COLORADO RIVER RECOVERY PROGRAM
FY 2014 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 129

I. Project Title: **Humpback chub population estimates for Desolation/Gray Canyons, Green River Utah.**

II. Bureau of Reclamation Agreement Number: R14AP00007

Project/Grant Period: Start Date: 05/01/2014
End Date: 09/30/2018
Reporting period end date: 09/30/2014
Is this a final report? Yes____ No__X__

III. Principal Investigator(s):

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IV. Abstract: Achievement of recovery goals (2002 amended recovery plan) for humpback chub requires monitoring six self-sustaining populations in the upper and lower Colorado River basins. Population estimates for Desolation and Gray Canyons were completed in 2001–2003. During the next round of estimates in 2006–2007 it was determined that humpback chub site fidelity in fall when sampling occurred was high (90–100%). As very little movement was occurring among humpback chub among sites, population estimates were calculated for each site and extrapolated across a determined number of available sites within Desolation and Gray Canyons (n=63; Badame, 2010). The same population estimation technique was followed in the 2010-2011 and 2014 sampling. The extrapolated canyon-wide population estimate for 2014 was 1,863 humpback chub (variance has not yet been calculated).

V. Study Schedule: Initial year 2014 – final year ongoing.

VI. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).

V.A. Measure and document population and habitat parameters to determine status and biological response to recovery actions.

GREEN RIVER ACTION PLAN: MAINSTEM

V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).
V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.
V.B. Conduct population estimate for humpback chub.
V.B.1. Desolation/Gray

VII. Accomplishments of FY14 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Complete three sampling trips in Desolation/Gray Canyon from August to October:

Three sampling passes were completed through Desolation and Gray Canyons on September 1–8, September 16–23, and October 1–8, 2014. Mean daily flows during sampling ranged from 2,940–6,170 cubic feet per second (cfs; USGS gage #09315000, Green River at Green River gauge). Average water temperatures during each pass were 21.3^{o} C, 21.6^{o} C and 15.5 ^{o} C respectively.

A total of six sites were sampled including four long-term trend sites and two sites randomly selected from those previously sampled during the 2001–2007 population estimates. The sites were located at river miles (RM) 185, 178.5, 174.4, 160.4, 150.8, and 145.7 (Figure 1). There are a number of sites (n=63) within Desolation and Gray Canyons that have been characterized as having the necessary habitat for maintaining humpback chub through the fall and winter (Badame, 2012). The six sites sampled in 2014 represent approximately 10% of the estimated available sites.

Total effort included 1,276 trammel net hours, 346 hoop net hours and 9.3 hours of electrofishing over three passes (Table 1). During the second pass, submersible PIT tag antennas were also deployed for a total of 471 hours. Sampling efforts resulted in 98 adult humpback chub and 1 juvenile *Gila* captured. Mean catch per unit effort (CPUE) for the long-term trend sites sampled was 0.081fish/net hour and ranged from 0.02-0.14 fish/net hour. The 2014 long-term trend-sites mean CPUE was lower than the peak values recorded from 1997–2000 which ranged from 0.19–0.23 fish/net, however, there is no significant declining trend in annual catch rate from 1985–2014 (r^2=0.058, p=0.294; Figure 2). Mean CPUE for humpback chub captured via trammel nets at all sites sampled averaged 0.077 fish/net hour and ranged from 0.017 to 0.139. Since 2003 trammel net CPUE for adult humpback chub in Desolation and Gray Canyons has not shown a significant declining trend (r^2=0.043, p=0.692) and has ranged between 0.04-0.13 fish/net hour (Figure 3); the years when sampling occurred in the summer were excluded (2001-2002).

Closed population estimates were calculated for each site with Program MARK utilizing the Huggins p and c model (Table 2). Model averaging was utilized when the AIC weights were less than 0.90; all site population estimates were completed using model averaging of M_o (constant p), M_t (time varying p), and M_b (behavioral reponse) models.

Initial capture (p-hat) and recapture (c) probabilities were calculated through model averaging and are reported in Figure 4. The adult humpback chub population estimate for the site at Cedar Ridge (RM 185) is 43 (SE= 23.5, 95% C.I. 0–90, C.V.=54.0%). The estimate for Wildhorse rapid (RM 178.5) is 20 (SE=8.7, 95% C.I. 2–37, C.V.=44.6%). The estimate for Log Cabin (RM 174.5) is 14 (SE=4.7, 95% C.I. 5–24, C.V.=33.1%). The estimate for Cow Swim (RM 167) is 30 (SE=13.7, 95% C.I. 3–57, C.V.=45.9%). At Range Creek (RM 150.8) 14 individuals were captured with no recaptures. The estimate for Coal Creek (RM 146) is 41 (SE=24.6, 95% C.I. 0–89, C.V.=60.7%).

