

I. Project Title:  
Native fish response to nonnative fish control in the middle Green River, Utah.

II. Principal Investigator:

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III. Project Summary:

Control actions targeting nonnative gamefish species are being evaluated across the Upper Basin to determine the level of reduction in abundance of these species necessary to minimize the threat to the recovery of the endangered Colorado River fishes. There are two key aspects to evaluating control of nonnative fishes: (1) can the abundance of the target species be reduced significantly by the approaches employed, and (2) is there a measurable positive response by populations of the endangered fish species and associated native fish community?

Given the preliminary stage of nonnative fish control evaluations and the confinement to select river reaches, the most likely first observed positive response will be evident in early life-stages of the native fish community (e.g. flannelmouth and bluehead sucker, roundtail chub, and speckled dace). Adult response may not be observed for several years following any significant removal. Also, an immediate response may not be observed because of the large ranging area of adults. A positive response in endangered fish species may be more difficult to measure statistically without a longer time frame for observation due to generation times within endangered fish populations. Data necessary for these analyses will be generated by current and future young-of-year sampling and population estimation projects for these endangered species in conjunction with nonnative fish removal efforts.

This project will focus on determining a response of early life-stages of native and small-bodied fishes to removal of nonnative predators, primarily smallmouth bass and northern pike. These fish will serve as indicators of the response that would be experienced by endangered fish species occupying the same habitat types, if their numbers were high enough to detect such a response. This project is slated to continue through FY2009.

IV. Study Schedule: 2005 – 2009

IV. Relationship to RIPRAP:

Green River Action Plan: Mainstem

III. Reduce negative impacts of nonnative fishes and sportfish management activities (Nonnative and sportfish management)

III.A.2.c Evaluate the effectiveness (e.g., nonnative and native fish response) and develop and implement an integrated, viable active control program.

VI. Accomplishment of FY 2008 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

*Objective 1:* Implement removal of northern pike from Island Park to Sand Wash and smallmouth bass from Split Mountain to Sand Wash (the Duchesne River beginning in 2007).

This task was completed. See annual report for project #123-b for results.

*Objective 2:* Assess abundance of northern pike and smallmouth bass in the middle Green River to determine removal effect.

This task was completed. See annual report for project #123-b for results.

*Objective 3:* Estimate response of small-bodied native fish to removal of northern pike and smallmouth bass in the middle Green River.

Sampling to evaluate a response of small-bodied native fish to nonnative predator removal was conducted by seining suitable low-flow and backwater habitats. Three low-velocity habitats were sampled every five miles dependent upon the number of these habits available within the reach. Currently, the first two backwaters encountered in each 5-mile subreach are sampled under project # 138, YOY Colorado pikeminnow monitoring; however, information from all three backwaters is included in this report. Sampled backwaters were blocked at the mouth using a large small-mesh seine in 2005 to allow for closed sampling and a better evaluation of fish species composition and densities. This was also to facilitate depletion sampling for abundance estimation. Abundance estimation was not attempted and therefore no block seine was used after 2005.

Backwater/low velocity habitats were sampled using a 1.2 m x 4 m seine with 3 mm mesh. In 2007, the seine was 4.6 m wide; however, all other measurements remained the same. At least two non-overlapping seine hauls were conducted in each habitat sampled.

Preferably the two seine hauls were parallel to one another and perpendicular to the axis of the backwater. However, if water depth was too great, a haul was completed along one shoreline. The first two seine hauls were taken at 1/3 and 2/3 the distance from the mouth of the backwater. Additional seine hauls were sometimes completed in other portions of the habitat including the mouth or shallow tail of a backwater. Length of each seine haul, maximum depth, and average depth were recorded for each sample. All endangered and native fishes were identified, measured (mm) for total length, and returned alive to the habitat (Tables 1, 3, 5, 7). Ray counts were completed for all chubs (*Gila* spp.) captured. All nonnative fishes were enumerated and buried in the sand (Tables 2, 4, 6, 8).

## 2005

Table 1. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for native fish and white sucker caught in backwater habitats of the middle Green River in October 2005. Total area sampled was 10,863m<sup>2</sup>.

