RAINBOW TROUT OF KAISER & REDWOOD CREEKS

Report

to

East Bay Municipal Utility District

and the

East Bay Regional Park District

by

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SUMMARY

A sample of 52 trout were received from Kaiser Creek (Contra Costa County) in August of 1986. This creek is located on East Bay Municipal Utility District (EBMUD) Watershed lands east of Oakland. A similar sample from Redwood Creek had been received from the East Bay Regional Park District (EBRPD) in October of 1984. Both creeks are tributaries to Upper San Leandro (USL) Reservoir which was constructed in 1926 -- 8,000 feet upstream of Chabot Reservoir. The trout were examined electrophoretically and the results compared to genetic profiles available for a wide range of rainbow trout from throughout California. It is concluded that the trout from Kaiser Creek and those from Redwood Creek represent a unique population of non-hybridized coastal (steelhead) rainbow trout that has been isolated from migrating steelhead for over 112 years (since construction of Chabot Dam in 1875). Their genetic profile combined with their anadromous behavior strongly supports the contention that these trout are descendants of native California steelhead. (In 1855, Dr. G. W. Gibbons described Salmo irideus as a separate and distinct species of trout from 3 specimens collected in San Leandro Creek). For these reasons this land-locked population of coastal (steelhead) rainbow trout is considered a valuable and unique scientific resource due to their unprecedented genetic integrity and management plans should be developed accordingly.

INTRODUCTION

The construction of Chabot Dam in 1875 effectively isolated steelhead trout from their normal migration route to the ocean via San Leandro Creek. The upstream construction of USL Dam in 1926 further isolated these trout on protected watershed lands not open to the general public. There are four major drainages flowing into USL Reservoir:

1. Redwood Creek flows into the west finger of USL Reservoir from the north;

2. The San Leandro Creek tributary located about four miles northeast of Redwood Creek flows into the main finger of USL Reservoir from the north;

3. The Moraga Creek tributary enters the main finger of USL Reservoir about 1 mile east of the mouth of San Leandro Creek and flows from the northeast; and

4. The Kaiser Creek tributary which drains the east side of the USL Reservoir watershed and enters the main finger of the reservoir from the east about 4 miles south of Moraga and San Leandro Creeks and 2 miles east of Redwood Creek.

EBMUD and EBRPD biologists have established that adult trout migrate out of the reservoir from January through April to spawn in the tributary creeks. After hatching (February through May) the young spend from one to two years in the creeks before returning to the reservoir during the fall run-off period. This behavior strongly suggests that these fish were descendants of anadromous steelhead trapped first behind Chabot Dam and later behind USL Dam when it was completed in 1926. It has been determined from planting records that USL Reservoir has not been planted with rainbow trout.

To ascertain whether these trout populations actually represented a refugium of native California steelhead, samples were obtained from Redwood and Kaiser Creeks for genetic analysis. The genetic profiles of USL Reservoir trout were then compared with other California populations of rainbow and steelhead trout.

METHODS

Samples of trout were collected and delivered live to the U.C. Davis Genetic Stock Identification Laboratory. A total of 53 fish were obtained from Redwood Creek in October, 1984 and a similar sample of 52 trout were obtained from Kaiser Creek in August, 1986. Tissue extracts were prepared by standard methods from each sample and stored until analyzed. Standard horizontal starch-gel electrophoresis was used to identify allele frequencies at seventeen biochemical marker-loci known to be diagnostic for variation among California rainbow trout populations (Busack et al. 1979).

The observed allele frequencies were compared to laboratory data on trout from present and former California steelhead streams ranging from the San Luis Rey River in the south to the Eel River in the north, and to average allele frequencies for inland streams known to possess coastal rainbow trout (Pit River hatchery stock, Lower Pit River and Lower McCloud River). Fish from all these areas are referred to collectively as the "coastal rainbow" group. In addition, allele frequencies for populations of redband type trout (Upper Pit River, Goose Lake, and Upper McCloud River) were used to determine if the trout from USL Reservoir could be distinguished from other rainbow trout groups. The populations and abbreviations used for data presentation are given in Table 1. Genetic similarities among populations were calculated using the methods of Nei (1978). Allele frequency comparisons were based on data for seven loci of particular interest in the Redwood and Kaiser Creek trout populations.

RESULTS AND DISCUSSION

The allele frequencies observed in trout from Kaiser and Redwood Creeks are presented in Table 2 and the frequencies for comparison populations are given in Table 3. The general genetic profile for the USL Reservoir trout sampled from Kaiser and Redwood Creeks was typical of that observed for coastal rainbow trout and different from that of redband and hatchery trout. Moreover, the USL Reservoir trout contain unusual variant alleles at several loci which characterized them as a relatively unique, isolated native trout.

