

Report on a Workshop to Revisit the Mohave Tui Chub Recovery Plan and a Management Action Plan

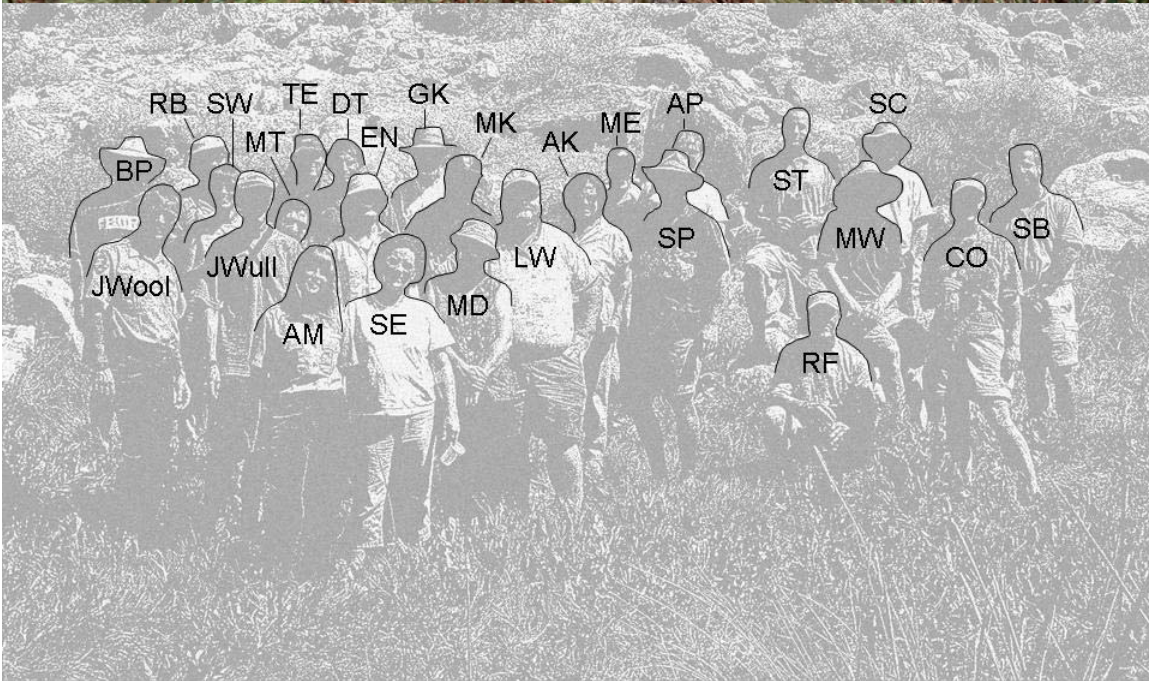


Mohave tui chub (*Siphateles bicolor mohavensis*)

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JULY 15, 2004

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Acknowledgements

This workshop was made possible by support from Larry Norris and the Desert Southwest Cooperative Ecosystem Studies Unit. Substantial contributors to the report include Scott Bonar, Casey Burns, Ray Bransfield, Marie Denn, Rob Fulton, Matthew Huffine, Steve Parmenter, Doug Threloff, Susan Williams, and John Wullschleger. Many thanks to the presenters and workshop participants, who volunteered their time and effort in making this a productive workshop, and to the Desert Studies Center for use of the facilities.

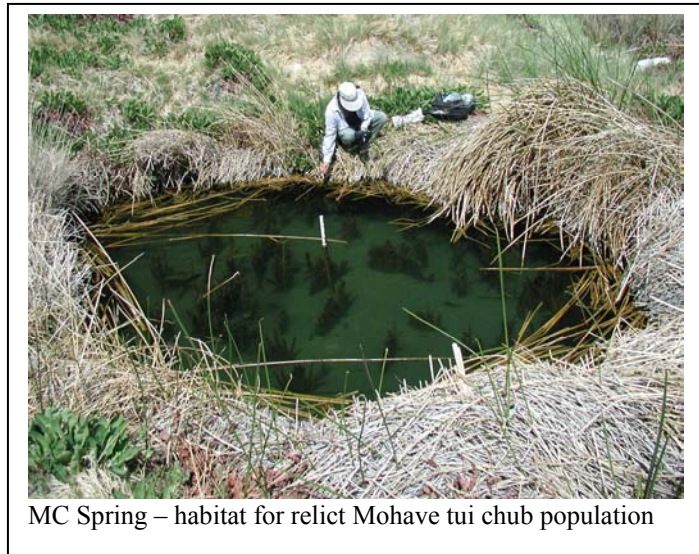
Abstract

Mojave National Preserve is home to the sole remaining source population of the Mohave tui chub (formerly *Gila bicolor mohavensis* now *Siphateles bicolor mohavensis*), an endangered desert minnow (Family Cyprinidae) subspecies with three remaining populations in existence: Zzyzx on Mojave National Preserve, Lark Seep on the China Lake Naval Air Weapons Station, and two artificial ponds at Camp Cady (managed by California Department of Fish and Game and Department of Recreation and Parks) The Mohave tui chub was listed as endangered under the Endangered Species Act in 1970 and under the California Endangered Species Act in 1971. A recovery plan completed in 1984 (United States Fish and Wildlife Service 1984) recommends recovery actions that have yet to be implemented and, indeed, may no longer be feasible.

The National Park Service hosted a two-day workshop in the California State University Consortium Desert Studies Center at Zzyzx to foster cooperation and coordination among the various parties interested in recovery of the Mohave tui chub. Representatives from government agencies, academia, and the original recovery team came together to review the current status of the tui chub, to discuss the potential for down-listing and delisting of the species, and to coordinate recovery management among all interested parties.

Background

The Mohave tui chub is the only fish native to the Mojave River basin in California.[•] Its population declined after sport fishermen introduced the arroyo chub (*Gila orcutti*) in the 1930s as live bait (Hubbs and Miller, 1943). The Recovery Plan explains that the arroyo chub hybridized with the Mohave tui chub, leading to its extirpation within the range of its historical habitat. But viability of the hybrids has not been demonstrated and genetic studies conducted on specimens collected from existing Mohave tui chub populations have identified only pure strains (May et al., 1997). Mohave tui chub also declined after headwater reservoirs altered natural flow regimes and provided more favorable habitat for non-native species. A relic population of genetically pure Mohave tui chub survived isolated in MC Spring (a.k.a. Mohave Chub Spring) that is now part of Mojave National Preserve. This relic population in MC Spring is the source for all existing Mohave tui chub populations. The fragmented character of the Mojave River basin is both the very reason for the continued existence of Mohave tui chub – it isolated the population at MC Spring – and a fundamental impediment to natural recovery of the species.



[•] There are two spellings. *Mojave* is the Spanish form and is used when referring to the Mojave National Preserve. The Native American form, *Mohave*, is used when referring to Mohave tui chub.

The Mojave River originates on the northerly slopes of the San Bernardino Mountains and flows northeasterly into the closed basin of Soda Lake about 100 miles away. The Soda Springs area is on the western shore of Soda Dry Lake at an elevation of 930 feet. MC Spring is a limnocrone (pond type) spring with a surface area of about 250 square feet and a volume on the order of 1000 cubic feet.

Recovery Plan

The Mohave tui Chub Recovery Plan was completed in 1984. It establishes thresholds for down-listing to threatened – establishment of six self-sustaining populations of at least 500 fish each – and delisting – establishment of viable populations in a majority of the species’ historic habitat in the Mojave River drainage. To achieve the latter, extensive rehabilitation of water flows and perhaps removal of arroyo chubs may be required. Three existing populations are mentioned in the Recovery Plan: Soda Springs (now part of Mojave National Preserve), China Lake Naval Weapons Center, and the Desert Research Station Pond at Hinkley. It also mentions an exhibit of Mohave tui chubs at the Bureau of Land Management’s Barstow Way Station, which is now the Desert Discovery Center. Sixty chub were originally planted in this 300-gallon display. Because of its small size, this location was not regarded as secure habitat. The Barstow Way Station population died off in the 1990s after maintenance of the artificial pond ceased. And the Desert Research Station Pond at Hinkley was closed by the Barstow Unified School District.

The Recovery Plan identified Camp Cady Wildlife Area, Afton Canyon Campground, and Mojave Narrows Regional Park as having the best potential for additional introductions of Mohave tui chub. Camp Cady now has a transplanted population in an excavated pond. Afton Canyon Campground and Mojave Narrows Regional Park were chosen for their perennial ponds. Exotic species extant in these habitats include black bullhead (*Ictalurus melas*), green sunfish (*Lepomis cyanellus*), fathead minnows (*Pimephales promelas*), and the arroyo chub (*Gila orcutti*). Research to assess species interactions and perhaps eradication of some exotic species may have to be done before Mohave tui chub could be reintroduced and expected to survive. Other protected species, such as the western pond turtle (*Clemmys marmorata*) in Afton Canyon, could be impacted. The Recovery Plan requires that populations reestablished in the Mojave River must survive at least one major flood before the species can be completely delisted..

The Recovery Plan mentions several failed introductions, such as the Desert Research Station Pond located 10 miles west-northwest of Barstow near Hinkley, California. In December 1978, 16 Mohave tui chubs were introduced to this pond. This population was subsequently augmented several times – twice in 1981 with 50, then 176 fish from Soda Springs, then again in 1986 with 56 from China Lake. This population failed when Barstow Unified School District closed the facility. Other now extirpated populations also existed at:

San Felipe Creek, San Diego County, California
Rio Santo Tomas, Baja California
Paradise Spa, Las Vegas, Nevada
Piute Creek, San Bernardino County, California
South Coast Botanical Garden, Palos Verdes, Los Angeles County, California
Two Hole Spring, San Bernardino County, California
Dos Palmas Spring, Riverside County, California
Lion Country Safari, Laguna Hills, Orange County, California

Busch Garden, Van Nuys, Los Angeles County, California
Lake Norconian, Norco, Riverside County, California

Current Populations

Soda Springs -- MC Spring and Lake Tuendae

In 1944, Curtis Howe Springer established Zzyzx Mineral Springs and Health Resort at Soda Springs. For ten years he built an extensive infrastructure to support his operation. Around 1955, Springer excavated an artificial pond about 125 wide by 500 feet long, calling it Lake Tuendae. It has a surface area of 1.4 acres and maximum depth of 3.3 feet (prior to dredging the westerly end in 2001). Lake Tuendae lies about four feet above the dry surface of Soda Lake and is surrounded by California and Mexican fan palms. A fountain in the middle of the lake, dubbed the “Enrico Caruso Fountain,” runs when groundwater is being pumped into the lake. The Lake has no protection from evaporation. It sustains an annual evaporative loss of about 410,000 cubic feet (9.4 acre-feet), five times its volume. Lake Tuendae is connected to the Soda Lake aquifer by seepage, which has probably prevented a long-term buildup of salinity. It gradually fills in with sediments and cattails that must be dredged about every 10 years. Springer or his associates most likely introduced the Mohave tui chub into Lake Tuendae.

In the fall of 2001 the National Park Service dredged Lake Tuendae, which was becoming filled with silt and cattails. Some fish were killed accidentally when an inflatable dam that was holding water in one half of the lake while the other half was being dredged slipped. Ten dead fish were sent to San Diego State University (tests conducted by Victoria Matey and the late Boris Kuperman,) for necropsy and all were found to be infected with Asian tapeworm (*Bothriocephalus achelognathii*). The Asian tapeworm is a parasite believed to have entered the U.S. in shipments of grass carp and spread to California by live baitfish. It is known to have deleterious effects on fish of the Cyprinid (minnow) family, of which the Mohave tui chub is a member. The Mohave tui chub shares Lake Tuendae with the Saratoga Springs pupfish (*Cyprinodon nevadensis nevadensis*) and the exotic mosquitofish (*Gambusia affinis*), which is native to southeastern U.S. *Gambusia* has traditionally been introduced to control mosquitoes but also may consume eggs and larvae of endemic fish. *Gambusia affinis* was first observed in Lake Tuendae around the time of the dredging and may have been the source of the tapeworm. Spring 2003 saw an anomalous plankton bloom, perhaps related to the dredging, perhaps related to the mosquitofish. Predation on zooplankton by mosquitofish could allow ecological release of phytoplankton in the lake and exacerbate an ecological imbalance. Tests of the water in the fall of 2003 showed alkaline pH (9.5), total dissolved solids of 2130 mg/L, and salinity of 2.2 ‰, all within the range tolerated by the chub. Mojave National Preserve installed a Greenspan CS304 multiparameter sensor in the center of the lake near the fountain for monitoring dissolved oxygen, conductivity, temperature, and pH. This instrument has been recording data hourly since November 6, 2003.

China Lake Naval Air Weapons Station

Mohave tui chub were introduced at China Lake Naval Air Weapons Station in 1971. Beginning with Lark Seep, chub were introduced into a series of channels and seeps that had been constructed to drain wastewater away from residential developments. Chub have been surveyed in Lark Seep, G1 Channel, G1 Seep, George Channel, and North Channel.

The Lark Seep habitat started out as a sewage problem. The city of Ridgecrest had grown up to serve China Lake Naval Air Weapons Station (NAWS), a 1.1 million acre military reserve managed by the Department of Defense (DOD) for the purpose of testing Navy air weapons and training troops. Disposal of wastewater led to the mounding of a shallow groundwater table. In 1945 the City of Ridgecrest built a wastewater treatment facility and the treated wastewater discharge became Lark Seep. As the area of surface water increased, channels were excavated to drain water away from the facilities (G1 Channel, G1 Seep, George Channel, and North Channel) and habitat for the tui chub increased. From MC Spring, 425 Mohave tui chub were introduced into Lark Seep in 1971, and demonstrated a remarkable ability to migrate between seeps. Cattails are removed annually and DOD has widened a channel in an attempt to maintain open water. Populations have been surveyed since 1979, with large confidence intervals due to low recapture rates, and the mosquitofish is widely abundant. Water quality is monitored with a Greenspan multiparameter sensor and population surveys are conducted periodically. Refer to the presentation in Appendix B, given by Susan Williams, for additional information.

Camp Cady

Camp Cady is a designated State Wildlife Area in the Mojave River drainage northeast of Barstow, California. Around 1986, the California Department of Fish and Game excavated two ponds to a maximum depth of 2.75 meters, lined them with clay, and stocked them with Mohave tui chub. The east pond suffered water loss problems and was eventually drained and lined with plastic in 1991. Each pond supported approximately 500 Mohave tui chub. In 2003 the Camp Cady caretaker suffered health problems and the east pond went dry in his absence. There is now only one pond for Mohave tui chub habitat at Camp Cady and its water level is maintained by California Department of Fish and Game volunteers. The loss of one of the ponds at Camp Cady should be an object lesson in the fragility of artificial impoundments and emphasizes the importance of establishing additional refuges.

Synopsis of the workshop

For two days in September 2003, land managers, regulators, scientists, and other interested parties met at the Desert Studies Center at Soda Springs in Mojave National Preserve. The workshop alternated between presentations, questions and answers, and open discussions in sweltering, humid heat. Discussion focused on the background and current status of the Mohave tui chub, the goals, objectives, limitations and potential of the recovery plan, and what could be accomplished towards recovery of the species. The meeting Agenda (Appendix A) included discussions of

- Species biology
- Recovery Plan
- Habitat management at Lake Tuendae
- Water quality monitoring at Lake Tuendae and MC Spring
- Aeration and water quality maintenance options for Lake Tuendae
- China Lake Naval Air Weapons Station Mohave tui chub management
- Asian Tapeworm in Small Southwestern Native Fishes
- Lewis Center for Educational Research – proposal for an artificial pond

- Status of recovery – US Fish and Wildlife Service
- Mojave River drainage hydrology
- Afton Canyon – Bureau of Land Management

Notes from the discussion (thanks to Danette Woo, Barbara Schneider, Cay Ogden, and others) are included in this report as Appendix B.

The group agreed that the goal should be to down list the Mohave tui chub from endangered to threatened status since it may not be feasible at the current time to implement actions that would allow the taxon to be delisted. An emphasis needs to be placed on education and public awareness. Guidance or protocols are needed both for immediate management actions and for long-term habitat management to achieve down listing in 10 to 15 years. Interagency coordination and cooperation must be stressed in these efforts.

The group laid out a strategy to down list the Mohave tui chub, plus a series of goals and management actions toward this end. It was generally agreed that more information must be gathered before management actions can be taken. A survey of Mohave tui chub in Lake Tuendae needs to be conducted before the impacts of mosquitofish, the Asian tapeworm, and the phytoplankton bloom can be determined. Research needs were also identified for determining arroyo chub distribution in the Mojave River drainage, assessing the viability of hybrids, and evaluating headwaters in the San Bernardino Mountains for potential reintroductions.

Assignments were distributed among the participants concerning: foundation concepts, geographic scope, science, education, recovery plan principles, population viability, refugia requirements, risk assessment and threats, and funding opportunities. Appendix C gives a summary of assignments and responsibilities. Appendix D is a reproduction of flip chart notes summarizing the workshop.

Summary of main conclusions

- Headwaters of the Mojave River may offer best opportunities for MTC¹ reintroduction.
- Studies are needed to determine the viability of hybrids that may arise between Mohave tui chub and arroyo chub.
- The Recovery Plan needs updating but is not a priority for FWS². Another agency/group could develop a draft revision and submit it to FWS for completion and approval.
- Delisting the taxon is not likely feasible at the present time but down-listing the fish from threatened to endangered status may be obtainable.
- Paradigm Shift: The existing recovery plan described recovery in terms of a few secure (i.e. permanent) populations. But newer thinking holds that more, less secure, more risky populations are acceptable though the existing ‘secure’ populations should not be considered expendable.³
- Public education and outreach is an essential component of the species recovery.