Species	Number Caught	Mean Length (mm)	Length Range (mm)	CPUE (Fish/100m <sup>2</sup> )
Bluehead sucker	6	56	50 – 60	0.06
Chub ( <i>Gila</i> spp.)	29	52	31 – 104	0.27
YOY Colorado pikeminnow	55	48	30 – 70	0.51
Juvenile Colorado Pikeminnow	2	128	123 – 132	0.02
Flannelmouth sucker	25	58	38 – 123	0.23
Speckled dace	3	51	49 – 52	0.03
White Sucker	48	64	44 - 87	0.44

Table 2. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for small-bodied nonnative fish caught in backwater habitats of the middle Green River in October 2005. Total area sampled was 10,863m<sup>2</sup>. Total area sampled for nonnative small-bodied cyprinids was 7,225 m<sup>2</sup>.

Species	Number Caught	CPUE (Fish/100m <sup>2</sup> )
Black crappie	105	0.97
Black bullhead	1	0.01
Channel catfish	8	0.07
Carp	46	0.42
Fathead minnow	1849	25.6
Green sunfish	38	0.35
Red shiner	38,705	535.7
Sand shiner	12,113	167.7
Smallmouth bass	7	0.06

## 2006

Logistical differences between effort in 2005 vs. 2006 include dates: 29 September through 18 October in 2005 vs. 13 September through 3 October in 2006; temperatures: 10°C to 14°C (main channel), 10°C to 16°C (backwaters) in 2005 vs. 7°C to 22°C (main channel), 9°C to 23°C (backwaters) in 2006; and flow: 1800 – 2200cfs in 2005 vs. 1100 – 1800cfs in 2006. In addition, crews in 2005 used a block net to keep fish from exiting the backwater during sampling. This block was not used in 2006 or any year thereafter.

Of potential interest in 2006 is the nearly triple catch rate of red shiner, from 535.7 fish/100m<sup>2</sup> to 1504.9 fish/100m<sup>2</sup>; the observation of small gizzard shad in backwaters; and the decrease in the number of native species and the number of individuals within each native species. Not all gizzard shad were measured; however, of those that were (n = 8), their mean length was 39.75mm. Lengths of these fish ranged from 36mm to 41mm. Given that fish of such small total lengths were found in multiple backwaters from river mile 281 to 215 (nine total backwaters), a logical conclusion is that this species has begun to reproduce in the middle Green River. Detection of recruitment will be reported if observed in future electrofishing efforts.

Table 3. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for native fish caught in backwater habitats of the middle Green River in September and October, 2006. Total area sampled was 8,886m<sup>2</sup>.

Species	Number Caught	Mean Length (mm)	Length Range (mm)	CPUE (Fish/100m <sup>2</sup> )
Colorado pikeminnow	5	45.8	36 – 50	0.06
Flannelmouth sucker	18	61.6	45 – 75	0.17
Bluehead sucker	2	47	47	0.02

Table 4. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for small-bodied nonnative fish caught in backwater habitats of the middle Green River in September and October, 2006. Total area sampled was 8,886m<sup>2</sup>. Total area sampled for small-bodied cyprinids was 5644 m<sup>2</sup> (In most years, the area sampled for small-bodied cyprinids is equal to the area of all the first seine hauls. This was not the case in 2006 and is denoted only in the database by an affirmative in the “FISH COUNT” column).

Species	Number Caught	CPUE (Fish/100m <sup>2</sup> )	Change from 2005
Black crappie	26	0.29	-0.68
Black bullhead	9	0.10	+0.09
Gizzard shad	51	0.47	N/A
Carp	180	2.03	+1.61
Fathead minnow	4356	77.18	+51.58
Green sunfish	24	0.27	-0.08
Red shiner	84,937	1504.9	+969.2
Sand shiner	7083	125.5	-42.2
White sucker	11	0.12	-0.32
Bluegill	3	0.03	N/A
Brown trout	21	0.24	N/A

Smallmouth bass	5	0.05	-0.05
Unidentified shiner	12,030	122.00	N/A

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## 2007

Logistical differences between effort in 2006 vs. 2007 include dates: 13 September through 3 October in 2006 vs. 24 September through 5 October in 2007; temperatures: 7°C to 22°C (main channel), 9°C to 23°C (backwaters) in 2006 vs. 10°C to 18°C (main channel), 10°C to 19°C (backwaters) in 2007; and flow: 1100 – 1800 cfs in 2006 vs. 1250-1490 cfs in 2007.

