TECHNICAL NOTES

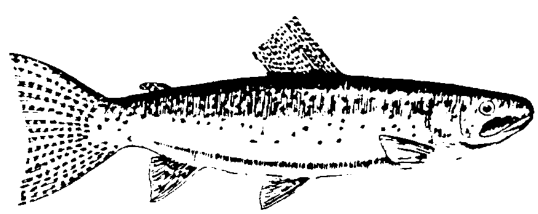
U.S. DEPARTMENT OF AGRICULTURE WYOMING SOIL CONSERVATION SERVICE

Biology No. 305 January 1986

Subject: CUTTHROAT TROUT*

General

Cutthroat trout, Salmo clarki, are a polytypic species consisting of several geographically distinct forms with a broad distribution and a great amount of genetic diversity. One study recognized 13 extant subspecies: Coastal cutthroat (S. c. clarki) in coastal streams from Prince William Sound, Alaska, to the Eel River in California; mountain cutthroat (S. c. alpestris) in upper Columbia and Fraser River drainages of British Columbia; west slope cutthroat (S. c. lewisi) in the upper Columbia, Salmon, Clearwater, South Saskatchewan, and upper Missouri drainages of Montana and Idaho; an undescribed subspecies in the Alvord basin, Oregon; Lahonton cutthroat (S. c. henshawi), Pauite cutthroat (S. c. seleniris), and an undescribed subspecies in the Humboldt River drainage of the Lahontan basin of Nevada and California; Yellowstone cutthroat (S. c. bouvieri) in the Yellowstone drainage of Wyoming and Montana and- the Snake River drainage of Wyoming, Idaho, and Nevada; an undescribed subspecies (fine spotted) in the upper Snake River, Wyoming; Bonneville cutthroat (S. c. utah) in the Bonneville basin in Utah, Nevada, Idaho, and Wyoming; Colorado River cutthroat (S. c. pleuriticus) in the Colorado River drainage in Wyoming, Utah, New Mexico, and Colorado; greenback cutthroat (S. c. stomias) in the South Platte and Arkansas River systems; and Rio Grande cutthroat (S. c. virginalis) in the Rio Grande River drainage of Colorado and New Mexico. Many of these 13 subspecies are included in Federal or State endangered or threatened species lists.



Prepared by: Richard Rintamaki, State Biologist

State Resource Conservationist

*Information taken from Ecoregion M3113 Handbook and Habitat Suitability Index Models, Wildlife Species Narratives (literature searches), U.S. Fish and Wildlife Service, various dates between 1978-1984.

Temperature and chemical preferences, migration, and other ecological and life history attributes vary among cutthroat subspecies. Differences in growth rate and food preferences have also been reported between some subspecies.

Age, Growth, and Food

Most male cutthroat trout mature at ages II to III, whereas females usually mature a year later. In Washington streams that contain anadromous populations of cutthroat, which predominantly smolt at age II, less that 15 percent of the cutthroat returning to the river for the first time are sexually mature females. The maximum life expectancy for coastal cutthroat is about 10 years, whereas the maximum reported age for interior cutthroat is 7 years. Size at maturity will vary depending on environmental conditions. Cutthroat mature at a smaller size in small headwater streams.

Trout are opportunistic feeders, but their diet consists mainly of aquatic insects. Other foods, such as zooplankton, terrestrial insects, and fish are locally or seasonally important. Cutthroat trout usually become more piscivorous as they increase in size.

Reproduction

Cutthroat trout are stream spawners. The fertilized ova are deposited in redds constructed primarily by the female in the stream gravels. Spawning begins in spring, as early as February, but can occur as late as August in colder areas. The time of spawning depends on water temperature, runoff, icemelt, elevation, and latitude.

Special Habitat Requirements

Optimal cutthroat trout riverine habitat is characterized by clear, cold water; a silt-free rocky substrate in riffle-run areas; an approximately 1:1 pool-riffle ratio with areas of slow, deep water; well vegetated streambanks; abundant instream cover; and relatively stable waterflow, temperature regimes, and streambanks. Cutthroat trout tend to occupy headwater stream areas, especially when other trout species are present in the same river system.

Optimal lacustrine habitat is characterized by clear, cold, deep lakes that are typically oligotrophic, but may vary in size and chemical quality, particularly in reservoir habitats. Cutthroat trout are stream spawners and require tributary streams with gravel substrate in riffle areas for reproduction to occur.

Trout literature does not clearly distinguish between feeding stations, escape cover, and winter cover requirements. Prime requisites for optimal feeding stations appear to be low water velocity and access to a plentiful food supply, e.g., energy accretion at a low energy cost. Water depth is not clearly defined as a selection factor, and overhead cover is preferred but not essential. Escape cover, however, must be nearby. The feeding stations of dominant adult trout will include overhead cover when available. The feeding stations of subdominant adults and juveniles, however, may not always include overhead cover.

