NONNATIVE, PREDATORY FISH REMOVAL AND NATIVE FISH RESPONSE, UPPER VERDE RIVER, ARIZONA: PRELIMINARY RESULTS

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The estimated native fish fauna of the upper Verde River in Arizona has declined dramatically since 1994 (Rinne et al. 1998; Rinne 1999; Rinne et al. 2001; Rinne in press). By contrast, introduced, nonnative fish species have increased proportionally. Factors such as lack of flooding (Stefferud and Rinne 1995; Rinne and Stefferud 1997) and change in grazing management (Rinne 1999; Medina and Rinne 1999) have been suggested to be responsible, in part, for these recorded changes in fish community structure. However, the presence of nonnative fishes is perhaps the most direct, negative impact on the native species (Minckley 1973; Rinne and Minckley 1991; Minckley and Deacon 1991; Rinne and Stefferud 1997) in the upper Verde.

Because of the possible impact on native fish species through predation (Rinne 1995; Rinne and Alexander 1995) by large-sized (>100 mm) nonnative species such as smallmouth bass (*Micropterus dolomieui*), green sunfish (*Lepomis cyanellus*), and yellow bullhead (*Ameiurus natalis*), a pilot study was designed to remove these species from reaches of the stream and to determine the response by three of the long-lived, larger-sized native species: desert sucker, *Catostomus clarki*; Sonora sucker, *Catostomus insignis*; and roundtail chub, *Gila robusta*. The primary objective of the study was to remove predatory, nonnative species of fish from three approximately 1 km reaches in the upper Verde River. Change in recruitment of young-of-year (YOY) of the three native species between initiation of treatment and a year later was used as an indicator of response.

Study Area

Three 1 km treatment reaches were established in the headwaters of the upper Verde River (Figure 1). Two reaches were in the area of the established Burnt Ranch long-term monitoring site and one was below the 638 Road established monitoring site (Stefferud and Rinne 1995).

Methods

Fishes were sampled with backpack DC electrofishing gear. Reaches were sampled from down to upstream, normally with two units operating simultaneously. Because of instream and streambank vegetation that provided abundant cover (especially for smallmouth bass and green sunfish), electrofishing units were deployed in parallel along stream margins. Fishes were captured with dip nets by at least two individuals attending each unit. An additional two persons with dip nets followed 3–5 m downstream to increase the efficiency of capture for fishes that were missed when stunned and transported downstream by water current.

All fish were enumerated. Adult native species were counted and returned alive immediately to the water downstream of the electrofishing field; YOY were measured and similarly released. Nonnative fishes were measured, their stomachs were examined for food habits, and they were disposed of at the site.

Removal was performed initially in the autumn (October-November) of 1999 at all three experimental reaches, in the summer (June-July) at the two Burnt Ranch removal sites, and again in October of 2000 at all sites. Predator removal was conducted only twice, October of 1999 and 2000, at the 638 Road experimental removal reach. Pretreatment data consisted of initial samples (October 1999) at each site and independent samples at both Burnt Ranch and 638 Road in October 2000. In autumn of 2000, control reaches were sampled contiguous to the respective experimental reaches at Burnt Ranch and 638 Road. These reference reaches were used to document any annual, natural changes in YOY recruitment for the two suckers

