

**COLORADO RIVER RECOVERY PROGRAM
FY 2009 ANNUAL PROJECT REPORT**

**RECOVERY PROGRAM
PROJECT NUMBER: 123b**

I. Project Title: Nonnative fish control in the middle Green River

II. Principal Investigator(s):

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III. Project Summary:

The Upper Colorado River Endangered Fish Recovery Program has determined that control of nonnative fish in the upper Colorado River Basin is essential to the recovery of the four endangered fish species: Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*). This determination has been documented specifically for Colorado pikeminnow, razorback sucker, and bonytail in nursery habitats and in the mainstem middle Green River in Section 4.3.2 of each species' Recovery Goals (U.S. Fish and Wildlife Service 2002) document.

Smallmouth bass (*Micropterus dolomieu*) abundance has dramatically increased in the Green River since 2000. This increase resulted in a recommendation from the December 2003 Nonnative Fish Control Workshop (Grand Junction, CO) to attempt control of this species in the Green River. Three years of removal, from 2004-2006 and annual Nonnative Fish Control Workshops have added to the knowledge base of the effort required to successfully remove smallmouth bass from the Green River. During the December 2006 workshop, participants discussed the importance of increasing this removal effort and discussed the need for a dramatic increase to be able to adequately suppress the middle Green River smallmouth bass population.

Northern pike (*Esox lucius*) are a significant predatory and competitive threat to the endangered fishes, and was rated by experts as one of the six nonnative species of greatest concern to the Colorado River native fish assemblage (Hawkins and Nesler 1991). Northern pike became established in the Yampa River in the early 1980's. Originally introduced as game fish in Elkhead Reservoir in 1977, the species escaped and invaded the upper Yampa River and have expanded their number and range within the Yampa and Green Rivers. In previous years, there has been evidence of successful spawning in Stewart Lake near Jensen, Utah and in Old Charlie Wash on the Ouray National Wildlife Refuge. A control program for northern pike in the Yampa River was initiated in 1999 and removal of northern pike in the middle Green River was initiated in 2001. Based on trends in catch rates of subsequent years, removal efforts have been

successful at significantly reducing the number of northern pike in the middle Green River. Control efforts since 2003 have resulted in the capture of less than 40 northern pike and as a result of these low catch rates; total effort was reduced to only a maintenance level beginning in 2005. Effort in 2009 was the minimal deemed required to keep their numbers under control. Northern pike populations will be monitored (and captured individuals removed) to locate ripe adults and determine if this lower level of effort is sufficient to minimize threats to endangered and other native fishes.

The purpose of this project is to minimize the expansion of all predatory nonnative fishes, especially smallmouth bass, in the Green River. The objectives to meet this goal are 1) conduct one tagging pass and eleven removal passes for smallmouth bass in the middle Green River from Split Mountain boat ramp (RM 319.3) to the Duchesne River confluence (RM 247.9); 2) maintain low occurrence of adult northern pike in the middle Green River; 3) determine efficiency of smallmouth bass and northern pike removal efforts; 4) calculate an annual population estimate of smallmouth bass in the middle Green River; 5) identify the means and levels of smallmouth bass and northern pike control necessary to minimize the threat of predation/competition on endangered and other native fishes. Additional predatory nonnative fishes removed as bycatch include: green sunfish, black crappie, and walleye. White sucker, which hybridize with native suckers, was also removed during these efforts.

IV. Study Schedule: Initial year - FY - 2009 Final year - FY 2009

V. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

- III. Reduce negative impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).
- III.A. Reduce negative interactions between nonnative and endangered fishes.
- III.A.2. Identify and implement viable active control measures.
- III.A.2.c. Implement and evaluate the effectiveness of viable active control measures.

GREEN RIVER ACTION PLAN: MAINSTEM

- III. Reduce impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).
- III.A. Reduce negative impacts to endangered fishes from sportfish management activities.
- III.A.4. Develop and implement control programs for nonnative fishes in river reaches occupied by the endangered fishes to identify required levels of control. Each control activity will be evaluated for effectiveness, and then continued as needed.
- III.A.4.a. Northern pike in the middle Green River.