Superoxide Dismutase (SOD-1): The most unusual frequency observed was for the slow (60) allele at the SOD-1 locus. This allele normally occurs at very low frequencies in some rainbow populations but had a frequency of 0.405 in Redwood Creek and 0.250 in Kaiser Creek. The (60) allele has been observed in rainbow trout populations from: San Luis Rey River, an old isolated population; Middle Fork Feather River; North Fork Little Squaw Creek, a tributary to Lake Shasta; the lower Pit River; and in steelhead from the Gualala River. This slow allele at SOD-1 is commonly found at high frequencies in golden trout from the Little Kern and Kern River drainages.

Isocitrate Dehydrogenase (IDH-3,4): Another genetic factor that links Kaiser and Redwood Creek trout and separates them from other rainbow trout is the frequency of alleles at the IDH-3,4 locus pair. Not only do both populations have similar frequencies for the three primary alleles, but they also possess unusually high frequencies of the (170) allele. The frequency was 0.155 in Redwood Creek and 0.264 in Kaiser Creek compared to 0.013 and 0.016 in steelhead rainbows from the Gualala and Eel Rivers, respectively. The (170) allele is also present at low frequency in trout from the lower and upper Pit River, North Fork Little Squaw Creek, Middle Fork Feather River, and lower and upper McCloud River and the Sacramento River, however it is absent in trout from the San Luis Rey River.

Conversely, the (100) allele is virtually absent in both Redwood and Kaiser Creek trout, which is in direct contrast to the high frequencies observed in the Feather River (0.209), North Fork Little Squaw Creek (0.365) and the upper Pit-Goose Lake group (0.150). The lower Pit River is the only group found to possess a low frequency of the (170) allele and to also lack the (100) allele at the IDH-3,4 loci.

Glucose Phosphate Isomerase (GPI-3): Trout from USL Reservoir are nearly unique in possessing the (85) allele at the fast glucose phosphate isomerase (GPI-3) locus. This allele is not found in rainbow trout or steelhead from the Pit, McCloud, Sacramento, Gualala, or Eel Rivers but occurs at a substantial frequency of 0.197 in Redwood Creek and at a frequency of 0.010 in Kaiser Creek. The only other location where this allele is known to occur among California trout is in the San Luis Rey River and its tributary, Pauma Creek, in southern California.

Malate Dehydrogenase (MDH-3,4): Variation at the MDH-3,4 loci represents another example of the probable ancestral relationship of USL Reservoir trout to coastal (steelhead) rainbow trout. This is especially obvious for Redwood Creek trout which possessed variability for all four alleles (75, 85, 100, and 107) found in populations of Gualala and Eel river steelhead. These alleles are also found in populations of coastal (steelhead) rainbows from the lower McCloud. None of the six lower McCloud populations, however, included in the composite frequencies (Table 3) possesses all four alleles. The absence of

two of the four alleles from the Kaiser Creek sample could be due to sampling error or to differentiation among USL Reservoir populations; the frequency of the (100) allele for Kaiser Creek was exceptionally high for a steelhead population.

Phosphoglucomutase (PGM-2): The variation observed at the PGM-2 locus for Redwood and Kaiser Creek trout was typical of coastal and inland rainbow trout and therefore, contributed little to our understanding of the origin of the USL Reservoir trout.

The genotype overlap method described by Ayala (1984) was used to determine the probability that trout from Redwood and Kaiser creeks could be assigned to any one of seven California groups of trout (Table 4): coastal rainbow, inland redband, Goose Lake (Pit River) redband, McCloud River redband, Little Kern golden trout, Volcano Creek golden trout, and Kern River rainbow. The resulting analysis clearly demonstrated that the USL Reservoir trout are correctly assigned to the coastal (steelhead) rainbow group. Based on the genetic profile of these trout and their anadromous behavior, it is very appropriate to consider the Redwood Creek and Kaiser Creek trout to be native California steelhead.

Because the rainbow trout in USL Reservoir have been isolated from upstream migration of ocean steelhead and because there were undoubtedly relatively few adult fish during the early years after Chabot Dam was constructed in 1875, the effects of genetic drift would be expected to have modified allele frequencies. As a result of this isolation, the frequency of some alleles are higher in the USL Reservoir trout than expected for steelhead trout. This, in turn, has resulted in the trout in Redwood and Kaiser Creeks taking on some very distinct characteristics.

A genetic similarity analysis documented that Redwood and Kaiser Creek populations have a genetic identity of 0.993. Their genetic identity with coastal (steelhead) rainbows was 0.988 while their identity with inland rainbow trout was 0.980.

In summary, all the genetic evidence strongly indicates that the Redwood and Kaiser Creek trout represent a unique group of coastal (steelhead) rainbow trout that have been isolated from migrating steelhead for over 112 years. Therefore, it is highly probable that these trout are descendants of native California steelhead that have not hybridized with domestic trout. They should be considered valuable scientifically because of their unprecedented genetic integrity and managed to conserve this uniqueness.

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