

## SAN JUAN WATERSHED

The San Juan River originates in the San Juan Mountains of southwestern Colorado. It enters New Mexico northeast of Farmington and flows westward for about 93 mi (150 km) to exit the state near “Four Corners.” Upstream of Four Corners, the river drains about 6,918,372 ac (2,799,780 ha), including portions within Colorado. Associated key perennial aquatic habitats are a large reservoir, 3<sup>rd</sup> and 4<sup>th</sup> order streams, and 5<sup>th</sup> order stream (San Juan River) (Fig. 5-14).

Navajo Dam impounds the upper 19 mi (30 km) of the river in New Mexico. From Navajo Dam downstream to Farmington, the river is restricted to a single, moderately incised channel and habitats are mainly cobbled riffles, moderately deep runs, and large pools. As the river progresses downstream from Farmington to Shiprock, gradient diminishes, but flow remains mainly in a single channel. Downstream of Shiprock, the river is frequently divided among two, three, or four channels and habitat diversity increases with channel complexity. In addition to habitats common in upstream reaches, backwaters, embayments, shoals, and secondary channels (having their own mix of habitats) are present. Navajo Dam controls flows in the river and its tailwaters support a nationally recognized trout fishery. Several low-head diversion dams seasonally diminish discharge. The San Juan River, within New Mexico, is permanently watered, but permanently flowing tributaries are currently limited to the Navajo, Animas, and Mancos rivers. The US Bureau of Land Management administers much of the watershed upstream of Farmington and large portions are on Navajo and Jicarilla Apache lands.

The population of San Juan County grew 24% from 1990 to 2000 and slightly less than half the 113,801 residents of San Juan County live in the municipalities of Aztec (6,378), Bloomfield (6,417), and Farmington (37,844) (US Census Bureau 2002). Mining, construction, and utilities are the most important economic activities in the county. In addition to regulated flows, aquatic habitats of the San Juan River are influenced by channelization in some sections, water diversion, runoff from municipalities and rowcrop agricultural lands, and petroleum-extraction activities. Currently, Navajo Reservoir operates to mimic a natural hydrograph in compliance with the conditions of a Biological Opinion issued to the US Bureau of Reclamation by the US Fish and Wildlife Service, under authority of Section 7 of the Endangered Species Act. Considerable data on water quality and habitats of the main stem San Juan River are available in various reports produced by the San Juan River Basin Recovery Implementation Program (USFWS 2004; <http://www.fws.gov/southwest/sjrip/>).

A number of non-native fish species have been captured or reported from the San Juan River, but only red shiner (*Cyprinella lutrensis*), common carp (*Cyprinus carpio*), fathead minnow, (*Pimephales promelas*), plains killifish (*Fundulus zebrinus*), white sucker (*Catostomus commersoni*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), and channel catfish (*Ictalurus punctatus*) are regularly found and comparatively common. Navajo Reservoir supports populations of non-native smallmouth bass (*Micropterus dolomieu*), largemouth bass, (*M. salmoides*), rainbow trout, and kokanee salmon (*O. nerka*). Considerable data on native and non-native fishes are available in various reports produced by the San Juan River Basin Recovery Implementation Program (USFWS 2004; <http://www.fws.gov/southwest/sjrip/>) and New Mexico Department of Game and Fish (NMDGF) federal aid reports.

