I. Project Title: Guide to Cyprinid Larvae and Early Juveniles of the Upper Colorado River Basin with Computer-Interactive Key.

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III. Project Summary: This project will improve the ability of Recovery-Program and other researchers to accurately identify cyprinid larvae and early juveniles collected from the Upper Colorado River Basin (UCRB). Objectives are to: (1) document morphological development of each species, (2) verify existing and find new diagnostic criteria, (3) assemble a computer-interactive key, and (4) prepare a manuscript guide similar to our recently updated guide for UCRB catostomids. Co-sponsors are the National Park Service Glen Canyon National Recreation Area and Bureau of Reclamation for species also included in a guide for the middle Rio Grande (USBR-MRG project).

IV. Study Schedule:
Task 1: Acquisition of specimens needed for developmental study—FY 2006-2007.
Task 2: Description and illustration of eggs, larvae, and early juveniles—FY 2006-2008.
Task 3: Preparation of computer-interactive key—FY 2006-2009.
Task 4: Synthesis, reporting, presentation, and publication of results—FY 2006-2009.

V. Relationship to RIPRAP: This project is related to General Recovery Program Support Action Plan items V.B (conduct research to acquire needed life history information) and V.C (develop and enhance scientific techniques required to complete recovery actions).

VI. Accomplishments of FY 2011 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings: Most of FY 2011 was spent working on morphometric, meristic, morphological, and pigment-pattern analyses; assembling or updating species accounts; and presenting selected results at annual Recovery Program and professional society meetings. Despite the no-cost extension of the project for a fifth and sixth year, still more time is needed. We now anticipate completion of the guide and key in Spring 2012.

Task 1: Acquisition of specimens needed for developmental study—This task was completed in FY 2010.

Task 2: Description and illustration of larvae and early juveniles—All illustrations were previously completed. In FY 2011, considerable progress was made in conducting and still needed morphometric and meristic, morphological, and pigment-pattern analyses, rechecking extreme values, and updating species accounts for the guide, and that work is now about 85% complete (Tables 1 and 2).

Task 3: Preparation of computer-interactive key to larvae and early juveniles of UCRB cyprinids—This task remains about 50% complete. A draft computer-interactive key to families of fish larvae had been prepared and work was initiated on the key in FY 2007 and 2008 for cyprinid larvae using existing data for some species. Further work on the cyprinid key will resume upon completion of descriptive work and the manuscript.

Task 4: Synthesis, publication, presentation, and reporting of results—This task is about 80% complete. Except for work on species accounts (Task 2), no new progress was made in FY-2011 on preparation of other portions of the guide manuscript (Table 3). Inquiries regarding prospective outlets and costs for publication of the guide (beyond those made 2009) have been deferred to FY 2012. Presentations of project results in 2011 included a poster on "Illustrations of the flexion mesolarvae of cyprinids in the Upper Colorado River Basin" by Darrel Snyder and Lynn Bjork which was presented at the annual Recovery Program Researchers Meeting in Moab, Utah, 12-13 January; the annual meeting of the Colorado-Wyoming Chapter of the American Fisheries Society (AFS) in Fort Collins, Colorado, 22-25 February; and the annual AFS-Early Life History Section Larval Fish Conference in Wilmington, North Carolina, 22-26 May. Also, last year's Larval Fish Conference oral paper on a "New description of larval and early juvenile brassy minnow, *Hybognathus hankinsoni*" was presented again by Jennifer Charles (co-authors Sean Seal, Darrel Snyder, and Lynn Bjork) at the 2011 Colorado-Wyoming AFS meeting. Our FY 2010 annual project report was submitted to the Recovery Program on 13 November 2010. The final project report (the manuscript for the guide and a proposal for publication thereof) has been deferred to FY 2012.

VII. Recommendations: As in our previous annual report, we recommend that a provision for guide publication be included in Program Guidance.

VIII. Project Status: Despite extensions through FY 2010 and 2011 at no additional cost to the Recovery Program, progress during 2011 was less than expected and this project remains behind schedule; completion is now expected in spring 2012.

IX. FY 2011 Budget Status

A. Funds Provided: $0 (+ ~$15,000 remaining from FY 2010 as part of USBR-MRG project).

B. Funds Expended: $0 (+ ~$10,000 via USBR-MRG project).

C. Difference: $0 (+ ~$5,000 via USBR-MRG project).
Explanation: See Section VI regarding tasks to be completed in FY 2012.

