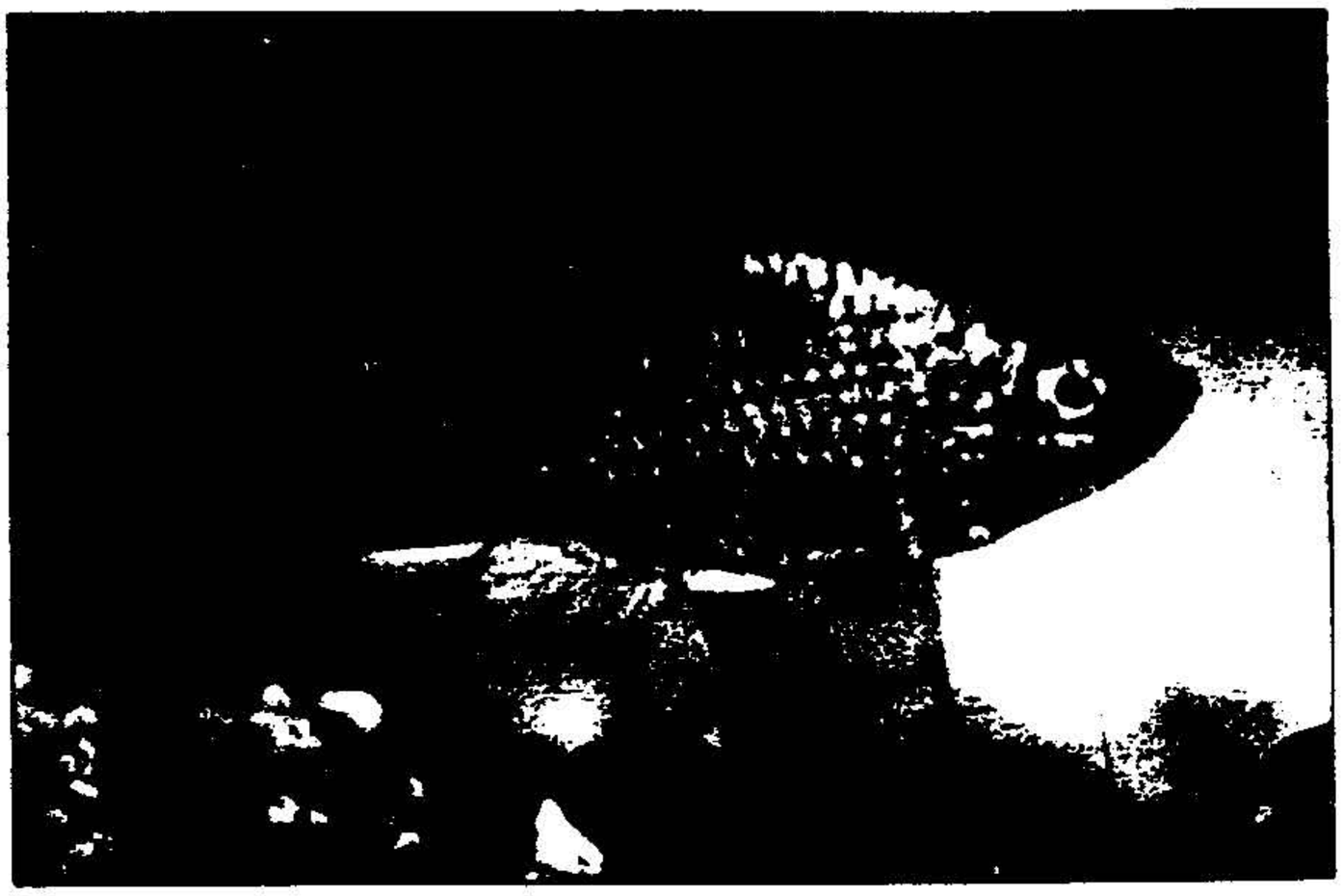
Can we sustain SW aquatic habitats and fishes?