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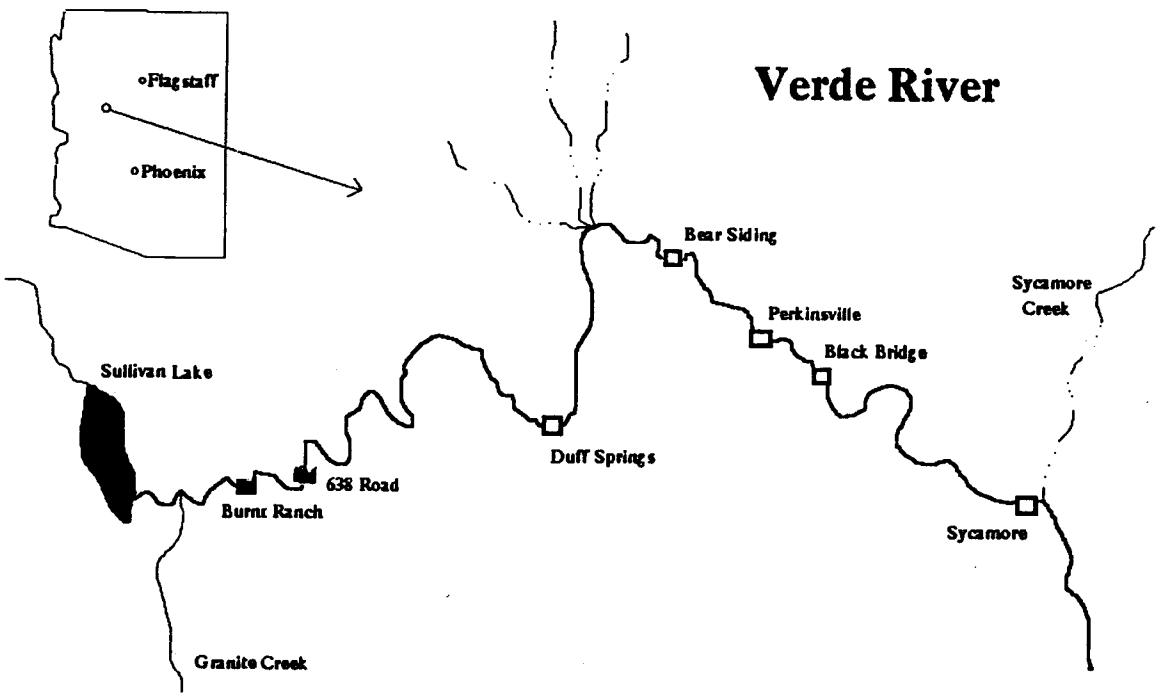

Figure 1. Map of upper Verde indicating the Burnt Ranch and 638 Road established monitoring sites where experimental removal was conducted.

and roundtail chub between autumn 1999 and 2000.

Results

Total numbers of fish captured in the experimental reaches in 1999 and 2000 are shown in Figure 2. Smallmouth bass was the dominant nonnative species present, followed by nearly equal numbers of green sunfish and yellow bullhead. Desert sucker dominated the native fishes captured, followed by Sonora sucker; roundtail chub were the least abundant. Bass were more abundant at the Burnt Ranch sites and averaged ca. 400 individuals per kilometer along the three experimental reaches. Roundtail chub increased successively downstream from the Burnt Ranch I to 638 Road reaches (Figures 1 and 2).

Through removal, smallmouth bass was reduced almost five-fold at Burnt Ranch I between autumn 1999 and July 2000; its abundance during the final removal activity in October 2000 was similar to July (Figure 3a). By comparison, no sunfish were captured during the initial removal at this site, but more than 80 individuals were captured in summer 2000 before dropping three-fold by the final removal event. Yellow bullhead were reduced five-fold from initial removal to summer 2000 but increased again by October 2000. The autumn 2000 reference sample indicated bass numbers similar to those in autumn 1999, but most were YOY individuals. Sunfish and bullhead numbers in the control sample, however, were lower than in all removal sample events.

At Burnt Ranch II, bass were reduced by only 50 percent by the final removal exercise in autumn 2000 (Figure 3b). Similar to Burnt Ranch I, sunfish increased in summer 2000 and declined almost three-fold by the autumn 2000 sampling. Bullheads followed a pattern similar to sunfish.

Recruitment of the native fishes responded to nonnative, piscine predator removal. YOY desert and Sonora sucker increased between autumn 1999 to 2000 at all removal sites (Figure 4). The numbers of YOY in control samples were almost identical between autumn 1999 and 2000. In contrast, no YOY roundtail chub were captured at the two Burnt Ranch sites, but 18 were collected at the 638 Road site in autumn 2000.

