Green River Basin

New Fork River

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Watershed Description

Six major watersheds were identified for conservation planning purposes under this State Wildlife Action Plan (SWAP) using hydrographic boundaries and fisheries assemblage and management considerations. The watersheds each include one to four sub-regions (4-digit hydrologic unit code [HUC] watersheds). This approach allows the nesting of multiple spatial and temporal scales for planning and prioritizing conservation actions.

The Green River basin corresponds with the Upper Colorado hydrologic unit in Wyoming (Figure 3; 2-digit HUC 14). Major drainages corresponding to 8-digit HUCs include Upper Green, New Fork, Upper Green-Slate, Big Sandy, Bitter, Upper Green-Flaming Gorge, Blacks Fork, Muddy, Vermillion, Great Divide Closed Basin, Little Snake, and Muddy (in Little Snake drainage). The Great Divide Basin is a closed basin and is included. These watersheds span about 21,000 square miles in southwestern Wyoming's Carbon, Lincoln, Sublette, Sweetwater, and Uinta counties. Very small portions of Fremont and Teton counties occur in the basin as well. Land ownership is predominantly public (72%). Much of the 28% of privately-held lands occur in the "checkerboard" band of ownership along the Union Pacific railroad. Green River basin public land is managed primarily by the Bureau of Land Management (56% of all surface acres) and U.S. Forest Service (10% of all surface acres).

There are approximately 23,000 miles of streams on the USGS National Hydrography Dataset in the Green River basin. Major river drainages include the Little Snake (Tributary to the Yampa River in Colorado), Henrys Fork, Blacks Fork, Hams Fork, Big Sandy, East Fork, New Fork, LaBarge, Cottonwood and Horse.

Additional information about the basins drainages, geography, geology, land forms, climate, dams, reservoirs and diversions, hydrology, habitat types, land use and water classifications are detailed in the 2010 SWAP.

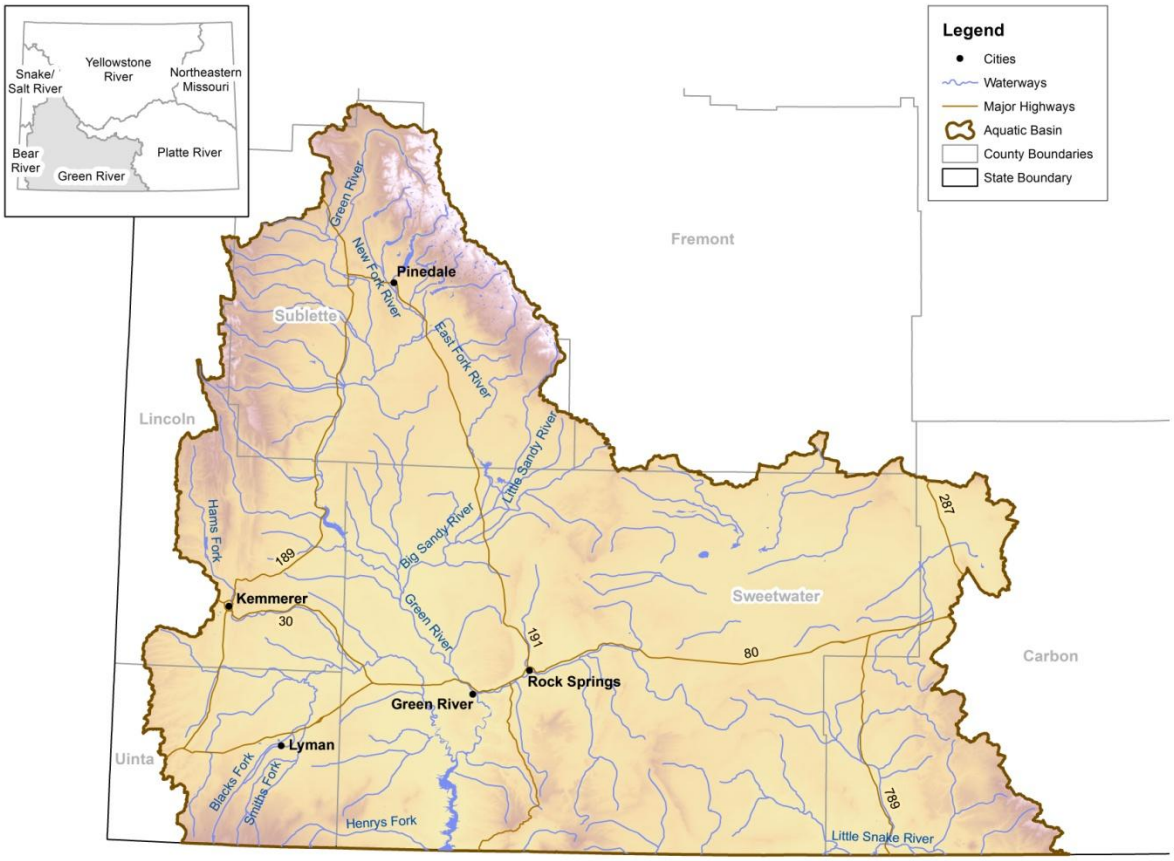

Figure 3. Green River Basin

Aquatic Wildlife

Fish

A detailed history of fish collections and surveys in this basin are chronicled in the 2010 SWAP. These surveys and collections are the basis for describing the native fish community. The 2010 SWAP also includes a summary of fish introductions to the basin. Most introductions were conducted by the WGFD but others were illegal or inadvertent.