VI. Accomplishment of FY 2009 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1. Capture and remove northern pike (UDWR – Vernal; March – May 2009).

Crews spent 41 fyke net nights and 29.6 electrofishing hours sampling for northern pike 24 March through 24 May 2009. Crews removed 38 northern pike during this effort. One pike had a yellow Floy tag (tag # 2813). This pike was originally tagged by CDOW at Yampa River mile 76.1 on 20 April 2006. It was 556 mm total length (TL) and 1090 g at the time of tagging and 742 mm TL and 2910 g at the time of removal. Bonytail, Colorado pikeminnow, flannelmouth sucker, razorback sucker and roundtail chub were the native species encountered during this effort. Fish species captured and the numbers of each are included in Table 1.

Table 1. Fish encountered during early spring fyke netting and electrofishing efforts. Species removed include black bullhead, black crappie, brown trout, green sunfish, northern pike, smallmouth bass, walleye and white sucker. All natives and the remaining nonnatives (listed below this table) were returned to the water alive.

	Fyke-netting				Electrofishing/Trammel netting			
	Number	Average Length (mm)	Range (mm)	Effort (#/fyke net night)	Number	Average Length (mm)	Range (mm)	Effort (#/hour)
Black bullhead	4	-	-	0.098	-	-	-	-
Black crappie	-	-	-	-	7	192	77 - 276	0.236
Bonytail	-	-	-	-	20	217	197 - 250	0.676
Brown trout	-	-	-	-	1	219	-	0.034
Channel catfish	5	425	-	0.122	8	-	-	0.270
Colorado pikeminnow	-	-	-	-	53	530	181 - 769	1.791
Flannelmouth	1	-	-	0.024	-	-	-	-
Flannelmouth x white	1	154	-	0.024	1	171	-	0.034
Green sunfish	2	125	-	0.049	2	116.5	112 - 121	0.068
Northern pike	11	519	431 - 797	0.268	27	530	382 - 772	0.912
Razorback sucker	-	-	-	-	76	423	295 - 558	2.568
Roundtail	-	-	-	-	1	287	-	0.034
Smallmouth bass	-	-	-	-	58	261	90 - 418	1.959
Walleye	-	-	-	-	11	520	198 - 670	0.372
White sucker	21	221	85 - 312	0.512	114	196	61 - 430	3.851

Other species observed include common carp.

Crews spent 40.19 hours electrofishing for the three species tagging pass on the middle Green River. This pass began on 18 May and ended on 12 June 2009. This pass was an effort to tag many of the bluehead and flannelmouth suckers in the middle Green River since there is no other project that does this. Nonnatives removed during this project, their average lengths, and the ranges of their lengths are included below in Table 2.

Table 2. Nonnative fish removed during the three species tagging pass in 2009.

	Number	Average length (mm)	Range (mm)	Effort (#fish/hour)
Black crappie	2	159	90 - 228	0.050
Brown trout	10	168	140 - 210	0.249
Creek chub	1	170	-	0.025
Green sunfish	7	86	53 - 152	0.174
Northern pike	3	615	440 - 752	0.075
Smallmouth bass	198	219	84 - 492	4.927
Walleye	15	502	405 - 630	0.373
White sucker	38	238	72 - 444	0.946

Task 2. Eleven smallmouth bass collecting passes from Split Mountain boat ramp to Duchesne River (UDWR – Vernal; June – October 2009).

Electrofishing was the primary gear type used to collect smallmouth bass for the mark recapture abundance estimate. Twelve complete shoreline electrofishing passes were completed. On the third electrofishing pass, smallmouth bass were marked with red Floy® tags. On the remaining eleven passes, smallmouth bass were examined for tags and removed from the river.

