

## Water: Temperatures and Levels

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### Temperature

How warm or how cold the water happens to be on a particular day will affect whether or not a fish will choose to take a fly. In summer, when temperatures reach an excessive level, it is a good idea to choose to fish earlier in the day or in a location that would be cooler for the fish. Similarly, when temperatures are colder, fish will tend to "slow down", particularly in the early morning and late in the day. Fish do not seem to become active until mid-morning to early afternoon.

*To become a knowledgeable angler, therefore, is more than being able to cast your line well; it is necessary to read water, and the natural conditions that are present.*

It is a good idea to carry a thermometer as part of your fishing gear. If you are unsure whether you should fish on a particularly hot (or cold) day, take a temperature of the water, just to be sure. Water warmer than 23 degrees Celsius is dangerous for salmon, as any excessive energy bursts can leave them at a higher risk of post-release mortality.

Dr. Bruce Tufts, Atlantic Salmon Journal, Summer 2002

### Water Levels

During certain times of the year, some rivers will experience lower or higher than normal levels. It is important to recognize when a river's levels are not at the optimum, as this will affect angling.

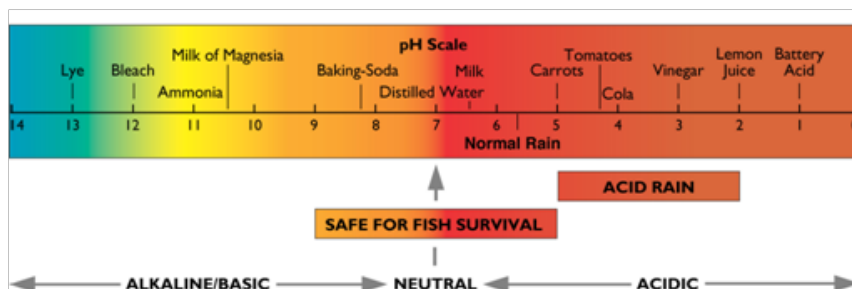
A few things to keep in mind:

- Salmon will most likely not take a fly when water levels are excessively high; salmon begin to take again when the water begins to drop and they start to hold in pools and runs;
- A salmon will likely take a fly better in shallow to moderate water (2-8 ft) versus deep pools
- If water levels are excessively low, it is probable that salmon will likely be held in pools or runs that have adequate depths.

Bruce Boudreau  
<http://members.attcanada.ca/~salmon/primer8.htm>

## The pH Scale

The pH Scale: The color distribution of the chart represents the indicator colors of pHyrion paper that is used to determine the pH of liquids.



## Helping a Salmon on its Way

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Water flow upstream and downstream past dams is especially important to migrating wild Atlantic salmon. **Fish ladders** are built to provide them an artificial flow upstream. **Downstream passage** through a tube, something like a waterslide, is used to assist their movement towards the ocean.

**Angling restrictions** are commonly applied to areas near dams and near these important migrational passages

### Fish ladders

Fish ladders are built with low barriers coming out into the water flow to slow it down, and provide a way for Atlantic salmon to actually gain height around the dam. It is important that the flow be sufficient to attract the salmon to the entrance of the fish ladder. Fish ladders need to be maintained, and repaired from time to time.

### Downstream passage

Downstream passage needs to have sufficient flow to attract the wild Atlantic salmon. If smolt or adult salmon are instead attracted to the flow passing through the hydro-electric dam turbines, there is a high likelihood of their not surviving.

An extra hazard is that sometimes sticks or even logs can become wedged in the downstream passage. It needs to be checked.



*Fish Ladder*

Tom Moffatt/ASF

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## River Restoration

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Note: The intent of this section is not to provide full details of a very complex topic, but to introduce the idea, along with some of the basic techniques being used.

*Through the years rivers have been abused through poor logging practices, agricultural abuses and in some cases overfishing. All of these can affect the quality of habitat for young fish, spawning beds, and the ability of Atlantic salmon to migrate through a river system. For trout, many of the same issues apply, especially destruction of habitat.*

For Atlantic salmon, the single most important key to restoration may be increasing the numbers returning from the ocean. However, stream habitat restoration remains the most important action we can take to secure the future of both Atlantic salmon and natural trout species in our rivers, streams and lakes.



A PEI river in trouble. It is filled with silt, making life for Atlantic salmon and trout difficult. Changes in agriculture are needed to eliminate such heavy loads of silt, to restore this river to health.

