Deacon and Nappe 1968

DRAFT

RARE AND VANISHING FISH OF NEVADA

Special Report
Date

Agricultural Experiment Station
Foresta Institute

Reno, Nevada

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DEFINITIONS

ENDANGERED--An endangered species or subspecies is one whose prospects of reproduction and survival are in immediate jeopardy. Its peril may result from one or many causes--loss of habitat or change in habitat, overexploitation, predation, competition, disease. An endangered species must have help, or extinction will probably follow.

RARE--A rare species or subspecies is one that, although not presently threatened with extinction, occurs in such small numbers throughout its range that it may be endangered if its environment deteriorates further. Close watch of its status is necessary.

PERIPHERAL--A peripheral species or subspecies is one whose occurrence in Nevada is at the edge of its natural range and which is rare or endangered within Nevada although not in its range as a whole. Special attention is necessary to assure retention in our state's fauna.

STATUS UNDETERMINED--A status-undetermined species or subspecies is one that has been suggested as possibly endangered, but about which there is not enough information to determine its status. More information is needed.

EXTINCTION--A species which once occurred in Nevada but has disappeared within historic times as a result of man's activities.

Maybe something about Frank Groves. He's been patient about helping

ACKNOWLEDGEMENTS

The data contained herein orginates from numerous sources in addition to the references cited. We thank especially Mr. Thomas Trelease and Dale Lockard of the Nevada Fish and Game Department for continuing interest in and information on Nevada's rare and endangered fishes. Drs. C. L. Hubbs and R. R. Miller have provided a wealth of information and continuous encouragement. Dr. W. L. Minckley has been generous with information on fishes of the Colorado System. Dr. R. J. Behnke has been invaluable in providing information on Salmonids. Mr. Clinton Lostter, co-ordinator of the Endangered Species Program for the Bureau of Sport Fisheries and Wildlife kindly reviewed themanuscript.

Foresta Institute is a private non-profit scientific and conservation education organization near Carson City, Nevada. Leontine Nappe works for the Institute specializing in vanishing wildlife. The drawings by Josette Gourley xxx were made available through courtesy of Foresta Institute. ~~Dr. James E Deacon, is in the Biology Department at the University of Nevada at Las Vegas.~~

The authors, James E Deacon and Leontine Nappe, are responsible for the numerous opinions presented here. While many data are unpublished or have not been developed, we believe the judgements made reflect the real conditions as closely as is possible at the present state of knowledge. We welcome suggestions or additional data.

James E. Deacon and Leontine Nappe

by James E. Deacon and Tina Nappe

INTRODUCTION

animals to study

Mammals and birds have always been more popular than cold blooded vertebrates, which are, therefore less well known. In the more progressive countries, studies have been undertaken on game fish and commercial oceanic fish but our knowledge even of them remains limited. Most of us find it much harder to "like" fish. There is no Bambi of the fish world, no ugly duckling, no Lassie, no Captain Silver's parrot. Fish have no arms or legs to express themselves nor do their faces tell us much. We accept ~~the~~ a gasping dying fish more readily than ~~the~~ a mortally wounded deer. Fish are slimy too and live underwater, a world which until the advent of skin-diving, marinelands, and underwater cameras we knew very little about. From our streamside or lakeshore view the backs of all fish were the same. So it is probably not surprising that relatively few people have devoted their lives to learning about the lives of fish.

We all do know that fish cannot escape the waters they live in. Deer run or birds fly and thereby escape immediate danger if not eventual extinction but with a few exceptions fish cannot escape polluted water or seek other waters if theirs disappears.

With the rapid changes even in underdeveloped countries it is probable that many fish will disappear before we know

of them. Each year new species of fish are discovered all over the world -- even in the United States. But, as with other animals, man-induced changes are occurring too rapidly for species to adapt or evolve into new species.

Over long periods of time fish have become conditioned to the waters to which they are bound. The process of adaptation to estuarine and then freshwater conditions followed by reinvasion of the seas for some groups required millions of years and involved many fundamental changes in structure and function. And while today, as in the past, fishes live in many kinds of waters with variations in temperature and degrees of salinity, they depend on different foods, spawning grounds, and hiding places, they do so as populations rather than as individuals.

Trout require lakes or cold, running streams and are therefore often restricted to small streams on mountain ranges. The warmer waters of the valleys, many, act as barriers, and In desert regions, often connecting waters do not exist so that trout in their limited mountain isolated habitats have become many species, or, in cases where isolation has been effective for a somewhat shorter period, subspecies or races. When forests are cut or mines are operated, the streams often become polluted with silt which can affect respiration by clogging gills or covering the gravel spawning grounds, thus suffocating the eggs. Attempts to control forest insects using pesticides, and mining processes that flush toxic wastes into streams also take their toll of trout and other aquatic animals. Sometimes, eager fishermen or

fishery managers, anxious to improve fishing, introduce another trout species, often resulting in interbreeding or hybridization which eliminates the native species as a pure strain. For these reasons the Greenback of Colorado, the Montana Westslope Cutthroat, the Gila trout of Arizona, and the Utah cutthroat trout are all considered endangered. The Piute of California has, in addition to the above, been overfished.

Over fishing has also affected the species of the Great Lakes ciscoes and sturgeon. The Atlantic sturgeon, like the Atlantic salmon, and the Lahontan cutthroat trout, has also declined because of river pollution and dams which discourage them from spawning. The adverse effects of pesticdes, mercury, and other heavy metals are becoming increasingly apparent in all major waterways and even in the oceans. On the Colorado River, dams, poisons, and introduced fishes have destroyed stretches of the river for the humpback chub, Colorado squawfish, razorback sucker, and the Little Colorado Spinedace. Creation of reservoirs for hydroelectric dams may have pushed the trispot and tuscumbia darters of Alabama to extinction. Introduction of mosquito fish into the habitats of the gila topminnow of Arizona and the Big Bend gambusia of Texas has severely depleted those populaitons. Water diversions and lowering of the ground-water have threatened the Big Bend gambusia and the Comanche Springs pupfish and have caused the extinction of two subspecies of Pahrump killifish, and so goes the general story of extinction. Man, in his headlong rush toward "progress", has seemed to run