Crews spent 438 hours electrofishing for smallmouth bass between 1 June and 15 October 2009. Nonnative numbers excluding bass, average lengths for each species, and effort expended to collect these species are included in Table 3.

Table 3. Nonnative fish removed during the SMB removal project 2009.

	Number	Average Length (mm)	Range (mm)	Effort (# fish/hour)
Black bullhead	12	143	95 - 195	0.027
Black crappie	20	154	74 - 260	0.046
Bluegill	14	117	76 - 200	0.032
Brown trout	22	170	82 - 246	0.050
Gizzard shad	11	443	417 - 458	0.025
Grass carp	1	843	-	0.002
Green sunfish	81	91	46 - 190	0.185
Northern pike	37	505	106 - 795	0.084
Rainbow trout	6	357	172 - 472	0.014
Walleye	43	384	91 - 683	0.098
White sucker	360	188	62 - 520	0.822

An initial population estimate for both juvenile and adult bass was obtained by calculating a two-pass Lincoln Peterson estimate (Table 4). A total of 265 smallmouth bass were tagged using red Floy® tags on the third electrofishing pass. A total of 423 smallmouth bass were captured on the fourth pass and examined for marks, 19 of these were recaptures.

Table 4. Original population estimate for juvenile and adult SMB 2009. *Juvenile pop estimate does not include SMB less than 100 mm.*

Juvenile Bass (<200 mm)		Adult Bass (\geq 200 mm)
M=	188	77
C=	249	174
R=	13	6
N=	3375	1950
95% Upper	5068.34	3301
95% Lower	1681.66	599
Standard Error	846.6699	675.4998
CV	25.0865	34.6410
Variance V(N)=	716850	456300
+/-2*(SE)	1693.34	1351

A population estimate corrected for fish recruiting into the adult size class is included in Table 5. A growth rate of 0.63 mm every day was used to account for this recruitment. Using this growth rate, only one mark/recaptured juvenile bass would have recruited into the adult size category between our mark and recapture passes.

Table 5. Corrected population estimate for juvenile and adult SMB 2009. *Juvenile pop est does not include SMB less than 100 mm.*

Juvenile Bass (<200 mm)		Adult Bass (\geq 200 mm)
M=	188	77
C=	250	173
R=	13	6
N=	3388.5	1938.857
95% Upper	5088.814	3281.976
95% Lower	1688.186	595.7384
Standard Error	850.1571	671.5594
CV	25.08948	34.63687
Variance V (N)=	722767.1	450992
+/-2*(SE)	1700.314	1343.119

The original and corrected exploitation rates were calculated for 2009. Table 6 includes the original population estimate and exploitation rates not corrected for recruitment and in Table 7, the population estimate and exploitation rates have been corrected for the 0.63 mm of growth every day.

Table 6. Original exploitation rates 2009 *Total does not include tagging pass 3 or the Sandwash pass

PASS	Juvenile Bass (<200mm) Pop Est = 3375		Adult Bass (≥200mm) Pop Est = 1950	
	# Tagged/Removed	% of Estimate	# Tagged/Removed	% of Estimate
1	154	4.6	105	5.4
2	246	7.3	115	5.9
3	188	5.6	77	3.9
4	307	9.1	174	8.9
5	166	4.9	97	5.0
6	116	3.4	131	6.7
7	75	2.2	134	6.9
8	64	1.9	93	4.8
9	76	2.3	120	6.2
10	115	3.4	129	6.6
11	95	2.8	81	4.2
12	60	1.7	112	5.7
Sandwash	263	7.8	195	10
Total	1474	43.6%	1291	66.3%

Table 7. Corrected exploitation rates 2009. *Total does not include tagging pass 3 or the Sandwash pass