Discussion

Sampling during removal to reduce potential large-sized, nonnative predatory fishes at the three sites in the upper Verde indicated substantial populations of smallmouth bass. The one-year

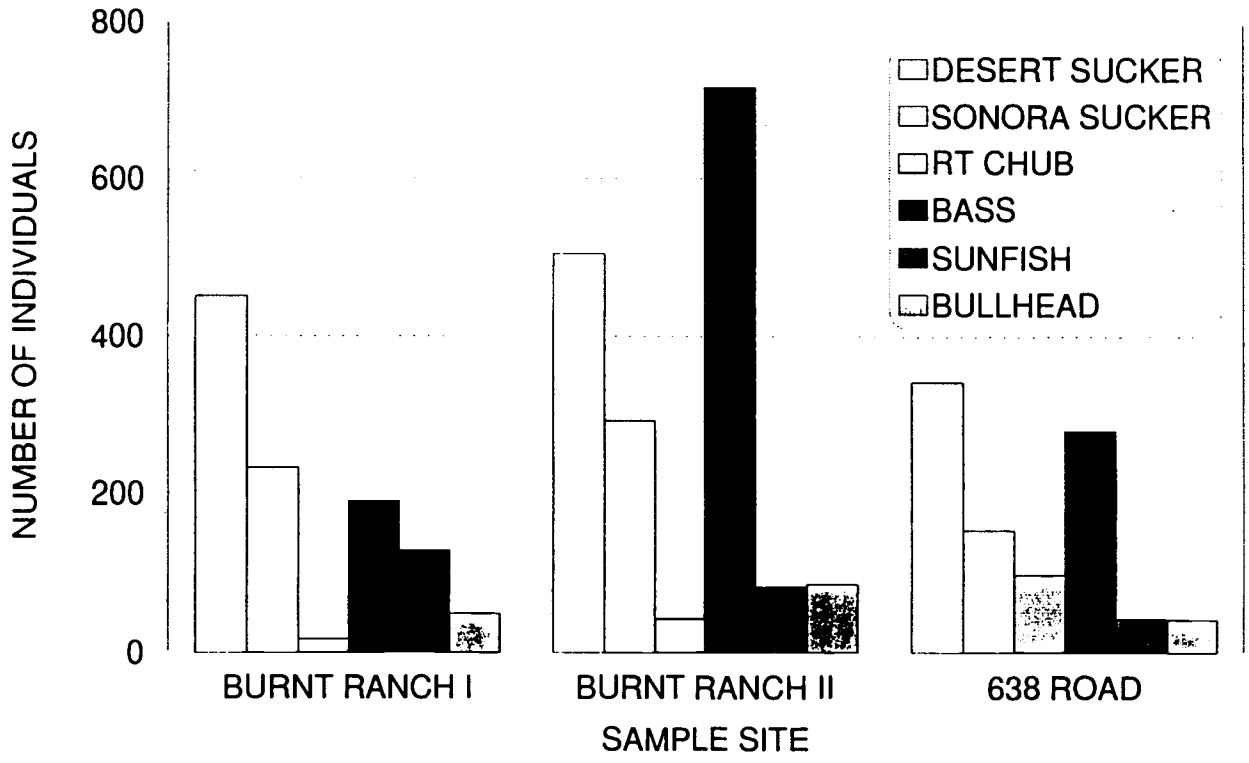

Figure 2. Total numbers of native and nonnative species captured during October 1999 to October 2000 at the three removal sites.

