THE RARE AND ENDANGERED FISHES OF THE DEATH VALLEY SYSTEM

A Summary of the Proceedings of the Second Annual Symposium Relating to Their Protection and Preservation

Volume II

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

Held at
Death Valley National Monument Headquarters
Furnace Creek, California
November 17 & 18, 1970

Produced by the Desert Fishes Council and California Department of Fish and Game in Cooperation with the U. S. National Park Service.

Submitted for publication October 8, 1971.

Desert Fishes Council, 407 West Line Street, Bishop, California 93514
APPENDIX

A. Origin of Major Springs in the Amargosa Desert of Nevada and Death Valley, California.


APPENDIX A

ORIGIN OF MAJOR SPRINGS IN THE AMARGOSA DESERT
OF NEVADA AND DEATH VALLEY, CALIFORNIA

by
Isaac J. Winograd

ABSTRACT

Studies of the hydrogeology of the southern Great Basin differ widely in their conclusions regarding the origin of major springs at Ash Meadows, in the Amargosa Desert, Nevada, and in the Furnace Creek-Nevares Spring area in Death Valley: First, ground water commonly moves between intermontane basins of the region via thick, highly fractured, and areally extensive Paleozoic carbonate rocks; the resulting lack of correspondence of topographic and ground-water divides precludes routine utilization of the water budget method in the study of these basins. Second, subsurface hydraulic data for the regional carbonate aquifer are sparse and difficult to interpret because of the complex subsurface disposition of, and hydraulic barriers within, the aquifer. A synthesis of hydrologic, geologic, geochemical, and isotopic data permits a first approximation of the subsurface watershed tributary to the cited spring groups.

Water temperature, chemistry, isotope content and head, and geologic relations, indicate that the major springs at Ash Meadows and in the Furnace Creek-Nevares-Spring area, though emerging from Quaternary strata, are fed by water moving directly from the underlying carbonate aquifer.

Joint use of potentiometric, geologic, and isohyetal maps indicates that the ground watershed tributary to Ash Meadows is no smaller than 4,500 square miles. The Ash Meadows ground water basin is bordered on the south and east by the Spring Mountains and Sheep Range (the principal recharge areas) and on the west by the Belted Range, Eleana Range, and Shoshone Mountain. A northern boundary was not definable, and some underflow from the southwestern White River ground water basin (namely, Paihranagat Valley and vicinity) 90 miles northeast of the springs, is likely. The hydrogeologic data do not support the conclusion of earlier studies that underflow from Pahrump Valley is the major source of the spring discharge at Ash Meadows; probably no more than a few percent comes from that valley.

Comparison of the size, climate, and discharge from the Ash Meadows basin with that of the surface watershed tributary to the Furnace Creek-Nevares Spring area indicates that most of the spring discharge in east-central Death Valley originates well beyond its confines. Disposition of the carbonate aquifer favors the movement of ground water into Death Valley from central Amargosa Desert; water in the carbonate aquifer in the latter area may be derived from the Ash Meadows basin, from the overlying valley fill, or both.
Five hydrochemical facies were distinguished by percentage of major cations and anions in ground water from 147 sources. The areal distribution of these facies provides quasi-independent evidence for a northeasterly source of the Ash Meadows discharge, absence of significant underflow from Pahrump Valley to Ash Meadows, and movement of water from the central Amargosa Desert to the Furnace Creek-Nevares Spring area. The data are also compatible with southwestward underflow into the Ash Meadows basin from the White River basin.

The deuterium content of 53 water samples from 27 major (valley-level) springs and select wells falls into several areally distinct groups. These patterns suggest that 35 to 45 percent of the Ash Meadows discharge is derived from the White River basin, underflow from Pahrump Valley is unlikely, and water discharging in the Furnace Creek-Nevares Spring area may be related to water in the carbonate aquifer within the Ash Meadows basin. The deuterium data are subject to several other interpretations; these are reviewed to illustrate the difficulty of using this, and other tracers (namely, \( \text{H}^\text{3} \), \( \text{C}^{14} \), and \( \text{O}^{18} \)), in the absence of considerable hydrogeologic and paleoclimatologic data. Unequivocal interpretations about the regional flow system are unlikely from isotopic data alone.
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APPENDIX B

A Proposal for Preservation of Endangered Fishes of the Death Valley System

Date: 17 and 18 November 1970

To: Members, Second Annual Symposium on Endangered Fish of Death Valley at Furnace Creek, California

Some of the gentlemen gathered here I know are familiar with the existence of a sizeable number of talented amateur aquarists throughout the country. Certain of these aquarists are especially interested in and devoted to the care, maintenance and reproduction of Cyprinodontid fishes. In 1961 a small number of us formed the American Killifish Association, an organization of expert aquarists, many with formal scientific training, all with considerable practical knowledge of the skills needed to reproduce fish in home aquaria. The AKA now has nearly 1000 members in the U.S.A. with an additional 50 or so foreign members in Europe, South America, Africa and Asia. With all due respect to the professional scientists in this audience, permit me to remind you that it often happens that amateur animal keepers possess more skill than professionals in providing conditions for healthy survival of captive animals and in the case of fish many of these non-professionals are better at inducing animals to reproduce than are many ichthyologists. I suggest that the talents of certain members of the AKA be called on to aid in the preservation of endangered cyprinodontids of the Death Valley System, in a manner analogous to practices now in common usage with endangered mammals and birds in zoos throughout the world.

I have had a hand in the formation of the AKA and know personally or through intragroup scuttlebut who are the most skilled and dedicated hobbyists. My proposal to this group today is in its essentials exceedingly simple. I suggest that I be charged with the responsibility of distributing to selected AKA people a few pairs of the various species in question with the understanding that they are to make every effort to maintain reproducing populations in their possession. I would keep track of who has what and periodically require of them a status report. Such a plan has much to recommend it. All that would argue against it is low natural numbers of some species, e.g. C. diabolis, E. latos. Even with some of these species a very few individuals in the hands of our best aquarists stand a good chance of survival and reproduction.

Should this idea find favor with members of this symposium body I suggest the following sequence of implementation.

1. A short article outlining the problem and the proposal to be prepared for publication as soon as possible in Killie Notes, the monthly of the AKA. This would call for volunteers to contact me, giving me information relative to their degree of skill and experience with aquarium fish culture, particularly of cyprinodontids, as well as assurance of possible long term commitment to the project.
2. Information sheets, prepared from the literature and unpublished data from sources such as Drs. Deacon, Miller, Brown, Liu, Walters, etc., giving temperature ranges, pH, water hardness, electrical conductivity, etc., as well as essentials of reproductive and social behavior, would be disseminated for each species to selected ACA members. This would allow aquarists to prepare suitable aquaria.

3. Field collections of limited numbers of specimens would then be undertaken. These would be returned to my facilities at Fresno State and from there would be sent by air mail special delivery to aquarists. Cost for shipment to be borne by participant. I am knowledgeable in the techniques for shipping small fish through the mails.

