PUPFISH HABITAT MANAGEMENT

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Abstract: The Bureau of Land Management (BLM) administers public land containing four springs which comprise habitat for two endangered pupfish subspecies. The BLM is responsible for the pupfishes' habitat, though it has no authority over water resources, or the fishes themselves. Intensive water pumpage for agricultural demands is reducing spring flows. Efforts by BLM to maintain and improve the pupfishes' habitat are described.

INTRODUCTION

The Bureau of Land Management, Las Vegas District, administers public lands in the Ash Meadows area of Nye County, Nevada, which contain four springs of unique biological significance.

Ash Meadows is a portion of the Death Valley System, a Pleistocene drainage that once united the now isolated waters of Owens Valley, Death Valley, and the Amargosa and Mohave River Basins (Miller 1969).

Less than a decade ago, dozens of warm, highly mineralized springs and extensive marsh areas provided habitat for a variety of endemic fish species and subspecies. Miller (1948, 1969) and LaRivers (1962) described the species and their distribution. They included: Devil's Hole pupfish (Cyprinodon diabolis), Big Spring Amargosa pupfish (Cyprinodon nevadensis mionectes), Lovell Spring Amargosa pupfish (Cyprinodon nevadensis pectoralis), Ash Meadows pupfish (Empetrichthys merriami), and Amargosa Speckle Dace (Rhinichthys osculus nevadensis).

Intensive biological surveys would probably disclose endemic plants and invertebrates as well.

With the advent of modern mad came drastic environmental change. Of greatest significance were agricultural development, introduction of exotic vertebrates, culture of tropical aquaria fishes, mining, and grazing. The groundwater discharging from the springs in Ash Meadows is part of a regional carbonate flow system (Fiero and Maxey 1970). The estimated 24,000 acre feet of available water is responsible for agricultural development and large scale groundwater withdrawal by pumping.

Man related activities within the past decade have rapidly transposed flourishing fish populations to small residual groups highly susceptible to disaster.

Devil's Hole pupfish are endangered (Superintendent of Documents 1970). The causative factor is drastic drop in pool water level. The Lovell Spring Amargosa pupfish is endangered (Superintendent of Documents 1970). Causative factors include decline in spring flow and introduction of exotic vertebrates. The Big Spring Amargosa pupfish is listed by the Bureau of Sport Fisheries and Wildlife (1968) as possibly rare or endangered. It has been eliminated from the type locality and several other springs, as well as an estimated 95% of the marsh area. Causative factors include marsh drainage, pumping, and introduction of exotic vertebrates. Ash Meadows pupfish are now extinct. Miller (1969) observed the species was scarce even 30 years ago. Man's role in the extinction is unknown.

METHODS AND RESULTS

In 1967, BLM personnel conducted inventories of rare and endangered wildlife species habitat in each Nevada District. Ash Meadows pupfish habitat was selected as top priority. A Habitat Management Plan was completed (Myers 1968) with assistance from the University of Nevada, Las Vegas, and the Nevada Department of Fish and Game.

Area: Four springs comprising pupfish habitat occur on public lands. In each case waters have been appropriated under Nevada State law to private parties. This compounds management problems since water appropriators cannot be lawfully denied access to, or use of their waters.

Chemical properties of springs in the area are similar, since they originate from the same carbonate aquafer (Fiero and Maxey 1970). Waters are hard, and high in dissolved solids. With few exceptions, springs are warm, ranging from 80°F. to 92°F. Water temperatures may vary up to 7°F. seasonally. Summer air temperatures may approach 120°F. and winter air temperatures, 20°F.

Jack Rabbit Spring: The largest public spring is Jack Rabbit. Under natural conditions a clear flow of 2.33 c.f.s. issues from a conically proportioned pool measuring 102 cubic feet, and into a natural stream course.

Big Spring Amargosa pupfish and Amargosa Speckle Dace inhabited the spring pool and the stream course. Deacon and Ivy (unpublished) deduced from trapping studies that the pupfish population varied seasonally from about 400 to 2,000 fish.

The primary management problem disclosed was competition for food and space between pupfishes and introduced mosquito fish (Gambusia affinis) and mollies (Poecilia latipinna). Introduced crayfish (Procambarus clarkii) and bullfrogs (Rana catesbeiana) are undesirable predators.

