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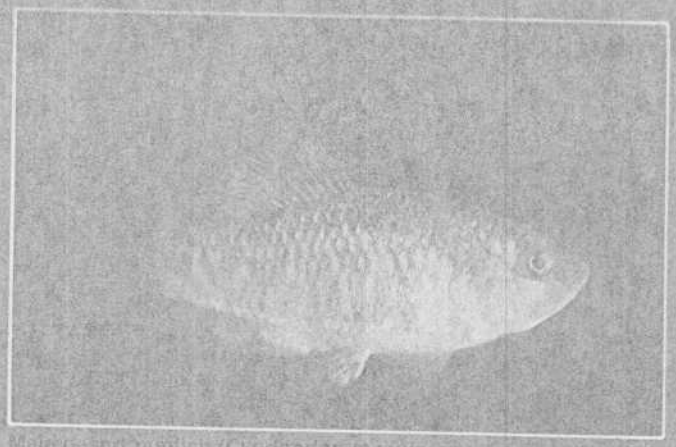
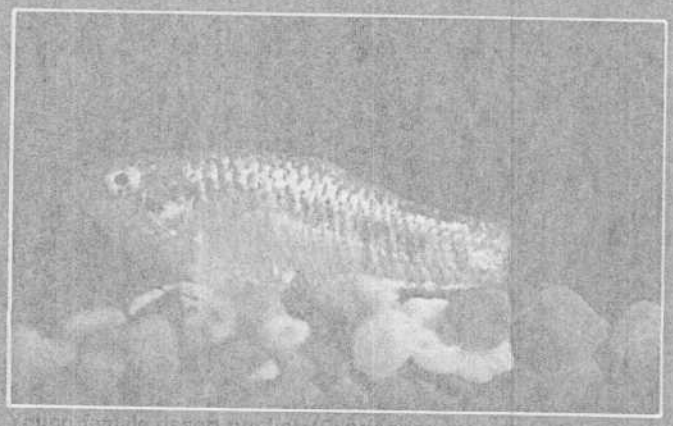
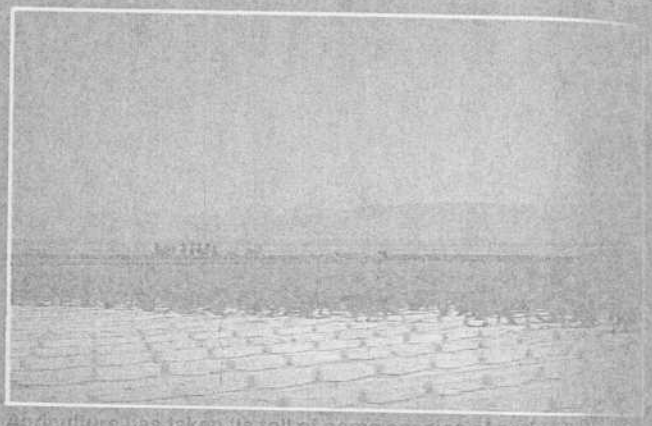


Male desert pupfish (*Cyprinodon macularius*)

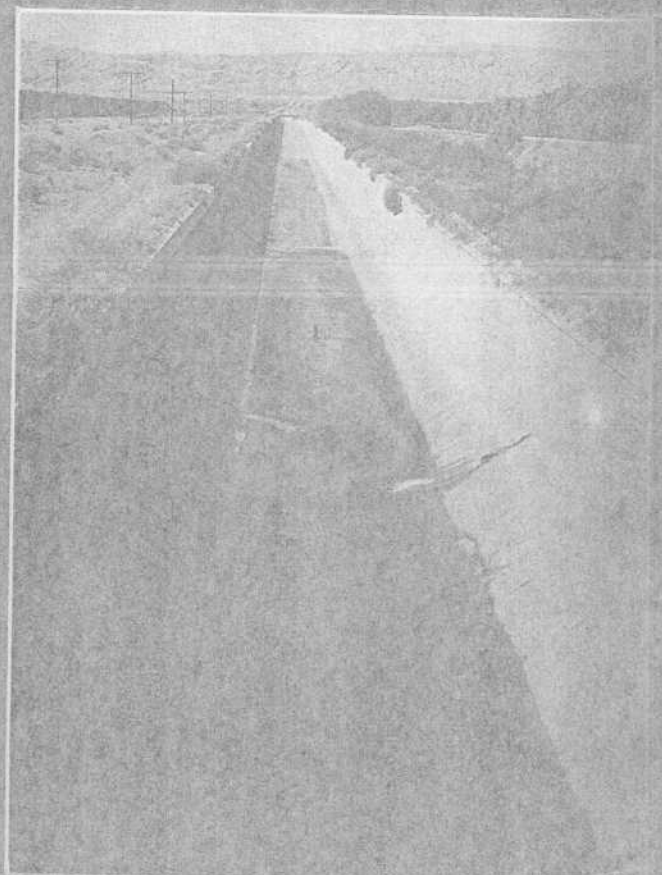
Close-up of the head of a male desert pupfish showing structure of the mouth



