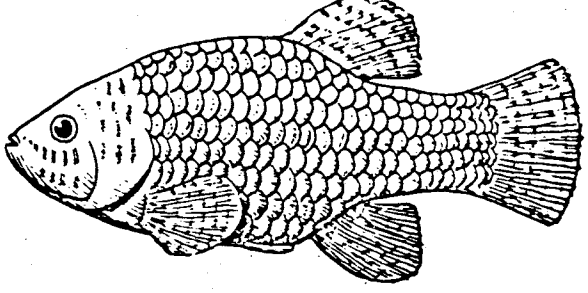
Desert Fishes Council



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

# *Proceedings of the Desert Fishes Council*

## VOLUMES III - IX

**Edited by**
**Edwin P. Pister**

## The Third - Ninth Annual Symposia

Produced in cooperation with the University of Nevada, Las Vegas

Desert Fishes Council
407 West Line Street
Bishop, California 93514

**December, 1983**

# FOREWORD

Proceedings of the Desert Fishes Council were published to cover the first two symposia held in 1969 and 1970. Although symposia have been held annually since 1969, the Council leadership became so involved with preservation efforts during the 1970's that publication was not resumed until the Proceedings of the Tenth Annual Symposium (1978) appeared in print in early 1980.

During the Thirteenth Annual Symposium, held at Death Valley National Monument in 1981, the membership agreed that the Council's limited publication capability should be directed toward completion of a proceedings compendium to cover the highly important events of the 1970's. This would be done prior to publishing the proceedings of more recent symposia. The compendium provides a history of those critical years, fraught with frustration but blessed with an evolution of thought. I hope it will serve as a firm stepping stone as we venture into an uncertain future.

Phil Pister
October 5, 1983

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## PREFACE

Upon the University of Michigan's Museums Building are carved the words of Louis Agassiz: "Go to Nature; take the facts into your own hands; look, and see for yourself."

Because two great latter-day scientists have followed faithfully the admonition of Agassiz in their intensive study of Great Basin natural history, we have been provided an enormous fund of knowledge basic to the current desert fish preservation movement. The unparalleled interest and faithful adherence to the study of fishes shown by these two men continues as a motivating and inspiring force, and it is appropriate that the Phoenix Gazette would provide a cover photograph showing Carl Hubbs (right) and Bob Miller during a discussion at the Fifth Annual Symposium held at Arizona State University, Tempe.

Irrespective of the contributions made to this field by future scientists, the work of Hubbs and Miller will live in perpetuity as the foundation upon which other endeavors will be based. The membership of the Desert Fishes Council takes pride in dedicating this compendium to Carl L. Hubbs of Scripps Institution of Oceanography and Robert Rush Miller of the University of Michigan's Museum of Zoology, and to their charming and equally admirable wives, on the day of this writing, Dr. Hubbs' eightieth birthday - October 18, 1974.*




*Editors Note: Dr. Hubbs passed away on June 30, 1979, after a long illness. The following obituary appeared in Fisheries (a journal of the American Fisheries Society, of which Carl was a member for 59 years), Vol. 4, No. 5. It seems appropriate to reproduce it here.

# PREFACIO

En el edificio que ocupa el Museo de la Universidad de Michigan, se encuentran gravadas las palabras de Luis Agassiz: "Ve a la naturaleza, -- obten los datos y analizalos; observa y mira por tí mismo lo que suce-- de."

Debido a que dos científicos contemporáneos, han seguido fielmente dentro de sus filosofías de trabajo sobre la historia natural de los Grandes Valles, las admoniciones de Agassiz, nos hemos visto provistos y beneficiados, con un enorme caudal de conocimientos que han sido decisi-- vos en apoyar y consolidar, los pilares del movimiento de nuestra organización.

El interés imparalelo y tenacidad con que éstas dos personas han demostrado siempre en el estudio de los peces, constituye una contínua fuerza de inspiración y motivación para todos nosotros; su influencia personal ha sido suficiente motivo para que la "Gaceta de Phoenix", incluya en su portada una foto de Carl Hubbs y Bob Miller, discutiendo sobre algunos de los trabajos presentados en el V Simposium Anual, celebrado en la Universidad de Arizona, en Tempe.

Independientemente de las contribuciones futuras que aporten otros científicos al tema, los trabajos de Hubbs y Miller, vivirán en perpetuidad, fungiendo como pilares, desde donde otros esfuerzos afines tendrán su - simentación.

En conmemoración del 80° aniversario del natalicio de Hubbs*, la Asam-- blea General del Desert Fishes Council, tiene el honor de dedicar el -- presente Compendium al Dr. Carl L. Hubbs, de la Institución Oceanográfica de Scripps y al Dr. Robert Rush Miller, del Museo de Zoología, de la Universidad de Mishigan como también hacemos extensivo este mérito a -- sus respectivas esposas, que con su esfuerzo, perseverancia y ayuda, -- han hecho posible la difusión de sus trabajos.

*Nota del Editor:
El Dr. Hubbs, falleció el 30 de Junio de 1979, después de una larga -- convalecencia. La revista Fisheries (Jour. del Amer. Fish. Soc., Vol. 4, No. 5, del cual Hubbs, fué miembro por casi 60 años) publicó su --- Necrología, que siento pertinente reproducir aquí.

# CARL LEAVITT HUBBS

Professor Carl L. Hubbs passed away on June 30 at the age of 84 years, a victim of the cancer that for several years had been draining his strength. Although I wept when I learned of his passing, I realized that my sadness was not really for Carl, but for all who have learned to love him. It helped enormously to know that Carl will never really leave us, but will live on forever both in memory and in the superb contributions that he made to fishery science.

His career began at Stanford under the immortal David Starr Jordan. Carl proved to be a worthy successor to his former mentor, and history will show him to be no less a man. Yet as great as were his scientific works, of even greater long-term significance was his magnificence as a person, friend, father, and selfless teacher. Carl was never too busy to greet colleague, student, or stranger with a smile and a genuine offer of assistance. There has never been a truly great man without humility, and Carl's greatness was matched and enhanced by his unfeigned awe at the magnificence of the creation about him.

A few years ago Carl and Laura sent a fine photograph of themselves taken at the time of the dedication of the Hubbs Sea World Research Institute. I keep it pinned next to my desk to serve as often needed inspiration. When I look at it and consider the scope of Carl's accomplishments, my own problems seem to dissolve. Typically Laura is at his side, ever a faithful wife, superb mother of his three children, colleague and helpmate, always a twinkle in her eye as she did so much to make him what he is. Their life together constitutes a love story seldom duplicated.

Perhaps the great philosopher and humanist Loren Eiseley said it best: "I see Christ in every man who dies to save a life beyond his life." He continues: "I have been accused of woollymindedness for entertaining even hope for man. I can only respond that in the dim morning shadows of humanity, the inarticulate creature who first hesitantly formed the words for pity and love must have received similar guffaws around a fire. Yet some men listened, for the words survive."

It was this same optimism that motivated Carl and made him so effective in inspiring others to work toward the goals that he knew were right. He, too, "received guffaws around a fire." Yet men did listen, and because of his great research, foresight, inspiration, and genius of communication, men are now beginning to understand and are working to preserve resources that otherwise would have passed unnoticed from the face of the earth. It is an absolute certainty that without Carl Hubbs, the Desert Fishes Council would never have been formed.

I find comfort in the knowledge that Carl is now with the Creator of all that he lived for and loved. And this same Creator will bless him for his good works here and the sensitivity and reverence for life that he exemplified, much as Carl would often express his appreciation to those who espoused and worked for the ideals that he held so dear.

Carl Hubbs is not really gone; but is just away. And even then, not very far.

Phil Pister
Executive Secretary
Desert Fishes Council
Bishop, CA 93514

## ACKNOWLEDGMENTS

Although many individuals have assisted with the affairs of the Council and in the preparation of this compendium, special thanks are due Miriam Romero for her many hours of tedious work in reviewing the 1973 tapes and preparing an easily edited draft transcript. Fred Partridge, David Soltz, Robert E. Brown, Jr., and David Travis, of the California Department of Fish and Game, prepared similar transcripts from the recordings of the 1971 and 1972 symposia. Robert Borovicka's comprehensive notes of the 1972 proceedings were especially helpful.

Dr. Paul Holden of BIO/WEST, Inc. (Logan, Utah) provided invaluable assistance by volunteering his firm's word processing equipment and the expert services of Nancy Hubbard in preparing the final prepublication drafts of the Compendium manuscript. This furnished the necessary impetus to allow the document to become a reality.

The secretarial staff of the Department of Biological Sciences at the University of Nevada (Las Vegas) played a key role in the preparation of the Compendium and provided the necessary liaison with the University of Nevada's highly competent printing department.

This venture is typical of most pioneering conservation efforts, in which many dedicated people donate unselfishly of their time and talents. To all of them a hearty thanks.

# THIRD ANNUAL SYMPOSIUM[1]

Furnace Creek, California, November 16-18, 1971

Tuesday, November 16

Following a cordial and sincere welcome to Death Valley National Monument by Superintendent Bob Murphy, Chairman Phil Pister expressed the Council's welcome to all in attendance (Appendix 1971-1).

Mr. Pister concluded his opening remarks by briefly reviewing the history of the desert fish preservation movement since its inception during the key April, 1969 Ash Meadows field trip; the formation and impact of Interior's Pupfish Task Force; the creation of the Desert Fishes Council at the Second Symposium in November, 1970; and summarized the collective effort to date. His comments led to

SESSION I - Progress reports on species preservation assignments made in November, 1970.

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

1. Pahrump killifish, Empetrichthys latos

Mr. Lockard, Dr. Miller, Mr. Sanchez, Mr. Pister

Dr. Miller reported that the refugium at Shoshone Ponds (Spring Valley, White Pines County) near Ely, Nevada, had been constructed by Bureau of Land Management. It has not yet stabilized sufficiently to allow a transplant, however. He further reported that a population check at Manse Spring in Pahrump Valley on June 29, 1971, revealed at least 12 adults (much plant cover excluded viewing others) and hundreds of young. The population looked better than at any time since July 1, 1967. Three young were caught by hand for identification and karyotyping. The long-range outlook for Manse Spring is bleak, however. The water level there continues to drop.

Mr. Lockard reported that a population has been established in Cow Creek, near Las Vegas, and is being carefully monitored.

Mr. Pister and Mr. Sanchez expressed the opinion that tentative plans to select a transplant site near Tecopa should be shelved pending better information on the status of fishes currently in existence there.

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[1]This compendium was prepared in a manner which, it is hoped, will enable the reader to grasp quickly the subject matter discussed in each session. In those instances in which papers or summaries were provided by the participants, the reader is referred to the Appendix.

2. Devils Hole pupfish, Cyprinodon diabolis

Mr. Sharpe, Mr. Trelease, Dr. Miller, Dr. Deacon

Phil Sharpe reported briefly and favorably on the Bureau of Reclamation's Amargosa Project Study and the status of the Hoover Dam pupfish refugium which, presumably, would be used to rear a stock of C. diabolis (Appendix 1971-2). He was followed by Dale Lockard who presented a summary of investigations for potential transplant sites in Nevada for C. diabolis prepared by Tom Trelease (Appendix 1971-3). Bob Miller indicated that he had examined Devils Hole on June 29, 1971. He estimated that 200-250 fish were present and that all C. diabolis appeared to be gone from Point of Rocks refugium, having been replaced by C. n. mionectes. Dr. Deacon concluded by reviewing current and past research by U. N. L. V. students at Devils Hole, most of which was done by Carol James as her master's project.

3. Tecopa pupfish, Cyprinodon nevadensis calidae

Mr. Pister and Mr. Sanchez

Collections were made at various locations in the Tecopa area and were forwarded to Dr. Miller for identification. No determination has yet been made, although superficially the specimens sent Dr. Miller bear the appearance of the Amargosa pupfish, C. n. amargosae. The search for a relict population in the Tecopa area will be continued.

4. Ash Meadows speckled dace, Rhinichthys osculus nevadensis

Dale Lockard reported that the population in Big Spring (Ash Meadows) appeared slightly improved over last year. The Nevada Department of Fish and Game is still contemplating the removal of exotic species from Big Spring and the installation of a downstream barrier to prevent their reintroduction.

5. Owens speckled dace, Rhinichthys osculus subsp. and

6. Owens Chub, Gila sp.

Phil Pister reported that the Owens dace appears to be extremely scarce, and that a concerted program was being launched in an attempt to locate new populations. The 16 introduced into the Warm Springs Sanctuary on September 7, 1970, apparently died or left the Sanctuary.

The Owens Chub appears fairly well established in its location below Crowley Lake Dam, but it must be successfully established in other locations before it may be considered secure. A serious problem in the Owens Valley preservation effort lies in repeated vandalistic introductions of largemouth bass (Micropterus salmoides) into the Owens Valley Native Fish Sanctuary. Each time this happens, all fish must be laboriously removed and the entire population again "started from scratch".

7. Ash Meadows pupfish, Cyprinodon nevadensis mionectes

Dale Lockard reported that the population status remains about the same as last year. This subspecies would benefit from the measures outlined for R. o. nevadensis at Big Spring.

8. Warm Spring pupfish, Cyprinodon nevadensis pectoralis

Dr. Miller, Mr. Lockard

It was reported that good populations exist in School Spring, Mexican Spring, and several other spots. As with all fishes in Ash Meadows, however, it is no safer than the groundwater level which sustains its habitat. Dr. Miller has forwarded to Dale Lockard a list of possible warm-spring transfer sites in northern Nevada.

9. Mojave chub, Gila mohavensis

Jim St. Amant's comprehensive report on this species appears as Appendix 1971-4 and covers all current recovery activities.

10. Owens pupfish, Cyprinodon radiosus

Phil Pister reported that Owens pupfish appears fairly secure in two locations within the Owens Valley. In cooperation with BLM, another sanctuary is being constructed at BLM Spring on the east side of Fish Slough. Additional transplant sites are currently being sought.

SESSION II - Progress and accomplishments of the Pupfish Task Force.

Jim McBroom's masterful presentation is included as Appendix 1971-5.

SESSION III - Regional plans for continuing Interior's desert fish preservation program.

Dr. Ted Perry of the Portland Office, BSFW, touched on the high points of the Bureau's current plans. He functioned primarily as a resource man for many questions which were posed later.

Dr. Perry referred to the hiring of Chuck Osborn in Las Vegas on a full-time basis (this is no small accomplishment in an era of deficient agency budgets) to work solely on desert fishes and related problems at the field level. Chuck will need help from the Council in getting started in his new assignment.

Clint Lostetter will continue in his position as Regional rare and endangered species coordinator. One of his main assignments has been to prepare a package for the acquisition of Ash Meadows land for a refuge or similar plan. This package has been submitted to the Washington Office of the BSFW, but approval to move ahead has not yet been granted. A large sum of money would be required for the necessary purchases--more than is readily available. The Bureau is ready to move ahead, however, if funds are approved.

Funds are currently available for the sanctuary on the Colorado River below Hoover Dam (see Appendix 1971-2), and an interagency agreement to administer the sanctuary is currently being drafted.

SESSION IV - The future preservation program - coordination of effort between the Department of the Interior and the Desert Fishes Council.

Led by Jim McBroom, Ted Perry, Ed Kinney, and Phil Pister, a general group discussion was held. The Council was assured that the Washington level interest would be maintained on an interagency basis, and that this would be accomplished primarily through the Office of Endangered Species with localized programs and communication being a function of the Portland Regional Office.

At this point the provisions of the Endangered Species Act of 1966 were reviewed, under which species are listed under a priority system for recovery programs, land may be acquired, etc., to provide maximum assurance that an animal will not become extinct.

Further assurance was given that communication would be maintained with the Council through the Portland Office, although the actual mechanism for accomplishing this was not clarified. The possibility of an "Endangered Species Newsletter" was mentioned.

SESSION V - A summary of the U.S. Geological Survey study of the Ash Meadows area.

Because of its close relationship to the proposed Desert Pupfish National Monument, this presentation was withheld to be combined with Session X scheduled for later in the evening.

SESSION VI - A review of current research on desert fishes.

Chairman: Shelby D. Gerking, Arizona State University

Dr. Gerking provided a general overview of current research and added that, of the various disciplines, taxonomy was in the best shape. He reviewed some of the current work at A.S.U. relative to growth and longevity in constant temperature springs as opposed to fluctuating temperature springs, and on Gambusia in hot and cold water springs.

Dr. Miller stated that studies of chromosomes in 13 species of Cyprinodon (prepared by Dr. Teruya Uyeno) show that all have a diploid number of 48 with 1 pair of metacentrics (not larger than acrocentrics), except that in C. diabolis this pair is closer to submetacentric.

Dr. Hubbs and Dr. Miller have a 400-page manuscript (accepted for publication as a Memoir of the California Academy of Sciences) on the Pluvial Hydrology and Relict Fishes of the North-Central Great Basin, giving details of lake and stream history and descriptions of new kinds of dace (Rhinichthys) and chubs (Gila) plus a new genus of relict dace.

Editor's Note: During the time period between the 1971 Symposium and the preparation of this compendium, several papers presented at the Symposium have been published. Abstracts of these papers appear as Appendix 1971-6.

SESSION VII - Progress report on aquarium culture of endangered fishes.

Chairman: Richard Haas, Fresno State College

Summaries presented by Dr. Haas and Al Castro of Steinhart Aquarium, San Francisco, are included as Appendices 1971-7 and 1971-8.

SESSION VIII - A philosophy of transplanting--its future and implications.

This paper, presented by Carl Hubbs and Bob Miller is included as Appendix 1971-9.

SESSION IX - The use of chemicals in the management of endangered fishes - the Big Spring controversy. Group discussion.

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

The planned "Group discussion" turned out to be just that. A great number of viewpoints were presented, and these were largely polarized that either chemicals definitely should be used, or they definitely should not be used.

Those favoring the use of chemicals felt that literally any means was justifiable in the battle to preserve R. o. nevadensis and C. n. mionectes, and that the presence of exotic species in Big Springs was intolerable. Those opposing chemicals justified their stand on the basis that the native fishes in Big Spring appear to be co-existing with the exotics and that the use of chemicals could well work toward the detriment of other life forms in the spring. The case of the Fish Slough endemic snail was used as an example.

It was decided that the fish population in Big Spring should be monitored and a population status report given at the next symposium by Dale Lockard. The Nature Conservancy is negotiating for the purchase of Big Spring and, when it is acquired, a management plan will be formulated.

SESSION X - The proposed Desert Pupfish National Monument and possible alternative land classification plans.

Chairman: Peter G. Sanchez, U.S. National Park Service

At the outset of the discussion, Bill Dudley of U.S.G.S. provided an excellent summary of his groundwater study in the Ash Meadows area. This led into a discussion of what changes should be made in proposed legislation to allow adequate protection of the aquifers supplying the springs in Ash Meadows. Following the Symposium, Bill Dudley prepared an amended map for incorporation into the symposium summary and for attachment to a resolution endorsing the protection of such an area. Dr. Dudley's map and cover letter are included as Appendix 1971-10.

During the general discussion, the features of a national wildlife refuge were described to the group. It was the group's consensus that whatever plan was most politically expedient and likely to be adopted would be endorsed, as long as the integrity of the Ash Meadows could be preserved.

SESSION XI - Allies in the Preservation Program.

Chairman: Clint Lostetter, BSFW

The Council has long recognized that its actions and policies can be effective only as long as public support is provided for them, and that an effective liaison with the public is not only desirable, but absolutely necessary. From the very outset, the support of the conservation groups was sought and received. This session was structured to promote understanding of certain of these groups. Also included as a strong, but poorly understood, ally in the conservation effort is the military, represented in this instance by Tilly Barling, Coordinator of Natural Resources Management at the China Lake Naval Weapons Center.

The written presentations of Tina Nappe, Larry Moss, and Bruce Wolfe are included as Appendices 71-13. Mrs. Barling's presentation comprised an excellent slide show and narrative relative to the biota and natural resources management on the Weapons Center. Everyone in attendance was amazed and gratified at the wildlife resource in existence at the Weapons Center and in the fine way the Navy manages it.

Wednesday, November 17

SESSION XII - Formalization of the Desert Fishes Council.

Chairman: Phil Pister, California Dept. Fish and Game

During this session the general organization of the Council was discussed, and the draft of a proposed constitution was circulated for discussion. Several changes were made, and the matter was turned over to the Technical Advisory Committee to thoroughly review and present a completed and revised draft for vote at the 1972 symposium. The revised constitution will be included as an appendix to a later symposium summary.

SESSION XIII - How can the Desert Fishes Council become more effective?

Chairman: James F. Deacon, U. N. Las Vegas

Jim Deacon's concise summary of this session is included as Appendix 1971-14.

SESSION XIV - Land and water development in the southwestern desert.

Chairman: Douglas R. Powell, University of California (Berkeley)

Mr. Powell gave a general overview of the basic reason why the Desert Fishes Council was formed: unprecedented development of desert areas has created a tremendous demand for water resources. During the past 20-40 years, people found the desert a good place to live, not simply to pass on through. This leads to development of various kinds in the form of mining, agriculture, outdoor recreation, gambling, etc., to a point where once barren desert has become a congested metropolis. Increased danger to the biota comes from man's ability to transport water to areas of need, from both surface and subterranean sources.

Relative to the desert, viewpoints are changing. There is no longer such a thing as "waste" land. All land has an increasing value from one standpoint or another. As land use plans for such areas are developed, such groups as the Desert Fishes Council can be of great assistance to planning agencies by pointing out natural values which must be protected.

Lou Jurs of BLM summarized the current status of the California Desert Plan under development by his agency, and Cecil McClaren of the Bureau of Reclamation described the current shift by the Bureau to a more environmentally based approach, especially as it relates to the Amagosa Project.

Bill Newman, of the Nevada Division of Water Resources, fielded a barrage of questions concerning the development of groundwater in Nevada. While Nevada law prohibits water mining, it is flexible enough to allow a "reasonable drawdown". This rather perplexing paradox is one of the biggest threats faced by fish populations in the Nevada desert.

"Land and Water Development in the Southwestern Desert", by Gil Cochran, Acting Director, Center for Water Resources Research, DRI, Reno, is included as Appendix 1971-15.

SESSION XV - New developments in environmental law.

Chairman: Larry Moss, Sierra Club.

Following Mr. Moss' introductory remarks, he presented his views on the subject as seen by the Sierra Club. His comments are included as Appendix 1971-16.

Larry King, Deputy Attorney General from the Environmental Unit of the California Attorney General's office, emphasized that although governmental agency response has historically been weak in the field of environmental law, he envisioned many more lawsuits in the future. Money and attorneys are evolving, and agencies should involve attorneys at the early stages of a developing environmental problem.

As an example of a developing environmental concern within the legal profession, Larry cited the Beverly Hills Bar Association, which has established a public law foundation to donate its time for public purposes. The Ford Foundation has given $1.5 million this year (1971) in grants to environmentally inclined law firms, and environmental law classes are now given at law schools.

A precedent has been set in a case of Texas vs. New Mexico which would give grounds for California to file suit against Nevada if the groundwater level within California is being adversely affected by action within Nevada. A bill is currently before the Governor of California which would allow the Attorney General to bring suit against anyone who pollutes, impairs, or destroys the natural resources of the state.

Larry emphasized again that "eternal vigilance is the price of liberty" and that legal action should be taken early to stop something detrimental before construction or other damaging activity starts or gets well underway.

SESSION XVI - Review of procedures for processing collecting applications.

Chairman: William M. Richardson, California Department of Fish and Game

Bill Richardson's concise summary of this session is included as Appendix 1971-17, as is a summary of procedures for collecting currently in effect with Nevada. This was prepared by Tom Trelease for presentation by Dale Lockard and is included as Appendix 1971-18. A similar statement prepared by Leonard Fisk, of California Fish and Game's Inland Fisheries Branch, summarizes current procedures within California (Appendix 1971-19).

SESSION XVII - Preparation of a new Death Valley System fishes priority list.

Chairman: Robert R. Miller, University of Michigan

A general group discussion was held, during which the following list was drafted, in order of degree of endangerment.

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

SESSION XVIII - Preparation and implementation of the 1972 action plan for species preservation.

Mr. Lockard - Nevada species
Mr. Pister - California species

1. Devils Hole pupfish, Cyprinodon diabolis

   a. Cooperate with Bureau of Reclamation in establishment and monitoring of refuge below Hoover Dam.
   b. Cooperate with National Park Service in transplant to Grapevine Spring in Death Valley during 1972 dependent, of course, upon status of population in Devils Hole at that time.
   c. Followup through Steinhart Aquarium their progress with artificial culture.

2. Pahrump killifish, Empetrichthys latos

   a. Followup transplant into Corn Creek and initiate an additional transplant during the spring of 1972 if needed.
   b. Initiate the transplant to BLM's Shoshone Ponds near Ely in White Pines County as soon as the habitat is suitable.

3. Owens speckled dace, Rhinichthys osculus subsp.

   a. Make an extensive search of probable habitats in the upper Owens Valley.
   b. If and when populations are located, make transplants to refuge areas within the natural range of the subspecies.

4. Tecopa pupfish, Cyprinodon nevadensis calidae

   a. Continue search for relict populations in the Tecopa (California) area.
   b. If such populations are located, implement whatever measures might be needed to assure protection of their habitat.

5. Owens chub, Gila sp.

   a. Extend inventory throughout the Owens River Gorge below Crowley Lake, the only known habitat for the species.
   b. When largemouth bass have been removed from the Owens Valley Native Fish Sanctuary, make whatever introductions are prudent in light of available numbers of chubs below Crowley Lake.
   c. Attempt to locate additional populations and transplant sites.

6. Ash Meadows speckled dace, Rhinichthys osculus nevadensis

   a. Investigate the feasibility and need for a fish barrier below Jackrabbit Spring to prevent reinfestation with Gambusia.
   b. Investigate the report of possible dace in the Clay Pits, Ash Meadows.
   c. No treatment or other removal projects will be initiated at Big Spring at least for this year and until such time as the property purchase can be consummated by the Nature Conservancy.

7. Ash Meadows pupfish, Cyprinodon nevadensis mionectes

   a. The same plan as outlined for the Ash Meadows speckled dace (above) will be followed for the Ash Meadows pupfish.

8. Warm Spring pupfish, Cyprinodon nevadensis pectoralis

   a. Intensify inventory of potential Nevada transplant sites.
   b. Urge BLM to fence (or provide fencing materials) at Mexican Spring, near School Spring.

9. Mohave chub, Gila mohavensis

   a. Inventory and evaluate past introductions at Piute Springs, San Bernardino County; Lark Seep Lagoon, China Lake Naval Weapons Center; Paradise Spa (Las Vegas), Clark County, Nevada; Lion Country Safari, Orange County, California.
   b. Reintroduce G. mohavensis into South Coast Botanic Gardens, Los Angeles County (this will depend upon the repair of the pond lining and refilling of the pond); and Two Hole Springs, San Bernardino County. One more attempt will be made to establish the chub here.
   c. New introductions. The water quality at Busch Gardens, Los Angeles County will be investigated and, if found suitable, will be planted with G. mohavensis.

10. Owens pupfish, Cyprinodon radiosus

a. Carefully monitor existing populations.
b. Cooperate with BLM in construction of refugium on east side of Fish Slough.
c. Continue search for additional transplant sites within natural range of the species.

SESSION XIX - Business meeting of the Council.

Chairman: Mr. Pister

1. The membership unanimously approved the preparation of three resolutions of concern to the Council:

71-1 Commending James T. McBroom
Motion by Pister, second by Miller
71-2 Retention of Pupfish Task Force
Motion by Castro, second by Sanchez
71-3 Creation of a Desert Pupfish National Wildlife Refuge
Motion by Brown, second by Miller

Copies of these resolutions are included as Appendices 1971-20, 21, and 22.

2. Approval was granted to send a letter to the Bureau of Reclamation reaffirming the Council's interest in the proposed refugium below Hoover Dam.

3. The following slate of officers was proposed and passed without dissenting vote:

Chairman, E. P. Pister
Chairman-elect, Dale V. Lockard
Secretary-Treasurer, Peter G. Sanchez

Motion by Deacon, Second by McBroom

The Third Annual Symposium was then adjourned, with the stipulation that the Fourth Annual Symposium be held at Furnace Creek, Death Valley National Monument, on November 14-16, 1972.

A field trip to the Ash Meadows area was conducted the following day, November 18, 1971.

A list of those in attendance at the Third Annual Symposium is included as Appendix 1971-23.

Appendix 1971-1

Introductory Remarks by E. P. Pister, Chairman,
Desert Fishes Council

I join Superintendent Murphy in welcoming you to Death Valley National Monument and to the Third Annual Desert Fishes Symposium. It is both comforting and reassuring to note the interest, dedication, and enthusiasm of a group such as this.

The essential reason we are gathered here has been eloquently stated by Joseph Wood Krutch in "The Place No One Knew":

> "This world grows more crowded year by year and at an ever-increasing rate. Men push farther and farther for "Resources" to be exploited, even for more space to occupy. Increasingly they tend to think of the terrestrial globe as "their" earth. They never doubt their right to deal with it as they think fit - and what they think fit usually involves the destruction of what nature has thought fit during many millions of year."

We are now at a crossroads in our philosophy concerning stewardship over our fellow creatures. The book of Genesis in the Old Testament grants mankind "Dominion over the fish of the sea and over the fowl of the air ... and over every creeping thing ... " Up until this point we have been able to exploit these resources as we have seen fit, and with the consequences of our imprudence being apparent to only a few. We have neglected the obvious implication that dominion bears the obligation of a wise stewardship.

However, mankind in general is now becoming concerned over these matters and, in effect, this has made our current effort possible. But now, as we stand at the crossroads, there is every reason to believe that most of society will continue to forge blindly ahead in the name of progress and under the guise of "This is what the people want." There are others of us who recognize that we cannot do this forever and get away with it, and to quote Mr. Krutch again:

> "It is not a sentimental but a grimly literal fact that unless we share this terrestrial globe with creatures other than ourselves, we shall not be able to live on it for long."

So we shall leave this main group of our fellow men and follow the dim trail left by those few who have preceded us. As with any group of pioneers, the way will be hard. There will be many rocks to move, trees to cut, cliffs to haul our wagons over, and mountain passes to traverse. But our wagons will get through. They <u>must</u> get through.

And the road we leave behind us will be a smoother one for those who will inevitably follow. And as they do so they will attract others to our route,

and the movement which we create will certainly prevail because of its essential righteousness.

As we move ahead we shall continue to encounter many frustrations. We shall encounter resistance from politicians, land developers, the general public and curiously, even from within our own agencies. But we shall continue to win our battles, slowly but surely, as we show the rest of the Nation that it is possible to have your cake and eat it too. It is possible to build cities, develop land, and to remove a harvestable surplus as long as this is done carefully and prudently, not at the expense of our other resources, and with due consideration for generations yet to come.

I look forward eagerly to my future involvement with the agencies cooperating in our effort, with the newly-formed Desert Fishes Council, and with each of you individually as we continue our pioneering in an effort to change man's viewpoint from "What can our Fish and Wildlife do for us?" to "What can we do for our Fish and Wildlife?"

Appendix 1971-2

# Bureau of Reclamation's Report on AMARGOSA PROJECT STUDY AND DEVELOPMENT OF A PUPFISH REFUGIUM (*Cyprinodon diabolis*) BELOW HOOVER DAM

by

Phil Sharpe

I am pleased to bring you a brief report on the Bureau of Reclamation's Amargosa Project Study and the status of the pupfish refugium. The Amargosa Project study area is generally southwest of U.S. Highway 95, and extends from near Beatty to State Highway 29, which connects Lathrop Wells with Death Valley Junction. The study was initiated as a result of the interest expressed by the State of Nevada in the groundwater in the Amargosa Valley as a source of water for irrigation, municipal, and industrial use. These investigations are particularly concerned with the conservation, development, and management of the resources in the valley.

A preliminary land classification study indicated that the investigation for an irrigation project should concentrate on the area west of the highway between Lathrop Wells and Death Valley Junction and southeast of the Big Dune. The nearest point of the area under study is approximately 10 miles from Devil's Hole.

We are also attempting to better determine the size and location of the groundwater storage basins. Our investigation in this field is a continuation of the work that has been done in the past. We are presently gathering field data to add points to the gravimetric study that was done by the Geological Survey several years ago.

Water samples from the study area and adjoining areas were analyzed for environmental isotypes deuterium, oxygen-18, and tritium. The results of these tests reveal that the source of water in the Ash Meadows Springs area is different from that of Amargosa Basin. Data gathered to date indicate that the use of water in the Ash Meadows area would have little or no effect on water in the area west of the highway, and vice versa. Apparently the water table in the Ash Meadows area is declining at the present time, while the water level in the Amargosa Basin is remaining stable. Of course, our studies are not complete.

In pursuing these investigations we are evaluating the effects a changing groundwater level may have on the overall environment of the valley.

Of particular concern is the fate of the Devils Hole Pupfish and desert fishes in general. Last winter, Bureau of Reclamation personnel investigated several warm springs just below Hoover Dam on the Nevada side of the river for the purpose of locating a source of water suitable for pupfish requirements. These investigations were pursued with the thought of

exploring alternatives for protecting the Devils Hole Pupfish. Our objective is to assure survival of the species until their natural habitat is protected. A secondary benefit will be the availability of these fish for additional observations and research.

A spring with 94°F water and ample flow was located just below Hoover Dam. A water quality analysis by our people showed, among other things, the water has a pH of 7.5 and a TDS of 884 ppm.

Following these preliminary investigations, we enlisted one of our engineers in designing a facility which would provide a stable and secure environment for the pupfish. Through consultation with biologists of the Nevada Department of Fish and Game, the Bureau of Sport Fisheries and Wildlife, and the University of Nevada at Las Vegas, we now have a design for a facility which we believe, without unforeseen complications, will be a major factor in ensuring survival of Cyprinodon diabolis.

Funds in the amount of $7,000 will be made available by the Bureau of Reclamation to construct the facility.

We have worked closely with the Nevada Department of Fish and Game, the Bureau of Sport Fisheries and Wildlife, and the University of Nevada at Las Vegas in planning this project. We will need even more cooperation from the Nevada Department of Fish and Game and the BSFW in the maintenance and operation of the facility. The Bureau of Reclamation will provide the engineering expertise and will construct the facility. The operation and maintenance will have to be the responsibility of the Nevada Department of Fish and Game and the BSFW. The details of these responsibilities will be outlined in a cooperative agreement. We have every indication that these agencies are willing to assume these responsibilities and continue the excellent cooperation we have enjoyed in planning the project.

Appendix 1971-3

# INVESTIGATIONS FOR POTENTIAL TRANSPLANTING SITES IN NEVADA FOR DEVIL'S HOLE PUPFISH (Cyprinodon diabolis)*

by

Thomas J. Trelease
Nevada Department of Fish and Game

Further investigations were made during the year into Wabuska Hot Springs about 10 miles northwest of Yerington, Nevada. These springs were formerly thought to be a good possibility for introduction of the Devil's Hole Pupfish. A pool 75'x30'x4' exists at the site. The water temperature entering the pool exceeds 100 F and at the outlet is 82 F. The outflow then courses through a marsh area after leaving the pool. Numerous mosquito fish (Gambusia) are found in the pond and marsh. Previous contacts were made with the owner of this spring who gave written approval for the introduction of the pupfish into the pool. Further investigation this year, however, has indicated to us that it would be extremely difficult to totally eradicate the mosquito fish population in the marsh and their reestablishment in the pool would be very likely. Screens may be installed in the outlet of the pond which could at least retard the reinfestation of the pond by the mosquito fish and give any introduced pupfish a better opportunity of establishing a population. At the most, it is felt that this site would only provide a stop gap measure and that sooner or later mosquito fish would pose a competitive threat to the introduced pupfish. In addition, the prior contacts made with the owner apparently stimulated serious interest on his part for the development of a tropical fish rearing facility at this site and he has notified us that he will be applying shortly for a permit to rear certain species of tropical fish. Being that this spring is entirely upon his land and under his ownership, we of course would be in a weak position to deny the permit unless we can demonstrate his operation would be detrimental to any existing fish population. Consequently, we feel that this site is of marginal value.

At the request of Dr. Robert Miller in 1970, we made a superficial examination of Gridley Hot Springs northeast of Winnemucca, Nevada. Further work this year has indicated that one of the two pools which exist at this site, which is approximately 20'x30'x6' exhibits temperatures ranging from 83 to 94 . The pond has heavy growths of algae, particularly during the mid and late summer months. It is totally unlike Devil's Hole except for water temperatures, but nevertheless, may offer possibilities.

Another site that was checked is Dyke Hot Springs also north and east of Winnemucca, Nevada, on the east side of the Pine Forest Mountains. Two man-made impoundments are found here with the smaller one having temperatures of well over 110 F. The larger impoundment which is about 180'x80' has temperatures ranging from 64 to 85 . It is doubtful that this site would be

suitable as the temperatures appear to be subnormal for the Devil's Hole Pupfish.

Another spring which was previously investigated is one about 20 miles north of Battle Mountain which has a temperature of 81 in a pool measuring about 125'x50'x4'. Submergent vegetation exists in the pool, but the spring does seem to have some potential and might be used on an emergency basis.

We are presently looking into another possibility, an unnamed spring on the Sheldon Antelope Refuge in northwestern Nevada. The temperature of this spring is 88 F. It presently has a population of guppies in it, indicating that it is suitable for the fish life. Little information is available on the site at the present.

Another site which was investigated this year and which may offer some possibility is Lee's Hot Spring south of Fallon, Nevada, which presently contains an abundant population of mosquito fish (Gambusia). Temperatures in a 100'x100'x3' pond range from 84 F to 55 F. A dense stand of cattails exists in the pond. It would be unlikely that this site would be suitable because of submarginal temperatures. The inflowing water is considerably hotter and with proper development it may offer some possibilities.

*Editor's Note:
During the early 1970's it was common to find the term Devil's (when used in conjunction with Devil's Hole) retaining the apostrophe. More recently the apostrophe has been deleted, as is not uncommon in geographic terminology. The American Fisheries Society lists the Devils Hole pupfish without the apostrophe, and this is now accepted as common usage.

Appendix 1971-4

# REPORT ON REESTABLISHMENT OF THE MOHAVE CHUB *Gila mohavensis* (SNYDER), AN ENDANGERED SPECIES

by

Jim St. Amant

The mohave chub, *Gila mohavensis*, once found extensively in the Mohave River and its tributaries, is the only native fish known to the Mohave River drainage (Hubbs and Miller, 1943). Pure strains of these chubs have steadily declined since about 1938, with the introduction of the coastal California chub, *Gila orcutti*, which resulted in competition and hybridization between the two species. They had been completely eliminated in the river proper by 1967 (Miller, 1967). Until recently the mohave chub was found only in Lake Tuendae at Zzyzx Resort south of Baker, California.

The population in Lake Tuendae is flourishing, but is in a precarious condition due to the present undetermined ownership of the property on which the lake is located. In 1969, following the recommendations of Miller (1967), the California Department of Fish and Game began transplanting the chubs to additional refugia from Lake Tuendae. Five locations, Piute Springs, South Coast Batanic Garden Ponds, Two Hole Spring, Lark Seep, and Lion Country Safari have been planted to date. A brief summary of the introductions follows:

## Piute Springs

Piute Springs, San Bernardino County, is located on Bureau of Land Management land northwest of the town of Needles, California. The spring lies at the bottom of a canyon and is sometimes subject to flashfloods. On December 18 and 19, 1969, Leonard Fisk, Ernest Lesh, David Frye, and Robert Winn, all with the California Department of Fish and Game, introduced 150 Mohave chubs into Piute Springs. The chubs averaged about 3.5 inches in length. Lou Jurs, Bureau of Land Management, reports he found live fish present during an inspection of the springs in September, 1971.

## South Coast Botanic Garden Pond

This two acre pond constructed at the South Coast Botanic Garden in Palos Verdes, Los Angeles County, California, is managed by the Los Angeles County Department of Arboretum and Botanic Gardens. Jim St. Amant and Shoken Sasaki introduced 147 Mohave chubs into the pond on January 27, 1970. The chubs measured approximately 1.5 to 2 inches with the exception of 5 fish that measured 4 to 7 inches in length.

On July 2, 1970, Sasaki and the author observed that 3 different spawnings had apparently occurred.

Appendix 1971-5

# PUPFISH TASK FORCE REPORT

by

James T. McBroom

Most of you will recall the splendid series of articles on the Desert Pupfish which appeared in "Cry California", the journal of California Tomorrow, a year and a half ago.

One of the articles is entitled "A Process of Destruction -- Man and Pupfish," written by James Deacon and Sterling Bunnell.

In the caption on the horror picture of a Spring Meadows pump sucking Jack Rabbit Spring dry, the authors wrote "The survival of all of these refuges, of course, as well as the unique pupfish populations in Death Valley National Monument depends on the maintenance of an adequate water table in the region -- a wholly unjustified assumption in the light of current plans."

We hope that events since that time, about which we'll talk here, have given rise to a somewhat more optimistic outlook.

Another article in the "Cry California" series was on a program for action to save the pupfish. It was written by Martin Litton, a former Travel Editor of Sunset Magazine.

Mr. Litton charged the National Park Service with a "unusual attitude of helplessness." He suggested to the then Secretary of the Interior, Walter J. Hickel, how easy it would be to practice what he called "instant conservation." It seemed simple enough to Mr. Litton for Secretary Hickel promptly to buy out Spring Meadows, Inc.; or to find the legal bases for banning irrigation pumping; or to convince the President that he is obliged to implement the mandate of Congress in the Echo Park and Grand Canyon cases by halting further irrigation in Ash Meadows; or to prohibit construction of wells, pumps, and irrigation canals; or to withhold money appropriated to the Bureau of Reclamation for studying the Amargosa Project.

The president and the Secretary of the Interior, Mr. Litton thought, could take action promptly to invalidate water rights exercised not in the public interest.

How easy it seemed to Mr. Litton, looking at the Federal government from the standpoint of a western author whose beat had apparently not included Washington.

He didn't know about how things happen in the Capital city -- like the fact that Federal agencies have to have specific authority for action -- like the

In July 1971, the pond was drained to repair excessive leakage. On July 7, 1971, 300 chubs were removed. Approximately 5,000 chubs were collected from the pond on July 13, 1971. Both collections were taken to the Chino Fish and Wildlife Base.

At this time, November, 1971, the pond at the South Coast Botanic Gardens is dry. Repair of the pond and refilling is delayed due to budgetary limitations.

Paradise Spa, Las Vegas, Nevada
Jim Deacon reports that the population existing in this water is thriving.

Two Hole Springs
The spring is located in San Bernardino County on Bureau of Land Management land, 1 to 2 miles south of highway 95 east of Lucern Valley, California. Maximum depth of the pool formed by the spring is two feet. On August 20, 1970, St. Amant, Ernest Lesh, and Bureau of Land Management personnel, Bill Templeton and Dick Manus, planted 41 chubs into the pool. Average length of the chubs measured approximately 2 inches; several measured approximately 4 inches. Bill Templeton, prior to the introduction, constructed a fence surrounding the 30 by 40 foot pool to keep cattle out.

Joe Lesh inspected the pool in the spring of 1971 and found no live fish. An extensive growth of Chara sp. existed in the pool which probably resulted in insufficient dissolved oxygen. The Chara sp. was removed from the pool and 150 chubs were introduced. The pond was inspected again on July 28, 1971. Dead chubs were found throughout the pond. Two seine hauls did not produce any live fish.

Lark Seep
On July 12, 1971, 400 chubs were introduced into Lark Seep Lagoon located on the United States Naval Weapons Station, China Lake, near Ridgecrest, Kern and Inyo counties by Joe Lesh and Phil Pister of California Fish and Game. Mrs. Tilly Barling, Natural Resources Specialist, has observed chubs in the Lagoon since the introduction.

Lion Country Safari
In July, 1971, 150 chubs were introduced into ponds located at Lion Country Safari, Orange County. The fish were released into several ponds and a 55 acre lake. Survival of the chubs is not known at this time.

fact that a Federal agency's funds to cover specifically described work are provided six months to a year in advance and budgeted two and one half years in advance; and -- like the fact that none of these things happen in secrecy. There is opposition to most proposals for action and the opposition has equal opportunity denied or to oppose appropriation of the funds -- like the fact that there is always pressure to reduce expenditures under every Administration.

The series of articles in "Cry California" and other written and oral comments by people interested in the welfare of the pupfish resulted in a fairly large level of criticism of the Interior Department, reaching its peak the spring months of last year. To many, it seemed like the Interior Department was doing little or nothing to carry out its responsiblity for the protection of endangered species of fish and wildlife in the critical Ash Meadows area.

Just to give you an indicator of attitude toward the Interior Department in those days, let me quote to you an excerpt from a letter of June 1970 to Senator Alan Cranston from Mr. Joel W. Hedgpeth, President of the Western Society of Naturalists, Marine Science Center, Oregon State University, Newport, Oregon. He said: "In behalf of the Society, I have been trying to assist in the effort to save from extinction the unique desert pupfish of the Death Valley and Amargosa desert areas. We have yet to be given satisfaction that our pleas have been heard. Mr. (Russell) Train's office referred our request to some limbo in the Department of the Interior on May 6 and nothing but silence has ensued. The manner in which this matter has been given the bureaucratic run around leads me to suspect that officials felt this to be a hopeless cause and rather than waste their efforts, they quietly buried the matter until it became moot. I sincerely hope not, and that there may yet remain time to save these unique species. However, it cannot be done by passing bills or referring requests through channels, it obviously requires an immediate executive order and I should think that you should be able to bring this to the attention of the White House in line with your very strong statement about the moral obligation to preserve species whenever possible.

The Interior Department about this time established the Pupfish Task Force.

I'll be honest with you. Up until May 1970, I had never heard of the desert pupfish. In my duties as Assistant Director for Cooperative Services in the Bureau of Sport Fisheries and Wildlife, I had been involved for many years with such matters as provision for fish and wildlife conservation in the water resources program, the proper administration of Federal Aid to the States for fish and wildlife restoration, the control of predatory animals injurious to livestock herds, and the provision of fishery services to Indian tribes and reservations. No where did these paths lead me to knowledge of the desert pupfish.

But about May 5 last year, Chuck Meacham, the then Deputy Assistant Secretary for Fish and Wildlife, Parks, and Marine Resources called me away from a meeting I was attending. He said to me, "Jim, the Interior Department has got to organize an effort to protect the desert pupfish."

Then he said "When Secretary Hickel told me to do this, I knew I needed the roughest, toughest man I could think of to head the program. It turned out to be you." This accolade, of course, was of doubtful flattery. But he was the boss. So I set about to learn something about pupfish and to organize the effort.

We first assembled a group of Interior Department people on May 7 to consider the pupfish. Bob Smith, Wildlife Division, Bureau of Land Management was there, along with Jerry Meyer, Water Resources Division, Geological Survey; Wally Wallis and Ed Reed, National Park Service; Harry Goodwin, Office of Endangered Species and Dr. Willis King, Division of Fishery Services of the Bureau of Sport Fisheries and Wildlife. As it happened, Regional Director John D. Findlay of the Bureau, who will now have charge of the program, was present at the very first Task Force meeting.

We decided right there and then on the initial elements of a Department of the Interior Pupfish Program as follows:

1. Reclassify Bureau of Land Management lands in the area.
2. Publicly oppose any future irrigation development.
3. Announce a special groundwater study.
4. Investigate sites for transplanting pupfish.
5. Develop a management plan for all of the springs and ponds in the area with the idea of preserving and reclaiming all pupfish habitats.
6. Investigate legality of present groundwater withdrawals.
7. Acknowledge great efforts by State and University scientists.

Soon after we were underway, new additions and changes were made in the Task Force composition. Louis A. Boll represented the Bureau of Land Management. He was later transferred out here to Bakersfield and was succeeded on the Task Force by Curt Hammit. Dr. Stanley J. Ware of the Office of Water Resources Research subsequently joined the Task Force, as did David A. Watts and Ronald Lambertson, attorneys from the Solicitor's Office, and Al Jones and Woody Seaman of the Bureau of Reclamation. Within the Bureau of Sport Fisheries and Wildlife, we soon had Dr. Warren J. Wisby, Aquarium Specialist and Director of the National Fisheries Center Aquarium; Dr. Edward C. Kinney, Division of Fishery Services, who was Secretary for the Task Force; Bill White and Joe Kathrein, Division of River Basin Studies, and Paul Handwerk of the Division of Fishery Research. Willis King and Harry Goodwin were named Deputy Task Force Chairmen.

The first product of the Task Force effort was a document entitled "A Task Force Report on Let's Save the Desert Pupfish," dated June 1970, which was widely distributed.

After describing the pupfishes and their problems, the report set forth a number of things the Department planned to do to save them. Briefly they were as follows:

1. Assuming availability of funds, undertake a critical and detailed study of the groundwater resources to better define the relationship between the level of the pools, the source of their water supply, and the effect of pumping ground water for agricultural purposes.
2. Seek to have the State of Nevada limit irrigation pumping.
3. Support and conduct scientific studies to define the requirements for the survival of the pupfish.
4. Again assuming the availability of funds, acquire privately-owned lands to protect the spring areas where pupfish habitats were threatened.
5. Initiate management programs by the Department of the Interior and encourage the same by State and private agencies to protect the pupfishes and their habitats.

We shortly established a communications system and kept it full of information. We sent copies of everything on the pupfish which the Task Force initiated and that which came to our attention from other sources to 52 people throughout the Nation interested in pupfish preservation. That activity -- keeping the pipelines of that communication system full -- continued to be a busy one throughout the life of the Task Force. Literally thousands of pages of material were circulated. My able secretary, Miss Alice Chamberlain, patiently worked long, hard hours to make this system function.

In the summer of 1970, we determined to take the bull by the horns to raise the necessary funds to start the needed groundwater study of Ash Meadows. We had a proposal from the Desert Research Institute of the University of Nevada to do the study, but the Task Force decided to have the work done by the Geological Survey. As you know, the Survey, one of our bureaus, has a tremendous reputation in the groundwater field and in all other earth science fields.

This was where we got a big boost from the Secretary's Office of Budget. With their help, we raised $50,000 to finance the groundwater study -- $10,000 from each of five Interior Department bureaus having a program interest and responsibility in this area. It is unlikely that any one Bureau could, in these days of tight finances, manage the entire $50,000. But here once again, the name of "cooperation" was magic -- $10,000 didn't seem like too much for any one Bureau.

In any event, the Geological Survey began the study with the funds we had raised. You will hear later in today's program a complete report on that study by Mr. William W. Dudley, Jr., the Geological Survey hydrologist who was the Project Leader.

The Desert Research Institute at the University of Nevada at Reno and its Center for Water Resources Research were not excluded from the picture. At the request of the Task Force, the Institute submitted a research proposal to the Office of Water Resources Research of the Interior Department. This proposal was designed to develop management methods for irrigation in the Ash Meadows area while preserving the natural environment, including the

pupfish. Among other things, the study was designed (1) to analyze all existing hydrologic data on the study area and to collect additional information where data were lacking, and (2) to develop a predictive model to analyze the most pressing groundwater production problems and the related possibility of irreversible threats to the environment.

The Office of Water Resources Research approved this proposal on the recommendation of the Task Force. This project was funded by the Office of Water Resources Research under Title II of the Water Resources Research Act of 1964, as amended. This provides for 100 percent Federal grants in cases of outstanding research competence by the State or the importance of the project proposed.

This is a two year investigation by the Desert Research Institute. The Interior Department, through the Office of Water Resources Research, granted $25,000 for the first year, which ended on November 1, 1971. For the second year, the Federal grant will be $50,000. In each year, non-Federal contributions by the Desert Research Institute, consisting of services and materials made available by the University, will be $20,000.

The Desert Research Institute research project is fully integrated with the ground-water study of the Geological Survey. Here, then, are two important new ground-water studies of the Ash Meadows area which have been fostered by the Task Force.

One of the problems the Task Force faced was the status of public lands in Ash Meadows. An old desert land entry claim existed in the School Spring area. At the request of the Task Force, this claim was extinguished. The Bureau of Land Management, at the request of the Task Force, also drilled a well near School Spring to provide that habitat with a back-up water supply.

On September 3, 1970, again at the request of the Task Force, the Assistant Secretary of the Interior for Public Land Management revoked the classification action of May 1968 by the State Bureau of Land Management Director. By his action, the Assistant Secretary classified 7,300 acres of public domain in the Ash Meadows area as not appropriate for disposal or exchange. The Assistant Secretary noted that the development of irrigation farming and pumping from wells had rapidly caused a reduction in the discharge of critical springs and lowering of the water level in Devils Hole. He said it would be unwise to have any further demands made on the ground water resources at least for the time being. This action halted all change in the status of these lands from public to private.

Meanwhile, the Task Force took action with the State Engineer of Nevada in an attempt to limit the issuing of permits for further withdrawals of ground water in the Ash Meadows area until the Interior Department ground-water study had been completed. The Western Service Center of the National Park Service wrote two or three letters to the State Engineer on this subject with respect to certain applications for a permit to withdraw ground water in Ash Meadows, in each case requesting that they be denied.

I, too, wrote the State Engineer on behalf of the Task Force on September 4, 1970. I noted that several applications had been filed for the appropriation of ground water in the Ash Meadows area near Devils Hole, School Spring, and Jack Rabbit Spring. I stated that these locations comprised habitat for the last remnants of several rare and endangered pupfishes, which had been placed on the Endangered Species List by the Secretary of the Interior pursuant to the Endangered Species Act of 1966. I then said that the Department of the Interior was undertaking extensive hydrologic studies of this section of Nevada and that preliminary data and reports had concluded that further ground water withdrawals would result in the lowering of the water table at Devils Hole and School Spring and that this would result in the inevitable loss of these species.

We urged a delay in approval of these applications in a moratorium of two or three years during which the State and Federal governments, working together, could more fully evaluate the hydrologic regimen of the area and the effect of further withdrawals on pupfish survival.

In his response of October 21, Mr. Roland D. Westergard, the State Engineer of Nevada, informed me that my request had required extensive consideration and evaluation. He said that the situation in the Ash Meadows area would not require postponement of action. However, he did indicate there would be hearings on the matter. Subsequently, these hearings were held, and a statement was presented by Mr. Otto Aho, the Interior Department Field Solicitor in Reno. All of this was, however, to no avail. The applications were granted as requested.

A few weeks after the Task Force was established, a system was installed for reporting on the status of the Devils Hole, School Spring, and other pupfish habitats in Ash Meadows. These reports were based on personal inspection, usually by the Bureau of Land Management or the National Park Service. The reports were circulated from the Task Force Chairman's office.

A reconnaissance habitat evaluation report for desert pupfish in the Ash Meadows area, dated October 12, 1970, was prepared by Clinton H. Lostetter, the Coordinator of Rare and Endangered Species program of the Bureau of Sport Fisheries and Wildlife in Portland, Oregon.

Also, a reconnaissance realty study was prepared by the Regional Office of the Bureau of Sport Fisheries and Wildlife at the request of the Task Force to ascertain the private holdings in the Ash Meadows area and to provide preliminary estimates on the value of such private holdings.

In the spring of 1971, Roy Greenaway, Administrative Assistant to Senator Alan Cranston of California, came to the Interior Department with a request. He noted that Senator Cranston had been receiving a considerable amount of mail asking what he, Senator Cranston, had done to save the desert pupfish.

Mr. Greenaway's idea was to enlarge the Devils Hole reservation to include School Spring. I told Mr. Greenaway that the Bureau of Land Management was doing a bang-up job of handling School Spring, as it was, and that the addition of it to the Devils Hole reservation would actually do very little for the pupfish.

Instead, I suggested the establishment of a Desert Pupfish National Monument to encompass approximately 35,000 acres of land, mostly in public ownership. Mr. Greenaway thought that this idea would appeal to Senator Cranston. It did. He asked the National Park Service for legislative drafting service, and they provided it. A Bill, S. 2141, was introduced by Senator Cranston on June 24, 1971. The co-sponsors of the Bill with Senator Cranston were Senators John Tunney of California, Fred Harris of Oklahoma, and Gaylord Nelson of Wisconsin. This Bill is pending in the Senate Interior Committee, which has asked for legislative reports from the Interior Department and other affected departments.

Recently, the Task Force considered alternates to the establishment of this area as a National Monument under the management of the National Park Service. One of the options is to establish it as a National Wildlife Refuge, under the jurisdiction of the Bureau of Sport Fisheries and Wildlife. The authority to establish such a refuge already exists in the Endangered Species Act of October 15, 1966, as amended; no further legislation would be required except that a ceiling in that Act on Appropriations to the Bureau of Sport Fisheries and Wildlife on endangered species would have to be raised. The funds could be made available for this purpose from the Land and Water Conservation Fund. This would have certain advantages since under the Bureau of Sport Fisheries and Wildlife policy there would be a great deal more flexibility for management than under the policies of the National Park Service. This alternate proposal is still under study.

In June 1971, the Task Force issued a new report entitled "Status of the Desert Pupfish." This report updated the material which had been incorporated in the previous report and described what was being done at that time. Several hundred copies of this report have been sent to those who requested them.

The climax of the Interior Department Pupfish Task Force activity came on August 17, 1971. On that day, the Department of Justice, at the request of the Interior Department, filed in the United States District Court of Las Vegas a complaint seeking to have Defendants Spring Meadows, Inc., B. L. Barnett of Spring Meadows Ranch, and others, cease pumping water from three wells in order to protect the Federal water rights in Devils Hole. The complaint was based entirely on information gathered by the Geological Survey ground-water study, which as I noted, had been undertaken at the request of the Task Force and financed through Task Force efforts.

The complaint noted that Devils Hole was withdrawn from the public domain to become a part of the Death Valley National Monument by Presidential Proclamation in January 1952. It added that, when these lands were withdrawn, the water was withdrawn from private appropriation and reserved for use on such lands by the United States to the extent necessary for the requirements and purposes of the reservation.

The complaint added that the Defendants drilled wells and began heavy pumping in the summer of 1968 and have continued every summer and fall since that time. The complaint added that the desert pupfish is recognized as an endangered species and is listed as such in the Rare and Endangered Species

List issued under the Rare and Endangered Species Act and that pumping by the Defendants had lowered the water levels at Devils Hole so as to expose seventy percent of the natural shelf which is used for feeding and reproduction of these fish. The complaint then asked that the Court determine and decree the water rights of the United States and issue a preliminary and permanent injunction enjoining the Defendants from pumping the three wells which affect the water levels in Devils Hole. A hearing was set for September 2, 1971, on the complaint.

Representatives of the Defendants promptly went to Washington after the complaint was filed. The result of their trip was a Stipulation of Continuance signed by two attorneys in the Department of Justice and Thomas R. C. Wilson, II, Attorney for Defendants Spring Meadows, Inc., B. L. Barnett, Francis Leo Cappaert, and Marilyn J. Cappaert.

The Stipulation provided for discontinuance of all pumping from the three wells in question from September 9, 1971, for the remainder of the calendar year. Also, it provided that pumping of the three wells would not be resumed during 1972 without mutual agreement of all parties. The lands supplied by the three wells would not be irrigated by increased pumping from other wells by the Defendants where such pumping would adversely affect Devils Hole. Furthermore, before the pumping of any of the Defendants' wells is increased, two weeks notice would be provided the United States of such increase to determine whether the increase would adversely affect Devils Hole.

The final part of the Stipulation was that the agreement could be terminated on 30 days notice by either party. Termination by Mr. Wilson and company would give the Federal government the opportunity to continue the case in the United States District Court toward seeking a permanent injunction if it so desired.

One of the final happenings in the life of the Task Force was the successful negotiation with the Bureau of Reclamation for financial support to construct a refugium in the wall of the Black Canyon near the Hoover Dam along the Colorado River.

At the request of the Task Force, State, University and other officials evaluated this location and pronounced it excellent as a place to which Devils Hole Pupfish could be transplanted. The problem was the need for construction funds to provide the necessary water supply and control facilities. On September 2, I requested that the Commissioner of Reclamation make available $7,000 for this purpose. I am pleased to report that in his memorandum to me of November 2, the Reclamation Commissioner advised that he can make available these funds to the Bureau of Sport Fisheries and Wildlife for construction of the refugium. This is another excellent example of two Interior Department bureaus working together for a common cause.

Throughout the existence of the Pupfish Task Force, we had a lively correspondence with a number of people interested in the pupfish. For example, we had correspondence with -- The Endangered Species Committee, Atlantic Chapter of the Sierra Club, New York City; fifteen people from

Missouri and California who sent a petition to President Nixon expressing concern for the pupfish.

The criticism of the Interior Department, which I noted earlier in this paper, had turned to praise. Those who thought the Department was standing pat and helpless have stood up and cheered because they thought the Department was doing its thing -- and forcefully -- to save the desert pupfish.

On October 15, a few days more than 17 months after it was established, Mr. Nathaniel P. Reed, Assistant Secretary of the Interior for Fish and Wildlife and Parks, dissolved the Task Force. Mr. Reed's view was that the initiative for action should henceforth come from the field level. He designated the Regional Director of the Bureau of Sport Fisheries and Wildlife at Portland, Oregon, to take the lead in the Departmental effort. The Regional Director, known to most of you, is Mr. John D. Findlay. I urge orally, as I have in writing, that all of you interested in pupfish preservation give Mr. Findlay the support you gave to me and the Task Force.

The Task Force, during its existence, established a vigorous program for several endangered fish species whereas before the principal programs for endangered species had been for birds or mammals. Now we have a good start in protecting these fishes.

This was a successful activity carried out by representatives of seven bureaus and offices of the Interior Department -- the Departmental Pupfish Task Force. Their record belies the reputation that it sometimes attributed to Interior that it is a Department whose Bureaus are constantly at war. In this case, the separate Bureaus of the Department worked and acted together efficiently with each contributing time, manpower, and money toward a common objective.

Throughout its existence, the Task Force worked in closest cooperation with this distinguished group of State, Federal and University scientists and those of you from conservation organizations all of whom have been concerned with the welfare of the pupfish for many years. The creation of the Desert Fishes Council and the support of the Council and its Chairman, Phil Pister, and the Advisory Group to the Task Force, which included Mr. Pister, Bob Miller of the University of Michigan, Jim Deacon, University of Nevada at Las Vegas, Dale Lockard, Nevada Fish and Game Department, and Carl Hubbs of the Scripps Institution of Oceanography, was invaluable to the work of the Task Force. Without such support, we could have done very little.

On a personal note, it has been a real privilege to work with all of you people associated with the pupfish preservation effort. It has been one of the most rewarding episodes of my career. I shall always hold a warm spot in my heart for the pupfish and do what I can, on an unofficial basis, for the pupfish and for those who are working to save them.

Appendix 1971-7

# Report on Attempts to Maintain Aquarium Populations of Endangered Death Valley Cyprinodonts

by

R. Haas, Fresno State College

At last year's symposium I made the suggestion that members of the American Killifish Association be recruited to attempt aquarium culture of certain species, e.g., Cyprinodon diabolis and Empetrichthys latos. In was suggested that since the AKA has as members the most knowledgeable and experienced aquarists in the United States, it would be through these persons that greatest promise of success in breeding and maintaining captive populations would be held. It would be from such aquarium stocks that reintroductions into the field could be made at such time as conditions in the fishes' native habitat become less threatening for continued survival in the wild. Aquarium maintenance would thus be a means of ensuring survival in the face of continued degradation of the natural habitat.

The recommended procedure was to establish a core of expert aquarists who would be supplied with a few pair of one of the two species in question which they would attempt to breed. With the exception of Cyprinodon diabolis, no difficulty in breeding any species of Cyprinodon has ever been experienced in aquarium culture. Empetrichthys undoubtedly would not be difficult to propagate. Those who would be given specimens will have been selected with great care using as criteria responses to a questionnaire probing such items as prior experience with substrate spawning cyprinodonts, motivation, physical equipment available, etc. Once fish are distributed by air mail special delivery in special thermal containers (Transit-Heet), the participants will be obligated to report to the chairman of the AKA committee at tri-monthly intervals the progress and status of the project and of the fish in their possession. Participants will agree not to disseminate any fish to any other persons except by permission of the chairman. Specific attention will be given by participants to conditions required to successfully propagate species held by them in order that this information be available to others working in this area. Publication of any useful data is anticipated.

The philosophy of the project is predicated upon considerations similar to those made by a number of zoos in their attempts to maintain breeding stocks in captivity of rare and endangered terrestrial vertebrates.

In August 1971, the final draft of the proposal was submitted to Mr. McBroom with the request that copies be forwarded for commentary and action by all appropriate agencies. In brief the proposal gave the rationale and anticipated procedure in detail as outlined above. A two-year funding of $3,500 was requested to cover incidental expenses such as initial collections, maintenance, shipping costs and purchase of shipping containers. The proposal calls for close liaison between the committee chairman and scientists who are professionally interested in the future of the Death Valley cyprinodonts. Action has not yet been taken on the proposal.

Appendix 1971-8

STEINHART AQUARIUM LOG FOR
DEVIL'S HOLE PUPFISH COLONY, Cyprinodon diabolis

At 7:10 a.m. on August 5, 1971, Steinhart Aquarium received 4 styrofoam shipping boxes, each with about 4 gallons of water and a total of 14 Cyprinodon diabolis (two adult males, two adult females and ten juveniles). Temperature on arrival was 86 F., pH was 8.4 and total hardness 280.

The Steinhart colony of Cyprinodon diabolis is housed on a 25 gallon fiberglass seasoned tank with water supplied by California Fish and Game. The temperature is held at 91 F with three aquarium heaters. There is subsoil and outside filtration on the tank, excess food is siphoned daily, and there is a once-a-week filtration with an Eheim power filter #476. Fish are fed at least 4 times daily on (a) newly hatched and (b) subadult brine shrimp (Artemia saliens) and twice weekly suppliemented with Daphnia or newly hatched mosquito larvae.

There have been 5 mortalities since arrival at Steinhart Aquarium:

(1) August 7, 1971 - adult male
(2) August 10, 1971 - adult female
(3) August 12, 1971 - adult male
(4) October 14, 1971 - adult female (last of original adults)
(5) November 12, 1971 - adult female

All fish have been carefully examined to determine a cause of death. All fish had food in gut, stored fat and no visible parasites. The female of October 14, 1971, had several unexpended eggs in ovaries, average size of 1.40 mm in diameter. The female of November 12, 1971, showed no parasites, food in gut, and ovaries were just beginning to develop.

The remaining colony consists of four males and five females.

The algae that came in the shipment was anticipated to be used as a spawning mat. However, it began to disintegrate, and on September 30, 1971, was discarded in favor of an artificial spawning mop (2 inches in diameter). Egg production has increased since the introduction of the artificial mop.

| Date | Number of Eggs | Remarks |
|---|---|---|
| 9/6/71 | 1 | no signs of division |
| 9/11/71 | 2 | showed division for 3 days, then ceased activity |
| 10/4/71 | 1 | no signs of division |
| 10/8/71 | 1 | no signs of division |
| 10/9/71 | 1 | no signs of division |
| 10/10/71 | 9 | 3 eggs laid on filter stem for outside filter. No signs of division. Of 6 eggs laid in mop, 2 showed signs of division, 1 lasting for 4 days before division ceased, 1 showing rudimentary eyes on 5th day and ceasing advancement on 6th day. |

| Date | Number of Eggs | Remarks |
|---|---|---|
| 10/11/71 | 7 | 5 with no signs of division, 2 eggs showed division for 3 days and then ceased |
| 10/14/71 | 7 | 6 with no signs of division, 1 egg lasting 3 days |
| 10/18/71 | 2 | no signs of division |
| 10/21/71 | 2 | 1 no signs of division, 1 egg lasting 2 days |
| 10/22/71 | 3 | no signs of division |
| 10/30/71 | 1 | no signs of division |

Eggs were measured after it was determined there was no life present: eggs of October 11 ranged in size from 1.230 mm to 1.401 mm with an average of 1.316 mm; eggs of October 14 through October 21 were measured at one time and ranged in size from 1.120 mm to 1.456 mm with an average of 1.318 mm; eggs known to be fertile ranged from 1.290 mm to 1.344 mm in diameter.

At present we are concerned with water quality and nutrition. Steinhart Aquarium Research Associate Bryce Anderson has synthesized a formula which duplicates G. F. Worts' U.S.G.S. 1953 water analysis of Devil's Hole. As we had considerable difficulty in dissolving this formula, we requested and received a later analysis from Mr. Dale Lockard done by U.S. Department of Interior dated December 9, 1966. At present this formula is being prepared and a report will follow.

Our next goal is to obtain a suitable vegetation for added nutrition that can be cultured.

Al Castro
Steinhart Aquarium
San Francisco

Appendix 1971-9

# PHILOSOPHY OF TRANSPLANTING--ITS FUTURE AND IMPLICATIONS

by

Carl L. Hubbs and Robert Rush Miller

Our overriding goal is the perpetuation of all the rare and endangered fishes of the Death Valley system, and of similarly isolated waters of the whole arid American West; preferably, wherever feasible, by the preservation of their entire habitat. Whenever the continuity of a species of a faunal assemblage seems endangered, it is wise to locate and implement sanctuaries where the species or fauna may be perpetuated.

The main purpose of transplanting stocks of desert fishes will undoubtedly be for their preservation, though other advantages may accrue.

The need for establishing refuges is particularly acute when the existence of a species is threatened -- as by the desiccation of Manse Spring or other desert waters, or by danger of piping the spring water, as has happened in other spring waters in Pahrump Valley, or through establishment of incompatible exotic fishes, or otherwise.

Other advantages that may accrue from transplantations are tests of the genetic integrity of the original stock (is it really a distinct species or subspecies?); or tests of the ability of an isolated endemic fish to adapt itself to another environment -- with or without genetic change.

In any event, it will be highly desirable to maintain repeated checks on the introduced stock.

The chance of perpetuating endangered species through transplantations becomes increasingly promising, now that the various state and federal agencies involved, as well as many individual citizens, have become deeply concerned with this problem.

Now that transplanting desert fishes is increasingly being considered and practiced, account needs be taken of the potential dangers and disadvantages involved, and of means to avoid such consequences.

Unless all such transplants are recorded in permanent and detailed form, the natural distribution of the transplanted species may be obscured or even falsified. This possibility will be lessened if transplants are made in the same interior-drainage basin.

In choosing transplant sites, care should be taken to avoid situations where the transplants might harm the native fauna through predation, competition, hybridization, or other serious disruption of the ecological balance, either in the transplant site selected or in waters into which the transplanted fish might spread.

Where it is deemed necessary or expedient to remove the local populations of exotic fishes, to increase the chance of successful transplantings, care should be taken to avoid the possible extermination of some other aquatic organisms -- such as an endemic snail feared by some to have been eliminated in the extermination of exotic fishes in the Owens Valley Native Fish Sanctuary.

Care should also be taken to avoid the possible spread of parasites or diseases. Care should also be exercised to avoid serious depletion of an endemic fish species in its native habitat through the removal at any one time of too large a proportion of a limited stock -- as of the Devil's Hole pupfish, for example.

However, the chance of successful establishments may depend on transferring a rather large stock, perhaps several hundred individuals.

When a serious depletion of a very limited population of some endemic fish seems possible, use may be made of small temporary refuges or of artificial culture to build up the supply; the possibilities of such culture has just been stressed by Dr. Haas.

It should be kept in mind that a very considerble number of attempted transplantations have failed. In Dr. Miller's 1968 accounting of his prior trials, only about 20% succeeded. To increase the probability of success the ecological features of the native habitat and of the proposed transplant site should be carefully considered and compared.

The danger of torrential floods in the new site must always be kept in mind, in the whole desert area of rare torrential precipitation. Thus our fears for a successful transplantation of Mojave chubs into Piute Spring seems to have eventuated promptly. Even the successful establishment of this species in Sentenac Canyon for 20 years, after introduction of 48 fish in 1939 and the probably unnecessary supplementation of about 100 more in 1940, came to an abrupt end in a flood 20 years later. Such temporary establishments, however, would supply the stock for more permanent habitats.

A number of successful establishments of desert fishes give hope for other successes. One example is the establishment in springfed ponds near Sodaville, Nevada, of a thriving population of the Railroad Valley springfish through transfer by Tom Trelease of a few individuals. Two subspecies of Cyprinodon nevadensis have succeeded in other waters, one in ZZYZX Spring and another, along with the dace Rhinichthys osculus, in River Springs in Adobe Valley. Some success seems to have resulted from the recent transplantations of the Mohave chub from ZZYZX Spring, through the efforts of Phil Pister and Jim St. Amant. There are other examples of establishments of desert fishes, including those that seemingly have resulted from escape of bait minnows, which provide indications that threatened species may be rescued from extinction by transplantations.

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
FEDERAL CENTER, DENVER, COLORADO 80225

November 23, 1971

Mr. Edwin P. Pister, Chairman
Desert Fishes Council
407 West Line Street
Bishop, California 93514

Dear Phil:

The enclosed map is a somewhat dressed-up version of the rough sketch that I prepared after Skip Worts pointed out the inadequacy of the originally proposed monument to protect the Ash Meadows area hydrologically. I have also included 12 sections in the northwestern part of T. 16 S., R. 50 E., that were not included on the earlier version.

The present boundaries were chosen so as to preclude development of ground water from the Paleozoic carbonates within 12 miles to the north or east of Devils Hole and from the basin-fill sediments within three miles to the west and south of other important pupfish habitats. The entire area encompasses about 278 square miles, or 223 more than the originally proposed monument.

The original of this map is being sent to Pete Sanchez to reproduce with the resolution passed at the Symposium last week.

When you get a chance, could you send me the address of the photographer whose pupfish pictures were displayed at the Symposium?

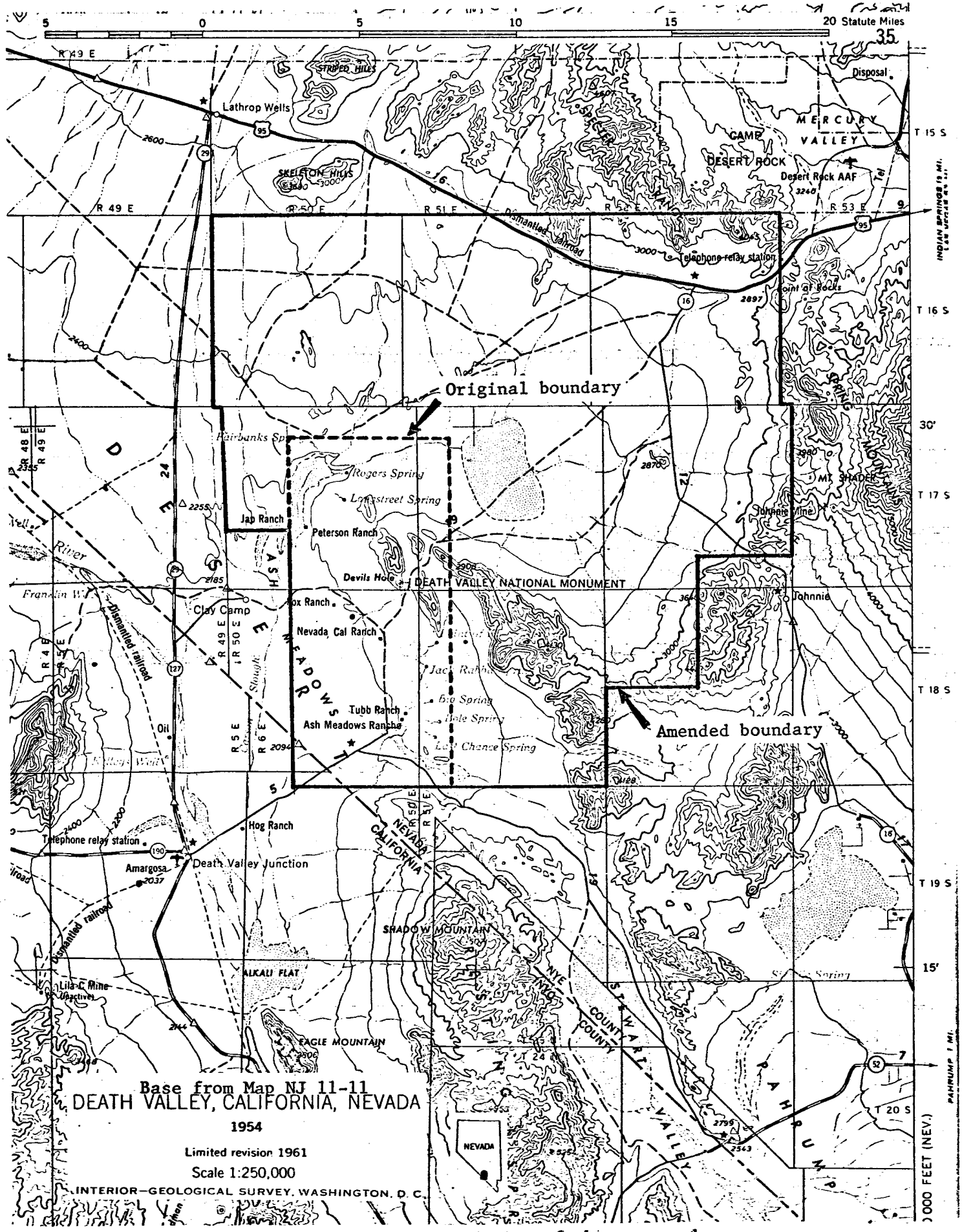
Very truly yours,

Bill

W. W. Dudley, Jr.
Research Hydrologist

cc with attachment:

Mr. Peter Sanchez, National Park Service, Death Valley, California
Assistant Chief, Ground-Water Branch, WRD, Washington, D.C.
Chief, Nevada District, WRD, Carson City, Nevada
Mr. C. H. Lostetter, BSFW, Portland, Oregon




Base from Map NJ 11-11
DEATH VALLEY, CALIFORNIA, NEVADA
1954
Limited revision 1961
Scale 1:250,000
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.

**Original and amended boundaries of the proposed**
**DESERT PUPFISH NATIONAL MONUMENT**
**U. S. Geological Survey, November, 1971**

Appendix 1971-11

# FORESTA INSTITUTE AND THE PUPFISH

by Tina Nappe

Foresta Institute is a small, non-profit, tax exempt foundation in Carson City, Nevada, involved in a number of projects, too many as a matter of fact, for the small number of staff, but who can so "no"? Emphasis in the last few years has been on environmental training of students and teachers on a local and international level. I have a few brochures of a four weekend Nevada teachers' training program in session this coming weekend when I plan to talk about pupfish, naturally, as I am really pushing for support in the schools. Other Foresta involvements have been in South America, Antarctica, land saving, parks, - well, as I have said, there is no end of issues.

My obvious prejudice aside, I think that Foresta has made important contributions to Nevada in trying to create a park and maintaining water pureness at Lake Tahoe, helping the state get the town of Berlin in Ichthyosaur State Park, creating strict air pollution standards.

Foresta Institute has been involved in endangered species work a long time, at least since the foundation began in 1960. Even before that, the Director, Dr. Miller, had been concerned with pupfish. He filed for a water application at Devil's Hole in the late 40's to protect fish and gave it up in 1952 when the State Water Engineer suggested he should because the fish were now protected as part of the Monument.

Dr. Miller is a member of the Survival Service Commission of IUCN. In 1966, he offered to sponsor a first meeting of Nevadans who might be concerned with endangered species. Like many initial undertakings, it started with a lot of enthusiasm about what ought to be done and ended up with a few who were willing to do something. Dr. Miller himself soon left us to our own devices thinking that having offered Foresta to house us, if needed, and me to do the nitty gritty secretarial work, he had interfered enough. Besides which, under the Endangered Species banner we decided to become political, something Foresta cannot do.

Through the spring of 1969, we drafted and managed to get passed, with the cooperation of the local Audubon Society, an Endangered Species Bill. We felt very delighted at the time, having lost only the invertebrate section (no funding, of course) and not until later became discouraged to discover the loopholes through which the water was passing. Although Foresta has sent me down to these meetings to observe, it is really the Endangered Species Committee which has done the political work on the pupfish bill.

We printed 500 of the pupfish pamphlets; we have none left except file copies. We sent one at least to every group and individual in Nevada we could think of. Additionally, we sent batches to most of the national groups. We also tried to inform all publications. In late August and September, we did receive a number of requests for more information,

especially from California where Mrs. Romero, I think, had distributed the fliers. We have received some nice replies from ISPA (International Society for the Protection of Animals), another from the Society for Protective Legislation (not sure of exact title); one from Richard Fitter in England saying he would mention the legislation in the Fisher and Oryx, both English publications devoted to endangered species information.

Then, too, both Dr. Miller and I have done some hounding of the congressional delegation to the point where I sometimes feel like McGovern, a one issue candidate, and wonder if Senator Bible thinks, "Oh, her again about the fish." Dr. Miller has also had some lengthy conversations with representatives of the Department of Interior, not always friendly ones. It is not because he is hateful, but because as he always tries to point out to me, we have an obligation to be as forceful as we can, rather like a gadfly, for there are always voices for moderation, voices who feel they are not as free as we at Foresta are to speak and act. When I am not as forceful as he would like, I remind him that that is why women's lib is so important, for the next generation of women will grow up more confident.

Dr. Miller is going to Washington and is hoping to urge Anthony Smith and his environmental coalition to become interested in the pupfish matter. Dr. Miller is on the board of the National Parks and Conservation Association and hopes this will help get their attention. Dr. Miller also feels that since a Monument requires only an executive order, why not push for that, or a park or refuge, which would offer stronger protection? He will discuss these approaches.

All our pupfish efforts are to no avail if nothing comes as a result of them, and this I am not in a position to say, not knowing how many letters have been written or how much interest aroused. This is where my being in Pullman really limits our work, for no one else at Foresta has time to push. In Pullman, Sierra Club has letter writing evenings, and I think this is the only way to go for those, like me, who tend to put things off.

I am hoping that at this conference we shall delineate objectives and approaches in regard to the bill, finances, etc. We should know when writing Congressmen would be the most effective, urge Sierra Club to put the bill on its environmental alert system, and decide on some method of communicating if the Task Force cannot be resurrected. Perhaps Jim McBroom will guide us in these things.

Appendix 1971-12

## Sierra Club

by Larry Moss

The Sierra Club is a rapidly growing international conservation organization with a current membership of approximately 150,000. The Club was formed in 1892 and John Muir, the eminent Scot naturalist, was the first president. The Club has had an abiding interest in preservation and protection of natural lands and ecosystems and has been one of America's responsible voices in this field.

During the past ten years the Club's interests have broadened to include the whole spectrum of environmental problems including those of urban areas. Legal actions have become an important part of our program.

We are interested in the program of the Desert Fishes Council and wish to lend assistance. We also encourage your participation in our programs if you share our goals. The necessary support for the enactment of legislation to protect the desert fishes will only be focused if we and you intelligently pursue this campaign.

Appendix 1971-13

REMARKS BY BRUCE F. WOLFE AT THE THIRD ANNUAL SYMPOSIUM RELATING TO THE PROTECTION AND PRESERVATION OF THE RARE AND ENDANGERED FISHES OF THE DEATH VALLEY SYSTEM

For those of you not acquainted with The Nature Conservancy, we are a non-profit public charity engaged in the acquisition and preservation of land of unique scientific, esthetic, or natural values. In the past twenty years of its existence, The Nature Conservancy has been responsible for the preservation of nearly one-quarter of a million acres of forest, swamps, marshes, prairies, desert lands, mountains and islands throughout the United States. The Conservancy works in three ways to save threatened areas: By purchase of land with funds raised through public subscription, by acceptance of land donations, and by advance acquisition of land for government agencies.

I would like to mention a single local example that may point out for you one way that the Conservancy works. In 1969, the Conservancy was requested by the National Park Service to acquire from the Harvey Hotel Enterprises an approximately 7,200 acre inholding within the Death Valley National Monument. The Conservancy obtained a loan guaranteed by the Ford Foundation in the amount of the purchase price and acquired and held the land until the National Park Service could repay our costs. The success of this project is measured in the savings to the taxpayers of many thousands of dollars which otherwise would have been paid to the private landowner because of appreciating land values. The Nature Conservancy's role, however, is not simply to act in behalf of public agencies. We have undertaken, and will continue to undertake, projects that result in the preservation of lands valuable for research purposes by private institutions, scientists, and other interested parties.

Such is the case with our Big Springs project. Here, the Conservancy has obtained an option on the 80 acres of land containing the spring and its resident population of the Cyprinodon nevadensis mionectes, among others. If management questions, legal complexities, and funding requirements are solved or solvable, the Conservancy will exercise its option as soon as the estate which holds the property has been probated and distributed. Our current plans are to retain the property and develop a management program that would insure the survival of its pupfish population. If Senate Bill 2141 or some other arrangement for federal protection of the lands becomes law, we would expect to transfer the spring to the United States for protection and preservation.

Perhaps the most significant problem we face in this project to secure Big Springs is the development of a management plan which will protect the pupfish, the spring, and the surrounding buffer lands. We must develop a program which will provide access for authorized persons and legitimate visits by the public, and still keep the habitat intact--all at the lowest possible cost. This will probably include surveying the property, fencing

it, relocating a road currently on the land, and providing adequate surveillance.

The cost of this will be high. In addition to our acquisition costs which are in the neighborhood of $10,000, the improvements we will need are certain to increase the total amount required to $15,000 or even $20,000. The funds for this must be provided by public subscription and donation. As soon as we finalize our purchase plans, we will initiate a campaign to raise the necessary monies. You will undoubtedly be made aware of our efforts in the meeting. Everyone at this conference can make a solid contribution to this campaign by informing potential donors of our requirements and the urgency and importance of any gift, however small. Contributions are tax deductible.

Finally, I would like to mention the urgent need for an advisory panel to advise the Conservancy in its management actions. We need to know that what we are doing is not a threat to the pupfish habitat and not a hindrance to legitimate scientific research. We would hope to involve the Desert Fishes Council, any interested public agencies, and the local residents of Ash Meadows in a joint effort to guide and assist our activities.

Normally, we request local Conservancy members to watch-dog our areas. In the case of Big Springs, this is not possible. Any help anyone can give to us in providing an extra pair of eyes on the property would be most appreciated. Our San Francisco Regional Office can be reached by telephone collect in the case of any emergencies. With one Field Representative to cover 13 states, you can see why we are spread a bit thin.

In summary, The Nature Conservancy is deeply interested in solving the problems of preserving habitat for the desert pupfish, particularly at Big Springs. We are looking for a practical solution for these problems so we might complete our acquisition and begin work on other endangered areas. We need help and advice to insure our success.

I would like to thank Phil Pister and the Desert Fishes Council for inviting me here, and giving The Nature Conservancy a chance to explain its program.

## Appendix 1971-14

### How Can The Desert Fishes Council Become More Effective?

The purpose of the Desert Fishes Council is to preserve Desert Fishes. With this purpose in mind the group discussion identified two primary goals of the council as follows:

1. To stimulate public and private agencies and/or individuals to acquire and control (by legal means if necessary) land and water important to the survival of Desert Fishes.

2. To institute a program of information and education designed to build an increasing awareness and appreciation of Desert Fishes by the public.

Pursuant to these major goals, the group identified several specific areas in which work is needed.

1. For each basin containing Desert Fishes, information should be collected and summarized relative to hydrology and biology of habitats containing fishes as well as information on the biology of the fish species present. This process should aim at defining areas where information is lacking and identifying potential problems likely to arise relative to the survival of Desert Fishes. The probable effects of large water-transport schemes on Desert Fishes should be included in the studies. Possibly a committee for each major basin would be appropriate.

2. Desert fish popualations known to be threatened or potentially threatened should be monitored regularly to develop continuing information on their status. This process could be handled largely by volunteer laymen or students, provided standardized techniques for evaluation of the population status were designed.

3. The Council should develop a policy regarding steps that should be taken in efforts to preserve genera, species, subspecies, races and populations. The policy should generally reflect the importance of maintaining fishes in their unaltered native habitat, define the role of transplant sites and aquarium culture in preservation efforts as temporary expedients until all hope of saving the native habitat is gone, consider the role of transplant sites and aquarium culture after all hope of saving the native habitat is gone and consider the relative importance, or relative effort that should be expended, in programs to preserve the various taxonomic units specified above.

4. Consider the techniques, impact and philosophy of attempts to "restore" habitats to their natural condition. This effort should include encouragement of studying ecosystem dynamics in an effort to define the impact of exotic species and predict the effects of their removal as well as the impact of removal attempts on the ecosystem. Also included should be the development of techniques for removing exotic species and for keeping them out.

5. The Desert Fishes Council should develop an information and education program to perpetuate continuing interest in preserving and understanding desert fishes. This program should include the use of all available media in order to gain support from aquarists, conservationists, sportsmen, laymen and all other individuals and groups reachable. It should also include the passage of strong resolutions and vigorous follow-up to insure that the purposes of the resolutions are realized.

6. The Desert Fishes Council should assist in the identification of funding sources available for projects of interest to the Council. The Council should also identify manpower availability that could assist in the realization of research goals.

7. The Desert Fishes Council should retain and develop additional close contacts and informational exchange with state and national legislators, taking care to coordinate efforts with them and acknowledge contributions made by them.

Appendix 1971-15

# Land and Water Development in the Southwestern Desert

by

Gilbert F. Cochran

Historical development of land and water in the West was predicated upon a conscious decision by the Congress of the United States through the Reclamation Act. Western region population growth and economic development was deemed to be in the national good and thus worthy of national support for irrigation and related projects which would promote these objectives. It is doubtful that without such support whether certain southwestern population centers would exist or be nearly their present size today. It seems that the philosophy which brought about this development still exists today even though the national need for such a philosophy may no longer exist.

In the early years of this century the magnitudes of available western water and land resources were large in comparison to the population and its demands on these resources. Planning for water and land resources development was thus principally a matter of preparing population projections or land reclamation plans and then sizing dams and conveyance facilities to meet these needs and harness the available resources. With few exceptions the water resources concerned were in the same drainage basins as the land resources. As population has increased, new and large projects have been conceived and most of them involve transbasin water diversions. Planning for resource development has thus exceeded the capacity of local systems and has begun to bring about major changes in areas other than where population growth is occurring--all of this at very great expense to the general taxpaying public.

The planning process as practiced today really boils down to projecting maximum growth and then planning the restructuring of the natural resource systems to fit the economic objectives. It would seem that a more rational approach, and one consistent with current needs, might be to assess available resources within an area and then plan the growth and development which will fit within those constraints. Such a planning process might avoid many of the costly "retrofit" solutions being attempted today to salvage seriously degraded environments; environments created by development greater than the assimilative capacity of the regions in question. As for example:

(a) smog in the Los Angeles basin,
(b) sewage effluent in Lake Tahoe basin,
(c) the pending water crisis in Lemmon Valley north of Reno, and
(d) the problems being addressed at this meeting.

The sciences of engineering and hydrology have made great advances in the past decade in their ability to examine very complex problems such as the effects of water appropriation on ground and surface-water resource systems. Most of these advances are based upon computer technology, which vastly increases the ability to examine and study the effects of alternative plans of action. Unfortunately, little of this new science is finding its way into the land and water resource planning process; a process which is almost strictly political.

It would seem to be time to re-orient the planning process in the western states at all governmental levels to attempt avoidance of environmental catastrophes, not only those associated with lower life forms but also those associated with human beings.

Appendix 1971-16

# LAW AND THE ENVIRONMENT

by

Larry E. Moss

In 1964 the National Parks Association was refused standing to sue when they attempted to use the courts to defend the Rainbow Bridge National Monument from inundation when Glen Canyon Dam was filled. Today there are significant cases in the courts in relation to the unfortunate power plants in the Four Corners area, an overcommitment of timber resources on the Tongass National Forest in Alaska, the California Water Project, air and water pollution, the Hudson River, Lake Superior, pesticides, and predator control. Obviously, significant things have happened in those seven years.

Laws have been unenforced and ignored for decades, and an increasing public pressure for change has forced issues into the courts. The Sierra Club, with the excellent assistance of Fred Fisher and Don Harris, has been instrumental in the careful development of environmental law in the United States.

The National Environmental Policy Act of 1969 is an innocuous sounding document which has had a great impact on American life. Court decisions have mandated this act be taken seriously and be respected. The Environmental Quality Act of California is modeled after the Federal Act and applies to California. This has not really been used or defined at this time. Palmdale, Ash Meadows, Calvert Cliffs, Parker, Overton Park, Hudson Valley Expressway, San Antonio, the Gila River are recent cases marking significant achievements. The bounty hunting which is allowed under the 1899 Refuse Act has been successfully used to control pollution during the past year.

Problems have arisen which need to be solved. Present laws are hazy and are often used for purposes other than originally intended. Standing to sue for environmental organizations is not presently guaranteed and should be clarified. There is a problem of tremendous cost which remains even though many attorneys volunteer their time. The Attorney General should be prosecuting many of the cases which environmental organizations are presently carrying.

Environmental law has its limitations. Law can only reflect a society and its concerns. If we fail to convince the population that the world needs to be treated with more respect, legal actions will merely be fingers in the dike rather than a path to a more humane society.

I would suggest three specific actions at this time:

(1) Interest an attorney in the problem and convince a Foundation to fund the program.
(2) Approach the State Environmental Quality Study Council to hold hearings on the matter.
(3) Develop a legal program to protect the Death Valley National Monument.

Appendix 1971-17

Prepared by William M. Richardson

Review of Procedures for Processing Collecting Applications.

Panel Members:

| | |
|---|---|
| William Richardson | California DF&G, Chairman |
| Dale Lockard | Nevada DF&G |
| Pete Sanchez | Death Valley National Monument |
| Phil Pister | California DF&G |
| Leonard Fisk | California DF&G |

Panel members emphasized the need for a well founded and well understood procedure for allocating permits to collect desert fishes.

Permits for collection and transportation of all species are required by both federal and state laws. These permits are issued under the concept of wise use consistent with the welfare and safety of the resource.

Collection for scientific research is recognized as an important use of these fishes because it can yield information on life history and habitat requirements that will help perpetuate the species and delineate critical parameters necessary for protection of the habitat.

Ironically, some of the very research that may guide the salvation of a rare or endangered species could conceivably lead to its demise if collection of test specimens is not controlled.

