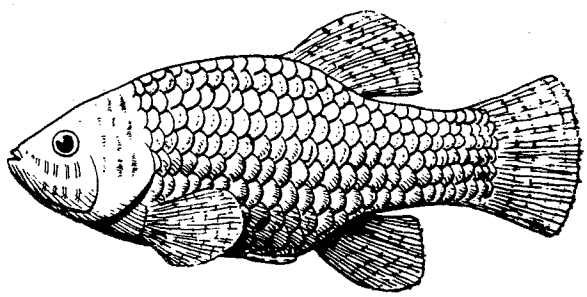
Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

A Summary of the Proceedings of the Tenth Annual Symposium

Edited by
Edwin P. Pister
California Department of Fish and Game
Symposium Coordinator

Held at
Holiday Inn de Las Cruces
Las Cruces, New Mexico
November 16-18, 1978

Produced by the Desert Fishes Council
in Cooperation with the University of Nevada, Las Vegas

Desert Fishes Council, 407 West Line Street, Bishop, California 93514
January 30, 1980

The proceedings of the Council's Tenth Annual Symposium are gratefully dedicated to Carl and Laura Hubbs, whose exemplary influence upon the living resources of the world and upon mankind transcends this life and extends into the eternities.

FOREWARD

This summary represents a continuation of similar reports which were completed and disseminated following the first and second annual symposia in 1969 and 1970. Summaries of symposia held between 1971 and 1977 have been completed and are now being prepared for publication as a compendium. The Council's executive committee decided to give priority to the publication of the 1979 meeting summary in order to make the most pertinent material available to the public at the earliest possible date. The 1971-77 compendium will, hopefully, follow shortly.

In line with the international concerns and philosophies inherent within the Council, authors and other participants were encouraged in 1978 for the first time to submit a Spanish abstract; or, when a paper was written or a presentation was made in Spanish, an English abstract was requested. These guidelines were occasionally adhered to.

The primary purpose of the Council remains one of sheer practicality: to preserve the native fishes and aquatic ecosystems of the North American deserts. The Council is unanimous in its feeling that this can best be accomplished through the widespread exchange and dissemination of research and management information. Symposium participants are given the choice of using this summary as a means of publishing papers or simply to provide English and Spanish abstracts, should they wish to publish elsewhere.

TABLE OF CONTENTS

Table of Contents - continued

Table of Contents - continued

THE PROCEEDINGS OF THE TENTH ANNUAL SYMPOSIUM

Introduction

The Tenth Annual Symposium was held on November 16-17, 1978 at the Holiday Inn de Las Cruces, Las Cruces, N.M. and was co-hosted by the New Mexico State University Chapter of the American Fisheries Society and the New Mexico Department of Game and Fish. The group was welcomed to the area by Dr. William H. Matchett, Dean of New Mexico State's graduate school, following which Dr. John Hubbard of the New Mexico Department of Game and Fish outlined New Mexico's nongame program. Dr. Hubbard reported that the nongame program is the Department's first to be financed from general fund revenues. Four biologists are now involved in the nongame program which covers (among the other nongame taxa) 60 native fishes. At this point invertebrate jurisdiction is limited to molluscs and crustaceans. Dr. Hubbard requests the assistance and ideas of other agencies in setting up New Mexico's program.

Endangered Species Act

Dr. James E. Williams, Staff Ichthyologist with the Office of Endangered Species, Washington, D.C., reported on the current status of the Endangered Species Act and the Office of Endangered Species. At that time things were in a very unsettled state owing to very recent amendments in the act which were not yet thoroughly understood (the legislation was signed late on Friday, November 10). The amended act was renewed for 18 months, and will be in a state of re-evaluation until then. It was Dr. Williams' understanding that a high level review board and committee will be established to consider irreconcilable cases, such as Tellico Dam, consisting of the secretaries of the Army, Interior, and Agriculture; the administrators of N.O.A.A., and the Environmental Protection Agency; a representative of the state (or states) involved; and the Chairman of the Council of Economic Advisors. Five of the seven representatives would need to vote in favor of exemption from the Endangered Species Act for such an exemption to be granted.

Much concern was expressed as to how political this board might become. In general, the next year will be a very critical time relative to endangered species management. Much care must be exercised to keep public opinion in favor of the concepts involved. Under the new circumstances, the speed of action of the O.E.S. will be slowed considerably.

If extinctions are expected to occur following a Board action, 30 days are granted to work out the problems of making introductions into new areas. We may expect a re-definition of critical habitat; i.e., the specific area occupied by a species on which are found the requirements of a species, including any outside areas necessary for its continued existence.

It is now necessary that consideration be given to the economic impact of specifying critical habitat, and local government must be notified of any plans in this respect.

Good News: The amended act covers plants, whereas the old one did not. It also allows for the purchase of land to preserve plants. Congress has deemed appropriate an expenditure of up to $23 million dollars to administer the Act in 1979, and $12.5 million for the 6 months of 1980 prior to its expiration. The review committee outlined earlier was allocated $900,000 for review processes.

REPORTS BY AGENCY REPRESENTATIVES

Chairman: Paul Turner, New Mexico State University, Las Cruces.

Forest Service

Jerry Stefferud of the Inyo National Forest, Bishop, reported on the following activities within the California Region:

1. Genetic studies to determine the purity of Paiute cutthroat trout (Salmo clarki seleniris) are underway, as are management programs to assure its continued existence, both in its native range and in transplant sites.

2. Studies to determine essential habitat are being conducted in the Modoc National Forest for the Modoc sucker (Catostomus microps), shortnose sucker (C. brevirostris), and Lost River sucker (C. luxatus).

3. A recovery plan was completed and submitted for the unarmored, three-spine stickleback (Gasterosteus aculeatus williamsoni) in the Angeles National Forest. Habitat restoration is being conducted to slow down the stream.

Bruce Anderson, speaking for the Gila National Forest, described spawning research, stream improvement and maintenance, and riparian vegetation studies being conducted in relation to the Gila trout, Salmo gilae.

Steve Loe represented the Coronado National Forest. He outlined a program designed to utilize forest habitats for fishes not doing well in big river situations. He described a common observation that Forest Service administrative personnel oppose establishment of endangered fishes in areas they want to develop.

Fish and Wildlife Service

Sacramento: Gail Kobetich.

The Sacramento Office is in charge of endangered species in Nevada, California, and eastern Oregon, with a staff of 2 botanists, 2 aquatic biologists, 2 ornithologists, a mammalogist, and a Section 7 team leader. Major activities are still centered around Great Basin fishes. $10,000 has been allocated for work on the Warner sucker (C. warnerensis); a contract has been issued to Jim Deacon for monitoring the fishes around

Las Vegas, and $40,000 has been designated for an extension of the cui-ui (Chasmistes cujus) restoration program.

Attempts were made this past spring to ascertain the population status of the Warner sucker. The species is temporarily safe, but purchase of key habitat areas is needed. Blocks to spawning grounds must also be removed.

Cui-ui are showing signs of recovery, and there are indications that hatchery released fish may now be contributing to the population. These fish were released as swimup fry.

Salt Lake City: Bill Miller.

Some positions were filled before the hiring freeze, and the Section 7 team is under the direction of John Gill. Most work is being devoted to raptors and fishes. The squawfish (Ptychocheilus lucius) plan has been completed, and an implementation workshop is now being set up. This will include an overview of the recovery plan, agency involvement, financial problems, propogation and reintroduction, and management. The humpback chub (Gila cypha) plan draft is now back and will soon go to Washington. A Colorado River fishes brochure is in preparation and should be out in a few weeks.

Efforts are being made to have the Bureau of Reclamation prepare an environmental impact statement for the Colorado River drainage. This is badly needed to pull all the problems together. The Fish and Wildlife Service received notice this week of law suits filed against them by water districts for being arbitrary and capricious concerning the Endangered Species Act holding up water projects.

Albuquerque: Jim Johnson.

Jim expressed mixed reactions at this time concerning the direction taken by the endangered fishes program. Programs are in three stages: 1) listing, 2) pre-management, and 3) management. Critical habitat designations for the squawfish and woundfin (Plagopterus argentissimus) have been published.

There is a budget of $100,000 for contract studies in Region 2, mainly on the smaller rivers. Two contracts are with Jim Deacon at UNLV for the woundfin: one is for a motion picture depicting the plight of the Colorado River squawfish, and one is for capturing squawfish for Willow Beach National Fish Hatchery for gene pool protection and reintroduction as habitat is rehabilitated. Consultation with the Fish and Wildlife Service is now required before exotic introductions may be made into the Colorado River. Stocking of squawfish into the San Juan River is now being made amidst mixed emotions within the Interior Department. Bureau of Reclamation projects will take 60 percent of the flow of the San Juan, which will dry it up at certain times of the year. Indian water rights are also involved here. The Service has consulted on Glen Canyon Dam, and Reclamation may fund endangered species studies below. The National Park Service is in

the process of closing to fishing the Colorado for 1/2 mile above and below the mouth of the Little Colorado to protect Gila cypha. Three recovery plans are ready for signature: Gila trout (Salmo gilae), woundfin (Plagopterus argentissimus), and Arizona trout (Salmo apache). The San Bernardino Ranch may be purchased to preserve the Rio Yaqui fish fauna.

Phoenix and Albuquerque: Dane Johnson

Ecological Services is concerned primarily with water development projects, to be certain that fish and wildlife resources are considered. Much time has been devoted to a comprehensive literature review (funded by the Bureau of Reclamation) of the distribution and abundance of fishes of the lower Colorado River from Lee's Ferry to the international boundary. Records were obtained of 79 species within 20 families and 9 orders. Of the 79 species, 60 are introduced. Of the 19 native fishes, Federal listings include 1 threatened, 4 endangered, 1 proposed as threatened, 1 proposed as endangered, and 1 subspecies proposed as endangered, leaving only 11 in a relatively secure status (for now, anyway).

Dexter Creek National Fish Hatchery: Buddy Jensen.

Dexter Creek Hatchery is located 20 miles southeast of Roswell, near the Pecos River in the southeast quadrant of New Mexico. It was constructed by the Fish and Wildlife Service in 1931 and was in the process of being closed down when it was converted to an endangered fish facility. It utilizes 22 ponds ranging in size from 0.3 to 3 acres in area. Only four of the ponds are less than 0.5 surface acres. Plans are to construct 20 new ponds. Funds for such construction are in short supply, but plans are to utilize Y.A.C.C. labor. Objectives of the facility are to:

1) Serve as a refugium for endangered and threatened fishes and to provide a gene pool reserve. There are currently 12 species being held at Dexter Creek.

2) Propogate endangered and threatened fishes for re-introduction following habitat restoration.

3) Provide stocks for research of other institutions and agencies.

4) Develop techniques for rearing. This is essentially an entire new field of fish culture.

5) Eventually construct a stream habitat.

6) Conduct research as directed by agencies and recovery teams.

7) Bring in researchers to work at the station.

The Dexter Creek program is totally financed by Endangered Species funds.

Despite the extreme care being exercised to minimize chances of mixing and subsequent hybridization, predatory birds pose a real threat by carrying live fish from one pond to another. Water quality is excellent at Dexter Creek, and disease currently poses no problem.

National Park Service: Pete Sanchez, Death Valley.

Currently, all is well in the Death Valley System, although we may expect round two in a couple of years when land division starts in Ash Meadows. Mining activity with the National Park System is now controlled by the Mining in Parks Act of 1976. The Park Service is now showing concern over "insignificant" creatures, such as snail habitat protection during water system reconstruction. Two unsuccessful attempts were made to control Gambusia affinis at Scotty's Castle during 1978, and the project will be carried on again in 1979 using new technology.

Bureau of Reclamation: Herb Guenther, Boulder City.

The Bureau is funding the following studies: 1) squawfish and humpback chubs in the Grand Canyon from Separation Rapids to Lee's Ferry (Museum of Northern Arizona); 2) baseline fisheries study from Boulder Canyon to Separation Rapids (Arizona Game and Fish); 3) baseline fisheries study from Boulder Canyon to Davis Dam (Nevada Fish and Game); 4) limnological study of Lakes Mead and Mohave (University of Nevada, Las Vegas); 5) five-year black bass study in Lake Mead (Arizona and Nevada Fish and Game Departments); 6) Zuni mountain sucker (New Mexico Game and Fish, Fish and Wildlife Service, University of Michigan, and State University of New York, Stony Brook); 7) fisheries study concerning Colorado River Basin salinity control project (Engineering Science - Calif.); 8) Utah Lake aquatic study (Eyring Institute); 9) change in game fishes below Flaming Gorge Reservoir (Utah Div. Wildlife Resources); 10) changes in macro-invertebrates and endemic fishes with empahsis on humpback sucker and squawfish (Paul Holden, Bio West).

Bureau of Land Management: Jim Yoakum, Reno.

Severe budget cutbacks allowed the attendance of only one BLM representative. Although BLM has been showing some signs of growing pains, it is also showing some signs of maturation. The Federal Land Use Policy Act mandates BLM to consider fish and wildlife management as an acceptable use of land. Jim strongly emphasized the need for state-federal cooperation.

Utah Division of Wildlife Resources: Marianne Crawford, Salt Lake City.

The Division is currently undergoing reorganization, and two new sections have been created: resource analysis and nongame management. The nongame section is staffed by a raptor biologist, an ornithologist, a mammalogist, and a fishery biologist (Ms. Crawford). Her graduate work was on the least chub (Iotichthys phlegethontis) and possibilities for its habitat rehabilitation. Recent work with the Division has been on Deep Creek and the Bonneville cutthroat (Salmo clarki utah). Utah is trying to get a strong program going rather than reacting only to crises.

New Mexico Department of Game and Fish: Mike Hatch and John Hubbard.

The outlook is positive for the state's nongame program. During the past year the Department has produced a handbook of endangered New Mexico species, which is available to all agencies involved with fish and wildlife matters. Thirty fish species are considered by New Mexico to be endangered, with four of them federally listed. New Mexico is active on two recovery teams. They are currently under contract from the Rocky Mountain Forest and Range Experiment Station to compile all available data concerning the fishes of New Mexico and to fill all known gaps. This includes a complete review of literature and records; contact with all major museums; compiling all data into a computer system; and filling gaps with field work. Day-to-day activities contribute to the progress of the statewide survey, and the San Juan River survey is a good example of this.

The Department is currently involved in a survey of the Zuni River drainage with the Bureau of Reclamation and the Fish and Wildlife Service. Primary work is on the Zuni mountain sucker, Pantosteus discobolus yarrowi. The primary purpose of the study is to inventory the resource before dams, etc., might be built. A similar study of the San Francisco River drainage was completed by Paul Turner of NMSU.

The Department is also working with John Rinne of the Rocky Mountain Forest and Range Experiment Station to determine key management areas for the Gila topminnow, Poeciliopsis occidentalis, and is involved in a major survey of the fishes of the Rio Grande. This type of survey will eventually be done for all waters in New Mexico.

Surveys are also underway to locate the bluntnose shiner (Notropis simus). An undescribed species of Notropis has been found in the lower Pecos River, and a dam is proposed there. Our assumptions that a species may be plentiful are often incorrect and must be verified by field observations. The silvery minnow (Hybognathus nuchalis) is native to the Pecos River drainage and was thought to be one of the most abundant fishes in the state. However, closer examination showed it to be nearly taken over by the Plains minnow (Hybognathus placitus).

A favorable evolutionary philosophical change relative to nongame animals is being noted within the Department, and John Hubbard described a philosophically liberal wildlife management plan within the Department which grants equal status to all species, game and nongame alike. This is of great value in justifying nongame programs. The New Mexico nongame function views itself as a reconstituted "biological survey". Work with certain agencies and consulting firms has been disappointing to date because they have often demonstrated a low degree of philosophical and biological competence.

The New Mexico endangered species handbook outlines why the component organisms reached endangerment. Interbasin transfers of fishes are rampant and are being documented. The new plan commits the Department to a program involving the maintenance of genetic diversity.

The need for a new classification of "experimental introduction" is needed to resolve the political objectives inherent in transplanting endangered and threatened fishes.

California Department of Fish and Game: Phil Pister

In the absence of Steve Nicola, who heads up California's nongame aquatic function, Phil Pister reported that California has a staff comprising a coordinator, two nongame fish biologists, a threatened trout biologist, an invertebrate zoologist, and two herpetologists. This is exclusive of regional biologists who spend much of their time on nongame management. Staff expenditures total about $250,000 annually, and $100,000 is spent annually by the regions. These figures include contractual funds and temporary help. Before Proposition 13 passed, we had hoped to add one biologist to the nongame staff and one biologist to each of the Department's five inland regions. However, Governor Brown's hiring freeze prevented this.

California law directs the Department (among other things) to strive for "the maintenance of sufficient populations of all species of aquatic organisms to insure their continued existence". This is a staggering mandate, but we are doing our best to achieve it in the face of very difficult curcumstances.

We have noted a 5-10 year gap between the recognition of an impending (or existing) problem and our ability to structure and fund a management program to handle it. It was this very situation which caused the formation of the Desert Fishes Council. California Fish and Game also coordinates an interagency Committee on Threatened Trout to handle threatened native trout species within the state.

RESEARCH PAPERS AND ABSTRACTS

Chairmen: Mike Hatch, New Mexico Department of Game and Fish, Santa Fe;
Phil Pister, California Department of Fish and Game, Bishop.

The Solution to the *Cyprinodon bovinus* Problem:

Eradication of a Pupfish Genome

Clark Hubbs
Department of Zoology
The University of Texas at Austin
Austin, Texas 78712

The Leon Springs pupfish, *Cyprinodon bovinus*, is restricted to the Leon Creek watershed, Pecos County, Texas. *Cyprinodon variegatus* of unknown provenance released into the creek between January and August, 1974, produced a major hybrid swarm in the lower segment of Leon Creek and threatened the genic purity of the species. The extensive efforts that resulted in the elimination of phenotypic evidence of hybridization are documented.

Cyprinodon bovinus was described by Baird and Girard (1853) based on 16 specimens (Girard, 1859) collected from "Leon's Springs, Texas" in 1851 by John H. Clark. The Leon Springs pupfish has many affinities with *C. tularosa* and *C. pecosensis* (Echelle and Echelle, 1978). As no further specimens of Leon Springs pupfish have been obtained from Leon Springs, it is appropriate to precisely identify the location and date of the material. John H. Clark was a naturalist assigned to the Mexican Boundary Survey. He is known to have accompanied Lt. Col. J. D. Graham during his journey from Indianola (23 April, 1851) to the boundary west of El Paso (13 September, 1851). It is assumed that Mr. Clark was with Col. Graham during the entire trip west. Col. Graham was in Castroville 19 May and Frontera 24 June. As Graham's profile map (1852) has 29 calculated elevations (= night camps?) between Castroville and Frontera (near El Paso) it is likely that they were camped at Leon Springs in the second week of June 1851. The "General Map" in Emory (1857), who succeeded Col. Graham after he had been relieved of his command, includes two listings for Leon Springs (and one King's Spring). The precise locations cannot be ascertained from the map but they seem close to 31°N., 103°W. Emory (1857:245) also reported that Lt. A.W. Whipple had located "Leon Spring" at 30°53' 33.1" N, 103°04' 13.0" W in 1850. Lt. Whipple who had preceded Col. Graham, was west of El Paso when Mr. Clark was travelling to El Paso. (Whipple had left Indianola in September 1850 and was in New Mexico in April 1851.) Lt. Whipple's coordinates plot slightly too far west for the present Leon Springs but there is no west longitude listed for the preceeding locality ("Camanche" Spring) in Emory (1857). Under any circumstance the latitude and longitude are even less appropriate for the alternate site as the latter is due north of Comanche Springs. Major Emory (p. 135) further listed Leon Springs as between Comanche and Varela (= Barrila) springs and 8.88 miles from

Comanche Springs (and 61.86 miles from Ft. Davis). The location of Leon Springs, 30°53' N, 103°01' W (Brune, 1975) is slightly more than 8 airline miles west of Comanche Springs (and 57 miles from Ft. Davis). Assuming minor increases due to road miles, the distances match well. Brune (1975) lists one Leon Spring(s) in Pecos County and none in Brewster, Jeff Davis, Presidio, or Reeves counties. The listing is for several springs (= outlets) 8 miles west of Fort Stockton. Although the spring had a reliable flow exceeding 0.5 stere (= cubic meter) per second prior to 1930, Brune listed it as having no flow by 1958.

