Ichthyofaunal Inventory of the East, Middle and West Forks Gila River

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New Mexico Department of Game and Fish
and
Gila National Forest

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Gila River Basin Native Fishes Conservation Program
Report No. 1

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Executive Summary

Figure 1. Middle Fork Gila River, New Mexico

Surveys were conducted on the East, Middle, and West Forks Gila River from April 2005 through August 2008 to document fish species occurrence and distribution. Sample sites were spread roughly equidistant throughout the warmwater sections of each fork and were at least 200m in length. Within each site, all mesohabitats were sampled and data from each were separately recorded. Fishes were collected with backpack electrofishing gear and seines. Length and mass were determined for all specimens collected. Following specimen collection, physical dimensions of sampled areas were determined and water quality measured. Field methods were similar to those used to monitor fish populations at Gila-San Francisco drainage permanent sites (Paroz et al. 2006).

Three native fishes (headwater chub *Gila nigra*, Sonora sucker *Catostomus insignis*, and desert sucker *Pantosteus clarkiii*) were collected among eight sites on East Fork Gila River. Six nonnative species (yellow bullhead *Ameiurus natalis*, flathead catfish *Pylodictus olivaris*, rainbow trout *Oncorhynchus mykiss*, western mosquitofish *Gambusia affinis*, green sunfish *Lepomis cyanellus*, and smallmouth bass *Micropterus dolomieui*) were collected in East Fork Gila River, giving it the greatness richness of nonnative species. Few individuals <100 mm total length (TL), native or nonnative, were collected. Sonora sucker was found at all sites, desert sucker at all but one, and headwater chub at four. Sonora sucker was the most common native species. Both yellow bullhead and smallmouth bass were collected at seven locations, and were about equally common.

Four native species (headwater chub, speckled dace *Rhinichthys osculus*, Sonora sucker, and desert sucker) were found among 13 Middle Fork Gila River sites. Sonora sucker was found at all Middle Fork Gila River sites and was the most common species, native or nonnative, found. Desert sucker and speckled dace were common at most locations where collected. Rainbow trout was the most frequently collected nonnative species. Four other nonnative fishes (black bullhead *Ameiurus melas*, yellow bullhead, green sunfish, and smallmouth bass) were collected, but none was frequently collected or common when found.

Six native species (longfin dace *Agosia chrysogaster*, headwater chub, spikedace *Meda fulgida*, speckled dace, Sonora sucker, and desert sucker) were found among 11 West Fork Gila River sites. Speckled dace, Sonora sucker, and desert sucker were found at all and were typically common at each. Headwater chub was found at eight sites, but longfin dace and spikedace were found at only one site. Four nonnative fishes (yellow bullhead, rainbow trout, fathead minnow *Pimephales promelas*, and smallmouth bass) were found in West Fork Gila River. Rainbow trout was found at all sites, but was not abundant at most.

Introduction

Prior to this study, no systematic survey had been conducted on the warmwater reaches of the East, Middle, and West forks Gila River. Huntington (1955) sampled portions of each fork, but his focus was on sport fish and little information on nongame species was provided in his report. Although he apparently sampled portions of West and Middle forks Gila River, Huntington (1955) provided no specific information on warmwater species he encountered in either stream. However, he provided some general information on native fishes in East Fork Gila River. In the early 1970s New Mexico Department of Game and Fish personnel sampled readily accessible portions of each fork, particularly East Fork, and these records provided the first site-specific documentation of nongame species in each fork (Parrish xxxx). Also in the early 1970s, W.L. Minckley and colleagues sampled the mainstem Gila River, but did not venture into the Gila River forks (LaBounty and Minckley 1972). Anderson (1978) sampled much of the East Fork Gila River and lower portions of West and Middle forks Gila River. Propst et al (1986 and 1988) sampled each fork at several locations, but they did not sample the upper warmwater reaches of the West and Middle forks Gila River or middle reaches of East Fork Gila River. Since the mid-1980s, each fork was opportunistically sampled at several locations.

Although previous sampling indicated that the upstream distributional limits of spikedace *Meda fulgida* and loach minnow *Tiaroga cobitis* in West and Middle forks Gila River were near the downstream terminus of each, both species historically occupied the East Fork Gila River from its inception with the confluence of Beaver and Taylor creeks downstream to its confluence with the West Fork Gila River. Based on the limited historical record, speckled dace *Rhinichthys osculus*, Sonora sucker *Catostomus insignis*, desert sucker *Pantosteus clarkiii* likely occurred throughout warmwater reaches of each Gila River fork. Historical collections of headwater chub were mainly from East Fork Gila River and there were few records of longfin dace from any fork, but most of both species were from the East Fork Gila River. Although Gila trout *Oncorhynchus gilae* historically occupied all cool -coldwater stream reaches of the Gila River drainage, it was limited to four headwaters by mid-twentieth century (Miller 1950, Huntington 1955, Mello and Turner 1980, Propst et al., 1992).

Most nonnative coldwater and warmwater species currently inhabiting the Gila River forks were present and established by the 1950s. Huntington (1955) reported smallmouth bass *Micropterus dolomieui*, largemouth bass *M. salmoides*, channel catfish *Ictalurus punctatus*, and yellow bullhead *Ameiurus natalis* from East Fork Gila River. He also reported red shiner *Cyprinella lutrensis* and fathead minnow *Pimephales promelas* in Wall Lake, a small impoundment in upper reaches of Taylor Creek (an East Fork Gila River tributary) and stated that western mosquitofish *Gambusia affinis* was widely distributed in the Gila River drainage. Huntington (1955) also reported rainbow *Oncorhynchus mykiss* and brown *Salmo trutta* trouts in each fork. Anderson (1978) did not find red shiner in any fork, and added no nonnative species to the ichthyofauna of the Gila forks. Propst et al. (1986, 1988) documented persistence of

fathead minnow, yellow bullhead, rainbow trout, brown trout, western mosquitofish, and smallmouth bass in lower reaches of each fork.

Permanent fish assemblage monitoring sites were established on each Gila River fork in the late 1980s (Paroz et al., 2006). The West and Middle forks Gila River sites were near the downstream terminus of each stream and the East Fork Gila River site was in upper reaches of the river. Collections from these sites suggested long-term declines in populations of native fishes, especially longfin dace *Agosia chrysogaster*, headwater chub *Gila nigra*, spikedace *Meda fulgida*, and loach minnow *Tiaroga cobitis* (Paroz et al. 2006, Propst et al, 2008). Although abundance of speckled dace, Sonora sucker, and desert sucker had declined, their declines were less dramatic than the aforementioned species. The declines in native fishes were most pronounced at the Middle Fork Gila River site and least evident at the West Fork Gila River site.

During the past 15 years, several wildfires burned large portions of the West and Middle forks Gila River watershed, but comparatively little of East Fork Gila River watershed was burned. The effect of wildfire associated ash flows on warmwater fish assemblages in each river was largely undocumented, except what might be gleaned from data obtained at permanent sites (Propst et al. 2009). Propst et al. 1992, however, documented the wildfire-caused elimination of Gila trout from Main Diamond Creek. From 1999 through 2004, drought diminished stream flows and this likely affected stream fish assemblages. The watersheds of each fork are almost entirely within the Gila National Forest and large portions of each are within the Gila (West and Middle forks Gila River) and Aldo Leopold (East Fork Gila River) Wildernesses. Consequently, human-related impacts are minimal, and largely a consequence of dispersed recreation and limited livestock grazing.

Over the past 150 years, the ranges of almost all native fishes of the Gila River drainage of Arizona, Sonora, and New Mexico have diminished considerably (Fagan et al. 2005). The lower reaches of West and Middle forks Gila River currently supports one of the few largely intact native fish assemblages in the Gila River drainage. This study was conducted to document the current distribution, and status of fishes in each fork of the Gila River.

Permanent Sites Summary 1988 – 2008

At the East Fork Gila River permanent site desert sucker *Catostomus (Pantosteus) clarkii* and Sonora sucker *Catostomus insignis* were the only native species collected in all years. Longfin dace *Agosia chrysogaster*, collected each year through 2000, has been intermittently found since 2000. Spikedace *Meda fulgida* has not been collected since 2000, speckled dace *Rhinichthys osculus* since 2002, and loach minnow *Tiaroga cobitis* since 1999. Headwater chub *Gila nigra* was absent in 2002 and 2003, but otherwise present. Smallmouth bass *Micropterus dolemieui*, yellow bullhead *Ameiurus natalis*, western mosquitofish *Gambusia affinis* and nonnative Chihuahua catfish *Ictalurus sp.*, an undescribed species, were frequently collected. Native fish relative abundance exceeded 80% in most years from 1988 through 1999, steadily declined from 2000 through 2003, and has been generally greater than 50% since then. Large

smallmouth bass (>200 mm TL) were collected at the site, particularly from 1998 through 2008 (Paroz et al. 2006, Propst et al., 2008).

Seven native and eight nonnative fish species were collected at Middle Fork Gila River Trailhead site from 1988 through 1995. All native species were present in all years, except spikedace in 1991 and 1994. From 2003 through 2005, Sonora and desert suckers were the only native species found at Trailhead site. In 2006, Sonora sucker was the only native species collected. In 2007, four native species were collected; both sucker species, longfin dace (last collected in 1997), and headwater chub (last collected in 2002). Additionally, another two native fishes (longfin dace and speckled dace) were found in 2008; loach minnow was the only native species not found in 2008. Sonora sucker was the only native species collected in all years. Nonnative yellow bullhead and smallmouth bass were collected in all years. Native fish relative abundance was generally greater than 75% from 1988 through 1993, but from 1994 through 2006 exceeded 50% only in 1995. In 2007 and 2008, native fish abundance exceeded 80%.

