

Yellowstone River Basin



Bighorn 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 Yellowstone River Basin includes portions of four 4-digit HUC subregions: the Missouri Headwaters in Yellowstone National Park (YNP; Madison and Gallatin Rivers), the Upper Yellowstone (also partly in YNP), the Bighorn River, and the Powder/Tongue River (Figure 11). A total of twenty-nine 8-digit HUC drainages are nested within these. These watersheds span over one-third of Wyoming,

covering 34,167 square miles in northern Wyoming’s Big Horn, Campbell, Fremont, Hot Springs, Johnson, Natrona, Park, Sheridan, and Washakie counties. Thirty-five percent of the land is privately held. Public land is managed primarily by the Bureau of Land Management (26% of total area), U.S. Forest Service (17%) and the National Park Service (7%). The Wind River Indian Reservation occupies 7% of the area.

There are approximately 38,600 miles of streams on the USGS National Hydrography Dataset in the Yellowstone River basin in Wyoming. Major river drainages in the basin include the Wind-Bighorn, Shoshone, Upper Yellowstone, Clarks Fork, Tongue and Powder.

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

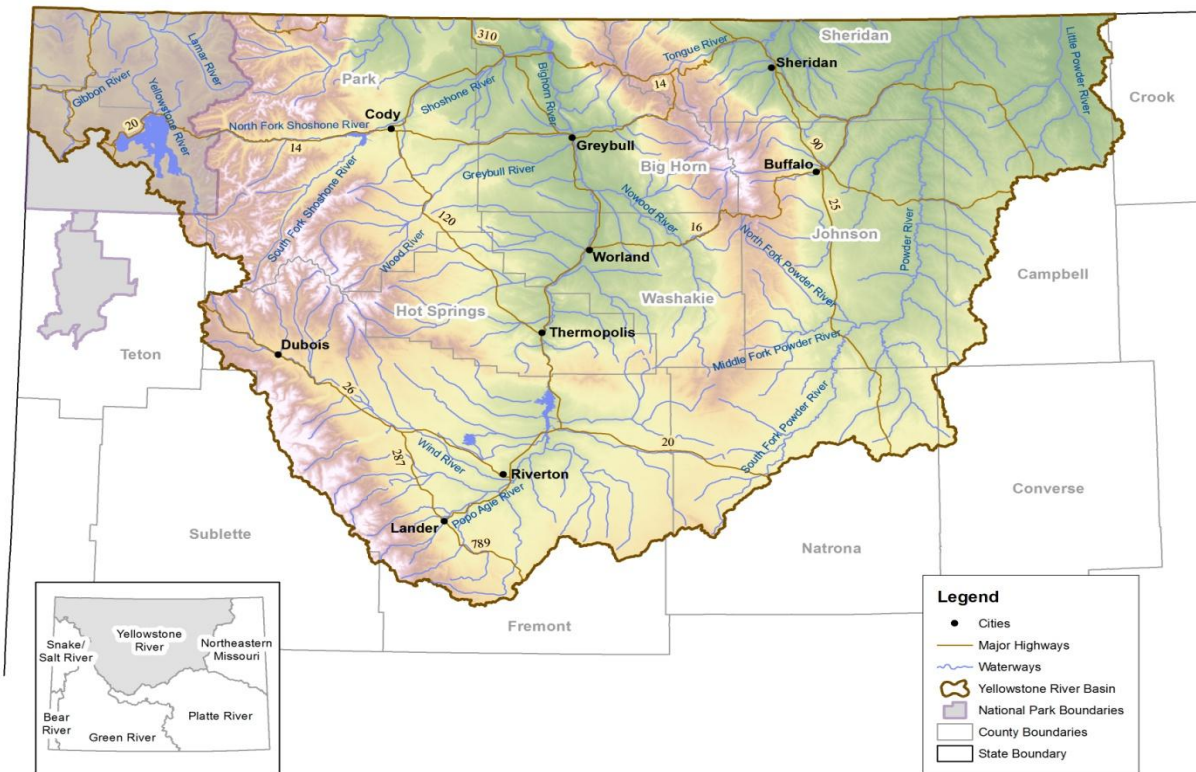


Figure 11. Yellowstone River Basin.

Aquatic Wildlife

Fish

A detailed history of fish collections and surveys in this basin, which began in the mid 19th century is 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 Yellowstone River Basin has seven native game fish and 16 native nongame fish (Table 11). A total of 20 game fishes and 10 nongame

fishes have been introduced to the basin (Table 11). The known fish assemblage of the Yellowstone River basin is shown in Table 11. Four game species and six nongame species are currently considered SGCN.

