

PHOTOGRAPH BY HILEMAN

## Some Common Food and Game Fishes

*The fifth in Nature Magazine's series of educational inserts*

By E. LAURENCE PALMER

WHEN Rupert Brooke wanted to write about Heaven he took the point of view of a fish and said,

"And in that Heaven of all their wish  
There shall be no more land, say fish."

Most humans would conceive any ideal environment as having a stream, or other body of water, as an important part of it. Yet some of us probably know as little of what goes on in our waterways as the fish know about what takes place on dry land.

Ignorance of the problems of waterways, and unwilling-

ness to use what knowledge we have, has led to widespread pollution of streams with consequent loss of valuable economic and recreational resources, not to mention creation of menaces to health. Nature Magazine has continuously, effectively and justly presented the ethical and economic aspects of pollution. This insert supplements the pollution information by presenting the stories of the lives and habits of the important fishes of our fresh waters. It also supplements the story of certain common aquatic insects, which appeared as the first of these inserts in October, 1938.

Since fishes are animals they perform the usual life functions of breathing, eating, reproducing and growing. Living in water, their breathing problems are somewhat different from those of animals that live surrounded by air. They must get their oxygen from the water. To do this, they are continuously drawing a current of water in through their mouths and letting it pass out over the gills, which are usually protected under flaps at either side of the back of the head. The gills are generally something like fringes of flesh, well supplied with blood. They are hung to a series of arches—or gill arches—so that the best use may be made of the water that passes through. When the water is not sufficiently supplied with air, the fish suffer or die, just as we would if we could not get air. When water is loaded with organic waste, so much of the oxygen in the water is used to dispose of the waste that there is not enough to support the fish. They therefore die. The plants and animals on which fishes feed also will die under these conditions. Pollution and fishes cannot ordinarily get along well together.

It is true that pollution by certain organic wastes, such as those from milk factories, may, if handled wisely, be used to supply foods for organisms that eventually may be eaten by creatures having food value for fishes. This, however, can be worked out only by careful management, and this has not as yet become general practice. The pollution of streams by inorganic wastes from smelters, gas plants and a variety of industrial factories cannot so be turned to profitable channels.

Try a few experiments with a goldfish to see how it behaves under different conditions. Reduce the amount of water available to the fish and see if the rate of breathing is increased or decreased. Raise the temperature of the water and watch what the fish does when the amount of air in the water is reduced by this method. Reduce the amount of surface of the water open to the air, either by applying a close cover to the jar or by putting a film of oil on top of the water. What the fish does under these circumstances, if reasonably interpreted, should teach more than anything that could be written here.

Try similar experiments, using fishes of two kinds at the same time to see whether they behave alike. It will be found that each kind of fish cannot survive a certain critical temperature of water. Because this temperature is lower with brook trout than it is with brown and rainbow trout, and lower with small-mouthed bass than with large-mouthed bass, the brook trout and small-mouthed bass are found in colder bodies of water and generally have a more northerly distribution than their near relatives just mentioned. Stream management requires, first of all, assurance that the temperature of the stream will not at any time of the year rise above the point that is fatal to the species to be raised in it. This temperature can be kept down by providing shade for the headwaters of the stream, and certain stretches of water below must be kept deep and cool by shade and springs.

Fishes appeared in the seas of the earth in Ordovician times and held a dominant place into the Devonian. Their migrations, food relations, enemies and abundance have,

since they first appeared, influenced the prosperity of other living things. Their home life involves indifference, jealous antagonisms, satisfaction of selfish desires and probably true parental care and solicitude. Monogamy, polygamy, polyandry and promiscuity are to be found represented in the domestic relationships of fishes. They are intelligent or dumb, sluggish or playful, cautious or pugnacious, indifferent or aggressive and, in terms of man's interests, useful or harmful. Such an array of varying qualities makes them worthy of study by all.

The distribution of North American fishes, as known at present, is largely conformable to the drainage systems as determined by the last ice age; conditions previous to that time, of course, had laid their own foundations. With the melting of the great ice barrier, the fishes that had been displaced were able to move northward again, often to occupy new territory. The present limits of many species are determined by barriers that were laid down during the period of readjustment. At the same period there were left, in many places, especially in mountain passes, ponds whose levels are still so nicely adjusted to the terrain that from them small streams issue that eventually find their way to oceans on opposite sides of the continent. Each of such streams, of course, unless its upper course is interrupted by impassable falls, contributes species to the other.

Perhaps the best known and most widely publicized of such cases in the United States is Two Ocean Pass, in northwestern Wyoming. In a level mountain meadow mix at times the waters of Atlantic and Pacific creeks, so-called from the final destination of their waters—the first in the Gulf of Mexico, via the Yellowstone, Missouri and Mississippi, and the other in the Pacific, via the Snake and the Columbia. David Starr Jordan considered it probable that this pass may have been one of the avenues that permitted trout of primitive times to pass from Pacific to Atlantic waters on the long journey that these tribes made from their original home in Asia—where he thinks it probable that the group originated—to eastern America; a trip that took ages, and was largely accomplished by short moves along the coasts from stream to stream.

In recent years, other similar mountain passes farther north in the Rocky Mountain system have been discovered, and these afford means of passage by interior waters of fishes of certain groups between Atlantic, Pacific and Arctic waters. The Arctic grayling, *Thymallus signifer*, is rather consistently confined to the Mackenzie drainage of central Canada. Preble, in 1908, pointed out that the occasional occurrence of the grayling in the Hudson Bay drainage might be explained by the fact that Black Lake, east of Athabaska Lake, outlets both to the Mackenzie and the Churchill, and that this route would seemingly account for the species reaching Hudson Bay, since a fish so well fitted for the negotiation of swift streams could hardly neglect so plain a route. The grayling is also taken in the Stikine, a river rising in the interior of British Columbia, and entering the Pacific through the panhandle of Alaska. Since this species is not known to enter salt water, its probable migration from the Mackenzie to the

Stikine by direct passage through some pass was suspected. The discovery by Preble of a small unnamed lake in a pass in the Rockies in central British Columbia, with small issuing streams that reach tributaries of the Peace and the Stikine, seemingly affords a feasible route. Farther north a similar water route exists between the Mackenzie and the Yukon by way of the Porcupine, and it is altogether probable that other similar pathways exist between the 56th parallel and the Arctic Circle. Perhaps, instead of Two Ocean Pass, some of these more northerly passes helped our trout species in their long migration in early times.