Observed site fidelity by humpback chub during the 2014 sampling was close to 100% with only one fish moving between sites. Since 2006 almost all within year and between year recaptures have occurred in their site of original capture. In 2006–07, 2010 and 2014 site specific population estimates were calculated due to very high fall site fidelity among humpback chubs. The site specific estimates were then used to determine an average site density for each year. The average site density was extrapolated across the 63 available habitats found in Desolation/Gray Canyons to provide a total population estimate for each year (Table 3). In 2014, the mean estimate per site (29.6) multiplied by the 63 available habitat sites, resulted in a total estimate of 1,863 humpback chub within Desolation and Gray Canyons (p-hat=0.264; variance for this has not yet been calculated). The probability of capture for 2014 is the highest reported p-hat since the new sampling protocol began in 2001 and may be partially explained by the increased effort via hoop nets and PIT antenna. Although the density extrapolation method may be the best option for this reach, this estimate should not be viewed as an accurate representation of population size as only 8% (5 of 63 sites) of potentially available sites were sampled; whether those sites were representative of those occupied by humpback chub within the canyons has yet to be determined.

The length frequencies of humpback chub captured in 2014 covered a similar spectrum to that observed in past years; however, fewer fish below 200 millimeters total length (mm TL) have been captured when compared to the first two sampling sessions (2001–2003, 2006–2007; Figure 5). One small juvenile at 167 mm TL was captured via hoop netting and no other sub-adults were captured. The metric of first-year adults (200–220 mm TL) as a percentage of total adults captured continues to be used as a measure of recruitment. The proportion of first-year adults has been declining since the first two sampling occasions (2001–2003, 2006–2007) when they accounted for an average of 13% of captured adults. During the 2010–2011 sampling period, first-year adults accounted for an average of 6.9% of captures and in 2014 they accounted for just 4% of the total adult captures.

Task 2 – Data entry:

The 2014 data have been entered and quality checked and will be transferred to the UCRRP database manger by January 15, 2015.

Task 3 –Annual reporting:
An annual progress report including an extrapolated population estimate, a summary of the 2014 data, and comparisons among present and past monitoring efforts will be submitted by November 14, 2014.

VIII. Additional noteworthy observations: Other native fish collected during the study included Colorado pikeminnow (n=6), bonytail chub (n=2), roundtail chub (n=1), razorback sucker (n=26), flannelmouth sucker (n=160), and bluehead sucker (n=39). The most notable nonnative fishes collected during the study include walleye (n=6) with a median total length of 478 mm (435–540 mm) and smallmouth bass (n=81) with a median total length of 200 mm (133–466 mm).

IX. Recommendations:

- Trammel net sampling should continue as the primary sampling tool for adult humpbacks. Hoop nets and electrofishing should continue to provide relative catch rates for juvenile *Gila*.
- Consider increasing hoop net sampling in an attempt to capture more humpback chub (juvenile and adult). Hoop net sampling captured 13% of all humpback chub as well as the only juvenile captured in 2014.
- In an effort to increase re-sights (individuals that were not recaptured but were encountered using the PIT tag antennas) of humpback chub consider purchasing and utilizing PIT antennas such as the ones used during the second pass in 2014 which increased the number of recaptures by 25%.
- The best method to determine population estimates in Desolation and Gray Canyons is by extrapolation using chub density and the number of available habitat sites. Current estimates of the number of fall/winter habitats within Desolation and Gray Canyons need to be refined through examination of detailed maps, past geomorphology or habitat reports, and discussion with other investigators familiar with the reach. In order to calculate more accurate estimates sampling must be increased to encompass approximately 20% of available habitat sites.
- Estimates from 2001–2003 should be examined in terms of site fidelity and mixing of individuals between passes within each year. If sufficient mixing is not found, then site specific estimates should be calculated and extrapolated as they were for 2006–2007.
- Examine population estimate trends and survival of humpback chub at long-term trend sites in an attempt to determine the trajectory of the population over time in light of the decline in first year adult humpback chub from 2001–2014.

