CANADIAN WATERSHED

The Canadian Watershed encompasses about one-sixth the land area of the state or about 1.1 million ac (0.4 million ha) (New Mexico Water Quality Control Commission 2002). Canadian River tributaries flow east and southeast from their origins on the east slopes of the Sangre de Cristo cordillera of northern New Mexico and southern Colorado. As it traverses the Great Plains in a southerly and then easterly direction, several perennial tributaries, including the Vermejo, Cimarron, Mora, and Conchas Rivers join the South Canadian River before it exits New Mexico toward Texas near Logan. The Upper Canadian, Middle Canadian, Upper Beaver, and the Dry Cimarron are the only sub-basins that are perennial. Key habitats in the Canadian Watershed include perennial large reservoirs, perennial marsh/cienega/spring/seep, perennial 1st and 2nd order streams, and perennial 3rd and 4th order streams (Fig. 5-9).

Settlement and irrigation withdrawal along high mountain valleys in the Mora River dates back to the 1700s. Since the late 1800s, the area has been subject to logging, grazing, and mining. Eagle Nest dam was built on the Cimarron River in 1918. Numerous other small impoundments and diversions have been built throughout the upper watershed for irrigation and municipal water. Livestock grazing continues to be the primary land use activity throughout the Canadian Watershed. Logging activities are now limited to small tracts in the upper tributaries. Most coal mines were abandoned by the 1950s. Two large dams, Conchas River (constructed 1938) and Ute Dam on the Canadian River (constructed 1962), impound reservoirs and modify natural flows as the river approached the New Mexico-Texas border.

Species of Greatest Conservation Need

Overall, 36 Species of Greatest Conservation Need (SGCN), excluding arthropods other than crustaceans, occur in the Canadian Watershed (Table 5-11). Most species (n = 19 or 53%) were classified as nationally secure but state vulnerable, imperiled, or critically imperiled. Eleven species (31%) were classified as vulnerable, imperiled, or critically imperiled both statewide and nationally, and the remaining six species were secure both nationally and in the state. Conservation status codes (abundance estimates) for each SGCN are provided in Appendix H. At present, the only fish SGCN that is known to occupy perennial spring, seep, marsh, or cienega habitats in the Canadian Watershed of New Mexico is the southern redbelly dace (*Phoxinus erythrogaster*). The distribution of southern redbelly dace in New Mexico is limited to the headwaters of the Mora River, particularly Coyote Creek, and tributaries to Black Lake (Sublette *et al*. 1990) where they are common in spring habitats, but are rare in stream habitats (Propst 1999, NMDGF 2004a). The southern redbelly dace was state listed as an endangered species (19 NMAC 33.1) in 1975. The species prefers spring-fed systems with dense aquatic vegetation and clear water (Pfleiger 1975).

Native crayfish of perennial reservoirs in the Canadian Watershed include the Conchas crayfish (*Orconectes deanae*) and the northern crayfish (*Orconectes virilis*). The former species is reported from Conchas Lake and riverine reaches (Conchas River and Canadian River) upstream (Lang and Mehlhop 1996), while the latter species occurs in Conchas Lake and Conchas Canal, where the non-native rusty crayfish (*Orconectes rusticus*) has been reported below Conchas Lake dam (Lang and Mehlhop 1996).

