug. 15	Aug. 23, 1977	37	5-Panel Gilnet	1
Southeast Arm, Plac.	June 18	June 20, 1975	106	3-Panel Gillnet	1
	June 14	June 17, 1976	51	3-Panel Gillnet	1
	Nov. 2	Nov. 3, 1976	27	3-Panel Gillnet	1
	May 18	May 19, 1977	16	3-Panel Gillnet	1
	July 6	July 7, 1977	10	3-Panel Gillnet	1
Salmo trutta					
North Hr. R., S.M.B.					
Outward	May 10	May 15, 1976	58	Lake Fyke Trap (R.S.)	1
Outward	May 17	May 21, 1976	43	Lake Fyke Trap (R.S.)	1
Inward	July 5	July 26, 1976	28	Lake Fyke Trap (R.S.)	1
Inward	Sept. 1	Sept. 23, 1976	101	Lake Fyke Trap (R.S.)	1
Outward	Apr. 13	June 1, 1977	116	Lake Fyke Trap (R.S.)	1
Inward	Aug. 11	Aug. 26, 1977	33	Lake Fyke Trap (R.S.)	1
Northeast Arm, Plac.	June 14	June 17, 1976	12	5-Panel Gillnet	1
	Sept. 2	Sept. 21, 1976	109	3 & 5 – Panel Gillnets	1 (of each)
	Nov. 2	Nov. 3, 1976	9	3-Panel Gillnet	1
	May 11	May 13, 1977	3	3-Panel Gillnet	1
	July 5	July 7, 1977	11	5-Panel Gillnet	1
	Aug. 15	Aug. 23, 1977	55	5-Panel Gillnet	1
Colinet Hr.	Apr. 28	May 3, 1977	5	3-Panel Gillnet	1
Colinet Hr.	Aug. 12	Aug. 27, 1977	31	5-Panel Gillnet	1
Colinet River	Sept. 14	Sept. 16, 1977	5	Lake Fyke Trap (L.S.)	2
Colinet River	Oct. 4	Oct. 8, 1977	8	Lake Fyke Trap (L.S.)	2
Colinet River	Oct. 24	Oct. 28, 1977	9	Lake Fyke Trap (L.S.)	2

R.S. = River Set
L.S. = Lake Set

Fig. 8. Fyke trap set in a river viewed from upstream (upper photo) and downstream (lower photo).





Samples from spawning areas were taken with a backframe mounted Smith-Root Type V electroshocker powered by a 12 volt snowmobile battery.

Prior to release, all specimens of each species taken in live traps during outward and inward movements were marked with either a numbered Carlin tag (North Harbour River, S.M.B.; 1976) or a fin clipping code (adipose and left pelvic for Southeast River, adipose and right pelvic for Beaver and North Harbour River, S.M.B. (1977) and adipose and anal for Northeast River) as suggested in Everhart et al. (1975). Length measurements (and weight in the case of North Harbour River, S.M.B. in 1976) and scale samples were also taken at this time. Carlin tag attachment followed Saunders (1968). Tagging operations and weight measurements were performed on fish anaesthetized with MS-222. A percentage of each run (maximum of approximately 100 fish) was killed at random over the sampling period in order to determine sex ratio, maturity and gut contents.

Fork lengths were taken to the nearest mm and weights (using a model 700 Ohaus triple beam balance) to the nearest 0.1 gm. Sacrificed specimens were generally processed in the field but when this was not possible, they were deep frozen (10 per polyethylene bag) for periods up to 6 months. Guts (from the lower esophagus to the anus) and gonads were preserved in 10% formalin.

Maturity ratings for females of both species were based on macroscopic examination of gonads according to Vladykov (1956). This author states that specimens reaching stage 2 will definitely spawn in the fall. This was used as the basis for classification of specimens taken in inward runs and in the sea from July onward as either mature or immature. Males were rated as immature, ripening or spent;

according to criteria in Lee (1971) and Bagenal and Braum (1970). Evidence of previous spawnings for females was based on gonad examination following Lee (1971). Because of atresia (Vladykov 1956), only specimens at stage 4 or 5 were selected for fecundity determinations. Egg enumerations were made by direct count. Since the majority of brook trout females were taken on the spawning grounds, a large number were partially spent and hence could not be used for egg counts. None of the brown trout females used for fecundity were taken from spawning areas. Low numbers of suitable females of each species from a given area necessitated combining data. A scatter plot of egg number on fork length for each species was non-linear. Length-fecundity relationships (unweighted regressions) were therefore determined according to the formula

$$F = aL^b$$

(where F = egg number, L = fork length in mm and a and b are constants) by linear regression of logarithmically transformed F and L values (the logarithmic form of the length-fecundity relationship is $\log_{10}F = \log_{10}a + b \log_{10}L$).

Length-weight relationships (weighted regressions) were calculated according to the formula

$$W = aL^b$$

(where W = weight in gm, L = fork length in mm and a and b are constants) by linear regression of logarithmically transformed W and L values (the logarithmic form of the length-weight relationship is $\log_{10}W = \log_{10}a + b \log_{10}L$).

Both species were aged using scales taken from an area slightly above the lateral line between the dorsal and adipose fins. A minimum of 10 scales from each specimen were mounted between two microscope slides (taped together at the ends) and read using a Bausch and Lomb Tri-Simplex microprojector (x 43). Life history interpretations based on scales (namely freshwater life versus sea life and spawning history) followed criteria in Hoar (1940) for brook trout and Dahl (1910), Nall (1930), Järvi and Menzies (1936) and Järvi (1940) for brown trout. Representative scales showing the various zones for each species are shown in Fig. 9.

Terminology used for the various life stages of brown trout was that presented in Allan and Ritter (1977). Table 2 summarizes these stages and gives the corresponding notation adopted in the present study. A modification introduced in the present investigation was that individuals returning to freshwater in the smolt year were designated as type 1 post-smolt while the post-smolt stage described at the end of the first sea-winter was referred to as type 2. For specimens captured in the sea from May through November in the year of smolt migration it was not possible to ascertain which type of post-smolt they were destined to become. They were therefore referred to as post-smolt (type unknown). Brook trout (see later) do not possess a type 2 post-smolt stage. Individuals of this species return to freshwater within a few months whether they are going to sea for the first time or making repeated trips. The terms and notations in Table 2 were applied with this basic difference in mind. The term post-smolt was used without an accompanying type 1 or type 2 designation. The notation 2.1^+, 2.2^+, etc. does not refer to successive winters spent in the sea as is the case for brown trout; it is taken instead to mean that out of a given whole year, a certain amount of time is spent in the sea as with the remainder.

Fig. 9. Representative scales of (a) *Salvelinus fontinalis* and (b) *Salmo trutta*.

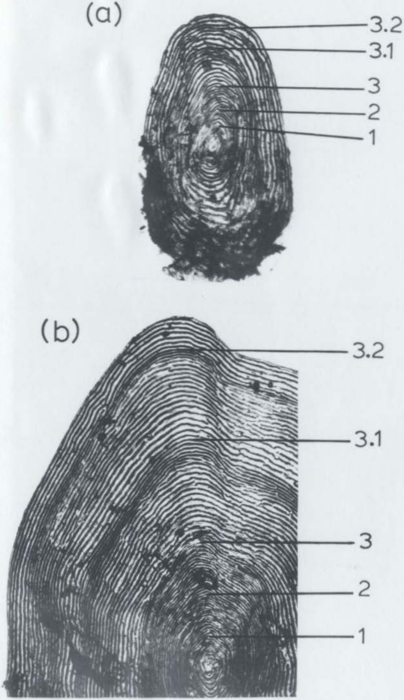

(a)
3.2
3.1
3
2
1
(b)
3.2
3.1
3
2
1

Table 2. Life history stages and corresponding notation as applied to <u>Salmo trutta</u> and with some modification (see text), to <u>Salvelinus fontinalis</u>. After Allan and Ritter (1977).

Term	Definition	Notation
PARR	Stage from dispersal from redd to migration as smolt	$0.^+, 1.^+, 2.^+$, etc.
SMOLT	Fully silvered juvenile migratory trout	$2.^+, 3.^+, 4.^+$, etc.
POST-SMOLT	Stage from departure from river as smolt until entry into freshwater in the smolt-migration year (type 1), or the end of the first sea-winter if there is no return to freshwater in the smolt migration year, as indicated by wide annulas formation (type 2).	
MIGRATORY TROUT (=SEA-TROUT)	All fish after the post-smolt stage	
(a) 0-sea-winter	Fish which has returned to freshwater in the year of its smolt migration	$2.0^+, 3.0^+, 4.0^+$, etc.*
(b) 1-sea-winter	Fish which has returned to freshwater after 1 winter at sea	2.1^+*
(c) 2-, 3-, (etc.) sea winter	Fish which has returned to freshwater after 2, 3, (etc.) winters at sea.	$2.2^+, 2.3^+$, etc*
(d) Previous spawner	Fish which has spawned on previous occasion(s) either as an 0-sea-winter migratory trout or after 1 or more sea winters.	
KELT	Spent or spawned-out migratory trout (a) until re-entry into salt water or (b) which shows re-growth on scales.	

*Number to the left of the decimal denotes freshwater life and to the right, life in the sea being spent in freshwater. A number of specimens of each species displayed freshwater life alternating with sea life. If, for instance, a fish spent its first two years in freshwater, its third year in the sea and its fourth year in freshwater, the notation would read 2.1.1+.

Scale length measurements were made with the aid of the above mentioned microprojector. The distance from the center of the focus to the approximate mid-point of the anterior margin of the scale (anterior scale radius) was measured to the nearest 0.5 mm. Body length-scale length relationships were non-linear for both species; also, in most cases, the scatter increased as the length of fish increased. In order to straighten the regressions (weighted) and more evenly distribute the scatter, the formula of Monastyrsky in Tesch (1970) was employed, namely

$$\log_{10}L_f = \log_{10}a + b\ \log_{10}L_s$$

where L_f = fork length in mm, L_s = projected scale length and a and b are constants. Fish length was back-calculated by averaging scale lengths for each year of life (Van Oosten 1953; Wiseman 1969; Tesch 1970) and applying the above equation.

Growth was analysed in terms of absolute and relative growth (Ricker 1975) employing length at time of capture (empirical) and back-calculation data. Growth was expressed in terms of total age (i.e. no distinction between freshwater and salt water) and for freshwater and salt water separately.

Where possible, statistical comparisons were made between areas for a given time period and between time periods for a given area for mean length at capture, mean smolt age and slopes (b) and intercepts (a) of the weighted length-weight and body length-scale length regressions. The t test was used when two means were involved and one way analysis of variance for greater than two. The t test was also used for differences between two slopes or intercepts and analysis of covariance for greater than two. In the event that a significant F value was found in either analysis of variance or covariance, the Newman Keuls multiple range test was used to determine where the differences were. All statistical analyses followed Zar (1974). In tables to follow, one (*) two (**) or three (***) asterisks corresponding to a statistical test value denotes significance at $P < 0.05$, $P < 0.01$, and $P < 0.001$ respectively; NS means the test is not significant ($P > 0.05$).

Annual survival rate between age groups was determined according to the formula:

$$S = \frac{N_{t+1}}{N_t}$$

in Ricker (1975) where S is the estimate of the survival rate from age t to t + 1; N = number of fish.

Mean annual survival rate (of all age groups) was calculated according to Jackson's formula in Ricker (1958), namely

$$S = \frac{N_2 + N_3 + N_4 + \dots\dots\dots + N_r}{N_1 + N_2 + N_3 + \dots\dots\dots + N_{r-1}}$$

where S = mean annual survival and N = number of fish in each group.

RESULTS

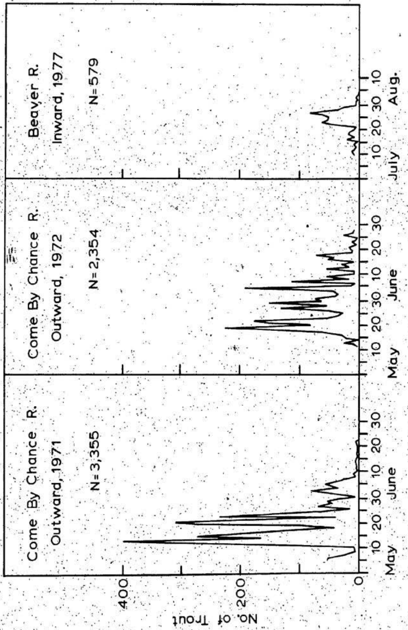
Movements and Marking Studies

Salvelinus fontinalis

Outward movements occurred during the spring. For reasons to be discussed later, it is assumed that the major part of the runs for 1976 and 1977 on North Harbour River, S.M.B. had already gone to sea prior to commencement of sampling (May 10 and April 13 respectively). Gear emplacement on Southeast River (April 18) and Beaver River (April 23) preceeded any substantial movement. A few specimens were encountered daily until around mid-May, but from that point on, numbers rose steadily to a maximum of 86 on May 26 for Southeast River and 92 on May 27 for Beaver River. Opening of the angling season and vandalism forced gear removal before the extent of these runs could be assessed. A subsequent set of fyke traps in Connaughtmans Pond on Southeast River revealed very few sea-trout present after the first week in June. Lake sets, however, give little information as to the direction of movement and this is an important consideration with respect to Northeast River. The movement here was assumed to be outward based on the time of year and the direction of movement in the other rivers. Outward runs for Come By Chance River in 1971 and 1972 (counting fence data) are presented in Fig. 10. These runs lasted from early May to late June with total counts of 3,355 and 2,354 for 1971 and 1972 respectively. Greatest movement for both years occurred more or less during the last two weeks in May (the peak was May 13 in 1971 and May 19 in 1972).

Inward movements were observed in July. Extremely low water levels and high temperatures on North Harbour River, S.M.B. during the first half of July in both 1976 and 1977 may have caused many to remain at sea

Fig. 10. Daily counts of outward migrants on Come By Chance River in 1971 and 1972 and inward migrants on Beaver River in 1977 (Salvelinus fontinalis).


Come By Chance R.
Outward, 1971
N=3,355
Come By Chance R.
Outward, 1972
N=2,354
Beaver R.
Inward, 1977
N=579
No. of Trout
400
200
0
10 20 30 10 20 30
May June
10 20 30 10 20 30
May June
10 20 30 10
July Aug.

and await more favorable conditions. In 1976, this period ended abruptly when heavy rain and flooding washed away the trap causing sampling to end prematurely. In 1977, similar flooding did not dislodge the gear; however, water broke over the leader and wing for several days probably allowing many fish to escape. The only inward movement sampled intact in 1977 was that of Beaver River (Fig. 10). A total of 579 fish were counted with the peak occurring on July 27. As can be seen in Table 1, brook trout were present in Northeast and Southeast Arms of Placentia during spring, summer and fall. They were present in both Arms before substantial outward movements began on Southeast River, Northeast River and Beaver River in 1977. No sampling was done during the winter months; however, Federal Fisheries Conservation and Protection personnel in the area report fish being caught through the ice in Southeast Arm in mid-winter.

Of the 304 fish tagged on North Harbour River, S.M.B. during the outward movement in 1976, 53 (17.43%) were angled from May 24 (opening of angling season) through the month of June. Most of these were taken during the first week of angling below head of tide; 16 (5.26%) were recaptured during the inward run in sampling gear. Out of 364 tagged during the inward run in 1976, 114 (31.32%) were angled in pools upriver from the point of release during the last two weeks of July. Some tagged fish from the 1976 inward movement were recovered in sampling gear in 1977 (3 in the outward run and 6 in the inward run); 6 recoveries were made by anglers (4 during the inward run in 1977 and 2 in Soldiers Pond in the winter of 1979) and 2 were caught in a herring net in adjacent Colinet Harbour in June 1978. No recoveries were made from the outward run of 1976 subsequent to July of that year. Two specimens (9.52%) out of 21 outgoing marked fish on North Harbour River, S.M.B. in 1977 were recaptured in the inward run of that year (sampling gear).

Recoveries of fin clipped fish on Southeast River and Beaver River revealed some straying between these two tributaries. A single specimen from Southeast River was recovered in sampling gear on Beaver River and vice versa; 3 fish bearing the Beaver River code were angled in September 1977 in a pond on Southeast River. Recovery rate during the inward run in 1977 of fish marked in the outward run on Beaver River was 18.38% (68 out of 370); none of the outgoing 156 marked fish on Southeast River were recaptured in sampling gear on that river which may have been due to the relatively small inward sample taken. None of the clipped fish from Northeast River, Southeast River and Beaver River were taken in sampling gear in Northeast and Southeast Arms.

The sojourn at sea for North Harbour River, S.M.B. fish as determined by tagging lasted from 47 to 65 days. For Beaver River, the first returns of fish clipped from May 21 to May 30 began to appear on July 12 and continued until August 1.

Salmo trutta

Outward and inward movements of brown trout occurred simultaneously with brook trout in both years of sampling on North Harbour River, S.M.B. Whereas no brook trout were taken after July, brown trout were still running inward when sampling ended in September of 1976 and August of 1977. A substantially larger number of specimens were encountered in July of 1977 compared with 1976; no sampling was done in August of the latter year.

Brown trout were present in Northeast Arm, Placentia throughout most of the year (winter not sampled). Only a single specimen was captured in adjoining Southeast Arm and that was on July 15, 1976. The species was encountered in Colinet Habour in spring and summer (the only times sampled).

A total of 101 outward moving brown trout were tagged and released at the same time as brook trout on North Harbour River, S.M.B. in 1976. In contrast to brook trout, none were angled during the outward migration period. Six tagged fish (5.94%) were recovered in sampling gear in the inward run of 1976 and 1 was angled in September of that year. Duration at sea as determined from the few tags recovered ranged from 54 to 127 days. No tagged fish were recaptured subsequent to 1976.

Size Composition

Savelinus fontinalis

Length frequency distributions and corresponding overall mean lengths for sexes separate and the combined category (which also includes unsexed fish) are shown in Figs. 11-14 and Appendix 1a-k. Distributions were essentially unimodal and positively skewed. Overall mean length of inward runs was greater than that of corresponding outward runs and modes were shifted more to the right for the former. Modes for males and females for a given sample were not necessarily coincident. There were some significant differences in overall mean length between males and females (Appendix 1a-k); spawning females were larger than spawning males on Southeast River while the reverse was true for Come by Chance River and males were also larger during the inward run in 1977 on the latter river. Of the outward runs sampled, Beaver River had the highest overall mean length while Northeast River (1976) and North Harbour River, S.M.B. (1976) were somewhat similar and lowest. Beaver River had the highest mean length during the inward run as well followed by Southeast

Fig. 11. Length frequency distributions and overall mean lengths for Salvelinus fontinalis for outward and inward runs on North Harbour River, S.M.B., Beaver River and Southeast River. C = sexes combined plus unsexed fish (where applicable).

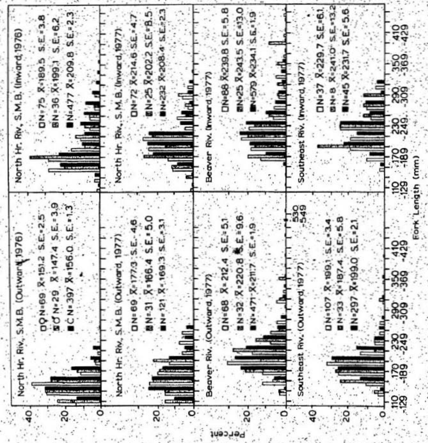

North Hr. Riv., S.M.B. (Outward 1976)
♀ N=69 X̄=151.2 S.E.=2.5
♂ N=29 X̄=147.4 S.E.=3.9
C N=397 X̄=156.0 S.E.=1.3
North Hr. Riv., S.M.B. (Inward, 1976)
N=75 X̄=189.5 S.E.=3.8
N=36 X̄=199.1 S.E.=6.2
N=477 X̄=209.8 S.E.=2.3
North Hr. Riv., S.M.B. (Outward, 1977)
N=69 X̄=177.3 S.E.=4.6
N=31 X̄=186.4 S.E.=5.0
N=121 X̄=169.3 S.E.=3.1
North Hr. Riv., S.M.B. (Inward, 1977)
N=72 X̄=214.6 S.E.=4.7
N=25 X̄=202.2 S.E.=8.5
N=232 X̄=208.4 S.E.=2.3
Beaver Riv. (Outward, 1977)
N=68 X̄=212.4 S.E.=5.1
N=32 X̄=220.8 S.E.=9.6
N=471 X̄=211.7 S.E.=1.9
Beaver Riv. (Inward, 1977)
N=88 X̄=239.8 S.E.=5.8
N=25 X̄=243.5 S.E.=13.0
N=579 X̄=234.1 S.E.=1.9
Southeast Riv. (Outward, 1977)
N=107 X̄=199.1 S.E.=3.4
N=33 X̄=187.4 S.E.=5.8
N=297 X̄=199.0 S.E.=2.1
Southeast Riv. (Inward, 1977)
N=37 X̄=229.7 S.E.=6.1
N=8 X̄=241.0 S.E.=13.2
N=45 X̄=231.7 S.E.=5.6
Percent
Fork Length (mm)
110-129
170-189
230-249
290-309
350-369
410-429
530-549

Fig. 12. Length frequency distributions and overall mean lengths for *Salvelinus fontinalis* for outward runs on Northeast River and inward runs on Come By Chance River and North Harbour River, P.B. C = sexes combined plus unsexed fish (where applicable).

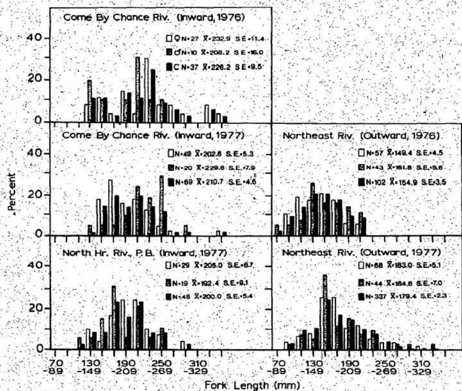
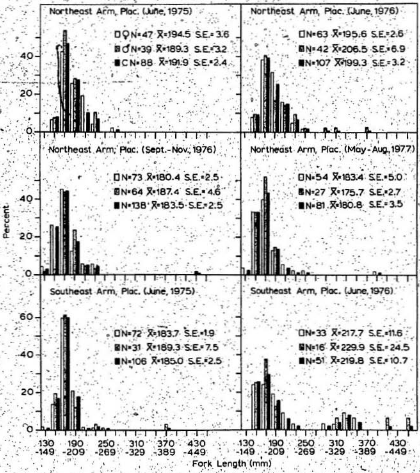
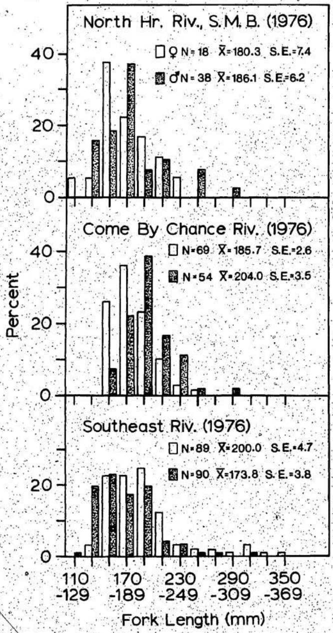

Come By Chance Riv. (Inward, 1976)
♀ N=27 X̄=232.9 S.E.=11.4
♂ N=10 X̄=208.2 S.E.=16.0
C N=37 X̄=226.2 S.E.=9.5
Come By Chance Riv. (Inward, 1977)
N=49 X̄=202.6 S.E.=5.3
N=20 X̄=229.6 S.E.=7.9
N=69 X̄=210.7 S.E.=4.6
Northeast Riv. (Outward, 1976)
N=57 X̄=149.4 S.E.=4.5
N=43 X̄=161.8 S.E.=5.6
N=102 X̄=154.9 S.E.=3.5
North Hr. Riv., P.B. (Inward, 1977)
N=29 X̄=205.0 S.E.=6.7
N=19 X̄=192.4 S.E.=9.1
N=48 X̄=200.0 S.E.=5.4
Northeast Riv. (Outward, 1977)
N=68 X̄=183.0 S.E.=5.1
N=44 X̄=184.8 S.E.=7.0
N=337 X̄=179.4 S.E.=2.3
Percent
0
20
40
70-89
130-149
190-209
250-269
310-329
Fork Length (mm)

Fig. 13. Length frequency distributions and overall mean lengths for Salvelinus fontinalis for samples taken in salt water in Northeast Arm and Southeast Arm, Placentia. C = sexes combined plus unsexed fish (where applicable).



Northeast Arm, Plac. (June, 1975)
♀ N=47 X̄=194.5 S.E.=3.6
♂ N=39 X̄=189.3 S.E.=3.2
C N=88 X̄=191.9 S.E.=2.4
Northeast Arm, Plac. (June, 1976)
N=63 X̄=195.6 S.E.=2.6
N=42 X̄=206.5 S.E.=6.9
N=107 X̄=199.3 S.E.=3.2
Northeast Arm, Plac. (Sept.-Nov., 1976)
N=73 X̄=180.4 S.E.=2.5
N=64 X̄=187.4 S.E.=4.6
N=138 X̄=183.5 S.E.=2.5
Northeast Arm, Plac. (May-Aug. 1977)
N=54 X̄=183.4 S.E.=5.0
N=27 X̄=175.7 S.E.=2.7
N=81 X̄=180.8 S.E.=3.5
Southeast Arm, Plac. (June, 1975)
N=72 X̄=183.7 S.E.=1.9
N=31 X̄=189.3 S.E.=7.5
N=106 X̄=185.0 S.E.=2.5
Southeast Arm, Plac. (June, 1976)
N=33 X̄=217.7 S.E.=11.6
N=16 X̄=229.9 S.E.=24.5
N=51 X̄=219.8 S.E.=10.7
Percent
0
20
40
60
130 -149
190 -209
250 -269
310 -329
370 -389
430 -449
Fork Length (mm)

Fig. 14. Length frequency distributions and overall mean lengths for <u>*Salvelinus fontinalis*</u> spawners for North Harbour River, S.M.B., Come By Chance River and Southeast River.


North Hr. Riv., S.M.B. (1976)
♀ N = 18 X̄ = 180.3 S.E. = 7.4
♂ N = 38 X̄ = 186.1 S.E. = 6.2
Come By Chance Riv. (1976)
N = 69 X̄ = 185.7 S.E. = 2.6
N = 54 X̄ = 204.0 S.E. = 3.5
Southeast Riv. (1976)
N = 89 X̄ = 200.0 S.E. = 4.7
N = 90 X̄ = 173.8 S.E. = 3.8
Percent
40
20
0
110 -129
170 -189
230 -249
290 -309
350 -369
Fork Length (mm)

River with the remainder not being that different from each other. Of those taken in salt water, Southeast Arm, Placentia in June, 1976 had the highest overall mean length.

The range in length in outward runs varied between areas. Northeast River exhibited the smallest specimens followed in ascending order by North Harbour, S.M.B., Southeast River and Beaver River. The size of the smallest specimens during inward runs were not that different from those of outward runs for a given area. The inward runs on North Harbour River, S.M.B. and, to a lesser extent, the inward run on Beaver River contained more large specimens than did corresponding outward runs. The outward run on Northeast River in 1977 had more large fish compared with that of 1976. Some of the largest specimens in this study were taken in salt water (Southeast Arm, Placentia in June 1976). A noticeable feature of samples taken in Northeast and Southeast Arms, Placentia (and some river samples to a lesser extent) was that many of the intervening larger length classes were not represented.

Whole weight distributions and corresponding overall mean weights for sexes separate and the combined category are presented in Tables 3-6. A significant difference in overall mean weight was found only for the inward run on Come By Chance River where males predominated. Essentially the same trends for means, modes and ranges described above for length were also observed for whole weight. The situation with respect to many of the intervening larger class intervals not being represented was much more prominent in the weight distributions.

Table 3. Whole weight distributions (Percent) for Salvelinus fontinalis from North Harbour River, S.H.B. Also included are within sample comparisons of males versus females (t test) for overall mean length. N's are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Weight Class (gm)	North Harbour River, S.H.B.											
	1976 (Outward)			1976 (Inward)			1977 (Outward)			1977 (Inward)		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
0- 19.9	13.04(9)	13.79(4)	10.08(40)				8.70(6)	16.13(5)	11.00(11)			
20- 39.9	62.32(43)	65.52(19)	56.17(223)	10.67(8)	2.78(1)	7.13(34)	37.68(26)	29.03(9)	35.00(35)	- (0)	11.54(3)	3.03(3)
40- 59.9	21.74(15)	20.69(6)	24.18(96)	28.00(21)	27.78(10)	27.26(130)	23.19(16)	25.81(8)	24.00(24)	20.55(15)	19.23(5)	20.20(20)
60- 79.9	1.45(1)	- (0)	5.29(21)	25.33(19)	30.56(11)	16.14(77)	13.04(9)	19.36(6)	15.00(15)	23.29(17)	23.08(6)	23.23(23)
80- 99.9	1.45(1)	- (0)	2.77(11)	14.67(11)	5.56(2)	6.92(33)	5.80(4)	6.45(2)	6.00(6)	10.96(8)	11.54(3)	11.11(11)
100-119.9	- (0)	- (0)	1.01(4)	6.67(5)	5.56(2)	5.24(25)	2.90(2)	3.23(1)	3.00(3)	17.81(13)	11.54(3)	16.16(16)
120-139.9	- (0)	- (0)	- (0)	2.67(2)	8.33(3)	4.19(20)	1.45(1)	- (0)	1.00(1)	5.48(4)	7.69(2)	6.06(6)
140-159.9	- (0)	- (0)	0.50(2)	2.67(2)	5.56(2)	4.40(21)	5.80(4)	- (0)	4.00(4)	- (0)	- (0)	- (0)
160-179.9				2.67(2)	- (0)	4.82(23)	1.45(1)	- (0)	1.00(1)	5.48(4)	3.85(1)	5.05(5)
180-199.9				1.33(1)	2.78(1)	4.82(23)				2.74(2)	- (0)	2.02(2)
200-219.9				1.33(1)	5.56(2)	3.77(18)				2.74(2)	- (0)	2.02(2)
220-239.9				1.33(1)	- (0)	2.10(10)				1.37(1)	- (0)	1.01(1)
240-259.9				1.33(1)	- (0)	2.31(11)				1.37(1)	3.85(1)	2.02(2)
260-279.9				- (0)	2.78(1)	1.89(9)				- (0)	- (0)	- (0)
280-299.9				1.33(1)	- (0)	2.31(11)				- (0)	- (0)	- (0)
300-319.9				- (0)	- (0)	1.68(8)				1.37(1)	3.85(1)	2.02(2)
320-339.9				- (0)	- (0)	1.47(7)				1.37(1)	- (0)	1.01(1)
340-359.9				- (0)	2.78(1)	0.63(3)				1.37(1)	- (0)	1.01(1)
360-379.9				- (0)	- (0)	1.26(6)				- (0)	3.85(1)	1.01(1)
380-399.9				- (0)	- (0)	0.21(1)				1.37(1)	- (0)	1.01(1)
400-419.9				- (0)	- (0)	0.63(3)				- (0)	- (0)	- (0)
420-439.9				- (0)	- (0)	0.84(4)				- (0)	- (0)	- (0)
440-459.9				- (0)	- (0)	- (0)				1.37(1)	- (0)	1.01(1)
460-479.9				- (0)	- (0)	0.21(1)				1.37(1)	- (0)	1.01(1)
480-499.9				- (0)	- (0)	0.21(1)						
500-519.9				- (0)	- (0)	0.63(3)						
560-579.9				- (0)	- (0)	0.21(1)						
600-619.9				- (0)	- (0)	0.21(1)						
700-719.9				- (0)	- (0)	0.21(1)						
860-879.9				- (0)	- (0)	0.21(1)						
TOTALS	100(69)	100(29)	100(397)	100(75)	100(36)	100(477)	100(69)	100(31)	100(100)	100(73)	100(26)	100(99)
$\bar{X}$	33.6	30.7	37.9	83.1	101.4	130.4	55.2	46.6	52.5	121.9	104.5	117.3
S.E.	1.55	2.17	0.96	6.03	11.68	5.09	4.39	4.39	3.34	10.95	16.82	9.20
t	1.0786 N.S.			1.3729 N.S.			1.3893 N.S.			0.8634 N.S.		

Table 4. Whole weight distributions (percent) for Salvelinus fontinalis from Beaver River and Southeast River. Also included are within sample comparisons of males versus females (t test) for overall mean weight. N's are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Weight Class (gm)	BEAVER RIVER						SOUTHEAST RIVER					
	1977 (Outward)			1977 (Inward)			1977 (Outward)			1977 (Inward)		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
20- 39.9	7.35(5)	3.13(1)	6.00(6)				7.48(8)	12.12(4)	8.57(12)			
40- 59.9	16.18(11)	18.75(6)	17.00(17)	6.82(6)	16.00(4)	8.85(10)	19.63(21)	42.42(14)	25.00(35)	8.11(3)	- (0)	6.67(3)
60- 79.9	23.53(16)	15.63(5)	21.00(21)	13.64(12)	12.00(3)	13.27(15)	29.91(32)	21.21(7)	27.86(39)	13.51(5)	12.50(1)	13.33(6)
80- 99.9	22.06(15)	18.75(6)	21.00(21)	20.46(18)	4.00(1)	16.81(19)	22.43(24)	6.06(2)	18.57(26)	18.92(7)	12.50(1)	17.78(8)
100-119.9	7.35(5)	18.75(6)	11.00(11)	11.36(10)	24.00(6)	14.16(16)	7.48(8)	9.09(3)	7.86(11)	5.41(2)	12.50(1)	6.67(3)
120-139.9	4.41(3)	12.50(4)	7.00(7)	12.50(11)	- (0)	9.74(11)	1.87(2)	6.06(2)	2.86(4)	5.41(2)	12.50(1)	6.67(3)
140-159.9	4.41(3)	- (0)	3.00(3)	4.55(4)	8.00(2)	5.31(6)	3.74(4)	- (0)	2.86(4)	16.22(6)	12.50(1)	15.56(7)
160-179.9	2.94(2)	3.13(1)	3.00(3)	6.82(6)	8.00(2)	7.08(8)	1.87(2)	- (0)	1.43(2)	8.11(3)	- (0)	6.67(3)
180-199.9	2.94(2)	- (0)	2.00(2)	1.14(1)	- (0)	0.89(1)	0.93(1)	- (0)	0.71(1)	2.70(1)	- (0)	2.22(1)
200-219.9	1.47(1)	- (0)	1.00(1)	2.27(2)	8.00(2)	3.54(4)	0.93(1)	- (0)	0.71(1)	5.41(2)	- (0)	4.44(2)
220-239.9	1.47(1)	- (0)	1.00(1)	2.27(2)	- (0)	1.77(2)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
240-259.9	1.47(1)	- (0)	1.00(1)	2.27(2)	- (0)	1.77(2)	0.93(1)	- (0)	0.71(1)	8.11(3)	12.50(1)	8.89(4)
260-279.9	1.47(1)	- (0)	1.00(1)	1.14(1)	- (0)	0.89(1)	0.93(1)	- (0)	0.71(1)	- (0)	12.50(1)	2.22(1)
280-299.9	1.47(1)	- (0)	1.00(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
300-319.9	- (0)	3.13(1)	1.00(1)	1.14(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
320-339.9	- (0)	- (0)	- (0)	- (0)	4.00(1)	0.89(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
340-359.9	- (0)	- (0)	- (0)	1.14(1)	4.00(1)	1.77(2)	- (0)	- (0)	- (0)	2.70(1)	- (0)	2.22(1)
380-399.9	1.47(1)	- (0)	1.00(1)	1.14(1)	- (0)	0.89(1)	- (0)	3.03(1)	0.71(1)	- (0)	12.50(1)	2.22(1)
400-419.9	- (0)	- (0)	- (0)	1.14(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
420-439.9	- (0)	3.13(1)	1.00(1)	1.14(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)	2.70(1)	- (0)	2.22(1)
440-459.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	2.70(1)	- (0)	2.22(1)
480-499.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	0.93(1)	- (0)	0.71(1)			
520-539.9	- (0)	- (0)	- (0)	2.27(2)	- (0)	1.77(2)	- (0)	- (0)	- (0)			
560-579.9	- (0)	- (0)	- (0)	1.14(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)			
600-619.9	- (0)	3.13(1)	1.00(1)	1.14(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)			
640-659.9				1.14(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)			
680-699.9				- (0)	4.00(1)	0.89(1)	0.93(1)	- (0)	0.71(1)			
780-799.9				1.14(1)	- (0)	0.89(1)						
920-939.9				- (0)	4.00(1)	0.89(1)						
940-959.9				- (0)	4.00(1)	0.89(1)						
980-999.9				1.14(1)	- (0)	0.89(1)						
1120-1139.9				1.14(1)	- (0)	0.89(1)						
TOTALS	100(68)	100(32)	100(100)	100(88)	100(25)	100(113)	100(107)	100(3)	100(140)	100(37)	100(8)	100(45)
$\bar{x}$	101.5	122.2	108.1	187.1	218.7	194.1	91.5	76.3	87.9	150.0	182.3	155.7
S.E.	8.14	20.76	8.64	21.19	51.31	19.95	7.87	10.97	6.55	15.92	40.00	14.80
t	0.9250 N.S.			0.5689 N.S.			1.1275 N.S.			0.7513 N.S.		

Table 5. Whole weight distributions(Percent) for *Salvelinus fontinalis* from Northeast River, Come by Chance River and North Harbour River, P.B. Also included are within sample comparisons of males versus females (t test) for overall mean weight. N's are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Weight Class (gm)	Northeast River						Come by Chance River						North Harbour River, P.B.		
	1976 (Outward)			1977 (Outward)			1976 (Inward)			1977 (Inward)			1977 (Inward)		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
0- 19.9	19.30(11)	9.30(4)	14.71(15)	2.94(2)	2.27(1)	2.68(3)									
20- 39.9	28.07(16)	32.56(14)	29.41(30)	17.65(12)	15.91(7)	16.96(19)	11.11(3)	20.00(2)	13.51(5)	8.16(4)	4.76(1)	7.14(5)	10.35(3)	15.79(3)	12.50(6)
40- 59.9	26.32(15)	16.28(7)	22.55(23)	30.88(21)	34.09(15)	32.14(36)	7.41(2)	10.00(1)	8.11(3)	24.49(12)	4.76(1)	18.57(13)	17.24(5)	21.05(4)	18.75(9)
60- 79.9	17.54(10)	16.28(7)	17.65(18)	19.12(13)	11.36(5)	16.03(18)	7.41(2)	- (0)	5.41(2)	16.33(8)	9.52(2)	14.29(10)	10.35(3)	21.05(4)	14.58(7)
80- 99.9	3.51(2)	11.63(5)	6.86(7)	8.82(6)	13.64(6)	10.71(12)	7.41(2)	20.00(2)	10.81(4)	22.45(11)	9.52(2)	18.57(13)	24.14(7)	5.26(1)	16.67(8)
100-119.9	- (0)	9.30(4)	3.92(4)	5.88(4)	6.82(3)	6.25(7)	3.70(1)	10.00(1)	5.41(2)	10.20(5)	14.29(3)	11.43(8)	10.35(3)	15.79(3)	12.50(6)
120-139.9	3.51(2)	4.65(2)	3.92(4)	2.94(2)	2.27(1)	2.68(3)	3.70(1)	10.00(1)	5.41(2)	6.12(3)	9.52(2)	7.14(5)	6.90(2)	5.26(1)	6.25(3)
140-159.9	1.75(1)	- (0)	0.98(1)	4.41(3)	4.55(2)	4.46(5)	11.11(3)	- (0)	8.11(3)	4.08(2)	19.05(4)	8.57(6)	6.90(2)	5.26(1)	6.25(3)
160-179.9				- (0)	2.27(1)	0.89(1)	14.82(4)	10.00(1)	13.51(5)	2.04(1)	14.29(3)	5.71(4)	10.35(3)	- (0)	6.25(3)
180-199.9				- (0)	- (0)	- (0)	3.70(1)	10.00(1)	5.41(2)	2.04(1)	9.52(2)	4.29(3)	- (0)	- (0)	- (0)
200-219.9				2.94(2)	- (0)	1.79(2)	3.70(1)	- (0)	2.70(1)	- (0)	- (0)	- (0)	- (0)	5.26(1)	2.08(1)
220-239.9				- (0)	- (0)	- (0)	3.70(1)	- (0)	2.70(1)	- (0)	- (0)	- (0)	- (0)	5.26(1)	2.08(1)
240-259.9				1.47(1)	4.55(2)	2.68(3)	- (0)	- (0)	- (0)	2.04(1)	- (0)	1.43(1)	- (0)	- (0)	- (0)
260-279.9				- (0)	- (0)	- (0)	7.41(2)	- (0)	5.41(2)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
280-299.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	3.45(1)	- (0)	2.08(1)
300-319.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	4.76(1)	1.43(1)			
320-339.9				1.47(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)			
340-359.9				- (0)	- (0)	- (0)	3.70(1)	10.00(1)	5.41(2)	- (0)	- (0)	- (0)			
380-399.9				1.47(1)	- (0)	0.89(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)			
400-419.9				- (0)	- (0)	- (0)	3.70(1)	- (0)	2.70(1)	- (0)	- (0)	- (0)			
440-459.9				- (0)	- (0)	- (0)	3.70(1)	- (0)	2.70(1)	- (0)	- (0)	- (0)			
540-559.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	2.04(1)	- (0)	1.43(1)			
560-579.9				- (0)	2.27(1)	0.89(1)	- (0)	- (0)	- (0)						
640-659.9							3.70(1)	- (0)	2.70(1)						
TOTALS	100(57)	100(43)	100(102)	100(68)	100(44)	100(102)	100(27)	100(10)	100(37)	100(49)	100(21)	100(40)	100(29)	100(19)	100(48)
$\bar{X}$	45.8	57.6	50.9	78.7	86.0	81.5	180.4	125.6	165.6	95.8	132.9	106.9	98.8	88.4	94.6
S.E.	4.02	5.14	3.16	8.16	13.94	7.36	28.05	30.07	22.19	11.23	13.28	8.99	10.42	13.12	8.11
t	1.8067 N.S.			0.4518 N.S.			1.3334 N.S.			2.1315*			0.6193 N.S.		

Table 6. Whole weight distributions (percent) for *Salvelinus fontinalis* from Northeast Arm and Southeast Arm, Placentia. Also included are within sample comparisons of males versus females (t test) for overall mean weight. N's are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Weight Class (gm)	NORTHEAST ARM - PLACENTIA											
	June 1975			June 1976			Sept - Nov., 1976			May - August 1977		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
20- 39.9	2.13(1)	- (0)	1.14(1)	- (0)	- (0)	0.93(1)	5.48(4)	3.13(2)	4.35(6)	5.56(3)	- (0)	3.70(3)
40- 59.9	48.94(23)	56.41(22)	52.27(46)	25.40(16)	45.24(19)	33.65(36)	52.06(38)	43.75(28)	48.55(67)	53.70(29)	66.67(18)	58.03(47)
60- 79.9	21.28(10)	33.33(13)	27.27(24)	42.86(27)	19.05(8)	32.71(35)	27.40(20)	39.06(25)	32.61(45)	25.93(14)	25.93(7)	25.93(21)
80- 99.9	8.51(4)	- (0)	4.55(4)	14.29(9)	4.76(2)	10.28(11)	4.11(3)	6.25(4)	5.07(7)	7.41(4)	3.70(1)	6.17(5)
100-119.9	12.77(6)	2.56(1)	7.96(7)	9.52(6)	11.91(5)	10.28(11)	5.48(4)	1.56(1)	3.62(5)	1.85(1)	3.70(1)	2.47(2)
120-139.9	2.13(1)	2.56(1)	2.27(2)	6.35(4)	7.14(3)	6.54(7)	5.48(4)	4.69(3)	5.07(7)	1.85(1)	- (0)	1.24(1)
140-159.9	2.13(1)	5.13(2)	3.41(3)	- (0)	4.76(2)	1.87(2)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
160-179.9	- (0)	- (0)	- (0)	1.59(1)	- (0)	0.93(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
180-199.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	1.85(1)	- (0)	1.24(1)
300-319.9	2.13(1)	- (0)	1.14(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
320-339.9				- (0)	2.38(1)	0.93(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
340-359.9				- (0)	2.38(1)	0.93(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
400-419.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
420-439.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
480-499.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
520-539.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
560-579.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
640-659.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
680-699.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
820-839.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	1.85(1)	- (0)	1.24(1)
840-859.9				- (0)	- (0)	- (0)	- (0)	- (0)	- (0)			
860-879.9				- (0)	2.38(1)	0.93(1)	- (0)	- (0)	- (0)			
960-979.9							- (0)	1.56(1)	0.73(1)			
1340-1359.9												
1560-1579.9												
TOTALS	100(47)	100(39)	100(88)	100(63)	100(42)	100(107)	100(73)	100(64)	100(138)	100(54)	100(27)	100(81)
$\bar{x}$	74.4	64.5	69.5	76.1	108.6	88.4	63.5	78.7	70.4	75.6	57.4	69.5
S.E.	6.54	3.94	3.93	3.32	20.99	8.56	2.65	14.25	6.76	14.64	2.66	9.82
t	1.2988 N.S.			1.4907			1.0536 N.S.			1.2252 N.S.		

continued

Table 6 (Continued)

Weight Class (gm)	SOUTHEAST ARM PLACENTIA					
	June 1975			June 1976		
	♀	♂	C	♀	♂	C
20- 39.9	4.17(3)	- (0)	3.74(4)			
40- 59.9	70.83(51)	77.42(24)	72.90(77)	39.39(13)	50.00(8)	43.14(22)
60- 79.9	20.83(15)	16.13(5)	18.69(20)	27.27(9)	25.00(11)	27.45(14)
80- 99.9	- (0)	- (0)	- (0)	9.09(3)	- (0)	5.88(3)
100-119.9	2.78(2)	- (0)	1.87(2)	- (0)	- (0)	- (0)
120-139.9	- (0)	3.23(1)	0.94(1)	- (0)	- (0)	- (0)
140-159.9	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.96(1)
160-179.9	1.39(1)	- (0)	0.94(1)	- (0)	- (0)	- (0)
180-199.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
300-139.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
320-339.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
340-359.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
400-419.9	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.96(1)
420-439.9	- (0)	- (0)	- (0)	3.03(1)	6.25(1)	3.92(2)
480-499.9	- (0)	- (0)	- (0)	3.03(1)	6.25(1)	3.92(2)
320-539.9	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.96(1)
560-579.9	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.96(1)
640-659.9	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.96(1)
680-699.9	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.96(1)
820-839.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
840-859.9	- (0)	3.23(1)	0.94(1)	- (0)	- (0)	- (0)
860-879.9						
960-979.9						
1340-1359.9				- (0)	6.25(1)	1.96(1)
1560-1579.9				- (0)	6.25(1)	1.96(1)
TOTALS	100(72)	100(31)	100(106)	100(33)	100(16)	100(51)
$\bar{x}$	56.0	81.1	63.0	166.2	284.1	198.9
S.E.	2.09	25.97	7.65	35.25	120.84	44.32
t	0.9637 N.S.			0.9367 N.S.		

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Salmo trutta

Length frequency distributions (Figs. 15-17 and Appendix 2a-e) were for the most part unimodal and positively skewed (except for spawners which had no well-definable modes). Mean overall length (Appendix 2a-e) was significantly higher in favor of females for Colinet River, spawners and both inward runs on North Harbour River, S.M.B.; there was no significant difference between males and females in Northeast Arm, Placentia. The same observations made above for brook trout with respect to means, modes and ranges of outward versus inward runs on North Harbour River, S.M.B. apply to brown trout. The largest specimen was taken in Colinet River.

Trends in whole weight distributions (Tables 7-8) closely followed those of length. Significant differences between males and females occurred in the same instances as above for length.

Length-Weight Relationships

Salvelinus fontinalis

The log-log regressions of weight on length for all samples as well as within sample comparison of males versus females for slopes and intercepts are presented in Table 9. Significant differences between males and females occurred in a few instances for slopes while for intercepts considerable variation was noted. Neither sex showed a consistent advantage.

Slopes of inward migrants were higher than those of outward migrants in all cases (Appendix 3a). The differences were significant for Beaver River for sexes separate and the combined category while the reverse was true for Southeast River; for North Harbour River, S.M.B., differences

Fig. 15. Length frequency distributions and overall mean lengths for *Salmo trutta* for outward and inward runs on North Harbour River, S.M.B. C = sexes combined plus unsexed fish (where applicable).

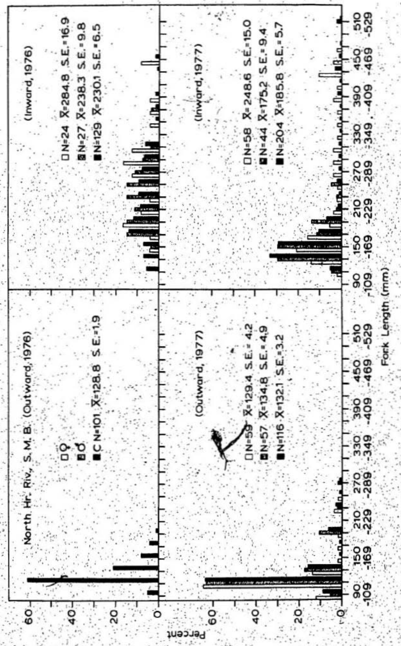
North Hr. Riv., S.M.B. (Outward, 1976)
♀
♂
C N=101 X̄=128.8 S.E.=1.9
(Inward, 1976)
N=24 X̄=284.8 S.E.=16.9
N=27 X̄=238.3 S.E.=9.8
N=129 X̄=230.1 S.E.=6.5
(Outward, 1977)
N=59 X̄=129.4 S.E.=4.2
N=57 X̄=134.8 S.E.=4.9
N=116 X̄=132.1 S.E.=3.2
(Inward, 1977)
N=58 X̄=248.6 S.E.=15.0
N=44 X̄=175.2 S.E.=9.4
N=204 X̄=185.8 S.E.=5.7
Percent
60
40
20
0
90-109
150-169
210-229
270-289
330-349
390-409
450-469
510-529
Fork Length (mm)

Fig. 16. Length frequency distributions and overall mean lengths for *Salmo trutta* for Northeast Arm, Placentia and Colinet Harbour and River. C = sexes combined plus unsexed fish (where applicable).

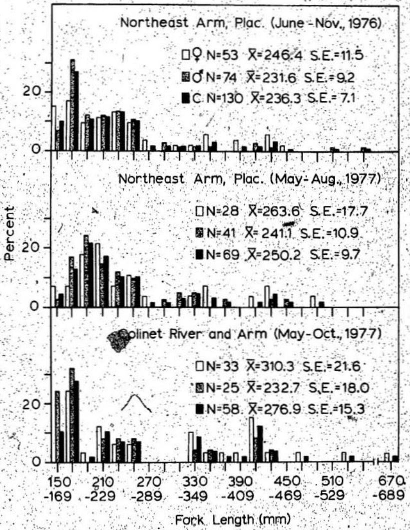
Northeast Arm, Plac. (June-Nov., 1976)
♀ N=53 X̄=246.4 S.E.=11.5
♂ N=74 X̄=231.6 S.E.=9.2
C. N=130 X̄=236.3 S.E.=7.1
Northeast Arm, Plac. (May-Aug., 1977)
N=28 X̄=263.6 S.E.=17.7
N=41 X̄=241.1 S.E.=10.9
N=69 X̄=250.2 S.E.=9.7
Colinet River and Arm (May-Oct., 1977)
N=33 X̄=310.3 S.E.=21.6
N=25 X̄=232.7 S.E.=18.0
N=58 X̄=276.9 S.E.=15.3
Percent
20
0
150 -169
210 -229
270 -289
330 -349
390 -409
450 -469
510 -529
670 -689
Fork Length (mm)

Fig. 17. Length frequency distribution and overall mean length for Salmo trutta male and female spawners. Sample is comprised of specimens from all areas and years combined.