X. Project Status: Project is on track and ongoing.

XI. FY 2014 Budget Status

A. Funds Provided: $66,470
B. Funds Expended: $66,470
C. Difference: $0
D. Percent of the FY 2014 work completed, and projected costs to complete: 100%
E. Recovery Program funds spent for publication charges: $0

XII. Status of Data Submission: The 2014 data have been entered and quality checked and will be transferred to the UCRRP database manger by January 15, 2015.

XIII. Signed: Julie Howard November 14, 2014
Principal Investigator Date

XIV. Literature Cited:

Badame, P.V. 2012. Population estimates for humpback chub (*Gila cypha*) in Desolation and Gray Canyons, Green River, Utah 2006–2007. Final report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

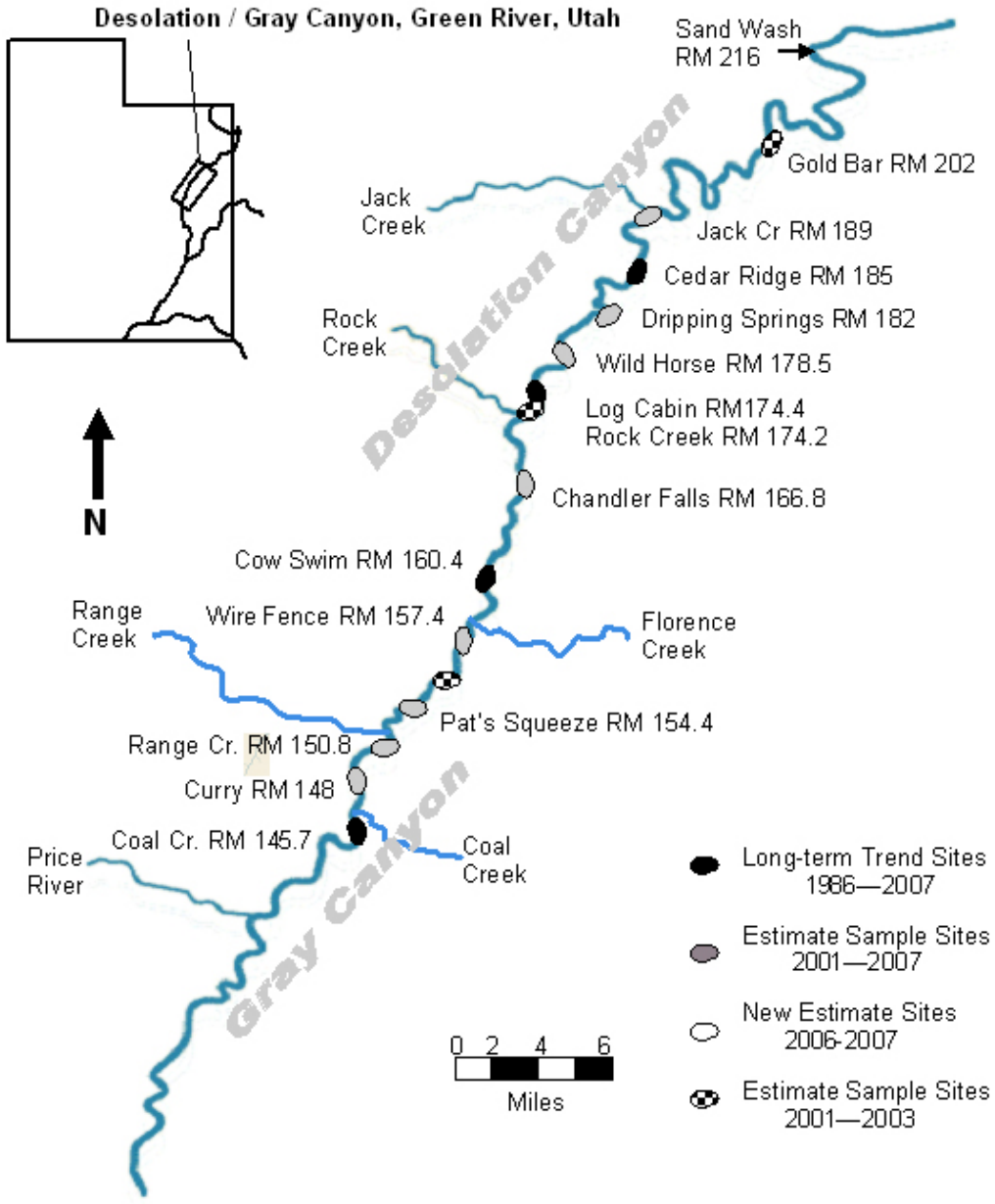

Figure 1: Fifteen sample sites located within Desolation and Gray Canyons of the Green River.

