SUNDAY

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14

FEB. 1982

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Success

13

FEB. 1982

DAY OF THE YEAR
44 -

SAT., FEB. 13

DAYS REMAINING
- 321

THE ZOOGEOGRAPHY, SYSTEMATICS AND MANAGEMENT OF CUTTHROAT TROUT

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The cutthroat trout, Salmo clarki, is an example of a polytypic species; that is, a species consisting of several geographically disjunct forms with a broad distribution and a great amount of genetic diversity. The potential of the cutthroat trout for fisheries management relates to their genetic diversity. Cutthroat trout are widely propagated and stocked into diverse habitats. The potential to utilize specific genotypes for specific environments and to create new types by intraspecific hybridization are fertile areas of fisheries management that have received scant attention. The native cutthroat trout has rapidly declined and has been completely eliminated from much of its original range in the interior waters of North America. Strong efforts should be made to preserve the remaining genetic diversity for its potential future use in fisheries programs. The practical aspects of utilizing genetic diversity in management programs is a most cogent reason for the support of an active and intelligent rare and endangered species program. Plant and animal breeding programs have abundantly demonstrated the value of utilizing a broad base of genetic diversity, accumulated by natural selection in ancestral stocks, to develop new useful races of plants and domestic animals.

Two important points must be emphasized. The first is that in fisheries management, as contrasted with the management of domesticated

varieties of plants and animals, fish stocked in natural environments as fry or fingerlings must successfully survive and grow under the rigorous conditions of natural selection. That is why "wild" genotypes will be more successful than domesticated varieties developed by artificial selection. No sheepherders or predator control agents can accompany a plant and protect them from competition and predation.

The second significant fact is that physiological, behavioral and ecological differentiation, are not necessarily correlated with taxonomic recognition; that is, certain life history traits, important for fisheries management consideration, may not be reflected in morphological characters used for classification. These "non-taxonomic" traits can play a decisive role in the relative success of an introduction and emphasizes the need to recognize individual units or genotypes of a species or subspecies and not merely consider formal taxonomic categories in a rare and endangered fish program.

Millions of cutthroat trout are propagated each year in western states, and several sources of eggs are used. Past fish cultural practices have indiscriminantly mixed several different races of cutthroat trout, usually with some rainbow trout influence also. At present, virtually none of the sources of cutthroat trout used in propagation represent pure stock.

Distribution

The original distribution of cutthroat trout occurred in coastal streams from Prince William Sound, Alaska, to the Eel River in northern California. In the interior regions, the range included the South Saskatchewan drainage, the upper Columbia and upper Missouri basins, the Snake River segment of the Columbia drainage, above and below Shoshone

Falls, the upper Colorado and Rio Grande systems, the South Platte and Arkansas drainages in Colorado, and the Great Basin (Bonneville, Lahontan and Alvord basins).

In coastal waters the cutthroat trout and rainbow trout coexist without massive hybridization. This sympatric occurrence of the two trouts, each maintaining its genetic integrity, provides the theoretical basis for recognizing Salmo clarki and S. gairdneri as two separate species. Throughout most of the interior range of the cutthroat trout, the rainbow trout was not native, and introductions have almost invariably led to complete hybridization. There are areas, however, such as the Snake River system below Shoshone Falls where interior cutthroat trout and rainbow trout are both native and have been able to coexist without large scale hybridization. The precise mechanisms to explain how rainbow trout and cutthroat trout can live together without hybridizing are poorly understood; however, it is not due to genetic incompatibility - hybrids are fully fertile.

Taxonomy

Early ichthyologists without an understanding of the range of morphological variability that may be expressed within a single species, proceeded to name many species of cutthroat trout, based on local varieties. At present, because it is assumed that all populations of cutthroat trout could freely hybridize with each other, if given the opportunity, only a single species is recognized. Subspecies designation is commonly used to denote those populations of a certain geographical region or major drainage basin. On morphological grounds, most subspecies of Salmo clarki have little validity. No characters have much efficacy in distinguishing S. c. lewisi, S. c. utah, S. c. pleuriticus, and S. c. virginalis.

The coastal cutthroat trout, S. c. clarki, has a distinct chromosome number from other subspecies. The Lahontan cutthroat trout, S. c. henshawi, has more gillrakers and a unique spotting pattern. The Colorado greenback cutthroat trout, S. c. stomias, has more scales and larger spots.

There are four distinctive groups of cutthroat trout that are not yet officially recognized. These undescribed subspecies include: the indigenous trout of the Humboldt River system of the Lahontan basin, Nevada; a few relict populations of the Alvord basin, Oregon; a trout found in the Mt. Wheeler area of Nevada, apparently derived from western Bonneville trout, but quite distinct from S. c. utah; and a fine spotted cutthroat trout native to the Snake River below Jackson Lake, Wyoming.

The fine spotted Snake River cutthroat trout is the only interior cutthroat trout that has held its own despite massive introductions of exotic trouts, including other cutthroat trout. Preliminary information presented below indicates that this trout can be a most useful trout in fisheries management. The most baffling aspect of the existence of a fine spotted group of trout in the Snake River is the fact that typical large spotted populations occur above and below their range. How has hybridization and fusion into a single type been avoided in a continuous environment?

The Humboldt drainage subspecies in Nevada also appears to be an extremely hardy trout with desirable management characteristics - evidently influenced by its evolutionary history of the past several thousand years in a hostile and unstable environment.

