POPULATION FLUCTUATIONS AND GENERIC DIFFERENTIATION IN THE HUMBOLDT CUTTHROAT TROUT OF GANCE CREEK, NEVADA

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ABSTRACT

Dramatic fluctuations in weights, lengths, numbers, and condition of a native population of cutthroat trout in Gance Creek, Elko County, Nevada, are described. Such fluctuations and ability to survive under a highly changeable environment are presented as ecological evidence for taxonomists to consider in possibly separating the Lahontan Basin native cutthroat trout into two subspecific taxa: Lahontan and Humboldt cutthroat trout.

INTRODUCTION

The Great Basin of the Western United States is composed of numerous, widely scattered, independent streams whose geologic histories have enabled them to serve as loci for the evolutionary divergence of native trout. In those drainages that have been isolated from anadromous salmonid runs since pre-Pleistocene time, the only native salmonids are subspecies of the cutthroat trout (*Salmo clarki* Richardson). In the Lahontan Basin of northern Nevada, the endemic subspecies is the threatened Lahontan cutthroat trout (*S. c. henshawi*). This trout exists in limited numbers in the small tributary streams of the Humboldt River system of northeastern Nevada, and in several lakes and streams of the Carson, Walker, and Truckee River systems of northwestern Nevada.

Based on a variety of ecologic, genetic, and meristic characters (Behnke 1979, 1981; Behnke and Zarn 1976; Loudenslager and Gall 1980[1/]), it is becoming increasingly evident that the riverine cutthroat trout populations in the eastern portion of the Lahontan Basin are substantially different from the essentially lacustrine stocks in the western portion. Be-

[1/] Loudenslager and Gall do not support the separation of the fish into two subspecies. They do believe the high relative allelic heterogeneity they observed for *S. c. henshawi* indicates that the Lahontan basin populations have undergone extensive subdivision; *S. c. henshawi* clustered into two geographic groups--one including the Humboldt drainage, the other the Walker and East Carson drainages and Summit Lake.

cause of these differences, and because the management needs of the two stocks may also differ, the Humboldt River variety may need to be more appropriately placed in its own subspecific taxon. This report discusses the natural population fluctuations observed in the Humboldt cutthroat trout in Gance Creek, Elko County, Nevada, and the significance that these fluctuations may have in the recognition of this fish as a separate subspecies.

STUDY AREA

Gance Creek is a small perennial tributary of the North Fork Humboldt River (Figure 1). The study area, in the Humboldt National Forest, experiences wide annual fluctuations in stream flows and water depth because of the exceedingly variable climatic conditions of the Great Basin. Lower reaches of the stream are diverted for irrigation, and for much of the year Gance Creek is prevented from reaching the North Fork Humboldt River. Fish populations in the Gance Creek study area consist of naturally reproducing Humboldt cutthroat trout, Paiute sculpin (*Cottus beldingi*), and a few suckers (*Catastomus sp.*). Rainbow trout (*Salmo gairdneri* Richardson) were stocked for a few years in Gance Creek and over a period of many years in the North Fork Humboldt River. Since rainbow trout were last stocked in Gance Creek, in 1955, they no longer exist anywhere in Gance Creek (P. Coffin, Chief of Fisheries, Nevada Department of Wildlife, pers. comm.).

