

NAWS MOHAVE TUI CHUB ANNUAL REPORT

Background

The City of Ridgecrest's Waste Water Treatment Facility (WWTF) evaporation and percolation ponds, existing on the Naval Air Weapons Station, China Lake (NAWS) since about 1945, elevated the already high groundwater mound and resulted in the establishment of Lark Seep. In order to control the expansion of Lark Seep and to encourage water to flow away from nearby structures and test sites, a system of channels were created directing water not only to and from Lark Seep but also to the China Lake playa where G1 Seep formed. This network of channels and seeps are referred to as the Lark Seep System.

The Mohave tui chub (*Gila bicolor mohavensis*) historically occurred in the Mojave River from the confluence of the east and west forks at the base of the San Bernardino Mountains to its terminus at Soda Dry Lake. Habitat modifications, including damming of the headwaters and withdrawals of the river's underflow, has been the major cause of the decline of the species. The Mohave tui chub were listed as endangered by the Service in 1970 and by the State of California in 1971. Due to the lack of natural habitat the California Department of Fish and Game and the US Fish and Wildlife Service decided to establish refuges for the rapidly disappearing fish. The Department chose NAWS as a refuge site and introduced the Mohave Tui Chub into Lark Seep in 1971. The chub currently do not exist in natural habitat within its native range with the possible exception of one small spring adjacent to Soda Dry Lake.

Genetically pure populations of chub now exist at refuge sites at the NAWS, MC spring at Soda Springs, and Camp Cady which is maintained by the Department.

Past mark and recapture surveys

Since 1995, annual mark and recapture surveys have been conducted to estimate the chub population at China Lake. The project was conducted at approximately the same time each year, last weekend in May or first weekend in June. Research indicates that water temperatures this time of year promote low activity in the chub. However, spawning fish have been encountered during the mark and recapture surveys. The mark and recapture methodologies were as followed: At each trapping location (see Maps 1 and 2 for locations) a modified minnow trap was baited with cat food, placed in a pre-defined location and left for approximately 12 hours (usually overnight). The next morning the traps were taken out and the fish were weighed, measured, the left pectoral fins were clipped and then the fish were released. The trap was then reset using the same methods as the previous day. The next day, fish were again weighed, measured and checked for the left pectoral fin mark before being released. In order to determine population numbers, the Lincoln-Peterson calculation method was used. The Lincoln-Peterson method assumes that fish do not migrate but live in one habitat area, a closed system. For the purposes of this calculation, the Lark Seep System is considered a "closed system".

Lincoln-Peterson calculation:

$$\hat{N} = \frac{(N_1 + 1)(N_2 + 1)}{(M + 1)} - 1$$

$$\text{Var}(\hat{N} | N) = \frac{(N_1 + 1)(N_2 + 1)(N_1 - M)(N_2 - M)}{(M + 1)^2 (M + 2)}$$

$$N_{CI} = \pm 1.96(\text{Var}(\hat{N}/N))^{.5}$$

Where: N = population.
 N₁ = total number of fish captured on day one.
 N₂ = total number of fish captured on day two.
 M = total number of fish re-captured on day two.
 N_{CI} = confidence interval

Table 1 shows the estimated population number and confidence interval for each year. Between 1997 and 1999 the mark and recapture results showed a decline in the chub population numbers at China Lake (Figure 1).

Table 1. Population estimate and confidence interval for 1997, 1998 and 1999 surveys.

Year	Population estimate	Confidence interval
1997	8192	4281
1998	7185	4292
1999	6815	2277

Past habitat enhancement projects

Habitat enhancement of the Lark Seep system was done in 1997. NAWS widened and deepened approximately 250 feet of channel south of Lark Seep. This enhancement was to discourage cattail (*Typha latifolia*) growth and allow greater water flow to minimize maintenance requirements. The enhancement was done according to all guidelines established in biological opinion 1-8-97-F-15.

To maintain the water distribution capacity of the Lark Seep System, the NAWS excavates cattails annually from the channels. Clearing is necessary because many of the channels are not sufficiently deep to prevent cattails from spreading and clogging the channels. All removals are conducted in accordance with guidelines established in the biological opinion (1-8-97-F-39R).

