**Progress Report to U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service**

# Nonnative Fish Removal in the Lower West Fork Gila River 2006-2009

DRAFT


**New Mexico Department of Game and Fish**
**Gila National Forest**
**New Mexico Fish and Wildlife Conservation Office**
**Kansas State University**

## Executive Summary

Mechanical removal of fishes was conducted on the West Fork Gila within the Heart Bar State Wildlife Area from 2006 through 2009. A total of seven removal efforts were conducted during that time period, removing 1745 nonnative fishes and 326 bullfrogs and bullfrog tadpoles. Several flow events >1000 cfs occurred during the study period. Per habitat density of nonnative fishes was lower in 2008 than 2007 but was not significantly different in 2009. Numbers of large nonnative fishes decreased in 2009. Density of native fishes was greatest in 2009, much of the increase due to the large numbers of age-1 and younger fishes that were collected. In addition, higher numbers of rare fishes (spikedace, loach minnow, headwater chub) were collected in 2009 than in previous years.

## Introduction

The West Fork of the Gila River near the confluence of the Middle Fork Gila is one of three remaining locations that spikedace *Meda fulgida* are regularly collected. Loach minnow *Tiaroga cobitis* and headwater chub *Gila nigra* are also found in the area. The study was conducted on approximately four kilometers of the West Fork Gila River on the NM Department of Game and Fish – Heart Bar Wildlife area from the property line upstream to the confluence of the Middle Fork Gila. The study area is not protected by barriers to prevent upstream migration of fishes and is also downstream of two large, complex watersheds. Commonly collected nonnative fishes include yellow bullhead *Ameiurus natalis*, smallmouth bass *Micropterus dolemieui*, brown trout *Salmo trutta*, and rainbow trout *Oncorhynchus mykiss*. It is likely that nonnative fishes pose a significant threat to the continued existence of native fishes, primarily due to predation effects. Barrier construction and chemical renovation may be inappropriate to protect this area due to the size and complexity of the watershed. In order to evaluate the merits of mechanical removal of nonnative fishes a three year study was conducted on this area to determine if mechanical removal is a useful tool in preserving native fisheries into the future.

## Methods

A pilot study to determine best methods and feasibility for removal was conducted in April 2006. A single backpack electrofisher and seines were used and samples were segregated by mesohabitat. Habitat area was not measured for this initial effort. Subsequent sampling efforts were conducted using two backpack electrofishers working in tandem. June sampling efforts (monitoring) were recorded by habitat similar to permanent sites monitoring (Paroz et al. 2006); measuring habitat area, depth, and substrate. Seines were used in shallow water habitats (shoals, riffles, shallow runs) during the June efforts. All fishes were collected, enumerated, and measured during the June effort. Native fishes were returned to the water, nonnative fishes were removed. Stomachs of nonnative fishes were preserved for use in cooperative studies. Non-June sampling efforts concentrated on the removal on nonnative fishes using electrofishing, habitat data was not collected. Density of fishes in June monitoring efforts was calculated the number of fishes per habitat area, averaged for the entire removal area. ANOVA and t-test statistics were performed using Excel® and Statistica®.

## Results

Eight native and ten nonnative fish species were collected during seven sampling efforts occurring April 2006 through June 2009 (Table 1). Over 1700 nonnative fishes were removed from the area. In addition, 326 bullfrogs were opportunistically removed. Brown trout and yellow bullhead were the most commonly collected nonnative fish; longfin dace and Sonora sucker the most commonly collected native fish. Though few in number, it appears that this is the first record of flathead catfish this far upstream in the Gila River.

Table 1. Numbers and species codes of fishes collected during each sampling effort from 2006 through 2009 on the West Fork Gila River, Catron County, New Mexico. Native fishes were only collected during June sampling efforts.

| Common Name | Species | Species Code | | April 2006 | June 2007 | November 2007 | June 2008 | August 2008 | December 2008 | June 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Longfin dace | *Agosia chrysogaster* | AGOCHR | Native | 18 | 115 | | 207 | | | 3444 |
| Common carp | *Cyprinus carpio* | CYPCAR | Introduced | | | 1 | | | | |
| Red shiner | *Cyprinella lutrensis* | CYPLUT | Introduced | | | 9 | | | | |
| Headwater chub | *Gila nigra* | GILNIG | Native | 32 | 38 | | 46 | | | 518 |
| Spikedace | *Meda Fulgida* | MEDFUL | Native | | | | 27 | | | 103 |
| Speckled dace | *Rhinichthys osculus* | RHIOSC | Native | 144 | 17 | 5 | 59 | | | 566 |
| Fathead minnow | *Pimephales promelas* | PIMPRO | Introduced | | | | 1 | | | |
| Loach minnow | *Tiaroga cobitis* | TIACOB | Native | 9 | 1 | | 8 | | | 50 |
| Desert sucker | *Catostomus (Pantosteus) clarki* | PANCLA | Native | 675 | 263 | | 360 | | | 1427 |
| Sonora sucker | *Catostomus insignis* | CATINS | Native | 586 | 511 | | 641 | | | 5328 |
| Green sunfish | *Lepomis cyanellus* | LEPCYA | Introduced | | 1 | 4 | | | | 1 |
| Smallmouth bass | *Micropterus dolemieui* | MICDOL | Introduced | 64 | 24 | 37 | 5 | 6 | 69 | 29 |
| Yellow bullhead | *Ameiurus natalis* | AMENAT | Introduced | 18 | 97 | 102 | 30 | 11 | 93 | 281 |
| Flathead catfish | *Pylodictis olivaris* | PYLOLI | Introduced | 1 | | 4 | | | 1 | 1 |
| Western mosquitofish | *Gambusia affinis* | GAMAFF | Introduced | | 15 | | | | | 4 |
| Gila trout | *Oncorhynchus gilae* | ONCGIL | Native | | | | 13 | | | 13 |
| Rainbow trout | *Oncorhynchus mykiss* | ONCMYK | Introduced | 20 | 48 | 19 | 14 | 23 | 27 | 47 |
| Brown trout | *Salmo trutta* | SALTRU | Introduced | 24 | 36 | 21 | 62 | 65 | 69 | 361 |
| Crayfish | | CRAYFISH | Introduced | 1 | 1 | | | | | |
| Bullfrog | | RANCAT | Introduced | 8 | 71 | 18 | 3 | 1 | 4 | 10 |
| Bullfrog tadpole | | RANCAT TAD | Introduced | 6 | 47 | 3 | | | | 155 |

Densities of individual species of native fish were significantly higher in 2009 than in previous years while no species of nonnative fish had significantly different density than 2007 levels (Table 2). Sonora sucker was the most common species in all years. Collectively native species density was higher in 2009 than both 2008 and 2009 (Table 3, Figure 1) and nonnative species density was significantly lower in 2008 than 2007.

