DESERT TRIP

by Michael Florez

It is 3:30 a.m. Monday morning. The alarm is blaring a samba with the disc jockey hammering out the beat. I have had two hours sleep--I'll sleep in the car on the way to the desert trip. I have read everything I could find about desert pupfishes. With the American Killifish Association convention winding down, this was the last leg of my trip to Los Angeles. I was not going to sleep through this one.

I promptly reported to the hotel lobby by 4:00 a.m. I wanted to be the first one ready. Harry Specht, Roger Brousseau, and host of others greeted me in the lobby. As the crowd began to swell, Roger and the rest of the drivers reviewed the maps and confirmed the route. At 5:00 a.m., we loaded into the cars. First, a quick stop to jump-start one of the vans, then on to Barstow, California. Breakfast at the IHOP followed by another stop to fill up on food and drink for the trip. On to Baker by 10:00 a.m.; the air temperature there is a sultry 93°F. Another stop at the Mad Greek's Restaurant, the "last chance" cafe before heading into the desert.

Goodall defined deserts as areas where "biological potentialities are severely limited by lack of water." The Southwest desert can also be defined geographically. The Death Valley System is a part of the Great Basin which comprises most of Utah and Nevada with fringes in California, Oregon, Idaho and Wyoming. The Great Basin is a series of valleys and mountain ranges created by tectonic or volcanic activity. This same tectonic activity is responsible for the changing climates which have included pluvial episodes and periods of severe aridity.

Death Valley was a part of a much larger, interconnected system which contained many large rivers and lakes during the latter part of the Pleistocene era (about 2,000,000 years long). The current arid climate began only 10,000 to 20,000 years ago at the end of this era. Prior to this time, during the last glacial or pluvial time, the Owens River overflowed Owens Lake and filled successive basins southward and eastward until it entered Lake Manly, the former body of water covering most of Death Valley. In addition, Death Valley regularly received the discharges from the Amargosa and Mohave Rivers at the south. The warmer climate caused many of the Pleistocene rivers and lakes to dry up or shrink. The remnants of these lakes and rivers dot the landscape as small streams and springs like "islands" in a sea of desert.

The fish fauna that persists in the desert has endured desert climates of relatively brief duration interrupted by longer episodes (30,000 to 40,000 years) characterized by pluvial climates. The desert fishes, especially the Cyprinodons, have broad physiological tolerances--0° C to 44° C (the warmest for any fish); dissolved oxygen concentrations <1.0 ppm; and salinity 3x sea water for some species. The only native U.S. Cyprinodons

which may be legally collected without a state or federal permit are *Cyprinodon hubbsi*, *C. rubrofluviatilis*, and *C. variegatus*.

Cyprinodons include some 30 species, of which 20 occur in deserts or semi-deserts. The fish populations evolved gradually as they became isolated. The longer the isolation, the greater the morphological and behavioral differences. On this trip, we had an opportunity to compare several subspecies of *Cyprinodon nevadensis* (Amargosa Pupfish) as well as a few separate species. The species *Cyprinodon nevadensis* has differentiated into several subspecies that have been intermittently connected. The period of isolation which led to the development of subspecies has been estimated to be 400 to 4,000 years.

After nearly 300 miles of driving, we made our first stop in the desert at the Harry Wade Exit Route Monument. The full importance of this monument escapes me; however, I believe that it marks the route by which Harry and the survivors of his party left Death Valley. Roger Brousseau was asked to say a few words about this monument, but I was too cramped to retain the information and just happy to get out of the car.

Our next stop was near the border of California and Nevada. We stopped near a farm in Tecopa. Roger explained that he noted very little vegetation around the spring on his first visit to this site. Now the reeds around the stream stood 4' to 6' tall due, in part, to excessive pumping of the spring water. The reeds are not a total detriment to the fish population as they provide cover from predators and shade to cool the water.

We walked along the edge of the spring to find its source. Our feet crunched through the thin salt film that had formed on the sand around the spring. At the spring source, the water temperature measured between 115° F and 120° F. This water has been percolating in the subterranean aquifers of the Great Basin for 8,000 to 12,000 years, driven to the surface along geological faults. These springs gave a whole new meaning to the term "aged water."

Back at the road, some 200-300 yards from the spring head, we observed a few fry of *Cyprinodon nevadensis amargosae*. Here the water temperature was a balmy 95o F. (Since the mid-60's, more people have kept and maintained this subspecies of pupfish than any other except *Cyprinodon variegatus*.)

Across the road, the pool cooled to 75° F. Here we observed a few small frogs and *Gambusia affinis* (Mosquitofish), the thoughtless introduction of some well-meaning "fish jockeys." I cannot believe that the advocates of these exotic introductions have ever observed Mosquitofish eat. Mine devour mosquito larva, worms, daphnia, flakes and anything else that falls into the tank with equal zeal. Why add such an effective predator into this ecosystem with such a limited food supply?

