ADDENDUM

I. Project Title: **Removal of Smallmouth Bass in the Upper Colorado River between Price-Stubb Dam near Palisade, Colorado, and Westwater, Utah.**

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III. The Recovery Program office requested that to establish consistency among ongoing nonnative fish management projects in the upper basin, juvenile and adult smallmouth bass be characterized by the following length categories: juveniles: < 200 mm, adults ≥ 200 mm. Standardizing length classes to identify age categories, i. e., juveniles and adults, would facilitate abundance comparisons among various nonnative fish management projects within the Upper Colorado River Basin.

In previous annual reports, for smallmouth bass in the Upper Colorado and Lower Gunnison rivers, catch statistics were reported using length categories of ≥ 100 and ≥ 150 mm. Abundance (mean population with 95% C.I.s and fish/mile estimates) and exploitation rates were recalculated for juvenile (100-199 mm) and adult (≥ 200 mm) smallmouth bass for 2006, 2007, and 2008. For the Upper Colorado smallmouth bass removal project, a slight deviation should be noted for these recalculations: population abundance (mean population plus 95 % C.I.s and fish/mile estimates) is reported for juveniles 100-199 because smallmouth bass < 100 mm were not marked. Catch/effort (fish/hr) was also recalculated for smallmouth bass < 100 mm (young-of-the-year), 100-199 mm (juvenile), and ≥ 200 mm (adult) for 2004 – 2008 . The attached tables (3) and figures (3) serve as an addendum to the 2008 Recovery Program Project No. 126(a). For the new length class categories adopted by the Recovery Program office, these new catch statistic computations reported herein should now be more comparable with smallmouth bass population parameters reported by other principal investigators in the upper basin.

Table 1. Population estimate with 95% confidence intervals (CI) and other statistics for smallmouth bass (100-199 mm and ≥ 200 mm) for the 15- and 18-mile reaches (river miles 185.6 to 152.6) of the Upper Colorado River and 2.3 miles of the Lower Gunnison River (Redlands Diversion Dam to the Colorado/Gunnison River confluence) for the summers of 2006, 2007, and 2008. Note: length of the area for the population estimate was 35.3 miles. Refer to Figure 1.

Year	Fish Length Size (mm)	Pop Estimate with 95% CI	SE	SmBass/ mile	Number Marked; No. Removed 1st Removal	Number Recaptured (1st Removal Pass)	Total Number Recaptured (all removal passes)	Total Number of Removal Passes	Total Number of SmBass Removed (all removal passes)	Percentage Removed (All Removal Passes)	CV (%)	p-hat
2004	NO POPULATION ESTIMATE PERFORMED											
2005	NO POPULATION ESTIMATE PERFORMED											
2006	100-199	No Pop Est.	- - -	- - -	25;18	0	0	4	54	- - -	- - -	- - -
	≥ 200	2,295 ± 1,500	765	65.0	97;163	6	8	4	449	19.6	33.3	0.038
2007	100-199	No Pop Est.	- - -	- - -	13;16	0	0	8	250	- - -	- - -	- - -
	≥ 200	1,007 ± 686	350	28.5	54;109	5	14	8	429	42.6	34.8	0.048
2008	100-199	804 ± 423	216	22.8	96;82	9	10	8	214	26.6	26.9	0.11
	≥ 200	393 ± 276	141	11.1	67;28	4	17	8	135	34.4	35.9	0.17

Table 2. Comparison of three different methods ("A", "B", "C") to compute exploitation rates for smallmouth bass (100 – 199 mm and ≥ 200 mm) collected in the Upper Colorado (river miles 187.8 – 152.6) and the Lower Gunnison (river miles 3.0 – 0.7) rivers during 2006, 2007, and 2008.

