

I. Project Title: **Monitoring the Colorado Pikeminnow Population in the Mainstem Colorado River via Periodic Population Estimates**

II. Principal Investigator(s):

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III. Project Summary:

The Interagency Standardized Monitoring Program (ISMP) was developed in 1986 to monitor population trends of Colorado pikeminnow and humpback chub in the Colorado River Basin using catch per effort (CPE) indices. ISMP was expanded in 1998 to include mark-recapture population estimates of the major Colorado pikeminnow and humpback chub populations. For Colorado pikeminnow in the upper Colorado River, population estimates were conducted annually during 1991-1994 and 1998-2000. In 2003, a new three-year effort began. For this round of estimates, annual effort was expanded in hopes of producing estimates with smaller standard errors.

In the first year, 2003, four complete passes were made through the 185-mile reach (excluding 12-mile-long Westwater Canyon) using a combination of electrofishing and backwater trammel-netting. In addition to more passes, effort per pass was also increased from one 2-person crew to two 2-person crews. This schedule was completed during a 12-week period from early April to mid-June. Although the field effort went very well, the number of Colorado pikeminnow captured was low relative to previous years. The number of fish marked in the first passes that were subsequently recaptured in later passes was especially low. This low recapture rate resulted in Model M_0 from Program CAPTURE (White et al. 1982) providing a relatively high point estimate of 784 individuals 450 mm TL and longer (95% CI: 350-1,940). However, this result was in contrast to the catch rate, measured as mean-number-of-Colorado-pikeminnow-per-net-set, that was lower than in any year since 1991. For the population estimate, the probability of capture (\hat{p}) was very low ($p = 0.03$), and the coefficient of variation was unacceptably high ($CV = 47\%$).

In 2004, the same high level of effort was applied per pass as during 2003, i.e., two 2-person boat crews in the upper reach (above Westwater Canyon) working concurrently with two 2-person boat crews in the lower reach (downstream of Westwater Canyon). However,

in 2004, the spring hydrograph was short-lived and although we got started (first week of April) well before runoff began (first week of May), pikeminnow began moving to spawning locations early (first week of June) and we were forced to curtail sampling after completing only three passes. In addition, runoff was so low that backwaters could not be netted, forcing us to rely exclusively on electrofishing. Again, for whatever reason, our recapture rate in the second and third passes was very low. However, in July, the smallmouth bass removal effort (Project No. 126) in the upper reach began and post-spawning pikeminnow capture data began coming in. Because of a lack of analogous data for the lower reach, this additional sampling could not be turned into a fourth pass for our population estimate. Instead these upper-reach captures were added to the third pass. This considerably boosted our third-pass recapture rate and allowed a reasonably good population estimate. These results are detailed in the discussion of initial findings provided below. One more year of sampling is scheduled for 2005 and it is possible that an additional year of study will be needed in 2006.

IV. Study Schedule: 2003-2005.

V. Relationship to RIPRAP:

Colorado River Action Plan: Colorado River Mainstem

V. Monitor populations and habitat and conduct research to support recovery actions.

V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.

VI. Accomplishment of FY 04 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Tasks

1. Capture and pitting Colorado pikeminnow (this task was met).
2. Analyze data (Preliminary population estimate calculated).

Three complete sampling passes were made through the 185-mile reach (excluding 12-mile-long Westwater Canyon) using electrofishing. This schedule was completed during a 10-week period from early April to early June. The field effort went well, but the low runoff prevented backwater trammel-netting and the early spawning season precluded a fourth sampling pass. Total number of captures (all pikeminnow ≥ 250 mm) was lower than in 2003 (149 versus 168) as expected with fewer passes; however, mean number of captures per pass was somewhat higher (50 in 2004 versus 42 in 2003). There was again a low number of recaptures (7) in the later passes (5 in 2003). Fortunately, there were additional capture data made available to us from another field effort (smallmouth bass removal). These data were added to those of our third pass resulting in a sizable increase in our number of recaptures (from 7 to 13 for fish > 450 mm). Preliminary abundance estimates were produced using Program CAPTURE (White et al. 1982). The additional fish added to pass 3 made the probability of capture vary by time (pass); hence, Model M_t might be the appropriate model. However, Model

M_1 was not selected by CAPTURE's model selection algorithm. Model M_0 (the null model) and M_1 produced similar point estimates of abundance: about 775 individuals >250 mm; about 475 individuals > 450 mm; about 370 individuals > 500 mm (Table 1). The 95% confidence interval for pikeminnow > 450 mm was 317-789 (Model M_0). The probability of capture (p) improved greatly from the previous year: $p\text{-hat} = 0.10$ (2004); $p\text{-hat} = 0.03$ (2003) for individuals >450 mm. Precision of the estimate was also higher than in 2003. A 'rule of thumb' for acceptable precision is to achieve a coefficient of variation (CV) of 20% or less (Pollock et al. 1990). The CV for our whole-river estimate of Colorado pikeminnow was 47% in 2003 and 24% in 2004.