Most of the fish SGCN in the basin (Brassy Minnow, Flathead Chub, Goldeye, Plains Minnow, Sturgeon Chub, Western Silvery Minnow, Sauger and Shovelnose Sturgeon) belong to an assemblage associated with large turbid free flowing rivers such as the Powder and Bighorn.

Table 11. Fishes present in the Yellowstone River Basin. Species of Greatest Conservation Need (SGCN) are followed by an asterisk (*).

Native game	Native nongame	Nonnative game	Nonnative nongame
Burbot*	Brassy minnow*	Bear River Cutthroat Trout	Brook Stickleback
Channel Catfish	Creek chub	Black Bullhead	Common Carp
Mountain Whitefish	Fathead Minnow	Black Crappie	Emerald Shiner
Sauger*	Flathead Chub*	Bluegill	Golden Shiner
Shovelnose Sturgeon*	Goldeye*	Brook Trout	Goldfish
Stonecat	Lake Chub	Brown Trout	Grass Carp
Yellowstone Cutthroat Trout*	Longnose Dace	Colorado River Cutthroat Trout	Johnny Darter
	Longnose Sucker	Golden Trout	Mottled Sculpin
	Mountain Sucker	Grayling	Plains Killifish
	Plains Minnow*	Green Sunfish	Spottail Shiner
	River Carpsucker	Lake Trout	
	Sand Shiner	Largemouth Bass	
	Shorthead Redhorse	Pumpkinseed	
	Sturgeon Chub*	Rainbow Trout	
	Western Silvery Minnow*	Rock Bass	
	White Sucker	Smallmouth Bass	
		Snake River Cutthroat Trout	
		Walleye	
		White Crappie	
		Yellow Perch	

The native large river fish assemblage remains intact in the Powder River where habitat remains largely unaltered by reservoir construction and water diversion. However, in the Wind-Bighorn where water development has been substantial, Goldeye and Shovelnose Sturgeon have been extirpated (Shovelnose Sturgeon have subsequently been reintroduced), Plains Minnow were last documented in the 1990's (Patton 1997) and Sturgeon Chub were last observed in 2001.

Burbot are native to the basin but were historically only abundant in the less turbid and colder reaches of the Wind River and its tributaries. Water developments in the basin that have increased available cold lentic habitats have allowed Burbot to expand their range. Threats to Burbot include limited range, angler exploitation and loss of population connectivity. Burbot are infrequently observed in the Tongue, Powder, and warmer turbid reaches of the Big Horn.

Yellowstone Cutthroat Trout are native to colder headwater streams and rivers of the basin. Degradation of habitat due to factors including water diversion and increased sedimentation have impacted cutthroat distribution and abundance. However the primary threat to Yellowstone Cutthroat Trout persistence is nonnative salmonids. These nonnatives are well documented competitors for resources, predators of cutthroat and hybridizing species that diminish cutthroat genetic integrity.

Substantial additional information on research and prior management of SGCN in the Yellowstone River Basin are summarized in the 2010 Wyoming SWAP (WGFD 2010).

Aquatic Reptiles

Three turtles are found in the Yellowstone River basin, all of which are native. The Western Spiny Softshell and Western Painted Turtle are SGCN, but the Eastern Snapping Turtle is not. The Western Spiny Softshell is known from the Little Powder, Powder, Tongue, Nowood and Bighorn Rivers. The Western Painted Turtle is

found in all of the major subdrainages in the Yellowstone River basin and is probably most common in Clear and Crazy Woman Creeks in the Powder River drainage. It is the only turtle species known from the Clarks Fork of the Yellowstone River in Wyoming. The Eastern Snapping Turtle is found in the Little Powder, Powder, Tongue, Little Bighorn, and Bighorn River drainages. The species has only been found in the downstream portions of the Little Bighorn and Bighorn River drainages, near the Montana state line.

Freshwater Mollusks and Crayfishes

Wyoming is still in the discovery phase in terms of its freshwater bivalve mollusks and gastropods. Although fingernail and pill clams and aquatic gastropods are often encountered during invertebrate sampling, few published accounts of mollusk collections exist (Beetle 1989, Henderson 1924, Hoke 1979, Hovingh 2004). Many native mussels, clams, and gastropods are considered SGCN due to a lack of information regarding status.

Two bivalve mussel species have been documented in the Yellowstone River basin. The Fatmucket is the most widespread. Populations are spread throughout the Powder, Tongue, and Wind-Bighorn river drainages. The Giant Floater exists in the Little Powder drainage near the Montana state line.