Seven native and five nonnative fish species have been collected at the West Fork site. Among native fishes, only speckled dace and desert sucker have been collected in all years. Sonora sucker was absent one year and longfin dace and spikedace were absent two years. Loach minnow was last collected in 2001 and headwater chub was present in about one-half the collections since 1989. Number of fish collected (and density) was greater in 2005 than in any year since 1998, but considerably fewer were collected in 2006 and 2007. Fish abundance was higher in 2008, but still considerably less than in late 1980s-early 1990s. Warmwater nonnative fishes were rarely found at West Fork Gila River Cliff Dwellings site, though nonnative salmonids were found in most years.

Objectives of the study were:

1. Determine the distribution and status of native and non-native warmwater fishes in the West, Middle, and East forks of the Gila River.
2. Characterize mesohabitat associations of all native and nonnative warmwater species occupying each fork.
3. Locate potential source populations for individuals to augment depleted populations of rare fishes (i.e., spikedace, loach minnow, and headwater chub).
4. Obtain somatic data (length and mass) from specimens for population size structure characterization and recruitment success evaluation.

Study Area and Methods

The study area included the West, Middle, and East forks Gila River in southwest New Mexico (Figure 2). Almost all of the West and Middle forks are within the Gila Wilderness of the Gila National Forest and a substantial portion of the East Fork is within the Aldo Leopold Wilderness of the Gila National Forest. Portions of East Fork Gila River flow through private lands, no collections were obtained from these private lands.

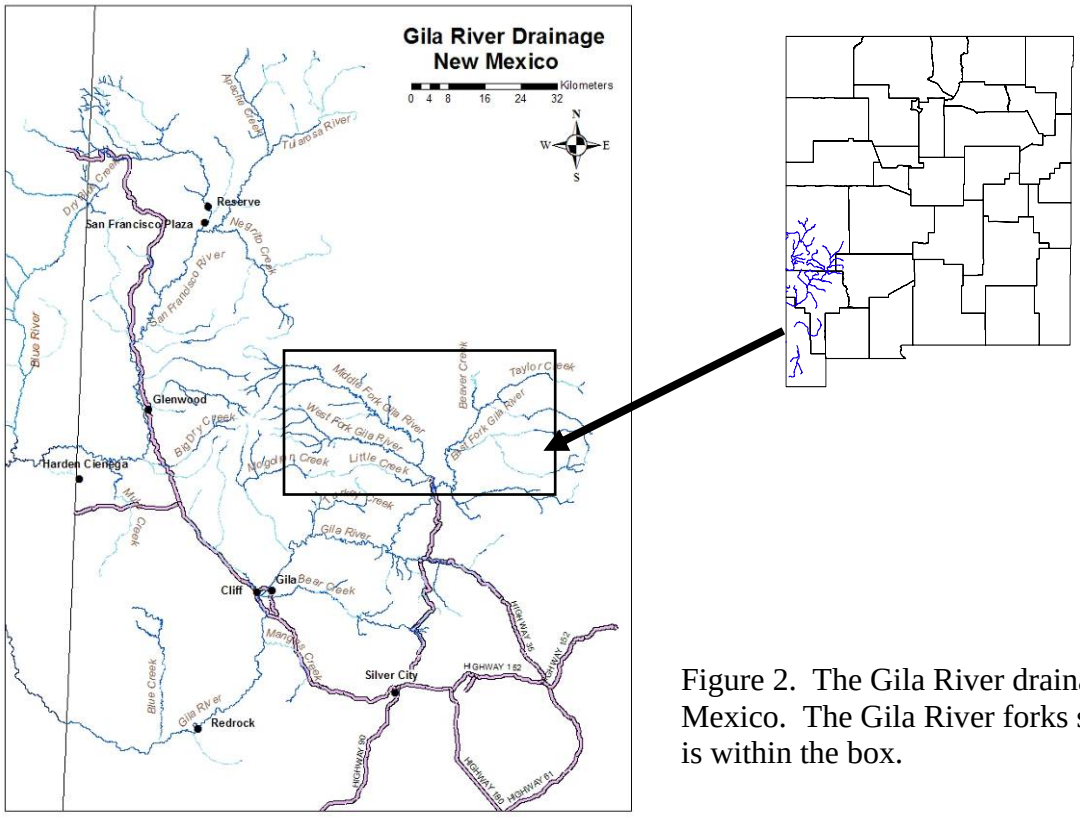

Figure 2. The Gila River drainage, New Mexico. The Gila River forks study area is within the box.

East Fork Gila River

The sites on East Fork Gila ranged from 1700 to 1850 meters in elevation. The river is mainly a C-type channel that wanders through meadows (Rosgen 1996), with low cliffs or hills 100 to 300 m from the stream channel. Woody debris and boulders were rare in the stream. Streamside vegetation consisted mainly of sedges and other riparian grasses with sporadic willows (Figure 3). There were several geothermal features (hot springs) near the floodplain in the lower section of the drainage. Substrate was mainly gravel and sand. There have been no high-intensity wildfires that caused significant ash flow into the system since 1996. Wall Lake, a small impoundment is near the confluence of Beaver and Taylor creeks and upstream of our sampling sites.

Figure 3. East Fork Gila River, New Mexico at Black Canyon confluence and Trails End Ranch.

Middle Fork Gila River

The sites on Middle Fork Gila River ranged from 1750 to 2160 meters in elevation. The river was generally a B-type channel in a canyon-bound area (Figure 4). The middle sections contained several large meadows. Boulders and woody debris were common. Streamside vegetation included alder, willow, and other deciduous trees as well as ponderosa pine. There were numerous geothermal springs in the drainage from the West Fork confluence upstream through the Meadows section below the confluence of Clear Creek. Substrate ranged from large cobble and boulder to silt and sand. The Bear Wildfire burned large portions of the upper watershed in 2006 and a large flood occurred in January 2008. Snow Lake, a small impoundment just outside the Gila Wilderness boundary, is in the upper reaches of the Middle Fork Gila River drainage. Nonnative rainbow trout *Oncorhynchus mykiss*, common carp *Cyprinus carpio*, and green sunfish *Lepomis cyanellus* occupied Snow Lake.

Figure 4. Middle Fork Gila River, New Mexico, near Canyon Creek confluence and Loco Mountain trail.

West Fork Gila River

The sites on West Fork Gila ranged from 1720 to 2010 meters in elevation. The physiographic features of West Fork Gila River were similar to Middle Fork Gila River; generally, a canyon-bound B-type channel with coarse substrata. Riparian vegetation included alder, willow, and other deciduous trees with large clumps of sedges along stream margins (Figure 5). Unlike the other two forks, there was little influence from geothermal springs. Several large wildfires burned most of the upper watershed in the past decade. Almost all of the West Fork Gila River catchment was within the Gila Wilderness and no impoundments or diversions were present.

Figure 5. West Fork Gila River, New Mexico, near Ring Canyon confluence and below Hells Hole.

Field Methods

Fish were collected from sites roughly equidistantly apart on each fork. Sites were a minimum of 200 m in length and selected where a diversity of habitats was present. Location (UTM) of the downstream terminus of each site was recorded (Figure 6, Table 1).

All mesohabitats (e.g., pool, pool-run, and riffle) within a site were sampled in rough proportion to their availability within each site. Fish were collected by mesohabitat. Each fish collected in a mesohabitat was identified, length and mass determined, released if native, and retained if nonnative. Collection data were recorded by mesohabitat. Fishes were stunned with battery-powered backpack electrofishing gear and collected with dipnets. In suitable mesohabitats, seines were used to collect specimens or used in tandem with backpack electrofisher to collect specimens from riffle habitats. Overall, methods were similar to those used for monitoring Gila River permanent sites (Paroz et al. 2006). Effort was recorded as CPUE (seconds shocked and area sampled). All data were recorded on standard field forms. For each mesohabitat, type, depth, primary substrata, and cover were noted.

