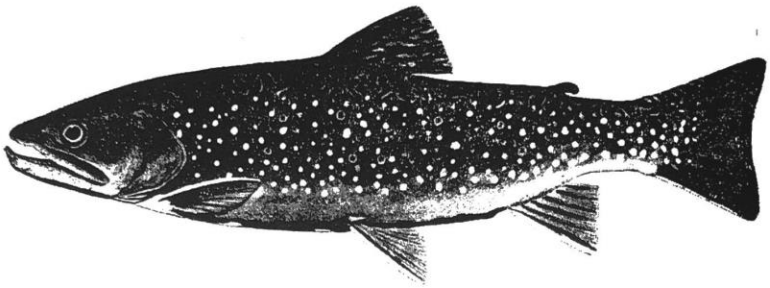
BROOK TROUT

Salvelinus fontinalis (Mitchill)



Description Body typically troutlike, elongate, average length 10–12 inches (254–305 mm), only moderately laterally compressed, greatest depth at, or in front of, dorsal fin origin, but body depth variable, 20–28% of total length depending upon size, sex, and state of maturity. Head relatively large, 22–27% of total length, eye moderate, its diameter 15–22% of head length; snout somewhat rounded, its length greater than eye diameter, 25–33% of head length; mouth terminal, large, maxillary extending posteriorly to beyond posterior margin of eye, breeding males may develop a hook (or kype) at the front of the lower jaw; well-developed teeth on upper and lower jaws (premaxillary, maxillary, and dentary), on the head of the vomer (not on shaft), on palatines, on tongue (in 2 rows), basibranchial (hyoid) teeth usually lacking. Gill rakers 14–22 (4–7 on upper arch, 10–15 on lower) (*see* Vladykov 1954). Branchiostegal rays 9–13, usually fewer on right side (10–13 on left, 9–12 on right). Fins: dorsal adipose present; principal dorsal rays 10–14; caudal with a shallow fork; principal anal rays 9–13; pelvic rays 8–10, a distinct pelvic axillary process present; pectoral rays 11–14. Scales cycloid, small, in about 230 rows at lateral line, 110–130 pores along lateral line, lateral line straight. Pyloric caeca total range 23–55 but usually less than 50. Vertebrae 58–62.

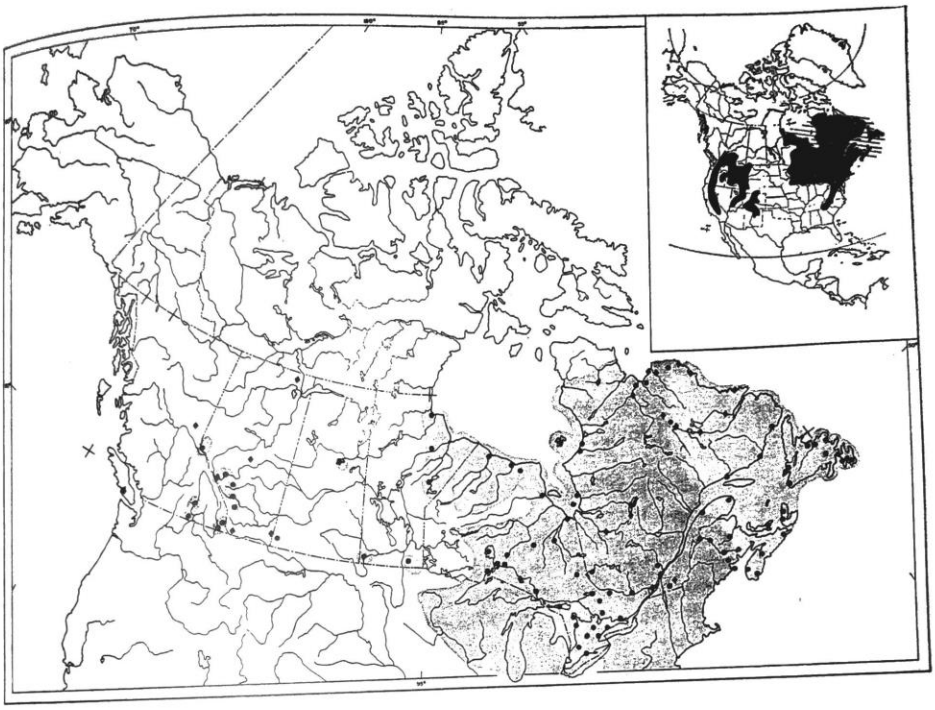
(*See also* Wilder 1952; Vladykov 1954; Bigelow 1963.)