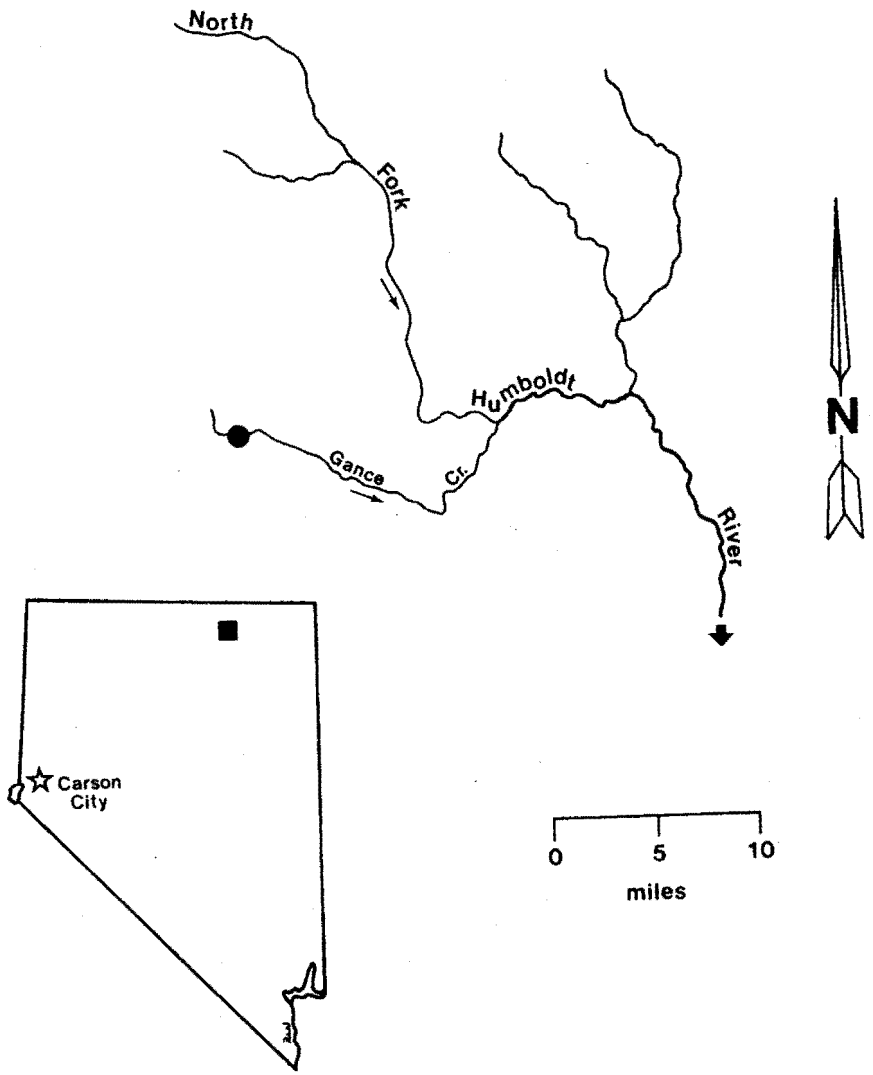

Figure 1. Location of the Gance Creek Study Area

METHODS

Cutthroat trout populations were estimated by electrofishing during each August from 1978 through 1981 within the same 549 m section of Gance Creek. Trout were collected using a four removal depletion method, and then identified, weighed, measured, and returned live to the stream. Population estimates were calculated using the maximum likelihood technique (Platts et al. 1983). The population condition factors were determined as $K = \bar{W} \times 10^5/L^{-3}$, where $\bar{W}$ is the individual weight in grams and L is individual length in mm. It was discovered that weights were not determined accurately in 1980 for all fish less than 100 mm in length (young of the year). We therefore pooled the data for all years excluding these poor data to calculate a length-weight equation from which we estimated weights for these young of the year fish.

Confidence intervals for length, weight, population estimate, and condition determination are given at the 95% level. Biomass is presented as estimated total trout weight in grams in the standard form of per square meter of water surface. We also determined trout biomass as estimated total trout weight per cubic meter of water because we believe this volumetric measurement more fully reflects the three dimensional character of the stream environment.

RESULTS

Gance Creek is a highly variable stream, and the extreme annual fluctuations in Humboldt cutthroat trout numbers reflect this instability (Table 1). The 207 individuals composing the trout population in the Gance Creek study area indicate that in 1978 the population was very low. Whatever the factors that depressed the population, they must have eased because the populations recovered quickly and increased rapidly over the next 2 years (Figure 2). The rate of population increase during this growth phase will fit either a linear or a power curve (neither shown), but the best fit is to a power curve of equation $y = 208.09x^{1.55}$. The r^2 value (1.00) for this curve is exceptional, with a highly significant F value (4822.84 with d.f. = 1). This rapid population growth was short-lived, however, and the population declined slightly in 1981 and precipitously in 1982.

Table 1. Humboldt cutthroat trout weights, lengths, numbers, and condition in Gance Creek Nevada.

