FISHES OF MAINE

MAINE DEPARTMENT OF INLAND FISHERIES AND GAME

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FOREWORD

The *Fishes of Maine* is presented by the Maine Department of Inland Fisheries and Game as a guide to fishermen in identifying the fish they catch and observe in our inland waters. The descriptions and life histories will perhaps add to the interest and enjoyment of the observations that fishermen make as they seek the many game fishes that live in the lakes and streams.

Scientific study and management of Maine's inland fisheries have progressed rapidly since 1950 (date of publication of the 1st Edition of the Fishes of Maine) under the administration of Commissioner Roland H. Cobb. Additional fishery biologists have been obtained from the best of the University of Maine graduates. The combination of good men and proper working environment has resulted in many studies yielding more and more information about Maine fishes. This information, much of it unknown before, has necessitated a second edition.

Each fishery biologist, as he plans and conducts his research projects, usually concentrates more on the study of a single species. This concentration makes possible a more intimate understanding of the life histories of our important game fishes. Several of the biologists have helped in the preparation of this book, and their names appear with the life histories they prepared.

The color print of the blueback trout was photographed by Mr. James G. Garvin, visual aids specialist for the Agricultural Extension Service and the Agricultural Experiment Station at the University of Maine. Mr. Carll Fenderson, Chief of the Information and Education Division, photographed the landlocked salmon, the largemouth bass, and the white perch. The remaining color plates were made from color prints taken by Mr. Arthur Rogers, Warden Supervisor. All color plates were prepared from the photographs of living fish by Mr. Robert Nichols of Waterville, Maine.

Mr. Kenneth White, Superintendent of the Craig Brook Federal Fish Hatchery, was very cooperative in providing the Atlantic salmon for the color plate of this species. Mr. Kenneth Shorey, Superintendent of the Enfield State Fish Hatchery, aided in the capture of the lake trout. Mr. Elmer Bickford, Superintendent of the Governor Hill State Fish Hatchery, cooperated in obtaining the rainbow and brown trout pictures. Mr. Robert E. Foye obtained the landlocked salmon, largemouth bass, and white perch. Mr. Bruce B. Collette, Research Assistant, Cornell University, very kindly furnished the life history material for the mud darter.

The keys to the families and species of fishes were modified to fit Maine fishes from those presented in the Fishes of the Great Lakes Region by Dr. Carl L. Hubbs and Dr. Karl F. Lagler, and published by the Cranbrook Institute of Science.

Mrs. Jane Rupp prepared the line drawings used to illustrate the characters for fish identification and designed the cover.

Mr. Kendall Warner reviewed the manuscript and offered many helpful suggestions.

W. Harry Everhart

Augusta, Maine
1958

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COLOR PLATES

FISH

A fish has been defined as, "a back-boned, cold-blooded animal adapted for a life in the water with limbs modified as fins, and obtaining oxygen from the water by gills throughout life." The number of different kinds of fishes present in the waters of the world today has been estimated at roughly 40,000. Since new forms are constantly being described this number is ever changing and always increasing. Fishes easily outnumber all other vertebrates combined, including the amphibians, reptiles, birds, and mammals.

A glance at the fishes inhabiting the waters of Maine will convince the observer that they are streamlined ideally for moving through the medium in which they live. In general the shape may be described as torpedo or "cigarlike." Some of the fishes have become rounded as the eels and others have become flattened from side to side as the basses and are known as compressed. Fishes of Maine are either rounded or compressed in body form.

Covering the fish externally is a layer of mucus secreted by the glands of the skin. This mucus protects fish from external infection. Fishermen have long been cautioned to wet their hands before handling fish which they intend to return to the water. Handling with dry hands would remove a large amount of this protective covering and leave the fish exposed to fungus and bacterial invasions. Immediately under the mucus lies the epidermis and under the epidermis are embedded the scales. The scales are laid down shortly after the fish is hatched and reflect changes which may occur in the life history of the fish. Age of fish can be determined from the number of year marks, and periods of good growth and poor growth can be detected from the spacing of the growth rings on the scale. Ages of fishes in this book refer to the number of completed year marks on the scale and conform to the manner in which we ordinarily report the age of a human. Among fishes of Maine the lamprey eel, hornpout, and freshwater sculpin are without scales. Scales of Maine fishes may be divided into the cycloid type and the ctenoid type. Cycloid scales are usually small, and embedded deeply in the skin. Trout and salmon are examples of fish with cycloid scales. Ctenoid scales have several rows of spines along their posterior or exposed edge. These spines, or ctenii, give the fish a rough or spiny feeling. Bass and white perch are examples of fish having ctenoid scales.

Fins of fishes are thin folds of skin supported by rays, spines, or both. Fish are frequently classified either as "soft-rayed" fish such as trout, or as "spiny-rayed" fish such as bass. Rays are finely segmented and often branched while spines are unsegmented, unbranched, and usually hard. Counts of rays and spines, since their number is reasonably constant, are frequently of value in identification of closely allied forms. Paired fins include the pectorals located behind the gill openings and the ventral or pelvic fins located on the lower side of the body.

Fish are frequently classified as to whether the fins are positioned posteriorly or anteriorly on the ventral side or belly of the fish. Most "advanced" fishes have the ventral fins placed under, or nearly under, the pectoral fins when the location is described as thoracic. If the ventral fins are in front of the pectoral fins then the location of the ventral fins is described as jugular. When the ventral fins are posterior their position is considered abdominal. Unpaired fins include the dorsal, adipose, caudal or tail fin, and the anal fin. Although a fish swims primarily by muscular movements of its body it depends on the caudal fin lending power to the movements, on the dorsal and anal fins for stabilizing the movement, and on the pectoral and ventral fins for steering and maneuvering.

Fish obtain their oxygen from water passing over the gills. Closing the gill covers, opening the mouth, and expanding the cheeks causes water to flow in. Closing the mouth, contracting the cheeks, and opening the gill covers causes water to flow out over the gills. Gills are made up of a fine network of capillaries or very small blood vessels with walls so thin that oxygen can pass from the water into the blood and carbon dioxide can pass from the blood into the water.

The manner of reproduction in fish is interesting and of great importance to correct management of the fishery concerned. Although internal fertilization and development are known in fishes all freshwater fishes of Maine fertilize the eggs externally. Development, therefore, takes place outside the body of the female. In some fishes the males take on spawning coloration or "breeding plumage" near and during spawning time. Approach of spawning season is the signal in most fishes for a migration to the spawning area. Distances traveled may be many miles as with Atlantic salmon or only a few feet as with lake trout. Certain fishes, particularly minnows and suckers, develop tubercles on the fins and head during the breeding season. These tubercles are more pronounced on males, and are used in grasping the female and in defending the spawning area. Some fishes build nests. Female trout and salmon have the job of preparing the nest, but neither parent assumes any responsibility once the eggs are fertilized and covered. Males of the sunfish family prepare the nest, and remain to guard the eggs and young. Many fishes prepare no nest, but merely broadcast the eggs which lie on the bottom among the rocks or aquatic plants. Pickerel and smelt are examples of the latter type. Most fish are polygamous with several males fertilizing the eggs of the female or with the eggs of several females fertilized by a single male.

Fishes may be classified in two categories according to their food habits. Those that feed on plankton are called herbivores and those utilizing insects and other fishes are known as carnivores. In many instances, the mouth and dentition serve as clues to the food habits of fish. An examination of the large mouth and teeth of the pickerel would leave no doubt as to the carnivorous food habits of this species. Like-

wise, the lack of teeth in the mouth of the whitefish would leave little doubt that this fish is primarily a plankton feeder. Fishes may travel together and feed in schools or may seek their food alone. Some species make characteristic daily migrations coming into shallow areas in the evening where they are readily taken by hook and line. Temperature plays an important part in feeding of fish. Extreme lows and highs tend to "throw the fish off their feed."

Sense organs of fish are variously developed. The eyes of the fish are very much like our own in their construction. However, the eyes of the fish are adapted for seeing only short distances. The question of whether fish can distinguish different color patterns has long been argued by scientists although at present most are in agreement with the fishermen in believing that fish can distinguish colors. The nostrils of a fish are located on top of the snout and open into small blind pouches lined with the organs of the sense of smell. Water is drawn in and out of the pouch. Although fish do not have an external ear they undoubtedly hear vibrations that are more readily transferred through the water. These vibrations travel through the skull to reach the inner ear. In addition, the lateral line organ of fish is reported as receiving vibrations of low intensity. The lateral line, easily observed along the sides of the fish, can be traced onto the head where it may divide into as many as five different branches.

The study of fish is interesting and far from complete. Fishermen and fishery scientists alike want to improve the quality of fishing. Only additional research by trained professionals can provide the methods for better fishery management.

IDENTIFICATION OF MAINE FISHES

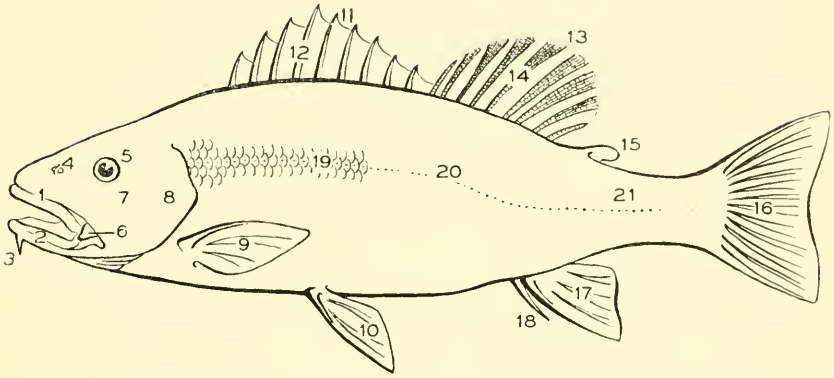
The average fisherman pursuing the sport of fishing for pleasure is little inclined to burden himself with the details of fish identification as practiced by the professional ichthyologist. Unknown animals or plants are identified through the use of keys defined as, "a tabulation of those characteristics which will most readily and reliably distinguish the form." An effort has been made to provide easily observed characteristics and to illustrate these characteristics whenever possible with line drawings emphasizing important features.

A great deal of confusion exists over common names of fishes. Common names used in this book are those proposed by the American Fisheries Society. Scientific names have been included as they are generally standardized throughout the world.

Before attempting an identification it is suggested that the reader acquaint himself with the drawing on page 9 representing a generalized fish and showing the location of the principal characters used throughout the keys.

The keys are designed to provide the observer with two choices. One of these choices will fit the fish you are trying to identify. Following the choices which fit the fish at hand will lead to the name of the specimen. First determine the family to which the fish belongs by consulting the key to families on page 10. Some families of fish found in Maine have only a single representative so that once the family is determined the name of the fish will be known. Other families may have several representatives. In this case determine the family to which the fish belongs and then turn to the page indicated and proceed through the key to the members of that family until correct identification is reached. Good practice in learning to identify fishes correctly would be the "keying out" of a specimen familiar to the observer.

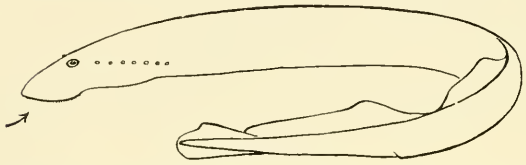
GENERALIZED FISH INDICATING CHARACTERS COMMONLY USED IN IDENTIFYING FISH



1. Upper Jaw (premaxillary and maxillary bones)
2. Lower jaw (dentary bone)
3. Barbel
4. Nostril
5. Eye
6. Maxillary barbel
7. Cheek
8. Bony gill cover
9. Pectoral fin
10. Ventral fin
11. Spiny dorsal
12. Fin spine
13. Soft dorsal
14. Fin ray
15. Adipose fin
16. Caudal fin
17. Anal fin
18. Anal spine
19. Lateral line scales
20. Lateral line
21. Caudal peduncle

KEY TO THE FAMILIES OF FRESHWATER FISHES OF MAINE

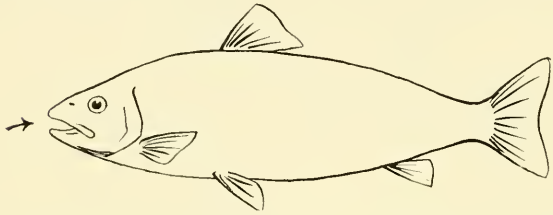
1. Mouth a sucker-like disc without jaws; gill openings seven; paired fins absent



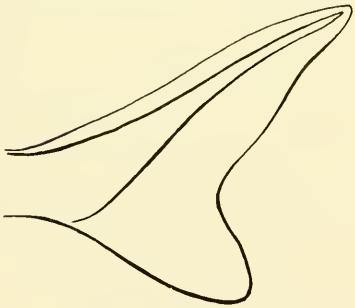
Sea Lamprey
Petromyzonidae

p. 16

Mouth with true jaws; gill slits four, protected by a gill cover; paired fins present 2



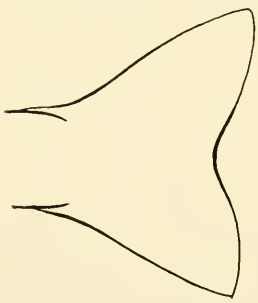
2. Caudal fin not symmetrical (heterocercal), caudal vertebrae extending into the upper lobe of the caudal fin



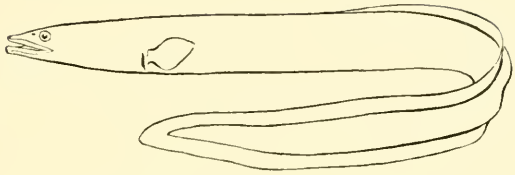
Atlantic Sturgeon
Acipenseridae

p. 18

Caudal fin more or less symmetrical (homocercal) 3

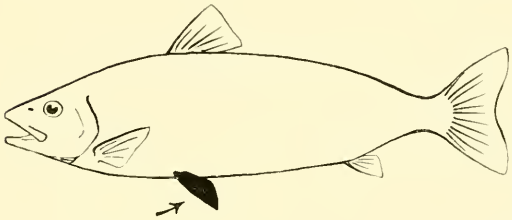


3. Body eel-shaped; ventral fins absent

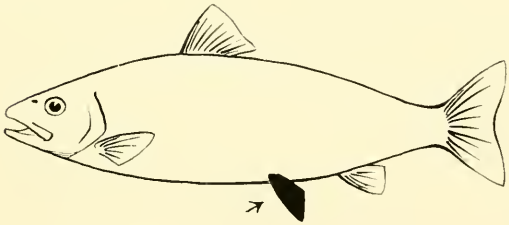


American Eel
Anguillidae
p. 69

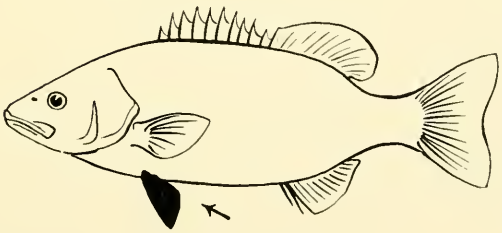
Body not eel-shaped; ventral fins present 4



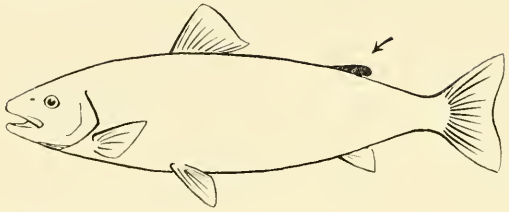
4. Ventral fins abdominal, inserted a considerable distance behind the pectorals 5