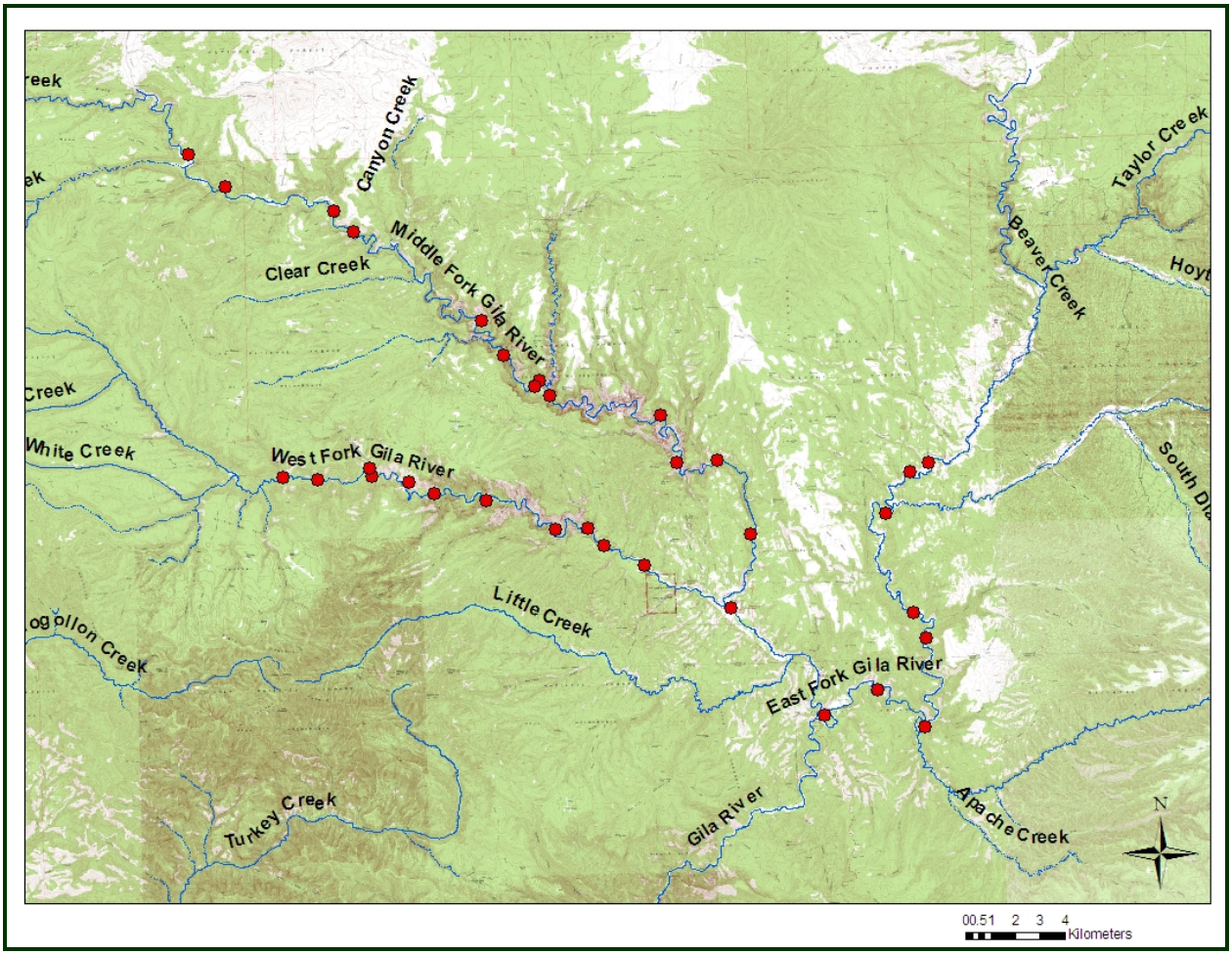

Figure 6. Sampling locations in the East, Middle and West Forks Gila, New Mexico2005 through 2008.

Table 1. Sample date and collection locations (NAD83) on East, Middle and West forks Gila River, New Mexico, 2005 through 2008.

Drainage	Site Number	Date Sampled	UTM-r	UTM-n	UTM-e	Total Area Sampled (m^2)
East Fork	1	11-May-05	12S	760848	3674860	210
	2	26-Apr-07	12S	763025	3675907	244
	3	26-Apr-07	12S	764922	3674404	193
	4	21-Apr-05	12S	764970	3678016	330
	5	21-Apr-05	12S	764463	3679035	452
	6	20-Apr-05	12S	763340	3683060	388
	7	20-Apr-05	12S	764335	3684738	462
	8	25-Apr-07	12S	765057	3685111	236
Middle Fork	1	13-May-08	12S	757870	3682238	227
	2	13-May-08	12S	756508	3685223	320
	3	14-May-08	12S	754876	3685128	108
	4	14-May-08	12S	754206	3687054	358
	5	10-Jul-08	12S	749723	3687834	283
	6	10-Jul-08	12S	749291	3688462	75
	7	10-Jul-08	12S	749114	3688217	259
	8	9-Jul-08	12S	747824	3689464	177
	9	9-Jul-08	12S	746952	3690875	164
	10	27-Aug-08	12S	741735	3694518	291
	11	27-Aug-08	12S	740935	3695343	160
	12	26-Aug-08	12S	736525	3696340	352
	13	26-Aug-08	12S	735053	3697634	306
West Fork	1	24-May-06	12S	757049	3679209	265
	2	23-May-06	12S	753538	3680977	214
	3	23-May-06	12S	751898	3681749	283
	4	22-May-06	12S	751248	3682453	155
	5	22-May-06	12S	749941	3682426	662
	6	24-May-07	12S	747147	3683565	249
	7	24-May-07	12S	745023	3683855	197
	8	25-May-07	12S	744014	3684352	288
	9	22-May-07	12S	742515	3684549	293
	9.5	25-May-07	12S	742394	3684869	--
	10	23-May-07	12S	740288	3684423	233
	11	23-May-07	12S	738880	3684525	185
Grand Total						8619

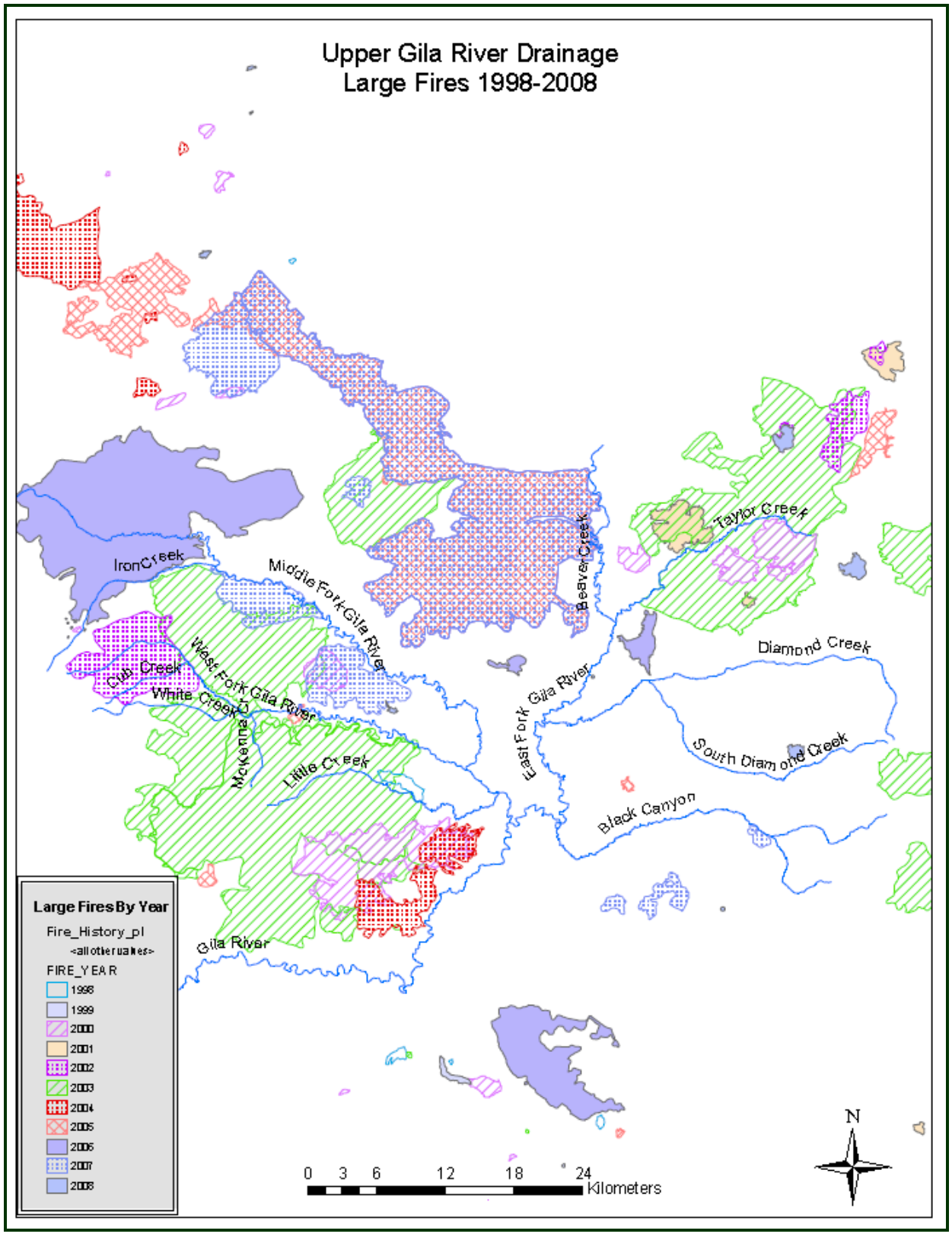

Figure 7. Wildfire history of Gila River Forks area,1998 through 2008.

Results and Discussion

Thirty two sites were sampled between April 2005 and August 2008. Fifteen species of fishes were collected (Table 2). Sonora sucker and desert sucker were the most common large-bodied fish collected in all forks. Speckled dace was abundant in Middle and West forks of the Gila and absent from East Fork Gila River. Longfin dace was only collected in the lower portion of West Fork Gila River. Three western mosquitofish specimens were the only small-bodied species collected in East Fork Gila River. Salmonids were the only nonnative species commonly collected in Middle and West forks Gila River. Smallmouth bass and/or yellow bullhead were collected at all sites on East Fork Gila River.

Juvenile large-bodied fishes were uncommon in East Fork Gila River. Less than 20 age-0 and age-1 Sonora sucker and desert sucker specimens were collected in the East Fork Gila River while hundreds of young of both spcies were found in each of the other two forks (Figures 8 and 9). Numbers of adult suckers were similar in all forks.

Table 2. Fishes collected from East, Middle and West forks Gila River, New Mexico, 2005-2008.