The native fish community of the Green River basin in Wyoming is arguably the most imperiled in the state. Twelve species and subspecies were historically found in the basin, three of which have been extirpated. The basin is also home to four of Wyoming's five NSS1 fishes, the Bluehead Sucker, Flannelmouth Sucker, Roundtail Chub, and the federally endangered Kendall Warm Springs Dace (Table 3). The native community also included at least three of the four federally endangered species of the Colorado River basin, the Colorado Pikeminnow, Razorback Sucker, and Bonytail, all of which have been extirpated from the state.

The Green River basin has two native game fish and 11 native nongame fish (four are extirpated from the state; Table 3). A total of 12 game fish and 14 nongame fish have been introduced into the basin (Table 3). One game fish species and four nongame fish species are currently considered SGCN (Table 4).

Table 3. Fishes present in the Green River Basin. * denotes Species of Greatest Conservation Need (SGCN). X denotes extirpated from Wyoming. E denotes federally endangered species. U denotes fishes that may have been present in Wyoming, but historic presence has not been confirmed.

Native game	Native nongame	Nonnative game	Nonnative nongame
Colorado River Cutthroat Trout*	Bluehead Sucker*	Bonneville Cutthroat Trout	Burbot
Mountain Whitefish	Bonytail[XE]	Brook Trout	Common Carp
	Colorado Pikeminnnow[XE]	Brown Trout	Creek Chub
	Flannelmouth Sucker*	Channel Catfish	Fathead Minnow
	Humpback Chub[EU]	Golden Trout	Iowa Darter
	Kendall Warm Springs Dace*[E]	Grayling	Lake Chub
	Mottled Sculpin	Kokanee Salmon	Longnose Dace
	Mountain sucker	Lake Trout	Longnose Sucker
	Razorback Sucker[XE]	Rainbow Trout	Northern Leatherside Chub
	Roundtail Chub*	Smallmouth Bass	Redside Shiner
	Speckled Dace	Snake River Cutthroat Trout	Sand Shiner
		Yellowstone Cutthroat Trout	Utah Chub
			Utah Sucker
			White Sucker

Aquatic Reptiles

No turtles are native to the Green River basin. Eastern Snapping Turtles have been found on occasion but none are known to have survived to reproduce.

Freshwater Mollusks and Crayfishes

Wyoming is still in the discovery phase in terms of its freshwater bivalve mollusks and gastropods. Although aquatic mollusks are often encountered during invertebrate sampling, few published accounts exist (Beetle 1989, Henderson 1924, Hoke 1979, Hovingh 2004). The WGFD retains SGCN status for some native bivalve mollusks and many gastropods due to lacking information.

No mussels are believed to be native to the basin but recent surveys found live Western Pearlshell mussels in the drainage (WGFD 2016).

Most of what is known about species presence and distributions of gastropods in the basin are summarized in Beetle (1989). All gastropods in the basin are SGCN due to lack of adequate population and distribution information.

No crayfish species are known to be native to the Green River basin in Wyoming. However, both Calico Crayfish and Virile Crayfish have been introduced (Hubert 1988, Hubert 2010). The Calico Crayfish is known from Fontenelle Reservoir and the Big Sandy River. The distribution of Virile Crayfish is much more widespread.

Table 4. Species of Greatest Conservation Need present in the Green River Basin

Fish

Bluehead Sucker
Colorado River Cutthroat Trout
Flannelmouth Sucker
Kendal Warm Springs Dace
Roundtail Chub

Identification of Conservation Areas

Conservation areas were identified based on distribution and conservation need for the Three Species (Roundtail Chub, Flannelmouth

Sucker and Bluehead Sucker) and Colorado River Cutthroat Trout.

Priority subdrainages for the conservation of Wyoming's Three Species include: Muddy Creek (tributary to the Little Snake River), Big Sandy River, Little Sandy Creek, Upper Bitter Creek, the Henrys Fork and select Finger Lakes near Pinedale.

Priority conservation areas for the Colorado River Cutthroat Trout are numerous and widespread. Priority areas in the Little Snake River drainage include: North Fork, West Branch of the North Fork, and the upper Roaring Fork of the Little Snake River; Dirtyman Creek watershed and upper Deep, Mill, Hatch, and Hells Canyon creeks in the Savery Creek watershed; Haggarty Creek; and Littlefield Creek in the Muddy Creek watershed. Priority areas in the Blacks Fork River drainage include: Muddy Creek, upper Sage and Gilbert creeks; and all tributaries to the upper Hams Fork River. Conservation areas in the upper Green River include LaBarge, Horse, and Cottonwood creek watersheds, North Piney Lake and the Lake Creek watershed, Beaver Creek watershed (tributary to Green River), Beaver creeks, Trail Ridge Creek and Fish Creek in the South Piney watershed, Tepee, Rock, Klondike, Jim, and Gypsum creeks.