Most of what is known about species presence and distributions of gastropods in the basin are summarized in Beetle (1989) and Narr (2011). With one exception all gastropods in the basin are SGCN due to lack of adequate population and distribution information. Cave Physa are the only gastropod with enough information to assess status (NSS4).

Little information is available on the distribution of Wyoming crayfishes. Two species (*Orconectes* Calico and Virile Crayfish), both of which are native, have been documented in the Yellowstone River basin (Hubert 1988, 2010). The Calico Crayfish are considered SGCN while the more common Virile Crayfish are not.

Table 12. Species of Greatest Conservation Need present in the Yellowstone River Basin.

Fish

Brassy minnow
 Burbot
 Flathead Chub
 Goldeye
 Plains Minnow
 Sauger
 Shovelnose Sturgeon
 Sturgeon Chub
 Western Silvery Minnow
 Yellowstone Cutthroat Trout

Aquatic Reptiles

Western Painted Turtle
 Western Spiny Softshell Turtle

Crustaceans

Calico Crayfish

Mollusks

Giant Floater Mussel

Identification of Conservation Areas

To address needs of the diverse aquatic assemblage of the Yellowstone River basin, conservation areas were identified to include wide-ranging habitats from mountain lakes, coldwater streams, warmwater streams, and large rivers (Figure 12).

Conservation areas were identified using a number of available tools. Results from Stewart et al. (2015) guided prioritization of cool and

warmwater habitats. Coldwater habitats in the basin were prioritized following conservation populations identified in the Yellowstone Cutthroat Trout Conservation Strategy (Range-Wide YCT Conservation Team 2009) and the known distribution of Burbot.

The Powder River conservation area includes the mainstem Powder River downstream of Kaycee, Wyoming, Clear Creek below Hwy 14/16, Crazy Woman Creek below Interstate 90, and the Little Powder River below the confluence of Cottonwood Creek.

The lower Nowood River, below Big Trails, Wyoming, is an important conservation area for native nongame species in the Bighorn River drainage. It is home to a diverse assemblage of fishes, including many SGCN (Bear 2009).

Priority areas for the conservation of native Yellowstone Cutthroat Trout are numerous and widespread. On the north and east slopes of the Bighorn Mountains, these include Lodgegrass Creek, the West Fork Little Bighorn River, Elkhorn Creek and Red Gulch creeks, the North and South forks of West Pass Creek in the Little Bighorn drainage, and the South Fork Little Tongue River.

In the Wind/Bighorn River drainage on the west side of the Bighorn Mountains, priorities include the North Fork Shoshone River drainage above Buffalo Bill Reservoir, Upper South Fork of the Shoshone River, Ishawooa Creek, Marquette Creek, Greybull and Wood River drainages, Trout Creek and Deer Creek (Porcupine Creek drainage), North and South Beaver Creeks (Shell Creek drainage), South Paintrock Creek, East Tensleep Creek, and the East Fork Wind River.

