RANGE-WIDE

CONSERVATION AGREEMENT AND STRATEGY FOR

ROUNDTAIL CHUB *Gila robusta*,

BLUEHEAD SUCKER *Catostomus discobolus*,

AND FLANNELMOUTH SUCKER *Catostomus latipinnis*

Prepared for
Colorado River Fish and Wildlife Council

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Publication Number 06-18
September 2006

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RANGEWIDE CONSERVATION AGREEMENT FOR ROUNDTAIL CHUB, BLUEHEAD SUCKER, AND FLANNELMOUTH SUCKER

I. INTRODUCTION

This Conservation Agreement (Agreement) has been developed to expedite implementation of conservation measures for roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), and flannelmouth sucker (*Catostomus latipinnis*), hereinafter referred to as the three species, throughout their respective ranges as a collaborative and cooperative effort among resource agencies. Threats that warrant the three species being listed as sensitive by state and federal agencies and that might lead to listing by the U.S. Fish and Wildlife Service as threatened or endangered under the Endangered Species Act of 1973, as amended (ESA), should be minimized through implementation of this Agreement. Additional state, federal, and tribal partners in this effort are welcomed, and such participation (as signatories or otherwise) is hereby solicited.

II. GOAL

The goal of this agreement is to ensure the persistence of roundtail chub, bluehead sucker, and flannelmouth sucker populations throughout their ranges.

III. OBJECTIVES

The individual state's signatory to this document will develop conservation and management plans for any or all of the three species that occur naturally within their state. Any future signatories may also choose to develop individual conservation and management plans, or to integrate their efforts with existing plans. The individual signatories agree to develop information and conduct actions to support the following objectives:

- Develop and finalize a conservation and management strategy (Strategy) acceptable to all signatories that will provide goals, objectives and conservation actions to serve as consistent guidelines and direction for the development and implementation of individual state wildlfe management plans for these three fish species.

- Establish and/or maintain roundtail chub, flannelmouth sucker and bluehead sucker populations sufficient to ensure persistence of each species within their ranges.

    1) Establish measureable criteria to evaluate the number of populations required to maintain the three species throughout their respective ranges.

    2) Establish measureable criteria to evaluate the number of individuals required within each population to maintain the three species throughout their respective ranges.

- Establish and/or maintain sufficient connectivity between populations so that viable metapopulations are established and/or maintained.

- As feasible, identify, significantly reduce and/or eliminate threats to the persistence of roundtail chub, bluehead sucker, and flannelmouth sucker that: 1) may warrant or maintain their listing as a sensitive species by state and federal agencies, and 2) may warrant their listing as a threatened or endangered species under the ESA.

IV. OTHER SPECIES INVOLVED

This Agreement is primarily designed to ensure the persistence of roundtail chub, bluehead sucker, and flannelmouth sucker within their respective distributions. This will be achieved through conservation actions to protect and enhance these species and their habitats. Although these actions will be designed to benefit the three species, they may also contribute to the conservation of other native species with similar distributions.

Bonytail *(Gila elegans),* Colorado pikeminnow *(Ptychocheilus lucius),* humpback chub *(Gila cypha),* and razorback sucker *(Xyrauchen texanus)* are currently listed as endangered under the ESA. In the Upper Colorado River Basin, recovery of one or more of these species has been undertaken by the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin and the San Juan River Basin Recovery Implementation Program. In the Lower Colorado River Basin, the Grand Canyon Monitoring and Research Center and the Lower

Colorado River Multi-Species Conservation Plan have committed to recovery actions for these species. Conservation actions for native fish in the Virgin River Basin are occurring under the direction of the Virgin River Resource Management and Recovery Program in Utah and the Lower Virgin River Recovery Implementation Team in Nevada and Arizona. Fish managed under these programs include the federally endangered woundfin *(Plagopterus argentissimus)* and Virgin River chub *(Gila seminuda),* as well as the Virgin spinedace *(Lepidomeda mollispinis mollispinis),* desert sucker *(Catostomus clarkii),* and flannelmouth sucker. Virgin spinedace is the subject species of a conservation agreement and is listed as a "conservation species" in Utah; it is also listed as "protected" in Nevada. The programs described above focus primarily on mainstem rivers where, in some cases, the three species spend parts of their life cycles. Although the three species are also found in tributary streams, conservation actions in these habitats have received less emphasis to date. Such actions are, therefore, likely to be the focus of state conservation and management plans developed as part of this Agreement. Any conservation actions implemented through existing recovery programs and/or this Agreement may benefit both the endangered fishes mentioned as well as the three species. The signatories will commit to implement conservation actions under this Agreement and Strategy that neither conflict with nor replicate any conservation actions that have been implemented, are being implemented, or will be implemented under any existing recovery program or conservation agreement.

Additionally, the Agreement may reduce threats to several native species that are not currently listed as threatened or endangered under the ESA, and thereby preclude the need for listing or re-listing in the future. Some of these native species include speckled dace *(Rhinichthys osculus),* Gila chub (*Gila intermedia*), headwater chub *(Gila nigra),* mountain sucker *(Catostomus platyrhynchus),* Zuni bluehead sucker *(Catostomus discobolus yarrowi),* Bonneville cutthroat trout *(Oncorhynchus clarkii utah),* Colorado River cutthroat trout *(Oncorhynchus clarkii pleuriticus),* Yellowstone cutthroat trout *(Oncorhynchus clarkii bouvieri),* mottled sculpin (*Cottus bairdi*), Paiute sculpin (*Cottus beldingi*), northern leopard frog *(Rana pipiens),* relict leopard frog *(Rana onca),* boreal toad *(Bufo boreas boreas),* Great Basin spadefoot *(Spea intermontana),* Great Plains toad *(Bufo cognatus),* New Mexico spadefoot *(Spea* *multiplicata),* red-spotted toad *(Bufo punctatus),* Woodhouse toad *(Bufo woodhousei),* canyon treefrog *(Hyla arenicolor),* and western chorus frog *(Pseudacris triseriata).*

V. INVOLVED PARTIES

The following state agencies are committed to work cooperatively to conserve the roundtail chub, bluehead sucker, and flannelmouth sucker throughout their respective ranges, and have further determined that a consistent approach, as described in this Agreement, is most efficient for conserving the three species. The state agencies signatory to this document are:

Arizona Game and Fish Department

Colorado Division of Wildlife

Nevada Department of Wildlife

New Mexico Department of Game and Fish

Utah Division of Wildlife Resources

Wyoming Game and Fish Department

Coordinated participation by state wildlife agencies helps institutionalize range-wide conservation of the three fish species, but federal and tribal partners are being encouraged to participate, as well. The participation of all resource managers in the areas where these species are found is important for the long-term survival of the three species. Some language in this Agreement has been included in anticipation of eventual federal and tribal participation. Any edits proposed by potential conservation partners that will allow them to sign this Agreement and participate in conservation actions will be carefully considered and will only be incorporated with the consensus of the existing signatories. This Agreement may be amended at any time to include additional signatories. An entity requesting inclusion as a signatory shall submit its request to the Council in the form of a document defining its proposed responsibilities pursuant to this Agreement.

VI. AUTHORITY

- The signatory parties hereto enter into this Conservation Agreement and the proposed Conservation Strategy under Federal and State Law, as applicable. Each species' conservation status is designated by state wildlife authorities according to the following table (updated from Bezzerides and Bestgen 2002):

Species	State	Status
Bluehead sucker	Utah	Species of Concern
	Wyoming	Special Concern
Flannelmouth sucker	Colorado, Wyoming	Special Concern
	Utah	Species of Concern
Roundtail chub	New Mexico	Endangered
	Utah	Species of Concern
	Arizona, Colorado, Wyoming	Special Concern

- The signatory parties further note that this Agreement is entered into to establish and maintain an adequate and active program for the conservation of the above listed species.
- The signatory parties recognize that each state has the responsibility and authority to develop a conservation and management plan consistent with the goal and objectives of this Agreement. The purpose of these documents will be to describe

specific tasks to be completed toward achieving the goal and objectives of this Agreement.

