More Questions than Answers

Gordon Mueller, NPS, USBR, USNBS and USGS retired

I had a plaque in my office that declared: "Education is the process of cocksure ignorance to thoughtful uncertainty". That really describes my 25-year experience with the razorback sucker. When I retired 10 years ago, I left both humbled and amazed at how little we know about this remarkable fish.

That should be the case with all of us with the discovery of not only recruitment, but what appears to be self-sustaining recruitment in Lake Mead. I came back to once again share some of my observations and to ask a few questions.

QUESTION: Do we really appreciate the evolution of these fish?

The literature reads like it was written by a team of blind scientists who were describing it by feel. Many were limited geographically by political and institutional barriers and most importantly, much of the natural river processes had been destroyed decades before by water development.

When I arrived in 1980, many of us were handling razorbacks older than OURSELVES. Adults are amazingly docile. During one of my surveys, a telemetry fish swam up to the boat and look me directly in the eye. It was an amazing encounter.

The Mohave population was well over 100,000 and spawners were found in nearly every cove from Hoover to Davis Dam. This was evidence at how they had taken advantage of a window of reproductive opportunity.

The river 200 years ago was one of the most harsh and unpredictable rivers this continent could offer. Today, it's the most controlled waterway. The best descriptions were made by early river runners; however, the best ecological description of the lower river is Leopold's chapter entitled "Green Lagoons" in his Sand's County Almanac.

The literature describes spawning the Vernal spawning bar, in a sand pit near Grand Junction, in nearly every reservoir, in hypolimnetic releases downstream of Hoover Dam, in nearly every mainstem reservoir; in hatchery rearing ponds and

historically in the Salt, San Juan, Gila rivers;…… the Salton Sea, Colorado River delta and possibly even in its estuary. The fish can spawn in a wet towel.

While they were generalists reproductively, they develop some highly specialized body features. One was their dorsal hump. Years ago, we speculated this so-called "Keel" helped fish navigate swift currents. However, it was shown to be a hydraulic hinderance. The current theory; it appears to be a physical deterrent to being swallowed by large predators. Did they need it? Imagine having the lips of a 100-pound pike minnow wrapping around your head.

Another specialized feature is the reflective membrane on their eye. They are the only known freshwater fish to possess it. When they roll their eyes, there is a noticeable reflective "flash" that been proven to be a territorial spawning display.

These are amazingly adaptive fish that evolved in an equally diverse and challenging ecosystem.

QUESTION: Why is recruitment happening in Lake Mead and nowhere else?

A lot of us thought we knew what was needed for recovery. We spent hours arguing whether their decline was due to habitat degradation or predation. About the only thing we agreed on, was that Lake Mead was that last place we expected recruitment to happen. That is clearly described in the listing documentation.

The most humbling aspect; is that recruitment happened without human intervention. We've spent nearly half a century, tens of millions of dollars, removed or killed millions of non-native fish, and stocked millions of razorbacks and didn't come close.

The most popular explanation is that this survival must be the result from some unique combination of habitat conditions. That is certainly possible. However, my experience leads me toward a different line of questions.

QUESTION: Could we be witnessing genetic adaptation?

That might sound crazy but I'll point out that both recovery and conservation programs based their approaches on the premise that genetic variability was essential for survival. Tens of millions have been spent to collect and maintain these genetically unique stocks.

The greatest misconception about genetic adaptation is that it takes thousands of years to occur. Actually, it can happen remarkably fast.

Let me give you a couple simple examples: Researchers have discovered several isolated populations of fish that have been genetically altered do to pollution. Natural selection has increased their tolerance of concentrations that would have been lethal just a few generations ago.

A Berkley study 50 years ago examined the impact of predation on spotted guppies. Tests revealed that communities exposed to fish predation after 4 years, evolved in 3 significant: First, they lost much of their coloration. Second, they became smaller in size and third, they sexually matured faster that control groups. That all happened in less than 10 generations. Lake Mead razorbacks have had 80 generation to adapt.

Razorbacks and common carp share many similarities. Is it possible a few sucker young survived by mimicked behavior or utilized nursery habitats used successfully by carp? Could that have started natural selection in Lake Mead?

QUESTION: Why is stocking survival so poor?

When we started the Native Fish Work Group, we were all shocked at how poor stocking survival was. I was blessed with the opportunity to study predator avoidance at Achi Hanyo. You can read the reports for the specifics but I want to describe 2 of my OMG moments during those studies.