Subsequent attempts to collect the species from Leon Springs were unsuccessful and it was listed as extinct by Hubbs (1957), Miller (1961) and in the 1966 list of Rare and Endangered Fish and Wildlife of the United States. No pupfish were found 9-10 September, 1938 from the outlet irrigation ditch or "improved" spring heads (likewise no Gambusia nobilis were obtained among the Astyanax mexicanus, Notropis lutrensis, Cyprinus carpio, and Gambusia affinis) (field notes by Carl L. Hubbs). The spring run was impounded in 1918 (The location is now listed as Lake Leon on highway maps.), has been treated with rotenone (Knapp, 1953), and was dry before 1958 (Brune, 1975). It is obvious that Leon Springs pupfish no longer existed at the type locality long before 1960. The probable cause for extinction was impoundment as this perturbation preceded the 1938 sampling effort. The lake formed by Lake Leon Dam (originally called Leon Springs Dam) backed water up to or over Leon Springs. A 21 January, 1920 letter from the Texas State Board of Water Engineers to G. L. Moody of the Leon Springs Irrigation Company reported that the flow from the springs could not be measured as the "lake had backed up over the springs." Irrigation associated perturbations preceded construction of Lake Leon as Mr. and Mrs. Thomas Trammel were diverting water in 1908 and the Leon Springs Irrigation Company was diverting water in 1911. The canal shown within the reservoir in Fig. 1 is probably an

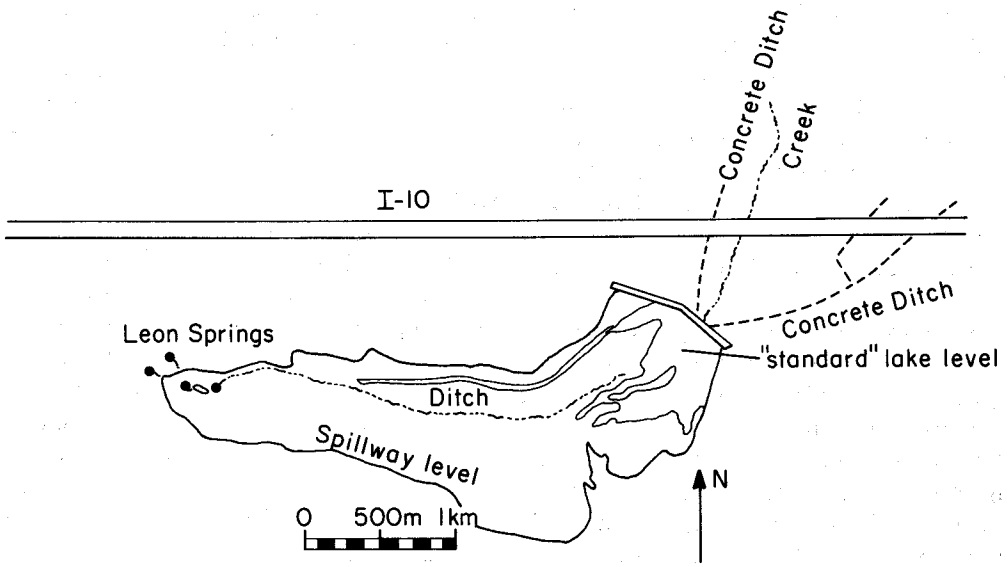


Fig. 1 Map of Lake Leon area. The extent of Lake Leon varies but seldom since 1950 has it extended to cover the dry Leon Springs. Flow down the creek is even less frequent and the dry bed has long been obscured.

initial diversion and the location of the 1938 fish sample. The area covered by Lake Leon in 1971 (the date for the map traced in Fig. 1) was probably less than that when the lake was full as the "level" mapped is 1 foot lower than the eroded and settled spillway. Presumably all spring heads were originally inundated. Water use reports for the lake indicate Lake Leon was full until 1932 (6 annual reports), had seasonally deficient supplies from 1939 until 1946, and that the source for irrigation water included artesian supplies consistently until 1946, alternated between creek or lake water and spring or artesian water from 1947 to 1951, and subsequently, the irrigation water was primarily or exclusively pumped ground water. Despite the change from artesian flow to pumped water, water use also suggested a decline in supply, above 5000 acre foot/year until 1932, above 4000 acre foot/year until 1944, above 3000 acre foot/year until 1960 and use was as low as 1000 acre foot in 1971. At the present, Lake Leon is formed from water pumped from wells and stored for gravity flow irrigation. The surrounding land is planned for development into a residential subdivision.

W. L. Minckley and W. E. Barber collected a pupfish from "Willbank Spring," north of Fort Stockton in December 1965 (Minckley and Arnold, 1969). The property at that time was owned by Henry Wilbank but the spring is properly named Diamond-Y Springs (Brune, 1975). Its location 31° N, 102° 54' W clearly does not correspond to that recorded by Lt. Whipple for Leon Springs and its elevation is lower than Fort Stockton, thus in contrast with the higher (1000 ft.) elevation of Leon Springs compared with Comanche Springs on Graham's (1852) elevation profile. Minckley thought the newly located population might be C. bovinus, a tentative identification confirmed by Echelle and Miller (1974). Hubbs and Echelle (1973) had previously discussed Cyprinodon bovinus as extant and endangered. Prior to the water depletion that accompanied extensive irrigation in the Leon Creek valley it is likely that water flowed from Leon Springs to that segment of Leon Creek adjacent to Diamond-Y Springs (if not permanently, at least with sufficient frequency that the population would have occasional genic interchange). Echelle and Miller (1974) report that the six remaining (of 16) syntypes (except for deterioration due to the age of the material) match well the attributes of pupfish recently collected from Leon Creek.

As Echelle and Miller (1974) point out, the entire range is in the middle of an oil and gas field and Diamond-Y Springs is less than one kilometer north (and down slope) from the Gomez (gas cracking) Plant of Northern Natural Gas Company. The oil field was developed in the 1940's (Ross L. Shipman, pers. comm.) and the pupfish have survived oil (and later gas) well drilling as well as more than 30 years of oil field operation, during which time a contamination sufficient to exterminate the fish did not occur before the fish was found to occur in the creek. Officials of Northern Natural Gas Company and Exxon Corporation (a primary participant in the oil field) have been receptive to ecological recommendations. In May 1974 the Soil Conservation Service built an earth dike to protect Diamond-Y Springs from possible problems that might occur in the Gomez Plant.

Existing permanent water inhabited by Leon Springs pupfish occurs in two semi-isolated segments about 15 km north of Fort Stockton (Fig. 2). The most pronounced spring source is Diamond-Y Springs which is located 500 meters north of the Gomez Plant. Water flows NE from Diamond-Y Springs for about 1 kilometer where it joins the main channel of Leon Creek. Leon Creek originates about 1 km to the west of the junction in

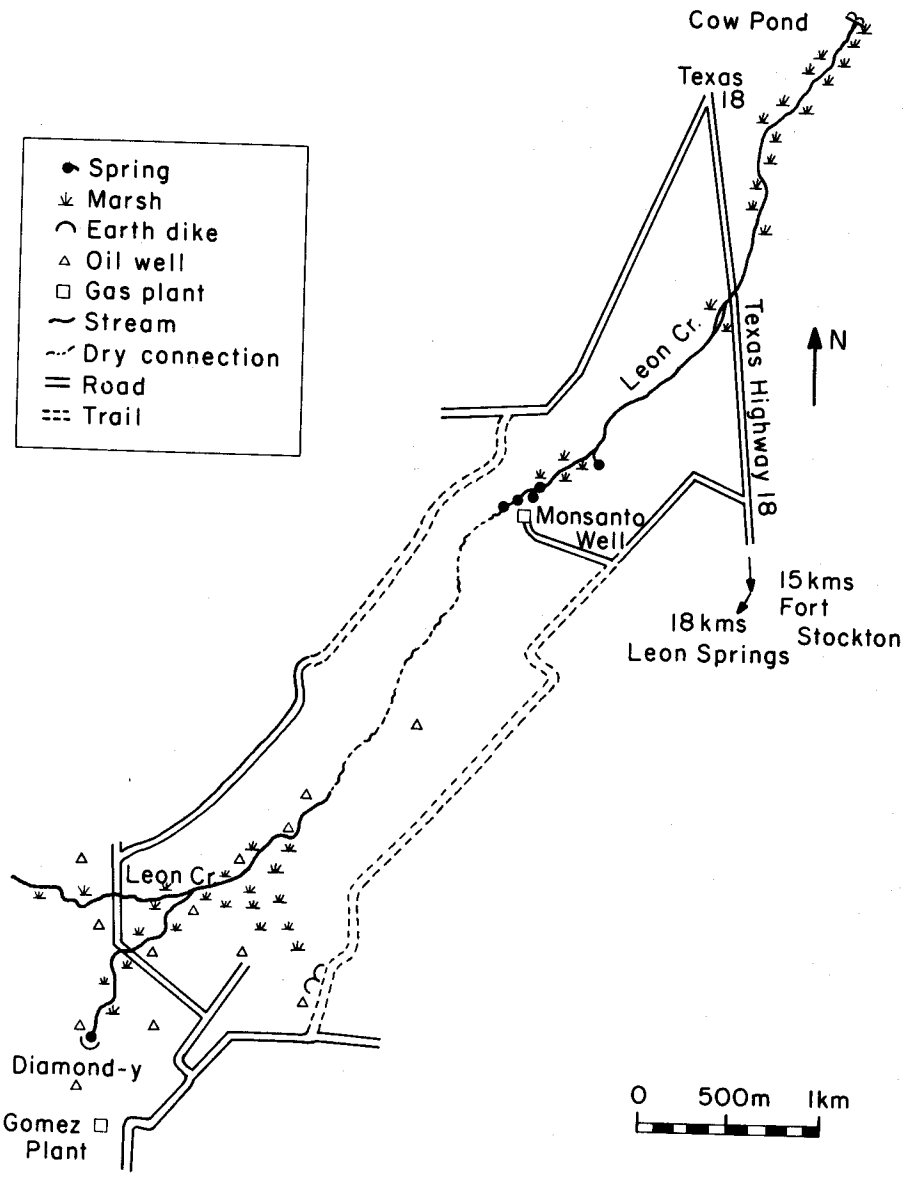


Fig. 2 Map of the two segments of Leon Creek. The upper segment is surrounded by an oil (shallow) and gas (deep) field. Other wells more than 100 meters from the creek occur throughout the area, and various pipelines form a complex network. Each well has an access road.

a series of seeps. Kennedy (1977) reported that at times Leon Creek was dry upstream from its confluence with the Diamond-Y Spring Run. The combined flow usually extends another kilometer NE and sinks into the soil. This upper segment was extensively studied by Kennedy (1977). The stream bed is often dry for the next 2 kilometers. Near a Monsanto Gas Company (= Monsanto Well) installation the stream bed again has water, much of it from springs in the bottom of a large pool 1.5 meters deep. Additional water comes from a series of springs on the south bank. The stream flows about 500 meters through a marsh and is then joined by the flow from another large south bank spring. From there it flows about a kilometer to the

Texas Highway 18 bridge. It continues NNE for up to 1.7 kilometers to end in two small stock tanks (= Cow Pond). The spring water in the lower segment is consistently 20°C and thus not likely to be reemerged upper segment water but rather another outflow from the same aquifer that initiates the flow of the upper section. The downstream extent of each segment varies depending upon prior climatic conditions. In March 1977 the lower segment was dry less than one kilometer NE of the Texas Highway 18 bridge but in August 1978 the two segments were connected by a substantial flow and the lower segment reached the Cow Pond. Similarly, the lower end of the upper segment may terminate nearly 200 meters SW of the location shown in Fig. 2. This variation is not especially seasonal but rather depends upon local climatic conditions-cool but dry winters and warm but occasionally wet summers. The water typically is highly saline with electrical conductivity between 13,000 and 17,000 micromhos/cm (Kennedy, 1977). MgSO4 composes a substantial part of the dissolved solids. The saline nature of the water is reflected in the absence of trees throughout the water courses and during all of our visits we avoided drinking the water.

Kennedy (1977) reported the fish fauna in the upper segment to consist of Fundulus zebrinus, Lucania parva, Cyprinodon bovinus, Gambusia geiseri, G. affinis, G. nobilis, hybrids between the last two species, Lepomis cyanellus, and Cyprinus carpio (in Diamond-Y Spring only). The lower segment lacks Gambusia geiseri and Cyprinus carpio. We have also obtained Notropis lutrensis (especially after suspected releases of Cyprinodon) and Micropterus salmoides. We also have hearsay reports of catfish (= Ictalurus punctatus). In addition, Astyanax mexicanus was collected from Leon Springs in 1938. The absence of Gambusia geiseri in the lower segment is considered to reflect inability to survive. None have been obtained subsequent to many being released on 28 February 1976. The Lepomis cyanellus were temporarily eliminated from the lower segment on 13 February 1976 and not found there again until August 1978 when the two segments were connected. On this date young Micropterus were also collected from the deep pools near Monsanto Well.

Conditions in Leon Creek were relatively stable between 1965 and 1974 when Stephen E. Kennedy obtained a sample in January from Leon Creek adjacent to the Texas Highway 18 bridge. That August, Royal D. Suttkus collected Cyprinodon variegatus from the same location. The release of C. variegatus into Leon Creek is likely to be associated with the live bait industry. As live bait is commonly transported long distances, occasional populations of coastal sheepshead minnows are found far inland (Stevenson and Buchanan, 1973; Hubbs, et al., 1979). This specific release may have resulted from the transport of live bait from the Gulf Coast to the Pacific Coast and the need to change water on this trip. There is little alternative available water on public land in trans-Pecos, Texas, and the saline nature of Leon Creek would not harm estuarine bait fish. By November 1975 an extensive hybrid swarm was apparent in the collections by Anthony A. and Alice F. Echelle. The production of the swarm may well have been enhanced by the preference by C. bovinus females for C. nevadensis and C. macularius males over C. bovinus males (Paul V. Loiselle, pers. comm.). Turner and Liu (1977) report that most Cyprinodon interspecific hybrids are fertile so it is not surprising that the hybrid swarm flourished. The Echelles' observations resulted

in recommendations to eradicate the hybrid swarm (Kennedy, 1977). The area was examined by Dr. Echelle and Texas Parks and Wildlife personnel in January 1976 to determine the extent of the hybrid swarm. They found hybrids in the entire lower segment from Monsanto Well to the Cow Pond but some segregation of C. bovinus phenotypes in flowing water and C. variegatus phenotypes in quiet water (A.A. Echelle, pers. comm.). A stock of C. bovinus was flown to the Federal Fish Hatchery in Dexter, New Mexico, by the Texas Parks and Wildlife airplane as insurance against a possible disaster. The lower segment of Leon Creek was treated with rotenone on 13 February 1976. Prior to the rotenone treatment six segments (up to 100 meters in length) were seined and all fish (except Cyprinodon) and macroinvertebrates set aside and reintroduced into the springs 500 meters ENE of Monsanto Well on 14 February (Hubbs, et al., 1978). On that date more than 100 C. bovinus and associated indigenous fishes were obtained from Leon Creek 350 meters NE of the junction with the Diamond-Y Springs outflow and were also released with the downstream samples. On 28 February 300+ more C. bovinus from the same pool and 100+ C. bovinus, from the Diamond-Y Spring Run, associated fishes (except for Lepomis cyanellus as we wished to avoid excessive predation when its prey fish species populations were at minimal levels), and macroinvertebrates were released at Monsanto Well, the spring site 500 meters ENE, and at the Highway 18 bridge. On 13 February the rotenone was initially released in the Cow Pond and the entire creek and adjacent marshes sprayed, downstream to upstream; by midday when the spray crews reached the Highway 18 bridge, the weather had warmed from near 0°C and courtship activity was noted in a pool upstream from the bridge. That spot was also treated with antimycin to kill any eggs that might have been spawned. Rotenone drip bottles were placed over the springs near Monsanto Well and those 500 meters to the ENE. The upper pool at Monsanto Well was so heavily treated with rotenone that the milky appearance of its water persisted until 28 February. During that visit the lower segment of Leon Creek was examined on foot and the only Cyprinodon (or any other fish) observed were near the two-week old release location. Subsequently, the other fishes were obtained and released.

Leon Creek was next examined 6 August, 1976 (Hubbs, et al., 1978) and samples were obtained from the Cow Pond, Highway 18 bridge, and Monsanto Well. All released fish species except G. geiseri were found in our collections. The hybrid swarm between G. nobilis and G. affinis was re-established (Hubbs, et al., 1978) and has subsequently resumed pretreatment conditions. Both Lucania and Fundulus are now quite abundant and the 1976 population decline was only temporary. Traces of Cyprinodon genic contamination were found in adults and young from the Monsanto Well sample (the highway bridge sample seemed uncontaminated but one large female with a hybrid phenotype was collected from the Cow Pond). The obvious failure to eradicate the hybrids was apparently concentrated near Monsanto Well. That location had been exposed to a substantial superlethal dose of rotenone but some adult hybrids must have survived. Our suspicion that a few individuals had found shelter in or around spring outflows flowing through the bottom muds in the large pool at Monsanto Well was supported by the discovery of a series of spring boils in 0.5 meter (diameter) depressions 0.1 meter deep in the rock bottom of the deepest part of the pool following scouring by a flood just prior to our August 1978 visit.

We next visited the region 27 November 1976 and seined extensively near Monsanto Well. Each pupfish with an apparently introgressed phenotype was preserved or discarded on the bank and each pupfish that externally appeared to be pure C. bovinus was returned to the creek. The distribution of pupfish phenotypes was associated with water temperature. Those individuals with classic C. bovinus appearance were concentrated around spring boils (the air temperature averaged 0°C) and the hybrid types were often found in the shallow (and cold) water. Because of the inclement weather (rain and strong north winds) this selective seining effect was construed to have had only partial success.

We visited Leon Creek again on 13 March 1977 en route to sample the saline Rio Grande faunal assemblage (Hubbs, et al., 1977). We made extensive samples from Monsanto Well downstream for 500 meters and from pools near Highway 18. No trace of hybridization was found more than 500 meters from Monsanto Well and contamination in the Cow Pond observed in August 1976 had been eradicated since the pool had dried. As before, pupfish with apparent hybrid phenotypes were killed and those that seemed pure C. bovinus were returned to the stream.

Anthony A. Echelle reported in November 1977 that hybrids were present extensively in the Monsanto Well area (and that the two segments were connected). It was felt that a concentrated effort to eradicate the hybrids should be reinitiated. It was planned to treat the lower segment with ichthyocides twice with a two-week interval between treatments. The first treatment was to be with antimycin and the second with rotenone (The application to use toxaphene was denied by the Environmental Protection Agency.). The use of different ichthyocides was to avoid selection for ichthyocide specific resistance; the second treatment with rotenone was because rotenone was the primary toxicant used on the first eradication effort. This plan was disapproved by the U. S. Department of Interior Permit Office because it would by necessity have killed many Gambusia nobilis (an officially endangered species, abundant in four areas 100+ kilometers apart) and Cyprinodon bovinus was merely proposed for listing despite its existance in only one area, where it was outnumbered by Gambusia nobilis. While efforts were underway to have the application denial reversed, Dr. Echelle reported that he had obtained some fish with a hybrid phenotype from the Diamond-Y Springs outflow. We felt it too hazardous to treat both segments with ichthyocides. He obtained several Notropis lutrensis in the same collection which suggests a bait bucket release as the cause of the new contamination.

As an extensive effort had been planned for the April poisoning; those volunteers were diverted (and their numbers expanded) to another selective seining operation. Three to four seines were in constant use during the three-day effort. The first day (21 April) was spent seining the 500 meter segment adjacent to Monsanto Well. The accessible locations were seined until Cyprinodon captures were nil (Much of the marsh area was overgrown with Scirpus, an environment dominated by Gambusia, with the Cyprinodon concentrated in the more open areas.), apparently pure C. bovinus were set aside and the fish with hybrid phenotypes were discarded. This process was done twice. On the second day the area around Diamond-Y Springs was extensively sampled but no fish with obvious hybrid phenotypes were obtained. A few that were remotely suspect were discarded. It seems that Dr. and Mrs. Echelle were so vigorous in their effort to document the

occurrence of hybrid phenotypes in the Diamond-Y outflow that they eradicated the contamination. We regret that Dr. Suttkus had not had similar results when demonstrating the presence of C. variegatus in the creek near the Highway 18 bridge. That afternoon we repeated the sampling effort (three times) in the Monsanto Well area and examined the circumstances downstream. The downstream locations showed no contamination except for the pool at the Highway crossing where a few fish with possible hybrid phenotypes were eliminated. The third day effort was concentrated in the Monsanto Well area (two times) and a sample from the pool by Highway 18 contained no suspected hybrids. Our efforts at Monsanto Well clearly were less productive on successive days and few possibly contaminated fish were found by the third day.

We returned 11 August, 1978 to assess the situation. We found no obvious hybrid phenotypes but again eliminated those few (ca 2%) within the C. bovinus phenotype but at the edge of its phenotypic variation most closely approaching C. variegatus. Variation within the sample was minimal and apparently the C. bovinus phenotype prevailed in the entire water course. The phenotypic extremes, hybrid and putative C. bovinus, occupied different habitats during our sampling, eurythermal and quiet water vs stenothermal and current, respectively. It is possible that natural selection was a major contributant to the reversion to the C. bovinus phenotype. Predation by the centrarchids, Lepomis cyanellus and Micropterus salmoides may further refine that selection as young of both species (with fish in their guts) were found near Monsanto Well in our August 1978 samples.