- All parties to this Agreement recognize that they each have specific statutory responsibilities, particularly with respect to the management and conservation of these fish, their habitat and the management, development and allocation of water resources. Nothing in this Agreement or the proposed companion Strategy to be developed pursuant to this Agreement is intended to abrogate any of the parties' respective responsibilities.
- This Agreement is subject to and is intended to be consistent with all applicable Federal and State laws and interstate compacts (To this end, the State of Arizona has attached appendix 1.)
- The state of Wyoming and the Commission do not waive sovereign immunity by entering into this Agreement, and specifically retain immunity and all defenses available to them as sovereigns pursuant to Wyoming Statute 1-39-104(a) and all other state law.
- This instrument in no way restricts the parties involved from participating in similar activities with other public or private agencies, organizations or individuals.
- Revisions to this Agreement will be made only with approval of all signatories.
- This Agreement may be executed in several parts, each of which shall be an original, and which collectively shall constitute the same Agreement.

VII. CONSERVATION ACTIONS

The signatories will review and document existing and ongoing programmatic actions that benefit the three species. As signatories develop their individual management plans for conservation of the three species, each signatory may include but is not limited by or obligated to incorporate the following conservation actions:

1) Conduct status assessment of roundtail chub, bluehead sucker, and flannelmouth sucker.

2) Establish and maintain a database of past, present, and future information on roundtail chub, bluehead sucker, and flannelmouth sucker.

3) Determine roundtail chub, bluehead sucker, and flannelmouth sucker population demographics, life history, habitat requirements, and conservation needs.

4) Genetically and morphologically characterize populations of roundtail chub, bluehead sucker, and flannelmouth sucker.

5) Increase roundtail chub, bluehead sucker, and flannelmouth sucker populations to accelerate progress toward attaining population objectives for respective species.

6) Enhance and maintain habitat for roundtail chub, bluehead sucker, and flannelmouth sucker.

7) Control (as feasible and where possible) threats posed by nonnative species that compete with, prey upon, or hybridize with roundtail chub, bluehead sucker, and flannelmouth sucker.

8) Expand roundtail chub, bluehead sucker, and flannelmouth sucker population distributions through transplant activities or reintroduction to historic range, if warranted.

9) Establish and implement qualitative and quantitative long-term population and habitat monitoring programs for roundtail chub, bluehead sucker, and flannelmouth sucker.

10) Implement an outreach program (e.g., development of partnerships, information and education activities) regarding conservation and management of roundtail chub, bluehead sucker, and flannelmouth sucker.

Coordinating Conservation Activities

- Administration of the Agreement will be conducted by a range-wide Coordination Team. The team will consist of a designated representative from each signatory to this Agreement and may include technical and legal advisors and other members as deemed necessary by the signatories.
- As a first order of business, the chair of the Coordination Team will be selected from signatory state wildlife agency participants. Leadership will be reconsidered annually, and any member may be selected as Coordination Team Leader with a vote of the majority of the team. The chair will serve no more than two consecutive one-year terms.
- Authority of the Coordination Team will be limited to making recommendations to participating resource management agencies to address status, threats and conservation of roundtail chub, bluehead sucker, and flannelmouth sucker.
- The Coordination Team will meet at least once annually in October or November to develop range-wide priorities, review the annual conservation work plans developed by each agency, review conservation accomplishments resulting from implementation of conservation work plans, coordinate tasks and resources to most effectively implement the work plans, and review and revise the Strategy and states' conservation and management plans as required. They will report on progress and effectiveness of implementing the conservation and management strategies and plans. The Coordination Team will decide the annual meeting date and location.
- Coordination Team meetings will be open to the public. Meeting decision summaries and annual progress reports will be distributed to the Coordination Team and the signatories. Other interested parties may obtain minutes and progress reports upon request.

Implementing Conservation Schedule

- Development of the range-wide Conservation Strategy and states' conservation and management plans will begin no later than March 2004 and be completed no later than December 2004. A 10-year period will be necessary to attain sufficient progress toward objectives outlined in this Agreement, the range-wide Strategy, and the state plans, but the time required to complete conservation actions may be revised with consensus of the signatories.
- Conservation actions will be scheduled and reviewed on an annual basis by the signatories based on recommendations from the Coordination Team. Activities that will be conducted during the first three to five years of implementation will be identified in annual work plans within the states' conservation and management plans. The Strategy and states' conservation and management plans will be flexible documents and will be revised through adaptive management, incorporating new information as it becomes available.
- The state wildlife agency that has the Coordination Team Leader responsibility will coordinate team review of conservation activities conducted by participants of this Agreement to determine if all actions are in accordance with the Strategy and state conservation and management plans, and the annual schedule.
- Following a 10-year evaluation, the Agreement, Strategy, and associated states' conservation and management plans may be renewed.

Funding Conservation Actions

- Expenditures to implement this Agreement and Strategy will be identified in states' conservation and management strategies and are contingent upon availability of funding.
- Implementation funding will be provided by a variety of sources. Federal, state, and local sources will need to provide or secure funding to initiate procedures of the Agreement and Strategy, although nothing in this Agreement obligates any agency to any funding responsibilities. To date, various federal and state sources have contributed to

conservation efforts for the three fish species, including development of the Agreement and Strategy.

- Federal sources may include, but are not limited to, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Bureau of Land Management, Land and Water Conservation funds, and the Natural Resource Conservation Service. Nothing in this document commits any of these agencies to funding responsibilities.
- State funding sources may include, but are not limited to, direct appropriation of funds by the legislature, community impact boards, water resources revolving funds, state departments of agriculture, and state resource management agencies. Nothing in this document commits any of these agencies to funding responsibilities.
- Local sources of funding may be provided by water districts, Native American Affiliations, cities and towns, counties, local irrigation companies, and other supporting entities, and may be limited due to factors beyond local control.
- In-kind contributions in the form of personnel, field equipment, supplies, etc., will be provided by participating agencies. In addition, each agency will have specific tasks, responsibilities and proposed actions/commitments related to their in-kind contributions.
- It is understood that all funds expended in accordance with this Agreement are subject to approval by the appropriate local, state or Federal appropriations. This instrument is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between the parties to this instrument will be handled in accordance with applicable laws, regulations, and procedures, including those for government procurement and printing, if applicable. Such endeavors will be outlined in separate agreements (such as memoranda of agreement or collection agreements) that shall be made in writing by representatives of the parties and which shall be independently authorized by appropriate statutory authority. This instrument does not provide such authority. Specifically, this instrument does not establish authority for noncompetitive awards to the cooperator of any contract or other agreement. Any

contract or agreement for training or other services must fully comply with all applicable requirements for competition.

Conservation Progress Assessment.

- A range-wide assessment of progress towards implementing actions identified in this Agreement and each state conservation and management plan will be provided to the signatories by the Coordination Team in the first, fifth and tenth years of the Agreement and every fifth year thereafter as dictated by any extension of this instrument beyond ten years. The Coordination Team will compile the annual assessment from submittals prepared by members of the Coordination Team. Copies of the annual assessment will be provided to the signatories, and to interested parties upon request.

VIII. DURATION OF AGREEMENT

The term of this Agreement shall be for two consecutive five-year periods. The first five-year period will commence on the date all state signatories to this document are completed. Prior to the end of each five-year period, a thorough analysis and review of actions implemented for the three species will be conducted by the Coordination Team. If all signatories agree that sufficient progress has been made toward conservation and management of the roundtail chub, bluehead sucker, and flannelmouth sucker, this Agreement may be extended without additional signatures being required. Any involved party may withdraw from this Agreement on 60 days written notice to the other parties.

IX. POLICY FOR EVALUATION OF CONSERVATION EFFORTS (PECE) COMPLIANCE

Pursuant to the federal Policy for Evaluation of Conservation Efforts (PECE) guidelines, the signatory agencies acknowledge the role of PECE in providing structure and guidance in support of the effective implementation of this conservation program and will address PECE elements within their respective state conservation and management plans. They also acknowledge and support the principle that documented progress toward stable and increased distribution, abundance, and recruitment of populations of the three species constitutes the primary index of effectiveness of this conservation program. Criteria describing population status and trends as well as mitigation of recognized threats comprise the primary basis for evaluation of conservation efforts conducted under this Agreement.

X. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

The signatories anticipate that any survey, collection, or non-land disturbing research activities conducted through this Agreement will not constitute significant Federal actions under the NEPA, and will be given a categorical exclusion designation, as necessary. However, each signatory agency holds the responsibility to review planned actions for their area of concern to ensure conformance with existing land use plans, and to conduct any necessary NEPA analysis for those actions within their area.