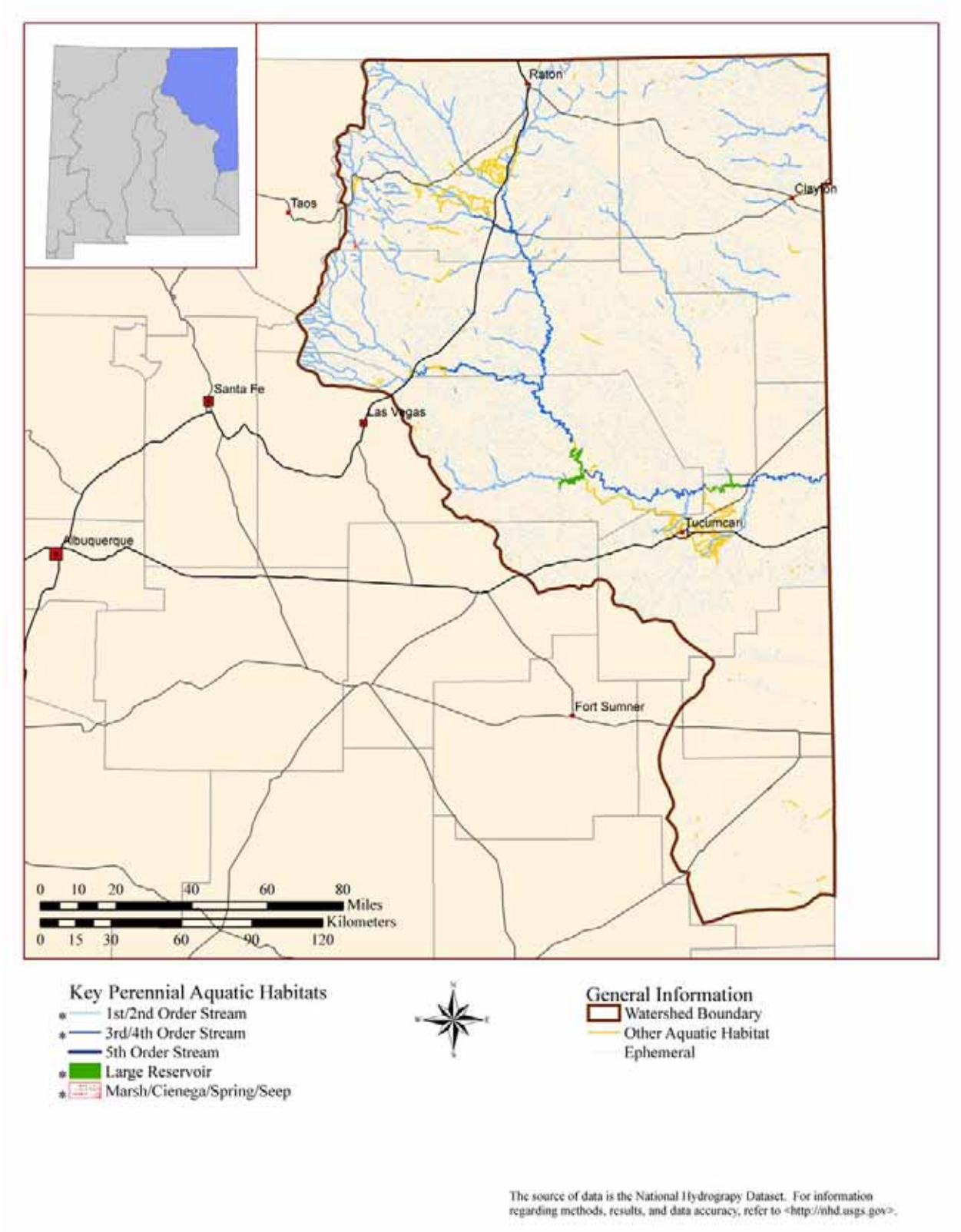

Figure 5-9. Key perennial aquatic habitats in the Canadian Watershed in New Mexico. Key habitats are designated with an asterisk (*).

Taylor (1983) first reported the freshwater mussel, paper pondshell (*Utterbackia imbecillis*), in Conchas Lake. Lang and Mehlhop (1996) extended the range of this species eastward to Ute Reservoir. They speculated that the paper pondshell was introduced during bait fish release or game fish stocking from a fish bearing glochidia (larvae that has been dispersed from a female mussel). The giant floater (*Pyganodon grandis*) was introduced into Conchas Lake and Ute Reservoir in a similar manner. Lang and Mehlop (1996) considered native habitats for the paper pondshell as primarily riverine, and questioned the native status of the reservoir populations.

The fingernail clams (*Musculium* spp.) SGCN (Table 5-11) are known from the Upper Arkansas and Upper Dry Cimarron sub-basins in the northeastern part of the state (Taylor 1983, NMDGF 2004a), where little is known about their distribution and abundance. Lang and Mehlhop (1996) reported the freshwater limpit (*Ferrissia rivularis*) in the Conchas Canal. This species likely occurs in the Canadian River upstream of Conchas Lake to Mills Canyon.

Four fish SGCN occupy perennial 1st and 2nd order stream habitats of the Canadian Watershed in New Mexico: Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*), southern redbelly dace, suckermouth minnow (*Phenacobius mirabilis*), and central stoneroller (*Campostoma anomalum*) (Table 5-11). The Rio Grande cutthroat is confined to 11 populations in the headwaters of the South Canadian River and the Mora River (Sublette *et al*. 1990). It is protected as a game fish under state law (17-2-3 NMSA 1978). Southern redbelly dace is limited in distribution to the upper headwaters of the Mora River and Coyote Creek (Sublette *et al*. 1990) and listed as state endangered (19 NMAC 31.1). Suckermouth minnows are rare in the South Canadian River upstream of Conchas Reservoir and may be extirpated from the Dry Cimarron (NMDGF 2002). The suckermouth minnow is listed as state threatened (19 NMAC 31.1). The Central stoneroller occupies reaches of the South Canadian River above Conchas Reservoir and the Dry Cimarron River, and the fish is not protected by state or federal regulation.

