

**COLORADO RIVER RECOVERY PROGRAM**  
**FY-2012 PROPOSED MODIFICATION to SCOPE OF WORK for:**  
Chemically Fingerprinting Nonnative Fishes in Reservoirs

Project No.: C-18/19

Lead Agency: Colorado State University

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**I. Title of Proposal:** Chemically Fingerprinting Nonnative Fishes in Reservoirs

**II. Relationship to RIPRAP:**

This modification to this scope-of-work addresses movement of nonnative fish into river reaches of critical habitat in the upper Colorado River basin (UCRB) from reservoirs known to support cool- and warmwater species of nonnative fish. Wolff et al. (2012) demonstrated the utility of microchemical signatures in the otoliths of nonnative fish species for detecting their escapement from reservoirs. Several of these nonnative fishes are believed to pose a significant predatory threat to various life stages of endangered and other native fishes (Tyus and Saunders 1996; Martinez et al. 2001; Johnson et al. 2008).

**III. Study Background/Rationale and Hypotheses:**

**Background/Rationale:**

Colorado Parks and Wildlife (CPW) seeks to expedite identifying the source of nine northern pike (NOP) recently captured in the upper Colorado River by U.S. Fish and Wildlife Service (USFWS) crews working above the Grand Valley near Rifle, Colorado. In addition, consideration of the proposal to reclaim (rotenone) the fish population in Red Fleet Reservoir, Utah will benefit from a better understanding about walleye (WLY) from this potential source population (established by illegal introduction) reaching critical habitat in the Green River basin.

#### **IV. Study Goals, Objectives, End Product:**

**Study Goals:** To identify or exclude sources of NOP collected in the Colorado River and WLY collected in the Green and Yampa rivers by comparing strontium isotope ratios in otoliths with those signatures in reservoirs that are potential sources of nonnative fishes to critical habitat.

#### **End Products:**

A memo to the Biology Committee describing the finding of the strontium ratio analyses of available otoliths from the Colorado River NOP and Green/Yampa River WLY. If timely, this analysis may be incorporated into the final report for this project.

#### **V. Study Area:**

The Colorado River in Colorado below the Rifle Creek confluence, the Green River in Utah between Island Park and Desolation Canyon, and the lowermost Yampa River in Colorado.

#### **VI. Study Methods/Approach:**

##### **Otolith preparation**

Methods will follow those previously established under this project. Sagittal otoliths removed with non-metallic forceps will be sonicated in Milli-Q water for five minutes. Left otoliths are used for all  $^{87}\text{Sr}/^{86}\text{Sr}$  analytical work; right otoliths were only used if the left otolith was broken or lost. Otoliths will be embedded in Epo-Fix<sup>TM</sup> epoxy prior to being sectioned through the core in a transverse plane on an Isomet<sup>TM</sup> low speed saw. Sections will be sanded to a thickness of approximately 200 - 250  $\mu\text{m}$  to expose the inner annuli, mounted onto glass slides using double-sided tape, washed with 5% ultrapure nitric acid and sonicated in ultrapure water for five minutes. Mounted otoliths are dried for 24 hours under a Class 100 laminar flow hood, and subsequently enclosed in polystyrene petri dishes prior to ablation analysis.

##### **Strontium isotope analysis**

Isotopic analysis will also conform to the methods developed previously in this project. Otolith thin sections will be assayed for  $^{87}\text{Sr}/^{86}\text{Sr}$  using a Thermo Finnigan Neptune multicollector inductively coupled plasma mass spectrometer (MC-ICP-MS) coupled to a New Wave Research UP 193 nm excimer laser ablation system at the Woods Hole Oceanographic Institution (WHOI) Plasma Mass Spectrometry Laboratory in Woods Hole, Massachusetts. The laser ablation MC-ICP-MS will be configured to run at 80% intensity, 10 Hz pulse rate, 35  $\mu\text{m}$  laser beam spot size, 5  $\mu\text{m}$  per second laser scan speed and 550  $\mu\text{m}$  laser ablation distance within annuli. Using this method, ablated otolith material is carried from the laser cell to the MC-ICP-MS via helium gas, where it is then mixed in a spray chamber with argon gas and a wet aerosol at which time a suite of isotopes were measured:  $^{48}\text{Ca}$ ,  $^{83}\text{Kr}$ ,  $^{84}\text{Sr}$ ,  $^{85}\text{Rb}$ ,  $^{86}\text{Sr}$ ,  $^{87}\text{Sr}$ ,  $^{88}\text{Sr}$ .