Improving a Human-impacted Stream

A variety of techniques can be employed to improve stream habitat, and to rectify errors of the past. Basically, the intent is to have cool water, sufficient depth for travel and living, and as little silt in the water as possible.

Here are some techniques used:

**Digger Logs**

Small to medium sized logs placed in streams to create plunge pools. They are intended for small streams only.



*Digger Log being placed in a stream*

**Rock sills** – create through scouring a pool downstream from the rock where current flow is too strong for digger logs.

**Wing deflectors** – shuttles water back and forth, causing scouring. In Nova Scotia and other areas, streams have been widened due to logging, or other reasons

**Creating Pools** – Pools are required in river systems to provide spawning areas in the lower sections, locations for other salmonids, and resting areas for adults in migration upstream. They can be especially important for survival during times of extremely low water.

**Plantings** – By planting dogwood, willow species, hardwood saplings and grasses can stabilize a bank that has been subject to erosion or the effects of livestock.

**Creating Barriers to Livestock** – Cows and other livestock can literally eat away the plant life that reduces erosion along streams. In addition, they can cause siltation, along with increase “bad” nutrient loading through defecating directly into the stream. Many conservation groups work in cooperation with farmers to build fencing that keep livestock a few feet/metres away from the stream. Replanting is also a help.

**Gabions** – These are rock filled cribs created from wire mesh, that can utilize small rocks, in order to reduce erosion along a section of river.

**Rock rip-rap** – Large rocks are used for riverbank stabilization and reduction of erosion and silt entering the river in many areas, instead of the gabions mentioned above.

**Riffle Creation and the reduction of Hanging Culverts** – At times roads have been built in such a way that a culvert’s lower end is too far above the stream for Atlantic salmon to continue migration. In some cases this can be rectified by rebuilding the culvert so that it is lower. The problem can also be addressed

**Boulder clusters** – Placing a group of boulders in a stream or river, to provide shelter for juveniles, and resting area for adults in migration.

**Wing Deflector** – a triangle-shaped device which extends from the bank and used to direct current towards the middle of the river.

If paired, they will direct current towards the middle. If staggered, they will redefine the stream channel to counteract poor land use practices.

**Breaching Driftwood Barriers** – In this case it is dismantling something, instead of building it. If an accumulation of driftwood actually block a stream, there may be a need to dismantle it to allow travel of fish along the stream.

How Can Farmers Help Restore Salmon Streams?

1. Keep livestock away from stream edges
2. Allow stream edges to regrow, or even encourage it with grasses, shrubs or tree plantings.
3. Maintain a buffer zone in crop agriculture and undertake any other measures needed to stop pesticide runoff.
4. If new land is being cleared, be very careful to maintain an effective tree buffer zone.
5. Work with your area salmon, trout and watershed groups in order to safeguard the future of streams for all.



**Constructed Pool**

Stream enhancement by stocking fry or parr

At one time this was considered to be a positive action, but the science of Atlantic salmon has shown that there are deficiencies. Often the young fish are imprinted on a hatchery, or are adapted to a life of receiving pellets as food, rather than chasing down wild prey. If genetically they are not from a particular river, they are unlikely to be fully able to deal with the particular combination of river conditions and ocean migration route required.

Nevertheless one technique especially has had some success in restoring wild Atlantic salmon:

Satellite Rearing Tanks –

The tank is located on the edge of the stream, and juvenile Atlantic salmon raised are genetically of that particular stream. The water comes from a pipe in the river upstream, and gravity provides the only pump action required. The young fish are accustomed to the stream water from the beginning.



Is there a problem with Satellite Rearing Tanks?

While this technique can work, it does not get around the issue that the fry or parr raised in the tank are accustomed to a tank existence where they are fed, and where predation is not a factor.



Tom Moffatt/ASF

An ASF biologist monitors a smolt wheel that catches them on their journey to the sea. They are measured, a scale taken, and then sent on their way.

## Atlantic Salmon and Migration

Each river has its own characteristic “run” of Atlantic salmon. In some rivers the salmon arrive early, while in others the run does not begin until autumn. Yet other rivers may have both spring and fall runs of Atlantic salmon. Some see the run heaviest in July, and then taper off.

For a river of interest to you:

- Learn about the characteristics of the river’s particular run
- Learn about the conservation needs for salmon on that particular river
- Learn how to read those stretches of a particular river that are of interest to you.

