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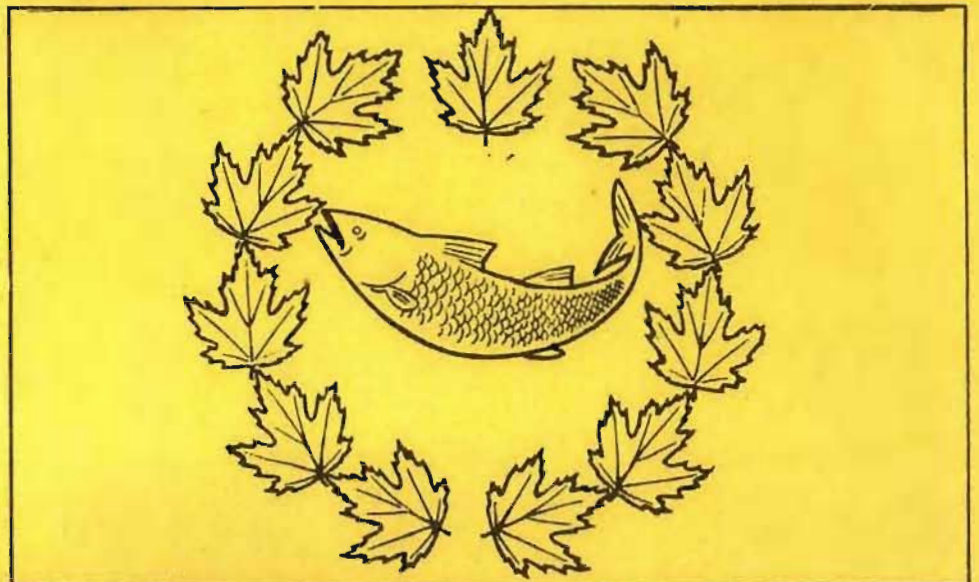
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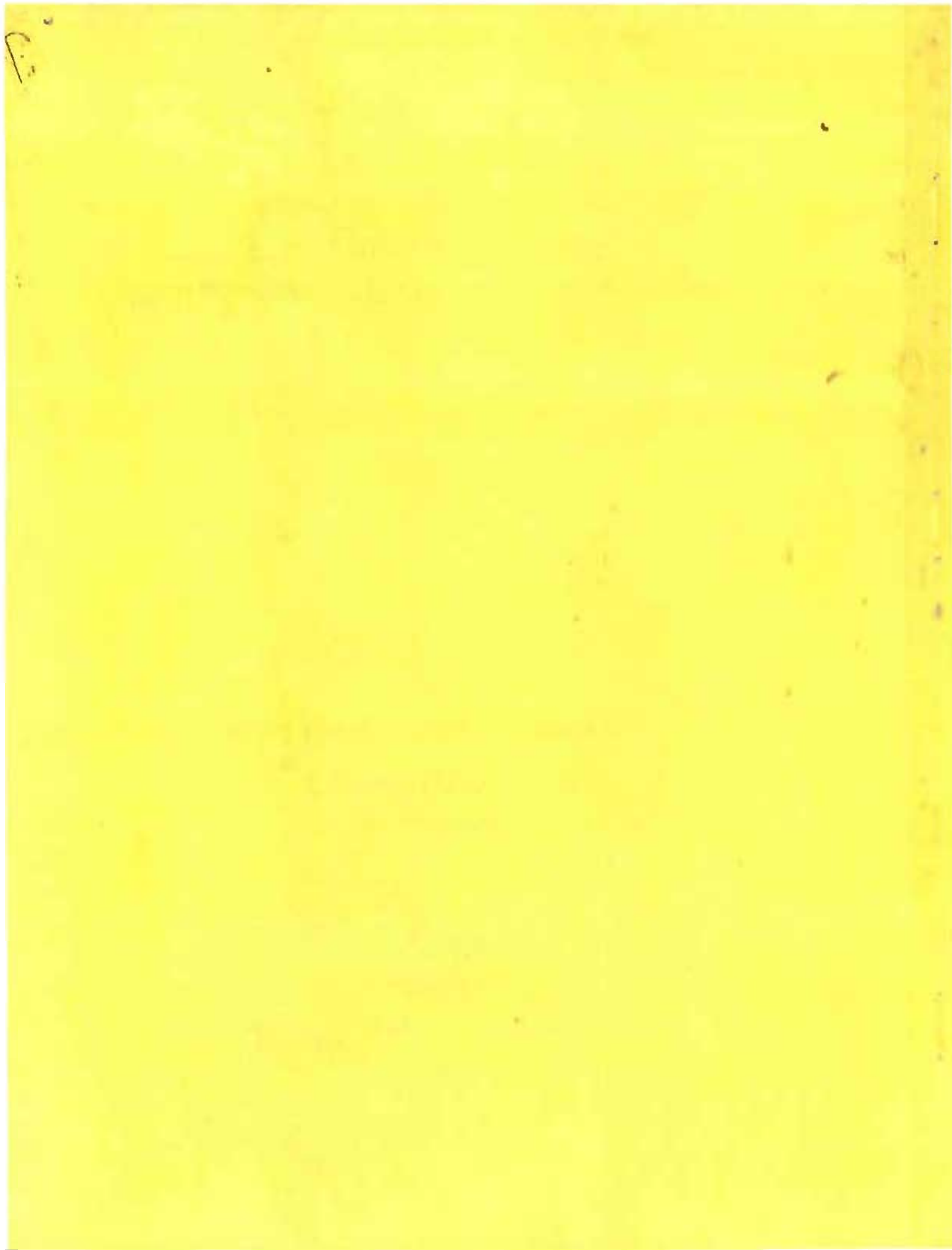
Biology of Atlantic Salmon in Newfoundland and Labrador