Colour Back olive-green to
brown, at times almost black, sides lig
becoming silvery white below; light gre
cream coloured wavy lines or vermicula
on top of head and on back, broken up
spots on sides. In addition to pale spo
sides are small discrete red spots surrou
with bluish halos. Dorsal fin with h
black, wavy lines, lending a marbled ap
ance. Caudal fin with variable black
sometimes two or three lines parallel t
trailing edge of the fin. Anal, pelvic, and
toral fins with an immaculate white le
edge usually followed by black pigmen
then reddish colouration. All colours int
fied at spawning time, lower flanks and
of males becoming orange-red with
pigmentation on either side of belly.

Sea-run brook trout become silvery
purple iridescence; only red spots are v
on sides. *See* colour illustration facing p.

Systematic notes The brook trou
hibits considerable variation in growth
colour, and other features, throughou
range, but generally speaking it is a stabl
well-defined species.

The systematic relationship between f
water and anadromous (sea trout) po
tions was investigated by Wilder (19
who also reviewed the nomenclatural hi
for the sea-run brook trout. Wilder concl
that sea-run brook trout were not taxon
cally distinct from freshwater trout. Se
trout were long considered to be a sp



distinct from the freshwater brook trout and were named *Salmo hudsonicus* by Suckley (1862b). Subsequently Hubbs (1926) designated the sea trout as a subspecies, *S. fontinalis hudsonicus*, but this view has not been substantiated. For additional information and discussion of freshwater and anadromous stocks, *see* Scott and Crossman (1964) and the many papers by Smith and Saunders, especially Smith and Saunders (1967).

Populations of non-speckled or non-spotted brook trout in a restricted portion of the Timiskaming District of Ontario were described by Henn and Rinkenbach (1925) as a distinct species, *Salvelinus timagamiensis*, the aurora trout. In a re-examination of this form, Sale (1967) demonstrated that it was closely allied to *S. fontinalis* and suggested that it be considered a subspecies, *S. f. timagamiensis*. Unfortunately the natural stock has been decimated and it is doubtful that any aurora trout live in any of the lakes from which it was described.

Vladykov (1954) and Slastenenko (1958) apparently favoured retention of *Baione* DeKay (1842) as a subgenus for *S. fontinalis* but this view does not have wide support.

Male brook trout may be crossed with female lake trout to produce a fertile hybrid, often called "splake." For additional information *see Systematic notes* for lake trout. Brook trout can also be crossed with brown trout to produce a so-called tiger trout; *see Systematic notes* for brown trout. An artificial hybrid between brook trout and kokanee (*Oncorhynchus nerka*) was described by Crossman and Buss (1966). *See also* Buss and Wright (1956, 1958) for additional information on hybrids involving brook trout.

Distribution The brook trout is a North American endemic species and under natural conditions occurs only in northeastern North America from the Atlantic seaboard south to Cape Cod, in the Appalachian Mountains southward to Georgia, west in the

upper Mississippi and Great Lakes drainages to Minnesota, north to Hudson Bay.

In Canada, the brook trout is widely distributed throughout the Maritime Provinces, including offshore islands, Newfoundland, Labrador, and Quebec, west through the Great Lakes drainage of Ontario, north to James and Hudson bays including the Belcher and Akimiski islands, coastwise to northeastern Manitoba where it occurs in the Nelson and Hayes River systems and north along the Hudson Bay coast to Seal River. In Ontario, it is absent from Lake Attawapiskat and the immediate drainage system although it occurs in the lower reaches of the Attawapiskat River, and from the extreme western portion of the province (*see also* Ryder et al. 1964).

The brook trout has been introduced widely and often successfully into many parts of the world because of its appeal as a sport fish. Included in its extended range are many parts of western North America, South America (including the Falkland Islands), New Zealand, Asia, and many parts of Europe. *See* MacCrimmon and Campbell (1969) for a review of the world distribution of brook trout.

Biology The brook trout spawns in late summer or autumn, the date varying with latitude and temperature. Through southern and eastern Canada spawning occurs usually during late September, October, or November, but it may take place as early as late August in the north and as late as December in the southern part of its Ontario range (Ricker 1932).