Another distribution factor, this time a barrier, seems worthy of mention. Access to long reaches of streams and lakes is denied in many places by the occurrence of falls that fishes cannot surmount. Diamond Lake in Oregon, a few miles north of Crater Lake (also naturally fishless) is of this class. Diamond Lake, with no fishes, was originally monopolized by the crayfish, which had almost no enemies. Trout have lately been introduced and have thrived wonderfully. In some cases such lakes, denied fish life by impassable cataracts, may be stocked by the eggs of fishes accidentally transferred in the mud adhering to the feet of birds. Many such cases have been discovered.

## ACKNOWLEDGMENT

As has been the case with other numbers of this series, this material is a modification of and an improvement on similar material that has appeared in numbers of the *Cornell Rural School Leaflet* published by the New York State College of Agriculture, and prepared by the author. This material is used with the consent of the college. The illustrations in this article are from the pen of Hope Sawyer, and are copyrighted.

The writer has personally collected specimens of each species here considered except the sturgeon, these collections being made from coast to coast. He has witnessed the breeding habits of half of the species mentioned and has supplemented his own observations with those of others. The most useful references for those interested in following these studies more intensively include the following:

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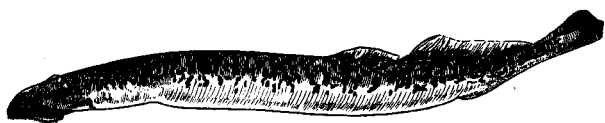
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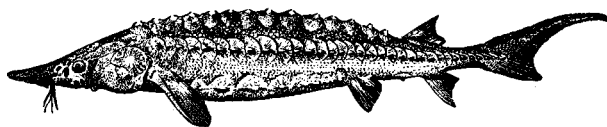
## THIRTY FISHES AND THEIR LIFE HISTORIES



LAMPREY. (1) SEA L. *Petromyzon marinus*. (2) LAKE L. *P. m. unicolor*. (3) BROOK L. *Lampetra* sp. Class Cyclostomata. Order Hyperoartia. Family Petromyzonidae. 15 species in Order. (1) and (2) have circular mouths lined with teeth; (3) teeth in groups. Length, (1) 3 feet, (2) 18 inches, (3) 8 inches.

Eggs laid April to June, in nest built by male, or both sexes. Larvae, "mud lampreys" in stream bottom 4 to 5 years; transform July to March; (1) and (2) go downstream to live 1½ to 3 years as fish parasites; (3) not parasitic, free swimming less than 1 month. All breed but once, always in streams.

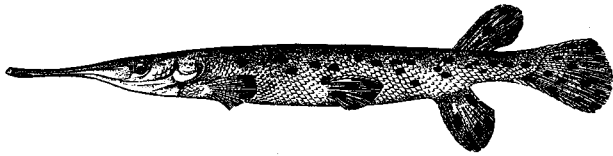
Fresh-water streams, all stages of (3), larvae and breeding adults of (1) and (2); lakes, immature of (2); and the sea, immature of (1). Larvae, good fish food; 45,000 used annually in New England for cod. Destroy many food fishes. Some eaten by man. Eggs of (1) to 235,950; of (2), 108,270; of (3), 3276.



(1) SEA STURGEON. (2) LAKE STURGEON. (3) SHORT-NOSED STURGEON. (1) *Acipenser sturio*; (2) *A. rubicundus*; (3) *A. brevirostrum*. Class Pisces. Order Chondrostei. Family Acipenseridae. Length, (1) to 12 feet; (2) to 6 feet; (3) to 3 feet. Weight, (1) to 550 pounds; (3) to 50 pounds. Back, with huge bony plates. Snout, variable.

Marine forms and others run up streams to mate and lay eggs which soon become sticky. (1) 1 to 2½ million; (2) and (3) 20% of weight of fish. (2) may lay eggs on rocky ledges. Eggs, about 1/9 inch in diameter. Adults in Russia believed to have lived as long as 300 years.

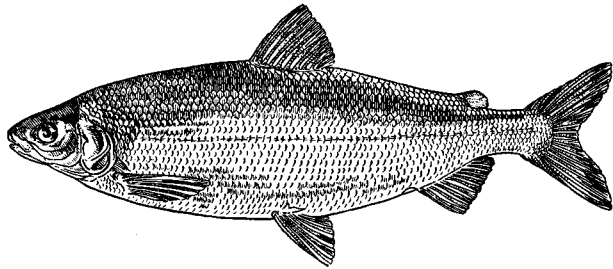
Great Lakes produced 3,500 tons in 1880, 50 tons in 1917; lost through unwise management, and "caviar" obtained from other fishes. One Lake Erie firm harvested 18,000 fish in one year. Flesh good, and eggs, when made into caviar by being salted, have high market value (to \$100 per fish). Swim bladder supplies material for making superior glues, court plasters and isinglass. Different species extend range through Old and New Worlds.



(1) COMMON GARPIKE. (2) ALLIGATOR GAR. (1) *Lepisosteus osseus*. (2) *L. tritoechus*. Order Holostei. Family Lepisosteidae. Length, (1) to 5 feet; (2) to 10 feet. Weight, (2) to over 100 pounds. Covered with large bony scales. Jaws, armed with sharp teeth.

Feeds largely on other fishes captured by sudden dashes. Can breathe without use of gills by using air in swim bladder much as a lung is used. Often seen at surface taking in supply of air. Eggs strewn among plants.

