

Species in a Bucket

By Edwin Philip Pister

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standing between life and extinction...**

[The naturalist] looks upon every species of animal and plant now living as the individual letters which go to make up one of the volumes of our earth's history; and, as a few lost letters may make a sentence unintelligible, so the extinction of the numerous forms of life which the progress of cultivation invariably entails will necessarily render obscure this invaluable record of the past. It is, therefore, an important object [to preserve them].... If this is not done, future ages will certainly look back upon us as a people so immersed in the pursuit of wealth as to be blind to higher considerations. Alfred Russel Wallace Journal of the Royal Geographical Society (1863)

When I retired in 1990, I built a small office in my backyard, equipped it with a phone and word processor, and began to reflect seriously upon a career that began in 1951 and continues even in retirement. I remain keenly aware of the legendary biologist Aldo Leopold's admonition that one of the penalties of an ecological education is that one lives alone in a world of wounds.

Virtually my entire career was spent as a district fishery biologist for the California Department of Fish and Game in the state's vast eastern sierra and desert regions. I worked on a great variety of management and research programs--from trying to keep millions of sports fishermen supplied with trout to preserving the biological integrity of desert springs that support life forms totally unknown to most Americans and even to most scientists.

Having studied wildlife conservation at Berkeley in 1948 under the tutelage of Aldo Leopold's son, A. Starker Leopold, I was exposed to the Leopolds' passionately held values regarding the natural world. Impressed by their view that nonconformity is the highest evolutionary attainment of social animals, I carefully avoided the usual career track that would have landed me in one of my department's major offices in a big city. As a graduate student, I had specialized in limnology, the study of freshwater lakes, and was given the responsibility for nearly a thousand bodies of water extending from the crest of the Sierra Nevada eastward to the Nevada state line. I was especially intrigued by the diversity of the landscape in my charge; if I left the roadhead near the base of 14,494-foot Mount Whitney at 9:00 a.m., I could make a leisurely drive to the east and have my lunch 282 feet below sea level on the floor of Death Valley. This area's life forms are commensurately diverse.

Today I sit at my desk surrounded by forty little pocket diaries, each one summarizing a year of my career. So many memories and experiences are packed into these 2.5- by 4-inch volumes, which, together, fill less than a shoebox. Daily entries recall a multitude of experiences: scaling through the usual routine meetings, conducting a twenty-seven-year project to restore the California golden trout within the Golden Trout Wilderness (still in

progress), fighting scores of ill-considered and highly destructive entrepreneurial invasions of valuable habitats and recreation areas, managing a legendary reservoir fishery where success is measured by tons of trout harvested, then moving 180 degrees from consumption to conservation by helping save the Devil's Hole pupfish (*Cyprinodon diabolis*), a battle carried successfully to the U.S. Supreme Court.

In 1976, the Court's landmark decision protected Devil's Hole—a swimming-pool-sized window into the underground aquifer and a disjunct portion of Death Valley National Monument--and its dependent life forms from the impact of a nearby ranching operation. (The ranchers were consuming vast quantities of unreplenishable groundwater from an aquifer that had been undisturbed since the Pleistocene.) The smallest and most highly evolved of the Death Valley system pupfishes, the Devil's Hole pupfish has been isolated from nearby pupfish populations for approximately 44,000 years. It exists in probably the most confined habitat of any vertebrate animal in the world: the ten- by fifty-foot pool in which it has evolved since its isolation.

Of more than ten thousand entries contained in my diaries, the date August 18, 1969, stands alone as the most dramatic and meaningful. Written with naive understatement: "Transplanted *Cyprinodon* at Fish Slough; purchased alkaline D-cells, \$2.00," this cryptic entry summarized a series of events that, had they not gone right, would have accompanied the greatest tragedy of my career. As it turned out, what happened that day simply underscored the lessons I had learned earlier from the Leopolds and other ecological mentors. Perhaps such an experience was necessary for me to fully comprehend that a person's values, which serve as a compass in uncertain times, are in the long run vastly more important than the sport-fishing technologies that have often created more problems than they have solved.

During the several pluvial periods of the Pleistocene epoch, much of the Great Basin of the American West was covered by large, freshwater lakes. With the approach of the Holocene, these waters shrank and largely disappeared, and fishes were isolated within the few remaining permanent aquatic habitats. In North America, only the Cuatro Ciénegas of Coahuila, Mexico, have as many well-defined local populations (species confined to the very small, isolated habitats in which they evolved). The Death Valley drainage area of eastern California and western Nevada is comparable to Charles Darwin's Galapagos Islands and their finch populations. They constitute, in effect, islands of water in a sea of sand.

