



National Park Service
U.S. Department of the Interior
Yellowstone National Park

Buffalo Creek Native Fish Restoration, Yellowstone National Park
Environmental Assessment
July 2023



Buffalo Creek in Yellowstone National Park

CONTENTS

| | | |
|-----|---|----|
| 1. | PURPOSE AND NEED | 1 |
| 1.1 | Proposal | 1 |
| 1.2 | Purpose and Need | 1 |
| 1.3 | Background | 2 |
| 1.4 | Project Location..... | 3 |
| 2. | PROPOSED ACTION AND ALTERNATIVES | 4 |
| 2.1 | Alternative 1: No Action Alternative - Continue Current Management | 4 |
| 2.2 | Alternative 2: Proposed Action and Preferred Alternative..... | 8 |
| 2.3 | Mitigation Measures | 11 |
| 3. | AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES | 14 |
| 3.1 | Summary of Past, Present, and Reasonably Foreseeable Future Actions and Trends..... | 14 |
| 3.2 | Yellowstone Cutthroat Trout..... | 16 |
| 3.3 | Plankton, Macroinvertebrates, and Amphibians..... | 19 |
| 3.4 | Grizzly Bears | 23 |
| 3.5 | Recommended Wilderness | 27 |
| 4. | CONSULTATION, AND COORDINATION | 36 |
| | APPENDIX A: ROTENONE APPLICATION AND NEUTRALIZATION | 37 |
| | APPENDIX B: Impact Topics Dismissed from Further Analysis | 40 |
| | APPENDIX C: federally listed species dismissed from further analysis..... | 46 |
| | APPENDIX D: Minimum requirement analysis worksheet | 47 |
| | REFERENCES | 52 |
| | Figure 1. Map of Native Fish Conservation Efforts..... | 2 |
| | Figure 2. Project Area Map..... | 4 |
| | Figure 3. Buffalo Creek Rotenone Treatments. | 7 |
| | Figure 4: Map of Proposed Slough Creek Staging Area..... | 9 |
| | Figure 5: Buffalo Creek Project Area Map..... | 10 |
| | Figure 6: Grizzly Bear Conservation Areas..... | 24 |
| | Figure 7: Yellowstone National Park Recommended Wilderness Map..... | 29 |
| | Table 1: Total number of NPS flights..... | 8 |
| | Table 2: Expected number of total USFS flights originating from the park. | 10 |

1. PURPOSE AND NEED

1.1 Proposal

The National Park Service (NPS) is initiating this Environmental Assessment (EA) to facilitate the removal of nonnative rainbow (*Oncorhynchus mykiss*) and hybridized trout from the Buffalo Creek drainage in Yellowstone National Park (park) and the Custer Gallatin National Forest using the fish toxicant rotenone. Following the removal of nonnative and hybridized trout, native Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) would be translocated into the Buffalo Creek drainage. The NPS previously approved this action for the portion of Buffalo Creek inside park boundaries under the [2010 Native Fish Conservation Plan and EA](#) (2010 Plan). In 2022, the U.S. Forest Service (USFS) and Montana Fish, Wildlife and Parks (MTFWP) proposed similar conservation measures for native Yellowstone cutthroat trout upstream of the park on lands administered by the USFS. Pursuant to 43 CFR 46.135 the NPS incorporates by reference the 2010 Plan and the USFS & MTFWP [Buffalo Creek Yellowstone Cutthroat Trout Conservation Project EA](#) (USFS Plan), and is providing this EA to provide site-specific impact analysis on park resources that may be affected as a result of the USFS Plan.

1.2 Purpose and Need

The purpose of this proposal is to complement ongoing native fish restoration efforts in the park by improving the viability of the native Yellowstone cutthroat trout population in the Lamar River watershed that is secure against threats from nonnative fish. Nonnative fish, specifically rainbow trout, were introduced into the upper reaches of the Lamar River watershed in the Buffalo Creek drainage in the 1920s and 30s, including in waters administered by the USFS in the Custer Gallatin National Forest upstream of the Yellowstone boundary. This project is needed because the native Yellowstone cutthroat trout population is threatened by the incursion and presence of nonnative trout from Buffalo Creek capable of interbreeding and producing a hybridized population (Heim et al. 2020). As hybrids become more prevalent and widespread, they breed with more native fish until, eventually, genetically pure Yellowstone cutthroat trout could become nonexistent (Rhymer and Simberloff 1996). Under the 2010 Plan, the park has the ability to implement native fish restoration efforts within the jurisdiction of the park, however, Buffalo Creek crosses jurisdictional boundaries and the park is dependent upon the USFS's ability to remove nonnative fish in the national forest in order to successfully preserve Yellowstone cutthroat trout in the park. Action is necessary to reduce the overall risk of hybridization and competition on native Yellowstone cutthroat trout throughout the Buffalo Creek drainage and restore a genetically pure native trout population across the entire watershed.

The objectives of this proposal are to:

- Reduce the overall risk of hybridization to Yellowstone cutthroat trout;
- Reverse the effects of hybridization by releasing Yellowstone cutthroat trout in Buffalo Creek;
- Increase the protection of Yellowstone cutthroat trout downstream in the Lamar River watershed;
- Complement efforts by Montana Fish, Wildlife and Parks and the U.S. Forest Service to remove nonnative rainbow and hybrid trout and reintroduce Yellowstone cutthroat trout to areas of the upper Buffalo Creek drainage where there are currently fish;
- Advance the long-term preservation of Yellowstone cutthroat trout by protecting an isolated cold-water refuge more resilient to climate warming than lower-elevation waters; and
- Protect and enhance recreational opportunities for visitors to angle, enjoy, and view Yellowstone cutthroat trout.

1.3 Background

The NPS provided guidance and an adaptive management framework for making decisions regarding fisheries and aquatic resources conservation in the 2010 Plan (USDI, NPS 2010). Under the 2010 Plan, Yellowstone National Park envisioned a range of restoration projects in streams, rivers, and lakes across the historic ranges of native fish in the park. Pursuant to the 2010 Plan, native Arctic grayling (*Thymallus arcticus*), and cutthroat trout (Yellowstone, westslope) have been restored (completed or ongoing actions) to about 163 stream miles and 282 lake acres (Figure 1). Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) were restored to East Fork Specimen Creek and High Lake and, along with Arctic grayling, Goose Lake, Grayling Creek, and the upper Gibbon River with Wolf, Ice, and Grebe lakes. Yellowstone cutthroat trout were reintroduced to the Elk Creek complex of streams and populations in Soda Butte and Slough creeks were protected by in-stream barriers and the removal of nonnative trout. Ongoing actions are removing nonnative fish from Buffalo and Rose creeks and portions of upper Slough Creek and the Lamar River (Koel et al. 2022a).