Young female desert pupfish (*Cyprinodon macularius*)



Agriculture has taken its toll of some species of native fishes in California's Imperial Valley



IN SEARCH OF THE DESERT PUPFISH

PHOTOS AND TEXT BY TOM BAUGH

the last issue of FAMA, ntributing Editor, Tom ugh related his experiences collecting the desert pupfish, *prinodon macularius*, in the serts of Southern California. this issue he discusses the tural history of the species.

PART TWO

O It is difficult to imagine the deserts the southwestern United States and thern Mexico as having once been vered by large inland lakes. It is ually difficult to relate the parched l arid lands of today with fishes. And , both the lakes and the fishes are, or east were, real.

Ten to twenty thousand years ago, ring Pleistocene time, large bodies of ter covered significant portions of American Southwest. Because of se lakes and their attendant rivers, eams and marshes, the flora and una of the area was rich. Over the illenia, however, the waters nished, evaporating under the sun or treating into vast underground servoirs. As the waters retreated so d the wildlife, especially the fishes. day, these waters are limited to a few nall marshes, seeps, springs and eeks. These sparse waters, the feblood of the desert, provide ecarious habitat for one of the most scinating, and unique group of fishes und on the North American continent the pupfishes.

Many of the species of pupfishes hich exist today are legally classified either threatened or endangered. The iversion of desert waters for gricultural purposes and the troduction of exotic species such as e sailfin molly and mosquitoe fish ave had a drastic effect on pupfish populations. One species, the desert pupfish *(Cyprinodon macularius)* remains without protective status although there is growing concern for its status.

The desert pupfish has been one of the most commonly occurring widespread species of this unique group. Originally, it was found in large numbers from the Salton Sea area of Southern California through Nevada, and into Arizona and Mexico. The major concentration of this species has been and continues to be in the vicinity of the Salton Sea where it is commonly found in isolated, saline pools along the shores of that large body of water.

Knowledge about the desert pupfish is quite good. Since it was first identified, this species has been studied in both field and laboratory and has been maintained in aquaria. Its possible use in aquaria was first mentioned by Dill and Shapovalov (1939) in their article "California fresh-water fishes and their possible use for aquarium purposes." As is often the case, the desert pupfish became popular in Europe where North American fishes were considered exotic (Axelrod et al. 1974).

The desert pupfish is an attractive, stocky little fish which, as an adult, ranges from 2" to 3". The lower jaw extends beyond and curves up to the upper part of the mouth. The body of the male is generally described as compressed and arched rising to a point just anterior to the dorsal fin. The shape of the female is more rounded than that of the male (Barlow 1961).

In general, the background color of both sexes is a silvery brown with lighter underparts. As with many fishes, it is during the breeding season that the male really shines. When courting, the body and both the dorsal and anal fins become a metallic blue. The black eyes are set-off by the yellow-orange of the pectoral and caudal fins and the caudal peduncle. Barlow, (1961) claims that the colors of the breeding males are so vivid that they can be seen by an observer ten meters away. Female body color is generally a yellowish-brown with darker brown, irregularly shaped vertical bars scattered over the body. The females have a dark ocellus (spot) at the posterior base of the dorsal fin. This mark distinguishes them from juveniles of both sexes.

Habitat deserves more of a mention than it so far has received. Although the desert pupfish is becoming increasingly scarce, its habitats continue to vary from crystal spring waters to the saline pools of the Salton Sea, to concrete lined irrigation canals. The variety of habitats is fascinating, but what is unique is the chemistry of the waters in which this fish is found.

