ARIZONA STATEWIDE CONSERVATION AGREEMENT FOR ROUNDTAIL CHUB (*GILA ROBUSTA*), HEADWATER CHUB (*GILA NIGRA*), FLANNELMOUTH SUCKER (*CATOSTOMUS LATIPINNIS*), LITTLE COLORADO RIVER SUCKER (*CATOSTOMUS* SPP.), BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS*), AND ZUNI BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS YARROWI*)

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GOAL

The goal of this Statewide Conservation Agreement ("Agreement") is to ensure the conservation of roundtail chub, headwater chub, flannelmouth sucker, Little Colorado River sucker, bluehead sucker, and Zuni bluehead sucker populations throughout Arizona.

OBJECTIVES

The Arizona Game and Fish Department (Department), with the help of its cooperators, intends to meet the above Goal through the following objectives.

The objectives of this Agreement with associated strategy is to address and ameliorate the five listing factors in accordance to Section 4(a)(1) of the Endangered Species Act of 1973, as amended:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;
(B) Overutilization for commercial, recreational, scientific, or educational purposes;
(C) Disease or predation;
(D) The inadequacy of existing regulatory mechanisms; or
(E) Other natural or manmade factors affecting its continued existence.

The objectives of this Agreement also correspond to those in the Range-wide Conservation Agreement ("RWCA") for roundtail chub, flannelmouth sucker, and bluehead sucker:

(A) Establish and/or maintain populations sufficient to ensure the conservation of each species within the state.

1. Establish measurable criteria to evaluate the number of populations required to maintain these species throughout their respective ranges.
2. Establish measurable criteria to evaluate the number of individuals required within each population to maintain these species throughout their respective ranges.

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

(C) As feasible, identify, significantly reduce and/or eliminate threats to the conservation of these species 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.

INTRODUCTION

In 2001, the Colorado River Fish and Wildlife Council began discussions of a range-wide conservation effort for three native southwest fish species [roundtail chub (*Gila robusta)*, flannelmouth sucker (*Catostomus latipinnis)*, and bluehead sucker (*Catostomus discobolus)*]. Representatives from the 6 states that comprise the range of these three fishes were brought into discussions and after 3 years, these discussions resulted in the completion of a Range-wide Conservation Agreement ("RWCA"), which the states of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming signed. By signing the RCA, these 6 states committed to developing conservation plans for any of the three species found within their jurisdictional boundaries. As a signatory to the RWCA, the Department has developed this Agreement for the purpose of meeting its commitment to the other 5 states and also for the conservation of these three species and other imperiled species involved, throughout the state. This Agreement does not constitute a predetermination that precludes listing under the Endangered Species Act of 1973, as amended (ESA).

Within Arizona, there is need to address concerns for other species and subspecies concurrently. Headwater chub (*Gila nigra*) is closely related to, occupies similar and overlapping habitats, and is able to hybridize with roundtail chub. The Little Colorado River sucker (*Catostomus* spp.) is morphologically similar to the flannelmouth sucker but due to isolation by a series of falls on the Little Colorado River, is considered a separate taxonomic group from mainstem Colorado River populations of flannelmouth sucker. The Zuni bluehead sucker (*C. d. yarrowi)* is a subspecies of the bluehead sucker. Therefore, for conservation purposes the Department and the signatories also see value in including these species and subspecies in this Agreement.

PURPOSE AND NEED

Status surveys for each of the covered species describe their respective ranges as diminished from historical accounts (Voeltz 2002; Weedman at al. 1996; Bezzerides and Bestgen 2002). This reduction in range is a result of many factors including habitat loss and degradation, competition from and predation by non-native fishes and amphibians, and disease and parasitism.

Roundtail and headwater chub were both petitioned for federal listing under the ESA; the 90-day finding by U.S. Fish and Wildlife Service found listing may be warranted and a status review is currently being conducted. The Arizona Game and Fish Department identifies roundtail chub on the list of Wildlife of Special Concern in Arizona (1996). More recently the Arizona Game and Fish Department identifies both roundtail and headwater chub as Wildlife of Greatest Conservation Need in Arizona within the Comprehensive Wildlife Conservation Strategy (2006). The U.S. Forest Service identifies roundtail chub on its sensitive species list. Roundtail chub are also placed in group 2 of the Navajo Endangered Species List.

Though none of the sucker species are federally listed, the Zuni bluehead sucker is a federal candidate species under the ESA. The Zuni bluehead sucker and Little Colorado River sucker are

both identified on the list of Wildlife of Special Concern. More recently the Arizona Game and Fish Department identifies all four sucker species as Wildlife of Greatest Conservation Need in Arizona within the Comprehensive Wildlife Conservation Strategy (2006). Also all four sucker species are considered sensitive species on the U.S. Forest Service's Sensitive Species list. The Little Colorado River sucker is identified as sensitive on the Bureau of Land Management Sensitive Species list. The Navajo Nation places both flannelmouth sucker and bluehead sucker in group 4 of the Navajo Endangered Species list. The status of these species is summarized in Table 1.

Table 1: Species Status

Subject Species	**ESA**	**Date listed**	**USFS**	**BLM**	**NESL**	**WSCA**	**CWCS**
roundtail chub	SC	1996-02-28	S		2	WSC	WGCN
headwater chub							WGCN
flannelmouth sucker	SC	1996-02-28	S				WGCN
Little Colorado River sucker	SC	1996-02-28	S	S		WSC	WGCN
bluehead sucker			S		4		WGCN
Zuni bluehead sucker	C	2002-06-13	S		4	WSC	WGCN

For information on status definitions refer to Appendix 1.

Occupied habitat of the species covered in this agreement is under the jurisdiction of a variety of federal, state, local government, tribal, and private entities. The primary land owners or managers of habitats occupied by the six species include Bureau of Reclamation, Forest Service, White Mountain Apache Tribe, San Carlos Apache Tribe, Arizona State Land Department, Hualapai Nation, National Park Service, Navajo Nation, Salt River Project, The Nature Conservancy, and Bureau of Land Management, and private individuals. Much of the habitat of the seven covered species occurs in areas managed primarily by the parties to the agreement.

This Agreement has been initiated to conserve the roundtail chub, headwater chub, flannelmouth sucker, Little Colorado River sucker, bluehead sucker, and Zuni bluehead sucker in Arizona by reducing threats to the six species, stabilizing the species populations, and maintain the ecosystems in which they occur. It also establishes a general framework for cooperation and participation among signatories. The signatories will provide support to the program as needed, and will provide input on current and future program needs. The Agreement is made and entered

into to meet the following objective: Implement the Statewide Conservation Strategy for six species (Appendix 3), thus establishing an open process by which to identify and carry out such actions as will conserve the species through voluntary participation of public and private partners.

OTHER SPECIES INVOLVED

The Statewide Conservation Agreement is designed to ensure the conservation of roundtail chub, headwater chub, flannelmouth sucker, Little Colorado River sucker, bluehead sucker, and Zuni bluehead sucker within Arizona. 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 six species of fish, they may also contribute to the conservation of other native species with similar distributions. These conservation actions may reduce threats to several native species that are not currently listed as threatened or endangered under the ESA, including candidate species, and thereby may improve the status of the species such that it may preclude the need for listing in the future. Additionally, any conservation actions implemented through existing recovery programs may benefit both the primary listed species, as well as the species covered in this Statewide Conservation Agreement. A Statewide Coordination Team will coordinate conservation actions under the Agreement with any existing recovery program or conservation agreement.

INVOLVED PARTIES

The Department readily acknowledges the need to bring land managers, regulatory authorities, researchers, and other interested parties into this Agreement. The participation of all resource managers in conservation areas where these subject species are currently or historically found is important for the long-term survival of these species. The following entities have expressed interest in becoming a signatory to this Agreement.

Arizona Department of Water Resources

Arizona Game and Fish Department

Arizona State Land Department

Hualapai Nation

National Park Service

Navajo Nation

Salt River Project

San Carlos Apache Tribe

The Nature Conservancy

USDA Forest Service

USDI Bureau of Land Management

USDI Bureau of Reclamation

USDI Fish and Wildlife Service

USDOD Army Corp of Engineers

White Mountain Apache Tribe

These entities have all expressed interest in conserving native fishes within Arizona either through Management Plans, Allotment Plans, Memorandums of Understanding, Habitat Conservation Plans, or other cooperative documents. Separate memorandums or cooperative agreements will be developed with these parties as necessary to ensure implementation of the Agreement.

Other entities have expressed interest in conserving native fishes within Arizona either through Management Plans, Allotment Plans, Memorandums of Understanding, or other cooperative documents. 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 Department in the form of a document defining its proposed responsibilities pursuant to this Agreement. The signatories will determine the request.

AUTHORITY

- The signatory parties hereto enter into this Agreement under Federal, State, and Tribal laws, as applicable.
- This Agreement does not constitute a predetermination that precludes species listing under the ESA.
- The signatory parties agree that this Agreement is entered into to establish and maintain an adequate and active program for the conservation of the covered species.
- All signatories to this Agreement recognize that they each have specific legal 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 companion Strategy is intended to abrogate any of the parties' respective responsibilities or authority.
- This Agreement is subject to and is intended to be consistent with all applicable Federal

and State laws and interstate compacts (Appendix 2).

- This Agreement in no way restricts the parties involved from participating in similar activities with other public or private agencies, organizations or individuals.

The authorities for the involved parties to enter into this Agreement derives from the following legislation and/or guidance:

ARIZONA STATE LANDS DEPARTMENT
Arizona Revised Statutes 37-102 and 37-132.A-3

ARIZONA GAME AND FISH DEPARTMENT
Arizona Revised Statute 17-231.B-7
Endangered Species Act of 1973, as amended

HUALAPAI TRIBE
Article IV, Section f of the Constitution of the Hualapai Tribe

NATIONAL PARK SERVICE
43 CFR 24.6, USDI fish and wildlife policy on state and federal relationships

NAVAJO NATION
Title 23 of the Tribal Code of the Navajo Nation

SAN CARLOS APACHE TRIBE
Article I, Section 1 of the Constitution of the San Carlos Apache Tribe
Article V, Section 1(b) and Section 1(f) of the Constitution of the San Carlos Apache Tribe

THE NATURE CONSERVANCY
Article X of Organization, Bylaws, and Corporate Authority Resolution

US ARMY CORP OF ENGINEERS
Endangered Species Act of 1973, as amended
Sikes Act of 1960, as amended

USDI BUREAU OF LAND MANAGEMENT
43 U.S.C. 1701 et seq., Federal Land Policy and Management Act of 1976

USDI BUREAU OF RECLAMATION
43 CFR 24.6, USDI Fish and Wildlife Policy on State and Federal Relationships

USDI FISH AND WILDLIFE SERVICE, Region 2:
Endangered Species Act of 1973, as amended
Fish and Wildlife Act of 1956, as amended

Fish and Wildlife Coordination Act, as amended

USDA FOREST SERVICE, Southwestern Region:
Endangered Species Act of 1973, as amended
National Forest Management Act of 1976
Sikes Act of 1960

WHITE MOUNTAIN APACHE TRIBE
Article IV, Section 1 of the Tribal Constitution

In addition to the above-listed legislative authorities, the Fish and Wildlife Service, Bureau of Land Management, Forest Service, National Park Service, National Marine Fisheries Service, International Association of Fish and Wildlife Agencies, Arizona Chapter of the Nature Conservancy, Hualapai Tribe, Navajo Nation, San Carlos Apache Tribe have entered into past interagency agreements, such as Memorandums of Understandings and Cooperative Agreements, providing a framework for cooperation and participation among involved parties in the effort to conserve species tending towards listing.

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: If required by law, the Parties agree to engage in alternative dispute resolution procedures authorized by their statutes, regulations and court orders, including but not limited to 5 U.S.C. § 575 and A.R.S. § 12-1518.
- 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.

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

- The Department of Agriculture and their respective agencies and office will handle their own activities and utilize their own resources, including the expenditure of their own funds, in pursuing these objectives. Each party will carry out its separate activities in a coordinated and mutually beneficial manner.

- Nothing in this Agreement shall obligate either the Department of Agriculture to obligate or transfer any funds. Specific work projects or activities that involve the transfer of

funds, services, or property among the various agencies and offices of the Department of Agriculture will require execution of separate agreements and be contingent upon the availability of appropriated funds. Such activities must be independently authorized by appropriate statutory authority. This Agreement does not provide such authority. Negotiation, execution, and administration of each such agreement must comply with all applicable statutes and regulations.

- This Agreement takes effect for the Department of Agriculture upon the signature of the Department of Agriculture and shall remain in effect for a period of no more than five years from the date of execution. This Agreement may be extended or amended upon written request of either the Department of Agriculture and the subsequent written concurrence of the other(s). Either the Department of Agriculture may terminate this Agreement with a 60-day written notice to the other(s).

- This Agreement is not intended to, and does not create, any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a party against the United States, its agencies, its officers, or any person.

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. They also acknowledge and support the principle that documented progress toward stable and increased distribution, abundance, and recruitment of populations of these 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.

In evaluating whether there is sufficient certainty of implementation, we will use the following PECE criteria:

1. The conservation effort, the party(ies) to the agreement or plan, and the staffing, funding level, funding source, and other resources necessary to implement the effort are identified.

2. The legal authority of the party(ies) to implement the effort and the commitment to proceed with it are described.

3. Legal procedural requirements (e.g. environmental review) necessary to implement the effort are described, and information is provided indicating that fulfillment of these requirements does not preclude commitment to the effort.

4. Authorizations necessary to implement the effort are identified (e.g. permits, landowner permission), and a high level of certainty is provided that the authorizations will be obtained.

5. The type and level of voluntary participation necessary for implementation are identified (e.g. the number of participants agreeing to alter management practices and the acres involved), and a high level of certainty is provided that this level of voluntary participation will be obtained.

6. Regulatory mechanisms necessary to implement the effort are in place (e.g. laws, regulations).

7. A high level of certainty is provided that the necessary funding to implement the conservation effort will be obtained.

8. An implementation schedule, including incremental completion dates, is provided.

9. The conservation agreement or plan is signed/approved by all responsible parties.

In evaluating whether there is sufficient certainty of effectiveness, we will use the following PECE criteria:

1. The nature and extent of the threats being addressed are described, and how the conservation effort reduces the threats.