Spawning takes place most often over gravel beds in the shallows of headwaters of streams but may be successfully accomplished in gravelly shallows of lakes if there is spring upwelling and a moderate current. In Lake Nipigon, large trout did not enter rivers but spawned on gravel beds near shore in water about 24 inches (61 cm) deep (Ricker 1932). Gravelly shallows of headwater streams with strong springwater flow are particularly favoured. Mature fish may travel many miles upstream to reach the spawning grounds. Males usually arrive first and often outnumber females. Individual males may display some territoriality but their aggressiveness increases when joined by a female. The actual spawning act is performed by one male and one female, but each may spawn with different mates during the reproductive period. The female clears away debris and silt from the nesting area by a series of rapid fanning movements of the caudal fin made while on her side. The circling and courting movements of the male, quite often larger than the female, produces currents which assist in cleaning the area. Both male and female will dart at intruders to drive them away. Spawning occurs during the daytime, in contrast to night spawning by lake trout.

Literature accounts of the spawning act differ, and accounts of the behaviour of hatchery fish, often artificially bred for generations, may not be characteristic of wild trout. In the Mad River, Ont., Ricker (1932) reported ". . . the females turn quickly on either side, give two to four flips of the tail, and the eggs are shot out." On the other hand, Greeley (1932) reported that the female took a position on the bottom of the nest, with pectoral and pelvic fins spread against the stones, at her side, the male arched his body to hold the female against the bottom and both vibrated intensely as eggs and milt were discharged. There are usually several extrusions followed by a resting period. The eggs are adhesive for a short period after extrusion which serves to prevent those not lodged in gravel from being washed away. On completion of spawning, the female covers the eggs with gravel in a manner resembling the excavation of the redd (*see* White 1930; Needham 1961).

The eggs are large, 3.5–5.0 mm in diameter. The number deposited depends upon the size of the female but may vary from 100 for a female 5.7 inches (144 mm) long to 5000 for one 22.2 inches (565 mm) in fork length. For further information on fecundity, *see* Vladykov (1956) who also provided coloured illustrations of dissected females to demonstrate prespawning and postspawning condition of ovaries.

The eggs incubate within the gravel sub-

strate, the total time required depending upon such factors as temperature and oxygen tension. At 41° F (5° C) eggs hatch in about 100 days, at 43° F (6.1° C) in about 75 days, and at 50° F (10° C) in 50 days. The upper lethal temperature limit for developing eggs is about 53° F (11.7° C). When hatched, the larvae or sac fry remain in the gravel within the redd until the yolk is absorbed. They become free swimming when about 1.5 inches (38 mm) long. Scales begin to form when the young are about 2 inches (50 mm) long.

Brook trout can be aged by means of their scales. Scale samples are usually taken from above the lateral line, between the dorsal and the adipose fins.

The rate of growth varies greatly throughout the native range, depending upon local conditions. Brook trout may overpopulate small streams, resulting in a large number of small trout less than 10 inches (254 mm) long. Unlike lake trout or arctic char, the brook trout is relatively short-lived and wild trout seldom live longer than 5 years, and never beyond 8 years. In California, introduced trout are said to live to 15 years (McAfee 1966). Sexual maturity is usually attained at age 3, but some individuals may mature at age 2 (Cooper 1940; Baldwin 1948).

The maximum size for brook trout was a 14.5-pound (6.6-kg) specimen caught in Rabbit Rapids, Nipigon River, Ont., in 1915, by Dr J. W. Cook of Fort William. From time to time rumours of larger brook trout are circulated but none have proved to be true. Recently a report of a 19.5-pound trout caught in a lake north of Goose Bay, Lab., reached our notice. The specimen proved to be an arctic char, not a brook trout. A number of brook trout weighing 5–6 pounds are caught each year. The largest entered in the Ontario Federation of Anglers and Hunters Big Fish Contest during 1968–1970 weighed 7 pounds 5 ounces, but there were many in the 6-pound class. Fish over 10 pounds are rare and few have been reported in recent years. Comparative rates of growth for populations from across Canada follow:

