Brief Life Histories and Atlantic Provinces Distribution of Fish and Other Species Included in the Atlantic Provinces Water Resources Study (Fisheries Section)

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Dept. of Fisheries of Canada
Resource Development Branch
Halifax, N.S.
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A. Freshwater

Anadromous (i) Atlantic salmon (Salmo salar)

The Atlantic salmon occur all along the Atlantic Coast from the Bay of Fundy to Ungava Bay. They spawn in late fall in nests or "redds" dug in the gravelly bottoms of coastal streams by female fish. The young, hatched the following spring, remain in freshwater from two to four years when, as smolts, they descend to the the sea. At sea, fish from various streams intermingle and range quite widely. Most fish eventually return at the end of a year at sea as grilse, or later as salmon, to their home stream to spawn. The spawning grounds may be a short distance from the sea or may involve movement of 200-300 miles in freshwater as, for example, the spawning in the Tobique River, a tributary of the St. John River.

Growth of parr in streams is slow and when these fish descend to sea as smolts, they are from 5-7 inches in length. Growth at sea is rapid. After one year at sea, some may return to freshwater as "grilse" to spawn and weigh from 3-6 pounds. Salmon that have been at sea for 2 years weigh from 6-15 lbs. They seldom live to be more than 9 years old and weigh up to 60 pounds but rarely over 30 lbs. Atlantic salmon often do not die after spawning but may return to sea in the fall or following spring. They may spawn more than once.

Excellent angling occurs in the following rivers, by province: New Brunswick - Restigouche, Miramichi and Saint John rivers. Nova Scotia - Margaree, St. Mary's and Medway rivers; landlocked in Grand Lake. Newfoundland - Humber, Harry's and Exploits rivers; landlocked in numerous lakes.

(Ref: Leim and Scott 1967. "Fishes of the Atlantic Coast of Canada")

(ii) Speckled trout (Salvelinus fontinalis)

The speckled trout spawns in gravelly areas of brooks and streams during October and November. The female trout deposits large (1/6 in. in diameter) eggs in a nest or "redd" which has been scooped out in the gravel by the female. The eggs develop throughout the winter and hatch the following spring. It has been shown that the speckled trout is, in general, a freshwater form but it may migrate to sea (from coastal streams) if stream conditions, such as rising temperatures, become unfavourable. Most movement occurs at night and most seaward migration occurs in the spring and early summer. When in the sea, speckled trout usually remain within the influence of the stream or river of descent.

Sea-run brook trout may grow to 7 lbs. or more but 3 lbs. is large in the Maritimes. The maximum size of 14½ lbs. was recorded for a fish caught in the Nipigon R., Ontario.

These trout occur in the lakes and rivers of the eastern Canadian mainland generally, including Newfoundland and Prince Edward Island. Sea-trout occur in Newfoundland, along the shores of the Gulf of St. Lawrence, outer coast of Nova Scotia and sparingly in the Bay of Fundy.

(Ref: Leim and Scott 1967. "Fishes of the Atlantic Coast of Canada")

(iii) Brown trout (Salmo trutta)

Brown trout occur, through introduction, in every Canadian province except Prince Edward Island. The natural range extends from the northern coast of Europe southward around the British Isles to the Mediterranean basin as a non-migratory form, and into the Black and Caspian Sea drainages.

In Maine, the brown trout spawns from October through February. They are normally a stream spawner and select coarse gravel or rubble bottom in which to construct their egg pits. Spawning may occur under a variety of conditions from lake shores to tiny lake tributaries. The young hatch out the following spring and spend 2 or 3 years in the parent stream. Later they move out into the lake or to the sea if they are sea-run fish. The brown trout is a fierce competitor and growth is often at the expense of other fish species present in the environment.

Records reveal that a sea-run brown trout with two years of freshwater and eight years of sea life had spawned in each of the last seven of its sea years. (Nall, H.G. 1930. The life of the sea trout. Seely, Service and Co., Ltd., London. cited in - Fishes occurring in the freshwaters of insular Newfoundland - W.B. Scott and E.J. Crossman 1964) Record size - 39 lbs. taken in Scotland 1866. Fish angled in Newfoundland average 5-6 pounds and fish weighing 28 pounds have been reported in recent years.

(iii) Brown trout (cont'd)

Atlantic provinces distribution: New Brunswick - successful introductions occur in the Mispec and Little river systems, Saint John County and in the Digdeguash River, Charlotte County. Nova Scotia - they occur in the Guysborough and Salmon rivers, in Clam Harbour River, in the Merigomish area, Kejimkujik Lake, Lower Mersey River, Salmon River (Yarmouth County), Cornwallis River and Harrison Lake. They are definitely anadromous in Guysborough River and have spread, through the sea, to neighboring rivers in this area. Newfoundland - Sea run populations have become established on the Avalon Peninsula, particularly on the Placentia Bay side. These Avalon Peninsula populations are possibly the largest available anywhere on this continent. (Ref: Leim and Scott 1967. "Fishes of the Atlantic Coast of Canada")

(iv) Rainbow trout (Salmo gairdneri)

The rainbow trout occurs naturally in the coastal and inland waters of British Columbia eastward into Alberta. It has been introduced in all the provinces from Saskatchewan eastward. The species may go to sea but it usually remains in freshwater. Sea-going trout are known as "steelheads" and those remaining in freshwater are called "rainbows".

Most wild fish are spring spawners, the period of spawning extending from February to June in coastal streams or tributaries to lakes. The rainbow usually spawns for the first time at the beginning of its fourth growing season. Most of the spawning run is made up of fish spawning for the first time but the same fish may spawn three or four times. Steelhead move from the ocean into the rivers to spawn at about the same time each year but not at the same time in each river. Usually the fish move in "winter runs" (December to April) but some rivers have summer runs (May to October). In either case spawning occurs in the spring months. The spawning ground is a fast moving riffle area with gravel bottom. The young hatch out in summer, from 30-60 days following spawning, depending on water temperature. The young may migrate to the lake during the first year or a minority may spend their whole life in a stream. Seaward migration of steelhead is usually in March to May and smolt size is approximately 6-8 inches depending on time in freshwater.