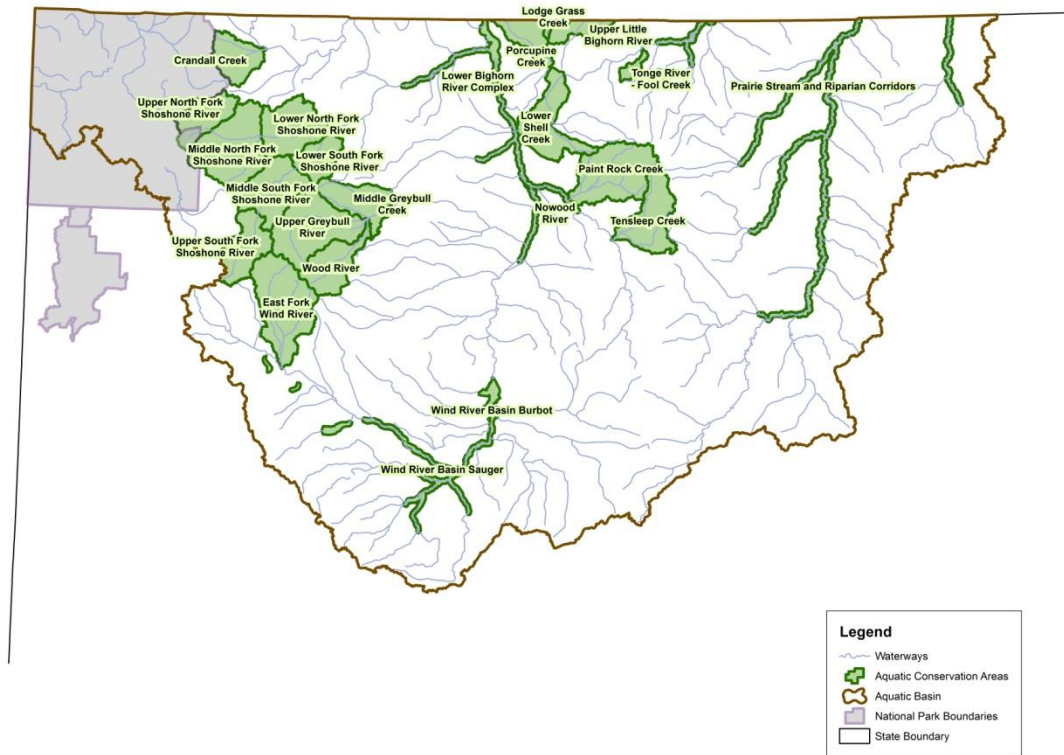


Figure 12. Aquatic Wildlife Conservation Areas in the Yellowstone River Basin.

In the upper Yellowstone River drainage, priorities include the Yellowstone River headwaters and tributaries, Crandall Creek and tributaries, Muddy Creek (tributary to Clarks Fork River), Littlerock Creek and Deep Lake.

To conserve Sauger in the Wind-Bighorn River drainage, the following areas have been identified below Boysen Dam: Big Horn Lake and the Bighorn River below the Lower Hanover Diversion south of Worland. Priorities above Boysen Dam are Boysen Reservoir to the upper extents of Sauger distribution. This includes the Wind River up to Diversion Dam, Popo Agie River up to confluence with North Fork Popo Agie River, Little Popo Agie River up to confluence with Willow Creek, and Little Wind River up to Sub-Agency Ditch Diversion.

To conserve Burbot in the Wind-Bighorn River drainage, the following areas have been identified: Bull Lake, Lower and Upper

Dinwoody lakes, Torrey, Ring, and Trail lakes on Torrey Creek, Boysen Reservoir, Bighorn River and Big Horn Lake.

Priority drainages and habitats have not yet been defined for the conservation of aquatic reptiles, freshwater mollusks, or crayfishes.

Threats

Water development/altered flow regimes – Moderate

Natural flow regimes in stream segments around the state have been altered by human activities, including irrigation diversions municipal water supply, hydropower, fisheries and recreation, and flood control. Altered flow regimes below diversions and reservoirs 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). Lateral and longitudinal hydrologic connectivity and physical access by fish populations to all habitats necessary to complete their life history is limited throughout the drainage. In-channel obstructions and decreased stream flow associated with increased diversions have reduced some populations of native stream fishes.

The need for additional water for human use will intensify in the immediate future, and that trend will be especially evident in the western U.S. This trend has multi-faceted consequences for fish and wildlife and the habitats upon which they depend. In Wyoming, trans-basin water diversions are not uncommon within some drainages and are likely to be further proposed and pursued. Energy development, including hydropower development, may increase as the nation's electrical energy demands rise.

Warmer conditions with more erratic precipitation—which some predict for Wyoming's future climate—may heighten the need for additional water storage for municipal and agricultural purposes. 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. Additional scrutiny of existing water uses and water rights is also likely as evidenced by the Bighorn River general stream adjudication conducted by the Wyoming district court from 1997 to 2007. This action reviewed water claims and rights of over 20,000 users and resulted in the elimination of many historic water rights due to non-use. Though this action did not significantly change water uses in most streams and reservoirs, it illustrates the potential of future legal efforts to effectively modify water use in certain places. The net effect of all such water management practices will be to alter

the timing, magnitude, and duration of natural hydrographs as well as the 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 other settings water conservation strategies may enhance stream flow in some segments of some streams.

While water development can threaten native species in some situations, some introduced species, including popular game fisheries, have thrived as a result of water development in some situations. The simplification of natural systems by human development tends to favor species with generalized and broad habitat requirements. For example, the Walleye fishery in Boysen Reservoir depends on the consistent deep water and forage production inherent in this manmade water body. Stable stream flow releases from dams, with relatively low peak flows and relatively high base flows, perpetuate productive game fisheries like trout fisheries below Boysen and the Shoshone River below Buffalo Bill Reservoir.