A. Method 1: most conservative estimate, biased because of fish movement out of the sampling area or mortality.

Year	Length Class (mm)	No. of Smth Bass Marked & Released during the Marking Pass	No. of Recaptured Marked Smth Bass (all removal passes)	% Exploitation Rate (μ)
2006 [a]	100-199	25	0	- - -
	≥ 200	97	8	8.9
2007 [b]	100-199	13	0	- - -
	≥ 200	54	14	25.9
2008 [b]	100-199	96	10	10.4
	≥ 200	67	17	25.4

B. Method 2: biased by fish moving into or out of removal reaches and mortality.

Year	Length Class (mm)	No. of Smth Bass Removed (all passes)	Point Population Estimate	% Exploitation Rate (μ)
2006 [a]	100-199	54	No Pop Estimate (no marked recaptures)	- - -
	≥ 200	449	2,295	19.6
2007 [b]	100-199	250	No Pop Estimate (no marked recaptures)	- - -
	≥ 200	429	1,007	47.3
2008 [b]	100-199	214	804	26.6
	≥ 200	135	393	34.4

[a] Four removal passes.
[b] Eight removal passes. Includes fish removed by FWS (passes 1 – 6) and CDOW (passes 7 – 8).

Table 2 (cont'd).

C. Method 3: this method reduces bias associated with movement, mortality, and growth, but assumes the probability of capture on the first removal pass is similar to all subsequent removal passes.

Year	Length Class (mm)	No. of Smth Bass Marked & Released during the Marking Pass	No. of Marked Smallmouth Bass Removed during the 1st Removal Pass	Probability of Being Captured on each pass (p-hat)	Probability of Being Captured after "n" Passes (or) Exploitation Rate (μ)
2006 [a]	100-199	25	0	- - -	- - -
	≥ 200	97	6	0.062	22.6 [a, c]
2007 [b]	100-199	13	0	- - -	- - -
	≥ 200	54	5	0.093	54.2 [b, c]
2008 [b]	100-199	96	9	0.094	54.6 [b, c]
	≥ 200	67	4	0.059	38.5 [b, c]

[a] Four removal passes ("n").

[b] Eight removal passes ("n"). Includes fish removed by FWS (passes 1 – 6) and CDOW (passes 7 – 8).

[c] Exploitation rate (μ) computed as, $\mu = 1 - [(1 - p)^n]$, where p is the probability of being captured on one pass as computed from the first removal pass, 1 – p is the probability of fish surviving one removal pass, $(1 - p)^n$ is the probability of surviving n passes, and $1 - [(1 - p)^n]$ is the probability of being captured after n passes (personal communication, Bruce Haines, USFWS (ret.), Vernal, Utah).

Table 3. Catch/effort (fish/hour) comparison by year for three different length classes (total length) of smallmouth bass (< 100 mm = young-of-the-year; 100–199 mm = juveniles; ≥ 200 mm = adults) for the Silt to Beavertail Mountain reaches (river miles 248.0 – 195.70 in the Upper Colorado River and the Upper Colorado River from Price-Stubb Dam to the Westwater BLM ranger station, Utah (river miles 187.7 – 127.6) and the Lower Gunnison River from the Redlands Diversion Dam to the Colorado/Gunnison River confluence (river miles 3.0 – 0.7) from 2004 – 2008. Note: passes were combined within years for the Silt to Beavertail Mountain and Price Stubb to Westwater, Utah, plus the Lower Gunnison River reaches. Refer to Figures 2 and 3.

	Smallmouth Bass						
River Reach	Length Class (mm)		Year				
			2008	2007	2006	2005	2004
Silt ▸ Beavertail Mountain	< 100	No. of fish	21	17	36	58	3
		Catch/ effort	0.25	0.20	0.96	1.46	0.15
	100-199	No. of fish	29	28	2	54	4
		Catch/ effort	0.34	0.32	0.05	1.36	0.20
	≥200	No. of fish	32	45	41	118	14
		Catch/ effort	0.37	0.52	1.09	2.96	0.71
Price-Stubb▸ Westwater, Utah + Lower Gunnison River	< 100	No. of fish	185	1,358	261	254	93
		Catch/ effort	0.63	4.15	1.61	1.46	0.55
	100-199	No. of fish	214	250	54	345	618
		Catch/ Effort	0.73	0.76	0.33	1.98	3.66
	≥200	No. of fish	135	429	449	768	456
		Catch/ Effort	0.46	1.31	2.77	4.39	2.70