Cover is recognized as one of the essential components of trout streams. One researcher was able to increase the number and weight of trout in stream sections by adding artificial brush cover and to decrease numbers and weight by removing brush cover and undercut banks. One study reported that the amount of cover was important in determining the number of trout in sections of a Montana stream. Cover for adult trout consists of areas of obscure stream bottom in areas of water ≥15 cm deep with a low velocity of ≤15 cm/sec. A study reported that, in larger streams, the abundance of trout ≥15 cm in length increased with depth; most were at depths of at least 15 to 45 cm. Cover is provided by overhanging vegetation; submerged vegetation, undercut banks, instream objects, such as debris piles, logs, large rocks; and pool depth or surface turbulence. A cover area of ≥25 percent of the total stream area will provide adequate cover for adult trout; a cover area of ≥15 percent is adequate for juveniles. The main use of summer cover is probably for predator avoidance and resting. In winter, Salmonids occupy different habitat areas than in the summer.

In some streams, the major factor limiting salmonid densities may be the amount of adequate overwintering habitat rather than the summer rearing habitat. Winter hiding behavior in salmonids is triggered by low temperatures. Cutthroat trout were found under boulders, log jams, upturned roots, and debris when temperatures neared 4° to 8°C, depending on velocity. One study found juvenile rainbows 15 to 30 cm deep in the substrate, which was often covered by 5 to 10 cm of anchor ice. One researcher reported that, during winter, adult rainbow trout tended to move into deeper water (class 1 pools). One study indicated that downstream movement during or preceding winter did not occur if sufficient winter cover was locally available. Trout move to winter cover to avoid physical damage from ice scouring and to conserve energy.

Headwater trout streams are relatively unproductive. Most energy inputs to the stream are in the form of allochthonous materials, such as terrestrial vegetation and terrestrial insects. Aquatic invertebrates are most abundant and diverse in riffle areas with rubble substrate and on submerged aquatic vegetation. However, optimal substrate for maintenance of a diverse invertebrate population consists of a mosaic of gravel, rubble, and boulders with rubble being dominant. The invertebrate fauna is much more abundant and diverse in riffles than in pools, but a ratio of about 1:1 of pool to riffle area (about 40 to 60 percent pool area) appears to provide an optimal mix of trout food producing and rearing areas. In riffle area, the presence of fines (>10 percent) reduces the production of invertebrate fauna.

Canlopy cover is important in maintaining shade for stream temperature control and in providing allochthonous materials to the stream. Too much shade, however, can restrict primary productivity in a stream. Stream temperatures can be increased or decreased by controlling the amount of shade. About 50 to 75 percent midday shade appears optimal for most small trout streams. Shading becomes less important as stream gradient and size increases. In addition, a well vegetated riparian area helps to control watershed erosion. In most cases, a buffer strip about 30 m deep, 80 percent of which is either well vegetated or has stable rocky streambanks, will provide adequate erosion control and maintain undercut streambanks characteristic of good trout habitat. The presence of fines in riffle-run areas can adversely affect embryo survival, food production, and cover for juveniles.

There is a definite relationship between the annual flow regime and the quality of trout habitat. The most critical period is typically the base flow (lowest flows of late summer to winter). A base flow ≥50 percent of the average annual daily flow is considered excellent, a base flow of 25 to 50 percent is considered fair, and a base flow of <25 percent is considered poor for maintaining quality trout habitat.

Of 66 streams sampled in British Columbia, those containing cutthroat trout had a pH of 6.0 to 8.8. Thirteen streams in Wyoming containing populations of Colorado River cutthroat trout had pH levels of 7.1 to 8.3. One study reported that the pH in three reservoirs containing cutthroat trout ranged from 7.8 to 8.5. Precise pH tolerance and optimal ranges for cutthroat trout are not well documented. Most cutthroat populations can probably tolerate a pH range of 5 to 9.5 with an optimal range of 6.5 to 8.

One study reported that at turbidities above 35 ppm cutthroat trout stopped feeding and moved to cover. Turbidities of less than 25 JTU and total dissolved solids from 38 to 544 mg/l characterized 13 Wyoming streams containing cutthroat trout.