### How Do Salmon and Trout Navigate?

*In rivers they likely use their keen sense of smell, along with some visual clues. In the ocean, it is speculated that salmon may use polarized light and have a built-in magnetic compass.*

*It has been established scientifically that rainbow trout do have microscopic magnetic compass structures in their olfactory bulb organs. Their ‘compass’ consists of several granules of magnetite iron fused together, creating a form of needle. The pressure from the needle on cell structures gives the rainbow trout the sense of direction. This research was conducted at the University of Auckland, New Zealand.*

### How Does a Salmon Jump?

*Atlantic salmon sense upwellings below a waterfall or rapids (see sidefact opposite). They will then move towards the bottom. When they feel ready for the effort, they accelerate to more than 20 mph in the upwelling area.*

*This allows wild Atlantic salmon to leap waterfalls as high as 12 feet (3.5m) high.*

*Since the direction of the Atlantic salmon’s leap is not always in exactly the right direction, they may need to make several attempts at leaping an obstacle.*



### Magnificent Migrations

Wild Atlantic salmon have several strategies for survival:

- *Travel to productive ocean feeding grounds:* Many Atlantic salmon runs head to waters off Greenland and Labrador once they reach the ocean. In Europe, salmon make a similar journey, some to Greenland waters, others to feeding grounds near the Faroe Islands.
- *Remain inshore, and return to spawn sooner:* Most grilse probably do not travel as far as Greenland waters, and return to their original river after a single winter at sea.
- *Remain in freshwater:* Landlocked Atlantic salmon are the same species, but tend to remain smaller, and most do not travel to the ocean. Instead they use a lake or river as a feeding ground, then ascend streams in order to spawn.



# ATLANTIC SALMON - WHERE THE RIVERS ARE...

While it can be generally said that Atlantic salmon live in rivers from the Connecticut to Labrador, and up the St. Lawrence as far as Lake Ontario, they no longer live in all the rivers they once inhabited.

Below is an over view of the rivers where Atlantic salmon are presently found.

## NEWFOUNDLAND

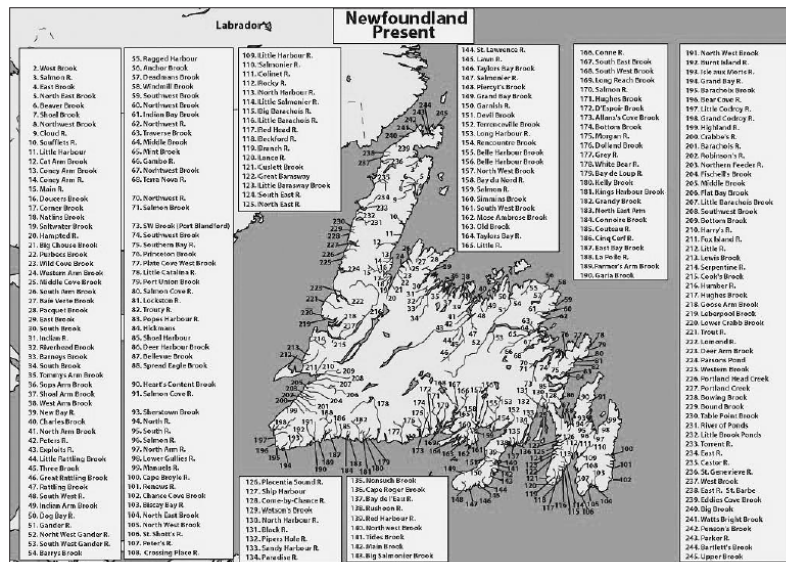
Newfoundland offers ideal habitat for Atlantic salmon. It has a large number of rivers of medium length with large uninhabited areas on the rivers' upper reaches. However, 5 rivers have lost their salmon populations.

In the mid 1990's, the range of Atlantic salmon in Newfoundland was substantially increased by opening large amounts of suitable habitat in four rivers - Torrent (223), Exploits (43), Terra Nova (68), and

Rocky (42) Rivers.

Newfoundland's rivers are also known for their waterfalls, and places such as Big Falls on the Humber, in the southwest, are wonderful locations for watching Atlantic salmon leap.

It is likely that Newfoundland's rivers were the first New World salmon rivers to be fished by Europeans, but no solid evidence exists for this.