Stream resident fish seldom exceed 2-3 pounds and average ½-¾ pounds. Lake resident fish have been recorded as large as 52½ pounds.

(iv) Rainbow trout (cont'd)

On the Pacific Coast, this trout is a renowned game fish and also has some commercial importance, but on the Atlantic Coast it is utilized only as a game fish.

Atlantic provinces distribution: New Brunswick - MacFadden's Lake and Crooked Creek, Albert County - Clear Lake and Creasey Lake, Charlotte County - St. John River. Prince Edward Island - in several ponds and streams, occasionally running to sea, as at Wilmot River and off the Dunk, Cardigan and Montague rivers. Nova Scotia - successful introductions have been made in lakes in Kings, Annapolis and Digby counties, and although no sea run has been established, some fish are suspected of having gone to sea. Newfoundland - ponds near St. John's have been stocked since 1866, but no sea-run populations have become established.

(Ref: Leim and Scott - "Fishes of the Atlantic Coast of Canada")

(v) Arctic char (Salvelinus alpinus)

The range of the arctic char is circumpolar in the northern hemisphere and although frequently sea run it occurs widely in freshwater where it might be landlocked.

Spawning occurs in September or October in gravelly spots in 6-16 feet of water either in lakes or deep pools of rivers. Sea-run char mature at 6-7 years of age and first seaward migration takes place between the 5th and 7th winters. Landlocked fish mature at 2 years. Migration to freshwater begins in July and continues through August. After spawning, the adults spend the winter in lakes or deep river pools. There is no evidence that any fish live in the sea over winter. Migration upriver is impeded by very low obstructions although the fish can maintain its position in fairly swift water.

Generally, sea-run char grow more rapidly than landlocked fish.

Arctic char are known to reach a weight of 26 lbs., but fish weighing over 10 lbs. are unusual.

The char is used by Eskimos for food both for themselves and their dogs. A commercial fishery exists on the Labrador Coast between Hopedale and Hebron where the fish are salted in barrels and sold as a gourmet item.

Atlantic provinces distribution: Newfoundland - South Twin Lakes (Exploits R.), Blue Gorge and Hind's Brook of Grand Lake (Humber R.), Gander Lake, Moreton's Harbour Pond, Landown's Pond (Harry's R.), Mobile Big Pond, Ocean Pond and Dildo Pond. Landlocked char also occur in Square Pond-Middle Brook, Gambo and Deer Lake - Humber R.

(v) Arctic char (cont'd)

Atlantic provinces distribution: Newfoundland (cont'd)

Char were also found in the Terra Nova system above the falls and an anadromous population was found in Parker's River (West R.) and Pistolet Bay. Other populations of this form may exist in the northwestern section of the Province.

(Ref: Scott and Crossman. "Fishes occurring in the freshwaters of insular Newfoundland" Can. Dept. of Fisheries)

New Brunswick - landlocked forms exist in Walton and Upsalquitch lakes.

(Ref: Leim and Scott. "Fishes of the Atlantic Coast of Canada")

(vi) Alewife or gaspereau (Pomolobus pseudoharengus)

The gaspereau ranges from Newfoundland the southern Gulf of St. Lawrence to North Carolina. It is found, apparently landlocked in Lake Ontario, Lake Erie and upper Great Lakes and in certain lakes in Maine and New York states.

Spawning migration of the alewife begins in the latter part of April and continues on into June. They spawn in lakes and in the quiet stretches of rivers above tidal influence. The eggs are scattered over the bottom where they adhere to sticks, stones and rubble. Hatching requires 3 days at 72°F. and 6 days at 60°F. After apawning, the adult alewives drop back to sea. Young alewives grow rapidly and begin their seaward migration about August and lasts through September. Size at time of migration varies from 1½ inches to 6 inches depending on time spent in freshwater. Alewives mature in 3-4 years and some fish spawn more than once.

Alewives are valuable as a commercial species and also as a forage food for other fish. They are used fresh for food or bait and also for meal and pet food. A cheap salted product is exported and is the main market outlet.

Atlantic pronvices distribution: Newfoundland - the alewife is a rare species in Newfoundland water, situated as it is on the northern limit of range for the species. Young alewife, 10 cm. long, were taken in Holyrood Pond, St. Mary's Bay in 1952 and gave the first record of probable spawning of alewives in the Newfoundland area.

(Ref: Scott and Crossman - "Fishes occurring in the freshwaters of insular Newfoundland" Can. Dept. of Fish.)

(vi) Alewife or gaspereau (cont'd)

New Brunswick - alewives run up many rivers of New Brunswick but the principal fisheries are associated with the Miramichi and St. John rivers. Nova Scotia - alewives are found to run up most rivers of Nova Scotia but the principal fisheries are associated with the Margaree, Mersey, Tusket, Gaspereau and Shubenacadie rivers. Prince Edward Island - The alewife is anadromous, ascending most Canadian rivers from the entrance of the Bay of Chaleur southward. No specific mention is made of Prince Edward Island.

(Ref: Leim and Scott - "Fishes of the Atlantic Coast of Canada")

(vii) Shad (Alosa sapidissima)

The shad ranges from the Gulf of St. Lawrence to Florida. Recently, they have spread through all of the upper Great Lakes and having been introduced to the Pacific Coast in 1871, have spread to southern California and Alaska.

Shad are anadromous and enter rivers in May or June to spawn. They do not go as far upstream as alewives, but some fish do make long journeys, a few ascending as far as Grand Falls on the St. John R. Spawning takes place in still waters of rivers in May and June when the water temperature is 53°F. The eggs settle to the bottom of the river but may be carried some distance by the current before reaching the bottom. The fish return to the sea soon after spawning takes place and spawning marks on the scales indicate they spawn more than once. Eggs hatch in 12-15 days at 54°F. and in 6-8 days at 63°F. The young are 2/5 inch long and some drift down to brackish water soon after hatching. Others remain in freshwater longer. All have left freshwater by September when they are 2-3 inches long.

Shad make most of their growth in the sea. A few spawn at 4 years but most are 5 years old when they first re-enter freshwater and are about 18-19 inches long. They live to be 9-11 years old and about 22 inches long.