Well meaning, but misguided, collection and transplants could eliminate unique populations through hybridization.

Ongoing research projects could be interrupted and delayed if test specimens are no longer available, or if available specimens are allocated to another project.

It seems advisable, then, to have some plan for overall, advisory guidance in the issuance of permits by the various state and/or federal agencies having jurisdiction. This guidance is available from the Council's Technical Advisory Committee, which is composed of the Executive Committee, two field biologists from separate states, 3 faculty members from educational institutions carrying on research on desert fishes, and 3 individuals selected from the membership at large.

This advisory committee, representing the diverse responsibilities and interests of the academic and governmental sectors, can obtain current information on the status of desert fish populations and needs of researchers and with an overall view suggest priorities for, and limitations on, collections by individuals.

Appendix 1971-19

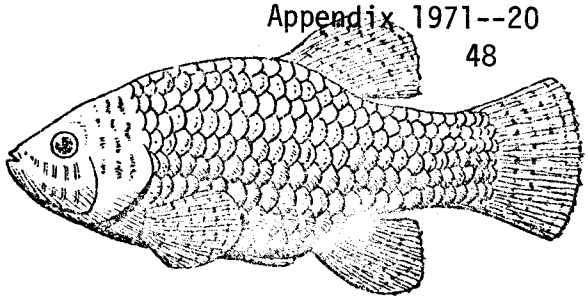
## Review of Procedures for Processing Applications

Applications for scientific collectors permits are sent to Sacramento, where they are processed by the Wildlife Protection Branch. Any request for work other than routine, or on possible threatened species, is given to the appropriate branch (Inland Fish, Wildlife Management, Marine Resources, Anadromous) for their recommendation.

Enaction of the Endangered Species Act of 1970 prohibits the importation, taking, possession, or sale of any animal deemed rare or endangered by the Fish and Wildlife Commission. The only way work can be done by anyone other than Fish and Game Department employees is by a Memorandum of Understanding between the Department and the organization or institution with which the researcher is affiliated. This can be done rather easily, and is coordinated by the appropriate branch in Sacramento.

Prepared by: Leonard O. Fisk
California Department of Fish and Game

# Desert Fishes Council



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

407 West Line Street
Bishop, California 93514
November 26, 1971

RESOLUTION 71-1

Commending James T. McBroom

WHEREAS the preservation of endangered fish and wildlife is a matter of vital concern to the people of the United States, and

WHEREAS the endangered fishes of the Death Valley drainage system constitute a significant portion of this nation's fauna, and

WHEREAS several of the endemic fishes of this system have become extinct during recent years, and

WHEREAS the creation of a special Pupfish Task Force by the Secretary of the Interior in May, 1970 constituted a major step toward the preservation of the remaining fishes, and

WHEREAS the prompt action of this Task Force was instrumental in preventing the extirpation of the Devils Hole pupfish (Cyprinodon diabolis), and

WHEREAS the system of National Parks and Monuments administered by the United States National Park Service constitutes one of this nation's most valuable resources, and

WHEREAS the hydrological research being conducted by the United States Geological Survey as part of this Task Force will provide information basic to the preservation of the major aquatic resources located within Death Valley National Monument and of the aquatic habitats upon which the fishes throughout the Amargosa River system are dependent for their existence, and

WHEREAS the programs and procedures developed in the desert fishes preservation effort will unquestionably be of value in solving and preventing similar problems within the United States, and

WHEREAS James T. McBroom of the Bureau of Sport Fisheries and Wildlife, in his position as Chairman of the Department of the Interior's Pupfish Task Force, has, through his enthusiasm and administrative expertise, been responsible for the many fine accomplishments of the Task Force, and

WHEREAS the progress and success to date of the entire desert fishes preservation program may in large measure be attributed to his untiring and progressive efforts; now therefore be it

RESOLVED that, in recognition of Mr. McBroom's activities in behalf of the national desert fishes preservation program, the membership of the Desert Fishes Council, comprising a nationwide representation of state, federal and university scientists and resource specialists, and representatives of private conservation organizations, herein assembled at Death Valley National Monument headquarters, Furnace Creek, California, during the Council's third annual symposium held on November 16 and 17, 1971, unanimously commends Mr. McBroom for his excellent service and dedication to the preservation of this unique portion of America; and be it further

RESOLVED that Mr. McBroom has, through his actions, proved himself to be a distinct credit to the Bureau of Sport Fisheries and Wildlife and to the United States Department of the Interior; and be it further

RESOLVED that copies of this Resolution be forwarded to the Secretary of the Interior; to the Assistant Secretary of the Interior for Fish, Wildlife and Parks; to the Acting Director of the Bureau of Sport Fisheries and Wildlife; and to Senator Alan Cranston of California.

AYES:

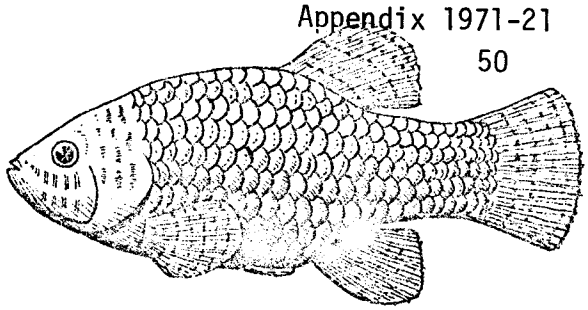
Unanimous

ATTEST:

Edwin P. Pister

Edwin P. Pister
Chairman

# Desert Fishes Council



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

407 West Line Street
Bishop, California 93514
November 26, 1971

RESOLUTION 71-2

Retention of Pupfish Task Force

WHEREAS the Pupfish Task Force of the Department of the Interior has been a key factor in the preservation effort for desert fishes, by reason of its effective role in achieving coordination and cooperation between the diversity of groups involved in this program, and

WHEREAS the full involvement and cooperation of Interior is critical to success in protecting and conserving desert fishes; now therefore be it

RESOLVED that the participants in the Third Annual Symposium on the Rare and Endangered Fishes of the Death Valley System, meeting in Death Valley, California, November 16-17, 1971, urge the Secretary of the U. S. Department of the Interior to retain the integrity and effectiveness of a Pupfish Task Force at a national level in order to achieve interagency communication and coordination, and as an advisory group; and be it further

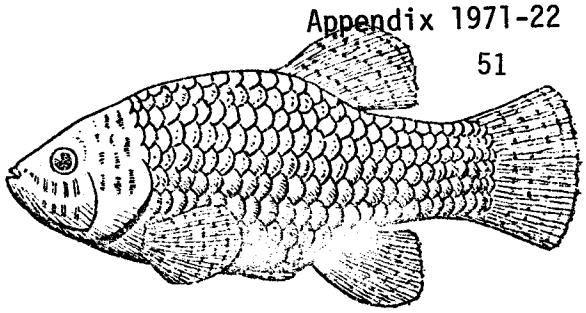
RESOLVED that copies of this Resolution be forwarded to the Secretary of the Interior; to the Assistant Secretary of the Interior for Fish, Wildlife and Parks; and to Senator Alan Cranston of California.

Passed without dissenting vote.

Attest:

Edwin P. Pister
Chairman

# Desert Fishes Council



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

407 West Line Street
Bishop, California 93514
November 26, 1971

RESOLUTION 71-3

CREATION OF A DESERT PUPFISH NATIONAL WILDLIFE REFUGE

The Desert Fishes Council resolves that there should be established a Desert Pupfish National Wildlife Refuge to include approximately 278 square miles for the protection of the Desert Pupfish in the Ash Meadows area of Nye County, Nevada and Inyo County, California, generally as outlined on a map informally prepared by the U. S. Geological Survey on the Desert Pupfish area and buffer zones.

The purpose of this National Wildlife Refuge as endorsed by the Desert Fishes Council is the preservation and perpetuation of several endangered or threatened species of desert fishes; all other objectives normally served by National Wildlife Refuges should be subordinate to this objective.

It is recognized that the establishment of this refuge will require acquisition by the Department of the Interior of the necessary private lands, waters, and interests therein. This will require an increase in the limitation in the Endangered Species Act on funds appropriated to the Secretary for endangered species purposes. We recommend this limitation be raised for the specific purpose of creating the Desert Pupfish National Wildlife Refuge indicated above.

The Desert Fishes Council recommends that the Department of the Interior propose to the Congress that Senator Cranston's bill, S 2141, be amended in accordance with the above.

It is further recommended to the Department that the lands in the Desert Pupfish National Wildlife Refuge, when and if established, not needed for the preservation and perpetuation of the Desert Pupfish, be left undisturbed as a means of preserving an example of a low desert ecosystem.

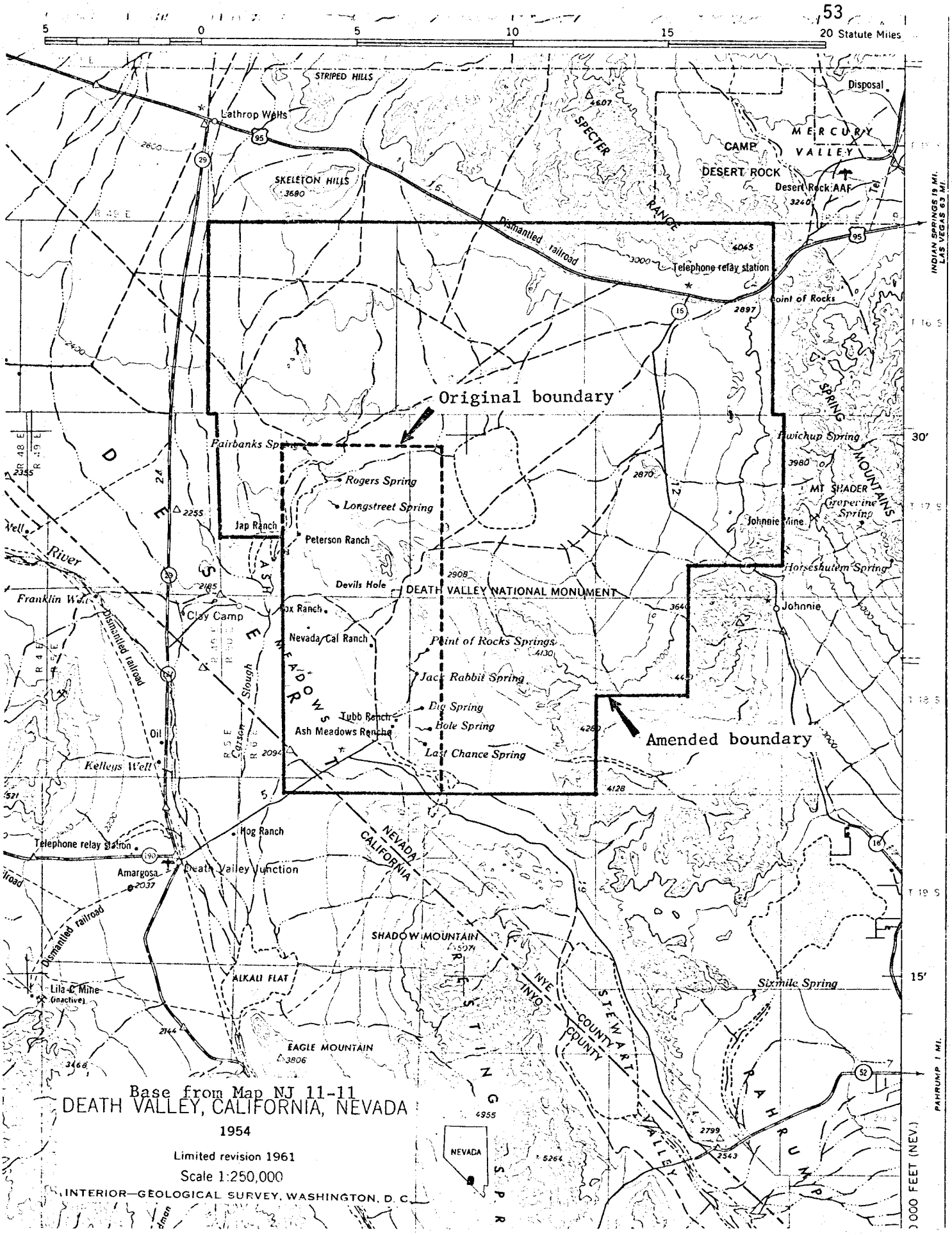
Passed by unanimous vote of the participants in the Third Annual Symposium sponsored by the Desert Fishes Council, concerning the Rare and Endangered Fishes of the Death Valley System, meeting in Death Valley, California, November 16-17, 1971, with the stipulation that copies of this Resolution be forwarded to the Secretary of the Interior; to the Assistant Secretary of the Interior for Fish, Wildlife and Parks; to the Director of the National Park Service; to the Acting Director of the Bureau of Sport Fisheries and Wildlife; to Senator Alan Cranston of California; to Senator John Tunney of California; to Senator Fred R. Harris of Oklahoma; and to Senator Gaylord Nelson of Wisconsin.

Attest:



Edwin P. Pister
Chairman

Map attached.




Base from Map NJ 11-11
DEATH VALLEY, CALIFORNIA, NEVADA
1954
Limited revision 1961
Scale 1:250,000
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.

Original and amended boundaries of the proposed
DESERT PUPFISH NATIONAL MONUMENT
U. S. Geological Survey, November, 1971

# FOURTH ANNUAL SYMPOSIUM

Furnace Creek, California, November 14-16, 1972

## Introduction to the Fourth Annual Symposium

The Symposium was followed on November 23, 1972, by a press release issued by Ralph Young, 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 20, 1972
For Immediate Release

## Twelve Types of Desert Fish Become Extinct

In the past 35 years 12 species or subspecies of desert fish indigenous to the American Southwest have become extinct, according to a leading authority on desert fishes.

Robert R. Miller, Professor of Zoology at the University of Michigan, told of the loss for the first time at the Fourth Annual Symposium of the Desert Fishes Council meeting last week in Death Valley.

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

On Dr. Miller's list of vanished species were:

Empetrichthys merriami, a killifish native to Ash Meadows, Nevada.
Empetrichthys latos pahrump, a killifish native to Pahrump Valley, Nevada.
Empetrichthys latos concavus, a killifish native to Pahrump Valley, Nevada.
Cyprinodon nevadensis shoshone, a pupfish native to California.
Cyprinodon nevadensis calidae, a pupfish native to California.
Cyprinodon macularius macularius, a pupfish native to Arizona.
Gila crassicauda, a chub native to California.
Gila purpurea, a chub native to Arizona.
Rhinichthys osculus reliquus, a dace native to Nevada.
Lepidomeda altivelis, a spinedace native to Pahranagat Valley, Nevada.
Lepidomeda mollispinnis pratensis, a spinedace native to Nevada.
Notropis lutrensis mearnsi, a red shiner native to Arizona.

Dr. Miller noted that several other types of fish, never formally described, also have disappeared in the past few years.

Seventy-four representatives from state and federal agencies, universities and the public at large attended the November 14-15 symposium at Furnace Creek in Death Valley to review progress over the past year and to map plans for next year in the continuing effort to save desert fishes.

Of primary concern to the Council is the dimishing water level in the Death Valley drainage system and the threat it poses to fish that live there.

For the second year in a row, the Devils Hole pupfish, Cyprinodon diabolis, remains at the top of Council's list of fishes most in danger.

The Devils Hole pupfish maintains a precarious existence in Devils Hole, a limestone sink in a detached portion of Death Valley National Monument in Nevada.

Wells in nearby Ash Meadows have reduced the water level in Devils Hole to the point that artificial sunlight has to be used for growing the algae that the tiny fish feeds on. Litigation now in the courts asks that the use of wells to further diminish the water table be forbidden.

It is estimated that only 200 of the fish, that traces its past back to the Pleistocene ice age, now survive.

The 1973 action plan for the Devils Hole pupfish calls for installation of a new spawning shelf, the monitoring of transplants, and a continuing census. The possibility of establishing an artificial refuge nearby is also under investigation.

Second on the Council's endangered list is the Pahrump killifish, Empetrichthys latos, which represents an entire genus that would be lost if the fish became extinct. Populations now exist in Corn Creek and Shoshone Pond.

Other desert fish on the endangered list include the Ash Meadows speckled dace, the Ash Meadows pupfish, the Warm Spring pupfish, the Owens chub, the Owens speckled dace, the Beatty subspecies of the dace, the Amargosa Gorge subspecies of the dace, the Mohave chub and the Owens pupfish.

Of these, only Owens pupfish and Owens chub appear to be assured of survival. Both have been established at the Native Fish Sanctuary in the Owens Valley, where their populations appear on the increase.

In looking toward the future, Dr. Miller introduced a list of 52 threatened fishes of the American deserts, and asked for their consideration at future meetings.

The list includes species native to Mexico, Texas, Idaho, Colorado, Wyoming, and Utah, in addition to California, Nevada and Arizona, those states which have participated thus far in the Desert Fishes Council.

In other business, James St. Amant, Associate Fishery Biologist for the California Department of Fish and Game, was elected chairman for the next two years, and Dr. Miller was elected vice-chairman.

Phil Pister, Associate Fishery Biologist for the California Department of Fish and Game, steps down from chairman to secretary-treasurer of the Council.

Tuesday, November 14

Superintendent Jim Thompson welcomed the group to the Monument and emphasized the great potential for disaster facing the desert fishes. He used as an example the Devils Hole pupfish which, during the past year alone, survived a lowering water level, earthquake, rock fall, flood, and human intrusion.

In facing such problems, he suggested the need for caution and thorough sound action but, due to the urgency of certain of the preservation problems, the Council must also be bold and innovative.

He observed that the preservation effort would not only provide a milestone for its biological accomplishments, but also for cooperative action between public agencies with a common goal.

SESSION I - Progress reports on species preservation assignments made in November, 1971.

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

For this session one individual was given the responsibility of assembling all current information on the status of the species involved and presenting it at the symposium. His name is listed at the beginning of each species report.

1. Devils Hole pupfish, Cyprinodon diabolis

Chuck Osborn, Bureau of Sport Fisheries and Wildlife, Las Vegas

The level of Devils Hole has declined 0.6 feet since last year, showing a "straight line" decline until late July, at which point it stabilized at -3.7. The Alaskan earthquake was tied to a disturbance within Devils Hole which produced water fluctuations so extreme as to damage the water level recorder, demolish the artificial shelf put in last year, and strip the natural shelf of all algal vegetation. Corrective measures undertaken include regrading to put more of the shelf (about 40 percent) under water. The water level is now stable, and a good fish population is present, with some young fish to carry the population through the winter. Dives since April showed numbers down from 400 in April to 200 presently. In addition, the urgency of the preservation program required that 125 be removed for transplant and aquarium projects.

About one half of the artificial shelf was rebuilt with an entirely new one expected to be completed in the near future. The incandescent lights within the Hole were replaced with fluorescent bulbs, to which algal response was quite favorable. Algae growth is now back to normal levels.

Some transplant details were then given. On August 31, 25 fish were taken to Grapevine Spring, and one week later counts ranged from 6 to 8. On November 12, only 4 adults were counted. A likely reason for this is the presence of predaceous insects, primarily immature dragonflies.

Purgatory Spring received 25 fish on June 13, and a shade structure was built to improve the habitat. A change in behavior patterns and increased aquatic vegetation created additional problems in censusing. On August 31, 25 more were placed in Purgatory Spring. On November 13, 30 fish were estimated as the total population. There was also evidence of possible reproduction, as small fish were observed. There is under consideration a new transplant to another spring in the area of Devils Hole.

2. Pahrump killifish, Empetrichthys latos

James F. Yoakum, Bureau of Land Management, Reno

a. Manse Spring in Pahrump Valley contains a population of Pahrump killifish in its native habitat. Latest field evaluations indicate the habitat is in a similar condition as last year and the killifish is likewise in a similar condition.

b. During 1971, a transplant was made to the spring at Corn Creek on the Desert National Wildlife Range. A recent Schnabel population estimate was made by the BSF&W and it is estimated that around 300 fish are present. Gambusia are also present but not dominant.

c. A second transplant of 15 killifish was taken to Shoshone Ponds (east of Ely, Nevada) during the spring of 1972 by the NDF&G. Observation six months later disclosed the fish alive and growing in size.

3. Owens speckled dace, Rhinichthys osculus subsp.

E. P. Pister, California Department of Fish and Game, Bishop

Populations in the Owens Valley are not as depressed as we had thought. Summer surveys of stream systems below alluvial fans show fair numbers, but the situation should be viewed with concern until the subspecies can be firmly established in a refugium. A transplant was made into the Owens Valley Native Fish Sanctuary, but the situation there has remained too unstable to allow fair evaluation because of the vandalistic introduction of largemouth bass and ensuing eradication measures.

4. Tecopa pupfish, Cyprinodon nevadensis calidae

E. P. Pister, California Department of Fish and Game, Bishop

This subspecies is thought to be extinct. Although extensive surveys and collections show no evidence of its existence, the search in the Tecopa area will be continued.

5. Owens chub, Gila bicolor snyderi

E. P. Pister, California Department of Fish and Game, Bishop

Collections were made below Long Valley Reservoir (Crowley Lake) in the Owens River Gorge from the only known remaining pure strain population, and specimens were placed in the Owens Valley Native Fish Sanctuary. Plans are being made to plant this subspecies elsewhere in suitable Owens Valley sites as they are located.

6. Ash Meadows speckled dace, Rhinichthys osculus nevadensis

Dave Lockard, Nevada Department of Fish and Game, Reno

The assignment was made last year to investigate the possible need of a fish barrier to prevent upstream migration of any fishes from Big Springs drainage into Jackrabbit Spring. Due to critically low water levels in the refugium, this was deemed unnecessary. The water level in the springs did not recover when pumps in Ash Meadows were shut down. Approximately 200 R. o. nevadensis were moved into Big Springs from Jackrabbit, and a recent check of Jackrabbit Spring shows a stable population still existing. A check of the Claypit Ponds revealed that the fish there were Cyprinodon, not Rhinichthys.

7. Ash Meadows pupfish, Cyprinodon nevadensis mionectes

Bruce Wolfe, The Nature Conservancy, San Francisco

Action on this subspecies was limited to acquisition of Big Spring by the Conservancy. As soon as the remaining estate is settled (one already has been), a management plan for Big Spring and its fishes will be developed and implemented. The status of the subspecies remains essentially unchanged from last year.

8. Warm Spring pupfish, Cyprinodon nevadensis pectoralis

James F. Yoakum, Bureau of Land Management, Reno

All of this subspecies known to exist are in the following springs in the Ash Meadows area:

a. School Spring: A survey was taken November 8, 1972, by personnel of the NDF&G and BSF&W by the Schnabel population estimate system. It was estimated that around 50 fish were in the chain linked enclosure and 170 in the public view pond. An estimate for the total population of pupfish in School Spring is 500.

b. Mexican Spring: A graduate student working during 1972 estimated that the total fish population for this spring was around 40 in September.

c. Scruggs Springs: No known current population inventory data available.

d. Indian Springs: Dave Soltz' studies for 1972 indicated that in September, around 170 fish occupied this habitat.

9. Mohave chub, Gila bicolor mohavensis

James A. St. Amant, California Department of Fish and Game, Long Beach

The major problem faced by this subspecies has been competition from the coastal chub (Gila orcutti) which has been introduced into the Mohave chub's native range. All efforts to preserve this fish will comprise transplants into both natural and artificial habitats. Toward this end, transplants have been made out of Zzyzx Spring to nine different waters: Paiute Springs, South Coast Botanic Gardens, Lion Country Safari, Dos Palmas Ranch, Two Hole Springs, Busch Gardens, Lark Seep Lagoon, Eaton Canyon Nature Center, and Paradise Spa (Las Vegas).

The Paiute Springs transplant appears unsuccessful due to flood conditions; however, visitors have reported seeing fish in the springs. At best, it is only a temporary refugium because of its susceptibility to flash flooding.

The South Coast Botanic Gardens were planted in 1970 with about 150 fish. They reproduced successfully, but a leak in the pond required its draining. Approximately 5,000 chubs were recovered, and more were introduced after the leak was repaired. Gull predation is now severe (there is no cover), but a number of fish are still there.

The Paradise Spa and Lark Seep Lagoon populations appear to be stable; the Lion Country Safari location remains unsuccessful after three transplant attempts, as does the Busch Gardens location after one attempt. The Dos Palmas Ranch (two ponds were planted there) transplant has not yet been evaluated; however, the water level is constant so there is reason for optimism.

10. Owens pupfish, Cyprinodon radiosus

E. P. Pister, California Department of Fish and Game, Bishop

Populations have been established in five Owens Valley locations, and all appear to be doing well. However, some trouble has been encountered with largemouth bass introductions into the Owens Valley Native Fish Sanctuary.

SESSION II - Review of pertinent litigation

Otto Aho, Field Solicitor, U.S. Department of the Interior, Reno, Nevada

Mr. Aho's presentation is included as Appendix 1972-1.

SESSION III - Possible expansion of areas of direct concern to the Desert Fishes Council. Group discussion.

Co-chairmen: Carl L. Hubbs, Scripps Institution of Oceanography; Robert R. Miller, University of Michigan

Dr. Hubbs expressed a desire to limit the scope of activities of the Council primarily to the fishes and avoid expansion to include other vertebrates. At the same time he advocated expansion of the Council's concern to include all fishes of the Great Basin.

Dr. Miller concurred with Dr. Hubbs' ideas and discussed in detail the avenues open for funding such expansion to form a regional facility in the southwest for rare and endangered fishes. Possibilities exist in the form of grants from I.U.C.N., World Wildlife Fund, or New York Zoological Society. Dr. Miller's proposal for such a facility is included as Appendix 1972-2.

Audience discussion favored limitation to desert fishes and expansion to all areas of Great Basin with the hope that the Desert Fishes Council could serve as a general clearing house and information source for all matters relating to the desert fishes. It is apparent here that a basic concern for ecosystem integrity will tend to assure the preservation of all life forms.

SESSION IV - The Hoover Dam, Mexican Spring, and Shoshone Ponds refugia.

Summaries of the presentations given by Phil Sharpe and Jim Yoakum are included as Appendices 1972-3 and 1972-4.

SESSION V - The progress of land acquisition and land management plans in the Amargosa Basin

Chairman: Clinton H. Lostetter, Bureau of Sport Fisheries and Wildlife, Portland

John Findlay, Regional Director, BSFW, indicated that the land acquisition plan submitted at the last symposium is still awaiting action by the U.S. Senate. Recent Bureau activity consists of reviewing alternatives in light of legal actions during past years. These alternatives include land and water right acquisition as related to preserving desert water habitats. Funding for any acquisitions would have to come from Land and Water Conservation funds which have been exhausted for this year. New legislation now pending in Congress would remove the ceiling from these funds and is

essential for the purchase of lands. BLM funds for acquisition of desert fish habitat must also be worked in with other priority considerations of the Bureau.

Cecil McClaren's presentation for the Bureau of Reclamation is included as Appendix 1972-5.

SESSION VI - The proposed Amargosa Canyon - Dumont Dunes Natural Area

Miriam Romero stated that a pupfish habitat committee was formed in her conservation group following last year's symposium. The Amargosa Canyon area was chosen as an initial habitat to work toward preserving. Inquiries with BLM revealed that the area was designated for off-road vehicle use. In order to demonstrate the area's value as fish and wildlife habitat, on March 14-15, 1972, a species inventory was carried out by a team of volunteer biologists. This work was compiled and submitted to BLM. It clearly showed the area's value with respect to early California history and early Indian societies in addition to its ecological value.

The dunes area was originally included as a buffer zone for the Amargosa Canyon. Additional study revealed the intrinsic value of the dunes themselves. Four district ecosystems, including rare and endangered species of desert flora were found in the Dumont Dunes. They also contain diverse populations of amphibians, reptiles, birds, and mammals. The proposed Natural Area contains many distinctive features not common to adjacent Death Valley National Monument. The backing of all major desert protective organizations has been expressed.

Walt Isaacs of BLM's Bakersfield District reviewed the present status of the Amargosa Canyon-Dumont Dunes area and stated that a Bureau protective withdrawal (not a natural area) might be easier to administer. This would have the benefit of preventing new mining interests from entering the area. Old claims would have to be recognized, but no new claims for mineral rights would be accepted. He was unsure of the situation as it related to off-road vehicle use.

Bruce Wolfe of the Nature Conservancy stated the basic purpose and intent of his organization and also explained their personnel and funding problems. The Amargosa Canyon-Dumont Dunes area would have to be considered along with other possible acquisitions.

SESSION VII - Current programs involving desert species preservation

Chairman: Peter G. Sanchez, U.S. National Park Service, Death Valley

A paper delivered by Frank Groves, Director, Nevada Department of Fish and Game, concerning Nevada's rare and endangered species program is included as Appendix 1972-6.

California -- Almo J. Cordone, Senior Fishery Biologist, California Department of Fish and Game

California's activities in this field were limited before 1970, when two significant acts were passed. The California Species Preservation Act called for an inventory of threatened fish and wildlife species, development of criteria for defining rare and endangered species, and required the Department of Fish and Game to report to the Governor and Legislature every two years on the status of these animals and to make recommendations for their preservation. In addition, the Endangered Species Act indicated strong legislative concern by defining "rare and endangered" gave the Department of Fish and Game authority to determine which animals fall into these categories, and outlined enforcement provisions.

In 1971, Howard Leach and Leonard Fisk, working with regional biologists, drafted a list of 46 animals, including 12 fish, 8 amphibians, and 5 reptiles.

The general statewide recovery program was described, including the environmental protection fund (license plates), which allows 50 percent of its proceeds to be used for habitat acquisition for preservation of rare and endangered species and unique wildlife habitats throughout California.

National Park Service - Francis N. Jacot, Western Regional Office

The Park Service has four programs affecting desert areas of California and Nevada comprising research, park planning, resource management, and laws and enforcement. Those affecting the Death Valley area include a possible study on desert holly, a hydrological and geological study of ground water use, and an evaluation of the effect of backpacking on vegetation. In the Lake Mead area, studies are being conducted on the potential effects of air pollution resulting from the Mojave Steam Plant and the quality of water entering Lake Mead.

At Death Valley, a tamarisk (salt cedar) control program is designed to naturalize the vegetation of the area.

Many similar programs are planned and in effect throughout the Southwest. The Park Service is currently heavily involved in various planning processes.

Bureau of Land Management - Max Bridge, Denver Service Center

Mr. Bridge outlined the picture in New Mexico and Arizona and emphasized problems presented by the complex land ownership along the Gila River. A cooperative endangered species management plan is now underway giving equal emphasis to flora an . Bureau's concern for 87 plants, 66 mammals, 85 amphibians, 165 birds, and 9 fish.

In Arizona, the Aravaipa Canyon is a primitive area, closed to mining and vehicular travel. Seven species of fishes are involved, and the watershed is endangered by grazing and soil instability. Off-road vehicle travel restrictions may be necessary. This area contains the largest number of indigenous species of any stream in Arizona.

Bob Borovicka - Portland Service Center, BLM

A summary of Bob's presentation entitled "Rare and Endangered Fish - Habitat Protection on the Western Public Lands" is included as Appendix 1972-7.

Bureau of Sport Fisheries and Wildlife - John Findlay and Clint Lostetter, Portland Office

A summary of BSFW work in the western desert is included as Appendix 1972-8.

Nature Conservancy - Bruce Wolfe, San Francisco Office

Mr. Wolfe presented a resume of negotiations for Big Spring. His organization hopes to preserve the area for the academic world, but he is in need of ideas for development of a management plan. A major Nature Conservancy project is in the Santa Rosa Mountains near the Salton Sea. This could comprise a 6,000 acre refugium of private and BLM administered lands. Other projects include Aravaipa Canyon, Arizona, and Ash Meadows, Nevada.

SESSION VIII - Coordination of Federal and State species preservation planning

E. P. Pister, California Department of Fish and Game, Bishop

Mr. Pister emphasized the need for extreme cooperation in getting joint state-federal programs off the ground and moving. Perhaps one of the best ways to achieve this is to enlist as much public support as possible, for in the long run it is the public which generates and forms agency policy.

At this point, Mr. Pister interjected a thought from a letter dated November 11, 1972, from Dr. Jim Reveal, Assistant Professor of Botany at the University of Maryland, and one of our staunchest allies in the effort to preserve Ash Meadows.

> "What we have here is a small, actually minute picture of what biologists will be facing in the future. It is minor that some small fish might be removed from this earth by radical exploitation of the environment by a few--but when this exploitation is multiplied, as it is rapidly becoming, it is no longer a mere question of a single fish, but of life itself ... ."

Gene Ruhr, of the Washington Office, BSFW, presented information on the Office of Endangered Species. Apparently, BSFW will concentrate its efforts on the most endangered species. The land management agencies will be

responsible for protecting the habitat of these animals. For any endangered species problem, the basis of operation will depend upon a recovery plan. Mr. Ruhr presented the general outline of the plan, a flow chart for budget preparation, and realistic needs to complete a project. He stated that teams will be formed to manage and implement the plan, and these teams will need the cooperation of all agencies and groups. Steve Taub of the Division of Fishery Services, Washington Office, stated that the Bureau hopes to build a refugium for the endangered Devils Hole pupfish a few hundred feet from Devils Hole.

From the BLM standpoint, Bob Borovicka stated that habitat management plans for rare and endangered species were signed by both state and federal agencies. The session chairman reiterated that land management decisions are all-important in species preservation, inasmuch as a protected habitat preserves everything in it, endangered and nonendangered alike.

Mr. Jacot of the National Park Service mentioned the three types of plans in use by his agency (master plan, wilderness plan, and resource plan) and how rare and endangered species programs were worked into them.

Frank Groves of Nevada Fish and Game mentioned three key points in planning R and E programs:

1. We must have the public behind the program.
2. Too much emotionalism may kill the program.
3. There must be a slowdown in collections of rare and endangered fish.

Jim St. Amant of California Fish and Game made a brief statement on good cooperation he has observed between agencies. He emphasized that hunters and fishermen have been real allies in state R and E programs, because they have funded these programs without protest, although by and large they have little interest in such programs. Jim further explained the operation of the Colorado River Wildlife Council. He described its list of prohibited fish species and regulations prohibiting the sale of native species.

Editor's Note: Much of this subject was covered under Session VII. The reader is again referred to Appendices 1972-6, 7, and 8.

SESSION IX - Interstate planning and water resource management coordination in the Amargosa River drainage

Robert Smith's presentation is included as Appendix 1972-9.

SESSION X - Review of organizational structure of Council and recommended bylaws changes to increase efficiency; election of officers

The Secretary was authorized to amend the bylaws to provide a two-year term for officers and to incorporate whatever changes might be necessary to administer the affairs of the Council throughout the Great Basin.

Officers for 1973-74, nominated by the nominating committee and elected by the Council are:

Chairman: James A. St. Amant
Chairman-elect: Robert R. Miller
Secretary-Treasurer: Edwin P. Pister

Wednesday, November 15

SESSION XI - Discussion of agency needs for a readily available listing of critical habitat areas

SESSION XII - A method of cataloging desert springs for use in transplant and management

Bob Borovicka outlined the agency needs for a listing of critical habitat areas that would be readily available to these agencies.

1. The Desert Fishes Council would be a vehicle to provide an official list of critical areas for habitat of desert fish.

2. Agencies that could use this help would be BLM, U.S. Forest Service, U.S. Bureau of Reclamation, U.S. Army Engineers, Soil Conservation Service, etc.

3. A discussion ensued on how a list should be made and who would make the inventories.

Borovicka presented a method for cataloging desert fish springs and other waters that could be used for transplants or management efforts. Copies of the proposed collection forms were distributed to the audience. It was suggested that a committee be formed to standardize the data collection in the Desert Fishes Council area and make recommendations on how information will be stored.

SESSION XIII - Review of hydrologic research in the Amargosa River Basin

A summary of the paper prepared by W. W. Dudley and G. F. Worts, Jr., U.S. Geological Survey, and presented by Mr. Worts, is included as Appendix 1972-10.

SESSION XIV - Review of current research on desert fishes

Chairman: Robert Feldmeth, Claremont College, Pomona

At the beginning of the session, Dr. Feldmeth observed that preserving the desert fishes is important not only from the conservation standpoint, but also because of what we can learn from them. Inasmuch as they live in fragile or extreme habitats subject to the impact of man, they serve as unusually good indicators of environmental quality.

Robert R. Miller, University of Michigan, Ann Arbor

Dr. Miller reviewed the general biology of Cyprinodon diabolis and stated an opinion that uneven counts in Devils Hole could well be attributable to daily vertical migrations of the fish, which are most active an hour after sunrise and an hour after sunset. Apparently this fish shuns sunlight and spends most of the day between 40 and 80 feet in depth. One male was seen at 85 feet. There are three "shelf" areas in the depths of Devils Hole located at 25-30 feet, 45-50 feet, and 60-75 feet below the surface. Apparently only adults and juveniles make the vertical migrations. This was not observed among very young fish.

Dr. Miller stated that he could not, as yet, find a true Tecopa pupfish (C. n. calidae) and felt that the fish found at Jed's Hot Springs were probably Amargosa pupfish (C. n. amargosae) or an integraded subspecies. The fish, however, are rare, and every effort should be made to protect the populations in the Tecopa Bore area. Tecopa Bore resulted from an artesian well drilled on public land.

Martin Brittan, California State University, Sacramento

Dr. Brittan made a brief statement of his projected research on eye lens protein and electrophoretic work in Cyprinodon.

Robert Behnke, Colorado State University, Fort Collins

Dr. Behnke made an appeal to preserve the genetic diversity of desert trout, the most endangered of which are the interior cutthroat and red-banded trout found in the northern Sierra Nevada of California, southern Oregon, and northern Nevada. He stated that the adaptive behavior of these fish may well have management implications.

Robert E. Brown, Jr., California State University, Fresno

Mr. Brown presented some facts on the Owens pupfish, Cyprinodon radiosus, relative to daily and seasonal behavioral changes in the population. At

Fish Slough, in a cool spring of 60 F, eggs were produced but no territorial behavior was exhibited and no spawning occurred. When water level was increased, creating peripheral areas with fluctuating temperature to above 68 F for 4 hours per day, normal behavior ensued and spawning occurred.

At BLM Spring in Fish Slough, with a constant 72 F temperature, the reproductive season began the third week of February and ended the last of August or first of September, apparently the direct result of the photoperiod.

At Warm Springs (near Big Pine in the Owens Valley), with a constant 83 F temperature, the reproductive season begins about February 1 and continues into October. As the season progresses, territorial behavior and spawning acts increase. Early territories are unstable. After a month or so the territories stabilize.

In a fluctuating temperature habitat (northwest springs in Fish Slough) the fish move from cooler areas (below 50 F) to warmer water. Mortality rates are greatest in males that have reproduced during the previous season and lowest in those that did not reproduce.

David Soltz, University of California at Los Angeles

Mr. Soltz reviewed his work on C. n. pectoralis, which he found to favor a constant temperature. He observed that a fluctuating temperature environment requires the rearing of many young. A stable environment results in a decrease in the reproductive rate of the fish.

He noted that the School Springs habitat had been reduced 50 percent by pumping in Ash Meadows.

Population estimates at Indian Springs ranged from a low of 45 to a high of 170. He found a three-fold increase in population size in a habitat of constant size (spring) as opposed to a ten-fold increase in a habitat of fluctuating size (Amargosa River). From this he concluded that environmental stress stimulates spawning. Dr. Miller confirmed this observation and noted that within a week after the Alaskan earthquake, which destroyed the artificial shelf in Devils Hole, spawning was indicated.

Shelby D. Gerking, Arizona State University, Tempe

Dr. Gerking reviewed his research on thermal tolerance of fish in Pupfish (Cottonball) Marsh (Death Valley) and noted that it had been published in Copeia. He also stated that the Amargosa pupfish (C. n. amargosae) is a good laboratory animal and is being successfully reared at A.S.U.

Dr. Feldmeth reviewed his studies of the effect of temperature fluctuations on thermal tolerance in pupfish to check adjustment mechanisms in the fish.

Robert Naiman, Arizona State University, Tempe

Mr. Naiman's research summary is included as Appendix 1972-11.

SESSION XV - Progress report by cooperating aquarists

Al Castro of Steinhart Aquarium reviewed his work with C. diabolis. He obtained 14 fish in August, 1971, and by November had only 11. He found production of eggs adequate but development virtually non-existent. Synthesis of aquarium water in an attempt to match Devils Hole water did not work. Actual Devils Hole water was substituted. By May, 1972, only three fish had survived. One C. diabolis hatched out (see Appendix 1972-12) and lived for five months. Observations indicate that C. diabolis prefers gravel for spawning.

Robert E. Brown, Jr., from Fresno State, summarized Dick Haas' aquarium work. On May 22, 1972, 24 C. diabolis were transferred to Fresno State's aquarium facility. The poor condition of these fish upon arrival improved during initial feeding. One tank broke during the summer with a substantial loss of the original stock. Matching photoperiod with light similar to sunlight produced one egg that hatched and several to the point of hatching. Artificial spawning habitat has not produced successful spawning. Dr. Haas will match aquarium light intensity with light levels around Devils Hole as the spring spawning period approaches. A total of 14 fish remains as a breeding stock.

SESSION XVI - Review of current desert protective legislation

Council member Bob Jennings, of Congressman Bob Matthias' office, was unable to be present but forwarded some very helpful information to the symposium. In Bob's absence, Miriam Romero summarized the current legislative picture.

There are approximately 11 million acres of California desert under the administration of BLM. Many valuable sites within this area are threatened by various recreational uses. In 1971, Senator Jackson introduced S.B. 921, the Public Domain Lands Organic Act, which provided funds for master planning BLM land and gave authority for a patrol force to cite anyone in violation of the provisions of the act. This bill died in committee.

H.R. 1312 (Goldwater), introduced in January, 1971, provided for arrest and punishment of violators, and other bills were introduced along the same lines. These bills, along with a reintroduced form of Senator Jackson's bill (S.B. 2401) died in committee.

With pressures for reelection over as the 93rd Congress convenes, Senator Cranston hopes to introduce a comprehensive bill with the support of the above legislators.

SESSION XVII - Fishes of the American desert

Chairman: Robert R. Miller

Dr. Carl Hubbs gave a general overview of the subject and noted that the four endemic fishes of the Owens Valley system (with the exception of the Owens dace (R. o. subsp.) are now given official recognition as a result of a recent publication by Bob Miller. Joining C. radiosus are the Owens chub, Gila bicolor snyderi, and Owens sucker, Catostomus fumeiventris.

Dr. Hubbs made further reference to the opus concerning the fishes of the northcentral Great Basin which is soon going to press. This paper will be authored by Carl Hubbs, Robert Miller, and Laura Hubbs and will give the status of all the fishes found in that extensive area.

Dr. Robert Behnke reviewed the pluvial history of the Great Basin and discussed trout speciation in light of this, reviewing speciation characteristics in the Lahontan cutthroat trout (Salmo clarki henshawi) and their natural history. The evolutionary history of trout in the Lahontan Basin was contrasted with that in the Bonneville Basin. He further stated that the Alvord form (one of two distinct subspecies from the Alvord Basin) is now extinct. Dr. Behnke then gave a slide presentation on the Lahontan, Bonneville, and Alvord trout, their habitats, and details of recent transplants, including the habitat of the red-banded trout of northern Nevada, which lives in a water temperature of 83 F. He mentioned the possibility of expanding the habitat of this genotype to include desert farm ponds and concluded his presentation by quickly reviewing the Greenback trout reestablishment program.

Dr. Deacon, of the University of Nevada (Las Vegas), offered some additions to the endangered species list reviewed earlier by Dr. Miller.

Dr. Minckley, of Arizona State University, stated that Mexico needs the support of the Desert Fishes Council as legislative attempts are made to define and regulate usage of the Mexican deserts. Also needed is a continuing surveillance on threatened fishes throughout the North American deserts. The last drought alone in Arizona reduced five species to a critically low level, and he stated that the Colorado River squawfish (Ptychocheilus lucius) is nearly extinct in Arizona. He voiced a hope that an attempt will be made in an Arizona hatchery to rear squawfish from a stock in Utah. Arizona has attempted to spawn and reintroduce both the squawfish and razorback sucker (Xyrauchen texanus).

Dr. Minckley mentioned a cooperative effort between Arizona State University, the Arizona Zoological Society, Arizona Fish and Game, and the Phoenix Zoo to construct a 27-acre area as a refuge for threatened desert fishes at the Phoenix Zoo. It would be strictly a zoo-type situation with "below surface" observation of fish in a natural condition. This would also include a lotic habitat for stream-dwelling species. Water for the refuge would be obtained from a city source prior to chlorination, and pesticides would be removed.

SESSION XVIII - Preparation and implementation of the 1973 action plan for species preservation

A priority history of endangered Death Valley system fishes and species preservation assignments follow.

1. Cyprinodon diabolis, Devils Hole pupfish.

   Primary responsibility lies with Cal Allan of Nevada fish and Game, who will coordinate the preservation effort for the species. Additional responsibility is as follows:

   National Park Service: Bob Miller (Collaborator) will continue to census the Devils Hole population, and Dean Garrett will assist in monitoring the populations at Purgatory and Grapevine springs.

   Bureau of Sport Fisheries and Wildlife: Clint Lostetter and Chuck Osborn will assist in a variety of ways. Chuck, especially, will assist in field preservation projects in the Ash Meadows-Las Vegas area.

   California Fish and Game: Phil Pister will attempt to locate any remaining fish in Upper Warm Spring (Saline Valley) and will assist in obtaining approval for importation in any additional aquarium projects within California.

   Bureau of Reclamation: Herb Guenther and Phil Sharpe will be primarily responsible for the Hoover Dam Refugium, along with BSFW and Nevada Fish and Game personnel.

   Bureau of Land Management: Jim Yoakum will assist if an additional refugium is constructed near School Spring. California State Office personnel will work with Phil Pister in evaluation of the Upper Warm Spring Refugium.

   Al Castro of Steinhart Aquarium and Dick Haas of California State University, Fresno, will complete their current projects and be on hand to assist if the Devils Hole population is adequate to allow further aquarium culture.

2. Empetrichthys latos, Pahrump killifish.

   Chuck Osborn of BSFW and Cal Allan of Nevada Fish and Game will monitor the Corn Creek and Manse Spring populations. Don Cain of BLM and Nevada Fish and Game personnel will monitor the Shoshone Ponds refugia near Ely, Nevada.

3. Rhinichthys osculus nevadensis, Ash Meadows speckled dace.

   Cal Allan of Nevada Fish and Game, with the assistance of Chuck Osborn of BSFW, will re-establish a population in Fairbank Spring and will introduce them into Corn Creek. They will also investigate the possibility of aquarium culture.

4. Cyprinodon nevadensis mionectes, Warm Spring pupfish.

   Mike Wright of the Nature Conservancy will continue with the purchase of Big Spring. Cal Allan and Chuck Osborn will make a general assessment of the various populations, using Jackrabbit Spring as a source for transplants within the Ash Meadows area. Aquarium culture will also be investigated.

5. Cyprinodon nevadensis pectoralis, Warm Spring pupfish.

   BLM (Jim Yoakum) will continue protective measures in effect at School and Mexican springs. The Chairman of the Desert Fishes Council (Jim St. Amant) will draft a letter or resolution to the Nevada State Director of BLM recommending a withdrawal of all spring sites containing desert fish populations, plus all those suitable for transplants. An additional letter will be sent to Mike Wright of the Nature Conservancy requesting that the Conservancy purchase the water rights on School, Scruggs, Mexican and Indian springs.

6. Gila bicolor snyderi, Owens chub.

   Phil Pister will continue to collect this fish from the old Owens River channel below Crowley Lake Dam and introduce it into the Owens Valley Native Fish Sanctuary and other natural habitats within the Owens Valley.

7. Rhinichthys osculus subsp., Owens dace.

   Phil Pister will continue to locate remnant populations and will introduce the subspecies as above.

8. Rhinichthys osculus subsp., Amargosa River near Beatty, Nevada.

   Nevada Fish and Game personnel (presumably Cal Allan), assisted by Chuck Osborn, University of Nevada (Las Vegas) and possibly Death Valley National Monument personnel, will inventory appropriate areas and send collections to Bob Miller for study and classification.

9. Rhinichthys osculus subsp., Amargosa River Gorge, below Tecopa.

   Phil Pister, assisted by Chuck Osborn and possibly UNLV and Death Valley National Monument personnel, will inventory appropriate areas and send collections to Bob Miller for study and classification.

10. Gila bicolor mohavensis, Mohave chub.

    Jim St. Amant and California Fish and Game personnel will inventory existing populations and investigate the desirability of creating new refugia.

11. Cyprinodon radiosus, Owens pupfish.

Phil Pister will continue with the program currently underway to establish the species in areas throughout its former range. The California Department of Fish and Game and the Inter-Agency Committee on Owens Valley Land and Wildlife are negotiating for the acquisition of privately held land within Fish Slough, the location of the Owens Valley Native Fish Sanctuary, as an initial move toward establishing the entire Fish Slough area as an ecological reserve. The Owens Valley Native Fish Sanctuary is already designated as an ecological reserve.

Council Chairman Phil Pister then concluded the regular meeting by turning over the chairmanship for the next two years to Chairman-elect Jim St. Amant. Pister's concluding comments are included as Appendix 1972-13.

A field trip to the Ash Meadows area was conducted on Thursday, November 16.

A list of persons attending the symposium is included as Appendix 1972-14.

Appendix 1972-1

SUMMARY OF TOPIC ASSIGNED TO OTTO AHO, FIELD SOLICITOR, INTERIOR DEPARTMENT, AT "PUPFISH CONFERENCE" AT DEATH VALLEY NATIONAL MONUMENT, NOVEMBER 14 AND 15, 1972

"PUPFISH LITIGATION"

The Government filed on August 18, 1971, a complaint against Spring Meadows, Inc., in the U.S. District Court, Las Vegas, to enjoin the pumping of water from underground sources from Spring Meadows wells Nos. 4, 5, and 6. On August 31, 1971, the parties entered into an agreement whereby wells Nos. 4, 5, and 6 would not be pumped during 1971 and 1972 without 30 days notice to the Government. The agreement allowed the Government to seek court action requiring the closing of additional wells should the need arise.

The temporary shut-down of the three wells did not halt the lowering of the water in Devil's Hole and the Government filed the present action entitled United States v. Cappaert, et al., Civil LV 1687, U.S.D.C., Nevada. In the present action, the Government asserts a claim of right to the use of so much of the waters of Devil's Hole and the underground aquifers that supply it, as is or may be necessary to maintain the Devil's Hole pupfish population, with a priority date of January 23, 1952. On the latter date, there was published in the Federal Register the Presidential proclamation of withdrawing the 40-acre tract that constitutes Devil's Hole from the public domain, and making it a non-contiguous part of Death Valley National Monument. The Government asserts its claim to the water on the basis of the "implied reservation doctrine", both as to surface and underground water. When President Truman withdrew the 40-acre tract for the purpose of preserving the unique Devil's Hole pool and the unique desert fish therein, this necessarily implied the reservation of water to accomplish the purposes for which the monument was established.

The Government seeks a preliminary injunction to enjoin the pumping of wells 1, 2, 3, 4, 5, 6, 16 and 17, all located within 2½ miles of Devil's Hole and to enjoin the defendants from all diversions and use of water from springs and aquifers in secs. 28, 33, and 37, T. 17 S., R. 50 E.; secs. 31 and 32, T. 17 S., R. 51 E.; secs. 2-4 and 9-15, T. 18 E., R. 51 E., except for domestic purposes. As a minimum, the Government seeks to enjoin the pumping from wells 1-6, 16 and 17 and all diversions and uses of waters from springs and aquifers by pumping in sec. 34, T. 17 S., R. 50 E.; secs. 31 and 32, T. 17 S., R. 51 E.; secs. 2, 3, 11-14, T. 18 S., R. 50 E.; and secs. 5-8, 17 and 18, T. 18 S., R. 51 E., except for domestic purposes.

The defendants contend:

1. The 1952 Presidential Proclamation did not add Devil's Hole to the Death Valley National Monument for the preservation of the pupfish, but for the purpose of protection of the underground pool.

2. President Truman did not intend to reserve water underneath thousands of acres of land for the purpose of preventing the shelf in Devil's Hole from becoming exposed.

3. Unless the Presidential Proclamation evidences an intent to reserve appurtenant water to keep the water level above the shelf, the reservation doctrine does not apply. There is no such intent, expressed or implied, in the Proclamation. It is the cavern and the underground pool which was intended to be protected by the Proclamation--not the fish, nor the shelf.

4. The reservation doctrine should not and cannot be applied to percolating waters. The reservation doctrine applies only to surface water.

5. Defendants have a right to withdraw percolating water as a property right incidental to ownership of its lands. The only constraints upon the exercise of this property right are those imposed by the Nevada laws, with which the defendants have complied.

6. The percolating waters passed with the patent issued to the defendants by the Government under the exchange. The patent reserved no waters.

7. The Government knew the defendants intended to use the exchanged Government lands for the grazing of cattle and the growing of feed for such purpose. The Government should be estopped from seeking to prevent such use.

8. The reservation doctrine does not apply and the Government will not prevail ultimately. The preliminary injunction should not issue. The issuance will cause enormous irreparable damage to the defendants.

In reply, the Government contends:

1. The 1952 Presidential Proclamation was intended to protect and preserve the pupfish as well as Devil's Hole.

2. The reservation doctrine applies to both surface and underground waters.

3. As of January 23, 1952, the date of the Proclamation, the United States reserved the lands along with the water from the underground aquifer sufficient for the purposes of maintaining the pool and the pupfish population. Thereafter, no right to the use of such reserved water could be acquired against the United States.

4. The exchange was initiated by the defendants--not the Government. No showing that the Government knew for what purposes the Government lands were desired by the defendants.

5. When the exchange was advertised, the NPS protested the exchange that it would be detrimental to the pupfish. The exchange was modified for this purpose in accordance with the then available information. The defendants were well aware that the Government wanted to protect the pupfish.

5. The Government patent could not and did not grant any water rights.

## STATE "LITIGATION"

Cappaert Enterprises filed applications 26609 and 26610 on March 14, 1972, to change the point of diversion of certain waters heretofore appropriated by Cappaert Enterprises. Protests were filed by both the NPS and the Nevada Department of Fish and Game on the grounds that the allowance would endanger further the pupfish in Devil's Hole.

On September 21, 1972, the State Engineer dismissed both protests stating that:

> "The places of use under Applications 26609 and 26610 are covered by numerous other rights. Applications 26609 and 26610 are both applications to change the point of diversion of prior existing rights. The changes proposed therein do not constitute an expansion of acreage nor will they provide for additional permitted withdrawal of water from the groundwater basin. In addition, the applications propose to change a total of 12 c.f.s., but not to exceed 700 acre feet per year withdrawal to a distance further from the Devil's Hole National Monument."

Appendix 1972-2

Banff, Canada
IX:9:1972

# Proposal to IUCN-WWF for a Regional Facility for Rare and Endangered Fishes

by

Robert Rush Miller
Chairman, Freshwater Fish Group
SSC, IUCN

The native fish fauna of the American Southwest, particularly that of the Colorado River basin, is dying and its distinctive (endemic) elements may be virtually wiped out within the next decade if positive action is not taken promptly.

Many of the species occupy small and fragile habitats, or are now restricted to a minute fraction of their original distribution, and are unable to adapt to introduced aggressive exotic species or to habitat modifications.

At least 5 species and 8 subspecies in 7 genera--of a limited but evolutionarily interesting fish fauna--have become extinct within the past 5 to 35 years in 6 southwestern states.

According to Agenda paper CSS 72/12, World Wildlife Projects 1972/73, less than 6% of the total proposed funding for 35 animal and plant species projects is devoted to fishes. Yet there may well be as many threatened fishes as there are threatened mammals which, with reptiles and amphibians, are slated to receive almost 75% of this funding.

No money has yet been directly allocated for saving endangered fishes in the United States (though this situation is expected to improve very soon).

Thus fishes, both freshwater and marine, have been the most consistently neglected group of vertebrates in conservation programs. Funding for them is, consequently, long overdue and their plight is particularly critical because aquatic habitats are especially susceptible to degradation by man.

Because the situation in the Southwest has now become desperate it is herewith proposed that a preliminary study to establish a regional facility for threatened fishes of the Southwest be funded as quickly as possible. A sum of $5,000 would permit the Phoenix Zoo to develop, engineer, and plan for a refugium for up to 20 species to be held and cultured until their original habitats are restored or suitable natural environments are found (or are created) for them.

This aquatic facility would also be used for--insofar as possible--other threatened aquatic organisms, such as mollusks. Reintroduction into the

wild following rehabilitation programs as well as the opportunity to identify ecological requirements would result from such a project.

Polluted, channelized (or otherwise altered) streams can be rehabilitated as, for example, by using flows from well-operated sewage disposal plants. Effluent from such plants after passing downstream for a relatively short distance--perhaps including subsurface flow--can provide excellent permanent water for endangered species. Changing industrial practices suggest the possibility for cleaning up certain sections of streams heretofore uninhabitable for endangered fishes. The critical need now is for a suitable facility for holding endangered populations for a few years.

Perhaps 20% of the $5,000 should be used for construction and purchase of temporary holding facilities to house the most critically endangered species.

A funding level of this magnitude would permit the Phoenix Zoo to plan the facility and to guarantee that the acreage they have already designated to be used for the propagation of endangered species would, in fact, get a rapid start in that direction.

The funds would be administered through the Lower Colorado River Basin Laboratory of Arizona State University, of which Prof. W. L. Minckley is Director. No overhead would be required, the funds being passed in their entirety to the Phoenix Zoo for planning purposes. Arizona State University (through Dr. Minckley) and the University of Nevada at Las Vegas (through Prof. James E. Deacon) would provide transportation to move critically threatened fishes to the temporary holding facilities. These populations are already identified and are being monitored.

Subsequent funding for a permanent facility would depend on the Phoenix Zoo, governmental agencies (both federal and state), and private sources. It is felt that if the $5,000 seed money can be provided the project will blossom into a major facility at the Zoo (which is already involved in the propagation of the Arabian oryx).

Appendix 1972-3

# STATUS REPORT OF THE DESERT PUPFISH SANCTUARY CONSTRUCTED BY THE BUREAU OF RECLAMATION BELOW HOOVER DAM, CLARK COUNTY, NEVADA

by

Phil Sharpe
U.S. Bureau of Reclamation, Boulder City

It has only been one year since my first participation with the Desert Fishes Council. A lot has transpired since this time last year. It is a very pleasant experience to participate with this group. This is one meeting where every individual and agency attending is working toward the same goal.

We have attempted to provide each of you with a copy of the chronology of events associated with the construction, testing, and initial operation of the refugium below Hoover Dam. I will touch on a few of these events briefly. You are all familiar with the original drafting of plans and other events leading up to the allocation of funds by the Bureau of Reclamation for construction of the refugium. Most of this had transpired by last year's meeting. Since that time, the plans were much altered and redesignated to include improvements and suggestions offered by representatives of the Nevada Department of Fish and Game, the Bureau of Sport Fisheries and Wildlife, and other members of the Desert Fishes Council.

After we had advertised and opened bids, we discovered the estimate of $7,500 as allocated by Reclamation was not adequate to cover the low bid of $10,486. We contacted and explained the problem to Mr. Del Rasmussen in Portland. The Bureau of Sport Fisheries and Wildlife was quick to transfer the additional $3,000 needed for this project. With this procedure in order, the contract was awarded and construction began on July 11, 1972. Construction was completed on August 22, 1972. The total cost for the actual construction phase of the project was $10,476.

Following construction, the sanctuary was filled with water and scrubbed intensively with wire brushes and flushed several times. Scuba gear was utilized to clean the lower end, or in the deep section of the tank. Upon refilling, continued monitoring of water temperature was initiated on a 24-hour basis. After the monitoring program was started, we were confronted with the problem that the water temperature exceeded 98 F. After considerable analysis and much manipulation, we found that by increasing or decreasing the flow rate we could control the temperature in the tank. The installation of a V-notch weir enabled us to determine the various flow rates. In fact, Mr. Guenther and his associates have been able to regulate the water temperature within the range of that considered ideal for the pupfish.

In a cooperative venture in late September among Nevada Department of Fish and Game, BSFW, National Park Service, and Reclamation, substrate from the spring itself was transferred to the sanctuary. After the substrate was leveled properly and the water condition was considered to be adequate, planarians and algae from Devil's Hole were introduced into the aquarium.

On October 2, 1972, after several days' observation of the amazing growth rate of the algae in the tank, seven pupfish were collected from Devil's Hole and transported to the site by automobile and the bioassay was begun. By October 8, two of these fish had died. Those remaining were active and appeared to be healthy. On October 13, following the successful bioassay period, 20 adult pupfish were collected at Devil's Hole, again by the same agencies, and transported to the refugium in the Bureau of Reclamation's helicopter. The result of this plant was 1 dead pupfish that was observed on October 15. Shortly thereafter, additional planarians, snails, and beetles, collected from Devil's Hole, were introduced into the refugium by Chuck Osborn, BSFW.

By October 21, it appeared that the transplant had been successful. In fact, we were pleasantly surprised to discover that reproduction was taking place in the tank. Almost daily observations were continued until Sunday, November 12.

During the first part of November, a concentrated effort was made to count the fish that were remaining in the refugium. At that time, a consolidated count revealed 20 to 24 fish. These counts were made by five biologists, each counting in a specific area of the tank.

In summary, the activities of the sanctuary as of November 12, are as follows: the food supply in the refugium was abundant and viable; there were approximately 20 to 24 adults and four young. The water temperature at the time was 92°F. Spawning behavior has once again begun following a brief period of inactivity.

The Bureau of Reclamation has made no attempt at news releases regarding the success of the refugium. We now anticipate a news release which will include input from the Nevada Department of Fish and Game and BSFW. The news release will simply present the status of the refugium and its inhabitants. The success of the refugium will depend upon the survival of enough young to sustain a population on a long-term basis.

At this time, the Bureau of Reclamation is making a formal request to the cooperating agencies to implement the operation and maintenance sections of the agreement. The agreement is explicit in outlining the responsibilities of the three agencies. The Bureau of Reclamation is much concerned with the success of the refugium and is looking forward to continued cooperation in this endeavor. However, at this time we must officially turn over the operation and maintenance responsibilities of the project to the Nevada Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife. This determination in no way deemphasizes the interest and support of Reclamation. We intend only to avoid becoming involved in the fish and wildlife responsibilities of a cooperating agency.

Reclamation has certainly gained from our experience with this project, and the cooperative nature of the various agencies and of the Desert Fishes Council. We look forward to the continued cooperation and success on this refugium. With continued attention and cooperation, we will have given the refugium its best chance.

Mr. Herb Guenther, Fish and Wildlife Biologist for the Environmental Office of the Bureau of Reclamation, has been very, very close, in fact, intimately involved with this refugium and the success of the program. In fact, I think Mr. Guenther has slept with the pupfish several nights. He has a very interesting series of slides that he would like to show you. If there are questions regarding any phase of this project, we will be most happy to try and answer them for you, either in this discussion or at a later time.

There are three informal recommendations that need to be accomplished prior to a total success of this program and I list them for your consideration. No. 1 is a program for surveillance of the sanctuary until its characteristics are well enough known so a frequency of observation pattern can be established.

Second is the need for an electrically controlled thermostat that will increase or decrease inflow of spring water in relationship to the desired temperature. The third is the need to replace the plywood covers with fiberglass or any material that would have a less toxic potential during heavy rains. These are all serious and pressing recommendations, and I hope that during this session of the Desert Fishes Council, they will come under serious scrutiny and a resolution of these problems can be accomplished.

## Chronology of Events for the Endangered Desert Pupfish Refugium Below Hoover Dam

| Observations - Young Pupfish | Date |
|---|---|
| First young pupfish observed - approx. 4 mm (Guenther) | 10/21/72 |
| Two young pupfish observed - both approx. 4 mm (Guenther) | 10/22/72 |
| One young pupfish observed - approx. 4 mm - 18 adults counted (Guenther) | 10/24/72 |
| Two young pupfish observed - both approx. 4 mm - one darker (Guenther, Jones) | 10/25/72 |
| One young pupfish observed - approx. 4 mm (Guenther, McClaren, Fulcher) | 10/26/72 |
| One young pupfish observed - approx. 7 mm (Osborn-Guenther) | 10/27/72 |
| One young pupfish observed - approx. 5 mm - being consumed by adult female four inches below water surface on south wall (Guenther) | 10/28/72 |
| One young pupfish observed - approx. 5-6 mm (Guenther) | 10/29/72 |
| One young pupfish observed - approx. 7 mm (Guenther) | 10/30/72 |
| Two young pupfish observed - one approx. 5 mm and the other approx. 7 mm - one additional possible observation - approx. 4 mm (Guenther) | 10/31/72 |
| Two young pupfish observed simultaneously - one approx. 8 mm and the other approx. 6 mm - one other observed later and appeared smaller - approx. 4 mm (Guenther-Romero) | 11/3/72 |
| One young pupfish observed - approx. 7 mm (Guenther) | 11/5/72 |
| One young pupfish observed - approx. 5 mm (Allen, Sitton, Guenther) | 11/6/72 |
| Three young pupfish observed - one approx. 7 mm, one approx. 9-10 mm, and one approx. 4 mm (Guenther) | 11/9/72 |
| Four young pupfish observed - one approx. 11 mm, two approx. 4-5 mm, and one approx. 10 mm free swimming (Guenther) | 11/12/72 |

Summary

Food supply abundant and viable - 20-24 adults surviving - 4 young surviving - water temperature 92°F - spawning behavior reduced, some chasing and one pair in serious breeding behavior 11/12/72

Ken Fulcher
Cecil McClaren
Bob Jones
- Bureau of Reclamation, Boulder City, Nevada

Appendix 1972-4

# A STATUS REPORT ON THE MEXICAN SPRING AND SHOSHONE POND REFUGIA

by

James F. Yoakum
Bureau of Land Management, Reno

MEXICAN SPRING: is a natural spring located a few hundred yards north of School Spring. This spring runs only about 15'. During the 1971 Desert Fishes Symposium, a recommendation was made for fencing of this spring. This was accomplished this year. The spring was also piped from the end of the flow to a pool (some 4' in diameter) down elevation. Litter and trash in the surrounding area was collected and hauled away.

SHOSHONE PONDS: are located some 60 miles east of Ely, Nevada. The refuge includes warm artesian waters from a drilled well and three ponds constructed in 1971. These ponds were stocked in 1972 with the following: 15 Pahrump killifish; 20 Moapa dace; and 20 Pahranagat bonytail. The success of these transplants will depend on species survival and reproduction which must wait for a later date for a true evaluation. This entire project to "create" habitat for endangered endemic fish is the result of a "Habitat Management Plan", cooperatively accomplished by personnel of the Nevada Department of Fish and Game, University of Nevada at Las Vegas, and the Bureau of Land Management.

Appendix 1972-5

# Status Report of Amargosa Project Study

by

C. E. McClaren

I am pleased to bring you a brief report on the Bureau of Reclamation's Amargosa Project Study. The study was initiated as a result of the interest expressed by the State of Nevada in the ground water in the Amargosa Valley as a source of supply for irrigation, municipal, and industrial use. These investigations are particularly concerned with the conservation, development, and management of the land and water resources in the valley.

Since our report last year, we have concentrated on the ground-water study. We have been working with the Geological Survey Service on expanding the existing gravimetric study of the area, particularly southwest of Lathrop Wells. Using our own men and a gravimeter which the GS loaned us, we ran additional stations for greater detail in the area of concern. As a result of this additional work, we have located and started drilling a test hole about 4 miles southwest of Lathrop Wells. We plan to drill to bedrock, taking soil samples all the way. It is expected that the depth will be around 1,800 feet. Also, we will take water samples and expect to run several logging tests and some pump tests to determine the quality and quantity of water in the area and the character of the saturated sediments.

Hopefully this will help us in determining the configuration of the ground-water basin and the inflow-outflow characteristics, the source of recharge, and the interrelationship with the adjoining areas.

Appendix 1972-6

# NEVADA'S RARE AND ENDANGERED SPECIES PROGRAM

Frank W. Groves, Director
Nevada Department of Fish and Game

Perhaps the first active step taken by the State of Nevada relative to rare and endangered species was in 1946 when research was started on the declining Pyramid Lake cui-ui to gather life history information on this endemic species. This was followed in 1947 by the transplanting of Railroad Valley pupfish from Lockes Spring in Railroad Valley in eastern Nevada to ponds at Sodaville in western Nevada as proposed developments in Railroad Valley threatened the native home of this species.

In 1954, a strain of cutthroat trout was found in Pine and Ridge Creeks in White Pine County that appeared to be quite different from other cutthroat with which we were familiar. Therefore, in order to protect them, a prohibition was placed on stocking the two streams and they were closed to fishing. These restrictions have existed since that time and today it appears, according to various fish taxonomists, including Dr. Robert Miller, that we may have a distinctive strain of cutthroat particularly adapted to a stream environment.

Also in connection with rare trout, the Department has developed a program for the utilization of the Lahontan cutthroat species as well as its preservation. This fish is now normally hatched and reared at our Verdi Hatchery for stocking primarily into Pyramid and Walker Lakes. In addition, pure strain broodstocks of this species have been developed and it is no longer under the threat of extinction that was formerly the case.

In 1964, the Department became further involved with rare and endangered fishes when it took concern over a newspaper article regarding a diver who had released a dye 100 ft. deep in Devil's Hole in an effort to determine if the water of Devil's Hole was connected to other artesian flows in the area. The Department was afraid that repetitions of this procedure may result in the elimination of the pupfish population of Devil's Hole if some toxic dye was used. They therefore contacted the Park Service and Clark Hubbs to express their concern and point out the hazard.

In 1967, the Commission adopted a Commission Policy relative to rare and endangered species of fish. This was done in cooperation with Dr. James Deacon of the University of Nevada at Las Vegas and was aimed at giving protection to many of the endemic fishes of Nevada. Later the Commission passed a regulation which placed 15 species of endemic fishes on the fully protected list.

In connection with refugiums, the Department, with the cooperation of the University at Las Vegas, constructed a pool and related facilities for the protection of the White River Springfish on the Kirch Wildlife Management

Area where the fish was found naturally. Also a pond at the Corn Creek headquarters of the Desert Bighorn Refuge was chemically treated and a transplant of Pahrump killifish was made to ensure the survival of this species.

The Department participated with the Bureau of Reclamation in the planning and development of the new refugium below Hoover Dam and aided in the transplanting of Devil's Hole pupfish into this potential sanctuary.

Cooperation was given the Bureau of Land Management in the planning of the Schoolhouse Springs refugium and the water was filed on for use by the pupfish inhabiting this spring pool.

Transplants of Devil's Hole pupfish were made to spring pools in both Nevada and California in an effort to establish these fish in other waters. Also this species was supplied to Steinhart Aquarium at San Francisco, California, and to Dr. Haas, an aquarist of Fresno, California, in an attempt to establish artificially cultured populations of this species.

Cooperation was also given to the Bureau of Land Management in the planning of the Shoshone Ponds refugium near Ely, Nevada. Pahrump killifish, Moapa dace and Pahranagat bonytail chub were recently stocked into this site with the cooperation of the University of Nevada at Las Vegas.

Aid was provided the U.S. Forest Service in stopping the construction of a road up Hendry's Creek in White Pine County. This creek harbors a unique strain of cutthroat and the road would have destroyed much of the lower half of the stream.

The Department also stopped a piping program at Preston and Lund in White Pine County. This project would have resulted in pipelines being constructed into the springheads and would have eliminated the populations of Springfish found therein. However, because of these fish, the project was altered so that a significant section of the streams from the springheads to the mouth of the pipelines was retained for the Springfish.

Current efforts consist of participation with the Bureau of Sport Fisheries and Wildlife on a proposed program for studying the cui-ui of Pyramid Lake and attempting to artificially rear this species.

Finally, our Department worked closely with pet shop owners and tropical fish organizations to develop an exotic species advisory committee and regulations to control the importation of tropical fish. Through this work we have received the cooperation of the tropical fish groups in making every effort to discourage the planting of exotic fish into the thermal waters of our State and have alerted these people to the value of our native species.

Our Department is now underway inventorying and compiling springs throughout the State which may provide ready alternate habitat for future transplants.

Our continued support is assured in protecting the non-game forms of our fisheries resources and in an effort to do a better job in this regard; our need for funds for this type of work has been brought to the attention of members of the Legislature.

Appendix 1972-7

# Rare and Endangered Fish - Habitat Protection on the Western Public Lands[1]

Audio-visual Presentation

by

Robert L. Borovicka
Bureau of Land Management

(1)[2] Isolated waters in the form of small springs, ponds, and streams form the last remaining habitat and refuges for some rare and endangered fish. (2) Many of the waters are found on the public lands in desert and high desert areas of the western United States. (3) The Bureau of Land Management, working in close cooperation with State fish and game agencies, Bureau of Sports Fisheries and Wildlife, (4) National Park Service and various universities, is protecting, improving, and constructing new habitat on Public Domain Land.

(5) In eastern central California relict populations of indigenous fish to the (6) Owens River system are now isolated in portions of the Upper Owens Valley. (7) The Owens River pupfish, Cyprinodon radiosus, is confined to (8) Fish Slough and a tributary BLM spring. The sanctuaries were also planned for other (9) species indigenous to the Owens River drainage--the Owens River chub, Gila sp; Owens sucker, Catostomus sp; and speckled dace, Rhinichthys osculus.

(10) To the east of the Owens and Death Valley, California, is found the Ash Meadows area in Southwestern Nevada. (11) The area is unique in having a number of small springs still remaining in the desert basin that support populations of (12) several rare fish.

(13) Big Spring in Ash Meadows is one of the better remaining refuges for the Nevada pupfish, Cyprinodon nevadensis mionectes. (14) The Devils Hole pupfish, Cyprinodon diabolis, is both rare and endangered because of loss of habitat from lowered water levels. Artificial lights and spawning areas have been applied; however, water levels continue to decrease.

(15) Schoolhouse Spring, one of the few remaining habitats of warm springs pupfish, Cyprinodon nevadensis pectoralis, (16) has been protected by fencing and water improvements. (17) The primary habitats of these small fish are spring seeps in the area. These have been improved and small pools excavated to increase the size of the habitat and fish populations.

[1]Presented at the 102nd Annual Meeting of the American Fisheries Society, Sept. 10-13, 1972, Hot Springs, Arkansas and the Desert Fishes Council, Death Valley, Nov. 14, 1972.

[2]Numbers refer to individual slides.

(18) Primary sources of water have been improved by the addition of wells. (19) A visitor's viewing pond was constructed for the general public. Nearby Mexican Springs will also be protected and improved. (20) Another habitat that the BLM tried to develop is Jack Rabbit Spring. Water (21) gauges did monitor flow, and past abuses of pumping directly from the spring were rectified. (22) Reliable water production in the springs of Ash Meadows is still uncertain because of (23) pumping from new wells for irrigation developments.

(24) Small artesian springs near Tecopa, California, and south of Ash Meadows were known to contain the tecopa (25) pupfish, Cyprinodon nevadensis calidae. BLM is working with California Department of Fish and Game for fish habitat protection.

(26) On the Death Valley National Monument, under administration of the National Park Service, protected habitats such as (27) Saratoga Springs hold good populations of the Amargosa pupfish, Cyprinodon nevadensis nevadensis. (28) The Salt Creek pupfish, Cyprinodon salinus, is found in Salt Creek and (29) Pupfish Springs in the floor of Death Valley. Some of the habitats such as (30) Pupfish Springs contain thriving populations in water much more saline than seawater, and temperatures approaching 100 F.

(31) In the lower reaches of the Amargosa River before reaching Death Valley, plans are now being developed to (32) protect public lands in the river area holding populations of the Amargosa pupfish.

(33) Work has included transplants of endangered fish into other suitable refugia. An area of old artesian wells on public land near Ely, Nevada, was selected for improvement. (34) Old pond areas were in place from past operations. After preparation of habitat management plans, the development work proceeded. (35) New wells were dug and a series of ponds created and designed to hold several of the endangered (36) fish from the Ash Meadows area. First of these transplants was the Pahrump killifish, Empetrichthys latos, considered to be the most endangered of the Ash Meadows fish. They were transplanted (37) in the fall of 1971 to the new ponds. Recent inventory work has indicated the population of killifish has nearly doubled in size in the Shoshone pond areas. Two other transplants were the Moapa dace, Moapa coriacea and the bonytail chub, Gila elegans.

(38) In the same general location, near Ely, Nevada, several small streams draining typical north-south mountain ranges have proved to be good refuges (39) for subspecies of the Utah cutthroat, Salmo clarkii sp. The fish are being described as the Mt. Wheeler trout. (40) Even though they have adapted to small, fast-flowing streams, that sump out in desert basins, erosion from storms and heavy runoff has harmed the habitat. In a cooperative (41) project with Nevada Fish and Game, BLM has instituted new watershed management practices and installed water gaging apparatus on Goshute Creek.

In (42) an attempt to duplicate the few small natural pools providing the primary habitat for the Utah cutthroat, (43) trash catchers have been installed to create this habitat below the structures. (44) In areas where the pools have been constructed, populations have increased from none in 1950 to 7,000 in 1972.

(45) In northern Nevada is Summit Lake, located on an Indian Reservation. A pure strain (46) of Lahontan cutthroat trout provides a subsistence fishery for the native Indians and a source (47) of eggs for propagation needs in fish hatcheries. (48) The major tributary to Summit Lake, Mahogany Creek, is primarily on public land. The watershed has been given special protection by Federal law. (49) A plan has been developed by BLM to improve the stream by controlling livestock use, construct instream devices to (50) make fish spawning areas and pools for resting and rearing.

(51) Also in northern Nevada, Salmon Falls Creek is scheduled for improvement by the Nevada Fish and Game Department to provide trout fishing and another attempted stocking of Lahontan cutthroat trout. (52) Chemical treatment is scheduled for the fall of 1972. The large fish barrier (53) constructed by BLM should be completed at that time to prevent future upstream movement of undesirable fishes.

(54) In southeastern Oregon, just above the Nevada border, in the small streams flowing to the north from the Whitehorse Mts., is the Alvord (55) cutthroat trout, Salmo clarkii sp. The fish have been isolated in the typical desert streams (56) that sump out in the Alvord Desert. Past livestock and beaver use has all but eliminated larger shade trees such as willow and aspen. (57) In cooperation with local interests, the Oregon Game Commission and the BLM have made willow plantings on the stream prepared from (58) cuttings of larger trees in other locations. In (59) areas needing more pools, trash catchers are being installed on an experimental basis. Gap fencing has helped to control livestock use. Most work on the isolated streams has been (60) done with the aid of helicopter to prevent unnecessary roads or disturbance. (61) Some tributaries, devoid of these native fish because of impassable barriers, have been stocked by transplanting the rare trout with helicopter.

These are highlights concerning a few projects now underway by (62) the Bureau of Land Management and other federal and state agencies. Work to protect rare and endangered desert fish is coordinated through the Desert Fishes Council.

Appendix 1972-8

# RESUME - DESERT PUPFISH PROGRAM

Bureau of Sport Fisheries and Wildlife
Portland, Oregon

In October 1971 the direction for the Desert Pupfish Program was assigned to Region 1 from the Washington Office. The coordination of agencies involved include the Bureau of Land Management, the National Park Service, the Geological Survey, Solicitor's Office, the game departments of both Nevada and California, the University of Nevada at Las Vegas, and the Desert Fishes Council.

The Bureau has employed a full-time Fishery Biologist, stationed at Las Vegas, as a field representative of the Bureau. He has worked at the "grass roots" with technicians of the above agencies. He has aided in locating suitable transplant sites for the Devils Hole pupfish, including Purgatory Springs on Bureau of Land Management land, and securing the necessary agreement with Cappaert Enterprises who have a special land use permit from the Bureau of Land Management for this site. Two transplants of the Devils Hole pupfish have been made to this site during the spring and summer of 1972. In order to establish a suitable habitat, an A-frame structure was built over the pool to maintain a certain amount of shade for the growth of algae and to develop a suitable habitat.

In addition, the biologist worked with the Bureau or Reclamation in setting up the experimental pupfish refugium below Boulder Dam. Devils Hole pupfish were transplanted here during late September and early October 1972.

The Bureau of Reclamation provided certain funds, supplemented by the Bureau of Sport Fisheries and Wildlife, for the construction of this refugium. Water source for this facility is a spring located in the side of the canyon approximately 150 to 200 feet away. Latest reports indicate the transplants of Devils Hole pupfish are surviving.

The Regional Office, Bureau of Sport Fisheries and Wildlife, was requested to prepare a land acquisition plan for desert pupfish in the Ash Meadows area. This was in part responsive to Senate Bill 2141, introduced at the last session of Congress. A reconnaissance plan for approximately 160,000 acres was submitted to the Washington Office, Bureau of Sport Fisheries and Wildlife, outlining the proposed desert pupfish refuge.

The Portland Office also prepared a supplemental report and alternative plan for the use of lands and waters in the area centering on Point of Rocks Springs. Water utilization plans of spring water and restricted well waters were promulgated. This plan entailed the restriction of well water for pumping from those wells located in the area of direct influence on the water level of Devils Hole. These were within the designated Unit 1 on the plan. This report suggested negotiations with Cappaert Enterprises on the

matter of water utilization and possible acquisition of land within this unit. The above all have been described in the report submitted to the Washington Office in August of 1972.

The Bureau of Sport Fisheries and Wildlife has approved the idea of experimental rearing of pupfish by aquarists. Dr. Richard Haas at Fresno received 25 fish in June of this year. Steinhart Aquarium received 25 fish in the fall of 1971. The latter institution has raised one pupfish to date, and they now have two adults and one young fish in their aquarium. Dr. Haas has about 12 fish left, with no young reported to date. The Bureau also was a cooperator in the transplant of Devils Hole pupfish to the new site at Grapevine Springs within the Death Valley National Monument. This took place during early October 1972.

The Regional Office and Coordinator of Endangered Species have been in close contact with Mr. Ron Lambertson of the Solicitor's Office in Washington and Mr. John Germeraad, Department of Justice, Washington, relating to the litigation on the injunction against Cappaert Enterprises. In September 1971 the Government filed in District Court in Las Vegas to enjoin Cappaert Enterprises (then Spring Meadows, Inc.) to stop pumping their wells that affected the water level in Devils Hole. An injunctive agreement was reached in early September whereby Spring Meadows would cease to pump from Wells No. 4, 5, and 6. The effect of not pumping from these wells, beginning on September 9, 1971, was only slightly helpful in slowing the lowering of the water level in Devils Hole. During the winter of 1971-72 the water level continued to decline. The Bureau of Sport Fisheries and Wildlife Regional Office and the National Park Service Regional Office made impassioned pleas to their respective Washington Offices to take further court action to reduce the pumping affecting Devils Hole. Finally, after considerable pressures, the pre-injunction hearing was held in Las Vegas on July 3 and 5, 1972. The court heard from the Government and from the plaintiff, Cappaert Enterprises, and asked that they submit briefs to the court at a later date. This was done, including the replies from the Government to the briefs, and this was completed on September 25. We are still awaiting the word of the court as to the outcome of this case.

Appendix 1972-9

# CALIFORNIA'S ROLE IN DESERT WATER RESOURCES STUDIES

Robert Smith
California Department of Water Resources, Los Angeles

The Amargosa Basin - an area of springs, seeps, a flowing river, and pupfish. California and Nevada both share a unique ecosystem that has created concern and heated discussion between the developer and the ecologist.

The California State Department of Water Resources is naturally concerned about any water system that exists within the State, and is actively involved in some interesting desert area studies.

## Comprehensive Water Quality Control Plans

During the next year, the State must adopt comprehensive water quality control plans for each of the 16 planning basins comprising the entire State. The plans will determine the future direction of water quality control for protection of California's water resources.

The plans have four purposes: (1) satisfy EPA grant requirements for wastewater treatment facilities; (2) satisfy requirements of the State Porter-Cologne Act for protection of the Quality of the State's water resources; (3) provide basis for establishment of priorities for federal and state grants; and (4) form basis for setting waste discharge requirements.

The State Water Resources Control Board has requested planning assistance from the Department for the Development of Water Quality control plans for 4 basins - Klamath River, South Lahontan, West Colorado River, and East Colorado River. Completion is scheduled for July 1, 1973. the Southern District is the primary contractor for all but the Klamath River Basin.

The Amargosa area, part of the South Lahontan Basin, is being evaluated in the same fashion as other desert basins. A great amount of work is being expended in general data assimulation and interpretation to establish meaningful facts on present and historic conditions from which intelligent decisions can be made regarding techniques for preserving and enhancing the quality of our water.

To date the Department staff has updated information on existing quality of surface and ground waters, land use, waste discharges, and plans of local agencies. Beneficial water uses and objectives are now being adopted in cooperation with the Regional Boards and local agencies through questionnaires, followup visits and workshops. The next step will be identification and comparison of alternative water quality management plans to achieve the water quality objectives. More workshops and public hearings will be held on the plans to assure input from all interested parties.

District personnel assigned to the program are aware of the water quality and quantity problems that are unique to the Amargosa Basin, and the problems that are inherent to interstate stream systems. Plans that are being prepared for this study will be coordinated with the State of Nevada. Both states should be in conformance with standards set by the Environmental Protection Agency.

## Groundwater Investigations

Another program concerning the desert which we have been involved in for some time, has been the Federal-State Cooperative Ground Water Investigations. These have been joint studies between DWR and USGS. Thus far, there have been 21 reports published under the Bulletin No. 91 series, on water wells and springs, 19 of which have involved the desert area. The general objective of the investigation is to collect and tabulate available groundwater data for the individual desert basins to provide public agencies and the general public with data and provide a foundation for a more comprehensive investigation. The typical Bulletin No. 91 describes the geologic and hydrologic features along with water quality of the basin.

The next Bulletin No. 91 will cover the Palo Verde Valley area. Field work is about finished and the report is scheduled to be completed by July 1973. The next area to be studied has not been determined, but the Amargosa area has been given high priority. A meeting between DWR and USGS is scheduled for November 16 and 17 when discussions will be held regarding the next area to be studied. Funding has always been a problem in this program, and it is expected the study will be supported by $9,500 from DWR along with matching funds from USGS. This may seem like a small program, but the results are extremely useful in establishing a bench mark for hydrologic data.

Appendix 1972-10

# Effect of Irrigation Pumping on Desert Pupfish Habitats by Ash Meadows, Southern Nevada

by

W. W. Dudley and G. F. Worts, Jr.
U.S. Geological Survey
Carson City, Nevada

The Ash Meadows area, at the southern tip of the Amargosa Desert in southern Nevada, discharges ground water collected over several thousand square miles of a regional flow system developed in Paleozoic carbonate rocks. Water moves westward across fault contacts from the bedrock into poorly interconnected gravel, sand, and terrestrial-limestone aquifers in the upper few hundred feet of the basin sediments at Ash Meadows.

A small pool in Devils Hole, which is a collapsed depression in Cambrian limestone, and numerous springs in the adjacent desert valley contain rare fish species of the genus Cyprinodon, faunal remnants of the biota of Pleistocene lakes. The Devils Hole pupfish, C. diabolis, is the most endangered of the several surviving species that have evolved since the post-pluvial isolation of their ancestors. This population feeds and reproduces on a slightly submerged rock ledge. Recent pumping for irrigation has nearly exposed this ledge.

Pumping tests and geochemical correlations established that the flow of certain springs diminished during the pumping of specific wells.

Well locations, water quality, and correlation of pumping histories with the Devils Hole hydrograph were considered in selecting three wells to be shut down in late 1971 in an effort to preserve the water level in Devils Hole. The early recovery, in spite of the continued pumping of eight other wells, was encouraging, but the water level started to decline again a few months later.

In terms of water-level change in Devils Hole, the natural level originally was about 1.4 feet below the copper washer. In October 1972, the level had declined to nearly 4 feet below the washer. The past record of water level fluctuations shows that the response to seasonal pumping each year has resulted in a decline averaging about 0.9 feet (April through November), followed by a rise averaging about 0.3 foot (December through March). The overall net decline in Devils Hole from April 1969 to October 1972 has been 2.6 feet.

Appendix 1972-11

# SUMMARY OF RESEARCH AT TECOPA BORE

Robert Naiman
Arizona State University

Ph.D. thesis title: The Tecopa Bore ecosystem: The effects of temperature on energy flow and resulting fish production.

At the present time, I am involved in a study of the pupfish population that inhabits the outflow of Tecopa Bore. For those that are not familiar with the Bore, it is a hot artesian well and associated stream located about 2-3 miles west of Tecopa, CA. The outflow of this artesian well is inhabited by a very dense population of pupfish; also the ecosystem at this locality is very simple. It is essentially a one-step food chain. The algal growth in this hot stream is very great and the fish feed directly on the algae. Very few invertebrates have been found and their influence on this ecosystem can be disregarded.

Currently I do not have enough data analyzed to present. The project began in earnest last June (1972) after several months of preliminary work. The field work in this study is scheduled to be completed in September 1973. All the associated laboratory investigations will be completed shortly thereafter. With a little luck and lots of hard work, I should be able to present a much better picture of the Tecopa Bore ecosystem at our meeting next year.

The main objective of this study is to quantify the flow of energy through the Tecopa Bore ecosystem. This system is unusual because:

1. It is a hot stream that contains fish. Production should be at a maximum around 30 C for the pupfish, and the fish in this habitat grow and reproduce the entire year.

2. It is a short, direct food chain. Almost all fish production studies have been concentrated on carnivorous fish; this necessitates the transfer and loss of energy at least three times as it passes through the food chain. Production at Tecopa Bore should be greatly increased because this population is herbivorous; only two trophic levels are present there.

When the study is finished I will have a value for production that I can compare with other published values; I expect production at this site to be very great.

By way of closing, I have two interesting pieces of data I might mention:

1. There may be a new species of harpacticoid copepod inhabiting the edges of the stream. It is now being checked over very carefully and appears to be endemic to the area.

2. The pupfish appears to have one of the highest energy contents per gram of body weight of any fish so far investigated, with just over 6000 cal/gm. This is most likely due to their high lipid content.

Appendix 1972-12

STEINHART AQUARIUM'S REPORT ON DEVIL'S HOLE COLONY,
*Cyprinodon diabolis* Wales, 1932, for July 27, 1972.
Last report: May 9, 1972.

Report Prepared by Al Castro

It's a girl

In the last report it was stated that there were only 2 fish left in the breeding colony, a male about 30 mm total length and a small female about 20 mm TL. On May 10, spawning behavior was noticed taking place in the gravel. It continued on the 11th but was not seen on May 12. On May 13, the gravel was being picked at by the adults. There was no more unusual activity seen in the tank. At 9:00 a.m. on Wednesday, May 17, while inspecting the tank, an unusual movement was seen at the rear of the tank. After I recognized it to be fry, the adults were removed from the tank and a search was started for the fry. It was caught, measured at 7 mm TL and transferred with 5 gallons of its own water to a holding tank. The gravel was stirred to locate any additional young, but only 5 undeveloped eggs were found. Water samples were taken and analyzed. The parents were reintroduced to the breeding tank. There was no breeding activity noticed in the tank until June 18, 19, 20, and 21. When the activity ceased and the adults began to search the bottom of the tank, they were removed. The gravel was stirred at which time 11 eggs were found but no development occurred. The adults were returned to the breeding tank, and activity was again seen on July 11, 12, and 13. The parents were again removed. The breeding tank was not stirred this time but left alone for 7 days. When no fry were found at this time, the tank was stirred. Four eggs were found, but no development was noticed. On July 20, the parents were returned to the breeding tank.

Results of water analysis of May 17, 1972:

| Breeding Tank | Stock Devil's Hole Water |
|---|---|
| pH = 8.4 | pH = 8.2 |
| Cl = 220 ppm | Cl = 21 ppm |
| total hardness = 332 ppm | total hardness = 164 ppm |

Pupfish fry size:

| May 17, 1972 fry | July 27, 1972 fry |
|---|---|
| 7 mm total length | 19 mm total length |

Offspring still alive and doing well, August 2, 1972.

Appendix 1972-13

Remarks Concluding the Fourth Annual Symposium

by outgoing Chairman Phil Pister

It has been an immense pleasure--the real high point of my career--to work with so many fine, competent, and truly dedicated and unselfish people. It has given me a much greater appreciation of the ability and potential of individuals in government, the universities, and the private conservation sector. My philosophy as Chairman has been that, if you can get sincere people working together on a personal basis, and minimize the emphasis on individual agency policies and philosophies, it is much easier to accomplish a given objective. Our successes have proved the validity of this theory. In the final analysis, agencies are nothing but people, and if the people work well together, so do the agencies. And another principle which has proved successful is to disregard the weak points of people and find out what they can do well--and the constituents of a group such as this possess many talents which they perform exceedingly well.

Looking back to that 1967 field trip with Death Valley naturalist Dwight Warren, during which we observed the first signs of development in Ash Meadows; and to the April, 1969 trip, again to Ash Meadows, which in reality was the beginning of the Desert Fishes Council, there is little question that we have been successful in many ways. I am confident that, if the Desert Fishes Council had not been formed, more than one species would have passed into oblivion and, nearly as important, we would not have created such an unprecedented public awareness of a seemingly insignificant resource, nor would we have established the many fine personal and interagency relationships which have been basic to our success, nor the various methods we have devised to detect and combat the habitat changes which inevitably precede species endangerment and extinction.

But we have a long way to go and it is time for a new chairman to lead us. Jim St. Amant is well qualified to do this. He has worked extensively with other Great Basin states in his activities in the areas adjacent to the Colorado River and will continue to work with them as, I hope, they join with us in our efforts. Jim and I share similar philosophies in the management of a fishery resource, and we have worked to lead the way in California to create interest among our colleagues to initiate nongame fishery programs. We have shared our successes and frustrations in this respect.

So as I step down from the chairmanship of the Council, I look back to the past with much pleasure, but I look forward to the future with tremendous enthusiasm, because we have broken the barrier and are well on our way. Our future successes will be limited only by our failure to take full advantage of our inherent capabilities.

