

REVIEW

RAINBOW TROUT IN MEXICO AND CALIFORNIA WITH NOTES ON THE CUTTHROAT SERIES

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The classification of the trouts and their allies has challenged taxonomists for more than a century. Although much has been learned about their biology and relationships, we still lack answers to fundamental questions bearing upon the systematics of this plastic group. Increased application of the experimental approach and of the study of internal characters (which are presumably less subject to rapid environmental modification) is needed to clarify the comparative roles of environment and heredity in molding the genus Salmo. It is hoped that the Needham and Gard work will stimulate such research.

Students of trout classification will be grateful to the authors of this ambitious study for their tedious work in analyzing certain morphometric and meristic data derived from 17 trout populations. The widely separated samples, all provisionally classified as rainbow trout (Salmo gairdneri), were taken from Eagle Lake, California, southward to the headwaters of Río del Presidio near Durango City, Mexico; all but 2 came from the Pacific slope, and 14 were collected in streams on the mainland of Mexico. Twelve counts and 28 measurements were made on 306 specimens (an average of 18 fish per locality) and are presented in the form of frequency graphs showing the variation in traits from north to south. The derived

data are subjected to careful statistical treatment, and two-thirds of the text is devoted to an analysis of the characters and a detailed comparison of the samples. Twenty of the 28 measurements overlap and show no definitive pattern; only 6 of the 12 counts show differences of sufficient magnitude to distinguish any of the 17 populations.

There is a very useful history of trout collections from Mexico, a general discussion of rainbow trout taxonomy, some comments on the California golden trout (which is not assigned to S. gairdneri), a brief account of the effect of hatchery environment on morphometric characters, and a discussion of the cutthroat trouts (S. clarki). Instances are cited from marking experiments to show that some members of supposedly resident rainbow stocks have gone to the ocean to return as steelheads.¹ The authors point out that the migratory urge may express itself repeatedly "wherever and whenever the genetic background and suitable environmental conditions" permit. A general discussion and summary are followed by literature citations (including unpublished studies) which bring the subject up to date.

¹See also the example of the development of a nonmigratory form of Pacific salmon near Vladivostok (U. S. Fish and Wildlife Service, Sport Fishery Abstracts, 3 (4): 200. Translation).

The most significant and interesting result of the field work in northwestern Mexico is the discovery of the Mexican golden trout, which is portrayed by a colored frontispiece that Dr. Needham assures me is a faithful rendition of its life appearance. This trout stands out from all of the other populations studied (and from any rainbow trout that I have seen) in its life colors; reduced number of vertebrae and branchiostegal rays; larger scales in the lateral line and above it; the slender, narrow, and short head; the short upper jaw and snout; bold spotting on the dorsal and caudal fins; and no or very little spotting below the lateral line or on the head. This fish is found in three separate but adjacent river systems and, with the exception of 7 specimens (of 90 that were analyzed), is consistent in its characters.

Although the Mexican golden trout is sufficiently well marked to warrant its nomenclatural recognition, the authors feel that its distinctive traits represent unstable features "that are easily and quickly modified by environmental changes." Even though the meristic and morphometric characters chosen for study "were those that presumably would be most affected by the environment," I find it difficult to believe that all of the outstanding features of the Mexican golden trout are due to direct environmental effect. The golden trout is very similar in the three river systems, yet just to the south and to the north of its range are trout that look surprisingly like ordinary rainbows of coastal California.

This poses a critical question. Are the present stocks of trout in northwestern Mexico truly representative of the original fish? Concerted efforts were made during the field work to discover whether trout had been planted in this region, with negative results. However, some stocking could have been done privately, with no record. I am aware of one such planting in the Yaqui basin of northern Sonora, and at least one other seems to have occurred. On the east slope of the Sierra Madre Occidental, in the Rio Casas Grandes, there is a rainbow trout (plate 5b) very

similar to the one in Black Canyon (in the headwaters of the Yaqui). Although the authors explain the existence of these "same phyletic stocks" by deriving the Casas Grandes form from that in the Yaqui via stream capture, the capture took place in the opposite direction.^{2/} Hence it is more than likely, as the authors themselves suggest (page 65), that the Casas Grandes rainbows were put there by man. There is also a suggestion, from the occurrence of a few individuals with exceptionally high scale counts (page 49 and figure 5), that the present Casas Grandes rainbow trout may be carrying some genes (from earlier hybridization and introgression) of a native cutthroat trout that gained access to the Casas Grandes from the Rio Grande. Although that species has been reported from the upper Yaqui, no specimens of *S. clarki* have been taken from this part of Mexico; however, Cope (in 1886) did report what evidently was a cutthroat from Pacific streams farther to the south; unfortunately, these fish have not been found.