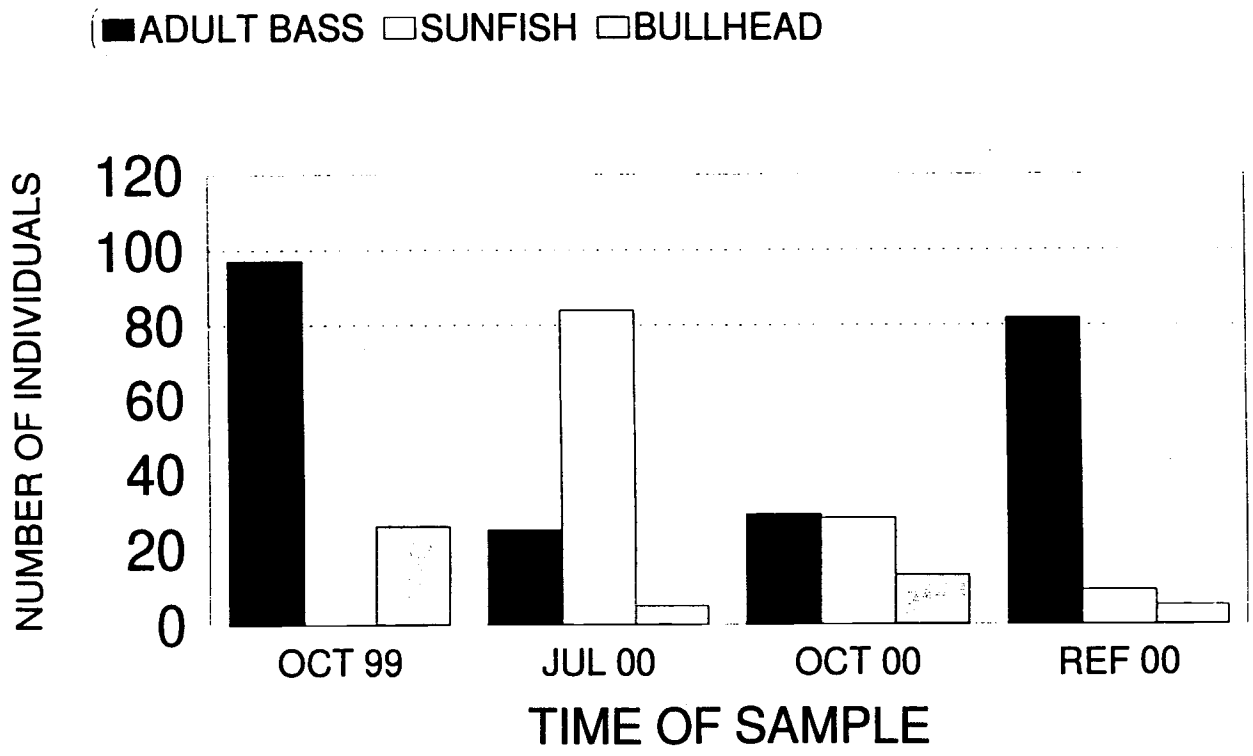

Figure 3a. Number of nonnative species removed over time at the Burnt Ranch I experimental reaches.

