

Cutthroat trout	<u>Salmo clarki</u> Richardson
Lahontan cutthroat trout	<u>S</u> <u>c</u> <u>henshawi</u> Gill and Jordan t
Utah cutthroat trout	<u>S</u> <u>c</u> <u>utah</u> Suckley t
Alvord cutthroat trout	<u>S</u> <u>c</u> <u>ssp. sc</u>
Humboldt cutthroat trout	<u>S</u> <u>c</u> <u>ssp. sc</u>

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### Importance

The cutthroat trout is one of the most popular sport fish in western America. It is avidly pursued, not only by elite fishermen, but by the rank and file as well. In the view of many, its sporting and table qualities excel that of all other trout. It is, however, not nearly as abundant, over much of its range, as the rainbow trout.

The Lahontan cutthroat trout in Pyramid Lake is of substantial economic and social importance to the Pyramid Lake Paiute Indian Tribe. Its adaptation to the highly saline waters of Pyramid Lake (total dissolved solids 5,500 ppm) also make it a unique natural history entity. It has been estimated that the historic annual production of Lahontan cutthroat trout, in the Pyramid Lake-Truckee River ecosystem, was at least one million pounds (Behnke 1974). At one time the Pyramid Lake cutthroat trout was the mainstay in the diet of the Pyramid Lake Paiutes and many other Indian tribes. It was also shipped to mining camps and other markets as far away as San Francisco (Sigler et al 1983). The other subspecies of cutthroat trout are important over their limited range; except the Humboldt trout which is not often locally abundant, but has a large range.

### Range



The cutthroat trout has the widest distribution of any species of western trout in North America. Its range along the Pacific coast is from southeastern Alaska to the Eel River in northern California. It is native to all major river drainages in western North America as far east as central Colorado. In the northern part of its range it is present on both sides of the Continental Divide. It occurs in fresh, brackish and salt water. While its original range has been decimated by a number of factors, it has been concurrently extended by extensive planting.

The cutthroat is the only trout native to the Great Basin. It is present there in many high, cold water streams and lakes. The range of the Lahontan cutthroat trout is the Truckee, Carson and Walker rivers, Donner Creek, and Pyramid, Walker, Donner, Independence and Summit lakes. It is also present in the Alvord Basin. The Utah cutthroat trout is now largely confined to Snake Valley in western Utah and Pine Creek, Nevada. A small population exists in Willow Creek, Jordan River drainage, Utah; another population is in Lake Alice, Bear River drainage, Wyoming (Behnke 1979). The Alvord cutthroat inhabits Willow and Whitehorse creeks of the Northwest Basin. The Humboldt cutthroat trout is throughout the Humboldt drainage.

#### Description

The back and sides of the cutthroat are frequently a steel gray covered with spots. These spots are larger, more regular in size and shape and more restricted than those on

redhead  
Oregon

Basin R  
Wyo  
Thom 2  
Smith 24



brown or rainbow trout. A slash mark, usually red or orange in adults, but sometimes lacking in young, runs along each branch of the lower jaw. The body is elongate and typically trout-like, rounded and slightly compressed; scales are cycloid and small to medium in size; 140 to 230 in the lateral line. The head is conical, moderate to short, eyes moderate, and snout rounded. The mouth is terminal and rather large. There are small sharp teeth on the jaw, vomer, tongue and median basibrachial plate between the lower end of the gill arches. The gill rakers are 14 to 22, usually 7 on the upper limb and 11 or 12 on the lower limb. The dorsal fin has 8 to 11 rays; the anal fin has 10 to 11; the caudal is slightly forked. The color and spotting is highly variable, often differing between watersheds, subspecies and local populations. The young have 9 or 10 oval parr marks along the lateral line (Simpson and Wallace 1978).

The Lahontan trout is characterized by its large size, spots evenly distributed extending from the head onto the caudal fin, and by having a higher number of pyloric caeca than any other subspecies. Spotting of the Humboldt cutthroat trout is less than the Lahontan and seldom on the ventral region. The Utah cutthroat trout has large evenly distributed spots on the side, more or less evenly distributed, but seldom on the ventral region. The Alvord cutthroat trout is characterized by spots similar to the Humboldt cutthroat. It has 9 to 11 branchiostegal rays

series  
200  
140-180  
see table

Humboldt 125-180  
Hemshawi  
21-28  
19-23  
16-21  
see table



(Behnke 1981).