# LABRADOR

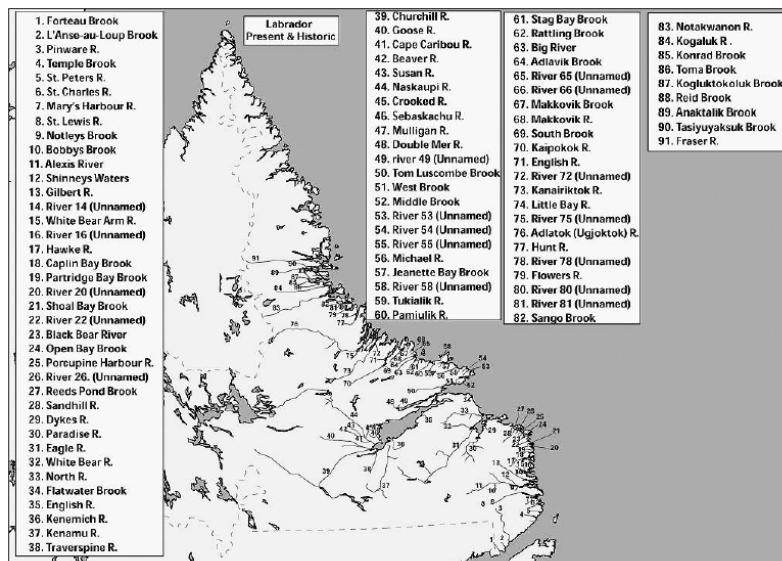
Labrador, along with Ungava Bay in Québec, represents the most northerly area in North America for Atlantic salmon. The Fraser River (# 91 on the map) is considered to be the most northern Atlantic salmon river in Labrador, although Dr. Rex Porter-Department of Fisheries and Oceans, St. John's, Newfoundland-reports that DFO Fisheries Officers have observed salmon occasionally in a few rivers above the Fraser, as far as the North River which is about a third of the way between the Fraser River and Cape Chidley (the northern tip of Labrador). Cold hardy, anadromous Arctic Char, however, are found as far as Cape Chidley in all northern Labrador rivers.

The vast majority of the rivers in Labrador still lie in a

pristine state, due mainly to the remoteness and low population density, which may account, in part, for the fact that Labrador is the only area in North America where no river - at least from the Fraser southward - has ever lost its salmon.

Another possible factor for the success of salmon in Labrador is the proximity of the feeding grounds off West Greenland (for 2 sea-year salmon), and the Labrador Sea (for 1 sea-year, i.e. grilse), resulting in fewer risks for migrating salmon. There is, however, a counterbalancing factor of juvenile salmon in northern Labradors requiring several summers of growth before they become smolt to begin the all-important migration to the sea.

Of the 91 rivers shown for Labrador, 28 are scheduled for salmon angling.



# NOVA SCOTIA

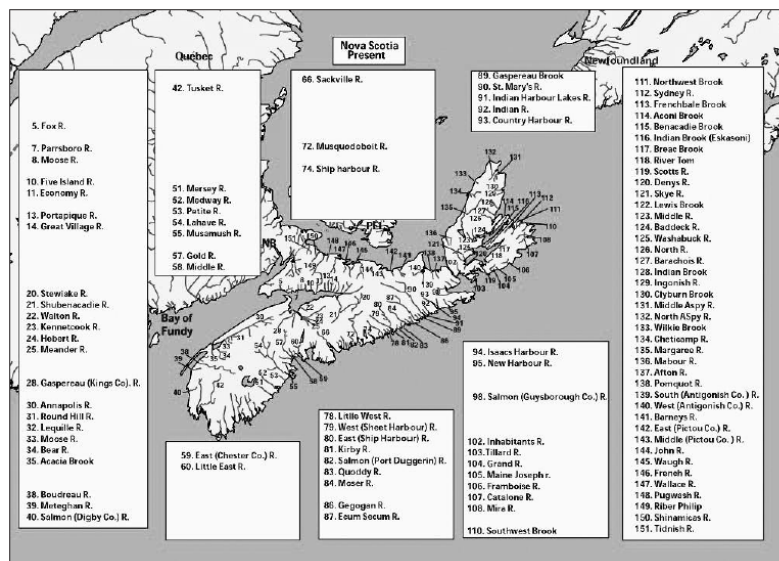
Nova Scotia's salmon rivers are generally short, rather than being part of long, and are without the complex watersheds found in many New Brunswick river systems.

Particular issues overshadow Nova Scotia salmon rivers. No other region, not even Lake Ontario and the upper part of the St. Lawrence River, where all its original salmon rivers lost their salmon, can match the 52 rivers in Nova Scotia whose salmon stocks were extirpated, mainly due to acid rain, an environmentally negative factor unique to Nova Scotia. Only three of of Nova Scotia's salmon rivers have been restored.