¹ Mohave tui chub (MTC)

² U.S. Fish and Wildlife Service (FWS)

³ The original distribution of the fish was probably dynamic, and isolated occurrences of the fish probably appeared and disappeared depending on flood events and habitat availability. It may be advantageous to develop a recovery strategy that mimics, and accepts this pattern of fish occurrences coming and going

Mohave Tui Chub Recovery Strategy

Philosophy

Mohave tui chub existed in interconnected lakes and rivers during the Pleistocene. Fossils of this fish, dated at 19,500 plus or minus 500 years, have been found in sediments of the former Lake Manix (Uyeno and Miller, 1963). Mohave tui chub became isolated in the Mojave River drainage during the Holocene as the climate became more arid and water bodies disappeared. It is the only fish species native to the Mojave River drainage and is adapted to the river's alkaline water quality. Historically the fish lived in deep pools in the intermittently flowing and occasionally flooding river.

Between the 1930s and 1960s, a variety of factors caused a substantial decline in the abundance and distribution of the Mohave tui chub. These factors include the hybridization of Mohave tui chub with arroyo chubs that were introduced into the Mojave River in the 1930s; over drafting of groundwater in the river basin which reduced the extent of aquatic habitat the fish historically occupied; changes in the hydrology of the river which occurred as a result of the construction of dams in the upper portions of the river drainage; and the introduction of non-native fish that prey on Mohave tui chub, e.g., largemouth bass. These factors, combined with rapid urbanization in a water-scarce desert region, prompted the U.S. Fish and Wildlife Service to list the Mohave tui chub as a federally endangered species in 1970.

The Endangered Species Act of 1973, as amended (Act), requires that federal agencies carry out programs that are designed to, and have the affect of, conserving threatened and endangered species. The Act defines conservation as the "...methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary", i.e., a species has been recovered and no longer needs special protection.

The optimal method for achieving the recovery and ultimate delisting of the Mohave tui chub is to establish viable, persistent populations of the fish in the majority of the species' historic range, i.e., in the Mojave River. In order to achieve this goal, it will be necessary to moderate or eliminate the factors that prompted the listing of the fish. Down listing of the Mohave tui chub from endangered to threatened status can be accomplished by establishing additional, self-sustaining populations of the fish that are protected from threats to their habitats. According to the recovery plan that was written to provide conservation strategies for the species (USFWS 1984), six geographically separated populations maintained for 10 years qualifies the species for down-listing from endangered to threatened status. The focus of this report is on maintenance of existing populations and establishment of new populations in selected habitats. This strategy for down-listing (and ultimately recovery) of the Mohave tui chub includes components of biology, ecology of pond habitats, species interactions, and outreach to build public support for the Mohave tui chub.

The following list of principles will be used to promote the recovery of the Mohave tui chub:

- Recovery actions will not adversely affect native species that are present in created or historical habitats.
- Meta-population perspective (establishment of both temporary and permanent populations).
- Down-listing of the Mohave tui chub will be achieved through partnerships that establish new refugia.

- New information will be acquired to assess the feasibility of reestablishing viable populations of the Mohave tui chub in the Mojave River

Strategy

The recovery strategy for the Mohave tui chub will include the following key elements:

- Maintenance of existing populations (Soda Springs, China Lake, and Camp Cady).
- Research to understand Mohave tui chub ecology and habitat requirements.
- Identification and reduction of threats to extant and future populations.
- Establishment of new populations with preference for habitats in the Mojave River drainage.
- Public outreach and education to support recovery efforts.

The recovery of the Mohave tui chub will require the participation of, and partnerships between, the following entities:

- State and federal agencies which include the National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, U.S. Forest Service, Department of Defense, and California Department of Fish and Game. This workshop report could form the basis for an Interagency Agreement.
- University and non-governmental organizations including, but not limited to, the Desert Studies Center, California State University Consortium, University of California, University of Arizona, the Lewis Center, Desert Fishes Council, and The Nature Conservancy.

Maintenance of existing populations

Providing adequate protection for both existing and new populations will require regular monitoring of the following:

- Population census, structure, and demography.
- Water quantity and quality (e.g. temperature, pH, conductivity, dissolved oxygen, turbidity) including possible stratification and hypoxia.

Research to understand Mohave tui chub ecology and habitat requirements

At the present time, the habitat parameters that govern the persistence of Mohave tui chub populations are not well understood, and additional studies are needed to identify the environmental factors that determine if reintroduction efforts are likely to be successful. Establishing new populations will require identifying sites with the conditions that meet Mohave tui chub life-history requirements and which demonstrate some degree of intra- and inter-annual stability (e.g. ponds which are ephemeral or lack adequate water supplies are clearly undesirable sites for reintroductions). In many cases, establishing new populations will require the support of land management agencies or agreements with private landowners. Most if not all sites will require regular habitat maintenance.

Questions regarding the interaction of Mohave tui chub with the arroyo chub are of particular importance with regard to reintroducing the Mohave tui chub to waters within its native range. A key question is the viability of hybrids. Although arroyo chub were identified as a significant factor that adversely affects the status of Mohave tui chub (USFWS, 1984), questions remain about whether this was caused by interbreeding or because the superior swimming ability of the arroyo chub confers a competitive advantage during floods. If hybrids are in fact not viable then

the presence of arroyo chub may not eliminate a particular habitat from consideration for Mohave tui chub reintroduction. A related question is the compatibility of Mohave tui chub with other species. Surveys of arroyo chub and other non-native fish species in the Mojave River drainage may be necessary based on the findings of this research.

Because the success of recovery efforts will depend on a better understanding of Mohave tui chub life history and ecology, a comprehensive bibliography that summarizes the existing literature pertaining to the listed fish should be compiled, and include documents that describe efforts in the 1970s and 1980s that attempted to establish new populations. Acquisition of the bibliography will help to synthesize the existing information pertaining to the fish, and identify major data gaps that need to be addressed to develop more successful management strategies for current and future populations of fish.

Studies of the ecology of existing habitats such as Lake Tuendae will facilitate better descriptions of life-history requirements of the Mohave tui chub and should contribute to the understanding of species interactions. These studies are needed not only to assess and maintain the health of existing populations but also to assist in identifying and designing habitats for new populations.

For long-term species recovery it will be important to address the questions of:

- How many refugia are necessary?
- How many fish are needed per refugium?
- What are the demographic characteristics of a viable population?
- Should land managers be concerned about the genetic characteristics associated with each fish population, and do these populations require special management to ensure that the limited genetic diversity within the taxon is preserved?

Identification and reduction of threats to extant and future populations

Maintenance of existing populations and establishment of new populations requires a thorough understanding of threats to existing populations and requirements of the species. Research on threats to existing populations is necessary to avoid those threats in establishing new populations. Some threats such as the draining or drying of ponds have adverse affects that are readily observed. However, there are other potential threats with effects that are unknown or poorly understood. In such cases research may be needed to understand the nature and magnitude of the threats and to determine how they may be reduced or eliminated. An understanding of the threats associated with the following will require additional research on:

- Effects of the Asian tapeworm.
- Ecology, limnology, and bioenergetics of small lakes and ponds.
- Effects of interactions with other species such as mosquitofish, arroyo chub and nonnative sport fishes.

Establishment of new populations with preference for habitats in the Mojave River drainage

Information from research discussed above and experience with past attempts to establish Mohave tui chub populations will guide the evaluation and selection of sites for future introductions. Habitat assessments, based on minimum habitat parameters and knowledge of species interactions need to be done for the following:

- Deep Creek at the headwaters of the Mojave River
- Afton Canyon

- Harper Dry Lake
- Mojave Narrows
- Oxbow Lake – Lewis Center

In addition, some consideration should be given to establishing additional refugia sites at the following locations:

- Spring Valley Lake
- Soda Valley Lakes
- Silver Lakes
- Calico Lakes
- Bryman Townsite/Palisades Ranch

The first list consists of public lands and the second is privately held.

Public outreach and education to support recovery efforts

Public outreach is an essential component of this strategy in order to build a political constituency for recovery. It's unlikely that many residents in the Mojave River basin know that the Mohave tui chub is the only fish native to the area or are aware of its remarkable story of survival and precarious predicament. Venues to inform the public and build awareness include:

- Environmental education and interpretation partnerships.
- Aquarium or pond at the Desert Discovery Center.
- Educational materials made available for instructors.
- Websites.

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Appendix A, meeting agenda

This is the planning agenda that was given to participants at the beginning of the workshop. The actual schedule changed after cancellations and additions and is documented in Appendix B.

Mohave tui chub workshop agenda

DESERT STUDIES CENTER

ZZYZX, CALIFORNIA

SEPT. 2-4, 2003

Tuesday, Sept. 2, 2003

Mid-late afternoon arrival. Self-guided walking tour around Zzyzx. Copies of papers and other material for perusal. Dinner served. Get-acquainted social hour.

Wednesday, Sept. 3

7:00 AM	Breakfast	
8:00 AM	Welcome, introduction, and purpose of workshop	Debra Hughson
8:15 AM	Biology of the species (evolution, genetics, ecophysiology)	Steve Parmenter
9:00 AM	Background/history of chub and recovery plan	Gail Kobetich, Phil Pister
9:30 AM	BLM history, NPS 2001 dredging operation	Kelly Hawk
10:00 AM	Break, walk around the pond	
10:30 AM	Present conditions at Zzyzx (gambusia, phytoplankton, tapeworm), annual census, need for population mixing	Steve Parmenter
11:00 AM	Water quality monitoring: past, ongoing, and future. CSU studies on Soda Springs hydrology.	Rob Fulton
11:30 AM	Aeration and water quality maintenance options	Annie Kearns
12:00 PM	Lunch	
1:00 PM	Present conditions at China Lake and Camp Cady.	Susan Williams, Steve Parmenter
1:30 PM	Asian tapeworm, threat and potential mitigation	Scott Bonar
2:00 PM	USFWS vision for species recovery	Doug Threloff, Ray Bransfield
3:00 PM	Break	
3:30 AM	1988 Recovery Plan Revision. Can we get to down-listing? Where can 3 new refugia be established? Should NPS/BLM create new artificial habitat? Should we try to reintroduce into West Pond? What features of refugia are critical?	Doug Threloff, Ray Bransfield
5:00 PM	Break	
6:00 PM	Dinner	
7:00 PM	Social hour, informal discussion, literature perusal	

Thursday, Sept. 4

7:00 AM	Breakfast	
8:00 AM	Mojave River/Narrows – Afton Canyon hydrology	Greg Lines, Chris Stamos
9:00 AM	BLM perspective (tamarisk, western pond turtle, arroyo chub)	Casey Burns
10:00 AM	Break	
10:30 AM	Top priorities for funding and partnerships. Research needs. Development of project statements.	
12:00 PM	Lunch	
1:15 PM	Cooperative agreement and comprehensive management plan between CDSC, NPS, CDFG, USFWS, and BLM	
2:40 PM	Break	
3:00 PM	Cooperative agreement and comprehensive management plan between CDSC, NPS, CDFG, USFWS, and BLM	
4:30 PM	Adjourn	
6:00 PM	Dinner and overnight accommodations for all attendees planning to travel on Friday, Sept. 5	

Appendix B, meeting notes

September 3-4, 2003, Mohave Tui Chub Workshop
Mojave National Preserve, Desert Studies Center (Zzyzx)

This summary of the meeting is primarily the work of one person trying to capture a group discussion by typing on a laptop. Attributable statements are identified by the speaker's initials. Un-attributable questions are identified as [?] and statements or comments as →. These are not direct quotes but are paraphrased. A single statement may summarize a lengthy discussion between several individuals.

September 3, 2003

WORKSHOP GOALS

1. Develop guidelines for immediate management.
2. Develop guidelines for long-term management and down-listing.
3. Provide foundation for interagency management plan.
4. 10-15 year goal → down-list the species.

8:00 AM Steve Parmenter – Species Biology

Genus *Siphateles* - some controversy, it has been *Gila* for a long time, but is now *Siphateles* again. Mohave tui chub is *Siphateles bicolor mohavensis*.

There are 22 tui chub subspecies in the Great Basin that date back to the Pleistocene. Waterways in Nevada were connected in wetter times but are isolated. Presently many basins host distinct subspecies.

The Lahontan basin of Nevada, Oregon and CA is the center for dispersal of tui chubs. Over 1.3 million years ago water Mono Lake was fresh and flowed north into the Lahontan Basin. Subsequent volcanic and tectonic events reversed the drainage, so it flowed south into Adobe, and thence to Owens basin (i.e., "North Fork of the Owens River). Owens spilled into Indian Wells Valley, Panamint Valley, and into Lake Manly (Death Valley). Amargosa and Mojave Rivers were also tributary to Lake Manly. Presumably the ancestral Mohave tui chub accessed the Mojave River via this route. This also suggests the tui chub were in China Lake and Death Valley at one point.

In 1930s, arroyo chub (AC) were brought into Mojave River via headwater reservoirs, presumably as live fish bait. AC is genus *Gila*, more closely related to Colorado chubs than tui chubs. There was mass hybridization between arroyo and Mohave tui chub in the early 1900's. Hubbs and Miller (1943) studied hybridization based on anatomy [scale radii of MTC ≤ 10 , AC ≥ 16].

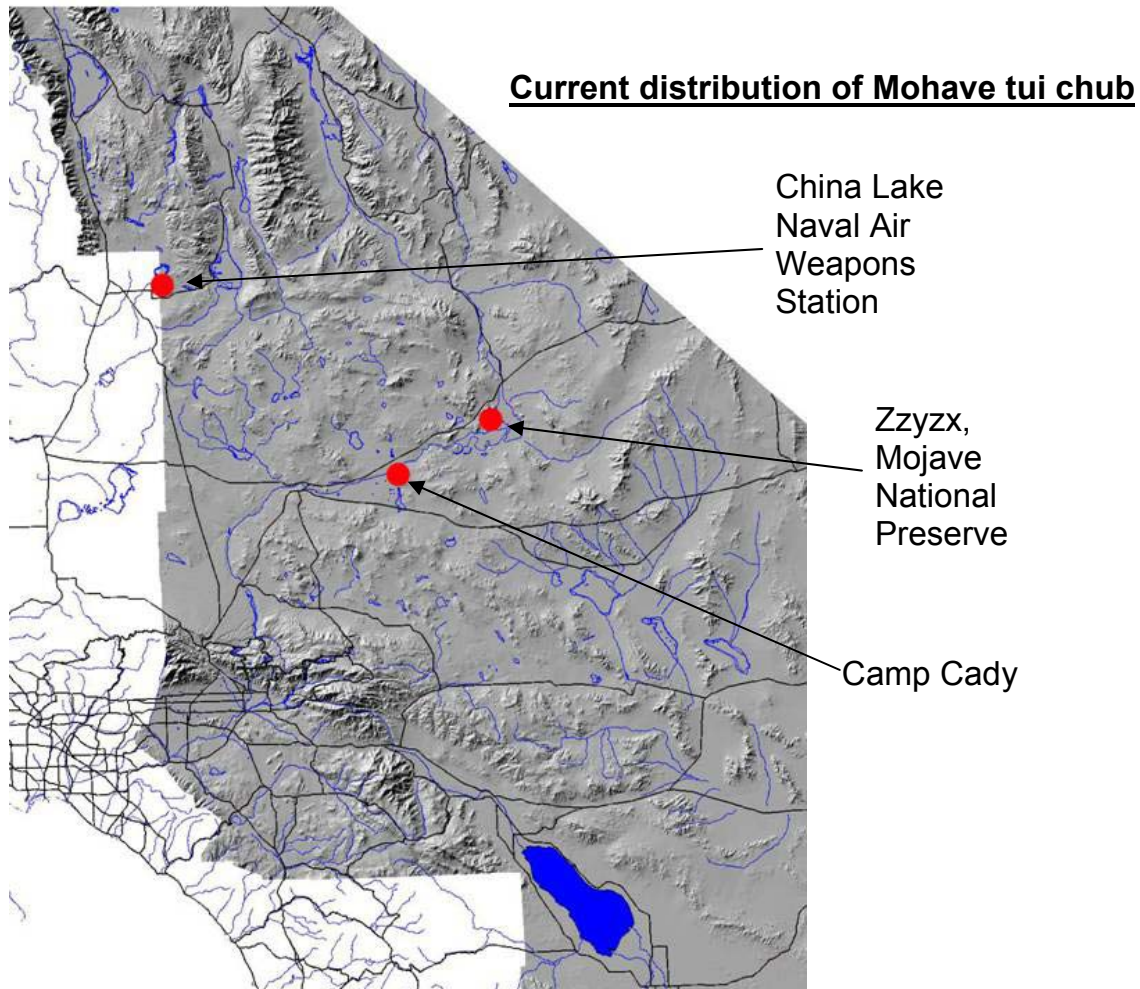
The "Great Flood of 1938" was a huge flood of the Mojave River System.

- Extremely rapid displacement of MTC by AC (i.e., from 100% MTC to 10% MTC at some sites)

- Mohave tui chub (MTC) may have been less able than AC to recover from the flood event.
- Only 7% hybrids at that time. Showed that competitive mechanism, not hybridization, drove population replacement.

Are hybrids viable? Probably not, but there is no evidence to the contrary. Important point to understand for planning of future recovery efforts.

1980s Castleberry & Cech (1986) looked at environmental preference of MTC and AC. MTC like cooler water, are less tolerant of low dissolved oxygen, and are weaker swimmers. Laboratory swimming trials showed AC have better swimming ability: MTC were pinned first 12 out of 15 times. MTC's characteristics describe an animal well suited to life in a cool pluvial lake. In contrast, the evolutionary history of AC occurred in warm streams of the LA basin, a habitat similar to the Mojave River of today. Castleberry and Cech's observations may explain why MTC appear to be at a competitive disadvantage to AC in the Mojave River today.



Historic distribution included lower Deep Creek and Mojave River. All extant populations came from MC Spring, where they are presumed native and made their "last stand." MC Spring chubs were established in Lake

Tuendae, from which 11 subsequent transplants were attempted. Of these transfers, only two are successful at the present: Camp Cady and China Lake.

MTC appear to be doing well At Zzyzx, China Lake, and Camp Cady, but three refuges do not make for a stable species.

Good Recovery Site Characteristics:

- Wet, isolated
- Cool water
- Lakes or pools (low velocity)

Isolation may not be paramount. MTC may be able to coexist with AC under the right conditions. There are no hatchery fish available. Back-cross studies are needed to determine hybrid viability.

Cooler headwaters of the Mojave River including reservoirs may offer the best opportunities for MTC reintroduction and recovery strategy.