Priority drainages and habitats have not yet been defined for the conservation of freshwater mollusks.

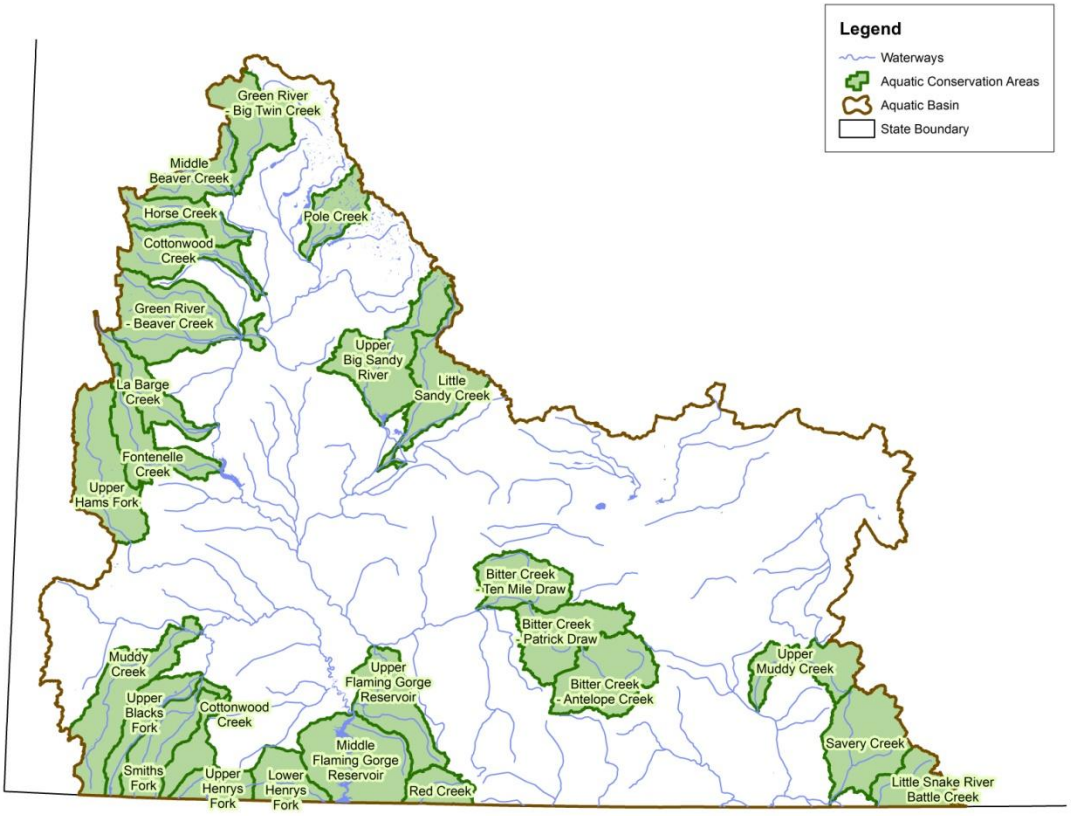

Figure 4. Aquatic Wildlife Conservation Areas in the Green River Basin.

Threats

Invasive species – High
Aquatic invasive species (AIS) present in the basin include curly pondweed. Additional descriptions and definitions of AIS can be found in the WGFD AIS management plan (WGFD 2010).

Curly pondweed was introduced into the United States in the mid 1800's and is now widespread. Curly pondweed reproduces by seed which can be easily transferred in mud or water. It is introduced into new areas through boating, fishing, and water hauling, and as an ornamental plant. New populations continue to be discovered in Wyoming. In the Green River Basin, it is found in New Fork Lake at the constriction between upper and lower New Fork lakes.

In addition to species designated as AIS, several introduced game fishes are problematic in the basin. Burbot, a voracious predator, are expanding in the basin and pose a significant threat to Flannelmouth and Bluehead Suckers in the Green and Big Sandy rivers and to the Three Species (Bluehead Sucker, Flannelmouth Sucker and Roundtail Chub) in the Blacks Fork and Hams Fork. White sucker in the drainage pose risk of competition and hybridization with native Flannelmouth and Bluehead suckers in the drainage. Additionally, competition and hybridization with nonnative trout poses a threat to important conservation populations of Colorado River Cutthroat Trout in the drainage. While nonnative game fish may need to be controlled for conservation and restoration of natives in some areas, these same fish support popular fisheries that provide important recreational and economic benefits (WGFD 2010).