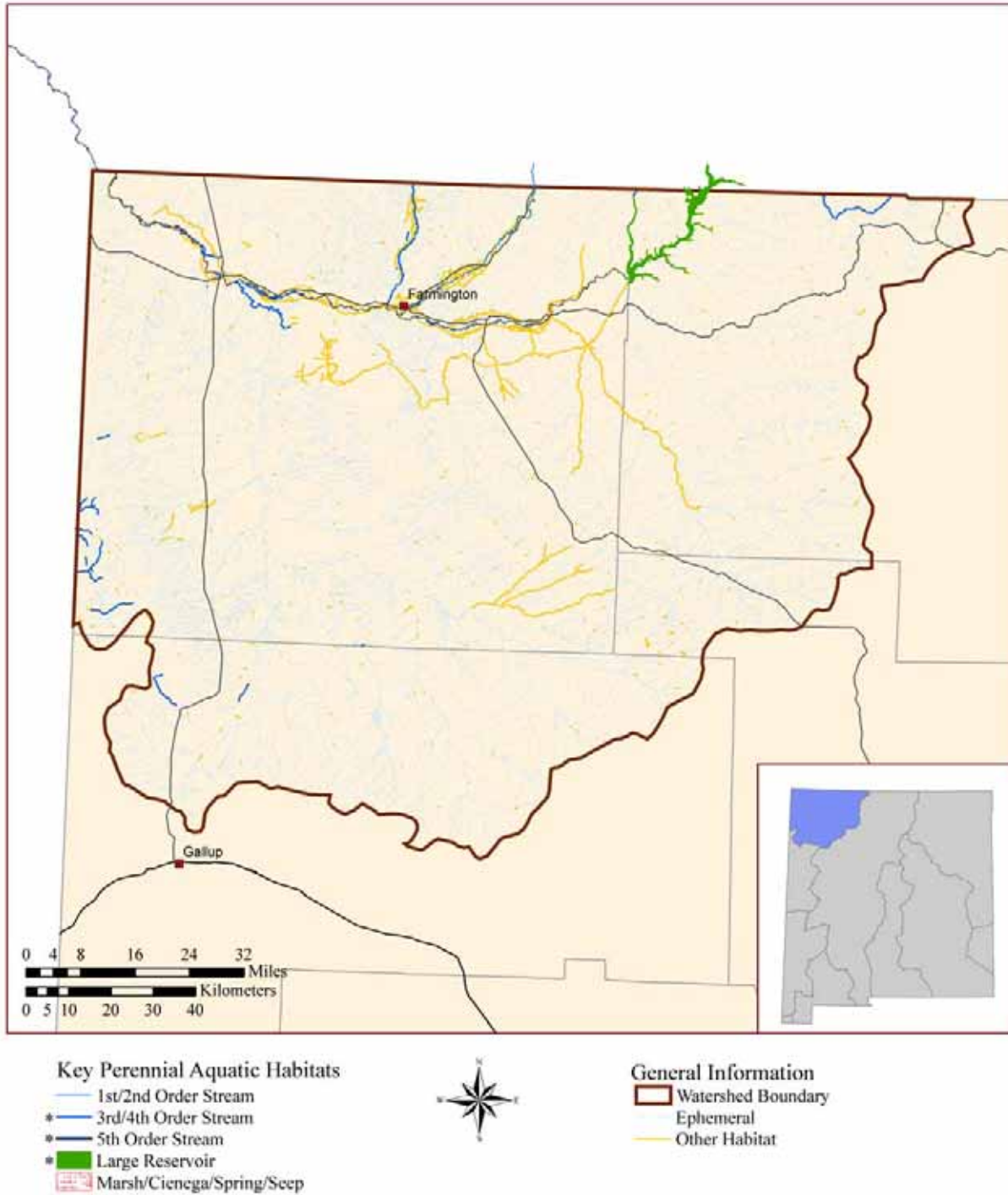


Figure 5-14. Key perennial aquatic habitats in the San Juan Watershed in New Mexico. Key habitats are designated with an asterisk (\*)

**Species of Greatest Conservation Need**

The New Mexico Department of Game and Fish identified 22 Species of Greatest Conservation Need (SGCN), excluding arthropods other than crustaceans, in the San Juan Watershed (Table 5-16). Twelve species (55%) are classified as vulnerable, imperiled, or critically imperiled in New Mexico, but secure nationally. Six species are classified as vulnerable, imperiled, or critically imperiled in New Mexico and nationally. Four species are considered secure both in the state and nationally. Conservation status codes (abundance estimates) for each SGCN are provided in Appendix H.

Table 5-16. Species of Greatest Conservation Need in the San Juan Watershed.