XI. SIGNATORIES

Arizona Game and Fish Department
2221 W. Greenway Rd.
Phoenix, Arizona 85023-4399

Duane L. Shroufe — 02/23/04
Director — Date

Colorado Division of Wildlife
6060 Broadway
Denver, Colorado 80216

for Russell George — 3/22/04
Director — Date

Nevada Department of Wildlife
1100 Valley Rd.
Reno, Nevada 89512

for: Terry Crawforth — 3/5/04
Director — Date

New Mexico Department of Game and Fish
P.O. Box 25112
Santa Fe, New Mexico 87504

Bruce Thompson — 4-15-04
Director — Date

Utah Division of Wildlife Resources
1594 W. North Temple, Suite 2110
P.O. Box 1456301
Salt Lake City, Utah 84114-6301

Kevin K. Conway 2/4/04
Kevin K.Conway Date
Director

Wyoming Game and Fish Department
5400 Bishop Boulevard
Cheyenne, Wyoming 82006

for 3-12-04
Terry Cleveland Date
Director

Ron Arnold 3/11/04
Ron Arnold Date
Chief Fiscal Officer

Approval as to form:

TC Preston 3/11/04
Ted Preston Date
Assistant Attorney General

The following signatories support the goals, objectives, and actions of the Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker, version 10.4.4 and agree to support the conservation efforts described.

Alan L Kesterke

Bureau of Land Management
Wyoming State Office

April 8, 2005

Date

The following signatories support the goals, objectives, and actions of the Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker, version 10.4.4 and agree to support the conservation efforts described.

Joel Wisely

Bureau of Land Management
Utah State Office

5/16/05

Date

The following signatories support the goals, objectives, and actions of the Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker, version 10.4.4 and agree to support the conservation efforts described.

Linda S.C. Rundell

Linda S.C. Rundell
State Director
Bureau of Land Management
New Mexico State Office

4/7/06

Date

The following signatories support the goals, objectives, and actions of the Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker, version 10.4.4 and agree to support the conservation efforts described.

National Park Service
Intermountain Region
12795 W. Alameda Parkway
P.O. Box 25287
Denver, Colorado 80225-0287

Michael D. Snyder | 7/5/05

Michael D. Snyder
Acting Director

Date

-Signature Page-

This signature page is an appendix to the Range-Wide Conservation Agreement for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker dated 27 January2004 ("Agreement").

The Jicarilla Apache Nation enters this Agreement pursuant to its inherent authority and pursuant to the Revised Constitution of the Jicarilla Apache Nation, Article XI, Powers of the Tribal Council. Nothing in this Agreement provides a basis for requiring the Jicarilla Apache Nation to comply with state law. Nothing in this Agreement diminishes the jurisdiction of the Jicarilla Apache Nation, including its legislative, regulatory, and judicial jurisdiction, nor does the Agreement waive the sovereign immunity of the Nation.

Jicarilla Apache Nation
Jicarilla Game and Fish Department
P.O. Box 507
Dulce, NM 87528

President Levi Pesata

5/10/06
Date

RANGEWIDE CONSERVATION STRATEGY FOR ROUNDTAIL CHUB, BLUEHEAD SUCKER, AND FLANNELMOUTH SUCKER

XII. INTRODUCTION

This conservation strategy (Strategy) has been developed to provide a framework for the long-term conservation of roundtail chub (Cyprinidae: *Gila robusta*), bluehead sucker (Catostomidae: *Catostomus discobolus*), and flannelmouth sucker (Catostomidae: *Catostomus latipinnis*), hereinafter referred to as the three species. Implementation of the Strategy is intended to be a collaborative and cooperative effort among resource agencies to support conservation of the three species throughout their respective ranges. This document provides goals, objectives, and conservation actions to serve as consistent guidelines and direction for the development and implementation of individual state wildlife management plans for the three species. These state conservation and management plans are being developed through an interagency and interested party involvement process. Specific tasks that affect the status of the three species are not reiterated in this document. Rather, we outline the general strategy summarizing the conservation actions to be taken to eliminate or significantly reduce threats and present an overall strategy for the long-term conservation of the three species.

Guidance for specific tasks in state conservation and management plans is summarized in this document. Specific tasks to be completed under the conservation actions set forth in this document will be detailed within respective state conservation and management plans. Likewise, specific tasks that have been completed toward achieving the objectives set forth in this document will also be detailed within the state conservation and management plans. Implementation of these tasks will identify and minimize threats to roundtail chub, bluehead sucker, and flannelmouth sucker that: 1) may warrant or maintain their listing as a sensitive species by state and federal agencies, and 2) may warrant their listing as a threatened or endangered species under the Endangered Species Act of 1973, as amended (ESA).

XIII. BACKGROUND

Geographic Setting

The Colorado River Basin (CRB) is home to 22 fish genera, at least 35 fish species and at least 26 endemic fish species, some of which have persisted for over 10 million years (Evermann and Rutter 1895, Miller 1959, Molles 1980, Minckley et al. 1986, Carlson and Muth 1989, Valdez and Carothers 1998, Bezzerides and Bestgen 2002). Geologic isolation, frequent drought and flood, widely ranging temperatures, and high sediment and solute loads in the CRB created a harsh environment that provided a unique setting for the evolution of a distinct group of endemic fishes (Behnke 1980, Ono et al. 1983, Minckley et al. 1986). The CRB is divided into upper and lower basins at Lee's Ferry in north central Arizona, near the Utah border. The San Juan, Colorado, and Green river basins form the upper CRB. In the lower CRB, the Colorado River flows through Grand Canyon National Park and forms state boundaries between Nevada, California and Arizona. Conjoining the Colorado River in Arizona are the Little Colorado and Gila rivers and the Virgin River joins the Colorado in Nevada. The three species occur in both upper and lower portions of the CRB.

The Bonneville Basin (Utah, Nevada, Wyoming, and Idaho) is an endorheic basin, wherein surface water collects from precipitation and upwelling groundwater, but no streams drain out of the basin (Hubbs et al. 1974). Historically, the Bonneville Basin had aquatic affinities with Hudson Bay, and several species stem from northeastern North American progenitors (Sigler and Sigler 1996 and references therein). During geologic history, the Bear River flowed into the Upper Snake River drainage (Columbia River Basin), but currently flows into the Bonneville Basin (Hubbs and Miller 1948; Sigler and Sigler 1996). The bluehead sucker historically occurred in both the CRB and the Bonneville Basin.

Species Descriptions, Life Histories and Hybrids

The three species share several morphological similarities commonly associated with hydrologically variable environments, including: 1) fusiform bodies, 2) leathery skins with embedded scales, and 3) large, often falcate fins. Such morphologic features, combined with relatively long life spans, may be adaptations to the harsh, unpredictable physical environment of the CRB (Scoppettone 1988, Minckley 1991, Stearns 1993, Bezzerides and Bestgen 2002). Life history characteristics, distribution and abundance have been described for roundtail chub (Bestgen and Propst 1989, Brouder et al. 2000, Voeltz 2002), bluehead sucker (e.g., McAda 1977, Holden and Minckley 1980, McAda and Wydoski 1983, Cavalli 1999 and Bestgen 2000), and flannelmouth sucker (Chart 1987, Douglas and Marsh 1998, McKinney et al. 1999). Bluehead sucker are also discussed in Valdez (1990), Mueller et al. (1998), Brunson and Christopherson (2001), and Jackson (2001).

Roundtail Chub

Roundtail chub utilize slow moving, deep pools for cover and feeding. These fish are found in the mainstem of major rivers and smaller tributary streams. Roundtail chub utilize a variety of substrate types (silt, sand, gravel and rocks) and prefer murky water to clear (Sigler and Sigler 1996, Brouder et al. 2000). Roundtail chub partition habitat use by life stage [adult, juvenile, young-of-year (YOY)].

Juveniles and YOY are found in quiet water near the shore or backwaters with low velocity and frequent pools rather than glides and riffles. Juveniles avoid depths greater than 100 cm and YOY avoid depths greater than 50 cm. Juveniles use instream boulders for cover, while YOY are found in interstices between and under boulders or the slack-water area behind boulders (Brouder et al. 2000).

Adults generally do not frequent vegetation and avoid shallow water cover types (overhanging and shoreline vegetation) (Sigler and Sigler 1996, Brouder et al. 2000). Adults are found in eddies and pools adjacent to strong current and use instream boulders as cover (Sigler and Sigler 1996, Brouder et al., 2000). Adults occupy depths greater than 20 cm and select for velocities less than 20 cm/s. Adults may range 100 m or less over the course of a year, often in search of pool habitats (Siebert 1980; Brouder et al 2000).