Discussion

[?] Need to identify research needs

- Hybrid viability
- Why transplants failed - revisit sites, does potential still exist?
- What characteristics of refuges are vital, what can be relaxed?

[?] Why did introductions (St.Amant) fail?

- Flooding in Piute Canyon (east Mojave)
- Artificial water supplies - valves turned off (Barstow Station)
- Botanical Gardens in Los Angeles - MTC replaced by another fish.
- Failures probably not due to competition.
- Literature does not include information about failures.
- Eco-physiology may be a limiting factor.

[?] When were the reintroductions done?

- 1970s. Sites were chosen by St.Amant for introduction and monitoring. When most sites failed they were not reconsidered.
- No follow-up coordination between agencies to make things happen.

[?] What are the necessary attributes for successful refuges?

- Actual requirements are very broad, fish have broad ecological tolerances.
- There are attributes we can play off of to consider new sites, by finding habitats where MTC's natural preferences are met.

[?] Doesn't recovery plan aim to eliminate AC completely?

- The traditional view is that this is not possible. As soon as you kill them off, someone else will introduce more (for bait).
- However, Conditions in Lake Silverwood have changed. State water project inadvertently introduced predatory fishes; AC believed gone. Opens the possibility of stepwise removal of AC from upstream to downstream.

[?] Are we trying to keep MTC isolated as a pure genetic strain?

- Isolation may not be paramount, if hybrids are infertile.

→ MTC may well out-compete AC in higher elevation coldwater habitats.

☐ Where can new refuges be sited?

→ Headwater reaches of Deep Creek and tributaries, potentially lakes and reservoirs like Green Valley Lake.

→ Artificial ponds in present day Mojave watershed.

→ Artificial water bodies in Pleistocene Mojave watershed area.

SP: Be careful of dogma and don't hang hat on one strategy. If we had concentrated on "coldwater habitats" we would not have tried transplantation at China Lake.

8:45 AM Gail Kobetich – Recovery Plan

Gail Kobetich, retired from US Fish & Wildlife Service, worked on original recovery plan, was on MTC recovery team.

Congress redid the Endangered Species Act (ESA) in 1973. All the listed species under the 1968 ESA had to develop reasons why these species could be viably recovered.

1976 - Sacramento endangered species office at that time ran the endangered species program for all of CA and NV. GK hired a fisheries biologist - Jack Williams. Jack wrote recovery plans for most of the listed fish species. He worked closely with Jim St. Amant on the MTC recovery plan. Sites where they tried to transplant MTC but the transplants did not work were not included in the original recovery plan.

This was in the early days of the ESA and putting recovery plans together. The MTC team received a lot of advice from the Desert Fishes Council (DFC). DFC said not to introduce a species outside its historic range. What is the definition of native range (e.g., Pleistocene)? Might fossil records count as opposed to written history?

GK has not been involved in MTC recovery efforts for the past 15 years.

Lake Tuendae and MC Spring do not look much different today than they did back in the 1970s.

Discussion

The recovery plan was written in 1984 and revision drafted in 1989. Then when the desert tortoise was listed, all work on the chub was dropped. The revision is still in draft form - it never was finalized.

☐ Is the purpose of this meeting to come up with revisions to the original recovery strategy?

→ Yes.

SP: DFC philosophy is to not transplant fishes outside their native range. Was there a FWS vision to define "native range?"

GK: Not that I am aware of. I don't remember anything or any time when anyone tried to define native range.

RB: We might take notes from how FWS has tried to recover the California condor. We started just in California but are now introducing them in AZ.

SP: I asked this question because I've seen recovery efforts for a species in the Owens Valley expand beyond its "native range" and I would reintroduce endangered fishes into the expanded range in a heartbeat.

GK: It is bad to have a dogmatic view of "native range."

SP: You could have range defined during wet times, and redefined during dry times.

☐ What does the Mojave River look like now? Like the Gila River? Perennial?

→ It's dammed; it's dry below Lower Forks Dam, confluence of the Mojave River. It's dry down to the fish hatchery and Upper Narrows of the Rivers. It peters out again at the Lower Narrows, slightly upstream from the National Trails Hwy Bridge (Rte. 66). This is usually a perennial stretch that involved in a lot of rehab work. Water peters out right before the sewage ponds. Entire rest of river with any water begins at sewage range down to Palisades Ranch, upstream from the Helendale community. In between on the Barstow/Hodge stretch it's dry with salt cedar. Dry to Camp Cady. There's a remnant stand of mesquite that's dying out. It's roughly dry from Camp Cady to Afton Canyon, where it picks up a mile upstream from the Mojave Bridge at Afton. Mojave River sink is dry, but with occasional water.

☐ So the fish community is arroyo chub in there now? What other species?

→ Any kind of sport fishing species. A lot of introduced bass, carp, catfish.

→ Fish hatchery is run by CDFG. Rainbow trout, with pumped groundwater.

→ Lewis Center owns part of the Upper Narrows that has potential for reintroduction.

☐ If the AC likes warmer water, and the MTC like cooler water, is the point to make conditions so prime for MTC so that no other species can live there?

→ That would be ideal.

9:10 AM Tom Egan/Steve Parmenter – Dredging at Lake Tuendae

TE: Don't know all the details. Can talk about the 1991 operation. Did the east end of Lake Tuendae. Did a variety of things. Had to

build a road in the middle of Lake Tuendae to bring the backhoe in. Didn't do the whole pond then. Kelly [Hawk, formerly MOJA NPS biologist] put together the plan for the 2001 dredging to cut back the cattails, reduce sedimentation.

RF: On the second project - we'll never know the final number of mortalities. A lot of fish were caught up in vegetation that dried up.

MK: Rapid buildup of sediment?

RF: Yes.

RF: The old leach field never had positive or negative influence on West Pond. Before 1991, it was a shallow pond that went eutrophic every fall. After dredging it still suffered from the same problems. Still hyper-salinic, hyper-alkalanic, no freshwater infusion.

RF: Out by MC Spring there is a pond-excavated with a backhoe, to see if the fish would move from MC Springs to the new hole. But in between are solid lakebed sediments, so it didn't work. We started to backfill this BLM hole, but an aquatic ecologist asked to keep the hole for teaching purposes.

RF: The characteristics at MC Spring are what we should be looking for.

RF: There have been several discussions about rehabilitating West Pond/Three Bats Pond, but we would have to address the water chemistry issue, create some kind of freshwater infusion system. If you look at the revised language in the recovery plan, recovering the West Pond does not count towards recovering the species. We have to have six stable populations over time. West Pond would just be an extension of the Zzyzx population.

☐ Any discussion about creating new habitats other than here?

→ No. A lot of potential sites are private lakes.

→ Kelly put an inflatable dam across the lake, filled it with water, pumped all the water from the west side over to the dry playa. Then all the fish were moved to the side with water. Removed sedimentation and cattails with a backhoe. One of the two coffer dams blew out. Partially drained. Much of the shallows bordering the lake went dry. Aquatic vegetation caught a lot of fish of all three species underneath and they expired. A lot of the water went turbid. Usually there is a lot of turbidity in the summer months, then it goes clear. But during 2003 winter, it did not clear. Then we started seeing continuation of this turbid condition. Climate was mild into spring, water temperatures were probably a little warmer, but we've seen this in years past. SP had an idea that during the dredging we kicked up a nutrient growth from the bottom that spurred on this phytoplankton bloom.

SP: This is a constructed pond. We aren't sure what was there before. It was originally an aesthetic landscaping feature.

RF: They dug through overburden into old playa sediments to create the original pond.

TE: 1991 allowed water but not sediment to pass from side to side.

SP: Kelly called me up about doing something with the overgrowth of cattails. I have a problem with burning fossil fuels to control for an endangered fish. I have several ideas about the algal bloom. All that plant material that was removed is not controlling nutrient load and algal growth. At the same time of the dredging, western mosquitofish appeared at Lake Tuendae. In addition to MC Spring and Lake Tuendae, Springer introduced Saratoga Springs pupfish into LT. I dove in, saw two male pupfish, no female pupfish, loads of Gambusia...

RF: I have not seen a MTC since the dredging. They are there but are staying deep into the water.

SP: Gambusia could have done some trophic restructuring that has led to this algal bloom problem. The Ruppia grass dying and regrowing, organic material buildup. Lake bottom looks mostly like playa sedimentation to me.

MK: Is one of the needs to develop guidelines, with schedule, for habitat maintenance? Also, should we follow-up with the proposed genetics study about what's going on in the pond?

DT: This lake system is far more complicated than Devils Hole [in Death Valley National Park, home to the Devils Hole pupfish, a federally endangered species], in other ways more simple. There may be a few reasons, probably basic, for that. The NPS should have a more thorough understanding of the basic ecology of the lake so management activities can be tailored to this particular system.

SB: There's a need for a fish survey. Is there any regular monitoring of the lake?

SP: There is some groundwater flowing into Lake Tuendae but it receives groundwater pumped from a well.

RF: If I cease pumping, there would still be 1-3 feet, since the lake is tied into the Playa. But the DSC [Desert Studies Center] pumps water regularly.

RF: We don't know exactly, but Lake Tuendae was probably first created in the early 1950s. As far as sewage, effluent discharges well west of the lake, and percolates into alluvium. Since the lake is maintained at a higher level than groundwater, we are creating a negative gradient with respect to the any sewage plume. Vegetation includes cattails, sedges, bulrush, and ruppia.

BP: The cattails are a continuing problem. They will continue to grow.

RF: The bulrush and sedges are not the problem of encroachment, only the cattails pose a problem over time.

SP: The LA County Museum of Natural History is working on identifying the Gambusia and their origin, to see if we can trace their introduction. Rob has been clearing the cattails at MC Spring. MC Spring is a natural spring but has been excavated into a cylindrical form. Cattails tend to lead to intro of mosquitofish, crayfish, and bullfrogs.

RF: Bullfrogs were taken out of Lake Tuendae in the late 1970s.

SP: At MC Spring, there was a profusion of cattail growth. If you take those cattails out, you'll be taking fish eggs out, that's take, per FWS. So I worked out with the FWS person that we will just cut the cattails off a few inches below the surface to manage the spring. I get almost complete mortality, at least as effective as pulling them out by the roots and cleaner. I've applied this technique to several springs for several species. Have completely restored certain habitats this way. It would be easy enough to launch this technique on Lake Tuendae. It's less effective on bulrush but does work on all bulrush species. It would be a maintenance thing with low impact.

RF: At what point do we want to maintain the cattail habitat? It is used by some migratory bird species, provides cover, etc.

11:20 AM Rob Fulton – Water Quality Monitoring

Pluvial lakes of the Pleistocene - from north of Bishop through to the Mexican border.

Mojave River currently terminates at Soda Dry Lake. The paleohydrology reveals that the drainage during Pleistocene times had various terminal basins spanning out from the Victorville Fan. Late in the last Ice Age, Lake Mannix was the terminal basin for the Mojave River. After the down cutting of Afton Canyon, Soda Lake basin, a transverse extensional basin, became the terminus. The water was then impounded at Pleistocene Lake Mojave. Now we have the two dry playas north and south of Baker (Silver and Soda Lakes respectively).

There are some ephemeral pools and salt marsh habitat that occur along the western shore of Soda Lake that are the result of groundwater seepage. The pools attract resident and migratory wildlife, and support breeding populations of Pacific tree frogs. The pools dry up by June as the evaporation rate exceeds the seepage rate, and reappear in late November as the rates reverse.

MC Spring is the only "real" spring left. During Holocene time, El Nino type winters were a probably the norm.

Locations of monitoring wells and interpolated groundwater contours April, 1995 (Dirling, 1997)

The low point in the Basin is north of Baker at Silver Lake Playa. In the big flood of 1993 there was 2' of water in the north end of that playa.

During the winter of 1990 Lake Tuendae completely froze over for 2 days.

Groundwater monitoring wells were put in by a CSUF [California State University Fullerton] professor and his students. During drawdown studies they pump about 130 gal/min at the Production Well (PW) next to West Pond.

Lake Tuendae is always higher than the groundwater level of the Playa.

There was bimonthly water sampling at Lake Tuendae and MC Spring for a year from Oct 1988-Oct 1989.

For the period of June-August 2003 weekly dissolved oxygen and water temperature in Lake Tuendae (taken around sunrise +/- 1.5 hours.) shows DO from 6.9 to 9.9 and temperatures from 24.4 to 27.9 C. Sampling was done at 6 stations in total and down to about ½ meter at each station for sampling.

Difference between stations: Varies less than 2 ppm from lowest to highest ends. DO consistently rose from west to east ends. Stations were always sampled in the same order.

11:40 AM Annie Kearns - Aeration and Water Quality Maintenance

Rob [Fulton] contacted NPS last late spring about the murkiness, potential algal bloom, etc. Annie [Kearns] and Rob calibrated their instruments together. There was a concern about potential phytoplankton die-off, eutrophication, and consequent loss of MTC.

Possible causes of the West Pond die off included ammonia toxicity (5-6 times greater than Lake Tuendae) and high conductivity. Conductivity was about 17,000 (much higher than Lake Tuendae and close to seawater).

We have \$4K in FY03 to spend on preventive measures to prevent a die-off in Lake Tuendae. One theory: Gambusia is grazing on zooplankton, which leaves phytoplankton out of control (zooplankton no longer eating the phytoplankton). As the summer moves into fall, all the photosynthesis will slow down, the phytoplankton will start to die off. The normal processes that break down the dead phytoplankton will not be able to keep up with current levels. The whole stratification condition will be set up to deplete the bottom of the lake completely of oxygen. The anaerobic bacteria will take over from the aerobic bacteria, and lack of DO could eventually kill the fish.

Options: To increase the DO levels, an interim solution might be to install surface fountains, bottom bubblers and recirculation pumps. The pumps have the best chance of breaking up the stratification that is suffocating the pond. It is considered the most efficient way to increase DO in the waterway. It provides complete turnover of the water from bottom to top to bottom. You could also do this with a bubbler if operated continuously. Recirculation breaks up the thermal stratification where the cold water on the bottom is mixed with the water at the surface.

The systems could be wind-powered or electric powered pumps. A drawback would be that the divider of the N-S ridge across Lake Tuendae would prevent aeration of both sides of the ponds. The divider would cut off circulation, so we would need 2 wind-generated units to cover the whole pond.

- Propeller pushes water from bottom to surface.
- Bubbler system recirculates water.
- Lake would need two pumps to cover each side, \$8K.
- Electric-generated system would cost \$3K for the whole pond.

Another recirculation system that is electrically generated could do the whole job with one unit to accomplish aeration on both sides of the pond for \$3K.

☐ Can you count on enough wind to operate a wind-generated system?

AK: Yes. It will work in 4-5 mph winds.

SP: What is the evidence that LT stratifies? This is counterintuitive to me, but...

RF: No evidence of stratification.

AK: In the literature, 4 feet is about the depth when stratification would occur.

MW: Stratification occurs in much shallower systems than Lake Tuendae.

SP: Your problem is that you are trying to anticipate something that may happen in the next couple of months.

SB: If you wanted to play it safe, if you had a wind-powered system on a windy day, would it give you the air in the lake on the days when you need it the most (on calm, cloudy days)? Also, you have a fountain out there. What purpose does that serve?

AK: The fountain is attached to the pump. It's only active when water is being pumped. If it is run continuously we will blow out the berm eventually. There's another problem. A surface fountain is the least effective method for adding oxygen to the water column.

SB: If you have still cloudy days after several days of sunshine ...

RF: You'll get several weeks of calm still days, then 60 mph winds.

BP: We don't know what the fountain is sitting on. If we start to remove the berm, we may lose the fountain completely.

CO: This has been going on for 24 months. Do you know this is associated with Gambusia? What other options have you considered?

AK: We are trying to come up with a contingency plan. Yes we are jumping the gun, before we lose the population completely.

CO: Could you hand-remove the Gambusia - at least 50% of them?

MW: The electric-powered pump is a good option. The fact that you have a divided pond is not a problem. The animals will move toward the aerated part of the pond. They will migrate toward the oxygen. As an emergency backup plan, don't worry too much about aerating both sides.

AK: One concern about aerating just one side is that if you are only aerating the deeper side, is the more shallow side going to produce a lot of toxic constituents because of the anaerobic detrital conditions?

MW: Anaerobic detrital conditions always exist, no matter what.

SB: This is a pretty common occurrence with fish farmers in the Southeast. They have it figured out what DO levels are needed.

SP: This is different from an aquaculture situation because this is a standing population of fish. Rob showed me his graph of DO levels since the 80's. There's little to no evidence of stratification. The lower layer, hypolimnion, maintains a stable temperature, and the upper layer reflects the sunlight and air temperature. The bottom and top temperatures are either the same or track together. Maybe stratification will not be the primary problem.

→ The Gambusia is not affecting the phytoplankton.

JWull: The fact that it does or doesn't stratify does not mean you won't have a fish kill.

SP: Stratification is a whole different level of risk than what we are describing here. The most efficient way to oxygenate the water is to destratify the water column.

AK: The pump pumps bubbles to the bottom of the water column that effectively drag water up to the surface.

TE: We did use diffusers in Barstow but had problems and the fish died.

1:10 PM Susan Williams - China Lake NAWS

The Naval Air Weapons Station (NAWS) is a 1.1 million acre naval installation.

Mission: to provide testing grounds for troops.

Boundaries with Ft. Irwin, Death Valley National Park [DEVA], and BLM Inyo, Kern, and San Bernardino Counties

NAWS provides support services for the Navy, also manages Point Mugu.