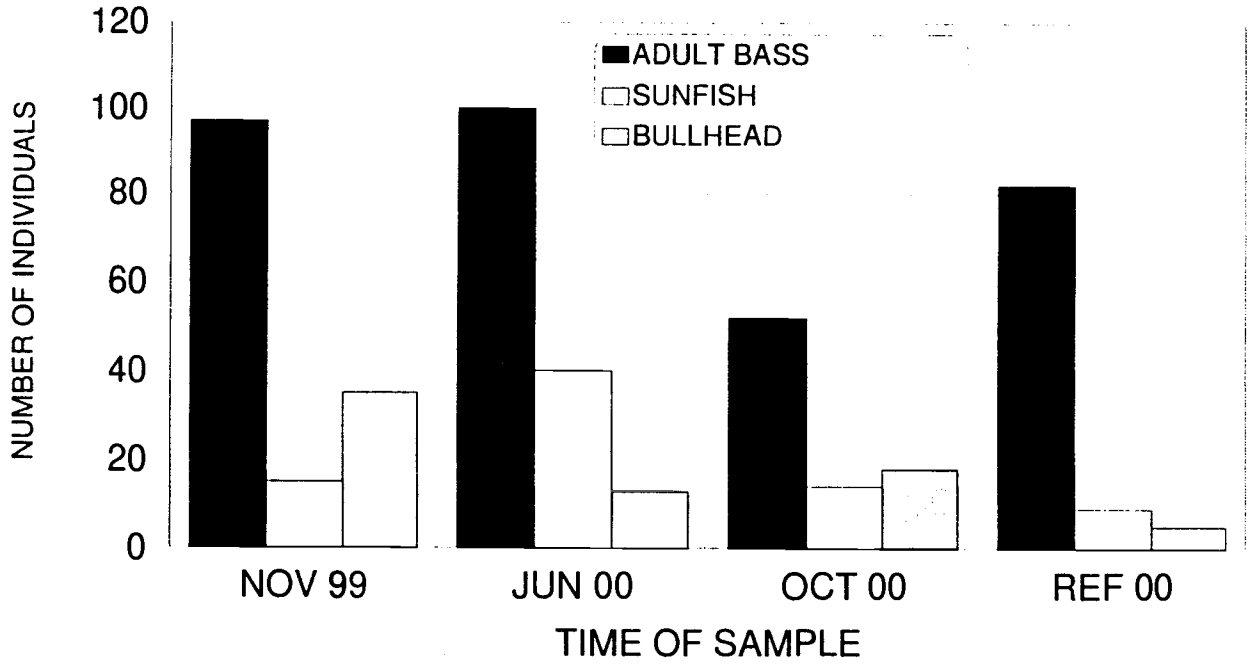

Figure 3b. Number of nonnative species removed over time at the Burnt Ranch II experimental reaches.

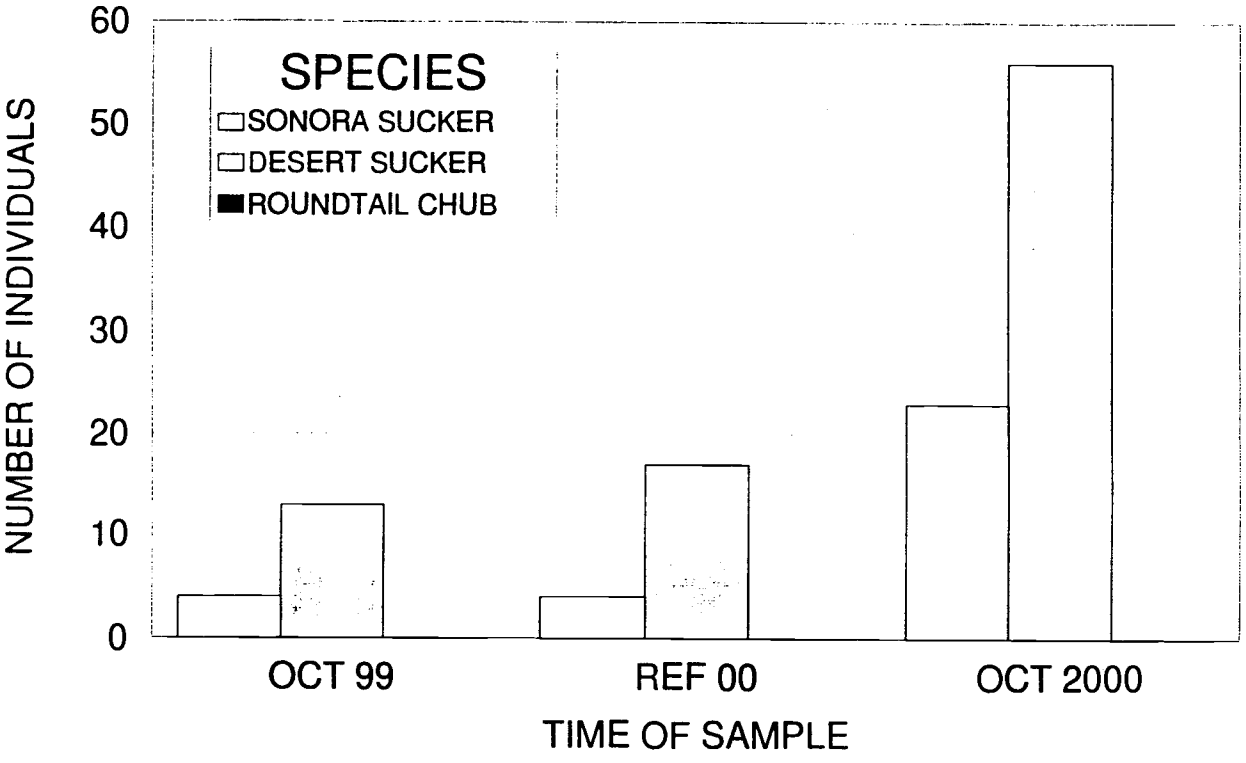

Figure 4a. Recruitment response of young-of-year native species with removal of nonnative species at Burnt Ranch I between autumn 1999 and autumn 2000.

