BEFORE THE COLORADO WATER CONSERVATION BOARD

STATE OF COLORADO

IN THE MATTER OF PROPOSED INSTREAM FLOW APPROPRATION IN WATER DIVISION 4: DOLORES RIVER (confluence San Miguel River to confluence West Creek)

PREHEARING STATEMENT OF CONSERVATION COLORADO EDUCATION FUND, SAN JUAN CITIZENS ALLIANCE, AND WESTERN RESOURCE ADVOCATES

Pursuant to the June 5, 2015 Notice of Prehearing Conference & Deadlines for Submissions, and Rule 5n(2) of the Rules Concerning Instream Flow and Natural Lake Level Program, 2 CCR 408-2 (ISF Rules), Conservation Colorado Education Fund, San Juan Citizens Alliance, and Western Resource Advocates (collectively, Conservation Groups), by and through the undersigned counsel, submit the following Prehearing Statement in support of the Staff's ISF Recommendation on the Dolores River, Water Division No. 4. *See* Notice of Contested 2015 ISF Appropriations (April 9, 2015), before the Colorado Water Conservation Board (CWCB or Board).

I. <u>Factual and Legal Claims</u>

The Conservation Groups support the CWCB Staff's ISF Recommendation[1] and the Board's declared intent to appropriate an in-stream flow water right for the Dolores River consistent with Staff's recommendation. We urge the Board to protect the natural environment in the Dolores River to a reasonable degree by appropriating the proposed instream flow water right.

The Staff's ISF Recommendation on the Dolores River, approved by the Board in January 2014, recognizes the urgent need to protect habitat for the Flannelmouth Sucker, Bluehead Sucker, and Roundtail Chub. The State of Colorado recognizes each of these species as a species of special concern and/or as sensitive species.[2] In September 2006,

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[1] Executive Summary of CWCB Staff's Analysis & Recommendation ("CWCB Staff Recommendation"), CWCB ID 14/4/A-006, *available at* http://cwcb.state.co.us/environment/instream-flow-program/Pages/2014ProposedInstreamFlowAppropriations.aspx.

[2] CWCB Staff Recommendation at 3.

state wildlife agencies in six western states, including Colorado Parks and Wildlife,[3] as well as the Bureau of Land Management (BLM), National Park Service, and the Jicarilla Apache Tribe signed the Range-wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (Three Species Agreement).[4] The Conservation Agreement is intended to minimize threats that could lead to listing of these fish species under the Endangered Species Act[5]. [6]

The Three Species Agreement details the decline in habitat for the Flannelmouth Sucker, Bluehead Sucker, and Roundtail Chub over the last fifty years. "Available literature suggests that the three species were common to all parts of the [Colorado River Basin] until the 1960s."[7] However, now the three species occupy approximately 50% or less of their historic habitat in the Colorado River Basin.[8]

The Three Species Agreement emphasizes the importance of physical habitat characteristics, including flows, to the survival of the Three Species:

> Habitat is an important component of metapopulation and species survival. Loss of available habitat may lead to the loss of individuals or populations that in turn may cause loss of metapopulation dynamics. Important physical habitat characteristics may include (but are not limited to) substrate, instream habitat complexity**,** and flow regimes.[9]

The Conservation Agreement further suggests the use of instream flow programs to protect habitat for the Three Species. *Id.* Finally, the Conservation Agreement recommends that signatories "[p]rovide flows needed for all life stages of the subject species."[10]

Biologist John Woodling, Ph.D. prepared a report (Woodling Memo) to further analyze the Three Species and determine what flow levels are required to preserve the Three Species to a reasonable degree. He found that reproducing populations of the bluehead sucker, flannelmouth sucker and roundtail chub inhabit the lower reaches of

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[3] Then called the Colorado Division of Wildlife.
[4] *Attached as* Exh. 3.
[5] 16 U.S.C. §§ 1531-1544.
[6] CPW-BLM Stakeholder recommendation at 16. For ease of reference, page citations for the CPW-BLM Stakeholder recommendation refer to the "PDF" page number of the electronic file posted on the CWCB 2015 Contested ISF Appropriation webpage, http://cwcb.state.co.us/environment/instream-flow-program/Pages/2015ContestedISFAppropriations.aspx.
[7] Exh. 3 at 41.
[8] *Id.* at 43-44.
[9] *Id.* at 31.
[10] *Id.* at 48.

several Colorado rivers including the Dolores River downstream of the confluence with the San Miguel River.[11]

The record demonstrates that protecting flows in this reach of the Dolores is – and should be – a priority for Three Species conservation efforts in Colorado. As stated by Colorado Parks and Wildlife Aquatic Biologist Dan Kowalski:

> This reach of the Dolores contains excellent populations of flannelmouth suckers, bluehead suckers, and roundtail chubs represented by multiple age classes including any large adults. This reach appears to support some the best populations of the three species in the Dolores River basin and has much more robust and healthy native fish populations than sites on the Dolores upstream of the San Miguel.[12]

Tributary flows from the San Miguel River and other smaller streams help mitigate the Three Species habitat problems generally found in the Dolores River below McPhee Dam and above the confluence with the San Miguel River.[13] The proposed instream flow reach of the Dolores supports a very high percentage of native fish and "appears to be one of the best populations of the three native fishes within the Dolores River watershed."[14] Any further decline in distribution and abundance of the Three Species is significant in any Colorado River.[15]

A. <u>There is a natural environment in the claimed reach that can be preserved to a reasonable degree by the Staff's ISF Recommendation.</u>

Colorado Parks and Wildlife and BLM placed ample data into the record that clearly establish (1) the existence of an important natural environment in the claimed reach of the Dolores River, and (2) that the Staff ISF Recommendation will help preserve the natural environment to a reasonable degree.

As the record shows, Colorado Parks and Wildlife's 2007, 2009 and 2010 fish surveys found between 76% and 89% of the fish in the proposed reach were native species.[16] In particular, the Three Species and other important native fish are present and healthy throughout the reach. As summarized by Colorado Parks and Wildlife Instream Flow Program Coordinator Jay Skinner, Colorado Parks and Wildlife biologists find that:

> this reach of the Dolores River appears to be one of the best populations of the three native fishes within the Dolores River watershed, and represents

[11] Memorandum by John Woodling, Ph.D. Re: "The relationship of proposed instream flow regimes in the Dolores River to native fishes" 2 (June 29, 2015), *attached as* Exh 1.
[12] CPW-BLM Stakeholder recommendation at 53.
[13] *Id.*
[14] *Id.* at 3.
[15] Woodling Memo at 3.
[16] CPW-BLM Stakeholder recommendation at 3.

> an intact and functional assemblage of native warm water fish. In addition, genetic testing of the two sucker species do not indicate any hybridization with non-native white suckers, which is known to occur in other major western Colorado rivers.[17]

Skinner concludes that "this river reach presents a rather unique opportunity for Colorado to protect a healthy reproducing assemblage of these native fish."[18]

Inflows from the San Miguel River give the proposed reach of the Dolores River a more natural hydrograph that does not exist above the confluence.[19] The proposed reach's "[n]ative fish populations are healthy and contain multiple age classes."[20] Therefore, record overwhelmingly shows that there is an important natural environment in the claimed reach of the Dolores River.

In addition, the record shows that the proposed instream flow water right is tailored to provide reasonable minimum flow protection of the existing natural environment. The maximum proposed protect spring runoff flow of 900 c.f.s. is substantial but still significantly less than the flows needed to provide the maximum amount of usable habitat for bluehead suckers in the proposed reach (1,200 c.f.s.).[21] The proposed maximum peak flow is barely more than the amount needed to provide maximum habitat to flannelmouth suckers in the reach (875 c.f.s.).[22] Colorado Parks and Wildlife and BLM assume that these flows will also adequately protect roundtail chub habitat.[23] These peak flows support all of the Three Species' life stages but are especially important for their reproduction and for juvenile fish.[24]

Similarly, the 100 c.f.s. base flow is essential to the fish's survival. Colorado Parks and Wildlife staff have identified this base flow as being especially important to maintaining existing native fish populations in the proposed reach of the Dolores River.[25] Colorado Parks and Wildlife and BLM used standard R2Cross methods in developing their base flow recommendation[26] and this proposed amount should be maintained in any final application to the water court.

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[17] *Id.* at 17.
[18] *Id.* at 17-18.
[19] *Id.* at 34 (CPW Aquatic Biologist Paul Jones contrasting the proposed reach from "degraded" Dolores River habitat above the confluence with the San Miguel).
[20] *Id.*
[21] *See* CWCB Staff Recommendation at 8.
[22] *Id.*
[23] CPW-BLM Stakeholder recommendation at 22.
[24] *Id.* at 6-7.
[25] *See id.* at 53.
[26] *Id.* at 24.

The bluehead sucker is a species that uses riffle habitats more than the other two members of the Three Species, the flannelmouth sucker and the roundtail chub.[27] Accordingly, the CPW/BLM recognized that in protecting the bluehead sucker the other two species would also be adequately protected.[28] Additionally, the Woodling Memo noted that water depth is the key factor when sampling for flannelmouth sucker, bluehead sucker and roundtail chub.[29] The Three Species will be most abundant when water is deepest in principal habitat used by each species; deep runs and pools for flannelmouth sucker, deep water riffles or runs for bluehead sucker and pools for the roundtail chub.[30]

Therefore the Staff's ISF Recommendation is foundational to preserving the natural environment in the Dolores River to a reasonable degree and does not reserve a higher flow than is needed to preserve the natural environment to a reasonable degree. Thus, the Board should find that there is a natural environment in the claimed reach that can be preserved to a reasonable degree by the Staff's ISF Recommendation.

B. <u>The natural environment in the claimed reach will be preserved to a reasonable degree by the water available for this ISF Appropriation.</u>

Colorado Parks and Wildlife and BLM set reasonable flow recommendations and adjusted them where needed to ensure that water would be available at least 50% of the time. The agencies appropriately selected PHABSIM to develop spring runoff recommendations due to the "big river" characteristics of the Dolores at peak flow.[31] In addition, the agencies used the familiar R2Cross methodology, which has been extensively used by the CWCB in the past, to establish the 100 c.f.s. base flow recommendation.[32]

The agencies also appropriately applied the Statemod modeling system to ensure an accurate and representative depiction of water availability in this reach of the Dolores River. Application of Statemod or another baseline modeling system is essential to determining water availability for this instream flow proposal because of the lack of a gage located directly within in the proposed reach and the relatively recent completion of the U.S. Bureau of Reclamation's Dolores River Project.[33] The Dolores Project did not make its full depletions until around the year 2000,[34] thus limiting the post-project hydrological record to a short and unrepresentative period of a dozen or so years. Statemod allows the agencies and the CWCB to evaluate a representative period of

[27] Woodling Memo at 4.
[28] *Id*.
[29] *Id*. at 5.
[30] *Id*. at 5.
[31] *See* CWCB Staff Recommendation at 5.
[32] *Id.*
[33] *See id.* at 12 (Statemod was selected because of its ability to analyze over 30 years of historical flow data while accounting for the recently completed Dolores River Project).
[34] CPW-BLM Stakeholder recommendation at 125.

record while applying more recent depletions from the Dolores Project and other more recent water users to develop a more accurate estimate of water availability in the basin.