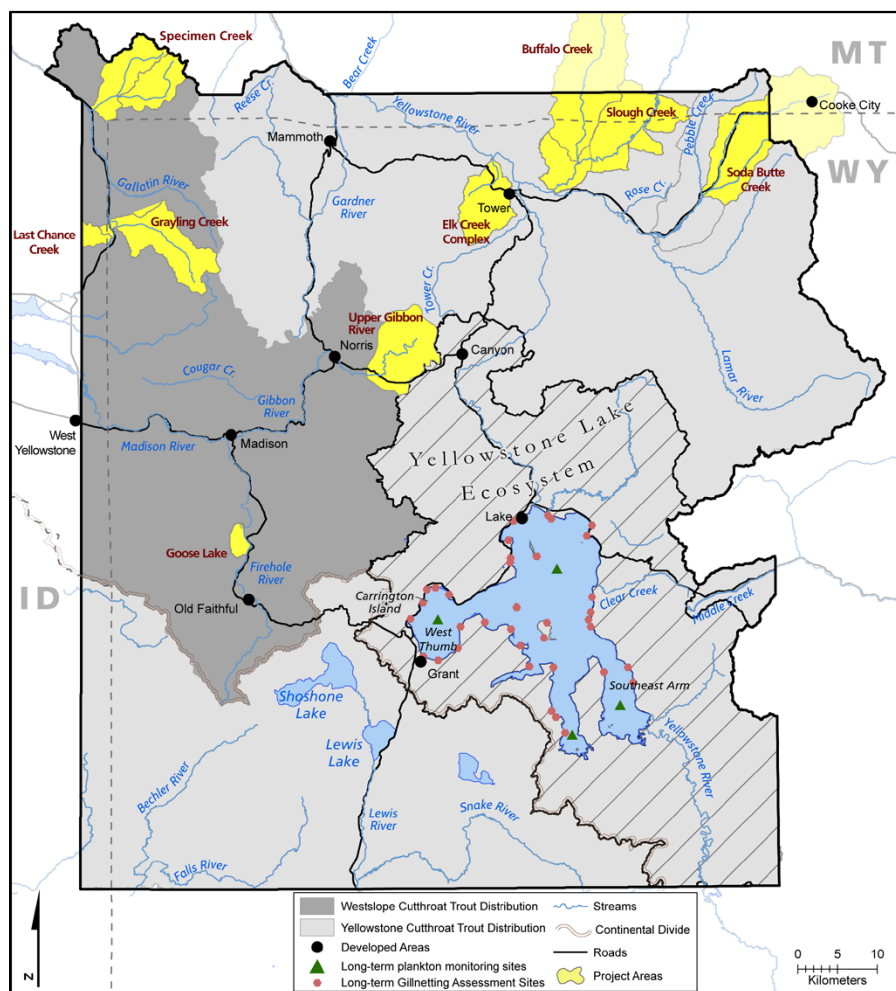


Figure 1. Map of Native Fish Conservation Efforts.

Yellowstone National Park with watersheds supporting native Arctic grayling and westslope cutthroat trout (dark gray) and Yellowstone cutthroat trout (light gray). Native fish conservation project areas outside of Yellowstone Lake are highlighted in yellow.

Techniques for targeted angling, electrofishing, netting, piscicide application and detoxification, and constructing fish barriers and weirs, as well as the effects of piscicide exposure to humans, fish, and non-target organisms, were described and evaluated in the 2010 Plan. Summaries of the techniques and effects described in the 2010 Plan are included later in this document where appropriate. Section 2.3.2.4 (pages 56-58) of the 2010 Plan indicated the NPS may develop additional projects based on emerging information and changing environmental conditions. These additional projects would be carried out within Yellowstone National Park with impacts not exceeding those disclosed in the 2010 Plan. This EA describes and evaluates a multijurisdictional project on Buffalo Creek, tiered from the original 2010 Plan, that includes additional actions in the Buffalo Creek drainage not previously analyzed (USDI, NPS 2010).

In April 2022, the USFS and MTFWP issued an EA proposing to use rotenone to remove nonnative rainbow trout from the Buffalo Creek drainage north of Yellowstone National Park in the Absaroka-Beartooth Wilderness and establish a secure population of Yellowstone cutthroat trout in areas currently with fish (MTFWP and USFS 2022). Due to the remote location of the project area, the USFS proposed using the Slough Creek transfer station in the park as an equipment staging area for numerous helicopter flights and pack stock trips to transport equipment, gear, food, and native fish into the Absaroka-Beartooth Wilderness over eight years. However, the NPS did not participate in the development of the EA, and the USFS did not provide impact analyses for the staging of equipment and helicopter flights from the Slough Creek transfer station in the EA.

This EA includes impact analyses for actions that may take place within the park in support of native fish restoration efforts on lands administered by the USFS. However, the NPS decision resulting from the NEPA review of the NPS proposed action (Alternative 2 and Preferred Alternative) would not authorize the preferred alternative proposed by the USFS. The responsible official for the Custer Gallatin National Forest would decide whether to authorize native fish restoration actions on USFS lands. If the NPS selects the Preferred Alternative, the park would provide logistical support (equipment staging areas, helicopter take-off and landing site) for USFS activities that originate from the park, and a memorandum of understanding would be prepared to facilitate cross-jurisdictional use of adjacent public lands.

1.4 Project Location

The Buffalo Creek drainage encompasses approximately 39,000 acres, including about 12,000 acres in Yellowstone National Park, with the remaining acres in the Absaroka-Beartooth Wilderness Area of the Custer Gallatin National Forest (Figure 2). Buffalo Creek is the largest tributary to Slough Creek, entering near the Slough Creek campground in the park. Historical records indicate the portion of Buffalo Creek within the park contained Yellowstone cutthroat trout (Jordan 1891). Buffalo Creek was apparently fishless north of the park due to several waterfalls that act as upstream migration barriers, but this section was stocked with 173,000 Yellowstone cutthroat trout in 1942 (Varley 1981). The exact location of the stocking is not known, but it was unsuccessful upstream of the waterfalls. In addition, 3,500 rainbow trout were stocked into Hidden Lake from 1920 to 1932. This lake is in the Absaroka-Beartooth Wilderness and connects to Buffalo Creek by an outlet channel (Varley 1981). These rainbow trout thrived and spread throughout the upper drainage and downstream into Slough Creek and the Lamar River in Yellowstone National Park (Ertel et al. 2017, Heim et al. 2020).

Slough Creek is a large tributary to the Lamar River. Despite the historic stocking of numerous fish species in the Lamar River and lower Slough Creek last century, the upper reaches of these waterways retained populations of genetically unaltered Yellowstone cutthroat trout through the 20th century (Varley 1981, Varley and Schullery 1998). Upper Slough Creek was thought to be protected from invasion by nonnative fish by a steep canyon reach above the Slough Creek Campground in the park. However, rainbow trout were discovered upstream of the canyon in the early 2000s. As a result, the NPS installed a

concrete barrier on Slough Creek above the campground in 2017. In addition, rainbow and hybrid trout are suppressed upstream and downstream of the barrier by biologists electrofishing and a must-kill regulation for anglers (NPS, YNP 2022; USDI, NPS 2022).