	1978		1979		1980		1981		1982	
Attribute	Value	Confidence interval	Value	Confidence interval	Value	Confidence interval	Value	Confidence interval	Value	Confidence interval
Mean weight (gm)	14.0	10.5-17.7	7.4	5.3-9.5	8.9	7.6-10.2	6.7	5.9-7.6	7.1	5.9-8.3
Mean length (mm)	79.2	71.7-86.7	55.4	51.9-58.8	62.3	59.3-65.3	70.4	68.0-72.9	69.9	66.9-72.9
Mean condition factor	1.23	0.84-1.62	0.75	0.73-0.77	0.88	0.87-0.89	0.97	0.92-1.02	1.40	1.01-1.79
Estimated population size	207	206-210	619	598-641	1135	1110-1160	1040	1027-1053	518	497-539
Estimated biomass (gm/m^2)	3.35	-	4.78	-	11.4	-	6.85	-	3.70	-
Estimated biomass (gm/m^3)	57.8	-	77.4	-	163.2	-	102.2	-	50.08	-

A drop in mean weights and lengths occurred between 1978 and 1979, which indicates that the rapid population increase began as a result of high reproductive and rearing success. After this first period of population growth, reproductive and rearing success remained high, but the gradual increase in mean lengths after 1979 suggests that older age classes were beginning to comprise an increasingly large proportion of the population.

The health of individual fish apparently peaked in 1978 and 1982 as suggested by the condition factors for the population (Table 1). Evidence that density-dependent factors are involved in the population fluctuations is obtained from the precipitous drop in the popu-

lation condition factor in 1979, and the fact that the condition remained low until the population declined markedly. Because the 1980 condition factor was obtained from lengths calculated by pooling lengths and weights for all years, it is probably over estimated; therefore, the real condition of the trout in 1980 may have been lower than in 1979, rather than higher as the data suggest.

