COLORADO RIVER RECOVERY PROGRAM
FY 2004 ANNUAL REPORT

RECOVERY PROGRAM
PROJECT NUMBER**:** C-6-bt

I. Project Title: Determination of factors affecting survival and growth of stocked razorback sucker and bonytail in multiple floodplain wetlands of the middle Green River.

II. Principal Investigator:

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III. Project Summary:

No knowledge on the habitat use of larval and juvenile razorback sucker *Xyrauchen texanus* and bonytail *Gila elegans* exists prior to major physical and biological modifications of the Colorado River Basin in the 20th Century. Given the lack of information on early life history needs of razorback sucker and bonytail, this project was directed toward describing the conditions in which razorback sucker and bonytail can survive and recruit in the wild. Specifically, this study reports on the use of the 'reset' concept to reduce the impacts of nonnative fish predation on razorback sucker and bonytail larvae in newly inundated floodplain habitats.

Results to date indicate that larval bonytail and razorback sucker can grow and survive in newly inundated floodplains before nonnative densities increase, as occurs when residual nonnative populations are allowed to accumulate in floodplains over successive years. This year completed the last of two field seasons and the final report will be prepared in the coming year.

IV . Study Schedule: 2003-2005

V. Relationship to RIPRAP:

Green River Action Plan: Mainstem
II.A.3. Implement levee removal strategy at high-priority sites
II.A.3.d. Evaluation
IV.A.1.c. Implement augmentation plan (bonytail)

VI. Accomplishments of FY 2004 Tasks and Deliverables, Discussion of Initial Findings and

Shortcomings:

Task 1: **Monitor physical parameters of study wetlands**.
Entering the spring of 2004, Old Charley Wash and L-10 floodplains were dry and no residual nonnative fishes were present. Johnson Bottom and Thunder Ranch floodplains retained water from the previous year. Johnson Bottom was monitored on March 8, 2004. Maximum water depth was 0.76 m, of which only 0.3 m was fluid (remainder being ice). Dissolved oxygen averaged 15.7 mg/l and temperature 5.3 ^{0}C between two sites under the ice.

Mean daily spring flood flows of the Green River at the Jensen gage peaked at 11,500 cfs on May 13, 2004. Discharge was insufficient to inundate floodplain dikes, but did access three of the four study wetlands via artificial drain and inlet structures. Flows entered Old Charley Wash at approximately 5,000 cfs (April 11 and 12) in early spring and provided enough water to stock fish prior to peak run-off flows. Johnson Bottom maintained sufficient water from the previous year to support stocked fish prior to spring runoff. Due to the low water availability to refuge floodplains, water control structures were closed on May 17 to retain the maximum quantity of water. Water in L-10 was supplemented by water transfer from Pelican Lake (beginning March 22) and direct pumping from the Green River. In 2004, water depth was relatively low in all study sites except L-10. L-10 maintained high water levels through the spring and summer, but a breach in a dyke occurred on or just before August 2 that drained approximately half the volume of the floodplain. Supplemental pumping from the river restored much of the elevation drop within two weeks (Figure 1). Water from the inlet and outlet structures did not fill Johnson Bottom and Old Charley Wash in the spring, and Thunder Ranch received no river recharge in 2004. Surface elevations dropped rapidly during the late spring and early summer and maximum depths in Old Charley Wash (Figure 1) and Thunder Ranch in July were less than 0.3 m in July. Turbidity was variable but highest in Old Charley Wash and Johnson Bottom (Figure 2). Dissolved oxygen was above 3.0 mg/l in Old Charley Wash and Leota in spring and summer but fell below 1.0 mg/l as early as June in Thunder Ranch and in Johnson Bottom in late July (Figure 3). Temperature was similar among floodplains in June, but temperatures exceeding 30^{0} C were measured in Old Charley Wash and Thunder Ranch (the two shallower sites) during July (Figure 4).

Task 2: **Monitor fish composition in study wetlands.**
Just over 1,000,000 razorback sucker and 264,000 bonytail larvae were stocked into four study floodplains between April 26 and May 3, 2004 (Table 1). Razorback sucker were provided by the Ouray National Fish Hatchery and bonytail were provided by Dexter National Fish Hatchery and Technology Center. Average densities stocked were 6,562 razorback sucker and, 1,653 bonytail per hectare. Fish composition was monitored in June, July, and during harvest. Due to declining water elevations, fish harvest (i.e., depletion population estimates) were conducted in mid July in Old Charley Wash, late July in Johnson Bottom, and late August and early September in L-10. Do to declining

water levels and lack of boat access, only monitoring occurred in the Thunder Ranch floodplain.