On occasion, extensive flow from the upper segment enters the Monsanto Well area. A large pool (or dry hole) is at the upper end of the Monsanto Well region. This pool results from water flowing over a clay bank creating a 0.3 meter high cataract when the pool is full. In August 1978 that pool had a typical Monsanto Well ichthyofauna but the creek immediately above had a vastly different assemblage dominated by Fundulus. Extensive efforts produced no Cyprinodon. Apparently, Fundulus could swim up over the cataract but not Cyprinodon. The Echelles made similar observations the previous July. It is therefore unlikely that lower Leon Creek pupfish are able to populate the upper segment in substantial numbers. Downstream gene flow seems likely (as occurred with Lepomis and Micropterus).

The homogenous Cyprinodon in Leon Creek could have resulted from selection (either ours or natural) for a C. bovinus like genome. Similarly, a breeding system with sexual preference for novel individuals would tend to reduce chance diversity. Loiselle's demonstration of preference for Cyprinodon nevadensis or C. macularius males over C. bovinus males by C. bovinus females would, if extended to C. variegatus males, result in substantial hybridization (= Dr. Echelle's November 1975 observations). Any hybrid hatched near the highway bridge that dispersed away from the bridge would then be a novel individual in that new environment and again have a mate selection advantage. Eventually the dispersants would reach the two ends of the stream and no longer be able to enter a population not previously exposed to any C. variegatus phenotype (no matter how dilute). Subsequently mating of opposites would result in uniformity in successive generations. Each unique fish would most often mate with the other extreme or in effect produce an intermediate. Random mating would occasionally result in pairing

of similar extremes and would maintain diversity. Perhaps preference for mates with a novel phenotype is beneficial in desert spring populations that often (and temporarily) occur in reduced numbers. Under those circumstances, the mating of the extreme phenotypes would produce offspring with extensive heterozygosity and thus reduce the possible chance elimination of beneficial genes. Nevertheless, individuals that maximize heterozygosity could also minimize morphologic diversity (= our August 1978 observations). It seems likely, however, that the vast majority (or all) of the genetic material now present in both Leon Creek populations is C. bovinus.

A large number of individuals generously donated time and effort in a hostile environment in order to reduce the genic contamination of the endemic C. bovinus. Many of them also paid their own travel expenses. A partial list includes: A.A. Echelle, A.F. Echelle, Tyson Echelle, Steve Lethinen, Doyle Mosier, and E. David Wiseman, Baylor University; Stephen E. Kennedy, Texas Land Commission; Neil E. Carter, Dwane Kippes, D.J. Morris, Floyd D. Potter, and Danny Swepston, Texas Parks and Wildlife; Jack Davis and Gary L. Powell, Texas Water Board; R.D. Suttkus, Tulane University; Jerry F. Bentley, Buddy Jensen, and James E. Johnson, U.S. Department of Interior; Robert R. Miller, University of Michigan; Robert Bodenhamer, Gene Calley, S. Michael Dean, Robert J. and Deborah C. Edwards, Gary P. and Linda Garrett, Michael S. Gunter, Ronald Ilg, Thomas Lucier, Edie and David S. Marsh, Elisabeth Milstead, Kenneth W. Thompson, John G., J. C., D. G., and M. S. Williams, University of Texas. I am especially indebted to the M. R. Gonzalez family of Fort Stockton for their permission to carry out this program on their property. Their interest is an example of how land owners can assist the survival of desert fishes.

Literature Cited

Baird, S.F., and C. Girard. 1853. Descriptions of new species of fishes collected by Mr. John H. Clark, on the U.S. and Mexican Boundary Survey, under Lt. Col. Jas. D. Graham. Proc. Acad. Nat. Sci., Philadelphia 6:387-390.

Brune, Gunnar. 1975. Major and historical springs of Texas. Texas Water Development Board Report 189: ix + 95 pp.

Echelle, Anthony A., and Alice F. Echelle. 1978. The Pecos River pupfish, Cyprinodon pecosensis n. sp. (Cyprinodontidae), with comments on its evolutionary origin. Copeia 1978:569-582.

Echelle, Anthony A., and Robert Rush Miller. 1974. Rediscovery and redescription of the Leon Springs pupfish, Cyprinodon bovinus, from Pecos County, Texas. Southwest. Nat. 19:179-190.

Emory, W. H. 1857. Report on the United States and Mexican Boundary Survey, made under the direction of the Secretary of the Interior. Vol. 1, xvi + 258 pp., 1 map.

Girard, C. 1859. Ichthyology of the boundary. In: United States and Mexican Boundary Survey, under the order of Lieut. Col. W. H. Emory. Vol 2 (2): 85 pp., 41 pls.

Graham, J. D. 1852. Lieutenant Colonel J. D. Graham's report addressed to Colonel J. J. Abert, Chief of the Corps of Topographic Engineers. Ex. Doc. 121, Report of the Secretary of War: 1-250.

Hubbs, Clark. 1957. Distributional patterns of Texas fresh-water fishes. Southwest. Nat. 2:89-104

Hubbs, Clark, and A. A. Echelle. 1973. Endangered non-game fishes of the upper Rio Grande basin. In: Endangered vertebrates in the southwest. William C. Huey (ed.). New Mexico Game and Fish:147-167.

Hubbs, Clark, Thomas Lucier, Gary P. Garrett, Robert J. Edwards, S. Michael Dean, Edie Marsh, and Denton Belk. 1979. Survival and abundance of introduced fishes near San Antonio, Texas. Texas J. Sci. 30:

Hubbs, Clark, Thomas Lucier, Edie Marsh, Gary P. Garrett, Robert J. Edwards, and Elisabeth Milstead. 1978. Results of an eradication program on the ecological relationships of fishes in Leon Creek, Texas. Southwest. Nat. 23:487-496.

Hubbs, Clark, Robert Rush Miller, Robert J. Edwards, Kenneth W. Thompson, Edie Marsh, Gary P. Garrett, Gary L. Powell, D. J. Morris, and Robert W. Zerr. 1977. Fishes inhabiting the Rio Grande, Texas and Mexico, between El Paso and the Pecos confluence. In: Importance, preservation and management of riparian habitat. A symposium. R. Roy Johnson and Dale Jones (eds.). U.S.D.A. Forest Service, General Technical Report RM-43:91-97.

Kennedy, Stephen E. 1977. Life history of the Leon Springs pupfish, Cyprinodon bovinus. Copeia 1977:93-103.

Knapp, Frank T. 1953. Fishes found in the fresh waters of Texas. Ragland Studio and Litho Printing Co. 166 + xvii pp.

Miller, Robert R. 1961. Man and the changing fish fauna of the American southwest. Pap. Mich. Acad. Sci., Arts, and Letters 46:365-404.

Minckley, W. L., and E. T. Arnold. 1969. "Pit digging" a behavioral feeding adaptation in pupfishes (genus Cyprinodon). J. Arizona Acad. Sci. 5:254-257.

Stevenson, M. M., and T. M. Buchanan. 1973. An analysis of hybridization between the cyprinodont fishes Cyprinodon variegatus and C. elegans. Copeia 1973:682-692.

Turner, Bruce J., and Robert K. Liu. 1977. Extensive interspecific genetic compatibility in the New World killifish genus Cyprinodon. Copeia 1977: 259-269.

FISH HABITAT LOSS IN THE SAN PEDRO RIVER, ARIZONA.

Randy M. McNatt, U.S. Fish and Wildlife Service, Riparian Habitat Analysis Group, Albuquerque, New Mexico.

Abstract--The San Pedro River basin formerly consisted of a large perennial mainstream with associated springs and tributaries. Diversions, headeater impoundments, depletion of underground aquifiers, clearing of riparian habitats, and a possible regional tendency toward increasing aridity have reduced mainstream surface flow to that of an intermittent stream, with perennial flow in 3 sections which comprise only 50 km of the total river length of 250 km. Aravaipa Creek, the largest tributary, presently contains 7 of the 13 native species reported from the basin, and is the only portion of the entire drainage that supports a relatively secure native fish fauna. Of the 7 species in Aravaipa Creek, 4 have not been found elsewhere in the basin since at least 1963.

Abstracto--El desaque de el Rio San Pedro, en tiempo, consisto en un gran corriente perenne con asociaciones de ojos y tributarios. Diversiones, lagunas en cabercera, depleción de aquíferos subterráneo, sitio sin vegetacion de ribereño, y posiblemente un tendencia regional para aumentar arideza, en reducido las corrientes principal de el superficie hasta que a creado una corrida intermitente. Corrientes perenne de los tres seccións solamente consiste en cincuenta kilómetros sobre dosciento cincuenta kilómetros de todo el rio. Arroyo Aravaipa, el mas grande de los tributarios, al presente tiene siete de los trece pescado nativos y solomente es el unico parte de todo el desaque que tiene pescados nativos que estan estable. De los siete pescados en el Arroyo Aravaipa, no han describrido cuatro pescados nativos en otras partes de la cuenca desde 1963.

The San Pedro River, a major tributary to the Gila, enters the United States from Sonora, Mexico, approximately 100 km east of Nogales, Arizona. The river channel then runs NNW for approximately 200 km to its confluence with the Gila River near Winkelman, Arizona. Headwaters of the river are located 40 km south of the International Boundary near Cananea, Mexico. Total area of the San Pedro basin is 11,621 km^2, of which 1,802 km^2 occur in Sonora. Elevation of the river channel is 1,303 m above mean sea level at the International Boundary, and drops to an elevation of 585 m at its confluence with the Gila River, an average gradient of 4 m/km (Roeske and Werrell, 1973). The largest tributary to the San Pedro is Aravaipa Creek, which drains an area of 1,530 km and enters the San Pedro mainstream 19 km upstream from Winkelman. Another tributary with small perennial flow sections is the Babacomari River, which joins the San Pedro 42 km north of the International Boundary.

San Pedro Valley sediments, bounded by several desert mountain ranges composed of low-permeability, crystalline and consolidated

sedimentary rocks, consist of well-bedded semi-consolidated to non-consolidated valley-fill material overlain by floodplain alluvium. The valley-fill upstream from Benson ranges from 90 m - 644 m thick, but has generally been eroded away further downstream (Reichhardt et al., 1978).

Floodplain alluvium, consisting of gravel, sand, and silt, along the channels and floodplains of the San Pedro mainstream and its tributaries ranges in thickness from 12 to 43 m. This alluvium is very porous and is capable of producing water flows in excess of 2,000 gallons per minute (7.57 cubic meters per minute). Ground water in the alluvium is under strong artesian pressure in the vicinity of Palominas - Hereford, St. David-Benson, and Mammoth. Further downstream, ground water occurs at increasing depths beneath the surface (Roeske & Werrell, 1973).

Because of high sediment porosity, ground water withdrawn from the alluvium is rapidly replaced by infiltration from periods of high surface runoff. During the past 25 years, net change in ground water level has been negligible except in the Sierra Vista-Fort Huachuca area due to domestic-industrial uses. The relatively constant ground water level may be due in part to replacement of native riparian vegetation by irrigated agricultural land (Roeske and Werrell, 1973).

Lack of substantial lowering of ground water since the early 1950's, however, does not mean that the flow regime of the San Pedro has not been radically altered. Diversions, headwater impoundments, depletion of underground aquifiers, and a possible regional tendency toward increasing aridity have reduced surface flow in the mainstream to that of an intermittent stream, with permanent water present in three main sections which comprise only 50 km of the total river length of ca 250 km. That the San Pedro historically contained consistently high surface flows is documented by occurrence of Colorado River squawfish, *Ptychocheilus lucius* (Miller, 1955), and razorback sucker, *Xyrauchen texanus*, species confined to swift, big-river habitats in excess of one meter deep (Minckley, 1973).

The San Pedro drainage historically supported at least 13 native fish species (Table 1). Aravaipa Creek, the largest tributary, presently contains 7 of 13 fishes reported, and is the only portion of the entire drainage that supports a relatively secure native fish fauna. Of these 7 species, 4 have not been reported elsewhere in the basin since at least 1963; of the remaining 6 species historically occurring in the San Pedro drainage as of November 1978, *Tiaroga* and *Meda* deserve special mention because both genera are endemic to the Gila River basin and have, except for populations in Aravaipa Creek, been virtually eliminated from Arizona. *Meda* persisted in small numbers in portions of the Verde River in 1972 and still occurs there as far as is known. A few *Tiaroga* were collected in the Blue River, Greenlee County, in 1977. Also, the species may still be present in the Black River drainage; specimens were collected there in the late 1960's.

Table 1. Distribution of native fishes in the San Pedro River Basin, Arizona, since 1963.

Species	Mainstream San Pedro	Aravaipa Creek	Babacomari River
Agosia chrysogaster	X	X	
Catostomus insignis		X	
*Catostomus latipinnis**			
*Cyprinodon macularius**			
Gila intermedia			X
Gila robusta grahami		X	
Meda Fulgida		X	
Pantosteus clarki	X	X	
*Poeciliopsis o. occidentalis***			
*Ptychocheilus lucius**			
Rhinichthys osculus		X	
Tiaroga cobitis		X	
*Xyrauchen texanus**			

* Extirpated in early 1900's
** Population discovered and extirpated in 1978

Further reduction of the already-depleted San Pedro native ichthyofauna occurred in February 1978, when pollutants from copper mining operations on the San Pedro headwaters in Sonora, Mexico apparently eliminated all fishes in the upper portion of the mainstream. Reestablishment of fishes in this section must occur from tributaries such as the Babocomari River where small populations of native species occur.

A recent occurrence south of Mammoth, Arizona, illustrated what is generally happening to fish and wildlife habitat along much of the San Pedro. A new locality for the Gila topminnow, *Poeciliopsis occidentalis occidentalis*, was identified in July 1978, in the outflow of an artesian well. At that time, clearing of mesquite immediately adjacent to the site was underway. By September, the well piping had been partially capped and dense mesquite around the well was removed by bulldozer. Much of the outflow area had become silted in and few fish could be observed. By early October, the well had been completely capped and connected to an irrigation system in the adjacent cleared area, resulting in complete drying of the former habitat and extirpation of the topminnow population. This incident is particularly significant because the well outflow was the only known locality in the entire San Pedro basin where *Poeciliopsis* was still present, and was one of only seven naturally-occurring populations presently known in the U.S. Thus, in a matter of three months, an important endangered species population was both discovered and extirpated.

According to Brown et al. (1977), only a few southwestern drainages such as the Rio Magdalena in Sonora, Mexico, and the San Pedro in Arizona, presently contain any extensive linear riparian forest development. Remaining riparian plant communities are continually subjected to upstream impoundments, channel cutting, channelization, irrigation diversions, groundwater pumping, and, in many cases, increased water salinity. In addition, overgrazing by cattle has negatively affected remaining forests, especially cottonwoods, which reproduce primarily from seed rather than sprouts (Horton et al., 1960).

A recent study by Reichhardt et al. (1978), compared various land-use practices along the San Pedro River from 1935-1978. Somewhat surprisingly, conclusions were that riparian areas composed of cottonwood, mesquite, salt cedar, and willow had increased since 1935, as had agricultural and cultural-industrial areas. These increases occurred simultaneously with a decrease in areas such as marsh lands, mesquite-scrub, river channel, and streambed thickets of annual and/or immature riparian species. However, these authors also concluded that, although mesquite and salt cedar areas appear to have increased significantly since the early 1900's, cottonwood and willow associations require essentially perennial streamflow and consequently are declining. Resulting loss of shade, cover, and bank stabilization are obvious consequences.

In summary, surface water flows in the San Pedro basin have declined dramatically from those historically present. Native fish populations have been decimated because of habitat loss throughout the basin. Aravaipa Creek remains the only relatively-unmodified perennial stream section, and contains 7 of the 8 native fish species which are still present.

LITERATURE CITED

Brown, Dave E., Charles H. Lowe, and Janet F. Hausler. 1977. Southwestern riparian communities: Their biotic importance and management in Arizona. In, R.R. Johnson and D.A. Jones, eds. Importance, preservation, and management of riparian habitat: A symposium. USDA Forest Service General Technical Report RM-43. pp. 201-211.

Horton, J.S., F.C. Mounts, and J.M. Kraft. 1960. Seed germination and seedling establishment of phreatophyte species. USDA Forest Service St. Pap. 48, Rocky Mountain Forest and Range Experiment Station, Fort Collins. 26 pp.

Miller, R.R. 1955. Fish remains from archaeological sites in the lower Colorado River basin, Arizona. Pap. Mich. Acad. Sci., Arts, Lett. 40:125-136.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 293 pp.

Reichhardt, Karen L., Brenda Schladweiler, and John L. Stelling. 1978. An inventory of riparian habitats along the San Pedro River. Office of Arid Lands Studies, Tucson, Arizona. 23 pp. plus bibliography.

Roeske, R.H. ad W.L. Werrell. 1973. Hydrologic conditions in the San Pedro Valley, Arizona (1971). USGS, U.S. Department of Interior. Arizona Water Commission, Bull. 4. 76 pp.

EL ESTADO ACTUAL DE MEGUPSILON APORUS Y CYPRINODON ALVAREZI DE EL POTOSI, NUEVO LEON

Michael Leonard Smith
Museum of Zoology, University of Michigan
Ann Arbor, Michigan 48109

Dos peces endémicos habitan una charca en El Potosí, Nuevo León, en el noroeste de México. La charca es parte de un sistema aislado de manantiales que nacen en una meseta árida casi 125 km al sur de Monterrey. Esta habitación restringida es probablemente el último rastro de un sistema acuático más grande que probablemente haya cubierto una gran parte de la meseta durante las épocas pluviales del pleistoceno (Miller y Walters 1972). Así como los manantiales son vestigios, también lo son sus especies indígenas. Son las únicas reliquias sobrevivientes de una biota acuática más antigua y más compleja. Aunque los peces nativos de El Potosí han sobrevivido los cambios climáticos del pleistoceno y la reducción severa de la habitación, ya se enfrentan con la extinción como consecuencia de la predación por los peces introducidos. Su situación se complica aún más por las modificaciones ambientales.

Cuatro clases de peces se encuentran en la charca de El Potosí. Cyprinodon alvarezi es un cyprinodóntido endémico relacionado a C. eximius (Miller 1976). Megupsilon es un género endémico cyprinodóntido que consta de una sola especie, M. aporus (Miller y Walters 1972). Las carpas doradas, Carassius auratus, han estado presente en la charca desde antes de 1961, y los robalos, Micropterus salmoides, se introdujeron cerca de 1974 (Contreras-Balderas 1978).

Los medios ambientes de estos peces han sido modificados mucho para proveer el agua a los usos domésticos y agrícolas. La charca se estableció para la construcción de unos malecones alrededor de uno de los manantiales. Cuatro manaderos nacen debajo de uno de los malecones, y manan en un sistema de regueras. Ninguna parte de la habitación actual queda en el estado natural. Aunque la habitación natural no es conocida, parece que era una ciénega porque los manantiales nacen de una área que está generalmente plana.

La profundidad máxima de la charca es cerca de 3 m, y la superficie varía mucho tal como el nivel del agua fluctua. En su máxima extensión, la longitud de la charca es 150 m y la superficie es cerca de 4500 m^2. La charca consta en parte de una ciénega 10-20 cm de profundidad y 1450 m^2 de superficie. La ciénega provea abrigo a los cyprinodóntidos en forma de manchas de Potamogeton, Nasturtium, y castañuelas. En el mes de mayo de 1978, la ciénega sustentó la población más grande de cyprinodóntidos, y se observaron allí los criaderos de Megupsilon y de Cyprinodon. Otra parte de la charca, cerca de 2100 m^2, consta de una mancha densa de Ceratophyllum. El resto de la charca, 950 m^2, es de agua abierta.

Cuando, en 1961, R.R. Miller visitó El Potosí, los cyprinodóntidos eran numerosos en el agua abierta alrededor de la charca central. Las carpas doradas estaban presentes también; no hay ninguna indicación que las carpas doradas afectan a los cyprinodóntidos. Sin embargo, los robalos llegan a ser numerosos en el agua más profunda y en la mancha de Ceratophyllum. Los cyprinodóntidos han desaparecido en estas partes como consecuencia de la predación y se limitan a la ciénega y las regueras donde no hay robalos.

El agua mana de la charca por conducto de una acequia de hormigón que está bastante honda para desaguar la ciénega. Por lo tanto, los cyprinodóntidos se hallan en apuro. Cuando el nivel de agua baja cado verano, los cyprinodóntidos se entrampan entre los lugares bajos que se están secando y las aguas más profundas donde hay peces predatorios. En mayo de 1977, la ciénega estaba completemente seca, y solo unos pocos cyprinodóntidos se podían encontrar a lo largo de la charca. En mayo de 1978, la ciénega se inundó otra vez, y el número de cyprinodóntidos aumentó.

Es probable que el agotamiento de las poblaciones de peces en la charca no tenga un efecto inmediato en el estado de C. alvarezi, siendo que es abundante en los manantiales y regueras también. Sin embargo, es posible que Megupsilon no sea capaz de supervivencia a largo plazo en estas habitaciones; éste no habitaba los manantiales hasta que fue introducido allí por Salvador Contreras-Balderas en 1976. Hasta ahora, se mantiene en uno de los manantiales y algunas regueras. Al principio pareció que Megupsilon había sido excluido de estas habitaciones por la competición con Cyprinodon. Hasta el momento, sabemos poco de la separación ecológica entre las dos especies. C. alvarezi tiene un intestino largo, casi doble el largo del cuerpo, y las algas filamentosas son el componente dominante de la dieta. El intestino de Megupsilon es más corto, casi 80% del largo del cuerpo, y esta especie come principalmente los invertebrados (Miller y Walters 1972).