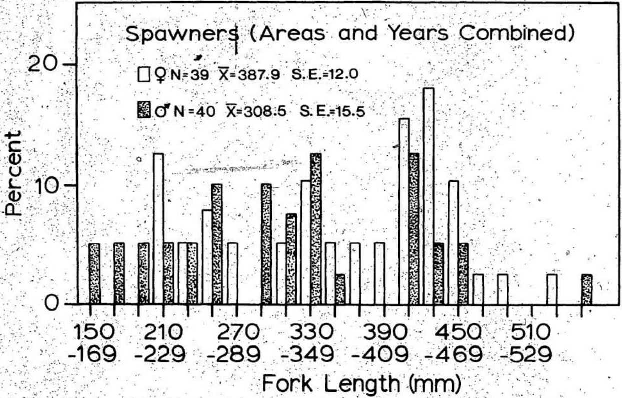
Spawners (Areas and Years Combined)
♀ N=39 X̄=387.9 S.E.=12.0
♂ N=40 X̄=308.5 S.E.=15.5
Percent
20
10
0
150 -169
210 -229
270 -289
330 -349
390 -409
450 -469
510 -529
Fork Length (mm)

Table 7. Whole weight distributions (percent) for Salmo trutta from North Harbour River, S.M.B. Also included are within sample comparisons of males versus females (t test) for overall mean weight. N's are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Weight Class (gm)	North Harbour River, S.M.B. 1976 (Outward) ♀	1976 (Outward) ♂	1976 (Outward) c	1976 (Inward) ♀	1976 (Inward) ♂	1976 (Inward) c	1977 (Outward) ♀	1977 (Outward) ♂	1977 (Outward) c	1977 (Inward) ♀	1977 (Inward) ♂	1977 (Inward) c
0- 19.9	-	-	44.55(45)	- (0)	- (0)	2.33(3)	55.93(33)	54.39(31)	55.17(64)	1.72(1)	4.55(2)	2.94(3)
20- 39.9	-	-	47.53(48)	- (0)	- (0)	13.18(17)	33.90(20)	31.58(18)	32.76(38)	22.41(13)	40.91(18)	30.39(31)
40- 59.9	-	-	5.94(6)	4.17(1)	14.82(4)	11.63(15)	3.39(2)	- (0)	1.72(2)	18.97(11)	25.00(11)	21.57(22)
60- 79.9	-	-	1.98(2)	12.50(3)	11.11(3)	10.08(13)	1.70(1)	3.51(2)	2.59(3)	10.35(6)	13.64(6)	11.77(12)
80- 99.9				8.33(2)	11.11(3)	8.53(11)	- (0)	7.02(4)	3.45(4)	3.45(2)	4.55(2)	3.92(4)
100- 119.9				8.33(2)	14.82(4)	9.30(12)	- (0)	- (0)	- (0)	3.45(2)	2.27(1)	2.94(3)
120- 139.9				4.17(1)	3.70(1)	3.88(5)	3.39(2)	1.75(1)	2.59(3)	1.72(1)	- (0)	0.98(1)
140- 159.9				- (0)	- (0)	3.10(4)	- (0)	- (0)	- (0)	1.72(1)	4.55(2)	2.94(3)
160- 179.9				- (0)	14.82(4)	6.20(8)	1.70(1)	- (0)	0.86(1)	- (0)	2.27(1)	0.98(1)
180- 199.9				4.17(1)	7.41(2)	4.65(6)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
200- 219.9				8.33(2)	3.70(1)	4.65(6)	- (0)	1.75(1)	0.86(1)	- (0)	- (0)	- (0)
220- 239.9				4.17(1)	7.41(2)	3.10(4)				3.45(2)	- (0)	1.96(2)
240- 259.9				- (0)	- (0)	1.55(2)				1.72(1)	- (0)	0.98(1)
260- 279.9				4.17(1)	- (0)	1.55(2)				- (0)	- (0)	- (0)
280- 299.9				8.33(2)	- (0)	3.10(4)				3.45(2)	- (0)	1.96(2)
300- 319.9				8.33(2)	- (0)	1.55(2)				- (0)	- (0)	- (0)
320- 339.9				- (0)	3.70(1)	3.10(4)				- (0)	- (0)	- (0)
340- 359.9				4.17(1)	3.70(1)	1.55(2)				- (0)	- (0)	- (0)
360- 379.9				- (0)	- (0)	- (0)				3.45(2)	- (0)	1.96(2)
420- 439.9				4.17(1)	- (0)	0.78(1)				- (0)	- (0)	- (0)
500- 519.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.98(1)
520- 539.9				- (0)	3.70(1)	1.55(2)				1.72(1)	- (0)	0.98(1)
540- 559.9				4.17(1)	- (0)	0.78(1)				- (0)	- (0)	- (0)
700- 719.9				4.17(1)	- (0)	0.78(1)				1.72(1)	- (0)	0.98(1)
720- 739.9				- (0)	- (0)	0.78(1)				1.72(1)	- (0)	0.98(1)
780- 799.9				- (0)	- (0)	0.78(1)				- (0)	- (0)	- (0)
800- 819.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.98(1)
840- 859.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.98(1)
880- 899.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.98(1)
900- 919.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.98(1)
920- 939.9				- (0)	- (0)	- (0)				3.45(2)	- (0)	1.96(2)
980- 999.9				4.17(1)	- (0)	0.78(1)				- (0)	- (0)	- (0)
1000-1019.9				- (0)	- (0)	- (0)				3.45(2)	- (0)	1.96(2)
1060-1079.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.98(1)
1160-1179.9				- (0)	- (0)	- (0)				1.72(1)	- (0)	0.93(1)
1180-1199.9				4.17(1)	- (0)	0.78(1)				- (0)	- (0)	- (0)
1560-1579.9										- (0)	2.27(1)	0.98(1)
TOTALS	-	-	100(101)	100(24)	100(27)	100(129)	100(59)	100(57)	100(116)	100(58)	100(44)	100(102)
$\bar{x}$	-	-	23.9	304.5	156.0	167.8	26.6	30.6	28.6	278.3	87.7	196.1
S.E.	-	-	1.12	59.59	20.89	16.25	3.66	4.56	2.91	46.58	35.86	31.74
t				2.3552*			0.6765 N.S.			3.2762**		

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Table 8. Whole weight distributions (Percent) for *Salmo trutta* from Northeast Arm, Placentia and Colinet River and Harbour. Also included are within sample comparisons of males versus females (t test) for overall mean weight. N's are in parentheses. c = sexes combined plus unsexed fish (where applicable)

Weight Class (gm)	Northeast Arm, Placentia June - November 1976 ♀	♂	c	May - August 1977 ♀	♂	c	Colinet River and Harbour May - October 1977 ♀	♂	c
20- 39.9				3.57(1)	- (0)	1.47(1)	- (0)	4.00(1)	1.72(1)
40- 59.9	20.76(11)	21.62(16)	23.08(30)	3.57(1)	7.50(3)	5.88(4)	9.09(3)	32.00(8)	18.97(11)
60- 79.9	15.09(8)	22.97(17)	19.23(25)	14.29(4)	17.50(7)	16.18(11)	18.18(6)	20.00(5)	18.97(11)
80- 99.9	7.55(4)	8.11(6)	7.69(10)	10.71(3)	17.50(7)	14.71(10)	- (0)	4.00(1)	1.72(1)
100- 119.9	5.66(3)	6.76(5)	6.15(8)	14.29(4)	12.50(5)	13.24(9)	3.03(1)	4.00(1)	3.45(2)
120- 139.9	3.77(2)	8.11(6)	6.15(8)	14.29(4)	12.50(5)	13.24(9)	9.09(3)	- (0)	5.17(3)
140- 159.9	13.21(7)	8.11(6)	10.00(13)	3.57(1)	7.50(3)	5.88(4)	3.03(1)	- (0)	1.72(1)
160- 179.9	3.77(2)	6.76(5)	5.39(7)	7.14(2)	2.50(1)	4.41(3)	3.03(1)	4.00(1)	3.45(2)
180- 199.9	1.89(1)	4.05(3)	3.08(4)	- (0)	- (0)	- (0)	- (0)	8.00(2)	3.45(2)
200- 219.9	3.77(2)	1.35(1)	2.31(3)	3.57(1)	5.00(2)	4.41(3)	6.06(2)	- (0)	3.45(2)
220- 239.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	- (0)	4.00(1)	1.72(1)
240- 259.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
300- 319.9	- (0)	1.35(1)	0.77(1)	- (0)	2.50(1)	1.47(1)	- (0)	- (0)	- (0)
340- 359.9	- (0)	1.35(1)	0.77(1)	- (0)	2.50(1)	1.47(1)	- (0)	- (0)	- (0)
360- 379.9	1.89(1)	- (0)	0.77(1)	- (0)	2.50(1)	1.47(1)	- (0)	4.00(1)	1.72(1)
380- 399.9	3.77(2)	- (0)	1.54(2)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
400- 419.9	- (0)	- (0)	- (0)	3.57(1)	- (0)	1.47(1)	- (0)	- (0)	- (0)
420- 439.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	9.09(3)	- (0)	5.13(3)
440- 459.9	- (0)	1.35(1)	0.77(1)	- (0)	2.50(1)	1.47(1)	- (0)	- (0)	- (0)
460- 479.9	- (0)	- (0)		3.57(1)	2.50(1)	2.94(2)	6.06(2)	- (0)	3.45(2)
500- 519.9	- (0)	- (0)	- (0)	3.57(1)	- (0)	1.47(1)	- (0)	- (0)	- (0)
520- 539.9	- (0)	1.35(1)	0.77(1)	- (0)	- (0)	- (0)	- (0)	4.00(1)	1.72(1)
540- 559.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	6.06(2)	- (0)	3.45(2)
560- 579.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
580- 599.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	- (0)	4.00(1)	1.72(1)
660- 679.9	1.89(1)	1.35(1)	1.54(2)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
680- 699.9	- (0)	- (0)	- (0)	3.57(1)	- (0)	1.47(1)	3.03(1)	- (0)	1.72(1)
700- 719.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.72(1)
740- 759.9	- (0)	- (0)		- (0)	- (0)	- (0)	3.03(1)	- (0)	1.72(1)
760- 779.9	- (0)	- (0)		3.57(1)	- (0)	1.47(1)	3.03(1)	4.00(1)	3.45(2)
840- 859.9	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	4.00(1)	1.72(1)
860- 879.9	- (0)	2.70(2)	1.54(2)	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.72(1)
880- 899.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
900- 919.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	3.03(1)	- (0)	1.72(1)
960- 979.9	- (0)	- (0)	- (0)	3.57(1)	- (0)	1.47(1)	- (0)	- (0)	- (0)
980- 999.9	1.89(1)	- (0)	0.77(1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
1000-1019.9	- (0)	- (0)	- (0)	- (0)	2.50(1)	1.47(1)	- (0)	- (0)	- (0)
1060-1079.9	- (0)	- (0)	- (0)	3.57(1)	- (0)	1.47(1)	- (0)	- (0)	- (0)
1120-1139.9	- (0)	- (0)	- (0)	- (0)	2.50(1)	1.47(1)	- (0)	- (0)	- (0)
1140-1159.9	1.89(1)	- (0)	0.77(1)				- (0)	- (0)	- (0)
1160-1179.9	- (0)	- (0)	- (0)				3.03(1)	- (0)	1.72(1)
1440-1459.9	- (0)	1.35(1)	0.77(1)				- (0)	- (0)	- (0)
1760-1779.9	- (0)	- (0)	- (0)				3.03(1)	- (0)	1.72(1)
1980-1999.9	- (0)	1.35(1)	0.77(1)				- (0)	- (0)	- (0)
3660-3679.9							3.03(1)	- (0)	1.72(1)
TOTALS	100(53)	100(74)	100(130)	100(28)	100(40)	100(68)	100(33)	100(25)	100(58)
$\bar{X}$	226.0	188.2	200.5	256.6	189.7	217.2	496.1	194.4	366.1
S.E.	36.56	35.66	25.19	54.61	36.40	31.06	120.53	47.44	73.76
t	0.8038 N.S.			1.0194 N.S.			2.3287A		

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Table 9. The log-log regression equations of weight on length for each sample of <u>Salvelinus fontinalis</u>. Included also are within sample comparisons of males versus females for slopes and intercepts (t test). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		Regression Equation	t: Slopes (b)	t: Intercepts (a)	r
North Hr. Riv., S.H.B.					
Outward, 1976	♂	log W = 2.5180 log L - 3.9774	1.6140(7)N.S.	46.1934(8)***	0.9968
	♀	log W = 2.3070 log L - 3.5305			0.9991
	C	log W = 2.6640 log L - 4.2834			0.9982
Inward, 1976	♂	log W = 2.8458 log L - 4.5849	2.8288(13)*	—	0.9949
	♀	log W = 3.1459 log L - 5.2699			0.9954
	C	log W = 3.0991 log L - 5.1567			0.9981
Outward, 1977	♂	log W = 2.7950 log L - 4.5920	0.8847(10)N.S.	8.2599(11)***	0.9979
	♀	log W = 2.9391 log L - 4.8709			0.9937
	C	log W = 2.7840 log L - 4.5564			0.9988
Inward, 1977	♂	log W = 3.3706 log L - 5.8274	2.6731(14)*	—	0.9943
	♀	log W = 2.9335 log L - 4.8001			0.9940
	C	log W = 3.0695 log L - 5.1019			0.9939
Beaver Riv.					
Outward, 1977	♂	log W = 2.8371 log L - 4.6344	0.5361(16)N.S.	3.2603(17)**	0.9962
	♀	log W = 2.7738 log L - 4.4659			0.9969
	C	log W = 2.8462 log L - 4.6448			0.9978
Inward, 1977	♂	log W = 3.3490 log L - 5.7874	0.8158(18)N.S.	8.6240(19)***	0.9965
	♀	log W = 3.4746 log L - 6.0827			0.9944
	C	log W = 3.3757 log L - 5.8824			0.9963

continued

Table 9 (Continued)

Southeast Riv.					
Outward, 1977	♀	log W = 3.3321 log L - 5.7374	1.1623(13)N.S.	29.0703(14)***	0.9925
	♂	log W = 3.0904 log L - 5.1869			0.9970
	C	log W = 3.2920 log L - 5.6473			0.9939
Inward, 1977	♀	log W = 3.4154 log L - 5.9316	1.1119(9)N.S.	43.7539(10)***	0.9975
	♂	log W = 3.7470 log L - 6.7021			0.9857
	C	log W = 3.5077 log L - 6.1392			0.9962
Northeast Riv.					
Outward, 1976	♀	log W = 2.8927 log L - 4.6883	2.6560(11)*	—	0.9952
	♂	log W = 2.5130 log L - 3.8266			0.9972
	C	log W = 2.5842 log L - 3.9952			0.9935
Outward, 1977	♀	log W = 2.9269 log L - 4.7684	0.8471(18)N.S.	13.9214(19)***	0.9955
	♂	log W = 3.0566 log L - 5.0789			0.9932
	C	log W = 2.9999 log L - 4.9359			0.9951
Come By Chance Riv.					
Inward, 1976	♀	log W = 3.1755 log L - 5.3411	0.8772(14)N.S.	25.7620(15)***	0.9980
	♂	log W = 3.0437 log L - 5.0319			0.9932
	C	log W = 3.1513 log L - 5.2870			0.9980
Inward, 1977	♀	log W = 3.1757 log L - 5.3949	1.8052(12)N.S.	49.6408(13)***	0.9973
	♂	log W = 2.9182 log L - 4.7808			0.9961
	C	log W = 3.0650 log L - 5.1227			0.9973
North Hr. Riv., P.B.					
Inward, 1977	♀	log W = 2.8408 log L - 4.5994	0.0527(12)N.S.	1.2756(13)N.S.	0.9955
	♂	log W = 2.8936 log L - 4.7111			0.9870
	C	log W = 2.7811 log L - 4.4502			0.9945
Northeast Arm, Plac.					
June, 1975	♀	log W = 3.7164 log L - 6.6597	1.6710(6)N.S.	56.1670(7)***	0.9841
	♂	log W = 2.8133 log L - 4.6060			0.9880
	C	log W = 3.6286 log L - 6.4543			0.9801

continued

Table 9 (Continued)

June, 1976	♀	$\log W = 2.6300 \log L - 4.1348$	1.6132(11)N.S.	48.5222(12)***	0.9899
	♂	$\log W = 3.3013 \log L - 5.6838$			0.9841
	C	$\log W = 3.3104 \log L - 5.7022$			0.9870
Sept.-Nov., 1976	♀	$\log W = 2.4314 \log L - 3.6846$	2.4653(9)*	—	0.9951
	♂	$\log W = 2.9681 \log L - 4.9010$			0.9961
	C	$\log W = 2.9346 \log L - 4.8205$			0.9949
May-Aug., 1977	♀	$\log W = 3.0347 \log L - 5.0557$	0.4467(7)N.S.	25.8709(8)***	0.9877
	♂	$\log W = 2.5662 \log L - 3.9932$			0.9568
	C	$\log W = 3.0320 \log L - 5.0476$			0.9881
Southeast Arm, Plac.					
June, 1975	♀	$\log W = 2.4157 \log L - 3.6819$	2.4323(8)*	—	0.9695
	♂	$\log W = 3.3166 \log L - 5.7369$			0.9917
	C	$\log W = 3.0506 \log L - 5.1121$			0.9814
June, 1976	♀	$\log W = 3.4811 \log L - 6.0854$	0.2041(12)N.S.	8.0441(13)***	0.9900
	♂	$\log W = 3.5264 \log L - 6.1831$			0.9971
	C	$\log W = 3.5714 \log L - 6.2970$			0.9940

were significant for males and combined in 1976 but for females only in 1977. Intercept values were significantly higher for the outward run on every occasion except one (North Harbour River, S.M.B. males in 1977).

Outward slopes and intercepts in 1977 are compared between areas in Appendix 3b. Significant F values for slopes were found for females and combined but not for males. Southeast River had the highest slope values. Intercept values were not significantly different. The outward run on North Harbour River, S.M.B. was compared with that on Northeast River in 1976 (Appendix 3c); slopes were not significantly different for sexes separate and combined while the reverse was true for intercepts.

Inward slopes and intercepts for 1977 are compared between areas in Appendix 3d. Significant F values were found for slopes for sexes separate and combined. In the case of sexes separate, although F values indicated significant differences, the Newman-Keuls test failed to detect them. In any event, Southeast River was highest and North Harbour River, P.B. lowest. With respect to combined samples, Beaver River and Southeast River (not significantly different) were significantly higher than the remaining areas.

Where possible, outward and inward runs were compared between 1976 and 1977 (Appendix 3e). Where slopes differed significantly for North Harbour River, S.M.B. and Northeast River, 1977 values were higher than those of 1976. For Come By Chance River, slope values were not significantly different for the two years. Significantly differing intercepts showed no trend in favor of either year.

Different sampling times in Southeast Arm and Northeast Arm, Placentia are compared in Appendix 3e and Appendix 3f respectively. Northeast and Southeast Arms are compared between June, 1975, and June 1976 in Appendix 3g.

Slope values for samples taken in June in Northeast Arm were higher than those for May-August and September-November.

Comparing a sample taken in Northeast River in June 1976 with one taken at the same time in its estuary, Northeast Arm (Appendix 3c), intercepts differed significantly for females. Slopes differed significantly for males and combined (Northeast Arm highest).

Salmo trutta

The log-log regressions of weight on length and within sample comparison of males versus females for slopes and intercepts are shown in Table 10. Intercept values were significantly different between males and females on every occasion (no consistent advantage for one or the other sex) whereas the reverse was true for slopes.

Comparing outward versus inward runs on North Harbour River, S.M.B. (Appendix 4a), slopes were significantly higher in favor of the inward runs (for the combined sample in 1976 and for females and combined in 1977).

There were no significant differences between 1976 and 1977 for slopes in either outward or inward runs (Appendix 4b); all intercepts were significantly higher in 1976.

There were no significant differences in slopes or intercepts between areas in 1977 for sexes separate and combined (Appendix 4c). Comparisons between North Harbour River, S.M.B. (inward run) and Northeast Arm, Placentia in 1976 revealed significant differences in intercepts for sexes separate and combined but none for slopes (Appendix 4b).

Table 10. The log-log regression equations of weight on length for each sample of *Salmo trutta*. Included also are within sample comparisons of males versus females for slopes and intercepts (t test). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		Regression Equation	t: Slopes (b)	t: Intercepts (a)	r
North Hr. Riv., S.M.B. Outward, 1976	♂	-	-	-	-
	♀	-	-	-	-
	C	log W = 2.5750 log L - 4.0694			0.9972
Inward, 1976	♂	log W = 2.9831 log L - 4.9485	0.0388(18)N.S.	15.2156(19)***	0.9954
	♀	log W = 2.9444 log L - 4.8643			0.9986
	C	log W = 3.0040 log L - 5.0009			0.9987
Outward, 1977	♂	log W = 2.7420 log L - 4.4293	0.3022(10)N.S.	4.3864(11)***	0.9981
	♀	log W = 2.7857 log L - 4.5154			0.9953
	C	log W = 2.8129 log L - 4.5784			0.9975
Inward, 1977	♂	log W = 3.0292 log L - 5.0545	0.0122(24)N.S.	28.5450(25)***	0.9981
	♀	log W = 3.0169 log L - 5.0223			0.9984
	C	log W = 3.0381 log L - 5.0735			0.9985
Northeast Arm, Plac. June-Nov., 1976	♂	log W = 2.9527 log L - 4.8534	0.8105(23)N.S.	22.1828(24)***	0.9982
	♀	log W = 3.0047 log L - 4.9848			0.9991
	C	log W = 2.9913 log L - 4.9533			0.9991
May-Aug., 1977	♂	log W = 2.8309 log L - 4.5792	1.0621(20)N.S.	13.9366(21)***	0.9981
	♀	log W = 2.9475 log L - 4.8308			0.9946
	C	log W = 2.8730 log L - 4.6694			0.9956
Colinet Hr. and Arm May-Oct., 1977	♂	log W = 3.0408 log L - 5.0750	1.1377(19)N.S.	27.5158(20)***	0.9921
	♀	log W = 2.8467 log L - 4.5993			0.9950
	C	log W = 3.0099 log L - 4.9985			0.9934

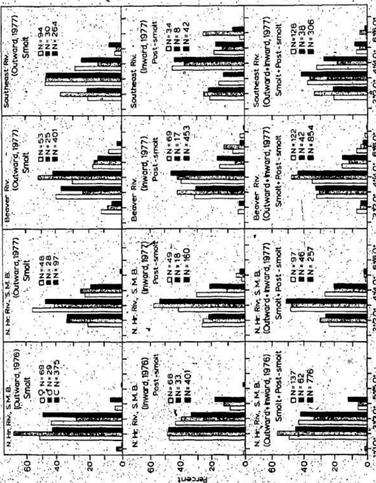
Age Composition and Survival

Salvelinus fontinalis

Age composition data in terms of the smolt/post-smolt portion of each whole sample are presented for all except spawners in Figs. 18-19 and Appendix 1a-j. Age composition in terms of each entire sample is also shown in Appendix 1a-j. Modal smolt/post-smolt age varied between areas and with sampling time and sex for a given area. In terms of the combined category, the lowest modal age was $2.^{+}/2.0^{+}$ (inward sample on North Harbour River, S.M.B. in 1976, Northeast River in 1976 and 1977 and Northeast Arm, Placentia in September-November, 1976); the highest was $4.^{+}/4.0^{+}$ as exhibited by Beaver River, Southeast River and Come By Chance River (1977). For the remaining samples it was $3.^{+}/3.0^{+}$. The youngest smolt/post-smolt were encountered on North Harbour River, S.M.B., North Harbour River, P.B. and Northeast River $(1.^{+}/1.0^{+})$ with the latter having the highest percentage. The maximum smolt/post-smolt age was $7.^{+}/7.0^{+}$ (Beaver River and Southeast Arm, Placentia). The maximum total age observed was 7^{+}.

The overall percentage of specimens in each whole sample beyond the post-smolt stage making repeated trips to sea varied with area and sampling time per given area (Table 11). There were fewer of these individuals in outward runs than in corresponding inward runs for North Harbour River, S.M.B. and Beaver River while the reverse was true for Southeast River. On Northeast River, 1977 had a higher percentage than 1976. Lowest percentages relatively speaking were found in samples taken in the sea. There was a general decrease composition-wise in the number of successive trips to sea. Nearly all samples contained individuals displaying freshwater life alternating with sea life; the percentage varied with sampling time per given area.

Fig. 18. Age composition in terms of the smolt (outward) and post-smolt (inward) portion of each whole sample and smolt and post-smolt combined for Salvelinus fontinalis for North Harbour River, S.M.B., Beaver River and Southeast River. C = sexes combined plus unsexed fish (where applicable).



N. Hr. Riv., S.M.B. (Outward, 1976) Smolt
N=69
N=29
N=375
N. Hr. Riv., S.M.B. (Outward, 1977) Smolt
N=48
N=28
N=97
Beaver Riv. (Outward, 1977) Smolt
N=53
N=25
N=401
Southeast Riv. (Outward, 1977) Smolt
N=94
N=30
N=264
N. Hr. Riv., S.M.B. (Inward, 1976) Post-smolt
N=68
N=33
N=401
N. Hr. Riv., S.M.B. (Inward, 1977) Post-smolt
N=49
N=18
N=160
Beaver Riv. (Inward, 1977) Post-smolt
N=69
N=17
N=453
Southeast Riv. (Inward, 1977) Post-smolt
N=34
N=8
N=42
N. Hr. Riv., S.M.B. (Outward+Inward, 1976) Smolt+Post-smolt
N=137
N=62
N=776
N. Hr. Riv., S.M.B. (Outward+Inward, 1977) Smolt+Post-smolt
N=97
N=46
N=257
Beaver Riv. (Outward+Inward, 1977) Smolt+Post-smolt
N=122
N=42
N=854
Southeast Riv. (Outward+Inward, 1977) Smolt+Post-smolt
N=128
N=38
N=306
Percent
0
20
40
60
1/1.0+
3/3.0+
5/5.0+
2/2.0+
4/4.0+
6/6.0+
Age (Years)

Fig. 19. Age composition in terms of the smolt/post-smolt portion of each whole sample for *Salvelinus fontinalis* for Northeast River (smolt), Come By Chance River, North Harbour River, P.B., Northeast Arm, Placentia and Southeast Arm, Placentia (post-smolt). C = sexes combined plus unsexed fish (where applicable).

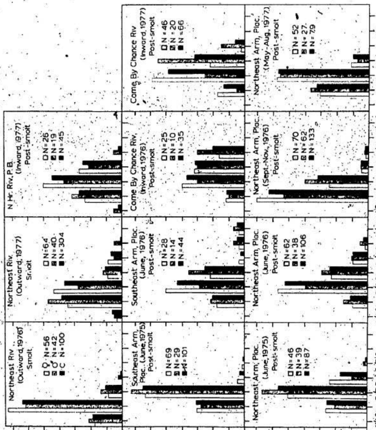
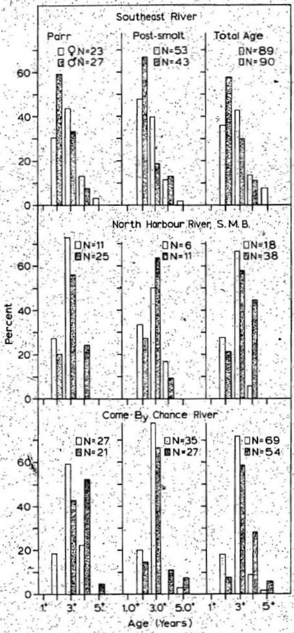

Northeast Riv. (Outward, 1976) Smolt
♀ N=56
♂ N=42
C N=100
Northeast Riv. (Outward, 1977) Smolt
N=64
N=40
N=304
N. Hr. Riv. P.B. (Inward, 1977) Post-smolt
N=26
N=19
N=45
Southeast Arm, Plac. (June, 1975) Post-smolt
N=69
N=29
N=101
Southeast Arm, Plac. (June, 1976) Post-smolt
N=28
N=14
N=44
Come By Chance Riv. (Inward, 1976) Post-smolt
N=25
N=10
N=35
Come By Chance Riv. (Inward, 1977) Post-smolt
N=46
N=20
N=66
Northeast Arm, Plac. (June, 1975) Post-smolt
N=46
N=39
N=87
Northeast Arm, Plac. (June, 1976) Post-smolt
N=62
N=38
N=106
Northeast Arm, Plac. (Sept.-Nov., 1976) Post-smolt
N=70
N=62
N=133
Northeast Arm, Plac. (May-Aug., 1977) Post-smolt
N=52
N=27
N=79
Percent
0
20
40
60
Age (Years)

Table 11. The overall percentage of specimens beyond the post-smolt stage in each whole sample (right hand column) and the percent composition of each successive sea sojourn year and specimens showing alternating freshwater and sea life within that portion for Salvelinus fontinalis. N's are in parentheses.

Sampling Area	Successive Sea Sojourns .1+	.2+	.3+	.4+	Alternating F.W. and Sea Life	Percentage of Whole Sample Beyond p.s.
North Hr. Riv., S.M.B.						
1976 Outward	81.25(13)	-	-	-	18.75(3)	4.03(16)
1976 Inward	69.70(46)	10.61(7)	1.52(1)		18.18(12)	13.84(66)
1977 Outward	91.67(22)	8.33(2)	-	-	-	19.84(24)
1977 Inward	88.06(59)	5.97(4)			5.97(4)	28.88(67)
Beaver Riv.						
1977 Outward	84.62(55)	-	6.16(4)	1.54(1)	7.69(5)	13.80(65)
1977 Inward	76.85(93)	11.57(14)	-	0.83(1)	10.74(13)	20.90(121)
Southeast Riv.						
1977 Outward	78.12(25)	9.38(3)	3.13(1)	-	9.38(3)	10.77(32)
1977 Inward	100.00(2)	-	-	-	-	4.44(2)
Northeast Riv.						
1976 Outward	100.00(1)	-	-	-	-	0.98(1)
1977 Outward	64.29(18)	7.14(2)	3.57(1)	-	25.00(7)	8.31(28)
Come By Chance Riv.						
1976 Inward	-	-	-	-	-	-
1977 Inward	100.00(3)	-	-	-	-	4.35(3)
North Hr. Riv., P.B.						
1977 Inward	100.00(3)	-	-	-	-	6.25(3)
Northeast Arm, Plac.						
1975 (June)	100.00(1)	-	-	-	-	1.14(1)
1976 (June)	-	-	-	-	100.00(4)	3.74(4)
1976 (Sept.-Nov.)	100.00(3)	-	-	-	-	2.17(3)
1977 (May-Aug.)	100.00(2)	-	-	-	-	2.47(2)
Southeast Arm, Plac.						
1975 (June)	100.00(5)	-	-	-	-	4.72(5)
1976 (June)	14.29(1)	57.14(4)	14.29(1)	-	14.29(1)	13.73(7)

Spawners consisted of parr, individuals captured in freshwater in their post-smolt year and those making repeated sea sojourns. Age composition data are presented in terms of parr, post-smolt and total age in Fig. 20 as well as in terms of entire samples in Appendix 1k. The relative proportion of the above life stages varied between areas. Parr predominated for North Harbour River, S.M.B. (64.3% of total) while for Come By Chance River and Southeast River it was post-smolt (50.4 and 54.6% of the total respectively); the highest proportion of specimens having made repeated trips to salt water was found on Southeast River (12.3% of the total). The youngest mature female parr age group was $2.^+$ (all areas); for males it was $2.^+$ for Southeast River and North Harbour River, S.M.B. and $3.^+$ for Come By Chance River. The oldest age group for female and male parr was $5.^+$ (Southeast River for the former and Come By Chance River for the latter). The youngest age of males and females taken in the post-smolt year was 2.0^+ (all areas). The oldest female age group in this category was 4.0^+ (North Harbour River, S.M.B. and Southeast River); for males it was 5.0^+ (Come By Chance River). In terms of total age the youngest spawners encountered were 2^+ years of age and the oldest 5^+ (both sexes). The modal age for female parr was $3.^+$ for all areas whereas for males it was $2.^+$ for Southeast River, $3.^+$ for North Harbour River, S.M.B. and $4.^+$ for Come By Chance River. The modal age for both sexes captured in the post-smolt year for Southeast River was 2.0^+; for North Harbour River, S.M.B. and Come By Chance River it was 3.0^+. The dominant age group for repeat migrants was 2.1^+. In terms of total age, the mode for females and males on North Harbour River, S.M.B. and Come By Chance River was 3^+; for Southeast River it was 2^+ for males and 3^+ for females.

Fig. 20. Age composition of Salvelinus fontinalis spawners in terms of parr, post-smolt and total age for North Harbour River, S.M.B., Come By Chance River and Southeast River.


Southeast River
Parr
Post-smolt
Total Age
♀N=23
♂N=27
N=53
N=43
N=89
N=90
North Harbour River, S.M.B.
N=11
N=25
N=6
N=11
N=18
N=38
Come By Chance River
N=27
N=21
N=35
N=27
N=69
N=54
Percent
0
20
40
60
1+
3+
5+
1.0+
3.0+
5.0+
Age (Years)

Annual survival rates (all data combined for a given area per year) between age groups and mean annual survival rates in terms of freshwater life alone and total age are shown in Table 12. Variation was noted between areas. Highest survival was exhibited by Beaver River fish.

Salmo trutta

Age composition data for the smolt/type 1 post-smolt portion of each whole sample for all except spawners are presented in Fig. 21 and Appendix 2a-d. Age composition in terms of each entire sample is also shown in Appendix 2a-d. The youngest smolt/type 1 post-smolt age encountered was $1.^{+}/1.0^{+}$ (North Harbour River, S.M.B.) and the oldest was $8.^{+}/8.0^{+}$ (Northeast Arm, Placentia). The youngest modal smolt/type 1 post-smolt age (combined category) was $2.^{+}/2.0^{+}$ (North Harbour River, S.M.B., 1977); for the remaining samples it was $3.^{+}/3.0^{+}$.

The overall percentage of specimens in each sample beyond the type 2 post-smolt stage (i.e. beyond the first sea-winter) showed variation between and within samples (Table 13). Just as observed for brook trout, there were fewer of these fish in outward runs compared with inward runs (North Harbour River, S.M.B.). There was a progressive decrease (percent composition) in the number of successive years spent in the sea before returning to freshwater for the first time. Only a single instance of freshwater life alternating with sea life was observed and that was in Northeast Arm, Placentia (June-November 1976). The maximum total age encountered was 11^{+} (4. freshwater and $.7^{+}$ sea years) in Colinet River.

Spawners as presented in Fig. 22 and Appendix 2e is a combined sample of individuals taken from each sampling area and is comprised of

Table 12. Annual survival rates between age groups and mean annual survival rates for *Salvelinus fontinalis* in terms of freshwater life and total age.

Sampling Area	Age Group					Mean Annual Survival
	2-3	3-4	4-5	5-6	6-7	
North Hr. Riv., S.H.B.						
1976 F.W. Life	0.92	0.29	0.03	-	-	0.55 (2-5)
1976 Total Age	-	0.30	0.07	-	-	0.25 (3-5)
1977 F.W. Life	-	0.39	0.12	-	-	0.32 (3-5)
1977 Total	-	0.46	0.20	-	-	0.38 (3-5)
Beaver River						
1977 F.W. Life	-	-	0.35	0.27	0.09	0.32 (4-7)
1977 Total Age	--	-	0.39	0.34	0.22	0.37 (4-7)
Southeast River						
1977 F.W. Life	-	0.66	0.31	0.19	-	0.49 (3-6)
1977 Total Age	-	0.62	0.36	0.28	-	0.49 (3-6)
Northeast River						
1976 F.W. Life	0.16	0.09	-	-	-	0.15 (2-4)
1976 Total Age	0.16	0.09	-	-	-	0.15 (2-4)
1977 F.W. Life	0.95	0.30	0.65	0.09		0.59 (2-6)
1977 Total Age	-	0.27	0.61	0.09	-	0.32 (2-6)
Come By Chance River						
1976 F.W. Life	-	0.85	0.66	-	-	0.75 (3-5)
1976 Total Age	-	0.85	0.66	-	-	0.75 (3-5)
1977 F.W. Life	-	0.66	0.19	-	-	0.47 (3-5)
1977 Total Age	-	0.67	0.23	-	-	0.49 (3-5)
North Hr. Riv., P.B.						
1977 F.W. Life	-	0.55	0.09	-	-	0.39 (3-5)
1977 Total Age	-	0.50	0.18	-	-	0.39 (3-5)
Northeast Arm, Plac.						
1975 F.W. Life	-	0.31	0.07	-	-	0.25 (3-5)
1975 Total Age	-	0.31	0.13	-	-	0.27 (3-5)
1976 F.W. Life	-	0.33	0.39	0.25	-	0.34 (3-5)
1976 Total Age	-	0.32	0.39	0.25	-	0.33 (3-5)
1977 F.W. Life	-	0.18	-	-	-	0.18 (3-4)
1977 Total Age	-	0.17	0.13	-	-	0.17 (3-5)
Southeast Arm Plac.						
1975 F.W. Life	-	0.05	0.33	-	-	0.07 (3-5)
1975 Total Age	-	0.04	0.33	-	-	0.07 (3-5)
1976 F.W. Life	-	0.58	0.09	-	-	0.40 (3-5)
1976 Total Age	-	0.63	0.33	1.00	-	0.57 (3-6)

Fig. 21. Age composition in terms of the smolt (outward) and type 1 and type unknown post-smolt (inward migrants and specimens captured in the sea in smolt year) portion of each whole sample for *Salmo trutta* for North Harbour River, S.M.B., Northeast Arm, Placentia and Colinet Harbour and River. C = sexes combined plus unsexed fish (where applicable).

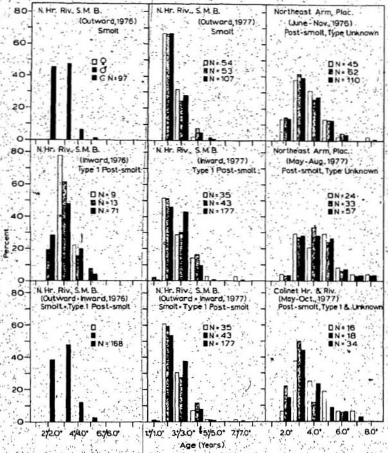
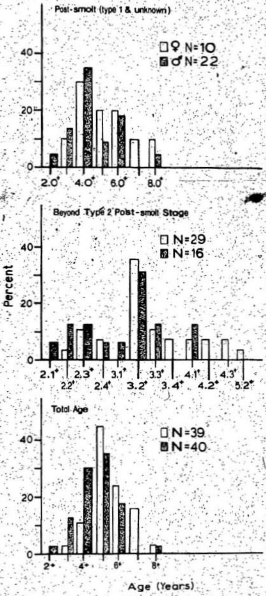

N. Hr. Riv., S.M.B. (Outward, 1976) Smolt
♀
♂
G N=97
N. Hr. Riv., S.M.B. (Outward, 1977) Smolt
N=54
N=53
N=107
Northeast Arm, Plac. (June - Nov., 1976) Post-smolt, Type Unknown
N=45
N=62
N=110
N. Hr. Riv., S.M.B. (Inward, 1976) Type 1 Post-smolt
N=9
N=13
N=71
N. Hr. Riv., S.M.B. (Inward, 1977) Type 1 Post-smolt
N=35
N=43
N=177
Northeast Arm, Plac. (May - Aug., 1977) Post-smolt, Type Unknown
N=24
N=33
N=57
N. Hr. Riv., S.M.B. (Outward + Inward, 1976) Smolt + Type 1 Post-smolt
N=168
N. Hr. Riv., S.M.B. (Outward + Inward, 1977) Smolt + Type 1 Post-smolt
N=35
N=43
N=177
Colinet Hr. & Riv. (May-Oct., 1977) Post-smolt, Type 1 & Unknown
N=16
N=18
N=34
Percent
Age (Years)

Table 13. The overall percentage of specimens beyond the post-smolt stage (type 2) in each whole sample (right hand column) and the percent composition of each successive sea year and specimens showing alternating freshwater and sea life within that portion for *Salmo trutta*. N's are in parentheses.

Sampling Area	Successive Years at Sea .1+	.2+	.3+	.4+	.5+	.6+	.7+	Alternating F.W. and Sea Life	Percentage of whole sample Beyond p.s.
North Hr. Riv., S.M.B.									
1976 Outward	100.00(3)	-	-	-	-	-	-		2.97(3)
1976 Inward	66.67(38)	22.81(13)	10.52(6)	-	-	-	-		44.19(57)
1977 Outward	100.00(7)	-	-	-	-	-	-		6.03(7)
1977 Inward	41.67(10)	41.67(10)	8.33(2)	8.33(2)	-	-	-		11.77(24)
N.E. Arm. Placentia									
1976 (June-Nov.)	45.00(9)	35.00(7)	10.00(2)	5.00(1)	-	-	-	5.00(1)	15.39(20)
1977 (May-Aug.)	33.33(3)	66.67(6)	-	-	-	-	-	-	13.04(9)
Colinet Hr. & River									
1978 (May-Oct.)	16.67(4)	37.50(9)	33.33(8)	8.33(2)	-	-	4.17(1)	-	41.37(24)

Fig. 22. Age composition of Salmo trutta spawners in terms of type 1 and type unknown post-smolt, specimens beyond the type 2 post-smolt stage and total age.


Post-smolt (type 1 & unknown)
♀ N=10
♂ N=22
40
20
0
2.0+
4.0+
6.0+
8.0+
Beyond Type 2 Post-smolt Stage
N=29
N=16
Percent
2.1+
2.2+
2.3+
2.4+
3.1+
3.2+
3.3+
3.4+
4.1+
4.2+
4.3+
5.2+
Total Age
N=39
N=40
2+
4+
6+
8+
Age (Years)

(1) parr (2.5% of total - shown in Appendix 2e but not Fig. 22), (2) type 1 post-smolt (40.5% of total) and (3) individuals beyond the type 2 post-smolt stage (55.7% of total). The two male parr were age 3.$^+$ and 4.$^+$. The youngest age of males in category 2 was 2.0$^+$ while for females it was 3.0$^+$; the oldest was 8.0$^+$ for both sexes. Modal age for both sexes was 4.0$^+$. The most important age group for specimens beyond the type 2 post-smolt stage was 3.2$^+$ (both sexes). In terms of total age the mode was 5$^+$ for both sexes (Fig. 22).

Annual survival rates (all data combined for a given year) between age groups and mean annual survival rates (in terms of freshwater life alone and total age) are presented in Table 14.

Mean Smolt Age

Salvelinus fontinalis

In areas where outward and inward runs were sampled in the same year, mean smolt age was determined by combining the two runs (i.e. smolt plus post-smolt). Marked fish from the outward runs recaptured in the inward runs were not included. Mean smolt age for each area in terms of sexes separate and the combined category and within sample comparison of males versus females are presented in Table 15. Females differed significantly from males in the case of Come By Chance River in 1977 where the latter predominated.

Differences between areas for mean smolt age in 1977 are shown in Appendix 5a. Beaver River was higher than all remaining areas and significantly so in the case of females and the combined category. The lowest mean smolt age observed was on Northeast River. Mean smolt age in 1977 was significantly higher than in 1976 for Northeast River and

Table 14. Annual survival rates between age groups and mean annual survival rates for <u>Salmo trutta</u> in terms of freshwater life and total age.

Sampling Area	Age Group						Mean Annual Survival
	2-3	3-4	4-5	5-6	6-7	7-8	
North Hr. Riv., S.M.B.							
1976 F.W. Life	-	0.25	0.20	-	-	-	0.30 (3-5)
1976 Total Age	-	0.49	0.57	-	-	-	0.52 (3-5)
1977 F.W. Life	0.70	0.21	0.09	-	-	-	0.46 (2-5)
1977 Total Age	0.72	0.31	0.29	0.50	0.40	-	0.52 (2-7)
Northeast Arm, Plac.							
1976 F.W. Life	-	0.65	0.47	0.29	-	-	0.53 (3-6)
1976 Total Age	-	0.73	0.54	0.32	-	-	0.59 (3-6)
1977 F.W. Life	-	-	0.94	0.27	0.50	-	0.62 (4-7)
1977 Total Age	-	-	-	0.19	0.50	1.00	0.30 (5-8)
Colinet Hr. & Riv.							
1977 F.W. Life	-	0.53	0.38	0.67	0.50	-	0.50 (3-7)
1977 Total Age	-	-	-	0.55	0.83	-	0.65 (5-7)

Table 15. Mean smolt age of *Salvelinus fontinalis* for each area. Included also are within sample comparisons of males versus females (t test). C = sexes combined plus unsexed fish (where applicable).

Sampling Area		N	$\bar{X}$	S.E.	t	df
North Harbour River, S.M.B.						
1976 (Outward + Inward)	♀	137	2.56	0.053	0.7242N.S.	196
	♂	61	2.48	0.085		
	C	780	2.67	0.024		
1977 (Outward + Inward	♀	97	3.05	0.075	0.5352N.S.	141
	♂	46	2.98	0.120		
	C	257	2.99	0.046		
Beaver River						
1977 (Outward + Inward)	♀	122	3.88	0.099	0.3594N.S.	162
	♂	42	3.81	0.136		
	C	799	3.82	0.032		
Southeast River						
1977 (Outward + Inward)	♀	128	3.31	0.080	1.1271N.S.	164
	♂	38	3.11	0.180		
	C	306	3.24	0.053		
Northeast River						
1976 (Outward)	♀	56	1.91	0.069	0.4684N.S.	96
	♂	42	1.98	0.105		
	C	100	1.94	0.057		
1977 (Outward)	♀	64	2.88	0.121	0.8125N.S.	102
	♂	40	2.73	0.171		
	C	309	2.76	0.057		
Come By Chance River						
1976 (Inward)	♀	25	3.58	0.185	0.6188N.S.	32
	♂	10	3.80	0.326		
	C	35	3.60	0.160		
1977 (Inward)	♀	46	3.09	0.102	3.7237 ***	64
	♂	20	3.80	0.171		
	C	66	3.30	0.096		
North Harbour River, P.B.						
1977 (Inward)	♀	26	3.04	0.141	0.5637N.S.	43
	♂	19	2.90	0.228		
	C	45	2.98	0.125		
Northeast Atm, Plac.						
June, 1975	♀	46	2.98	0.105	0.2000N.S.	83
	♂	39	2.95	0.104		
	C	87	2.94	0.074		
June, 1976	♀	62	3.37	0.108	0.6351 N.S.	98
	♂	38	3.50	0.172		
	C	106	3.41	0.092		
Sept.-Nov., 1976	♀	70	2.37	0.077	0.1770N.S.	130
	♂	62	2.55	0.085		
	C	133	2.45	0.037		
May-Aug., 1977	♀	52	2.81	0.087	0.7127N.S.	77
	♂	27	2.70	0.117		
	C	79	2.77	0.043		
Southeast Arm, Plac.						
June, 1975	♀	69	2.77	0.072	0.3964N.S.	96
	♂	29	2.72	0.085		
	C	101	2.74	0.056		
June, 1976	♀	28	3.36	0.220	0.6426N.S.	40
	♂	14	3.64	0.387		
	C	44	3.41	0.188		

North Harbour River, S.M.B. for sexes separate and combined (Appendix 5b); for Come By Chance River, 1976 was significantly higher than 1977 for females.

Mean smolt age varied with sampling time in Northeast and Southeast Arms, Placentia (Appendix 5c). Highest values for Northeast Arm were encountered in June 1976 (differences significant for sexes separate and combined). Lowest values occurred in September-November 1976 and the difference was significant in the case of females. In Southeast Arm, June of 1976 was significantly higher than June 1975 for sexes separate and combined. Comparisons were also made between Northeast Arm and Southeast Arm in June 1975 and June 1976 (Appendix 5d). The only significant difference found was in 1975 at which time the combined sample from Northeast Arm was highest.

Salmo trutta

Mean smolt age for North Harbour River, S.M.B. in 1976 and 1977 was determined by combining the outward and inward runs (smolt plus type 1 post-smolt). Mean smolt age for each area for sexes separate and the combined category and within sample comparison of males versus females are shown in Table 16. Female mean smolt age was significantly higher than that of males for Colinet with the remaining areas showing no difference.

Comparing between areas in 1977 (Appendix 6a), Northeast Arm, Placentia was highest (significantly so in the case of males and combined) while North Harbour River, S.M.B.was significantly lowest for sexes separate and combined. Mean smolt age for sexes separate and combined in 1976 was significantly higher than in 1977 for North Harbour River,

Table 16. Mean smolt age of <u>Salmo trutta</u> for each area. Included also are within sample comparisons of males versus females (t test). C = sexes combined plus unsexed fish (where applicable).

Sampling Area		N	$\bar{X}$	S.E.	t	df
North Harbour River, S.M.B. 1976 (Outward + Inward)	♀	9	3.22	0.147	0.2568N.S.	20
	♂	13	3.15	0.222		
	C	168	2.78	0.057		
1977 (Outward + Inward)	♀	89	2.53	0.088	0.0622N.S.	183
	♂	96	2.52	0.077		
	C	284	2.56	0.043		
Northeast Arm, Plac. June-Nov., 1976	♀	45	3.62	0.175	0.4829N.S.	105
	♂	62	3.51	0.134		
	C	110	3.55	0.104		
May-Aug., 1977	♀	24	4.38	0.294	0.1326N.S.	55
	♂	33	4.24	0.222		
	C	57	4.29	0.177		
Colinet Hr. and River May-Oct., 1977	♀	16	4.00	0.329	2.0688*	32
	♂	18	3.17	0.232		
	C	34	3.64	0.204		

S.M.B.; the reverse was true for Northeast Arm, Placentia (Appendix 6b). The Northeast Arm, Placentia combined sample was significantly higher than that of North Harbour River, S.M.B. in 1976 (Appendix 6c).

Length Distribution of the Age Groups and Mean Length at Capture

Salvelinus fontinalis

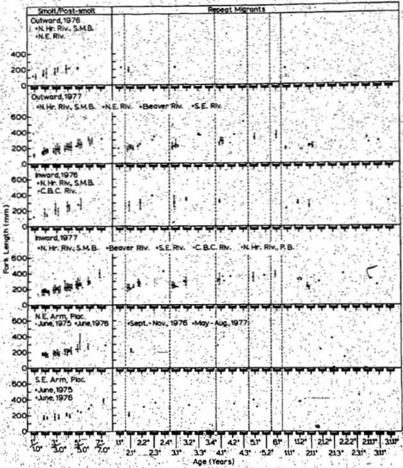
The degree of overlap of age groups with respect to length was somewhat consistent from area to area (Fig. 23). In terms of total age, upper and lower limits of the range of length were progressively higher the greater the amount of time spent in the sea. In most instances this resulted in a fairly wide range of length for a given total age (e.g. the range between a 4.$^{+}$ smolt and a repeat migrant of the same total age with two sea sojourns (2.2^{+}).

Mean length at capture for sexes separate and combined and within sample comparisons of males versus females for each age group for all samples except spawners are shown in Appendix 1a-j. Since in the great majority of cases, there was no significant difference between males and females, these data are summarized graphically in terms of the combined category (sexes combined plus unsexed fish) and grouped according to outward runs, inward runs and specimens taken in the sea in Fig. 23.

For virtually all age groups on North Harbour River, S.M.B. in 1976 and 1977 (Appendix 7a) and Southeast River (Appendix 7b), inward mean length was significantly higher than that of outward; this general trend did not apply to the same extent to Beaver River (Appendix 7c).

Most of the significant differences between areas in the 1977 outward run were confined to the smolt stage (Appendix 7d). In terms of combined samples, North Harbour River, S.M.B. smolt were significantly

Fig. 23. Mean length at time of capture for Salvelinus fontinalis in terms of the combined category (sexes combined plus unsexed fish) grouped according to outward and inward runs and specimens captured in the sea. Vertical lines indicate the range in length corresponding to each mean.


Smolt/Post-smolt
Repeat Migrants
Outward, 1976
N. Hr. Riv., S.M.B.
N.E. Riv.
Outward, 1977
N. Hr. Riv., S.M.B.
N.E. Riv.
Beaver Riv.
S.E. Riv.
Inward, 1976
N. Hr. Riv., S.M.B.
C.B.C. Riv.
Inward, 1977
N. Hr. Riv., S.M.B.
Beaver Riv.
S.E. Riv.
C.B.C. Riv.
N. Hr. Riv., P.B.
N.E. Arm, Plac.
June, 1975
June, 1976
Sept.-Nov., 1976
May-Aug., 1977
S.E. Arm, Plac.
June, 1975
June, 1976
Fork Length (mm)
Age (Years)
1.0+
3.0+
5.0+
7.0+
1.1+
2.1+
2.2+
2.3+
2.4+
3.1+
3.2+
3.3+
3.4+
4.1+
4.2+
4.3+
5.1+
5.2+
6.1+
1.1.1+
1.1.2+
2.1.1+
2.1.2+
2.1.3+
2.2.2+
2.3.1+
2.1.1.1+
3.1.1+
3.1.1.1+

smaller than the remaining areas for all age groups represented. There was no consistent trend evident for any of the remaining areas. In 1976, the North Harbour River, S.M.B. smolt run can be compared with that of Northeast River only (Appendix 7e); here as well, smolt age groups 2.$^+$ and 3.$^+$ were signigicantly smaller for the former. When the outward run on North Harbour River, S.M.B. is compared between 1976 and 1977, except for the 4.$^+$ age group (combined), there were no significant differences between age groups (Appendix 7f). Comparing Northeast River between 1976 and 1977 (Appendix 7g), the former year was significantly higher than the latter for the 3.$^+$ age group.

When the inward run in 1977 is compared between areas (Appendix 7h), it is evident that while North Harbour River, S.M.B. was still somewhat lower in some instances, it differed significantly only from Southeast River. The overall number of significant differences in the inward run was lower than that observed for the outward run. Although a significant F value was observed for 3.0$^+$, the Newman-Keuls multiple range test failed to detect where the differences were. In 1976, the North Harbour River inward run (post-smolt) can be compared to Come By Chance River only (Appendix 7c); where significant differences occurred, the former was highest. Comparing North Harbour River, S.M.B. between 1976 and 1977 for the inward run, where significant differences occurred, the former year was highest (Appendix 7f); comparing these two years for Come By Chance River (Appendix 7g), 2.0$^+$ fish were significantly larger in 1977.

Different sampling times in Northeast Arm, Placentia are compared in Appendix 7j. In terms of combined samples, 2.0$^+$ and 3.0$^+$ specimens taken in May-August, 1977 were significantly smaller than the remaining sampling periods which were in turn not significantly different. Significant F values were obtained for females and combined in the 4.0^+ age group, but the Newman-Keuls multiple range test failed to detect differences. When June 1975 was compared with June 1976 for Southeast Arm, Placentia (Appendix 7k), the only significant difference found was for 2.0 males where 1975 predominated. For Northeast Arm versus Southeast Arm in June 1975 and June 1976 (Appendix 7l), 2.0^+ and 4.0^+ males were significantly larger for the former.

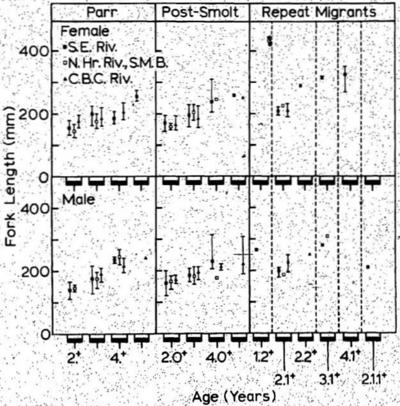
Mean length at capture for male and female spawners for each age group is presented in Fig. 24 and Appendix 1K. The sexes are compared statistically within samples in Appendix 1k. Some significant differences occurred in each of the parr, post-smolt and repeat migrant categories. Comparing between areas (Appendix 7m) the only significant differences for both sexes occurred in the parr stage.

Salmo trutta

In regard to length distribution of the age groups, except possibly for type 1 post-smolt in Northeast Arm, Placentia for September-November 1976, the same observations made above for brook trout more or less apply to brown trout also (Fig. 25).

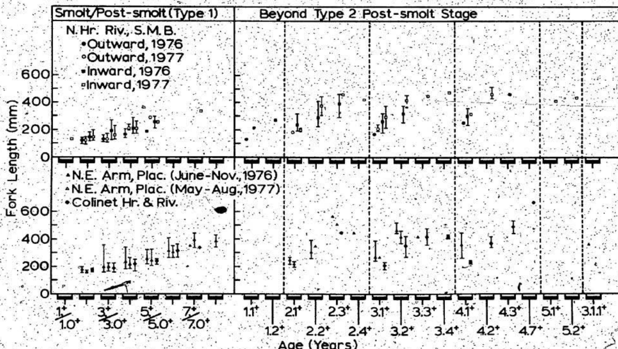
Mean length at capture for sexes separate and the combined category for each sample and within sample comparison of males versus females for all except spawners are shown in Appendix 2a-d. Again, since few significant differences were noted between males and females, these data are summarized in terms of the combined category and grouped according to outward runs, inward runs and specimens taken in the sea in Fig. 25.

Fig. 24. Mean length at time of capture for Salvelinus fontinalis spawners for Southeast River, North Harbour River, S.M.B. and Come By Chance River. Vertical lines indicate the range in length corresponding to each mean.



Parr
Post-Smolt
Repeat Migrants
Female
▪S.E. Riv.
▫N. Hr. Riv., S.M.B.
▴C.B.C. Riv.
Male
Fork Length (mm)
400
200
0
2+
4+
2.0+
4.0+
1.2+
2.1+
2.2+
3.1+
4.1+
2.1.1+
Age (Years)

Fig. 25. Mean length at time of capture for Salmo trutta in terms of the combined category (sexes combined plus unsexed fish) grouped according to outward and inward runs and specimens captured in the sea. Vertical lines indicate the range in length corresponding to each mean.


Smolt/Post-smolt (Type 1)
Beyond Type 2 Post-smolt Stage
N. Hr. Riv., S.M.B.
•Outward, 1976
∘Outward, 1977
▪Inward, 1976
▫Inward, 1977
▲N.E. Arm, Plac. (June-Nov., 1976)
△N.E. Arm, Plac. (May-Aug., 1977)
•Colinet Hr. & Riv.
Fork Length (mm)
0
200
400
600
1+/1.0+
3+/3.0+
5+/5.0+
7+/7.0+
1.1+
1.2+
2.1+
2.2+
2.3+
2.4+
3.1+
3.2+
3.3+
3.4+
4.1+
4.2+
4.3+
4.7+
5.1+
5.2+
3.1.1+
Age (Years)

Just as observed for brook trout on North Harbour River, S.M.B., inward mean lengths at capture were significantly higher than those of outward for nearly all age groups (Appendix 8a). Some differences were noted in 1977 when the inward run on North Harbour River, S.M.B. was compared with specimens taken from Northeast Arm, Placentia and Colinet Harbour and River; however, no consistent trends were evident (Appendix 8b). In 1976, Northeast Arm, Placentia was significantly higher than the inward run on North Harbour River, S.M.B. for the combined category in each of age groups 2.0^{+} and 3.2^{+} (Appendix 8c).

Variation was noted between 1976 and 1977 for both North Harbour River, S.M.B. (Appendix 8d) and Northeast Arm, Placentia (Appendix 8e).

Body Length - Scale Length Relationships

Salvelinus fontinalis

The log-log regressions of body length on scale length for all samples as well as within sample comparison of males versus females are presented in Table 17. Slopes differed significantly only for Southeast River (outward and inward) and Northeast River (outward 1977). Intercepts showed considerable significant variation with neither sex showing a consistent trend.

Intercept values differed significantly on every occasion except one (males on North Harbour River, S.M.B. 1977) when outward and inward runs are compared (Appendix 9a). Slopes were significantly different on two occasions only (females on North Harbour River, S.M.B. in 1976 and Southeast River); the inward runs were highest.

Comparing outward runs in 1977 (Appendix 9b), a significant F was found for slopes for males and for intercepts for females. The Newman-Keuls

Table 17. The log-log regression equations of body length on scale length for each sample of *Salvelinus fontinalis*. Included also are within sample comparisons of males versus females for slopes and intercepts (t test). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		Regression	t: Slopes (b)	t: Intercepts (a)	r
North Hr. Riv., S.M.B.					
Outward, 1976	♂	$\log L_f = 0.7217 \log L_s + 1.2769$	0.4892(7)N.S.	4.1597(8)**	0.9908
	♀	$\log L_f = 0.8019 \log L_s + 1.1782$			0.9253
	C	$\log L_f = 1.0142 \log L_s + 0.9209$			0.9945
Inward, 1976	♂	$\log L_f = 1.0088 \log L_s + 0.9103$	0.6450(12)N.S.	4.0883(13)**	0.9936
	♀	$\log L_f = 0.9275 \log L_s + 1.0289$			0.9468
	C	$\log L_f = 1.1633 \log L_s + 0.6895$			0.9973
Outward, 1977	♂	$\log L_f = 0.9638 \log L_s + 0.9757$	1.8078(10)N.S.	28.6770(11)***	0.9869
	♀	$\log L_f = 1.3270 \log L_s + 0.4939$			0.9420
	C	$\log L_f = 1.0547 \log L_s + 0.8516$			0.9879
Inward, 1977	♂	$\log L_f = 1.0453 \log L_s + 0.8462$	1.1731(14)N.S.	9.9827(15)***	0.9819
	♀	$\log L_f = 1.2502 \log L_s + 0.5744$			0.9521
	C	$\log L_f = 1.1817 \log L_s + 0.6478$			0.9836
Beaver Riv.					
Outward, 1977	♂	$\log L_f = 0.9680 \log L_s + 0.9680$	2.2036(16)*	—	0.9759
	♀	$\log L_f = 1.1979 \log L_s + 0.6177$			0.9864
	C	$\log L_f = 1.0940 \log L_s + 0.7795$			0.9899
Inward, 1977	♂	$\log L_f = 1.1357 \log L_s + 0.6979$	0.3335(18)N.S.	8.6722(19)***	0.9724
	♀	$\log L_f = 1.0802 \log L_s + 0.7874$			0.9279
	C	$\log L_f = 1.1314 \log L_s + 0.7091$			0.9924
Southeast Riv.					
Outward, 1977	♂	$\log L_f = 1.0012 \log L_s + 0.9192$	2.2700(13)*	—	0.9940
	♀	$\log L_f = 1.2391 \log L_s + 0.6029$			0.9777
	C	$\log L_f = 1.1143 \log L_s + 0.7563$			0.9942

continued

Table 17 (Continued)

Inward, 1977	♀	$\log L_f = 1.3212 \log L_s + 0.4030$	3.0721(9)*	—	0.9904
	♂	$\log L_f = 0.6789 \log L_s + 1.3721$			0.8470
	C	$\log L_f = 1.1195 \log L_s + 0.6968$			0.9662
Northeast Riv.					
Outward, 1976	♀	$\log L_f = 0.9898 \log L_s + 0.9476$	0.1988(11)N.S.	3.2043(12)***	0.9919
	♂	$\log L_f = 1.0133 \log L_s + 0.8916$			0.9774
	C	$\log L_f = 1.0498 \log L_s + 0.8524$			0.9784
Outward, 1977	♀	$\log L_f = 1.0931 \log L_s + 0.8251$	2.2397(18)*	—	0.9715
	♂	$\log L_f = 0.8705 \log L_s + 1.1067$			0.9846
	C	$\log L_f = 0.9884 \log L_s + 0.9451$			0.9763
Come By Chance Riv.					
Inward, 1976	♀	$\log L_f = 1.1914 \log L_s + 0.6920$	2.0463(13)N.S.	23.2737(14)***	0.9443
	♂	$\log L_f = 0.8594 \log L_s + 1.1190$			0.9927
	C	$\log L_f = 1.1054 \log L_s + 0.7998$			0.9458
Inward, 1977	♀	$\log L_f = 1.1726 \log L_s + 0.7095$	1.2943(11)N.S.	20.6023(12)***	0.8885
	♂	$\log L_f = 0.6476 \log L_s + 1.4135$			0.6679
	C	$\log L_f = 1.1300 \log L_s + 0.7786$			0.9298
North Hr. Riv., P.B.					
Inward, 1977	♀	$\log L_f = 0.9705 \log L_s + 0.9714$	0.2260(12)N.S.	1.9572(13)N.S.	0.9506
	♂	$\log L_f = 1.0154 \log L_s + 0.9374$			0.9400
	C	$\log L_f = 1.0629 \log L_s + 0.8465$			0.9801
Northeast Arm, Plac.					
June, 1975	♀	$\log L_f = 0.9405 \log L_s + 0.9951$	0.2577(7)N.S.	5.5115(8)***	0.9208
	♂	$\log L_f = 0.8723 \log L_s + 1.0798$			0.9772
	C	$\log L_f = 0.9536 \log L_s + 0.9675$			0.9832
June, 1976	♀	$\log L_f = 1.2851 \log L_s + 0.5063$	0.4908(11)N.S.	5.2209(12)***	0.9690
	♂	$\log L_f = 1.1794 \log L_s + 0.6534$			0.9767
	C	$\log L_f = 1.1999 \log L_s + 0.6276$			0.9835

continued

Table 17 (Continued)

Sept.-Nov., 1976	♀	$\log L_f = 1.3894 \log L_s + 0.3622$	0.5151(9) N.S.	16.1090(10)***	0.9147
	♂	$\log L_f = 1.5432 \log L_s + 0.1194$			0.9861
	C	$\log L_f = 1.4700 \log L_s + 0.2388$			0.9840
May-Aug., 1977	♀	$\log L_f = 1.0492 \log L_s + 0.8993$	0.0979(7) N.S.	2.3336(8)*	0.9082
	♂	$\log L_f = 0.9556 \log L_s + 0.9706$			0.9801
	C	$\log L_f = 1.0498 \log L_s + 0.8980$			0.9084
Southeast Arm, Plac.,					
June 1975	♀	$\log L_f = 1.2520 \log L_s + 0.5379$	0.7188(8) N.S.	9.4485(9)***	0.9566
	♂	$\log L_f = 1.1053 \log L_s + 0.7572$			0.9847
	C	$\log L_f = 1.1909 \log L_s + 0.6207$			0.9848
June 1976	♀	$\log L_f = 1.0915 \log L_s + 0.7892$	0.1723(12) N.S.	6.5368(13)***	0.9889
	♂	$\log L_f = 1.1265 \log L_s + 0.7224$			0.9649
	C	$\log L_f = 1.1660 \log L_s + 0.6759$			0.9869

test failed to detect where the differences were. However, North Harbour River, S.M.B. had the highest slope value and Northeast River the lowest; for intercepts, North Harbour River, S.M.B. again was highest with Southeast River lowest. Comparing inward runs in 1977, no significant differences were noted for slopes (Appendix 9c). Females and combined had significant F values for intercepts; again the Newman-Keuls test failed to locate the differences (North Harbour River, P.B. was highest for females and combined; Southeast River was lowest for females and North Harbour River, S.M.B. lowest for combined).

Northeast River females (outward) had a significantly higher slope than North Harbour River, S.M.B. in 1976; the male intercept value was significantly higher for the latter (Appendix 9d).