Drought and climate change – Moderate

Climate change may increase air and surface water temperatures, alter the magnitude and seasonality of precipitation and run-off, 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 annual cycle and to lower base flows (Barnett et al. 2004). Extended low flow periods lowers water tables, leading to reduced plant growth and reproduction. Changes in riparian vegetation lead to lower bank stability, higher siltation and altered stream habitat quality and quantity. Lower water levels associated with reduced shading from riparian vegetation typically increases water temperatures and reduces the quality of habitat available to cool and cold water fish species and other aquatic wildlife.

Invasive species – Moderate

Several aquatic invasive species (AIS) are present in the basin, including the New Zealand mudsnail, curly pondweed, and Brook Stickleback. Additional descriptions and definitions of AIS can be found in the WGFD AIS management plan (WGFD 2010).

New Zealand mudsnails were first discovered in 1996 in the Madison River in Yellowstone National Park. The mudsnail is spread by fish and birds, natural downstream dispersal, upstream through rheotactic behavior, and by humans on fishing gear. The pathway of introduction into Wyoming is unknown, but spread on recreational angling gear is likely given the first location of introduction (WGFD 2010).

Currently, in the Yellowstone River Basin, mudsnail occur in Yellowstone National Park (Madison and Gardner rivers drainages), the Bighorn River from Boysen Dam to the town of Thermopolis, and the Shoshone River through the town of Cody. In the Bighorn and Shoshone rivers, mudsnail populations have decreased in abundance relative to first establishment, a trend observed elsewhere (Vinson et al. 2007). In 2014, a new population of New Zealand mudsnails was found at the boat ramp in Lake Cameahwait near Shoshoni. This represents this first new population of this invasive snail in the basin in over a decade.

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 Yellowstone River Basin, it is found in Boysen Reservoir, the Shoshone River near Cody, and Lake DeSmet.

The Brook Stickleback has been introduced to many states outside of its native range. Brook Stickleback are spread as a result of bait introductions or accidental introductions with aquaculture species. Juvenile fish and fish eggs

may be difficult to see and can be moved in standing water in boats and bait buckets. Brook Stickleback are commonly found in the basin in the Shoshone River, Bighorn River, and Badwater drainages. A new population was found in 2015 in the South Fork Powder River, likely spread from the Badwater Creek drainage through movement of bait and water hauling.

In addition to species designated as AIS, several introduced game fishes are problematic in the basin. Nonnative rainbow trout present a substantial threat to Yellowstone Cutthroat Trout through hybridization, while other introduced trout are predators and/or competitors that have proven successful at eliminating Yellowstone Cutthroat Trout populations.

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 and at major waters in the basin, including Buffalo Bill Reservoir, Boysen Reservoir, Big Horn Lake, and Lake DeSmet. Twenty-three (23) 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.

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 conducted to manage 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 Idaho, Montana, Nevada, Utah, and Wyoming, along with the U.S. Forest

Service and Grand Teton and Yellowstone National Parks, signed a Memorandum of Agreement to jointly conserve, protect, and restore Yellowstone Cutthroat Trout populations within their historic range (Endicott et al. 2016). As part of the agreement the interstate working group under the auspices of the 2000 Memorandum of Agreement (MOA), completes range-wide status assessments (May et al. 2003, 2007).

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 first two cover the Yellowstone River Basin. Additional information on Fish Habitat Partnerships can be found in the 2010 SWAP.

Ongoing and completed conservation actions

Numerous projects have been completed to benefit SGCN in the Yellowstone 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

WGFD biologists studied the fish community composition and habitat conditions of Crazy Woman Creek from 2004 to 2006 (Edwards

2013). Patterns of species abundance shifted but wasn't readily explainable with a decreasing abundance of sand shiner through the study period.

WGFD biologists in cooperation with the U.S. Fish and Wildlife Service, Montana Fish Wildlife and Parks and Shoshone and Arapaho tribes undertook attempts in the Wind-Bighorn drainage to bolster populations of Sauger by conducting stream-side spawning operations above and below Boysen reservoir between 2011 and 2016 (Hochhalter 2015).

WGFD biologists examined age and growth of Sauger in the Wind-Bighorn drainage in relation to environmental factors (Gerrity and Smith 2013). No consistent relationships were found between year-class strength and environmental factors.

WGFD biologists examined juvenile Sauger habitat use in the Wind River above Boysen Dam from 2014 – 2016. It was found that the upstream end of Boysen Reservoir (primarily Poison Creek Bay) and the Wind River upstream from Boysen Reservoir are nursery areas for juvenile Saugers (WGFD 2016).

WGFD biologists examined methods to capture larval Sauger from the Bighorn River. Sampling conducted in 2013 yielded 57 larval fish, none of which were Sauger (WGFD 2014). Sampling conducted in 2014 yielded 100 larval fish, of which four were Sauger (WGFD 2015).