Common Name	Perennial		
	Large Reservoir	3 <sup>rd</sup> and 4 <sup>th</sup> Order Stream	5 <sup>th</sup> Order Stream
<b><i>Fish</i></b>			
Roundtail Chub	X	X	X
Colorado Pikeminnow			X
Razorback Sucker			X
Mottled Sculpin		X	X
<b><i>Birds</i><sup>1</sup></b>			
Eared Grebe	X	X	X
American Bittern			
White-Faced Ibis	X		
Northern Pintail	X	X	X
Osprey	X	X	X
Bald Eagle	X	X	X
Northern Harrier			
Peregrine Falcon	X	X	X
Sandhill Crane	X		X
Wilson's Phalarope	X		
Southwestern Willow Flycatcher		X	X
Bank Swallow		X	X
Yellow Warbler		X	X
<b><i>Mammal</i><sup>1</sup></b>			
American Beaver	X	X	X
<b><i>Amphibians</i><sup>1</sup></b>			
Western Chorus Frog		X	
Northern Leopard Frog		X	X
<b><i>Reptile</i><sup>1</sup></b>			
Western Painted Turtle	X	X	X
<b><i>Crustacean</i><sup>1</sup></b>			
Amphipod	X	X	X

<sup>1</sup> Additional conservation concerns for these taxa are addressed in the Statewide Distributed Riparian Habitats, Statewide Distributed Ephemeral Habitats and Perennial Tanks and/or Ecoregion and terrestrial habitat sections.

The native fish fauna of San Juan Watershed historically consisted of at least eight or nine species. Bonytail chub (*Gila elegans*) occupied San Juan River downstream in Utah but was not documented in upstream portions of the river. Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) were likely found in coldwater tributaries of the San Juan but there are no extant populations of the subspecies known in New Mexico. Conservation concerns for birds, mammals, amphibians, and reptiles are primarily addressed in the statewide distributed riparian habitats section and/or the discussion of terrestrial habitats in each ecoregion. Additional concerns for molluscs and crustaceans are addressed in the statewide distributed ephemeral habitats and perennial tanks section.

### **Perennial Large Reservoir**

#### **Habitat Condition**

Navajo Reservoir is the large perennial reservoir in the San Juan Watershed. It has permanent surface water and is primarily inhabited by non-native sport fishes such channel catfish, kokanee salmon, smallmouth bass, and yellow perch (*Perca flavescens*). Roundtail chub (*Gila robusta*) and flannelmouth sucker (*Catostomus latipinnis*) are the only native species documented in Navajo Reservoir and neither is common. Navajo Reservoir provides only incidental habitat for native fishes in San Juan Watershed.

#### **Problems Affecting Habitats or Species**

##### *Water Withdrawals*

Changes in water volume in large reservoirs directly affect the amount and quality of habitats available for fishes. Water withdrawals during the irrigation season lower reservoir levels, potentially affecting fish spawning and nursery habitats. Though detrimental to non-native sport fishes, such changes may be indirectly beneficial to resident native fishes. Reservoir releases to meet agricultural and municipal needs may adversely affect native riverine fishes through displacement, modified thermal regime, or habitat modification.

##### *Non-Native Species*

The fish assemblages of Navajo Reservoir are composed almost entirely of non-native sport fishes. While desirable for recreational purposes, these non-native fishes preclude occupancy of the reservoir by native fishes via predation or competition. It also provides a source of non-native fishes that move into up-stream reaches of the San Juan River.

#### **Information Gaps**

Electrofishing surveys for centrarchids and passive net surveys for all species are annually conducted on Navajo Reservoir. Data collected in these efforts are useful in tracking overall status and trends of resident fishes. There are, however, numerous information gaps regarding perennial large reservoirs that weaken our ability to make informed conservation decisions.

- Little information is available on predator-prey relationships among perennial large reservoir fishes and the emigration of reservoir fishes to other waters up stream.
- The effects of water level fluctuations on spawning and recruitment in perennial large reservoirs are poorly understood.
- We lack information on mesohabitats used by native fishes in reservoirs.
- We do not have good estimates of the occurrence and abundance of small-bodied fishes such as fathead minnow and red shiner in perennial large reservoirs.
- The existing environmental conditions or thresholds that limit populations of SGCN in perennial large reservoirs are unknown.
- Information is lacking regarding the extent to which invasive and non-native species may alter perennial large reservoirs and limit populations of SGCN.

### **Research, Survey, and Monitoring Needs**

Surveys conducted on perennial large reservoirs by NMDGF primarily focus on game species though data are collected on all incidentally captured non-game species as well. Data from these surveys can be used to characterize assemblage dynamics, effects of water-level manipulations on species abundances and recruitment success, and growth and longevity of common species. Additional research, survey, and monitoring needs are described below.