Comparisons between 1976 and 1977 for outward and inward runs are shown in Appendix 9e. Slopes differed significantly on one occasion only (outward females on North Harbour River, S.M.B.). Intercepts were significantly different in nearly all cases.

A significant F value was found for male slopes (September-November 1976 was significantly higher than the remainder which were in turn not different from each other) compared between sampling dates in Northeast Arm, Placentia (Appendix 9f); for intercepts, differences (not detected by the Newman-Keuls test) were significant for females and combined (June 1975 highest and September-November 1976 lowest in both cases). In Southeast Arm, there were no significant differences in slopes for sexes separate and combined between 1975 and 1976 with the reverse true for intercepts (Appendix 9e).

Northeast Arm versus Southeast Arm, Placentia in June 1975 and June 1976 showed no significant differences in slopes (Appendix 9g);

intercepts differed significantly for sexes separate and combined in 1975 whereas in 1976 it was for females only.

Comparison of Northeast River with a sample taken in its estuary (Northeast Arm) for the same sampling period (Appendix 9d) revealed no differences in slopes with the reverse true for intercepts.

Salmo trutta

The log-log regressions of body length on scale length for all samples as well as within sample comparison of males versus females are presented in Table 18. No significant differences were observed for slopes while intercepts differed in every case except Colinet. No consistent trends in favor of either sex were noted for intercepts.

Outward versus inward runs on North Harbour River, S.M.B. (Appendix 10a) showed no significant differences for slopes with the reverse true for intercepts. The latter were consistently higher in the outward run.

There were no significant differences for slopes for sexes separate and combined when areas are compared in 1977 (Appendix 10b). For intercepts, the combined sample had a significant F value (differences not detected by the Newman-Keuls test; Colinet highest and Northeast Arm lowest). There were no significant differences in slopes between 1976 and 1977 on North Harbour River, S.M.B.; the reverse occurred for intercepts where 1976 was consistently higher (Appendix 10c). North Harbour River, S.M.B. (inward run) and Northeast Arm, Placentia are compared in 1976 in Appendix 10C; slopes were significantly higher for the latter for sexes separate and combined.

Table 18. The log-log regression equations of body length on scale length for each sample of *Salmo trutta*. Included also are within sample comparisons of males versus females for slopes and intercepts (t test). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		Regression	t: Slopes (b)	t: Intercepts (a)	r
North Hr. Riv., S.M.B.					
Outward, 1976	♂	–			–
	♀	–	–	–	–
	C	$\log L_f = 0.9131 \log L_s + 0.7379$			0.9972
Inward, 1976	♂	$\log L_f = 0.9366 \log L_s + 0.6911$	0.0921(18)N.S.	2.6903(19)*	0.9614
	♀	$\log L_f = 0.9259 \log L_s + 0.6952$			0.9843
	C	$\log L_f = 1.0161 \log L_s + 0.5405$			0.9954
Outward, 1977	♂	$\log L_f = 0.9416 \log L_s + 0.6506$	0.5798(10)N.S.	18.7520(11)***	0.9636
	♀	$\log L_f = 1.0175 \log L_s + 0.5515$			0.9919
	C	$\log L_f = 0.9940 \log L_s + 0.5740$			0.9665
Inward, 1977	♂	$\log L_f = 1.0612 \log L_s + 0.4611$	0.5920(24)N.S.	17.3448(25)***	0.9866
	♀	$\log L_f = 1.0214 \log L_s + 0.5367$			0.9945
	C	$\log L_f = 1.0615 \log L_s + 0.4599$			0.9915
Northeast Arm, Plac.					
June-Nov., 1976	♂	$\log L_f = 1.2649 \log L_s + 0.0270$	1.0134(23)N.S.	14.8298(24)***	0.9632
	♀	$\log L_f = 1.1421 \log L_s + 0.2689$			0.9808
	C	$\log L_f = 1.1853 \log L_s + 0.1837$			0.9799
May-Aug., 1977	♂	$\log L_f = 1.0598 \log L_s + 0.4295$	0.3396(20)N.S.	4.1944(21)***	0.9678
	♀	$\log L_f = 1.1020 \log L_s + 0.3504$			0.9697
	C	$\log L_f = 1.0655 \log L_s + 0.4240$			0.9679
Colinet Hr. and Arm					
May-Oct., 1977	♂	$\log L_f = 0.9402 \log L_s + 0.6996$	0.3976(19)N.S.	1.4184(20)N.S.	0.9498
	♀	$\log L_f = 0.9914 \log L_s + 0.5890$			0.9803
	C	$\log L_f = 0.9519 \log L_s + 0.6777$			0.9650

Back-calculation of Growth

Salvelinus fontinalis

The body length-scale length relationships used for back-calculation were derived by combining all available data for each area. These relationships (logarithmic form) are given in Table 19.

Mean back-calculated length at annulus formation and growth for each area in terms of freshwater life versus sea life (grouped according to smolt age and using only repeat migrants), overall freshwater life (using all specimens) and overall freshwater and sea life combined (total age) are presented in Tables 20-27. Growth of specimens displaying alternating freshwater and sea life is not included.

The effect of first sea sojourn is readily demonstrated by the sudden increase in growth increment and relative growth compared to the situation in freshwater.

As seen earlier, mean length at time of capture for all smolt age groups on North Harbour River, S.M.B. was significantly lower than all other areas. Thus the amount of "plus growth" for the time of year in question was considerably lower for North Harbour River, S.M.B. If, on the other hand, calculated lengths at annulus formation are examined, it can be readily seen that freshwater growth for North Harbour River, S.M.B. compares quite favorably with other areas and in fact surpasses some. The comparable portion of the yearly growth increment is therefore attained later in the growing season on North Harbour River, S.M.B.

Salmo trutta

Just as for brook trout, body length-scale length relationships used for back-calculation were derived by combining data for each area

Table 19. Regression equations used for the back-calculation of growth in length for *Salvelinus fontinalis* from each area (all data for each area combined).

Sampling Area	Regression	r
North Hr. Riv., S.M.B.	$\log L_f = 1.0691 \log L_s + 0.8350$	0.9967
Beaver Riv.	$\log L_f = 1.1221 \log L_s + 0.7320$	0.9926
Southeast Riv.	$\log L_f = 1.0329 \log L_s + 0.8638$	0.9758
Northeast Riv.	$\log L_f = 1.0424 \log L_s + 0.8650$	0.9777
Come By Chance Riv.	$\log L_f = 1.1800 \log L_s + 0.7043$	0.9656
North Hr. Riv., P.B.	$\log L_f = 1.0629 \log L_s + 0.8465$	0.9801
Northeast Arm, Plac.	$\log L_f = 1.2998 \log L_s + 0.4902$	0.9828
Southeast Arm, Plac.	$\log L_f = 1.2193 \log L_s + 0.5863$	0.9849

Table 20. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salvelinus fontinalis* from North Harbour River, S.M.B. Presented also are growth increments (mm) and relative growth (%).

	N	Calculated Length and Growth at Successive Annuli				
		1	2	3	4	5
Freshwater vs. Sea life						
1st 2 Years in freshwater	101	47.9	96.8	*183.6	231.0	268.9
Increment			48.9	86.8	47.4	37.9
Rel. Growth			102.1	89.7	25.8	16.4
1st 3 Years in freshwater	42	41.8	93.8	140.8	*226.4	300.0
Increment			52.0	47.0	85.6	73.6
Rel. Growth			124.4	50.1	60.8	32.5
1st 4 Years in freshwater	11	44.7	97.2	145.3	192.7	*271.4
Increment			52.5	48.1	47.4	78.7
Rel. Growth			117.5	49.5	32.6	40.8
Overall Freshwater Life	1,206	49.6	103.0	148.2	199.6	223.7
Increment			53.4	45.2	51.4	24.1
Rel. Growth			107.7	43.9	34.7	12.1
Overall F.W. and Sea Life Combined (Total Age)	1,206	49.6	103.2	153.6	208.0	254.7
Increment			53.6	50.4	54.4	46.7
Rel. Growth			108.1	48.8	35.4	22.5

*First year of sea life

Table 21. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for Salvelinus fontinalis from Beaver River. Presented also are growth increments (mm) and relative growth (%).

	N	Calculated Length and Growth at Successive Annuli						
		1	2	3	4	5	6	7
Freshwater vs. Sea life								
1st 2 Years in freshwater	86	40.4	84.1	*172.8	239.6	339.2	377.7	
Increment			43.7	88.7	66.8	99.6	37.8	
Rel. Growth			108.2	105.5	38.6	41.6	11.1	
1st 3 Years in freshwater	41	40.6	82.4	127.6	*213.3	279.1	365.5	426.6
Increment			41.8	45.2	85.7	65.8	86.4	61.1
Rel. Growth			103.0	54.9	67.2	30.9	31.0	16.7
1st 4 Years in freshwater	19	42.6	93.3	140.0	190.4	*281.8	368.4	516.1
Increment			50.7	46.7	50.4	91.4	86.6	147.7
Rel. Growth			119.0	50.1	36.0	48.0	30.7	40.1
1st 5 Years in freshwater	16	39.7	84.3	129.4	171.4	216.9	*307.0	
Increment			44.6	45.1	42.0	45.5	90.1	
Rel. Growth			112.3	53.5	32.5	26.6	41.5	
1st 6 Years in freshwater	5	36.7	83.7	128.9	177.8	230.2	284.1	*371.9
Increment			47.0	45.2	48.9	52.4	53.9	87.8
Rel. Growth			130.6	54.0	37.9	29.5	23.4	30.9
Overall Freshwater Life	1,041	42.4	90.2	139.9	182.5	220.0	267.7	371.2
Increment			47.8	49.7	42.6	38.3	46.9	103.5
Rel. Growth			112.7	55.1	30.5	21.0	21.2	38.7
Overall F.W. and Sea Life Combined (Total Age)	1,041	42.4	90.2	143.1	185.8	232.8	288.8	388.9
Increment			47.8	52.9	42.7	47.0	56.0	100.1
Rel. Growth			112.7	58.7	29.8	25.3	24.1	34.7

*First year of sea life

Table 22. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salvelinus fontinalis* from Southeast River. Presented also are growth increments (mm) and relative growth (%).

	N	Calculated Length and Growth at Successive Annuli					
		1	2	3	4	5	6
Freshwater vs. Sea Life							
1st 2 Years in freshwater	16	46.1	93.0	*177.7			
Increment			46.9	84.7			
Rel. Growth			101.7	91.1			
1st 3 Years in freshwater	6	47.7	84.8	126.1	*206.4	262.5	350.1
Increment			37.1	41.3	80.3	56.1	87.6
Rel. Growth			77.8	48.7	63.7	27.2	33.4
1st 4 Years in freshwater	9	43.7	84.8	123.3	163.4	*246.2	320.8
Increment			41.1	38.5	40.1	82.8	74.6
Rel. Growth			94.1	45.4	32.5	50.7	30.3
Overall Freshwater Life	340	50.6	102.7	147.6	183.3	221.3	266.0
Increment			52.1	44.9	35.7	38.0	44.7
Rel. Growth			103.0	43.7	24.2	20.7	20.2
Overall F.W. and Sea Life Combined (Total Age)	340	50.6	102.7	149.4	184.5	228.4	293.6
Increment			52.1	46.7	35.1	43.9	65.2
Rel. Growth			103.0	45.5	23.5	23.8	28.6

*First year of sea life

Table 23. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salvelinus fontinalis* from Northeast River. Presented also are growth increments (mm) and relative growth (%). The case where N = 1 is included for comparison.

	N	Calculated Length and Growth at Successive Annuli 1	2	3	4	5	6
Freshwater vs. Sea Life							
1st Year in freshwater	2	58.3	*183.7				
Increment			125.4				
Rel. Growth			215.1				
1st 2 Years in freshwater	19	42.5	80.6	*162.4	231.5	328.9	
Increment			38.1	81.8	69.1	97.4	
Rel. Growth			89.7	101.5	42.6	42.1	
1st 3 Years in freshwater	1	46.0	79.2	113.4	*183.7		
Increment			33.2	34.2	70.3		
Rel. Growth			72.2	43.2	62.0		
Overall Freshwater Life	438	47.9	96.4	137.6	183.5	220.0	264.7
Increment			48.5	41.2	45.9	36.7	44.5
Rel. Growth			101.3	42.7	33.4	20.0	20.2
Overall F.W. and Sea Life Combined (Total Age)	438	47.9	96.8	141.1	187.4	224.6	264.7
Increment			48.9	44.3	46.3	37.2	40.1
Rel. Growth			102.1	45.8	32.8	19.9	17.9

*First year of sea life.

Table 24. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salvelinus fontinalis* from Come By Chance River. Presented also are growth increments (mm) and relative growth (%). Cases where N = 1 are included for comparison.

	N	Calculated Length and Growth of Successive Annuli 1	2	3	4	5
Freshwater vs. Sea Life						
1st 2 Years in freshwater	1	47.7	82.8	*182.5		
Increment			35.1	99.7		
Rel. Growth			73.6	120.4		
1st 3 Years in freshwater	1	31.5	73.7	120.9	*193.2	
Increment			42.2	47.2	72.3	
Rel. Growth			134.0	64.0	59.8	
1st 4 Years in freshwater	1	39.5	82.8	111.2	141.0	*225.9
Increment			43.3	28.4	29.8	84.9
Rel. Growth			109.6	34.3	26.8	60.2
Overall Freshwater Life	104	43.4	90.5	137.1	186.2	233.0
Increment			47.1	46.6	49.0	46.8
Rel. Growth			108.5	51.5	35.8	25.1
Overall F.W. and Sea Life Combined (Total age)	104	43.4	90.5	137.6	186.4	232.4
Increment			47.1	47.1	48.8	46.0
Rel. Growth			108.5	52.0	35.5	24.7

*First year of sea life

Table 25. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for Salvelinus fontinalis from North Harbour River, P.B. Presented also are growth increments (mm) and relative growth (%). The case where N = 1 is included for comparison.

	N	Calculated Length and Growth at Successive Annuli				
		1	2	3	4	5
Freshwater vs. Sea Life						
1st 2 Years in freshwater	2	63.3	117.4	*225.0		
Increment			54.1	107.6		
Rel. Growth			85.5	91.7		
1st 4 Years in freshwater	1	46.5	97.9	133.4	178.8	*262.2
Increment			51.4	35.5	45.4	83.6
Rel. Growth			110.5	36.3	34.0	46.8
Overall Freshwater life	48	52.0	99.9	141.4	183.0	253.0
Increment			47.9	41.5	41.6	70.0
Rel. Growth			92.1	41.5	29.4	38.3
Overall F.W. and Sea Life Combined (Total Age)	48	52.0	100.0	146.1	183.4	257.7
Increment			48.0	46.1	37.3	74.3
Rel. Growth			92.3	46.1	25.5	40.5

*First year of sea life

Table 26. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for <u>Salvelinus</u> <u>fontinalis</u> from Northeast Arm, Placentia. Presented also are growth increments (mm) and relative growth (%).

	N	Calculated Length and Growth at Successive Annul					
		1	2	3	4	5	6
Freshwater vs. Sea Life							
1st 2 Years in freshwater	4	32.3	76.6	*183.6			
Increment			44.3	107.0			
Rel. Growth			137.2	139.7			
1st 4 Years in freshwater	2	37.5	93.9	155.5	218.3	*321.4	
Increment			56.4	61.6	62.8	103.1	
Rel.Growth			150.4	65.6	40.4	47.2	
Overall Freshwater Life	411	40.1	90.7	136.9	177.9	223.8	288.0
Increment			50.6	46.2	41.0	45.9	64.2
Rel. Growth			126.2	50.9	30.0	25.8	28.7
Overall F.W. and Sea Life Combined (Total Age)	411	40.1	90.7	137.5	178.7	235.8	291.9
Increment			50.6	46.8	41.2	57.1	56.1
Rel. Growth			126.2	51.6	30.0	32.0	23.8

*First year of sea life

Table 27. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life are combined for *Salvelinus fontinalis* from Southeast Arm, Placentia. Presented also are growth increments (mm) and relative growth (%). The case where N=1 is included for comparison.

	N	Calculated Length and Growth at Successive Annuli						
		1	2	3	4	5	6	7
Freshwater vs. Sea Life								
1st 2 Years in freshwater	6	40.2	85.2	*173.9	233.6	315.8		
Increment			45.0	88.7	59.7	82.2		
Rel. Growth			111.9	104.1	34.3	35.2		
1st 3 Years in freshwater	2	23.3	58.7	103.3	*184.8	274.1		
Increment			35.4	44.6	81.5	89.3		
Rel. Growth			151.9	76.0	78.9	48.3		
1st 4 Years in freshwater	1	26.5	54.9	94.8	129.4	*204.0	284.4	
Increment			28.4	39.9	34.6	74.6	80.4	
Rel. Growth			107.2	72.7	36.5	57.7	39.4	
1st 5 Years in freshwater	2	33.2	82.4	142.9	194.4	233.6	*331.7	
Increment			49.2	60.5	51.5	39.2	98.1	
Rel. Growth			148.2	73.4	36.0	20.2	42.0	
Overall Freshwater Life	157	41.5	93.6	138.3	174.2	237.4	297.5	337.1
Increment			52.1	44.7	35.9	63.2	60.1	39.6
Rel. Growth			125.5	47.8	26.0	36.3	25.3	13.3
Overall Freshwater and Sea Life Combined (Total Age)	157	41.5	93.6	141.5	181.7	254.2	317.2	337.1
Increment			52.1	47.9	40.2	72.5	63.0	19.9
Rel. Growth			125.5	51.2	28.4	39.9	24.8	6.3

* First year of sea life

and these are presented in Table 28. The same groupings used for the brook trout presentation also apply to brown trout and are shown in Tables 29-31. The effect on growth of going to sea is quite apparent for this species also. Freshwater growth beyond the second year was consistently slower for North Harbour River, S.M.B.

Spawning Times and Spawning Areas

Salvelinus fontinalis

Spawning occurred during the first three weeks of October in 1976 on Come By Chance River and North Harbour River, S.M.B.; for Southeast River, it was the first three weeks of November. Spot checks for each area in 1977 showed spawning times to more or less coincide with the previous season.

A redd count conducted on Come by Chance River in November of 1972 and 1973 revealed a total of 49 for the former year and 98 for the latter in the headwaters region. Of these, all but 13 in 1972 and 12 in 1973 were located in the electroshocked area (Fig. 5). Two Atlantic salmon (Salmo salar) redds were found in this area in 1972 and 1 in 1973. There was no evidence of salmon spawning activity in 1976 although it could have occurred later. It is possible that this spawning area was used almost exclusively by brook trout. Other salmon redds in 1972 and 1973 (11 and 34 respectively) were located further downstream. Gravel size in which brook trout spawned ranged from 10 to 30 mm.

On Southeast River, brook trout spawned in the electroshocked area shown in Fig. 3. Salmon spawned in the same area and at the same time (several redds were noticed and precocious male parr were plentiful). Salmon spawned in gravel areas in the main flow of the river. Trout, on

Table 28. Regression equations used for the back-calculation of growth in length for *Salmo trutta* from each area (all data for each area combined).

Sampling Area	Regression	r
North Hr. Riv., S.M.B.	$\log L_f = 1.0067 \log L_s + 0.5653$	0.9960
Northeast Arm, Plac.	$\log L_f = 1.1369 \log L_s + 0.2811$	0.9823
Colinet Hr. and Riv.	$\log L_f = 0.9512 \log L_s + 0.6762$	0.9630

Table 29. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salmo trutta* from North Harbour River, S.M.B. Presented also are growth increments (mm) and relative growth (%).

	N	Calculated Length and Growth at Successive Annuli						
		1	2	3	4	5	6	7
Freshwater vs. Sea Life								
1st Year in freshwater	3	44.5	*130.0	211.2				
Increment			85.5	81.2				
Rel. Growth			192.1	62.5				
1st 2 Years in freshwater	27	38.4	99.8	*185.8	254.6	318.7		
Increment			61.4	86.0	68.8	64.1		
Rel. Growth			159.9	86.2	37.0	25.2		
1st 3 Years in freshwater	42	43.3	92.0	136.0	*221.5	317.9	385.1	444.7
Increment			48.7	44.0	85.5	96.4	67.2	59.6
Rel. Growth			112.5	47.8	62.9	43.5	21.1	15.5
1st 4 Years in freshwater	17	42.1	100.8	130.9	166.4	*252.9	398.6	
Increment			58.7	30.1	35.5	86.5	145.7	
Rel. Growth			139.4	29.9	27.1	52.0	57.6	
1st 5 Years in freshwater	2	29.6	69.0	116.2	157.9	207.4	*312.4	371.7
Increment			39.4	47.2	41.7	49.5	105.0	59.3
Rel. Growth			133.1	68.4	35.9	31.4	50.6	19.0
Overall Freshwater Life	482	40.3	91.0	122.8	166.3	202.3	222.6	260.7
Increment			50.7	31.8	43.5	36.0	20.3	38.1
Rel. Growth			125.8	35.0	35.4	21.7	10.0	17.1
Overall F.W. and Sea Life Combined (Total age)	482	40.3	91.2	128.4	195.5	270.3	357.3	369.6
Increment			50.9	37.2	67.1	74.8	87.0	12.3
Rel. Growth			126.3	40.8	52.2	38.3	32.2	3.4

*First year of sea life

Table 30. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salmo trutta* from Northeast Arm, Placentia. Presented also are growth increments (mm) and relative growth (%).

	N	Calculated Length and Growth at Successive Annuli							
		1	2	3	4	5	6	7	8
Freshwater vs Sea Life									
1st 2 Years in freshwater	11	37.2	88.8	*205.6	293.8	432.6			
Increment			51.6	116.8	88.2	138.8			
Rel. Growth			138.7	131.5	42.9	47.2			
1st 3 Years in freshwater	13	33.5	73.2	115.5	*236.8	338.2			
Increment			39.7	42.3	121.3	101.4			
Rel. Growth									
1st 4 Years in freshwater	5	34.5	69.6	115.9	164.9	*268.9			
Increment			35.1	46.3	49.0	104.0			
Rel. Growth			101.7	66.5	42.3	63.1			
Overall Freshwater Life	197	39.7	90.0	134.8	176.7	213.9	272.8	316.7	333.3
Increment			50.3	44.8	38.9	37.2	58.9	43.9	16.6
Rel. Growth			126.7	49.8	28.9	21.1	27.5	16.1	5.2
Overall Freshwater and Sea Life Combined (Total Age)	197	39.7	90.0	139.1	191.1	247.6	282.4	316.7	333.3
Increment			50.3	49.1	52.0	56.5	34.8	34.3	16.6
Rel. Growth			126.7	54.6	37.4	29.6	14.1	12.2	5.24

* First year of sea life

Table 31. Mean back-calculated length (mm) at annulus formation in terms of freshwater life versus sea life, overall freshwater life alone and overall freshwater life and sea life combined for *Salmo trutta* from Colinet Harbour and River. Presented also are growth increments (mm) and relative growth (%). The case where N = 1 is included for comparison.

	N	Calculated Length and Growth at Successive Annuli										
		1	2	3	4	5	6	7	8	9	10	11
Freshwater vs. Sea Life												
1st 2 Years in freshwater	1	47.0	100.8	*215.2	336.3	415.4						
Increment			53.8	114.4	121.0	79.2						
Rel. Growth			114.5	113.5	56.2	23.6						
1st 3 Years in freshwater	14	43.1	86.3	134.2	*216.0	304.5	388.5					
Increment			43.2	47.9	81.8	88.5	84.0					
Rel. Growth			100.2	55.6	61.0	41.0	27.6					
1st 4 Years in freshwater	9	38.2	77.4	126.7	169.1	*258.1	333.0	401.6	[1]426.7	[1]524.4	[1]584.4	[1]629.4
Increment			39.2	49.3	42.4	89.0	71.9	68.6	26.1	97.7	60.0	45.0
Rel. Growth			102.6	63.7	33.5	52.6	27.9	20.6	6.25	22.9	11.4	7.7
Overall Freshwater Life	58	40.9	87.6	131.1	171.0	217.0	258.1					
Increment			46.7	43.5	39.9	46.0	41.1					
Rel. Growth			114.2	49.7	30.4	26.9	18.9					
Overall F.W. and Sea Life Combined (Total Age)	58	40.9	87.6	132.7	191.9	274.8	342.6	368.8				
Increment			46.7	45.1	59.2	82.9	67.8	26.2				
Rel. Growth			114.2	51.5	44.6	43.2	24.7	7.7				

*First year of sea life

[1]Based on a single specimen

the other hand, were confined to a semi-circular area out-pocketed off the main river where there was slow water movement and bottom type was of a sandy-silty consistency with some gravel.

No definite spawning concentrations of brook trout were detected on North Harbour River, S.M.B. even though there was ample gravel available in many areas. Mainly ripe and partly spent fish were taken in the electroshocked areas (Fig. 2) in early October but towards the end of that month only spent individuals were encountered. Time between sampling occasions (usually about one week) may have been the reason for not encountering a concentration; flooding conditions between sampling times may also have erased any sign of redds. It may be that spawning activity was more diffusely spread in this river compared with the other two.

Salmo trutta

No spawning concentrations of this species were located in any of the rivers studied. Federal Fisheries Conservation and Protection personnel reported seeing spawning activity in the vicinity of some of the lower pools on North Harbour River, S.M.B. during the last week in October and the first two weeks in November some years previous; they were also observed spawning around the same time in the lower reaches of the Colinet River.

Sex Ratios, Maturity and Length-Fecundity Relationship

Salvelinus fontinalis

Sex ratios in terms of overall samples are presented in Table 32 and analysed according to individual age groups in Appendix 1a-j. The

Table 32. Sex ratios in terms of overall samples for <u>Salvelinus fontinalis</u>.

Sampling Area	N ♀	N ♂	♀:♂	X^2 (df = 1)
North Hr. Riv., S.M.B.				
Outward, 1976	69	29	2.4: 1	16.3265***
Inward, 1976	75	36	2.1: 1	13.7027***
Outward, 1977	69	31	2.2: 1	14.4400***
Inward, 1977	72	25	2.9: 1	23.5102***
Beaver Riv.				
Outward, 1977	68	32	2.1: 1	12.9600***
Inward, 1977	88	25	3.5: 1	35.1239***
Southeast Riv.				
Outward, 1977	107	33	3.2: 1	39.1143***
Inward, 1977	37	8	4.6: 1	18.6889***
Northeast Riv.				
Outward, 1976	57	43	1.3: 1	1.9600 N.S.
Outward, 1977	68	44	1.6: 1	5.1429*
Come By Chance Riv.				
Inward, 1976	27	10	2.7: 1	7.8108**
Inward, 1977	49	20	2.5: 1	11.2000***
North Hr. Riv., P.B.				
Inward, 1977	29	19	1.5: 1	2.0833 N.S.
Northeast Arm, Plac.				
June, 1975	47	39	1.2: 1	0.7442 N.S.
June, 1976	63	42	1.5: 1	4.2000*
Sept.-Nov., 1976	73	64	1.1: 1	0.5912 N.S.
May-Aug., 1977	54	27	2.0: 1	9.0000**
Southeast Arm, Plac.				
June, 1975	72	31	2.3: 1	16.3203***
June, 1976	33	16	2.1: 1	5.8980*

X^2 test was used to determine significance of departure from an expected one to one ratio. In terms of overall samples, females outnumbered males in every case and with only a few exceptions (Northeast River 1976 and Northeast Arm, Placentia, June 1975 and September-November 1976) the differences were significant. Significant differences per age group were confined mainly to smolt/post-smolt and there was a certain amount of variation between areas and sampling times within a given area. Again, whether differences were significant or not, females outnumbered males in virtually all cases.

Percent composition of female maturity stages by age group and in terms of overall samples are presented for 1977 outward and inward runs in Table 33. The highest maturity rating reached in the outward runs was stage 1. The relative proportion of stage 0 and stage 1 (overall samples) varied between areas as did the composition by age group. The overall percentage of kelts ranged from 10.28 (Southeast River) to 26.76 (North Harbour River, S.M.B.); collectively (on the basis of scale analysis), the majority of these had spawned the previous fall as parr. The highest maturity for inward runs was stage 2. The overall percentage of this stage ranged from 12.68 (North Harbour River, S.M.B.) to 14.29 (Come By Chance River); post-smolt comprised the majority of specimens for all areas concerned except North Harbour River, S.M.B. where repeat migrants predominated. A number of fish that spawned the previous fall were detected in the Beaver River, Come By Chance River and North Harbour River, P.B. inward runs (3.41, 2.04 and 6.90% respectively overall). There was no evidence to suggest that these fish would have ripened for spawning in the fall of 1977.

Table 33. Percentage composition of each maturity stage by age group and in terms of overall samples (extreme right hand column) for female *Salvelinus fontinalis* in the 1977 outward and inward runs. N's are in parentheses

Area	Stage	Smolt/Post-smolt 1+/1.0+	2+/2.0+	3+/3.0+	4+/4.0+	5+/5.0+	6+/6.0+	7+/7.0+	Repeat Migrants 2.1+	2.2+	2.3+	3.1+	3.2+	3.3+
North Hr. Riv, SMB Outward	0	-	29.42(10)	38.24(13)	14.71(5)	-	-	-	8.82(3)	-	-	5.88(2)	2.94(1)	-
	1	1	-	44.44(8)	16.67(3)	5.56(1)	-	-	11.11(2)	-	-	16.67(3)	5.56(1)	-
	Kelt	-	-	31.58(6)	15.79(3)	-	-	-	-	10.53(2)	-	15.79(3)	-	-
Inward	0	-	50.00(9)	33.33(6)	16.67(3)	-	-	-	-	-	-	-	-	-
	1	-	9.09(4)	31.82(14)	25.00(11)	-	-	-	20.46(9)	2.22(1)	-	9.09(4)	-	-
	2	-	-	-	11.11(1)	-	-	-	-	22.22(2)	-	22.22(2)	11.11(1)	-
Beaver River Outward	0	-	25.00(2)	25.00(2)	12.50(1)	-	-	-	25.00(2)	-	-	12.50(1)	-	-
	1	-	7.84(4)	29.41(15)	27.45(14)	13.73(7)	3.92(2)	-	11.77(6)	-	-	5.88(3)	-	-
	Kelt	-	-	-	11.11(1)	22.22(2)	22.22(2)	-	11.11(1)	-	-	-	-	-
Inward	0	-	11.11(2)	33.33(6)	27.78(5)	-	-	-	22.22(4)	-	-	5.56(1)	-	-
	1	-	1.82(1)	29.10(16)	36.36(20)	14.55(8)	3.64(2)	-	5.46(3)	1.82(1)	-	-	1.82(1)	-
	2	-	-	-	8.33(1)	16.67(2)	25.00(3)	16.67(2)	-	-	-	-	-	-
	[1]S.P.F.	-	-	-	33.33(1)	-	-	-	-	-	-	-	-	-
Southeast River Outward	0	-	45.16(14)	41.94(13)	12.90(4)	-	-	-	-	-	-	-	-	-
	1	-	7.69(5)	46.15(30)	24.62(16)	4.62(3)	-	-	7.69(5)	-	-	3.08(2)	-	-
	Kelt	-	-	9.09(1)	63.64(7)	9.09(1)	-	-	-	-	-	-	-	9.09(1)
Inward	0	-	60.00(6)	30.00(3)	-	-	-	-	-	-	-	10.00(1)	-	-
	1	-	4.76(1)	9.52(2)	57.14(12)	19.05(4)	4.76(1)	-	4.76(1)	-	-	-	-	-
	2	-	-	-	60.00(3)	40.00(2)	-	-	-	-	-	-	-	-
Northeast River Outward	0	7.69(2)	57.69(15)	34.62(9)	-	-	-	-	-	-	-	-	-	-
	1	-	26.92(7)	53.85(14)	3.85(1)	-	-	-	11.54(3)	-	-	-	-	-
	Kelt	-	6.67(1)	33.33(5)	33.33(5)	26.67(4)	-	-	-	-	-	-	-	-
Come By Chance Riv. Inward	0	-	31.58(6)	63.16(12)	5.26(1)	-	-	-	-	-	-	-	-	-
	1	-	9.09(2)	59.09(13)	22.73(5)	4.55(1)	-	-	-	-	4.55(1)	-	-	-
	2	-	-	28.57(2)	57.14(4)	-	-	-	-	-	-	-	-	-
	[1]S.P.F.	-	-	-	-	-	-	-	100.00(1)	-	-	-	-	-
North Hr. Riv, P.B. Inward	0	-	40.00(6)	46.67(7)	13.33(2)	-	-	-	-	-	-	-	-	-
	1	-	-	41.67(5)	41.67(5)	-	-	-	16.67(2)	-	-	-	-	-
	[1]S.P.F.	-	-	50.00(1)	-	-	-	-	-	-	-	-	-	-

continued

[1] Spawned Previous Fall

Table 33 (Continued)

Area	Stage	Repeat Migrants (continued) 4.1+	5.1+	5.2+	6.1+		2.1.1+	2.1.2+	Percentage Comp. of Each Stage/Sample
North Hr. Riv., SHB Outward	0	-	-	-	-	-	-	-	47.89(34)
	1	-	-	-	-	-	-	-	25.35(18)
	Kelt	26.32(5)	-	-	-	-	-	-	26.76(19)
Inward	0	-	-	-	-	-	-	-	25.35(18)
	1	-	-	-	-	-	2.27(1)	-	61.97(44)
	2	22.22(2)	-	-	-	-	-	11.11(1)	12.68(9)
Beaver River Outward	0	-	-	-	-	-	-	-	11.77(8)
	1	-	-	-	-	-	-	-	75.00(51)
	Kelt	11.11(1)	22.22(2)	-	-	-	-	-	13.24(9)
Inward	0	-	-	-	-	-	-	-	20.46(18)
	1	3.64(2)	1.82(1)	-	-	-	-	-	62.50(55)
	2	16.67(2)	8.33(1)	8.33(1)	-	-	-	-	13.64(12)
	[1]S.P.F.	-	-	-	33.33(1)	-	-	-	3.41(3)
Southeast River Outward	0	-	-	-	-	-	-	-	28.97(31)
	1	4.62(3)	-	-	-	-	1.54(1)	-	60.75(65)
	Kelt	9.09(1)	-	-	-	-	-	-	10.28(11)
Inward	0	-	-	-	-	-	-	-	27.78(10)
	1	-	-	-	-	-	-	-	58.33(21)
	2	-	-	-	-	-	-	-	13.89(5)
Northeast River Outward	0	-	-	-	-	-	-	-	38.81(26)
	1	-	-	-	-	-	3.85(1)	-	38.81(26)
	Kelt	-	-	-	-	-	-	-	22.39(15)
Come By Chance Inward	0	-	-	-	-	-	-	-	38.78(19)
	1	-	-	-	-	-	-	-	44.90(22)
	2	14.29(1)	-	-	-	-	-	-	14.29(7)
	[1]S.P.F.	-	-	-	-	-	-	-	2.04(1)
North Hr. Riv, PB Inward	0	-	-	-	-	-	-	-	51.72(15)
	1	-	-	-	-	-	-	-	41.38(12)
	[1]S.P.F	50.00(1)	-	-	-	-	-	-	6.90(2)

Maturity data for outward and inward moving males in 1977 are presented in Table 34. Outgoing specimens were either immature or kelts. Overall percentages of the latter ranged from 33.33 (North Harbour River, S.M.B.) to 45.46 (Southeast River) and just as for females, the majority had spawned the previous fall as parr. Inward, the percentage of ripening fish varied from area to area (from 15.79 for North Harbour River, P.B. to 50.00 for Southeast River and Come By Chance River). Both ripening and immature fish were predominately post-smolt with some representation from repeat migrants. Specimens which spawned the previous fall were present in the Beaver River, Southeast River and Come By Chance inward runs (28.00, 12.50 and 10.00% respectively overall). Just as for females, there was no indication that these fish were maturing for 1977.

Maturity ratings for females captured in the sea are shown in Table 35. In 1976, the maximum maturity attained in June in Northeast Arm and Southeast Arm, Placentia was stage 1 (no fish which spawned the previous fall were taken); in September-November, the maximum maturity encountered in Northeast Arm was stage 3 while for Southeast Arm it was stage 1. Specimens displaying stages 2 and 3 in Northeast Arm were present in September only; these stages together comprised 22.22% of the overall sample. In 1977, specimens which spawned the previous fall were encountered in Northeast Arm in May. Percent composition of maturity stages was calculated only for the portion of the sample taken in July-August. Stages 2 and 3 together comprised 9.52% of the overall sample. The majority of fish in stages 2 and 3 in 1976 and 1977 were post-smolt.

Males taken in the sea (Table 36) were found to be ripening in June 1976 in both Northeast Arm and Southeast Arm (17.50 and 6.67%

Table 34. Percent composition of each maturity stage by age group and in terms of overall samples (extreme right hand column) for male *Salvelinus fontinalis* in the 1977 outward and inward runs. N's are in parentheses.

Area	Stage	Smolt/Post-smolt 1.+/1:0+	2.+/2:0+	3.+/3.0+	4.+/4.0+	5.+/5:0+	6.+/6.0+	Repeat Migrants 2.1+	3.1+	3.2+	4.1+	4.2+	5.1+
North Hr. Riv., SHB Outward	Immature	-	38.10(8)	42.86(9)	14.29(3)	-	-	-	-	4.76(1)	-	-	-
	Kelt	-	10.00(1)	20.00(2)	40.00(4)	10.00(1)	-	10.00(1)	-	10.00(1)	-	-	-
Inward	Immature	-	27.78(5)	55.56(10)	-	-	-	16.67(3)	-	-	-	-	-
	Ripening	-	-	12.50(1)	25.00(2)	12.50(1)	-	25.00(2)	12.50(1)	-	-	-	-
Beaver River Outward	Immature	-	11.11(2)	27.78(5)	38.89(7)	5.56(1)	-	11.11(2)	5.56(1)	-	-	-	-
	Kelt	-	-	7.14(1)	42.86(6)	21.43(3)	-	7.14(1)	-	7.14(1)	-	-	-
Inward	Immature	-	-	53.85(7)	30.77(4)	-	15.39(2)	-	-	-	-	-	-
	Ripening	-	-	-	40.00(2)	20.00(1)	-	-	-	-	-	20.00(1)	20.00(1)
	S.P.F.[1]	-	-	-	-	-	14.29(1)	42.86(3)	28.57(2)	-	-	-	-
Southeast River Outward	Immature	-	61.11(11)	27.78(5)	11.11(2)	-	-	-	-	-	-	-	-
	Kelt	-	-	60.00(9)	13.33(2)	6.67(1)	-	6.67(1)	-	-	6.67(1)	-	-
Inward	Immature	-	33.33(1)	-	66.67(2)	-	-	-	-	-	-	-	-
	Ripening	-	25.00(1)	-	-	25.00(1)	50.00(2)	-	-	-	-	-	-
	S.P.F.[1]	-	-	-	100.00(1)	-	-	-	-	-	-	-	-
Northeast River Outward	Immature	8.33(2)	58.33(14)	29.17(7)	4.17(1)	-	-	-	-	-	-	-	-
	Kelt	-	21.05(4)	21.05(4)	21.05(4)	15.79(3)	5.26(1)	15.79(3)	-	-	-	-	-
Come by Chance Inward	Immature	-	12.50(1)	37.50(3)	50.00(4)	-	-	-	-	-	-	-	-
	Ripening	-	-	20.00(2)	50.00(5)	30.00(3)	-	-	-	-	-	-	-
	S.P.F.[1]	-	-	-	100.00(2)	-	-	-	-	-	-	-	-
North Hr. Riv. P.B Inward	Immature	6.25(1)	37.50(6)	43.75(7)	6.25(1)	6.25(1)	-	-	-	-	-	-	-
	Ripening	-	-	-	100.00(3)	-	-	-	-	-	-	-	-

[1] Spawned Previous Fall

continued

Table 34 (Continued)

Area	Stage	Repeat Migrants (continued) 6.1+	2.1.1+	2.2.2+	Percent Comp. of Each Stage/Sample
North Hr. Riv., SHB					
Outward	Immature	-	-	-	66.67(21)
	Kelt	-	-	-	33.33(10)
Inward	Immature	-	-	-	69.23(18)
	Ripening	-	12.50(1)	-	30.77(8)
Beaver River					
Outward	Immature	-	-	-	56.25(18)
	Kelt	7.14(1)	7.14(1)	-	43.75(14)
Inward	Immature	-	-	-	52.00(13)
	Ripening	-	-	-	20.00(5)
	1S.P.F.	-	-	14.29(1)	28.00(7)
Southeast River					
Outward	Immature	-	-	-	54.56(18)
	Kelt	-	6.67(1)	-	45.46(15)
Inward	Immature	-	-	-	37.50(3)
	Ripening	-	-	-	50.00(4)
	1S.P.F.	-	-	-	12.50(1)
Come by Chance					
Inward	Immature	-	-	-	40.00(8)
	Ripening	-	-	-	50.00(10)
	1S.P.F.	-	-	-	10.00(2)
Northeast River					
Outward	Immature	-	-	-	55.81(24)
	Kelt	-	-	-	44.19(19)
North Hr. Riv., P.B.					
Inward	Immature	-	-	-	84.21(16)
	Ripening	-	-	-	15.79(3)

Table 35. Percent composition of each maturity stage by age group and in terms of overall samples (extreme right hand column) for female *Salvelinus fontinalis* taken at various times in Northeast Arm and Southeast Arm, Placentia in 1976 and 1977. N's are in parentheses.

Area	Stage	Post-smolt						Repeat Migrants								Percent Comp. of
		2.0^+	3.0^+	4.0^+	5.0^+	6.0^+	7.0^+	2.1^+	2.2^+	2.3^+	3.2^+	4.1^+	4.2^+	5.2^+	$2.1.2^+$	Each Stage/Sample
Northeast Arm, Placentia June 1976	0	14.63(6)	63.42(26)	17.07(7)	4.88(2)	-	-	-	-	-	-	-	-	-	-	65.08(41)
	1	-	40.91(9)	27.27(6)	22.73(5)	4.55(1)	-	-	-	-	-	-	-	-	4.55(1)	34.92(22)
Sept-Nov 1976	0	74.47(35)	21.28(10)	2.13(1)	-	-	-	2.13(1)	-	-	-	-	-	-	-	65.28(47)
	1	77.78(7)	11.11(1)	-	-	-	-	11.11(1)	-	-	-	-	-	-	-	12.50(9)
	2	50.00(5)	40.00(4)	10.00(1)	-	-	-	-	-	-	-	-	-	-	-	13.89(10)
	3	16.67(1)	50.00(3)	16.67(1)	16.67(1)	-	-	-	-	-	-	-	-	-	-	8.33(6)
May 1977	0	100.00(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	7.69(1)
	1	25.00(2)	63.00(5)	-	-	-	-	12.50(1)	-	-	-	-	-	-	-	61.54(8)
	[1]S.P.F.	-	25.00(1)	50.00(2)	-	-	-	-	-	-	-	25.00(1)	-	-	-	30.77(4)
July-Aug 1977	0	44.44(8)	55.56(10)	-	-	-	-	-	-	-	-	-	-	-	-	42.86(18)
	1	25.00(5)	55.00(11)	15.00(3)	-	-	-	5.00(1)	-	-	-	-	-	-	-	47.62(20)
	2	33.33(1)	33.33(1)	33.33(1)	-	-	-	-	-	-	-	-	-	-	-	7.14(3)
	3	-	100.00(1)	-	-	-	-	-	-	-	-	-	-	-	-	2.38(1)
Southeast Arm, Plac. June 1976	0	31.25(5)	56.25(9)	12.50(2)	-	-	-	-	-	-	-	-	-	-	-	48.49(16)
	1	-	29.41(5)	23.53(4)	5.88(1)	5.88(1)	5.88(1)	-	5.88(1)	5.88(1)	5.88(1)	-	5.88(1)	5.88(1)	-	51.52(17)
Sept-Nov 1976	0	25.00(3)	33.33(4)	41.67(5)	-	-	-	-	-	-	-	-	-	-	-	66.67(12)
	1	16.67(1)	16.67(1)	66.67(4)	-	-	-	-	-	-	-	-	-	-	-	33.33(6)

[1]Spawned Previous Fall

Table 36. Percent composition of each maturity stage by age group and in terms of whole samples (extreme right hand column) for male *Salvelinus fontinalis* taken at various times in Northeast Arm and Southeast Arm, Placentia in 1976 and 1977. N's are in parentheses.

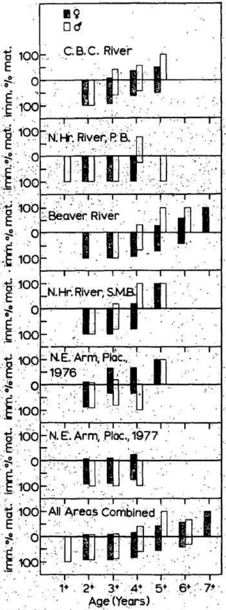
Area	Stage	Post-smolt						Repeat Migrants						Percent Comp. of Each
		2.0^+	3.0^+	4.0^+	5.0^+	6.0^+	7.0^+	2.1^+	3.2^+	$2.1.2^+$	$2.1.3^+$	$2.2.1^+$	$2.3.1^+$	Stage/Sample
Northeast Arm Placentia June 1976	Immature	18.18(6)	33.33(11)	33.33(11)	6.06(2)	3.03(1)	-	-	-	3.03(1)	-	3.03(1)	-	82.50(33)
	Ripening	-	42.86(3)	14.29(1)	14.29(1)	14.29(1)	-	-	-	-	14.29(1)	-	-	17.50(7)
Sept-Nov 1976	Immature	54.55(30)	38.18(21)	5.46(3)	-	-	-	1.82(1)	-	-	-	-	-	87.30(55)
	Ripening	37.50(3)	50.00(4)	-	12.50(1)	-	-	-	-	-	-	-	-	12.70(8)
May 1977	Immature	60.00(3)	40.00(2)	-	-	-	-	-	-	-	-	-	-	100.00(5)
July-Aug 1977	Immature	35.00(7)	60.00(12)	5.00(1)	-	-	-	-	-	-	-	-	-	90.91(20)
	[1]S.P.F	-	50.00(1)	50.00(1)	-	-	-	-	-	-	-	-	-	9.09(2)
Southeast Arm Placentia June 1976	Immature	21.43(3)	28.57(4)	28.57(4)	-	7.14(1)	7.14(1)	-	7.14(1)	-	-	-	-	93.33(14)
	Ripening	-	-	-	-	-	-	-	-	-	-	-	100.00(1)	6.67(1)
Sept-Nov, 1976	Immature	25.00(3)	33.33(4)	41.67(5)	-	-	-	-	-	-	-	-	-	100.00(12)

respectively overall); 12.20% of those in the September-November sample in Northeast Arm (present in September only) were nearly ripe while all were immature in Southeast Arm. Virtually all specimens were post-smolt. In 1977, fish that spawned the previous fall were taken in July in Northeast Arm. There were no indications that they would have ripened for the spawning season in 1977.

As already seen, age at first maturity in terms of total age for both sexes as determined from specimens captured on the spawning grounds (Fig. 20 and Appendix 1k) was 2^+. The smallest mature female encountered was 126 mm (North Harbour River, S.M.B.); the smallest male was 112 mm (Southeast River). Both of these specimens were parr. The smallest female spawning in the post-smolt year (2.0^+) was 144 mm (Come By Chance River); the smallest male (2.0^+) was 121 mm (Southeast River). Data in Tables 33-36 (specimens taken during inward runs and in the sea from July-August onward considered only) are summarized in terms of total age as percent mature versus percent immature in Fig. 26. For North Harbour River, S.M.B. and Come By Chance River, age at first maturity as determined from inward migrants was higher than indicated by specimens captured on the spawning grounds. This could be due to the relatively small numbers of ripening specimens encountered in the former sampling situation compared with larger samples drawn from concentrations of spawning fish in the latter. When all areas are combined, age at first maturity (2^+) was the same as observed for spawning ground specimens.

Except for Northeast Arm, Placentia, the percentage of mature males in a given age group tended to be higher than that of females. Males were 100% mature at age 4^+ for North Harbour River, S.M.B. and 5^+ for Come By Chance River, Beaver River and Northeast Arm, Placentia (1976).

Fig. 26. Percentage of immature and mature Salvelinus fontinalis for areas separate and combined in terms of total age.


♀
♂
C.B.C. River
N.Hr. River, P.B.
Beaver River
N.Hr. River, S.M.B.
N.E. Arm, Plac., 1976
N.E. Arm, Plac., 1977
All Areas Combined
imm. % mat.
100
0
100
1+ 2+ 3+ 4+ 5+ 6+ 7+
Age (Years)

Females were 100% mature at 5^+ years of age for North Harbour River, S.M.B. and Northeast Arm, Placentia (1976); this did not occur until 7^+ for Beaver River. For all areas combined, 100% of males were mature at 5^+ while for females it was 7^+.

No definite spawning marks were found on any of the scales examined. Gonad examination failed to establish whether or not any of the specimens taken on the spawning grounds had spawned previously.

The fork length-fecundity relationship (determined by combining data from different areas) is shown exponentially in Fig. 27. The logarithmic form of the equation is $\log F = 2.3837 \log L - 3.0656$.

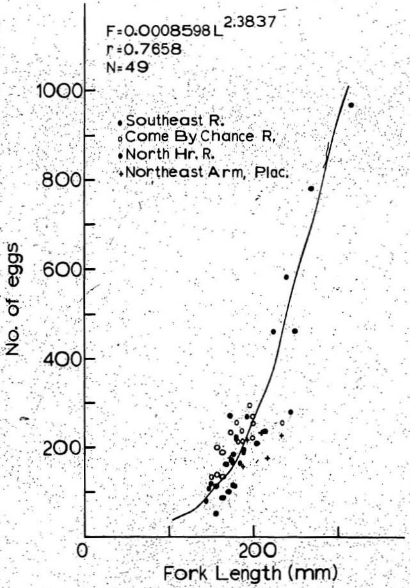
Salmo trutta

Sex ratios in terms of overall samples are presented in Table 37 and analysed according to individual age groups in Appendix 2a-d. Overall for North Harbour River, S.M.B. and Colinet River, females outnumbered males but not significantly while the reverse was true for Northeast Arm, Placentia. Taken per age group, in Northeast Arm, Placentia, males outnumbered females in virtually all cases (not significantly so) while for the other two areas there was no apparent trend in favor of either sex.

Maturity data for females are presented in Table 38. Stages 0 and 1 comprised 94.83 and 5.17% respectively of the outward run on North Harbour River, S.M.B. in 1977; the majority were smolt with only a few specimens beyond the type 2 post-smolt stage represented. No kelts were observed. In the 1976 inward run, stages 2 and 4 comprised 20.84% of the total and consisted of specimens beyond the type 2 post-smolt stage; stages 0 and 1 were nearly equally present as type 1 post-smolt and those beyond the type 2 post-smolt stage. In 1977 (inward), stages 2 and 3 (22.81% of whole sample) were confined mainly to specimens beyond the type 2 post-smolt stage. Stages 0 and 1 were present as type 1 post-smolt and specimens beyond the type 2 post-smolt stage with the former predominating. A total of 2 specimens which spawned the previous fall were encountered in this run (both beyond the type 2 post-smolt stage) and both showed no evidence of ripening for the spawning season in 1977. In Northeast Arm, Placentia, stages 2-4 comprised 26.00% of the total in September-November 1976 with nearly equal numbers present as type 1 post-smolt (specimens beyond stage 2 would have spawned in the year in question and hence the post-smolt type can be designated) and those beyond the type 2 post-smolt stage; except for one instance (the 4.1^{+} age group), stages 0 and 1 were post-smolt (type unknown). In 1977 (only specimens taken in July-August considered in the Table), stage 3 individuals constituted 22.22% of the overall sample and were again equally present as type 1 post-smolt and those beyond the type 2 post-smolt stage. Stages 0 and 1 were mainly post-smolt (type unknown). For the Colinet sample (only specimens taken in August-October considered), stages 0 and 1 (51.72% overall) were predominately post-smolt (type unknown) and specimens caught in freshwater in the type 1 post-smolt year. Stages 3-5 (42.42% overall) were primarily beyond the type 2 post-smolt stage. Two out of four specimens taken in salt water in May had spawned the previous fall and both were beyond the type 2 post-smolt stage (3.2^{+} and 3.3^{+}). The other two were stage 0.

All males in the outward run on North Harbour River, S.M.B. in 1977 were immature (Table 39) and with one exception (in the 3.1^{+} age group) were all smolt. Only 11.11% of inward males in 1976 were ripening (all

Fig. 27. Length-fecundity relationship for Salvelinus fontinalis (data combined from different areas).



F=0.0008598L^2.3837
r=0.7658
N=49
• Southeast R.
○ Come By Chance R.
• North Hr. R.
+ Northeast Arm, Plac.
1000
800
600
400
200
No. of eggs
0
200
Fork Length (mm)

Table 37. Sex ratios in terms of overall samples for <u>Salmo trutta</u>

Sampling Area	N ♀	N ♂	♀:♂	X^2 (df = 1)
North Hr. Riv., S.M.B.				
Inward, 1976	24	27	0.9: 1	0.1765 N.S.
Outward, 1977	59	57	1.0: 1	0.0345 N.S.
Inward, 1977	58	44	1.3: 1	1.9216 N.S.
Northeast Arm, Plac.				
June-Nov., 1976	53	74	0.7: 1	3.4724 N.S.
May-Aug., 1977	28	41	0.7: 1	2.4493 N.S.
Colinet Hr. and Riv.	33	25	1.3: 1	2.4828 N.S.

Table 38. Percent composition of each maturity stage by age group and in terms of overall samples (extreme right hand column) for female *Salmo trutta* taken in outward and inward runs (North Harbour River, SHB) and also in the sea (Northeast Arm, Placentia and Colinet Harbour) in 1976 and 1977. N's are in parentheses.

Area	Stage	Smolt/Post-smolt (type 1 and type unknown)							Beyond Post-smolt Stage (type 2)						
		$2.^+/2.0^+$	$3.^+/3.0^+$	$4.^+/4.0^+$	$5.^+/5.0^+$	$6.^+/6.0^+$	$7.^+/7.0^+$	$8.^+/8.0^+$	1.2^+	2.1^+	2.2^+	2.3^+	2.4^+	3.1^+	3.2^+
North Hr. Riv SHB 1976 Inward	0	-	50.00(7)	14.29(2)	-	-	-	-	7.14(1)	-	14.29(2)	-	-	-	7.14(1)
	1	-	-	-	-	-	-	-	-	-	-	40.00(2)	-	40.00(2)	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-	-	-	50.00(2)	-	-	25.00(1)
North Hr. Riv SHB 1977 Outward	0	65.46(36)	30.91(17)	-	-	-	-	-	-	-	-	-	-	1.82(1)	-
	1	-	-	33.33(1)	-	-	-	-	-	33.33(1)	-	-	-	-	-
" " " Inward	0	48.65(18)	24.32(9)	13.51(5)	2.70(1)	-	-	-	-	2.70(1)	-	-	-	5.41(2)	0
	1	-	-	-	-	-	-	-	-	-	20.00(1)	-	-	40.00(2)	20.00(1)
	2	-	-	-	-	-	14.29(1)	-	-	-	14.29(1)	-	-	28.57(2)	-
	3	-	-	-	-	-	-	-	-	-	-	16.67(1)	16.67(1)	-	50.00(3)
	[1]S.P.F.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeast Arm Placentia Sept-Nov 1976	0	19.36(6)	48.39(15)	25.81(8)	6.45(2)	-	-	-	-	-	-	-	-	-	-
	1	-	16.67(1)	33.33(2)	33.33(2)	-	-	-	-	-	-	-	-	-	-
	2	-	-	100.00(1)	-	-	-	-	-	-	-	-	-	-	-
	3	-	25.00(1)	50.00(2)	25.00(1)	-	-	-	-	-	-	-	-	-	-
	4	-	-	12.50(1)	-	12.50(1)	-	-	-	-	12.50(1)	-	12.50(1)	-	37.50(3)
" May-Aug 1977	0	-	38.89(7)	22.22(4)	33.33(6)	5.56(1)	-	-	-	-	-	-	-	-	-
	1	-	-	33.33(1)	66.67(2)	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	16.67(1)	16.67(1)	16.67(1)	-	-	-	16.67(1)	-	-	33.33(2)
*Colinet Hr. and River	0	10.00(1)	50.00(5)	20.00(2)	10.00(1)	-	-	-	-	-	-	-	-	10.00(1)	-
	1	-	-	20.00(1)	20.00(1)	20.00(1)	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	-	-	25.00(1)	-	25.00(1)	-	-	-	-	-	-	-	25.00(1)
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	20.00(1)

* Specimens taken in salt water (August) and freshwater (September-October) combined

[1] Spawned Previous Fall

continued

Table 38 (Continued)

Area	Stage	Beyond Post-smolt Stage (type 2)-continued 3.3^+	3.4^+	4.1^+	4.2^+	4.3^+	4.7^+	5.1^+	5.2^+	Percentage Comp of Each Stage/ Sample
North Hr. Riv SHB 1976 Inward	0	-	-	7.14(1)	-	-	-	-	-	58.33(14)
	1	-	-	20.00(1)	-	-	-	-	-	20.83(5)
	2	-	-	-	-	100.00(1)	-	-	-	4.17(1)
	3	-	-	-	-	-	-	-	-	
	4	-	-	25.00(1)	-	-	-	-	-	16.67(4)
North Hr. Riv SHB 1977 Outward	0	-	-	1.82(1)	-	-	-	-	-	94.83(55)
	1	-	-	33.33(1)	-	-	-	-	-	5.17(3)
" " " Inward	0	-	-	2.70(1)	-	-	-	-	-	64.91(37)
	1	-	-	-	20.00(1)	-	-	-	-	8.77(5)
	2	14.29(1)	-	-	14.29(1)	-	-	14.29(1)	-	12.28(7)
	3	-	-	-	-	-	-	-	16.67(1)	10.53(6)
	[1] S.P.F.	-	50.00(1)	50.00(1)	-	-	-	-	-	3.51(2)
Northeast Arm Placentia Sept-Nov 1976	0	-	-	-	-	-	-	-	-	62.00(31)
	1	-	-	16.67(1)	-	-	-	-	-	12.00(6)
	2	-	-	-	-	-	-	-	-	2.00(1)
	3	-	-	-	-	-	-	-	-	8.00(4)
	4	-	-	12.50(1)	-	-	-	-	-	16.00(8)
May-Aug 1977	0	-	-	-	-	-	-	-	-	66.67(18)
	1	-	-	-	-	-	-	-	-	11.11(3)
	3	-	-	-	-	-	-	-	-	22.22(6)
* Colinet Hr. and River	0	-	-	-	-	-	-	-	-	34.48(10)
	1	-	-	-	20.00(1)	-	20.00(1)	-	-	17.24(5)
	2	-	-	-	-	-	-	-	-	-
	3	60.00(3)	20.00(1)	-	-	20.00(1)	-	-	-	17.24(5)
	4	-	-	-	-	25.00(1)	-	-	-	13.79(4)
	5	-	20.00(1)	-	60.00(3)	-	-	-	-	17.24(5)

Table 39. Percent composition of each maturity stage by age group and in terms of overall samples (extreme right hand column) for male *Salmo trutta* taken in outward and inward runs (North Harbour River, S.H.B.) and in the sea (Northeast Arm, Placentia and Colinet Harbour) in 1976. N's are in parentheses.