Family	Common Name	Species	Status	Species Code	East Fork Gila	Middle Fork Gila	West Fork Gila	Total
Cyprinidae	Longfin dace	*Agosia chrysogaster*	*Native*	AGOCHR	0	0	4	4
	Headwater chub	*Gila nigra*	*Native*	GILNIG	12	51	161	224
	Spikedace	*Meda Fulgida*	*Native*	MEDFUL	0	0	119	119
	Speckled dace	*Rhinichthys osculus*	*Native*	RHIOSC	0	436	605	1041
	Fathead minnow	*Pimephales promelas*	*Introduced*	PIMPRO	0	0	1	1
Catostomidae	Desert sucker	*Catostomus (Pantosteus) clarkiii*	*Native*	PANCLA	72	215	310	597
	Sonora sucker	*Catostomus insignis*	*Native*	CATINS	186	452	592	1230
Centrarchidae	Green sunfish	*Lepomis cyanellus*	*Introduced*	LEPCYA	4	23	0	27
	Smallmouth bass	*Micropterus dolomieui*	*Introduced*	MICDOL	39	3	16	58
Ictaluridae	Black bullhead	*Ameiurus melas*	*Introduced*	AMEMEL	0	7	0	7
	Yellow bullhead	*Ameiurus natalis*	*Introduced*	AMENAT	21	11	24	56
	Flathead catfish	*Pylodictis olivaris*	*Introduced*	PYLOLI	4	0	0	4
Poeciliidae	Western mosquitofish	*Gambusia affinis*	*Introduced*	GAMAFF	3	0	0	3
Salmonidae	Rainbow trout	*Oncorhynchus mykiss*	*Introduced*	ONCMYK	2	85	96	183
	Brown trout	*Salmo trutta*	*Introduced*	SALTRU	5	46	134	185

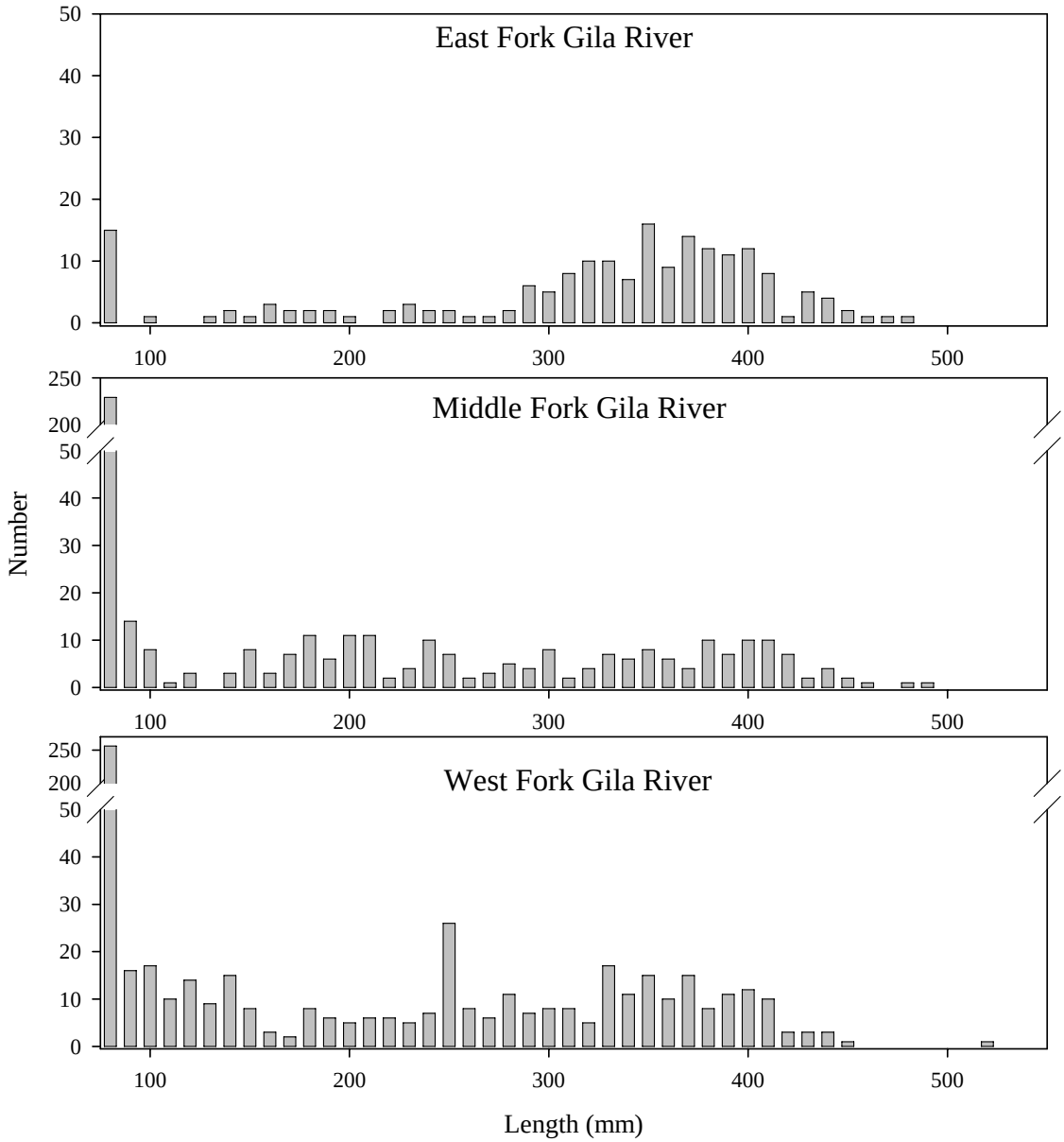

Figure 8. Length frequency of Sonora sucker collected in the East, Middle, and West Forks of the Gila River, New Mexico, 2005-2008.

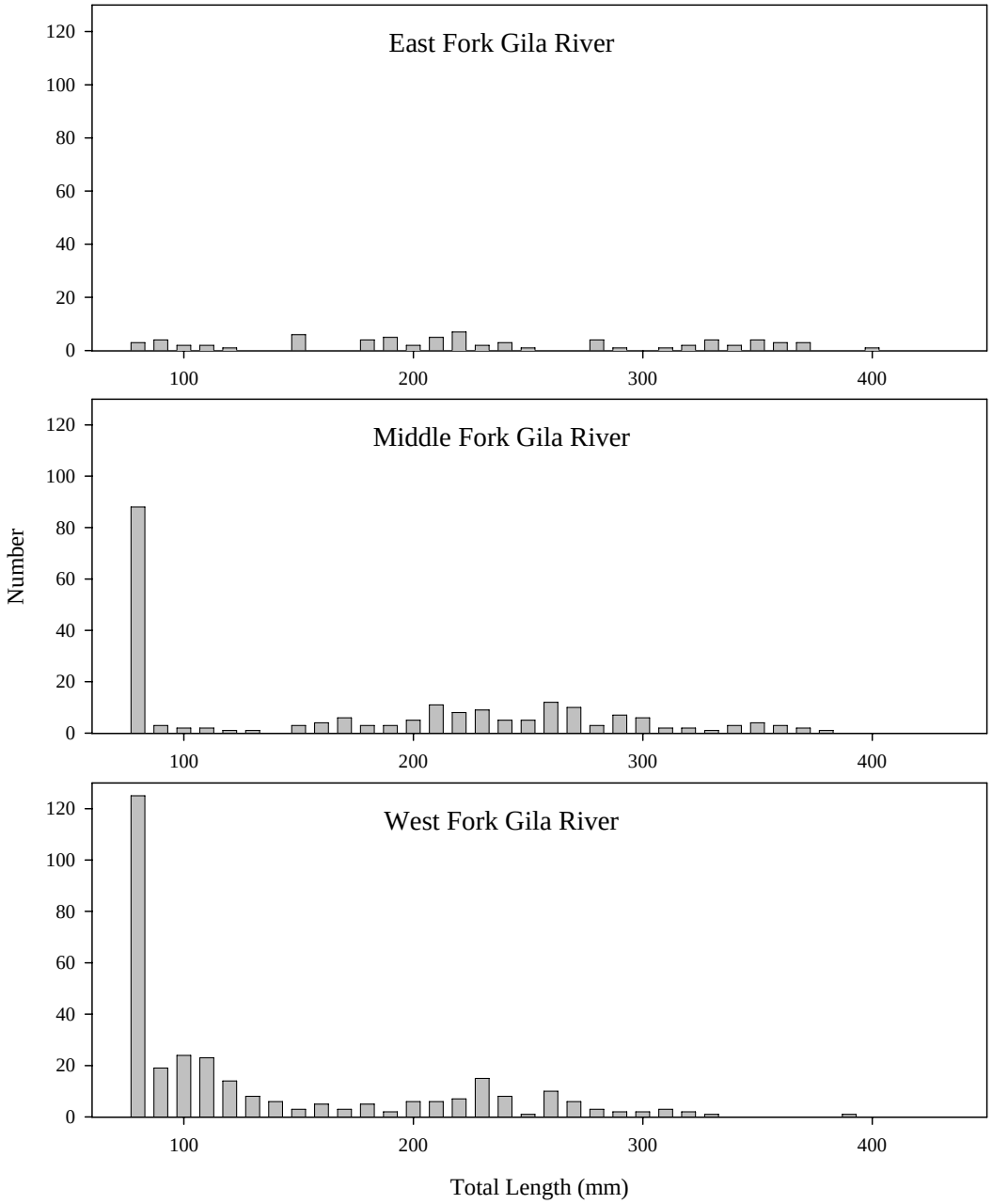

Figure 9. Length frequency of desert sucker collected in the East, Middle, and West Forks of the Gila River, New Mexico, 2005-2008.

In each fork, headwater chub was present if pools with some type of cover (e.g., woody debris, root wads, undercut banks, or boulders) were within the site (Figure 10). Several juvenile headwater chub specimens were collected in Middle and West forks Gila River, but only a single juvenile was found in East Fork Gila River, at the confluence with West Fork Gila River (Figure 11). Based upon number of juvenile headwater chub specimens collected, it is likely that the lower portion of the West Fork Gila River is an important spawning and nursery area for headwater chub.

Figure 10. Headwater chub habitat, West Fork Gila River and adult headwater chub.