Three fish SGCN occupy the perennial 3rd and 4th order stream habitats of the Canadian Watershed in New Mexico. They are suckermouth minnow, Arkansas River speckled chub (*Macrhybopsis tetranema*), and central stoneroller. Suckermouth minnows are rare in 3rd and 4th order stream habitats. Arkansas River speckled chub is restricted to the South Canadian River downstream of Ute Reservoir. Within this reach it was moderately common in the early 1990s, but no recent surveys have been conducted to accurately characterize its status in New Mexico. It is listed as threatened by the state (NMDGF 2004a).

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.

Table 5-11. Species of Greatest Conservation Need in the Canadian Watershed in New Mexico.

Common Name	Perennial			
	Large Reservoir	Marsh/ Cienega/ Spring/ Seep	1st and 2nd Order Stream	3rd and 4th Order Stream
Fish				
Rio Grande Cutthroat Trout			X	X
Central Stoneroller			X	X
Canadian Speckled Chub				X
Suckermouth Minnow				X
Southern Redbelly Dace		X	X	X
Birds[1]				
Eared Grebe	X	X		X
American Bittern		X		
White-Faced Ibis	X	X		
Northern Pintail	X	X		X
Osprey	X			X
Bald Eagle	X	X		X
Northern Harrier		X		
Common Black-Hawk		X	X	X
Peregrine Falcon	X	X		X
Sandhill Crane	X	X		
Snowy Plover	X			
Interior Least Tern	X			X
Southwestern Willow Flycatcher		X		X
Bank Swallow				X
Yellow Warbler		X	X	X
Mammals[1]				
American Beaver	X	X	X	X
Prairie Vole		X		
Amphibians[1]				
Tiger Salamander		X		
Western Chorus Frog		X	X	X
Plains Leopard Frog		X		X
Northern Leopard Frog	X	X	X	X
Reptile[1]				
Arid Land Ribbon Snake		X	X	X
Molluscs				
Swamp Fingernailclam				X
Long Fingernailclam				X
Lake Fingernailclam				X
Paper Pondshell Mussel	X			
Star Gyro Snail		X	X	X
Creeping Ancylid Snail				X

Table 5-11 Cont.

Common Name	*Perennial* Large Reservoir	Marsh/ Cienega/ Spring/ Seep	1st and 2nd Order Stream	3rd and 4th Order Stream
Crustaceans				
Conchas Crayfish	X			X
Northern Crayfish (Canadian River)	X		X	X
Amphipod	X	X	X	X

[1] 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.

Perennial Large Reservoirs

Habitat Condition

The large reservoirs (Eagle Nest, Conchas, and Ute) in the Canadian Watershed have highly variable water levels depending on annual precipitation and irrigation needs. Habitat conditions can change dramatically with water levels. All three reservoirs have associated state parks that are popular recreation areas. There are several small perennial reservoirs within the Canadian Watershed. Some of these small reservoirs include Maxwell Lakes, Storrie Reservoir, McAllister Lake, and Clayton Lake. Like large reservoirs, most of the fish community consists of non-native fish species. There are no fish SGCN in large perennial reservoirs in the Canadian Watershed.

Problems Affecting Habitats or Species

Invasive Species
Non-native bivalves such as the Asian clam (*Corbicula fluminea*), the giant floater, and the invasive rusty crayfish have been introduced to the Canadian Watershed (Lang and Mehlhop 1996). Due to previous bait fish release and game fish stocking, it may be virtually impossible to discern the native species of the paper pondshell from Conchas Lake using genetic techniques, unless an extant population is located in perennial tributaries of the Canadian Watershed (R. Hoeh, unionid taxonomist, Kent State University, pers. comm.). Native crayfish populations of reservoirs are threatened by non-native crayfish. All stakeholders deriving beneficial use from Canadian River mainstem reservoirs are threatened by the potential introduction of zebra mussels (*Dreissena polymorpha*) and its sister species the quagga mussel (*Dreissena bugensis*).

Information Gaps

There are numerous information gaps regarding perennial large reservoirs that weaken our ability to make informed conservation decisions. Information gaps identified are outlined below.

- We lack information on reservoir meso-habitats used by native aquatic species.

- The existing environmental conditions or thresholds that preclude populations of SGCN are unknown.