# Appendix 1972-14

## Persons in Attendance at Fourth Annual Desert Fishes Symposium, Furnace Creek, November 14-15, 1972

| NAME | AFFILIATION |
|---|---|
| M. Abraham | The Hebrew University, Jerusalem |
| Otto Aho | Solicitor, U.S.D.I., Reno |
| Dave Babb | BLM, Bishop |
| Robert Behnke | BSFW, CSU, Fort Collins |
| Louis Boll | BLM, Bakersfield |
| Bob Borovicka | BLM, Portland |
| Max Bridge | BLM, Denver |
| Marty Brittan | Sac. State University |
| John Brode | Dept. Fish and Game, Sacramento |
| R. E. Brown, Jr. | Fresno State University |
| Sterling Bunnell | Conservationist, Marin Co., Calif. |
| John Burridge | Sierra Club, Tustin, CA |
| Claudia Carlson | Humboldt State Univ., Arcata |
| Al Castro | Steinhart Aquarium, S.F. |
| Frances Clark | Scripps Institution, La Jolla |
| Al Cordone | Dept. Fish and Game, Sacramento |
| Jim Deacon | U.N.L.V. |
| Donald Duff | BLM, Salt Lake City |
| Bob Feldmeth | Claremont College |
| John Findlay | BSFW, Portland |
| Dean Garrett | NPS, Death Valley |
| Shelby Gerking | Arizona State University |
| Frank Groves | Nevada Dept. F&G, Reno |
| Herb Guenther | USBR, Boulder City |
| Chuck Hansen | U.N.L.V. and NPS |
| Carl and Laura Hubbs | Scripps Institution and UCSD |
| Walter Isaacks | BLM, Bakersfield |
| Jake Jacot | NPS, San Francisco |
| Ase Jespersen | Univ. Copenhagen, Denmark |
| Jay Jones | Humboldt State Univ., Arcata |
| Gail Kobetich | BSFW, Parker, Arizona |
| Dale Lockard | Nevada F&G, Las Vegas |
| G. R. Love | Landowner, Ash Meadows |
| Clint Lostetter | BSFW, Portland |
| Charles Marshall | Calif. F&G, Blythe |
| Dave Marty | Resources Agency of Calif., Sacramento |
| Cecil McClaren | USBR, Boulder City |
| Alan McCready | Private citizen, Sacramento |
| Sandy McLanahan | Wayne University School of Medicine |
| Bob and Fran Miller | U. Mich., Ann Arbor |
| Wendell Minckley | Arizona State Univ., Tempe |
| Yoshitaka Nagahama | Hokkaido Univ., Hakedata, Japan |

| NAME | AFFILIATION |
|---|---|
| Robert Naiman | Arizona State Univ., Tempe |
| Tina Nappe | Foresta Institute, Carson City |
| Bill Newman | Nevada Div. Water Res., Carson City |
| Steve Nicola | Calif. F&G, Sacramento |
| Chuck Osborn | BSFW, Las Vegas |
| Phil Pister | Calif. F&G, Bishop |
| Gary Ponder | Calif. F&G, Blythe |
| Larry Powell | BLM, Phoenix |
| William Radtkey | BLM, Sacramento |
| Del Rasmussen | BSFW, Portland |
| Russell H. Rawson | L.A. Dept. of Water and Power, Bishop |
| Miriam Romero | Environmental Consultant, Montrose |
| Gene Ruhr | BSFW, Washington, D.C. |
| Pete Sanchez | NPS, Death Valley |
| Phil Sharpe | USBR, Boulder City |
| Bob Smith | Calif. Dept. Water Res., L.A. |
| Dave Soltz | U.C.L.A. |
| Jim St. Amant | Calif. Dept. F&G, Long Beach |
| W. A. Stumpf | NPS, Lake Mead |
| Jerry Tash | BSFW, Tucson |
| Steve Taub | BSFW, Washington, D.C. |
| Harold Thompson | NPS, Death Valley |
| James Thompson | NPS, Death Valley |
| Bob Tubb | Rancher, Ash Meadows |
| Charles Watson | NORA, Inc. |
| Gerard Witucki | NPS, San Francisco |
| Bruce Wolfe | Nature Conservancy, S.F. |
| George F. Worts | USFS, Carson City |
| Jim Yoakum | BLM, Reno |
| Ralph Young | Calif. Dept. F&G, Long Beach |
| Chuck Ziebell | BSFW, Tucson |

# FIFTH ANNUAL SYMPOSIUM

## Arizona State University, Tempe, November 13-14, 1973

## Summary of Proceedings

### Tuesday, November 13

Dr. Duncan T. Patten, Assistant Vice President and Acting Director of Arizona State University's Center for Environmental Studies, welcomed the group to the campus and the Fifth Annual Symposium.

Following Dr. Patten's remarks, Mr. Pister thanked the University for its hospitality. The Symposium had been held in each prior year at Death Valley National Monument, and Mr. Pister commented that the new location comprised an effort to lessen the provincialism which meeting solely in Death Valley tended to create. He stressed the fact that moving to new meeting areas in no way lessens concern over the Death Valley area fishes, but is a result of broadened interest and concern over other areas of the Southwest.

SESSION I - Federal Habitat Maintenance Programs

Chairman: J. A. St. Amant, California Department of Fish and Game and Chairman, Desert Fishes Council.

1. Recovery plan concepts and implementation

C. E. Ruhr, Office of Endangered Species, BSFW

Not all recovery plans are operating, but progress is being made. Even after listing a species and focusing attention upon it, one soon realizes that time alone does not assure its restoration. The recovery plan concept comprises a series of steps from listing through restoration to a point where a species is no longer endangered, and to assure that another level of management will take over its care.

A major problem exists in the neglect most states show their nongame species. BSFW is attempting to motivate the states to manage properly their entire fish and wildlife resource rather than solely those species with an obvious economic value. New laws may become necessary to assure species preservation, and public education programs may have to be implemented to minimize public antagonism.

A completed recovery plan discusses the concepts involved, a history of species status, a section concerned with intent, and a series of flow diagrams to summarize implementation. A recovery plan must be flexible and dynamic, and a basic responsibility of a recovery team is to maintain the plan, coordinate activities on a local basis, and prepare annual reports.

Robert Azevedo, BSFW, Albuquerque, NM, then discussed operating recovery plans in Arizona, New Mexico, Oklahoma, and Texas. Fishes involved here include the razorback sucker (Xyrauchen texanus) and squawfish (Ptychocheilus lucius). He expressed confidence in the recovery plan concept but warned against the team becoming too large. He praised the Desert Fishes Council for its part thus far in the endangered species preservation program.

Del Rasmussen, BSFW, Portland, Oregon, reported briefly on the work of Clint Lostetter and Chuck Osborn and complimented Jim Yoakum of BLM's Nevada State Office for its excellent recovery plan for C. n. pectoralis.

2. Inventory and maintenance of natural habitats on forest lands

Charles Kennedy, U.S. Forest Service, Albuquerque, NM, assessed the fishes in Arizona and New Mexico as presenting an interesting challenge. Some related problems are administrative, and others are resource oriented. Both are of equal importance.

The Forest Service has developed a relatively precise and objective method of evaluating stream habitat and has used it for several years with a fair degree of success. The method considers gravel, pools, flow, condition of riparian vegetation, temperatures, etc. Each item is rated numerically, and the sum of ratings allows ranking of the habitat. The basic flaw in the system is that

different raters will view things differently, and the final rating is limited by the person doing the rating. Also, few forest fishery biologists are available, and ratings are currently being done primarily by wildlife biologists. Another problem is the difficulty in knowing just what constitutes a "norm" in a southwestern river. Then, even if the stream could be accurately evaluated, we would not be dealing with the problem, only describing the condition.

Many problems originate outside the stream, such as overgrazing. This problem has existed for over 100 years, and many individuals are unaware that the absence of trees along southwestern streams is an abnormal condition. Water temperatures in streams have changed, and energy flows through the stream system have been greatly reduced. Efforts are being made to train foresters that one cannot separate the fish from the trees. The Forest Service wishes to revise their programs to include streamside revegetation. Cattle use must be carefully controlled, but not eliminated, in order to remove surplus forage in some areas.

Problems of reseeding denuded streambank areas were discussed, and some plans and current programs were evaluated. The Forest Service is attempting to break personnel out of their disciplines and think about the total ecosystem and energy flow that occurs on wild lands.

Harold Hunter, Inyo National Forest, Bishop, California, presented an overview of Forest Service involvement with team efforts on his forest. He used the Paiute cutthroat trout (Salmo clarkii seleniris) as an example and summarized the assistance provided by graduate student researchers and state fish and game biologists.

3. Projects geared toward maintenance of natural habitats on national resource lands.

Paul Cuplin, BLM, Denver Service Center, summarized some of the projects that have been going on in the various 11 western states, as follows:

California: Bill Templeton, BLM, Riverside Office, reported in detail on the California Desert Plan later in the symposium (see Miscellaneous Presentations, Nov. 14).

Oregon: BLM has been working on habitat improvement for Alvord cutthroat trout and has also been engaged in a cooperative effort to improve habitat for fencing streams. This has resulted in a very gratifying response of riparian vegetation.

Arizona: Two important things have happened in the Aravaipa Canyon to assist in habitat preservation: 1) restriction of vehicular travel, and 2) cessation of mineral exploration. In addition, a grazing plan is being prepared. BLM is participating in the lower Colorado River recovery team effort, and recommendations for habitat improvement may soon be forthcoming.

New Mexico: BLM has been an active participant in inventories of fish, wildlife, and vegetation along the Gila River. Other participants include the

Bureau of Reclamation, Forest Service, Soil Conservation Service, New Mexico Department of Game and Fish, New Mexico State University, Fish and Wildlife Service, and the National Park Service. This work should be completed by June, 1974.

Colorado: Status of the Colorado River cutthroat (Salmo clarkii pleuriticus) is currently undetermined, and BLM hopes it will be recognized as a threatened species. Possible effects on the subspecies of oil shale development were discussed, and these could prove to be significant. BLM is trying to establish riparian vegetation along the banks of East Fork, Parachute, and Trapper creeks. Colorado BLM would like to receive input and documentation relative to riparian vegetation establishment on Rock Creek, Montana, and similar work conducted by the Wisconsin Conservation Department.

Mr. Cuplin closed by emphasizing the problems BLM experiences through lack of fishery biologists on their staffs. BLM needs help from other agencies.

4. Projects and policies directed toward maintenance of natural habitats and aquatic organisms on private lands.

John Yordin, U.S.S.C.S., Phoenix, reported that the Soil Conservation Service is the Department of Agriculture's technical arm for soil and water conservation. The SCS has the unique responsibility of assisting private landowners and users in preparing conservation plans for their lands. The agency has no regulatory function (only advisory) and can control how a private landowner uses his land only when he requests and receives federal assistance. SCS recognizes fish and wildlife as a natural resource but is prohibited by law to practice species management. SCS recognizes and respects the states' management rights; it conducts no wildlife research. SCS admits to errors in the past, where fish and wildlife resources have been adversely affected, but feels they have learned from their mistakes. They now have a standing policy with Arizona Fish and Game to contact them before advising on any project which might affect wildlife or perennial water sources.

Mr. Yordin concluded his remarks by assuring the Desert Fishes Council that SCS will do its utmost to insure the survival of all rare and endangered wildlife, and to exercise extreme care in advising its cooperators against the introduction of exotic fishes into private waters without proper clearance by resource management agencies.

SESSION II - Species preservation plans for Lower Colorado River Basin fishes

Chairman: S. D. Gerking, Arizona State University, Tempe, Arizona

1. Lower Colorado River Task Force - Status report on razorback sucker (Xyrauchen texanus) and Colorado River squawfish (Ptychocheilus lucius)

Gail Kobetich, Bureau of Sport Fisheries and Wildlife, Parker, Arizona

In March 1973 an interagency recovery team was established to study ways to protect the remaining populations of the big river fishes of the Lower Colorado River drainage system. The fishes of principal concern to the recovery team are the razorback sucker, Xyrauchen texanus; the Colorado River squawfish, Ptychocheilus lucius; the bonytail chub, Gila elegans; the roundtail chub, Gila robusta; and the humpback chub, Gila cypha. The Gila complex was defined as those members of the genus which were and are confined to the main stream Colorado River and its major tributaries.

Initial efforts were concentrated on the razorback sucker and the squawfish, and recovery plans for both species were drafted. A small broodstock of Colorado squawfish was acquired, and attempts to get a broodstock of razorback suckers will be made during March or April 1974.

Work will begin at a later time on the Gila complex.

Mr. Kobetich described in detail the goals of the recovery team, to date and work yet to be done. Some copies of the recovery plan for the razorback sucker are now available.

A discussion followed on the status of the razorback sucker and whether it should be considered endangered. The consensus was that it should be so considered.

2. Status of woundfin (Plagopterus argentissimus) recovery plans

Wayne Deason, Bureau of Reclamation, Boulder City, Nevada

Presently the Woundfin Recovery Team is in its infancy and consists of an acting recovery team chairman and members from BSFW; Arizona Game and Fish Department; Nevada Department of Fish and Game; BLM, Salt Lake City; Forest Service; and Drs. James Deacon and W. Minckley. As yet there is no member from the Utah Division of Wildlife Resources. It is important to have a member from the state of Utah, inasmuch as the Utah segment of the Virgin River is the primary source of Plagopterus.

BSFW and Bureau of Reclamation jointly provided a total of $14,000 to Dr. Deacon to determine what effects the closing of La Verkin Springs in the Virgin River would have on the survival of Plagopterus. Measurements made during 1972 on La Verkin Springs indicate that the flow is between 11 and 12 cfs with an average concentration of 9,650 mg/l TDS. This source contributes about 100,000 tons of salt to the Colorado River system each year. A report is being prepared by Reclamation under their Colorado River Water Quality Improvement Program on a plan to collect the spring flow for delivery to a desalting plant. The desalted water would then be returned to the Virgin River and the remaining brine delivered to a brine disposal pond for evaporation. Of interest to biologists is what will happen to Plagopterus when salt is removed from the system. In order to answer this question, Dr. Deacon and one of his graduate students, Jeff Cross, began conducting a research project last spring entitled "Ecological Life History of the Woundfin, Plagopterus argentissimus."

Present woundfin range is from La Verkin Springs on the mainstream of the Virgin River and the lower portions of La Verkin Creek and Ash Creeks in Utah, downstream to Bunkerville, Nevada. A single specimen was taken from the Middle Moapa River, Clark County, Nevada, in the late 1960's.

The woundfin has been transplanted into four rivers in Arizona. In the Hassayampa, flooding destroyed the entire population in 1972-3. In the Verde, attempts to locate members of the transplant have yielded negative results. In Sycamore Creek, a few specimens from the 1971 transplant survived, and two individuals were found which were gravid in August of 1973. The fourth transplant in the Paria River has not yet been evaluated.

Discussion followed these remarks regarding the salt content in the Virgin River, with Dr. Deacon responding to questions.

3. Status of the Gila complex in the Lower Colorado River Basin

W. L. Minckley, Arizona State University, Tempe

The Gila complex has for many years been a bone of contention taxonomically. At present it is believed that five or more forms of the robusta complex exist in the Lower Basin. Gila cypha, recently taken in the Grand Canyon, has been hybridizing extensively with Gila robusta robusta and Gila elegans. Gila elegans appears to be maintaining small populations in Lake Mohave and Lake Havasu. Gila intermedia is now known in five or six localities. Gila robusta robusta is still widespread and occurs abundantly in certain canals in the Phoenix metropolitan area and is also found in the Verde and Salt rivers. It is rare in the main stream of the Colorado, but occurs in the Grand Canyon.

Other Gila include: Gila grahamii, found in hanging tributaries of the Verde, in the San Pedro and up into New Mexico; Gila purpurea (not of the robusta series) appears to be extinct in the U.S. Gila ditaenia occurs in Sycamore Canyon, Santa Cruz County in southern Arizona and is in good shape in its restricted habitats.

4. Status of the spinedaces, genus Lepidomeda

James E. Deacon, University of Nevada, Las Vegas

Lepidomeda albivallis is maintaining populations in cool springs and streams on the Kirch Wildlife Management Area, Sunnyside, Nevada, by Nevada Fish and Game. There are also populations at LundTown and Preston Big Springs. Proposed irrigation projects threaten habitats at Preston Big Springs.

Lepidomeda altivelis: Extinct.

Lepidomeda mollispinis pratensis: Extinct.

Lepidomeda mollispinis mollispinis: Occurs and is confined to Virgin River system of Utah, Arizona, and Nevada. Is a primary consideration in a research project currently in progress at UNLV. Occurs at Littlefield Spring and Beaver Dam Wash, maintains its largest population in Santa Clara River and Mogotsu

Creek; is common in lower reaches of Leeds Creek, Ash Creek, La Verkin Creek, North Fork of the Virgin River in Zion Canyon below the narrows. Upper lethal temperature limits are 29-31.5 C. Movements of species are frequent and extensive. Foods utilized are Diptera, Coleoptera, plant material and organic debris. Ephemeroptera are used heavily during May and June. Spawning occurs from March to mid-June. Status: endangered because of habitat modification and exotic species; therefore a decline in populations. Recommendations: Monitor and work on reproduction.

Lepidomeda vittata: Minckley et al. have described population fluctuation in the Little Colorado system based on water availability. This year spring rains were sufficient to stimulate excellent spawning in the headwaters of the East Clear Creek drainage. Virtual absence of summer rains apparently prevented dispersal; therefore, huge populations built in the East Clear Creek area, but nowhere else, again emphasizing the crucial role of East Clear Creek in the survival of this species. Vigilance was stressed for all species. Eternal vigilance is the price not only of liberty, but also of species preservation.

5. Status of the spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis)

J. F. LaBounty, Bureau of Reclamation, Phoenix, and Arizona State University, Tempe

The two species occur in the upper Gila River, in a tributary to the San Pedro, and in Aravaipa Canyon. Meda was last collected in the summer of 1963. They are not considered to be endangered, as they are quite abundant in the upper Gila River. However, they should be watched closely. A number of factors could place them in endangered status. The status of Meda is yet undetermined. Tiaroga was not abundant in Aravaipa Creek last fall when Randy McNatt did some collecting, but he found some young. Both species are tolerant of flooding. Introduction of exotics poses danger to these fish. At a recent interagency meeting on the upper Gila River, a resolution was passed asking the New Mexico Fish and Game Department to abolish the use of bait minnows in the upper Gila River drainage. It was rejected. This would have been a valuable first step in helping to save the species.

SESSION III - Review of Death Valley System Species Presentation Plans, and Recovery Plan Workshop

Chairman: E. P. Pister

Mr. Pister:

Owens chub (Gila bicolor snyderi). We are in the process of inventorying its little-known habitat and are collecting and introducing it into the Owens Valley Native Fish Sanctuary. We hope to expand its population and extend its range. The subspecies was first described by Robert R. Miller in April 1973.

Owens dace (Rhinichthys osculus subsp.). A thorough species inventory by electrofishing is now being conducted of all stream systems in the Owens Valley. At the completion of this survey we will have a much better idea of

the status of this fish. Indications are that it is more widespread than we initially had thought.

Owens pupfish (Cyprinodon radiosus). The species is doing well in two refugia, but is in some jeopardy in a third. A big problem is created by local people who introduce black bass into the refugia, requiring complete eradication of all fishes and starting from scratch. Acquisition of privately-owned land in Fish Slough is in progress and is necessary before we can consider removing the species from the endangered list.

Tecopa pupfish (Cyprinodon nevadensis calidae). If the subspecies still exists, it might well deserve top rating on the Death Valley System endangered list. We had presumed it to be extinct until March 1973, when Jim Deacon and some of his students collected fish from an isolated spring in the Tecopa area, which Bob Miller felt could be a relict population. This habitat was expanded with hand tools to allow the population to expand. This situation provides stimulus for retaining our optimism concerning such matters. In the Tecopa area, BLM has refuge sites where C. n. calidae could be reestablished.

At this point, Dr. Minckley commented that recent mollusc collections in the Death Valley System had turned up Melanoides, a highly injurious snail, and that it appears to be spreading rapidly. This snail is injurious to many aquatic life forms.

Devils Hole pupfish (Cyprinodon diabolis). Dean Garrett, National Park Service, Death Valley: Current litigation over Devils Hold is confusing and complex, involving a preliminary and permanent injunction, motions for dismissal, countermotions, etc. In the early part of the summer of 1973 a hearing was held in Federal District Court, Las Vegas, where the entire matter was discussed. Chuck Osborn and Jim Deacon testified for the Government, with the judge directing that the water level not fall below 3.03 feet (below the copper washer). The judge also appointed Leonard C. Halpenny of Tucson, Arizona, as special water master and granted him authority to direct the operation of pumps in the area in order to maintain the designated water level. This decision was appealed, and a ruling of the appellate court changed the necessary level to 3.30 feet. Government attorneys are attempting to have 3.00 ruling restored, but no decision in this respect has yet been rendered.

As a matter of clarification, water levels at Devils Hole are measured as the distance between a copper washer index point and the water surface. Therefore, a measurement of 3.00 indicates a higher water level than 3.50.

The water master is now actively pursuing his assignment and has been regulating pumping to raise the Devils Hole water level. The current level exceeds 3.30, and it has been determined that wells #1 and #17 are very critical in this respect. Level readings are taken three times per week and are passed on to the water master. The court also ordered USGS to install a 24-hour continual recorder outside the fence at Devils Hole to allow the ranch to monitor water levels themselves.

Chuck Osborn: The lowest level on record is 3.91. Recent population estimates are as follows: 180 in February, March and June, increasing to 250 in August and dropping to 235 on November 6.

At Purgatory Spring, 3 miles north of Devils Hole, 25 fish were initially stocked and 25 added at a later date. The current population there is estimated at between 25 and 50 fish, and a good number of these were hatched there. The artificial lights in Devils Hole seemed to be ineffective and were turned off. In addition, the original artificial shelf was removed and replaced with a new one. Another facility similar to the one at Hoover Dam is contemplated near School Spring.

Herb Guenther reported on the status of the Hoover Dam Refugium. In so doing, he reviewed the history of the refugium and its stocking in 1972. Counts since that date are listed below:

| January 29, 1973 | Male | Female | Total |
|---|---|---|---|
| Original DH stock | 11 | 12 | 23 |
| Refugium produced pupfish | 7 | 34* | 41 |
| Larvae | | | 20 |
| | | | 84 |
| **April 27, 1973** | | | |
| Adults (greater than 15 mm) | 64 | 71 | 135 |
| Juveniles (8-15 mm) | | | 28 |
| Larvae | | | 8 |
| | | | 171 |
| **July 27, 1973** | | | |
| Adults (greater than 12 mm) | 45 | 88* | 133 |
| Juveniles (less than 12 mm) | | | 29 |
| Larvae | | | 4 |
| | | | 166 |
| **November 8, 1973** | | | |
| Adults (greater than 12 mm) | 58 | 68* | 126 |
| Juveniles (less than 12 mm) | | | 58 |
| Larvae | | | 0 |
| | | | 184 |

*These figures represent adult females and individuals larger than 12 mm in length of undiscernible sex. These are actual counts and do not include fish hidden in the substrate or in algae.

Feeding and breeding behavior: Most vigorous feeding activity occurs during early morning hours and just before sunset. During periods of low food supply, feeding was continuous. Breeding activity was most vigorous during late morning and late afternoon, with most of the chase originating in the deep end. Breeding continued throughout the year, and young were observed during every month of the year.

Air temperature: Ambient air temperature during the past 12 months ranged from 30.0 F on December 12, 1972, to 115.2 F on July 5, 1973.

Food supply: Algae appears to be the basic food item utilized at Hoover Dam Refugium. Invertebrates introduced there from Devils Hole do not appear to have increased significantly in number. Midge larvae were heavily utilized by the pupfish.

Other parameters measured during 1973 were water chemistry and temperature, inflow rates, air temperature, food supply, feeding, and breeding behavior.

Water chemistry: pH remained at approximately 7.7, and DO ranged from 6.2 to 8.6 ppm.

Water temperature and inflow rates: Extremes to date are 92.6 F on June 26, 1973, and 81.1 F on August 28, 1973. Optimum temperature range is from 90-92 F. Source water temperatures range between 98 and 101 F. Heat loss is effected by convection, which is mechanically regulated by increasing and decreasing the rate of inflow. Temperature fluctuation and consequent flow regulation are the most serious problems yet encountered. Acceptable temperatures were maintained during the past summer, but only with intensive monitoring and implementation of emergency measures. There is an urgent need for a fail-safe automated temperature regulatory system, and the Council was urged to seek aid in this respect. Additional life history information and study of known critical parameters are needed to allow the formulation of a plan for long-term refugium operation.

Pahrump killifish (Empetrichthys latos).

Dr. Deacon reported that the Corn Creek (Desert National Wildlife Refuge) transplant made two years ago was successful, with a recent population estimate approximately 1400. However, Corn Creek also has a population of several thousand Gambusia. Dr. Deacon added that he had recently stopped at Manse Spring for the first time in three years. The fish seemed in good condition, but the spring was not. He doubted that it would last another three years. He further noted that the natural shelf in Devils Hole was improved by the removal of rubble, allowing a higher percentage of shelf coverage.

Ash Meadows speckled dace (Rhinichthys osculus nevadensis).

The entire Jackrabbit Spring population was lost last summer when the spring went dry. However, the subspecies exists at Big Spring. No population data were available.

Ash Meadows pupfish (Cyprinodon nevadensis mionectes).

Status remains unchanged, other than as reported above for Jackrabbit Spring. A good population exists at Big Spring, and the subspecies is widespread within Ash Meadows.

Mohave chub (Gila bicolor mohavensis). Jim St. Amant noted that the transplanted fish are doing well in Piute Springs (San Bernardino County), in South Coast Botanic Garden in Palos Verdes (Los Angeles County), and at Lark Seep Lagoon at the China Lake Naval Weapons Center (Kern County). Transplants failed at Dos Palmas Ranch near Salton Sea, at Lion Country Safari (Orange County), and at Busch Gardens (Los Angeles County). The most reliable population remains at Zxyzx (Fort Soda) Springs, San Bernardino County.

Speckled dace (Rhinichthys osculus subsp.) from Amargosa River near Beatty, Nevada. No change from last year.

Speckled dace (Rhinichthys osculus subsp.) from Amargosa River Gorge below Tecopa, California. No change from last year.

Warm Springs pupfish (Cyprinodon nevadensis pectoralis). Jim Yoakum reported on the forthcoming recovery plan, which delineates current thinking concerning the methodology of how to improve the status of the subspecies. He presented a slide show depicting School Spring, the habitat, legal problems, and involvement of citizens in the recovery work to date. The land around School Spring has been withdrawn from mining exploration and land exchange. Water rights are under adjudication, and spring maintenance remains a problem.

Review of pending endangered species legislation, and recovery plan workshop.
C. E. Ruhr, Office of Endangered Species and International Activities, Bureau of Sport Fisheries and Wildlife, Washington, D.C.

Gene Ruhr reported that S1893 and HR37, amendments to the Endangered Species Act of 1966, were recently passed by Congress and are now in conference committee. Each bill would provide the Secretary of the Interior with authority over all rare and endangered fish and wildlife in the United States.

The bills would give the Secretary power to manage these species, including the prohibition of their take. While this appears to be an outright takeover of the State's right to manage resident fish and wildlife, the intent is to return that authority to the states whenever they have satisfied the Federal government that the state has instituted an adequate rare and endangered species protection and management program.

The apparent purpose of this legislation is to stimulate foot-dragging states to face reality and recognize that their responsibility is to all forms of fish and wildlife and not just game species.

Ruhr also noted that the new bills will (1) remove the existing ceiling on the amount of Land and Water Conservation Funds that can be spent on individual habitat acquisition projects, (2) require all Federal agencies to protect rare and endangered species, and (3) provide grants-in-aid to individual states for rare and endangered species programs. An appropriation of $3 million is expected the first year.

In response to questioning, Ruhr stated that:

----The Federal list of Endangered and Threatened species is not complete for fishes as it should be.
----Howard Campbell is the person on the Office of Endangered Species staff responsible for preparing the sections in the "red-book" on cold blooded vertebrates.
----Suggestions for additions to the Federal Register (Endangered species) are now being solicited by the Bureau.

----The Office plans to prepare a list of endangered and threatened crustaceans and mollusks.
----Land and Water Conservation Fund money is still frozen, with no prospect for a thaw unless the pending legislation is passed.
----The budget of the Department of the Interior for programs for rare and endangered species is $4 million in FY 1973-74.
----None of this money is being made available for programs for species not on the Federal Endangered List.
----The long-term goal of an endangered species recovery program should be to preserve and restore its natural habitat whenever possible.
----He is concerned about the possibility of "artificial" evolution in man-made refugia.

SESSION IV - Preservation of endangered ecosystems

Chairman: Robert Rush Miller, University of Michigan, Ann Arbor, and Chairman-elect, Desert Fishes Council

1. Current status of the Amargosa Canyon

Miriam Romero, Environmental Consultant

Monitoring of the canyon has occurred monthly during the past year, and bird and wildlife censuses have continued. A total of 179 bird species have been tallied, over 40 of them water-related. The total includes 12 raptors. The Amargosa vole (Microtus californicus scirpensis), which had been declared extinct in 1917, was discovered in the canyon this past summer (1973). The private inholders have removed their cattle from the canyon, and no more grazing is allowed. BLM has closed the area to ORV use and withdrawn it from mining and mineral exploration. The California Department of Water Resources is now interested in the quality and quantity of water in the canyon and Amargosa River in general and is concerned over probable effects within California of water development programs within Nevada. Because of the untimely death of Dr. Charles Hansen, survey work for the Park Service prior to recommendation of the Amargosa Gorge as a national Natural Historie Landmark is not yet complete. Filing for National Historic and Cultural Landmark status has been made, however.

Three private holdings exist within the Amargosa Gorge under the names of Modine, Hess, and China Ranch (Brown). Of these, the Hess property is the most critical and should be purchased. The owner is difficult to communicate with. The Modine and China Ranch properties are fortunately owned by people who care about the area.

2. The river fishes of Sonora

Merritt Keasey, Arizona Sonora Desert Museum, Tucson, AZ

Mr. Keasey described the museum concept, which includes a public education program stressing the entire ecosystem. A slide show was presented depicting distribution and problems of the desert fishes of Sonora insofar as they had

been observed by museum personnel on field trips. The museum has been collecting in the Rio Yaqui, Rio Mayo, and Rio Cuchujaqui for over 10 years and is in a position of being able to generally assess the decline of fish populations in that area, summarized as follows:

a) Rio Yaqui: there are many irrigation projects in the area, and water hyacinths are choking the waterways. It is very difficult to find any fishes.

b) Rio Mayo: Things are in bad shape here and are deteriorating rapidly. Fishes that used to be abundant in this river have not recently been collected, and no shrimp have been seen during the past two years.

c) Rio Cuchujaqui: Native fish are found in this small picturesque mountain stream above Mocuzari Reservoir, although black bass are also found there now. At Navajoa native fishes are largely replaced by exotics. Agricultural pesticide use is extensive.

In summary, the situation is deteriorating in Sonora due to pollution, habitat destruction, and exotic introductions.

3. The changing status of aquatic habitats of the Cuatro Cienegas Basin, Coahuila, Mexico.

Biol. M. Sc. Salvador Contreras-Balderas, Universidad de Nuevo Leon, Monterrey, N.L., Mexico; and W. L. Minckley, Arizona State University, Tempe.

Dr. Minckley briefly reviewed the history of the Cuatro Cienegas and related its physical description. He emphasized that its biological value is not being considered by development forces in Mexico and that it is in imminent danger of destruction by groundwater removal. The fauna of the Cuatro Cienegas comprise three components: 1) very ancient forms which, when distribution of these animals is plotted, bring the continents together; 2) those forms related to northern South America; and 3) those forms supposedly North American in derivation. We can anticipate additional discoveries if the area is not drained. Salvador Contreras-Balderas has started negotiations for National Park status, and support from the United States and the Desert Fishes Council would be appreciated. The Cuatro Cienegas was recently described in a Russian zoogeographic journal as one of the outstanding zoogeographic regions of the world.

Biol. M. Sc. Contreras-Balderas indicated that the Cuatro Cienegas harbors several endemic aquatic plants and numerous endemic crustaceans, molluscs, fishes, reptiles, and amphibians. He described the group in Mexico which is currently supporting National Park status.

A discussion of the proposed resolution of support followed the above presentation. Dr. Carl Hubbs urged a supporting resolution and reiterated success he had had having Scammon's Lagoon set aside for the whales and the positive attitudes expressed by the President of Mexico on these projects. He cited the great help from Chas. Lindbergh on the Scammon's Lagoon project.

Wednesday, November 14, 1973. Pima Room Memorial Union

SESSION V - Research

Chairman, Dr. W. L. Minckley

1. Review of current research on the desert fishes

Elna Arnold, Arizona State University, Tempe

Pupfishes (genus Cyprinodon) of Cuatro Cienegas: hybridization in an intermediate niche.

Two species of pupfish, Cyprinodon bifasciatus and C. atrorus occur in the Cuatro Cienegas basin, Coahuila, Mexico. The first occurs in thermal head springs and larger streams. The latter is a euryhaline, eurythermal inhabitant primarily of saline playa lakes and temporary waters. Although the fishes are potentially sympatric in many parts of their ranges, hybridization rarely has been observed in undisturbed habitats.

Slumping in an underground stream in one spring-river playa system formed a habitat which is intermediate chemically and thermally to the species habitats. A stable hybrid swarm (resembling backcrosses to C. bifasciatus) has occurred in this new area for at least eight years.

2. Mating strategies of the Gila Topminnow (Poeciliopsis occidentalis)

George D. Constantz, Dept. of Zoology, Arizona State Univ.

In most fish species indeterminate growth probably contributes to the hierarchical elevation of the individual. Males of the fish family Poeciliidae, however, cease growing upon attainment of sexual maturity. Therefore, individual males maturing at a small body size may be locked into subordinate status in the local size-dependent aggression hierarchy. Large and small male topminnows exhibit contrasting behavioral and morphological adaptations for mating apparently as a result of these different competitive abilities.

Large males (26-30 mm) often were aggressive, defended territories, turned jet black, and courted females entering their territories. In contract, tiny males (14-20 mm) remained light, submissive, and attempted "sneak" copulations. Territorial males appeared to gain tactile information about the females by nibbling the females' genital area. By contrast, tiny males seldom contacted a female prior to a quick gonopodial thrust. "Sneak" mating behavior of small males consisted of a series of hesitations in frozen or quivering postures, alternating with quick approaches and reversals, always with the head oriented toward the female.

"Sneak" males appeared to have a morphological advantage over territorial males. The correlation coefficient between standard length and gonopodial length expressed as fraction of standard length is -0.708 ($p<0.001$). Thus, males with a competitive disadvantage attempted copulation with a longer and presumably more accurate gonopodium.

3. Ecological distribution of the fishes of the Virgin River System

Jeffrey Cross, University of Nevada, Las Vegas

The Virgin River has its headwaters in the southwestern corner of Utah and flows in a southwesterly direction through Arizona into Nevada where it empties into Lake Mead.

Seventeen species of fish have been collected; of these, 6 are native to the Virgin River System. The remaining 11 species have been introduced by one means of another.

The fish fauna can be divided into 3 general types: 1) the typically downstream, warm-water, slow-water types (Notropis lutrensis, Cyprinus carpio, Gambusia affinis, Lepomis macrochirus, Chaenobryttus cyanellus, Micropterus salmoides, Ictalurus melas, Ictalurus punctatus); 2) the euryplastic fish occupying various habitats from the mainstream to the upper regions of the tributaries (Gila robusta seminuda, Catostomus latipinnis, Plagopterus argentissimus, Lepidomeda m. mollispinnis, Rhinichthys osculus, Pantosteus sp.); and 3) the headwaters fauna (Richardsonius balteatus, Salmo trutta, Salmo gairdneri). Introduced fish occupy only one habitat in the Virgin River System, whereas native fish occupy various habitats.

Western streams and rivers (those unaltered or little altered by man), known for often severely fluctuating environmental conditions, contain a depauperate fauna. Due to the relatively recent speciation in a fluctuating environment, the native fauna is euryplastic.

4. Physio-chemical factors and primary production at Tecopa Bore

Robert Naiman, Arizona State University, Tempe

Tecopa Bore, a thermal artesian stream, is located 2 km west of Tecopa Hot Springs, California. It supports a dense population of the herbivorous Amargosa pupfish (Cyprinodon nevadensis amargosae) in the outflow and has several characteristics not usually associated with streams. For example, all available light energy reaches the thick algal mats, and the pupfish is the only significant primary consumer.

Tecopa Bore is a sulfate-chloride stream issuing from the ground at 47.5 C and flowing in a thermal gradient to a marsh 1000 m away. Water discharge shows a sharp annual variation ranging from 2.5-7.0 $m^3$/min. Stream depth is usually less than 12 cm and the width varies from 3-6 m. The fish population is sensitive to changes in water discharge and cooling rate, occupying an average of 17% of the study area.

Primary production was estimated utilizing a modified $C^{14}$ method for 16 consecutive minutes. All portions of the stream were highly productive at all times of the year, averaging 2.5 to 4.0 gm C/$m^2$/day with an overall yearly average of 3.32 gm C/$m^2$/day. This is one of the most productive aquatic ecosystems studied so far. The high primary production supports the dense pupfish population and assures the fish of an ample food supply throughout the year.

The fish are able to withstand thermal changes of at least 20 C in one day and are able to forage into areas up to 43 C, which is their critical thermal maximum. They will spend several hours each day foraging on the algae in areas only 2 or 3 C below their CTM and literally centimeters away from thermal death. In short, the pupfish is inherently capable of exploiting thermal ecosystems.

5. Effects of temperature on development of the Amargosa pupfish

Joy Shrode, Arizona State University, Tempe

Adult Cyprinodon n. nevadensis were collected from Saratoga Springs, Death Valley National Monument, California, and bred in the laboratory at 28 C, 16L 8D. Eggs were incubated at constant temperatures and at diel fluctuating temperatures. Greater than 50% normal hatch occurred between constant temperatures of 20-36 C and at fluctuating temperatures 28-20 C, 36-28 C, and 38-30 C. Eggs were able to withstand a daytime high temperature, 38 C, when the temperature was allowed to drop at night, which was not tolerable under constant conditions. The tolerance limits for normal egg development parallel the temperatures reported in the literature for breeding behavior observed in the field.

Critical thermal maxima of young fish were consistently higher than those of older fish acclimated under the same conditions. The tolerance to high temperature is apparently lowest during the egg stage, highest in young fish, and intermediate in large adults.

There was a significant difference in the number of vertebrae among any of the following experimental groups on which counts were made: fish which had been incubated at 1) constant temperatures 20 through 36 C; 2) diel fluctuating temperature 28-20 C, 36-30 C; 3) photoperiods 16L 8D, 24L 24D, at temperatures 24, 28, and 36 C; and 4) adults collected from the marsh and spring pond at Saratoga Springs. It may be advantageous for the pupfish to have reduced sensitivity to temperature in affecting vertebral number by reducing developmental abnormalities which might otherwise occur under widely fluctuating temperatures in the natural habitat.

6. Status of the native Arizona fishes of Aravaipa Creek

Randy McNatt, Arizona State University, Tempe

Aravaipa Creek, Graham and Pinal counties, Arizona, acts as a refugium for 7 of the 12 known native fish species of the San Pedro River drainage (Catostomus insignis, Pantosteus clarki, Rhinichthys osculus, Agosia chrysogaster, Gila robusta, Tiaroga cobitis, and Meda fulgida). Extreme fluctuations in relative abundance of these fishes have been the rule over a 13-year period of study, although a general decline in numbers of individuals of all species has occurred. As an example, when compared to 1972 collections, Tiaroga was exceedingly scarce in 1973, found only at two collecting sites in the lower portion of the creek. Rhinichthys, however, was abundant in the upper creek in 1973, and was totally absent from collections made in 1972. Thus there appears to be a pattern of generally mutual exclusion between Tiaroga and Rhinichthys.

The remaining five species of native fishes appear to be maintaining healthy populations in the creek despite fluctuations of considerable magnitude. Meda increased from 1% of the total fishes in 1972 to 30% in 1973. Aravaipa Creek remains the least modified example of a Sonoran desert stream in Arizona in terms of both physical alterations and the lack of exotic species.

SESSION VI - Miscellaneous presentations

1. The politics of preservation

Tina Nappe, Foresta Institute, Carson City, Nevada

What is the state's role in desert fishes protection? So far it has been mostly federal and scientific involvement. It is important that the states be brought into this and, also, that citizens be brought into what the Council is trying to do. Interest in Nevada in the fishes started slowly, but has been growing and this year dominated the meeting of the Nevada Resources Conference because of the litigation over Devils Hole. The State of Nevada has filed briefs with Cappaert in this and they have some very good reasons. Development in Nevada is contingent upon development of water. The suit is precedent-setting in Nevada. The state feels that water is a state resource and the federal government has no right to have a say in it. And if the federal government has a right to have a say in it, they have no rights to make a decision on private land use, but only on water effects on public lands. Implications of groundwater rights might be far-reaching since not that much is known about groundwater.

Ms. Nappe discussed future development of Nye County in Ash Meadows and Pahrump. Nevada is 86% federally owned. Only three areas in Nevada in the southern part of the state have private inholdings: Ash Meadows, Pahrump and Las Vegas.

Nevada Fish and Game Commission is not interested in nongame species. The Department is, but not the Commission.

Ms. Nappe stressed the need for educational programs.

In a discussion which followed the above remarks, Jim Yoakum of Nevada BLM pointed out that the matter of state and federal agencies getting too involved in the political arena re: fishes was very sensitive and if the Council would start passing resolutions, etc., then state and federal agencies could well become very restrictive. He proposed a panel discussion on this matter in the future. Mr. Yoakum stressed that wildlife is not considered by state law to be a beneficial use of water and, in regard to fish, that is indeed a problem. Under state law, fish have no right to exist in Nevada. Unfortunately, people in Nevada aren't doing anything about it, and this is a political arena that conservation organizations can (and we hope will) be a partner in.

2. The environmental backlash-how best to cope with it?

E. P. Pister, California Fish and Game, Bishop

When we started the Desert Fishes Council, those of us who looked at the problems realistically realized that hard decisions would have to be made. There was a great possibility that, in some cases, law suits might have to be initiated as a last resort. We were amazed when the bumper stickers: "Save The Pupfish" came out. We had supporters. When the stickers came out that say: "Kill the Pupfish", we knew we were doing our job. In Owens Valley we have not had outright malice toward fish refuges. The problem of state-federal relationships continues to be a concern, but political considerations are kept secondary. The resource is of prime importance, not who does the job. It is disturbing to see apathy at the state agency level. The resource demands protection, and someone has to do it. I propose more discussion on this.

3. Review of the Great Basin cutthroat trouts

R. J. Behnke, Colorado State University, Fort Collins

At least two species and numerous subspecies of trout are native to the desiccating basins of the western United States. The more ancient distribution is that of the cutthroat trout, Salmo clarki, native to the Bonneville, Lahontan, and Alvord basins. In each of these three basins, the cutthroat trout was represented by two distinct groups (subspecies). Four of these subspecies are undescribed, and one is extinct (the trout once found in Trout Creek and Virgin Creek, Nevada and Oregon, tributary to the Alvord Desert). The extant subspecies are all rare.

The desiccating basins of southeastern Oregon-Harney-Malheur, Catlow Valley, Fort Rock, Chewaucan, Warner Lakes and the Goose Lake systems have a trout I call the red-banded trout, the closest affinities of which appear to be with Salmo aguabonita, the California golden trout. The red-banded trout is also native to the upper Pit and McCloud Rivers in California, to the upper Klamath Lake drainage of Oregon and California, and to some isolated tributaries of the Owyhee River (Columbia River basin) of Oregon and Nevada.

The decline of the native trouts of the Great Basin is associated with degradation of habitat and introduction of non-native trouts. Both the cutthroat trout and the red-banded trout freely hybridize with rainbow trout. Current threats to remnant populations include mining activities and cattle grazing, which can degrade the habitat to an extent that all fish are eliminated from small streams.

Habitat protection and transplants to new waters are the major tools used to save the rare trouts of the Great Basin from extinction. Top priority is given to intra-basin transplants; but if no suitable habitat is available within a basin, then transplants outside the basin should be made to perpetuate unique genotypes.

4. The Colorado River Wildlife Council's Prohibited and Protected Species Committee

J. A. St. Amant, California Fish and Game, Long Beach

The Committee of the Colorado Wildlife Council represents seven western states: Wyoming, Utah, Colorado, Nevada, Arizona, New Mexico, and California. It was formed to develop recommendations for control of exotic species and later expanded to improve and enhance species indigenous to the Colorado River drainage. We also expanded it from fish to include amphibians and reptiles.

As a result of these efforts, a common list of prohibited species was developed, and this is being utilized in regulations of Colorado River States. One good example is Utah, which took recommendations verbatim and now has the best recommendations on prohibited species of any of the states.

Criteria used as to what should be on the endangered list include: Does a species present danger to humans or other animals? Does it prey on desirable species or compete with desirable species? Is it unmanageable? Is it destructive of the habitat? Does it have potential danger to fisheries in neighboring states? Is the species undesirable as a game species or of no apparent beneficial use? Is it compatible with rare and endangered species?

At the present time there are 26 species on the list, including 18 fishes. The rest are reptiles and amphibians.

The other part of the work of the Council is on protected species. The committee recommended the following programs be implemented by the seven states: 1) conduct inventories and studies to determine status of native species, their habitats and requirements for survival; 2) species found to be threatened should have programs immediately implemented to assure their survival; 3) habitat essential to survival of species be protected by law; 4) provide the council with a list of species they protect.

Mr. St. Amant discussed work on status lists from the various states. The forming of a recovery team was also discussed. He concluded by stating that he thought this type of council was a good way to coordinate state and federal efforts.

5. The California Desert Plan

Bill Templeton, Bureau of Land Management, Riverside

Mr. Templeton opened his remarks by presenting a slide show on the California Desert Plan and going over the problems encountered in the California desert with off-road vehicles. He explained the desert visitor management plan which will be put into operation by BLM in the California desert. In 1972 there were 11 million visitor days on the deserts of California.

He also discussed the inventory of the desert resources that the Desert Study Team carried out, which included input from the general public. The plan is now called the Interim Management Plan. He explained the classification of ORV areas.

Relative to desert fish habitats, the Mohave chub (Gila bicolor mohavensis) in San Bernardino County falls into a special design management area.
Piute Springs - a designated routes and trails area.
Amargosa Canyon - closed to ORV's.
Upper Warm Springs - closed.
Zzyzx Springs - matter of court case still going on.

SESSION VII - The Phoenix Zoo, Arizona Zoological Society, and Miscellaneous Presentations

General Chairman of Zoo session: Jack Tinker, Arizona Zoological Society and Director, Phoenix Zoo

Mr. Tinker opened the Zoo session by introducing the members of the Board of Directors of the Phoenix Zoo. This was followed by a welcome by the President of the Society. The Zoo staff was then introduced, and this was followed by a presentation on the status of the planning and development of refugia for desert fishes at the zoo.

Two years ago, talks between the Zoo and Dr. Minckley regarding a refugium for desert fishes became serious and a presentation was made to the Board, which directed further study. Dr. Minckley has done most of the investigation to date.

Dr. Minckley: There are two major components of the overall plan. Monies for the planning were from the New York Zoological Society. We have been trying to solve problems regarding water temperature control, etc., but how do you actually get a natural environment? Or do you modify gene pools by moving animals into an unnatural environment? The goal is to create a semi-natural environment into which organisms can be transplanted, not as individual species of rare and endangered fishes, but as communities. We prefer to set up springs, marshes, and streams of various types to accommodate various communities. One of the problems is to separate the species that hybridize. The refugium complex must be compatible with zoo concepts and must also maintain breeding populations. This is all more complex than was first anticipated, but the Zoo has been very cooperative. We hope to have a walk-down system like the Arizona-Sonora Desert Museum so people can see the fish. This would help researchers observe fish, too. Obtaining the money will be a major problem.

Dr. Minckley stressed the fact that in the Southwest we are in a biological salvage operation; the big things are easy to see, but "the little critters are going fast." Arizona has lost seven species in the last three years, of which five are losses to the fauna of the entire United States.

Phil Pister asked Dr. Minckley whether he had had dealings with the Defenders of Wildlife on this matter. The Defenders at this time are against any concept of this type and would literally rather have a species become extinct than resort to any artificial rearing facility.

Dr. Minckley: Objections have been overridden, as we are attempting insofar as is possible a natural habitat. This should work in Phoenix because there would be a minimum of thermal problems. Also, fish will be available for viewing by

the public, and this is difficult in the natural habitats. Such a facility should increase interest in fish protection and preservation. The Colorado River fish are of the utmost importance, as there are only about 10 years left for them. Researchers could also learn a lot about the fish in a facility as this, which is difficult in the native habitat.

Following the various presentations regarding the facility, the Desert Fishes Council was taken on a tour of the zoo grounds to observe the areas where the proposed refugia are planned.

SESSION VIII - Southwestern preservation programs

Chairman: J. A. St. Amant

Programs concerning maintenance of natural habitats and native fishes in various southwestern states. Presentations by agency representatives and researchers.

1. California Department of Fish and Game

Almo J. Cordone, Sacramento

The Department is actively engaged in a wide variety of programs designed to protect and restore the habitat upon which fishes, amphibians, reptiles and other forms of wildlife depend so completely.

Habitat protection and restoration is given the highest priority. This concern gained considerable impetus during the mid-50's when we began to exert more control over water diversions and water pollution. With strong laws and improved manpower, great strides are being made in the protection of remaining streams, rivers, and estuaries.

There has been an increase in land acquisition programs. The Department now has title to about 125,000 acres. Most of this land is in waterfowl management areas and winter deer ranges. Initially they were managed for fish and game animals of direct interest to sportsmen. Now all native fish and wildlife species are given serious consideration in management programs, particularly the rare and endangered animals. Funds for the purchase of these lands come from the sale of hunting and fishing licenses and a special tax on horse race wagering. Excess military lands and land leased from the State Lands Division are also involved. In recent years, growing concern for unique habitat and animals threatened with extinction culminated in legislation and then active programs for the acquisition and management of key habitat. Native fishes, amphibians, reptiles and other wildlife are all part of this effort. The Marks-Badham Environmental Protection and Research Act of 1970 established the Environmental Protection Fund into which fees from the sale of Environmental License Plates are deposited. The total program is diverse, and part of it is devoted to the acquisition of rare and endangered wildlife habitat and other areas of unique ecological value. A number of essential habitats have already been acquired, and many others are pending. This is only a partial and brief glimpse of the programs in this field being conducted by the California Department of Fish and Game.

2. Status report on the unarmored 3-spined stickleback (Gasterosteus aculeatus williamsoni)

Jonathan N. Baskin, California State Polytechnic University, Pomona

Dr. Baskin described the distribution and differences of the subspecies found in the Santa Clara River and presented slides to show their habitat.

The threats to the fish are: 1) the possibility of hybridization from Gasterosteus aculeatus microcephalus which occurs downstream. If the latter were to get into the upper river we would no longer have williamsoni in unaltered form; 2) competition from other species; 3) alteration and/or destruction of habitat. In regard to #3, he described the threat of the use of ORV's through the river in breeding areas. ORV use emanates from a private campground along the river.

Dr. Baskin is currently a part of a recovery team which is: 1) studying and defining the range of the species, preferably in the driest part of the year; 2) trying to determine the extent of the possible threat of microcephalus; and 3) describing the area and biology of the fish--where do they live, and where do they breed?

Dr. Baskin reviewed the findings of the recovery team to date. Again the matter of whether to publicize the plight of the fish and destruction of habitat was discussed. This has continually been a problem in the management of any endangered species. A great risk is run by publicizing species and habitats; yet without public support it is difficult to save them.

3. Programs in Texas

Dr. Minckley

Cyprinodon bovinus in west Texas, which had been considered extinct for many years, is now in good condition. There is also a stock of Gambusia nobilis. The stock of Gambusia gaigei in both the above area and in Big Bend seems to be doing all right. Cyprinodon elegans in Balmorrhea State Park and Fort Stockton appears to be in good condition. Gila pandora in Davis Mtns.- status unknown.

4. Programs in Arizona

Bud Bassett, Arizona Game and Fish Department

Slides were shown of various phreatophyte clearing projects being undertaken in Arizona. There are projects going on or proposed for the lower Colorado River and Gila River; also the Verde River, Big Sandy Basin, and Salt River. A large amount of clearing has been done on the San Carlos Indian Reservation by the BIA and funded by USGS, with authorization by the Army Corps of Engineers. The Indians did the work.

The Central Arizona Project was described and discussed. Because of water problems in the state and laws regarding water, there is a great deal of emphasis on the need to increase flows in rivers. Therefore, channelization and phreatophyte clearing projects have high priority.

On the Verde River near Camp Verde, a fish loss ranging from 47-100 percent was noted where banks were cleared. Surveys made over a four-year period by Prescott University and the Museum of Northern Arizona showed a direct linear relationship between the ground cover and bird nesting density of an area. Further relationship was noted between the amount of remaining cover, the number of species, and the total population. The entire clearing project has been highly detrimental to fish and wildlife resources.

5. Programs in Utah

Don Duff, BLM, Salt Lake City

The Bureau of Land Management in Utah is concerned with the management and status of desert aquatic habitats and their related fish fauna. BLM is responsible for resource management on about 23 million acres (43%) of Utah's land mass. Fishes in which BLM is actively interested include the least chub (Iotichthys phlegethontis), Utah cutthroat trout (Salmo clarki utah), and the woundfin (Plagopterus argentissimus).

6. Programs in Nevada

James E. Deacon, U.N.L.V.

A few years ago the Nevada Department of Fish and Game established a refugium for the White River springfish, Crenichthys baileyi, in their Sunnyside Wildlife Management Area. This year, Nevada hired its first biologist for nongame species work. Unfortunately, the people of Nevada are only marginally interested in nongame species. A proposal has been made to the Nevada Fish and Game Commission that at least two more nongame biologists should be hired with funding through Dingell-Johnson, Pitman-Robertson, or Defenders of Wildlife. An offer has been made by DOW, but was rejected by Nevada. Nevada has an Endangered Species Advisory Council which needs reactivation.

Jim Yoakum, of BLM's Nevada State Office, attributed the hiring of Nevada's nongame biologist to the untiring efforts of Tina Nappe, who personally carried this concept through the legislature. He stressed the need for concentrating on habitat preservation, rather than emphasizing species preservation per se, and that transplants should be made only as a last resort. Successful transplants imply that the problem is solved, when actually matters have been complicated by the transplant. The fact that we can create a "zoo" may be temporarily helpful, but it is not solving the basic problem, which is overexploitation and destruction of the habitat. If a habitat loses its ability to support wildlife, it often loses its capability to support man.

7. Additional programs in California

J. A. St. Amant, California Department of Fish and Game, Long Beach

See remarks concerning the Colorado River Wildlife Council. In addition to its involvement with fishes, California also has the responsibility to conserve and manage amphibians and reptiles and is acquiring data on these classes of animals. A recovery team for the desert tortoise (Gopherus agassizii) has been formed.

Progress report by cooperating aquarists.

Richard Haas, California State University, Fresno

Dr. Haas reported that he was unsuccessful in rearing the Devils Hole pupfish (C. diabolis). All 25 specimens delivered in May 1973 were lost. He described in detail the various rearing attempts. Upon analyzing his failure, he felt that perhaps the approach to try next would be oxygen reduction. He attributed part of his failure to contaminated nitrogen.

Al Castro, Steinhart Aquarium, San Francisco

Mr. Castro reported failure with C. diabolis at Steinhart and requested more fish for further rearing experiments.

SESSION IX - General Business Meeting of the Desert Fishes Council

During the general business meeting, various items of business were discussed, "loose ends" were attended to, and a plan of action firmed up for consolidating the affairs of the Council. A summary follows:

1. The next symposium will be held in Las Vegas, with Dr. Deacon in charge of details and planning.

2. Dr. Minckley and Dr. Miller will collaborate in preparing letters and resolutions necessary to indicate the support of the Council for the proposals recommended by Salvador Contreras-Balderas for the Cuatro Cienegas. A resolution will be prepared expressly for the President of Mexico.

3. The Desert Fishes Council supports the concept of a refugium at the Phoenix Zoo and will direct a resolution to Mr. Tinker in this respect.

4. Concerning aquarium culture, the following needs were expressed to support current preservation efforts:

   C. diabolis for Steinhart Aquarium and Dr. Haas.
   E. latos for Steinhart and Dr. Minckley at Arizona State University.

In addition, it was deemed desirable to move some more fish from Devils Hole to Hoover Dam Refugium. The Council will assist in obtaining clearance for the procurement of these fishes for the purposes designated.

The matter of the difficulty of getting the minutes transcribed from the tapes and typed and printed was discussed in detail. It would help a great deal if those presenting papers at the symposium would hand in typed papers or copies of their presentations. It is difficult to find someone who can do this work. Tilly Barling volunteered to type 1971 and 1972 minutes. Miriam Romero volunteered to transcribe and type 1973 minutes. Dr. Deacon will attempt to include the minutes from 1974 symposium in his planning for that symposium. It was suggested that the department or agency hosting the symposium would be responsible for the minutes.

There was a discussion of where regional meetings would be held. There would, perhaps, be various sub-committee meetings in the Southwest and Mexico, breaking along geographical rather than political boundaries.

The meeting was adjourned after gratitude was expressed to all at Arizona State University for the outstanding arrangements which helped to make the symposium so successful.

On the following day, a very successful field trip was conducted to the Aravaipa Canyon area. The Council is grateful to Defenders of Wildlife and the Arizona Game and Fish Department for their efforts in making the trip possible.

# ATTENDANCE LIST, FIFTH ANNUAL DESERT FISHES SYMPOSIUM
Arizona State University, Tempe
November 13-14, 1973

| NAME | AFFILIATION |
|---|---|
| Steve Alcorn | Ariz. Coop. Fish. Unit, U of A, Tucson |
| Elna Arnold | Scottsdale Comm. College |
| Bob Azevedo | BSFW, Albuquerque, New Mexico |
| Jonathan N. Baskin | California State Polytechnic Univ. |
| Tilly Barling | Naval Weapons Center, China Lake, CA |
| Robert Behnke | Colorado State Univ., Ft. Collins |
| Denton Belk | Arizona State University |
| Ken Boyer | BLM, Bishop, California |
| Robert E. Brown, Jr. | California State University, Fresno |
| Sterling Bunnell, M.D. | San Francisco, California |
| Claudia M. Carlson | California State University, Humboldt |
| Alfred Castro | Steinhart Aquarium, San Francisco |
| Gary Constantz | Arizona State University |
| Salvador Contreras-Balderas | Universidad de Nuevo Leon, N.L., Mexico |
| Peter C. Cook | University of Arizona, Tucson |
| Almo Cordone | California Fish & Game, Sacramento |
| Jeffrey Cross | University of Nevada, Las Vegas |
| Paul Cuplin | BLM, Denver, Colorado |
| Kevin Curry | Ariz. Coop. Fish. Unit, U of A, Tucson |
| James Deacon | University of Nevada, Las Vegas |
| Wayne Deason | Bureau of Reclamation, Boulder City, NV |
| Don Duff | BLM, Utah State Office, Salt Lake City |
| Gary Edwards | Arizona Game and Fish |
| Robert Feldmeth | Claremont Colleges, California |
| Lloyd Findley | University of Arizona, Tucson |
| Dean R. Garrett | National Park Service, Death Valley |
| Shelby D. Gerking | Arizona State University |
| Herb Guenther | Bureau of Reclamation, Boulder City, NV |
| Ron Gumtow | BSFW |
| Richard Haas | California State University, Fresno |
| Jim Herman | California State Poly. Univ. |
| Wendy Hodepons | Phoenix, Arizona |
| Carl L. Hubbs | Scripps Institution of Oceanography |
| Laura C. Hubbs | Scripps Institution of Oceanography |
| Harold Hunter | U.S. Forest Service, Bishop, CA |
| Francis H. Jacot | National Park Service, San Francisco |
| Jay R. Jones | California State University, Humboldt |
| Merritt Keasey | Arizona-Sonora Desert Museum |
| David Kenagy | Pomona College, California |
| Charles Kennedy | U.S. Forest Service, Albuquerque |
| David Kennedy | Ariz. Coop. Fish. Unit, U of A, Tucson |
| Gail Kobetich | BSFW, Parker, Arizona |
| Boyd Kynard | Ariz. Coop. Fish. Unit, U of A, Tucson |
| James F. LaBounty | Bureau of Reclamation, Phoenix |
| Tom Liles | Arizona Game and Fish |
| David Lindquist | University of Arizona, Tucson |

| NAME | AFFILIATION |
|---|---|
| Steve Loe | USFS, Prescott, Arizona |
| G. R. Love | Rancher, Ash Meadows |
| Charles Marshall | California Fish & Game, Blythe |
| Randy McNatt | Arizona State University |
| R. G. Miller | Foresta Institute, Carson City, NV |
| Robert Miller | Univ. Michigan, Ann Arbor |
| C. O. Minckley | Northern Arizona University |
| W. L. Minckley | Arizona State University |
| Nancy M. Moffatt | University of Arizona, Tucson |
| Mark Morton | BSFW, Retired |
| Robert Naiman | Arizona State University |
| Leontine Nappe | Foresta Institute, Carson City, NV |
| Steve Nicola | California Fish & Game, Sacramento |
| Charles Osborn | BSFW, Las Vegas |
| Lynn E. Otte | Ariz. Coop. Fish. Unit, U of A, Tucson |
| Alan Pickard | California Fish & Game, Blythe |
| Phil Pister | California Fish & Game, Bishop |
| Gary Ponder | California Fish & Game, Bishop |
| Brian Rampsch | Scottsdale, Arizona |
| D. H. Rasmussen | BSFW, Portland, Oregon |
| Tom Robinson | Arizona Game and Fish |
| Miriam Romero | Environmental Consultant, Montrose, CA |
| Gene Ruhr | BSFW, Washington, D.C. |
| Kevin Ryan | BSFW |
| Mike Saiki | Ariz. Coop. Fish. Unit, U of A., Tucson |
| James A. St. Amant | California Fish & Game, Long Beach |
| Elwood A. Seaman | Bureau of Reclamation, Washington, D.C. |
| Joy Shrode | Arizona State University |
| E. Linwood Smith | Arizona State University |
| Milt Somerfeld | Arizona State University |
| Gene Sturla | Arizona State University |
| Jerry Tash | Ariz. Coop. Fish. Unit, U of A, Tucson |
| Bill Templeton | BLM, Riverside, California |
| Jack L. Tinker | Arizona Zoological Soc. & Phoenix Zoo |
| David Travis | California Fish & Game, Bishop |
| Ken Whaley | Pomona College, California |
| Jim Yoakum | BLM, Reno, Nevada |
| John D. York | Soil Conservation Service, Arizona |
| Paul F. Yull | BLM, Arizona |

# SIXTH ANNUAL SYMPOSIUM

Showboat Hotel, Las Vegas, Nevada, November 12-14, 1974

A Summary of the Proceedings of the Symposium Relating to the Protection and Preservation of the Desert Fishes

Note: The year 1974 represents the first time that most participants provided prepared papers or summaries for inclusion in the proceedings. These papers are included, as received, in the order presented. Summaries of the remaining papers and proceedings were extracted from a review of tape recordings and notes prepared by David Travis of the California Department of Fish and Game.

## Tuesday, November 12

The symposium was presided over by the outgoing chairman, James A. St. Amant of the California Department of Fish and Game, Long Beach. Following introduction of Council officers and guests, the first session was started.

## SESSION I - Research

Chairman: J. A. St. Amant, California Department of Fish and Game and Chairman, Desert Fishes Council.

The following papers were presented.

1. Demographic studies of the Nevada pupfish, Cyprinodon nevadensis

David L. Soltz, California State University, Long Beach

This study compares the life histories of some populations of Nevada pupfish living under markedly different environmental regimes: (1) Amargosa River--a highly variable stream habitat; (2) Big Spring--a large, constant temperature warm spring; and (3) a series of small warm springs. The hypothesis is examined that, because of the constancy of their environments, pupfish inhabiting warm springs are more K-selected than those in the Amargosa River. The life history features that appear most directly subject to natural selection are: fecundity, age at maturity, and adult body size (reflecting differences in growth and survivorship). K-selected populations are predicted to exhibit: (1) decreased fecundity, (2) delayed maturity, (3) slower growth, and (4) increased survivorship.

The life histories of the pupfish populations studied differed markedly. Reproduction is more strongly seasonal in the Amargosa River. Density fluctuates most in the Amargosa River and least in the small warm springs, where food appears to be consistently available. The populations differ from one another with respect to age at maturity. Maturity is delayed in females from

the Amargosa River relative to those from Big Spring. The age structure of adult Amargosa River pupfish is indicative of higher adult survivorship. This population also apparently has higher adult growth rates. Females in the Amargosa River are more fecund at any given body size and grow to larger adult body size than females in Big Spring. Since both populations are producing essentially equal-sized eggs, it is evident that Amargosa River pupfish put more effort into reproduction.

The life histories of these populations differ in the directions predicted to theory of r- and K-selection only in age specific fecundity. The apparent lack of correlation between most pupfish life history features and the constancy and temperatures of their environments may result from the effects of genetically invariant, temperature-dependent metabolic processes on growth.

2. Status of the Virgin River roundtail chub (Gila robusta seminuda) and the Utah cutthroat trout (Salmo clarki utah) in the Virgin River system

Jeffrey Cross, University of Nevada, Las Vegas

Gila robusta seminuda, endemic to the Virgin River, prefers deep runs or pools with sand and gravel bottoms adjacent to areas of swift water. It has been collected only in the mainstream of the Virgin River from Mesquite, Nevada, upstream to Hurricane, Utah. Typical chub habitat is scarce on the Virgin River. Published accounts and collection data indicate that modifications of the river for irrigation purposes with a concomitant decline in water quality due to agriculture and urbanization are largely responsible for the tenuous status of the chub. No ecological work has been accomplished on this subspecies. Unlike its close relative, G. r. robusta, in the upper and lower Colorado River basins, G. r. seminuda is not found in the relatively clear tributaries; reasons for this are largely unknown. In any event the chub population in the Virgin River appears to be much reduced from its former numbers. An effort should be made to protect this subspecies before it becomes extirpated.

The Utah cutthroat trout, native to the Bonneville Basin, was collected from the headwaters of the Santa Clara River near Pine Valley, Utah. This may be one of the few remaining pure populations of this species. It was probably introduced into the area by early Mormon settlers from the headwaters of the Sevier River. From published accounts the population seems to have remained fairly stable over the last 15 years. The remoteness of the habitat and a downstream barrier falls largely protect this population from man-induced disturbances and introductions of hatchery trouts.

3. Reproductive strategy of the female Gila topminnow, Poeciliopsis o. occidentalis

George C. Constantz, Arizona State University, Tempe

Reproduction strategy of the female Gila topminnow, Poeciliopsis o. occidentalis, was studied at a spring in Santa Cruz County and in a desert wash in Pima County, Arizona. The spring is a constant-temperature, comparatively stable environment in Upper Sonoran grassland. By contrast, the wash population inhabits a pocket of permanent water surrounded by Lower Sonoran desert, and is subject to flooding, desiccation, and vast changes in the local resources and physico-chemical parameters. Optimality theory in ecology predicts differing reproductive strategies for female individuals of the same species inhabiting two such contrasting environments. In the predictable, stable, spring habitat, density dependent factors (e.g., food limitation) should be important in influencing reproductive strategy so that natural selection should favor females maximizing competitive abilities of their offspring, not the quantity of young produced. By contrast, in an unpredictable, fluctuating desert wash, density-independent factors (e.g., sudden increases in habitat volume with precipitation and lowered fish densities) should be more important in molding reproductive strategy. Selection in the latter habitat should favor females producing many fry, with less priority placed upon their competitive abilities.

Preliminary data appear to support the above theory. Females from the spring invested more energy (calories) per offspring, resulting in a larger, presumably more competitive fry. By contrast, females in the wash appear to have been maximizing fecundity, with lowered investment of energy per fry.

In the spring habitat, investment per offspring appeared to increase with size of the parental female, a situation that does not appear to be the case in females from the desert wash. It may be that in a situation of greater density-dependence, larger females have a competitive advantage and are able to acquire more food resources for constructing larger eggs. Greater survivorship may be associated with eggs containing more calories because fry are born larger and presumably more competent at competitive interactions. Thus, female reproductive strategy appears not only to differ under different ecological conditions, but also possibly with age (size) of the individual fish.

4. Studies of the woundfin, Plagopterus argentissimus

Jerry Lockhart, University of Nevada, Las Vegas

In Mr. Lockhart's absence, Dr. Deacon reported that the woundfin was confined to the mainstream of the Virgin River, where it was found in sandy bottom habitat. It has been transplanted to three or four other streams, but thus far without success.

## 5. An isolated population of the Colorado River cutthroat trout, *Salmo clarki pleuriticus*, in eastern California[1]

E. P. Pister, California Department of Fish and Game, Bishop

Prior to a 1948 Act of the California legislature prohibiting transportation of golden trout eggs and fry out of the state, it was common practice to make such shipments to other states and, on occasion, to foreign countries. Often this was done in exchange for eggs or fry of species native to the area involved.

One such incident of unusual significance occurred in 1931, when 25,000 golden trout eggs were shipped to the Colorado Fish Commission in return for (according to the Mt. Whitney Hatchery log) "30,000 black spotted from Denver, Colorado Fish and Game Commission. Native trout of Colorado." Presumably, they were Colorado River cutthroat, *Salmo clarki pleuriticus*. Colorado's main source of cutthroat trout eggs has remained unchanged since that time: Trapper's Lake at the head of the White River in west-central Colorado (Wayne Seaman, pers. comm., 1961).

J. O. Snyder, Chief of the California Bureau of Fish Culture, recognized the unique character of these fish and directed Mt. Whitney Hatchery Superintendent George McCloud to rear them in a remote portion of the hatchery and plant them in an isolated location to preclude mixing or later hybridization. Superintendent McCloud's crew followed their instructions to the letter (Leon A. Talbott, pers. comm., 1974).

Mt. Williamson (elev. 4,381 m.) is the second highest peak in the Sierra and holds a commanding position over the southern Owens Valley. On the northwest shoulder of this majestic peak lies a group of seven lakes ranging in elevation from 3,383 to 3,814 m. Access is extremely difficult, involving either a ten hour climb and elevation increase of 2,000 meters through brush and boulder fields up the outlet stream or an equally time-consuming climb over 3,657 m. Shepherd Pass.

Inasmuch as most of the Shepherd Pass trail is negotiable by stock, this route was selected. Even then, the fish had to be transported in rubber backpacks for about two km. and down 427 m. through a boulder field to reach the lowest lake. The fish adapted well to their new home in the lower three lakes and soon stabilized into self-sustaining populations.

Snyder's extreme care in handling and planting these fish was vindicated shortly thereafter, when Yellowstone cutthroat trout (*Salmo clarki lewisi*) were planted in Trapper's Lake from 1943-50, thus jeopardizing the genetic integrity of the native *S. c. pleuriticus*. However, it is presumed that a reasonably pure strain of the Colorado River cutthroat still exists in Trapper's Lake because of a unique ability of this native stock to resist hybridization with non-native trout (Robert J. Behnke, pers. comm., 1974). Dr. Behnke is also

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[1]The first recorded occurrence of this subspecies in California was in the Salton Sea (Evermann, 1916). However, it soon disappeared, presumably because of increasing water temperatures and salinity.

of the opinion that remnant populations of essentially pure S. c. pleuriticus may still be found in the native range, primarily in the Green River drainage. However, these populations are currently threatened by possible oil shale development, water diversion, and exploratory oil drilling.

Behnke points out (pers. comm., 1974) the possibility that the Trapper's Lake cutthroat sent to California in 1931 had been exposed to possible hybridization from non-native trout in the 1890's because of the variety of sources of cutthroat eggs utilized by the Leadville federal hatchery. Leadville Hatchery was then the stocking source for many waters, and the general lack of records during that era places in question the genetic purity of many Great Basin trout populations. However, the native Trapper's Lake stock no doubt exerted the same resistance to hybridization referred to earlier.

A field check made in September 1974 revealed thriving populations of extremely beautiful fish in the three lakes planted in 1931. Irrespective of the status of the Colorado River cutthroat in its native range, it is comforting to know that, thanks to Snyder's foresight and his crew's dedication, the lower Williamson lakes contain a reservoir of essentially pure strain fish available for whatever use the future may dictate.

## SESSION II - Miscellaneous presentations

Chairman: Robert L. Borovicka, BLM, Portland

### Introduction

The subject Miscellaneous Presentations is a true representation of the new desert-wide approach of the Desert Fishes Council. We seem to cover everything from Cyprinodon to Salmo. The habitat protection role of the federal land management agencies is the first subject under consideration.

### Federal Progress Reports

Under the requirements of the endangered species act, federal agencies have become deeply involved in the impacts to habitat of all species of wildlife. Some of the activities that may have an impact on desert fishes are as follows:

1. Irrigation - agriculture
2. Land development
3. Forest practices
4. Channelization
5. Land actions, such as sale and exchange of public lands and desert land entry laws
6. Grazing and range management
7. Mineral exploration and development
8. Recreation use, such as off-road vehicles.

Federal programs may involve all or part of the following major headings.

1. Coordination and cooperation with state agencies such as the state fish and wildlife management and research agencies, state water resource boards, and state planning agencies.

2. Providing scientific knowledge of fish ecology in each habitat. This is accomplished by encouraging research at both the state agency and university level, providing man-months of biologists and other personnel time and also materials, cash allowances, and providing habitat for scientific study.

3. Identification of impacts to specific populations of fish.

4. Aquatic habitat management plans or engaging in recovery plans.

5. Through habitat acquisition, protection and development (so called dirt money).

6. Providing leadership in problems of litigation in the process of acquiring or protecting habitat.

Federal habitat maintenance programs

Forest Service: Dave Garber, Inyo National Forest, Bishop

I am knowledgeable only of programs in the California Region of the Forest Service, where three east-side forests have been working with fishes of interest to the Council.

The Plumas and Modoc National Forests have been involved in programs with the Modoc sucker, Catostomus microps, considered endangered by the State of California and status undetermined by the U.S. Department of Interior. A five-agency team has been working towards recovery of this fish. The Modoc Forest is attempting to provide better habitat conditions by securing water releases from Clear Lake into the Lost River where summer low flows are detrimental to the species.

The Inyo National Forest is involved in programs with two species of fish of Great Basin origin: the Colorado River cutthroat trout, Salmo clarki pleuriticus and the Paiute cutthroat trout, Salmo clarki seleniris, both of which exist outside of their native waters. The history and status of the Colorado cutthroat has been presented earlier in this session.

The second year of cooperative studies with the California Department of Fish and Game has been completed on the Paiute Cutthroat in Cottonwood Creek (White Mtns.) on the Inyo Forest. Generally, the population is healthy but not expanding to a desirable number. Our management programs will strive to improve habitat conditions, especially for spawning, and encourage better distribution within the stream. Available evidence suggests that the Cottonwood population has the highest potential for genetic purity of any population of Paiute cutthroat. We believe that complete recovery of this fish inevitably involves replacement of this pure stock or equally pure stock into native waters. The Cottonwood Creek habitat will be managed as a refugium until reintroduction activities are accomplished, after which a different management scheme may be considered.

Fish and Wildlife Service: Gene Ruhr

Gene Ruhr of the Office of Endangered Species, Fish and Wildlife Service, reported on prospects for increased land acquisition funds in fiscal year 1977. He also reminded the Council that the National Environmental Protection Act provides considerable benefits for endangered species, requiring that a determination be made as to whether a species will become endangered by a proposed project, or whether the project site may be a potential transplant site of an endangered species.

Fish and Wildlife Service: Check Osborne

Chuck Osborne spoke briefly on the status of three artificial habitats for desert fishes monitored by Fish and Wildlife Service. the population of C. n. pectoralis at Purgatory Springs is on the decline, consisting of 35 adults at present, with no sign of successful reproduction. Empetrichthys latos at Corn Creek has diminished to approximately 250 individuals from a high of 1300-1400, apparently due to resurgence of the Gambusia population survivors from the initial treatment. Plans are being considered to re-do the entire operation. Mechanical difficulties at the School Springs Refugium delayed adequate testing, and this site is not yet operational.

Bureau of Land Management: Robert L. Borovicka

BLM state and district offices have been given clear directions from the Washington, D.C., office at the Directorate level. The Director of BLM expects employees to encourage, plan, and carry out deliberate, aggressive programs to benefit endangered species which occur on lands administered by BLM, and those that use habitat under their control or may be affected by BLM programs. In addition, he expects BLM administrators to take whatever actions are necessary tp prevent any native animal from becoming endangered.

BLM has had an active part in the initial development of the Desert Fishes Council and in participation in progress, goals, and meetings. To enhance the inventory need, BLM has recently hired new fishery biologists for the State Offices of Colorado, California, and Nevada.

Following are some of the rare and endangered species that have required the attention of BLM.

Oregon

The Oregon Lakes Basin: The Alvord trout, Alvord chub, Warner sucker, and the Red-Band trout.

California

All Owens Valley desert fishes including the Owens pupfish, Mohave chub, Tecopa pupfish, and the Amargosa pupfish.

Nevada

Nevada has worked with habitat of the Utah cutthroat, Lahontan cutthroat, and the School Springs pupfish. Artificial habitats for rare fish have been built at Shoshone Ponds in the Ely district. Later in this program, a complete report will be given on the work in Nevada and Utah. BLM has also worked on the Red-Band trout in Elko, Nevada, and the Lahontan cutthroat in the Salmon Falls Creek area.

Colorado

In the Colorado system, BLM has taken active part in the recovery team of the Colorado squawfish and the other Colorado River cyprinids.

Arizona

Arizona has had a very active program of habitat protection in the Aravaipa Canyon.

Utah

BLM has been active in Utah in the following habitat management work:

1. Participation on the Woundfin recovery team in the Virgin River drainage.

2. Participation in formation of a recovery team for Colorado River squawfish in the Upper Colorado River Basin.

3. Completion of the interagency stream habitat surveys for the Utah cutthroat in central Utah with the Utah Division of Wildlife Resources, U.S. Forest Service, and the U.S. Fish and Wildlife Service personnel.

4. Initiation of stream habitat surveys for the Snake Valley cutthroat in Utah's west desert mountain ranges.

5. Initiation of Desert Springs habitat inventories for the least chub, in Utah's west desert area.

6. Initiation of stream habitat surveys in the upper part of Green River Basin in Utah and suspect areas of Colorado River cutthroat inhabitance; and in the White River oil shale area for Colorado River squawfish and humpback chub.

National Park Service: Pete Sanchez, Death Valley National Monument

Pete Sanchez reviewed the history of salt cedar invasion in the U.S. and emphasized the problems its introduction into desert spring habitats presents. Found on the West Coast in the mid-1800's as a garden plant, salt cedar is now covering over 1.3 million acres, and its presence has reached a crisis status in the Monument's spring areas. The evapotranspiration water requirements of salt cedar are such that on a small spring the trees will take the available

water and eliminate all stretches of open water. Salt cedar invasion threatens all aquatic forms as well as the migrant/resident birds and mammals. Salt cedar can be controlled in its early stages on small springs by cutting, trimming and treating the ends with drops of herbicide. Small amounts of work done early enough and on a continuing basis will control the growth of the cedar. Removal of established large trees requires heavy equipment, much money, and causes heavy environmental damage to these fragile habitats. But caught early enough, the control work is easily done, almost incidental to other field work done in the area.

Sanchez briefly highlighted the studies and programs sponsored by the National Park Service at Devils Hole and Death Valley. He noted that primary production in Devils Hole is now less than half of what it was before pumping began at Ash Meadows.

Bill Newman of Nevada Division of Water Resources explained the content of the Water Resources Division State Water Plan, highlighting its various reports, including the most recent forecast for fish and wildlife resources. The reports may be obtained after January 20, 1975, from the Nevada Division of Water Resources, 201 S. Fall Street, Carson City, Nevada 89701.

Bob Smith, California Department of Water Resources, summarized three recent publications from the DWR. The Desert Area Land and Water Use Survey (1972) covers the Lahontan and Colorado desert areas. Bulletin 160-74, California Water Plan Outlook in 1974, has become available through the DWR, P. O. Box 6598, Los Angeles 90055. Also highlighted was the water quality control plans for E&W Colorado Basin and Lahontan area.

Steve Nicola gave a brief summarization of California Fish and Game's management plans for the Lahontan cutthroat trout. The basic long range plan calls for the re-establishment and re-introduction of Lahontan cutthroat strains into as many suitable habitats as possible. Recent collections in California portion of the East and West. E&W. Walker systems indicate that there may be some pure strains remaining in portions of these drainages. Additionally, re-establishment work is being conducted with cutthroat trout on the East Fork Carson River headwaters, the Independence Lake population in the Truckee River drainage, and a Truckee River origin cutthroat in a Yuba River tributary. The Lahontan cutthroat trout status is still considered insecure.

## Cooperating Aquarists

Al Castro, Steinhart Aquarium, reaffirmed the willingness of private aquarists to help the Desert Fishes Council in any way possible. Specifically mentioned were American Killifish Association, North American Native Fishes Association, and the Cyprinodon Study Group whose members would be able to conduct laboratory studies.

W. L. Minckley spoke for the Arizona Zoological Society, covering the progress of a spring-like habitat development at the Phoenix Zoo. The project is currently being held up through funding problems.

## Progress in Implementing the Endangered Species Act of 1973

Gene Ruhr and Jim Williams

Gene Ruhr and Jim Williams of the Washington Office of Endangered Species spoke in general about the Endangered Species Act's procedures, conflicts and consequent effectiveness.

Important aspects of the Act include its focus on ecosystems as well as individual members of that system, recognizing the importance of habitat and the commitment to protect it. Additionally, all animals, including plants, are now covered, and separate populations may be listed, eliminating the subspecies cut-off point.

The procedures to have an animal listed as either endangered or threatened were reviewed, including approximate time schedules and opportunities for pertinent comments and public hearings.

Questions from the members of the Council centered primarily around the interpretation of "take." The term has been broadened to include harassment, and much concern was apparent as to how this expanded definition would be viewed by both the Washington Office in granting study/collection permits and the various enforcement agencies in the field.

Finally, Gene Ruhr noted that his office was apprising all government agencies to review their actions in relation to critical habitats to insure their compliance with the Act.

## Activities on National Resource Land within Nevada

Jim Yoakum preceded special presentations by two BLM representatives with a summary of activities in Nevada by the Bureau of Land Management. National Resource Land is the new term applied to BLM lands, formerly referred to as the public domain. Habitat Management Plans, which identify problems facing a species or population and recommended management resources, and Allotment Management Plans, concerned with livestock demands, are two more new terms the BLM must cope with. In the Elkhorn and Baler Mtn. Districts, the BLM has completed HMPs which have resulted in the fencing of several miles of stream. In the Winnemucca District, with the cooperation of the Fish and Wildlife Service, two projects for the elimination of natural barriers along Mahogany Creek (tributary to Summit Lake) have opened new spawning areas for the Lahontan cutthroat trout. The Soldier Meadow dace appears to be in danger due to geothermal leasing and spring development along its restricted habitat on private lands.

## Progress Report on School Spring, Ash Meadows, Nevada

Denise P. Meridith, BLM Natural Resource Specialist, Las Vegas

School Spring is located on BLM land about 70 miles west of Las Vegas. Inventories during the late 1960's revealed that the isolated population of

Cyprinodon nevadensis pectoralis in School Spring needed protection to insure its survival. There was always the threat that exotic species or pollutants could be easily introduced into the spring, wiping out this endangered pupfish. It was in 1969 that the Bureau of Land Management became involved in the struggle to preserve these fish.

A habitat management plan was written for this pupfish habitat area. A chain link fence was constructed around the original pond to provide complete protection. An observation pond was excavated nearby to allow the public an opportunity to see some of these lively and interesting fish. A sign was erected which briefly described the history and significance of the pupfish population. A picnic table, trash can and outhouse were placed near the visitors' pond. A well was drilled nearby to insure that a constant supply of water will always be available for the two ponds.

An inventory on November 7th and 8th of this year estimates the present population of the two ponds to be 231. This compares with 136 fish in 1973. A new problem has developed: fast-growing phreatophytes frequently clog the spring and must be removed periodically to provide a reasonable amount of living space for the fish population. A large population of frogs also plagues the observation pond. The habitat management plan must soon be updated to recommend methods of dealing with these problems and to include some of the large amounts of information that have been discovered since 1969 about the pupfish, its habits and habitat needs.

Public curiosity about the pupfish remains high. Earlier this year, a pupfish slide show was presented to six classes in a Henderson junior high school and two youth groups took field trips to School Springs, where they helped clear out phreatophytes and erect a new 'visitor' sign. Of course, scientific interest in the plight of the pupfish also remains high. In a relatively short period of time, this tiny, attractive, territorial fish has adapted itself to life in small, warm, highly mineralized springs. Thus pupfish are important to anyone with an interest in the evolution, genetics, ecology, or behavior of life forms in the desert.

Progress Report on Shoshone Ponds

Wayne Logan, Bureau of Land Management, Ely

Purpose: To develop refugia for three endangered species of Nevada desert fish, Pahrump killifish (Empetrichythys latos), Pahranagat bonytail (Gila robusta) and Moapa dace (Moapa coriacea).

Accomplishments

| | |
|---|---|
| Dec. 17, 1970 | Completed Wildlife Habitat Management Plan N-4 WHA-A2 for Shoshone Ponds |
| Oct. 10, 1971 | Completed drilling of Shoshone Well #2 which provides 86 F water 8 gpm to each pond |

| | |
|---|---|
| March 9, 1972 | Introduction of 16 Pahrump killifish into nearly complete pond |
| March 9, 1972 | Installed a thermal recorder in the refuge |
| June, 1972 | Completed construction of 3 ponds, North pond 25' x 25' x 5', Middle pond 40' x 40' x 5', South pond 40' x 40' x 5' |
| July 3, 1972 | Completed construction of 4-strand barbed wire fence enclosing 2 acres around the ponds |
| Sept. 26, 1972 | Introduction of 20 Moapa dace into north pond |
| | Transfer of 8 Pahrump killifish from middle pond to south pond |
| | Introduction of 20 Pahranagat bonytail into middle pond |
| July 3, 1973 | Completed installation of interceptor drain system |
| | Completed installation of wire grids above each pond to discourage use of ponds by waterfowl |

Present Status

On August 28, 1974, 14 Pahranagat bonytails were observed in the middle pond by Wayne Logan, Wildlife Specialist, Ely BLM. Several fish were estimated to be 8 inches long, which is much larger than when they were introduced. All large fish were observed, so apparently there has been no reproduction. No fish were observed in either the north or south ponds since this spring (personal communication with Don Cain and Leroy McLelland).

Temperature of the middle pond was recorded at 70 F on August 28, 1974.

Nevada Department of Fish and Game personnel are in the process of reintroducing new stocks of Moapa dace and Pahrump killifish. Ely District BLM is in the process of submitting Job Documentation Reports to complete construction of two artificial streams to provide spawning habitat for Moapa dace and Pahrump killifish. Also a JDR to install a more effective waterfowl deterrent screen system over the ponds.

An on-site interpretive sign is being developed by the Ely District outdoor recreation planner.

Report to Desert Fishes Council on Current Status of Amargosa Canyon

Mirian Romero, Pupfish Preservation Committee, Montrose,
reported by Bob Smith

As of November 1974, BLM Bakersfield District, Lou Boll, Manager, has padlocked the gate at the north end of the canyon and also the one at the entrance to the

canyon from China Ranch. The area is posted as being closed to ORV's. Lou Boll is to be commended for his actions. The south end of the canyon has not been padlocked or fenced or gated, although it was signed a year ago. However, ORV users continue to come into the area from the south, and repeated requests to have the canyon protected from the south have been to no avail. This entrance is in the Riverside District, BLM, Del Vail, Manager.

Bird censuses have continued each month. The presence of 4 species on the endangered species list has definitely been established. There are now 200 species on the list altogether.

There has been no plan for management of the area or cooperative agreements between California Fish and Game and BLM. Although BLM has officially withdrawn and closed the area to mining, ORV use and designated it a natural area, no management plans have been made.

No effort on the part of California Fish and Game has been made to close the area to recreational shooting and plinking (we are not here discussing legal hunting during hunting season). We have not received word that the subspecies of meadow vole that had been found in the area (that had been declared extinct in 1917) has been placed on the list of rare and/or endangered species.

There was a heavy rain storm and flash flood in June and the reservoir in China Ranch was completely wiped out. The resultant deluge of water caused much damage to riparian vegetation and alteration of ecosystems in the Willow Creek area and at the confluence with the Amargosa River.

Cattle are again being grazed by the local 4-H club in the ecosystem just west of China Ranch, much to our dismay. These cattle are on private lands; but there is no fencing, so the cattle are free to roam on public lands in the canyon.

Fingerling bass were observed in the river and at the waterfalls on the Amargosa in June, but none were found in October 1974.

The local people in Tecopa seem more aware of the values of the area. They are becoming more tourist-oriented and seem more willing to protect the canyon than they did a year ago.

The problem of the private inholdings remains unsolved. Nature Conservancy has expressed an interest in buying the Hess property, and there is continued interest in China Ranch. However, the interest of the Conservancy is contingent upon BLM fully protecting the area, and upon cooperative agreements with California Fish and Game to protect predator species and total wildlife in area.

We feel the Council has not really used whatever muscle it might have to aid in solution of some of these problems and would urge the Council to renew their determination to have this area fully protected as a wildlife and desert fishes sanctuary. Laymen can only do so much--and for many of us, conservation is becoming a financial luxury we can no longer afford.

Therefore, for the coming year, we recommend and urge the Council to do the following:

a) Prevail upon the Riverside District of BLM to physically (with gates, fences, and padlocks) close the south end of the canyon to ORV users.

b) Arrange for a meeting of the various agencies having jurisdiction over the canyon to discuss a management program. This would include BLM, California Department of Fish and Game, California Department of Water Resources, Inyo County and San Bernardino County Planning Depts., U.S. Bureau of Sport Fisheries and Wildlife, and Office of Endangered Species, plus the private property landowners, Nature Conservancy, etc.

c) The State of California recently appropriated several million dollars from license plate money to buy habitat lands for endangered species. Would recommend the Council go after funds for China Ranch.

Private Conservation Sector

Tina Nappe, Foresta Institute, Carson City, Nevada

Tiny Nappe gave a brief summary of her work within the private conservation sector. She stressed the need for additional funding, particularly for the Endangered Species Advisory Board, and the need to stimulate public interest in the status of endangered fish. The philosophy of fish protection, if made more appealing to the public, could stimulate major interest in the species themselves, as well as indicators of water supply and quality.

SESSION III - Reports from Great Basin Area Coordinators concerning status of habitats and species, and other matters relating to biological integrity.

Chairman: J. A. St. Amant, California Department of Fish and Game and Chairman, Desert Fishes Council.

Sonoran Desert - Mexico and United States

Mexico

W. L. Minckley reported that during a recent trip along the coastal portion of Sonora made by Bob Naiman, he collected at all coastal streams crossed without any evidence of natives. Bluegill and largemouth bass only were collected.

Herb Guenther briefly gave the details of two trips made to the Santa Clara Slough, Sonora in June and September of 1974 while studying the native fishes of the historical Colorado River drainage in Mexico. A large population of C. macularius was found in a small marsh area in the Slough. The marsh's water

source is primarily runoff from agricultural lands around Riato. There was no obvious presence of any predator fish, although bird predation appears heavy. No desert pupfish were found in the main Colorado River. The full details are forthcoming in a paper, which will include the recommendation that any transplants be made only with the full sanction of both governments and the Desert Fishes Council.

United States

W.L. Minckley gave the details on continuing deterioration of habitat throughout the U.S. portion of the Sonoran Desert, including the Gila River system. A recent trip along the Colorado River in the Yuma area upstream from Parker Dam showed no evidence of any native fishes remaining there. The Gila River system still has a few viable populations of Poeciliopsis occidentalis within their native ranges, as well as some good populations in some spring areas. Gila intermedia and P. occidentalis are thriving in a stream habitat on the Cienega Ranch (private land). The expanding population of smallmouth black bass in the Salt River drainage above Roosevelt Lake has apparently limited native fish reproduction, as Minckley collected only large adults--no young. The SMB have moved into the Salt River Canyon and are showing signs of stunting. Salmo apache is in danger along Ord Creek (tributary to East Fork White River) as major timber sale operations on the Indian lands are destroying its habitat. The Yaqui drainage in SE Arizona shows continuing habitat deterioration. P. sonorensis in that drainage is limited to the good population in Leslie Creek and one small spring and three artesian wells in that area.

Chihuahuan Desert - Mexico

Salvador Contreras-Balderas reported on the continuing degradation of habitats in the Mexican portion of the Chihuahuan Desert and commented on his frustrations in attempting to elicit concern in this respect from Mexican authorities. There is still hope that a de facto National Park status, and consequent protection, might be achieved for the Cuatro Cienegas, and he expressed the desire that the Council continue to work in this direction.

Additional comments on the Mexican Chihuahuan Desert follow in the report by Robert Rush Miller.

First, a brief summary of the International Symposium on the Biological Resources of the Chihuahuan Desert Region, U.S. and Mexico, held at Sul Ross State University, Alpine, Texas, 16-18 October 1974. This symposium, attended by close to 400 people, was co-sponsored by the Southwestern Region of the National Park Service and the Texas Parks and Wildlife Department. Some 40 papers, involving nearly 60 scientists, were presented on Quaternary environments, botany, ichthyofauna, herpetology, mammals, and avifauna, with a concluding three-hour panel session. The Chihuahuan Desert, some 1400 km by 500 km in major dimensions and lying mostly in Mexico, is one of the largest, richest, and least investigated biotic regions in North America. Speakers frequently referred to rare and endangered organisms and commented on deficiencies in the existing system of resource conservation. The Panel recommended formation of (1) a Binational Committee to identify important areas in the

Chihuahuan Desert, that, because of their great scientific significance, should be established as protected biological reserves, and (2) a Binational Research Program on the biota of North American desert ecosystems.

