

Desert Fishes Council
407 West Line Street
Bishop, California 93514

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The Resources Agency of California
Department of Fish and Game

THE RARE AND ENDANGERED FISHES OF THE DEATH VALLEY SYSTEM -
A SUMMARY OF THE PROCEEDINGS OF A SYMPOSIUM RELATING
TO THEIR PROTECTION AND PRESERVATION
Volume I

By
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California Department of Fish and Game
Symposium Coordinator

Held at National Park Service Headquarters
Furnace Creek, California
November 18 and 19, 1969

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Preface

Shortly after the conclusion of the Death Valley Symposium, the Los Angeles office of the California Department of Fish and Game issued the following release to all news media in Southern California. This suffices admirably as an abstract of what occurred there.

December 1, 1969
For Immediate Release

WAY SOUGHT TO SAVE RARE DESERT FISHES

While a thousand persons attended the Governor's Conference on California's Changing Environment, held recently in Los Angeles, an alarmed team of eminent life scientists was in the field, 300 miles away, mounting an attack on an acute and significantly related problem in environmental survival.

Forty-five of the nation's leading ecologists, zoologists, biologists, resource managers and public land and water administrators made up the task force, using Death Valley National Monument headquarters as their command post.

Working two days and nights in session and in the field, they formed battle lines to save from extinction some of the nation's rarest and most endangered life forms—the ancient but little-known desert fishes of the Death Valley drainage system.

At least one of the fish species has somehow developed the ability to survive and reproduce in water up to 100 degrees in temperature, six times as saline as sea water, and with very little oxygen content.

The scientists believe that within the unique fishes, now threatened with extinction by man, may lie a biological key to man's adaptation and survival in his own changing environment.

Involved are six species of the colorful desert pupfish, hardly more than an inch long when full grown, and the unheralded Mojave chub—all of which evolved following the Pleistocene ice age and are the last of their species on earth.

When their prehistoric lakes dried up, the fishes adapted and survived in small, isolated, warmwater springs that still flow in North America's most extreme desert environment. The total of some of the separate species is confined to one or two bathtub-size pools.

Now, well drilling and the pumping of springs and the underground for new and planned agricultural developments within the Death Valley drainage system are on the brink of wiping out the fishes. At least two species have already been lost

Coordinated by California's Department of Fish and Game, the desert conference drew an impressive array of talent and knowledge.

Included were scientists and specialists from National Park Service headquarters in Washington, D. C., U.S. Fish and Wildlife Service and Bureau of Land Management regional headquarters in Portland, Ore., Scripps Institute at La Jolla, the State universities and colleges of Michigan, California, Nevada and Arizona, the California and Nevada Departments of Fish and Game, regional officials of concerned Federal agencies, and informed conservationists from the private sector.

Their first accomplishment was the cataloging of the location, size, limnology, ownership and development status of every known water in which the endangered fishes are still living. Included are waters in Death Valley, Owens Valley and the Mojave Easin in California, and the Amargosa Valley in California and Nevada.

Priority listings of the most endangered species and waters followed, and from those listings a plan of action was worked out. Included are administrative action to hopefully save the rare fishes in their remaining, original habitat, and the transplanting of some of the fishes into suitable, alternate waters for temporary sanctuary.

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My first thought in reporting on the symposium was to list in detail the points made by the various panel participants. However, I felt that to do this would result in a rather cumbersome volume which might well tend to defeat the basic purpose of our meeting: the formulation and initiation of an action plan designed to preserve the various species and their habitats. Consequently, I have decided instead to summarize briefly each panel discussion and list in some detail the action plan and the assignments necessary to bring it to a successful conclusion.

It is a natural tendency, when considering the problems of environmental protection and preservation in the face of almost unbelievable social and technocratic problems, to become unnecessarily pessimistic in discussing a means of overcoming them. If those of us who are concerned with these problems take this attitude, not only the Death Valley fishes, but mankind itself, face extinction.

Rather, I prefer to take the attitude that, if man really wants to overcome these problems and is willing to sacrifice accordingly to do so, nearly anything is possible. In effect, if we are able to muster the necessary finances and technology to place an astronaut on the moon, we most certainly can devise a means of preserving in acceptable condition not only pupfish habitat but the remainder of the earth's environment as well. It is within this philosophy that the symposium was initially conceived at a meeting in Death Valley during April, 1969. It is with this same philosophy that we must approach our current problems of environmental protection if we are to be successful in solving them. In the long run, things like preserving pupfish are far more important than running a successful space program. For if we fail in the former, our spaceships may well, at some future date, find themselves with nothing to return to.

Summary

Following an introduction and welcome by Superintendent Robert Murphy of Death Valley National Monument, the various agenda items were discussed, as summarized below. A list of those in attendance is appended.

Tuesday, November 18.

8:00 a.m. Current status of the various species, with a priority listing of those most endangered.

Chairman: Dr. Robert R. Miller, University of Michigan

Panel Members: Dr. James Deacon, University of Nevada, Las Vegas
Dr. David Greenfield, Calif. State College, Fullerton
Dr. Carl L. Hubbs, Scripps Institution of Oceanography

Discussion:

Prior to 1900, the native fish fauna of the Death Valley System had not been significantly altered by man. Since that time, conditions have changed drastically in locations throughout the area. Instrumental here were the introduction of mosquitofish (Gambusia affinis), water export from the lower Owens Valley by the City of Los Angeles, the introduction of largemouth black bass (Micropterus salmoides) and brown trout (Salmo trutta) into various portions of the drainage and, most recently, the development of large-scale agricultural operations in portions of Nye County, Nevada. Of the various factors listed, the latter ranks with the introduction of Gambusia as the most detrimental and, if carried to an extreme, could very likely lower the water table of the Ash Meadows area to a point where all remaining habitat will be eliminated.

The first step toward habitat protection in this area was the establishment in 1952 of Devil's Hole as part of Death Valley National Monument. Interestingly, this was done ostensibly because of the unique travertine limestone formations, but not to preserve Cyprinodon diabolis, the unique fish inhabitant.