Shad are caught in weirs, traps and gill nets mainly in estuaries and rivers during the spawning run. They are used fresh and salted and the roe is considered a delicacy.

Atlantic provinces distribution: Newfoundland - occurs in Salmonier, Conception Bay and Bonavista. New Brunswick - occurs in most coastal rivers, the major ones being the Miramichi, Petitcodiac and St. John rivers. Nova Scotia - occurs in most coastal rivers with the

(vii) Shad (cont'd)

Atlantic provinces distribution (cont'd)

major ones being the Mersey, Tusket, St. Mary's, Annapolis and Shubenacadie rivers. Prince Edward Island - no specific mention is made of Prince Edward Island but shad generally occur in coastal waters and rivers from Gulf of St. Lawrence to Florida. (Ref: Leim and Scott - "Fishes of the Atlantic Coast of Canada")

(viii) American Atlantic sturgeon (Acipenser oxyrhynchus)

The Atlantic sturgeon ranges from Hamilton Inlet, Labrador, and possibly Ungava Bay, to the Gulf of Mexico.

Sturgeon leave the sea in spring and migrate to freshwater where they spawn in May and June. Young hatch out in 1-2 weeks depending on water temperature and develop in freshwater where they remain for several years before going to sea. Males reach a length of 77 inches and females 88 inches in 12 years. Life history studies estimate the age as 20 to 30 years before they spawn for the first time. Females may spawn as many as 4 million eggs, depending on size, but probably do not spawn every year. Sturgeon prefer to spawn in running water as much as 10 feet deep over small rubble or gravel.

Scarcity in numbers of this fish limits the commercial market. The roe is the well-known caviar, and the flesh of t adult fish is sometimes smoked.

Atlantic provinces distribution: Newfoundland - Hermitage Bay New Brunswick - Miramichi estuary, Passamaquoddy Bay, Bay of Fundy and St. John R. Nova Scotia - Cheticamp and Aspy Bay, Bay of Fundy, Minas Basin and Avon River.

(Ref: Leim and Scott - "Fishes of the Atlantic Coast of Canada")

(ix) Striped bass (Roccus saxatilus)

The striped bass is distributed along the North American Atlantic Coast from the St. Lawrence River and southern Gulf of St. Lawrence to northern Florida.

Large striped bass migrate up rivers in early June and deposit their eggs near the head of tide. In the Shubenacadie River the eggs have been found in slightly brackish water to which they may have drifted. Striped bass spawn more than once but not necessarily every year. Eggs hatch in 3 days at 58-60° F. and in 2 days at 67°F.

Striped bass fry are about 1-1½ inches long in August and September in the Shubenacadie R. At the same time fish from 2½-4 inches long (one year olds) are very abundant in the Minas Basin. Two year olds are from 6½-9 inches long, later growth has not been determined. Females reach maturity at 4-5 years and males somewhat earlier. They reach 35-50 lbs. in size at an age of 8-10 years.

Striped bass are not caught in large enough quantities in Canada to be an important food fish. When small, they are eaten by other predacious fish such as silver hake and cod but as mature fish they have few enemies. In the southern states they are an important sport fish.

Atlantic provinces distribution: New Brunswick - Miramichi river and estuary, Richibucto River, along the shores of St. John county, St. Croix R., Digdeguash R., St. John R., and Kennebecasis R. Nova Scotia - Cheticamp shores, River Philip, coast off Canso, Mira Bay, Chedabucto Bay and Mahone Bay. Along shores of Yarmouth County, and in the Shubenacadie and Annapolis rivers as well as Shubenacadie Lake. Prince Edward Island - off the coast near Tignish, Summerside and in Malpeque Bay.

(x) Pink salmon (Oncorhynchus gorbuscha)

This Pacific salmon, native to rivers of the Pacific slope from California to Alaska, northern Japan and Arctic drainages from Siberia to the lower MacKenzie R., is the most recent in Newfoundland of the many introduced fish of the family Salmonidae. Preliminary investigations concerning the introduction of Pacific salmon into Newfoundland were begun in 1958 and the pink salmon was chosen as the most suitable.

On the Pacific Coast, the great quantities of salmon are made possible by the short river or lake life before the young salmon enter the sea with its abundant food. The young of pink salmon go down to sea 2-3 months after hatching so that all that is needed in the river is a spawning ground, often close to the sea in a small river, though they live in large rivers also. Pink salmon live only 2 years.

The spawning procedure is much the same as other salmonids, ascending coastal streams after spending only 14 months in the sea, to spawn in a "redd" excavated in gravel bottom by the female fish. Pink salmon grow very rapidly reaching 24 inches and 4 lbs. in weight in their short life of 2 years.

The introduction of pink salmon was started in 1958 by the planting of 5,700 eyed eggs in rivers of St. Mary's Bay to check fry recovery and egg survival. Fry from this hatch were not allowed to go to sea. Next year, 250,000 eyed eggs were planted in North Harbour River.

The returns of adults to the present have been too few to replace the eggs from which these salmon were produced. The returns, however, are biologically interesting in that some adults have returned and spawned in their home river.

(x) Pink salmon (cont'd)

(Ref: Templeman "Marine resources of Newfoundland")

(Ref: Scott and Crossman "Fishes occurring in the freshwaters of insular Newfoundland")

(xi) Sockeye salmon (Oncorhynchus nerka)

The sockeye salmon, the most valuable Pacific salmon, has been considered as a species worthy of introducing to Newfoundland. Newfoundland has some lakes which may be suitable for young sockeye if the food supply is sufficient. Some of the larger lakes, like Gander Lake, are deep and probably relatively lacking in food for young salmon. Because young Atlantic salmon live in streams, neither the pink nor the sockeye is likely to compete significantly with young Atlantic salmon.

The sockeye returns from sea at age four and sometimes five in the fall of the year to the inland areas where it was hatched to spawn and die. The spawning act is the same as the pink salmon except the sockeye usually moves farther upstream to choose its spawning site.

Their length at maturity averages about 2 feet and weigh about 5 lbs. The young hatch out the spring following spawning and migrate downstream to lakes where they spend one to three years before descending to the ocean during March and April. The sockeye has the best quality flesh of any of the Pacific salmon and is canned in great quantities for human consumption.