- Information is needed about the extent to which invasive and non-native species may alter aquatic community structure and preclude populations of SGCN in perennial large reservoirs.

Research, Survey, and Monitoring Needs

Research or survey efforts needed to make informed conservation decisions for perennial large reservoirs or SGCN are outlined below.

- Research is needed to investigate life history and ecology of the Conchas crayfish populations from all aquatic habitat types (perennial streams and reservoirs) in the Canadian Watershed.

- While Pittenger (2004) reported stable populations of the Conchas crayfish in the Canadian Watershed, routine inventory throughout the watershed is needed to monitor the population status of this species.

- Recreational use surveys are needed to assess intrastate and interstate boating activity of perennial reservoirs. These data are necessary for development and implementation of an effective statewide aquatic nuisance species plan.

Desired Future Outcomes

Desired future outcomes for perennial large reservoirs in the Canadian Watershed include:

- Perennial large reservoirs persist in the condition, connectivity, and quantity necessary to maintain viable and resilient populations of SGCN while sustaining diverse and minimal resource use conflicts.

- Sport fish management is focused on species that are appropriate for biotic and abiotic conditions of each reservoir.

- Non-preferred sport fish species are controlled or eliminated.

- The emigration and subsequent impacts of non-native fishes from reservoirs into surrounding habitats is minimized.

- The spread of non-native and aquatic nuisance species within the Canadian River Watershed is eliminated or reduced.

Prioritized Conservation Actions

Although species management of large reservoirs is often focused on recreational species, stewardship of New Mexico's biodiversity will require adaptive conservation and management 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 land managers to assure minimum conservation pools for reservoirs persist so as to provide year round recreational opportunities and maintain sport-fish populations.

2. Collaborate with federal and state agencies and affected publics to create awareness and understanding of large reservoirs functions, services, and values. Emphasis should be placed on educating the public of the risks posed by undesirable non-native fishes and aquatic nuisance species.

3. Work with public and private land managers to develop strategies to prevent escape of non-native species from large perennial reservoirs into surrounding areas.

4. Discourage the continued introduction of non-native crayfish and other invasive aquatic species through state regulations (such as, NMDGF bait dealer regulation 19-31-9, NMAC). An approach may include restricting the use of baitfish to only fathead minnows in perennial large reservoirs of the Canadian Watershed.

5. Work with law enforcement agencies to achieve compliance with regulations regarding illegal transport and release of undesired non-native fishes (including sport fishes) into perennial large reservoirs of the Canadian Watershed.

6. Collaborate with federal and state agencies and affected publics to enhance and improve Canadian Watershed large reservoir habitats used 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 SGCN and the perennial large reservoirs outlined in the Research, Survey, and Monitoring Needs section.

8. Draft and implement an aquatic nuisance species plan for New Mexico that incorporates concerns in the Canadian Watershed.

9. Establish partnerships with federal, state, and local agencies (such as Interstate Stream Commission, New Mexico State Parks, New Mexico Environment Department, etc.) to monitor reservoir water quality relative to potential use by SGCN.

Perennial Marsh/Cienega/Spring/Seep

Habitat Condition

Perennial springs and seeps occur through out the Canadian Watershed from high mountain elevations of the Sangre de Cristo Mountains to marsh areas in the lower Canadian Watershed. Upper elevation springs are dependent on snow pack while lower elevation springs/seeps are maintained by natural groundwater discharge from local aquifers or the surrounding water table. Factors affecting Canadian Watershed springs and seeps include grazing, logging, groundwater removal and invasion by non-native vegetation. Hudson Lake (Quay County) is an example of a low elevation spring/seep. Present condition of many of these habitats is unknown as most of them occur on private land and have not been inventoried. Some habitats, such as those on Vermejo Park Ranch are in relatively good condition due to changes in land use practices (reduced grazing intensity) in recent years. Other perennial marsh/cienega/spring/seep habitats in the Canadian Watershed continue to be influenced as landowners using historical land use practices struggle with economic stability.

Problems Affecting Habitats or Species

Urban Development/Dewatering
The town of Angel Fire and the Moreno Valley have experienced significant residential and recreational development in the past decade. The Angel Fire Resort and Ski Area and Eagle Nest Lake provide the focus for most of the development. All of the problems associated with human development, including groundwater depletion, sewage/septic contamination of water supplies, and drainage of wetlands have a high potential to affect SGCN in this locality. Excessive groundwater pumping and drought could lead to lower spring levels that would be detrimental to all species occupying these habitats.