Colorado Parks and Wildlife and BLM adjusted some of the proposed flow rates downward to ensure that each flow rate in the proposed water right would be available. The agencies reduced the peak flow rate from 900 c.f.s. for three seasonal periods: (1) to 400 c.f.s. from June 15 to July 14; (2) to 200 c.f.s for March 15 to April 14; and (3) to 200 c.f.s for July 15 to August 14.[35] As a result the agencies conclude that there is water available for the proposed flow rates at least 50% of the time.[36] The Woodling Memo reaches the same conclusion, and elaborates that:

> [t]he CPW/BLM recommendation was not based solely on the biological needs of the native sucker species but addressed seasonal water quantity fluctuations. The CPW/BLM recommendations do not request that the existing seasonal flow regime be maintained in the claimed reach of the Dolores River. Water in excess of the CPW/BLM proposal is currently present in the river seasonally on an annual basis.[37]

As discussed in the record, the Three Species would benefit from more water than the proposed water right would protect.[38] However, the agencies and CWCB Staff balanced the needs of the fish with other potential future uses of water. This is just one of the many ways in which the instant instream flow proposal "correlate[s] the activities of mankind with some reasonable preservation of the natural environment."[39] Therefore, the natural environment in the claimed reach will be preserved to a reasonable degree by the water available for this ISF Appropriation.

Finally, the impact of climate change to future river flows is an undeniably important component of statewide water management and planning for coming years.[40] However, any blanket assertion that climate change will cause average annual flows to decrease at the location of this proposed instream flow water right does not appear to be supported by the latest scientific analysis available this time[41] and should not form the basis of a finding regarding water availability for this proposed instream flow water right.

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[35] *Id.* at 11.
[36] *Id.* at 13.
[37] Woodling Memo at 9.
[38] CPW-BLM Stakeholder recommendation at 11.
[39] *See* C.R.S. § 37-92-102(3).
[40] *See, e.g.,* Southwestern Water Conservation Dist. (SWCD), Notice to Contest Instream Flow Appropriation at ¶ III.A.3.a (Mar. 26, 2015) (questioning whether there is water physically available for the proposed water right in light of the potential impacts of climate change).
[41] *See* Jeff Lukas, et al., Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation, A Report for the Colorado Water Conservation Board at ES-4 (2d Ed., 2014) ("Climate model projections show less agreement regarding future precipitation change for Colorado."), *attached as* Exh. 2.

C. <u>The natural environment in the Dolores River can exist without material injury to water rights.</u>

Because the proposed ISF on Schaefer Creek is a new junior water right, the instream flow appropriation can exist without material injury to senior decreed water rights.[42] In addition, under the instream flow statute,[43] the CWCB will recognize any undecreed uses or exchanges of water in existence on the date this ISF water right is appropriated.

D. <u>This ISF Appropriation is consistent with present uses or exchanges of water being made by other water users pursuant to appropriation practices in existence on the date of such appropriation, whether or not previously confirmed by court order or decree.</u>

Pursuant to C.R.S. section 37-92-102(3)(b), all ISF appropriations "shall be subject to the present uses or exchanges of water being made by other water users pursuant to appropriation or practices in existence on the date of such appropriation, whether or not previously confirmed by court order or decree." If a person establishes a documented and verified "present use or exchange of water" within the meaning of C.R.S. section 37-92-102(3)(b), then, as a matter of law, such use is entitled to protection against injury by this proposed instream flow application. The Conservation Groups recommend that contesting parties should adequately document and verify any such undecreed uses within a reasonable time after the deadline to file statements of opposition with water court and before the court issues a final decree.

E. <u>This ISF Appropriation is consistent with the beneficial use of the water of the people of the State of Colorado under law and interstate compact.</u>

CWCB Staff's ISF Recommendation advances the beneficial use of the water of the people of the State of Colorado. Under C.R.S. § 37-92-103(4), "beneficial use" includes "the appropriation by the state of Colorado in the manner prescribed by law of such minimum flows between specific points or levels for and on natural streams and lakes as are required to preserve the natural environment to a reasonable degree." As described in Section I, Part A above, the Staff's ISF Recommendation will help preserve the natural environment of the San Miguel River to a reasonable degree. Therefore, Staff's ISF Recommendation is consistent with – and advances – the beneficial use of the water of the people of the State of Colorado.

Furthermore, the Staff's ISF Recommendation leaves ample water that is physically available for other beneficial uses in the Dolores River. SWCD incorrectly

[42] *Farmers Water Development Co. v. CWCB*, 346 P.3d 52, 61 (Colo. 2015) (holding that instream flows are administered within the priority system and therefore cannot take water way from existing senior users).
[43] C.R.S. § 37-92-102(3)(b).

implies that this proposed instream water right will "appropriat[e] all available water for an instream flow use."[44] However, this suggestion is directly rebutted by the administrative record. BLM estimates that in a median year, there is **89,000 acre feet of excess flows** physically available above and beyond the Staff's ISF Recommendation.[45] Despite the proximity of this proposal to the state line, **this excess water may be developed upstream of the proposed instream flow reach** and therefore, Staff's ISF Recommendation is consistent with present and future beneficial use of Colorado's compact apportionments.

F. Other Legal Issues to be Decided.

Other legal issues that the Board should decide may include, but are not necessarily limited to:

a. "[T]he appropriation of instream flows in order to protect the natural environment is a policy determination delegated to the CWCB. . . . Furthermore, the CWCB's determination that a particular ISF will preserve the environment to a reasonable degree is a prospective policy determination."[46]

b. "[I]nstream flows are administered within the priority system, the instream flow cannot take water away from existing uses and the senior [water rights holder will always be able to make its diversion for its decreed beneficial uses."[47]

The Conservation Groups reserve the right to address these and any other legal issues that may arise in this hearing.

II. Exhibits, Reports, or Other Documents to be Introduced at Hearing

The Conservation Groups submit the following technical documents, attached to this prehearing statement (listed by exhibit number):

1. Memorandum by John Woodling, Ph.D., "The Relationship of Proposed Instream Flow Regimes in the Dolores River to Native Fishes, (June 29, 2015) (Woodling Memo).

2. Jeff Lukas, et al., Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation, A Report for the Colorado Water Conservation Board at (2d Ed., 2014).

3. Range-wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (2006).

[44] SWCD Notice to Contest at ¶ III.B.2.
[45] CPW-BLM Stakeholder recommendation at 13.
[46] *Farmers Water Development*, 346 P.3d at 59.
[47] *Id.* at 61.

The Conservation Groups anticipate providing legal argument at the hearing and reserve the right to submit legal memoranda in support of their position and for rebuttal purposes.

III. **Witnesses**

The following witnesses may testify at the hearing as described below, may give rebuttal testimony, and may be available at the hearing to answer questions from the Board:

A. John Woodling, Ph.D., Contract Biologist (resume attached to the end of Exh. 1), may testify regarding the habitat needs of Flannelmouth Suckers, Bluehead Suckers, and Roundtail Chub.

B. Laura Belanger, P.E., Water Resources and Environmental Engineer for Western Resource Advocates, or another water resources engineer, may provide rebuttal testimony regarding hydrology in the Dolores River.

The Conservation Groups reserve the right to identify and present any additional rebuttal witnesses as needed.

IV. **Written Testimony**

The Conservation Groups offer a technical memorandum by John Woodling, Ph.D., "The Relationship of Proposed Instream Flow Regimes in the Dolores River to Native Fishes, (June 29, 2015) (Woodling Memo) as Exhibit 1.

V. **Conclusion**

Wherefore, the Conservation Groups hereby request that the Board approve the Staff's ISF Recommendation for the Dolores River (confluence San Miguel River to confluence West Creek).

Respectfully submitted this 30th day of June, 2015.

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CERTIFICATE OF SERVICE

I hereby certify that on June 30, 2015, the above **Prehearing Statement** was served upon all parties herein by email as follows:

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Robert K. Harris

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MEMORANDUM

TO: Western Resource Advocates
FROM: John Woodling, Ph.D. Woodling Aquatics
DATE: 6/29/2015
SUBJ: The relationship of proposed instream flow regimes in the Dolores River to native fishes.

Introduction

The Colorado Parks and Wildlife (CPW) and the US Bureau of Land Management (BLM) have recommended an instream flow right in the claimed reach of the Dolores River to protect native fish species. Three of these native fish species, the bluehead sucker (*Catostomus discobolus*), the flannelmouth sucker (*Catostomus latipinnis*) and the roundtail chub (*Gila robusta*) are the object of interstate efforts designed to halt the decline in range and numbers of the fish. This group of fish species is collectively referred to as the Three Species. I have worked with the Three Species since April 1974 when I first sampled the Dolores River as a part of an investigation of the San Miguel River as a researcher for the Colorado Water Quality Control Division.

I have sampled rivers throughout western Colorado since 1975. I have sampled and studied the Three Species often from 1978 through 2003 as a fishery biologist with the Colorado Division of Wildlife. I was fortunate to write a book about fish species not normally targeted by anglers titled “Colorado’s Little Fish” that was published in 1982. This book included descriptions of more than 40 fish species including life history information, range descriptions, habitat, etc. Descriptions of the Three Species were included in this book. I currently am aging otoliths of several sucker species including the flannelmouth and bluehead suckers.

I believe the analysis and data generated by BLM/CPW in this matter are excellent and were done in a professional manner. I recommend that instream flows be approved for the claimed reach of the Dolores River (from the confluence with the San Miguel River downstream to the confluence with West Creek) based on analyses performed by the CPW/BLM as follows,

1. A flow of 900 cfs from April 15 through June 14,

2. A flow of 400 cfs from June 15 through July 15,

3. A flow of 200 cfs from July 16 through August 14,

4. A flow of 100 cfs from August 15 through March 15

5. A flow of 200 cfs from March 16 through April 14.

A minimum stream flow in the Dolores River is needed to protect the Three Species to a reasonable degree, based on the status of the Three Species throughout the species range and also status of native fish species assemblage throughout the western slope of Colorado. The following sections address the status of the native fish assemblage on the western slope of Colorado, the status of the flannelmouth sucker, the bluehead sucker and the roundtail chub in the Dolores River Basin. Also included are sections on the influence of water diversions on flannelmouth and bluehead suckers, the importance of water depth to the flannelmouth sucker and bluehead sucker, and the proposal of the CPW/BLM. Each of these topics is addressed separately in the following sections.