4. Separate collections and mailings would be made for each species.

5. At regular intervals feedback would be required of the participants on a standard prepared form giving the status of the fish in their possession.

I envisage the idea as being eminently possible and workable with much to be gained if successful and nothing more to be lost than is currently being lost should it fail. Since those with whom I suggest we work are expert aquarists, I think the opportunities for success are excellent. I solicit your commentary and suggestions.

Richard Haas, Ph.D.
Department of Biology
Fresno State College
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## APPENDIX C

### ROSTER

1970 PUFFIN SYMPOSIUM

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The naturalist looks upon every species of animal and plant now living as the individual letters which go to make up one of the volumes of our earth's history; and, as a few lost letters may make a sentence unintelligible, so the extinction of the numerous forms of life which the progress of cultivation invariably entails will necessarily render obscure this invaluable record of the past. It is therefore an important object to preserve them. If this is not done, future ages will certainly look back upon us as a people so immersed in the pursuit of wealth as to be blind to higher considerations. They will charge us with having culpably allowed the destruction of some of those records of creation which we had it in our power to preserve, and while professing to regard all living things as the direct handiwork and best evidence of a Creator, yet, with a strange inconsistency, seeing many of them perish irrecoverably from the earth, uncared for and unknown."

A. R. Wallace, 1863.
Journal of the Royal Geographic Society
FOREWORD

ullace's prefatory statement describes pretty well what this is all about—
our battle to save the Death Valley System fishes from extinction. For what
are attempting to do here is, in many ways, to save the unknown—to save
this resource for future generations which, hopefully, will be more under-
standing and better able to appreciate and utilize it than we are. From my
personal standpoint, I am trying to save, along with the Death Valley fishes,
my own self respect and conscience. For I realize that, if man destroys this
resource, it will be because I have not worked hard enough to save it; and if
do not work hard enough to save it, probably no one else will either.

We are at a very critical point now in the evolution of the "ecology ethic."
I have seen, almost overnight, man's reverence and respect for Nature turn
gross indifference. He has viewed the bountiful gifts bestowed upon him
by an Almighty Creator simply as the raw materials to be utilized for his
own selfish economic gain, and with scarcely a thought of the needs of future
generations of Americans.

Now he is beginning to see the light and, suddenly, is waking up to the fact
that this type of misuse cannot go on forever and ultimately will defeat him—
probably within his own lifetime if allowed to proceed unchecked.

Now we have a few adherents to our cause from among the American public
and are gaining more all the time as the basic laws governing the universe
become increasingly apparent.

It we do not have much time to sit back and philosophize. We are fighting
this battle against time—time measured not in years anymore, but in months,
ours and minutes. We have already lost Empetrichthys merriami, and we may
be too late to save Cyprinodon diabolis. Others have passed on unheralded
before these. Water levels throughout the upper Amargosa Basin continue to
rise, and we continue to fight a complex and obscure enemy comprising big
business, tax laws, development-oriented state government, local tax revenues,
conflicting policies and philosophies of governmental agencies, an American
public which is just now waking up to the facts of life and, paradoxically,
he "American Dream" which has been repeated so many times that we view it as
blasphemous to question the desirability and need of clearing and "developing"
and.

However, sometimes the night seems darkest just before the dawn. Although we
still have a long way to go before we win this battle, we have a lot going
or us that we did not have two years ago, or two months ago, for that matter.
and, in the words of John Paul Jones: "We have not yet begun to fight."

Or what we have in the Ash Meadows area, and throughout the Death Valley
system, is far more than a few pupfish and a declining water table. We have
this system a tiny microcosm which reflects, basically, the same problems
which the entire Earth faces, or soon will face. In the Ash Meadows area we
ive some fish species which are facing extinction because of needless en-
roachment on their habitat by man simply for economic gain. This is essen-
tially the basis of the world's environmental problems today.

opefully, in our battle to save the desert fishes, we can set up guidelines
and procedures which will be valuable in solving similar problems elsewhere.
an must begin, sooner or later, to decide where the line must be drawn be-
tween environmental preservation and economic development. In many cases,
he must, sooner or later, make a choice between economic development and
environmental preservation. It may not always be a pleasant decision, but
must be made.

obert Louis Stevenson once said: "You cannot run away from weakness; you
ust sometime fight it out or perish; and if that be so, why not now, and
here you stand?"

his is where we stand, and this is why we are fighting.

Bishop, California
August 1, 1971
ACKNOWLEDGMENTS

The writer gratefully acknowledges the assistance of Miss Linda Balatti, of the National Park Service, for her accurate notes of the various panel discussions. Dale Lockard, of the Nevada Department of Fish and Game, recorded the all-important session relating to the preparation of the 1971 park plan. Robert Brown and David Soltz, graduate students at U.C.L.A. and summer employees of the California Department of Fish and Game, reviewed the tape recordings and prepared comprehensive notes of the entire proceedings. Mr. Brown also made valuable suggestions concerning preparation of the text. The U.S. National Park Service made available its facilities at the Furnace Creek Visitors' Center throughout the symposium. The manuscript was typed by Madelyn Turner, of the Inyo National Forest.

Finally, special thanks are due the members of the Department of the Interior's Pupfish Task Force and the Desert Fishes Council Advisory Group for their support and enthusiasm in the entire preservation effort.
INTRODUCTION

The Symposium was followed on November 23, 1970, by a press release issued by Ward Gillilan, Information Officer of the California Department of Fish and Game's southern region. This release is printed verbatim as an abstract of the proceedings of the meeting.

November 23, 1970
For Immediate Release

Rare Desert Fishes Gain
Temporary Lease on Life

A nationwide blend of state, federal and university scientists and resource specialists, formally organized last week as the Desert Fishes Council, can point with pride to its past year's accomplishments while viewing with alarm the continuing habitat changes which necessitated the group's first meeting a year ago.

The purpose of the council is to preserve the vanishing native fishes of the Southwestern Desert.

In the past year the group has temporarily saved from extinction the tiny pupfish of Devils Hole in Nevada, a detached portion of Death Valley National Monument, where the nearby pumping of new wells for private land development apparently is lowering the water table.

But whether the Pahrump killifish, Devils Hole pupfish and eight other rare and endangered fish species unique to the Death Valley drainage system in Nevada and California can be saved over the long haul remains in doubt.

The answer, says the council, will be determined by the outcome of its battle to restore and preserve the springs and waterholes which have sustained the little-known fishes since the Pleistocene ice age.

These facts surfaced last week at Death Valley National Monument headquarters during a two-day (Nov. 17-18) workshop meeting of 81 of the nation's leading biologists, geologists, hydrologists, ecologists, resource managers, public land and water administrators and conservationists.

They came from California, Nevada, New Mexico, Texas, Colorado, Michigan, Maryland, Virginia and Washington, D.C.