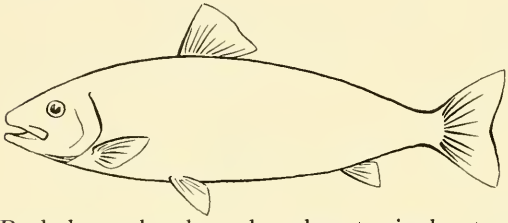
Ventral fins thoracic (in close proximity to the pectoral fins but behind) or jugular (ventral fins anterior to pectoral fin) 13



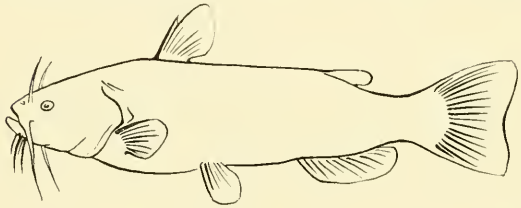
5. Adipose fin present 6



Adipose fin absent 9



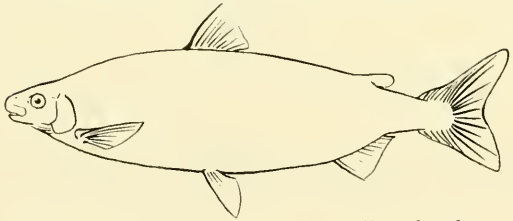
6. Barbels on head; scales absent; single stout spine in dorsal and pectoral fins



Brown Bullhead
Ictaluridae
p. 67

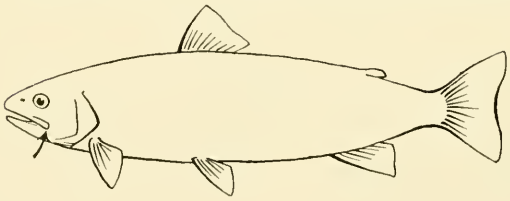
Barbels absent; scales present; pectoral fins without spines .. 7

7. Mouth small; upper jaw not extending back to below center of eye; teeth on jaws and tongue weak

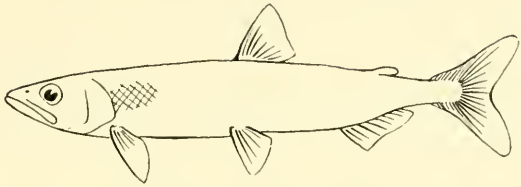


Whitefishes
Coregonidae
p. 52

Mouth large; upper jaw extending back at least to below center of the eye; strong conical teeth on jaws and tongue 8

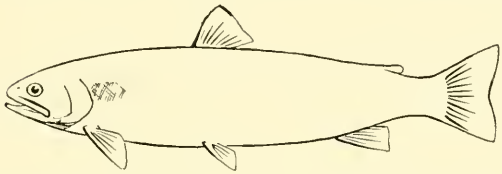


8. Scales large, fewer than 75 along lateral line



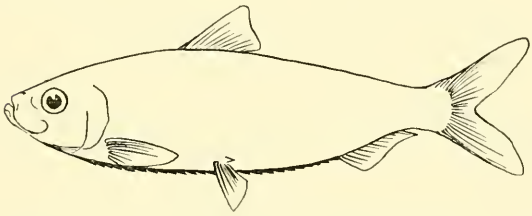
American Smelt
Osmeridae
p. 55

Scales small, more than 105 along lateral line



Salmon and Trout
Salmonidae
p. 21

9. Midline of belly provided with saw-like keel

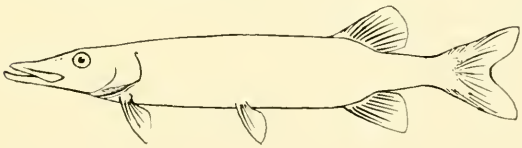


Alewife
Clupeidae
p. 19

Midline of belly without a saw-like keel 10

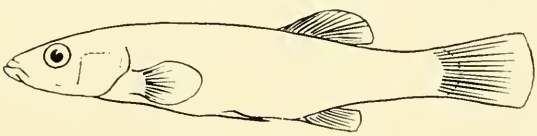
10. Head scaly or partially scaly 11
Head without scales 12

11. Jaws elongated, shaped like a duck's bill; large irregular teeth; caudal fin forked



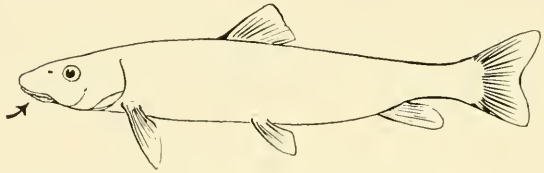
Chain Pickerel
Esocidae
p. 68

Jaws not elongated; teeth weak; caudal fin more or less rounded



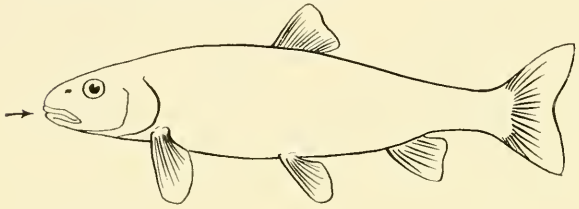
Killifish
Cyprinodontidae
p. 70

12. Mouth points downward (inferior), is sucker-like with thick, papillose lips; dorsal fin with 10 or more rays



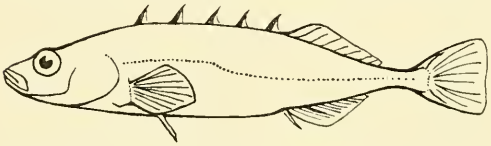
Suckers
Catostomidae
p. 57

Mouth opening toward the front (terminal or subterminal); dorsal fin with less than 10 rays



Minnows
Cyprinidae
p. 61

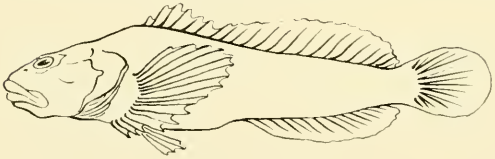
13. Dorsal fin preceded by free dorsal spines



Sticklebacks
Gasterosteidae
p. 91

Dorsal fin not preceded by free dorsal spines 14

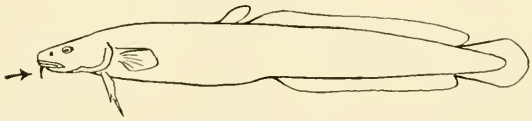
14. Body scaleless, but may be covered with spines or prickles; head large; eyes in top of head; pectoral fins large



Sculpin
Cottidae
p. 90

Body with scales 15

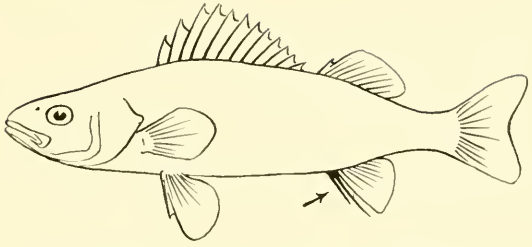
15. Single median barbel on chin



Burbot
Gadidae
p. 71

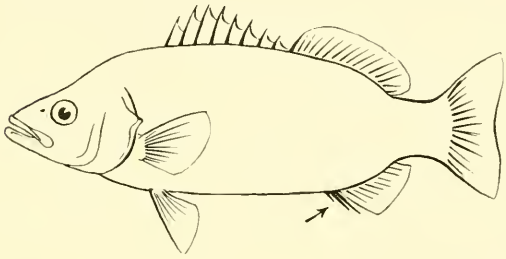
No barbel on chin 16

16. Anal spines 2 or less

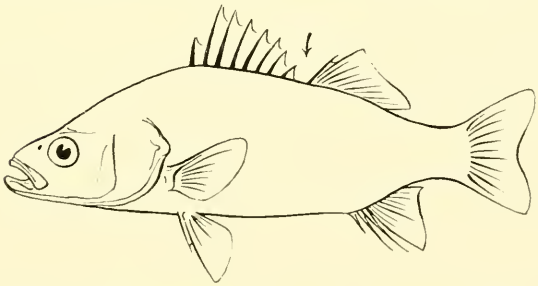


Perch
Percidae
p. 75

Anal spines 3 or more, the first spine is short and sometimes difficult to observe 17

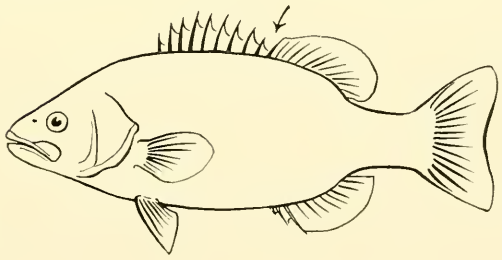


17. Dorsal fins entirely separated or but slightly joined



White Perch
Serranidae
p. 73

Dorsal fins confluent; without longitudinal dark stripes or with only one



Sunfishes
Centrarchidae
p. 78

LAMPREY FAMILY (Petromyzonidae)

SEA LAMPREY

Petromyzon marinus Linnaeus

The sea lamprey is eel-like in appearance with a soft cartilaginous skeleton, and represents a primitive group of fishes. Distinctive characters are the round jawless mouth and the row of seven gill openings along each side just behind the head. General range is the Atlantic coasts of Europe and North America from Labrador south to Florida in the Western Atlantic. In recent years sea lampreys have become landlocked in the Great Lakes basin where they have almost eliminated some commercial and sport fisheries. Fortunately distribution in Maine is confined to coastal rivers and their tributaries.

Sea lampreys spend their adult life in marine waters returning to freshwater rivers to spawn during May and early June. As spawning time approaches the digestive tract degenerates and the entire activity and metabolism of the animal is concentrated on reproduction. Peak of the spawning runs occurs at night although stragglers can be observed moving upstream at all times. These migrating lampreys are seeking a suitable area in which to build their nests. Usually nests are constructed in a rapidly moving current with a good volume of water and with a gravelly bottom. Nests are rarely constructed in water over two feet deep.

Males make their way up the streams into freshwater spawning areas first and do most of the nest construction carrying stones in their sucking mouths. After the female arrives on the spawning area she may or may not help with the nest. Nest completed, the male grasps the female behind the head and wrapping his body around hers shakes vigorously. Nonadhesive eggs are released, fertilized, and deposited at the bottom of the nest in the gravel. A single female may have as many as 235,000 eggs. Spawning completed, the adults drift downstream to die.

Several days later larval lampreys, called ammocoetes in this stage, emerge from the nest and drift downstream seeking an area where the gradient has leveled off and flow is slight. Here they burrow into a mud bank. These nonparasitic larvae feed for three to five years on organic material strained from the water. At the end of the larval period, at a length of four to six inches, they transform into the adult stage. The transformation takes about two months and during this period the larval lamprey loses the fringe of cirri, the eyes come to the surface, and the horny teeth on the rasping tongue are developed along with anticoagulent secreting glands.

Along the coast of Maine these newly transformed lampreys begin their migration to the sea in the fall before the streams are ice covered.

Once in the ocean the lamprey begins to feed parasitically on other fishes by hanging on with its sucking mouth and rasping with its tongue to obtain nourishment in the form of the blood and other body fluids of unfortunate victims. After several years of parasitic life the lamprey is mature and begins the spawning migration back to fresh water completing the life history. The entire life cycle takes five to eight years.

Lampreys, on their spawning runs in Maine coastal streams, will average between two and two and one-half feet in length although exceptional lengths of three feet have been observed.

Although the lamprey has become adapted to an entirely freshwater environment in the Great Lakes and has seriously depleted fish populations in these waters, there is as yet no evidence that any of our freshwater game fish populations have been harmed in Maine.

STURGEON FAMILY (Acipenseridae)

ATLANTIC STURGEON

Acipenser oxyrhynchus Mitchill

The Atlantic sturgeon is covered by bony plates in the head region and has five rows of bony shields or scutes extending the length of the body. The snout is flattened and elongated. The tail is asymmetrical with the dorsal lobe of the caudal fin being much larger and containing the up-turned vertebral column. General range is both sides of the North Atlantic from north of the St. Lawrence River to the Gulf of Mexico along the American coast.

In the past sturgeon were reported from nearly all of our coastal rivers and streams. Now the present scarcity of these fish makes capture in commercial fisheries an infrequent occurrence. Lengths of up to 18 feet have been reported. Mr. Sidney Johnson of Winterport was kind enough within the last year to save a four-pound sturgeon for the University of Maine teaching collection. Mr. Johnson fishes several nets in the Penobscot River estuary and reports that sturgeon are certainly not numerous, but on the other hand they are not surprised when the nets yield a specimen.

The Atlantic sturgeon is anadromous running to fresh water to spawn. Life history studies estimate the age as 20 to 30 years before they spawn for the first time. Females may spawn as many as 2,000,000 eggs, but present knowledge indicates that breeding probably does not take place every year. Sturgeon prefer to spawn in running water as much as 10 feet deep over small rubble or gravel. Adult fish begin spawning runs about the same time as shad and alewives in the spring but actual spawning may not take place until July. There is no parental care of eggs or young. Young sturgeon hatch a few days after spawning, and spend the first few years of their life in the lower tidal reaches of the river.

The mouth of the Atlantic sturgeon is located underneath the elongated and flattened snout, and is preceded by four barbels. Such an arrangement suits the needs of a bottom-feeding fish. As bottom mud is disturbed the sensitive barbels are quick to detect any food items that may be uncovered and the protrusible mouth is used to suck up the food. Teeth are present in only very young sturgeon.

Scarcity of numbers precludes a large commercial market. Roe of the sturgeon is the well-known caviar.

HERRING FAMILY (Clupeidae)

ALEWIFE

Alosa pseudoharengus (Wilson)

The alewife is the most numerous of fishes migrating up Maine's coastal streams and rivers. The row of spiny scutes along the midline of the belly is a distinguishing character and has been responsible for the common name, "sawbelly." General range of the alewife is from Nova Scotia and the Gulf of St. Lawrence to the Carolinas. Although landlocked populations are abundant in the Great Lakes and New York's Finger Lakes, alewives of Maine spend the larger portion of their life history in the ocean.

Spawning runs of adults begin the latter part of April and continue on into June in more northern waters. As the end of the spawning run approaches, ripe fish on their way upstream are passing spent fish returning to the ocean, although some adults may stay in fresh water until December. Average length of migrating adults is slightly less than one foot in Maine with an average weight of one-half pound. Fish may be 3, 4, 5, or 6 years old but the majority of the spawning run will be 4- and 5-year-olds. A fairly significant percentage return to spawn again. Movement takes place largely during daylight hours. Most of the runs are restricted to a few miles, but alewives reach the headwaters of the Narraguagus and East Machias Rivers in their search for a freshwater pond.

Females will deposit from 60,000 to 100,000 eggs depending on the size fish. The eggs fall to the bottom where they attach to stones, sticks, and any other objects that may be present. Neither eggs nor young receive any parental care. Young alewives hatch in slightly less than a week and spend their first, or at least part, of their first summer in the freshwater pond growing rapidly on a diet of minute animals and plants. Fishes utilizing this type of diet are referred to as plankton feeders. Young alewives begin their seaward migrations about the middle of the summer and the migration continues as late as November. Size at migration varies with the length of time spent in fresh water after hatching and may range from 1½ inches to 6 inches. Observations made as part of the study of anadromous brook trout indicate that one and two-year-old alewives frequent estuaries in large numbers apparently as part of their feeding activities.