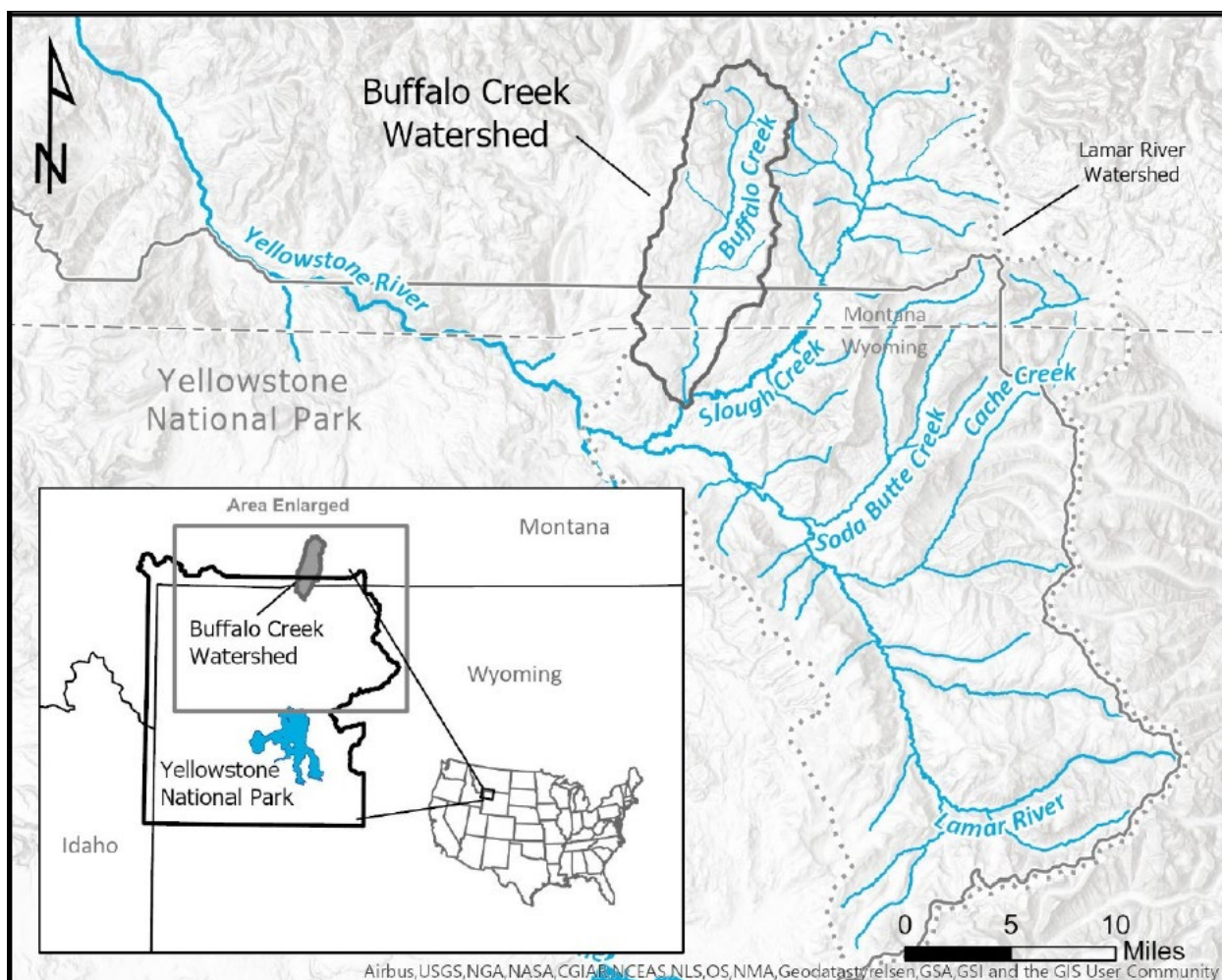


Figure 2. Project Area Map.

The Lamar River watershed encompasses about 430,000 acres and many tributaries in the northeastern portion of Yellowstone National Park and nearby areas of Montana and Wyoming, primarily in the Absaroka-Beartooth and North Absaroka Wilderness areas. The drainage ranges from about 6,000 feet to 10,600 feet in elevation and has a montane climate with long cold winters (daily temperatures ranging from 9 degrees Fahrenheit (°F) to 34°F) and short cool summers (37°F to 80°F), although average annual temperatures have increased by about 2.3°F since 1950 with a longer snow-free season (Houston 1982, Hostetler et al. 2021). Water temperatures vary from 32°F to 60°F at higher elevations to 32°F to 65°F in the lower-elevation valleys.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 Alternative 1: No Action Alternative

Continuation of current management direction under the 2010 Native Fish Conservation Plan

Under this alternative, the park would continue suppressing nonnative rainbow and hybridized rainbow-cutthroat trout in the Lamar River and portions of Buffalo and Slough creeks within Yellowstone National Park using must-kill angling regulations, electrofishing, trapping and netting, fish barriers, and rotenone treatments pursuant to the 2010 Plan, which is incorporated by reference (USDI, NPS 2010). Short summaries of these techniques are provided in the following paragraphs.

In addition, under the No Action Alternative, the NPS would not authorize the use of park lands for staging and access by the USFS for implementation of their proposal to conserve native Yellowstone cutthroat trout in the Custer Gallatin National Forest.

Targeted Angling

Per park regulations and the Yellowstone Superintendent's Compendium, all nonnative fish, including rainbow trout and identifiable cutthroat-rainbow trout hybrids, must be killed in the Lamar River watershed, including all tributaries and lakes (NPS, YNP 2022; USDI, NPS 2022). Park staff would promote angling harvest of rainbow trout in this area and trained members of the Yellowstone Flyfishing Volunteer Program would target early generation hybrids for removal. Since 2002, more than 900 volunteers have contributed almost 23,000 hours to support native fish conservation by removing nonnative fish and tagging fish to assess the distribution of rainbow and hybrid trout throughout the drainage (Detjens et al. 2017). The roughly 10,000 anglers that fish in Slough Creek and the Lamar River annually can contribute to the protection of Yellowstone cutthroat trout by removing rainbow and hybrid trout.

Electrofishing

The NPS would continue to conduct electrofishing on Slough Creek during summer to remove as many rainbow and hybrid trout as possible from the north park boundary near the Silver Tip Ranch downstream through its three upper meadows to the confluence with the Lamar River. Techniques for electrofishing were addressed in Appendix B of the environmental assessment for the Native Fish Conservation Plan and, pursuant to 43 CFR 46.135, the NPS incorporates that document (USDI, NPS 2010) and the analyses therein into this EA by reference. Biologists float two to three rafts downstream to conduct electrofishing surveys through the system using a gasoline generator or battery to produce electrical current that is applied to water in a metered fashion using an electrical control box. Fish caught within the electrical field are temporarily stunned and immobilized, thereby allowing them to be netted. Backpack electrofishing units are used in smaller tributaries where practical. Captured trout are identified to species, sampled for length, weight, and maturity. A small tissue sample is removed from a subsample of fish to determine genetic purity of the population and assess the ability to identify hybrid fish in the field. Yellowstone cutthroat trout may also be fitted with a passive integrated transponder (PIT) tag for future identification. All Yellowstone cutthroat trout are released back into the system near their point of capture after allowing them to revive in a holding tank, while rainbow and hybrid trout are killed. Most gear for this project is transported by NPS personnel or stock pulling a wagon up an existing two-track road along Slough Creek that leads to the Silver Tip Ranch. A single helicopter flight occurs annually to transport the rafts and associated gear between the upper meadows (second to first meadow).

Within the Lamar River, the selective removal of rainbow and hybrid trout would continue in the Lamar Valley and lower Lamar River, downstream of the Slough Creek confluence. Sampling would be conducted as described for Slough Creek. An additional two helicopter flights would be conducted annually to transport gear into and out of lower Lamar River.

Trapping and Netting

Weirs and traps for migrating rainbow and hybrid trout would be used in Hidden Creek (a tributary to Slough Creek) and Rose Creek near the Buffalo Ranch in the Lamar Valley to capture adult rainbow and hybrid trout as they move into these tributaries to spawn. Weirs would consist of a structure placed in the

stream to block migration and funnel fish into a trap. The structure would be made of wood and metal (angle iron and conduit) and assembled each season prior to the onset of spawning migration. The weir and trap would be removed at the end of the spawning season for rainbow and hybrid trout, which is typically late June.

Fyke and drifting gill nets may be used in Buffalo and Slough creeks to increase the catch of rainbow and hybrid trout. Fyke nets would be set in pre-designated areas and anchored in place by pounding small rebar posts into the streambed. Nets would be checked every 24 to 48 hours and all fish would be sorted and removed from the net. Native Yellowstone cutthroat trout would be released back into the creeks and rainbow trout and hybrids would be killed. Drifting gill nets would be used in the slower, deeper sections of Slough Creek. Nets would be drifted over a short distance and immediately have fish removed. No gill nets would be set in place for an extended duration.

