

China Lake Revisits Strategies to Protect Endangered Fish

Partnerships Benefit Survival of the Mohave Tui Chub

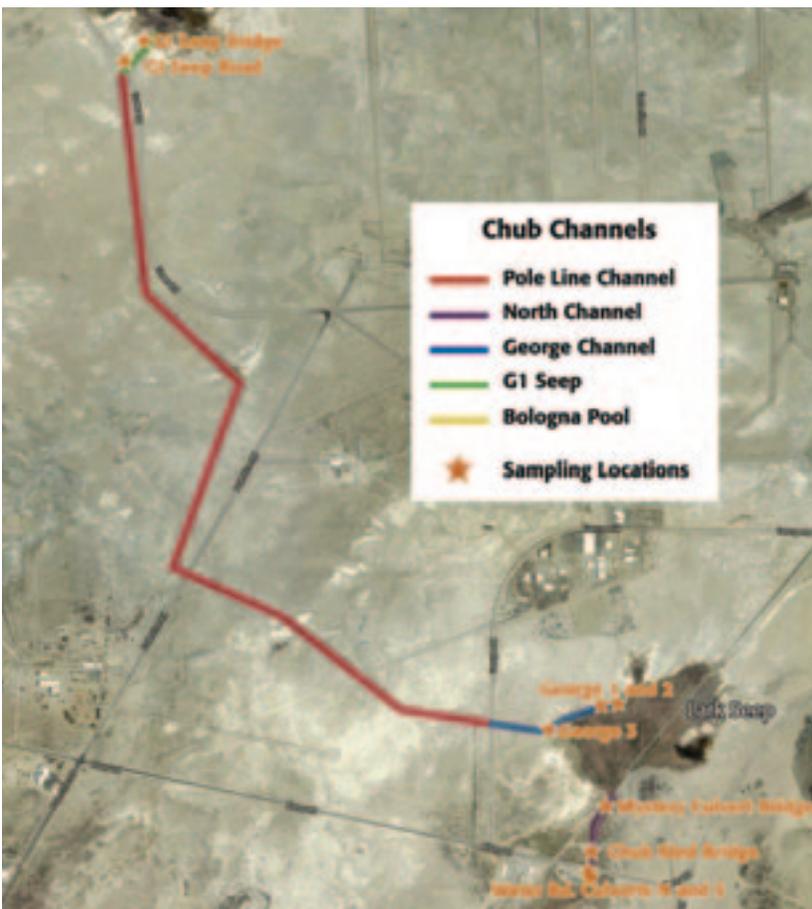
AFTER A CLOSE call with a rare species, personnel from the Naval Air Weapons Station (NAWS) China Lake and its partners revisited strategies to improve the habitat of the Mohave tui chub and its future.

NAWS China Lake is the largest naval installation, comprising over a million acres and 43 percent of all Navy land. It is also home to the largest and most genetically diverse population of a rare, federally-listed, endangered fish called the Mohave tui chub (*Siphateles bicolor mohavensis*). The fish, which is now extinct within its native Mojave River habitat due to habitat alteration and hybridization with the introduced arroyo chub, lives in a system of constructed channels on the installation, and at only four other off-installation locations near the Mojave River. Management of this vital population has come with its own challenges. Partnership and collaboration have proven to be effective tools in overcoming such challenges, and continue to be strategies to reduce future costs and efforts for conservation of this rare species.

The NAWS China Lake population is the only one remaining from a 1972 translocation project in which the

U.S. Fish and Wildlife Service (USFWS) moved genetically pure Mohave tui chub from the Mojave River to fourteen locations in an effort to establish refuge populations

to save the species. Considering the fact that much of the installation lies in the Mojave Desert, it's a bit of a surprise that there is enough water to support a fish in the arid land-



scape. The China Lake Mohave tui chub habitat is located within the installation's largest body of surface water, a roughly 2.5 mile-long network of manmade channels that ultimately drain into flatter marshy areas. During the 1950's and 1960's, the channels were created to divert groundwater away from roads and facilities. As a result, water currently flows downstream from the Bologna Pool, located near Lark Seep, through the North Channel. Water also appears to flow through a large area of cattails that separates the North Channel from George

Channel, through George Channel and further downstream. It eventually flows into G1 Channel and G1 Seep, marking the end of the channel system.

Key components of China Lake's Mohave tui chub management strategy have included habitat management, particularly cattail removal, in concert with population and water quality monitoring. In 1997, the North Channel was deepened and widened to improve habitat quality and prevent cattail overgrowth. In other channel areas, cattail

must be regularly removed to maintain water flow, which helps to maintain dissolved oxygen levels the fish need for respiration. These levels, as well as temperatures, conductivity, and pH, have been recorded during water quality monitoring efforts. Population monitoring has included abundance surveys, which show population trends over time. In addition to providing valuable long term data, monitoring results can also signal any alarming changes occurring in the system.