by
T.R. Porter

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DEPARTMENT OF THE ENVIRONMENT
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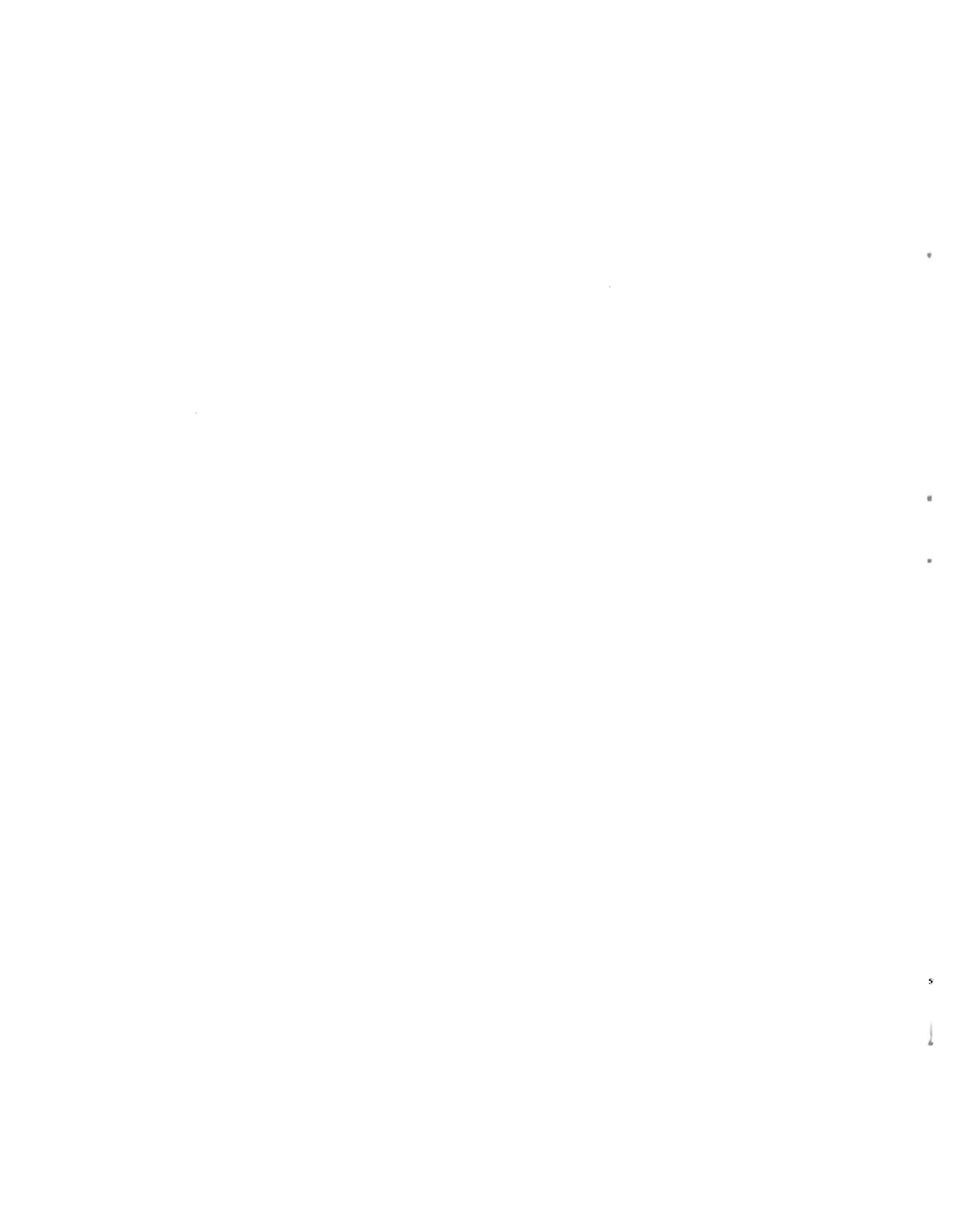
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INTRODUCTION