Invasive Species
Predatory non-native fish species may also affect native fishes in these habitats by reducing their abundance in smaller habitats. Brown trout (*Salmo trutta*) have been established throughout the Mora River drainage, and rainbow trout (*Oncorhynchus mykiss*) are stocked for recreational angling in the drainage. The extent to which these non-native trout negatively affect populations of southern redbelly dace is unknown. Non-native aquatic species, such as crayfish and the New Zealand mudsnail (*Potamopyrgus antipodarum*), threaten the diversity of aquatic biota and functional integrity of this perennial habitat type.

Non-native vegetation is also adversely affecting perennial spring-fed habitats. Saltcedar (*Tamarix* spp.) occurs around some of the Canadian Watershed springs and seeps. This invasive plant has long taproots that allow it to intercept deep water tables and interfere with natural aquatic systems. This plant disrupts the structure and stability of native plant communities and degrades native wildlife habitat by out competing and replacing native plant species and over-

exploiting limited sources of moisture. The State Forest and Watershed Health Plan devotes significant planning to the management of non-native invasive phreatophytes (New Mexico Energy, Minerals, and Natural Resources Department 2004).

Information Gaps

In addition to problems affecting perennial spring-fed habitats, there are several major information gaps that may weaken our ability to make informed conservation decisions. These are outlined below:

- Data are lacking on the distribution, abundance and natural history of SGCN, especially fish, associated with spring/seep/marsh/cienega habitats in the Canadian Watershed.

- Little is known about locations and condition of marsh/cienega/spring/seep habitats in the Canadian Watershed.

- Logging and grazing continue to be primary economic interests in the Canadian Watershed but the level and extent of effects from these activities on perennial marsh/cienega/spring/seep habitats is currently unknown.

Research, Survey, and Monitoring Needs

A survey of the distribution and conservation status of fishes of the South Canadian River Drainage is currently being conducted (Platania and Dudly 2003). The results of this survey will significantly increase our knowledge of the distribution of fishes. Additional research or survey efforts needed to make informed conservation decisions are detailed below.

- Additional surveys are needed that focus on the distribution of southern redbelly dace throughout the Mora River drainage.

- Research, surveys, and monitoring are greatly needed for SGCN occupying spring/seep/marsh/cienega habitats in the Canadian Watershed. Little is known of the extent of their distribution, their biology, or stability of their populations and microhabitats.

- Assess the potential for site-specific impacts from ongoing development in the Black Lake area where known populations of southern redbelly dace occur.

- A comprehensive survey is needed of aquatic macroinvertebrates in perennial marsh/cienega/spring/seep habitats in the Canadian Watershed.

- Investigate the extent to which land use activities (such as timing, intensity, and duration of livestock grazing, logging, human development and invasive or non-native species invasions) fragment and otherwise alter habitats in relation to size, edge effect, and use by wildlife. This information is important in understanding the effects of such disturbances upon SGCN in perennial marsh/cienega/spring/seep habitats.

Desired Future Outcomes

Desired future outcomes for perennial marsh/cienega/spring/seep in the Canadian Watershed include:

- Perennial marsh/cienega/spring/seep 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.

- Marsh/cienega/spring/seep habitats persist at natural water levels with water quality adequate to support resident SGCN.

- Non-native predatory or competitive fish species are excluded from these habitats, such that the present distribution and abundance of self-sustaining populations of southern redbelly dace, and all other native species, are maintained or improved.

- Collaborative relations are established among state, federal, NGO's, universities, and landowners to secure, enhance, and restore perennial marsh/cienega/spring/seep habitats.

- Non-native vegetation around these habitats is eradicated or controlled to minimize impacts to SGCN.

Prioritized Conservation Actions

Much of the Canadian Watershed marsh/cienega/spring/seep habitat occurs on private land. Thus, conservation actions need to include private landowners input and support. Since the southern redbelly dace is listed as endangered by the state, some conservation actions are already in place. 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, private landowners, research institutions, and universities to establish a better understanding of the distribution and abundance of southern redbelly dace and the distribution and condition of marsh/cienega/spring/seep habitats in the Canadian Watershed (especially Black Lake, Coyote Creek and upper Mora River) through continued survey efforts.

2. Establish partnerships with other federal, state and local agencies (New Mexico Environment Department, US Geological Survey, New Mexico Office of the State Engineer, etc.) to encourage monitoring local aquifers for water quantity and quality as it relates to specific habitat locations and identifying potential threats to habitats important to the southern redbelly dace and other SGCN.