Coordinated by California's Department of Fish and Game, it was the second annual meeting of the group which formed itself into the Desert Fishes Council, elected California DFG biologist Phil Pister as the council's chairman, and updated work plans and priorities for the coming year.
Topping the list of the 10 most endangered species is the Pahrump killifish, whose entire population exists in an isolated spring in Nevada's Pahrump Valley. The species is not expected to survive another 10 years, although attempts are being made to transplant it to other areas.

Snatched from the brink of doom by emergency action resulting from the group's first meeting a year ago, the colorful, inch-long Devils Hole pupfish, which began evolving thousands of years ago in the limestone sink bearing its name, is still in big trouble and remains at No. 2 on the council's list of the 10 most endangered desert fish species.

A drop in the Devils Hole water level has shut out sunlight needed to grow the fish's food. The lowering water level is also exposing a shallow, underwater ledge which, through the ages, has provided the fish's only suitable spawning area.

As an emergency measure, the biologists installed an artificial spawning shelf last May 7. A bank of electric lights, to promote food growth, was installed July 17. Since then the fish have reproduced well and seem to be at least holding their own.

As added insurance against total disaster, the biologists on August 14 transplanted 24 of the Devils Hole pupfish into a remote desert spring in California's nearby Inyo County.

The carefully-selected transplant spring closely matches the 92-degree temperature and chemical makeup of the water in Devils Hole, and the fish apparently are surviving there.

But the biologists warn that long-term living in an artificial or new environment would inevitably change the fish themselves, and the species that nature has produced would be lost.

The workshop consensus was that the Devils Hole pupfish and the other endangered fishes in the Ash Meadows area of the Amargosa River Basin can be saved only if the springs in which the fishes evolved are quickly restored to and maintained in their pre-pumping condition.

And this, it was agreed, can happen only if the land developers who own the critical water rights convert to a surface-flow catchment system for most of their irrigation water and limit their pumping to those areas where it will not adversely affect the home springs of the endangered fishes.

Meanwhile, the U.S. Department of the Interior is taking these additional emergency actions: (1) The Bureau of Land Management is reclassifying public lands in the area so that further irrigation development can be limited, and (2) under direction of a special task force, a geologic study is being made to clarify the relationship between pumping and the area's waterhole levels and spring discharges.
Identified by the Desert Fishes Council as their priority list of Death Valley drainage system fishes threatened with extinction are:

(1) Pahrump killifish, Nevada; (2) Devils Hole pupfish, Nevada; (3) Tecopa pupfish, California; (4) Ash Meadows speckled dace, Nevada; (5) Owens River speckled dace, California; (6) Owens River chub, California; (7) Ash Meadows pupfish, Nevada; (8) Warm Spring pupfish, Nevada; (9) Mohave chub, California; and (10) Owens pupfish, California.

Positive action taken by DFG biologists in constructing refuges and making transplants to more secure water sources has materially strengthened the position of the Owens pupfish and Mohave chub. Although these fishes are still considered endangered, the possibility of their becoming extinct has been materially lessened.
SUMMARY OF PROCEEDINGS

Eddy, November 17

Herbert Murphy, Superintendent of Death Valley National Monument, presented brief introduction and welcome. His remarks, though brief, emphasized the fact that the potential problems of yesterday are the actual problems of today. This philosophy applies to such critical items of Park and Monument administration as indiscriminate vehicle use, crowd control, vandalism of natural habitat and recreational facilities, and law enforcement. The lesson is clear: We should begin now to estimate and predict our future problems and prepare for them in whatever way we can.

Following Superintendent Murphy's introductory remarks, Mr. Pister gave a brief "Introduction to the Pupfish" and reviewed developments since the symposium held on November 18-19, 1969. He emphasized the key role played by the Department of the Interior's Pupfish Task Force. Since its formation by Commissioner Charles Meacham and Secretary Walter Hickel in 1970, the Task Force has taken a leading and very effective role in gathering various preservation programs for the desert fishes. Strong and enthusiastic leadership for the Task Force has been provided by Chairman T. McBroome of the Washington Office, Bureau of Sport Fisheries and Wildlife.

Mr. Pister then summarized the current status of the various endangered species. Their status is treated in detail in the following section.

SESSION I - Progress report on species preservation assignments made in November, 1969.


Pahrump killifish, Empetrichthys latos.

Dr. Deacon, Mr. Lockard, and Mr. Myers.

On June 4, 1970, 31 individuals were collected from Manse Spring, all in good condition, and taken by a helicopter provided by the Bureau of Reclamation to a spring area adjacent to Lake Mohave. Two springs were planted, with approximately half of the fish in each one. Spring temperatures were 70°F. and 76°F. The current status of the transplant is unknown, but fish were still alive about two months thereafter. Dr. Deacon estimated a population of about 200 E. latos in Manse Spring. Goldfish are still present there.

Devils Hole pupfish, Cyprinodon diabolis.

Mr. Sanchez, Dr. Deacon, Mr. Lockard, Mr. Fisk, and Mr. Pister.
Devils Hole has experienced unprecedented declines in water levels during recent months. Because of this, an artificial shelf was installed during the summer of 1970 in an attempt to compensate for the natural limestone feeding and spawning shelf from which the water is receding. The artificial shelf was constructed from fiberglass roofing material and suspended from styrofoam floats. Shortly thereafter the Park Service installed electric lights above the shelf to stimulate algae growth which would naturally diminish from increasing darkness as the water level dropped. Both the shelf and lights appear to be functioning satisfactorily.

Two transplant attempts were made during the past year. On August 17, 1970, 24 C. diabolis were collected at Devils Hole and transplanted into Upper Warm Spring in Saline Valley, Inyo County, California. The current status of these fish is not known, although four fish were seen there in mid-September. This transplant was covered by CBS-TV and was released shortly thereafter in southern California.

Another transplant attempt was made into an artificial pond dug near Point of Rocks Spring by Spring Meadows, Inc. Although the area above the pond was chemically treated prior to the introduction, contamination by C. n. mionectes has apparently occurred already. This points out the necessity of insuring that genetically pure populations of rare or endangered fishes are not contaminated by transplants of other rare or endangered fishes.

Owens pupfish, Cyprinodon radiosus.

Dr. Miller, Mr. Berggren, Mr. Pister

On June 30, 1970, 428 fish were introduced into the Owens Valley Native Fish Sanctuary in Fish Slough, Mono County, located about ten miles north of Bishop, California. These fish have reproduced very successfully to their current level of several thousand. To date no other endemic fishes have been introduced into the sanctuary.

An additional introduction of 39 fish was made from the Fish Slough population into the Warm Springs Sanctuary, located about eight miles south of Bishop on October 28, 1970. This should provide ideal habitat for C. radiosus.

A third sanctuary is currently under construction at BLM Spring, located on the east side of Fish Slough. Considerable planning is being devoted to this project, inasmuch as Indian artifacts are located nearby, and the entire concept lends itself ideally to a study area and a public interpretive site. This project is endorsed by the Inter-agency Committee on Owens Valley Land and Wildlife and is being constructed with funds provided by the John Muir Institute, Bureau of Land Management, and California Department of Fish and Game.