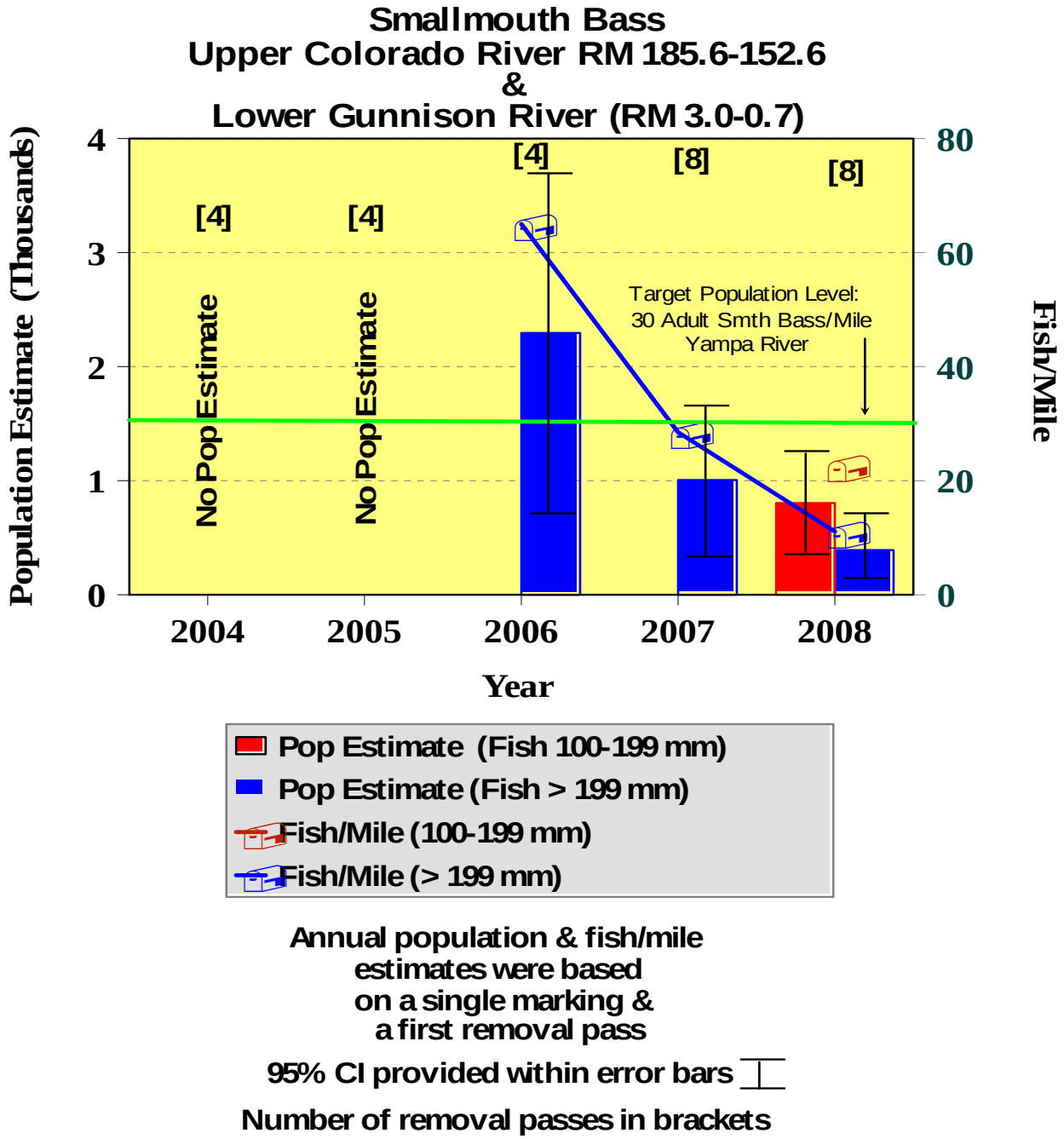

Figure 1. Population abundance estimate comparison (fish/mile and point estimate with 95 % C.I.s) for smallmouth bass (100-199 mm and ≥200 mm) for the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers, 2006, 2007, and 2008. Note: no population estimate was computed for juvenile bass 100-199 mm for 2006 and 2007 because no marked fish were recaptured. Refer to Table 1.