Parece que las dos especies son reproductivamente activas simultaneamente. En febrero, marzo, y mayo (los únicos meses para los cuales tengo ejemplares), las hembras de ambas especies traen huevos de varios tamaños. Evidentemente, son capaces de reproducción repetida sobre un período largo. Los cyprinodóntidos pueden competir para los criaderos. Comunmente, C. alvarezi es del tamaño doble de Megupsilon y es más agresivo. Se ha visto a aquél amenazar a los machos de Megupsilon que estaban defendiendo los criaderos.

La proporción de Cyprinodon a Megupsilon fluctua mucho, quizás debido al cambio de la habitación. En 1961, Megupsilon era muy escaso, pero en 1968 había tres veces más Megupsilon que Cyprinodon. En tres distintos años desde entonces, Cyprinodon ha sido más abundante. Los números de ambas especies fueron calculados en mayo de 1978; se contáron los individuos visibles en cuadrados de un metro de cado lado. El promedio de la densidad de Cyprinodon en la ciénega, basado en 73 cuadrados, fue 8.4 peces por m^2 que señala casi 12,180 Cyprinodon en toda la ciénega. La densidad de Megupsilon era 1.9 peces por m^2 que

señala una población de casi 2750 individuos en la ciénega. Ninguna de las dos ocurre en números significantes en otras partes de la charca (basado en 50 cuadrados).

Desde la introducción de los robalos, los cyprinodóntidos se han considerado amenazados, particularmente en el caso de Megupsilon. En mayo de 1978, la situación había mejorado, pero esto podía haber sido una respuesta temporaria al tiempo que estaba excepcionalmente pluvioso en aquel año.

El esfuerzo para eliminar los robalos de El Potosí con redes no ha tenido éxito. Parece imprudente emplear métodos más efectivos porque los cyprinodóntidos y otros organismos endémicos pueden ser afectados adversamente. Por eso, la conservación debe ser basada en el manejo del medio ambiente. Las investigaciones sobre la separación ecológica y las requirimientos ambientales de los cyprinodóntidos están en desarrollo como base de un planeamiento del manejo de los ambientes.

THE STATUS OF MEGUPSILON APORUS AND CYPRINODON ALVAREZI AT EL POTOSI, NUEVO LEON

Two unique endemic fishes inhabit a spring-fed pond at El Potosí, Nuevo León, in northeastern Mexico. The pond is part of an isolated system of springs which rise on a high arid plateau about 125 km south of Monterrey. This limited habitat is probably the last remnant of a larger aquatic system which may have covered much of the plateau during Pleistocene pluvial periods (Miller and Walters 1972). Just as the pond is a vestige, so are its native species. They are the only surviving relicts of an earlier, more complex aquatic biota. Although the native fishes of El Potosí have survived Pleistocene climatic changes and a severe reduction of their habitat, they are now facing extinction by predatory fish which were introduced into the pond in the early 1970's. Their plight is further complicated by structural modifications of their habitat.

Four species of fishes now occur at El Potosí. Cyprinodon alvarezi is an endemic pupfish (Cyprinodontidae) which is closely related to the C. eximius complex (Miller 1976). Megupsilon aporus constitutes a monotypic pupfish genus which is also endemic to El Potosí (Miller and Walters 1972). Goldfish, Carassius auratus, have been present in the pond since sometime prior to 1961, and largemouth bass, Micropterus salmoides, were introduced about 1974 (Contreras-Balderas 1978).

The aquatic habitat at El Potosí has been highly modified to provide water for domestic and agricultural use. A pond has been created by construction of walls and dikes around one of the spring areas. Four springs rise at the base of one of the dikes and issue into a system of irrigation ditches which extends several kilometers into adjacent fields. An additional spring lies north of the pond and also connects with the irrigation system. No habitat remains in its

natural state. Although the original habitat is unknown, it seems likely that it was a marsh since the springs rise in a generally flat area.

The pond is shallow, about 3 m at its deepest point, and its total surface area varies greatly as water levels fluctuate. At its greatest extent, the pond is about 150 m long and has a surface area of approximately 4500 m^2. This includes 1450 m^2 of marsh with an average depth of 10-20 cm. This shallow area provides heavy cover for pupfish in the form of patches of narrow-leaved and broad-leaved Potamogeton, Nasturtium, and sedges. In May, 1978, the marsh supported the densest pupfish populations, and breeding territories of both Megupsilon and Cyprinodon were observed there. An area of about 2100 m^2 is covered with a dense mat of Ceratophyllum. The remainder of the pond, 950 m^2, is open water.

When R.R. Miller visited El Potosí in 1961, pupfish were abundant in open water around the central pool. Goldfish were also present and may have been there for some time; there is no indication that they have a negative impact on the pupfish. However, bass have become abundant since their introduction, particularly in deeper areas and the Ceratophyllum mat. The pupfishes have disappeared from those areas and are now restricted to the marsh and irrigation ditches where bass are absent.

Water leaves the pond through a concrete sluice about 0.5 m deep, which is deep enough to completely drain the marsh. The pupfish are therefore in a difficult situation. When water levels drop each summer, the pupfish are caught between the drying shallows and predation in deeper water. In May, 1977, the marsh was completely dry and only a few pupfish could be found along the margins of the main pool. In May of the next year, the marsh was flooded again, and pupfish were abundant.

The depletion of stocks in the pond might not have an immediate impact on the status of C. alvarezi since it is abundant in the springs and ditches outside the pond. However, Megupsilon may not be capable of long-term survival in those areas. It was not known to occur in the springs until it was introduced there by Salvador Contreras-Balderas in 1976. So far it has held on in one spring and some of the ditches. Earlier it had appeared that Megupsilon was excluded from those habitats by competition with Cyprinodon.

We do not yet know much about ecological segregation between the two pupfish species. C. alvarezi has a long gut, about twice its standard length, and filamentous algae are the dominant component of its diet. M. aporus has a shorter gut, about 80% its standard length, and feeds primarily on invertebrates (Miller and Walters 1972). It has been seen feeding at the surface.

The two species seem to be reproductively active at the same time. In February, March, and April (the only months for which specimens are available), the females of both species carry size-graded series of eggs; they are apparently capable of repeated reproduction over a long period of time. Both species establish breeding territories in the fine vegetation of the marsh, sometimes within 20 cm of each other, and competition for territories may be intense. C. alvarezi is commonly twice the size of M. aporus and is more aggressive. It has been seen to threaten Megupsilon males which were defending territories.

The proportion of Cyprinodon to Megupsilon fluctuates greatly, possibly in response to habitat changes. When the pond was visited in 1961, Megupsilon was apparently rare. In 1968, however, there were three times as many Megupsilon as Cyprinodon. In three different years since then, Cyprinodon has been dominant. Population sizes of the two species were estimated in May, 1978, by counting individuals visible in meter-square quadrats in each habitat type. The average density of Cyprinodon in the marsh, based on 73 quadrats, was 8.4 fish per m^2 which indicates about 12,180 Cyprinodon in the whole marsh. The average density of Megupsilon was 1.9 fish per m^2 which indicates a population of about 2750 individuals in the marsh. These are probably underestimates since many fish were concealed. The proportion of four Cyprinodon to each Megupsilon may be biased toward Cyprinodon, since Megupsilon sometimes takes cover when the former species is present. Neither species occurred in significant numbers in other parts of the pond (based on 50 quadrats).

Since the introduction of bass at El Potosí, the two pupfishes have been considered threatened, Megupsilon critically so. In May, 1978, the situation had improved, but this may have been a temporary response to an unusually wet spring. Efforts to eliminate bass at El Potosí with gill nets have proven unsuccessful. It seems imprudent to use more effective means of bass eradication as the pupfish and other endemic organisms might be adversely affected. Preservation efforts will therefore be based on habitat management with the objective of altering predator-prey interactions in favor of pupfish. Research on life histories, habitat requirements, and ecological segregation is currently under way and will provide the basis for a future management program.

Acknowledgements.--Field work was supported in part by grants from the National Science Foundation (DEB77-17315) and the Fauna Preservation Society, London (both to R.R. Miller) and by a Scott Turner Award in Earth Science. Ellie Baker Koon assisted in field work in 1977, and R.R. Miller, Edie Marsh, and Salvador Contreras-Balderas and his students from the Universidad Autónoma de Monterrey participated in 1978. Permission to conduct field work in Mexico was kindly granted by the Dirección General de Regiones Pesqueras.

LITERATURE CITED

Contreras-Balderas, S. 1978. Speciation aspects and man-made community-composition changes in Chihuahuan Desert fishes, pp. 405-431. In: Symposium on the biological resources of the Chihuahuan Desert Region. R.H Wauer and D.H. Riskind (eds.). U.S. National Park Service.

Miller, R.R. 1976. Four new pupfishes of the genus Cyprinodon from Mexico, with a key to the C. eximius complex. Bull. South. California Acad. Sci. 75(2):68-75.

Miller, R.R., and V. Walters. 1972. A new genus of cyprinodontid fish from Nuevo León, México. Contrib. Sci. Nat. Hist. Mus. Los Angeles Co. 233:1-13.

THE STATUS OF MEGUPSILON APORUS AND CYPRINODON ALVAREZI AT EL POTOSI, MEXICO

Michael L. Smith, University of Michigan Museum of Zoology.

The isolated pond and springs at El Potosí, Nuevo León, constitute the only habitat of two unique pupfish species, Megupsilon aporus and Cyprinodon alvarezi, which are now threatened by the effects of groundwater pumping and predation and competition by introduced black bass. The pupfishes have been eliminated from parts of the main pond, but persist in a marginal marsh, lateral springs and irrigation ditches. Though populations were adequate in May, 1978, their restriction to peripheral habitats makes them susceptible to lowered water levels and other results of human activity. The long-term survival of the pupfishes will depend on careful management of their habitat.

THE DISTRIBUTION AND ASPECTS OF THE LIFE HISTORY OF *MEDA FULGIDA* IN NEW MEXICO.

Richard Moore Anderson, New Mexico State University.

Investigations were made to determine the distribution and some life history aspects of spikedace, *Meda fulgida* Girard 1856, in the Gila River drainage of New Mexico. The San Francisco River and its tributaries were sampled 32 times at 24 localities, between March 1976 and September 1977. Spikedace were not found in the San Francisco River during this study, and probably no longer occur there. The reason for the disappearance of spikedace from the San Francisco River appeared to be related to habitat loss and modification. The Gila River and its tributaries were sampled 57 times at 33 localities, between November 1975 and September 1977. The most downstream collection of spikedace was made at Red Rock (1219 m) and the most upstream collection was in Taylor Creek, near the mouth of Beaver Creek (1905 m), 5 km below Wall Lake. However, spikedace were most commonly found between the Lower Middle Box of the Gila River (1305 m) and the lower 2 km of the Middle Fork (1809 m) and up to Tom Moore Canyon in the East Fork (1830 m). The current distribution of spikedace in New Mexico is more restricted than it was 30 years ago.

The spikedace preferred shallow (< 30 cm), gravel and rubble-bottomed riffles with moderate to swift current. In years (1975 and 1976) of above average water discharge, year-class strength was much greater than in 1974 when there was a drought in the winter and spring months. Most growth occurred in the summer and early fall. No winter growth was observed. In March, the size range of age-1 fish was 35-60 mm and was 63-75 mm for age-2 spikedace. Spikedace were sexually mature at age-1. The spawning season extended from mid-March into May. Age-2 females spawned 3-4 weeks before most age-1 females. Some age-1 and most age-2 females apparently spawned at least twice during the spawning season. Most age-2 fish died during or immediately following their second breeding season. Spikedace fed exclusively on aquatic insects. Mayflies of the family Beatidae were most commonly utilized along with subimago mayflies. Caddisflies and chironomid (blood worms) larvae were also commonly eaten.

Because of their drastic decline in the Gila River in Arizona, spikedace distribution and abundance appears to be affected by habitat modification and competition from the introduced red shiner. Red shiners are presently in the San Francisco River and moving up the Gila River from Arizona into New Mexico. Also activities, such as channelization and dam construction, which reduce the amount of suitable riffle habitat for spikedace, are proposed for the Gila River in New Mexico downstream of Turkey Creek. Channelization, damming and the establishment of the red shiner will probably result in further reductions in the distribution and abundance of spikedace in New Mexico.

The Status of the Desert Pupfish, *Cyprinodon macularius*, at the Salton Sea, California.

by Glenn Black
California Department of Fish & Game

The desert pupfish, *Cyprinodon macularius*, is the only species native to the Salton Sea area and has been reported as "abundant" as recently as 1958 by Barlow. However, incidental collections made in the last 15 years indicate that their distribution and numbers may have been severely reduced. This seems to have coincided with the introductions of several exotic species into the irrigation drains leading to the Salton Sea and to their movement into habitats utilized by desert pupfish. The above-mentioned exotic species include the sailfin molly, *Poecilia latapinna*, the shortfin molly, *P. mexicana*, the red shiner, *Notropis lutrensis* and Zill's cichlid, *Tilapia zillii*.

In order to determine the extent of the immigration of these exotic species into desert pupfish habitats, the California Department of Fish and Game has conducted three quarterly surveys at the Salton Sea. Live minnow traps and seines were used to sample fish populations in irrigation drains and tributaries to the Salton Sea as well as in shoreline pools (pools of Salton Sea water separated from the Sea by sand bars) and the Salton Sea proper.

Results from the three surveys have shown that 14 species of fish have been collected from the various habitats and that the most abundant and widely distributed of all species is the sailfin molly. The sailfin molly has made up 73%, 85% and 86% of the fish captured from the irrigation drains; 86%, 69% and 69% of the fish from the tributaries; 89%, 93% and 93% of the fish from the shoreline pools; and 74%, 90% and 97% of the fish from the Salton Sea proper during the three surveys. In contrast to this, the desert pupfish has contributed to less than 1%, 9% and 2% of the fish sampled from the irrigation drains during the three surveys; to less than 1% of the fish sampled in all three surveys of the tributaries; to 5%, 2% and less than 1% of the fish sampled in the surveys of the shoreline pools; and to 1% or less in the surveys of the Salton Sea proper.

Despite the fact that pupfish have been found in all four types of habitats sampled, they appear to be very restricted within each habitat, especially in irrigation drains. They prefer areas of irrigation drains that have a sand substrate, a water depth of less than 3 feet (0.9 m), turbidity of less than 100 JTU's and aquatic vegetation.

The three surveys clearly show that the desert pupfish is in serious trouble at the Salton Sea due to the introduction of exotic species. In addition to this, another serious threat exists in the form of possible permanent alteration of irrigation drain habitat through the concrete lining or piping of these drains by the irrigation districts surrounding the Salton Sea.

A bleak picture has been painted, but there may be some hope for the desert pupfish because in August of this year, we found a sizeable population in San Felipe Creek, a tributary to the Salton Sea. Even though there are several exotic species of fish present in the creek, they are relatively low in numbers. A survey was conducted in November of this year of a four-mile section of the creek and showed that pupfish made up 68% of the total catch, sailfin mollies 28%, mosquito fish, Gambusia affinis 3%, and shortfin mollies 1%. Land ownership in San Felipe Creek is two-thirds Bureau of Land Management land and one-third private land. Efforts will be made to purchase the remaining private land, especially since there is a possible threat of wells being drilled for irrigation in proximity to the creek. This could seriously affect the three springs that provide water to the creek and its associated marsh.

Due to these threats to the future existence of the desert pupfish at the Salton Sea, Fish and Game and State Park personnel established a second desert pupfish refugium pond within Anza-Borrego State Park at Palm Spring. Forty-five adult desert pupfish were placed in the refugium in May of this year and when checked in October the pond had numerous juvenile pupfish.

The Department of Fish and Game believes that artificial refugia are not the solution to the plight of the desert pupfish at the Salton Sea, but only a temporary measure. The answer lies in being able to ensure their survival within naturally occurring desert spring environments and San Felipe Creek may be the desert pupfish's last chance.

LIFE HISTORY, DISTRIBUTION AND STATUS OF THE PLACID CRAYFISH, PACIFASTACUS FORTIS.

Bob Daniels, University of California, Davis.

The midreaches of the Pit River system, northeastern California, were surveyed between 27 May and 21 October, 1978, to delineate the range, estimate the abundance and gather information of the life history of the endemic crayfish, Pacifastacus fortis. P. fortis was collected at 19 sites in the drainage, including Crystal, Baum and Rising River Lakes of the Hat Creek subdrainage, Spring Creek, Lava Creek, Big Lake and the Fall River and in the Pit River. A significant positive correlation was found between mean width and flow; a significant negative correlation occurred with gradient and stream order. In a stepwise linear regression, 64% of the variability was explained by: % weeds, mean width, % riffle, mean depth and % sand. Abundance ranged between $0.09/m^2$ at Baum Lake to $6.89/m^2$ at Crystal Lake. During the survey, the exotic crayfishes P. leniusculus and Orconectes virilis were also collected. O. virilis was established in the Pit River; a large population of P. leniusculus was found in Baum Lake. P. fortis was found sympatrically with both species. P. fortis appears non-aggressive and gregarious. Fecundity of 5 individuals averaged 0.95 eggs/mm carapace length (CL). Copulation occurs in the autumn and females remain in berry until early June when hatching occurs. Early instars were found in the marsupium until mid-July. Growth appears to be slow and the largest specimen collected were two males of 44.5 mm CL. Molting occurs from early June through September; 3-19% of the individuals collected at 2 week intervals were new molts. No new molts were found among 38 individuals collected in October.

Excluding the possibility of extensive shoreline development, most populations of P. fortis appear secure. The greatest danger is the probable range entension of both exotic forms either naturally or by bait fishermen. P. fortis appears less aggressive, has a lower fecudity, grows slower and to a smaller maximum size and releases its young into the environment at a later date than either exotic species. These factors, combined with the observed lower relative abundances of P. fortis at the sympatric sites, indicate that P. fortis would not be favored in any competitive encounter. The small range and the presence of possible competitors within the range suggest the need of continued monitoring of the populations and full legal protection.

ENDANGERED AND THREATENED FISHES OF THE WEST.

James E. Deacon, University of Las Vegas, Las Vegas, Nevada.

The endangered and threatened fish fauna of the United States exhibits problems resulting primarily from habitat modification by man. The evolutionary history of the fauna has left it especially sensitive to biotic interactions. In addition, many forms are of such restricted distribution that the entire taxon can be destroyed by very minor perturbations. The effects of habitat modification on woundfin and roundtail chub in the Virgin River of Utah, Arizona and Nevada are discussed. Parasitism by Lernea on White River springfish is shown to coincide with population decline in some, but not all, cases. Population declines of Pahrump killifish are related to biotic interactions with both goldfish and mosquitofish. Population sizes of Devils Hole pupfish are shown to be quite responsive to small changes in habitat availability.

Fishes of the west are affected by the same general kinds of ecological problems that are causing extinctions throughout the world. The interplay of economics with perceived value in society has led us into the numerous ecological problems facing us today. There is some evidence to suggest that society is making some preliminary effort to slow the rate of extermination. Perhaps this is happening because the conclusions of ecologists, philosophers and theologians regarding the relationship of man and environment are to some extent being translated into legislation as well as into conventional wisdom.

REPRODUCTIVE PERFORMANCE OF THE DESERT PUPFISH (CYPRINODON N. NEVADENSIS IN RELATION TO SALINITY.

Shelby D. Gerking and Raymond M. Lee, Arizona State University, Tempe.

The reproductive performance of the desert pupfish, Cyprinodon n. nevadensis, was tested for relationship with salinity. Breeding pairs were exposed to a range from nearly 0°/oo to over 40°/oo salinity. In the reproductive parameters utilized; eggs per gram body weight per day, eggs per spawning and the %hatch, the pupfish reproduced best at 10°/oo and gradually below 10°/oo, producing a plateau of statistically equivalent reproduction from .3 to 20°/oo.

This species of pupfish exhibited an upper salinity tolerance of 53°/oo and a lower limit of less than 0.1°/oo, in a 96 hour LD-50 test.

UN ESTUDIO DEL ICTIOFAUNA DEL RIO YAQUI.
Dean Hendrickson, Arizona State University.

Un estudio recien hecho en la cuenca del Rio Yaqui (Sonora, Chihuahua y Arizona) ha registrado un total de 37 especies icticas (excluyendo 15 formas marinas), de las cuales 21 son nativas. Las afinidades de esta fauna son al las faunas del Rio Gila al norte y al Rio Bravo al oriente. Distribuciones de las especies y diferencias meristicas dentro de algunas especies apoyan evidencia geologica para el desarrollo de la cuenca de hoy por una captura, probablemente tarde en el Terciario, que conecto cuencas del norte y del sur que estuvieron antes independentes. Los datos indican dos origenes independentes de los componentes de la fauna procedentes del Rio Bravo.