A half-day session on fishes, chaired by Clark Hubbs, included papers by Robert Rush Miller (composition and derivation), W. L. Minckley (Cuatro Cienegas Basin), and Salvador Contreras-Balderas (changing fish fauna, species diversity correlated with drainage size). Much field work remains to be done before the total fish fauna will be known. At present, 107 species in 16 families are recognized, of which about 65 percent are endemic (including 4 genera); 15 percent are undescribed (species and subspecies). Some 75 percent of the fauna is included in the Cyprinidae-Catostomidae-Ictaluridae group and the cyprinodontoids (Cyprinodontidae, Goodeidae, Poeciliidae), including 14 species of pupfishes (Cyprinodon). Lic. Horacio Gallegos, Director of National Parks for Mexico, said that the conservation of the unique Cuatro Cienegas basin had high priority and is scheduled next (after Big Bend Peace Park) on the list of projects for consideration by Mexico. The Symposium Proceedings will be published in their entirety by the National Park Service, hopefully in 1975.

In the Texas-New Mexico part of the Chihuahuan Desert (as reported to me by Clark Hubbs), the current status of rare (peripheral), threatened, or endangered species is as follows:

Campostoma ornatum, Mexican stoneroller. Peripheral. Occurs in Alamito, Terlingua, and Tornillo creeks (the latter two in Big Bend National Park). The species is widespread in Mexico (and also occurs in U.S. in Rucker Canyon, Arizona), but is likely being reduced in numbers in Tornillo (and Terlingua) Creek by competition with the exotic Plains killifish, Fundulus kansae (Hubbs and Wauer, 1973, Southwest. Nat., 17: 375-379); its taxonomic status is under study by Brooks Bur, Illinois Natural History Survey.

Dionda diaboli, Devil's River minnow. Threatened. In U.S. only in Devil's River; in Mexico, rare in Rio San Juan basin and Rio San Carlos, Coahuila.

Notropis chihuahua, Chihuahua shiner. Peripheral. Rare in U.S. (Terlingua and Tornillo creeks). Presumably still common in the Rio Conchos basin of Mexico.

Notropis proserpinus, Proserpine shiner. Threatened. U.S. populations of this clearwater species have declined markedly in the last 20 years so that it is now a rare species in the U.S. and is depleted in Mexico.

Notropis simus, bluntnose shiner. Endangered. This species, known only from the main Rio Grande and lower Rio Conchos, has not been taken in recent years and may be extinct.

Moxostoma austrinum, Mexican redhorse. Peripheral. This species (as identified by Dr. R. E. Jenkins of Roanoke College, Virginia) is known in the U.S. only in Alamito Creek. It is otherwise confined to the Rio Conchos basin of Mexico, where it is depleted.

Cyprinodon bovinus, Leon Springs pupfish. Threatened. Rediscovered in 1965 (after having been thought to be extinct for more than 30 years), this species

recently has been redescribed (Echelle and Miller, 1974, Southwest. Nat., 19: 179-190, fig. 1) from an 8-10 km segment of Leon Creek north of Fort Stockton, Texas, where its habitat is surrounded by an oil and gas field. However, officials of the Northern Natural Gas Company and Humble Oil Company are aware of this pupfish and are taking precautions to avoid adverse modification of the habitat. This species is to be added to the official list of threatened U.S. Wildlife.

Cyprinodon elegans, Comanche Springs pupfish. Endangered. This species is extinct at the type locality, Comanche Springs (Fort Stockton, Texas), but survives in the Balmorhea area to the west. The destruction of Comanche Springs is dramatic testimony of the effect of water mining on a major aquifer. These springs produced 35 million gallons of water daily until well drilling started in 1950. By 1954, the spring stopped flowing, and by 1956 its orifice was completely dry. A refuge for the Comanche Springs pupfish is being constructed at San Solomon Springs in Balmorhea State Park by the Texas Parks and Wildlife Department.

Cyrpinodon eximius, Conchos pupfish. Peripheral. This species occurs in the U.S. only in Alamito Creek (collected there on October 19, 1974) and in Terlingua Creek (where scarce). Its status in Mexico needs study.

Gambusia amistadensis, Amistad gambusia. Endangered. This species is extinct in nature because of the flooding over its only known place of occurrence, Goodenough Spring, after the completion of Amistad Dam on the Rio Grande (Peden, 1973, Copeia, No. 2: 210-221). A surviving stock is being held in Austin, Texas, by Clark Hubbs. There is urgent need to find a suitable (preferably fishless) spring into which this stock can be transplanted.

Gambusia gaigei, Big Bend gambusia. Endangered. This species survives in nature only in a spring in Big Bend National Park (Hubbs and Broderick, 1963, Southwest. Nat., 8: 46-48).

Gambusia nobilis, Pecos gambusia. Threatened. This species occurs in five different localities, within springs and creeks, of the Trans-Pecos area (Leon Creek, San Solomon Springs, Blue Spring, Bitter Lakes National Wildlife Refuge, and Bottomless Lakes State Park). Its official U.S. status should be changed from Endangered to Threatened.

Gambusia senilis, blotched gambusia. Peripheral. This species, recorded from Devil's River, Texas, its only known U.S. record, may not be extinct in the U.S. It is not uncommon in the Conchos River basin of Mexico although its status there needs monitoring. Perhaps some thought should be given to reestablishing it in the U.S. provided a suitable habitat can be found.

Etheostoma grahami, Rio Grande darter. Peripheral. Known to occur in the lower Pecos River, Dolan Creek, San Felipe Creek, and Devil's River above Dolan Creek.

Percina macrolepida, largescale darter. Threatened? This recently-described species (Stevenson, 1971, Southwest. Nat., 16: 65-83) is now extinct in the Pecos River, but the Pecos stock is abundant in the Yuba River basin and the

delta region of the Sacramento River in California (Steve Nicola, pers. comm. X:13:1974). It is scarce in Mexico (one record) but occurs to the west of our region along the Edwards Plateau of Texas. Its current status is uncertain; monitoring is needed.

The endemic pupfish of the Tularosa basin, New Mexico, Cyprinodon tularosa, is being described by Miller and Echelle in the December 1973 issue of Southwestern Naturalist. It occurs in at least three separate localities north of White Sands National Monument.

Within the Mexican part of the Chihuahuan Desert the following species are of concern:

Gila modesta, Salinas chub. Threatened. Now restricted to a spring-fed area on a tributary of Rio Salinas, south of Saltillo, Nuevo Leon. Needs monitoring.

Catostomus conchos, Conchos sucker. Status uncertain. Has been collected only three times since its description in 1903, most recently in 1965 (W. L. Minckley).

Prietella phreatophila, Mexican blindcat. Endangered. Current status unknown; confined to one or two adjacent wells in Coahuila. Not checked during past decade.

Megupsilon aporus, Potosi killifish. Endangered. This species is confined to a single spring (Miller and Walters, 1972, Contrib. Sci. Nat. Hist. Mus. L.A. Co., No. 233: 1-13) into which largemouth bass were recently introduced; as a result, this endemic genus may be extinct. An undescribed species of pupfish living with it is also threatened with extinction.

Xiphophorus couchianus, Monterrey platyfish. Endangered. This species is now known from only a few localities near Monterrey; It is extinct in Huasteca Canyon (Rio Santa Catarina), to the west of Monterrey, where it was formerly abundant. It should be added to the official list of endangered fauna.

Xiphophorus gordoni, northern platyfish. Threatened. This species is one of the endemic fishes of the Cuatro Cienegas basin, an area being disturbed by man's modification through canal construction and water diversion.

Five species are known to have become extinct within the Chihuahuan Desert Region in the past half century. One of these, the shovelnose sturgeon, Scaphirhynchus platorynchus, formerly lived in the Rio Grande but has not been reported from that river for 25 years or more. The remarkable snail-eating minnow, Stypodon signifer (an endemic genus), Cyprinodon latifasciatus (the Parras pupfish), and Characodon lateralis (the northern goodeid) have all become extinct in the Parras basin, Coahuila. C. lateralis still survives in springs near Durango. Gambusia amistadensis survives in captivity only.

Changes in the fish fauna of the Chihuahuan Desert over the past century have been shown by Salvador Contreras-Balderas to be marked for a number of stations where repeated collections have been made. In some instances (as in the Parras

Basin), major extinctions have occurred but, hopefully, at many of the other localities where native species have disappeared or been replaced by exotic ones, relict populations may still be found in other (usually upstream) parts of the drainages concerned.

Threats to individual species are, in most cases, not solved by species management but by management of the ecosystem. In most instances the management needs to be not man's manipulation of the environment but man's protection of the environment from man.

Bonneville Basin: Donald A. Duff, Bureau of Land Management, Salt Lake City

During 1974 many significant items have been initiated and accomplished in the interest of desert fishes and their respective habitats by state and federal resource management agencies. These items can be listed as follows:

1. Least chub, Iotichthys phlegethontis: The Bureau of Land Management (BLM) has become increasingly aware of this species and its habitat status in view of increasing demands for, and exploration of, oil and gas and geothermal resources in the desert area of west-central Utah. Funding was obtained to collect baseline desert aquatic data for BLM's planning system and environmental analyses. A contract for habitat and species inventories of least chub springs, both of known and suspect inhabitance, was issued to the Utah Division of Wildlife Resources (UDWR) in the spring of 1974. The UDWR subsequently contracted these studies to Dr. William F. Sigler, Utah State University.

Dr. Sigler could not attend this DFC meeting due to these study commitments and is at this present time on the study location sites in Snake and Tule Valleys inventorying these least chub springs. He states that he is impressed by the habitat resource and the possible populations that will be inventoried, and will be able to present a more intensive report of his inventory work at the 1975 DFC meeting.

Physical habitat and species population data collected by Dr. Sigler will be recorded on the DFC field study forms drafted last year for use in desert spring waters, and copies of the completed data will be sent to the DFC for information and files.

2. Utah cutthroat, Salmo clarki subsp.: Dr. Bob Behnke's verification of three Utah sites where this species is now known to occur sparked interest in management planning for this species and its habitat by state and federal agencies. This species inhabits two areas on the Dixie National Forest and one area located on national resource land administered by the BLM and Fishlake National Forest land administered by the U.S. Forest Service.

An interagency aquatic habitat survey was made on the stream site near Beaver, Utah, administered by the BLM and USFS, with personnel from the USFS, U.S.F.W.S., UDWR, and BLM. Following analyses of the field data, a cooperative habitat management plan will be drafted by the BLM and USFS to provide for the maintenance, enhancement, and protection of this unique subspecies. The existing habitat and population at present are being threatened by livestock and off-road vehicle (ORV) use within its 2½ mile habitat range.

The Forest Service (Wasatch National Forest) and the UDWR are also cooperating in a rehabilitation of Red Butte Canyon Creek on the Ft. Douglas Military Reservation and Wasatch N.F. bordering Salt Lake City on the east. Once stream rehabilitation is completed, a population of the Utah cutthroat will be reintroduced back into its native range. The Red Butte Canyon Creek area has been withdrawn from public use for a long time, and because of this the USFS plans to manage this area as a natural research area. The area should provide a valuable research area for the Utah cutthroat and the aquatic ecosystem relationships.

3. Snake Valley cutthroat, Salmo clarki subsp.: In the spring of 1974, BLM biologists in the course of conducting aquatic habitat surveys, in cooperation with the Utah DWR, found an isolated population of cutthroat in the headwater reach, above natural barriers, of a stream on the east slope of the Deep Creek Mountain Range in Tooele and Juab counties. Cutthroat samples sent to Dr. Behnke at Colorado State University were verified as pure strain individuals bearing close similarities to the only other previously known cutthroat in the area from the Mountain Wheeler area (Humboldt N.F.) in Nevada located just across the state line to the south. Dr. Behnke is calling this subspecies in western Utah and eastern Nevada the Snake Valley cutthroat due to its location in Snake Valley within the Bonneville Basin.

Dr. Behnke has stated that this subspecies contains different meristematic and genetic characteristics than the three known populations of Utah cutthroat. Dr. Clair Stalnaker, Utah State University Cooperative Fishery Unit in Logan, also agrees, based on blood chemistry analyses from both subspecies, that this Snake Valley cutthroat is different from the Utah cutthroat. The BLM feels that these two subspecies are unique to national resource lands in Utah and should be nominated for inclusion in the endangered species list because of their limited habitat and the precarious status of this habitat due to present land uses.

Also, in connection with this Snake Valley cutthroat found in Nevada, the Ely District of the BLM has provided an additional 5 miles of fencing along Goshute Creek to protect the riparian habitat and the cutthroat from livestock use. The cutthroat were introduced into Goshute Creek several years ago in an attempt to extend the range of this subspecies as well as for survival of the subspecies. Additional plans for extension of this subspecies' range and survival have been developed by the Nevada Department of Fish and Game, and a list of potential streams for reintroduction has been submitted to the Nevada BLM for review. This subspecies is protected in Nevada, and no fishing is allowed for it at present. This exemplifies a strong effort of interagency coordination between state and federal resource management agencies for the protection of an endangered species and its habitat.

4. The recent publication by the California Academy of Sciences of "Hydrographic History and Relict Fishes of the North-Central Great Basin" by Dr. and Mrs. Carl Hubbs and Dr. Robert Miller has greatly aided resource management agencies in providing information and describing Great Basin ecosystems and associated fish fauna. This publication should prove valuable in documenting habitat changes rapidly occurring within the Great Basin and in locating and providing management for relict fish fauna surviving still within the area.

Anyone actively interested in the management of desert fishes should obtain a copy of this document for review and reference use.

Lower Colorado: Gail Kobetich

Gail Kobetich of the Fish and Wildlife Service gave the Council the overall status of various native fishes and mentioned specific problems facing populations in the major tributaries. Good populations of R. osculus and native suckers exist in the Paria River; however, the Plagopterus transplant does not seem to have taken. Two special problems were pointed out to exist among tributaries to the Little Colorado River. Small populations of native suckers in the Zuni River are being protected now by attempts to have them listed as threatened and through an agreement with the tribe of protection of the habitat. Another tributary to the Little Colorado, Silver Creek, has lost its population of Gila robusta due to chemical poisoning from an upstream source. G. robusta may be gone entirely down to the Little Colorado. Along the Virgin River, limited populations of Plagopterus seem stable and the native sucker populations are not in any immediate danger. The Bill Williams River has undergone extensive modification, and consequently all native fish are assumed gone from this drainage. In the Grand Canyon area of the Colorado River all large river forms are extinct or nearly so, due to habitat changes resulting from the construction of Glen Canyon Dam. More work will be done to determine the size of known populations of razorback suckers, especially in Lake Mojave and Lake Havasu. Two Gila species are considered to be in the most critical status now in the Lower Colorado River area. Both G. robusta seminuda and G. elegans need listing as threatened forms.

An overview of the squawfish and razorback sucker hatchery programs was given. A paper was later submitted giving the details.

Al Pickard, California Fish and Game in Blythe, presented slides showing the status of aquatic habitat along the Lower Colorado River. The channelization projects and flow control work on the river have altered habitat considerably, contributing to the loss of native fishes.

Jim St. Amant, California Fish and Game, spoke on the work of the Prohibited and Protected Committee of the Colorado River Wildlife Council. The Prohibited and Protected Committee now has 17 species of fish and 20 species of reptiles and amphibians on their prohibited species list. The Committee is now preparing a complete checklist of the fish, amphibian, and reptile species of the Colorado River system. A slide presentation of some prohibited species followed, highlighting the work with the African clawed frogs in South California.

Pete Carbone, Fish and Wildlife Service, Willow Beach Hatchery, gave the details of the successful hatchery spawning of Colorado River squawfish and razorback suckers. Seven adult squawfish spawned in late May 1974 at the hatchery after attempts at hand spawning and chemical initiation of the spawn had showed success. At present 5,000-7,000 fry averaging 2½" are being held at the hatchery in three different systems. Razorback suckers were raised from eggs hand spawned from adults in Lake Mojave. Approximately 3,000 fry averaging 2½-3" long are at the hatchery, along with several adult razorbacks

transferred at the same time from Lake Mojave. Future plans and stocking locations are being considered for these fish by the Fish and Wildlife Service. Congratulations and gratitude were offered by the DFC.

Upper Colorado: Bruce May, Clair Stalnaker, Robert Wiley

The following status report presented by the Upper Colorado River Area Committee catalogs the efforts of those agencies and organizations working with threatened or endangered fishes of the upper Colorado River drainage. Significant information on those rare and endangered endemic species of the upper Colorado River has been gathered with many more studies in the planning stages.

The Endangered Species Committee of the Bonneville Chapter of the American Fisheries Society has completed a detailed report on the endangered and threatened fishes in Utah. This report, presented at the Utah Academy of Arts, Letters, and Sciences fall meeting 1974, summarizes the present status of all species and populations of fish that are threatened or endangered in Utah. The report gives a good synopsis of the present status of endangered species within the Colorado River drainage in Utah. Dr. Paul Holden, Chairman of the Bonneville Chapter's Endangered Species Committee, has also completed a dissertation covering the distribution, abundance and life history of the fishes of the upper Colorado River basin. These two works provide a substantial foundation in outlining the factors affecting Colorado River fishes and in pointing out areas for future study.

Present research on upper Colorado River drainage fishes includes three studies being sponsored by the Cooperative Fisheries Unit of Utah State University. Dr. Clair Stalnaker and Mr. Gerald Klar are completing research on the Colorado River cutthroat trout (Salmo clarki pleuriticus). The emphasis of their work is the use of blood chemistries to differentiate between fish populations. Work on the Colorado River squawfish (Ptychocheilus lucius) is presently underway on the Yampa River. This river is a major tributary to the Colorado River and at present is one remaining area of good squawfish populations. This work on the squawfish centers on the use of radio telemetry to aid in gaining much needed information on squawfish spawning requirements. Another telemetry study underway is being performed by Dr. Wydoski and Mr. Chuck McAda, Utah State University. Their work is being done on the humpback sucker (Xyrauchen texanus) in the Colorado River.

State agencies that are presently developing programs to study certain of the endangered species of the upper Colorado River under the 1973 Endangered Species Act are Utah Division of Wildlife Resources and Colorado Division of Game, Fish, and Parks. These proposed studies will supply greatly needed information on the present status of fishes in the upper Colorado River.

In summary, some work on the endangered endemic species of the upper Colorado River has been completed. At present several studies are underway with numerous others in the planning stages. All the information gained will be of paramount importance to the understanding and well-being of these fishes. Because of the tremendous amount of human exploitation that is proposed for the upper Colorado River drainage area, all available information on the present

status of endemic species should be reviewed, so areas of highest priority can be determined. It is hoped that, with continued effort a greater concern for the unique organisms of the upper Colorado River will be generated, thus insuring the future of the endemic fishes.

Added comments on this report brought out the fact that BLM has subcontracted detailed studies on the Colorado squawfish and humpback chub and sucker in the White River to the University of Utah. The studies are designed to determine the effect two oil shale lease contracts may have on these endemic forms, and will include water quality analysis.

Additionally, Robert Miller stressed the importance of designating the Yampa as a wild river as many native fishes of the Green River have moved up into the Yampa, escaping the lower water temperatures resulting from the Flaming Gorge project.

Lahontan Basin: Dale Lockhard, Nevada Department of Fish and Game

Lahontan Cutthroat Trout (Salmo clarki henshawi)

1. This species is presently being cultured extensively in Nevada by both the Nevada Department of Fish and Game and the U.S. Fish and Wildlife Service. This combined total production of cutthroat within Nevada during 1974 was near 1,563,000 fish. Angling pressure exerted upon this species primarily in Pyramid and Walker lakes of western Nevada, is significant (137,000 angler days use during 1973).

This cutthroat is presently listed as an endangered species by the Fish and Wildlife Service; however, the Nevada Department of Fish and Game is encouraging its removal at the present time due to the extent of culture and use levels. We have recommended in conjunction with the local U.S. Fish and Wildlife Service officials, that the pure-strain population found in Summit Lake, Nevada, be retained as an endangered species to offer some protection to this uncontaminated source. Considerable management and research efforts are being expended upon the sport aspects of this fish.

Other strains and subspecies of cutthroat exist within the Lahontan Basin and are receiving consideration and protection under our fishery management plans

Cui-ui (Chasmistes cujas)

2. The Cui-ui lakesucker is native only to Pyramid Lake at the terminus of the Truckee River. A sister population was lost with the desiccation of Winnemucca Lake in 1938. The Cui-ui has been utilized historically as a food fish by the Pyramid Lake Indians and in more recent years has also been pursued by white men.

With the buildup of the large sand delta at the river mouth, the Cui-ui was no longer able to ascend to spawn. Spawning activity was therefore restricted to the lake shoreline, the consequence being a reduction in species abundance.

During 1969 and since, the Indians restricted the harvest of Cui-ui only to Indian fishermen.

At the present time, culture techniques are being experimented with by the U.S. Fish and Wildlife Service and to some degree by the Nevada Department of Fish and Game. Further work is planned with culture and planting depending upon the availability of spawning adults.

The Marble Bluff Dam and fishway now being constructed at the river mouth will allow escapement of both the Cui-ui and Lahontan cutthroat into the Lower Truckee River. This should bolster the native reproductive capability of the Cui-ui and, hopefully, its stock in the lake.

Soldier Meadows Dace (Eremichthys acros)

3. Although this fish is not listed under the federal list of endangered fauna, it is given the status of a protected species under state regulation. It is found only in the Soldier Meadows area of Humboldt County.

We are exploring the possibility of establishing this species in other springs in the general proximity to the native source and, in particular, those on BLM lands. A potential threat to the entire stock is pending in the way of private property and BLM public domain land leasing for geothermal exploration. We will be keeping a close eye on these activities.

Interbasin: Cal Allan, Nevada Department of Fish and Game

Cal Allan presented his report on the status of the endemic fishes of the Interbasin area. The Moapa dace is considered by him the most endangered species in Nevada. Its White River habitat is suffering from urban development in the form of creek channelization and resort facilities on the feeder hot springs as well as from competition from exotics. An inventory of the dace population is planned to see if population size will allow some transplants to be made. An artificial refuge in the stream or at one of the spring heads is being considered. White River Spring Fish (C. baileyi) is secure in many areas and is successfully competing with introduced exotics. The Hot Creek Refuge has been infested with Black Bass. Treatment of the refuge and re-introduction of C. baileyi is planned. C. nevadae population in Railroad Valley is still secure; no new work has been done on this fish. Pahranagat bonytail is secure, as is the White River spinedace population.

Oregon Lakes Area

General Report on Oregon Lakes: Carl E. Bond, Oregon State University

I. The drainages covered in this report are the following: Klamath Basin above the falls plus the Lost River drainage, Goose Lake, Summer Lake--Chewaucan River--Albert Lake complex, Silver Lake, Alkali Lake, Warner Valley, Catlow Valley, Alvord Basin and Harney Basin. These have received attention from ichthyologists over the past nine decades with Cope exploring

the region in the 1870's. Other early studies were made by Evermann, Gilbert, Meek and Seale. In the early 1900's, J. O. Snyder worked in the region and published a paper that has formed an excellent basis for more recent work. The work of Hubbs and Miller has provided an excellent understanding of the relationships involved.

II. Status of selected species.

A. Klamath Basin.

1. Chasmistes brevirostris - This species should be considered as endangered. Population levels were low through the 1950's and 1960's and the species was thought to be virtually extinct. However in recent years it has been discovered in small numbers in Sprague River and in the Lost River drainage. The "Klamath Basin Threatened Fishes Recovery Team," under the chairmanship of Craig Harasek, has encouraged study of the species. Dr. David Koch and students surveyed the Clear Lake Reservoir--Lost River system--and have recommended further study. At Oregon State University, James Andreasen and C. E. Bond, aided by a contract with the Bureau of Sport Fisheries and Wildlife, have initiated studies on population levels, life history, effect of the legal snagging fishery and the extent of hybridization of this species with Catostomus snyderi. Data are still being analyzed, but at the present nothing has indicated that C. brevirostris has a safe future. No firm recovery plan has been devised for the populations in Oregon. If study does not identify specific reasons for decline of populations, or if hybridization is seen as a major factor, a recovery plan will be difficult to formulate.

2. Catostomus luxatus - This species is endangered in California waters but is doing well in Upper Klamath Lake in Oregon. Although few of the 6 to 8 kg fish formerly encountered in the snagging fishery are seen now, the spawning concentrations in Sprague River and over springs in Upper Klamath Lake appear to include a few thousand fish each year. C. luxatus is receiving attention from the Klamath Recovery Team and is being studied by James Andersen. No recovery plan has been made for California populations, but studies are being proposed that should lead to such plans within a year. California Department of Fish and Game, the U.S. Forest Service, and the University of Nevada have been involved in studies of this sucker.

3. Salvelinus malma - The Klamath Basin populations of the Dolly Varden are small. The species is certainly rare here and possibly is endangered, but we have insufficient knowledge of its status. Competition from the introduced Salvelinus fontinalis may have aided the decline of the S. malma populations.

4. Other species.

a. Lampetra lethophaga seems to be more common than previously thought, as additional locality records have been obtained. The species is being included in studies by Ting T. Kan at Oregon State University.

b. Lampetra tridentata subsp., the landlocked parasitic lamprey, is common in Upper Klamath Lake.

c. Cottus tenuis, an endemic, is common in the streams of the basin above Klamath Falls.

d. Cottus princeps, an endemic species, was once present in Lost River, but does not appear to live there. It is common in Upper Klamath Lake.

B. Goose Lake drainage.

1. Cottus pitensis was thought to be extinct in Oregon as no specimens were seen between 1954 and 1974, but one specimen was obtained recently. This species was not uncommon around 1950 but declined shortly thereafter. The decline was probably due to natural, but unknown, causes, as no severe adverse activities in the watersheds have been identified. No recovery plan has been proposed, although some thought has been given to reintroduction from tributaries of Pit River, where Dr. Peter Moyle has found the species in fair abundance.

2. Salmo sp., the redband trout, has been identified from the drainage by Dr. Richard Wilmot, but appears to be very rare. Frequent introductions of Salmo gairdneri may be involved in the decline of the redband.

3. Lampetra tridentata subsp., the landlocked parasitic lamprey, is common in the drainage. It is under study by T. T. Kan.

4. The status of Hesperoleucus sp. in the basin is undetermined.

C. Summer Lake - Chewaucan River - Albert Lake Complex.

1. Gila bicolor is represented in Ana Spring north of Summer Lake, Chewaucan River, and XL Spring north of Abert Lake. The Ana Spring population has survived rotenone treatment, and all populations have survived the introduction of other species. XL Spring is the type locality of G. b. oregonensis. Hubbs and Miller have indicated that the other populations are somewhat distinct from that of XL Spring.

2. The Salmo species (probably the redband) originally present in the Chewaucan system has apparently lost its identity. It was called S. purpuratus by Cope and S. clarki by Snyder.

D. Silver lake.

1. Salmo sp., the redband trout is common in the headwaters of Bridge and Buck creeks despite introductions of other species. These populations were studied by the Oregon Cooperative Fishery Unit.

2. The other species present, Rhinichthys osculus and Gila bicolor, are common.

E. Alkali Lake.

1. The only species present is Gila bicolor, living in the small Hutton (Alkali) Spring. The population consists of only a few hundred individuals, and should be protected from any changes in the spring that would reduce the water volume.

F. Warner Valley.

1. Catostomus warnerensis, once common in the basin, is now in danger of extinction. Almost all access to spawning areas in tributary systems has been cut off by irrigation dams, and much of the creek water is diverted to fields. The species appears to be absent from Deep Creek and is rarely seen in Honey and Twenty-mile Creeks. In 1974 a few adults ascended Honey Creek to the irrigation dam at the county road. Recovery of this species could be facilitated by management of the irrigation diversions to allow upstream and downstream passage of fish. No public land is involved. All negotiations for protection of the Warner sucker would be with private landowners. The status of the fish has been studied by James Andreasen and C. E. Bond.

2. Rhinichthys osculus is present in several streams and lakes of the basin, but the population in tiny Fosket Spring in the floor of dry Coleman Lake appears to be distinctive. The population probably consists of 1,000 to 2,000 individuals, mostly in the shallow overflow of the spring. This fish could be threatened by any reduction in water volume. The population could be increased by impoundment of the spring, which is on private land. Relationships of this population to others in this and adjacent basins will require further study.

3. Hesperoleucus sp. has been collected in Warner Valley in recent years but was not collected by Snyder in the early 1900's. Whether its presence represents an introduction is not known, and its status in the basin is undetermined.

G. Catlow Valley.

1. Salmo sp., the redband trout, is common to abundant in streams on the east side of the basin. Population dynamics of this species are under study by Dr. J. D. McIntyre and Clair Kunkel of the Oregon Cooperative Fishery Unit. Under present conditions, these populations do not appear to be threatened.

2. The Catlow chub, Gila sp., is maintaining good populations in the streams. Systematic relationships of this fish are being studied by Peter Bisson and C. E. Bond.

H. Alvord Basin.

1. Salmo clarki subsp., the Alvord cutthroat trout, is maintaining populations in Willow and Whitehorse Creeks, but the native trout of

Trout Creek has become extinct through hybridization with introduced S. gairdneri. The Alvord cutthroat, because of the dangers inherent in range fires, overgrazing, and possibilities of introductions of other trout, should be considered threatened. Habitat protection is being accomplished by a cooperative effort of the Bureau of Land Management and Oregon Wildlife Commission.

2. Gila alvordensis, the Alvord chub, is not threatened under present conditions. It occurs in Trout Creek as well as many springs and ponds here and in Virgin Valley. Hot or Borax Lake north of Fields represents a unique environment that should be protected.

Gila alvordensis is under study by Dr. C. L. Hubbs. Dr. David Kerley of Eastern Oregon State College is interested in the physiology of the species.

I. Harney Basin.

1. The Malheur sculpin, Cottus bairdi subsp., is found in the following creeks: Poison, Devine, Smyth, Riddell and Silver. Individuals from Donner and Blitzen River may have light prickles and may not be typical of the form originally described by Bean as Potamocottus bendirei from Rattlesnake Creek. The species apparently disappeared from the type locality about 1960. This fish is representative of the old fauna of the Harney Basin and should be protected. There is interest on the part of the U.S. Forest Service and other public agencies in perpetuating the populations.

Further study of the relationship of the Malheur sculpin to other representatives of C. bairdi will be undertaken at Oregon State University.

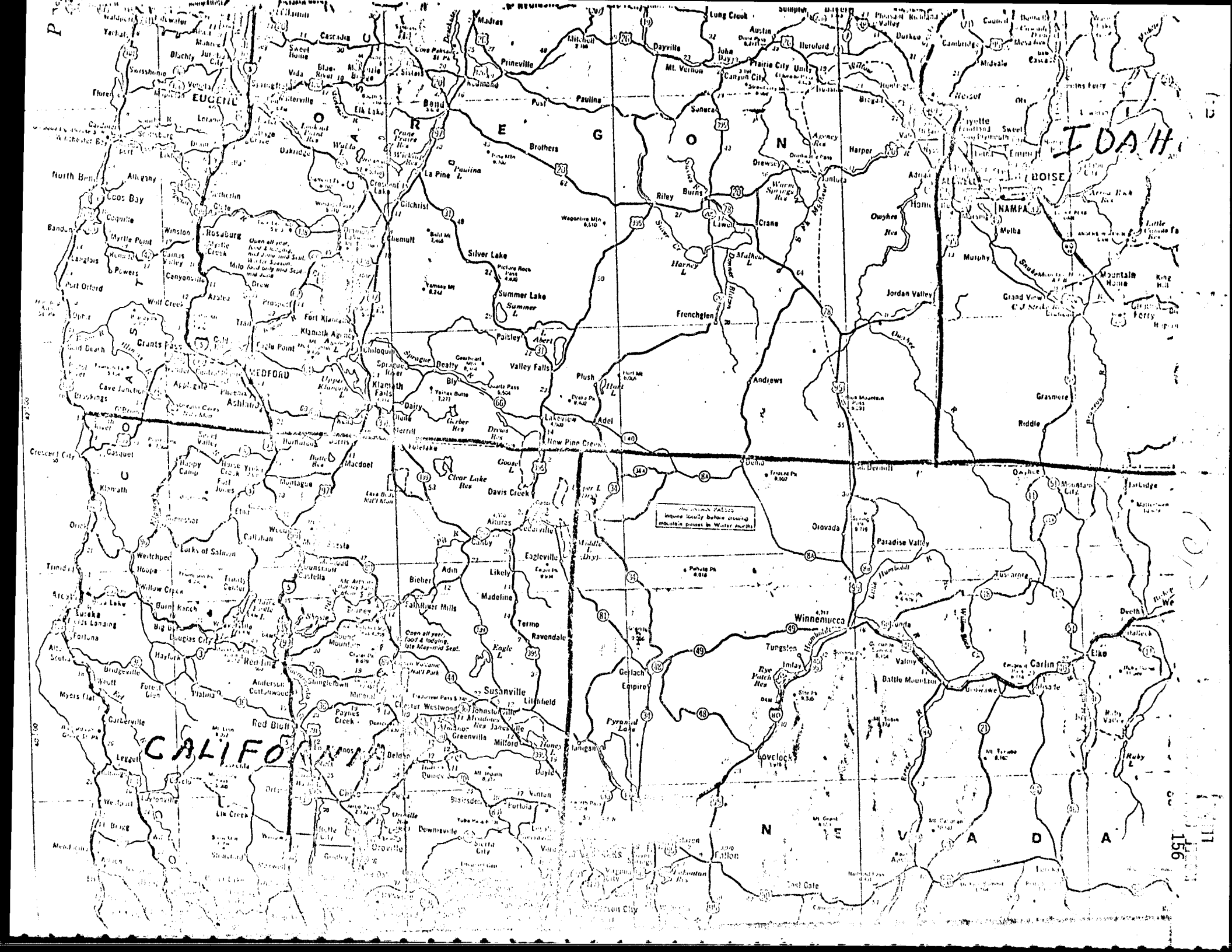
2. Salmo sp., the redband trout, is present in Rattlesnake Creek and the Donner and Blitzen drainage even though rainbow trout have been introduced to the latter system.

3. Other species - Additional systematic study is needed to clarify relationships of some of the fishes of the basin. Work with Rhinichthys osculus is planned at Oregon State University.

Status of the Alvord Chub: Art Oakley, Oregon State Office, BLM

General Background

The Alvord chub is a small fish similar to other fish species endemic to desert areas of North America. Aquatic habitat of desert species is often restricted to small springs, shallow sloughs, or lakes where these fishes have been able to survive only by adapting to quite harsh environmental conditions. Survival is sometimes dependent upon one, small, uncontrolled source of water creating a precarious situation for an entire population. Desert species often have a very limited geographic range, as is the case with the Alvord chub found only in the Alvord Basin of southeastern Oregon.


OREGON
IDAHO
CALIFORNIA
NEVADA
EUGENE
BEND
BROTHERS
PRINEVILLE
MADRAS
CASCADIA
SISTERS
REDMOND
PAULINA
LA PINE
GILCHRIST
CHEMULT
SILVER LAKE
SUMMER LAKE
PAISLEY
VALLEY FALLS
PLUSH
ADEL
LAKEVIEW
FRENCHGLEN
DRAWS RES
NEW PINE CREEK
DAYVILLE
MITCHELL
MT. VERNON
JOHN DAY
AUSTIN
LONG CREEK
SUMPTER
HEREFORD
PRAIRIE CITY
CANYON CITY
SUNERIA
DREWSEY
BURNS
RILEY
LAWEN
CRANE
HARPER
ADRIAN
WARM SPRINGS RES
OWYHEE RES
JORDAN VALLEY
ANDREWS
GRASMERE
RIDDLE
BOISE
NAMPA
MELBA
MURPHY
MOUNTAIN HOME
GRAND VIEW
OWYHEE
DENIO
ORIANE
MOUNTAIN CITY
JARBIDGE
WINNEMUCCA
TUNGSTEN
IMLAY
ROCKLAND
GERLACH
EMPIRE
PYRAMID LAKE
LOVELOCK
FALLON
BATTLE MOUNTAIN
VALMY
CARLIN
ELKO
DEETH
TUSCARORA
PARADISE VALLEY
OROVADA
DENIO
SILVER LAKE
HARNEY L.
MALHEUR L.
ABERT L.
GOOSE L.
CLEAR LAKE RES
DAVIS CREEK
ALTURAS
CEDARVILLE
EAGLEVILLE
LIKELY
MADELINE
TERMO
RAVENDALE
ADIN
BIEBER
FALL RIVER MILLS
CANBY
EAGLE L.
SUSANVILLE
LITTLEFIELD
JANESVILLE
GREENVILLE
MILFORD
HONEY L.
BOYD
BIDWELL PARK
LASSEN VOLCANIC NAT'L PARK
MT. LASSEN
MT. HOUGHTON
MT. IGNATIO
MT. SHASTA
MT. SHASTA CITY
WEED
MACDOEL
MONTAGUE
YREKA
FORT JONES
HAPPY CAMP
KLAMATH
CRESCENT CITY
ORICK
ARCATA
EUREKA
FORTUNA
FERNDALE
LOOKS OF SALMON
WESTWOOD
CHESTER
WESTWOOD
JOHNSTONVILLE
MT. MEADOWS RES
DIXIE MOUNTAIN
DIXIE PASS
DIXIE VALLEY
FREDONIA MOUNTAIN
SHINGLETOWN
ANDERSON
COTTONWOOD
REDDING
RED BLUFF
PAYNES CREEK
BELDEN
QUINCY
MT. INGALLS
PLUMAS
BLAIRSDEN
PORTOLA
VINTON
DOWNIEVILLE
OROVILLE
SIERRA CITY
MT. ELWELL
MT. TOBIN
MT. GRANT
MT. CAMERON
MT. BLITZEN
MT. BRUNO
MT. DIABLO
MT. HAMILTON
MT. LOMA PRIETA
MT. MADONNA
MT. TAMALPAIS
MT. SAN ANTONIO
MT. SAN JACINTO
MT. SAN GORGONIO
MT. PINOS
MT. WILSON
MT. BALDY
MT. LOWE
MT. HARVARD
MT. WHITNEY
MT. ROSE
MT. DAVIDSON
MT. TALLAC
MT. LOYALTON
MT. LINCOLN
MT. EVANS
MT. BIRCH
MT. ANTERO
MT. PRINCETON
MT. YALE
MT. ELBERT
MT. MASSIVE
MT. OF THE HOLY CROSS
MT. SNOWMASS
MT. CASTLE
MT. SOPRIS
MT. WERNER
MT. ZIRKEL
MT. ELLINGWOOD
MT. HARVARD
MT. YALE
MT. PRINCETON
MT. ANTERO
MT. OF THE HOLY CROSS
MT. MASSIVE
MT. ELBERT

## Taxonomic Classification

Until recently this species was undescribed. Hubbs and miller described and named this fish the Alvord chub, Gila alvordensis, in the Transactions of the San Diego Society of Natural History, Vol. 17, No. 8, 29 Sept., 1972. It is a member of the minnow family (Cyprinidae), and can therefore be referred to as a cyprinid species.

## Geographic Distribution

According to Dr. Carl E. Bond, Professor of Fisheries at Oregon State University, this species has been collected at Red Point School, Borax Lake, lower Trout Creek, and from one lake north of Mann Lake (probably either Juniper Lake or Tencent Lake). A complete fishery inventory of all perennial waters of Alvord Basin has never been made. This fish could therefore be inhabiting other waters within the basin, but this possibility has not been confirmed to date.

The Alvord chub is considered a rare fish because of its restricted distribution. However, Miller does not list the Alvord chub as a rare species in his publication "Threatened Freshwater Fishes of the United States" (Transactions of the American Fisheries Society, Vol. 101, No. 2, April 1972). This omission probably occurred because the fish was not officially named and described until September 1972.

## Present Habitat Conditions and Fish Populations

On November 8, 1972, Art Oakley (OSO) observed the aquatic habitat and fish populations at Red Point School and Borax Lake with Bill Bright and Gary Sheeter (Burns DO).

At Red Point School a spring on private property (Sec. 24, T40S, R35E) provides a small amount of water that flows through shallow irrigation ditches in the meadow lands of the Pueblo Slough drainage. The water table in the meadow fields is nearly at the surface of the ground. Some adult chub were observed in the vertically-installed culvert at the spring. Numerous adult and juvenile chub were seined in the shallow, algae-clogged irrigation ditch on BLM land in Sec. 13, and on private property in Sec. 24.

Borax Lake is located on private property in Sec. 14, T37S, R33E. Several schools of adult and juvenile chub were observed swimming in shallow waters by the shore of Borax Lake near its outlet. Some adult and numerous young chub were observed and seined in the outlet stream for at least 100 yards below Borax Lake. However, no fish were observed in the unnamed lake located on BLM land one-quarter mile west of Borax Lake in Sec. 15, T37S, R33E. The water in the unnamed lake may not be suitable for fish life as the pH value was 9.5 compared to 7.9 in Borax Lake.

Field observations were not made in lower Trout Creek or any of the lakes north of the Alvord Desert.

The present populations of Alvord chub appear to be in a satisfactory condition at both Borax Lake and Red Point School. However, either of these populations could become endangered immediately if uses of the water changed. The source of water is controlled by private ownership at each locality.

Bureau Responsibility

Recent legislation directing appropriate federal agencies to preserve rare and endangered species of wildlife include the Endangered Species Preservation Act of 1966 (PL 89-669) and the Endangered Species Conservation Act of 1969 (PL 91-135). The Secretary of the Interior provided direction and general policy guidelines in an August 5, 1971, memorandum to Interior agencies. This policy was quoted in Instruction Memo No. 71-306 as follows:

> "The Secretary has directed us to take strong and positive action for the benefit of both endangered species and those that could become endangered."
>
> "I expect you to encourage, plan, and carry out deliberate, aggressive programs to benefit endangered species which occur on lands you administer, which use habitat under your control, or which may be affected by your programs. In addition, I expect you to take whatever actions are necessary to prevent any native animal from becoming endangered."
>
> "At the earliest possible time, you should undertake or complete surveys of any lands you may administer to identify habitat which is essential or potentially useful to endangered species. A very high priority should be given the protection, improvement, or management of such areas for the benefit of endangered species. The welfare of endangered species of fish and wildlife must also be given prompt and serious consideration in any land or water development or other projects over which your office has any control."

The Desert Fishes Council was created in 1969 to formulate and coordinate interagency programs for the management and preservation of the endemic fishes of desert systems. Initially only the Death Valley system was considered, but all desert systems of North America are now included. The BLM has taken an active role in participating in this council as much of the habitat for desert in fishes is on public domain.

UNIVERSITY OF CALIFORNIA, DAVIS

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COLLEGE OF AGRICULTURAL AND
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October 21, 1974

Mr. Robert Borovicka
Bureau of Land Management
P. O. Box 2969
Portland, Oregon 97208

Dear Bob:

This letter will serve as a report to you on my studies of the native fishes of northeastern California. I hope members of the Desert Fishes Council will find it of interest. I really wish I could afford the time to attend the meetings.

For the past two years I have been conducting a survey of streams of the Pit River system, in Modoc, Lassen, and Shasta counties. The studies have been possible only because of the cooperation of Stephen J. Nicola, of the California Department of Fish and Game, who encouraged them in many ways, most importantly by arranging to have two of my students, Alan Marciochi and Robert Daniels, hired as seasonal aides. They conducted much of the field work in the summers of 1973 and 1974, respectively.

In 1973, our efforts concentrated on streams of the middle reaches of the Pit River system, since we were attempting to evaluate the status of the Modoc sucker (Catostomus microps). Prior to our studies, it was known only from Rush Creek, Modoc County. Although we found Modoc suckers in five additional streams in two widely separated tributary systems, at least 75% of them live in Johnson Creek, the main tributary to Rush Creek. We were able to make only crude population estimates, but the total number of Modoc suckers is probably less than 5,000. The number of Modoc suckers has undoubtedly been reduced in recent years due to the extensive channelization of most of the suitable habitat in Rush Creek. Johnson Creek, fortunately, is mostly on U. S. Forest Service land and steps are now being taken to assure that the Modoc sucker habitat there will be maintained. I have two papers in press on the Modoc sucker; one on status (Cal-Neva Wildlife), and one on life history (Copeia), and another paper in preparation on the effects of the channelization of Rush Creek.

In 1974, we attempted to sample all the streams not sampled in 1973. Special attention was paid to the sculpins since the rough sculpin (Cottus asperimmus) was considered to be a rare species, the Pit sculpin (C. pitensis) was considered to be endangered in Oregon, and the Pit River form of the marbled sculpin (C. klamathensis) was of uncertain status. The rough sculpin was found to be restricted in its distribution to certain habitats in the Pit and Fall rivers (and tributaries) in Shasta County.

It was very abundant where found, however. The Pit sculpin is the common sculpin of the Pit system and is abundant as well in the California tributaries to Goose Lake. The marbled sculpin was the most uncommon of the three species in the Pit system. In part because it may need special protection in the Pit system, its systematic status is being reviewed. (It was described by Rutter as a distinct species, C. macrops). Several papers are in various stages of preparation from these studies, the most important being a study of the distribution and ecology of all the fishes of the Pit River system and a study of the comparative ecology and life history of the three sculpin species. The latter is the M.S. thesis of Robert Daniels.

In June 1974, at the request of Carl L. Hubbs, we visited the Cowshead Lake (Surprise Valley) region in the extreme northeast corner of California, looking for a population of tui chubs (Gila bicolor) that may deserve subspecific recognition. We found the chubs to be present in large numbers in an extensive slough that drains the dry lake bed. Also present in the slough and streams flowing from the Warner mountains were speckled dace (Rhinichthys osculus) and rainbow trout (Salmo gairdneri). Although the slough appears to have plenty of water in it, the feeder streams are small and used for pasture irrigation and cattle watering by the local ranchers. Also, this was a relatively wet year, so a series of very dry years might be disastrous for these chubs. Dr. Hubbs is currently working on the systematic status of the chubs. However, an effort should probably be made soon to determine what steps would be necessary, if any, to assure the long term survival of this isolated population of fish.

I hope this information is adequate for your purposes. Please write or call if you need additional information. Enclosed are some slides of the Modoc sucker and the Cowshead Lake tui chubs, and their habitats. I would appreciate their return when you are through with them (but feel free to duplicate them).

Sincerely,

Peter B. Moyle
Assistant Professor

PBM:pjb
Enclosure

cc: C. Bond
C. Hubbs
S. Nicola
R. Daniels

UNITED STATES GOVERNMENT

# *Memorandum*

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Burns District Office
74 South Alvord, Burns, OR 97720

IN REPLY REFER TO:

OCT 22 [illegible]

File/ [illegible]

To : State Director, Oregon
Attn: Bob Borovicka, Fisheries Biologist
From : District Manager, Burns

Date:

Subject: Desert Fishes Council Report

During the past year, BLM work at Red Point included partial construction of two ponds 70 feet by 110 feet and fencing around these ponds. We expect to complete the ponds this year.

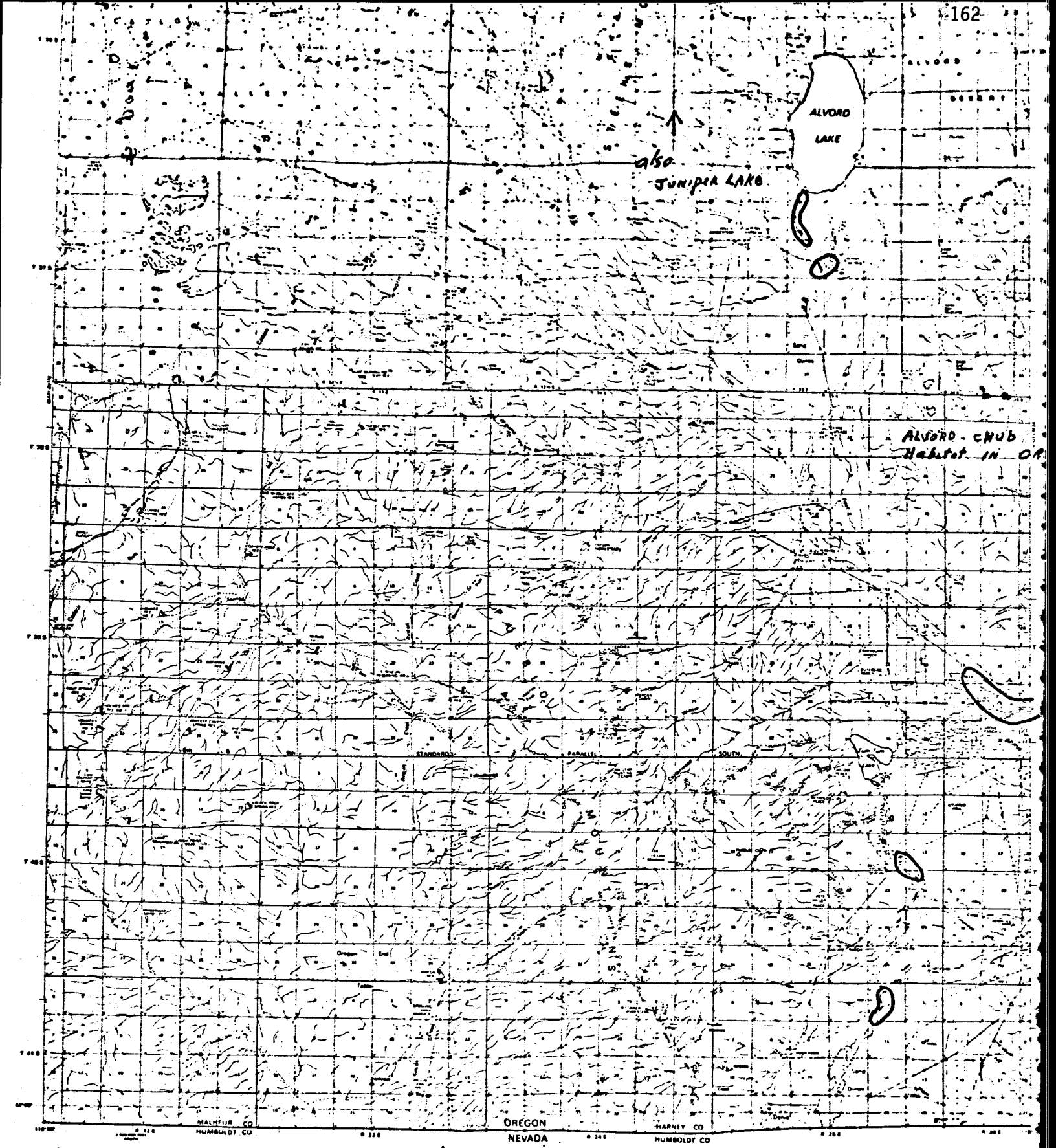
We have located two other areas that are Alvord Chub habitat, Pueblo Slough and south of Alvord Lake (map enclosed). Pueblo Slough is a narrow, marshy channel of about four surface acres at low water. It is dependent on artesian wells for water during the dry months. This area, was fenced by Oregon Wildlife Commission in June, 1974 to improve waterfowl habitat. BLM plans to graze this area once every three or four years, and have contracted to drill wells in the Pueblo Slough area to increase the surface water. The artesian wells presently there are about 30 feet deep. We expect these new wells to benefit both waterfowl and Alvord Chubs.

Another new area where we have found Alvord Chub is in small (two to ten yards square) pools south of Alvord Lake. These fish probably move downstream from the Borax Works and are stranded in pools when the flow dries up.

This year a fisheries habitat management plan will be prepared for the Alvord Chub. No extensive projects to create additional Alvord Chub habitat are planned at this time, only protection of the present habitat. The areas that could be most easily damaged by man's activities are the Borax Works Complex and Red Point. Water at the Borax Works comes out of hot springs on deeded land. Water control and geothermal activity on deeded land may adversely effect this small aquatic area.

At Red Point, water during the dry months comes off deeded land. The adjacent land owner has spent considerable money trying to convert desert rangeland to alfalfa and grain. Large pumps have been installed to pump water out of two ponds on deeded land in order to irrigate nearby agriculture land. To our knowledge these pumps have never been used for this purpose. Extensive pumping could almost dry up some of the Alvord Chub habitat on deeded land and would reduce the flow that feeds the partially completed ponds on national resource land. Hopefully, we can deepen these ponds so they will get enough subsurface flow to be perennial.

[signature]




Juniper Lake contains Alvord chub but not shown on this map.
Pools in Lower Trout Ck probably also contain A chub.

Dave Kerley, Professor of Zoology, Eastern Oregon College of Education, La Grande, Oregon, has been working on the physiology of the Alvord Chub. Most of his studies have been concerned with the fish and habitat in the hot springs of the old Borax Works near Alvord Lake in Oregon. Mr. Kerley is being advised of the habitat work in the Bureau of Land Management.

To: Desert Fishes Council Members
From: Executive Committee
Subject: Meeting of the Death Valley System Committee, January 10-11, 1974

We have just concluded our Fifth Annual Symposium. The cooperation of our Arizona membership was outstanding in making the very finest arrangements for us at Arizona State University and in providing a firm footing for our first step outside the Death Valley System. We are working on the Symposium summary and will distribute it at the earliest possible date. Some really outstanding presentations were made there.

Perhaps the most significant part of the meeting, along with our discussion of the Cuatro Cienegas Basin, concerns the Council's decision to establish committees to handle the specific problems within various areas of the Great Basin. Time limitations precluded designation of these areas while we were in Tempe, and it was decided that this would be done at the initial meeting of the Death Valley System Committee.

In order to expedite general committee designation and carry on the basic purpose of the Death Valley System Committee - thorough discussion and implementation of preservation plans for the Death Valley System fishes - a meeting will be held at Park Service Headquarters, Death Valley National Monument, Furnace Creek, on January 10-11, 1974. It will be primarily a workshop session with two basic purposes: 1) designation of geographic areas to be handled by the committees and 2) discussion of status reports and preservation planning for the Death Valley System fishes. This will include discussion of legal aspects and hydrology, also.

The January meeting will be sufficiently general that attendance of anyone interested in the Council's work would be appropriate, as in past symposia at Death Valley. We have the ball moving now, so let's get it rolling faster.

Furnace Creek Ranch has limited accommodations available for the nights of January 9 and 10 (and 11 if desired). Rates are $17.00 per night for double occupancy and $13.00 for a single. Send your reservation requests directly to Furnace Creek Ranch, Death Valley, California 92328 and note that you are affiliated with the Council in your correspondence.



# A Summary of the First Annual Meeting of the Death Valley System Committee, Desert Fishes Council

E. P. Pister, Chairman

Held at Furnace Creek Inn, Death Valley National Monument, January 10-11, 1974

The primary purpose of the meeting was to set up the machinery for establishing Great Basin Subarea Committees as decided upon at the Fifth Annual Symposium held in Tempe, Arizona, in November 1973. This was accomplished and was consummated in August 1974, at which time the areas and their coordinators were designated in a letter report dated August 19 by E. P. Pister (copy follows).

In addition, the status of the various endemic fishes within the basin was discussed and general assignments were made to enhance their current positions as follows:

1. Devils Hole pupfish, Cyprinodon diabolis. Cal Allan and Chuck Osborne were to investigate possibility of a new Hoover Dam-type refugium at School Spring using pumped water. The Hoover Dam population was estimated at about 150, and the possibility of transplants and use discussed as follows: 1) School Spring, 2) Steinhart Aquarium, 3) Preservation for comparison with original stock, and 4) possible use by other aquarists. All are dependent upon uses permitted under the Endangered Species Act and allowed by the State of Nevada.

2. Pahrump killifish, Empetrichthys latos. Chuck Osborne and Cal Allan estimate Corn Creek population at 1300-1400. Possible rearing at Steinhart was discussed, again contingent upon permissible uses.

3. Ash Meadows dace, Rhinichthys osculus nevadensis. Jerry George, Nature Conservancy, stated that title to Big Spring has been acquired, and the land will soon be fenced. However, the Conservancy has no title to the water.

4. Ash Meadows pupfish, C. n. mionectes. Abundant at this time with no immediate threat of endangerment, other than through long-range habitat depletion resulting from imprudent pumping in and around Ash Meadows.

5. Warm Spring pupfish, C. n. pectoralis. Chuck Osborne reported that the fence installed around Mexican Spring by BLM resulted in its drying up, probably because of phreatophyte growth. The ponds at School Spring need cleaning out, as population is down. A recovery team is being developed for this fish.

6. Owens chub, Gila bicolor snyderi. Phil Pister reported it to be holding its own in its de facto sanctuary below Crowley Lake Dam. Its status in the Owens Valley Native Fish Sanctuary remains in doubt because of unauthorized but repeated introductions of exotic game fishes.

7. Owens dace, R. o. subsp. Phil Pister reported it to be more abundant than generally thought in lower sections of streams flowing off the Sierra Nevada in northern Inyo County.

8. Amargosa dace, R. o. subsp. near Beatty, Nevada. Cal Allan and Chuck Osborne hope to check and collect in April.

9. Amargosa dace, R. o. subsp. in Amargosa Gorge near Tecopa. Phil Pister hopes to check this in the coming spring for forwarding to Miller for identification.

10. Mohave chub, Gila bicolor mohavensis. Jim St. Amant reported on status of various transplant populations. The Fort Soda (Zzyzx) population seems the most secure.

11. Owens pupfish, Cyprinodon radiosus. Phil Pister reported that the Warm Springs population is generally secure, although the interspecific competition with Gambusia is not fully understood. The population in the Owens Valley Native Fish Sanctuary is jeopardized both by the introduction of game fishes and the existence of 200 acres of privately-owned land, less than a mile away, where development is threatened. Every effort should be made to place this land in public ownership, and all possibilities in this respect are being evaluated.

12. Tecopa pupfish, C. n. calidae. If the subspecies is rediscovered, and verified, transplants will be considered. However, the subspecies appears to be extinct.

## Great Basin Subarea Committees

At the Fifth Annual Symposium held in Tempe last November, it was decided that the affairs of the council could best be handled by assigning local committees to the various areas within the Great Basin. The first such meeting (of the Death Valley System Committee) was held in January, at which time the Council's leadership listed the areas most logically administered under this concept. Since that time we have been in contact with individuals who might best serve as committee chairmen. The newly appointed chairmen are now selecting committeemen to serve with them.

GREAT BASIN AREA COORDINATORS

| AREA | CHAIRMAN |
|---|---|
| Bonneville | William F. Sigler<br>Utah State University<br>Logan |
| Interbasin (including White River) | Cal Allan<br>Nevada Department of Fish and Game<br>Las Vegas |
| Death Valley | E. P. Pister<br>California Department of Fish & Game<br>Bishop, California |

| AREA | CHAIRMAN |
|---|---|
| Oregon Lakes | Robert L. Borovicka<br>Bureau of Land Management<br>Portland, Oregon, and<br>Carl Bond<br>Oregon State University<br>Corvallis, Oregon |
| Lahontan | Dale V. Lockard<br>Nevada Department of Fish and Game<br>Reno |
| Sonoran Desert - Mexico | Lloyd T. Findley<br>University of Arizona<br>Tucson |
| Sonoran Desert - U.S. (including Gila River) | W. L. Minckley<br>Arizona State University<br>Tempe |
| Chihuahuan Desert - Mexico | Salvador Contreras-Balderas<br>University of Nuevo Leon<br>Monterrey, Mexico |
| Chihuahuan Desert - U.S. (New Mexico and Texas) | Clark Hubbs<br>University of Texas<br>Austin |
| Chihuahuan Desert - Isolated Basins | Robert R. Miller<br>University of Michigan<br>Ann Arbor |
| Lower Colorado | Gail Kobetich<br>Bureau of Sport Fisheries & Wildlife<br>Parker, Arizona |
| Upper Colorado | Bruce May<br>Utah Division of Wildlife Resources<br>Page, Arizona |

If any of the membership should wish to assist a specific committee, please so indicate to the appropriate committee chairman, with a copy of your correspondence to the Secretary in order that we may keep up with developments.

One of the high points of the Annual Symposium will be reports from the various committees concerning the status of the fishes within their areas of responsibility. This will serve as a basis for the Council's future actions.

Any questions concerning the new organizational plan should be directed to the Secretary, Desert Fishes Council.

E. P. Pister
Secretary

SESSION IV - Miscellaneous items

Chaired by Executive Committee

1. It was reported that a book on the Death Valley fishes was being prepared by Dave Soltz and Bob Naiman.

2. It was decided that coordination with state fish and game agencies would be the general responsibility of the area coordinator.

3. The consensus concerning the area coordinator concept was favorable and that it worked very well during its first year. It was decided that the area coordinator would be responsible for substantiating the endangered status of fishes in his area.

4. Mirian Romero (through Bob Smith) requested that the Council encourage the Riverside District BLM to physically close the south end of the Amargosa Canyon to ORV use. She stressed the desirability of an interagency meeting to establish a management program for the area.

5. Field trips to Ash Meadows, Willow Beach National Fish Hatchery, and the Virgin River were discussed as possible activities for the following day (November 14).

6. A resolution was passed relative to the Council's concern over interbasin transfer of indigenous fishes. The Secretary was directed to draft the resolution and forward it to the Chairman for signature and distribution to all Great Basin states and the Colorado River Wildlife Council.

7. The Chairman was authorized to direct a letter to the National Park Service encouraging removal of the artificial shelf in Devils Hole and adding recommendations concerning the artificial lighting.

8. Don Toney, of the Willow Beach National Fish Hatchery, gave a very interesting and encouraging presentation concerning the use of Willow Beach for rearing razorback suckers (Xyrauchen texanus) and Colorado River squawfish (Ptychocheilus lucius), which seem to thrive on a diet of rainbow trout. His enthusiasm for the work was both infectious and commendable. On the following day (November 14) a field trip was made to Willow Beach to inspect the items Don outlined during his talk.

9. It was decided that the Seventh Annual Symposium would be held in Death Valley on November 12-14, 1975.

## Business Meeting

Old Business

DFC is ok financially

Compendium being done by the Navy at China Lake

Election of officers - Bob Miller - Chairman
Phil Pister - Secretary/Treasurer
Jim Deacon - Chairman elect

More state cooperation in respect to new endangered species act is needed; therefore, state personnel will continue to serve in DFC officer roles, federal personnel in biological and advisory positions.

Constitutional changes - 1) Spell out different basins
2) Two-year term of office instead of one year

New dues structure passed:
$3 Contributing
$5 Full
$10 Sustaining
$25 Organizational
$100 Lifer

PARTIAL ATTENDANCE LIST, SIXTH ANNUAL SYMPOSIUM
DESERT FISHES COUNCIL
Las Vegas, Nevada
November 12-14, 1974

| NAME | AFFILIATION |
|---|---|
| Otto Aho | Solicitor, USDI, Reno |
| Robert C. Allan | Nevada Dept. Fish and Game |
| Dave Almand | BLM, Washington, D.C. |
| Norman Alstot | So. Calif. Edison, Rosemead |
| Gregg Berry | BLM, Bakersfield |
| Bob Borovicka | BLM, Portland |
| Al Castro | Steinhart Aquarium, San Francisco |
| Robert Christensen | Yuma, AZ |
| George Constantz | Arizona State University, Tempe |
| Glen Contreras | DRI, Univ. Nevada, Reno |
| Salvador Contreras-Balderas | Univ. Nuevo Leon, Monterrey |
| Al Cooperrider | BLM, Riverside, CA |
| Jeff Cross | University of Nevada, Las Vegas |
| Paul Cuplin | BLM, Denver |
| Jim Deacon | University of Nevada, Las Vegas |
| Don Duff | BLM, Salt Lake City, UT |
| Bob Furtek | University of Nevada, Las Vegas |
| Dave Garber | USFS, Bishop, CA |
| Dean Garrett | NPS, Death Valley |
| Herb Guenther | Bureau of Reclamation, Boulder City |
| Eric Gustafson | Arizona State University, Tempe |
| Ann Heller | Los Angeles |
| Carl Hubbs | Scripps Institute Oceanography |
| Gail Kobetich | FWS, Parker, AZ |
| David Koch | DRI, Univ. Nevada, Reno |
| Jerry Larson | USGS, Las Vegas |
| Dale Lockard | Nevada Dept. Fish & Game, Reno |
| Wayne Logan | BLM, Ely, NV |
| G. R. Love | Private citizen, Ash Meadows |
| Larry Mangan | BLM, Bishop, CA |
| Denise Meredith | BLM, Las Vegas |
| Robert R. Miller | Univ. Michigan, Ann Arbor |
| W. L. Minckley | Arizona State University, Tempe |
| Tina Nappe | Foresta Institute, Reno |
| Bill Newman | Nevada Div. Water Resources |
| Steve Nicola | Calif. Dept. Fish & Game, Sacramento |
| Chuck Osborne | FWS, Las Vegas |
| Al Pickard | California Dept. Fish & Game, Blythe |
| Phil Pister | California Dept. Fish & Game, Bishop |
| Gary Ponder | California Dept. Fish & Game, Bishop |
| Norman Reigle | Boulder City, NV |
| C. E. Ruhr | USFWS, Washington, D.C. |
| Kevin Ryan | BLM, McNary, AZ |
| J. A. St. Amant | Calif. Dept. Fish & Game, Long Beach |
| P. G. Sanchez | NPS, Death Valley |

| NAME | AFFILIATION |
|---|---|
| Bill Scoggins | NANFA, Emeryville, CA |
| Robert D. Smith | Dept. Water Resources, Los Angeles |
| David L. Soltz | California State, Los Angeles |
| Robert Solwedel | Lebanon, NJ |
| Royal D. Suttkus | Professor, Tulane University |
| William White | USFWS, Salt Lake City, UT |
| James D. Williams | USFWS, Washington, D.C. |
| Thomas R. C. Wilson | Nevada Senate, Washoe Co. |
| Jim Yoakum | BLM, Reno, NV |

# SEVENTH ANNUAL SYMPOSIUM

Furnace Creek, California, November 13-14, 1975

## Welcoming Remarks by James B. Thompson, Superintendent

Once again it is a pleasure to welcome on behalf of the National Park Service, the members and observers of the Desert Fishes Council to its meeting in Death Valley.

We are particularly pleased because we have seen the fruits of the work of this group in the tenuous preservation of the Devils Hole pupfish. And we continue to find ourselves in controversial preservation programs. All of the environmental parameters in Death Valley are stressed, and any effort to preserve, must be an active one. The welfare of our pupfish has taken us to the Supreme Court. Mining within the past year has led us to precedental court decisions, nationwide publicity, and the beginning of action in the halls of Congress. The growing population of burros and their environmental impacts will become a prominent public issue within the next 6 months.

It is our objective to restore and reestablish conditions conducive to the perpetuation of natural processes as they operated in Death Valley before the coming of technological man. This is easier for people to appreciate the fruits of, than it is to understand and accept the programs that lead to it. We know, however, that this group understands this concept, and we support you in your efforts, as you do us in ours. Best wishes for a successful symposium.

## SESSION I - Research

Chairman: Phil Pister, Calfornia Department of Fish and Game, Bishop

### 1. Studies of the Woundfin, *Plagopterus argentissimus*

Jerry Lockhart, University of Nevada, Las Vegas

### Distribution

Present distribution of *P. argentissimus* is restricted to the Virgin River in Nevada, Arizona, and Utah and a tributary stream, lower LaVerkin Creek, Washington County, Utah. The Virgin River heads in the Zion Canyon area of Utah and flows southwesterly through Arizona, emptying into Lake Mead, Nevada. The woundfin occupies only the last approximate 135 km from a hot spring area, Pah Tempe Springs, to the lake.

Habitat Requirements

The general habitat requirements which have been investigated thus far are outlined as follows:

1) Temperature - The woundfin has been collected during 1973 and 1974 in temperatures ranging from 10 C to 35.5 C. The woundfin taken below 18 C are sluggish and display very little escape response. Those taken above 28 C show quick bursts of escape movements and then exhausted movements. Above 30 C the species begins to discolor and handling causes high levels of mortality. High temperatures drove the fish into deep pools with good current flow. A series of laboratory tests on temperature tolerance has shown an $LD_{50}$ temperature of 34.5 C in 52 hours from an original acclimation temperature of 21 C. When salts are added, the $LD_{50}$ temperature tends to become reduced.

2) Current - The woundfin tends to seek out moving water. The average velocity of the river when collections were taken is 0.51 m/sec. The maximum has been 1.132 m/sec and the minimum has been 0.095 m/sec. Any current that is so slowly moving or not turbulent enough to keep a mud bottom from building up appears to be uninhabited by the woundfin.

3) Turbidity - The woundfin is one species which thrives in highly turbid waters. They have been taken in water with so much suspended material that a litre sized sample when allowed to settle will be one-half solid material.

4) Substratum - The woundfin can be taken almost exclusively over a flat, mobile sand bottom. When temperatures rise, they will move to deeper pools usually associated with rock and gravel bottom or they tend to move to the deepest, fastest flow over a sand bottom.

5) Dissolved Oxygen - Measurement of standard metabolism shows an average usage of .004 ppm DO/min/gm body weight at 20 C. In addition, at low DO concentrations, no apparent stress is displayed.

6) Food - Preliminary studies indicate that the woundfin is quite unselective in its requirements. The fish appear to feed on material drifting in the water and most usually over the bottom. Materials churned up from the sandy bottoms would be what has been found in some of the stomachs examined. The dominant food in the preliminary series of stomachs is a filamentous algae of the Zygnemataceae. Other materials have not been found consistently but include insects of the Formicidae (ants); small, brown, apparently undigestible, hard coated, seeds; ostracods; nematodes; and Simuliidae (black flies).

7) Interspecific Associations - Interspecific relationships varied from area to area. In the lower river, Notropis, Gila, Gambusia, Ictalurus, Micropterus, Lepomis, Cyprinus, Pantosteus, and Catostomus have been collected with Plagopterus. The Plagopterus and Notropis appear as codominant species.

In the middle sections of the river, Rhinichthys and Lepidomeda are added and Cyprinus, Notropis, and Ictalurus are deleted. The Plagopterus is dominant.

In the upper river, Micropterus and Lepomis are deleted.

With the exception of Gila, the native species are usually dominant except in the lower areas where the Notropis is codominant. Plagopterus and Pantosteus are the only species found throughout the system with Plagopterus being the dominant species.

After this general look at Plagopterus habitat requirements, one can begin to evaluate the effects of Pah Tempe (LaVerkin) Springs. The water from the springs is 42 C. It contains no dissolved oxygen, it has a very high total dissolved solids, the specific conductance is $6 \times 10^4$ umho/cm, and the pH is 6.0. In October 1974, 100 meters below the spring inflow in the mainstream, the water temperature was 37.8 C, above the spring 18 C; dissolved oxygen below was 7.4 ppm, above 7.6 ppm: specific conductance below was $15.5 \times 10^4$ umho/cm, above $1.45 \times 10^4$ umho/cm; the pH below was 5.45, above it was 7.4. At the time, the water flow was low and the estimated spring inflow was greater than the river flow. Downstream about 1 km from the springs, the temperature was still 34 C. This indicates a strong warming influence on the river during low flows. However, the cooling effects from tributaries and air lowers the temperatures to the same as that above the springs within an approximate 10 km of the Utah 17 Bridge near the springs.

Bioassays have been run in the laboratory. Initial investigations using as little as 1% concentration levels of Pah Tempe spring water have proven lethal to Plagopterus. A 0.5% solution was tested using Plagopterus, Pantosteus, Catostomus, and Gila. The Pantosteus $LD_{50}$ was 4 hours, Catostomus was 5.5 hours, Gila was 5.6 hours, and Plagopterus was 15 hours.

## Population Data

A composite length-frequency diagram of Plagopterus collected from the Virgin River from 1961 to the present has been constructed. Observation indicates October-December is apparently a period during which mortality of larger individuals results in a decline of the mean size of the population. Relatively slow growth apparently occurs until May. This period, October to December, coincides generally with extremes in minimal water flow, minimal temperatures, and most likely minimal abundances of food. All these factors are naturally occurring stress which will drive a population toward static growth rates. Spawning appears to begin in the period April-May and probably continues through August since the youngest age group begins to appear in June and is apparent through August. This period corresponds with the period of increased water flow, warmer temperatures, and presumably more abundant foods. An interesting note here is that the recently hatched larval and juvenile fish appear not to enter the general population group, but tend to remain in more quiet backwater or somewhat isolated areas. In the Virgin River Gorge, during low water or dry periods, one can find juveniles in astounding numbers in the seep areas. The woundfin is the only species present and the juveniles are the only age group to be found. The only readily observable food is the Zygnematales which is in great abundance. Downstream from the diversion dam near Washington, Utah, there exists a similar situation--the only difference being that the water is not from seeps but is from irrigation outflows. Recruitment into the main river population begins in June and is virtually completed in August as this is when the greatest number of smallest individuals are collected in the river and virtually every size attained by the woundfin is represented.

August to October appears to be the period of greatest growth for the new recruits. The smaller age group is no longer collected by September, and the maximum size is attained by the older fish. October begins the cycle again with the general loss of the largest adults.

Reproduction

Female gonad weights as per cent body weight of year class II show largest percentages beginning in late March and ending in early May. Highest gonad weights were in the 21% range during this period. Fishes in the lower river tended to show gonad development earliest and highest. Fish in Mesquite were in high reproductive capability in March-April, and those in Utah were more capable in April-May.

Male gonad weight tended to be highest in all areas during April. April is a very critical time for reproduction, and it can be assumed as when major reproductive activity occurs. The time of gonad development between March and May is not consistent with the females. Peaks seem to vary from year to year. Day-length periodicity may have strong influences on these patterns, but other environmental factors also prevail.

Conclusion

As compared to historical events, P. argentissimus in the Virgin River appears to be surviving the rigors placed upon its environment by man. Agriculture, urban usage, flood control, sewage disposal, exotic fish introduction and dams have all had an influence on the population, but unlike Gila, which appears to be diminishing in numbers, Plagopterus seems to have had enough resiliency to survive. They reproduce during the time of year when these extraneous events have least effect.

Modification of river flow would then have a great influence upon reproduction and would explain why the woundfin has disappeared from southern Arizona where extensive water and channel diversion has dried up the Gila River.

Man-induced alterations of the Virgin River will definitely have detrimental effects by changing river temperature, turbidities, ionic composition, and substratum. These changes may not affect the woundfin individually, but may increase competitive stress, change available foods, and make other inadvertent changes.

2. The decline of the desert pupfish (Cyprinodon macularius) in the vicinity of the Salton Sea

David Soltz, California State University, Los Angeles

The following summary was prepared from a review of tape recordings.

A current study is being conducted by graduate students working under Dr. Soltz' direction to determine the status of C. macularius in the environs of the Salton Sea.

C. macularius was initially the only native fish in and about the Salton Sea, entering the basin when the sea filled in 1906-07. It was considered very abundant at that time, but this is no longer true. Currently the desert pupfish is greatly exceeded numerically by mollies, mosquitofish, Notropis lutrensis, Tilapia zillii, Gillichthys, Bairdiella, largemouth black bass, and possibly carp. In some locations, only 1 percent of the species composition comprises C. macularius, and this has decreased from nearly 10 percent 3 years ago. A recent collection revealed a mollie:pupfish ratio of 720:19.

There are also strong indications that Tilapia zillii is taking over the sea and its environs, also that largemouth bass numbers are strongly on the increase, and pupfish are known to be heavily preyed on by LMB. Numerous juvenile Tilapia have been observed right in pupfish habitat. Tilapia zillii are known to be omnivorous and regularly consume Gambusia. Therefore, it may be assumed that T. zillii will prey on pupfish. Juvenile Tilapia are competitors and egg predators, if nothing else. Dr. Soltz recommends establishment of a C. macularius refugium. He further raised a question relative to current Tilapia research.

3. The use of Cyprinodont fishes in mosquito control

Kaaren J. Hiscox, Butte County Mosquito Abatement District
Oroville, California

The following abstract was prepared by Alfred Castro for Vol. 9, No. 3 of the Journal of the American Killifish Association.

Her report stated that she had attempted to use South American annual killifish to control mosquito populations in the rice fields of Butte County but had very limited success. A change in study animal was indicated so she switched to the desert pupfish, Cyprinodon macularius. This worked much better but still did not fit the bill because Cyp. macularius was felt to be not quite cold-hardy enough. A further switch carried her research to the Owens pupfish, Cyprinodon radiosus. This is working out splendidly and may well be used in large scale operations in the near future. (An interesting side note to this report is that Cyprinodon radiosus was considered extinct until 1964 when a small population was rediscovered. Careful management by several D.F.C. members has brought this fish to a point where it can be made available for this type of study.) Kaaren also gave a brief report on work that is being done in Lake County, California, along similar lines. Lake County Mosquito Abatement District is attempting to find a pupfish that will live in a high borax concentration which will then be used to combat biting black flies. At present they are working with Cyprinodon macularius (but that species has problems adapting to concentrations of over 150 ppm borate while the lakes in question have concentrations of 80-500 ppm borate) and have applied for a permit to use Cyprinodon milleri which naturally occurs in high concentrations of borate but is on the California rare list.

This talk was very important as it pointed out a readily understandable value to pupfish that should impress even non-ecology minded people.

4. Distribution and systematics of the unarmored threespine stickleback, Gasterosteus aculeatus williamsoni in the Santa Clara River System

Michael Bell, University of California, Los Angeles

Abstract

The history and known distribution of Gasterosteus aculeatus williamsoni (Girard 1854) is reviewed. The distribution of other fish species within the Santa Clara River System and their potential for predation of G. a. williamsoni is discussed.

G. a. williamsoni is restricted to the upper Santa Clara River and San Francisquito Canyon. The lower Santa Clara River and its tributaries contain G. a. microcephalus or G. a. microcephalus x G. a. williamsoni intergrades. Sticklebacks could not be found in other localities listed by Miller and Hubbs (1969) as containing G. a. williamsoni. The minor effect of exclusion of unplated specimens from calculations of mean lateral plates at all stations indicates that the two subspecies intergrade in the Santa Clara River System. There has been an interplay of natural selection and gene flow to produce the observed geographical distribution of sticklebacks with different numbers of lateral plates.

Habitat destruction, destruction of geographical barriers to stickleback dispersal, and introduction of exotic species (including sticklebacks in imported water and piscivorous predators) pose a threat to G. a. williamsoni in the upper Santa Clara River.

Parties in a position to influence the welfare of unarmored threespine stickleback populations should be informed of their responsibilities under the law.

5. Oxygen and temperature tolerance of the unarmored threespine stickleback, Gasterosteus aculectus williamsoni

Robert C. Feldmeth, Claremont College, Pomona

Summarized from tape recordings.

Dr. Feldmeth described joint research conducted with Dr. Jon Baskin of Cal Poly, Pomona. He emphasized that habitat parameters are very important in endangered species work: temperature, $O_2$, pH, velocity, substrate, reproduction, growth, etc. We should learn as much as possible, but this cannot be done without exhaustive and time-consuming research. This fact prompted Dr. Feldmeth to devise a method to save time in determining the habitat requirements and biological characteristics of a fish. This theory was first persented in 1956 by Brett in a treatise relating to the thermal requirements of North American fishes. In this paper he claims that one can correlate habitat with temperature tolerance in that fishes with the lowest thermal tolerances seek the coldest, clearest water; i.e., the salmonids seek cold, clear streams, and centrarchids, catfish, etc., seek out warmer water.

Gambusia etc. choose stagnant pool areas where the water is warm. Conversely, fishes with the lowest oxygen tolerance occur in stagnant waters, warm and low in DO. Fishes in cooler waters have higher oxygen tolerances. In other words, fish are physiologically adapted to their habitats, and by closely observing their adaptations, we may learn both about a fish and its habitat. Laboratory methodologies were described for possible consideration by recovery teams in establishing refugia. An added advantage, particularly in those instances where population numbers are very low, is that fish may be returned to their habitat after the completion of tests.

6. Recent studies of the unarmored threespine stickleback

Jonathan Baskin, California State Polytechnic Univ., Pomona

Summarized from tape recordings.

Dr. Baskin summarized population size in different habitats, population structure, reproduction (observation of nests, ovaries), etc. The Department of Fish and Game and Forest Service were anxious to know how habitat related to population numbers: ponds, straight stream sections, dense vegetation, open running water, etc. Fish distribution was found to differ in these situations.

Population estimates were made by cordoning off areas, etc. The most effective method was through mark and recapture, and was found to be very difficult in watercress-infested areas. This work was done in 1975 to refine methodology and thereby get a more acceptable and accurate figure. Early estimates indicated about 3.5 sticklebacks per square meter of pond, but the reliability was questionable. Estimates were only 0.5 per square meter in stream habitats. Interestingly, the best habitats were artificial, having been constructed by picnickers, children, etc.

Recruitment was found to be largest in early spring (March-April), continuing to a lesser extent into August and September and, in some cases, even into November and December. Breeding begins in late February or early March, and at least one new nest was sighted in every month except January. Maximum nest sightings were in September. Nests are difficult to detect, resembling blobs of algae on the bottom (Fish have been kept alive for two years in aquaria.). Most nests were found along the edges of ponds, close to vegetation, and almost invariably in shallow, slow-flowing backwaters. Man probably helps the fish by building the ponds which provide these habitat conditions.

## 7. Habitat degradation and the flora of Ash Meadows, Nye County, Nevada

James L. Reveal, University of Maryland, College Park

### Abstract*

The flora of Ash Meadows is neither extensive nor exciting. Most of it may be found elsewhere in the Great Basin. The problem in Ash Meadows lies not in the many, but in the few, those small inconspicuous, and unique individuals endemic only to Ash Meadows.

To most fishery biologists, these plants are only of passive interest. However, there exists a mutual problem of survival. The plight of a fish in a disappearing pool of water is simply more obvious than that of an individual species of plant, but extinction by bulldozer, plow, or wandering grazing animal is just as final and permanent as through the drying up of a desert spring.

The history of botanical exploration in Ash Meadows corresponds with the discovery of fishes; i.e., the Death Valley expedition of 1891. However, the collections were made at the wrong time of year, were incomplete, and failed to recognize the unique character of certain of the plant species. Collections made in the vicinity of Ash Meadows in the 1950's (primarily near Tecopa) resulted in the discovery of unique taxa, but not until 1968, with the work of Janice Beatley and Jim Reveal, did the time significance of the Ash Meadows flora begin to be recognized. At this time were discovered three additional endemic species of flowering plants and various species not normally found in alkaline clay flats. It is fortunate that investigations were started in that year, for within a year's time, much of this unique flora was plowed under, the ground leveled, and the vegetation and springs which supported it were desecrated in a wanton act of destruction.

Dr. Reveal followed the introductory portion of his talk with a series of transparencies, many of which were in use in the Smithsonian Institution, where they were integrated into a campaign to save endangered plant species.

Ash Meadows prior to 1968 was a habitat of numerous plant species dominated by a scattering of ash trees (for which the area is named) and low shrubs. The periphery of the area is typified by Atriplex and low shrubs (Campodiaceae). The south end of Ash Meadows comprises Atriplex and mesquite, and the central part is dominated by clay flats which comprise the basic habitat of numerous rare species and Atriplex. The last major area comprises the grasslands forming the lower part of central Ash Meadows.

Miscellaneous comments during slides:

1) Ash Meadows once harbored two species of sunflowers (one endemic), both of which have been eliminated from the area.

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*Prepared from tape by E. P. Pister.

2) Dust storms are now frequent because of a lack of vegetative cover.

3) Certain species of plants not normally found in alkaline soils are found in Ash Meadows. Example: Dodecatheon (shooting star), making it a unique biotype. Others in this category are Castilleja and Centaurium.

4) A total of 10 species found in Ash Meadows are currently on the Smithsonian list of endangered and threatened plants.

5) Dr. Reveal emphasized the importance of an interdisciplinary approach in initiating measures for the protection of Ash Meadows.

6) Concerning the concept of "refugia" for plants, Dr. Reveal pointed out the extreme difficulty of rearing plants under artificial conditions because of a lack of genetic viability and variability.

7) The protection of our threatened and endangered plants (as with our fishes) is going to require a lot of hard, fast work.

8. Invertebrate faunas of desert springs with emphasis on the Gastropods (Mollusca)

J. Jerry Landye, Lower Colorado River Basin Research Lab,
Arizona State University, Tempe

With the emphasis of this council on fish, perhaps a look at desert aquatic invertebrates is in order. Since my area of specialization is mollusks, more specifically the family Hydrobiidae (Gastropoda), my comments will be biased. First, let us explore some of the reasons for investigations of these invertebrates and second, a review of some of the localities in which these organisms occur.

Perhaps the most important reason to maintain these mollusks and many other desert spring invertebrates is that they are a living link with the past. Much of the geological and biological history has been based on fossils; however, due to the nature of these relict living organisms, much can be learned about their evolutionary history.

What kind of aquatic organisms are we talking about?: aquatic isopods, amphipods, ostracods, gastropods, and other smaller (less than 1 mm) organisms. Since most of the discussion will be on gastropods, I will quickly point out the importance of aquatic isopods. For example, in Socorro, New Mexico, and Aqua Calientes, Mexico, two very similar species of aquatic isopods occur, differing only in a few small details. In 1971, W. L. Minckley, C. O. Minckley, myself and others found an additional species near Chihuahua, Mexico, that was an intermediate form. If one reviews the possibilities of origin of these three species, one is drawn to the evidence of a Cretaceous embayment, that according to a recent geology of Mexico publication, had its margins in these three places. Estuarine isopods like those found around the margins of the Gulf of Mexico are the closest related isopods.

As alluded to in the previous discussion, evolutionary rates of these spring organisms may be rather slow due to the constant environmental factors (temperature, flow, chemical, $O_2$, and $CO_2$) in their habitats. These discussions should not only cover Pleistocene periods, but at the least Miocene or earlier. I should stress also that the relict invertebrate fauna is complex. Multiple invasions of the fauna have occurred such as the situation of gastropods in Cuatro Cienegas, Coahuila, Mexico.

Here in the American Southwest there is one genus of gastropod, Tryonia, that is implicated in Pleistocene movement, whereas the Fontelicella group remained isolated at their springheads during this period. Since Tryonia usually lives on algae and detritus in the ponding portions of the springs, their chances of movement are much greater during periods of flow than those that are restricted to the immediate area of the headspring. Further evidence is the numbers of Tryonia fossils that one finds in the Southwest in Pleistocene lake beds. The same species of Tryonia also is found in isolated areas along the Pleistocene White River in Nevada (Muddy, Pahranagat, and White River valley springs).

The external morphology of Hydrobiid shells is of little use in identification at the species level. At the present time very few species have been described from western North America. I would hope that future descriptions of new species will be accomplished by competent investigators as there are already enough problems in molluscan systematics. In identifications of hydrobiids the external morphology of the animals can be helpful, but for a competent description, one has to make a study of the details of the internal anatomy of a 2-3 mm snail. Easily determined external characters are the tentacles, shape of the foot, pigmentation patterns and the verge.

Why do I stress the internal features? External features, although a good place to start, are subject to many external factors. The more conservative internal systems, female reproductive, nervous, and circulatory systems will show more evolutionary history than external features.

If the western North American hydrobiid fauna (Mexico and the United States) show more relationships with Asian forms than European ones, we should look very closely at possible infections of Asian human schistosomiasis. Two species of human Schistosoma, the endemic Mekong species and Schistosoma japonicum have as their intermediate host species of Hydrobiidae. African and South American forms of schistosomiasis use a different family of gastropoda (Planorbidae). If the Asian connection is made, a long range testing program will be necessary to prevent the introduction of Asian human schistosomiasis into North America. Meanwhile these hydrobiids can be used for information on Pleistocene drainages, marine embayments, plate tectonics, and rates of evolution.

An additional important family of gastropods are the Assimineidae which are distributed widely in salt marshes from California and Mexican coasts to the shorelines of Southeast Asia. The only described inland species, Assiminea infirma S.S. Berry 1947 is from Badwater, Death Valley National Monument, but other newly discovered species are at Grapevine Springs, Nevares Springs, Death Valley National Monument; Blue Point Spring, Lake Mead National Recreation Area, Ash Meadows, Nevada; marsh near Fort Stockton, Texas; and Cuatro Cienegas, Coahuila, Mexico.

Some specific localities of these gastropods need some protection and watching. The extinction of Amnicola neomexicana Pilsbry 1916 near Socorro, New Mexico, was due to extensive capping of the springs for a domestic water supply. The Fish Slough, California, species of Fontelicella was almost extirpated due to the efforts to create a Cyprinodon radiosus refuge. However, a small population has been found in a nearby spring. Thus, necessary manipulation of habitats should be supervised closely. Groundwater pumping in the Lower Mimbres basin near Deming, New Mexico, caused the drying of a spring at Palomas Vieja, Chihuahua due to the lowering of the water table. This spring supported three endemic hydrobiids which are now extinct, and the endemic Cyprinodon is in trouble at last report. It is situations like these that I hope can be avoided in the future.

9. An overview of research within the Death Valley System*

Carl L. Hubbs, Scripps Institution, La Jolla, CA

Dr. Hubbs began his studies with David Starr Jordan, and Charles Henry Gilbert was Hubbs' major professor and authored the fish section of the original Death Valley survey.

Other early workers comprised J. O. Snyder and Richardson. In 1915 Snyder received a grant from the federal government for a study of the fishes of the Bonneville system, and Hubbs served as Snyder's assistant during this study. It is of interest that pluvial Lake Bonneville rose to a depth of over 1,000 feet, and covered an area comparable to that of Lake Superior, about 14,000 years ago.

In 1938 Hubbs came out from the University of Michigan to study Nevada fishes. He was in correspondence with Robert R. Miller (at that time a student at Pomona College) and invited him to participate in the study. Miller accepted the invitation and transferred his academic affiliation to the University of Michigan, from which he conducted his classic study on the Cyprinodont fishes of the Death Valley System (his doctoral dissertation). Thus was formed an association which stands among the really great study teams in the history of fishery science and which remains as active today as it did when formed nearly 40 years ago.

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*Abstract prepared from notes and tape review by E. P. Pister.

SESSION II - Miscellaneous Presentations

Chairman: James F. LaBounty, Bureau of Reclamation, Denver

Fish habitat maintenance programs - progress reports.

Bureau of Land Management - Terrell King, Bakersfield, California District Office*

1) Desert planning is taking longer than anticipated, but the data are much better as a result. BLM is receiving much reaction to the Desert Plan from both sides, with each side wanting additional restrictions placed on the other.

2) The El Paso-Red Mtn. Planning Units, which were scheduled for sign-off in October, are now held up until January 15 for public comment.

3) Many organizations with views in opposition to general Sierra Club philosophy have organized into a group called National Outdoor Council, with potentially strong lobbying capability.

4) Some problems in BLM off-road vehicle management have been created by the National Wildlife Federation suit against BLM.

5) The Amargosa-Dumont Dunes Natural Area finally was published in the Federal Register in September (1975), but enforcement of the regulations involved is proving to be a problem. Work is now being done toward the establishment of special areas in the Eureka Dunes and Jawbone Canyon.

6) The Desert Tortoise Natural Area (near California City) is in for final publication.

7) The development of geothermal power is now receiving much attention. The Bakersfield Office is planning to issue some non-competitive leases to Kerr-McGee on Searles Lake by the end of 1975, and BLM is currently working on a joint environmental impact statement with the U.S. Forest Service for the Mono-Long Valley area. Temperature gradient exploration is being conducted near Crowley Lake, and Getty Oil has requested permission to drill 5, 500-foot holes south of Owens Lake. BLM also has non-competitive lease applications on file for areas near Tecopa, Bridgeport, Owens Lake, Little Lake-Coso area, and in Saline Valley.

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*Abstract prepared by E. P. Pister from tape recordings and notes.

National Park Service - F. H. Jacot

Current policies relative to management of waters (1975 Management Policies), in part recognize that:

- Conservation and protection of water resources are of prime concern to management.

- Surface or ground waters may be consumptively used so long as withdrawals do not significantly alter natural processes and ecosystems.

- Returned waters shall meet or exceed applicable state and federal water quality standards.

- Reserved right principle, where applicable, will apply to lands withdrawn or reserved from the public domain and will also apply to use for authorized purposes.

- Where reserved right principle is not applicable, rights will generally be obtained in accordance with state laws.

- All water rights of other parties within parks will be acquired.

- The Service and its agents, consistent with applicable federal, state and local laws, will maintain the quality of all waters originating within boundaries of parks or flowing through or bounding on parks.

- The Service will continue the traditional practice of sport fishing in parks, cognizant that:

  Waters may be closed to fishing to protect rare, threatened, or endangered plant and animal species in the waters or in adjacent habitat.

  Portions of park waters may be closed to fishing when the fish life and other aquatic life has greater value to greater numbers of visitors for the appreciation of plant and animal life, for scientific study, interpretation, or environmental education.

  Fishing may be prohibited in certain waters and at certain times when necessary to protect spawning grounds of endemic fish species or to maintain natural distributions or densities of native wildlife species that use fish for food.

  Fishing may be permitted in historic zones when it does not intrude adversely on the historic scene or harm historic resources.

  Where fishing is allowed, it shall be in accordance with applicable state and federal laws and regulations.

  Commercial fishing is permitted only where authorized by law.

- In natural parks no artificial stocking of fish exotic to a park will occur, however, stocking may be employed to reestablish native species.

- In natural parks barren waters will not be stocked.

- In recreational parks, altered natural environments, new ecological environments and niches are created. Fish stocking of exotic and preferably native species, or both, may occur and must be in cooperation with State Fish and Game officials in order to encourage active management and recreational use of all game species. Habitat enhancement and maintenance for all fish, amphibians, mammals, birds, mollusks and crustaceans will be directed towards maintaining populations for aesthetic, ecological, recreational, educational or scientific values.

- As necessary, visitor use and access to habitats of threatened and endangered species will be controlled, including closure to entry for other than official purposes.

- Non-native and exotic plants or animals may not be introduced into natural parks or zones. They may be introduced if desirable to the scene of a historical park or zone or a recreational park.