Analysis instream flow recommendations

Native fish assemblage

Only 13 fish species are currently thought to be native to waters of the western slope in Colorado, a relatively depauperate fauna compared to most major river basins in the Continental United States. Five of these species are currently federally and/or state listed as threatened or endangered, including the razorback sucker (*Xyrauchen texanus*), the Colorado pikeminnow (*Ptychocheilus lucius*), the humpback chub (*Gila cypha*), the bonytail chub (*Gila elegans*), and two lineages of the native cutthroat trout (*Oncorhynchus clarkii*). The exact taxonomic status of the cutthroat trout is somewhat confused. The mountain sucker (*Catostomus platyrhynchus*) is also listed as a species of concern by the State of Colorado. The flannelmouth sucker, the bluehead sucker and the roundtail chub are considered by many groups to currently warrant federal or state listing. The (BLM) considers the flannelmouth sucker, bluehead sucker and roundtail chub to be “sensitive” species.

The Three Species are a Colorado River Basin fish assemblage component that is often treated as a single management unit. The Three Species are the focus of a multi-state and federal effort. Protection and enhancement of existing populations of the Three Species are a component of many state and federal fish management programs. All three taxa appear to be restricted to about 45% of the species’ historic range in the Upper Colorado River Basin (Bezzerides and Bestgen 2002). The Upper Colorado River Basin is that portion of the Colorado Basin upstream of Glen Canyon Dam. The objective of the state and federal efforts is to avoid federal listing of any of these three species. Reproducing populations of the bluehead sucker, flannelmouth sucker and roundtail chub inhabit the lower reaches of several Colorado rivers including the Dolores River downstream of the confluence with the San Miguel River.

The fish assemblage of the Dolores River is less diverse than that of the entire Colorado River Basin. About eight of the fish species found on the west slope of Colorado are not expected to occur in the Dolores River downstream of the San Miguel River including the mottled sculpin, the Paiute sculpin, the mountain whitefish, the mountain sucker, the bonytail chub, the humpback chub, the razorback sucker and Colorado pikeminnow. The Paiute sculpin, the mountain whitefish and the mountain sucker are generally restricted to the northwestern part of Colorado while the bonytail chub, humpback chub, razorback sucker and Colorado pike minnow seem to be found in the lower mainstem Gunnison River and Colorado River within the state. However, the flannelmouth sucker, bluehead sucker and roundtail chub are found in the Dolores River (Anderson 2003 and DPW Fort Collins data base). Four native fish species inhabit the claimed reach of the Dolores River. These four native species are the speckled dace, the flannelmouth sucker, the bluehead sucker and roundtail chub. Numbers of the Three Species present in the Dolores River are not considered to be “strong” populations of this species complex (Bestgen et al. 2011).

In total, nine of the 13 fish species (69%) of the native fish species on the western slope of Colorado have declined in numbers and distribution to the point that some form of designation has been applied to the taxa. The decline in the fish assemblage on the west slope of Colorado can be compared to a similar nationwide phenomenon. A total of 37% of the native fish species in the United States have declined in abundance and distribution to the point that the species have some form of official designation as imperiled (Master et al. 2000). In contrast, 69% of the fish assemblage on the western slope of Colorado has declined to a point where some level of designation has occurred. In general, the native fish assemblage of Colorado’s western slope has experienced twice as much of a decline as the rest of the United States. Such declines in fish throughout Colorado have resulted in design and implementation of a variety of recovery endeavors to protect these species. The problem of conserving these species is compounded by the fact that at least five of these declining species are endemic to the Colorado River basin and found nowhere else in the United States.

Any further decline in distribution and abundance of the Three Species is significant in any Colorado River. Most western slope Colorado Rivers still support reproducing populations of the Three Species, although the flannelmouth sucker and bluehead sucker have disappeared from the Gunnison River upstream of Blue Mesa Reservoir (Woodling 1982). The relative robust Colorado Three Species populations are somewhat of an anomaly compared to the status of the populations throughout the entire native range of the species group. The distribution of the Three Species is also different for the individual fish species. Flannelmouth sucker are still found in most of the species’ historical range in Wyoming and Colorado but the species has disappeared or become less abundant throughout the remainder of the species range; California, Utah, Arizona and Nevada (Rees et al. 2006b). Thus a decrease in abundance or distribution of the Three Species in Colorado has more influence on the status of the taxa than in other states where most populations have disappeared. The failure to protect Colorado populations could lead to the listing of one or more of the Three Species on the national level, an occurrence that could have relatively more implications in Colorado where the taxa are still found in most of their native range.

Water Diversions

Water diversions are one human-related action that has resulted in a decrease in numbers and species of native fish throughout the western slope of Colorado. A variety of other human-related impacts have caused declines in fish species’ abundance and distribution, including urbanization, agriculture, mining, roadways, silviculture, etc. The list is long. However, water diversions are the one form of human activity that has most often occurred on Colorado’s Western Slope. Water diversions have been influencing the distribution of fish since the late 1870’s in Colorado.

Two general forms of water depletion often occur; those associated with water storage and water loss associated with direct crop irrigation. Water is often diverted from rivers to be stored for future use. This storage often occurs during the spring snowmelt periods when stream flows are elevated. Reduced spring snowmelt flows can have a deleterious impact on fish species that spawn in relation to the rising or declining hydrograph associated with the spring snowmelt period. The Dolores River downstream of the San Miguel River has a natural hydrograph in relation to spring peak flows present in most Colorado river systems. However, water diversions in late summer and early fall months reduce the base flow condition of that season. During the late irrigation season (August through October) Dolores River stream flows are heavily influenced by irrigation diversions. Irrigation diversions can be used to remove a high percentage of the streamflow recorded at the upstream reaches of the San Miguel River. As such, water depletions reduce the amount of water in the Dolores River for eight to nine months a year. The reduced flows in the claimed reach of the Dolores River travel down through a stream channel that developed over many decades based on native flow patterns, not the flow pattern resulting from current water use patterns. Currently, the claimed reach of the Dolores River is both shallower and slower than conditions found only a century ago; a short time in development of a river channel.

CPW/BLM flow recommendations
Water depth and velocity

Technically sound methods were used by the CPW/BLM to create the instream flow proposal for the claimed reach of the Dolores River. The CPW/BLM developed their flow recommendations using the R2Cross section method for periods of low stream flow and used the Physical Habitat Simulation model (PHABSIM) for the spring snowmelt time periods. The CPW/BLM balanced depth and velocity requirements against the current amount of water in the claimed reach of the Dolores River to further refine seasonal flow recommendations that will support the existing populations of the Three Species in the claimed reach.

The bluehead sucker is a species that uses riffle habitats more than the other two members of the Three Species, the flannelmouth sucker and the roundtail chub. Accordingly, the CPW/BLM recognized that in protecting the bluehead sucker the other two species would also be adequately protected. Fish population data for bluehead sucker and flannelmouth suckers were analyzed with flow data to create support for instream flow recommendations. The CPW/BLM balanced depth and velocity requirements for the two sucker species against the amount of water present in the Dolores River to create flow recommendations supportive of native suckers based on habitat models. Protection of deep water riffles for bluehead suckers provides protection for not only bluehead suckers but also the flannelmouth sucker and roundtail chub (Stewart and Anderson 2007).

The maximum amount of bluehead sucker usable habitat is realized at a flow of 1,200 cfs while a flow of 875 cfs provides the maximum amount of usable habitat for flannelmouth sucker (CWCB staff recommendation Dolores River page 8). The CPW/BLM staff selected a maximum snowmelt flow of 900 cfs to adequately protect the flannelmouth sucker “while protecting more than 90% of the usable habitat for bluehead sucker” (CWCB staff recommendation, Dolores River, page 8).

An average water depth of 1.0 feet and a flow velocity of 1.3 feet/second provides “marginally suitable” habitat for bluehead suckers (Anderson and Stewart 2003). The CPW/BLM determined that an instream flow of 100 cfs results in riffle depths and velocities near the levels determined by Anderson and Stewart (2003).

CPW/BLM also examined flow records when determining instream flow recommendations for the claimed reach of the Dolores River. CPW/BLM determined that 900 cfs of water was available during the central portion of the spring snowmelt period (April 15 through June 14). These flows are not available during at the initial onset of spring runoff leading from the base flow period (August 15 through March 15) to the peak spring snowmelt flows. In addition 900 cfs was not available for the rapidly declining hydrograph that follows maximum snowmelt flow periods. The CPW/BLM then developed flow recommendations based on available flows during these "shoulder" time periods. The flow recommendation for the Dolores River are as follows,

1. A flow of 900 cfs from April 15 through June 14,

2. A flow of 400 cfs from June 15 through July 15 (shoulder season),

3. A flow of 200 cfs from July 16 through August 14 (shoulder season),

4. A flow of 100 cfs from August 15 through March 15

5. A flow of 200 cfs from March 16 through April 14 (shoulder season).

Water depth and water velocity are two habitat variables that influence whether a fish species can inhabit an area and the number and size of a given species. Water depth and water velocity are also two variables that are utilized to develop the instream flow recommendations brought to the CWCB. Water depth and velocity preference for flannelmouth sucker, bluehead sucker and roundtail chub can be compared to the riffle depth and riffle velocity data generated as part of the CPW/BLM field studies used to develop the claimed flows for the Dolores River to determine if recommended flows are the minimum to provide reasonable protection for the Three Species downstream of the San Miguel River.

Water depth is the key factor when sampling for flannelmouth sucker, bluehead sucker and roundtail chub. The Three Species will be most abundant when water is deepest in principal habitat used by each species; deep runs and pools for flannelmouth sucker, deep water riffles or runs for bluehead sucker and pools for the roundtail chub. Flannelmouth suckers are often encountered in deep runs when water is from waist to chest deep while bluehead suckers are often collected in slightly faster waters that may be a little shallower. The roundtail chub seems to use deeper water in the day and shallower water in the nighttime hours. Roundtail chub are associated with diverse habitat where water is relatively deep, and structure is more prevalent, including areas of undercut banks, large rocks on the substrate or stream bank and in some stream reaches overhanging shrubs and trees. The pattern however, is the same. These three species are more likely to be captured in the deepest part of the river or stream when the appropriate habitat is being sampled.

Published data support the qualitative observations of field biologists using electro-fishing techniques to sample the Three Species. The optimum depth for flannelmouth suckers in Colorado waters appears to be a depth between 1.3 feet and 6.6 feet (Anderson and Stewart, 2003, page 56, Figure 8). Flannelmouth in Wyoming selected waters from 1.6 feet to 3.3 feet in depth (Sweet 2007). Bluehead suckers do not appear to select for water as deep as flannelmouth suckers. The optimum depth for bluehead suckers in Colorado waters appears to be a depth between 1.6 feet and 5 feet (Anderson and Stewart, 2003, page 55, Figure 7). Bluehead suckers in Wyoming selected waters from 1.6 feet to 3.3 feet in depth (Sweet 2007). Specific information regarding roundtail chub and water depth is lacking. However adults and juveniles are usually taken in comparatively deep water with low water velocity (Rees et al. 2005) and in stream reaches with a complex combination of pool and riffle habitat and cover (Bezzerides and Bestgen 2002).