2000 and 2001 Projects

Water monitoring.

To ensure that water quality is within acceptable levels for the chub, weekly water quality measurements are taken. The results are entered into a database and the NAWS hydrologist

assesses the results regularly. The monitoring is being conducted using a Horiba U10 water quality meter. The water quality parameters being monitored are: dissolved oxygen, pH, temperature, conductivity, turbidity and salinity.

The NAWS hydrologist assisted in establishing the monitoring locations along the Lark System. Water flow, habitat, and previous area history were taken into consideration when choosing the locations. Monitoring locations are shown on Maps 3 and 4.

Water flow measurements were attempted using many different types of meters; however, none of the meters were able to detect flow rates. Conclusions made from visual observations at culverts indicate water flow through the Lark Seep System from east to west.

2000 Mark and Recapture

The 2000 mark and recapture survey was conducted May 26-28, 2000. The mark/recapture program spanned three days beginning late afternoon May 26, 2000. The procedures followed were similar to previous years' surveys. Modified minnow traps were used for the project. Traps were baited with cat food and placed in position on May 26, 2000. The morning of May 27th the traps, beginning with site 1 (the Bologna Pool), were systematically checked and processed. The process was kept the same for each trap site. Water was taken from the trap site and placed into two buckets, holding and recovery. The fish were then retrieved from the holding bucket, weighed, measured and the left pectoral fin was clipped before being transferred to the recovery bucket. After the last fish is processed, the recovery bucket is then released and the trap reset. The next morning the traps were again checked and the fish were weighed, measured and checked for the left pectoral fin mark before being released.

Due to the dead fish found in the traps at sites 1 and 2 on the first day, May 27th, water quality measurements were taken again that morning. Results showed that sites 1 and 2 had very low levels of dissolved oxygen, the lowest level in the channel system. The decision was made not to replace the traps in that area. Instead one trap was set at the intersection of the north channels at the Water Road culvert (Trap 1A).

Table 2 shows the daily capture numbers for each trap including the recapture results. After using the Lincoln-Peterson equation the population estimate was 3143 individuals with a confidence interval of ± 672 individuals (Figure 2).

Table 2. Number of fish caught at each trap site during the 2000 mark and recapture survey.

	Number of fish on day 1	Number of fish on day 2	Number of fish recaptured
Trap 1	19	0	0
Trap 2	1	0	0
Trap 3	65	56	15
Trap 4	157	78	19
Trap 5	116	58	9
Trap 6	22	29	3
Trap 7	61	85	7
Trap 8	32	10	1
Trap 10	32	15	3
Trap 11	18	5	1
Trap 1A	0	29	2
Total	523	365	60

The number of fish recaptured was higher than in previous years resulting in a lower estimated population. Similar to the past three years (1997 – 1999) the 2000 population estimate shows a decrease in the NAWS Mohave tui chub population. Due to the limited amount of research done on this species, it is difficult to know if this decline is significant in terms of survival of the entire population. It is also unknown what factors may contribute to this population decline.

2001 Mark and Recapture

The 2001 mark and recapture survey spanned three days beginning late afternoon on November 12, 2001. The survey date was moved from May to November with hopes of decreasing the amount of spawning fish encountered, and the resultant egg loss from the fish during handling. Before traps were set on November 12th water monitoring was conducted. All data recorded was within normal levels for the channel system.

Modified minnow traps were baited with cat food and placed in position on Nov 12, 2001. Because of fatalities during the 2000 survey, large floats were put on the traps at sites 1 and 2 so they would float at the top of the water column. The morning of November 13th the traps, beginning with site 1, were systematically checked and processed. The process was kept the same for each trap site. Water was taken from the trap site and placed into two buckets, holding and recovery. The fish were then retrieved from the holding bucket, weighed, measured and the left pectoral fin was clipped before being transferred to the recovery bucket. After the last fish was processed, the recovery bucket occupants were then released and the trap was reset. The next morning, November 14th, the traps were again checked and the fish were weighed, measured and checked for the left pectoral fin mark.

There were some minor changes made to the equipment used during the 2001 survey. The most significant change was the use of an oxygen tank and air stones to aerate the holding and recovery buckets. Larger holding tanks (75 gallons) were also experimented with, but problems arose from their size and dark color. The pump used to fill these tanks was found to be too large and difficult to manage.