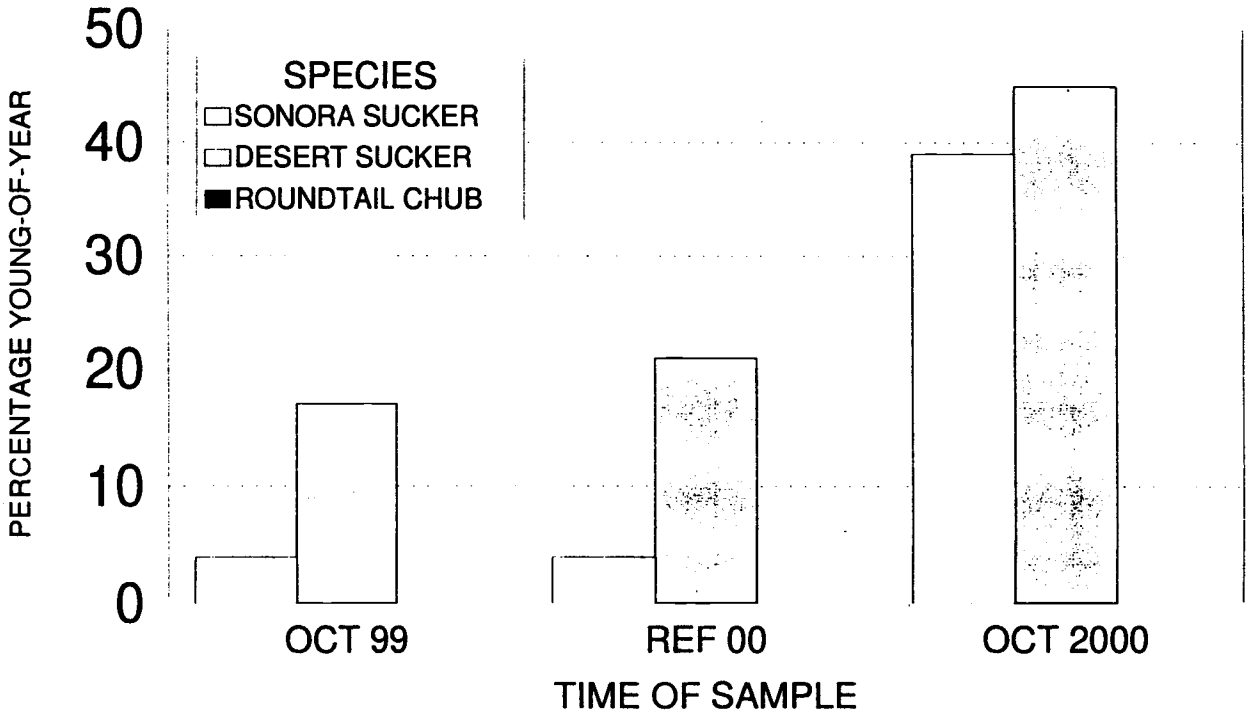

Figure 4b. Recruitment response of young-of-year native species with removal of nonnative species at Burnt Ranch II between autumn 1999 and autumn 2000.