Se notaron impactos humanos localizados sobre los ambientes acuaticos, pero remotos areas grandes de la cuenca retienen ambientes casi completamente naturales y sin alteraciones. El futuro inmediato de la fauna parece seguro, pero fueron verificadas algunas introducciones de especies exoticas antes desconocidas en la cuenca. De interes particular son las especies Gambusia affinis, Ictalurus furcatus e Ictalurus punctatus por sus impactos potenciales sobre las nativas Poeciliopsis occidentalis e Ictalurus pricei.

A Survey of the Rio Yaqui Ichthyofauna. Dean Hendrickson, Arizona State University.

A recent survey of the Rio Yaqui basin (Arizona, Sonora and Chihuahua) has recorded a total of 37 fish species (excluding 15 marine forms), 21 of which are known natives. The fauna shows affinities to the faunas of the Gila River basin to the North and the Rio Grande to the East. Species distributions and meristic differences within some species support geological evidence for development of the present drainage as two formerly independent North and South basins probably connected in late Tertiary. Two independent origins of the Rio Grande components of the Yaqui fauna is indicated.

Localized human impacts on aquatic systems were noted, but large remote areas of the basin retain almost completely undisturbed, natural habitats and the immediate future of the fauna appears secure. New records reported here of the exotics Ictalurus furcatus, Ictalurus punctatus and Gambusia affinis however merit attention and monitoring of their potential impacts on the natives, Ictalurus pricei and Poeciliopsis occidentalis.

WILL OUTLET MODIFICATION OF FLAMING GORGE DAM HELP THE COLORADO SQUAWFISH?

Paul B. Holden, BIO/WEST, Inc., Logan, Utah

Flaming Gorge Dam was closed in 1962 and in the following 4-5 years an excellent tailwater trout fishery was established. During this same period, Colorado squawfish were eliminated for 65 miles below the dam, to the mouth of the Yampa River. Below this point, squawfish were fairly common and reproduced successfully. The tailwater trout fishery started to decline in 1968-69, at the same time that Colorado squawfish reproduction stopped in the Green River in Dinosaur National Monument. Cold tailwater temperatures were blamed for both declines. An analysis of temperature and flow data from the Green River indicates that tailwater temperatures were reduced more due to high flows than actual release temperatures. The Bureau of Reclamation installed outlet modifications in 1978 to warm the tailwater temperatures and, hopefully, improve the trout fishery. BIO/WEST is conducting a study below the trout habitat portion to determine effects of the modifications on distribution and reproduction of warm water fishes. The study is designed to last 3 years and compare pre- and post-modification conditions. Data collected to date suggests native species will successfully reproduce in portions of the river previously too cold for reproduction.

THE BREEDING SYSTEM OF THE BOTTOMLESS LAKES PUPFISH (CYPRINODON PECOSENSIS).

Astrid Kedric-Brown and Renee Vestal, Department of Ecology & Evolutionary Biology, University of Arizona.

At high population density the breeding system of Cyprinodon pecosensis is one of male territoriality. Males established breeding territories on substrates with significant topographic complexity, such as rocky embankments, mats of submerged aquatic vegetation or single rocks scattered over a featureless silty bottom.

Females preferred oviposition substrates which coincided with male preferences for territorial sites. Females preferred to oviposit on rocky substrates (93% of a total of 365 spawnings).

Male reproductive success depended on territory quality and individual characteristics. Males with territories on rocky substrates had the highest spawning success (13 females mated per 30 min.). Occupants of territories situated primarily on silty substrate had lower spawning success (7 males mated per 30 min.). There was a positive correlation between male reproductive success and the topographic complexity of the habitat ($r = 0.57$; $P < 0.005$; $N = 40$). Topographic complexity was defined as the ratio of the area occupied by prominent topographic features to total area of a territory. Both individual characteristics of males and the number of breeding males in an area enhance reproductive success. Males with fully developed breeding colorations had higher spawning rates (4 females mated per 30 min.) than pale males (0.5 females mated per 30 min.). Males defending territories in areas where there were several adjacent territories had a higher reproductive success (1.8 females mated per 30 min.) than solitary territorial males (0.9 females mated per 30 min.).

"NATIVE" TROUT OF THE RIO YAQUI.

Robert R. Miller, University of Michigan, Ann Arbor.

The three described trouts of the American Southwest are briefly reviewed. Preliminary observations are given on 13 samples of unidentified trout from Rio Yaqui and adjacent Rio Mayo, northern Mexico. A total of 154 specimens were collected between May and July 1978. Probably most, if not all, of these represent native stocks, although absolute purity cannot be determined for certain from preserved fish.

These trout are more closely related to the rainbow than to the cutthroat series, and some osteological characters suggest a possibly close relationship to Salmo gilae. Morphometric data and additional skeletal studies are needed as are the determination of karyotypes and biochemical traits before a confident identification will be possible.

Recovery of the humpback chub, Gila cypha, and observations on that species, 1977-1978

by C. O. Minckley

Biology Department
Museum of Northern Arizona, Flagstaff, Arizona

ABSTRACT: During 1978, twenty adult humpback chubs were placed at Willow Beach National Fish Hatchery, for propagation purposes. The fish were collected from the Little Colorado River, in the vicinity of its mouth, flown to the south rim of the Grand Canyon, and transported to Willow Beach. All fish arrived in good condition and were in the hatchery raceways within five hours of lift-off from the Little Colorado River.

During 1978, 555 humpback chubs were collected. Of these fish, 21.5% (196) were juveniles, and 78.5% (359) were adults. Distribution of this species within the mainstream Colorado River was extended to river mile 194, based on a report from a commercial river runner. General distribution within the system reflects the size of fish, with larger adults preferring water over two meters in depth. Juvenile fish occurred in water less than two meters in depth. Both size groups were usually found in moderate to slow current over silt-sand bottom in the Little Colorado River.

Schooling was observed both in adult and juvenile humpback chubs, as was feeding behavior. Schooling fish were observed feeding both on the bottom substrate and the surface film. Adult chubs were observed to take Cladophora sp. as well as food from commercial river parties. The stomachs of three young-of-the-year humpback chubs were found by direct examination to contain dipteran Families of Chironomidae, Ceratopogonidae and Dolichopodidae.

Reproduction appeared to have occurred in early June based on the small size of the fish collected by seining ($\bar{x}$ T. L. = 19 mm). It is suspected that spawning commences in early spring (March) and continues through early summer, as observed.

Estimated numbers of humpback chubs, based on seining collections, ranged from 122 fish/hectare in May up to 1527 fish/hectare in June. Tagging operations were also implemented in July of 1978 using 3/8" x 1/8" fingerling tags. To date, 120 humpback chubs have been tagged and none have been recaptured.

Major problems faced by this population of humpback chubs are human impact, water fluctuations, and a newly discovered infestation of the anchorworm parasite Learnea sp. During October, 54% of the chubs collected were infested.

This research was supported by grants to the Biology Department, Museum of Northern Arizona from the National Park Service, Grand Canyon, U. S. Bureau of Reclamation, Boulder City, and the Office of Endangered Species, Region II, Albuquerque.

THE SPAWNING HABITAT AND BEHAVIOR OF SALMO GILAE MILLER, A RARE SOUTHWESTERN SALMONID.

John Rinne, Rocky Mountain Forest and Range Experiment Station, Tempe, Arizona.

The spawning season of Salmo gilae in three streams in the Gila National Forest, New Mexico commenced in early April and persisted through June, dependent upon stream elevation. Water temperature and streamflow interacted to induce spawning, however, the former was more important. Spawning commenced at water temperatures of ∿8° C.

Normally a single or a pair of fish occupied a redd, but three to four fish was not uncommon. Most spawning activity occurred between midday and late afternoon (1100-1600 hours). Fry emerged in 8 to 10 weeks at 15 to 20 mm in size and inhabited riffle areas. Avoidance of pools by fry indicated that cannibalism may occur.

Redds were normally located about a quarter the distance of stream width from a bank in waters averaging from 6.0 to 15.0 cm in depth. Fine gravel (2 to 9 mm in size) comprised the greatest percentage (by weight) of substrate materials. Spawning fish selected redd sites more based on depth of water and substrate than they did on velocity. Normally, cover was less than 5 m from a redd site. Redds ranged in size from less than 0.1 m^2 to near 2.0 m^2. Redd depressions averaged 3 to 4 cm in depth.

SURVIVAL POTENTIAL OF MOSQUITOFISH (GAMBUSIA AFFINIS) IN SALINE HABITATS.

Peter G. Sanchez, Death Valley National Monument, Death Valley, California.

Native to waters of the eastern and southwestern United States, the mosquitofish (Gambusia affinis) has been introduced worldwide for its reputed value as a biological control for mosquito larvae.1/

Mosquitofish thrive in a wide variety of habitats and are abundant in certain springs in Ash Meadows, Nevada (adjacent to Death Valley National Monument), where they appear to compete with native fishes. Within Death Valley National Monument, mosquitofish were stocked in irrigation ditches at Furnace Creek Ranch some 40 years ago.

Around 1973 mosquitofish suddenly appeared in a fishless stream at Scottys Castle, 50 miles north of Furnace Creek.2/ Fish periodically (and mysteriously) appear in a concrete pond at the Death Valley Museum during holidays when visitors are numerous. One busy weekend in 1977 about 20 Gambusia were removed from the weather station evaporation pan at Furnace Creek. "Coffee can" transplants--the seemingly innocent, but potentially damaging collection, transport and dumping of fish--from irrigation ditches by children are believed to be the dispersal means in Death Valley.

The potential for exotic fish introductions into native fish habitats within Death Valley National Monument is worthy of serious concern and a general lack of information concerning salinity tolerance of Gambusia has added to the uncertainity. Pupfish (Cyprinodon spp.) occur at five localities. The potential survival of Gambusia in the more saline of these habitats, including Salt Creek, has never been measured.

To test survival potential, 15 mosquitofish were placed in a five-gallon aquarium containing Salt Creek Water (26,500 ppm TDS)3/ and 30 fish were kept in another aquarium containing tap water. The test began on April 20 and concluded June 15, 1978. Water lost through evaporation was replenished with Salt Creek water, thereby increasing salinity each time water was added. Calculated salinity at conclusion of the test was 38,100 ppm TDS. Despite two prolonged power outages which shut down air pumps early in the study and three weeks of virtual starvation toward the end of the test period, Gambusia survived for 55 days in water which, at the conclusion, contained a 30% higher dissolved solids concentration than did the Salt Creek water at the beginning of the study. Survival of Gambusia in Salt Creek, therefore, appears likely, should a transplant somehow occur.

The experiment was designed to provide information relative to the probable survival of Gambusia in Salt Creek. No attempt was made to evaluate other survival parameters. Further studies are needed to make these determinations.

References and Notes

1. Ira LaRivers, Fishes and Fisheries of Nevada, 1962, p. 534.

2. Several attempts were made to eradicate Gambusia from these waters. The most recent attempt was made on September 26, 1978.

   The National Park Service, in furtherance of its policy to secure and maintain natural habitats by control and/or elimination of exotic species, is continuing to work toward the removal of mosquitofish from all waters in Death Valley.

3. Conductivity measurement made from Salt Creek water sample on April 13, 1978 by Walt Redington is acknowledged with thanks.

4. I thank Edwin P. Pister for reviewing and improving the manuscript.

RELACIONES DE ALIMENTACION DE PECES EN ARAVAIPA CREEK, ARIZONA.
Donald C. Schreiber, Arizona State University (now at University of Oklahoma).

Se estudiaron habitos de alimentacion de siete especies nativas de peces durante un tiempo de 13 meses en Aravaipa Creek, Graham County, Arizona. Se estimo la disponibilidad de alimentos a los peces por muestras del bentos y lo llevado por la corriente. Se presentaron tres niveles troficos: herbivoria por Pantosteus clarki; omnivoria por Agosia chrysogaster y carnivoria por las demas cinco especies (Gila robusta, Meda fulgida, Rhinichthys osculus, Tiaroga cobitis, y Catostomus insignis). Ninfas de Efemeroptera fueron la comida predominante de los peces carnivoros y del omnivoro, y fueron el invertebrato dominante en ambos el bentos y lo llevado por la corriente.

Cuando se disminuyeron dramaticamente las densidades absolutas y tamanos promedios de los cuerpos de ninfas de efimera, tres especies de peces cambiaron a una rapina diferente alterna, y tres otras no respondieron obviamente. (Una especie, G. robusta, no se estudio cuantitativamente). Los peces que respondieron a la rapina alterna se aumentaron la especializacion de comportamiento de alimentacion y repartimiento espacial del ambiente. Los que no repondieron se quedaron como generalistas en cuanto a su alimentacion. Interacciones interespecifas relacionadas a habitos de alimentacion son probablemente minimas en Aravaipa Creek por la abondanza de organismos comestibles y segregacion espacial de los peces.

FEEDING INTERRELATIONSHIPS OF FISHES OF ARAVAIPA CREEK, ARIZONA.
Donald C. Schreiber, Arizona State University (now at University of Oklahoma).

Food habits of seven native species of fishes were examined over a 13-month period in Aravaipa Creek, Graham County, Arizona. Availability of foods to the fishes was estimated by sampling benthic communities and stream drift. Three trophic patterns were presented: herbivory by a mountain-sucker (Pantosteus clarki); omnivory by longfin dace (Agosia chrysogaster); and carnivory by the remaining five species (Gila robusta, Meda fulgida, Rhinichthys osculus, Tiaroga cobitis, and Catostomus insignis). Ephemeropteran nymphs were the predominant food of the carnivorous fishes, and of the omnivore, and were the dominant invertebrate in both benthos and drift.

When absolute densities and average individual body sizes of mayfly nymphs decreased dramatically, three fish species each shifted to a different alternate prey, and three others did not obviously respond. (One species, G. robusta, was not studied quantitatively.) Fishes which responded to alternate prey increased special feeding behavior and spatial partitioning of habitat. Those which did not respond remained as generalized feeders. Interspecific interactions related to feeding habits are probably minimal in Aravaipa Creek because of the abundance of food organisms and spatial segregation of the fishes.

LIFE HISTORY AND ECOLOGY OF THE COLORADO SQUAWFISH (PTYCHOCHEILUS LUCIUS) IN THE UPPER COLORADO RIVER BASIN.

Karl Seethaler, Utah State University.

The Colorado squawfish (Ptychocheilus lucius) was once abundant throughout the Colorado River system; it is now an endangered species found in small numbers only in limited portions of the upper basin. The major cause of this decline is attributed to man-made alterations of the river environment.

The Endangered Species Act of 1973 was enacted in response to increased public concern for vanishing native wildlife, although the rationale for the preservation of species is not yet universally understood. Federal and state agencies charged with the management of endangered species and their environments found that they needed to gather considerable information on such endangered species as the Colorado squawfish.

This work constitutes a broad synthesis of current knowledge about the Colorado squawfish: distribution; abundance, habitat requirements, systematics, reproduction, early life development, age and growth, food habits, movement, maturity, diseases and parasites, causes of decline, and the phenomenon of its endangered status. The main objective was to synthesize this knowledge into a single volume to aid in effective management decisions.

An exhaustive chapter on historical and present distribution of the Colorado squawfish documents every known sighting of this species in all rivers and tributaries in the Colorado River system since 1825. A wide-ranging piscivore, this species frequents all habitat types in the river except the cold headwaters, though it was most often found in eddies, backwaters, and deep holes.

Field observations were made primarily in Dinosaur National Monument and adjacent areas of the upper Green and Yampa rivers, and at Grand Junction on the Colorado River main stem. Trammel nets, seines, and occasionally electrofishing were used to capture fish.

The Colorado squawfish, one of four species of the genus Ptychocheilus, evolved with the Colorado River system. Attesting to its reputation as a food and sport fish, it has locally acquired such names as "salmon", "whitefish", and "pike". In fact, the species is the largest cyprinid in North America, a family which arrived in this continent about the time of the Miocene epoch.

Although captured from two widely separated geographical localities in the Colorado and Green Rivers, the species apparently consists of a single population. Analysis of electrophoretic and meristic data failed to show any intraspecific differences between fish captured from these two locations.

Positive identification of larval and juvenile fish often presents a problem to collectors. Because there is a need for

adequate description of the young, a series of 15 detailed drawings was made using a "camera lucida". These drawings document the development of young Colorado squawfish from egg, various larval stages, and juveniles. Morphometrics and meristics were tabulated for each stage.

Age and growth were similar for fish captured in the Yampa-Green Rivers and Colorado River at Grand Junction, Colorado, during 1974-76. Moreover, there was no significant difference between these fish and those from the upper Green River in 1964-66.

Colorado squawfish became mature when individuals reached a size of 428-503 mm in total length and an age of 6-8 years. Spawning requirements were speculated from observations in the field and hatchery, and comparison from related species. Food habits are similarly deduced from observations and the literature.

Movement of the Colorado squawfish has been difficult to validate, but seasonal patterns were noted. Two squawfish were tracked briefly with the use of sonic tags.

The most common parasite of the Colorado squawfish is the copepod, Lernea sp. Other parasites and diseases include the fungus, Ichthyophthirius sp., the tapeworm Proteocephalus ambloplites, and the protozoa Myxosoma sp. and Myxobolus sp.

The decline of the species appears to have resulted from the loss of habitat due to environmental changes in stream flow and biological composition. Dewatering, dams and reservoirs, alteration of stream flow and stream morphology, changes in water quality, and the introduction of exotic species are discussed as being the principal causal factors.

While additional studies would be useful to management, the urgency of the situation indicates the need for expeditious efforts at preservation. Artificial propagation is a very important means of buying time and should be vigorously undertaken for all endangered native species. Public education, in the long run, is probably the most important consideration. Further water development projects, especially in the upper Green River and its tributaries, should be considered incompatible with the recovery effort.

IS RADIO-TAGGING A VIABLE TECHNIQUE FOR COLORADO SQUAWFISH?
Douglas Selby, BIO/WEST, Inc.

A study to determine the spawning requirements of the endangered Colorado Squawfish (Ptychocheilus lucius) was begun in April 1978 under a contract from the Western Energy and Land Use Team of the U.S. Fish and Wildlife Service. The project made use of radio tags surgically implanted in the fish, a technique frequently used on salmon, but never on Colorado squawfish and only once previously in the Colorado drainage. Transmitters, receivers, and antennas used were all manufactured by Smith-Root Corporation. The transmitters operated on the 40.600 Mhz band. Transmitters were implanted in seven squawfish, all of which seemed to be little affected by the surgical procedure. All but one of the seven fish were lost within a week and never relocated despite intensive searches. The one fish which was tracked moved a total of 89 miles downriver from its point of release in a period of six weeks. He was frequently monitored during this time and all indications were that he was healthy and behaving normally.

The problem in locating the other fish apparently was the result of weak transmitters. After thorough searches for the lost fish with negative results, 5 unimplanted transmitters were tested under field conditions and found to be much weaker than advertised. In 2 feet of water, all of the transmitters had ranges of under 100 yards and 2 had ranges of under 100 feet. The transmitters also lost strength with extended operation.

Because the transmitters were the obvious cause of the failure of the project, we have recommended a second attempt to determine spawning requirements of squawfish using new pretested transmitters. The successful tracking of one fish for 6 weeks indicates the research potential of radio tagging other native species in the Green River.

MOVIMIENTOS DE TRES PECES EN ARAVAIPA CREEK, ARIZONA.
Darrell J. Siebert, Arizona State University.

Los movimientos de tres peces, Gila robusta, Catostomus insignis y Pantosteus clarki, estan bajo investigación en Aravaipa Creek, Arizona, utilizando el método de marcar-recapturar. Al capturar los peces, se estan marcados con marcas de ancla "Floy" individualmente numeradas, y devueltos al agua. Se notan sitios de marcar y subsecuentamente, de recapturar. Se estan marcando un rango de tallas de peces entre 6 y 38 cm. Ya se cuenta con un año de datos.

Gila robusta y Catostomus insignis muestran pautas de movimientos similares, ambos mostrando movimiento al dentro del canon abrigado de Aravaipa, tanto de arriba como de abajo. Pantosteus clarki no presenta una pauta fija de movimiento. Los movimientos de ésta parecen ser al azar.

MOVEMENTS OF THREE FISHES IN ARAVAIPA CREEK, ARIZONA. Darrell J. Siebert, Arizona State University.

Movements of three fishes, Gila robusta, Catostomus insignis, and Pantosteus clarki, are being investigated in Aravaipa Creek, Arizona by a mark-recapture method. Fish are captured, marked with an individually numbered Floy anchor tag, and released. Original capture and subsequent recapture localities are carefully noted. Marked fish range in size from 6 cm to 38 cm. Data collection has been in progress for a year.

Gila robusta and Catostomus insignis show similar movement patterns, both species showing a pattern of movement into the sheltered Aravaipa Canyon from upstream and downstream. Pantosteus clarki does not present a clear pattern of movement. Movements of this fish appear to be random.

EFFECTOS DE LA TEMPERATURA Y SALINIDAD EN EL METABOLISM ENERGETICO Y ELECTROLYTICO DEL PUPFISH, CYPRINODON SALINUS.

Edward L. Stuenkel y Stanley D. Hillyard, Instituto de Investigaciones Biologicas del Desierto, Universidad de Nevada en Las Vegas.