#### Size and longevity

The growth of cutthroat trout depends primarily on two factors; water temperature and abundance and kind of food available. The slowest growth is in the cold, high lakes or streams with a short growing season where food is generally confined to invertebrates. The anadromous cutthroat trout grows fast in salt water during the summer, but returns to fresh water during the winter months. Cutthroat trout in high cold water areas usually attain a length of 14 to 16 inches and the weight of a pound or more in four to five years. The average life span of the cutthroat trout is about seven to eight years, with few living more than ten. Buckley (1961) reports the yearly length in inches, for Yellowstone Lake, Wyoming cutthroat as: 1.8, 5.1, 8.9, 12.3, 15.5, 17.5 and 19.1. In a three year study on Pyramid Lake, Nevada (Sigler et al 1983) 562 Lahontan cutthroat trout ranged in size from 7.5 inches and 1 1/4 ounces, to 31 inches and 13.5 pounds. A total of 676 fish reached the yearly following length in inches: 8.5, 11.5, 14.2, 17.0, 19.6, 22.5, 24.8. The all tackle hook and line record cutthroat trout was a Lahontan, weighing 41 pounds, caught by John Skimmerhorn in Pyramid Lake, Nevada, December, 1925. The largest recorded Lahontan cutthroat trout caught since then weighed 28 pounds. It was taken by Ralston Fillmore from Pyramid Lake in April, 1976.

#### Decimating factors



Since cutthroat trout are taken quite readily on a large variety of lures, hook and line fishing is the predominant mortality factor. The cutthroat trout does not have the ability to compete favorably with introduced fish such as rainbow trout, brown trout or brook trout in a degraded habitat. The once widespread populations of cutthroats in streams and lakes of the Lahontan Basin have now been replaced by rainbow trout, brown trout and brook trout in many streams. In streams they have hybridized excessively with rainbow trout, which has become the dominant species. Possibly, pure rainbow trout are more aggressive than either cutthroat or the hybrids and displace them from feeding territories (Moyle 1976). Displacement not only makes the cutthroat trout more vulnerable to predation and fishing, but it also decreases its growth rate and reproductive potential. According to Moyle, competition and predation from introduced lake trout were presumably important factors in the complete elimination of cutthroat trout from Lake Tahoe. However, there were other factors, such as the eliminating the spawning run from Pyramid Lake. However, in prime cutthroat trout habitat, genetically pure cutthroat compete very well. For example, when rainbow trout were introduced into Yellowstone Lake, Yellowstone National Park, Wyoming, the rainbow trout did not prosper. In Bear Lake, Utah-Idaho, the cutthroat trout fare better than the rainbow trout.

nilsson  
Northcote  
b-r  
brook  
brown

Disease sometimes devastates cutthroat populations,



something that has happened more often since the advent of fish hatcheries. Females may spawn only once or twice in a lifetime, and the post spawning mortality is often high. The most serious environmental hazard facing stream dwelling or cutthroat trout is the loss of habitat due to reduced flows, degradation of water quality, or change in basin configuration.

In Yellowstone Lake, Wyoming, the white pelican was at one time a serious predator of spawning fish.

#### Food and feeding

Wydoski and Whitney (1979) found inland subspecies of cutthroat trout feed primarily on aquatic insects, although the larger fish may feed entirely on fish. They report, that in the Oregon coastal subspecies, there is a preference for insects, along with frogs, earthworms and juvenile salmon. Other foods include crayfish, terrestrial arthropods, salamanders and sculpins.

Scott and Crossman (1973) report cutthroat food consists mainly of insects, both aquatic and terrestrial. Other food includes various plankton crustaceans, crayfish, salmon eggs and dead salmon. Midges and other true fly larvae, mayflies, and beetles also enter the diet. Young cutthroat start feeding in 14 to 23 days after hatching; older fish in rivers and lakes feed almost exclusively on fish.

Small cutthroat trout in Pyramid Lake, Nevada, feed largely on insects and zooplankton. They start feeding on



fish when they are 12 to 13 inches and eat a higher percent of fish as they grow older. The diet of fish which are 20 to 30 inches long is about 94 percent fish (Sigler et al 1983). They feed almost entirely on tui chubs.

Moyle (1976) states that stream dwelling cutthroat trout defend feeding territories and feed mostly on drift; their food typically being a mixture of terrestrial and aquatic insects. In some of the high Uinta, Utah mountain lakes, where the growing season is less than six weeks, and lake productivity is very low, the cutthroat apparently subsist primarily on terrestrial insects, including large swarms of migrants.

#### Breeding habits

In the spring, after the ice has disappeared and the water temperature approaches <sup>40 - 50</sup> 50 to 55 F, cutthroat trout spawn in the clear, cold, shallow riffles of small streams. The female fans out a nest with her tail in a gravel bed and deposits her eggs. The eggs are then fertilized, and the female moves immediately upstream to cover the eggs and spawn again; she moves downstream after covering the eggs, if spawning is complete.

A typical redd may be two feet long by a foot and a half wide, and in seven to ten inches of water. The eggs may be covered with five to seven inches of coarse gravel (Wydoski and Whitney 1979). Coastal cutthroat spawn in the winter months, usually January or February. Both lake dwelling and coastal cutthroat migrate up streams to spawn.