City of Ridgecrest built a waste water treatment facility in 1945 at China Lake, which elevated an already high groundwater mound. This resulted in a surface water expression called Lark Seep. The more

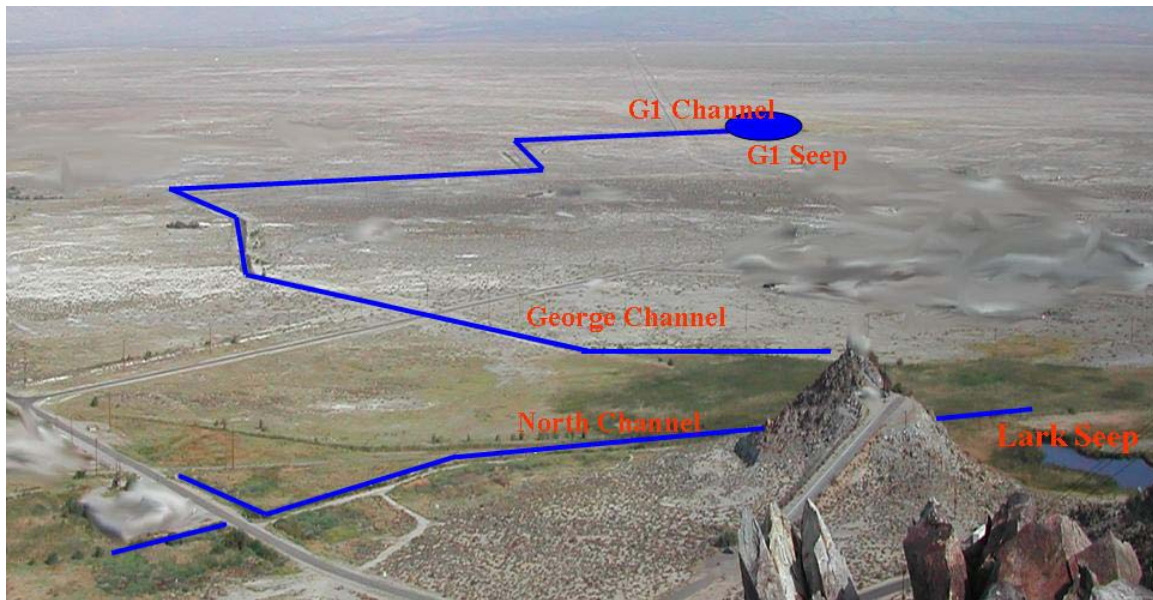
people that moved into Ridgecrest, the more water that came into the evaporation ponds, which led to flooding problems. The City started a series of channels to divert water away from the facilities (G1 Channel, G1 Seep; George Channel, North Channel).

We didn't know if fish could migrate between seeps.

425 MTC were introduced into Lark Seep in 1971. Also, 59 China Lake chub were sent to Hinkley CA in 1986 - didn't survive for political reasons (the facility was closed and the water shut off).

Questions arose if China Lake fish are really MTC. A 1997 study (May, 1997) proved yes.

Cattails must be removed annually. If water is 10' or deeper, you are not supposed to have cattails. So in 1997, they widened and deepened the channel to "enhance the habitat." But, due to sedimentation from sloughing from the banks, cattails have been growing back since.



Population surveys: 1979, 1980, 1981, 1986, 1989, 1995. Annual surveys started in 1997 and are conducted the last weekend in May or first weekend in June. Most of the trapping is done in the channels. The chub have migrated from the seep into the channels because there is a flow in the channels, more like their native habitat.

Population surveys have historically trapped at 11 sites in the system. 1997-2001, used a modified minnow trap with canned cat food as bait. Fish were weighed, measured, and left pectoral fin clipped, with notes of physical abnormalities.

Used Lincoln-Peterson Model for population estimates in 1997-2001, but because of low recapture rates this resulted in broad confidence intervals and questions about the validity of the results.

Problems: Traps were set during low fish activity periods; fish became trap-aware; large fish were not able to enter the traps; occasional capture of gravid females.

The 2002 survey tried to address these problems by: leaving traps longer during periods of greater activity (mid-morning) and including a day of rest implemented for trap sites. Also implemented three trap sizes (one each larger and smaller than original trap) and used different trapping times.

The existing biological opinion was modified to change to fall trapping dates to reduced risk of capturing gravid females. Also started using Visible Implant Elastomer (VIE) markers. VIE markers have reliable retention rates, provides distinct visual marks, and are quickly and easily applied.

- No significant difference in DO or temperature readings
- No gravid females captured
- Visible implant fluorescent elastomer marking.

Defining suitable habitat: Some areas are not suitable (intermittent shallow areas, changes in bed elevation). Habitat zones suitable for chub are defined by depth and width of channel and length of habitat. North channel, George Road channel, and G-1 channel were deemed viable.

Utilized Popan-5 software for calculating population estimate. Recapture rates in 2002 remained low. Only 9 recaptures after 500 fish sampled. Confidence intervals still large relative to population numbers.

Conclusion:

- Need more traps per habitat type
- Longer trapping periods required
- Weather station installed at Chub Med.
- 24-hour water quality meters for pH, DO, conductivity, temperature.
- Removed tamarisk trees.

In fall 2003 NAWS will: (1) map north channel topography to better understand the extent of fish habitat and to know where to place traps; (2) conduct a DO study; and (3) add two additional 24 hour water meters.

There are plans to determine water flow through Lark Seep system and remove bullfrogs in the future.

Contact for NAWS: Steve Pennix, (760) 939-3238

Is each population separate from the others?

SW: Yes, but they all originated from the Lark Seep population and somehow migrated from Lark Seep to these channels.

You do populations estimates over a couple of days?

SW: Yes, because the computer models we use demand data are collected all in one day or two days.

[?] What other fish species/invertebrates are there?

SW: Gambusia galore out there.

[?] Have they been tested for Asian tapeworm?

SW: Steve's [Pennix] part of the project.

[?] In the marking of different fish from different channels...

SW: We haven't done our trapping this year yet.

[?] Did you randomize the places of the traps?

SW: No we didn't. We measured depth, width, length, and determined number of traps according to depth of water column. A lot of it also depends on access. Sometimes it is 10 feet before you hit the surface of the water. Makes trapping more difficult.

[?] In your traps, did you see large dichotomy of #s between traps?

SW: Yes. We saw large numbers of Gambusia in some of the traps, but also saw numbers of small chub. There have been some years where >100 fish in a trap, then none the following year.

[?] Do they school?

BP: They school in small groups (10-12) but not in large numbers.

DH: You have all these Gambusia, so you have tapeworm too?

SW: That's a good question. I don't know.

OTHER COMMENTS

- Water temperatures vary over length of channel.
- Fish were originally introduced to Lark Seep and have made their way to other channels.
- Trapping will be in October-November this year.
- MTC stay in groups causing clumped distribution with some traps having high numbers, and others with none.

1:45 PM Scott Bonar - Asian Tapeworm

Talk about what we've got going on in Arizona and potential regional effects of the exotic Asian tapeworm.

Europeans in 1800s started collecting plants, animals etc. for the Smithsonian Institution. Then more and more people started settling out here in Southwest. They did not like eating southwestern fish species, so started to import and introduce European and eastern United

States species they were used to. This resulted in a big migration of animals.

Diagram shows tapeworm lifecycle. The life cycle works like this - tapeworm eggs hatch in sediment, larvae infect copepods, infected copepods are eaten by fish, fish develop tapeworm infestations, fish feces containing eggs go to the sediment.

Exotic fishes were not all bad. Developed valuable tourism and sport fishing opportunities but they had downsides.

EPA did standardized monitoring of streams for factors related to native fish abundance. Some of the most negatively related variables to native species relative abundance were the density of non-native species.

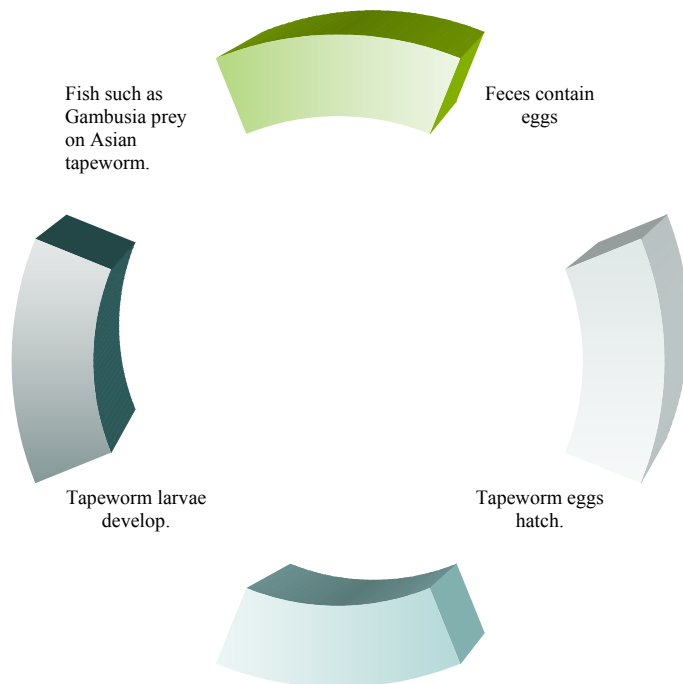
Economic impact: impact of all non-native, invasive species to US economy each year = \$123 billion (from a Cornell University study). In comparison, first Gulf War = \$61 billion, all the world natural disasters in 2002 = \$70 billion, cost of Hoover Dam = \$0.16 billion.

Invasive species brought infestations with them (e.g. Asian tapeworm).

Tapeworm first migrated from China to Russia. Thought to have come to U.S. with grass carp and then to the U.S. Southwest via bait fish.

Effects of Asian tapeworm: Not a lot is known about it. It started to show up in young grass carp with hundreds of parasites per fish and mortality approaching 90% in China. It caused mass mortality of wild carp in Lake Lenin, Ukraine. Mortality of carp in Russian ponds was 67% where there was a previous history of the disease, and up to 90%

where there's no prior history of the disease.



Study in North Carolina: survivorship of infected mosquitofish was significantly lower than uninfected mosquitofish. Study concluded the tapeworm could be devastating to cyprinids and that transfer should be avoided.

It kills by blocking the intestines and creating lesions on the intestinal wall.

What do we know about southwest fishes? It's the small cyprinids in warm water that are

the most susceptible to Asian tapeworm. The largest numbers of endangered fishes in the Southwest are cyprinids. Most are found in warm water.

[?] How do we know it wasn't here all the time?

→ There have been a lot of fish sampled with negative results over the years. Also, this is a significant parasite and would have been noticed.

In 1979 the tapeworm appeared for the first time in the Virgin River. It has been spreading since the early 1980s. It is now present in the Colorado River, and since 1995 in the Rio Yaqui. Between 1995 and 2000 they have been showing up in California.

Available literature is extremely sparse.

University of Arizona current work: Goals are:

1. Compare mortality and growth between infected and uninfected small cyprinids in microcosms.
2. Define relationship between infection intensity in the wild and characteristics of the site (habitat, presence of copepods, etc.)

Where are we at now?

- Initial stages.
- Fully funded to study effects of the tapeworm on the fishes of the Rio Yaqui drainage.
- Partially funded to examine relationship among site characteristics and infection rates.
- Seeking partnerships to expand study to other fishes and fully fund field portion of study.

2:15 PM Manna Warburton – USGS Parasite Survey

2000-present parasite survey on USFS land in Southern California: started to collect animals from Santa Clara River to Tijuana River in the south and in major coastal drainages in between, to test for fish parasites. We're looking for everything (in terms of general fish parasites). USFS declined to refund the study after 2001, so USGS tries to piggyback onto other programs when possible to continue the work. Right now we are piggybacking onto the NAWQA program.

We have also sampled for other parasites - anchorworms and pet-store parasites (which show up as small white dots on the surface of the skin caused by a protozoan). Both parasites were found throughout the sampling range.

We have found Asian tapeworm everywhere we sampled. Infection rates in systems where we have sampled for multiple years change greatly - half to two-thirds reduction from one year to the next - and also from season to season.

[?] Any indication that the tapeworm actually causes mortality in the fish?

MW: Our studies are not set up to determine mortality. Sample sizes are small. Not doing broad scale surveys of these fish, not enough funding. Arroyo chub were found at 3-4 cm. sizes with over 100 parasites.

MW: It's very possible for animals to sustain themselves through the infection and later lose the parasite, becoming essentially "healthy". The tapeworm is apparently a short-lived organism.

SB: But the fact is we don't have the data on survivorship and even if you see "healthy" animals how many are going to the bottom?

MW: We collected information for FWS on the Santa Ana chub. This is an important species and it turns out they are not susceptible to tapeworm infection. This appears to be based on diet. The Santa Ana chub feeds on benthic algae. Apparently fish that do not feed on copepods are apparently not susceptible to tapeworm infection.

SB: This is confirmed in the literature for fish that change diet seasonally.

SB: Tapeworm eggs will die when a pond is dried up and they will die when lime is applied to a pond.

[?] Have you sampled for environmental variables? What is the coldest system you sampled?

MW: We haven't sampled environmental variables. The coldest system we sampled was the San Gabriel River and we found infected fish.

MW: Send us some fish and we'll let you know if you have *Bothriocephalus*.

DH: I think we can say this workshop has identified the effects of Asian tapeworm as a research need.

2:30 PM Amanda Pearson and Molly Estes – Lewis Center Proposal

Lewis Center, Apple Valley California
Home of the Academy for Academic Excellence

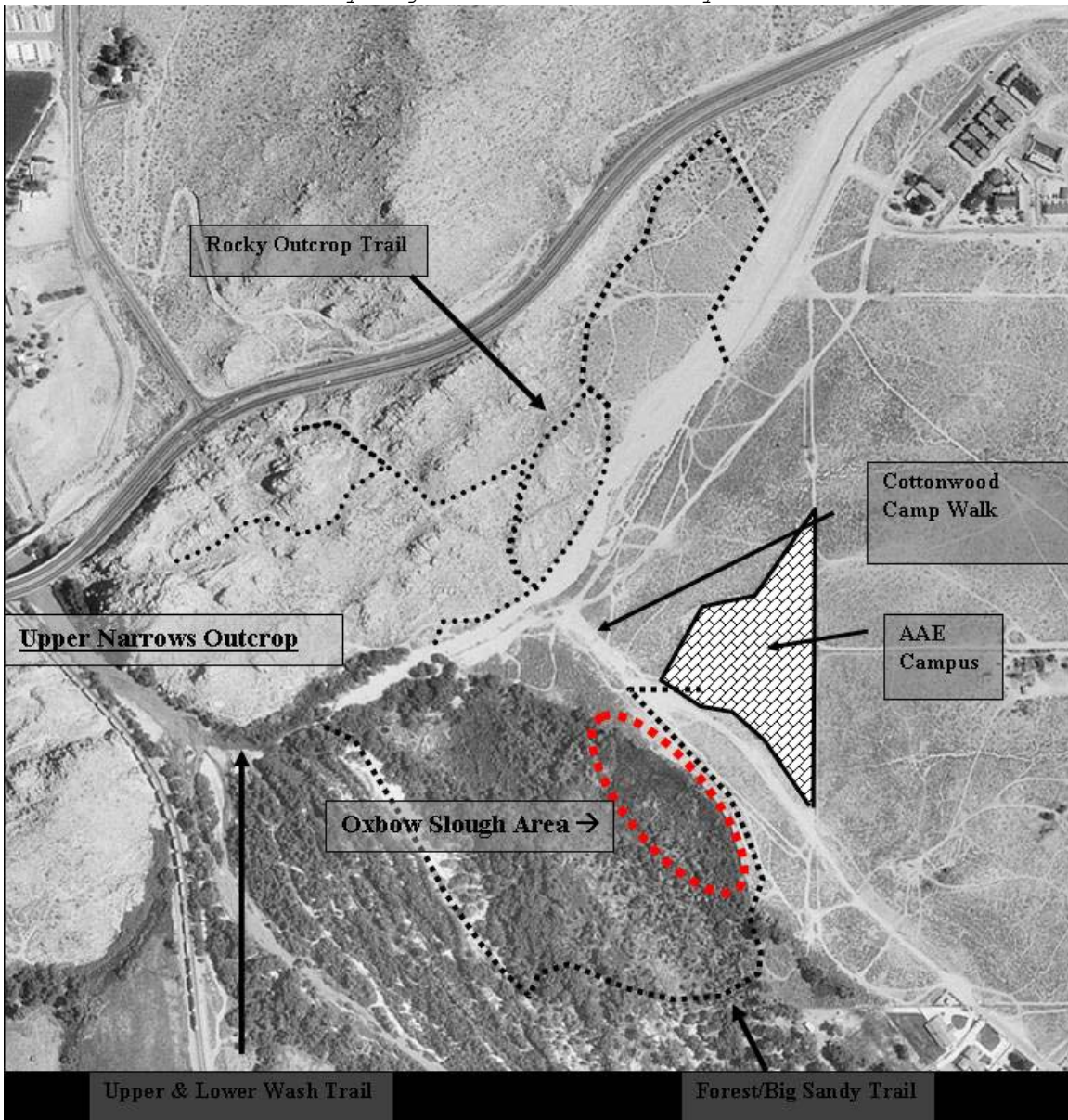
- 150 acres
- 12 acres are the school campus
- 138 acres managed for wildlife
- Mojave River runs through the school property
- Dedication to educational research both on and off campus
- Methods used: survey, education programs, progress testing

Students in the Mojave River Student Scientists Class choose and research a project about the Mojave River or anything on the campus

This area is a good environment for Mohave tui chub in the Mojave River This segment of the river is the last section to go dry. The reach may also have arroyo chub and/or the hybrid. The school also has desert

tortoise - a mating pair. Other rare species include the Victorville shoulder banded snail and the Mojave River vole.

The school has an artificial pond lined with plastic on campus. We want to develop a campus refugium for the MTC. We want to transplant and maintain a population in the pond. We want to raise a population to reintroduce into the Mojave River - may need to remove the AC and hybrid. We want to build a building on campus to carry on genetic studies and offer a children's museum for younger students. We want to nurture an interest in younger students to carry on the work.



Education is the key, particularly to overcoming hurdles of getting the chub back into the Mohave River and in private ponds. Congressman Lewis comes to 'his' campus often and is accompanied by reporters.

DH: The recovery plan describes an introduction into the Mojave River to recover the species. This project would be a big step toward recovery of the species.

TE: Issues include tamarisk, AC, bullfrogs, reliability of water supply, flow issues.

Various - There are many issues with these maintained ponds. The schools at Silver Lake are another option for this.