As observed last year, shiners (*Notropis lutrensis* and *N. stramineus*) and larger carp *Cyprinus carpio* tended to be more abundant shortly after connection with the river, and fathead minnow *Pimephales promelas*, juvenile carp, black bullhead *Amierus melas* and green sunfish *Lepomis cyanellus* were more abundant later in the summer within the refuge floodplains (Table 2). The greatest biomass of fish in all but Thunder Ranch floodplain consisted of adult carp. Fyke nets set in Johnson Bottom prior to inflow from the river confirmed overwinter survival of fish in the floodplain despite its shallow depth. In addition to numerous nonnative fishes, razorback sucker and bonytail stocked the previous year also survived through the winter in Johnson Bottom (Tables 2-3). Only three fish species were collected in the Thunder Ranch floodplain: three-spine stickleback *Culea inconstans*, green sunfish, and razorback sucker. Because the Thunder Ranch floodplain has not been connected to the river since the 1980's, it is probable that conditions existed in most years to overwinter at least some fishes.

Razorback sucker stocked in the spring were collected later in all four floodplains and bonytail were found in all but the Thunder Ranch floodplain. Two razorback sucker were collected from Thunder Ranch during the June monitoring collections, but none were collected in minnow traps set in July. Depletion estimates (based on the software program CAPTURE) from the remaining floodplains calculated the number of surviving age-0 razorback to be between 229 in Leota-10 and 1,563 in Johnson Bottom (Table 3). Razorback sucker survival rates were similar among the three refuge sites varying between 0.7% and 0.1%. Bonytail abundance estimates showed greater variability ranging between 2 in Old Charley Wash and over 2,647 in Johnson Bottom. Survival rates of age-0 bonytail ranged from 0.0% (Old Charley Wash) to over 2.8% (Johnson Bottom). High confidence existed among all abundance estimates except for bonytail in Johnson Bottom. The high degree of uncertainty in the Johnson Bottom estimate indicated that the number of fish present was probably higher than estimated. Regression analysis of catch-per-unit-effort estimated 8,960 bonytail, which was similar to the number estimated for age-0 bonytail in 2003. The low survival rates in Leota 10 are minimum estimates of survival because a breach in the coffer dam blocking the drainage canal occurred in early August that resulted in approximately half the volume lost in the floodplain. Because the catch rate of 18.2 razorback suckers/net was similar to those in Old Charley Wash and Johnson Bottoms in July (19.3 and 24.3 fish/net), but much lower (3.2 fish/net) during the depletion sampling in August/September, it is probable that fish were lost during the draining incident. Estimates of age-1 razorback sucker and bonytail in Johnson Bottom were 26 and 6 for razorback sucker and bonytail, respectively (Table 3). Because of intense avian predation in the shallow water of the floodplain at the time the estimate was made, these estimates also probably under-estimate the number of age-1 fishes that survived in the floodplain when it was deeper. In general, survival of razorback sucker was higher, and that of bonytail lower than observed last year.

Growth of stocked fish was variable with outstanding growth observed in L-10, and low growth observed in Old Charley Wash (Table 4). Growth rates were similar to last season and ranged between 0.4 and 0.8 mm/d for both species (Table 4). Growth rate was greatest in L-10 for both species and the length of razorback sucker at harvest was the greatest observed during the study with 21% of fish harvested $\geq$ to 125 mm TL. Because fish were relatively small (i.e., $\leq$ 1.0 g), condition factors could only reliably be determined for age-0 razorback sucker and bonytail in Leota Bottom and age-1 fish in Johnson Bottom. Condition factor (K) for age-0 razorback sucker and bonytail in Leota Bottom at the end of August were 0.970 and 0.625 respectively, and age-1 razorback sucker and bonytail condition in Johnson Bottom were 1.032 and 0.720, respectively for razorback sucker and bonytail.

Using depletion sampling estimates, the total nonnative biomass (using cumulative biomass vs biomass/pass linear regression) in Old Charley Wash and L-10 was 9.7 kg/ha and 8.8 kg/ha, respectively (Figure 5). Depletion of nonnative biomass was not achieved in Johnson Bottom and an estimate could not be determined. Estimates of the percent of stocked razorback sucker and bonytail biomass to total biomass harvested was similar among floodplains measuring 0.6% in L-10, 1.1% in Old Charley Wash, and 1.6% in Johnson Bottom. Gape width of potential age-0 predators was compared with body depth (generated using average daily growth rates) of stocked razorback sucker and bonytail to determine potential predation risk of the large number of young of the year produced in the floodplain. Using these criteria, few razorback sucker (i.e., Old Charley Wash) were vulnerable to the fastest growing nonnative age-0 predators reared in the floodplains at any time through the growing season (Figure 6). However, most bonytail were vulnerable to the faster growing age-0 black bullheads through much of the summer. Both razorback sucker and bonytail were vulnerable to predation by fathead minnow and red shiners through May (razorback sucker) and mid-June (bonytail). Age-0 razorback sucker and bonytail were vulnerable to predation by age-1+ green sunfish, carp and black bullhead which accessed the floodplain from the river.

