

STUDIES ON THE PAIUTE CUTTHROAT TROUT IN THE NORTH FORK OF COTTONWOOD CREEK, WHITE MOUNTAINS, CALIFORNIA

James S. Diana and Darrell M. Wong
California State University
Long Beach, California

Abstract. The Paiute cutthroat trout is an endangered subspecies of trout that has been transplanted into Cottonwood Creek. This paper reports on the studies that were conducted on this population to aid future management plans. The data are the results of two summers of observation and several electroshocking surveys. The population of these fish was estimated to be 500. The majority of them do not live beyond three years. Growth of the fish was isometric, and the age-length data showed a linear growth. Mortality was attributed to natural causes because of a lack of predators in the area. The fish appear to spawn mainly in the spring, and the age at first spawning is three years. Food was not a limiting factor to the population. The fish were found to limit themselves to two kilometers out of a total five kilometers of stream. No appreciable movement of the fish was detected during three movement studies. Fish that were transplanted to a vacant stream section remained there, but few fish repopulated the area vacated by their removal. A high degree of sedimentation, and its resultant suffocation of trout eggs and larvae while they are in the gravel, appears to be the limiting factor on this population.

INTRODUCTION

The Paiute (previously spelled Piute) cutthroat trout (Salmo clarkii seleniris Snyder) evolved in a small upstream area of Silver King Creek, Alpine County, California. The subspecies has always existed in low numbers due to its limited range. Several transplants of this fish have been made, the most successful being to the North Fork of Cottonwood Creek, in the White Mountains of California. Since the original introduction of fish into Cottonwood Creek in 1946, an inadvertent planting of rainbow trout (Salmo gairdneri) in Silver King Creek has placed the genetic integrity of that population of Paiute trout in jeopardy. The Cottonwood Creek population now represents the major, genetically pure, population of these rare fish.

The limited number of Paiute cutthroat led to their inclusion as an endangered subspecies by the Secretary of the Interior. The endangered classi-

fication means conditions exist which places the chance of survival for this subspecies in immediate jeopardy. Studies were conducted in 1973-74 on Cottonwood Creek because a pure population of Paiute cutthroat trout still exists. Information on the biology of this subspecies was obtained while causing as little harm to the population as possible. This paper presents a preliminary research summary. The studies will be more fully reported in later publications. A bibliography of literature on the Paiute cutthroat trout is also given. Funding of field research was by the California Department of Fish and Game and the U.S. Forest Service.

ENVIRONMENTAL DESCRIPTION

The North Fork of Cottonwood Creek is located in an isolated area of the White Mountains, 27 km east of Bishop, California. The North Fork has as its main water source several springs at an elevation of 3096 m. The stream drops 312 m in a distance of 5.3 km to a barrier falls delimiting the lower extremity of the study area. It had a mean flow of 0.8 cfs during 1973 and 1974. The creek was characterized by mean maximum and minimum daily water temperatures of 14 and 4 C during the summer.

POPULATION ESTIMATE

The number of fish within the stream was estimated from two electroshocking surveys. The combined electroshocking resulted in a complete survey, except for 100 m of stream which was inaccessible. During electroshocking 397 fish were captured or known to have escaped. The efficiency of electroshocking, estimated by two mark-recapture experiments, was found to be 50 and 75 percent. The efficiency of electroshocking, estimated by successive removal of shocked fish from an enclosed test section, was found to be 79 percent. Consequently, a population between 397 and 704 fish was estimated. It is most likely that the trout population approaches 500 fish.

AGE AND GROWTH

The age distribution of fish was determined primarily from length-frequency distributions, utilizing data from summer and fall electroshocking surveys. Scale annuli back-calculations were in general agreement with the conclusions from the length frequency method.

The majority of the population is made up of fish one to three years old. Although only 3.8 percent of the population survives past the third year, a few may survive to five or six years of age. The age-length data was fitted to various regression models; the most appropriate model for fish 10 months or older was a straight line of the form: $FL = 4.5A - 10.43$, where FL is fork length in mm and A is age in months.

Growth is nearly isometric. The growth rate is relatively rapid in young fish and decreases at greater ages. Paiute cutthroat trout fry experienced relatively constant growth in captivity for approximately 39 days after emergence from the gravel during the first week of August. The mean length of the 1973 year class was 63 mm in July 1974.