Sigler and Sigler (1996) report that roundtail chub mature at five years of age and/or 254 mm to 305 mm in length and that spawning begins in June to early July when water temperatures reach 18.3 °C. However, Peter Cavalli, Wyoming Fish and Game Department, has collected unpublished data (2004 personal communication) indicating that roundtail chub in Upper Green River drainage lakes may mature at sizes as small as 150 mm in water temperatures of 14.4 °C. Eggs from one female may be fertilized by three to five males over gravel in water up to 9.1 m. A 305 mm female can produce 10,000 eggs, 0.7 mm in diameter. The eggs are pasty white and adhesive, sticking to rocks and other substrate or falling into crevices (Sigler and Sigler 1996).

Roundtail chub are carnivorous, opportunistic feeders. Documented food items include aquatic and terrestrial insects, fish, snails, crustaceans, algae, and occasionally lizards (Sigler and Sigler 1996, Osmundson 1999, Bestgen 2000, Brouder 2001).

Bluehead Sucker

Bluehead sucker tend to utilize swifter velocity, higher gradient streams than those occupied by either flannelmouth sucker or roundtail chub. These fish are found in warm to cool streams (20 °C) with rocky substrates (Sigler and Sigler 1996, Bestgen 2000). Bluehead sucker do not do well in impoundments (Sigler and Sigler 1996, Bezzerides and Bestgen 2002). Bluehead sucker partition habitat use by life stage [adult, juvenile, young-of-year (YOY)]. Larval fish inhabit near-shore, low velocity habitats (Childs et al. 1998). As they age, they move to deeper habitats further away from shore, and with more cover (Childs et al. 1998).

Larval and early-juvenile bluehead sucker eat mostly invertebrates (Childs et al. 1998). At later life-stages, they are more opportunistic omnivores, consuming algae, detritus, plant debris, and occasionally aquatic invertebrates (Sigler and Sigler 1996, Osmundson 1999, and Bestgen 2000). This species feeds in riffles or deep rocky pools (McAda 1977, Sigler and Sigler 1996).

Bluehead sucker mature at two years of age and/or at 127 to 179 mm in length. Spawning occurs in shallow areas when water temperatures reach 15.6 °C. Time of spawning varies by elevation, i.e., spring and early summer at low elevations and warm water temperatures, and mid- to late summer at higher elevations and cooler temperatures (Sigler and Sigler 1996). Fecundity is related to length, body weight (Holden 1973), and water temperature (McAda 1977). A 38 to 44 cm female may produce over 20,000 eggs (Andreason 1973). Eggs hatch in seven days at water temperatures of 18 to 21 °C (Holden 1973). Bluehead sucker, when disturbed during spawning, will compress to the bottom of the stream and can be captured by hand (Sigler and Sigler 1996). After hatching, larval fish drift downstream and seek out near-shore, slow-velocity habitats (Robinson et al. 1998).

Flannelmouth Sucker

Flannelmouth sucker reside in mainstem and tributary streams. Elements of flannelmouth habitat include 0.9 to 6.1 m deep murky pools with little to no vegetation, and deep runs and riffles (McAda 1977, Sigler and Sigler 1996, Bezzerides and Bestgen 2002). Substrates utilized consist of gravel, rock, sand, or mud (McAda 1977, Sigler and Sigler 1996). Flannelmouth sucker partition habitat use by life stage, with young fish occupying quiet, shallow riffles and near-shore eddies (Childs et al. 1998), and adults occupying deep riffles and runs. Many authors report that flannelmouth sucker do not prosper in impoundments (McAda 1977, Sigler and Sigler 1996, Bezzerides and Bestgen 2002); however, some lakes in the Upper Green River drainage in Wyoming supported large flannelmouth sucker populations historically (Baxter and Stone 1995; P. Cavalli, Wyoming Game and Fish Department, 2004 personal communication). Flannelmouth sucker are opportunistic, benthic omnivores consuming algae, detritus, plant debris, and aquatic invertebrates (McAda 1977, Sigler and Sigler 1996, Osmundson 1999, Bezzerides and Bestgen 2002). Food consumed depends on availability, season, and the individual's age class (McAda 1977, Sigler and Sigler 1996). Larval and early juveniles consume mostly invertebrates (Childs et al. 1998).

Flannelmouth suckers mature at four to five years of age. Males mature earliest (McAda 1977, Sigler and Sigler 1996). Females ripen at water temperatures of 10 °C, whereas males ripen earlier in the spring (6.1 to 6.7 °C) and remain fertile for longer periods than females (McAda 1977, Sigler and Sigler 1996). Seasonal migrations are made in the spring to suitable spawning habitat (Suttkus and Clemmer 1979, Sigler and Sigler 1996). McKinney et al. (1999; see also Chart 1987, Chart and Bergersen 1987, Bergersen 1992) documented long-range movements (ca. 98-231 km) among adult and sub-adult fish, although the roles these movements play in life history are unclear and need further investigation. Obstructions to movements such as dams may also be an important consideration in the conservation of flannelmouth suckers. Flannelmouth suckers generally spawn for two to five weeks over gravel. A female will produce 9,000 to 23,000 adhesive, demersal eggs. After fertilization, the eggs sink to the bottom of the stream and attach to substrate or drift between crevices (Sigler and Sigler 1996). After hatching, larvae drift downstream and seek out near-shore, low-velocity areas (Robinson et al. 1998).

Hybrids

Potential hybridization among *Gila* species in the CRB has caused management agencies to carefully consider their conservation actions. In Utah, hybridization between humpback chub *(Gila cypha)* and bonytail *(G. elegans)* in Desolation and Gray Canyons of the Green River has been postulated by many observers. The Virgin River chub *(Gila seminuda)* found in the Muddy River has been historically treated as a subspecies of roundtail chub *(G. robusta)* and is thought to be a hybrid between the bonytail *(G. elegans)* and the Colorado roundtail chub *(G. r. robusta;* Maddux et al. 1995, Sigler and Sigler 1996 and references therein). In 1993, taxonomic revisions were accepted, and the Virgin River chub was asserted species status as *G. seminuda* (DeMarais et al. 1992, Maddux et al. 1995). The Virgin River chub is currently listed as endangered under the ESA.

Whether biologists and agencies recognize two species, two species and a hybrid form, three species, or some other combination has implications for how the fish are managed. Because roundtail chub are congeners with humpback chub and bonytail, the potential for hybridization with roundtail exists, although this has not been as well documented as the hybridization between humpback chub and bonytail (e.g., Valdez and Clemmer 1982, Kaeding et al. 1990, Dowling and DeMarais 1993, Douglas and Marsh 1998). Valdez and Clemmer (1982) have suggested that hybridization is a negative result of dramatic environmental changes, while Dowling and DeMarais (1993) and McElroy and Douglas (1995) suggest that hybridization among these species has occurred continually over geologic time, providing offspring with additional genetic variability. Barriers to hybridization among *Gila* species suggest that it is a paraphyletic genus (Coburn and Cavender 1992 and references therein). Putative roundtail chub in the Gila River drainage of New Mexico and Arizona was recently divided into three species, *G. robusta*, *G. intermedia*, and *G. nigra* (Minckley and DeMarais 2000). Additional investigation of these relationships and resulting offspring is required and results may affect future conservation and management actions for roundtail chub and other *Gila* species. Hybridization between bluehead sucker and Rio Grande sucker (*C. plebius*) is thought to have produced the Zuni bluehead sucker (*C.d. yarrowi*), a unique subspecies found mainly in Rio Nutria, NM.

Douglas and Douglas (2003) report that both indigenous bluehead and flannelmouth sucker currently hybridize with invasive white sucker (*Catostomus commersoni*) in the Little Yampa Canyon region of the Yampa River, Colorado. Two hybrids between flannelmouth and bluehead sucker were also found in their study, which is extremely rare elsewhere in the CRB. Douglas and Douglas (2003) suggest backcrossing of fertile indigenous and invasive sucker hybrids as a mechanism that perpetuates introgressed genes. They also speculate that the species boundary between flannelmouth and bluehead suckers could be compromised as a result.