roughshod over the environment and processes within it upon which his very existence depends. The disappearance of species of fish or any other animal is a symptom of the increasing inability of our environment to support life. We must recognize that each well we permit, each zoning variance, each highway constructed, each airplane flown, each person born has an impact on the environment we all must live in. Continuing a trade-off of people and their machines for the lives of fish or the clean and flowing water upon which they depend can only lead us to the ultimate destruction of our own life-support system on spaceship Earth. We must recognize that providing more water (or any other service) to permit growth of Las Vegas costs us not only money but a piece of our life-support system. The strange part of the story is that while Los Angeles has come to epitomize a life of low quality, Nevada (especially Las Vegas) seems bent on duplicating and welcoming the duplication of the polluted megalopoline characteristics of Los Angeles. Could it be that we have already permitted technology to control our actions? Are we facing the consequences of our urge to promote "growth"? Have we as a people been made to believe in a "system" that no longer serves the best interests of those of us living in it? We urge you to define what elements of the good life you would like to have access to in the future and then determine whether or not you are more or less likely to achieve them as Nevada grows.

NEVADA'S UNIQUE FISHES

Between the sun and the sage there would seem to be hardly any room for the wide variety of native fish species in Nevada (some 40 species). With the exception of a few good sized lakes like Pyramid, Tahoe, and Walker, and a few streams like the Colorado, Truckee, Humboldt, and Walker, there would not appear to be any suitable habitat. Yet, Nevada has more species listed on the rare and vanishing species list than any other state, testifying to the rapid changes occurring in the state as well as to the extreme restriction and sensitiveness of the fishes' habitats to change. To understand these phenomena we must look to the past and to geography. During the Pleistocene, Lake Lahontan covered much of the Great Basin. Streams originating in central Nevada flowed into the Colorado River, and the Amargosa River, a large river, at one time flowed toward its terminus in Death Valley. The snowcapped mountains formed year round creeks running down to the lakes that filled valleys now dry. Earthquake activity on faults in the earth's crust created channels through which innumerable springs burst forth.

The springs in particular have enriched Nevada's fish fauna by becoming refuges for fish populations that would otherwise have been lost when the large Pleistocene lakes finally disappeared about 10,000 years ago. About 16 species inhabit these springs today; two species and three subspecies have become extinct.

Nevada probably has less water than any other state.

Consequently although fish have been affected by other man-made threats such as pollution, pesticides and introductions of other fish; man's manipulation of existing water resources is the worst threat. While one might forgive ranchers for ignoring "useless" inch-long fish, it is harder to understand that even the biggest game fish, the Lahontan cutthroat trout (Salmo clarki henshawi), has been drastically affected by man's activities. Prior to 1940, sportsmen came from all over the world to fish for this largest of all cutthroat and a commercial fishery was even operated at Pyramid and Tahoe for this remarkable fish. Overfishing, erosion, pollution, certainly affected this species but it was the creation of Derby Dam, the first Federal reclamation project of its type, that destroyed the famous fishery. The dam presented an impassable barrier to upstream spawning runs and diverted enough water from Pyramid lake to begin the process of lake level decline, that is still going on. The result was to render impossible movement out of the lake into the river while at the same time warming up the lower river to such an extent that egg survival became impossible for much of the season. Other problems, most notably hybridization with rainbow trout, contributed to the decline and final extinction of the river and Lake Tahoe populations of Lahontan cutthroat trout. Today pure populations of Lahontan cutthroat trout exist in Summit Lake, Nevada; Independence Lake, California; Pole Creek, tributary to Truckee River; Murray Canyon, tributary to East Carson River; the headwaters of East Carson River; Dog Creek, tributary to Walker River and a small isolated tributary

of Yuba River. Stocks of Lahontan cutthroat now being propagated in hatcheries are largely derived from Heenan Lake stock, a stock that has been contaminated with rainbow trout genes and therefore apparently does not attain the large size of the pure lake stocks of Lahontan cutthroat. Experimentation with pure stocks of Lahontan cutthroat, especially those from Independence Lake and/or Pole Creek might result in the production of even larger trout in Pyramid Lake.

For fishes living in springs, the situation has been even more crucial. Five of the six extinct forms of fish in Nevada formerly lived in springs. Since most fishes living in Nevada springs have been isolated, alone or with only a few other species, for many thousands of years they have not evolved protective mechanisms common to fish species living in environments containing more kinds of fish and other competitive or predaceous animals. In addition, since water is relatively precious in Nevada, men tend to concentrate their activities near water and modify or completely destroy the natural character of these fragile spring habitats. Both the Pahranagat Spinedace and the Big Spring Spinedace became extinct as a result of irrigation diversions plus introductions of predatory (on eggs and larvae) mosquitofish and bullfrogs. Carp also probably contributed to the decline of the Pahranagat Spinedace. The Ash Meadows killifish (Empetrichthys merriami) was never very abundant, possibly because it was at a competitive disadvantage with the more agressive pupfish sharing its

habitat in Ash Meadows. In any case when an additional competitive and predatory burden was placed on this species during the late 1940's and 1950's with the introductions and establishment of crayfish, mosquitofish, black mollies and bullfrogs, the species disappeared. The other two extinctions occurred in Pahrump Valley as a result of heavy mining (or overpumping) of the ground water supply. The Pahrump and Raycraft subspecies of Pahrump killifish became extinct about 1957 when their spring habitats dried up as a result of heavy pumping for irrigation in Pahrump Valley. The only remaining population of killifishes belonging to the genus Empetrichthys exists at Bowman's Ranch in Pahrump Valley in a spring that will probably dry up within the next few years. Although it is yet far from certain, there is a chance that the fish may be saved by artificial propagation, but the habitat which literally made the fish over eons of time is doomed, another victim of man's dream of being able to remove more from the environment than is put back into it.

The last species mentioned above, (Empetrichthys latos) and the Devil's Hole pupfish, are the most immediately endangered species in the state. The Pahranagat bonytail chub while suffering from the same causes that resulted in extinction of the Pahranagat spinedace is still precariously surviving in Pahranagat Valley. Recently, tropical fishes have been established in the warm waters of the valley and have added to the burden of both the bonytail and the native springfish (Crenichthys baileyi). Tropical fishes, as well as water

development for recreation and domestic supply, have also played prominently in the decline of Moapa dace and springfish in Moapa Valley.