In the Inner Bay of Fundy many rivers have been

declared endangered, and surveys have shown wild Atlantic salmon have entirely disappeared from some of these. As for New Brunswick's Inner Bay of Fundy runs, these salmon do not stray far beyond the Bay of Fundy instead of migrating long distances to Labrador or Greenland waters as do Outer Bay of Fundy salmon.

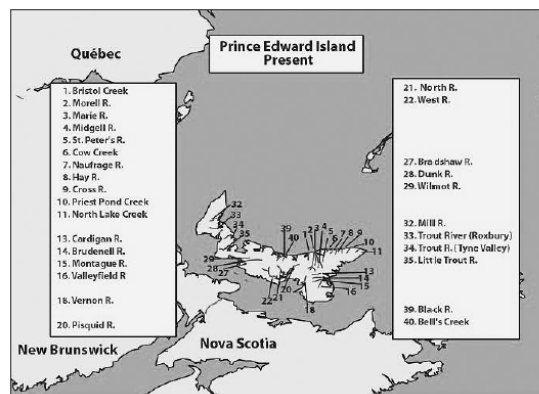
Salmon runs in the north of the province, in rivers exiting to the Gulf of St. Lawrence, are generally healthy, examples being the Margaree in Cape Breton, and River Philip on the mainland, not far from the NB border.



## PRINCE EDWARD ISLAND

Prince Edward Island has a large number of short rivers supporting modest Atlantic salmon populations. A recent survey by the University of Prince Edward Island shows that many rivers thought to be devoid of salmon actually have modest populations of juvenile salmon, and potentially these salmon populations could increase significantly. Currently only the Morell, Dunk and West Rivers have enough salmon to support angling.

PEI is the most agricultural province in eastern Canada, and pesticide and soil runoff impact many rivers. Two million tons of soil enter the rivers annually, and since 1994 there have been two dozen fishkills due to pesticide runoff. Bringing these problems under control has the potential for greatly increasing the number of wild Atlantic salmon in PEI rivers.



## NEW BRUNSWICK

In general all rivers connected to the Bay of Fundy have critically low populations of salmon, particularly the Inner Bay of Fundy rivers (rivers occurring clockwise, east of the St. John River, ending with the Annapolis River in Nova Scotia). Thirty-two of these rivers have been declared endangered with respect to their salmon populations by COSEWIC (Committee on the Status of Endangered Wildlife in Canada), of which 10 are in New Brunswick. A special case of a salmon river in trouble is the Petitcodiac River (#70 in map), the fourth most productive New Brunswick salmon river in the 1950s, whose salmon run has been almost extirpated by tidal gates installed at the river's mouth.