(Ref: Templeman - "Marine resources of Newfoundland")

(Ref: Fisheries fact sheet - sockeye salmon. Info. & Consumer Service, Dept. of Fish. Can.)

Catadromous (i) American eel (Anguilla rostrata)

The American eel is distributed along the North American Coast from the Hamilton Inlet-Lake Melville estuary on the Labrador Coast southward in the Strait of Belle Isle, the Gulf of St. Lawrence and Newfoundland to the Gulf of Mexico, Panama and the West Indies.

The eel lives much of its life in freshwater and returns to the sea to breed. Adults spawn in deep water off the continental shelf perhaps to the south of Bermuda. They spawn in mid-water and the spawning adults are not seen again. The eel is very prolific, the female producing from 5-20 million eggs, depending on size. The eggs hatch into elongate larvae with large teeth; these develop into the transparent, broad, ribbon-like "leptocephalus" stage. They remain in this stage for about one year during which time they actively swim or are carried toward shore. They then transform into the long,narrow, nearly cylindrical elver stage. These elvers, which are first nearly transparent and later become pigmented, appear in estuaries of the Canadian shore in April. During May and June, the elvers enter freshwater in large numbers and become heavily pigmented, almost black. Elvers are 2½-3 inches long when they enter freshwater and are over a year old. Scales do not appear on these fish until the third year when the fish are 6-8 inches long. Adult eels grow to 3½ feet (females), and 2 feet (males) and may be 10-12 years old.

The species is not utilized to any great extent although it is highly regarded in western Europe as a food fish.
Atlantic provinces distribution: Newfoundland - the American eel is numerous in many Newfoundland streams, rivers, ponds, estuaries and barachois.

(i) American eel (cont'd)

Other Atlantic provinces - the eel is found in most accessible rivers and lakes of the Atlantic Provinces.

Resident (i) Landlocked Atlantic salmon (Salmo salar)

Landlocked Atlantic salmon smolts migrate to lakes instead of going to sea. Landlocked salmon grow more slowly and make little additional growth after the first spawning. Spawning adults move up tributary streams to spawn the same as the sea-going fish migrate to coastal streams and rivers.

They occur in Nova Scotia (Grand Lake), New Brunswick (Chamcook Lake) and Newfoundland (Red Indian Lake, Terra Nova Lakes, lakes at head of Gambo River, Long Pond Bay Bulls and many other watersheds).

Ref: Scott 1967. Freshwater fishes of eastern Canada, University of Toronto Press.

Scott and Crossman, 1964. Fishes Occurring in the freshwaters of Insular Newfoundland. Can. Dept. of Fisheries.

(ii) Speckled trout (Salvelinus fontinalis)

See "anadromous" section.

(iii) Brown trout (*Salmo trutta*)

See "anadromous" section.

(iv) Rainbow trout (Salmo gairdneri)

See "anadromous" section.

(v) Chain pickerel (Esox niger)

The chain pickerel is distributed throughout southern and eastern Canada and eastern United States in quiet, weedy waters.

Adults spawn as soon as the ice breaks up in spring with mature adults migrating into swampy backwater regions. One female usually has several males attending her during spawning. No nest is constructed and the sticky eggs drop to the bottom to adhere to whatever they fall upon. Young pickerel hatch after 1-2 weeks incubation and there is no parental care. The largest chain pickerel on record was 36 inches long and weighed 10 lbs., 10 oz. but they are usually 1-2 lbs. growing to 20-25 inches in length.

Chain pickerel are not commercially important but some anglers regard them as a sport fish.

Atlantic provinces distribution

Nova Scotia - occurs only in several lakes on or near the Spectacle Brook drainage near Comeauville, Digby Co. It is very common within its limited range. New Brunswick - apparently restricted to lower St. John R., and entire St. Croix system.

The chain pickerel is apparently not found in Newfoundland, and no mention could be found of it in Prince Edward Island.

(Ref: Livingstone 1953 "Freshwater fishes of Nova Scotia" Prov. Inst. Sci.)

(Ref: Scott & Crossman 1959 "The Freshwater fishes of N.B.: a checklist with distributional notes")

(vi) Sucker (Catostomus commersoni)

The white sucker is generally distributed in North America east of the Great Plains region from the Mackenzie R. in northern Canada to the Hudson Bay and Ungava Bay drainages and to the Labrador Peninsula.

Adults spawn in May either in shallow margins of lakes or in streams. The female is usually attended by more than one male. The spawning act occurs in shallow, moving water and the fertilized eggs drop to the bottom among gravel. Adults immediately move downstream to the lakes or if a stream resident, to deep pools. The young hatch out after about 3 weeks depending on water temperature and the newly hatched young provide forage for other game species.

Suckers are bottom feeders, sucking up bottom fauna and flora with their sucker-like mouth. After they are too large to serve as forage for other fish, suckers are not utilized. They are of no commercial value and are not considered a sport fish. Suckers can attain 25 inches and 6½ pounds.

Atlantic provinces distribution

Nova Scotia - one of the most common fish throughout the province. Occurs in some lakes and streams, but not all, in every region except the plateau of northern Cape Breton. More common in soft rock areas than in granite areas. New Brunswick - abounds in most rivers and streams of New Brunswick. Newfoundland - apparently not found in Newfoundland.

(Ref: Livingstone "Freshwater fishes of N.S.")

(Ref: Scott & Crossman "The Freshwater fishes of N.B.: a checklist with distributional notes")

(vii) Lake whitefish (Coregonus clupeaformis)

Located in northern North America, chiefly in lakes, sometimes in rivers, north from the Great Lakes.

Adult whitefish spawn over hard bottom of lakes when about 14 inches long, or 4 years old, during October and November. Young hatch out the following spring. Growth rates vary considerably depending on water temperature and available food. Their commercial value is very high in the inland lakes fishery but they are not considered of value as a sport fish.

Lake whitefish live to be 10-12 years old and attain lengths of 15-18 inches.