They do not spawn in lakes. According to Moyle (1976) the distances migrated are usually small, but migration of over 60 miles are not unusual. There is good evidence that spawning Lahontan cutthroat trout at one time migrated from Pyramid Lake, up the Truckee River into Lake Tahoe, a distance of 120 stream miles.

The cutthroat trout generally mature in their second to fourth year. In Pyramid Lake many of the males mature at age two and females at age three or occasionally, four. On one occasion, one lot of hatchery held Lahontan cutthroat trout males matured at age one. According to Moyle (1976) the immediate stimulus for upstream migration in coastal cutthroat is poorly understood, but lake dwelling Lahontan cutthroat seem to respond to a combination of increasing daylight and increasing stream temperatures, probably moving when temperatures exceed 46 to 50 F.

The Pyramid Lake Lahontan cutthroat trout, around the turn of the century, had two distinct spawning runs, one beginning in December and lasting until March, the other starting in March and lasting into May or June. In general the winter spawning run was composed of larger fish than the spring run. There has been minimal or no reproduction in the Truckee River for many years. However, in 1981, there was a substantial run of spawning fish, starting in January, into a small artificial stream running into the lake just south of Sutcliffe, Nevada. In 1982 the run again started in January and numbered more than 9,000 mature fish. This



would appear to indicate there is a remnant of the original  
gene pool of winter spawning Lahontan cutthroat trout in  
Pyramid Lake. Fecundity of Pyramid Lake cutthroat ranges  
from 1,241 to 7,963 eggs, with a mean of 3,815 (Sigler et al  
1983).

\*  
near  
1,2

- relative fecundity ?

The oldest male in the Pyramid Lake study (Sigler et al  
1983) was seven years; the oldest female was six years.  
There is evidence that the Pyramid Lake female Lahontans are  
alternate year spawners. This means many of them will spawn  
no more than twice. Considering the relatively high post  
spawning mortality, they may spawn only once.

#### Habitat

The cutthroat trout is present in streams ranging from  
sea level to altitudes of over 10,000 feet. The coastal  
cutthroat, an anadromous fish, spends its summers in salt  
water and winters in fresh water. The cutthroat is  
established in a wide variety of cold waters, ranging from  
large alkaline lakes, e.g., Pyramid Lake, Nevada, to small  
mountain lakes, to major rivers, to small tributaries (Moyle  
1976, Sigler et al 1983).

In large bodies of water the cutthroat trout prefers  
areas around rocks, sandy or rocky shores and deep waters.  
In the mountain stream the fish chooses habitat around rocky  
areas, riffles, deep pools, under hanging logs and  
over-hanging banks. The cutthroat trout does well in high  
altitude lakes of clear, cold water that are low in  
fertility.



A thriving population of cutthroat in the Uinta mountains live in waters with a pH of 7.0, total dissolved solids 40 and a very sparse benthic fauna. Some of these small lakes are fed by perpetual glaciers (snowbanks).

Preservation of the species

The maintenance or upgrading of cutthroat trout habitat is the most urgent need today. Competition from other trout species should be reduced or removed whenever possible. No other trout should be stocked with cutthroat trout, unless it can be demonstrated they do not compete or interbreed with them. Different subspecies, races, or strains of cutthroat should not be indiscriminately mixed in hatcheries. Genetic strains should be stocked where they have evolved and adapted over a long period of time.

Angling restrictions should be compatible with numbers of fish available and fishing pressure. Where the number of spawning fish each year is limited, restrictions on the number of mature fish that can be taken should be low. The number of smaller fish may then be more liberal.



## Rainbow trout

Salmo gairdneri (Richardson)Importance

In point of its contribution to the fishery, the rainbow trout is the most important trout in North America, as well as the most important of all game fish in the Great Basin. It is being continuously stocked in substantial numbers in almost all habitable trout waters in the United States. It fights well, leaps repeatedly when hooked and whether it is smoked, fresh, or canned is highly palatable. Therefore the total catch (and catch rate) is very high. The onus of catching a stocked fish (where it exists) rarely bothers the average fisherman.

The main reason rainbow is stocked so widely is not only that they are the easiest of all trout to raise, but it costs less per pound to raise. Admittedly, some strains are semi-domesticated, but in the eyes of the hatcherymen and the fishermen alike, this changes nothing. The commercial trout farmers raise and sell more rainbow trout than any other cold water fish in North America. The Thousand Springs area of south-central Idaho alone produces hundreds of millions of pounds of rainbow trout each year.