XIV. CONSERVATION GUIDELINES

This section presents a generalized discussion on conservation topics relevant to the conservation of the three fish species. Intended as a guide for development of state conservation plans, it does not specifically outline minimum requirements for development of such plans. Rather, the signatories recognize that the priority of issues discussed in this section may vary widely from state to state and that the feasibility of resolving management implications discussed herein is situation- and species-specific. Furthermore, it is likely that conservation issues discussed in these sections will frequently be interrelated. For example, genetic concerns will likely be addressed in concert with metapopulation, population viability, and nonnative fish issues. Likewise, nonnative fish control issues may impact habitat management, and in some instances, hybridization issues (e.g., occurrence of white sucker in the upper CRB), and so on. It is therefore desirable that state managers identify interrelationships between conservation issues and formulate their state plans accordingly.

Habitat Maintenance and Protection

Habitat is an important component of metapopulation and species survival. Loss of available habitat may lead to the loss of individuals or populations that in turn may cause loss of metapopulation dynamics. Important physical habitat characteristics may include (but are not limited to) substrate, instream habitat complexity**,** and flow regimes. Chemical characteristics may include (but are not limited to) instream pH, temperature, specific conductance, suspended solids, dissolved oxygen, major ions (e.g., carbonate), nutrients, and trace elements. If needed, the signatories will develop habitat improvement actions to support individual populations and metapopulation dynamics. Rigorous standards for habitat protection can be incorporated into state fishery and land use plans. Current guidelines exist for many agencies that can be incorporated into these efforts, including (but not limited to) Best Management Practices or other state water quality standards, Forest Plan Standards and Guidelines, National Park Service Natural Resources Management Guidelines (DO-77), and recommendations from related broad-scale assessments. Properly Functioning Condition (PFC) protocols are found in Bureau of Land Management publication TR 1737-15 (1998) "Riparian Area Management, a User Guide to Assessing Proper Functioning Condition and Supporting Science for Lotic Areas."

One of the most dramatic anthropogenic changes imposed on the CRB and Bonneville basins is alteration of natural flow regimes. Instream flow and habitat-related programs administered through existing recovery and conservation programs in upper and lower Colorado River basins can provide guidance for development of similar programs for the three species. Studies conducted by the Upper Colorado River Basin Endangered Fish Recovery Program can aid in identifying habitat requirements for main channel three species populations and select tributary populations (e.g., Chart and Lenstch 1999, Trammel et al. 1999, Muth et al. 2000, Osmundson 2001, Tyus and Saunders 2001, McAda 2003). Other examples of habitat management for tributary cypriniform populations have been proposed for the Virgin River (Lentsch et al. 1995; Lentsch et al. 2002).

Habitat availability for flannelmouth and bluehead sucker as a function of stream discharge was recently identified in Anderson and Stewart (2003). The goal of this study was to derive biologically based instream flow recommendations for non-endangered native fish, which makes the study germane as a three species conservation guideline. Habitat quality and quantity were derived by relating output from two-dimensional (2-D) hydraulic models of mesohabitat availability (as a function of discharge) to patterns of fish abundance over a three-year period among three different systems (Dolores, Yampa, and Colorado rivers). The 2-D approach is advantageous over previous instream flow methods because it is not dependent on microhabitat suitability curves (and their attendant assumptions) for prediction of habitat availability. The higher level of spatial resolution attained by the 2-D allows for greater accuracy in habitat quantification. The 2-D approach as utilized in Anderson and Stewart (2003) is also advantageous because output is interpreted alongside relevant biological information such as non-native fish abundance and native fish size structure in the modeled stream reaches.

Nonnative fish control

Impacts of nonnative fish on native fish fauna of the Southwestern U.S. are dramatic. Of 52 species of fish currently found in the upper CRB, only 13 are native (six of these are endangered; U.S. Fish and Wildlife Service [FWS] 2003b). Native fish populations in the lower CRB have been similarly impacted by establishment of nonnative fish populations (Minckley et al. 2003). Direct and indirect impacts of nonnative fish on native fish fauna can be measured as changes in the density, distribution, growth characteristics, condition or behavior of both individual native fish and native fish populations (Taylor et al. 1984; Hawkins and Nesler 1991). These changes result from altered trophic relationships (predation, competition for food), spatial interactions (competition for habitat), habitat alteration, hybridization, and/or disease or parasite introductions.

All major recovery plans in the Southwestern U.S., including those of the San Juan River Basin Recovery Implementation Program (SJRIP; SJRIP, 1995), the Upper Colorado River Endangered Fish Recovery Program (UCREFRP; FWS 2003b), the June Sucker Recovery Implementation Program (JSRIP; FWS 1999), and the Virgin River Resource Management and Recovery Program (FWS 1995), identify control of nonnative fish species to alleviate competition with and/or predation on rare fishes as a necessary management action. Due to extensive use by the three species of lower-order streams throughout their range, however, states may have to identify HUC-specific control measures for nonnative fish. Guidelines for development of nonnative fish management actions (Hawkins and Nesler 1991; Tyus and Saunders 1996; Lenstch et al. 1996; SWCA Inc. 2002) include:

1) Assessment of impacts of nonnative fish on native fish populations, including problem species and probable impact mechanisms.
2) Identification of spatial extent of impacted populations and potential nonnative source systems; prioritization of areas by severity and cost/benefit ratios.
3) Development of coordinated nonnative fish control strategies; identification of potential sport fishing conflicts.
4) Identification and use of effective nonnative control methods.
5) Development of programs to monitor results of nonnative control measures.
6) Assurance that I & E and outreach programs are in place to communicate intentions and findings to the public.

Tyus and Saunders (1996) identified three basic strategies for nonnative fish control in the upper CRB:

1) Prevention. Nonnative fish are prevented from entering a system by physical barriers or other control structures, removed directly from potential source water bodies, or prevented from being stocked through regulatory mechanisms.
2) Removal. Nonnative fish are removed directly from a system or forced out through creation of unfavorable habitat conditions.
3) Exclusion. Nonnative fish are excluded from preying upon or otherwise interfering with native fish through active management, particularly in nursery areas including, but not limited to, installation of barriers during rearing periods.

Strategies may be applied at the basin-wide level or applied to high priority areas within a specific body of water such as nursery or reproductive habitats where native offspring are most vulnerable to predation. Strategies for control of nonnative fish should be developed at the state level. Evaluations of state nonnative fish stocking policies can be found for Colorado (Upper Colorado River Endangered Fish Recovery Program 2002; Martinez et al., in review) and Utah (Holden et al. 1996; Upper Colorado River Endangered Fish Recovery Program 2002). Potential conflicts of nonnative fish control actions with sport fishing management may be difficult to resolve, and may require the development of regional coordinated sport and native fish management strategies. Such strategies often include sufficient monitoring to demonstrate results of nonnative fish control efforts. Outreach programs have been utilized to communicate these results to the public.

Nonnative fish control techniques, specifically applications to southwestern fisheries, have been identified by Lentsch et al. (1996) and SWCA Inc. (2002). Control techniques are categorized as mechanical (angling, commercial fishing, electrofishing, netting), chemical (rotenone, antimycin), biological (introduce predator/competitor, genetically altered individuals, or disease), physical (barriers, screens), physicochemical (habitat modification), or some combination of these. Based on a survey of available literature, SWCA Inc. (2002) identified use of a combination of techniques as the most effective means of controlling nonnative fish abundance. All approaches require a prior knowledge of the target species life history and the physical characteristics of the system they reside in. Documentation of a positive native fish population response to control efforts poses a formidable challenge to managers, but one that ultimately must be addressed.

Population Viability

One of the most fundamental and difficult questions that a wildlife conservation program can address is whether a wild population of animals will persist into the future. Evaluation of the viability of populations may consider available information from the past, the current condition of the species, and the degree of known threats. Population viability analysis also considers what is known about population genetics and demographics, e.g. the probability that very small populations will inbreed and be lost.

This Strategy does not prescribe any one specific method of population viability analysis. Instead, all state signatories agree to develop their own manner of estimating population viability, recognizing the importance of overlapping methods where feasible and applicable. In addition, is it recognized that additional information will be acquired over the course of the Agreement and will thus be adaptive in their approach for estimating population viability. The Strategy identifies the following population viability factors that may be considered, although other appropriate factors may be added to this list in the future:

1. Known and potential threats
2. Available habitat(s)
3. Habitat stability
4. Genetic stability
5. Metapopulation connectivity and stability
6. Reproductive opportunity and potential, including recruitment into the effective population
7. Potential to expand population sizes and distribution

Population viability is a function of population demographics (size and age structure), population redundancy (number and distribution), habitat carrying capacity (resource limitations), and genetic stability (inbreeding and genetic diversity; Franklin 1980; Soulé 1980; Shaffer 1987; Allen et al. 1992). Viable, self-sustaining populations are characterized as having a negligible chance of extinction over century time scales, are large enough to be sustained through historical environmental variation, are large enough to maintain genetic diversity, and maintain positive recruitment near carrying capacity. Establishment of functioning metapopulations (see next section) can fulfill several of these criteria, including stabilization of population dynamics (Wilcox and Murphy 1985, Hanski and Gilpin 1991), increasing range-wide genetic heterogeneity (Simberloff and Abele 1976), and decreasing probability of population losses through environmental and demographic stochasticity (Roff 1974, Wilcox and Murphy 1985).

