

PREDATION BY NONNATIVE FISH ON NATIVE FISHES IN THE SAN JUAN RIVER,
NEW MEXICO AND UTAH

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Introduced predaceous fishes can decrease the abundance or result in extirpation of native fish species (Miller et al., 1989; Krueger and May, 1991). In particular, studies of fishes in the American Southwest have suggested that predation of larvae and juveniles may affect recruitment of native fish (Ruppert et al. 1993; Scopettone, 1993; Marsh and Douglas, 1997). Although adults of many native fishes in the San Juan River (e.g., catostomids) are too large to be consumed by some nonnative fishes, their larvae are vulnerable to predation. In addition, because many nonnative fishes use similar low velocity habitats as do larval and juvenile native species, the potential for negative interactions among species is increased (Tyus et al., 1982; Gido and Propst, 1999).

Some nonnative fishes have exhibited different feeding behaviors depending on location. In a study within the Colorado River system, Ruppert et al. (1993) found a relatively high occurrence (15%) of larval fish in stomachs of *Cyprinella lutrensis*. They compared those results to a study by Jennings and Saiki (1990) who found no larval fish in stomachs of *C. lu-*

trensis from the San Joaquin River drainage. The disparity between these studies could be a function of site specific characteristics such as availability of alternative food items (Ruppert et al., 1993), or it could be due to specific behavior and vulnerability of prey (e.g., Johnson et al., 1993). The purpose of our study was to determine if nonnative fishes, primarily *C. lutrensis* and *Pimephales promelas*, prey on larvae of native species in the San Juan River, New Mexico and Utah.

In the San Juan River, the syntopic occurrence of native and nonnative fishes provided the opportunity to assess specific interactions in this system. Although we concentrated on food habits of *C. lutrensis* and *P. promelas*, several individuals of *Cyprinus carpio*, *Fundulus zebrinus*, *Micropterus salmoides*, and *Ameiurus melas* also were examined. Fish were collected from four study sites located in the middle reach of the San Juan River between Shiprock, New Mexico and Bluff, Utah. For a detailed description of the study area and fish assemblage in this reach of the San Juan River see Gido et al. (1997).

TABLE 1.—Nonnative species taken from the San Juan River that were examined for the presence of larval fish in the gut.

Species	Number examined	Size range (mm SL)	Percent occurrence
<i>Cyprinella lutrensis</i>	414	31–68	0.97
<i>Cyprinus carpio</i>	7	20–50	0.00
<i>Pimephales promelas</i>	95	33–62	0.00
<i>Ameiurus melas</i>	4	58–71	0.00
<i>Fundulus zebrinus</i>	3	20–25	50.00
<i>Micropterus salmoides</i>	6	33–68	33.33

Fish were collected with a 1.6 mm-mesh seine during daylight hours in June–July 1994 and June 1995. Collections were taken in low velocity backwater habitats that typically contained inundated vegetation. During our sampling, larval native fish were present, but most of the nonnative species had not yet spawned (Gido and Propst, 1999). Fish from each seine haul were preserved as discrete collections in 5% buffered formalin.

To maximize the likelihood of documenting larval fish predation, we only examined digestive tracts of nonnative fish from collections where larval native fish were present ($n = 35$). Food items of nonnative fish (>20 mm standard length, SL) were examined under a stereomicroscope. All fish larvae discovered were identified to family, and most were identified to species. Contents in the bottom of collecting jars also were examined to ensure that any regurgitated fish were detected.

Of the six nonnative species collected, only *C. lutrensis*, *M. salmoides*, and *A. melas* had consumed larval fish (Table 1). The occurrence of larval predation, however, was relatively low; only eight of the 529 individuals dissected had consumed larval fish. The larval fish were unidentified cyprinidae ($n = 3$), *R. osculus* ($n = 2$), *C. latipinnis* ($n = 2$), and *C. discobolus* ($n = 1$). The largest number of larval fish ($n = 4$) was found in *C. lutrensis*. *Ameiurus melas* and *M. salmoides*, although represented by a few specimens, had the highest frequency of consuming larval fish. No larval fish remains were observed in the bottom of collection jars.

Despite targeting habitats where adult nonnative and larval native fishes occurred together, only a few specimens had consumed larval

fish. It is possible we may have underestimated predation of larvae due to rapid digestion or potential shredding of flesh by pharyngeal teeth. However, because water temperatures were relatively low ($<18^{\circ}\text{C}$) during the time of collection, digestion presumably would be relatively slow. Tearing by pharyngeal teeth was most likely to occur in *P. promelas*, which has been documented to shred its prey (Dunsmoor, 1995). In the other specimens in which we found larval fish, there was little indication of tearing by pharyngeal teeth.

Alternatively, larval predation by *C. lutrensis* and *P. promelas* in the San Juan River appeared to be relatively low in comparison to Ruppert et al. (1993). Several factors may limit larval predation by nonnative cyprinids in the San Juan River. Gape size could have limited the availability of larval prey for smaller nonnative fishes. Some support for this conclusion is provided by the high frequency of larval fish in stomachs of juvenile *A. melas* and *M. salmoides*, which, even as juveniles, have relatively large gapes. In addition, *C. lutrensis* that consumed larvae were relatively large (40, 51, 51, and 64 mm SL). Other factors that could reduce the occurrence of larval predation include high abundance of alternate food sources (Ruppert et al., 1993) or availability of refugia habitats to escape predation (e.g., Meffe, 1985).

Recruitment for the common native fishes in the San Juan River (*C. latipinnis*, *C. discobolus*, and *R. osculus*) is sufficient to sustain relatively large populations (D. Propst, pers. comm.). Thus, along with results of this study, larval predation by nonnative fishes does not appear to greatly reduce recruitment for these species. However, larvae of rare species such as *Ptychocheilus lucius* and *Xyrauchen texanus* have been shown to have poor recruitment (Platanía et al., 1991). Therefore, we cannot discount the importance of larval predation by nonnative fishes. Rather, we have documented that larval predation does occur, but further studies should be designed to determine the relative importance to the various native species within this system. In particular, indirect effects of predators (e.g., Mittelbach and Chesson, 1987) must also be considered when assessing the impact to native fish populations.

Resumen—La de predación de peces nativos por especies introducidas se considera uno de

los mayores factores que contribuyan a la disminucion de peces endemicos, en el Suroeste American. En este estudio, examinamos la dieta de peces no-nativos obtenidos del Rio San Juan, New Mexico y Utah, para documentar la depredacion de la larva de peces nativos. La mayoria del contenido estomacal que analizamos corresponden a dos especies; *Cyprinella lutrensis* y *Pimephales promelas*, tambien examinamos varios especimenes de *Cyprinus carpio*, *Fundulus zebrinus*, *Micropterus salmoides*, y *Ameiurus melas*. Se encontro que unicamente *C. lutrensis*, *M. salmoides*, y *A. melas* consumieron la larva de peces nativos. Aungue logramos documentar la depredacion de la larva de peces nativos, la presencia de estos fue pequena. Solamente 8 de 529 e Jemplares tuvieron larva de peces en su dieta diaria. Estudios adicionales deban designarse para determinar la importancia relativa de la depredacion de la larve de varias especies nativas dentro del sistema.

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