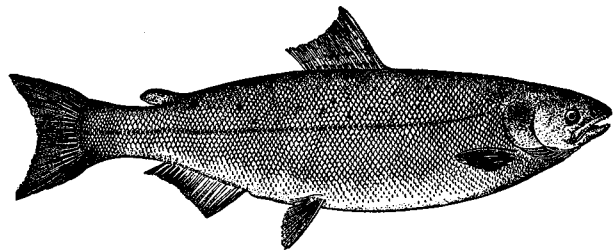
(1) Great Lakes to Rio Grande and along Atlantic coast even in sea. (2) Southern states north to the Ohio River. Great pests as destroyers of more valuable fishes. Bony covering so hard it has been used to cover war shields by primitive peoples, and to cover plows. (2) Large ones may be dangerous to any animal.



**WHITEFISH.** *Coregonus clupeaformis*. Order Isospondyli. Family Salmonidae. Unlike the salmon and trouts the mouth is small and the upper jaw extends only to the eye. Length, 5 months, 2-3; 1 year, 8-9; 2 years, 12-15 inches; max. 2 feet. Weight, to 23 pounds. Color, olive, with white sides.

Mates in November and lays eggs in shallow water over rocks, up to 75,000 in number but normally about 10,000 per pound. Eggs, 1/8 inch in diameter. Many are reared artificially in hatcheries to try to maintain a supply. Incubation, 5 months. Mature in 5 years. Food, like that of trouts, animals.

Most valuable food fish of the Great Lakes and the supply is diminishing through unwise harvest methods. Most of year in deep water. May make spring feeding migration to shallows. Found in the Great Lakes and north to the Arctic Circle. Captured in gill nets, now being set in very deep water.

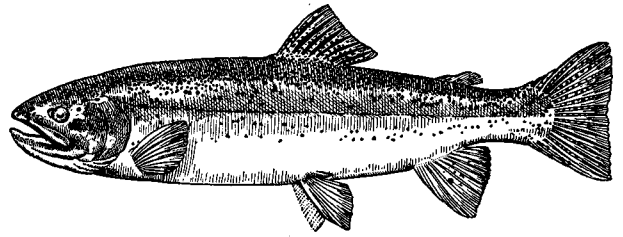


**PACIFIC SALMON.** (1) KING; (2) SILVER; (3) RED OR SOCKEYE; (4) PINK. (1) *Oncorhynchus tshawytscha*; (2) *O. kisutch*; (3) *O. nerka*; (4) *O. gorbuscha*. Family Salmonidae. Max. weight, (1) 100 lbs.; (2) 10; (3) 7; (4) 6. Anal fin rays, (1) 15-17; (2) 13-15; (3) 14; (4) 14-16. Black spots in (1) larger than in (2).

Swim upstream, (1) July-Oct.; (2) Sept.-Nov. at age of (1) 3-8 years; (2) 2-7; (3) 4-8; (4) 2; for long distance (1) and (3). Female builds nest, mates, spawns, dies. After (1) few weeks; (2) 1-2 years; (3) number of months to 3 years, young returns to sea, length (1) 1 1/2 inches; (2) 5 inches. Parr marks, or dark areas on sides, in (1) broad; (3) round; (4) absent.

Eggs, used as bait; hatch at 50° F. in 50 days. Most valuable food fish, in Columbia River alone worth \$10,000,000 annually,

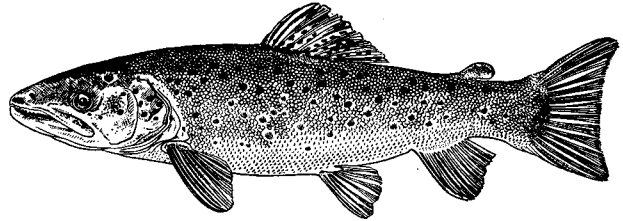
employs 25,000 people, industry threatened by Federal dams. 1935 total, \$32,475,266. From California to Alaska. Finest sport fish.



(1) RAINBOW TROUT. STEELHEAD. *Salmo gairdnerii*. (2) ATLANTIC SALMON. *Salmo salar*. Family Salmonidae. Anal rays, 9 or 10. Length, 5 months, 2-3; 1 year, 4-6; 2 years, 8-9 inches. Weight, (1) to 42 pounds; (2) to 103 pounds. Many relatively small, black spots on lighter background. Steelheads, silvery sea-run fish, become darker.

Migrates to spawn February to June. Female builds nest in riffle over gravel. Eggs, 200 to 9,000, fertilized and abandoned. Incubation, 22 days at 57° F. 5-inch fish known to grow 1 inch a month at 63° F. Breeding male (1) shows conspicuous rose bands on sides. Breeds more than one year in both (1) and (2).

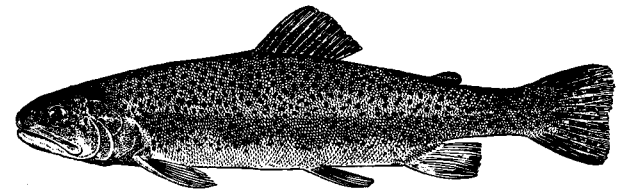
(1) Can survive stream temperature of 83° F. Prefers streams connected to sea or large lake. (1) Native of Pacific coast but widely established over world; superior game fish. (2) Formerly an important food fish from Delaware north along Atlantic coast to Spain; now practically gone in America; some resident in lakes.



**BROWN TROUT. LOCH LEVEN TROUT.** *Salmo trutta*. Family Salmonidae. Length, 5 months, 2-3; 1 year, 4-6; 2 years, 8-9 inches. Weight, to 40 pounds. Yellow-brown with (usually) large, dark spots on lighter background on sides and (usually) few red spots. Lower fins, white or pale yellow. Scales, larger than those of brook trout.

Spawns in fall, running upstream to shallower water and breeding much as does brook trout. Incubation, about 31 days at 57° F. and fertilization about 99 percent. Nest abandoned and young left to shift for selves. Fish may breed year after year. Nest may be in water 4 feet deep, but usually shallower.

Can survive water temperature of 81° F. but naturally prefers cooler water. Favors more quiet water than brook trout. Introduced from Europe and widely established. Will drive out native brook trout in warmer waters. Crossed with true Loch Leven trout, which were introduced in 1884.