Metapopulation Dynamics and Function

A metapopulation consists of a series of populations existing in discrete habitat patches linked by migration corridors. Although individual populations should be managed and protected, some degree of interconnectedness among populations (i.e., a metapopulation) is needed to maintain genetic exchange and stabilize population dynamics (Meffe 1986; Wilcox and Murphy 1985, Hanski and Gilpin 1991). Metapopulations stabilize local population dynamics by: 1) allowing genetic exchange among local populations and thereby increasing genetic heterogeneity (Simberloff and Abele 1976); 2) decreasing vulnerability of populations to losses through environmental and demographic stochasticity (Roff 1974, Wilcox and Murphy 1985); and 3) increasing resistance of populations to changes in deterministic variables (birth, survival and death rates; Connell and Sousa 1983; Rieman and McIntyre 1993). Metapopulation dynamics and persistence depend on species life history, connectivity between habitat patches, and the amount and rate of change in available habitat. A metapopulation may thrive as long as immigration (or recruitment) is greater than extinction (or mortality), the amount of habitat remains the same or increases, and populations remain connected. Metapopulations facilitate exchange of genetic material among populations. If migration is prevented over time, populations that were once connected can follow different evolutionary paths for adaptation to local environments. Migrating breeders within a metapopulation help slow or prevent inbreeding depression by maintaining genetic diversity and contributing genetic material not represented in local populations.

Metapopulations can stabilize populations throughout their range. Stream reaches depopulated following stochastic or anthropogenic events may re-populate from connecting, neighboring populations as long as sufficient migration corridors are maintained. However, diversions, dams, and dewatering within stream systems decrease the amount of connectivity between populations of aquatic species. Corridors require sufficient flows, at least during migration periods, and cannot exceed maximum migration distances. Diversions and dams eliminate connectivity by blocking fish migration routes. Dewatering a stream reach may also temporally reduce the amount of available habitat within a stream and, depending on life history, impact survival of the species in question. Potential management actions may include improving and protecting migration corridors that provide connectivity between historically connected populations, moving fish beyond impassable barriers to simulate historical migration patterns, and improving, protecting, and expanding available flows and habitat. Metapopulation issues (together with conservation genetics) involving interstate waters should be addressed through coordination among the bordering states and with cooperative work between federal land management agencies and state agencies.

Conservation Genetics

Genetic issues vary throughout the range of the three species. Rather than identify issues here for each state, state conservation plans should contain their own prioritization conservation genetics issues among the three species. However, the general goals of range-wide conservation genetics should be to preserve available genetic diversity, including identifying and preserving genetically distinct populations as well as those providing redundancy of specific genetic material across the species' range. Genetically distinct populations should receive special management consideration. Effective conservation and management of the three fish species requires knowledge of the levels of genetic diversity that exist both within and among populations (Chambers and Bayless 1983; Hamrick 1983; Meffe 1986; Soulé 1986, Hallerman 2003). Small, fragmented populations are at greatest risk of genetic diversity loss due to increased frequency of rare, deleterious alleles *within* the population and consequent decreased ability to respond to environmental changes (Lande 1988). *Among* population variation indicates a historical lack of gene flow and subsequently the opportunity for local adaptation, although rapid outbreeding among such groups can cause reductions in relative fitness of offspring. Aquatic systems in the CRB and the Bonneville Basin have undergone large-scale anthropogenic changes in the last 150 years, including alteration of natural hydrology, temperature regime, sediment loads and community composition through introductions of exotic species. System fragmentation, species range contraction, and local declines in population size resulting from these changes can impact genetic diversity within and among populations. Protection of genetic diversity can be accomplished through protection of existing populations, maintenance or re-establishment of migration corridors, transplants of fish from other areas (augmenting existing populations or re-establishing lost populations), or other means.

A first step toward a conservation and management program is to identify genetically distinct populations or management units within individual state boundaries and among interstate waters. As the signatories to this Strategy assess the status of the three species, genetic diversity of the populations should be evaluated, including review of available data and literature on genetic structuring and identification of necessary morphologic and molecular data needed to make management decisions regarding the species' biological requirements. Genetic (and probably metapopulation-related) issues involving interstate waters should be addressed as such, and coordination among the bordering states is necessary to resolve these issues.

No single approach is best to determine the levels of differentiation within and among populations and it is best to incorporate a variety of different kinds of information for each population. For example, geographic, molecular and morphological or meristic data can all provide important quantitative information on population differences (Chambers 1980; Vrijenhoek et al. 1985; Meffe 1986). Conservation and management actions for divergent populations of the three species may be based on the results of these analyses in conjunction with other fish population assessment tools, such as population estimates, population viability analysis, life history information, distributions, and habitat analysis. From a genetic perspective, identification and designation of populations may include 1) analysis of nuclear DNA markers, 2) mitochondrial DNA analysis, and 3) meristic and morphologic traits. The signatories will work together as appropriate to ensure that genetic techniques and tools can be used during range-wide assessments.

The signatories will review available peer-reviewed and gray literature sources for data regarding genetic structuring of the three species. In the absence of information to the contrary, populations from neighboring hydrologic units (taken from the U.S.G.S. Hydrologic Unit Code, or HUCs) will be assumed more similar to each other and more distinct from populations of the same species distributed farther away. Populations within the same HUC are presumably more similar to each other than to populations of the same species from neighboring HUCs. These assumptions and any relevant management recommendations will be evaluated as additional data become available. Additional data can be used to help identify the most genetically unique populations as well as those HUCs where the greatest diversity among populations of one or more of the three species is distributed. Unless data to the contrary are developed, populations with greater proportions of heterozygotes will be designated more diverse and resilient to environmental change than those of greater proportions of homozygotes (Reed and Frankham 2003, Hallerman 2003).

Hybrids

Fitness is defined herein as a species' ability to thrive and reproduce in its environment and respond to environmental change. While the ability to respond to environmental change is often impossible to predict, geneticists generally agree that genetically diverse populations exhibit high degrees of fitness. Conversely, populations with less diversity are less fit as they have fewer alleles that may be expressed in response to changing environmental conditions (Reed and Frankham 2003). There are examples of detrimental hybridization whereby fitness of either species does not increase or decline. In fishes, high fecundity and external fertilization increase the probability of hybridization, which may have given rise to some of the species we recognize today. The ability to hybridize does not always lead to the loss of one or more species. Persistent, long-term hybridization among species has been documented between flannelmouth suckers and razorback suckers (Buth et al. 1987). The observation that many of the various *Gila* species native to the CRB share alleles suggests ongoing hybridization between roundtail chub and other chubs (DeMarais et al. 1992, Dowling and DeMarais 1993). By incorporating additional non-deleterious alleles, hybridization may confer additional fitness or increased ability to respond to environmental stressors. As available habitat has been reduced from historic times, especially due to impoundment and reduced flows, the likelihood of hybridization among closely related species has increased.

There are two documents which could potentially affect the states' conservation and management actions regarding populations comprised partly by hybrids: 1) The Proposed Policy on the Treatment of Intercrosses and Intercross Progeny (Intercross Policy; 61 FR 4709); and 2) The Policy Regarding the Recognition of Distinct Population Segments Under the Endangered Species Act (DPS Policy; 61 FR 4722). Under the non-binding Intercross Policy, the FWS has responsibility for conserving hybrids under ESA (intercrosses) if 1) offspring share traits that characterize the taxon of the listed parent, and 2) offspring more closely resembles the listed parent's taxon than an entity intermediate between it and the other known or suspected non-listed parental stock. The Intercross Policy proposes the use of the term "intercross" to represent crosses between individuals of varying taxonomic status (species, subspecies, and distinct population segments). Under this proposed policy, populations can contain individuals that represent the protected species and intercrosses between the protected species and another.