- Control or eradication of noxious or exotic plant and animal species will be undertaken when they are undesirable in terms of public health, recreational use and enjoyment, or when their presence threatens the faithful presentation of the historic scene or the perpetuation of significant scientific features, ecological communities, and native species, or where significantly harmful to the interests of adjacent landowners. Care should be taken that control programs do not result in significant damage to native species.

Mining within Death Valley National Monument

Death Valley is presently open to prospecting and mining under the General Mining Laws subject to certain federal regulations governing surface uses. The present controversy has not resulted from subsurface mining nor the federal regulation of surface uses by locators. Rather it is due to a proposal to strip mine federal lands within the monument on located and apparently valid claims. The solicitor of the Department of the Interior has ruled that lands within Death Valley National Monument cannot be withdrawn from appropriations under the General Mining Laws for protection of scenic values.

Two bills have therefore been introduced by the Congress of the United States. H.R. 9540 introduced by Rep. John F. Seiberling (Ohio) and 40 co-sponsors would amend or repeal mining laws affecting future mining in Death Valley and five other parks--Crater Lake, Glacier Bay, Coronado, Mount McKinley, and Organ Pipe Cactus.

S.2371, introduced by Senator Lee Metcalf (Montana) and five co-sponsors, would go one step further than the House bill. It not only would call a halt to future mining but would establish a 3-year moratorium on present mining of all public and private lands within Death Valley National Monument. During this 3-year period, the Department of the Interior would investigate the validity of

mining claims and would advise the Congress of the estimated cost of acquiring outstanding rights.

Hearings on both pieces of legislation were held on the 6th and 7th of October. It appears a final bill will be sent to the President this year. Furthermore, it would appear minimum benefits from this legislation will include:

1. Withdrawal of all six park areas from mining claim location.

2. The right of the Secretary to manage the surface of the land.

## Mining Situation in Death Valley National Monument

### Introduction

Prospecting and mining activity in Death Valley National Monument, California and Nevada, has significantly expanded since 1970, and continues to expand due to an unprecedented demand for minerals, and increasing mineral prices. The greatest impact on the Monument from such activity is from employment of open pit or strip mining methods used in mining borate and talc deposits in the Monument beginning in 1971.

As a result the natural, scenic, scientific and educational features, which the Monument was established to protect, are being irreparably destroyed at an ever increasing rate.

Open pit and strip mining with their associated dumps are permanently destroying well over 100 acres of the Monument's lands each year. Exploration (prospecting), work on mine access roads, and minimum work which must be done to retain legal right to mining claims (assessment work) is marring many hundreds of acres of additional lands, widespread throughout the Monument.

Surface disturbance accelerates both water and wind erosion, affects wildlife habitat for several rare species, including the desert bighorn sheep and fragile Death Valley plant life which includes 36 species which exist no place else.

Some of this land could be partially restored at a high cost if funds were available, but restoration of pristine features in the arid environment, in most cases, will not take place by natural forces and cannot be accomplished by artificial means. Vanished species cannot be replaced.

Existing regulations make no requirement that mining interests protect or attempt to reclaim the natural features on their mining claims.

### Mineral Production

Open pit mining of borates by Tenneco Mining, Inc., a subsidiary of Tenneco Oil Co., is the first large-scale production of borates from the area of Death Valley National Monument. The prior history of borate mining in the Monument, with all of its "20-mule team" fame, is pale by comparison. U.S. Borax and Chemical Corp. with its long history of mining borates in the area retains

borate reserves in the Monument, although it is not currently mining in Death Valley. U.S. Borax is a subsidiary of Rio Tinto Zinc Corp., Ltd. (RTZ).

Borate minerals mined by Tenneco include colemanite (calcium borate) and ulexite (sodium calcium borate). Borates are mainly used in production of structural glass fiber and insulation. Colemanite, because of its desired ratio of calcium to boron, is advantageous in manufacturing of heat-resistant glass and glass fiber. In the United States, colemanite represents an estimated 16% of boron minerals and compounds used in glass manufacture.

Tenneco produces from two open pit operations in the Monument, the Boraxo Mine, now 3000 feet by 600 feet and 230 feet deep and the Sigma Mine, now 500 feet by 400 feet and 75 feet deep. Both are being enlarged by ongoing mining. The spoil or waste dumps are highly visible from the scenic highway to the Dantes View overlook. Other large Tenneco deposits in the same general area, have proven reserves of borates, but have not been developed for production. Development of one of these deposits, the Billie, by far the largest mineral deposit ever delineated in the Monument, will threaten a portion of the highway to Dantes View.

Tenneco intends to explore all of the potential borate area in the Monument and has recently located claims in the Gower Gulch area, a scenic canyon immediately to the southwest of famed Zabriskie Point. The company, earlier this year, applied for a permit to use the scenic trail that leads from Zabriskie Point to Gower Gulch for trucks to move mining supplies to the claims. At present, the permit has not been approved. Tenneco more recently has located claims one mile northeast and in full view of the Monument's Visitor Center and main campgrounds at Furnace Creek.

Tenneco's production from borate mines in the Monument is currently estimated at 180,000 tons per year. Its borate reserves in the Monument are estimated to be sufficient to sustain production for 25 to 40 years.

Talc mining in Death Valley began shortly before the Monument was founded. It became securely established in the Monument during World War II due to a demand for talc for special military purposes. Since then, widening uses for high specification talc, especially in paint and ceramics, has resulted in a steady growth in talc production from the Monument. Talc producers in the Monument are Johns-Manville Corp., Pfizer, Inc., and Cyprus Industrial Minerals Co.

Talc production from the Monument is currently near 100,000 tons per year. Talc reserves in the Monument are estimated to be sufficient to sustain production for more than 30 years.

Borates and talc represent the total current mineral production from Death Valley National Monument. Their production in the Monument has a market value estimated at $12 million annually, a seven-fold increase over the average annual mineral production for the period 1940-1970. Production can be expected to increase by more than 50% within four years mainly from increased production of borates.

Mineral production from the Monument from 1940 until 1970, by comparison, is estimated to have averaged under $1.5 million annually, representing mostly talc production. Total value of other production for the entire 1940-1970 period is estimated at only $4 million consisting mostly of lead-silver with a small amount of tungsten.

For all the popular literature on Death Valley concerning borax mines, gold mines and other mines and mineral occurrences, the total value of mineral production for the entire 1882-1940 period is estimated at only $5 million. Death Valley National Monument contributed only 2% of the mineral production of Inyo County for the period.

## Open Pit and Strip Mining

It is doubtful if anyone envisioned the massive open pit or strip mining in Death Valley National Monument at the time it was opened to mining on June 13, 1933 by an Act of Congress, four months after its establishment by Presidential Proclamation on February 11, 1933. In fact, based on the small mineral production of the previous period, Secretary Ickes stated to Congress that opening Death Valley to mining "would in no way interfere with the preservation of the characteristic of the area sought to be preserved."

At present, there are nine open pit mines in the Monument, which include the two borate mines operated by Tenneco, and seven talc mines, operated by Johns-Manville, Pfizer and Cyprus. Johns-Manville and Cyprus, each in addition, operate an underground mine.

With the massive material moving equipment available today, open pit mining is the most economical method for mining portions of deposits near the surface. For borate and talc deposits in Death Valley, when the amount of waste rock removed reaches near 10 times the amount of mineral mined, mining will revert to underground methods, at depths of 50 to 450 feet, depending on the size and position of the deposit. Waste dumps and stockpile areas adjacent to open pits occupy more land area than the pits. The stacked material has a greater visible impact than the pits, especially at the talc mines because of contrast to the dark-colored rock of the area.

## Mining Claims

The current inventory of claims in which an active interest is maintained totals 1,827. Of these, 207 claims are patented and 1,560 claims are unpatented. Currently, ten of the unpatented claims are being considered for patent. An estimated 1,200 claims, or 77% of the unpatented claims, are held by claimants performing the minimum work required by law to hold a claim, speculating on higher market values. A total of 450 claims of the inventory are located on the borate and talc resource area and held by the producing companies and U.S. Borax; 66 of these are patented. Total area covered by the unpatented claims throughout the Monument is about 35,000 acres.

The aggregate damage to the natural features in performance of the annual labor required to hold unpatented claims can be equated to open pit mining. Although disturbance is small on any one claim or claim group, it is annual and the claims are scattered throughout the Monument.

New mining claims are being located at a rate of 200 per year. Some claims are being abandoned, but at a rate less than new claim location.

Mineral Resources

Borates and talc represent the only mineral reserves and predictable mineral production potential in Death Valley National Monument.

Borate reserves and potential are limited to the Furnace Creek area consisting of about 50,000 acres.

Best talc reserves and potential are in the Warm Spring Canyon-Galena Canyon area, consisting of about 25,000 acres where all three talc producing companies operate. Good talc reserves and potential are in the Ibex Hills in the south area of the Monument, and some reserves and potential remain in the Cottonwood Mountains in the northwest area of the Monument.

Tenneco, after five years of operation, apparently has now captured about one-quarter of the domestic market for borate minerals and compounds used in glass, and its production represents near 10% of domestic production. Tenneco currently produces virtually all the colemanite boron mineral in the United States. However, there are deposits held by Tenneco and others outside of the Monument. Other boron compounds can be substituted for colemanite, but at a higher cost.

About one-half of all domestic production of borates is exported. Expansion planned at U.S. Borax's Boron, California, mine and expanding exports from Turkey are off-setting factors. United States resources are adequate to supply domestic needs for boron at current rates for nearly 100 years without production from the Monument.

Talc mines in the Monument are intermittent operations. Two of the talc producers, Cyprus and Pfizer, hold mines outside of the Monument in California to the northwest near Talc City and immediately southeast near Tecopa, and potential exists at these locations and nearby in Nevada. Most talc produced in the Monument is marketed in the Los Angeles area. Geographically, in the United States, there are adequate talc deposits near the areas where it is consumed, an important exception being the high quality talc produced in Montana. No import necessary. Talc occurs widely in 30 or more countries, and resources are enormous.

## Bureau of Reclamation

Jim LaBounty presented an overview of the various programs conducted by the Bureau and emphasized the Hoover Dam Refugium project and its many ramifications.

## Naval Weapons Center

Tilly Barling, National Resources Management Coordinator at the Weapons Center, gave a listing of preservation work there. Although habitats have been created for desert fish transplants (Tennessee Spring, etc.), major activity to date has been devoted to Lark Seep Lagoon, where the transplanted population of Mohave chub (Gila bicolor mohavensis) is thriving.

## U.S. Forest Service

Jerry Stefferud, of the Inyo National Forest, summarized research being conducted on the Paiute cutthroat trout (Salmo clarki seleniris) in Cottonwood Creek, Mono County, California. The life history and behavioral data being gathered for this subspecies should prove to be of great value in recovery efforts.

## Fish and Wildlife Service - Portland

Endangered Species - General Recovery Plan Overview

Clinton H. Lostetter, Staff Specialist for Endangered Species

The Endangered Species act of 1973 directs the Secretary of the Interior and the Secretary of Commerce, in cooperation with the States and other federal entities, to carry out a national program for the "conservation" of species of fish, wildlife and plants facing extinction. The Secretary of the Interior delegated his responsibilities under the Act to the U.S. Fish and Wildlife Service, and the Secretary of Commerce to the National Marine Fisheries Service. The importance of state participation and cooperation in restoration programs is noted in Sections 4(b) and 6 of the Act. The guidelines have been issued that lay out procedures selected by the Fish and Wildlife Service to implement coordinated programs for those domestic threatened and endangered species that come under its jurisdiction.

The recovery plan concept, which is an important part of the program, is neither magic nor a panacea for the restoration of endangered or threatened fish and wildlife species. In attacking the problem of rehabilitating habitat and improving animal populations, a plan--call it what you may--a management plan should be made. This, then, is a guide to the agencies concerned and the individuals who carry out the details of the plan and planned recovery of the species. This is not all a federal program, but also a state program whereby the Fish and Wildlife Service and cooperating federal agencies assist the states.

The plan is little different than those ideas and procedures used by states in their Dingell-Johnson and Pittman-Robertson federal aid programs. The application of logical reasoning, problem statement, and identification of objectives are the main points of the plan and its problem solution.

The major objective of this whole program is the restoration of endangered or threatened species to a status whereby a viable population will insure the continued existence of the species.

Recovery plans and teams provide a means to combine the varied programs of such organizations into single, effective, and concentrated efforts for each species which will eventually lead to qualifying many for removal from lists of endangered or threatened species or relisting from endangered to threatened status. The immediate goal for many will be to prevent extinction which would otherwise occur very soon. When plan objectives have been met, the recovery team can be abolished and the plan considered terminated. Plans and teams are a "vehicle" to accomplish objectives and are not an end but a beginning to this overall effort.

A recovery plan is a guide that delineates and schedules actions required for securing or restoring an endangered or threatened species as a viable, self-sustaining member of its ecosystem. A typical plan should be built around a step-by-step outline of problems or limiting factors contributing to an animal's endangered or threatened status which must be overcome. Actions necessary for meeting these factors should be identified, divided into specific assignments, and placed in suggested time frames and priority sequences for handling, by those organizations and individuals participating in the plan's implementation.

Although a separate plan for endangered and threatened species requiring coordinated actions is contemplated, there are instances where one plan will suffice for a group of endangered or threatened species occupying a common ecosystem and affected by the same or similar problems. There are also instances where it is advantageous to split a widespread species into populations and provide separate plans for each population. The length and complexity of each recovery plan may vary with the complexity of problems facing the species, its geographical distribution, and number of organizations involved. A brief plan may be all that is necessary for a program consisting of the simple removal of a threat to a vulnerable species whose population has always been limited and whose status had not yet changed.

The California Department of Fish and Game has prepared an excellent endangered species management plan for the Hidden Palm Ecological Reserve, the only known location of the endangered desert slender salamander. This management plan fulfills to a great extent the need for a recovery plan as it contains those elements needed for species survival.

It is hoped that a recovery plan acceptable to each cooperating agency concerned can result. This may not always be possible because of conflicting interests and responsibilities of the agencies involved. Letters of comment and concurrence as to their respective responsibilities will be sought by Regional Directors from affected or cooperating agencies and placed in the appendix of the plans before they are submitted to the Director for approval.

It is acknowledged that agencies cannot commit funds in advance, but they can indicate intent on a basis of anticipated funding.

In recognition of a need for flexibility, a rigid format for recovery plans is not intended. However, continuity is needed to fulfill the objectives agreed upon in the plan.

Groups of three to seven people to be known as recovery teams will typically play the key role in preparing, coordinating, and implementing plans for species being handled or coordinated by the Fish and Wildlife Service. Recovery teams will be formed, at the discretion of a state, for species residing entirely within a state and being handled by a state.

Recovery teams will thus consist of on-the-ground professionals who carry the greatest responsibilities and expertise with respect to the species concerned. One member of each team will serve as team leader. Teams may also include consultants. In most cases, recovery team leaders, members and consultants will be nominated by Regional Directors in consultation with the states, other cooperating organizations and the Office of Endangered Species. Since teams will be the entities directly responsible for preparing and coordinating the implementation of recovery plans, it is imperative that team members and leaders be selected with utmost care.

Species selections for this effort will be made by the Program Manager for Federal Assistance, and transmitted to appropriate Regional Directors through program advices. The selections will be made in accordance with species priorities, need for coordination of on-going activities, land acquisition needs and availability of funds.

The Service will exercise its direction over recovery team operations through the following procedures which provide the necessary Service oversight as required by the Act:

1) By the appointment and replacement of team members;

2) By its authority to approve initial recovery plans and their subsequent amendments; and

3) By instructions to Service representatives on the teams.

Teams will meet as frequently as necessary for matters such as preparing revisions and implementing plans. It is recognized that much of the business of a team will take place within the content of recovery plans but supported by written communication and dialogue among members. It should not be overlooked that the best team decisions may be made with members interacting in person, and that meetings, on a regular or called basis, are a means to accomplish this. Reports on accomplishments, such as inventory work, often are presented at team meetings and become a part of the minutes. A copy of such minutes should also be sent to the Office of Endangered Species and to the Regional Offices concerned.

It must be emphasized that a free flow of information and recommendations to and from recovery teams is highly desirable. Communications should flow freely

between recovery teams and any party with whom there is need to communicate. Service members of recovery teams will represent the Service and will receive direction and instructions regarding Service positions, relative to the species concerned, from the Regional Director or his designated representative.

It is expected there will be representatives from conservation organizations or interested citizens who will want their views considered or whose views will be sought by a team. Such persons may be designated as observers by a team leader.

It should be apparent from the above that recovery teams are autonomous units. Financing of routine team business can be handled between the team leader and Regional Director through a memorandum of agreement. If the team leader is divested of his duties as "team leader", a new agreement must be prepared and signed by the Regional Director and newly appointed team leader.

In implementing a recovery plan, the management responsibilities culminate in a "job list" as assigned to cooperating parties for action. These jobs can be one-time actions, or continuing operations such as management of a refuge or law enforcement. Cooperating parties each have their own funding procedures. Recovery plans, as they are approved, will become the basis for Fish and Wildlife Service endangered species restoration programming, including research, law enforcement and land acquisition.

Recovery operations handled exclusively by a state use the programs designed and implemented by a state, are subject to Service review, and are an option to the procedures previously discussed with the following differences:

1) The species involved resides entirely within one state; and

2) The state qualifies under the Act to "conserve" the species and has expressed a desire to "take the lead" for the species. We foresee two situations qualifying a state:

    a) Under a cooperative agreement; or
    b) In the absence of a cooperative agreement, the Service can accept a letter from the state to the appropriate Regional Director expressing a desire to conduct a program for the subject species.

A state conducted program for a given species may or may not involve a recovery team. The means selected by a state to administer a recovery program is optional, and it is possible that the state may exercise complete control over the recovery process. However, the Service has the responsibility under the Act to periodically review the state's program and take corrective action if needed. Every possible effort will be extended to encourage states to handle, on their own, endangered species that qualify under the above immediate situations.

In summary, the recovery program for endangered or threatened species is not a Fish and Wildlife Service program, but a program supporting the states. It is all inclusive of federal agencies, as spelled out in the Endangered Species Act of 1973, to conserve endangered and threatened species. An important part of the restoration program is the recovery plan concept and its implementation

through recovery team functioning. These teams are entities for preparing the recovery plan and coordinating the attainment of the plan's objective.

Teams appointed by the Director of the Fish and Wildlife Service take on an "official" capacity and are eligible for team administrative funding. At this point, funding does not include research, studies, or salaries of team members.

## Fish and Wildlife Service, Washington, D.C.

Jim Williams, of the Office of Endangered Species, reported progress in implementing the Endangered Species Act of 1973. He also presented the concept of critical habitat and how it works into recovery planning. Following the initial presentation, Dr. Williams presented a proposed listing of endangered and threatened fishes of the southwestern United States (copy included) for discussion and input by the Council. This list was discussed at great length.

## Aquarium Reports

W. L. Minckley of Arizona State University reviewed funding problems related to the proposed refugium at Phoenix Zoo. This project holds much promise for the Colorado River fishes in particular, and every effort will be expended to acquire the necessary finances. Dr. Minckley is handling the Council's liaison with Phoenix Zoo in this project.

Al Castro, of Steinhart Aquarium (San Francisco) was unable to report, inasmuch as he had not yet received his fish.

## The Southwestern Fishes Council

Royal D. Suttkus, Tulane University, New Orleans

Perhaps our beginning should be considered as the early fall of 1974 when a draft of the constitution was circulated to a selected number of individuals in the southeast for review and comments. Later, in March of 1975, at an Alabama endangered species meeting in Tuscaloosa, Alabama, a group reconvened at Herbert Boschung's residence to discuss the draft constitution and also the comments which had been received up to that time. Then at the annual meeting of the ASIH in Williamsburg, Virginia, during June, 1975, the Southeastern Fishes Council was officially formed. I was elected as the Chairman; David Etnier, University of Tennessee, is Chairman-elect; Herbert Boschung, University of Alabama, is the Secretary-Treasurer.

Our stated objectives in the constitution emphasize environmental preservation and perpetuation more so than does the constitution for the Desert Fishes Council. But perhaps in practice we will be quite similar in our activities. Our objectives include the preservation of habitats which contain rich natural assemblages of fishes as well as populations of single, unique species. Another objective is to direct appropriate attention to the retention and curatorial care of the documentary evidence, that is, the collected specimens.

ENDANGERED AND THREATENED FISHES OF THE WESTERN UNITED STATES
TO BE CONSIDERED BY THE DESERT FISHES COUNCIL

| Status | Scientific Name | Common Name | State Distribution |
|---|---|---|---|
| | FAMILY CATOSTOMIDAE | | |
| | *Catostomus luxatus* | Lost River sucker | CA, OR |
| | *Catostomus microps* | Modoc sucker | CA |
| | *Catostomus warnerensis* | Warner sucker | OR |
| | *Chasmistes brevirostris* | Shortnose sucker | CA, OR |
| | *Xyrauchen texanus* | Humpback sucker | AZ, CA, CO, NV, UT, WY |
| | FAMILY CENTRARCHIDAE | | |
| | *Micropterus trecculi* | Guadalupe bass | TX |
| | FAMILY COTTIDAE | | |
| | *Cottus asperrimus* | Rough sculpin | CA |
| | *Cottus pitensis* | Pit sculpin | CA, OR |
| | FAMILY CYPRINIDAE | | |
| | *Dionda diaboli* | Devil's River minnow | TX |
| | *Eremichthys acros* | Desert dace | NV |
| | *Gila alvordensis* | Alvord chub | OR |
| | *Gila bicolor euchila* | Fish Springs Tui chub | NV |
| | *Gila bicolor newarkensis* | Newark Valley Tui chub | NV |
| | *Gila bicolor obesa* | Humboldt Creek Tui chub | NV |

| Status | Scientific Name | Common Name | State Distribution |
|---|---|---|---|
| | FAMILY CYPRINIDAE (Continued) | | |
| | Gila bicolor isolata | Warm Springs Tui chub | |
| | Gila bicolor snyderi | Owens Tui chub | CA |
| | Gila elegans | Bonytail chub | AZ, CA, CO, NV, UT, WY |
| | Gila intermedia | Gila chub | AZ |
| | Gila robusta seminuda | Virgin River roundtail chub | AZ, NV, UT |
| | Iotichthys phlegethontis | Least chub | UT |
| | Lepidomeda albivallis | White River spinedace | NV |
| | Lepidomeda mollispinis mollispinis | Virgin River spinedace | AZ, UT |
| | Lepidomeda vittata | Little Colorado spinedace | AZ |
| | Meda fulgida | Spikedace | AZ, NM |
| | Notropis proserpinus | Proserpine shiner | TX |
| | Notropis simus | Bluntnose shiner | NM, TX |
| | Rhinichthys osculus lethoporus | Independence Valley speckled dace | NV |
| | Rhinichthys osculus oligoporus | Clover Valley speckled dace | NV |
| | Rhinichthys osculus robustus | Lahontan speckled dace | NV |
| | Tiaroga cobitis | Loach | AZ, NM |
| | | | |
| | FAMILY CYPRINODONTIDAE | | |
| | Crenichthys baileyi | White River killifish | NV |
| | Crenichthys nevadae | Railroad Valley killifish | NV |
| | Cyprinodon bovinus | Leon Springs pupfish | TX (Pecos Co.) |
| | Cyprinodon macularius | Desert pupfish | AZ, CA, Mexico |

| Status | Scientific Name | Common Name | State Distribution |
|---|---|---|---|
| | FAMILY CYPRINODONTIDAE (Continued) | | |
| | Cyprinodon milleri | Cottonball Marsh pupfish | CA |
| | Cyprinodon nevadensis | Amargosa pupfish | CA, NV |
| | Cyprinodon tularosa | White Sands pupfish | NM |
| | Cyprinodon sp. | Devil's River pupfish | TX (Val Verde Co.) |
| | Cyprinodon sp. | Monkey Spring pupfish | AZ |
| | Cyprinodon sp. | Pecos pupfish | NM, TX |
| | FAMILY ICTALURIDAE | | |
| | Satan eurystomus | Widemouth blindcat | TX (Bexar Co.) |
| | Trogloglanis pattersoni | Toothless blindcat | TX (Bexar Co.) |
| | FAMILY POECILIIDAE | | |
| | Gambusia amistadensis | Amistad gambusia | TX |
| | Gambusia georgei | San Marcos gambusia | TX |
| | FAMILY SALMONIDAE | | |
| | Salmo aguabonita whitei | Little Kern golden trout | CA |
| | Salmo clarki pleuriticus | Colorado River cutthroat trout | CO, NM, UT, WY |
| | Salmo clarki virginalis | Rio Grande cutthroat trout | CO, NM, TX? |
| | FAMILY UMBRIDAE | | |
| | Novumbra hubbsi | Olympic mudminnow | WA |

We feel that specimens and associated collection data, specifically date of collection, width, dated photographic records of the habitat, etc., are of obvious great importance, particularly when endangered and threatened species are involved. Earlier this month, the executive committee met and appointed an eleven-person technical advisory committee. We also made steps toward a newsletter. As of the first of November this year, we have a paid membership of 48 members. We will have our first meeting as an official organization next April in New Orleans in association with the Association of Southeastern Biologists. We certainly welcome the attendance of Desert Fishes Council members. Thank you.

Question: What is your geographic coverage?

Answer: We don't want to exclude anybody, but essentially our boundaries include all of Florida and let's say westward along the Gulf Coast over to eastern Texas up to approximately the central part of the state of Texas, say the Balcones Escarpment where you begin to get what I think is included in the Desert Fishes Council area. Then northward in the Mississippi Valley, including the Ozark region, up to the Missouri River, along the southern side of the Ohio River, over to approximately the Potomac in the East. We haven't gotten around to dividing this area into regions for purposes of monitoring drainages and populations of some of our single species that live in isolated springs.

I hope that shortly we will be able to get out a newsletter that we will try to send out not only to the membership but also to agencies. At the present time we do not have the state biologists represented in our membership. I'm quite sure that we will get additions to our membership from state organizations and from other private individuals that are not associated with the ASIH.

Dues are five dollars to join as a member. We have other categories such as life membership, $100.

## The Desert Tortoise Council

James A. St. Amant, Calif. Dept. Fish and Game, Long Beach

We had a recovery team for the desert tortoise and now we have changed that to the Desert Tortoise Council so that everybody can be involved. We are not limited to just a recovery team which is normally people from various agencies and universities. This will include anybody interested in tortoises, including tortoise societies and clubs. So we now have three desert councils: the Bighorn, the Fishes, and the Tortoise. Everybody here is welcome to join the Tortoise Council. Our first annual symposium is going to be held towards the end of March. We haven't set a date yet, but it will be in Las Vegas. We're going to try there because we've got four states involved and we tried to pick one in the middle someplace to get everybody to attend. Dues are $5 for the regular memberhsip, $3 for students, and of course you have the patron $100 dues for life or whatever, and again I mention that we welcome anybody that wants to join to contact me. We have two chairmen, myself and Kristin Berry, as we're going to be pretty busy.

## Miscellaneous Comments

Should we implement a new system of endangered species priority assessment?

Robert R. Miller presented the basis of a new system described in the following publication:

Sparrowe, R. D. and H. M. Wight
1975. Setting priorities for the Endangered Species Program. Trans. 40th N. Am. Wildlife and Nat. Res. Conf., pp. 142-156.

Dr. Miller was joined by Dr. Jim Deacon in the discussion. It was suggested that interested Council members should acquaint themselves with the above system for further discussion and possible implementation into Council administrative procedures. Until that time, it was suggested that we continue with current programs and place our emphasis on the obvious needs of the resource.

## SESSION III - General discussion and evaluation of Desert Fishes Council

Chairman: Robert R. Miller

This is the seventh meeting of this organization in six years. We've come a long way since 1969. Much of the success attained by this group is due to the organizational genius and friendly persuasion of our first chairman and secretary, Phil Pister. We can take pride in our accomplishments, but an organization such as this, in order to remain viable, must also look at its program with a critical eye. When we do that, we see plenty of opportunity for improvement. This morning, Jim Reveal brought up a very important point, in effect, unless we as individuals become politically involved, natural biotas are going to go down the drain. The 1970's have been referred to as the environmental decade and there has certainly been a remarkable reversal of philosophies. I think particularly back to that relatively recent period of 1972 when the infamous Green River poisoning took place, and I would hate to quote whose words I'm thinking about, but there were a number of fishery biologists who were not concerned about the native fish fauna and referred to them as trash fish and didn't care whether they were all exterminated by the poison. That philosophy has been completely reversed. The same people who were not caring about the trash fish are now doing everything they can to preserve the trash fish, now no longer called trash fish. So things have really reversed, thanks in large part to a courageous woman, Rachel Carson, whose book, Silent Spring, changed the course of history. There are many opportunities for us to become involved politically, and I hope everyone who has an opportunity will do so, instead of saying, "well I'll let John take care of it." Issues are coming up all the time.

One of the suggestions I have for us to consider this evening is that we do something that the IUCN, International Union for Conservation of Nature and Natural Resources, has done. This is an organization based in Morges, Switzerland, that was established in 1948 to monitor the world's biota. It has two prominent commissions, one on ecology and the other one (in which we are

interested) the Survival Service Commission, whose job it is to try to keep the world's biota from becoming extinct. I mean the biota, not just the fishes or the birds or the mammals. In the last two years, they have set up what they call an "Alert Group," which is an action group that gets information out on critically threatened forms to those who can do something about it in the shortest possible time. One of our great problems, and the problem of the world today, I think, is lack of communication. We must figure out some way to overcome this serious defeat. I suggest, therefore, that we establish something like the action or alert group of the SSC so that when issues come up we don't have to wait from November 12, 1975 to November 14, 1976 to do something about it.

It was the group's consensus that the Council is proving to be effective and is heading in the right direction. A need for a better method of producing the transactions was mentioned, and the Secretary stated his intent to do everything possible to get summaries on papers from each participant. This would nearly eliminate the problem, although to do so is much easier said than done.

Two resolutions were implemented relative to 1) Preservation of the Colorado River cutthroat trout (Salmo clarki pleuriticus), and 2) Designation of the Yampa River of Colorado as a Wild River. Copies of the resolutions are included in these proceedings.

The Treasurer's report was favorable. Income and expenditures have averaged about $500 each, per year.

It was decided that the next meeting of the Council would be held on November 18-20 at Grand Junction, Colorado, with the Bureau of Reclamation serving as the host agency.

An attendance list was prepared and is included.

## RESOLUTION 75-1

### Preservation of the Colorado River Cutthroat Trout, Salmo clarki pleuriticus Cope

WHEREAS the Colorado River cutthroat trout is endemic to various waters of the eastern Great Basin; and

WHEREAS the subspecies is of great value in enhancing the faunal diversity of the Great Basin and for many other reasons is worthy of man's recognition and concern; and

WHEREAS the integrity of the subspecies has recently been seriously threatened through both hybridization and habitat deterioration; and

WHEREAS the States of Utah and Wyoming are contributing significantly to the recovery and perpetuation of the Colorado River cutthroat trout; now therefore be it

RESOLVED that the participants in the Seventh Annual Symposium of the Desert Fishes Council, meeting in Death Valley, California on November 13-14, 1975, do hereby commend the States of Utah and Wyoming for their efforts in behalf of this fish; and be it further

RESOLVED that copies of this Resolution be forwarded to the Directors of the Utah Division of Wildlife Resources and Wyoming Game and Fish Department, to the Governors of both states, and to the Director of the United States Fish and Wildlife Service.

Ayes: unanimous

Attest:

Robert Rush Miller
Chairman

RESOLUTION 75-2

Designation of the Yampa River of Colorado as a Wild River

WHEREAS various endangered and threatened big river fishes of the Colorado River system (including the razorback sucker, Xyrauchen texanus; Colorado River squawfish, Ptychocheilus lucius; and humpback chub, Gila cypha) are known to exist in the Yampa River; and

WHEREAS a major cause of endangerment of these fishes is widespread habitat destruction and change throughout their native range; and

WHEREAS the Yampa River still provides habitat conditions which allow the existence of breeding populations of these fishes; and

WHEREAS the loss of such habitat within the Yampa River would likely render these fishes extinct; and

WHEREAS designation of the Yampa River as a wild river would tend to preserve both the required habitat and the fishes; now therefore be it

RESOLVED that the participants in the Seventh Annual Symposium of the Desert Fishes Council, meeting in Death Valley, California, on November 13-14, 1975, do hereby request that the State of Colorado designate the Yampa as a wild river, and by so doing assure the preservation of a vital part of the scenic and fishery resources of the state and nation; and be it further

RESOLVED that copies of this resolution be forwarded to the Director of the Colorado Division of Wildlife, to the Governor of Colorado, and to the Director of the United States Fish and Wildlife Service.

Ayes: unanimous

Attest:

Robert Rush Miller
Chairman

The very fine movie, "Pupfish of the Desert" concluded the evening session.

SESSION IV - Reports from Great Basin Area Coordinators

Sonoran Desert - Mexico and U.S. - No report was provided.

Chihuahuan Desert - Mexico - Salvador Contreras-Balderas emphasized again the frustrations encountered in gaining support for a special status designation for such areas as the Cuatro Cienegas. Whatever assistance might be provided by the Council in this respect would be greatly appreciated. Salvador felt that much could be accomplished if the Council were to meet in Monterrey, and this possibility was briefly discussed, although it was felt to be infeasible because of the substantial loss of attendance such a move would create--attendance which is the life blood of the Council.

Chihuahuan Desert - U.S. and Isolated Basins - No report was provided. The reader is referred to the comprehensive reports for these areas in the 1974 and 1976 proceedings.

Upper and Lower Colorado - No reports were provided.

Lahontan Basin Area of Great Basin

Lahontan Cutthroat Trout

During 1975 the Lahontan cutthroat trout was de-classified on the federal list of endangered fauna from an endangered to threatened status. Some arguments both pro and con have been voiced with regard to removing the species entirely from the federal list. It is the desire of the Nevada Department of Fish and Game to do so as this species presently occurs in at least 83 individual waters in Nevada and we feel is in no jeopardy.

During the fiscal year 1974-75, the Verdi Hatchery (NDF&G and the Lahontan N.F.H.) planted some 2,082,581 cutthroat trout into the waters of Nevada, primarily Pyramid and Walker Lakes. The future production picture looks much improved with the pending renovation of the Verdi Hatchery and recent completion of a small facility on the Pyramid Lake Indian Reservation. These two fisheries, Pyramid and Walker Lakes, supported some 117,500 angler days use during 1974. In summary, population levels of the cutthroat are good although considerable attention needs to be directed to the associated environmental factors, in particular watershed protection and enhancement. The native cutthroat trout is a popular species to the local and nonresident anglers and therefore is an important game fish species with, hopefully, a long and bright future.

Cui-ui Lakesucker

So far as is known, the status of the Cui-ui populations in Pyramid are unchanged. Fishing (snagging) is closed to Non-Indians. The Cui-ui recovery team is nearing the completion point of a recovery plan. Under a Bureau of Reclamation funded study, the Nevada Department of Fish and Game applied sonic transmitters to some 22 Cui-ui in hopes of learning something of their spawning migration patterns and areas in the Lower Truckee River. The project data are inconclusive probably in large part due to the physical effect of the internally-implanted tags.

The Marble Bluff Dam and fishway was recently completed (Bureau of Reclamation project) which will enhance spawning runs of cutthroat trout and Cui-ui into the Lower Truckee River.

Desert Dace

We are still concerned about the future of the Desert Dace populations of northeast Nevada in light of potential geothermal activity. Nearly all the populations are situated on private lands. The BLM lands surrounding these private lands do not presently support any known populations of this species. The private lands involved are under geothermal lease and therefore the concern. We will monitor the entire situation as it develops.

Other

Work is continuing with the other cutthroats of the Lahontan area with respect to inventory work, new potential sites, protection of present pure populations (strains?) and monitoring of habitat conditions.

Interbasin - No report was provided.

Bonneville - W. F. Sigler

Since I am currently spending all my time on Pyramid Lake, I will not be able to make the Desert Fishes Council meeting in November. I am, therefore, giving you a brief interim report as per your request of October 8. The first part of the study on the least chub was done by Gar Workman and myself in Snake and Tule Valleys in western Utah.

We found least chub in the Leland Harris spring area. Incidentally, Bob Miller found them there also. We also took fish that I identified as least chub in one of the Twin Springs. However, I would like Bob to check these before I give them final identification. No least chub were identified from Tule Valley which incidentally, we believe, has a considerably less acceptable habitat for least chub than does Snake Valley.

We took water chemistry and other ecological data on several of the springs. We did an age and growth study on about fifty of the least chubs from the Leland Harris area.

We recommended that an intensive study be done on the least chub on a year-round basis in Snake Valley, then that extensive range and distribution studies be made for least chub for the balance of the state of Utah. It is our understanding that these recommendations will quite probably be acted upon.

Oregon Lakes - No report was provided.

Death Valley - E. P. Pister

The Second Annual Meeting of Death Valley System Committee was held at Furnace Creek Inn, Death Valley National Monument, on February 10, 1975, with 27 in attendance.

Superintendent James B. Thompson referred to the ping-pong justice involved in the matter of the Devils Hole pupfish, wherein the existence of the species has essentially been bounced back and forth between the courts. Although the species remains highly endangered, it still exists. Perhaps through the efforts of the Council, reflected Superintendent Thompson, we can solve the problem of how to manage the species for survival. Toward this end, and toward the solution of similar problems within the Death Valley System, he again welcomed the Committee to Death Valley National Monument.

Status reports were then given for the endemic fishes of the Death Valley System as follows:

1. Pahrump killifish, Empetrichthys latos.

Manse Spring remains essentially unchanged as far as the water level is concerned. Heavy vegetation makes accurate counting nearly impossible. The species still persists there, however.

The transplanted population at Corn Creek near Las Vegas has dropped from approximately 1,400 a year ago to about 250 at this time. Competition with Gambusia affinis remains a problem, and consideration will be given to making an attempt to eliminate this species.

A letter received subsequent to the meeting from Wayne Logan from the Ely BLM office revealed (as suspected by Dale Lockard) that E. latos no longer exists at Shoshone Ponds. Happily, though, Wayne reported that the Pahranagat bonytail (Gila robusta jordani) is doing well, and one specimen measuring 10 inches in length was taken.

A recovery team concept planned for E. latos is described under the following section covering the Devils Hole pupfish, C. diabolis. Among other things, the level of Manse Spring will be monitored. Until the recovery team is operative, Dale Lockard will oversee the status of this fish.

2. Devils Hole pupfish, Cyprinodon diabolis.

The current population in Devils Hole is approximately 200, and it should be 400 at this time of year. Since September the population has dropped between 25 and 30 per month.

The Hoover Dam refugium population has also declined, and the size of the fish has decreased somewhat from the extraordinary growth noted during the early stages of the refugium.

In order to provide a more coordinated approach to the preservation of the species, a recovery team is planned under the chairmanship of Jim Deacon of the University of Nevada, Las Vegas. Membership in the team would include Chuck Osborn, Fish and Wildlife Service; Osborn Casey, Bureau of Land Management; Herb Guenther, Bureau of Reclamation; Dale Lockard, Nevada Department of Fish and Game; David Soltz, California State University, Los Angeles; and Dean Garrett, National Park Service. I would also serve on the team in an advisory capacity as Chairman of the Death Valley System Committee and to coordinate any aquarium culture or other recovery activities which might occur within

California. Formation of the team is contingent upon receipt of approval from the Department of Justice.

An identical team, under the chairmanship of Dale Lockard, is being formed for the Pahrump killifish.

3. Ash Meadows speckled dace, Rhinichthys osculus nevadensis.

Population status remains essentially unchanged. Chuck Osborn will determine the feasibility of constructing a barrier below Jackrabbit Spring and introducing the subspecies into Corn Creek following removal of Gambusia affinis.

4. Ash Meadows pupfish, Cyprinodon nevadensis mionectes.

Population status in Big Spring and Jackrabbit Spring remains unchanged. Bob Love agreed to monitor the populations throughout the year and, as a weekly visitor to the area, is in an excellent position to do so. The Nature Conservancy is proceeding with management plans for Big Spring.

5. Warm Spring pupfish, Cyprinodon nevadensis pectoralis.

The School Spring population remains in satisfactory condition, as do the other four populations in Ash Meadows. However, as with all endemic Ash Meadows fishes, the subspecies must be considered endangered as long as the pumping threat remains.

A recovery team has been nominated for C. n. pectoralis as follows: Chairman Jim Yoakum, BLM, Reno. Team members: Cal Allan and Dale Lockard, Nevada Department of Fish and Game; Chuck Osborn, Fish and Wildlife Service; and Jim Deacon, University of Nevada, Las Vegas. The initial thrust of the team will be directed toward land ownership and possible acquisition, and estimation of population numbers in the five springs containing the subspecies.

6. Owens chub, Gila bicolor snyderi.

The status of this subspecies remains unchanged. The Owens River Gorge below Crowley Lake (Mono County) contains a small, stable population which appears to be secure. As soon as a few operational problems are overcome at the Owens Valley Native Fish Sanctuary, another introduction will be made there. Earlier introductions were ineffective because of chemical treatments conducted to remove illegally established populations of largemouth bass (Micropterus salmoides). Phil Pister will oversee recovery operations.

7. Owens dace, Rhinichthys osculus subsp.

A general inventory of Owens Valley fish populations made during 1974 revealed that several populations of Owens dace exist in the northern portion of the valley from the Bishop Creek drainage northward. These populations will be monitored regularly, and another introduction will be made into the Owens Valley Native Fish Sanctuary as discussed previously for the Owens chub. Phil Pister will supervise this work.

8. Rhinichthys osculus subsp., Amargosa River near Beatty, Nevada.

There has been no known change in the status of this undescribed subspecies. Jim Deacon will handle existing collections and make further collections as necessary to improve our knowledge of both status and taxonomy. As necessary, assistance will be requested and provided by Cal Allan and Chuck Osborn.

9. Rhinichthys osculus subsp., Amargosa River Gorge, below Tecopa.

There has been no known change in the status of this subspecies. Jim Deacon will handle existing collections and assist in further collecting as necessary. A general fish population survey of the Amargosa River Gorge is currently planned for this area during mid-April, which will significantly improve our information concerning both distribution and population numbers. Phil Pister is coordinating this interagency endeavor.

It is of interest that BLM has closed the Amargosa Gorge to off-road vehicle use.

10. Mohave chub, Gila bicolor mohavensis.

Four of ten transplant operations have been successful, and the subspecies is felt to be reasonably secure. Operation of the Zzyzx Springs population is now in the hands of BLM, and this former resort area may be used by the State College and University System for teaching and research purposes. Jim St. Amant is coordinating recovery efforts for this subspecies.

11. Owens pupfish, Cyprinodon radiosus.

Phil Pister will continue with the program currently underway to establish the species in areas throughout its former range. The California Department of Fish and Game and the Inter-Agency Committee on Owens Valley Land and Wildlife are negotiating for the acquisition of privately held land within Fish Slough, the location of the Owens Valley Native Fish Sanctuary. The Owens Valley Native Fish Sanctuary is already designated as an ecological reserve. Other populations in the northern Owens Valley will continue to be monitored.

12. Tecopa pupfish, Cyprinodon nevadensis calidae.

On February 11, the day following the Death Valley System Committee meeting, a group of us met with a landowner in the Tecopa area who is very interested in desert fishes and the welfare of this subspecies in particular. He showed us an area where a relict population may still exist, and we shall collect from there at the earliest opportunity. Because the area is heavily overgrown, collecting with nets was impossible. Traps will be used during the next collecting effort, and the collection (if we are successful) will be sent immediately to Bob Miller at the University of Michigan for taxonomic studies. Further recovery operations will be dependent upon Bob's determinations. If they are positive, immediate action will be taken to assure the preservation of an adequate gene pool. Phil Pister will coordinate this effort.

13. Cottonball Marsh pupfish, Cyprinodon milleri.

There has been no known change in the status of this species. Population numbers and habitat conditions will be monitored by Pete Sanchez.

14. Saratoga Springs pupfish, Cyprinodon nevadensis nevadensis.

The population at Saratoga Springs remains stable and, if the integrity of the aquifers supplying the springs can be retained and no exotic fishes are introduced, the subspecies should remain safe. Pete Sanchez will continue to monitor the situation.

15. Amargosa pupfish, Cyprinodon nevadensis amargosae.

This subspecies is apparently well established throughout the Amargosa River within California, with substantial populations noted in the area near Tecopa at the head of the Amargosa River Gorge. More detailed information will be obtained during the April field survey described under Rhinichthys osculus subsp., which Phil Pister is coordinating.

16. Salt Creek pupfish, Cyprinodon salinus.

There has been no known change in the status of this species. The National Park Service is planning to improve interpretive facilities in the current viewing area, including walkways designed to minimize impact on the surrounding terrain. Pete Sanchez will continue to monitor the Salt Creek population.

17. Owens sucker, Catostomus fumeiventris.

This species is widespread in the upper Owens River system in and above Crowley Lake and appears to be in no danger. However, geothermal exploration is planned for that general area, and this poses something of a threat from several standpoints to the aquatic ecosystems. Phil Pister will monitor this general area.

Other items discussed during the meeting included:

A. New developments in the interstate water picture relative to the Amargosa River system.

A task force headed by the California Department of Water Resources is concerned over the possibility that extensive groundwater development in Nevada may ultimately exert a detrimental, and irreversible, effect on California ecosystems, including those within Death Valley National Monument. The Council shares this concern. On February 7 I made a presentation before this group, outlining the basic resource and voicing our general views on this matter, the initial effect of which is already apparent in Ash Meadows. As a result of this presentation the matter will be brought to a higher administrative level as an initial step toward funding studies which will become a necessary part of any interstate litigation which may ultimately occur.

B. The problem of Gambusia affinis within Death Valley National Monument.

Mosquitofish are currently widespread within Furnace Creek and the water systems associated with Scotty's Castle in the northern portion of the monument. This is undesirable from two major aspects: 1) the presence of an exotic species within the monument is in conflict with Park Service policy, and 2) the continued presence of mosquitofish poses a constant threat from the standpoint of possible introduction by tourists into waters containing native fishes.

It was the group's consensus that the mosquitofish should be removed. Consequently, on Wednesday, February 12, Gary Ponder, Pete Sanchez, and I toured both Furnace Creek and Scotty's Castle areas. The initial step in the eradication program is planned for June, when an effort will be made to remove Gambusia from the Scotty's Castle area. This work will be conducted within the administrative policies of both the National Park Service and California Department of Fish and Game and will be performed only following a careful biological inventory designed to assure the protection and preservation of all other life forms within the waters involved.

C. Possible involvement in the forthcoming national meeting of the American Fisheries Society and International Association of Game, Fish, and Conservation Commissioners.

A phone call from Bob Miller during the February 10 meeting indicated that the Council has been given the opportunity to present a 1½ hour symposium concerning the conservation of desert fishes. General guidelines were discussed during the meeting, and details were refined later that evening. A draft agenda has been formulated and sent to Bob Miller for his comments. It seems wise to use a highly visual approach to the subject and to present the various phases of desert fish conservation as interestingly as possible. In summary, we feel that the components of the symposium should include a broad overview, a specific case history of a preservation project, a general look at an area outside the Death Valley System (the DV System will be covered in the overview), and a view of some of the more intriguing research aspects.

The next meeting of the Death Valley System Committee will be held early in 1976.

NOTE: Following the typing of this manuscript I received a letter from Bob Liu and Dave Soltz relative to a number of items discussed at the meeting, plus a summary of their observations during a field trip on the following day (February 11). Because of the relevance of these matters, I am including their letter in the appendix along with a list of participants in the meeting.

UNIVERSITY OF CALIFORNIA, LOS ANGELES

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DEPARTMENT OF PATHOLOGY
SCHOOL OF MEDICINE
THE CENTER FOR THE HEALTH SCIENCES
LOS ANGELES, CALIFORNIA 90024

February 19, 1975

E.P. Pister
Desert Fishes Council
407 W. Line Street
Bishop, CA 93514

Dear Phil:

This is to summarize some of the points brought up by Dave and myself at the 10 February meeting in Death Valley to review the Status of Death Valley System Fishes.

1. We want to strongly emphasize the need to periodically sample the various populations of desert fishes, especially pupfishes, so that any changes in the populations through time can be monitored and thereby detected. As with any problems with legal ramifications, it is necessary to know the status of a population prior to any changes. We feel it is safe to make these periodical samples because of the inherent ability of most desert fishes, especially pupfishes, to rapidly repopulate their habitats. In many of these habitats, the natural annual mortality(due to dessication, predation, etc.) is so large that small samples removed for study would be insignificant in comparison. The interval and size of the samples involved should be based upon the individual habitats involved, but should not be taken less than annually.

This ability of desert fish populations to rapidly repopulate must be kept in mind when the size of transplant populations are considered, since an initial transplant population that is too small merely lessens the chance of a successful transplant and may represent too limited a sample of the original population's genome, and with it possible, subsequent harmful effects.

It should be the part of each recovery team's plan to have provisions for such sampling. These preserved samples should be maintained at easily accessible site(s) where good curatorial procedures prevail.

2. In line with the above suggestion for periodical study samples, there should be a general easing and clarification of procedures for researchers to collect and work with desert fishes. Much of the above discussion pertains to this point.

3. On 11 February we visited Crystal Pool and found large populations of pupfish, mollies and gambusia, but no apparent sign of bass. However, we noted flow into the spring from habitats containing C.n.pectoralis, therefore we are uncertain whether the pupfish in this spring are mionectes or pectoralis(or intergrades?). A collection should be taken and sent to Dr. Robert R. Miller for identification.

4. On the same day we observed the transplanted diabolis population at Purgatory Spr. for about an hour. Most of these fish were definitely larger than the maximum natural size for this species and many were mis-shapen, with abnormally large abdomens. We propose that if no further work is to be done with this population, the entire population should be removed and preserved, because there is no apparent successful reproduction and the transplants represent a unique situation with regards to size and morphology. Since this habitat is now partially shaded(which was not the case at the time of original transplant), newly introduced diabolis protected from the possible harmful effects of prolonged, direct sunlight may then be able to successfully reproduce and become established. Thus, if another transplant were to be made, it should be closely followed

and monitored from the inception of the introduction, since extant transplants have not been so treated and it is of obvious scientific value to have such information. In this same vein, the Hoover Dam Refugium should be studied as soon as possible, as it is the sole succesful introduction of diabolis.

It was good to see you again and both of us felt the meeting was extremely worthwhile.

Sincerely,

Robert K. Liu, Ph.D
Dept of Pathology
Univ of California
Los Angeles, CA 90024

David L. Soltz, Ph.D.
Biology Dept
California State Univ
Los Angeles, CA 90032

# APPENDIX II

## Attendance List, Death Valley System Committee Meeting, Furnace Creek Inn, February 10, 1975

| Name | Address | Affiliation |
|---|---|---|
| Tilly Barling | Code 7080, Naval Weapons Center<br>China Lake, CA 93555 | Naval Weapons Center |
| Greg Berry | 800 Truxton<br>Bakersfield, CA 93301 | BLM |
| Vern Bleich | Route 5, Bird Farm Road<br>Chino, CA 91710 | CDF&G |
| Robert L. Borovicka | 729 N. E. Oregon Street<br>Portland, OR 97225 | BLM (9B)<br>Portland, OR |
| Allen Cooperrider | 1695 Spruce Street<br>Riverside, CA 92506 | BLM |
| Jim & Maxine Deacon | 2772 Quail<br>Las Vegas, NV 89109 | UNLV |
| Woodroe Dulin | 1818 Industrial Road<br>Las Vegas, NV 89102 | Valley Elec. Assn. |
| Dean R. Garrett | P. O. Box 73<br>Shoshone, CA 92384 | NPS |
| Tim Hafen | Pahrump, NV 89041 | Pahrump Rancher<br>Valley Elec. Assn. |
| Bill Hoeft | 2800 Cottage Way, Room 2844E<br>Sacramento, CA 95825 | BLM<br>CA State Office |
| Gail C. Kobetich | P. O. Box 830<br>Parker, AZ 85344 | USFWS |
| Phil Lehenbauer | P. O. Box 3737<br>Portland, OR 97208 | US Fish & Wildlife Svc. |
| Robert Liu | Dept. of Pathology, UCLA<br>Los Angeles, CA 90024 | UCLA |
| Dale V. Lockard | Box 10678<br>Reno, NV 89510 | Nevada Fish & Game |
| Bob Love | P. O. Box 3927<br>Fullerton, CA 92634 | Ash Meadows |

| Name | Address | Affiliation |
|---|---|---|
| Steve Nicola | 1416 Ninth Street<br>Sacramento, CA 95819 | Dept. of Fish & Game |
| Chuck Osborn | Box 16000, Federal Station<br>Las Vegas, NV 89101 | USFWS |
| Gary Ponder | 407 West Line Street<br>Bishop, CA 93514 | CDF&G |
| Dick Rayner | Death Valley National Monument<br>Death Valley, CA 92328 | NPS |
| Pete Sanchez | Death Valley National Monument<br>Death Valley, CA 92328 | NPS |
| David L. Soltz | Dept. of Biology, Cal State<br>Los Angeles, CA 90032 | Cal State, LA |
| Orville Spear | 1818 Industrial Road<br>Las Vegas, NV 89102 | Valley Elec. Assn. |
| James B. Thompson | Death Valley National Monument<br>Death Valley, CA 92328 | NPS |
| Ralph Young | 350 Golden Shore<br>Long Beach, CA 90802 | CDF&G |
| James St. Amant | 350 Golden Shore<br>Long Beach, CA 90802 | CDF&G |
| Phil Pister | 407 West Line Street<br>Bishop, CA 93514 | CDF&G |

# Status Report - Warm Springs Pupfish

A Recovery Team for the Warm Springs Pupfish (WSP) (Cyprinodon nevadensis pectoralis) was appointed at the first of this year. Members are:

Dale Lockard - Nevada Department of Fish and Game (Asst. Team Leader)
Cal Allen - Nevada Department of Fish and Game
Jim Deacon - University of Nevada at Las Vegas
Chuck Osborn - Fish and Wildlife Service
Jim Yoakum - Bureau of Land Management (Team Leader)

The Recovery Team first met April 2 and 3, 1975. A field trip was made to Ash Meadows, and all known habitat of the WSP was visited and evaluated. Discussions resulted in the first draft of parts of the Recovery Plan.

A second Recovery Team meeting was held May 29, 1975. The proposed Recovery Plan was reviewed, modified, and updated with 70% completed.

A third Recovery Team meeting was held November 12, 1975, when the draft Recovery Plan was again reviewed and updated. The services of an advisor were considered to assist in gathering data for the Recovery Plan.

Goals of the Recovery Team were also established and are as follows:

1. Complete Recovery Plan, through to official approval no later than June 1, 1976.

2. Initiate implementation of the Recovery Plan by:

   a. Studies and documentation of population status.

   b. Initiating withdrawal of public lands classified as "Critical Habitat".

   c. Initiating action to perpetuate waters to maintain fish.

   d. Drafting a leaflet on the objectives and goals of this Recovery Team for public distribution.

James F. Yoakum
Dec. 3, 1975

IN REPLY REFER TO:

6840
(N-043)

# United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Ely District Office
Pioche Star Route, Ely, Nevada
89301

February 6, 1975

Mr. Phil Pister
407 W. Line Street
Bishop, California 93514

Dear Mr. Pister:

On January 21, 1975, LeRoy McLelland (NF&G Fisheries Biologist from Ely) and I visited Shoshone Ponds to investigate the endangered fish in one of the ponds. Earlier reports had indicated that the fish in the middle pond were much larger than our information indicated. We suspected that maybe some other species of fish might have gotten introduced in the pond. The endangered fish that was introduced into this pond was the Pahranagat Bonytail (Gila Robusta). Our information indicates that these fish are normally less than 6-1/2" long. We seined the pond two times and captured seven fish each time.

| Number 1 Seine | | Number 2 Seine | |
|---|---|---|---|
| Number of Fish | Length | Number of Fish | Length |
| 5 | 9" | 6 | 9" |
| 1 | 10" | 1 | 8" |
| 1 | 8-1/2" | | |

As you note we measured these fish to the nearest one-half inch, because it was too cool to spend a great deal more time for accuracy.

Other observations we made were that two of the fish in Number 1 Seine appeared to be swollen with eggs, and all the fish had bright ventral red coloring, possibly spawning colorations.

These fish spawn in moving water and in the 1976 Annual Work Plan we have planned to develop some moving water spawning habitat. I have discussed this plan with Dr. Deacon and NF&G.

As I find new information on our endangered desert fishes, I will relay it to you.

Sincerely yours,

Wayne D Logan

Wayne D. Logan
Wildlife Biologist

# 1975 Status Report on the Devil's Hole Pupfish, *Cyprinodon diabolis*, at the Hoover Dam Refugium

Jack E. Williams, Department of Biological Sciences
The University of Nevada, Las Vegas

It is a pleasure to appear before this symposium and present you with the status report on the Devil's Hole pupfish population at the Hoover Dam Refugium. As you may know, I am a relative newcomer here at the Desert Fishes Council. At present, I have just begun on my thesis research on the refugium population. Therefore, my present data are quite limited. However, today I would like to present some of the more recently derived information at the refugium while informing those here today with my future prospects of investigation.

As you are well aware, since the establishment of the refugium population of *Cyprinodon diabolis* on 2 October 1972, there has been a sparse amount of investigation undertaken at this site. Fortunately, Herb Guenther, of the Bureau of Reclamation, has taken an active interest in this fish and has maintained surveillance on the refugium whenever possible. Hopefully, I will be able to conduct an intensive surveillance of the refugium, as this is essential to the requirements for maintaining a viable population in light of the need to monitor temperature and flow rates in accordance with the fishes' needs.

Along with maintenance of the refugium, I intend to obtain data of ecological significance, such as bioenergetics, population dynamics, and so forth. However, I plan the main thrust of my research to be aimed at the changes in morphological and meristic characters of *Cyprinodon diabolis* which may have been brought about since the pupfishes' establishment in the refugium slightly over three years ago. Apparently, some of their characteristics have changed during this time, and I feel that the evolutionary aspects of this phenomena cannot be overlooked, nor can the biochemical parameters which have initiated the changes. With this in mind, perhaps next year I will have more and varied statistics to present to you.

However, I presently do have some data which I feel is of interest. I would, at this time, like to briefly summarize the population count data which have been collected over the past few years to familiarize you with the population trend.

| | |
|---|---|
| 29 January 1973 | total fish-84 |
| 29 April 1973 | total fish-171 |
| 27 July 1973 | total fish-166 |
| 8 November 1973 | total fish-184 |
| 14 March 1974<br>0 juveniles<br>Adult sex ratio 1.47 M : 1.00 F | total fish 194-204<br>1 larva |

6 November 1974 — total fish 110-117
3 juveniles — 0 larva
Adult sex ratio 1.45 M : 1.00 F

18 October 1975 — total fish-62
9 juveniles — 2 larvae
Adult sex ratio 2.92 M : 1.00 F

Two rather striking points are brought to our attention by this set of data. One, Cyprinodon diabolis is at one of its lowest recorded population densities within the refugium; and two, our population counts have been few and far between. Hopefully, beginning with this October's count, I will be able to conduct monthly counts thereby obtaining more substantial data.

Despite the count of 62 fish which we obtained on 18 October 1975, the population did appear to be exhibiting a healthy appearance. Just prior to the last count, nightly ambient air temperatures were dropping quite radically. Upon our initial examination of the refugium on 18 October, we found the water temperature to be 26.8 C (80.3 F), one of the lowest temperatures ever recorded in the refugium. At this unusually low temperature we found the entire population, with the exception of five juveniles, to be schooling at the deep end of the refugium. Upon increasing the flow rate, and thereby raising the water temperature to the more acceptable level of 30.0 C (86.0 F), the fish began dispersing throughout the refugium. The two larvae which we observed on 18 October were approximately three days old. This then, represents successful reproduction at relatively low temperatures.

On 9 November 1975 an examination of the introduced hydrobiid snail, Tryonia, was conducted by Jerry Landye, Sue Morgensen, and myself. Results showed that the hydrobiid had become established and was reproducing within the refugium. The abundance of Tryonia was described as "common to rare". Also on 9 November I observed the exuviae of a large species of dragonfly. This apparently indicates the first known predator on Cyprinodon diabolis in the refugium.

Recently, we have also noticed an individual, a large male, which exhibited a bug-eyed characteristic. Most probably this is caused by a parasite which is as yet unidentified.

Now I can intensify my observations and subsequent investigations of this unique population. The pupfish refugium represents a very valuable resource, not only in terms of scientific investigative ramifications, but perhaps more importantly, in terms of the long-term survival of this species and perhaps other endangered fauna.

# ATTENDANCE LIST, SEVENTH ANNUAL SYMPOSIUM
# DESERT FISHES COUNCIL
# Death Valley National Monument
# November 13-14, 1975

| NAME | AFFILIATION |
|---|---|
| Tilly Barling | Naval Weapons Center, China Lake |
| Jonathan A. Baskin | Cal. Poly Univ., Pomona, CA |
| Bruce and Donna Besskin | USNPS, Shoshone, CA |
| Fred Bills | OSU, Corvallis, OR |
| Carl E. Bond | OSU, Corvallis, OR |
| Martin R. Brittan | Calif. State U., Sacramento, CA |
| Lou Carufel | USFS, Redding, CA |
| Osborne Casey | BLM, Reno, NV |
| Al Castro | Steinhart Aquarium, San Francisco, CA |
| Charles Chester | Tri-City Aquarium Soc., Colton |
| Emma Chester | Tri-City Aquarium Soc., Colton |
| Frances Clark | La Jolla, CA |
| Richard Conover | ASU, Tempe, AZ |
| Salvador Contreras-Balderas | Univ. Nuevo Leon, Monterrey |
| Candia Coombs | OSU, Corvallis, OR |
| James Cooper | Desert Research Inst., UN, Reno |
| Jim and Maxine Deacon | UN, Las Vegas, NV |
| Mary DeDecker | Independence, CA |
| Robert Feldmeth | Claremont Colleges, Pomona |
| Mary Gilbert | ASU, Tempe, AZ |
| Herb Guenther | US Bur. Rec., Boulder City |
| Joanne Hankins | Sonora, CA |
| John Hiscox | Cal. Fish and Game, Oroville, CA |
| Kaaren Hiscox | Butte Co. Mosq. Ab. Dist., Oroville, CA |
| Kevin M. Howe | OSU, Corvallis, OR |
| Carl L. Hubbs | Scripps Inst., La Jolla, CA |
| Laura C. Hubbs | Scripps Inst., La Jolla, CA |
| F. H. Jacot | USNPS, San Francisco, CA |
| James Johnson | BLM, Arvada, CO |
| Bill Kepner | ASU, Tempe, AZ |
| Terrel F. King | BLM, Bakersfield, CA |
| Dave Koch | Desert Research Inst., UN, Reno |
| J. A. LaBounty | US Bur. Rec., Denver, CO |
| J. Jerry Landye | ASU, Tempe, AZ |
| Jerry Lockhart | UN, Las Vegas, NV |
| Clinton Lostetter | USFWS, Portland, OR |
| Bob Love | Fullerton, CA and Ash Meadows |
| Lou Mannatt | Inyo Co. Health Dept., Independence, CA |
| Bruce May | Utah Div. Wildlife Res., Cedar City, UT |
| Alan McCready | Sacramento, CA |
| Randy McNatt | ASU, Tempe, AZ |
| Martin Meed | U.N., Las Vegas, NV |
| Frances H. Miller | U. Michigan, Ann Arbor |
| Robert R. Miller | U. Michigan, Ann Arbor |
| Robert Minckley | ASU, Tempe, AZ |

| NAME | AFFILIATION |
|---|---|
| W. L. Minckley | ASU, Tempe, AZ |
| Sue Morgensen | ASU, Tempe, AZ |
| James L. Reveal | Univ. Maryland and Smithsonian Inst. |
| John W. Rinne | RR#1, Burchard, Nebraska |
| John M. Salevwaakis | Cedar City, UT |
| Douglas Selby | U.N., Las Vegas, NV |
| Sydney Shafroth | Nature Conservancy, San Francisco |
| Joy Shrode | ASU, Tempe, AZ |
| Darrell Siebert | ASU, Tempe, AZ |
| David L. Soltz | Cal. State Univ., L.A. |
| Wayne Southwick | Phoenix, AZ |
| Jerry Stefferud | USFS, Lone Pine, CA |
| Royal D. Suttkus | Tulane Univ., New Orleans |
| Brenda Wales | OSU, Corvallis, OR |
| J. H. Wales | OSU, Corvallis, OR |
| Mel Wilhelm | BLM, St. George, UT |
| Chuck Williams | Friends of the Earth, Petaluma, CA |
| Jack Williams | UN, Las Vegas, NV |
| James Williams | USFWS, Washington, D.C. |
| Ken Williams | ASU, Tempe, AZ |
| Darrell Wong | Calif. Fish & Game, Blythe |
| Jim Yoakum | BLM, Reno, NV |

# EIGHTH ANNUAL SYMPOSIUM

Ramada Inn

Grand Junction, Colorado, November 18-20, 1976

## PREFACE

The selection of Grand Junction, Colorado, as the 1976 meeting location reflects the policy of the Council to hold even-year meetings in suitable locations throughout the Great Basin and odd-year meetings in Death Valley, where the initial meeting was held in 1969.

The Council members are grateful for the hospitality extended by the City of Grand Junction and Coloradans generally for their part in making the symposium successful and the visit to Colorado a very pleasant one.

## Thursday, November 18

A welcome to the symposium was given by Robert Raleigh of the Western Energy and Land Use Team, Fort Collins. Following Dr. Raleigh's welcome and a series of announcements by program chairman Phil Pister of the California Department of Fish and Game, the symposium proceeded as follows:

## SESSION I - Research

Chairman: Dr. James D. Williams, U.S. Fish and Wildlife Service, Washington, D.C.

### Dynamics of the Transplanted Population of *Cyprinodon diabolis* in the Hoover Dam Refugium, Clark Co., Nevada

Jack E. Williams, University of Nevada, Las Vegas

ABSTRACT

In October 1972 a multiagency effort at establishing a second population of the endangered Devil's Hole pupfish, *Cyprinodon diabolis*, was initiated with the transplanting of 27 fish into a refugium below Hoover Dam, Clark County, Nevada. From October 1975 through October 1976 the first concentrated effort at examining the dynamics of this transplanted population was undertaken. Four generations of pupfish have now been produced in the refugium, establishing it as a second population of the fish. Population fluctuations correspond well with those noted in the fish's original habitat, Devil's Hole, with the highest numbers occurring in late summer and lowest levels in midwinter. Morphometric measurements showed an increase in standard length in the fish in the transplanted population, as well as significant differences in four of six other measurements taken. Meristic data, appearing less susceptible to change, showed insignificant variation between the transplanted and Devil's Hole populations.

## Update on the use of cyprinodont fishes in mosquito control

Kaaren Hiscox, Butte County Mosquito Abatement District, Oroville, CA

From: Journal of the American Killifish Assoc. and Killie Notes, Vol. 9, No. 3.

NOTE: Entire paper reproduced in Journal of American Killifish Assoc., July 1976, Vol. 9, No. 7.

Kaaren Hiscox, Butte County Mosquito Abatement District, Oroville, California, stated that she had attempted to use South American annual killifish to control mosquito populations in the rice fields of Butte County but had very limited success. A change in study animal was indicated so she switched to the desert pupfish, Cyrpinodon macularius. This worked much better but still did not fit the bill because Cyp. macularius was felt to be not quite cold hardy enough. A further switch carried her research to the Owens pupfish, Cyprinodon radiosus. This is working out splendidly and may well be used in large scale operations in the near future. (An interesting side note to this report is that Cyprinodon radiosus was considered extinct until 1964 when a small population was rediscovered. Careful management by several D.F.C. members has brought this fish to a point where it can be made available for this type of study.) Kaaren also gave a brief report on work that is being done in Lake County, California, along similar lines. Lake County Mosquito Abatement District is attempting to find a pupfish that will live in a high borax concentration which will then be used to combat biting black flies. At present they are working with Cyprinodon macularius (but that species has problems adapting to concentrations of over 150 ppm borate, while the lake in question has concentrations of 80-500 ppm borate) and have applied for a permit to use Cyprinodon milleri which naturally occurs in high concentrations of borate but is on the California rare list.

This talk was very important as it pointed out a readily understandable value to pupfish that should impress even non-ecology minded people.

## Observations of Pahrump killifish with Special Reference to Thermal Ecology

Douglas Selby, University of Nevada, Las Vegas
and U.S. Fish and Wildlife Service

Preliminary studies of the Pahrump killifish, Empetrichthys latos latos Miller, show that this fish has a wide thermal tolerance when subjected to seasonal variations in water temperature. Populations at the University of Nevada, Las Vegas, Latos Pool, and the horse trough at Corn Creek have undergone the full seasonal range of temperatures in these various habitats without supplemental heating or cooling. Recorded minimum temperature for the killifish is 4 C in the horse trough with an ice cover. At lower temperatures diurnal activities are depressed with little swimming activity observable.

Maximum thermal tolerances and temperature preferences are in the process of being determined. Tests of dissolved oxygen tolerance are also planned along with distributional studies in Corn Creek Pond on the Desert Game Range. A different response to light has also been noted for young and adult fish resulting in a spatial separation of these groups.

## Some Problems with Texas Pupfishes

Anthony A. Echelle

Six species of pupfishes (Genus Cyprinodon) occur in Texas. Two species, the Leon Springs pupfish, C. bovinus, and the Comanche Springs pupfish, C. elegans, are considered to be endangered. Each of these species is presently restricted to a single spring system in southwest Texas. The endangerment of both species results primarily from two agents: (1) a continually dropping water table resulting in declining spring flow and (2) hybridization with introduced populations of C. variegatus. The latter is viewed as an immediate danger with the potential to destroy the integrity of the gene pools of the endemic species. Attempts to remove C. variegatus from the waters supporting C. bovinus have met with partial success, but the problem remains. The current status of the two species is put into historical perspective with a review of the zoogeography of the Pecos River pupfishes. In addition to C. bovinus and C. elegans, an undescribed species also occurs in the Pecos system. It is more widespread and may have resulted from genetic intermingling between original populations in the ancestral lower Pecos River and a C. rubrofluviatilis-like population. The latter was hypothetically transferred to the lower Pecos by a capture of a portion of an ancestral portion of the Colorado River of east Texas, creating the upper portion of the present Pecos River. Undoubtedly there was early reproductive contact between the three Pecos River pupfishes. Despite this, the three species are presently very distinct in breeding coloration and in meristic and morphometric characters. However, the present populations and ranges of C. elegans and C. bovinus are too small to allow for the development of ecological and reproductive segregation. It is only a matter of time until the introduced C. variegatus will become established in headwater areas where there are many pockets of favorable habitat. This will create considerable pressures for the endemic species. These include competition and hybridization and will most likely lead to the destruction of these very unique pupfishes.

## Systematic Studies of the Colorado River Chubs of the Genus Gila

Gerald R. Smith, Robert Rush Miller, W. Daniel Sable

Fishes of three species, the roundtail chub (Gila robusta), the bonytail (Gila elegans), and the humpback chub (Gila cypha), have been confused by recent workers, largely because of the lack of decisive, objective taxonomic evidence. Because two of these species are endangered, it is imperative that the relationships of the three species be understood and that their identification be accurately determined in population evaluations and ecological studies.

Multivariate analysis shows these species to be clearly separate, but parallel evolution in the unique big-river habitat, allometric growth of the abrupt dorsal profile of two of them, and occasional hybrids among the three species, have produced some gradation in key characters. New characters are incorporated in our studies that enable separation, of juveniles as well as adults, at the species level.

Gila robusta is the most widespread (occurring well south of the Colorado River basin in northwestern Mexico), least specialized, and least vulnerable of the three. Gila elegans and G. cypha are most specialized in response to the hydrodynamically and trophically demanding environment of the Colorado Plateau drainage. They are also the species most vulnerable (especially the bonytail) to cultural environmental change.

Important refuges for these fishes occur in the lower Yampa and Green rivers in Dinosaur National Monument and in the Colorado River and its major tributary, the Little Colorado River, in Grand Canyon National Park. It is essential for the survival of these and other endangered and/or threatened Colorado River fishes that their habitats be maintained in a condition suitable for them. Designating these two habitats as essential critical habitats for the humpback chub will place legal constraints upon any cultural perturbations in their environment.

## Effects of Constant and Fluctuating Temperatures on Reproductive Performance of a Desert Pupfish, Cyprinodon n. nevadensis[1]

Joy B. Shrode[2] and Shelby D. Gerking
Department of Zoology, Arizona State University

### Introduction

Upper and lower lethal temperatures have been used as a criterion of survival for many species of fish. However, fish rarely encounter lethal temperatures either in nature or in areas of thermal pollution. This observation, coupled with the fish's ability to avoid extreme temperatures, leads us to believe that the outright elimination of local populations from thermal death is rare. Temperature affects all life processes, and survival of populations depends on their response to a range of temperatures well within the lethal limits. Therefore, we have chosen to examine the range of temperatures over which reproduction can be successfully accomplished, because survival of populations depends on their ability to reproduce. We have called this study reproductive temperature tolerance.

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[1]The research was conducted under contract E(11-1)-2493 of the Energy Research and Development Agency (ERDA). The authors thank Ray Lee and Sandy Gerbitz for their technical help.

[2]Present address: Dept. of Biology, Occidental College, Los Angeles, CA 90041.

The effects of various constant and daily fluctuating temperature regimes on reproductive performance have been investigated in a eurythermal fish, the Amargosa pupfish, Cyprinodon n. nevadensis. This species occurs in the drainage system of the Amargosa River extending from southern Death Valley, California, to the southwestern border of Nevada. We chose the Amargosa pupfish as an experimental animal because it is hardy in the laboratory, it breeds over the whole year, and the females release their eggs individually. Thus, the pupfish provides us with the advantage of year-round observations and an unusual measure of reproductive effort, i.e., eggs laid per unit time.

The genus Cyprinodon has attracted attention because it is widely distributed throughout the deserts of the southwestern United States and several of its species are endangered. The critical thermal maximum (CTM), or short-term temperature tolerance, of adult pupfish from several springs and marshes from Arizona and the Death Valley region has been determined: C. macularius (Lowe and Heath 1969), C. nevadensis, C. salinus and C. diabolis (Brown and Feldmeth 1971) and C. milleri (Otto and Gerking 1973). Studies have also been conducted on the production of a pupfish population (C. nevadensis amargosae) in a thermal stream (Naiman 1976), social organization and life history (Soltz 1975), and temperature effects on growth and metabolic efficiency in C. macularius by Kinne (1960) and in C. n. nevadensis by Raush (1976). The effect of temperature on development rate and upper and lower limits for egg incubation have been determined under constant temperature conditions for C. macularius (Kinne and Kinne 1962), C. rubrofluviatilis (Echelle, Hubbs, and Echelle 1972) and under constant and daily cycling temperatures in C. n. nevadensis (Shrode 1975).

Several conclusions have emerged from our research. First, the temperature range for successful reproduction is narrower than the upper and lower critical thermal limits by a considerable margin. Next, our results show that the upper and lower thresholds (about 24-32 C) for optimum egg production parallel the temperature range for successful hatching (about 24-30 C). Also, the maximum daytime temperature for egg production under fluctuating temperature regimes is slightly greater than the maximum achieved under constant temperature conditions. Last, the design of our experiments revealed that oogenesis is the most temperature sensitive phase of the life cycle, whereas eggs and larvae have heretofore been viewed as the most sensitive stages.

## Materials and Methods

A breeding stock of Cyprinodon n. nevadensis was collected from the marsh of Saratoga Springs, Death Valley National Monument, California. A breeding pair from the field stock produced the sibling $F_1$ parental stock. Breeding pairs of this sibling parental stock were placed in 17, 20-liter aquaria separated by a perforated clear plastic divider which was removed for 30 minutes daily to allow spawning. Eggs were laid on a yarn mop from which they were removed and incubated in petri dishes. These $F_2$ sibling fish became the experimental stock.

Breeding pairs, eggs and larvae were maintained at 28 C under a photoperiod of 16L 8D with incandescent and flourescent lights. Fish were fed commercial fish food and brine shrimp daily.

Reproductive performance tests were conducted with the $F_2$ fish at age four to five months. For each test, males and females were acclimated at least 21 days to the test temperature in separate tanks. Breeding pairs were then placed in divided 20 1 aquaria in a controlled environment chamber which maintained the test temperature within 0.5 C and a photoperiod of 16L 8D. After a three day adjustment period, the divider was removed from each aquarium at 0800 hr for 30 minutes each day for 21 days to allow spawning. Egg laying was completed within the half-hour period; if the female was not ready to spawn, she swam toward the surface as the male approached. Eggs were collected from spawning mops, the yolk diameter was measured with an ocular micrometer at the two- to eight-cell stage along the axis perpendicular to the animal-vegetal pole. Eggs were then counted and placed in petri dishes in controlled environment rooms for incubation.

On the 22nd day, before spawning, female fish were weighed and measured (total length). The ovaries were removed, weighed, and preserved in Gilson's fluid.

Reproductive tolerance experiments were conducted at constant temperatures 18, 20, 22, 24, 26, 28, 30, 32, 34, and 36 C and at daily fluctuating temperatures 24-16, 32-28, 36-28, 38-28, and 39-30 C. The low temperature occurred at 0800 hr and the peak at 2000 hr (Figure 1). Spawning occurred at the lowest temperature of the cycle. In natural situations spawning occurs early in the morning, at the lowest temperature period, in warm months (Soltz 1974). All tests were conducted between March and October.

Thermal tolerance of adult fish was determined as the critical thermal maximum (CTM). CTM tests were conducted on male fish from the reproductive tolerance tests. At the termination of the reproductive experiments, the males were transferred to 22 1 test tanks at the acclimation temperature. At 1000 hr the next day, the temperature was increased 0.3 C/min with a 600 watt thermostatically controlled heater. The temperature at which each fish appeared to lose equilibrium was recorded; the mean represented the CTM.

Results from reproductive tolerance tests were analyzed in a one-way analysis of variance with log transformation of all egg production data, except proportional measurements, to remove the dependence of the standard deviation on the mean.

## Results

An attempt was made to use fish within as small a size range as possible for the reproductive tolerance test; however, during acclimation and testing, fish at intermediate temperatures, 28 and 30 C, grew faster and were slightly larger by the end of the test period (Table 1). In a control experiment, egg production of 57 four and five-month old fish ranging in weight from 0.31 to 1.45 g ($x = 0.78$, $SD = 0.22$) and TL from 28 to 42 mm ($x = 34$, $SD = 3$) was monitored for three weeks at 28 C. Within this size range there was no correlation between body weight and percentage of days on which eggs were laid ($r = 0.16$, $r^2 = 0.03$, $P = 0.2$), eggs per spawning ($r = 0.02$, $r^2 = 0.00$, $P = 0.9$), or mean number of eggs laid per day ($r = 0.07$, $r^2 = 0.00$, $P = 0.6$).

At test temperatures 24 through 34 C, males were in vivid breeding color with bright blue sides, yellow forehead, and strong black bands on posterior margins of anal, caudal and dorsal fins (see Table 2 for male lengths and weights). They immediately began pursuing females when the divider was removed and maintained their interest throughout the allocated spawning period. At 22 C both male and female were often hidden under the spawning mop. Occasionally both would swim around and at times the males chased the females. Males were in pale breeding color except one which was medium blue. At 20 C pale breeding colors were seen only on one male; the others showed no breeding coloration. All activities were slow at 20 C; the fish often remained on the bottom or hidden in the mop and showed little interest in each other. At 36 C the color of the males was usually very pale, but they pursued the females vigorously.

There was no pattern to the sequence of days on which spawning occurred, or in the sequence of number of eggs per spawning at any test temperatures. The proportion of days on which eggs were laid ranged from 2 percent at 36 C to 72 percent at 30 C, with a mean of 38 percent (Figure 2). At 28 C eight of twelve females laid eggs at least two-thirds of the days. At 30 C seven of ten females spawned at least two-thirds of the time and four fish missed two or less days out of 21. Differences between temperatures in the porportion of days on which eggs were laid were significant in an analysis of variance test with arcsin transformation of data ($F = 4.3$ with 14 and 134 df; $p<0.01$). Performance was optimum at constant temperatures 24 through 32 C and fluctuating regimes 32-28 and 36-28 C.

The number of eggs per spawning was also affected by temperature. An analysis of variance on log transformed data was highly significant ($F = 9.7$ with 14 and 134 df; $P<0.01$). The mean number of eggs per spawning for all temperatures was four and the maximum was ten at 30 C (Figure 3). The number of eggs per spawning was greatest at constant temperatures 24 through 32 C and at fluctuating temperatures 32-28 and 36-28 C.

The number of eggs laid per gram of female weight per day followed a pattern similar to that of number of eggs per spawning (Figure 4). An analysis of variance on log transformed data was highly significant ($F = 14.8$ with 14 and 134 df; $P<0.01$). The range of temperatures at which egg production per gram body weight was greatest was for constant temperatures 24 through 32 C and for fluctuating temperatures 32-28 and 36-28 C. Production dropped sharply above and below these temperatures.

When egg production among the first, second and third week of each constant temperature experiment was compared, no significant differences were observed at 20, 22, 26, 28, and 30 C. At 24 and 32 C, the third week was better than the second, which in turn was better than the first (analysis of variance, $F = 6.1$ with 2 and 27 df; $P<0.01$). At 34 C the order was second, third and first ($F = 7.8$ with 2 and 21 df; $P<0.01$).

Egg production under a daily fluctuating temperature regime was comparable to egg production at the constant temperature equivalent to the mean of the fluctuating regime when the maximum or minimum temperature of the regime did not exceed the optimal constant range of 24 to 32 C (Figures 2, 3 and 4). However, at temperature regimes in which the peaks fell above or below this range, egg production was slightly reduced in comparison with performance at constant

temperature equivalent to the mean of the fluctuating regime. Performance was slightly better than that at the constant temperature equivalent to the maximum temperature of the fluctuating regime.

Ovary weights (Table 3) and number of yolked oocytes per ovary were determined at the end of each breeding experiment. High variation in both measures occurred at all but extreme temperatures. There was no indication of accumulation of eggs or of atretic eggs at any temperature.

The temperature at which fish were maintained affected not only the number of eggs produced, but also the quality. There was an inverse relationship between temperature and the yolk diameter of eggs; the differences in yolk diameters at the test temperatures were significant (analysis of variance; $F = 240.6$ with 8 and 1719 df; $P$ 0.01, Table 3).

A number of small, soft egg shells containing no yolk were produced at 32 C and above. These were not included in egg production or hatchability counts. They were not included in yolk diameter measurements which may explain the larger mean yolk diameters at these temperatures.

Eggs which were exposed to identical temperatures during oogenesis and incubation had greater than 50 percent normal hatch at test temperatures between 24 and 30 C and at 32-28 and 36-28 C (Figure 5). This corresponds to the optimum range for egg production, except at 32 C where egg production was high but hatching success was low. This range was much narrower than that for successful hatching of eggs which underwent oogenesis and were spawned at 28 C and then were transferred to test temperatures from 18 to 39 C. Under these conditions, greater than 50 percent normal hatch occurred at constant temperatures 20 through 36 C and at fluctuating temperatures 28-20, 36-28 and 38-30 C. The two hatching success experiments were conducted at different times and in different laboratories in the same building. The experiments where oogenesis and incubation were performed at identical temperatures were a part of the present series; those where the eggs underwent oogenesis and were spawned at 28 C, subsequently being transferred to test temperatures from 18 to 39 C, were a part of an earlier reported series (Shrode 1975). The lack of strict comparability of the two series of experiments probably accounts for the difference of 26 percent in the maximum hatching success obtained under optimal temperature conditions. On the other hand, the difference of about 70 percent at 20 C and at 32 C can be attributed to differences in experimental treatment, i.e., temperature during oogenesis. Thus, the tolerance limits for oogenesis were narrower than the range of temperatures for successful hatching of healthy eggs subjected to the temperature stress at an early stage (two- to eight-cell) of development.

The critical thermal maximum (CTM) was related to acclimation temperature (Figure 6). The highest CTM attained, at acclimation temperature 36 C, was 43.5 C. the critical thermal minimum for fish acclimated at 28 C was 4.5 C; at 20 C it was 2.8 C. The CTM of fish acclimated to cycling temperatures was near that of fish acclimated to a constant temperature equivalent to the peak of the cycle, with the exception of the low temperature acclimation cycle 24-16 C, where the response was similar to that of fish acclimated to the mean temperature, 20 C. The reproductive tolerance limits fell toward the upper end

of the acutely determined limits under which fish can escape unfavorable conditions.

## Discussion

Our results bear on four questions dealing with temperature tolerance. First, the limits for successful reproduction are narrower than either the limits for normal activity or for spawning. Second, the response to cycling temperature acclimation is different for successful egg production than it is for critical thermal limits. Third, acclimation temperature of the female during egg maturation affects the quality of the eggs. Fourth, we suggest that our results have some application to thermal problems concerning fish in general and possibly to other poikilothermal animals.

Although adult pupfish can exist under a wide range of temperature conditions (Feldmeth et al. 1974), our results show that the conditions for successful reproduction are much narrower. The highest constant temperature to which these fish were acclimated with negligible mortality was 38 C and the lowest temperature at which fish remain active was about 10 to 12 C. The critical thermal limits are about 2 and 44 C. The Amargosa pupfish produces eggs with limited hatching success in the laboratory between constant temperatures 22 to 34 C. Thus, as determined under constant temperatures, the fish breed over a range which is about one-half the activity range or about one-third the critical thermal tolerance range (Figure 7).

The temperatures at which most eggs were laid coincide with those at which successful hatch was greater than 50 percent, with the exception of 32 C. The optimum constant temperatures for egg production, with the greatest number of eggs spawned and greater than 50 percent hatching success, are from 24 to 30 C, or about one-fifth the activity range and one-seventh the critical thermal range. In spite of the fact that egg hatching was poor above 30 C, breeding coloration and spawning behavior occurred at much higher constant temperatures, up to 36 C. The limits for successful egg production were narrower than the limits at which spawning occurred.

Our laboratory results under fluctuating temperatures coincide with the temperature conditions under which reproductive behavior has been observed in nature. In the Amargosa River, which has both wide daily and seasonal thermal cycles, spawning by C. n. nevadensis was limited to temperatures between 18 and 35 C (Soltz 1974). In our study under chosen laboratory cycling temperature regimes, egg production and hatching were also observed at temperatures cycling up to 36 C.

Acclimation to cycling temperatures for successful reproduction apparently differs from that observed for critical thermal limits. It is generally found that poikilotherms acclimate to the maximum, or near maximum, of a cycle in their critical thermal response (fish, Brett 1944, Heath 1963, Feldmeth et al. 1974, Otto 1974; frogs, Hutchinson and Ferrance 1970). Our CTM responses for fish acclimated to cycling temperatures were similar.

However, under the cycling regimes utilized in this study, pupfish responded to a temperature between the extremes in terms of their reproductive performance.

For example, when egg production was monitored at 36-28 C the fish laid 3.8 eggs per gram per day, close to that at the mean temperature of 32 C (4.7 eggs per gram per day), but far greater than the number laid at 36 C (0.4 eggs per gram per day). The same was true at the low cycling regime. At 24-16 C eggs were laid at a rate of 0.2 per gram per day whereas none were laid at 16 C, 4.1 per gram per day at 24 C, and per gram per day at 20 C. Egg production was not diminished by exposure to high temperature for a part of each day such as fish experience during the summer in the natural habitat.

The temperature at which females were maintained affected not only the number of eggs produced but also the quality as shown by differences in size and hatchability. Over the range of temperatures for 50 percent hatch or greater, yolk diameter was inversely correlated with temperature. Echelle et al. (1972) also found this to be true for the Red River pupfish, C. rubrofluviatilis. Since productivity in desert water also varies with temperature, low in winter and early spring and increasing in summer with the mean water temperature (Naiman 1976), change in egg size may be a facultative response to the availability of food for fry, providing greater yolk reserve under less favorable conditions.

Temperature conditions during oogenesis affect the hatchability of eggs. Eggs which underwent oogenesis at 28 C were capable of development with a hatching success greater than 50 percent when they were transferred after spawning to constant temperatures as high as 36 C; whereas no eggs hatched which both matured in females and were incubated at 36 C. Eggs which underwent oogenesis at temperatures as low as 32 C were not capable of development with a 50 percent hatching success at the same temperature (see Figure 5). The thermal tolerance for oogenesis is much more limited than is the tolerance for eggs during the developmental period from spawning to hatching.

Studies on many species of fish have determined the thermal tolerance limits for early life history stages. In many cases the thermal history of the spawning adults, including those conditions during oogenesis, are unknown or unreported. These factors should be taken into consideration, because fish will come into spawning condition within a range of environmental conditions where abiotic factors appear to affect the viability and tolerance of the eggs produced.

The reproductive temperature tolerance limits established for the Amargosa pupfish are skewed toward high temperatures when compared with the probable limits of the majority of temperate zone fishes. Although these limits are species specific, we might predict from our results that the tolerance limits of other species occupy about the same proportion of the temperature range that limits activity and survival--one-fifth of the activity range and one-seventh of the critical thermal range. This narrow range is greatly influenced by the fact that oogenesis is the most sensitive stage of the life history to temperature. As a result, some doubt is cast on the general significance of temperature tolerance tests on eggs and larvae for assessing the effects of localized temperature changes caused by the thermal effluent of various industries.

Finally, this same argument may have some bearing on the question of year-class strength in many fishes. The wide year-to-year variations in year classes that are commonly observed in fish populations are generally conceded to be due to abiotic factors, often considered to be temperature changes during spawning. Since small departures from the tolerance limits drastically reduce egg production and quality, perhaps the temperature experience of the female during the period of egg maturation may be one of the determining elements in controlling year-class strength.

## Summary

1. Reproductive temperature tolerance tests were performed in the laboratory on an inbred stock of Amargosa pupfish, Cyprinodon n. nevadensis.

2. Egg production was optimal at constant temperatures 24 through 32 C and at fluctuating temperatures 32-28 and 36-28 C.

3. The reproductive tolerance range, defined as the range of optimal egg production with at least 50 percent hatchability, was 24 through 30 C, which is one-fifth of the range for normal activity and one-seventh of the critical thermal tolerance range.

4. Temperature also affected the quality of eggs produced; temperature and yolk diameter were inversely related.

5. The tolerance limits for oogenesis were narrower than the limits for successful hatching of healthy eggs exposed to temperature stress after spawning.

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Table 1. Length and weight of females used in reproductive tolerance tests. SD = standard deviation: L = length.

| TEMP | N | MEAN WEIGHT (g) | ±SD | Range MIN (g) | Range MAX (g) | MEAN L (mm) | ±SD | Range MIN (mm) | Range MAX (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 18C | 7 | 0.875 | 0.301 | 0.487 | 1.294 | 30.4 | 2.3 | 27 | 36 |
| 20C | 14 | 0.818 | 0.278 | 0.424 | 1.351 | 30.1 | 3.1 | 24 | 35 |
| 22C | 7 | 0.617 | 0.101 | 0.431 | 0.724 | 23.9 | 1.3 | 27 | 31 |
| 24C | 10 | 0.794 | 0.095 | 0.622 | 0.930 | 30.3 | 1.1 | 28 | 31 |
| 26C | 10 | 0.896 | 0.178 | 0.619 | 1.142 | 31.3 | 1.6 | 29 | 34 |
| 28C | 12 | 1.059 | 0.158 | 0.882 | 1.450 | 32.5 | 1.9 | 30 | 37 |
| 30C | 10 | 1.194 | 0.215 | 0.806 | 1.623 | 33.6 | 1.9 | 30 | 36 |
| 32C | 10 | 0.832 | 0.250 | 0.587 | 1.369 | 29.2 | 1.8 | 27 | 33 |
| 34C | 9 | 0.734 | 0.182 | 0.402 | 1.036 | 28.8 | 2.7 | 24 | 33 |
| 36C | 10 | 0.759 | 0.108 | 0.591 | 0.896 | 29.4 | 1.0 | 28 | 31 |
| 24-16C | 10 | 1.013 | 0.245 | 0.699 | 1.458 | 32.7 | 2.3 | 30 | 37 |
| 32-28C | 11 | 0.754 | 0.082 | 0.614 | 0.882 | 29.5 | 1.4 | 28 | 32 |
| 36-28C | 11 | 0.773 | 0.110 | 0.634 | 1.028 | 30.2 | 1.1 | 29 | 32 |
| 38-28C | 8 | 0.763 | 0.094 | 0.555 | 0.860 | 29.5 | 1.5 | 26 | 31 |
| 39-30C | 10 | 0.793 | 0.184 | 0.400 | 1.043 | 29.8 | 2.6 | 24 | 32 |

Table 2. Length and weight of males used in reproductive tolerance tests. SD = standard deviation: L = length.

| TEMP | N | MEAN WEIGHT (g) | ±SD | Range MIN (g) | Range MAX (g) | MEAN L (mm) | ±SD | Range MIN (mm) | Range MAX (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 18C | 7 | 1.27 | 0.50 | 1.06 | 1.85 | 40.3 | 6.2 | 40 | 46 |
| 20C | 14 | 1.16 | 0.49 | 0.53 | 2.10 | 38.9 | 4.1 | 33 | 45 |
| 22C | 7 | 0.57 | 0.16 | 0.37 | 0.81 | 31.6 | 3.0 | 28 | 36 |
| 24C | 10 | 0.91 | 0.21 | 0.61 | 1.21 | 36.7 | 2.7 | 33 | 41 |
| 26C | 10 | 1.24 | 0.31 | 0.86 | 1.97 | 40.2 | 2.6 | 36 | 46 |
| 28C | 12 | 1.12 | 0.25 | 0.76 | 1.49 | 39.0 | 2.4 | 35 | 43 |
| 30C | 10 | 1.34 | 0.34 | 0.75 | 1.86 | 41.1 | 4.3 | 31 | 46 |
| 32C | 10 | 0.84 | 0.18 | 0.58 | 1.18 | 35.9 | 1.9 | 34 | 40 |
| 34C | 9 | 0.93 | 0.19 | 0.69 | 1.33 | 36.4 | 3.1 | 32 | 42 |
| 36C | 10 | 1.94 | 0.24 | 0.66 | 1.31 | 37.1 | 2.0 | 35 | 40 |
| 24-16C | 10 | 0.90 | 0.25 | 0.60 | 1.43 | 36.5 | 4.4 | 31 | 47 |
| 32-28C | 11 | 0.99 | 0.26 | 0.69 | 1.49 | 37.9 | 3.3 | 33 | 44 |
| 36-28C | 12 | 0.95 | 0.29 | 0.63 | 1.46 | 37.0 | 3.0 | 33 | 42 |
| 38-28C | 8 | 0.76 | 0.25 | 0.47 | 1.31 | 34.5 | 3.1 | 31 | 41 |
| 39-30C | 10 | 0.83 | 0.23 | 0.56 | 1.35 | 35.5 | 1.6 | 32 | 37 |

Table 3. Yolk diameter of eggs laid and Gonosomatic Index (GSI)[2]

| TEMP | MEAN YOLK DIAMETER | ±SD | N | MEAN GSI | ±SD | N |
|---|---|---|---|---|---|---|
| 18C | 1.07 | 0.09 | 40 | 0.05 | 0.02 | 7 |
| 20C | 1.08 | 0.09 | 64 | 0.08 | 0.04 | 14 |
| 22C | 1.07 | 0.04 | 16 | 0.09 | 0.03 | 7 |
| 24C | 1.06 | 0.05 | 335 | 0.13 | 0.06 | 10 |
| 26C | 1.02 | 0.08 | 212 | 0.14 | 0.05 | 10 |
| 28C | 1.01 | 0.05 | 187 | 0.10 | 0.03 | 12 |
| 30C | 1.00 | 0.05 | 375 | 0.07 | 0.04 | 10 |
| 32C | 1.02[1] | 0.07 | 373 | 0.09 | 0.05 | 10 |
| 34C | 1.04[1] | 0.08 | 126 | 0.05 | 0.02 | 9 |
| 36C | | | | 0.02 | 0.02 | 10 |
| 24-16C | | | | 0.09 | 0.03 | 10 |
| 32-38C | 1.01 | 0.06 | 266 | 0.09 | 0.04 | 11 |
| 36-28C | 1.00 | 0.06 | 203 | 0.09 | 0.04 | 11 |
| 38-28C | 0.98 | 0.07 | 44 | 0.04 | 0.02 | 8 |
| 39-30C | 0.93 | 0.08 | 51 | 0.04 | 0.02 | 10 |

[1]Does not include measurements of large numbers of small, fragile eggs laid at these temperatures.