There was a large cohort that showed up in 2003. These fish appear to be from one year-class, and based on their size, probably were hatched in 1998. In 2003, about half fell into the size range that qualified them as subadults about to recruit, according to Recovery Goal criteria, or those 400-449 mm long. By 2004, some of these had become larger than 450 mm and therefore classed as adults, while most of the remainder had moved up into the subadult size range (Fig. 1).

Data were too sparse to partition out the subadult-sized fish and develop a separate mark-recapture estimate of their abundance. Therefore, we used length frequency to estimate that 23 captured subadults (400-449 mm) in 2003 represented about 14% of the estimated population of pikeminnow >250 mm that year, providing an estimate of 203 subadults. In 2004, these calculations resulted in an estimate of 110 subadults. In both cases, the estimates were larger than the number of adults expected to die in each year (118 in 2003 and 72 in 2004) assuming an annual mortality rate of 15% (see Osmundson et al. 1997). Hence, in 2003 and 2004, recruitment (as measured by the number of subadults about to recruit) exceeded expected adult mortality, theoretically resulting in a net gain to the adult population. Year classes just prior to and after this strong 1998-produced cohort were evidently very weak.

VII. Recommendations: Continue as planned for 2005. However, we recommend that to obtain three years of reliable estimates of acceptable precision (to comply with Recovery Goal monitoring criteria), an additional sampling year be added in 2006 to replace the low-quality 2003 estimate. The more precise estimate produced in 2004 indicated the 2003 point estimate was artificially high. This decision might wait until after the 2005 estimate is in. If it is in relatively close agreement with the 2004 estimate, we can assume the 2003 estimate was indeed inaccurate and a 2006 estimate will be needed.

VIII. Project Status: On track

IX. FY 04 Budget

A. Funds Provided:	146,400
B. Funds Expended:	146,400
C. Difference:	0
D. N/A (BR projects)	0

E. Publication Charges 0

X. Status of Data Submission: Capture data for razorback sucker and bonytail encountered during this project have been submitted to the database manager. Colorado pikeminnow data will be submitted by the end of December. Results were presented at the 2004 Population Estimation workshop in Grand Junction.

XI. Signed: *Doug Osmundson*, November 4, 2002.

Literature

Osmundson, D. B., R. J. Ryel, and T. E. Mourning. 1997. Growth and survival of Colorado squawfish in the upper Colorado River. *Transactions of the American Fisheries Society* 126:687-698.

Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. *Wildlife Monographs* 107.

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, LA-8787-NERP, Los Alamos, New Mexico.

USFWS. 2002. Colorado pikeminnow (*Ptychocheilus lucius*) Recovery Goals: amendment and supplement to the Colorado Squawfish Recovery Plan. U. S. Fish and Wildlife Service, Denver.

Table 1. Summary of Program CAPTURE results for 2004 Colorado pikeminnow data from the upper Colorado River. These results should be treated as preliminary. MSC = model selection criteria. P = probability of capture. N = point estimate of population size.

Model	Fish >250 mm				Fish >450 mm				Fish >500 mm			
	MSC	N	95% CI	P	MSC	N	95% CI	P	MSC	N	95% CI	P
M ₀	0.96	767	494-1269	0.08	0.81	481	317-789	0.10	0.77	371	233-652	0.10
M _h Chao	1.00	1199	702-2159	0.05	0.89	728	596-6837	0.06	0.82	593	325-1178	0.06
M _b	0.14	Failed	--	--	0.01	Failed	--	--	0.02	Failed	--	--
M _b h	0.30	Failed	--	--	0.00	Failed	--	--	0.00	Failed	--	--
M _t Chao	0.00	780	489-1330	0.06, 0.07, 0.10	0.07	475	306-803	0.08, 0.08, 0.14	0.35	369	225-676	0.08, 0.07, 0.15