A paper by Miller and Pister pertaining to the management of the Owens pupfish will be published during the coming year in the Transactions of the American Fisheries Society.

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Ash Meadows pupfish, *Cyprinodon nevadensis mionectes*.

Mr. Lockard, Dr. Miller, Mr. Myers

Crystal Spring, Jackrabbit Spring, and Forest Spring had all experienced complete eradication of their *C. n. mionectes* populations. However, this subspecies still exists in several springs in the Ash Meadows area. Lew Myers briefly reviewed the rare and endangered species program conducted by BLM and discussed their 1968 habitat management plan for Jackrabbit Spring. At that time the main problem there was the presence of exotic fishes. An attempt was made to obtain the concurrence of Spring Meadows, Inc., in fencing the spring and creating public viewing areas. However, no reply was received. On July 26, 1969 a pump was discovered in the spring, and the populations of both *C. n. mionectes* and *Rhinichthys sp.* were destroyed. By January, 1970 a cooperative agreement to pump only from a pumping pit was signed, and the pump was removed from the spring. During the summer of 1970 the spring was maintained at 1 - 2 feet below the normal outflow level; but there was much fluctuation, and the water increased in temperature and turbidity. Dr. James Brown announced that the spring at Fairbanks Ranch was completely dry.

Although no representative of the Nature Conservancy was present, a telegram from Keith Artz of the Conservancy's San Francisco office revealed that negotiations for the purchase of Big Spring are proceeding satisfactorily.


Mr. St. Amant

The only known genetically pure population of Mohave chubs in recent years was at Zzyzx Spring near Baker, California. On December 18, 1969, 150 *G. mohavensis* from Zzyzx were transplanted into Piute Spring, northwest of Needles, California. However, this is considered temporary because of the likelihood of flash floods. A total of 140 chubs was sent in January, 1970 to the South Coast Botanical Gardens near Los Angeles. In July, 1970 they were very abundant and three size classes were present.

Transplant sites at One-hole and Two-hole Springs, San Bernardino County, California, were reviewed. Two-hole Spring was fenced, and an introduction was made using fish smaller than four inches in length.

The California Department of Fish and Game announced its intent, in cooperation with the Department of the Navy, to introduce *G. mohavensis* into Lark Seep Lagoon, on the China Lake Naval Weapons Center near Ridgecrest, California.

5. Tecopa pupfish, *Cyprinodon nevadensis calidae*.

Dr. Miller
It is felt that the species is probably extinct. However, Dr. Miller wants to check additional collections to see if they are *C. n. amargosae* or *C. n. calidae*.

Warm Spring pupfish, *Cyprinodon nevadensis pectoralis*.

Mr. Myers, Dr. Deacon, Mr. Lockard, Dr. Miller

Mr. Myers described the habitat management plan for School Spring. In June, 1969 a one-acre exclosure was built around the spring, with a "viewers' pond" constructed below in an attempt to get public support for this type of project. During the spring of 1970 the flow appeared to be seriously reduced, resulting in a well being drilled on June 30, 1970 to provide supplementary water to School Spring. A pumping test of this well showed no adverse effect either on School Spring or Devils Hole. Dr. Miller reported that two 1967 collections from Scruggs Spring were identical with the School Spring fish and thus were *C. n. pectoralis*.

SESSION II - The Department of the Interior's Pupfish Task Force - its origin, purpose, and future.

Mr. James T. McBroom, Task Force Chairman

he Department of the Interior's Pupfish Task Force was established in May, 1970 at the direction of Deputy Assistant Secretary Charles Meacham. James T. McBroom was appointed as Task Force Chairman. It was noted that 33 Interior employees were present at the symposium.

he agencies within Interior currently represented on the Task Force are: Bureau of Land Management, Geological Survey, National Park Service, Office of the Solicitor, Bureau of Sport Fisheries and Wildlife, and Bureau of Reclamation. The basic purpose of the Task Force will be to organize communications and provide high level endorsement of pupfish preservation.

The Task Force determined that the primary and most urgent need at this time was a groundwater study of the Ash Meadows area. Financing in the amount of $50,000 has been provided for this study.

The primary activities of the Task Force to date may be summarized as follows:

1. Cooperative efforts with the Nevada Department of Fish and Game and University of Nevada, Las Vegas, have resulted in the positive action described earlier at Devils Hole.

2. A Task Force decision and recommendation led to the new well at School Spring.

3. The Ash Meadows groundwater study has been financed by Interior and is being conducted by William Dudley of the Denver office, U.S. Geological Survey.
Attempts are being made to obtain an Office of Water Resources Research grant to supplement the U.S.G.S. study.

The critical habitat areas in Ash Meadows are checked, reported to Washington, and the reports disseminated to Task Force members on a weekly basis.

Formal requests have been made to the Nevada State Engineer to place a moratorium on granting any and all new permits for the use of Ash Meadows water until the groundwater study is completed.

Dale Lockard (Nevada Department of Fish and Game) and Clinton Lostetter (Bureau of Sport Fisheries and Wildlife) have completed a habitat evaluation study of surface waters in Ash Meadows.

The pamphlet, "Let's Save the Desert Pupfish" has been published and given wide circulation.

Considerable quantities of mail in favor of saving the pupfish have been received and answered.

Interior has reclassified all remaining lands in Ash Meadows so that they are no longer available for exchange.

SESSION III - Consideration of proposal to establish a "Desert Fishes Protective Council" and a Pupfish Advisory Committee to work with Interior's Pupfish Task Force.

Mr. Pister.

Considerable group discussion was held concerning this item, and the Desert Fishes Council was formed by unanimous vote. Phil Pister was selected as chairman, and he was given the assignment of preparing a constitution and bylaws, as well as appointing committees and "getting the Council off the ground." Also involved here would be setting up advisory groups, designating procedures requisite to administering the affairs of the Council, and assisting the Task Force in the solution of technical problems. Formal discussion and adoption of the constitution, etc., was set for the November 16-17, 1971 symposium.

SESSION IV - The ecology and research value of the Death Valley System fishes.

Dr. James Brown

Dr. Brown gave a brief narration on why biologists are interested in pupfish. He reviewed Pleistocene events and the reduction of aquatic habitats since that time, resulting in "islands of water in a sea of sand."

He stated that biologists are currently asking two basic questions:

1. Evolutionary - how much divergence has occurred in isolated populations, and
2. Ecological — how have pupfish been so successful in so many different environments? There exists here a series of natural experiments.

k to date may be summarized as follows:

1. a. Dr. Miller worked out the morphological differences.
   b. Dr. Uyeno is currently studying the chromosome karyotypes.
   c. Dr. Liu has studied the behavioral divergences.
   d. Mr. Turner is studying enzyme differentiation.

2. Studies of behavioral energetics and populational response to environmental variation are in progress at the University of Nevada (Las Vegas), U.C.L.A., and Arizona State University (Tempe).