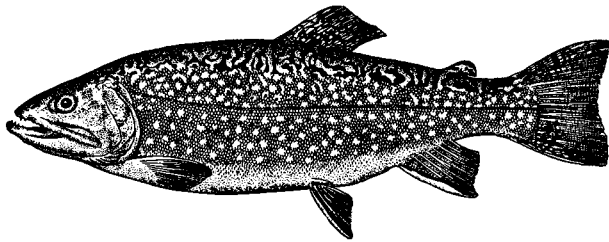


**CUT-THROAT. BLACK-SPOTTED TROUT.** *Salmo clarkii*. Family Salmonidae. Weight, to 20 pounds. Anal rays, 10. Commonly heavily spotted with black. Sides, without red spots; characteristic but often inconspicuous red on under side of jaws on either side. Scales, relatively coarse and easily rubbed off as with rainbow and brown trouts.

Breeding male shows rose band on sides resembling rainbows. Spawns in spring in nest built by female. May be crossed with

rainbows in nature or in hatcheries but such eggs are not virile. Some ascend from sea for short distance. Lake forms go up adjacent swift streams, general procedure resembling the rainbow.

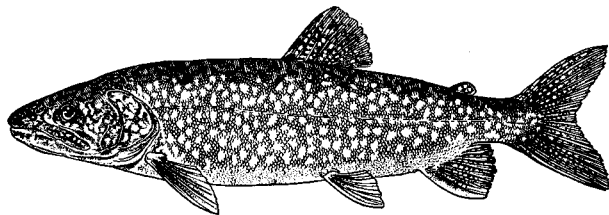
Excellent sport and panfish of the west, some being found as far east as Montana and the Yellowstone and present in most of Pacific coast streams. May destroy great numbers of eggs of salmon and rainbow trout, although this may also be said of the rainbow trout itself.



**BROOK TROUT.** *Salvelinus fontinalis*. Family Salmonidae. Length, 5 months, 2-3; 1 year, 4-6; 2 years, 8-9 inches. Weight, to 17 pounds. Back, with worm-like markings. Body, red-spotted. Lower fins, edged with black and orange. Color varies with nature of bottom. Flesh, firm and of superior food value. Very gamy.

Starts upstream about October, males first. Female makes nest in riffle over gravel, and mates. 3-year fish lays 100 to 300 eggs; older, up to 5000, about 80 percent fertile. Hatch in 44 days at 50° F.; in 90 days, at 40° F. Male may guard nest 3 weeks. Eggs stick to gravel. May spawn at 6 inches, second year.

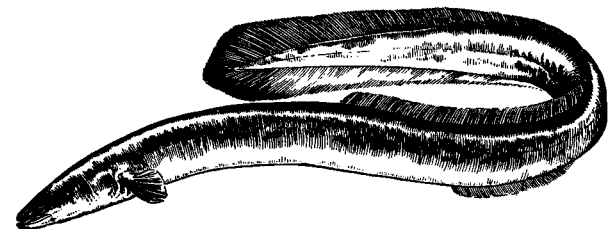
Best in hard- or soft-water streams with maximum temperature of 66° F. but can survive 75° F. Labrador Peninsula to Georgia, west to Montana and Saskatchewan, sea-run in Labrador. Introduced over world. Now freed from hatchery when of legal capture size. Easily reared in hatcheries and most popular of stream fishes.



**LAKE TROUT. MACKINAW TROUT.** *Cristivomer namaycush*. Family Salmonidae. Length, 5 months, 2-3 inches; 1 year, 6-7 inches. Weight, to 80 pounds. No red spots but large white spots on darker background show on sides and back. Fins, gray and similar to general color. "Cristivomer" refers to raised and toothed vomer bone in roof of mouth.

Mates over nests or hard bottoms, in water 3 to 20 feet deep, a 24-pound fish producing about 15,000 eggs. Young not cared for by parents. Eggs are suitable for rearing in hatcheries though fish themselves do not normally live in types of water commonly found in trout hatcheries.

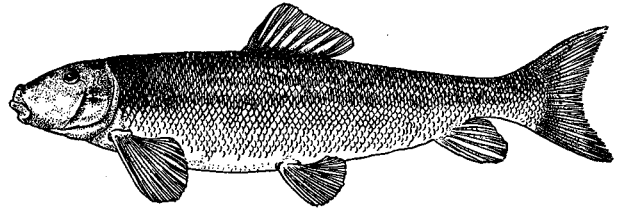
Found in large cool lakes from New England to Montana, British America, Alaska, the Great Lakes region being a valuable source of commercial fishing. Supply decreasing rather dangerously because of excessive catches due to modern techniques of fishing.



**COMMON EEL.** *Anguilla bostoniensis*. Order Apodes. Family Anguillidae. One American species. Males, up to 3 feet long; females, up to 5 feet. All slender, with small head but sharp teeth and large mouth. Scales, minute, imbedded and hidden.

American eel breeds but once, laying up to 10,000,000 eggs deep in sea between Bermuda and West Indies. Young, transparent, flat, to 3-inch *Leptocephali* for a year; 2d spring, ascends streams, going as high as 8000-foot elevation in Colorado. May burrow in mud in winter. Spends 6 to 8 years inland, then returns to sea to breed and die.

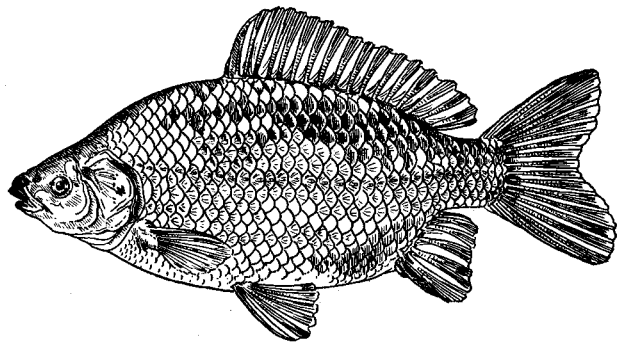
In fresh and brackish water, in all parts of world except Pacific coast of North America and Pacific islands. Males, rare in fresh water. European eels breed near West Indies. Valuable food fishes unfortunately caught just before breeding time though reproductive organs do not mature until after return to sea. Feeds mostly at night. Annual U. S. catch worth about \$250,000.