Table 2. Average per habitat density of fishes collected in June sampling trips, West Fork Gila River, Catron County, NM.

| | April 2006 | June 2007 | | | June 2008 | | | June 2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Number** | **Number** | **Density** | **SE** | **Number** | **Density** | **SE** | **Number** | **Density** | **SE** |
| AGOCHR | 18 | 115 | 0.0127 | 0.0079 | 207 | 0.0093 | 0.0045 | 3444 | 0.1290 | 0.0228 |
| AMENAT | 18 | 97 | 0.0030 | 0.0005 | 30 | 0.0009 | 0.0003 | 281 | 0.0076 | 0.0027 |
| CATINS | 586 | 511 | 0.0159 | 0.0041 | 641 | 0.0222 | 0.0047 | 5328 | 0.1393 | 0.0205 |
| GAMAFF | | 15 | | | | | | 4 | 0.0002 | 0.0002 |
| GILNIG | 32 | 38 | 0.0028 | 0.0011 | 46 | 0.0020 | 0.0008 | 518 | 0.0195 | 0.0566 |
| LEPCYA | | 1 | | | | | | 1 | 0.0000 | 0.0000 |
| MEDFUL | | | | | 27 | 0.0004 | 0.0002 | 103 | 0.0022 | 0.0007 |
| MICDOL | 64 | 24 | 0.0008 | 0.0003 | 5 | 0.0002 | 0.0001 | 29 | 0.0007 | 0.0003 |
| ONCGIL | | | | | 13 | 0.0004 | 0.0002 | 13 | 0.0004 | 0.0003 |
| ONCMYK | 20 | 48 | 0.0012 | 0.0003 | 14 | 0.0005 | 0.0002 | 47 | 0.0019 | 0.0005 |
| PANCLA | 675 | 263 | 0.0128 | 0.0026 | 360 | 0.0191 | 0.0038 | 1427 | 0.0468 | 0.0069 |
| PIMPRO | | | | | 1 | | | | | |
| PYLOLI | 1 | | | | | | | 1 | 0.0000 | 0.0000 |
| RHIOSC | 144 | 17 | 0.0010 | 0.0005 | 59 | 0.0024 | 0.0006 | 566 | 0.0243 | 0.0042 |
| SALTRU | 24 | 36 | 0.0012 | 0.0004 | 62 | 0.0019 | 0.0005 | 361 | 0.0155 | 0.0131 |
| TIACOB | 9 | 1 | 0.0000 | 0.0000 | 8 | 0.0003 | 0.0001 | 50 | 0.0021 | 0.0009 |
| CRAYFISH | 1 | 1 | | | | | | | | |
| RANCAT | 8 | 71 | | | 3 | | | 10 | | |
| RANCAT TAD | 6 | 47 | | | | | | 155 | | |

Table 3. Values for t-test comparisons between years for native and nonnative species densities, West Fork Gila River, Catron County, NM. Yellow indicates significant difference.

| **Native** | **t** | **p** |
|---|---|---|
| 2007-2008 | 0.667 | 0.5055 |
| 2008-2009 | 6.7067 | 1.615E-10 |
| 2007-2009 | 8.6268 | 4.323E-16 |
| **Nonnative** | **t** | **p** |
| 2007-2008 | -2.09 | 0.0375 |
| 2008-2009 | 1.314 | 0.19027 |
| 2007-2009 | 1.348 | 0.1787 |

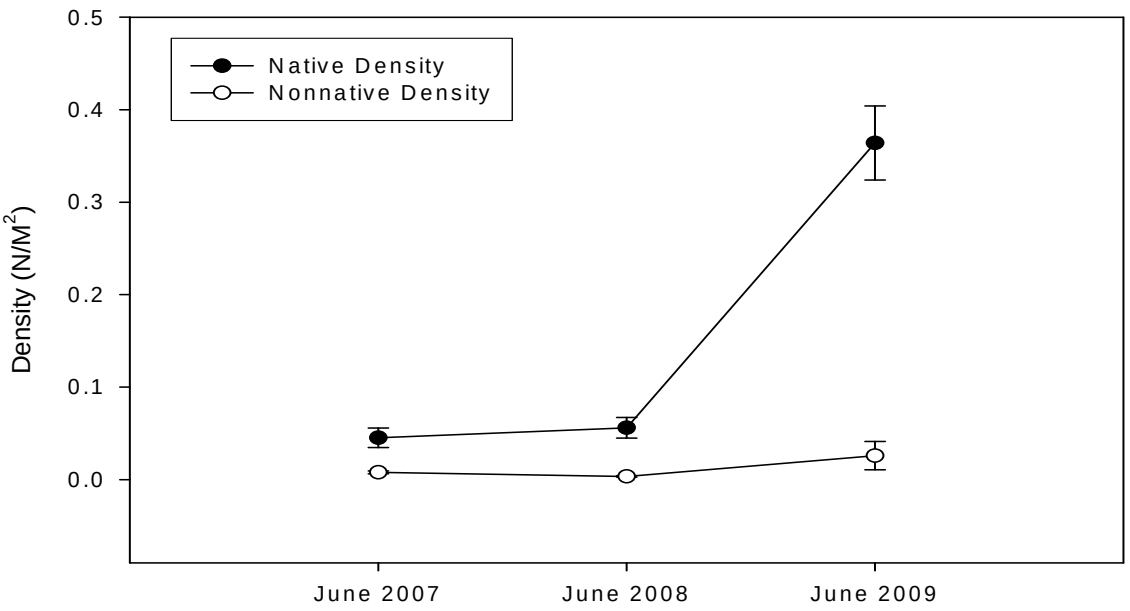


Figure 1. Average density of native and nonnative fishes collected in the West Fork Gila River, Catron County, NM 2007-2009. Error bars = 1 SE.