VII. Recommendation:

Analyze data and complete final report.

VIII. Project Status:

Field work completed, final report will be prepared in the coming fiscal year.

IX. FY 04 Budget Status:

A. Funds provided: $69.9K
B. Funds expended: $69.9K

C. Difference: -0-
D. Percent of the FY 2004 work completed: 100
E. Recovery Program funds spent for publication charges: -$0-

X. Status of Data Submission: Data will be sent to database manager upon completion of the project in 2005. Data are currently being entered on spreadsheets in excel.

XI. Signed: *Tim Modde* October 12, 2004
Principle Investigator Date

Table 1. Area and stocking record of the four floodplain study sites in 2004.

Floodplain	Hectares	Date	RZ larvae Number of larvae	BT larvae
Johnson	57	4/26/2004	360,000	
		5/03/2004		93,750
OCW	34	4/26/2004	240,000	
		5/03/2004		57,000
L-10	49	4/26/2004	300,000	
		5/03/2004		80,250
Thunder Ranch	20	4/26/2004	150,000	
		5/03/2004		33,500
Total	163		1,050,000	264,500

Table 2. Fish composition during monitoring and depletion collections in four study floodplains along the Green River during 2004.

Thunder Ranch

	June				July			
Species	No.	%	Wt	%	No.	%	Wt	%
Pimephales promelas	6.7	9.5	27.0	4.3				
Lepomis cyanellus (Ad)	21	30.0	562.0	89.0				
Lepomis cyanellus (Juv)								
Amierus melas (Ad)								
Amierus melas (Juv)								
Amierus melas (Age-0))								
Cyprinus carpio (Ad)								
Cyprinus carpio (Age-1))								
Cyprinus carpio (Age-0)								
Notropis lutrensis								
Notropis stramineus								
Gila elegans (Ad)								
Gila elegans (Age-0)								
Xyrauchen texanus (Age-0)	0.7	1.0	0.3	0.0				

Species	No.	%	Wt	%	No.	%	Wt	%
Xyrauchen texanus (Age-1)								
Pomoxis nigromaculatus (Ad)								
Pomoxis nigromaculatus (Age-0)								
Ictaluris punctatus (Ad)								
Ictaluris punctatus (Juv)								
Culea inconstans	41.7	59.4	42.7	6.8	60.3	100.0	172.4	100.0
Misc. YOY cyprinids								
Total	70.1		632.0		60.3		172.4	

Johnson Bottom

	June				July Harvest			
Species	No.	%	Wt	%	No.	%	Wt	%
Pimephales promelas	25.8	17.9	48.2	2.2	141.8	16.6	138.7	4.3
Lepomis cyanellus (Ad)	9.8	6.8	135.4	6.3	0.5	0.1	8.2	0.3
Lepomis cyanellus (Juv)	2	1.4	5.4	0.3	5.0	0.6	6.0	0.2
Amierus melas (Ad)	10.4	7.2	275.6	12.8	1.2	0.1	23.0	0.7
Amierus melas (Juv)	27.4	19.1	234.0	10.8	0.4	0.0	5.4	0.2
Amierus melas (Age-0))					17.7	2.1	15.2	0.5
Cyprinus carpio (Ad)	0.6	0.4	1112.0	51.5	1.2	0.1	1889.2	58.2
Cyprinus carpio (Age-1))	3.2	2.2	134.0	6.2	0.7	0.1	61.3	1.9
Cyprinus carpio (Age-0)					603.5	70.8	927.2	28.6
Notropis lutrensis	60.4	42.0	102.4	4.7	53.8	6.3	67.7	2.1
Notropis stramineus	2.6	1.8	3.2	0.1	0.3	0.0	0.2	0.0
Gila elegans (Ad)								
Gila elegans (Age-0)					0.5	0.1	0.8	0.0
Xyrauchen texanus (Age-0)	0.8	0.6	1.0	0.0	24.3	2.9	76.5	2.4
Xyrauchen texanus (Age-1)	0.2	0.1	9.0	0.4				
Pomoxis nigromaculatus (Ad)								
Pomoxis nigromaculatus (Age-0)					1.5	0.2	1.0	0.0
Ictaluris punctatus (Ad)	0.4	0.3	80.0	3.7	0.2	0.0	26.7	0.8
Ictaluris punctatus (Juv)	0.2	0.1	17.6	0.8				
Culea inconstans								
Misc. YOY cyprinids								
Total	143.8		2157.8		852.6		3247.1	

Old Charley Wash

	June				July Harvest			
Species	No.	%	Wt	%	No.	%	Wt	%
Pimephales promelas	12.6	1.2	17.4	0.6	5.3	0.4	2.3	0.1
Lepomis cyanellus (Ad)	0.6	0.1	30.0	1.1				
Lepomis cyanellus (Juv)					25.0	2.0	7.8	0.4
Amierus melas (Ad)					0.1	0.0	2.6	0.1
Amierus melas (Juv)	0.2	0.0	2.0	0.1				
Amierus melas (Age-0))								
Cyprinus carpio (Ad)	0.8	0.1	1292.0	47.2	0.6	0.0	1475.	66.9