Area	Stage	Smolt/Post-smolt (type 1 and type unknown)							
		$1.^+/1.0^+$	$2.^+/2.0^+$	$3.^+/3.0^+$	$4.^+/4.0^+$	$5.^+/5.0^+$	$6.^+/6.0^+$	$7.^+/7.0^+$	$8.^+/8.0^+$
N.Harbour River, S.H.B. 1976 Inward	Immature	-	8.33(2)	33.33(8)	8.33(2)	4.17(1)	-	-	-
	Ripening	-	-	-	-	-	-	-	-
N.Harbour River, S.H.B. 1977 Outward	Immature	-	62.50(35)	23.21(13)	7.14(4)	1.79(1)	-	-	-
" Inward	Immature	2.33(1)	51.17(22)	30.23(13)	13.95(6)	-	-	-	-
	Ripening	-	-	-	100.00(1)	-	-	-	-
Northeast Arm, Plac. Sept-Nov, 1976	Immature	-	15.09(8)	37.74(20)	22.64(12)	11.32(6)	-	-	-
	Ripening	-	-	9.09(1)	27.27(3)	18.18(2)	9.09(1)	-	-
July-Aug, 1977	Immature	-	3.70(1)	29.63(8)	33.33(9)	22.22(6)	-	3.70(1)	-
	Ripening	-	-	20.00(2)	10.00(1)	20.00(2)	20.00(2)	-	10.00(1)
*Colinet Harbour and River	Immature	-	23.53(4)	58.82(10)	5.88(1)	-	-	-	-
	Ripening	-	-	-	33.33(2)	-	16.67(1)	-	-

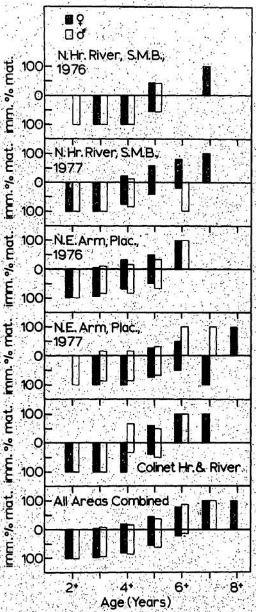
Area	Stage	Beyond Post-smolt Stage (type 2)								Percent Comp. of each Stage/Sample
		2.1^+	2.2^+	2.3^+	3.1^+	3.2^+	3.3^+	4.1^+	4.2^+	
N.Harbour River, S.H.B. 1976 Inward	Immature	8.33(2)	8.33(2)	-	16.67(4)	4.17(1)	-	8.33(2)	-	88.89(24)
	Ripening	-	-	-	-	66.67(2)	-	33.33(1)	-	11.11(3)
N.Harbour River, S.H.B. 1977 Outward	Immature	-	-	-	5.36(3)	-	-	-	-	100.00(56)
" Inward	Immature	-	-	-	-	-	-	-	2.33(1)	97.73(43)
	Ripening	-	-	-	-	-	-	-	-	2.27(1)
Northeast Arm, Plac. Sept-Nov, 1976	Immature	1.89(1)	3.77(2)	-	3.77(2)	1.89(1)	-	1.89(1)	-	82.81(53)
	Ripening	9.09(1)	-	9.09(1)	-	-	9.09(1)	9.09(1)	-	17.19(11)
July-Aug, 1977	Immature	7.41(2)	-	-	-	-	-	-	-	72.97(27)
	Ripening	-	10.00(1)	-	-	10.00(1)	-	-	-	27.03(10)
*Colinet Harbour and River	Immature	-	-	-	-	5.88(1)	-	5.88(1)	-	70.83(17)
	Ripening	-	-	16.67(1)	-	16.67(1)	16.67(1)	-	-	25.00(6)

*Sepcimens taken in salt water (August) and freshwater (September-October) combined beyond the type 2 post-smolt stage); immatures were distributed evenly between type 1 post-smolt and those beyond the type 2 post-smolt stage. In 1977, ripening inward males were represented by a single type 1 post-smolt specimen; immatures were mainly type 1 post-smolt. In Northeast Arm, Placentia, ripening males comprised 17.19% of the overall September-November 1976 sample and were predominately type 1 post-smolt. In 1977 (only specimens taken in July-August considered in Table), the overall percentage of ripening males was 27.03% and likewise were mainly type 1 post-smolt. Immatures in both years were predominately post-smolt (type unknown). On the basis of scale analysis, one of the two fish taken in May 1977 (4.0^+) which spawned the previous fall had done so as a parr. Ripening males for Colinet (25.00% overall with only specimens taken in August-October considered) were nearly equally distributed as type 1 post-smolt year and those beyond the type 2 post-smolt stage. A single male taken in May (4.1^+) had spawned the previous fall.

Age at first maturity in terms of total age for males was 2^+ (captured in freshwater in the type 1 post-smolt year) while for females it was 3^+ (post-smolt). Corresponding size at first maturity for each sex was 166 and 275 mm respectively.

Data in Tables 38 and 39 (specimens taken during the inward runs and in the sea from July-August onward considered only) are summarized as percent mature versus percent immature in terms of total age in Fig. 28. This figure portrays age at first maturity as 3^+ for both sexes. This is at odds with Fig. 22 and Appendix 2e which give the age at first maturity for males as 2^+. The difference lies in the fact that the male specimen in question was electrofished on North Harbour River, S.M.B. subsequent to the inward run.

Fig. 28. Percentage immature and mature *Salmo trutta* for areas separate and combined in terms of total age.


♀
♂
N. Hr. River, S.M.B., 1976
N. Hr. River, S.M.B., 1977
N.E. Arm, Plac., 1976
N.E. Arm, Plac., 1977
Colinet Hr. & River
All Areas Combined
imm. % mat.
100
0
100
2+
4+
6+
8+
Age (Years)

While there was a tendency for the percentage of males maturing in a given age group to be higher than that of females for Northeast Arm, Placentia in 1977, the reverse was true for 1976; for the remaining samples and all areas combined results were inconclusive. The age at which females were 100% mature was 6^+ for Northeast Arm, 1976 and Colinet, 7^+ for North Harbour River, S.M.B. in 1976 and 1977 and 8^+ for Northeast Arm in 1977; with all areas combined it was 7^+. Males were 100% mature at 6^+ for Northeast Arm in 1976 and 1977 and Colinet and at 7^+ for all areas combined.

Use of scales for evidence of previous spawnings proved inadequate since no definite spawning marks were detected in any of the specimens examined. This was the case even for the 4.7^+ specimen encountered in Colinet. Gonad examination failed to establish whether or not any of the maturing fish had spawned previously.

The fork length-fecundity relationship (data combined from different areas) is shown exponentially in Fig. 29. The logarithmic form of the equation is $\log F = 3.0222 \log L - 4.7334$.

Food and Feeding

Salvelinus fontinalis

The food of outward and inward migrants in 1977 is shown in Table 40. Food consisted largely of insects regardless of the direction of the run. Aquatic larval and nymphal stages of insects were utilized to a greater extent in the outward run than during the inward run. Adult stages of insects utilized in the outward run were mainly those of aquatic insects while during the inward run adults of wholly terrestrial forms (i.e. all stages terrestrial) became relatively important.

Fig. 29. Length-fecundity relationship for Salmo trutta (data from different areas combined).

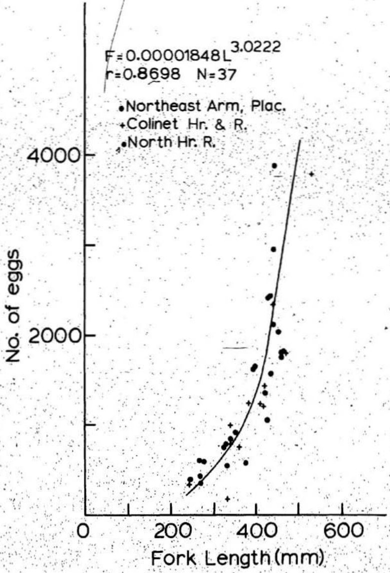

F=0.00001848L^3.0222
r=0.8698 N=37
Northeast Arm, Plac.
Colinet Hr. & R.
North Hr. R.
4000
2000
No. of eggs
0
200
400
600
Fork Length (mm)

Table 40. The food of outward and inward moving Salvelinus fontinalis (in terms of number of organisms) in 1977. Percent occurrence is in parentheses.

Organisms	North Harbour River, S.H.B.		Beaver River		Southeast River		Northeast River
	Outward	Inward	Outward	Inward	Outward	Inward	Outward
Amphipoda							
Hyalella azteca (Saussure)	23(6.12)	-	140(24.49)	-	46(22.45)	289(11.36)	152(44.00)
Gammarus oceanicus Segerstråle	-	38(14.29)	-	-	-	-	-
Decapoda							
Crangon septemspinosus Say	-	3(6.12)	-	-	-	-	-
Arachnida							
Hydracarina	19(14.29)	1(2.04)	4(8.16)	3(4.00)	19(8.16)	2(2.27)	-
Araneae	-	-	-	-	-	1(2.27)	-
Plecoptera nymphs	42(42.86)	-	5(8.16)	-	6(8.16)	-	1(2.00)
Plecoptera adults	348(61.22)	-	-	-	-	-	-
Ephemeroptera nymphs	71(48.98)	6(12.24)	47(36.74)	11(12.00)	156(61.22)	10(9.09)	289(68.00)
Ephemeroptera adults	-	3(4.08)	56(24.49)	4(2.00)	17(12.24)	3(6.82)	-
Odonata							
Anisoptera nymphs	3(6.12)	-	12(22.45)	5(10.00)	-	3(6.82)	12(18.00)
Anisoptera adults	-	-	-	-	-	-	-
Zygoptera nymphs	-	-	6(8.16)	-	6(8.16)	-	11(14.00)
Zygoptera adults	-	-	-	-	-	10(15.91)	-
Hemiptera adults	2(4.08)	-	3(6.12)	-	19(14.29)	12(20.46)	48(42.00)
Coleoptera larvae	2(4.08)	-	6(8.16)	1(2.00)	-	8(18.18)	1(2.00)
Coloptera adults	23(30.61)	71(48.98)	8(12.24)	9(10.00)	12(4.08)	37(34.09)	7(8.00)
Mecoptera adults	-	2(4.08)	-	-	-	-	-
Trichoptera larvae	394(93.88)	6(10.20)	124(65.31)	98(38.00)	115(53.06)	17(18.18)	197(66.00)
Trichoptera pupae	1(2.04)	6(6.12)	-	-	2(2.04)	-	-
Trichoptera adults	22(20.41)	36(36.74)	1(2.04)	11(12.00)	1(2.04)	103(56.82)	-
Lepidoptera larvae	-	-	-	-	-	2(4.55)	-
Lepidoptera adults	2(4.08)	13(12.24)	-	1(2.00)	-	6(11.36)	-
Diptera larvae	107(46.94)	-	26(20.41)	2(4.00)	100(14.29)	1(2.27)	172(18.00)
Diptera pupae	20(18.38)	1(2.04)	346(22.45)	2(2.00)	7(2.04)	7(6.82)	69(34.00)
Diptera adults	3(2.04)	14(10.20)	230(28.57)	1(2.00)	45(14.29)	28(29.55)	283(32.00)
Hymenoptera adults	1(2.04)	479(59.18)	-	49(30.00)	-	25(29.55)	-

continued

Table 40 (Continued)

Organisms	North Harbour River, S. M. B.		Beaver River		Southeast River		Northeast River
	Outward	Inward	Outward	Inward	Outward	Inward	Outward
Gastropoda							
Physidae	-	-	-	-	1(2.04)	1(2.27)	-
Planorbidae	1(2.04)	-	6(6.12)	-	-	-	454(18.00)
Amnicolidae	14(2.04)	-	75(36.74)	2(2.00)	64(22.45)	157(22.73)	122(36.00)
Pelecypoda							
Sphaeriidae	-	-	8(12.25)	2(2.00)	107(16.33)	1(2.27)	297(42.00)
Pices							
Salmo salar Linnaeus	-	-	1(2.04)	-	-	-	-
Osmerus mordax (Mitchill)	-	4(4.08)	-	-	19(20.41)	1(2.27)	-
Gasterosteus aculeatus Linneaus	-	-	-	-	-	-	5(2.00)
Mammalia							
Insectivora	-	-	2(4.08)	1(2.00)	-	-	-
Unidentifiable Insect Remains	+(93.88)	+(87.76)	+(87.76)	+(50.00)	+(67.35)	+(56.82)	+(94.00)
Unidentifiable Crustacean Remains	-	+(28.57)	-	+(4.00)	-	-	-
Unidentifiable Fish Remains	-	-	+(4.08)	-	-	-	-
Fish Eggs	-	-	+(2.04)	-	+(2.04)	-	-
Number of Guts Examined	49	49	49	50	49	44	50
Number of Guts Empty	0	1	1	13	6	5	0

+ = Present
\- = Absent

In the outward run, Trichoptera larvae and Ephemeroptera nymphs were very important both numerically and in terms of percent occurrence. The former was most important for North Harbour River, S.M.B. and Beaver River while the latter predominated for Northeast River and Southeast River. Collectively, Trichoptera families encountered included Limniphilidae, Lepidostomatidae, Phryganeidae, Hydropsychidae, Helicopsychidae and Hydroptilidae. Limnephilidae was dominant in numbers and percent occurrence for North Harbour River, S.M.B. and Southeast River while for Northeast River Hydroptilidae was first. Helicopsychidae was encountered only on Beaver River and Northeast River and Lepidostomatidae only on North Harbour River, S.M.B. The dominant Ephemeroptera family in all areas was Leptophlebiidae; Ephemerellidae was next for North Harbour River, S.M.B. while for Northeast River, Baetidae and Heptageniidae made occasional appearances. Plecoptera nymphs (Perlodidae and Nemouridae) were more important for North Harbour River, S.M.B. than for the other areas. Greatest utilization of Diptera larvae (Ceratopogonidae, Chironomidae and Tipulidae to a lesser extent) occurred on North Harbour River, S.M.B. while the reverse was true for adults (Chironomidae, Simuliidae and Culicidae). Coleoptera consisted mainly of larvae and adults of Elmidae and Dytiscidae with minimal representation by terrestrial adults. Emerging adults of Plecoptera and Trichoptera were very important during the outward run on North Harbour River, S.M.B. relative to the remaining areas. Gastropoda, Pelecypoda and Amphipoda (Hyalella azteca) were relatively important for all areas except North Harbour River, S.M.B. Southeast River trout were most piscivorous (feeding on landlocked Osmerus mordax); Salmo salar smolt and Gasterosteus aculeatus were utilized minimally on Beaver River and Northeast River respectively.

During the inward run, Trichoptera larvae remained relatively important on Beaver River compared with the other areas. The families involved (in descending order of importance) were Hydropsychidae, Leptoceridae, Brachycentridae and Rhyacophilidae. The latter three were not encountered in the outward run. For the remaining areas, the same Trichoptera families were involved as in the outward run. This also applied to the Ephemeroptera. Hymenoptera adults (mainly sawflies) were important for all areas. Coleoptera were predominately terrestrial adults. Some fresh run fish on North Harbour River, S.M.B. contained marine crustaceans (Gammarus oceanicus and Crangon septemspinosus). Unidentifiable marine crustacean remains were found in some Beaver River fish. Osmerus mordax (anadromous) were eaten by some fresh run fish on North Harbour River, S.M.B.; landlocked smelt were utilized on Southeast River.

The food of specimens taken in Northeast and Southeast Arms, Placentia from June 1976 through May 1977 is shown in Table 41. Even in the marine environment, insects (mostly adults) played an important role (especially in June and September). The insect diet was not as varied in November and May. Some specimens had just run to sea prior to being caught as indicated by the presence of freshwater insect larvae and nymphs. Reliance on crustaceans was greater in fall and early spring than in June. The most important crustacean eaten in terms of number and occurrence was Gammarus oceanicus. Molluscs were taken with greatest frequency in Northeast Arm in June 1976 and May 1977 while in Southeast Arm there was no real change with time. Some samples were comparatively small which must be considered in any conclusions drawn regarding seasonal changes in feeding habits. Fish species consumed included Osmerus mordax, Mallotus villosus and Gasterosteus aculeatus.

Table 41. The food of *Salvelinus fontinalis* (in terms of number of organisms) for different sampling times in Northeast Arm and Southeast Arm, Placentia. Percent occurrence is in parentheses.

Organisms	Northeast Arm, Placentia				Southeast Arm, Placentia		
	June 1976	September 1976	November 1976	May 1977	June 1976	November 1976	May 1977
Polychaeta	11(10.68)	2(1.22)	6(27.27)	4(25.00)	-	1(5.00)	2(12.50)
Isopoda							
Idotea balthica (Pallas)	-	-	9(9.09)	54(50.00)	15(11.77)	60(55.00)	4(12.50)
Porcellio scaber Latreille	-	21(8.54)	-	-	-	-	-
Oniscus asellus Linnaeus	5(1.94)	-	-	-	-	-	-
Amphipoda							
Gammarus oceanicus Segerstråle	96(30.10)	2293(65.86)	159(54.55)	41(50.00)	54(26.47)	293(65.00)	92(50.00)
Decapoda							
Crangon septemspinosus Say	36(16.50)	75(43.90)	-	12(6.25)	2(2.94)	-	-
Arachnida							
Hydracarina	1(0.97)	1(1.22)	-	-	-	-	-
Araneae	7(5.83)	32(26.83)	1(4.55)	-	3(8.82)	-	-
Orthoptera adults	1(0.97)	-	-	-	-	-	-
Plecoptera nymphs	-	4(3.66)	-	-	-	-	-
Plecoptera adults	-	5(3.66)	-	2(12.50)	-	-	1(6.25)
Psocoptera adults	-	139(36.59)	-	-	-	-	-
Thysanoptera adults	-	10(7.32)	-	-	-	-	-
Ephemeroptera nymphs	15(5.83)	1(1.22)	-	-	1(2.94)	-	-
Odonata							
Anisoptera nymphs	1(0.97)	1(1.22)	-	-	-	-	-
Zygoptera nymphs	1(0.97)	-	-	-	-	-	-
Hemiptera adults	23(16.51)	134(41.46)	2(9.09)	-	5(14.71)	-	-
Homoptera adults	4(1.94)	-	-	-	-	-	-
Coleoptera larvae	2(1.94)	-	2(9.09)	-	-	-	-
Coleoptera adults	95(32.04)	23(14.63)	4(18.18)	-	21(32.35)	1(5.00)	-
Trichoptera larvae	35(15.53)	3(1.22)	5(9.09)	-	6(2.94)	-	4(12.50)
Trichoptera adults	1(0.97)	-	-	1(6.25)	1(2.94)	-	2(12.50)
Lepidoptera larvae	7(3.88)	26(18.29)	2(9.09)	-	1(2.94)	-	-
Lepidoptera adults	4(3.88)	31(26.83)	48(50.00)	1(6.25)	7(5.88)	10(25.00)	3(18.75)
Diptera larvae	225(8.74)	3(2.44)	-	-	1(2.94)	-	1(6.25)
Diptera adults	322(40.78)	169(56.10)	4(13.64)	-	305(38.24)	-	-
Hymenoptera adults	77(28.16)	118(37.81)	8(27.27)	-	27(38.24)	5(25.00)	1(6.25)
Gastropoda							
Littorina obtusata Linnaeus	226(20.39)	5(3.66)	3(13.64)	136(68.75)	70(29.41)	38(30.00)	4(25.00)
Hydrobia totteni Morrison	205(22.33)	1(1.22)	-	340(43.75)	2(5.88)	-	1(6.25)
Unidentified Gastropoda	27(5.83)	7(7.32)	-	-	-	-	-
Pelecypoda							
Mytilus edulis Linnaeus	1(0.97)	-	-	2(12.50)	63(14.71)	-	-
Modiolus modiolus Linnaeus	-	-	-	-	2(5.88)	-	-

Table 41 (Continued)

Organisms	Northeast Arm, Placentia				Southeast Arm, Placentia		
	June 1976	September 1976	November 1976	May 1977	June 1976	November 1976	May 1977
Pices							
Mallotus villosus (Müller)	-	-	-	-	10(11.77)	-	-
Osmerus mordax (Mitchill)	2(1.94)	-	-	-	8(20.59)	-	-
Gasterosteus aculeatus Linnaeus	1(0.97)	-	-	-	-	-	25(6.25)
Unidentifiable Insect Remains	+(52.43)	+(87.81)	+(90.91)	+(18.75)	+(52.94)	+(15.00)	+(6.25)
Unidentifiable Crustacean Remains	+(33.01)	+(81.71)	+(72.73)	+(18.75)	+(32.35)	+(10.00)	-
Unidentifiable Fish Remains	-	-	-	-	+(17.65)	-	-
Fish Eggs	+(11.65)	-	-	-	-	-	-
Number of Guts Examined	103	82	22	16	34	20	16
Number of Guts Empty	8	1	2	0	0	1	2

\+ = Present
\- = Absent

In freshwater, specimens below 200 mm tended to feed almost exclusively on insects. From 200 to 300 mm, fish became increasingly important (speaking mainly for Southeast River where landlocked smelt was involved). Above 300 mm, food consisted mainly of fish with relatively small numbers of insects and other invertebrates taken. In salt water, the same trends were evident and where invertebrates were involved, crustaceans and molluscs assumed greater importance relative to insects compared with freshwater. There was no evidence to suggest that there was a differential preference for either insects or crustaceans with increase in size in salt water.

Salmo trutta

The food of brown trout for North Harbour River, S.M.B. (outward and inward runs, 1977) and the freshwater portion of the Colinet sample (fall 1977) is shown in Table 42. For the North Harbour River, S.M.B. outward run, brown trout consumed the same organisms as brook trout for most part; however, percent occurrence was somewhat different. Trichoptera larvae were the most important items followed by Plecoptera (Perlodidae and Nemouridae) and Ephemeroptera nymphs (for brook trout, Ephemeroptera nymphs were slightly more important than Plecoptera). The dominant Trichoptera family was Lepidostomatidae followed by Limnephilidae; other families encountered sporadically were Glossosomatidae, Hydropsychidae, Brachycentridae and Leptoceridae (Limnephilidae dominated for brook trout). The most important Ephemeroptera families were Leptophlebiidae and Ephemerellidae with some appearances by Baetidae and Heptageniidae. Diptera were utilized less by brown trout than by brook trout. Plecoptera and Trichoptera adults remained just as important. Both species utilized

Table 42. The food of Salmo trutta (in terms of number of organisms) for the outward and inward runs in 1977 on North Harbour River, S.M.B. and for specimens captured in Colinet River. Percent occurrence is in parentheses.

Organisms	North Hr. Riv., S.M.B. Outward	North Hr. Riv., S.M.B. Inward	Colinet Riv.
Oligochaeta			
Lumbricus sp.	-	-	74(17.86)
Amphipoda			
Hyalella azteca (Saussure)	7(5.77)	-	17(21.43)
Gammarus oceanicus Segerstrale	-	5(4.00)	-
Decapoda			
Crangon septemspinosus Say	-	64(6.00)	-
Plecoptera nymphs	49(51.92)	-	-
Plecoptera adults	122(53.85)	-	-
Psocoptera adults	4(3.85)	1(2.00)	-
Ephemeroptera nymphs	140(48.08)	8(12.00)	3,843(7.15)
Odonata			
Anisoptera nymphs	-	-	1(3.57)
Zygoptera numphs	-	-	1(3.57)
Zygoptera adults	-	1(2.00)	-
Hemiptera adults	1(1.92)	-	1(3.57)
Homoptera adults	-	-	1(3.57)
Coleoptera larvae	36(30.77)	2(4.00)	2(7.14)
Coleoptera adults	30(32.69)	4(6.00)	19(17.86)
Mecoptera adults	-	3(6.00)	-
Trichoptera larvae	454(86.54)	6(8.00)	44(71.43)
Trichoptera pupae	18([illegible])	-	4(7.14)
Trichoptera adults	51([illegible]7)	12(14.00)	3(3.57)
Lepidoptera larvae	-	-	1(3.57)
Lepidoptera adults	-	2(4.00)	1(3.57)
Diptera larvae	20(21.15)	6(8.00)	-
Diptera pupae	-	7(2.00)	-
Diptera adults	2(1.92)	7(8.00)	-
Hymenoptera adults	-	91(26.00)	3(3.57)
Gastropoda			
Physidae	-	-	15(14.29)
Planorbidae	-	-	12(7.14)
Amnicolidae	4(5.77)	-	110(17.86)
Littorina littorea Linnaeus	-	1(2.00)	-
Pelecypoda			
Sphaeriidae	-	-	3(10.71)
Unidentifiable Insect Remains	+(90.39)	+(76.00)	+(67.86)
Unidentifiable Crustacean Remains.	-	-	-
Number of Guts Examined	52	50	28
Number of Guts Empty	2	6	1

+ = Present
\- = Absent

Coleoptera adults to the same extent while larvae were more important for brown trout.

The food of inward running brown trout on North Harbour River, S.M.B. was also similar to that of brook trout and again some differences in percent occurrence were noted. Hymenoptera adults (sawflies) were relatively important but utilized to a lesser extent than observed for brook trout. Trichoptera and Coleoptera adults were used less frequently by brown trout. The trend towards greater reliance on adults of aquatic insects and terrestrial insects during the inward run compared with the outward as described above for brook trout was noted for brown trout as well. The presence of marine forms (Gammarus oceanicus, Crangon septemspinosus and Littorina littorea) indicates some specimens were caught soon after entering the river.

In Colinet River, Trichoptera was the dominant group in terms of percent occurrence but not numbers; the reverse was true for Ephemeroptera. The Trichoptera family involved was Phryganeidae while for Ephemeroptera it was Leptophlebiidae.

Small samples for June and November compared with September 1976 in Northeast Arm, Placentia (Table 43) make any conclusions drawn about food habits on a seasonal basis open to question. Generally speaking, marine food was similar to that observed for brook trout. Brown trout had a tendency to consume more fish than brook trout. Colinet Harbour food was similar to Northeast Arm. Gammarus oceanicus was important in both areas; however, there was less reliance on molluscs for Northeast Arm. Mysids were utilized in Northeast Arm but not Colinet Harbour; this group was not encountered for brook trout.

The same trends with respect to size versus food habits observed for brook trout applied more or less to brown trout.

Table 43. The food of Salmo trutta (in terms of number of organisms) for different sampling times in Northeast Arm, Placentia and Colinet Harbour. Percent occurrence is in parentheses.

Organisms	Northeast Arm, Plac.			Colinet Harbour
	June 1976	September 1976	November 1976	May-September '77
Polychaeta	-	1(1.28)	1(16.67)	1(2.86)
Mysidacea				
Mysis stenolepsis Smith	-	-	4(16.67)	-
Mysis gaspensis Tattersall	-	108(38.46)	-	-
Isopoda				
Idotea balthica (Pallas)	-	140(32.05)	11(33.33)	2(5.71)
Amphipoda				
Gammarus oceanicus Segerstrale	9(16.67)	525(41.03)	9(66.67)	189(34.28)
Decapoda				
Crangon septemspinosus Say	3(16.67)	52(6.41)	8(33.33)	34(60.00)
Arachnida				
Araneae	-	5(5.13)	1(16.67)	1(2.86)
Plecoptera nymphs	-	-	-	1(2.86)
Psocoptera adults	-	59(15.39)	-	-
Thysanoptera adults	-	1(1.28)	-	-
Ephemeroptera adults	1(8.33)	-	-	15(8.57)
Odonata				
Anisoptera adults	-	-	-	2(5.71)
Zygoptera adults	-	-	-	4(2.86)
Hemiptera adults	-	29(19.23)	-	1(2.86)
Homoptera adults	-	2(2.56)	-	4(5.71)
Coleoptera adults	2(8.33)	1(.128)	-	3(5.71)
Mecoptera adults	-	-	-	2(2.86)
Trichoptera larvae	-	4(3.85)	1(16.67)	3(5.71)
Trichoptera adults	1(8.33)	1(1.28)	-	-
Lepidoptera adults	-	18(15.39)	1(16.67)	5(8.57)
Diptera larvae	-	1(1.28)	-	-
Diptera pupae	-	-	-	1(2.86)
Diptera adults	6(25.00)	28(12.82)	1(16.67)	3(5.71)
Hymenoptera adults	2(16.67)	14(15.39)	1(16.67)	78(34.29)
Gastropoda				
Littorina obtusata Linnaeus	17(41.67)	276(17.95)	34(50.00)	1(2.86)
Hydrobia totteni Morrison	85(25.00)	46(8.97)	-	-
Pelecypoda				
Modiolus modiolus Linnaeus	1(8.33)	1(1.28)	1(16.67)	-
Pisces				
Osmerus mordax (Mitchill)	3(8.33)	-	-	4(5.71)
Gasterosteus aculeatus Linneaus	25(16.67)	152(24.36)	3(16.67)	17(14.29)
Unidentifiable Insect Remains	+(58.33)	+(69.23)	+(83.33)	+(40.00)
Unidentifiable Crestacean Remains	+(50.00)	+(64.10)	+(83.33)	+(20.00)
Unidentifiable Fish Remains	+(25.00)	+(28.21)	-	-
Number of Guts examined	12	78	6	35
Number of Guts Empty	0	8	1	1

+ = Present
– = Absent

DISCUSSION

Movements

Salvelinus fontinalis

Anadromous brook trout movements were studied in conjunction with the pink salmon transplant on North Harbour River, S.M.B. from 1959 to 1975 (Lear and Day 1977). Downstream movements were reported to occur from early May to the end of June (peak during the last week of May) with the major portion of the inward run occurring during July (a few fish can continue to enter until the end of September).

Compared with the time frame given by Lear and Day (1977) for North Harbour River, S.M.B., outward movements observed in the present study were much earlier. In 1976, the relatively large number of fish taken during the first few days of sampling compared with subsequent dwindling numbers through May indicates that the end of the run was being sampled. In 1977, fish tagged during the inward run of 1976 were caught below the fyke trap near the head of tide. Federal Conservation and Protection personnel reported that tagged fish were seen in the vicinity of the mouth of the river as early as two weeks previous to trap installation (April 13). A few fish were taken in the trap shortly after installation; however a gap occurred in the run from then until early May after which time the bulk of the sample was taken. Factors associated with movements of anadromous brook trout are temperature, rise and fall in water level and living space (Smith and Saunders 1958, 1967). As mentioned earlier, North Harbour River, S.M.B. is subject to rapid fluctuations in water level. The winters of 1976 and 1977 were characterized by low levels of precipitation (especially the latter year) and spring breakup was early. This may account for the early outward runs. Timing of the inward runs on North Harbour River, S.M.B. in 1976 and 1977 was much the same as described in Lear and Day (1977). For the remaining areas, outward runs occurred in May and early June with inward runs in July and early August. Much the same time frame has been reported for other areas, namely, Little Codroy River, Newfoundland (Murray 1968), Moser River, Nova Scotia (White 1940, 1941), Koksoak River, Ungava Bay, Quebec (Coleman 1970) and Richmond Gulf, Hudson Bay, Quebec (Dutil and Power 1980). A six year study of Ellerslie Brook, Prince Edward Island by Smith and Saunders (1958) revealed outward movements occurring in May (a minor run), October and early January and inward movements in April, June-July and November. In addition to movements in one direction, simultaneous upstream and downstream movements were noted. This study utilized 2-way counting fences on a year-round basis in contrast to some of those cited above (White 1940, 1941; Murray 1968) which operated only from April-May through November. Major movements were noted for Ellerslie Brook during the period not monitored in the other investigations. As seen above, there are indications that movements between fresh and salt water throughout the year as observed for Ellerslie Brook occur also on Northeast and Southeast Rivers, Placentia.

The length of time spent in salt water observed for North Harbour River, S.M.B. and Beaver River agrees with White (1941) for Moser River (42-84 days) and previous findings for North Harbour River, S.M.B. (47-65 days) by Lear and Day (1977). Bigelow (1963) reviewed the literature up to that point regarding the extent of movements in the sea. Trout may remain in the general influence of the estuary for the entire sea sojourn or travel out of the estuary into the open sea, sometimes straying into other rivers. The most extensive journey reported was 8 miles (12.9 km). In the present study, tagged fish from North Harbour River, S.M.B. were caught in herring nets in the adjacent estuary Colinet Harbour, a distance of approximately 20 km. Whether or not movement occurs between the adjacent estuaries of Northeast Arm and Southeast Arm, Placentia is not known since none of the fin clipped fish from Northeast River and Southeast River (including its tributary Beaver River) were recaptured in salt water. White (1941) reported some straying of Moser River fish to other systems. At the same time he presented evidence for homing (although some straying was evident) to Moser River and its tributary Mill Brook. There appears to be a degree of homing to Southeast River and its tributary Beaver River.

Salmo trutta

Various authors have dealt with the movements of anadromous brown trout (Malloch 1910; Dahl 1918; Nall 1930; Alm 1950; Skrochowska 1969a–d; Pemberton 1976a; Allan and Ritter 1977). The following summary is based on Nall (1930) which is the most comprehensive of the above studies (it must be emphasized though that there can be a certain amount of variation from this broad description in a given population). Essentially, smolt descend to salt water, usually from mid-May through June. The majority of these will return to freshwater in the year of smolt migration (type 1 post-smolt) either in July–August or late summer and autumn, depending on locality. The remainder will stay at sea for over a year (beyond type 2 post-smolt stage) before returning to freshwater (also in July–August or late summer and autumn). Over the following winter and into the spring these individuals will again go to sea (the majority leave before the end of April) where they may remain for a few months or over a year before returning to freshwater for a second time, etc. Thus, individuals with a previous sea history leave freshwater earlier in the year than smolt in a more or less discrete run. In addition to these principal runs, there can be runs to freshwater throughout the winter comprised of fish which have spent the greater part of that season in salt water (type 2 post-smolt and specimens beyond this stage). If they enter the river prior to and during February, they will return to sea that spring; if, however, they return to freshwater after February, they will remain in the river until the next winter. These are referred to as winter and spring runs respectively. As distinguished from the above "runs" (or concentrations of outward or inward moving fish), individual trout (especially type 2 post-smolt) may enter rivers all through the winter.

According to Lear and Day (1977), fish in the size range of smolt as observed in the present study generally leave North Harbour River, S.M.B beginning in early May through to the end of June with the peak occurring during the last week in May. For both years of the present study small numbers of fish were encountered throughout May and decreased over time at a period when according to Lear and Day (1977) they should have been peaking. This suggests that the runs had gone out earlier and probably the same reasons presented above for brook trout apply to this species also.

For inward runs, Lear and Day (1977) report that some enter in July with the bulk arriving from the first of August through to the middle of September. The same was noted more or less for the present study. As mentioned above, a larger number entered during July of 1977 than in July of 1976.

Very few brown trout with a previous history of sea life were encountered in the outward run relative to the inward run on North Harbour River, S.M.B. The bulk of these fish may have gone out earlier in a separate run as described above. Evidence that this might be so comes from the fact that anglers have taken large brown trout of the size in question near the mouths of Avalon Peninsula rivers in January and February, especially after periods of heavy rain and sometimes resultant ice rafting. Some of these fish could also be those which have wintered in the estuary or sea and are on their way back to freshwater.

Age and Growth

Salvelinus fontinalis

Anadromous populations of brook trout in the Maritime Provinces of Canada have been described as short-lived. The maximum age reported for Moser River, Nova Scotia was 6^+ (Wilder 1952). In Ellerslie Brook, Prince Edward Island, individuals beyond 4^+ are scarce (Smith and Saunders 1958). The maximum age observed for the present study was 7^+ which together with the Maritimes is substantially lower than reported for more northern populations, namely 12^+ for Koksoak River, Ungava Bay (Coleman 1970) and 11^+ for Richmond Gulf, Hudson Bay (Dutil and Power 1980).

The predominant age group for Moser River smolt is $2.^+$ (79.4%) with the remainder being $3.^+$ (White 1940). The modal age group for outward migrants on Ellerslie Brook (Smith and Saunders 1953) is $2.^+$ and there is representation by $1.^+$ and $3.^+$ individuals as well. Most trout descending Koksoak River for the first time are $2,^+$ years of age (Coleman 1970); in Richmond Gulf, the major age groups involved are $3.^+$ and $4.^+$ (Dutil and

Power 1980). As already pointed out, modal smolt age in the present study as determined from scale analysis showed variation depending on when and where samples were taken (lowest was $2.^{+}$ and the highest was $4.^{+}$).

The mean length at time of capture reported for $2.^{+}$ and $3.^{+}$ Moser River smolt by White (1940) was 170 and 197 mm respectively (total length). By using formulae developed by Wilder (1952) for the same population, the above mean lengths can be converted to fork length and thus become 163 and 191 mm respectively. This compares with a low of 136 mm (North Harbour River, S.M.B., 1977) and a high of 167 mm (Southeast River) for the $2.^{+}$ age group and 162 (North Harbour River, S.M.B., 1977) and 204 mm (Northeast River, 1976) for the $3.^{+}$ age group. The overall mean length of outward migrants on Ellerslie Brook as reported by Smith and Saunders (1958) was 160 mm and these consisted mainly of fish going to sea for the first time. The overall mean length of outward migrants in Richmond Gulf is 200 mm, many of which are 3^{+} and 4^{+} years of age (Dutil and Power 1980). The lowest overall mean lengths in the present study occurred on Northeast River and North Harbour River, S.M.B. in 1976 (155 and 156 mm respectively) while the highest was 212 mm (Beaver River).

As mentioned above, modal smolt age (and also mean smolt age) showed variation between and within areas. Some of this variation may have been due to the fact that in all cases except one (inward run on Beaver River) sampling was restricted to only a portion of each run and, depending on the area, sizes and ages of fish may not have been evenly distributed over the entire run. This might also explain the greater numbers of larger (and older) fish present in inward runs relative to outward runs. It is apparent that the larger fish on North Harbour River, S.M.B. move outward during the earlier stages of the run; the situation for the inward run is inconclusive. The inward run on Beaver River (sampled entirely) revealed no tendency towards a particular size of fish being restricted to a definite portion of the run. Another factor to be considered for samples taken in freshwater concerns whether or not traps were set in a river (completely barring it off) or set in ponds (as was the case for Northeast River and part of the Southeast River sample). There may have been error introduced associated with a differential response to the way in which the gear was set. With respect to salt water, White (1940) noted that there was a tendency for fish to be in separate schools according to size, with fewer of the larger fish present. This could possibly explain why many of the intervening larger length and weight classes were not represented and the relatively low numbers of larger fish taken in Northeast and Southeast Arms, Placentia. Other factors that could be involved include gillnet selectivity, sample size on any one sampling occasion and an inadequate number of sampling stations resulting in a poor representation spatially in each estuary. Despite possible problems associated with sampling, collectively for a given area, length frequency distributions could reflect a heavy exploitation of the larger (and older) fish. Beaver River had the highest modal $(4.^{+})$ and mean (3.82) smolt age, best overall freshwater survival as well as the largest and oldest specimens encountered in the outward runs of all areas studied (even when compared with Southeast River, of which it is a tributary). This could be a function of lower exploitation in freshwater since, in contrast to the other areas studied, virtually all of this tributary extends away from roads and railway lines.

In general, the growth rate of the freshwater form of the brook trout in Newfoundland is slower than for other areas in North America (Wiseman 1969, 1972). The growth in freshwater of the anadromous form is similar to that of the freshwater form in Newfoundland and is subject to great variation from area to area (Scott and Crossman 1964). Back-calculated growth of anadromous brook trout (weighted means of all areas combined) in terms of overall freshwater life, total age (freshwater and sea life combined) and freshwater versus sea life is compared with that of the freshwater form (average of 44 lakes on the Avalon Peninsula, Newfoundland) presented in Whelan and Wiseman (1977) in Fig. 30. It is evident that growth is somewhat slower than the Avalon Peninsula average for both overall freshwater life and total age. When total age is compared with overall freshwater life, the effect on growth of going to salt water is not very dramatic. However, when growth is described in terms of freshwater and sea life separately (grouped according to smolt age), the advantage of going to salt water is quite apparent. In terms of total age, the overall effect of going to sea is most likely masked by the low number of repeat migrants relative to those making their first sea sojourn which brings the average length at each annulus downward. Fish going to sea as 6. year old smolt attain a smaller ultimate size than those going to sea at 5. years old. The situation for fish characterized by smolt ages between 2. and 4. is uncertain but taken together, reach a larger size than those with smolt ages 5. and 6.

Fig. 31 compares mean length at capture for inward migrants (weighted means of all areas combined) with that in Wilder (1952), Wiseman (1969) and Coleman (1970) as well as with fish taken in brackish water between July and September in Dutil and Power (1980) and with a sample comprised

Fig. 30. Back-calculated growth of anadromous Salvelinus fontinalis (weighted means of all areas combined) in terms of overall freshwater life (f.w.), total age (t.a.) and grouped according to smolt age (2., 3. etc.) compared with the average of 44 Avalon Peninsula lakes for the freshwater form presented in Whelan and Wiseman (1977).

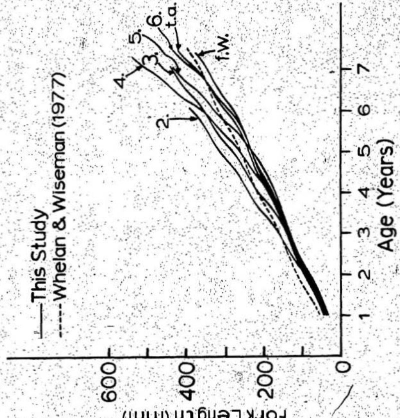
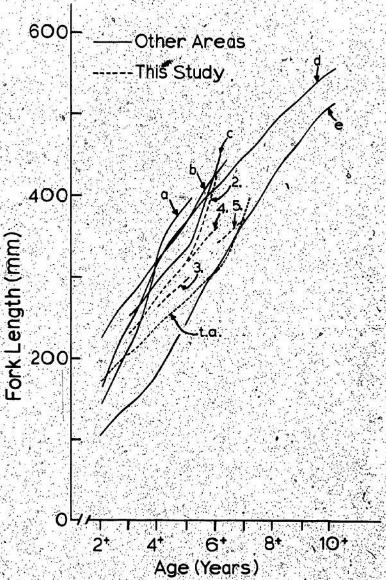

This Study
Whelan & Wiseman (1977)
2.
3.
4.
5.
6.
t.a.
f.W.
Fork Length (mm)
0
200
400
600
Age (Years)
1
2
3
4
5
6
7

Fig. 31. Empirical growth for *Salvelinus fontinalis* inward migrants (weighted means at time of capture of all areas combined) in terms of total age (t.a.) and grouped according to smolt age (2., 3. etc.) compared with other areas: (a) Holyrood Pond, Newfoundland (O'Connell *et al.* 1979); (b) Moser River, Nova Scotia (Wilder 1952); (c) Indian River, Newfoundland (Wiseman 1969); (d) Richmond Gulf, Quebec (Dutil and Power 1980); (e) Koksoak River, Quebec (Coleman 1970).



Other Areas
This Study
600
400
200
0
Fork Length (mm)
2+
4+
6+
8+
10+
Age (Years)
a
b
c
d
e
2.
3.
4.
5.
t.a.

of a mixture of the freshwater form and the anadromous form taken in fresh and salt water between June and August in O'Connell et al. (1979). Some degree of uniformity exists in the above comparisons of empirical growth in regard to sampling time and also the fact that fish had either just finished their sea sojourn or were taken late in the growing season in the sea. In terms of total age, growth exhibited by the present study is substantially lower than all areas except Koksoak River (Coleman 1970). When grouped according to smolt age with sea life considered separately, the same effect on growth the younger the smolt age as seen for back-calculated growth is evident (see especially the 2 year old smolt). Also evident is the downward averaging effect referred to above due to the low number of repeat migrants (probably resulting from heavy exploitation of these fish and/or in part the sampling problems referred to above) relative to post-smolt when total age is considered. Because of such averaging, analysis of growth in terms of total age (as is the case in the literature) can be misleading regardless of whether empirical or back-calculation data are used since the great difference in growth potential between freshwater and salt water in terms of a particular life history group is obliterated leaving no reflection of its true absolute growth. This situation is compounded even further the older the smolt age groups represented (eg. as is the case for Beaver River). If one accepts the 2 year old smolt grouping as probably exemplifying best growth in the present study, it is evident that even here growth is slower than that presented in terms of total age for the other areas. In addition to exploitation and sampling error, possible differences in environmental (temperature, food availability, length of growing season, etc.) and/or genetic factors could be involved.

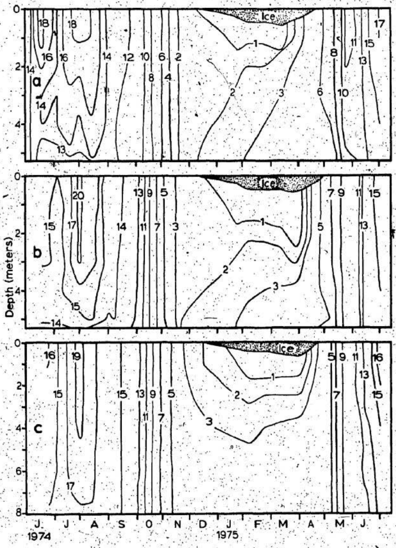
In terms of individual fish, the largest specimen taken in the present study was 533 mm in length (no weight measurement) and came from Beaver River. A second specimen measuring 447 mm (1.6 kg) was taken in Southeast Arm, Placentia. Scott and Crossman (1964) reported a specimen from Romaine's Brook, Newfoundland (taken in 1908) which reached 31.5 in. (800 mm) in length and weighed 15 lbs. (6.8 kg) as well as fish between 7 and 8 lbs. (3.2-3.6 kg) for Alexander Bay and 9 lbs (4.1 kg) for Deer Harbour. Dutil and Power (1980) reported a specimen for Richmond Gulf at 756 mm (4.5 kg). For Moser River, Scott and Crossman (1964) cite Wilder (1944) as stating the largest fish encountered to be 19.1 in. (485 mm) long and 3.75 lbs. (1.7 kg) in weight.

As seen earlier, mean length at time of capture for each smolt age group on North Harbour River, S.M.B. was significantly lower than for all the remaining areas. However, if back-calculated growth at annulus formation is compared, it can be seen that North Harbour River, S.M.B. is quite comparable to the other areas. Thus, in terms of parr which do not smoltify, it is evident that the growth deficiency apparent for the time of year in question is compensated for later on in the growing season. In a comprehensive review of environmental factors (both biotic and abiotic) affecting growth, Brett (1979) identified temperature as the only controlling factor, setting the paçe for the integrated series of rate functions, namely feeding, assimilating, metabolizing, transforming and excreting. The fact that salmonids feed during the winter has been shown by several authors (Needham 1930; Lord 1933; Leonard 1942; Maciolek and Needham 1951; Bridges 1958; Needham and Jones 1959; Power and Coleman 1967; Elliott 1967; Elliott and Jenkins 1972; Hunt and Jones 1972). Lear and Day (1977) presented mean daily temperatures taken 150 m above head of tide pooled to give monthly averages for North Harbour River, S.M.B. for each year covering the period 1959-1975. These data are summarized in Table 44 (mean of the 17 years plus range for each month). Temperatures from January through March ranged from 1.11 to 2.26°C. This is lower than temperatures resulting from inverse thermal stratification in Churchills Pond and Goobies Pond on Come By Chance River and Fitzgeralds Pond on Northeast River (O'Connell and Andrews, unpublished) which were in excess of 3.0°C for the greater part of the period in question (Fig. 32). Davis (1972, 1973) reported similar inverse stratification for two other Avalon Peninsula lakes with no attendant oxygen depletion. Wiseman (1971, 1972) suggested that all brook trout left the nursery streams and became lake resident by the autumn of the year of hatching for Thomas Pond and Paddys Pond on the Avalon Peninsula. Saunders (1969) reported that most of the brook trout migrating from streams to Matamek Lake were 1^+ or 2^+ years of age with small numbers at 0^+ and 3^+. It might be possible that anadromous brook trout do not become lake resident but rather move into lakes to overwinter with subsequent return to the streams in spring as reported for juvenile brown trout by Stuart (1957). In any event, as already seen, North Harbour River, S.M.B. possesses very few lakes relative to the other systems. It is conceivable therefore that a sizeable proportion of the brook trout population overwinters in the river and therefore are subjected to the lower temperature regimes just described. In stream channel experiments, Sutterlin and Waddy (1975) found evidence to indicate that brook trout choose specific locations related to flow patterns around bottom obstructions; it was suggested that the lateral line detects flow or pressure discontinuities enabling maintenance of position with a

Table 44. Daily temperatures pooled to give monthly averages for North Harbour River, S.M.B. This is a summary (mean of 17 years plus range for each month) of Table 8.1 in Lear and Day (1977):

Month	Mean Temp (°C)	Range
January	1.11	0.60-2.46
February	1.26	0.40-2.43
March	2.26	0.30-3.67
April	4.58	2.60-6.04
May	8.86	7.13-11.81
June	13.21	11.00-15.60
July	17.47	13.80-19.16
August	17.50	15.60-19.32
September	13.89	11.28-16.90
October	8.95	7.20-11.40
November	5.58	3.30-7.87
December	2.49	1.10-4.80

Fig. 32. Seasonal isotherms for Churchills Pond (a) and Goobies Pond (b) on the Come By Chance River System and Fitzgeralds Pond (c) on the Northeast River System (O'Connell and Andrews, unpublished).


Ice
Depth (meters)
a
b
c
J J A S O N D J F M A M J
1974
1975

minimum expenditure of energy. In stream tank experiments, Gibson (1978) found that below 9.0°C, both juvenile Atlantic salmon and brook trout hid in crevices in the rubble. Sheltering from fast water was believed to be an adaptation against physical displacement during winter when metabolic activity is low. Similarly, Rimmer (1980) concluded that the need for shelter during autumn and winter (at temperatures less than 10°C) is likely related to a decline in performance as indicated by a lessened ability to stem water currents (there was some evidence to the effect that photoperiod could also be responsible for cryptic behavior in that in autumn fish became negatively phototrophic; however, it was not possible to satisfactorily distinguish the relative roles of temperature and photoperiod). This author also pointed out that such sheltering behavior would remove fish from areas of maximum invertebrate drift (regions of greatest water current) at a time when total drift density is declining and under such circumstances the optimum strategy would be to conserve energy and make brief feeding forays into fast water. If one considers the higher temperatures, possibly a greater food supply both in terms of quantity and accessibility and more living space provided in lakes, then it is quite conceivable that fish destined to smoltify which overwinter in such a habitat could obtain a growth advantage over those in flowing water. In larger systems with many lakes, fish which had not become pond resident prior to smoltification could still probably take advantage of the more favorable conditions in lakes simply by passing through them on the way to salt water.

It was stated above that North Harbour River, S.M.B. parr which do not smoltify catch up to the other areas later in the growing season.

This delay could be related to the cryptic behavior mentioned above in that they may not emerge from the substrate and begin intensive feeding until temperatures get above 9-10°C at which time metabolic activity will allow sufficient performance to prevent physical displacement. Also, there would be less interspecific and intraspecific competition for food and space at this time due to emigration to sea of many of the fluviatile brook trout, brown trout and Atlantic salmon.

The physical appearance of smolt in the present study was similar to that described for Moser River, Nova Scotia by Wilder (1952). All outward migrants possessed a guanin coat which upon subsequent return to freshwater showed signs of itensifying in most cases. This is in contrast to the situation for Ellerslie Brook, Prince Edward Island, where silvering was not noted for fish moving to salt water although a guanin coat was acquired after a salt water sojourn (Smith and Saunders 1958). Wilder (1952) found that when immature freshwater brook trout were transferred directly to seawater (30.0 $^{o}/oo$), resistance to the change in salinity increased with size (fish ranged in length from 60 to 150 mm). Sutterlin et al. (1976) reported 150 gm to be the maximum size where negligible mortality occurs upon direct transfer into full seawater (>30.0 $^{o}/oo$). In the present study, the majority of smolt were below Sutterlin's limit, especially those of North Harbour River, S.M.B. and some specimens on Northeast River. Wilder (1952) pointed out that direct transfer experiments subject fish to greater and more abrupt changes than they would usually experience in nature; in areas of sea trout abundance, inshore salinity is usually less than 30.0 $^{o}/oo$ and the rivers are characterized by long brackish estuaries allowing sufficient opportunity for acclimation. Gibson and Whoriskey (1980) attempted to induce anadromy in freshwater brook trout by releasing them into an estuary (between May 29 and July 29). Upon later recapture they found that only 15% appeared to be sea trout and in general, growth was relatively poor. Probable reasons given for such results were that brackish water habitat was limited for the number of fish released (only fish 150 gm and larger would acclimate to full seawater while those smaller than this were possibly limited to short forays into the sea, remained in the restricted brackish water environment or remained entirely in freshwater) and release at an inappropriate time. Saunders et al. (1974) in an attempt to acclimate hatchery brook trout to 30.0 $^{o}/oo$ seawater at ambient temperatures (September through October) reported that the fish found considerable difficulty adjusting to salinities over 25 $^{o}/oo$. These fish were larger than most in the present study and sizes reported by White (1940) and Smith and Saunders (1958). They attributed the failure to adapt to the fact that in nature, smoltification and attendant salinity tolerance is a seasonal phenomenon, a process to which the specimens used were not subjected. Hoar (1976) made a broad generalization that salmonids show a sharp increase in salinity resistance in spring time, being greatest in larger and fastest growing individuals; this change is rhythmical and develops prior to and independent of smolt transformation. The response regresses when fish are retained in freshwater. However, he also states that many variations from this have been detailed in studies of the different species of salmonids. One such variation pertains to Ellerslie Brook (Smith and Saunders 1958) where major movements to salt water occur in autumn and early winter. This is contrary to a statement by Saunders et al. (1974) that possibly salinity resistance is not as well developed in fall as it is in spring. Whether the majority of the "small" smolt on North Harbour River, S.M.B. move out into full seawater or remain in brackish water remains to be seen. Some specimens were angled from a wharf in North Harbour approximately 3.0 km beyond the point mentioned above as possessing salinities of 22.5 and 24.0 °/oo for surface and bottom (2.0 m) respectively. Also, tagged smolt were observed in the same area. The majority of fish taken in Northeast and Southeast Arms, Placentia were well below 150 gm and were captured in areas where salinity was usually in excess of 25 °/oo. Some of the inward migrants on North Harbour River, S.M.B. and Beaver River possessed "sea lice" (which was also noted for brown trout in the former river). It is apparent therefore that while size can be an important feature of smoltification and salinity resistance, other factors are involved also (eg. temperature, photoperiod, water level, living space, etc.) perhaps acting synergistically. This could help explain the failure of direct transfer experiments. It might be that smoltification and development of salinity tolerance will not occur for a given fish until a certain "set" of environmental circumstances have been satisfied.

An exponent or slope (b) value of 3.0 in the length-weight relationship describes isometric growth which is characteristic of a fish having an unchanging body form and unchanging specific gravity; although this value is approached in many species, variation can be introduced by the effect on weight of such factors as time of year, stomach contents, spawning condition, etc. (Ricker 1975). Values greater or less than 3.0 are characteristic of allometric growth; fish become heavier with respect to length if b>3.0 with the reverse occurring for values of b<3.0 (Tesch 1970; Ricker 1979). Thus the slope can be used as an indicator of condition. A slope value of 1.0 in the body length-scale length relationship as used in this study is indicative of isometric growth while higher or lower values than this denote allometric growth (Kipling 1962). Lear and Day (1977) found that the slope of the length-weight relationship for inward moving brook trout was significantly higher than that of outward migrants for North Harbour River, S.M.B. Wilder (1952) reported the same for Moser River. In the present study, combined samples on North Harbour River, S.M.B. concurred with these findings in 1976 but not in 1977; Beaver River also agreed but not Southeast River. Regardless though of whether the differences were significant or not, inward migrants were in better condition than outward migrants for a given area. In Northeast Arm, Placentia, specimens taken in June were in better condition than those taken at other times. Gibson and Whoriskey (1980) stated that June and possibly earlier appeared to be an important feeding time on the North Shore of the Gulf of St. Lawrence. Based on inward migrants (major feeding activity probably in May and June), conditions for growth in Southeast Arm, Placentia appear to be better than in North Harbour River, S.M.B., North Harbour, P.B. and Come By Chance estuaries. Northeast Arm, Placentia is comparable to Southeast Arm (using values for June in each Arm). In terms of the body length-scale length relationship, growth varied between isometric and slightly allometric ($b>1.0$).

Salmo trutta

The maximum age reported for freshwater brown trout in Newfoundland is 11^+ (Lee 1971). Two specimens of anadromous brown trout angled at Witless Bay, Newfoundland in 1960 and 1962 each had a total age of 13^+ (Williamson 1963). This compares with a total age of 11^+ (4.7^+ for Colinet River) in the present study. The oldest fish reported by Nall (1930) was 18^+ and was taken in Scotland.

Out of 27 populations of British anadromous brown trout presented in Nall (1930), the modal smolt age for 22 of them was 3.$^+$ (percent composition ranged from 47.7 to 80.6); for the remainder the mode was 2.$^+$ (68.4-89.0% composition). The range was 1.$^+$-6.$^+$. Age groups 1.$^+$, 4.$^+$, 5.$^+$ and 6.$^+$ were represented in 2, 26, 15 and 4 populations respectively with corresponding percent composition ranging from 0.06-0.5, 0.25-26.2, 0.03-3.8 and <1.0 respectively. Mean smolt age calculated from Nall's data by the present author (this has been done for all studies cited where mean smolt age is not presented) ranges from 2.11 to 3.26. Fahy (1978) reported a similar range in mean smolt age for British populations. Järvi (1940) found that modal smolt age decreased from 4.$^+$ (57.7% composition) in the north to 2.$^+$ (70.1% composition) in the south in the Baltic Sea. The range for the north was 3.$^+$ (38.3%) - 6.$^+$ (1.8%) while for the south it was 1.$^+$ (20.0%) - 3.$^+$ (2.0%); mean smolt age calculated from Järvi's data ranges from 2.11 in the south to 3.72 in the north. For 7 Irish populations presented in Went (1952, 1954, 1956), smolt age ranged from 1.$^+$ to 5.$^+$; modal smolt age varied between 2.$^+$ and 3.$^+$ while mean smolt age ranged from 2.14 to 2.79. For the River Rega in Poland, composition of smolt is 2.17, 78.20 and 19.55% for age groups 1.$^+$, 2.$^+$ and 3.$^+$ respectively; mean smolt age is 2.17 (Chelkowski 1966). In Norway, Dahl (1910) reported smolt age composition for age groups 2.$^+$ through 6.$^+$ to be 13.0, 40.6, 34.9, 10.9 and 0.01% respectively; for the same age groups, Jensen (1968) reported 2.1, 56.6, 37.4, 3.2 and 0.6% respectively. Mean smolt age calculated from their data is 4.63 and 3.43 respectively. Smolt age ranges from 1.$^+$ (1.6%) to 5.$^+$ (0.2%) for the Åva Stream in Sweden (Alm 1950) while the mode is 2.$^+$ (68.6%). Mean smolt age calculated for this study is 2.30.

Although modal smolt age (combined samples) in Newfoundland ($3.^+$ for all except North Harbour River, S.M.B. in 1977 where $2.^+$ was recorded) is comparable to the above, the range ($1.^+$ - $8.^+$) is greater. Mean smolt age in the present study ranged from 2.56 to 4.29. Nall (1930) observed that smolt age can fluctuate from year to year for a given river and that there can be wide differences between neighbouring rivers. This certainly appears to be the case in the present study (the sampling problems considered above for brook trout should be considered here also). Age at migration depends largely on growth rate in that fast growing parr tend to migrate at an earlier age (Nall 1930; Pentelow et al. 1933; Järvi 1940; Skrochowska 1969d). This is especially apparent on a latitudinal basis as shown by Järvi (1940) where, as mentioned above, smolt age increases from south to north in the Baltic Sea. Similar findings have been reported for Atlantic salmon (Templeman 1967; Power 1969; Lear and Misra 1978). The slower growth rate of parr in more northern areas has been attributed to lower temperatures, a shorter growing season and less food relative to more southern areas. It can be seen from Table 45 that parr growth in Newfoundland is somewhat similar to more northern European areas (Norway and the Bothnian Bay) but much slower than the more southern populations (small differences may be due to the fact that fork length for Newfoundland has been compared with total length for the other areas). In other words, collectively in Newfoundland, smolt age structure and growth of parr resembles that displayed by the more northern parts of the range of the species in Europe.