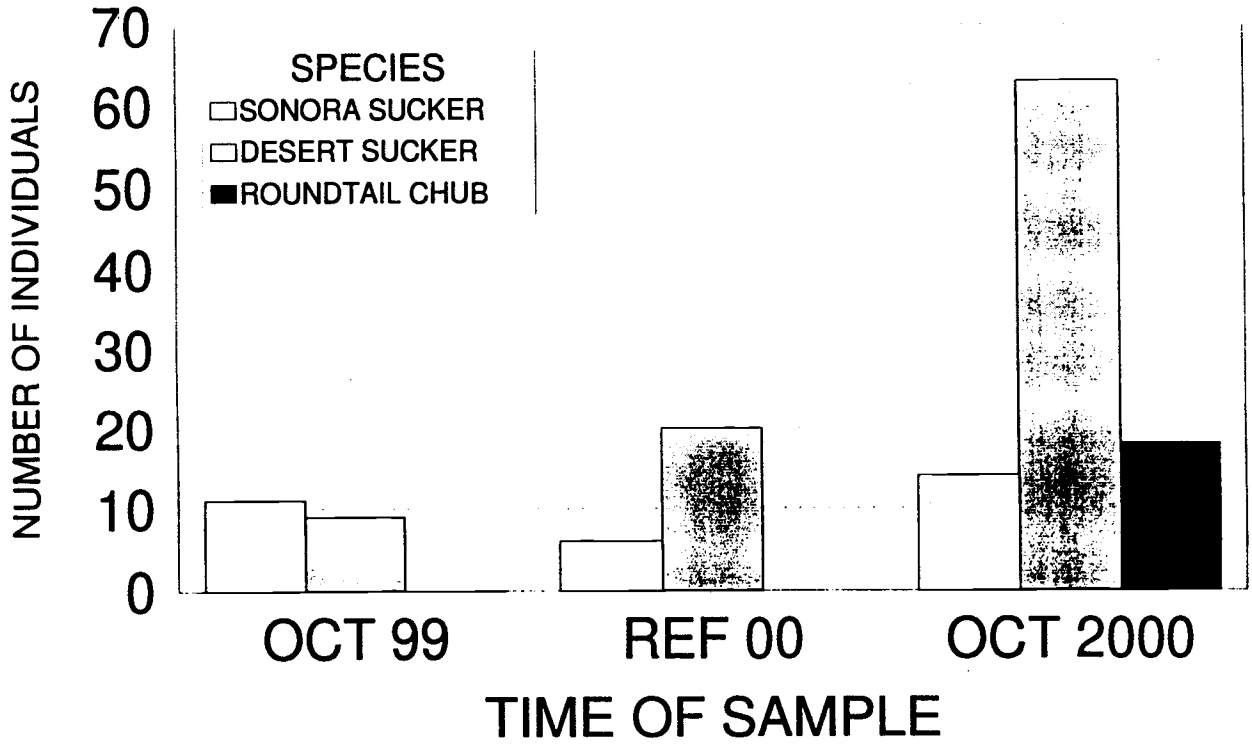

Figure 4c. Recruitment response of young-of-year native species with removal of nonnative species at 638 Road between autumn 1999 and autumn 2000.

pilot removal study suggests that predation is very likely a causative factor in the sustained reduction in populations of desert and Sonora sucker and roundtail chub. YOY of the two sucker species increased two- to three-fold between autumn 1999 and 2000 at all sites and roundtail chub appeared in samples at the 638 Road experimental removal reach.

Based on these results, nonnative, piscine predation also is very likely largely responsible for the almost total loss of the three smaller-sized native species, longfin and speckled dace and the threatened spikedace (Rinne et al. 1998). Only one longfin dace, no spikedace, and seven speckled dace were collected at established monitoring sites in the upper Verde River in 2000. In 2001, of the three small-sized native species, only two longfin dace were captured (Rinne in press). Because the adult size of these three species (50–80 mm) is similar to the size of YOY of the larger three species, and the response in recruitment of the latter group of native species, spikedace, longfin, and speckled dace are vulnerable to predation at all life stages. In contrast, by their second year of life (130+ mm), the three large-sized, native species may become less vulnerable to predation by the three nonnative fish predators in the upper Verde.

Longevity and reduction of predation vulnerability of the suckers and chub have permitted these three species to persist in greater numbers than the three small-sized species (Rinne in press). Habitat may also influence the relative abundance of the three large-sized species. The chub is an obligate pool dweller (Rinne and Stefferud 1996) and is often captured in association with cover. This native predator responded least to predator removal. Smallmouth bass also occupy pool habitats and prefer cover in southwestern rivers (Rinne et al. 2001). Chub increased successively downstream at the three removal sites (autumn 1999 sampling). The only positive response in this native species was at the lowermost removal site, 638 Road, where the species was most abundant initially in autumn 1999. Sonora sucker, also a pool dweller (Rinne and Stefferud 1996), responded less to predator reduction than did desert sucker. Desert sucker most frequently inhabits low to high gradient riffle habitats, especially at the YOY life stage, which conceivably reduced vulnerability to predation by bass. This native species responded most positively in all three experimental removal reaches (Figure 4).