Atlantic salmon is an anadromous fish; that is, the adult lives in the sea and spawns in freshwater. After spawning the surviving adults return to sea. The young remain in fresh water for 2 to 6 years, then descend to the sea to spend one or more years feeding and growing before returning to freshwater to spawn.

Each river system has its own stock or population of Atlantic salmon which is adapted to the conditions in that river. Hence, there are considerable variations in: (1) the timing of runs to and from the rivers, (2) migratory routes in the ocean, (3) length of time spent in the rivers and ocean, (4) size of the adults, (5) survival of the juvenile fish, and (6) food composition.

The following is a general description of the life history and biology of Atlantic salmon as it applies to Newfoundland and Labrador. Most of the information given is taken from various studies conducted by the Fisheries and Marine Service of Environment Canada, Newfoundland Region. References to published studies are given throughout the report. Scott and Crossman (1973) give an excellent description of the identifying characteristics of Atlantic salmon, and a brief description of its life history, as well as other freshwater fishes of Canada.

SPAWNING

Adult salmon migrate into Newfoundland rivers from early May to early September, depending on the river system. The Conne River and

Garnish River on the south coast, as well as the following rivers in St. Georges Bay: Southwest and Bottom Brooks, Fishels Brook, Middle Barachois Brook, Crabbs River, Highlands River, Robinsons River and Grand Codroy River have runs that enter the river in May. In all other rivers, the escapement of salmon into the river usually extends from late June to early August. The lower Humber River has a late run of salmon that enters the river in early September.

On shore ice conditions can delay the timing of salmon reaching the river mouths. The rate of upstream movement varies with water levels and water temperature. Exceptionally low water levels or high water temperatures may delay the movement of salmon up the river for several weeks.

Salmon have an exceptional ability to surmount or jump falls and obstructions. Under ideal conditions adult salmon can jump a 4 m (13 ft) falls. Important factors are the height and slope of the falls, the pool below the falls, the velocity of water, and the depth of water at the top of the falls. A general "rule of thumb" is that for every foot of height the salmon requires one foot depth of pool below the falls.

As the adult salmon enters the river, they stop feeding. However, there have been isolated incidents where salmon stomachs have been opened and found to contain food.

Shortly after entering the river, the silvery appearance of the salmon changes to gold-brown and the brown spots become more pronounced. The head of the male salmon elongates and the lower jaw becomes enlarged and hooked at the tip forming a KYPE.

Spawning areas may occur anywhere from the estuary to the headwaters.

Usually it occurs in the smaller tributaries and headwaters of the main river. The actual nesting site is chosen by the female, usually a gravel riffle area above or below a pool. Ideal gravel is 2-8 cm (0.5-3 inches) in size and is silt-free. This would allow adequate percolation of water through the gravel to supply oxygen to the eggs.