**WHITE SUCKER. COMMON SUCKER.** *Catostomus commersonii*. Order Eventognathi. Family Catostomidae. About 70 species in 15 genera. Length, 5 months, 1 1/2-2; 1 year, 2-3; 2 years, 5-7; max. 18 inches. Mouth, with suckling lips, on lower side of head. Scales, small. Flesh, bony, and soft.

Runs upstream in early spring to breed in shallow nests built of gravel in swift water. Eggs fertilized as deposited. Young unprotected; swim near surface and feed about 10 days. Matures at 6 inches. Adult returns to deeper waters after breeding to wait and develop for another breeding season. Food of fish over 3 inches long, small animals.

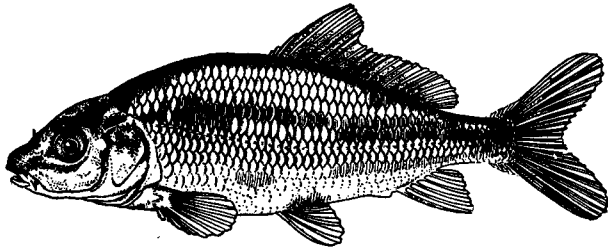
Found in fresh waters over mud bottoms except in breeding season from Labrador to Montana and south to Georgia and Missouri, with 67 related American species and 2 eastern Asiatic species. An inferior but popular food fish. May destroy the eggs of more valuable species.



**GOLDFISH.** *Carassius auratus*. Order Eventognathi. Family Cyprinidae. The European goldfish *Carassius carassius* has not produced many types. Well known as aquarium fish usually white or red with relatively large scales and often appearing with unusual eyes, fins and colors. Some black and some brown.

Mates early morning to afternoon, April to May, laying 10 to 20 amber eggs at a time to total over 500, which stick to submerged or floating plants. Hatch at 70°F. in 3 to 7 days. Good breeder has 2-inch body, matures second year, breeds until 9 and may live until 15. Food, that of a general scavenger.

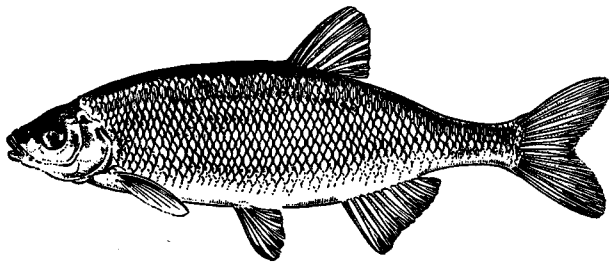
Originated in the Orient and widely distributed over world in water containing lime and between 70° and 55°F. for best development. Has a good sale value for aquarium and pond use and where reared commercially is fed by putting mixture of 2/3 sheep manure and 1/3 superphosphate fertilizer on bottom of pond.



**CARP.** *Cyprinus carpio*. Family Cyprinidae. Coarse-scaled, soft-fleshed fish, blackish above and golden yellow on sides and belly, with 4 barbels on mouth. Length, 5 months, 3-5; 1 year, 6-8; 2 years, 12-15 inches. American maximum weight, 42 pounds. A fish caught in Switzerland in 1825 weighed 90 pounds.

In central New York, breeds in May and June, a 16-pound fish laying as many as 2,000,000 eggs, which hatch in 5 to 12 days depending on temperature. Maturity reached in 2 or 3 years. Breeds and feeds in shallow water. Does not protect young. Food, plant and animal matter strained from mud, fish eggs.

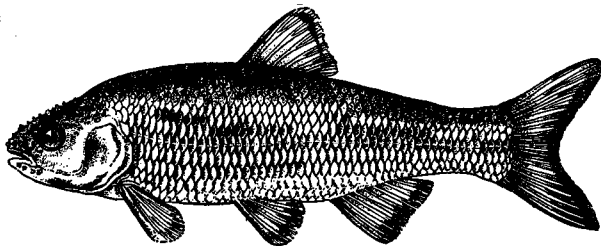
May supplant superior fish by destroying eggs, nests and young. Some 250 tons harvested annually in New York as cheap food and to protect more valuable species. Carp found in fresh waters in Europe and eastern Asia. Too well established in America. Generally considered as fish pests here.



**GOLDEN SHINER. ROACH.** *Notemigonus crysoleucas*. Family Cyprinidae. Length, 5 months, 1; 1 year, 1½-2; 2 years, 2½-3; max. 12 inches. Golden green in upper parts with sides silvery and fins yellow. Lateral line more or less parallels the bottom line of the body. Mouth, small.

Unique in food habits since from 90 to 95 percent of food is plant material and only a small amount is composed of invertebrate animals. Because of this, the animals are not competitors for food with the usual game fish and they are themselves superior food for the more valuable species.

Common in ponds and slow streams where there is an abundance of vegetation, from Nova Scotia to the Dakotas and south to Texas and Tennessee. One of the best bait minnows, being hardy and living long on the hook and being abundant within its range. Not of direct food value to man.

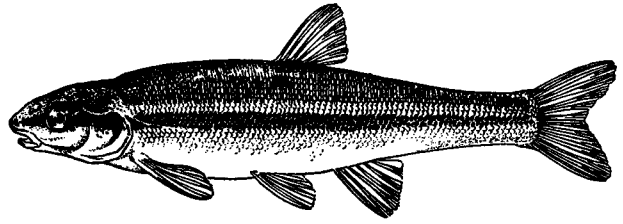


**COMMON SHINER. REDFIN. DACE.** *Notropis cornutus*. Family Cyprinidae. Length, to 8 inches. Scales, large. Back, dark steel-blue. Sides and belly, silvery. About 100 species closely related. In the spring, belly of male is pink and head roughened.

Male builds nest in shallow, swift water, and eggs are laid here by a number of females when the temperature is about 73°F. Male protects nest and eggs. Food, about 85 percent plants and 15 percent small animals. Grows relatively rapidly where food is abundant and enemies few.