Atlantic provinces distribution

Prince Edward Island & Nova Scotia - no lake herring have been reported from these provinces. New Brunswick - found in several lakes and the lower St. John R. Newfoundland - the species was introduced into lakes near St. John's in 1886.

(Leim and Scott "Fishes of the Atlantic Coast of Canada")

(viii) Smallmouth bass (Micropterus dolomieui)

The smallmouth was probably distributed originally in the St. Lawrence, Ohio and upper Mississippi Rivers, and in the Great Lakes. Through introduction they now range through most of eastern United States and Canada.

The male adult smallmouth builds a nest during June or when the water temperature has reached the mid-fifties. An average male bass will be mature when he is about 9 inches long and 3 years of age. The male clears off a circular area of gravel from 1½ to 2 times his length in diameter. The gravel area selected is in a shallow part of a lake usually under an overhanging tree or near a large boulder or stump. Eggs are adhesive and attach to the cleaned gravel area prepared by the male. The female leaves after spawning and the area is guarded by the male whose fin movements keep the eggs clean and well oxygenated. The eggs hatch in 3-4 days depending on water temperature and the young hide in crevices in the gravel bottom. After a few days, the young darken in colour and rise from the gravel. They grow rapidly and gradually move away from the nest area and prefer to feed alone.

Smallmouth bass are highly regarded as a sport fish and grow to a length of 12-15 inches and live to be 8-10 years in age. Adults spawn every year.

Atlantic provinces distribution:

New Brunswick - St. Croix R. system--Potter's Lake, Mud Lake, Chiputneticook Lakes, York Co.; St. John R. system--Kennebecasis R., Hammond R., Kings Co., Spruce, Ashburn, Sunset, Shaw and Clark's lakes, St. John Co.; Bocabec R. system--Wheaton Lake, Charlotte Co.; Magaguadavic Lake, York Co.; Magaguadavic R., York and Charlotte counties; Lake Utopia, Charlotte Co.

(viii) Smallmouth bass (cont'd)

Atlantic provinces distribution (cont'd)

Miscellaneous Bay of Fundy drainages - Lockhart Lake, Albert Co.; Big Meadow Pond, Deer Island; Miller's Pond, Grand Manan.

Nova Scotia - fish is native to central North America but it has been introduced very widely. Plantings have been made in a number of Nova Scotia Lakes, including several around Yarmouth and Amherst, and Lily Lake in Hants Co. Newfoundland - apparently are not found in Newfoundland.

(ix) Lake trout (Salvelinus namaycush)

Lake trout are distributed from Labrador to Alaska, south to California and through the Great Lakes to New England.

Adults spawn in mid-October to mid-November over a coarse gravel or boulder-covered bottom of a lake shoal. The male trout cleans an area in the rubble and the female later spawns over this area, the eggs falling into deep crevices of rocks. Eggs hatch from 140 to 166 days at a water temperature of 37°F. and the young migrate to deep water immediately following hatching. Males mature at 5-6 years and females at 3-4 years. Lake trout in northern Canada have been estimated at being 40 years old and weighing 80 lbs. Growth of the fish depends on water temperature and available food but since they are primarily lake dwellers and prefer cold water, they are usually slow growers.

Atlantic provinces distribution

New Brunswick - headwaters of St. John, St. Croix and Restigouche rivers, and some isolated lakes in southwestern N.B. but not in the Miramichi R. system. Nova Scotia - occurs in various deep water lakes in Halifax, Lunenburg, Shelburne, Annapolis and Kings counties. Newfoundland - not found in Newfoundland.

(Ref: Scott & Crossman "Freshwater fish of New Brunswick-a checklist with distributional notes")

(Ref: Livingstone "Freshwater fishes of N.S.")

B. Estuaries

1. List fish and molluscs present under ecological headings and give brief life histories (timing, reproduction, etc.)

Anadromous

(i) Atlantic salmon (Salmo salar)
(See "freshwater" section)

(ii) Speckled trout, sea run (Salvelinus fontinalis)
(See "freshwater" section)

(iii) Brown trout (Salmo trutta)
(See "freshwater" section)

(iv) Arctic char (Salvelinus alpinus)
(See "freshwater" section)

(v) Pink salmon (Oncorhynchus gorbuscha)
(See "freshwater" section)

(vi) Sockeye salmon (Oncorhynchus nerka)
(See "freshwater" section)

(vii) Alewife (Pomolobus pseudoharengus)
(See "freshwater" section)

(viii) Shad (Alosa sapidissima)
(See "freshwater" section)

(ix) Smelt (Osmerus mordax)

The smelt occurs along the Atlantic Coast from Labrador and Gulf of St. Lawrence to New York. Landlocked populations are found in lakes of Maine, New Hampshire, New Brunswick, Nova Scotia, Quebec and New York. The smelt has gained access to the Great Lakes and is spread throughout the waters of that region.

Spawning usually takes place in tributary streams at night just before, during, and just after the spring breakup of ice. Spawning also may occur on sand, stones or vegetation on lake shores or bars. The spawners ascent a stream for a short distance and groups of adults pick a spawning area in brisk current over a riffle. As the females release small groups of eggs, the males release milt to fertilize them. Adhesive eggs stick to anything they touch and develop to hatching stage in 15-40 days, depending on temperature. The young smelt hatch and are carried downstream to pools or lake whichever it may be. Smelt may attain lengths of 12-14 inches but are usually 8-10 inches.

Smelt are fished commercially and used as food. They also provide forage for salmon and several other species but they also, as adults, prey on the young of other game fish.

Atlantic provinces distribution

Newfoundland - smelt are distributed around the entire Newfoundland coast. They run up most rivers and brooks along the coast that have no obstacles or run as far as the obstruction.
New Brunswick - abundant in Miramichi estuary and river, Bay of Fundy and landlocked in Lake Utopia and associated lakes.
Nova Scotia - coast of Nova Scotia and Bay of Fundy, landlocked in Grand Lake.

(Ref: Leim & Scott "Fishes of the Atlantic Coast of Canada")

(x) Sturgeon (Acipenser oxyrhynchus)

(See "freshwater" section)

(xi) Striped bass (Roccus saxatilis)

(See "freshwater" section)

(xii) Tomcod (Microgadus tomcod)

The tomcod ranges from southern Labrador to Virginia in coastal and brackish waters, occasionally found in freshwater.