Table 3 shows the daily capture numbers for each trap including the recapture results. After using the Lincoln-Peterson equation the population estimate was 10,406 individuals with a confidence interval of ±10,021 individuals (Figure 3).

Table 3. Number of fish caught at each trap site during the 2001 mark and recapture survey.

	Number of fish on day 1	Number of fish on day 2	Number of fish recaptured
Trap 1	0	0	0
Trap 2	0	0	0
Trap 3	18	8	0
Trap 4	47	44	0
Trap 5	1	0	0
Trap 6	53	48	2
Trap 7	44	2	0
Trap 8	5	1	0
Trap 10	16	15	0
Trap 11	38	21	0
Total	222	139	2

figure 3

Due to the dramatic decrease in the number of fish recaptured on the second day, the confidence interval is almost equal to the population estimate. Therefore, there is little validity to the population estimate calculated for 2001.

It is that that with the water and ambient temperatures being cooler and the days being shorter the traps may not have been set at the proper times. The chub may not be active during the dark. In May the days are longer by 2 to 3 hours as well as being warmer. This idea will be taken into account when planning for the 2002 survey.

There have also been ideas that the trap hole size is too small for many of the fish visually observed in the channels. Although visual observations noted that each time the trap was set at site 5 a school of fish, approximately 50 to 100 individuals, were attracted to the trap, only one fish was caught at site 5 during the 2001 survey. This idea will influence changes made when planning for the 2002 survey.

It should be noted that no spawning fish were encountered during the 2001 mark and recapture survey.

Cattail removal

The 2001 cattail removal effort began on December 26, 2001. Due to the limit reach of the existing equipment owned by NAWS only a small portion of the Lark Seep and G-1 Seep System could be cleared due to the limited reach of the excavator. Therefore, NAWS will attempt to rent an extended reach excavator to complete the removal process in the remaining areas in early 2002. All removals are conducted in accordance with guidelines established in the biological opinion (1-8-97-F-39R).

Proposed changes and experimental projects

Population calculation methods

Due to the configuration of the Lark Seep and G-1 Seep System it is possible the Lincoln-Peterson method is not appropriate for determining the population of the NAWS Mohave tui chub. Research of alternative methods is currently taking place.

Trap hole size alterations

It appears that populations of large and small fish are being overlooked in the population census. On November 20, 2001 two traps with modified hole sizes were experimented with. At site 1 a trap with a smaller hole size was set mid-morning and pulled mid-afternoon that same day. Two fry chub were found inside. At site 5 a trap with a larger hole size was set mid-morning and pulled mid-afternoon that same day. Five large fish were found inside this trap.

Further experimentation is needed to determine how trap hole size affects the results of the population surveys. It is possible that in future surveys multiple traps with different hole sizes will be set at each location in order to capture more of the chub population.

Daytime versus nighttime feeding cycles

From the results of the 2001 survey it has been theorized that the chub are day time feeders. The reduced amount of daylight during November evenings might explain why the total number of fish caught during the 2001 survey was down considerably from past years. It has been proposed that for the 2002 survey, traps should be set out in the evening, but not checked until the afternoon of the next

day. The extra hours in the morning that the trap is in the water may increase the likelihood of capturing more of the chub population.

Fish processing methodologies

Smaller tanks and water pump will be used during the 2002 survey. A safer method of releasing the fish is also being researched and designed. Weighing the fish might be eliminated from the procedure in order to decrease the amount of handling the fish receive.

A new methodology of marking the fish has been proposed by NAWA and is awaiting the approval of the US Fish and Wildlife Service. The new marking method would be implanting Visible Implant Fluorescent Elastomer (VIE) into the fish. Due to the permanence of this marking method it would be possible to detect captured fish from previous years' surveys.

Habitat maintenance and enhancement

Due to the encroachment of tamarisk trees around the Lark Seep System a tamarisk removal plan has been written. Tamarisks are an introduced weed that out-competes native vegetation and uptake an extreme amount of water annually. Removal of tamarisks in and around the chub habitat may increase the amount of water flowing in the channels.