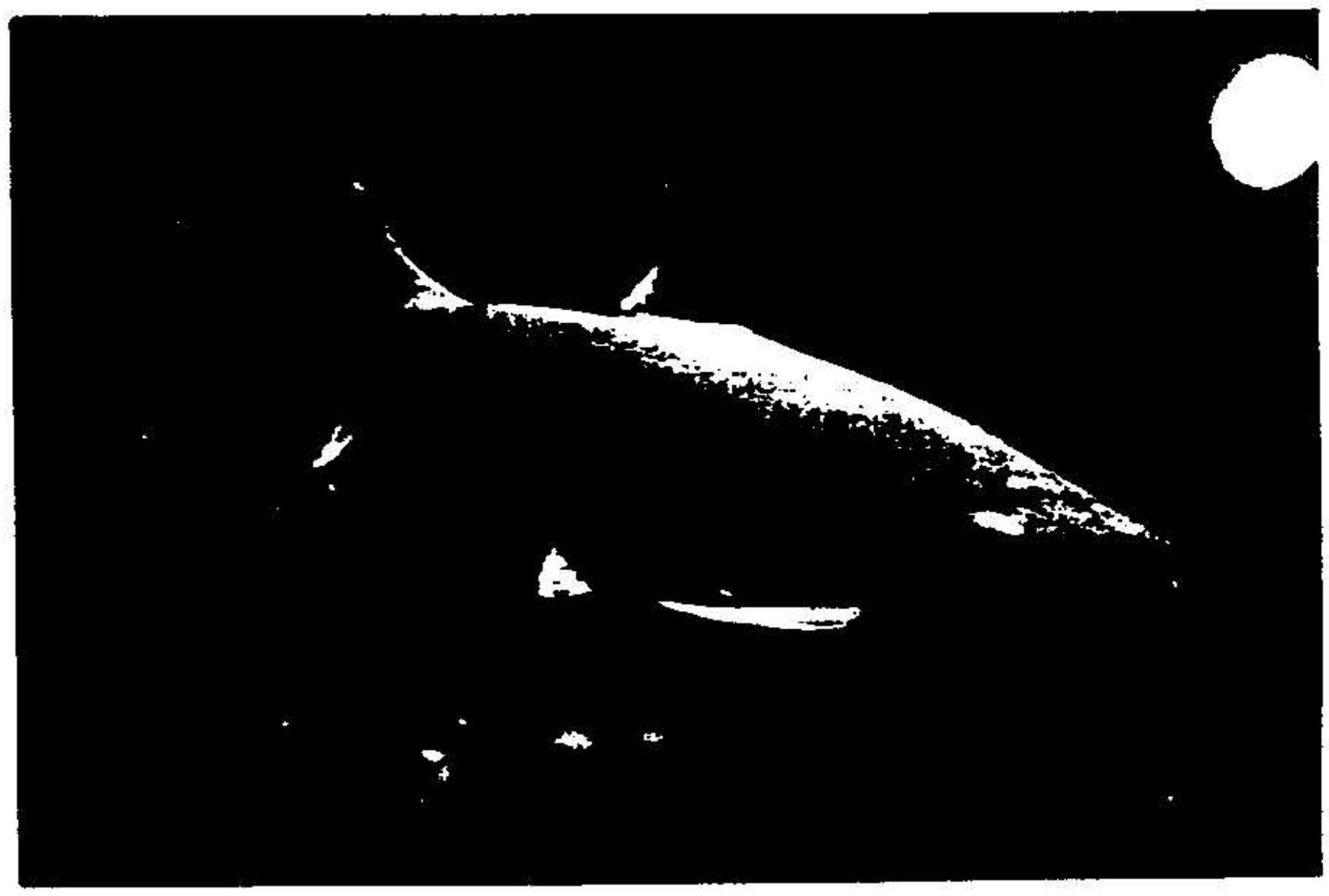
by John Rinne and
Rick Fletcher
Rocky Mountain Station

Historically, riparian areas of the Southwest have been home to several rare native fishes such as the Gila and Apache trouts, Colorado Squawfish and bonytail and humpback chubs. However, these vital habitats and the native fishes they supported have declined markedly due to dam construction, water diversion, channelization and groundwater mining. Many species could not adapt to these impacts, leading to a dramatic decline in the native fish fauna. Some species even became extinct. Although the extent of these biological and hydrological alterations has slowed, their legacy persists.