In addition, Dr. Brown cited several examples of physiological and populational response of *Cyprinodon* to environmental parameters based on current or completed research. The response of pupfish dependence on their habitat was mentioned with regard to:

1. Temperature. Drs. Brown and Feldmeth found that Devils Hole pupfish (*C. diabolis*) can tolerate, on a short term basis, temperatures from 32°F to 108°F.

2. Salinity, both in unusual overall concentrations and in ionic composition. Pupfish have been observed in concentrations ranging from nearly distilled water to several times that of sea water.

3. Absolute differences in habitat size (example given was from Mexican Spring to the Amargosa River near Tecopa). Populational homeostasis was emphasized, wherein populations are adjusted to habitats of various sizes. In Jackrabbit Spring an introduction of 100 *C. n. mionectes* increased to over 3,000 in about three months, but in Mexican Spring the population never exceeded 50 fish in a full year's observations.

4. Seasonal variation in habitat size (example: annual recolonization of Salt Creek and the Amargosa River within Death Valley National Monument from the source springs area).

5. Productivity (example: Devils Hole has little sunlight and very low productivity, whereas essentially the opposite is true at Big Spring).

Brown's suggestions (made as an ecologist rather than an ichthyologist) refer to:

1. Preserve the original habitats in a natural condition. Each population of pupfish is unique and irreplaceable, and an alteration of their habitats can alter the populations, making them different and less interesting. "Man cannot improve upon Nature."
2. Be careful about introducing pupfish into waters that have never had fish. The communities of endemic invertebrates are unique in their own right and just as worthy of protection as the fish species we are trying to preserve.

Editor's Note: We must exercise keen judgment in our enthusiasm to preserve the desert fishes, inasmuch as we might well undo much of the inherent good in our overall program by neglecting other portions of the biota which may be damaged or destroyed through our preservation efforts. We are, in fact, dealing with communities of exceedingly complex interactions, of which we have a woefully inadequate understanding.

3. Further research must be encouraged, but we must likewise exercise restraint so that our research efforts do not adversely affect the very delicate populations we are studying. Dr. Brown's implicit point was that the very research which is too often viewed with disdain may well provide the information necessary to both understand and preserve the pupfish.

In reply to the question: "Will not these populations eventually become extinct through natural processes anyway?", Dr. Brown stated that natural extinctions are certainly tolerable, but man-caused extinction can never be justified. We must plan programs that will solve the problems of species preservation, not just prolong the time to extinction.

SESSION V - Review of current research on Death Valley System fishes, and additional research necessary for species preservation.

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

Dr. Walters, Dr. King, Dr. Miller, Dr. Brown

Dr. Walters described current research being conducted by three graduate students at U.C.L.A.

a. Bruce Turner is conducting electrophoretic studies of polymorphism and the degree of genetic divergence that has taken place between the various populations.

b. Robert Brown is studying environmentally controlled behavioral changes in *Cyprinodon* and *Cyprinodon salinus*.

c. Robert Maier is beginning a study of feeding and food habits of various *Cyprinodon* populations.

d. David Soltz is conducting research on the effect of behavioral and environmental variables on life history features and dispersal rates of pupfish populations in small springs.
Dr. King described the hydrologic study being conducted by U.S.G.S. in Ash Meadows. He also pledged the support of the Task Force and Bureau of Sport Fisheries and Wildlife in the research effort on desert fishes and indicated that efforts would be made to place a BSFW biologist in the desert area to assist in the overall preservation effort.

Dr. Miller commented on the importance of chromosome study in elucidating the degree of evolutionary divergence. The work which he and Dr. Teruya Uyeno are doing (karyological analysis of Cyprinodon) has revealed that all 13 forms studied have the same number (48). A form from El Potosi showed a male count of 47 and a female count of 48. This is the only known case in fishes where a sexual dimorphism in chromosome numbers has been encountered.

All American minnows, including the Death Valley forms, have 50 chromosomes. The catostomids apparently arose by polyploidy from the cyprinids. All those studied (most species) have 100 chromosomes and twice the amount of DNA.

Dr. Brown discussed his research (in collaboration with Dr. Feldmeth and Mr. Soltz) at "Tecopa Bore," a well (water temperature 48°C.) flowing down to a marsh near the Amargosa River. Studies of the pupfish population living in this gradient showed that they live right at their lethal temperature (42°C.). This illustrates the precision of behavioral and ecological interactions.

Comparisons are also being made of the size and structure for a constant (Big Spring) population and a fluctuating (Amargosa River) population. Mr. Soltz is collaborating on some of the above areas.

Mrs. Astrid Brown (Dr. Brown's wife) is studying the effects of environment on behavior at Big Spring.

Dr. Feldmeth commented at this point that the lethal temperature extreme study directed toward determining how and why different pupfish populations can tolerate a wide range of temperature (all through acclimation) indicates little genetic change. He also stated that little is known of ionic and osmotic regulation: how, for instance, Cottonball Marsh fish can adapt to a concentration of 80 p.p.m. of boron, a level which had previously been considered lethal to both plants and animals.

Dr. Deacon described the work of his students at the University of Nevada (Las Vegas) in reviewing previously acquired data in an attempt to trace energy flow patterns through the Saratoga Springs ecosystem, and to determine how much energy is removed from the system.

**SION VI** - The hydrogeology of the Ash Meadows area and Amargosa River System.

Chairman: Dr. G. B. Maxey, Desert Research Institute.

Mr. Dudley, Mr. Winograd
Maxey was asked by the Department of the Interior to prepare a preliminary report on the Ash Meadows problem. This has been completed, but no further reference was made to it.

The consultant hydrogeologist retained by Spring Meadows, Inc., erred in his data interpretation and grossly overestimated (perhaps by as much as three times) the amount of water available and, therefore, the amount of land which could be irrigated. The amount of water discharged from the basin (17-24,000 c.f. annually) is all that is legally and feasibly available for development. Maxey was of the opinion that Spring Meadows, Inc., was simply a victim of poor technical advice, both from the standpoint of available water and expanding damage to desert fish habitat.

Maxey's proposed plan is in two phases: (1) to develop a water management system for Ash Meadows, and (2) to apply this generalized system to "areas of much more extensive concern."

The U.S. Geological Survey will produce the data for this plan which, Dr. Maxey hopes, will allow both Spring Meadows, Inc., and the pupfish to survive.

William Dudley, of the Denver Office, U.S. Geological Survey, stated that the basic purpose of his study is to determine why the water level within Devils Hole has been dropping and why the discharge of other springs in the Ash Meadows area has been decreasing. His working hypothesis is that pumping in the area is the cause of both situations.

Primary consideration in this study will be to quantitatively determine the proportion of pumped water originating from various sources: (1) how much is being proportionally removed from storage in the alluvial and carbonate aquifers.

Other objectives of the study will be to determine which of the present pumping centers are causing the greatest damage to pupfish habitats. The hydrogeology of the aquifers and faults will be studied and described as a basis for understanding the mechanics of the connections of the present pumping centers to the pupfish habitats. The approach to this problem will be essentially as follows:

1. Had the water level of Devils Hole ever been below the level of the shelf? Divers went to a depth of about 90 feet and found no evidence that it had.