Following the symposium, Bob Miller summarized the current status of the Death Valley System fishes in a report to the National Park Service as follows:

Survival of Fish Populations

The fishes inhabiting the Death Valley System - which includes the drainage basins of Owens River, Mohave River, Amargosa River, and Pahrump Valley, in California and Nevada - comprise 11 species in 3 families: the minnows (1 dace and 2 chubs), suckers (1 species), and killifishes (5 pupfishes, genus Cyprinodon, 2 killifishes, genus Empetrichthys). As of the date of the symposium one full species, the Ash Meadows killifish (Empetrichthys merriami) and one subspecies, the Shoshone pupfish (Cyprinodon nevadensis shoshone),

are extinct: the status of the Tecopa pupfish (Cyprinodon nevadensis calidae) is uncertain, but it too may be gone. Man is directly or indirectly responsible for the loss of these fishes.

Other populations of Cyprinodon nevadensis are badly depleted and some are seriously endangered. The Pahrump Valley killifish (Empetrichthys latos) is in critical condition - an entire genus threatened with extinction. Even the Devil's Hole pupfish (Cyprinodon diabolis), protected within a detached part of Death Valley National Monument, is endangered by the proposed sinking and pumping of a well within feet of the monument boundary. (A 1963 U.S. Geological Survey report indicates that the aquifer feeding Devil's Hole, the sole abode of this unique species, could be seriously altered within one year after pumping commences.)

Below Tecopa, and especially in Death Valley proper, the native fish populations appear to be in good condition as of this writing. Proposed development of the Amargosa River (see end of report) however, could change this, thereby threatening ecosystems in Death Valley National Monument.

Priority Listing of Endangered Species

In order to propose an action program designed to preserve and maintain endangered fishes and their aquatic ecosystems, it is necessary to identify the threatened forms and to arrange them by priority. This listing follows:

1. Pahrump killifish, Empetrichthys latos. Originally there were 2 living species in this genus but now only 1 survives. It is therefore the most critically threatened fish in the Death Valley System since the survival of an entire genus is in jeopardy. The only population, reduced to a handful of individuals, is barely existing at Manse Ranch, Pahrump Valley, Nevada.
2. Devil's Hole pupfish, Cyprinodon diabolis. This species is endangered because of its very restricted habitat - scarcely as large as a backyard swimming pool - and low population (about 200 to 700 individuals, annual fluctuation). It is now further threatened by well pumping (the device already installed but not functional as of Nov. 18, 1969) at the very edge of the boundary of Death Valley National Monument.
3. Owens pupfish, Cyprinodon radiosus. This species, now restricted to Fish Slough, Owens Valley, California, was nearly lost last summer when much of its known remaining habitat dried; alert action by Bob Brown of UCLA, aided by Phil Pister, probably saved the fish. The Owens Valley Native Fish Sanctuary in Fish Slough was completed shortly before the Death Valley Symposium and will be ready for occupancy after the exotic species have been eliminated. Post-conference investigation of BIM spring, also in Fish Slough, proposed as a supplemental refuge, revealed that the Owens pupfish survives there as it probably does also in several other places in the Fish Slough region. Hopefully, by 1971, this fish may be removed from the world list of endangered freshwater fishes (Miller, 1969).

4. Nevada pupfish, Cyprinodon nevadensis mionectes. Many populations of this fish, which is confined to Ash Meadows, Nevada, have already been lost and others are threatened by agricultural development, especially by excessive (and presumably illegal) pumping and also by physical destruction (by mechanized technocracy) of natural habitats. Springs so destroyed may be lost forever. In view of the post-conference information on the Owens pupfish, the Nevada pupfish probably deserves a higher priority listing.
5. Mohave chub, Gila (Siphateles) mohavensis. Unquestioned pure populations of this species now appear to be restricted to Lake Tuendae, the spring-fed pond at Zzyzx Resort on the west side of Soda (Dry) Lake about 9 miles south of Baker, San Bernardino County, California.
6. Tecopa pupfish, Cyprinodon nevadensis calidae. The current status of this subspecies is uncertain, and additional field work and further taxonomic analyses of new material are needed to clarify its status. Originally it was known only from the outlets of Tecopa Hot Springs, Inyo County, California, where it now appears to be extinct.
7. Warm spring pupfish, Cyprinodon nevadensis pectoralis. The type locality of this fish in Ash Meadows, Nevada, has been set aside by BIM as a refuge, with an artificial pond outside of the fenced habitat for public viewing of the subspecies. Its very restricted range places this fish in the endangered category.

Undetermined Status of Endangered Species

It was thought advisable not to give priority rating to several species of Owens Valley fishes whose current population sizes are unknown, but which have decreased markedly in abundance in past decades. These are:

1. Owens chub, Gila (Siphateles) sp. D. W. Greenfield reported that he has been unable to find this fish in Owens Valley proper (where it was formerly common), but he did locate a population in the Lake Crowley (Long Valley) part of Owens River; a chub has also been taken by UCLA workers and the California Department of Fish and Game in the gorge of Owens River below Lake Crowley as well as in the reservoir itself. The identity of these chubs has not been determined but will be soon. This species and the two that follow are to be reintroduced in 1970 into the Owens Valley Native Fish Sanctuary in Fish Slough north of Bishop.
2. Speckled dace, Rhinichthys osculus. The status of the Owens River populations is unknown.
3. Owens sucker, Catostomus sp. This fish still survives throughout much of Owens River.

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9:45 a.m. Progress report on existing and planned sanctuaries.

Chairman: Dr. James Deacon, University of Nevada, Las Vegas

Panel Members: Dr. Wendell Minckley, Arizona State University, Tempe.
Mr. James St. Amant, California Department of Fish and Game, Los Angeles.
Mr. Philip Pister, California Department of Fish and Game, Bishop.
Mr. Robert Borovicka, Bureau of Land Management, Portland, Oregon.
Mr. James Yoakum, Bureau of Land Management, Reno, Nevada.
Mr. Lewis Myers, Bureau of Land Management, Las Vegas, Nevada.