For freshwater populations of brown trout in Newfoundland, Liew (1969) also found that the growth rate of Newfoundland freshwater

Table 49. Comparison of mean back-calculated length (mm) at each annulus of parr of Salmo trutta in Newfoundland with that of European populations.

Study Area	Annulus 1	2	3	4	5	6	7	8
[1]North Hr. Riv., S.M.B.	40	91	123	166	202	223	261	-
[1]N.E. Arm, Plac.	40	90	135	177	214	273	317	333
[1]Colinet Hr. and Riv.	41	88	131	171	217	258	-	-
[2]Norway	-	131	148	168	201	-	-	-
[3]Norway	35	79	125	153	-	-	-	-
[4]Sweden	71	149	202	-	-	-	-	-
[5]Bothnian Bay	44	96	152	197	217	-	-	-
*[6]Poland	72	155	222	-	-	-	-	-
**[7]United Kingdom	-	176	205	235	-	-	-	-

[1]This Study; [2]Dahl (1910); [3]Jensen (1968); [4]Alm (1950); [5]Järvi (1940) [6]Frank (1967); [7]Nall (1930)

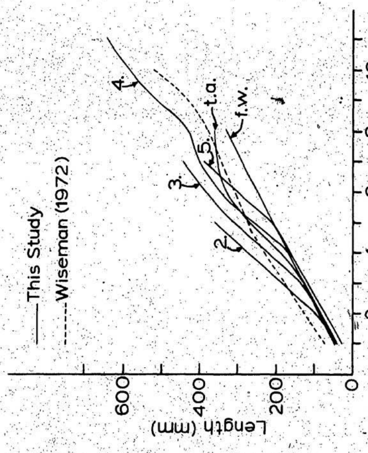
*Values obtained by combining data for Rivers Raba and Dunajec in Frank (1967).

**Values obtained by combining data in Table 2 Appendix in Nall (1930).

populations is slower than reported for Europe and other areas of North America. If one assumes that the growth rate of anadromous and non-anadromous brown trout is similar in freshwater, it can be seen in Fig. 33 that overall back-calculated freshwater growth in the present study (weighted means of all areas combined) is substantially slower than that of the average of 7 Avalon Peninsula lakes in Wiseman (1972). Another consideration in this comparison is the age at which freshwater populations become pond resident and whether pond residency is a feature of anadromous populations prior to going to sea (such was not discernible from scale analysis in the present study). Pond residency can have a decided effect on growth relative to stream residency (Liew 1969; Wiseman 1972).

Nall (1930) found that post-smolt and specimens beyond this stage can likewise show great variation in growth rate from area to area and also display a wide range in length for a given age group. He gives the size of post-smolt as ranging usually from 6 to 14 oz (170-397 gm) with some reaching up to 3.0 lb (1.4 kg). This compares with a much lower range of between 20 and 80 gm for Newfoundland with occasional specimens reaching 300-600 gm. Nall observed that the size of post-smolt can be governed largely by the age (and consequently size) at which smolt migration occurs, i.e. the larger the smolt, the larger the post-smolt. This holds true for the present study. The effect on growth of going to sea in terms of total age is more pronounced for this species than for brook trout (Fig. 33). Growth surpasses that reported in Wiseman (1972) beyond 4^+ years of age. When comparisons are made according to groupings based on smolt age the same dramatic effect of salt water growth observed for brook trout is evident. Apparent also is the advantageous effect of a younger smolt age on eventual size attained in the sea (at least for

Fig. 33. Back-calculated growth of anadromous Salmo trutta (weighted means of all areas combined) in terms of overall freshwater life (f.w.), total age (t.a.) and grouped according to smolt age (2., 3. etc.) compared with the average of 7 Avalon Peninsula lakes presented in Wiseman (1972) for the freshwater form.

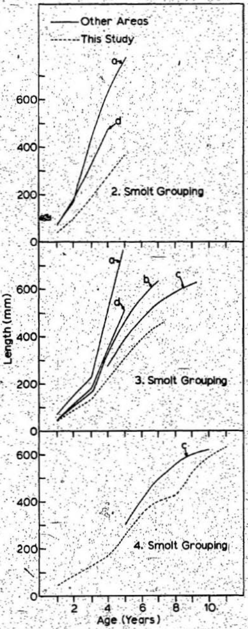


This Study
Wiseman (1972)
Length (mm)
Age (Years)
0
200
400
600
2
4
6
8
10
2
3
4
5
t.a.
f.w.

the age groups represented). Nall (1930) stated that there is a tendency to lose this advantage after migration as age advances. Fahy (1978) reported that equilization can occur as early as the first winter after migration. Frank (1967) noted that there was no advantage apparent for the River Raba; however, the reverse was true for River Dunajec (Poland). Whether or not Newfoundland populations would equalize beyond the age groups presented above is impossible to say in light of present data.

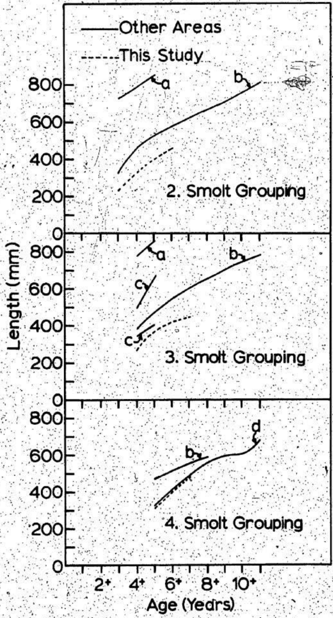
Back-calculated growth in Newfoundland is decidedly less than that reported for European populations for specimens beyond the type 2 post-smolt stage (Fig. 34). The same is true for empirical growth (Fig. 35). It should be pointed out that fork length for Newfoundland populations was compared with total length for all studies except Campbell (1977) where fork length was also used. Such slow growth could be due in part to the portion of the yearly increment acquired while over-wintering in salt water with probably temperature being the dominant determining factor. As seen above, winter temperatures in Placentia Bay and St. Mary's Bay can fall to <0°C and estuaries can be ice-covered. This compares with ice free conditions and minimum winter temperatures for Great Britain and Norway of 5-8°C (Brett 1974; Saunders et al. 1974). In fact, Nall (1930) reports the width of circuli laid down during the winter as being comparable to that of summer for certain British populations. Warmer temperatures also most likely result in greater food abundance in winter for these European populations. In the classification system of Allan and Ritter (1977), specimens displaying repeated sea life on their scales are assumed to be beyond the type 2 post-smolt stage and return to freshwater for the first time after one or more winters in the sea. Even though this classification was adopted in the present study, it was

Fig. 34. Back-calculated growth of anadromous Salmo trutta specimens beyond the type 2 post-smolt stage (weighted means of all areas combined) grouped according to smolt age (2., 3. etc.) compared with other areas: (a) Poland (Frank 1967); (b) Bothnian Bay (Jarvi 1940); (c) Norway (Jensen 1968); (d) Scotland (Campbell 1977). In the 4. smolt grouping, growth from 7 years onward is based on a single specimen from Colinet River.



Other Areas
This Study
2. Smolt Grouping
3. Smolt Grouping
4. Smolt Grouping
Length (mm)
Age (Years)

Fig. 35. Empirical growth of anadromous Salmo trutta specimens beyond the type 2 post-smolt stage (weighted means at time of capture of inward migrants on North Harbour River., S.M.B. and specimens captured in the sea combined) grouped according to smolt age (2., 3. etc.) compared with other areas: (a) Poland (Frank 1967); (b) Sweden (Alm 1950); (c) United Kingdom (maximum and minimum - Nall 1930); (d) Norway (Jensen 1968).


Other Areas
This Study
800
600
400
200
0
2. Smolt Grouping
a
b
800
600
400
200
0
3. Smolt Grouping
a
b
c
c
800
600
400
200
0
4. Smolt Grouping
b
d
Length (mm)
2+
4+
6+
8+
10+
Age (Years)

applied with some reservation. Nall (1930) reported that in addition to fish displaying this particular life history pattern, certain individuals may return to freshwater each successive year after a few months in the sea. Based on scale analysis, it was not possible to ascertain if one or the other or both situations apply to Newfoundland populations. Saunders et al. (1974) cite Koops (1972) to the effect that the lower lethal temperature for brown trout in brackish water (salinity ranging from 13 to 20 ‰) ranges from -0.5 to -0.9°C. As already seen, temperatures in Placentia Bay and St. Mary's Bay can fall below this. It is conceivable therefore that anadromous brown trout might overwinter in freshwater or the mouths of rivers in order to escape lethal temperatures. This is not to say that there may not be some estuaries or certain areas in a particular estuary where temperature could permit overwintering. As mentioned above, conditions conducive to the presence of brook trout were encountered in Southeast Arm, Placentia in mid-winter (specimens were angled through the ice). Certainly more work needs to be done in regard to movements of brown trout in relation to environmental conditions in Newfoundland waters. The end result whether fish overwinter in freshwater or salt water would most likely be slower growth than exhibited by European populations under the influence of the North Atlantic Drift and also in the Baltic Sea (judging by annual temperature regimes published in the hydrography section of Annales Biologiques, Conseil International Pour L'Exploration De La Mer). It is possible that environmental conditions conducive to better growth (particularly temperature and food availability) are to be found in European waters for the remainder of the year as well. Genetic factors could also be operant.

The largest individual specimen taken in the present study came from Colinet River (4.7^{+} years of age) which measured 672 mm long and weighed 3.67 kg. A specimen of the same age structure in Bothnian Bay (Järvi 1940) was considerably larger at 950 mm in length and weighed 10.0 kg. The two angled specimens (each 13^{+} years total age) from Witless Bay, Newfoundland reported by Williamson (1963) were 1,005 and 1,040 mm long with corresponding weights of 12.53 and 12.93 kg. Scott and Crossman (1973) reported a record of 39 lbs. and 4 ozs. (17.9 kg) for a Scottish specimen. Nall (1930) reported a fish from Scotland weighing 31 lbs. (14.1 kg) and one from Orkney reaching 29 lbs. (13.2 kg); this author also records a Norwegian specimen weighing 30 lbs. (13.6 kg) and one from Sweden at 28.5 lbs. (12.9 kg).

On North Harbour River, S.M.B., inward moving brown trout are in better condition ($b = 3.0$) than in the outward run ($b<3.0$). Growth tended to be isometric for all samples taken in salt water with the exception of Northeast Arm, Placentia, 1977, where allometry was noted ($b<3.0$). Slope values of the body length-scale length relationship indicates that growth for most part is isometric.

Reproduction

Salvelinus fontinalis

Age at first maturity (total age of 2^{+} for both sexes) observed in the present study is the same as reported by Wiseman (1969) for several freshwater populations of brook trout in insular Newfoundland. Lee (1971) observed males maturing for the first time at 1^{+} and females at 2^{+} for a combined sample from four Avalon Peninsula lakes. Both these authors reported that males tend to mature earlier than females. Lee

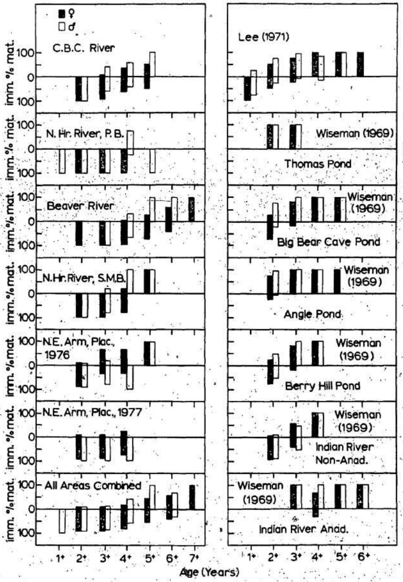
(1971) believed his female specimens to be alternate spawners and also reported that 48% were repeat spawners. For central North American populations of anadromous brook trout, Power (1980) describes males as maturing before females; multiple spawning is usual and once maturity is attained spawning is annual. In northern populations, multiple spawning is usual, males spawn annually and females may spawn one year in three or annually. For the most part males tended to mature earlier than females in the present study and also alternate spawning of both sexes is indicated. As mentioned above, scale analysis and gonad examination failed to detect the presence of repeat spawners either in samples taken on the spawning grounds or elsewhere. Hoar (1940) stated that scale analysis is unreliable for determining the spawning history of anadromous brook trout. It might also be possible that the macroscopic criteria used was not sufficient to detect spawning history in the present study in that the "mending" process may not have left any clear cut evidence of previous spawnings.

In the present study, scale analysis revealed that parr of both sexes and specimens with a sea history were present in the same spawning concentrations. Examination of kelts also gave an indication that both sexes can spawn prior to going to sea for the first time. Power (1980) stated that some males may mature before going to sea for central North American populations. Hoar (1940) noticed an absence of evidence for sea growth on the scales of some Moser River kelts (both sexes) and concluded that they had either spawned prior to going to sea or that sea growth is not always evident. As mentioned above, Wilder (1952) concluded that there was no evidence to show that freshwater and anadromous brook trout on this river are genetically distinct. Thus it is reasonable to assume that there is no spatial and/or temporal separation of each form in regard to spawning on Moser River. Smith and Saunders (1958) reported inconclusive evidence for a hereditary influence on anadromy for brook trout in Ellerslie Brook. At the same time, in discussing the possibility that the freshwater and anadromous forms are genetically distinct, they state "this view would appear untenable on the *a priori* grounds that in a stream such as Ellerslie adequate isolation in spawning would not continue over a sufficiently long period to maintain the genetic integrity of different groups of brook trout." They concluded that data obtained at Ellerslie Brook plus the findings of Wilder (1952) support the contention that movements from fresh to saltwater are in response to environmental conditions and there is no need to postulate races of brook trout with heritable differences to explain their movement to sea. Recent reviews by Behnke (1972, 1980), who cites many examples of reproductively isolated sympatric populations by arctic char and other salmonids occurring in small bodies of water suggests the opposite can occur. Ferguson and Mason (1981) reported three reproductively isolated sympatric populations of brown trout in a lake in Ireland based on allozyme evidence. Some of the parr and specimens with a history of sea life utilizing the same spawning grounds in the present study were partially spent at time of capture. This, plus the fact that a number of smolt which showed evidence of spawning as parr were encountered in virtually all areas, suggests that they are anadromous fish which mature prior to going to sea for the first time and will be considered as such in this discussion.

White (1940) reported that a large number of brook trout returning to Moser River from the sea were not maturing. Dutil and Power (1980) found that 72% of females and 82% of males in Richmond Gulf were immature; the proportion of maturing fish was higher with increased age (however, immature fish could be found in any age group and as many as 30% of fish older than 6 years were not maturing). Similar results were observed in the present study. Whoriskey et al. (1979) and Gibson and Whoriskey (1980) each reported that the percentage of fish maturing in samples captured in salt water was lower than observed for corresponding river populations in Quebec (Moisie River and Matamek River respectively). A comparison of inward migrants and specimens taken in the sea from late July onward with freshwater populations in Wiseman (1969) and Lee (1971) suggests that the same applies to Newfoundland (Fig. 36). An exception occurs in the case of Indian River (Wiseman 1969) where the reverse was observed. This could be due to the comparatively small number of in the anadromous sample (11 females and 9 males) especially in the 3^+ and 6^+ age groups.

Of 7 Newfoundland freshwater populations of brook trout examined by Wiseman (1969), males outnumbered females in 3 (significantly in 2 cases) while the reverse was true for the remainder (significant in 1 case); females outnumbered males in the single anadromous population (Indian River) but not significantly (sample size was small as seen above). Lee (1971) found a sex ratio significantly in favor of males for a combined freshwater sample from four Avalon Peninsula lakes. For the anadromous populations in the present study, females significantly outnumbered males regardless of the direction of the run and also in the sea. The same was observed by White (1940) and Wilder (1952) for Moser River (78% and 72% females respectively). Coleman (1970) reported a sex ratio in favor of females for Koksoak River, Ungava Bay (anadromous).

Fig. 36. Percentage immature and mature anadromous Salvelinus fontinalis compared with that of the freshwater form reported in Wiseman (1969) and Lee (1971).


♀
♂
C.B.C. River
N. Hr. River, P. B.
Beaver River
N.Hr. River, S.M.B.
N.E. Arm, Plac., 1976
N.E. Arm, Plac., 1977
All Areas Combined
Lee (1971)
Wiseman (1969)
Thomas Pond
Wiseman (1969)
Big Bear Cave Pond
Wiseman (1969)
Angle Pond
Wiseman (1969)
Berry Hill Pond
Wiseman (1969)
Indian River Non-Anad.
Wiseman (1969)
Indian River Anad.
imm. % mat.
100
0
100
1+ 2+ 3+ 4+ 5+ 6+ 7+
Age (Years)

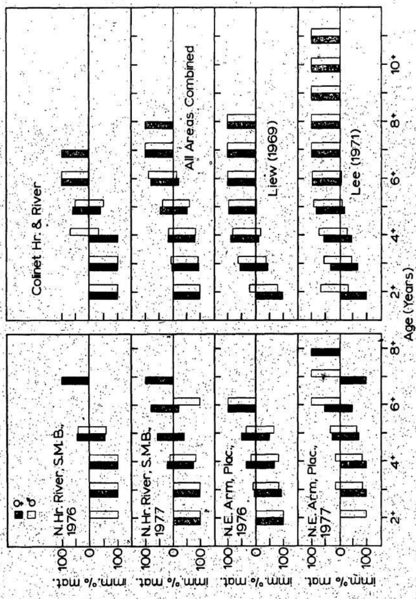
A preponderance of females in outward and inward movements and in the sea has been reported for other anadromous salmonid species. Skrochowska (1969d) reported that both male and female anadromous brown trout can mature prior to going to sea for the first time in the River Raba, Poland. This author attributed the high sex ratio in favor of females to the fact that for males the process of sexual maturation is biologically antagonistic to smoltification whereas for females, such is not the case. The processes of sexual maturation (oogenesis and spermatogenesis) and smoltification both utilize stores of glycogen and fat. The difference between males and females in regard to attainment of smoltification stems from the fact that the action of the testes extends long into the winter (often into spring) whereas ovaries can cease to function at the time the eggs are shed into the body cavity (i.e. even before being passed out of the body) and return to the resting state. Thus, in terms of available energy stores, the process of smoltification can be inhibited in males causing them to remain in freshwater. Dalley (1978) reported high percentages of females in the smolt run of Atlantic salmon on North Harbour River, S.M.B. (81% female), Northeast River (90% female) and Southeast River (92% female). Each of these populations possesses a high incidence of precocious male parr (no female parr mature prior to going to sea). The lack of males in the smolt run was attributed to either high mortality as a result of precocious sexual development or the inhibitory effect described above. Wilder (1952) reported a sex ratio highly in favor of males (71%) in a sample taken in freshwater after the anadromous trout had gone to sea (Moser River). Skrochowska (1969d) and Dalley (1978) reported the same reversal for parr of anadromous brown trout and Atlantic salmon respectively.

Salmo trutta

For freshwater populations of brown trout in Newfoundland, males mature for the first time at 2^+ (total age) and females at 3^+ years of age (Liew 1969; Lee 1971). The same was observed for the present study. Both these authors reported a higher percentage of males maturing than females in age groups 2^+- 5^+ (100% of specimens of each sex were mature from 6^+ onwards). Results on this point in the present study were inconclusive (comparison is made with Liew (1969) and Lee (1971) in Fig. 37). The tendency for a greater number of fish to be mature at a given age for freshwater populations compared with fish in the sea is evident for this species also.

The earliest age at maturity observed by Nall (1930) for specimens with a history of sea life was 2.0^+. Fahy (1978) reported the percentage of post-smolt maturing in Wales, Scotland and Ireland to be 30.95, 6.15 and 8.76 respectively. This compares with 11.3% in the present study (calculated for sexes combined from data in Tables 38 and 39). For specimens beyond the type 2 post-smolt stage, Fahy (1978) gives the percentage of fish maturing after 1 through 3 post-migration winters as 47.9, 41.1 and 9.6 respectively. This compares with 20.0, 60.5 and 88.2% for the present study. For the River Istra in Norway (Jensen 1968) the majority of both sexes mature after 3 post-migration winters ($.3^+$). It is quite evident from the above that a large percentage of type 1 post-smolt and also $.1^+$, $.2^+$ and to a lesser extent $.3^+$ sea-winter fish entering freshwater in Newfoundland are not maturing. This is in agreement with Nall (1930) and Menzies (1936). Alm (1950) on the other hand reports that only mature specimens ascend the Åva Stream in Sweden.

Fig. 37. Percentage immature and mature anadromous Salmo trutta compared with that of the freshwater form reported in Liew (1969) and Lee (1971).



♀
♂
N. Hr. River, S.M.B., 1976
N. Hr. River, S.M.B., 1977
N.E. Arm, Plac., 1976
N.E. Arm, Plac., 1977
Colinet Hr. & River
All Areas Combined
Liew (1969)
Lee (1971)
imm.% mat.
100
0
100
2+
4+
6+
8+
10+
Age (Years)

Lee (1971) reported that between 54 and 65% of mature female freshwater brown trout were repeat spawners (Avalon Peninsula). Both scale analysis and gonad examination failed to detect the occurrence of repeat spawning in the present study. According to Jensen (1968), examination of scales from recaptured tagged fish for River Istra, Norway has shown that spawning marks may be completely absent on anadromous brown trout kelts. The same was more or less observed in the present study (established by gonad examination). The degree of erosion giving rise to spawning marks can vary considerably from area to area and in fact there can be variation with respect to different scales from the same fish (Nall 1930). Lee (1971) believed his female specimens to be alternate spawners. There is evidence for the same for females in the present study. Nall (1930) on the other hand states that once maturity is attained, anadromous brown trout are annual spawners as a rule. For the River Istra, Norway, after first spawning, the surviving fish might spawn again the next year or two or more years could pass before the next spawning (Jensen 1968). In the Åva Stream, Sweden, the majority (84.2%) spawn annually; 10.5% spawn the two following years while the remainder (5.3%) can be away for one, two or three years before the next spawning migration (Alm 1950). Järvi (1940) reports successive spawning to be an exception in the Bothnian Bay.

Nall (1930) found no evidence that parr of anadromous brown trout mature prior to going to sea for the first time. Allan and Ritter (1977) indicated that there was no record for the existence of precocious male parr. Contrary to this, the presence of precocious males in the River Jörlandaån in Sweden has been reported by Bohlin (1975); in the River Raba, Poland, both sexes can mature prior to smoltification

(Skrochowska 1969d). There is some evidence that males mature prior to going to sea on North Harbour River, S.M.B. (based on two mature parr taken in the fall of 1976); smolt examination on the other hand revealed no kelts which spawned as parr. A male captured in Northeast Arm, Placentia in May, 1977 had spawned as a parr.

Liew (1969) found females to outnumber males (not significantly so) for three freshwater populations of brown trout on the Avalon Peninsula with the reverse occurring (significant difference) for another. Lee (1971) also found females to outnumber males (not significantly) for two populations. No significant differences from 1:1 were found in the present study; females outnumbered males on North Harbour River, S.M.B. and Colinet River while the reverse was true for Northeast Arm, Placentia. A preponderance of females has been reported for anadromous brown trout by several authors (Alm 1950; Jensen 1968; Campbell 1977). A comprehensive review of this subject in regard to anadromous brown trout (involving smolt, inward migrants and specimens taken in the sea) has been provided by Skrochowska (1969d). The reasoning outlined in this paper for the disproportion of sexes in favor of females has been discussed above in conjunction with brook trout. The degree to which male parr mature could explain the relatively lower female:male ratios for Newfoundland anadromous brown trout compared with the literature as well as the differences noted between areas.

Food and Feeding

Salvelinus fontinalis

Food and feeding habits of freshwater populations of brook trout in Newfoundland has been dealt with previously by Wiseman (1969) who found in general a similarity to other North American populations.

Scott and Crossman (1964) stated that while in freshwater, food of anadromous brook trout is similar to that of the freshwater form. Clemens (1928), Metzelaar (1929) and Wiseman (1969) reported that reliance on invertebrates decreases with increased size and fish assume greater importance. This appears to be the case for the present study in both freshwater and salt water. Seasonally, for New York, Needham (1930) found that brook trout depend on aquatic sources of food from December to March; for the remainder of the year terrestrial items (larvae, pupae and adults of terrestrial insects, terrestrial adult stages of aquatic insects, various other arthropods and earthworms) constitute a large proportion of the food. Similar findings were reported by Lord (1933) and Wiseman (1969) for Vermont and Newfoundland respectively. In the present study, outward migrants tended to rely more on aquatic sources of food than inward running fish. However, terrestrial food certainly seems to be utilized when available during the outward run as exemplified by North Harbour River, S.M.B. where there was a relatively heavy consumption of adult Plecoptera.

White (1940) found no food in the stomachs of ascending brook trout in Moser River even though they rose to an artificial fly. Scott and Crossman (1964) stated that the cessation of active feeding could probably result from the physiological readjustment to freshwater and the sudden absence of the larger food items such as utilized in the sea. In the present study, the great majority of stomachs of fresh run fish contained food and while remnants of marine forms were found in some, the bulk consisted of freshwater and terrestrial forms. Whether or not feeding ceases at a later date in freshwater is uncertain since no gut analysis was performed subsequent to the inward migration period. Wiseman (1969) found no food in the stomachs of sea trout taken after a long period in freshwater (August) for Indian River.

White (1942) and Dutil and Power (1980) report the food of trout in salt water for Moser River and Richmond Gulf respectively to consist mainly of fish. In Northeast and Southeast Arms, Placentia on the other hand, invertebrates predominated. This departure can probably be explained in terms of the size of trout analysed in the present study relative to the above two areas. The bulk of specimens in Northeast and Southeast Arms, Placentia were less than 200 mm in length. This is the reverse of the situation for Richmond Gulf (Dutil and Power 1980) where the majority were in excess of 300 mm and very few were below 200 mm. As stated above, in the present study in salt water, invertebrates were consumed almost exclusively by trout below 200 mm and it is not until after 300 mm is reached that fish predominate in the diet (relatively few specimens of this size were taken in salt water).

<u>Salmo trutta</u>

The food and feeding habits of freshwater populations of brown trout in Newfoundland are for most part similar to those reported in the literature for Europe and other North American areas (Liew 1969).

As noticed above for brook trout, there is also a change in feeding habits from invertebrates to predominately fish with increase in size for freshwater brown trout (Metzelaar 1929; Allen 1938; Idyll 1942; Nilsson 1955, 1957; Liew 1969; Hunt and Jones 1972; Johnsen 1978; Yevsin and Ivanov 1979). Liew (1969) reported that forage fish constitute the main food of Newfoundland freshwater brown trout over 350 mm in length. A study of post-smolt feeding in the North Argyll sea lochs of Scotland by Pemberton (1976b) revealed fish species to be increasingly more important than invertebrates in the diet of anadromous brown trout over 210 mm in length. O'Donoghue and Boyd (1930, 1932, 1934) examined specimens mainly over 250-310 mm in length which were taken in salt water and found fish to predominate. These observations apply more or less to the present investigation.

The seasonal variation noted above for brook trout in regard to feeding on aquatic versus terrestrial food has been reported for freshwater brown trout as well (Nilsson 1955; Ball 1961; Chaston 1969; Johnsen 1978; Yevsin and Ivanov 1979). The food of outward versus inward migrants on North Harbour River, S.M.B. bear this out to a degree. The autumn sample from Colinet River indicates a heavier reliance on aquatic food than terrestrial food. In Scottish sea lochs, Pemberton (1976b) found benthic organisms to be more important in winter while midwater and surface organisms (young fish and insects) are preferred in summer. Small sample sizes in June and November relative to September in Northeast Arm, Placentia render any conclusions in regard to change in habits open to question. However, referring only to September, it would appear that benthic food is dominant. The same is true for Colinet Harbour for May-September (the bulk of the sample was taken in August).

The diet in salt water for Newfoundland is considerably less varied in terms of diversity of organisms utilized than that reported for Great Britain by O'Donoghue and Boyd (1930, 1932, 1934) and Pemberton (1976b). In the present study, five species of crustaceans, three species of molluscs and two species of fish were encountered compared with twenty-five, three and seventeen species respectively for the Scottish sea lochs as reported by Pemberton (1976b). The major groups of insects involved in each situation were much the same.

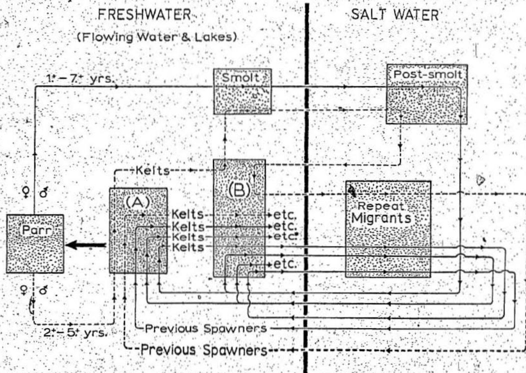
Life History Strategy

Up to this point, various characteristics of the life history and biology of the two species have been described, discussed in relation to environmental conditions and also have been compared with populations elsewhere. An attempt will now be made to synthesize the above in terms of life history theory, a subject which has received comprehensive treatment by authors such as Cole (1954), MacArthur and Wilson (1967), Murphy (1968), Gadgil and Bossert (1970), Pianka (1970), Schaffer (1974), Stearns (1976, 1977, 1980) and Begon and Mortimer (1981). Also, comparison will be made with Atlantic salmon, which, as mentioned above, occurs in all river systems studied.

A recapitulation of the salient features of the life histories of brook trout and brown trout as well as that of Atlantic salmon (as reported in previous studies) is presented below and represented schematically in Figs. 38–40. Brook trout smolt age ranged from $1.^{+}$ to $7.^{+}$ years. Major outward runs occur in April–June with inward runs occurring in July–August. There is evidence that movements between fresh and salt water might occur throughout the year. Duration at sea is around 2 months. The species is iteroparous and both sexes are alternate spawners. Both sexes can mature as parr (age at first maturity $2.^{+}$ years). Age at first maturity for post-smolt is 2.0^{+} years (both sexes). Individuals in a given year class attain maturity at different ages. The majority of specimens returning from the sea will not spawn in the fall of the year of return. The percentage of both sexes of inward migrants reaching maturity in a given age group is lower than that reported for corresponding age groups for the freshwater form; the ratio of mature to immature specimens increases with increased age. The maximum total age observed was 7^{+}

Fig. 38. A Schematic representation of the main features of the life history of anadromous Salvelinus fontinalis. A = spawning areas; B = overwintering areas.

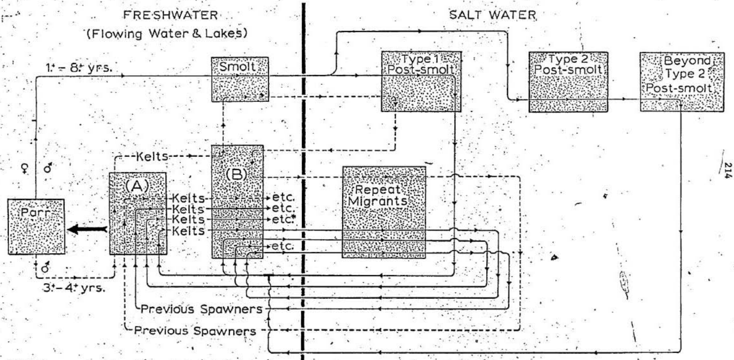
Salvelinus fontinalis – Iteroparous / Alternate Spawners (♀ & ♂)



* Will spawn again alternately

Fig. 39. A schematic representation of the main features of the life history of anadromous Salmo trutta. A = spawning areas; B = overwintering areas.

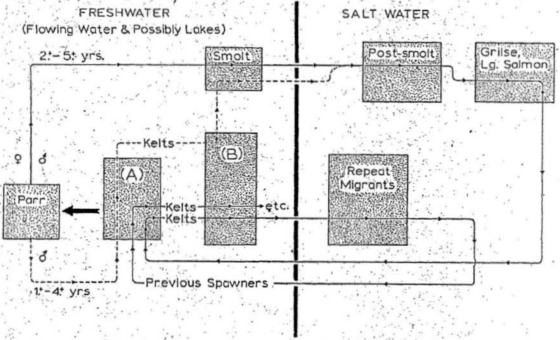
Salmo trutta- Iteroparous / ♀-Alternate Spawners; ♂- ?



*Will spawn again alternately

Fig. 40. A schematic representation of the main features of the life history of <u>Salmo salar</u>. A = spawning areas; B = over-wintering areas.

Salmo salar–Iteroparous/Consecutive Spawners



years. Brown trout smolt age ranged from 1.+ to 8.+ years. Outward runs of smolt occur concurrently with those of brook trout; outward movements of fish with a previous history of sea life possibly occur in early winter. Type 1 post-smolt (similar to the post-smolt stage of brook trout) return to freshwater in the year of smolt migration (duration at sea ranges from around 2 to 4 months). Type 2 post-smolt do not return to freshwater until after one or more winters in salt water. Inward movements occur from July through September. The species is iteroparous and there is evidence that females are alternate spawners. Males mature as parr. Total age at first maturity is 2+ years for males and 3+ years for females. Just as for brook trout, individuals in a given year class attain maturity at different ages. Also, the same observations with respect to the percentage of mature specimens in inward runs, the percentage of specimens maturing in a given age group relative to the freshwater form and ratio of mature to immature specimens with increased age as reported above for brook trout apply to brown trout as well. The maximum total age observed was 11+ years. Modal smolt age for Atlantic salmon for North Harbour River, S.M.B., Northeast River, Southeast River and Beaver River was 3.+ years (generally in excess of 80% composition compared with less than 50% for a given mode for brook trout and brown trout) while the range was 2.+-5.+ years (Dalley, unpublished data collected concurrently with that of the present study). Smolt move to sea around the same time as that noted for brook trout and brown trout. The great majority of adults are grilse (fish which return to freshwater after one sea-winter) as opposed to large salmon which spend 2 or more winters at sea (Porter *et al.* 1974). The bulk of adults enter the river in June through September. Unpublished data in the files of the Freshwater and Anadromous Fisheries Management Program, Department of Fisheries and Oceans, St. John's, indicate that for the rivers in the present study, both sexes are iteroparous and in contrast to brook trout and brown trout, are consecutive (successive) spawners; also all specimens are maturing upon entering the river. As for the other two species, individuals in a given year class mature at different ages. Males mature as parr (Dalley 1978). This species does not display a type 1 post-smolt stage. Given a 2-sea-winter adult (which is the usual for large salmon on the Avalon Peninsula) and the oldest smolt age of $5.^{+}$ years, the maximum expected total age would be 7^{+} years. The usual total age though, considering the high percentage of $3.^{+}$ smolt and the fact that the majority of adults are grilse, is 4^{+} years.

It should be pointed out that the above life history patterns are in the aftermath of exploitation and therefore cannot be considered in the context of virgin stocks. For brook trout, Beaver River is the least exploited and could represent some semblance to the unexploited stock situation. Brown trout are relatively unexploited compared to brook trout (see below). For Atlantic salmon, the effects of the commercial fishery on the ratio of grilse to large salmon (Schaffer and Elson 1975) have to be considered. The possible confounding effects of exploitation should therefore be kept in mind with respect to the interpretations of interspecific differences to follow.

The evolution of the smolt stage (Hoar 1976) was a very significant event in the phylogenetic development of the Salmonidae in that it allowed exploitation of the vast food resources of the sea (assuming of course, as did Hoar, that the salmonids originated in freshwater).

Migration is a strategy that can lead to greater growth and hence greater fecundity, better survival and ultimately optimization of reproductive success (Northcote 1978). Yet, in contrast to Atlantic salmon, substantial numbers of brook trout and brown trout do not utilize the resources in salt water for purposes of reproduction after their first or even repeated sea sojourns. Alm (1959) showed attainment of maturity to be a function of size in some cases and age in others. With respect to size, he reported that faster growing individuals in a year class tend to mature earlier than slower growing fish. Nall (1930), Pentelow et al. (1933), Järvi (1940) and Skrochowska (1969d) stated that fastest growing brown trout tend to smoltify at an earlier age. Although not presented in the Results section, back-calculation data in the present study show that the same applies to both brook trout and brown trout. However, Wilder (1952) and Sutterlin et al. (1976) report a negative correlation between salinity tolerance and maturity which decreases with increase in size. The net effect therefore serves to delay maturity in salt water. If the greater accrual of energy in salt water relative to freshwater is not used for reproductive products by all individuals after a sea sojourn as is the case for Atlantic salmon, then what is the ecological significance of increasing the total energy budget by going to salt water? Reproductive effort has been negatively correlated with longevity (Hirshfield and Tinkle 1975; Mann and Mills 1979; Bell 1980; Hirshfield 1980). Williams (1966), Gadgil and Bossert (1970) and Schaffer (1974) suggested that in iteroparous species selection should favour increased reproductive effort with age. Increase in body size has been positively correlated with egg size (Bagenal 1978) which has in turn led to increased survival of juveniles (Bagenal 1969). It is therefore conceivable that the negative relationship between maturity and salinity tolerance combined with alternate spawning (possibly a function of growth rate) serve to increase longevity (size) and juvenile survival. Murphy (1968) postulated that iteroparity with its attendant selection for long life, late maturity and repeated reproduction is a means of insuring reproductive success when coping with uncertain environmental conditions which result in variable juvenile survival. Reproduction in anadromous brook trout and brown trout in this context is spread over the maximum number of years incorporating traits that tend to maximize juvenile survival. Also, the wide range in size of spawners caused by fish that mature as parr versus sea-going fish that delay maturity as well as the gradual attainment of maturity by slower growing individuals in a cohort, result in a corresponding wide range in egg size. Mann and Mills (1979) suggest that variation in egg size and consequently larval size increases the range of appropriate food organisms thereby reducing intra-specific competition and increasing the survival chances of each individual.

As mentioned above, for brook trout and brown trout, the fastest growing individuals of both sexes in a year class can either mature prior to going to sea for the first time or alternatively, smoltify and delay maturity (the mechanism determining which proportion will take one or the other course is certainly not apparent in the present study). This is in contrast to the apparent situation for anadromous Atlantic salmon where, except for precocious males, maturity rests with sea-going fish. Rounsefell (1958) rated the degree of anadromy of the Salmonidae (ranging from wholly freshwater – Salvelinus namaycush to obligatory anadromous – Oncorhynchus gorbuscha) on the basis of (1) extent of migrations in the sea, (2) duration of stay in the sea, (3) state of maturity attained at sea, (4) spawning habits and habitat, (5) mortality after spawning and (6) occurrence of freshwater forms. Bell (1980) interpreted Rounsefell's classification in terms of reproductive effort based on fecundity, egg size and the ratio of clutch weight to total weight. Effort is lowest in the genus Salvelinus and highest in the genus Oncorhynchus with the genus Salmo intermediate. In terms of the predictions of r/K theory Atlantic salmon should be more r-selected than brook trout and brown trout. Accordingly, for rivers in the present study, there should be an increase in reproductive effort relative to the other two species associated with the observed overall shorter life span which includes the absence of a type 1 post-smolt stage and a reduction in the number of life history groupings of the type 2.1^+, 3.2^+, 4.2^+, etc. Also, as already pointed out, contrary to brook trout and brown trout, Atlantic salmon are consecutive spawners. Probably the most important determining factors dictating the degree to which the marine environment can be utilized to maximize reproductive effort which might operate to the advantage of Atlantic salmon over brook trout and brown trout are salinity resistance (bearing in mind its relationship to maturity), duration at sea and extent of migration (none of which may be mutually exclusive). Hoar (1976) rates the ability to withstand sea water for smolt of the genus Salmo as S. gairdneri > salar > trutta; the ability of Salvelinus to smoltify is less than that of Salmo. Of the three species in the present study, duration at sea and extent of migration is least in brook trout and highest in Atlantic salmon with brown trout being intermediate (Rounsefell 1958).

Atlantic salmon display greater uniformity in size of spawners than the other two species, hence there might be more uniformity in egg size and larval size. This suggests possibly more niche specialization with respect to feeding than for brook trout and brown trout. Although Dalley (1978) reported a high incidence of precocious male salmon in the river systems in the preent study, he also related in a personal communication to the author that he located a mature female approximately 20 cm in length on the same spawning grounds as sea-run adults on Northeast River (which is completely accessible to the sea) during the height of the spawning season. The question arises therefore whether or not this was a precocious female in the same sense as noted above for brook trout and brown trout, i.e. represents a proportion of the fastest growing individuals in a year class that mature prior to smoltification as opposed to those that smoltify without first attaining maturity. The fact that Dalley (1978) found no female smolt with a previous spawning history (in contrast to the situation for males) suggests that if this phenomenon does occur, the incidence is very low. The size of the specimen indicates that it could have been a residual (slow growing) anadromous salmon that spawned with adults. It may also have been a representative of a reproductively isolated landlocked population which strayed unto the spawning grounds or one which would have utilized the same area after the spawning of sea-run fish was over. If it was a precocious female or a residual then the same survival value attached to a range in egg size and hence larvae size in relation to a range in size of available food items mentioned above for brook trout and brown trout could apply to this species also.

It was stated above that anadromous brook trout cease feeding (at least for a time) after entering freshwater. Nall (1930) reports a reduction in the feeding of anadromous brown trout if freshwater. This is in contrast to Atlantic salmon where feeding virtually ceases (Nall 1930;

Scott and Crossman 1973). Massive deposits of fat were noted in the area of the pylorus part of the stomach and pyloric caecae of most of the inward running specimens of brook trout and brown trout for both immature and maturing specimens. Presumably these energy reserves are drawn upon during the period when feeding ceases or is reduced. Movement to sea as mentioned above in the case of North Harbour River, S.M.B. can serve to lessen competition for resources on the part of the pre-smolt juveniles. Along the same lines, it therefore makes sense to reduce the dependence by fish returning from salt water on resources being utilized by the freshwater component of the population. O'Connell et al. (1979) reported cannibalism in freshwater by larger brook trout. Dependence on stored reserves could lessen the possibility of this occurring. Fish that remain in freshwater for a year or more after a sea sojourn will in all probability compete for resources and could become a potential predator; however, the number of fish in this category is relatively small. There is an overall tendency therefore to reduce dependence on freshwater for resources by both brook trout and brown trout once sea-going behavior is initiated. In the classification of Rounsefell (1958) this culminates in the pink salmon (Oncorhynchus gorbuscha) which uses freshwater solely as an egg incubation habitat (fry migrate to sea). Withler (1982) comments that while Pacific salmon are noted for their remarkable ability to "home" from great distances at sea, they are equally adept at invading new territory by straying. In terms of the r/K Continuoum of Pianka (1970), pink salmon are at the r-selected extreme, i.e. characterized by a short life span, high reproductive effort and semelparous. Such a life history strategy is well adapted for colonization in the face of juvenile mortality due to density independent factors. The three salmonid species considered in the present study are more K-selected (longer life span, lower reproductive effort and iteroparous) and the freshwater residency period can last for several years with juveniles subject to mortality from both density independent and density dependent factors. Leggett and Carscadden (1978) suggested that the fine tuning of reproductive strategies to the energy flow regimes of local environments could be the ultimate basis for the evolution of homing. It is possible then that homing has greater overall species survival value for brook trout, brown trout and Atlantic salmon than for pink salmon where straying might be an important survival mechanism. Delay in maturity until a large size is attained can be of value for colonization purposes. Larger trout probably have a better chance of survival in the marine environment and in addition to producing larger eggs and larvae, mature individuals entering a new river could dig deeper, safer redds which in itself should result in better egg to fry survival. This latter feature is an asset in home rivers as well.

Several authors have reported intraspecific variation in adaptation to specific environmental conditions on a micro-geographical or local scale. Carscadden and Leggett (1975) found that a lake dwelling population of American shad had a higher relative fecundity, lower mean age at maturity and had a lower proportion of repeat spawners than a nearby river dwelling population; differences in adaptation were believed to be due to differences in temperature and distance to spawning grounds. Riddell and Leggett (1981) found that body morphology and time of downstream migration of parr differed between two populations of Atlantic salmon on two different tributaries of the Miramichi River, New Brunswick and related such to differences in average flow velocities. Hart and Begon

(1982) reported a smaller reproductive effort, delay of maturity and production of more numerous, smaller young in a population of winkles (Gastropoda - Littorina rudis) inhabiting a boulder environment (r-selecting habitat) than in a "crevice" dwelling population (K-selecting habitat); both habitats were spatially adjacent. These paradoxical findings plus the fact they found differences in selection pressures between the two environments which had nothing to do with r- and K-selection led these authors to warn against excessive use of r/K theory and the tendency to conform to the "accepted scheme" of Stearns (1977). They concluded that life history strategies can be understood only by reference to specific ecologies of the individuals concerned and that general theories cannot provide short cuts. Stearns (1980) offered evidence that physiological problems can overwhelm the expected coadaptations of life history traits. The difference in size of brook trout smolt on North Harbour River, S.M.B. compared with the remaining areas does not appear to have an adaptive basis but rather reflect a homeostatic compensatory response to temporal environmental conditions as described by Bagenal (1978) and Mann and Mills (1979). In a recent treatment of homeostasis in terms of neo-Darwinian principles, however, Calow (1982) suggests the existence of the possibility of selection for active regulation according to homeostatic principles. Atlantic salmon smolt are also significantly smaller on North Harbour River, S.M.B. than on Northeast River, Southeast River and Beaver River (Dalley, unpublished data). This could be related to over-wintering in flowing water as opposed to lakes as noted above for brook trout; Pepper (1976) showed that lake rearing of salmon parr occurs in Newfoundland. Also, it might be due to simply passing through lakes on the seaward migration. Since no brown trout smolt were located in any of the other rivers, it is difficult to say if the same applies to this species; however, the fact that smolt of all three species of salmonids on North Harbour River, S.M.B. were virtually the same size suggests that it does. With respect to life history traits of brook trout, North Harbour River does not appear that different from the other areas; certainly there is nothing that can be isolated from the possible effects resulting from differences in exploitation. With respect to fecundity, meaningful comparisons between areas were not possible because of insufficient sample sizes (see Methods section). Whether or not there are any morphological differences remains to be seen.

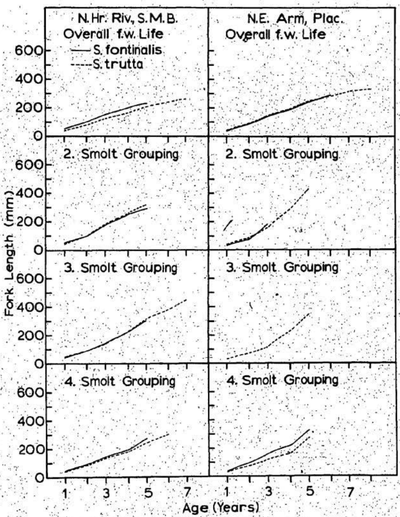
As mentioned in the Introduction, brown trout introduced into Newfoundland were predominately British and of freshwater stock. These fish have since become anadromous. Compared with published information on British stocks (which is assumed to apply to the orignal donor stock), growth rate in Newfoundland is lower (Liew 1969). As already seen, freshwater and salt water growth is less than that published for anadromous British stocks and there is a concomitant increase in mean smolt age. In fact, freshwater growth characteristics are similar to that of the northern clinal extremes reported for anadromous trout in Europe. Age at maturity also increases with latitude in Europe and alternate spawning replaces consecutive spawning. Even though Newfoundland is farther south, the combined effects of the Gulf Stream Current, Labrador Current and prevailing westerly winds originating from continental North America result in more extreme and more variable conditions than experienced in Great Britain. Age at first maturity for type 1 post-smolt females in Newfoundland is 3.0^+ years compared with 2.0^+ years reported by Nall (1930) for Great Britian. Mean age at first maturity for specimens beyond the type 2 post-smolt stage (both sexes combined in Newfoundland (calculated from Appendix 2e) is 2.43 post-migration years compared with 0.71, 0.80 and 1.12 post-migration years for Wales, Ireland and Scotland respectively reported by Fahy (1978). However, as Fahy points out, comparisons based on mean age and subject to error resulting from sample size and longevity. British stocks are consecutive (successive) spawners; however, in Newfoundland they are alternate spawners. A comparison of fecundity between Newfoundland and Great Britain is not possible since a literature search failed to locate published information on this subject for wild British anadromous populations. Life history theory predicts that reproductive effort would be lower in Newfoundland waters. It can also be predicted that a proportion of both sexes will mature prior to smoltification; however, sex ratios suggest that this is not occurring to a large degree at present in the rivers studied. With respect to longevity, except for the extremes in age referred to above, it can be said that in general, Newfoundland fish tend to live to be older than British fish overall. The development of anadromy and possibly a tendency towards attainment of a life history strategy along the lines predicted by life history theory attests to a high degree of plasticity in the ability of this species to adapt to different environmental conditions. An interesting question that arises is, if selection is proceeding as predicted by life history theory, has an optimum with respect to coadapted traits been reached in the time frame that the species has existed in Newfoundland? It could be that within that time frame, some or all of the life history differences are due mainly to the influence of environmental factors and that very little if any selection has occurred. Differences in exploitation over the years and between Newfoundland and Great Britain could compound any assumptions based on life history predictions.

Factors Affecting the Spread of Salmo trutta and the Effects of Range Changes on Anadromous Salvelinus fontinalis

Anadromous brown trout are capable of fairly extensive migrations in the sea. Skrochowska (1969c) reports that smolt descending from the River Raba, Poland were recaptured at distances between 161 and 640 km from the point of release; some specimens in their second year of descent from this river were recovered outside the Baltic Sea (a distance of 950 km). Yet, after being present for nearly 100 years in insular Newfoundland, colonization through the sea seems to be a rather slow process in that the species is as yet confined mainly to the southeast corner of the island. Some factors which could account for this are: (1) straying rate (which as suggested above might be low if there is a strong affinity to the home river in regard to regulation of energy flow and reproductive strategy), (2) slow growth rate and hence low egg deposition potential and (3) the fact that a relatively high percentage of specimens of both sexes may not mature after entering a river and that at least females are known to be alternate spawners. In combination, these factors most likely result in low egg deposition and minimal chances of fertilization. This is in direct contrast to the high colonization potential produced by the "big bang" approach of a species like the r-selected pink salmon which as seen above also has a strong tendency to stray. Atlantic salmon would also be a better colonizer than brown trout in the sense that it has a shorter generation time and all individuals entering a river are mature.

The ecological requirements (temperature relations, food, habitat preference and spawning time) of brook trout and brown trout have been described as being very similar (MacCrimmon and Marshall 1968; Scott and Crossman 1973). In his study of the ecological interaction of brown trout and brook trout occurring sympatrically in Waterford River, St. John's, Newfoundland, Nyman (1970) concluded that food and habitat segregation would be difficult to maintain in the limited bodies of water of small rivers and because of the similar ecological requirements of the two species, domination and predation by brown trout plus differential angler catchability to the detriment of brook trout tends to exclude the latter species. In a stream in Michigan, Fausch and White (1981) found that brown trout excluded brook trout from preferred resting positions which they speculated would also allow brown trout growth and survival to increase at the expense of brook trout. They also commented that dominance of brown trout should be important in changing the relative abundance of sympatric populations of brook trout and brown trout but that environmental factors, fishing mortality and predation may also favor one species in certain situations and effect changes that are difficult to separate from those caused by interspecific competition. No in situ observations in regard to habitat segregation or preference were conducted in the present study. On the surface, the large overlap in diet on North Harbour River, S.M.B. during the outward run might suggest that there is no appreciable food segregation on that river either in itself or in conjunction with habitat segregation. However, it must be pointed out that since the smolt stage of each species was examined, any differences in diet produced from habitat segregation during the parr stage might not be detectable due to the breakdown of same in the seaward migration. Overall back-calculated growth in freshwater of brown trout relative to brook trout (Fig. 41) suggests that at the present time in North Harbour River, S.M.B. and Northeast River the

Fig. 41. A comparison of back-calculated growth for Salmo trutta versus Salvelinus fontinalis in terms of overall freshwater life and groupings according to smolt age (2., 3. etc.) for North Harbour River, S.M.B. and specimens taken in Northeast Arm, Placentia.


N. Hr. Riv, S.M.B.
Overall f.w. Life
S. fontinalis
S. trutta
N.E. Arm, Plac.
Overall f.w. Life
2. Smolt Grouping
2. Smolt Grouping
3. Smolt Grouping
3. Smolt Grouping
4. Smolt Grouping
4. Smolt Grouping
Fork Length (mm)
0
200
400
600
1
3
5
7
Age (Years)

former species lacks the competitive advantage reported for other areas on the Avalon Peninsula. The individual relationship of each of these species to anadromous Atlantic salmon also has to be considered in regard to the ease at which colonization on a particular river could occur. With respect to brook trout versus Atlantic salmon, Gibson 1973 demonstrated interactive segregation when the two species occurred sympatrically on the Matamek River, Quebec. For brown trout versus Atlantic salmon, Bietz et al. (1981) found that on larger rivers on the Avalon Peninsula, Newfoundland, the former inhabited faster, shallower areas than the latter but this relationship broke down in smaller streams. They found no evidence that segregation results from the displacement of one species by the other but rather appeared to be the result of habitat preference. It was concluded that brown trout may not be a serious competitor with salmon in Newfoundland.

Lear and Day (1977) reported a decline in the number of inward running brook trout on North Harbour River, S.M.B. between 1961 and 1975 concomitant with an increase in numbers of brown trout. Their data in this regard during the outward runs are inconclusive (probably due to the fact that counting fence installation was usually early in May and, as pointed out above in connection with the present study, substantial numbers of both species may have already gone to sea). Although in light of present data it is not possible to say if competitive interactions to the detriment of brook trout are occurring on this river, tag returns strongly suggest that differential angling mortality is favoring the increase in numbers of brown trout. It remains to be seen however if angler tag returns reflect differences in catchability *per se* or instead are indicative of differences in migratory behavior in that brown trout may not have remained in the area of major exploitation (lower river) to the same extent as brook trout, or are the result of a combination of both factors. Angler preference might be a factor affecting tag returns during inward runs. The number of anglers taking advantage of the inward run of brook trout was observed to be higher than for the later occurring brown trout run (granted of course there is a certain amount of overlap where both species are exploited). Conversations with anglers during the course of the present study generally revealed brook trout to be the favorite sport fish. The question of angler preference as a function of angler success also has to be considered.

Up to and including 1978, the licenced angling season for most insular Newfoundland rivers (designed mainly for Atlantic salmon management) was in effect from May 24 to September 15. However, from 1968 to 1973 inclusive, North Harbour River, S.M.B. was closed to angling from August 1 to September 15 in connection with the pink salmon adult returns. This of course allowed the brook trout inward runs to be exploited fully while the majority of brown trout escaped. From 1974 to 1978 inclusive, inward runs of both species were exploited. In 1979, new regulations were imposed for insular Newfoundland which saw the angling season shortened for most rivers (June 15 to August 31) and these are in effect at present. This again results in less exploitation of inward running brown trout since a large portion of the run enters the river in early September. The latest regulations however favor brook trout outward runs since virtually all fish enter salt water before the season opens, thereby escaping river exploitation (some angling occurs in North Harbour estuary but proportionately much less than observed for the lower river and river mouth area).

It is obvious that the life history strategies of anadromous brown trout and brook trout are quite similar in many respects, and as slow as the process might seem, brown trout are adapting successfully to Newfoundland waters. Even though evidence to the effect that the combined effects of differential angling mortality, angler preference, angling regulations and possible resource competition are causing displacement of brook trout can be construed as somewhat circumstantial, literature reports that the occurrence is fairly widespread should be of concern to fisheries managers in Newfoundland if proper management of each species is to be achieved.

SUMMARY

1. The biology of anadromous brook trout (indigenous) and brown trout (introduced) was studied for some river systems flowing into Placentia Bay and St. Mary's Bay, Newfoundland.

2. Outward movements of brook trout were observed from April to June; inward movements occurred during July and early August. It is possible that movements between fresh and salt water occur throughout the year in Northeast and Southeast Arms, Placentia. Duration at sea as determined from tagging studies ranged from 47 to 65 days. Tagged fish from North Harbour River, S.M.B. were caught approximately 20 km from that river in the adjacent estuary Colinet Harbour. There is some evidence for homing to Southeast River and its tributary Beaver River.

3. Outward movements of brown trout occurred concurrently with those of brook trout on North Harbour River, S.M.B. Inward movements were observed from July through September. Duration at sea as determined from tagging studies for type 1 post-smolt ranged from 54 to 127 days.

4. Brook trout smolt age ranged from $1.^{+}$ to $7.^{+}$ years of age. Modal and mean ±S.E. smolt age varied with sex, area and sampling time within a given area (the former ranged from $2.^{+}$ to $4.^{+}$ years while the combined category for the latter ranged from 1.94 ± 0.057 to 3.82 ± 0.032 years). The percentage of repeat migrants (specimens beyond the post-smolt stage) in outward runs, inward runs and for samples captured in salt water ranged from 0.98 to 19.84, 0.00 to 28.88 and 1.14 to 13.73 respectively with the remainder being smolt/post-smolt. The maximum total age observed for both sexes was 7^{+}.

5. Smolt age of brown trout ranged from $1.^{+}$ to $8.^{+}$ years. Modal smolt age was predominately $3.^{+}$ years; mean ± S.E. smolt age varied with sex, area and sampling time within a given area (range was 2.56 ± 0.043 to 4.29 ± 0.177 years for the combined category. The percentage of specimens beyond the type 2 post-smolt stage ranged from 2.97 to 6.03 for outward runs, 11.77 to 44.99 for inward runs and 13.04 to 41.37 for samples taken in salt water. It is believed that on North Harbour River, S.M.B., fish with a previous sea history leave the river in a more or less discrete run earlier in the year than the one observed in April and May which was comprised almost exclusively of smolt. The maximum total age observed for males was 8+ and for females 11^{+} years.

6. For brook trout, intercept values of the length-weight relationship showed considerable significant variation with sex, area and sampling time within a given area. No consistent trends were evident. Slope values of inward migrants were higher than those of outward migrants (significantly so in some cases). Slope values as a whole showed much less variation than intercepts. The same observations applied more or less to brown trout.

7. Intercept values of the body length-scale length relationship likewise showed considerable variation for both species. Slope values showed very little significant variation for brook trout and none for brown trout.

8. Mean length at capture for each smolt age group on North Harbour River, S.M.B. was significantly lower than all remaining areas. Corresponding age groups of inward migrants were only slightly lower than the other areas and differed significantly from just one

(Southeast River). When back-calculated overall freshwater growth at each annulus is compared between areas it is seen that North Harbour River, S.M.B. compares quite favorably and surpasses some. The reason for the smaller smolt on North Harbour River, S.M.B. is believed to be related to the relative absence of lakes on that system compared with the others which could serve as overwintering areas. Trout overwintering in lakes could be subject to (a) higher temperature regimes, (b) greater accessibility to food as a result of not being removed from areas of food availability as might be experienced by fish forced to adopt cryptic behavior at temperatures below 9-10°C in the stream and (c) more living space.

9. Parr which do not smoltify on North Harbour River, S.M.B. catch up to the other areas later in the growing season. This delay could be related to the fact that they do not emerge from the substrate and begin intensive feeding until temperatures exceed 9-10°C at which time metabolic activity will allow sufficient performance to prevent physical displacement. Also at this time there would be less interspecific and intraspecific competition for food and space due to the emigration to sea of many of the fluviatile brook trout, brown trout and Atlantic salmon.