Shallow water does not result in elimination of these two native suckers and the roundtail chub but does result in the presence of smaller fish. Flannelmouth suckers are found in Yellow Jacket Creek in the southwest corner of Colorado. The runs were about 1.5 feet deep and the largest flannelmouth suckers were less than 14 inches in length. Yellow Jacket Creek water depth was at the low end of "optimum" for flannelmouth sucker but lack of deeper runs and pools resulted in comparatively smaller fish. Flows in the Dolores River upstream of the San Miguel River confluence are even lower and flannelmouth suckers only reach a maximum length of eight to ten inches (R. Anderson, personal communication). In contrast flannelmouth sucker can be 25 inches in length in streams and rivers with runs and pools in excess of 3.3 feet deep. A decrease in size may well lead to a lower fecundity in smaller reproducing adults and a lower fitness of the population as a whole.

Water depths may become so low that the fish populations become extirpated. An average depth of 1.0 foot is considered "marginally suitable" habitat for bluehead suckers (Anderson and Stewart 2003). Stream depth will be shallowest in the riffle areas preferred by bluehead suckers at any given instream flow. Fish such as the bluehead sucker do not disappear when average depths are less than 1.0 foot, but size and numbers decrease.

Water depth is directly related to water velocity. Water velocity and water depth increase as the flow volume increases during spring snow melt time periods, during summer thunderstorms or as irrigation return water enters the claimed reach of the Dolores River. Water velocities in riffles, runs and pools increase as water volume increases. Both flannelmouth and bluehead suckers may select different areas within the stream as flow levels change. For example, flannelmouth sucker may well be in deep water runs at water velocities of 3 ft/sec to 4 ft/sec but move to slower current pool areas when water velocities exceed 4 ft/sec at higher stream flows. Bluehead suckers may move to deep water runs and flannelmouth sucker may move to pool areas with slower current. Movement of bluehead sucker and flannelmouth sucker within rivers like the claimed reach of the Dolores River is a coordinated pattern depending on fluctuations in flow rates that influence both water depth and water velocity and sensitive stages of the fish species' natural history.

The numbers and size of the Three Species currently inhabiting the claimed reach of the Dolores River are determined to a certain extent by current flow regime. The abundant numbers of native fish and size of fish are a response to the current flow regime. Much of the water present in summer and fall months in the claimed reach of the Dolores River is comprised of irrigation return flows from the San Miguel River (Dan Kowalski, personal communication). These flows are less than historic native stream flows. Consequently water depth in riffles, runs and pools is probably less than what was present prior to the introduction of an irrigation-based agricultural system in the late 1800's. Thus, the CPW/BLM instream flow recommendations are based on the current flow regime in a stream channel that developed over the last several hundred years. The current habitat of the claimed reach of the Dolores River is not pristine and current flows are less than what was present historically.

The Dolores River is a comparatively small tributary to the mainstem Colorado River that drains much of southwestern Colorado. Water depths in the Dolores River vary seasonally and the CPW/BLM instream flow recommendations mirror that seasonal variation. At the requested flows the mean riffle depth in the claimed reach of the Dolores River ranges from 0.6 feet to 1.16 feet at a flow of 100 cfs during the extended winter and early spring seasons, August 15 through March 15 (Table 1). Mean riffle depth will be highest in the shorter snowmelt period (and spawning season of the Three Species) of April 15 through July 15 (range 1.84 feet to 2.56 feet). The mean riffle depth would then decrease somewhat (1.23 feet to 2.04 feet) during a midsummer flow period of June 15 through July 15 at a claimed flow of 400 cfs. Two "shoulder" seasons would be a buffer between the low riffle water depths of winter and fall and the spring snowmelt period. Late spring, summer and fall mean riffle water depths would be higher than those of the late fall and winter. The mean riffle depth in the spring early summer period would be about twice the mean riffle depth in late fall and winter.

The same pattern would exist for maximum riffle depth. Maximum riffle depths would be present during the spring and early summer spawning periods (April 15 through July 15), with lowest maximum riffle depths in the time period of August 15 through March 15.

Mean velocities exhibited the same pattern with maximum levels in the time period of April 16 through July 31. The lowest mean riffle velocities were determined for the low flow period of December through April 15.

Table 1. Depth and velocity data from CPW/BLM flow proposal for the Dolores River at the various flows.

Proposed flow (cfs)	Variable		Depth or velocity values (feet)
Q = 900 cfs	Mean depth feet	Min	1.84
April 15-June 14		Max	2.56
		Median	2.0
	Maximum depth feet	Min	3.2
		Max	3.7
		Median	3.48
	Velocity feet/sec	Min	2.9
		Max	4.2
		Median	3.18
Q =400 cfs	Mean depth feet	Min	1.23
June 15-July 15		Max	2.04
		Median	1.66
	Maximum depth feet	Min	2.45
		Max	3.79
		Median	2.8
	Velocity feet/sec	Min	1.8
		Max	3.7
		Median	2.45
Q = 200 cfs	Mean depth feet	Min	0.91
March 16- April 14		Max	1.59
July 16- August 14		Median	1.17
	Maximum depth feet	Min	1.92
		Max	2.91
		Median	2.27
	Velocity feet/sec	Min	1.41
		Max	2.5
		Median	2.0
Q = 100cfs	Mean depth feet	Min	0.62
August 15- March 15		Max	1.16
		Median	0.85
	Maximum depth feet	Min	1.47
		Max	2.26
		Median	1.92
	Velocity cm/sec	Min	1.15
		Max	2.02
		Median	1.7

Comparison of Dolores River CPW/BLM instream flow recommendations to habitat needs of the Three Species

The CPW/BLM instream flow recommendations were based in part on the amount of water believed to be seasonally available in the Dolores River downstream of the San Miguel River confluence. The seasonal flows requested are the water levels believed by the CPW/BLM to be available at least 50% of the time, not higher water volumes present less than 50% of the time. Thus, the CPW/BLM recommendation was not based solely on the biological needs of the native sucker species but addressed seasonal water quantity fluctuations. The CPW/BLM recommendations do not request that the existing seasonal flow regime be maintained in the claimed reach of the Dolores River. Water in excess of the CPW/BLM proposal is currently present in the river seasonally on an annual basis. Higher water flows are present during the spring snowmelt period than the amount claimed by the CPW/BLM (Executive summary Staff analysis of Dolores River, CWCB ID 14/4/A-006 page 13). The existing flow regime provides the habitat that supports the current numbers and size groups of the Three Species in the claimed reach of the Dolores River. The population demographics of the Three Species is a response to the current flow regime. The existing population demographics will change in the future if water in excess of the claimed flows is diverted based on subsequent junior water rights, Future reductions in water may well result in negative impacts to the Three Species compared to existing population demographics if another party claims and removes water in excess of the 900 cfs instream flow during the spring snowmelt period.

Future water depletions could be possible in the claimed reach of the Dolores River, even after instream flow rights are established. Future diversions could be approved for all flows in excess of those granted to the CPW/BLM. Approval of future water rights could decrease flow compared to current patterns. Water depths could well decrease compared to existing levels. Shallower water could well reduce both numbers and size of the Three Species. Colorado's instream flow program is designed for "reasonable protection" of aquatic resources, not a total protection. The Three Species are relatively long-lived fish where adults can be present many years in a river. The presence of adults from many age classes increases the level of difficulty in assessing status of these species.

The claimed flows for the Dolores River downstream of the San Miguel River provide different levels of protection for the Three Species. The life cycle requirements of the Three Species also vary from season to season and flow to flow.

Base flows 100 cfs (*August 15- March 15)*

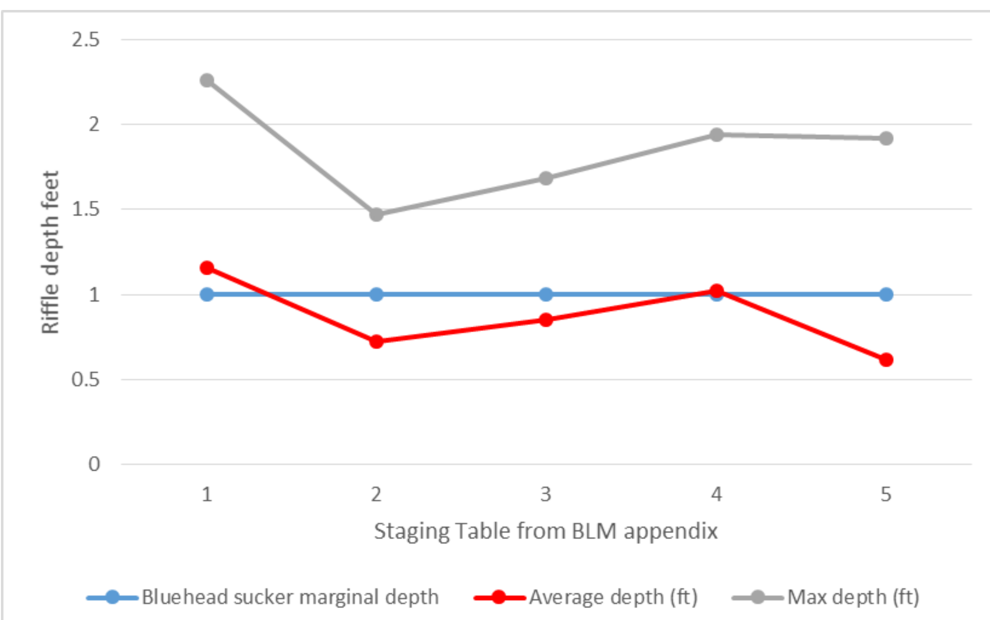
The base flow periods in Colorado Mountain streams such as the Dolores River downstream of the San Miguel River confluence are a time of low flows following and preceding the spring and early summer snowmelt time periods. The CPW/BLM recognized the various stages of the Dolores River hydrograph and recommended a seasonal flow recommendation for this base flow condition.

Base flows are a critical component of the life history of the Three Species in the claimed reach of the Dolores River. Bluehead sucker are predominately a riffle species while roundtail chub feed in riffle areas. All of the Three Species access deeper water areas by moving through riffle areas in the fall and winter months. Riffle areas with a mean depth of one foot and mean flow greater than 1.3 ft/sec provide marginally suitable bluehead sucker habitat (Anderson and Stewart 2003).

A flow of 100 cfs (as recommended by the CPW/BLM from 8/15 through 3/15) results in average depths ranging from 0.62 feet to 1.16 in riffle areas throughout the claimed reach (Figure 1). The average riffle depth would often be less than 1.0 feet, the level marginally supportive of bluehead sucker at the claimed flow of 100 cfs in some riffle areas. In other riffles, the average riffle depth would slightly exceed 1.0 feet. These average riffle depths will vary slightly around the minimum level needed to protect bluehead sucker through the claimed reach to a reasonable degree.