Discussion:

Wendell Minckley has been successful in maintaining populations of several species (not C. diabolis) in concrete ponds at Arizona State University. These populations have existed without either significant care or feeding in temperatures that drop to as low as 34-35°F. This lends cause for optimism concerning the creation of artificial refugia. Nevertheless, it was the consensus of the group that every effort should be made to maintain these fishes in their native environments and to resort to artificial refugia only if absolutely necessary to maintain the species.

The Bureau of Land Management reported that all federal conservation agencies were directed by Congress (under the rare and endangered species act) in 1966, to concern themselves with the preservation of rare and endangered species. Following this, the Nevada Fish and Game Commission and University of Nevada at Las Vegas requested BIM to initiate a cooperative land management and conservation program. Under this program, the Fish and Game Commission and University determine which species need attention, then habitat management plans are developed by BIM. Under the law, BIM manages the habitat but not the fish and wildlife species existing therein. As part of their general investigations under this cooperative arrangement, BIM has located 15-20 warm springs in other areas of Nevada as possibilities for transplant sites. School and Jackrabbit Springs have already been set aside as sanctuary sites.

Discussion was again held emphasizing the need for preserving the original habitat. The disadvantages of enlarging existing habitats were enumerated. In this connection, when School Spring was recently set aside as a sanctuary, it was enlarged to duplicate what originally existed there.

The evolution of the Owens Valley Native Fish Sanctuary north of Bishop was described. Completed in October, 1969, this five-acre pond will provide refuge not only for Cyprinodon radiosus, but for the other three native Owens Valley species (Rhinichthys osculus, Catostomus sp., and Gila sp.) as well. An additional refugium, planned at BIM Spring on the east side of Fish Slough, was also described. The plight of Cyprinodon radiosus during the summer of 1969 was described in detail.

Because of ever-increasing interest by the academic community in the ecology of the Owens Valley, the idea of requesting Ecological Reserve status for the entire Fish Slough area is worthy of further consideration. The Fish Slough drainage is the only portion of the Owens Valley which remains essentially unaffected by man's activities.

Lew Myers, BLM District Wildlife Specialist from Las Vegas, reviewed inventory work done on rare and endangered species habitats by BLM in 1967 which resulted in a "first priority" classification for the native fishes in Ash Meadows. Habitat management plans were completed in 1968 for Jackrabbit and School springs. At that time Jackrabbit Spring was in good condition but contained exotic species. School Spring was in poor condition, with most of the habitat destroyed through overuse by livestock, waste of water in non-habitat areas, and an excess of aquatic plants.

The habitat management plan for Jackrabbit Spring recommended barriers to exclude exotic species, fences to exclude livestock, and additional ponds to allow viewing by the public.

The habitat management plan for School Spring called for protection and complete fencing of spring areas and the construction of another pond to utilize wasted water. This pond provides additional habitat and facilitates viewing by the public. A barrier was installed in the pond water supply pipe to prevent fish from moving between the first and second ponds.

In the case of both springs, BLM owns the land but private interests own the water rights. BLM has an agreement for the use of School Spring water for a sanctuary, but no agreement exists for Jackrabbit Spring.

It was further pointed out that about 7 wells have been drilled within $3\frac{1}{2}$ miles of Devil's Hole, and reports indicate that the water level in this area will soon be affected. One well has been drilled within a few hundred yards of Devil's Hole at the edge of the National Monument boundary.

Lew Myers also reported that the Ely District of BLM has developed large warmwater pool areas for use as refugia.

Lew's report provided good background information for the afternoon's field trip to Ash Meadows, which he led with the assistance of Dale Lockard of Nevada Fish and Game and Jim Deacon of the University of Nevada at Las Vegas.

1:30 p.m. Field trip to Ash Meadows

Leaders: Mr. Lew Myers, BLM, Las Vegas.

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

Mr. Dale Lockard, Nevada Fish and Game Commission, Las Vegas.

The few hours spent on the Ash Meadows tour were more than adequate to point out the immense destruction and alteration of the terrestrial and aquatic habitats resulting from the activities of Spring Meadows, Inc. Several springs have been severely changed and their fish populations either eliminated or placed in extreme jeopardy. Pumping was being carried on directly from Jackrabbit Spring, and all fish life had been destroyed.

Longstreet Spring has been bulldozed and dirt piled up on the banks; and Point of Rocks Spring has a pump located immediately adjacent to it. The pump next to Devil's Hole has already been described.

On the brighter side, Big Spring is largely untouched, and a good possibility exists that it might be purchased by the Nature Conservancy.

Underlying the entire problem, however, is the somber fact that, almost unquestionably, sustained pumping in the Ash Meadows area will ultimately destroy all remaining habitat if continued indefinitely. The only real uncertainty is just when this will occur. Perhaps this item should henceforth receive the majority of our attention.

8:30 p.m. Discussion of current research on Death Valley system endangered species, and additional research desirable for species preservation.

Chairman: Dr. Vladimir Walters, U.C.L.A.

Panel Members: Dr. Robert R. Miller, University of Michigan
Dr. James Deacon, University of Nevada, Las Vegas
Dr. Wendell Minckley, Arizona State University, Tempe
Dr. David Greenfield, Calif. State College, Fullerton
Dr. Robert K. Liu, U.C.L.A.
Dr. James Brown, U.C.L.A.
Mr. James Labounty, U.S. Bureau of Reclamation, Las Vegas
Mr. Robert E. Brown, U.C.L.A.

Discussion:

It was very evident from the discussion that our knowledge of the taxonomy of the Death Valley system fishes greatly exceeds our knowledge of their biology. A minor point of disagreement was resolved concerning the responsibilities of the agencies as opposed to the universities relative to habitat development, research, etc. It was generally agreed, and seems rather obvious, that problems of land use, sanctuary development and similar items should be handled by the public agencies, whereas most research work should be carried on by the academic community. However, close communication and cooperative effort between the two groups is both desirable and necessary if we are to accomplish our goal of species preservation, inasmuch as the proper development of habitat and sanctuary areas is completely dependent upon the extent of our knowledge of the species involved.