Note added by Matt Huffine: The Lewis Center, Mojave River Campus contains an "Oxbow lake created by the 1938 flood. The water level in this "lake/pond" is actively maintained by beaver dikes and mud berms and water only flows out into the river during the fall "green-down" period and the winter-spring rainy season. The water sources are a shallow groundwater table and occasional water releases from a nearby "production well" operated by Apple Valley Ranchos. Students currently monitor the ground water table from 5 monitoring wells (USGS and Mojave Water Agency) south and north of the "Oxbow lake" as well as the lake level at 15 min intervals. Students also monitor the water quality of all surface water sources (pH, Temp, TDS, and Salinity). This "Oxbow" lake-pond-marsh may provides a perfect habitat for the MTC if some cattails were removed. The lake/pond is more than an acre (surface area of the perennially wet riparian area) and rarely is less than an acre during the summer month. It has not been dry since 2000.

2:45 PM Ray Bransfield – USFWS Perspective

I am thrilled that Debra Hughson and the National Park Service are working on recovery of the Mohave tui chub. The recovery plan for this species is decades out of date and, although the National Park Service, Bureau of Land Management, California Department of Fish and Game, and U.S. Navy have been good stewards of the refugia for this species, we really need to update our science and vision if we want to make a serious effort to further the recovery of the Mohave tui chub. We know that, through good science and effective cooperation, we can promote the recovery of species; we have seen examples where species on the brink of extinction - such as the American alligator and peregrine falcon - have been delisted and others - such as the least Bell's vireo and California least tern - have increased dramatically in numbers as a result of effective management.

Returning the Mohave tui chub to the Mojave River may not be possible. Ultimately, re-establishing the species in the river may be what is appropriate to consider the Mohave tui chub to be recovered, but the obstacles may be too great. For example, the river just does not have as much water as it did in decades past and that trend does not seem likely to change soon. Interactions with arroyo chub and other non-native species may prevent us from establishing the Mohave tui chub where water persists for longer periods of time. Intermittent floods that would wash Mohave tui chubs from portions of the river where we restore are another problem. Finally, we would need to do extensive public relations work and probably rule makings to get Mohave tui chubs into the Mojave River. However, even with all of these obstacles, we may be able to re-establish fish there on some sort of basis that allows them to exist in their natural habitat on some sort of limited basis.

First, let's establish some background. The last official version of the recovery plan for the Mohave tui chub was signed in 1984. Frank Hoover from the California Department of Fish and Game started an effort to revise the recovery plan in 1989. However, the state and federal listing of the desert tortoise in 1989 put an end to this informal effort when Frank and I were assigned virtually all of the work on the desert tortoise for our agencies.

Skipping forward 14 years, the Service is still busy. Most of the Service's work with regard to listing and recovery planning in the western United States is litigation-driven. The Ventura Fish and Wildlife Office, which is the lead office for the Mohave tui chub, has conducted no discretionary listing or recovery planning activities in the last several years; with the projected workload we face, it will be years before we have time to try to work on a revision of the recovery plan for the Mohave tui chub. Also, I do not think our office is going to see any substantial increase in staffing or funding in the near future. Our workload and the thought that the National Park Service is willing to spearhead an update of the recovery plan and undertake recovery actions make us doubly grateful to Debra for starting this effort.

Given the Service's inability to jump to the lead on this effort, let's look at what we have and think about moving forward. The existing recovery plan calls for six sites containing the Mohave tui chub as a goal for recovery. I think, with what we have learned since 1984 about conservation biology in general and the Mohave tui chub in particular, that six sites is not a tremendously great hedge against extinction. My instinct is that the recovery plan should be thoroughly revised, using the best new information, rather than mildly revisited.

While we are working on a recovery plan, I think we could also be investigating current issues and opportunities. For example, I suspect we need to learn more about what is going on in Lake Tuendae; let's figure out what's going on with mosquito fish, pupfish, tapeworms, and algae before we drain the lake and start over. We need to ensure that the places where we currently have Mohave tui chub are secure; we don't want to lose the fish at Camp Cady or China Lake because of some oversight. We also need to make sure that we don't compromise other resources as we manage the Mohave tui chub; for example, the ponds at Camp Cady are now important habitat for a disjoint population of western ponds turtles.

Before we start moving Mohave tui chubs around, we should test the fish for tapeworm and other parasites. Do we need to survey the ages of the fish? Is the age structure in our refugia appropriate or is it skewed for some reason? Can we sample younger fish?

Do we have opportunities to work with other partners, such as the Lewis Center and private landowners with ponds that are or can be made suitable? Should we start to think about the Mojave River as a re-introduction site? Maybe. I think we need to have a different mindset in that we can spare individuals for the good of species; the biology of the species would seem to allow us to do that. We can take a calculated level of risk in experimenting with different ideas for the good of the species.

We need to look again at what we consider the range; is it just the Mojave River and its tributaries or does it extend to the Pleistocene lakes? That is an important policy issues that we need to discuss within the Service; the decision regarding what we consider the range would dramatically affect the amount of paper work required to try new sites.

Answering at least some of these questions would help us know where we want to go with a revised recovery plan. The National Park Service could take the lead for a new recovery plan. If this is what we decide to do, I recommend that we run the idea up the line within the Service to ensure we don't run into unanticipated roadblocks later. We would also want to ensure that any recovery plan goes through the appropriate reviews so the Service can adopt it when it is complete. An early decision to make is whether we want to try to put together a recovery team; given the complexity and multitude of issues, that would seem to be a wise decision. However, we would have to understand how it would operate. For example, the Service usually pays expenses for recovery teams, but we may not in this case because this task is not on our annual work plans. Can the National Park Service and maybe California Department of Fish and Game provide funding?

My bottom line is that we should revise the recovery plan. We have new science that we can incorporate to help us do a better job and having an updated recovery plan may assist us in getting additional funding to implement recovery actions. And again, maybe more importantly, the Service appreciates the willingness of the National Park Service to lead this effort.

TE: One of best opportunities for species will be in education. Using sites like that at the Lewis Center will be great, if they don't have to go through 50 tons of paperwork.

RB: Many groups do not like to deal with endangered animals because of all the regulation. Reintroducing Mohave tui chub into Mojave River will be a difficult task because all the agencies involved in management of the river will be wary of their ability to conduct flood control activities, release treated effluent, pump underflow, and undertake other actions. We need to figure out a way to ensure that people can still conduct legitimate, legal actions in and around the river and, if we can do that, educate people about how the Mohave tui chub in the Mojave River will not end life as they know it. Safe harbor agreements may help but we need to be willing and able to help people get through the government's red tape; for example, the Mojave Water Agency is unlikely to spend a ton of money putting OUR fish in the river. We need to make it easier for people to help us as recover the species.

RF: Do we have any tapeworm-free populations beside MC Springs?

RB: I really don't know. We need to look at existing sites where the Mohave tui chub occurs for things like tapeworm. The combination of mosquito fish and tapeworm may mean that we only have adult fish.

→ Comment that maybe we need to go through the 1989 draft and critique it as a starting point.

RB: We should look at things like the current recommendation of six sites being needed for recovery. Any such number should have a scientific rationale. How many fish should be at each site? How long should the population be stable before we consider it a 'good' site? Do we need to have specific age and size-class structures?

GK: When we we're working on that (for the Recovery Plan), how many fish at how many places made for a viable population, we we're all over the map with those numbers.

RF: I just want to emphasize that every Mohave tui chub in existence today is derived from the population in MC Spring.

LN: We need a vision thing from the FWS. What is the big goal here? We have started going in little directions, but we need the big goals. Can the FWS field the recovery team? If not then we need to develop ideas for this. What type of cooperative agreements could we come up with? The Feds do not have the people or the money (that is why this has sat around for so long), so we need other ideas.

RB: The Service does not have the resources to develop the recovery plan. I think we can help another agency to do put together a recovery team and draft a recovery plan. It could be the National Park Service, the Lewis Center, the Bureau, or someone else.

DH: The reason we are here is to help the FWS do this. The big question is can we recover the species, and the answer has to be yes. Maybe we need to look at different baskets to hold the species. This group can help us provide the big answers to how this could be done - maybe outside the Mojave River system.

RB: Without having Mohave tui chub in the Mojave River, I don't think we could really delist the species. Just creating refugia populations will not do this. We may be able to downlist it to threatened with a greater number of refugia, but I doubt we could get it off the list of endangered and threatened species.

GK: The spirit of the ESA is that the species has to be a viable operator in its native ecosystem to be completely delisted.

RF: Maybe we should work for realistic situations. We can reasonably get more refuges for the MTC, but getting MTC back into Mojave River may be something that will not happen.

RB: We should look at potential places in the headwaters of the Mojave River. We may have other opportunities than ponds. The process of using in-stream sites may take many years, whereas we can use ponds now. We will never get to a point where we can say the Mohave tui chub are completely able to take care of themselves; we will always have work to do to keep them around. Perhaps we can get out of the crisis mode.

DT: The Mohave tui chub is a byproduct of thousands of years of evolution. The fish has been affected by the particular environment in which it has lived, and possesses a morphology, ecology, and physiology that is adapted to living in a particular riverine system. It would therefore be desirable to attempt to return to the fish to its native

habitat in order to re-create the evolutionary processes and environment that have shaped the taxon. If, instead, there is a reliance on maintaining the fish in artificial ponds, we should expect that the evolutionary trajectory of the taxon will be altered.

RB: This will work better if it is not the FWS alone saying this is what needs to be done. I think many people and groups would be opposed to such a scenario, particularly if we tried to put Mohave tui chubs somewhere where people would perceive them as a threat to their existing way of life. If another group - say the Lewis Center - takes on this project, it may go better. I think we also need to do a lot of groundwork to provide some assurances to people that having Mohave tui chubs in the river or some ponds will not mean they will be subject to further restrictions. The last thing we want to do is introduce Mohave tui chubs somewhere and try to use the Endangered Species Act to try to impose restrictions. We'll need to work with land owners and others to provide good assurances beforehand.

RF: Why was Saratoga Springs never considered as a refuge site?

→ We need to think about things like this very carefully. We need to make sure we do no additional damage.

DH: The purpose of this workshop is to gather the technical information and provide managers with the information they need to make appropriate decisions.

RB: I think it's important for Doug and me to present this to our office and as a group exercise. If we go back and say we need a staff person to get this effort going, I can guess the answer will be no. But if we work together, the group can show that it can get things done, FWS management will agree to support the effort. The FWS wants to help people do what is necessary to recover animals, but we don't have staff to do this ourselves; given the current lack of staffing, we would just not be able to start an initiative like this without substantial support from the group.

JWool: It would be good to include an education strategy if this is going to work.

→ The growth expected in this area makes it essential that some education be done. We need partnerships to make recovery a reality.

RB: We need to figure out ways to make it easier for groups to participate. We (the FWS) can't expect to get too much out of partnerships if we make it too difficult for people to work with us.

ME: Great to think about big picture but a key is education. This is probably the hardest thing, yet it will have to move us to long-term success.

RF: Original goal of Recovery Plan was down-listing. But the general consensus here was that delisting is not possible.

DT: If particular problems or constraints involving water and exotics can be resolved, we should consider reintroducing the Mohave tui chub to the river from which it came, even if those reintroductions are not

likely to persist for 20 or more years. It is likely these fish had a dynamic distribution in the river, and that the presence and abundance of individuals in particular pools or locations within the river changed as flood events or habitat suitability changed. It would therefore be advantageous to not assume that fish continuously occupied a particular location, and that our management philosophy was based on a expectation that fish in particular locations come and go.

DH/DT: What is the right thing to do for the chub? Answer must be collaborative.

[?] What is process for stocking endangered fish in private ponds?

RB: This could be done as long as subsequent management would not result in 'take.' There are ways to do this such as 'safe harbor' agreements. If anyone other than CDFG wanted to move Mohave tui chubs into a private pond, they would need a recovery permit from the FWS. If the FWS is going to take the time to issue a permit to move Mohave tui chubs into a pond, we sure will take the time to address 'take' that might occur during future management. I think we could even address 'take' that might occur as part of the normal operation of the pond, as long as the overall status of the Mohave tui chub in the pond was secure.

[?] Revised Recovery Plan: Is down-listing possible? Delist - reestablish in Mojave River - difficult at best. How to accomplish? What are the new refugia options?

→ Recovery implies persisting in the wild without intervention.

→ Current Recovery Program - very overdue for review and revision. The FWS official revision is not planned for now.

→ NPS could take the lead on a new plan - how? - by using the best available science - lots of new information. Recovery team, advisory group - submit to FWS for review and approval.

→ Random issues

- Private ponds
- The term 'experimental population' - could use some change
RB: (comment added) *'Experimental population' has a very specific meaning under FWS regulations. It may be that we might have to designate experimental populations for some introductions but it is a lot of work.*
- 'Safe harbor' is easier, should be easier to work with
- Recovery agreements - need some security about allowing take, assurance, not being held liable. What kind of agreement would work with private concerns? (FWS would be willing to work with parties to get the appropriate legal issues ironed out without trying to predict exactly how it might be done.)
- Choosing a refuge carefully. Range of values: geographic, size, physical variables
- West Mojave process, soon to be a Habitat Conservation Plan (HCP). 30 players, including private, state, and federal. Doesn't mention MTC.

RB: (comment added) *The West Mojave Plan does not deal with the Mohave tui chub at this time because the species does not currently exist on any lands where someone might need an incidental take permit from us because they are at risk of 'take'. The 'water in the Mojave River' issue has been a pretty contentious one; the WMP has been contentious without including the Mohave tui chub; we would only up the degree of difficulty by trying to work the Mohave tui chub into the regulatory framework of the WMP. Focus should be on cooperative recovery efforts that are not tied to development.*

- The FWS is not pursuing safe harbor agreements and other recovery opportunities for the Mohave tui chub at this time because no one is asking to establish new occurrences on their land and FWS does not have the funding or staff to search out these opportunities.

September 4, 2003

8:00 AM Greg Lines - USGS Mojave River Hydrology

Mojave River is a dry stream, flows almost perennially in a few spots - Lower Narrows area in Victorville, Afton Canyon almost full time, Victor Valley treatment plant, Arroyo Grande downstream from Victor Valley treatment plant,

Lower Narrows area and Afton Canyon are probably the only two feasible places for [MTC] reintroduction.

Afton Canyon has about 2000 square miles of drainage area.

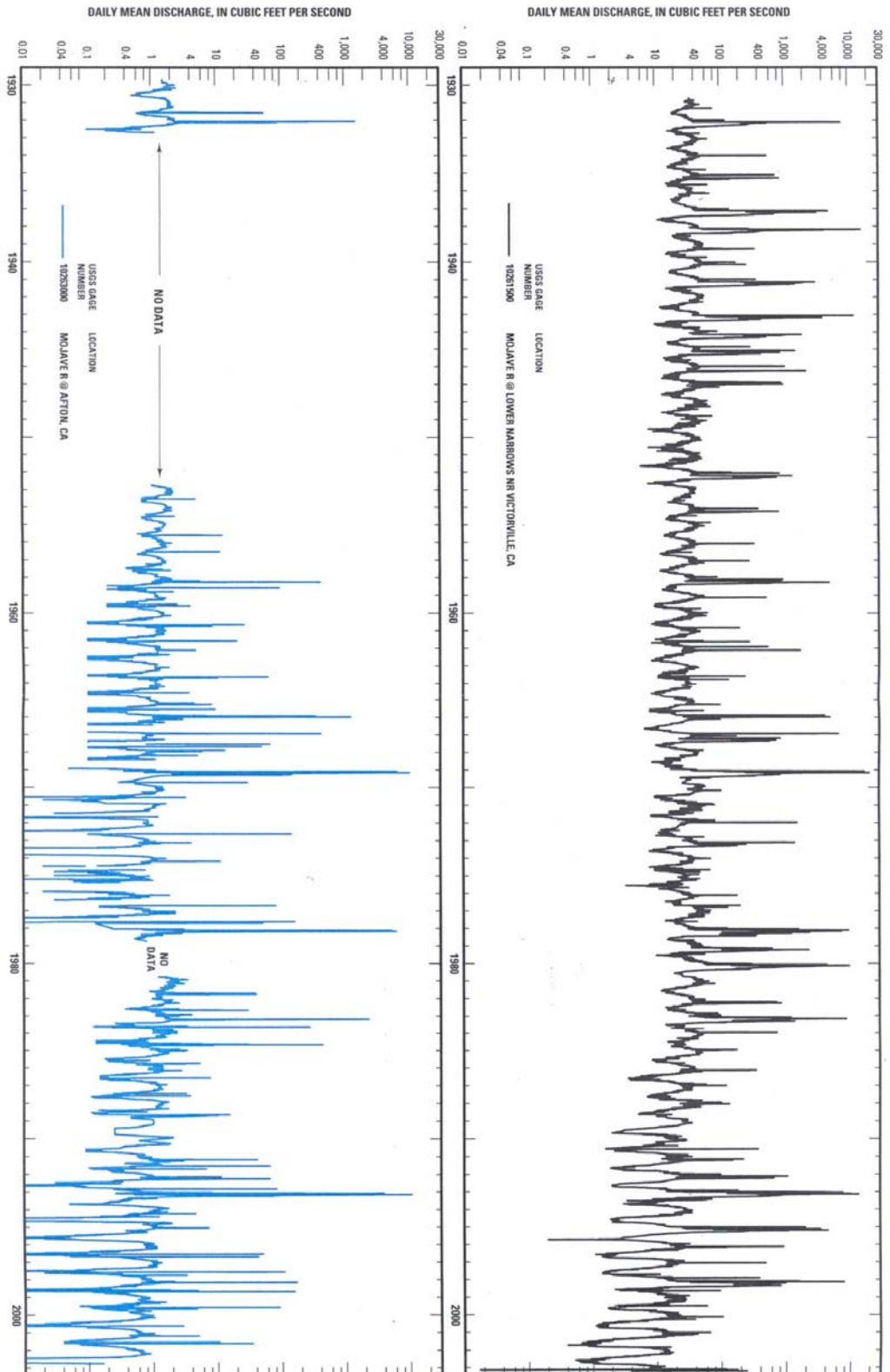
Extremely slow drainage but with periodic recharge from floods.

Alluvium along river 1/4 mile back from river edge, 250 feet thick, to the major aquifer. The alluvium is recharged during floods and then water slowly drains back into channel.

Primarily evapotranspiration pulls water out of the drainage. In the winter, water primarily leaves the drainage into the groundwater system (recharge). Summer evapotranspiration = seasonal dips in the groundwater table. Groundwater pumping also depletes the water table.