							0	
Cyprinus carpio (Age-1))	0.4	0.0	48.0	1.8	0.4	0.0	19.5	0.9
Cyprinus carpio (Age-0)	816	78.2	752.0	27.5	293.5	23.7	497.3	22.6
Notropis lutrensis	195	18.7	184.0	6.7	22.5	1.8	13.4	0.6
Notropis stramineus	15.2	1.5	15.2	0.6	5.6	0.5	4.3	0.2
Gila elegans (Ad)								
Gila elegans (Age-0)								
Xyrauchen texanus (Age-0)	0.8	0.1	0.8	0.0	19.3	1.6	21.5	1.0
Xyrauchen texanus (Age-1)								
Pomoxis nigromaculatus (Ad)	0.6	0.1	140.0	5.1				
Pomoxis nigromaculatus (Age-0)					5.4	0.4	3.9	0.2
Ictaluris punctatus (Ad)	0.2	0.0	256.0	9.3				
Ictaluris punctatus (Juv)	0.2	0.0	2.0	0.1				
Culea inconstans								
Misc. YOY cyprinids					861.9	69.5	156.4	7.1
Total	1043		2739		1240		2204	

Leota-10

	June				July				August Harvest			
Species	No.	%	Wt	%	No.	%	Wt	%	No.	%	Wt	%
Pimephales promelas	16.4	17.2	40.2	1.6	50.8	10.0	47.0	2.3	905.8	53.8	1116	33.6
Lepomis cyanellus (Ad)	18.6	19.5	404.0	16.0					0.2	0.0	6.7	0.2
Lepomis cyanellus (Juv)					261.0	51.5	311.0	15.1	322.7	19.2	643.8	19.4
Amierus melas (Ad)	2	2.1	168.0	6.7	8.4	1.7	342.6	16.6	4.8	0.3	163.2	4.9
Amierus melas (Juv)	13.6	14.3	100.0	4.0	6.0	1.2	61.0	3.0	4.8	0.3	11.3	0.3
Amierus melas (Age-0))					115.8	22.9	194.4	9.4	395.2	23.5	921.7	27.7
Cyprinus carpio (Ad)	0.8	0.8	1340.0	53.2								
Cyprinus carpio (Age-1))	6.6	6.9	412.0	16.4	6.6	1.3	871.0	42.2	1.3	0.1	231.3	7.0
Cyprinus carpio (Age-0)	1.2	1.3	1.2	0.0	22.2	4.4	91.6	4.4	20.2	1.2	135.7	4.1
Notropis lutrensis	29.2	30.6	48.4	1.9								
Notropis stramineus					6.2	1.2	11.0	0.5	13.2	0.8	21.8	0.7
Gila elegans (Ad)												
Gila elegans (Age-0)					11.4	2.3	23.4	1.1	11.0	0.7	29.7	0.9
Xyrauchen texanus (Age-0)	7	7.3	4.0	0.2	18.2	3.6	109.6	5.3	3.2	0.2	41.2	1.2
Xyrauchen texanus (Age-1)												
Pomoxis nigromaculatus (Ad)												
Pomoxis nigromaculatus (Age-0)												
Ictaluris punctatus (Ad)												
Ictaluris punctatus (Juv)												
Culea inconstans												
Misc. YOY cyprinids												
Total	95.4		2518		507		2063		1682		3323	

Table 3. Abundance estimates (with profile likelihood estimates in parentheses), density, and survival of razorback sucker and bonytail sampled into four study floodplains along the Green River in 2004.

	Razorback			Bonytail		
Floodplain	Abundance	Density fish/ha	Survival %	Abundance	Density fish/ha	Survival %
Johnson Age-0	1,523 (1484 - 1587)	36.1	0.6	2,647	46.4	2.8
Johnson Age-1	26 (20 - 54)	0.4	5.7*	6	0.1	0.1*
Leota 10 Age-0	229 (222 - 255)	4.7	0.1	687 (650 - 773)	14.0	0.9
Old Charley Age-0	1,563 (1523 - 1622)	46.0	0.7	2	0.0	0.0
Thunder R. Age-0	2	T	--	0	--	–

* Based on abundance estimated in August 2003.

Table 4. Total length (mm) and growth rate (mm/d), in parentheses, of stocked razorback sucker and bonytail at monitoring dates and harvest from three floodplain study sites.