2. Explicit incremental objectives for the conservation effort and dates for achieving them are stated.

3. Steps necessary to implement the conservation effort are identified in detail.

4. Quantifiable, scientifically valid parameters that will demonstrate achievement of objectives, and standards by which progress will be measured, are identified.

5. Provisions for monitoring and reporting progress on implementation and effectiveness are provided.

6. Principles of adaptive management are incorporated.

CONSERVATION ACTIONS

Coordinating conservation activities

- Administration of this Agreement will be through a State Coordination Team composed of one representative from each signatory, designated by that participating group. The

designated voting ability will be limited to the one representative, who is authorized to vote and otherwise act in the participating groups behalf on matters before the State Coordination Team. Each member may appoint alternates to act as its voting representative in the absence of its regular representative. The authority for this Agreement will not be solely limited to the implementation of this agreement, since management and conservation actions will occur at this level.

- The State Coordination Team will work to finalize, coordinate, and implement the Statewide Conservation Strategy ("Strategy"), the current draft of which is Appendix 3 to this Agreement.
- The State Coordination Team will meet twice per year to propose and approve annual work plans, provide progress reports and project successes, develop annual priorities, coordinate tasks and resources, and recognize accomplishments.
- Lead agencies for current projects will remain in the lead position; this Agreement does not give the signatories the lead position for any project that is not already led by that signatory.
- Each meeting of the State Coordination Team must be open to the public, and any person attending a State Coordination Team meeting may file a written statement, or provide reasonable and timely oral input regarding topics on the meeting agenda.

Implementing conservation schedule

- The RWCA is scheduled to last a minimum of 10 years, while this Agreement is scheduled for to last a minimum of five years. Following a five-year evaluation, this document is planned for renewal to meet RWCA requirements, and may be renewed indefinitely in five-year increments.
- In order to meet the objectives of this Agreement, seven conservation actions will be implemented. These conservation actions are 1) administer the State Conservation Agreement and Strategy; 2) identify status of species, habitat, and management, 3) secure, enhance, and create habitat; 4) establish and enhance populations; 5) monitor extant populations and occupied or suitable habitat; 6) conduct research, and 7) apply adaptive management and are defined and detailed in the Strategy.
- The Strategy is a flexible document and will be revised through adaptive management, incorporating new information as it becomes available.

Conservation progress assessment

- The State Coordination Team will conduct an annual statewide assessment of progress towards implementing actions identified in the Strategy. Copies of this annual assessment will be provided to the signatories of the RWCA, signatories of this Agreement, and to interested parties upon request.
- At the end of this agreement the Department will begin a status assessment for each species.

Conservation Strategy

- The draft statewide conservation strategy is contained within Appendix 3. The Strategy

identifies the known threats to the species, the conservation actions to reduce those threats, metrics to demonstrate progress of achieving threat reduction, provisions for monitoring and reporting progress, and adaptive management.

- The Strategy is intended to be a "living" document that is based on the best available science known today, identifies critical research and data needs, and incorporates new information into conservation actions through adaptive management.
- The Strategy will be updated annually based on review by the State Coordination Team in an adaptive management framework.

Funding conservation actions and the Strategy

- Appendix 4 identifies expenditures currently anticipated, to complete conservation actions in the Strategy; however, the actual completion of actions is 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 accomplish the actions in the Strategy, although nothing in this Agreement obligates any agency to any funding responsibilities. To date, various federal, state, tribal and non-governmental organizations have contributed to conservation efforts for the subject species, including development of the RWCA and this Agreement.

- Federal funding sources may include, but are not limited to, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, U.S. Bureau of Land Management, Land and Water Conservation funds, and the U.S. Natural Resources 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.

- Tribal nations may provide sources of funding. Nothing in this document commits any of these sovereign nations to funding responsibilities.

- Water districts, cities, towns, counties, local irrigation companies, and other supporting entities may provide sources of funding. Nothing in this document commits any of these agencies to funding responsibilities.

- In-kind contributions in the form of personnel, field equipment, supplies, etc., will be provided by participating agencies. In addition, each signatory participating group may engage in specific tasks, responsibilities, and proposed actions/commitments related to their in-kind contributions (Appendix 4).

- It is understood that all funds expended in accordance with this Agreement are subject to approval by the appropriate local, state or Federal authorities. This instrument is not 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 will 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.

DURATION OF AGREEMENT

The term of this Agreement is a five-year period and will begin once the initial Department signatory has signed. At the end of the five-year period, conservation efforts will be evaluated and, if sufficient progress has been made towards the conservation and management of the subject species, the agreement will be renewed to continue for a second five-year period. The Agreement may be renewed indefinitely in five-year increments. Any involved party may withdraw from this agreement on 60 days written notice to the other signatories.

CONSERVATION COMMITMENT

By signing this Agreement the signatories agree to delegate a representative for participation in the State Coordination Team. Signatories agree to meet twice per year to propose and approve annual work plans, provide progress reports and project successes, develop annual priorities, coordinate tasks and resources, and recognize accomplishments. Signatories agree to work on meeting the objectives of this Agreement by assisting on the implementation of the 7 conservation actions listed in the Strategy. These conservation actions are 1) administer the State Conservation Agreement and Strategy; 2) identify status of species, habitat, and management, 3) secure, enhance, and create habitat; 4) establish and enhance populations; 5) monitor extant populations and occupied or suitable habitat; 6) conduct research, and 7) apply adaptive management. The Signatories agree to contribute in-kind contributions in the form of personnel, field equipment, and supplies provided by participating agencies. In addition, each signatory participating group agrees to engage in specific tasks, responsibilities, and proposed actions/commitments related to their in-kind contributions.

APPENDIX 1:

STATUS DEFINITIONS
ARIZONA GAME AND FISH DEPARTMENT (AGFD)
HERITAGE DATA MANAGEMENT SYSTEM (HDMS)

FEDERAL US STATUS

ESA **Endangered Species Act** (1973 as amended)
U.S. Department of Interior, Fish and Wildlife Service (USFWS) (http://arizonaes.fws.gov)

Listed

LE Listed Endangered: imminent jeopardy of extinction.
LT Listed Threatened: imminent jeopardy of becoming Endangered.
PS Partial Status: listed Endangered or Threatened, but not in entire range.
XN Experimental Nonessential population.

Proposed for Listing

PE Proposed Endangered.
PT Proposed Threatened.

Candidate (Notice of Review: 1999)

C Candidate. Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed rules have not yet been issued because such actions are precluded at present by other listing activity.
SC Species of Concern. The terms "Species of Concern" or "Species at Risk" should be considered as terms-of-art that describe the entire realm of taxa whose conservation status may be of concern to the U.S. Fish and Wildlife Service, but neither term has official status (currently all former C2 species).

Critical Habitat (check with state or regional USFWS office for location details)

Y Yes: Critical Habitat has been designated.
P Proposed: Critical Habitat has been proposed.
N No Status: certain populations of this taxon do not have designated status.

USFS **U.S. Forest Service** (1999 Animals, 1999 Plants: corrected 2000)
U.S. Department of Agriculture, Forest Service, Region 3 (http://www.fs.fed.us/r3/)

S Sensitive: those taxa occurring on National Forests in Arizona which are considered sensitive by the Regional Forester.

BLM **U.S. Bureau of Land Management** (2000 Animals, 2000 Plants)
U.S. Department of Interior, Bureau of Land Management, Arizona State Office (http://azwww.az.blm.gov)

S Sensitive: those taxa occurring on BLM Field Office Lands in Arizona which are considered sensitive by the Arizona State Office.

TRIBAL STATUS

NESL **Navajo Endangered Species List** (2000)
Navajo Nation, Navajo Fish and Wildlife Department
(http://www.heritage.tnc.org/nhp/us/navajo/esl.html)

The Navajo Endangered Species List contains taxa with status from the entire Navajo Nation which includes parts of Arizona, Utah, and New Mexico. In this notebook we provide NESL status for only those taxa whose distribution includes part or all of the Arizona portion of the Navajo Nation.

Groups

1 Those species or subspecies that no longer occur on the Navajo Nation.

2 Any species or subspecies which is in danger of being eliminated from all or a significant portion of its range on the Navajo Nation.

3 Any species or subspecies which is likely to become an endangered species, within the foreseeable future, throughout all or a significant portion of its range on the Navajo Nation.

4 Any species or subspecies for which the Navajo Fish and Wildlife Department (NF&WD) does not currently have sufficient information to support their being listed in Group 2 or Group 3 but has reason to consider them. The NF&WD will actively seek information on these species to determine if they warrant inclusion in a different group or removal from the list.

STATE STATUS

Wildlife - WSCA **Wildlife of Special Concern in Arizona** (1996)
Arizona Game and Fish Department (http://www.azgfd.com)

WSC Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA,1996).

Wildlife – CWCS Comprehensive Wildlife Conservation Strategy (2006)
Arizona Game and Fish Department (http://www.azgfd.com)

WGCN Wildlife of Greatest Conservation Need in Arizona.

APPENDIX 2:

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: If required by law, the Parties agree to engage in alternative dispute resolution procedures authorized by their statutes, regulations and court orders, including but not limited to 5 U.S.C. § 575 and A.R.S. § 12-1518.
- 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.

APPENDIX 3:

ARIZONA STATEWIDE CONSERVATION STRATEGY FOR ROUNDTAIL CHUB (*GILA ROBUSTA*), HEADWATER CHUB (*GILA NIGRA*), FLANNELMOUTH SUCKER (*CATOSTOMUS LATIPINNIS*), LITTLE COLORADO SUCKER (*CATOSTOMUS* SPP.), BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS*), AND THE ZUNI BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS YARROWI*)

Draft

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GOAL

The goal of this Conservation Strategy ("Strategy") is to bring together land and water managers, fish and wildlife agencies, and other interested parties to develop and implement management actions that, taken together, will reduce or eliminate threats to ensure the long-term conservation of roundtail and headwater chub, and flannelmouth, Little Colorado River, bluehead, and Zuni bluehead sucker within the state of Arizona. The Strategy implements the provisions of the Statewide Conservation Agreement ("Agreement") for these species.

OBJECTIVES

The objectives of this Strategy is to address and ameliorate the five listing factors in accordance to Section 4(a)(1) of the Endangered Species Act of 1973, as amended (ESA):

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;

(C) Disease or predation;

(D) The inadequacy of existing regulatory mechanisms; or

(E) Other natural or manmade factors affecting its continued existence.

The objectives of this Strategy also correspond to those in the Range-wide Conservation Agreement ("RWCA"):

(A) Establish and/or maintain populations sufficient to conserve each subject species within their ranges.

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

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

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

(C) Identify, significantly reduce and/or eliminate threats to the subject species 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.

BACKGROUND

Headwater chub *(Gila nigra)* and roundtail chub (*Gila robusta)* are members of the family Cyprinidae. Within Cyprinidae, the genus *Gila* is widespread throughout western North America (Hubbs 1940, 1941; Miller 1946). Seven *Gila* species, including these two, are endemic to the Colorado River basin; all of them have experienced recent range reductions. The roundtail chub is identified as a species of special concern by the Arizona Game and Fish Department (AGFD) in prep and endangered by the New Mexico Fish and Game Department (NMFGD 2003). The headwater chub may at some point be assigned a state status designation; however, this species has only recently been described (Minckley and DeMarais 2000). At present, neither of these species is federally listed; however, both have been petitioned for listing as endangered under the ESA; the USFWS has issued a 90-day finding that these listings may be warranted.

Roundtail chub and headwater chub, though not well documented historically, were thought to be widespread and abundant throughout their ranges in Arizona (Minckley 1973; Holden and Stalnaker 1975; Propst 1999). Roundtail chub is reportedly found in almost all high order tributaries and streams in Arizona except in the Tonto Basin, where only headwater chub have been reported (Minckley and DeMarais 2000). The roundtail chub is considered extirpated from much of its original mainstem habitat (Colorado, Little Colorado, Bill Williams, San Francisco, lower Gila, and the San Pedro rivers) (Voeltz 2002). Headwater chub is still found in many of its historical localities; however, threats remain for all populations (Voeltz 2002).

All of the sucker taxonomic groups covered in the SCA and this Strategy are members of the family Catostomidae. Catostomids are northern hemisphere freshwater species, all but two of which are restricted to North America (Minckley 1973). Of the Catostomids covered under this Strategy, only the Zuni bluehead sucker (*Catostomus discobolus yarrowi)* and the Little Colorado River sucker (*Catostomus* spp.) are covered under regulatory guidance in the state of Arizona. The Zuni Bluehead sucker is a candidate under the ESA and both are identified as candidates in the Wildlife of Special Concern in Arizona (AGFD) in prep.

Both the flannelmouth sucker (*Catostomus latipinnis)* and bluehead sucker (*Catostomus discobolus)* were once widespread and common throughout much of the Colorado River Basin. The Little Colorado River sucker and the Zuni bluehead sucker were also more common and abundant throughout their limited range (portions of the Little Colorado River) historically. All of these species have experienced range reductions over the last decades. The Zuni bluehead sucker and flannelmouth sucker have been the most severely reduced.

SYSTEMATICS

Baird and Girard (1853a) originally described *G. robusta* from specimens collected in 1851 from the Zuni River. Cope and Yarrow (1875) originally described *Gila nigra* from specimens collected in 1874 from Ash Creek and the San Carlos River. Although full species status has not

been questioned for *G. robusta* (Miller 1946), several generic and specific names have been applied to the species over the years (Rinne 1976; Sublette et al. 1990; Minckley and DeMarais 2000; Voeltz 2002).

Little is known concerning the systematics of flannelmouth sucker. Douglas et al. (2003) studied the effects of a warm, dry period that swept western North America 7500 years ago and its relation to flannelmouth sucker genetics. They found that flannelmouth sucker genetic variation was quite low throughout the Colorado River basin despite the species' ancient origins. They postulated this low level of variation might be a result of "a rapid expansion following a recent period of low effective population size at the end of the Pleistocene." They concluded that the flannelmouth sucker could be treated as one Evolutionary Significant Unit. They suggest that further division into smaller management units (Moritz 1994) will require the employment of "faster-evolving nuclear markers" (as per Brunner et al. 1998; Douglas et al. 1999).