Afton has less slope on the recession index than Lower Narrows since there is so much more aquifer storage upstream. While water may move through the floodplain aquifer at a few feet per day, it may take hundreds of years for water to travel from the Narrows to Afton. But eventually the effects of pumping, etc. upstream will be seen at Afton Canyon.

It takes major flood events to completely recharge the floodplain aquifer. In 1993 we got 400,000 acre-feet of recharge from the river to the floodplain aquifer.



Hydrograph of gaging stations on the Mojave River at Lower Narrows (right) and Afton Canyon (left).

Mainly what you see on the hydrograph is gradual groundwater drainage and these major flood events every 8, 10 years that fill the floodplain aquifer up again. But if you have several dry years, you will get the stream drying up.

The major events supply water to the aquifer that, in turn recharge the stream. Flash floods tend to drain out the system and be gone. But wetter periods, where the ground is maintained as wet, more water infiltrates to recharge the floodplain aquifer.

Mainly what you see on the hydrographs is a gradual groundwater reduction, major flood events that rejuvenate, and an evening out of the system. The hydrographs shows slow, slight downward trend for the Narrows and Afton. Peaks in the hydrograph are due to summer storms and winter flows.

A lot of the peaks at Afton Canyon are summer storms, not winter recharge events. They are so flashy that they don't really supply much water to the aquifer. Recharging is a time-related event.

Afton Canyon is dry at the water gauge right now. The water table is close to the surface even where surface stream exists.

Very little water quality data has been collected. Handful of analyses over seventy years of flow monitoring, 300-400 TDS [parts per million of Total Dissolved Solids], depending on flood cycle.

Downward trend in water discharge is a reality. 200,000 acre-feet is pumped each year, 90,000 acre-foot recharge/year in the Victorville area. There is a downward decline in the water level.

No major floods since 1993. At the lower Narrows, fish hatchery maintains flow in river. The fish hatchery gets its water from deep wells.

The aqueduct brings in water but it is not enough to offset pumping effects. Most goes to Riverside and Orange County.

Peak flood in 1993 caused flood stage in Afton Canyon to reach 10,000 cubic feet per second.

We need to look at the recovery plan and recovery criteria to see if places like Afton Canyon can really survive a flood event. Maybe we will need to revise the recovery plan. Perhaps they should be introduced into the headwaters.

Mojave River is unique. It is not a river, it's a sandbox. It's not like the Rio Grande. Its flood events do not negatively impact vegetation and surrounding habitat.

Discussion

☐ Do you think the water quality has changed as a result of human activity?

GL: That's one thing we don't know. Very little water quality analysis has been done on the Mojave River. Generally, the water is not too bad. We need more water quality work, problem of funding.

[?] I see a downward trend on the hydrographs. Is that reality?

GL: Yes, I think so. Ever since the 1950s, when people started moving out here, you can see a decline in the aquifer on the hydrographs.

[?] Even with the overdraft, with the two stretches of the Mojave, you'll always have water there, right?

GL: Afton Canyon is dry, except for the ponds there.

[?] What are the long-term surface water levels in the river?

GL: The important thing is the base flow. I don't think you'll see it getting any worse. The only thing maintaining the Lower Narrows is that fish hatchery. Afton Canyon is dry now. If it gets worse, I don't know how it can't get any worse.

GL: If we leave a system long enough, a plant community will be established dependent upon the existing local water.

[?] The water at Silver Lakes...

→ All that water is used elsewhere, not used by residents in the High Desert. All the growth is really mining water, there's not really any other input.

→ There's some water being taken out of the Aqueduct, very little at this time. There's a proposal to take some water from the Aqueduct and put it into the Barstow pipeline.

→ That's still not enough to balance the growth.

[?] Would you say there are 3 major floods at Afton?

GL: '69, '78, '80, '83, '93. '93 was the biggest flood of water coming down (but not biggest in terms of recharge). The last big one I know of is '93.

RF: If you are going to reintroduce the fish to the river system, the best place is probably near the headwaters. I've seen them washed out at Afton Canyon and other places downstream. The only fish that could survive were those that could find relatively stable places high on the river. Reintroducing them back to the river seems to be just an experiment and further downstream they will not be a sustainable population. You need to find areas that are slightly protected from major flood events. Places with slow-moving waters, with eddies, sloughs, etc.

[?] What is known historically about the surface water?

GL: Very little information. Water flowed at one time perennially at Barstow. Water coming out at the lower Narrows almost always went to

Silver Lakes. There was definitely more water in the river, at different spots, than there is now.

[?] Did those fish historically at lower parts of the river system have to be replenished regularly by fish populations from upstream?

RF: The floods that might have been coming on 10, 12-year cycles did not have to rebuild the water level in the watercourse. Now that's not the case. When we do have an El Niño year, floods fill the surface beds first, making downstream populations a lot more tenuous.

SP: Afton Canyon has potential habitat, this may be the best place to put them in as pond populations. What would it take to put them there repeatedly? As far as Rob's comments, we don't have enough information about arroyo Chubs in the headwaters. We could identify tributary streams that maybe have a little bit of isolation. Lastly, I think in Hubbs and Millers days, Silver Lakes may not have had arroyo chub introduced. It was stocked with a lot of sport fishes - bass, etc. Today, it may be our best hope for chub reintroduction. MTCs coexist with some species of game fish - trout, some bass.

[?] Mojave Narrows, how does the water flow surface and subsurface?

GL: Flows from hatchery, on surface about $\frac{3}{4}$ miles, then into the aquifer. It comes out at more than one point along the narrows. Perhaps what we need is a specific evaluation, to find a specific site where the fish wouldn't be washed out and would be protected from major flood events.

8:55 AM Casey Burns – BLM Perspective

[POWERPOINT PRESENTATION] Mohave Tui Chub On Lands Managed by the Bureau of Land Management, Barstow Field Office

Grazing allotments follow the river. Have fencing along there for a year now that is keeping the cows out for now. BLM manages the whole canyon in Afton.

Afton Canyon is an Area of Critical Environmental Concern (ACEC). A lawsuit by the Center for Biological Diversity forced cattle out of the ACEC for the past year. BLM owns almost all of the aquatic habitat.

[POWERPOINT PRESENTATION] BLM MISSION STATEMENT: to sustain the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations.

Nothing really jumps out in the BLM mission statement, priorities or BLM policy on Special Status Species Management (2001) regarding protecting listed species.

*[POWERPOINT PRESENTATION]
BLM PRIORITIES*

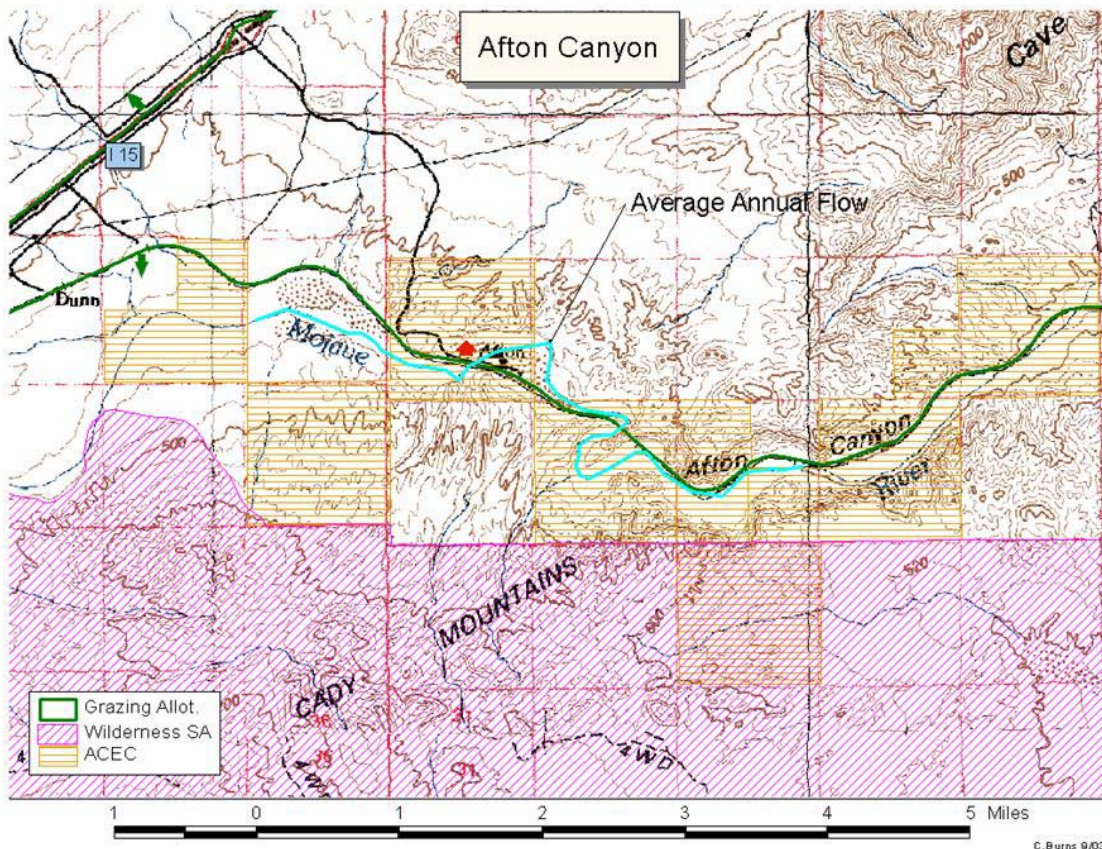
- To improve the health and productivity of the land to support the BLM multiple-use mission.*

- To cultivate community based conservation, citizen-centered stewardship, and partnership through consultation, cooperation, and communication.
- To respect, value and support our employees, giving them resources and opportunities to succeed.
- To pursue excellence in business, improve accountability to our stakeholders, and deliver better service to our customers.

BLM Policy on Special Status Species Management (2001), Objectives:

- To conserve listed species and the ecosystems on which they depend
- To ensure that actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list and special status species, either under provisions of the ESA or other provisions of this policy

Special Status Fish Strategy for the California Desert District (1994): Stabilize and improve populations of the... Mohave chub on public lands and the ecosystems on which they depend to promote the recovery of the species.



The Special Status Fish Strategy for the California Desert District (1994) does specify that BLM is to stabilize and improve populations of the MTC. It's not a major focus of our office, unfortunately.

There are limited BLM policies/guidelines to manage threatened and endangered species. Local BLM managers have not spent a lot of time coordinating with FWS or CDFG.

[POWERPOINT PRESENTATION]

BLM Perspective

Sad Facts:

- No extra \$\$ in budget in near future*
- Not enough staff to devote large amounts of time to a project - 50 to manage 3 million acres*
- Not a current priority of management*
- Will not get much participation out of the BLM unless upper management is convinced reintroduction of the Mohave tui chub is feasible and desired by the public.*

SP: Would it be your impression that it's the local manager's bent that other agencies are not working with BLM to protect species?

CB: I think it's local. The tui chub interest group does not have the ear of the local management of BLM.

TE: There's been absolutely no coordination between BLM and CDFG, which is really different from most BLM offices.

CO: These same sad facts were mentioned by FWS.

CO: Why was the ACEC set up?

TE: Riparian values.

CB: Afton doesn't have a lot of the smaller canyon watersheds feeding it. It doesn't have a large watershed to the north and south sides of the canyon. It's fed from the headwaters on down.

TE: Tamarisk is a problem in Afton Canyon. The Management Plan recognizes the need to control salt cedar. BLM is using CCC crews for salt cedar removal in addition to other projects.

SB: Could you explain the goals of an ACEC?

CB: Goals vary from ACEC to ACEC. They are set up for wildlife protection, scenic values. There are no hard and fast rules that you can apply to ACECs.

JWull: By virtue of the name ACEC, you should infer something about protection, conservation, etc.

[POWERPOINT PRESENTATION]

Afton Canyon

(1) Management Issues

- Area of Critical Environmental Concern (ACEC)*
- Management plan offers no provisions or prescriptions to benefit the tui chub*
- Tamarisk eradication efforts for 10+ years, 90% complete*
- Increases in surface water flow*
- Little water in the Summer*

- Winter/Spring flow averages 7-8 miles
- Heavily vegetated with sedges, rushes, and cattails
- Arroyo chub present, as well as bluegill and catfish
- Low numbers of southwestern pond turtle
- Moderate public use
- Campground with 22 sites, 2 toilets, and a water pump
- USGS monitoring station
- Potential for semi-protected pond location
- Flood through Afton would hamper tui chub reintroduction efforts

(2) Mojave River Facts Regarding Afton Canyon

- Total drainage above Afton is 2,121 square miles
- Average discharge of the Mojave River through Afton from 1950-1978 was 5.15 cubic feet per second
- Maximum discharge over this period was 18,000 cfs on 1/26/69
- The last time the River flowed all the way to Afton was 1991
- In 1978 macroinvertebrates sampled included mayflies, adult and larval beetles, snails, and annelids
- Average rainfall ~ 4 inches

Have a series of water data of Upper Afton Canyon from October 1965 to Sept 1966 and 1983-1984.

[POWERPOINT PRESENTATION]

Desert Discovery Center

- Jointly managed by the BLM and other partners
- Environmental Education Program to kick off this fall (2003)
- Former tui chub population in 300 gallon pool
- Potential for small population for educational purposes

Desert Discovery Center had MTC in a pool (300 gallons) but they died from neglect similar to the pond at Hinkley.

RN: MTC were alive at the Discovery Center in 1995.

Potential Habitat

[POWERPOINT PRESENTATION]

Harper Lake ACEC

- Considered part of the Mojave River Drainage (subsurface)
- Restoration efforts ongoing
- Currently ~6 acres of open water
- Average depth ~2 feet
- Maximum depth ~3 feet
- Water chemistry in the lakebed may be questionable, but a ~2 acres pond was dug above the lakebed
- Water chemistry analysis to be preformed Fall 2003
- Mitigation \$\$ from IMC Chemicals may increase the site by 100-130 acres in the next few years.

Discussion

SB: If people want to see MTC, where can they do that?

→ Nowhere in a tank. You could go to Camp Cady but it's hard to see them in the pond.

SB: You keep talking about the education part of the plan, but having these fish in tanks where people don't have to drive there. Because I keep hearing over and over again, there's not the public pressure to put these fish on the radar screen.



Harper's Lake, BLM. Introducing an endangered species in an area managed for multiple uses would restrict management options. Water chemistry and pumping necessary during dry seasons may be concerns.

CB: A tank at the California Welcome Center would have lots of visibility.

SW: Especially if you already have a tortoise program going on, because you don't know how strong the tortoise interest is here.

MK: I think we should develop out of this meeting a MTC traveling trunk. . The NPS has about 6 of these. Hagerman Fossil Beds has one of horse fossils through the evolutionary chain. The parallel here is that there is a teaching curriculum tied into it. They brought in local teachers to help develop the curriculum. Just think of the tui chub and all the fantastic information we have been hearing about over the last 2 days and including this in this trunk. Regarding the NPS's NRPP funds, 10 years ago I worked on 3-year NRPP \$900,000 project for desert tortoise included an interpretive component. I think there was \$20k set aside for it, but the interpretive people didn't follow through with this. You could sell these trunks, or the NPS could have a certain number to send out for free, or could send out instructions for building these trunks yourself.

JWool: We need to incorporate an appreciation for MTC because so many people do not appreciate what they have in their own back yard. An

idea I might propose is to say to the Desert Managers Group that they should propose to do this education.

SE: As a home schooling mom, I think it would be great to have a study packet for students.

SP: Returning to Casey's representation, on Harper Lake I've inquired about the potential for MTC restoration there. I was told by CDFG officials, No, that would complicate the negotiations. From CDFG's side, that would not be a practicable component here. The project would not work long term for MTC unless you had regular cattail removal. There could be a synergy there for management of more than just the chub, say if BLM were managing for other species that are compatible with the chub.

TE: There's a wealth of water quality data that CDFG should have access to and that CEC [California Energy Commission] does. Everyone who has looked at it says that Steve would be wrong about low potential of Harper Lake.

SP: Well, I don't know anything about the water quality there, but chub are broadly tolerant of a range of poor conditions.

CB: After a couple of years, let BLM finish what it's doing, let Harper Lake get established, it could have potential. Right now the political climate is not right.

MT: We should in the meantime dissuade BLM from planting any other non native fishes out there right now.

TE: It's almost impossible for BLM to plant any animals.

SP: It's unfortunate that there's such an institutional reluctance because biologically, the chub wouldn't have to be in the way of other management programs.

CB: We are drying the ponds out in the summers. That would be our big hurdle. 40% dry out by August. We leave the 15 gpm pump on all year long. There is not a mosquito problem that I know of, I haven't seen any but they could be out there. There are two issues that continue to exist: they will continue to dry out, and continue to flood.

[?] What is Union Pacific's relationship?

CB: UP does pretty much what it wants out there.

BP: UP would have to be on board if we were to do anything to recover an endangered species.

SB: One of the things we talked about yesterday was the establishment of small research ponds. Would the Desert Discovery Center be appropriate for use in experimental programs, if it didn't detract from the interpretive value of the pond? For example, yesterday we identified the need for a controlled facility in which to house fish to research the question if hybrids are fertile.

JWool: The Regional Discovery Center would have multiple partners and would act as a clearing house for education activities and hands on experiences. But it could take a few years to fully reach its potential.

→ There is the strong suggestion that BLM has the facilities that would be helpful in resolving some issues like the hybridization.

CB: I think you should propose to plant chub in the pond (Desert Discover Center) first, then address research opportunities after.

TE: We should put this on the fast track; we could develop a letter on the West Mojave Plan today (comment period closes in two days) that everyone here at the workshop could sign, addressed to the agency managers. We want to bypass the bureaucratic inertia. We don't want to be still here 10 year from now.

→ West Mojave Plan (WEMO) might be tied up for a long time.

DH: The letter would have more bang if it came from, say, the Lewis Center, as opposed to one of the agencies here.

MK: If Tom Egan drafts something, we would want to review it and give buy in.

DH: Letter would be from this group with a series of recommendations regarding the recovery of the species in the West Mojave Plan.

CO: How does this group sign on? As individuals or representatives for the agencies?