PASS	Juvenile Bass (<200mm) Pop Est = 3389		Adult Bass (≥200mm) Pop Est = 1939	
	# Tagged/Removed	% of Estimate	# Tagged/Removed	% of Estimate
1	154	4.5	105	5.4
2	246	7.3	115	5.9
3	188	5.5	77	4.0
4	308	9.1	173	8.9
5	168	5.0	95	4.9
6	115	3.4	131	6.8
7	75	2.2	134	6.9
8	61	1.8	93	4.8
9	75	2.2	120	6.2
10	116	3.4	128	6.6
11	95	2.8	81	4.1
12	60	1.8	112	5.8
Sandwash	263	7.8	195	10.1
Total	1473	43.7%	1287	66.3%

A population estimate for 2008 corrected for fish recruiting into the adult size class for both juvenile and adult bass was obtained by calculating a two-pass Lincoln-Peterson estimate (Table 8). A total of 91 smallmouth bass were tagged using red Floy® tags on the first electrofishing pass. A total of 508 smallmouth bass were captured on the second pass and examined for marks, five of these were recaptures.

Table 8. Corrected population estimate for juvenile and adult SMB 2008.

Juvenile Bass (<200 mm)		Adult Bass (≥ 200 mm)
M=	37	54
C=	387	121
R=	2	3
N=	4915	1678
95% Upper	9810.296	3153.1
95% Lower	19.03687	201.9001
Standard Error	2447.815	737.7999
CV	49.80633	43.98211
Variance V (N)=	5991798	544348.8
+/-2*(SE)	4895.63	1475.6

The corrected exploitation rates were calculated for 2008. Table 9 includes the population estimate and exploitation rates that have been corrected for recruitment.

Table 9. Corrected exploitation rates 2008.

PASS	Juvenile Bass (<200mm) Pop Est = 4915		Adult Bass (≥200mm) Pop Est = 1678	
	# Tagged/Removed	% of Estimate	# Tagged/Removed	% of Estimate
1	40	.81	54	3.2
2	387	7.9	121	7.2
3	291	5.9	54	3.2
4	163	3.3	54	3.2
5	210	4.3	58	3.5
6	382	7.8	58	3.5
7	329	6.7	79	4.7
8	440	9.0	81	4.8
9	287	5.8	43	2.6
10	124	2.5	29	1.7
11	170	3.5	43	2.6
12	71	1.4	29	1.7
Total	2894	58.91%	703	41.9%

A population estimate was calculated in 2007 for the smallmouth bass removal effort. This effort consisted of 9 passes from Split Mountain boat ramp to the mouth of the Duchesne River (Table 10).

Table 10. Population estimate for juvenile and adult SMB 2007.

Juvenile Bass (<200 mm)		Adult Bass (\geq 200 mm)
M=	68	54
C=	583	151
R=	1	4
N=	20,148	1,672
95% Upper	43,373	3,014
95% Lower	3,077	329
Standard Error	11612.518	671.27044
CV	57.64	40.15
Variance V (N)=	134,850.564	450,604
+/-2*(SE)	23,225.035	1,342.5409

The corrected exploitation rates for 2007 are shown in Table 11.

Table 11. Corrected exploitation rates 2007.

PASS	Juvenile Bass (<200mm) Pop Est = 20,873		Adult Bass (\geq 200mm) Pop Est = 1411	
	# Tagged/Removed	% of Estimate	# Tagged/Removed	% of Estimate
1	68	.33	54	3.8
2	604	2.9	130	9.2
3	427	2.0	76	5.4
4	833	4.0	81	5.7
5	1179	5.6	140	9.9
6	961	4.6	97	6.9
7	1080	5.2	44	3.1
8	926	4.4	33	2.3
9	22	.10	7	.50
Total	6100	29.13	662	46.80

A population estimate was calculated in 2004 for the smallmouth bass removal effort. This effort consisted of 4 passes from Split Mountain boat ramp to the Sandwash boat ramp (Table 12).

Table 12. Population estimate for juvenile and adult SMB 2004.

Juvenile Bass (<200 mm)			Adult Bass (\geq 200 mm)
M=	114		181
C=	241		215
R=	2		3
N=	9277		9828
95% Upper	18495		18536
95% Lower	57		1119
Standard Error	4609.494		4354.329
CV	49.69		44.31
Variance V (N)=	21247432		18960178
+/-2*(SE)	9218.987		8708.657

No population estimates were calculated in 2005 or 2006 due to a lack of recaptures.