Douglas and Douglas (2002) placed the undescribed sucker *Catostomus* spp. of the upper Little Colorado River (LCR) basin (Minckley 1973) within *C. latipinnis*. Though it is contained within the greater taxonomic classification, it will be considered genetically distinct in this Agreement and Strategy as it is physically separated from flannelmouth sucker populations in the Grand Canyon by a series of falls in the lower reaches of the LCR (Minckley 1973).

The type locality for the Zuni bluehead sucker is the Zuni River in western New Mexico (Cope 1874). The subspecies is thought to be a result of hybridization between the bluehead sucker and the Rio Grande sucker (*Catostomus plebeius)* (Smith 1966; Smith et al. 1983). This could have occurred as a result of the capturing of a headwater tributary to the Rio Grande by the Zuni River during the late Pleistocene (Propst 1999). Smith (1966) and Smith et al. (1983) pinpointed the specific location as the Rio Nutria in New Mexico.

LIFE HISTORY

Description of the Species

The roundtail chub generally reach total lengths of 250-350 mm (Sigler and Miller 1963; Minckley 1973; Sublette et al. 1990), but can occasionally reach 500-600 mm (Sublette et al. 1990). In comparison, headwater chub are generally smaller. Bestgen (1985) suggested that the observed differences in chub length are a direct result of local habitat conditions.

The chub species have been characterized as having a thick or chunky body shape with a slender caudal peduncle (Minckley 1973; Page and Burr 1991). Roundtail chub are often described as thick, but not chubby (as compared with the close relative the Gila chub *G. intermedia*, which is not addressed in this document.

The sucker family displays a variety of body forms, the one distinctive characteristic tends to be the inferior mouth position with expanded, fleshy lips.

In the lower Colorado River basin, the flannelmouth sucker tends to be "…light tan on the back and silvery white on the sides and belly" (Holden 1973). Flannelmouth suckers also tend to have larger fins, a more elongate body with a narrower caudal peduncle, small and numerous scales along the lateral line, and larger, fleshier lobes of the lower lip than other Colorado River Basin suckers (Sigler and Miller 1963).

Little Colorado River sucker is quite similar to the flannelmouth sucker, though the caudal peduncle is thicker and deeper, the lower lip is smaller, and the distal margin of the dorsal fin is slightly falcate to square (Page and Burr 1991).

Bluehead sucker is normally but not always distinguished from other Colorado River basin suckers by its bluish head, strongly developed jaws with cartilaginous scraping edges, relatively slender caudal peduncle, and large body size, though body form does vary with habitat conditions and is smaller than a flannelmouth sucker (Smith 1966; Minckley 1973; Holden and Stalnaker 1975; Sigler and Sigler 1987). In clear water, the bluehead sucker tends to be dark olive to black on the back and sides and yellowish on the belly (Bezzerides and Bestgen 2002). In turbid water, the color tends to fade to a silvery tan or lighter green on the back and sides and off-white on the belly (Bezzerides and Bestgen 2002). As a sub species to the bluehead sucker, the Zuni bluehead sucker is similar in appearance, but the species' ranges do not overlap.

Origins and Distribution

The origin of the roundtail chub and headwater chub is speculative and is often thought to be intertwined with the origin of the Gila chub. Rinne (1976) and DeMarais (1986, 1995) proposed various hypotheses. Rinne (1976) hypothesized a series of invasions of the lower Colorado River gave rise to the current distribution, and an early form of roundtail chub was present in the lower basin that had already begun to differentiate. An early form or ancestor of Gila chub invaded from the south and settled into streams south and west of the Mogollon. The connection of the Gila basin to the lower Colorado allowed for another invasion of roundtail chub into areas occupied by both of the other species. Finally, the interaction of the two forms of roundtail chub eventually gave rise to the current distribution.

DeMarais' (1986) hypothesized headwater chub resulted from hybridization between Gila chub and roundtail chub during the Miocene or early Pliocene. DeMarais (1986) also suggests that headwater chub likely arose multiple times over the course of species evolution. Hybrids occurring in mainstem habitats were out-competed by roundtail chub and left only in headwater habitats. Minckley and DeMarais (2000) support this hybridization hypothesis and the recognition of headwater chub as a distinct species, arguing that the purpose of taxonomy is to focus on uniqueness where it exists.

The restriction of Gila chub and headwater chub to isolated headwater habitats and smaller tributaries makes these species more susceptible to the effects of dwindling population sizes on genetic structure of the population and more vulnerable to natural stochastic events. The

presence of roundtail chub in much of the mainstem habitat in Arizona over the last century has made it more susceptible to the impacts of nonnative fishes. The species experienced a reduction in the number of populations throughout Arizona where nonnative introductions and riparian and aquatic habitat destruction have occurred (DeMarais 1986). Current conventional wisdom for the genus *Gila* designates geography as the species identifier in many Arizona streams (Minckley and DeMarais 2000).

The family Catostomidae, genus *Catostomus,* house all four suckers species pertaining to this document. The sucker family, Catostomidae, is thought to have arisen from the minnows through a doubling of the number of chromosomes (Minkley 1973, Uyeno and Smith 1972). The genus *Catostomus* comes from two Greek words, "kata", meaning downward, and "stoma", meaning mouth, therefore *Catostomus* is a reference to the downward pointing mouth of a sucker. This genus is thought to have arisen in North America and Siberia. The subgenera of the genus *Catostomus*, which this document addresses, are *Catostomus* and *Pantosteus*. Subgenera *Catostomus*, which includes both flannelmouth sucker and the Little Colorado River sucker, has a historic widespread distribution based upon their adaptation both ecologically and morphologically (Smith 1966, Koehn 1969) and is characteristic of warmer temperature waters and lower elevations than *Pantosteus* (Koehn 1969). The formation of mountain ranges in western North America gave rise to the subgenus *Pantosteus*, or mountain sucker. The subgenus *Pantosteus* includes both the bluehead sucker and Zuni bluehead sucker. Allopatric speciation occurred when the dividing of different mountain ranges developed drainage basins, in which acted as barriers, separating the subgenus *Pantosteus* (Smith 1966). According to Koehn (1969), members of the subgenus *Catostomus* generally occur sympatrically with the species of the subgenus *Pantosteus,* which is the case for many populations of bluehead sucker with both the Little Colorado sucker and the flannelmouth sucker.

Table 1 contains a complete list of streams in Arizona historically and currently occupied by the subject species.

Habitat

Roundtail chub and headwater chub share similar preferences for habitat types, though roundtail chub tend to inhabit higher order streams more often than headwater chub. Adults of these species prefer deep pools and often use the darkness of pools as cover (Rinne and Minckley 1991). Other preferred forms of cover, especially in streams lacking deep pools, are instream boulders, undercut banks, overhanging vegetation, and root wads (Rinne and Minckley 1991). According to Minckley and DeMarais (2000), roundtail chub are less prone to using instream cover than other species of *Gila*. Adults feed in swift water and move back to pools or other forms of cover when disturbed (Minckley 1973; Vanick and Kramer 1969). Juveniles occupy backwater habitats and tend to reside primarily in shallow, swifter habitats, as they grow older (Minckley 1973; 1991; Propst 1999; Brouder et al. 2000; Bryan et al. 2000).

Though also found in small streams, flannelmouth sucker tend to inhabit pools and deeper runs in higher order streams in the lower Colorado River Basin (Sigler and Miller 1963; Minckley and

Holden 1980; Baxter and Stone 1995). Though notable declines are apparent in many impounded areas (Jonez and Summer 1954; McCall 1980; Schmidt et al. 1977, 1980; Wiley 1978; Minckley 1973; McAda 1977), Mueller and Wydoski (2004) describe a successful population stocked below Davis Dam in the 1970's. The flannelmouth sucker is found in a variety of habitat types throughout their ranges (Bezzerides and Bestgen 2002; AGFD 2002). Gorman et al. (1994) observed flannelmouth sucker in the lower Little Colorado River in moderate to deep areas with cover and substantial vertical structure during the day and a wide array of habitats at night. The ability to move long distances has been noted as an important life cycle attribute for the flannelmouth sucker (Chart and Bergersen 1992; Holden 1973; Weiss 1993; McKinney et al. 1999; Cavalli 1999; McKinney et al. 1999). The construction of dams and subsequent loss of migration ability have been implicated as potential reasons for the species' dramatic decline in distribution in the lower Colorado River basin (Bezzerides and Bestgen 2002). For example, Chart and Bergersen (1992) noted that barriers to migration may be one of the causes that tend to aggregate flannelmouth suckers below dams (other potential factors may include higher autotrophic production in tailwater habitat).

Little Colorado River sucker has been documented in habitats such as creeks, small to medium rivers, and impoundments. It is predominantly found in pools with abundant cover, though it is also found in riffles in juvenile stages (AGFD 2002). Bezzerides and Bestgen (2002) also found the Little Colorado River sucker in a variety of habitat types throughout their ranges.

Bluehead sucker is found in a variety of mainstem, tributary, and headwater habitats throughout the Colorado River basin. Adults generally occupy pool habitats or areas with a great deal of cover (Sigler and Miller 1963; Gorman et al. 1994; Beyers et al. 2001). A number of researchers have found adult bluehead suckers predominantly in areas with moderate or faster currents and rocky substrates (Sigler and Miller 1963; Banks 1964; Vanicek 1967; Holden and Stalnaker 1975; Carlson et al. 1979; McAda et al. 1980; Miller et al. 1982; Tyus et al. 1982; Valdez et al. 1982; Sublette et al. 1990). The species is found in a variety of stream temperatures, though prefer cooler temperatures. Larval and juvenile life stages tend to use shallow, low velocity shorelines and backwater areas (Sigler and Miller 1963; Haines and Tyus 1990; Hoffnagle et al. 1994; Robinson et al. 1998).

Zuni bluehead sucker is found in small streams, predominantly in areas of slower stream velocities and shallower depths than *C. discobolus* (AGFD 2002). Propst et al. (2001) observed the species in low-velocity, moderately deep pools and pool-runs with seasonally dense perilithic and periphytic algae.

Diet

Numerous researchers have documented the omnivorous diet of both the roundtail chub and headwater chub (Propst 1999; Griffith and Tiersch 1989; Schreiber and Minckley 1981).

Propst (1999) noted that roundtail chub tend to eat aquatic and terrestrial insects, aquatic vegetation, and detritus. Schrieber and Minckley (1981) documented evidence of consumption of

both aquatic and terrestrial invertebrates, fish, lizards, filamentous algae, and detritus. As roundtail chub grow larger, so does their prey base. Vanicek and Kramer (1969) found that chubs 100 mm total length (TL) or smaller ate predominantly insects, whereas fish remains were observed in stomach contents of chub larger than 100 mm TL. Bestgen (1985) observed crayfish parts in chubs greater than 170 mm from the Gila River mainstem.

Neve (1976) noted seasonal variation in prey items among headwater chub in Fossil Creek. During spring, predominant food items included aquatic invertebrates, macrophytes, and algae. During summer months, chub incorporated diatoms and terrestrial insects into their diet and consumed primarily algae and diatoms during the fall and winter months. Fish remains were not found in headwater chubs in this study; however, remains of iguanid lizards were found in two individuals.

All of the sucker species are omnivorous, feeding on a variety of algae, debris, detrital material, and aquatic macroinvertebrates (AGFD 2001, 2002, 2003). Brienholt and Heckmann (1980) described the flannelmouth sucker as an herbivore, feeding mainly on algae, diatoms, parts of higher plants, and seeds and the bluehead sucker as a bottom feeder that scrapes algae and other organisms off of rocks. Minckley (1973) observed feeding behavior in the Little Colorado River sucker in the late evening and early morning hours. He also observed large adults moving into shallow riffles and covering large areas over mostly gravel and sand substrate with their feeding activities.

Reproduction

In the lower Little Colorado River, flannelmouth suckers and bluehead suckers are capable of spawning year round, though focused spawning occurs mainly from March to June (Minckley 1973, 1991; Kaeding and Zimmerman 1983; Tyus and Karp 1990; Robinson et al. 1998).

Weiss et al. (1998) observed flannelmouth sucker spawning activity in March and April in the Paria River and in March in Bright Angel Creek. Weiss et al. (1998) observed these fish expelling gametes over loosely compacted, small to medium sized substrate. Fertilized eggs often settled into interstitial spaces. These events were described as “promiscuous” due to observations of individual females spawning with one, sometimes two males for a given event (Weiss et al. 1998). Females often changed partners between spawning events and multiple females occasionally deposited eggs over the same spawning location at a spawning ratio of 3:1 (male:female) in the Paria river. McAda and Wydoski (1985) observed flannelmouth sucker fecundity varied with different body sizes (4,000 ova in a 450 mm fish to > 40,000 ova in 500 mm fish) in the upper Colorado River basin. Mueller and Wydoski (2004) suggested that flannelmouth sucker females can produce as many as 15,000 eggs per year and can spawn for up to 20 years, which allows them to have low recruitment years without experiencing drastic population declines.

Substrates selected in the Paria River and Bright Angel Creek for spawning ranged from 16 to 32 mm; spawning occurred at depths of 10 to 25 cm in the Paria and 19 to 41 cm in Bright Angel

Creek; water temperatures ranged from 9° to 18° C and were more variable in the Paria (Weiss et al. 1998). McKinney's et al. (1999) and Chart and Bergersen (1992) reported spawning flannelmouth suckers in the cold-water temperature in Lee's Ferry reach of the Colorado River, but also in the warmer portions of the Paria River. The lower 14.2 km of the LCR is also a known spawning location for both flannelmouth sucker and bluehead suckers (Robinson et al. 1998; Carothers and Minckley 1981; Kaeding and Zimmerman 1983). Spawning in this stretch of both suckers tends to occur in relatively swift current with gravel substrates (Minckley 1973; Maddux and Kepner 1988; Weiss 1993).

