

T11.13 FRESHWATER FISHES

Forty-three species of fish have been recorded in the lakes and streams of Nova Scotia (Table T11.13.1). Only one species, the Sea Lamprey, is of the jawless fish (Agnatha) class; the rest are bony fish (Osteichthyes) and can be divided into four categories:

1. freshwater species
2. euryhaline/marine species—occasionally venture up into estuaries.^{1,2}
3. diadromous species—fishes that migrate between the sea and freshwater
4. anadromous species mature at sea and spawn in fresh water; catadromous species mature in fresh water and spawn at sea (American Eel only);

The fish fauna of Nova Scotia's lakes and streams is characterized by two prominent features, both of which relate to the peninsular nature of the province:

1. the fish fauna is impoverished compared to the numbers of species found further west (a feature shared by the flora and other fauna of the province)
2. the fauna is heavily influenced by the salt-water environment which surrounds Nova Scotia.

DISTRIBUTION OF SPECIES

The seventeen purely native freshwater species have all entered Nova Scotia during the 13,000 years since the retreat of the last ice sheet. Before human intervention, movement from one watershed to another would depend on river capture (see T3.2) or on the freshening of the coastal waters by the melting ice sheet enabling freshwater species to move around the coast from one river to another.

The distribution pattern of freshwater fish in Nova Scotia shows a definite decrease in species diversity, moving away from the Chignecto lowlands. This pattern may be explained in two ways. The increase in species in the Cumberland County area suggests that certain fish, such as the Blacknose Dace, have not yet been able to penetrate any further into the province. The absence of any purely freshwater species on Digby Neck and in northern Cape Breton is thus a reflection of these regions' distance from the point of entry and lack of freshwater colonization routes.

A second interpretation sees the pattern as an indication that many species were once much more widely distributed and have since been eliminated from certain regions, possibly due to habitat loss. The high species diversity in Cumberland County therefore becomes a reflection of the higher productivity of freshwater environments in that area than the southern uplands.

Species which exhibit various degrees of tolerance to salt water were able to move more readily from one river system to another via estuaries, and are therefore more widely distributed. Acidity and geographic considerations may, however, restrict distribution of some species (such as Atlantic Salmon) and decrease their relative abundance. This increases the relative abundance of other species (such as eels) within the broader constraints imposed by temperature and stream size. Species distribution in two Nova Scotia river systems (the Medway and Gold) included primarily Brook Trout, Atlantic Salmon and American Eel. In the Medway River system, the relative abundance of salmon was reduced and that of eels increased when compared to those in the Gold River system due to pH differences. (The midsummer distribution of major fish species in these rivers was determined primarily by stream size and temperature).⁴

The Brook Trout is native only to northeastern North America; however, its popularity as a game fish has caused the species to be widely distributed throughout the world.³ Commonly known as the Speckled Trout, its habitat in Nova Scotia extends from rapidly moving streams and rivers, beaver ponds and lakes to estuaries. It prefers waters between 10°C and 18°C.

Brook Trout in Nova Scotia mature at two years of age and usually spawn in late September. The eggs overwinter in gravel beds, hatching in April to release the sac-fry, each equipped with a yolk sac to nourish it for a further six weeks' residence in the gravel beds. In optimum conditions, the Brook Trout can expect to reach 5–10 cm in their first year. Further growth depends on water quality, competition for food and other habitat factors. The Brook Trout usually only survives three to four years and may attain 25 cm in a stream or small river, 30 cm in a large lake and 35 cm in an estuary. A 61-cm sea-run trout weighing 3.4 kg was caught in the Salmon River, Halifax County, in 1871 and is now preserved in the Nova Scotia Museum of Natural History.