Table 1: Effort for each gear type and total number of humpback chub (HBC) collected during population sampling in Desolation and Gray Canyons, 20012014, includes all captures from all sites.

				Trammel		Electofishing		Hoop net/minnow trap	
Year	Months	Passes completed	# Sites sampled	Hours	HBC	Hours	HBC	Hours	HBC
2001	Jun-Jul	3	12	2,803	214	8	3	0	-
2002	Jun-Jul	2	12	2,008	239	22.5	38	1,440	7
2003	Sep-Oct	3	12	3,042	236	11.0	1	1,946	5
2006	Sep-Oct	3-4	12	3,289	119	16.4	12	729	9
2007	Sep-Oct	3	12	2,7,27	130	0.0	-	988	6
2010	Sep-Oct	3	5	1,163	68	7.0	5	0	-
2011	Sep-Oct	3	6	1,013	55	6.4	8	0	-
2014	Sep-Oct	3	6	1,276	99	9.3	6	346	12

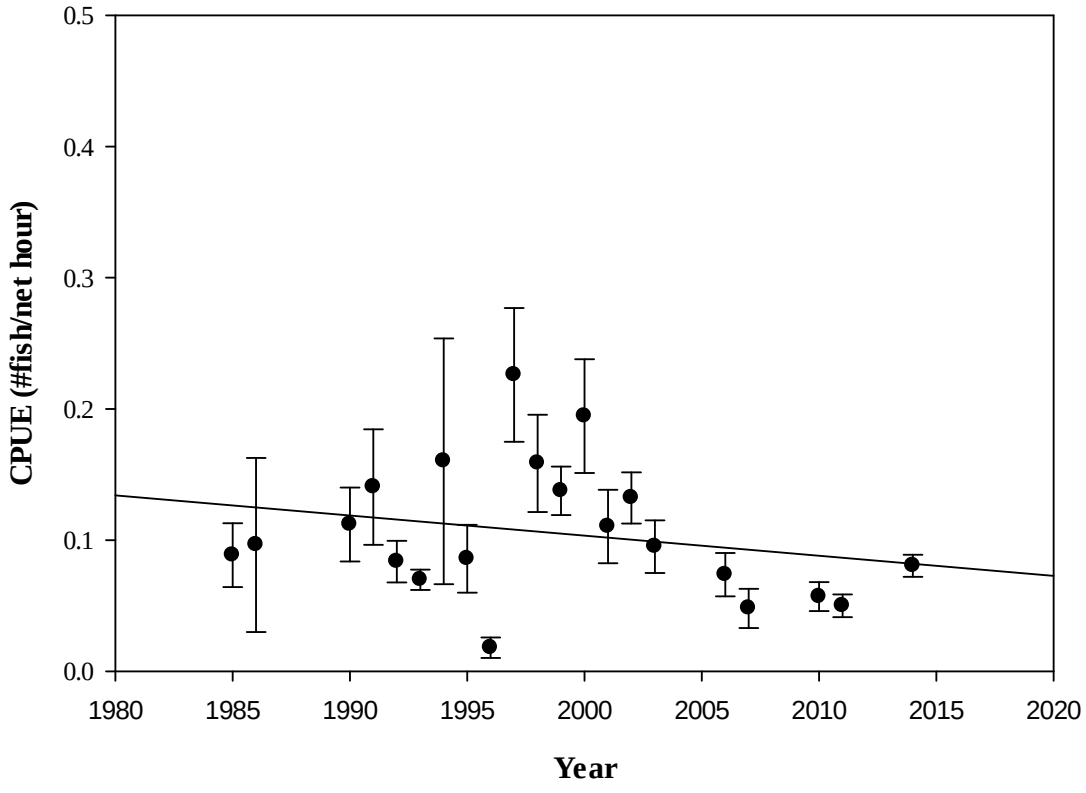

Figure 2: Long-term trend-sites mean CPUE for all humpback chub (trammel net captures only), 1985–2014 including both summer and fall sampling events. The 1989 data point has been excluded as an outlier (0.59) to maintain scale. Error bars represent one standard error. The trend line is based on a linear regression and is not significant (r^2=0.058, p=0.294).