Other suggestions that trout may have been introduced and that hybridization with native stocks may have taken place along the mainland of Mexico are: (1) The V-shaped clinal trend illustrated in many of the graphs, showing that the most distinctive populations (Mexican golden trout) occur in the middle of the area rather than at the extreme southern (or northern) limits; (2) in the Mexican golden trout complex, two samples are aberrant, more nearly resembling rainbows both to the north and south in certain features; (3) the sample from Rio Truchas, taken above a power dam and reservoir, has the general appearance of "typical rainbows." Stilwell's claim,^{3/} from secondhand information, that the engineers who built

^{2/}Miller, Robert R. 1959. Origin and affinities of the freshwater fish fauna of western North America. In: A symposium on zoogeography. Amer. Assoc. Adv. Sci., Publ. 51 (1959): 187-222.

^{3/}Stilwell, Hart. 1948. Fishing in Mexico. 296 pp. Alfred A. Knopf, New York.

the dam introduced the trout is strongly disputed by local testimony. (Stilwell also claimed that English immigrants stocked trout in northwestern Mexico in the 1880's; and, in 1955, Needham agreed.^{4/} Though trout are surely native in northwestern Mexico, we certainly have reason to believe that some of the present stocks are contaminated.

The authors contend (pages 3, 46) that even if hatchery trout had been stocked in these streams, it is unlikely that the native gene pools would have become contaminated. This conclusion may be challenged. When rainbow trout are introduced into streams containing only native cutthroat trout (S. clarki), a large part or even all of the population may show introgression of traits. Thus "rainbows" and "cutthroats" of Alberta clearly exhibit a number of features which demonstrate that mutual intermixing of genes has occurred,^{5/} and the two species have fused in Grebe Lake, Wyoming.^{6/} The native trout of the Gila River basin in New Mexico and Arizona has been reduced to the verge of extinction, in part through hybridization and introgression of characters, so that it is now often difficult to be certain of the purity of the original stock (personal observations).

The discussion of the cutthroat trout trout series contains valuable information on the natural history of this species, some of which is summarized from previously unpublished studies. An interesting series of photographs of the coastal form is shown in plate 8. Most, but not all, coastal cutthroats migrate to the ocean during some phase of their life cycle but

^{4/}Needham, Paul R. 1955. Trail of the Mexican trout. *Pacific Discovery*, 8 (4): 18-24.

^{5/}Miller, Richard B. 1957. Have the genetic patterns of fishes been altered by introductions or by selective fishing? *Jour. Fish. Res. Bd., Canada*, 14 (6): 797-806.

^{6/}Kruse, Thomas E. 1959. Grayling of Grebe Lake, Yellowstone National Park, Wyoming. *U. S. Fish and Wildlife Service, Fish. Bull.* 149: 307-351.

spend relatively little time in salt water, primarily in estuaries. Differences in time of spawning and in preferred spawning site explain why hybrids between cutthroats and rainbows are almost unknown where the two species are naturally sympatric. The cutthroat trout of Independence Lake, California, is described as a unique surviving population of the native Lahontan cutthroat. The authors rightly bemoan the general failure of fishery biologists and conservationists to protect and develop such strains. Presented here are some unpublished data on artificially produced cutthroat-rainbow hybrids which confirm the belief that F₁ hybrids may be fertile, although to what degree is not shown. There appears to be no sound basis for suspicion that future studies will lead to the merging of S. clarki and S. gairdneri.

Needham and Gard have inaugurated an important and controversial study which reopens the problem of trout classification and suggests ways for a solution. The need for experimental work is stressed, and we are now afforded a unique opportunity to apply this approach to the long-isolated, distinctive Mexican golden trout. Additional field work is also called for, as half of the 14 samples from Mexico contain too few specimens (2 to 14) for thorough comparative treatment. In my critical perusal of the paper for this review, I have at times had the uneasy feeling that the derived data, rather than the fish populations, have too often been overstressed. The possibility that cutthroat trout still exist somewhere in the rugged mountains of northwestern Mexico merits careful investigation. Fresh material is needed for studies of comparative osteology, which may contribute importantly to a more sound basis for classification. Lastly, a thorough knowledge of the entire fish fauna of northwestern Mexico may help to reveal the probable course of evolution in the trouts.

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