The tomcod ascends rivers to the head of tide in December and January to spawn. The eggs are deposited on bottom where they adhere to rocks and debris. The eggs hatch in 22-35 days at 40°F. and about twice that time at 32°F. The young remain in brackish water for several months and are 2-2½ inches long by August.

The tomcod attains a length of 15 inches but is usually smaller. Tomcod have a limited use as human food and are commercially fished as food for animals.

Atlantic provinces distribution

Newfoundland - Pistolet Bay, landlocked in Deer Lake. New Brunswick - Miramichi estuary and Bay of Fundy. Nova Scotia - Bay of Fundy. Prince Edward Island - no specific mention of P.E.I. but its general range includes coastal waters of P.E.I.
(Leim & Scott "Fishes of the Atlantic Coast of Canada")

Resident

(i) Oysters (Crassostrea virginica)

Oysters are found in the Maritimes close to shore in the southern Gulf of St. Lawrence. A few struggling stocks may be found southward and westward on the outer coast of Nova Scotia, but there are none in the Bay of Fundy region. Populations are present in Bras d'Or Lake and Aspy Bay, Cape Breton, N. S.

The oyster does not spawn until the water temperature reaches 68°F. and there are few places in the Maritimes where the water regularly gets that warm in summer.

They spawn when they are about 1 inch long and spawn every year thereafter as long as they live. When females spawn, they clap their shells gently, about twice a minute, and at each clap they eject a small cloud of eggs into the water. The males merely open their shells slightly and shed their sperm in a steady, barely visible flow. The sperm carries a hormone which induces other oysters, both male and female, to spawn. Oysters do not release all their spawn at one spawning. After approximately ½ hour, spawning ceases but may start again several days later if environmental conditions encourage it. The spawning activity of one individual may last for a month to 6 weeks.

After a few hours, the fertilized egg develops into a small larva and moves about by means of vibrating hairs. After 36 hours, a shell forms over the larva which is now about 1/300 inch long. The larvae swim and drift with the current some being carried many miles, other just moving back and forth over the oyster bed. After 3 weeks the larva is about 1/75 inch high and barely visible to the naked eye.

Before settlement, the larva goes on an extensive tour--swimming until it reaches a solid object, crawling over it and swimming away if not satisfied. It selects a solid surface free of slimy growths and it prefers one on which some other oyster larvae have already settled. Finally the larva extrudes a blob of cement which sets firmly within a few minutes. Newly attached oysters are called spat. In most inlets, spatfall ranges from surface to bottom in depths up to 25 feet or more.

Spat grow quickly and after 10 days, they have grown to 1/16 inch in length. By autumn, those that settled first may be an inch long. The oyster obtains food by opening its shells and filtering water through the gills. Our oysters usually take from 4 to 7 years to reach a marketable size of 3 inches in length. Oysters may live to be 20 years old, reach 15 inches and weigh 3 lbs.

Oyster farming is quite prevalent and about one half the marketed oysters are cultured. Areas of water are leased from the Department of Fisheries and fishermen collect spat and carefully cultivate their oyster crops.

Areas of water that are polluted cannot be utilized unless the fisherman has a permit. Then he can harvest the oysters and move them to a government approved unpolluted area where the oysters are resown and left for a specified period. During this time, the oysters cleanse themselves so they are safe for human consumption. (Ref: Medcof, J.C. "Oyster farming in the maritimes" Fisheries Research Board of Canada Bulletin #131)

(ii) Blue mussel (Mytilus edulis)

The blue mussel is the most abundant and most widely distributed of the Canadian mussels. Its biology is very similar to the soft-~~shell~~ shell clam. There is a small commercial fishery, the mussels being used for human consumption.

(iii) Clam (soft-shell clam Mya arenaria)

The soft-shell clam is found from the coast of Labrador to the region of Cape Hatteras, N.C..

In the cold maritime waters, the fertilized eggs from the spawning adults develop into a swimming trochophore larva in about 12 hours. The larva moves by hairlike projections (cilia) arranged in distinct bands around the body. The larva also has a mouth and a minute shell gland which will give rise, during the next 24 to 36 hours, to the two calcified valves that will envelop and protect the clam body throughout life. A swimming organ develops, formed by the modification of the trochophores ciliated bands into a circular pad. This organ keeps the animal suspended in the water mass where currents can carry it long distances. This swimming pad gradually reduces in size and function and a muscular foot develops. The clam is now ready to "set" or attach itself to sand grains, plants or other materials by a tough, horny thread, the byssus. The byssal threads can be cast off if the animal wishes to relocate. With the coming of winter months, young clam burrows into bottom material.

Sexual maturity may be reached at one year of age (about ½-¾ inch in length). Spawning is related to water temperature and occurs from early June to mid-August. Commercial sized clams may take 5-6 years to grow.

The scallop, oyster and soft-shell clam have long been the important three of the commercial molluscs, but the quahaug (Mercenaria mercenaria) is also important. It thrives in the southern Gulf of St. Lawrence where the warmest waters of the maritimes favour its reproduction and rapid growth.

(iii) Clam (soft-shall clam) (cont'd)

(Ref: The soft-shell clam. U.S.D. of Interior Fish and Wildlife Service Bureau of Comm. Fish. Circ./62.)

C. Immediate Coastal Waters

Anadromous (i) Atlantic salmon (Salmo salar)

(See "freshwater" section)

Resident (i) Herring (Clupea harengus)

Atlantic herring are distributed from Block Island (near the entrance to Long Island Sound, New York State), northwards to Labrador and Greenland.

The herring deliberately lays its eggs on the sea bottom and the fish selects certain areas where the bottom is firm. The eggs adhere to sand or clay or other debris that they land on. In eastern Canadian waters, spawning occurs in spring, summer and fall depending on the locality and the herring stocks. Most of the Nova Scotian coast stocks spawn in late August or September, whereas there are both spring and fall spawners in the Gulf of St. Lawrence.