	Dates Sampled			
Species/Age	July 13	July 28	July 27	August 28
	Old Charley Wash	Johnson	Leota-10	Leota-10
Razorback age-0	48.2 (0.48)	65.0 (0.58)	81.3 (0.77)	106.9 (0.77)
Razorback age-1		243.5		
Bonytail age-0	36.3 (0.40)	57.8 (0.58)	63.5 (0.66)	68.9 (0.52)
Bonytail age-1		150.0		

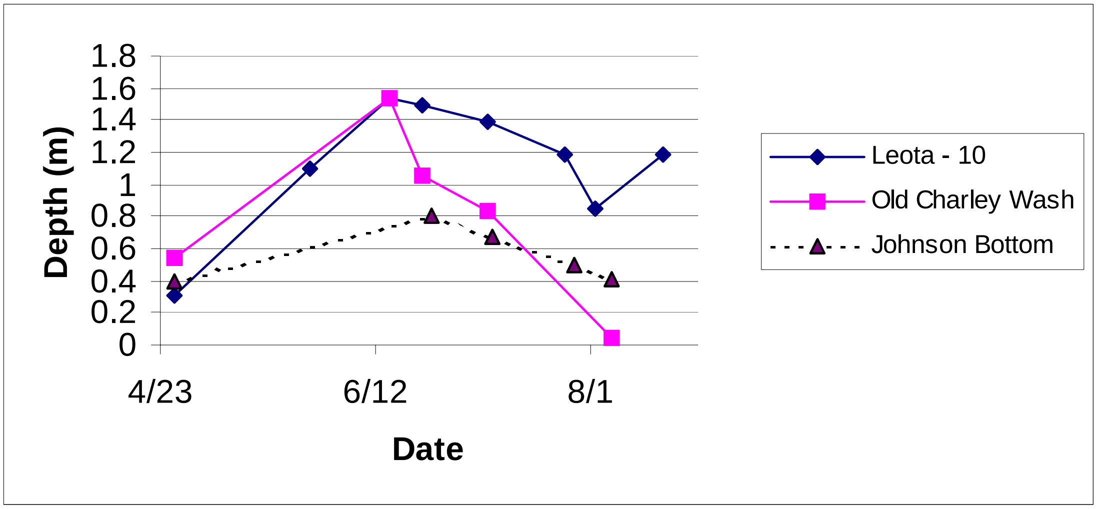

Figure 1. Maximum depths (outlet gage measurements) at three study floodplains on the Ouray National Wildlife Refuge.

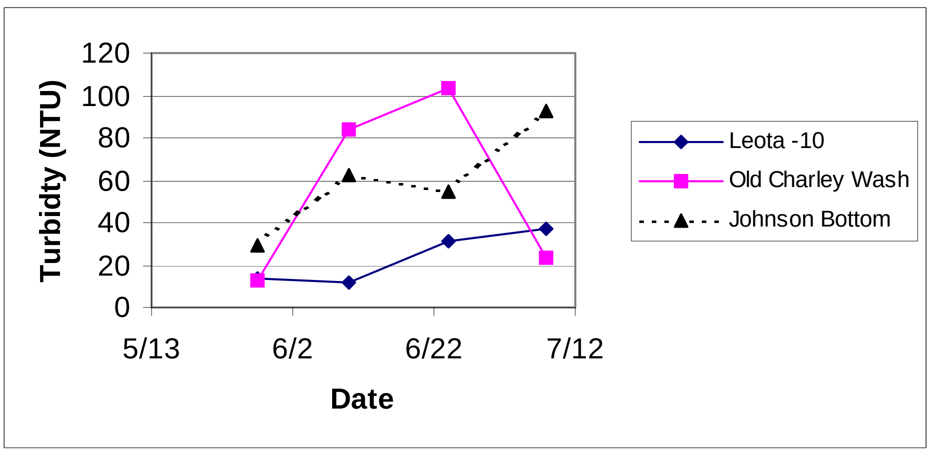

Figure 2. Turbidity measurements from three study floodplains on Ouray National Wildlife Refuge in the spring and summer of 2004.