For a more comprehensive perspective, the systematics of cutthroat trout must be considered within a framework of the evolution of western North American Salmo. The currently accepted notion that only two major

evolutionary lines - S. gairdneri and S. clarki - are involved and that all western North American Salmo are derived from one or the other species, must be rejected. Based on morphology, zoogeography and supplemented with recent chromosome studies, it is now apparent that the ramifications of the evolutionary pathways leading to the living groups of western North American Salmo are not as simple and straightforward as previously thought. Several groups of trouts of dubious relationships, and not recently derived from S. clarki nor S. gairdneri, include the primitive Mexican golden trout, Salmo chrysogaster, the California golden trout, S. aguabonita, the Gila trout, S. gilae, the Apache trout, currently being described by Dr. R. R. Miller, and a diverse group of trout indigenous to several desiccating basins in southern Oregon and in parts of the McCloud and Pit river basins of northern California. I apply the name red-banded trout to these undescribed trout. Based on certain color characteristics and similarities in karyotypes, the red-banded trout appears to have relationships to S. aguabonita.

Much more information will be needed before we can do more than guess at how the connecting lines of a phylogenetic diagram of western North American Salmo should be plotted. It is evident, however, that many more major evolutionary divergences have occurred to produce the present diversity than has been generally believed.

Management

The most urgent need in cutthroat trout management is to initiate and carry out projects to preserve rare and endangered populations of pure, native genotypes. Examples of creating new habitat, eliminating non-native fishes and constructing barriers to upstream migration and introductions

into previously barren waters have been used to modestly expand the range of the greenback cutthroat trout, the Gila trout and the Apache trout.

The major problem for rare and endangered trout programs is taxonomy. How can a pure, native population be recognized if found? The Colorado Cooperative Fishery Unit maintains a reference collection and has amassed data on the characters of thousands of specimens of western North American Salmo from throughout their range. Evaluation of any population can be made by comparisons with these data. Several reports summarizing the status of various rare forms of trout are available from the Colorado Cooperative Fishery Unit.

Information on ecology, behavior and physiology of cutthroat trout, necessary for scientifically based management programs, is sorely lacking. This information is basic to answer such questions as what form (genotype) of cutthroat trout best survives, grows and contributes to a fishery in different environments? Under what conditions are cutthroat trout more successful than rainbow trout or brook trout and why?

Unfortunately, the concept that slight genetic differentiation, not recognized taxonomically, can greatly influence the success of certain stocks in fisheries management is yet to gain wide understanding. The matter is more than mere hair splitting. The Lahontan cutthroat trout population once native to Pyramid Lake, Nevada, was probably the largest of all western North American Salmo. Maximum weight attained was 40-60 lbs. The average size of 195 specimens from the last spawning run from Pyramid Lake in 1938 was 20 lbs. The Pyramid Lake stock of S. c. henshawi was the last population representing direct continuity of evolution in a lacustrine environment for perhaps more than 50,000 years - as the only large predatory species among numerous minnows and suckers. The native

Pyramid Lake population became extinct after 1938 with complete blocking of spawning runs in the Truckee River. The trout raised as S. c. henshawi today has a very different evolutionary history and has been influenced by hybridization with rainbow trout. More important from a management point of view is the fact that the maximum size attained in Pyramid Lake by this trout is less than the average weight of the last spawning runs of the original native genotype. The state of Nevada and the U. S. Bureau of Sport Fisheries have ambitious programs to propagate Lahontan cutthroat trout and rehabilitate the Pyramid Lake fishery. Should some thought be devoted to the possibility that they are using the wrong trout? Might remnant populations of the original Pyramid Lake stock persist in some introduced populations? Millions of fry from Pyramid Lake parents were widely distributed in the early part of this century.

The only pure, native lacustrine stock of S. c. henshawi in California occurs in Independence Lake. Despite wide publicity given to the significance of the Independence Lake cutthroat trout, catchable rainbow trout were stocked into Independence Lake for "instant fishing" without regard to the possible consequences. This example illustrates the need to organize a rare and endangered fish program with firm and clear objectives and guidelines and to be certain all employees fully understand what is involved. If the Independence Lake cutthroat trout are lost through hybridization with the introduced rainbow trout who should be held accountable - the Director? The Chief of Fisheries? Or the biologist who made the introduction?

Example of Systematic Research Applied to Management

An ongoing systematic study of cutthroat trout has provided the basis for evaluating the amount of genetic divergence between various

groups. The assumption that taxonomic differences should also be manifested in ecological differentiation provided the theoretical basis for a study being conducted by Colorado Cooperative Fishery Unit student John Trojnar. We were particularly interested in learning more about the fine spotted Snake River cutthroat and its role in fisheries management. The Snake River cutthroat trout is the only cutthroat trout that still is dominant over introduced trouts in its native range and has resisted hybridization with rainbow trout and other forms of cutthroat trout. The preliminary data based on the first three months of the 1971 field season from North Michigan Lake, Colorado, is presented in the following table.

	Snake River Cutthroat	Colorado Cutthroat
No. fry stocked 1968	24,000 (16%)	126,000 (84%)
1971 gillnet samples	38 (52%)	35 (48%)
1971 creel census	116 (78%)	32 (22%)

Although the sample size is small, the proportion of Snake River cutthroat trout in the anglers catch has been steadily increasing throughout the year. At present, the 16 fold increase in the catch from what would be expected based on the 1968 stocking ratios is not likely due to chance and we attribute it to the genetics of the trout involved.

Similar studies should be carried out in diverse environments with all of the stocks of cutthroat trout now being propagated to compile a "breeders handbook" on the genetics and ecological potential of Salmo clarki.