The first happened when we introduced a 10-pound flathead catfish in a long land with about 500, 10-inch suckers. The flathead went to the far end of the tank and

remained on the bottom. It was immediately swarmed by all the suckers. They had a “NEW Buddy”.

My second OMG moment was during our predation tests. We simulated stocking in a 25-foot diameter that had 4 submerged trashcans where 5 large flatheads resided. We normally “stocked” 20 razorbacks for each trial. Without exception, suckers would scatter throughout the tank and eventually took up shelter with the catfish.

Those movements mimicked what we had observed earlier in telemetry studies. Sonic tagged juveniles disperse rapidly and after a day or two were found in what we believed was cover. In far too many cases, those transmitters didn’t move again. Did they find a catfish?

QUESTION: Do wild fish behave differently?

Very much so. We commonly referred to Cibola as being “predator free”. While, nonnative fishes were absent; nearly everything else there ate suckers. Sucker eggs and larvae were eaten by odonates, tadpoles, crayfish and even by other razorbacks. Older life stages were lost to frogs, bonytail, osprey, herons and several over species of birds.

Juveniles were extremely secretive. I spent a lot of time in the water, and during my 5 years there, I only saw a handful of young suckers and those were at night. I’m not suggesting Cibola fish were equipped to deal with the current nonnative predator community. However, they had developed a predator avoidance behavior that served them at Cibola.

QUESTION: Are these behavioral differences significant?

My search for answers led me to literature on hatchery domestication and genetic adaptation. I learned that genetic change can happen remarkably fast and those changes can be passed on to wild stocks through stocking. A classic example is the documented decline of wild steelhead caused by the influx of poor genetics from stocking augmentation.

QUESTION: Are hatcheries a blessing or a curse?

They can be a little of both. We would have lost a lot of our fish if it hadn't been for hatcheries. However, they fail miserably in preparing fish for the wild. This falls into two categories; behavioral and possibly genetics.

The talks given yesterday are perfect examples. We lose a significant portion of our stocked fish to bird predation. Wild fish are nocturnal, nonmature fish feed at night and seek cover during daylight hours. By contrast hatchery fish are fed during the day and on the surface, actually making stocked fish more accessible to birds. Raceways and rearing posts are normally netted to prevent bird predation and that also makes these fish totally predators naïve.

A solution would be to provide these fish overhead cover from birds and condition them to be nocturnal by feeding them at night and on the bottom.

I listened to an upper basin presentation of their breeding protocol early in my career. They developed a genetic protocol to cross-breed, brood stock, raise each breeding lot separately and then draw their fish in equal numbers from all lots. That meant that the lot having the lowest hatching success determined how many fish would be pulled from the other mating lots. Surplus fish would be destroyed.

Professor Bob Behnke vibrantly argued that was manipulated breeding of the worst kind. The focus should be on survival rather than pedigree and their plan rewarded poor reproductive performance while penalizing lots showing exceptional production. Those surplus fish were killed. The professor's argument fell totally in line with the reintroduction philosophies of terrestrial programs. That performance and survival are the ultimate goal; genetics is simply the means to get there.

Consider these questions closer to home:

Have we inadvertently bred a predator naive razorback by removing predation pressure from our hatchery fish? Are we seeing evidence of that in their behavior and poor survival rates?

Could predator naivety manifest itself, genetically during the past 40 generations of breeding as it did for steelhead salmon? Does this explain stocking failures?

If it has manifested itself, could this explain why the only place we haven't stocked fish (Lake Mead) is experiencing recruitment?

Why aren't we selectively breeding fish that exhibit predator avoidance skills? We certainly would if they were game or commercial harvested fish.

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One Last Question: **What is the biological future of the razorback?**

Hatchery production or even what's happening in Lake Mead certainly isn't the evolutionary path these fish would have taken WITHOUT human interference.

Phil Pister and W.L. Minckley are 2 of my heroes. Phil preached conservation biology; he believed all organisms are genetic treasures, worth saving. That is the role of good stewardship.

W.L. published a sanctuary plan over a decade ago for that very purpose. Habitats where these fish could maintain self-sustaining communities and evolve to the selective pressures of nature rather than human intervention. Sanctuaries are essential for the ethical conservation of these fish. Hatcheries are not.

In closing; I'll add that it's much easier to ask questions than produce answers. However, those questions need to be asked. Good luck and I'll keep my fingers crossed for the Mead population.

Thank you for your time.