Eggs hatch in 10-15 days in Georges Banks-Bay of Fundy area. In colder water, hatching time is longer. Young herring hatched in late summer to early autumn grow to ¾ inch by December. Over winter, growth is very slow. They reach a length of about 4 inches by the end of their first full year, 7 inches after 2 years, and 10 inches after 3. Some spawn at age three but most at age four. They spawn every year after that and may live 20 years and reach 17 inches in length.

Herring are a very important fish and are caught in great quantities by commercial fishermen and utilized as food. Small herring are the renowned "sardines". Some are used as bait in the lobster fishing industry and some are made into meal and oil.

Atlantic provinces distribution

Herring are distributed in all the coastal waters of the

(i) Herring (cont'd)

Atlantic provinces distribution (cont'd)

Maritime Provinces, with the young fish known as "sardines" being concentrated in the lower Bay of Fundy.

(ii) Capelin (Mallotus villosus)

Capelin are distributed from Arctic and sub-Arctic regions southward along the Atlantic Coast to the Gulf of Maine. They are also found the Coast of Newfoundland during June and July and on the Grand Banks and Gaspe.

In June and early July, capelin approach the coast in vast numbers to spawn on or near the beaches. They also spawn over the Southest Shoal of the Grand Banks. Majority of the spawners is comprised of three-year-old-fish. Smaller numbers of two and four year olds are present and the odd five year old is there. The eggs hatch in about 2 weeks at 50°F. The capelin may spawn more than once up to 3 years in succession. Larval capelin reach 1-1½ inches by first winter. They average 3½ inches when a year old. They may live 7 years and grow to 9 inches but usually 5 years is the lifespan.

Their chief importance is to provide food for cod and other commercial species. Their importance to the commercial fishery is shown by their wide use as human food, bait in cod fishing, dog food, fertilizer, and in manufacture of fish meal.

Atlantic provinces distribution

Abundant around coast of Newfoundland, becoming less abundant over the Magdalen shallows. Occurs irregularly in Bay of Fundy (from Kings Co., N. S. to Passamaquoddy Bay, N. B.).

(iii) Tomcod (Microgadus tomcod)

(See estuaries section)

(iv) Pothead or Pilot whale (Globicephala melaena)

The male pothead reaches a size of about 20 feet and the female, 16 feet, with the maximum weight being about 3 tons. The average food intake is about 30 lbs. per meal. The breeding season extends from May to November, the peak being in May. The gestation period is about 15½ to 16 months with lactation lasting 22 months. Lactation and gestation rarely overlap so that the average reproductive cycle extends 40 months. The maximum number of calves produced in a full reproductive lifetime is 9. Females mature at 6-7 years of age and males, 12 years. There is an excess of mature females, the males maturing later in life and having a higher rate of mortality, and the species is undoubtedly polygamous.

The pothead whale occurs in herds of 10-200 individuals. They play follow the leader, usually the largest male of the group acts as leader. They are susceptible to being driven ashore in herds and being stranded in large numbers. The main area of exploitation in the Atlantic Provinces is at Trinity Bay and Bonavista Bay, Newfoundland where fishermen drive the animals ashore to collect the blubber for oil extraction and the meat to be frozen for mink food.

The pothead feeds almost exclusively on short-finned squid and population fluctuation of squid influences the abundance of pothead whales.

The pothead ranges widely over the northern part of the North Atlantic.

(Ref: Templeman "Marine resources of Newfoundland")

(Ref: D.E. Sargeant. 1962. "The biology of the pilot or pothead whale, Globicephala melaena (Traill) in Newfoundland waters. F.R.B.C. Bull. 132)

(v) Bluefin tuna (Thunnus thynnus)

The bluefin tuna is almost world-wide in distribution being found on both sides of the Atlantic and Pacific oceans. In the western Atlantic it is found from Newfoundland southward at least as far as the West Indies and probably to Brazil.

During summer, the Atlantic bluefin is found over the continental shelf at depths of 15-100 fathoms from Cape Hatteras to Newfoundland. Smaller individuals are found to the south, larger ones to the north. In winter they leave the continental shelf and are widely dispersed in the Atlantic. They are gregarious fish and usually travel in schools.

The whole life history of the tuna is still not completely known. Large fish spawn between Cuba and the Bahamas near the edge of the Florida current during April and May. The fish swim northward in the shallow water off the islands. The fish stop periodically and mill around in the water. This is when they are suspected of spawning. The eggs are buoyant and float at the surface where they hatch in a few days.

Young tuna grow extremely fast and fish hatched in June may weigh over one pound by September and eight pounds by the end of their first year. A two-year old weighs about 15 lbs. and a ten-year old, 350 lbs. A 700 lb. fish is probably 14-15 years old. They may grow to over 1200 lbs. but are seldom landed over 900 lbs.

Bluefin tuna are fished commercially as food for human consumption. They are also considered an excellent sport fish.

Atlantic provinces distribution

Newfoundland - Dildo, Trinity Bay; east coast of the Avalon Peninsula, and at Bonne Bay. New Brunswick - Chaleur Bay and ater Miramichi estuary. Infrequently taken in Passamaquoddy Bay and Grand Manan. Nova Scotia - reported from Cape Breton, Canso, St. Margaret's

(v) Bluefin tuna (cont'd)

Atlantic provinces distribution (cont'd)

Bay, shores from Liverpool to Yarmouth and occasionally in Bay of Fundy. Prince Edward Island - taken at Malpeque Bay.

(vi) Lobster (Homanus americanus)

The lobster is distributed from Labrador to North Carolina. It is most abundant in the Southern Gulf of St. Lawrence, southern Nova Scotia, and Maine.

Lobsters mature when they are 7 to 12 inches long weighing from ½ to 2 pounds. Aging techniques are not accurate but is thought these lobsters are between 5-10 years of age. Mating takes place mainly in summer between hard-shelled males and soft-shelled females. The male deposits sperm in the females sperm sac located between the last 2 pairs of legs. Egg laying takes place from early June to September, a month or more after mating. As the eggs are laid, they are fertilized by sperm released from the sperm sac and are fastened by a glue-like secretion to the females swimmerets. The female carries the eggs until they hatch about a year later.