The steelhead (a sea run form of rainbow) adds an especially important dimension to the fishery in the Pacific Northwest. It grows faster and is larger than most inland rainbow. It is eagerly sought by fishermen and a catch of one fish per day satisfies many anglers, even in a catch and



release fishery. Another form of rainbow trout, the Kamloops, grows to a large size in big lakes with an abundance of forage fish.

#### Range

The native range of the rainbow trout (including all forms) is the Pacific Coast streams, mainly west of the Rocky Mountains. It extends from northwest Mexico, including extreme northern Baja California, to the Kuskokwim River, Alaska. In addition to being introduced widely throughout the United States, it has also been introduced into New Zealand, Australia, Tasmania, South America, Africa, Japan, southern Asia, Europe, and Hawaii (Scott and Crossman 1973).

In Canada it occurs outside of British Columbia from the Avalon Peninsula of Newfoundland, across the southern portions of the provinces from Nova Scotia to Ontario, north through central Manitoba and central Saskatchewan, to northern Alberta and the Yukon Territory.

Steelhead, the anadromous form of this species, originally was native to the Snake River and its tributaries as far upstream as Shoshone Falls. Dams have now reduced this range in the Snake River to below Hell's Canyon and to the drainages of the Salmon and Clearwater rivers. The Kamloops was introduced from British Columbia into Pend Oreille Lake, Idaho (Simpson and Wallace 1978).

Fish hatcheries operated by the Nevada Department of Wildlife, the Utah Wildlife Resources Division and the U.S.



Fish and Wildlife Service stock rainbow heavily in almost every habitable drainage in the Great Basin. The Great Basin, however, does not have large populations of lake dwelling rainbow. Fish Lake, Utah, has a sizeable population and Bear Lake has a moderate population. There are rainbow trout in the Truckee River but none in Pyramid Lake. The Great Basin has no steelhead and few Kamloops.

#### Description

The body is elongate, moderately compressed and rather deep; the cycloid scales number 120 to 160 in the lateral <sup>series</sup> line. The head is short, the snout rounded, eyes moderate, and the mouth terminal. There are small sharp teeth on the jaws and tongue, but they are poorly developed <sup>on</sup> in the vomer and are absent from the basibranchial plate (the base of the tongue) between the lower ends of the gill arches. The dorsal fin rays and anal fin rays both number 11, <sup>typically 10-11</sup> the caudal fin is slightly forked (Simpson and Wallace 1978).

The color in the rainbow trout is variable and depends on habitat, size and sexual condition. Stream residents and spawners have darker and more intense colors than lake residents which tend to be silvery. Bear Lake rainbow tend to be quite silvery and some of them almost entirely lose their spots.

The adult is normally bluish to olive-green on the back; the sides are lighter and silvery with a reddish horizontal band; the belly may either be white or silvery. There are generally irregular black spots on the back, side



and head. The dorsal, adipose and caudal fins are also spotted. Although there are no nuptial tubercles during the breeding season, minor changes in head and mouth occur among males during spawning.

The young trout is blue to green on the dorsal surface, silver to white on the sides, and white below. There are generally 5 to 10 marks on the back, between the head and the dorsal fin. There are also 5 to 10 oval parr marks spaced on the sides and straddling the lateral line. The steelhead and the Kamloops are generally more silvery than the other forms of rainbow. Some stocked rainbow trout in the Great Basin have a trace of a cutthroat slash along the crease of the lower jaw. This presumably indicates some cutthroat ancestry.

#### Size and longevity

Non-migratory rainbow trout, excluding Kamloops, average two to four pounds and are considered large at six to eight pounds. Simpson and Wallace (1978) report a 37 pound Kamloops taken from Pend Oreille Lake in 1947. They also report steelhead range from 4 to 20 pounds. The all tackle hook and line record (probably a steelhead) weighing 42 pounds, 2 ounces, was caught by David Robert White, Belle Island, Alaska, June 22, 1970 (Kutz 1982). It is interesting to note that the Kamloops, when introduced from Pend Oreille Lake into other areas in Idaho, shows no better growth than other forms of rainbow trout (Simpson and Wallace 1978). This is at times true of other forms or



strains of rainbow trout when introduced outside their natural habitat.

The rainbow trout that are markedly larger than two to four pounds are very often piscivorous (fish eating). For example: the steelhead trout on the West Coast, the Kamloops in Pend Oreille Lake and the rainbow trout in Fish Lake and Bear Lake, Utah. However, there are some notable exceptions to this rule. Kamloops introduced into some barren lakes, which contained vast numbers of Gammarus and other large crustaceans, grew to 14 pounds in as few as three years. According to Scott and Crossman (1973) this growth rate often decreases gradually as the trout population increases and food decreases. However, they state that other lakes are able to maintain populations of fish to four or five pounds on invertebrates alone. They also comment on the long-documented history of a single population of Kamloops trout in Paul Lake, B.C. The invertebrate population was adequate, before the introduction of the redbreasted shiner. The shiner competed for food to the detriment of the Kamloops fishery.