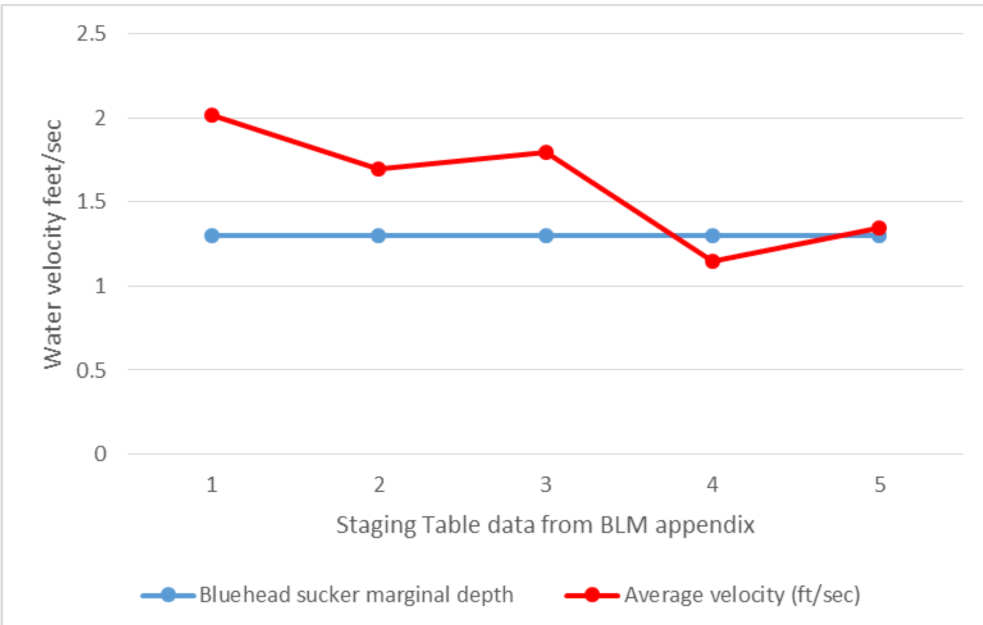
Maximum riffle depths in the claimed reach will be somewhat deeper ranging from 1.47 feet to 2.26 feet (Figure 1). Flannelmouth sucker prefer water depths ranging from 1.3 feet to 6.6 feet while bluehead sucker prefer slightly shallower water depths of 1.6 feet to 5.0 feet. The maximum riffle depths in the claimed reach are in the same range as the lower end of the preferred water depths for both the bluehead sucker and flannelmouth sucker. These two species can move access runs, riffles, glides and pool areas via the riffle areas during the base flow periods of August 15- March 15.

Figure 1. Average and maximum riffle depths at a flow of 100 cfs in claimed reach of Dolores River compared to marginally suitable depth required by bluehead suckers.



Average riffle water velocity will range from 1.15 to 2.02 feet/second during the base flow period of 100 cfs (Figure 2). These levels bracket the velocity of 1.3 feet/second considered to the marginally supportive of bluehead suckers. As with average riffle depth, the average riffle velocities within the claimed reach will not be "marginally" supportive of bluehead sucker in all riffles. As such, these water velocities represent minimum flows that will reasonable protect the Three Species.

Figure 2. Average riffle velocity at a flow of 100cfs in claimed reach of Dolores River compared to marginally acceptable velocity required by bluehead suckers.



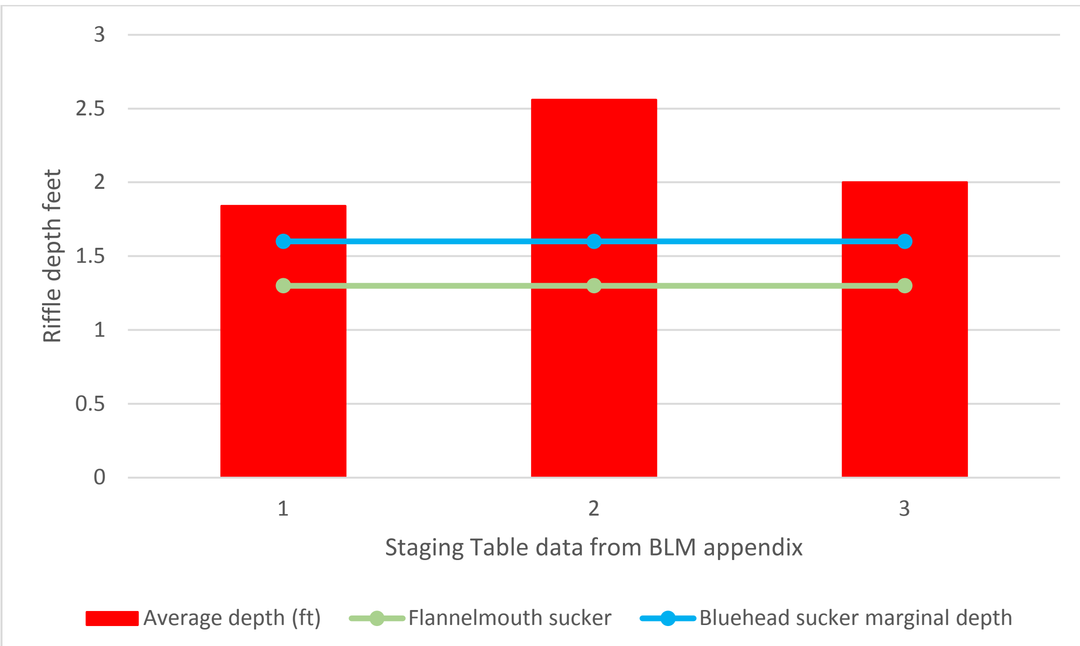
A flow of 100 cfs through the claimed reach of the Dolores River is indeed a minimum flow that provides reasonable protection for the Three Species assemblage. Lower winter time flows would not provide enough protection to assume the Dolores River Three Species group would be a viable, vigorous community surviving over an extended time period.

Spring flows 900 cfs (April 15-June 14)

Spring flows through the claimed reach of the Dolores River may be the most critical season. Spring is the spawning season for the Three Species. These species spawn in riffle areas. Flannelmouth suckers are broadcast spawners. Males move with gravid females into a riffle area. Usually more than one male will swim closely alongside the female. The female releases eggs while the attending males release sperm. The fertilized eggs then drift downstream to begin embryonic development. These eggs require appropriate habitat. The more water in the river at that time the more the eggs will be dispersed, settling into a wider range of microhabitats and perhaps enhancing survival of eggs.

CPW/BLM proposed a flow of 900 cfs through the claimed reach of the Dolores River from April 15 through June 14 for the spring spawning period. The average riffle flow depth exceeds the low end of preferred water depths for flannelmouth sucker and the bluehead sucker (Figure 3). The optimal water depth for flannel mouth sucker ranges from 1.3 feet to 6.6 feet. The optimal water depth for bluehead sucker ranges from 1.6 feet to 5.0 feet. The average depth of riffles ranges from 1.8 feet to 2.56 feet in the claimed reach at the 900 cfs flow. The average depth of riffles will be less than 50% of the maximum optimal depth for flannelmouth sucker and bluehead sucker in the claimed reach of the Dolores River. These depths are warranted to assure successful reproduction and represent the minimum levels needed to protect these species.

Figure 3. The low end of optimal riffle depth (feet) for bluehead sucker and flannelmouth sucker compared to average riffle depth in the claimed reach of the Dolores River at a 900 cfs flow.



Montrose County opposed instream snowmelt season, spring flows of 325 cfs (proposed by the CPW/BLM) in the claimed reach of the San Miguel River during a 2012 CWCB hearing. Montrose County asserted that a lower flow of 200 cfs from April 14 to June 14 “likely would be more suitable for younger life stages of (native) suckers which are more sensitive to higher velocity” (Conklin 2011). Montrose County also asserted that spring and summer flows of 325 cfs and 170 cfs in the San Miguel River “may be too high and limit the survival of these life stages” (Conklin 2011). These assertions are not correct. Trout reproduction and recruitment is better when spring snowmelt flows are comparatively low in Colorado mountain streams (Nehring and Anderson 1993, Woodling and Rollings 2005).

However the exact opposite is true for west slope native suckers where high recruitment was documented in years with high spring snowmelt flows (Burdick 1995). A strong bluehead sucker reproductive success in the Gunnison River was associated with a “normal” spring snowmelt in

2003 and low flows in the 2002 drought year resulted in poor bluehead sucker reproductive success (Anderson and Stewart 2006). Sweet (2007) indicated that low spring flows might have contributed to poor reproductive success in bluehead sucker and flannelmouth sucker in a headwater Wyoming river. High spring and summer snowmelt events enhance reproductive success in bluehead suckers and flannelmouth suckers. The habitat for the Three Species may well not be “optimum” during the days of maximum spring snowmelt but elevated flows appear to be needed to support robust populations of the Three Species.
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A claimed flow of 900 cfs as proposed by the CPW/BLM implies that an adequate flow rate for the time period of April 15 through June 14 is 900 cfs. The CPW/BLM analysis demonstrated that a snowmelt period of 1,200 cfs was the best flow for bluehead suckers. CPW/BLM appears to have been conservative when creating their proposal and selected the lower of two flows (900 cfs and 1,200 cfs) during the peak spring snowmelt period. Many aspects of a rivers ecology are related to maximum spring river flows. Sediments move when flows reach certain levels. Successful fish reproduction is connected to elevated flows. The stream channel is altered based on elevated river levels. The 900 cfs flow recommendation is much less than the water levels currently present in the Dolores River during the spring snowmelt period.

The current population numbers of the Three Species are a response to the current flow regime in the claimed portion of the Dolores River. The numbers and sizes of the Three Species present will decrease if further reductions in spring snowmelt flows occur. Accordingly the CWCB would be well advised to approve an additional seasonal flow period to provide reasonable protection for the current numbers and sizes of the Three Species present in the claimed reach. That flow would be 1,500 cfs for a week long period in late May and early June (See Executive summary Staff analysis of Dolores River, CWCB ID 14/4/A-006 page 13). These flows are available and are a minimum spring snowmelt flow needed to provide reasonable protection for the existing numbers and sized of the Three Species present in the claimed reach of the Dolores River.

Shoulder season 400 cfs (June 15-July 15)

Colorado mountain river flows decrease rather precipitously at the end of the spring snowmelt period. Water levels begin returning to base flows. CPW/BLM proposed a flow of 400 cfs for the time period of June 15 to July 15. This proposal was based on the existing flow regime in the Dolores River and not biological requirements of the Three Species. Flannelmouth sucker spawning season extends into the middle of June in some Colorado waters. I have observed flannelmouth sucker spawning in riffles after June 14. The CPW/BLM proposal for the June 15-July 15 addresses the needs of maximizing the reproductive success of the Three Species based on the existing flow regime of the Dolores River in the claimed reach.

The higher flows of 400 cfs also result in higher wetted perimeter levels. Emerging larvae and fry of the Three Species will have more habitat in which to disperse at a flow of 400 cfs compared to all lower stream flows. This additional habitat, for even a short time, may enhance fry survival.