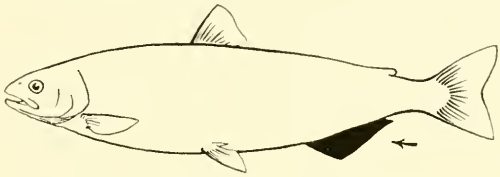
There is a direct correlation between size of run and available lake area. A properly managed alewife fishery must provide for some escapement of adults to provide young stock. Fishways must be constructed where barriers exist to permit easy passage upstream for adults and for downstream passage of young. Many runs of alewives have been reestablished in Maine rivers during the past few years.

Alewives are valuable for their commercial fisheries and also as food for game fish. The alewife fishery in Maine is largely with dip nets used during the spawning migration of adults. Migrating adults are easily diverted into pools or runways where they are dipped and removed. Necessary fish meal for fertilizers and the protein content of animal foods provides the major markets. The small alewife converts plankton into protein and is in turn eaten by game fish. This increases the productivity of lakes to support game fish and improves our sport fisheries.

SALMON FAMILY (Salmonidae)

Key to the many members of salmon and trout found in Maine

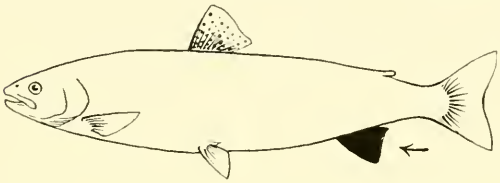
1. Dorsal fin seldom spotted; anal fin longer than high with 13 or more developed rays



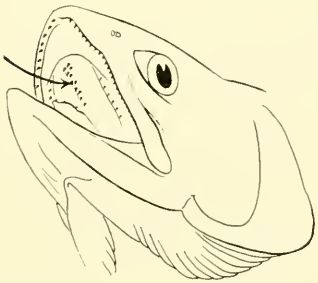
Pacific Silver Salmon
Oncorhynchus kisutch
(Walbaum)

p. 25

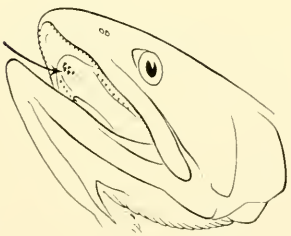
Dorsal fin usually with many black spots in young and adults; anal fin higher than long with 12 or less developed rays . . 2



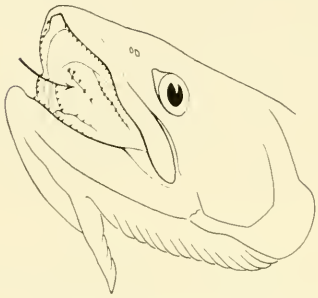
2. Black or red spots (Atlantic salmon up to two years have a few red spots); vomer (bone in center of roof of the mouth) with a plain shaft bearing teeth in alternate rows; scales conspicuous 3



Gray or red spots; vomer (bone in center of roof of the mouth) with shaft depressed, toothed only on anterior end; scales inconspicuous 5



3. Vomerine teeth little developed with those on the shaft of the bone few and deciduous



Atlantic or

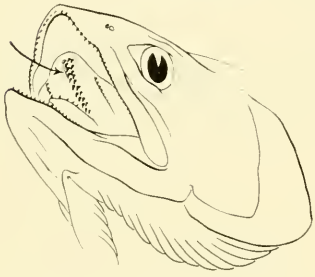
Landlocked Salmon

Salmo salar Linnaeus

pp. 27, 31

(Ichthyologists do not presently consider that there are enough anatomical differences between the Atlantic and landlocked salmon to distinguish between them on a subspecific level.)

Vomerine teeth well developed, numerous and persistent in a double or zig-zag row 4



4. Caudal fin heavily spotted with black; adipose fin spotted or margined with black; no red spots. Red stripes on the sides of the body and gill covers of spawning males during the early spring turning to a faint pink band the remainder of the year

Rainbow Trout

Salmo gairdneri Richardson

p. 39

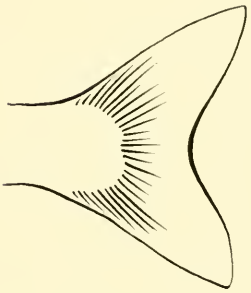
Caudal fin not spotted with black, adipose fin margined with red or orange never with black; general color brownish yellow

Brown Trout

Salmo trutta Linnaeus

p. 35

5. Caudal fin deeply forked; large whitish spots on background of darker color; no red spots; fins uncolored; general color usually dark gray

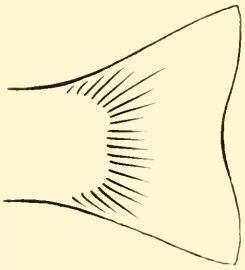


Lake Trout

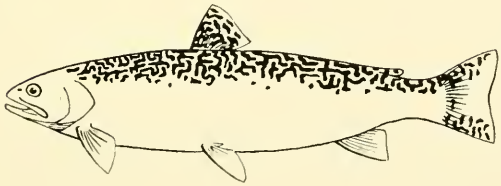
Cristivomer namaycush (Walbaum)

p. 43

Caudal fin little forked; red or orange spots; no black spots . . 6



6. Obvious dark, wavy, worm-like lines on the back



Eastern Brook Trout

Salvelinus fontinalis (Mitchill)

p. 47

No obvious dark, wavy, worm-like lines on the back 7

7. Back brownish colored; anal fin rays usually 8

Sunapee Trout
Salvelinus aureolus Bean
p. 49

Back dark blue; anal fin rays usually 9 or 10

Blueback Trout
Salvelinus oquassa (Girard)
p. 51

(It is difficult to find distinctive differences between these two trout. At least one ichthyologist is inclined to lump them together as populations of Arctic Charr, *Salvelinus alpinus* (Linnaeus).)

PACIFIC SILVER SALMON

Oncorhynchus kisutch (Walbaum)

Each of the five Pacific salmon has been introduced into Maine waters at one time or another, but only a few populations of silver salmon remain at present.

Silver salmon were introduced initially into Maine during May of 1905. One million, three hundred thirty-six thousand fry were distributed in the Piscataqua, Saco, Kennebec, Damariscotta, Penobscot, Narraguagus, Dennys, St. Croix, Aroostook, Union, and Orland Rivers. Eggs were obtained from the State of Oregon and hatched at the Craig Brook Fish-Cultural Station at East Orland.

Silver salmon were stocked from 1943 to 1952 in the Pemaquid River, Tunk Stream, Chandler River, Ducktrap River, and Cove Brook to supply an additional fishery in estuaries and streams that did not support runs of Atlantic salmon. One hundred and fifty adults were estimated to have returned to the Ducktrap River in November of 1947, and a few were captured. Twenty-one adult silvers were seined and scale samples taken at the mouth of the Ducktrap River in November of 1952. Reports of adult silver salmon in the Chandler River have been checked from time to time but the fish have not been observed by fishery biologists.

Eleven small silver salmon were taken in the fall of 1956 in the Cove Brook trap operated as part of the Atlantic salmon program. These grilse, or "jacks" as they are called on the Pacific Coast, ranged from 11.1 to 13.2 inches in total length. Four of these fish were definitely ripe males. An interpretation of the growth patterns on the scales revealed that the fish were two-year-olds having spent the first summer following hatching in fresh water and the second year in the marine environment. Lengths and weights of these fish were average and compare favorably with those for precocious male silver salmon on the west coast of Canada. The normal life cycle of the silver consists of one year in fresh water and two in salt water. Variations in these periods can be expected.

Five mature silver salmon were taken at the Cove Brook trap in the fall of 1957. These mature adults ranged from 24.5 to 30.5 inches in total length and from 5 pounds 5 ounces to 9 pounds 5 ounces in weight. The fish were the result of natural propagation and were in excellent shape. Examination of the growth patterns on the scales indicated the average life cycle of three years at maturity.

ATLANTIC SALMON

ATLANTIC SALMON

Salmo salar Linnaeus

Richard E. Cutting

Atlantic Salmon Commission

Atlantic salmon were originally distributed on both sides of the Atlantic Ocean from Portugal north into the White Sea on the European continent and from the Delaware River north into Hudson Bay on the North American continent. The number of Maine rivers originally supporting salmon runs exceeded 20. That number has declined to less than nine, although stray fish appear in other streams. Dams that block migration of mature adults upstream have been the major cause of decline. Atlantic salmon must reach the spawning and nursery areas if thriving populations are to be maintained.

The majority of adult Atlantic salmon enter rivers in the spring taking advantage of the freshets occurring at this time, although fresh-run fish in September and October are common. A good salmon river should have cool, deep, shaded resting pools where adults are protected until spawning time in the fall. Fresh-run salmon are silvery with a light green-brown back. Maturing fish in fresh water become mottled and darker; the back takes on a dull brownish-red hue and the underside begins to tinge with dull red. Mature males also possess elongated jaws with a prominent hook, or kype, at the tip of the lower jaw.

Although Atlantic salmon do not necessarily die after spawning it is certain that the majority are making their first spawning migration and are referred to as maiden fish. Approximately 85 percent of the fish are returning to fresh water for the first time and are usually at least four or five years old. Small salmon weighing up to five pounds have spent only one year in the ocean and are known as grilse. Grilse are sexually mature and almost invariably males. Unusually large fish may be either returning to spawn again or fish that have stayed an extra year or two in the marine environment.

Adult Atlantics begin their spawning runs in the spring, but the actual spawning period extends from October through into November with peak activity during the last week in October. A river must provide adequate riffle areas of gravel and rubble with clean, cool running water to insure successful natural reproduction. Ripe females will choose a nesting site at the head of a riffle or the tail of a pool where the water is accelerating. Nesting areas of salmon and trout are frequently referred to as redds. Each nest or redd contains several egg pits.

The female digs the egg pit by turning on her side and flapping vigorously with the caudal fin and peduncle. Most of the digging is the result of the water currents created rather than the actual contact of the body. Digging activity is alternated with frequent rest periods. The male spends his time courting the female or driving away smaller or less vigorous males from the area. When the egg pit is finished the female settles into the depression, the male swims into position beside her, and the eggs and milt are extruded into the pit. Eddy currents in the egg pit mix the eggs and sperm for efficient fertilization and hold the eggs in the pit until the female can cover them with gravel. Frequently the male salmon parr (4 to 6 inches in length) mature early and participate in the spawning act. Experiments have demonstrated that parr-fertilized eggs are just as viable as if fertilized by an adult male. When spawning is completed in the first egg pit the female moves upstream to dig the second pit. As the gravel is displaced it is carried downstream to cover eggs in the pit below. A ten-pound female will normally deposit about 8,000 eggs. A completed salmon nest will measure from 3 to 20 feet in length and from 2 to 3 feet in width. Eggs are usually buried 5 to 6 inches deep, but may be found as deep as 10 inches.

After spawning the adults (called kelts at this time) for the most part migrate back to the ocean. However, some remain overwinter in fresh water and return to the ocean in the spring. These thin dark fish are called blacks or racers and are taken by anglers in the early spring.

The thick-walled eggs develop slowly in their gravel nest as cold water percolates through the egg pits keeping the eggs moist and supplied with oxygen. Young salmon hatch from the egg during late March or early April but will remain in the gravel for about six weeks until the yolk sac is absorbed. Then the fry, as these little salmon are called, wiggle up between the stones and begin to swim and feed. As growth continues the small salmon are called parr because of the dark stripes or parr-marks on their sides. Salmon parr remain in freshwater streams for two or three years. Thus the best salmon rivers must provide extensive nursery areas where young fish can find sufficient food and good protection from predators. Salmon parr are able to withstand higher temperatures than brook trout and consequently may be found throughout the summer in the riffle areas of our larger rivers when trout have migrated to colder waters. As the time to leave the freshwater life approaches parr turn silvery and are known as smolts. Smolts, from 5 to 9 inches in length, migrate to the ocean where they usually spend two years. It is during this period that the Atlantic salmon makes its rapid growth. As the salmon becomes mature the life cycle is completed with the spawning migration to fresh water. Most salmon return to the stream in which they were spawned and reared.

Atlantic salmon average about 2½ inches at the end of the first summer, 4½ inches at the end of the second, and 7 inches at the end of

the third summer. Adults that have spent two years in the ocean are between 29 and 32 inches in total length and weigh about 10 pounds. Larger fish are common.

LANDLOCKED SALMON

LANDLOCKED SALMON

Salmo salar Linnaeus

KENDALL WARNER

Regional Fishery Biologist

Landlocked salmon, a native of Maine, are one of the most important coldwater game fish. Maine maintains the reputation of possessing the largest sport fishery for landlocks in the world, although this fish has been widely distributed in many other states and in foreign countries.

Landlocked salmon were originally restricted to the lakes of four different river basins in Maine: St. Croix River drainage in Washington County, including West Grand Lake; Union River drainage in Hancock County, including Green Lake; Piscataquis River sub-drainage of the Penobscot River system in Penobscot County, including Sebec Lake; and the Presumpscot River drainage in Cumberland County, including Sebago Lake. Since 1875 the landlocked salmon has been widely distributed throughout the State by fish culturists.

Ichthyologists, studying the taxonomic characters of the Atlantic and landlocked, now consider them to be essentially the same fish structurally. However, populations vary as Atlantics run to salt water and landlocked populations spend their entire life in fresh water.

Spawning takes place in the fall, primarily between October 15 and November 30. However, migrations to spawning areas may commence weeks earlier and salmon may be found gathered near tributary mouths as early as the first week in September. Salmon reproduce successfully in lake inlets and outlets in swift riffle areas with gravel or rubble bottom. The female constructs the same type of nest as the Atlantic salmon digging pits by turning on her side and flapping vigorously with the caudal peduncle and caudal fin.

Long-term research studies by Maine biologists demonstrate the preference of the landlocked for outlets of lakes. The greater majority of mature salmon migrating to the outlet of a lake to spawn return to the lake. Salmon will also spawn on lake shoals and at the mouths of tributary streams when they are unable to reach the desirable outlet streams, but the success of this spawning, while of doubtful value, is unknown. At one time fishermen were prone to insist that lake outlets be screened to prevent the "loss" of fish downstream. Now, most appreciate the fact that salmon must reach a specific area to obtain the best natural reproduction and make the largest contribution to the sport fishery.

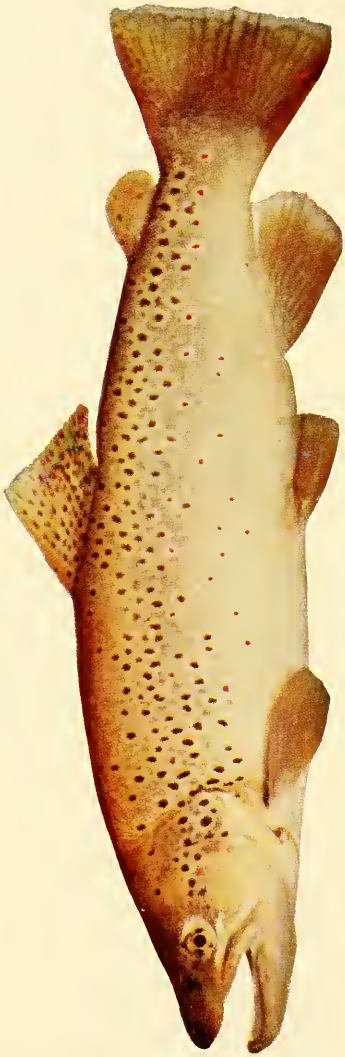
The spawning run of salmon in one of Maine's larger lake chains is composed primarily of fish of age 3, 4, 5, and 6. Most female salmon in these waters mature to spawn first at age 4 or 5, while most male salmon spawn first at age 3 or 4. A few females mature at age 3, and many of the small precocious young male parr are ripe at ages 1 and 2. Seventy percent of each spawning run is composed of salmon spawning for the first time. Most fish over five years old have spawned at least once previously. Some salmon spawn for several consecutive seasons and some skip one or two years between reproductive cycles. Salmon lose considerable body weight during the spawning and even by the following spring may appear long and thin. Such fish are called "racers" by anglers. Many weeks are required before these fish regain their normal body condition.