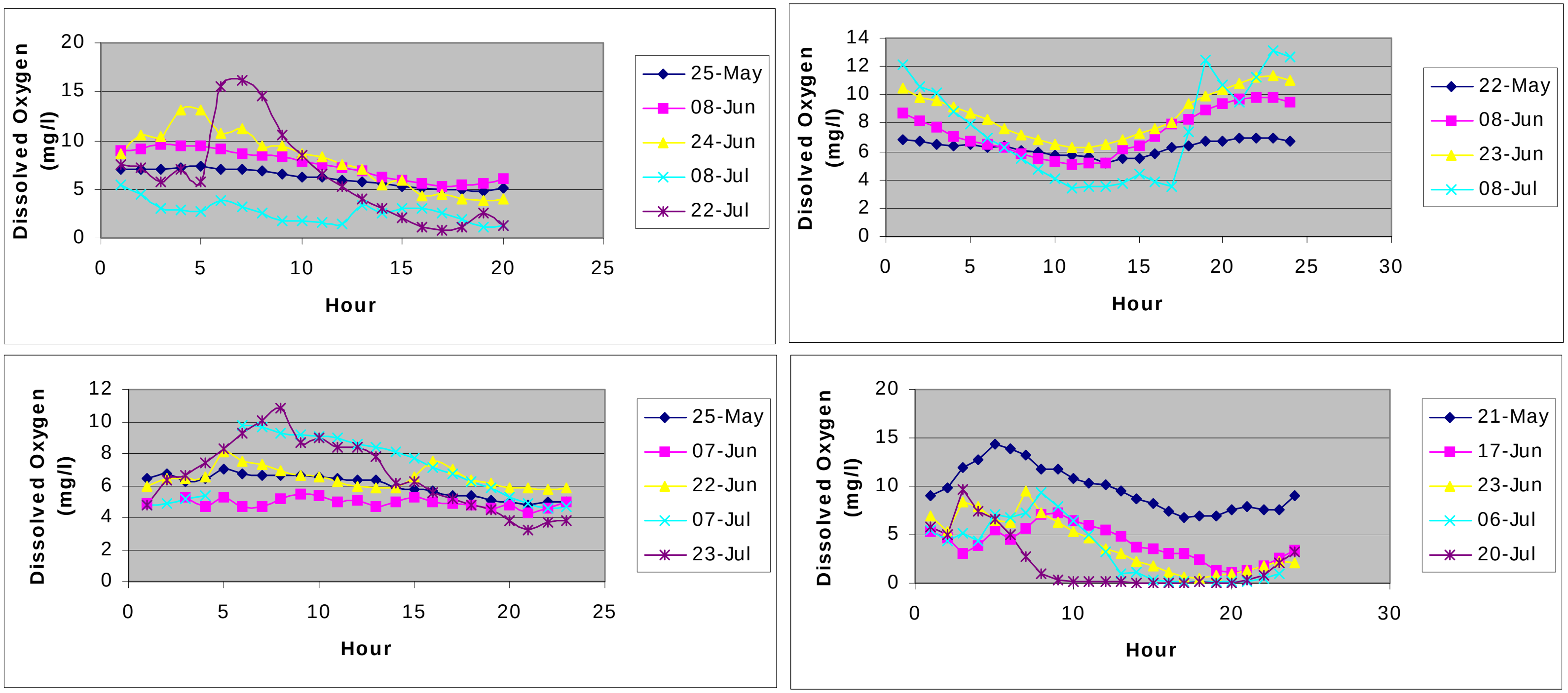

Figure 3. Dissolved oxygen measurements over 24 hr monitoring periods in study floodplains. Top left = Johnson Bottoms, top right= Old Charley Wash, bottom left = Leota 10, and bottom right = Thunder Ranch floodplain.