10. Back-calculated freshwater growth of anadromous brook trout was somewhat lower than that reported for freshwater populations in lakes on the Avalon Peninsula. Mean length at capture was lower than reported previously for Newfoundland and for all other North American areas except Ungava Bay, Quebec. The effect on growth of going to salt water is very dramatic when specimens are grouped according to smolt age. There was a tendency for the ultimate size

attained to be larger the younger the smolt age. Using the slope of the length-weight relationship as an indicator of condition, inward migrants were in better condition than outward migrants. Growth of inward migrants and specimens in salt water varied between isometric (b = 3.0) and allometric (b > 3.0) while the reverse was true for outward migrants (b < 3.0). The slope of the body length-scale length relationship showed growth to vary between isometric (b = 1.0) and allometric (b > 1.0).

11. While size has been reported as a very important factor in smoltification and salinity tolerance in brook trout, it is not the only one. Smolt in the present study were substantially smaller than those reported in the literature as suffering high mortality upon direct transfer to sea water. The attainment of such is probably a synergistic process involving several environmental factors.

12. Back-calculated freshwater growth of anadromous brown trout was slower than that reported for the freshwater form in several Avalon Peninsula lakes. Back-calculated and empirical growth in freshwater and in salt water was slower than that reported for European populations. The same dramatic effect on growth of going to sea and also the greater the ultimate size attained the younger the smolt age as mentioned above for brook trout was evident for this species also. The condition of inward migrants and specimens taken in salt water (b = 3.0 - b > 3.0) was better than that of outward migrants (b < 3.0). Growth for most part was isometric (b = 1.0) as indicated by the slope values of the body length-scale length relationship.

13. Spawning of brook trout occurred during the first 3 weeks of October on Come By Chance River and North Harbour River, S.M.B. For Southeast River it was the first 3 weeks of November. No spawning concentrations of brown trout were located.

14. The sex ratio of brook trout was for most part significantly in favor of females in outward runs, inward runs and in salt water. Total age at first maturity for both sexes was 2^+. Size at first maturity for males was 112 mm while for females it was 126 mm. The majority of specimens in inward runs were immature (i.e. showed no indication that they would ripen in the fall). There was a tendency for a higher percentage of males to reach maturity in a given total age group than females. The percentage of both sexes reaching maturity in a given total age group for inward migrants and in salt water was lower than that reported for corresponding age groups for the freshwater form. There is evidence to suggest that both sexes are alternate spawners. Based on scale analysis it was determined that both parr and fish with a history of sea life spawn together; also, kelts of each sex in the outward runs spawned as parr. The length-fecundity relationship was $\log F = 2.3837 \log L - 3.0656$.

15. For anadromous brown trout, sex ratio favored females in some samples and males in others (none significantly). Total age at first maturity for males was 2^+ while for females it was 3^+. Corresponding size at first maturity for each sex was 166 and 275 mm respectively. Just as for brook trout, the majority of specimens in inward runs were not maturing. There was no clear cut trend in favor of either sex in regard to the percentage of mature versus immature fish in a given total age group in a given area.

The tendency for a greater number of fish to mature at a particular total age for freshwater populations compared with fish in salt water was evident for this species also. Females are alternate spawners. There is evidence to suggest that males spawn as parr. The length-fecundity relationship was log F = 3.0222 log L - 4.7334.

16. Except for some differences in percent occurrence of items in gut contents, food of both species in fresh and salt water were fairly similar. In freshwater, specimens of each species below 200 mm tended to be highly insectivorous; for those from 200 to 300 mm, fish became increasingly important while over 300 mm, fish predominated. The same trends were evident in salt water except for the fact that where invertebrates were involved, crustaceans and molluscs assumed greater importance relative to freshwater.

17. Reproduction for anadromous brook trout and brown trout is spread over the maximum number of years; a portion of the population matures prior to smoltification while the remaining number migrates to salt water without maturing in freshwater and delays maturity. Delayed maturity probably results in greater longevity concomitant with an increase in reproductive effort which is correlated with increased size. Considering reports in the literature of positive correlations between (1) body size and egg size and (2) egg size and larvae size, the effect of delay of maturity is most likely maximization of juvenile survival. Atlantic salmon which cohabits the rivers in the present study are more r-selected; they display an overall shorter life span which includes elimination of the type 1 post-smolt stage and a reduction in the number of life history groupings such as 2.1^+, 3.2^+ years etc. and probably produce

a higher reporductive effort. Also, consecutive spawning is exhibited instead of alternate spawning. Probably the most important factors operating to the advantage of Atlantic salmon over brown trout and brook trout with respect to the degree to which the marine environment is used for reproductive purposes are salinity tolerance, duration of sea sojourn and extent of migration. Brook trout rate lowest, Atlantic salmon highest and brown trout intermediate.

18. The difference in size of brook trout smolt on North Harbour River, S.M.B. compared with the remaining areas (items 8 and 9 of this Summary) does not appear to have an adaptive basis but rather reflects a homeostatic compensatory response to temporal environmental conditions. Life history traits of brook trout on North Harbour River, S.M.B. do not appear that different from the other areas; differences, however could be compounded by differential exploitation.

19. Brown trout introduced to Newfoundland were mainly from British stocks and were of the freshwater form. They have since become anadromous. Compared to published information on British populations, in Newfoundland, growth rate in freshwater and salt water is lower, age at first maturity of both type 1 post-smolt and specimens beyond the type 2 post-smolt stage is higher, longevity appears to be higher and alternate spawning is exhibited instead of consecutive spawning. Life history theory predicts that fecundity is also lower.

20. The seemingly slow rate of spread of brown trout could be related to straying rate, slow growth rate and hence low egg deposition potential and the fact that a relatively high percentage of specimens of both sexes may not mature after entering freshwater and females and possibly males are alternate spawners. Possible interactions

in freshwater with indigenous salmonids also have to be considered in this regard.

21. Although it is not possible to say in light of present data if competitive exclusion of brook trout by brown trout is occurring on North Harbour River, S.M.B., there is reason to believe that the decline in numbers of the former species concomitant with an increase for the latter is in part due to a combination of differential angling catchability, angler preference and adjustments in the length and timing of the licenced angling season both past and present on that river.

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Appendix 1a. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from North Harbour River, S.H.B. (outward and inward). Included also are within sample comparisons of males versus females (t tests) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable). 1976 Samples.

Length Class (mm)	Smolt/Post-smolt 1.+ / 1.0+ ♀	♂	c	2.+ / 2.0+ ♀	♂	c	3.+ / 3.0+ ♀	♂	c	4.+ / 4.0+ ♀	♂	c	5.+ / 5.0+ ♀	♂	c
Outward															
110-129	0	1	1	10	6	54									
130-149				18	8	83	3	1	41						
150-169				6	5	21	21	3	87	0	0	1			
170-189				1	0	3	6	4	53	1	0	3			
190-209				1	0	1	0	0	6	1	1	7	0	0	1
210-229							0	0	1	1	0	9	0	0	1
230-249										0	0	0			
250-269										0	0	2			
	-	[b](3.45)	[b](0.27)	[b](52.17)	[b](65.52)	[b](43.20)	[b](43.48)	[b](27.59)	[b](50.13)	[b](4.35)	[b](3.45)	[b](5.87)	-	-	[b](0.53)
N	0	1	1	36	19	162	30	8	188	3	1	22	0	0	2
Age Comp.	-	(3.45)	(0.25)	(52.17)	(65.52)	(40.81)	(43.48)	(27.59)	(47.36)	(4.35)	(3.45)	(5.34)	-	-	(0.50)
$\bar{X}$ Length	-	-	-	139.9	138.6[illegible]	137.0	160.1	166.5	161.8	199.3	-	206.3	-	-	215.5
S.E.	-	-	-	2.82	3.6[illegible]	1.08	2.19	5.83	1.15	12.73	-	4.38	-	-	6.50
t				0.2941 N.S.			1.0270 N.S.								
χ^2	1.0000 N.S.			17.0000***			25.4737***			3.0000 N.S.					
Inward															
110-129	1	0	1	0	0	1									
130-149				2	0	12									
150-169				17	6	94	3	1	7						
170-189				13	9	71	7	5	29						
190-209				0	1	11	11	2	31	0	0	1			
210-229				0	0	2	6	4	31	2	1	5			
230-249							2	1	25	1	1	18			
250-269							0	0	9	2	2	20			
270-289							0	0	4	1	0	18	0	0	1
290-309							0	0	1	0	0	6			
310-329										0	0	3			
330-349															
350-369															
370-389															
390-409															
	[b](1.47)	-	[b](0.25)	[b](47.06)	[b](48.49)	[b](47.63)	[b](42.65)	[b](39.39)	[b](34.17)	[b](8.82)	[b](12.12)	[b](17.71)	-	-	[b](0.25)
N	1	0	1	32	16	191	29	13	137	6	4	71	0	0	1
Age Comp.	(1.37)	-	(0.21)	(43.84)	(44.44)	(40.90)	(39.73)	(36.11)	(29.34)	(8.22)	(11.11)	(15.20)	-	-	(0.21)
$\bar{X}$ Length	-	-	-	167.5	174.1	168.5	195.9	200.8	211.7	244.2	244.8	261.9	-	-	-
S.E.	-	-	-	2.15	2.86	1.08	3.86	6.96	2.51	9.08	9.45	2.94	-	-	-
t				1.8450 N.S.			0.6176 N.S.			0.0445 N.S.					
χ^2	1.0000 N.S.			5.3333*			6.0952*			0.4000 N.S.					

a Unaged fish included in length class
b Age Composition in terms of Smolt/Post-smolt

continued

Appendix 1a - Continued

Length Class (mm)	Repeat Migrants														
	2.1+			2.2+			2.3+			3.1+			3.2+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward															
110-129															
130-149															
150-169	0	0	1												
170-189	0	0	7												
190-209	0	0	3												
210-229	0	0	1							0	0	1			
230-249															
250-269															
N	0	0	12							0	0	1			
Age Comp.			(3.02)									(0.25)			
$\bar{X}$ Length			187.3												
S.E.			5.39												
t / χ^2															
Inward															
110-129															
130-149															
150-169															
170-189															
190-209	1	0	3												
210-229	0	0	0	0	0	1									
230-249	0	0	5	0	0	0				0	0	1			
250-269	2	0	6	0	0	0				0	0	3			
270-289	0	0	9	0	0	0	0	0	1	0	1	3			
290-309	0	1	7	0	0	2				0	0	1			
310-329	0	0	1	0	0	0				0	0	1	0	0	1
330-349				0	0	2				0	0	1	0	0	0
350-369										0	0	1	0	0	1
370-389										0	0	1			
390-409										0	0	1			
N	3	1	31	0	0	5	0	0	1	0	2	13	0	0	2
Age Comp.	(4.11)	(2.78)	(6.64)			(1.07)			(0.21)		(5.56)	(2.78)	-	-	(0.43)
$\bar{X}$ Length	236.3	-	265.1	-	-	301.4	-	-	-	-	259.0	301.9	-	-	346.5
S.E.	20.80	-	5.47	-	-	21.89	-	-	-	-	14.00	13.78	-	-	18.50
t / χ^2	1.0000 N.S.									2.0000 N.S.					

continued

Appendix 1a - continued

Length Class (mm)	Repeat Migrants - continued 4.1⁺			1.1.1⁺			1.1.2⁺			2.1.1⁺			3.1.1.1⁺			Length Frequency Distribution		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
110-129																10(14.49)	7(24.14)	[a]56(14.11)
130-149																21(30.44)	9(31.04)	124(31.23)
150-169																27(39.13)	8(27.59)	110(27.71)
170-189																8(11.59)	4(13.79)	67(16.88)
190-209				0	0	1				0	0	1				2(2.90)	1(3.45)	[a]22(5.54)
210-229				0	0	1										1(1.45)	0 -	[a]16(4.03)
230-249																0 -	0 -	0 -
250-269																0 -	0 -	2(0.50)
N				0	0	2				0	0	1				69	29	397
Age Comp.						(0.50)						(0.25)						
$\bar{X}$ Length						270.0										151.2	147.4	156.0
S.E.						11.0										2.46	3.90	1.29
t																0.8204 N.S.		
χ^2																16.3265***		
Inward																		
110-129																1(1.33)	0 -	2(0.42)
130-149																2(2.67)	0 -	12(2.52)
150-169																[a]21(28.00)	7(19.44)	[a]103(21.59)
170-189																[a]21(28.00)	14(38.89)	[a]106(22.22)
190-209																12(16.00)	3(8.33)	47(9.85)
210-229																8(10.67)	5(13.89)	[a]40(8.39)
230-249				1	0	1				0	0	2				4(5.33)	3(8.33)	52(10.90)
250-269										0	0	3				4(5.33)	2(5.56)	41(8.60)
270-289							1	0	1	0	0	0				2(2.67)	1(2.78)	[a]37(7.76)
290-309	0	0	1				0	0	1	0	0	0				0 -	1(2.78)	19(3.98)
310-329	0	0	0				0	0	0	0	0	2	0	0	1	0 -	0 -	9(1.89)
330-349	0	0	1				0	0	1							0 -	0 -	5(1.05)
350-369																0 -	0 -	2(0.42)
370-389																0 -	0 -	1(0.21)
390-409																0 -	0 -	1(0.21)
N	0	0	2	1	0	1	1	0	3	0	0	7	0	0	1	75	36	477
Age Comp.	-	-	(0.43)	(1.37)	-	(0.21)	(1.37)	-	(0.64)	-	-	(1.50)	-	-	(0.21)	-	-	-
$\bar{X}$ Length	-	-	323.5	-	-	-	-	-	301.3	-	-	269.1	-	-	-	189.5	199.1	209.8
S.E.	-	-	16.50	-	-	-	-	-	15.06	-	-	13.71	-	-	-	3.75	6.23	2.31
t				1.0000 N.S.			1.0000 N.S.									1.3269 N.S.		
χ^2																13.7027***		

Appendix Ib. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from North Harbour River, S.M.B. in 1977 (outward and inward). Included also are within sample comparisons on males versus females (t tests) for mean length at capture per age group and overall and χ² values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes plus unsexed fish (where applicable).

Length Class (mm)	Smolt/Post-smolt												Repeat Migrants					
	$2.^+ / 2.0^+$			$3.^+ / 3.0^+$			$4.^+ / 4.0^+$			$5.^+ / 5.0^+$			2.1^+			2.2^+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
110-129	5	5	12															
130-149	4	4	18	6	1	11							1	0	1			
150-169	1	0	2	14	5	22	1	2	3				1	0	1			
170-189				6	3	10	4	2	6				2	1	3			
190-209				1	2	3	4	3	7				1	2	3			
210-229							1	0	1	0	1	1	1	0	1	1	0	1
230-249							1	0	1							1	0	1
250-269																		
	b(20.83)	b(32.14)	b(32.99)	b(56.25)	b(39.29)	b(47.42)	b(22.92)	b(25.00)	b(18.56)	-	b(3.57)	b(1.03)						
N	10	9	32	27	11	46	11	7	18	0	1	1	6	3	9	2	0	2
Age Comp.	(14.49)	(29.03)	(26.45)	(39.13)	(35.48)	(38.02)	(15.94)	(22.58)	(14.88)	-	(3.23)	(0.83)	(8.70)	(9.68)	(7.44)	(2.90)	-	(1.65)
$\bar{X}$ Length	130.6	134.4	136.4	161.2	170.6	162.2	192.0	179.3	187.1	-	-	-	177.3	196.0	183.6	224.0	-	224.0
S.E.	3.64	3.11	1.93	3.08	5.33	2.43	5.77	6.18	4.41	-	-	-	10.96	11.00	8.36	7.00	-	7.00
t	0.8021 N.S.			1.5414 N.S.			1.5037 N.S.						1.2019 N.S.					
χ²	0.0526 N.S.			6.7368**			0.8889 N.S.			1.0000 N.S.			1.0000 N.S.			2.0000 N.S.		
Inward																		
110-129	0	0	1															
130-149	0	0	0	0	1	1												
150-169	7	2	15	1	1	4												
170-189	5	1	17	4	6	32	1	0	2				0	0	1			
190-209	1	1	2	13	2	39	3	0	8				1	1	6			
210-229				2	1	9	9	2	18	0	0	2	6	3	21			
230-249				0	0	1	0	0	2	0	0	0	2	0	7	1	0	1
250-269							1	0	1	1	0	2	1	1	3	0	0	0
270-289							1	0	2	0	0	0				0	0	0
290-309							0	0	0	0	1	1				1	0	1
310-329							0	0	1							1	0	1
340-349																		
	b(26.53)	b(22.22)	b(21.88)	b(40.82)	b(61.11)	b(53.75)	b(30.61)	b(11.11)	b(21.25)	b(2.05)	b(5.56)	b(3.13)						
N	13	4	35	20	11	86	15	2	34	1	1	5	10	5	38	3	0	3
Age Comp.	(18.06)	(16.67)	(15.42)	(27.78)	(45.83)	(37.89)	(20.83)	(8.33)	(14.98)	(1.39)	(4.17)	(2.20)	(13.88)	(20.83)	(16.74)	(4.17)	-	(1.32)
$\bar{X}$ Length	170.2	161.4	171.1	193.7	182.8	191.8	218.3	220.0	221.3	-	-	254.2	224.1	224.4	221.4	291.0	-	291.0
S.E.	2.89	11.21	2.22	2.96	5.19	1.61	5.79	1.00	4.40	-	-	15.19	5.71	7.46	2.70	25.24	-	25.24
t	0.7561 N.S.			1.8128 N.S.			0.2834 N.S.						0.0319 N.S.					
χ²	4.7647*			2.6129 N.S.			9.9412**			0.0000 N.S.			1.6667 N.S.			3.0000 N.S.		

a = Unaged fish included in length class
b = Age composition in terms of Smolt/Post-smolt

continued

Appendix Ib (Continued)

Length Class (mm)	Repeat Migrants - continued															Length Frequency Distribution		
	3.1+			3.2+			4.1+			2.1.1+			2.1.2+					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
110-129																5(7.25)	5(16.13)	12(9.92)
130-149																11(15.94)	5(16.13)	30(24.79)
150-169																17(24.64)	7(22.59)	28(23.14)
170-189	2	0	2													14(20.29)	6(19.36)	21(17.36)
190-209	3	0	3													9(13.04)	7(22.59)	16(13.22)
210-229	1	0	1													4(5.80)	1(3.23)	5(4.13)
230-249	1	0	1				2	0	2							5(7.25)	0 -	5(4.13)
250-269	1	0	1				3	0	3							4(5.80)	0 -	4(3.31)
N	8	0	8				5	0	5							69	31	121
Age Comp.	(11.59)	-	(6.61)				(7.25)	-	(4.13)									
X̄ Length	210.3	-	210.3				255.4	-	255.4							177.3	166.4	169.3
S.E.	10.63	-	10.63				6.96	-	6.96							4.56	4.99	3.09
t																1.6199 N.S.		
χ^2	8.0000**						5.0000*									14.4400***		
Inward																		
110-129																0 -	0 -	1(0.43)
130-149																0 -	1(4.00)	[a]2(0.86)
150-169																8(11.11)	3(12.00)	19(8.19)
170-189																10(13.89)	7(28.00)	52(22.41)
190-209																18(25.00)	4(16.00)	[a]58(25.00)
210-229	2	0	4							1	0	2				20(27.78)	6(24.00)	57(24.57)
230-249	0	0	4							0	0	0				3(4.17)	0 -	15(6.47)
250-269	3	0	7							0	0	0				6(8.33)	1(4.00)	13(5.60)
270-289	1	0	1							0	0	1				2(2.78)	[a]1(4.00)	[a]4(1.72)
290-309	0	1	1	1	0	1	1	0	1				1	0	1	3(4.17)	2(8.00)	6(2.59)
310-329							1	0	2							2(2.78)	0 -	4(1.72)
330-349							0	0	1							0 -	0 -	1(0.43)
N	6	1	17	1	0	1	2	0	4	1	0	3	1	0	1	72	25	232
Age Comp.	(8.33)	(4.17)	(7.49)	(1.39)	-	(0.44)	(2.78)	-	(1.76)	(1.39)	-	(1.32)	(1.39)	-	(0.44)			
X̄ Length	248.2	-	250.0	-	-	-	308.5	-	316.3	-	-	242.7	-	-	-	214.6	202.2	208.4
S.E.	9.65	-	5.24	-	-	-	16.50	-	9.67	-	-	17.82	-	-	-	4.72	8.47	2.34
t																1.2977 N.S.		
χ^2	3.5714 N.S.			1.0000 N.S.			2.0000 N.S.			1.0000 N.S.			1.0000 N.S.			23.5102***		

Appendix 1c. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from Beaver River in 1977 (outward and inward). Included also are within sample comparisons of males versus females (t tests) for mean length at capture per age group and overall mean length and χ² values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Smolt/Post-smolt																	
	2.+/2.0+			3.+/3.0+			4.+/4.0+			5.+/5.0+			6.+/6.0+			7.+/7.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
130-149	2	1	4															
150-169	4	1	11	3	1	12	1	0	1									
170-189	0	0	8	6	2	80	0	5	20									
190-209				8	2	46	9	1	64	1	0	5						
210-229				1	0	3	6	6	70	1	0	11						
230-249				0	1	3	0	1	9	3	3	23	0	0	4			
250-269				0	0	1	0	0	2	3	1	11	1	0	3			
270-289										0	0	3	3	0	4			
290-309										0	0	0	0	0	1			
310-329										1	0	1				0	0	1
330-349																		
350-369																		
370-389																		
390-409																		
430-449																		
450-469																		
530-549																		
	b(11.32)	b(8.00)	b(5.74)	b(33.96)	b(24.00)	b(36.16)	b(30.19)	b(52.00)	b(41.40)	b(16.98)	b(16.00)	b(13.47)	b(7.55)	-	b(2.99)	-	-	b(0.25)
N	6	2	23	18	6	145	16	13	166	9	4	54	4	0	12	0	0	1
Age Comp.	(8.82)	(6.25)	(4.93)	(26.47)	(18.75)	(31.05)	(23.53)	(40.63)	(35.54)	(13.24)	(12.50)	(11.49)	(5.88)	0	(2.57)	-	-	(0.21)
X̄ Length	153.3	155.5	165.0	187.4	192.3	187.8	206.4	206.0	208.2	247.9	242.8	238.7	270.8	-	262.8	-	-	-
S.E.	4.65	6.50	2.92	3.50	10.28	1.27	3.36	4.97	1.25	10.79	5.01	2.93	6.46	-	5.99	-	-	-
t	0.2712 N.S.			0.4554 N.S.			0.0729 N.S.			0.4319 N.S.								
χ²	2.0000 N.S.			6.0000*			0.3104 N.S.			1.9231 N.S.			4.0000*					
Inward																		
110-129	0	0	1															
130-149	0	0	1															
150-169	0	0	4	0	0	2												
170-189	3	0	8	7	4	41	0	0	3									
190-209	0	0	3	9	3	51	5	0	36	0	0	2						
210-229				5	0	30	8	3	76	3	0	7						
230-249				1	0	11	12	3	65	2	0	22	0	0	1			
250-269				0	0	1	1	1	18	3	0	19	1	1	4			
270-289							1	0	2	1	0	11	1	0	5			
290-309										1	1	11	1	0	3			
310-329										0	0	1	0	2	5			
330-349										0	0	2	2	0	5	1	0	1
350-369																0	0	0
370-389																0	0	0
390-409																0	0	0
410-429																0	0	0
430-449																0	0	0
450-469																1	0	1
	b(4.35)	-	b(3.75)	b(31.88)	b(41.18)	b(30.02)	b(39.13)	b(41.18)	b(44.15)	b(14.49)	b(5.88)	b(16.56)	b(7.25)	b(11.77)	b(5.08)	b(2.90)	-	b(0.44)
N	3	0	17	22	7	136	27	7	200	10	1	75	5	2	23	2	0	2
Age Comp.	(3.41)	-	(2.96)	(25.00)	(28.00)	(23.65)	(30.68)	(28.00)	(34.78)	(11.36)	(4.00)	(13.04)	(5.68)	(8.00)	(4.00)	(2.27)	-	(0.35)
X̄ Length	183.7	-	173.2	201.1	189.6	201.3	228.1	235.3	225.5	249.4	-	260.2	304.4	287.5	299.2	398.5	-	398.5
S.E.	1.86	-	5.06	3.09	4.33	1.60	3.43	5.53	1.32	8.85	-	3.41	16.15	22.50	6.53	52.50	-	52.50
t				0.0160 N.S.			1.1079 N.S.						0.6102 N.S.					
χ²	3.0000 N.S.			7.7586 **			11.7647***			7.3636**			3.5714 N.S.			2.0000 N.S.		

continued

Appendix 1c (Continued)

Length Class (mm)	Repeat Migrants																	
	2.1+			2.2+			2.3+			2.4+			3.1+			3.2+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
130-149																		
150-169																		
170-189	2	0	4															
190-209	3	1	12										0	0	1			
210-229	3	2	11										0	1	1			
230-249	1	0	5										1	0	5			
250-269													1	0	2			
270-289													0	0	1			
290-309													0	0	0			
310-329													1	0	1			
330-349							0	0	1									
350-369																		
370-389																		
390-409																		
430-449																		
450-469																		
530-549																		
N	9	3	32				0	0	1				3	1	11			
Age Comp.	(13.24)	(9.38)	(6.85)				-	-	(0.21)				(4.41)	(3.13)	(2.36)			
X̄ Length	206.1	215.3	209.4				-	-	-				269.0	-	244.4			
S.E.	5.19	9.67	2.66				-	-	-				23.52	-	8.94			
t	0.8416 N.S.												1.0000 N.S.					
χ²	3.0000 N.S.																	
Inward																		
110-129																		
130-149																		
150-169																		
170-189	1	1	3															
190-209	2	1	15															
210-229	4	1	19										1	1	3			
230-249	0	0	8	1	0	1							0	1	7	0	0	1
250-269	0	0	3	0	0	1							0	0	5	0	0	0
270-289				0	0	0							0	0	3	1	0	5
290-309				0	0	2										0	0	1
310-329																0	0	0
330-349																0	0	0
350-369																0	0	1
370-389																		
390-409																		
410-429																		
430-449										0	0	1						
450-469																		
N	7	3	48	1	0	4				0	0	1	1	2	18	1	0	8
Age Comp.	(7.96)	(12.00)	(8.35)	(1.14)	-	(0.70)				-	-	(0.17)	(1.14)	(8.00)	(3.13)	(1.14)	-	(1.39)
X̄ Length	208.3	205.0	216.1	-	-	273.3				-	-	-	-	230.0	248.1	-	-	286.4
S.E.	3.45	11.27	2.65			14.22								8.00	4.61	-	-	10.40
t	0.2624 N.S.																	
χ²	1.600 N.S.			1.0000 N.S.									0.3333 N.S.			1.0000 N.S.		

continued

Appendix 1c (Continued)

Length Class (mm)	Repeat Migrants - continued																				
	3.3+			3.4+			4.1+			4.2+			4.3+			5.1+			5.2+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																					
130-149																					
150-169																					
170-189																					
190-209																					
210-229																					
230-249							0	0	1												
250-269							0	0	0												
270-289							0	0	2												
290-309							0	0	0							0	0	1			
310-329							1	0	1							1	0	2			
330-349							0	0	1							1	0	1			
350-369	0	1	1													0	0	0			
370-389	0	0	1													0	0	1			
390-409																					
430-449				0	0	1															
450-469				0	0	1							0	0	1						
530-549																					
N	0	1	2	0	0	2	1	0	5				0	0	1	2	0	5			
Age Comp	–	(3.13)	(0.43)	–	–	(0.43)	(1.47)	–	(1.07)				–	–	(0.21)	(2.94)	–	(1.07)			
$\bar{X}$ Length	–	–	372.0	–	–	446.0	–	–	290.4				–	–	–	325.5	–	327.8			
S.E.	–	–	12.00	–	–	13.00	–	–	17.45				–	–	–	14.50	–	13.51			
t / χ^2	1.0000 N.S.						1.0000 N.S.									2.0000 N.S.					
Inward																					
110-129																					
130-149																					
150-169																					
170-189																					
190-209																					
210-229																					
230-249																					
250-269							0	0	1												
270-289							1	0	3												
290-309							0	0	1							1	0	2			
310-329							1	0	2							0	0	2			
330-349							1	0	3							0	0	1			
350-369							1	0	3	0	1	1				1	0	3			
370-389							0	0	0							0	0	1	1	0	1
390-409							0	0	1							0	1	1			
410-429																					
430-449																					
450-469																					
N							4	0	14	0	1	1				2	1	10	1	0	1
Age Comp							(4.55)	–	(2.43)	–	(4.00)	(0.17)				(2.27)	(4.00)	(1.74)	(1.14)	–	(0.17)
$\bar{X}$ Length							332.0	–	323.3	–	–	–				328.0	–	341.8	0	0	0
S.E.							19.56	–	11.25	–	–	–				42.43	–	11.99	–	–	–
t / χ^2							4.0000*			1.0000 N.S.						0.3333 N.S.			1.0000 N.S.		

continued

Appendix 1c (Continued)

Length Class (mm)	Repeat Migrants (Continued) 6.1+ ♀	6.1+ ♂	6.1+ c	2.1.1+ ♀	2.1.1+ ♂	2.1.1+ c	2.2.2+ ♀	2.2.2+ ♂	2.2.2+ c	2.1.1.1+ ♀	2.1.1.1+ ♂	2.1.1.1+ c	3.1.1+ ♀	3.1.1+ ♂	3.1.1+ c	Length Frequency Distribution ♀	♂	c
Outward																		
130-149																2(2.94)	1(3.13)	4(0.85)
150-169																8(11.77)	2(6.25)	24(5.11)
170-189																8(11.77)	7(21.88)	[a]113(24.04)
190-209																21(30.88)	4(12.50)	127(27.02)
210-229				0	0	1										12(17.65)	9(28.13)	[a]100(21.28)
230-249				0	0	2										5(7.35)	5(15.63)	[b]53(11.28)
250-269																5(7.35)	1(3.13)	19(4.04)
270-289													0	0	1	3(4.41)	0 -	11(2.34)
290-309																0 -	0 -	2(0.43)
310-329	0	0	1							0	1	1				3(4.41)	1(3.13)	8(1.49)
330-349	0	0	0													1(1.47)	0 -	3(0.64)
350-369	0	0	0													0 -	1(3.13)	1(0.21)
370-389	0	0	0													0 -	0 -	2(0.43)
390-409	0	1	1													0 -	1(3.13)	1(0.21)
430-449																0 -	0 -	1(0.21)
450-469																0 -	0 -	1(0.21)
530-549																0 -	0 -	1(0.21)
N	0	1	2	0	0	3				0	1	1	0	0	1	68	32	471
Age Comp	-	(3.13)	(0.43)	-	-	(0.64)				-	(3.13)	(0.21)	-	(3.13)	(0.21)			
$\bar{X}$ Length	-	-	360.5	-	-	230.7				-	-	-	-	-	-	212.4	220.8	211.7
S.E.	-	-	48.5	-	-	2.33				-	-	-	-	-	-	5.06	9.55	1.90
t																0.7800 N.S.		
x^2	1.0000 N.S.									1.000 N.S.			1.0000 N.S.			12.9600 ***		
Inward																		
110-129																0 -	0 -	1(0.17)
130-149																0 -	0 -	1(0.17)
150-169																0 -	0 -	6(1.04)
170-189																11(12.50)	5(20.00)	55(9.50)
190-209				0	0	1										16(18.18)	4(16.00)	[a]109(18.83)
210-229				0	0	5										21(23.86)	5(20.00)	[a]141(24.35)
230-249				1	0	5										17(19.32)	4(16.00)	[b]121(20.90)
250-269													0	0	1	5(5.68)	2(8.00)	55(9.50)
270-289																5(5.68)	0 -	[a]30(5.18)
290-309																3(3.41)	1(4.00)	20(3.45)
310-329																1(1.14)	1(4.00)	10(1.73)
330-349																4(4.55)	0 -	12(2.07)
350-369	0	0	1													2(2.27)	1(4.00)	9(1.55)
370-389	0	0	1													1(1.14)	0 -	3(0.52)
390-409	0	0	0				0	1	1							0 -	2(8.00)	3(0.52)
410-429	1	0	1													1(1.14)	0 -	1(0.17)
430-449																0 -	0 -	1(0.17)
450-469																1(1.14)	0 -	1(0.17)
N	1	0	3	1	0	11	0	1	1				0	1	1	88	25	579
Age Comp	(1.14)	-	(0.52)	(1.14)	-	(1.91)	-	(4.00)	(0.17)				-	(4.00)	(0.17)			
$\bar{X}$ Length	-	-	388.3	-	-	226.4	-	-	-				-	-	-	239.8	243.5	234.1
S.E.	-	-	19.06	-	-	4.36	-	-	-				-	-	-	5.83	13.02	1.87
t																0.2574 N.S.		
x^2	1.0000 N.S.			1.0000 N.S.			1.0000 N.S.						1.0000 N.S.			35.1239***		

a = Unaged fish included in length class
b = Age composition in terms of Smolt/Post-smolt

Appendix Id. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from Southeast River in 1977 (outward and inward). Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable)

Length Class (mm)	Smolt/Post-smolt														
	2.+/ 2.0+			3.+/ 3.0+			4.+/ 4.0+			5.+/ 5.0+			6.+/ 6.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward															
130–149	2	2	5	2	0	2									
150–169	8	5	25	4	3	16									
170–189	7	4	22	13	4	38	4	0	9						
190–209	2	0	3	19	6	52	10	3	24						
210–229				6	1	14	8	1	27	1	0	4			
230–249							3	0	4	2	1	10			
250–269							1	0	1	0	0	3	0	0	1
270–289							1	0	1	1	0	2	0	0	0
310–329													0	0	1
350–369															
390–409															
	b(20.21)	b(36.67)	b(20.83)	b(46.81)	b(46.67)	b(46.21)	b(28.72)	b(13.33)	b(25.00)	b(4.26)	b(3.33)	b(7.20)	-	-	b(0.76)
N	19	11	55	44	14	122	27	4	66	4	1	19	0	0	2
Age Comp	(17.76)	(33.33)	(18.52)	(41.12)	(42.42)	(41.08)	(25.23)	(12.12)	(22.22)	(3.74)	(3.03)	(6.40)	-	-	(0.67)
$\bar{x}$ Length	168.1	161.5	167.3	189.2	187.8	189.4	213.8	201.8	209.9	247.3	-	241.3	-	-	290.0
S.E.	3.35	4.16	1.87	2.79	4.52	1.59	4.11	4.52	2.20	13.08	-	4.07	-	-	38.00
t	1.2362 N.S.			0.2586 N.S.			1.9764 N.S.								
χ^2	1.0667 N.S.			15.5172***			17.0645 ***			1.8000N.S.					
Inward															
150–169	1	0	1												
170–189	4	0	4												
190–209	1	2	3	3	0	3	2	1	3						
210–229	1	0	1	2	0	2	2	0	2						
230–249							7	2	9	2	0	2			
250–269							2	0	2	1	0	1	0	1	1
270–289							2	0	2	1	1	2	1	0	1
290–309										0	0	0	0	1	1
310–329										2	0	2			
	b(20.59)	b(25.00)	b(21.43)	b(14.71)	-	b(11.91)	b(44.12)	b(37.50)	b(42.86)	b(17.65)	b(12.50)	b(16.67)	b(2.94)	b(25.00)	b(7.14)
N	7	2	9	5	0	5	15	3	18	6	1	7	1	2	3
Age Comp.	(19.44)	(25.00)	(20.00)	(13.89)	-	(11.11)	(41.67)	(37.50)	(40.00)	(16.67)	(12.50)	(15.56)	(2.78)	(25.00)	(6.67)
$\bar{x}$ Length	184.0	204.5	188.6	207.2	-	207.2	239.1	224.7	236.7	276.5	-	276.1	-	285.5	282.0
S.E.	5.50	4.50	5.23	4.14	-	4.14	6.22	10.73	5.53	13.37	-	11.31	-	16.5	10.15
t	2.8837*						1.1661 N.S.								
χ^2	2.7778 N.S.			5.0000*			8.0000**			3.5714 N.S.			0.3333 N.S.		

a = Unaged fish included in length class
b = Age composition in terms of Smolt/Post-smolt

continued

Appendix 1d (Continued)

Length Class (mm)	Repeat Migrants																					Length Frequency Distribution		
	2.1+			3.1+			3.3+			4.1+			4.2+			2.1.1+			2.1.1.1+					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																								
130-149																						4(3.74)	2(6.06)	7(2.36)
150-169																						12(11.22)	8(24.24)	41(13.81)
170-189	3	1	6																			27(25.23)	9(27.27)	75(25.25)
190-209	2	0	7	1	0	1										1	0	1				35(32.71)	9(27.27)	88(29.63)
210-229	0	0	2	0	0	0																15(14.02)	2(6.06)	47(15.83)
230-249				1	0	3										0	1	1				6(5.61)	2(6.06)	18(6.06)
250-269										2	0	3							0	0	1	3(2.80)	0 –	9(3.03)
270-289										1	0	1										3(2.80)	0 –	4(1.35)
310-329										1	1	2										1(0.94)	1(3.03)	3(1.01)
350-369							0	0	1				0	0	2							1(0.94)	0 –	4(1.35)
390-409													0	0	1							0 –	0 –	1(0.34)
N	5	1	15	2	0	4	0	0	1	4	1	6	0	0	3	1	1	2	0	0	1	107	33	297
Age Comp.	(4.67)	(3.03)	(5.05)	(1.86)	–	(1.35)	–	–	(0.34)	(3.74)	(3.03)	(2.02)	–	–	(1.01)	(0.93)	(3.03)	(0.67)	–	–	(0.34)			
$\bar{x}$ Length	183.2	–	195.3	221.0	–	226.0	–	–	–	277.8	–	280.0	–	–	365.0	–	–	216.5	–	–	–	199.1	187.4	199.0
S.E.	3.15	–	4.15	12.00	–	5.70	–	–	–	17.05	–	14.06	–	–	12.53	–	–	20.50	–	–	–	3.36	5.84	2.07
t																						1.7395 N.S.		
χ^2	2.6667 N.S.			2.0000 N.S.						1.8000 N.S.						0.0000 N.S.						39.1143***		
Inward																								
150-169																						1(2.70)	0 –	1(2.22)
170-189																						4(10.81)	0 –	4(8.89)
190-209	1	0	1																			7(18.92)	3(37.50)	10(22.22)
210-229				1	0	1																a7(18.92)	0 –	a7(15.56)
230-249																						9(24.32)	2(25.00)	11(24.44)
250-269																						3(8.11)	1(12.50)	4(8.89)
270-289																						4(10.81)	1(12.50)	5(11.11)
290-309																						0 –	1(12.50)	1(2.22)
310-329																						2(5.41)	0 –	2(4.44)
N	1	0	1	1	0	1																37	8	45
Age Comp.	(2.78)	0	(2.22)	(2.78)	–	(2.22)																		
$\bar{x}$ Length	–	–	–	–	–	–																229.7	241.0	231.7
S.E.	–	–	–	–	–	–																6.09	13.22	5.55
t																						0.7760 N.S.		
χ^2	1.0000 N.S.			1.0000 N.S.																		18.6889***		

Appendix 1e. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from Northeast River in 1976 and 1977 (outward). Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and x^2 values for sex ratios per age group and overall. Percentages are in parentheses, c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Smolt																	
	1.+			2.+			3.+			4.+			5.+			6.+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
1976 Outward																		
70-89	0	2	2															
90-109	5	2	7	2	0	2												
110-129	5	3	8	6	0	6												
130-149	0	2	2	10	9	19												
150-169				12	7	20												
170-189				8	6	15	2	1	3									
190-209				3	3	6	0	2	2									
210-229				0	1	1	3	3	6	0	1	1						
	b(17.86)	b(21.43)	b(19.00)	b(73.21)	b(61.90)	b(69.00)	b(8.93)	b(14.29)	b(11.00)	-	b(2.38)	b(1.00)						
N	10	9	19	41	26	69	5	6	11	0	1	1						
Age Comp.	(17.86)	(20.93)	(18.81)	(73.21)	(60.47)	(68.32)	(8.93)	(13.95)	(10.89)	-	(2.33)	(0.99)						
$\bar{X}$ Length	109.1	113.4	111.2	152.1	164.7	157.2	205.2	203.3	204.2	-	-	-						
S.E.	3.66	6.89	3.71	4.13	4.57	3.07	12.05	5.16	5.81	-	-	-						
t	0.5566 N.S.			2.0551*			0.1424 N.S.											
x^2	0.0526 N.S.			7.0533**			0.0909 N.S.			1.0000 N.S.								
1977 Outward																		
90-109	2	1	8															
110-129	0	1	10	4	2	20	0	0	1									
130-149	0	0	1	3	2	28	2	0	6									
150-169				8	9	42	9	7	38									
170-189				5	4	19	10	1	35	0	0	1						
190-209				2	2	10	4	2	22	1	1	9						
210-229							3	1	10	3	1	12						
230-249							0	0	1	2	3	11	0	0	1			
250-269										0	0	1	1	1	8			
270-289													2	0	8			
290-309													2	1	4	0	0	1
310-329													0	0	0	0	0	0
330-349													1	0	1	0	0	0
																0	1	1
	b(3.13)	b(5.00)	b(6.15)	b(34.38)	b(47.50)	b(38.51)	b(43.75)	b(27.50)	b(36.57)	b(9.38)	b(12.50)	b(11.00)	b(9.38)	b(5.00)	b(7.12)	-	b(2.50)	b(0.65)
N	2	2	19	22	19	119	28	11	113	6	5	34	6	2	22	0	1	2
Age Comp	(2.94)	(4.55)	(5.64)	(32.35)	(43.18)	(35.31)	(41.18)	(25.00)	(33.53)	(8.82)	(11.36)	(10.09)	(8.82)	(4.55)	(6.53)	-	(2.27)	(0.59)
$\bar{X}$ Length	105.5	110.5	111.3	158.1	162.2	155.3	176.6	175.6	178.0	221.8	228.6	219.3	274.2	252.5	257.1	-	-	313.3
S.E.	2.50	16.50	2.40	5.22	4.90	2.05	3.98	6.26	2.06	7.30	9.09	3.46	9.76	18.50	4.36	-	-	24.59
t	0.2996 N.S.			0.5675 N.S.			0.1479 N.S.			0.5805 N.S.			1.0359 N.S.					
x^2	0.0000 N.S.			0.2195 N.S.			7.4103**			0.0909 N.S.			2.0000 N.S.			1.0000 N.S.		

a = Unaged fish included in length class
b = Age composition in terms of Smolt

continued

Appendix 1e (Continued)

Length Class (mm)	Repeat Migrants 1.1+ ♀	1.1+ ♂	1.1+ c	2.1+ ♀	2.1+ ♂	2.1+ c	2.2+ ♀	2.2+ ♂	2.2+ c	2.3+ ♀	2.3+ ♂	2.3+ c	3.1+ ♀	3.1+ ♂	3.1+ c	1.1.1+ ♀	1.1.1+ ♂	1.1.1+ c	2.1.1+ ♀	2.1.1+ ♂	2.1.1+ c	Length Frequency Distribution ♀	♂	c
1976 Outward																								
70-89																						0 -	2(4.65)	2(1.96)
90-109																						7(12.28)	2(4.65)	9(8.82)
110-129																						11(19.30)	3(6.98)	14(13.73)
130-149																						10(17.54)	11(25.58)	*21(20.59)
150-169																						*13(22.81)	7(16.28)	21(20.59)
170-189																						10(17.54)	7(16.28)	18(17.65)
190-209																						3(5.26)	6(13.95)	9(8.82)
210-229	0	1	1																			3(5.26)	5(11.63)	8(7.84)
N	0	1	1																			57	43	102
Age Comp.	0	(2.33)	(0.99)																					
X̄ Length	-	-	-																			149.4	161.8	154.9
S.E.	-	-	-																			4.51	5.56	3.48
t																						1.7407 N.S.		
x^2	1.0000 N.S.																					1.9600 N.S.		
1977 Outward																								
90-109																						2(2.94)	1(2.27)	8(2.37)
110-129																						4(5.88)	3(6.82)	31(9.20)
130-149																						5(7.35)	2(4.55)	35(10.39)
150-169																						17(25.00)	16(36.36)	80(23.74)
170-189				1	0	3										0	0	1				17(25.00)	5(11.36)	59(17.51)
190-209	0	0	1	0	2	5										0	0	1				7(10.29)	7(15.91)	50(14.84)
210-229				2	1	6							0	0	1				1	0	4	8(11.77)	3(6.82)	32(9.50)
230-249				0	0	2													0	0	1	3(4.41)	4(9.09)	23(6.82)
250-269							0	0	2													2(2.94)	0 -	11(3.26)
270-289																						2(2.94)	1(2.27)	5(1.48)
290-309										0	1	1										0 -	1(2.27)	1(0.30)
310-329																						1(1.47)	0 -	1(0.30)
330-349																						0 -	1(2.27)	1(0.30)
N	0	0	1	3	3	16	0	0	2	0	1	1	0	0	1	0	0	2	1	0	5	68	44	337
Age Comp.	-	-	(0.30)	(4.41)	(6.82)	(4.75)	-	-	(0.59)	-	(0.27)	(0.30)	-	-	(0.30)	-	-	(0.59)	(1.47)	-	(1.48)			
X̄ Length	-	-	-	202.3	202.3	206.1	-	-	251.0	-	-	-	-	-	-	-	-	194.5	-	-	224.2	183.0	184.6	179.4
S.E.	-	-	-	7.67	5.20	4.25	-	-	0.00	-	-	-	-	-	-	-	-	11.50	-	-	5.41	5.10	7.02	2.25
t				0.0000 N.S.																		0.1227 N.S.		
x^2				0.0000 N.S.						1.0000 N.S.									1.0000 N.S.			5.1429 *		

Appendix 1f. Length Distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from Come by Chance River in 1976 and 1977 (Inward). Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and x^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Post-Smolt											
	2.0+			3.0+			4.0+			5.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
1976 Inward												
130-149	1	1	2	1	1	2						
150-169	2	0	2	1	1	2						
170-189				1	0	1						
190-209				3	0	3	1	1	2			
210-229				1	1	2	0	1	1	0	1	1
230-249				3	0	3	5	1	6	0	0	0
250-269							1	0	1	1	1	2
270-289							1	0	1	1	0	1
290-309										1	1	2
330-349												
350-369										1	0	1
	b(12.00)	b(10.00)	b(11.42)	b(40.00)	b(30.00)	b(37.14)	b(32.00)	b(30.00)	b(31.43)	b(16.00)	b(30.00)	b(20.00)
N	3	1	4	10	3	13	8	3	11	4	3	7
Age Comp.	(12.00)	(10.00)	(11.42)	(40.00)	(30.00)	(37.14)	(32.00)	(30.00)	(31.43)	(16.00)	(30.00)	(20.00)
$\bar{X}$ Length	148.7	-	147.0	201.0	171.7	194.2	242.9	216.7	235.7	300.8	258.3	282.6
S.E.	7.31	-	5.43	10.05	19.94	9.29	6.37	10.65	6.36	20.54	24.89	16.81
t				3.3139 N.S.			2.1119 N.S.			1.3145 N.S.		
x^2	1.0000 N.S.			3.7692 N.S.			2.2727 N.S.			0.1429 N.S.		
1977 Inward												
130-149				0	1	1						
150-169	4	1	5	5	0	5						
170-189	4	0	4	8	1	9	1	0	1			
190-209				6	1	7	2	1	3			
210-229				8	1	9	0	4	4			
230-249				0	1	1	5	3	8			
250-269							2	3	5	0	3	3
270-289										1	0	1
290-309												
350-369												
	b(17.39)	b(5.00)	b(13.64)	b(58.70)	b(25.00)	b(48.49)	b(21.74)	b(55.00)	b(31.82)	b(2.17)	b(15.00)	b(6.06)
N	8	1	9	27	5	32	10	11	21	1	3	4
Age Comp.	(16.33)	(5.00)	(13.04)	(55.10)	(25.00)	(46.38)	(20.41)	(55.00)	(30.44)	(2.04)	(15.00)	(5,80)
$\bar{X}$ Length	170.5	-	170.1	192.6	195.8	193.1	228.3	234.7	231.7	-	262.0	266.8
S.E.	3.83	-	3.40	3.99	14.26	3.93	7.29	5.17	4.35	-	3.79	5.45
t				0.2165 N.S.			0.7190 N.S.					
x^2	5.4444a			15.1250aaa			0.0476 N.S.			1.0000 N.S.		

a = Unaged fish included in length class
b = Age Composition in terms of Post-Smolt

continued

Appendix 1f (Continued)

Length Class (mm)	Repeat Migrants 2.1+ ♀	2.1+ ♂	2.1+ C	3.1+ ♀	3.1+ ♂	3.1+ C	4.1+ ♀	4.1+ ♂	4.1+ C	Length Frequency Distribution ♀	♂	C
1976 Inward												
130-149										2(7.41)	2(20.00)	4(10.81)
150-169										3(11.11)	1(10.00)	4(10.81)
170-189										1(3.70)	0 -	1(2.70)
190-209										4(14.82)	1(10.00)	5(13.51)
210-229										1(3.70)	3(30.00)	4(10.81)
230-249										8(29.63)	1(10.00)	9(24.32)
250-269										2(7.41)	1(10.00)	3(8.11)
270-289										2(7.41)	0 -	2(5.41)
290-309										1(3.70)	1(10.00)	2(5.41)
330-349										a2(7.41)	0 -	a2(5.41)
350-369										1(3.70)	0 -	1(2.70)
N										27	10	37
Age Comp.												
$\bar{X}$ Length										232.9	208.2	226.2
S.E.										11.43	15.96	9.45
t										1.2577 N.S.		
X^2										7.8108 **		
1977 Inward												
130-149										0 -	1(4.76)	1(1.45)
150-169										9(18.37)	1(4.76)	10(14.49)
170-189										13(26.53)	1(4.76)	14(20.29)
190-209										8(16.33)	2(9.52)	10(14.49)
210-229	1	0	1							9(18.37)	5(23.81)	14(20.29)
230-249				1	0	1				6(12.25)	4(19.05)	10(14.49)
250-269										2(4.08)	6(28.57)	8(11.59)
270-289										1(2.04)	0 -	1(1.45)
290-309										0 -	0 -	1(1.45)
350-369							1	0	1	1(2.04)	0 -	1(1.45)
N	1	0	1	1	0	1	1	0	1	49	20	69
Age Comp.	(2.04)	-	(1.45)	(2.04)	-	(1.45)	(2.04)	-	(1.45)			
$\bar{X}$ Length	-	-	-	-	-	-	-	-	-	202.6	229.6	210.7
S.E.	-	-	-	-	-	-	-	-	-	5.30	7.89	4.61
t										2.8388**		
X^2	1.0000 N.S.			1.0000 N.S.			1.0000 N.S.			11.2000***		

Appendix 1g. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinalis* from North Harbour River, P.B. in 1977 (inward). Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Post-Smolt														
	1.0^+			2.0^+			3.0^+			4.0^+			5.0^+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Inward															
110-129				0	1	1									
130-149	0	1	1	3	0	3									
150-169				1	2	3	0	1	1						
170-189				2	3	5	3	3	6						
190-209							5	1	6	2	0	2			
210-229							4	2	6	3	1	4	0	1	1
230-249							1	0	1	1	1	2			
250-269										1	2	3			
290-309															
	–	a(5.26)	a(2.22)	a(23.08)	a(31.58)	a(48.00)	a(50.00)	a(36.84)	a(44.44)	a(26.92)	a(21.05)	a(24.44)	–	a(5.26)	a(2.22)
N	0	1	1	6	6	12	13	7	20	7	4	11	0	1	1
Age Comp.	–	(5.26)	(2.08)	(20.69)	(31.58)	(25.00)	(44.83)	(36.84)	(41.67)	(24.14)	(21.05)	(22.92)	–	(5.26)	(2.08)
$\bar{X}$ Length	–	–	–	158.0	162.7	160.3	202.7	191.3	198.7	225.3	249.8	234.2	–	–	–
S.E.	–	–	–	5.60	9.20	5.19	5.80	8.48	4.83	6.73	10.78	6.61	–	–	–
t				0.4330 N.S.			1.1110 N.S.			1.9253 N.S.					
χ^2	1.0000 N.S.			0.0000 N.S.			1.8000 N.S.			0.8182 N.S.			1.0000 N.S.		