Landlocked salmon fry emerge from the gravel during the first two weeks in June and begin feeding on small aquatic insects and other invertebrates. These young salmon, called parr at this stage, remain in the river or stream for one or two years before migrating to the lake.

Diet gradually changes from insects to fish after migration to the lake. Presence of adequate forage fishes may be a key to the success of salmon. Principal forage species for salmon in Maine are smelts, young alewives, sticklebacks, yellow perch, and minnows. Many other fishes are utilized on occasion.

Most of the landlocked salmon taken by Maine fishermen are ages 3, 4, 5, and 6. Few fish older than age 7 are taken. Maximum recorded age in a Maine lake is 11 years. The legal length of 14 inches is attained in most waters at age 3, although some populations may exhibit slower growth and not become legal before reaching age 4 or 5. Exceptional growth may bring them into the fishery at age 2. Average growth rate of landlocked salmon in Maine is:

	Age								
	1	2	3	4	5	6	7	8	9
Total length (inches)	5.9	11.6	15.2	18.1	20.3	22.2	23.5	25.2	27.9



BROWN TROUT

BROWN TROUT

Salmo trutta Linnaeus

Carll N. Fenderson, *Chief*

Information and Education

Few freshwater game fish have attracted more attention and been the subject of more controversy and misinformation than the brown trout.

Originally distributed over a wide area on the continent of Europe and the British Isles, the brown trout became established in many geographically isolated drainages. Populations in Scotland, for example, exhibited color characteristics and minor physical features that differed from those exhibited by the same species in the Swiss highlands. Identification was further complicated in early European sport fishing history by sea-run populations present throughout most of its original range. Coming as it did from various European areas, the brown trout was called a variety of common names.

Many of these local names, originating in Europe, followed the introduction of brown trout into North America in the latter part of the nineteenth century. Some of the more commonly used names are Scotch sea-trout, sea-run brown trout, Von Behr trout, Loch Leven trout, German trout, and Swiss lake trout.

Brown trout exhibit a greater range of color variation than native salmon and trout. The typical brown trout is yellowish brown with large brown or black spots on its sides, back, and dorsal fin. These spots are usually surrounded by faint halos, and a few red or orange spots on the sides are usually evident. The adipose fin may be spotted with orange or red. However, brown trout are taken in Maine waters each year and commonly identified by fishermen as landlocked salmon because of silvery coloration and their close physical resemblance to the salmon. Sea-run brown trout may closely resemble the Atlantic salmon, both in shape and coloration. Differences in the vomerine tooth structure constitute the most reliable field character for distinguishing brown trout from native salmonids (see page 22).

One of the first introductions of brown trout in the United States was in Branch Lake, Ellsworth, Maine in 1885. Until the early 1930's brown trout were stocked in large numbers throughout the state, but modern fishery management methods in Maine have recommended a much more restricted use of hatchery-reared brown trout. Present Inland Fisheries and Game Department policy is to stock brown trout in only those waters where they will not compete with the native brook

trout and landlocked salmon. Brown trout populations have become established in a number of waters in Maine ranging from Aroostook County to the southern tip of the state. The species is common in southern and coastal freshwater lakes and streams, but abundant in only a small percentage of these. Small populations of brown trout are known to exist in several of Maine's major salmon and trout waters in northern and inland sections.

Living requirements of the brown trout are less critical than those of the brook trout and landlocked salmon. Brown trout are able to withstand higher water temperatures than brook trout, and the brown's ability to compete for food and space and to reproduce its kind under conditions considered adverse for other salmonids are important considerations in management of this species.

Unfortunately the brown trout's ability to adapt itself to a wider range of living conditions than native salmonids is not matched by its "catchability." Fishery research in Maine has shown that the average fisherman has difficulty catching brown trout and, measured in terms of return to the angler in relation to the angler's hourly effort, this species becomes a poor investment for any water area capable of supporting native salmonids.

Brown trout spawn in Maine from October through February. They are normally a stream spawner, and select coarse rubble bottom in riffle areas similar to those selected by landlocked salmon. Spawning may, however, take place under a variety of conditions ranging from lake shores to tiny lake tributaries when ideal conditions are not available, although results may be meager. A large female will usually dig three or four egg pits up to 12 inches deep, distributed along an area which may extend 20 to 30 feet along the stream bottom. Males defend their chosen territories against the intrusion of rival males prior to the actual spawning act. The young hatch out the following spring, and normally spend the first two to three years of life in the parent stream feeding on insects and other minute animal life. Later, moving out into the lake, they depend more and more on a fish diet as they increase in size. Growth is frequently obtained at the expense of other kinds of fish present since the brown trout is a fierce competitor once it becomes well established.

Growth rates vary considerably from one body of water to another. The following table represents an average growth rate for brown trout in Branch Lake:

	Age									
	1	2	3	4	5	6	7	8	9	10
Total length (inches)	4.1	5.7	12.0	15.8	19.8	23.4	24.7	26.8	27.1	27.6

Brown trout, once they have become well established in a lake, tend to increase in average size and at the same time become increasingly difficult to catch. A few trophy-sized brown trout coming from a lake sometimes leads to the mistaken idea that this species is producing excellent fishing, even though the total number of fish taken is low. This does not mean that brown trout do not have a place in fishery management in Maine. It does mean that management of this species must be carefully controlled.

RAINBOW TROUT

RAINBOW TROUT

Salmo gairdneri Richardson

LYNDON H. BOND, *Assistant Chief*

Fishery Research and Management Division

Rainbow trout were introduced in Maine from the West Coast of the United States. Their original distribution was from southern California to southern Alaska, but the successful propagation in hatcheries has resulted in introductions in many other sections of the United States.

Rainbow trout that migrate to the sea are known as "steelheads" and those that remain in fresh water are called rainbows. In Maine there are no sea-run rainbows or "steelheads." All of the populations are resident in a limited number of streams in the Kennebec, Androscoggin, and Aroostook River basins.

Kennebec River rainbow trout are confined to the section of the river from Wyman Dam in Bingham to the Solon Flowage above the town of Solon. Rainbow trout are present above Wyman Dam in Pleasant Pond Stream and a few, below Solon Dam; but the major sport fishery is in the four miles of main river immediately below Wyman Dam. The Androscoggin River rainbow trout fishery is confined to the cold, spring-fed tributaries of the upper Androscoggin River in Oxford County. The Aroostook River has a few rainbow trout and they are occasionally taken by anglers in the main river.

The rainbow is the only spring-spawning trout in Maine. Studies on the Kennebec River, in 1954 and 1955, indicated spawning started about April 20, but the spawning period may extend from February to June. Spawning was observed in all tributary streams accessible to the rainbow trout, including streams that did not maintain a flow throughout the summer. The rainbow usually spawns for the first time at the beginning of its fourth growing season. Majority of the spawning run is made up of fish spawning for the first time; however, the same fish may spawn as many as three or four times.

When the fish become mature and enter tributaries to spawn they are quite silvery in appearance. As actual spawning time approaches, this silvery coloration darkens. Prominent pink or reddish stripes develop along the sides and the black spots on the body and fins show very clearly. Older male rainbow develop a prominent, hooked lower jaw and take on the typical slab-sided characteristics of an adult spawning male. The spawning female is more silvery with less prominent reddish stripes on the sides and with a rounded body conformation.

Areas selected for spawning are in fast moving riffle areas of a stream on gravel and rubble bottom free of silt. Size of the redd, constructed by the female, varies from one foot to two feet wide and from two feet to four feet long, depending on the size of the spawning fish. Excavation of a rainbow trout redd in the Kennebec River study confirmed the efficient fertilization of naturally spawned eggs.

At the time the eggs are laid, water temperatures are in the low forties, and egg development is slow. As the water warms, the eggs develop more rapidly. At an average water temperature of 50 F., hatching takes place about 30 days after the eggs are laid in the gravel. Young rainbows remain buried in the gravel until the yolk sac is entirely absorbed. When the reserve food of the yolk sac is used young rainbow move up through the gravel to the flowing stream. The fish are now known as advanced fry. In the Kennebec River study fry emerged from the nest by July 15.

Feeding begins on minute particles of food that flow by as the small fry remain on, or near, the stream bottom. Food of young rainbow trout consists of insects and crustaceans and, as they reach adulthood, fish become an important item of the diet. At the end of the first summer of growth, young rainbows will be three to four inches in length, and are known as fingerlings. At this time the parr markings of dusky vertical bands on the sides are clearly visible. Some rainbows move downstream as advanced fry, some remain in the stream a year or more, and others may become resident in the stream of their birth and remain throughout their life in a limited area.

Age and growth of 41 rainbow trout taken by fishermen in the Kennebec River and tributaries from Pleasant Pond Stream in Caratunk to Solon Dam in Solon follow:

	Age				
	2	3	4	5	6
Total length (inches)	9.7	12.5	17.3	20.1	21.1

The rainbow trout in the Kennebec River attain legal length (6 inches) in September of their second summer of growth. Six specimens taken by anglers in September averaged 8.9 inches in total length. The bulk of the fishery is made up of fish in age groups 2 and 3 in their third and fourth summer of growth.

Rainbow trout will probably always be limited in their distribution in Maine. They seem to demonstrate greater migratory tendencies than either brook or brown trout and this characteristic tends to make it difficult to establish the species. Feeding habits and spawning requirements

of the rainbow are very similar to our native salmon and brook trout. The State of Maine is famous for its landlocked salmon and brook trout fisheries and it would be unwise to encourage distribution of the rainbow trout in brook trout and salmon waters.

LAKE TROUT

LAKE TROUT

Cristivomer namaycush (Walbaum)

STUART DEROCHE

Regional Fishery Biologist

Lake trout, more commonly called togue in Maine, are distributed from Labrador to Alaska, south to California, and through the Great Lakes to northern New England. Distribution in Maine is confined to the large, deep, coldwater lakes, and they thrive best in lakes with irregular bottom contours and with shore lines covered with boulders and gravel. The lake trout is the second largest member of the salmon and trout family with recorded weights of as much as 80 pounds.

Lake trout are lake dwellers; however, in more northern latitudes where water temperatures are not a limiting factor, they are occasionally found in rivers. During spring and fall when the waters are cold these fish may inhabit shallow water, but at other times they live in deep water where temperatures are colder and more favorable. Lake trout have been taken at depths exceeding 300 feet.

In Maine, lake trout can be found in shallow water over a coarse gravel or boulder-covered bottom from mid-October until mid-November engaged in their annual spawning activity. Spawning commences with the males entering the spawning area first. Unlike most other species of trout and salmon no nest is prepared. However, the males appear to clean the rubble by swimming close to the bottom and occasionally flipping the rocks with their caudal fins and peduncles. Evidence that lake trout have "worked" an area is apparent in the rather large areas of silt-clean rocks and gravel. A few days later females enter the area and spawning commences. The spawning season is approximately 20 days. No particular changes occur in either sex during spawning season as is common in other members of the salmon and trout family.

Tagging experiments in Maine have established definitely that lake trout, once sexual maturity has been reached, return each year to spawn. The number of years a lake trout will spawn successfully varies, but growth curves from various Maine lakes indicate a heavy natural mortality after the ninth or tenth year. Thus a maturity of five or six years for males and three or four years for females would be possible.

Lake trout have been observed spawning in depths from only a few inches to 168 feet. The spawning act is usually accomplished by two or more males crowding about a single female and pressing against her sides until spawning is completed. Usually this is accompanied by considerable splashing and thrashing around, especially obvious in shallow water. Eggs are broadcast over the rocky bottom where they roll into the deep crevices, and are protected from predation. Eggs hatch in from 140 to 166 days at a water temperature of 37° F. Little or nothing is known of young lake trout once they emerge from the sac fry stage. Since they have never been found in the shallow water the speculation can be made that they migrate to deep water immediately after they are able to swim and take food.

The adult lake trout is primarily a fish eater, preferring smelt, whitefish, and freshwater sculpin. In some lakes, where the forage fish supply is inadequate, they subsist largely on aquatic invertebrates and various forms of plankton.

Growth rate of lake trout is variable depending on the environment offered by the individual lake. Sexual maturity cannot be established at any definite age or length, but under average conditions male lake trout will become sexually mature at four years (total length 13″ to 15″) and females will reach sexual maturity at six or seven years (total length 17.5″ to 19.0″).

Ages of lake trout have been estimated at 20 to 40 years for some large lake trout in certain lakes in Canada. The oldest fish recorded in our Maine studies was 13 years old and weighed 21 pounds.

Average lengths of togue from three Maine lakes are listed below by age:

Total length (inches)	Age 4	5	6	7	8	9
Moosehead	11.0	14.6	16.1	18.4	21.1	22.4
Branch	15.4	18.1	20.2	22.7	25.9	——
Cold Stream	16.6	17.5	19.2	20.6	22.7	24.2

Fishing for lake trout, considered by many fishermen as an art, is growing in popularity each year. The most successful anglers obtain best results using a lead-core line, heavy spinners, and "sewed-on" smelts trolled in deep water over bars where the lake trout feed. Other fisher-

men prefer the less spectacular "still" fishing, although bobbing the line increases the chances of success.

EASTERN BROOK TROUT

EASTERN BROOK TROUT

Salvelinus fontinalis (Mitchill)

KEITH A. HAVEY

Regional Fishery Biologist

The brook trout is a native of Maine with an original distribution northward into Labrador, southward along the Appalachian Mountains into Georgia, and westward to some of the northern headwaters of the Mississippi River. Beauty of the species and its attractiveness to anglers have prompted man to distribute it over much of the world.

Brook trout are truly coldwater fish. In Maine they are never abundant in habitats that do not provide some water where temperatures are less than 60-65° F. In shallow ponds this coldwater area may be provided by one or more bottom springs or at the mouth of a permanent, cold spring tributary. In streams it is often furnished by small spring feeders.

Of all the coldwater fishes, brook trout may well be the least tolerant of competing fishes. It appears to thrive best in waters no other fishes inhabit. This fact has been utilized in stocking the reclaimed ponds that have met with so much success in Maine and in many other states in recent years.

In coastal areas of its range, brook trout sometimes frequent salt or brackish water. Fish exhibiting this trait are known to anglers as "salters" or "sea-run trout."

Brook trout are a relatively short-lived fish. Age studies over a wide area of North America, including Maine, have demonstrated that brook trout more than three or four years of age are relatively rare. Individuals as old as seven years are occasionally taken but two- and three-year-old fish make up the bulk of angler's catches.

Growth varies depending on habitat. A four-year-old trout inhabiting a perpetually cold spring brook may be no more than six inches in length and weigh only an ounce or so. A trout of the same age inhabiting a relatively rich lake habitat may be 15 to 20 inches in length and weigh as much as four pounds. The following table lists lengths of Maine brook trout at different ages. The figures are primarily from brook trout captured in lakes.

	Age				
	2	3	4	5	6
Total length (inches)	10.2	13.1	15.9	18.7	20.4

Brook trout are normally mature at an age of two years, but size at maturity depends upon growth rate. In cold mountain brooks, trout may spawn at three to four inches. In other more productive habitats they may be 12 to 14 inches in length before maturing.