One such habitat exists in eastern California's Owens Valley, where the Owens pupfish (*C. radiosus*) has been evolving since the Pleistocene. Because of major habitat changes and the introduction of predacious gamefishes (a deadly combination) during the early part of the twentieth century, the Owens pupfish was gradually eliminated from a range that once covered vast marshlands. By the time it was scientifically described in 1948, the species was believed to be extinct. One of the Death Valley area pupfishes, all of which evolved in the absence of predatory fishes, the Owens is almost totally defenseless against such introduced predators as largemouth bass, which I call "chainsaws with fins." The Owens pupfish was among the first fishes to be designated an endangered species, a status that it unfortunately still retains.

Pupfishes (named for their frolicsome, playful behavior) are members of the killifish family, a group of fishes very popular among aquarium enthusiasts. The Owens pupfish is the largest of the nine Death Valley pupfishes, occasionally reaching two inches in length; the

Devil's Hole pupfish rarely exceeds one inch. Habitats are varied. The Owens pupfish thrives in the shallow, warm water that hot summer days bring to desert marshes; this same habitat may be covered with an inch or two of ice during wintertime, when air temperatures drop below zero. Conversely, the Devil's Hole pupfish lives in the upper reaches of a cavern so vast that its depth has never been determined, and in water at a constant 92 degrees F. All pupfishes are feeding opportunists, consuming immature insects and algae. They are also highly territorial.

To survive in these rigorous habitats, pupfishes have evolved specialized adaptations. Some live in water that exceeds 100 degrees F., and can tolerate up to 113 degrees for short periods; daily fluctuations may be as much as 36 degrees. Others live in pools with several times the salinity of seawater. The potential for research on the pupfishes is exciting. What they could tell us about kidney function, temperature tolerance and adaptation, and other areas of vertebrate physiology alone would justify our concern for preserving them. In recent years, however, it has been heartening to note a shift in emphasis from what they can do for us to what we can do for them, regardless of their potential value.

In 1964 researchers located a remnant population of Owens pupfish in a desert marshland called Fish Slough, a few miles from my home in Bishop, California. A recovery effort was started by gradually reintroducing them into a few apparently suitable habitats, thereby getting a jump on the more sophisticated recovery programs made possible later under the Endangered Species Act of 1973. These early preservation efforts for fishes preceded the relatively recent, and highly commendable, formalization of the science of conservation biology.

However, an unusual set of circumstances that began to coalesce in the late 1960s brought the Owens pupfish to the brink of extinction. Without constant surveillance, which even now is very difficult for harried state biologists to maintain, the pupfish gradually disappeared from their new homes and finally were confined to a room-sized pond a short distance below Fish Slough's northwest headwater springs. The winter of 1968-69 had brought heavy rains to the Owens Valley, but by August the unusually thick vegetation was throwing off a great deal of moisture, and an unexplained reduction in spring flow contributed to the rapid depletion of the pond. It was almost completely dried up when an alert assistant came into my office and announced: "Phil, if we don't get out to Fish Slough immediately, we are going to lose the species." His pronouncement was no exaggeration. It was the hard truth!

I stopped work on a trout management program for a major reservoir (the relative importance of the two projects has long since served as a source of humor for me), shouted a few words of explanation to our receptionist, and bolted for the door. Grabbing buckets, dip nets, and aerators, we were joined by another colleague and immediately headed for Fish Slough, normally a fifteen-minute drive north of our office in Bishop (we shaved at least five minutes off the usual driving time.) We hastened to the drying pond and carefully removed 800 remaining individuals, placing them in three wire mesh cages within the main northwest channel of the slough, in a diminishing flow already less than two cubic feet per second. We planned to move them later to safer locations within the same general area.

Having done all we could for the moment, we decided to take a quick dinner break before returning to move half of the fish (about 400) across the slough to a location supplied by

another spring source. In endangered species preservation work, a cardinal rule is always to place your eggs in more than one basket. We had come very close to witnessing a species extinction or, nearly as bad, a population so reduced in numbers as to eventually effect the same tragic consequence.

Temporarily alone in the marsh, I decided to make one final check (sometimes it pays to be a worrier). A glance into the nearest mesh cage showed that we were not yet out of the woods. In our haste to rescue the fish, we had unwisely placed the cages in eddies away from the influence of the main current. Reduced water velocity and accompanying low dissolved oxygen were rapidly taking their toll. When taken from their natural habitat, pupfish are fragile creatures. They were overcrowded in their cages and had been stressed by unavoidably rough treatment on a hot summer afternoon.