Based on the original population estimates for 2004, 2007, 2008, and 2009, the number of individuals per river mile was calculated. In 2004, 130 juvenile smallmouth bass and 138 adult smallmouth bass per river mile was estimated. In 2007, 282.2 juvenile smallmouth bass per river mile and 23.4 adult smallmouth bass per river mile were estimated, in 2008, 66 juvenile smallmouth bass and 25 adult smallmouth bass per river mile were estimated and in 2009, 47 juvenile smallmouth bass and 27 adult smallmouth bass per river mile were estimated.

Catch rates for the entire reach, all passes combined, were calculated for 2004-2009 smallmouth bass removal effort (Table 13). Years 04-06 include 4 passes from Split Mountain boat ramp to the Sandwash boat ramp, year 07 includes 9 passes from Split Mountain boat ramp to the Duchesne River, year 08 includes 12 passes from Split Mountain boat ramp to the Duchesne River and year 09 includes 12 passes from Split Mountain boat ramp to the Duchesne River and one trip down to Sandwash boat ramp.

Table 13. Catch rates for SMB.

Year	04	05	06	07	08	09
CPUE (fish/hour)	9.33	4.02	4.71	26.04	8.56	7.96

Catch rates during each pass along with the number of smallmouth bass caught during each pass and the total caught for all passes for 2009 are shown in Table 14.

Table 14. Catch rates for SMB during each pass for 2009.

Pass	Effort (hours)	Captures	CPUE (fish/hour)
	09	09	09
1	42.3	259	6.1
2	39	361	9.3
3	44.4	306	6.9
4	36.2	481	13.3
5	34.4	263	7.6
6	35.4	247	7.0
7	37	209	5.6
8	33	157	4.8
9	30	196	6.5
10	30.2	244	8.1
11	33.1	176	5.3
12	29.2	172	5.9
Sandwash	15	458	31
Total	439.20	3529	

The number of marked and recaptured smallmouth bass for each pass for 04-09 is shown in Table 15. In the tag retention study in 2007, 6 out of the 22 recaptured smallmouth bass had a pit tag but no Floy® tag, demonstrating some issues with tag retention. In 2008, no smallmouth bass were captured that had a fin clip but no Floy® tag. No tag retention study was conducted in 2009.

Table 15. Number of tagged and recaptured SMB per pass 2004-2009.

Pass	Number Tagged						Recaptures					
	04	05	06	07	08	09	04	05	06	07	08	09
1	295	315	98	122	91	-	0	0	0	0	0	0
2	-	-	-	-	-	-	5	0	1	5	5	0
3	-	-	-	-	-	265	23	0	0	1	4	0
4	-	-	-	-	-	-	19	0	0	0	1	19
5				-	-	-				9	1	7
6				-	-	-				3	2	4
7				-	-	-				2	0	3
8				-	-	-				2	0	6
9				-	-	-				0	2	3
10					-	-					1	3
11					-	-					0	0
12					-	-					0	0
Sandwash						-						0
Total	295	315	98	122	91	265	47	0	1	22	16	45

Movement of marked smallmouth bass was seen both upstream and downstream from the Ouray section. In 2004, 2 marked bass from the Ouray reach were found in the Desolation stretch of the Green River and in 2005, 3 marked bass from the Yampa River were caught in the Ouray section. In 2006, three marked bass from the Ouray reach were found in the Yampa River and in 2008, 3 smallmouth bass from the Echo Park area were recaptured in the Ouray reach. Seven smallmouth bass tagged in the Ouray reach were

found in the Echo Park area in 2009 and four bass tagged by the USFWS in the Echo reach were found in the Ouray reach.