[2]Gonosomatic Index = ovary weight/(body weight - ovary weight).

Figure 1. Daily cycle of fluctuating temperature regimes. 10 C daily temperature change, dashed line, 8 C, solid line, 6 C, dotted line. Spawning occurred at 0900 hr.

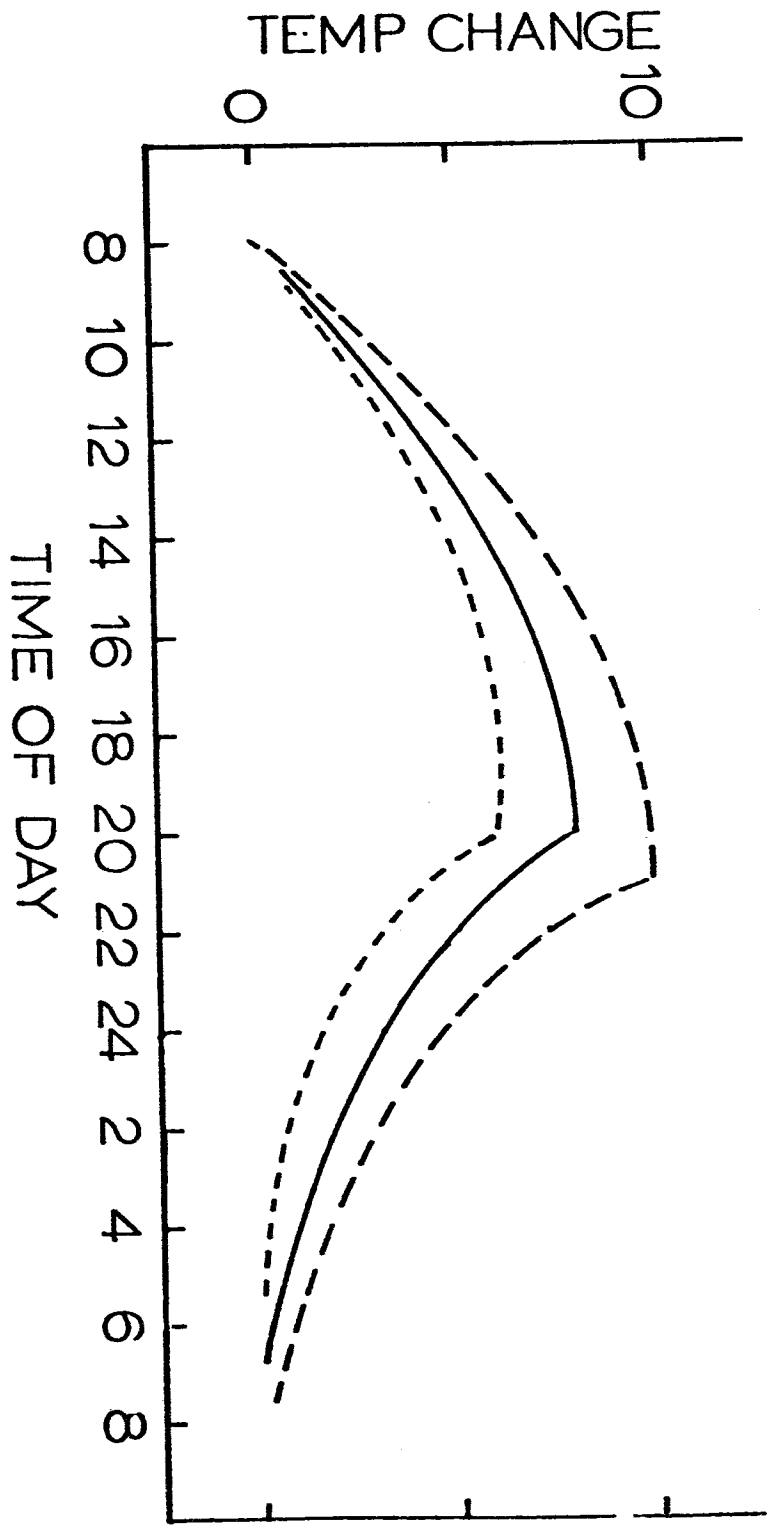

TEMP CHANGE
0
10
TIME OF DAY
8
10
12
14
16
18
20
22
24
2
4
6
8

Figure 2. Mean (± SD) proportion of days on which spawning occurred for breeding pairs of Cyprinodon n. nevadensis acclimated and then bred for 21 days at test temperatures 18 through 39 C. Number of individuals at each temperature can be found in Table 1.

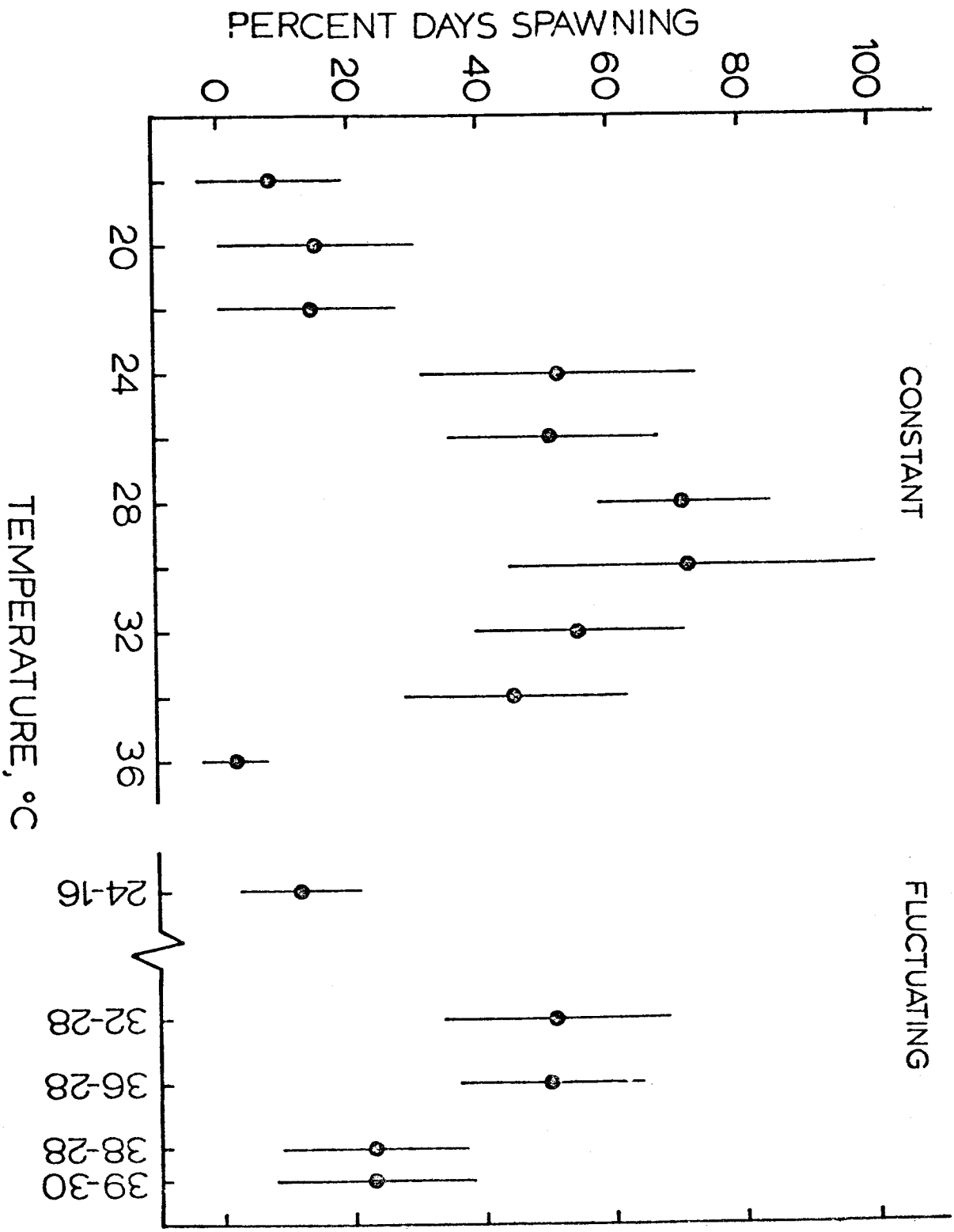

PERCENT DAYS SPAWNING
0
20
40
60
80
100
TEMPERATURE, °C
20
24
28
32
36
CONSTANT
24-16
32-28
36-28
38-28
39-30
FLUCTUATING

Figure 3. Mean (± SD) number of eggs per spawning for breeding pairs of Cyprinodon n. nevadensis acclimated and then bred for 21 days at test temperatures 18 through 39 C. Number of individuals at each temperature can be found in Table 1.

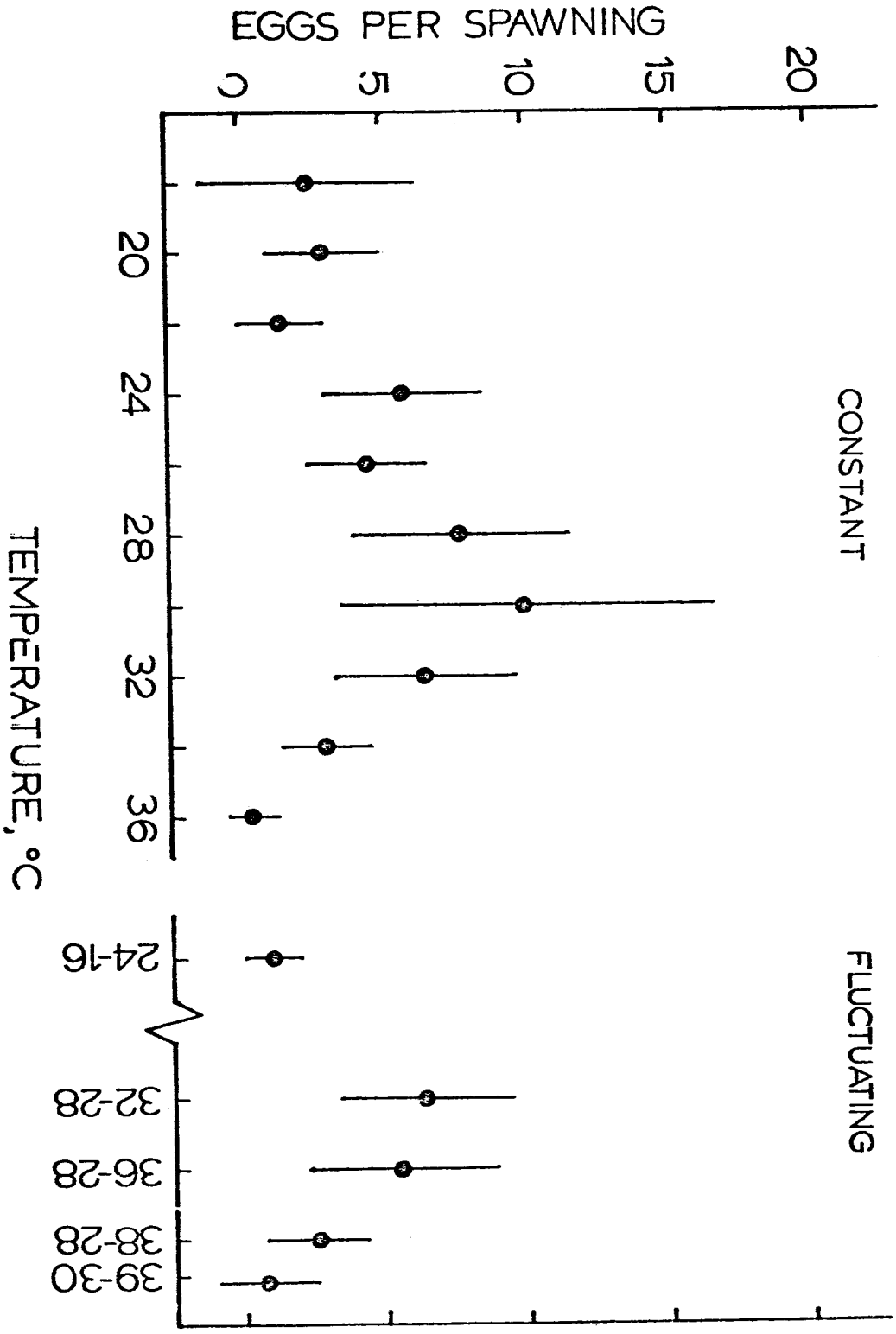

EGGS PER SPAWNING
0
5
10
15
20
TEMPERATURE, °C
20
24
28
32
36
CONSTANT
24-16
32-28
36-28
38-28
39-30
FLUCTUATING

Figure 4. Mean (± SD) number of eggs (per gram of body weight) per day for Cyprinodon n. nevadensis acclimated and then bred at test temperatures 18 through 39 C for 21 days. Number of individuals at each temperature can be found in Table 1.

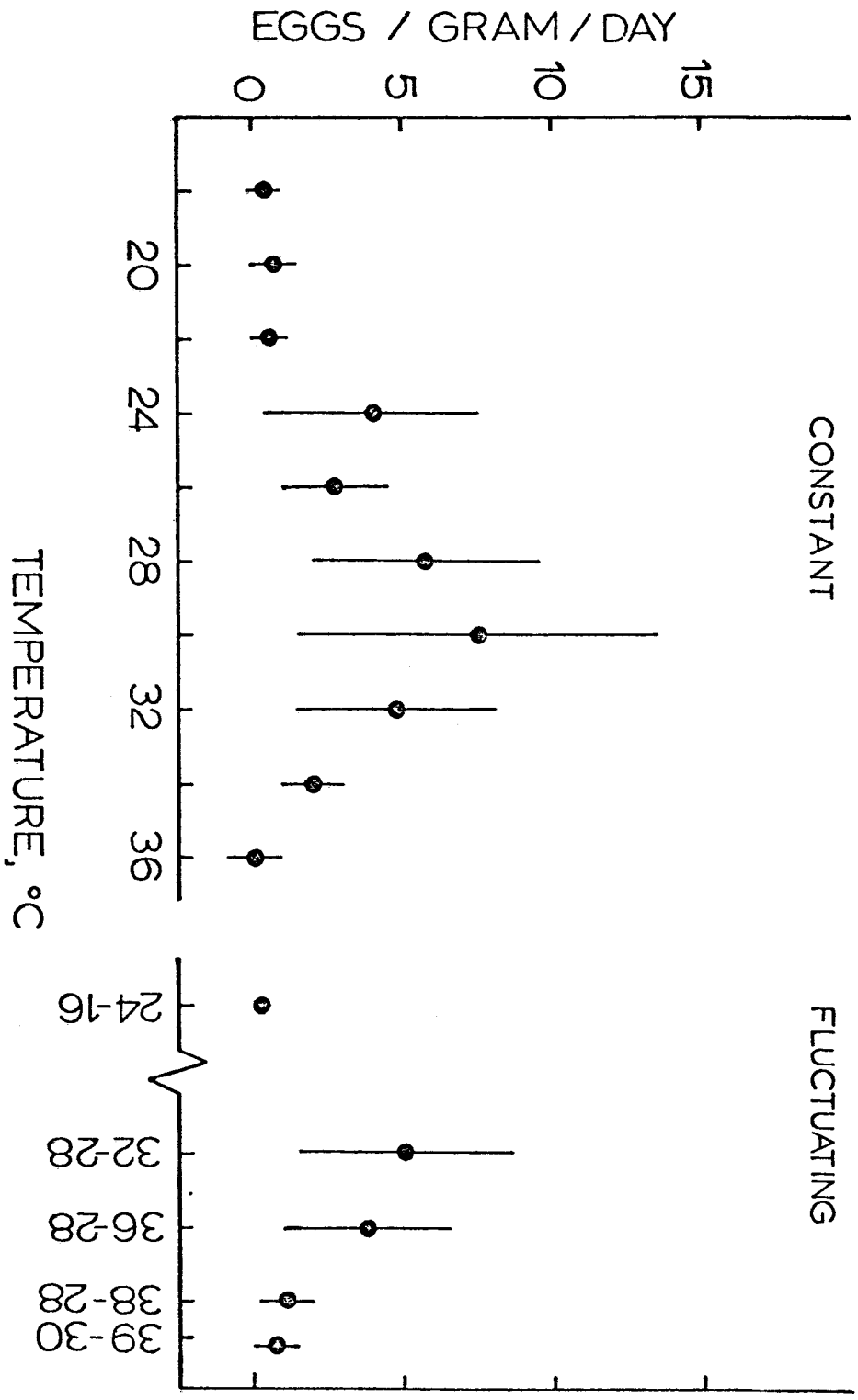

EGGS / GRAM / DAY
0
5
10
15
TEMPERATURE, °C
20
24
28
32
36
CONSTANT
24-16
32-28
36-28
38-28
39-30
FLUCTUATING

Figure 5. A comparison of percentage of eggs hatched between (1) closed circles, eggs exposed to 28 C during oogenesis and transferred at spawning to incubation temperatures ranging from 18 through 39 C, N = 270 at each temperature (Shrode 1975), and (2) open circles, eggs exposed to identical temperatures during oogenesis and incubation, N = 300 to 400 for 24 through 34 C, N = 50 to 150 for 18 through 22 C, N = 7 for 36 C, N = 50 to 150 for fluctuating temperatures.

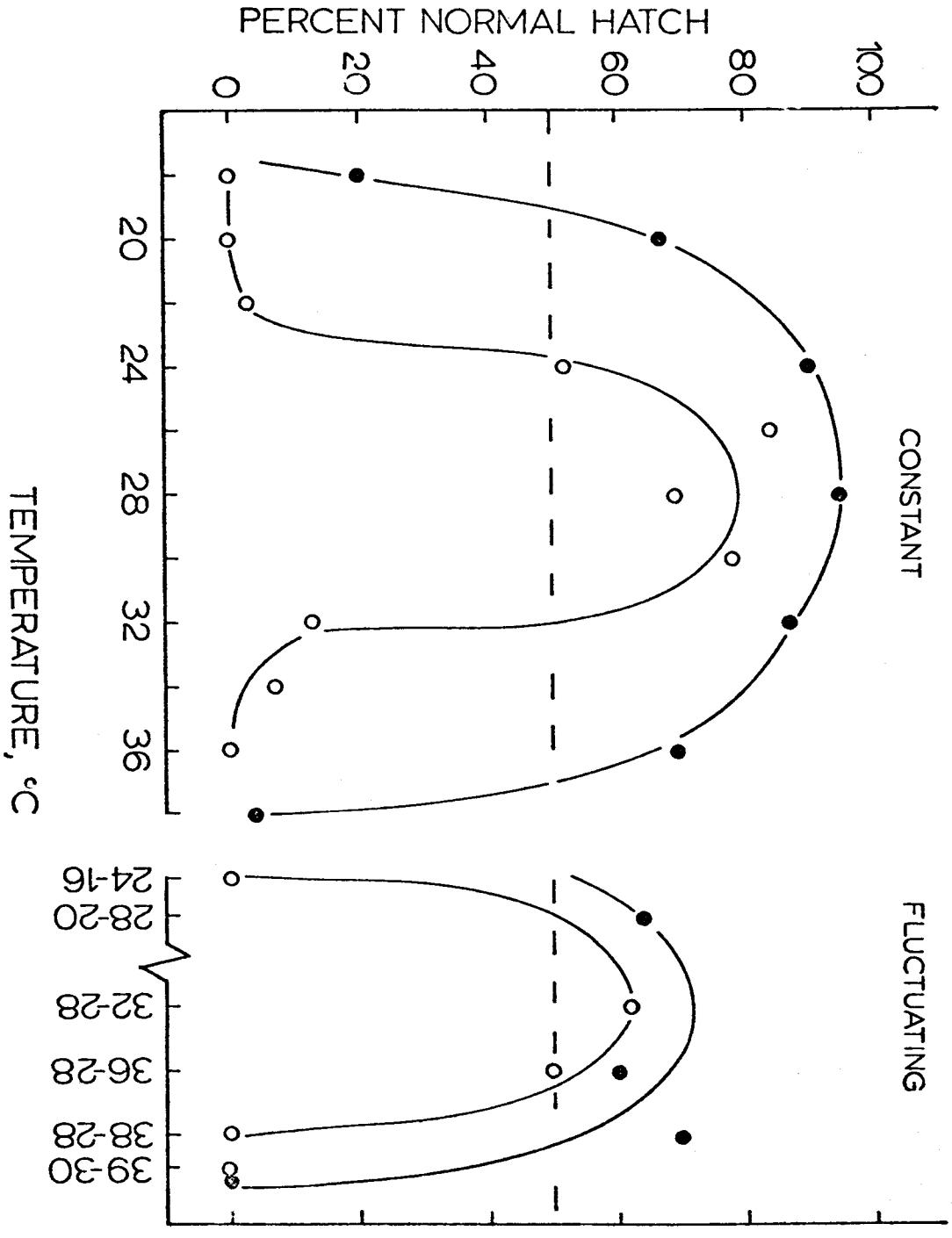

PERCENT NORMAL HATCH
0
20
40
60
80
100
20
24
28
32
36
TEMPERATURE, °C
CONSTANT
FLUCTUATING
24-16
28-20
32-28
36-28
38-28
39-30

Figure 6. Critical thermal maxima (± SD) of male Cyprinodon n. nevadensis acclimated at temperatures 18 through 39 C. These males had participated in the reproductive tolerance tests.

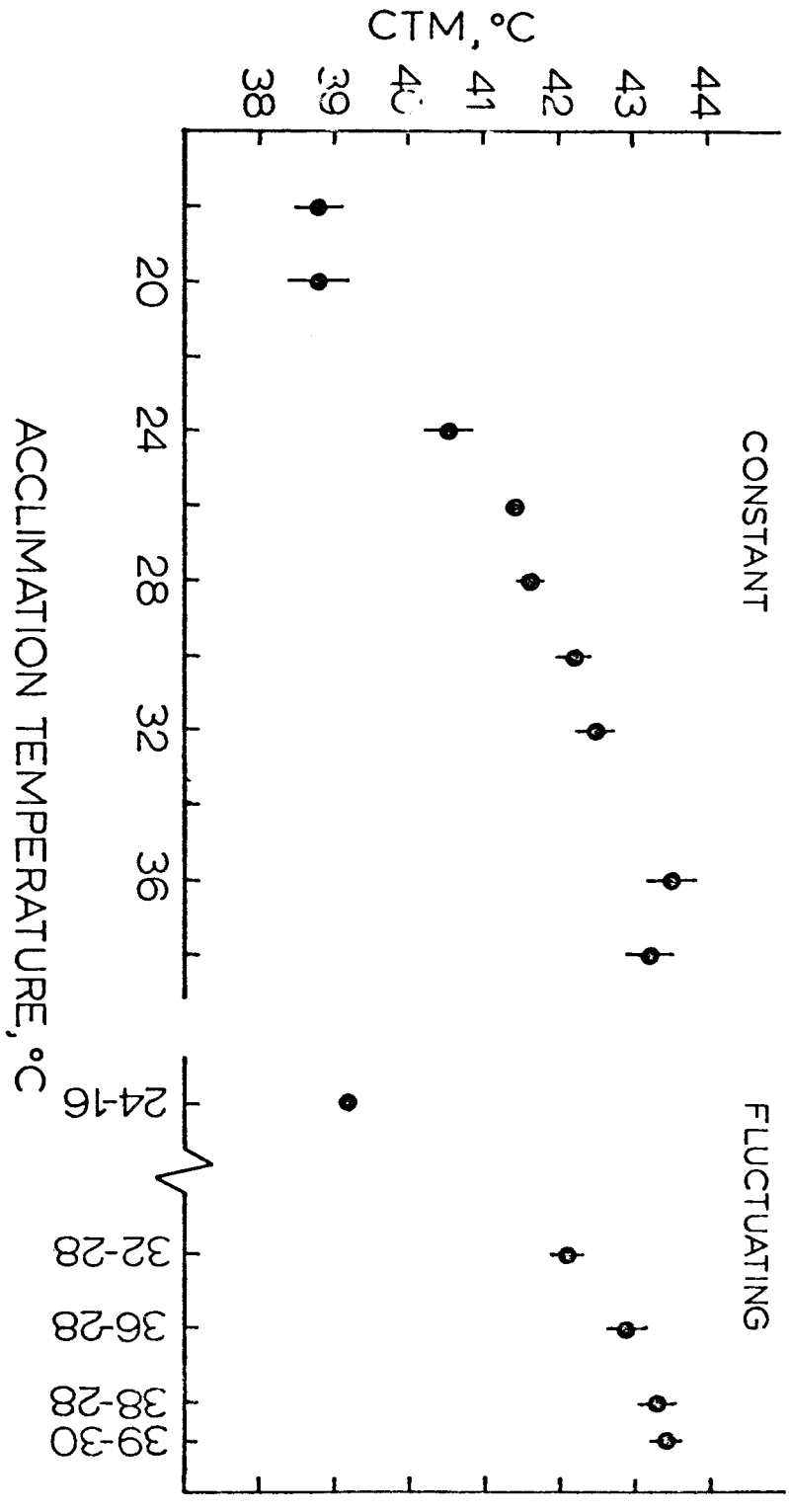
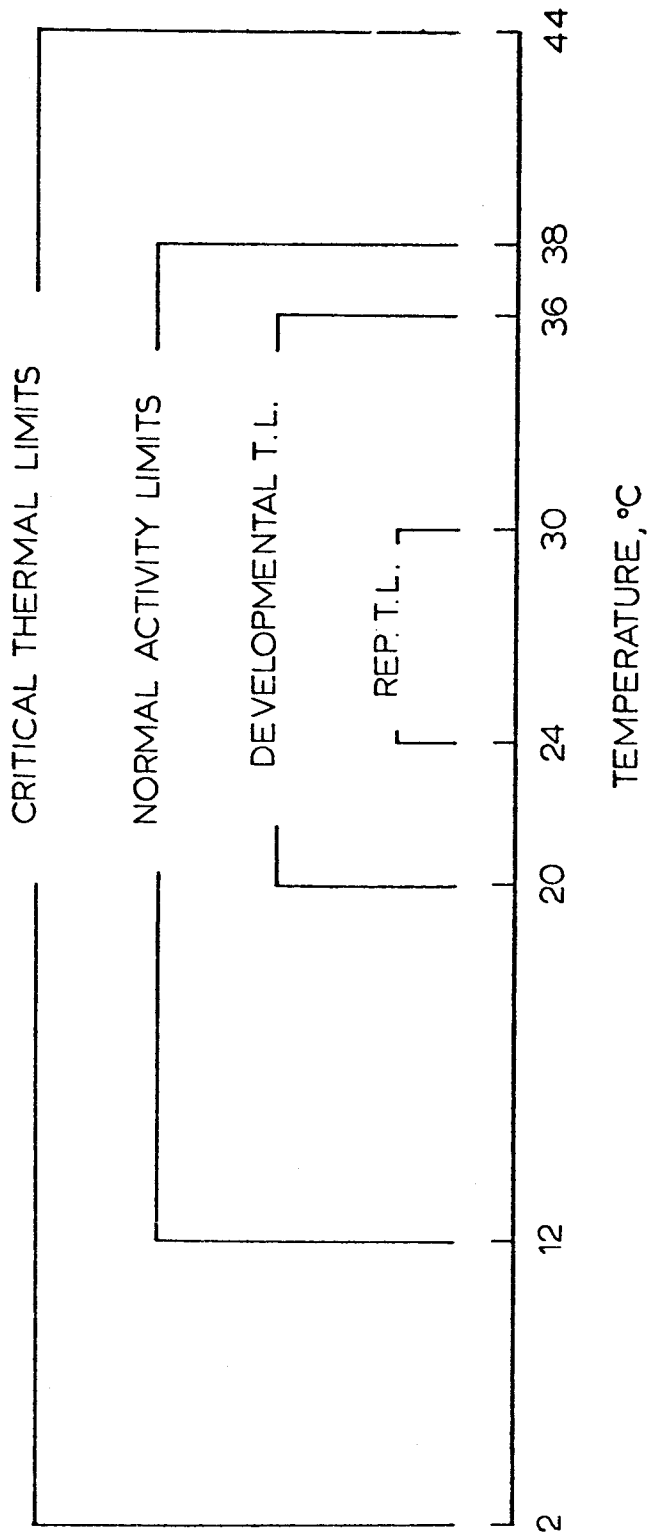

CTM, °C
38
39
40
41
42
43
44
20
24
28
32
36
CONSTANT
FLUCTUATING
24-16
32-28
36-28
38-28
39-28
ACCLIMATION TEMPERATURE, °C

Figure 7. Diagrammatic representation of reproductive tolerance, developmental tolerance, normal activity, and critical thermal limits determined under constant temperature laboratory conditions for Cyprinodon n. nevadensis.


CRITICAL THERMAL LIMITS
NORMAL ACTIVITY LIMITS
DEVELOPMENTAL T.L.
REP. T.L.
2
12
20
24
30
36
38
44
TEMPERATURE, °C

## The Least Chub (Iotichthys phlegethontis, Cope) in Juab County, Utah

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### Introduction

The least chub (Iotichthys phlegethontis - Cope) (Bailey et al. 1960) was common in some areas of the Bonneville Basin (Sigler and Miller 1963, Jordan 1891, Holden et al. 1974). However, due to the changing aquatic environment in those areas, distribution of this fish is now unknown except in Juab County, Utah.

### Discussion and Summary

The least chub of Juab and Millard counties appears to be very limited in distribution. Of the nine potential habitat spring sites examined, only one spring contained least chub. It is possible that this species may be present in these waters, although the present survey would suggest that they must be rare.

The limited distribution and abundance of this species are probably dependent on several factors. Water chemistry and visual inspections of each site show that some pollution and habitat damage are taking place, although this appears to be minor. The most apparent limiting factor of least chub would probably be introduced aquatic predators. The most serious of these appear to be largemouth bass and sunfish.

Least chub that were collected were healthy and appeared to be doing well even though some of the water temperatures were very cold at the time of the survey. The size of the fish collected was comparable to least chub measurements from other sites in years past by various fisheries investigators.

## SESSION II - Miscellaneous Presentations

### Southwestern Fishes Council

Royal D. Suttkus

Held our last meeting at New Orleans, Louisiana, April 21, 1976, in conjunction with (ASB) Association of Southwestern Biologists. Sixty-three members and guests attended; now have membership of about 125.

Same officers reelected: R. D. Suttkus - Chairman, Tulane University
David Etnier - Chairman-Elect, University of Tenn.
Herbert T. Boschung - Secretary-Treasurer, University of Alabama

Editorship transferred from Boschung to Glenn H. Clemmer, Mississippi State University

Three endangered species reports given:

Snail darter, Percina tanasi: David Etnier, Univ. of Tenn.
Okaloosa darter, Etheostoma okaloosae: M. F. Mettee, Geological Survey of Alabama.
Watercress darter, Etheostoma nuchale: W. M. Howell, Samford University

Special Committee Reports:

Carter Gilbert - Compilation of type holdings in southeastern collections.

Neal Douglas - Use of systematic fish collections by state game and fish agencies.

James M. Barkuloo - Gave report on location, size, nature (freshwater or marine) and usage of federal fish collections in southeast.

Proceedings:

Published two numbers:

1. Feature article of Vol. 1, No. 1 was:
   A statement concerning the snail darter.

2. Feature article of Vol. 1, No. 2 was:
   A status report on the Okaloosa darter in northwest Florida.

Our next meeting will be held in June at Gainesville, Florida, in conjunction with (ASIH) American Society of Ichthyologists and Herpetologists.

## The Role of Federal Refugia in the Endangered Species Program Present and Future

### ABSTRACT

Jim Johnson, Endangered Species Biologist

This paper starts off with a specific discussion of Dexter National Fish Hatchery in southeastern New Mexico as a federal refugium for endangered native fishes of the Southwest. Dexter is presently being funded by the Endangered Species Program (U.S.F.W.S.) to maintain 9 native fish species (Cyprinodon elegans, C. bovinus, Gambusia gaigei, G. nobilis, G. amistadensis, Etheostoma fonticola, Poeciliopsis occidentalis occidentalis, P. sonoriensis, Gila purpurea). The first 6 species have been there 18 months and have prospered. The last 3 species were introduced last month. Dexter has a potential to maintain several times this number of fish species, but needs support for the program. Major questions are if these species should be moved out of their native drainage and what damage they might do if accidently introduced into the Pecos River drainage. Overflow from the ponds can be captured in a series of dry lakes that should prevent accidental introductions.

A second portion of the paper was a brief review of several fish refugia in the Southwest and a discussion of how these scattered and little known efforts should be coordinated in the future. Too often the good intentions of small, on-site refugia are being lost through foreseeable accidents. There should be a set of standards developed to guide and coordinate present and future refugia, and the U.S. Fish and Wildlife Service seems the logical agency to initiate this program.

## Status of the Genus Tilapia in California's Estuarine and Marine Waters

## or

## Get Your (Expletive Deleted) Exotic Freshwater Fishes Out of My Ocean

Eric H. Knaggs, Operations Research Branch
California Department of Fish and Game

### Introduction

Tilapia mossambica and Tilapia zillii were introduced in 1973 at a number of freshwater locations in southern California. Several of these locations were within the Pacific slope drainage and during certain times access to the Pacific Ocean was available to these fish.

This paper is (1) a documentation of the establishment of Tilapia in California's coastal marine and estuarine waters, (2) present status of the genus Tilapia in California's coastal waters, and (3) possible consequences Tilapia may have on the marine environment.

## History of Establishment

T. mossambica and T. zillii were introduced in 1973 into tributaries of the San Gabriel and Santa Ana Rivers in southern California. On August 3, 1974, the first large-scale collection of T. mossambica were made in the estuarine portion of the San Gabriel River. These fish were identified and are now in the Los Angeles County Museum (LACM) fish collection. A fish kill of T. mossambica occurred in February 1975 at the upper end of the San Gabriel River tidal prism. A large breeding population of T. mossambica was observed in August 1976, and fish captured ranged in size from 27 mm standard length (SL) to 147 mm SL. Fish were mouth brooding and viable fry were captured also. A collection was made again in October 1976 which almost duplicated the results of the August collection.

On September 15, 1976, a breeding population of T. mossambica was located and sampled in the Los Cerritos flood control channel in Long Beach, California. This flood control channel is ½ mile west of the San Gabriel River. It is cement lined its entire length and collects "surface street" runoff only. Therefore, the source of these T. mossambica must be from the San Gabriel River stock. This location was sampled again in October and spawning was still occurring.

Another breeding population of T. mossambica was discovered the third week in October at Colorado Lagoon in Long Beach, California. This area is 2½ miles west of the San Gabriel River.

Although the geographic range extensions are small, these new locations are outside of the San Gabriel River drainage and represent marine coastal areas. It should be noted that T. mossambica has been taken also on marine public fishing piers at Seal Beach and Long Beach, California.

T. zillii was first captured in marine waters during a heat treatment at the Huntington Beach electric generating plant in Orange County on December 7, 1974. These fish are now in the fish collection at LACM. T. zillii, one specimen, was captured in 1976 in upper Newport Bay.

A fish kill of Tilapia (estimated fish killed 10 to 20) occurred within tidal waters on October 9, 1974, in the East Garden Grove-Wintersberg flood control channel. This flood control channel enters Bolsa Bay near Seal Beach, California. Unfortunately identification to species was not made. Franklin Hoover with the California Department of Fish and Game checked the flood control channels in Orange County during July and August 1975 where T. mossambica and T. zillii were released. He did not find any Tilapia at this time.

## Present Status

At the present time, T. zillii has been collected twice in the marine environment and these collections were separated in time by two years. Therefore, T. zillii is probably not established in large breeding populations within California's marine coastal areas.

Three breeding populations of T. mossambica are now established in California's coastal areas. The San Gabriel River location has probably been used since

1974, while the two other locations, Los Cerritos flood control channel and Colorado Lagoon, are estimated to be new and established in 1976.

## Possible Consequences of Tilapia in the Marine Environment

I believe there are three major consequences that may occur and should be pondered if Tilapia becomes established in marine waters: (1) what population sizes can we expect, (2) how far will they spread, and (3) how will Tilapia affect other species?

## Potential Population Sizes

There are a number of electric generating plants in southern California which use marine waters for cooling purposes. These waters are warmed in the plants and then discharged back into the marine environment. These waters would serve as a warm water reservoir for Tilapia to overwinter.

The water in the San Gabriel River within its tidal prism ranges from 87.5 F (30.8 C) to 69.5 F (20.8 C), with most temperatures ranging from the middle 70's to low 80's F. The 69.5 F temperature was right after a rainstorm and there was a large flow of freshwater coming down the river. These year round temperature ranges indicate there would be no mortality to T. mossambica from temperatures in the lower San Gabriel River. If we couple the warm water with the availability of year round freshwater flows which are now entering marine waters in southern California, I think there is a high probability substantial populations may become established.

It is interesting to note also that the literature reports T. mossambica will not spawn nor will the gonads develop in salinities above 30 o/oo. T. mossambica in the San Gabriel River and Los Cerritos flood control channel were spawning successfully and viable larvae were found in 34.5 o/oo salinity. T. zillii are reported to live and reproduce in salinities between 10-45 o/oo.

## California Population Ranges

T. mossambica has adapted to the San Gabriel estuarine environment and now appears to be spreading slowly by establishing breeding populations in other marine coastal areas.

I have taken water temperature data from certain shore stations along the southern California coastline. I have assumed that a total mortality would occur if temperatures fell below 55 F (12.8 C) for T. mossambica and that a partial mortality would occur below 60 F (15.5 C). It should be mentioned that T. mossambica can tolerate lower temperatures with increasing salinities, but for this paper I will use only the mortality data for freshwater. The temperature data (Table 1) indicate that a total mortality would occur in most years if it takes only a few days of low temperature to kill these fish. These temperature data also indicate that in certain years and certain areas, an overwintering population could occur. Along this same line of reasoning, there were 169 consecutive days in 1972 where temperatures were above 60 F (15.5 C) at La Jolla, 134 days in 1973, 200 days in 1974, and 75 days in 1975. These days of higher temperatures are considered the time in which T. mossambica would increase its range.

T. zillii is a completely different matter as far as temperatures are concerned. Mortality studies done in freshwater on this species indicate that first mortality occurs at 52 F (11.1 C) and total mortality at 45 F (7.2 C). With this information, there seems to be very little in the way of low temperatures (Table 1) to cause a complete mortality or prevent establishment anywhere in marine waters below Port San Luis, California.

## Tilapia's Effect on Other Species

The San Gabriel River was sampled in 1971 in the same area where T. mossambica is now established and the following species were found:

| Species | Number | Percentage |
|---|---|---|
| Fundulus parvipinnis | 1,122 | 84.0 |
| Anchoa compressa | 142 | 10.6 |
| Atherinops affinis | 63 | 4.7 |
| Gambusia affinis | 4 | 0.3 |
| Dorosoma petenense | 2 | 0.2 |
| Paralichthys californicus | 1 | 0.1 |
| Leptocottus armatus | 1 | 0.1 |
| TOTAL | 1,335 | 100.0 |

Two studies on either side of the San Gabriel River from estuarine waters show a large variety of fish (Table 2). Number of species captured in the Anaheim Bay study was 45, while the Los Angeles River study produced 26.

The San Gabriel River was sampled again on two occasions in 1976, and the following fish were found:

| Species | Number | Percentage |
|---|---|---|
| T. mossambica | 376 | 94.0 |
| Fundulus parvipinnis | 10 | 2.5 |
| Atherinops affinis | 10 | 2.5 |
| Gambusia affinis | 4 | 1.0 |
| TOTAL | 400 | 100.0 |

If the reduced number of species and reduced numbers of each species is caused by T. mossambica, the effect of this fish on other coastal marine fishes may be huge.

## Conclusion

T. zillii and T. mossambica can spawn successfully in saline waters up to and including 34.5 o/oo. Coastal marine water temperatures may cause mortalities; however, the large number of electric generating plants using ocean waters may create havens for overwintering populations. Effects of Tilapia may be dramatic on other species of marine fishes.

T. zillii would appear not to be established yet in coastal marine waters, while T. mossambica is slowly expanding its range.

T. mossambica appears to be one of the "milder" species in the genus Tilapia; therefore, I personally recommend that no other species of Tilapia be introduced into California's waters until we find out what effects T. mossambica is going to have on the marine environment.

Table 1. Number of days below 55 F (12.8 C) at certain California shore stations

| Year | La Jolla-Scripps Pier | Oceanside | Newport Beach Pier | Santa Monica | Ventura Marina | Port San Luis (Avila) |
|---|---|---|---|---|---|---|
| 1963 | 0 | 1 (1) | 2 (1) | 9 (3) | - | 42 (9) |
| 1964 | 3 (1) | 5 (5) | 3 (1) | 18 (9) | - | 90(20) |
| 1965 | 9 (4) | 12 (9) | 1 (1) | 17 (5) | 20 (9) | 45(13) |
| 1966 | 1 (1) | 3 (3) | 5 (4) | 2 (2) | 26 (6) | 11 (4) |
| 1967 | 3 (1) | 5 (3) | 4 (2) | 2 (2) | 21 (8) | 23(11) |
| 1968 | 0 | 3 (1) | 3 (1) | 0 | 16(11) | 25 (7) |
| 1969 | 5 (3) | 3 (3) | 8 (4) | 4 (3) | 39(23) | 18 (5) |
| 1970 | 10 (9) | 18 (8) | 9 (3) | 12 (3) | 25(12) | 33(20) |
| 1971 | 50(21) | 51(17) | 79(23) | 62(17) | 58(20) | 124(27) |
| 1972 | 35(13) | 44(11) | 29(16) | 23 (5) | 44(17) | 88(37) |
| 1973 | 0 | - | - | - | - | - |
| 1974 | 18 (3) | - | - | - | - | - |
| 1975 | 21 (6) | - | - | - | - | - |
| | | | Number of days below 52 F (11.1 C) | | | |
| 1963 | 0 | 0 | 0 | 0 | - | 3 (2) |
| 1964 | 0 | 0 | 0 | 0 | - | 17 (4) |
| 1965 | 0 | 0 | 0 | 0 | 0 | 2 (1) |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 1 (1) |
| 1969 | 3 (3) | 0 | 0 | 0 | 1 (1) | 0 |
| 1970 | 0 | 0 | 0 | 0 | 3 (2) | 2 (1) |
| 1971 | 3 (3) | 1 (1) | 3 (1) | 7 (7) | 14 (5) | 25(15) |
| 1972 | 0 | 0 | 0 | 0 | 5 (4) | 5 (1) |
| 1973 | 0 | - | - | - | - | - |
| 1974 | 0 | - | - | - | - | - |
| 1975 | 0 | - | - | - | - | - |
| | | | Number of days below 50 F (10.0 C) | | | |

All stations reported 50 F or above except Port San Luis - one day in 1964.

Table 2. Fish captured in two estuaries located on either side of the San Gabriel River

| Scientific Name | Common Name | Location: Anaheim Bay | Location: Los Angeles River |
|---|---|---|---|
| Mustelus californicus | gray smoothhound shark | x | |
| M. henlei | brown " " | x | |
| Triakis semifasciata | leopard shark | x | |
| Squatina californica | Pacific angel shark | x | |
| Platyrhinoides triseriata | thornback | x | |
| Rhinobatos productus | shovelnose guitarfish | x | |
| Myliobatus californica | bat ray | x | x |
| Urolophus halleri | round stingray | x | x |
| Dorosoma petenense | threadfin shad | x | |
| Anchoa compressa | deepbody anchovy | x | x |
| Engraulis mordax | northern anchovy | x | x |
| Porichthys myriaster | specklefin midshipman | x | x |
| Fundulus parvipinnis | California killifish | x | x |
| Atherinops affinis | topsmelt | x | x |
| Leuresthes tenuis | California grunion | | x |
| Syngnathus leptorhynchus | bay pipefish | x | |
| Morone saxatilis | striped bass | x | |
| Paralabrax maculatofasciatus | spotted sand bass | x | x |
| P. nebulifer | barred sand bass | x | x |
| Cynoscion nobilis | white seabass | x | |
| Genyonemus lineatus | white croaker | x | x |
| Menticirrhus undulatus | California corbina | x | x |
| Seriphus politus | queenfish | x | x |
| Roncador stearnsi | spotfin croaker | x | |
| Umbrina roncador | yellowfin croaker | x | |
| Cymatogaster aggregata | shiner perch | x | x |
| Embiotoca jacksoni | black surfperch | x | x |
| Hyperprosopon argentewn | walleye surfperch | x | x |
| Hypsurus caryi | rainbow surfperch | x | |
| Phanerodon furcatus | white perch | x | x |
| Rhacochilus vacca | pile perch | x | x |
| Mugil cephalus | mullet | x | x |
| Hypsoblennius gilberti | rockpool blenny | | x |
| H. gentilis | bay blenny | x | |
| Clevelandia ios | arrow goby | x | x |
| Gillichthys mirabilis | longjaw mudsucker | x | x |
| Ilypnus gilberti | cheekspot gody | x | |
| Quietula y-cauda | shadow goby | x | |
| Sarda chiliensis | Pacific bonito | x | x |
| Peprilus simillimus | Pacific butterfish | x | |
| Leptocottus armatus | Pacific staghorn sculpin | x | x |
| Citharichthys stigmaeus | speckled sanddab | x | |
| Paralichthys californicus | California halibut | x | x |
| Pleuronichthys verticalis | hornyhead turbot | x | |
| Parophrys vetulus | English sole | x | |
| Hypsopsetta guttulata | diamond turbot | x | x |
| Symphurus atricauda | California tonguefish | x | |

# Fishery Habitat Management on National Resource Lands in SE Utah

Neil B. Armantrout, Fisheries Biologist

## Introduction

The Moab District of the Bureau of Land Management was formed in 1975 by the union of the Price and Monticello Districts. It covers 8,774,561 acres in Carbon, Emery, Grand, and San Juan counties, of which 54% is National Resource Lands (NRL) administered by the Bureau of Land Management. The District has about 1700 miles of major stream channel of which approximately 2/3 have a perennial flow. There are about 100 surface-acres of impoundments, mostly developed for livestock use.

The District is in the Colorado Plateau Region. Drainage is in the Colorado River Basin. Most streams originate within the District on the LaSal, Abajo, Book Cliff, and Wasatch Mountains. The Green, Colorado, San Juan, and Dolores rivers head in other states, all terminating within the Moab District except for the Colorado River. Mileages of the major rivers in the Moab District are: Colorado River - 100 miles; Green River - 170 miles; San Juan River - 57 miles; Dolores River - 28 miles; Price River - 95 miles; San Rafael River - 85 miles; and Muddy River - 55 miles.

The climate is arid, with under 10 inches of precipitation per year. This falls mainly as snow in winter or as intense summer thunderstorms. Flows are highly variable, being greatest in the May-June period, and lowest in August-September. Many stream beds and washes have water 9-10 months of the year, but are dry in late summer. All streams are subject to occasional severe flooding. Silting and temperature variability show wide fluctuations. Winter lows may reach -30 F, while summer temperatures reach over 115 F.

Because of land ownership patterns and program needs, management efforts to date have centered on the larger rivers. Interest in the smaller streams has centered on those with special problems or needs, such as energy development or consideration for primitive status. As a result of lack of background data, much of the initial effort in management has centered on basic data gathering on all aspects of the rivers.

Following are a few observations on the various rivers and streams, with some comments on major management problems.

## Major Rivers

### Colorado River

The Moab District manages the Colorado River from the Colorado State Line to the eastern boundary of Canyonlands National Park. From the Park boundary to the Arizona State Line, management of the river itself is under the National Park Service, although BLM administers most of the lands adjacent to the river.

The Canyons area of the Colorado River begins in Colorado near the State Line and continues through the Glen Canyon and Grand Canyon areas to near the

Mexican border. The canyon becomes increasingly deep, inaccessible, with only limited riparian area. The Westwater Canyon, just across the state line into Utah, is the first of the true canyon sections.

Near the Colorado State line, the river is primarily a riffle-pool type, with extensive riparian habitat area along one or both sides. In Westwater, the canyon is narrow, with almost no streamside riparian area; it also contains the first rapids of the canyons area. Below Westwater, there is an extensive stretch with moderate sides, many shallows and riffle areas, and moderate to extensive riparian habitat on both sides. At Moab, where the Spanish Valley meets the river, is a broad area lacking canyon walls that represents the last easily accessible point on the river above Grand Canyon. Near the junction of the Green and Colorado Rivers the walls close in again, the canyon becomes deeper, and a series of rapids begin that is moderated by the construction of Glen Canyon and Boulder dams.

Where topography permits, extensive agriculture is conducted along the river. Grazing is a major activity, with irrigated farming where conditions permit. Uranium, oil and potash exploration, extraction and processing occur along the river above the confluence with the Green River.

Recreational use has increased in importance in recent years. Daily trips originate near Moab; no use figures are available since permits are not required. In Westwater Canyon, it has been necessary to implement a permit system as a result of the demand for use of the limited camping areas. Since river patrols were instituted four years ago, there has been a general upward trend in river use:

Westwater Canyon Visitor Use-Passenger Days

| Type of Use | Allocation | 1973 | 1974 | 1975 | 1976 |
|---|---|---|---|---|---|
| Total commercial use | 5,230 | 4,762 | 3,741 | 4,243 | 3,456 |
| Total private use | | 760 | 2,937 | 3,434 | 3,448 |
| Total use | | 5,522 | 6,678 | 7,677 | 6,904 |

The Colorado River in Utah, from the state line to the mouth of the Dolores River, has been proposed for Wild and Scenic River designation. Several related studies are underway. Two biological studies were conducted this summer, although no reports are yet available on either. George Kidd of Grand Junction inventoried the fish populations under a contract with the Bureau of Reclamation, while Dr. Robert Winget of Brigham Young University conducted a study of macroinvertebrates under a BLM contract.

Green River

The Moab District administers the Green River from Sand Wash, 96 river miles upstream from Green River, Utah, to the northern boundary of Canyonlands National Park, about 45 miles above its confluence with the Colorado River.

As has been well-documented, much of the Colorado River has been drastically altered by the actions of man. The lower Green River, perhaps more than any

other section of the big river system, has remained much like it was originally. Even there, however, the influences of man can be felt. Flaming Gorge Dam, by storing water during peak flows, has reduced maximum flow levels in the lower canyons. Daily discharge cycles can be seen in the fluctuations in flow level downstream.

Sand Wash, main access point to the river below Ouray, is situated at the lower end of the shale oil-bearing Green River formations. This gives way to the reddish Wasatch Formation that forms the heart of Desolation Canyon. There are steep walls on both sides rising to over 2,000 feet, bisected periodically by tributary canyons off of neighboring ridges. Where these tributaries enter the Green River they have formed extensive alluvial fans that provide most of the riparian habitat in the canyon and create rapids and riffles. Below Florence Creek, the Wasatch Formation gives way to the Mesa Verde Group, a grayish rock forming only short bluffs along both sides.

At Green River, Utah, where the Mancos Shale predominates, there is a stretch of relatively flat land where major east-west travel routes cross and a thriving agriculture has developed. Below Green River, the river again cuts downward, this time creating steep sandstone walls several hundred feet high. In this lower stretch of the river, called Labyrinth Canyon, the Green River has extensive riparian areas on both sides, but lacks the rapids and riffles found in Desolation and Grey Canyons.

Productivity is limited in the river because of unstable substrates and heavy silt loads. In general, 90% of the productivity occurs in the rapids and riffles area. Actual figures for productivity are not available, but estimates are that the standing crop ranges from 1-5 $gm/M^2$ in the more unstable substrates, to a range of 10-25 $gm/M^2$ in the rapids and riffles. Of the 155 kilometers from Sand Wash to the town of Green River, 14.42 km is classified as rapids and 15.45 km as riffle, which provides most of productive capacity in the Green River within the Moab District.

Desolation/Grey Canyon receives heavy recreation use from float boaters. It tends to concentrate in the May to July period, with some use in the August to November period. Permits have been required for non-Indian use since 1973. Visitor use for the period, based on permits issued, was:

Desolation-Grey Canyon Visitor Use-Passenger Days

| Type of Use | Allocation | 1973 | 1974 | 1975 | 1976 |
|---|---|---|---|---|---|
| Total commercial use | 19,401 | 7,489 | 8,125 | 12,861 | 11,846 |
| Total private use | | 1,622 | 4,127 | 10,334 | 12,326 |
| Total use | | 9,111 | 12,252 | 23,195 | 24,172 |

Permits are not required for Labyrinth Canyon. Heaviest use there is during the Friendship Cruise, when several hundred vessels make the trip on the Green and Colorado rivers from Green River, Utah to Moab.

Greatest non-recreational use along the river is agriculture and mining. Irrigated farming is centered near the town of Green River, drawing its water

supply from the Green River. Grazing is found along the river. Two ranches, Rock Creek and McPherson Ranches, once existed in Desolation Canyon, but neither is functioning any longer. McPherson Ranch has been converted into a comfortable resort by the Ute Indians.

Oil was first discovered in Utah near the town of Green River. Further drilling continues throughout the adjacent areas. Uranium was found along the lower Labyrinth Canyon area. Many abandoned or inactive mines dot the area, some adjacent to the river.

Coal is found in the Book Cliffs at the mouth of Grey Canyon. Several mines are found in nearby areas, but none actually in the river canyon. In recent coal lease nominations, the area near the mouth of Range Creek, a tributary in Grey Canyon, was one of the sites nominated for future leasing. An energy corridor running from the town of Green River to Price has been proposed that would coordinate development of the energy resources in the area.

No recent studies of fish populations have been made. This summer Colorado squawfish were taken near Florence Creek, the Price River and near the town of Green River; humpback chub were seen at several points between Sand Wash and Rock Creek; and one bonytail chub was caught near Chandler Creek, with three other unconfirmed reports from near McPherson Lodge.

San Juan River

The San Juan River just within the Utah state line is entirely within the boundaries of the Navajo Indian Reservation. The rest of its length in Utah and San Juan River serves as the northern boundary of the Indian Reservation. The northern bank is divided between the BLM and the National Park Service Glen Canyon National Recreation Area.

The upper 40% of the river in Utah flows between bluffs, with a rather broad river valley. Several miles below the town of Bluff, the river begins to cut a canyon as it seeks the level of the Colorado River. This canyon becomes deeper and narrower below Mexican Hat, with very little riparian area. Eventually, it flows into Lake Powell. The river is broad, flat, and shallow, with a heavy silt load. This is reflected in the unstable, silt-sand bed. There are few riffle or rapid areas above Mexican Hat.

The San Juan River is the third river in the District with a sizeable recreation use. Because of the sudden drop in releases from the Navajo Reservoir, river trips usually stop abruptly around the fourth of July. Visitor use is primarily from Bluff to Mexican Hat; some use occurs to Lake Powell, but access points are limited. Based on permits issued, visitor use between Montezuma Creek and Mexican Hat for the first three years was:

San Juan River Use-Passenger Days

| Type of Use | Allocation | 1974 | 1975 | 1976 |
|---|---|---|---|---|
| Total commercial use | 2,692 | 862 | 1,199 | 700 |
| Total private use | | 900 | 1,604 | 3,651 |
| Total use | | 1,762 | 2,802 | 4,351 |

Three activities are found extensively along the river: grazing, irrigated farming and mineral extraction. Topography permits irrigated farming downstream to the Bluff area, but not further because of the narrowing canyon. Grazing is found all along the river on NRL and Indian lands.

The major mineral is oil. The Aneth Field near Montezuma Creek is one of the largest in Utah, with wells along the river and stretching into the neighboring hills. New drilling is underway over a broad area. Some small spills have occurred, but nothing major to date.

No recent inventories of fishes has been made in Utah. Humpback suckers were found in rather abundant numbers in one irrigation pond taking water from the river near Bluff, but otherwise there is no information available on fishes present or population sizes. Macroinvertebrate and chemical studies were conducted this past summer but no results are yet available.

Dolores River

Most of the Dolores River is in Colorado, with only the lower 28 miles in Utah. All of the Utah portion is in a canyon, with only occasional broad floodplain area, mostly broad, flat, with an unstable bed of silt, sand and gravel. Flows fluctuate widely; in summer, as a result of water extractions upstream, it is nearly dry.

Grazing occurs along its length. Some agriculture occurs where sufficient flat land can be found near the river. There has been extensive placer mining, some of it still occurring. Uranium has been found in nearby areas, and extensive exploration is still underway.

Uranium processing began upstream near Uravan in the 1950s. Populations of fish declined as a result of pollution from the mines and processing plants. The pollution from the uranium industry has been reduced, but fish populations have not recovered. One reason is the extremely low flows as a result of upstream summer diversions. The other is the heavy salt concentrations coming from water originating in the Paradox Basin near the Colorado-Utah state line. Native fish species were once common in the river, but are now essentially absent.

Some float boating takes place in spring when flows are greatest, but the rapid drop when irrigating season begins limits recreation use. The Dolores River above the state line is being considered for Wild and Scenic designation; the portion in Utah was not included in the original proposal, but may be included under the same Wild and Scenic River proposal now being studied on the Colorado River.

San Rafael River

Headwaters of the San Rafael River are in the Wasatch Mountains, arising as typical mountain streams. These streams enter a flat valley where Ferron, Huntington, and Cottonwood creeks join near the town of Castle Dale to form the San Rafael River. The river cuts into an area called the San Rafael Swell, where it flows in a deep, rocky, inaccessible canyon. Below the Swell the

San Rafael crosses a flatter, broken area dominated by the Carmel Formation and Sandstone before flowing into the Green River.

Much of the human activity associated with the San Rafael River occurs in the headwaters area. Coal is found in the canyons along the headwater streams. Several reservoirs have been constructed to provide water for irrigation and energy development. A coal-fired power plant has already begun operation near Huntington, and a second plant is under construction near Emery. Both of these plants draw water from the San Rafael system. Water is also utilized for grazing, farming and domestic use in the valley area between the Wasatch Range and the San Rafael Swell.

Little activity occurs within the Swell. There, and downstream towards the mouth, the only real activity is grazing.

The San Rafael, typical for the area, carries a heavy silt load. There is limited riffle or rapid areas, mostly found in the canyon of the Swell. Below the Swell, the banks are dirt, more like a wash than a canyon. Flows have been reduced as a result of upstream withdrawals, so that silt and dissolved solid levels have risen as flows have declined.

Historically native threatened and endangered species of fish were found in the San Rafael River, but none have been found in recent years. Tolerant forms, such as flannelmouth suckers and speckled dace, predominate.

Price River

As with the San Rafael, the Price River begins as a series of typical mountain streams which join at a point now inundated by the Scofield Reservoir. Near Price the Price River emerges into a valley area at the base of the mountains. It enters a canyon area on the northern end of the San Rafael Swell, running in a shallow canyon for several miles before emerging to cross a flat portion of the Mancos Shale. Fourteen miles above its confluence with the Green River, it enters a canyon cut into the Book Cliffs in which it flows to its terminus.

The major human activity near the Price River is energy development. Not far below Scofield Reservoir the Price River enters the Castle Gate coal fields. There, the river is channelized, with coal mines and load facilities on both sides. A coal-fired power plant is in operation near the mouth. Near Price, water is utilized for agriculture, grazing and domestic use. Even below Price, tributaries from coal-bearing areas to the north enter the river. Little use is made of the water below Wellington as a result of the high salt concentrations.

Below the Wasatch Mountains the river flows generally between dirt banks. The bed is silt and sand with very little rock. It is predominately shallow, slow-moving water, with very little riffle area. Trout are found in the headwaters area. Only tolerant forms, such as flannelmouth suckers and speckled dace, dominate the lower reaches.

### Muddy River

The Muddy River is the third major stream originating in the Wasatch Mountains. It crosses a valley near the town of Emery before entering a rocky canyon. It joins with the Fremont River near Hanksville to form the Dirty Devil River. Most of its length it flows within dirt banks with some rocky areas in the canyons. Flows in summer are quite low with some dry sections. Salt concentrations are high. Silt loads are high, particularly during the periodic floods.

Water is removed for grazing, irrigation and domestic use. Most activity is in the valley area below the Wasatch Mountains. A proposal has been made to build a storage dam, but it has not yet begun. This would be primarily for agriculture use. Near its mouth, the large IPP Power Plant has been proposed. While it would be in the Muddy Creek drainage, most of the water would come from the Fremont River and groundwater.

## Other Streams

Three other types of streams are found in the Moab District. Often, one stream will show characteristics of two or three types as it crosses different terrain or formations.

### Mountain Streams

Reference has already been made to the fact many of the streams in the District begin at higher elevations as typical mountain streams. Since the U.S. Forest Service administers the higher elevations in the Wasatch, LaSal, Abajo and Book Cliff Mountains, headwater areas are seldom under BLM control. A number of streams, such as the headwater streams for the San Rafael, Price and Muddy Rivers, Indian Creek, Dark Canyon, LaSal Creek and Mill Creek, begin on the Forest but still retain mountain stream characters even after entering NRL lands.

These streams are typified by narrow canyons, moderate to steep gradients, rocky beds, and alpine vegetation. Water arises from springs and from seasonal snow melt. Fish, when present, are rainbow trout, sculpins, with some dace and suckers. Cutthroat trout were probably native to the area, although they have been supplanted by rainbow trout. In at least two streams, Indian Creek and Rock Creek, trout with cutthroat markings have been found, but it is uncertain whether or not they represent a remnant population.

Mountain streams are subjected to less flow variability, temperature fluctuation and flooding. Most have been impacted by humans to at least some degree. In the Wasatch and Book Cliff areas the development of coal mines and power plants have had severe impacts. In more inaccessible areas, such as Dark Canyon, human influence is minimal.

Because of the rugged terrain in the area, canyons make natural access points so that much of the road construction and recreation use has centered in the canyons. Grazing, uranium development and some farming occur along these streams.

## Washes

Many of the streams, particularly those off the Book Cliffs, cross a flat plateau area with low gradients. Perhaps the largest such area is the Mancos Shale area that runs almost the entire length of the District from east to west in the northern part of the District. When crossing these flatter areas, the streams form typical washes, with dirt banks, flat sandy beds, and a general absence of surface flow. Vegetation in these areas is centered in the Wash bottoms, and is usually willow, tamarisk and cottonwoods.

Because of the absence of springs or other water sources, there is seldom perennial water in the washes. Even where water is perennial there is often an extreme temperature fluctuation as a result of the lack of shade and the shallowness of the water. Occasional severe flash floods occur.

Fish are seldom found in the washes. There are some transient populations. Those which are found are usually highly tolerant forms, such as killifish, which can tolerate the severe conditions.

Absence of water also limits the development in the area of washes. Grazing is the primary activity. Because of the shortage of water and vegetation the cattle tend to congregate in the wash bottoms, so that severe pressures are put upon the riparian vegetation. Some uranium and oil exploration occurs also, but development is limited.

## Deep Canyons

As already mentioned, the major rivers have cut deep canyons across most of the District. Tributary streams, in reaching down to the level of the major rivers, have cut similar, smaller tributary canyons. Like the river canyons, these smaller canyons have steep rocky sides and narrow bottoms. Often they end abruptly several miles from the river; all have steep gradients, at least in their upper ends.

Water depends on availability of a source. In mountain regions, there is usually a perennial source from headwater areas. In most of the canyons, water comes from seeps and springs along the sides or in the bottom. These springs occur most commonly along seams in the rocks. Flows are highly variable, being greatest in the spring. There are periodic flash floods.

Fish are found in several of these deep canyons; usually they are an extension of the populations in the larger rivers, such as speckled dace, suckers, fathead minnows, etc. During the spring when flows are high, many of these fishes move from the big rivers into the tributary canyons, spawning there. As the waters recede, the fish move back down into the big rivers, leaving only an occasional remnant population of the more hardy species. Because of the interchange with the big river, any native populations have a constant renewal that limits the possibility of development of new forms. In only one instance (Hatch Wash, which is isolated nearly the full year from the Colorado River some 15 miles downstream) exists a population of fish that, to date, has not been identified.

Survival in the canyons seems a precarious existence. Flows fluctuate widely, and in the driest year most streams dry up completely. Winter brings intense cold that freezes most of the streams, while summer temperatures can climb into the 80s or higher. Where fish have survived, it appears they require not only a perennial flow, but one that depends upon seepage and springs to moderate climatic variability. Where the streams have been disturbed, as with intense grazing, construction or mining, the natural vegetation is lost, pools silt in, and the streams no longer retain their fish populations.

The canyons, because of their rather sharply defined topography, have a tendency to concentrate human use. Much of the mining exploration for uranium occurs in the canyons where seams are exposed along the sides. Roads are often built along the canyon bottoms. The canyons also concentrate livestock use so that intense grazing occurs along the banks.

The Canyons area was also home to the pre-white residents. Because of the availability of water, their populations also concentrated along the canyon bottoms. Ruins of these Anasazi villages are found all along the canyons, particularly in the San Juan River drainage. These ruins act as a natural attraction for recreation use, four-wheel activity and pothunters, which puts additional stress on such areas.

## Fish Populations

Over 70% of the fish species in the Moab District are exotics, introduced by design or accident. The dominance of the introduced fishes stems from their greater competitive ability and the alterations which have been made in the aquatic habitat. In the smaller streams, the demands for water and the alterations due to human activity have reduced stream flows, removed riparian vegetation, and increased silt and dissolved solid levels. Fish populations have been reduced or eliminated. The introduction of rainbow trout in all accessible streams has led to the probable elimination of the native Colorado River cutthroat. As mentioned, possible remnant populations have been found in two streams, but even there they have, if present, probably interbred with the rainbow.

There are a few streams, of which Rattlesnake Creek shows most promise, that may have remnant native trout populations.

In the big rivers, the construction of dams and the removal of water have altered the natural habitat. Within the Moab District, this alteration has probably been less than in any other area within the entire Colorado River drainage. Within Desolation and Grey canyons, Labyrinth Canyon, and the Colorado River there persists much of the remaining unaltered natural habitat for native species. Even here, there is intense pressure from introduced species which show much greater competitive ability.

All four of the threatened and endangered native species have been seen in the District within the last year. Desolation Canyon, in particular, seems to be a stronghold of these remnant populations. Sightings have been accidental or the result of sport fishing.

## Management Problems

A number of management problems that have a direct effect upon the river systems are receiving consideration. At the present time energy and grazing have the highest priority as the result of environmental impact statements that will have to be written in the near future. Several other studies are also underway for proposals dealing with coal and other energy development, Wild and Scenic River proposals, and the increased recreation use in several areas.

### Energy

Three types of energy development are underway in the District: coal, uranium and oil. A fourth, shale oil development, is proposed in areas directly adjacent to the District and would have an impact on waterways in the Moab District, but none of the development areas are directly under Moab District administration.

Coal - Coal is found in the Wasatch Mountains, Book Cliffs, and Henry Mountains. Mining originated in the Price-Castle Gate area, and is still centered there. Most of the current mining operations are in the Wasatch Mountains southward from Price to Emery, and in the Book Cliffs eastward from Price. Many coal-bearing areas have yet to be opened up. In 1976 nominations for new coal leasing areas were requested by the Department of Interior. The nominations are now being reviewed for possible future action.

Mining is often conducted along stream channels, with loading yards, processing and hauling facilities, coal washing areas and staging areas near streams. Some water is removed, but more often the effect is more from dumping and construction along the stream than from utilization of water. Some mines produce water which is eventually put into the streams, although there are controls on discharge. More of a problem is the coal fines and dust falling into the water, and the destruction of riparian habitat associated with the mining operations. Where intense mining has occurred, fish populations have usually been reduced or eliminated altogether.

Removal of water for the development of coal energy is more of a problem with the continued development of coal-fired electric steam generating plants. Two plants, one at Huntington and the other at Castle Gate, are already in operation. A third, the Emery power plant, is under construction. A fourth, the IPP plant, is proposed just south of the Moab District in the Muddy River drainage.

In addition, an energy corridor, running from Green River to Price, has been proposed. This would involve the construction of a series of smaller coal-fired power plants, energy-needing industries, and the support facilities for people working in the area. Water would be drawn from streams in the area, particularly the Green River. Already a dam has been proposed on the Green River in Grey Canyon which would be for storage and water supply for energy development.

Uranium - Uranium is found in Grand and San Juan counties. Moab, in fact, was the center of the big uranium boom of the 1950s, a boom which did much to

open up the surrounding areas. Claim markers, mine shafts, abandoned roads and tailings piles still dot the canyon areas around Moab. Several mines and processing plants are still in operation, but these are mostly run by large firms rather than the small-time operator. As a result of a recent price increase for uranium, interest has picked up and much new exploration is underway throughout the region. The recent BLM Organic Act, with its new regulations on filing mining claims, may have some impact on the disposition of many abandoned claims in the area.

There is little direct radiation hazard from the mining and milling of uranium ore. More of a problem is the long-term storage of tailings and waste, and the drainage from abandoned mines. To date, almost nothing is being done to see if there is any problem arising from abandoned facilities. Mine processing wastes can remain "hot" for literally hundreds of years; care is taken to ameliorate any hazards at active processing plants, but a long-term monitoring and control problem is probable.

Oil - The first producing oil well in Utah was developed near Green River. Some exploration and exploitation still continues throughout Emery, Grand and San Juan counties. Largest producing area is the Aneth Field along the San Juan River near the Four Corners area. Producing wells in the Aneth field are found along the river bottom, in adjoining washes, and on neighboring hills. Several small leaks have occurred, but no major spills. Because of the aridity of the terrain, small leads can be easily contained.

## Minerals

Historically, gold was placer mined along the Dolores and Colorado rivers. Remnants of the operation are still visible in Westwater Canyon and along the Dolores. Some placer mining still takes place along the Dolores, but most of it is upstream in the state of Colorado.

Copper was also mined, but only on a small scale. At least one semi-active mine still exists near Arches National Park; it operates only when prices are high and the operation becomes economical.

The largest mining operation is for potash. Potash is mined by solution, then collected by evaporation in the solution in large ponds near Deadhorse Point State Park. The potash is processed in a plant nearby and shipped out by railroad. Sodium chloride, a by-product of the operation, is stored in ravines behind the plant. Exploration for additonal supplies of potash is underway.

## Grazing

As a result of a lawsuit by the National Resource Defense Council, BLM will be writing 212 environmental impact statements on grazing for all BLM-administered lands throughout the West. The Canyonlands EIS, near Moab, will be the second one written in Utah, and is currently underway.

Grazing, perhaps more than any other activity in the District, has had a detrimental effect on the riparian habitat. Because of the competition for open range in the early days of white settlement, many of the ranges were severely

overgrazed. This was particularly true of the alpine summer ranges. Winter range exceeded summer range capacity, but, in order to try and control as much of the range as possible, herds were based on the capacity of the more extensive winter range. As a result, some of the summer range was so badly overgrazed that cattle could not find enough to eat.

Because of the shortage of water and shade, the tendency is for cattle to congregate along the waterways. In the alpine areas, many now under Forest Service control, the destruction of riparian habitat was so severe that once well-defined mountain streams became wide gravel beds with little bankside vegetation.

Even today, the penchant of cattle for waterways leads to problems in maintaining riparian habitat. It is usually the riparian areas that suffer first and the most. The cattle eat the streamside vegetation and trample the ground, breaking down banks and polluting the streams. This has led to a loss of vegetation and increased erosion. Silt loads increase, and the pool areas fill in. Where grazing use is heavy, fish populations on NRL lands are reduced or absent. It is not an easy problem to deal with, since it has proven impossible, even if it were desireable, to fence off all riparian areas. No way has yet been found to effectively disperse cattle when they prefer the shade and water of the riparian areas.

Recreation - One form of recreation which has received a growing amount of attention in the Moab District is float-boating. With its collection of major rivers, the Moab District probably offers more float-boating opportunities than any comparable area in the country. The two most visited runs are Desolation-Grey Canyon and Westwater. A smaller contingent float the San Juan. Seasonal and daily use is also common on the Dolores, in Labyrinth Canyon, and on the Colorado River between Moab and Dewey Bridge. Many of the float trips through Cataract Canyon also originate within the Moab District, although Cataract Canyon itself is under National Parks jurisdiction.

Use centers on the May to July period, with some activity in the late summer and fall. In two canyons, the San Juan and Westwater, camping sites are somewhat limited; in Desolation, because of its length, there are more sites available. Yet, boaters tend to favor a few sites, usually because of the presence of potable water or unusual sights. Areas which receive heavy use often suffer the usual effects of over-utilization; damaged vegetation, an accumulation of fire pits and ashes, garbage, and human wastes.

In 1973 a permit program was instituted to put some controls on river use. Commercial operators now receive seasonal allocations of visitor use. Private parties must obtain permits for floating the river, but as yet no restrictions have been placed on the number of parties going on the river in a season. In addition to Utah and Coast Guard regulations, each party is to provide a fire pan for fires and a portable toilet. Most parties have cooperated with efforts to preserve the canyons. Still, some problems persist.

For instance, in Desolation Canyon there are only five streams with perennial flow; only two of these are of good quality and readily accessible. One of these, Rock Creek, was once the site of an early ranch. A ranch building

complex was constructed of stone, and irrigated farming begun. Later, the farm was abandoned but grazing continued. Today, the whole operation has been abandoned. The ranch, plus nearby Indian petroglyphs remain a popular drawing card.

Rock Creek itself originates at a series of springs about two miles from the Green River. It has a perennial flow in excess of 7 cfs, with clean, cold water. It has a population of rainbow trout, apparently immigrants from upstream, and perhaps a remnant of a native Colorado cutthroat trout population. Because of the clean, cool water it is popular not only as a water supply but for bathing, fishing, and other activities. Until this year, it received heavy use as the most popular camping spot on the river.

Vegetation was removed on nearby fields during the period the area was used as a ranch and farm. The vegetation along the stream recovered much faster than neighboring fields, partly because the stream flows between steep alluvial banks several feet deep. In using the stream, visitors have had to go down these banks. They have broken through the banks, trampled vegetation along the stream, and in general opened the way for increasing erosion. In order to preserve this unique habitat, a management program was implemented to try and limit use along the creek and to repair some of the damage through bank protection and plantings.

Other recreation problems are typical of other areas, such as control of off-road vehicles, camping and hiking. Because of the sharply defined canyon habitat, there is a tendency to concentrate activities in the canyon bottoms. This means that the impacts on riparian areas are likely to be more intense than for similar activities in other areas. The fact that many of the attractions, especially Indian ruins and scenery, are usually found in the canyon bottoms, acts as a drawing card for these areas, so that an inordinate amount of the recreation activity centers in the canyons.

Salinity - As part of a basin-wide study, the Moab District has begun studies into the sources and concentrations of salts reaching the Colorado River. Several causes of increased salinity have been mentioned: reduced flows in streams, increased erosion from grazing, mineral activity, and return of irrigation water, domestic effluent, and other activities along the streams. While salinity increases in the Colorado River itself are of interest, there have been some problems within the District itself, particularly in the Price and San Rafael rivers where increased loading and lowered flows have made downstream areas practically unusable.

## Threatened and Endangered Species

Four species of endangered Colorado River fishes are known to be in the Moab District. As mentioned, much of the best remaining natural habitat left in the Colorado system is within the District. As a result, consideration is being given to these threatened and endangered species in District planning. A major problem is the shortage of recent data on the population sizes and distribution, and on the habitat requirements for these fishes. Efforts are being made to coordinate with the Colorado River Fishes Recovery Team and other agencies in developing studies and planning.

Colorado cutthroat were probably native to the Moab District, but, to date, no pure populations have been found. Several streams which may contain populations are due for study in the future as time permits. Most of these are tributary to Desolation-Grey Canyon, and the Dolores River in Utah.

Summary

The Moab District has over 1,000 miles of streams, including over 500 miles of major rivers, including some of the major remaining Colorado River natural habitat. Because of the growing demand for use of these rivers for power, water supply, energy development and recreation, there is a need to learn more about these rivers and their tributaries. Studies have begun and will continue of physical habitat, chemical constitution, biotic communities and fish populations. An inventory of smaller streams is underway, with emphasis on these streams in the problem areas. An attempt is being made to locate and define populations of threatened and endangered fishes in order to better manage the aquatic resources of the Moab District of the Bureau of Land Management.

## The Extirpation of Endemic Pupfish from Laguna Prieta, Sonora, Mexico

Boyd Kynard and Bob Garrett, University of Arizona, Tucson

A short film was presented documenting an expedition to Laguna Prieta in northern Sonora, Mexico in May 1976. The purpose of the expedition was to collect samples of pupfish which were seen as recently as December 1974 by a National Park Service ecologist.

No pupfish were observed in the main body of water due to water quality conditions. Salinity was six times that of sea water. Even so, it was teeming with Artemia.

Water quality conditions in a small marshy area 60 meters west of the main body of water were well within acceptable limits for pupfish and similar to water quality in 2 other habitats in Sonora which support thriving pupfish populations. This marshy area was later identified as the site of the former pupfish population.

However, there were no pupfish trapped, seined or observed in the marshy area.

The apparent cause of the extirpation was due to the removal of the water from the marsh to irrigate an adjacent garden. As of May 1976, neither the gardeners nor the pupfish were present at Laguna Prieta.

Editor's Note: This classic presentation will long remain in the memories of those in attendance, not unlike a strong desert windstorm.

## A Preliminary Study of the Inyo Mountain Salamander, Batrachoseps campi

Larry S. Mangan, Bureau of Land Management, Bishop

A new species of salamander was discovered in the Inyo Mountains of Inyo County, California, in 1973. In 1976 the BLM contracted for a study of this salamander in the Saline Valley area. The BLM study has significantly extended the range of this salamander. It has been found in elevation ranges from 1600' to 8600' and in almost every major canyon in the area. All specimens have been found in moist areas, usually under rocks which have soil underneath. The species is also found under vegetation and in rock crevices where the proper temperatures and humidity requirements are met. Studies are underway elsewhere to determine the exact species status of this salamander.* Management will concentrate on protecting the habitat of this species.

## Wild, Free-roaming Burros of Saline Valley, California: An Evaluation and Management Plan, 1976

Jerry Stefferud, Inyo National Forest, Lone Pine

With protection offered by state and federal legislation, the number of feral burros in Saline Valley, Inyo County, California, has increased beyond the carrying capacity of the habitat, and a plan for the management of those animals and their habitat is indicated. A study of the burros, their habitat, and their effects on other resources in Saline Valley was conducted from November 1974 to August 1975 by the U.S. Forest Service and Bureau of Land Management, and the State of California.

That study determined a total of 201 burros existed in three distinct herd units. Although interchange between the herds probably occurs during winter, the burros' maximum range during summer was restricted by the availability of water. Adult sex ratio was approximately 2 males/female. Recruitment by natality was high: foals surviving to three months of age equalled 77/100 females.

Established Forest Service range techniques were used to determine carrying capacity, and soil and forage conditions. Carrying capacity was estimated to total 108 burros. Form and age class analysis of the burros' preferred forage showed it to be in poor condition with a downward trend, and soil condition was rated as unsatisfactory.

The Saline Valley region is managed for a variety of resource values within the goal of providing multiple uses for public welfare. Dominant activities included mining, recreation, and some livestock grazing.

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*The species was described in:
Marlow, Ronald William, John M. Brode, and David B. Wake. 1979. A new salamander, genus Batrachoseps, from the Inyo Mountains of California. Contrib. in Science, Nat. Hist. Mus. of L.A. County, No. 308, March 16, 1979.

Unique resource values known to occur in the Saline Valley area for which special management was required included: (1) small populations of desert bighorn sheep, (2) populations of rare and threatened plants, and (3) a newly described salamander (Batrachoseps campi).

All this information was assimilated into a management plan for the wild, free-roaming burros of Saline Valley. The objectives of the plan were: (1) to maintain healthy vegetation, (2) to provide for native wildlife, (3) to protect threatened and rare plants, and (4) to maintain the burro population as directed by Federal legislation.

Procedures that will be used to accomplish these objectives are: (1) to reduce the number of burros to within the carrying capacity of the resources, (2) to monitor the health of plant and animal habitats, (3) to monitor the condition of the forage plants, and (4) to monitor the effects on the burro population.

In summary, burros in Saline Valley are out of balance with their habitat, and as a consequence other resources suffer. A management program is needed to correct this. Our program calls for a reduction in burro numbers and monitoring of resource conditions.

## SESSION IV - Agency Reports

### Arizona Progress Report

Donald Siebert, Wildlife Biologist

### Studies and Inventories

Two contracts were initiated in FY 76 to gather fisheries information. These were the Aravaipa Creek and Gila River Complex Baseline Wildlife and Water Quality Studies.

Aravaipa Creek Study - This contract was let with Drs. Minckley and Sommerfeld of Arizona State University, to study eight endemic fishes of the Aravaipa Canyon. The species include loach minnow and others. The study also includes the impact of the green sunfish on the system. In addition to the water quality studies, the study will also provide information on the impacts of livestock grazing and recreational use on the ecosystem. The study will last about two years.

Gila River Complex Study - This contract was let with Drs. Minckley, Ohmart and Sommerfeld of Arizona State University to collect baseline terrestrial and aquatic wildlife, fisheries, and water quality information, plus the impacts of potential geothermal steam development and existing mining operations on the ecosystem. The contract will cover 55,000 acres, including 60 miles of streams along the Gila River, San Francisco River, and Eagle and Bonita Creeks. Impacts of livestock use, recreational use, and agricultural use on the system will also be addressed. The study is for two years.

### Development and Implementation of Habitat Management Plans

The Cocio Wash HMP for the endangered Gila topminnow, the first aquatic HMP in the state, will be completed this next month. The plan is being written

jointly with the Arizona Game and Fish Department under the Sikes Act. The plan calls for fencing out the entire habitat and known population of the Gila topminnow in the wash on NRL (one mile of stream). The improvement work will be completed this FY.

Three aquatic HMPs are tentatively scheduled to be written under the Sikes Act for FY 78. These are: Aravaipa Creek, Burro Creek and Trout Creek. The latter two areas are on the Santa Maria Drainage system, south of Kingman. Aquatic habitat inventories and stream surveys are being conducted this FY by BLM personnel on Burro and Trout creeks.

## An Agency Report to Desert Fishes Council
## U.S. Forest Service: Rocky Mountain Station, Tempe, Arizona

John H. Rinne

As the fishery biologist for the Station at Tempe, I will work strictly with rare and endangered species of fish. This is part of a 3-year program directed toward research with rare and endangered vertebrate species. The work unit description for the endangered fishes species research includes three major efforts:

1) Extensive stream survey work in Arizona and New Mexico
2) Habitat evaluation of Arizona and Gila trouts and,
3) Cooperation and coordination with recovery teams.

Rare and endangered species are designed on the basis of reduction in numbers and/or range. Accordingly, statewide surveys are planned and will be oriented toward finding new localities for both state and federally listed fish species. This work in part is under contract with Arizona Game and Fish Department. Similar avenues will be followed in New Mexico.

Selected streams in the Gila River headwaters in New Mexico and the White Mountains of Arizona will be studied to determine habitat requirements of the Gila and Arizona trouts, respectively. Physical, chemical, and biological factors will be measured intensively in several streams for each species. Other streams will be examined in a more cursory manner. The factor or combination of factors which is/are most important (correlated with) trout biomass and numbers will be determined. This information can conceivably be used in selection of streams for reintroduction and expansion of ranges and for future management of these two trouts as sport fisheries.

The effects of grazing and logging on trout habitat will also be measured where appropriate. McKnight Creek in New Mexico (Gila National Forest) has been placed under stringent grazing control to facilitate studies for endangered species. The effects of logging on trout habitat will be examined primarily in streams on the White Mountain Apache Indian Reservation.

The Colorado squawfish, Gila topminnow, and woundfin are included in the research work unit description. To date, meetings of existing recovery teams have been attended. The Salt River is a prime locality for probable persistence of the squawfish. Attempts to rediscover this species in the Salt River Canyon will be made. This reach of stream is also a possible reintroduction and monitoring area as designated by the Recovery Team.

## The Arizona Trout Recovery Team Report

Presented by John H. Rinne for Bill Silvey

Salmo gilae is most common (7 streams) on the White Mountain Apache Indian Reservation, but has been introduced into over a dozen streams on the Apache, Coronado and Kaibab National Forests. The success of these attempts to increase its range are unknown.

A draft copy of the recovery plan for this threatened salmonid is in existence. Resignation by Joe Stone as Team Leader in summer 1976 has slowed progress on production of a final copy and recommendation of critical habitat. The step-down plan includes provisions for both maintaining and increasing wild populations and establishing a hatchery brood stock to serve as a "refugium" and for future implantations.

## U.S. Fish and Wildlife Service, Albuquerque Regional Office Report

Jim Johnson, Endangered Species Biologist

Area offices will be established in Phoenix, Arizona, and Austin, Texas. One of the professional staff members in each office will have his time equally divided between endangered species and fisheries services.

Recovery Plans:

Colorado squawfish - Recovery Team being expanded to Colorado Fishes Recovery Team, and will include Gila cypha immediately, and Gila elegans and Xyrauchen texanus when they are listed. Critical habitat and the Environmental Analysis for the Colorado squawfish have been sent to Washington. The areas recommended were: the Yampa River from Milk Creek to the Green River, the Green River from the Yampa River to the Colorado River, the Gunnison River from the Highway 141 Bridge to the Colorado River, and the Colorado River from Plateau Creek (above Grand Junction, Colorado) to Lake Powell, a total of approximately 623 stream miles. A final draft Recovery Plan is nearly ready to be sent out for comments. Region 6 will be administering this team from now on.

Woundfin - The critical habitat recommendation has been sent to Washington. It includes: the Virgin River from LaVerkin Springs to Lake Mead, and the lower six miles of LaVerkin Creek. A final Recovery Plan draft is nearing completion.

Gila trout - Second draft Recovery Plan nearing completion. Critical habitat should be submitted by year-end.

Apache trout - First draft Recovery Plan nearing completion.

Listing: six species of fish have been recommended to the Washington Office for listing as endangered. They are: San Marcos gambusia, Amistad gambusia, Leon Springs pupfish, Devil's River minnow, toothless blindcat, widemouth blindcat.

Species Reports:

Big Bend gambusia - The population of Gambusia gaigei was nearly extirpated by cold water last winter in Big Bend National Park. The NPS is presently assisting in the development of a management plan for this species that will include rejuvenation of a spring and stream habitat.

Gila topminnow - Several artificial and natural habitats were checked this September. Of 68 listed waters planted by Arizona Game and Fish with Poeciliopsis occidentalis, only one (Boyce-Thompson Arboretum) is known to be successful. Natural populations are still found at: Bylas Springs, Monkey and Cottonwood Springs, Cocio Wash, Santa Cruz River (near Lochile, Arizona), and Cienega Creek.

Rio Yaqui - In September, Leslie Creek was found to be nearly dry and Austin Spring was dry. Gila purpurea and the Yaqui topminnow were moved to Dexter NFH for safety. Both species still exist in two small springs on the San Bernardino Ranch.

## Abstract Agency Report from New Mexico

Michael Hatch, New Mexico Department of Game and Fish, Albuquerque

Following passage of the Endangered Species Act of 1973, the State of New Mexico made complimentary provisions for the protection and restoration of their endangered or threatened fish and wildlife with the passage of the Wildlife Conservation Act of 1974. The New Mexico Department of Game and Fish was designated as the responsible agency to implement the provisions of the Act. Presently, four biologists have been hired to work with endangered and threatened fish and wildlife on a full time basis; one of the four biologists concentrates strictly on fish.

Today, thirty species of fish are protected under the Wildlife Conservation Act. This number represents approximately a third of the state's native fish. Four of these species are also regarded as endangered throughout their range by the Secretary of the Interior, these being the Gila trout, Colorado River squawfish, Pecos gambusia and Gila topminnow.

Among our protected fish, only the White Sands pupfish is entirely confined to New Mexico. Fourteen species occur only in our state and in an adjacent one or two. This indicates that in spite of many of the species being peripheral in our area, they are not widely distributed. Consequently, the protection afforded them in New Mexico may be quite significant. Following is a list of the species of fish which New Mexico considers to be endangered or threatened:

Endangered Species and Subspecies of New Mexico

Group No. 1 - Species and subspecies whose prospects of survival or recruitment in New Mexico are in jeopardy.

shovelnose sturgeon, Scaphirhynchus platorynchus
American eel, Anguilla rostrata
Gila trout, Salmo gilae

blue sucker, Cycleptus elongatus
gray redhorse, Moxostoma congestum
bonytail chub, Gila elegans
Mimbres chub, Gila nigrescens
Colorado River squawfish, Ptychocheilus lucius
southern redbelly dace, Phoxinus erythrogaster
bluntnose shiner, Notropis simus
beautiful shiner, Notropis formosus
proserpine shiner, Notropis prosperpinus
silverband shiner, Notropis cf. shumardi
Arkansas River shiner, Notropis girardi
Pecos gambusia, Gambusia nobilis
Gila topminnow, Peociliopsis occidentalis occidentalis

Group No. 2 - Species and subspecies whose prospects of survival or recruitment within the state are likely to be in jeopardy within the foreseeable future.

Mexican tetra, Astyanax mexicanus
Zuni mountain sucker, Pantosteus discobolus yarrowi
roundtail chub, Gila robusta
loach minnow, Tiaroga cobitis
suckermouth minnow, Phenacobius mirabilis
roundnose minnow, Dionda episcopa
spikedace, Meda fulgida
rainwater killifish, Lucania parva
Pecos pupfish, Cyprinodon sp.
"Chihuahua" pupfish, Cyprinodon sp.
White Sands pupfish, Cyprinodon tularosa
bigscale perch, Percina macrolepida
Pecos darter, Etheostoma lepidum
brook stickleback, Culaea inconstans

The State of New Mexico has also adopted a prohibited importations list:

| Family Involved | Species or Genera Prohibited |
|---|---|
| Petromyzontidae - lampreys | All |
| Polamotrygonidae - freshwater stingrays | All |
| All families of sharks | All |
| Amiidae - bowfins | Species Amia calva, bowfin |
| Lepisosteidae - gars | Genus Lepisosteus, gars - all species |
| Clupeidae - herrings | Species Dorosoma cepedianum, gizzard shad |
| Cyprinidae - minnows and carps | Genus Leuciscus, European whitefish, ide, orfe - all species |
| | Species Ctenopharyngodon idellus, grass carp or white amur |
| Characidae - characins | Genus Astyanax, banded tetra - all species |
| | Genera Serrosalmus, Serrasalmo, Pygocentrus, Pygopristis, Rooseveltiella, Teddyella, piranha- all species |
| | Species Hoplias malabaricus, tiger fish, guavinas |

| Family Involved | Species or Genera Prohibited |
|---|---|
| Cetopsidae and Trichomycteridae | Candiru, carnero, bloodsucker-all species |
| Poeciliidae - livebearers | Species Belonesox belizanus, pike top-minnow |
| Serranidae - sea basses | Species Morone (Roccus) americanus, White perch |
| Clariidae - airbreathing catfishes | Genera Clarias, Heteropneustes, Heterobronchus, Dinotopterus, walking catfish - all species |
| Sciaenidae - drums | Species Aplodinotus grunniens, freshwater drum, sheepshead |
| Ophicephaliidae or Channidae | Genera Ophicephalus, Channa snakehead - all species |
| Cichlidae - cichlids | Species Tilapia sparmanii, T. zillii, T. aurea, tilapia |

In addition to giving our endangered and threatened fish and wildlife legal protection, efforts are being made to enhance their status which will hopefully culminate in full recovery. Most noteworthy of these efforts is a multi-agency project being planned for the recovery of Gila trout; definite recovery action is expected to begin in the summer of 1977.