SPECIES	ORIGIN	STRATEGIA
Sea Lamprey	Native	Anadromous
Atlantic Sturgeon	Native	Anadromous
Tarpon	Visitor	Marine
American Eel	Native	Catadromous
Blueback Herring	Native	Anadromous
Gaspereau (Alewife)	Native	Anadromous
American Shad	Native	Anadromous
Atlantic Menhadin	Annual visitor	Marine
Lake Whitefish	Introduced	Freshwater
Atlantic Whitefish	Native	Anadromous
Coho Salmon	Introduced	Anadromous
Chinook Salmon	Introduced	Anadromous
Rainbow Trout	Introduced	Freshwater
Atlantic Salmon	Native	Anadromous and landlocked
Brown Trout	Introduced	Anadromous
Brook Trout	Native	Freshwater (& sea run pop.)
Lake Trout	Native	Freshwater
Rainbow Smelt	Native	Anadromous
Chain Pickerel	Introduced	Freshwater
Goldfish	Introduced	Freshwater
Northern Redbelly Dace	Native	Freshwater
Lake Chub	Native	Freshwater
Golden Shiner	Native	Freshwater
Common Shiner	Native	Freshwater
Blacknose Shiner	Native	Freshwater
Blacknose Dace	Native	Freshwater
Creek Chub	Native	Freshwater
Fallfish	1 record	Freshwater
Pearl Dace	Native	Freshwater
White Sucker	Native	Freshwater
Brown Bullhead	Native	Freshwater
Atlantic Tomcod	Native	Anadromous
Banded Killifish	Native	Freshwater
Mummichog	Native	Euryhaline-Marine
Atlantic Silverside	Native	Euryhaline-Marine
Fourspine Stickleback	Native	Freshwater-Euryhaline-Marine
Brook Stickleback	Native	Freshwater
Threespine Stickleback	Native	Freshwater-Euryhaline-Marine
Ninespine Stickleback	Native	Freshwater (brackish)
White Perch	Native	Freshwater
Striped Bass	Native	Anadromous and Catadromous
Smallmouth Bass	Introduced	Freshwater
Yellow Perch	Native	Freshwater

Table T11.13.1: Origin and habitat strategies of freshwater fish species in Nova Scotia.

Introduced Species

Human intervention also plays an important part in the distribution of species throughout Nova Scotia. Six species—the Rainbow Trout, Brown Trout, Chain Pickerel, Lake Whitefish, Goldfish and Smallmouth Bass—have been introduced through public stocking programs and privately by Nova Scotia anglers. These introductions, particularly that of the Smallmouth Bass, have changed the community structure in freshwater habitats by competing with native species.

Fish Assemblages

A recent survey of fish in 145 headwater lakes in Nova Scotia concluded that three major factors determine fish distribution: lake area, lake acidity and geographic location.⁵ (Some of the smaller species, such as Banded Killifish and sticklebacks as well as the American Eel, were excluded from the survey because of the method of sampling chosen.) Peterson and Martin-Robichaud identified five types of fish assemblages in Nova Scotia lakes:

- 1 Brook Trout
- 2 Brook Trout–White Sucker
- 3 multi-species, with White Sucker, Yellow Perch and Brown Bullhead as the most frequent members
- 4 Yellow Perch
- 5 multi-species, with Smallmouth Bass and/or White Perch predominant

Lake area was the single most important variable separating the five assemblages, with Brook Trout lakes averaging the smallest in area, while White Perch/Smallmouth Bass inhabit lakes of the greatest area. High levels of acidity were correlated with low species diversity and the predominance of Yellow Perch.

Type 1 lakes were the only kind found on Cape Breton Island, while Type 4 lakes were encountered only in southwestern and eastern Nova Scotia. Type 3 lakes were the most numerous and were dispersed throughout the province.

WATER QUALITY FACTORS

The influence of such factors as climate and water quality on distribution at the regional scale is not yet fully known. The water-temperature regime varies considerably from one lake to another, depending on basin size and shape. In general, the waters of southwest Nova Scotia are somewhat warmer than in the rest of the province. Some warmer-water species, such as White Perch and

Banded Killifish, appear to be at the northern limit of their range in this area.⁶

The influence of water chemistry on different species still requires further study. In general, the harder waters of the sedimentary rocks in the Carboniferous Lowlands (Region 500) support a larger number of species. Certain species have not been recorded in the granitic areas of the Atlantic interior (Region 400) and the Atlantic Coast (Region 800), and it is possible that the very soft waters are not sufficiently productive for them.

The relationship between the number of fish species and the type of bedrock may partly relate to the pattern of invasion of Nova Scotia by freshwater species. The number of species is highest in the Chignecto Isthmus and declines with increasing distance from it towards the southwest and northeast extremities of the province. Coincidentally, granitic bedrock is concentrated some distance from Chignecto to the south of a line joining Chedabucto Bay and Annapolis. The relationship between bedrock type and species diversity may be partly but not entirely due to this coincidence.

HABITAT FACTORS

One consequence of the limited number of species in Nova Scotia is that the reduced competition and predation permits them to occupy a wider range of ecological niches. For example, the Banded Killifish throughout most of its range in North America is restricted to weedy lake shallows and slow-moving streams. In Nova Scotia, however it is also found in swift-flowing streams and deep open water. Similarly, many salmonids occupy a wider variety of niches than has been observed elsewhere. In some areas, the trout population is being displaced from marginal habitats by increasing competition and predation.