CAUSES OF MORTALITY

Predators of adult fish are almost nonexistent in the study area. Due to fishing closure on the stream since 1964, fishing mortality is assumed to be nearly zero. Predation by American Dippers (*Cinclus mexicanus*) accounts for some egg mortality; and dippers, water shrews (*Sorex palustris*), and some aquatic insects probably prey on young fish. Cannibalism probably occurs but its extent is unknown. Sediment deposition in redds, resulting in suffocation of eggs and alevins, is believed to be the major limiting factor to trout production in the creek.

REPRODUCTIVE BIOLOGY

Paiute cutthroat trout pair and exhibit various forms of courtship behavior prior to spawning. Aggressive behavior towards other fish occurs at spawning sites, which are located in the tails of pools. The parameters of an excavated redd suggest that redd building and spawning acts are similar to those of other salmonids. The fish probably spawn first in their third year, and most likely spawn yearly thereafter. Ovaries exhibit atresia, and ovary maturation is similar to that of other salmonids. Although substantial spawning occurs in the spring, some evidence suggests that spawning may occur through late fall and winter.

FEEDING

Paiute cutthroat trout are generally opportunistic feeders. Fish over 100 mm in length utilized a variety of aquatic and terrestrial food items, while smaller fish fed exclusively on dipter larvae and baetid naiads. Food availability does not appear to limit trout production in Cottonwood Creek and is great enough to support a much larger fish population.

DISTRIBUTION OF FISH

The distribution of trout in the creek was determined by electroshocking and visual surveys. Three electroshocking surveys in 1973 and 1974 delimited the main portion of the population to be between 1.3 and 3.3 km downstream from the headwater springs. Fish above or below the main populated area were scarce, and no fish were found at the two extremities of the stream. Visual surveys (in which 20 to 40 percent of the population was seen) agreed with the distribution determined by electroshocking.

Another distributional aspect noted was that larger fish had a distinct preference for pools; smaller fish were usually found in the runs.

MOVEMENT OF FISH

Three methods of detecting movement were used. The first method was a mark and recapture experiment. Forty six fish were captured by electroshocking from test sections 50 to 70 m in length, and these fish were given marks. Recaptures three months later showed that 78 percent of the recaptured marked fish were still in the original capture area. Fifteen months later all 10 of the recaptured marked fish were within 50 m of their original capture site.

Another method used to determine movement was the use of traps. The traps blocked the entire stream so that all fish attempting to move upstream or downstream through the traps were captured. In 45 days of operation, only seven fish were taken in the traps located in the main populated area, and all of these were moving upstream. Six of these appeared to be stimulated to move by unnatural disturbances. No fish were found that moved beyond the two ends of the main populated area.

Visual observations were utilized to determine local movements and social structures. During prolonged observations of large pools over two summers, no fish were ever seen leaving the pool where they normally resided. Observations disclosed that adults established partial territories along major currents based on stable linear dominance hierarchies. Results from all of these methods demonstrate a very limited movement of Paiute cutthroat trout in the North Fork of Cottonwood Creek.

TRANSPLANTATION AND REPOPULATION

During transplanting and repopulation studies, 21 fish were removed from an area between two traps (0.2 km apart) and planted in an unpopulated area 2.5 km downstream from the removal area also located between two traps (0.2 km apart). The traps were removed two weeks later, and no fish had attempted to move from the transplant area during that time. After 63 days, both areas were rechecked by electrofishing. Fifteen fish were recaptured in the transplant area, and the six transplanted fish that were not recaptured were all small fish that were probably missed by electroshocking. Only two fish had moved into the vacated area upstream. This indicates that the fish may be successfully transplanted to vacant stream areas, but the normal rate of repopulation of vacant stream is very slow. A lack of movement by the transplanted fish is also indicated.

EXTRINSIC FACTORS OF THE HABITAT

Substantial amounts of organic and inorganic sediments are deposited in the North Fork as a result of abundant streamside vegetation and normal erosive forces. A combination of high sediment volume and lack of flushing flows result in the infiltration of gravel interstices by sediments, contributing to egg and alevin mortality.

The effect of cattle on the stream banks did not appear to increase sedimentation or be significantly detrimental to the trout population during the study period. Three beaver dams were present at the beginning of the study, increasing to 15 dams by the end of the study. Beaver impoundments may indirectly limit the trout population by destroying spawning areas as a result of siltation.

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