Survey work is being conducted on all drainages so that problems can be accurately defined and appropriate remedial action can be taken. So far, fairly detailed surveys have been completed on the Mimbres, Pecos, Canadian and Arkansas drainages. The Colorado and the Rio Grande drainages are the most neglected and unknown drainages; detailed survey work is expected to begin on both drainages in the summer of 1977 and will continue for several years.

Natural History Museum of Los Angeles County

Camm C. Swift, Section of Fishes

Current activities of the Natural History Museum of Los Angeles County, in addition to participation on the Unarmored Three-spine Stickleback Recovery Team, fall into three categories. The first is an inventory of southern California coastal drainages, which will result in a semi-popular book on the freshwater fishes of this area from Morro Bay to the Mexican border. Second, a study of the biology of Gila orcutti, the arroyo chub, is underway in Malibu Creek, Los Angeles County. Finally, a museum exhibit is being planned to tell museum visitors what non-game, rare, and endangered species are, why they are important, and how various agencies are involved in their study and protection.

SESSION V - Area Coordinator Reports

Texas - New Mexico

Clark Hubbs, University of Texas, Austin

1) Etheostoma fonticola Schench and Whitesides Copeia 1976: 697-703 discuss the status and report abundant populations and no foreseeable problems as long as water levels are maintained.

2) Gambusia gaigei No fish observed in 2 visits to refugium pool during winter and spring of 1975-76. A small population found there in August that must have overwintered. My guess is that two or more immatures were there (perhaps as fertilized eggs) during the previous examinations. The stock there was supplemented by fish transported from Austin stocks. A recovery team has been set up to establish a natural refugium matching the pre-1940 conditions.

3) Cyprinodon elegans The Texas Parks and Wildlife Refugium has been constructed and has been invaded by C. elegans (as was expected). This population is healthy, flourishing and no problems are foreseen. Plans are underway to decide on shade tree plantings that will best supplement existing conditions.

4) Cyprinodon bovinus A report on this species is due to be published in Copeia 1977 #1 by Steve Kennedy. That paper will address conditions prior to 1974. A new problem has developed that is reported below. This problem is restricted to the lower segment of Leon Cr (= Diamond Y Wash) containing water. That segment is isolated from the upper segment by a dry stretch of about 1 kilometer (the actual distance varies seasonally - greater in summer than in winter). Both segments are about 4 km long and have abundant populations of Cyprinodon bovinus (and Gambusia nobilis; an officially endangered fish - C. bovinus is "officially" extinct so not yet on the federal listing). The lower segment is crossed by Texas Highway 18 at about the midpoint of that stream segment. Much of the sampling is done at that highway crossing.

In June 1974 Steve Kennedy obtained a sample of C. bovinus from the highway crossing. In July 1974 Royal Suttkus obtained a sample from the same locality that also contained numerous C. variegatus, all ca. 30 mm SL. He reports also collecting Dionda episcopa, a species not otherwise found at that location. In November 1974 Tony Echelle obtained several very large C. variegatus there and numerous hybrids. During the following summer, Tony found that the hybrids were increasing in abundance and threatened the genetic purity of C. bovinus in that lower segment. In January 1976 plans were initiated to rectify the matter and Texas Parks and Wildlife flew Tony to Leon Cr. to determine the extent of the problem and to transfer uncontaminated stocks of C. bovinus to the Dexter National Fish Hatchery. That exploratory study determined that genetic contamination was throughout the lower segment but (thankfully) that the upper segment had no contamination from C. variegatus. On 13 February 1976 the lower segment was treated with rotenone by a group representing Tulane University, Baylor University, The University of Texas at Austin, Texas Parks and Wildlife Commission, the Texas General Land Office, and The Texas Water Development Board. That treatment involved the removal of a substantial part of the

pretreatment aquatic biota, some was preserved for voucher and comparative purposes, but much was maintained for reintroduction on 14 February. No Cyprinodon were released but a substantial sample (ca. 100) was obtained from the upper segment and released into the lower segments. The segments are connected during high water so it was deemed likely that there was little racial differentiation within those C. bovinus populations. One Cyprinodon was observed at a spring source at the time of release. That fish escaped and its identification as a probable C. bovinus could not be confirmed. On 27 February the area was reexamined by Texas Parks and Wildlife and University of Texas personnel. Two Cyprinodon were observed close to the release site (many at the release site) that may well have been released and both seemed to me to be pure C. bovinus. On 6 August a group from the University of Texas made samples from the treated segment. The pretreatment conditions were reasonably replicated for biota other than Cyprinodon. The Cyprinodon populations were virtually pure bovinus except at one location. Plans are formulated to visit that spot 26 November in order to catch Cyprinodon and cull out all possible contaminated individuals collected. These efforts hopefully will minimize the evolutionary impact of the unfortunate release of C. bovinus.

## Lahontan Basin Report

Dale V. Lockard

Work on the two listed species within the basin has been fairly extensive this past year; on the endangered Cui-ui and the threatened Lahontan cutthroat.

As you know, the status of the Lahontan cutthroat has been reduced from endangered and threatened. Culture programs by the states of California and Nevada and the Fish and Wildlife Service have been emphasized during recent years. This, coupled with current habitat conditions throughout their range, were justification for this status change. We in Nevada even feel that the current status of the species is sufficiently good to warrant its removal entirely from the Endangered and Threatened Species List.

The Lahontan cutthroat is a significant species in the Nevada sport fishery. It is being utilized in many of the drainages of the state, primarily in lake and reservoir habitats. The most recent establishment has been into the Lake Mead fishery of the Colorado River.

It is worthy of mention that there is question about the genetic purity of most populations in Nevada, including the Summit Lake population. We still maintain a brood stock of the original Walker Lake strain in our cultural program.

The Pyramid Lake Paiute Indian Tribe, the Fish and Wildlife Service, and the Fish and Game agencies of California and Nevada are presently working cooperatively on studies which are in part designed to evaluate the feasibility and desirability of reestablishing the range of the Lahontan cutthroat trout throughout the Truckee River system. Phases of work include radio tagging of adult spawning migrants, dye-marking of juvenile emigrants, diversion flow impacts, spawning and survival qualities of river gravels and associations with other species in the system.

Construction of the Marble Bluff Dam and fishway have been completed on the Truckee River near the mouth of the river on the Indian Reservation and were first operative during the spring spawning period of 1976. This structure coupled with another fish ladder upstream at Numana Dam now allow access of spawning migrant cutthroat to the entire lower river up to the infamous Derby Dam, the 1905 barrier which effected the demise of two species, the cutthroat and Cui-ui.

The next step is to evaluate access above this barrier; the fish laddering needed, diversion screening requirements; and species management and regulatory implications of the total sport fishery.

The other species of concern here is the Cui-ui. With the loss of Winnemucca Lake early in this century, the Cui-ui now exists only in the Pyramid Lake system.

A recovery team for this species is close to completing a final plan pending approval of the regional and central offices of the Fish and Wildlife Service.

Current enhancement activities include a significant cultural program by the Fish and Wildlife Service and, to a smaller degree, the Nevada Department of Fish and Game.

The harvest of adult Cui-ui has, for several years, been restricted to the Indians of the reservation. We really have no feel for the level of this harvest, but it is thought to be minimal.

Although the historical range of the Cui-ui included several miles of the Lower Truckee during spawning periods, the species has been virtually confined entirely to Pyramid Lake for many years due to a migration barrier created by the river delta. The design criteria of the new fishway from the lake were created around the Cui-ui to allow its access into the river for spawning purposes.

Radio tagging of a few spawning adults indicated a large concentration of Cui-ui at the entrance of the fishway but no attempt to ascend the first ladder was made. Even reductions in flow and velocity failed to effect ascension into the ladder. Further evaluation of this problem will be accomplished in 1977.

A few final miscellaneous comments about other fishes in the Lahontan Basin:

1) The native desert dace (Eremichthys acros) may be in some future jeopardy due to some potential geothermal developments in that area.

2) We are looking at several populations of cutthroat trout in the Humboldt River drainage from the standpoint of genetic variability and management adaptability. Some experimental culture work will be initiated in 1977.

## Arizona and Gila River Basin Report

John N. Rinne, Forest Hydrology Laboratory, A.S.U., Tempe

### ABSTRACT

Most native fish populations in Arizona and the Gila River Basin are above average due to good rainfall and streamflow during the past year. Salmo gilae (endangered) persists in half a dozen headwater streams in New Mexico. Natural populations of S. apache (threatened) mostly occur in an unquantified state on the White Mountain Apache Indian Reservation. Populations of the Gila topminnow (P. occidentalis) are stable in natural, isolated localities and coexist in an, as yet, undefined spatial manner with the exotic Gambusia affinis in one stream. Species native to the Yaqui River have declined in both numbers and localities in its extreme headwaters in southern Arizona.

## Bonneville Basin Report

Donald A. Duff, BLM, Salt Lake City

Activities within the basin have increased during the last year for desert fishes and their habitats which show the interest in this area by concerned individuals and agencies.

Dr. William Sigler completed a baseline inventory of several known springs in the west desert area of Juab County, Utah, where the least chub (Iotichthys) was known to occur. This work was completed for the Utah Division of Wildlife Resources (DWR) under contract from the U.S. Bureau of Land Management (BLM). Only one spring, Leland Harris Spring, was found to have least chub populations present. The BLM is funding a more intensive survey in 1977 with DWR to inventory the entire Bonneville Basin for the least chub. The U.S. Forest Service and DWR are cooperating in reestablishing the Utah cutthroat in Red Butte Creek in Salt Lake City on the Wasatch National Forest and the Fort Douglas Military Reservation. The project has been stopped by the Army due to municipal water supply facilities being located on the Reservation and the possible impact on these facilities from fish eradication programs in the upper watershed by the DWR and USFS although adequate precautions were planned to prevent downstream impacts.

The BLM, USFS, and DWR are cooperating in studies for the Utah cutthroat on Birch Creek, near Beaver, Utah. The BLM has implemented a habitat management plan on Birch Creek in 1976 under the Sikes Act which includes streamside fencing, livestock removal, road closure, and stream improvement structure construction to improve and restore habitat for the cutthroat. Brigham Young University, under contract by BLM, has been conducting macroinvertebrate and water quality investigations on Birch Creek as well as several other Utah streams where these unique cutthroat populations occur.

Dr. Robert Behnke, Colorado State University, under contract by BLM, has completed fisheries and habitat inventories in the Deep Creek Mountain Range for the Snake Valley cutthroat. This cutthroat has been found in 2 streams

totaling about 1½ miles. The BLM has begun habitat improvement projects for these fish under the Sikes Act. The Ely District of Nevada BLM has completed habitat improvements on Goshute Creek for the Snake Valley cutthroat. This work has included fencing, livestock removal, stream improvement structure construction and a fish passage structure.

## Upper Colorado River Area Committee

Bruce E. May, Area Coordinator

The following is the third annual report prepared by the Upper Colorado River Committee.

Students under the direction of Dr. Richard Wydoski have completed work on several aspects of Colorado River squawfish and humpback sucker life history, distribution and ecology. Their work also supplemented current knowledge of flannelmouth and bluehead suckers found in the study area. Information gained from these efforts will provide much needed background data and will provide much of the input needed to direct future research efforts on large river fish fauna.

A very exciting off-shoot of the project is the formulation of an extensive bibliography covering many aspects of the Upper Colorado drainage (fish, invertebrates, geology, hydrology, etc.); this should be available in the near future.

The squawfish recovery team under direction of Mr. John Livesay is near completion of a recovery plan for the Colorado River squawfish. Key aspects of the plan will include collection of additional life history data along with data of habitat requirements for spawning. Techniques for artificial propagation are continuing with a brood stock of 2,000 fish on hand for this work. The recovery team has recommended that the humpback sucker and bonytail chub be included as species endangered at the present time.

It should also be noted that the Bureau of Reclamation has several studies in progress on the Yampa, Dolores, and Little Snake rivers. These studies are designed to supply data needed to evaluate impacts from several proposed projects.

The Wyoming Game and Fish Department is continuing their work with the Colorado River (Green River) cutthroat. As a result of their efforts, two populations of pure strain fish have been isolated. The two streams where the pure fish are found are Archie Creek and the Little West Fork of the Blacks Fork River. The culture phase of their program includes the establishment of a brood stock of pure strain cutthroat in a small lake. Culture techniques that will be beneficial in expanding fish numbers are also being evaluated. The purpose of the program is to reestablish populations of pure strain Colorado River cutthroat in suitable streams. It should be noted that the resolution adopted at last year's meeting did much to stimulate the interest of Wyoming officials in the future of this endemic fish. I guess the old adage is true, "You can catch more flies with honey than with vinegar." It would be the area committee's recommendation that more of this type of communication be undertaken by the

Council. As a note, similar work on the Utah cutthroat is being contemplated in Utah.

The committee coordinator would like to thank the Desert Fishes Council for the opportunity to serve on the committee. Because of other responsibilities and duties, the coordinator is going to have to step down from this committee assignment.

## Chihuahuan Desert (Mexico)

Salvador Contreras Balderas

The collection made in 1975 has been fully processed. One paper and 3 reports have resulted from them:

1) Fish Species Composition Changes in Selected Biotopes of Northern Mexico, by Veronica Landa Salinas.

2) Fish Species Changes in Communities Along the Lower Rio Grande (below Falcon Dam), by Gloria Rodriguez Olmos.

3) Fish Species Composition Changes in Selected Biotopes in Northern Mexico. II. 15 more localities, by Teresa Villegas Gaytan.

4) PECES, PISCICULTURA, PRESAS POLUCION, PLANIFICACION PESQUERA Y MONITOREO EN MEXICO, O LA DANZA DE LAS P. (Fish, Fish Culture, Dams, Pollution, Fisheries Planning, and Monitoring in Mexico, or The Dance of P's). Salvador Contreras, V. Landa, T. Villegas, G. Rodriguez. Presented at the Simposio Nacional de Pesquerias en Aguas Continentales (National Symposium on Inland Fisheries), Tuxtla Gutierrez, Chiapas, November 3-5, 1976.

A program was initiated to eliminate black bass and carp from the type and only locality known for Megupsilon aporus, Cyprinodon alvarezi, and the cryafish Cambarellus alvarezi, in Potosi, Nuevo Leon, Mexico, with support from England, through the assistance of Dr. Robert Rush Miller.

Summary

The fish fauna of continental Mexico is composed of at least 461 species, 403 described (87.4 %), and 58 known but undescribed (12.6 %). There are 6 extinctions suspected. Knowledge is far from adequate. Fish cultural activities, damming, and pollution, affect the fish fauna, usually to detriment. Fisheries planning cannot be realistic without consideration of the interplay of the factors mentioned, and the known responses of fish to them.

Recent monitoring of fish communities in 27 localities of northern Mexico disclosed that only 4 (14.8 %) do not show species disappearance, 23 (85.2 %) have communities reduced by 16.7 to 100%, mean loss 43.9 %, with 12 (44.4 %) higher than 50% loss. Some localities in series show increase in reduction with increase in damming. Other adverse factors are aquifer overexploitation, and salinization, the last consequential to damming, and shown by invasions by

euryhaline species and receding primary fishes in the lower Rio Grande. A map and tables of fish community composition changes through time are included.

Intensive monitoring of fish communities, other organisms and certain environmental parameters is recommended to discover inconvenient changes. Also recommended is the increase in exchange of information between biologists and other environmental scientists, to alert them so that movements to protect the biological resources, and sound development, can be achieved.

## Oregon Lakes

Carl E. Bond

### ABSTRACT

The Oregon Wildlife Commission and Oregon Fish Commission have merged in the past year into a single agency, the Oregon Department of Fish and Wildlife, and this agency has a new director, Dr. J. R. Donaldson. These events will, hopefully, provide a more efficient and effective agency concerned with all fish and wildlife. Continuing surveys for fishes in the Oregon Lakes region has revealed two previously unknown fish-containing springs, one in the Alvord Basin (Gila alvordensis) and one in the Alkali Basin (Gila bicolor). The Pit sculpin, Cottus pitensis, previously thought to be extinct or very rare in Oregon, appears to be coming back. One M.S. thesis has been completed by Mr. Claire Kunkle on the biology and production of the red-band trout (Salmo sp.) in southeastern Oregon and another M.S. thesis by Mr. Fred Bills on the variation in isolated populations of Gila bicolor oregonensis is nearing completion. The Warner sucker continues to be Oregon's most endangered fish as the result of lack of access to spawning areas and water diversions. No efforts have been taken to ensure its survival. The shortnose sucker, Chasmistes brevirostris, is in decline through a combination of fishing and habitat alteration although a spawning group (100-300 individuals) was discovered which is separated in time and space from anglers. The Fosket Spring dace, Rhinichthys osculus subsp., one of the most restricted populations of fishes in Oregon, has been brought to the attention of the BLM and Nature Conservancy and a proposal for its protection (preservation) has been drawn up. Recently, a paleontological site with abundant fish fossils has come under severe impact by off the road vehicles and we are working with the BLM to protect this vulnerable unstudied resource.

## Death Valley System Committee - Held February 19, 1976

E. P. Pister

Superintendent James B. Thompson gave a review of current happenings within Death Valley National Monument. Underground nuclear testing at the Nevada Test Site has been greatly intensified in recent months and will probably continue at an accelerated rate through March, at which time the Nuclear Test Ban Treaty is supposed to take effect. Congress, however, may not ratify the treaty, in which case it will continue. Current blasts have significantly disturbed the shelf within Devils Hole and have caused other types of damage within the Monument.

Everyone is eagerly awaiting the Supreme Court decision relative to Devils Hole, which should be forthcoming in the near future.

The Senate has passed a bill to place strict controls on mining within the Monument, and a companion bill is now before the House, where more opposition is expected.

Status reports were then given for the endemic fishes of the Death Valley System, as follows:

1) Pahrump killifish, Empetrichthys latos.

Populations currently exist at Corn Creek, U.N. Las Vegas, and Steinhart Aquarium; and the latter two have reproduced. However, they are not yet considered safe and stable. Corn Creek has not yet been treated to remove Gambusia sp. An allotment of $25,000 has been made available for general improvements at Corn Creek, including rehabilitation of two ponds, covering of the springs, etc.

Studies are being made of the new School Spring C. diabolis refugium. If the temperature stays at 26 C., E. latos will be introduced there. Gail Kobetich, who bears the major responsibility for E. latos at this time, and is spearheading the effort, reports good cooperation from Nevada Fish and Game in the recovery work.

It was decided that critical habitat for E. latos should be designated as Corn Creek and Manse Spring. Gail will forward map descriptions to the Office of Endangered Species in Washington.

To protect the Corn Creek habitat and water supply, the Fish and Wildlife Service is acquiring 320 acres of privately-owned land adjacent to the Corn Creek property at a cost of $.75 million.

Al Castro reported that 20 adults (9 males and 11 females) were received by Steinhart on November 20. He gave a complete history of the population since he received it. In summary, there was some initial mortality attributable (superficially, at least) to a nematode infestation, primarily in the heart and lung tissue. Heavy adipose tissue deposition was also noted. Major feeding of the adults occurs at low light levels, whereas the young feed only in bright light. Egg laying begins at about five months of age. Current status at the Steinhart Aquarium is 12 adults, 9 fry, and 4 good eggs.

2) Devils Hole pupfish, Cyprinodon diabolis.

Jim Deacon reported that the population at Devils Hole appears to be in better condition than at any time during the past three years and has not dropped below 200 individuals all winter. However, it remains far below its pre-pumping level. Observations made on the morning of the February 14 nuclear blast revealed dislocation of sediment and small rocks, with a possibility of egg destruction resulting from grinding action of the rocks. However, there was no apparent significant change in the integrity of the shelf.

Jack Williams, a U.N.L.V. student possessing unique and unusual potential, is studying the Hoover Dam Refugium population. His study will be most valuable in increasing our understanding of C. diabolis (and all similar fishes) under existing transplant conditions. In this connection, it was decided that a transplant to improve the gene pool should be made into the Hoover Dam Refugium in July 1977 to allow adequate pre-transplant research.

Research in Devils Hole during the next year will include monthly population censuses through the fall of 1976, and at a reduced level thereafter. This will complete four years of population information and will provide unusually good baseline data.

Cappaert, et al. has applied for a point of diversion change for one of the wells near Devils Hole, involving the drilling of a well one mile south-southeast of Devils Hole to pump six cfs. The National Park Service and various private citizens have protested the granting of this permit.

Relative to critical habitat, it has not yet been decided whether the critical habitat level should be established at 1.2 or 1.4 on the guage. No action will be taken in this respect until after the Supreme Court renders its decision.

3) Ash Meadows speckled dace, Rhinichthys osculus nevadensis and
4) Ash Meadows pupfish, Cyprinodon nevadensis mionectes.

Bob Love reported a good population of both species in Big Spring the week prior to the meeting. Although Jackrabbit Spring did not go dry last summer, it has no fish. There is a strong connection between Jackrabbit Spring and Spring Meadows' pumps 1 and 2. Critical habitat areas, comprising the waters in Ash Meadows containing these fishes, were delineated on a quadrangle map for forwarding to the Fish and Wildlife Service.

A Big Spring Committee has been established, consisting of Bob Love (chairman), Gail Kobetich, Pete Sanchez, and Mary DeDecker (a botanist residing in Independence, California). Bob Miller and Jim Deacon serve as advisers to the committee. A meeting of the Committee, held on February 20, was attended by Love, Kobetich, and Sanchez. Also in attendance was Sydney Shafroth of the Nature Conservancy, who serves as Committee Coordinator.

5) Warm Spring pupfish, Cyprinodon nevadensis pectoralis.

Osborne Casey reported that the School Spring Refugium is heavily grown up with vegetation. A good population still exists there, however. Critical habitat was listed as School, Scruggs, and Indian springs, and the recovery team will forward pertinent information to the Fish and Wildlife Service.

6) Owens chub, Gila bicolor snyderi.

Inventories were continued of the known habitat area in the Owens River Gorge below Crowley Lake Dam, and a small population was noted. However, the stream channel is heavily vegetated, and electrofishing equipment does not operate efficiently under these circumstances. Chubs were also collected in the Hot Creek-Mammoth Creek area of southern Mono County and will be examined by Bob

Miller to determine whether or not they represent an unhybridized form. Similar populations in Inyo County will be sampled and examined at the earliest possible date.

7) Owens dace, Rhinichthys osculus subsp.

Sampling of Owens River tributaries in northern Inyo County revealed that this undescribed subspecies remains fairly numerous and widespread. It appears to be in no immediate danger.

8) Rhinichthys osculus subsp., Amargosa River near Beatty, Nevada and
9) Rhinichthys osculus subsp., Amargosa Gorge, below Tecopa.

Examination of the Tecopa population in 1975 by California Department of Fish and Game personnel indicated no apparent difference between individuals of this group and the Nevada speckled dace, Rhinichthys osculus nevadensis. However, the Beatty population bears indications that it may be distinct. Drs. Deacon and Minckley are maintaining a strong interest in this matter and hope to assign a graduate student to conduct further research.

10) Mohave chub, Gila bicolor mohavensis.

The primary habitat for this subspecies remains at Zzyzx Springs (Fort Soda), San Bernardino County, which is located on national resource land. A cooperative agreement is currently being consummated between BLM and the State College and University System to turn Zzyzx into a research and study area. Preservation of the chub will remain the primary consideration in management of the research facility. Other populations of the Mohave chub are located in artificial habitats (Busch Gardens, Lion Country Safari, etc.).

11) Owens pupfish, Cyprinodon radiosus.

The population is expanding in the Owens Valley Native Fish Sanctuary despite the unfortunate presence of Gambusia affinis. No predatory species have been noted in the sanctuary, and hopefully our efforts to eradicate largemouth bass have been successful.

Invasion of tules (Scirpus sp.) into the Warm Springs Sanctuary reduced breeding territory to a point where eradication measures became necessary. As a consequence, the water level was reduced in the fall of 1975, excessive vegetation was cut out, and the refugium left at a low level throughout the winter to allow freezing action to further affect plant growth. The Cyprinodon population is therefore at a low level at this time, but will build up in the spring months as water level rises and habitat conditions again approach optimum.

The population in BLM Spring Refugium (Fish Slough) remains stable and at a satisfactory level.

The status of this species, although currently satisfactory, will remain in jeopardy until approximately 200 acres of privately-owned land in the northern part of Fish Slough are acquired and placed in public ownership. Funding is

available through the University of California's Natural Land and Water Reserve Committee, but the owner is currently unwilling to sell at the appraised cost.

Critical habitat descriptions were forwarded to the Fish and Wildlife Service.

12) Tecopa pupfish, Cyprinodon nevadensis calidae.

Attempts made since the last Death Valley Committee meeting to collect this subspecies have been frustrated by the heavily overgrown character of the spring area where we suspect that they may exist, and by lack of time to do the job properly. Three specimens were collected in February, 1975, but more are needed before an accurate determination may be made. Further attempts to collect will be made during the spring and summer of 1976.

13) Cottonball Marsh pupfish, Cyprinodon milleri.

There has been no apparent change in this stable and apparently healthy population. A field trip to check this out will be made in the spring of 1976.

14) Saratoga Springs pupfish, Cyprinodon nevadensis nevadensis.

No apparent change in this population, which remains satisfactory.

15) Amargosa pupfish, Cyprinodon nevadensis amargosae.

This subspecies is numerous throughout the Amargosa River within California. However, heavy groundwater extraction within Nevada and placer mining applications along the Amargosa River in San Bernardino County place the Amargosa River and its endemic fauna in jeopardy. The status of the river and its fishes will be investigated during the spring of 1976.

16) Salt Creek pupfish, Cyprinodon salinus.

The status of this population remains satisfactory and should be enhanced by the 3000 feet of boardwalk being installed for the National Park Service by the Inyo Ecology Center as a means of improving interpretive aspects of Salt Creek and protecting the riparian and aquatic habitat.

17) Owens sucker, Catostomus fumeiventris.

Although currently widespread and in good condition in the upper Owens River system, proposed geothermal research and development pose a serious threat to all aquatic ecosystems in that area. Baseline environmental studies are planned, and every effort will be made to prevent damage from occurring.

Other items discussed during the meeting include:

A. Developments in the interstate water picture relative to the Amargosa River system.

On May 8, 1975, Phil Pister presented concerns of the Desert Fishes Council relative to underground water extraction in the upper Amargosa River system to

a State-Federal Interagency Task Group involved in the study of critical water management problems in the southwest. A forthcoming U.S.G.S. report concerning the water resources of Death Valley will be of assistance in governmental evaluation of this problem.

B. The problem of Gambusia affinis within Death Valley National Monument.

Progress during the past year has been manifested in biological inventories of the springs and aquatic systems associated with Scotty's Castle. Jerry Landye, a malacologist from Arizona State University, has been in contact in this respect with Dwight Taylor, another acknowledged expert in this field. Jerry feels that, if chemical treatment is restricted to that area below the intake structure, we need not be concerned with eradicating endemic snails. A similar inventory of other life forms conducted in June 1975 revealed nothing of a rare or threatened status. A tentative treatment period of June 1976 has been set. Initial plans are to use antimycin as a fish toxicant. Antimycin should exert less influence than rotenone on life forms other than fish.

C. The Colorado River Wildlife Council wishes to introduce into Arizona Cyprinodon macularius macularius from Santa Clara Slough in Mexico. A letter of endorsement will be forthcoming from the Desert Fishes Council, with the provision that the introduction be within the original range of the subspecies.

D. It was the feeling of those assembled at Death Valley that critical habitat should be designated for Gila cypha and Ptychocheilus lucius. It was agreed that Jim Johnson, of Colorado BLM and a member of the Desert Fishes Council, would be an effective leader for a recovery team involving these fishes.

E. Concern was expressed concerning the spread of Tilapia in the southwest. Several in attendance questioned the integrity of certain phases of current research involving the various subspecies of this fish.

F. It was pointed out that the Eighth Annual Symposium of the Desert Fishes Council will be held on November 18-20 at Grand Junction, Colorado.

G. It was decided that, considering the generally deteriorating habitat situation in the Amargosa drainage (and in Ash Meadows in particular), we should consider all subspecies of Cyprinodon nevadensis as threatened. The only exception to this would be C. nevadensis nevadensis, which is located completely within the confines of Saratoga Springs, an isolated area within Death Valley National Monument. Even so, because of upstream water demands, C. n. nevadensis will bear watching. Included now as threatened would be C. n. amargosae, which is jeopardized not only by water extraction, but also by potential placer mining operations.

Attendance List, Death Valley System Subcommittee, Death Valley National Monument Headquarters, Furnace Creek, February 19, 1976

| | |
|---|---|
| Osborn Casey | BLM, Reno Nevada |
| Alfred Castro | Steinhart Aquarium, San Francisco |
| James E. Deacon | Biology Dept., UNLV, Las Vegas |
| Maxine Deacon | Biology Dept., UNLV, Las Vegas |
| Richard Enriquez | BLM, Las Vegas, Nevada |
| Keith E. Harms | NPS, Death Valley |
| C. W. Hoeft | BLM, Sacramento |
| Frank Hoover | CDFG, Chino |
| Gail Kobetich | FWS, Las Vegas |
| Bob Love | Fullerton, Calif. |
| Larry Mangan | BLM, Bishop |
| Steve Nicola | CDFG, Sacramento |
| Phil Pister | CDFG, Bishop |
| Gary Ponder | CDFG, Bishop |
| Michelle Rivera | NANFA*, Oakland, Calif. |
| Pete Sanchez | NPS, Death Valley |
| Bill N. Scoggins | NANFA*, Oakland, Calif. |
| Jerry Stefferud | Inyo Nat. Forest, Lone Pine |
| Larry Thomas | NPS, Death Valley |
| Jim Thompson | NPS, Death Valley |

*North American Native Fishes Association

## Nevada Interior Basins

Gail Kobetich

### Steptoe dace

Steptoe dace habitat was examined at the following location: Ely Creek, McGill Springs, and at various locations on the CCC Ranch. Fish were collected on the CCC Ranch but the habitat was grossly polluted from cattle and few fish were visible. Six were collected and are alive at UNLV. No native fish were observed at the other sites. Mosquito fish and other exotics were observed at the McGill Springs. Water at all sites appeared enriched because of the enormous amounts of aquatic vegetation. From these observations a more intensive survey of all known sites for Relictus solitarius needs to be made before their exact status is known. Hopefully by this time next year we will have better information.

### Pahrump killifish

During July of 1975 Manse Spring, the home of the Pahrump killifish, failed and all fish were lost. Prior to this, transplants of these fish had been made to three localities outside the Pahrump Valley. Killifish were transplanted to Corn Creek Springs pond on the DNWR, to Latos Pools, two plunge basins in Roaring Rapids Wash which flows into Lake Mohave from the Nevada side about 20 miles below Boulder Dam, and Shoshone Ponds, a BLM facility south and east of

Ely, Nevada. The Shoshone Ponds transplant failed. The Latos Pools transplant at first appeared to fail but in July of 1976, killifish were discovered in a thriving population with several age classes present. The Corn Creek population succeeded but numbers were depressed because of a large population of bullfrogs and mosquito fish.

After the failure of Manse Spring the remaining killifish, which at that time was thought to be only the Corn Creek population, needed more intensive management. Therefore, most of the killifish were trapped and moved to the Fish Facility at UNLV, and Corn Creek Springs Pond was drained and treated to rid it of mosquito fish. The killifish remaining in the pond were held at Corn Creek and were placed in the Amargosa Pupfish Station. After renovation of the pond, the killifish being held at Corn Creek were placed back in the pond and have spawned. Killifish are now abundant at Corn Creek. There are 14 fish now at APS and on the last day of August 1976, 50 killifish were transferred to Shoshone Ponds for another attempt at establishing a population there. Wayne Logan will tell you more of that effort. There are about 50 fish at UNLV. In addition to the removal of the mosquito fish at Corn Creek other renovation features are being constructed. The spring heads are being covered and the inflow streams from the spring heads to the pond are being lined with concrete to prevent clogging with Phragmites. The middle pond downslope from the main pond is being redone (see diagram) to hold water, and killifish will be stocked in it.

The Recovery Team has a first draft of the recovery plan well underway and hopefully the entire project, which will secure the existence of the Pahrump killifish for the foreseeable future, will be completed by this time next year. The status of the Pahrump killifish at this time is good.

## The Native Fishes of the Virgin River

James E. Deacon

During the past year three major collecting trips were made to the Virgin River. On two of these collecting trips, the River was sampled at 7 sites, from the inflow of LaVerkin Creek to 5 miles below the bridge at Riverside, Nevada. The collecting trip intensively sampled the area from immediately below the outflow of La Verkin Springs to the mouth of La Verkin Creek. One station above La Verkin Springs was also sampled on this trip.

Results of the sampling give a good picture of the status of the native fishes in the main stem of the Virgin River. All of the native fish appear to be maintaining adequate population levels. The woundfin, Plagopterus argentissimus, was found from about ¼ to ½ mile below La Verkin Springs to the last sampling station below Riverside during the two major sampling periods. Two sites below the Riverside bridge were sampled in July. Woundfin were found at both sites. At all the upper sites (above the diversion at Mesquite, Nevada) woundfin of all age classes were found. Below Mesquite, juvenile fish predominated. Above the Mesquite diversion dam, woundfin were the dominant fish numerically. Below the diversion dam, red shiners, Notropis lutrensis, were numerically dominant. From all available information, the woundfin population appears to be maintaining itself.

The Virgin River spinedace, Lepidomeda mollispinis mollispinis, was collected in good numbers from the one site above La Verkin Springs and from ½ mile below La Verkin Springs to about 300 meters below the inflow of Ash Creek. A sampling site about 3 miles up from the Virgin River on La Verkin Creek yielded good numbers of this fish also. This spine dace was also captured immediately below the inflow of Beaver Dam Wash.

The speckled dace, Rhinichthys osculus, was found at all the stations from the mouth of Beaver Dam Wash upstream. They were also found at the station in La Verkin Creek. They appear to be maintaining an adequate population.

The Virgin River roundtail chub was collected at Beaver Dam Wash, Bloomington Bridge, and in the La Verkin area. Several age classes were collected. The population appears to be in good condition. However, because of the limited distribution of this fish, the continued disappearance of deeper pools and runs in the Virgin River, and proposed projects which will impact the aquatic environment, the status of this fish can only be described as precarious.

The two native suckers, Pantosteus clarki and Catostomus latipinnis, were found at all stations, with the desert sucker being more common at the upper stations. The flannelmouth sucker was common at all stations except the lowest two, where only juveniles were found.

Exotic fish were present at all stations in low numbers except below the Mesquite diversion, where red shiners predominated. This situation will continue as long as the Virgin River above the Mesquite diversion remains essentially as it now is.

# APPENDIX I

## Financial Report

| | |
|---|---|
| Balance as of 11/17/75 | $ 691.49 |
| Expenditures since 11/17/75 | 470.63 |
| Balance - | $ 220.86 |
| Deposits since 11/17/75 | 505.82 |
| Balance - | $ 726.68 |

# APPENDIX II

## Report to National Park Service of the Eighth Annual Meeting of the Desert Fishes Council

Robert R. Miller

This letter constitutes a report to the National Park Service of the Eighth Annual Meeting of the Desert Fishes Council, which took place in Grand Junction, Colorado, 18-20 November 1976. This was an extraordinarily full meeting, with 52 individual papers and reports during a two-day period, followed by a field trip on the Colorado River on the third day. The summary presented here deals only with matters of direct concern to NPS.

On the 17th of November, I spent the entire day attending the meeting of the Colorado River Fishes Recovery Team (until January known as the Colorado Squawfish Recovery Team), which has now been transferred from Region 2 to Region 6 of the U.S. Fish and Wildlife Service. Designation of critical habitat for the Colorado squawfish and humpback chub have gone to Washington, D.C. Much of the day was devoted to the final revision of the recovery plan for the Colorado squawfish, a species that occurs (among other places) in Dinosaur National Monument, Canyonlands National Park, and (very rarely) in Grand Canyon National Park.

The Devils Hole pupfish attained an estimated maximum population size of 400 last summer, the highest in recent years. On 9 December, the government will again go to court to seek a change in water level from 3.3 to 3.0 (at least).

Ecological studies on the Pahrump killifish, which no longer survives in its native Manse Spring (dried up completely last summer), show that it has a high thermal tolerance (6 C to 40 C) and that the species is nocturnally active in water from 21-23 C. The species now survives in three or four refugia, of which the one at the Desert National Wildlife Range at Corn Creek (N of Las Vegas) supports an estimated 2,850 individuals.

Characters for field identification of Gila cypha and G. elegans, the endangered humpback and bonytail chubs, respectively, were presented. Both are readily distinguished from the sympatric roundtail chub, Gila robusta. G. cypha has reproducing populations in both Dinosaur National Monument and in Grand Canyon National Park. G. elegans, the most endangered Colorado River fish, persists in reservoirs of the lower Colorado (e.g., Lake Mohave), and perhaps in some places in the upper Colorado, but it desperately needs help if extinction is not to follow soon. A program of rearing at the Willow Beach National Fish Hatchery should be successful in producing young fish, but suitable habitat must either be found or unsuitable (but formerly known) habitat rehabilitated for it if such a program is to be successful. The lowest part (especially near its mouth) of the Little Colorado River in Grand Canyon has been determined as a nursery area for G. cypha. Consequently, there should be no changes (e.g., dam construction, pollution, water withdrawal, desalinization) permitted on that river that could have deleterious effects on the well-being of the humpback chub. Moreover, fishing in the Colorado River between Lees Ferry and Spencer Canyon, Arizona, should be prohibited

immediately because fishermen are now catching G. cypha, an act that subjects the fishermen to a heavy federal fine (Endangered Species Act, 1973).

Experimental studies on the reproductive thermal tolerance of the Saratoga Springs pupfish (C. n. nevadensis) revealed a significant breakthrough that may be widely applicable. This was the determination that oogenesis is the sensitive period (not the critical thermal limits or the developmental tolerance limit) in the life history and survival of the species. This limit (for C. n. nevadensis) was determined to be only 24-30 C, whereas the thermal tolerance limit was 2-44 C. This was the most significant scientific finding of the meetings.

The attempt to rear Empetrichthys latos at Steinhart Aquarium appears to have met with failure (only 5 males are left as of November 1976). The reasons for this failure are not known but I recommend that no more Pahrump killifish be sent to Steinhart until an explanation is forthcoming.

One of the most important happenings during the past year has been the preparation of a book on the natural history of the fishes of the Death Valley system by David Soltz and Robert Naiman. It is to be published by the Death Valley Natural History Association, hopefully in 1977. I critically reviewed the book just prior to the meetings and am very enthusiastic about it. I predict that it will sell very well and will be a fine reference to send out to the numerous persons requesting information on desert pupfishes. It should provide a model for semi-popular publications on the fishes of other national parks, such as Big Bend. I have, myself, had accepted for publication in WILDLIFE (an international journal published in Great Britain), a popular, illustrated article entitled "The Desert Pupfish Fights for Survival." It is scheduled to appear early in 1977.

Of interest to NPS is the Pinacate National Park in Mexico, which is, in effect, a southward continuation into Mexico of Organ Pipe Cactus National Monument, the type locality of the Sonoyta pupfish (in Quitobaquito Springs). More than likely, this distinctive subspecies (description being prepared by Minckley and Miller) will become extinct in Mexico in 1977 (due to heavy water pumping there), leaving the Quitobaquito population as the sole representative of this taxon.

A four-year moratorium on mining in national parks affects Death Valley and Organ Pipe, removing (at least temporarily) the threat to endemic fish species and subspecies.

The recovery plan for the Warm Springs pupfish (Cyprinodon nevadensis pectoralis) of Ash Meadows is virtually finished.

The Death Valley System Committee will meet in February 1977 in Death Valley. I would like to attend but that will depend entirely on whether you wish me to go to Death Valley then and represent you at this special meeting when the current status of Death Valley fishes will be considered in more detail than was possible in Grand Junction.

The desert pupfish, Cyprinodon macularius, formerly common in Salton Sea and in springs and streams about that sea, in California, and in the Gila-Santa Cruz-San Pedro rivers of Arizona (as well as in the delta region of the Colorado River in Mexico), is now critically depleted. Dr. David Soltz found, in studies conducted during October-November, 1976, in lateral canals of Salton Sea, that of 6,336 fishes taken from 49 stations in 6 different drains, 32 percent were mollies (3 species), 54.4 percent were red shiners (Notropis lutrensis), 9.2 percent were Gambusia affinis, 3.2 percent were Tilapia zillii, but only 0.7 percent were desert pupfish. Nine years ago the proportion of mollies to pupfish was 10:1; now it is more like 200:1. Nursery grounds for the exotic cichlid (T. zillii) probably constitute optimum habitat for the pupfish. This is a very serious situation. There is one refuge for the desert pupfish at Anza-Borrego Desert State Park in Borrego Valley, California, but the current status of the pupfish population there is not known. A population of the desert pupfish is known to inhabit "Santa Clara Slough" (small collection sent to Minckley in 1974), Sonora, Mexico, that I will be sampling on 1 December 1976, in order to determine its relationship to other populations of this species. I would expect to have my study complete for presentation at the meeting in Death Valley in February 1977; also a status report on the description and relationships of the Quitobaquito pupfish.

The day before I left for Grand Junction I learned that there is a plan to channelize 198 miles of the Rio Grande, from the mouth of the Rio Conchos (near Presidio) to well below Big Bend National Park. In my estimation this would be a disaster for the aquatic biota as well as an esthetic rape, and I intend to look into the matter. I understand that an EIS is being prepared but that those responsible are unaware that this section of the river contains endangered species. I will keep you informed of my findings.

The Desert Fishes Council has decided to go ahead on plans to publish a Newsletter, but an editor and publications committee have yet to be selected. In the meantime, the Proceedings of our annual meetings of recent years has been or is being prepared. Perhaps your office would be willing to mail these out to the membership and other interested organizations and individuals?

This was an important meeting. We look forward to convening in Death Valley for our Ninth Annual Symposium in November, 1977.

# APPENDIX III

## Desert Fishes Council Attendance List
## Eighth Annual Symposium - Grand Junction, Colorado
## November 18-20, 1976

| | | |
|---|---|---|
| Bruce Adams | University of So. Calif. | Los Angeles, CA |
| Neil B. Armantrout | BLM | Moab, UT |
| Jonathan N. Baskin | Calif. Poly. Univ. | Pomona, CA |
| Bruce Bauerle | Mesa College | Grand Junction, CO |
| Robert J. Behnke | Colorado State Univ. | Ft. Collins, CO |
| Richard Bottorff | Colorado State Univ. | Ft. Collins, CO |
| Gary Bryant | Bureau of Reclamation | Boulder City, NV |
| Osborne Casey | BLM | Reno, NV |
| Paul Cuplin | BLM | Denver, CO |
| Bob David | Bureau of Reclamation | Durango, CO |
| John R. Davis | Fish & Wildlife Service | Lakewood, CO |
| James E. Deacon | University of Nevada | Las Vegas, NV |
| Maxine Deacon | University of Nevada | Las Vegas, NV |
| Jack Dean | Fish & Wildlife Service | Denver, CO |
| Don Duff | BLM | Salt Lake City, UT |
| Anthony Echelle | Baylor University | Waco, TX |
| Beula Edmiston | Comm. for Pres. of Tule Elk | Los Angeles, CA |
| Tasker Ediston | Comm. for Pres. of Tule Elk | Los Angeles, CA |
| Bob Garrett | University of Arizona | Tucson, AZ |
| Shelby Gerking | Arizona State University | Tempe, AZ |
| Robert Gervais | BLM | Denver, CO |
| John R. Gold | Texas A&M University | College Station, TX |
| Herb Guenther | Bureau of Reclamation | Boulder City, NV |
| Ron Gumtow | BLM | Cheyenne, WY |
| Mike Hatch | New Mexico Dept. Game & Fish | Albuquerque, NM |
| Terry Hickman | Colorado State University | Ft. Collins, CO |
| John Hiscox | Calif. Dept. Fish & Game | Oroville, CA |
| Kaaren Hiscox | Butte Co. Mosq. Abate. Dist. | Oroville, CA |
| Paul B. Holden | BIO/WEST, Inc. | Logan, UT |
| Kevin Howe | Oregon State University | Corvallis, OR |
| Carl L. Hubbs | Scripps Institution | La Jolla, CA |
| Laura Hubbs | Scripps Institution | La Jolla, CA |
| Buddy Jensen | Fish & Wildlife Service | Parker, AZ |
| James Johnson | Fish & Wildlife Service | Albuquerque, NM |
| Chuck Kennedy | Forest Service | Albuquerque, NM |
| Gail C. Kobetich | Fish & Wildlife Service | Las Vegas, NV |
| Astrid Kodric-Brown | University of Arizona | Tucson, AZ |
| Boyd Kynard | University of Arizona | Tucson, AZ |
| James F. LaBounty | Bureau of Reclamation | Denver, CO |
| Jerry Landye | Malacologist | Flagstaff, AZ |
| David Langlois | Colo. Div. of Wildlife | Denver, CO |
| Ray Lee | Arizona State Univ. | Tempe, AZ |
| Dale V. Lockard | Nevada Dept. Fish & Game | Reno, NV |
| Wayne D. Logan | BLM | Ely, NV |
| Larry Mangan | BLM | Bishop, CA |
| Terry McCall | Northern Arizona Univ. | Flagstaff, AZ |
| Bill Miller | Bureau of Reclamation | Grand Junction, CO |

| | | |
|---|---|---|
| Frances H. Miller | University of Michigan | Ann Arbor |
| Robert Rush Miller | University of Michigan | Ann Arbor |
| C. O. Minckley | Northern Arizona Univ. | Flagstaff, AZ |
| Sue Morgensen | Arizona State University | Tempe, AZ |
| Robert J. Naiman | Oregon State University | Corvallis, OR |
| Stephen Nicola | Calif. Dept. Fish & Game | Sacramento, CA |
| Phil Pister | Calif. Dept. Fish & Game | Bishop, CA |
| Gary Ponder | Calif. Dept. Fish & Game | Bishop, CA |
| Robert Raleigh | WELUT | Ft. Collins, CO |
| John Rinne | R.M. For. & Range Exp. Sta. | Tempe, AZ |
| Donald Sada | Calif. State Univ. | Long Beach, CA |
| James A. St. Amant | Calif. Dept. Fish & Game | Long Beach, CA |
| Peter G. Sanchez | National Park Service | Death Valley, CA |
| Paul Schumann | University of Nevada | Las Vegas, NV |
| Karl Seethaler | Utah State University | Providence, UT |
| Doug Selby | University of Nevada | Las Vegas, NV |
| Donald Siebert | BLM | Phoenix, AZ |
| Tess Smith | State Water Res. Control Bd. | Sacramento, CA |
| Jerry Stefferud | Inyo National Forest | Lone Pine, CA |
| Sally Stefferud | Calif. Dept. Fish & Game | Lone Pine, CA |
| Ed Stuenkel | University of Nevada | Las Vegas, NV |
| Royal D. Suttkus | Tulane University | Belle Chasse, LA |
| Camm Swift | Los Angeles County Museum | Los Angeles, CA |
| Paul R. Turner | New Mexico State Univ. | Las Cruces, NM |
| Lester Wheeler | Mesa College | Grand Junction, CO |
| William C. White | Fish & Wildlife Service | Salt Lake City, UT |
| Cindy Williams | University of Nevada | Las Vegas, NV |
| Jack Williams | University of Nevada | Las Vegas, NV |
| James Williams | Fish & Wildlife Service | Washington, D.C. |
| Tom Withrow | Mesa College | Grand Junction, CO |
| Ann Wong | Unaffiliated | Blythe, CA |
| Darrell Wong | Calif. Dept. Fish & Game | Blythe, CA |

NINTH ANNUAL SYMPOSIUM

Desert Fishes Council
Death Valley, California, November 17-18, 1977

## PREFACE

The Symposium was followed on November 21, 1977, by a press release issued by Ralph Young, Information Officer of the California Department of Fish and Game's southern region. This release is printed verbatim as a preface to the general proceedings.

NEWS RELEASE - Calif. Dept. Fish & Game, Long Beach - November 21, 1977

FUTURE APPEARS BRIGHTER FOR DEVIL'S HOLE PUPFISH

The Devil's Hole pupfish has doubled its population in the past year and prospects for its survival have brightened, according to Dr. James Deacon of the University of Nevada at Las Vegas.

Deacon attributes the resurgence of the pupfish to a U.S. Supreme Court ruling in June, 1976, that limited the amount of water that could be taken from underground basins in the Ash Meadows section of Nevada, a detached part of the Death Valley National Monument.

Ash Meadows is the site of Devil's Hole, a water-filled limestone cavern and the only place where the inch-long pupfish, Cyprinodon diabolis, is found.

The news that the population of the Devil's Hole pupfish was now estimated at more than 400 highlighted a meeting of the Desert Fishes Council Nov. 17-18 in Death Valley.

The council is a nationwide organization dedicated to the preservation of America's desert fishes, and its membership includes some of the foremost ichthyologists and resource managers in the nation, among them Dr. Carl L. Hubbs of Scripps Institution of Oceanography, La Jolla, and Robert Rush Miller of the University of Michigan, both known worldwide for contributions to fishery science.

Dr. Deacon is chairman of the biology department at UNLV and chairman of the council.

Program chairman for the two-day fisheries meeting was Phil Pister of Bishop, a fishery biologist for the California Department of Fish and Game.

/more/

NEWS RELEASE - Calif. Dept. Fish & Game, Long Beach - November 21, 1977

Pister said the water level in Devil's Hole has risen about three inches during the past year, probably because of the limitation on pumping.

The additional water in the cave increases the pupfish spawning area on a critically placed limestone ledge and also increases the area for algae to grow, Pister said. The pupfish, which live close to the surface at the top of the cavern, are dependent on the algae for survival.

Pister said he is hopeful that the pupfish population will build up to about 700 or 800 which was the level before pumping lowered the water table in the cavern and threatened the continued existence of the tiny fish which has existed there since the Pleistocene age.

The build-up in the underground water basins at Ash Meadows also brightens the long-range outlook for several other small desert fish, including the endangered Warm Springs pupfish, Pister said.

## Summary of Proceedings

### Thursday, November 17

Following a welcome to Death Valley National Monument by Superintendent Donald Spalding, the Council launched into its first session, Research and Status Reports, chaired by Dr. Martin R. Brittan, California State University, Sacramento. Papers are listed in the order presented.

NINTH ANNUAL SYMPOSIUM

Desert Fishes Council
Death Valley, California, November 17-18, 1977

# Preliminary Report on Thermal Tolerances of *Gila robusta*

Paul B. Schumann, University of Nevada, Las Vegas

## ABSTRACT

Young-of-the-year *Gila robusta* were tested to determine their tolerances to extremes of temperature and low levels of dissolved oxygen, and their preferred temperature at various temperatures of acclimation. Young spawned and reared in an artificial stream in spring 1977 were acclimated in September 1977 to constant temperatures of 8, 23 and 30 1 C, respectively for 2 to 3 weeks. Five to eight animals from each acclimation group were tested for critical thermal maxima and minima (CTM) as determined by loss of equilibrium. CTMax was found to vary directly with temperature of acclimation and ranged from 30.5C for 8 acclimated individuals to 39.5 C for 30 acclimated fish; and CTMin varied with acclimation temperature but not linearly, ranging from 7.7 C for the 30 C group to ‹1.0 C for the 8 C fish. Preferred temperatures as determined in a horizontal gradient varied for different groups, as 8 C acclimated fish preferred lower temperatures but no particular value, while both 23 C and 30 C groups preferred the 22-24 C range. Tolerances to low dissolved oxygen levels were determined in tanks depleted of oxygen by sodium sulfite, and minimum tolerances as determined by loss of equilibrium ranged from 0.82 ppm for the 8 C group to 0.26 ppm for the 30 C group, exhibiting an inverse relationship between acclimation temperature and minimum DO levels tolerated. Young with access to an oxygen-rich surface layer appear capable of sustaining themselves indefinitely in extremely hypoxic environments. Tolerances to temperature and oxygen extremes in all cases exceeded environmental extremes, thus these are probably not the principal factors limiting distribution in the Moapa River (Clark Co., Nevada); but it is likely that *Gila* lives in suboptimal habitats in some parts of its range with respect to these and other environmental parameters.

SUMMARY OF CTM DATA FOR *GILA ROBUSTA* SSP. YOUNG-OF-THE-YEAR AT VARIOUS ACCLIMATION TEMPERATURES

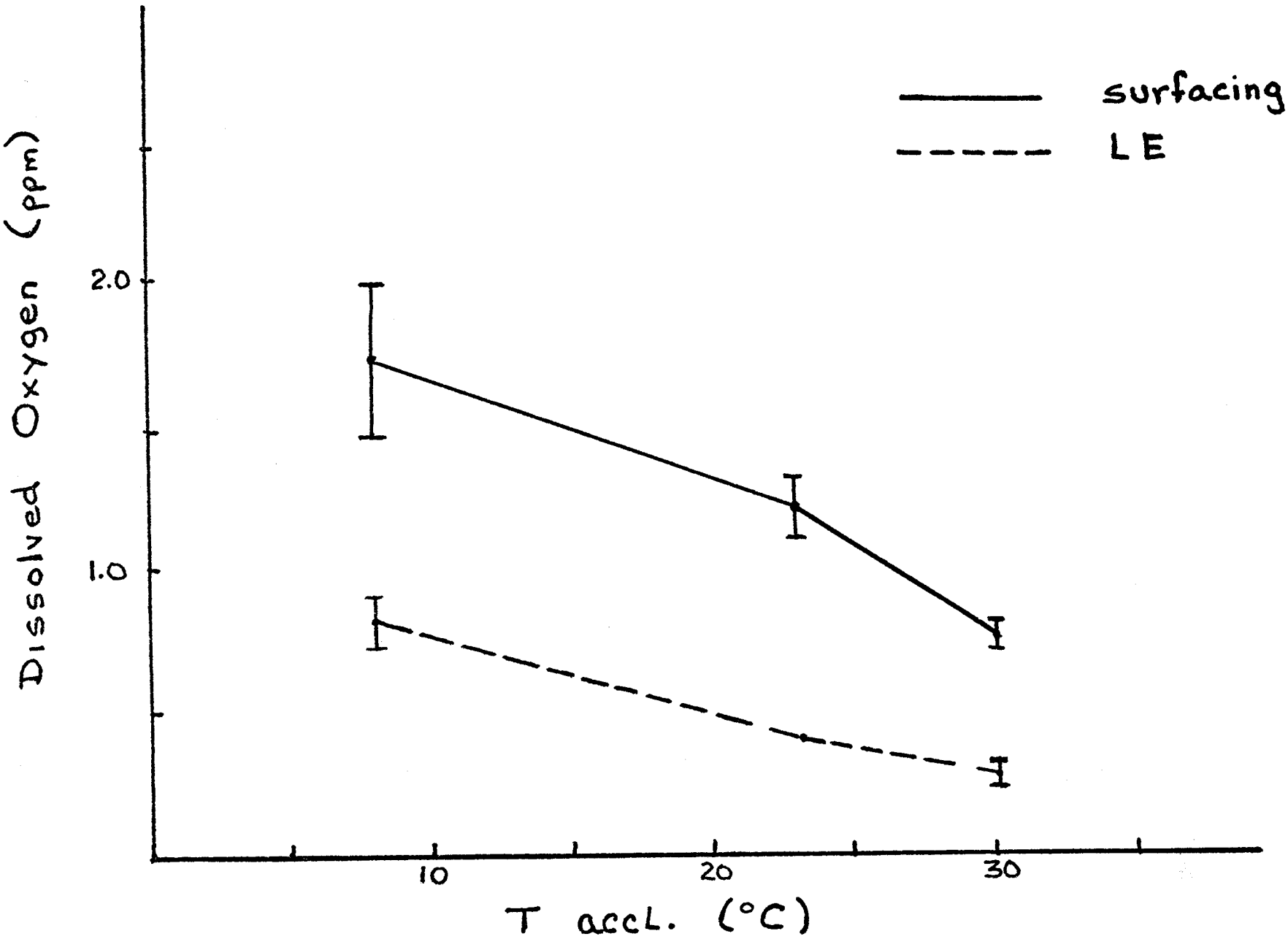
| ACCLIM. TEMP. C | NO. TESTED MAX/MIN | CT MAX. C | CT MIN. C | RANGE C |
|---|---|---|---|---|
| 8 | 6/6 | 30.45 ± 1.16 | < 1.0 | >29.45 |
| 15* | 6/5 | 32.28 ± 0.52 | 1.96 ± 0.65 | 30.32 ± 1.17 |
| 22 | 6/6 | 36.48 ± 0.44 | 3.71 ± 0.17 | 32.77 ± 0.61 |
| 30 | 8/6 | 39.45 ± 0.39 | 7.71 ± 0.39 | 31.74 ± 0.78 |

* ADULT INDIVIDUALS TESTED

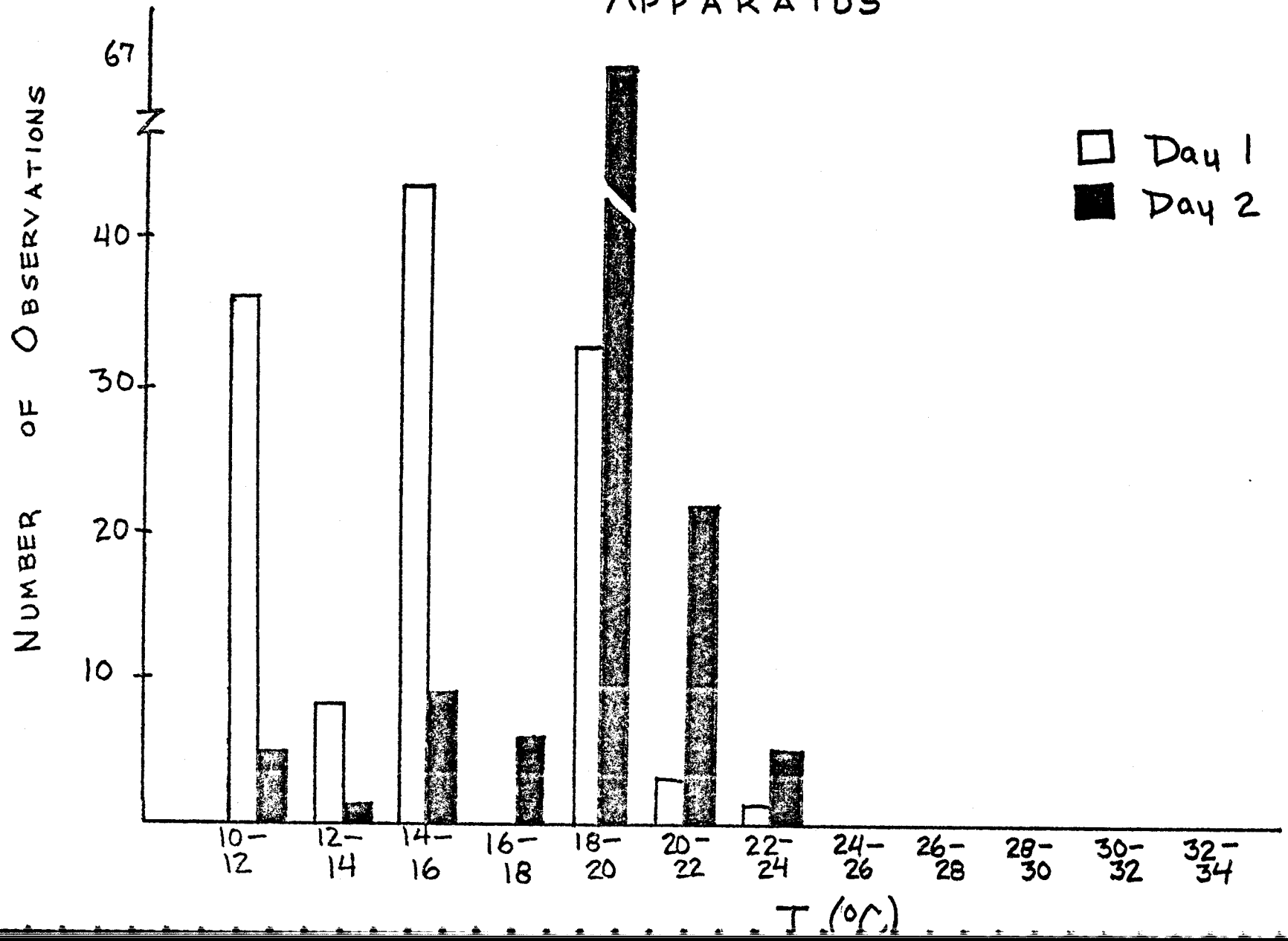
OXYGEN TOLERANCES OF *GILA ROBUSTA* SSP. YOUNG-OF-THE-YEAR AT VARIOUS ACCLIMATION TEMPERATURES

| ACCLIM. TEMP. C | NO. TESTED | "SURFACING" PPM DO | LE PPM DO |
|---|---|---|---|
| 8 | 6 | 1.75 ± 0.27 | 0.82 ± 0.10 |
| 22 | 6 | 1.21 ± 0.10 | 0.40 ± 0.0 |
| 30 | 8 | 0.74 ± 0.04 | 0.26 ± 0.04 |

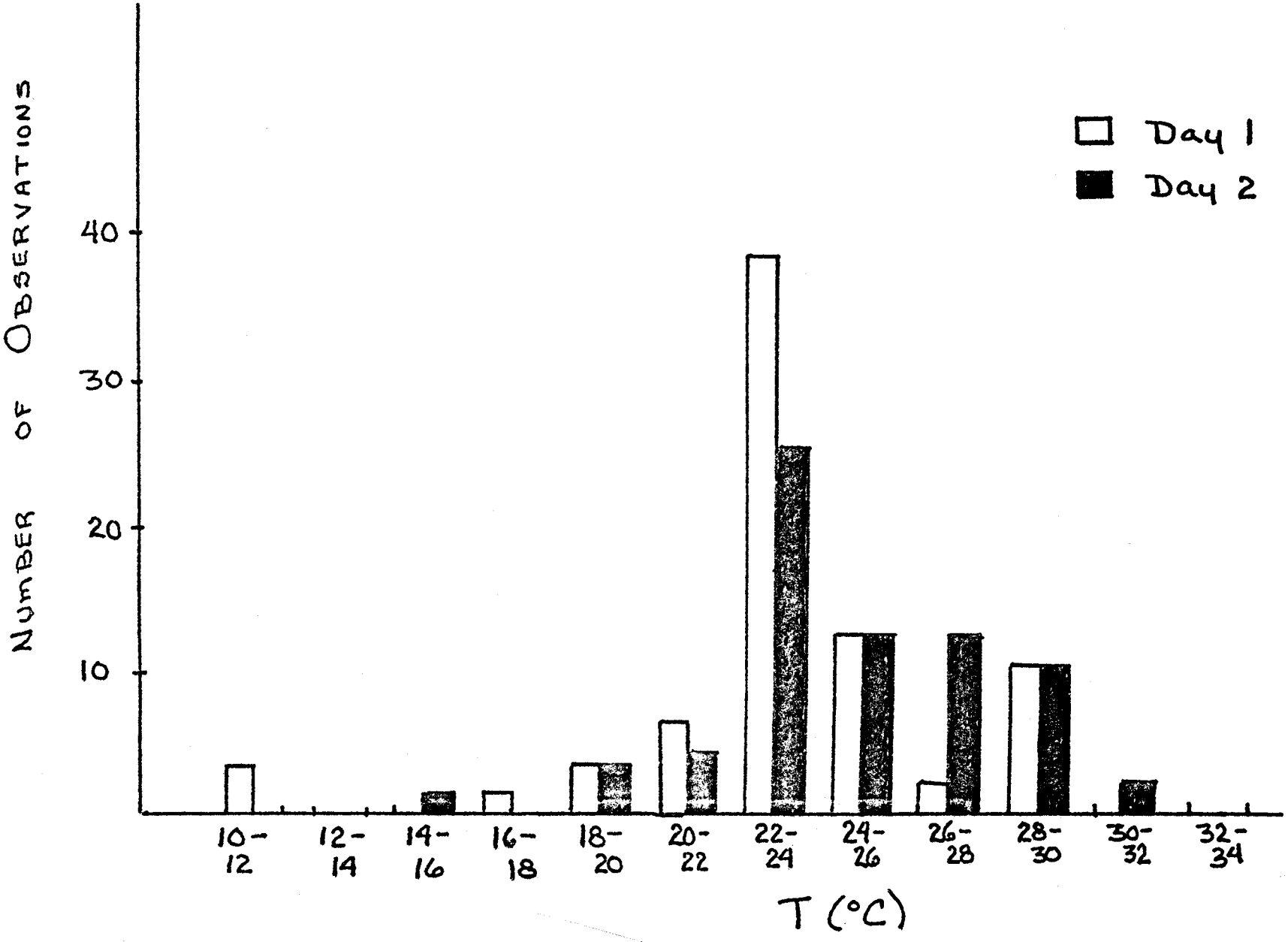
# Dissolved Oxygen Tolerance vs. Acclimation Temperature For *G. robusta*



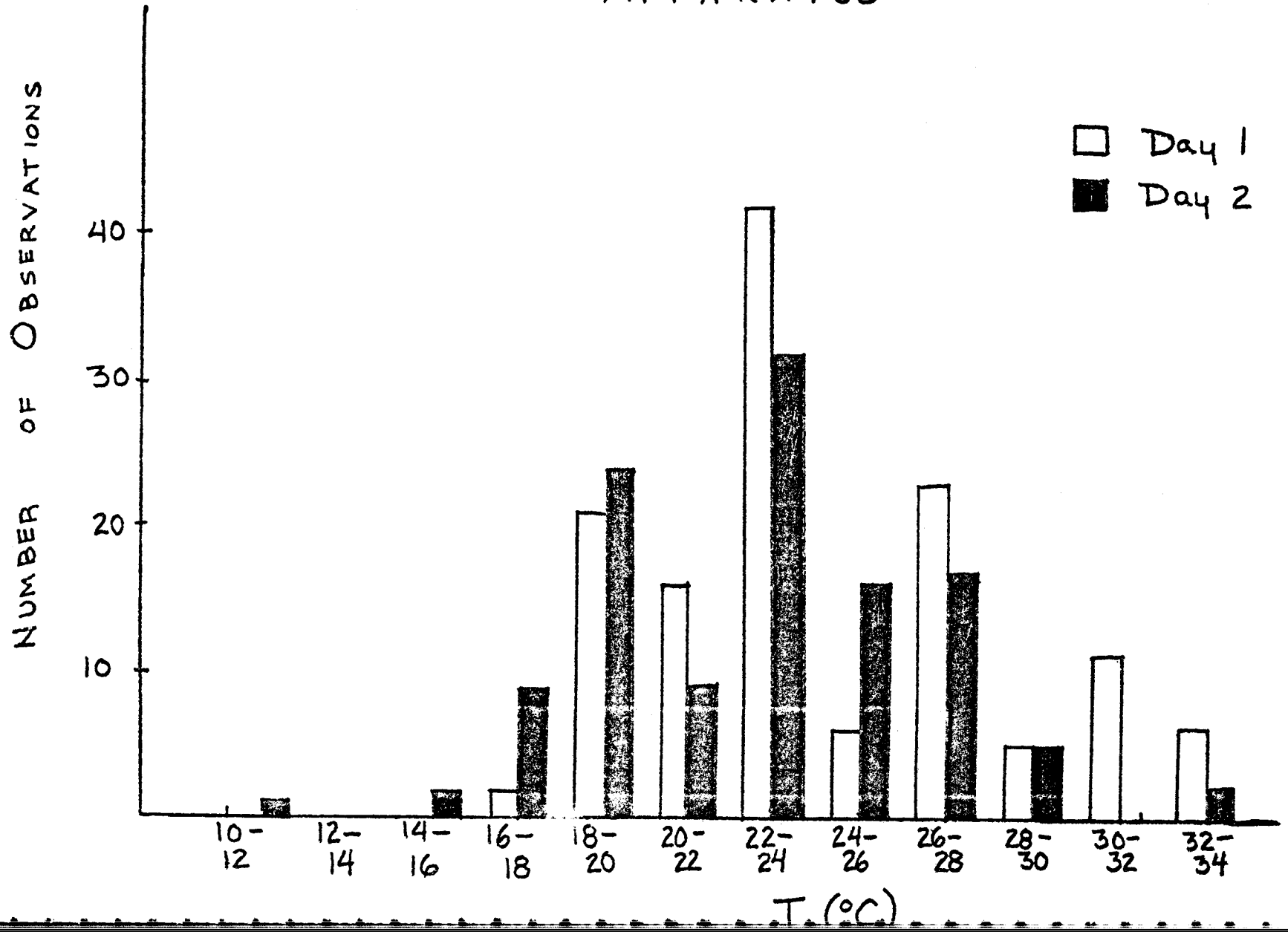
# Frequency Distribution of 8°-Acclimated *G. robusta* in Temperature Preference Apparatus



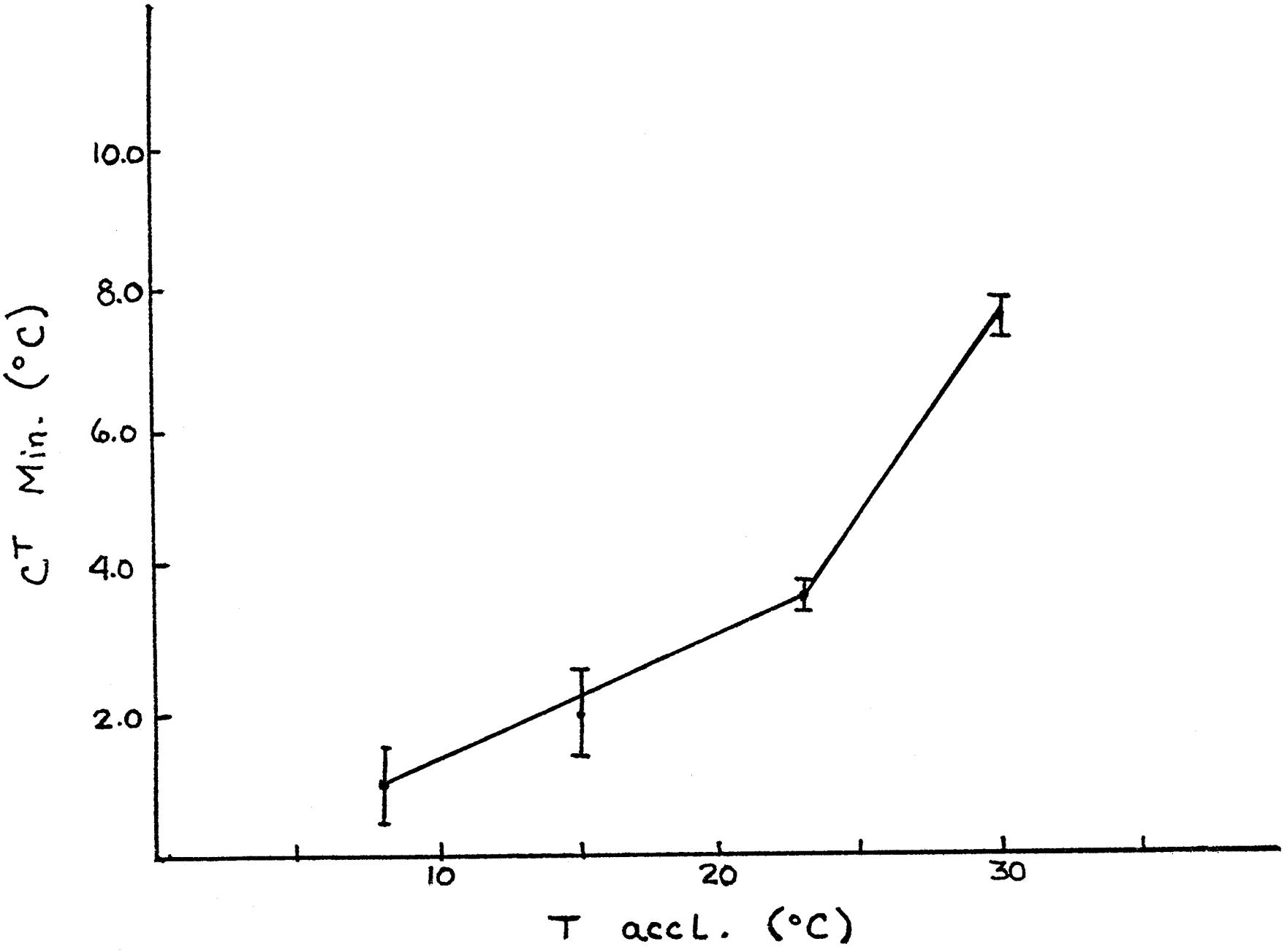
# Frequency Distribution of 23°-Acclimated *G. robusta* in Temperature Preference Apparatus



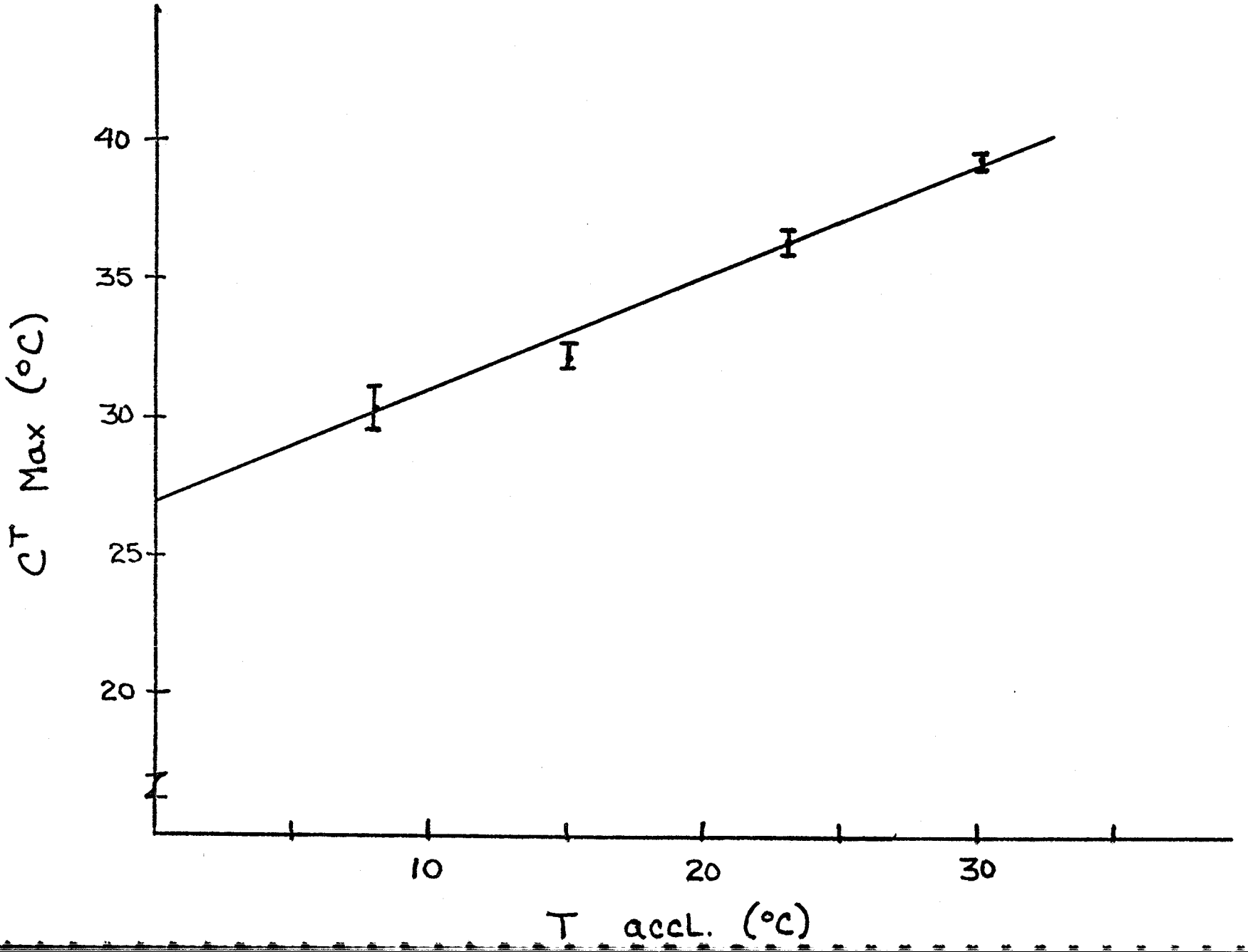
# Frequency Distribution of 30°-Acclimated *G. robusta* in Temperature Preference Apparatus



# Critical Thermal Minima vs. Acclimation Temperature For *G. robusta*



# Critical Thermal Maxima vs. Acclimation Temperature For *G. robusta*



## Genetic Interaction Between an Endangered Pupfish, Cyprinodon bovinus, and an Introduced Congener, C. variegatus

Anthony A. and Alice F. Echelle, Baylor University, and
Royal D. Suttkus, Tulane University

ABSTRACT

Sometime between January and August, 1974, Cyprinodon variegatus, a common species on the Gulf Coast of Texas, was introduced into the highly restricted habitat of C. bovinus in Leon Creek, Pecos County, Texas. Morphological and biochemical analyses demonstrate extensive hydribization and backcrossing. C. variegatus influence is restricted to a lower segment of the watercourse which is isolated from an upper segment that still supports a pure population of C. bovinus. An attempt to eliminate the bovinus x variegatus population was only partially successful. The biochemical analysis suggests that in some habitats the probability of encountering a "pure" bovinus specimen is less than 1 X $10^{-6}$, while other habitats seem to support pure bovinus. Despite some degree of habitat segregation, continued persistence of the bovinus x variegatus population probably will lead eventually to a thorough disruption of the bovinus genome.

## Recent Aquatic Manipulations in California and Nevada and Their Effects on Endemic Gastropods[1]

J. Jerry Landye
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ABSTRACT

Manipulation of four springs inhabited by endemic gastropods has taken place in the National Desert Wildlife Range, Nevada and Death Valley National Monument, California. Two of the projects were for fish renovation and two were for domestic water systems. To this date no endemic gastropods have been extirpated, but populations have been reduced in two cases. These reductions were due to physical changes in the habitat. With better planning these declines could be reduced. Fintrol$^{R}$ with Antimycin-A was used as a fish poison in two cases and caused no visible effects on amphipods or gastropods.

During the past two years four projects in endemic gastropod habitats have been started and/or completed in the National Desert Wildlife Range, Nevada and Death Valley National Monument, California. Two of the projects, Grapevine Canyon #1, Death Valley National Monument and Corn Creek Spring, National Desert Wildlife Range were for renovation of habitats by removal of Gambusia affinis. The other two were for redevelopment of domestic water systems at Travertine and Grapevine Canyon #3 springs, Death Valley National Monument.

1. National Park Service funded a majority of this investigation in Death Valley National Monument with field support by Peter G. Sanchez, National Park Service. Gail Kobetich, U.S. Fish and Wildlife Service, contributed his notes on specific Fintrol treatments.

## Renovation

Removal of Gambusia affinis was conducted mainly by Gail Kobetich, U.S. Fish and Wildlife Service. Prior to implementation of the eradication program, I surveyed the Corn Creek springs and the lower half of the Grapevine Canyon #1 Spring. At Corn Creek an undescribed genus-species of Hydrobiidae gastropod was found, but at Grapevine Canyon #1 I found only the common pond snail, Physa virgata. Access to the latter headspring was impossible at the time due to dense vegetation.

Treatment at Corn Creek springs consisted of using most of one unit of Fintrol-5$^{R}$ with Antimycin-A from Ayerst Laboratories in the head spring pools on March 22-23, 1976, after the pond had been drained. The pond was allowed to refill on March 25, 1976, and the remainder of the Fintrol-5 was put in the lower end of the spring run.

The snails were checked again in March, 1977, but unknown to me the spring run had just been put in a prefabricated cement canal and the headspring covered with a wooden structure. These structures were designed to prevent future growth of sedges and other emergent vegetation along the spring runs. Snail populations at this time were of extremely low density, surviving only on a few rocks in the canal. Whether or not the decreased density was due to Fintrol or the cement lining of the spring runs could not be ascertained at that time.

Last summer, June 30, 1977, Grapevine Canyon Spring #1 was treated with one unit concentrated Fintrol and two units of Fintrol-5. The concentrate was put in at drip stations located at the head spring and one at the old swimming hole. The Fintrol-5 was used in the marshy areas along the run. One month later, I examined the headspring for the first time and found both Hyalella azteca and the endemic Fontelicella n. sp., previously known from #2 and #3 springs in the canyon. Snail densities were high with a minimum of 1 snail/cm$^2$ in the suitable habitats.

## Domestic Water Systems

This past summer Scotty's Castle experienced extreme water shortages. Since the endemic Fontelicella n. sp. was known to be present in their water supply springs, plans were made to incorporate a natural habitat for them in the improved water delivery system which was to be installed. This was accomplished by placing an underflow pipe in the Grapevine Canyon #3 spring collection box, assuring the Fontelicella n. sp. with enough water to support their habitat. This system was completed just a few weeks ago and despite the dramatic change in the habitat, several snails were found alive. If at the end of one year the Fontelicella n. sp. have not reestablished their populations in the new spring run, material from springs #1 and #2 will be used to transplant stock.

Also in Death Valley National Monument, the water system that supplies Furnace Creek Inn and Ranch, Indian Village, and the Monument's Visitor Center is in disrepair. Thus a new system had to be installed. Three days ago the construction of the new delivery system began. One of the primary sources is Texas Springs which had been capped many years ago. From subfossil shells, it

is known to have been inhabited by at least one endemic gastropod, but they did not survive due to the lack of a surficial drainage. The original plans called for the complete capping of Travertine Springs where an undescribed genus-species of Hydrobiidae and Assiminea n. sp. live. Modifications of the construction plans have been made to provide a natural area in the spring system. This natural area will be fed by an underflow pipe from the Line #1 collection box and supplemented with three smaller spring runs. This latter water may cease to flow if the collection area cuts off their water source. Thus the underflow pipe is designed to be a sure source of water. An additional area has been set aside until completion of the Line #1 collection area for snail stocks for transplant material if some unforeseen circumstance occurs.

## Conclusions

1. Endemic gastropods can be provided for with proper planning and design of domestic water systems.

2. Fintrol and Fintrol-5 with the active ingredient Antimycin-A have no visible effects on the amphipod, Hyalella azteca or members of the family Hydrobiidae: Gastropoda.

3. Placing of spring runs in cement lined canals can lead to population extinction unless suitable habitats are placed within those canals.

## Thermal Responses of the Pahrump Killifish, Empetrichthys latos latos

Douglas Selby
University of Nevada, Las Vegas

Thermal tolerances and preferred temperatures of the Pahrump killifish, an endangered cyprinodont fish, were determined at the University of Nevada, Las Vegas. Killifish acclimated to temperatures from 11.5 C to 31 C were subjected to temperature increases or decreases at 0.2 C/minute until the fish lost equilibrium. The highest and the lowest temperature tolerated by the fish were taken to be the critical thermal maximum (CTMax) and critical thermal minimum (CTMin) respectively. Fish acclimated to 11.5 C had a CTMin of near 0 C and a CTMax of 30.0 C. Fish acclimated to 31 C had a CTMin of 6.9 C and a CTMax of 40.0 C. It was not possible to define a preferred temperature for the Pahrump killifish. Observations in a temperature gradient showed killifish to be distributed over the entire available temperature range with no specific temperature preference. A tentative conclusion, awaiting support by similar experiments with other fish from thermal habitats, is that the Pahrump killifish lacks the ability to effectively thermoregulate. This lack of thermoregulatory ability may be correlated with the constant temperature conditions of the fish's native habitat.

## Is the Tecopa Pupfish Extinct?

Douglas Selby
University of Nevada, Las Vegas

All known aquatic systems in the Tecopa area of southeastern California were surveyed during the summer of 1977 in an effort to locate new populations of the endangered Tecopa pupfish (Cyprinodon nevadensis calidae). Many artificial and natural habitats contain populations of C. nevadensis which should be evaluated by a competent taxonomist. Perhaps one of these populations could be a transplant of C. n. calidae. Habitats were also surveyed for basic water chemistry, physical description, and invertebrate life. The information has been compiled in a report to California Department of Fish and Game.

## Status and Preferred Habitat of the Rare Fishes of the Green River, Utah

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

### ABSTRACT

Over 19,000 fish were collected by seines and electrofishing gear in August and September, 1977, in the Green River between Jensen and Green River, Utah. Adults and juveniles of all four rare fishes (Colorado squawfish, Ptychocheilus lucius, humpback chub, Gila cypha, bonytail chub, Gila elegans, and razorback sucker, Xyrauchen texanus) were found. The collection of young-of-the-year razorback suckers is the first for the upper Colorado Basin. Young-of-the-year Colorado squawfish preferred backwaters with no current, a silt substrate and 1-2 feet of depth. Juvenile squawfish preferred backwaters with more than 1 foot of depth, but also used slow eddies. Subadult squawfish were primarily found in eddies and runs. Young-of-the-year humpback chubs used backwaters and eddies with velocities of less than 0.5 fps, a preferred depth of 2 feet and a silt and sand substrate. Juvenile chubs used a wider range of microhabitat, but preferred velocities of less than 0.6 fps. Adult humpback chubs used a variety of habitats, velocities, substrate, and depths, with no clear preferences. Young-of-the-year Colorado squawfish were fin clipped in one backwater to determine movement. Few marked fish were found, indicating movement, but the extent of the movement was not determined. Many introduced fishes were found in samples containing young rare fishes, indicating the possibility of competition and/or predation.

## Effects of Generation-Long Temperature Acclimation on Reproductive Performance of the Desert Pupfish, Cyprinodon n. nevadensis[1]

Shelby D. Gerking, Raymond Lee and Joy B. Shrode[2]
Arizona State University, Tempe, Arizona

ABSTRACT

The hypothesis was tested that reproductive temperature tolerance limits would be subject to temperature acclimation in a manner analagous to the effect of acclimation on upper and lower lethal temperature limits. Desert pupfish, Cyprinodon n. nevadensis, were bred and the eggs reared at the optimum temperature for reproduction, 28 C, and at two marginal temperatures, 24 and 32 C. Each brood was divided into three groups, and reproductive performance was tested at the acclimation temperature and at the two alternate temperatures. The eggs laid per spawning and eggs laid per gram body weight per day showed no adaptation to temperature. Reproductive performance was optimal at the 28 C temperature regime and was poor at the marginal temperatures, regardless of the previous thermal history of the fish.

## The Effects of Temperature and Salinity on the Metabolic Rate of Cyprinodon salinus

Ed Stuenkel and Stan Hillyard

ABSTRACT

The Salt Creek pupfish, Cyprinodon salinus, survives under some of the harshest of environmental conditions. Water temperatures in Salt Creek range from below 10 C in the winter to 35 C or above in summer. Likewise, salinities vary from less than one half seawater up to seawater or even greater in isolated pools. The metabolic cost of temperature acclimation and osmotic regulation was determined for C. salinus by comparing standard metabolic rates over a range of experimental salinities and temperatures. To study the effects of salinity on metabolic rates three groups of fish were kept for two weeks in freshwater (80 millisomoles/kg) and in Salt Creek water adjusted to approximately one half seawater (641 milliosmoles/kg) or seawater (1168 milliosmoles/kg). The effects of temperature on metabolism were evaluated by maintaining fish at each of the above salinities at three environmental temperatures; 15 C, 25 C, and 30 C for the two-week period. In general, increases in temperature or salinity were accompanied by increases in metabolic rate. Higher metabolic rates were found in cold acclimated animals at any given temperature, although at the

[1]The research was conducted under contract EE-76-S-02-2498 of the Energy Research and Development Administration (ERDA). The authors are grateful for the technical help of Sue Morgensen.

[2]Present address: Department of Biology, Occidental College, Los Angeles, California 90041.

temperature of acclimation the cold acclimated metabolized less than did the warm acclimated. The metabolic rates of one half seawater acclimated fish were greater than freshwater acclimated fish at all temperatures. Seawater acclimated fish reached a metabolic maximum at 25 C with no change occurring at 30 C. Interestingly, the metabolic rates of seawater acclimated fish were not significantly different from the value obtained for one half seawater acclimated fish at 30 C indicating a respiratory maximum may have been reached.

## SESSION II - Reports by Agency Representatives

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

### Status Report, National Park Service, Death Valley National Monument

P. G. Sanchez

Native fishes (listed below) and their habitats in Death Valley are unchanged in status from last year's report. Habitats are stable and no new threats are known.

Mining claims have been withdrawn or extinguished on the Amargosa River. Mining activities in the Monument are strictly regulated under provisions of Public Law 94-429.

The boardwalk at Salt Creek has been operational for over a year. Trailing by people has markedly decreased; most people stay on the trail. For the first time wheelchair visitors can see the pupfish and their habitat.

A final court ruling on the Devil's Hole water level is still pending. Present water level is set at 3.00 feet below the reference point. There has been no pumping of groundwater since September 1977. The ranch has ceased operations and equipment has been auctioned. Mean daily water levels for September and October 1977 was -2.78 feet (extremes for this period were -2.85, -2.67). High fish count was 490 on 26 September 1977.

*Gambusia affinis*. Waters at Scottys Castle at the north end of Death Valley were treated with Antimycin A (Fintrol) to eradicate *Gambusia* on 30 June and 1 July 1977. California Department of Fish and Game, Fish and Wildlife Service, and National Park Service personnel worked together on this project. Though most of the mosquitofish were killed, a few remain.

All of the following fishes, endemic to the Monument, are presently safe:

| | |
|---|---|
| *Cyprinodon diabolis* | Devil's Hole |
| *C. nevadensis nevadensis* | Saratoga Springs |
| *C. nevadensis amargosae* | Amargosa River |
| *C. salinus* | Salt Creek |
| *C. milleri* | Cottonball Marsh |

# Agency Report to the Desert Fishes Council

John N. Rinne

Forestry Sciences Laboratory
Rocky Mountain Forest and Range Experiment Station
Arizona State University Campus, Tempe, AZ 85281

In summer and autumn 1977, almost 3 dozen streams on the Fort Apache Indian Reservation and Apache-Sitgreaves National Forest were sampled. Approximately 250 "Salmo apache" were collected and are in different stages of analyses. To date, vertebrae and pyloric caecae have been counted on 75% of specimens. Karyotypes have been processed for about a third of all fish collected, mostly from streams on the Fort Apache Indian Reservation. Two streams (Grant and Ash creeks) on the Graham Mountains with introduced populations of Arizona trout have been collected and the vertebrae have been counted. Counts indicate that the former population (59.8) is pure and the latter (61.2) perhaps hybridized.

The usefulness of chromosomes for detection of hybrid S. apache x S. gairdneri is unconfirmed. This is largely attributable to the inability to produce karyotypes of fish from suspect hybrid populations. Electrophoresis of 50+ native and rainbow trout indicate a great degree of variability, and no separating bands have been positively identified that will separate pure and hybridized fish. Karyotypes, on the other hand, are very constant from different cells in the same fish and in general do agree with meristics.

Habitat analyses have been conducted primarily in McKnight Creek which is inhabited by an introduced population of Gila trout (Salmo gilae). This phase of research has been delayed for S. apache until taxonomic and distributional studies are complete. Gila trout spawning will be examined in spring 1978.

Ord Creek on the Fort Apache Indian Reservation was rennovated under the direction of the U.S. Fish and Wildlife Service, Pinetop, Arizona, in late August of this year; over 9,500 fish (270 kg.) were recovered. Brook trout (Salvelinus fontinalis) predominated (52% by numbers, 77% by weight) followed by brown trout (Salmo trutta) (8% and 18%, respectively). One hundred and two native Arizona trout were lost due to antimycin treatment. Ninety-one S. apache were returned to the stream alive following treatment. Mean vertebral and pyloric caecae counts (58.7 and 32, respectively) of 30 S. apache from Ord Creek, combined with the absence of rainbow trout (S. gairdneri), suggest that the strain is pure.

The Salt River above the U.S. 60 bridge was surveyed for squawfish (Ptychocheilus lucius) in late May of this year. None were taken. Gap Creek, Arizona (Prescott National Forest), which contains an introduced population of S. gilae was partially surveyed (0.5 km) in November. Eighteen adults (16 to 30 cm) and 17 young (less than 10 cm) were captured, counted and returned alive to the stream.

The Poeciliopsis occidentalis - Gambusia affinis co-occurrence phenomenon in southern Arizona was examined in March. A paper is now in press (December) on the situation.

## Bureau of Reclamation

James F. LaBounty, Research Biologist
Engineering and Research Center, Denver, Colorado

During the past year, I think it is safe to say that the Bureau of Reclamation has been in a state of change. The creation of the new Department of Energy has resulted in a loss to the Bureau of many activities and personnel. In addition, the administration's much publicized policy on water resources development in the West has placed many authorized and planned Bureau projects in question. As far as desert fishes are concerned, this new approach is both good and bad. If certain projects are not constructed by the Bureau, this opens the door to private development. If no Federal funds are used in these private developments, it is less likely that the fate of desert fishes will be even concerned with by the developer. Whereby, if Federal funds are used in any way, the developer, whether it be the Government or private interests, is under constraint to protect the existing biota. This is a situation that must be watched very closely. As energy development within the Western States increases, the Desert Fishes Council must continue to be watchful of native fishes because the key to this development is water.

I am not going to dwell on specific Bureau projects, except in a couple of cases. The Hoover Dam Pupfish Refugium continues to operate and population estimates are being made. The latest estimate made by biologists from the Bureau and University of Nevada, Las Vegas, is 40 Devil's Hole pupfish. This is an extremely low count. Jack Williams' study of the usefulness of the refugium, sponsored by the Bureau, is complete and will be available as a published report sometime in December.

Construction of the multilevel outlet at Flaming Gorge will begin soon. The purpose of this is to increase the water temperature of the Green River below to enhance the trout fishery. Native fishes may also respond to these more optimum water temperatures. The Bureau will sponsor a study of the native fishes of the Green River and the impact of this modification on them.

The Bureau's support of and participation in the activities of the Desert Fishes Council remains solid. I personally invite queries on any of the Bureau's activities as they affect desert fishes, and the Bureau will remain responsive to the needs of desert fishes.