Today, a group of scientists with the Rocky Mountain Station's research lab in Flagstaff, AZ, are coordinating extensive research and management efforts to help curb this dramatic loss of habitat and fishes, and to reverse its trend.

Research Fish Biologist John Rinne explains, "The native fish fauna in streams in the arid Southwest is 'poverty-stricken' compared to that of drainages in the East. Endemism is high in fishes in the Southwest, and specialization of forms is the rule."





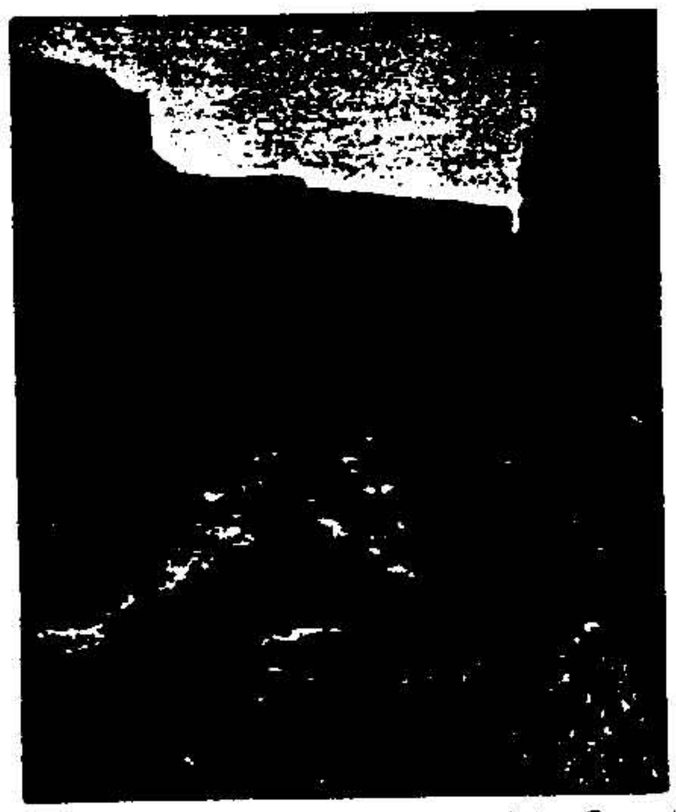
From the most diminutive endangered pupfish to the largest known minnow in the world, the Colorado squawfish, the fishes in the Southwest comprise an endangered fauna.

In addition to water projects, the progressive depletion of native fishes has also resulted from introductions on non-native fishes. Many species were introduced largely for recreational or sport fishing; some were introduced accidentally. As a result, the fish fauna of Arizona has almost tripled since 1900. Today, 60 percent of the native fishes in the Southwest are listed by federal and state agencies as threatened, endangered or of special concern.

Hydrologic impacts

Over the years, the hydrology of the Southwest has been altered dramatically. In Arizona alone, 80 percent of mainstream river habitats have either been physically and chemically altered or completely lost through drying. In the late 1800s, more than a dozen native fishes swam in the waters of the Salt River near Tempe. Now, only an assemblage of introduced species such as carp, catfish, sunfishes and cyprinids from the bait industry can be collected in the few remaining artificial aquatic habitats created by gravel mining, developments and sewage effluent.

Similar to the Salt, the Gila River dried following completion of Coolidge Dam. The Gila topminnow and desert pupfish once abounded in these waters, and the large Colorado salmon, or squawfish, once ran in spawning schools. These once extensive and diverse aquatic habitats are now rivers of sand characterized only by intermittent of subsurface flow.



The abrupt, remarkable walls of the Grand Canyon attest to the powerful erosional forces of the once untamed Colorado River. The river is now controlled and extensively modified by a half dozen mainstream dams.