		Age (*years*)							
		0+	1+	2+	3+	4+	5+	6+	7+
sea-run	SL *inches*	–	–	7.9	9.7	10.8	13.2	15.6	–
Moser R., N.S.	*mm*	–	–	201	247	274	334	396	–
(Wilder 1952)									
freshwater	SL *inches*	1.5	4.3	6.2	7.0	8.8	10.8	–	–
	mm	39	109	156	178	224	274	–	–
Matamek L.	FL *inches*	1.5	3.5	4.9	6.8	8.4	9.9	11.6	13.3
Saguenay Co., Que.	*mm*	38	88	124	172	212	251	294	337
(Saunders and Power 1969)	Wt (*oz*)	-	0.3	0.8	2.1	3.9	6.6	10.9	–
Red Rock L., Ont.	TL *inches*	1.4	6.1	9.1	11.7	14.8	17.4	–	–
(Baldwin 1948)	*mm*	36	155	231	297	376	442	–	–
Nelson &	TL *inches*	–	–	11.6	15.2	17.3	19.1	20.9	–
Hayes R., Man.	*mm*	–	–	295	386	439	486	531	–
(& tributaries)	Wt (*oz*)	–	–	7.5	20.5	29.9	43.6	57.0	–
(Doan 1948)									
Pyramid L., Alta.	FL *inches*	–	5.4	8.6	11.1	14.0	16.5	–	–
(Rawson and	*mm*	–	137	218	282	356	419	–	–
Elsey 1950)	Wt (*oz*)	–	1.5	5.5	10.5	22.0	34.0	–	–

The brook trout, or speckled trout as it is more frequently called in Canadian literature, has been widely used as an experimental animal and, hence, there is much information in the literature on many aspects of its biology not mentioned above (*see* Brown 1957a; Shepard 1955; Job 1955; under *Suggested Reading* section for pertinent literature).

Brook trout occur in clear, cool, well-oxygenated streams and lakes. They tend to seek temperatures below 68° F (20° C) when surface waters warm up. In Red Rock Lake, Algonquin Park, Ont., Baldwin (1948) observed that brook trout moved to depths between 15 and 27 feet (4.6–8.2 m) during July and August. In streams and rivers brook trout move downstream to larger bodies of water when temperatures rise and may move completely out of the river system into lake or sea. In the northern part of its range, the brook trout may remain in rivers throughout the summer, as in Ungava, Que. (Power 1966), or they may leave the streams and go to sea as they do in many Hudson Bay tributary streams in Ontario, Quebec, the Maritime Provinces (Smith and Saunders 1958, 1967) and Newfoundland (Scott and Crossman 1964).

Brook trout are carnivorous, and feed upon a wide range of organisms, although stomachs sometimes contain traces of plant remains. Young and medium-sized trout eat large numbers of aquatic insect larvae and terrestrial insects. In a very thorough study of brook trout in Ontario, Ricker (1932) provided also a review of the organisms eaten. The list of organisms is astonishing and suggests that brook trout will eat any living creature its mouth can accommodate: worms, leeches, crustaceans (cladocerans, amphipods, decapods), aquatic insects (over 80 genera eaten but mayfly, caddisfly, midge, and blackfly larvae common), terrestrial insects (over 30 families, ants sometimes in abundance), spiders, molluscs (including clams and snails), a number of fish species, including young brook trout and brook trout eggs, minnows, sticklebacks, and cottids, frogs, salamanders, and a snake (in a 7-inch trout). Although not mentioned by Ricker, larger trout, particularly in northern waters during summer, are known to eat numbers of small mammals, mainly the field mouse, *Microtus*, but also the redback vole, *Cleithrionomys*, and shrews. Sea-run trout eat invertebrates and fishes found in marine and brackish waters.

In a study of food consumption and growth, Baldwin (1957) observed that brook trout weekly ate 50% of their own weight (in minnows) at 55.4° F (13° C) but less than this amount at 48.2° F (9° C) and 62.6° F (17° C).

Brook trout engage in a limited amount of cannibalism, eating their own eggs at spawning time and their own young in spring (Ricker 1932; White 1924). White also noted that young trout were eaten by rock bass. Possibly the most serious predators are fish-eating birds, such as kingfishers and mergansers, whose brook trout eating habits have been documented by White (1936, 1937, 1938, 1953, 1957) for the Maritime region.

Long interest in brook trout as a hatchery-reared and pond-cultured sport fish has resulted in the accumulation of much information on its parasites.