The following areas of research were discussed and outlined as desirable for species preservation, although the potential for research on Cyprinodon is nearly infinite.

1. Interrelationships of the different species of Cyprinodon.
2. Cytomorphology (should be included in taxonomic work).
3. Behavioral reactions and interactions of Cyprinodon and mollies as related to courtship and feeding.
4. How have these fishes endured for so long in such a restricted habitat? Why and how are they so plastic?

5. Osmoregulation and demographic parameter studies on types of artificially created habitat.

Jim Deacon reported that his current research on the Death Valley fishes is primarily ecological and in the field. Work is being conducted on Salt Creek, Pupfish Marsh, Zzyzx and Saratoga Springs. Taxonomic and feeding habit studies are in progress, and it is likely that a new species will be described from Pupfish Marsh. At Saratoga Springs, population size and structure is being studied in relation to reproductive influences. It has been found that starvation is an important factor in summer months when both populations and degree of activity are at a maximum.

The range of temperature tolerance for populations at Saratoga Springs is from 33-34°F. to 110°F. However, the temperature there does not exceed 95°F. for any significant length of time. Fish are not found active in the marsh at temperatures below 40°F. Below this temperature they burrow in the mud and exist under nearly anaerobic conditions.

Cyprinodon diabolis populations in Devil's Hole fluctuate from about 200 to 700, reaching a maximum near the end of summer. Starvation during periods of maximum population is probably their limiting factor. Their temperature tolerance drops to 8-9°C. (46-48°F), but they are immobilized at 14°C. (57°F.).

Bob Miller has found a significant difference in the Shoshone Springs populations when comparing fish collected in 1947 and 1969. This was primarily noted in increased pelvic ray counts and a rounded body characteristic in collections made in 1969. Collections made in 1947 showed greatly reduced pelvic ray counts and a slab-sided appearance. He concluded that the population presently inhabiting Shoshone Springs is derived from the Amargosa River populations and that C. n. shoshone is extinct.

Work has been conducted recently by Dave Greenfield in comparing various species of Gila: mohavensis, orcutti, and snyderi from Owens Valley. Chromosome numbers were determined as 54 in snyderi, 52 in mohavensis, and 50 in orcutti. These differences have been confirmed by electrophoretic studies of eye lens tissue.

Jim LaBounty reported that Cottonball (Pupfish) Marsh Cyprinodon are meristically different from C. salinus and that they can exist in water ranging from distilled to 6 times sea water. C. salinus exhibits a tolerance range of about half this magnitude.

In this connection, Bob Brown's proposal to study the osmoregulatory processes of the genus takes an even greater interest and significance. Part of this study will involve the effect of monovalent and divalent ions on mucus production.

The interest and activity of the various colleges and universities in conducting research on Cyprinodon and related species is most heartening. Ultimately, our ability to preserve these fishes may well depend upon the extent of our knowledge concerning them. Hence the desirability of learning as much as possible as quickly as possible.

Adjournment for November 18 at 11:00 p.m.

Wednesday, November 19.

8:00 a.m. Land acquisition costs and funding -
the role of non-governmental groups.

Chairman: Mr. Clinton Lostetter, Rare and Endangered Species
Coordinator, Bureau of Sport Fisheries and Wildlife,
Portland, Oregon.

Panel Members: Mr. Martin Litton, Free-lance writer and Sierra
Club Director
Mr. Keith Artz, The Nature Conservancy
Dr. Sterling Bunnell, The Nature Conservancy

Discussion:

Senate bill 11363, which was enacted on November 10, 1969, provides financing for rare and endangered species preservation and prohibits importation and interstate shipments of endangered species. This bill provides a firm basis for rare and endangered species work by the federal government. However, the assistance of other public agencies and private individuals is necessary to get the job done effectively.

Keith Artz and Sterling Bunnell outlined the role of the Nature Conservancy and clarified the mechanics of its operation. Inasmuch as the purchase of the land provides the most certain way to insure habitat preservation, the Nature Conservancy prefers to purchase a given area and then transfer it to a management agency with a revertible clause in the deed. For this purpose, the Nature Conservancy can borrow money (at prime interest plus one percent) with Ford Foundation backing. Where possible, this is done with the intent of ultimately having the land purchased by the governmental agency involved. This allows the "holding" of desirable lands until the necessary funds can be budgeted through regular channels. The Nature Conservancy recently purchased Furnace Creek Ranch in this manner, and is now awaiting reimbursement from the National Park Service.

Martin Litton pointed out the need for immediate publicity and legal advice to preserve the various Ash Meadows habitats. In this connection, the effect of groundwater exploration in Ash Meadows on the various features of Death Valley (Furnace Creek, Amargosa River, Devil's Golf Course, Badwater, etc.) should be quickly and competently ascertained. Martin has some excellent connections with the news media and will work with them in publicizing the problem.

11:00 a.m. Status report on existing and potential habitats and water sources.

Chairman: Mr. Robert Borovicka, Bureau of Land Management,
Portland, Oregon.

Panel Members: Mr. Ed Smith, BLM, Sacramento
Mr. Bob Jennings, BLM, Bakersfield
Mr. Bill Templeton, BLM, Riverside
Mr. Don Cain, BLM, Ely, Nevada
Mr. Jim LaBounty, Bureau of Reclamation, Las Vegas
Mr. Pete Sanchez, National Park Service, Death Valley
Mr. Dale Lockard, Nevada Fish and Game, Las Vegas
Mr. Phil Pister, California Department of Fish and Game, Bishop

Discussion:

The Multiple Use Act of 1964 changed the basic orientation of BLM, and the California Desert Study has been the first major step by BLM geared toward inventorying and planning for the use of desert lands. This, of course, is basic to acquiring funds for management projects. Initial phases of the study have involved the cooperation of a Park Service team. Of approximately 15 million acres of desert lying within California, over 11 million are administered by BLM. A district ranger concept is being considered, together with interpretive centers in several locations.