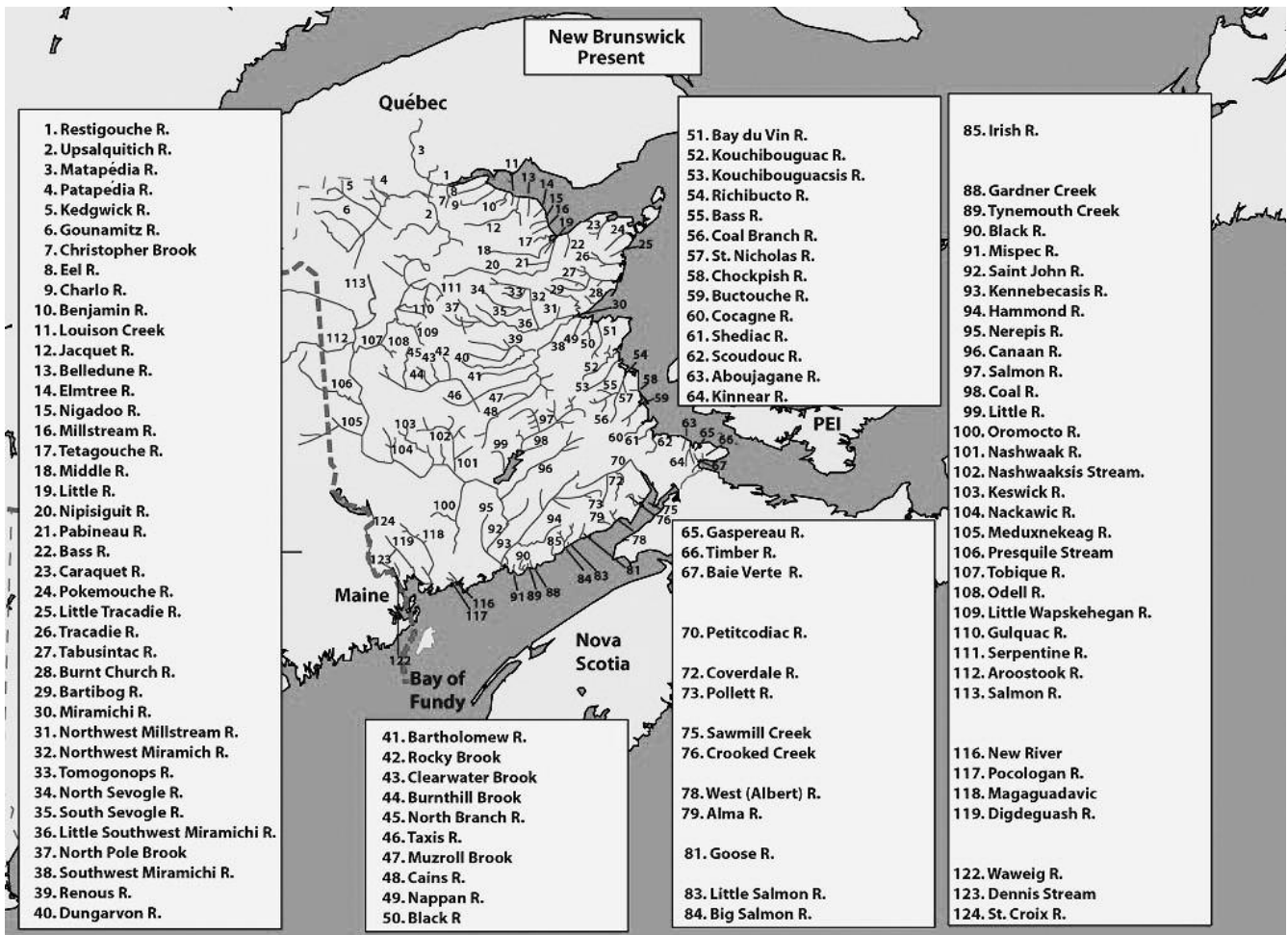
Recent research indicates that salmon from the Inner Bay of Fundy rivers migrate no further than the Gulf

of Maine, if even that far, before returning to spawn.

Outer Bay of Fundy rivers such as the St. John, Magaguadavic, and St. Croix have seen a critical decline in numbers since 1990.

Rivers exiting into the Gulf of St. Lawrence are in somewhat better shape than those in the Bay of Fundy. The Miramichi River is capable of producing more Atlantic salmon than any other river in North America. The Restigouche is noted for its large salmon which spend two, sometimes more, years at sea before returning to spawn.

While 17 rivers lost their salmon, in only three - the St. Croix, Aroostook and the Nipisiguit - have salmon runs been restored.



## NEW ENGLAND

Salmon populations are in grave difficulty in New England's rivers. New England has a number of long and complex river systems, including the Kennebec, Penobscot, Merrimack and Connecticut. In southern New England, major restoration efforts remain on the Connecticut and Merrimack River systems.

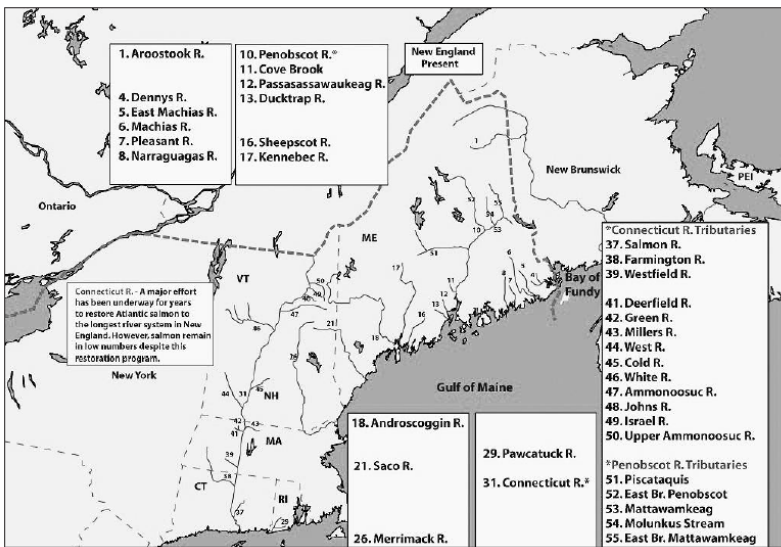
In eight - all in Maine - Sheepscot, Ducktrap, Cove Brook, Pleasant, Narraguagus, Machias, East Machias and Dennys - the salmon are considered still wild (i.e. genetically correspond to historic populations). The populations of these rivers have been declared endangered by the U.S. Federal Government. In the other rivers, stocking of hatchery fish has kept salmon swim-

ming in the rivers, but still at critically low levels.