Brook trout spawn in the fall from September into December. Lake populations usually seek out cold lake tributaries, while trout already inhabiting stream or river areas spawn near their year-round home or migrate varying distances in main streams or into feeder streams. Populations inhabiting lakes with no cold tributaries may spawn in areas of spring seepage in the lake itself or sometimes move into the outlet.

Courtship and spawning behavior includes digging of an egg pit by the female for deposition of the eggs and a concurrent display of courting behavior by the male. Males vie vigorously for favor by the female with biting and nipping often taking spectacular form. Two male trout have been observed to lock jaws and roll over and over down a relatively long length of riffle area. The female digs and cleans the 4- to 12-inch-deep egg pit with her tail and fins. Lying on her side, she moves the broad tail fin rapidly up and down near the bottom. Bottom material loosened by this process is carried downstream by current.

During the actual spawning act, one or more males swim to the side of the female in the egg pit she has dug and eggs and milt are extruded simultaneously. Following the spawning act, the female works quickly to cover the fertilized eggs by digging slightly upstream from the egg pit. Newly loosened bottom material covers the eggs.

Egg pits are constructed in bottom types ranging from fine sand to coarse, uncompacted gravel and rubble. The latter is usually considered an ideal spawning material. Bottom or side spring seepage is apparently an important factor effecting choice of a spawning site by brook trout. Trout in Maine waters have often been observed to ignore a good rubble area in favor of a sandy area where spring seepage is evident.

Eggs hatch in 90 days at 40°F. Length of the incubation period depends on water temperatures. Newly hatched sac fry, or prolarvae, remain in the gravel nourished from the yolk sac. As the yolk sac is absorbed, young trout become more active and work their way out of the nest.

Trout fry feed primarily on immature stages of aquatic insects. Stream populations of larger fish eat aquatic and terrestial insects, aquatic worms, leeches, crustaceans, and small fish. Trout inhabiting lakes feed primarily on aquatic insects and other small organisms while small, but become voracious fish eaters at lengths of 8 to 10 inches. The most important food of large brook trout in Maine lakes is the smelt.

The brook trout takes bait or a fly readily and is quite easily caught, even by inexperienced fishermen. This characteristic, combined with its high aesthetic value and food qualities makes the species a fine one for intensive fish management purposes. In Maine natural reproduction still largely supports the brook trout fishery. In more densely populated areas brook trout fisheries must be maintained by stocking with hatchery fish. Pre-season or in-season stocking with large trout has generally given the most satisfactory results.

SUNAPEE TROUT

Salvelinus aureolus Bean

Sunapee trout and blueback trout are very closely related. Distinguishing characters are difficult to find, and at least one competent ichthyologist believes that they are the same fish and that both should be included as populations of the Arctic char, *Salvelinus alpinus*. At the present time the Sunapee, or golden trout, is found only in Floods Pond in Otis. Years ago these fish were known from Jordan Pond on Mount Desert Island and from Green Lake, and may also have been present in Harriman and Branch Lakes.

The Sunapee trout is much like the lake trout (togue) in behavior. They move into shallow gravelly areas along the shore or over bars to spawn. No nest is prepared and spawning fish move about in groups. There is no parental care of eggs or young.

New Hampshire has been culturing and studying the Sunapee for several years and reports hybrids between the Sunapee and lake trout. During the spawning period both fishes are taken from the same areas. Discovery of these New Hampshire hybrids makes our Floods Pond population the only positively pure one.

Floods Pond is a 654 acre lake with a maximum depth of 133 feet. Salmon and brook trout are also present in the lake. In the interests of preserving our only population of Sunapee trout no stocking of other fishes is recommended. Good catches of Sunapee trout are taken by fishermen who know the pond and are willing to fish deep.

The following ages and lengths were recorded from 24 specimens:

	Age				
	2	3	4	5	6
Total length (inches)	6.0	9.8	12.7	16.4	19.5

BLUEBACK TROUT

BLUEBACK TROUT

Salvelinus oquassa (Girard)

Blueback trout were originally observed and studied in the Rangeley Lakes of Maine. In fact, the species is named for Oquossoc Lake. Bluebacks probably became extinct in the Rangeley Lakes in the early 1900's, and certainly the 1939 biological survey did not take any specimens. In recent years the continuing inventory of Maine lakes reports bluebacks in eight ponds. Other populations will undoubtedly be discovered as more remote water areas are studied.

The blueback is very similar to the Marstoni trout *(Salvelinus marstoni)* of Canada, and the two may, indeed, represent a single species. Also, like the Sunapee, the blueback may actually be only a landlocked population of Arctic Char, *Salvelinus alpinus*. Several competent taxonomists are studying the problem.

Bluebacks collected in September, very near the spawning season, are strikingly colored with a deep red on fins and belly. During the remainder of the year, the sides, belly, and fins are a salmon color. The teeth are well developed, the lateral line is very evident, and the adipose fin is long and slender.

Past accounts of the blueback trout report them as rarely seen during most of the year. They appeared each year about the middle of October and migrated into streams to spawn. At this time, since they usually spawned in shallows not too far from the lakes, they were removed in huge quantities by netting and spearing. Reports of the numbers taken refer to bushels and to cartloads. This heavy exploitation must have been of some importance in the decline to extinction of the blueback in the Rangeley Lakes. The decline of the blueback population also coincided with the great increase of salmon in the Rangeleys and some workers attribute the loss to salmon predation.

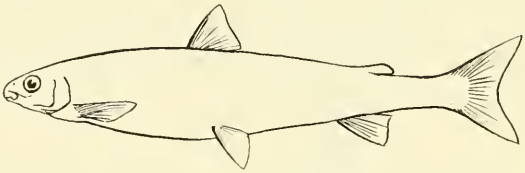
The Rangeley Lakes' bluebacks were small trout with the adults ranging from 6 to 9 inches in total length. Seven 4-year-old specimens collected from northern Aroostook County have the following total lengths (inches): 10.3, 12.3, 12.4, 12.5, 12.8, 13.4, and 14.0.

All the ponds supporting blueback trout populations are cold and deep. Angler reports indicate that the fish are commonly caught on the surface with dry flies in the spring and are readily taken on worms throughout the summer. Bluebacks are also taken in the early fall as the spawning season approaches and surface water temperatures are cooling.

WHITEFISH FAMILY (Coregonidae)

Key to the two members of the whitefish family found in Maine

1. Body nearly cylindrical (chub-like in shape); a single flap between the nostrils

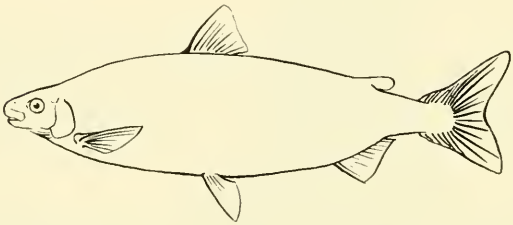


Round Whitefish

Prosopium cylindraceus (Pallas)

p. 53

Body more compressed (flattened from side to side); a double flap between the nostrils



Lake Whitefish

Coregonus clupeaformis (Mitchill)

p. 54

ROUND WHITEFISH

Prosopium cylindraceus (Pallas)

Round whitefish are distributed from New England west through the Great Lakes to Alaska. No game fish, round whitefish are important to our fisheries as a forage. Lake trout in particular are frequently taken with round whitefish in their stomachs. Small aquatic organisms in turn make up the food of this whitefish.

The spawning season runs from October to December in the shallow waters of stream mouths. Young round whitefish possess three rows of dusky spots along the sides.

Average lengths of different age groups are:

	Age								
	2	3	4	5	6	7	8	9	10
Total length (inches)	9.2	10.7	10.9	11.4	12.6	13.0	14.3	14.8	15.9

LAKE WHITEFISH

Coregonus clupeaformis (Mitchill)

Lake whitefish are found in the larger and deeper lakes of Maine and west to Lake Superior and southern Canada. Although they may be taken on flies, whitefish are not generally considered a game species.

Lake whitefish spawn in the fall with the peak of activity in early November. Spawning migrations are made to shoal areas or they ascend streams. Males usually become mature in the third or fourth year and females in their fifth year. The eggs are spawned, fertilized, and fall to the bottom where they develop. There is no parental care of the eggs or young. Young whitefish hatch in March or April.

Lake whitefish are abundant in many Maine lakes where they provide excellent forage for our coldwater game fishes. Although the bulk of their diet is small crustaceans and aquatic insects, specimens have been taken with their stomachs full of small smelt and occasionally a small game fish.

Average lengths of different age groups are:

	Age								
	2	3	4	5	6	7	8	9	10
Total length (inches)	10.3	12.5	13.0	13.4	14.1	15.1	15.7	16.6	16.3

During routine sampling of fish populations for the lake inventories of 1957 several populations of small mature whitefish were found in northern Aroostook County lakes. Total lengths of these mature fish were in the 7- or 8-inch range. A pigmy whitefish has been described from Canada and it may be that populations exist in Maine.

SMELT FAMILY (Osmeridae)

American Smelt

Osmerus mordax (Mitchill)

ROBERT S. RUPP

Regional Fishery Biologist

The American Smelt is an elongate, slender fish characterized by its soft-rayed fins; its rayless, median, adipose fin; its large, deciduous, cycloid scales; and its large head with well-developed jaws and canine teeth. Color is transparent olive-green above grading to silvery on the sides. There are numerous very fine dark spots on sides and fins. Young specimens, those less than approximately two inches long, are often entirely transparent.

Range of the smelt extends 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. From early introductions into lakes of the lower peninsula of Michigan, the smelt gained access to the Great Lakes and has now spread throughout the waters of that region. Anadromous smelt inhabiting coastal waters and the freshwater, landlocked smelt of inland lakes are considered one and the same species.

Usual summer habitat of freshwater smelt consists of the clear, cool waters found in the deeper portions of our deep, cold (oligotrophic) lakes. All available evidence indicates that smelts travel about the depths of these lakes associated in compact groups or schools. These schools usually confine themselves to the deep water in summer but wander all over the lakes during winter, often being seen through holes in the ice. Some wandering takes place during summer also since they are occasionally seen schooling at the surface on calm summer evenings.

Until recent years "normal" habitat of the freshwater smelt was thought to consist solely of stratified, coldwater lakes. Recent findings of the Maine Lake Survey have shown that this is not correct; smelt are quite often found in many of our small, unstratified, warmwater ponds which are inhabited mainly by warmwater species. There is no reason for considering that this is not a "normal" situation.

Food of the smelt is varied depending on size. Small individuals feed mainly on plankton and entomostraca, with insects making up a large part of the latter. Larger individuals feed more on young fishes and larger insects. It is said that young smelts make up the bulk of the diet of smelts over 8 or 10 inches long. Freshwater smelts may attain a length of 14 inches and a weight of half-a-pound and, at this size, the diet is almost entirely fish.

Spawning usually takes place in tributary streams at night just before, during, and just after the break-up of ice. Exceptions to this occur, however. In one lake in Maine the run begins in late February and takes place under heavy ice cover on both lake and brook. In several places the run, and presumably spawning also, take place in daytime as well as

at night. Spawning on sand or stones or vegetation on lake shores or on bars is also known from several localities, even though suitable tributaries may be present and completely accessible.

Larger members of a population spawn first with small smelts bringing up the end of the spawning run. Spawners ascend the stream a short distance and pick a spawning area in a brisk current over a shallow riffle. In this current males and females come together in compact groups of 6 or 8 individuals, all pressing and wriggling against each other, the males covered with numerous horny breeding tubercles and the females smooth skinned. As large numbers of these small breeding groups cluster together on all suitable riffle areas the females extrude small groups of eggs and the males extrude milt. Fertilization takes place free in the water, and the adhesive eggs stick to anything they touch. During the height of spawning egg deposition often becomes so intense that eggs are deposited on everything in the brook, including the spawning fish. Spawning usually begins immediately after nightfall and continues all night unless interrupted by fishing or other disturbance. The spawning run is usually confined to the lower 100 yards or so of the flowing part of the stream since the spawning smelt is not a vigorous swimmer and it takes very little in the way of falls or turbulence to constitute a barrier to upstream movement.

Development of eggs begins immediately and is completed in 15 to 30 or 40 days, depending on temperature. Upon hatching, the larvae, transparent and about one-quarter inch in length, wiggle free of their eggshell and swim free in the water, drifting downstream with the current. Their first movements are controlled entirely by currents and it is assumed that they are swept immediately into the deeper waters of the lake. The young smelt is properly considered a member of the plankton and his first food is plankton.

Smelt populations that inhabit Maine lakes have long been known to exhibit striking differences in maximum length attained. Smelts in certain lakes may, as stated above, reach lengths of 12 to 14 inches while smelts in other lakes may grow no longer than 4 or 5 inches. These differences are thought to be the result of differences in growth rate which are, in turn, the result of differences in temperature, food supply, competition, etc.

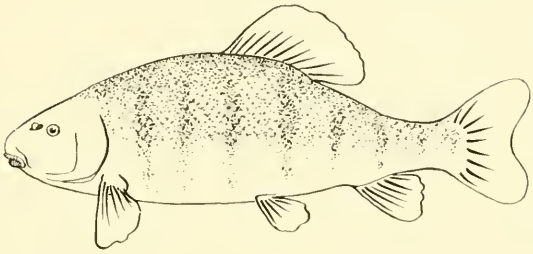
The importance of smelts in Maine inland waters lies chiefly in the fact that they:

a. Constitute the most important single food item of Maine's landlocked salmon.
b. Feed on insects and small fish and thus compete with game fishes for food.
c. Feed heavily on small fish when large and thus may be guilty of preying on the young of game fishes.
d. Constitute a game and food fish where they are taken by bait fishing with hook and line and by dipnet fishing in the brooks on the spawning run.
e. Constitute a highly esteemed and highly valuable bait species.

SUCKER FAMILY (Catostomidae)

Key to the three members of the sucker family found in Maine

1. Lateral line absent; body oblong; mouth subinferior; color pattern of dusky, narrow vertical bars in adult

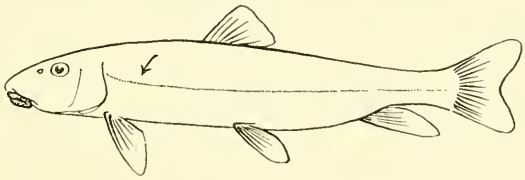


Creek Chubsucker

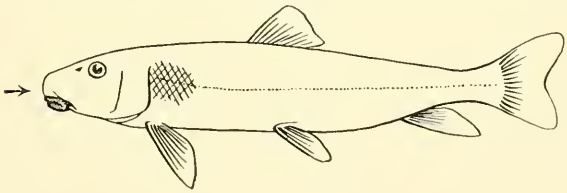
Erimyzon oblongus
(Mitchill)

p. 58

Lateral line present; body round; mouth inferior and definitely ventral; dusky, narrow vertical bars absent 2



2. Scales large, less than 80 in the lateral line; snout not pointed

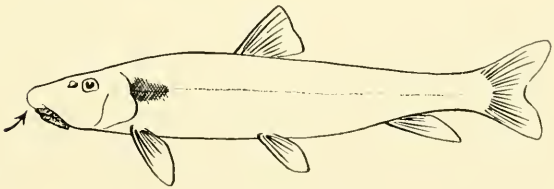


White Sucker

Catostomus commersoni
(Lacépède)

p. 59

Scales small, more than 80 in the lateral line; snout pointed, extending considerably beyond the mouth



Longnose Sucker

Catostomus catostomus
(Forster)

p. 60

CREEK CHUBSUCKER

Erimyzon oblongus (Mitchill)

The creek chubsucker is distributed in the Atlantic drainage from New England south to Virginia. There have been no extensive studies of the life history of this species so there is little actually known about it.