Length frequency distribution shows the presence of multiple year classes including young-of-the-year throughout the study reach. A larger proportion of juvenile smallmouth bass were collected during 2007 than any other year of the removal project.

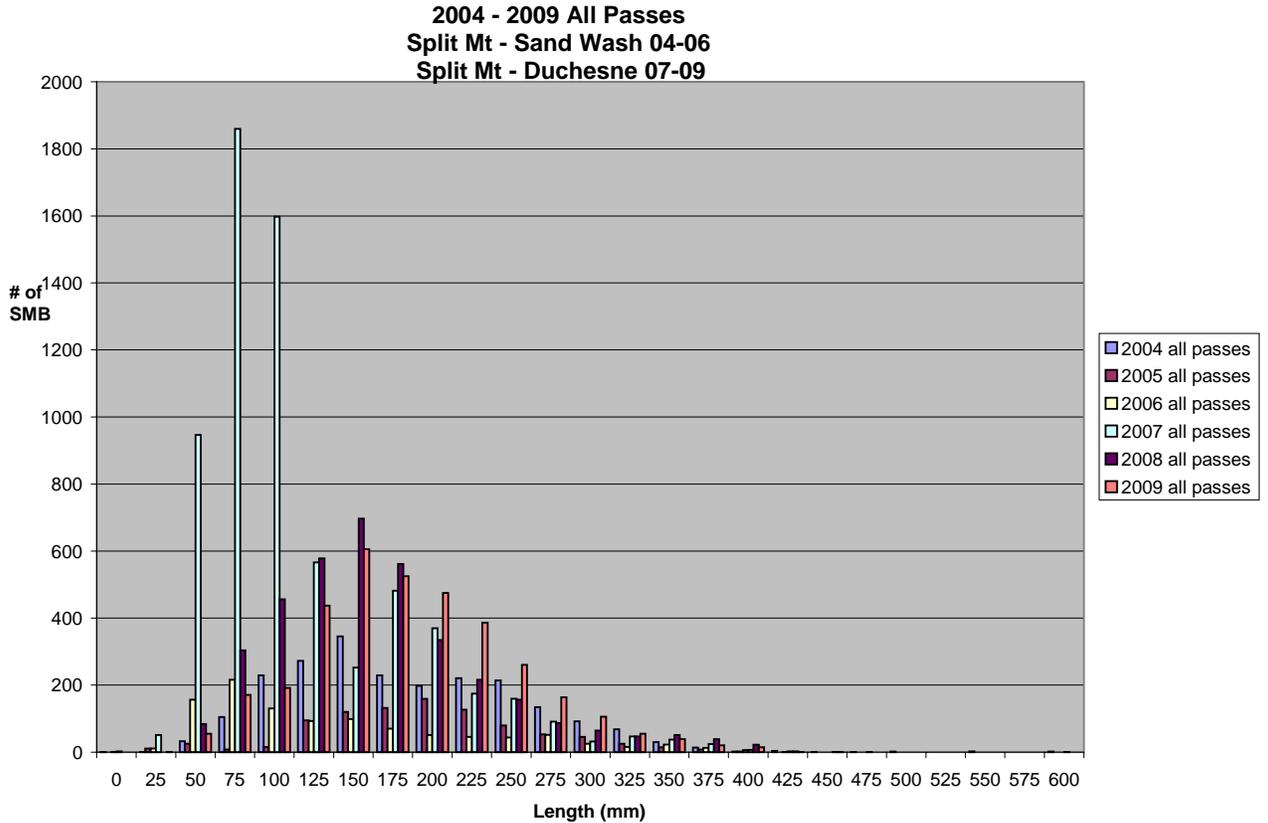


Figure 1. Length frequency distribution of smallmouth bass collected on all passes in the middle Green River: 2004-2009.

Task 3: Data Management, Analysis, and Reporting

Annual RIP Report (Nov 2009)

VII. Recommendations:

- Focus effort on concentration areas
- Remove smallmouth bass from Duchesne River to Sandwash

VIII. Project Status:

Ongoing