Some of our stream fishes are also suffering from the ways in which we are using our waters. Most notably, the spectacular Colorado squawfish, Ptychocheilus lucius, once so abundant that it was removed from the river with pitchforks to be used as fertilizer by farmers along the Colorado, is apparently extinct in Nevada, although populations still exist in the upper Colorado. This species which belongs to the minnow family Cyprinidae attains a maximum size of 80 to possibly over 100 lbs. The large dams on the Colorado river coupled with cold temperatures below the dams have effectively eliminated this species from the lower river. The last known specimen taken in border waters of the state, above Willow Beach, Lake Mojave, was a 16 lb. specimen taken by Mr. St. Clair of Las Vegas on in 1961.

The woundfin, Plagopterus argentissimus, extinct in the Gila River basin since the turn of the century, is now restricted to the mainstream of the Virgin River in Utah, Arizona and Nevada. Proposals by the Bureau of Reclamation to build a dam above St. George, Utah and by the U. S. Army Corps of Engineers to channel the lower Virgin River, if effected would almost certainly spell doom for the woundfin. The species is apparently very sensitive to habitat changes since it was one of the first to disappear from the Gila River during the period of rapid habitat change in Arizona resulting from the combination of overgrazing and climatic adversity in the 1880's.

THE PUPFISH

The pupfishes of the genus Cyprinodon living in the Death Valley System of Nevada-California have been the center of much national attention in recent years. This group descended from an ancestral form that occupied the marshes, shores and tributary streams of ancient Lake Manly is one of the most tolerant groups of fishes in the world. From many standpoints it would seem that these fish which often live in constant warm springs would be restricted to such amenable conditions. It is therefore surprising to realize that these fishes actually seem to owe their success and survival to their ability to tolerate very hot temperatures, very saline waters and very low concentrations of oxygen. During the long period of existence in Death Valley these fishes have apparently been subjected to mountain-building earthquakes that have shut off and/or changed the discharge point of their constant spring sources. This left the forms at the mercy of the marsh habitats which in Death Valley can become very hot, very salty and very oxygen deficient, especially during the summer. It would not be surprising, after all the data are in, to find that Cyprinodon holds the world's record for toleration of these three environmental factors. The fact that pupfish still survive in the Death Valley System is a testimony to the fact that they can take about anything nature has to offer.

The immediate danger to pupfish in Nevada stems from the irrigation pumping being done by a rancher in Ash Meadows under permits issued by the Nevada State Water Engineer. The ground water system in Ash Meadows which supplies water to the springs in the area is very sensitive to pumping. Therefore spring discharge and water level responds quickly when pumps are used for irrigation. Some springs have already been temporarily dried up while nearly all have declined in flow. Obviously, while pupfish can survive very extreme conditions they cannot live through even temporary lack of water. Many agencies and private people are involved in attempts to solve the many problems prior to extinction of the Devil's Hole pupfish. The ranch is anxious to operate efficiently without causing extinction of the fish. At this point, no clear means of doing so has been identified, although if time does not run out there is some hope of finding a viable compromise.

The Nevada species--Warm Springs pupfish (Cyprinodon nevadensis pectoralis), Ash Meadows pupfish (C. n. mionectes) and Devil's Hole pupfish (Cyprinodon diabolis), are included in the following sheets. However many closely related populations living nearby in California are not listed. We include brief descriptions of these populations below to provide a more complete picture of the group.

The NEVADA PUPFISH (Cyprinodon nevadensis nevadensis) found in the spring and associated marshes at Saratoga Springs in the southeastern corner of Death Valley National Monument, Calif. is abundant and well protected. The prime danger to this form is human carelessness or interruption of the water supply upstream in the ground water system.

The AMARGOSA PUPFISH (Cyprinodon nevadensis amargosae) occurs in the permanent marshes and streams of the Amargosa River from Tecopa, Calif., downstream for about eight miles into the Amargosa Canyon and at Valley Springs where the river finally surfaces again in the floor of Death Valley. The form may move away from these two permanent water sources during floods or unusually wet years but in general is confined by water availability.

The TECOPA PUPFISH (Cyprinodon nevadensis calidae) has been eliminated from most of its former range at Tecopa Hot Springs, Calif., by human construction, diversion and pollution. The outflows from a few new wells that drain clean water into the marshes associated with Amargosa River near Tecopa have become colonized by the Amargosa pupfish. The only apparent possible locations that may still contain populations of Tecopa pupfish are a few very tiny springs that do not have a surface connection to the Amargosa River. Careful identification of these populations is pending. This form may already be extinct.

The SHOSHONE PUPFISH (Cyprinodon nevadensis shoshone) formerly occurred only at Shoshone Spring, Calif. This form apparently

became extinct sometime during the 1960's. Competitive pressure from introduced mosquitofish and green sunfish seems to explain the extinction. Recently the spring has been repopulated by Amargosa pupfish either by upstream movement during high water or by transplant by some unknown person.

The SALT CREEK PUPFISH (Cyprinodon salinus) lives entirely below sea level in Death Valley National Monument. The population exists in essentially an undisturbed and entirely natural habitat.

The COTTONBALL MARSH PUPFISH (Cyprinodon sp.) This recently discovered new species of pupfish also lives entirely below sea level in Cottonball marsh, Death Valley National Monument. Its habitat too is undisturbed and may include the saltiest environment in which any fish is known to exist.

The OWENS RIVER PUPFISH (Cyprinodon radiosus) once occurred widely in the waters of Owens Valley. Thought to be extinct since 1942, a remnant population was relocated in 1964. Since then the California Dept. of Fish and Game in cooperation with the Los Angeles Metropolitan Water District and the Bureau of Land Management has completed two sanctuarys for the protection of this species. The species has responded well and seems to be safe barring unforseen catastrophe.

Nevada's EXTINCTIONS—Fishes

Pahranagat Spinedace (Lepidomeda altivelis) once existed in Ash Spring and the Upper Pahranagat Lakes in Lincoln Co. Became extinct sometime between 1938 and 1959 most probably because of introduced carp, mosquitofish and bullfrogs plus habitat disturbances accomplished for irrigation.