As soon as the fry absorbs its yolk sack it emerges from the gravel. At this time it is from three-eighths to five-eighths of an inch long. By the end of the first summer it may be four inches long and weigh one-third of an ounce.

Rainbow trout from high mountain lakes live only four to five years. Simpson and Wallace (1978) believe the life



span of rainbow trout is fairly short, few living beyond five years of age. Moyle (1978) states the oldest known rainbow, age 11 years, was from Eagle Lake, California. He further states that steelhead occasionally reach nine years of age, but the maximum age for most rainbow is seven years. In a Logan River, Utah, study only about three percent of the rainbow stocked lived through the first winter. It is believed that lake stocking has a somewhat higher overwintering rate. However, the mortality rate in Bear Lake was extremely high after the first year (McConnell, et al 1957).

Scott and Crossman (1973) state that the life expectancy may be as low as three or four years in stream and lake populations, but for steelhead and Great Lakes populations it would appear to be six to eight years.

#### Decimating factors

Since the rainbow trout is easily caught, and avidly sought by fishermen, fishing is by far the number one mortality factor. Some strains of rainbow trout are also relatively short-lived. In a study on the Logan River, Utah, more than 70 percent of the stocked rainbow trout were caught the first year, two to three percent the second year and less than one percent the third year. The eggs and young of rainbow trout that spawn in the spring, in high-flow turbulent streams, face the twin hazards of siltation and oxygen depletion of the redd. This effects both the numbers and health of emerging fry. Under these



flow regimes the fry may also be pushed downstream into undesirable habitat. According to Wydoski and Whitney (1979) although 95 percent of the rainbow trout eggs are fertilized, only 65 to 85 percent survive the embryonic stage.

Water temperatures in the high 70s, except under otherwise ideal conditions, may cause stress which predisposes disease, or, in some cases, death. The rigors of spawning induces stress, that not infrequently results in mortality of spawners. According to Simpson and Wallace (1978) the post-spawning mortality of steelhead approaches 100 percent. Wydoski and Whitney (1979) state it slightly differently. They say, "Not all adult rainbow trout or steelhead die after spawning".

Moyle (1976) states rainbow trout will survive temperatures of 32 to 82 F if they have been acclimated to the upper temperature and the water is saturated with oxygen. Moyle believes that the mortality is highest in stocked rainbow when they are planted in relatively small numbers in a stream that also sustains a wild trout population. This, he believes, is because the planted fish are unable to break into the established dominance hierarchies of the wild trout. If the stocked trout are put there in large numbers, the effect of sheer numbers may disrupt the established hierarchies of the wild fish, making the wildfish more vulnerable to angling and dislocation. This factor, Moyle believes, does not operate in lake

J. DeLoe  
700 miles  
Guelph  
382/50



stocking.

Scott and Crossman, quoting a Kamloops study, state that the upper lethal temperature for fingerlings was 75.2 F when they had been acclimated at 51.8 F. They believe rainbow trout are most successful in habitats with temperatures of 70 F or slightly lower, but only so long as there is cooler, well-oxygenated water into which they can retreat as the surface waters warm over 70 F.

Rainbow trout are subject to predation by other trout by diving birds and a variety of mammals. Logan River, Utah periodically produces prize winning (14 to 23 pounds) brown trout. The associates of these large, fast-growing brown trout are a few mottled sculpin, a moderate number of mountain whitefish and very large numbers of rainbow trout. It seems highly probable that the brown trout would not grow to the size they do, if there were no stocked rainbow trout for them to feed on.

#### Food and feeding

Young rainbow trout feed on small benthic (bottom) invertebrates; primarily insects and crustaceans. Rainbow trout, more than any other trout, tend to feed on algae and, to a lesser extent, on vascular plants. The rainbow continues this diet until it reaches a size of one to two pounds; after this there is a tendency to turn to a fish diet, if it is available. One of the paradoxes of rainbow trout feeding habits is that although they are primarily bottom feeders, they tend to rise to the surface and feed



on surface insects, both aquatic and terrestrial. This is a fact fly fishermen know quite well.

In the summer months, stream dwelling rainbow tend to feed heavily on drift organisms which are quite abundant, but they still feed actively on bottom invertebrates. The rate of feeding and available food is considerably reduced in winter, primarily due to an almost complete lack of drift organisms, and perhaps more importantly, to the fact that their metabolism is reduced by the cold water.