Management proposals included treatment of the spring to eliminate exotics, construction of upstream barriers to exclude exotic species from the spring, and fencing to protect the spring. Visitors would be encouraged by interpretive signs to view pupfish in newly created pond areas below the spring. A copy of the plan was submitted to the water appropriator for concurrence.

Nearly one year later, in July 1969, a newly installed pump was discovered in Jack Rabbit Spring. It consisted of a metal framework spanning the spring and a propane powered pump of approximately 100 horsepower. A ten-inch casing was suspended into the spring within one foot of the bottom.

The initial effect of the pumping was extirpation of the pupfish and dace. Only a few mosquito fish and crayfish survived.

After determined efforts by the BLM, the water appropriator agreed to cooperate in management efforts. A signed agreement was consummated with provision for a pumping-storage pit to be located at least 300 feet downstream of the spring. The appropriator agreed to pump only from the pit and to allow water to flow through the natural water course. The pump was subsequently removed.

The Big Spring Amargosa pupfish was re-introduced from nearby Big Spring.

During the summer of 1970, flow temporarily ceased at Jack Rabbit Spring. A rather stagnant pool was maintained throughout the summer, varying from one to three feet below normal output level. Cessation of flow is attributed to heavy pumping. At least five large volume, producing wells occur within two miles of the spring. Spring flow varied erratically throughout the summer, from no flow to 300 gallons per minute. This suggests a very high degree of transmissivity in the aquafer in common to the spring and certain wells.

Pupfish survived the summer of 1970. Most fish mortality occurred in the outflow, in association with periodic flowing and drying. We have proposed a downstream barrier as a remedial effort to reduce this mortality.

BLM plans for interpretation, fencing, barrier, and pond construction have been curtailed pending restoration and stabilization of spring flow.

School Spring: The second public spring is School Spring. Its natural form and condition are unknown. Prior to improvement by BLM, it consisted of a circular spring pool about five feet in diameter, and a lower "bathtub" sized pool which provided most of the habitat for the Lovell Spring Amargosa pupfish. Lovell and School Springs are the same. A car hood extending from the clay substrate maintained most of the pool. Some pupfish inhabited foot prints in the clay made by watering horses and cattle. Spring flow has varied from 7 to 10 gallons per minute. Flow fluctuation is probably induced by agricultural pumpage. Water temperature varies from 89°F. in winter to 94°F. in summer.

Management problems included competition with introduced swordtails (Xiphophorus sp.), wasted water and limited ponded habitat, predation by introduced bullfrogs, and livestock trampling.

A one-acre exclosure was constructed to offer maximum protection to the spring. Fencing consisted of six foot high, industrial chain link. A second exclosure, of barbed wire, was constructed and designed to admit visitors while excluding livestock. Spring water was piped to the visitors area, where a small pond was constructed.

Existing pupfish habitat was increased by more than 135 percent through construction of additional ponded space. All available water was utilized.

An interpretive sign and road directional signs were added as public aids. An educational brochure was completed to acquire public support for, and understanding of an endangered species.

Employees of the Nevada Department of Fish and Game succeeded in removal of introduced fishes. A few introduced bullfrogs remain.

During the spring of 1970, it appeared as though School Spring flow was seriously reduced. The Management Plan recommended development of a supplementary well-water system in the event spring flow began subsiding. Immediate action was taken. Emergency funds were sought and obtained. A well was completed, located 1,500 feet south of the spring. Total well depth is 280 feet. Static water level is 50 feet. Regional flow is reported to enter from the north, so the well should have minimal affect on normal spring flow. Chemical analyses show that the School Spring and well waters are very similar (Table 1). Sustained well water temperature is 102°F., or 10°F. greater than the spring water temperature. Water is pumped by a one h.p. Barnes submersible pump through 1-1/2 inch polyethylene pipe. The pipeline is buried three feet to maximize cooling effects. Water temperature at the pipeline outlet is 93°F..

Numerous pumping tests were conducted to ascertain the affects on spring flow. Nine tests were completed at rates of 13-140 gallons per minute. School Spring flow was sustained at 7.4 gallons per minute throughout the tests. Sustained production from the well is 35 gallons per minute.