Other invasive species, such as zebra and quagga mussels and silver carp, are present in neighboring states and potentially very harmful to the aquatic wildlife in the basin. Through outreach and education, watercraft inspections, and monitoring, the harmful impacts of these and other invasive species may be prevented. Watercraft are inspected at key locations entering the basin at Evanston and Kemmerer, and at major waters including Flaming Gorge Reservoir, Fontenelle Reservoir, and Fremont Lake. Twenty (20) waters in the basin are monitored annually to detect the presence of invasive species. These efforts to keep existing species in the basin from spreading to new waters, and other harmful species from entering the basin will continue.

Water development/altered flow regimes – High
Natural flow regimes in stream segments around the state have been altered by human activities including irrigation diversions and water developments for more reliable water supply, hydropower, recreation and flood control. These altered flow regimes are also a consequence of broad-scale changes in land use and management associated with agriculture, grazing, timber harvest, and housing development (see Wyoming Leading Wildlife Conservation Challenges – Disruption of Historic Disturbance Regimes). The majority of the Green River basin is publicly owned. Because it is such an arid region, the limited amount of irrigated cropland has a significant impact on aquatic wildlife in some areas. Besides the direct effects of depleting stream flow in some streams and enhancing stream flow where return flows are considerable in other places, irrigation diversions often impede movement, and in many situations significant numbers of fish are lost to entrainment into the irrigation ditches. Lateral and longitudinal hydrologic connectivity and physical access by fish populations to all habitats necessary to complete their life history is limited in portions of the drainage. In-channel obstructions and increased dewatering have reduced some populations of native fishes.

The need for additional water for human consumption will intensify in the immediate future, and that trend will be especially evident in the western U.S. Demand for additional water primarily in states that are downstream from Wyoming will increase even more than demand in Wyoming. This trend has multi-

faceted consequences for fish and wildlife and the habitats upon which they depend, depending on how such demand influences water management. In Wyoming, trans-basin water diversions are not uncommon and are likely to be further proposed and pursued. Warmer conditions with more erratic precipitation— which some predict for Wyoming — may heighten the need for more creative water management including additional water storage for municipal, agricultural, and recreational purposes.

In recent years, entities from the lower Colorado River Basin have explored an incentive-based program to encourage Wyoming water users (mostly irrigators) to forgo late season irrigation as a way to produce more water in the system for those entities in the lower basin. If this practice continues, the net result could be to enhance late season flow in some stream segments which could improve habitat and species distribution for some species of fish and other aquatic organisms. Given the demand for water in the lower basin these kinds of water management practices could persist or increase.

The likely trend will be water development projects closer to the delivery point and conveyance via pipelines instead of stream channels. Additional emphasis will likely be placed on lining irrigation ditches and other practices to more efficiently use water for consumptive purposes. The net effect of all such water management practices will be to alter the timing, magnitude, and duration of natural hydrographs and reduce intra- and inter-annual variability in Wyoming's streams and associated riparian corridors (see Wyoming Leading Wildlife Conservation Challenges – Climate Change, and the Riparian habitat chapter). In many situations, changes in stream channel hydrologic patterns can alter habitat with the concurrent effect of altering the species or aquatic organisms that are found there.

Several water development projects have been proposed for the upper Green River Basin. Proposed sites are located on the Green River and Wyoming Range and Wind River tributaries (Green River Basin Plan 2010).

While water development can threaten native species, some introduced species, including those in popular sport fisheries, have thrived in the face of water development. The simplification of natural systems by human development tends to simplify habitat structure which can favor species with generalized and broad habitat requirements. For example, the Lake Trout fishery in Flaming Gorge Reservoir depends on the consistent deep water and forage production inherent in this man-made water body. Stable stream flow releases from dams, with relatively low peak flows and relatively high base flows, perpetuate productive sport fisheries like the Green River below Fontenelle Reservoir.

Drought and climate change – moderate
Climate change may increase air and surface water temperatures, alter the magnitude and seasonality of precipitation and runoff, and shift the reproductive phenology and distribution of plants and animals (Seavy et al. 2009) (see Wyoming Leading Wildlife Conservation Challenges – Climate Change).

Changes in precipitation patterns under various climate change scenarios are predicted to produce peak flows earlier in the yearly cycle and to lower base flows (Barnett et al. 2004). Drought lowers water tables, leading to reduced plant growth and reproduction. Riparian vegetation declines lead to lower bank stability, higher siltation and altered stream habitat quality and quantity. Lower water levels increase water temperatures and reduce the habitat available to fish and other aquatic wildlife. All these conditions can be detrimental to the health and reproductive success of all aquatic wildlife species.

Conservation Initiatives

Department plans and policies
The WGFD's Fish Division has developed basin management plans to guide management across the state. These plans provide background and history of aquatic wildlife management as well as management direction. These plans reference the SWAP and the Strategic Habitat Plan (SHP), attempting to incorporate management direction relevant to each basin.