The female uses her tail or caudal fin to excavate a REDD (nesting depression) 15 to 35 cm (6 to 14 inches) deep while the male drives away other males and intruders from the spawning site. The female tests the depth of the redd and water currents in the redd with her pelvic and pectoral fins. When the eggs are deposited, the water current near the bottom of the redd must not be strong enough to wash away the eggs. When the redd is prepared to the female's satisfaction, she settles in the nest, releases a chemical from her vent or anal opening, which stimulates the male to align himself beside her. The eggs and sperm are released simultaneously. The female then covers the redd with gravel.

The female salmon may not deposit all her eggs at the same time. Hence, the redd digging operation continues until all the eggs are spawned. The eggs are about 5-7 mm (0.25 inches) in diameter after released into the water. The number of eggs deposited by one female varies from river to river. On the average, a female deposits about 700 eggs per 454 g (1 lb) of body weight. After spawning the parent fish are called KELTS.

KELT

In most rivers, kelt return to sea in the spring just before and during the smolt migration. However in some rivers, kelt enter salt water in the fall. By the time kelt returns to the sea, it has lost 41-44% of its body weight (Mills, 1971).

Kelt have difficulty adapting to the salt water as they enter the marine environment. As low as 10% survival has been reported for some rivers (Mills, 1971). However, in West River (St. Barbe) over-winter survival of 90% was recorded; (Porter, unpublished data); the mortality upon entering salt water is not known. A small number of mended kelt (recovered to normal body weight) return to spawn the same year that it went to sea. These are called CONSECUTIVE SPAWNERS. The majority of the mended kelt return to spawn after one winter at sea. These are called ALTERNATE SPAWNERS.

EGG INCUBATION

The eggs incubate in the gravel during the winter, the rate of development depending on water temperature. The higher the temperature, the faster is the rate of development and hatching of the eggs. Hatching occurs in April or early May. The newly hatched are called ALEVINS and remain in the gravel for 4-5 weeks till early June. The alevins are approximately 2.5 cm (1 inch) long and have a yolk sac attached to their ventral surface, which is used for food. When the yolk is completely absorbed, the alevin must leave the gravel and actively

feed. When the alevins emerge from the gravel, they are about 4 cm (1.5 inches) long. Predators on the eggs and alevins include large aquatic insects and leeches. Eggs that are not adequately buried in the gravel or drifting downstream may be eaten by trout, parr or eels. It is expected that these eggs would not have survived if not eaten.

PARR REARING

When the newly emerged salmon leave the area of the redd, they are called PARR. By the end of the first growing season, the young parr have 8-11 narrow pigmented parr marks on each side with a single red spot between each mark along the lateral line. In Newfoundland, parr remain in the rivers from 2 to 4 years; in Labrador they remain in the rivers 3 to 6 years. The slower the growth rate the longer the period of time the parr remain in the river.

Parr rearing habitat is identified by bottom composition and water velocity. The ideal bottom type contains boulders and rubble; gravel is used to a lesser extent. Utilization of ponds and steadies for parr rearing is questionable. Indications are that in the absence of trout, parr will use pools and steadies as rearing area to the same extent as riffle areas (Saunders and Gee, 1964). Also during adverse physical conditions, such as flood conditions, low water levels, high water temperatures, and winter freezing, parr may move into deeper pools, steadies and ponds. Gibson (1973) studied interactions of brook trout and parr on the Matemek River, Quebec. In early summer when food was abundant, both species were found co-habiting close to rapids.

During mid-summer when food was scarcer, the parr were found near the rapids but trout were in pools. In areas where there were no parr, trout occupied areas near rapids all summer.

The upper lethal temperature (temperature at which mortality occurs) for parr is 27.8 C (82 F) (Garside, 1973). However, mortality may occur at lower temperatures under conditions of additional stress such as low water flow.

During the first year after emerging from the gravel (age 0⁺ or under-yearlings), parr usually occupy areas of slow flowing water and in smaller tributaries in the vicinity of the redd. As the parr increase in size they move into faster flowing water, such as riffles or rapid areas.

Parr are very territorial; that is, they defend a defined area of stream bottom. This may vary from approximately 1 m² (1 yd²) to several m² (yd²). Parr removed from a riffle and released 0.4 km (0.25 miles) from capture location have been known to return to the same riffle (Saunders and Gee, 1964). It has been reported that the territorial behavior of juvenile Atlantic salmon reduces predation by brook trout (Symons, 1973).