Of potential interest in 2007 is the dramatic decrease in the red shiner population. It was noticeable during the sampling effort and is reflected in the CPUE decrease of over 1200 fewer red shiner per 100m<sup>2</sup> this year compared with last year. The most likely explanation for this is the apparent cyclical nature of the red shiner population over the last 20 years (the final report for this project may elaborate on this relationship if this analysis makes sense). This decrease in red shiner population occurred in conjunction with an increase in CPUE for sand shiner. Fathead minnow CPUE actually decreased from 2006 to 2007; however, in the Horseshoe Bend/Stirrup reach, we noticed that in seine hauls done “just for fun” with no dimension measurements (thus these fish were only counted as anecdotal observations), we caught a large number of fathead minnow. It is difficult, therefore, to draw conclusions from both the observed decline in catch rates and the anecdotal observation.

In addition, gizzard shad appear to be doing quite well in the middle Green River since the first observed occurrence in 2005. In addition to numerous adult fish captured during fall electrofishing, we saw an increase in the number of young-of-year and age-1 gizzard shad as well. These fish were captured throughout the reach; however, the majority of gizzard shad were caught from one backwater (RM 257.7; just below Leota Bottom). If the fish from that backwater were not included in the CPUE, it would fall to 0.16, a decrease from 2006.

Essentially, we saw an increase in the catch rate of every non-cyprinid, nonnative species, with the exception of bluegill. White sucker increased from 2006. We began a white sucker removal project this year in hopes of keeping white sucker numbers and average lengths as low as possible to minimize potential for these hybrids to occur. Young-of-year observations for this species in 2008 and 2009 will be quite telling with regards to whether or not we can cause a decrease or an overall length decrease in the white sucker population.

Smallmouth bass catch rates also increased from 2006. In 2006, we saw only five smallmouth bass; however, in 2007, we saw 27. The last smallmouth bass caught in the 2007 effort was captured at RM 252.7 at the lower end of Ouray National Wildlife

Refuge. Most of the smallmouth bass were captured between Split Mountain (RM 319) and Above Brennan (RM 270).

Finally, native fish catch rates all increased from 2006, though the difference is not likely significant. In addition to the native fish captured in Table 5, we did a number of seine hauls “just for fun,” in which we did not take measurements on the haul. These fish cannot be included in the CPUE; however, including these fish, we saw nine more Colorado pikeminnow, seven more bluehead sucker, six more flannelmouth sucker, one additional flannelmouth x bluehead hybrid, and five more roundtail chub. Figures 1-4 show length frequencies for all native fishes captured during the 2005-2007 young-of-year sampling effort, including those not included in the CPUE calculation.

Table 5. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for native fish caught in backwater habitats of the middle Green River in September and October, 2007. Total area sampled was 9179m<sup>2</sup>.

Species	Number Caught	Mean Length (mm)	Length Range (mm)	CPUE (Fish/100m <sup>2</sup> )
YOY Colorado pikeminnow	9	67.0	42 – 80	0.10
Juvenile Colorado pikeminnow	1	94.0	94.0	0.01
Roundtail chub	4	52.0	38 – 68	0.04
Flannelmouth sucker	35	57.2	33 – 84	0.38
Bluehead sucker	29	64.1	39 – 92	0.32
Flannelmouth x Bluehead sucker	5	87.4	68 – 125	0.05

Table 6. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for small-bodied nonnative fish caught in backwater habitats of the middle Green River in September and October, 2007. Total area sampled for small-bodied cyprinids was 4448m<sup>2</sup>; total area sampled for all other nonnatives was 9179m<sup>2</sup>.