Transects on otoliths from core (corresponding to natal origin) to edge (corresponding to time of capture) will be ablated to obtain  $^{87}\text{Sr}/^{86}\text{Sr}$  profiles throughout the lifetime of each fish. The

instrument will also provide data on Sr:Ca ratio, which supplements isotope information; the use of both of these traces improves our ability to track origins and chemically “fingerprint” reservoir sources. For reservoir fishes, each otolith will be ablated within 3-4 adjacent annuli from the outermost annulus (hereafter, “edge”) to get balanced year comparisons (e.g., 2008-2011). A compound light microscope will be used to determine fish ages from otolith annuli and from capture date, the year corresponding with within-annulus ablations.

**VII. Task Description and Schedule:**

Colorado State University (CSU) personnel (Dr. Brett Johnson and Brian Wolff) provided an initial cost estimate of ~\$4,500 to CPW analyze the otoliths of the nine NOP from the Colorado River. CSU advised that about 40 otoliths could be analyzed for this approximate cost, given the fixed costs of travel to the Woods Hole Oceanographic Institute (WHOI) and the rental of their laboratory instruments.

An accounting of additional otoliths available for analysis in relation to pressing management questions/issues indicated that sufficient WLY otoliths from the Green and Yampa rivers (to investigate escapement) and from Red Fleet Reservoir (to reconfirm its strontium signature) were available to fulfill this opportunity to have about 40 otolith samples analyzed at WHOI by CSU. The quantity of these samples, including the river/reach or reservoir and year of their collection, is provided below.

River/reach or reservoir	Species	Year	Number of samples
Colorado River/below Rifle Creek	NOP	2011	9
Green River/Desolation Canyon	WLY	2011	14
Yampa River/ lower 4.2 miles	WLY	2010	1
Red Fleet Reservoir	WLY	2010	10
Upper Green River	WLY	2009	6
Upper Green River	WLY	2007	2
Lower Green River	WLY	2007	5
TOTAL			47

The analysis of as many of these otoliths as feasible (in priority fashion: NOP = Colorado River; WLY = upper Green River, Desolation Canyon, Red Fleet Reservoir,) will be completed by the end of April, 2012. A memo containing the results will be provided to the Biology Committee by mid-May, 2012. If timely, this analysis may be incorporated into the final report for this project.

**VIII. Budget**

Labor (B. Wolff, Research Associate, otolith preparation and analyses): \$1,350  
 - otolith preparation: 47 samples @ 1hr labor; \$19.72/hour = \$927  
 - otolith analysis: 47 samples @ 1 hr labor; \$ 9.00/hour = \$423

Lodging/per diem (Woods Hole, MA) \$ 450

Transportation (air fare, car rental, parking, mileage to and from DIA)	\$1,250
<u>Laboratory instrument rental (WHOI ICP Mass Spec for one day)</u>	<u>\$2,050</u>
Subtotal	\$5,100
<u>17.5% overhead</u>	<u>\$ 900</u>
TOTAL	\$6,000

**IX. Budget Summary**

Final cost to Recovery Program **\$6,000**

**X. Reviewers:**

**XI. References:**

Johnson, B. M., P. J. Martinez, J. A. Hawkins, and K. R. Bestgen. 2008. Ranking predatory threats to nonnative fishes in the Yampa River, Colorado, via bioenergetics modeling. *North American Journal of Fisheries Management* 28:1941-1953.

Martinez, P. J., B. M. Johnson, and J. D. Hobgood. 2001. Stable isotope signatures of native and nonnative fishes in Upper Colorado River backwaters and ponds. *The Southwestern Naturalist* 46: 311-322.

Tyus, H. M., and J. F. Saunders, III. 1996. Nonnative fishes in natural ecosystems and a strategic plan for control of nonnatives in the Upper Colorado River basin. *Recovery Implementation Program DRAFT REPORT. Cooperative Agreement No. 14-48-006-95-923. U.S. Fish and Wildlife Service, Denver, Colorado.*

Wolff, B. A., B. M. Johnson, A. R. Breton, P. J. Martinez, and D. L. Winkelman. 2012. Origins of invasive piscivores determined from the strontium isotope ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) ratio of otoliths. *Canadian Journal of Fisheries and Aquatic Sciences*: in press.