2. Complete historical records and continue taking records of water levels and spring discharges. All major springs and some minor ones are currently giving continuous records.

3. A correlation of nuclear and seismic activity with spring flows has been partially completed. To date no relationship has been indicated.

4. A correlation of spring flows with climatic records likewise showed no relationship.
The chemical composition of well and spring water is now being monitored in an attempt to understand the present hydrology of groundwater. Water is carried through carbonate aquifers, and how it discharges in Ash Meadows is not understood.

Pump tests will be run during the 1970-71 winter to determine effects on both Devils Hole water levels and spring discharges within Ash Meadows.

The lowest recorded level in Devils Hole between 1956-67 was approximately 5 feet below the copper index washer. In 1968 the low dropped to 1.7 feet low the washer, in 1969 to 2.3 feet and, on August 28, 1970 to 3.08 feet. Is low in 1970 exposed approximately 55 percent of the crucial limestone elf. Hence the reason for the study and our concern.

The following flow figures from various springs in the Ash Meadows area summarize the general decrease in groundwater levels during the past decade:

<table>
<thead>
<tr>
<th>Spring</th>
<th>1960 flow (c.f.s.)</th>
<th>1970 flow (c.f.s.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairbanks</td>
<td>3.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Soda</td>
<td>0.2</td>
<td>dry</td>
</tr>
<tr>
<td>Longstreet</td>
<td>2.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Crystal</td>
<td>6.6</td>
<td>5.8</td>
</tr>
<tr>
<td>Point of Rocks</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Jackrabbit</td>
<td>1.4</td>
<td>0 to 0.4</td>
</tr>
<tr>
<td>Big Spring</td>
<td>2.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Scruggs</td>
<td>No data</td>
<td></td>
</tr>
<tr>
<td>School</td>
<td>No data</td>
<td></td>
</tr>
</tbody>
</table>

The current study will not cover water quality, although this is an essential consideration in a long-term irrigation project.

In the discussion which followed, Dr. Clark Hubbs emphasized that mining of fossil water beyond renewable amounts is a problem in many areas. Dr. Maxey applied that the policy of the Nevada State Engineer precludes allowing the mining of groundwater. (Editor's note: Current policy of the Nevada State Engineer is to allow a "reasonable annual drawdown," which was not specifically defined.)

Dr. Maxey pointed out the problem of ultimate needs for water in southwestern desert areas. It was his opinion that the City of Las Vegas will eventually propose to export groundwater from the Amargosa Basin and will probably be successful.

Dr. Maxey referred to a paper prepared specifically for the symposium by Ike Vinograd of the University of Arizona. This paper relates to the hydrogeology of the Amargosa system and is reproduced in the appendix of the symposium summary.

This session of the symposium was punctuated by a lively exchange concerning a fact which is painfully apparent to all of us: all professions exhibit
practitioners with varying degrees of competence. It is only natural, there-
fore, that some glaring examples of incompetence will occasionally occur.
Another fact was indisputable: the professions of hydrogeology and biology
questionably produce practitioners with both quick minds and quick tempers.

SESSION VII - Landownership in key areas - progress report on property
acquisition.

Clinton Lostetter, Bureau of Sport Fisheries and Wildlife,
Portland, Oregon.

Mr. Lostetter reviewed activities of his office which, at the request of
the Pupfish Task Force, acquired information on land holdings in the Ash
Meadows area. He stated that approximately 85,000 acres is leased government
and, and 15,000 acres is in private ownership. A total of 5,000 acres of
Spring Meadows, Inc., land was acquired through exchange from the Bureau of
Land Management. There are 34 private landowners in the Ash Meadows area.
Negotiations by the Nature Conservancy to purchase Big Spring are proceeding
slowly.

SESSION VIII - Studies and plans relating to land development in the Death
Valley System.

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

Mr. Kuebler, Mr. Wilson, Mr. Tower, Mr. McClaren

Bruce Kuebler, of the Los Angeles Department of Water and Power, reviewed the
history of the Los Angeles land acquisition and water export program in the
Owens Valley. Over 300,000 acres of land in the Owens and Mono basins were
purchased for the protection of the Los Angeles water supply. The activities
of the Inter-agency Committee on Owens Valley Land and Wildlife were outlined,
and the wildlife preservation programs conducted by the Los Angeles Department
of Water and Power were discussed. The history and development of the Owens
Valley Native Fish Sanctuary at Fish Slough, north of Bishop, were described
in some detail. The majority of Fish Slough is owned by the City of Los Angeles
and will remain withdrawn for preservation purposes.

Dr. Dennis Williams, geohydrologist with the Los Angeles Department of Water
and Power, estimated the safe yield of ground water in the Owens Valley to
be approximately 220 c.f.s.

Mr. Thomas R. C. Wilson III, attorney for Spring Meadows, Inc., (although he
appeared at the symposium as a private attorney) summarized the activities for
Spring Meadows, Inc., in the Ash Meadows area. To date SMI has invested 5-6
million dollars in their ranching operation. Their present method of pump-
ing from wells is the most economical way to procure water for their agricul-
tural ventures.

Mr. Wilson felt that the most obvious answer to our current problem is to use
surface flow (spring discharge) supplemented by those wells which do not
fect pupfish habitat. He outlined the many benevolent gestures offered
uncalily by SMI (well monitoring, Point of Rocks Sanctuary, etc.) as
idence of the corporation's concern for the environment.

siderable discussion followed Mr. Wilson's presentation. Mr. McBroome
quested that SMI withdraw their current applications for well permits, to
ich Mr. Wilson replied that eight pending applications are for operating
ls and that permit applications for new wells could be withdrawn. He
ferred to consult with his client concerning a moratorium on pumping and new
ll drilling and gave no concrete answers when questioned about long-range
velopment plans of SMI.

James Brown posed a rather perplexing question concerning to what extent
was responsible for lowering the water level in Devils Hole, which in-
rm reduces the value to the American people of one of their national monu-
ments.

Art Tower, of the Las Vegas office of the Bureau of Land Management, re-
ewed the land status in Ash Meadows. He stated that on December 23, 1970
will lose their authority to sell land.

September, 1966 Spring Meadows, Inc., applied to exchange about 13,000
res of land (in an unstated location) for a similar acreage in Ash Meadows
plement approximately 5,000 acres purchased from the Nye County Land
pany. Over 5,000 acres were transferred in October, 1969; other lands in
area were encumbered by mining claims, etc. On September 3, 1970 the
ssification of other land applied for was revoked by BLM, and on October 23
70 an exchange application was rejected.

other positive actions by BLM, 56 acres were classified for the protection
Jackrabbit Spring, and 60 acres were classified to protect School Spring.
additional 2,020 acres of land in the Devils Hole area are proposed for
classification.

Fiero brought up the point that, if the initial land exchange had not been
ide, there most likely would not have resulted so serious a threat to the
fish. This statement was followed by some rather lively discussion.