The flannelmouth sucker spawning behavior is quite similar to that of the bluehead sucker (Maddux and Kepner 1988; Otis 1994). Maddux and Kepner (1988) observed one to four males spawning with one female, though many more males attempted to initiate spawning with the female in Kanab Creek. McAda and Wydoski (1983) estimated fecundities of bluehead sucker between 5000 and 8000 eggs per female of length 319 mm, depending on stream location in the upper basin. Ova of bluehead sucker observed in Kanab Creek were 2.4 to 3.1 mm in diameter and were slightly adhesive (Maddux and Kepner 1988). McAda and Wydoski (1983) observed bluehead sucker ova in the upper Colorado River basin and found they ranged from 1.22 - 2.26 mm diameter. Maddux and Kepner (1988) observations focused on a 6.6 m^2 gravel bed spawning location, and reported females preferred loosely consolidated gravel averaging 6.6 mm + or – 6.2 mm in diameter. During spawning, unlike the flannelmouth sucker, a depression was created by a, "rapid fanning or shuddering motion of the body and pelvic, anal, and caudal fins of spawning fish." They observed 63 spawning events over a 12-hour period.

Little Colorado River sucker spawns in early to mid-spring (Minckley 1973). Specific spawning behaviors of the Little Colorado River sucker have not been reported.

Roundtail chub follow a seasonal spawning cycle, with spawning beginning in late spring and extending to early summer (Bestgen 1985b; Propst 1999). In some instances in the upper basin, roundtail chub are found in breeding condition as late as July in years with extended high flows (Karp and Tyus 1990). In the upper Colorado River Basin, roundtail chub were observed spawning at temperatures within a range of 14°C to 24°C (Kaeding et al. 1990). Other researchers in the upper Verde River and the Colorado River have observed spawning behavior in roundtail chub when water temperatures reached approximately 18°C to 22°C (Vanicek and Kramer 1969; Brouder et al. 2000). Spawning has also been associated with a descending hydrograph, when lower flows and warmer water temperatures become more prevalent (Bestgen 1985b; Vanicek and Kramer 1969; Kaeding et al. 1990).

Roundtail chub in reproductive condition tend to display breeding coloration and tubercules. Color and tubercules are more prevalent and more intensely displayed in males that generally have bright red to orange around the cheeks and ventro-lateral surfaces of the head, abdomen, and paired anal fins (Minckley 1973; Propst 1999). Tubercules in males tend to cover most of the anterior body and fins and occasionally extend to the caudal peduncle and anal fin. Female coloration tends to be restricted to the bases of the paired fins (Bestgen 1985b). Tubercules

develop to a lesser degree around the head, pectoral fins, and between the dorsal fin and the head (Bestgen 1985b; Propst 1999).

Fecundity tends to be size dependent in roundtail chub (Propst 1999). Anecdotal evidence for this is given from Fossil Creek, where Neve (1976) observed females ranging from 100 to 260 mm in size that contained between 1,000 and 4,300 eggs. Brouder et al. (2000) observed females in the Verde River ranging from 270 to 427 mm that contained between 7,267 and 26,903 eggs. Brouder et al. (2000) also reported that the average female from this site measured 328 mm in length and contained 13,948 eggs.

Headwater chub first reproduce at approximately 2 to 5 years of age. As in roundtail chub, both males and females exhibit spawning coloration and tubercules, though the male's display is usually more extensive than females. Spawning generally occurs at similar water temperatures as roundtail chub and has been observed by Bestgen (1985b) at the East Fork of the Gila River when afternoon water temperatures reached 22°C. Minckley (1981) described spawning by headwater and roundtail chub as similar to other cyprinids in that several males escort each spawning female and release sperm as the female releases ova.

Age and Growth

Roundtail chub hatch approximately 5 to 7 days after fertilization (Muth et al. 1985). Propst (1999) observed that roundtails grew to lengths of 50 mm in the first year. For individuals in this study, growth began to slow at age 4, though by age 7 some individuals had attained lengths of 300 mm. Growth, fecundity, mortality, and a host of life history characteristics vary by locality; however, the period of greatest growth was consistently the first summer after hatching (Bestgen 1985). Brouder (2001) found that late winter and early spring runoff was strongly correlated with survival of age-0 fish through their first year in the Verde River; this observation supports Bestgen's (1985) observation that late runoff delays spawning by adults and growth of progeny.

Robinson et al. (1998) suggested larvae of bluehead sucker and flannelmouth sucker actively seek nearshore habitats. According to Childs et al. (1998), both bluehead and flannelmouth sucker moved farther from shore into deeper habitats as they aged. Older flannelmouth larvae seemed to move into habitats with more woody cover in contrast to bluehead larvae that seemed to move into habitats with less woody cover.

Robinson and Childs (2001) reported flannelmouth sucker have the fastest growth rates of native fish studied in the lower LCR. Growth rates for both flannelmouth sucker and bluehead sucker were positively correlated with stream temperatures. McKinney et al. (1999) reported an average growth of 45.9 mm (over 7 years) and an annual average of 5.5 mm in flannelmouth sucker in the Lee's Ferry reach of the mainstem Colorado River. McAda and Wydoski (1985) observed sexually mature flannelmouth suckers at 405 mm (females) and 391 mm (males) in large streams in the upper Colorado River basin.

HISTORIC DISTRIBUTION WITHIN ARIZONA

Native fish surveys prior to nonnative fish stockings were by no means complete. However, museum records, agency databases, literature references, and consultations indicate members of the genus *Gila* occupied every major basin and many of the tributaries in those basins in Arizona (Table 1). Roundtail chub and headwater chub were thought to be common in abundance in many of their localities (Minckley 1973; Holden and Stalnaker 1975; Propst 1999). Voeltz (2002) discussed the historic distribution and status for both roundtail chub and headwater chub.

Minckley (1973) indicated roundtail occurrences in the Colorado River around Shinimu Creek and the Paria River. Roundtail were thought to have occurred at various localities in the mainstem of the Colorado River (Minckley 1979; Valdez and Carothers 1998), but their historic distribution and abundance is not well known. A small number of collection records exist from Lake Mohave, Imperial Dam, Davis Dam, and Glen Canyon Dam. This small number may be a result of habitat alterations; however, it may also be an indicator of actual population condition. Headwater chub is thought to never have occurred in the Colorado mainstem.

Roundtail chub was found in mainstem and larger tributaries throughout the Little Colorado (LCR), Bill Williams, Salt, San Pedro, and Gila River drainages. In the LCR drainage, records of roundtail have been taken from the Zuni River, Chevelon Creek, and East Clear Creek (Baird and Girard 1853), though some locality confusion does exist for the Zuni River specimen (Smith et al. 1979). Museum records exist for 11 streams within the Bill Williams' drainage: Big Sandy, Bill Williams, and Santa Maria rivers, Boulder, Burro, Conger, Francis, Kirkland, Sycamore, Trout, and Wilder creeks). Tributaries to the Gila River that likely supported roundtail include: San Francisco river, San Pedro river, Eagle creek, Aravaipa creek, and Turkey creek (tributary to Aravaipa Creek) (Voeltz 2002). Roundtails were likely common in the lower Gila River when hydrologic conditions provided adequate habitat. Roundtail chub were found throughout the Salt River and its tributaries. Specimens, often recorded as "bonytails," were historically found in the mainstem Salt River through Tonto National Forest (Madsen 1935), in the Black River System as far up as the East Fork of the Black River (Gee 1938), in the White River through the North Fork, and a number of smaller tributaries: Canyon, Carrizo, Cedar, Cherry, Corduroy, and Salome creeks. Girmendonk and Young (1997) located roundtail chub from numerous tributaries of the Verde River: Wet Beaver, Dry Beaver, Oak, West Clear, East Verde, Webber, Fossil, and Deadman creeks.

The range of the headwater chub was never extensive; however, they were once widespread throughout the Tonto River Basin (Salt River drainage) and in tributaries to the Verde River. Madsen (1935) noted them as "abundant" in Christopher, Haigler, Marsh, and Spring creeks; "common" in Horton Creek; and "rare" in Sharp Creek (tributary to Christopher Creek). Though abundance was never recorded, headwater chub was also observed in Gun and Rye creeks (tributaries to Tonto Creek), Buzzard Roost and Rock creeks (tributaries to Spring Creek), and Gordon Creek (tributary to Marsh Creek). Headwater chubs are found in the East Verde River and in Deadman Creek (Minckley and DeMarais 2000; P. Unmack, pers. comm.) and were

discovered in Wet Bottom Creek in 2000 (Marsh 2001). Headwater chub also occurred in the Gila River Basin in Ash creek (tributary to San Carlos River), Beaver creek (tributary to East Fork Gila River), and Taylor creek (tributary to East Fork Gila River) (Voeltz 2002).

Minckley (1973) states that the former distribution of the flannelmouth sucker likely paralleled the former range of the razorback sucker and the Colorado pikeminnow, which in the lower Colorado River basin meant "larger, strongly flowing streams" throughout the basin (mainstem Colorado, Salt, Gila, and Bill Williams rivers). They were considered widespread and abundant throughout the Colorado River Basin (Bezzerides and Bestgen 2002).

Little Colorado River sucker was historically in the mainstem upper LCR drainage of Arizona above Lyman reservoir (AGFD 2002) and certain tributaries within that drainage: East Clear Creek, Barbershop Canyon, Chevelon Creek, Silver Creek, and Nutrioso Creek (Silvey et al. 1984).

The bluehead sucker was historically found in the mainstem Colorado River in and above the Grand Canyon including the following rocky canyon bound tributaries: the Paria and Little Colorado rivers, and Bright Angel, Crystal, Deer, Elves Chasm, Diamond, Havasu, Kanab, Lava, Nankoweap, National Canyon, Pipe, Royal Arch, Shinumo, Spencer, and Tapeats creeks (Bezzerides and Bestgen 2002).

The Zuni bluehead sucker, is considered endemic to the Little Colorado River drainage in east-central Arizona and west-central New Mexico (Smith 1966; Smith et al. 1979; Crabtree and Buth 1987; Propst and Hobbes 1996; Propst 1999). The subspecies was once considered common in the Little Colorado and Zuni River drainages. Smith (1966) reported the Zuni bluehead sucker in four east-central Arizona streams in the upper LCR drainage, though in the late 1970s, Smith et al. (1983) was only able to collect them from East Clear Creek and Kinlichee Creek. Surveys in 2000 by the Zuni Pueblo and the New Mexico Department of Game and Fish verify that it does remain in Kinlichee Creek.

CURRENT DISTRIBUTION WITHIN ARIZONA

Roundtail chub and headwater chub are considered extirpated from 12 streams, present in at least 36 streams, and unknown in 9 streams. From locality information, Voeltz (2002) estimated that roundtail and headwater chub were historically found in approximately 5,000 km of stream around the state. That number is reduced to 1000 km today, though their status in 700 km is currently unknown.

Minckley (1973) captured flannelmouth sucker in only the Salt River, Virgin River, and mainstem Colorado River (upstream from Lake Mead). A more recent study by Bezzerides and Bestgen (2002) estimated flannelmouth sucker are extirpated from nearly 25% of its entire historic range (i.e., upper and lower Colorado river Basins). It is currently considered extirpated in the Gila River basin (AGFD 2001) and therefore is no longer found in the Salt River. It is also considered extirpated from the Bill Williams drainage (AGFD 2001). The Department stocked

flannelmouth sucker above Davis Dam in the 1970's to reduce black fly populations in the area. Multiple years of recruitment have been documented, although in some years success was low (Mueller and Wydoski 2004). Besides this stocked location, flannelmouth sucker are still observed and caught in the mainstem Colorado River from Glen Canyon Dam to the upper end of Lake Mead, lower reaches of a handful of Grand Canyon tributaries, and the Virgin River (Bezzerides and Bestgen 2002).

Since 1979, the Little Colorado River sucker has been captured (though not vouchered) in East Clear Creek, Chevelon Canyon, Silver Creek and Nutrioso Creek, all tributaries to the Little Colorado River (Bezzerides and Bestgen 2002).

The bluehead sucker has been reduced to 60% of its historical habitat in the lower Colorado River basin (Bezzerides and Bestgen 2002). Recent monitoring efforts reveal that bluehead sucker is still found in many of the same locations as found historically. Besides the mainstem Colorado River, it is currently known to persist in Shinumo, Havasu, Kanab, and Bright Angel creeks, and the LCR (Bezzerides and Bestgen 2002). AGFD (2003) also indicates it is still found (though considered rare) in Clear Creek and Diamond Creek. It may also be found in a few areas on the Navajo Reservation and in the San Juan Drainage (AGFD 1995; Minckley 1995)

The range of the Zuni bluehead sucker has been reduced by 90% in the last 20 years (Propst 1999). In Arizona, it is currently found in Kinlichee Creek in Arizona (Crabtree and Buth 1987), however the population status in many historically occupied reaches is unknown (Table 1).

The current status and distribution of all covered species is summarized in Table 1.