Rotenone Treatments

Techniques for applying rotenone were addressed in Appendix B of the 2010 Plan (USDI, NPS 2010). Piscicides, such as rotenone, are chemical toxins applied to water to kill fish. Rotenone is effective at removing fish from complex habitats where nets, electrofishing, angling, traps, or other methods are impractical or ineffective. More information on the application and neutralization of rotenone are provided in Appendix A of this document.

To slow the rainbow and hybrid trout invasion of the Lamar River, once every 3 to 5 years (up to 4 total treatments over project lifespan) the NPS would apply rotenone to Buffalo Creek and its tributaries within the park. Crews working on this project will mostly be based at a remote backcountry camp and the Slough Creek Campground. Prior to rotenone treatments, biologists will survey the portion of Buffalo Creek within the park to document baseline conditions, including fish densities, distribution, and species composition, aquatic invertebrate community composition, and the water quality parameters of dissolved oxygen, temperature, specific conductance, pH, and turbidity. In addition, they will release an inert, non-toxic dye tracer (Fluorescein, Rhodamine, or equivalent) into sections of the creek to determine travel time of creek flows and decide where to place rotenone drip stations at appropriate intervals.

Rotenone treatments would occur over a 7-day period and be conducted under the supervision of state-certified pesticide applicators, following Environmental Protection Agency product label guidance for application and concentration. When handling piscicides, NPS staff would follow all label requirements for personal protective equipment. Trained project staff other than certified applicators would only contact undiluted liquid piscicide when mixing a pre-measured amount of product into a dispensing station, reservoir, or backpack sprayer during a treatment. After rotenone has been diluted, it would only be handled by certified applicators and trained project staff wearing personal protective equipment.

The rotenone treatment period would occur during August or September after stream flows have decreased to seasonal lows, but before daily average water temperatures decline below 41°F, which is considered the lower limit of effectiveness for rotenone. Rotenone and other equipment will be transported to remote project sites using helicopters. Five helicopter flights will occur during rotenone treatment years to transport the rotenone and application equipment to areas near the north park boundary, and to move the detoxification station (potassium permanganate, auger, and generator) to lower Buffalo Creek near its confluence with Slough Creek.

A liquid formulation of rotenone would be applied for up to 8 hours at each of several treatment (drip) stations placed sequentially upstream to downstream (Figure 3). Drip stations would be operated during daylight hours and only with close, continuous observation by trained personnel. A diluted liquid formulation would also be applied using backpack sprayers to effectively treat standing waters. Powdered rotenone would be applied following label guidelines to connected wet meadows and spring seeps that do

not require a drip station. Nets extending across the stream would be used at night and during any breaks in the treatment to prevent potential upstream movement of rainbow or hybrid trout into previously treated areas. Staff would camp overnight in a nearby area during rotenone application. Live trout will be placed in sentinel cages at the end of each treatment reach and observed during rotenone application to ensure the entire stream length has been effectively treated by the drip station.

To ensure the active rotenone is neutralized and does not persist in Buffalo Creek, a neutralization station will be placed at the downstream end of the treatment areas. This station will consist of a steel hopper with an auger driven by an electric motor that is powered by a small portable gas generator. The auger meters crystalized potassium permanganate into the stream at a concentration (2.5%) that ensures complete oxidation (neutralization) of rotenone at the downstream end of the treatment area. The rotenone neutralization site would be located as far downstream in Buffalo Creek as possible, near the confluence with Slough Creek, to allow rotenone to break down naturally through exposure to water movement and sunlight, thereby reducing detoxification time and the duration of generator noise. The effectiveness of the piscicide neutralization would be determined by observing the survival of sentinel fish in cages at a location downstream corresponding to the distance traveled during 30 and 60 minutes of potassium permanganate contact time. The concentration of potassium permanganate may be increased if complete neutralization is not achieved after 30 minutes of contact time. A secondary neutralization set-up will be on hand as a back-up in case of an operation failure in the primary station.

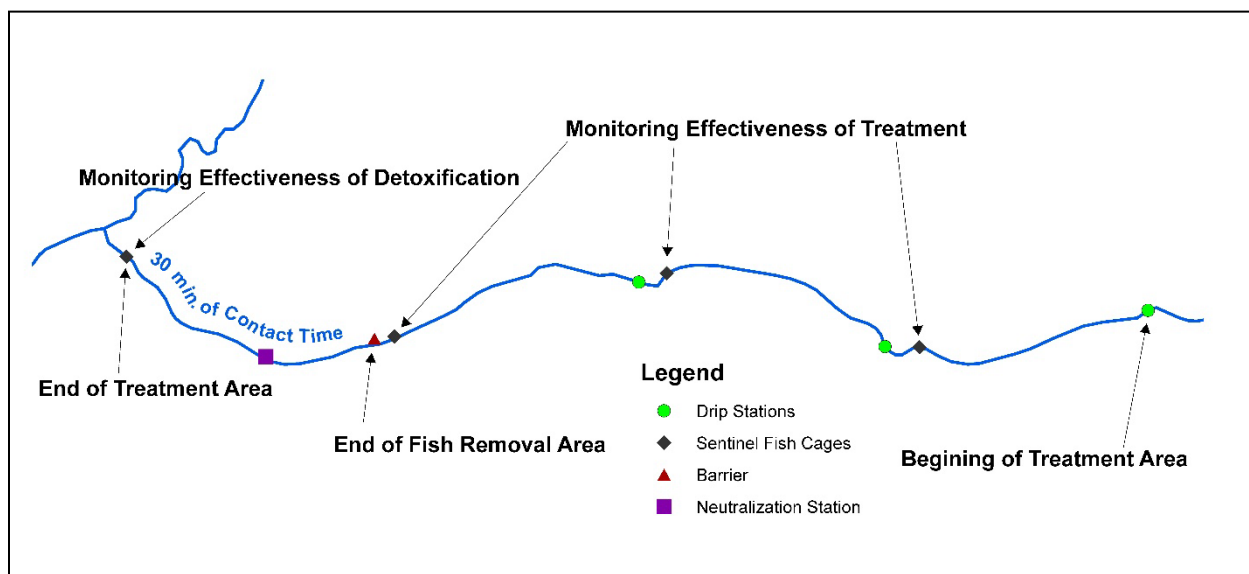


Figure 3. Buffalo Creek Rotenone Treatments.

Chemical treatment model proposed for Buffalo Creek showing spatial relationships among chemical treatment (drip) stations, sentinel fish cages, and the potassium permanganate neutralization station. Sentinel fish are used to monitor the effectiveness of the chemical treatment and the neutralization process (30 minutes downstream of the potassium permanganate station and at the lower end of the treatment area).

Upon completion of treatment in each stream reach, the drip and neutralization stations would be moved as a group in leap-frog fashion downstream over a period of several days until reaching the confluence of lower Buffalo Creek with Slough Creek. Risks from rotenone and potassium permanganate to the public would be mitigated by public awareness through press releases prior to project initiation and signage (placards) in and around the project area (trailheads) in accordance with label requirements, and at backcountry offices. The public may be temporarily restricted from entering the project area, particularly treated waters, during and after the treatment for up to two weeks per treatment year. In addition, human

consumption of water would be restricted during and immediately after rotenone application and detoxification in accordance with Environmental Protection Agency guidelines.

Handling and transporting dead fish long distances through grizzly bear habitat could be unsafe. Therefore, dead fish along streams will be left to decay in remote areas so their nutrients contribute to the recovery of invertebrate populations. In the lower one mile of treatment close to the confluence with Slough Creek, dead fish will be collected to prevent creating a bear attractant near the Slough Creek Campground. Terrestrial scavengers contribute to the disappearance of carcasses, and piscicide-treated fish do not present health risks to organisms consuming them. Dead fish usually decay beyond recognition within 1 to 2 weeks (USDI, NPS 2010; MFWP and USFS 2022).