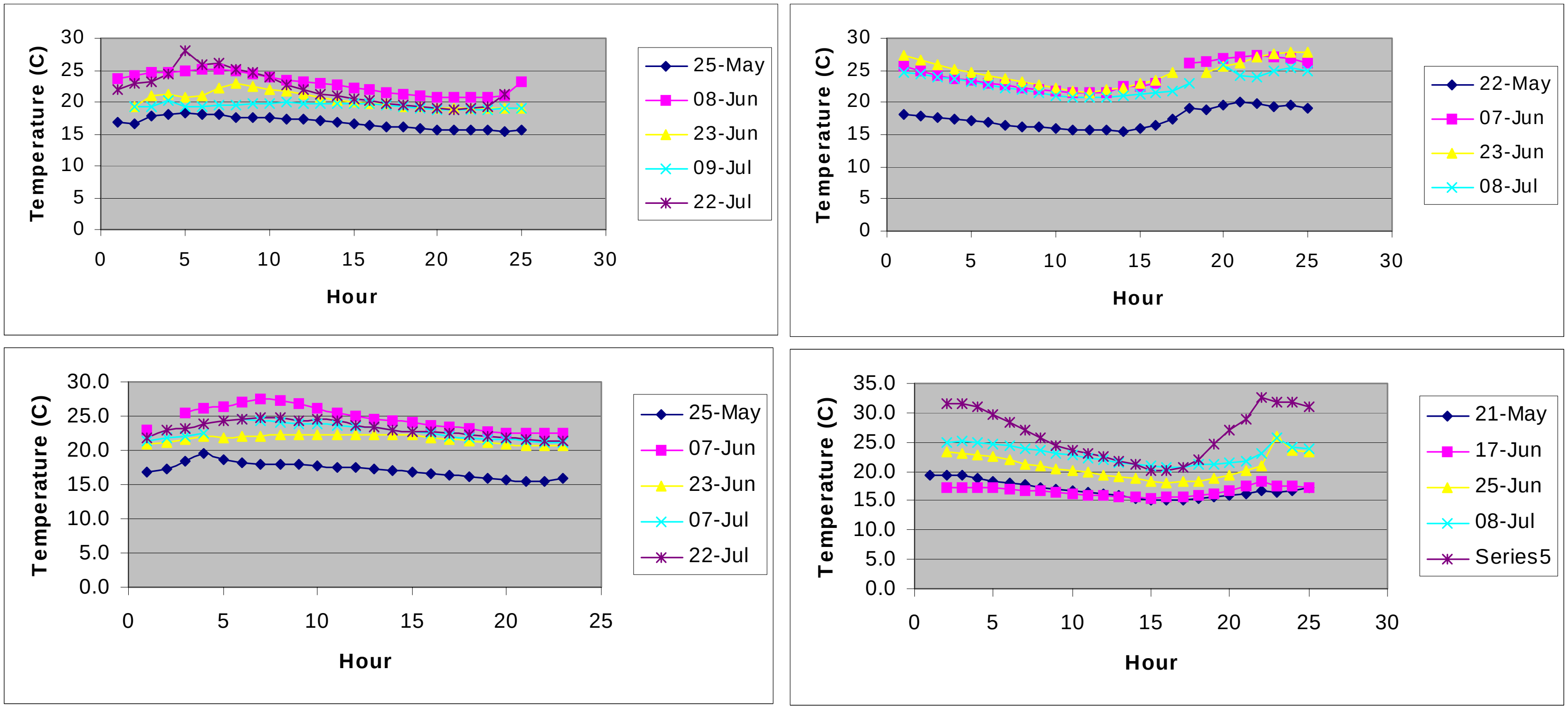

Figure 4. Temperature measurements over 24 hr monitoring periods in study floodplains. Top left = Johnson Bottoms, top right= Old Charley Wash, bottom left = Leota 10, and bottom right = Thunder Ranch floodplain.