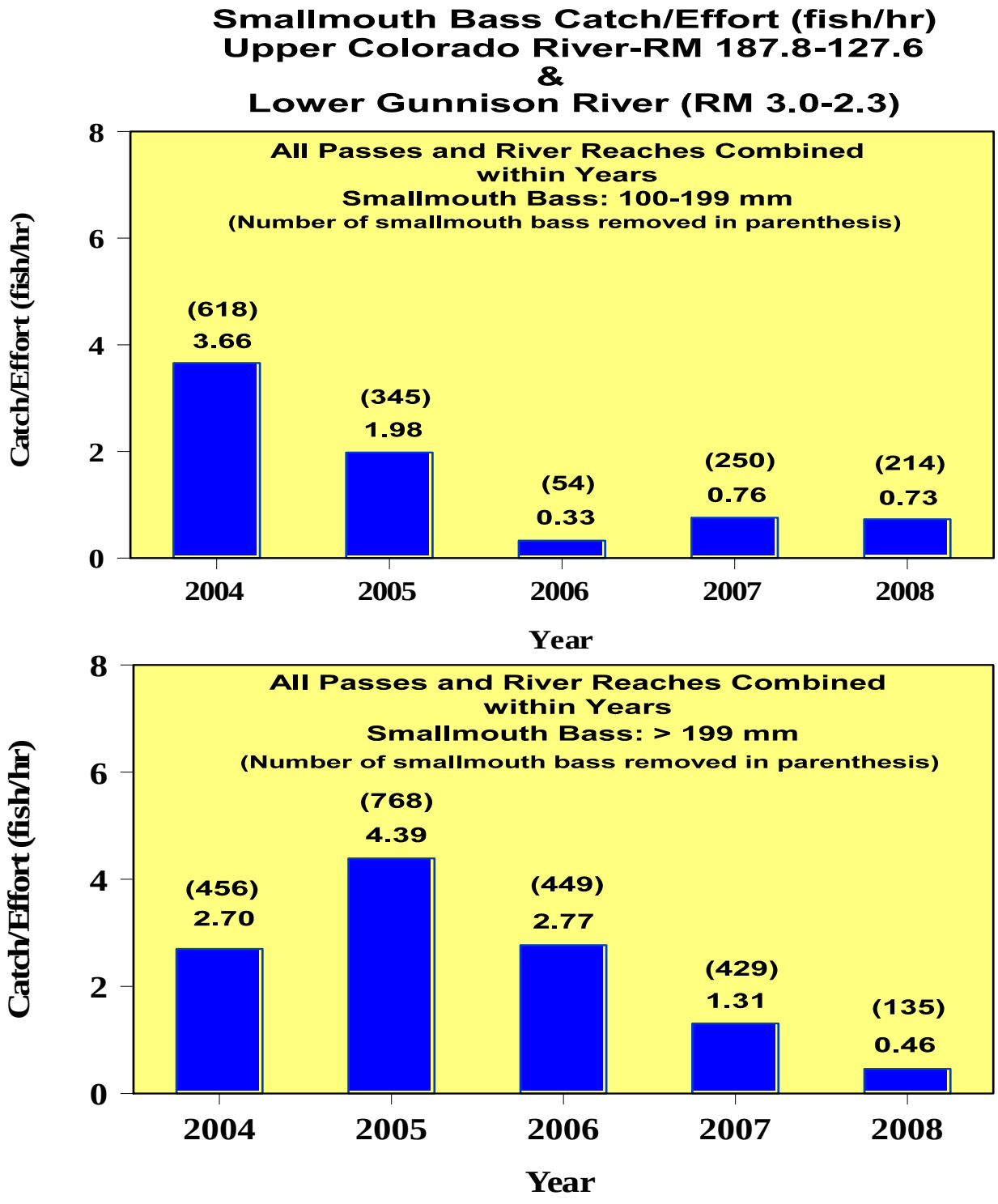

Figure 2. Five year comparison (2004 – 2008) of catch/effort (fish/hr) for smallmouth bass 100-199 mm (top) and ≥ 200 mm (bottom) for the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. Refer to Table 3.