A number of dead and dying fish were already floating belly up or swimming irregularly, and it was clear that both mesh cages and fish would have to be moved immediately upstream to more favorable conditions nearer the springheads. I ran to my pickup truck and found only two buckets (the other two were on their way back to town). However, there were two aerators available in addition to the all-important dip net.

I netted the surviving fish into the buckets, wincing as each dead one forcefully demonstrated the fragility of life. I then relocated the cages and returned to the buckets, trusting that the battery-powered aerators had not failed during my brief absence. Although the passage of time has obscured my exact words and thoughts as I lugged two heavy buckets and their precious cargo (each weighing more than thirty pounds) over the treacherous marsh terrain, I remember mumbling something like: "Please don't let me stumble. If I drop these buckets we won't have another chance!" I distinctly remember being scared to death. I had walked perhaps fifty yards when I realized that I literally held within my hands the existence of an entire vertebrate species. If I had tripped over a piece of barbed wire or stepped into a rodent burrow, the Owens pupfish would now be extinct! But good fortune smiled upon us, and the recovery continues today.

Efforts to preserve endangered desert life forms never end, but essentially constitute only a temporary reprieve as aquatic habitats gradually decline throughout North America. Indiana University's Lynton Caldwell, speaking of our environmental crisis, observed that while endangered species are part of this lamentable phenomenon, "more importantly, the crisis is concerned with the kind of creatures we are and what we must become in order to survive."

We have received adequate warning from our prophets. Aldo Leopold's "Land Ethic," published more than forty years ago in *A Sand County Almanac*, redefined Gifford Pinchot's "resource conservation ethic" (the greatest good for the greatest number in the long run) and placed humans as simply another species within the global ecosystem. This concept has since become painfully obvious as we learn more about ourselves in relation to our environment.

Having spent much of the past two decades responding to the cynical question: "What good are they?" (in reference to my efforts on behalf of the pupfish and similar "insignificant" organisms), I have made use of an effective counterquery: "What good are you?" (a very thoughtful question). I then add a Leopold corollary: "To keep every cog and wheel is the first precaution of intelligent tinkering."

Rank-and-file American citizens have been generally apathetic about the conservation of biological diversity, but one would hope not to find similar unconcern within the scientific community. Yet there is much complacency among professionals, particularly among those biologists trapped within a tenure track and faculty advancement syndrome that often ranks quantity over quality in the research endeavor. If such scientists express an interest in conservation, they usually are of the opinion (naively and incorrectly) that someone else will attend to saving species. At the 1992 annual meeting of the American Society of Ichthyologists and Herpetologists, for instance, only a small percentage of 385 research papers related to the specific area of conservation.

Workers in the pragmatic field of conservation biology frustrated by a critical need for answers to questions posed by species recovery programs, draw analogies of mowing the lawn while the house burns down. The possibility always exists, of course, that any research, no matter how seemingly esoteric, may someday be of value in saving a species. Albert Einstein put it this way: "I have little patience with scientists who take a board of wood, look for its thinnest part, and drill a great number of holes where the drilling is easy." Unfortunately, the deadly serious matter of preserving biodiversity generally places one in the position of facing unpredictably thick boards, full of knots, and then being forced to drill holes with a bit significantly dulled by the bureaucratic process.

As I walked back to my truck following the final transplant within Fish Slough, the sun had long ago set. In my dip net remained a few dead pupfish. I glanced up at the darkening desert sky and thought of Pierre Teilhard de Chardin's concept of the infinitely large, the infinitely small, and the infinitely complex, represented here (in order) by the Milky Way, the pupfish, and the difficulty in pointing out the paramount value of such things to an increasingly materialistic society.

The day had been long. We had won an early round in a fight that will inevitably continue as long as we have a habitable planet. As a realist, I could not help but ponder the ultimate fate not only of the Owens pupfish but of all southwestern fishes and species in general. I wondered about our future. Can the values driving the industrialized nations be modified sufficiently to allow for the perpetuation of all species, including humans? Will we ever realize the potential implicit in our specific designation as *Homo sapiens*, the wise species? I hope the day will come when public policy will be guided by the wisdom of Aldo Leopold: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." Such recognition could constitute perhaps the first major step toward creating the sustainable society upon which our long-term survival obviously depends.

That August day twenty-three years ago had been a very humbling experience for me. The principles of biogeography and evolution I had learned many years before at Berkeley had taught me why the pupfish was here; it took the events of those few hours in the desert to teach me why I was. Such are the reflections of a biologist who, for a few frightening moments long ago, held an entire species in two buckets, one in either hand, with only himself standing between life and extinction.

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Edwin P. (Phil) Pister is Executive Secretary of the Desert Fishes Council in Bishop, California. A former district fishery biologist for the California Department of Fish and Game, he now works to develop and promote conservation ethics.