Maine sportsmen frequently observe spawning concentrations at outlets of lakes in May and the early part of June. During this period males develop a few prominent tubercles on the head.

Young chubsuckers tend to travel in schools and would seem to play an important role as a forage fish, but no obvious concentrations have been observed in the food of our game fish. Chubsuckers feed on immature aquatic insects, aquatic plants, and minute crustaceans.

The creek chubsucker is the least abundant of the three kinds of suckers found in Maine. Three specimens taken as part of the biological inventory measured 11.5, 11.8, and 12.0 inches in total length.

WHITE SUCKER

Catostomus commersoni (Lacépède)

The white sucker is the most common and most abundant of the suckers found in Maine. It is generally distributed in North America east of the Great Plains region. This sucker is probably one of the most abundant of the larger fishes in the lakes and tributary streams of Maine.

White suckers are most easily observed during the spawning season in May when unbelievable numbers migrate into streams to spawn. The early trout fisherman is well aware of these spawning concentrations. Spawning will also take place in the shallow margins of lakes. Male suckers develop tubercles on the anal fin, on the lower part of the tail fin, and on the upper sides of the paired fins. The female is usually attended by more than one male. Eggs and milt are released when the males press in on either side of the female. This actual spawning act takes place in shallow moving water, and the fertilized eggs drop to the bottom among the gravel. No nest is constructed and there is no parental care. Adults drop downstream following spawning to return to the lakes or, if a stream resident, to the deep pools.

Young suckers hatch after an average incubation period of three weeks. These swarms of newly hatched suckers furnish the first fish food of many of our game fishes. This role as a forage for other fishes is played by white suckers until they become too large for other fishes to swallow.

Suckers are bottom-dwelling fishes and obtain their food by sucking up bottom fauna and flora. The sucker-like mouth is also adapted for cleaning diatoms and snails from the rocks, a feeding habit easily observed in streams.

Valuable as the white sucker is as food for our game fish they become a problem once they have reached a large size. Many lakes have huge populations of large suckers that cannot be utilized by other fish. These large suckers take up space in our waters and compete with more desirable fish for the total productivity of the water. Efforts to reduce these populations by netting or trapping are useless. Chemical reclamation in the smaller ponds has been effective in removing the sucker populations.

Fishermen frequently condemn the sucker as an egg predator on salmon and trout. An examination of over 100 sucker stomachs in a salmon-spawning area revealed no salmon eggs. A similar study in togue-spawning areas revealed an insignificent number of eggs in the stomachs of the suckers, only during the peak of the spawning.

Some idea of the size that may be attained by the white sucker can be demonstrated by the 6½-pound 25-inch, and 5¾-pound 22-inch specimens taken during the past field season by Maine fishery biologists.

LONGNOSE SUCKER

Catostomus catostomus (Forster)

The longnose sucker and the white sucker are similar in appearance and it is unlikely that they are considered as different fishes by most people.

The longnose is taken in colder lakes and at greater depths. White suckers are not so specific in habitat requirements and are probably more abundant for this reason. Maine lake studies report the longnose as living pelagically in the deeper waters. Lake Superior commercial fishermen take this species at depths of 600 feet. Spawning migrations coincide in general with those of the white sucker.

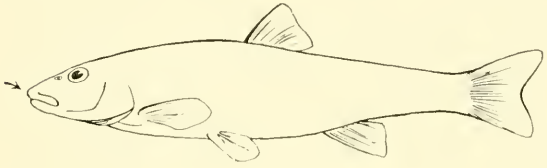
These two species of suckers, the white and longnose, were found to make up one of the principal foods of lake trout over five pounds.

Average lengths of longnose suckers taken from Maine waters range between 8 and 10 inches in total length, although several specimens have been taken measuring up to 17.3 inches and weighing 2 pounds.

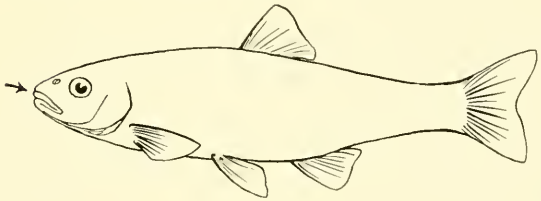
MINNOW FAMILY (Cyprinidae)

Key to the various members of the minnow family found in Maine

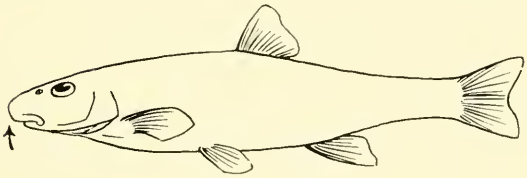
1. Upper lip connected with the skin of snout by a bridge of tissue across which the premaxillary groove does not pass 2



Upper lip separated from skin of snout by the deep premaxillary groove continuous across the midline 3



2. Snout projecting far beyond the horizontal mouth

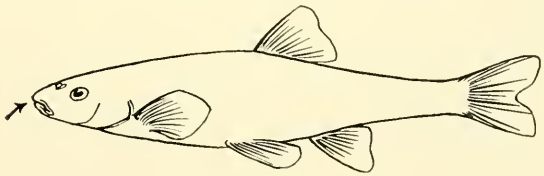


Longnose Dace

Rhinichthys cataractae

(Valenciennes)

Snout scarcely projecting beyond the somewhat oblique mouth

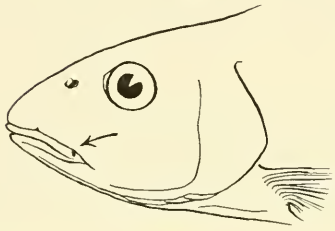


Blacknose Dace

Rhinichthys atratulus

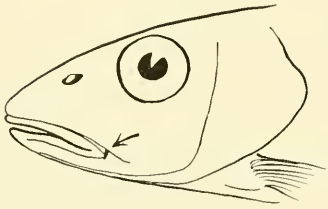
(Hermann)

3. Maxillary with a barbel, the barbel is small and often hidden in the groove above the upper jaw. Care must be taken if the barbel is to be observed, and it may be necessary to pull out the upper jaw a little 4



Maxillary without a barbel 7

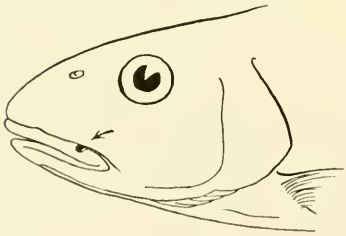
4. Barbel slender and at, or near, the end of the maxillary



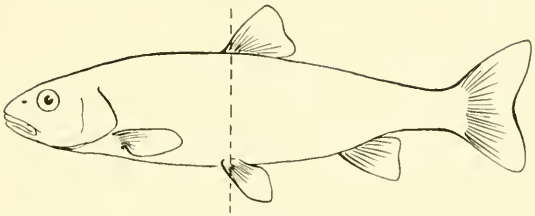
Lake Chub

Hybopsis plumbea (Agassiz)

Barbel often flaplike and obsolescent, and located on the lower edge of the maxillary well in advance of the posterior end, usually concealed in the groove between the maxillary and premaxillary 5

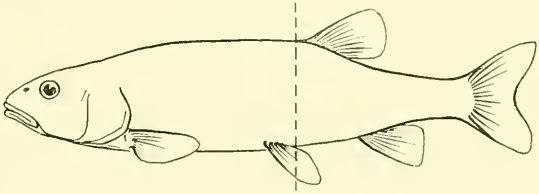


5. Dorsal fin beginning over base of ventral fins; scales large, 45 in lateral line; silvery



Fallfish
Semotilus corporalis (Mitchill)

Dorsal fin beginning just behind base of ventral fins; scales smaller, about 50 in lateral line 6



6. Black spot on dorsal fin near front of base, indistinct in young; mouth large, upper jaw extending at least to below front of eye; sides not mottled by specialized dark scales; scales in lateral line fewer than 60

Creek Chub
Semotilus atromaculatus (Mitchill)

No black spot on dorsal fin; mouth small, upper jaw not extending to below front of eye; sides mottled by specialized dark scales; scales in lateral line about 65 to 75

Pearl Dace
Semotilus margarita (Cope)

7. Lateral line scales more than 60 8
Lateral line scales less than 55 10

8. Lateral line incomplete; more than 80 scales in lateral line

Finescale Dace
Chrosomus neogaeus (Cope)

Lateral line complete; scales fewer than 80 in lateral line ... 9

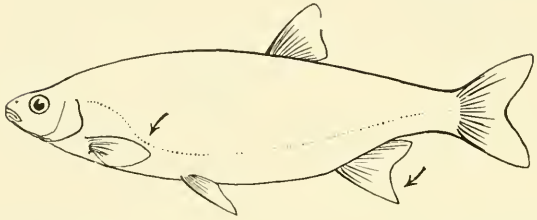
9. Body with a single dusky lateral band; intestine short, with a single main loop, and less than twice as long as the body

Pearl Dace
Semotilus margarita (Cope)

Body with two black lateral bands; intestine elongate, with two crosswise coils in addition to the primary loops, and more than twice as long as the body

Northern Redbelly Dace
Chrosomus eos (Cope)

10. Lateral line much decurved; anal fin curved like a sickle; abdomen behind ventral fins with a scaleless fleshy keel

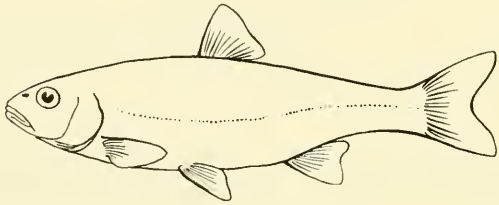


Golden Shiner

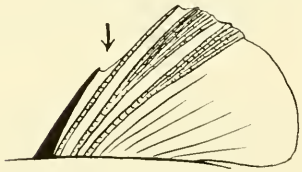
Notemigonus crysoleucas

(Mitchill)

Lateral line not greatly decurved; anal fin scarcely sickle shaped; abdomen behind ventral fins rounded and scaled 11



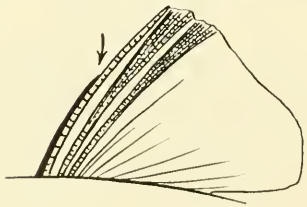
11. First dorsal ray more or less thickened, separated by membrane from first well-developed ray, and with a thicker coating of adipose tissue; a dark spot, faint in young and some females, at front of dorsal fin near, but not at, base; back flattish (these characters conspicuous only in adults)



Fathead Minnow

Pimephales promelas Rafinesque

First dorsal ray a thin splint, closely attached to first well-developed ray, and with a thinner covering of adipose tissue; no dark spot at front of dorsal near base; back little flattened .. 12



12. Anal rays 9 to 12, rarely 8

Common Shiner

Notropis cornutus (Mitchill)

Anal rays 7 or 8, rarely 9 13

13. Anal rays typically 8; fins smaller; length of depressed dorsal about 1.5 in distance from occiput to dorsal; dorsal usually inserted nearer base of caudal than tip of snout, and distinctly behind the ventral insertion; predorsal scales rather irregularly arranged and from 13 to 22 in number

Blacknose Shiner

Notropis heterolepis Eigenmann and Eigenmann

Anal rays typically 7; fins larger; length of depressed dorsal about 1.2 in distance from occiput to dorsal; dorsal usually inserted nearer tip of snout than base of caudal, and distinctly over or before ventral insertion; predorsal scales rather regularly arranged and usually 12 or 13 in number

Bridled Shiner

Notropis bifrenatus (Cope)

MINNOW FAMILY (Cyprinidae)

The term minnow is frequently used to refer to all small fishes. Actually it should be reserved only for members of the largest family of freshwater fishes, the Cyprinidae. Minnows are usually small, with no scales on the head, a forked caudal fin, and a toothless mouth. These small fish "chew" with pharyngeal teeth located in their throat. These teeth vary in number and character, and are used by the experts as an aid in identification of various species. Externally many kinds of minnows are so similar that obvious differences cannot be found and the family is hard to study.

Minnows are usually abundant because they can occupy a great variety of habitats, eat many types of foods, and a large number can occupy a small water area.

Spawning migrations of minnows are limited with no movement more than a short distance upstream or beyond the shoals of a lake. All are spring or summer spawners. Some of the males become highly colored during the breeding season and develop conspicuous tubercles about the head and on the fins. These tubercles are used in defending breeding areas and for holding the female during spawning.

Various spawning habits are displayed from elaborate nest preparations to no nest construction and no parental care. The most frequently observed nest of the Maine minnows is that of the fallfish. These nests are made of stones averaging as much as two inches in diameter piled as high as three feet and with a diameter up to six feet. Nest construction is largely the responsibility of the male.

Minnows are important in the management of an inland fishery for their position in the food chain. They serve as one of the most efficient agents in the transformation of various minute aquatic foods into protein readily available to many of our game fishes. Thus, their primary value comes as a forage for more desirable food and game fishes.

A 7½ pound carp *(Cyprinus carpio)* was taken in the Abagadasset River in 1950. This European minnow was introduced into United States in 1877 and since then has become a serious problem in many states. Carp are a large minnow that compete with more desirable fishes for food and space. Care must be taken not to spread this pest into any other areas of Maine.

CATFISH FAMILY (Ictaluridae)

Brown Bullhead

Ictalurus nebulosus (LeSueur)

The brown bullhead, or hornpout as it is frequently called in Maine, is distributed throughout New England southward in the Atlantic drainage to Virginia and westward to North Dakota. These fish are commonly found in weedy waters of lakes and sluggish streams. Young and adults are chiefly nocturnal, increasing their activity with the approach of darkness.

Brown bullheads usually spawn in late spring or early summer in May or June although occasional ripe females may be taken later. Nests are usually located near some shelter over a sandy bottom in shallow water one-half to two feet deep. The adhesive eggs are cream colored and laid in masses resembling those of the frog. Average incubation period is between 3 and 5 days depending on water temperature. One or both parents remain to guard the eggs and young. Adults ward off intruders and some observers report that the eggs are sucked into the mouth of the parent and blown out again into the nest. It is presumed that this serves to aerate as well as clean the eggs. Parent fish remain with the school of young bullheads until the young fish are one to two inches in length. Young bullheads will be found together throughout the first summer in the relatively shallow waters sheltered among the aquatic vegetation.

Bullheads are omnivorous feeders eating many kinds of plant and animal material. Stomachs examined from 44 bullheads taken from Maine waters contained mostly algae and other plant remains, fish, and aquatic insects. Fifty-one percent of 143 bullheads examined during the spawning period of lake trout in one lake contained lake trout eggs in their stomachs.

Bullheads over 18 inches are rarely taken in Maine.

PIKE FAMILY (Esocidae)

Chain Pickerel

Esox niger LeSueur

Chain pickerel are generally distributed throughout eastern United States and southern and eastern Canada in quiet weedy waters. They represent one of the four most abundant warmwater game fish in Maine.

Chain pickerel are one of the first fishes to spawn after ice-out in the spring with mature adults migrating into swampy or marshy backwater areas. Females are usually attended by several males and there is a great deal of splashing and lashing of their tails as the eggs are spawned and fertilized. No nest is prepared, and the adhesive eggs drop to the bottom to cling to whatever they happen to fall upon. There is no parental care. Young pickerel hatch after an incubation period of one or two weeks depending on the temperature. Small pickerel may be observed throughout the summer in shallow areas near shore.