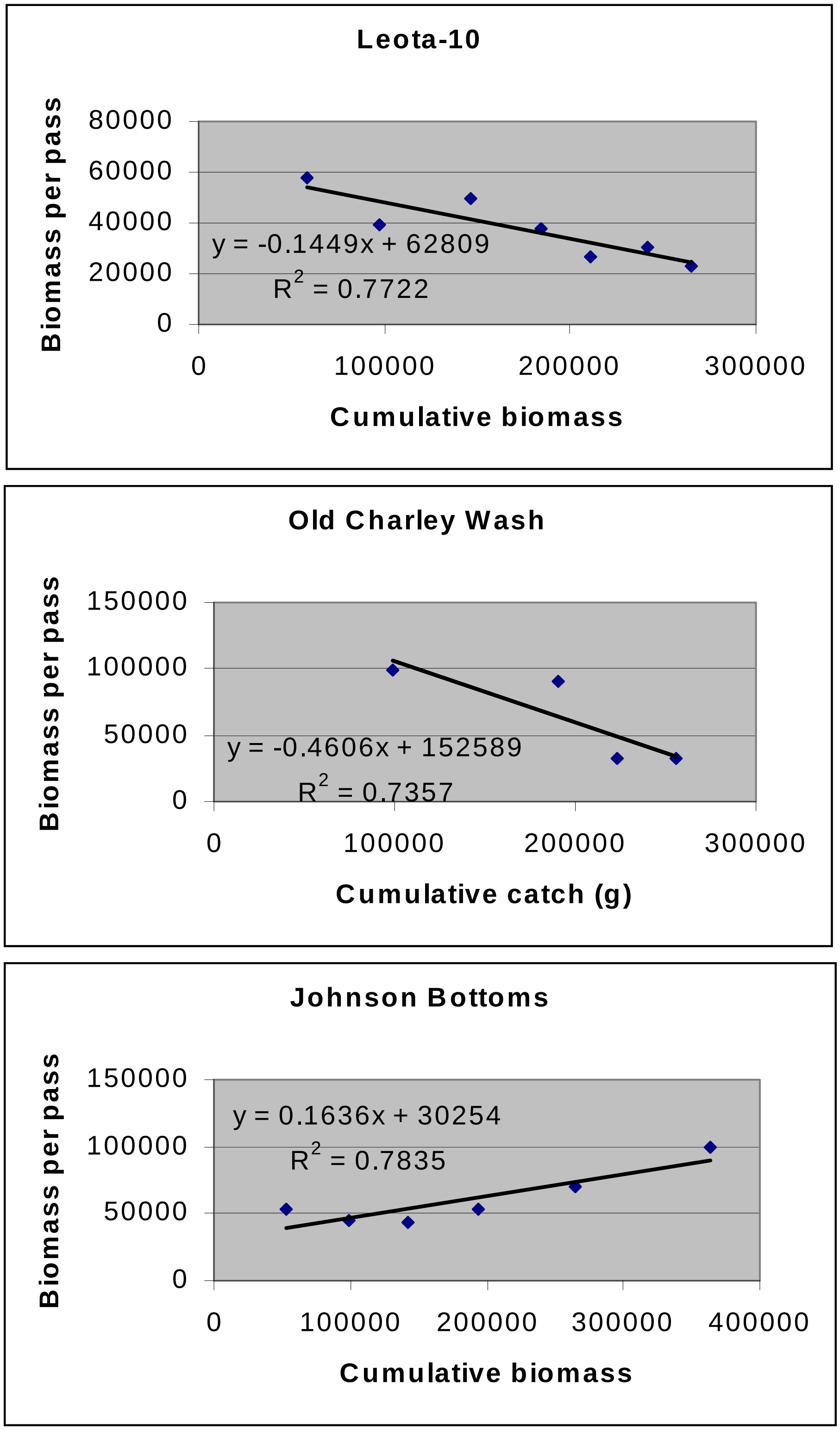

Figure 5. Nonnative biomass estimates at the time of depletion sampling for three study floodplains on the Green River in 2004.

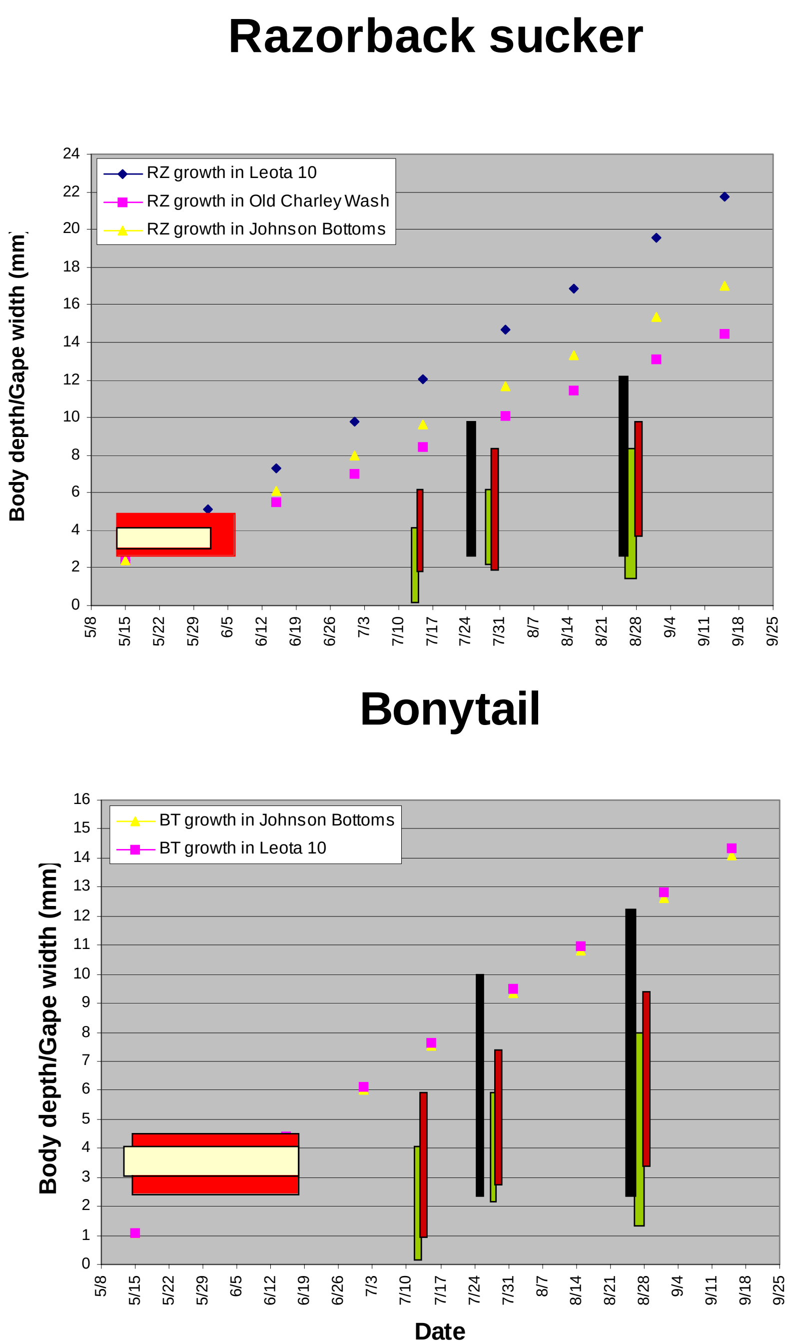

Figure 6. Comparison of average body depth of razorback sucker (top) and bonytail (bottom) in study floodplains, based on average daily growth rates through the spring and summer, to average gape width of available fathead minnow (yellow rectange), red shiner (red rectangle), age-0 green sunfish (green bars), age-0 carp (brown bars), and age-0 black bullhead (black bars) collected during all monitoring and harvest samples.