Big Spring Spinedace (Lepidomeda mollispinis pratensis) lived at Big Spring near Panaca, Lincoln Co. The diversion of water may have led to the loss of suitable habitat. In addition mosquitofish and bullfrogs were introduced placing a further strain on the population.

Ash Meadows killifish (Empetrichthys merriami) lived in the springs at Ash Meadows, Nye Co. Perhaps because of the competition from the Ash Meadows pupfish, the Ash Meadows killifish was never very common. It has not been collected since 1942. When mosquitofish, mollies and other exotics were introduced, the pupfish probably displaced the killifish and the killifish having no place to go became extinct.

Pahrump Ranch Pahrump killifish (Empetrichthys latos pahrump) occurred only at the Pahrump Ranch in Pahrump Valley, Nye Co. In 1957 this spring failed and the population perished.

Raycraft Ranch Pahrump killifish (Empetrichthys latos concavus) inhabited a spring on the Raycraft ranch in Pahrump Valley, Nye Co. Around 1957 this spring was filled in by the rancher thus destroying the population. The spring was nearly dry at the time it was filled so that the real cause of extinction, as with the Pahrump Ranch killifish must be considered to be excessive pumping of the ground water for irrigation.

Colorado River Squawfish (Ptychocheilus lucius) was last taken in border waters of Nevada in 1961 when Mr. St. Clair hooked an 18 lb. specimen above Willow Beach. The species is now probably extinct below Grand Canyon although a population continues to exist in the Colorado River above Grand Canyon and one was reportedly taken in Grand Canyon during the summer of 1971.

ENDANGERED

Lahontan Cutthroat Trout
Salmo clarki henshawi

Order: CLUPEIFORMES Family: SALMONIDAE

Distinguishing Characteristics: Has a dash of red between the lower jaw and isthmus. It reaches a larger size than other cutthroats and is adapted to highly mineralized water. Spots are large and evenly distributed on body; gillrakers 21-28; pyloric caeca typically 40-60.

Present Distribution: Pure populations are known only from: Independence Lake, California; Murray Canyon Creek, tributary to East Carson River at Dumont Meadows; Dog Creek, tributary in East Walker River drainage, Mono Co., California; and headwaters of Pole Creek, tributary to Truckee River about 10 miles below Lake Tahoe.

Former Distribution: Lahontan basin tributary waters of Pluvial Lake Lahontan, California and Nevada, except for the Humboldt River drainage.

Status: Endangered. The original populations are extinct in Pyramid Lake, Lake Tahoe and Truckee, Carson and Walker Rivers. The present populations are maintained in Pyramid and Walker Lakes by stocking with Lahontan Cutthroat reared from stocks containing some rainbow trout influence.

Estimated Numbers: Perhaps 1,000-2,000 in Summit and Independence Lakes; approximately 1,000 in each of the four streams mentioned above.

Breeding Rate in Wild: Unknown. The cutthroat trout ascends rivers and creeks to spawn. Originally there were two distinct spawning runs from Pyramid and Winnemucca Lakes up the Truckee River. The first and largest run began in late fall and was usually over by March. A spring run began in April and was completed by July. Adult females taken from Catnip Resevoir on the Sheldon Antelope Refuge average about 2,500 eggs per fish; 230-315 eggs per ounce, about 1200 eggs per pound of female. The spawning run is from the middle of April to late May. The Lahontan cutthroat has been widely stocked without much success except within its original range in highly alkaline waters with a high pH.

Reasons for Decline: Damage to spawning beds resulting from forest removal, forest fires and overgrazing; dams which block spawning runs, pollution; and loss of water to irrigation use. Introduction of rainbow trout into waters occupied by cutthroat trout in early days. A cutthroat trout from Heenan Lake, California is widely propagated as S. c. henshawi. Heenan Lake trout are predominantly henshawi but have been influenced by hybridization with S. gairdneri. Heenan Lake was stocked with

trout from Blue Lake, California. Blue Lake was originally stocked with henshawi from the Carson River in 1864. Subsequently, two introductions of rainbow trout were made into Blue Lake and hybridization occurred. Other sources of "henshawi" used in propagation such as Catnip Reservoir, Nevada, are derived from Heenan Lake stock. Walker Lake & Summit Lake strains are still being returned as pure stocks.

Protective Measures Taken: Pole Creek closed to fishing; rainbow trout and Heenan Lake cutthroat no longer stocked in Independence Lake. U. S. Bureau of Land Management has placed Summit Lake watershed in special protected category.

Protective Measures Proposed: Continued systematic study in attempt to find more pure populations. Improvements on the Lower Truckee have been recommended.

Breeding Potential in Captivity: A few thousand Summit Lake trout are raised at Verdi Hatchery, Nevada for stocking each year.

Remarks: The Lahontan cutthroat is the most differentiated of the interior cutthroat trouts. It is an important and beautiful sport fish which reaches a large size and is adapted to the highly alkaline waters of a few ancient lakes in the Lahontan basin. Experimentation with the available stocks of Lahontan cutthroat might yield a better hatchery fish for use in Pyramid and Walker Lakes.

STATUS UNDETERMINED ?

ENDANGERED

Snake Valley Cutthroat Trout
Salmo clarki ssp.

Order: CLUPEIFORMES Family: SALMONIDAE

Distinguishing Characteristics: Spotting more uniformly distributed over the body than in S. c. utah; usually more than 15 basibranchial teeth; having a "chunky" appearance; usually with more gill rakers than in S. c. utah.

Present Distribution: Pine Creek, Hampton Creek, Goshute Creek, Mill Creek, Hendrys Creek, Ridge Creek, Weaver Creek.

Former Distribution: Local testimony suggests that Hendrys Creek may have held the only native population of Snake Valley cutthroat trout. However it seems probable that all the streams of the Snake Valley region at one time contained populations of this unique form. Pure populations may yet be discovered in isolated streams on the Goshute Indian Reservation.

Status: Endangered. Recent collections from Mill and Hendrys Creek show evidence of hybridization with introduced rainbow trout. Pine Creek, Hampton Creek and Goshute Creek apparently contain pure populations.