While the intercross policy has not been formally adopted, the FWS has scientifically developed intercross policy concepts in completing their 12-month finding for westslope cutthroat trout (WCT; FWS 2003a). They justified inclusion of hybridized fish in their assessment of WCT if such fish conformed morphologically to published taxonomic descriptions. While such fish may have a genetic ancestry derived by up to 20% from other fish species, the FWS concluded that they also possessed the same behavioral and ecological characteristics of genetically pure fish. They stress, however, that additional criteria should be evaluated, including whether the individual is hybridized with a native or introduced fish and the geographic extent of hybridization. Similar to portions of the FWS testimony, Peacock and Kirchoff (2004) recommended that hybridization policies be flexible enough to allow for conservation of hybridized fish, if in fact genetically pure populations are rare. These concepts could have significant influence in the interpretation of genetic and biological data on roundtail chub, which are suspected to hybridize with endangered *Gila* species (*G. elegans, G. cypha*) in certain regions of the CRB.

The DPS Policy requires the FWS to consider three elements in decisions regarding the status of a possible DPS: 1) discreteness of the population segment in relation to the remainder of the species to which it belongs; 2) the significance of the population segment to the species to which it belongs, and 3) the population segment's conservation status in relation to ESA standards for listing. The policy recognizes the importance of unique management units to the conservation of the species and that management priorities can vary across a species' range according to the importance of those population segments. Taken together, the Intercross and DPS policies require that conservation actions for the species be completed by compiling standardized information for each population such that the influence of hybridization and other unique characteristics of the population segments can be identified (Lenstch et al. 2000).

Signatories should review the literature available on hybridization and adequacy of existing data to characterize the degree of hybridization and its impact on fitness among the three species. If additional data are required, additional research on this subject should be conducted. Additional research may characterize genetic structure of the populations, quantify the degree of hybridization, and evaluate whether hybridization appears to be decreasing, maintaining or increasing fitness. If hybridization (whether with nonnative or native species) is decreasing fitness, then management actions to reduce deleterious hybridization may be implemented.

XV. STATUS ASSESSMENT OF ROUNDTAIL CHUB, BLUEHEAD SUCKER, AND FLANNELMOUTH SUCKER

Distribution

The roundtail chub, bluehead sucker, and flannelmouth sucker are three of the least-studied fishes native to the CRB and the Bonneville Basin. Available literature suggests that the three species were common to all parts of the CRB until the 1960s (Sigler and Miller 1963, Jordan and Evermann 1869, Minckley 1973). There have been no range-wide distribution or status assessments for any of these three species preceding the current review of Bezzerides and Bestgen (2002), which concludes that distributions of all three fish species have contracted 50%, on average, from their historic distributions.

Roundtail chubs are found in Wyoming in tributaries to the Green River and in several lakes in the upper portion of the basin. Extant, but declining roundtail chub populations in Utah occur in the Escalante and San Rafael rivers; portions of the middle and upper San Juan River and some tributaries; the Colorado River from Moab to Silt, Colorado; the Fremont River; the Green River from the Colorado River confluence upstream to Sand Wash and from Jensen to Echo Park; the White River from the Green River confluence upstream to near Meeker, Colorado (Bezzerides and Bestgen 2002); and the Duchesne River from the Green River confluence upstream to Myton (Brunson 2001). Roundtail chub presently occur in the lower Colorado River basin in Arizona and New Mexico, in tributaries of the Little Colorado River and Bill Williams River, and in the Gila River and tributaries (Voeltz 2002). Lee et al. (1980) also recorded occurrences in northern Mexico, which was anecdotally confirmed by personal communications in 2001 with S. Contreras-Balderas (Bioconservacíon A.C., Monterrey, Nuevo Leon) and A. Varela-Romero (Universidad de Sonora, Hermosillo). Fishes formerly considered roundtail chub outside the Colorado River basin in Mexico are now considered a different species, *Gila minacae* (S. Norris, California State University Channel Islands, personal communication 2004).

Although little information exists on distribution of bluehead sucker (but see McAda 1977, Holden and Minckley 1980, and McAda and Wydoski 1983), they historically occurred in large rivers and tributaries in the CRB (including the Colorado, Green, and San Juan river sub-basins), the Bonneville Basin in Utah, the Snake River Basin in Idaho, Nevada, and Utah (Lee et al. 1980; Ryden 2001), and the Little Colorado River Basin in Arizona and New Mexico (Minckley 1973). Bluehead sucker are found in portions of the Bonneville and Snake River Basins in Wyoming (Baxter and Stone 1995) as well mainstem habitats and several tributaries to the Colorado and Green rivers.

Bluehead sucker populations occur in the Escalante, Dirty Devil, and Fremont rivers (Colorado River tributaries) and in the San Rafael, Price, and Duchesne rivers (Green River tributaries); in the Weber and upper Bear River drainages; in the mainstem Green River from the Colorado River confluence upstream to Lodore, Colorado; in the White River from the Green River confluence upstream to near Meeker, Colorado; in the Yampa River from the Green River confluence upstream to Craig, Colorado; in the San Juan River, Utah, New Mexico and Colorado; in the Colorado River from Lake Powell upstream to Kremmling, Colorado; in the Dirty Devil River in Utah; and in the Dolores River from the Colorado River confluence upstream to McPhee Reservoir, Colorado (Holden and Stalnaker 1974; Sigler and Sigler 1996; Bezzerides and Bestgen 2002). Bluehead sucker also occur in the following tributaries to the Colorado River in Grand Canyon: Bright Angel Creek, Little Colorado River (including headwater tributaries Nutrioso Creek, East, West, and South Fork of the Little Colorado River, East Clear Creek, and Chevelon Creek), Clear Creek, Shinumo Creek, Kanab Creek, and Havasu Creek.

Flannelmouth sucker occur above Flaming Gorge Reservoir in the Green River and its tributaries as well as in some naturally occurring lakes in this drainage. Flannelmouth sucker are currently found in the Escalante and Fremont rivers (Colorado River tributaries), the San Rafael, Price and Duchesne rivers (Green River tributaries); the mainstem San Juan River and tributaries; the Colorado River from Lake Powell upstream to near Glenwood Springs, Colorado; the Gunnison River in Colorado; the Dolores River; the Green River from the Colorado River confluence upstream to Flaming Gorge Reservoir; in the Dirty Devil River in Utah; and the Yampa and White rivers upstream from their confluences with the Green River. Populations of flannelmouth sucker also exist in the main channel Colorado River below Glen Canyon Dam and in the Virgin River. Flannelmouth sucker also occur in the following Grand Canyon tributaries during portions of their life cycle: Paria River, Bright Angel Creek, Kanab Creek, Shinumo Creek, Havasu Creek and the Little Colorado River including Nutrioso Creek and possibly other headwater tributaries (Little Colorado sucker may or may not be genetically distinct from flannelmouth sucker). Flannelmouth sucker are also common below Davis Dam (Mueller and Wydoski 2004) on the lower Colorado River. Although flannelmouth sucker populations usually do not persist in impoundments (Sigler and Sigler 1996; Bezzerides and Bestgen 2002), individuals were recently documented in Lake Havasu and Lake Mead, Lower Colorado River (Mueller and Wydoski 2004, Arizona Game and Fish Department, unpublished).

Status

Available information indicates that roundtail chubs now occupy approximately 45% of their historical range in the CRB. In the upper CRB (New Mexico, Colorado, Utah, and Wyoming), it has been extirpated from approximately 45% of their historical range, including the Price River (Cavalli 1999) and portions of the San Juan River, Gunnison River, and Green River (Bezzerides and Bestgen 2002). Data on smaller tributary systems are largely unavailable, and population abundance estimates are available only for short, isolated river reaches (Bezzerides and Bestgen 2002). In the lower CRB, current estimates of roundtail chub distribution are as low as 18% of their former range (Voeltz 2002). A petition to list the lower Colorado River Basin roundtail chub under the ESA was filed in April 2003 and the finding from the Fish and Wildlife Service is expected in 2006. Roundtail chub are listed as a species of concern by the states of Arizona, Utah, Wyoming, and Colorado. The state of New Mexico lists roundtail chub as endangered.