Table 1. Population status (extant or extirpated) for historic and currently occupied reaches of roundtail chub, headwater chub, flannel mouth sucker, Little Colorado sucker, and Zuni sucker. (E = Extant; X = Extirpated; U = Historic-Unknown Status)

Management Area (MA)	Tributaries	Species					
		Roundtail chub	Headwater chub	Flannelmouth sucker	Little Colorado sucker	Bluehead sucker	Zuni sucker
Colorado River	Mainstem	X		E		E	
	Aztec Creek			U		U	
	Bright Angel Creek			U		E	
	Carbon Creek					U	
	Chuar Creek					U	
	Clear Creek			U			
	Crystal Creek			U		U	
	Deer Creek			U		U	

Table 1. Population status (extant or extirpated) for historic and currently occupied reaches of roundtail chub, headwater chub, flannel mouth sucker, Little Colorado sucker, and Zuni sucker. (E = Extant; X = Extirpated; U = Historic-Unknown Status)

Management Area (MA)	Tributaries	Species					
		Roundtail chub	Headwater chub	Flannelmouth sucker	Little Colorado sucker	Bluehead sucker	Zuni sucker
	Diamond Creek			U		U	
	Granite Creek			U			
	Havasu Creek			E		E	
	Hermit creek					U	
	Kanab Creek			U		E	
	Matkatamiba Creek			U		U	
	Nankoweap Creek					U	
	National Canyon			U		U	
	Paria River			E		U	
	Pipe Creek			U		U	
	Royal Arch Creek			U		U	
	Shinumo Creek			U		E	
	Spencer Creek			U		U	
	Unkar Creek			U		U	
	Tapeats Creek			U		U	
	West Canyon Creek					U	
Virgin River	Mainstem			E	E		
	Beaver Dam			E			
Little Colorado River	Mainstem	X		E		E	
	Barbershop Canyon				U	U	
	Bear Canyon					E	U
	Black Soil wash						U

Table 1. Population status (extant or extirpated) for historic and currently occupied reaches of roundtail chub, headwater chub, flannel mouth sucker, Little Colorado sucker, and Zuni sucker. (E = Extant; X = Extirpated; U = Historic-Unknown Status)

Management Area (MA)	Tributaries	Species					
		Roundtail chub	Headwater chub	Flannelmouth sucker	Little Colorado sucker	Bluehead sucker	Zuni sucker
	Canyon De Chelly						U
	Canyon del Muerto						U
	Chevelon Creek	E			E	E	
	East Clear Creek	E			E	E	
	East Fork LCR					E	
	Gentry Creek					U	
	Kinlichee Creek						E
	Leonard Canyon				E	E	
	Miller Creek					E	
	Nutrioso Creek				U	E	
	Pueblo Colorado Wash						U
	Rudd Creek					E	
	San Juan River						U
	Scattered Willow Wash						U
	Show low Creek					E	
	Silver Creek				E	E	
	Tsaile Creek						U
	Turkey Creek					U	
	Wheatfields Creek						U

Table 1. Population status (extant or extirpated) for historic and currently occupied reaches of roundtail chub, headwater chub, flannel mouth sucker, Little Colorado sucker, and Zuni sucker. (E = Extant; X = Extirpated; U = Historic-Unknown Status)

Management Area (MA)	Tributaries	Species					
		Roundtail chub	Headwater chub	Flannelmouth sucker	Little Colorado sucker	Bluehead sucker	Zuni sucker
	West Chevelon Creek					E	
	Willow Creek					E	
	Whiskey Creek						U
	Zuni River	X					X
Bill Williams	Mainstem	X					
	Big Sandy River	X		X			
	Boulder Creek	E					
	Burro Creek	E					
	Conger Creek	E					
	Francis Creek	E					
	Kirkland Creek	E					
	Santa Maria River	E					
	Sycamore Creek	E					
	Trout Creek	E					
	Wilder Creek	E					
Gila River	Mainstem			X			
	Ash Creek		U				
	Aravaipa Creek	E					
	Blue River	X					
	Eagle Creek	E					
	Lower Gila River	X					

Table 1. Population status (extant or extirpated) for historic and currently occupied reaches of roundtail chub, headwater chub, flannel mouth sucker, Little Colorado sucker, and Zuni sucker. (E = Extant; X = Extirpated; U = Historic-Unknown Status)

Management Area (MA)	Tributaries	Species					
		Roundtail chub	Headwater chub	Flannelmouth sucker	Little Colorado sucker	Bluehead sucker	Zuni sucker
	San Carlos River		U				
	San Francisco River	X					
	San Pedro River	X		X			
	Upper Gila River	E	E				
Salt River	Mainstem	E		X			
	Black River	E					
	Buzzard Roost Creek		E				
	Canyon Creek	U					
	Carrizo Creek	U					
	Cedar creek	U					
	Cherry Creek	E					
	Christopher Creek		X				
	Cibique Creek	U		X			
	Corduroy Creek	U					
	East Fork Black River			X			
	Gordon Creek		E				
	Gun Creek		E				
	Haigler Creek		E				
	Horton Creek		X				
	Marsh Creek		E				

Table 1. Population status (extant or extirpated) for historic and currently occupied reaches of roundtail chub, headwater chub, flannel mouth sucker, Little Colorado sucker, and Zuni sucker. (E = Extant; X = Extirpated; U = Historic-Unknown Status)

Management Area (MA)	Tributaries	Species					
		Roundtail chub	Headwater chub	Flannelmouth sucker	Little Colorado sucker	Bluehead sucker	Zuni sucker
	Rye Creek		X				
	Rock Creek		E				
	Salome Creek	E					
	Spring Creek		E				
	Tonto Creek		E				
	White River	U					
Verde River	Mainstem	E					
	Deadman Creek		E				
	Dry Beaver Creek	X					
	East Verde River		E				
	Fossil Creek	E	E				
	Oak Creek	E					
	Webber Creek		E				
	West Clear Creek	E					
	Wet Beaver Creek	E					
	Wet Bottom Creek		U				

REASONS FOR DECLINE AND THREATS TO SURVIVAL
(LISTING FACTORS)

Present or threatened destruction, modification, or curtailment of covered species habitat or range

Severe fragmentation and alteration of aquatic habitats in the southwestern United States has likely constricted many wide-ranging aquatic species into isolated pockets. Principal causes of habitat fragmentation in the southwest are dam and reservoir construction, water diversion, groundwater pumping, and increased sedimentation resulting from a variety of land management

practices (Miller 1961). These threats are described generally for southwestern ecosystems, but threats specific to the species covered by this strategy may not be well defined or understood, and may require additional survey, monitoring, and/or investigation as provided in this strategy

Dams and diversions act as barriers to fish movement and can disrupt metapopulation dynamics. Dams also alter instream habitat characteristics creating greater amounts of lentic habitat, while decreasing lotic habitat upstream of impoundments. In turn these changes may have direct impacts on habitat and forage availability for subject species. Lentic habitats created by dams often favor introduced species that prey or compete with subject species. Dams may change the spatial and temporal quantity and quality of habitat in downstream reaches due to higher or lower flow releases compared to the natural system. In many locations, these species now consist of genetically isolated populations.

Water management of impoundments often affects the downstream hydrograph. Southwestern rivers are naturally highly variable systems characterized by high runoff in winter and early spring, and low summer flows punctuated by short duration high flow events caused by monsoon storms. Hydrograph alteration due to dam operation can change the frequency, magnitude, timing, and rate of change of stream flow below dams (Poff et al. 1997). Brouder 2001, suggested that specific life stages or spawning events of the covered species are timed with seasonal flow rates, and alterations to the hydrograph may limit population recruitment and persistence.

Groundwater pumping for irrigation and development can lower the water table, causing reductions in stream base flow, and alter attenuation of flow during high runoff events (Rinne and Minckley 1991). For example, roundtail chub habitat is essentially eliminated as flows drop below 0.3 cms (USFWS 1989). The effects of water diversions and groundwater pumping can be exacerbated by drought in the arid southwestern United States. The compounded effects of water reductions limit available habitat, reduce connectivity, and may increase negative intra- and interspecific interactions (e.g., greater predation pressure).

Changes to habitat type (lotic to lentic), reductions in instream flows, and changes to seasonal flow regimes can cause changes in water temperature, affect aquatic vegetation, and alter water chemistry and dissolved oxygen levels, which may negatively impact covered species populations (Stout et al. 1970; Rinne 1975; Carpenter 1992; Dudley 1995). As stated above, where nonnatives interact with native species, these changes may result in greater abundance of nonnative fish, causing more frequent interactions and greater competition and predation.

As early as the turn of the century, Chamberlain (1904) identified cattle grazing, erosion, and water diversions for irrigation and mining as causes of water quality problems resulting in the decline and extinction of Southwestern fishes. Platts (1991) concluded that livestock grazing negatively impacts riparian habitats and fish populations. Unmanaged livestock trample stream banks, compact soils, and remove protective riparian vegetation from the stream bank, resulting in increased erosion, sedimentation, water temperatures, and decreased habitat quality for native

fish species. Watershed degredation (i.e., overgrazing) causes arroyo cutting, erosion and the disappearance of riparian vegetation; direct results of a lowered water table (Rinne and Minckley 1991). Grazing impacts stream morphology by contributing to the deterioration of soil stability and porosity and increasing erosion and soil compaction (Fleischner 1994). In grazed areas, stream channels contain more fine sediment, stream banks are more unstable, and banks are less undercut (Platts 1991). The activities of livestock (removal of vegetation and trampling) are additive in their effects on the aquatic habitat. The trampling and loss of undercut banks results in a homogenization of habitat types, this process is accelerated by removal of riparian plant species, particularly sedges, grasses, and shrubs, which stabilize undercut banks. In addition, trampling results in wider channels, which results in higher summer and colder winter water temperatures, but these temperature changes are exacerbated by the removal of vegetative and undercut bank cover. Removal of riparian vegetation results in lower plant density and less complex structure, which results in increased erosion and therefore increased turbidity. Turbidity is also increased due to trampling of stream banks and urination onto unprotected soils (Platts 1991).

Threat Reduction Strategy:
The primary objectives to reduce the threat of habitat loss and fragmentation will be to inventory each population to evaluate threats (e.g., past, current, or future groundwater withdrawal or diversions), work to secure existing habitat and flow (i.e., instream flow protection or aquisition), and work with water managers to identify opportunities to improve habitat/flow conditions. For example, the Bill Williams River Steering Committee worked with the Army Corps of Engineers to develop and institute more natural flow regimes to benefit downstream habitats for native flora and fauna on the Bill Williams River. In some cases, reconnecting populations may not be feasible (e.g., large dams; historic groundwater pumping has reduced flows) or would be contrary to management goals (i.e., barriers are needed to prevent ingress of nonnative fish), however, managers will identify the need to move individuals between populations to re-establish connectivity and gene flow based on management plans. Genetic management for these subject species will likely mean focusing on maintaining genetic variability by maximizing founder population size in captive and translocated wild populations (Dobson et al. 1991). Periodic augmentation of captive or wild populations may be necessary to avoid the deleterious effects of loss of variability. As part of the status inventory and assessment, reaches that are negatively affected by watershed degradation will be identified. The SCT will work to restore altered channel and habitat features to conditions suitable for the covered species. The SCT will also identify opportunities for collaboration with watershed groups to conduct habitat improvement projects that may reduce other types of degradation (i.e., overgrazing by ungulates), which will benefit instream flow and habitat conditions. Potential projects include road restoration to reduce erosion, culvert improvements, livestock and or elk fencing, stream bank stabilization using bioengineering techniques.

Overutilization for commercial, recreational, scientific, or educational purposes.
The threat of these factors is small and considered not significant.

Threat Reduction Strategy:
The Department currently issues Scientific Collecting Permits through an application process thoroughly evaluated by state biologists. A Scientific Collecting Permit is for the purpose of wildlife management, gathering information valuable to maintenance of wild populations, education, the advancement of science, or for promotion of the public health and welfare. This permit authorizes access to wildlife, either live or dead, as long as the purpose is in the best interest of the wildlife or the species, will not adversely impact other affected wildlife in Arizona, may be served without posing a threat to wildlife or public safety, and as long as the purpose does not unnecessarily duplicate previously documented projects. Currently roundtail chub is one of only two native sportfish in the state; the current bag limit is one per person per day and must be larger than 13 inches. All other subject species have restricted take in Arizona. Recommendations by the SCT concerning regulations or rules can be made to the department to enhance the conservation of the subject species.

Disease and Predation
Parasites are thought to decrease the growth rate of otherwise healthy fish and may lead to stress and possibly death. This occurs through the inability of the fish to take up adequate nutrients to sustain both itself and the parasites. Parasites can also cause secondary infection and blood loss at wound sites (i.e. *Lernaea* attachment sites). Researchers have detected a variety of parasites in the genus *Gila* (Vanicek 1967; Neve 1976; Mpoame 1981; Robinson et al. 1998; Brouder 1999; Bryan et al. 2000). Mpoame (1981) found protozoans (*Ichthyophthirius multifilis*), trematodes (*Ornithodiplostomum ptychocheilus*, *Clinostomum marginatum* and *Plagioporus* sp.), cestodes (*Isoglaridacris bulboocirrus*), and nematodes (*Dacnitoides* sp., *Rhabdochona decaturensis*, and other *Rhabdochoma* sp.) infesting roundtail chub in Aravaipa and Oak creeks. Ectoparasites of *Gila* include yellow grub (*Clinostomum marginatum*) and anchor worms (*Lernaea* sp.) (Vanicek 1967; Bryan et al. 2000). Brouder (1999) detected Asian tapeworm in hatchery-raised roundtail chub (the chub were infected from nonnative mosquitofish (*Gambusia affinis*) present in the water source for the hatchery). These fish displayed a slower growth rate as tapeworm infection increased.

Brienholt and Heckmann (1980) found a variety of parasites present in a majority or all of the flannelmouth and bluehead sucker sampled. Among this list of parasites, they found 12 genera and 12 species, the most common of which was *Gyrodactylus elegans*, a trematode. They found representatives from each of the following groups in their samples: protozoans, trematodes, cestodes, menatodes, and leeches. In their research, they found that flannelmouth sucker were more often parasitized than bluehead sucker (specimens were taken from La Verkin Creek and the Fremont River, both in Utah).

Together with habitat alteration, the introduction of predatory and competitive nonnative fishes has been shown to be the primary threat to native fish conservation, and the literature supporting the impact is extensive (sensu Hubbs 1955; Miller 1961; Minckley and Deacon 1968; Rinne and Minckley 1970; Minckley 1973; Naiman and Soltz 1981; Meffe 1985; Williams and Sada 1985; AGFD 1988; Bestgen and Propst 1989; USFWS 1989; Rinne and Minckley 1991; Dunsmoor

1993; Ruppert et al. 1993; Douglas et al. 1994 Stefferud 2000). Numerous studies have documented specific predators and competitors with native fish including: channel and flathead catfish, largemouth and smallmouth bass, red shiner, fathead minnow, mosquitofish, green sunfish, brook, brown, and rainbow trout (Id.). In addition, the presence of predaceous nonnative fishes in many mainstem habitats limits subject species migration between many streams and populations (e.g., flathead catfish in the Salt River prevents movement of roundtail chub between the Black River and many of the lower tributaries). Such fragmentation when combined with habitat alteration further reduces connectivity and gene flow among populations.

Specific instances of impacts to subject species have been reported. Stefferud (2000) showed a decline in native fish abundance, including the roundtail chub, coinciding with a large population increase in red shiner in the upper Verde River. Bestgen and Propst (1989) reported that smallmouth bass, flathead catfish, and channel catfish were the species that most greatly impacted roundtail chub populations in New Mexico. Minckley (1973) observed a complete suppression of reproductive success of roundtail in the Black River owing to a "population explosion" of smallmouth bass in the upper Salt River and its tributaries. Recent surveys indicate a decline in roundtail chubs and other native fishes in the Salt River above Roosevelt Lake, with an increase in flathead and channel catfish numbers (Creef and Clarkson 1993; Jahrke and Clark 1999).