For example, the specimens which I took from the Salton Sea (see September FAMA) were from waters with salinities approaching that of sea water. I have been successful as have others, in habituating these fish to fresh water.

Conversely, in 1929 George A. Coleman was doing some research in the area of the Salton Sea where he interviewed a man named Hartley, owner and operator of the Hartley Salt Works. Hartley told Coleman that the desert pupfish often got into the salt vats where it survived salt water up to 50 percent saturation. This casual field observation has been the subject of doubt and Barlow (1958) states that he was able to get the desert pupfish to tolerate salinities of about 90%.

Not only is the desert pupfish abnormally tolerant of high salinities, it is also incredibly tolerant of high temperatures. Lowe and Heath (1969), working with specimens from Quitobaquito Springs in Organ Pipe Cactus National Monument, Arizona found that members of this species could be acclimated to temperatures of

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from page 35

44.6± 0.05 C (112.2F). In speaking of pupfish in general, Soltz and Naiman (1978) state that these fishes "are among the most heat tolerant of all fishes." The physiological changes necessary to handle tolerance to high temperatures are caused by isoenzymes. Apparently, specific groupings of isoenzyme molecules come into action as the lower limit of a particular range of temperatures is reached, a new set of isoenzymes helps the fish adapt.

Movement also helps the desert pupfish cope with its demanding environment. The temperatures of the water in the pools along the fringe of the Salton Sea changes considerably throughout the day. The shallower water of these pools heats and cools more rapidly than does the deeper water. The desert pupfish migrate into the shallows during the cooler parts of a twenty-four hour period and then move back into the depths as the water temperature rises in the shallows with the passage of the desert sun.

The social behavior of the desert pupfish is quite complex. Barlow (1965), working with fish captured from the Salton Sea pools, identified 21 motor behavior patterns typical of this species. These patterns are meandering, nuzzling, contacting, tilting, nipping, halting, sidling, s-shaping, wrapping, jerking, patrolling, facing, eyeing, arching, tail-beating, charging, circling, fleeing, escaping, digging, and plowing. Most of these terms are self-descriptive. Although these are individual behaviors, they most often take place as a sequence of behaviors oriented to a particular process such as reproduction or territoriality. For example, both digging and plowing are involved in what Minckley and Arnold (1969) call "pit digging," a process whereby the desert pupfish, as well as other species of pupfish, excavate depressions in the bottom substrate. This digging is related to feeding behavior.

Thomas Cox (1972), in a study of the food habits of the desert pupfish of Quitobaquito Springs, found that the species consumes a wide variety

ncluding water mites, insects and
t larvae, and *Daphnia*. In
on, many of the fish studied by
ad consumed decaying vegetable
and algae. In only one case did
find the remains of a juvenile
sh in the stomach contents of an
pupfish. Crear and Haydock
) investigated the possibility of
the desert pupfish for an
imental laboratory animal. They
is species frozen brine shrimp.
esert pupfish is also known to take
brine shrimp, *Tubifex*, *Daphnia*,
yclops. As the diet of the wild fish
tes, the desert pupfish will also
me vegetable matter. In aquaria,
pecies will take all of the foods
oned above as well as a wide
y of prepared flake foods.

summary, the desert pupfish
rinodon macularius) is an
sting and attractive member of a
e group of fishes. The pupfishes
by very special ecological niches
ne arid, sometimes harsh
ronments of the southwestern
d States and northern Mexico. A
rity of the pupfishes are either
tened or endangered due to
ioration of habitat or competition
exotic fishes.

fortunately, the desert pupfish has
ecial protective status and this
es now appears to be suffering the
fate as the other pupfishes. Within
ast 20 years the numbers of this
, attractive fish have seriously
ned. Desert springs which once
ded habitat for the pupfish have
destroyed, their waters depleted
se in agricultural and livestock
ires. Competition from exotic fish
rts have also made serious inroads
pulations of the desert pupfish.

ousands of years of increasingly
alized adaptation to some of the
hostile and demanding habitats on
planet has prepared the desert
sh for almost everything except
ontation with that species which
e its best friend or its most deadly
– man!

Acknowledgement

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