The second phase of the Desert Study is currently under consideration in Washington and, if approved, will lead to the third phase which will involve the implementation of planning drafted in the first two phases.

Possible habitat areas at Saline Valley, China Lake Naval Weapons Center, Fish Slough, River Springs, Zzyzx, Piute Springs, Two-Hole Springs, Baker Lake Charcoal Pit, Benton, Keough's, and Owens Lake (all in California); and Mt. Wheeler and Big Spring (both in Nevada) were discussed in varying degrees of detail. Many of them present excellent possibilities and will be included for further investigation prior to the next meeting of the group.

Zzyzx Spring is located on an invalid mining claim which will soon come up for review. Final eviction will not occur for some time at best. A management plan will be prepared if the current occupant is evicted.

The use of the Hot Springs on the western slope of Mt. Wheeler shows great promise for reestablishing three species of rare fishes: The Moapa dace (Moapa coriacea), Pahrnagat roundtail chub (Gila robusta jordani), and Pahrump Killifish (Empetrichthys latos). A habitat management plan for this area is being given top priority, and refugia should be constructed in 1970 for two or three species.

Nevada Fish and Game is currently corresponding with the owner of Big Spring (Ash Meadows) in an attempt to negotiate a lease or purchase. The Nature Conservancy may also become involved in this venture. In addition, Nevada Fish and Game is inventorying and documenting all water sources containing populations of rare species. One of their problems (which is general) is the infestation of suitable sites with exotic species.

An intriguing idea interjected at this point was the possibility of interesting Howard Hughes in developing a desert museum for rare fishes in the Las Vegas area. Martin Litton will investigate this further.

A review by Jim LaBounty of a Bureau of Reclamation reconnaissance report recently released on the proposed Amargosa River project, reveals that the area currently contemplated covers from six miles north of Devil's Hole northward through Lathrop Wells. The water in this area is suitable for irrigation, as opposed to Ash Meadows water, which is reported to be unsuitable. In the area which Jim described are 92,000 acres of arable land with good underground water supplies. A favorable benefit-cost ratio of 3.6 to 1 has been calculated. A more detailed study has been authorized for the period 1971-74 at a cost of \$750,000.

Actual work to date by California Fish and Game has been restricted to Fish Slough, with considerable reconnaissance being conducted in other areas. Ground reconnaissance has been supplemented by a set of aerial photographs of the entire Amargosa River and Death Valley drainage areas which have already been useful in locating additional refugia. Especially promising here is a location near Scotty's Castle which later ground reconnaissance indicated to be apparently suitable for the purpose at hand.

3:00 p.m. Legal bases for protecting existing water sources and habitat.

Chairman: Mr. Leonard Fisk, Calif. Dept. of Fish and Game, Sacramento

Panel Members: Mr. Dale Lockard, Nevada Fish and Game, Las Vegas
Mr. Robert Murphy, National Park Service, Death Valley
Mr. William Newman, Nevada Div. of Water Resources,
Carson City, Nevada
Mr. Homer Leach, National Park Service, Death Valley
Mr. Orthello Wallis, National Park Service, Washington, D.C.
Mr. Robert Borovicka, BLM, Portland, Oregon

Discussion:

Perhaps one of the best signs of our immaturity as a society (as reflected in conservation legislation) is the problem we face in gaining recognition of fish and wildlife as beneficial uses in water rights matters.

Progress is being made in this direction, but very slowly. Dale Lockard reviewed the current situation in Nevada and was followed by Bill Newman, who gave a brief history of Nevada water law and stated the problems encountered by a water administrator in the face of stock and agriculture oriented state government. At present, Nevada Fish and Game may protest a water application, but has very little legal basis for having the protest recognized in the courts.

Nevada initially adhered to a strict riparian doctrine which was repudiated in 1885 and changed to a system of prior appropriation. At present, application for water appropriation is made to the State Engineer. The notice of intent is then published followed by a 30-day period for filing protests. The State Engineer researches the application to determine if any prior rights have been infringed upon, and then renders his decision.

The establishment of Death Valley National Monument in 1933 was conditioned upon recognition of existing water rights. The rights of the Park Service and private in-holdings have been perfected. Currently, the Park Service files for water rights and then can issue a secondary water right to a

permittee within the Monument.

The Natural Landmarks Program was outlined, and its possible value in rare species preservation planning was discussed. This might have value at Manse Spring.

The point was made that land ownership does not necessarily include the water right and that the law of prior appropriation applies in most instances. The states control the water rights, and a determined effort should be made by all states to have fish and wildlife included as a beneficial use of water.

5:00 p.m. Summary and preparation of plan.

Chairman: Mr. Richardson, Calif. Dept. of Fish and Game, Los Angeles
Mr. Pister, Calif. Dept. of Fish and Game, Bishop

Participants: All remaining at session
(About 25 key persons were able to remain for this all-important discussion).

Discussion:

Sufficient data and discussion had now been presented to allow for the preparation of an action plan for species preservation. Although adhering firmly to the concept that every effort should be made to preserve and enhance all existing natural habitat, the group felt it would be wise to establish "money in the bank" refugia while awaiting the results of our current issue with technocracy. Priorities for preservation of the various species are summarized below:

1. Empetrichthys latos
2. Cyprinodon diabolis
3. Cyprinodon radiosus
4. Cyprinodon nevadensis mionectes
5. Gila mohavensis
6. Cyprinodon nevadensis calidae
7. Cyprinodon nevadensis pectoralis

Several species of Owens Valley fishes were not given priorities but were listed for further study to ascertain their status: Owens chub, Gila (Siphateles) sp.; Owens sucker Catostomus sp.; and Speckled dace, Rhinichthys osculus.

PLAN

1. Empetrichthys latos, Pahump killifish
 - a. Jim Deacon will make application for natural landmark status at Manse Spring.
 - b. Jim Deacon will coordinate a committee of Lew Myers, Dale Lockard, and himself to investigate spring areas in Nevada as additional refugia for E. latos. This committee investigated the spring seepage east of the road from Manse Ranch and found it to be an artesian well located on private land.