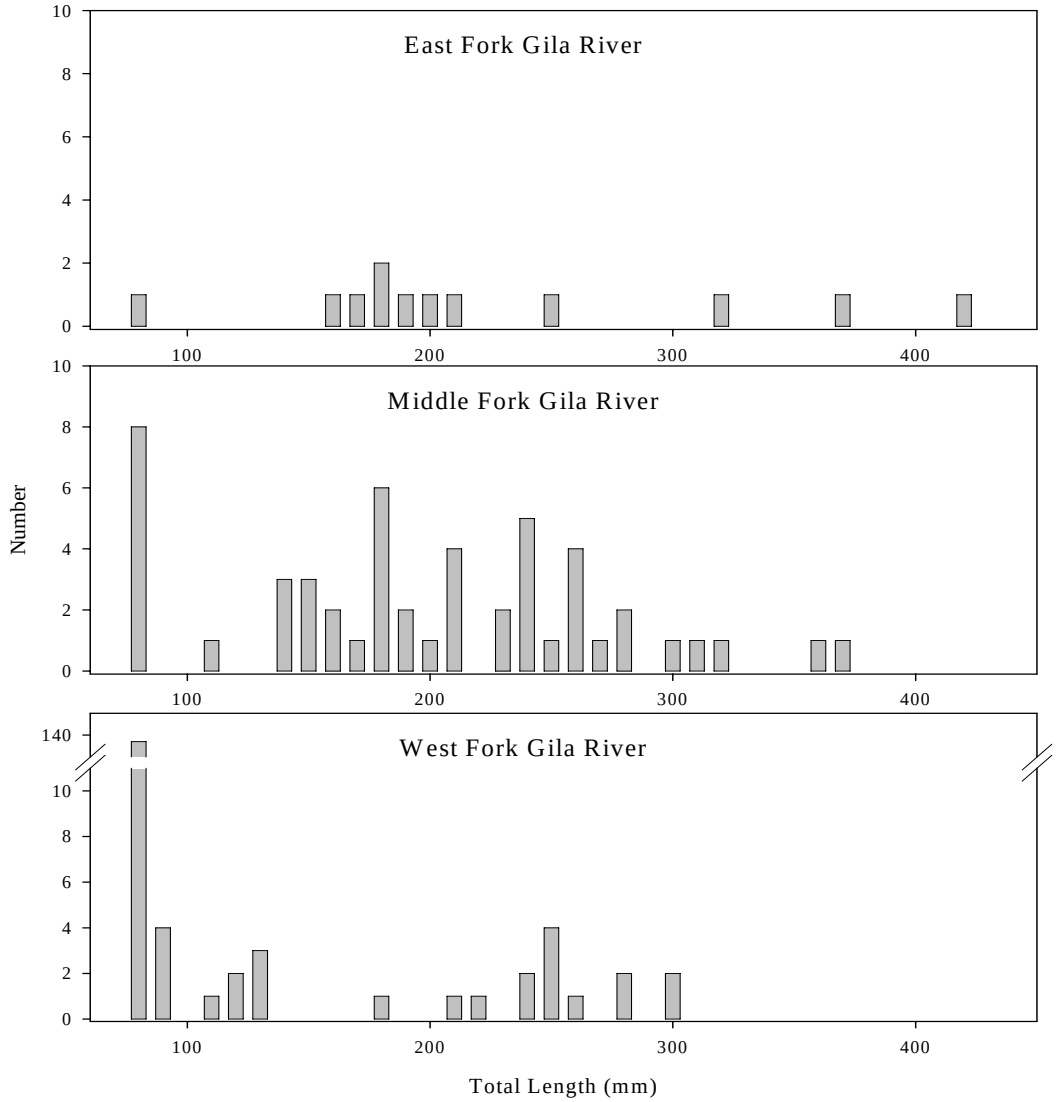

Figure 11. Length frequency of headwater chub collected in the East, Middle, and West forks Gila River, New Mexico, 2005-2008.

Several length-classes of yellow bullhead were present at most sites on the East Fork Gila River (Figure 12). A few individuals were captured in the lower portion of the Middle and West Forks; however, the majority of yellow bullhead captured in the Middle Fork Gila River were from a single off channel spring system.

Figure 12. Length frequency of yellow bullhead collected in the East, Middle, and West forks Gila River 2005-2008.

The East Fork Gila River was the only stream where multiple size classes of smallmouth bass were present (Figure 13). Smallmouth bass was captured at all sites on East Fork Gila River, except one. Several age-1 smallmouth bass were found in a short reach of West Fork Gila River, whereas only three individuals were collected in the Middle Fork Gila River.

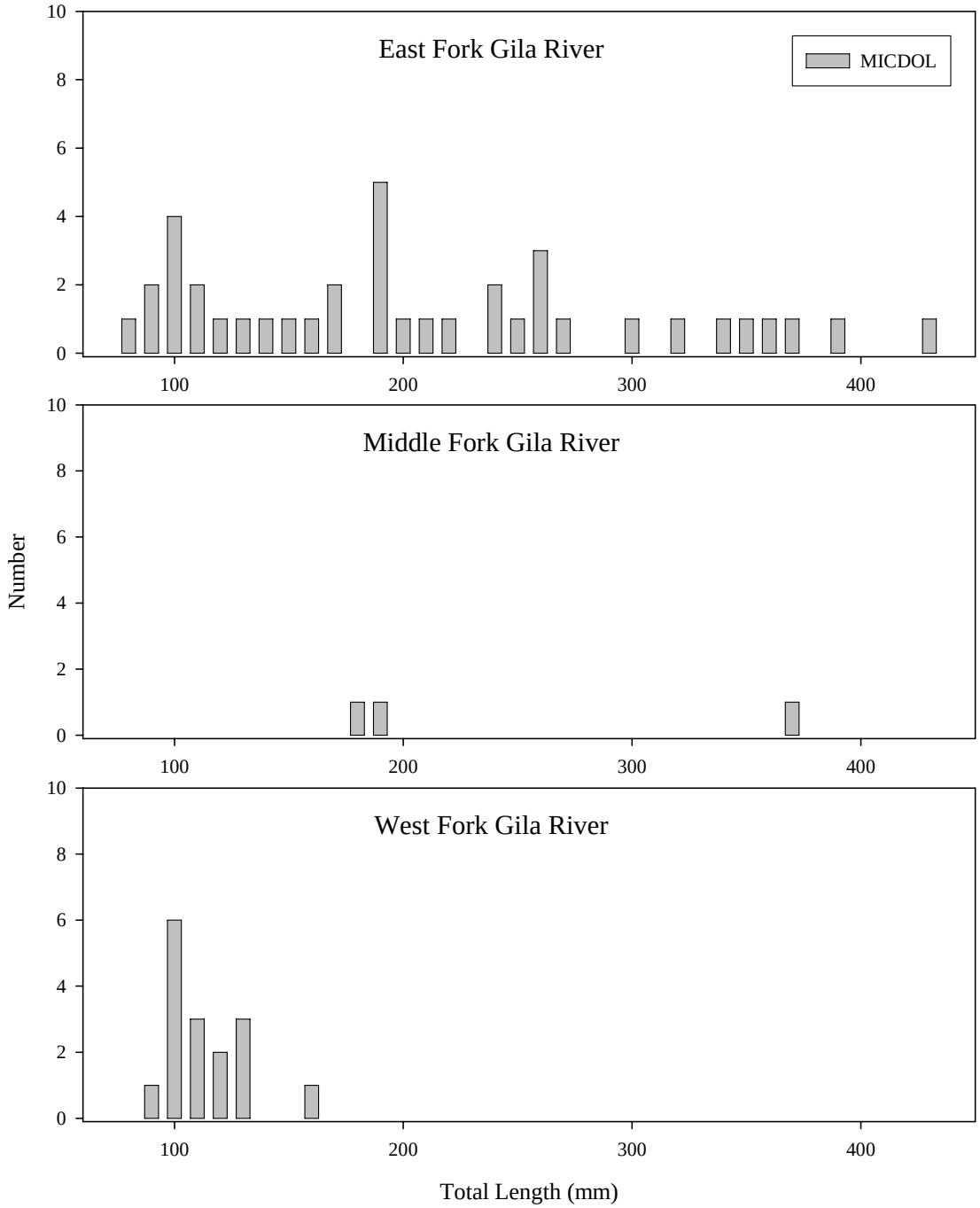

Figure 13. Length frequency of smallmouth bass collected in the East, Middle, and West forks Gila River, New Mexico, 2005-2008.

Multiple age classes of rainbow and brown trout were collected in the Middle and West Forks Gila River (Figure 14). Neither fork has been stocked by New Mexico Department of Game and Fish since the early 1990s so these populations have maintained themselves as wild fisheries. Trout were uncommon in East Fork Gila River.