The greatest remaining Atlantic salmon river in New England is the Penobscot. While numbers have been dropping, the run is still significant. Alas, many dams form barriers to salmon migration on the Penobscot and other New England rivers, and have had a devastating effect on populations.

In New England, many of the rivers have seen their salmon populations extirpated, and relatively few have seen some degree of restoration for those populations.

Note that in Maine, all angling for sea-run Atlantic salmon is closed. Angling for landlocked salmon is permitted in some lakes and rivers.

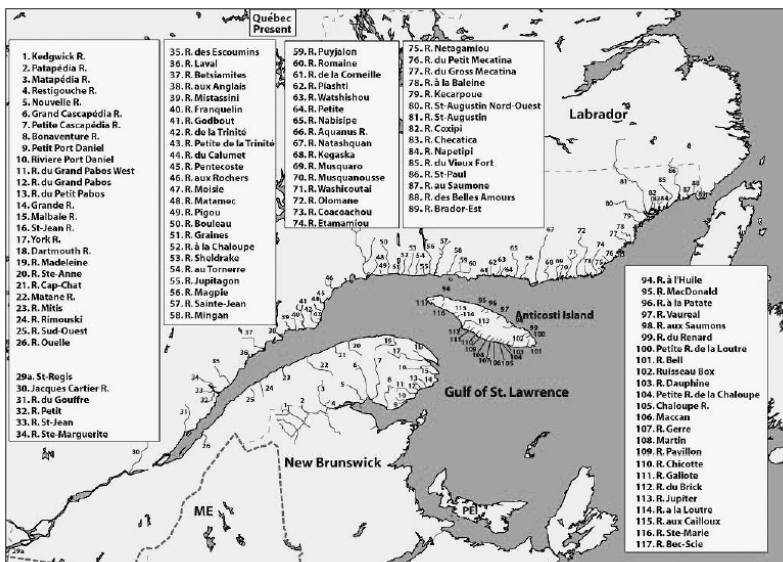


## QUEBEC - SOUTH

Roaring salmon rivers of the North Shore, crystal-clear emerald green rivers in the Gaspé, and historic rivers of the St. Lawrence South Shore fished since the 1600s, show the array and diversity of salmon rivers in Québec.

While some Québec rivers are meeting spawning targets, not all is well. Five rivers branching from the upper portions of the St. Lawrence lost their salmon runs, some more than a century ago. In only one, the

Jacques Cartier, was the salmon run restored. Hydro dams continue to be barriers to migration upstream and down on many other rivers. The St-Francis River, emptying into the St. Lawrence just downriver from Montreal, is thought to have been the most "upstream" St. Lawrence tributary to have had truly anadromous, i.e. sea-run, salmon.

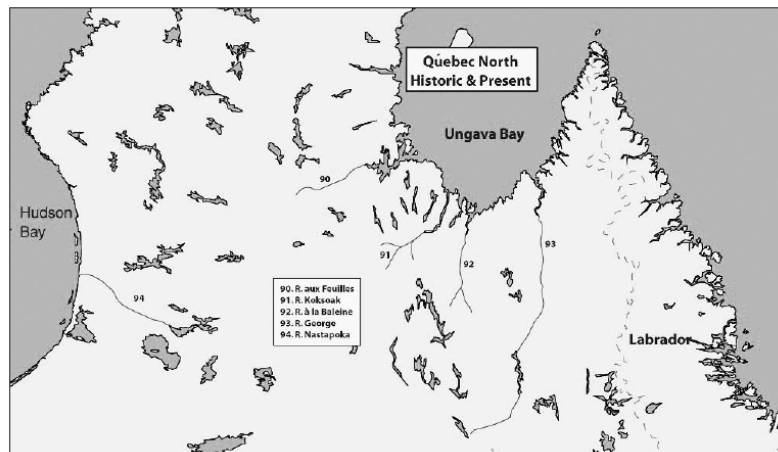




## QUEBEC - NORTH

Being in a comparatively cold climate with a short summer season, it may take Atlantic salmon parr up to eight years before they become smolt and migrate to sea. In addition, some populations of these Atlantic salmon, such as in the Koksoak (#91) and the Nastapoka (see below), consist of some fish which spend the summer in the estuary like sea trout, and others which are truly anadromous, migrating to feeding grounds off west Greenland.