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Mohave Tui Chub History

MOHAVE TUI CHUB (*Siphateles bicolor mohavensis*) are the only fish native to the Mojave River in California. Related to minnows, adult fish can range in length from four to nine inches. (Note: The name of the fish follows the Native American spelling while the name of the river does not.)

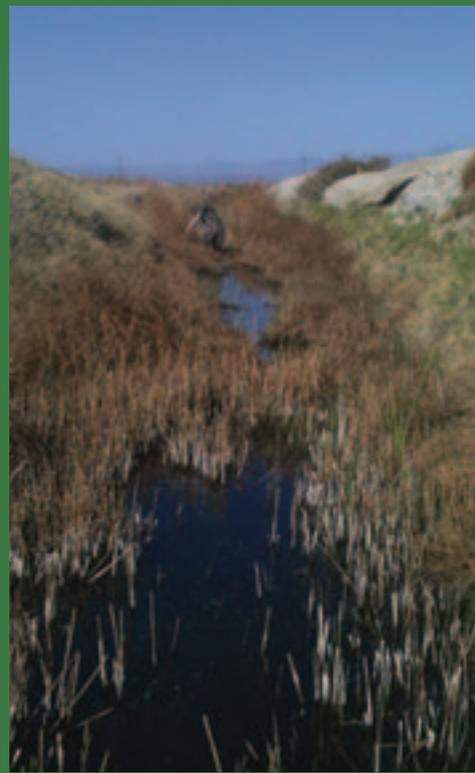
The federal government first included them on an endangered species list in 1970. As with many endangered species, the Mohave tui chub populations have been affected by habitat modification, as well as exotic species. Arroyo chubs (*Gila orcutti*), introduced into the headwaters of the Mojave River in the 1930's, reached Mohave tui chub habitat and interbreeding resulted in a hybridized chub. As noted in the USFWS's 1984 recovery plan, by 1970 there were no longer any genetically pure Mohave tui chub remaining in the river. A genetically pure population, however, was discovered in Soda Springs, which includes Lake Tuendae and Mohave Chub Spring.

The recovery plan specifies the recovery level for downlisting, from endangered to threatened, as six self-sustaining populations of at least 500 fish each. Efforts to expand the populations have included transplanting individuals from some of the remaining Mohave chub populations to

other potentially viable locations. The Lark Seep population at China Lake was introduced in 1972 and 1976. The fish population subsequently expanded into the North, George and G1 channels in the Lark Seep system.

Few of the other populations transplanted during the 1970's survived. Continuing efforts to establish populations in new areas have resulted in only five currently existing populations—Soda Springs, Camp Cady, Morning Star Mine, Lewis Center, and NAWS China Lake. The populations at China Lake have maintained a strong genetic make-up and have the largest number of fish.







LEFT PAGE, TOP ROW: George Channel in 2012, before an excavator removed cattails; 2012 cattail excavation effort; Some cattails were left in the channels to leave the chub with cover and protection from predators. MIDDLE ROW: Some vegetation regrowth has occurred since the 2012 excavation effort; Targeted manual cattail trimming has been successful at managing cattail growth in the North, George, and G1 Channels. BOTTOM ROW: Lark Seep; A biologist trims cattails in the channels. This helps maintain water flow through the channel system.

THIS PAGE, TOP ROW: Surveyors collect elevation, water depth, and topographical information during the 2014 channel hydrologic mapping project.

MIDDLE ROW: An unusually large Mohave tui chub is weighed during population monitoring efforts; Fish length and weight are recorded for every chub captured and subsequently released; Chub are briefly held in containers before and after measurements are taken.

BOTTOM: G1 Channel in 2015, after excavation efforts restored water flow to the channel.

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This type of routine water quality monitoring of the channels in July of 2012 revealed a severe drop in the water level at G1 Channel. The water surface had dropped inches below the culvert that connects the flow within the G1 Channel to the rest of the channel system. The lack of water flow, combined with warm summer temperatures significantly increased the evaporation rate, further lowering the water level and depleting dissolved oxygen levels. This process threatened the survival of a significant number of chub stranded in small pools within the drying channel.

Responding to the situation, personnel from the NAWS China Lake's Environmental Management Division (EMD), the USFWS, and the

California Department of Fish and Wildlife worked together on a plan to save the large number of stranded fish. The EMD staff conducted an intensive emergency effort to trap and relocate chub from the stagnating G1 Channel to the North Channel which still had a high water level. Over the span of three consecutive nights, approximately 1,400 chub were successfully relocated.