Species	Number Caught	CPUE (Fish/100m <sup>2</sup> )	Change from 2006
Black crappie	45	0.49	+0.20

Black bullhead	27	0.29	+0.19
Gizzard shad	159	1.73	+1.26
Carp	47	0.51	-1.52
Channel catfish	24	0.26	N/A
Fathead minnow	1,089	24.48	-52.7
Green sunfish	23	0.25	+0.02
Red shiner	13,124	295.0	-1209.9
Sand shiner	11,590	260.57	+135.07
White sucker	50	0.54	+0.42
Bluegill	1	0.01	-0.02
Smallmouth bass	27	0.29	+0.24

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## 2008

Logistical and environmental differences between effort in 2007 vs. 2008 include dates: 24 September through 5 October in 2007 vs. 22 September through 2 October in 2008; temperatures: 10°C to 18°C (main channel), 10°C to 19°C (backwaters) in 2007 vs. 14.0°C to 20.8°C (main channel), 14.0°C to 24.4°C (backwaters); and flow: 1250-1490 cfs in 2007 vs. 2060-2110 cfs in 2008.

Again, of potential interest in 2008 is the further decrease in the red shiner population. We also witnessed a dramatic decline in the sand shiner population as well. This difference was noticeable during the sampling effort and is reflected in the CPUE decrease of 204 fewer red shiner per 100 m<sup>2</sup> and 194 fewer sand shiner per 100 m<sup>2</sup> this year compared with last year. As mentioned previously, the most likely explanation for this is the apparent cyclical nature of shiner populations over the last 20 years; however, other explanations may include a higher than average water year or the higher temperatures during 2008 sampling than in 2007 (meaning that fish may not be seeking refuge in the backwaters yet).

Numbers of native fish remained essentially consistent between 2007 and 2008. Catch per effort for YOY pikeminnow did increase slightly. CPE for flannelmouth and bluehead suckers did decrease slightly. However, none of these changes is enough to be

considered significant. This is the fourth year of attempting to measure whether the native fishes are responding to removal of nonnative fish. It is likely too early to definitely say one way or another; however, comparing CPE from 2005 with this year's results, CPE for YOY pikeminnow decreased by 0.24 fish/100m<sup>2</sup>. CPE for *Gila spp.* declined by 0.26 fish/100m<sup>2</sup>. Catch rates for sucker species have increased, flannelmouth sucker by 0.04 fish/100m<sup>2</sup> and bluehead sucker by 0.09 fish/100m<sup>2</sup>. Three species sampling in the Green River in 2007 and 2008 revealed a healthy, reproducing population of both bluehead and flannelmouth sucker. Very few adult roundtail chub (individuals listed as *Gila spp.* were mostly roundtail chub) were captured. Numbers of adult Colorado pikeminnow captured can be found for these years in the annual report for project #128 for these years.

Another species of potential interest is green sunfish. This species was more numerous in backwaters this year than in any past year of this project. While the increase is not necessarily significant, it was obvious during sampling that green sunfish comprised a large component of the catch this year. We bring this up as a potential talking point because this may be a response to increased removal of green sunfish in 2007. Green sunfish have always been removed during smallmouth bass removal efforts; however, with the increase in smallmouth bass removal passes, we increased our removal effort for green sunfish as well. We do not have information for green sunfish removed from 2004-2006; however, in 2007, we removed 968 green sunfish ranging in length from 40 mm to 193 mm. Data from other regions of the country show that green sunfish mature at age two or three. We do not know growth rates of green sunfish in this area, nor if the population is stunted or not; however, by again using information from other areas of the country, it is likely that the majority (99% if maturity is assumed at age two; 94% if maturity is assumed at age three) of the fish we removed were mature fish. It is likely that by removing many of these adults, we were providing more space overall for a greater number of YOY green sunfish. Removal information for 2008 would support this assertion. In 2008, we removed 381 green sunfish ranging from four mm to 301 mm. By assuming the same growth rates and age at maturity as before, 74% were mature if we assume age at maturity is two or 22% if we assume age at maturity is three. We cannot be sure what this means for the green sunfish population; however, it does appear that we are reducing the overall size of the population in the Green River. Because green sunfish are known predators of larval, native fish (Carpenter and Mueller 2008), this size shift could be a positive change (assuming larger green sunfish are more problematic than smaller green sunfish).