Estimated Numbers: Unknown. (Need data)

Breeding Rate in Wild: Unknown. Populations have been maintaining themselves for many years.

Reasons for Decline: Hybridization with introduced rainbow trout.

Protective Measures Taken: Goshute Creek has been designated a Natural Area and Weaver Creek has been designated a Senic Area by the Bureau of Land Management. Pine & Ridge Creeks have been closed to fishing & stocking since 1953 to protect this fish

Protective Measures Proposed: None. (Need proposals)

Breeding Potential in Captivity: Unknown.

Remarks: The Snake Valley cutthroat trout occupies the Nevada portion of the Lake Bonneville drainage. It appears quite distinct from S. c. utah, a form which therefore probably was never native in Nevada.

RARE

Humboldt Cutthroat Trout
Salmo clarkii subsp.

Order: CLUPEIFORMES Family: SALMONIDAE

Distinguishing Characteristics: Spots medium-large, evenly distributed on body; scales in lateral series typically 125-145; gillrakers 19-23.

Present Distribution: About 20-30 small, headwater tributaries in Humboldt River drainage of Lahontan Basin, Nevada.

Former Distribution: Probably throughout the Humboldt River system, Nevada.

Status: Rare.

Estimated Numbers: Populations vary according to size and condition of streams from only a few dozen, in areas where total habitat is restricted to one or two spring-fed beaver ponds, up to perhaps 1,000 individuals in the better streams. Most of these streams probably have less than 100 adult trout because suitable habitat is severely restricted.

Breeding Rate in Wild: Unknown.

Reasons for Decline: Deterioration of habitat due to agricultural practices and mining.

Protective Measures Taken: None.

Protective Measures Proposed: None.

Number in Captivity: None.

Breeding Potential in Captivity: Unknown.

Remarks: This seems to be an amazingly hardy cutthroat. Many of these streams have been heavily stocked with rainbow trout, Yellowstone cutthroat trout and brook trout, a situation almost inevitably leading to the elimination of native cutthroat populations in the West, but there is no evidence of hybridization in the populations sampled, and the native cutthroat dominate the brook trout where they co-exist. Also, the native cutthroat enters irrigation reservoirs constructed in their drainage and their growth and condition far exceed that of rainbow and brook trout stocked in these reservoirs.

RARE

White River Sucker
Pantosteus clarki intermedius

Order: CYPRINIFORMES Family: CASTOSTOMIDAE

Distinguishing Characteristics: Similar to Pantosteus clarki of the Gila River, but with slenderer caudal peduncle, narrower jaws, and fewer pelvic rays.

Present Distribution: Cool spring streams of White River Valley, Nevada.

Former Distribution: Cooler waters of White River and Pahranagat Valleys, Nevada.

Status: Rare.

Estimated Numbers: Unknown. a few thousand individuals in White River Valley; (breed data to subhoot status)

Breeding Rate in Wild: Unknown.

Reasons for Decline: Irrigation diversion and introduced fishes in Pahranagat Valley have apparently been responsible for the complete extirpation of this fish from that valley. No documented decline has occurred in White River Valley.

Protective Measures Already Taken: None.

Protective Measures Proposed: Establish Preston Big Spring as a refugium.

Number in Captivity: None.

Breeding Potential in Captivity: Poor.

RARE

Razorback Sucker
Xyrauchen texanus

Order: CYPRINFORMES Family: CATOSTOMIDAE

Distinguishing Characteristics: This monotypic genus is characterized by a laterally compressed and elevated nuchal hump between the occiput and dorsal origin which is produced by highly developed interneural bones in that area.

Present Distribution: Colorado River system.

Former Distribution: Colorado and Gila River systems.

Status: Rare.

Estimated Numbers: Unknown.

Breeding Rate in Wild: Unknown.

Reasons for Decline: Modification of habitats by man, including construction of dams and irrigation systems with consequent alteration of large rivers.

Protective Measures Taken: None.

Protective Measures Proposed: Basic life history information is essential in order to assess the status and plan for management of the species.

Number in Captivity: None.

Culture Potential in Captivity: Probably poor.

Remarks: This species disappeared from the Gila River resevoirs during the 1960's after having maintained high population densities for many years. Reproductive requirements are unknown and young are very rarely seen, especially in Nevada waters. Numbers do not seem to have declined markedly in Nevada, yet reproductive success has not been documented. The means of maintaining population size relatively constant remains a msytery.

ENDANGERED

Cui-ui
Chasmistes cujus

Order: CYPRINIFORMES Family: CATOSTOMIDAE

Distinguishing Characteristics: A large, heavy-bodied sucker, commonly reaches 6 pounds in weight, with subterminal mouth, thin non-papillose lips, oblique lower jaw, and fewer than 70 scales in the lateral line.

Present Distribution: Pyramid Lake, Washoe Co., Nevada.

This is doubtful. The species has been regularly present in recent years.

Former Distribution: Pyramid and Winnemucca Lakes and the lower part of the Truckee River.

Status: Endangered. The relict lake suckers of the genus Chasmistes (3 recognized living species) are either extinct or threatened. This one has the best chance for survival. It is of both economic (to the Indians) and biological importance.

Estimated Numbers: Unknown.

Breeding Rate in Wild: Not known. Eggs are small and numerous.

Reasons for Decline: Declining flow in lower Truckee River due to dams and irrigation.

Protective Measures Taken: ~~Catch limits have been imposed on non-Indians.~~ No cui-ui may be taken by non-Indians recently due to decline in population.

Protective Measures Proposed: Restoration of spawning access and habitat. Increased effort at artificial propagation and stocking of young and/or adults in Pyramid Lake and, if possible, in some other suitable lake. Probably most essential for planning and intelligent management are basic life history studies of the species.

Number in Captivity: None.

Culture Potential in Captivity: Has not been reared in captivity beyond the yolk-sac stage.

Remarks: This is a relict genus now known only from Pyramid Lake and (a different species) from the Klamath Lake area of Oregon and adjacent California. It was more widespread and speciose in the Plio-Pleistocene epochs.