Common in small streams through entire region east of the

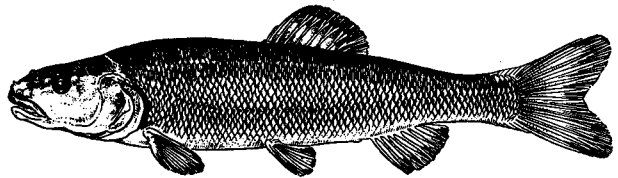
Rockies to north of Texas and the Neuse River. Related species extend the range particularly to the south. Acceptable and attractive aquarium fish and hardy bait minnow which does not compete for food with more valuable game species.



**BLACK-NOSED DACE.** *Rhinichthys atratulus*. Family Cyprinidae. Length, to 3 inches. Slender, active, varying considerably through range with the males rosy on fins in spring. Conspicuous, black, lateral band. Body, slender. American species, 3; Mexican, 1.

Mates in spring and early summer, sometimes two males to one female usually in swift water over gravel. Male may have whole body a crimson color at height of breeding season. Food, largely small animals (example, 70 percent midge larvae, 17 percent Mayfly larvae). Also eats fish eggs.

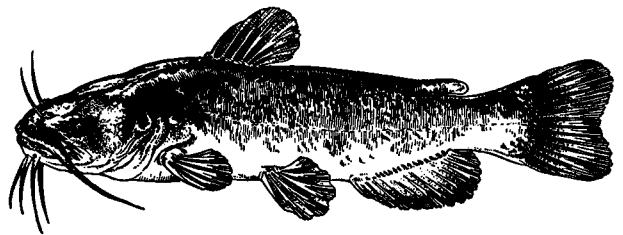
Common in clear brooks and streams where water is swift from New England to Minnesota and south to Alabama, with related species and genera extending range into Rockies, west and south. Good aquarium fish but not to be desired in fish hatcheries. Food for and competitors of other species.



**HORNED DACE. COMMON CHUB.** *Semotilus atromaculatus*. Family Cyprinidae. Length, 5 months, 1-1½; 1 year, 1½-2; 2 years, 3-4; max. 10 inches. Scales, crowded and smaller in front of dorsal fin which has a dark spot at base and is placed above middle of body. Steel-blue above; sides and belly, silvery.

In breeding season, heads of males are orange and horn-covered. Male builds nest in May to July in swift water using small stones pushed in to make a circular pit. Females enter and lay eggs, which are fertilized and guarded by male. More than one female may lay in a nest of a male. Some breeding in migration.

Common in fresh-water streams from Maine to Wyoming and south to Alabama. The ideal fish for the small boy since it bites readily at almost anything and fights well for freedom. Is edible but inferior to other fish of the same waters. May eat the eggs of superior species.



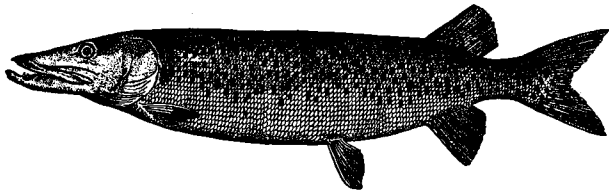
**BULLHEAD, HORNED POUT, CATFISH.** *Ameiurus nebulosus*. Nematognathi. Family Siluridae. 900 species in the family, 30 in the United States. Length, 5 months, 2-2½; 1 year, 3-4; 2 years, 5-7; max. 20 inches. Mouth, large. Scales, lacking. Single, coarse spines in dorsal and forward side fins. Barbels, conspicuous. Dark to silvery.

Food, from bottom, of variety of materials, may be tasted along under side of body. Mates in late spring and lays about 2,000 ⅛-inch eggs in nest built and guarded by male. Incubation, about 5 days. Young, which are coal black, may stay in school protected



by father through first summer.

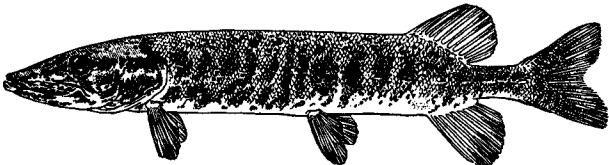
Common in quiet, warm, mud-bottomed waters from Maine to Dakota and south to Texas and Florida. Introduced in California. Close relatives extend range. Superior pan and small boy fish and excellent food for man. A related catfish caught in the Mississippi in 1878 weighed 150 pounds—a record.



**MUSKALLUNGE. MUSKY.** *Esox masquinongy*. Order Haplomi. Family Esocidae. Length, to nearly 9 feet. Weight, to 100 pounds (?). Real authentic record of 75 pounds from Wisconsin. Lower half of cheeks and of gill covers not covered with scales. Rays of dorsal fin, 17 to 19.

Mates in May and June in shallower water among the brush and weeds, a 35-pound fish being able to lay up to 265,000 eggs, each about 1/11 inch in diameter and not likely to stick to others of its kind. Young not cared for by parents. Food, entirely other fish and animals.

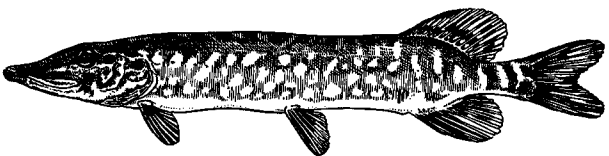
Found in lakes from the Great Lakes region, occasionally into the Ohio valley or even as far south as North Carolina. Considered one of the best of game fishes because of its superior fighting ability coupled with great size and general food properties. Naturally destroys other fishes.



**BROOK PICKEREL.** *Esox americanus*. Family Esocidae. Length, 5 months, 4-5; 1 year, 6-7; 2 years, 8-10; max. about 14 inches. Cheeks and gill covers, entirely covered with scales. Mouth, large, terminal and well armed with sharp teeth. Scales, small and for the most part uniform.

Mates in early spring in shallow, weedy water, producing several thousand eggs fertilized as two parents swim side by side. Eggs hatch in 2 weeks. Eggs do not adhere to each other. Young not protected by parents or placed in a nest. Food, any animal that can be captured.