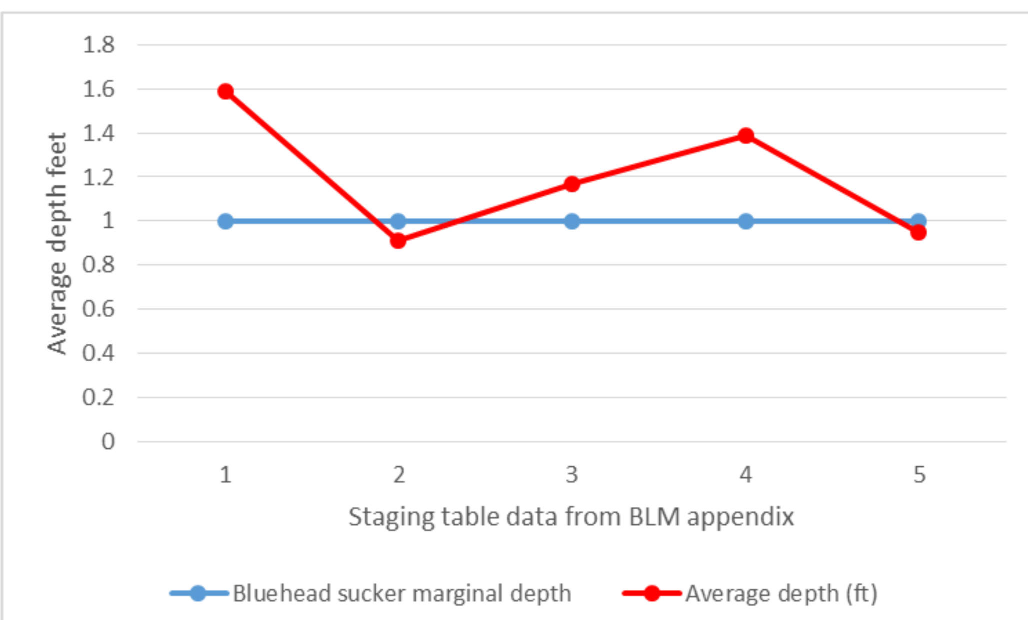
The average riffle depth in the claimed reach would range from 1.23 feet to 1.66 feet (Table 1) at a flow of 400 cfs from June 15 to July 15. A level of 1.23 feet is more than the water depth of one foot that is marginally supportive of bluehead sucker and is less than a depth of 1.6 feet, the low end of the optimal range for bluehead sucker. Riffle depths at a 400 cfs flow will generally provide bluehead sucker habitat that is more than marginally acceptable and less the optimal. This 400 cfs flow is a minimum level that provides reasonable protection for several life stages of the Three Species in the time period where flows in Colorado streams begin to decline after the peak spring snowmelt period.

Shoulder seasons 200 cfs (March 16-April 14 and July 16-August 14)

Seasonal changes in stream and river flows do not occur in a single day. The spring snowmelt period is a gradual process over a period of days and weeks. In addition, flows decrease in the late summer rather rapidly after the snowmelt period ends. The CPW/BLM recognized this time period and established two shoulder season flows on each side of the base flow period (March 16-April 14 and July 16-August 14).

A flow of 200 cfs (as recommended by the CPW/BLM from March 16-April 14 and July 16-August 14) results in average depths ranging from 0.91 feet to 1.59 in riffle areas throughout the claimed reach (Figure 4). The average riffle depth would often be less than 1.0 feet, the level marginally supportive of bluehead sucker at the claimed flow of 100 cfs in some riffle areas. In other riffles, the average riffle depth would slightly exceed 1.0 feet. Average riffle flows during these two brief "shoulder" seasons (claimed low of 200 cfs) would be somewhat greater than during the longer 100 cfs claimed flow period of August 15- March 15. However, the claimed flows at 200 cfs will still vary slightly around the "marginally" protective level of 1.0 feet for bluehead sucker.

Figure 4. Average riffle depths at a flow of 200 cfs in claimed reach of Dolores River compared to marginally suitable depth required by bluehead suckers.



Maximum riffle depths in the claimed reach will be somewhat deeper from March 16-April 14 and July 16-August 14 compared to the base flow period of August 14 through March 16. Average riffle depth for this 200 cfs flow will range from 1.92 feet to 2.91 (Table 1). Flannelmouth sucker prefer water depths of 1.3 feet to 6.6 feet while bluehead sucker prefer slightly shallower water depths of 1.6 feet to 5.0 feet. The maximum riffle depths in the claimed reach are in the same range as the lower end of the preferred water depths for both the bluehead sucker and flannelmouth sucker. These maximum riffle depths are less than the high end of preferred water depths. The Three Species can move access runs, riffles, glides and pool areas via the riffle areas during the shoulder flow periods of March 16-April 14 and July 16-August 14.

Average riffle water velocity will range from 1.41 to 2.5 feet/second during the “shoulder” season flow period of 200 cfs (Table 1). These levels exceed the velocity of 1.3 feet/second considered to the marginally supportive of bluehead suckers. The average riffle velocity of 1.41 feet/second is just higher than the velocity of 1.3 feet/second that is marginally supportive of bluehead suckers. As such, these water velocities represent minimum flows that will reasonably protect the Three Species.

The slightly higher average flows through riffle areas at the claimed flow of 200 cfs will allow bluehead suckers to access greater portions of riffles in the claimed reach in comparison to the low flow period of August 15- March 15. However mean riffle depths will be less than one foot in some stream areas, limiting bluehead sucker numbers and size. A flow of 100 cfs through the claimed reach of the Dolores River is indeed a minimum flow that provides reasonable protection for the Three Species assemblage.

Flow analysis summary – A variety of factors must be assessed before a determination is made that the claimed flows for the Dolores River are not appropriate in some manner. Only one habitat variable has to be less than a level that reasonably supports a fish population to assure that a fish population will be harmed in some manner. The level of harm may be rather benign, such a smaller sizes of rather serious, such as reduced population numbers. Instream flows are one such environmental factor.

No scale exists that indicates when a habitat (or flow) becomes unsuitable for colonization by a fish species. The habitat of the Dolores River upstream of the San Miguel River confluence is such that adult flannelmouth suckers, bluehead suckers and roundtail chub are much smaller than in the Dolores River downstream of the confluence with the San Miguel River. In addition, nonnative fish species are more prevalent in the Dolores River upstream of the confluence with the San Miguel River, perhaps due to stress associated with low flows.

A flow that results in 20% of optimum habitat be closer to a condition where adult fish are smaller and nonnative fish more abundant in the Dolores River. A low that results in 40% may be the condition where reasonable protection is provided. No proof exists that any given percentage of optimum habitat is appropriate or provides the “reasonable protection” as defined by the instream flow program. Each claimed stream reach must be analyzed separately and appropriate instream flows adopted.

The depth preferences for flannelmouth sucker, bluehead sucker and roundtail chub compared to riffle depth data generated as part of the CPW/BLM field studies demonstrates that the claimed stream flows for the Dolores River claimed reach are minimum levels that provide “reasonable” protection for the Three Species.

1. 100 cfs (August 15 through March 15),

A flow of 100 cfs from August 15 through March 15 provides some marginal riffle habitat for bluehead sucker and allows all of the Three Species to move between deeper water habitats in the claimed reach of the Dolores River. The 100 cfs proposal was based on the current flow regime in the claimed reach.

2. 200 cfs (July 16 through August 14 and March 16 through April 14),

A flow of 200 cfs from July 16 through August 14 and March 16 through April 14 provides for additional riffle habitat for bluehead sucker and is based on greater stream flow levels that are available during those two time periods.
The recommendation for the June 15 to July 14 and July 15 to August 14 time periods are designed to maintain as much bluehead sucker and flannelmouth sucker habitat as possible during a period of the year when flows are rapidly declining toward base flows in the late summer or increasing in the first part of the spring snowmelt period.

3. 400 cfs (June 15 through July 15).

A flow of 400 cfs proposed for June 15 through July 15 was based on the amount of water historically present in this time period and developed to retain spawning habitat for the Three Species.

4. 900 cfs (April 15 through June 14).

A flow of 900 cfs from April 15 through June 14 provides spawning habitat and riffle habitat analysis for the Three Species. The CPW/BLM proposal for this time period was based on hydrograph data from the Dolores River from about 1974 to 2006 (Executive summary Staff analysis of Dolores River, CWCB ID 14/4/A-006 page 13).

All of the seasonal claimed flows for the Dolores River are appropriate minimum flows that provide reasonable protection for the Three Species and incorporate limitations imposed by current flow regimes in the claimed reach.

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Climate Change in Colorado

A Synthesis to Support Water Resources Management and Adaptation

     

A Report for the Colorado Water Conservation Board

Executive Summary

Adapted from the Report

Western Water Assessment

CIRES

University of Colorado Boulder

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Climate Change in Colorado

A Synthesis to Support Water Resources Management and Adaptation

Second Edition - August 2014

A Report for the Colorado Water Conservation Board

Western Water Assessment, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado Boulder

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Western Water Assessment CIRES University of Colorado Boulder COLORADO Colorado Water Conservation Board Department of Natural Resources

Executive Summary

This report is a synthesis of climate science relevant for management and planning for Colorado's water resources. It focuses on observed climate trends, climate modeling, and projections of temperature, precipitation, snowpack, and streamflow. Climate projections are reported for the mid-21st century because this time frame is the focus of adaptation strategies being developed by the State of Colorado and other water entities.

Overview

In the past 30 years, Colorado's climate has become substantially warmer. The recent warming trend in Colorado is in step with regional and global warming that has been linked to increasing atmospheric concentrations of greenhouse gases. Annual precipitation, which has high natural variability, has not seen a statewide trend over that period. However, some drought indicators have worsened due to the warmer temperatures.

As greenhouse gases and other human effects on the climate continue to increase, Colorado is expected to warm even more by the mid-21st century, pushing temperatures outside of the range of the past century. The outlook for future precipitation in Colorado is less clear; overall increases or decreases are possible. The risk of decreasing precipitation appears to be higher for the southern parts of the state.

The future warming is projected to generally reduce Colorado's spring snowpack, cause earlier snowmelt and runoff, and increase the water use by crops, landscaping, and natural vegetation. While future increases in annual natural streamflow are possible, the body of published research indicates a greater risk of decreasing streamflow, particularly in the southern half of the state.

Summit Lake Park, along Mount Evans Scenic Byway.
Photo: Creative Commons, Matt Wright.

Observed climate trends in Colorado (Section 2)

- Statewide annual average temperatures have increased by 2.0°F over the past 30 years and 2.5°F over the past 50 years (Figure ES-1). Warming trends have been observed over these periods in most parts of the state.
- Daily minimum temperatures in Colorado have warmed more than daily maximum temperatures during the past 30 years. Temperatures have increased in all seasons.
- No long-term trends in average annual precipitation have been detected across Colorado, even considering the relatively dry period since 2000.
- Snowpack, as measured by April 1 snow-water equivalent (SWE), has been mainly below-average since 2000 in all of Colorado's river basins, but no long-term (30-year, 50-year) declining trends have been detected.
- The timing of snowmelt and peak runoff has shifted earlier in the spring by 1–4 weeks across Colorado's river basins over the past 30 years, due to the combination of lower SWE since 2000, the warming trend in spring temperatures, and enhanced solar absorption from dust-on-snow.
- The Palmer Drought Severity Index (PDSI) shows a trend towards more severe soil-moisture drought conditions in Colorado over the past 30 years, reflecting the combination of the below-average precipitation since 2000 and the warming trend.
- No long-term statewide trends in heavy precipitation events have been detected. The evidence suggests that there has been no statewide trend in the magnitude of flood events in Colorado.