3. Work with appropriate state and federal government entities, NGOs, and private land owners to protect and secure habitats essential to the long-term survival of southern redbelly dace through partnerships with private landowners using existing federal conservation programs (LIP or other incentives), conservation easements and land acquisition.

4. Seek acceptance of "instream flow" water rights for wildlife conservation needs in New Mexico that will benefit perennial marsh/cienega/spring/seep habitats in the Canadian Watershed.

5. Discourage the continued introduction of predatory non-native fishes into Canadian Watershed habitats known to support southern redbelly dace or other SGCN.

6. Work with public and private land managers in the Canadian Watershed to develop sustainable livestock production practices on native rangelands around perennial marsh/cienega/spring/seep that would reduce spring degradation.

7. Provide outreach to private landowners, developers and other publics to encourage the protection, maintenance, and rehabilitation of Canadian Watershed habitats essential to the long-term survival of SGCN such as the southern redbelly dace.

8. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN and perennial marsh/cienega/spring/seep as outlined in the Problems or Research, Survey, and Monitoring Needs section.

9. Collaborate with public and private land managers in the Canadian Watershed to develop, adopt, and implement a program to eradicate and stop the spread of invasive plants. This program could be based on *the New Mexico Strategic Plan for Managing Noxious Weeds 2000-2001*; BLM, Partners Against Weeds Action Plan; US Forest Service, Stemming The Invasive Tide; National Interagency Strategy, Pulling Together and the National Invasive Species Management Plan.

Perennial 1st and 2nd Order Streams

Habitat Condition

Most of the tributaries of the Canadian Watershed begin in the high elevations of the Sangre de Cristo Mountains. The exception is Ute Creek, which is now ephemeral (Sublette *et al*. 1990). Most of the headwater streams of these tributaries are under the administration of the US Forest Service, but some lie within the boundaries of large, long-standing land grants. Habitats for most of the 1st and 2nd order streams are in relatively good condition, but grazing, logging, and roads continue to affect these small streams.

Problems Affecting Habitats or Species

Invasive Species
The primary threat to SGCN, such as the Rio Grande cutthroat trout, is the introduction of non-native salmonids that compete with, prey on and/or hybridize with them. Stressors specific to the southern redbelly dace include modification of spring systems and introduction of non-native predators. Brown trout have been established throughout the upper reaches of the watershed and compete with, or prey upon SGCN. Rainbow trout, which are stocked for recreational angling, also compete and prey upon SGCN and hybridize with Rio Grande cutthroat trout.

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 in 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. Very little is known regarding whether the disease exists in Rio Grande cutthroat trout. However, it is likely that if *M. cerebralis* were to spread to Core Conservation Areas for Rio Grande cutthroat trout, the species would be at risk of infection.

Habitat Alteration
Traditional land uses such as grazing, logging, and agriculture are the primary economic activities in this watershed. Sedimentation, desiccation, and other forms of habitat degradation to perennial 1st and 2nd order stream habitats are often attributed to improper grazing, logging, and water diversion for irrigation. Another potential factor that may alter these habitats is the lack of fire management.

Oil and Gas Exploration
Recent localized gas and oil exploration in the upper Canadian and Vermejo drainages has a potential for affecting these habitats. The degree to which these activities are affecting specific habitats on private land is not known. Where these habitats occur on public land, existing federal and state laws require consultation and mitigation to reduce negative effects. Desiccation of habitat or alteration of natural flows is a serious problem in aquatic ecosystems in New Mexico.

Information Gaps

Information gaps that limit our ability to make informed conservation decisions for perennial 1st and 2nd order stream habitats are outlined below:

- With exception of the Rio Grande cutthroat trout, data on the distribution and abundance of fish SGCN and the location and condition of 1st and 2nd order stream habitats is lacking.

- Information is lacking on the status of 1st order perennial stream habitat for the Rio Grande cutthroat trout in parts of the Canadian Watershed.

- The extent to which introduced predators negatively impact populations of SGCN, particularly the southern redbelly dace in this watershed, is unknown.

- The extent to which land use activities (such as timing, intensity, and duration of livestock grazing, human development, road-building, and oil and gas development) fragment and alter habitats in relation to size, edge effect, and use by wildlife is unknown. This information is important in understanding how these disturbances affect SGCN in perennial 1st and 2nd order streams.

- Limited information on the status of suckermouth minnow in New Mexico coupled with a lack of data on its life history make it difficult to determine what measures are needed to conserve the minnow in the Canadian Watershed and across the state.

- Data on the current distribution and status of the central stoneroller is also lacking and needs to be updated.