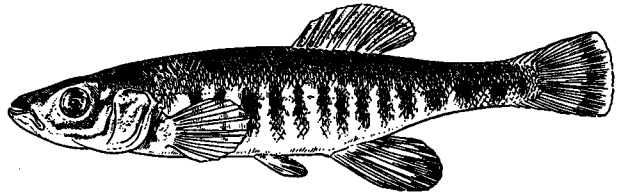
Common in ponds and slow streams among vegetation from Maine to Florida and west (as *E. vermiculatus*) in the Great Lakes and Mississippi basins. An excellent game fish intolerant of competition with other species and easily reared in hatcheries though cannot be crowded because of cannibalism.



**PIKE, JACK FISH.** *Esox lucius*. Family Esocidae. Cheeks, entirely scaly; gill covers, not scaly on lower half. Length, 5 months, 5-7; 1 year, 8-12; 2 years, 14-17 inches; max. over 4 feet. Weight, to over 40 pounds. Blue or greenish-gray, the scales appearing small. Dorsal fin, with 16 or 17 rays while the pickerels have 14 or less.

Breeds in spring, in shallower waters of lakes and streams. Parents swim side by side dropping 100,000 or more 1/3-inch eggs, which do not stick together, among the weeds. Eggs hatch in 2 to 3 weeks without parental protection. Food, almost entirely other fishes captured by sudden dashes.

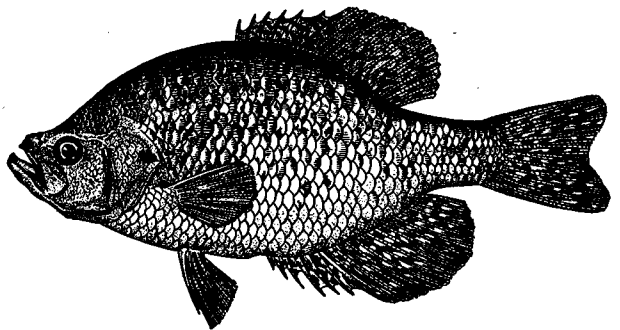
A superior game fish with excellent food qualities, easily reared in hatcheries during earlier stages. Found from Alaska eastward through Canada and south to New York and Ohio; also in northern Europe and Asia. Introduced and established elsewhere where conditions are suitable. Generally very popular.



**TOP-MINNOW. KILLIFISH.** *Fundulus* sp. Order Haplomi. Family Poiciliidae. Some 180 species in 30 related genera. Length, to 4 inches. Lower jaw projects up and beyond upper. In related genus *Gambusia*, anal fin of male is sword-shaped; in *Fundulus*, it is normal.

Males, more brilliant than females. In *Fundulus*, eggs fertilized outside the female and deposited in vegetation. In *Gambusia*, eggs fertilized and partly developed in female. Food, almost entirely small forms of life caught near the water surface. Destroys immature mosquitoes.

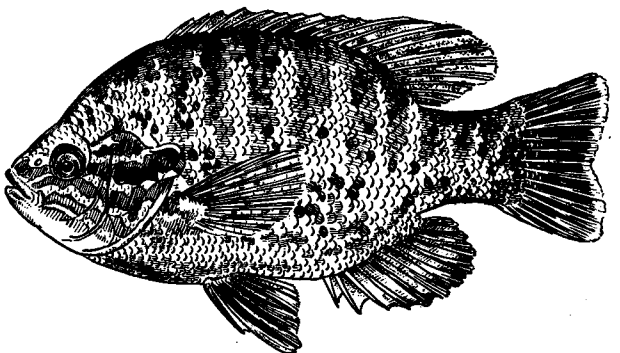
Found near surface of fresh and brackish waters of Europe, Africa and America, one common species, *F. heteroclitus*, ranging from Maine to Mexico. Makes satisfactory aquarium fish and is used with varying success in large mosquito control projects. Not useful of course in temporary ponds.



(1) **CRAPPIE.** *Pomoxis annularis*. (2) **CALICO BASS,** *P. sparoides*. Order Acanthopteri. Family Centrarchidae. Length, to 1 foot. Anal fins nearly as long as dorsal. Dorsal spines of (1) 5 or 6; of (2) 7 or 8. (2) is deeper, generally darker and heavier than (1).

Spawn in early summer in rather deep water over gravel in separated nests not easily observable. Incubation a few days to 2 weeks or more and likely to be injured below 58°F. or destroyed below 55°F.

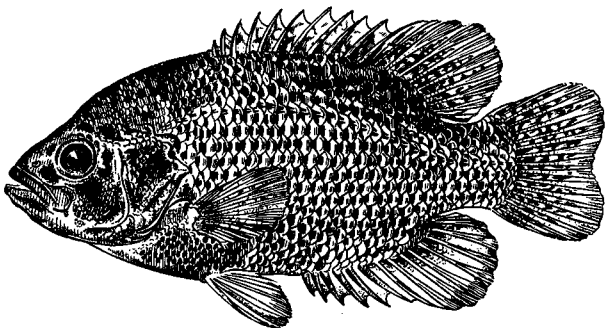
Both are popular ready-biting panfish (1) being sometimes called "strawberry bass". Feeds chiefly on aquatic insects and kin. Found mostly in pools and slow streams from Texas to Alabama and north to Vermont and the Dakotas.



**COMMON SUNFISH, BREAM, PUMPKIN SEED.** *Eupomotis gibbosus*. Family Centrarchidae. Length, 5 months, 2-2½; 1 year, 3-4; 2 years, 5-6; max. 8 inches. Spines on anal fin, 3 as with warmouth but no teeth on the tongue in the sunfishes. Body, deep. Color, brilliant from green to olive with orange belly and spots on sides.

Male builds a nest on the bottom commonly among weeds. Bottom of nest hollowed out and about 1 foot across; may be rootlets or gravel. Eggs and young are protected vigorously by the male. Food is any small animals which may be captured such as insects, other fish, worms and crayfish.

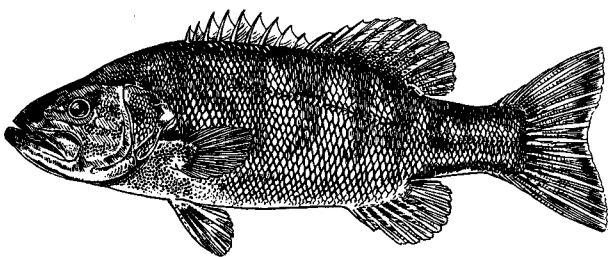
An ideal fish for the small boy and an excellent panfish. Common in ponds and streams where there are mud and vegetation from Maine to Minnesota and south through Florida through the Mississippi Valley though more uncommon in the south. Were it larger it would be an outstanding game fish.