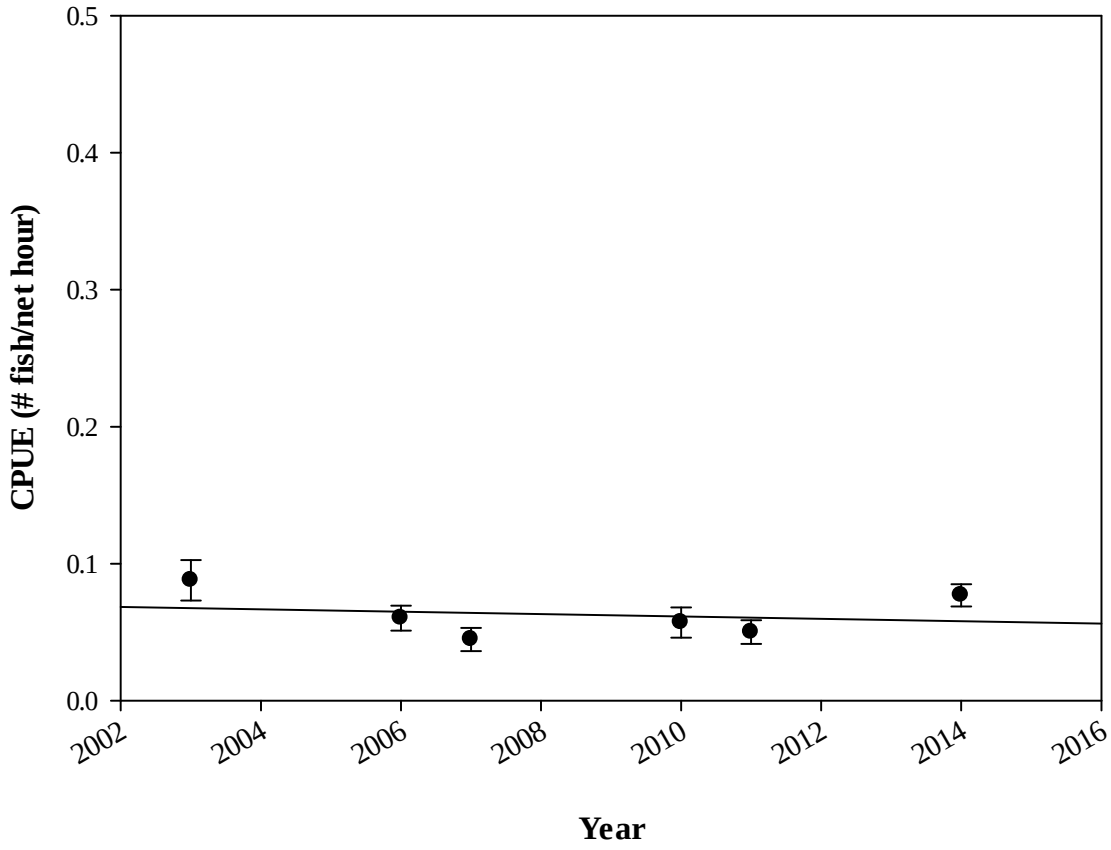

Figure 3: Mean CPUE for all sites sampled in Desolation and Gray Canyons for all humpback chub (trammel net captures only), 2003–2014. Only those years where sampling took place in the fall are included (excludes 2001–2002). Error bars represent one standard error. The trend line is based on a linear regression and is not significant (r^2=0.043, p=0.692).

Table 2: Program MARK Huggins model output by site for all models used in model averaging; models are listed from top to bottom by AIC weight (highest to lowest). Models were averaged at all sites where AIC weights for the top model were <0.90.