Habitat management efforts are guided by the SHP that is regularly revised and approved by the Wyoming Game and Fish Commission. The SHP includes five goals: 1) Conserve and manage wildlife habitats that are crucial for maintaining terrestrial and aquatic wildlife populations for the present and future, 2) Enhance, improve, and manage priority wildlife habitats that have been degraded, 3) Increase wildlife-based recreation through habitat enhancements that maintain or increase productivity of wildlife, 4) Increase public awareness of wildlife habitat issues and the critical connection between healthy habitat and abundant wildlife populations, and 5) Promote collaborative habitat management efforts with the general public, conservation partners, private landowners, and land management agencies. Efforts are focused in priority areas in each of the management regions and include crucial areas essential for conservation of important species and communities and enhancement areas, which represent places where work should be done to maintain or improve wildlife habitat.

In addition to these guiding documents, the WGFD has a number of tools, policies and protocols to protect and enhance native aquatic wildlife. Additional details on these tools, policies and protocols including environmental commenting, aquatic wildlife stocking and transplant, and disease prevention can be found in the 2010 SWAP.

Interagency plans and agreements
The states of Colorado, Utah, and Wyoming along with the U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Ute Tribe and National Park Service, signed a Conservation Agreement to jointly conserve, protect, and restore Colorado River Cutthroat Trout within their historic range (CRCT Conservation Team 2006). As part of the agreement the interstate working group under the auspices of the Conservation Agreement completes range-wide status assessments (e.g. Hirsch et al. 2013).

The states of Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming and U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, U.S. Bureau of Reclamation, Jicarilla Apache Nation, Southern Ute Indian Tribal Council, and U.S. Forest Service are signatories to a range-wide conservation agreement and strategy for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker (UDWR 2009). As part of the agreement an interstate working group meets annually to discuss conservation needs and produces regular status assessments.

The National Fish Habitat Action Plan (NFHAP) was developed by a coalition of fisheries professionals, state and federal agencies, tribes, foundations, conservation and angling groups, businesses and industries, all determined to reverse the declines of America's fish habitats. The WGFD is involved with three NFHAP partnerships, Great Plains Fish Habitat Partnership, the Western Native Trout Initiative, and the Desert Fishes Habitat Partnership. The Western Native Trout Initiative and the Desert Fishes Habitat Partnership cover the Green River Basin. Additional information on Fish Habitat Partnerships can be found in the 2010 SWAP.

The Kendall Warm Springs Dace (KWD) is federally listed as an Endangered species. The U.S. Fish and Wildlife Service recovery plan for KWD is the primary guiding document for management of this species (USFWS 2015).

The Wyoming Landscape Conservation Initiative (WLCI) coalesced in the mid 2000s and is a long-term science-based effort to assess and enhance aquatic and terrestrial habitats at a

landscape scale in Southwest Wyoming. To ensure Southwest Wyoming's wildlife and habitat remain viable in areas facing development pressure, the U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Geological Survey, USDA Forest Service, National Park Service, the U.S. Bureau of Reclamation, the Wyoming Department of Agriculture, the Wyoming Game and Fish Department, local conservation districts, and local counties are implementing the WLCI.

Ongoing and completed conservation actions

Numerous projects have been completed to benefit SGCN in the Green River basin since the implementation of the 2010 SWAP (previous accomplishments are documented in the 2010 SWAP). Multiple sources of funding have been used to implement projects. Projects have been completed by department personnel and through contracting and granting with research partners. Accomplishments are listed under headings taken from the Recommended Conservation Actions in the 2010 SWAP. While accomplishments are not duplicated under more than one action they commonly address multiple actions. Although this list is not comprehensive of all actions, most of the significant initiatives are summarized below.

Secure and enhance populations and habitats in SGCN priority areas

The WGFD completed a fish migration barrier on and chemically removed nonnative trout from Bare Creek. The stream will be re-stocked with genetically pure Colorado River Cutthroat Trout (WGFD 2016).

Determine the status and distribution of native aquatic wildlife assemblages with emphasis on Colorado River Cutthroat Trout, Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

WGFD biologists conducted a statewide survey of Mountain Whitefish (SGCN in 2010 SWAP) from 2009 to 2013. A primary achievement of the study was the development of a sampling approach for assessing populations (Edwards 2014). The study demonstrated most populations are robust leading to the determination that a non SGCN status rank (NSS5) is appropriate.

WGFD biologists investigated the seasonal movements of Colorado River Cutthroat Trout in North and South Cottonwood Creeks. Results suggest variable movement and isolation of fragment populations (Rhea 2015).

The WGFD and Bridger-Teton National Forest aquatics biologists inventoried the distribution and abundance of Colorado River Cutthroat Trout in the upper Green River (Rhea and Gardiner 2012).

WGDF biologists assessed the habitat availability and use by Flannelmouth Sucker in Bitter Creek. Recommendations include barrier enhancement and channel modification (Senecal 2011).