El pupfish de Salt Creek, Cyprinodon salinus fue aclimatado a aqua dulce, al agua de Salt Creek que su concentracion de sales es aproximadamente 641 milliosmoles/kilogramo, alrededor de la mitad de la concentracion del agua de mar, y finalmente al agua de mar que tiene una concentracion de 1,168 milliosmola/kilogramo y al mismo tiempo a tres diferentes temperaturas: 15, 20 y 30 centigrados. El metabolismo de norma (VO_2) en esta investigacion pudo verse que aumento significantemente con el aumento de la salinidad, sin embargo los peces aclimatados en agua de mar no hubo ninguna diferencia en el VO_2 entres los peces aclimatados a 25 y 30 C. La actividad especifica del ATPase de $Na^+ - K^+$ de las agallas del pupfish fue mas baja en los peces aclimatados a mitad de agua de mar que en los peces aclimatados en agua dulce y en agua de mar en cada diferente temperatura de aclimitasion. La temperatura de aclimitision tambien influjó la activadad del ATPase de $Na^+ - K^+$ de las agallas del pupfish porque se encontró que la actividad fue mas grande en los peces aclimatados a 15° C que a los de 30° en los dos grupos de agua dulce y mitad de agua de mar. La osmoladidad del plasma no fue afectado significamente por las diferentes temperaturas de aclimatacion en los peces de mitad de agua de mar. In los peces aclimatados agua dulce y agua de mar, la osmoladidad del plasma bajó y subio respectivamente con la temperatura de aclimacion. Cyprinodon salinus parce ver que tolera mucho mesor salinidad a altas temperaturas que a bajas y estos datos physiologicos estan de acuero con los datos de obserbaciones en Salt Creek que la salinidad es mucho mas grande en Salt Creek in los meses de verano.

EFFECTS OF TEMPERATURE AND SALINITY ON ELECTROLYTE AND ENERGY METABOLISM IN THE PUPFISH, CYPRINODON SALINUS.

Edward L. Stuenkel and Stanley D. Hillyard, Desert Biology Research Center, University of Nevada, Las Vegas, Nevada.

Salt Creek pupfish, Cyprinodon salinus, were acclimated to freshwater (FW) and to concentrations of Salt Creek water which approximated ½ sea water (½ SW; 641 mosm/kg) and sea water (SW; 1,168 mosm/kg) at three acclimation temperatures: 15, 25 and 30 C. Standard metabolic rate (VO_2) was found to increase significantly with increasing acclimation salinity although in SW, the VO_2 of 25 and 30 C acclimated fish was not different. The specific activity of gill $Na^+ - K^+$ ATPase was lowest in ½ SW acclimated fish at each acclimation temperature and increased two-fold with acclimation to FW or SW. The acclimation temperature also influenced gill $Na^+ - K^+$ ATPase activity with higher activity values observed in the 15° than in the 30° acclimation groups in FW and ½ SW. Plasma osmolality was not significantly affected by acclimation temperature in the ½ SW acclimated fish. In FW and SW, however, plasma osmolality decreased or increased, respectively as the acclimation temperature decreased below 30°. C. salinus, thus, appears to tolerate elevated salinity better at higher temperatures which correlates with the field observations that environmental salinities in Salt Creek are highest during the hot summer months.

WHAT THE CIBOLA NATIONAL FOREST HAS DONE FOR THE ZUNI MOUNTAIN SUCKER, PANTOSTEUS DISCOBOLUS YARROWI.

F.A. Winter, Wildlife Biologist, Cibola National Forest, Albuquerque, New Mexico.

Fiscal year 1978 included incremental funding for Zuni Mountain Sucker habitat improvement. Two specific tasks had been designated--removal of debris blocking stream channels and digging potholes for water collecting sites. A survey of the area described indicated about a half day's work for debris removal, and to dig potholes would be futile. The reason for not digging potholes was that the high intensity--short duration summer thunderstorms would nullify the effort.

Another problem was the broken ownership pattern in the area where suckers were found. The ratio of National Forest lands compared to private ownership was extremely small--less than 10%. Federal funds can only be spent on Federal lands.

The Forest Service Youth Conservation Corps (YCC) needed a project for a portion of the summer. The idea of fencing out an area to protect sucker habitat from cattle had been previously discussed with Mt. Taylor Ranger District personnel. An area, including a spring, was needed for this project.

Radosevich Creek which runs through an isolated section of National Forest land and included Radosevich Spring was the site selected. Forest Service and Bureau of Indian Affairs YCC, from Ft. Wingate, New Mexico, working together, began the project. The YCC crews cut juniper trees for corner posts, drove steel posts and strung barbed wire. What was estimated to be about a week's work ended up over three weeks' worth. An area about one-quarter mile long by about 200 feet wide was fenced. Cattle are now excluded from this area of habitat which is felt critical to survival of the sucker on National Forest lands. The cattle permittee was very cooperative and encouraged our efforts.

In the future, other sites on other streams will be selected for fencing to exclude cattle to protect the habitat of this species.

POPULATION DYNAMICS OF *CYPRINODON RADIOSUS*: A PRELIMINARY REPORT.

David K. Young, California State University, Fresno.

The Owens pupfish, *Cyprinodon radiosus*, is a member of a limited desert fish fauna whose existence has been sustained by the efforts of various government and private agencies, as well as several committed individuals. In 1964, the actions of Dr. C. Hubbs, Dr. R. Miller, and Mr. Phil Pister resulted in rediscovering a remnant population of this once thought extinct species. Since then the Owens pupfish has been the subject of an intense preservation program. In 1968, it was listed as endangered by the U.S. Department of Interior.

Historically, the distribution of *C. radiosus* was restricted to the Owens Valley drainage, from near Lone Pine in Inyo County, Ca., in the south, to Fish Slough in Mono County, Ca., in the north. Today, the Owens pupfish is limited to three sanctuaries. One refugium is found at Warm Spring near Big Pine, Inyo County. The other two sanctuaries, the Owens Valley Native Fish Sanctuary and the BLM Spring Sanctuary, are located at Fish Slough.

I visited these refuges in July and August, 1976, with Professor Robert Brown (C.S.U.F.). It was during one of these visits to the BLM Spring Sanctuary that I noticed that a gravel barrier, originally constructed to prevent upstream movement of predatory fish into the sanctuary, had been destroyed. We searched the stream between the two dams but failed to find pupfish. By using electrofishing gear we were able to obtain a population index of ten largemouth bass (*Micropterus salmoides*). The stream section north of the upstream dam appeared to be free of bass and here we observed many pupfish and mosquitofish (*Gambusia affinis*). I brought these findings to the attention of Phil Pister who suggested that I pursue the following objectives:

1. To eradicate the existing population of largemouth bass, repair the gravel dam and reintroduce *Cyprinodon radiosus* into its native habitat.
2. To study the population dynamics of the Owens pupfish and to monitor the growth characteristics of this species, as well as the ecological consequences of this growth.
3. To observe and record the behavioral patterns of *C. radiosus* in the field.
4. To describe the distribution of this species in relation to spring inflow, vegetation types, water quality, and temperatures.
5. To develop recommendations for effective management.

Work began in March, 1977, by chemically treating the stream and repairing the gravel percolator dam. This resulted in the

formation of a small overflow pond of shallow water covering an area about 350 square meters, and a mean depth of 30 cm. In April 1977, 300 adult pupfish (in a 172 ♀: 128 ♂), collected from the Warm Spring refuge, were introduced into this habitat. Sixty-three days later fry were observed in the overflow area on the west side of the pond. Eighty-four days after introduction, young pupfish were easily observed and trapped throughout the shallow pond; however, they were never observed or trapped in the main channel (≈ depth 2.5'). The adults which were introduced into the main channel were rarely seen. The incipient population appeared to have been readily reestablished. Therefore, the remaining objectives of this study were pursued.

The estimation of population size $\hat{n}$ was made during September, 1977, June, 1978, and September, 1978, using the Peterson mark and recapture method. Pupfish were captured in minnow traps, weighed to the nearest 0.1 gram, standard length measured to the nearest mm, caudal fin clipped, and then released.

Population size was estimated at 2,000 fish in September, 1977, 9,000 fish in June, 1978, and ∿ 10,000 fish in September, 1978. It appeared that the population had stabilized during the 1978 season. This may be due to two reasons: the population stabilizing near the carrying capacity of the pond or, emigration of young fish downstream from the pond (and out of the sanctuary) may be cropping the population below the carrying capacity. The second hypothesis is supported from observations made in late June, 1978, when I estimated a population size of 560 fish in an area 25 meters downstream from the pond (below the downstream dam). I then explored the marshy areas and other ponds one mile downstream from the sanctuary where I found pupfish (< 25 mm) young quite common. The general distribution pattern is described as a population of segregated age groups -- with larger fish (older) dispersing just a short distance from the sanctuary and the smaller fish (younger) dispersing further downstream.

The average size in September, 1977, of the first generation was 28.3 mm, with a mean weight of 0.9 grams (n=389). In September, 1978, the average size of the total population was 30.4 mm, with a mean weight of 0.98 g (n=821).

In September, 1978, less than ten percent of the population was made up of adult pupfish, which had a mean length of 42.9 mm and a mean weight of 2.7 g. I classified these fish as Age Group I, they are the surviving members from the 1977 first generation. Age Group II was made up of 1978 young and had an average length of 29.3 mm and a ≈ weight of 0.84 g.

By calculation, I estimated the standing crop and production at various time intervals. Biomass in April, 1977 (0.81 kg), was due entirely to the introduced adults from Warm Spring

Refuge. No adults were ever trapped; therefore, their abundance in September, 1977, is unknown. Standing crop in September 1977, (1.81 kg) is made up from the first year young. Standing crop in September 1978, (9.84 kg) is composed of two age groups. The survivors of the 1977 season contributed less than 0.5 kg to the standing crop. Age Group II contributed the larger biomass to the population and was also the most widely distributed age group.

In order to evaluate the environmental performance of BLM habitat on the pupfish population, production values were calculated. At the end of the first season (September 1977) production was determined for first generation pupfish (3.1 kg). For September, 1978, I divided production into the two age groups. Total production for 1978 is 13.7 kg or 39 gm of fish per square meter. Production was most influenced by the numbers of pupfish young (Group II). Age Group II accounts for nearly 85 percent of the annual production.

Estimation of pupfish production in this study required several assumptions and this data should be interpreted accordingly. Major assumptions were:

1. Egg mortality, mortality and growth of young were assumed to be linear.

2. Immigration of pupfish into the sanctuary was insignificant.

Some support for the second assumption came from drift net data collected from the upstream dam. During the sample period no pupfish young or eggs were ever collected, however, mosquito fish fry were.

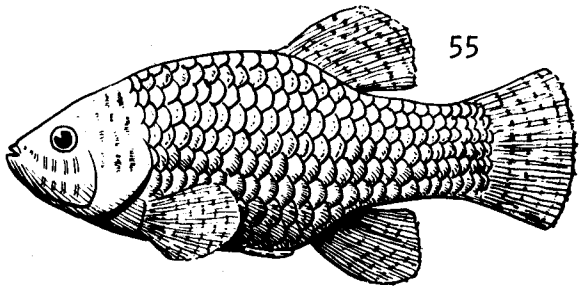
In summary, the repopulation of pupfish in BLM Sanctuary appears successful. Evidence has been presented that suggests population stability, and segregated distribution downstream of age groups. Young pupfish made the greater contribution to the production estimates.

REPORTS FROM AREA COORDINATORS

Chairman: Jim Johnson, U.S. Fish & Wildlife Service, Albuquerque.

The following reports were presented at the 1978 symposium. Inasmuch as changes are currently being made within the area coordinator structure, it may be expected that a more complete reporting will be made in 1979.

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"
407 West Line Street
Bishop, California 93514
March 9, 1978

To: All Persons and Agencies Concerned

From: Chairman, Death Valley System Committee

Subject: Fifth Annual Meeting, Death Valley System Committee

Subject meeting was held at the National Park Service Auditorium, Furnace Creek, on February 23, 1978 with 25 in attendance (list attached). The following agenda items were discussed:

1. Status of Ash Meadows. Tasker Edmiston reported that, following the November, 1977 Symposium, he toured Ash Meadows with Bob Love and photographed all of the major springs. Enlargements have been forwarded to Senator Alan Cranston's office. Word received from Senator Cranston during the week of February 27 revealed that S.2589, to establish a Desert Pupfish National Monument, has been introduced.

   In order to assist Senator Cranston in this respect, the Council will prepare an information packet at the earliest possible date, with the specific assignments as follows:

Invertebrates	Jerry Landye
Fishes	Doug Selby
Plants	Gail Kobetich
	Jim Reveal
	Pete Sanchez
Birds and Mammals	Doug Selby
Archaeology	Pete Mehringer via Jerry Landye
Herpetology	U.N.L.V. via Jim Deacon
Hydrology	Bill Dudley's report (U.S.G.S. Open file report 74-188)
Land ownership	Kurt Ballantyne

   This material will be forwarded to the Death Valley System Committee chairman for assembling and preparation of a cover letter. Final submission will be made to Senator Cranston by Tasker and Beula Edmiston.

2. Status of BLM California State Office fishery biologist position. A resolution endorsing the re-establishment of this position has been prepared and will be forwarded to the California State Director at an early date.

3. The status of Crenichthys nevadae and Railroad Valley petroleum exploration. Kurt Ballantyne reported as follows:

BLM is in the process of updating the Railroad Valley Habitat Management Plan. Since the Plan was written in 1973, several problems have arisen:

a. Oil exploration and development. Approximately 20 wells have been drilled since June, 1976, 10 of which are now producing 960,000 barrels per month.

b. Discovery of 70 acres of fenced public lands at Lockes Ranch, on which 3 spring sources are located (North Spring and North and South Reynolds), all containing springfish.

c. Elimination of a reservoir population of White River spinedace (Lepidomeda albivallis) owing to an introduction of Sacramento perch (Archoplites interruptus). Inasmuch as the spinedace are not indigenous to the Railroad Valley area, their loss is of no great concern. However, the existence of the exotic and highly predaceous Archoplites is viewed with concern because of the likelihood of unauthorized transplants to waters containing Crenichthys and Gila.

Oil exploration and development per se seem not to be a major problem at this time. Associated human disturbance appears to be the greatest threat.

Council action relative to this subject includes the following proposals:

a. A letter urging funding for taxonomic work on the Gila and Crenichthys populations should be directed to the Nevada State Director of BLM. This work could be done at U.N. Las Vegas or the University of Michigan.

b. A letter will be sent to the BLM Battle Mountain District Manager endorsing the construction of fish barriers as necessary to protect the indigenous fishes of Railroad Valley and emphasizing the general policy opposing transplants out of natural drainage systems. The eradication of Sacramento perch and restocking of endemic Gila will be urged for Big Well Channel.

c. The Council will support the purchase or exchange of Lockes Ranch through the BLM planning process.

4. Recent surveys of Ash Meadows Cyprinodon and R. o. nevadensis populations. Doug Selby's report follows:

Under a cooperative agreement between UNLV and USFWS I have been conducting a survey of the Ash Meadows ichthyofauna. The survey is not yet complete; the following is a brief summary of progress to date.

Since cessation of pumping from wells on Spring Meadows properties (recently purchased by Calvada developers) the springs have shown rapid recovery. All of the springs examined thus far have been full and flowing well. Unfortunately, the outlook is not so encouraging for the native fishes.

Most of the springs contained large numbers of exotic species including crayfish, mollies, mosquitofish, and the Oriental snail, Melanoides. In spite of this

infestation the native pupfish are generally doing well although they have been eliminated from some former habitats. They occupy almost every spring examined with the exception of Forest and Tubb's Springs.

The Ash Meadows speckled dace, R. o. nevadensis, is not in such a favorable condition as the pupfish. From my survey it appears the dace is on the verge of extinction in this area. Dace were captured in only two springs, Tubb's Spring outflow and one of the Bradford Springs. In each instance only one fish was captured despite fairly intensive attempts using traps, seines, and dipnets. Point of Rocks Spring, Fairbanks Spring, and Forest Spring are all apparently devoid of dace. Fairbanks Spring historically contained the greatest relative abundance of dace. Big Spring, another known habitat of the dace, has not been examined yet this year, but last spring the population there was very low.

Since few of the habitats appear to have been drastically altered physically it is my assumption that the many exotic species present are reponsible for the decline in numbers of dace in Ash Meadows.

A final report will be prepared for the FWS upon completion of the survey in March.

5. Status of Devils Hole water levels. Jim Deacon reported that U.S. District Court Judge Roger Foley ruled in December, 1977 that water levels must remain no farther below the copper index washer than 2.7 feet. Previously the court had ruled 3.0 feet.

6. Legal status of Desert Fishes Council. The Council's attorney has filed tax exemption forms with both the Internal Revenue Service and California Franchise Tax Board. He anticipates no difficulty in our being granted tax-exempt status.

7. Progress of resolutions passed at 1977 symposium. Chairman Deacon reported that, with the exception of the resolution concerning the BLM California State Office fishery biologist position, all resolutions had been completed, signed, and disseminated.

8. Progress of the newly-revised area coordinator program. In the absence of Chuck Minckley, Jerry Landye reported that all coordinators were functioning and that Chuck is awaiting reports of their annual meetings. The 1977 Death Valley System Committee report has been forwarded to Chuck, and the 1978 report will follow shortly.

9. Progress of the proposed DFC newsletter. Gail Kobetich has agreed to serve as editor and hopes soon to put out the first edition, which will be produced on a quarterly basis. Content of the newsletter will comprise, essentially, summaries of the area coordinator reports plus other newsworthy material as warranted. Jim Deacon is preparing a map, to appear in the first edition, which will delineate the various drainage systems administered under the area coordinator concept.

10. Status of Gambusia affinis at Scotty's Castle. A three-agency attempt (NPS,FWS, and Cal.Fish and Game) to eradicate this exotic population with Antimycin was made on June 30, 1977. However, a few Gambusia remain, and a second effort will be made as soon as the necessary clearances are received by the Park Service.

11. Environmental assessment record-proposed potassium leasing on a playa near Death Valley Junction (north of Eagle Mountain). Jeff Aardahl of BLM, Ridgecrest reported as follows:

    The resources staff of the Ridgecrest Area Office, BLM, is preparing an Environmental Assessment Record for proposed potassium prospecting on a playa in the Amargosa River drainage near Death Valley Junction. The playa is immediately north of Eagle Mountain.

    The prospecting and mineral production proposals will basically involve drilling on the playa surface, pumping the brine solution to the surface and evaporating the solution in large ponds to obtain various salts to be refined.

    Our office is in the initial stages of data collection. We believe the Desert Fishes Council will be interested in commenting on the draft and final Environmental Assessment Records. The purpose of this environmental study is to determine whether or not the proposed prospecting and development is environmentally acceptable. We hope to work closely with the Council in development of this Environmental Assessment Record. One of our concerns is the possible impact of the proposed development on various fishes in the Death Valley System from Ash Meadows to Tecopa.

12. Mono Basin water diversion. The diversion of most of the surface water from the Mono Basin into the Los Angeles Aqueduct is causing an accelerated desiccation of Mono Lake and is almost certain to damage the Mono Lake ecosystem. Fishes (post-Pleistocene) are not indigenous to the Mono Basin. However, the Council is concerned with the integrity of all Great Basin aquatic ecosystems. On this basis, a letter is being drafted by Louis Courtois encouraging Assistant Interior Secretary Herbst to utilize funds earmarked for National Heritage preservation for use in reducing water export from Mono Basin.

13. Status reports on the Death Valley System fishes follow:

    a. Pahrump killifish, Empetrichthys latos.

    Gail Kobetich reported that the Corn Creek population is in good shape in the main spring pond and is building up in the middle pond. However, it may have to be stocked in the lower pond. Doug Selby's observations at Shoshone Ponds (near Ely, Nevada) in early February revealed a good population there. The recovery plan needs typing and submission. Manse Spring will go dry annually, and it will therefore be necessary to hold the species elsewhere.

b. Devils Hole pupfish, Cyprinodon diabolis.

Jim Deacon reported that the recovery plan will be forwarded to Portland next week. The water level of 2.7 established by Judge Foley is proving to be helpful in the buildup of the population. Pre-pumping levels were approximately 1.2-1.4. During the extremely low levels experienced during pumping times, the population dropped below 100 fish. Since the level has been stabilized at 3.0, it has never been less than 200. With the water level at or above 2.7, Dr. Deacon expects the population to increase to over 500. Counts are made once per month, and a maximum count of 525 was made last summer(1977).

Doug Selby's report on the Hoover Dam population follows:

> During the past four censuses at the refugium the maximum population count has varied from 41 to 48 fish. There is occasional evidence of reproduction in the form of young fish. A build up of sediment on the bottom of the refugium may be partially responsible for the decline in reproductive success and population numbers. Because of this, attempts are being made to siphon off this sediment in hopes of increasing the population.

c. Ash Meadows speckled dace, Rhinichthys osculus nevadensis.

Gail Kobetich reported that most of the good habitat for the subspecies has been removed. Because of this and other uncertainties in the Ash Meadows area, he will suggest that it be listed as endangered.

d. Ash Meadows pupfish, Cyprinodon nevadensis mionectes.