LN: WEMO has been going on for 15 years or so, this workshop has been going on for 2 days? I think this group has something to say to the WEMO drafters, but I don't think we can say it in 2 days. I propose that one of the outcomes of this workshop is that we say, based on our strategy to recover, down-list this species, we go to the planning authorities as that time, with the agencies putting their letterhead on it, with signatures of their directors, ...

TE: No, I am thinking we sign the letter as individuals.

LN: Private citizens? Who here can write a letter that will direct policy of the NPS or any other agency?

TE: I am not suggesting we direct policy.

DH: If you believe the ecosystem should be addressed as a whole, and we want to recover the species, then our opportunity to comment as private citizens is open only until tomorrow. From the agency level, we would want our regional directors to sign and send letters of comment.

TE: But there's not as much onus on them to take action.

10:45 AM Larry Norris - Where Do We Go From Here?

Session to organize our thoughts into a product of this workshop.

LN: We are going to put some structure to this discussion now. (Larry Harris acts as structured discussion facilitator.)

Lewis Center folks are gone. That's unfortunate because we need to address the education component.

LN: Mitigation funds (a fund consisting of fines levied against companies by court action) might be available once the plan is in place.

TE: San Bernardino County Fish & Game Advisory Commission meets monthly to consider proposals.

MK: NPS potential funding in the Pacific West Region. We have regional money of about \$400K, spent on natural resource management projects, plus the funding call from NPS-WASO - different funding pools. The regional Natural Resources Advisory Council will be meeting the first week in December to discuss proposals for next year, plus the next 2 to 3 years.

DH: This workshop has already identified the tapeworm as a research need. Scott Bonar and I are working on that proposal for the next NPS funding call.

[FLIP CHART]

PROPOSED STRATEGY TO DOWN-LIST MOHAVE TUI CHUB

Foundation Concepts

- *Multi-agency participation and funding for mitigation - Desert Managers Group (DMG) includes NPS, USGS, BLM, USFWS, USFS, DOD - MOJA*
- *University and NGO partners - CSU system, UC system, University of Arizona - Larry Norris, Tom Egan*
- *Contract where necessary*
- *NPS will be coordinating agency - John Wullschleger, Doug Threlhoff*
- *Statement of problem, front matter - Steve Parmenter, Doug Threlhoff, John Wullschleger, Bill Presch*
- *Coordination - Danette Woo to coordinate electronic communication, etc.*
- *TNC - Larry Norris can talk to the TNC in Arizona and follow up with this.*

TE: National Fish and Wildlife Foundation, Wildlife Conservation Board (State of California - Scott Clemens).

MK: Debra and I will follow up on the NPS funding calls. The Desert Network will be meeting September 15 to set priorities.

SP: I can take the lead/CDFG sponsorship of proposals to the Wildlife Conservation Board.

TE: Another source - The Nature Conservancy is embarking on a three-state desert rivers program (The Desert Rivers Unit, out of Sacramento).

RF: All of these funding initiatives will be competing with other things. Can we make a statement that the "MTC is the most endangered vertebrate in the Mojave River System?" as common statement that reappears in all of these proposals.

→ No.

RF: Among? I see there has been a 12-year vacuum, and now there will be an inundation of proposals. We need to have a unifying phrase that reappears in all of these proposals.

MD: It may not be the most endangered but this may be the most opportune time to address it and have the most potential for recovery efforts.

LN: The unifying statement is a statement of the problem. Who's going to draft the statement of problem and need for action?

LN: Who will take charge of the email list?

→ Mojave National Preserve will generate and maintain a mailing list.

MK: We could also include Bert Frost, Great Basin CESU Coordinator, on some of these tasks (e.g. pursuing funding).

SP: With regard to NFWF, I've never had a fulfilling conversation with people from that organization. I would suggest someone else approach them.

DT: Does USGS-BRD have any funding opportunities open to us? Wasn't there a funding source once called "Species at Risk?"

SB: Yes, we do have some money for that. I would like a clarification of what the funding is for.

LN: We will get to that because we have a whole list of research needs.

MK: About USGS-BRD, there are two funding sources that NPS and BRD in common. BRD internally decides which Species at Risk projects it conducts, independent of the NPS. The other pile of money is NRPP funds that NPS gave BRD, and BRD asks NPS every year for projects to fund.

TE: NFWS operates with agency money.

SP: Species at Risk is designed for species that are not currently listed, so the MTC does not qualify.

DT: But what if we put it in context of the arroyo Chub? (laughter)

SP: The arroyo Chub is a species at risk within its native habitat.

DT: I will take on identifying the funding source for species at risk.

MK: I will help Doug out with this.

MD: We should find out how much the Lewis Center would contribute toward this with funding. Also, private foundations, non-profits.

DH: We'll put Matt Huffine [Lewis Center] on our mailing list.

SB: At least with NFWF and some others, you need non-federal matching funds. Exploring non-federal sources (e.g. Lewis Center) will make these federal sources more powerful.

JWull: There doesn't even have to be money, you can match with labor, etc.

TE: Talk to Rick Pearcy, Lewis Center CEO.

LN: If we are going to approach National Park Foundation, etc., there may be expertise outside of this room who could do just that. Partnership reps of each agency.

SB: The Desert Studies Center is a good match for housing, etc.

BP: You are talking about the California State University system and University of California system. We are in-kind contributions in that way.

RF: Could we get a Cal State student to start studying the MTC at Lake Tuendae, etc.?

BP: We don't have other pots of money. The [DSC] Board would be supportive of the effort but it would be up to me to obtain funding for such a student. There are various ways around the cash infusion. We can provide a university vehicle, equipment, etc.

LN: When we get into our science needs, let us identify equipment and other in-kind needs.

JWull: Need to look at cost-share (private foundations) monies also.

DH: Western National Parks Association is another source. I just put in a proposal for \$2500 for a graduate student to look at MTC.

MK: Another source through the NPS is the Canon Fellowships for Graduate Students. There are 8 scholarships every year. They are competitive but provide good source and amount of funding.

SP: CalTrans has a source, Environmental Enhancement Mitigation (EEM) grants. I would go after those grants. Another source is Endangered Species Act Section 6 funds. In the past, I had a completely non-federal funded position that used matching funds. I'd pursue those, as well.

BP: Mojave Water District is a good source of local funding. They probably wouldn't be interested in the chub but would be interested in water quality studies. I would volunteer to look into that.

LN: There will be a need for proposal coordination.

SB: We have a limited number of projects we can look at within the cooperative unit. We can work creatively over in Arizona at the University to match this with University equipment.

LN: CESUs too. We are in the Desert Southwest CESU, and the CSU system, and UNLV. When you get one campus, you get them all.

DH: And the Great Basin CESU.

LN: We still need to develop timeframes. We need probably someone to take on timeframes for NPS.

DH: All we need by September 15 are ideas, titles, and a statement of what we want to do. The final proposals will be due by end of October for FY04 money.

MK: One requirement we may want to get out is there are four or five points (ranking criteria) that need to be addressed. Larry Whalon will have that.

LN: Any others?

DH: WNPA's annual call deadline was last Monday.

BP: I think the Mojave Water District board meets once a month. I can look into that.

RF: Department of Defense.

BP: John Hamill and Clarence Everly are the ones to talk to about DOD Legacy funds. Who will take this on?

SW: I was planning on bringing this back and bringing it up with China Lake but that's as far as I can go. In addition, one of the guys at the China Lake office is on the DMG and helping out with the WEMO.

TE: \$80m is available for species recovery in the WEMO.

BP: Contacting DOD is a spin-off from Debra's discussion with DMG.

DH: I will talk to both John and Clarence about getting on the DMG agenda.

TE: You want to talk to Clarence. FWS has ultimate control of the WEMO \$80m and how it will be spent.

A discussion follows of UNLV and UNR possible interest and who will pursue this lead, also NGO's such as Nature Conservancy and Sonoran Desert Museum.

FLIP CHART

Geographic Scope

- "Range-wide" "recovery" goals articulated in plan
- Guidance on immediate management "actions"

DH: We have real problems facing us in these refugia now. We need, think we need, to do something. We need this group to tell us yes/no, what to do.

LN: Some of this is captured in a discussion of science coming up.

DH: I know we need help, China Lake is under control, I don't know about Camp Cady.

SP: Camp Cady needs recommendations also.

DT: How do you compare Camp Cady with Zzyzx?

SP: There are a lot of similarities.

■ ~~———— Bulk of Refugia System will be proposed for Federal Public Lands~~

■ ~~———— Refugia on Private Lands will be proposed in Parallel Package. (These items were deleted from the notes after further discussion/acknowledgment that there is a need for this effort to take a landowner-neutral approach which considers all land equally while also understanding that there will be different bureaucratic processes to follow depending on the landowner).~~

TE: Do we need to replace federal with NPS?

→ No.

CB: We need to continue to look at Afton as a possibility.

MK: Are there any potential state lands?

RF: Camp Cady is already state.

LN: Do we need a point person?

RF: For private lands, we need a consistent strategy to use when approaching various landowners.

LN: We need a point person [RF volunteered] to spearhead this effort. This is the missionary assignment where you take your message out, try to sell it.

FLIP CHART

- B/C - Articulate required "minimum" characteristics of refugium; "refuge parameters," human influence -Steve Parmenter, Susan Williams, Rob Fulton
- List other studies/research needed on MTC
 - Asian tapeworm - Scott Bonar, Sean Tackley, B
 - Limnology question - C

- *Aeration, Lake Tuendae ecology study - B*
- *Population structure, census/index - Rob Fulton, Bill Presch, Melissa Trammell, Doug Threlhoff, B*
- *Interaction within Lake Tuendae - Debra Hughson, Scott Bonar, Steve Parmenter, Mietek Kolipinski, B*
- *Compatability with other species - John Wullschleger, B*
- *Bioenergetics - B*
- *All extant and future refugia monitored under uniform protocols - Annie Kearns, Steve Parmenter, Susan Williams, Debra Hughson, Melissa Trammell*
 - *Population census - add to long-term study*
 - *Water quality/quantity - add to long-term study*
 - *Turbidity - add to long-term study*
- *Habitat assessments B/C*
 - *Deep Creek (USFS headwaters) - Tom Egan, Ray Bransfield*
 - *Above Silver Lake (including Lewis Center) - Casey Burns, Debra Hughson, JW?, RB?*
 - *Afton Canyon, Harper Dry Lake - Casey Burns, Bill Presch, Ray Bransfield*
- *Arroyo Chub distribution in Mojave Basin B - Steve Loe, Steve Parmenter B*
- *Hybrid question - Steve Parmenter, Bernie May, UNLV - Dexter B*

SP: I should probably volunteer to do this but I could sing you a song about agency priorities, etc. This is true for a number of tasks already discussed. The State could become involved by obtaining a Section 6 grant, contracting with a private company, reach to one of these funding sources that the agencies cannot access.

MD: Are you talking about both permanent and temporary refugia?

SP: There are reports already done on this. Is there anything in addition that needs to be done?

MK: One of the most useful documents we could have is not just a literature review but also all those papers abstracted and synthesized. This would need to be funded but would be useful for the long term.

MD: And we would need someone to keep it current for the group?

MK: I was thinking of a publication.

RF: This may already exist. All lot of this is institutional knowledge by St. Amant.

JWull: There are two different tasks: one is a literature review, the other, why past attempts failed.

TE: A lot of this information was already gathered for the lawsuit. A lot of this has to be institutional knowledge linked to specific sites.

MT: We keep getting away from the question of why these attempts failed. This may be what is missing from the existing literature. Maybe I'm wrong.

BP: There are a number of failed attempts for which we don't and will never have data. Most of the pre-1984 sites were not even included in the recovery plan.

JWool: What you bring up are the bureaucratic reasons for these failures. Which groups worked for these reintroduction sites?

TE: A lot of the sites were too poor, too small, tended to dry out.

SP: I could review the current documentation with Tom, then add it to the notes to pass this task by the group.

→ GROUP decides to defer to SP and TE to complete this task.

List Other Studies/research needed on MTC:

- Asian tapeworm - Scott Bonar, Sean Tackley
- Aeration -
- Population structure - Scott Bonar, Rob Fulton, Bill Presch, Doug Threlhoff, Steve Parmenter
- Interactions within Lake Tuendae - Scott Bonar, Debra Hughson, Mietek Kolipinski, John Wullschleger, Marie Denn, Melissa Trammel

SP: Aeration came up as a simple, cheap safeguard. It wouldn't hurt to have a water pump on the ground in case our estimates are wrong and population comes to the verge of collapsing.

CO: Of those 4 items, we have 2 items across the species, 2 items across the sites, 2 items specific to this site.

BP: We need to know something about the biology of the MTC in the lake. We need to do sampling, continue DO sampling, turbidity. We need to answer also water chemistry questions. These seem to me to be the two basic standards. Aeration doesn't come into question until we answer some of these questions with data. We'll also have to answer these questions before we go to Afton Canyon.

- Compatibility with other species - Scott Bonar

LN: Should we combine this with Population Structure?

→ Yes.

- Bioenergetics - Scott Bonar

MK: Doug, what do you think? Seems it would be related to compatibility and population structure.

DT: There are only a few individuals who could do this. There are a lot of factors to be considered. To take on a system of that size will be a considerable undertaking with a large amount of money required.

MK: We want to understand the dynamics of what is happening as much as possible.

DH: Perhaps we could simplify, put all of this into one proposal specific to Lake Tuendae. Other studies would be written up as other proposals.

MK: If the dollar amount goes too high, we could break it into phases.

SB: What are the questions that we want to answer? Bioenergetics may not be the question we want answers to.

DT: My suggestion is that maybe it will be better to define the study in terms of limnology, not bioenergetics. If there is a need to identify what has caused the plankton bloom, there is probably a need to understand what processes affect the algae community. A better understanding of different water chemistry variables would likely provide insight into what is affecting algae composition and abundance. This information could also be used to better understand the productivity of the aquatic environment. The productivity of the system likely affects the fish numbers. We need to tie the plankton community out there into the fish community; this would be much more basic than a bioenergetics question.

CO: I would lump all these together and throw out the bioenergetics part.

SP: I think our group is going to do that.

- All Refugia Monitored Under Uniform Protocols - Debra Hughson, Melissa Trammel, Steve Parmenter, Susan Williams, Annie Kearns
 - o population census
 - o water quality and quantity
 - o turbidity

DH: Our national inventory and monitoring program is developing protocols. These protocols need to be worked into the NPS protocols.

MD: Melissa is correct that we will develop protocols out of our policies, but also we will be developing new ones to suit our needs.

SP: I have a protocol I have used for 13 years on 20+ refuges.

TE: Wasn't there a protocol between the DMG agencies?

DH: NPS contracted with Don Sada regarding springs in Mojave Network - Level 1 has been developed (needs identification), Level 2 (biological inventory and water chemistry) and Level 3 (guidance for comprehensive study of the ecology of the spring system) remain to be done.

- Habitat Assessments
 - o ~~Deep Creek~~ USFS/headwaters - Tom Egan, Ray Bransfield
 - o Above Silver Lake/Lewis Center - James Woolsey, Ray Bransfield, Casey Burns, Debra Hughson
 - o Afton Canyon/Harper Dry Lake - Casey Burns, Bill Presch, Ray Bransfield
- University and NGO partners

LN: This can go in any direction we want. There are 2 universities identified right now. Any others?

BP: 25 campuses completely when you add up CSU, UC, and UA systems. You can probably get some support from Jim Andre for UC Reserve support. Unless there's a particular biologist who's interested in doing this, UNLV will probably not be interested in California issues.

GK: I could ask Don Sada at the Desert Research Institute. He's done a lot of work on desert fishes. I could ask if he has any interest in pursuing research on MTC.

RN: Joan Schneider, at UC Riverside, has done brine shrimp studies with grinding mortars. And Senator Harry Reid may have an interest.

RF: The tie-in with Joan Schneider, Claude Warren at UNLV is the contact.

LN: What do we do about NGOs?

MD: It would be important to keep interest groups like the Desert Fishes Council in the loop.

RF: Is anyone aware of a professional society of ichthyologists that has funding?

LN: I'll take our ideas to the Sonoran Desert Museum. Tom Egan will go to similar NGOs in California.

- Contract where necessary.
- Lead Agency

JWull: A lot of the activities proposed in this plan will occur outside of NPS areas.

MD: We need to consider groups that will be miffed if we leave them out.

LN: Do people here have distribution lists of people interested in desert fishes? Can you select off that? Does this workshop crew have a way to connect with people interested in desert fishes that are not here now?

TE: Yes, I'll do that.

LN: On the lead agency question, this is a formal arrangement.

DT: Are you suggesting the NPS be the lead agency on efforts to down-list the species?

LN: Yes, that's what we said yesterday. We agreed we cannot delist the species, but can work to down-list it to threatened.

DT: The FWS is the only agency that has the authority to list, down list, or delist a taxon. Other agencies can conduct activities that will increase the likelihood that these things will happen, however. We

will coordinate and pool our resources with other agencies that are willing to work with the FWS.

GK: I've been away from FWS for four years, and am not aware of current policies but whatever document is prepared; FWS must be the lead agency. Another body can write it, it can be contracted, whatever.

DT: I'm not sure it's appropriate to state that NPS is the lead agency.

LN: I'm talking in NEPA jargon, but am not familiar with the appropriate language.

RF: Let's change the language, that NPS will be the lead coordinating agency. FWS will be the lead agency.

DT: Or let's say FWS will be the lead agency in coordination with the NPS.

CO: FWS is the lead agency to sign a recovery plan. If you sign on as a lead agency but then hold back the momentum behind implementing this plan, that will be a problem.

LN: Who's going to spearhead this discussion on lead agency?

DH: I want to volunteer someone else, because this needs to be at the Washington level.

JWull: I volunteer.

DT: I will do it for FWS.

CO: Do we need to discuss the scope of these habitat assessments?

LN: If this strategy took these four sites, would that be adequate?

TE: As long as it spoke to willingness by the landowner.

FLIP CHART

<p><u>PRIVATE LANDS SITE ASSESSMENTS</u> Spring Valley Lake Soda Valley Lakes Silver Lakes/Helendale Calico Lakes Bryman Townsite/Palisades Ranch Upper Narrows/Lower Narrows Stretch (includes Lewis Center) Hatchery <u>Narrows Stretch - Mojave Narrows Regional Park? (owned by CDFG)</u></p>

TE: What if there's negative willingness for Deep Creek?