The WGFD funded a research project at the University of Wyoming that determined endocrine disrupting compounds were not the cause of low Sauger recruitment in the Wind River (Johnson 2014).

WGFD biologists continued to monitor sites on the Powder River to assess changes in the fish community since a major WGFD study was conducted in 2004-2006 (WGFD 2010-2015).

The WGFD funded a research project at the University of Wyoming to investigate the natal origins of Shovelnose Sturgeon in the Bighorn River and Yellowstone Cutthroat Trout in Dead Indian Creek. The objectives of the study were

to determine to what degree if any, stocking was playing in maintaining populations. Results for sturgeon were inconclusive but found cutthroat stocking was no longer necessary to sustain a viable population (Carleton 2013).

WGFD biologists studied the movement and life history strategies of Burbot in the Torrey Creek drainage. Glaid et al. (2016) determined that Torrey Creek upstream from Trail Lake is an important spawning and nursery area for the Torrey drainage Burbot population. Additionally, multiple life history strategies are likely utilized in the drainage.

The WGFD funded a research project at Colorado State University to investigate the impact of an illegal introduction of Walleye on Yellowstone Cutthroat Trout and Rainbow trout in Buffalo Bill Reservoir. Results suggest the combination of Lake Trout and Walleye predation may depress the wild Cutthroat and Rainbow Trout populations (Johnson and Johnson 2015).

The WGFD has been actively working to restore Yellowstone Cutthroat Trout in priority sub-drainages within the Yellowstone basin. Genetic purity of native cutthroat populations was assessed by Pisces Molecular, LLC (Boulder, CO), using the amplified fragment-length polymorphism (AFLP) technique. Since the previous SWAP (2010), genetically pure Yellowstone Cutthroat Trout populations were confirmed in the North Fork Shoshone drainage (Hunter Lake), and North Fork Popo Agie drainage (High Meadow Creek). Hybridization with other cutthroat trout sub-species were detected in North Fork Popo Agie and Lonesome Lake (Popo Agie drainage), Cedar Creek (Bighorn drainage) and Lodgegrass Creek (Little Bighorn drainage).

Since the previous SWAP (2010), chemical rehabilitation projects to remove nonnative salmonids and secure native cutthroat populations were completed on Soda Butte Creek in cooperation with Montana Fish Wildlife and Parks and Yellowstone National Park. Two projects proposed to chemically remove nonnatives and establish Yellowstone

Cutthroat Trout (Porcupine Creek in the Bighorn drainage and Eagle Creek in the Shoshone drainage) were postponed due to lagging public support.

WGFD biologists investigated Western Spiny Softshell abundance and population structure along the Bighorn River in 2010. Abundance of Spiny Softshell turtles was low (6 turtles in 76 trap nights) and all captured individuals were males. No other turtle species were captured. Habitat alteration could be impacting turtle assemblages in the Bighorn River drainage (WGFD 2011).

Complete status assessments of native species in the basin

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.

The WGFD funded a research project at Montana State University to investigate the influence of angler exploitation on Burbot populations in lakes in the Wind River drainage. While variable, exploitation was low for all but one lake during one year (Lewandoski 2015). Results suggest variability in Burbot abundance is likely better explained by factors other than angler exploitation.

Continue aquatic habitat work in the basin

WGFD biologists completed several efforts to improve the structure and function of stream segments and watershed features that benefit aquatic SGCN. River restoration improvements were completed on the WGFD's Spence Moriarty property including Bear Creek, Wiggins Fork and East Fork Wind River. These improvements to stream banks and channel bedform diversity reduce sediment and improve trout cover (e.g. WGFD 2013).

Explore water management approaches that enhance fish habitat

The WGFD completed studies on 12 instream flow segments covering over 42 miles. Instream flow water rights have been filed on nine of these including North and South Fork of Beaver Creeks (Robertson 2013a, Robertson 2013b), Dry Medicine Lodge Creek (Robertson 2013c), Buckskin Ed Creek (Robertson 2014a), Cedar Creek (Robertson 2014b), Lodge Grass Creek (Robertson 2014c), West Fork Little Bighorn River (Robertson 2014d), Soldier Creek (Robertson 2014e), and Trout Creek (Robertson 2014f). The other three completed studies have not yet resulted in filings for water rights; these include Crandall Creek (Robertson 2015a), Dead Indian Creek (Robertson 2015b), and Muddy Creek (Robertson 2015c).