## State of Colorado, Department of Natural Resources
## Division of Wildlife

David Langlois, Nongame Aquatic Specialist

The most important Division of Wildlife program for endangered species in Colorado is conducted by our Environmental Resources (ER) Section. The ER section is fast growing because of the enormous need for environmental protection in the face of large-scale energy and water development. The ER section reviews environmental impact statements, has spearheaded our minimum stream

flow work, and as such are watchdogs over most development-related environmental problems. As always, habitat destruction continues to plague endangered fishes.

The nongame staff has been only slowly growing in terms of personnel. However, this past year we received a real carrot in the form of $150,000 grant to manage endangered wildlife. The Colorado squawfish and humpback chub have both benefitted from this grant. The Division has conducted a population monitoring program to look for endangered fishes reproduction. As a corollary, Colorado State University has been partially funded to develop a comprehensive guide to the identification of larval upper Colorado River basin fishes. We have also implemented a habitat monitoring program to quantify the characteristics of remaining endangered fishes habitat. An incremental analysis of this habitat is being developed in cooperation with the Instream Flow Service Group, U.S. Fish and Wildlife Service.

In the upper Rio Grande River basin, Lloyd Hazzard and the field personnel in southwestern Colorado have been working to restore the Rio Grande cutthroat trout. This fall they undertook a major stream reclamation project to create habitat for Rio Grande trout in Trinchera Creek. Hopefully, all the introduced and hybrid trout were removed, insuring the genetic integrity of the restocked Rio Grande trout.

Another threatened cutthroat trout, the greenback, was also beneficiary of OES funds. A crew inventoried likely habitats along the front range, and located two new possible greenback trout populations. A greenback trout brood stock was established at the Bozeman R & D Hatchery in Montana (USFWS). If all goes well, eggs and fry for reintroduction programs will be available next spring.

Until this year, no one had reported the presence of the threatened plains orange-throat darter in Colorado for more than 60 years. Through a comprehensive species and habitat inventory in the upper Republican River drainage, four streams are now known to harbor this darter. It may be delisted soon.

## Nevada Department of Fish and Game

Cal Allan, Regional Assistant, Fisheries Management

### Protected Species Range Extension

An extension of the range for the Railroad Valley springfish, Crenichthys nevadae was noted on May 19, 1977. A limited amount of collecting was accomplished near the source of Hot Creek (Hot Creek, Range T8S, R49E). Several Railroad Valley springfish were collected, and many others were observed.

It is assumed that this occurrence is the result of an unauthorized transplant into this remote portion of the Pluvial Lake Railroad system.

## Re-discovery of a Spinedace

Lepidomeda mollispinis pratensis, Big Spring spinedace, were collected from Panaca Big Spring by C. L. Hubbs, R. R. Miller, and A. J. Calhoun on July 10, 1938.[1]

The original collection consisted of only the type specimen and six paratopotypes. These were obtained by prolonged seining effort. Evidently, these fish were not abundant in the type locality in 1938.

Extensive fish collections in other portions of Meadow Valley Wash (Pluvial Carpenter River) during 1938, showed no other populations of spinedace in this relict river system.

Subsequent collections by Hubbs and Miller in 1959 indicated these spinedace had become extinct, a consequence of extensive habitat modifications and the introduction of mosquito fish.

It was suspected by Region III personnel that some segments of the relict system had not been adequately inventoried by the original collectors, and the possibility for survival of a remnant population of spinedace was good.

A BLM contract for fish population inventories in the Caliente Resource Area presented an opportunity to investigate some of these overlooked segments. Consequently, Condor Canyon was selected for a likely sample site.

On September 23, 1977, fisheries personnel hiked from the lower end of Dry Valley into the upper reaches of Condor Canyon. The sample area was a large pool below a 50-foot (est.) waterfall. Sampling gear was limited to one fine mesh dip net, since the shocker is not completely portable.

Small fish of 2½ to 3 inches were abundant in the pool, and dip net collection was not difficult. The population of fishes appeared to be of one species, so only 4 were collected for preservation and identification. Perfunctory field identification was spinedace species (unident.).

Subsequently, the specimens were sent to Dr. Hubbs at Scripps Oceanographic Institution, and he confirmed our suspicion that they were L. m. pratensis. Dr. Miller now has the fish in his possession for further study, but he is reasonably certain of that identification.

Additional field work is needed in the Panaca area of the Meadow Valley Wash. Particularly, we should define the totally occupied area and determine relative abundance of the species. The waterfall in Condor Canyon may be a historic barrier to upstream migration of the spinedace, and this may be the upper limit of their distribution. Although native speckled dace and desert suckers occur above this point, the spinedace may have been late migrants into the Pluvial Carpenter River system.

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[1]Miller, Robert Rush and C. L. Hubbs. The Spiny-rayed Cyprinid Fishes (Plagopterini) of the Colorado River System. Miscellaneous Publications, Museum of Zoology, University of Michigan. No. 115, July 5, 1960.

It appears that approximately 3.5 miles of permanent stream flows from the waterfall to the diversion point below the mouth of the canyon. This may be the only remaining suitable habitat for the subspecies. However, other possible sites within the drainage are considered for transplant possibilities.

Geographical isolation from other forms of spinedace adds validity to the subspecies classification and provides additional clues to the historic geology and meteorology of the relict White River and Carpenter Systems.

## SESSION III - Miscellaneous Presentations

Chairman: Dr. James E. Johnson, U.S. Fish and Wildlife Service, Albuquerque

### Comparative Courtship Behavior in Five Populations of Desert Pupfish

Boyd E. Kynard
School of Renewable Natural Resources, University of Arizona

Male pupfish from 5 locations (3 in Lower Colorado River drainage of Mexico, 2 in Rio Sonoyta drainage) were compared for courtship behavior. Most observations were conducted in 6 m diameter circular pools, although extensive observations were also conducted in the field on the Quitobaquito and Rio Sonoyta populations. Description and classification of individual motor patters were after Liu (1977). Behavior was recorded by movie camera and tape recorder. Major behavioral differences were found in the courtship of each population, and no two populations had the same repetoire of motor patterns. These differences represent major genetic divergence. The adaptive significance of the courtship diversity between populations may be related to differences in living in lentic or lotic environments.

### Additions to Cross's Ecological Distribution of the Fishes of the Virgin River

Neil B. Armantrout

During 1976, inventories were conducted in streams of the Virgin River drainage in Washington County, Utah. Several streams not mentioned by Cross in his study were found to contain fish. Information regarding these fish was obtained through interviews with persons who had worked in the area, examination of museum specimens, and direct observation by Bureau of Land Management personnel. The following additions to the fish fauna distribution were noted.

1. South Creek. A tributary of the East Fork Virgin River just a short way above its confluence with the North Fork Virgin. In a steep-sided valley, it is subjected to periodic flooding and very heavy silt loads. Banks are unstable and the bed mostly silt. Gradients are 5 to 10% in areas with fish. Most of the fish are found in shallow pools around the base of large rocks, and in gravel riffles. Species included:

Speckled Dace
Desert Sucker

2. Leeds Creek. A tributary of the Virgin River near the town of Hurricane. Near the I-15 bridge, at the mouth of Cottonwood Wash, is a series of springs. In addition to the species Cross reported, the Virgin River roundtail chub has been found here historically.

3. Mill Creek. Flows through the town of Washington and into the Virgin River. About two miles above Washington are a series of springs in a 100' deep canyon. The canyon floor is narrow, with a good cottonwood development. Bed is mostly fine material with some rocks. Water is shallow. Two species have been found here:

Speckled Dace
Desert Sucker

4. Ft. Pierce Wash. A series of springs arise near old Ft. Pierce and flow about one half mile before sinking into the ground. The area has a mostly silty bottom, several large rocks with deep pools at the base. The area is subjected to occasional severe flooding. Species found here:

Speckled Dace
Desert Sucker

5. Beaver Dam Wash. Beaver Dam Wash begins as the East and West Forks, which flow together near the town of Motoqua. Much of the headwaters of the West Fork are in Nevada. Both Forks contain water in their upper ends, but because of irrigation withdrawal, are dry at their mouths most of the year. The main channel of Beaver Dam Wash is dry except for occasional springs. It seeps again to the surface near its mouth, in Arizona. The headwaters are in very steep canyons, with narrow floors. The Wash below the confluence at Motoqua flows between sheer banks cut into the alluvium. The following fish were reported:

   a. West Fork Beaver Dam Wash. Cross found no fish above Shroeder Reservoir: at the time of the inventory, rainbow trout and desert suckers were abundant.

      1. Pine Park Canyon. Begins as a series of springs several miles above its mouth, and flows into West Fork Beaver Dam Wash above Shroeder Reservoir. Mostly gravel and rock bed, gently riffles, with some pool. Slow gradient. Good riparian vegetation. Summer temperatures can be quite high. Appears to serve as a spawning and rearing area for trout from Shroeder Reservoir. The following species were encountered:

Rainbow Trout
Desert Sucker

2. Sheep Canyon. A steep, very narrow canyon. About one half mile above its mouth into the West Fork of Beaver Dam Wash is a series of warm springs. Flow is never over 0.1 or 0.2 cubic feet per second, but flow and temperature remain quite constant. Rainbow trout and desert suckers were found in the stream. Adults were few, but juvenile rainbow trout abundant, suggesting the stream is used as a spawning and rearing area.

Rainbow Trout
Desert Sucker

b. East Fork Beaver Dam Wash. Two spring areas are located in the Wash, one about two miles above the mouth, the other just above the old mining town of Goldstrike. Both are shallow, rocky areas, with abundant riparian vegetation. Near Goldstrike, livestock use is heavy and trampling in the springs common. In both spring areas the following species were encountered:

Speckled Dace
Desert Sucker
Virgin River Spinedace

1. Bull Canyon. Bull Canyon is a tributary of East Fork Beaver Dam Wash, and flows into the Wash near Goldstrike. Near its mouth is a spring that flows about 50 meters. It is heavily trampled, with a muddy bottom except for pools in the bedrock. The species here are the same as for the East Fork at Goldstrike.

c. Main stem of Beaver Dam Wash. In the area of Township 42, Range 19 and 20, is a series of springs and wells. There are several ranches that divert the water for irrigation. In the springs and in the irrigation canals are found the following:

Speckled Dace
Desert Sucker
Spinedace

Species

Speckled Dace - Rhinichthys osculus Girard
Desert Sucker - Pantosteus clarki Baird & Girard
Rainbow Trout - Salmo gairdneri Richardson
Virgin River Spinedace - Lepidomeda mollispinis mollispinis Miller & Hubbs

References

Bureau of Land Management 1977, Hot Desert Grazing Environmental Statement. Prepared by the Cedar City District, Utah.

Cross, Jeffrey N. 1975, Ecological Distribution of the Fishes of the Virgin River (Utah, Arizona, Nevada). MS Thesis, University of Nevada, Las Vegas.

# Fish Distribution in Southeast Utah

Neil B. Armantrout

Very little study has been made of the fishes of Southeast Utah. Because of the difficulty of access, collections that have been made were mainly from important sport fisheries or areas easily accessible by road. Because of recent environmental pressures from development of energy resources, grazing and increased recreation pressure, some studies of the fish populations of Southeast Utah has begun.

During the past year, the Bureau of Land Management issued two contracts for study of fish populations in Southeast Utah. The studies were done by the Utah Division of Wildlife Resources. Other studies, concentrating on the major rivers, took samples from the Colorado, Green and San Juan rivers.

This report summarizes the information available from these contracts, plus additional information available from published reports, museum specimens, and from information provided by the Utah Division of Wildlife Resources.

The Southeast Utah area is all the Colorado River drainage and all of the Green River drainage below Sand Wash, 96 river miles above the town of Green River. It includes all of the Colorado River, San Juan River, Dolores River, San Rafael River, Price River, and Muddy River in Utah, and the lower 225 miles of the Green River, plus their tributaries. Tributary streams arise in mountainous areas of the Wasatch Plateau, Book Cliffs, LaSal Mountains and Blue Mountains, and are typical mountain streams. Once they leave the mountains, these streams become warm water fish streams. The major rivers contain primarily warm water species, although trout are commonly found in the rivers during winter.

Fish found in these streams are shown in the accompanying table.

Two trends are noticeable. First, native species have been replaced by introduced species. This has been well documented in the major rivers. In the cold-water fish areas, native cutthroat trout, once reported to be common, have been replaced by introduced trout species. To date, no populations of pure native cutthroat trout have been identified.

Second, natural habitat has been modified by alteration, primarily the construction of dams and the removal of water. Several of the larger streams now go dry or nearly so during late summer. Demands on water will further aggravate the problem in the future.

SESSION IV - Research and Status Reports

Chairman: Dr. Peter B. Moyle, U.C. Davis

## The Effect of Temperature and Salinity on Sodium and Potassium ATPase Activity in the Gills of Cyprinodon salinus

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ABSTRACT

The specific activity of the transport enzyme, $Na^+$-$K^+$ ATPase, was determined in homogenates of gill tissue obtained from the Salt Creek pupfish, Cyprinodon salinus. This species is known to be extremely euryhaline and eurythermal. In order to assess the effects of salinity on the activity of this enzyme, three groups of fish were kept for two weeks in fresh water (80 milliosmoles/kg) and in Salt Creek water adjusted to approximately ½ sea water (641 milliosmoles/kg) or sea water (1168 milliosmoles/kg). The effects of temperature on $Na^+$-$K^+$ ATPase activity were evaluated by maintaining fish at each of the above salinities at three environmental temperatures; 15 C, 25 C and 30 C, for the two-week period. It was observed that enzyme activity increased with increasing salinity at each of the three temperatures employed. Also, at each salinity, there was a general increase in enzyme activity with decreasing temperature. These increases in ATPase activity correlate with the increases in metabolic rates observed after two weeks' exposure to the same temperatures and salinities as were used in this study (Stuenkel & Hillyard, DFC abstract, 1977). It is suggested that the elevation in metabolic rate which is produced by increasing salinity and decreasing temperature may arise, at least in part, by an increase in $Na^+$-$K^+$ ATPase activity in the gills, stimulating the need for ATP production by oxidative metabolism. The role of this enzyme in other tissues remains to be studied.

## Current Status of Cutthroat Subspecies

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Abstract. Recent discoveries of native cutthroat trout populations in desert mountain ranges of the western fringe of the Bonneville Basin have prompted intensified management efforts by state and federal agencies. Analysis of Snake Valley cutthroat specimens in Trout Creek, Deep Creek Mountain range, Utah, indicate this is a pure strain of the trout which once inhabited Pleistocene Lake Bonneville and which was thought to be extinct in Utah. The Snake Valley cutthroat is similar to Salmo clarki utah of the eastern Bonneville Basin, however electrophoretic and morphomeristic analysis show unique genetic differences brought about by long-term isolation (8,000 years) from the rest of the Bonneville Basin cutthroat. This cutthroat is a common

ancestor to several other limited cutthroat populations within the Basin in Nevada. In may 1977, the BLM withdrew from mineral entry about 27,000 acres within the Deep Creek Mountains for protection of this cutthroat and other unique resources on the range. Results of 1977 stream surveys on the Pilot Peak Mountain Range, Utah, indicate the presence of the threatened Lahontan cutthroat, Salmo clarki henshawi, in one isolated stream.

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## Introduction

Historically, the ancient Pleistocene Lake Bonneville in the Great Basin once supported a cutthroat trout, native to the Snake Valley area of Utah-Nevada. This trout once abounded in the area's several streams upon the lake's decline (Hickman 1977). The cutthroat population rapidly declined because of deteriorating habitat in the Twentieth Century to a point where it was believed to be extinct within its native range (Behnke 1976a) (Refer Figure 1).

In 1953 Ted Frantz, Nevada Fish and Game Department, discovered a cutthroat trout population in Pine Creek on Mt. Wheeler, Nevada (Frantz and King 1958). Samples were sent to Dr. Robert Miller who indicated that they represented pure cutthroat trout. But Dr. Miller was unable to assign them to any described subspecies (letter from Dr. Miller to F. Dodge, May 26, 1971). It was assumed that this cutthroat was introduced from Trout Creek drainage of the Snake Valley area (Miller and Alcorn, 1946). This seemed unlikely when one considers that there were streams closer to Pine Creek which probably contained cutthroat trout (Lehman, Baker, Snake and Hendry's creeks). Behnke (1976a) indicates the most logical origin of the Pine Creek cutthroat was from Lehman Creek (Mt. Wheeler tributary of the Snake Valley region) via the Osceola Ditch, constructed as a pioneer waterway.

During 1953 the Nevada Fish and Game Department introduced 44 fish from Pine Creek into Hampton Creek, Nevada. A second transplant of 54 cutthroat from Pine Creek was made into Goshute Creek, Nevada, in 1960. The Nevada Fish and Game Department, assuming these were Utah cutthroat, Salmo clarki utah, closed these streams to fishing and listed S. c. utah as an endangered species in Nevada. Mr. Frank Dodge, Nevada Fish and Game Department, in 1972, found a population of cutthroat trout in the headwaters of Hendrys Creek (Mt. Moriah tributary of the Snake Valley region) which resembled those found in Pine Creek. Following this, several unsuccessful attempts were made by the Nevada Fish and Game Department to locate additional pure populations of cutthroat trout in the Snake Valley area of Utah and Nevada.

In 1973 the BLM (Utah) began stream habitat surveys in the Deep Creek Mountain Range in an attempt to define critical habitats and possible remnant populations of the cutthroat. In the spring of 1974, BLM biologists Don Duff and Josh Warburton discovered cutthroat in the extreme headwaters of Trout Creek, Utah, above a natural barrier falls. Subsequent sampling and analysis by the BLM, Utah Division of Wildlife Resources and Colorado State University (under contract funded by BLM) determined that Trout Creek specimens were pure strain fish of the Bonneville Basin. Inventories have continued to date and the only stream found to contain a pure population was Trout Creek. Hybridized populations (with rainbow trout) were found in Birch Creek and Johnson Creek (Hickman 1977) (Refer to Figure 2).

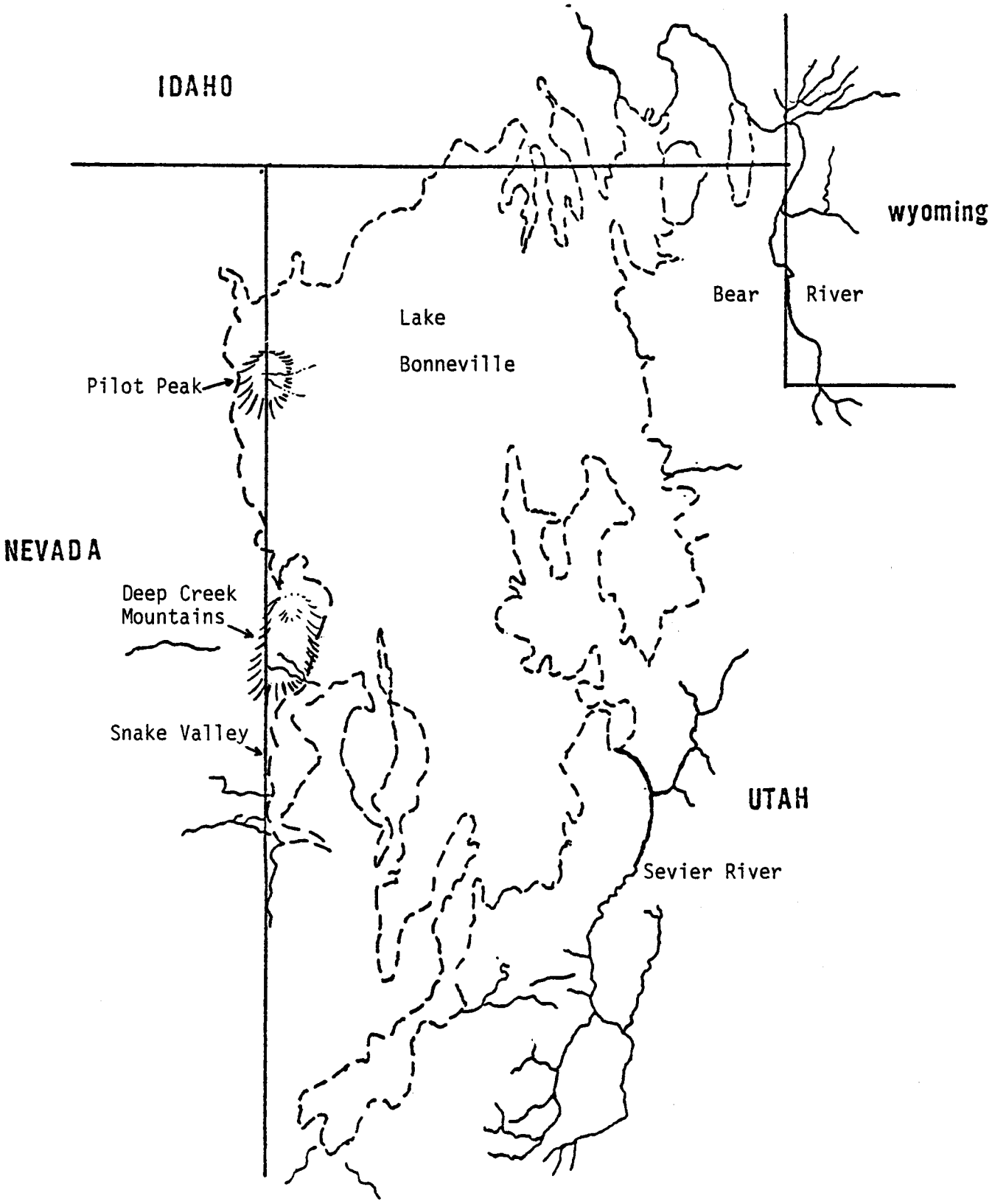



Figure 1. Area Map Location Showing The Western Bonneville Basin Area.

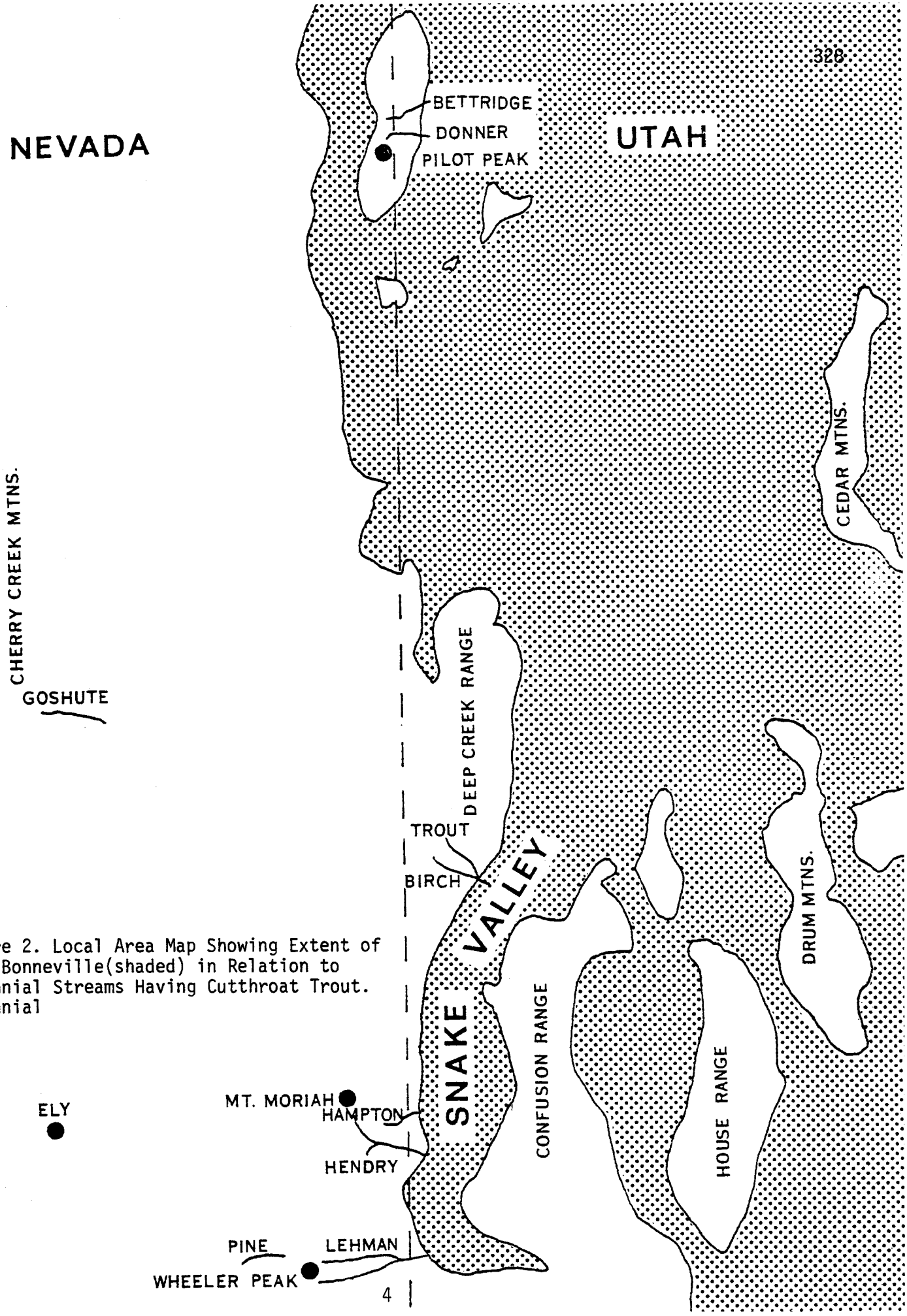



Figure 2. Local Area Map Showing Extent of Lake Bonneville(shaded) in Relation to Perennial Streams Having Cutthroat Trout. Perennial

Reasons for Decline

When the Snake Valley arm of Lake Bonneville dried up there were relatively few perennial streams in the area. In addition to this, since the mid 1800's, introductions of non-native trouts, climatic conditions, irrigation practices and habitat loss and degradation have been influential in reducing the number of cutthroat populations in the Snake Valley area. Replacement and hybridization from introductions of exotic rainbow trout (Salmo gairdneri) have posed the most significant impact to the survival of the Snake Valley cutthroat. Virtually every stream in the Snake Valley region, capable of supporting trout, has been stocked with rainbows. Brook trout are also capable of replacing the cutthroat through competition because of earlier spawning periods and its abi-

Exploitation, though not likely a limiting factor by itself, can reduce the number of catchables and may act to favor other exotics such as the brooks, browns, and hybrids. It has been documented that cutthroat trout are highly vulnerable to angling mortality (Behnke and Zarn 1976).

Livestock grazing imposes a serious and subtle threat to the survival of the cutthroat trout, in the arid Snake Valley region. Grazing becomes significant when discussing sites for reintroductions, since much of the prime grasslands exist in headwater meadow areas. Livestock interests in the Bonneville Basin have been unconcerned about stream protection of rare trout populations. These problems have made the BLM very cautious in planning for additional habitat sites for future reintroductions of the Snake Valley cutthroat. Many studies have shown that livestock grazing destroys and degrades riparian vegetation and streambank soil stability, resulting in alterations of channel morphology, loss of cover, and a reduction in numbers and biomass of fish, particularly older and larger trout (Behnke 1977). Studies and management of livestock impacted areas should occur in order to rehabilitate the grazed areas either through improvement of the existing grazing system, or livestock exclusion (Platts 1977). The BLM in Utah and Nevada has been involved in stream side fencing programs to protect the riparian habitat of streams containing sensitive, or rare trout populations from continued livestock damage (Goshute Creek, Nevada, and Birch Creek, near Beaver, Utah).

Droughts and violent thunderstorms may have historically eliminated cutthroat populations from some high gradient streams, since natural recolonization could not be effective after desiccation of the pluvial lake in Snake Valley. This may account for the high number of barren streams found in the Snake Valley region prior to rainbow trout introductions.

Past surface disturbance impacts from mining have been slight and of short duration, the main damage resulting from equipment movement and road construction to and from the mine site. There exists little room for trails or roads in some of the narrow canyons; therefore, the streambed may be utilized for such purposes in some areas. Recent uranium mining activities in Utah's Deep Creek Mountains have caused concern over the future impacts of mining to the resources of this fragile desert island ecosystem environment.

The effects of all these environmental impacts on the cutthroat trout populations are greatly magnified when considered collectively. Many of the streams in the Snake Valley region have been affected by all of these major impacts at some point in time during the recent past history of the area.

Uniqueness of Snake Valley Cutthroat Trout

Ancient Lake Bonneville went through several periods of fluctuation in which water levels which were closely associated with climatic conditions (Gilbert 1879). According to Broecker and Kaufman (1965), four low levels occurred between 8,000 and 22,000 years ago, including one period of complete desiccation followed by refilling that took place about 11,000 years ago. The final desiccation occurred approximately 8,000 years ago. This final desiccation of Lake Bonneville resulted in ten or twelve independent basins being formed, one of which was the Snake Valley basin (Gilbert 1890). The northern portions of Snake Valley show a lake level elevation of about 5,100 feet. This would have prevented water from flowing out of Snake Valley and into the Great Salt Lake Basin. In addition to such physical isolation, the cutthroat were forced to seek refuge in the streams to overcome the increased saline conditions brought on by the desiccation (Hunt et al. 1953). Thus, many populations of cutthroat in the Bonneville Basin have been isolated from contact with each other for about 8,000 years.

Wydoski et al. (1976) conducted a study of the electrophoretic patterns of proteins in cutthroat located in the Bonneville Basin, as well as with several other groups of cutthroat and rainbow trout. No protein was unique or distinctive for S. c. utah specimens, but an unusual variation for muscle lactate dehydrogenase (LDH) was found in cutthroat from Trout and Goshute creeks, indicating a common ancestor. This unusually complex variation seems to indicate the presence of a variant allele. A unique evolutionary event, or series of events, occurred in the Snake Valley cutthroat trout LDH, which would indicate long-term isolation from the rest of the Bonneville Basin cutthroat trout.

Comparison of samples of the least chub (Iotichthys phlegethontis) in the western Bonneville Basin add credence to the assumption of incipient speciation in fishes isolated in Snake Valley. Samples from Donner Springs (Pilot Peak Area) have the typical fin ray counts given by Sigler and Miller (1963). Those found in Snake Valley have one less ray in the dorsal (7), anal (6) and pelvic (7) fins.

Smith (1966) stated that the mountain sucker (Pantosteus platyrhynchus) of Deep Creek, in the Deep Creek Mountain area, is differentiated from the typical Northern Bonneville form.

The Snake Valley cutthroat trout differs from other cutthroat trout of the Bonneville Basin by having more basibranchial teeth and gillrakers, and fewer scales in the lateral line series. The spotting pattern is more uniformly distributed over the body, and not so concentrated posteriorly as in other Bonneville Basin cutthroat. The head appears longer and deeper with the body being more compressed and caudal peduncle deeper, all of which gives it a more chunky body appearance (Behnke 1976a, b).

## Status of the Snake Valley Cutthroat Trout

Pure populations are found in Pine, Goshute, Hampton, and Hendry's creeks in Nevada and in Trout Creek, in Utah (refer to Figure 2). Hybridized populations are found in Muncy and Mill creeks, Nevada, and Birch and Johnson creeks, Utah (Behnke 1976a, Hickman 1977).

Goshute Creek probably has the highest number of Snake Valley cutthroat, having about 1,500 in 4 miles of stream (McLelland 1975). The Nevada BLM, and Nevada Fish and Game Department (NFG), have been instrumental in protecting and enhancing the habitat in Goshute Creek. During the 1977 drought, Goshute Creek lost about 38% of the cutthroat population per mile. Because of these conditions a concerned NFG took 71 cutthroat from Goshute Creek and transplanted them proportionately into Water Canyon Creek (four stream miles habitat) and Clear Creek (one stream mile habitat).

Pine Creek, a very small stream with little habitat, has about 100 cutthroats (excluding fry), as does Hampton Creek, which is also a small stream (McLelland 1975). Pine Creek suffered some mortality as a result of the 1977 drought. Mile Creek, another creek with transplanted cutthroat, lost its entire population as the creek dried up from the drought.

Hendry's Creek had about 200 cutthroat in the headwater area in 1973. In 1974, eradication of rainbow trout below the barrier was conducted on Hendry's Creek to aid the fish's survival. Hendry's, Goshute, and Pine creeks have now been closed to angling use. Goshute and Hampton Creeks have past histories of losing all of their fish from flash floods, and this is the reason they were barren in 1953 and 1960. Because of its small size, Pine Creek is also vulnerable to flash flooding. Therefore, the potential exists that the cutthroat populations in these streams could be lost in the future. During the 1977 drought, NFG estimates that 50% of the cutthroat populations in Hendry's and Hampton creeks were lost because of dry stream sections. In the interest of managing these unique fish, NFG has identified about 25 streams suitable for reintroductions. They plan to rehabilitate about two to four streams per year in this effort.

During 1977, one of the most significant items to take place in the basin for the protection of desert fishes, and the environment, occurred in the Deep Creek Mountains when the BLM filed for an emergency withdrawal of a 27,000 acre area of critical environmental concern within the mountain range because of increased uranium mining activity, which threatened to destroy many of the unique resources of the mountain area. A significant item in justifying this action was the presence of the rare Snake Valley cutthroat in only about 1¼ miles of critical habitat on Trout Creek as well as the presence of the rare giant stonefly (Pteronarcys princeps). The area was withdrawn from mineral entry on May 3, 1977, by the Secretary of the Interior under section 204(e) of the Federal Land Policy and Management Act of 1976 (PL 94-579). This withdrawal stays in effect for a 3-year period, and allows time for study of all resources to ascertain their values.

In September 1977, the BLM (Utah) funded a contract to the Utah Division of Wildlife Resources to provide for an inventory of all fish and wildlife resources on the mountain range. The contract will last until April 1979, and

will provide BLM with inventory data necessary to evaluate the future withdrawal status. Hopefully, the contract will define other streams inhabited by the cutthroat on the mountain.

In late October 1977, the Utah Division of Wildlife Resources (DWR) eradicated the rainbow trout below the natural falls barrier on Trout Creek as a start to implementing management plans designed to expand the cutthroat population. Future plans call for the transportation of cutthroat from Trout Creek into the headwaters of Red Cedar Creek, a remote stream on the mountain, which was given first priority for transplant efforts. The DWR plans to rehabilitate about seven additional east slope streams to enhance cutthroat survival back into their historic range. A habitat management plan (HMP) being developed for the entire mountain ecosystem by the BLM, in cooperation with the Utah Division of Wildlife Resources, will specify management of all east slope streams for the cutthroat. The complete HMP is scheduled for completion in 1978-79 for all of the mountain resources, of which the cutthroat is an integral part of the fauna. At present the BLM has developed a HMP for Trout Creek and begun implementation of this plan in 1977 using Sikes Act (PL 93-452) authorities. Using Youth Conservation Corps (YCC) workers, some 75 long-type stream improvement structures were constructed in July in Trout Creek to aid the bank stabilization and pool quality enhancement for the cutthroat. Stream improvement work is scheduled again in 1978 by BLM using the YCC.

Although there are differences in the taxonomic characters between *S. c. utah* and the cutthroat found in Snake Valley, there also exists much overlap. Basibranchial teeth counts, which seem to be a distinctive characteristic separating the two forms, were found to be similar in number in one *S. c. utah* sample from Willow Creek, Jordan River drainage, Utah (Hickman 1977). With the analysis of more samples from the Bonneville Basin, the degree of overlap between these cutthroat becomes more obvious. This overlap is further substantiated through the use of a computer-aided discriminant function analysis, which evaluates the similarities and differences between samples (Hickman 1977). Sixteen (16) morphomeristic character measurements (refer to Table 1) from samples of various described and undescribed subspecies of cutthroat trout, and one sample of rainbow trout, were compared (refer to Figure 2). The closer the group centroid (represented by dot in Figure 3), the more similar the samples. The cutthroat trout in Snake Valley and *S. c. utah* are closely situated, indicating a high degree of similarity. Of interest is the similarity depicted in the discriminate function plot between *S. c. pleuriticus* (Colorado River cutthroat) and *S. c. stomias* (Greenback cutthroat). This supports the taxonomic evaluations of Behnke and Zarn (1976) that *S. c. pleuriticus* gave rise to *S. c. stomias* via an ancient headwater transfer, and that there exists little taxonomic difference between the two subspecies.

Table 1. Morphomeristic Characters Used in the Discriminant Function Analysis, 1977.

| | |
|---|---|
| Head Length | Gillrakers total |
| Upper Jaw Length | Branchiostegal rays right |
| Snout tip to dorsal fin origin | Branchiostegal rays left |
| Dorsal fin length | Scales above lateral line |
| Caudal peduncle depth | Pelvic fin rays |
| Caudal peduncle length | Pyloric caecae |
| Gillrakers upper | Basibranchial teeth |
| Gillrakers lower | |

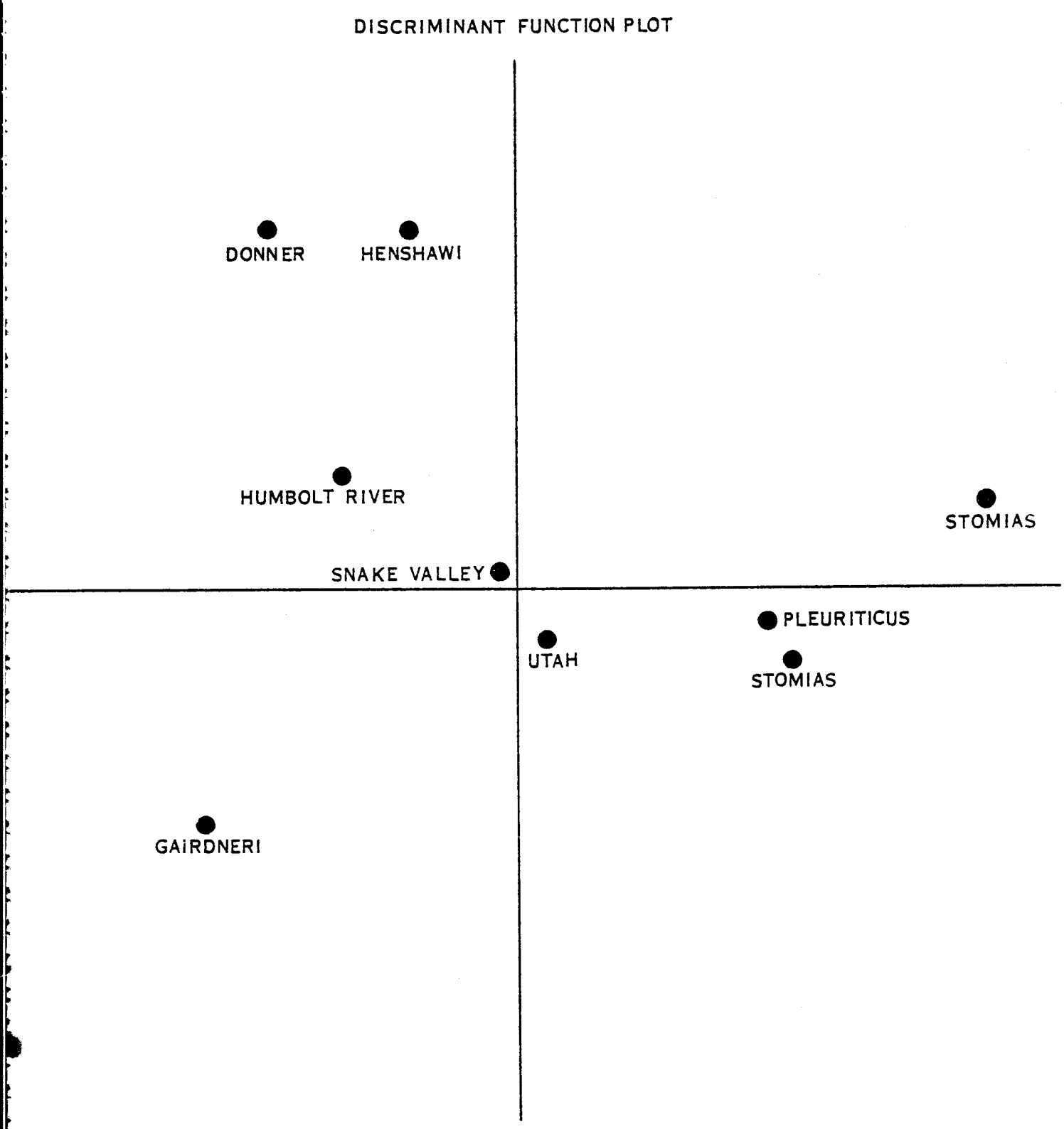



Figure 3. Discriminant Function Plot Analysis Chart Showing Relationship of Cutthroat Subspecies Based on Morphomeristic Characters.

To avoid taxonomic confusion, which has led to subspecies classification delays, the cutthroat trout in Snake Valley should be considered a unique form of S. c. utah. S. c. utah is not abundant in any portion of its native range, and at one point was thought to be extinct as a pure form (Miller 1950, Cope 1955, Platts 1957, and Sigler and Miller 1963). The 1973 version of the U.S. Department of Interior's "Red Book" of endangered and threatened species listed S. c. utah as "status undetermined;" the International Union for the Conservation of Nature (1969) listed it as rare; Holden et al. (1974) considered it endangered; the Wyoming Game and Fish Department lists it as rare; the Nevada Fish and Game Department considers it endangered; and Behnke (1973, 1976b) considers it to be rare with a highly restricted distribution.

## Cutthroat Discovery in the Pilot Peak Range

In an effort to locate additional populations of Bonneville Basin cutthroat trout, a survey of the Pilot Peak Range (north of Wendover on the Utah-Nevada border) was conducted in 1977 by the BLM and Colorado State University (under a contract funded by BLM).

As a result of these surveys, only two streams were found containing sufficient annual flows to support trout populations. One stream to the north of Pilot Peak, Bettridge Creek, has an abundant population of rainbow trout which were first stocked by the Utah Division of Wildlife Resources in the 1940's or early 1950's. The other stream, located in the adjacent canyon to the south of Bettridge Creek, is unnamed (for the present we have called it Donner Creek, since it historically drained into Donner Springs). The city of Wendover, Utah, obtains a portion of its water supply from this creek.

Mr. Kent Summers, Utah Division of Wildlife Resources, discovered the presence of the cutthroat in Donner Creek in April 1977 while sampling the stream at the request of the BLM. Subsequent collection of specimens by the authors and their later analysis at Colorado State University confirmed this classification. Taxonomic analysis of the 17 trout sampled from Donner Creek proved most interesting. They are pure strain cutthroat trout (no sign of hybridization) and have a higher gillraker count than any other cutthroat population (24-29, avg. 26.1).

The origin of this cutthroat is uncertain; however, Mr. Howard Gibson, retired water master for the city of Wendover, indicated that the cutthroat were in Donner Creek when he commenced work on the stream in 1952 (personal comm. with H. Gibson, Wendover, Utah). None of the other local residents contacted could provide any information pertaining to the cutthroat, and most were unaware of its existence in Donner Creek. The Nevada Fish and Game Department has no record of cutthroat stockings in the Pilot Peak Range (letter to Don Duff, BLM, SLC from Pat Coffin, Nevada Fish and Game Dept., Elko, October 1977). The only cutthroat exhibiting such high gillraker numbers is the Lahontan cutthroat trout (S. c. henshawi) (Behnke and Zarn 1976). The most probable origin of the Donner Creek cutthroat is Pyramid Lake, since from the late 1890's to 1930 cutthroat trout from Pyramid Lake were stocked extensively in Nevada. In 1910 Elko County received a large shipment of eggs, but no records exist indicating where these fish were stocked. Little stocking of Lahontan cutthroat occurred from 19311942, but in 1950 Lahontan trout from Summit Lake, Nevada, were used

for stocking. After 1930 S. c. henshawi was considered rare, and it seems unlikely that a creek in the Pilot Range would be stocked with this cutthroat subspecies.

The discriminant function analysis (Table 1 and Figure 3) indicates that the cutthroat from Donner Creek are the most similar to S. c. henshawi.

## Summary

The Snake Valley cutthroat, a form of S. c. utah, is a unique desert fish resource located in the western Bonneville Basin which is worthy of protection and management for the scientific community as well as the American public. S. c. utah has promising possibilities for enhancing the basin states' fisheries programs for wild trout management. The 1975 listing of endangered and threatened fishes of the western U.S. by the Desert Fishes Council did not consider this subspecies. We feel adequate habitat and species data now exist on which to base subspecies (taxonomy and ) status recommendations for this cutthroat. It is our recommendation to the Council that this subspecies be listed on the Council's list as threatened throughout its range in Utah, Nevada, and Wyoming. This classification should serve as an aid to organizations and agencies responsible for management of habitat and species in the future. The ultimate management design for this subspecies, and all others so classified is to provide management to a degree whereby survival and protection of the species and its habitat are assured, so critical status classification can be removed. However, should environmental conditions continue to deteriorate and this subspecies eventually be listed by the U.S. Fish and Wildlife Service as threatened, then this classification would provide the necessary protective status while still allowing for recovery programs to function.

The interest in desert fishes management has been intensified by agencies and the scientific community by the discovery in 1977 of S. c. henshawi in Donner Creek of the Pilot Peak Mountain Range. The major significance of this kind of S. c henshawi is that it very likely represents the original Pyramid Lake genotype - the largest trout native to western North America and long believed to be extinct (Trojnar and Behnke 1975, Behnke and Zarn 1976). This find is worthy of intense management effort by the Utah Division of Wildlife Resources (DWR) and the BLM, since the existence of this pure strain fish is extremely limited as indicated by its official threatened status by the U.S. Fish and Wildlife Service. Colorado State University is continuing contract studies on this mountain range for the BLM. The BLM plans to implement the Pilot Peak Mountains HMP in 1978 under Sikes Act authorities in cooperation with the DWR. Stream habitat improvements are being planned for Bettridge Creek which at present has a natural reproducing population of rainbow trout. This creek could serve in the future as a possible transplant site for the Lahontan cutthroat in Donner Creek. Both creeks have good stream habitat, being relatively undisturbed by man and livestock activities and located in a remote area adjacent to the arid wastes of the Great Salt Lake desert salt flats.

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## Middle Rio Grande Fishes and the Boundary Preservation Project

Clark Hubbs and Robert Rush Miller

### ABSTRACT

The International Boundary and Water Commission's plan to preserve the course of the Rio Grande has led to a number of biological surveys, starting early in 1977. One of these was an examination of the fish fauna by Clark Hubbs, Robert R. Miller, students, and state personnel, over a 2-week period between 14 March and 7 April. The fishes of the Middle Rio Grande may be divided into three faunal assemblages: (1) the saline fauna, comprising widely distributed and salt-tolerant species upstream from the mouth of the Rio Conchos; (2) the Rio Conchos-Rio Grande fauna, mostly south Texas and Mexican species, between the Conchos and Pecos rivers; and (3) the tributary creek fauna (Chihuahuan species plus some derivatives) that depend on tributary creeks for all or part of their life-history stages. The endangered bluntnose shiner (Notropis simus) and the threatened shovelnose sturgeon (Scaphirhynchus platorynchus) seem to have been eliminated already. Large populations of

longnose dace (Rhinichthys cataractae) and blue sucker (Cycleptus elongatus) occur between the Conchos and Pecos, in an area possibly to be designated part of the Wild and Scenic River program. Fish evidence alone does not provide a compelling argument for retention of a wholly natural channel between El Paso and Presidio, the area covered by the proposed preservation project--i.e., this area contains no rare, threatened, or endangered fishes. However, it was noted that in three already channelized areas there was a reduction in fish diversity and biomass.

## Morphological Variation Between Isolated Populations of the White River Killifish, Crenichthys baileyi

Jack E. Williams
Dept. of Fisheries and Wildlife, Oregon State University

Gene R. Wilde Jr.
Dept. of Biological Sciences, University of Nevada, Las Vegas

Crenichthys baileyi is endemic to a series of isolated springs along the 322 km Pluvial White River system of southern Nevada. The drying of this Pluvial river system has resulted in isolation of various populations in the remaining spring habitats for approximately 10,000 years. This extended geographic isolation, coupled with the environmental diversity which prevails between the spring habitats, have accounted for a considerable morphological divergence occurring between the spring populations. Morphological comparisons indicate that several populations warrant subspecific status. Two of these populations have been extirpated and others are threatened by loss of habitat through introductions of exotic fish species.

## Water Rights in California, With Particular Reference to the South Lahontan Basin

William D. Winchester
California Regional Water Quality Control Board, Lahontan Region

### ABSTRACT

Groundwater rights in the desert regions are fundamental to any program dealing with the preservation of desert fishes.

California has about the weakest groundwater rights legislation of the western states. This is despite the fact that California uses about 15 million acre-feet of groundwater each year, comprising about 40 percent of the state's yearly applied water needs. This results in an annual groundwater basin overdraft of about 2.2 million acre-feet. In 1977, the overdraft will be about 10 million acre-feet, due to increased pumping as a result of the drought.

Groundwater rights may be obtained by correlative right, appropriative right, and by prescriptive right. Rights may also be determined by court adjudication.

Correlative right is obtained by owning the overlying land of a groundwater basin. Generally, no permit or review process is required to use a reasonable share of the water supply.

Appropriative right is obtained by filing for a permit through the State Water Resources Control Board.

Prescriptive right is obtained by infringing on another's right for an uninterrupted period of five years.

California makes a distinction between two types of groundwater: 1) that which flows in a known and definite channel, and 2) percolating groundwater.

Groundwater which flows in a known and definite channel is secured through an appropriative water right.

Percolating groundwater is usually secured by the correlative right; thus, no permit or review process is required by the State for most geographical areas. The same situation exists for most spring waters. This has proved to the detriment of the desert fishes inhabiting the South Lahontan Basin.

In contrast, most other western states have a statutory appropriation permit system applicable to all groundwaters.

Water rights can be determined by court adjudication. This is difficult to accomplish, and has not succeeded in the South Lahontan Basin.

The California groundwater problem is now being studied by a task force known as the Governor's Commission to Review California Water Rights Law.

SESSION V - Reports From Area Coordinators and Recovery Team Leaders

Chairman: Pete Sanchez, U.S. National Park Service, Death Valley

## 1977 Report of Fisheries Activities Within the Bonneville Basin

Don Duff, Bonneville Basin Coordinator, Salt Lake City, Utah

Fisheries management activities were many and diversified within the basin in 1977 by the various agencies and groups active in desert fisheries management. Before summarizing these activities, it may be helpful to put into perspective some of the physical facts on the basin for the Council's reference.

The Bonneville Basin occupies about a 34 million acre area (53,325 sq. mi.) in the Great Basin primarily in central and northern Utah, but with some area in eastern Nevada, southeastern Idaho and southwestern Wyoming. Ancient pleistocene Lake Bonneville, from which the basin was named, occupied a 13 million acre area (19,940 sq. mi.) within the basin. At its maximum depth of 1,000 feet the lake's total volume of water would have required the normal outflow to the oceans of all rivers of the United States for a period of six years. The lake eventually spilled in its northern extremity into the Snake River drainage through Red Rock Pass in SE Idaho. The Great Salt Lake is a remnant of this once great lake, occupying only a 1,500 square mile area today. Major river drainages within the basin today are the Bear, Ogden, Weber, Provo, and Sevier Rivers.

During 1977 the following agencies were involved in major fisheries management activities within the various segments of the basin.

### Southern Bonneville Basin:

The Utah Division of Wildlife Resources (DWR) began an active program for management of unique native cutthroat populations. The Southern Region of the DWR (Cedar City), cooperating with the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM), which manage the habitat on Birch Creek near Beaver, Utah, transplanted 50 adult Utah cutthroat, Salmo clarki utah, from Birch Creek to Samstowe Creek, on the Fishlake National Forest in the Sevier River drainage. The creek had previously been treated to remove exotic rainbow trout. The transplant was brought about by the drought and done in an effort to extend the range of the fish back into its historic range. Birch Creek had experienced some dryup and fish mortality prior to the move, and this hastened the effort to relocate the fish. The DWR is researching different ways to transplant these fish, i.e. eggs/fry, in the future to avoid removal of further adult stock in Birch Creek.

### Central Bonneville Basin

The DWR Central Region (Provo) cooperated with the BLM in fisheries management activities for the Snake Valley cutthroat, Salmo clarki subsp., in the Deep Creek Mountains, Juab-Tooele counties, Utah. Since this thought-to-be-extinct

subspecies was discovered in 1974 by BLM fisheries biologists in Trout Creek, management plans have been under preparation for this species since that time. BLM developed a Habitat Management Plan (HMP) for Trout Creek and began implementation of this plan in 1977 using Sikes Act (P.L. 93-452) authorities. Using Youth Conservation Corps (YCC) workers, some 75 log-type stream improvement structures were constructed in July in Trout Creek to aid in bank stabilization and pool quality enhancement for the cutthroat. The DWR, in October, treated Trout Creek below the existing natural barrier falls to eradicate exotic rainbow trout, thereby enhancing the maintenance of the pure strain cutthroat above the barrier. Additional management plans call for transplanting these cutthroat into other streams of their historic habitat on the east slope of the mountain range to assure their perpetuation and usefulness to Utah's fishery resource.

One of the most significant items to take place in the basin occurred in the Deep Creek Mountains when the BLM filed for an emergency withdrawal of a 27,000 acre area of critical environmental concern within the mountain range because of increased uranium mining activity, which threatened to destroy many of the unique resources of the mountain area. A significant item in justifying this action was the presence of the rare Snake Valley cutthroat in only about 1¼ miles of critical habitat on Trout Creek as well as the presence of the rare giant stonefly (Pteronarcys princeps). The area was withdrawn from mineral entry on May 3, 1977, by the Secretary of the Interior under Section 204(e) of the Federal Land Policy and Management Act of 1976 (PL 94-579). This withdrawal stays in effect for a 3-year period and allows time for study of all resources to ascertain their values.

In September, 1977, the BLM (Utah) funded a contract with the DWR to provide for an inventory of all fish and wildlife resources in the mountain range. The contract will last until April, 1979, and will provide BLM with inventory data necessary to evaluate the future withdrawal status. Hopefully, the contract will define other streams inhabited by the cutthroat on the mountain.

Snake Valley cutthroat populations within the extreme western side of the Bonneville Basin in Nevada remain in a static condition on Hendry's and Hampton creeks of the Humboldt National Forest. USFS fisheries and stream habitat inventories are being planned for in 1978 in cooperation with the Nevada Department of Fish and Game.

From the stock of Snake Valley cutthroat introduced into Goshute Creek (BLM) some years ago, the Nevada Fish and Game and BLM (Nevada) cooperated in October 1977, and transplanted some of these fish into BLM's nearby Water Canyon Creek. Within the same area Nevada Fish and Game and BLM plan to transplant the relict dace, Relictus solitarius, from Steptoe Valley near Goshute Creek to vacant habitat in the Shoshone Ponds.

Also, within this western basin area near the Nevada border, the BLM (Utah) has funded a contract to the DWR to inventory desert spring/pond habitats for the least chub, Iotichthys phlegethontis. This contract became effective in February 1977 for areas of Millard, Juab, Beaver and Tooele counties, Utah, and lasts until December 1978. To date, the only spring/marsh area found containing the least chub has been Leland Harris springs in Snake Valley, Juab County, Utah.

Within the Great Salt Lake desert area in Juab, Tooele, and Box Elder counties, Utah, Utah State University completed a study of vegetative types and terrestrial wildlife populations. The study was funded by the U.S. Fish and Wildlife Service (FWS) from U.S. Air Force monies under Sikes Act authority. While aquatic habitats were mentioned in the study, the fish, associated with desert seeps, if any were present, were not inventoried. The study was done to provide data for development of a habitat management plan for the military bombing range areas operated by the Army and Air Force.

On the eastern flank of the basin along the Wasatch Front, the USFS (Wasatch National Forest) is cooperating with the DWR and the FWS to provide fisheries management in the Red Butte Creek natural research area adjacent to Salt Lake City. Plans to rehabilitate Red Butte Creek for introduction and management of the Utah cutthroat are moving ahead for 1978 after being turned down by the U.S. Army (Ft. Douglas Military Reservation) in 1976. Plans call for eradication of the creek's rainbow fishery and reintroduction of the Utah cutthroat into its historic habitat within this protected watershed. The three management agencies hope the Army will allow implementation of this project in 1978. The Army's refusal of the project in the past centered around the possible contamination of the reservation's water supply, which had been given adequate consideration by the agencies.

Northern Bonneville Basin

During 1977 the BLM (Utah) began development of a habitat management plan (HMP) for the Pilot Peak mountain range in western Box Elder County, Utah, adjacent to Nevada. In conducting fish reconnaissance surveys for the BLM, the DWR discovered the presence of a cutthroat trout in an unnamed creek in Utah and Nevada (tentatively called Donner Creek) in April. Followup habitat and fish inventories by Colorado State University (CSU) funded by BLM, collected specimens of cutthroat from Donner Creek which led to the classification of these fish by Dr. Robert Behnke, CSU, as pure strain Lahontan cutthroat, Salmo clarki henshawi.

Although not native to the basin, these cutthroat, as far as records indicate, probably were from Pyramid Lake stock. Nevada Fish and Game suspects these fish were planted in the Pilot range by railroad and wagon between 1895 and 1940. This find of pure strain Lahontan cutthroat is a major discovery and worthy of intense management effort by the DWR Northern Region (Ogden) and the BLM, since the existence of this pure strain fish is extremely limited as indicated by its official threatened status by the FWS. CSU is continuing contract studies on this mountain range for the BLM. The BLM plans to implement the Pilot Peak Mountains HMP in 1978 under Sikes Act authorities in cooperation with the DWR. Stream habitat improvements are being planned for Bettridge Creek, located to the north of Donner Creek, which at present has a natural reproducing population of rainbow trout. The creek could serve in the future as a possible transplant site for the Lahontan cutthroat in Donner Creek. Both creeks have good stream habitat being in a relatively undisturbed state from man and livestock activities and located in a remote area adjacent to the arid wastes of the Great Salt Lake desert salt flats.

The BLM (Wyoming) has been conducting some stream habitat improvement activities in Thomas Fork, tributary to the Bear River, Lincoln County, Wyoming. This activity resulted from a 1976 contract to Colorado State University funded by BLM (Wyoming) to determine possibility of Salmo clarki utah inhabiting the basin. Dr. Behnke's analysis concluded that a trout entirely typical in appearance to S. c. utah completely dominates the trout fauna of the Thomas Fork drainage. His report indicates that trout native to the Bear River drainage tend to have more numerous pyloric caeca than do populations of S. caccae utah in the rest of the basin.

The BLM's HMP for the area is attempting to manage and protect riparian aquatic habitat for this trout from the past and present impacts of livestock grazing. Dr. Behnke states that this trout represents the first known instance in the Bonneville Basin where a cutthroat trout identical in appearance to S. c. utah persists and is the dominant element of the trout fauna despite habitat deterioration and large-scale introductions of non-native trouts.

Summary

All of these above reported activities bear the close watchfulness of the Council to assure that adequate management considerations are and will continue to be given by the agencies concerned. These resources and activities, in behalf of desert fisheries management, are an integral part of the Great Basin ecosystem which must be managed and protected for the American public, as well as the scientific community.

As Bonneville Basin Coordinator, I would suggest to the Council that a resolution be initiated commending the management activities of the DWR, USFS, and BLM for their active roles (sometimes taken under much duress) in desert fish and habitat management in the basin in 1977, with support for their program continuation in the future.

To: All Persons and Agencies Concerned

From: Chairman, Death Valley System Committee

Subject: Fourth Annual Meeting, Death Valley System Committee

Subject meeting was held at the National Park Service Auditorium, Furnace Creek, on February 25, 1977, with 29 in attendance.

Superintendent Don Spalding welcomed the group to Death Valley National Monument and briefly reviewed current happenings there. He mentioned his appreciation of the concern shown by the Council for the aquatic resources of the Monument and for the Council's actions in this respect. The Devils Hole Supreme Court decision was used as a case in point.

Following Superintendent Spalding's presentation, Monument mining engineer Bob Mitchum reviewed the current status of mining within Monument boundaries. Fortunately, recent legislation has placed a moratorium on mining within the Monument, and this has greatly eased pressures and potential habitat and scenic degradation therein.

The following agenda items were then reviewed:

1. Big Spring Committee. Bob Love reported that the Committee is active and functioning. However, funds are needed to complete the management plan (fencing, etc.). The Nature Conservancy owns the property now and is attempting to acquire the necessary funding.

2. Report of Executive Committee concerning area coordinators. Chairman Jim Deacon has authorized Chuck Minckley of Northern Arizona University (Flagstaff) to strengthen the area coordinator concept by contacting appropriate individuals at the direction of the Executive Committee in those areas where Council effectiveness would be enhanced by such action. A proposed list of individuals to be contacted in this respect has been furnished to Mr. Minckley, and an amended listing of area coordinators will be presented to the Council membership at the Ninth Annual Symposium scheduled for November 17-19 at Furnace Creek.

3. Report concerning bibliography of Death Valley System fishes. Bob Miller's report follows:

   "The bibliography entitled 'Fishes and Aquatic Resources of the Death Valley System, California-Nevada, 1889-1976,' by Robert R. Miller, David L. Soltz, and Peter G. Sanchez will be published by the Western Region of the U.S. National Park Service. The manuscript, now in semi-final form, comprises 240 titles that cover not only references to the Death Valley System but also to articles on desert fishes that are closely related to those living in the Death Valley System. In addition to references on the fishes, selected accounts on geography, geology (including paleontology) and hydrology are included. In addition to the published and unpublished technical literature, the bibliography also includes popular books and magazine articles, but not newspaper stories. Although a cut-off date of

31 December, 1976, was adhered to, any articles known by the authors to be in press as of March 1977 have been included.

It is suggested that 1200-1500 copies be published (by offset reproduction from camera-ready copy provided by the University of Michigan). Their distribution will be by Death Valley National Monument. The basic mailing list will be the membership of the Desert Fishes Council and the involved governmental agencies. Pete Sanchez requests additional appropriate names and addresses from the membership.

A map showing aerial coverage of the Bibliography is yet to be made, as is the final editing of the citations. This will be taken care of at Michigan."

4. Collecting permits. Inasmuch as certain potentially valuable (from the standpoint of species preservation) studies have been severely hampered or precluded by the inability of researchers to obtain fish, agency representatives were asked to review their administrative procedures and problems encountered in issuing collecting permits. It was the general consensus of the agencies that most applications fail to include sufficient justification of need and that researchers should be careful to include as much information as possible to assist agency administrators in making their decisions on whether or not a permit should be issued. Occasionally an "anti-academic" administrator may pose a problem, but this is relatively rare. California has refined its permit procedures to a point where, if sufficient data are included with the application, a permit may be issued within a matter of hours.

   The Council is hopeful that both agency procedures and collecting permit applications will be improved in order that a maximum of life history data will become available for use in formulation of preservation plans.

5. Distribution of resolutions enacted at 1976 Symposium. Resolutions were in the process of being drafted on the February 25 meeting date. Since that time the following resolutions have been completed and disseminated.

   76-1 Commendation of U.S. Fish and Wildlife Service for attempts to develop Dexter National Fish Hatchery as an endangered fishes refugium.

   76-2 Condemnation of Tilapia zillii categorically in natural waters of the United States, and the urging of exercise of extreme caution relative to use of other species of Tilapia.

   In addition, a letter supporting the designation of Gila elegans as endangered and Xyrauchen texanus as threatened was forwarded to the Colorado Division of Wildlife, as agreed upon at the 1976 Symposium.

6. Progress on the Newsletter. It was the decision of the Executive Committee that a newsletter should be produced, and that this would essentially comprise the annual reports of the various area coordinators. Inasmuch as the Council has divided the Great Basin into 12 areas, each under the direction of a coordinator, this concept would fit nicely into a monthly

publication. However, it is obvious that the success of such an idea is dependent upon the selection of responsible and functioning area coordinators.

7. Eradication of Gambusia from Scotty's Castle area. This project is still planned by the Park Service and Department of Fish and Game. However, an adequate supply of Antimycin is essential to assure successful treatment. Manufacture of the chemical is apparently temporarily halted. When it again becomes available, we shall conduct the chemical treatment.

8. Fish and Wildlife Service endangered and threatened fishes program. It was the group's consensus that, to date, major emphasis in the West has been placed by the Fish and Wildlife Service on research and recovery efforts involving birds and mammals and that this is partially the Council's fault for not communicating similar needs concerning fishes to the appropriate individuals. Consequently, a letter will be sent from the Council to the Portland Office of the Fish and Wildlife Service expressing our concern and designating both the species involved and the research that needs to be done. Again, it is very apparent that our ability to preserve species is directly dependent upon the availability of life history information.

9. Possible petroleum development in Railroad Valley, Nevada. The Northwest Exploration Company now has 3 oil wells in Railroad Valley and plans for 20 more in both 1977 and 1978. General plans call for a well on every 80 acres. A total of 14,000 acres have been withdrawn from mineral entry in the Railroad Valley area. There will be no surface occupancy and no drilling within ¼ mile of water.

   The Bureau of Land Management is in the process of determining the flow of water from the springs and wells within the Railroad Valley Wildlife Management Area and will watch very closely the habitat of the Railroad Valley Springfish (Crenichthys nevadae).

10. The new administration of Fort Soda (Zzyzx) and the preservation of Gila bicolor mohavensis. The new status of Fort Soda as a desert research center under the administration of a consortium involving the biology departments of certain campuses of the State College and University System gives us better control of the Mohave chub habitat and should enable us to improve our current recovery efforts for this subspecies. In addition to its use in recovery work for the Mohave chub, Fort Soda is also being used to assist in recovery efforts for the desert tortoise (Gopherus agassizi). Better coordination of the recovery plans with University uses is needed, and efforts are now being exerted in this respect.

11. The progress and future of Death Valley System recovery teams. It was the group's consensus that recovery efforts for the Death Valley System fishes could better be handled through a system-wide recovery team, rather than to establish a separate team for each fish requiring special management in this respect. Following the meeting, the Executive Committee formulated a list of proposed team members. This concept is now being formalized and will soon be forwarded to the Fish and Wildlife Service for review, comment, and action.

12. Tilapia update, and the Anza-Borrego preservation program for Cyprinodon macularius. The threat posed by Tilapia remains very real and is growing. There seems to be a definite correlation between increasing abundance of Tilapia and seriously decreasing numbers of C. macularius, which is in the process of being proposed for threatened status.

Recovery efforts for C. macularius were discussed, and current efforts of California Department of Parks and Recreation personnel to create refugia within Anza-Borrego Desert State Park are especially noteworthy and commendable. The following status report by Bud Getty, Area Manager, and Ray Patton, Park Naturalist, summarizes their work.

"C. macularius existed in the Split Mountain area of Fish Creek in Anza-Borrego Desert State Park until 1916. Major flooding and landslides apparently wiped out all native fish.

In May 1970, the park built an artificial pond (approximately 60' x 10') and introduced 48 of the Salton Sea fish. This population is doing quite well. They number 1,000 or more.

Introductions were made to other areas within the park. These populations have apparently all been eliminated by flash flooding. Other individuals have been introduced to other small artificial ponds (private) in the Borrego Springs area.

The Santa Catarina Springs area in Coyote Canyon is a potential habitat if the Gambusia can be eradicated. Introductions could also be made in the Carrizo Marsh area. This area is currently a private inholding within Anza-Borrego."

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

a. Pahrump killifish, Empetrichthys latos.

Gail Kobetich reported that the upper pond population at Corn Creek is in good shape and that the two lower ponds have been rehabilitated. Re-introduction into the lower ponds is planned for the spring of 1977. The concrete runways constructed to provide a water supply to the ponds have been installed and are functioning.

Another population exists in an outside tank at U.N.L.V., and Doug Selby is successfully rearing an aquarium population. There has been no recent check of Latos Pools, located along the Colorado River about 23 miles below Hoover Dam. Fish were present there at the last check, made in August, 1975. There are no fish in Manse Spring.

b. Devils Hole pupfish, Cyprinodon diabolis.

Jim Deacon indicated a population in excess of 200 as a result of the count made the previous day (February 24). A count made on March 24 revealed that the Devils Hole population has dropped below 200, but a population decrease at this time of year is to be expected. Lots of

reproductive activity was noted on March 24, and the population is expected to rise shortly. The Hoover Dam population remains at about 60. Very obviously, the Devils Hole pupfish remains in jeopardy.

c. Ash Meadows pupfish, Cyprinodon nevadensis mionectes and

d. Ash Meadows speckled dace, Rhinichthys osculus nevadensis.

Jim Deacon reported several populations of each species in the Ash Meadows area. Jackrabbit Spring had gone dry, and the fish populations were lost. However, the spring level has risen and, with the approval of the Nevada Department of Fish and Game, a transplant was recently made. A report by Gail Kobetich follows:

"At 3:00 p.m. on a cold, windy March 12, 1977, I along with my wife, Maxine, and two UNLV grad students, Doug Selby and Gene Wilde, transplanted 88 Cyprinodon nevadensis mionectes from Big Spring to Jackrabbit Spring in Ash Meadows. The water temperature at Big Spring was 26 C and at Jackrabbit 25 C. The flow at Jackrabbit Spring was an estimated 1 cfs. Cray fish were visible but no other aquatic organisms were sighted. A check on the well being of these fish will be made in two weeks. Four Rhinichthys osculus nevadensis were also transplanted. More specimens will be moved at a later date when the dace population at Big Spring is higher."

The status of both the Ash Meadows pupfish and dace appears satisfactory (in view of general groundwater levels in Ash Meadows) and essentially unchanged from last year.

e. Warm Spring pupfish, Cyprinodon nevadensis pectoralis.

The School Spring Refugium population is in satisfactory condition, and work will soon be conducted with BLM to rehabilitate the observation pool below the refugium. The recovery team is functioning satisfactorily under the leadership of Jim Yoakum of the BLM Nevada State Office.

f. Owens chub, Gila bicolor snyderi.

The only known population exists in the Owens River Gorge below Crowley Lake Dam. An introduction was made into the Owens Valley Native Fish Sanctuary at Fish Slough, but its success is still unknown. Chubs collected in the Hot Creek-Mammoth Creek area of southern Mono County were examined by Bob Miller and found to be hybridized forms. Another isolated chub population was discovered in the same general location during the winter, and collections will be made and forwarded to Bob Miller at the earliest possible date.

g. Owens dace, Rhinichthys osculus subsp.

Sampling of Owens River tributaries in northern Inyo County revealed this undescribed subspecies to be fairly numerous and widespread, with

no immediate threat to its existence. Status unchanged from last year.

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

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

Although no apparent differences exist between these two subspecies, the Beatty population bears indications that it may be distinct. Further work needs to be done here. There has been no known change in numbers or distribution during the past year.

j. Mohave chub, Gila bicolor mohavensis.

The primary habitat for this subspecies remains at Fort Soda (Zzyzx), San Bernardino County (see #10 above), with another secure population in Lark Seep Lagoon at the China Lake Naval Weapons Center. Other populations exist, but they are relatively insecure.

k. Owens pupfish, Cyprinodon radiosus.

Slow progress is being made toward the acquisition of the remaining 200 acres of privately held land in Fish Slough, Mono County. When this is finally acquired by the University of California, the most serious threat to the general habitat will be removed, and consideration can be given to removing it from the endangered list. The other major population, at Warm Springs Refugium near Big Pine, Inyo County, is increasing in numbers following the eradication of most of the Gambusia a year ago. California Department of Fish and Game work plans call for continuing reconnaissance for transplant sites in other locations within its native range in the lower Owens Valley.

l. Tecopa pupfish, Cyprinodon nevadensis calidae.

No progress was made during the past year in locating this endangered subspecies, which may well be extinct. However, occasional reports of "new" locations by residents in the Tecopa area have resulted in the scheduling of a May field trip to the area to check out these reports and make collections, if this becomes possible. Geothermal exploration is contemplated for this area, and this will increase the jeopardy of any remaining populations, should they exist.

m. Cottonball Marsh pupfish, Cyprinodon milleri.

Pete Sanchez of Death Valley National Monument reported both the habitat and its fishes to be stable and under no current threat. A field trip to the area on April 30, 1976, revealed an apparently healthy population.

n. Saratoga Springs pupfish, Cyprinodon nevadensis nevadensis.

Both the habitat and its fish population are in good condition and under no current threat.

o. Amargosa pupfish, Cyprinodon nevadensis amargosae.

The subspecies exists in good numbers throughout the lower Amargosa River. The mining moratorium within Death Valley National Monument will add to the protection of the subspecies, and the only known threats at this time are goundwater development in Nevada and possible geothermal activity in the Tecopa area. However, these constitute major threats and will be watched closely.

p. Salt Creek pupfish, Cyprinodon salinus.

The status of this population remains satisfactory. The new 3,000-foot boardwalk observation facility has been highly successful in improving interpretive aspects of Salt Creek and in protecting the riparian and aquatic habitats.

q. Owens sucker, Catostomus fumeiventris.

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

r. Desert pupfish, Cyprinodon macularius.

See #12 above.

Edwin P. Pister, Chairman
Death Valley System Committee

# ATTENDANCE LIST, DEATH VALLEY SYSTEM COMMITTEE MEETING

Furnace Creek, Death Valley National Monument

February 25, 1977

| Name | Affiliation | Address |
|---|---|---|
| Jeff Aardahl | BLM | Ridgecrest, CA 93555 |
| Robert C. Allan | Nev. Dept. Fish & Game | Las Vegas, NV |
| Osborne Casey | BLM | Reno, NV 89509 |
| Alfred D. Castro | Steinhart Aquarium | San Francisco, CA 94118 |
| Allen Cooperrider | BLM | Riverside, CA 92507 |
| James E. Deacon | Univ. of Nevada | Las Vegas 89154 |
| Mary DeDecker | Observer | Independence, CA 93526 |
| Bud Getty | Calif. Parks & Recreation | Borrego Springs, CA |
| C. W. (Bill) Hoeft | BLM | Sacramento, CA 95825 |
| Frank Hoover | Calif. Dept. Fish & Game | Pomona, CA 91767 |
| Gail Kobetich | Fish & Wildlife Service | Las Vegas, NV 89154 |
| James Landye | Malacologist | Flagstaff, AZ 86001 |
| Randy Legler | BLM | Riverside, CA 92507 |
| Paul Loiselle | Univ. Calif. | Berkeley, CA 94720 |
| Bob Love | Nature Conservancy | Fullerton, CA 92634 |
| Larry Mangan | BLM | Bishop, CA 93514 |
| Rocky McCreight | National Park Service | Shoshone, CA 92384 |
| Robert R. Miller | Univ. of Michigan | Ann Arbor, Mich. 48109 |
| Bob Mitchum | National Park Service | Death Valley, CA 92328 |
| Steve Nicola | Calif. Dept. Fish & Game | Sacramento, CA 95814 |
| Ray Patton | Calif. Parks & Recreation | Borrego, Springs, CA |
| Phil Pister | Calif. Dept. Fish & Game | Bishop, CA 93514 |
| Gary Ponder | Calif. Dept. Fish & Game | Bishop, CA 93514 |
| Peter G. Sanchez | National Park Service | Death Valley, CA 92328 |
| Paul Shelton | Observer | Arcadia, CA 91006 |
| Joy Shrode | Occidental College | Los Angeles, CA 90041 |
| David Soltz | Calif. State University | Los Angeles, CA 90032 |
| Don Spalding | National Park Service | Death Valley, CA 92328 |
| Jim St. Amant | Calif. Dept. Fish & Game | Long Beach, CA 90802 |

## Sonoran Desert, United States

W. L. Minckley
Department of Zoology and Center for Environmental Studies,
Arizona State University, Tempe

Considering widespread drought conditions in the American Southwest, resulting in lower-than-modal flows in essentially all natural streams, native fishes are sustaining well. Only in areas of man-induced changes are declines in fish populations noticeable.

The Rio Yaqui fauna, although technically in the Chihuahuan Desert Region (reported upon, in part, by Echelle in the present Proceedings), is of critical concern. The San Bernardino Ranch (Texas John Slaughter Ranch), on San Bernardino Creek east of Douglas, Arizona, has been placed for sale (or may be sold). The owner for the past few years was sympathetic to native fishes, but this may obviously change, and must be investigated. Pumpage of ground water has increased rapidly in the past few years, both in the United States and Mexico, and surface waters are declining rapidly (McNatt, 1974). Poeciliopsis occidentalis sonoriensis persisted there in 1976-77, as did a tiny population of Gila purpurea. The only other populations of these two forms in the United States are in Leslie Creek, Swisshelm Mountains, were introduced by myself (Minckley 1973), and at Dexter Fish Hatchery in New Mexico (J.E. Johnson, pers. Comm.). Under hatchery conditions, the poeciliid has reproduced successfully; the chub stock has not been checked for reproduction at this writing. Mexican stonerollers (Campostoma ornatum) presently persist in Rucker Canyon, Chiricahua Mountains, under conditions of low discharge and pressures of introduced (repeatedly) rainbow trout (Salmo gairdneri), and now Pimephales promelas (established in 1976). The stoneroller also has been recorded in Leslie Creek, but is rare and may be extirpated by extremely low water conditions in that stream. Catostomus bernardini and Notropis formosus mearnsi are almost certainly extinct in the United States, and populations in Mexico have not been checked.

On the lower Colorado River mainstream, populations of Mugil cephalus and Elops affinis are doomed to extirpation with drying of natural waters as a result of desalinization operations. The Santa Clara Slough in Sonora, Mexico, has increased dramatically in size as a result of increased input of water from new canal systems, and from flooding by tidal bores during tropical storms this spring. A bore reportedly extended upstream from the Sea of Cortez to near El Doctor (H. Guenther, pers. comm.). Studies of Xyrauchen texanus are continuing, and we have now completed extensive age-and-growth analysis on the basis of scales. Variation is high on an individual fish, and among fishes, but those killed in 1974 age between 17 and 23 years, with a mean age of 21 years. Therefore, the population of large individuals in Lake Mohave would have hatched about 1953, or about two years after closure of Davis Dam. Otoliths now are available to check these data, but opercular marks confirm already the approximate dates. There seems little doubt that little, if any, reproduction has occurred in the population, despite the facts that reproductively active adults have been repeatedly taken and spawning activities have been observed. The population of adults is large, comprising more than 50% of the total numbers of fishes caught in nets during our operations, and more than

50% of the individual fishes seen by divers working on other aspects of the fishery (Gunther, pers. comm.). Therefore, a large number of adults could be moved in an attempt to establish other populations in the lower Colorado River Basin. Due to the extended drought, Roosevelt Lake is nearly dry. It is recommended that adult razorback suckers be transferred this winter into the Salt River upstream from that reservoir, in an attempt to exploit the apparent tendency for the fish to spawn in "newly created" waters when the reservoir fills. (This is obvious in the case of the filling of Lake Mohave, and strongly implied by data from the Salt River Reservoirs in central Arizona; unpubl. data.)

With regard to Poeciliopsis occidentalis occidentalis, a paper on its co-occurrence with Gambusia affinis, and a review of its status in Arizona, will appear in December (Minckley, Rinne, and Johnson, in press). A Habitat Management Plan (Bureau of Land Management) for the Cocio Wash population of P. occidentalis has been accepted and will be expedited in 1977-78. Arizona Game and Fish Department is maintaining a stock, and has introduced Gila topminnow in a number of places within its native range, with variable success. A stock of Cyprinodon macularius from Santa Clara Slough, Sonora, was obtained by R.R. Miller, myself, and party, and is being maintained jointly by Arizona Game and Fish and Arizona State University, and stocking of that species into parts of the Gila River drainage is anticipated in the near future.

Studies of Aravaipa Creek, funded by Bureau of Land Management, will be completed in 1978. Native fishes in that stream are in excellent condition, despite low discharges, with Meda fulgida (surprisingly) being the most abundant species in many habitats.

Similar research on the Gila River in eastern Arizona has provided large amounts of comparative data on desert stream ecology, and has given considerable insight (along with Aravaipa Creek data) on benthic invertebrates and other biotic components of desert systems. Also, information is available to support the proposed introduction of Plagopterus argentissimus in that area. Suffice it to say that almost all physical, chemical, and biological features of the mainstream Gila River in the vicinity of the inflow of San Francisco River are comparable to those of the Virgin River near Littlefield, Arizona. Specific information is available to interested parties.

Citations

McNatt, R.M. 1974. Re-evaluation of the native fishes of the Rio Yaqui in the United States. Proc. West. Assoc. St. Game & Fish Comm., 54:273-279.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Dept.

Minckley, W.L., J.N. Rinne, and J.E. Johnson. 1977. Co-occurrence of Gila topminnow (Poeciliopsis o. occidentalis) and mosquitofish (Gambusia affinis). USDA Forest Service Station Bull., Rocky Mtn and Range Exp Sta., in press.

# Progress Report

## Warm Springs Pupfish Recovery Team

1. Recovery Team:

   Jim Yoakum (Leader), BLM, Reno, NV
   Dale Lockard (Alternate Leader), NDF&G, Reno, NV
   Gail Kobetich, NDF&G, Las Vegas, NV
   Charles Osborn, NDF&G, Las Vegas, NV
   Cal Allan, NDF&G, Las Vegas, NV
   Jim Deacon, U. Nevada, Las Vegas, NV

2. 1976: Team started - 3 meetings held; Recovery Plan developed.

3. 1977: Recovery Plan officially approved by all cooperating agencies and signed by FWS.

   FIRST Recovery Plan officially signed for fish west of Mississippi River.

4. 1978: Plan ready for implementation
   - perpetuate quality habitat;
   - initiate studies and research;
     - any college or university interested, please contact us;
   - request DFC support Recovery Plan's full immediate implementation (see resolution);

# APPENDIX A

## Attendance List and Resolutions

# Ninth Annual Symposium Attendance List
## Death Valley National Monument Headquarters, November 17-18, 1977

| | |
|---|---|
| Cal Allan | NFG, Las Vegas, NV |
| Norman Alstot | So. Calif. Edison Co., Rosemead, CA |
| Neil Armantrout | BLM, Moab, UT |
| Mary Bacon | Calif. State Univ., Sacramento, CA |
| Kurtis Ballantyne | BLM, Tonopah, NV |
| Glen Black | CFG, Long Beach, CA |
| Martin Brittan | Calif. State Univ., Sacramento, CA |
| Gary Bryant | U.S. Bur. of Reclamation, Boulder City, NV |
| G. L. Burton | USFWS, Phoenix, AZ |
| Joe Capodice | BLM, Bishop, CA |
| Al Castro | Calif. Academy of Science, Steinhart Aquarium |
| Jim Cooper | Desert Res. Institute, Reno, NV |
| Bob Daniels | U.C., Davis, CA |
| Bob David | U.S. Bureau of Reclamation, Durango, CO |
| Jim Deacon | Univ. Nevada, Las Vegas, NV |
| John Dentler | U.C., Davis, CA |
| Kenneth Detweiler | BLM, Las Vegas, NV |
| George Divine | USFWS, Albuquerque, NM |
| David Drake | CFG, Long Beach, CA |
| Don Duff | BLM, Salt Lake City, UT |
| Nick Dye | Arizona State Univ. |
| Tony Echelle | Baylor Univ., Waco, TX |
| Tasker and Beula Edmiston | Monterey Park, CA |
| Tim Ford | U.C., Davis, CA |
| Bob Furtek | Univ. Nevada, Las Vegas, NV |
| Bob Gervais | BLM, Denver, CO |
| Ellen Gleason | CFG, Blythe, CA |
| Eric Gerstung | CFG, Sacramento, CA |
| Herb Guenther | U.S. Bureau of Reclamation, Boulder City, NV |
| Cay Goude | Calif. State Univ., Sacramento, CA |
| Thom Hardy | Univ. Nevada, Las Vegas, NV |
| Mike Hatch | New Mexico Game and Fish, Albuquerque, NM |
| Frank Henry | CFG, Chino, CA |
| Bruce Herbold | Calif. State Univ., Los Angeles, CA |
| Terry Hickman | Colorado State Univ., Fort Collins, CO |
| Stan Hillyard | Univ. Nevada, Las Vegas, NV |
| Michael Hirshfield | Calif. State Univ., Los Angeles, CA |
| C. W. Hoeft | BLM, Washington, D.C. |
| Paul Holden | BIO/WEST, Inc., Logan, UT |
| Frank Hoover | CFG, Chino, CA |
| Kevin Howe | Oregon State Univ., Corvallis |
| Carl and Laura Hubbs | Scripps Institution of Oceanography, La Jolla |
| Buddy Jensen | USFWS, Parker, AZ |
| Jim Johnson | USFWS, Albuquerque, NM |
| Helen Kennedy | USNPS, Death Valley National Monument |
| Bill Kepner | Arizona State University, Tempe, AZ |
| Frederick Kerr | Aquarium Industry Publications |
| Bruce Kimsey | U.S. Bureau of Reclamation, Sacramento, CA |
| Gail Kobetich | USFWS, Sacramento, CA |

| | |
|---|---|
| Sally Stefferud | CFG, Bishop, CA |
| Jim St. Amant | CFG, Long Beach, CA |
| Edward Stuenkel | Univ. Nevada, Las Vegas, NV |
| Royal Suttkus | Tulane Univ., Bella Chasse, LA |
| John Turner | Water Res. Control Bd., Sacramento, CA |
| Paul Turner | New Mexico State Univ., Las Cruces, NM |
| Susan L. Vandermeer | Calif. State Univ., Sacramento |
| Gary Vequist | USNPS, Death Valley National Monument |
| Gene Wilde | Univ. Nevada, Las Vegas, NV |
| Jack Williams | Oregon State Univ., Corvallis |
| William Winchester | Calif. Reg. Water Qual. Cont. Bd., Victorville |
| Darrell Wong | CFG, Blythe, CA |
| Bruce Rosenlund | USFWS, Leadville, CO |
| Jim Yoakum | BLM, Reno, NV |

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|---|---|
| David Koch | Desert Research Institute, Reno, NV |
| Boyd Kynard | Univ. Arizona, Tucson |
| James La Bounty | U.S. Bureau of Reclamation, Denver, CO |
| Jerry Landye | Consultant, Flagstaff, AZ |
| David Langlois | Colorado Division of Wildlife, Denver |
| Raymond Lee | Arizona State University, Tempe, AZ |
| Jim Lloyd | BLM, Winnemucca, NV |
| Paul Loiselle | U.C., Berkeley, CA |
| Cathy Lowe | Calif. State Univ., Sacramento, CA |
| Bob Love | Fullerton, Calif. and Ash Meadows |
| Chuck Marshall | CFG, Chino, CA |
| Bruce May | Utah Wildlife Resources, Cedar City |
| Chuck McAda | USFWS, Salt Lake City, UT |
| Terry McCall | Northern Arizona Univ., Flagstaff |
| Alan McCready | Carmichael, CA |
| Patricia McDonald | USNPS, Death Valley National Monument |
| Randy McNatt | Arizona State University, Tempe, AZ |
| Bill Miller | USFWS, Salt Lake City, UT |
| Gary Mason | USNPS, Death Valley National Monument |
| Peter Moyle | U.C., Davis, CA |
| Robert and Fran Miller | Univ. of Michigan, Ann Arbor |
| Chuck Minckley | Northern Arizona Univ., Flagstaff, AZ |
| Robert Minckley | Arizona State University, Tempe, AZ |
| W. L. Minckley | Arizona State University, Tempe, AZ |
| Dick Navarre | USFWS, Sacramento, CA |
| Steve Nicola | CFG, Sacramento, CA |
| John Norton | CA State Water Res. Cont. Bd., Sacramento, CA |
| Richard Olendorff | BLM, Sacramento, CA |
| Cornelio Padilla | NFG, Las Vegas, CA |
| Paul Peek | BLM, Cedar City, UT |
| Phil Pister | CFG, Bishop, CA |
| Gary Ponder | CFG, Bishop, CA |
| W. L. Platt | Mus. of Nat. History, Univ. Nev., Las Vegas |
| Scott Reitz | BLM, Moab, UT |
| Carl Richards | Calif. State Univ., Los Angeles, CA |
| John Rinne | USFS, Tempe, AZ |
| Del Robinson | USFWS, Vernal, UT |
| Don Sada | USFS, Bishop, CA |
| Peter Sanchez | USNPS, Death Valley National Monument |
| Ken Sasaki | CFG, Santa Barbara, CA |
| Allan Schoenherr | Fullerton College, CA |
| Paul Schumann | Univ. Nevada, Las Vegas, NV |
| Karl Seethaler | Utah State University, Logan, UT |
| Donald Seibert | BLM, Phoenix, AZ |
| Douglas Selby | USFWS, Las Vegas, NV |
| Jill Selby | Univ. Nevada, Las Vegas, NV |
| Bill Silvey | Arizona Game & Fish, Phoenix, AZ |
| Mignon Shumway | CFG, Bishop, CA |
| David Soltz | Calif. State Univ., Los Angeles, CA |
| Jim Sommer | Univ. Nevada, Reno, NV |
| Tess Smith | State Water Res. Cont. Bd., Sacramento, CA |
| Jerry Stefferud | USFS, Bishop, CA |

January 5, 1978

Resolution 77-1

Relative to the Preservation of Ash Meadows Fauna and Flora

Whereas, the water level in the Devils Hole has been lowered below its historic level by pumping of the ground water in Ash Meadows for agricultural use; and

Whereas, the reproduction of Pupfish in the Devils Hole has been seriously threatened; and

Whereas, a stable water supply is necessary for the continued survival of the several species of Pupfish native to Ash Meadows; and

Whereas, Ash Meadows contain numerous unique and endemic aquatic and terrestrial organisms;

Therefore, be it resolved:

That the Pupfish of Ash Meadows be protected by an Act of Congress by whatever means may be deemed appropriate by the Congress of the United States; and

Be it further resolved:

That the DESERT FISHES COUNCIL supports this Resolution with all its resources and at every opportunity to insure the lasting protection of the Pupfish and aquatic and terrestrial ecosystems of Ash Meadows.

Be it further resolved:

That copies of this Resolution be transmitted to Senator Cranston of California and Senator Cannon of Nevada and to the appropriate federal agencies.

Passed without dissenting vote.

Attest

E. P. Pister
Executive Secretary

# Resolution 77-2

## Relative to the Status of Endemic Cutthroat Trout Subspecies Within the Bonneville Basin

WHEREAS a subspecies of cutthroat trout (Salmo clarki utah) was endemic to the waters of Lake Bonneville Basin drainage within the boundaries of the states of Utah, Nevada, and Wyoming; and

WHEREAS several pure populations of the cutthroat trout subspecies have been found to exist in unique aquatic habitats of small isolated streams within the state of Utah; and

WHEREAS other populations of the subspecies are known to exist that are only slightly hybridized but still retain the phenotypic characteristics of the original cutthroat trout subspecies; and

WHEREAS other populations of the subspecies are suspect to occur in remote and isolated aquatic environments, and which, if found, could contribute greatly to the understanding, development, and perpetuation of the unique cutthroat subspecies; and

WHEREAS present and future well-being of these cutthroat trout subspecies is dependent upon wise land management practices including the management of the aquatic environments suitable for the subspecies; and

WHEREAS the well-being of these cutthroat trout is also closely related to present and future fishery management practices; and

WHEREAS the subspecies of cutthroat have the potential to become more important in the state's fishery management programs involving the productivity and protection of suitable environments; now therefore be it

RESOLVED that the Desert Fishes Council meeting in Death Valley on November 17-18, 1977, do hereby commend the efforts of the Utah State Division of Wildlife Resources, Nevada Dept. of Fish and Game, and the Wyoming Dept. of Game and Fish for their fishery management efforts in behalf of this unique subspecies of cutthroat trout; and the Desert Fishes Council also commends the efforts of the U.S. Forest Service and U.S. Bureau of Land Management which are responsible for land-water management for their attention to the well-being of the subspecies in land use and habitat management plans, and especially that emergency withdrawal action taken by the U.S. BLM in the Deep Creek Mtns., Utah, to aid in the protection of this subspecies; and be it further

RESOLVED that the Desert Fishes Council urges all responsible agencies and individuals in these agencies to continue to provide adequate attention to the inventory, management, protection, and enhancement for

the perpetuation of this unique subspecies of cutthroat trout and its habitats, and be it further

RESOLVED that copies of this resolution be forwarded to the Directors of the Utah Division of Wildlife Resources, Nevada Dept. of Fish and Game; Wyoming Dept. of Game and Fish; the Regional Forester, Region 4, U.S. Forest Service, and the State Directors of the U.S. BLM in Utah, Nevada, and Wyoming.

Passed without dissenting vote.

Attest

E. P. Pister
Executive Secretary

January 5, 1978

Resolution 77-3

Relative to the Preservation of *Gila cypha* and *Gila elegans*

WHEREAS two members of the genus *Gila* of the Colorado River system are in grave danger of extinction: the humpback chub (*Gila cypha*) and the bonytail chub (*Gila elegans*); and

WHEREAS the Desert Fishes Council considers that propagation is imperative to insure the survival of these species as well as to provide information on the taxonomical relationships within the species comprising the genus *Gila*;

NOW, THEREFORE BE IT RESOLVED, that the Desert Fishes Council strongly and urgently recommends that adequate numbers of these species be secured at the earliest possible date; and

BE IT FURTHER RESOLVED, that the Desert Fishes Council urges the Fish and Wildlife Service to seek the funding, facilities, and personnel necessary to complete this task.

Passed without dissenting vote.

Attest

E. P. Pister
Executive Secretary

November 17, 1977

Resolution 77-4

Relative to the Warm Springs Pupfish Recovery Plan

WHEREAS the Warm Springs Pupfish Recovery Plan was cooperatively developed in 1976 and officially approved in 1977, and

WHEREAS the Recovery Plan now is ready for implementation, requiring the cooperative efforts of various state and federal agencies, and

WHEREAS when the Recovery Plan is properly implemented, this subspecies may be delisted from the Endangered Species list,

NOW, THEREFORE BE IT RESOLVED, that the Desert Fishes Council at its November 1977 annual meeting does hereby encourage all cooperating agencies of the Warm Springs Pupfish Recovery Plan, to proceed with reasonable haste to implement the Recovery Plan.

Passed without dissenting vote.

Attest

E. P. Pister
Executive Secretary