Adult. Dissolved oxygen requirements vary with species, age, prior acclimation temperature, water velocity, activity level, and concentration of substances in the water. As temperature increases, the dissolved oxygen saturation level in the water decreases while the dissolved oxygen requirements for the fish increases. As a result, an increase in temperature resulting in a decrease in dissolved oxygen can be detrimental to the fish. Optimal oxygen levels for cutthroat trout are not well documented, but appear to be >7 mg/l at temperatures ≤ 15°C and ≥ 9 mg/l at temperatures > 15°C. Researchers have demonstrated that swimming speed and growth rates for salmonids declined with decreasing dissolved oxygen levels. At temperatures ≥15°C, cutthroat trout generally avoid water with dissolved oxygen levels of less than 5 mg/l.

Cutthroat trout usually do not persist in waters where maximum temperatures consistently exceed 22°C, although they may be able to withstand brief periods of water temperature as high as 26°C if considerable nighttime cooling takes place.

Focal point velocities for adult cutthroat trout on territorial stations in Idaho streams were primarily between 10 and 14 cm/sec with a maximum of 22 cm/sec.

Embryo. Incubation time varies inversely with temperature. Eggs usually hatch within 28 to 40 days, but may take as long as 49 days. One study reported that cutthroat trout spawning temperatures ranged from 6° to 17°C. The optimal temperature for embryo incubation is approximately 10°C. The combined effects of temperature, dissolved oxygen levels, water velocity, and gravel permeability are important for successful incubation. In a 30 percent sand and 70 percent gravel mixture, only 28 percent of implanted steelhead embryos hatched; of the 28 percent that hatched, only 74 percent emerged. We assume that these same results would be true for the closely related cutthroat trout. We further assume that optimal spawning gravel conditions include ≤5 percent fines, and that ≥30 percent fines will cause low survival of embryos and emerging yolk-sac fry. Suitable incubation substrate is gravel 0.3 to 8 cm in diameter. Optimal substrate size will depend on size of spawners, hut we assume it will average 1.5 to 6.0 cm in diameter. One study reported that salmonids incubated at low dissolved oxygen levels were weak and small with slower development and more abnormalities. Dissolved oxygen requirements for cutthroat trout embryos are probably similar to the requirements for adults.

Fry. Cutthroat trout remain in the gravel for about two weeks after hatching and emerge 45 to 75 days after egg fertilization, depending on water temperature. When moving from natal gravels to rearing areas, cutthroat trout fry exhibit three distinctly different genetically controlled patterns: 1) downstream to a larger river or lake; 2) upstream from an outlet river to a lake; or 3) local dispersion within a common spawning and rearing area to areas of low velocity and cover. Fry of lake resident fish may either move into the lake from natal streams during the first growing season or overwinter in the spawning stream and move into the lake during subsequent growing seasons.

Fry residing in streams prefer shallower water and slower velocities than other life stages. Fry utilize velocities of less than 30 cm/sec, but less than 8.0 cm/sec are preferred. Fry survival decreases with increased velocity after optimal velocity has been reached. A pool area of 40 to 60 percent of the total stream area is assumed to provide optimal fry habitat. Cover in the form of aquatic vegetation, debris piles, and the interstitial spaces between rocks is critical. *One* researcher states that younger trout live in shallower water and stay closer to escape cover than do older trout. Few fry are found more than 1 m from cover. As the young cutthroat grow, they move to deeper, faster water. One study suggested that one reason for this movement was the need for cover, which is provided by increased water depth, surface turbulence, and larger substrate.

Trout fry usually overwinter in shallow areas of low velocity near the stream margin with rubble being the principal cover. An area of substrate 10 to 40 cm in size at a rate of ≥10 percent of the total habitat will probably provide adequate cover for cutthroat fry and small juveniles. The use of smaller diameter rocks (gravel) for winter cover may result in increased mortality due to greater shifting of the substrate. The presence of fines (≥10 percent) in the riffle-run areas impairs the value of the area as cover for fry and small juveniles.

Juvenile. Juvenile cutthroat trout in streams are most often found in water depths of 45 to 75 cm and velocities of 25 to 50 cm/sec. One study reported focal point velocities for juvenile cutthroat in Idaho of between 10 and 12 cm/sec with a maximum velocity of 22 cm/sec.

Metabolic rates are highest between 11° and 21°C with an apparent optimal temperature of 15°C.

Researchers have demonstrated that juvenile cutthroat trout used rubble and overhanging banks as cover. The juveniles also showed a preference for clean, as opposed to silted, rubble for cover. Common types of cover for juvenile trout are upturned roots, logs, debris piles, overhanging banks, and small boulders. Young salmonids occupy different habitats in winter than in summer with log jams and rubble important as winter cover. One researcher observed that larger cutthroat trout (>15 cm long) tended to use streamside cover (overhanging hanks and vegetation) more often than instream objects, while juveniles (≤15 cm) preferred instream substrate cover.