Distribution of species was similar throughout the project area (Figure 2). There was a greater proportion and more diverse array of nonnative species in 2007. In 2009 most nonnative fishes, namely brown trout, were collected in the lower portion of the project area. Loach minnow was generally only collected in the lower sections of the study area while spikedace were more abundant further upstream. Headwater chub were distributed throughout. Large beaver ponds were present in the lower portions of the study area in 2009 that were not present in previous years.

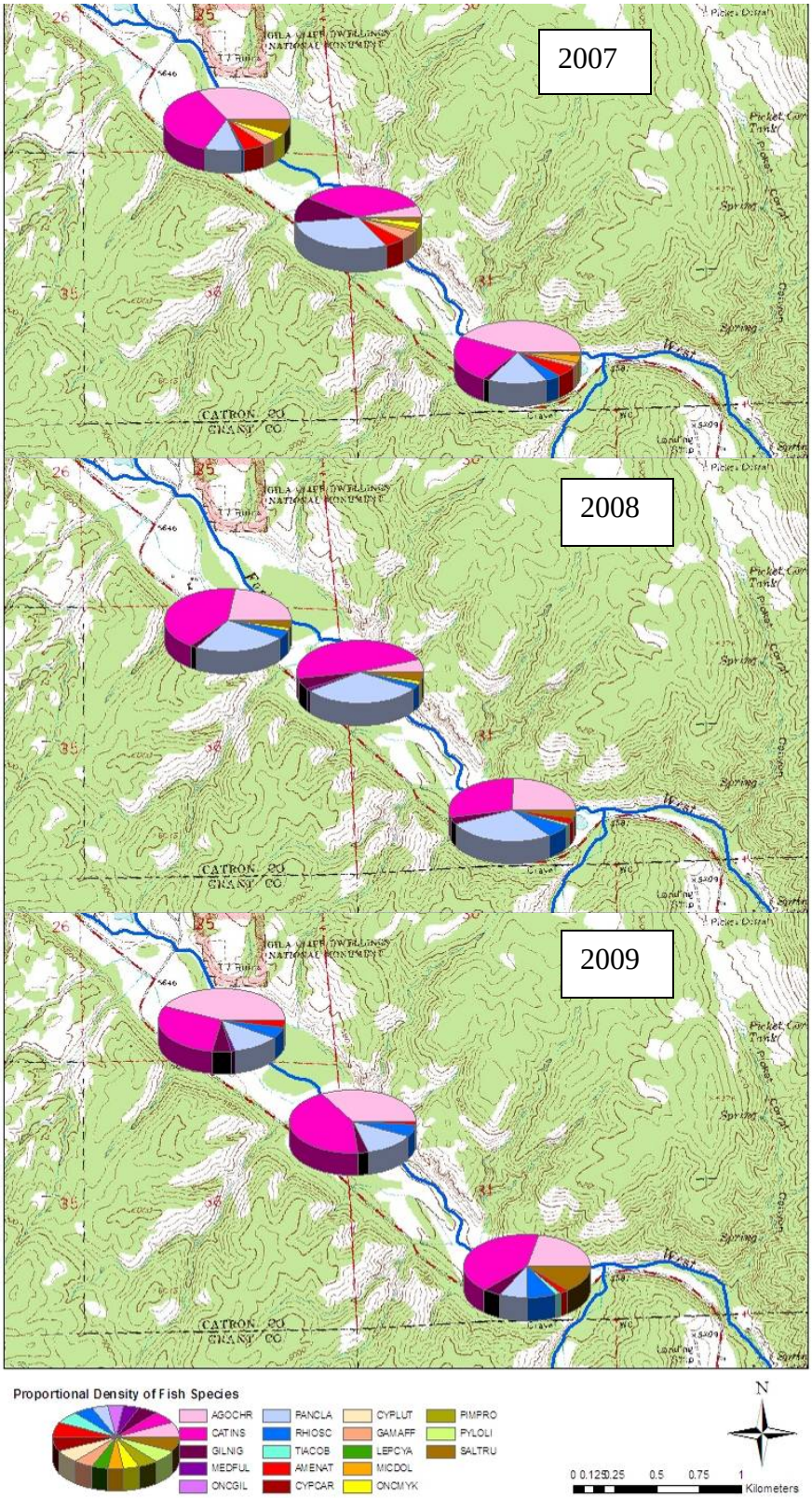


Figure 2. Proportional density of fishes in the lower, middle, and upper project area, West Fork Gila River, 2007-2009.

From 2006 through 2009 there were several high water events recorded at the Gila River gage at Gila > 30 miles downstream of the study area (Figure 3). High water levels were present in August and September of 2006 as well as a short duration flood events in December 2007 and January 2008. June sampling efforts occurred during low water levels each year. Generally it was difficult to sample effectively if discharge was greater than 300 cfs at the Gila gage.