Mth Chao	0.37	1035	513- 2338	0.05, 0.05, 0.07	0.33	640	326- 1453	0.06, 0.06, 0.10	0.50	574	254- 1553	0.05, 0.04, 0.09
Mtb	0.42	369	190- 1798	0.13, 0.16, 0.24	0.40	334	150- 2046	0.11, 0.12, 0.21	0.46	238	116- 1252	0.12, 0.11, 0.24
M _{t_{bh}}	0.96	No model	--	--	1.00	No model	--	--	1.00	No model	--	--

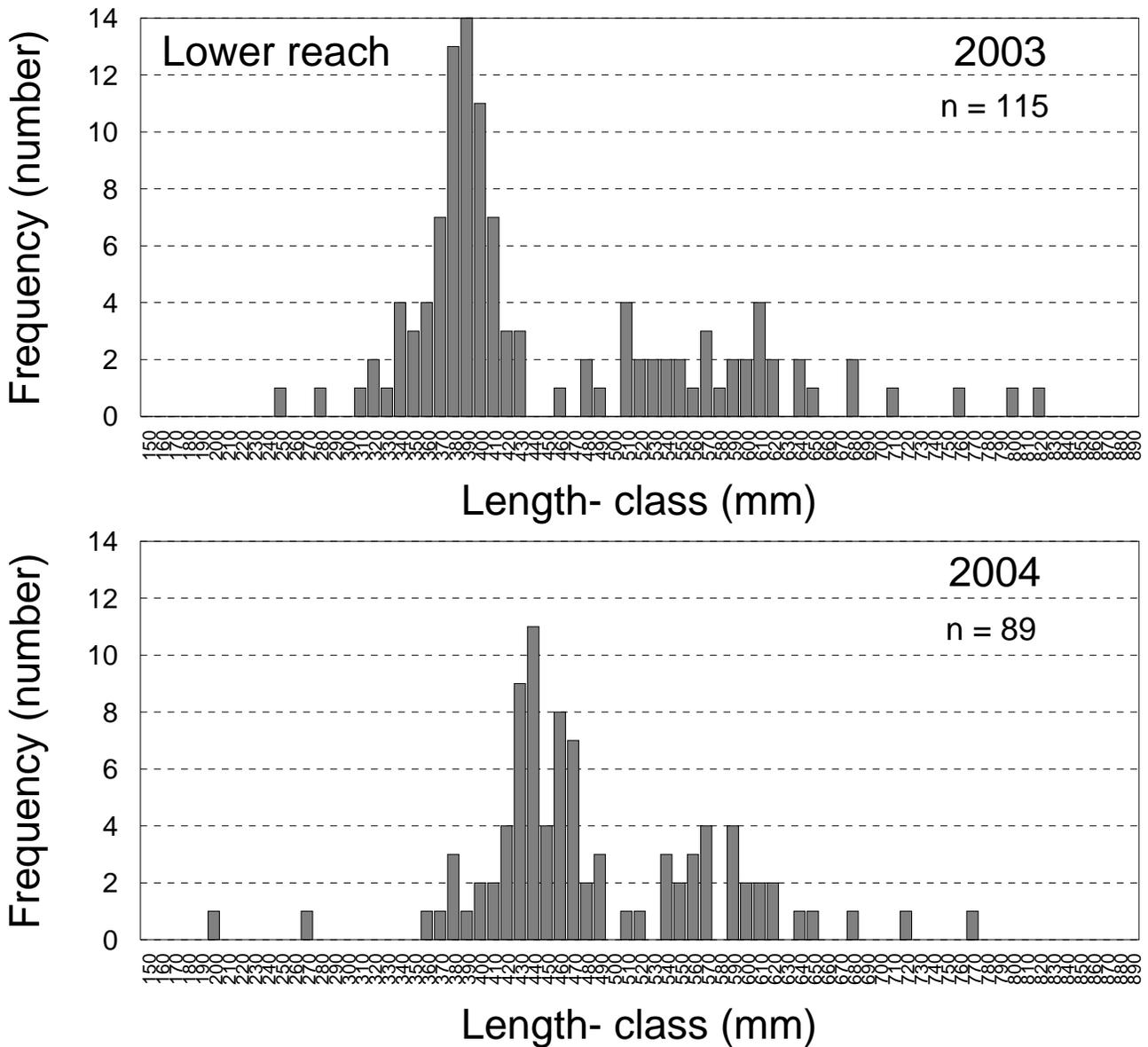


Figure 1. Length frequency of Colorado pikeminnow captured from throughout the upper Colorado River during April-June 2003. Length classes are in 10-mm increments with each labeled with the lower end of the range (example: 350 = those fish 350-359 mm long).