- The existing environmental conditions or thresholds that limit populations of SGCN in perennial 1st and 2nd order streams of the Canadian Watershed are unknown.

- The potential and risk for whirling disease to spread among salmonids of 1st and 2nd 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

Although efforts for Rio Grande cutthroat trout in these habitats are conducted under ongoing Federal Aid Fisheries Grants (New Mexico Department of Game and Fish 2002) there are additional research and surveys needed to inform conservation managers.

- A better understanding of the distribution, abundance, and biology of SGCN is needed. Studies on the southern redbelly dace, suckermouth minnow, and central stoneroller in the Canadian Watershed are especially desirable.

- Further studies are needed to characterize habitat criteria and the biology of SGCN in the Canadian Watershed to guide further development of conservation actions and monitoring plans.

- Investigate the extent to which land use activities fragment and otherwise alter perennial 1st and 2nd order stream habitats in the Canadian Watershed.

- Research is needed to determine environmental conditions or thresholds that limit populations of SGCN in perennial 1st and 2nd order streams of the Canadian 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 1st and 2nd order stream habitats include:

- Perennial 1st and 2nd order streams of the Canadian Watershed 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 minimal resource use conflicts.

- Factors that contribute to degraded habitat quality and quantity are eliminated or minimized in order to maintain or improve conditions that ensure the survival of self-sustaining populations of SGCN.

- Collaborative relations are established among state and federal agencies, NGO's, universities, and private landowner to protect, enhance, and restore perennial 1st and 2nd order streams habitats of the Canadian Watershed.

Prioritized Conservation Actions

Much of the 1st and 2nd order stream habitat in the Canadian Watershed occurs on private land. Thus, conservation activities need to include private landowner input and support. Existing conservation activities occur for the state endangered southern redbelly dace and the state threatened suckermouth minnow. 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. Work with federal and state agencies, private landowners, research institutions, and universities to establish a better understanding of the distribution and abundance and biology of southern redbelly dace, suckermouth minnow and central stoneroller in the Canadian Watershed. This information will further guide the development of conservation actions and monitoring plans for these species.

2. Collaborate with federal and state agencies and affected publics to continue to implement the long-range management plan for Rio Grande cutthroat (NMDGF 2002a).

3. Seek acceptance of "instream flow" water right for wildlife conservation needs in New Mexico that benefit 1st and 2nd order stream habitat in the Canadian Watershed.

4. Work with state, federal and private land managers to mitigate and reduce impacts from land and water use practices to perennial 1st and 2nd order streams in this watershed.

5. Discourage the continued introduction of predatory non-native fishes into Canadian Watershed habitats known to support southern redbelly dace, suckermouth minnow, and central stoneroller or other SGCN.

6. Work with appropriate state and federal government entities, NGOs, and private land owners to protect and secure habitats essential to the long-term survival of southern redbelly dace, suckermouth minnow, central stoneroller, and other SGCN through partnerships and using existing federal conservation programs (LIP or other incentives), conservation easements and/or land acquisition for protection.

7. Encourage private landowners to protect and maintain habitats essential to the long-term survival of SGCN such as the southern redbelly dace.

8. Establish partnerships with the New Mexico Environment Department, US Geological Survey, New Mexico Office of the State Engineer, and other local, state, and federal agencies to monitor surface and ground water quantity and quality as it relates to specific habitat needs of SGCN.

9. Work with federal and state agencies, private landowners, research institutions, NGOs, and universities to design and implement projects that will provide information about SGCN and perennial 1st and 2nd order stream habitats of the Canadian Watershed outlined in the Problems or Research, Survey, and Monitoring Needs section.

10. Collaborate with federal and state agencies and affected publics to create public awareness and understanding of perennial 1st and 2nd order stream habitat functions, services, and values in the Canadian Watershed.

Perennial 3rd and 4th Order Streams

Habitat Condition

Perennial 3rd and 4th order streams in the Canadian Watershed vary from high elevation cascades, to high sediment systems in low elevations with low gradients. Tributary streams meander across the low relief plains and often flow through narrow canyons. Flow is usually permanent in canyon-bound reaches but may be seasonally intermittent in less restricted reaches. In the upper reaches (3rd order), water is diverted to many small off-channel impoundments for irrigation, drinking water, and recreation. This results in many of the lower elevation systems becoming ephemeral prior to entering the main stem of the South Canadian River. Some portions of these 3rd order streams maintain sections of permanent flow from groundwater and spring discharge and maintain isolated populations of native and non-native fishes, generally in pool and marsh habitats. Habitats in both the main stem South Canadian River and its tributaries vary from deep pools formed around large boulders in canyon reaches to shallow, sand-bottomed runs.