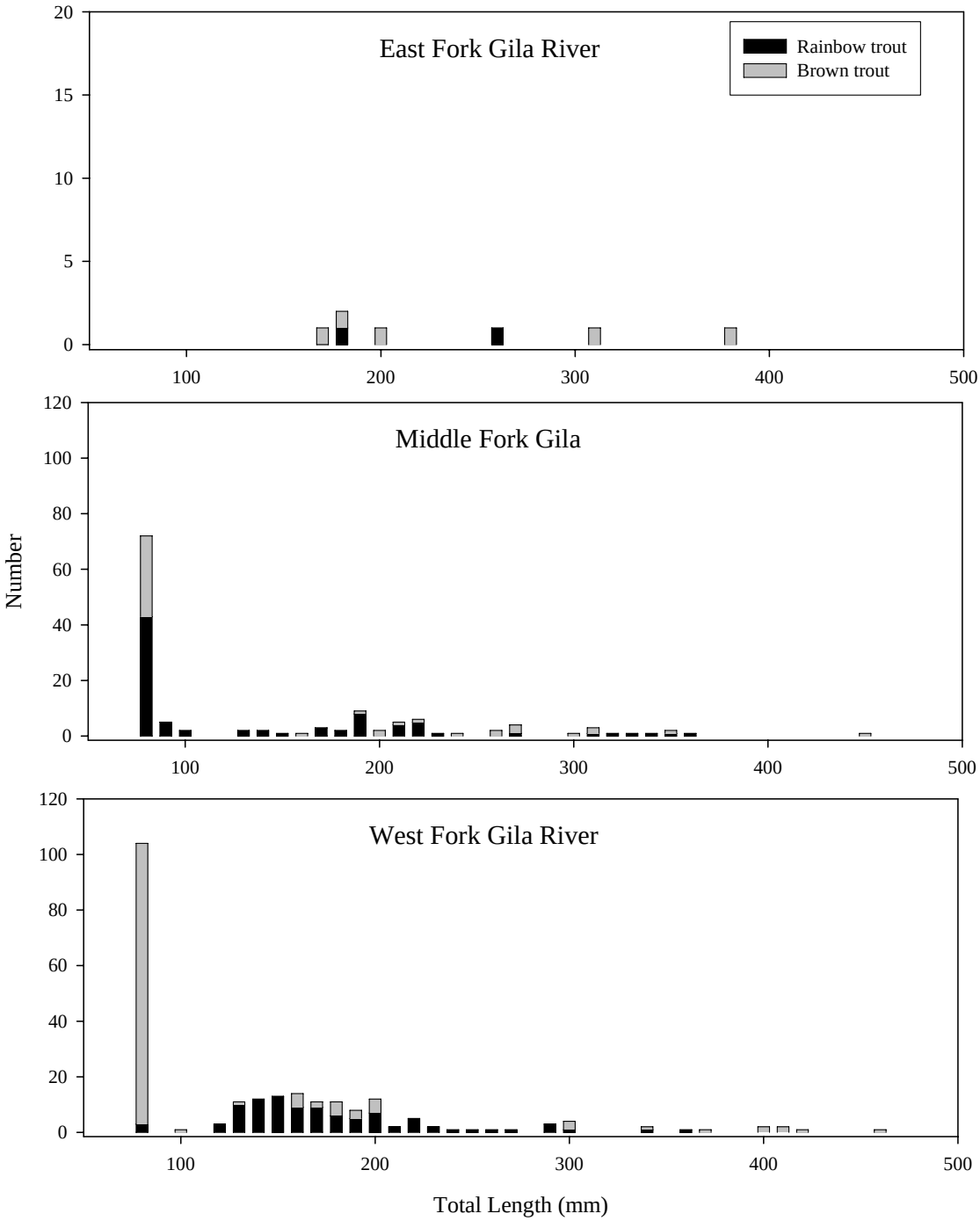

Figure 14. Length frequency of rainbow and brown trouts collected in the East, Middle, and West forks Gila River, New Mexico, 2005-2008.

East Fork Gila River was the only fork where smallmouth bass and yellow bullhead were present in most samples. Smallmouth bass was especially common in the lower sites of the East Fork Gila River. Fish assemblages were taxonomically similar at most sites in the Middle and West forks Gila River, consisting mainly of a native fishes (Sonora sucker, desert sucker, speckled dace, and headwater chub) and nonnative trout (rainbow trout and brown trout). An off-channel warm spring on the Middle Fork Gila River contained almost exclusively nonnative green sunfish, black bullhead, and yellow bullhead. These species were not in nearby stream collections. Although ash flows from recent wildfires had occurred in both the Middle and West forks Gila River, fish were distributed, and comparatively common, throughout each system (Figure 15).

Habitats sampled in the East Fork Gila River contained a greater proportion of optimal habitats for spikedace (shoal) and loachminnow (riffle), but neither species was collected. Loach minnow and spikedace were typically present in low numbers in the nonnative removal section West Fork Gila River between confluences of Middle and East forks Gila River, but only a few spikedace were collected at a site just upstream of the Gila Cliffdwellings on the West Fork in slow run habitat.

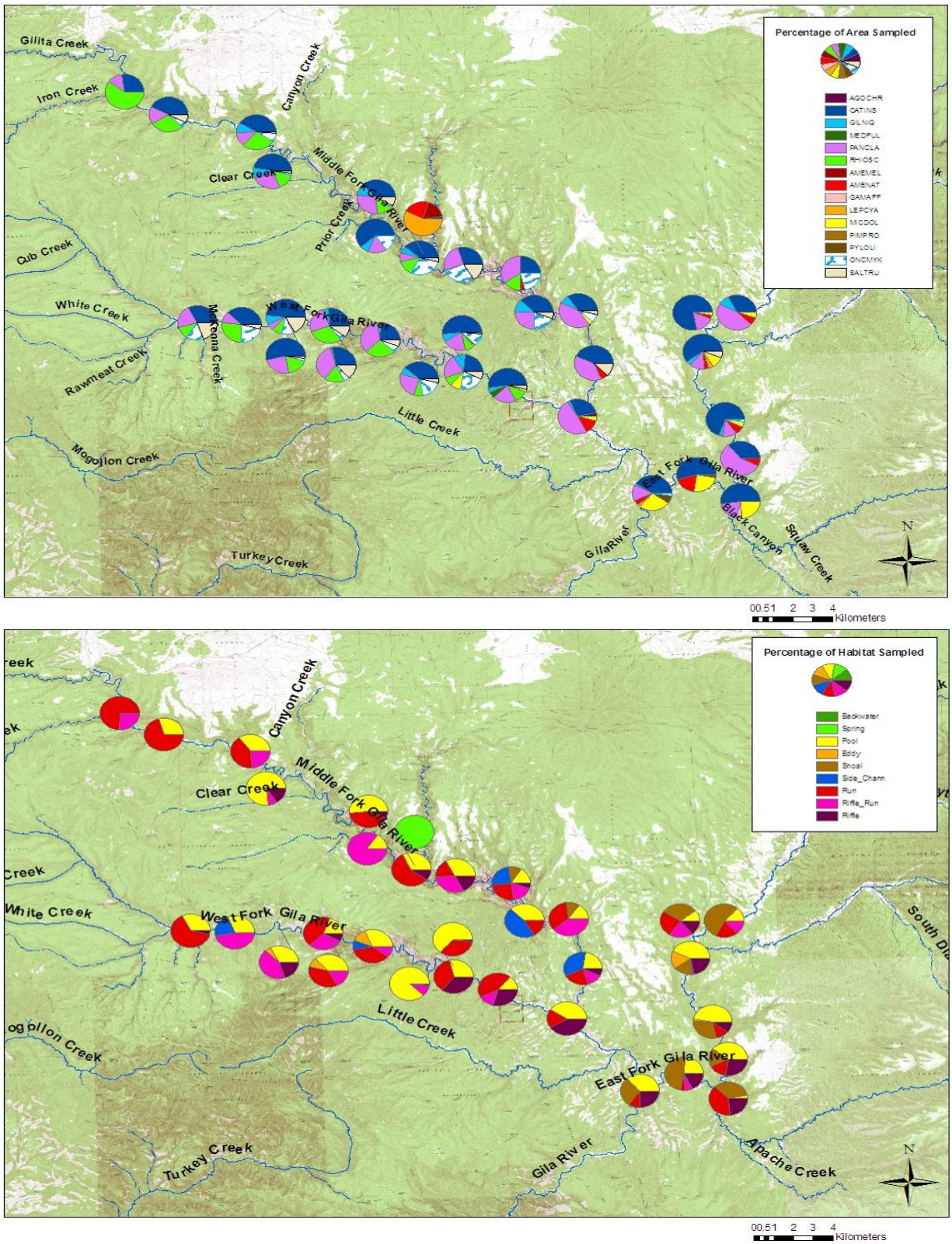

Figure 15. Relative abundance of each species collected and proportion of each habitat sampled at sites in the East, Middle and West forks Gila River, 2005-2008.

Density of most native species (Sonora sucker, desert sucker, and headwater chub) in pool habitats were similar among the three forks ($F_{(2, 79)}$<0.226, p>0.797), with the exception of speckled dace being absent from East Fork Gila River (Figure 16). Density of smallmouth bass was significantly higher in East Fork Gila River than the Middle or West forks Gila River ($F_{(2, 79)}$=4.6675, p=0.012-Tukey HSD p<0.035). Riffle and riffle run habitats contained few fish in East Fork Gila River whereas nonnative trout and small native fishes were relatively common in these habitats in the Middle and West forks Gila River. Headwater chub was only found in pool habitats in the East Fork Gila River, but in the Middle and West forks Gila River a few individuals (mainly juveniles) were found in other habitats.

There was no clear longitudinal (downstream to upstream) density pattern of native or nonnative fishes (Figure 17 and 18). However, Sonora sucker, speckled dace, rainbow trout, and brown trout densities were positively correlated with latitude while that of yellow bullhead and smallmouth bass were negatively correlated (r>0.13, p<0.03). Density of most large-bodied species was positively correlated with densities of other fishes (r>0.16, p<0.02), thus species density was likely more related to the location being sampled than the effect of other fish being in the area.