D. Percent of the FY 2011 work completed, and projected costs to complete: 67%, completed; ~$5,000 to complete (as part of USBR-MRG project).

E. Recovery Program funds spent for publication charges: $0

X. Status of Data Submission (Where applicable): Not applicable.

XI. Signed: Darrel E. Snyder — 11 November 2011
Principal Investigator — Date

Signed: Kevin R. Bestgen — 11 November 2011
Principal Investigator — Date

Table 1. Project status—estimated percentage completion of specimen analyses by species.

Species	% Completed Morphometrics	Morphology	Pigmentation	Overall
Cyprinella lutrensis	100	100	100	100
Cyprinus carpio	90	90	90	90
Gila atraria	95	100	100	98
Gila cypha	75	50	50	58
Gila elegans	75	50	50	58
Gila robusta	75	50	50	58
Hybognathus hankinsoni	100	100	100	100
Notemigonus crysoleucas	90	95	95	93
Notropis stramineus	90	90	90	90
Pimephales promelas	100	100	100	100
Ptychocheilus lucius	75	90	90	85
Rhinichthys cataractae	100	100	100	100
Rhinichthys osculus	90	90	90	90
Richardsonius balteatus	100	100	100	100
Semotilus atromaculatus	100	100	100	100

Table 2. Project status—estimated percentage completion of species accounts.

Species Accounts	% Completed Figures Ad	Lar	Map	Text Desc	Tables Meri	Size/de	Size/di	Morph	Overall
Cyprinella lutrensis	100	100	100	100	100	100	100	100	100
Cyprinus carpio	100	100	100	100	99	95	95	75	96
Gila atraria	100	100	0	50	95	95	95	75	76
Gila cypha	100	100	50	50	90	90	90	75	81
Gila elegans	100	100	100	100	100	99	99	90	99
Gila robusta	100	100	100	100	100	99	99	95	99
Hybognathus hankinsoni	100	100	95	100	99	99	99	99	98
Notemigonus crysoleucas	95	100	0	0	0	0	0	0	24
Notropis stramineus	95	100	0	0	50	50	50	50	49
Pimephales promelas	100	100	100	100	95	95	95	95	98
Ptychocheilus lucius	100	100	100	100	100	99	99	90	99
Rhinichthys cataractae	100	100	0	50	99	99	99	99	81
Rhinichthys osculus	100	100	100	100	100	99	99	95	99
Richardsonius balteatus	100	100	0	50	99	99	99	99	81
Semotilus atromaculatus	100	100	0	50	99	99	99	99	81

(Heading abbreviations: Ad—adult; Lar—larvae and juveniles; Desc—adult description, reproduction, young (brief text summaries); Meri—juvenile/adult meristics; Size/de—size at onset of developmental events; Size/di—size at developmental interval and gut phase transitions; Morph—morphology.)

Table 3. Project status—estimated percentage completion of final draft of guide by section (guide contents).

Contents	% Completed
PREFACE	80
ACKNOWLEDGMENTS	80
ABSTRACT	25
INTRODUCTION	
Importance of Early Life History Investigations and Identification	95
This Guide and Prior Descriptions	10
Status and Distribution of the Fish	10
A Combined Developmental Interval Terminology	100
Characteristics Useful in Identification of Cypriniform Fish Larvae	
Myomeres	99
Fins and finfolds	99
Other countable structures	99
Morphology	99
Pigmentation	99
Osteology	99
METHODS	
Specimens Examined	0
Specimen Data, Observations, and Illustrations	95
Computer-Interactive Key	99
RESULTS AND DISCUSSION	
Species Accounts	
Cyprinella lutrensis	100
Cyprinus carpio	96
Gila atraria	76
Gila cypha	81
Gila elegans	99
Gila robusta	99
Hybognathus hankinsoni	98
Notemigonus crysoleucas	24
Notropis stramineus	49
Pimephales promelas	98
Ptychocheilus lucius	99
Rhinichthys cataractae	81
Rhinichthys osculus	99
Richardsonius balteatus	81
Semotilus atromaculatus	81

continued

Table 3. Continued.

Contents	% Completed
Comparative Summary	
Size relative to state of development	50
Meristics and morphometrics	50
Pigmentation	50
Mouth characters	50
Computer-Interactive Key	
Installation	99
Use	99
LITERATURE CITED	50
APPENDIX I–Pictorial Guide to Families of Fish Larvae in the Upper Colo. R. Basin	90
APPENDIX II–Glossary	100