Problems Affecting Habitats or Species

Habitat Alteration
The primary factors adversely affecting the suckermouth minnow, central stoneroller and other SGCN in perennial 3rd and 4th order stream habitats are excessive sedimentation of stream run habitats, habitat desiccation, and habitat fragmentation. Water diversion, groundwater pumping, and regulated reservoir releases are the primary stressors to the Arkansas River speckled chub. Habitat conversion caused by improper grazing, irrigation withdrawals, urbanization, and intensive stocking of non-native sport fish has also been implicated in population declines of freshwater limpit (Hovingh 2004).

Diseases and Pathogens
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. Very little is known regarding whether the disease exists in Rio Grande cutthroat trout. However, it is likely that if *M. cerebralis* were to spread to Core Conservation Areas for Rio Grande cutthroat trout, the species would be at risk of infection.

Information Gaps

Information gaps for perennial 3rd and 4th order stream habitats in the Canadian Watershed that impair our ability to make informed conservation decisions are outlined below.

- Information is lacking on the distribution and abundance of fish fauna, including the three fish SGCN, in the 3rd and 4th order stream habitats in the Canadian Watershed.

- Limited information on the status of resident SGCN and on the life history of some (e.g. suckermouth minnow) in New Mexico impedes determination of potentially effective conservation measures.

- 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 watershed.

- Interactions among the various native fishes and introduced fishes in perennial 3rd and 4th order streams are unclear.

- It is unknown the extent to which land use activities (such as livestock grazing, human development, and agriculture) alter habitats in relation to connectivity, patch size, edge effect, and use by SGCN. This information is important in understanding how different land use intensities and frequencies of disturbances affect SGCN in perennial 3rd and 4th order streams.

- The potential and risk for whirling disease to spread among salmonids of 3rd and 4th 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

Research, Survey, and Monitoring needs for perennial 3rd and 4th order streams include:

- A better understanding of the distribution, abundance, and biology of SGCN in the Canadian Watershed is needed. Studies on the southern redbelly dace, suckermouth minnow, central stoneroller, freshwater limpit, fingernail clams, and other sphaeriid bivalves are especially desirable.

- Further studies are needed to characterize habitat needs and biology of these species in the Canadian Watershed to guide further development of conservation actions and monitoring plans.

- Investigate the extent to which land use activities fragment and alter perennial 3rd and 4th order stream habitats.

- Research is needed to determine environmental conditions or thresholds that limit populations of SGCN in this habitat.

- 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 3rd and 4th order streams in the Canadian Watershed include:

- Perennial 3rd and 4th order streams 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 minimal resource use conflicts.

- Factors that contribute to degraded habitat quality and quantity are eliminated or minimized in order to maintain or improve conditions that ensure the survival of self-sustaining populations of SGCN in the Canadian Watershed.

- Collaborative relations are established among state and federal agencies, NGO's, universities, and private landowner to protect, enhance, and restore perennial 3rd and 4th order stream habitats of the Canadian Watershed.

- Natural stream flow regimes are established and maintained with the absence of non-native predators.

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. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement studies to establish a better understanding of the distribution, abundance, status, and biology of suckermouth minnow, Arkansas speckled chub, and central stoneroller in the Canadian Watershed.

2. Adopt and enforce strict regulations regarding the use of baitfish in the Canadian Watershed.

3. Establish partnerships with New Mexico State Engineer and the Bureau of Reclamation to establish and maintain permanent flows in South Canadian River downstream of Ute Dam. This flow should at least minimally mimic a natural hydrograph for the benefit of Arkansas speckled chub and other SGCN.

4. Seek acceptance of "instream flow" water rights for wildlife needs in New Mexico (such as below Conchas and Ute Reservoirs) benefit perennial 3rd and 4th order stream habitats in the Canadian Watershed.

5. Work with state, federal and private land managers to mitigate and reduce impacts from land and water use practices to perennial 3rd and 4th order streams in the Canadian Watershed.

6. Work with public and private land managers to develop sustainable land use practices on native rangelands around perennial 3rd and 4th order stream that would reduce stream degradation in the Canadian Watershed.

7. Collaborate with federal and state agencies and affected publics to continue control and eradication of non-native species and reestablish native fish communities where feasible in perennial 3rd and 4th order streams of the Canadian Watershed.

8. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN and perennial 3rd and 4th order stream outlined in the Information Gaps and Research, Survey, and Monitoring Needs section.