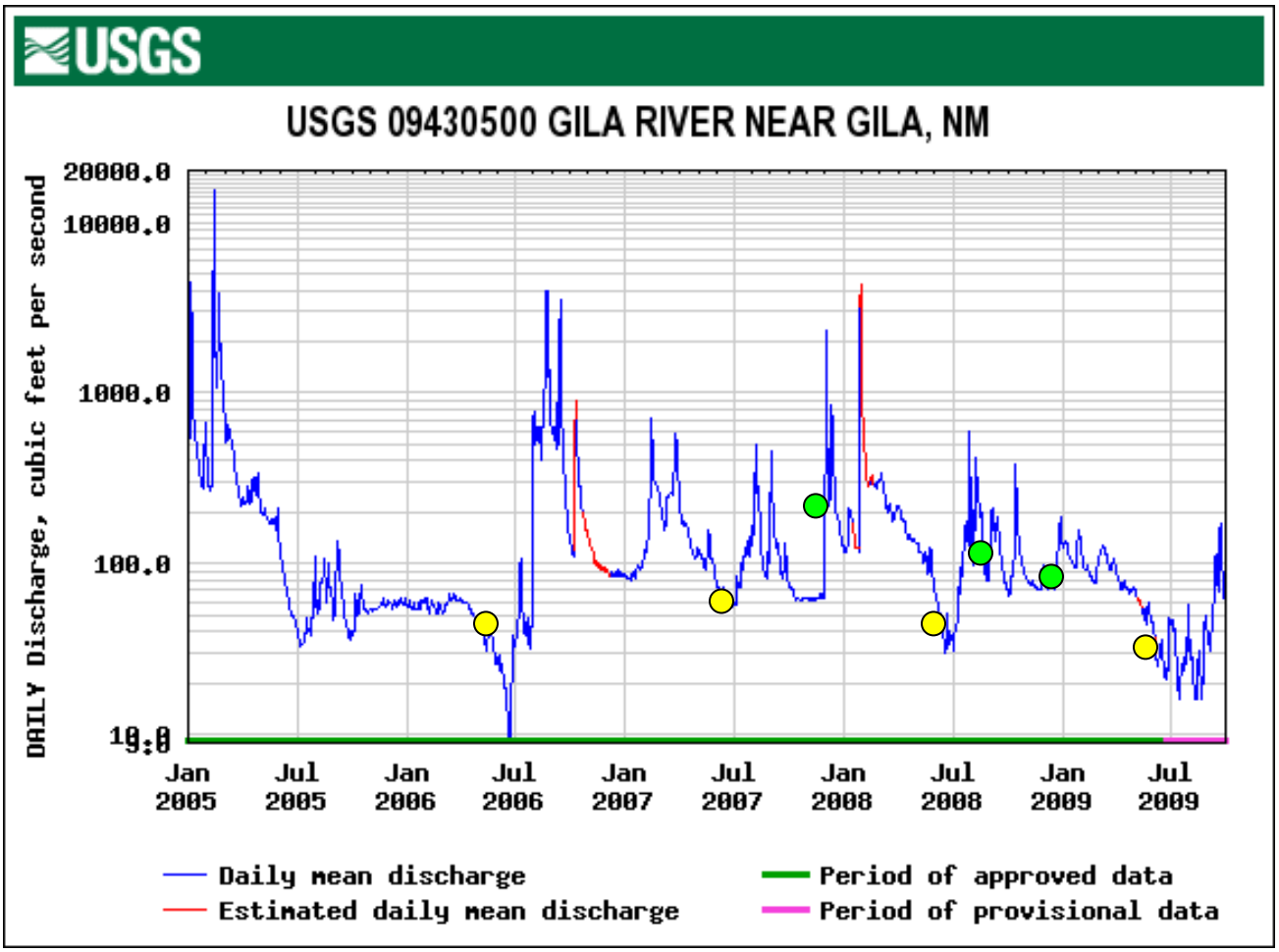


Figure 3. Discharge at Gila gage from 2005 through 2009. Yellow dots indicate approximate times of monitoring (all species). Green dots indicate nonnative removal efforts.

Average total length of yellow bullhead captured in June 2009 (80mm, SE=5.0) was lower than the previous three years (2006 – 207mm, SE=13.7; 2007 – 188mm, SE=6.6; 2008 – 199, SE=10.4). Bullheads from 150-250mm which were previously commonly captured were rare in 2009 (Figure 4). Small bullheads (<100mm) were nearly absent in 2008.