- c. Lew Myers will check the possibility of using pumped water or spring flow diverted to BLM lands for additional refugia.
 - d. Phil Pister will coordinate a committee of Ed Smith (or his representative from BLM), Tom Jenkins from the Sierra Nevada Aquatic Research Laboratory of the Bureau of Sport Fisheries and Wildlife, Bob Brown of U.C.L.A., and Vern Burandt of California Fish and Game to determine the feasibility of constructing a refuge at the cold spring at Lower Warm Spring on the east side of Saline Valley.
2. Cyprinodon diabolis: Devil's Hole pupfish
- a. Phil Pister will coordinate a committee of Ed Smith (or his representative from BLM), Tom Jenkins, Bob Brown and Vern Burandt to construct a refuge at Upper Warm Spring on the east side of Saline Valley.
 - b. Dale Lockard will check a spring area about seven miles southwest of Denio, Humboldt County, Nevada to determine its suitability for development into a refuge.
 - c. Leonard Fisk will check with Millard Coots of California Fish and Game concerning warm spring areas about 10 miles east of Susanville, near Wendell.
 - d. Clint Lostetter and Dale Lockard will check a large pool area at a Nevada State Park near Garlock to determine its suitability for Cyprinodon diabolis.

Should the areas referred to prove suitable for the establishment of C. diabolis, the persons involved will make every possible effort to create refuges at the earliest possible date.

3. Cyprinodon radiosus, Owens pupfish.

- a. Phil Pister will work with Bob Miller and Bob Brown in re-establishing C. radiosus into the newly-created Fish Slough sanctuary, probably in June or July of 1970.
 - b. Phil Pister will work with Ed Smith of BLM to plan construction of another refuge on the east side of Fish Slough at BLM Spring.
 - c. Bob Miller will write a letter to the State Director of BLM urging construction of a sanctuary at BLM Spring at the earliest possible date.
4. Cyprinodon nevadensis mionectes, Ash Meadows pupfish.
- a. Keith Artz of the Nature Conservancy is collecting photos and will start work on possibility of acquiring Big Spring through a publicity campaign for fund raising.

- b. Dale Lockard and Jim Deacon will, depending upon results under "a" above, attempt to achieve Natural Landmark status for Big Spring.
 - c. Lew Myers will meet with Spring Meadows, Inc., on November 20 in an attempt to achieve rehabilitation of Jackrabbit Spring.
 - d. Jim Deacon will arrange for hydrologic survey of Big Spring by a Las Vegas consultant.
 - e. Vlad. Walters and Jim Brown, working with Jim Deacon and Dale Lockard, will make every effort to keep duplicate populations in aquaria at U.C.L.A., although doing so successfully involves overcoming some very difficult technical problems.
 - f. A series of letters expressing general concern over the problem at Ash Meadows and expressing thanks for positive action to date will be sent to Nevada Fish and Game, Nevada State Office of BIM, Nevada Division of Water Resources, Senator Alan Bible, and other legislators. These letters will be drafted by Tina Nappe for Bob Miller's signature.
5. Gila mohavensis, Mohave chub.
- a. The Mohave chub is now established at Paradise Spa near Las Vegas. Jim Deacon and Dale Lockard will watch over this introduction.
 - b. Leonard Fisk, Jim St. Amant, and Bill Richardson will investigate habitat and suitability at Lark Seep Lagoon (Naval Weapons Center), South Coast Botanic Garden near Marineland, 1-Hole and 2-Hole Springs, San Felipe Creek in Sentenac Canyon (San Diego County) and Piute Springs. Introductions will be made where feasible.
 - c. Dave Greenfield of Cal State Fullerton will work with Bill Templeton of BIM and Jim St. Amant and Leonard Fisk of Cal. Fish and Game in watching Zzyzx Spring and will formulate a plan if the current resident, Dr. Springer, is evicted.
6. Cyprinodon nevadensis calidae, Tecopa pupfish.
- a. Phil Pister and Jim Deacon will check populations in the Tecopa area.
 - b. A series of specimens will be sent to Bob Miller at Ann Arbor for identification.
 - c. Further action will be dependent upon Bob Miller's determinations.
7. Cyprinodon nevadensis pectoralis, Warm Spring pupfish.
- a. BIM has completed a fenced refugium at School Spring, Ash Meadows. Lew Myers, Jim Deacon, and Dale Lockard will investigate the possibility of broadening the School Spring refuge to include Mexican Spring and Scruggs Spring, both of which are on BIM land.
 - b. Lew Myers is preparing a habitat management plan for the entire Ash Meadows complex.

Summary of assignments:

1. Empetrichthys latos
 - a. Deacon
 - b. Deacon, Myers, Lockard
 - c. Myers
 - d. Pister, Smith, Jenkins, Brown, Burandt
2. Cyprinodon diabolis
 - a. Pister, Smith, Jenkins, Brown, Burandt
 - b. Lockard
 - c. Fisk, Coots
 - d. Lostetter, Lockard
3. Cyprinodon radiosus
 - a. Pister, Miller, Brown
 - b. Pister, Smith
 - c. Miller
4. Cyprinodon nevadensis mionectes
 - a. Artz
 - b. Lockard, Deacon
 - c. Myers
 - d. Deacon
 - e. Walters, Brown, Deacon, Lockard
 - f. Nappe, Miller
5. Gila mohavensis
 - a. Deacon, Lockard
 - b. Fisk, St. Amant, Richardson
 - c. Greenfield, Templeton, St. Amant, Fisk
6. Cyprinodon nevadensis calidae
 - a. Pister, Deacon
 - b. Miller
 - c. Miller
7. Cyprinodon nevadensis pectoralis
 - a. Myers, Deacon, Lockard
 - b. Myers