The final note of interest is the difference in catch rates of native fishes above and below the Duchesne/White River confluences. Chub and flannelmouth sucker tend to be found above the White River (Table 9), predominantly in the Split Mountain area. Bluehead sucker seem to vary according to year. This variability may be the result of spawning by this species within the White River. Colorado pikeminnow seem to show a distinct trend of being found predominantly below the White River. This may be the result of a number of factors. It is not likely that availability of backwater habitat is different; however, habitat suitability may be different. In addition, Colorado pikeminnow larvae may be

more heavily impacted by increased electrofishing in this reach than other natives and have chosen to settle below locations where we have increased our smallmouth bass removal efforts. Finally, albeit unlikely, a number of Colorado pikeminnow were introduced into Kenny Reservoir between 1988 and 1990. It is known that these fish escaped the reservoir and moved into the White River. Because these fish were not spawned in the Yampa River, they may have imprinted on the White River as their natal stream and they may have found suitable spawning habitat there, thus contributing to YOY pikeminnow captures below the White River.

Table 7. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for native fish caught in backwater habitats of the middle Green River in September and October, 2008. Total area sampled was 7739 m<sup>2</sup>.

Species	Number Caught	Mean Length (mm)	Length Range (mm)	CPUE (Fish/100m <sup>2</sup> )
YOY Colorado pikeminnow	20	44.5	37 – 56	0.26
<i>Gila spp.</i>	3	37.3	37 – 38	0.04
Flannelmouth sucker	21	52.7	40 – 66	0.27
Bluehead sucker	15	47.7	34 – 56	0.19

Table 8. Total numbers, lengths and mean catch-per-unit-effort (CPUE; fish/100m<sup>2</sup>), by species for small-bodied nonnative fish caught in backwater habitats of the middle Green River in September and October, 2007. Total area sampled for cyprinids was 3072 m<sup>2</sup>; total area sampled for all other nonnatives was 7739 m<sup>2</sup>.

Species	Number Caught	CPUE (Fish/100m <sup>2</sup> )	Change from 2006
Black crappie	61	0.79	+0.3
Black bullhead	21	0.27	-0.02
Gizzard shad	27	0.35	-1.38
Carp	221	2.86	+2.35
Channel catfish	7	0.09	-0.17

Fathead minnow	603	19.63	-4.66
Green sunfish	436	5.63	+5.42
Red shiner	2787	90.72	-204.28
Sand shiner	2058	66.99	-193.58
White sucker	56	0.72	+0.18
Smallmouth bass	7	0.09	-0.20
Plains killifish	1	0.01	N/A

Table 9. Percentage of total number of each species captured above and below the White River confluence by year.

Species	Year	Percent of capture found below the White River	Percent of capture found above the White River	Total number captured
BH	2005	100%	0%	4
	2006	100%	0%	2
	2007	56%	44%	27
	2008	20%	80%	15
CH	2005	10%	90%	4
	2006	0%	0%	0
	2007	33%	67%	3
	2008	0%	100%	3
CS	2005	36%	64%	55
	2006	100%	0%	5
	2007	60%	40%	10
	2008	90%	10%	20
FM	2005	48%	52%	25
	2006	11%	89%	18
	2007	10%	90%	40
	2008	24%	76%	21

Figure 1. Length Frequencies for all bluehead sucker captured during the 2005-2008 Native Fish Response sampling effort.