Moyle (1976) believes rainbow trout in lakes have a greater proclivity for feeding on fish than do stream dwelling rainbow, although he states fish do not normally become an important element in the diet until the trout are 12 to 14 inches long. In some high altitude, low productivity mountain lakes, the rainbow may be forced to feed heavily on terrestrial insects. Many of the trout stocked in Bear Lake, in years past did not reach a large size; however, after a stocking of Kamloops, many rainbow weighing eight to nine pounds were caught. One rational is that these trout learned to feed on the abundant forage fish base while the others did not. The rainbow trout in Fish Lake, Utah, after reaching a size of about a pound and one-half, feed almost exclusively on Utah chub and grow rapidly thereafter (Sigler 1953).

In general, rainbow trout feed on various invertebrates, including zooplankton, crustaceans, such as Gammarus ; it may continue to feed on these organisms rather



than shift to fish.

#### Breeding habits

Non-migratory rainbow trout normally spawn in the spring; however, hatchery strains have been developed that spawn every month of the year. There is a winter and a summer spawning run of steelhead, although some probably migrate upstream every month of the year (Wydoski and Whitney 1979).

The rainbow trout is a stream spawner and unlike the charrs, it is unable to spawn in lakes. It seeks out gravel bars in the early spring when the water temperatures reach 50 to 60 F. The female digs a redd in the gravel by turning on her side and beating her tail up and down. In this way she cleans up the gravel and excavates a pit that is longer and deeper than her body. Nest building takes place day and night. When ready to spawn, the female rests near the bottom, at the center of the redd, the dominant male moves into position parallel to her. Both bodies are pressed together and the eggs and milt are released over a few seconds. The male courts the digging female and aggressively tries to drive other males away from a redd; although in the spawning process there is generally more than one male spawning with each female. As soon as the female has spawned, she immediately moves upstream to the edge of the nest and begins displacing gravel to cover the eggs. Females may dig and spawn in several redds with the male or other males (Scott and Crossman 1973).



Eggs usually hatch in four to seven weeks and alevins take an additional three to seven days to absorb the yolk before becoming free-swimming. At an average water temperature of 50 F, eggs hatch in about 50 days.

The average age of first spawning is two to three years; some hatchery rainbow spawn at age one and some wild fish do not first spawn until they are age five. In some instances, a high percent of some strains of hatchery rainbow do not spawn in the wild. If spawning rainbow and cutthroat are in the same area, hybridization is often high.

According to Scott and Crossman (1973), individual rainbow have been known to spawn in as many as five successive years. They admit survival rate for repeat spawners is often very low, probably less than 10 percent. Simpson and Wallace (1978) believe spawning mortality is close to 100 percent for spawning rainbow.

#### Habitat

The rainbow trout is highly adaptable to a wide range of aquatic habitats. It prospers in large, deep lakes and in small farm ponds. It lives in some of the largest rivers of North America and in small creeks with a flow of only a few cubic feet per second. Some strains of rainbow trout, in lakes, tend to stay close to shore, rarely moving into deep water, except to avoid high temperatures. Other strains are far ranging and pelagic.

Optimum temperatures for growth, and reproduction range



from 55 to 70 F. At low temperatures it can withstand low oxygen concentrations, if it is inactive, but at high temperatures it requires near saturation levels. It prospers in lakes ranging in pH from 5.8 to 9.6.

Stream inhabiting rainbow trout tend to be highly aggressive, setting up feeding territories which it defends against aggressors. This territorialism is not evident in lakes, where the rainbow tend to form schools and move about in a more or less aimless fashion. Generally, the territory utilized by lake residing rainbow is not great.

The area inhabited by stream dwelling rainbow may be only a few hundred yards in the life of the fish, or in some cases, it may be confined to one or two pools and the riffles just above them. Steelhead are highly migratory.

#### Preservation of the species

The two prongs on which rainbow trout fishery management rest today are control of the catch and stocking. *steel head environment down*  
Everything else is secondary. When a rainbow trout is stocked, in a habitat where it will not likely survive the winter, fishing regulations should be so designed that a high percent of the fish will be caught within a few weeks after it is stocked. This at times means letting the public know where the rainbow have been stocked and stocking it in accessible places. When the fishing pressure is very heavy this may not be a problem, and the cost of rearing catchable size fish may make it necessary to limit the daily catch to two or three fish. In general, smaller bodies of water need



tighter restrictions than larger bodies of water. In large lakes where the rainbow trout overwinters successfully, fingerling stocking rather than that of larger fish may be in order. The question the fishery manager asks himself is, "What size fish will produce the lowest cost per pound in the creel?" Stocking programs are dictated by various socio-political aspects as well as biological reasons. In the final analysis, the number of fish stocked by any state in a given year is determined by the budget.