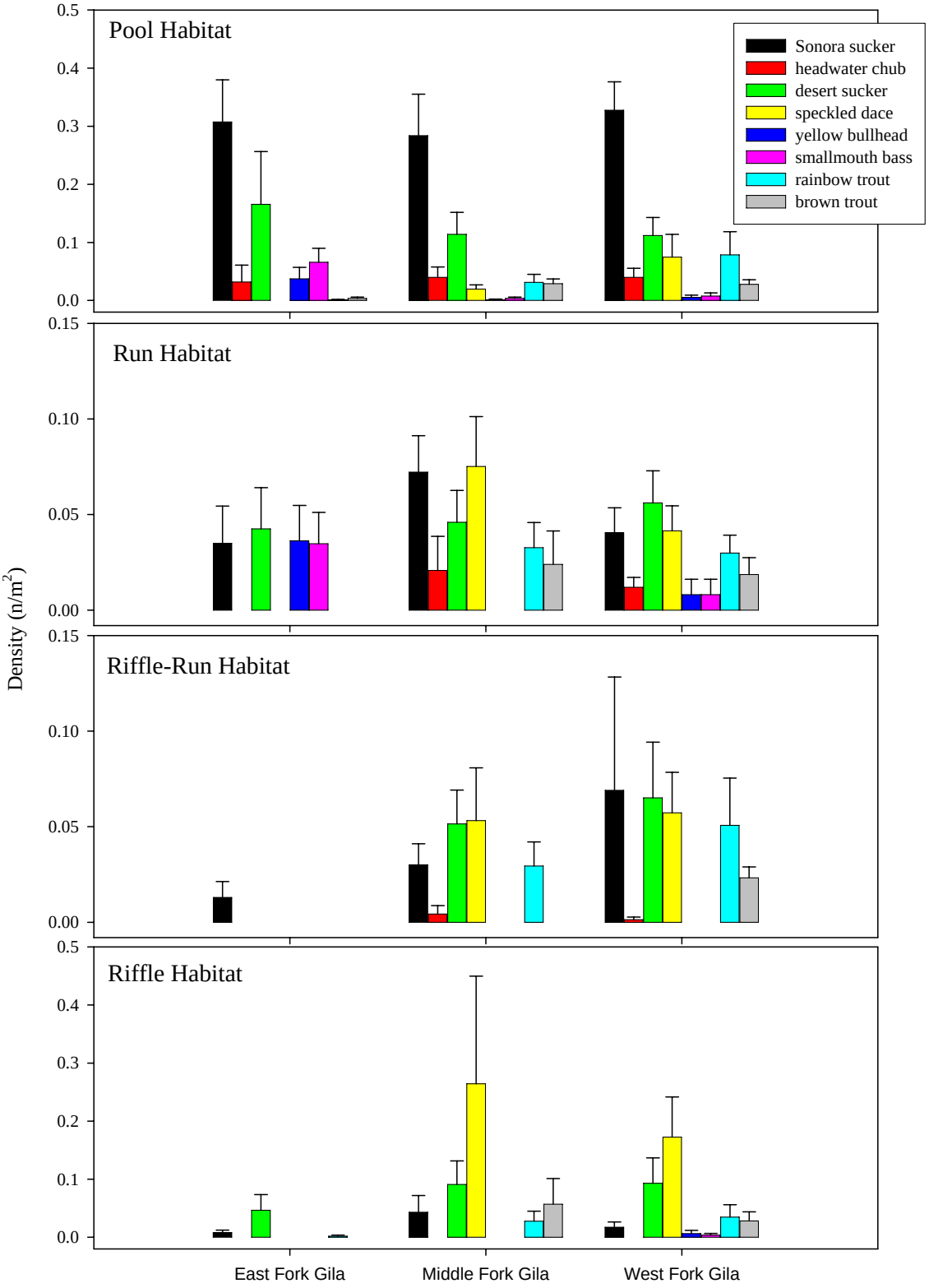

Figure 16. Density (n/m^2) of fishes in mesohabitats of the East, Middle, and West forks Gila River, New Mexico, 2005-2008. Error bars represent one standard error.

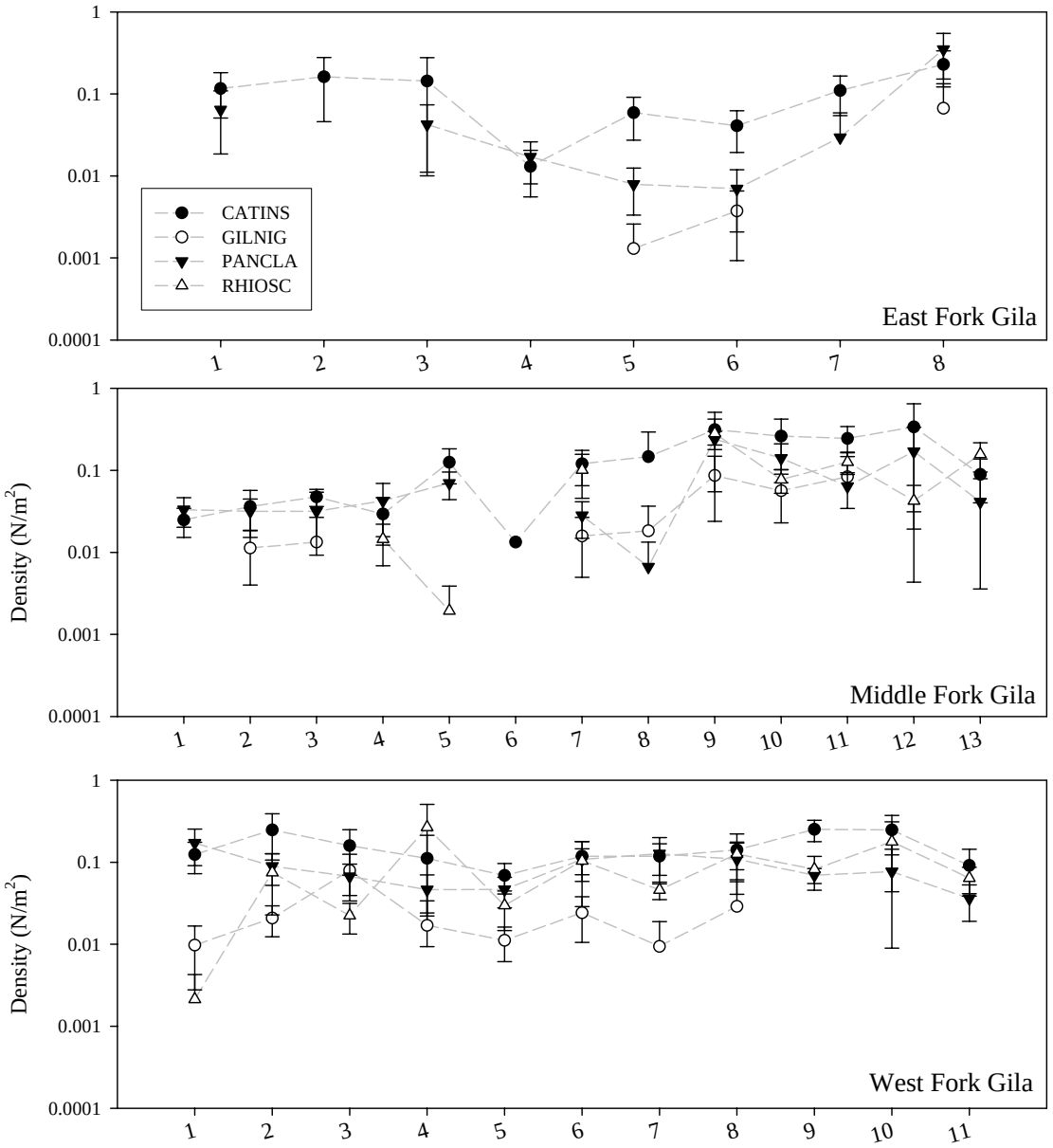

Figure 17. Density (n/m^2) of commonly collected native species from downstream to upstream locations in the East, Middle and West forks Gila River, New Mexico, 2005-2008. Error bars represent one standard error. See Table 1 for site locations. Note log scale for density.

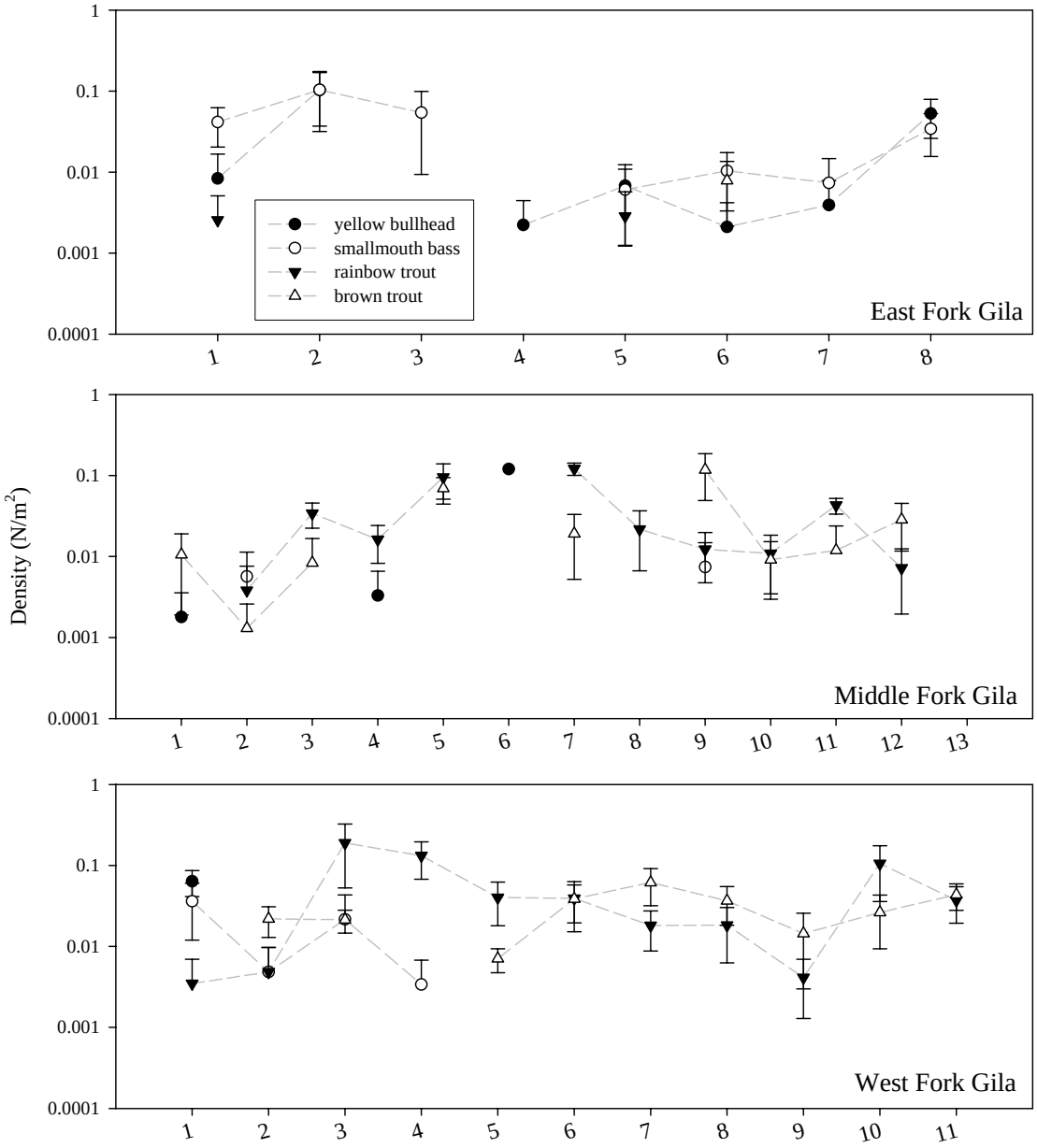

Figure 18. Density (n/m^2) of commonly collected nonnative species from downstream to upstream locations in the East, Middle and West forks Gila River, New Mexioc, 2005-2008. Error bars represent one standard error. See Tabel 1 for site number locations. Note log scale for density.