Reference (control) reach sampling in autumn 2000 documented that there was not an innate, natural, annual increase in recruitment of the three natives. Nevertheless, study results are based on a single year of sampling and have to be considered preliminary. Another or even two additional annual replicates may be necessary before one can unequivocally state that nonnative, piscine predation is a primary, negative impact to the native fish fauna in the upper Verde River. Further, instream physical habitat changes resulting from a lack of significant (i.e. > 10 yr recurrence) flooding since 1995 and changes in grazing management are extant in the study area, as well as the influences of other introduced biological organisms, such as crayfish. These interactive factors also potentially affect native fish populations and must ultimately be factored into conclusions and future management of the native fish resource.

Literature Cited

Medina A. L., and J. N. Rinne. 1999. Ungulate/fishery interactions in southwestern riparian ecosystems: Pretensions and realities. Proceedings of the North American Wildlife and Natural Resources Conference 62:307–322.

Minckley, W. L. Fishes of Arizona. Arizona Game and Fish Department, Phoenix.

Minckley, W. L., and J. E. Deacon, eds. 1991. Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson.

Rinne J. N. 1995. Interactions of predation and hydrology nonnative southwestern fishes: Little Colorado spinedace in Nutrioso Creek, Arizona. Hydrology and Water Resources in Arizona and the Southwest 22–25:33–38.

Rinne J. N. 1999. The status of spikedace, *Meda fulgida*, in the Verde River, 1999. Implications for research and management. Hydrology and Water Resources in the Southwest 29:57–64.

Rinne, J. N. In press. Comparative fish community structure in the Desert Southwest: Lessons for management and conservation. In Proceedings of Symposium on Practical Approaches to Conservation of Inland Native Fishes, edited by R. Gresswell and B. Shepard. June 6–8, Missoula, Montana.

Rinne J. N., and W. L. Minckley. 1991. Native fishes of arid lands: A dwindling natural resource of the desert Southwest. USDA Forest Service, General Technical Report RM-206, pp. 1–45. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Rinne J. N., and M. A. Alexander. 1995. Nonnative salmonid predation on two threatened native species: Preliminary results of field and laboratory studies. Proceedings of the Desert Fishes Council 26:114–116.

Rinne J. N., and J. A. Stefferud. 1996. Relationships of native fishes and aquatic macrohabitats in the Verde River, Arizona. Hydrology and Water Resources in Arizona and the Southwest 26:13–22.

Rinne J. N., and J. A. Stefferud. 1997. Factors contributing to collapse yet maintenance of a native fish community in the desert Southwest (USA). In Developing and Sustaining World Fisheries Resources: The State of Science and Management, edited by D. A. Hancock, D. C. Smith, A. Grant, and J. P. Beaumer, p. 157–162. Second World Fish Congress, Brisbane, Australia. July 28–August 2, 1996.

Rinne J. N., J. A. Stefferud, A. Clark, and P. Sponholtz. 1998. Fish community structure in the Verde River, Arizona, 1975–1997. Hydrology and Water Resources in Arizona and the Southwest 28:75–80.

Rinne J. N., P. Boucher, D. Miller, A. Telles, J. Montzingo, R. Pope, B. Deason, C. Gatton, and B. Merhage. 2001. Comparative fish community structure in two southwestern desert rivers. In Restoring Native Fish to the Lower Colorado River: Interactions of Native and Non-Native Fishes: A Symposium and Workshop, edited by S. Leon, P. Stine, and C. Springer.

Stefferud J. A., and J. N. Rinne. 1995. Preliminary observations on the sustainability of fishes in a desert river: The roles of streamflow and introduced fishes. Hydrology and Water Resources in Arizona and the Southwest 22–25:26–32.