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

The WGFD created, produced and disseminated a poster detailing the states native fishes.

Continue building voucher collections for all aquatic wildlife

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

Complete the comprehensive survey for freshwater mussels

The WGFD conducted two SWG-funded projects in 2012 and 2014-2015 to assess the distribution and abundance of native mussels. Inventory surveys were conducted in the Wind-Bighorn (Mathias 2015), and Powder and Tongue, (Mathias 2016). Live Fatmucket were documented in the Bighorn drainage (Mathias 2015). No evidence of mussels (live or dead) were found in the Powder River drainage (Mathias 2016). Live Fatmucket were documented in the Tongue River drainage (Mathias 2016).

Follow up on recommendations from the graduate research project on gastropods

No actions reported.

Increase connectivity where appropriate

WGFD biologists worked with partners and contributed funding to many projects to enhance fish passage and connectivity. These efforts are detailed in annual Strategic Habitat Plan Accomplishments reports (e.g., WGFD 2011).

WGFD biologists assessed a newly constructed fish passage channel around Kendrick Dam on Clear Creek (Powder River tributary). Many SGCN including Flathead Chub, Sauger, Goldeye, Plains Minnow and Western Silvery Minnow were documented passing the structure that had impeded upstream movement since 1911 (Bradshaw 2015).

The WGFD completed a fishway and diversion screen on Piney Creek at the PF1 Diversion in 2016, a tributary to Clear Creek (WGFD 2016). Earlier work in 2013-2014 improved passage upstream at the Dunlap Diversion on Piney Creek. Improved connectivity benefits about 10 fish species including possibly Brassy Minnow.

A diversion screen and passage project on the Nowood River has been under development and phased construction for several years (e.g. WGFD 2011). Dual cone screens have been installed in a diversion to limit entrainment of potentially 16 fish species. Improved passage at the diversion is being developed to potentially benefit Sauger and Shovelnose Sturgeon.

Passage projects led or partially funded by WGFD to benefit Yellowstone Cutthroat Trout include a fish ladder on the Greybull River, fish screens on diversions off Trout Creek in the North Fork Shoshone drainage, a fish screen on the Valley Ditch off the North Fork Shoshone River, screens and diversion reduction on Greybull River drainage tributaries, fish screen and diversion passage improvements on Bear Creek (East Fork Wind River tributary) at the Bear Creek and Thunderhead Diversions, diversion passage improvement at the East Fork Wind River diversion, and water use and diversion improvements on East Fork Wind River tributaries.

Yellowstone Cutthroat Trout entrainment studies were conducted by WGFD on diversion ditches from the Greybull River and tributary Francs Fork River (WGFD 2011), and on tributaries to the East Fork Wind River. These diversions were found to entrain sufficient numbers to warrant screening.

The WGFD used SWG funds to conduct a research project at the University of Wyoming to study the influence of outmigration and canal entrainment on Burbot populations in the upper Wind River. Researchers found water development is having variable but minimal effects on Burbot populations in the drainage (Underwood 2015).

Recommended Conservation Actions**Secure, enhance, or establish SGCN populations**

Evaluate the feasibility of reducing populations or removing problematic nonnative fishes from the basin to enhance or expand SGCN.

Complete chemical rehabilitation projects to restore Yellowstone Cutthroat Trout within the species' native range. Complete scheduled projects in Soda Butte Creek, Eagle Creek (North Fork Shoshone) and other streams identified as priorities.

Complete analysis of alternatives for securing Yellowstone Cutthroat Trout in West Pass Creek by removing and constructing barriers and restoration stocking. Pursue implementation if feasible.

Survey streams above existing or potentially constructed barriers in the basin to determine potential for establishing Yellowstone Cutthroat Trout refugia.

Identify candidate streams for genetic refugia for Elkhorn Creek Yellowstone Cutthroat Trout.

Inventory, assess, or examine life history requirements of SGCN

Further determine the status, distribution, and habitat associations of turtles, mollusks, and crayfishes in the Yellowstone River basin.

Determine if Plains Minnow, Western Silvery Minnow, and Sturgeon Chub persist in the Bighorn River and document associated habitats.

Measure the degree of successful recruitment for Sauger stocked in the Wind River drainage via genetic parentage assignments and/or stable isotope analysis.

Conduct studies to better understand how migratory SGCN fishes use the Powder River Basin, particularly Sturgeon Chub, Western Silvery Minnow, Plains Minnow, Goldeye, Sauger, Shovelnose Sturgeon and Flathead Chub.

Complete assessment of natural recruitment potential of Shovelnose Sturgeon in the Bighorn River.