The young, called larvae, are about 1/3 inch long. They rise to the water's surface and spend 1 to 2 months swimming freely and carried by currents. During this period they molt three times, each time changing form and growing appreciably. By their fourth larval stage, they are over ½ inch in length and resemble an adult in colour and shape. They settle to the bottom during this stage and behave as an adult, living in crevices in rocks. In their free-swimming form, lobsters are very susceptible to predation and heavy mortalities occur.

Lobster is one of Canada's most valuable fisheries species, and the Canadian catch in recent years has made up over 60% of the North American total. They are fished along most of the Newfoundland coast, the coasts of Magdalen Islands, Prince Edward Island,

(vi) Lobster (cont'd)

New Brunswick, Nova Scotia, and from Maine to New Jersey.

(Ref: Fisheries Fact Sheet - The American Lobster. by D.G. Wilder, F.R.B.C. Issued by Information and Consumer Service, Dept. Fish. Can.

(vii) Scallops (Placopecten magellanicus and Chlamys islandicus)

The sea scallop, also called the giant or smooth scallop, Placopecten magellanicus, is the most important commercial species of molluscan shellfish on the Canadian east coast. Chlamys islandicus, the Iceland scallop, is the only other scallop in our east coast waters. It is found in deep water but is more northern in distribution, less abundant and of no economic importance.

The sea scallop is a bivalve, i.e., it has two, almost circular shells held together by a small hinge at one side. The lower shell is flat, smooth and has a white or cream colour, while the upper is arched, usually reddish in colour. The centrally located muscle, which is used to close the valves together, is the part of the scallop eaten in Canada. The Iceland scallop only grows to 4-5 inches and its two valves are nearly similar, having 50 to 100 raised and radiating ribs on their outside surface.

Sea scallops are found in the northwest Atlantic from the north shore of the Gulf of St. Lawrence to Cape Hatteras, North Carolina. In the northern portion of their range, they occur in water less than 10 fathoms while in the southern portion, are found deeper than 30 fathoms. They frequently occur in beds in sufficient concentration to support a commercial fishery. Major fisheries continuing for the past 10 years are located off the Virginia Capes, off New York City, around Block Island, Rhode Island, on Georges Bank, in Cape Cod Bay, along the Maine coast, in the Bay of Fundy (particularly off Digby, N. S.), in the southern Gulf of St. Lawrence, on St. Pierre Bank, and in Port au Port Bay, Newfoundland.

Scallop reproduction closely resembles that of oysters, clams and mussels. The sexes are separate. Spawning varies from late Augusttto early September in the Bay of Fundy region, to late September or early October on Georges Bank. The microscopic eggs are shed into the water by the female and are fertilized by sperm shed by the male. The eggs develop into free-swimming larvae and last about 3 weeks in this stage. The larvae may be carried long distances by currents before they settle when bhey are about the size of a pinhead. By the start of their first winter, scallops are about 1/5 inch long.

In general, the growth rate is slowest in the Gulf of St. Lawrence and fastest on Georges Bank. On Georges Bank, 4-year-old scallops have a shell diameter of approximately 3½ inches. The majority of the commercial catch is made up of 4-8 year old scallops. The maximum life span is 16-17 years of age at which time the shell diameter may measure 8-9 inches.

Sea scallops are found on different types of bottom but prefer a firm type such as gravel, shells or rock. They are almost sedentary, lying on the ocean floor. The very small ones attach themselves to bottom objects by small, strong threads (byssus).

The scallop muscle is eaten in Canada and is a noted seafood The commercial fishery is quite substantial especially in Nova Scotia (Ref: Fisheries of Canada Jan. 1967, pg. 17)

(viii) Squid (Illex illecebrosus)

In summer, the short-finned squid may be found northward at least to Hamilton Inlet Bank, westward to the western shore of the Gulf of St. Lawrence, and eastward at least to Flemish Cap. It occurs southward to the Gulf of Mexico and the Caribbean Sea.

Because the smallest individuals appearing on the south-western Grand Bank in May and later inshore are already half-grown, and no larvae or small young have been caught, the squid probably spawn a considerable distance away from the Newfoundland banks. They very likely spawn in deep water; otherwise the eggs or young of the spawning accumulations should have been found. Apparently the adults die after spawning, as all the squid that move to shore are small, immature individuals.

In the Newfoundland banks, the short-finned squid is mainly pelagic and is not readily available in quantity to the otter trawl. The entire Newfoundland catch is taken close to shore in shallower waters where the squid are more concentrated.

Large quantities of dried squid were once exported to China for human food; recently, it has been used almost exclusively as bait in the local cod line fishery and also by the Portuguese, Norwegian and Faeroese line fisheries in the Northwest Atlantic.

(ix) Irish moss and other seaweeds (Chondrus crispus and others)

Irish moss - Chondrus crispus

Irish moss is a seaweed that grows in abundance along the Atlantic coast from New Jersey northward to Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland. This seaweed has been collected commercially for over a century. It is gathered from beaches during low tide and spread on wooden racks to dry in the sun. The dried material is baled and sold to be manufactured. It is the source of a phycocolloid called carrageenin which is widely used as a stabilizer in chocolate milk, salad dressing, toothpaste, etc. It grows throughout the year on rocks, shells and woodwork in the sea.

Dulse - Rhodymenia palmata

Dulse is a seaweed that grows attached to rocks along various parts of the coast of Nova Scotia and New Brunswick. Dulse is hand picked from these rocks, the harvest lasting for 5-6 months during the summer season. The picking takes place at low tide when the seaweed-bearing rocks are uncovered. The dulse is placed in motor-powered dories and taken ashore. It is laid out on rocks to dry in the sun, then packaged for human consumption. The most active harvest of dulse is carried out near Grand Manan, N. B. at Dark Harbour. Dulse is made up of over 25% mineral salts, having potassium, iodine, fluorine, sodium, calcium, phosphorus, iron, magnesium, copper, arsenic, manganese, zinc, nickel, cobalt, molybdenum, chromium, strontium, titanium and vanadium. Salts are present mainly as chlorides, sulphates, and phosphates.

(Ref: Trade News, July, 1960)

(x) Oysters (*Crassostrea virginica*)

(See "estuaries" section)