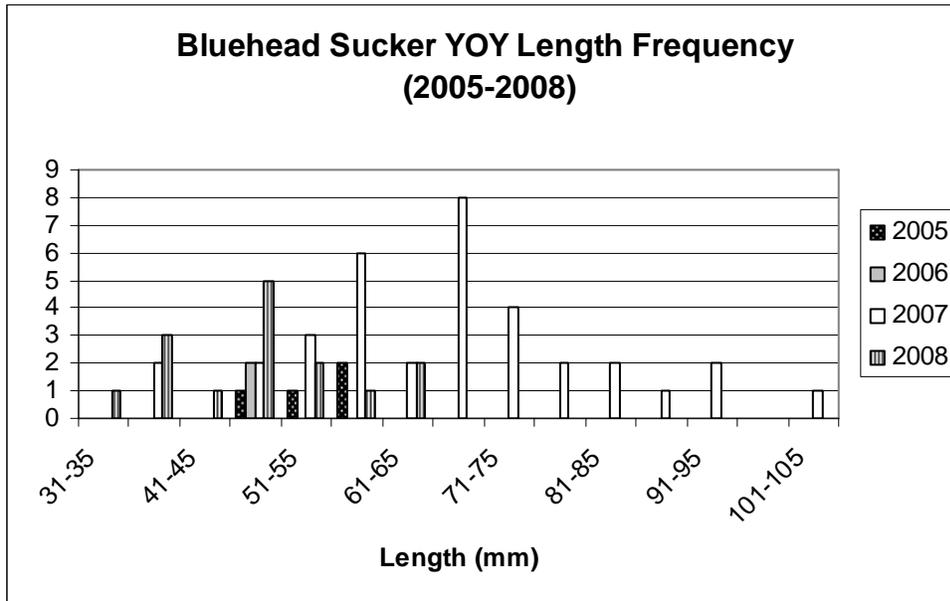


Figure 2. Length Frequencies for all Colorado pikeminnow captured during the 2005-2008 Native Fish Response sampling effort.

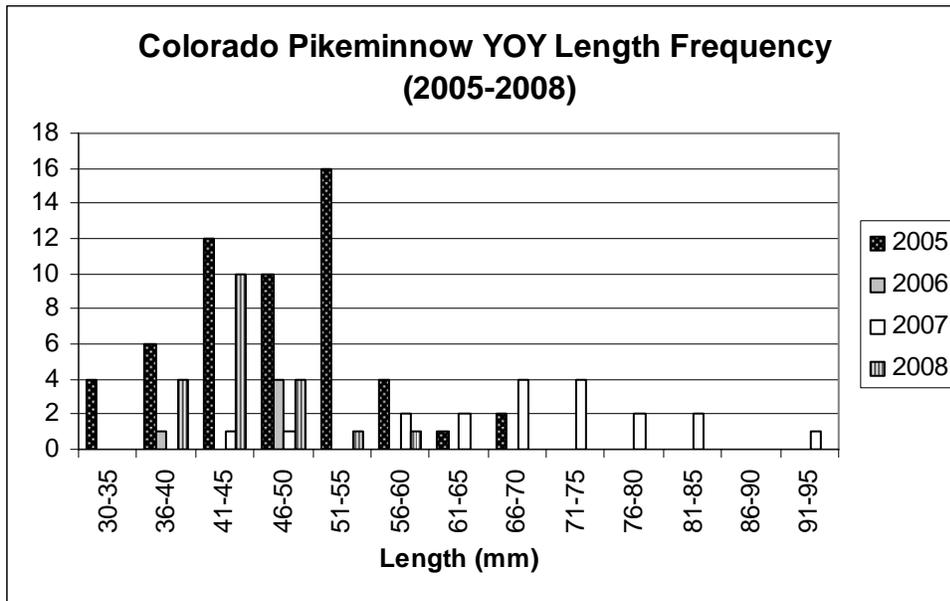


Figure 3. Length Frequencies for all flannelmouth sucker captured during the 2005-2008 Native Fish Response sampling effort.