Parr feed on insects or insect larva drifting downstream.

During the spring of each year, parr which have attained the size of 12 to 20 cm (5-8 inches), lose their parr-marks, become silvery and migrates to sea as SMOLT.

SMOLT

The silvery appearance of smolt is caused by a guanine deposit in the epidermis. This, plus a physiological change, enables the juvenile salmon to adapt to salt water.

Migration to the sea occurs in May and June when the water temperature reaches 5-10 C (40-50 F).

There are four known factors that trigger downstream migration: (1) rise in water temperature, (2) increase in number of hours of daylight each day, (3) an increase in invertebrate or insect drift and (4) spring run off (Jones, 1959). When smoltification begins, the parr form schools as they move downstream. The migration occurs mainly at night. Smolt require approximately 10 hours in estuary to adapt or acclimate to salt water (Jones, 1959).

MARINE ENVIRONMENT

The Atlantic salmon will remain at sea for one to three years before returning to the river for its first spawning. While at sea, the salmon undergo rapid growth. Those salmon that return to spawn after one year at sea are called one sea-winter salmon or GRILSE. These weigh less than 2.7 kg (6 lb). Those salmon that spend two or three years at sea before returning to spawn are called two or three sea-winter salmon or LARGE SALMON. These weigh 2.7 kg or more.



In Newfoundland grilse, tagged as smolt, were usually recaptured within 161 km (100 miles) of its home river. It is not certain how far these fish move away from the river mouth during the post-smolt stage; one grilse tagged at Cape St. John, Newfoundland was recaptured in Miramichi River, New Brunswick (Lear, personal communication).

Feeding areas for large salmon have been located in the Labrador Sea and along the west coast of Greenland. These fish are usually found within two fathoms of the surface. At west Greenland, the feeding area is utilized by both North American and European salmon stocks.

The main food items include caplin, sand lance, squid, herring, barracudina, other fish and organisms found near the surface.

Predators on salmon include sharks, toothed whales and man. Seals will eat salmon caught in nets; however it is questionable whether or not they prey on free swimming salmon.

ADULT SALMON MIGRATION

There are a number of theories on how salmon find their way back to its native river. The most generally accepted theory is that salmon use the ocean currents to get back to the vicinity of its native stream. Each river has a unique chemical composition which can be detected by salmon and used to identify its natal river. Tagging experiments on the Moser River (Quebec) indicated more than 80% returned to its home tributary (Huntsman, 1952).

The rate of travel by salmon in the sea has been reported by several authors. Belding and Préfontaine (1938) reported a maximum rate

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REFERENCES

- Belding, D.L. and G. Prefontaine, 1938. Studies on the Atlantic salmon. -II. Report on the salmon of the 1937 Port-aux-Basques (Newfoundland) Drift-Net fishery. Contributions de l'Institut de Zoologie de l'Université de Montreal - No. 3 59 p.
- Blair, A.A. 1956. Atlantic salmon tagged in east coast Newfoundland waters at Bonavista. J. Fish. Res. Bd. Canada 13: 219-232.
- Garside, E.T. 1973. Ultimate upper lethal temperature of Atlantic salmon Salmo salar L. Can. J. Zool. 51: 898-900.
- Gibson, R.J. 1972. Interactions of juvenile Atlantic salmon (Salmo salar L.) and brook trout (Salvelinus fontinalis (Mitchill)). Proc. of Intl. Atlantic salmon symposium. St. Andrews, N.B. Sept. 1972: 181-202.
- Huntsman, A.G. 1952. Factors which affect migration. Salm. and Trout Mag. 130: 227-239.
- Jones, J.W. 1959. The salmon. Collins, London: 192 p.
- Mills, D. 1971. Salmon and trout: A resource, its ecology, conservation and management. Oliver and Boyd: Edinburgh. 351 p.
- Saunders, R.L. and J.H. Gee 1964. Movements of young Atlantic salmon in a small stream. J. Fish. Res. Bd. Canada. 21: 26-37.
- Scott, W.B. and E.J. Crossman 1973. Freshwater Fishes of Canada. Fish. Res. Bd. Canada. Bull. 184. 966 p.
- Symons, P.K. 1973. Territorial behavior of juvenile Atlantic salmon reduces predation by brook trout. Can. J. Zool 52: 677-679.