The pickerel has earned a well-deserved reputation as a predaceous fish with an undisputed piscivorous diet. Adults are solitary feeders lying motionless in wait for their prey and then capturing it in one quick lunge. Yellow perch, white perch, and minnows are important food of pickerel in Maine. These are fishes with which the pickerel is ecologically associated. Other interesting, but less important and infrequent items of diet, include frogs, snakes, ducklings, mice, and muskrats.

The largest pickerel on record was 36 inches in length and weighed 10 pounds and 10 ounces. Following are some ages and average lengths of chain pickerel taken in Maine:

	Age				
	3	4	5	6	7
Total length (inches)	11.6	15.2	18.2	20.5	23.5

EEL FAMILY (Anguillidae)

American Eel

Anguilla rostrata (LeSueur)

The American eel has one of the most interesting life histories of all fishes. It is generally distributed throughout eastern North America, and is easily distinguished from other fishes with the possible exception of the lamprey eel. However, the American eel possesses a true mouth with jaws and the lamprey has the jawless sucking disc.

The spawning migration of the freshwater American eel has attracted attention of natural historians for many years as one of the most unusual of natural phenomena. Most fishermen have observed the fall downstream migration of eels, particularly obvious in fishways. Again in the spring of each year they have noted the upstream migration of millions of elvers three to four inches in length and slightly smaller than the diameter of a pencil. Elvers migrating up the stream are thought to be females while males remain behind in the estuaries.

Both sexes feed voraciously during their stay in fresh water which may extend anywhere from 5 to 20 years. When adults reach sexual maturity they grow darker, lose their voracious appetites and begin their downstream migrations. Their destination is somewhat southeast of Bermuda in the Sargasso Sea in the warmest waters of the North Atlantic. Here they spawn and die.

When first hatched the small eels are known as leptocephali, shaped in the manner of a leaf and transparent. These larval eels reach the coast of United States in autumn of their first year, attain their full larval development that winter, and are ready to move up the rivers in the spring as elvers. These elvers then are the young of the adults that migrated downstream over a year ago rather than the previous fall.

The eel has the reputation of being a voracious fish. Females commonly reach a length of three to four feet and occasional large ones are taken six feet in length. Males are smaller.

KILLIFISH FAMILY (Cyprinodontidae)

Banded Killifish

Fundulus diaphanus (LeSueur)

Freshwater killifish are found along the eastern coast of United States from the Maritime Provinces of Canada down to South Carolina and into eastern sections of New York and Pennsylvania. Fishermen usually consider them as minnows although the teeth of the killifish readily distinguish them from members of the minnow family.

Killifish are usually found in lakes in shallow water areas although they may be observed in quiet rivers. They are one of the more abundant fish in shoal areas traveling in large schools.

Peak of their spawning season comes towards the end of July when males take on a bright coloration. Schools of mature adults are easily observed swimming about in shallow water usually among aquatic vegetation. There is no nest preparation or care of the young.

The value of the killifish as a forage is limited because they rarely stray into water much over a foot in depth.

Mummichogs *(Fundulus heteroclitus)* are usually in salt or brackish water, but may be observed in fresh water.

COD FAMILY (Gadidae)

Burbot

Lota lota lacustris (Walbaum)

The burbot, sometimes called cusk, is the only representative of the cod family found in fresh water. It can be easily identified from other fishes of Maine by the single prominent barbel on the underside of the chin near its tip. The burbot is distributed from Labrador to the southern New England states and westward to the Missouri River drainage. Although the burbot is commonly associated with cool deep lakes, populations are observed in Maine streams by both fishermen and biologists.

Burbot are winter spawners and usually complete spawning by the time the ice is gone. Not too much is known of their breeding habits, but they have been observed spawning in riffle areas of streams and the young are in the streams. The fact that many newly hatched young are found on shallow sandy bottoms of lakes is an indication at least that some spawning may occur in lakes.

Burbot are taken in routine sampling of our lake and stream populations. Stomach analyses confirm that burbot compete with our cold-water game fishes, particularly togue, for food. Smelts and suckers are frequently eaten.

A size of three pounds is considered large from Maine waters but records from other parts of their range report lengths up to 30 inches and weights of 10 pounds.

WHITE PERCH

SEA BASS FAMILY (Serranidae)

White Perch

Roccus americanus (Gmelin)

ROGER P. AUCLAIR

Regional Fishery Biologist

White perch are more closely related to striped bass than to any species of fish in our inland waters. The white perch is found along the Atlantic Coast from Nova Scotia to North Carolina principally in estuaries of rivers, in brackish and freshwater ponds closely connected to the sea, and completely landlocked in freshwater lakes and ponds. Recently the range of white perch has been extended as far inland as the Great Lakes. In Maine this species is found in all major river drainages, in ponds that were once accessible from the sea, and has been introduced by man into many lakes and ponds that were naturally inaccessible.

Large schools of mature white perch seek a tributary stream, a shallow cove, or the upper portion of a river estuary to spawn when the temperature of the water is up to 60°F. This is usually during the month of June in Maine. Large numbers of perch are sometimes seen milling and thrashing about in shallow water. Females indiscriminately release streams of minute eggs and males immediately gather round to fertilize the eggs with their milt. The spawning method seems rather haphazard but the eggs and especially the sperm are released in such enormous numbers that there is little chance of failure. A one-pound female will release approximately 150,000 eggs at spawning time.

The eggs have an adhesive disk so that when they sink to the bottom they become permanently fastened to rocks, grass, or debris that they chance to rest upon. Within a week, depending upon temperature of the water, tiny fry, less than one-eighth of an inch long and almost invisible to the naked eye, emerge from the egg. There is no parental care. A sudden drop of 4 or 5 degrees in water temperature can wipe out all the eggs deposited, but spawning is spread over a period of ten days to two weeks and it is very unlikely that reproduction would be a complete failure in any year.

During the first two years of life young white perch feed upon small crustaceans and insect larvae. Thousands of small perch one to three inches long can be seined in the evening along sandy beaches where they come in to feed. Young-of-the-year white perch in turn are a principal food item of many game fishes including larger white perch. In spring larger white perch feed mainly on insects and crustaceans but during summer their diet gradually changes to include fish and toward

the end of summer their diet consists almost entirely of fish. Yellow perch, smelts, and white perch are eaten.

Growth of white perch varies considerably in various lakes and ponds of Maine. In one pond a six-year-old perch may be as much as 12 inches long and weigh more than a pound whereas in another water area a perch of the same age may be less than 7 inches long and weigh only a few ounces. In general, lakes, ponds, or flowages that have large areas of shallow, fairly warm water produce the fastest growing perch.

White perch usually become the most abundant of all the species inhabiting the same waters. Minimum legal length regulations and other restrictions may only serve to aggravate the situation.

If the environment is favorable and the body of water is a few hundred acres or more in area it is very unlikely that a population with such a high reproductive potential could be reduced by angling. It is more logical that fluctuations in white perch populations are caused by unfavorable temperature and water conditions soon after spawning.

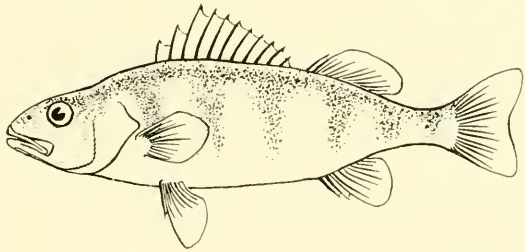
Production of salmon and trout is greatly reduced when white perch are introduced into good salmon and trout waters where they become serious competitors.

White perch are ranked among the first ten as a freshwater game fish and as a food fish they are one of the most palatable.

PERCH FAMILY (Percidae)

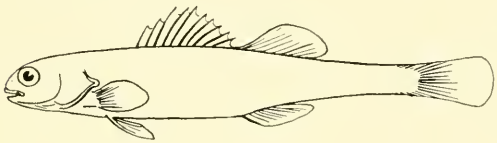
Key to the two* members of the perch family found in Maine

1. Preopercle strongly toothed or saw-like; mouth large; fishes of medium to large size



Yellow Perch
Perca flavescens
(Mitchill)
p. 76

Preopercle with smooth edge; mouth small; small fishes not exceeding 3 inches



Mud darter
Etheostoma fusiforme
(Girard)
p. 77

* Yellow walleye pike were introduced unsuccessfully into the Belgrade Lakes about 40 or 50 years ago. Great Pond, the site of the original introduction, has produced some spear fishing by night on the spawning grounds. No walleyes were checked in the catches during a recent census of the angling on Great Pond. Although the walleyes were reported to have migrated into Long and Snow Ponds they do not enter the sport fishery.

The yellow walleye is the largest member of the perch family and can be recognized by the large canine-type teeth.

YELLOW PERCH

Perca flavescens (Mitchill)

The yellow perch is one of the four most important warmwater game fish in Maine, although it is not presently as popular with the resident anglers of Maine as it is with the anglers from other states within its range. Yellow perch are found along the Atlantic drainage from Nova Scotia to South Carolina and westward to the upper Mississippi valley. Their preferred habitat is a warm weedy lake with the young in shallows and the adults in deeper waters.

Spawning takes place near shore in April and early May when the water temperatures are between 44 and 54 F. Each gravid female is followed by 15 to 25 males that fertilize the eggs as they are spawned. The eggs are unique among freshwater fishes as they are laid in a gelatinous matrix in accordian-like strings. These strings of eggs swell considerably upon contact with water becoming one to eight feet long, depending on the size of the female. Egg strings are grayish-white in color, semibuoyant, and nonadhesive. Spawning almost always takes place near shore where the egg strings can be woven in and around aquatic plants or brush where they are deposited. There is no parental care and many egg masses are eaten by other animals or destroyed when they are washed up on shore or when low water strands them. Young perch hatch in three or four weeks.

The yellow perch is carnivorous, feeding on young fishes (including yellow perch), aquatic insects, crustaceans, and other animal material. This fish is a serious competitor of the other game fishes.

Yellow perch reach a length of about 12 inches and a weight of nearly a pound in 9 or 10 years. A fast-growing female may attain a length of 12 inches in 5 years. A two-pound perch is a very large one. The all-time record is a four and one-quarter pound specimen taken in the Delaware River in 1865.

MUD DARTER

Etheostoma fusiforme (Girard)

BRUCE B. COLLETTE

Research Assistant, Cornell University

The mud darter is the smallest species of freshwater fish found in Maine. It is widely distributed along the Gulf and Atlantic coastal plains but extends only into the southernmost tip of Maine, in York County, where it has been taken in the Ogunquit and Cape Neddick Rivers. It is the only darter found in Maine.

The mud darter is a member of a very interesting group of North American freshwater fishes. This small fish, having lost its air bladder during the course of evolution, must spend its life resting on the bottom or in clumps of aquatic plants. From its resting place it moves out in short, rapid dashes that have given rise to the common name of darter.

Unlike other species of darters which prefer clear, running water, the mud darter is usually found in muddy, swampy areas. It occurs rarely in faster streams and then only in clumps of vegetation. However, when the mud darter gains access to ponds or small lakes, it frequently multiplies rapidly and can become quite numerous.

Virtually nothing was known of the life history of the mud darter until recently. Sexual dimorphism is apparent, especially before and during the spawning season which includes May and June. Females possess an enlarged genital papilla which projects outward from the genital orifice. Males develop a concentration of black pigment in the dorsal and anal fins and, to a lesser extent, upon the body.

During courtship, the male swims up behind the female, and then "beats" her with his pelvic fins. The female swims into a clump of plants and projects her genital papilla forward into the plants when ready to spawn. The eggs are laid and fertilized while the pair undergo a quivering motion. The young hatch in about 8 to 10 days at a temperature of 70 F. At first they are free-swimming but soon settle down to a life on the bottom.

Collections made throughout the year on Cape Cod and Long Island indicate the presence of only one major size class. However, collections made in the Ogunquit and Cape Neddick Rivers of Maine on September 18, 1957 show two distinct size classes. This indicates that the mud darter in Maine may live for two years while southern populations only live for one. The reason for this may be the slower growth and later spawning season as a result of the colder waters of Maine.

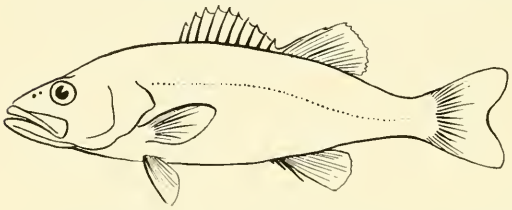
Mud darters probably feed mainly on small aquatic insects and other invertebrates, although few food studies have been made. This species relies mainly on vision in food detection, and in aquariums it darts forward quickly at the slightest movement.

In Maine the mud darter has been taken along with the creek chub, American eel, white sucker, golden shiner, chain pickerel, pumpkinseed sunfish, and brown bullhead. Although a very small fish, seldom more than 2½ inches in total length, it may be important locally as a forage fish. Studies in New Jersey and Florida have indicated it to be of some importance in the diet of pickerel and bass.

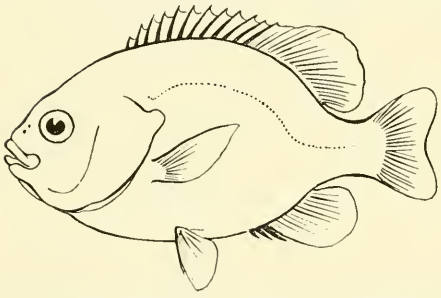
SUNFISH FAMILY (Centrarchidae)

Key to the five members of the sunfish family found in Maine

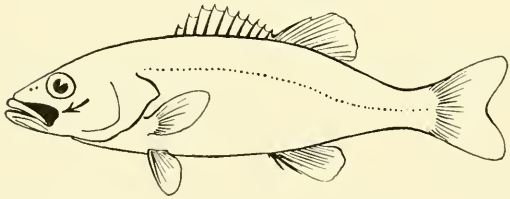
1. Body relatively long, the depth being only about one-third the length; dorsal fin deeply notched between the spinous and soft-rayed portion; scales small, 58 or more in lateral line 2



Body short and deep, its depth usually more than two-fifths the length; dorsal fin not deeply notched between the spinous and soft-rayed portion; scales larger, 53 or fewer in lateral line .. 3



2. Upper jaw not extending beyond the eye; notch between spinous and soft-rayed dorsal not deep; scale rows on cheek from 15 to 18; pyloric caeca single



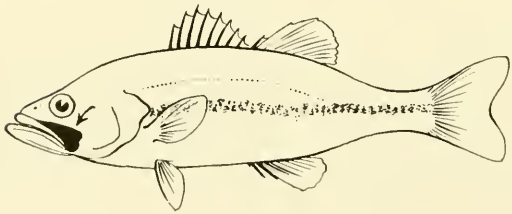
Smallmouth Bass

Micropterus dolomieui

Lacépède

p. 81

Upper jaw extending beyond eye; notch between spinous and soft-rayed dorsal deep; scale rows on cheek from 10 to 11 rows; pyloric caeca forked



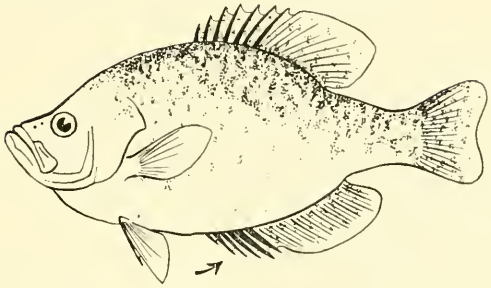
Largemouth Bass

Micropterus salmoides

(Lacépède)

p. 85

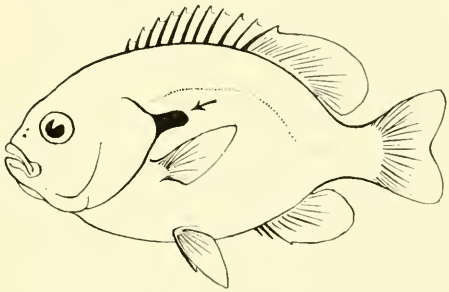
3. Anal spines 5 or more, body speckled



Black Crappie
Pomoxis nigromaculatus
LeSueur
p. 87

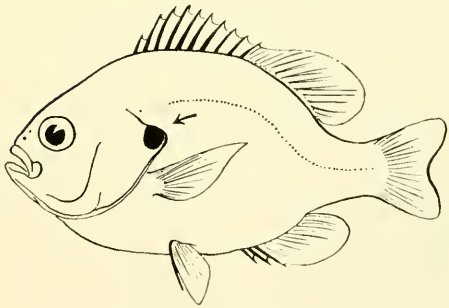
Anal spines 3, body uniformly colored 4

4. Ear flap elongated, dark



Yellowbelly Sunfish
Lepomis auritus
(Linnaeus)
p. 88

Ear flap short, with bright red tip



Pumpkinseed Sunfish
Lepomis gibbosus
(Linnaeus)
p. 89

SMALLMOUTH BASS

SMALLMOUTH BASS

Micropterus dolomieui Lacépède

The smallmouth bass is one of Maine's most valuable game fish. Originally the smallmouth were probably distributed in the St. Lawrence, Ohio, and upper Mississippi Rivers, and in the Great Lakes. Before the Civil War there were no bass in Maine. Records show that bass were first stocked in Maine in 1869, and since then there have been many additional stockings and smallmouth have adapted easily to our large, shallow, clear water lakes.