Editor's note: This is a classic example of barndoons and escaped horses.
important point here is that we have all learned many lessons from our
perience with the pupfish in the Death Valley System. We recognize our
stakes and, hopefully, are now engaged in a coordinated effort to save the
resource.)

Cecil McClaren, Chief of Project Studies for the Bureau of Reclamation's
oulder City, Nevada office, briefly described the proposed Amargosa River
asin Project. The Bureau is now beginning a feasibility study for a project
digned for "turning thousands of acres of desert into fertile farmland."
he Bureau will attempt to design the project with a "positive" impact upon
environment. The exact meaning of this last statement was not fully
arified.
Considerable discussion followed Mr. McLaren's presentation, but nothing really constructive was accomplished. Although the Bureau's goal of a "positive" environmental impact is indeed admirable, this statement (and the project in general) was received somewhat cynically by those in attendance. As Congressman Johnson of California's Second District stated in a recent newsletter to his constituents: "We shall withhold judgment on the Amargosa Project until all facts are available." Hopefully, he will do exactly this.

SESSION IX - The current legal situation.

Chairman: Mr. Leonard Fisk, California Department of Fish and Game, Sacramento.

Mr. Newman, Mr. Aho, Mr. Lostetter

In summarizing current Nevada water law, Mr. Newman stated that there had been no new developments in this respect. The doctrine of prior appropriation is followed, and "beneficial use" is the measure and criterion for evaluating new water applications.

There are two ways to acquire water within Nevada:

1. By adjudication - beneficial use prior to current law;

2. By permit to develop to a beneficial use.

An application is published for four weeks, after which 30 days are allowed for protests to be filed. After this a permit may be issued. A certificate of beneficial use is processed, and the water right is then made a perfected water right.

Any decision made by the State Engineer relative to a water right may be appealed within 30 days.

"Water mining" is illegal in Nevada; however, in critical areas (Pahrump Valley, for example), a certain amount of overdraft for "successful" agricultural development is permitted (i.e., if economic demands require).

Water law may have to be changed to allow for developments such as the Amargosa Valley Project, to allow for a drawdown of the water table of as much as 100 feet. (Editor's note: This statement is extremely significant from the standpoint of the preservation of desert spring habitats. We should attach full significance to it in our thinking and long-range planning.)

Mr. Aho explained the controversy between Federal and State water law. All western states claim that water belongs to the state, and application must be made to the state. The question then arises concerning the use of water by the Federal government on Federal public lands. The Federal government contends that it has not given over its water rights to the states, and that it must not accede to state jurisdiction. The priority of the Federal government to the water in Devils Hole was established in 1952!!
nton Lostetter reviewed various rare and endangered species laws and borated on the Endangered Species Conservation Act of December 9, 1969. s is a more comprehensive act than the one previously in force and spells the various protected species. A total of 189 species of vertebrates currently listed in the Secretary of the Interior's "Redbook."

SION X - The role of the news media in rare and endangered species preservation, with specific reference to the pupfish problem.

seems to be typically American to be mowing the lawn while the house burns down. But news is news, and the culmination of the 30-day climb up the face of El Capitan in Yosemite National Park at the time of the symposium precluded attendance of the panel Chairman and several panelists.

ever, the subject was reviewed, and some film clips of the C. diabolis nesplant from Devils Hole to Upper Warm Spring in Saline Valley, which was available throughout southern California by CBS television in Los Angeles, were shown for our use at the symposium. This was typical of the excellent coverage given the desert fishes problem by the media, and it was generally agreed that good publicity is one of the most effective weapons we must use in our battle to save the desert fishes from extinction. We shall actively to assure the continuation of this type of coverage.

SION Xa - Discussion of general preservation problems in the Ash Meadows area.

Chairman: Mr. Pister

ollowing the abbreviated session concerning the role of the news media in rare and endangered species preservation, a general discussion was held relative to the operations of Spring Meadows, Inc., and how they might be altered to allow for the preservation of the endemic fishes. The primary participants were Tom Wilson and Jim McBroom.

became immediately apparent that very little could be decided, or even recommended, without first conducting a hydrological study of the Ash Meadows area. Mr. Wilson suggested that Interior might carry the burden of the study to also cover the investment made by Spring Meadows, Inc., in their underground water system. It was generally felt, however, that the hydrological study was necessary before this could even be considered by Interior.

A suggestion was made by several participants that a moratorium be placed on well drilling until such time as the groundwater study is completed. There was considerable discussion of the suggestion that Spring Meadows, Inc., switch to the use of surface water supplemented, perhaps, by wells that do not influence spring flows. No commitments were made by SMI on either of these points, and it was admitted by both sides that little could be decided without more data, and this could be acquired only through the groundwater study.

Deacon made the very good, but generally unknown, point that we are trying to preserve only the last remnants of the Ash Meadows fish populations, and we cannot afford to sacrifice anything more.
Wednesday, November 18.

Between 8:00 A.M. and 12:00 Noon the entire group toured the problem areas in Sh Meadows in order to gain a better picture of habitat degradation and resultant species preservation problems. Leading this field trip were Dr. Deacon, R. Sanchez, Mr. Myers, and Mr. Lockard.

SESSION XI - Review of possible transplant locations.

Chairman: Dale Lockard, Nevada Department of Fish and Game.

R. Lockard briefly reviewed the general subject. However, inasmuch as transplant locations would be a significant part of the preparation of the action plan, discussion was temporarily held in abeyance.

SESSION XII - Reassignment of priorities for species preservation.

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

R. Miller conducted a general discussion of the various species involved, and priorities for species preservation were reassigned as follows:

1. Pahrump killifish, Empetrichthys latos
2. Devils Hole pupfish, Cyprinodon diabolis
3. Tecopa pupfish, Cyprinodon nevadensis calidae
4. Ash Meadows speckled dace, Rhinichthys osculus nevadensis
5. Owens River speckled dace, Rhinichthys osculus ssp.
6. Owens River chub, Gila sp.
7. Ash Meadows pupfish, Cyprinodon nevadensis mionectes
8. Warm Spring pupfish, Cyprinodon nevadensis pectoralis
9. Mohave chub, Gila mohavensis
10. Owens pupfish, Cyprinodon radiosus

General discussions of the various species were held as priorities were reassigned. Pertinent comments are listed below.

Relative to the habitat of Empetrichthys latos, if predictions made by several knowledgeable individuals are correct, there may not be any surface water left in Manse Spring by the end of the decade.