Length Class (mm)	Repeat Migrants						Length Frequency Distribution		
	2.1			4.1					
	♀	♂	c	♀	♂	c	♀	♂	c
Inward									
110-129							0 –	1(5.26)	1(2.08)
130-149							3(10.35)	1(5.26)	4(8.33)
150-169							1(3.45)	3(15.79)	4(8.33)
170-189							5(17.24)	6(31.58)	11(22.92)
190-209							7(24.14)	1(5.26)	8(16.67)
210-229							7(24.14)	4(21.05)	11(22.92)
230-249	1	0	1				3(10.35)	1(5.26)	4(8.33)
250-269	1	0	1				2(6.90)	2(10.53)	4(8.33)
290-309				1	0	1	1(3.45)	0 –	1(2.08)
N	2	0	2	1	0	1	29	19	48
Age Comp.	(6.90)	–	(4.17)	(3.45)	–	(2.08)			
$\bar{X}$ Length	245.5	–	245.0	–	–	–	205.0	192.4	200.0
S.E.	10.50	–	10.50	–	–	–	6.67	9.12	5.42
t							1.1134 N.S.		
χ^2	2.0000 N.S.			1.0000 N.S.			2.0833 N.S.		

a = Age composition in terms of Post-Smolt

Appendix 1h. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for Salvelinus fontinalis from Northeast Arm, Placentia in June 1975 and June 1976. Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Post-smolt														
	2.0+			3.0+			4.0+			5.0+			6.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June 1975															
150-169	2	2	5	1	1	2									
170-189	10	4	14	9	16	25	1	1	2						
190-209	0	2	3	12	9	21	0	0	0						
210-229	-			1	0	1	8	0	8						
230-249							2	3	5	0	1	1			
270-289															
	b(26.09)	b(20.51)	b(25.29)	b(50.00)	b(66.67)	b(56.32)	b(23.91)	b(10.26)	b(17.24)	-	b(2.56)	b(1.15)			
N	12	8	22	23	26	49	11	4	15	0	1	1			
Age Comp.	(23.53)	(20.51)	(25.00)	(48.94)	(66.67)	(55.68)	(23.40)	(10.26)	(17.05)	-	(2.56)	(1.14)			
$\bar{X}$ Length	174.3	183.5	178.3	188.7	183.7	186.0	220.3	225.0	221.5	-	-	-			
S.E.	2.46	4.48	2.39	2.15	1.92	1.47	5.02	13.83	4.94	-	-	-			
t	1.7947 N.S.			1.7649 N.S.			0.3213 N.S.								
χ^2	0.8000 N.S.			0.1837 N.S.			3.2667 N.S.			1.0000 N.S.					
June 1976															
150-169	1	1	2	3	2	6	1	0	1						
170-189	5	5	10	17	9	27	2	3	5						
190-209				13	3	16	6	4	10	1	0	1			
210-229				2	1	3	5	3	8	3	2	5			
230-249							0	1	1	1	1	2	1	0	1
250-269										1	0	1	0	1	1
290-309										0	1	1			
310-329													0	1	1
370-389															
	b(9.68)	b(15.79)	b(11.77)	b(56.45)	b(39.47)	b(50.98)	b(22.58)	b(28.95)	b(24.51)	b(9.68)	b(10.53)	b(9.80)	b(1.61)	b(5.26)	b(2.94)
N	6	6	12	35	15	52	14	11	25	6	4	10	1	2	3
Age Comp.	(9.52)	(14.63)	(11.32)	(55.56)	(36.59)	(49.06)	(22.22)	(26.83)	(23.59)	(9.52)	(9.76)	(9.43)	(1.59)	(4.88)	(2.83)
$\bar{X}$ Length	176.0	173.2	174.6	188.6	183.1	186.3	200.5	205.4	202.6	231.7	247.8	238.1	-	283.0	268.7
S.E.	2.25	2.63	1.70	1.99	2.82	1.67	5.02	6.08	3.83	6.54	18.92	8.30	-	28.00	21.61
t	0.8192 N.S.			1.5421 N.S.			0.6167 N.S.			0.8033 N.S.					
χ^2	0.0000 N.S.			8.0000 **			0.3600 N.S.			0.4000 N.S.			0.3333 N.S.		

a = Unaged fish included in length class

b = Age composition in terms of Post-smolt

continued

Appendix Ih (Continued)

Length Class (mm)	Repeat Migrants															Length Frequency Distribution		
	2.1⁺			4.1⁺			2.1.2⁺			2.1.3⁺			2.2.1⁺					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June 1975																		
150-169																3(6.38)	3(7.69)	7(7.96)
170-189																20(42.55)	21(53.85)	41(46.59)
190-209																12(25.53)	11(28.21)	24(27.27)
210-229																9(19.15)	0 -	9(10.23)
230-249																2(4.26)	4(8.50)	6(6.82)
270-289				1	0	1										1(2.13)	0 -	1(1.14)
N				1	0	1										47	39	88
Age Comp.				(2.13)	-	(1.14)												
X̄ Length				-	-	-										194.5	189.3	191.9
S.E.				-	-	-										3.55	3.15	2.37
t																1.0844 N.S.		
χ^2				1.0000 N.S.												0.7442 N.S.		
June 1976																		
150-169																5(7.94)	*4(9.52)	*10(9.35)
170-189																24(38.10)	17(40.48)	42(39.25)
190-209																20(34.75)	7(16.67)	27(22.43)
210-229																10(15.87)	6(14.29)	16(14.95)
230-249							1	1	2				0	1	1	3(4.76)	4(9.52)	7(6.54)
250-269																1(1.59)	1(2.38)	2(1.87)
290-309																0 -	1(2.38)	1(0.94)
310-329																0 -	1(2.38)	1(0.94)
370-389										0	1	1				0 -	1(2.38)	1(0.94)
N							1	1	2	0	1	1	0	1	1	63	42	107
Age Comp.							(1.59)	(2.44)	(1.89)	-	(2.44)	(0.94)	-	(2.44)	(0.94)			
X̄ Length							-	-	236.5	-	-	-	-	-	-	195.6	206.5	199.3
S.E.							-	-	0.50	-	-	-	-	-	-	2.61	6.90	3.16
t																1.4121 N.S.		
χ^2							0.0000 N.S.			1.0000 N.S.			1.0000 N.S.			4.2000 *		

Appendix 11. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length distribution for *Salvelinus fontinalis* from Northeast Arm, Placentia in September-November, 1976 and May-August, 1977. Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Post-smolt											
	2.0+			3.0+			4.0+			5.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Sept-Nov 1976												
130-149	3	1	4									
150-169	20	10	31	0	4	4						
170-189	22	19	41	10	9	19						
190-209	4	3	7	5	9	14	0	1	1			
210-229				1	2	3	2	1	3			
230-249				1	1	2	1	1	2	1	0	1
430-449										0	1	1
	b(70.00)	b(53.23)	b(62.41)	b(24.29)	b(40.32)	b(31.58)	b(4.29)	b(4.84)	b(4.51)	b(1.43)	b(1.61)	b(1.50)
N	49	33	83	17	25	42	3	3	6	1	1	2
Age Comp.	(68.06)	(52.38)	(61.03)	(23.61)	(39.68)	(30.88)	(4.17)	(4.76)	(4.41)	(1.39)	(1.59)	(1.47)
$\bar{X}$ Length	170.8	174.8	172.2	192.0	189.0	190.2	222.0	221.7	221.8	-	-	333.0
S.E.	1.87	2.13	1.41	3.71	3.90	2.75	5.20	9.39	4.80	-	-	
t	1.4130 N.S.			0.5648 N.S.			0.0310 N.S.					
χ^2	3.1220 N.S.			1.5238 N.S.			0.0000 N.S.			0.0000 N.S.		
May-Aug 1977												
130-149	2	0	2									
150-169	10	6	16	8	3	11						
170-189	4	4	8	17	9	26	0	1	1			
190-209				5	3	8	1	1	2			
210-229							3	0	3			
230-249							1	0	1			
250-269							1	0	1			
390-409												
	b(30.77)	b(37.04)	b(32.91)	b(57.69)	b(55.56)	b(56.96)	b(11.54)	b(7.41)	b(10.13)			
N	16	10	26	30	15	45	6	2	8			
Age Comp.	(29.63)	(37.04)	(32.10)	(55.56)	(55.56)	(55.56)	(11.11)	(7.41)	(9.88)			
$\bar{X}$ Length	163.6	166.3	164.7	178.6	180.4	179.2	221.5	187.0	212.9			
S.E.	3.14	2.99	2.22	2.19	3.48	1.84	9.04	7.00	8.80			
t	0.6170 N.S.			0.4301 N.S.			3.0183*					
χ^2	1.3846 N.S.			5.0000*			2.0000 N.S.					

a - Unaged fish included in length class
b - Age composition in terms of Post-smolt

continued

Appendix II (Continued)

Length Class (mm)	Repeat Migrants 2.1+ ♀	Repeat Migrants 2.1+ ♂	Repeat Migrants 2.1+ c	Repeat Migrants 4.1+ ♀	Repeat Migrants 4.1+ ♂	Repeat Migrants 4.1+ c	Length Frequency Distribution ♀	Length Frequency Distribution ♂	Length Frequency Distribution c
Sept-Nov. 1976									
130-149							3(4.11)	1(1.56)	4(2.90)
150-169							20(27.40)	14(21.88)	35(25.36)
170-189							*33(45.21)	28(43.75)	*61(44.20)
190-209	0	1	1				9(12.33)	*15(23.47)	*24(17.39)
210-229	1	0	1				4(5.48)	3(4.69)	7(5.07)
230-249	1	0	1				4(5.48)	2(3.13)	6(4.35)
430-449							0 –	1(1.56)	1(0.73)
N	2	1	3				73	64	138
Age Comp.	(2.78)	(1.59)	(2.21)						
$\bar{X}$ Length	232.5	–	222.7				180.4	187.4	183.5
S.E.	13.50	–	12.55				2.49	4.58	2.51
t							1.3474 N.S.		
χ^2	0.3333 N.S.						0.3912 N.S.		
May-Aug 1977									
130-149							2(3.70)	0 –	2(2.47)
150-169							18(33.33)	9(33.33)	27(33.33)
170-189							21(38.89)	14(51.85)	35(43.21)
190-209	1	0	1				7(12.96)	4(14.82)	11(13.58)
210-229							3(5.56)	0 –	3(3.70)
230-249							1(1.85)	0 –	1(1.24)
250-260							1(1.85)	0 –	1(1.24)
390-409				1	0	1	1(1.85)	0 –	1(1.24)
N	1	0	1	1	0	1	54	27	81
Age Comp.	(1.85)	–	(1.24)	(1.85)	–	(1.24)			
$\bar{X}$ Length	–	–	–	–	–	–	183.4	175.7	180.8
S.E.	–	–	–	–	–	–	5.01	2.65	3.46
t							1.3700 N.S.		
χ^2	1.0000 N.S.			1.0000 N.S.			9.0000**		

Appendix 1j. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salvelinus fontinelis* from Southeast Arm, Placentia in June, 1975 and June 1976. Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Post-smolt																	
	2.0+			3.0+			4.0+			5.0+			6.0+			7.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June 1975																		
130-149				1	0	1												
150-169	6	3	10	4	3	8												
170-189	15	4	20	26	15	41	1	0	1									
190-209	0	1	1	12	3	15	1	0	1									
210-229				1	0	1	0	0	0									
230-249							1	0	1									
250-269										1	0	1						
390-409																		
	[a](30.44)	[a](27.59)	[a](30.69)	[a](63.77)	[a](72.41)	[a](65.35)	[a](4.35)	-	[a](2.97)	[a](1.45)	-	[a](0.99)						
N	21	8	31	44	21	66	3	0	3	1	0	1						
Age Comp.	(29.17)	(25.81)	(29.25)	(61.11)	(67.74)	(62.26)	(4.17)	-	(2.83)	(1.39)	-	(0.94)						
$\bar{X}$ Length	175.8	176.8	175.8	183.8	182.0	183.0	205.0	-	205.0	0	0	0						
S.E.	1.95	4.34	1.70	1.96	2.13	1.49	14.42	-	14.42	-	-	-						
t	0.1976 N.S.			0.6456 N.S.														
χ^2	5.8276*			8.1385**			3.0000 N.S.			1.0000 N.S.								
June 1976																		
150-169	4	3	7	4	1	6												
170-189	1	0	2	6	3	9	1	3	4									
190-209				3	0	3	3	2	5									
210-229				1	0	1	2	0	2									
230-249										1	0	1						
290-309																		
310-329																		
330-349													1	1	2			
350-369																1	0	1
410-429																0	1	1
450-469																		
	[a](17.86)	[a](21.43)	[a](20.46)	[a](50.00)	[a](28.57)	[a](43.18)	[a](21.43)	[a](35.71)	[a](25.00)	[a](3.57)	-	[a](2.27)	[a](3.57)	[a](7.14)	[a](4.55)	[a](3.57)	[a](7.14)	[a](4.55)
N	5	3	9	14	4	19	6	5	11	1	0	1	1	1	2	1	1	2
Age Comp	(15.15)	(18.75)	(17.65)	(42.42)	(25.00)	(37.26)	(18.18)	(31.25)	(21.57)	(3.03)	-	(1.96)	(3.03)	(6.25)	(3.92)	(3.03)	(6.25)	(3.92)
$\bar{X}$ Length	169.8	162.7	169.1	181.4	179.3	180.0	198.3	185.8	192.6	-	-	-	-	-	336.0	-	-	391.0
S.E.	3.69	1.76	3.05	4.25	4.52	3.35	5.18	4.39	3.83	-	-	-	-	-	2.00	-	-	25.00
t	1.7429 N.S.			0.3398 N.S.			1.8475 N.S.											
χ^2	0.5000 N.S.			5.5556*			0.0909 N.S.			1.0000 N.S.			0.0000 N.S.			0.0000 N.S.		

a = Age Composition in terms of Post-smolt

continued

Appendix Ij (Continued)

Length Class (mm)	Repeat Migrants																					Length Frequency Distribution		
	2.1+			2.2+			2.3+			3.2+			4.2+			5.1+			2.3.1+					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June 1975																								
130-149																						1(1.39)	0 –	1(0.94)
150-169																						10(13.89)	6(19.35)	18(16.98)
170-189																						42(58.33)	19(61.29)	62(58.49)
190-209	3	0	3																			16(22.22)	4(12.90)	20(18.87)
210-229	0	0	0																			1(1.39)	0 –	1(0.94)
230-249	0	1	1																			1(1.39)	1(3.23)	2(1.89)
250-269																						1(1.39)	0 –	1(0.94)
350-409																0	1	1				0 –	1(3.23)	1(0.94)
N	3	1	4													0	1	1				72	31	106
Age Comp.	(4.17)	(3.23)	(3.77)													–	(3.23)	(0.94)						
$\bar{X}$ Length	196.3	–	206.0													–	–	–				183.7	189.1	185.0
S.E.	2.85		9.87													–	–	–				1.87	7.47	2.51
t																						0.7292 N.S		
χ^2	1.0000 N.S.															1.0000 N.S.						16.3203***		
June 1976																								
150-169																						8(24.24)	4(25.00)	13(25.49)
170-189																						8(24.24)	6(37.50)	15(29.41)
190-209																						6(18.18)	2(12.50)	8(15.69)
210-229																						3(9.09)	0 –	3(5.88)
230-249																						1(3.03)	0 –	1(1.96)
290-309				1	0	1																1(3.03)	0 –	1(1.96)
310-329										0	1	1				1	0	1				1(3.03)	1(6.25)	2(3.92)
330-349										1	0	1	1	0	1							3(9.09)	1(6.25)	4(7.84)
350-369							1	0	1													2(6.06)	0 –	2(3.92)
410-429																						0 –	1(6.25)	1(1.96)
450-469																			0	1	1	0 –	1(6.25)	1(1.96)
N				1	0	1	1	0	1	1	1	2	1	0	1	1	0	1	0	1	1	33	16	51
Age Comp.				(3.03)	–	(1.96)	(3.03)	–	(1.96)	(3.03)	(6.25)	(3.92)	(3.03)	–	(1.96)	(3.03)	–	(1.96)	–	(6.25)	(1.96)			
$\bar{X}$ Length				–	–	–	–	–	–	–	–	334.0	–	–	–	–	–	–	–	–	–	217.7	229.9	219.8
S.E.				–	–	–	–	–	–	–	–	7.00	–	–	–	–	–	–	–	–	–	11.55	24.56	10.70
t																						0.4510 N.S.		
χ^2				1.0000 N.S.			1.0000 N.S.			0.0000 N.S.			1.0000 N.S.			1.0000 N.S.			1.0000 N.S.			5.8980*		

Appendix 1k. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for Salvelinus fontinalis spawners from Southeast River, North Harbour River, S.H.B., and Come By Chance River in 1976. Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length. Percentages are in parentheses.

Length Class (mm)	Parr 2.+ ♂	2.+ ♀	3.+ ♂	3.+ ♀	4.+ ♂	4.+ ♀	5.+ ♂	5.+ ♀	Captured in Freshwater in Post-smolt year 2.0+ ♂	2.0+ ♀	3.0+ ♂	3.0+ ♀	4.0+ ♂	4.0+ ♀	5.0+ ♂	5.0+ ♀
S.E. River																
110-129	0	5	0	1					0	2						
130-149	2	6	0	0					1	11						
150-169	4	4	1	3	1	0			13	12	1	2				
170-189	1	1	3	2	1	0			9	8	6	4				
190-209			3	2	1	0			2	3	11	4	1	2		
210-229			3	1	0	1					2	0	3	2		
230-249					0	1	1	0			1	0	1	2		
250-269							1	0					0	0	1	0
270-289							1	0					0	0		
290-309													0	0		
310-329													1	1		
330-349																
350-369																
	a(30.43)	a(59.26)	a(43.48)	a(33.33)	a(13.04)	a(7.41)	a(13.04)	-	b(40.08)	b(67.92)	b(40.39)	b(18.87)	b(11.54)	b(13.21)	b(11.92)	-
N	7	16	10	9	3	2	3	0	25	26	21	10	6	7	1	0
Age Comp.	(7.87)	(17.78)	(11.24)	(10.00)	(3.37)	(2.22)	(3.37)	-	(28.09)	(40.00)	(23.60)	(11.11)	(6.74)	(7.78)	(1.12)	-
X̄ Length	154.1	141.9	198.0	175.7	185.0	234.0	256.0	-	170.2	159.9	196.0	185.1	238.1	229.9	-	-
S.E.	5.20	5.03	6.25	9.41	11.37	10.00	10.21	-	2.51	3.06	3.50	4.32	15.69	15.45	-	-
t	1.6964 N.S.		1.9773 N.S.		3.2356*				2.5921*		1.9522N.S.		0.4001 N.S.			
N.Hr.River (S.H.B.)																
110-129	1	0														
130-149	1	4	0	1					0	1						
150-169	1	1	3	3					2	1	0	2				
170-189			3	8					0	1	1	3	0	1		
190-209			2	2							1	1	0	0		
210-229					0	3					1	1	0	0		
230-249					0	0							1	0		
250-269					0	3										
270-289																
290-309																
	a(27.27)	a(20.00)	a(72.73)	a(56.00)	-	a(24.00)			b(33.33)	b(27.27)	b(50.00)	b(63.64)	b(16.67)	b(9.09)		
N	3	5	8	14	0	6			2	3	3	7	1	1		
Age Comp.	(16.67)	(13.16)	(44.44)	(36.84)	-	(15.79)			(11.11)	(7.90)	(16.67)	(18.42)	(5.56)	(2.63)		
X̄ Length	145.3	145.2	175.1	176.4	-	242.3			161.0	164.0	204.0	180.3	-	-		
S.E.	11.89	3.22	5.58	3.79	-	9.04			8.00	12.50	14.15	7.20	-	-		
t	0.0108 N.S.		0.1826 N.S.						0.2021 N.S.		1.4932 N.S.					
C.B.C River																
150-169	2	0	4	1					4	2	8	1				
170-189	2	0	11	4	1	0			2	2	7	6				
190-209	1	0	0	4	2	4			1	0	9	9	0	1		
210-229			1	0	2	5					3	2	0	2		
230-249					1	2	0	1							0	1
250-269															1	0
270-289															0	0
290-309															0	1
	a(18.52)	-	a(59.26)	a(42.86)	a(22.22)	a(52.38)	-	a(4.76)	b(20.00)	b(14.82)	b(77.14)	b(66.67)	-	b(11.11)	b(2.86)	b(7.41)
N	5	0	16	9	6	11	0	1	7	4	27	18	0	3	1	2
Age Comp.	(7.46)	-	(23.88)	(16.98)	(8.96)	(20.75)	-	(1.89)	(10.45)	(7.55)	(40.30)	(33.96)	-	(5.67)	(1.49)	(3.77)
X̄ Length	174.4	-	178.3	190.1	205.8	214.0	-	-	167.8	173.5	185.7	193.9	-	212.0	-	275.5
S.E.	6.64	-	3.31	4.09	8.42	4.28	-	-	6.32	5.78	3.84	2.86	-	4.93	-	33.50
t			2.2413*		0.8647N.S.				0.6919 N.S.		1.7184 N.S.					

a = Unaged fish included in length class, b= Age Composition in terms of parr only, c= Age Composition in terms of post-smolt only.

continued

Appendix 1k (Continued)

Length Class (mm)	Repeat Migrants 1.2+ ♀	1.2+ ♂	2.1+ ♀	2.1+ ♂	2.2+ ♀	2.2+ ♂	3.1+ ♀	3.1+ ♂	4.1+ ♀	4.1+ ♂	2.1.1+ ♀	2.1.1+ ♂	Length Frequency Distribution ♀	Length Frequency Distribution ♂
S.E. River														
110-129													0 -	1(1.10)
130-149													3(3.37)	18(19.78)
150-169													20(22.47)	21(23.08)
170-189			0	1									20(22.47)	16(17.58)
190-209			4	6							0	1	22(24.72)	18(19.78)
210-229			3	0									11(12.36)	4(4.40)
230-249													3(3.37)	3(3.30)
250-269	0	1											2(2.25)	1(1.10)
270-289							0	1	1	0			2(2.25)	1(1.10)
290-309					1	0	0	0	0	0			1(1.12)	0 -
310-329							2	0	0	0			3(3.37)	1(1.10)
330-349									1	0			1(1.12)	0 -
350-379									1	0			1(1.12)	0 -
N	0	1	7	7	1	0	2	1	3	0	0	1	89	90
Age Comp.	-	(1.11)	(7.87)	(7.78)	(1.12)	-	(2.25)	(1.11)	(3.37)	-	-	(1.11)		
$\bar{X}$ Length	-	-	208.7	196.4	-	-	318.0	-	323.3	-	-	-	200.0	173.8
S.E.	-	-	3.03	4.22	-	-	1.00	-	26.17	-	-	-	4.65	3.77
t			2.3632*										4.3887***	
M.Hr.River (S.M.B.)														
110-129													1(5.56)	0 -
130-149													1(5.56)	6(15.79)
150-169													6(33.33)	7(18.42)
170-189			0	1									4(22.22)	14(36.84)
190-209			0	0									3(16.67)	3(7.89)
210-229			1	0									2(11.11)	4(10.53)
230-249													1(5.56)	0 -
250-269													0 -	3(7.89)
270-289													0 -	0 -
290-309							0	1					0 -	1(2.63)
N			1	1			0	1					18	38
Age Comp.			(5.56)	(2.63)			-	(2.63)						
$\bar{X}$ Length			-	-			-	-					180.3	186.1
S.E.			-	-			-	-					7.44	6.20
t													0.5989 N.S.	
C.B.C River														
150-169													a18(26.09)	4(7.41)
170-189													a25(36.23)	12(22.22)
190-209			3	2									16(23.19)	a21(38.89)
210-229			1	0									7(10.14)	9(16.67)
230-249			1	2									2(2.90)	6(11.11)
250-269					0	1							1(1.45)	1(1.85)
270-289													0 -	0 -
290-309													0 -	1(1.85)
N			5	4	0	1							69	54
Age Comp.			(7.46)	(7.55)	-	(1.89)								
$\bar{X}$ Length			210.4	225.5	-	-							185.7	204.0
S.E.			7.58	12.97	-	-							2.62	3.46
t			0.8056 N.S.										4.2064***	

Appendix 2a. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for Salmo trutta from North Harbour River, S.M.B. in 1976 (outward and inward). Included also within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Smolt/Post-smolt (type 1)											
	$2.^{+}/2.0^{+}$			$3.^{+}/3.0^{+}$			$4.^{+}/4.0^{+}$			$5.^{+}/5.0^{+}$		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward												
90-109			3			2						
110-129			37			24						
130-149			4			15			1			
150-169						4			3			
170-189						1			1			1
190-209									1			
			b(45.37)			b(47.42)			b(6.19)			b(1.03)
N			44			46			6			1
Age Comp.			(44.00)			(46.00)			(6.00)			(1.00)
$\bar{X}$ Length			118.8			130.3			164.7			-
S.E.			1.23			2.20			9.01			-
Inward												
110-129	0	0	6	0	0	1						
130-149	0	0	6	0	0	3						
150-169	0	0	4	1	1	5						
170-189	0	2	4	1	1	8	0	0	4			
190-209				3	4	10	1	0	3			
210-229				1	0	3	1	1	3	0	1	1
230-249				1	1	3	0	1	2	0	0	0
250-269				0	1	1	0	0	1	0	0	1
270-289							0	0	1	0	0	0
290-309										0	0	1
310-329												
350-369												
370-389												
390-409												
430-449												
450-469												
	-	b(15.39)	b(28.17)	b(77.78)	b(61.54)	b(47.89)	b(22.22)	b(15.39)	b(19.72)	-	b(7.69)	b(4.23)
N	0	2	20	7	8	34	2	2	14	0	1	3
Age Comp.	-	(7.41)	(15.63)	(29.17)	(29.63)	(26.56)	(8.33)	(7.41)	(18.75)	-	(3.70)	(2.34)
$\bar{X}$ Length	-	175.5	143.2	198.6	205.5	188.6	212.0	228.0	213.6	-	-	255.3
S.E.	-	5.50	4.59	9.26	11.58	5.77	7.00	2.00	7.97	-	-	24.48
t				0.4672 N.S.			2.1977 N.S.					
χ^2	2.0000 N.S.			0.0667 N.S.			0.0000 N.S.			1.0000 N.S.		

a = Unaged fish included in length class
b = Age composition in terms of Smolt/Post-smolt (type 1)

continued

Appendix-2a (Continued)

	Beyond type 2 Post-smolt Stage														
	1.1+			1.2+			2.1+			2.2+			2.3+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward															
90-109															
110-129			1												
130-149															
150-169															
170-189															
190-209															
N			1												
Age Comp.			(1.00)												
$\bar{X}$ Length			-												
S.E.			-												
Inward															
110-129															
130-149															
150-169															
170-189							0	1	1						
190-209							0	0	2						
210-229	0	0	1				0	0	1	0	1	1			
230-249							0	0	0	0	1	1			
250-269							0	1	4	0	0	0			
270-289				1	0	1	0	0	0	1	0	1			
290-309							0	0	0	1	0	2*	1	0	1
310-329							0	0	1						
350-369													1	0	1
370-389													0	0	0
390-409										0	0	1	1	0	1
430-449													0	0	1
450-469													1	0	1
N	0	0	1	1	0	1	0	2	9	2	2	6	4	0	5
Age Comp.	-	-	(0.78)	(4.17)	-	(0.78)	-	(7.41)	(7.03)	(8.33)	(7.41)	(4.69)	(16.67)	-	(3.91)
Length	-	-	-	-	-	-	-	220.0	237.6	292.0	226.0	289.0	376.5	0	388.2
S.E.	-	-	-	-	-	-	-	31.00	13.64	17.00	4.00	27.53	34.71	-	29.33
t										3.7791 N.S.					
X^2				1.0000 N.S.			2.0000 N.S.			0.0000 N.S.			4.0000*		

continued

Appendix 2a (Continued)

Length Class (mm)	Beyond type 2 Post-smolt Stage (continued)												Length Frequency Distribution		
	3.1^+			3.2^+			4.1^+			4.3^+					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward															
90-109													-	-	5(4.95)
110-129													-	-	62(61.39)
130-149													-	-	21(20.79)
150-169			1										-	-	8(7.92)
170-189			1										-	-	4(3.96)
190-209													-	-	1(0.99)
N			2										-	-	101
Age Comp.			(2.00)												
$\bar{X}$ Length			168.5												128.8
S.E.			7.50												1.85
Inward															
110-129													0 -	0 -	7(5.43)
130-149													0 -	0 -	9(6.98)
150-169													1(4.17)	1(3.70)	9(6.98)
170-189	0	0	1										1(4.17)	4(14.82)	18(13.95)
190-209	0	0	0										4(16.67)	4(14.82)	15(11.63)
210-229	0	0	1										2(8.33)	3(11.11)	11(8.53)
230-249	0	1	5				0	0	1				1(4.17)	4(14.82)	12(9.30)
250-269	0	1	3	0	1	1	0	0	1				0 -	4(14.82)	12(9.30)
270-289	0	1	3	1	0	1	0	2	2				3(12.50)	3(11.11)	[a]10(7.75)
290-309	0	1	2	0	0	0	2	1	3				4(16.67)	2(7.41)	9(6.98)
310-329	2	0	3	0	1	2	1	0	2				3(12.50)	1(3.70)	8(6.20)
350-369							0	0	1				1(4.17)	0 -	2(1.55)
370-389				1	1	2							1(4.17)	1(3.70)	2(1.55)
390-409													1(4.17)	0 -	2(1.55)
430-449													0 -	0 -	1(0.78)
450-469										1	0	1	0 -	0 -	2(1.75)
N	2	4	18	2	3	6	3	3	10	1	0	1	24	27	129
Age Comp.	(8.33)	(14.82)	(14.06)	(8.33)	(11.11)	(4.69)	(12.50)	(11.11)	(7.81)	(4.17)	-	(0.78)			
$\bar{X}$ Length	314.0	269.0	264.1	326.0	312.7	316.7	307.3	291.0	295.6	-	-	-	284.8	238.3	230.1
S.E.	4.00	11.67	8.53	50.00	35.24	20.59	10.17	9.07	10.84	-	-	-	16.94	9.76	6.45
t	3.6480*			0.2179 N.S.			1.1983 N.S.						2.3810*		
x^2	0.6667 N.S.			0.2000 N.S.			0.0000 N.S.			1.0000 N.S.			0.1765 N.S.		

Appendix 2b. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution for *Salmo trutta* from North Harbour River, S.M.B. in 1977 (outward and inward). Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Smolt/Post-smolt (type 1)																	
	1.⁺/1.0⁺			2.⁺/2.0⁺			3.⁺/3.0⁺			4.⁺/4.0⁺			5.⁺/5.0⁺			7.⁺/7.0⁺		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
90-109				7	3	10												
110-129				26	26	52	11	10	21									
130-149				3	6	9	5	3	8									
150-169							1	0	1									
170-189																		
190-209										0	4	4						
210-229										0	0	0						
230-249										1	0	1						
250-269																		
270-289													0	1	1			
				b(66.67)	b(66.07)	b(66.[illegible])	b(31.48)	b(24.53)	b(28.04)	b(1.85)	b(7.55)	b(4.67)	-	b(1.89)	b(0.94)			
N				36	35	71	17	13	30	1	4	5	0	1	1			
Age Comp.				(62.07)	(62.50)	(62.28)	(29.31)	(23.21)	(26.32)	(1.72)	(7.14)	(4.39)	-	(1.79)	(0.88)			
$\bar{x}$ Length				116.6	119.7	118.2	129.7	124.5	127.5	-	205.5	212.0	-	-	-			
S.E.				1.65	1.58	1.15	3.19	1.51	1.95	-	0.87	14.61	-	-	-			
t				1.3701 N.S.			1.4661 N.S.											
χ^2				0.0141 N.S.			0.5333 N.S.			1.8000 N.S.			1.0000 N.S.					
Inward																		
110-129	0	1	1	1	1	7	0	0	2									
130-149				5	13	44	2	0	22									
150-169				6	7	23	6	6	36									
170-189				5	0	5	1	5	12	3	0	4						
190-209				1	1	3	1	1	3	0	4	7						
210-229							0	1	1	1	0	1						
230-249										1	1	2						
250-269										0	2	3	1	0	1			
270-289																		
290-309																		
310-329																		
330-349																1	0	1
350-369																		
370-389																		
390-409																		
410-429																		
430-449																		
450-469																		
470-489																		
510-529																		
	-	b(2.33)	b(0.57)	b(51.43)	b(51.16)	b(45.76)	b(28.57)	b(30.23)	b(42.94)	b(14.29)	b(16.28)	b(9.61)	b(2.86)	-	b(0.57)	b(2.86)	-	b(0.57)
N	0	1	1	18	22	81	10	13	76	5	7	17	1	0	1	1	0	1
Age Comp	-	(2.27)	(0.50)	(31.58)	(50.00)	(40.30)	(17.54)	(29.55)	(37.81)	(8.77)	(15.91)	(8.46)	(1.75)	-	(0.50)	(1.75)	-	(0.50)
$\bar{x}$ Length	-	-	-	160.1	146.4	147.5	160.7	175.9	158.4	199.8	222.6	210.8	-	-	-	-	-	-
S.E.	-	-	-	4.54	3.36	1.78	6.11	5.26	2.12	13.60	11.27	7.15	-	-	-	-	-	-
t				2.4357*			1.8881 N.S.			1.2897 N.S.								
χ^2	1.0000 N.S.			0.4000 N.S.			0.3913 N.S.			0.3333 N.S.			1.0000 N.S.			1.0000 N.S.		

continued

Appendix 2b (Continued)

Length Class (mm)	Beyond Type 2 Post-smolt Stage																				
	2.1+			2.2+			2.3+			2.4+			3.1+			3.2+			3.3+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																					
90-109																					
110-129																					
130-149																					
150-169																					
170-189	1	0	1																		
190-209													1	2	3						
210-229													0	0	0						
230-249													0	1	1						
250-269																					
270-289																					
N	1	0	1										1	3	4						
Age Comp.	(1.72)	-	(0.88)										(1.72)	(5.36)	(3.51)						
X̄ Length	-	-	-										-	212.0	207.8						
S.E.	-	-	-										-	14.53	11.12						
t / χ²	1.0000 N.S.												1.0000 N.S.								
Inward																					
110-129																					
130-149																					
150-169																					
170-189																					
190-209	1	0	2																		
210-229													1	0	1						
230-249													0	0	0						
250-269													0	0	0						
270-289													2	0	2						
290-309				1	0	1							1	0	1						
310-329				0	0	0							1	0	1						
330-349				0	0	0							0	0	0						
350-369				0	0	0							0	0	0	1	0	1			
370-389				0	0	0							1	0	1	0	0	0			
390-409				0	0	0										1	0	1			
410-429				0	0	0				1	0	1				0	0	0			
430-449				0	0	1										1	0	1	1	0	1
450-469							1	0	1							1	0	1			
470-489																					
510-529																					
N	1	0	2	2	0	2	1	0	1	1	0	1	6	0	6	4	0	4	1	0	1
Age Comp.	(1.75)	-	(0.100)	(3.51)	-	(0.100)	(1.75)	-	(0.50)	(1.75)	-	(0.50)	(10.53)	-	(2.99)	(7.02)	-	(1.99)	(1.75)	-	(0.50)
X̄ Length	-	-	196.5	374.5	-	374.5	-	-	-	-	-	-	294.3	-	294.3	413.8	-	413.8	-	-	-
S.E.	-	-	5.50	72.50	-	72.50	-	-	-	-	-	-	22.09	-	22.09	21.87	-	21.87	-	-	-
t / χ²	1.0000 N.S.			2.0000 N.S.			1.0000 N.S.			1.0000*			6.0000*			4.0000*			1.0000 N.S.		

continued

Appendix 2b (Continued)

Length Class (mm)	Beyond Type 2 Post-smolt Stage (continued)															Length Frequency Distribution		
	3.4^+			4.1^+			4.2^+			5.1^+			5.2^+					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
Outward																		
90-109																7(11.86)	3(5.26)	10(8.62)
110-129																38(64.41)	36(63.16)	74(63.79)
130-149																8(13.56)	10(17.54)	18(15.52)
150-169																1(1.70)	0 -	1(0.86)
170-189																1(1.70)	0 -	1(0.86)
190-209																1(1.70)	6(10.53)	7(6.03)
210-229																0 -	0 -	0 -
230-249				1	0	1										2(3.39)	1(1.75)	3(2.59)
250-269				1	0	1										1(1.70)	0 -	1(0.86)
270-289																0 -	1(1.75)	1(0.86)
N				2	0	2										59	57	116
Age Comp.				(3.45)	-	(1.75)												
$\bar{X}$ Length				250.5	-	250.5										129.4	134.8	132.1
S.E.				1.50	-	1.50										4.20	4.86	3.20
t																0.8437 N.S.		
χ^2				1.0000 N.S.												0.0345 N.S.		
Inward																		
110-129																1(1.72)	2(4.55)	10(4.90)
130-149																[a]8(13.79)	13(29.55)	[a]67(32.84)
150-169																12(20.69)	13(29.55)	[a]60(29.41)
170-189																9(15.52)	5(11.36)	21(10.29)
190-209																3(5.17)	6(13.64)	14(6.86)
210-229																2(3.45)	1(2.27)	3(1.47)
230-249																1(1.72)	1(2.27)	2(0.98)
250-269																1(1.72)	2(4.55)	4(1.96)
270-289																2(3.45)	0 -	2(0.98)
290-309																2(3.45)	0 -	2(0.98)
310-329				1	0	1										2(3.45)	0 -	2(0.98)
330-349																1(1.72)	0 -	1(0.49)
350-369																1(1.72)	0 -	1(0.49)
370-389																1(1.72)	0 -	1(0.49)
390-409										1	0	1				2(3.45)	0 -	[a]3(1.47)
410-429																1(1.72)	0 -	1(0.49)
430-449							2	0	2				1	0	1	6(10.35)	0 -	6(2.94)
450-469							0	0	0							2(3.45)	0 -	2(0.98)
470-489	1	0	1				0	0	0							1(1.72)	0 -	1(0.49)
510-529							0	1	1							0 -	1(2.27)	1(0.49)
N	1	0	1	1	0	1	2	1	3	1	0	1	1	0	1	58	44	204
Age Comp.	(1.75)	-	(0.50)	(1.75)	-	(0.50)	(3.51)	(2.27)	(1.49)	(1.75)	-	(0.50)	(1.75)	-	(0.50)			
$\bar{X}$ Length	-	-	-	-	-	-	435.5	0	462.7	-	-	-	-	-	-	248.6	175.2	185.8
S.E.	-	-	-	-	-	-	4.50	-	27.29	-	-	-	-	-	-	15.01	9.43	5.71
t																4.1429***		
χ^2	1.0000 N.S.			1.0000 N.S.			0.3333 N.S.			1.0000 N.S.			1.0000 N.S.					

a = Unaged fish included in length class
b = Age composition in terms of Smolt/Post-smolt (type 1)

Appendix 2c. Length distribution of the age groups, mean length at capture per age group, mean overall length, age composition and length frequency distribution for Salmo trutta from Northeast Arm, Placentia in June-November 1976, and May-August 1977. Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined plus unsexed fish (where applicable).

Length Class (mm)	Post-smolt (type unknown)														
	2.0+			3.0+			4.0+			5.0+			6.0+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June-Nov 1976															
150-169	4	1	5	4	4	8									
170-189	2	7	9	6	13	22	1	3	4						
190-209	0	1	1	2	5	7	3	3	6						
210-229				3	4	7	2	2	4	1	2	3			
230-249				1	0	1	4	4	8	2	3	5	0	1	1
250-269				0	0	0	4	2	6	1	2	3	0	1	1
270-289				0	0	0	0	0	0	2	0	2	0	0	0
290-309				0	0	0	0	1	1	0	0	0	0	0	0
310-329				0	0	0	0	0	0	0	1	1	1	0	1
330-349				0	0	0	0	1	1				0	0	0
350-369				1	0	1	-						0	0	0
390-409													0	0	0
410-429													0	1	1
430-449															
450-469															
550-569															
	b(13.33)	b(14.52)	b(13.64)	b(37.78)	b(50.00)	b(41.82)	b(31.11)	b(25.81)	b(27.27)	b(13.33)	b(12.90)	b(12.73)	b(2.22)	b(4.84)	b(3.64)
N	6	9	15	17	26	46	14	16	30	6	8	14	1	3	4
Age Comp.	(11.32)	(12.16)	(11.54)	(32.08)	(35.14)	(35.39)	(26.42)	(21.62)	(23.08)	(11.32)	(10.81)	(10.77)	(1.89)	(4.05)	(3.08)
$\bar{X}$ Length	167.2	181.3	175.7	199.2	185.7	189.9	230.9	230.8	230.8	252.2	249.5	250.6	-	303.7	308.8
S.E.	5.72	3.18	3.40	11.65	3.46	4.79	7.76	10.82	6.70	9.15	11.39	7.34	-	53.51	38.18
t	2.1636*			1.1109 N.S.			0.0134 N.S.			0.1825 N.S.					
x^2	0.6000 N.S.			1.8837 N.S.			0.1333 N.S.			0.2857 N.S.			1.0000 N.S.		
May-Aug 1977															
150-169	1	1	2	1	0	1									
170-189				2	6	8	0	1	1						
190-209				1	2	3	2	5	7	2	1	3			
210-229				3	1	4	2	3	5	1	2	3			
230-249							0	2	2	2	2	4			
250-269							1	0	1	1	2	3	1	0	1
270-289										1	0	1	0	0	0
290-309										0	0	0	0	1	1
310-329										0	1	1	0	1	1
330-349													0	0	0
350-369													1	0	1
370-389															
410-429															
430-449															
450-469															
490-509															
	b(4.17)	b(2.94)a	b(3.51)	b(29.17)	b(26.47)	b(28.07)	b(20.83)	b(32.35)	b(28.07)	b(29.17)	b(23.53)	b(26.32)	b(8.33)	b(5.88)	b(7.02)
N	1	1	2	7	9	16	3	11	16	7	8	15	2	2	4
Age Comp.	(3.57)	(2.56)	(2.99)	(25.00)	(23.08)	(23.88)	(17.86)	(28.21)	(23.88)	(25.00)	(20.51)	(22.39)	(7.14)	(5.13)	(5.97)
$\bar{X}$ Length	-	-	157.0	199.4	191.6	195.0	218.6	209.2	212.1	231.3	246.1	239.2	305.0	303.0	304.0
S.E.	-	-	7.00	7.93	4.68	4.31	11.13	6.31	5.46	9.39	12.67	8.02	46.00	8.00	19.07
t				0.8556 N.S.			0.7362 N.S.			0.9409 N.S.			0.0428 N.S.		
x^2	0.0000 N.S.			0.2500 N.S.			2.2500 N.S.			0.0667 N.S.			0.0000 N.S.		

a = Unaged fish included in length class
b = Age composition in terms Post-smolt (type unknown)

continued

Appendix 2c (Continued)

Length Class (mm)	Post-smolt (type unknown) - (continued)						Beyond Type 2 Post-smolt Stage											
	7.0+			8.0+			2.1+			2.2+			2.3+			2.4+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June-Nov, 1976																		
150-169																		
170-189																		
190-209																		
210-229							0	1	1									
230-249							0	0	0	0	1	1						
250-269							0	1	1	0	1	1						
270-289										0	0	0						
290-309										0	0	0						
310-329										0	0	0						
330-349										0	0	0						
350-369				1	0	1				0	0	0						
390-409										1	0	1						
410-429																		
430-449																1	0	1
450-469																		
510-529																		
550-569													0	1	1			
				b(2.22)	-	b(0.91)												
N				1	0	1	0	2	2	1	2	3	0	1	1	1	0	1
Age Comp.				(1.89)	-	(0.77)	-	(2.70)	(1.54)	(1.89)	(2.70)	(2.31)	-	(1.35)	(0.77)	(1.89)	-	(0.77)
X̄ Length				-	-	-	-	238.0	238.0	-	254.0	300.7	-	-	-	-	-	-
S.E.				-	-	-	-	23.00	23.00	-	9.00	46.96	-	-	-	-	-	-
t / χ^2				1.0000 N.S.			2.0000 N.S.			0.3333 N.S.			1.0000 N.S.			1.0000 N.S.		
May-Aug, 1977																		
150-169																		
170-189																		
190-209							0	1	1									
210-229							0	0	0									
230-249							0	1	1									
250-269																		
270-289																		
290-309																		
310-329																		
330-349	1	0	1	0	1	1				0	1	1						
350-369	0	0	0	0	0	0												
370-389	0	0	0	0	0	0												
410-429	0	0	0	1	0	1												
430-449	0	1	1															
450-469																		
490-509													1	0	1			
	b(4.17)	b(2.94)	b(3.51)	b(4.17)	b(2.94)	b(3.51)												
N	1	1	2	1	1	2	0	2	2	0	1	1	1	0	1			
Age Comp.	(3.57)	(2.56)	(2.99)	(3.57)	(2.56)	(2.99)	-	(5.13)	(2.99)	-	(2.56)	(1.49)	(3.57)	-	(1.49)			
X̄ Length	-	[illegible]	391.0	-	-	384.0	-	213.5	213.5	-	-	-	-	-	-			
S.E.	-	[illegible]	51.00	-	-	41.00	-	18.50	18.50	-	-	-	-	-	-			
t / χ^2	0.0000 N.S.			0.0000 N.S.			2.0000 N.S.			1.0000 N.S.			1.0000 N.S.					

continued

Appendix 2c (Continued)

Length Class (mm)	Beyond Type 2 Post-smolt Stage (continued)															Length Frequency Distribution		
	3.1+			3.2+			3.3+			4.1+			3.1.1+					
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
June-Nov, 1976																		
150-169																8(15.09)	5(6.76)	13(10.00)
170-189																9(16.98)	23(31.08)	35(26.92)
190-209																5(9.43)	9(12.16)	14(10.77)
210-229																6(11.32)	9(12.16)	18(11.54)
230-249	0	1	1													7(13.21)	10(13.51)	17(13.08)
250-269	0	0	0							0	1	1				5(9.43)	8(10.81)	13(10.00)
270-289	0	0	0							0	0	0				2(3.77)	0 -	2(1.54)
290-309	0	1	1							0	0	0				0 -	2(2.70)	2(1.54)
310-329										0	0	0				1(1.89)	1(1.35)	2(1.54)
330-349										1	0	1				1(1.89)	1(1.35)	2(1.54)
350-369										1	0	1	0	1	1	3(5.66)	1(1.35)	4(3.08)
390-409										1	0	1				2(3.77)	0 -	2(1.54)
410-429							0	1	1	0	0	0				0 -	2(2.70)	2(1.54)
430-449				2	0	2				0	1	1				3(5.66)	1(1.35)	4(3.08)
450-469				1	0	1										1(1.89)	0 -	1(0.77)
510-529				0	1	1										0 -	1(1.35)	1(0.77)
550-569																0 -	1(1.35)	1(0.77)
N	0	2	2	3	1	4	0	1	1	3	2	5	0	1	1	53	74	130
Age Comp.	-	(2.70)	(1.54)	(5.66)	(1.35)	(3.08)	-	(1.35)	(0.77)	(5.66)	(2.70)	(3.85)	-	(1.35)	(0.77)			
$\bar{X}$ Length	-	265.0	265.0	443.0	-	461.3	-	-	-	358.3	353.5	356.4	-	-	-	246.4	231.6	236.3
S.E.	-	26.00	26.00	7.77	-	19.06	-	-	-	16.76	91.50	30.38	-	-	-	11.50	9.17	7.07
t										0.0519 N.S.						1.0027 N.S.		
χ^2	2.0000 N.S.			1.0000 N.S.			1.0000 N.S.			0.2000 N.S.			1.0000 N.S.			3.4724 N.S.		
May-Aug, 1977																		
150-169																2(7.14)	1(2.44)	3(4.35)
170-189																2(7.14)	7(17.07)	9(13.04)
190-209																5(17.86)	[a]10(24.39)	[a]15(21.74)
210-229																6(21.43)	6(14.63)	12(17.39)
230-249																2(7.14)	5(12.20)	7(10.15)
250-269	0	1	1													3(10.71)	[a]4(9.76)	[a]7(10.15)
270-289																1(3.57)	0 -	1(1.45)
290-309																0 -	1(2.44)	1(1.45)
310-329																0 -	2(4.88)	2(2.90)
330-349																1(3.57)	2(4.88)	3(4.35)
350-369				1	0	1										2(7.14)	0 -	2(2.90)
370-389				0	1	1										0 -	1(2.44)	1(1.45)
410-429				0	0	0										1(3.57)	0 -	1(1.45)
430-449				2	0	2										2(7.14)	1(2.44)	3(4.35)
450-469				0	1	1										0 -	1(2.44)	1(1.45)
490-509																1(3.57)	0 -	1(1.45)
N	0	1	1	3	2	5										28	41	69
Age Comp.	-	(2.56)	(1.49)	(10.71)	(5.13)	(7.46)												
$\bar{X}$ Length	-	-	-	414.3	419.0	416.2										263.6	241.1	250.2
S.E.	-	-	-	22.73	36.00	16.91										17.71	10.89	9.68
t				0.1096 N.S.												1.0839 N.S.		
χ^2	1.0000 N.S.			0.2000 N.S.												2.4493 N.S.		

Appendix 2d. Length distribution of the age groups, mean length at capture per age group, overall mean length; age composition and length frequency distribution for *Salmo trutta* from Colinet River and Harbour in 1977. Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length and χ^2 values for sex ratios per age group and overall. Percentages are in parentheses. c = sexes combined.

Length Class (mm)	Post-smolt (type unknown) and those caught in Freshwater in Type 1 Post-smolt year																	
	2.0^+			3.0^+			4.0^+			5.0^+			6.0^+			7.0^+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
150-169	0	2	2	0	3	3	0	1	1									
170-189	1	2	3	5	5	10	1	1	2									
190-209				1	0	1	0	0	0									
210-229				0	1	1	2	0	2	1	0	1						
230-249							1	1	2	1	0	1						
250-269							0	1	1	1	0	1	1	0	1			
330-349													0	0	0	1	0	1
350-369													0	1	1			
370-389																		
390-409																		
410-429																		
430-449																		
470-489																		
530-549																		
670-689																		
	[a](6.25)	[a](22.22)	[a](14.71)	[a](37.50)	[a](50.00)	[a](44.12)	[a](25.00)	[a](22.22)	[a](23.53)	[a](6.25)	-	[a](8.82)	[a](6.25)	[a](5.56)	[a](5.88)	[a](6.25)	-	[a](2.94)
N	1	4	5	6	9	15	4	4	8	3	0	3	1	1	2	1	0	1
Age Comp.	(3.03)	(16.00)	(8.62)	(18.18)	(36.00)	(25.86)	(12.12)	(16.00)	(13.79)	(9.09)	-	(5.17)	(3.03)	(4.00)	(3.45)	(3.03)	-	(1.72)
$\bar{X}$ Length	-	169.8	171.6	183.5	177.0	179.6	218.3	215.0	216.6	237.0	-	237.0	-	-	313.5	-	-	-
S.E.	-	5.68	4.77	2.22	6.62	4.06	11.10	24.87	12.62	11.06	-	11.06	-	-	47.50	-	-	-
t				0.9312 N.S.			0.1193 N.S.											
χ^2	1.8000 N.S.			0.6000 N.S.			0.0000 N.S.			3.0000 N.S.			0.0000 N.S.			1.0000 N.S.		

Length Class (mm)	Beyond Type 2 Post-smolt Stage																	
	2.3^+			3.1^+			3.2^+			3.3^+			3.4^+			4.1^+		
	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c	♀	♂	c
150-169																		
170-189				1	0	1												
190-209				0	0	0												
210-229				1	0	1										0	1	1
230-249																0	1	1
250-269							0	1	1									
330-349							1	1	2									
350-369							0	0	0	1	0	1						
370-389							0	0	0	0	0	0						
390-409							0	0	0	1	0	1						
410-429							2	0	2	1	1	2	2	0	2			
430-449	0	1	1							0	0	0						
470-489										1	0	1						
530-549																		
670-689																		
N	0	1	1	2	0	2	3	2	5	4	1	5	2	0	2	0	2	2
Age Comp.	-	(4.00)	(1.72)	(6.06)	-	(3.45)	(9.09)	(8.00)	(8.62)	(12.12)	(4.00)	(8.62)	(6.06)	-	(3.45)	-	(8.00)	(3.45)
$\bar{X}$ Length	-	-	-	201.0	-	201.0	391.3	299.5	354.6	412.8	-	412.8	415.0	-	415.0	-	228.5	228.5
S.E.	-	-	-	26.00	-	26.00	26.21	36.50	29.07	22.55	-	17.47	1.00	0	1.00	-	7.50	7.50
t							2.0437 N.S.											
χ^2	1.0000 N.S.			2.0000 N.S.			0.2000 N.S.			1.8000 N.S.			2.0000 N.S.			2.0000 N.S.		

continued

Appendix 2d (Continued)

Length Class (mm)	Beyond Type 2 Post-smolt Stage (continued)									Length Frequency Distribution		
	4.2+			4.3+			4.7+					
	♀	♂	c	♀	c	♂	♀	♂	c	♀	♂	c
150-169										0 -	6(24.00)	6(10.35)
170-189										8(24.24)	8(32.00)	16(27.59)
190-209										1(3.03)	0 -	1(1.72)
210-229										4(12.12)	2(8.00)	6(10.35)
230-249										2(6.06)	2(8.00)	4(6.90)
250-269										2(6.06)	2(8.00)	4(6.90)
330-349	2	0	2							4(12.12)	1(4.00)	5(8.62)
350-369	0	0	0							1(3.03)	1(4.00)	2(3.45)
370-389	1	0	1							1(3.03)	0 -	1(1.72)
390-409	0	0	0							1(3.03)	0 -	1(1.72)
410-429	0	1	1							5(15.15)	2(8.00)	7(12.07)
430-449				1	0	1				1(3.03)	1(4.00)	2(3.45)
470-489				0	0	0				1(3.03)	0 -	1(1.72)
530-549				1	0	1				1(3.03)	0 -	1(1.72)
670-689							1	0	1	1(3.03)	0 -	1(1.72)
N	3	1	4	2	0	2	1	0	1	33	25	58
Age Comp.	(9.09)	(4.00)	(6.90)	(6.06)	-	(3.45)	(3.03)	-	(1.72)			
$\bar{X}$ Length	358.0	-	371.8	486.5	-	486.5	-	-	-	310.3	232.7	276.9
S.E.	14.50	0	17.15	44.50	-	44.50	-	-	-	21.60	18.01	15.29
t										2.7589**		
X^2	1.0000 N.S.			2.0000 N.S.			1.0000 N.S.			2.4828 N.S.		

a = Age composition in terms of Post-smolt (type unknown) and those caught in Freshwater in Type 1 Post-smolt year

Appendix 2e. Length distribution of the age groups, mean length at capture per age group, overall mean length, age composition and length frequency distribution of *Salmo trutta* spawners (sample comprised of individuals from the different areas combined). Included also are within sample comparisons of males versus females (t test) for mean length at capture per age group and overall mean length. Percentages are in parentheses.

Length Class (mm)	Parr				Caught at Sea in Smolt Year and Captured in Freshwater in Type 1 Post-smolt Year													
	3+		4+		2.0+		3.0+		4.0+		5.0+		6.0+		7.0+		8.0+	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
150-169	0	1			0	1												
170-189							0	2										
190-209							0	0	0	2								
210-229							0	1	0	2	0	2						
230-249			0	1			0	0	0	1	2	0						
250-269							0	0	3	1	0	1						
270-289							1	0	0	0	0	0						
290-309									0	1	0	1	0	1				
310-329									0	0	0	1	1	1				
330-349									0	1			0	0	1	0	0	1
350-369													1	1			0	0
370-389													0	0			0	0
390-409													0	0			0	0
410-429													0	1			1	0
430-449																		
450-469																		
470-489																		
490-509																		
530-549																		
550-569																		
					–	b(4.55)	b(10.00)	b(13.64)	b(30.00)	b(36.36)	b(2.00)	b(22.73)	b(2.00)	b(18.18)	b(1.00)	–	b(1.00)	b(4.55)
N	0	1	0	1	0	1	1	3	3	8	2	5	2	4	1	0	1	1
Age Comp.	–	(2.50)	–	(2.50)	–	(2.50)	(2.63)	(7.50)	(7.89)	(20.00)	(5.26)	(12.50)	(5.26)	(10.00)	(2.63)	–	(2.63)	(2.50)
$\bar{X}$ Length	–	–	–	–	–	–	a –	188.3	266.3	247.9	245.0	263.2	337.5	344.3	–	–	–	–
S.E.	–	–	–	–	–	–	–	11.70	1.20	18.19	1.00	18.80	13.50	26.04	–	–	–	–
t									1.0126 N.S.		0.9665 N.S.		0.2301 N.S.					

a Unaged fish included in length class
b Age Composition in terms of Post-smolt

continued

Appendix 2e (Continued)

Length Class (mm)	Beyond Type 2 Post-smolt Stage 2.1+ ♀	2.1+ ♂	2.2+ ♀	2.2+ ♂	2.3+ ♀	2.3+ ♂	2.4+ ♀	2.4+ ♂	3.1+ ♀	3.1+ ♂	3.2+ ♀	3.2+ ♂	3.3+ ♀	3.3+ ♂	3.4+ ♀	3.4+ ♂
150-169																
170-189																
190-209																
210-229																
230-249																
250-269	0	1									0	1				
270-289											0	0				
290-309											0	0				
310-329											0	1				
330-349			0	1					0	1	1	1				
350-369			0	0							0	0	1	0		
370-389			0	0							1	0	0	0		
390-409			1	0							1	0	0	0		
410-429			0	1			1	0			1	1	1	2	2	0
430-449							1	0			4	0	0	0		
450-469					2	1	0	1			2	1	0	0		
470-489					0	0							1	0		
490-509					1	0										
530-549					0	0										
550-569					0	1										
N	0	1	1	2	3	2	2	1	0	1	10	5	3	2	2	0
Age Comp.	-		(2.63)	(5.00)	(7.89)	(5.00)	(5.26)	(2.50)	-	(2.50)	(26.32)	(12.50)	(7.89)	(5.00)	(5.26)	-
X̄ Length	-	-	-	377.0	474.3	506.0	432.5	-	-	-	418.7	354.6	418.3	415.5	415.0	-
S.E.	-	-	-	33.00	15.38	61.00	11.50	-	-	-	11.77	36.66	30.90	2.50	1.00	-
t					0.5033 N.S.						1.6646 N.S.		0.0913 N.S.			

Length Class (mm)	Beyond Type 2 Post-smolt Stage (continued) 4.1+ ♀	4.1+ ♂	4.2+ ♀	4.2+ ♂	4.3+ ♀	4.3+ ♂	5.2+ ♀	5.2+ ♂	Length Frequency Distribution ♀	Length Frequency Distribution ♂
150-169									0 -	2(5.00)
170-189									0 -	2(5.00)
190-209									0 -	2(5.00)
210-229									0 -	5(12.50)
230-249									2(5.13)	2(5.00)
250-269									3(7.69)	4(10.00)
270-289									2(5.13)	0 -
290-309	0	1							0 -	4(10.00)
310-329	1	0							2(5.13)	3(7.50)
330-349	1	0	1	0					4(10.26)	5(12.50)
350-369	0	0	0	0					2(5.13)	1(2.50)
370-389	0	0	1	0					2(5.13)	0 -
390-409	0	0							2(5.13)	0 -
410-429	0	0							6(15.39)	5(12.50)
430-449	0	1			1	0	1	0	7(17.95)	2(5.00)
450-469					0	0			4(10.26)	2(5.00)
470-489					0	0			1(2.56)	0 -
490-509					0	0			1(2.56)	0 -
530-549					1	0			1(2.56)	0 -
550-569									0 -	1(2.50)*
N	2	2	2	-	2	0	1	0	39	40
Age Comp.	(5.26)	(5.00)	(5.26)	-	(5.26)	-	(2.63)	-		
X̄ Length	329.5	377.0	365.5	-	486.5	-	-	-	387.9	308.5
S.E.	3.50	68.00	21.50	-	44.50	-	-	-	11.98	15.48
t	0.6976 N.S.								4.0588 ***	

Appendix 3a. Comparison of slopes and intercepts (t-test) of the log-log regressions of weight on length for outward versus inward moving *Salvelinus fontinalis* from North Harbour River, S.M.B., Beaver River and Southeast River. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom in parentheses.

Sampling Area			Outward		Inward		t	
			b	a	b	a	b	a
North Hr. Riv., S.M.B.								
	1976	♀	2.5180	-3.9774	2.8458	-4.5849	1.8205(11)N.S.	42.4438(12)***
		♂	2.3070	-3.5305	3.1459	-5.2699	4.6512(9)**	—
		C	2.6640	-4.2834	3.0991	-5.1567	3.7545(18)**	—
	1977	♀	2.7950	-4.5920	3.3706	-5.8274	3.6901(13)**	—
		♂	2.9391	-4.8709	2.9335	-4.8001	0.0247(11)N.S.	6.1862(12)***
		C	2.7840	-4.5564	3.0695	-5.1019	2.0470(15)N.S.	37.7461(16)***
Beaver Riv.								
	1977	♀	2.8371	-4.6344	3.3490	-5.7874	4.1475(19)***	—
		♂	2.7738	-4.4659	3.4746	-6.0827	4.6092(15)***	—
		C	2.8462	-4.6448	3.3757	-5.8513	5.1434(22)***	—
Southeast Riv.								
	1977	♀	3.3321	-5.7374	3.4154	-5.9316	0.3960(14)N.S.	8.9578(15)***
		♂	3.0904	-5.1869	3.7470	-6.7021	2.0531(8)N.S.	70.1824(9)***
		C	3.2920	-5.6473	3.5077	-6.1392	1.1502(15)N.S.	26.7690(16)***

Appendix 3b. Slopes and intercepts of the log - log regressions of weight on length compared bewteen areas (analysis of covariance) for outward moving *Salvelinus fontinalis* in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not signficantly different P > 0.05). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom in parentheses.

	Ascending Order of b				F
	1	2	3	4	
♀	2.7950[a]	2.8371[b]	2.9269[d]	3.3321[c]	4.6457 (3,31)**
♂	2.7738[b]	2.9391[a]	3.0566[d]	3.0904[c]	1.7125 (3,26) N.S.
C	2.7840[a]	2.8462[b]	2.9999[d]	3.2920[c]	4.4265 (3,35)**

	Ascending Order of a				F
	1	2	3	4	
♀	-	-	-	-	-
♂	-5.0789[d]	-5.1869[c]	-4.8709[a]	-4.4659[b]	2.3751 (3,26) N.S.
C	-	-	-	-	-

[a]N.Hr., S.M.B. [b]Beaver [c]S.E. [d]N.E.

Appendix 3c. Comparison of slopes and intercepts (t test) of the log-log regressions of weight on length for *Salvelinus fontinalis* for Northeast River versus Northeast Arm, Placentia in June, 1976 and Northeast River versus North Harbour River, S.M.B. during the outward run, 1976. C = sexes combined plus unsexed fish (where applicable). Degrees of freedon are in parentheses.

Sampling Period		N.E. Riv.		N.E. Arm, Plac.		t	
		b	a	b	a	b	a
June, 1976	♀	2.8927	-4.6883	2.6300	-4.1348	1.1069(9)N.S.	8.1025(10)***
	♂	2.5130	-3.8266	3.3013	-5.6838	3.3980(13)**	—
	C	2.5842	-3.9952	3.3104	-5.7022	3.0989(13)**	—

Sampling Period		N.E. Riv.		N.Hr.Riv., S.M.B.		t	
		b	a	b	a	b	a
Outward, 1976	♀	2.8927	-4.6883	2.5180	-3.9774	2.0700(9)N.S.	34.4116(10)***
	♂	2.5130	-3.8266	2.3070	-3.5305	1.3497(10)N.S.	13.3437(11)***
	C	2.5842	-3.9952	2.6640	-4.2834	0.4799(11)N.S.	25.1670(12)***

Appendix 3d. Slopes of the log-log regression of weight on length compared between areas (analysis of covariance) for inward running *Salvelinus fontinalis* in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b					F
	1	2	3	4	5	
♀	2.8408[e]	3.1757[d]	3.3490[b]	3.3706[a]	3.4154[c]	4.3584(4,36)**
♂	2.8936[e]	2.9182[d]	2.9335[a]	3.4746[b]	3.7470[c]	3.8067(4,29)*
C	2.7812[e]	3.0650[d]	3.0695[a]	3.3757[b]	3.5077[c]	6.7141(4,43)***

[a]N.Hr., S.M.B. [b]Beaver [c]S.E. [d]Come By Chance [e]N.Hr., P.B.

Appendix 3a. Slopes and intercepts of the log-log regressions of weight on length compared between 1976 and 1977 (t test) for outward and/or inward moving (*Salvelinus fontinalis*) from North Harbour River, S.M.B., Northeast River and Come By Chance River. June, 1975 and June 1976 are also compared for for Southeast Arm, Placentia. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling area			1976		1977		t	
			b	a	b	a	b	a
North Hr. Riv., S.M.B.								
	Outward	♀	2.5180	-3.9774	2.7950	-4.5920	2.1886(10)N.S.	87.1091(11)***
		♂	2.3070	-3.5305	2.9391	-4.8709	3.0590(9)*	—
		C	2.6640	-4.2834	2.7840	-4.5564	1.3577(11)N.S.	33.1469(12)***
	Inward	♀	2.8458	-4.5849	3.3706	-5.8274	3.0056(14)**	—
		♂	3.1459	-5.2699	2.9335	-4.8001	1.1042(13)N.S.	41.9894(14)***
		C	3.0991	-5.1567	3.0695	-5.1019	0.2588(22)N.S.	15.4395(23)***
Northeast Riv.								
	Outward	♀	2.8927	-4.6883	2.9269	-4.7684	0.1999(14)N.S.	15.2828(15)***
		♂	2.5130	-3.8266	3.0566	-5.0789	3.2851(15)**	—
		C	2.5842	-3.9952	2.9999	-4.9359	2.6994(17)*	—
Come By Chance Riv.								
	Inward	♀	3.1755	-5.3411	3.1757	-5.3949	0.0018(15)N.S.	2.6143(16)*
		♂	3.0437	-5.0319	2.9182	-4.7808	0.6697(11)N.S.	13.9009(12)**
		C	3.1513	-5.2870	3.0650	-5.1227	0.8313(17)N.S.	16.6892(18)***

Sampling area			1975		1976		t	
			b	a	b	a	b	a
Southeast Arm, Plac.								
	June	♀	2.4157	-3.6819	3.4811	-6.0854	2.8518(11)*	—
		♂	3.3166	-5.7369	3.5264	-6.1831	0.8400(8)N.S.	8.1413(9)***
		C	3.0506	-5.1121	3.5714	-6.2970	2.0397(15)N.S.	41.2539(16)***

Appendix 3f. Slopes and intercepts of the log-log regressions of weight on length for <u>Salvelinus fontinalis</u> compared between sampling times (analysis of covariance) for Northeast Arm, Placentia. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b				F
	1	2	3	4	
♀	2.4314[c]	2.6300[b]	3.0347[d]	3.7163[a]	3.9008(3,18)*
♂	2.5662[d]	2.8133[a]	2.9681[c]	3.3013[b]	0.8643(3,15)N.S.
C	2.9346[c]	3.0320[d]	3.3104[b]	3.6286[a]	0.0165(3,22)N.S.