RARE

Colorado Bonytail
Gila elegans

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: Distinguishable primarily by the very slender caudal peduncle, flattened snout and pronounced nuchal hump; nine pelvic rays, scalation reduced.

Present Distribution: Colorado River mainstream.

Former Distribution: Colorado and Gila River mainstreams.

Status: Rare.

Estimated Numbers: Unknown.

Breeding Rate in Wild: Unknown.

Reasons for Decline: Modification of habitats by man, including construction of dams, and irrigation systems with consequent alteration of large rivers.

Protective Measures Taken: None.

Protective Measures Proposed: Basic life history information in the lower Colorado is essential to an understanding of the status of this species.

Number in Captivity: None.

Breeding Potential in Captivity: Probably poor.

Remarks: As with the Razorback sucker, this species appears to be maintaining population size in Nevada waters. Reproductive success has not been observed.

ENDANGERED

Pahranagat Bonytail
Gila robusta jordani

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: Similar to Gila robusta robusta but differs by being less elongate, having more scales above, below, and on the lateral line, and in having a distinctive greenish color with black blotches.

Present Distribution: Outflow of Crystal and Ash Springs, Pahranagat Valley, Lincoln Co., Nevada.

Former Distribution: Throughout most of the streams in Pahranagat Valley.

Status: Endangered.

Estimated Numbers: Unknown.

Br[illegible] Unknown.

Pahranagat Bonytail

Re Protective Measures Proposed: The native
of habitat has been examined by both federal
ra and state agencies in an unsuccessful attempt
at developing a viable management plan to
Pr protect the species. The entire habitat is
on private land. Therefore the only choice
Pr appears to be to transplant the species into
su a refugium provided by BLM in Spring Valley
Nevada in the hopes of maintaining a popu-
Nu lation with the hope of being able to trans-
plant it if the natural habitat can be restored.

Breeding Potential in Captivity: Probably poor.

Remarks: Collecting trips to Pharanagat Valley since 1967 have resulted in locating very few of these fishes. La Rivers (1962) saw the species at Crystal Spring in 1948-49. Tanner (1950) designated Crystal Spring the type locality. The fish currently appears to be restricted to a small population living in a short section of stream above a main irrigation ditch which accepts the combined outflow from Crystal and Ash Springs. It has not been seen or taken in the outflow from Crystal Spring above the confluence with Ash Spring waters during the 1960's.

ENDANGERED

Moapa Dace
Moapa coriacea Hubbs & Miller 1948

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: A monotypic genus with 5-4 dentition, hidden premaxillary frenum, small (70-80) deeply embedded scales in leathery-textured skin, and a prominent black spot at caudal base.

Present Distribution: Restricted to warm springs and their outlets near source of Moapa (Muddy) River, Clark Co., Nevada.

Former Distribution: Not known to be different from present.

Status: Endangered.

Estimated Numbers: ~~Not known~~ a few thousand individuals.

Fecundity: Unknown.

Reasons for Decline: The springs and headwaters of Moapa River are being altered for various commercial and domestic water uses. Invasion of these habitats by exotic species may also be promoting the decline.

Protective Measures Taken: BLM is building a refugium in Spring Valley, Nevada.

Protective Measures Proposed: Designate the headwaters of Moapa River a Natural History Landmark; transplant the species into the refugium being prepared in Spring Valley, White Pine Co., Nevada by BLM.

Number in Captivity: None.

Breeding Potential in Captivity: Not likely to reproduce well.

Remarks: This genus is known only from a very restricted area; it is a biological relict threatened by exotic species (Gambusia, Poecilia, bullfrogs) and a proposed irrigation and dam project.

RARE

Desert Dace
Eremichthys acros

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: A monotypic genus of small minnow with 5-4 teeth, prominent horny sheaths on each jaw, and fine scales (70-80 in lateral line) that bear radii on all fields.

Present Distribution: Known only from suitable habitat in Soldier Meadows west of the Black Rock Desert in Humboldt Co., Nevada.

Former Distribution: Approximately the same as present.

Status: Rare; an isolated endemic living in a small unique habitat.

Estimated Numbers: Not known.

Breeding Rate in Wild: No data.

Reasons for Decline: No decline has been demonstrated; water diversions for irrigation practices may have eliminated the species from some places where it once occurred but generally appear to have increased available habitat.

Protective Measures Taken: None.

Protective Measures Proposed: Set aside part of warm-spring habitat as a sanctuary, wildlife monument or designate a Natural History Landmark.

Number in Captivity: None.

Breeding Potential in Captivity: Unknown.

ENDANGERED

Devil's Hole Pupfish
Cyprinodon diabolis (Whales, 1932)

Order: ATHERINIFORMES Family: CYPRINODONTIDAE

Distinguishing Characteristics: Small size (generally less than 25 mm. S.L.), no pelvic fins, caudal fin convex, no vertical bars in females.

Present Distribution: Restricted to a single, spring-fed pool, Devil's Hole, in Ash Meadows, Nevada.

Former Distribution: Same as present.

Status: Endangered.

Estimated Numbers: 200 to 700; at times as few as 125 breeding adults.

Breeding Rate in Wild: Good if undisturbed. Breeding occurs March through August.

Reasons for Decline: Reduction in habitat due to pumping of ground water for irrigation.

Protective Measures Taken: 40 acres set aside in 1952 as a detached section of Death VAlley National Monument. The immediate area is currently fenced.

Protective Measures Proposed: Transplant Devils Hole pupfish.

Protective measures proposed: See this category under Nevada Pupfish for the best solution. In addition because of the dangers to the habitat, transplanting to suitable refugia and concentrated efforts to develop techniques of artificial propagation must be undertaken immediately to insure that the species remains available to occupy the natural habitat if it can be saved.

Remarks: This species has been the center of a tremendous amount of national publicity. Its habitat was very seriously reduced by pumping of groundwater for irrigation. Through considerable efforts by many people and excellent cooperation of the farm owners there is now some hope of saving Devil's Hole and therefore the Devil's Hole pupfish.

RARE

Steptoe Dace
Undescribed

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: ~~(Preliminary)~~ A description of the genus ~~is in preparation as a monograph by Hubbs and Miller~~ by Carl Hubbs and R. R. Miller will soon be published by the Calif. Acad. Sci.