The Bureau of Reclamation suggested that a good transplant site for C. diabolis exists below Hoover Dam. Some discussion was also held concerning the possible contamination by C. n. mionectes of the new Point of Rocks "sanctuary." Dr. Liu commented that numbers of fish transplanted to a new location should be kept as large as feasible.
sible transplant locations around the newly acquired Scotty's Ranch pro-
ties were also discussed. Some in attendance questioned whether or not
introduction within Death Valley National Monument of exotic species (Note:
tic to a specific drainage area within the Monument), even though rare and
angered, is within National Park Service policy. This question was left
answered, pending further consideration. Although all in attendance were
ically sympathetic with the intent of the policy, it was the group consensus
it would be tragic if, after a thorough analysis of the individual situa-
showed that no harm would be done by such a transplant, a species be-
be extinct because of an inflexible policy.

diabolis has been neither reared nor introduced successfully outside of
native habitat. Any waters selected as transplant sites for this species
uld therefore approach as closely as possible those conditions existing
hin Devils Hole.

Owens River speckled dace, Rhinichthys osculus ssp., may well be one of our
it seriously endangered species. A total of 18 were collected during the
mer of 1970 at Mathieu's Ranch, five and one-half miles south of Benton,
County, California, and were transplanted into the Warm Springs Sanctuary
Big Pine, Inyo County. However, none have been seen since, and we have
able to locate additional specimens.

e only known stocks of the Owens River chub, Gila sp., have been located
low Crowley Dam, Mono County, California. Those above and below this area
ve apparently hybridized with exotic forms.

Miller commented that Rhinichthys osculus ssp. once occurred in Forest
ring and that the forms of R. O. ssp. in the Amargosa River, Ash Meadows, and
Beatty, Nevada are all distinct.

e telegram was received from Keith Artz, of the Nature Conservancy's San
ancisco office, that negotiations of the Conservancy to purchase Big Spring
re proceeding satisfactorily.

ssible chemical treatment to remove exotic fishes from Big Spring in Ash
adows was discussed, but no decision was reached.

was suggested that Corn Creek, on the Desert Game Range in Nevada, would
a suitable location for the Pahranagat bonytail chub, Gila robusta jordani,
Empetrichthys latos.

he problem of the exotic mosquito fish, Gambusia affinis, within Furnace
reek was discussed, and it was generally agreed that they should be removed.

ick Haas, of Fresno State College, presented a proposal whereby certain
bers of the American Killifish Association would be allowed to conduct
eeding experiments with the various endangered fishes. This suggestion
well received, and it was suggested that Dr. Haas work up a formal proposal
or further consideration by the Task Force and Desert Fishes Council.

An action plan for species preservation was then prepared, in the hope that most assignments would be completed prior to the next annual symposium.

Chairman: Mr. Lockard
Mr. Pister

The species and protective measures planned for them in 1971 are listed below, in order of the priority assigned to them at the symposium.

1. Pahrump killifish, *Empetrichthys latos*
   a. The Nevada Department of Fish and Game will check initial introductions in Lake Mead Recreation Area and will add additional fish to pond, if needed. Assignment of responsibility: Lockard.
   b. A letter will be sent to the Nevada State Director of the Bureau of Land Management requesting that every effort be made to procure funding for the construction of refugia at Shoshone, Spring Valley, White Pines County, Nevada. This is currently recommended as having the best potential of any known transplant site for this species. Assignment of responsibility: Pister and Miller.
   c. The California Department of Fish and Game and U.S. National Park Service will evaluate potential transplant sites at Tecopa, Inyo County, California. Assignment of responsibility: Pister and Sanchez.

2. Devils Hole pupfish, *Cyprinodon diabolis*
   a. The Bureau of Reclamation will evaluate the feasibility of constructing refugia below Hoover Dam. Assignment of responsibility: Jonez.
   b. The Nevada Department of Fish and Game will construct refugia in northern Nevada. Assignment of responsibility: Trelease and Lockard.
   c. Five or six specimens will be sent to Bob Miller for karyotyping. Assignment of responsibility: Miller, Lockard and Deacon.

Since Bob Miller's estimate of November 18 and letter of November 22, several independently conducted counts have been made at Devils Hole and all indicate that the population has now dropped to less than 300 individuals. This number approximates that which is thought to occur there normally at this time of the year, according to both Pete Sanchez and Jim Deacon.

Consequently, we feel that no fish should be taken for any purpose until another count is made after the population begins to build up again in 1971. At that time we shall reevaluate our needs and decide how best to utilize any fish which might be available for transplanting.

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Tecopa pupfish, *Cyprinodon nevadensis calidae*

California Department of Fish and Game and U.S. National Park Service will evaluate possible spring areas near Tecopa and will collect material for Bob Miller's investigation. Assignment of responsibility: Pister and Alchez.

Ash Meadows speckled dace, *Rhinichthys osculus nevadensis*

Nevada Department of Fish and Game will attempt to remove exotic species from Big Spring, Ash Meadows, Nye County, install a suitable barrier downstream from the spring, and reintroduce populations of *R. o. nevadensis* and *R. mionectes*. Assignment of responsibility: Lockard.

Owens River speckled dace, *Rhinichthys osculus ssp.* and
Owens River chub, *Gila sp.*

A total of 16 dace were transplanted into the Warm Springs Sanctuary near Pine (Inyo County) on September 7, 1970. These fish were initially collected near Benton (Mono County) and were held within a live cage in the Mono Valley Native Fish Sanctuary at Fish Slough for several weeks prior to the transplant. The California Department of Fish and Game will attempt locate additional dace populations and will transplant these fish plus the 16 River chubs collected below Crowley Lake dam into existing refugia in the Owens Valley during the spring and summer of 1971. Assignment of responsibility: Pister.

Ash Meadows pupfish, *Cyprinodon nevadensis mionectes*

Is included in the action plan designated for the Ash Meadows speckled dace, already discussed under number 4.

Warm Spring pupfish, *Cyprinodon nevadensis pectoralis*

Miller will forward to Dale Lockard a list of potential transplant sites in northern Nevada, and the Nevada Department of Fish and Game will determine their suitability. Assignment of responsibility: Miller and Lockard.

Mohave chub, *Gila mohavensis*

Deacon and Dale Lockard will investigate an existing population at the Deuce Spa, Las Vegas, Nevada; and an additional transplant is planned by the California Department of Fish and Game into Lark Seep Lagoon on the China Lake Naval Weapons Center (Kern and Inyo counties, California), probably in February, 1971. The Mohave chub was transplanted to several locations in 1970.

Owens pupfish, *Cyprinodon radiatus*

Though the Owens pupfish has been introduced into two refugia in the Owens Valley, we still feel it advisable to extend the range to other refugia and,
ventually, to other suitable areas within the Owens Valley. Consequently, refuge will soon be constructed at BLM Spring on the east side of Fish lough in a cooperative venture involving the Bureau of Land Management, California Department of Fish and Game, Los Angeles Department of Water and Power, and California Division of Forestry. Additional investigations of refuge sites and transplant areas will be pursued vigorously. Assignment of responsibility: Berggren and Pister.

Finally, refugia are planned for the Naval Weapons Center at China Lake. The selection of species will depend upon a post-construction analysis of the habitats. Assignment of responsibility: Barling and Pister.

The 1970 symposium was then dismissed, with the agreement that the third annual symposium would be held at Furnace Creek, as usual, on November 16-17, 1971.