Another instance is the taming of the Colorado River, which began in 1935 with Boulder Dam impounding Lake Mead. Again, successive dams below and above this initial structure completely controlled and altered this highly diverse and hydrologically variable aquatic habitat.

Watershed impacts

Other impacts have come from the upper elevation forests of central Arizona which have been extensively harvested and grazed, resulting in increased erosion and siltation. In addition, the post-war westward movement of people, combined, with the 1960 Multiple Use and Sustained Yield Act, brought about increased use of our national forests through hunting, fishing and general recreational activities — all increasing the disturbance to these already fragile ecosystems.

"Often," says Rinne, "the concepts of the intimacy of watersheds and their use, and the functioning and health of riparian/stream systems and the disciplines of hydrology and fisheries were not fully realized."

Aravaipa Creek, in Arizona, sustains 7 of the original 17 native Gila River Basin fish species. Presently, two of these are threatened and four are candidate species for federal listing.

Biological impacts

Another major impact on native fishes was, and continues to be, hybridization with introduced species. Rainbow and cutthroat trout were first introduced around the turn of the century. Because of its spring spawning habits, the rainbow freely hybridizes with the native Apache trout. As a result, the Apache has been reduced drastically in range and numbers. The native trout is now found in less than 5 percent of its former range in Arizona. The massive range reduction of the Apache trout can also be attributed to habitat alteration and competition with brown and brook trouts.

However, progress is being made. Much of the hybridization that occurred between Apache and rainbow trouts is diminishing with the cessation of stocking of fingerling rainbow trout. In addition, the combination of either using "catchables" or the prohibition of stocking of rainbow trout in steams containing native trout and the apparent innate genetic trait have dampened the historic, more extensive hybridization effect.

A final negative factor facing native trouts is competition with non-native fishes for food and space. Laboratory experiments show that adult brook trout are more aggressive than Apache trout, and can interfere with feeding and spawning. For instance, one study shows that the red shiner, a "habitat generalist," typically becomes abundant and dominates many fish assemblages in midwestern streams. This dominance usually occurs to the detriment of more specialized fishes. Today, the red shiner is widespread in aquatic habitats of the Southwest, and scientists believe it has contributed significantly to the decline of native fish populations in that region.

"Evidence of the importance of predation on natives by introduced fishes is increasing," says Rinne. "For example, studies show that rainbow trout have a significant impact on the native Little Colorado spinedace and the green sunfish appears to be replacing the native Gila chub. In addition, the drastic decline of the razorback sucker in the lower Colorado River has been attributed in part to predation by catfish. Finally, the mosquitofish, labeled the 'fish destroyer,' introduced worldwide as a biological control agent for mosquito larvae, has drastically reduced the range of the native Gila topminnow."

Current lab experiments at the aquatics lab in Flagstaff are demonstrating the significance of introduced predatory trout on young Apache trout and the Little Colorado spinedace — both federally threatened species.

Conservation efforts

Serious efforts to conserve native fishes in North American deserts began in the late 1960's and early 1970's — all based on the National Environmental Policy Act of 1969, the Endangered Species Preservation and Conservation Acts of 1966 and 1969, and ultimately the 1973 Endangered Species Act. They laid the legislative groundwork to conserve and sustain all threatened and endangered species and their habitats. In the Southwest, conservation efforts are normally outlined in multi-agency recovery plans that include objectives and activities aimed at securing, maintaining and enhancing habitats. These activities may involve removal of non-native fishes with piscicides (chemicals designed to kill fish). "However," says Rinne, "the success of habitat renovation can be reduced due to size and/or complexity of habitat, lack of habitat security through ownership or special management, variable conditions of habitats from year-to-year, and the ever-present threat of introduced species." Rinne notes the need to move from protection and listing of native Southwestern species to active recovery.