- Document the occurrence and abundance of small-bodied fish species such as fathead minnows in Navajo Reservoir.
- Determine how water withdrawal and subsequent lower reservoir levels potentially affect spawning fish and nursery habitats. This information will help in designing sustainable watershed conservation and management practices.
- Determine habitat use by native fishes in large reservoirs.
- Determine seasonal movements of native fishes into and out of Navajo Reservoir.
- Quantify the extent to which invasive and non-native species alter perennial reservoir habitats and limit populations of SGCN.

### **Desired Future Outcomes**

Desired future outcomes for the perennial large reservoir in the San Juan Watershed include:

- Perennial large reservoir habitats persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land uses with reduced resource use conflicts.

- Sport fish management is focused on species that are appropriate for biotic and abiotic conditions.
- The non-preferred sport fish species are controlled or eliminated.
- The emigration and impact of non-native fishes from Navajo Reservoir into surrounding habitats is minimized.

### **Prioritized Conservation Actions**

Although species management of large reservoirs is often focused on those of high recreational interests, conservation of New Mexico's biodiversity will require multiple conservation actions. Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Collaborate with land managers to assure minimum conservation pools in reservoirs persist to provide year-round recreational opportunities and maintain sport fish populations.
2. Collaborate with federal and state agencies and affected publics to create public awareness and understanding of large reservoir functions, services, and values. Emphasize educating anglers about the risks posed by undesirable non-native fishes to both sport and native fishes.
3. Work with public and private land managers to develop strategies to prevent emigration of non-native species into surrounding areas.
4. Restrict baitfish use to fathead minnows.
5. Work with law enforcement agencies to increase compliance with regulations regarding transport and release of undesired non-native fishes (including sport fishes).
6. Collaborate with federal and state agencies and affected publics to enhance and improve large perennial reservoir habitats for use by native fishes.
7. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about perennial large reservoir habitats and associated SGCN outlined in the Research, Survey, and Monitoring Needs sections.

## **Perennial 3<sup>rd</sup> and 4<sup>th</sup> Order Streams**

### **Habitat Condition**

The Navajo, Animas, and Mancos tributaries to the San Juan River are perennial 3<sup>rd</sup> or 4<sup>th</sup> order streams. Although the La Plata River does not have continuous discharge in its lower reaches, it does have permanent surface water in vicinity of the Colorado/New Mexico border. These perennial 3<sup>rd</sup> or 4<sup>th</sup> order stream habitats range from large boulder and debris pools, to cobbled riffles, and backwaters. Habitats in the La Plata River consist mainly of pools and shallow runs. Water diversion for agriculture seasonally reduces flow in all. Non-native fish occur in each tributary. Of these, rainbow and brown trout, white sucker, and common carp are the most common. Perennial 3<sup>rd</sup> and 4<sup>th</sup> order streams currently support four native fish SGCN. The Navajo River, within New Mexico, flows largely within the Jicarilla Apache Reservation.

### **Problems Affecting Habitats or Species**

#### *Water Withdrawal*

Water development projects in the San Juan drainage include Navajo Reservoir, the San Juan-Chama Diversion, the pending Animas/La Plata Project, the proposed Gallup-Navajo Project, and miscellaneous irrigation diversions. Water removal as a result of these developments may have direct and indirect effects on native fishes in 3<sup>rd</sup> and 4<sup>th</sup> order streams. Some mortality to native fishes may occur through entrainment by water withdrawal structures.

#### *Non-Native/Invasive Species*

Non-native fish species have become established throughout the system. The water development projects noted above may facilitate the transport of non-native species among associated 3<sup>rd</sup> and 4<sup>th</sup> order streams.

#### *Diseases and Pathogens*

The presence of whirling disease in rainbow trout was confirmed in New Mexico the spring of 1999. Since this confirmation, portions of the San Juan, Rio Grande, Canadian, and Pecos Watersheds in New Mexico have tested positive for *Myxobolus cerebralis* (whirling disease causal agent) (Hansen 2002). Routine testing and remediation procedures have begun in New Mexico's hatcheries and a testing program has been initiated coldwater streams and reservoirs that may have been inadvertently stocked with rainbow trout carrying the disease or infested through transmission by natural or anthropogenic vectors.

### **Information Gaps**

Information gaps that limit our ability to make informed conservation decisions for perennial 3<sup>rd</sup> and 4<sup>th</sup> order streams of the San Juan Watershed are outlined below.