MOVING-WATER ENVIRONMENTS

River systems generally exhibit a gradation of lotic (moving water) environments, ranging from shallow, fast, turbulent waters in the headwaters down to the slower, deeper waters of the lower reaches. In areas that have a diverse fish fauna a comparable zonation of species often develops. In Nova Scotia this is less obvious due to the smaller number of species and their resulting use of a wider range of habitats. In general, upstream fishes are very active, streamlined predators and have the ability to hold their position in swift currents. The salmonids are typical species of this habitat.

Much of Nova Scotia is drained by slower-moving waters as a result of the comparatively gentle slope of the Atlantic Interior and the predominance of the deranged drainage pattern. In these slower-moving waters, minnows and perch are more typical. As the water slows down even further, the larger bottom, feeding species, such as White Suckers, become more common.

STILL-WATER ENVIRONMENTS

Lentic (still water) environments are characterized by size, circulation patterns and trophic status. A large, deep lake will usually become thermally stratified in the summer, permitting the year-round existence of cold-water fish in the deeper layers. Oligotrophic lakes, which predominate in Nova Scotia, have abundant oxygen at all depths but low nutrient levels. They support a low biomass, and fish growth is slow. Trout are the characteristic species. Eutrophic lakes are more productive but have lower oxygen content. In such lakes, salmonids are replaced by Chain Pickerel, Smallmouthed Bass, perch, killifish and bullheads.

MIGRATORY SPECIES

A number of species are anadromous: they mature in salt water but return to fresh water to spawn. Included in this group are Gaspereau, salmon, Striped Bass, Smelt, Atlantic Whitefish and the Sea Lamprey. The American Eel is the only catadromous species found in North America. Eels leave fresh water in fall and migrate to the Sargasso Sea to spawn.⁶

SPECIAL FEATURES

1. The Lake Whitefish is a valuable freshwater species elsewhere in Canada. In Nova Scotia, the species was introduced at the turn of the century, and today populations are found in lakes in Kejimikujik National Park, in several lakes near Musquodoboit Harbour and in St. Marys River drainage basin. A unique population exists in the Mira River, Cape Breton. They are, however, apparently more common in western Nova Scotia. The Lake Whitefish is a cool-water species which feeds on benthic invertebrates and requires lakes that are stratified in summer. The Nova Scotia populations exhibit very slow growth rates and are considered to be threatened.
2. The first record of an Atlantic Whitefish (Acadian Whitefish) was established in 1925; the only populations in the world today are in

the Petite Rivière watershed in Lunenburg County and possibly the Tusken River system. The species is listed under COSEWIC as endangered.

3. In 1978, spawning Coho Salmon were recorded in the Cornwallis River. The following year, three juveniles were reported in Salt Brook, a tributary of the Cornwallis River.⁷ The identity of Chinook Salmon was also verified in the Nictaux River.⁷ Their spawning was unsuccessful, however, and the species may have since disappeared.⁸ Both the Coho and Chinook Salmon are Pacific fish and apparently originate from stocking programs in New Hampshire.⁷
4. There are several landlocked populations of anadromous fish in Nova Scotia. The populations are smaller than sea-run populations and can occur naturally or anthropogenically. The Shubenacadie watershed supports a population of Atlantic Salmon which feed on a natural, landlocked population of Rainbow Smelt (American Smelt). The Atlantic Whitefish, on the other hand, is landlocked in the Petite Rivière watershed as a result of the damming of the Petite Rivière River.

The Rainbow Trout were introduced as a game species in several systems in Nova Scotia but have usually run to sea, where they are called Steelheads. There are stocked populations of Rainbow Trout in landlocked lakes in Annapolis, Kings and Cape Breton counties.

CULTURAL FACTORS

Water quality can change from runoff and siltation occurring as a result of forestry, agriculture and development. Acid rain has also affected water quality of lakes and rivers in southwestern Nova Scotia. The ability for fish like salmon to survive in freshwater habitats is an important indicator as to water quality.

The decline in the numbers of fish species in Nova Scotia lakes surveyed since 1960 has been positively correlated with pH and lake surface area.⁹ The pH of lakes from which acid-intolerant species such as Brook Trout and White Perch had disappeared was significantly lower than that which still supported populations of those species.