Bluehead suckers presently occupy approximately 50% of their historically occupied range in the CRB. In the upper CRB (Utah, Wyoming, Colorado and New Mexico), bluehead suckers currently occupy approximately 45% of their historical habitat. Recent declines of bluehead suckers have occurred in the White River below Taylor Draw Dam (Utah and Colorado) and in the upper Green River (Holden and Stalnaker 1975; Bezzerides and Bestgen 2002). Bluehead sucker have been extirpated in the Gunnison River, Colorado above the Aspinall Unit Reservoirs (Wiltzius 1978). Bluehead sucker were documented in the Escalante River during the mid to late 1970’s, but were absent from samples collected in recent years (Mueller et al. 1998). Bluehead sucker are listed as a species of concern by the states of Utah and Wyoming. In Wyoming, hybridization with white sucker appears to be compromising the genetic purity of several populations of bluehead sucker.

Recent investigation of historical accounts, museum specimens, and comparison with recent observations suggests that flannelmouth suckers occupy approximately 50% of their historic range in the upper CRB (Utah, Wyoming, Colorado, and New Mexico; Bezzerides and Bestgen 2002). Their relative abundance in the Green River tributaries is not well known. Populations have declined since the 1960’s due to impoundment in the mainstem Green River in Wyoming (Flaming Gorge, Fontenelle Reservoir) and in the Colorado River in Glen Canyon, Utah (Lake Powell). Flannelmouth sucker are listed as species of concern by the states of Arizona, Utah, Colorado, and Wyoming.

XVI. RANGE-WIDE CONSERVATION OF ROUNDTAIL CHUB, BLUEHEAD SUCKER, AND FLANNELMOUTH SUCKER

Goal

The goal of this strategy is to outline measures that the states can implement and expand upon to ensure the persistence of roundtail chub, bluehead sucker, and flannelmouth sucker populations throughout their ranges as specified in the Conservation Agreement, and to provide guidance in the development of individual state conservation plans. The range-wide strategy will be reviewed by the signatories every five years to ensure the incorporation of new adaptive management strategies or to alter portions of the strategy to better-fit existing conditions.

Objectives

The individual state signatories to the Conservation Agreement for the three species (signatories) will develop conservation and management plans for any or all of the three species that occur naturally within their states. Any future signatories may also choose to develop individual conservation and management plans or to integrate their efforts with existing plans. The individual signatories agree to develop information and conduct actions to support the following objectives:

- Establish and/or maintain roundtail chub, flannelmouth sucker and bluehead sucker populations sufficient to ensure persistence of each species within their ranges.
    1) Establish measureable criteria to evaluate the number of populations necessary to maintain the three species throughout their respective ranges.
    2) Establish measureable criteria to evaluate the number of individuals necessary within each population to maintain the three species throughout their respective ranges.
- Establish and/or maintain sufficient connectivity between populations so that viable metapopulations are established and/or maintained.
- As feasible, identify, significantly reduce and/or eliminate threats to the persistence of roundtail chub, bluehead sucker, and flannelmouth sucker that: 1) may warrant or maintain their listing as a sensitive species by state and federal agencies, and 2) may warrant their listing as a threatened or endangered species under the ESA.

XVII. CONSERVATION ACTIONS AND ADAPTIVE MANAGEMENT

The signatories will review and document existing and ongoing programmatic actions that benefit the three species. Signatories will identify information gaps regarding species distribution, status, and life history requirements, and develop research and analysis programs to fill those gaps. Through coordination with other states, the signatories to the Conservation Agreement will develop and implement conservation and management plans for each state. The signatories agree that the goals and objectives are appropriate across the respective ranges of the three species, though they acknowledge that as more information is gathered, the objectives may change with a consensus of the signatories to better allow for implementation of the Agreement according to the new information. Signatories also agree to incorporate the preceding conservation actions into their conservation and management plans as applicable, though each management plan should also incorporate the ability to adapt to new information and to incorporate new information where necessary. As signatories develop their individual management plans for conservation of the three species, each signatory may include but is not limited or obligated to incorporate the following conservation actions within their plans:

1) Conduct status assessment of roundtail chub, bluehead sucker, and flannelmouth sucker.
    - Identify concurrent programs that benefit the three fish species. Monitor and summarize activities and progress.
    - Establish current information regarding species distribution, status, and habitat conditions as the baseline from which to measure change.
    - Identify threats to population persistence.
    - Locate populations of the subject species to determine status of each.
2) Establish and maintain a database of past, present, and future information on roundtail chub, bluehead sucker, and flannelmouth sucker.
    - Establish format and maintain compatible databases. Signatories have identified the need to maintain a range-wide database as the primary means to conduct a range-wide assessment.
    - Establish and maintain bibliography of subject species.
3) Determine roundtail chub, bluehead sucker, and flannelmouth sucker population demographics, life history, habitat requirements, and conservation needs.

- Determine current population sizes of subject species and/or utilize auxiliary catch and effort data to identify trends in relative abundance.
- Identify subject species habitat requirements and current habitat conditions through surveys and studies of hydrological, biological and watershed features.
- Determine if existing flow recommendations and regimes are adequate for all life stages of the subject species. Develop appropriate flow recommendations for areas where existing flow regimes are inadequate.
- Where additional data is needed to determine appropriate management actions, conduct appropriate, focused research and apply results.

4) Genetically and morphologically characterize populations of roundtail chub, bluehead sucker, and flannelmouth sucker.

- Determine if known information is adequate to answer management questions related to conservation genetics and assess need for additional genetic characterization of subject species.
- Apply new information to management strategies.
- Review the literature available on hybridization and adequacy of existing data to characterize the degrees of threats to conservation of the three species posed by hybridization.
- Develop genetic management plans for all three species that outline maintenance of species at the population level and discuss application to reestablishment efforts.

5) Increase roundtail chub, bluehead sucker, and flannelmouth sucker populations to accelerate progress toward attaining population objectives for respective species.

- Assure regulatory protection for three species is adequate within the signatory states.

6) Enhance and maintain habitat for roundtail chub, bluehead sucker, and flannelmouth sucker.

- Enhance and/or restore connectedness and opportunities for migration of the subject species to disjunct populations where possible.
- Restore altered channel and habitat features to conditions suitable for the three species.
- Provide flows needed for all life stages of the subject species.
- Maintain and evaluate fish habitat improvements throughout the range.
- Install regulatory mechanisms for the long-term protection of habitat (e.g., conservation easements, water rights, etc.).

7) Control (as feasible and where possible) threats posed by nonnative species that compete with, prey upon, or hybridize with roundtail chub, bluehead sucker, and flannelmouth sucker.

- Determine where detrimental actions occur between the subject species and sympatric nonnative species.
- Control detrimental nonnative fish where necessary and feasible.
- Evaluate effectiveness of nonnative control efforts.
- Develop multi-state nonnative stocking procedure agreements that protect all three species and potential reestablishment sites.

8) Expand roundtail chub, bluehead sucker, and flannelmouth sucker population distributions through transplant, augmentation (i.e., use of artificially propagated stock), or reintroduction activities as warranted using a genetically based augmentation/reestablishment plan.

9) Establish and implement qualitative and quantitative long-term population and habitat monitoring programs for roundtail chub, bluehead sucker, and flannelmouth sucker.

- Develop and implement monitoring plan for the subject species.
- Evaluate conditions of populations using baseline data.
- Develop and implement habitat monitoring plan for the subject species.
- Evaluate habitat conditions using baseline data.

10) Implement an outreach program (e.g., development of partnerships, information and education activities) regarding conservation and management of roundtail chub, bluehead sucker, and flannelmouth sucker.

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APPENDIX 1: STANDARD LANGUAGE REQUIRED BY THE STATE OF ARIZONA

The Arizona Game and Fish Commission, acting through its administrative agency, the Arizona Game and Fish Department, enters into this Agreement under authority of A.R.S. § 17-231.B.7).

The following stipulations are hereby made part of this Agreement, and where applicable must be adhered to by all signatories to this Agreement.

- **ARBITRATION: To the extent required pursuant to A.R.S. § 12-1518, and any successor statutes, the parties agree to use arbitration, after exhausting all applicable administrative remedies, to resolve any dispute arising out of this agreement, where not in conflict with Federal Law.**

- **CANCELLATION: All parties are hereby put on notice that this agreement is subject to cancellation pursuant to A.R.S. § 38-511.**

- **OPEN RECORDS: Pursuant to A.R.S. § 35-214 and § 35-215, and Section 41.279.04 as amended, all books, accounts, reports, files and other records relating to the contract shall be subject at all reasonable times to inspection and audit by the State for five years after contract completion. Such records shall be reproduced as designated by the State of Arizona.**