Lyster (1940a) discussed parasitism of brook trout in Lake Commandant, Que. He reported three trematodes, one, *Ptychogonimus fontanus*, in considerable quantity in the stomach and upper digestive tract. Cestodes, especially the large tapeworm *Eubothrium salvelini*, light infections of the acanthocephalan *Neoechinorhynchus cylindratus*, and two species of nematodes were also reported. Lyster (1940b) also reported black-spot caused by the trematode *Apophallus brevis*.

Bangham and Hunter (1939) found light infections of the nematode *Cystidicloides harwoodi* only, in 40 of the 63 specimens they examined from the upper portions of streams flowing into Lake Erie.

MacLulich (1943b) studied parasitism of trout in Algonquin Park, Ont., and reported that microsporidian parasites, forming white cysts in the kidneys, were abundant in both lake and brook trout, the abundance differing with locality. He also reported small numbers of the trematode *Crepidostomum farionis* in

the intestines of a few trout, and the unusual occurrence of two flukes, *Crepidostomum*, in the gall bladder of one trout from Red Rock Lake. Black-spot occurred on pectoral fins of some trout from Proulx and Red Rock lakes. The cestode *Diphyllobothrium* sp. was absent from brook trout he studied, but *Eubothrium salvelini* occurred in 66% of specimens examined and *Proteocephalus parallacticus*, a new species of tapeworm (MacLulich 1943a), and *P. ambloplitis* were also reported. Infestation by roundworms, *Cystidicola stigmatura*, was heavy but did not appear to seriously affect the hosts. *See* MacLulich (1943b) for detailed list.

Bangham and Venard (1946) reported several of the species of parasites reported by MacLulich, but added *Hepaticola bakeri* and *Contracaecum brachyurum*. In Lake Huron waters Bangham (1955) reported light infections only.

See Choquette (1948) for incidence of internal helminths in speckled trout in Laurentide Park, Que., and also Choquette (1955) for common occurrence of the nematode, *Metabronema salvelini*.

All nine specimens examined from Flynn Lakes, Gatineau County, Que., contained *E. salvelini* (Worley and Bangham 1952).

In British Columbia, where brook trout is an introduced species, Bangham and Adams (1954) reported it had fewer parasites than native forms, and stated that all parasites identified were of scattered occurrence, except *Crepidostomum farionis* (in 64% of the 110 specimens examined), *Metabronema salvelini* (22%), and *Bulbodacnitis globosa* (15%).

Mortalities of brook trout have been reported caused by acanthocephalans (Pippy and Sandeman 1967) and leeches (Rupp and Meyer 1954).

Ulcer disease and furunculosis may cause considerable loss of hatchery stock. *See* Snieszko (1952), McCraw (1952), Davis (1953), and Margolis (1954).

Relation to man The brook trout is a most highly esteemed game fish and one of the most popular game fishes in eastern Canada. It is fished by artificial fly, spin casting, or live bait. Since it is classed as a game fish, commercial sale for food is illegal in Ontario, but not everywhere in Canada.

Rearing brook trout in hatcheries has been practised for decades. In addition to government hatcheries, many private producers sell hatchery fish (fry, fingerlings, yearlings) for stocking private ponds. Many private trout clubs maintain their own brood stock, hatcheries, and rearing ponds, and offset some of their overhead by offering surplus stock for sale to other clubs.

For information on pond culture and practices, *see* Ayers et al. (1963), Cooper (1959), Eipper (1964), and Séguin (1955).

Nomenclature

Salmo fontinalis — Mitchill 1815a: 435 (type locality vicinity New York City, N.Y.)
Salmo canadensis — Smith (*in* Cuvier 1834: 474)
Salmo immaculatus — Storer 1857: 264
Salmo hudsonicus — Suckley 1862b: 310
Salvelinus fontinalis — Jordan and Copeland 1878: 430
Baione fontinalis — Slastenenko 1958: 82
Salvelinus timagamiensis Henn and Rinkenbach — Scott and Crossman 1967: 8

Etymology *Salvelinus* — an old name for char; *fontinalis* — living in springs.

Common names Brook trout, Eastern brook trout, speckled trout, aurora trout, brookie, square-tail, speckled char, sea trout, common brook trout, mud trout, coaster, eastern speckled trout, native trout, mountain trout, breac, squaretailed trout. **French common names:** ***omble de fontaine, truite, truite de mer, truite mouchetée.***