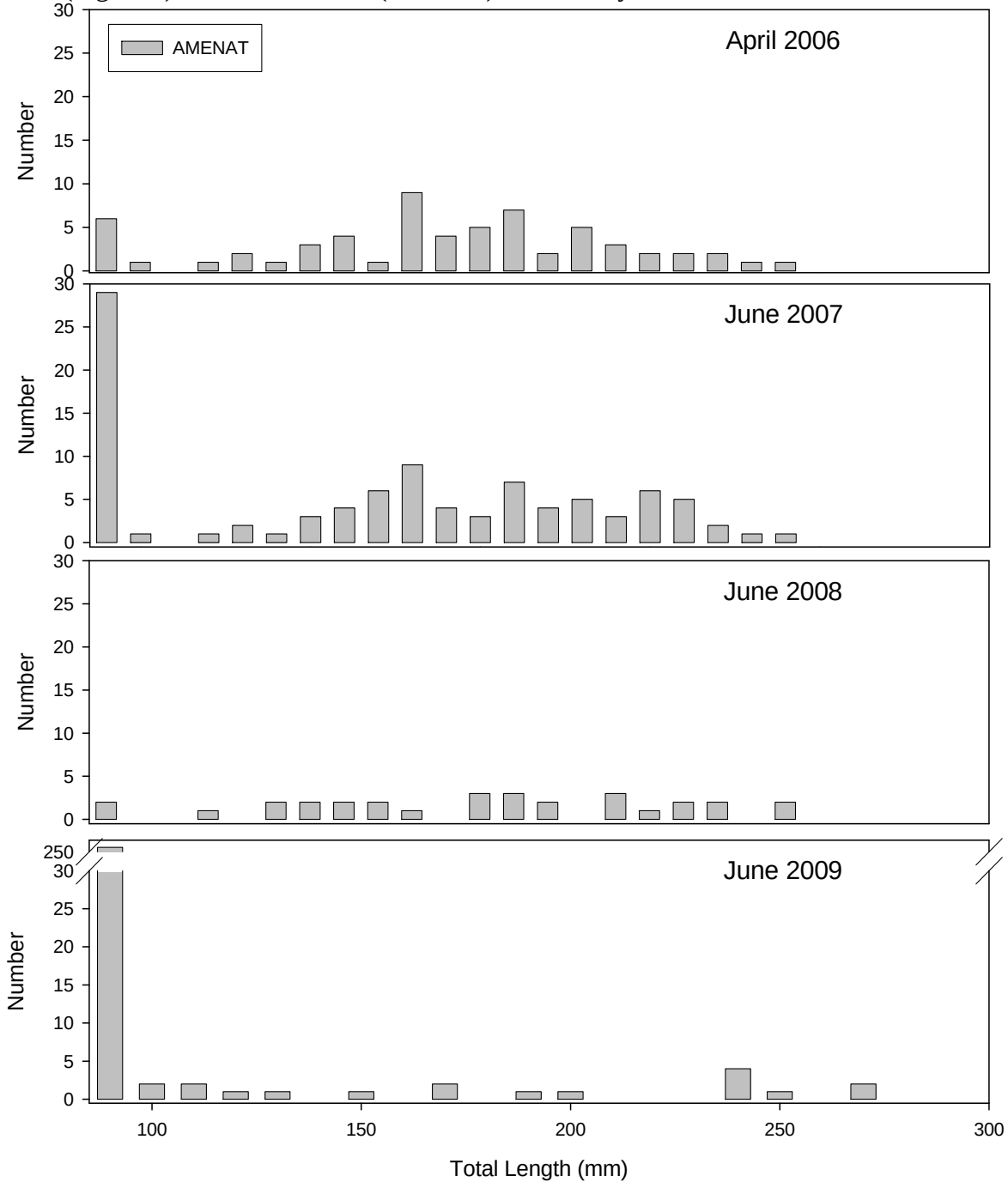


Figure 4. Length frequency histogram of yellow bullhead captured during spring nonnative removal efforts, West Fork Gila River 2006 through 2009.

Sonora sucker of various size classes were abundant each year from 2006-2009. Length frequency histograms (Figure 5) indicate that five to seven age classes were present each year. There were strong young-of-year classes of Sonora sucker in 2008 and 2009.

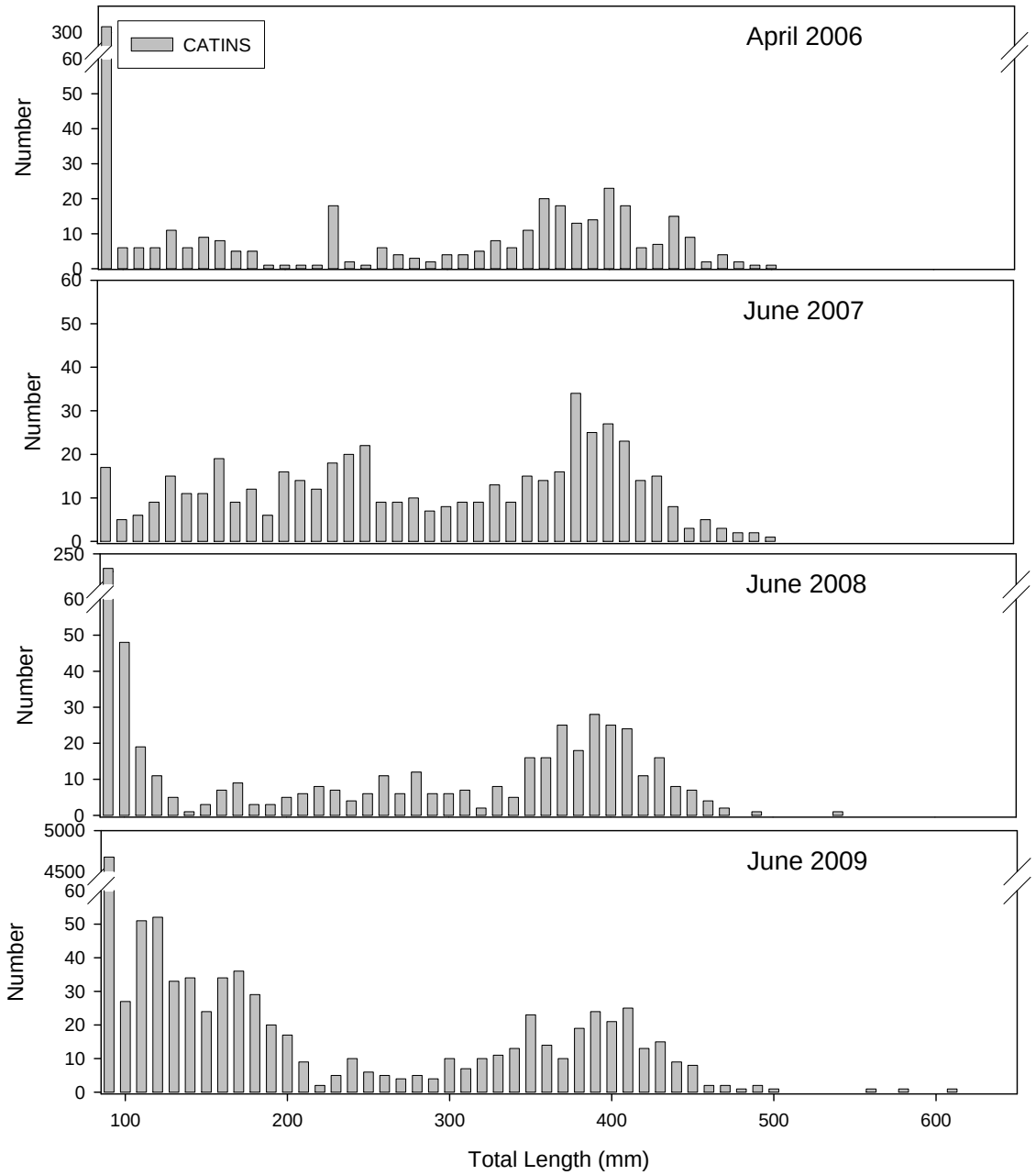


Figure 5. Length frequency histogram of Sonora sucker captured during spring nonnative removal efforts, West Fork Gila River 2006 through 2009.

Large numbers of age-1 headwater chub were collected in June 2009 (Figure 6) though few adults were captured the previous year (2008). Size distribution of Headwater chub was very similar in 2006 and 2007.