Additional Assignments

1. Martin Litton will serve as publicity coordinator, working with whatever media he feels can best handle the matter of creating a public awareness of the plight of the Death Valley fishes in general and the problems created by Spring Meadows, Inc., in particular. In this connection, any information and progress reports having publicity value should be sent to Martin for his use.
2. Pete Sanchez, Homer Leach, and Bob Murphy will contact USGS concerning the ground water level in Ash Meadows and the effect of pumping both on the Ash Meadows springs and the water resources within Death Valley National Monument.
3. Dale Lockard will provide Martin Litton with Hughes contacts concerning the Desert Museum concept.
4. Pete Sanchez will contact the operators of Furnace Creek Ranch concerning the use of rotenone to remove Gambusia affinis from the Furnace Creek system. Phil Pister will work with Pete Sanchez in this matter.
5. Bob Miller will prepare a check list of items to be considered in determining whether or not a certain spring area might be suitable for pupfish introduction. This will be of great value to agency field personnel who are unfamiliar with ecological requirements and will reduce the number of areas to be checked by eliminating those which are obviously unsuitable.
6. Phil Pister will continue to serve as coordinator for the interagency plan to preserve the Death Valley fishes. Bob Miller, Jim Deacon, and Bob Borovicka will assist. In this connection, the coordinating committee requests that close communication be continued between all in attendance at the symposium. We ask especially that reports be sent regularly to Phil Pister, Department of Fish and Game, 407 West Line Street, Bishop 93514, as your work on the action plan progresses.
7. Bob Borovicka raised the question of how many individuals of the various Death Valley fishes could safely be removed from their existing habitats, even for valid research purposes. Authority to grant such requests rests with the fish and game departments of Nevada and California under the laws governing scientific collecting permits. In the case of a request to collect within Death Valley National Monument, an additional collector's permit must be obtained from the Park Service.

It was decided that requests to any agency to collect any of the Death Valley fishes should be forwarded to Phil Pister, who will send copies to Miller, Deacon, and Borovicka for their comments and recommendations. Approval must be unanimous, or the request will be returned to the agency involved with the recommendation that it be denied. However, inasmuch as final approval rests with the agency and not the coordinating committee, a recommendation for approval or denial does not guarantee that the agency will act accordingly.

Much of this will seem to constitute unnecessary red-tape to those who wish to collect fish for individual research projects and who regard such collections from an understandably narrow viewpoint. However, recent publicity given to pupfish by the news media, plus increased research demands by the academic community, have resulted in an almost unbelievable number of requests to the three agencies involved. Hopefully, collectors will realize that their request may well be only one of many and, if carried to extremes, could result in the very thing we are trying to prevent: the extinction of certain groups of Death Valley fishes.

The coordinating committee wishes to thank all those who attended the symposium, and in particular those who participated in the panel discussions. We feel the meeting was very successful, in that a vast amount of knowledge was presented, discussed, and worked into a sound plan for habitat protection and species preservation. However, although we now have a coordinated approach to the problem, we still have a long way to go before we win the battle. Our plan will be no more effective than the amount of time and industry we are willing to devote to it. We are further faced with an agricultural development plan for the Amargosa River basin which is considerably greater than that already in operation at Ash Meadows. We must therefore work hard and remain alert to any plans for additional habitat destruction within the Death Valley system. Of extreme importance will be our ability to communicate the overall problem to the public who, in the final analysis, will decide whether agriculture, pupfish, or a compromise of both will prevail within the Death Valley system.

We wish to extend special thanks to Superintendent Bob Murphy of Death Valley National Monument for making available the excellent meeting facilities at Park Service Headquarters. Much of the success of the meeting is directly attributable to the cooperation of Bob and his staff.

In order to keep our program alive, we have scheduled a similar symposium for November 17 and 18, 1970, at Furnace Creek. At this meeting we shall evaluate progress to date on the action plan, discuss new developments in our search for refuge sites, review the state of affairs at Ash Meadows, and generally reassess our position and the status quo. We are already looking forward to meeting with you again.

P

A P P E N D I X

Developments Since Symposium Ended on November 19

1. Lew Myers and Bob Borovicka met with Spring Meadows, Inc. on November 20. At this meeting it was agreed that the pump complex would be removed from Jackrabbit Spring and that they would use only a natural channel to the south of the spring to receive spring flow (the ditch to the west will be restored). Spring Meadows, Inc. will construct a water storage pit at least 300 feet from the spring to receive the full spring flow via the natural channel. This will be used as a pumping pit. The foregoing will allow the restoration of Jackrabbit Spring as pupfish habitat, and C. n. mionectes will be reintroduced. Spring Meadows, Inc. still wishes to pump from the well at the corner of the Devil's Hole property line. However, BIM stood firm on their decision denying them a right of way for a ditch from the well. BIM further recommended that Spring Meadows, Inc. abandon the well and restore the site.
2. On November 21, Bob Murphy and other Park Service representatives met with Spring Meadows, Inc. specifically concerning the Devil's Hole pump. Because of widely divergent philosophies of the two groups, no agreement was reached. However, Spring Meadows, Inc. indicated its intent to bring the matter before higher authority within the Department of Interior. Nothing further has been heard in this matter.

Spring Meadows, Inc. apparently is in the process of trying to acquire additional acreage near Devil's Hole. This would tend to strengthen their argument to utilize the existing well and to develop others. Under the circumstances, it would seem appropriate to express individual opinions to the Secretary of Interior indicating concern over the problem and urging his denial of any requests for further development of the area unless it can be conclusively proven that such development will in no way adversely affect the natural resource either at Devil's Hole or within Death Valley itself.