The existing populations are holding their own. However, it is also suggested for listing as at least threatened status under the same rationale listed under (c) above.

e. Warm Springs pupfish, Cyprinodon nevadensis pectoralis.

Doug Selby's report follows:

> A habitat management recommendation has been prepared outlining a procedure to eradicate the exotic fish species from habitats of the Warm Springs pupfish. The habitats presently containing exotics are both Scrugg's Springs and both Indian Springs. The proposal calls for installation of fish barriers on the outflow of each of the springs. A low gradient barrier of the type successfully used at Fish Slough (Mono County, California) will be constructed for this purpose. The springs will be seined and trapped to remove the largest number of C. n. pectoralis. The fish will be held in separated, labeled cages at the nearby Amargosa Pupfish Refugium. The springs will then be treated with Antimycin concentrate distributed from drip stations above the first occurrence of exotic fishes. After detoxification the fish will be returned to their respective habitats.

f. Owens chub, Gila bicolor snyderi.

Habitat conditions remain unchanged for the Owens chub, but more life history information is needed to allow for the preservation of the subspecies. California Fish and Game plans to hire a graduate student to conduct a life history study in its only remaining natural habitat - the Owens River Gorge below Crowley Reservoir - during 1978.

g. Owens dace, Rhinichthys osculus subsp.

The subspecies is fairly numerous and widespread in tributaries to the Owens River in northern Inyo County, with no immediate threat to its existence. Status apparently unchanged from last year.

h. Rhinichthys osculus subsp., Amargosa R. near Beatty, Nevada

and

i. Rhinichthys osculus subsp., Amargosa Gorge, below Tecopa.

Although no apparent differences exist between these two subspecies, Dr. Deacon feels the Beatty population may be distinct and recommends that further work be done here. Gail Kobetich reported good numbers of dace in the Beatty area despite heavy rains and floods in recent weeks. There have been no known changes in the habitat near Tecopa, so we assume a stable population there. Efforts will be made to locate a graduate student interested in pursuing a study of the Amargosa River and its dace populations.

j. Mohave chub, Gila bicolor mohavensis.

The primary habitat, Fort Soda, needs maintenance and weed removal. Also badly needed are the installation of an aeration system and implementation of the management plan agreed upon at the July 1, 1977 meeting. Hopefully, BLM will provide the necessary financing and motivation for this to occur. Without it, a good chance exists that the entire population will be lost through inadequate oxygen as temperatures and weed growths increase. Such an occurrence would virtually render the subspecies extinct.

k. Owens pupfish, Cyprinodon radiosus.

During the summer of 1977, the 200 remaining acres of privately held land in Fish Slough located near the Owens Valley Native Fish Sanctuary changed hands, and the new owner is anxious to begin raising alfalfa there. BLM, although extremely short of help in the Bishop area office, is attempting to negotiate a land exchange. To assist in this respect, Roger Samuelsen, of the University of California's Natural Land and Water Reserves System, has arranged with Dr. Ken Norris, of U.C. Santa Cruz, to provide student assistance in performing the evaluation work which must precede the exchange. Hopefully, this work will begin in the near future and the landowner will respect a resolution from the Land and Water Reserves Committee not to disrupt the Fish Slough ecosystem by initiating a land development project. If all else fails, eminent domain procedures will be implemented by the Fish and Wildlife Service. Funds are available for purchase of the land.

The C. radiosus population in the Fish Slough refugium appears to be in good condition, as do those in the B.L.M. Spring and Warm Springs refugia. However, numbers in the latter refugia are much smaller than in the main sanctuary, and their populations are much more vulnerable to vandalism. In order that the integrity of the species may be assured, it is necessary that the 200 acres of privately held land be acquired at the earliest possible date.

David K. Young, a graduate student at California State University, Fresno is conducting a study of the population dynamics of C. radiosus in B.L.M. Spring. He has completed one season of field work and will continue his field studies in 1978.

l. Tecopa pupfish, Cyprinodon nevadensis calidae.

Doug Selby's report follows:

> An extensive survey of all existing aquatic habitats in the Tecopa, California area was undertaken for California Fish and Game during the summer of 1977. This survey failed to locate any populations of pupfish which could be clearly identified as C. n. calidae. All pupfish examined appeared to be the more common Amargosa pupfish, C. n. amargosae native to the marsh and river below the habitat of C. n. calidae. It is reasonable to assume that the Tecopa pupfish is extinct.

m. Cottonball Marsh pupfish, Cyprinodon milleri.

Pete Sanchez reported that the population appears to be in good condition. Heavy rains in the desert all season have flooded portions of the floor of Death Valley and lengthened the normal course of Salt Creek. An attempt will be made by aerial reconnaissance to determine whether or not there is, or has been, any mixing of the two waters, inasmuch as mixing of the two fish populations could have enormous impact on the integrity of the species involved.

n. Saratoga Springs pupfish, Cyprinodon nevadensis nevadensis.

Pete Sanchez reported that both the habitat and its fish population are in good condition and under no current threat.

o. Amargosa pupfish, Cyprinodon nevadensis amargosae.

The subspecies exists in good numbers throughout the lower Amargosa River. The only known threat at this time is groundwater development in Nevada.

p. Salt Creek pupfish, Cyprinodon salinus.

The status of this population remains satisfactory. The 3,000 foot boardwalk observation facility continues to be highly successful in improving interpretive aspects of Salt Creek and in protecting the riparian and aquatic habitats. See item (m) above.

q. Owens sucker, Catostomus fumeiventris.

The species remains widespread and abundant in the upper Owens Valley, especially in Crowley Lake. Geothermal exploration and possible development pose a threat and will be watched carefully.

r. Desert pupfish, Cyprinodon macularius.

Bob Miller's call from Ann Arbor on the morning of the meeting (February 23) revealed that the desert pupfish is being recommended for endangered status in the new edition of the IUCN red data book. Similar action by the Fish and Wildlife Service was recommended by the Council at the November symposium in Death Valley. These actions are fully compatible with recent observations made by biologists from California Fish and Game and California State University, Los Angeles. It is hoped that California will recommend similar status.

E. P. Pister, Chairman
Death Valley System Committee

Attendance List - Death Valley Committee Meeting
Desert Fishes Council, Feb. 23, 1978

Name	Affiliation	Address
Phil Pister	Cal. Fish & Game	Bishop, CA 93514
Jeff Aardahl	BLM-Ridgecrest	P.O. Box 219, Ridgecrest,Ca. 93555
Gene Ryder	" "	" "
Jerry McKnight	None	Rt. 8 Box 102A Bakersfield,CA 93307
Bob Love	The Nature Conservancy	P.O. Box 1006 Yorba Linda,CA 92686
Tasker L. Edmiston	814 W. Markland Drive	Monterey Park, CA 91754
Beula Edmiston	" "	" "
Gail C. Kobetich	USFWS	2800 Cottage Way Sacramento,CA95825
Gary M. Sonnevil	USFWS	4600 Kietzke Lane Reno, Nev. 89502
Glenn Black	Cal.Fish & Game	Rt. 5 Bird Farm Rd. Chino,CA 91764
Gary Ponder	" "	407 W. Line St., Bishop 93514
Terry Mills	" "	987 Jedsmith Sacramento 95819
Louis Courtois	" "	" "
Larry L. Eng	" "	1416 Ninth St., Sacto. 95814
Pete Sanchez	NPS	Death Valley, CA 92328
Jim Deacon	UNLV	Las Vegas, Nev. 89154
Doug Selby	UNLV/FWS	Las Vegas, Nev. 89154
Don Sada	BLM	Bishop
Jerry Stefferud	Inyo Natl Forest	Bishop 93514
Jim St. Amant	Cal. Fish & Game	350 Solden Shore,Long Beach 90802
Joe Capodice	BLM,Bishop	873 N. Main , Bishop 93514
Kenny Detweiler	BLM, Las Vegas Dist.	P.O. Box 5400 Las Vegas Nev.89102
Kurt Ballantyne	" Tonopah Resource Area	P.O. Box 911 Tonopah Nev. 89049
Herb Guenther	USBR Lower Colorado Region	Boulder City, Nev. 89005
Jerry Landye	Consultant	3465 N. Jamison Flagstaff,Arix.8600

SPECIAL REPORT ON GASTROPODS AT TRAVERTINE SPRINGS.
J. Jerry Landye.

Final inspection of Travertine Springs after the completion of the new water system for Furnace Creek, Death Valley, California revealed that the two endemic freshwater gastropods were alive and well. Populations of the undescribed genus, new species of hydrobiid snail and Assiminea n. sp. were in excellent condition and far exceeded the minimum expectations of the planning and construction phases of the operation. The outlook is excellent for maintaining these two species of snails even though their habitats have been reduced in size. This was a good example of preconstruction planning to prevent the loss of gastropod and other invertebrate populations. Stratton Bros, the construction company and National Park Service personnel are to be congratulated on a job well done.

J. Jerry Landye
November 17, 1978
Read in the Death Valley
area report.

DESERT FISHES COUNCIL

1978 Report of Fisheries Activities Within the Bonneville Basin*

Bonneville Basin Coordinator, Don Duff
Salt Lake City, Utah

Fisheries activities remain much the same as reported within the Bonneville Basin to the Council in 1977. During 1978 however, the following agencies were involved in major fisheries activities within the various segments of the basin.

Southern Bonneville Basin

The Utah Division of Wildlife Resources(DWR), Bureau of Land Management(BLM), and the Forest Service(FS) continue studies and management of the Birch Creek Utah cutthroat population. The creek remained perennial in 1978 and experienced no fish mortality due to low flows. The aquatic-riparian habitat still remains in poor condition because of livestock use along the stream on BLM and FS land.

The BLM's Hot Desert Grazing Environmental Statement provides for the management protection of several perennial streams in the Washington County, Utah area from livestock grazing. These streams could become refuges for the native Colorado River cutthroat if reintroductions of this species is contemplated in the future.

The endangered woundfin minnow in the Virgin River is still being discussed and cussed by the opponents and proponents of the Allen Warner Valley Power Project. A biological opinion has been issued to the BLM by the U.S. Fish and Wildlife Service(FWS) calling for a seasonal committment of instream flows to protect the woundfin. The project can still be built with the proposed flows but the proponents are unwilling to accept them based on states rights issues. The BLM has yet to make a decision on the flows and in all probability will seek a decision from the Secretary of the Interior. A court case over the woundfin appears a probability in the future.

Central Bonneville Basin

The Utah DWR is winding up a 2 year study, funded by BLM, to inventory the Deep Creek Mountain,Juab County. The fisheries inventory is complete now and no new populations of the Utah cutthroat(Snake Valley strain) has been discovered on the mountain. Birch Creek was treated in October to eradicate exotic fishes and DWR plans to transplant Trout Creek fish into the creek in November. Other streams on the mountains east slope will be treated and transplants put into them in 1979.

The BLM continues to study the Deep Creek Mountains in preparation for submission of a report to Congress in May 1980 as to whether or not the area of critical environmental concern should be open or closed to future mineral exploration and development.

*For the Annual Meeting November 16-18,1978, Las Cruces, New Mexico

The Nevada Department of Fish and Game(NDFG) is involved in a native cutthroat trout project which includes eastern Nevada. This project calls for a determination of the genetic purity and classification of several populations of Nevada cutthroat including the Lahontan, Humboldt, Mt. Wheeler(Utah cutthroat), and Yellowstone cutthroats. This activity was started in 1978 and is scheduled for several years under contract to Dr. Graham Gall at U.C. Davis. NDFG is beginning a five year program of eradicating exotic trouts in streams and transplanting native trout back into these waters. Transplants of Mt. Wheeler(Utah) and Humboldt cutthroats into barren streams has been a active program for the past 10 years.

NDFG, FS, and BLM are cooperatively involved in a inventory program surveying populations and habitat of native cutthroats. The project is funded through 1979. NDFG is presently surveying for the Lahontan cutthroat in Elko County. The Snake Range of Eastern Nevada will probably not be surveyed until after 1979.

Marianne Crawford, Utah DWR, has completed her M.S. thesis involving the least chub, Iotichthys phlegehtontis. Her work was funded at Utah State University by the DWR and BLM. She now assumes the job of non-game fisheries biologist with the DWR. The BLM funded inventory of the central basin for the least chub being done by DWR and Gar Workman, Utah State University is being completed now and a final report to the BLM is forthcoming this year. The DWR is actively looking for transplant sites for the least chub and some transplants may be accomplished this year to barren spring sites in Utah's west desert area.

The U.S. Departments of the Army and the Air Force have no new or ongoing biological studies for desert fisheries at the present time although I feel a complete inventory of all desert waters within their jurisdiction is in order now to ascertain the presence or absence of unique native species. This could be done with the use of the Sikes Act funds available to them. The DWR and BLM would be willing cooperators with them if this was proposed in the future.

The FT. Douglas Military Reservation, DWR, and the Forest Service are still discussing the use of the Red Butte Canyon Natural Research Area adjacent to Salt Lake City for a transplant and study site for the Utah cutthroat. I think that its about time all agencies resolve their differences and move ahead to manage a unique fish resource before it is to late and the resource is lost.

Northern Bonneville Basin

The Utah BLM is implementing a habitat management plan(HMP) for the Pilot Peak Range in fiscal year 1979. This plan includes habitat work for the threatened Lahontan cutthroat. The Nevada BLM plans to inventory their Bonneville Basin streams in 1979 and 1980. Ponds south of the Pilot Peak area will be inventoried since they are suspect to contain the least chub.

The Utah DWR is inventorying several northern desert springs for possibly transplant sites for the least chub. Suitable habitat sites in northwest Utah are being looked at for the Lahontan cutthroat reintroductions.

The Utah BLM's Randolph grazing environmental statement is identifying several stream areas for the reintroduction of the Utah cutthroat. Habitat management and grazing systems are being proposed for these area streams.

The Wyoming BLM is continuing work in the Thomas Fork drainage of the Bear River for the Utah cutthroat populations present there. This is a cooperative effort between the Wyoming Game and Fish Commission and the BLM.

The Utah Museum of Natural History in Salt Lake City at the University of Utah is now acting as a repository for all fish collected in Utah and the surrounding area according to James K. Lawton, Curator. A specimen of each species and subspecies is set aside for casting to be exhibited at the public level in the museum's permanent exhibition hall. The scientific community is also welcome to use the facility. Mr. Lawton is also researching all salmonids which inhabit the area for a forthcoming publication on the salmons, trouts, and charrs of North America. All specimens collected for this publication will go into the permanent scientific collection at the museum.

Summary

Desert fisheries activities are being proposed and implemented more readily by the agencies involved in species and habitat management within the Bonneville Basin now. The unique and diverse habitats found within this basin of 13 million acres are critical life support systems for the native flora and fauna. This basin ecosystem bears close watch by the Desert Fishes Council in the future since both energy and land management activities could threaten the resources in this remote and barren desert. I would suggest to the Council that consideration be given to hold a annual meeting soon in the future somewhere in the northeast Nevada - western Utah area so that the resources of the northern Great Basin desert can be seen, appreciated and studied by the Council.

INTERBASIN REPORT TO THE DESERT FISHES COUNCIL - 1978

by

Thom Hardy

University of Nevada, Las Vegas

November 16-18, 1978

ABSTRACT

The Interbasin Area of Nevada contains a diverse fish fauna adapted to a variety of fragile ecosystems. Their existence has been and continues to be in a precarious balance as habitat modification and exotic introductions continue. Of the 10 (ten) species found within this area, 6 (six) are considered rare by the NDFG and 2 (two), the Pahranagat Roundtail (Gila robusta jordani) and the Moapa dace (Moapa coriacea) are federally listed as endangered.

This report is an update on the status of these interbasin fishes and was compiled with the cooperation of the NDFG, USFWS, BLM and personnel of the University of Nevada, Las Vegas.

Los manantiales de los valles de Nevada contienen una gran variedad de peces que se han adaptado a los diferentes ecosistemas. La existencia de estos peces ha side y continuará en un estado precario mientras continúan las modificanciones a su hábitat y la introducción de variedades exóticas en estos lugares. De las 10 (diez) especies que son nativas de Nevada, 6 (seis) se consideran raras por NDGF y 2 (dos), Gila robusta jordani y Moapa coriacea están en la lista federal de las especies en peligro de desaparecer.

Moapa coriacea. The Moapa dace has recieved special attention in the last few months from the FWS, as critical habitat is being reviewed for purchase. Surveys of the area continue to show that the Moapa dace is declining throughout its range and has been extirpated from several known localities. Recent bioassays from Blue Point Springs indicates that this habitat is unfit as a potential refugium site. Immediate action is essential if we hope to preserve this unique desert minnow.

Crenichthys baileyi. The White River springfish is continuing to hold out against high populations of exotics throughout the White River drainage. In a recent evaluation of its habitats, cichlids, mollies and mosquito fish, as well as carp and bass, were observed in most areas. Only at Hot Creek did we fail to observe any exotics. The populations at Ash and Crystal Springs were not very abundant as of July, 1978. Continual habitat modifications are also increasing with spring flows being channelized and increased agricultural and domestic demands being placed on water resources.

Crenichthys nevadae. Railroad Valley was visited recently, and populations were abundant in Locks Ranch Spring, Reynolds 1 and 2, Coral, North and Big Springs. No exotics or habitat modifications were observed, but oil developments are continuing in the valley. A major increase or prolonged pumping could cause a drop in the valley water table, threatening the extinction of this species. The populations at Duckwater are numerous, though the water levels had dropped over a foot from July to October with the immediate cause being a pump that was supplying water to local road construction water trucks.

Gila robusta jordani. The Pahranagat roundtail is still known only to occur from the confluence of Ash and Crystal Springs to the south boundary of Burns Ranch. Exotic fishes and channelization of spring flows were primary threats for this species until recently. Pahranagat Valley is now experiencing a tremendous population boom as operations at the nearby Tempiute mine have been expanded and the Ramada Inn is considering Ash Springs as a potential site for development. Population surveys to determine the current numbers of roundtail will be conducted in the upcoming year.

Gila bicolor. The status of the Tui chub populations of the Interbasin at the time are not completely known. The G. b. euchulia from Fish Creek Valley could only be found in one small spring head pool. Adjacent habitats produced only trout. This appeared to be a recent introduction as large numbers of the trout were dead along the habitat margins. The last known chub habitat in Diamond Valley failed to produce any chubs. They were known to be present in the Fall of 1977. A comprehensive survey of this valley is scheduled for the coming spring. G. b. newarkensis (Newark Valley chub) has been discovered by a recent survey to exist in at least 9 (nine) new localities throughout the valley; yet, ironically, it has been extirpated from its original three habitats as described by Hubbs and Miller.

Rhinichthys osculus. The speckled dace of the Interbasin contain several subspecies and a wide range of distribution. A recent paper by Jack Williams has given subspecific status to the Moapa form, R. o. moapae. The subspecies is now rare and has not been collected in large numbers. Reasons for the decline include exotic fish introductions and declining water quality. The White River speckled dace (R. o. velifer) is still common in the upper White River drainage, but adequate surveys are still lacking. The Pahranagat form of the speckled dace will be included in the G. r. jordani surveys. Other isolated populations will hopefully receive attention as time permits.

Relictus solitarius. The steptoe dace is currently being threatened by oil well exploration and habitat modifications in Steptoe Valley. Lack of surveys, though, do not permit an overall evaluation of their status at this time. The transplanted population at Shoshone Ponds near Ely was visited in October, but no fish were observed. Lack of permits at that time did not allow seining to determine their presence. The permits have subsequently been issued, and population estimates will be conducted at the earliest opportunity.

Pantosteus intermedius. The White River sucker is currently known to inhabit Preston #3 and Lund Town Springs. The presence of Poecilia and gold fish apparently is not affecting these populations, but other exotic introductions and habitat modifications could prove deleterious.

Lepidomeda albivallis. The White River spinedace is also known to occur in Preston #3 and Lund Town Springs. They are numerous in these habitats, but lack of more adequate surveys do not permit a statement concerning their status throughout their range.

Lepidomeda mollispinis pratensis. The Big Spring spinedace that had been previously reported extinct, then rediscovered in Condor Canyon by NDFG, may actually be extinct. Following their rediscovery, flooding through the canyon has destroyed most of the new habitat. No adult fish were observed, and only small fingerlings of unknown species were found. This information was generously provided by Cal Allan. If further efforts produce adult fish, it would be advantageous to try a reintroduction into the type locality of Panaca Big Springs after exotic fish extirpation.

Basin Report

Oregon, Northern California and Nevada

Desert Fishes Council, 1978

by

Carl Bond

Oregon State University

The Oregon Department of Fish and Wildlife initiated a wild trout program. Under the program the protection and enhancement of wild stocks will be given first and highest consideration in fish management programs. Hatchery or foreign stocks will be released only where deemed necessary to provide optimum benefits for the resource. Three management options will be used: Manage exclusively for wild fish; Manage for wild plus hatchery fish; and Manage exclusively for hatchery fish.

Four streams have been designated for inclusion as wild trout streams; the lower 100 miles of the Deschutes, a portion of the Klamath River, the Williamson River and Spencer Creek. Additional streams will be named in the future.