Present Distribution: Springs in Steptoe, Ruby, Butte and Goshute Valleys, White Pine and Elko Co., Nevada.

Former Distribution: Approximately same as present.

Status: Rare.

Estimated Numbers: Unknown.

Breeding Rate in Wild: Unknown.

Reasons for Decline: Some springs have been modified for domestic, agricultural or recreational purposes to the detriment of the Steptoe Dace.

Protective Measures Taken: None.

Protective Measures Proposed: None.

Number in Captivity: None.

Breeding Potential in Captivity: Unknown.

Remarks: This species is being described by Carl Hubbs and Robert R. Miller in an extensive monograph covering geologic history and fish distribution in a series of basins of interior drainage in eastern Nevada. They will probably identify several springs that would be suitable for the establishment of refugia.

RARE

White River Spinedace
Lepidomeda albivallis

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: A species of spinedace distinguished from others in having 5-4 teeth in the main row, lateral-line scales typically fewer than 90, mouth moderately oblique, dorsal fin of moderate height, and melanophores extending well below level of lateral line.

Present Distribution: Occurs in cool springs and their outflows in remnants of the upper part of the pluvial White River system in White River Valley, Nevada.

Former Distribution: Not known to be different from present.

Status: Rare.

Estimated Numbers: Unknown.

Breeding Rate in Wild: No data.

Reasons for Decline: Habitat alteration for irrigation, Introduction of exotic species.

Protective Measures Taken: None.

Protective Measures Proposed: Set aside Preston Big Spring as a sanctuary or wildlife monument. Establish Lund Town Spring as a Natural History Landmark.

Number in Captivity: None.

Breeding Potential in Captivity: Probably not good.

Remarks: This species is closely related to the Pahranagat Spinedace which is now extinct. Habitats in White River Valley have not been altered to the extent that they have been in Pahranagat Valley. Should this occur with increased development, however, the White River spinedace may follow the Pahranagat spinedace to extinction. This is a relict species belonging to the distinctive spiny-rayed cyprinid fishes (Plagopterini) of the Colorado River Basin.

RARE

Virgin River Spinedace
Lepiodomeda mollispinis mollispinis

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: Pharyngeal teeth 5-4 in main row, relatively weak and soft-tipped (second) dorsal spine, 9 anal rays, fewer than 90 lateral line scales.

Present Distribution: Tributary streams and clearer waters of Virgin River, Utah, Arizona and Nevada.

Former Distribution: Generally the same as present distribution. The population in Santa Clara River has declined and a few other populations have disappeared.

Status: Rare.

Estimated Numbers: Unknown.

Breeding Rate in Wild: Spawning season extends from April through June. ~~to July.~~ Females may produce ~~up to about~~ 400-900 eggs.

Reasons for Decline: Construction of a dam in the Santa Clara River. Competition from introduced fishes.

Protective Measures Taken: Life history studies have been completed. Work toward developing techniques of artificial propagation is being conducted at UNLV.

Protective Measures Proposed: Continue the present efforts.

Number in Captivity: About 50.

Breeding Potential in Captivity: Work is progressing to improve our understanding of breeding requirements in captivity.

ENDANGERED

Woundfin
Plagopterus argentissimus Cope

Order: CYPRINIFORMES Family: CYPRINIDAE

Distinguishing Characteristics: The most specialized genus of the Plagopterini, Plagopterus has a scaleless body, a long first dorsal spine, head and belly flattened, a well developed barbel, 8 or 9 dorsal rays, 10 anal rays, and a nearly horizontal mouth.

Presert Distribution: Main stream of the Virgin River below Hurricane, Utah.

Former Distribution: Virgin River, Utah, Arizona, Nevada; and lower Gila River, Arizona.

Status: Endangered because of a proposed dam and channel dredging that would affect 80 of the 90 miles of river habitat still available to the species.

Estimated Numbers: Not known.

Breeding Rate in Wild: ~~Not known.~~ Spawning occurs april through June.

Reasons for Decline: Modification of habitat by man. The species is adapted to life in sandy, swift, turbid rivers.

Protective Measures Taken: None.

Protective Measures Proposed: Do not modify the river more than it has already been modified.

Number in Captivity: None.

Breeding Potential in Captivity: Probably not good.

ENDANGERED

Warm Spring Pupfish
Cyprinodon nevadensis pectoralis (Miller, 1948)

Order: ATHERINIFORMES Family: CYPRINODONTIDAE

Distinguishing Characteristics: A subspecies of Cyprinodon nevadensis characterized principally by an increased number of pectoral fin rays, usually 17.

Present Distribution: School (formerly Lovell's) Spring, Scruggs Spring and Indian Spring, in the ~~northern~~ east-central part of Ash Meadows, Nye County, Nevada.

Former Distribution: Not known to be different from present distribution.

Status: Endangered because of its very restricted distribution.

Estimated Numbers: Insufficient data (probably 500-2000).

Breeding Rate in Wild: Unknown but probably similar to C. n. mionectes.

Reasons for Decline: Introduction of the predatory fish Gambusia affins; disturbance of habitat by man.

Protective Measures Taken: The spring source and pool at School Spring has been fenced, exotic fishes have been removed, and the habitat has been enlarged by BLM.

Protective Measures Proposed: Continue surveillance, expand the habitats at School Spring to the limit supportable by the spring outflow.

Number in Captivity: None.

Breeding Potential in Captivity: Unknown but probably good.

RARE

Nevada Pupfish
Cyprinodon nevadensis mionectes (Miller, 1948)

Order: ATHERINIFORMES Family: CYPRINODONTIDAE

Distinguishing Characteristics: Scale and fin ray counts lower than average for the species. This subspecies has a reduced size, a short, deep, and slab-sided body with a greatly arched and rather compressed predorsal profile, and a very long head and opercle.

Present Distribution: Confined to the warm springs and their outflows in Ash Meadows, in the southeastern section of the Amargosa Desert, Nye County, Nevada.

Former Distribution: Included at least one spring and extensive marshes in Ash Meadows from which this subspecies is now gone.

(I think this is correct but you may add to it if you wish.)