## Brown trout

Salmo trutta LinnaeusImportance

Once an adequate breeding population has been established, brown trout provides some of the finest wild trout fishing in North America. At a time when hatchery costs are increasing and fishermen are becoming more abundant, a trout that is able to reproduce in the wild and hold its own against both the hazards of its environment and heavy fishing pressure is unique. It is more difficult to catch than most trout; a bonus for the exceptional fisherman and a frustration for those with less experience. It is more competitive than most trout, and it readily feeds on other trout. Fisherman may catch a high percentage of other trout in a stream, but few or no brown trout; thereby reaching the conclusion that there are no fish left. At one time brown trout was considered by both biologists and fishermen as a mixed blessing. This attitude is changing. Biologists are more appreciative of self-sustaining populations and fishermen are learning to catch them.

Range

The brown trout is native to Europe and western Asia. Since it is partially anadromous there, it is also present in the British Isles and Iceland (Moyle 1976). Brown trout was first introduced into North America in 1883. It was introduced in the Truckee River in 1895 (LaRivers 1962). It is present in most trout waters throughout the United States



and Canada, including the Great Basin. It has been stocked in South America, Africa, India, Australia and New Zealand.

#### Description

The brown trout has a back of olive to greenish-brown. The lower portions are often yellow, fading beneath to gray or white. Yellow coloring is more likely to be found in mature fish, especially in males during the breeding season. Rather large, dark spots appear upon the back and sides, but are not developed on the caudal fin. The reddish spots are profuse over the upper part of the body and have pale borders. Frequently, the front edge of the pelvic fins and the anal fin has a yellow margin. In young brown trout, the adipose is orange, without dark spots or margins. The tail fin is truncate (square), not forked. Scales number 115 to 120 along the side, about two rows above the lateral line (Sigler and Miller 1963). Basibranchial teeth are absent. The dorsal fin has 12 to 14 major rays; the anal fin, 10 to 12 major rays; the pelvic fins, 9 to 12 each; and the pectoral fins, 12 to 14 rays each. There are 14 to <sup>21</sup>17 gill rakers on each arch and 9 to 11 branchiostegal rays.

#### Size and longevity

Brown trout usually average four to seven pounds by their sixth year. Fish weighing eight to 12 pounds are not uncommon. In a Utah study, brown trout yearly length in inches was: 3.5, 6, 10, 14, 16 and 18. Brown trout are fast growing, moderately long-lived fish. Scott and Crossman (1973) give the often quoted, but unrecognized,



world's hook and line record as 39 pounds 4 ounces, caught in Scotland, in 1866. In 1937, a 37 and 3/4 pound brown trout was taken from the lower impoundment of the Logan River, Utah; it is, however, not a hook and line record since it was hooked, lost and later retrieved by a couple of youngsters. In one week on the Logan River, one fisherman caught a 14 pound 4 ounce and a 14 pound 14 ounce brown trout from the same general area. Other large fish captured include an 18+ pound and a 23 pound fish. The all tackle hook and line record for landlocked brown trout, weighing 33 pounds 10 ounces, was caught by Robert L. Bringhurst in Flaming Gorge Lake, Utah, March 4, 1977. 2

#### Decimating factors

The brown trout is limited by low water temperatures; it is rare in the cold high reaches of mountain streams. It is also inhibited by waters that warm to the high 70s. Neither does it prosper in very small bodies of water. Brown trout stocked in small natural ponds in northern Utah (one-half to two acres) grew slowly and remained in poor condition, even though there was an abundance of food. It is believed that the little fish in the pond were so well protected, by an abundance of cover, that the brown trout was not able to feed on them. There are undoubtedly other factors that were not recognized. The brown trout is, to some extent, preyed upon by fish-eating birds, mammals and fish.

#### Food and feeding



Small brown trout, less than two pounds, live largely on such insects as mayflies, caddisflies, stoneflies and truefly larvae. Other invertebrate foods include aquatic earthworms, fresh water clams and crayfish. At an earlier age than most trout, it feeds largely on fish. Brown trout, except the young, feed more actively morning and evening than during midday. In both lakes and streams small brown trout feed heavily on zooplankton and bottom dwelling insects. A typical stream feeding pattern for brown trout, as it grows older, is from drift organisms and zooplankton, to aquatic and terrestrial insects, to small fish and then to large fish. Scott and Crossman (1973) report brown trout eat a variety of organisms; particularly aquatic and terrestrial insects, crayfish, mollusks, salamanders, frogs, rodents and fish.

Logan River, Utah, has over the years, produced a number of large brown trout. In the areas where the large fish were caught, the food consists of a few mottled sculpin, a moderate number of mountain whitefish and often a large number of stocked rainbow trout. It would be difficult not to conclude the stocked fish are what is producing the trophy fishery.