The WGFD funded a research project at Colorado State University to aid in the design of fish migration barriers to prevent White Sucker and Burbot from entering conservation areas for Flannelmouth Sucker, Bluehead Sucker and Roundtail Chub (Gardunio 2014).

WGFD biologist monitored populations of Colorado River Cutthroat Trout, Flannelmouth Suckers, Bluehead Suckers and Roundtail Chub in the Muddy Creek drainage (WGFD 2011, 2012, 2015).

Assess the genetic purity of Colorado River Cutthroat Trout, Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub populations

The WGFD funded a study at the University of Wyoming to determine genetic purity and patterns of hybridization amongst Wyoming suckers (Mandeville et al. 2015). The study included numerous samples from Bluehead Sucker and Flannelmouth Sucker from the Green River basin.

Identify and reduce threats to native fish populations from nonnative species

The WGFD funded a research project at the University of Idaho to investigate the scale and scope of nonnative Burbot invasion in the

Green River and determine if population control may be feasible. Results suggest Burbot are widespread and abundant near reservoirs (Klein 2015).

In advance of work to restore Bluehead Sucker and Flannelmouth Sucker to the Big Sandy River, the WGFD conducted a study to determine effective lethal dosage of rotenone on Burbot (Compton 2013).

The WGFD led a mechanical removal of nonnative fish from tributaries of the Green River to protect and enhance populations of Roundtail Chub, Flannelmouth Sucker and Bluehead Sucker (Atwood and Keith 2012).

The WGFD chemically removed nonnative species (Longnose Sucker) from Meeks Lake in the Big Sandy drainage to eliminate competition and hybridization of native sucker species (WGFD 2013).

WGFD built fish migration barriers on Long Draw in the Little Sandy drainage and Sculpin Creek in the Big Sandy drainage to isolate the tributaries and facilitate chemical treatments which have eliminated significant source populations of nonnative species that are impacting native sucker species (WGFD 2013, 2016).

The WGFD chemically removed nonnative species from Sculpin Creek in the Big Sandy drainage and from Long Draw in the Little Sandy drainage to eliminate predation, competition and hybridization of native sucker species (WGFD 2013, 2016).

Trout Unlimited, in partnership with WGFD, completed the Eagle Creek fish migration barrier on McKinney Creek and the Bridger Pass fish barrier on Muddy Creek in the Muddy Creek drainage (WGFD 2016).

WGFD in partnership with BLM chemically removed nonnative species from McKinney Creek above the Eagle Creek fish barrier to eliminate predation, competition and hybridization of the three species (WGFD 2016). Bluehead Suckers and Roundtail Chub will be transplanted from downstream habitats into voided habitat.

WGFD began construction of a fish migration barrier on Big Sandy River to keep nonnative species from moving upstream into habitat used by native sucker species.

WGFD constructed the East Fork Rearing Station near the Boulder Rearing Station to hold native suckers and chubs during chemical treatments targeting non-native fishes. Studies were also conducted to determine the feasibility of salvaging and holding native suckers and chubs in captivity (WGFD 2013).

Implement existing plans and agreements to conserve SGCN

WGFD and cooperating entities continue to implement actions spelled out in Conservation Strategies for Colorado River Cutthroat Trout (CRCT Conservation Team 2006), and Roundtail Chub, Flannelmouth Sucker, and Bluehead Sucker (UDWR 2009).

Increase educational efforts about the ecological, economic, and social values of aquatic SGCN.

The WGFD created, produced and disseminated a poster detailing the state's native fishes.

WGFD created, produced and disseminated stickers and magnets featuring Flannelmouth Sucker, Bluehead Sucker, and Roundtail Chub.

Continue building voucher collections for all aquatic wildlife

WGFD biologists collected numerous fish voucher specimens since the last SWAP (2010). All vouchers specimens are submitted to the Museum of Southwestern Biology, Albuquerque NM.

Continue aquatic habitat work in the basin

WGFD biologists investigated Colorado River Cutthroat Trout passage and entrainment at Cheyenne Board of Public Utilities diversions in the Little Snake River drainage (Luginbill and Compton 2011). Results suggest the diversions

are barriers that impeded movement while entrainment is a low-level threat.

WGFD completed entrainment studies on several private land diversions in the Cottonwood drainage (WGFD 2016).

The WGFD partnered with USFS, TU, and USFWS to improve passage at two road crossings in upper LaBarge Creek to open up five miles of habitat to Colorado River Cutthroat.

The WGFD assessed 231 of 296 known points of diversions in the upper Green Basin (primarily along the East slope of the Wyoming Range) for fish passage needs and prioritization.

Fish passage was improved at four irrigation diversions in three different drainages; Horse Creek, Cottonwood Creek, and Piney Creek. A fish screen was installed in a large diversion of Pine Creek, tributary to the New Fork River, to eliminate entrainment.

Trout Unlimited in partnership with WGFD and Little Snake Conservation District modified numerous sheet piling structures to allow for fish passage in the Muddy Creek drainage (WGFD 2015, 2016).