FIGURE ES-1. Colorado statewide annual temperature, 1900–2012

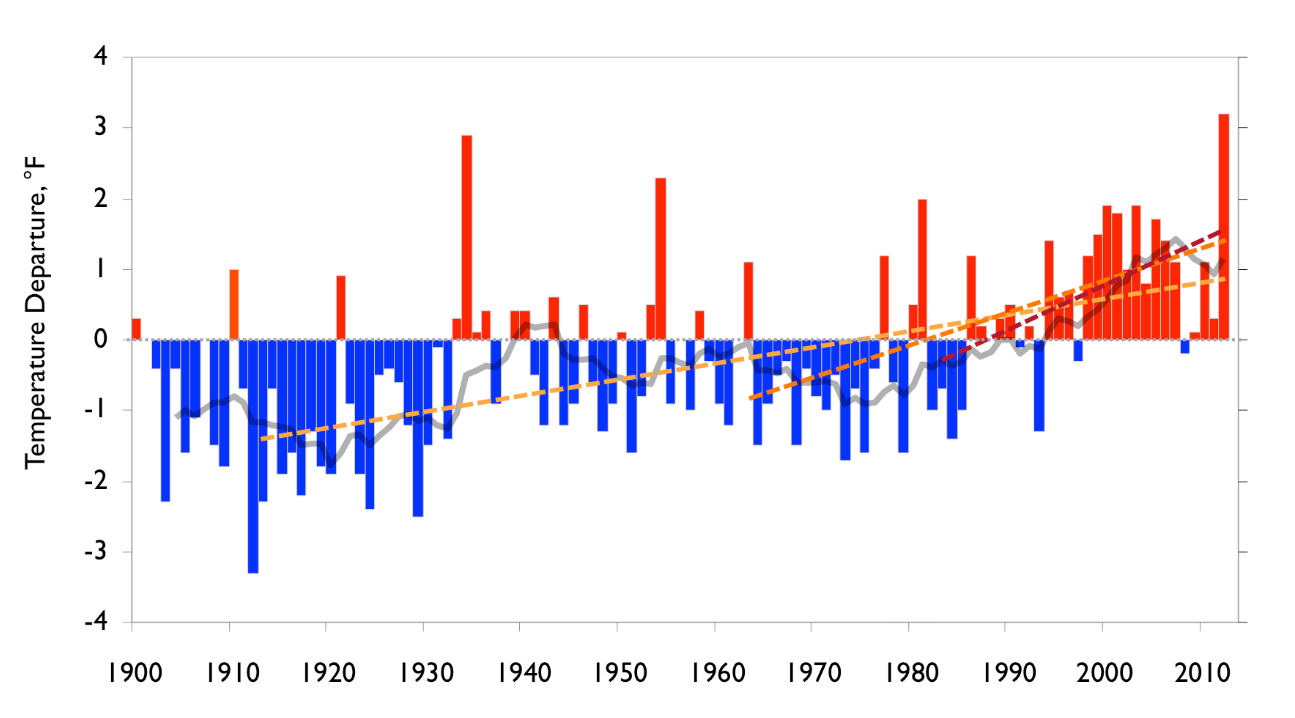

Fig. ES-1. Colorado statewide annually-averaged temperature (°F), 1900–2012. Annual departures are shown relative to a 1971–2000 reference period. The light-orange, orange, and red lines are the 100-year, 50-year, and 30-year trends, respectively. All three warming trends are statistically significant. The gray line shows the 10-year running average. The record shows a cool period from 1900 to 1930, a warm period in the 1930s and again in the 1950s, a cool period in the late 1960s and 1970s, and consistently warm temperatures since the mid-1990s. (Data source: NOAA NCDC; http://www.ncdc.noaa.gov/cag/)

- Tree-ring records and other paleoclimate indicators for Colorado show multiple droughts prior to 1900 that were more severe and sustained than any in the observed record.

Linking changes in Colorado to global changes (Section 4)

- The global climate system has warmed since 1900, particularly in the past 30 years, as evidenced by increased surface, atmospheric, and ocean temperatures; melting glaciers and ice sheets; rising sea levels; and increased atmospheric water vapor.
- These global changes have been attributed mainly to anthropogenic (human-caused) influences, primarily the increase in greenhouse gases in the atmosphere to the highest levels in at least 800,000 years.
- In North America, temperatures have increased by about 2°F in the last 30 years, with anthropogenic influences making a substantial contribution.
- In Colorado, temperatures have also warmed by 2°F in the past 30 years. The statewide warming is plausibly linked to anthropogenic influences, but definitive attribution at this spatial scale is difficult.
- Recent variability in Colorado's annual precipitation has not exhibited trends that might be attributed to anthropogenic climate change.
- Anthropogenic climate change may have increased the severity of recent drought conditions in the western U.S., due to the influence of the warming on snowpack, streamflow, and soil moisture.

Projections of Colorado's future climate and implications for water resources (Section 5)

- All climate model projections indicate future warming in Colorado (Figure ES-2). The statewide average annual temperatures are projected to warm by +2.5°F to +5°F by 2050 relative to a 1971–2000 baseline under a medium-low emissions scenario

FIGURE ES-2. Projected annual temperature and precipitation changes for the western U.S. for 2050

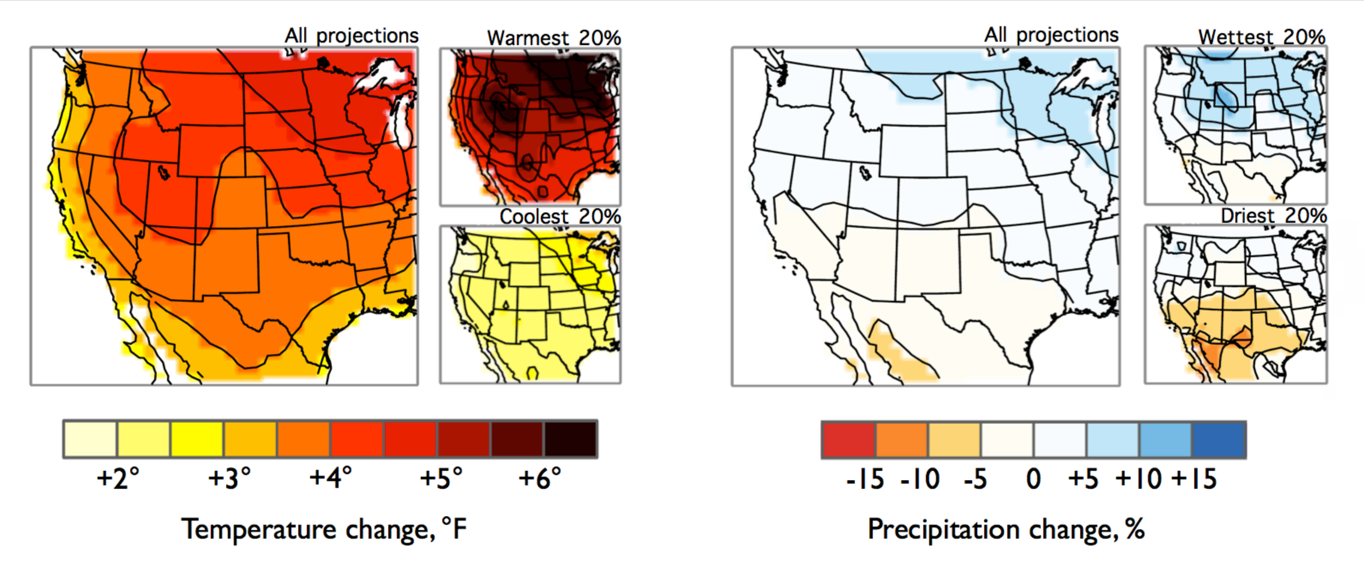

Fig. ES-2. Projected changes in annual average temperature and precipitation by 2050 (2035–2064) over the western US from an ensemble of 37 climate models under RCP 4.5, a medium-low emissions scenario. The large maps show the average change for all of the models (n=37), and the small maps show the average changes for the highest 20% (n=8) and lowest 20% (n=8) of the models, based on the statewide change for Colorado. For Colorado, all models show substantial warming, but there is less agreement about the direction of precipitation change. See Figure 5-1 for an expanded version that also shows seasonal changes. (Data source: CMIP5 projections re-gridded to 1-degree grid, Reclamation 2013; http://gdo-dcp.ucllnl.org/)

(RCP 4.5). Under a high emissions scenario (RCP 8.5), the projected warming is larger at mid-century (+3.5°F to +6.5°F), and much larger later in the century as the two scenarios diverge.

- Summer temperatures are projected to warm slightly more than winter temperatures. Typical summer temperatures by 2050 are projected under RCP 4.5 to be similar to the hottest summers that have occurred in past 100 years.

- Climate model projections show less agreement regarding future precipitation change for Colorado. The individual model projections of change by 2050 in statewide annual precipitation under RCP 4.5 range from -5% to +6% (Figure ES-2). Projections under RCP 8.5 show a similar range of future change (-3% to +8%).

- Nearly all of the projections indicate increasing winter precipitation by 2050. There is weaker consensus among the projections regarding precipitation in the other seasons.

- In the first projections of future Colorado hydrology based on the latest climate model output, most projections show decreases in annual streamflow by 2050 for the San Juan and Rio Grande basins. The projections are more evenly split between future increases and decreases in streamflow by 2050 for the Colorado Headwaters, Gunnison, Arkansas, and South Platte basins. However, other hydrology projections show drier outcomes for Colorado, and the overall body of published research indicates a tendency towards future decreases in annual streamflow for all of Colorado's river basins.

- The peak of the spring runoff is projected to shift 1–3 weeks earlier by the mid-21st century due to warming. Late-summer flows are projected to decrease as the peak shifts earlier. Changes in the timing of runoff are more certain than changes in the amount of runoff.

- Most projections of Colorado's spring snowpack (April 1 SWE) show declines for the mid-21st century due to the projected warming.

- Most climate projections indicate that heat waves, droughts and wildfires will increase in frequency and severity in Colorado by the mid-21st century due to the projected warming.

Incorporating climate change information into vulnerability assessment and planning (Section 6)

- Colorado water entities have been at the forefront of incorporating climate change into long-term planning, and their experience can inform future efforts by others.

- Observed records of climate and hydrology are still fundamental to assessing future climate risk, but should be supplemented with information from climate model projections and paleoclimate records.