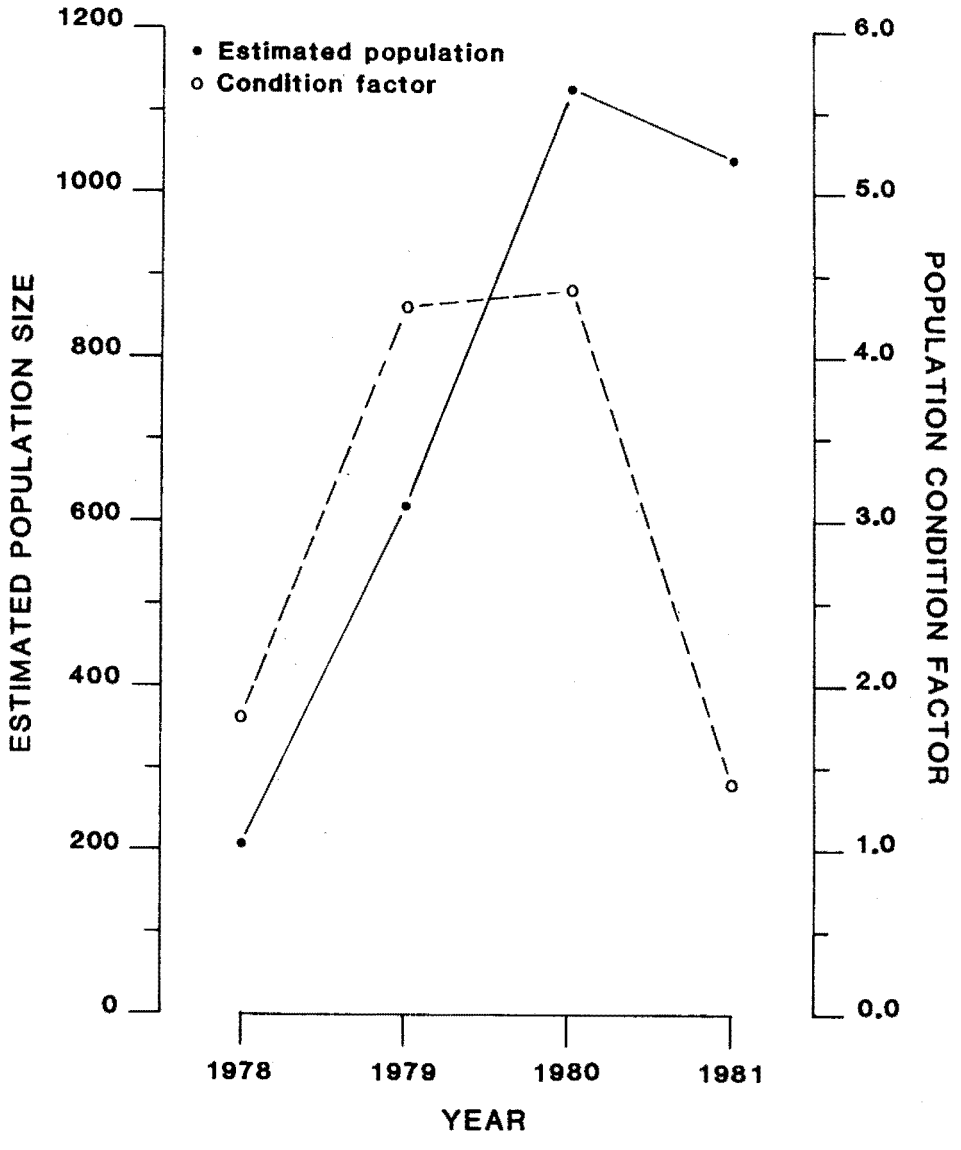

Figure 2. Changes in Humboldt cutthroat trout numbers and condition over time.

DISCUSSION

The variable and unpredictable climatic conditions in the Great Basin are expressed in Gance Creek by the trout habitat conditions, which can be favorable, marginal, or poor at any given time. We have found that the channel of Gance Creek can erode or aggrade up to 0.6 meters within our study area on most water years. Annual precipitation can average as low as 20 cm causing Gance Creek to almost dry up in late summer. Since 1979 Gance Creek has been recorded to flow 60 cfs in May and down to only 1 cfs in August. Much of this

variability is undoubtedly natural, though it is quite possible that historic land use practices, such as livestock grazing, have increased the variability. In the early 1900's over 10,000 sheep were being grazed in the Gance Creek drainage. In the 1930's about 2,000 cattle were also using the allotment. Overgrazing has been a continual problem with the U. S. Forest Service putting in grazing reductions, different grazing strategies, and allotment pastures to try and cope with the problem. Fortunately, the Humboldt cutthroat trout have evolved adaptations to these naturally unstable conditions and have the ability to rebound quickly from depressed population levels. This ability has undoubtedly helped this rare trout survive the watershed and habitat alterations brought on by livestock grazing.

Nonnative, introduced rainbow trout have also exerted pressure on this cutthroat trout. About 1,100 catchable-size rainbow trout were stocked each year in Gance Creek, some just above the study area, with the last stocking in 1955 (P. Coffin, pers. comm.). Rainbow trout or brook trout were also stocked in the North Fork Humboldt River annually until 1977. These stocked fish would have access to Gance Creek if so desired. Rainbow trout were found in Gance Creek by electrofishing crews in 1955 (P. Coffin, pers. comm.). There was no evidence found of natural reproduction as only catchable-size rainbow trout were observed. In many original cutthroat trout streams that have experienced rainbow trout introduction, interspecific competition has usually reduced or eliminated the indigenous cutthroat trout, or hybridization has destroyed the purity of the native strain. In the western Lahontan basin, populations of Lahontan cutthroat trout are maintained principally by protection from rainbow trout invasion, and we know of no single example where Lahontan cutthroat (excluding the Humboldt cutthroat) co-exist in a stream with nonnative trout (Behnke, pers. comm.). In Gance Creek, however, the opposite situation seems to have occurred: the native trout were apparently so much better adapted to the system that they either outcompeted the rainbow trout, or the rainbow trout were unable to tolerate the harsh environmental conditions.

The ability of the Humboldt cuttnroat trout to survive marginal situations, their ability to rapidly rebound in population numbers during favorable periods, and their ability to persist in the face of rainbow trout introductions which is unusual for cutthroat trout, may provide ecological evidence for distinguishing both a Lahontan and Humboldt cutthroat trout strain. This evidence, plus the taxonomic distinctions reported by Behnke (1979) and the genetic variability described by Loudenslager and Gall (1980), gives evidence that this cutthroat deserves a separate subspecific taxa, as they seem to satisfy the criteria for subspecies consideration outlined by Hubbs (1943).

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