Examine the spatiotemporal pattern of Burbot occupancy in Big Horn Lake and the Bighorn River.

Examine spatial occurrence of Yellowstone Cutthroat Trout and Rainbow trout hybridization in the North Fork Shoshone drainage.

Evaluate the magnitude of Walleye and Sauger hybridization in the Bighorn River.

Investigate the distribution of Western Spiny Softshell, Western Painted and Eastern Snapping turtle in the Bighorn River drainage and possible reasons for anecdotal declines (WGFD 2011).

Conduct baseline gastropods surveys in the basin and identify needed actions to maintain or restore populations.

Survey to fill gaps in knowledge about native mussel distribution.

Provide passage and reduce entrainment at barriers impacting SGCN

Continue collecting physical measurements and logging locations of natural and manmade barriers.

Continue populating the WGFD database to store physical measurements at barriers and barrier locations.

Implement a passage solution at the Tongue River Interstate Diversion and evaluate entrainment.

Assess passage solutions and entrainment at the Lower Sunshine Diversion on the Wood River for potential modifications.

Improve road crossings and fish passage in Alkali, Meadow, Pine and Castle Creeks, Yellowstone Cutthroat Trout spawning tributaries to the East Fork Wind River.

Complete screening improvements and passage enhancements on Yellowstone Cutthroat Trout waters on the Department's Spence Moriarty unit (Bear Creek, Wiggins Fork, and East Fork Wind River) and manage diversions to minimize entrainment and maximize passage.

Maintain and operate the Kendrick fishway on lower Clear Creek and pursue passage solutions upstream in the basin to completely re-connect waters throughout this basin.

Improve aquatic habitat for SGCN

Continue discussions with irrigators to obtain fish passage past the next barrier upstream from Kendrick Dam in Clear Creek.

Monitor instream flow segments for compliance with approved instream flow levels. Pursue compliance as needed when water is available and in priority.

Complete aquatic habitat assessments within basins containing SGCN to identify areas aquatic habitat degradation and restoration projects to benefit SGCN.

Complete assessment and stream restoration projects within Upper and Middle Sunlight Creek subwatershed to improve habitat functions. Restoration will benefit Yellowstone Cutthroat Trout if coupled with chemical rehabilitation and reintroduction efforts.

Identify and complete habitat protection and improvement projects on private land along Marquette Creek to benefit Yellowstone Cutthroat Trout.

Complete assessment, stream restoration, and diversion structure improvement projects on Medicine Lodge and Paint Rock Creeks. Projects will reduce channel instability, sediment loads, and benefit downstream habitats for SGCN such as Sauger and Shovelnose Sturgeon.

Identify and complete watershed improvement projects in Shoshone watershed to reduce the sediment inputs into the Lower Shoshone River.

Participate in working groups and conduct habitat assessments to identify ways to reduce non-point sediment sources and identify future restoration projects within the Big Horn River watershed.

Complete habitat assessment, stream restoration and diversion structure improvement projects on Canyon Creek and South Paintrock Creek drainage to benefit Yellowstone Cutthroat Trout.

Continue in channel habitat enhancement efforts in the East Fork Wind River watershed to improve functions and benefit Yellowstone Cutthroat Trout.

Employ water management strategies that improve habitat for SGCN

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 studies and file for state-held instream flow water rights.

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

No actions identified.

Continue building voucher collections for 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.

Monitoring

Establish standardized monitoring protocols and locations for SGCN

Monitor natural recruitment, density, and size structure of newly established and/or expanded Yellowstone cutthroat trout populations.

Use eDNA to determine if nonnative trout remain in Little Tongue River and Elkhorn Creek.

Monitor Sauger abundance, annual recruitment, and angler exploitation in the Bighorn/ Wind River drainage, including Boysen Reservoir, Bighorn River and Big Horn Lake.

Monitor Burbot populations in the Bighorn/ Wind River drainage, including Boysen Reservoir, Big Horn, Trail, Ring, and Torrey lakes.

Develop and implement a standardized monitoring protocol for Shovelnose Sturgeon in the Bighorn River.

Re-survey a sub-sample of selected sites from the Bighorn warm-water stream project (Bear 2009).

Monitor water quantity and temperature in areas containing important native SGCN populations.

Monitor the establishment and spread of invasive species.

Develop and implement a long-term monitoring plan for high priority sites in the Powder River drainage.

Monitor fish movements and entrainment where passage projects have been implemented or being planned in the South Fork Shoshone, Greybull River, Clear Creek, and East Fork Wind River drainages.

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