Reasons for decline

The Crystal Springs population was destroyed by bass; ~~the Fairbanks one by crayfish, Forest Springs by a commercial aquaria farmer, and~~ Jackrabbit by pumping. Carson Slough was, drained, bulldozed ~~XXXXXXXXX~~ for peat and plowed for agriculture.

Nevada Pupfish. Begin this with --
"The best solution, as suggested by the Desert Fishes Council on November 17, 1971, is to establish a large area of some 275 square miles to protect the drainage basin supplying the springs in Ash Meadows. This would provide protection for all spring habitats in Ash Meadows containing pupfish and other endemic organisms. Less satisfactory but nevertheless

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~~species.~~ A more comprehensive solution would be to establish a Pupfish National Monument as proposed in S.B. 2141 Ultimately it will be needed to ~~protect the water source~~ by limiting pumping in Ash Meadows.

Number in Captivity: None.

Breeding Potential in Captivity: Good.

Remarks: Release of tropical fishes in Ash Meadows, development of reservoirs for sport fishing, increased farming activity, proposed townsite development, introductions of crayfish, bullfrogs, mollies, bass and mosquitofish, and the disappearance of Cyprinodon nevadensis mionectes from one spring in which it formerly occurred suggest that the situation in Ash Meadows is becoming critical. Populations in Deep Spring appear to be maintaining themselves in the face of present competition. The developments in the area are rapidly and drastically changing the character of the entire area. All populations, except the one in Deep Spring, have declined during the past year.

RARE

White River Killifish
Crenichthys baileyi

Order: ATHERINIFORMES Family: CYPRINODONTIDAE

Distinguishing Characteristics: A distinctive species of the pluvial White River system in Nevada, lacking pelvic fins, with lateral dark spots in two parallel series, a posteriorly placed dorsal fin and bicuspid jaw teeth.

Present Distribution: Occurs in eleven constant temperature springs along the course of pluvial White River, Nevada.

Former Distribution: Included one spring (Hiko) in which it is now extinct, otherwise not different from present.

Status: Rare.

Estimated Numbers: 50-2000 in each of eleven springs.

Breeding Rate in Wild: 21-38 ova per female per spawning period; two spawning periods per year.

Reasons for Decline: Introduction of competing and predatory species; alteration of habitat for recreational, agricultural, and domestic use.

Protective Measures Taken: The Hot Creek Spring population has been protected by the establishment of a refugium by the Nevada Fish and Game Department in cooperation with the Bureau of Sport Fisheries and Wildlife, and University of Nevada, Las Vegas.

Protective Measures Proposed: Establish additional refugia to protect other forms of this species.

Number in Captivity: None.

Breeding Potential in Captivity: Good.

RARE

Railroad Valley Killifish
Crenichthys nevadae

Order: ATHERINIFORMES Family: CYPRINODONTIDAE

Distinguishing Characteristics: Similar to the White River killifish, but differing in the possession of only a single row of lateral dark spots.

Present Distribution: Springs in Railroad Valley. ~~Transplanted successfully~~ springs and ponds at Sodaville, Mineral Co., Nevada
Former Distribution: Not different from present.

Status: Rare.

Estimated Numbers: A few thousand to a few hundred in the constant temperature springs in Railroad Valley and Sodaville

Breeding Rate in Wild: Unknown.

Reasons for Decline: No decline documented.

Protective Measures Taken: A successful transplant ~~has been~~ of pit fish was made by Tom Trelease, Nevada Fish and Game Department into a spring and pond at Sodaville, Nevada on Sept. 4, 1947.

Protective Measures Proposed: Reserve Duckwater Spring and possibly one other spring as a BLM natural area.

Number in Captivity: None.

Breeding Potential in Captivity: Unknown.

ENDANGERED

Pahrump Killifish
Empetrichythys latos (Miller, 1948)

Order: ATHERINIFORMES Family: CYPRINODONTIDAE

Distinguishing Characteristics: A cyprinodontid without pelvic fins, with a comparatively broad mouth, usually 31 or 32 scales in the lateral series, and with conical lower pharyngeal teeth.

Present Distribution: A spring-fed pool on Manse Ranch, Pahrump Valley, Nye County, Nevada.

Former Distribution: Three isolated springs (each with an endemic subspecies) in Pahrump Valley.

Status: Endangered. Seriously threatened with extinction.

Estimated Numbers: A few hundred.

Breeding Rate in Wild: Good, when undisturbed.

Reasons for Decline: Introduction of goldfish; modification of habitat by removal of vegetation; complete drying of 2 springs and decline of the third because of pumping of groundwater for irrigation.

Protective Measures Taken: Empetrichythys latos latos has been transplanted to Corn Creek Spring on the Desert National Wildlife Range, Clark Co., Nevada, where it is apparently building a population. in Aug. 1971,

Protective Measures Proposed: Establish an additional population in the BLM refugium in Spring Valley, Nevada. Make additional transplants into both Corn Creek Spring and the Spring Valley refuge to help establish enough genetic heterogeneity to insure continued survival of the transplanted populations.

Number in Captivity: None.

Breeding Potential in Captivity: Poor.

Remarks: Empetrichthys, a genus known only from two desert valleys east of Death Valley, is now threatened with extermination, since one of the species is already extinct and the other one persists on a very tenuous thread in a drying spring.

RARE

Sculpin
Cottus bairdi semiscaber

Order: PERCIFORMES Family: COTTIDAE

Distinguishing Characteristics: A sculpin with the head about 3.0 times into body length; eye about 5.0 times into head length; maxillary extending caudally about to posterior eye margin; the two preopercular spines are blunt and short; lateral line incomplete.

Present Distribution: In Nevada occurring only in Lake Creek and Spring Creek on the Snake Range of eastern Nevada.

Former Distribution: Not known to be different than present.

Status: Rare by reason of its restricted distribution in the Nevada portion of the Bonneville Basin.

Estimated Numbers: Unknown.

Breeding Rate in Wild: Unknown; spawning occurs in early spring.

Reasons for Decline: No decline documented.

Protective Measures Taken: None.

Protective Measures Proposed: None.

Number in Captivity: None.

Breeding Potential in Captivity: Not good.

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