#### Breeding habits

The brown trout spawns in the fall, from late October to December. It initiates spawning on a dropping temperature of 45 to 50 F. The mature brown trout moves out of deep pools, or lakes, upstream to the nearest acceptable



riffle area where the female selects the redd site and starts a depression by turning on her side and digging with her tail. This initial activity attracts a male who defends the female and redd from other males. The male does not help with the construction of the redd, although he may continuously court the female as she works. After the redd is complete, the female sinks to the bottom of the depression, the male swims alongside and the eggs and sperm are released. Following this the female moves upstream and covers the eggs by digging a new redd. This may be repeated several times. Females lay from 200 to more than 6,000 eggs, which hatch in 48 to 52 days at a constant water temperature of 51 F. The average age of maturity is two to three years, with males often maturing earlier than females. Brown trout are raised in hatcheries, but most hatcherymen consider it more difficult to raise than rainbow trout.

#### Habitat

Adult brown trout inhabit the bottom of deep pools in streams; the young may be in shallow pools, close to shore in shallow water, or in riffles. At twilight, adults often move to the surface or into riffle areas to feed. It is more of a big water fish than most trout. It inhabits large lakes and streams; in medium size streams it frequents the deepest pools. It does not seek small streams. Anadromous brown trout, along both the east and west coast, may at times be in salt water except during the breeding season. In Logan River, Utah, it does not generally move upstream



above an altitude of 5,500 feet; although ones inadvertently stocked at 6,200 feet, appear to prosper.

Preservation of thje species

Once a brood stock has been established in an acceptable habitat, the brown trout is able to produce a sustained and substantial population. Although it is somewhat difficult to catch, it can be overfished by above average fishermen. There is serious question whether or not brown trout should be stocked where there are rainbow trout or where it will be stocked, or with cutthroat or brook trout. Unfortunately, in many cases, this is an after-the-fact decision. In northern Utah it did not prosper in small springfed ponds. In Flaming Gorge Lake, Utah-Wyoming, on the Green River, it is producing a trophy fishery; to the detriment of the once great rainbow trout fishery, it should be added.



## Golden trout

Salmo aguabonita JordanImportance

The golden trout is of minor importance in the Great Basin. In California, where it is the official state fish, and in Wyoming, it is important to angling. It attracts fishermen primarily because of its relative scarcity and its brilliant colors. It is said to have fighting ability equal to the rainbow trout, but it is easier to catch.

Range

The golden trout is native only to the upper Kern River Basin, Tulare and Kern counties, California. According to Moyle (1976) early records indicate it was present in the basin in the upper main Kern River, the Little Kern River, Golden Trout Creek and the south fork of the Kern River. Today it is present in over three hundred high mountain lakes and streams in California. There is a lesser number in Wyoming and a limited number in the Humboldt River drainage of the Great Basin.

Description

The coloration of golden trout is spectacularly bright. The belly and cheeks are bright red to orange, the lower sides are bright gold, the central lateral band is red-orange and the back is deep olive green. Usually about ten parr marks are present, even in adults, centered on the lateral line. It is distinguished from the cutthroat by the absence of the cutthroat mark and the lack of basibranchial



teeth. The dorsal, anal and pelvic fins have distinct white tips offset by a black bar. Scales in the lateral line number from 175 to 210; scales above the lateral line, 34 to 45; pelvic rays, 8 to 10; gill rakers, 17 to 21; pyloric caeca, 25 to 40. It has an oily flesh.

#### Size and longevity

The golden trout is a slow-growing, relatively short-lived fish. An average yearly growth in inches may be as follows: 2, 5, 7, 10 (Carlander 1969). Although a 10 to 12 inch golden trout is average, fish up to 24 inches are taken, occasionally. The all tackle hook and line record, weighing 11 pounds, was caught by Charles S. Reed, Cook's Lake, Wyoming, August 5, 1948.

#### Decimating factors

Golden trout are generally not able to compete with other species of trout. They interbreed readily with rainbow trout <sup>& cutthroat</sup> and lose their identity. They also tend to migrate out of lakes into areas where they are not able to compete. They are one of the easiest of all trouts to catch; perhaps their best defense is the remote areas they inhabit.

#### Food and feeding

The golden trout is primarily insectivorous, preferring caddisfly larvae, midges and other available insects. It also feeds on zooplankton, particularly copepods and cladocerans.

#### Breeding habits



Spawning may occur anytime from late May to August, depending on the altitude, when water temperatures reach 45 to 50 F. According to Moyle (1979) they require gravel riffles for successful spawning. Although spawning has apparently been observed in lakes, it rarely, if ever, is successful. They do, however, spawn successfully in inlet or outlet streams of lakes.

#### Habitat

Golden trout do best in swift, high altitude streams and in lakes in altitudes ranging from 6,000 to 11,500 feet. They are true wilderness animals.

#### Preservation of the species

The golden trout needs protection from other fish and from heavy angling pressure. Their range may be extended by stocking them in barren, remote areas.