CO: The Recovery Plan describes protected refugia that will succeed over time. I'm concerned about metapopulations that will wink out, and require intensive biological management.

RF: I think we knew from the get-go that we have to build up the population before we get to self-sustaining viable populations.

JWull: I don't think the two are mutually exclusive. It is desirable to do both.

CO: My perception before was that people didn't want to put fish into Afton Canyon because they wouldn't be sustainable over the long run.

SP: I agree that there is a paradigm shift here that we need to make. In the 1970s, managers looked at pond refuges as beautiful thing that would be there forever. Today we realize they are temporary and we need to look at other options. We need to accept that risk.

CO: A part of that shift is you need to rethink the number of populations you will require in a revision of the recovery plan.

→ Paradigm Shift: The existing recovery plan described "recovery" in terms of a few secure (permanent) populations. But newer thinking has us thinking that more, less secure, more risky populations are acceptable though the existing 'secure' populations should not be considered expendable.

CB: Is there any way Natural Resources Conservation Service or Resource Conservation District could help us with these private sites?

- Arroyo Chub Distribution in Mojave Basin - Steve Lowe, Steve Parmenter

SB: We need to identify barriers both up and downstream to reintroduction. Distribution in terms of applicability of information. We know more about downstream, little about upstream.

CO: Purpose of survey is to understand AC distribution relative to the MTC.

- Hybrid Question - Steve Parmenter

CO: What I saw in the recovery plan was that wherever AC exists, we will not consider those sites for reintroduction. But what we discussed yesterday, we said we should not draw such a hard and fast line.

MT: If it's a good graduate question, good laboratory study, I know Northern Arizona University is equipped to do this.

SP: My idea is that Bernie May and a grad student who have already worked on chub, they already have the markers to determine what is and isn't a hybrid - they would be the ones to do this.

GK: Dexter National Fish Hatchery is a potential area where hybridization experiments could occur.

FLIP CHART

Education Component

- Interpretation/Environmental Education Partner Effort - James Woolsey, BLM/EE, Desert Studies Center (B. Presch)
- Fish tank and pond at DDC - James Woolsey, Rose-BLM, Doug Threlhoff, Casey Burns
- MTC traveling trunk - James Woolsey, Mietek Kolipinski
- MTC on the Desert Managers Group web site -- Debra Hughson
- Other venues - James Woolsey, Scott Bonar

JWool is lead for all of this, but needs assistance from Casey Burns and Rose Foster at BLM. The DSC Group will also consider/ask whether their partners could participate.

- Interpretation/EE partner -
- Fish pond and tank at DDC - Woolsey, Rose Foster and Casey Burns. Requires a permit application so Doug Threlhoff needs to be involved.
- MTC - traveling trunk - Mietek will get info to Woolsey
- Desert information research group - DMG website

→ All lot of these could be merged into a current group (the Barstow area group)

- Other venues - consider other locations for an outreach effort to the public and try to catch those who would not go to the Discovery Center.

→ Website - Debra will take lead and work with existing NPS websites.

→ Are there basic concepts that we need to openly acknowledge?

→ Review the AFS guidelines to assess whether or how to tailor them to guide any introductions of this species. Concepts group needs to incorporate this into the problem statement.

→ We will work towards down-listing by establishing a number of refuge populations including using created habitats.

FLIP CHART

Plan Principles - include front matter

- No plan proposal would do harm to "ecosystem"
 - Created habitats
 - Native habitats
 - AFS guidelines
- Permanent and temporary populations okay
- Work on down-listing by establishing refugia

Work on delisting - acquiring information to assess feasibility

→ Then incorporate the new information to revisit the delisting description at a future time when that may be necessary.

→ Acknowledge the paradigm shift in the recovery strategy.

? How many refugia are necessary to achieve down-listing?

→ Depends on the risk factors for each individual refugia, and then looking at the aggregation. The paradigm shift factors into this.

? How many individuals, of what sex ratio, constitute a viable population?

→ Need to articulate a science question about population viability analysis. This question cannot be answered without further study. But we don't have the basic demographic data to feed these studies.

FLIP CHART

Down and Dirty Decisions

- How many refugia are truly necessary for down-listing?
 - How many individuals of what sex ratio constitute a viable population?
- Population viability, risk assessment section, threats list - *M. Culver* (?), *M Trammell*, *John Wullschleger*, *Bernie May*

→ Requires further study.

→ Melissa, John and Melanie Culver will scope these questions after consultation with experts (including Bernie May) and they will bring it back to the group for vetting.

→ More plan principles: The motivation for a down-listing focus rather than delisting is the perception or reality that population management may have fewer hurdles if the species were threatened rather than endangered (i.e. there are bureaucratic obstacles that come with the endangered status)

→ Need to keep these planning thoughts in sync with State laws to assure they don't get crosswise. California has two laws which will complicate movement/management of this species.

→ Management actions needed now in anticipation of the unknown effects of the recent algae blooms in Lake Tuendae and the recently discovered occurrence of tapeworms here.

- Buy equipment to have ready in case the algae bloom begins causing fish mortality. SP will work with DH to determine the equipment needs.
- Develop a protocol to monitor the population informally until the more formal analyses can occur. MT and SP will work with RF.

Appendix C – assignment of responsibilities

POST-WORKSHOP ASSIGNMENTS	
VOLUNTEERS	TASKS
Scott Bonar/Sean Tackley	<ul style="list-style-type: none"> ▪ Other studies/research needed - Asian tapeworm ▪ Other studies/research needed - Interaction within Lake Tuendae (D. Hughson, S. Parmenter, M. Kolipinski) ▪ Education -Other venues (J. Woolsey) ▪ Funding-National Fish & Wildlife Foundation ▪ Funding-FWS Cooperative Unit/University of Arizona
Casey Burns	<ul style="list-style-type: none"> ▪ Habitat Assessment-above Silver Lake (C. Burns, D. Hughson, JW, R. Bransfield) ▪ Habitat Assessment-Afton Canyon & Harper Dry Lake (B. Presch, R. Bransfield) ▪ Fish pond at Desert Discovery Center (J. Woolsey, Rose-BLM, D. Threlloff)
Ray Bransfield	<ul style="list-style-type: none"> ▪ Habitat Assessment-above Silver Lake (D. Hughson, J. Woolsey) ▪ Habitat Assessment-Afton Canyon & Harper Dry Lake (C. Burns, B. Presch, R. Bransfield)
Tom Egan Partnerships	<ul style="list-style-type: none"> ▪ University and NGO partnerships (L. Norris) ▪ Habitat Assessment-Deep Creek (R. Bransfield)
Rob Fulton	<ul style="list-style-type: none"> ▪ 'Minimum' requirements of refugium (S. Parmenter, S. Williams) ▪ Other studies/research needed - population structure, census/index (B. Presch, M. Trammell, D. Threlloff)
Debra Hughson	<ul style="list-style-type: none"> ▪ Other studies/research needed - Interaction within Lake Tuendae (D. Hughson, S. Bonar, S. Parmenter, M. Kolipinski) ▪ Refugia monitoring protocols (A. Kearns, S. Parmenter, S. Williams, M. Trammell) ▪ Habitat Assessment-above Silver Lake (C. Burns, J. Woolsey, R. Bransfield) ▪ MTC on Desert Managers Group website ▪ Funding-Department of Defense Legacy/Desert Managers Group (L. Whalon) ▪ Funding-Lewis Center

POST-WORKSHOP ASSIGNMENTS	
VOLUNTEERS	TASKS
Anne Kearns	<ul style="list-style-type: none"> ▪ Refugia monitoring protocols (S. Parmenter, S. Williams, D. Hughson, M. Trammell)
Mietek Kolipinski	<ul style="list-style-type: none"> ▪ Other studies/research needed - Interaction within Lake Tuendae (D. Hughson, S. Bonar, S. Parmenter) ▪ MTC traveling trunk (J. Woolsey) ▪ Funding-Species at Risk (D. Threloff)
Bernie May	<ul style="list-style-type: none"> ▪ Hybrid questions (B. May) ▪ Population viability & risk assessment (M. Trammell, M. Culver, J. Wullschleger)
Larry Norris	<ul style="list-style-type: none"> ▪ University and NGO partnerships (T. Egan) ▪ Funding-The Nature Conservancy [Three Desert Rivers]
Steve Parmenter	<ul style="list-style-type: none"> ▪ Statement of problem, front matter (D. Threloff, B. Presch, J. Wullschleger) ▪ 'Minimum' requirements of refugium (S. Williams, R. Fulton) ▪ Other studies/research needed - Interaction within Lake Tuendae (D. Hughson, S. Bonar, M. Kolipinski) ▪ Refugia monitoring protocols (A. Kearns, S. Williams, D. Hughson, M. Trammell) ▪ Arroyo Chub distribution (S. Parmenter) ▪ Hybrid questions (S. Parmenter, B. May) ▪ Funding-WC Board, Scott Clemens ▪ Funding-CalTrans EEM grants ▪ Funding-Endangered Species Act Section 6
Bill (William) Presch	<ul style="list-style-type: none"> ▪ Statement of problem, front matter (S. Parmenter, D. Threloff, J. Wullschleger) ▪ Other studies/research needed - population structure, census/index (R. Fulton, M. Trammell, D. Threloff) ▪ Habitat Assessment-Deep Creek (T. Egan) ▪ Habitat Assessment-Afton Canyon & Harper Dry Lake (C. Burns, B. Presch) ▪ Funding-Desert Studies Center in-kind contributions ▪ Funding-Mojave Water District water quality studies
Steve Lowe	<ul style="list-style-type: none"> ▪ Arroyo Chub distribution (S. Lowe, S. Parmenter)

POST-WORKSHOP ASSIGNMENTS	
VOLUNTEERS	TASKS
Doug Threlhoff	<ul style="list-style-type: none"> ▪ NPS will be coordinating agency (see J. Wullschleger) ▪ Statement of why MTC is in need of substantial funding. Describe the threats that currently affect the fish(S. Parmenter, B. Presch, J. Wullschleger) ▪ Develop methods for pursuing other studies/research and assessing population structure and abundance. These activities will be done in coordination with R. Fulton, B. Presch, M. Trammell) ▪ Assess potential for reintroducing fish to Fish pond at Desert Discovery Center (J. Woolsey, Rose-BLM, C. Burns) ▪ Pursue the potential for getting funding through the Species at Risk program (M. Kolipinski)
Melissa Trammell	<ul style="list-style-type: none"> ▪ Other studies/research needed – population structure, census/index (R. Fulton, B. Presch, D. Threlhoff) ▪ Refugia monitoring protocols (A. Kearns, S. Parmenter, S. Williams, D. Hughson) ▪ Population viability & risk assessment (M. Culver, J. Wullschleger, B. May)
Susan Williams	<ul style="list-style-type: none"> ▪ 'Minimum' requirements of refugium (S. Parmenter, R. Fulton) ▪ Refugia monitoring protocols (A. Kearns, S. Parmenter, D. Hughson, M. Trammell)
Larry Whalon	<ul style="list-style-type: none"> ▪ Funding-Department of Defense Legacy/Desert Managers Group (D. Hughson)
Danette Woo	<ul style="list-style-type: none"> ▪ MTC Workshop notes ▪ Coordinate communication between workshop participants/other interested parties
James Woolsey	<ul style="list-style-type: none"> ▪ Habitat Assessment-above Silver Lake (C. Burns, D. Hughson, R. Bransfield) ▪ Interpretation/Environmental Education partnering (BLM-EE, Desert Studies Center) ▪ Fish pond at Desert Discovery Center (J. Woolsey, Rose-BLM, D. Threlhoff, C. Burns) ▪ MTC traveling trunk (M. Kolipinski) ▪ Education -Other venues (S. Bonar, J. Woolsey)

POST-WORKSHOP ASSIGNMENTS	
VOLUNTEERS	TASKS
John Wullschleger	<ul style="list-style-type: none"> ▪ NPS will be coordinating agency ▪ Statement of problem, front matter (S. Parmenter, D. Threlhoff, B. Presch) ▪ Other studies/research needed - compatibility with other species ▪ Population viability & risk assessment (M. Trammell, M. Culver, B. May)

Appendix D – flip chart meeting notes

Names of workshop participants are associated with certain tasks and themes.

FLIP CHART NOTES

(1) GOALS

- Develop guidance for immediate management actions
 - 1) fish sampling
- Develop guidance for longer-term habitat and down-listing
 - 1) necessary attributes LT?
- Provide foundation for interagency management plan
- 10-15 year goal → down-list species
- Identify research needs
 - 1) hybridization?
 - 2) Why did St. Amant's reintroductions fail?

(2) MANAGEMENT ACTIONS

1. Monitor for stratification
 - Aeration → yes → bubbler? One side only? Other alternatives
 - no → go to 2.
2. Monitor turbidity - Secchi disk. Correlate to dissolved oxygen (DO)
3. Status of tapeworm in all known populations.
4. Survey - sample - population structure in Lake Tuendae.
5. Research needs
 - How many refugia - 3? 6?
 - How many fish in a viable population - 300? 500?
 - Can we ever recover this fish? **NO**
 - Can we down-list this fish? **YES**
 - How many refugia? → Lewis Center can get FWS permit in one year - promise from Ray Bransfield (September 3, 2003).
 - How many fish per refugium?
 - For how long?
6. Actions
 - 1) Lewis Center will consult closely with USFWS to develop a proposal to stock an artificial pond on Lewis Center land.
 - 2) FWS will attempt to issue a permit within one year.
 - 3) This will create a new refugium and provide unlimited public outreach/educational opportunities.

(3) PLAN PRINCIPLES

Pursue down-listing through options

- Special rule (explored) - regulatory relief
- Public awareness
- Education

Immediate Management Actions

1. Aerate Lake Tuendae
2. Set up trapping schedule to track population status/trends

(4) PROPOSED STRATEGY TO DOWN-LIST MOHAVE TUI CHUB

Foundation Concepts

- Multi-agency participation and funding for mitigation: Desert Managers Group (DMG) includes NPS - MOJA, USGS, BLM, USFWS, USFS, DOD
- University and NGO partners: CSU system, UC system, University of Arizona - Larry Norris, Tom Egan

- Contract where necessary
- NPS will be coordinating agency - *John Wullschleger, Doug Threloff*
- Statement of problem, front matter: *Steve Parmenter, Doug Threloff, John Wullschleger, Bill Presch*
- Coordination - Danette Woo to coordinate electronic communication, etc.
- TNC - Larry Norris can talk to the TNC in Arizona and follow up with this.

Geographic Scope

- “Range-wide” “recovery” goals articulated in plan
- Guidance on immediate management “actions”

Science Stuff

- B/C - Articulate required “minimum” characteristics of refugium; “refuge parameters,” human influence - *Steve Parmenter, Susan Williams, Rob Fulton*
- List other studies/research needed on MTC
 - Asian tapeworm - *Scott Bonar, Sean Tackley, B*
 - Limnology question - C
 - Aeration, Lake Tuendae ecology study - B
 - Population structure, census/index - *Rob Fulton, Bill Presch, Melissa Trammell, Doug Threloff, B*
 - Interaction within Lake Tuendae - *Debra Hughson, Scott Bonar, Steve Parmenter, Mietek Kolipinski, B*
 - Compatability with other species - *John Wullschleger, B*
 - Bioenergetics - B
- All extant and future refugia monitored under uniform protocols - *Annie Kearns, Steve Parmenter, Susan Williams, Debra Hughson, Melissa Trammell*
 - Population census - add to long-term study
 - Water quality/quantity - add to long-term study
 - Turbidity - add to long-term study
- Habitat assessments B/C
 - Deep Creek (USFS headwaters) - *Tom Egan, Ray Bransfield*
 - Above Silver Lake (including Lewis Center) - *Casey Burns, Debra Hughson, JW?, RB?*
 - Afton Canyon, Harper Dry Lake - *Casey Burns, Bill Presch, Ray Bransfield*
- Arroyo Chub distribution in Mojave Basin B - *Steve Loe, Steve Parmenter B*
- Hybrid question - *Steve Parmenter, Bernie May, UNLV - Dexter B*

Education Component

- Interpretation/Environmental Education Partner Effort - *James Woolsey, BLM/EE, Desert Studies Center*
- Fish tank and pond at DDC - *James Woolsey, Rose-BLM, Doug Threloff, Casey Burns*
- MTC traveling trunk - *James Woolsey, Mietek Kolipinski*
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- Other venues - *James Woolsey, Scott Bonar*

Plan Principles - include front matter

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- Work on delisting - acquiring information to assess feasibility

Down and Dirty Decisions

- How many refugia are truly necessary for down-listing?
 - How many individuals of what sex ratio constitute a viable population?
 - Population viability, risk assessment section, threats list
- M. Culver, M Trammell, John Wullschleger, Bernie May*

(6) FUNDING

- NPS-NRPP/T&E/WRD/NRAC - December 2003 - *MOJA/PGSO*
15 September, 2003 Desert Parks Network meeting
USGSBRD → Species at Risk - *Mietek Kolipinski, Doug Threlloff*
Canon Scholarship
CCS/Western National Parks Association
MOJN I&M
- National Fish and Wildlife Foundation - *Scott Bonar*
- WC Board (Scott Clemens) - *Steve Parmenter*
- The Nature Conservancy - Three Desert Rivers - *Larry Norris*
- Lewis Center - *Mojave National Preserve* to initiate
- Desert Studies Center in-kind contributions
- CalTrans EEM Grants - *Steve Parmenter*
- Endangered Species Act Section 6 funds with DFG match - *Steve Parmenter*
- Mojave Water District water quality studies - *Bill Presch*
- FWS Cooperative Unit, University of Arizona - non-federal match - *Scott Bonar*
- DOD Legacy Fund - Desert Managers Group -- *Mojave National Preserve*

Habitat Assessment continued

(6) PRIVATE LANDS SITE ASSESSMENTS

Silver Lakes/Helendale
Calico Lakes
Bryman Townsite, Palisades Ranch
Narrows Stretch
Hatchery
Spring Valley