The team succeeded in eliminating the immediate threat to the stranded fish, but it was clear that the cause of the emergency also needed to be identified and addressed. While routine manual cattail removal efforts had been successfully managing cattail growth in the known chub habitat areas, areas with steep banks that prevent safe entry for manual cattail removal had become crowded with cattails. Evapotranspiration

occurring in the large masses of cattails seemed to be contributing to the severe reduction in water flow through the channel system. With the help of Naval Facilities Engineering Command (NAVFAC) Southwest staff in San Diego and NAWS China Lake's Public Works Division (PWD), the EMD was able to secure funding and equipment to promptly address the problems immediately posed by the excessive cattail growth. PWD and EMD personnel worked together to excavate the channel areas outside of known chub habitat and remove excess cattail growth. This effort quickly restored water flow for chub living throughout the entire Lark Seep System, and also led to the discovery of additional suitable chub habitat. Since then, the G1 Channel has consistently held water throughout the year. While fundamentally successful, the effort was expensive and time intensive. Maintenance efforts in the inaccessible channel areas would likely only become more difficult over time, so new strategies needed to be developed.

In 2013, in order to minimize potential future costs, NAWS China Lake EMD personnel focused their resources on developing a strong foundation for future work. It again collaborated and partnered with federal and state agencies, and the NAVFAC Southwest Regional Office to address current and future Mohave tui chub management and conservation needs. Two priority goals were defined:

1. Collect hydrology data to support informed management decisions regarding the fish's habitat on the installation.
2. Develop a long-term habitat management and population monitoring strategy.

George Channel, following manual cattail removal. Implementing effective habitat management strategies is necessary to efficiently maintain Mohave tui chub habitat within the channels.



All agreed that subject matter expertise must be integrated into the process to ensure that the best available scientific information would guide the effort.

As plan implementation got underway in 2014, EMD personnel and supporting contractors initiated hydrology studies while continuing to collect water quality data. They deployed automated data loggers to record continuous temperature data, along with dissolved oxygen levels, in three important areas of the channels known to support chub. These data will provide important information on the channel system's dynamics. For example, water quality

dense cattails, mapping channel topography, including the banks, channel bottom, and water depth. They studied surface water flow volume, velocity and direction and recorded culvert locations and dimensions. Water samples from the channels and wells located around the entire Lark Seep System were collected to study water chemistry, including metals and chemical compounds. These data, in combination with previous research on hydrology and chub physiology, will help NAWS China Lake personnel better understand how the water flowing into and through the Lark Seep System could be affecting the fish.

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patterns throughout the year can be compared with environmental factors such as rain events, drought, and other significant weather patterns. Determining how weather affects the chub in those three channels areas throughout the year will help guide management efforts, including how to conduct habitat management and population surveys during optimal conditions to minimize environmental stress on the fish.

As part of the hydrology studies, hydrogeologists and surveyors began mapping the channel system. They first installed long-lasting survey markers (benchmarks) in the Lark Seep System area for the most accurate channel measurements. Next, the team worked in areas with

In December 2014, a team of biologists met in Ridgecrest, California to discuss the history and future of the Mohave tui chub at NAWS China Lake. Biologists from the Installation, NAVFAC Southwest's Desert Integrated Product Team (IPT), the USFWS, and the California Department of Fish and Wildlife met with staff from the supporting contractor, AMEC Foster Wheeler, and subject matter experts from Colorado State University and the private sector. Participants worked together during the workshop to consolidate important information needed to develop science-based strategies for Mohave tui chub management and conservation on the installation. Drawing on the group's wide-ranging expertise, the participants analyzed chub biology, natural history and ecology; population survey methods; invasive species; monitoring and sampling strategies, including genetic techniques; and overall priorities and goals for future efforts.

The meeting results are being used to develop strategies to create a sustainable, science-based, and efficient management and monitoring plan for NAWS China Lake's Mohave chub population. The installation plans to begin implementing these strategies in the fall of 2015. 

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The Basics About China Lake

NAWS CHINA LAKE provides quality shore-based infrastructure, base operating support services, safety and security, range and airfield support to the Navy's Research, Development, Acquisition, Test & Evaluation (RDAT&E) mission, Navy training capability, and other fleet and fleet support activities. Nearly every significant Navy and Marine Corps airborne weapon system in the past five decades was developed and/or tested at China Lake. Included in this mission is the significant environmental stewardship of approximately 1.1 million acres, covering all aspects of natural, cultural, and historic resources.