"Large-scale rearing of fishes in hatchery environments, coupled with intensive, long-term re-introduction into what is deemed 'favorable habitat' in the wild, also has been used extensively in conservation efforts," he says. "Several extensive re-introductions of razorback sucker into un-renovated streams and rivers in Arizona have failed largely because of predation by non-native species."

He says that purchase and management of riparian/stream habitats by private agencies such as The Nature Conservancy have been a boon to desert fishes.

"Improving aquatic habitat though instream improvements has become a common practice for recovery of salmonids. However, because such instream, site-specific improvement is often conducted without regard to surrounding land use and resultant condition of the supplying watersheds, the probability of failure increases," says Rinne.

The sustainability question

The bottom line — "Can native Southwestern fishes and their habitats be sustained?" In part the answer lies in 1) securing habitats, 2) species management strategies, and 3) ecosystem or landscape, versus project or target, management of natural resources.

"First," says Rinne, "we must undertake conservation activities where the habitat is relatively secure, and where we can reasonably be most effective. Acquisition of large, important habitats and numerous riparian/stream areas has been, and will continue to be, critical to sustaining native fish species. Recent land exchanges by the USDA Forest Service are prerequisite to sustaining native fishes in the wild, and special designation and management of riparian/stream areas are both timely and critical. Finally, cooperative interagency management that is synergistic in recovering species and sustaining biodiversity in our streams and rivers should be adopted. Multi-disciplinary approaches incorporating hydrologists, biologists, geneticists, geologists and botanists that address the overall ecosystem, or biodiversity philosophy of conservation, must also be formulated.

"Secondly, too often, past management and conservation efforts for native desert fishes were undertaken under crisis situations and were narrowly focused and monospecific in nature. Conservation of desert fishes must consider diversity of the fauna and begin to move away from single-species management toward ecosystems or groups of species. Successful strategies for sustaining native fishes must include the multitude of fish species that are becoming rare but are not yet federally listed," he says.

Rinne and his associates believe that managers and researchers that consider such candidate, vulnerable, restricted, sensitive or special species are becoming more proactive. For example, in the Southwest Region of the Forest Service (NM and AZ), there are more than 230 sensitive vertebrate species, 15 of which are fishes. "Unfortunately," says Rinne, "much endangered species management and research has adopted a flagship philosophy, wherein budgeting and efforts are directed toward a few high-profile species such as the bald eagle, grizzly bear, whooping crane and spotted owl. Although flagship efforts may indirectly spill over and affect other species needing immediate conservation attention, this is a serendipitous, but less desirable, way to manage ecosystems. Through timely conservation we can increase the probability that many of these species will never be listed as threatened or endangered. Further, if we design our conversation efforts on an ecosystem basis, a greater number of species in need of help will automatically be addressed.

"To be successful, such a philosophy necessitates a multi-agency and multi-disciplinary approach," he says. "That is, the broader the landscape a recovery or conservation plan addresses, the greater the probability that more than one agency will be involved in management. Equally important, the probability is greater that a larger component of total fish diversity, rather than single, indicator or threatened and endangered species, will be addressed.

Both education and involvement of the public at the earliest possible age play an essential role in sustaining the endangered southwestern fish fauna.

"Great strides have been made in understanding the issues of conservation and perpetuation of biodiversity of fishes in the Southwest since enactment of the Endangered Species Act," Rinne concludes. "It behooves us to adopt innovative approaches in future conservation efforts for this regional fish fauna. It is time to move from 'saving' native fishes to 'recovering' and sustaining them in their native habitats. We have come far, yet have far to go. Only if the overall aquatic and related resources are given priority in our conservation effort will aquatic habitats and native fish biodiversity be maintained fc perpetuity."

For more information on this research, contact John Rinne, Southwest Forest Science Complex, 2500 S. Pine Knoll, Flagstaff, AZ 86001, (602) 556-2181, FAX (602) 556-2130. Copies of a reprint that describe these studies are available from the Rocky Mountain Station. Request *Declining Southwestern Aquatic Habitats and Fishes: Are They Sustainable?*

United States
Department of
Agriculture

Forest Service

Forestry Research West

November 1994

25p