	Model	AICc	Delta AICc	AICc Weights	Deviance
Cedar Ridge	{p(.)=c(.)} M_o	58.202	0	0.65001	81.0476
	{p(.),c(.)} M_b	60.256	2.0548	0.23266	80.9441
	{p(t)=c(t)} M_t	61.626	3.4241	0.11732	80.0687
Wildhorse	{p(t)=c(t)} M_t	41.407	0	0.53939	48.0985
	{p(.),c(.)} M_b	42.105	0.6979	0.3805	51.1488
	{p(.)=c(.)} M_o	45.221	3.8139	0.08012	56.4901
Log Cabin	{p(.)=c(.)} M_o	38.838	0	0.70123	31.9427
	{p(.),c(.)} M_b	41.091	2.2532	0.22729	31.8943
	{p(t)=c(t)} M_t	43.405	4.5669	0.07148	31.7294
Cowswim	{p(.)=c(.)} M_o	61.133	0	0.6874	68.007
	{p(.),c(.)} M_b	63.297	2.1647	0.23289	68.0034
	{p(t)=c(t)} M_t	65.442	4.3092	0.0797	67.8873
Coal Creek	{p(t)=c(t)} M_t	44.128	0	0.83534	64.9758
	{p(.),c(.)} M_b	48.239	4.1106	0.10697	71.3652
	{p(.)=c(.)} M_o	49.4735	5.3453	0.0577	74.7796

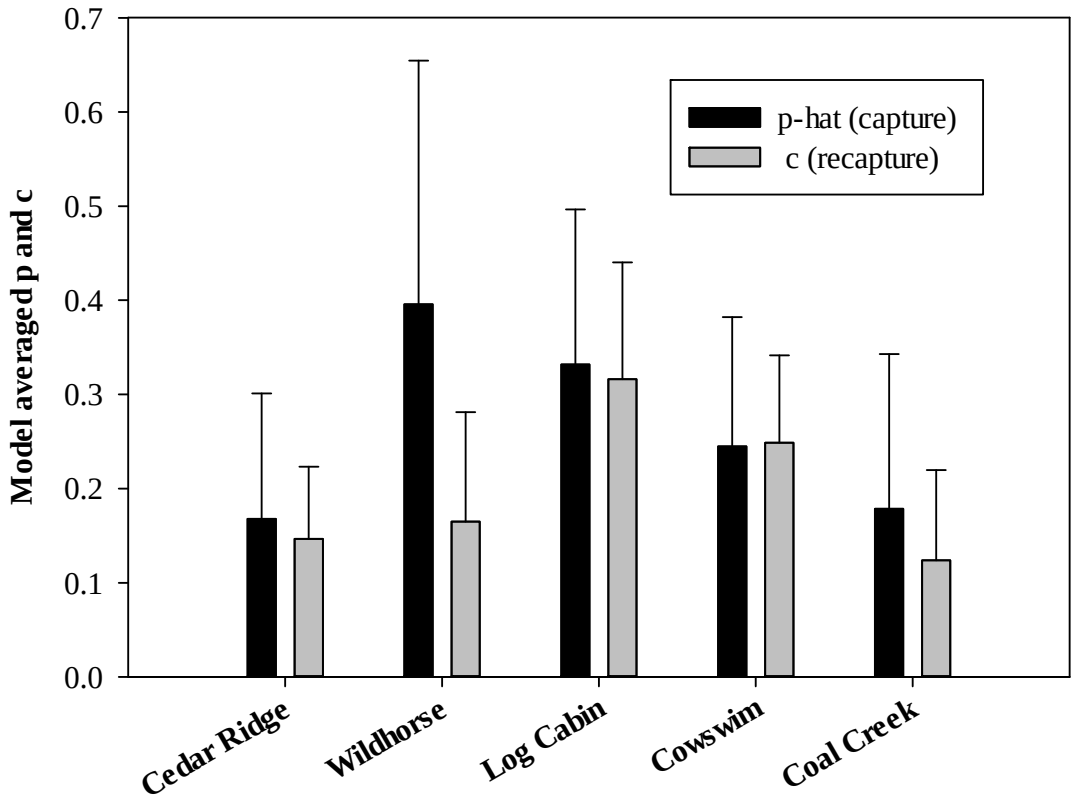

Figure 4: Model averaged probability of capture (p-hat) and recapture (c) by site, 2014. Error bars represent one standard error.

Table 3: Summary of population estimates (N) for Desolation/Gray Canyons 2001–2011. Column headings include the 95% confidence interval (C.I.), probability of capture (p-hat), and coefficient of variation (C.V.). No 95% C.I was calculated for 2014 due to insufficient time for reporting. Methods of estimation prior to 2006 combined all annual capture data into one population estimate and likely underestimated the population size significantly. *An estimate was not calculated for 2011 due to insufficient recaptures therefore the number of individuals captured is presented.