Note: Shown in the lower left corner on this map is another far northern river, the Nastapoka, about half way up the east coast of Hudson Bay, which has Atlantic salmon.



## ONTARIO & NEW YORK

Up until probably the late 1700's, rivers flowing into Lake Ontario supported an extremely large population of Atlantic salmon. These runs, however, were very susceptible to the destruction of migration routes upstream and down by dams. By the 1880s few salmon were left.

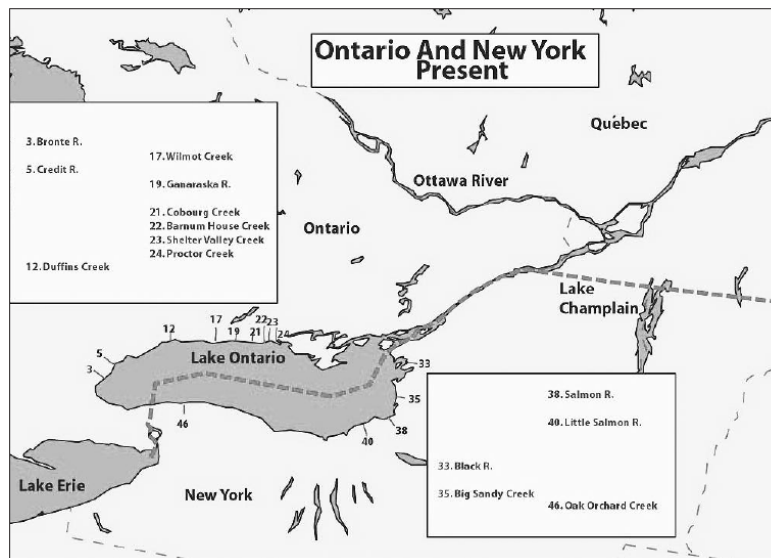
Did some of these Atlantic salmon migrate down the St. Lawrence to the Atlantic Ocean? The available evidence - a few scale samples from museum specimens - suggests not. Lake Ontario apparently served as the "ocean".

Atlantic salmon could not pass, of course, the impenetrable barrier presented by Niagara Falls. Thus they

were not found in the upper Great Lakes.

Recently there have been major efforts to restore Atlantic salmon to their ancestral streams around Lake Ontario, and presently they are found in 11 streams in Ontario and New York. Unfortunately introduced salmonids from the West Coast appear to be interfering with such restoration efforts by competing for habitat, food, and spawning sites.

It would be a major success to reintroduce Atlantic salmon into the Lake Ontario rivers on a self-sustaining basis, but it will be a difficult goal to reach.



# THE PREDATOR GAME HOMEWORK...

Atlantic salmon and trout are pursued by a wide variety of predators during their lives. Below are shown a wide variety of these predators.

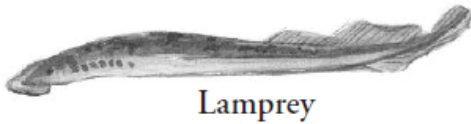
For each predator, can you determine what life stage the salmon or trout might be prey?



Seal



Cormorant



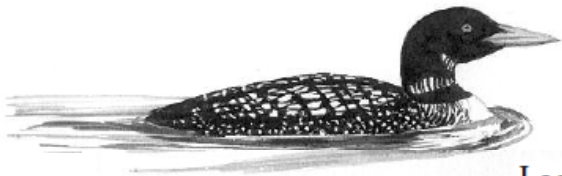
Lamprey



Angler



Great Blue Heron



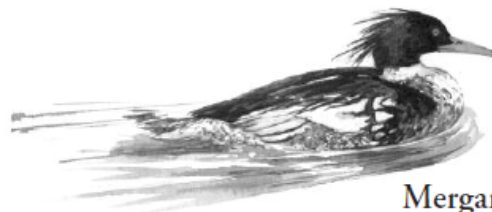
Loon



Otter



Kingfisher



Merganser

Illustrations by J. O. Pennanen  
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