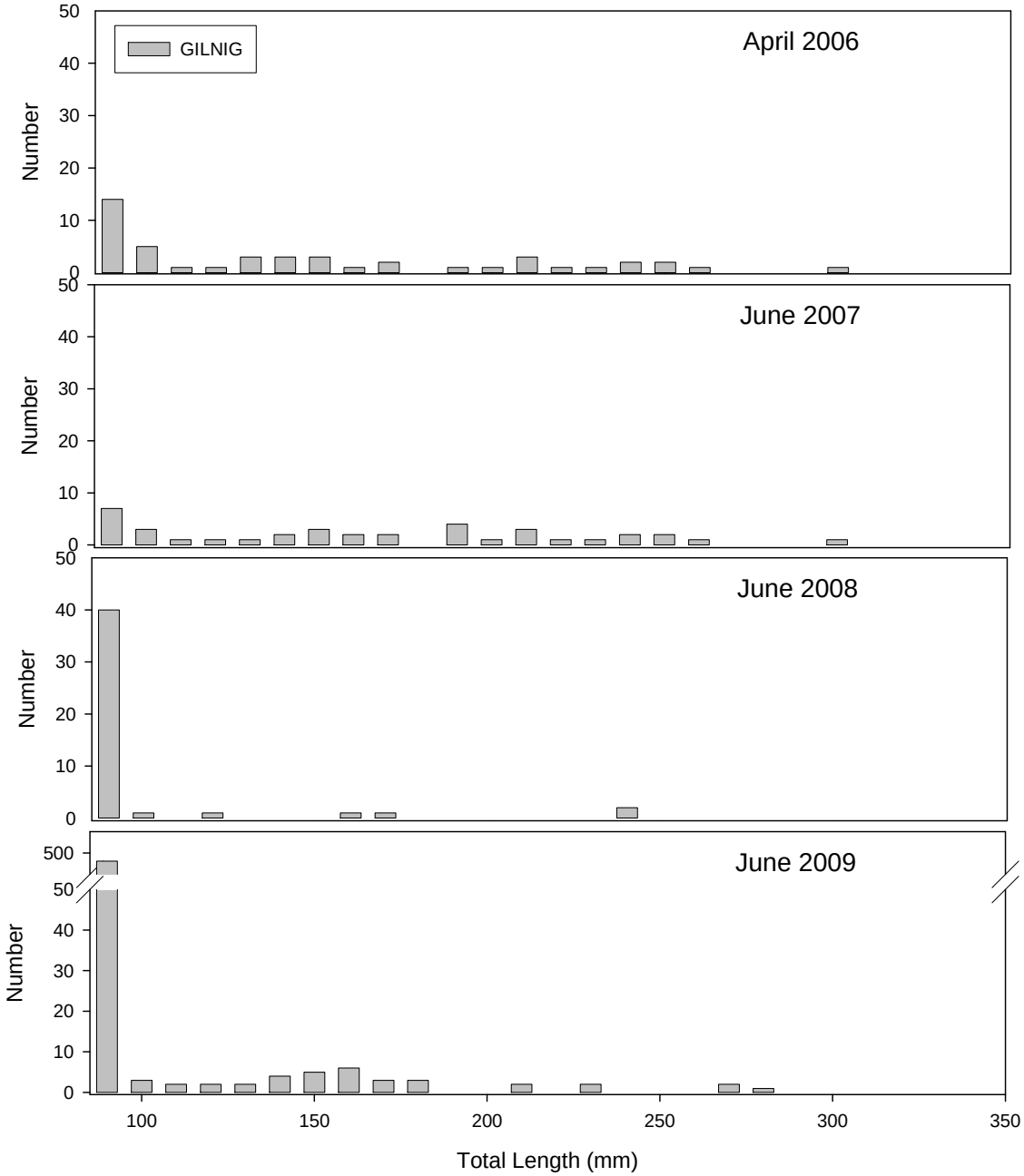


Figure 6. Length frequency histogram of headwater chub captured during spring nonnative removal efforts, West Fork Gila River 2006 through 2009.

Large smallmouth bass (>200mm), present in 2006 and 2007, were absent in 2008 and 2009 (Figure 7). The average length of smallmouth bass was largest in 2007 (199mm, SE=15.8) and smallest in 2008 (96mm, SE=4.2). Very few smallmouth bass were collected in 2008.