Helicopter Support

Alternative 1 includes the use of helicopter flights in support of native fish conservation efforts provided by the 2010 Plan. Table 1 below provides a breakdown of flights included under Alternative 1.

Table 1: Total number of NPS flights

| Flight Type from Slough Creek transfer station | Number of Flights | Total Flights |
|---|--|----------------------|
| NPS Equipment Mobilization | 5 per treatment year, up to 4 total treatments | 20* |
| NPS Electrofishing | 3 per year | 12** |
| | | 32 |

*Number of treatments will be based on effectiveness of each treatment.

**Number based on 4 treatment years. Number of flights may increase or decrease based on effectiveness of treatment.

2.2 Alternative 2: Proposed Action and Preferred Alternative

Alternative 2 includes the actions described under Alternative 1, and also provides site-specific resource analysis for USFS actions within Yellowstone National Park. This alternative would allow the NPS to provide logistical and project implementation support to the USFS and MTFWP to remove rainbow and hybridized trout from portions of the Buffalo Creek drainage in the Absaroka-Beartooth Wilderness and reintroduce Yellowstone cutthroat trout to areas currently with fish. The EA prepared by the USFS and MTFWP describes their proposed actions and, pursuant to 43 CFR 46.135, the NPS incorporates that document (MFWP and USFS 2022) and the project description and analyses therein into this EA by reference. Under the USFS Plan, rotenone would be applied to about 33 stream miles and 2 lakes (11 lake acres) in the portion of the Buffalo Creek drainage in the Custer Gallatin National Forest over about 12 to 14 days each summer for up to 3 years. Thereafter, Yellowstone cutthroat trout would be reintroduced to waters that previously supported fish via horse packing or helicopters for up to five years (MFWP and USFS 2022). It is critical to note that although this alternative describes component parts of the USFS Plan, any decision issued by the NPS on this project would not authorize work to commence within the USFS project area. The USFS must issue its own decision to allow for the commencement of work on National Forest lands.

Located within the Absaroka-Beartooth Wilderness, the portion of the Buffalo Creek drainage within the Custer Gallatin National Forest is extremely remote. The nearest road access to the USFS project area is the Slough Creek Trailhead in Yellowstone National Park, approximately 6 linear miles to the south of the USFS administrative boundary. The terrain between the Slough Creek trailhead and the USFS project area is managed by the NPS as wilderness and is extremely rugged, consisting of creeks, ponds, rolling hills, mountains, and dense vegetation. To overcome access constraints, the USFS is proposing to use the

Slough Creek transfer station, adjacent to the Slough Creek trailhead in Yellowstone National Park for staging and access (Figure 4). Upon approval of their Plan, the USFS would coordinate with the NPS to use the Slough Creek transfer station in the park prior to the USFS implementing their selected action.

The Slough Creek transfer station is located between the Slough Creek campground and Slough Creek trailhead in the northern portion of Yellowstone National Park. The transfer station is commonly used as a parking and staging area, and for helicopter operations. Following approval by the park Superintendent, the USFS could conduct about 30 helicopter flights (10 per year over three years) from the Slough Creek transfer station into USFS project locations to haul equipment and gear into the Custer Gallatin National Forest. This equipment and gear could include large metal cages and food storage boxes for securing rotenone, garbage, food, and other attractants in backcountry camps from grizzly bears.

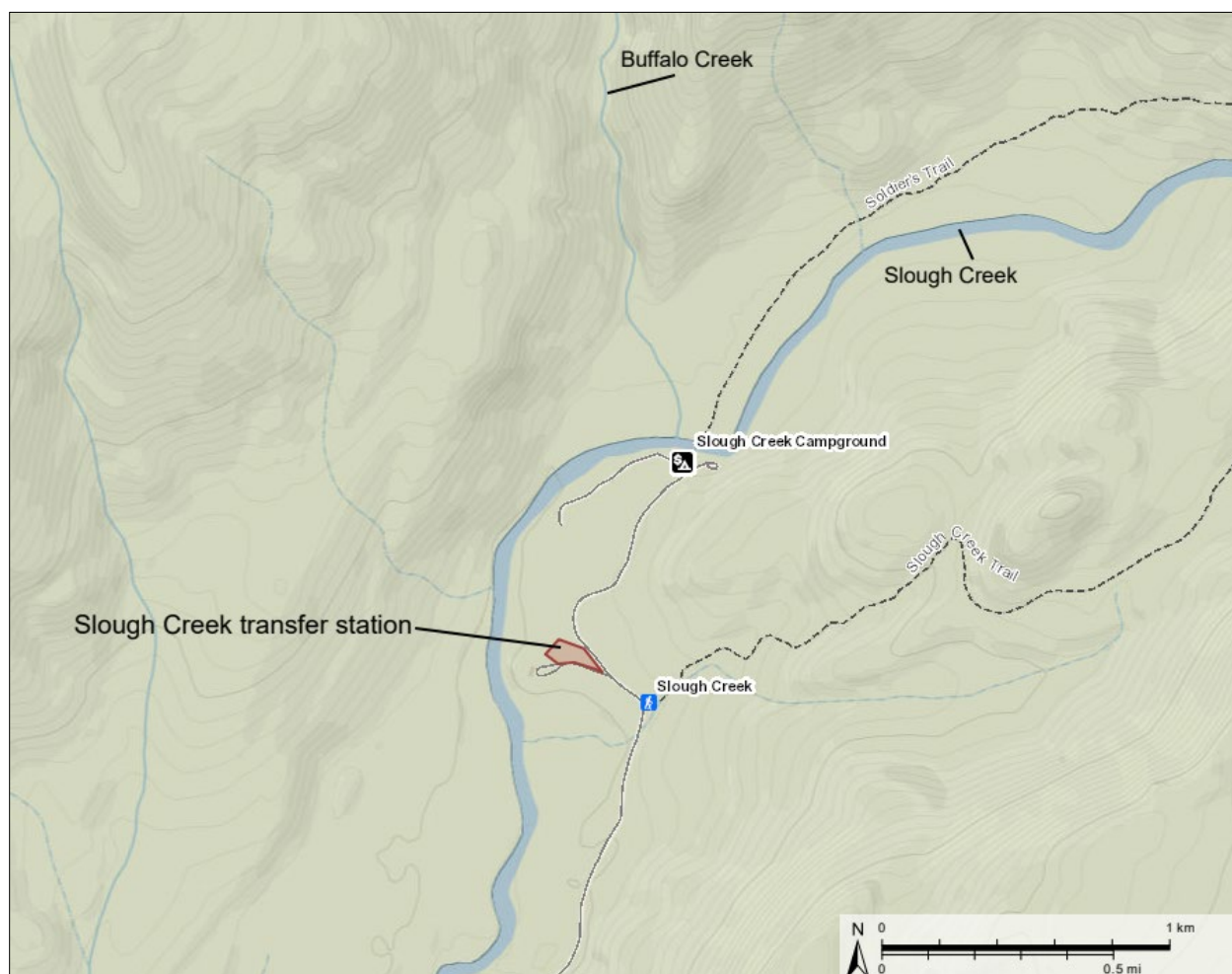


Figure 4: Map of Proposed Slough Creek Staging Area.