The most severe impacts from acid rain are limited to the southwestern half of the province, where acidification of lakes has halved fish populations.¹⁰ It is technically feasible to restore lost habitat by adding limestone. A small-scale liming project has been carried out by the Department of Fisheries and Oceans in order to establish a refuge for the preser-

vation of a nucleus of native salmon stock.¹¹ In most cases, however, the cost of the liming program is not perceived as justified by the economic benefits of the anticipated salmon enhancement: a liming project would expend approximately \$200 per restored salmon.¹²



Associated Topics

T3.2 Ancient Drainage Patterns, T4.3 Post-glacial Colonization by Animals, T6.2 Oceanic Environments, T6.4 Estuaries, T8.1 Freshwater Hydrology, T8.2 Freshwater Environments, T11.14 Marine Fishes, T11.16 Land and Freshwater Invertebrates, T12.11 Animals & Resources

Associated Habitats

H2.5 Tidal Marsh, H3 Fresh Water, H4 Freshwater Wetlands

References

- 1 Gilhen, J. (1974) *The Fishes of Nova Scotia's Lakes and Streams*. Nova Scotia Museum, Dept. of Education, Halifax.
- 2 Nova Scotia Museum Collections, N.S. Dept. of Education.
- 3 Sabean, B. (1983) "The Wild Brook Trout of Nova Scotia." *Nova Scotia Conservation* 7(1).
- 4 Peterson, R.H. (1991) "Fish species' associations in riffle habitat of streams of varying size and acidity in New Brunswick and Nova Scotia." *J. Fish Biol.* 38.
- 5 Peterson, R.H. and D.J. Martin-Robichaud (1989) "Community analysis of fish populations in headwater lakes of New Brunswick and Nova Scotia." *Proc. N.S. Inst. Sci.* 38.
- 6 Scott, W.B. and E.J. Crossman (1973) *Freshwater Fishes of Canada*. Fisheries Research Board of Canada, Environment Canada, Ottawa.
- 7 Scott, W. B. and M.G. Scott (1988) *Atlantic Fishes of Canada*. University of Toronto Press, in Co-operation with the Minister of Fisheries and Oceans and Canadian Government Publishing Centre, Supply and Services Canada, Toronto.
- 8 Amiro, Peter (Personal Communication 1993) Stock Assessment and Enhancement Biologist, Department of Fisheries and Oceans.

- 9 White, W.J. (1992) "Effects of pH on the zoogeographical distribution of freshwater fish in Nova Scotia." In B.L. Beattie (ed.) *The Atlantic Region LRTAP Monitoring and Effects Working Group Report for 1991*. Environment Canada.
- 10 Watt, W.D. (1987) "A summary of the impact of acid rain on Atlantic Salmon (*Salmo salar*) in Canada." *Water, Air, and Soil Pollution* 35.
- 11 Watt, W.D. and W.J. White (1992) "Creating a de-acidified Atlantic Salmon refuge in the East River, Nova Scotia." In B.L. Beattie (ed.) *The Atlantic Region LRTAP Monitoring and Effects Working Group Report for 1991*. Environment Canada.
- 12 Watt, W.D. (1988) "Major causes and implications of Atlantic salmon habitat losses." In R.H. Stroud (ed.) *Present and Future Atlantic Salmon Management*. Atlantic Salmon Federation and National Coalition for Marine Conservation.

Additional Reading

- Alexander, D., J. Kerekes and B. Sabean (1986) "Description of selected lake characteristics and occurrence of fish species in 781 Nova Scotia lakes." *Proc. N.S. Inst. Sci.* 36(2).
- American Fisheries Society (1991) *Common and Scientific Names of Fishes from the United States and Canada*, (Special Publication 20).
- Milton, G.R. and J. Towers (1991) "A survey form for the rapid assessment of fish habitat in streams adjacent to forestry operations." *Report No. 16, St. Mary's River Forestry-Wildlife Project*, Canadian Institute of Forestry, Antigonish, Nova Scotia.
- Milton, G.R. and J. Towers (1990) "Fish habitat improvement structures and the forest industry." *Report No. 6, St. Mary's River Forestry-Wildlife Project*, Canadian Institute of Forestry, Antigonish, Nova Scotia.
- Watt, W.D. (1989) "The impact of habitat damage on Atlantic Salmon (*Salmo salar*) catches." In *Proc. National Workshop on the Effects of Habitat Alterations on Salmon Stocks*. (Can. Fish. Aquat. Sci. Spec. Pub. No. 105).