Next stop was Shoshone, California, north on Route 127. Here we observed *Cyprinodon nevadensis shoshone*. This species was presumed extinct by Miller as late as 1978. The fish appeared in great numbers in streams less than 3" deep. The fry schooled throughout the winding streams while more adults inhabited the deeper pools. The spawning males of this subspecies differed from *Cyprinodon nevadensis amargosae* by the appearance of a darker blue saddle behind the dorsal fin and through the caudal peduncle. We also observed that the adults were a good bit smaller than the "buffaloes" that live in our tanks or make it to the shows. Considerably more effort must be spent in finding food and in staying alive in the wild than in growing.

Back in the cars for a short run to Point of Rock Springs, Nevada. Despite the lack of a state border sign, we knew the instant we entered Nevada. The roads turned to pitted gravel paths. In the pools at Point of Rock Springs, we observed *Cyprinodon nevadensis mionectes*. The water temperature was measured at 90° F. The clear pools were patrolled by large, silver-blue males in the open areas with olive females darting in and out of the surrounding vegetation to spawn. In one of the pools, we observed small frogs and the exotic *Gambusia affinis* and *Poecilia latipinna* (Sailfin Mollies).

Upon returning to the cars, we discovered that one of the vans had a flat tire. To add insult to the unfortunate circumstance, the American-made van was outfitted with a spare tire just a little larger than the bagel I had for breakfast, and not quite as tough. We assured our companions that we would not leave them for the scorpions and the sand fleas should they lose another tire. However, they insisted on heading to Las Vegas for repairs. We said goodbye as they left one desert for another; this one short on water, that one short on morality.

Less two in our caravan, we headed to Devil's Hole. In 1888, William Manly wrote, "On the second or third night we camped near a hole of clear water which was quite deep and had some little minus [sic] in." This began the struggle of *Cyprinodon diabolis* which culminated in the 1976 U.S. Supreme Court decision upholding the federal government's right to appropriate ground water for the preservation of natural aquatic ecosystems.

The Devil's Hole Pupfish differs morphologically from most other Cyprinodons in its lack of pelvic fins. Some scientists have estimated the period of isolation of *Cyprinodon diabolis* to be 10,000 to 20,000 years. This may explain the morphological differences. Additionally each fish, genetically, is a virtual clone of the other due to the years of inbreeding of the small population (varying from 150 to 800 fishes).

The habitat, dug deep into a small hill, was surrounded by fencing with several wooden signs proclaiming the importance of the efforts to save these wretched survivors. Had we the presence of mind to contact the Fish and Game authorities in advance of our trip, we would have had an opportunity to climb down the ladder for a closer inspection.

Content to say we had seen the habitat, if not the fish, we ventured deeper along the weathered paths to the next patch of vegetation. The springs were easily visible from a distance. Anywhere the plants climbed out of the rocks indicated the presence of water, and often times, pupfish. After seeing the desolate nature of these habitats, I began to feel less of an aquarist for all the fish I have killed in my tanks.

Next, we went to an abandoned refugium, thought to be School Spring, in search of *Cyprinodon nevadensis pectoralis*. We circled the trees and brush around the spring, but found no fish. Later, we found out that this spring was Indian Spring, and, indeed, the fish were present, though deep in the center of the spring.

By 5:00 p.m., the sun was no less intense and the air temperature stayed an oppressive 105° F. We approached the wind-torn entrance to the gates of Hell, Death Valley National Monument. Four hundred miles from civilization, near a wooden sign ravaged by sun and sand, we were greeted by Dale Weber, another A.K.A. member. He had started from a different place, taken a different route, and was headed in a different direction. We paid our respects with a mouthful of water before moving on.

A quick stop at the Death Valley Museum to load up on maps, books, and other memorabilia, then on to to the Salt Creek Nature Trail. This trail runs through a portion of the Salt Springs on an elevated boardwalk, with stops along the way that correspond to a narrative guide book. In the shallow streams, we saw schools of *Cyprinodon salinus* fry. In the deeper pools, the larger adults were spawning. The pool temperature measured 78° F and the salinity measured 1.025. Once again, the adults seem smaller by comparison to what we see as aquarium strains. The males were more brown and green than male *Cyprinodon nevadensis*. The females were much more difficult to differentiate. This fact emphasized the importance of separating each species of pupfish.

I am thankful for the opportunity to view these habitats before they are lost to the ever-increasing demand for water from the population centers of Los Angeles, Las Vegas and Phoenix. And, while we focused our study on the fish fauna, we are ever mindful of the complex mosaic that makes up these unique biosystems. While noble and important, species maintenance outside the habitats, by definition, ignores the reality of the fundamental interrelationships. The fish fauna evolved with the

plants and other unseen and unknown organisms in the desert. Removal of one animal may save that one from extinction, but does nothing to preserve the matrix of green plants and microorganisms --weeds and bugs--which molded this animal's structure and behavior. For example, the efforts to establish *Cyprinodon diabolis* outside Devil's Hole have resulted in a larger and different fish than the fish in the habitat.

> *"All these considerations converge to the same conclusion: ex situ methods will save a few species otherwise beyond hope, but the light and the way for the world's biodiversity is the preservation of natural ecosystems."*
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> *E. O. Wilson, The Diversity of Life*

I had looked forward to this trip for over six months. I was not disappointed. I was also glad to spend the time with good people who share an interest in the desert. Baba Dioum, a conservationist from Senegal, said, "In the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught."

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