	Ascending Order of a				F
	1	2	3	4	
♀	–	–	–	–	–
♂	-5.6838[b]	-4.9010[c]	-4.6060[a]	-3.9932[d]	0.7925(3,15)N.S.
C	-6.4543[a]	-5.7022[b]	-5.0476[d]	-4.8205[c]	0.1653 (3,22)N.S.

* = Significant $p < 0.05$ [a]June, 1975 [b]June, 1976 [c]Sept.-Nov., 1976

N.S. = Not significant $p > 0.05$ [d]May-Aug., 1977

Appendix 3g. Slopes and intercepts of the log-log regressions of weight on length for *Salvelinus fontinalis* compared between Northeast Arm, Placentia and Southeast Arm, Placentia (t test) for June, 1975 and June, 1976. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Period		N.E. Arm, Plac.		S.E. Arm, Plac.		t	
		b	a	b	a	b	a
June, 1975	♀	3.7164	-6.6597	2.4157	-3.6819	3.0160(9)*	-
	♂	2.8133	-4.6060	3.3166	-5.7369	0.9232(5)N.S.	29.3954(6)***
	C	3.6286	-6.4543	3.0506	-5.1121	1.1938(10)N.S.	28.8898(11)***
June, 1976	♀	2.6300	-4.1348	3.4811	-6.0854	2.2238(10)N.S.	64.7644(11)***
	♂	3.3013	-5.6838	3.5264	-6.1831	0.8933(12)N.S.	19.4117(13)***
	C	3.3104	-5.7022	3.5714	-6.2970	1.1041(16)N.S.	25.7629(17)***

Appendix 4a. Comparison of slopes and intercepts (t-test) of the log-log regression of weight on length for outward versus inward moving *Salmo trutta* from North Harbour River, S.M.B. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

			Outward		Inward		t	
			b	a	b	a	b	a
North Hr. Riv., S.M.B.								
	1976	♀	—	—	—	—	—	—
		♂	—	—	—	—	—	—
		C	2.5750	-4.0694	3.0040	-5.0009	3.8076(19)**	—
	1977	♀	2.7420	-4.4293	3.0292	-5.0545	2.9886(23)**	—
		♂	2.7857	-4.5154	3.0169	-5.0223	1.8145(12)N.S.	35.0175(13)***
		C	2.8129	-4.5784	3.0381	-5.0735	2.6781(25)*	—

Appendix 4b. Slopes and intercepts of the log-log regressions of weight on length compared between 1976 and 1977 (t test) for outward and inward moving *Salmo trutta* from North Harbour River S.M.B. The inward run on North Harbour River, S.M.B., and the June-November sample for Northeast Arm, Placentia in 1976 are also compared. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling area		1976		1977		t	
		b	a	b	a	b	a
North Hr. Riv., S.M.B.							
Outward	♀	—	—	—	—	—	—
	♂	—	—	—	—	—	—
	C	2.5750	-4.0694	2.8129	-4.5784	1.8651(11)N.S.	47.980[illegible](12)***
Inward	♀	2.9831	-4.9485	3.0292	-5.0545	0.5257(27)N.S.	7.7272(28)***
	♂	2.9444	-4.8643	3.0169	-5.0223	0.8217(15)N.S.	5.5387(16)***
	C	3.0040	-5.0009	3.0381	-5.0735	0.5931(32)N.S.	20.2623(33)***

Sampling area		N.Hr.Riv., S.M.B. Inward		N.E. Arm, Plac. June-Nov.		t	
		b	a	b	a	b	a
N.Hr., Inward, 1976	♀	2.9831	-4.9485	2.9527	-4.8534	0.2968(21)N.S.	19.2430(22)***
N.E. Arm, June-Nov., 1976	♂	2.9444	-4.8643	3.0047	-4.9848	0.8658(20)N.S.	41.8220(21)***
	C	3.0040	-5.0009	2.9913	-4.9533	0.2443(29)N.S.	22.5030(30)***

Appendix 4c. Slopes and intercepts of the log-log regression of weight on length compared between areas (analysis of covarience) for *Salmo trutta* in 1977. Values underscrored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b			F
	1	2	3	
♀	2.8309[b]	3.0292[a]	3.0408[c]	2.0790 (2,39) N.S.
♂	2.8467[c]	2.9475[b]	3.0169[a]	0.8466 (2,24) N.S.
C	2.8730[b]	3.0099[c]	3.0381[a]	1.3446 (2,45) N.S.

	Ascending Order of a			F
	1	2	3	
♀	-5.0750[c]	-5.0545[a]	-4.5792[b]	0.6961 (2,39) N.S.
♂	-5.0223[a]	-4.8308[b]	-4.5993[c]	1.0084 (2,39) N.S.
C	-5.0735[a]	-4.9985[c]	-4.6694[b]	0.1711 (2,39) N.S.

[a]N. Hr., S.M.B. [b]N.E. Arm [c]Colinet.

Appendix 5a. Mean smolt age of *Salvelinus fontinalis* compared between areas in 1977 (one way anlaysis of variance). Values underscored by the same line (Newman-Keuls multiple comparison test) are not sifnificantly different ($p < 0.05$). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

	Ascending Order of $\bar{X}$ Age (years)						F	df	
	1	2	3	4	5	6		Groups	Error
♀	2.88(64)[d]	3.04(26)[f]	3.05(97)[a]	3.09(46)[e]	3.31(128)[c]	3.88(122)[b]	15.3984***	5	477
♂	2.73(40)[d]	2.90(19)[f]	2.98(46)[a]	3.11(38)[c]	3.80(20)[e]	3.81(42)[b]	7.8779***	5	199
C	2.76(309)[d]	2.98(45)[f]	2.99(257)[a]	3.24(306)[c]	3.30(66)[e]	3.82(799)[b]	76.7349***	5	1,777

[a] N.Hr., S.M.B. [b] Beaver [c] S.E. [d] N.E. [e] Come By Chance

[f] N.Hr., P.B.

Appendix 5b. Mean smolt age of Salvelinus frontinalis compared between 1976 and 1977 (t test) for North Harbour River, S.M.B., Come By Chance River and Northeast River. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Sampling Area		X̄ age (years)		t	df
		1976	1977		
North Hr. Riv., S.M.B.	♀	2.56(137)	3.05(97)	5.4235***	232
	♂	2.48(61)	2.98(46)	2.3758***	105
	C	2.67(780)	2.99(257)	6.1078***	1,035
Come By Chance River	♀	3.58(25)	3.09(46)	2.3178*	69
	♂	3.80(10)	3.80(20)	0.0000N.S.	28
	C	3.60(35)	3.30(66)	1.5924N.S.	101
Northeast Riv.	♀	1.91(56)	2.88(64)	6.9643***	118
	♂	1.98(42)	2.73(40)	3.7277***	80
	C	1.94(100)	2.76(309)	10.1440***	407

Appendix 5c. Mean smolt age of *Salvelinus fontinalis* compared between sampling times for Northeast Arm, Placentia (one way analysis of variance) and for Southeast Arm, Placentia (t test). Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p < 0.05$). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Sampling Area		Ascending Order of $\bar{X}$ Age (Years) 1	2	3	4	F or t	df Groups	df Error
N.E. Arm	♂	2.37(70)[c]	2.81(52)[d]	2.98(46)[a]	3.37(62)[b]	21.8993***	3	226
	♀	2.55(62)[c]	2.70(27)[d]	2.95(39)[a]	3.50(38)[b]	12.8409***	3	162
	C	2.45(133)[c]	2.77(79)[d]	2.94(87)[a]	3.41(106)[b]	33.6493***	3	401
S.E. Arm	♂	2.77(69)[a]	3.36(28)[b]	—	—	2.5890*		95
	♀	2.72(29)[a]	3.64(14)[b]	—	—	2.3211*		41
	C	2.74(101)[a]	3.41(44)[b]	—	—	3.4049**		143

[a]Jun., 1975 [b]Jun., 1976 [c]Sept.-Nov., 1976

[d]May-Aug., 1977

Appendix 5d. Mean smolt age of Salvelinus fontinalis compared between Northeast Arm and Southeast Arm, Placentia (t test) in 1975 and 1976. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Sample		$\bar{X}$ Age (years)		t	df
		N.E.Arm	S.E.Arm		
June, 1975	♀	2.98 (46)	2.27 (69)	1.6472N.S.	113
	♂	2.95 (39)	2.72 (29)	1.6804N.S.	66
	C	2.94 (87)	2.74 (101)	2.1637*	186
June, 1976	♀	3.37 (62)	3.36 (28)	0.0565N.S.	88
	♂	3.50 (38)	3.64 (14)	0.3376N.S.	50
	C	3.41 (106)	3.41 (44)	0.0000N.S.	148

Appendix 6a. Mean smolt age of *Salmo trutta* compared between areas (one way analysis of variance) in 1977. Values underscored by the same line (Newman-Keuls Multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

	Ascending Order of $\bar{X}$ Age (years)			F	df	
	1	2	3		Groups	Error
♀	2.53(89)[a]	4.00(16)[c]	4.38(24)[b]	38.0508***	2	126
♂	2.52(96)[a]	3.17(18)[c]	4.24(33)[b]	43.1662***	2	144
C	2.56(284)[a]	3.64(34)[c]	4.29(57)[b]	101.5538***	2	372

[a]N.Hr., S.M.B. [b]N.E. Arm [c]Colinet

Appendix 6b. Mean smolt age of Salmo trutta from North Harbour River, S.M.B. and Northeast Arm, Placentia compared between 1976 and 1977 (t test). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Sampling Area		$\bar{X}$ age (years)		t	df
		1976	1977		
North Hr. Riv., S.M.B.	♀	3.22 (9)	2.53 (89)	4.0561***	96
	♂	3.15 (13)	2.52 (96)	2.6937**	107
	C	2.78 (168)	2.56 (284)	3.1048**	450
Northeast Arm, Placentia	♀	3.62 (45)	4.38 (24)	2.2020*	67
	♂	3.51 (62)	4.24 (33)	2.8030***	93
	C	3.55 (110)	4.29 (57)	3.6695***	165

Appendix 6c. Mean smolt age of *Salmo trutta* compared between North Harbour River, S.M.B. and Northeast Arm, Placentia in 1976 (t test). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

$\bar{X}$ Age (years)		t	df
N.Hr.Riv., S.M.B.	N.E.Arm, Plac.		
♀ 3.22 (9)	3.62(45)	1.7508N.S.	52
♂ 3.15 (13)	3.51(62)	1.3980N.S.	73
C 2.78 (168)	3.55(110)	6.4050***	276

Appendix 7a. Comparison of mean length at capture per age age group (t test) for outward versus inward moving *Salvelinus fontinalis* from North Harbour River, S.M.B. in 1976 and 1977. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) outward	$\bar{X}$ Length (mm) inward	t	df
1976					
Smolt/Post-smolt					
$2^+/2.0^+$	♀	139.9(36)	167.5(32)	7.8034***	66
	♂	138.6(19)	174.1(16)	8.4443***	33
	C	137.0(162)	168.5(191)	20.7827***	351
$3^+/3.0^+$	♀	160.1(30)	195.9(29)	8.0684***	57
	♂	166.5(8)	200.8(13)	3.7824**	19
	C	161.8(188)	211.7(137)	18.0663***	323
$4^+/4.0^+$	♀	199.3(3)	244.2(6)	2.8670*	7
	♂	— (0)	244.8(4)	—	—
	C	206.3(26)	261.9(71)	10.5243***	95
Repeat Migrants					
2.1^+	♀	— (0)	236.3(3)	—	—
	♂	— (0)	— (0)	—	—
	C	187.3(12)	265.1(31)	10.1262***	31
1977					
Smolt/Post-smolt					
$2^+/2.0^+$	♀	130.6(10)	170.2(13)	8.5027***	21
	♂	134.4(9)	161.4(4)	2.3169*	11
	C	136.4(32)	171.1(35)	11.8003***	65
$3^+/3.0^+$	♀	161.2(27)	193.7(20)	7.6056***	45
	♂	170.6(11)	182.7(11)	1.6377N.S.	20
	C	162.2(46)	191.8(86)	10.1360***	130
$4^+/4.0^+$	♀	192.0(11)	218.3(15)	3.2200**	24
	♂	179.3(7)	220.0(2)	6.5048**	7
	C	187.1(18)	221.3(34)	5.4920***	50
Repeat Migrants					
2.1^+	♀	177.3(6)	224.1(10)	3.7843**	14
	♂	186.0(3)	224.4(5)	2.1367N.S.	6
	C	183.6(9)	221.4(38)	4.3112***	45
2.2^+	♀	224.0(2)	291.0(3)	—	3
	♂	— (0)	— (0)	—	—
	C	224.0(2)	291.0(3)	2.5580N.S.	3
3.1^+	♀	210.3(8)	248.2(6)	2.6414*	12
	♂	— (0)	— (1)	—	—
	C	210.3(8)	250.0(17)	3.3552**	23
4.1^+	♀	255.4(5)	308.5(2)	2.9651*	5
	♂	— (0)	— (0)	—	—
	C	255.4(5)	316.3(4)	5.1060**	7

Appendix 7b. Comparison of mean length at capture per age group (t test) for outward versus inward moving Salvelinus fontinalis from Southeast River in 1977. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) outward	$\bar{X}$ Length (mm) inward	t	df
Smolt/Post-smolt					
$2.^{+}/2.0^{+}$	♀	168.1(19)	184.0(7)	2.4762*	24
	♂	161.5(11)	204.5(2)	7.0248***	11
	C	167.3(55)	188.6(9)	3.8248***	62
$3.^{+}/3.0^{+}$	♀	189.2(44)	207.2(5)	3.6127***	47
	♂	187.8(14)	— (0)	—	—
	C	189.4(122)	207.2(5)	4.0099***	125
$4.^{+}/4.0^{+}$	♀	213.8(27)	239.1(15)	3.3937**	40
	♂	201.8(4)	224.7(3)	1.9687N.S.	5
	C	209.9(66)	236.7(18)	4.5100***	82
$5.^{+}/5.0^{+}$	♀	247.3(4)	276.5(6)	1.5638N.S.	8
	♂	— (1)	— (1)	—	—
	C	241.3(19)	276.1(7)	2.9023**	24
$6.^{+}/6.0^{+}$	♀	— (0)	— (1)	—	—
	♂	— (0)	285.5(2)	—	—
	C	290.0(2)	282.0(3)	0.2033N.S.	3

Appendix 7c. Comparison of mean length at capture per age group (t test) for outward versus inward moving *Salvelinus fontinalis* from Beaver River in 1977. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) outward	$\bar{X}$ Length (mm) inward	t	df
Smolt/Post-smolt					
$2.^+/2.0^+$	♀	153.3(6)	183.7(3)	6.0639***	7
	♂	155.5(2)	— (0)	—	—
	C	165.0(23)	173.2(17)	1.4310N.S.	38
$3.^+/3.0^+$	♀	187.4(18)	201.1(22)	2.9335**	38
	♂	192.3(6)	189.6(7)	0.2477N.S.	11
	C	187.8(145)	201.3(136)	6.6191***	279
$4.^+/4.0^+$	♀	206.4(16)	228.1(27)	4.3921***	41
	♂	206.0(13)	235.3(7)	3.9373***	18
	C	208.2(166)	225.5(200)	9.4622***	364
$5.^+/5.0^+$	♀	247.9(9)	249.5(10)	0.1082N.S.	17
	♂	242.8(4)	— (1)	—	—
	C	238.7(54)	260.2(75)	4.8818***	127
$6.^+/6.0^+$	♀	270.8(4)	304.4(5)	1.9347N.S.	7
	♂	— (0)	287.5(2)	—	—
	C	262.8(12)	299.2(13)	4.1179***	23
Repeat Migrants					
2.1^+	♀	206.1(9)	208.3(7)	0.2890N.S.	14
	♂	215.3(3)	205.0(3)	0.6959N.S.	4
	C	209.4(32)	216.1(48)	0.7617N.S.	78
3.1^+	♀	269.0(3)	— (1)	—	—
	♂	— (1)	230.0(2)	—	—
	C	244.4(11)	248.1(18)	0.3669N.S.	27
4.1^+	♀	— (1)	322.0(4)	—	—
	♂	— (0)	— (0)	—	—
	C	290.4(5)	323.5(14)	1.5940N.S.	17
5.1^+	♀	325.5(2)	328.0	—	2
	♂	— (0)	— (1)	—	—
	C	327.8(5)	341.8(10)	0.7751N.S.	13
6.1	♀	— (0)	— (1)	—	—
	♂	— (1)	— (0)	—	—
	C	360.5(2)	388.3(3)	0.5341N.S.	3
$2.1.1^+$	♀	— (0)	— (1)	—	—
	♂	— (0)	— (0)	—	—
	C	230.7(3)	226.4(11)	0.8699N.S.	12

Appendix 7d. Mean length at capture per age group compared between areas (one way analysis of variance or t test) for outward moving *Salvelinus fontinalis* in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		Ascending Order of $\bar{X}$ Length (mm) 1	2	3	4	F or t	df Groups	df Error
Smolt 2.+	♀	130.6(10)[a]	153.3(6)[b]	158.1(22)[d]	168.1(19)[c]	9.0373***	3	53
	♂	134.3(9)[a]	155.5(2)[b]	161.5(11)[c]	162.2(19)[d]	5.9025**	3	37
	C	136.4(32)[a]	155.3(119)[d]	165.0(23)[b]	167.3(55)[c]	20.6460***	3	225
3.+	♀	161.2(27)[a]	176.6(28)[d]	187.4(18)[b]	189.2(44)[c]	14.7467***	3	113
	♂	170.6(11)[a]	175.6(11)[d]	187.8(14)[c]	192.3(6)[b]	2.5859N.S.	3	38
	C	162.2(46)[a]	178.0(113)[d]	187.8(145)[b]	189.4(122)[c]	31.9103***	3	422
4.+	♀	192.0(11)[a]	206.4(16)[b]	213.8(27)[c]	221.8(6)[d]	4.6079**	3	56
	♂	179.3(7)[a]	201.8(4)[c]	206.0(13)[b]	228.6(5)[d]	8.3116***	3	25
	C	187.1(18)[a]	208.2(166)[b]	209.9(66)[c]	219.3(34)[d]	13.9235***	3	280
5.+	♀	247.3(4)[c]	247.9(9)[b]	274.2(6)[d]	—	1.7321N.S.	2	16
	♂	242.8(4)[b]	252.2(2)[d]	—	—	0.5087N.S.		4
	C	238.7(54)[b]	241.3(19)[c]	257.1(22)[d]	—	6.3846**	2	92
6.+	♀	270.8(4)[b]	—	—	—	—	-	—
	♂	—	—	—	—	—	-	—
	C	262.8(12)[b]	290.0(2)[c]	313.5(2)	—	3.7711N.S.	2	13
Repeat Migrants 2.1+	♀	177.3(6)[a]	183.2(5)[c]	202.3(3)[d]	206.1(9)[b]	3.9088*	3	19
	♂	196.0(3)[a]	202.3(3)[d]	215.3(3)[b]	—	1.2065N.S.	2	6
	C	183.6(9)[a]	195.3(15)[c]	206.1(16)[d]	209.4(32)[b]	6.5126***	3	68
2.2+	♀	291.0(3)[a]	—	—	—	—	-	—
	♂	—	—	—	—	—	-	—
	C	291.0(3)[a]	251.0(2)[d]	—	—	3.8571N.S.		3
3.1+	♀	210.3(8)[a]	221.0(2)[c]	269.0(3)[b]		3.8165N.S.	2	10
	♂	—	—	—	—	—	-	—
	C	210.3(8)[a]	226.0(4)[c]	244.4(11)[b]	—	3.5092*	2	20
4.1+	♀	255.4(5)[a]	277.8(4)[c]			1.2136N.S.		7
	♂	—	—	—	—	—	-	—
	C	255.4(5)[a]	280.0(6)[c]	290.4(5)[b]	—	1.6270N.S.	2	13
2.1.1+	♀	—	—	—	—	—	-	—
	♂	—	—	—	—	—	-	—
	C	216.5(2)[c]	224.2(5)[d]	230.7(3)[b]	—	0.2162N.S.	2	7

[a]N.Hr., S.M.B.; [b]Beaver; [c]S.E.; [d]N.E.

Appendix 7e. Mean length at capture per age group for North Harbour River, S.M.B. versus Northeast River (t test) outward moving Salvelinus fontinalis (1976). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm)		t	df
		N.Hr.Riv.	N.E. Riv.		
Smolt					
2.+	♀	139.9(36)	152.1(41)	2.4411*	75
	♂	138.9(19)	164.7(26)	4.7354***	43
	C	137.0(162)	157.2(69)	6.2000***	229
3.+	♀	160.1(30)	205.2(5)	3.6832***	33
	♂	166.5(8)	203.3(6)	4.7284***	12
	C	161.8(188)	204.5(11)	7.1563***	197

Appendix 7E. Mean length at capture per age group for outward and inward moving *Salvelinus fontinalis* compared between 1976 and 1977 (t test) for North Harbour River, S.M.B. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) 1976	1977	t	df
Outward Smolt					
$2.^+$	♀	139.9(36)	130.6(10)	2.0099N.S.	44
	♂	138.6(19)	134.4(9)	0.9553N.S.	36
	C	137.0(162)	136.4(32)	0.2888N.S.	192
$3.^+$	♀	160.1(30)	161.2(27)	0.2771N.S.	55
	♂	166.5(8)	170.6(11)	0.5235N.S.	17
	C	161.8(188)	161.2(46)	0.1521N.S.	232
$4.^+$	♀	199.3(3)	192.0(11)	0.5246N.S.	12
	♂	— (0)	179.3(7)	—	—
	C	206.3(26)	187.1(18)	3.7167***	42
Repeat Migrants					
2.1^+	♀	— (0)	177.3(6)	—	—
	♂	— (0)	196.0(3)	—	—
	C	187.3(12)	183.6(9)	0.3799N.S.	19
Inward Post-smolt					
2.0^+	♀	167.5(32)	170.2(13)	0.7278N.S.	43
	♂	174.1(16)	161.4(4)	1.1000N.S.	18
	C	168.5(191)	171.1(35)	1.0668N.S.	224
3.0^+	♀	195.9(29)	193.7(20)	0.4687N.S.	47
	♂	200.8(13)	182.8(11)	2.0766*	22
	C	211.7(137)	191.8(86)	6.6858***	221
4.0^+	♀	244.2(6)	218.3(15)	2.3986*	19
	♂	244.8(4)	220.0(2)	2.6055N.S.	4
	C	261.9(71)	221.3(34)	7.6761***	103
Repeat Migrants					
2.1^+	♀	236.3(3)	224.1(10)	0.5673N.S.	11
	♂	— (0)	224.4(5)	—	—
	C	265.1(31)	221.4(38)	7.1539***	67
2.2^+	♀	— (0)	291.0(3)	—	—
	♂	— (0)	— (0)	—	—
	C	301.4(5)	291.0(3)	0.3112N.S.	6
3.1^+	♀	— (0)	248.2(6)	—	—
	♂	259.0(2)	— (1)	—	—
	C	301.9(13)	250.0(17)	3.5158**	28
4.1^+	♀	— (0)	308.5(2)	—	—
	♂	— (0)	— (0)	—	—
	C	323.5(2)	316.3(4)	0.3790N.S.	4
$2.1.1^+$	♀	— (0)	— (1)	—	—
	♂	— (0)	— (0)	—	—
	C	269.1(7)	242.7(3)	1.1778N.S.	8

Appendix 7g. Mean length at capture per age group for outward (Northeast River) and inward (Come By Chance River) moving *Salvelinus fontinalis* compared between 1976 and 1977 (t test). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) 1976	1977	t	df
Come By Chance Riv. (Inward) Post-smolt					
2.0+	♀	148.7(3)	170.5(8)	2.6460*	6
	♂	— (1)	— (1)	—	—
	C	147.0(4)	170.1(9)	3.6076**	11
3.0+	♀	201.0(10)	192.6(27)	0.7775N.S.	35
	♂	171.7(3)	195.8(5)	0.9845N.S.	6
	C	194.2(13)	193.1(32)	0.1127N.S.	43
4.0+	♀	242.9(8)	228.3(10)	1.5056N.S.	16
	♂	216.7(3)	234.7(11)	1.5254N.S.	12
	C	235.7(11)	231.7(21)	0.5270N.S.	30
5.0+	♀	300.8(4)	— (1)	—	—
	♂	258.3(3)	262.0(3)	0.1957N.S.	4
	C	282.6(7)	266.8(4)	0.8955N.S.	9
Northeast River (Outward) Smolt					
1.+	♀	109.1(10)	105.2(2)	0.8124N.S.	10
	♂	113.4(9)	110.5(2)	0.1647N.S.	9
	C	111.2(19)	111.3(19)	0.0357N.S.	36
2.+	♀	152.1(41)	158.1(22)	0.8920N.S.	61
	♂	164.7(26)	162.2(19)	0.3838N.S.	43
	C	157.2(69)	155.3(119)	0.5131N.S.	186
3.+	♀	205.2(5)	176.6(28)	2.2508*	31
	♂	203.3(6)	175.6(11)	3.4257**	15
	C	204.2(11)	178.0(113)	4.4238***	122

Appendix 7h. Mean length at capture per age group compared between areas (one way analysis of variance or t test) for inward running *Salvelinus fontinalis* in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish. N's are in parentheses.

Age Group		Ascending Order of $\bar{X}$ Length (mm) 1	2	3	4	5	F or t	df Groups	df Error
Post-smolt									
2.0+	♀	158.0(6)[e]	170.2(13)[a]	170.5(8)[d]	183.7(3)[b]	184.0(7)[c]	4.8705**	4	32
	♂	161.4(4)[a]	162.7(6)[e]	204.5(2)[c]	—	—	2.9912N.S.	2	9
	C	160.3(12)[e]	170.1(9)[d]	171.1(35)[a]	173.2(17)[b]	188.6(9)[c]	4.1792**	4	77
3.0+	♀	192.6(27)[d]	193.7(20)[a]	201.1(22)[b]	202.7(13)[e]	207.2(5)[c]	1.7123N.S.	4	82
	♂	182.8(11)[a]	189.6(7)[b]	191.3(7)[e]	195.8(5)[d]	—	0.5472N.S.	3	26
	C	191.8(86)[a]	193.1(32)[d]	198.7(20)[e]	201.3(136)[b]	207.2(5)[c]	4.4847**	4	274
4.0+	♀	218.3(15)[a]	225.3(7)[e]	228.1(27)[b]	228.3(10)[d]	239.1(15)[c]	1.8961N.S.	4	69
	♂	220.0(2)[a]	224.7(3)[c]	234.7(11)[d]	235.3(7)[b]	249.8(4)[e]	1.4298N.S.	4	22
	C	221.3(34)[a]	225.5(200)[b]	231.7(21)[d]	234.2(11)[e]	236.7(18)[c]	2.5650*	4	179
5.0+	♀	249.4(10)[b]	276.5(6)[c]	—	—	—	1.6901N.S.		14
	♂	262.0(3)[d]	—	—	—	—	—	—	—
	C	254.2(5)[a]	260.2(75)[b]	266.8(4)[d]	276.1(7)[c]	—	0.7789N.S.	3	87
6.0+	♀	304.5(5)[b]	—	—	—	—	—	—	—
	♂	285.5(2)[c]	287.5(2)[b]	—	—	—	0.0717N.S.		2
	C	282.0(3)[c]	299.2(13)[b]	—	—	—	1.4269N.S.		14
Repeat Migrants									
2.1+	♀	208.3(7)[b]	224.1(10)[a]	245.5(2)[e]	—	—	4.4103*	2	16
	♂	205.0(3)[b]	224.5(5)[a]	—	—	—	1.4354N.S.		6
	C	216.1(48)[b]	221.4(38)[a]	245.5(2)[e]	—	—	3.2625*	2	85
2.2+	♀	291.0(3)[a]	—	—	—	—	—	—	—
	♂	—	—	—	—	—	—	—	—
	C	273.3(4)[b]	291.0(3)[a]	—	—	—	0.6127N.S.		5
3.1+	♀	248.2(6)[a]	—	—	—	—	—	—	—
	♂	230.0(2)[b]	—	—	—	—	—	—	—
	C	248.1(18)[b]	250.0(17)[a]	—	—	—	0.0438N.S.		33
4.1+	♀	308.5(2)[a]	322.0(4)[b]	—	—	—	0.5276N.S.		4
	♂	—	—	—	—	—	—	—	—
	C	316.3(4)[a]	323.5(14)[b]	—	—	—	0.4886N.S.		16
2.1,1+	♀	—	—	—	—	—	—	—	—
	♂	—	—	—	—	—	—	—	—
	C	226.4(11)	242.7(3)	—	—	—	0.8888N.S.		12

[a] N.Hr., S.M.B.; [b] Beaver; [c] S.E.; [d] Come By Chance; [e] N.Hr., P.B.

Appendix 7i. Mean length at capture per age group for North Harbour River, S.M.B. versus Come By Chance River (t test) inward running *Salvelinus fontinalis* in 1976. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

		$\bar{X}$ Length (mm)		t	df
		N.Hr.Riv. (S.M.B.)	C.B.C.Riv.		
Post-Smolt					
2.0^+	♀	167.5(32)	148.7(3)	2.4757*	33
	♂	174.1(16)	— (1)	—	—
	C	168.5(191)	147.0(4)	3.8765**	193
3.0^+	♀	195.9(29)	201.0(10)	0.4708N.S.	37
	♂	200.8(13)	171.7(3)	1.3818N.S.	14
	C	211.7(137)	194.2(13)	1.8133N.S.	148
4.0^+	♀	244.2(6)	242.9(8)	0.1164N.S.	12
	♂	244.8(4)	216.7(3)	1.9726N.S.	5
	C	261.9(71)	235.7(11)	3.7294***	80

Appendix 7j. Mean length at capture per age group for Salvelinus fontinalis compared between sampling times (one way analysis of variance or t test) for Northeast Arm, Placentia. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.005$). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		Ascending Order of $\bar{X}$ Length (mm)				F or t	df	
		1	2	3	4		Groups	Error
Post-smolt								
2.0^+	♀	163.6(16)[d]	170.8(49)[c]	174.3(12)[a]	176.0(6)[b]	2.5571N.S.	3	79
	♂	166.3(10)[d]	173.2(6)[b]	174.8(33)[c]	183.5(8)[a]	3.4475*	3	53
	C	164.7(26)[d]	172.2(83)[c]	174.6(12)[b]	178.3(22)[a]	5.5209**	3	139
3.0^+	♀	178.6(30)[d]	188.5(35)[b]	188.7(23)[a]	192.0(17)[c]	5.8935***	3	101
	♂	180.4(15)[d]	183.1(15)[b]	183.7(26)[a]	189.0(25)[c]	1.2965N.S.	3	77
	C	179.2(45)[d]	186.0(49)[a]	186.3(52)[b]	190.2(42)[c]	5.2299**	3	184
4.0^+	♀	200.5(14)[b]	220.3(11)[a]	221.5(6)[d]	222.0(3)[c]	3.4487*	3	30
	♂	187.0(2)[d]	205.4(11)[b]	221.7(3)[c]	225.0(4)[a]	1.9849N.S.	3	16
	C	202.6(25)[b]	212.8(8)[d]	221.5(15)[a]	221.8(6)[c]	3.6295*	3	50
5.0^+	♀	231.7(6)[b]	—	—	—	—	-	—
	♂	247.8(4)[b]	—	—	—	—	-	—
	C	238.1(10)[b]	333.0(2)[c]	—	—	0.9364N.S.	10	

[a]June, 1975 [b]June, 1976 [c]Sept-Nov., 1976

[d]May-Aug., 1977

Appendix 7k. Mean length at capture per age group for *Salvelinus fontinalis* from Southeast Arm, Placentia compared between June, 1975 and June, 1976 (t test). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm)		t	df
		June, 1975	June, 1976		
Post-smolt					
2.0+	♀	175.8(21)	169.8(5)	1.4395N.S.	24
	♂	176.8(8)	162.7(3)	3.0054*	9
	C	175.8(31)	169.1(9)	1.9151N.S.	38
3.0+	♀	183.8(44)	181.4(14)	0.5263N.S.	56
	♂	182.0(21)	179.3(4)	0.5414N.S.	23
	C	183.0(66)	180.0(19)	0.7796N.S.	83
4.0+	♀	205.0(3)	198.3(6)	0.4351N.S.	7
	♂	— (0)	185.8(5)	—	—
	C	205.0(3)	192.6(11)	0.8285N.S.	12

Appendix 71. Mean length at capture per age group for *Salvelinus fontinalis* compared between Northeast Arm and Southeast Arm, Placentia in June, 1975 and June, 1976 (t test). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) N.E. Arm	$\bar{X}$ Length (mm) S.E. Arm	t	df
June 1975 Post-smolt					
2.0^{+}	♀	174.3(12)	175.8(21)	0.4706N.S.	31
	♂	183.5(8)	176.8(8)	1.0825N.S.	14
	C	178.3(22)	175.8(31)	0.8413N.S.	51
3.0^{+}	♀	188.7(23)	183.8(44)	1.6923N.S.	65
	♂	183.7(26)	182.0(21)	0.5942N.S.	45
	C	186.0(49)	183.0(66)	1.5674N.S.	113
4.0^{+}	♀	220.3(11)	205.3(3)	1.0000N.S.	12
	♂	225.0(4)	— (0)	—	—
	C	221.5(15)	205.3(3)	1.0844N.S.	16
June 1976 Post-smolt					
2.0^{+}	♀	176.0(6)	169.8(5)	1.4335N.S.	9
	♂	173.2(6)	162.7(3)	3.3195*	7
	C	174.6(12)	169.1(12)	1.5655N.S.	22
3.0^{+}	♀	188.5(35)	181.4(14)	1.5139N.S.	47
	♂	183.1(15)	179.3(4)	0.7293N.S.	17
	C	186.3(52)	180.0(19)	1.6987N.S.	69
4.0^{+}	♀	200.5(14)	198.3(6)	0.0301N.S.	18
	♂	205.4(11)	185.8(5)	2.6082*	14
	C	202.6(25)	192.6(11)	1.8461N.S.	34
5.0^{+}	♀	— (1)	— (1)	—	—
	♂	283.0(2)	— (1)	—	—
	C	268.7(3)	336.0(2)	3.1032N.S.	3

Appendix 7m. Mean length at capture compared between areas (one way analysis of variance or t test) for *Salvelinus fontinalis* spawners. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		Ascending Order of $\bar{X}$ Length (mm) 1	2	3	F or t	df Groups	df Error
Parr							
2^+	♂	143.5(3)[a]	154.1(7)[b]	174.4(5)[c]	4.0026*	2	12
	♀	141.9(16)[b]	145.2(5)[a]	—	0.5572N.S.		19
3^+	♂	175.1(8)[a]	178.3(16)[c]	198.0(10)[b]	6.0801**	2	31
	♀	175.7(9)[b]	176.4(14)[a]	190.1(9)[c]	1.8134N.S.	2	29
4^+	♂	185.0(3)[b]	205.8(6)[c]	—	20.8333***		7
	♀	214.0(11)[c]	234.0(2)[b]	242.3(6)[a]	5.6561*	2	16
Captured in R.s. Year							
2.0^+	♂	161.0(2)[a]	167.8(7)[c]	170.2(25)[b]	0.4880N.S.	2	31
	♀	159.9(36)[b]	164.0(3)[a]	173.5(4)[c]	1.0461N.S.	2	40
3.0^+	♂	185.7(27)[c]	196.0(21)[b]	204.(3)[a]	2.5745N.S.	2	48
	♀	180.3(7)[a]	185.1(10)[b]	193.9(18)[c]	2.7946N.S.	2	32
4.0^+	♂	238.7(6)[b]	—	—	—	-	—
	♀	212.0(3)[c]	229.9(7)[b]	—	1.1014N.S.		8
Repeat Migrants							
2.1^+	♂	208.7(7)[b]	210.4(5)[c]	—	0.2065N.S.		10
	♀	196.4(7)[b]	222.5(4)[c]	—	1.9120N.S.		9

[a]N.Hr., S.M.B. [b]S.E. [c]Come By Chance

Appendix 8a. Comparison of mean length at capture per age group (t test) for outward versus inward moving *Salmo trutta* from North Harbour River, S.M.B. in 1976 and 1977. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) Outward	$\bar{X}$ Length (mm) Inward	t	df
1976					
Smolt/post-smolt (type 1)					
$2^+/2.0^+$	C	118.8(44)	143.2(20)	5.1407***	62
$3^+/3.0^+$	C	130.3(46)	188.6(34)	9.4267***	78
$4^+/4.0^+$	C	164.7(6)	213.6(14)	4.0656***	18
Beyond Post-smolt (type 2)					
3.1^+	C	168.5(2)	264.1(18)	8.4124***	18
1977					
Smolt/Post-smolt (type1)					
$2^+/2.0^+$	♀	116.6(36)	160.1(18)	9.0123***	52
	♂	119.7(35)	146.4(22)	7.1704***	55
	C	118.2(71)	147.5(81)	13.8766***	150
$3^+/3.0^+$	♀	129.7(17)	160.7(10)	4.5002***	25
	♂	124.5(13)	175.9(13)	9.3834***	24
	C	127.5(30)	158.4(76)	10.6992***	104
$4^+/4.0^+$	♀	— (1)	199.8(5)	—	—
	♂	205.5(4)	222.6(7)	1.5110N.S.	9
	C	212.0(5)	210.8(17)	0.1215N.S.	20
Beyond Post-smolt (type2)					
3.1^+	♀	— (1)	294.3(6)	—	—
	♂	212.0(3)	— (0)	—	—
	C	207.8(4)	294.3(6)	3.5014*	8

Appendix 5b. Mean length at capture compared between areas (one way analysis of variance or t test) for *Salmo trutta*. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish. N's are in parentheses.

Age Group		Ascending Order of $\bar{X}$ Length (mm) 1	2	3	F or t	df Groups	df Error
Post-smolt (type 1 and type unknown)							
2.0^+	♀	160.1(18)[a]	—	—	—	-	—
	♂	146.4(22)[a]	169.8(4)[c]	—	3.5457**		24
	C	147.5(81)[a]	157.0(2)[b]	171.6(5)[c]	5.8021**	2	85
3.0^+	♀	160.7(10)[a]	183.5(6)[c]	199.4(7)[b]	10.3959***	2	20
	♂	175.9(13)[a]	177.0(9)[c]	191.6(9)[b]	2.2797N.S.	2	28
	C	158.4(76)[a]	179.6(15)[c]	195.0(16)[b]	5.4166**	2	104
4.0^+	♀	199.8(5)[a]	218.3(4)[c]	218.6(5)[b]	0.8032N.S.	2	11
	♂	209.2(11)[b]	215.0(4)[c]	222.6(7)[a]	0.4261N.S.	2	19
	C	210.8(17)[a]	212.1(16)[b]	216.6(8)[c]	0.1179N.S.	2	38
5.0^+	♀	231.3(7)[b]	237.0(3)[c]	—	0.3939N.S.		8
	♂	246.1(8)[b]	—	—	—	-	—
	C	237.0(3)[c]	239.2(15)[b]	—	0.1610N.S.	-	16
6.0^+	♀	305.2(2)[b]	—	—	—	-	—
	♂	303.0(2)[b]	—	—	—	-	—
	C	304.0(4)[b]	313.5(2)[c]	—	0.1865N.S.		4
Beyond Post-smolt (type 2)							
2.1^+	♀	—	—	—	—	-	—
	♂	213.5(2)[b]	—	—	—	-	—
	C	196.5(2)[a]	213.5(2)[b]	—	0.8808N.S.		2
3.1^+	♀	201.0(2)[c]	294.3(6)[a]	—	2.7357*		6
	♂	—	—	—	—	-	—
	C	201.0(2)[c]	294.3(6)[a]		2.7357*		6
3.2^+	♀	391.3(3)[c]	413.8(4)[a]	414.3(3)[b]	0.2915N.S.	2	7
	♂	299.5(2)[c]	419.0(2)[b]	—	2.3310N.S.		2
	C	354.(5)[c]	413.8(4)[a]	416.2(5)[b]	2.5262N.S.	2	11
4.2^+	♀	358.0(3)[c]	435.5(2)[a]		5.1037*		3
	♂	—	—	—	—	-	—
	C	371.8(4)[c]	62.7(3)[a]	—	2.8206*		5

[a]N.Hr., S.M.B. (inward run); [b]N.E. Arm, Plac.; [c]Colinet

Appendix 8c. Comparison of mean length at capture per age group (t test) between North Harbour River, S.M.B. (inward run) and Northeast Arm, Placentia (June-November sample) in 1976 for *Salmo trutta*. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) N.Hr. Riv. inward, 1976	$\bar{X}$ Length (mm) N.E.ARM, Plac. Jun.-Nov., 1976	t	df
Post-smolt (type 1 and type unknown)					
2.0^+	♀	— (0)	167.2(6)	—	—
	♂	175.5(2)	181.3(9)	0.9182N.S.	9
	C	143.2(20)	175.7(15)	5.6844***	33
3.0^+	♀	198.6(7)	199.2(17)	0.0446N.S.	22
	♂	205.5(8)	185.7(26)	1.6393N.S.	32
	C	188.6(34)	189.9(46)	0.1796N.S.	78
4.0^+	♀	212.0(2)	230.9(14)	1.8107N.S.	14
	♂	228.0(2)	230.8(16)	0.2501N.S.	16
	C	213.6(14)	230.8(30)	1.6586N.S.	42
5.0^+	♀	— (0)	252.2(6)	—	—
	♂	— (1)	249.5(8)	—	—
	C	255.3(3)	250.6(14)	0.1836N.S.	15
Beyond Post-smolt (type 2)					
2.1^+	♀	— (0)	— (0)	—	—
	♂	220.0(2)	238.0(2)	0.4663N.S.	2
	C	237.6(9)	238.0(2)	0.0166N.S.	9
2.2^+	♀	292.0(2)	— (1)	—	—
	♂	226.0(2)	254.0(2)	2.8430N.S.	2
	C	289.0(6)	300.7(3)	0.2144N.S.	7
3.1^+	♀	314.0(2)	— (0)	—	—
	♂	269.0(4)	265.0(2)	0.1404N.S.	4
	C	264.1(18)	265.0(2)	0.9448N.S.	18
3.2^+	♀	326.0(2)	443.0(3)	2.3123N.S.	3
	♂	312.7(3)	— (1)	—	—
	C	316.7(6)	461.3(4)	5.3532***	8
4.1^+	♀	307.3(3)	358.3(3)	2.5268N.S.	4
	♂	291.0(3)	353.5(2)	0.6797N.S.	3
	C	295.6(10)	356.4(5)	1.3361N.S.	13

Appendix 8d. Mean length at capture per age group for outward and inward moving *Salmo trutta* compared between 1976 and 1977 (t test) from North Harbour River, S.M.B. C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) 1976	1977	t	df
Outward Smolt					
2.+	C	118.8(44)	118.2(71)	0.3810N.S.	113
3.+	C	130.3(46)	127.5(30)	0.9801N.S.	74
4.+	C	164.7(6)	212.0(5)	4.2516**	9
Beyond Post-smolt (type 2)					
3.1+	C	168.5(2)	207.8(4)	2.9270*	4
Inward Post-smolt (type 1)					
2.0+	♀	— (0)	160.1(18)	—	—
	♂	175.5(2)	146.4(22)	4.5215***	22
	C	143.2(20)	147.5(81)	0.8756N.S.	99
3.0+	♀	198.6(7)	160.7(10)	3.4135**	15
	♂	205.5(8)	175.9(13)	2.3251*	19
	C	188.6(34)	158.4(76)	4.9057***	108
4.0+	♀	212.0(2)	199.8(5)	0.7978N.S.	5
	♂	228.0(2)	222.6(7)	0.4745N.S.	7
	C	213.6(14)	210.8(17)	0.2568N.S.	29
Beyond Post-smolt (type 2)					
2.1+	♀	— (0)	— (1)	—	—
	♂	220.0(2)	— (0)	—	—
	C	237.6(9)	196.5(2)	2.7915*	9
2.2+	♀	292.0(2)	374.5(2)	1.1078N.S.	2
	♂	226.0(2)	0 —	—	—
	C	289.0(6)	374.5(2)	1.1025N.S.	6
3.1+	♀	314.0(2)	294.3(6)	—	—
	♂	269.0(4)	— (0)	—	—
	C	264.1(18)	294.3(6)	1.2787N.S.	22
3.2+	♀	326.0(2)	413.8(4)	1.6079N.S.	4
	♂	312.7(3)	— (0)	—	—
	C	316.7(6)	413.8(4)	3.5947**	8

Appendix 8e. Mean length at capture per age group for *Salmo trutta* from Northeast Arm, Placentia compared between June-November, 1976 and May-August, 1977 (t test). C = sexes combined plus unsexed fish (where applicable). N's are in parentheses.

Age Group		$\bar{X}$ Length (mm) Jun.-Nov., 1976	$\bar{X}$ Length (mm) May-Aug., 1977	t	df
Post-smolt (type unknown)					
2.0^+	♀	167.2(6)	— (1)	—	—
	♂	181.3(9)	— (1)	—	—
	C	175.7(15)	157.0(2)	2.3982*	15
3.0^+	♀	199.2(17)	199.4(7)	0.0137N.S.	22
	♂	185.7(26)	191.6(9)	1.0092N.S.	33
	C	189.9(46)	195.0(16)	0.7866N.S.	60
4.0^+	♀	230.9(14)	218.6(5)	0.9085N.S.	17
	♂	230.8(16)	209.2(11)	1.7228N.S.	25
	C	230.8(30)	212.1(16)	2.1646**	44
5.0^+	♀	252.2(6)	231.3(7)	1.5932N.S.	11
	♂	249.5(8)	246.1(8)	0.2204N.S.	14
	C	250.6(14)	239.2(15)	1.0736N.S.	27
6.0^+	♀	— (1)	305.0(14)	-	—
	♂	303.7(3)	303.0(2)	0.0123N.S.	3
	C	308.4(4)	304.0(4)	0.1113N.S.	6
Beyond Post-smolt (type 2)					
2.1^+	♀	— (0)	— (0)	—	—
	♂	238.0(2)	213.5(2)	0.8300N.S.	2
	C	238.0(2)	213.5(2)	0.8300N.S.	2
3.2^+	♀	443.0(3)	414.3(3)	1.1933N.S.	4
	♂	— (1)	419.0(2)	—	—
	C	461.4(4)	416.2(5)	1.7681N.S.	7

Appendix 9a. Comparison of slopes and intercepts (t test) of the log-log regression of body length on scale length for outward versus inward moving *Salvelinus fontinalis* from North Harbour River, S.M.B., Beaver River and Southeast River. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		Outward		Inward		t	
		b	a	b	a	b	a
North Hr. Riv., S.M.B.							
1976	♀	0.7217	1.2769	1.0088	0.9103	4.4260(11)**	—
	♂	0.8019	1.1782	0.9275	1.0289	0.5728(9)N.S.	11.0398(10)***
	C	1.0142	0.9209	1.1633	0.6895	1.1807(18)N.S.	60.6361(19)***
1977	♀	0.9638	0.9757	1.0453	0.8462	0.8197(13)N.S.	21.4243(14)***
	♂	1.3270	0.4939	1.2502	0.5744	0.2519(11)N.S.	0.6379(12)N.S.
	C	1.0547	0.8516	1.1817	0.6478	1.2001(16)N.S.	25.1250(17)***
Beaver River.							
1977	♀	0.9680	0.9680	1.1357	0.6979	1.4914(19)N.S.	27.7562(20)***
	♂	1.1979	0.6177	1.0802	0.7874	0.7148(15)N.S.	5.0522(16)***
	C	1.0940	0.7795	1.1314	0.7091	0.7035(31)N.S.	6.8860(32)***
Southeast Riv.							
1977	♀	1.0012	0.9192	1.3212	0.4030	3.7549(14)**	—
	♂	1.2391	0.6029	0.6789	1.3721	2.2899(8)N.S.	23.3480(9)***
	C	1.1143	0.7563	1.1195	0.6968	0.0491(16)N.S.	10.0754(17)***

Appendix 9b. Slopes and intercepts of the log-log regression of body length on scale length compared between areas (analysis of covariance) for outward moving *Salvelinus fontinalis* in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b				F
	1	2	3	4	
♀	0.9638[a]	0.9680[b]	1.0012[c]	1.0931[d]	0.7431 (3,31) N.S.
♂	0.8705[d]	1.1979[b]	1.2391[c]	1.3270[a]	6.3656 (3,26) **
C	0.9884[d]	1.0547[a]	1.0940[b]	1.1143[c]	1.2055 (3,41) N.S.

	Ascending Order of a				F
	1	2	3	4	
♀	0.9192[c]	0.9476[d]	0.9680[b]	0.9757[a]	6.0574 (3,31) **
♂	–	–	–	–	–
C	0.7563[c]	0.7795[b]	0.8516[a]	0.8524[d]	0.5623 (3,41) N.S.

[a] N.Hr., S.M.B. [b] Beaver [c] S.E. [d] N.E.

Appendix 9c. Slopes and intercepts of the log-log regressions of body length on scale length compared between areas (analysis of covariance) for inward moving Salvelinus fontinalis in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b					F
	1	2	3	4	5	
♀	0.9705[e]	1.0453[a]	1.1357[b]	1.1726[d]	1.3212[c]	0.8642(4,36)N.S.
♂	0.6476[d]	0.6789[c]	1.0154[e]	1.0802[b]	1.2502[a]	1.4917(4,28)N.S.
C	1.0629[e]	1.1195[c]	1.1300[d]	1.1314[b]	1.1817[a]	0.0395(4,47)N.S.

	Ascending Order of a					F
	1	2	3	4	5	
♀	0.4030[c]	0.6979[b]	0.7095[d]	0.8462[a]	0.9714[e]	5.7766(4,36)**
♂	0.5744[a]	0.7874[b]	0.9374[e]	1.3721[c]	1.4135[d]	0.9558(4,28)N.S.
C	0.6478[a]	0.6968[c]	0.7091[b]	0.7786[d]	0.8465[e]	12.1729(4,47)***

[a]N.Hr., S.M.B. [b]Beaver [c]S.E. [d]Come By Chance
[e]N.Hr., P.B.

Appendix 9d. Comparison of slopes and intercepts (t-test) of the log-log regressions of body length on scale length for *Salvelinus fontinalis* for Northeast River versus Northeast Arm, Placentia, June, 1976 and Northeast River versus North Harbour River, S.M.B. during the outward run, 1976. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Period		N.E. Riv.		N.E. Arm. Plac.		t	
		b	a	b	a	b	a
June, 1976	♀	0.9898	0.9476	1.2851	0.5063	1.8717(9)N.S.	43.0662(10)***
	♂	1.0133	0.8916	1.1794	0.6534	1.2234(13)N.S.	22.6620(14)***
	C	1.0498	0.8524	1.1999	0.6276	1.1757(13)N.S.	23.9746(14)***

Sampling Period		N.E. Riv.		N.Hr.Riv.,S.M.B.		t	
		b	a	b	a	b	a
Outward, 1976	♀	0.9898	0.9476	0.7217	1.2769	3.5495(9)**	-
	♂	1.0133	0.8916	0.8019	1.1782	1.0553(9)N.S.	11.9577(10)***
	C	1.0498	0.8524	1.0142	0.9209	0.2984(11)N.S.	0.3205(12)N.S.

Appendix 9e. Slopes and intercepts of the log-log regressions of body length on scale length compared between 1976 and 1977 (t test) for outward and/or inward moving *Salvelinus fontinalis* from North Harbour River, S.M.B., Northeast River and Come By Chance River. June, 1975 and June, 1976 are also compared for Southeast Arm, Placentia. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		1976		1977		t	
		b	a	b	a	b	a
North Hr. Riv., S.M.B.							
Outward	♂	0.7217	1.2769	0.9638	0.9757	2.8838(10)*	—
	♀	0.8019	1.1782	1.3270	0.4939	1.7351(7)N.S.	30.8651(8)***
	C	1.0142	0.9209	1.0547	0.8516	0.5001(12)N.S.	11.8706(13)***
Inward	♂	1.0088	0.0434	1.0453	0.8462	0.4324(14)N.S.	10.2748(15)***
	♀	0.9275	0.1285	1.2502	0.5744	1.5705(13)N.S.	19.8505(14)***
	C	1.1633	0.0236	1.1817	0.6478	0.2869(23)N.S.	1.1340(24)N.S.
Northeast Riv.							
Outward	♂	0.9898	0.9476	1.0931	0.8251	0.7696(14)N.S.	11.5455(15)***
	♀	1.0133	0.8916	0.8705	1.1067	1.4298(15)N.S.	7.0983(16)***
	C	1.0498	0.8524	0.9884	0.9451	0.5263(17)N.S.	2.9528(18)**
Come By Chance Riv.							
Inward	♂	1.1914	0.6928	1.1725	0.7095	0.0727(14)N.S.	0.1468(15)N.S.
	♀	0.8594	1.1190	0.6476	1.4135	0.7329(10)N.S.	10.6531(11)***
	C	1.1054	0.7998	1.1300	0.7786	0.1152(15)N.S.	0.2628(16)N.S.

Sampling Area		1975		1976		t	
		b	a	b	a	b	a
Southeast Arm, Plac.							
June	♂	1.2520	0.5379	1.0915	0.7892	1.0080(12)N.S.	10.9251(13)***
	♀	1.1053	0.7572	1.1265	0.7224	0.1038(8)N.S.	4.6082(9)**
	C	1.1909	0.6207	1.1660	0.6759	0.2357(15)N.S.	2.7644(16)*

Appendix 9f. Slopes and intercepts of the log-log regression of body length on scale length for Salvelinus fontinalis compared between sampling times (analysis of co-variance) for Northeast Arm, Placentia. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different (p 0.05). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b				F
	1	2	3	4	
♀	0.9405[a]	1.0492[d]	1.2851[b]	1.3894[c]	0.4800(3,18)N.S.
♂	0.8723[a]	0.9556[d]	1.1794[b]	1.5432[c]	4.2865(3,15)*
C	0.9536[a]	1.0498[d]	1.1999[b]	1.4700[c]	2.0759(3,22)N.S.

	Ascending Order of a				F
	1	2	3	4	
♀	0.3622[c]	0.5063[b]	0.8993[d]	0.9951[a]	3.2279(3,18)*
♂	–	–	–	–	–
C	0.2388[c]	0.6276[b]	0.8980[d]	0.9675[a]	4.2372(3,22)*

[a]June, 1975 [b]June, 1976, [c]Sept.-Nov., 1976
[d]May-Aug., 1977.

Appendix 9g. Slopes and intercepts of the log-log regression of body length on scale length for <u>Salvelinus fontinallis</u> compared between Northeast Arm, Placentia and Southeast Arm, Placentia (t test) for June, 1975 and June, 1976. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Period		N.E. Arm, Plac.		S.E. Arm, Plac.		t	
		b	a	b	a	b	a
June, 1975	♀	0.9405	0.9951	1.2520	0.5379	1.1982(9)N.S.	23.3996(10)***
	♂	0.8723	1.0798	1.1053	0.7572	1.1118(5)N.S.	20.4121(5)***
	C	0.9536	0.9675	1.1909	0.6207	1.7134(10)N.S.	28.7536(10)***
June, 1976	♀	1.2851	0.5063	1.0915	0.7892	1.1490(11)N.S.	18.3874(12)***
	♂	1.1794	0.6534	1.1265	0.7224	0.3015(12)N.S.	0.1502(13)N.S.
	C	1.1999	0.6276	1.1660	0.6759	0.3166(16)N.S.	0.7891(17)N.S.

Appendix 10a. Comparison of slopes and intercepts (t test) of the log-log regression of body length on scale length for outward versus inward moving *Salmo trutta* from North Harbour River, S.M.B. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		Outward		Inward		t	
		b	a	b	a	b	a
North Hr. Riv., S.M.B.							
1976	♀	—	—	—	—	—	—
	♂	—	—	—	—	—	—
	C	0.9131	0.7379	1.0161	0.5405	1.6040(18)N.S.	47.6147(19)***
1977	♀	0.9416	0.6506	1.0612	0.4611	0.2152(23)N.S.	24.0355(24)***
	♂	1.0175	0.5515	1.0214	0.5367	0.0039(11)N.S.	9.1415(12)***
	C	0.9940	0.5740	1.0615	0.4599	0.8107(25)N.S.	22.5322(26)***

Appendix 10b. Slopes and intercepts of the log-log regression of body length on scale length compared between areas (analysis of covariance) for *Salmo trutta* in 1977. Values underscored by the same line (Newman-Keuls multiple comparison test) are not significantly different ($p > 0.05$). C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

	Ascending Order of b			F
	1	2	3	
♀	0.9402[c]	1.0598[b]	1.0612[a]	1.0201(2,39)N.S.
♂	0.9914[c]	1.0214[a]	1.1020[b]	0.6015(2,24)N.S.
C	0.9519[c]	1.0615[a]	1.0655[b]	1.3196(2,49)N.S.

	Ascending Order of a			F
	1	2	3	
♀	0.4295[b]	0.4611[a]	0.6996[c]	2.9090(2,39)N.S.
♂	0.3504[b]	0.5367[a]	0.5890[c]	3.2004(2,24)N.S.
C	0.4240[b]	0.4599[a]	0.6777[c]	3.3858(2,49)*

[a]N.Hr., S.M.B. [b]N.E. Arm [c]Colinet

Appendix 10c. Slopes and intercepts of the log-log regression of body length on scale length compared between 1976 and 1977 (t test) for outward and inward moving *Salmo trutta* from North Harbour River, S.M.B. The inward run on North Harbour River, S.M.B. and the June-November sample for Northeast Arm, Placentia in 1976 are also compared. C = sexes combined plus unsexed fish (where applicable). Degrees of freedom are in parentheses.

Sampling Area		1976		1977		t	
		b	a	b	a	b	a
North Hr. Riv., S.M.B.							
Outward	♀	–	–	–	–	–	–
	♂	–	–	–	–	–	–
	C	0.9131	0.7379	0.9940	0.5740	0.5447(11) N.S.	15.1920(12)***
Inward	♀	0.9366	0.6911	1.0612	0.4611	1.4709(28) N.S.	17.7533(29)**
	♂	0.9259	0.6952	1.0214	0.5367	1.3774(15) N.S.	6.8925(16)***
	C	1.0161	0.5405	1.0615	0.4599	1.0379(32) N.S.	16.3167(33)***

		N.Hr.Riv.,S.M.B. Inward		N.E. Arm, Plac. June-Nov.		t	
		b	a	b	a	b	a
North Hr., Inward, 1976, N.E. Arm, June-November 1976	♀	0.9366	0.6911	1.2649	0.0270	2.3516(20)*	–
	♂	0.9256	0.6952	1.1421	0.2689	2.1960(20)*	–
	C	1.0161	0.5405	1.1853	0.1837	2.6331(29)*	–

END

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