**ROCK BASS.** *Ambloplites rupestris*. Family Centrarchidae. Length, 5 months, 1-1½; 1 year, 1½-2½; 2 years; 3-4 inches; max., 1 foot. Anal spines, 5 to 8; dorsal, 11. Gill rakers, less than 10. Contrast with Sacramento Perch *Archoplites* with 20 gill rakers, 12 to 13 dorsal spines; and warmouth, *Chaenobryttus*, with 3 anal and 10 dorsal spines.

Breeds in early summer in water of about 74°F. temperature, placing eggs in nests prepared and defended by male. Food, other fish, crayfish, worms and insects which it is able to capture. Bites vigorously. Fights valiantly for life when hooked. If larger, would be great game fish.

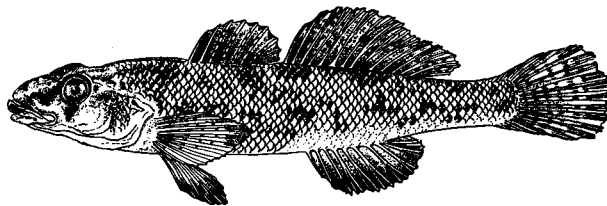
Excellent panfish, generally popular and abundant, in lakes and slow rivers from Vermont to Manitoba, south to Alabama, Louisiana and Texas, being most common west of the Alleghenies. Related Sacramento perch is found in the Sacramento and San Joaquin Rivers. In south, is the related warmouth.



**SMALL-MOUTHED BLACK BASS.** *Micropterus dolomieu*. Family Centrarchidae. Length, 5 months, 2-3; 1 year, 4-5; 2 years, 6-8 inches; max. 2 feet. Back margin of lower jaw in front of center of eye rather than behind it, as in the large-mouthed black bass or "trout" of the South. Tail, with dark band. General color, uniform, dull green.

Male builds nest, cares for young and eggs from May through July. About 7,000 eggs per pound of weight of the female. Eggs, stick together unless cared for and young die unless protected. Food, minnows, crayfish, hellgrammites and other aquatic animals. Probably the best game fish of its environment.

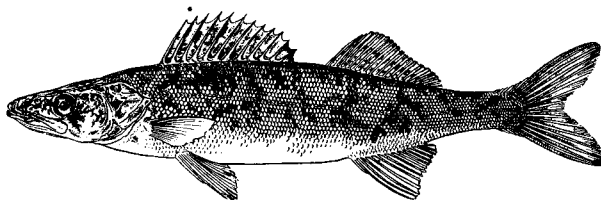
Commonest in clear, cool lakes and streams from Lake Champlain to Manitoba and south to South Carolina and Arkansas. Widely established by planting outside normal range, particularly in New England. Requires water cooler than 100°F., which large-mouthed survives. Not raised easily in hatchery trays.



**JOHNNY DARTER.** *Boleosoma nigrum olmstedii*. Order Acanthopteri. Family Percidae. Length, rarely over 3 inches. Scales, fins and head, relatively large. Color, olive with numerous black blotches particularly on the sides. Body, tapers only slightly to rear.

In spring, male is commonly darker in forward parts. Most darters attach their eggs to under sides of stones or pebbles in a nest-like excavation, which is built usually in swift water. Food is essentially small animal life though some are destroyers of the eggs of other fishes.

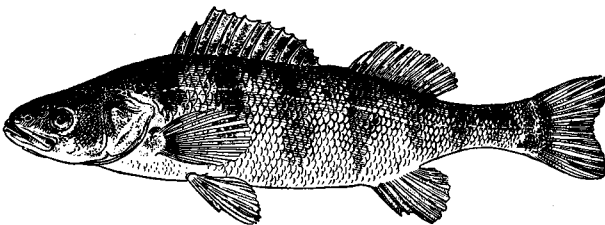
Common on bottoms of small, cool streams, among weeds and stones and unable to get to surface except with effort. This species found in territory east of Colorado and Manitoba but close relatives extend range. May make interesting aquarium fish if the temperature can be kept down sufficiently.



**PIKE-PERCH, WALL-EYED PIKE, DORÉ.** *Stizostedion vitreum*. Family Percidae. Length, 5 months, 5-7; 1 year, 8-12; 2 years, 12-15 inches; max. 3 feet. Weight, to 25 pounds. Cheeks and gill covers sparsely scaled as distinguished from sauger or sand-pike, *S. canadense* (Smith) in which they are fully scaled. Color, dark olive green with darker blotches; pinkish belly.

Mates in April and May. 2-pound fish produces 45,000 1/5 inch eggs per pound. Incubation, 2 weeks. No parental protection. Lends itself to hatchery conditions, many fish being stripped when they are taken in nets by market fishermen. Millions are distributed yearly from hatcheries.

Found in lakes and large rivers from Hudson Bay and upper Mackenzie south through Vermont, Pennsylvania and Georgia and west to Alberta, being more abundant in its northern range but particularly important in Great Lakes region. Known in the west and south erroneously as "jack salmon."



**YELLOW PERCH.** *Perca flavescens*. Family Percidae. Length, 5 months, 2-2½; 1 year, 3-4; 2 years, 5-6 inches; max. to about 1 foot. Weight, to 3 pounds. Color, yellowish, with dark green bands. Scales, moderate. Skin, tough. Flesh, excellent. Body cavity, relatively small.

Mates early summer, pairs swimming through weeds laying, fertilizing and abandoning among weeds 1/8-inch eggs in zig-zag ribbons sometimes 7 feet long. 24-ounce fish may produce 41 ounces of eggs. Food, small animals such as worms, minnows and crayfish.

A superior and popular food and game fish caught on hook and line or in nets and sold in markets. Found in lakes and streams, preferably where there is a mud bottom and little current, from Nova Scotia to Dakota and south to Ohio, with related species in Europe and in Asia.