Year	N	95% CI	C.V.	p-hat
2014	1,863	-	-	0.264
2011*	55	-	-	-
2010	1,625	1,023–5,465		0.173
2007	1,108	1,071–4,914		0.188
2006	2,578	1,151–9,736		0.141
2003	937	636–1,520	0.21	0.083
2002	2,612	1,477–8,509	0.36	0.045
2001	1,254	733–2,697	0.31	0.053

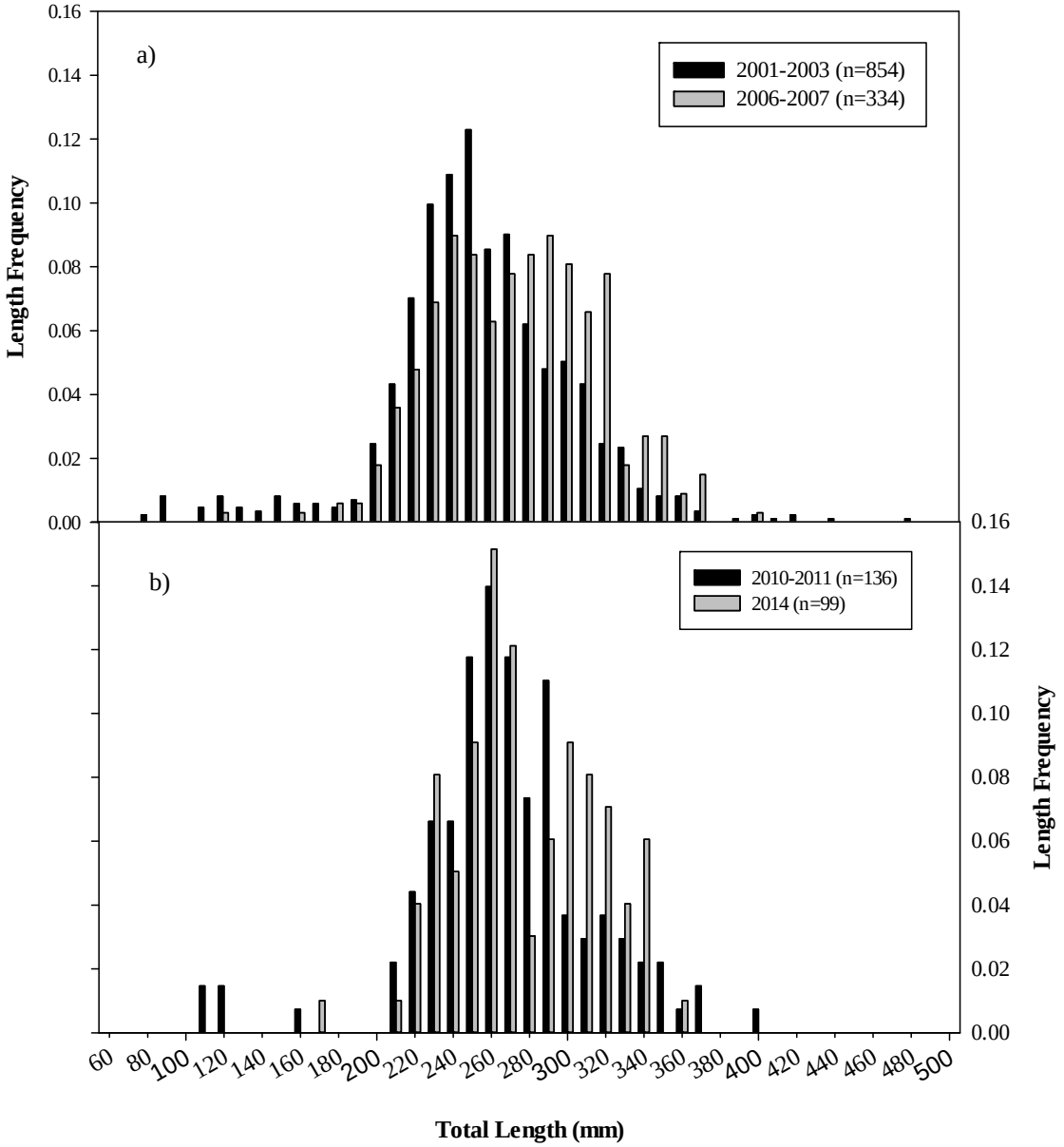

Figure 5: Desolation and Gray Canyon humpback chub length frequency histograms for all humpback chub captured via all methods for a) 2001–2003, 2006–2007 and b) 2010–2011, 2014.