- It is unknown the extent to which habitat fragmentation in the watershed will affect the long-term viability and genetic diversity of species that were historically free to move about the drainage.

- Interactions are unclear among the various native fishes and introduced fishes in perennial 3<sup>rd</sup> and 4<sup>th</sup> order streams of the San Juan Watershed.
- Current data is inadequate on species distributions in many of these 3<sup>rd</sup> and 4<sup>th</sup> order tributaries.
- Information is lacking regarding the current distribution, life history, habitat use, and genetics of the mottled sculpin (*Cottus bairdi*) and the roundtail chub in the San Juan Watershed.
- The potential and risk for whirling disease to spread among salmonids of 3<sup>rd</sup> and 4<sup>th</sup> order stream habitats is uncertain until investigations into the extent of *M. cerebralis* distribution within the watershed has been completed.

### Research, Survey, and Monitoring Needs

The US Department of the Interior, Bureau of Reclamation (BOR) and the Southern Ute Indian Tribe are cooperating in conducting surveys on the Animas River in New Mexico and Colorado. The intent is to set up baseline information prior to the implementation of the proposed Animas/La Plata water diversion project south of Durango, Colorado. This project is described in an Environmental Impact Statement issued by the BOR in 2000. The Colorado Division of Wildlife is making efforts to protect and restore native fishes to the Mancos and La Plata rivers. Additional research, survey, and monitoring needs that would enhance our collective conservation efforts are outlined below.

- Determine the current distribution of SGCN in perennial 3<sup>rd</sup> and 4<sup>th</sup> order stream habitats.
- Investigate the effects of water withdrawals on the distribution and abundance of aquatic SGCN in perennial 3<sup>rd</sup> and 4<sup>th</sup> order streams of the San Juan Watershed.
- Determine the current distribution, life history, habitat use, and genetics of the mottled sculpin (*Cottus bairdi*) and the roundtail chub in perennial 3<sup>rd</sup> and 4<sup>th</sup> order streams of the San Juan Watershed.
- There is a need to complete the ongoing investigation into the distribution of *M. cerebralis* to determine the risk of whirling disease to Rio Grande cutthroat trout by this parasite.

### Desired Future Outcomes

Desired future outcomes for perennial 3<sup>rd</sup> and 4<sup>th</sup> order streams in the San Juan Watershed include:

- Perennial 3<sup>rd</sup> and 4<sup>th</sup> order stream habitats persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land uses with reduced resource use conflicts.

- Diversion structures and water withdrawals on 3<sup>rd</sup> and 4<sup>th</sup> order streams do not impair SGCN.
- Impacts to native species by non-natives are eliminated or significantly reduced.
- Extirpated native fishes are successfully restored to many previously occupied areas.
- Channel conditions are stabilized with appropriate streamside vegetation and substrates.
- Natural flow regimes are maintained.

### **Prioritized Conservation Actions**

Approaches for conserving New Mexico's biological diversity at the species or site-specific level are inadequate for long-term conservation of SGCN. Conservation strategies should be ecosystem-based and include public input and support (Galeano-Popp 1996). Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Collaborate with federal and state agencies and affected publics to minimize the effect of diversion structures and water withdrawals on native fishes. This may include timing of withdrawals, removal of barriers or impediments to fish movement, physical movement of fish over barriers, fish ladders, and enhancement of native habitat to provide refuge during low-flow periods.
2. Encourage collaboration and coordination among state and federal agencies, NGO's, and private land stewards in designing and implementing irrigation water withdrawal structures that minimize entrainment of native fishes.
3. Work with federal and state agencies and affected publics to control non-native fishes by physical means or habitat manipulation.
4. Adopt and encourage compliance with strict baitfish regulations.
5. Continue collaboration with federal and state agencies and affected publics to support the Three Species Conservation Agreement to protect, manage, and preserve bluehead sucker (*Catostomus discobolus*), flannelmouth sucker, and roundtail chub throughout their range. Continued participation in the agreement, including drafting and implementation of state management plans, is essential to the conservation of these species. NMDGF is currently completing a recovery plan for roundtail chub.
6. Collaborate with federal and state agencies and publics to develop conservation activities that gain public support for native fish management and conservation. Actions may include promoting public awareness and understanding of stream functions and values.

7. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about perennial 3<sup>rd</sup> and 4<sup>th</sup> order stream habitats and associated SGCN outlined in the Information Gaps and Research, Survey, and Monitoring Needs sections.

### **Perennial 5<sup>th</sup> Order Stream**

#### **Habitat Condition**

From Navajo Dam to its exit from New Mexico near Four Corners, the San Juan River is a perennial 5<sup>th</sup> order stream. Upstream of Shiprock, suburban and urban development is common along the river. Irrigated rowcrop and pasture agriculture is also common where the land is not under residential development. Downstream of Shiprock, the primary land use shifts from irrigated cropland to dispersed livestock grazing. The riparian area of the lower San Juan was once dominated by cottonwood bosque. Except where development impinges, non-native Russian olive (*Elaeagnus angustifolia*) and saltcedar (*Tamarix* spp.) border the river. Several low head diversion dams seasonally divert water from the river. Non-native fishes (especially common carp, channel catfish, red shiner, and fathead minnow) are common, particularly downstream of Shiprock. Habitats consist mainly of moderately deep runs, but cobbled riffles, shoals, backwaters, debris pools, and secondary channels are common. The San Juan River downstream of Navajo Dam supports seven native fishes. Problems affecting of 5<sup>th</sup> order streams and associated SGCN are similar to those for species in 3<sup>rd</sup> and 4<sup>th</sup> order habitats.

#### **Problems Affecting Habitats or Species**

##### *Modification of Natural Processes*

Impoundment of the San Juan River behind Navajo Dam inundated river habitats occupied by several native fishes, particularly Colorado pikeminnow (*Ptychocheilus lucius*), roundtail chub, and razorback sucker (*Xyrauchen texanus*). Habitat loss and physical and thermal regime modification of the river downstream of the dam have precluded these lower reach habitats from use by most native fish species. The reservoir also traps sediment and thus disrupts or alters the sediment budgets of downstream reaches. Such decreases in sediment inputs alter the natural dynamics of mesohabitat creation and maintenance. Dams also fragment species ranges, preventing upstream and downstream movement of fishes. Navajo Dam regulates flows of the San Juan and loss of a natural flow regime is the over-arching problem for native fish assemblages in the main stem. Under the San Juan River Basin Recovery Implementation Program (USFWS 2004; <http://www.fws.gov/southwest/sjrip/>), water is released from Navajo Reservoir to mimic a natural flow regime.

##### *Pollution*

Irrigation water returns are common in the river reach upstream of Cudei. Agricultural and municipal runoff has affected habitat quality.

*Non-Native/Invasive Species*

Non-native fish species have severe impacts on the native-fish fauna of the San Juan through competition for resources and predation. In addition, injury to native fish from the spines of non-native channel catfish has been documented.

**Information Gaps**

Several information gaps limit our ability to make informed conservation decisions regarding the San Juan River and associated SGCN:

- Current distribution, life history, habitat use, and genetic information on roundtail chub in the San Juan River are needed to adequately protect and manage this species.
- The reasons are largely unknown for the near elimination of roundtail chub from San Juan River habitats.
- Information is needed on the effects of non-native fishes on the trophic dynamics of San Juan River mesohabitats.
- Information is needed on the extent and effects of hybridization of flannelmouth and bluehead suckers with non-native white sucker and the extent of detrimental competitive interactions among white, bluehead, and flannelmouth suckers.
- Little is known about trophic dynamics within 5<sup>th</sup> order streams and other aquatic habitats in the San Juan Watershed.
- Information is lacking regarding the growth and survival of common native fishes in the 5<sup>th</sup> order stream habitats of the San Juan Watershed.
- The efficacy and opportunities for using non-native fishes as forage for native piscivores are unknown.
- The effects of interrupting natural flow regime in the Animas River on native and non-native fish assemblage are poorly understood.
- Information is needed regarding factors affecting over-winter survival of rare fishes in the San Juan River.
- Although water release from Navajo Reservoir is conducted to mimic a natural flow regime, little is known about the effectiveness of this strategy in maintaining essential 5<sup>th</sup> order stream habitats.

### Research and Survey Efforts

Most research and monitoring on fishes in San Juan River are accomplished under the auspices of San Juan River Basin Recovery Implementation Program (USFWS 2004; <http://www.fws.gov/southwest/sjrip/>). In addition, US Bureau of Reclamation and the Southern Ute Indian Tribe have conducted fisheries investigations on the Animas River. This information is compiled in a GIS database at the University of New Mexico and in annual reports by participating agencies and groups (<http://www.fws.gov/southwest/sjrip/annualrpts.html>).