Juvenile Yellowstone cutthroat trout would then be moved to the upper watershed on eight pack animals in panniers (baskets) with insulated coolers, ice blocks, and oxygen tanks. For those stream segments inaccessible to pack animals, fish would be delivered by personnel carrying backpack coolers (300 fish per cooler). Helicopter flights would also be used to translocate Yellowstone cutthroat trout to a temporary instream holding facility located in the park just downstream from the boundary with the Custer Gallatin National Forest (Figure 5). This would require up to 10 additional helicopter flights (2 flights over 1 day for up to 5 years). Personnel would set up a net pen in Buffalo Creek as a temporary

fish holding facility. The helicopter would deliver up to two loads of 11,000 fish per load (22,000 total) to the temporary holding facility each year. At least two people would guard the net pen from bears while fish are present. Over two days, eight pack stock (16 animal trips) would transport these fish from the holding facility into the Absaroka-Beartooth Wilderness for stocking.

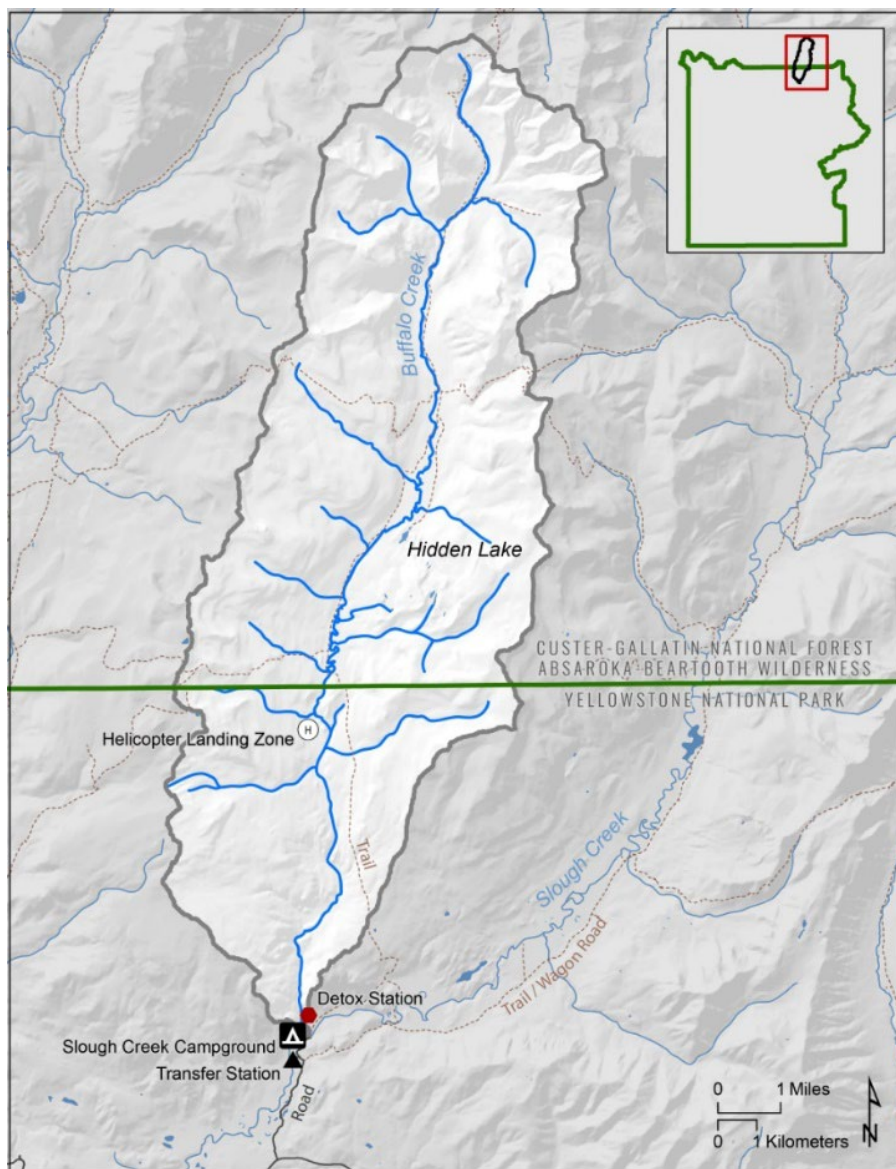


Figure 5: Buffalo Creek Project Area Map.

Project area map showing the approximate location of the temporary instream holding facility in the park, near the location described as the “Helicopter Landing Zone.”

Helicopter Support

Alternative 2 includes the use of helicopter flights in support of native fish conservation efforts described in the USFS Plan. Table 2 below provides a breakdown of flights included under Alternative 2.

Table 2: Expected number of total USFS flights originating from the park.

| Flight Type from Slough Creek transfer station | Number of Flights | Total Flights |
|--|-------------------|---------------|
|--|-------------------|---------------|

| | | |
|---|------------------------------|----|
| USFS Equipment mobilization | 10 per year over three years | 30 |
| USFS Yellowstone Cutthroat Trout Restocking | 2 per year up to 5 years | 10 |
| | | 40 |

2.3 Mitigation Measures

The following measures would be implemented as part of the project description for both alternatives.

Native Fish (NPS, YNP 2022; USDI, NPS 2022)

- Anglers are asked to clean, drain, and dry gear before entering the park. To reduce the potential for introduction or spread of aquatic invasive species, footwear with absorbent felt or other fibrous material on the soles are prohibited in Yellowstone National Park.
- Staff would inspect generators, fuel lines, fittings, and other equipment for leaks prior to beginning project activities each day. Petroleum products would be properly stored in spill-proof and bear-proof containers. Absorbent supplies would be on-site to address spills.
- The *Piscicide and Potassium Permanganate Emergency and Spill Plan* in Appendix C of the Native Fish Conservation Plan (USDI, NPS 2010) would be followed for the storage, transport, and any fuel or hazardous material leak in Yellowstone National Park.

Canada Lynx and their Designated Critical Habitat, Grizzly Bears, and Wolverines

- Project managers would ensure all participants, including contractors, collaborators, and volunteers, are given orientations on how to avoid disturbing or encountering bears and other wildlife, including regulations regarding vehicle speed limits, food storage, disposal of garbage and other attractants, and approaching or harassing wildlife.
- When helicopters are used for project activities, staff would report all observations of grizzly bears, lynx, and wolverines to the pilot and project manager as soon as possible after observation.
- Except when taking off and landing, or as necessary for project activities, helicopters would travel at least 500 feet above ground to reduce potential disturbance to wildlife below.
- As feasible, helicopter landings would be restricted to pre-determined locations and the number of landings would be minimized to reduce the duration and extent of disturbance.
- If a grizzly bear, lynx, or wolverine is observed in or near (~200 yards) a helicopter flight path or landing zone, the pilot would alter the flight path and landing zone to avoid the animal, including during future trips.
- Anglers are instructed not to discard fish carcasses or entrails along stream banks or lake shores to avoid attracting bears and other wildlife.

USFWS Grizzly Bear Reporting

- Project managers would maintain an up-to-date record of project-related helicopter use, including but not limited to the following:
 - The amount of secure grizzly bear habitat temporarily affected by project-related helicopter use implemented during the previous year.
 - The number of helicopter landings (helicopter use below 500 meters above ground level) that occurred in secure habitat during the previous year.
- Project managers would complete a report with the above information and submit it to the USFWS's Montana Field Office annually for the preceding calendar year throughout the duration of the project.

Health and Human Safety

- All appropriate personal protective equipment (PPE) would be worn by applicators when handling chemicals.
- All product guidelines and instructions would be followed according to product labels.
- Warning signs notifying the public to not consume or recreate within the Buffalo Creek drainage would be placed frequently on trails near the project area and at the Slough Creek trailhead.