- Planning approaches that explore multiple futures, rather than assuming a single future trajectory, are more compatible with climate projections and may improve preparedness for a changing climate.

- The uncertainty in projections of precipitation and streamflow for Colorado should not be construed as a "no change" scenario, but instead as a broadening of the range of possible futures, some of which would present serious challenges to the state's water systems (Table ES-1).

To download the full report, go to:

http://cwcb.state.co.us/environment/climate-change/

Supplemental information is available at:

http://wwa.colorado.edu/climate/co2014report/

TABLE ES-1. Summary of projected changes and potential impacts to water resources for Colorado

Element	Projected changes and potential impacts	Studies that have assessed this vulnerability for Colorado
Overall surface water supply	Most projections of future hydrology for Colorado's river basins show decreasing annual runoff and less overall water supply, but some projections show increasing runoff. Warming temperatures could continue the recent trend towards earlier peak runoff and lower late-summer flows.	CWCB (2012); Reclamation (2012); Woodbury et al. (2012)
Water infrastructure operations	Changes in the snowpack and in streamflow timing could affect reservoir operations, including flood control and storage. Changes in the timing and magnitude of runoff could affect the functioning of diversion, storage, and conveyance structures.	CWCB (2012); Reclamation (2012)
Crop water demand, outdoor urban watering	Warming temperatures could increase the loss of water from plants and soil, lengthen growing seasons, and increase overall water demand.	CWCB (2012); Reclamation (2012)
Legal water systems	Earlier and/or lower runoff could complicate the administration of water rights and interstate water compacts, and could affect which rights holders receive water.	CWCB (2012)
Water quality	Warmer water temperatures could cause many indicators of water quality to decline. Lower streamflows could lead to increasing concentrations of pollutants.	EPA (2013)
Groundwater resources	Groundwater usage for agriculture could increase with warmer temperatures. Changes in precipitation could affect groundwater recharge rates.	
Energy demand and operating costs	Warmer temperatures could place higher demands on hydropower facilities for peaking power in summer. Warmer lake and stream temperatures, and earlier runoff, could affect water use for cooling power plants and in other industries.	Macknick et al. (2012)
Forest disturbances in headwaters regions	Warmer temperatures could increase the frequency and severity of wildfire, and make trees more vulnerable to insect infestation. Both have implications for water quality and watershed health.	
Riparian habitats and fisheries	Warmer stream temperatures could have direct and indirect effects on aquatic ecosystems, including the spread of non-native species and diseases to higher elevations. Changes in streamflow timing could also affect riparian ecosystems.	Rieman and Isaak (2010)
Water- and snow-based recreation	Earlier streamflow timing could affect rafting and fishing. Changes in reservoir storage could affect recreation on-site and downstream. Declining snowpacks could impact winter mountain recreation and tourism.	Reclamation (2012); Battaglin et al. (2011); Lazar and Williams (2008)

Table ES-1. Potential water-related impacts from climate change in different areas and sectors. See the *References* section of the full report for the studies cited in the last column.

To download the full report, go to:

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RANGE-WIDE

CONSERVATION AGREEMENT AND STRATEGY FOR

ROUNDTAIL CHUB *Gila robusta*,

BLUEHEAD SUCKER *Catostomus discobolus*,

AND FLANNELMOUTH SUCKER *Catostomus latipinnis*

Prepared for
Colorado River Fish and Wildlife Council

Prepared by
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Director

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

I. INTRODUCTION

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

II. GOAL

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

III. OBJECTIVES

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

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

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

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

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

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

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

IV. OTHER SPECIES INVOLVED

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

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

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

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

V. INVOLVED PARTIES

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

Arizona Game and Fish Department

Colorado Division of Wildlife

Nevada Department of Wildlife

New Mexico Department of Game and Fish

Utah Division of Wildlife Resources

Wyoming Game and Fish Department

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

VI. AUTHORITY

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

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

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

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

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

VII. CONSERVATION ACTIONS

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

1) Conduct status assessment of roundtail chub, bluehead sucker, and flannelmouth sucker.
2) Establish and maintain a database of past, present, and future information on roundtail chub, bluehead sucker, and flannelmouth sucker.
3) Determine roundtail chub, bluehead sucker, and flannelmouth sucker population demographics, life history, habitat requirements, and conservation needs.
4) Genetically and morphologically characterize populations of roundtail chub, bluehead sucker, and flannelmouth sucker.
5) Increase roundtail chub, bluehead sucker, and flannelmouth sucker populations to accelerate progress toward attaining population objectives for respective species.
6) Enhance and maintain habitat for roundtail chub, bluehead sucker, and flannelmouth sucker.
7) Control (as feasible and where possible) threats posed by nonnative species that compete with, prey upon, or hybridize with roundtail chub, bluehead sucker, and flannelmouth sucker.
8) Expand roundtail chub, bluehead sucker, and flannelmouth sucker population distributions through transplant activities or reintroduction to historic range, if warranted.
9) Establish and implement qualitative and quantitative long-term population and habitat monitoring programs for roundtail chub, bluehead sucker, and flannelmouth sucker.
10) Implement an outreach program (e.g., development of partnerships, information and education activities) regarding conservation and management of roundtail chub, bluehead sucker, and flannelmouth sucker.

Coordinating Conservation Activities

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

Implementing Conservation Schedule

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

Funding Conservation Actions

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

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

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

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

Conservation Progress Assessment.

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

VIII. DURATION OF AGREEMENT

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

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

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

X. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

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

XI. SIGNATORIES

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

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

Colorado Division of Wildlife
6060 Broadway
Denver, Colorado 80216

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

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

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

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

Bruce Thompson ____ 4-15-04
Director ____ Date

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

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

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

for 3-12-04
Terry Cleveland Date
Director

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

Approval as to form:

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

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

Alan L Kesterke

Bureau of Land Management
Wyoming State Office

April 8, 2005

Date

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

Joel Wisely

Bureau of Land Management
Utah State Office

5/16/05

Date

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

Linda S.C. Rundell

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

4/7/06
Date

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

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

Michael D. Snyder — 7/5/05

Michael D. Snyder
Acting Director

Date

The U.S. Bureau of Reclamation, Upper Colorado Region (Reclamation), hereby states its support of the goals, objectives, and actions of the Range-Wide Conservation Agreement for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (Utah Division of Wildlife Resources publication no. 06-18).

Financial support of any activity prescribed to the signatories of the Conservation Agreement is not guaranteed and is contingent upon Reclamation's authority and adequate funds being made available and allocated to Reclamation.

Reclamation recognizes that implementation of certain conservation actions identified in the Conservation Agreement are directed toward the state signatories.

Acting for

Rick L. Gold
Regional Director

4/3/07
Date

CONSERVATION COMMITMENT

The U.S. Fish and Wildlife Service, Mountain-Prairie Region, hereby states its intent and commitment to assist with and participate in the support of the Range-wide Conservation agreement and strategy for roundtail chub *Gila robusta*, bluehead sucker *Catostomus discobolus*, and flannelmouth sucker *Catostomus latipinnis*, as prepared for the Colorado River Fish and Wildlife Council. Specific involvement may include:

1. Providing representation to the Three Species Conservation Team.

2. Consistent with applicable laws and procedures, funding for eligible projects through the State Wildlife Grant program as long as State matching funds are available and projects are consistent with the State Wildlife Plan.

3. Providing comments under existing laws and regulations for any projects federally authorized, funded, or carried out that may impact any of the three species.

4. Using the Service's authority under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j), as amended, and the Migratory Bird Hunting Stamp Act (16 USC .718), to protect the three species from land and water altering activities, on National Wildlife Refuge System lands.

Performance of all activities listed above is contingent upon the annual receipt of adequate funding. This commitment shall not prohibit the signatory agency from engaging in management actions regarding three species conservation beyond those described in this commitment page and in the associated Plan. Such management actions should be coordinated with the Three Species Conservation Team.

This commitment shall become effective on the date of signature by the participating party and shall remain in effect until the signatory party chooses to terminate the commitment or until the Three Species Conservation Team decides (by consensus) to terminate the Plan. The signatory party will provide 90 days written notification to the other parties upon deciding to terminate involvement.

The U.S. Fish and Wildlife Service has the authority to enter into this commitment through the Endangered Species Act of 1973, as amended; the Fish and Wildlife Act of 1956, as amended; the Fish and Wildlife Coordination Act, as amended; and 43 CFR part 24, U.S. Department of Interior's fish and wildlife policy on State and Federal relationships.

By signing the document below, the Service acknowledges that it is also signing as a party and participant to the whole of the 2006 Three Species Conservation and Management Plan attached hereto.

Mitch King, Regional Director
U.S. Fish & Wildlife Service, Mountain-Prairie Region

12-28-06
Date

-Signature Page-

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

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

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

President Levi Pesata

5/10/06
Date

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

XII. INTRODUCTION

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

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

XIII. BACKGROUND

Geographic Setting

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

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

Species Descriptions, Life Histories and Hybrids

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

Roundtail Chub

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

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

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

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

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

Bluehead Sucker

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

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

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

Flannelmouth Sucker

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

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

Hybrids

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

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

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

XIV. CONSERVATION GUIDELINES

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

Habitat Maintenance and Protection

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

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

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

Nonnative fish control

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

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

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

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

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

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

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

Population Viability

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

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

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

Population viability is a function of population demographics (size and age structure), population redundancy (number and distribution), habitat carrying capacity (resource limitations), and genetic stability (inbreeding and genetic diversity; Franklin 1983; Soulé 1980; Shaffer 1987; Allen et al. 1992). Viable, self-sustaining populations are characterized as having a negligible chance of extinction over century time scales, are large enough to be sustained through historical environmental variation, are large enough to maintain genetic diversity, and maintain positive recruitment near carrying capacity. Establishment of functioning metapopulations (see next section) can fulfill several of these criteria, including stabilization of population dynamics (Wilcox and Murphy 1985, Hanski and Gilpin 1991), increasing range-wide genetic heterogeneity (Simberloff and Abele 1976), and decreasing probability of population losses through environmental and demographic stochasticity (Roff 1974, Wilcox and Murphy 1985).

Metapopulation Dynamics and Function

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

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

Conservation Genetics

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

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

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

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

Hybrids

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

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

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

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

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

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

Distribution

The roundtail chub, bluehead sucker, and flannelmouth sucker are three of the least-studied fishes native to the CRB and the Bonneville Basin. Available literature suggests that the three species were common to all parts of the CRB until the 1960s (Sigler and Miller 1963, Jordan and Evermann 1896, Minckley 1973). There have been no range-wide distribution or status assessments for any of these three species preceding the current review of Bezzerides and Bestgen (2002), which concludes that distributions of all three fish species have contracted 50%, on average, from their historic distributions.

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

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

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

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

Status

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

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

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

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

Goal

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

Objectives

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

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

XVII. CONSERVATION ACTIONS AND ADAPTIVE MANAGEMENT

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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APPENDIX 1: STANDARD LANGUAGE REQUIRED BY THE STATE OF ARIZONA

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

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

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

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

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