The introduction of predatory, nonnative fishes has been implicated as a major factor in the decline of bluehead sucker and flannelmouth sucker, as well as roundtail chub (Wiltzius 1978; Bestgen and Propst 1989; Platania 1990; Martinez et al. 1994; Wheeler 1997; Miller and Rees 2000). Predation impacts may be exacerbated by habitat alteration. For example, Robinson et al. (1998) hypothesized that the cold tailwaters below Glen Canyon Dam produced thermal shock in drifting bluehead sucker and flannelmouth sucker which reduced swimming ability and predator avoidance mechanisms. Further, those larvae that successfully drift to protected nearshore habitats are likely killed when swept away by daily fluctuations in discharge from Glen Canyon Dam.

Other predators such as crayfish and bullfrogs are known to be voracious and can cause declines as a result of their presence (Hyatt 2004, Lannoo 2005).

Threat Reduction Strategy:
During population surveys and monitoring, parasites and disease will be identified. Introduction of parasites and disease due to translocation/augmentation of fish or other native aquatic wildlife into the wild will be reduced or eliminated using the HAACP (Hazard Analysis and Critical Control Points) protocol. HAACP is a process mapping approach to identify critical control points and results in the development of checklists and a set of related processes that work towards the elimination of threats. The SCT may also propose, collaborate, and assist in research on parasite management.

All presently occupied and habitat identified as high priority for repatriation of subject species will be assessed to determine if nonnative species are a current or potential future threat to

population conservation. In reaches where feasible, nonnative removal (i.e., chemical or mechanical) actions may be used to secure habitats. Generally, where streams are threatened by predators that may move into a conservation reach due to hydrologic connectivity, construction of fish barriers will be considered. For example, a barrier and renovation was recently completed for Fossil Creek, which protects 9 miles of habitat for roundtail chub and headwater chub, among other native aquatic species. The SCT may evaluate the efficacy of mechanical suppression efforts in selected reaches. For example, there is an ongoing study in the upper Verde River by the Forest Service assessing the effectiveness of mechanical removal in mainstem reaches.

Inadequacy of Existing Regulatory Mechanisms
Federal protection:
Both roundtail chub and headwater chub were petitioned for listing under the ESA. The Service completed a 90-day finding in July 2005 that found that the listing may be warranted and thus are conducting a status review (USFWS 2005). Of the four Catostomids covered under this Agreement, only one (the Zuni bluehead sucker) is currently recognized as a candidate species under the ESA.

The Federal Land Policy Management Act of 1976 (43 U.S. C. 1701 et seq.) and the National Forest Management Act of 1976 (16 U.S. C. 1600 et seq.) direct Federal agencies to prepare management plans to guide management decisions. In addition, the Forest Service is required to "maintain viable populations of existing native and desired nonnative species" in their planning area (36 CFR 219.19). The Forest Service is currently revising the Forest Management Plans, which will cover all sensitive species. The subject species in this document are planned for listing as sensitive species by the National Forests in these plans.

The National Environmental Policy Act of 1969 (NEPA) (42 U.S. C. 4321-4370a) requires Federal agencies to consider the environmental impacts of their actions. The NEPA process requires these agencies to describe a proposed action, consider alternatives, identify and disclose potential environmental impacts of each alternative, and involve the public in the decision-making process. Most actions taken by the Forest Service, the Bureau of Land Management, and other Federal agencies that affect subject species are subject to the NEPA process.

The Clean Water Act of 1977 established the basic structure for regulating discharges of pollutants into the waters of the United States. The goal of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters which indirectly protects the subject species and their habitats covered in this document.

The Fish and Wildlife Coordination Act directs any department or agency of the U.S. diverting or modifying water bodies to consult with the U.S. Fish and Wildlife Service and the state wildlife agency of the state in which the action will occur.

State Protection:

Roundtail chub is listed as threatened in the Department's Wildlife of Special Concern in Arizona (1996). Roundtail chub is one of only two native sportfish in the state; the current bag limit is one per person per day. As a designated sportfish, the Department can utilize Sportfish Restoration dollars to manage the populations. The Little Colorado River sucker and the Zuni bluehead sucker are identified as Wildlife of Special Concern in Arizona list (1996). The designation as Wildlife of Special concern provides a guide to state and federal resource managers when assessing impacts and determining minimization and mitigation measures for these high priority species. Similarly, all covered species are identified in the Comprehensive Wildlife Conservation Strategy (CWCS; AGFD 2005). CWCS will provide protection/management of stressors and threats through identification, providing a nexus for funding and, strategic level goals and objectives applicable to all watersheds covered in this Strategy. The Department also has an ongoing internal review process and Federal compliance program with U.S. Fish and Wildlife Service for its statewide sportfish stocking program to assess and eliminate potential impacts to Federally listed and state sensitive species, including the subject species.

Conservation of instream flow is a critical component of protecting subject species habitat. Both surface water and groundwater is regulated and managed by the Arizona Department of Water Resources (ADWR). Arizona Revised Statutes Title 45 governs surface and groundwater water rights within Arizona, with the exception of the Colorado River, which is govern by a complex set of legislation, court cases, and international treaties known as the "Law of the River". Instream flow as a beneficial and appropriative right within Arizona, and the Instream Flow program instituted by ADWR was recently upheld in Arizona Court of Appeals. This case, pending appeal, provides assurance that the Instream Flow Program will continue into the future and can be used as a tool to protect species habitats. The Forest Service and Nature Conservancy hold or have filed for instream flow rights to protect aquatic resources along some Arizona streams. However, outside Active Management Areas (i.e., geographical area designated by ADWR for groundwater management), unregulated groundwater pumping is a past and ongoing threat to stream flow maintenance, irregardless of surface flow rights in some stream reaches.

Regulatory Threat Reduction:
The existing Federal legislation provides significant opportunity to comment on projects and work with project proponents to minimize and mitigate current and future threats to covered species.

The Department's planning efforts identify the covered species as high priority taxa to conserve, and the CWCS document is a roadmap to identify and manage threats. The Department will continue to evaluate the statewide sportfish stocking program to assess and eliminate potential impacts to covered species. Similarly, AGFD periodically reviews baitfish rules and regulations to assess impacts on native species, including the subject species. The Department will review sportfishing rules and allowable catch limits for roundtail chub to determine impacts/threats to individual chub populations.

As a component of the status inventory and assessment, the threat of existing and future water diversions and groundwater pumping will be identified. SCT will review existing instream flow protections of high priority conservation reaches to determine if threats are present and if there is inadequate protection. SCT may consider filing new instream flow rights to conserve water resources in high priority conservation reaches. SCT will also coordinate with ADWR and water users to identify opportunities to reduce surface and groundwater pumping threats to conserve habitats.

Other natural or man-made factors affecting its continued existence
Fire Regime Change:
Changes in fire regimes over the past century have increased the likelihood of uncontrolled, high intensity fires (Dahms and Geils 1997). The 2002 fire season was extreme in Arizona, resulting in over 600,000 acres burned within the state's boundaries (USDA Forest Service 2002, Southwest Area Wildland Fire Operation 2003). While fewer acres were burned by catastrophic wildfires in the subsequent years, these fires often had a greater impact on native fish due to location. Impacts occur to aquatic organisms, including native fish, in a number of ways: ash-laden runoff acts to suffocate gill-breathing organisms, fire retardants contribute to eutrophication of water bodies or fish kills if applied directly to water sources (Kalabokidis 2000), and nonnative organisms (predators, competitors, or pathogens) are potentially introduced from the transport of water from cattle tanks, reservoirs, and large rivers in order to fight fires.

When a population of native fish is threatened by impacts from catastrophic wildfires, biologists may choose to salvage the population. This worked well for Gila chub in Sabino Canyon in 2003 and Gila trout in Raspberry Creek in 2004 as adequate hatchery space remained for their indefinite holding. Fish threatened by forest fire impacts are not always salvaged. Headwater chub in Wet Bottom and Deadman creeks were threatened by the Willow Fire in 2004, but were not salvaged due to access issues, lack of storage capacity in hatcheries, and lack of predictability of direct effects to the population. Species such as Little Colorado spinedace, Gila and Apache trout, and loach minnow are commonly salvaged from systems. This is partially due to their occurrence in locations more often impacted by forest fires; however, it is also a result of their greater scarcity than species covered in this Agreement and Strategy. Less potential exists to salvage roundtail and headwater chub because limited hatchery space is often filled by threatened and endangered species.

Fire Regime Change Threat Reduction:
Rectification of this situation is planned by coordinating salvage efforts and the development and use of more refuge habitats on private and public-owned lands. Coordination will also be done in efforts to restore natural fire regimes in the watersheds of extant populations helping secure populations from catastrophic fire danger.

OUTLINE OF CONSERVATION STRATEGY TASKS

The tasks identified below are a summary of those activities that will be undertaken to reduce the threats identified above for the conservation of the subject species. The tasks also include detailed actions needed to implement the Agreement and Strategy (i.e., administration and inter-agency coordination, baseline data collection, database and information management, and research needs). Provisions for monitoring and reporting the progress of the Agreement and Strategy implementation and Adaptive Management are also provided.

1. Administration of the State Conservation Agreement and Strategy
   The diverse backgrounds and expertise of the signatories make the administration of the State Conservation Agreement and Strategy an essential asset to specific activities outlined in this Strategy.
   1.1 Formalize the State Coordination Team.
   - Administration of the Statewide Conservation Agreement and Strategy is through the State Coordination Team (SCT).
   - The SCT is composed of representatives from each signatory (decided by the signatory agency) with the voting ability limited to one representative from each signatory.
   - The Native Fish Project Coordinator for the Department is appointed as the chairperson for the SCT.
   - An alternate representative will be designated for each signatory with voting ability in the absence of the designated representative.

   1.2 Management plan
   - Develop management plans establishing prioritization criteria that will help prioritize efforts and projects outlined in this Strategy.
   - The Department will develop this document for lands within their jurisdiction. All tribal signatories are responsible for developing a document for their own sovereign nations (e.g. San Carlos Apache Tribe Fishery Management Plan)

   1.3 State Coordination Team meetings.
   - Meet a minimum of twice per year: Hold meetings in late winter (February) and fall (October). The February meeting finalizes work plans for the upcoming field season and the October meetings reviews the previous field season and preliminarily plan the upcoming field season.
   - Hold additional meetings as needed.
   - All meeting are open to outside interested parties within the capacity of the meeting place.
   - The SCT sets priorities and plans activities for the subject species.
   - Any change to the strategy requires a 2/3 majority vote to be accepted.
   - Dissenting minority can file an appeal and file a minority report.
   - The SCT may institute one or more technical subcommittees to investigate, report, and/or advise the SCT on specific issues or components of this Agreement and Strategy.

   1.4 Prepare annual work plans.
   - Work plans are prepared for and presented at the SCT meeting.

1.5 Coordinate activities.
- Coordinate and organize specific activities and conservation actions year round.
- These activities are planned during the SCT meetings.

1.6 Explore funding sources and develop proposals.
- Seek funding to insure the implementation of certain conservation actions.
- Develop proposals for conservation actions.

1.7 Establish and maintain a database of past, present, and future information on subject species.
- The Range-wide Coordination Team will develop and maintain a range-wide "3 species database" in Salt Lake City, UT. This database design will build on the relevant existing databases. Database design is in the early phases. This database design will include identifying streams designated for native fish uses and those that can be managed for both native fish and for sportfish uses. All existing information on the subject species (2.1) will be assimilated into the database to aid prioritization of projects.

1.8 Establish and maintain a bibliography of subject species.
- Create an electronic bibliography of literature files for all subject species. (e.g. USGS's Bibliography of Colorado River Big Fishes).

1.9 General public outreach
- Create general public outreach through the use of educational signs, presentations to local clubs, groups, or schools, meetings with landowners, fishing regulation updates, and the exploration of opportunities for urban and/or backyard native fish ponds.
- General public outreach also includes educating the public on the problems associated with and the consequences of introducing nonnative aquatic species into riparian and stream habitats.
- General public outreach also includes improving working relationships with all cooperators (agency, private, Tribal) for the purposes of improving species management.

1.10 Media coverage of releases and conservation activities
- Prepare press releases of the subject species and keep the local media informed of noteworthy activities. Internet site department website for releases

2. <u>Identification.</u>

Closing these information gaps identifies where conservation actions are needed.

2.1 Conduct status assessment of the subject species.
- Review and assimilate literature for the identification of gaps in information on a species level.
- Annual assessments of progress will be conducted.
- Every five years the Department will begin a status assessment for each species. This will be done to track progress and quantify success.

2.2 Identify concurrent programs that benefit the subject fish species. Monitor and summarize their activities and progress.

- Identify concurrent programs that benefit the subject fish species and use them to conduct initial status assessment.

2.3 *Identify habitat requirements.*

- Determine habitat conditions (e.g., stream size, length, substrate, flow) needed to sustain all life stages of the subject species.

2.4 Identify threats.

- Monitor populations of the subject species and provide information where these species interact with threats to species conservation. Threats are defined as the present or threatened destruction, modification, or curtailment of its habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; and/or other natural or manmade factors affecting its continued existence.
- Compile this information and maintain it in a database (1.7).
- Prioritize where subject species and threat interaction can be minimized.

2.5 Identify management opportunities.

- Explore and identify habitat enhancement opportunities of the subject species.
- Explore, identify and designate potential locations for native fish management, and prioritize those with a high likelihood of successfully managing or eradicating threats to the species.

2.6 *Genetically and morphologically characterize populations of the subject species.*

- Use biogenetic techniques to better understand the inter and intra variability within and among populations of the subject species.
- Determine if known information is adequate to answer management questions related to conservation genetics and assess need for additional genetic characterization.

3. <u>Secure, enhance, and create habitat.</u>

Manage threats to the subject species through the use of securing, enhancing and creating habitat. Focus on key areas of importance in maintaining metapopulation structure and in areas where efforts will be effective. Important tributary streams should be protected.