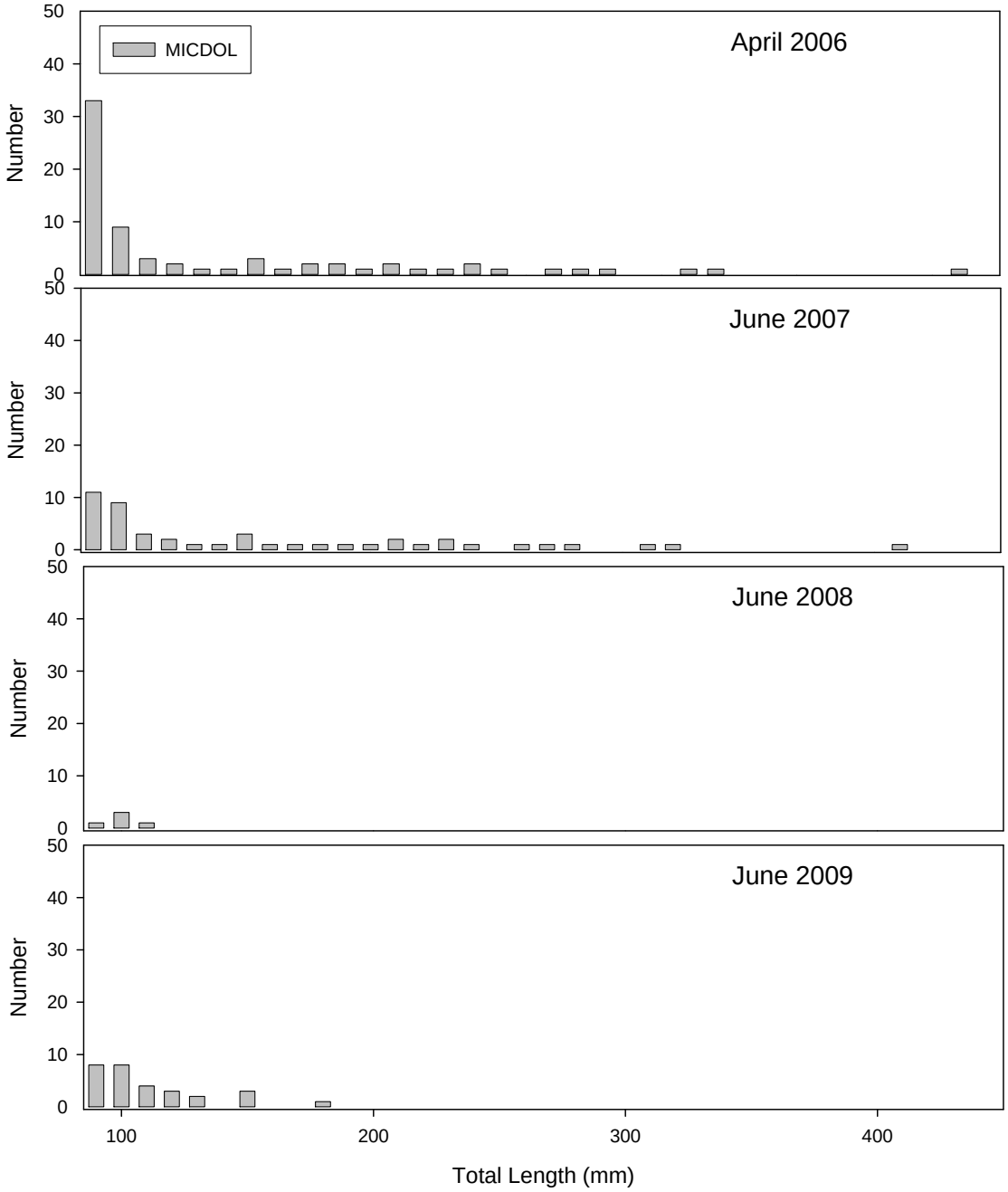


Figure 7. Length frequency histogram of smallmouth bass captured during spring nonnative removal efforts, West Fork Gila River 2006 through 2009.

Though there were large numbers of age-0 and age-1 (<150mm) Desert sucker present in 2006 and 2007, few age 2+ Desert sucker (>150mm) were collected in 2008 (Figure 8). The average size of Desert sucker in 2006 was 213 mm (SE=12.7) while the average size in 2007 and 2008 was less than 126 mm (SE=2.5). Large numbers of young Desert sucker were present in 2009 as well as a few larger individuals, similar to 2006.

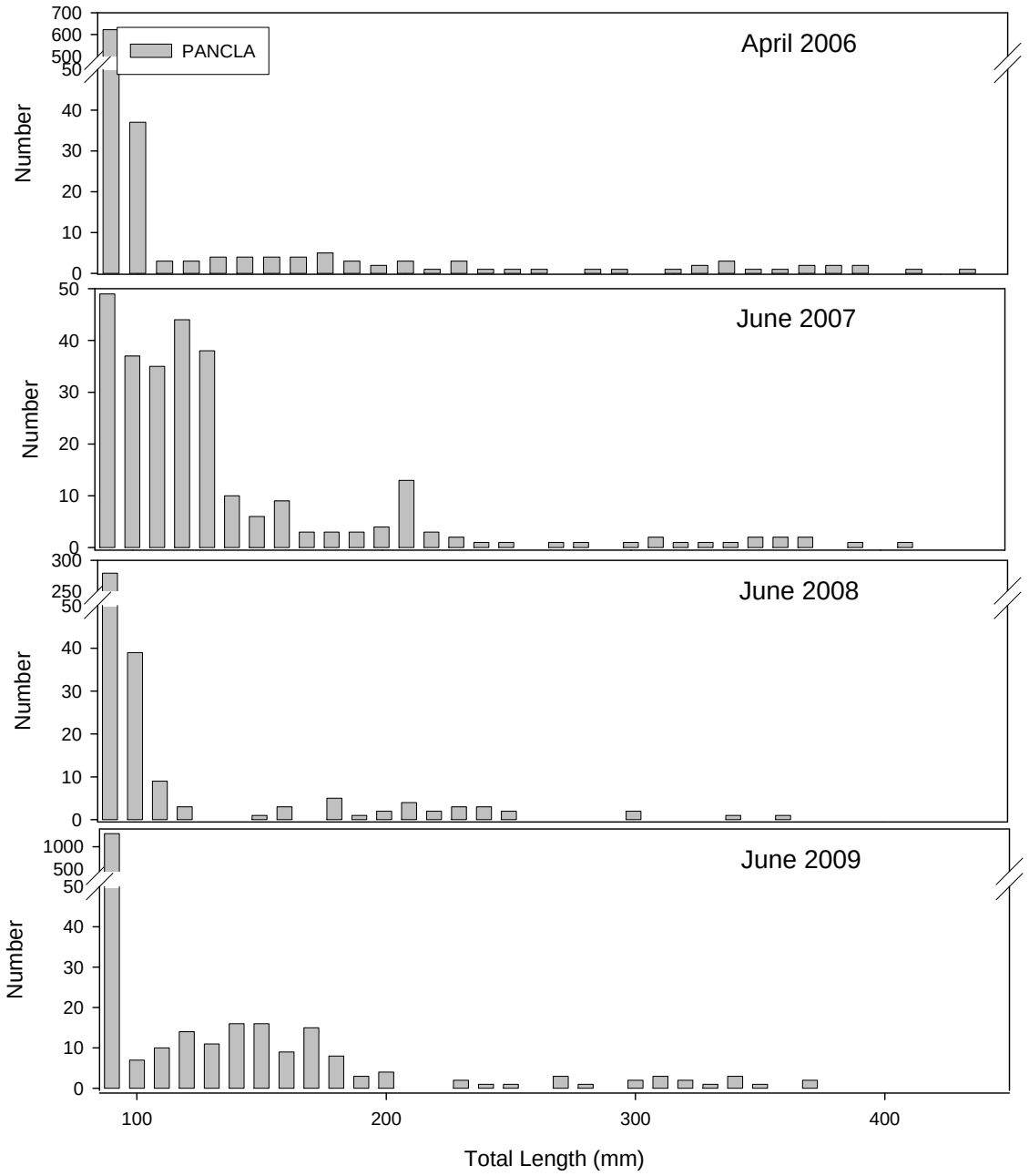


Figure 8. Length frequency histogram of Desert sucker captured during spring nonnative removal efforts, West Fork Gila River 2006 through 2009.

Nonnative salmonids, rainbow and brown trout, were rare in 2008 (Figure 9). Size class distribution was similar in 2006 and 2007 for both species. Large numbers of age-1 rainbow trout were collected in 2009. Most of the brown trout collected in 2009 were >175mm, likely age-2 or greater.