Three-Mile Creek was closed to angling. It is a major source of the eggs from red-band trout. The Department, in cooperation with BLM, is conducting inventories to locate red-band trout populations. This is part of an effort by BLM to locate native trout populations in Oregon, and to develop habitat management programs.

While the state of Oregon does not have an endangered species listing program, it has provided protection to four fishes, based on their reduced numbers. The four are the Hutton Spring chub, Fosket Spring dace, Alvord chub and Warner sucker.

Oregon State University, with cooperation from other agencies did an assessment of the Warner sucker population and of fish distribution in the Warner Lakes Basin. Several populations of the Warner sucker were found in (Twentymile Creek, Honey Creek, Snyder Creek and Hart Lake). The final report on the fish distribution is not yet available.

A paper has been submitted by Dr. Carl Bond and Fred Bills describing the Cowhead Lake chub, a new subspecies. Jack Williams, an OSU graduate student also collected a new form of Gila in the Guano Lake Basin, which he is now working on.

Two studies will be initiated this summer. BLM will fund a study of the Jenny Creek sucker, and the U.S. Forest Service will study the Pit River sculpin.

Seven species of fish have been proposed for listing as threatened or endangered species. The seven are: Warner sucker (Catostomus warnerensis Snyder); Shortnose sucker (Chasmistes brevirostris Cope); Alvord chub (Gila alvordensis Hubbs & Miller); Fosket Spring dace (Rhinichthys osculus subsp.); Lost River sucker (Catostomus luxatus (Cope)); Borax Lake chub (Gila bicolor subsp.); and the Hutton Spring chub (Gila bicolor subsp.).

In addition to the above-named species, the following are being proposed for the American Fisheries Society listing of endangered, threatened or special concern species: Oregon chub (Hybopsis crameri Snyder); Gila bicolor oregonensis; Malheur sculpin (Cottus bairdi subsp.); Redband trout (undescribed sp.); Alvord trout (undescribed subsp. of Salmo clarki); and Catlow Tui chub (Gila bicolor subsp.).

Three geothermal lease areas were offered on bid in the area, but no leases have been granted. Four wells were drilled on private land last summer, none closer to Borax Lake than 1500 feet.

Report on Chihuahuan Desert, Isolated Basins

Robert R. Miller, Coordinator

November 17, 1978

The Catarina pupfish, Megupsilon aporus Miller and Walters, described in 1972 from an isolated spring-fed pond (El Potosi) in Nuevo León, has been regarded as one of the most endangered fishes in Mexico. Predation from largemouth bass, stocked in 1974, reduced its numbers drastically, almost to the point of extinction.

A three-day visit to El Potosi in May, 1978, by R. R. Miller and graduate students Michael L. Smith (Michigan) and Edie Marsh (Texas) revealed a dramatic increase which indicates a temporary recovery of this genus. The increase is correlated with high-water conditions. The only other native fish, the Potosi pupfish, Cyprinodon alvarezi Miller, is much more abundant than Megupsilon. Population estimates were approximately 2,800 for Megupsilon and 12,000 for Cyprinodon. A 1976 transplant of Megupsilon to an adjacent spring by Salvador Contreras-Balderas succeeded in establishing the genus outside of the pond area that contains the bass; the species was common in the spring and outflows at the time of our visit. A long-term prediction for the continued health of these species is difficult to make. A marked increase in water consumption could pose a serious problem for their survival. No practical method for eliminating the largemouth bass has been devised; their numbers were low during our visit. Details are given in the paper presented by M. L. Smith.

A new species of pupfish was collected by us in an isolated spring in northern Chihuahua, where it is abundant although exotic mosquitofish (Gambusia affinis) are common. A new crayfish was obtained from the same spring. The mosquitofish has become established at a number of other isolated springs in the Chihuahuan Desert that contain endemic pupfishes, but the Cyprinodon are still holding out.

BUSINESS MEETING

Chairmen: James E. Deacon and Peter G. Sanchez, incoming and outgoing chairmen, Desert Fishes Council.

a) Old and new business consisted of a discussion of publication of the proceedings and how to expedite the process. It was decided that the submission of camera-ready copy by all participants, without the need for further typing or editing, would greatly facilitate preparation of the proceedings. It would then simply be a matter of putting the material in proper order and handing it to a printer. It was also decided that technical papers should include an abstract in Spanish, and that papers submitted in Spanish should include an English abstract. Authors were given the option of submitting just abstracts.

Editor's note: The above plan of submitting camera ready copy was adhered to very well in 1978 by authors of technical papers. However, all agency reports again had to be transcribed from the tapes, a laborious and unnecessary process which invariably causes delays. After negotiating with several printers, University of Nevada, Las Vegas was selected for printing the 1978 proceedings.

Phil Pister also reported that all manuscripts are complete for the years 1971-77 and are ready for typing and printing. This matter was left in abeyance, and all effort will be made to have the 1978 proceedings completed prior to the 1979 symposium. Members were asked to give some thought as to how the years 1971-77 could best be handled. These are critical years in the history of the Council, and this information should be made available without further delay.

b) Constitution and bylaws: no change.

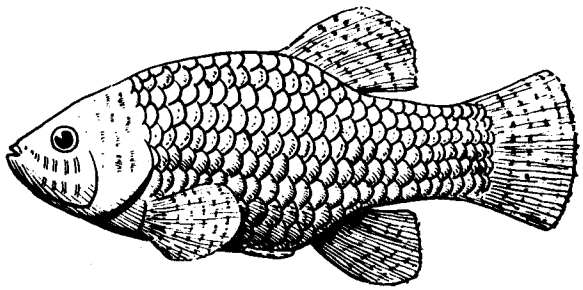
c) Legal status: the Council's attorney is handling this matter and will report to us as soon as he has matters of tax exemption and incorporation completed.

d) Resolutions. Resolutions relative to 1) the Colorado squawfish, 2) administrative restrictions adversely affecting the Department of Fish and Game, 3) transplantation of animals and plants, and 4) the restoration of San Simon Ciénaga were passed by the membership. Complete drafts are printed in the appendix.

e) Treasurer's report. Phil Pister reported that the Council is financially sound. Bank balance as of December 31, 1978 was $1854.43. This money will be available to assist in the financing of the proceedings.

APPENDIX A

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

P.O. Box 276
Death Valley, CA 92328
February 7, 1979

RESOLUTION 78-1

RELATIVE TO THE COLORADO SQUAWFISH (PTYCHOCHEILUS LUCIUS)

WHEREAS the Colorado squawfish is a species in serious danger of extinction, and

WHEREAS it appears certain that preservation of the Colorado squawfish is not compatible with continued alteration of its environment, and

WHEREAS the Desert Fishes Council fully supports the intent of the Federal Endangered Species Act to preserve native species and the integrity of the natural ecosystems which support their existence, and recognizes its responsibility to preserve this heritage for the benefit of future generations, and

WHEREAS the Director of the U.S. Fish and Wildlife Service has requested comment on the Colorado Squawfish Recovery Plan and on the proposed designation of critical habitat, which includes reaches of the Colorado, Green, Yampa, and Gunnison rivers, now therefore be it

RESOLVED that the Desert Fishes Council, an organization numbering in excess of 300 persons and comprising a nationwide and international representation of federal, state, and university scientists and resource specialists, members of private conservation organizations, and individuals concerned with long-term environmental values, meeting at its Tenth Annual Symposium in Las Cruces, New Mexico on November 17, 1978, does hereby recommend that no upstream developments be constructed which will result in decreased flows in the section of river to be designated as critical habitat until the flow requirements are determined; and be it further

RESOLVED that copies of this Resolution be forwarded to the Director of the U.S. Fish and Wildlife Service; to the Regional Offices of the U.S. Fish and Wildlife Service in Regions II and VI; to the Governors of the States of Colorado, Utah, and Wyoming; to the Leader of the Colorado River Fishes Recovery Team; to the Bureau of Reclamation Regional Offices in Boulder City, Nevada and Salt Lake City, Utah; to the Secretary of Interior; to the Environmental Protection Agency; to the Army Corps of Engineers; to the Commissioner of Reclamation; and to the Superintendent of Dinosaur National Monument.

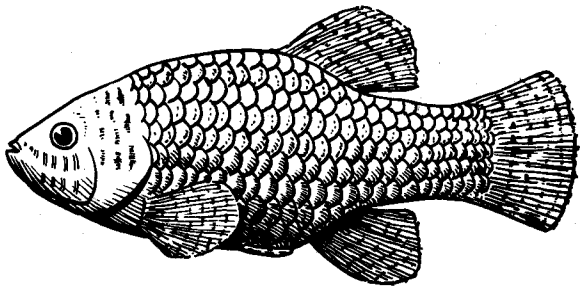
PASSED WITHOUT DISSENTING VOTE

ATTEST:

Peter G. Sanchez
Chairman

APPENDIX B

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

P.O. Box 276
Death Valley, CA 92328
February 7, 1979

RESOLUTION 78-2

RELATIVE TO CURRENT ADMINISTRATIVE RESTRICTIONS
AFFECTING THE CALIFORNIA DEPARTMENT OF FISH AND GAME

WHEREAS the Governor of California has directed that a freeze on hiring and severe limitations on spending be implemented by all California state agencies, and

WHEREAS under such restrictions the Department of Fish and Game cannot effectively manage the fish and wildlife resources of the state, and

WHEREAS the Department of Fish and Game is essentially self supporting through the sale of fishing and hunting licenses purchased voluntarily and in good faith by the people of California as a means of assuring the services they are currently being denied, and

WHEREAS the hiring and spending restrictions currently imposed upon the Department of Fish and Game cannot be justified by any reasonable rationale, now therefore be it

RESOLVED that the Desert Fishes Council, an organization numbering in excess of 300 persons and comprising a nationwide and international representation of federal, state, and university scientists and resource specialists, members of conservation organizations, and individuals concerned with long-term environmental values, meeting at its Tenth Annual Symposium in Las Cruces, New Mexico on November 17, 1978, does hereby request that the hiring and spending restrictions currently imposed upon the Department of Fish and Game be immediately rescinded and that no similar restrictions be incorporated into the 1979-80 Department budget, in order to allow the Department to more effectively manage the fish and wildlife resources of California, and be it further

RESOLVED that copies of this resolution be forwarded to the Governor of California, to various news media, to the chairpersons of appropriate committees within the California Legislature, to the Director of Finance, to the Secretary for Resources, to the Director of Fish and Game, to the Southern Council of Conservation Clubs, and to members of the California Legislature as deemed appropriate.

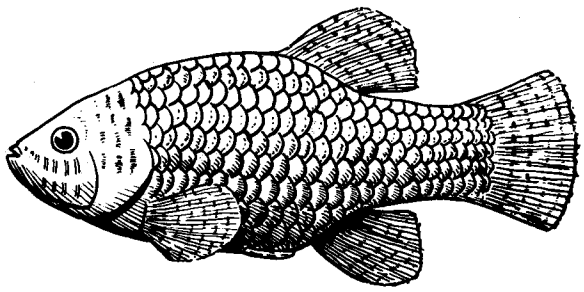
PASSED WITHOUT DISSENTING VOTE

ATTEST:

Peter G. Sanchez
Chairman

APPENDIX C

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

P.O. Box 276
Death Valley, CA 92328
February 7, 1979

RESOLUTION 78-3

RELATIVE TO THE TRANSPLANTATION OF ANIMALS AND PLANTS

WHEREAS many animals and plants are listed as endangered and threatened under the Federal Endangered Species Act, and

WHEREAS transplantation within historic ranges may be a feasible and desirable management option designed to preserve these species, and

WHEREAS acceptance of such transplantation by states, organizations, and individuals needs to be widened; now therefore be it

RESOLVED that the Desert Fishes Council, an organization numbering in excess of 300 persons and comprising a nationwide and international representation of federal, state, and university scientists and resource specialists, members of conservation organizations, and individuals concerned with long-term environmental values, meeting at its Tenth Annual Symposium in Las Cruces, New Mexico on November 17, 1978, does hereby recommend that the U.S. Fish and Wildlife Service explore the legal basis for, and the possible rapid implementation of, a policy to declare such transplanted populations as experimental and as unlisted under the Act, and to exempt such populations from inclusions under designations of critical habitat, unless and until such transplants may be demonstrated to be essential to prevent extinction of such taxa, except that prohibitions and penalties against unauthorized possession, taking, and related actions shall still apply, and be it further

RESOLVED that copies of this Resolution be forwarded to the Director of the U.S. Fish and Wildlife Service, to the Governors of the 50 states, and to the Secretaries of Agriculture and Interior.

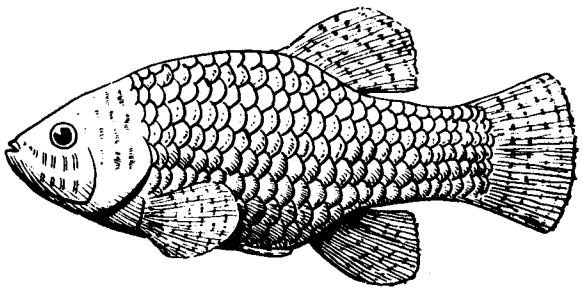
PASSED WITHOUT DISSENTING VOTE

ATTEST:

Peter G. Sanchez
Chairman

APPENDIX D

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

P.O. Box 276
Death Valley, CA 92328
February 7, 1979

RESOLUTION 78-4

RELATIVE TO THE RESTORATION OF SAN SIMON CIÉNAGA

WHEREAS aquatic and associated ecosystems in the southwestern United States are both highly important biologically and greatly diminished in their present state, and

WHEREAS San Simon Ciénaga, Hidalgo County, New Mexico and Cochise County, Arizona is such an ecosystem on public land, and

WHEREAS this Ciénaga has been greatly altered to provide a refuge for the Mexican duck (Anas platyrhynchos diazi) and other wildlife-related purposes, and

WHEREAS such alterations are no longer necessary priorities and have in fact been detrimental to some native species and to the original character of the ecosystem; now therefore be it

RESOLVED that the Desert Fishes Council, an organization numbering in excess of 300 persons and comprising a nationwide and international representation of federal, state, and university scientists and resource specialists, members of conservation organizations, and individuals concerned with long-term environmental values, meeting at its Tenth Annual Symposium in Las Cruces, New Mexico on November 17, 1978, does hereby recommend that the Bureau of Land Management restore the area to a more natural state, with emphasis on the re-creation of the primeval biota, to include the Gila topminnow (Poeciliopsis o. occidentalis), Gila chub (Gila intermedia), and other native fishes, both to preserve the natural diversity of the region and to foster scientific and educational benefits for mankind, and be it further

RESOLVED that copies of this Resolution be forwarded to the State Directors of the Bureau of Land Management in New Mexico and Arizona, to the Regional Director of the U.S. Fish and Wildlife Service in Albuquerque, New Mexico, and to the Directors of the Game and Fish Departments in New Mexico and Arizona.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Peter G. Sanchez
Chairman

APPENDIX E

Tenth Annual Symposium Attendance List
Holiday Inn de Las Cruces, Las Cruces, New Mexico Nov. 16-17, 1978

Richard Anderson	New Mexico State Univ., Las Cruces
Bruce Anderson	" " " " " "
Lief Ahlm	" " " " " "
Robert Behnke	Colo. State Univ., Fort Collins
Eric Bigelow	New Mexico State Univ., Las Cruces
Rick Billings	" " " " " "
Ken Britt	New Mexico State Univ., Las Cruces
Martin R. Brittan	Cal. State Univ., Sacramento.
John D. Burd	Phoenix, AZ
James Burton	U.S.D.A., Arizona State Univ.
Gary Bell	U.S.F.S., Flagstaff, AZ.
Janie Chavez	NM Dept. of Water Resources
Richard Cole	New Mexico State Univ., Las Cruces
Salvador Contreras-Balderas	Ciudad Universitaria, Monterrey, Mexico
Marianne Crawford	Utah Div. of Wildlife Resources
Sam Crow	New Mexico State Univ., Las Cruces
Bob Daniels	U.C. Davis, Davis
Robert Davis	New Mexico State Univ., Las Cruces
Dr. Jim Deacon	Univ. of Nevada, Las Vegas
Andrew Dubrasky	Tennessee
Nick Dye	Arizona-Sonora Desert Museum, Tucson
Tony Echelle	Baylor Univ., Waco, Texas
Tasker and Beula Edmiston	Monterey Park, Calif.
Fatima Quiroga Franco	Univ. N. L., Monterrey, Mexico
Jere R. Galle	New Mexico State Univ., Las Cruces
Gary Garrett	Univ. of Texas, Austin
Shelby &Louisa Gerking	Arizona State Univ., Tempe
Ellen Gleason	Cal. Dept. of Fish and Game, Blythe
Herb Guenther	Bureau of Reclamation, Boulder City, Nevada
Pat Haddock	Arizona State Univ., Tempe
Jim Hanson	Pine Top, AZ
Thom & Tina Hardy	University of Nevada, Las Vegas
Mike Hatch	NM Dept. of Game and Fish
Dean Hendrickson	Arizona State Univ., Tempe
Terry Hickman	Col. State Univ., Fort Collins
Stan Hillyard	Univ. of Nevada, Las Vegas
Paul Holden	Bio West, Logan, Utah
Brent L. Hollingsworth	Hydro Lab, Austin, Texas
Ken Holmes	New Mexico State Univ., Las Cruces
John Hubbard	NM Dept. of Game and Fish
Clark Hubbs	Univ. of Texas, Austin
Judy Hurt	New Mexico State Univ., Las Cruces
Gerald Jacobi	" " " " " "
Richard D. James	B.L.M., Las Cruces, N.M.
Buddy Jensen	Fish and Wildlife Serv., Dexter, NM
Dane Johnson	Fish and Wildlife Serv., NM
Jim Johnson	Fish and Wildlife Serv., Albuquerque
Merritt Keasey	Arizona-Sonora Desert Museum, Tucson.
Jim Kenney	New Mexico
William G. Kepner	Arizona State Univ., Tempe
Astrid Kodic-Brown	Univ. of Arizona, Tucson
Gail Kobetich	Fish and Wildlife Service, Sacramento
Ben Kuykendal	New Mexico State Univ., Las Cruces

Jerry Landye	Flagstaff
Raymond M. Lee	Arizona State Univ.
Steve Loe	Tucson, U.S.F.S.
Bob Love	Private, Yorba Linda, Calif.
Arthur Lucero	Las Cruces, NM - N.M.S.U.
John Mannes	Albuquerque, U.S.F.W.S.
Gayle Marrs	New Mexico State Univ., Las Cruces
Chuck McAda	Fish and Wildlife Service, Salt Lake City
Terry McCall	Arizona Dept. of Game and Fish, Kingman
Jerry McKnight	Private, Bakersfield
Randy McNatt	Fish and Wildlife Serv., Albuquerque
Robert Mesta	New Mexico State Univ., Las Cruces
Paula Mihalick	" " " " " "
Bill Miller	Fish and Wildlife Serv., Salt Lake City
Dr. Bob Miller	University of Michigan, Ann Arbor
Dave Miller	Colo. State Univ., Ft. Collins
Chuck Minckley	Museum of Northern Arizona, Flagstaff
W. L. Minckley	Arizona State University
Sue Morgenson	Arizona State University
Darlene Osborne	Calif. Dept. of Fish and Game, Sacto.
Phil Pister	Calif. Dept. of Fish and Game, Bishop
Steve Prchal	Arizona-Sonora Desert Museum, Tucson
Walt Reid	CFG, Bishop
John Rinne	Arizona State Univ., Tucson
Ben Robertson	U.S. FWS, Arizona
Marylou Rynkiewicz	New Mexico State Univ., Las Cruces
Don & Barbara Sada	USFWS, Sacto.
Pete Sanchez	NPS, Death Valley
Mike Saiki	USFWS, UCD, Davis
Sanford Schemnitz	New Mexico State University
Carl Seethaler	Utah State Univ.
Doug Selby	Bio West, Logan
Joy Shrode	Occidental College
Mignon Shumway	CFG, Bishop
Darrell Siebert	Arizona State Univ., Tempe
Mike Smith	Univ. of Michigan, Ann Arbor
David Soltz	Cal. State Univ., L.A.
John Souder	Albuquerque, U.S.F.W.S.
Jerry & Sally Stefferud	USFS, Bishop
Peter Stine	USFWS, Phoenix
James Sublette (& Mary)	Eastern New Mexico Univ., Portales
Phil Swank	New Mexico State Univ., Las Cruces
Rosemary Thompson	HDR Ecoscience, Santa Barbara
Paul Turner	NM State Univ., Las Cruces
Arcadio Valdez-Gonzalez	Utah State Univ., Logan
Renee Vestal	Univ. of Arizona
Ed Wick	Colorado State Univ., Fort Collins
Francis Winter	USFS, Albuquerque
James D. Williams	USFWS, Washington
Gene Wilde	Univ. of Oklahoma
Craig Wright	New Mexico State Univ., Las Cruces
Darrell Wong	CFG, Bishop
Jim Yoakum	BLM, Reno
Dave & Jeanette Young	Cal. State Univ., Fresno
Gary Helbing	New Mexico State Univ., Las Cruces
Terry Merkel	USFWS, New Mexico