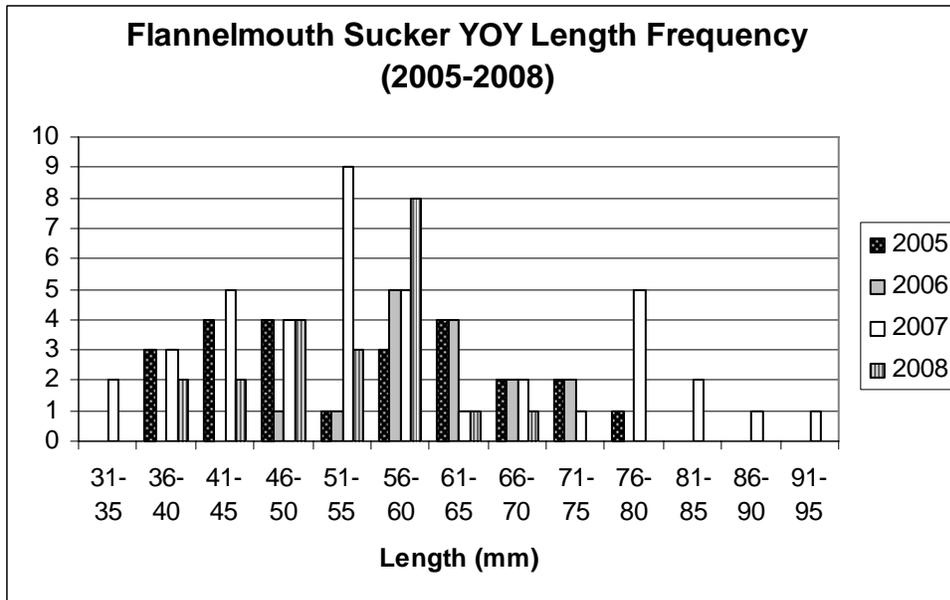
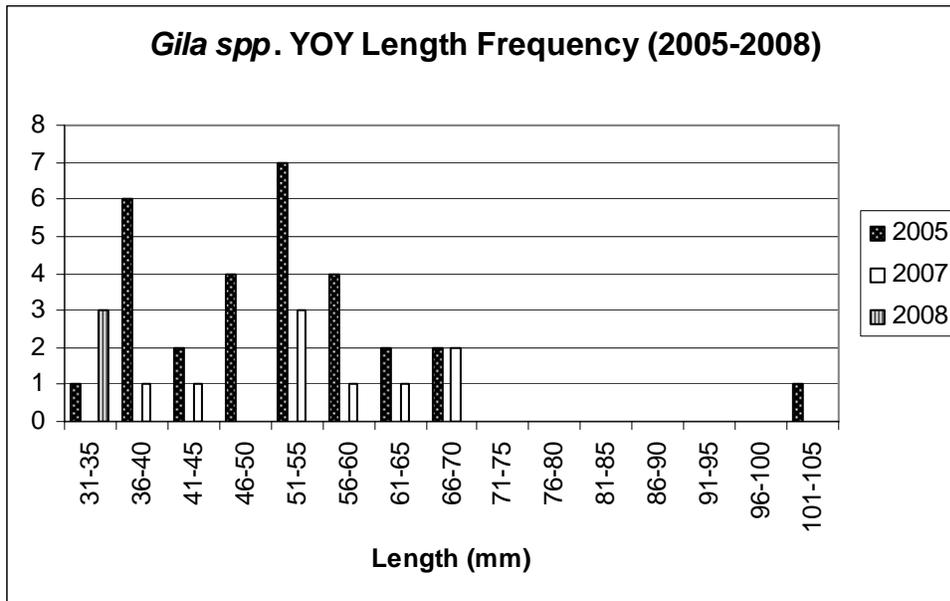


Figure 4. Length Frequencies for all *Gila spp.* captured during the 2005-2008 Native Fish Response sampling effort.



VII. Recommendations:

We have not seen enough fluctuations in numbers captured to determine whether we are seeing a positive response to nonnative fish removal. Continue monitoring efforts as outlined in approved scope of work.

Analyze nonbiological information from inception of YOY study to current to determine whether habitat suitability in backwaters above the White River has been declining in recent years.

Drift net within the White River Duchesne River to verify that these rivers are not a source of pikeminnow to the system. This will narrow down the scope of our investigation as to why pikeminnow YOY are declining in the middle Green River.

Examine potential impacts of increased electrofishing effort (4 removal passes to 12 or 15 depending on reach) on viability of larval fish.

VIII. Project Status: on track and ongoing

IX. FY 2008 Budget Status

- A. Funds Provided: \$34,256
- B. Funds Expended: \$20,000
- C. Difference: \$14,256

D. Percent of the FY 2008 work completed, and projected costs to complete: We still need to do a great deal of data analysis and finish up the final report. We will need money from FY09 to finish the report since all of our FY08 money has reverted back to the Program.

E. Recovery Program funds spent for publication charges: \$0

X. Status of Data Submission: Data will be submitted to database manager January 2008.

XI. Signed: Trina Hedrick November 1, 2008  
Principal Investigator Date

XII. References

Carpenter, J. and G.A. Mueller. 2008. Small nonnative fishes as predators of larval razorback suckers. The Southwestern Naturalist 53(2): 236-242.