Macroinvertebrates and Amphibians

- Managers would avoid working in the upper-most extent of high-elevation streams that originate from glacial meltwater and could be inhabited by the western glacier stonefly.
- Staff would spray a 10% disinfectant, such as bleach, and remove all mud and debris from waders/shoes when moving from one tributary to the next to reduce the spread of chytrid fungus.
- If possible, managers would conduct rotenone treatments when tadpoles and juvenile amphibians are no longer present or in their older life stages.
- If post-treatment sampling indicates populations of macroinvertebrates are not naturally recolonizing the treatment area, biologists may relocate them from nearby similar habitat.

Monarch Butterfly

- To the extent feasible, no nectar feeding plants or host plant species for monarch butterflies or caterpillars would be removed during project activities.
- If habitat disturbance is necessary, project managers would try to adjust the timing of activities in areas containing plants used by monarchs to avoid interfering with breeding or feeding.

Whitebark Pine

- Managers would attempt to minimize impacts to whitebark pine seedlings and saplings and avoid impacts to mature cone-bearing trees.

Vegetation, and Soils

- To the extent feasible, the project area would be surveyed for rare plants before work begins and locations of rare plants would be marked and avoided.
- Landing Sites, work areas, and backcountry camps would be surveyed for rare plant species, cultural resources, and wetlands before implementation on a case-by-case basis.
- To the extent possible, the creation of social trails (the repeated use of the same pathway) by fisheries crews working near streams will be avoided to reduce long term trampling of vegetation and soil compaction. In any instance where a social trail is inadvertently created, upon completion of the project Yellowstone National Park resource protection specialists will be brought in to rehabilitate the area.
- As necessary, areas of disturbance would be rehabilitated and restored in consultation with staff from the park's Vegetation Program using seeds and plants originating from the park or other approved sources.
- All equipment and materials would be cleaned and inspected prior to entering the park to prevent the spread of non-native invasive plants and aquatic invasive species.

Wilderness

- Because both alternatives could affect wilderness character and includes uses prohibited under Section 4(c) of the Wilderness Act (motorized equipment and helicopter landings) within recommended wilderness, a minimum requirements analysis (MRA) is required by NPS policy. An MRA has been developed concurrently with the National Environmental Policy Act (NEPA) analysis and has been appended to this document (Appendix D).
- To the extent feasible, generators would have the lowest possible noise production while still meeting project requirements.

- Helicopters would fly along the two-track road between the Slough Creek transfer station and the Silver Tip Ranch, which is not within recommended wilderness, before veering off to reach their specific location in Yellowstone National Park or the Absaroka-Beartooth Wilderness.
- To the extent possible, equipment and personnel will enter the project area by foot or stock in order to avoid unnecessary trips by helicopter.

Visitor Experience and Human Health and Safety

- Park staff would use press releases, signage, and other outreach to inform the public of rotenone application and detoxification activities, educate visitors about project activities, and explain the importance of native fish conservation.
- The park's backcountry permit office would be notified in advance of the projected rotenone application and detoxification dates to minimize inconvenience to visitors planning a backcountry camping trip in the area.

Archeological Resources

- In the unlikely event that human remains, funerary objects, sacred objects, or objects of cultural patrimony are discovered during project implementation, provisions outlined in the Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001) would be followed. Project work would cease immediately and the NPS would consult with the affected tribe(s) and, if necessary, the Idaho, Montana, or Wyoming state historic preservation office. The location of any such ethnographic sites would remain undisclosed.
- If any cultural materials are discovered during project implementation, work in the area would halt immediately, the appropriate federal agency would be contacted, and the materials evaluated by an archeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards (48 FR 22716, Sept. 1983).

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The Affected Environment

The affected environment describes existing conditions for those elements of the natural and cultural environment (including human health and safety and the visitor experience) which could be affected by the actions proposed in the alternatives.

The affected environment also includes other current and future actions and general trends. The analysis of impacts includes all effects that are reasonably foreseeable and have a reasonably close causal relationship to this proposal. Effects to Yellowstone cutthroat trout, plankton, macroinvertebrates, and amphibians, grizzly bears, and recommended wilderness are discussed in this chapter. Other resources that were dismissed from detailed analysis are discussed in Appendix B of this document.

Impacts

According to the 2022 Council on Environmental Quality (CEQ) revised regulations, “effects or impacts” are changes to the human environment that include reasonably foreseeable (1) direct effects, (2) indirect effects, and (3) cumulative effects [40 CFR §1508.1(g)].

Agencies consider the potentially affected environment and degree of effects to determine the significance of an action’s impacts. The degree of effects is assessed in the context of the Park’s purpose and significance and any resource-specific context that may be applicable. When assessing the degree of effects, agencies consider:

- Both short (during construction and rehabilitation)- and long-term (post construction & rehabilitation) effects.
- Both beneficial and adverse effects.
- Effects on public health and safety.
- Effects that would violate Federal, State, Tribal, or local law protecting the environment. [40 CFR § 1501.3(b)]. None of the alternatives analyzed in this EA would violate any federal, state, tribal, or local laws that protect the environment.

Cumulative Impacts Methodology

In accordance with the CEQ revised regulations, this EA also considers cumulative impacts, “which are effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions” [(§1508.1(g)(3)]. Cumulative impacts have been addressed in this EA by resource and are considered for each alternative.

3.1 Summary of Past, Present, and Reasonably Foreseeable Future Actions and Trends

- **Past, Present and Reasonably Foreseeable Future Actions**
 - USFS & MTFWP *Buffalo Creek Yellowstone Cutthroat Trout Conservation Project*. This project would remove nonnative rainbow and hybridized trout from Buffalo Creek in the Absaroka Beartooth Wilderness upstream of the park and restock native Yellowstone cutthroat trout to those waters. Rotenone would be applied to about 33 stream miles and 2

lakes (11 lake acres) upstream of the park boundary over about 12 to 14 days each summer for up to 3 years.

- NPS Native fish restoration efforts throughout the park. Notable actions include lake trout suppression efforts in Yellowstone Lake, and tributary restoration efforts in Soda Butte Creek and the Upper Gibbon River.
- Continuation of lake trout suppression efforts in Yellowstone Lake and a number of native fish restoration projects involving rotenone treatments and native stocking in various drainages within the park. Future native fish restoration projects are expected in the following drainages: Black Butte Creek, Blacktail Deer Creek, Buffalo Creek, Canyon Creek, Cougar Creek, Specimen Creek, Lava and Lupine Creeks, Reese Creek, Ribbon Lake, Rose Creek, Soda Butte Creek, and Tower and Carnelian Creeks. For more detailed information about NPS native fish restoration efforts in Yellowstone, please refer to the discussion in previous sections and Appendix A of this EA, and the 2010 Native Fish Restoration Plan.
- NPS infrastructure rehabilitation and construction projects include the North Entrance Road reconstruction project, the Northeast Entrance Road rehabilitation project, Yellowstone River Bridge reconstruction, and the Norris to Golden Gate Grand Loop Road rehabilitation project (phase 3).
- Rehabilitation of the Slough Creek fish barrier damaged by the 2022 flood event.
- NPS and administrative activities in front country and recommended wilderness including trail maintenance, wildlife management, telecommunications maintenance, wildland fire management, and research activities.
- Hazard fuel reduction treatments in developed areas throughout the park.

- **Trends**

- Climate: Shifting climate trends observed in the Greater Yellowstone Ecosystem include increasing temperatures and changes in precipitation and snowmelt. These trends are responsible for altering precipitation patterns, increasing water temperatures and the frequency of droughts, and more intense storm events. These trends are expected to continue, which are likely to result in the continued proliferation of nonnative species into native habitats, declining native species populations, habitat loss, increased fire activity, and future major weather events. However, the Greater Yellowstone Ecosystem is considered to be more resilient to climate change compared to lower-elevation areas, and therefore provides opportunities to serve as a climate refugia for native species that may otherwise be significantly impacted by the effects of climate change across a given species range.