Smallmouth thrive best in lakes that have at least several hundred acres of water surface, are rich in food, contain good shoreline gravel for nest-building, have a stable water level, and are relatively shallow.

Nests in the salmon and trout family are prepared by the females, but it is the male of the sunfish family that builds the nest and protects the eggs and young. An average male bass will be mature when he is about 9 inches long and 3 years old. He begins nest construction when the water has warmed to temperatures in the mid-fifties. June is the peak of the spawning season in Maine. A bed of coarse gravel is selected with some protection preferred, such as an over-hanging tree or a large boulder. Water depths may vary from 10 inches to 12 feet.

The male cleans off a circular area of gravel from 1½ to 2 times his length in diameter. During the cleaning process, and following, the male protects the area from all intruders and particularly from other male bass. Once the nest is completed he begins his courtship of the female to persuade her to lay eggs in the nest. Spawning will usually take place when the temperature is between 59°F. and 65°F. The female is about a year older than the male at maturity and consequently two or three inches longer. An average of 8,000 eggs per pound of body weight is carried by the female. The eggs are adhesive and attach themselves to the gravel cleaned and prepared by the male. After spawning the female leaves and the male remains to guard the eggs and young. His fin movements serve to keep the eggs clean and well oxygenated.

The eggs hatch in three or four days depending on the temperature and the newly hatched young remain protected in crevices among the

gravel. In a few days the fry, as young fish are called, begin to darken up and finally rise from the gravel as "black fry." After this the young develop rapidly and move farther and farther from the nest. The young smallmouth is more solitary, preferring to feed alone, while the young largemouth apparently prefers to remain in schools for at least a part of the first summer.

Young bass begin to feed on minute animals or plankton and gradually at an average length of 1½ inches begin to feed more on immature stages of aquatic insects and on small fishes. As they increase in age and size, fish and crayfish form staples of the diet.

Growth of the smallmouth bass in Maine is demonstrated by the ages and average lengths listed below:

	Age								
	2	3	4	5	6	7	8	9	10
Total length (inches)	6.9	9.2	11.3	11.9	13.4	15.5	15.6	17.5	17.6

The large number of eggs spawned by the female and the protection of eggs and young by the male combine to produce a high reproductive potential for the smallmouth. This high natural production makes it unnecessary to stock smallmouths in waters where they already occur. Initial introductions of adult smallmouths are being made in suitable lakes to provide additional fishing. These introductions are under the supervision of the Regional Fishery Biologists and are recommended only after biological study of the water area involved.

LARGEMOUTH BASS

LARGEMOUTH BASS

Micropterus salmoides (Lacépède)

ROBERT E. FOYE

Regional Fishery Biologist

The largemouth bass was originally distributed in waters of southern Canada, the Great Lakes drainage, the Mississippi Valley, northern Mexico, Florida, and the Carolinas. Its range in the United States has been gradually extended northward into New England and into waters west of the Rockies to California.

Largemouths were introduced into Maine sometime during the early 1900's although the exact time of the first introductions is unknown. Largemouth bass were established in Long Pond and Messalonskee Lake of the Belgrade Chain and in several nearby waters by 1940. They are now in many other waters mostly in central and southern Maine. The largemouth thrives in shallow, warm, weedy, mud-bottom ponds, and sluggish streams. Although this species is sometimes found in deep, rocky-bottom lakes they prefer shallow weedy habitat and seldom venture into deep, unproductive areas.

Spawning habits of largemouth bass are similar to those of smallmouth bass. In northern waters largemouth bass usually reach sexual maturity at the age of two or three. Nesting activities commence during late spring or early summer when water temperatures reach 63 F. The nests of largemouth bass are usually less elaborate than those of the smallmouth. They may be found at depths of from one to three feet on a mud bottom often at the base of old stumps and submerged plants. Largemouth also spawn occasionally along gravel shores similar to the type selected by smallmouth bass for spawning. Nest construction is the responsibility of the male largemouth. Once the nest is completed the male bass entices a female to spawn. Female largemouth usually lay only a few hundred eggs at a time which are fertilized by the male. The eggs are adhesive and fasten to the bottom of the nest. The female bass then departs and may later return to spawn with the same male or she may choose to spawn in the nest of one or more other males. Often several female bass spawn in a single nest. The number of eggs per nest is dependent upon the number of females utilizing it and may range from a few hundred to several thousand eggs. Female bass usually contain from 2,000 to 7,000 eggs per pound of body weight.

The male largemouth guards the nest during incubation and for a short time after the young emerge from the eggs. The eggs usually hatch within a period of a week to ten days depending upon water temperature. Extreme fluctuations in water temperatures during incubation may result in heavy egg mortality. Dominant year classes often occur in years of

successful spawning followed by years of low natural reproduction. A few days after hatching largemouth bass fry quickly disperse among aquatic vegetation which affords them protection most of their lifetime.

Young largemouth bass feed largely upon plankton and small insects gradually extending their feeding habits as they become larger to include crayfish, frogs, and small fish.

Largemouths in Maine and other northern waters grow more slowly than their relatives in southern waters with longer growing seasons. In Long Pond of the Belgrade Chain largemouth bass reach 10 inches in total length during their fourth growing season, reach 15 inches at the age of 6 years and are usually 18 inches after 8 years. Optimum growth occurs in waters having temperatures of 80°F. or higher.

Largemouth bass like smallmouths may become infected with the mature and larval stages of the bass tapeworm, *Proteocephalus ambloplites,* a common parasite of bass and certain other fishes in many waters. Bass infected with the bass tapeworm are still edible. Severe infection with the larval stage may often cause sterility in bass and normal growth may be retarded when individual incidence is high. Needless to say optimum conditions for bass are associated with waters free from this parasite. Extreme caution on behalf of fishermen should be exercised to prevent the introduction and spread of the bass tapeworm into uninfected waters. The bass tapeworm is most easily transmitted by introducing bass, perch, minnows, and other fishes infected with this parasite.

Desirable methods and techniques for the management of this species have been formulated by extensive studies of largemouth bass throughout the United States. Many studies have disproved the need for minimum length restrictions, protection during spawning, bag limits and closed seasons, and have resulted in more liberal fishing regulations for this species in many states. It is interesting to note that at this writing as few as ten states have minimum length limits.

While it is well known that the male bass protects the nest and eggs during incubation, there is substantial evidence indicating that angling for bass during the spawning season has no serious effect on bass production. On the other hand unbalanced populations of less desirable species, often serving as forage fish for bass, may seriously limit bass production. Fluctuations in water levels during spawning may sometimes result in heavy losses of eggs and fry, especially in waters where the lowering of lake levels exposes extensive spawning areas.

Bass stocking in lakes that already contain this species has no biological basis and is poor management. The introduction of bass may, however, serve the useful purpose of establishing this species in desirable waters where they do not presently occur.

BLACK CRAPPIE

Pomoxis nigromaculatus (LeSueur)

The introduction of the black crappie into Maine is an unfortunate example of the fishery management problems that occur when uninformed individuals violate state regulations regarding the introductions of fish species not native to an area. The black crappie has become established in the Sebago Lake drainage of Maine in competition with more prized native game fish.

Black crappie were taken for the first time by Fishery Division biologists from Sebago Lake, type habitat for the landlocked salmon, in 1952. Since that time additional specimens have been taken by anglers, and identified from Kewaydin Lake and Proctor Pond.

Investigations of possible sources for this unwise introduction uncovered the interesting information that these fish were reportedly stocked in Virginia Lake in Stoneham in 1921. Removal of the fish screen from Virginia Lake in 1945 may have been the beginning of a long migration that has ended in Sebago Lake and other lakes in the drainage. Fish screens, however, do not usually contain the young fish so that the migration may have begun even before removal of the screen.

The crappie is a member of the sunfish family like the smallmouth and largemouth, and general spawning habits are similar. Circular nests are prepared by males although they will usually be located in deeper water than those of the basses. Young crappies migrate from their nests to shallow water after hatching.

Crappies are taken weighing as much as three pounds but the usual size is much smaller.

First food of the young is largely minute organisms and immature aquatic insects, but they quickly move to deeper water and graduate to a fish diet.

YELLOWBELLY SUNFISH

Lepomis auritus (Linnaeus)

The yellowbelly sunfish is distributed from Maine to Florida and Louisiana with greatest abundance east of the Alleghenies and south of New York. This is one of the two species of sunfishes distributed widely in Maine. Since they rarely reach a length much over 6 inches they are little sought after by fishermen.

Like the other members of the sunfish family the male yellowbelly sunfish prepares a nest in shallow water easily recognized as an evenly scooped out hollow with gravel in the center. Nests average about 12 inches in diameter. Males begin to make these nests during June usually, but the exact date depends on the water temperature which should be between 65°F. and 70°F. The male escorts the female into the nest and after a few minutes courtship, the eggs are spawned and fertilized. The adhesive eggs drop to the bottom of the nest on the gravel. The male attends the eggs and the young for a short period.

Yellowbelly sunfish do well in warmwater lakes where aquatic vegetation is relatively thick. They are usually associated with pumpkinseed sunfish and yellow perch.

PUMPKINSEED SUNFISH

Lepomis gibbosus (Linnaeus)

The pumpkinseed is distributed from southern Canada to the Gulf States and is common in the Great Lakes region. Schools of pumpkinseed may be found swimming around weedy areas or over and around rocky stretches. They seem to prefer weedy lakes and ponds containing warm waters.

Spawning of the common sunfish may be anytime within a period extending from the first of June until the beginning of August. Peak of spawning lies between the end of June and the beginning of July. Like the yellowbelly, nests are built in colonies by males. These nests are constructed in shallow water and may be made over mud, gravel, or sand. After the nest is completed the male lures the female into the nest and spawning takes place. Fertilized eggs drop to the bottom. The male guards the eggs preventing their destruction by small fishes.

Food of the pumpkinseed sunfish in Maine has been reported as molluscs, terrestrial insects, and plant material. Most of the food is bottom fauna with snails making up a large portion.

Size of the pumpkinseed in Maine varies between 6 and 10 inches. The pumpkinseed is little sought by the anglers of Maine.

FRESHWATER SCULPINS (Cottidae)

Cottus cognatus Richardson

The freshwater sculpin is a curiously ugly little fish usually not observed unless a special effort is made to collect them. They inhabit the depths of our coldwater lakes and the riffle areas of the cold trout streams. Usually they are a bottom-dweller frequently hiding under stones, and they must be dislodged before they can be collected.

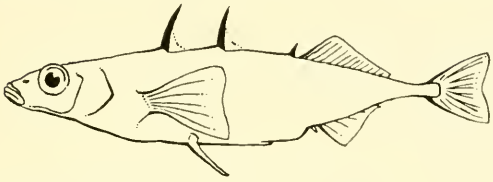
Freshwater sculpins spawn in the spring attaching the fertilized eggs in clumps under stones. The male guards the eggs until they hatch.

Food of the sculpin is listed as aquatic insects, small fish, and algae. Although the sculpin is accused of feeding on trout eggs the point needs confirmation with further investigations and proof. Most of the trout eggs that would be available to the sculpin would be those not properly covered and doomed to destruction for this reason.

Sculpins furnish food for the brook trout, salmon, and togue.

STICKLEBACK FAMILY (Gasterosteidae)

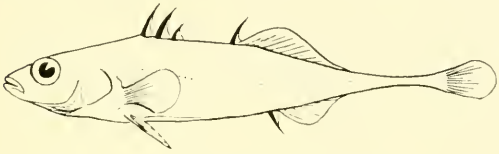
1. Three free dorsal spines; lateral plates developed



Threespine Stickleback
Gasterosteus aculeatus
Linnaeus

More than three free dorsal spines 2

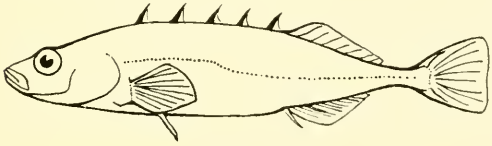
2. Four free dorsal spines, occasionally with fewer; never with lateral plates developed



Fourspine Stickleback
Apeltes quadracus
(Mitchill)

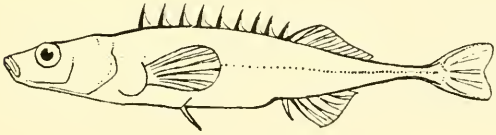
More than four free dorsal spines 3

3. Free dorsal spines 5 or 6



Brook Stickleback
Eucalia inconstans
(Kirtland)

Free dorsal spines 8 to 11



Ninespine Stickleback
Pungitius pungitius
(Linnaeus)

STICKLEBACK FAMILY (Gasterosteidae)

Sticklebacks are small fishes of little economic importance although they have been used in recent experiments on animal behavior. Threespine, fourspine, and ninespine sticklebacks may be found in both salt and fresh waters, but in any case they are distinctly shore fishes. The brook stickleback is never marine. Sticklebacks are fishes of quiet cool waters, and are frequently observed in backwaters having a barely perceptible current.

Their breeding and nesting habits are of interest. Spawning takes place in the spring in May and June. The male builds a small nest about the size of an English walnut among the aquatic vegetation. The nest is a hollow spherical or cylindrical mass of grass and twigs bound together by the secretion from a modified portion of the male kidney. The nest is constructed in quiet water where flow is very slow and constant. The male defends the nesting area from other males and other intruders. Once the nest is finished the male lures a female into the nest where she lays a few eggs. The male follows and fertilizes them. Usually a female will lay fewer than 100 eggs.

The male guards the eggs presenting a very belligerent attitude by raising his spines and readily attacking fishes much larger than himself. The young are guarded for a short time after hatching.

Sticklebacks feed on small invertebrates and small fish fry.

INDEX TO COMMON NAMES