Explore water management approaches that enhance fish habitat
A two year pilot program was initiated that paid water users to stop irrigation in early July and allow water to bypass their diversion with the goal to reach states in the lower Colorado River basin. Extra flow during late summer is very beneficial to habitat conditions at a critical time period for fish.

Follow up on recommendations from the graduate research project on gastropods
No reported projects.

Recommended Conservation Actions

Secure, enhance, or establish SGCN populations
Finish building fish migration barrier on the Big Sandy River, salvage native fish and chemically remove nonnative suckers, chubs and Burbot.

Restore Little Sandy Creek to a native fish assemblage including the three species. Build fish migration barriers and establish fish passage as necessary to facilitate restoration efforts.

Continue restoring Muddy Creek and its tributaries to a native fish assemblage including the three species and Colorado River Cutthroat Trout. Build fish migration barriers and establish fish passage as necessary to facilitate restoration efforts.

Transplant Roundtail Chub from lower Muddy Creek into Lowest Deep Gulch Reservoir. Increase the capacity of the East Fork Rearing Station (three species rearing facility) to hold and maintain additional fish.

Identify refuge lakes and implement transplants for Roundtail Chubs in lakes in the basin.

Restore Sage Creek, Currant Creek and Trout Creek to a native fish assemblage including Colorado River Cutthroat trout. Build fish migration barriers and establish fish passage as necessary to facilitate restoration efforts.

Reconnect East Muddy Creek, West Muddy Creek and Van Tassel Creek as metapopulation of native fish including Colorado River Cutthroat trout. Eliminate nonnative fish as necessary with chemical treatments. Protect the population with a fish migration barrier below the convergence of the three Muddy Creek tributaries.

Inventory, assess, or examine life history requirements of SGCN
Conduct baseline gastropods surveys in the basin and identify needed actions to maintain or restore populations.

Conduct sampling on non-wadeable streams in the Green River drainage which were undersampled in 2002-2006 surveys (Gelwicks et al. 2009) to better understand the status of Flannelmouth Sucker, Bluehead Sucker and Roundtail Chub in these waters.

Determine current status of Roundtail Chub populations in the Blacks Fork and Hams Fork drainages, especially after the recent invasion by non-native Burbot.

Conduct a study to better understand life history and movement patterns of Roundtail Chub in the Blacks Fork and Hams Fork drainages.

Provide passage and reduce entrainment at barriers impacting SGCN
Conduct entrainment study of seven irrigation diversions in the Cottonwood Creek drainage to determine need for screening.

Work with TU and landowner on South Cottonwood Creek to improve passage past two diversions and a road crossing.

Work with partners in the Henry's Fork drainage and its tributaries to improve fish passage and reduce or eliminate entrainment by irrigation diversions as necessary for Flannelmouth Suckers, Bluehead Suckers and Colorado River Cutthroat Trout.

Work with partners to improve fish passage in the Muddy Creek drainage for Colorado River Cutthroat Trout and the three species.

Work with partners to maintain existing fish migration barriers and to improve fish passage as needed in the Gilbert Creek drainage.

Work with project partners to improve passage at nine additional road crossings in upper LaBarge Creek to connect the entire watershed upstream of the fish migration barrier.

Assist water users with entrainment study on the Lee Ditch, a diversion on Pine Creek.

Assess remaining irrigation diversions and road crossings in the basin for fish passage and prioritization for fish friendly improvements.

Improve aquatic habitat for SGCN
Implement stream restoration designs on the New Fork River downstream of Pinedale to improve stream function and habitat conditions.

Implement stream restoration and habitat improvement projects on the Big Sandy River downstream of Buckskin Crossing to narrow and deepen the channel and expose hard surfaces for native suckers.

Implement stream riparian restoration projects in the Red Creek drainage to enhance habitat for native fish including Colorado River Cutthroat Trout.

Employ water management strategies that improve habitat for SGCN
Identify opportunities to work with private water right holders to manage water diversions and uses with the goal of restoring natural flow regimes. Where opportunities exist, develop cooperative strategies with landowners and other partners to implement strategies that are beneficial to aquatic resources.

Identify stream segments where habitat and available flow regimes indicate a need to file instream flow water rights for SGCN. As opportunities are identified, conduct needed studies and file for state-held instream flow water rights.

Continue building voucher collections for all aquatic wildlife
Continue to fill voids in voucher inventory for fish per WGFD protocol (Zafft and Bear, 2009).

Build gastropod voucher collection and find permanent repository.

Increase educational efforts about the ecological, economic, and social values of aquatic SGCN
No specific actions identified.

Monitoring

Routinely monitor SGCN populations
Conduct routine population assessments of Colorado River Cutthroat Trout at established monitoring sites.

Conduct routine population assessments of Roundtail Chub, Flannel Mouth Sucker and Bluehead Sucker at established monitoring sites.

Establish standardized monitoring protocols and locations for native SGCN
Develop a plan to monitor Flannelmouth Sucker, Bluehead Sucker and Roundtail Chub populations identified in Gelwicks et al. (2009).