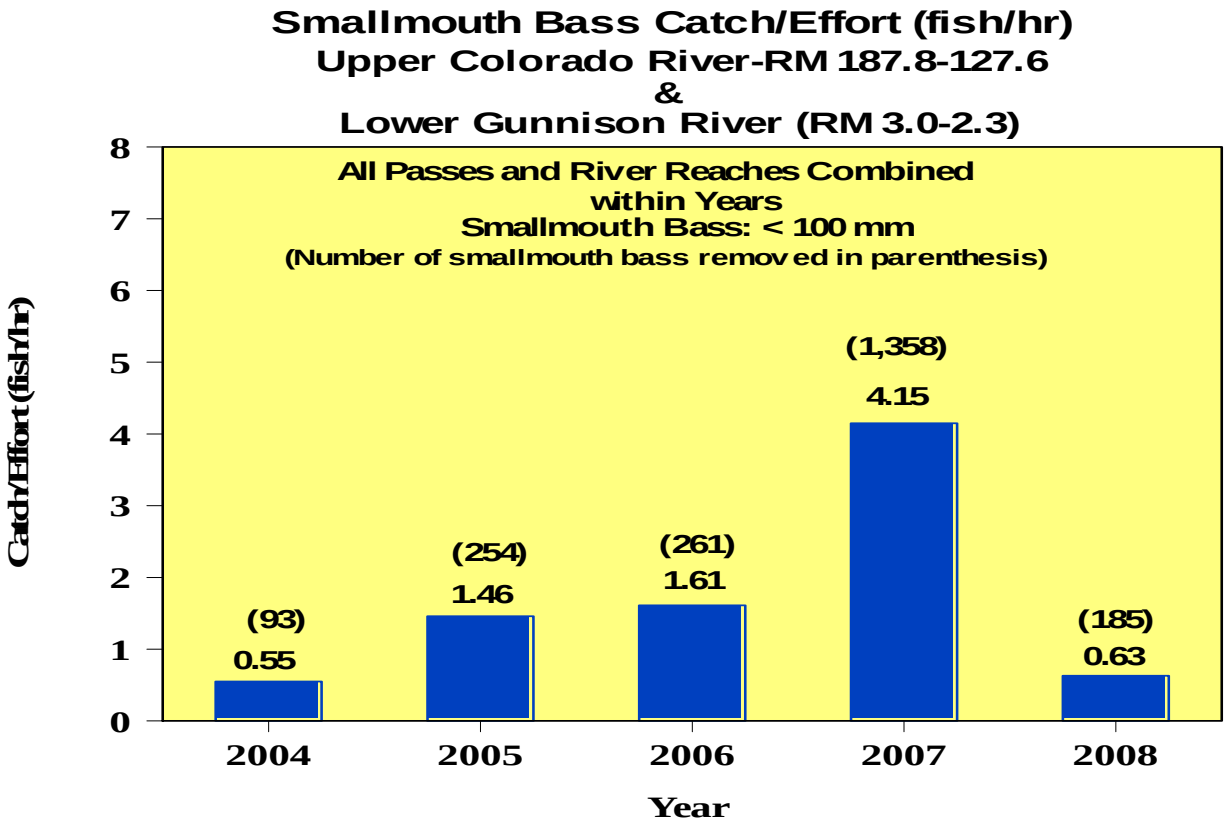

Figure 3. Five year comparison (2004 – 2008) of catch/effort (fish/hr) for smallmouth bass < 100 mm for the Grand Valley reaches of the Upper Colorado and Lower Gunnison rivers. Refer to Table 3.