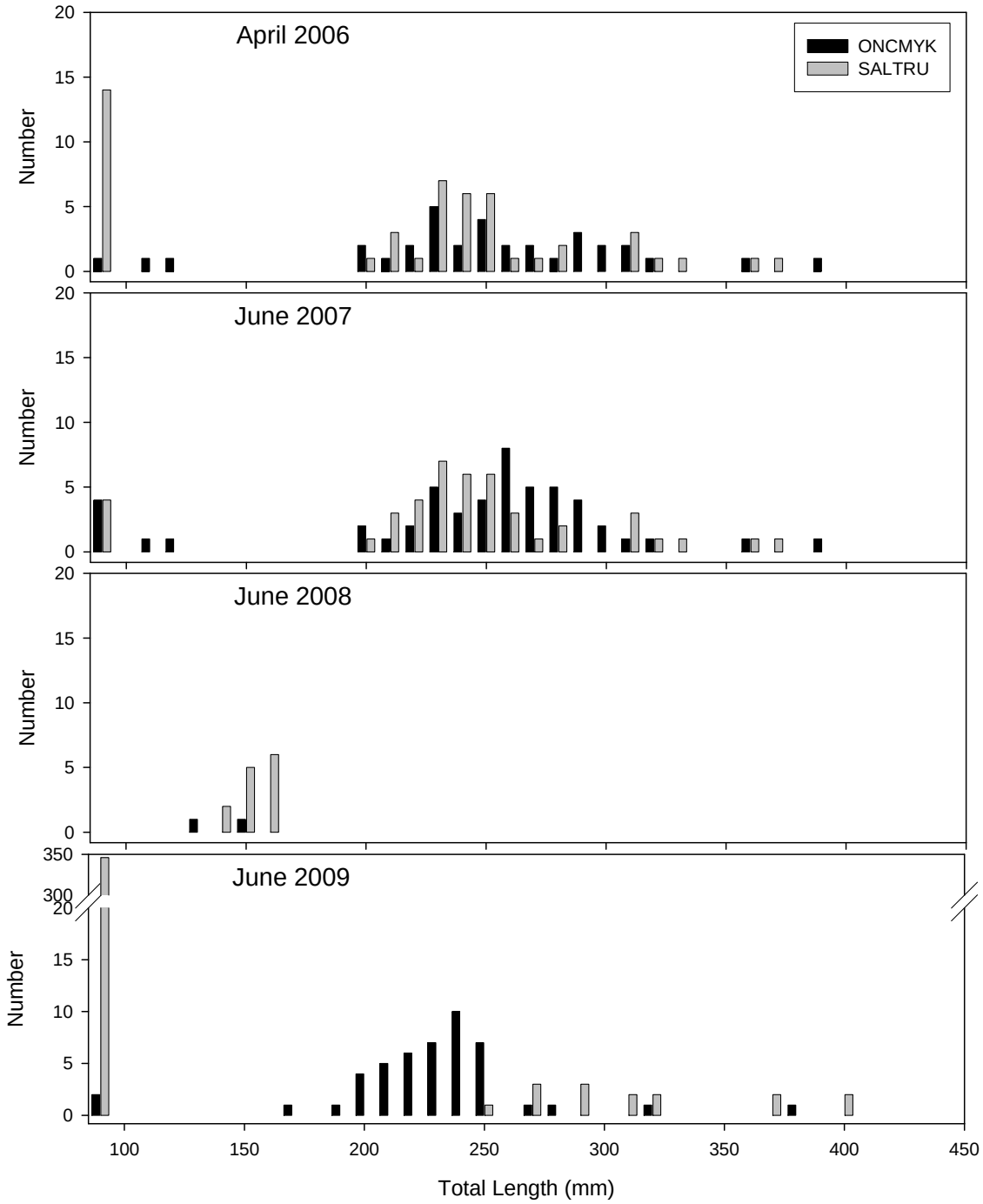


Figure 9. Length frequency histogram of nonnative salmonids (rainbow trout and brown trout) captured during spring nonnative removal efforts, West Fork Gila River 2006 through 2009.

## Summary

- Seven trips between April 2006 and June 2009 removed 1745 nonnative fishes and 326 bullfrogs and tadpoles from the West Fork Gila River.
- Native fish densities were highest in 2009.
- The greatest numbers of all three rare fish species (spikedace, loach minnow, and headwater chub) were collected in 2009.
- Large flow events occurred during the study; August through September 2006, December 2007 and January 2008.
- Numbers of large smallmouth bass (>200mm) declined significantly in 2008 and 2009.
- Numbers of large yellow bullhead (>150mm), though present, were lower in 2008 and 2009 than 2006 and 2007.
- Numbers and sizes of brown trout were similar in 2009 to 2006 and 2007.
- Juvenile rainbow trout were numerous in 2009.
- Results indicate that continued effort of mechanical removal might suppress numbers of nonnative predators within the study area.

## Recommendations

Due to the variable discharge pattern and other environmental variables during the study it is difficult to determine if the change in size and composition of nonnative fishes was all or in part due to the mechanical removal efforts. The decrease in numbers of large nonnative predatory fishes (smallmouth bass and yellow bullhead) may be significant for the continued existence of rare fishes within the Gila forks area. Though the spikedace population in the area is small, it is one of only three remnant populations that exist in numbers great enough to be easily located in sampling efforts. Surveys in the upper portions of the West, Middle, and East Forks of the Gila River indicate that the lower West Fork is the only area that spikedace and loach minnow are consistently present and may be an important area for recruitment of headwater chub into the East Fork Gila. These surveys also indicate that there are not large populations of smallmouth bass, yellow bullhead or other warm-water nonnative fishes in the West and Middle Forks of the Gila River above the study reach but nonnative salmonids are abundant. The East Fork Gila and the main-stem Gila below the study area would likely be the source of further invasions of nonnative warm-water fishes.

## References

Paroz, Y. M, D. L. Propst, and J. A. Stefferud 2006. Long-term monitoring of fish assemblages in the Gila River drainage, New Mexico. Report to U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. New Mexico Department of Game and Fish, Santa Fe.