If present hydrologic conditions persist, supplementary pumping will be needed only during summer months at about three to five gallons per minute. The well can be used if necessary to entirely replace spring flow.

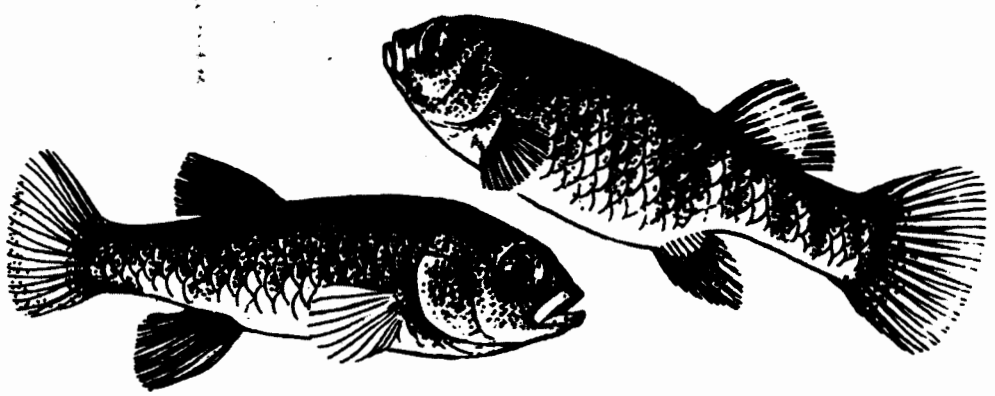
Well water is currently being pumped to the visitors pond, where introduced pupfish are being used in a bio-assay of water suitability. Well water can be deployed to the visitors pond, spring pool, or both, by use of a valve system.

Scruggs Springs: Two additional very small springs occur on public lands--they are Scruggs Springs. They are less than 200 yards apart. The two Scruggs Springs, along with School Spring, comprise the only known habitat for the Lovell Spring Amargosa Pupfish. Management problems include the threat to sustained flow and limited ponded habitat. No work has been completed on these springs due to the uncooperative nature of the water appropriator.

Table 1. Chemical analyses of School Spring and School Spring supplementary well waters.

	Test*	School Spring	School Spring Well
1.	Temperature	92°F.	102°F.
2.	Alkalinity:		
	(Total)	101 ppm	90 ppm
	(HCO_3)	101 ppm	90 ppm
3.	Calcium	48 ppm	48 ppm
4.	Chloride	30 ppm	20 ppm
5.	Flouride	1.7 ppm	2.6 ppm
6.	Hardness:		
	(As $CaCO_3$)	100 ppm	95 ppm
	(Total)	190 ppm	160 ppm
7.	Magnesium	19 ppm	15 ppm
8.	Nitrate	0 ppm	0.4 ppm
9.	Sodium and Potassium	81 ppm	59 ppm
10.	Sulfate	82 ppm	76 ppm
11.	Total Dissolved Solids	405 ppm	390 ppm
12.	pH Value	8.3	8.1

* Data derived in part by the author using colorimetric and titration procedures, and in part by Nevada State Health Division using standard methods.



DISCUSSION

Worsening conditions in the status of the pupfishes habitat in 1970 prompted the Secretary of the Interior to appoint an inter-agency Task Force to "Save the Desert Pupfish." The Task Force has been instrumental in acquiring funds for much needed studies of the Ash Meadows water resources. The U. S. Geological Survey will complete a hydro-geologic study in 1971. Data gathered by the USGS will be employed by the Center for Water Resources Research, University of Nevada, in the development of predictive models for a water management system.

Groundwater withdrawal by pumping could perhaps be instituted, using the predictive model as a guide and the pumped water combined with spring flow would make available most of the estimated 24,000 acre-feet of perennial recharge with negligible interference with spring discharge and no decline of the water level in Devil's Hole (Fiero and Maxey 1970).

Fiero and Maxey (1970) observed that "ultimately, as more water is withdrawn from storage by wells, water levels will decline in the basin and the springs will decrease in flow and probably dry up completely, at least during the pumping season."

The precarious position of Nevada's pupfishes results from a confrontation with agriculture, but more important, a confrontation with our society's tradition of economic development. It is important we bear this in mind, since species almost invariably meet extinction within the frameworks of existing policies and laws.

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