3.1 Maintaining instream flow.

- Secure habitat through acquisition of water rights or agreements with water rights holders to maintain instream flow.

3.2 Manage detrimental nonnative fish/aquatic species in streams designated for conservation of the subject species.

- Manage detrimental effects of nonnative fish/aquatic species in streams designated for conservation of the subject species. Control techniques will be variable depending on the location and nonnative fish/aquatic species. Potential management techniques include the use of piscicides or mechanical

removal through electroshocking, etc. Other techniques will be incorporated as identified.

3.3 Evaluate effectiveness of nonnative management efforts.

- Develop criteria to determine effectiveness of the nonnative management efforts and length of monitoring effort and identify the triggers or thresholds indicating further nonnative management actions.
- Monitor locations where nonnative control and management techniques have been employed.

3.4 Restore natural fire regimes in the watersheds of extant populations of the subject species.

- Secure habitat through the use of prescribed fire and noncommercial understory thinning to restore natural fire regimes. Natural fire regimes can help protect habitat from large-scale catastrophic fires.

3.5 *Manage the spread of infectious diseases and parasites to habitats of the subject species.*

- Manage detrimental effects of disease and parasites by implementing Hazard Analysis of Critical Control Points (HAACP) protocols when visiting subject species habitats (Appendix 3).

3.6 Enhance and/or restore connectedness and opportunities for migration of the subject species to disjunct populations.

- Prioritize locations by immediacy of dewatering threat and current water levels
- Maintain metapopulation dynamics if connectivity between occupied habitats cannot be maintained through the use of moving individuals of the subject species between fragmented populations.
- Evaluate new water development features and minimize and mitigate the negative effects on subject species. In addition, placement of fish barriers for native fish management should be done only when necessary to prevent highly piscivorous or highly competitive fishes from reaching native fish areas.

3.7 Develop appropriate flow recommendations for areas where existing flow regimes are inadequate.

- Assess the influence of hydrologic regimes on covered species conservation. This data will be used to make flow recommendations (3.8) and to guide evaluation under adaptive management (7)

3.8 Implement flow recommendations and evaluate to provide flows needed for all life stages.

- Focus and prioritize conservation efforts on maintaining water and preferably flows in high priority areas and to improve habitat for specific life stages (especially larvae and YOY).
- Maintain migration corridors by securing instream flow (e.g. water rights, leases, agreements) to prevent intermittency of currently perennial streams and enhance and/or restore connectedness and opportunities for migration of

the subject species to disjunct populations.

- Support other land mangers to maintain migration corridors by securing instream flow (e.g. water rights, leases, agreements) to prevent intermittency of currently perennial streams and enhance and/or restore connectedness and opportunities for migration of the subject species to disjunct populations.

3.9 Restore altered channel and habitat features to suitable conditions.

- Evaluate potentially high priority areas for habitat improvements. These areas include but are not limited to de-watered areas and highly degraded areas historically home to the subject species.
- Eliminate, reduce, and take actions to prevent physical, chemical, and biological stressors to the stream channel, riparian area, and the upland watershed where subject species populations exist. Stressors may include but are not limited to unnatural flow regimes, erosion, gullying, head cutting, water diversions, excessive water table pumping, road construction, urbanization, removal of riparian vegetation, streambank destabilization, excessive nutrients, siltation, higher temperatures, excessive pH levels, potential of chemical spills.
- Utilize habitat improvements. Habitat improvements include but are not limited to the mimicking of natural flow regimes, addition of large woody debris, chemical pipe caps, reconstructing natural meander patterns, installations of weirs for grade control, installation of sediment traps, reconnecting water bodies, bank resloping, utilization of toe rock for bank stabilization, channel realignment, and use of native plant bioengineering practices in bank and over bank zones to ensure bank stabilization.

3.10 Create, maintain and evaluate fish refugia throughout historic range.

- Create, maintain, and evaluate refugia habitats (e.g. instream, off-channel, aquarium, and other secure habitats) that can be used for grow out of the subject species for the purpose of providing them non-native free spawning habitats. Contingency plans must be in place for the purpose of eradicating any non-native species. Observations of fishes maintained in refugia areas may help in answering life history, demographic, and ecology questions.

3.11 Maintain habitat quality

- Establish mitigation plans that provide a mechanism to ensure no net loss of habitat for each species. Mitigation plans will address activities that reduce the quality of fisheries habitat (reductions in water quality and habitat quality).

4. <u>Establish, and enhance populations.</u>
   Protect and increase populations of subject species to accelerate progress toward attaining population objectives for respective species, expand population distributions of subject species through transplant, augmentation (i.e., use of artificially propagated stock) or reintroduction activities as warranted.

4.1 Establish current information regarding species distribution, status, threats, and habitat conditions as the baseline from which to measure change.

- Contribute currently available information/data on the status and distribution of these species into a database, which should be housed in a centralized location. This information will be updated as signatories acquire additional survey information.

4.2 Assure regulatory protection for these species is adequate.

- Review existing regulatory protection and provide recommendations to enhance the conservation.

4.3 Salvage efforts.

- Salvage subject species individual populations facing dire conditions and place in refuge habitats (2.4).
- Appoint a salvage operation lead from the State Coordination Team to coordinate the efforts.

4.4 Augment populations.

- Individuals of populations facing dire conditions will be salvaged (4.3) and placed into refuge habitats (3.11), allowed to spawn, grow out, and then returned to instream habitats. Adequate numbers in parent populations should be used.

4.5 Preserve existing variation in order to maintain existing genetic diversity and the species adaptive capabilities.

- Until more genetic information is known, the signatories will manage each of these species separately and within each species, each watershed (i.e., Little Colorado River, Bill Willams, Verde, Salt River and Gila River) will be considered unique and treated as a management area (MA).
- Effective population size for the subject species will be determined on a case-by-case basis.
- The signatories will assess the level of hybridization of the subject species and determine and evaluate the implications for management and conservation of the subject species.

4.6 Replicate to guarantee no net loss of extant populations.

- Replicate as many populations within each MA where opportunity exists. Replicating populations will ensure no net loss of populations.

4.7 Improve hatchery facilities for propagation programs.

- Improve hatchery facilities for propagation of these species to allow stocking of roundtail chub as sportfish and other subject species for conservation and outreach purposes in appropriate streams and historic range with appropriate genetic stock.

4.8 Expand subject species population distributions through transplant, augmentation (i.e., use of artificially propagated stock) or reintroduction activities.

- Expand population distributions by establishing sustainable populations in currently unoccupied appropriate habitats within historic range through translocation and stocking programs based on genetic information located in the managements plan. Expanding population distributions may also include

stocking into currently fishless streams, within historic habitats to increase the number of refuge populations and expand distribution.

5. Monitor extant populations and occupied or suitable habitats.
Establish and implement qualitative and quantitative long-term population and habitat monitoring programs for the subject species.

5.1 *Implement monitoring plan.*

- Develop and implement a monitoring plan. Though many of these occupied streams are remote, the importance of regular sampling is well understood and recognized. It is extremely important that areas where information is lacking are sampled more often.
- Streams should be sampled once every five years and potentially more often if threats are greater and more imminent.
- Adopt a standardized low-impact population sampling protocol for the use of low impact sampling that is consistent. This protocol will incorporate status, trajectory, and the ability to detect change.

5.2 Develop and implement a habitat protocol (including threats).

- Develop or adopt criteria for a habitat monitoring protocol through surveys, studies, and data of hydrological, biological, and watershed features. The protocol will incorporate habitat needs to establish evaluation methods for the purpose of identifying adequate habitat for translocation and monitor threats to the subject species populations.

5.3 Determine current population sizes and/or utilize auxiliary catch and effort data to identify trends in relative abundance.

- Develop criteria for a long term monitoring protocol with the objective to estimate population size and evaluate a trend over time.
- Identify long term monitoring for other species available, which could be used to estimate current population sizes and trends in relative abundance. This information will be used as a baseline estimate.
- Compile long-term datasets to estimate changes. This information will be used to prioritize implementation actions for the subject species.

5.4 Evaluate conditions of populations using baseline data.

- Use current information as baseline data.
- Assess conditions of populations to prioritize needs.

6. Research
Conduct research to address information gaps that will help determine appropriate management actions.

6.1 Identify research needs and develop study designs to improve understanding.

- Identify and address questions in need of research, for example:
    - Do current flows fulfill needs appropriate for all life stages of the subject species?

- Is known information adequate to answer management questions related to conservation genetics and assess need for additional genetic characterization of the subject species?
- Do current surveys accurately represent the subject species population status and trends?
- Is variability in reproduction and recruitment of the subject species due to duration between flooding events?
- Are parasite management techniques achievable and effective?

7. Adaptive Management

New information collected during monitoring and research activities will be incorporated into the Strategy.

7.1 Assess new information.

- This task will be ongoing as information is gathered.

7.2 Incorporate new information into management and activity plans. Apply new information to management strategies.

- New information will help to guide priorities and will be used in planning. This strategy is flexible and is designed to allow for adapting to changing situations, priorities, and techniques. In emergency situations, new information may be acted on rapidly. If deviations from the strategy are temporary, no written modifications to the strategy are necessary.

7.3 Modify strategy to reflect new information from monitoring and research.

- The strategy may require modifications should significant changes occur in known threats to the subject species or in the manner best suited to address those threats. Any proposed modifications should have data to support the changes.
- Signatories may propose changes. Signatories must approve deviations from the signed strategy.

Summary of Incremental Objectives, Schedule, and Reporting Requirements:

The following table is a list of deliverables and timeframes as incremental objectives to meet the overall goals of the strategy to conserve covered species through reduction and/or elimination of known threats.

Deliverables	Expected Completion Date (yrs.)
Annual Work Plans	Annual
Annual Accomplishments	Annual
AGFD Native Fish Management Plan	2
San Carlos Apache Tribe Fisheries Management Plan	Completed
White Mountain Apache Tribe Fisheries Management Plan	2
Hualapai Tribe Fisheries Management Plan	2
Navajo Nation Fisheries Management Plan	2
Monitoring Plan	1
Broodstock Management Plan	Completed
Electronic Database	2
Electronic Bibliography	2
Status Assessment and Threat Identification	5

SUCCESS CRITERIA

At the end of five years, the SCT will evaluate success of this project through monitoring of survival and recruitment of the current and reintroduced populations of subject species. The SCT will renew the Agreement for the remaining years of the Rangewide Conservation Agreement and Strategy. The Agreement was developed as a ten year document but limited to five years due a five-year maximum commitment allowed by some federal agencies. At the end of RCAS, a status assessment (3.1) will be completed to evaluate the success of the Agreement and will be deemed successful if populations are surviving and recruiting in currently occupied habitat and significant efforts are underway to meet each of the 3 objectives listed in the Range-wide Conservation Agreement and Strategy, also listed in this Agreement. Significant efforts are defined as specific projects with ownership to and timelines for completion. A series of questions to help evaluate success of the Agreement and Strategy are as follows:

Population Stability Criteria:

- What is the current distribution of the subject species?
- Are current and reintroduced populations stable or increasing?
- Are populations self-sustaining and is there adequate data to estimate population viability?
- Does each population meet or exceed genetic effective population size (Ne)?
- Is there connectivity (natural or managed) with one or more metapopulations for each population?

- Is there sufficient sampling effort to monitor population status and threats of the subject species?

Threat Reduction Success Criteria:

- Have threats for each population been identified?
- Are there management actions or plans in place to mitigate or eliminate the threats to the conservation of the subject species:
  - (1) The present or threatened destruction, modification, or curtailment of its habitat or range;
  - (2) Overutilization for commercial, recreational, scientific, or educational purposes;
  - (3) Disease or predation;
  - (4) The inadequacy of existing regulatory mechanisms; and/or
  - (5) Other natural or manmade factors affecting its continued existence.

- Are habitats in which the species occur stable and/or improving?
- Is there adequate monitoring to evaluate threat reduction, success or failure of actions, and long-term threats?
- Are adaptive management principles used to improve threat reduction management and strategy implementation?

APPENDIX 4:

Timelines and expenditures currently anticipated

* Nothing in this document commits any signatory to funding responsibilities.