3. Bob Miller and Tina Nappe have been doing an excellent job in communicating with legislators and other influential people and organizations.
4. Bob Miller's summary report to the National Park Service is especially appreciated in view of the difficulties involved in producing this report within such a short time following the close of the symposium.
5. Following the symposium, Boyd Walker sent suckers and chubs taken from the upper Owens River drainage to Carl Hubbs for identification. These were identified as Catostomus fumeiventris (MS) and Gila snyderi (MS). If the specimens identified by Dr. Hubbs (which were taken from below Crowley Lake dam) are the same as those existing in Crowley Lake and the Owens River drainage above, they are in sufficient numbers to remove any concern relative to their general abundance. Additional collections have been made and will soon be forwarded to Dr. Miller for identification.
6. Within a few days following the meeting, Sterling Bunnell acquired \$1,000.00 to finance the sanctuary at BIM Spring on the east side of Fish Slough. A cooperative agreement between BIM and California Fish and Game is now being drafted to allow construction during the early summer of 1970.

7. Considerable interest in Cyprinodon among the general public has resulted from our symposium. This has been evident from a variety of newspaper articles. Martin Litton's article in the November, 1969 "Sunset" has been of immense value in this respect, and we may expect similar response from an article on Death Valley appearing in the January, 1970 "National Geographic."
8. On December 18 Jim St. Amant and Leonard Fisk transferred 150 Gila mohavensis from Zzyzx Spring to Piute Springs, San Bernardino County. Additional investigations were made at One Hole and Two Hole springs, San Bernardino County, to determine their suitability as stocking sites for endangered species. Another transplant of Gila mohavensis was made on January 27, when 147 individuals were introduced into a pond located at the Los Angeles County Botanic Garden.
9. In December, Jim Deacon made collections of Cyprinodon in small, isolated warm springs near Tecopa Hot Springs and forwarded them to Bob Miller for identification.
10. Sterling Bunnell has arranged for the February, 1970 issue of "Dry California" to be devoted to publicity on the Cyprinodon problem.
11. Many new fields have been prepared and new pumps installed in Ash Meadows since the November, 1969 symposium. In correspondence dated February 16, 1970, Pete Sanchez informed us that an earth fill dam over one-half mile long is being completed northeast of Point of Rocks Spring.

SELECTED REFERENCES RELATING TO THE DEATH VALLEY SYMPOSIUM

California Department of Water Resources

1964. Ground water occurrence and quality, Lahontan region.
June, 1964. DWR Bulletin No. 106-1. State Printing Office, Sacramento.

Miller, Robert Rush

1967. Status of populations of native fishes of the Death Valley system in California and Nevada. Completion report of resource studies problem undertaken for the U.S. National Park Service, June-July, 1967. University of Michigan, Ann Arbor. August 4, 1967.

1969. Symposium on rare and endangered fishes of the Death Valley system. Summary report to the National Park Service. Museum of Zoology, The University of Michigan, Ann Arbor, December 1, 1969.

Morts, G. F., Jr.

1963. Effect of ground-water development on the pool level in Devil's Hole, Death Valley National Monument, Nye County, Nevada. Report prepared at the request of the National Park Service. U.S. Department of the Interior, Geological Survey, Water Resources Division, Carson City, Nevada, August, 1963.

THOSE IN ATTENDANCE AT RARE FISH SYMPOSIUM, FURNACE CREEK, Nov. 18-19, 1969

<u>NAME</u>	<u>AGENCY</u>	<u>ADDRESS</u>
Ed Smith	BLM	2800 Cottage Way, Sacramento 95825
Jim Blaisdell	NPS	450 Golden Gate Ave., S.F. 94102
Homer P. Leach	NPS	Death Valley, Calif. 92328
Lewis H. Myers	BLM	Las Vegas
Don Cain	BLM	Ely, Nevada
Bill Templeton	BLM	Riverside, Calif.
Bob Jennings	BLM	Bakersfield, Calif.
Robert Rush Miller	Univ. of Michigan	Ann Arbor, Mich.
Frances H. Miller	Univ. of Michigan	Ann Arbor, Mich.
Frances N. Clark		San Pedro, Calif.
O. L. Wallis	NPS	Washington, D.C.
Laura S. Hubbs	Scripps Inst.	La Jolla, Calif.
Robert L. Borovicka	BLM	710 N.E. Holladay St., Portland, Ore.
Martin Litton		180 Bear Gulch, Portola Valley, Calif. 94025
Keith R. Artz	The Nature Conservancy	134 Madrone Ave., San Anselmo, Calif.
Sterling Bunnell	The Nature Conservancy	32 Millwood, Mill Valley, Calif. 94941
Paul Fodor	NPS	Death Valley, Calif.
James LaBounty	Bureau of Reclamation	2565 Van Patten #2, Las Vegas, Nev. 89109
Dale U. Lockard	Nevada Fish and Game	P.O. Box 4336, Las Vegas, Nevada 89106
William J. Newman	Nev. Div. Water Resources	201 S. Fall St., Carson City
Wayne P. Alley	Calif. State College at Los Angeles	5151 State College Drive, Los Angeles, 90032
Clinton H. Lostetter	BSFW	Portland, Oregon
David W. Greenfield	Calif. State College	Fullerton
James E. Deacon	Univ. Nev., Las Vegas Dept. Biol. Science	Las Vegas, Nev. 89109
W. L. Minckley	Ariz. State Univ.	Tempe, Arizona 85281
Ward Gillilan	Calif. Fish and Game	107 S. Broadway, Los Angeles 90012
Vern Burandt	Calif. F. & G. Warden	647 Inyo St., Lone Pine, Cal.
Carl L. Hubbs	Scripps Inst. Oceanography	La Jolla, Calif.
Jim St. Amant	Calif. Fish and Game	107 S. Broadway, L.A. 90012
Leonard Fisk	Calif. Fish and Game	1416-9th St., Sacramento 95814
William M. Richardson	Calif. Fish and Game	107 S. Broadway, L.A. 90012
Phil Pister	Calif. Fish and Game	407 W. Line St., Bishop 93514
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Vladimir Walters	UCLA	Dept. Zoology, UCLA, L.A. 90024
Tom Jenkins	Bureau Sport Fisheries and Wildlife	Bishop, Calif. Rt. 3, Box 198
Robert Liu	UCLA	Dept. Pathology, UCLA, L.A. 90024
Tina Nappe	Foresta Inst.	Box 620 Rt. 1, Carson

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