Opportunistically collected, non-fish aquatic species collected were recorded in the field notes. Of special note was collection of narrow-headed garter snakes *Thamnophis rufipunctatus* at several sites on the Middle Fork Gila River (Figure 19). These records were reported to the NMDGF and Gila National Forest herpetological specialists.

Figure 19. Narrow-headed garter snake captured on Middle Fork Gila River, New Mexico, 2008.

Recommendations

The species composition in East Fork Gila River has changed dramatically in the past 20 years. Small-bodied fishes that were collected in the 1980s are currently extremely rare in the system. Habitat conditions in East Fork Gila River have not changed appreciably so it is likely that the nonnative fishes in the system have had a negative impact on the native fish fauna. It also appears that recruitment of native fishes within East Fork Gila River is low and native populations are sustained by migrants from adjacent rivers. Removal of nonnative fishes from East Fork Gila River may improve recruitment of native fishes and also allow the re-establishment of small-bodied fish. There is some sport-fishing for smallmouth bass in East Fork Gila River, and their removal or control might be somewhat controversial. Regardless, there are few locations in the Gila River drainage in New Mexico that continue to support a largely intact native fish assemblage and all reasonable and feasible efforts to secure the Gila River forks for native fishes should be made.

Prior to this survey there was limited sampling of Middle and West forks Gila River. Consequently, it is not possible to determine if faunal changes have occurred as a result of wildfires and associated ash flow or not. Because we do not have historical data for comparison, it is difficult to predict if nonnative fishes will (re)establish themselves in these two forks or if there are habitat limitation(s) that preclude their establishment. If Middle and West forks Gila River habitats are suitable for nonnative smallmouth bass and yellow bullhead, East Fork Gila

River will be a likely source of colonists. Although difficult, the potential to construct a barrier, downstream of Middle and West forks Gila River confluence, should be explored and if feasible constructed.

The Forks area of the Gila River is a stronghold for headwater chub in New Mexico; currently, it appears that the population is persisting and annual recruitment has been documented in Middle and West forks Gila River, but it is marginally maintaining itself in East Fork Gila River. In addition, small populations of spikedace and loach minnow occur in the lower West Fork Gila River and both were formerly more common in Middle and East forks Gila River. Given their isolation from downstream populations, it is likely these fish are somewhat different genetically from other populations. Abundance of other native fishes in each fork has varied over time, but among the three forks relatively robust populations of longfin dace, speckled dace, Sonora sucker, and desert sucker persist. The collective security of this native assemblage is tenuous, and removal of nonnative fishes (an ongoing activity) and avoidance of habitat alteration must remain integral to management and conservation activities of New Mexico Department of Game and Fish and U.S. Forest Service.

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References

Anderson, R.M. 1978. The distribution and aspects of the life history of *Meda fulgida* in New Mexico. Unpubl. MS thesis, New Mexico State University, Las Cruces.

Fagan, W.F., C.M. Kennedy, and P.J. Unmack. 2005. Quantifying rarity, losses, and risks for native fishes of the lower Colorado River basin: Implications for conservation listing. Conservation Biology 19: 1872-1882.

Huntington, E.H. 1955. Fisheries survey of the Gila and Mimbres river drainages. Final Report, Federal Aid Project F-1-R, New Mexico Department of Game and Fish, Santa Fe.

LaBounty, J.F., and W.L. Minckley. 1972. Native fishes of the upper Gila River, New Mexico. Pp. 134-146 in Symposium on rare and endangered wildlife of the southwestern United States, New Mexico Department of Game and Fish, Santa Fe.

Miller, R.R. 1950. Notes on the cutthroat and rainbow trouts with the description of a new species from the Gila River, New Mexico. Occasional Papers of the Museum of Zoology, University of Michigan 529: 1-42.

Mello, K., and P.R. Turner. 1980. Status of the Gila trout. Endangered Species Report 6, U.S. Fish and Wildlife Service, Albuquerque, NM.

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.

Paroz, Y. M. and D. L. Propst 2007. Distribution of spikedace, loach minnow, and chub species in the Gila River basin, New Mexico. Report to U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. New Mexico Department of Game and Fish.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1986. Distribution, status, biology, and conservation of the spikedace (*Meda fulgida*) in New Mexico. Endangered Species Report 15, U.S. Fish and Wildlife Service, Albuquerque, NM.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minnow (*Tiaroga cobitis*) in New Mexico. Endangered Species Report 17, U.S. Fish and Wildlife Service, Albuquerque, NM.

Propst, D.L., K.B. Gido, and J.A. Stefferud. 2008. Natural flow regimes, nonnative fishes, and native fish persistence in arid-land river systems. Ecological Applications 18: 1236-1252.

Propst, D.L., J.A. Stefferud, and P.R. Turner. 1992. Conservation and status of Gila trout, *Oncorhynchus gilae*. The Southwestern Naturalist 37: 117-125.

Propst, D. L., Y. M. Paroz, S. M. Carman, and N. D. Zymonas 2009. Systematic investigations of warmwater fish communities. FW-17-R-36 Performance report to U.S. Fish and Wildlife Service, New Mexico Department of Game and Fish.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs Colorado.

Appendix -

Table of fishes collected at each sampling location.

Drainage	Location		Date Sampled	UTM-r	UTM-n	UTM-e	Total Area Sampled	AGOCHR	AMEMEL	AMENAT	CATINS	GAMAFF	GILNIG	LEPCYA	MEDFUL	MICDOL	ONCMYK	PANCLA	PIMPRO	PYLOLI	RHIOSC	SALTRU	Grand Total
East Fork Gila	at West Fork Confluence	1	11-May-05	12S	760848	3674860	210.6			2	19		1	1		11	1	6		3			44
	Just Above Lyons Lodge	2	26-Apr-07	12S	763025	3675907	243.9			6	25					8				1			40
	200m Upstream of Black Canyon	3	26-Apr-07	12S	764922	3674404	193.2				11	3				5		4					23
	3 miles downstream from Spring Canyon	4	21-Apr-05	12S	764970	3678016	330			1	5							8					14
	Tom Moore Canyon (downstream of spring canyon)	5	21-Apr-05	12S	764463	3679035	452.35			3	28		1			2	1	5					40
	.5 miles downstream from Diamond Confluence	6	20-Apr-05	12S	763340	3683060	388.4			3	48		3	3		8		10				5	80
	upstream of Main Diamond	7	20-Apr-05	12S	764335	3684738	462.25			1	25					1		5					32
	Below Trails End Ranch On USFS	8	25-Apr-07	12S	765057	3685111	235.62			5	25		7			4		34					75
Middle Fork Gila	2 Miles Upstream From Visitors Center	1	13-May-08	12S	757870	3682238	227.13			1	7							6				2	16
	1 Mile below Little Bear Canyon Trail	2	13-May-08	12S	756508	3685223	320.2				9		2			1	2	11				1	26
	0.5 Miles above Little Bear Canyon	3	14-May-08	12S	754876	3685128	107.5				6		2				3	4				1	16
	Upstream from Jordan Hot springs	4	14-May-08	12S	754206	3687054	358.3			1	8						11	11			89		120
	Below Indian Creek	5	10-Jul-08	12S	749723	3687834	283.2				28						26	24			1	15	94
	Warm Spring Downstream of Meadows	6	10-Jul-08	12S	749291	3688462	75		7	9	1			23									40
	The Meadows	7	10-Jul-08	12S	749114	3688217	258.55				38		7				28	8			14	4	99
	2 Miles upstream of Meadows	8	9-Jul-08	12S	747824	3689464	177.3				8		1				2	2					13
	3.5 Miles upstream from The Meadows	9	9-Jul-08	12S	746952	3690875	164				60		17			2	2	47			21	14	163
	Upstream from Canyon Creek	10	27-Aug-08	12S	741735	3694518	290.6				90		15				2	35			25	3	170
	Below Loco Man Trail	11	27-Aug-08	12S	740935	3695343	160.4				31		7				6	9			21	1	75
	2 Miles Downstream from Iron Creek	12	26-Aug-08	12S	736525	3696340	351.5				42						3	11			41	5	102
	200 meters Upstream of Iron Confluence	13	26-Aug-08	12S	735053	3697634	305.5				124							47			224		395
West Fork Gila	Bridge near heartbar-below MF confluence	1	24-May-06	12S	757049	3679209	264.56	4		24	36		3			5	1	63			1		137
	1 mile upstream from Cliffdwellings	2	23-May-06	12S	753538	3680977	214.3				188		88		119	2	1	39			36	7	480
	1/2 mile upstream from ZigZag trail - 2 miles from Cliffdwellings	3	23-May-06	12S	751898	3681749	282.85				45		23			8	18	31			53	54	232
	4 miles upstream from Gila Cliffdwellings	4	22-May-06	12S	751248	3682453	155.05				63		25			1	10	17	1		35	1	153
	6 miles upstream from Cliffdwellings	5	22-May-06	12S	749941	3682426	662.31				49		10				21	31			126	12	249
	Below Ring Canyon	6	24-May-07	12S	747147	3683565	248.74				22		3				5	35			63	6	134
	Above Phallic Landmark	7	24-May-07	12S	745023	3683855	197.18				17		1				3	21			49	8	99
	Near Caves below Hells Hole	8	25-May-07	12S	744014	3684352	287.51				26		5				4	25			64	11	135
	Hells Hole	9	22-May-07	12S	742515	3684549	293.33				44						2	19			79	2	146
	Hells Hole #2	9.5	25-May-07	12S	742394	3684869	Not Measured				50		3				4	7			53	10	127
	1st Trail Crossing below Pine Flats	10	23-May-07	12S	740288	3684423	232.94				34						19	10			40	9	112
	0.5 Miles below McKenna Creek Confluence	11	23-May-07	12S	738880	3684525	184.6				18						8	12			6	14	58