Conservation Strategy Implementation Schedule, 2006-2010

Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000)				
							FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
		1.	**Administration**								
→	1	1.1	Formalize State Coordination Team	0	ALL	5	5	0	0	0	0
☐	1	1.2	Management Plans	2	AGFD SCAT WMAT HT NN						
☐	1	1.3	State Coordination Team Meetings	↻	ALL	10	2	2	2	2	2
☐	1	1.4	Prepare Annual Work Plans	↻	ALL	25	5	5	5	5	5
☐	1	1.5	Coordinate Activities	↻	ALL	10	2	2	2	2	2
☐	1	1.6	Explore Funding Sources and Develop Funding Proposals	↻	AGFD SRP BLM USBR USFWS	5	1	1	1	1	1
☐	1	1.7	Establish and maintain a database of past, present, and future information on subject species	↻	ALL	42	22	5	5	5	5
☐	3	1.8	Establish and maintain a bibliography of subject species	1	AGFD SRP	5	5	0	0	0	0
☐	2	1.9	General public outreach	↻	AGFD SRP BLM, USBR USFWS	15	3	3	3	3	3
☐	3	1.10	Media coverage of releases and conservation activities	↻	AGFD SRP BLM USFWS	5	1	1	1	1	1
		2	**Identify Status of Species, Habitat, and Management**								
☐	2	2.1	Conduct status assessment	↻	AGFD BLM USFWS	9	1	1	1	1	5
☐	3	2.2	Identify concurrent programs	↻	AGFD SRP BLM USFWS	5	1	1	1	1	1
☐	2	2.3	Identify habitat requirements	2	AGFD BLM USFWS	10	5	5	0	0	0

Conservation Strategy Implementation Schedule, 2006-2010							Cost estimates ($000)				
Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
☐	1	2.4	Identify threats	2	AGFD SRP BLM USFWS	10	5	5	0	0	0
☐	1	2.5	Identify management opportunities	↻	AGFD BLM USBR USFWS			***unknown***			
☐	1	2.6	Genetically and morphologically characterize populations	3	AGFD USFWS	21	7	7	7	0	0
		3	**Secure, enhance, and create habitat**								
☐	1	3.1	Maintaining instream flow	↻	AGFD BLM SRP TNC			***unknown***			
☐	1	3.2	Manage detrimental nonnative fish/aquatic species in streams designated for conservation of the subject species	↻	AGFD SRP BLM USBR USFWS	41000	8200	8200	8200	8200	8200
☐	2	3.3	Evaluate effectiveness of management efforts	↻	AGFD SRP BLM USBR USFWS	80	16	16	16	16	16
☐	3	3.4	Restore natural fire regimes in the watersheds of extant populations of the subject species	↻	AGFD BLM USFWS TNC			***unknown***			
☐	2	3.5	Manage the spread of infectious diseases and parasites to habitats	↻	AGFD BLM USBR USFWS	5	1	1	1	1	1
☐	2	3.6	Enhance and/or restore connectedness and opportunities for migration to disjunct populations	↻	AGFD BLM USBR USFWS			***unknown***			
☐	3	3.7	Develop appropriate flow recommendations for areas where existing flow regimes are inadequate	3	AGFD BLM USFWS	500	0	200	100	200	0
☐	3	3.8	Implement flow recommendation and evaluate to provide flows needed for all life stages	↻				***unknown***			

Conservation Strategy Implementation Schedule, 2006-2010											
Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000)				
							FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
☐	1	3.9	Restore altered channel and habitat features to suitable conditions	↻	AGFD BLM USFWS TNC	12800	2560	2560	2560	2560	2560
☐	1	3.10	Create, maintain and evaluate fish refugia throughout historic range	↻	AGFD BLM USBR USFWS TNC	2900	580	580	580	580	580
☐	1	3.11	Maintain habitat quality	1	AGFD USFWS	1000	1000				
		4	**Establish and enhance populations**								
☐	1	4.1	Establish current information regarding species distribution, status, threats, and habitat conditions as the baseline from which to measure change	↻	AGFD BLM USFWS	20	5	5	5	5	5
☐	2	4.2	Assure regulatory protection for these species is adequate	↻	AGFD BLM USFWS	1	1	0	0	0	0
☐	2	4.3	Salvage efforts	↻	AGFD BLM USBR USFWS			***unknown***			
☐	3	4.4	Augment populations as necessary	↻	AGFD SRP BLM, USFWS	5	1	1	1	1	1
☐	1	4.5	Preserve existing variation in order to maintain existing genetic diversity and the species adaptive capabilities	↻	AGFD BLM USFWS	9	5	1	1	1	1
☐	1	4.6	Replicate to guarantee no net loss of extant populations	↻	AGFD USBR USFWS	2900	580	580	580	580	580
☐	2	4.7	Improve hatchery facilities for propagation programs	↻	AGFD SRP USFWS	750	150	150	150	150	150
☐	2	4.8	Expand subject species population distributions through transplant, augmentation (i.e., use of artificially propagated stock) or reintroduction activities	↻	AGFD BLM USBR USFWS			***unknown***			
		5	**Monitor extant populations and occupied or suitable habitats**								

Conservation Strategy Implementation Schedule, 2006-2010											
Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000)				
							FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
☐	1	5.1	Develop and implement monitoring plan for the subject species	↻	AGFD SRP BLM, USBR USFWS	180	36	36	36	36	36
☐	2	5.2	Develop and implement a habitat protocol (including threats)	↻	AGFD BLM USFWS	180	36	36	36	36	36
☐	2	5.3	Determine current population sizes of subject species and/or utilize auxiliary catch and effort data to identify trends in relative abundance	↻	AGFD BLM USFWS	180	36	36	36	36	36
☐	1	5.4	Evaluate conditions of populations using baseline data	↻	AGFD BLM USFWS	180	36	36	36	36	36
		6	**Research**								
☐	3	6.1	Identify research needs and develop study designs to improve understanding	↻	AGFD BLM USFWS FSRMRS	10	2	2	2	2	2
		7	**Adaptive Management**								
☐	2	7.1	Assess new information	↻	ALL			***unknown***			
☐	2	7.2	Incorporate new information into activity plans. Apply new information to management strategies	↻	ALL			***unknown***			
☐	2	7.3	Modify Strategy to reflect new information from monitoring and research	↻	ALL			***unknown***			

LITERATURE CITED

Arizona Game and Fish Department. 1988. Threatened native wildlife in Arizona. Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 1996. Wildlife of special concern in Arizona. Arizona Game and Fish Department Publication. Phoenix, Arizona. 32 pp.

Arizona Game and Fish Department. 2006. Comprehensive Wildlife Conservation Strategy. Game and Fish Department Publication. Phoenix, Arizona.

Bestgen, K.R. and D.L. Propst. 1989. Distribution, status and notes on the ecology of *Gila robusta* (Cyprinidae) in the Gila River drainage, New Mexico. Southwestern Naturalist, 34(3): 402-412.

Bezzerides, N. and K.R. Bestgen. 2002. Draft Final Report: Status Review of Roundtail Chub *Gila robusta*, Flannelmouth Sucker *Catostomus latipinnis*, and Bluehead Sucker *Catostomus discobolus* in the Colorado River Basin. Submitted to U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah. Larval Fish Laboratory Contribution 118, Colorado State University, Ft. Collins.

Brienholt, J.C. and R.A. Heckmann. 1980. Parasites from two species of suckers (Catostomidae) from southern Utah. Great Basin Naturalist 40: 149-156.

Brouder, M.J. 2001. Effects of flooding on recruitment of roundtail chub, *Gila robusta*, in a southwestern river. The Southwestern Naturalist, 46(3): 302-310.

Brouder, M.J. 1999. Relationship between length of roundtail chub and infection intensity of Asian fish tapeworm *Bothriocephalus acheilognathi*. Journal of Aquatic Animal Health, 11:302-304.

Bryan, S.D. and A.T. Robinson. 2000. Population characteristics and movement of roundtail chub in the lower Salt and Verde rivers, Arizona. Final Report submitted to the Bureau of Reclamation. Cooperative Agreement No. 98-FG-32-0240. Arizona Game and Fish Department, Phoenix, Arizona.

Bryan, S.D., A.T. Robinson, and M.J. Fry. 2000. Native-nonnative fish interactions in the lower Salt and Verde rivers. Final Report submitted to the Bureau of Reclamation. Cooperative Agreement No. 98-FG-32-0240. Arizona Game and Fish Department, Phoenix, Arizona.

Carpenter, J. 1992. Summer habitat use by Sonora chub in Sycamore Creek, Santa Cruz County, Arizona. M.S. thesis. The University of Arizona, Tucson, Arizona.

Chamberlain, F.W. 1904. Unpublished Arizona field notes. Smithsonian Institution, Washington, D.C.

Creef, E.D. and R.W. Clarkson. 1993. Razorback sucker (*Xyrauchen texanus*) and Colorado squawfish (*Ptychocheilus lucius*) monitoring, Verde and Salt rivers, Arizona, 1991-1993. Completion report to the U.S. Fish and Wildlife Service on Project E5-4, Job 7, Title VI of the Endangered Species Act. Arizona Game and Fish Department, Phoenix, Arizona.

Dahms, C.W. and B.W. Geils (tech eds.). 1997. An assessment of forest ecosystem health in the Southwest. General Technical Report RM-GTR-295. Fort Collins, CO. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experimental Station.

Dobson, A.P., G.M. Mace, J. Poole, and R.A. Brett. 1991. Conservation biology: the ecology and genetics of endangered species. Pages 405-430 in R.J. Berry, T.J. Crawford, and G.M. Hewitt eds. Genes in ecology. Blackwell Scientific Publications, London, England.

Douglas, M.E., P.C. Marsh, and W.L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: *Meda fulgida* (Cyprinidae) as a case study. Copeia, (1): 9-19.

Dudley, R.K. 1995. The effects of green sunfish on the distribution, abundance and habitat use of Gila chub in Sabino Creek, Tucson, Arizona. M.S. thesis (draft), The University of Arizona, Tucson, Arizona.

Dunsmoor, L. 1993. Laboratory studies of fathead minnow predation on catastomid larvae. Klamath tribes research report: TY-93-01. Natural Resources Department, The Klamath Tribes, Chiloquin, Oregon.

Fleischner, T. L. 1994. Ecological costs of livestock grazing in Western North America. Conservation Biology, 8:629-644.

Hubbs, C.L. 1955. Hybridization between fish species in nature. Syst. Zool., 4: 1-20.

Hyatt, Matthew W. 2004. Investigation of Crayfish Control Technology. Final Report submitted to the Bureau of Reclamation. Cooperative Agreement No. 1448-20181-02-J850. Arizona Game and Fish Department, Phoenix, Arizona.

Jahrke, E. and D.A. Clark. 1999. Razorback sucker and Colorado pikeminnow reintroduction and monitoring in the Salt and Verde rivers. Nongame and Endangered Wildlife Program Technical Report 147. Arizona Game and Fish Department, Phoenix, Arizona.

Lannoo, Micheal. 2005. Amphibian Declines, University of California Press, Berkley CA

Martinez, P.J., T.E. Chart, M.A. Trammel, J.G. Wullschleger, and E.P. Bergersen. 1994. Fish species composition before and after construction of a mainstem reservoir on the White River, Colorado. Environmental Biology of Fishes, 40: 227-239.

Meffe, G.K. 1985. Predation and species replacement in American southwestern fishes: a case study. Southwestern Naturalist, 30(2): 173-187.

Miller, R.R. 1961. Man and the changing fish fauna of the American Southwest. Paper Michigan Academy of Sciences, Arts, Letters, 46: 365-404.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix. Pages 156-159, 170-171.

Minckley, W.L. and J.E. Deacon. 1968. Southwestern fishes and the enigma of "Endangered Species."

Mpoame, M. 1981. Parasites of some fishes native to Arizona and New Mexico, with ecological notes. Ph.D. dissertation, Arizona State University, Tempe, Arizona.

Naiman, R.J. and D.L. Soltz (eds). 1981. Fishes in North American deserts. John Wiley and Sons, Inc., New York, New York.

Neve, L.L. 1976. The life history of the roundtail chub, *Gila robusta grahami*, at Fossil Creek, Arizona. M.S. thesis. Northern Arizona University, Flagstaff, Arizona.

Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. Department of Biology, Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM. 143p.

Platts, W.S. 1991. Livestock grazing. Pp.389-423 *in* W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Poff, N.L. J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The Natural Flow Regime, a paradigm for river conservation and restoration. BioScience, 47 (11): 769-784

Rinne, J.N. 1975. Changes in minnow populations in a small desert stream resulting from natural and articificially induced factors. Southwestern Naturalist, 20(2): 185-195.

Rinne, J.N. and W.L. Minckley. 1991. Native fishes of arid lands: a dwindling resource of the desert southwest. General Technical Report RM-206. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Ft. Collins, Colorado.

Rinne, J.N. and W.L. Minckley. 1970. Native Arizona fishes, Part III-the minnows called "chubs." Arizona Wildlife Views, 17(5): 12-19.

Robinson, A.T., R.W. Clarkson, and R.E. Forrest. 1998. Dispersal of larval fishes in a regulated river tributary. Transactions of the American Fisheries Society 127: 772-786.

Robinson, A.T., P.P. Hines, J.A. Sorensen, and S.D. Bryan. 1998. Parasites and fish health in a desert stream, and management implications for two endangered fishes. North American Journal of Fisheries Management 18: 599-608.

Ruppert, J.B., R.T. Muth, and T.P. Nesler. 1993. Predation on fish larvae by adult red shiner, Yampa and Green rivers, Colorado. Southwestern Naturalist 38: 397-399.

Smith, G.R. 1966. Distribution and evolution of the North American Catostomid fishes of the subgenus *Pantosteus*, Genus *Catostomus*, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

Stefferud, J. A. 2000. May 12, 2000 summary for fishery studies conducted on the upper Verde Rive during Spring 2000, under direction of the Rocky Mountain Research Station, Flagstaff, Arizona. Tonto National Forest, Phoenix, Arizona.

Stout, G.G., E.C. Bloom, and J.K. Glass. 1970. The fishes of Cave Creek, Maricopa County, Arizona. Journal Arizona Academy Science, 6(2): 109-113.

USDA Forest Service. 2002. National Fire Report for Fiscal Year 2002, Southwestern Region.

U.S. Fish and Wildlife Service. 1989. Fish and Wildlife Coordination Act Substantiating Report. Central Arizona Project, Verde and East Verde River Water Diversions, Yavapai and Gila counties, Arizona. USFWS, Phoenix, Arizona.

U.S. Fish and Wildlife Service. 1983. Environmental assessment; proposed determination that *Gila intermedia* (Gila chub) is a threatened species pursuant to the Endangered Species Act with critical habitat, U.S. Department of the Interior, Washington, D.C.

U.S. Fish and Wildlife Service. 2005. 90-day finding on the petition to list a distinct population segment of the roundtail chub in the Lower Colorado River Basin and to list the headwater chub as endangered or threatened with critical habitat.

Uyeno, T. and G.R. Smith. 1972. Tetraploid origin of the karyotype of Catostomid fishes. Science, 175: 644-666

Vanicek, C.D. 1967. Ecological studies of native Green River fishes below Flaming Gorge Dam, 1964-1966. Ph.D. dissertation, Utah State University, Logan, Utah.

Voeltz, J.B. 2002. Roundtail chub *Gila robusta* status survey of the lower Colorado River basin. Nongame and Endangered Wildlife Program Technical Report 186. Arizona Game and Fish Department, Phoenix, Arizona.

Wheeler, C.A. 1997. Current distributions and distributional changes of fish in Wyoming west of the Continental Divide. M.S. Thesis, University of Wyoming. Laramie, Wyoming. 113p.

Williams, J.E. and D.W. Sada. 1985. American's desert fishes; increasing their protection under the Endangered Species Act. Endangered Species Technical Bulletin. 10(11): 8-14.

Wiltzius, W.J. 1978. Some factors historically affecting the distribution and abundance of fishes in the Gunnison River. Final Report for Fisheries Investigations of the Lower Gunnison River Drainage. Colorado Department of Natural Resources, Division of Wildlife, Ft. Collins, Colorado, 215p.