Literature Cited

ATWOOD, P. AND R. KEITH. 2012. Mechanical removal of non-native fishes to conserve native Bluehead Sucker, Flannelmouth Sucker and Roundtail Chub in the Green River Drainage of Wyoming 2009-2011. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

BARNETT, T., R. MALONE, W. PENNELL, D. STAMMER, B. SEMTNER AND W. WASHINGTON. 2004. The effects of climate change on water resources in the West: introduction and Overview. Climatic Change 62: 1–11.

BEETLE, D. E. 1989. Checklist of recent Mollusca of Wyoming. Great Basin Naturalist 49(4): 637–645.

COMPTON, R. I. 2013. Toxicity of rotenone to Burbot. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

CRCT CONSERVATION TEAM. 2006. Conservation strategy for Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*) in the states of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins, CO.

GARDUNIO, E. 2014. Jumping and swimming performance of Burbot and White Sucker: Implications for barrier design. Master's Thesis. Colorado State University, Fort Collins.

GELWICKS, K. R., C. J. GILL, A. I. KERN, AND R. KEITH. 2009. Current status of Roundtail Chub, flannelmouth sucker, and Bluehead Sucker in the Green River drainage of Wyoming. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

GREEN RIVER BASIN PLAN. 2010. Wyoming Water Development Commission, Basin Planning Program. Cheyenne, WY.

HENDERSON, J. 1924. Mollusca of Colorado, Utah, Montana, Idaho and Wyoming. University of Colorado Studies 13:65–223.

HIRSCH, C.L., M.R. DARE, AND S.E. ALBEKE. 2013. Range-wide status of Colorado River cutthroat trout (Oncorhynchus clarkii pleuriticus): 2010. Colorado River Cutthroat Trout Conservation Team Report. Colorado Parks and Wildlife, Fort Collins.

HOVINGH, P. 2004. Intermountain freshwater mollusks, USA (Margaritifera, Anodonta, Gonidea, Valvata, Ferrissia): geography, conservation, and fish management implications. Monographs of the Western North American Naturalist 2:109–135.

HUBERT, W. A. 1988. Survey of Wyoming crayfishes. Great Basin Naturalist 48:370–372.

HUBERT, W.A. 2010. Survey of Wyoming crayfishes: 2007–2009. US Geological Survey Report to the Wyoming Game and Fish Department, Cheyenne, WY.

KLEIN, Z. B. 2015. Population ecology and the suppression of Burbot in the Green River, Wyoming. Master's Thesis. University of Idaho, Moscow.

LUGINBILL, J. S. AND COMPTON, R. I. 2011. Fish passage and entrainment in the North Fork Little Snake River drainage, Wyoming. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

MANDEVILLE, L., PARCHMAN, T. AND C. A. BUERKLE. 2015. Genomic analyses of sucker hybridization in the upper Colorado River basin. Final Report to the Wyoming Game and Fish Department, Cheyenne, WY.

RHEA, D. 2015. Seasonal movements among fragmented populations of Colorado River Cutthroat Trout in the Cottonwood Creek

drainage. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

RHEA, D. AND A. GARDINER. 2012. Distribution and abundance of Colorado River Cutthroat Trout in tributaries within the upper Green River basin, Wyoming. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

SEAVY, N.E. T. GARDALI, G.H.GOLET, F.T. GRIGGS, C.A. HOWELL, R. KELSEY, S.L. SMALL, J.H.VIERS, AND J.F.WEIGAND. 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. Ecological Restoration 27:330-338.

SENECAL, A. C. 2011. Assessment of habitat availability and use patterns for Flannelmouth Suckers in the upper Bitter Creek, Wyoming. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.

UDWR. 2009. Rangewide conservation agreement and strategy for Roundtail chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*). Utah Division of Wildlife Resources, Salt Lake City, UT.

WGFD. 2010. Wyoming aquatic invasive species management plan. Wyoming Game and Fish Department Report. Cheyenne, Wyoming.

WGFD. 2011. Annual fisheries progress report on the 2010 work schedule. Wyoming Game and Fish Department, Cheyenne.

WGFD. 2012. Annual fisheries progress report on the 2011 work schedule. Wyoming Game and Fish Department, Cheyenne.

WGFD. 2013. Annual fisheries progress report on the 2012 work schedule. Wyoming Game and Fish Department, Cheyenne.

WGFD. 2015. Annual fisheries progress report on the 2014 work schedule. Wyoming Game and Fish Department, Cheyenne.

WGFD. 2016. Annual fisheries progress report on the 2015 work schedule. Wyoming Game and Fish Department, Cheyenne.

WYOMING GAME AND FISH COMMISSION. 2009. Strategic Habitat Plan. Cheyenne, WY.

ZAFFT, D.J. AND E.A. BEAR. 2009. Guidelines for the collection of fish voucher specimens. Wyoming Game and Fish Department Administrative Report, Cheyenne, WY.