Current research and survey efforts with this program include: 1) long term monitoring of channel morphology, 2) habitat mapping, 3) water quality and temperature monitoring, 3) movement of fish through the hogback fish ladder, 4) trophic relationships among Colorado pikeminnow and its prey in the San Juan River, 5) evaluation of Colorado pikeminnow and razorback sucker augmentation programs, 6) non-native species removal, 7) yearly monitoring of large and small-bodied fishes, and 8) evaluation of the current level of fish entrapment in irrigation canals associated with the San Juan River. Additional research and survey efforts that would enhance our ability to make informed conservation decisions are outlined below.

- Quantify the current distribution of roundtail chub in the San Juan River.
- Determine the factors that make secondary channels important habitat for non-native fishes.
- Determine the extent to which land use activities such as urban development, irrigated rowcrop and pasture agriculture, and livestock production alter habitats in relation to size, edge effect, and use by wildlife. This information is important in understanding how different land use intensities and frequencies of disturbance affect SGCN in perennial 5<sup>th</sup> order stream habitats in the San Juan Watershed.
- Characterize the life history, biology, and habitat associations of SGCN associated with perennial 5<sup>th</sup> order stream habitat in the San Juan Watershed, including the effects of non-native species on native assemblages.
- Investigate the effectiveness of current endeavors to mimic natural flow regimes from the Navajo Reservoir in maintaining 5<sup>th</sup> order stream habitats.

### Desired Future Outcomes

Desired future outcomes for perennial 5<sup>th</sup> order streams in the San Juan Watershed include:

- The perennial 5<sup>th</sup> order stream habitats of the San Juan River persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land uses with reduced resource use conflicts.
- San Juan River management and conservation activities are directed towards effective restoration or mimicry of natural flow regimes.

- Non-native fishes are eliminated from perennial 5<sup>th</sup> order stream habitats, and self-sustaining populations of historically occurring native fishes are present.
- Stocking of non-native sport fishes, except in limited areas such as the Navajo Dam Special Trout Waters, where potential interactions with native fishes are minimal, are eliminated.
- Baitfish use regulations that preclude introduction of non-native species garner wide public support and compliance.
- Native fish management and conservation of perennial 5<sup>th</sup> order stream habitats in the San Juan Watershed are widely supported by the public.

### **Prioritized Conservation Actions**

Approaches for conserving New Mexico's biological diversity at the species or site-specific level are inadequate for long-term conservation of SGCN. Conservation strategies should be ecosystem-based and include public input and support (Galeano-Popp 1996). Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Continue research and management activities under the auspices of the San Juan River Basin Recovery Implementation Program (USFWS 2004) to benefit the federally protected Colorado pikeminnow and razorback sucker. These activities also benefit other native species.
2. Collaborate with federal and state agencies and affected publics to continue efforts to remove fish ladders and non-native fishes, particularly channel catfish and common carp, around diversion dams on the San Juan River.
3. Collaborate with ongoing research investigating energy pathways and effects of non-native fishes on carrying capacity of the San Juan River.
4. Encourage water release endeavors that are designed to mimic natural flow regimes below Navajo Reservoir.
5. Continue NMDGF current policy of not stocking non-native warm water sport fishes in lotic habitats of the San Juan Watershed.
6. Collaborate with the Colorado Division of Wildlife in propagating and rearing captive roundtail chub.

7. Continue participating with involved western states in the recently initiated “Three Species Conservation Agreement” to conserve flannelmouth sucker, bluehead sucker, and roundtail chub throughout their historical ranges in the San Juan Watershed.
8. Complete development and implementation of the Roundtail Chub Recovery Plan.
9. Collaborate with federal and state agencies and affected publics to create public awareness and understanding of perennial 5<sup>th</sup> order stream ecosystem functions, services, and values to SGCN.
10. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide the information about perennial 5th order stream habitats and associated SGCN outlined in the Information Gaps and Research, Survey, and Monitoring Needs sections.
11. Compile, analyze, and synthesize the considerable demographic data collected for bluehead and flannelmouth suckers and speckled dace and develop appropriate management plans for each species.