3.2 Yellowstone Cutthroat Trout

Affected Environment

The Lamar River and its tributaries, including Buffalo and Slough creeks, comprise a large, natural watershed supporting an abundant population of Yellowstone cutthroat trout at relatively high elevations where water temperatures are cooler (Varley and Schullery 1998). Some of these trout are large river migrants that travel long distances upstream annually for spawning, while others are headwater residents (Ertel et al. 2017, Heim et al. 2020). This robust population of Yellowstone cutthroat trout has high conservation value because it is protected within a national park and recommended wilderness area and, as a result, could persist into the 21st century as the climate continues to warm (Isaak et al. 2015, 2017; Al-Chokhachy et al. 2018). The population also supports a natural food web, including bald eagles (*Haliaeetus leucocephalus*), grizzly bears, and otters (*Lontra canadensis*), and a sport fishery coveted by fly fishermen from around the world (USDI, NPS 2010, Bergum et al. 2017). All subspecies of cutthroat trout in western North America are impacted to some extent by hybridization with nonnative rainbow trout and, as a result, efforts to protect remaining nonhybridized populations have increased in importance (Gresswell 2011).

Yellowstone cutthroat trout are native to the Lamar River and many of its tributaries, including the lower reaches of Buffalo and Slough creeks within Yellowstone National Park (Varley and Schullery 1998, Koel et al. 2022b). The reaches of Buffalo Creek upstream of a barrier cascade (near the boundary of the park) in the Absaroka-Beartooth Wilderness of the Custer Gallatin National Forest evidently were fishless historically, but about 5,000 Yellowstone cutthroat trout and 3,500 rainbow trout were stocked into a small lake (Hidden Lake) near the upper end of the watershed in 1920 and 1932, respectively (Varley 1981, Koel et al. 2022b). Additional Yellowstone cutthroat trout stockings in Buffalo Creek took place in 1916 and 1920 (exact location unknown) and 1922 and 1942 within the Absaroka and Beartooth Primitive Areas, prior to wilderness designation in 1978 (Varley 1981). Some of these rainbow trout moved through the outlet stream into Buffalo Creek, which flows south into Yellowstone National Park as a tributary to Slough Creek which, in turn, flows into the Lamar River. Rainbow trout invaded the large tributary network of Buffalo Creek in the Absaroka-Beartooth Wilderness, as well as the mainstem of the creek and several tributaries downstream. Hybridization occurred in the lower reaches of Buffalo and Slough creeks where rainbow trout from Buffalo Creek mixed with genetically unaltered Yellowstone cutthroat trout from Slough Creek and the Lamar River watershed (Heim et al. 2020). By the mid-1990s, nearly all fish in the lower reaches of Buffalo Creek were hybrids and evidence of hybridization was found in the lower reach of Slough Creek and the Lamar River from the Lamar Valley to its confluence with the Yellowstone River (Ruhl and Koel 2007, Ertel et al. 2017).

Most Yellowstone cutthroat trout in the upper reaches of the Lamar River, such as Cache, Calfee, and Flint creeks, remain unhybridized (Heim et al. 2020). As part of the 2010 Plan, the NPS installed a concrete barrier on Slough Creek above the campground in 2017 and implemented rainbow and hybrid trout suppression upstream and downstream via electrofishing and targeted angling, including a must-kill regulation (NPS, YNP 2022; USDI, NPS 2022). However, this barrier was damaged by flood waters in 2021 and 2022, which could lead to rainbow and hybridized trout from Buffalo Creek moving upstream into the upper reaches of Slough Creek and threaten native trout populations in those waters.

Given the abundance of nonnative rainbow trout in the portion of the Buffalo Creek drainage in the Absaroka-Beartooth Wilderness north of the park, rainbow trout will continue to invade Slough Creek and hybridize and compete with native Yellowstone cutthroat trout in the Lamar River watershed. Over time, the Yellowstone cutthroat trout population could become extensively hybridized unless the source of the invasion from Buffalo Creek is eliminated or at least substantially suppressed (Ertel et al. 2017, Heim et al. 2020).

Ongoing administrative activities such as road reconstruction and maintenance, backcountry operations, facilities maintenance, and hazard fuels reduction projects can contribute to adverse impacts on Yellowstone cutthroat trout and habitat. Road maintenance activities can cause occasional minor disturbances to native fish by heavy equipment operation. Backcountry operations include horse patrols and trail maintenance can cause localized temporary disturbances of native fish. Most facilities maintenance would take place in developed areas where minimal impacts to native fish would occur. However adverse impacts to native fish may become necessary because some native fish-bearing waters may temporarily be disturbed for general operation practices. Additionally, Yellowstone's hazard fuels reduction projects require the removal of excess fuel (trees) from developed areas. Impacts to native fish are reduced by minimizing time and disturbance in riparian areas and monitoring construction and maintenance activities. Park visitation is expected to increase each year as a result of population growth in nearby communities and elsewhere. Therefore, recreational use such as angling, camping, and hiking would increase parkwide. An increase in recreational users would likely place additional pressures on native fish as more people hike and camp in Yellowstone National Park and disturb native fish.

Recent and future changes in climatic conditions have and are expected to substantially alter aquatic communities in the GYE and surrounding areas (Shepard et al. 2016). Cutthroat trout have relatively narrow thermal tolerances (Bear et al. 2007), and migration timing and life-history expressions are strongly tied to thermal and hydrologic regimes (DeRito et al. 2010). Warming summer temperatures coupled with changes in the magnitude and timing of precipitation and snowmelt runoff are likely to create more stressful summer conditions for Yellowstone cutthroat trout in some areas (Uthe et al., in review). As stream temperatures warm, the amount of thermally suitable habitat for Yellowstone cutthroat trout may be reduced considerably in some populations (Al-Chokhachy et al. 2013, Isaak et al. 2015). Lake-dwelling populations will also be affected by climate change because they rely on adequate connectivity to tributary streams (Kaeding 2010). In addition to the direct effects of changing thermal regimes, Yellowstone cutthroat trout are likely to become increasingly exposed to diseases in streams where temperatures warm dramatically (Koel et al. 2006) and suffer increased mortality from catch-and-release angling (Cooke and Schramm 2007). Most fish managers in the region restrict opportunities for angling when water temperatures reach critical levels, and these restrictions will likely become more frequent as the climate warms. Such restrictions may affect visitation to the Yellowstone area because angling is often an important component of tourism.

Environmental Consequences

Alternative 1 (No Action)

Under the No Action Alternative, the NPS would not authorize the use of park lands for staging and access by the USFS for implementation of their proposal to conserve native Yellowstone cutthroat trout in the Custer Gallatin National Forest. The park would continue to use the adaptive management framework provided by the 2010 Plan to employ rotenone treatments and other nonnative fish removal techniques on Buffalo Creek. As a result, impacts to Yellowstone cutthroat trout would be the same or similar to what is described in the Affected Environment, which includes a description of the current and expected future conditions of the species. Yellowstone may be somewhat successful at reducing the population of hybridized and nonnative fish in the near term through localized rotenone applications, targeted angling, and electrofishing.

Though targeted angling can reduce the abundance, distribution, and influence of nonnative fish in some circumstances, it is not effective at eradicating nonnative fish from streams. The mainstem of the Lamar River and lower Slough Creek in Yellowstone National Park, which are accessible via roads, are heavily fished during summer, but far fewer anglers venture into the remote tributaries of the Lamar River watershed. Reaching these areas often requires long strenuous hikes over steep, rugged terrain in grizzly bear country and many smaller streams are surrounded by abundant deadfall timber that makes access

difficult (MFWP and USFS 2022). Thus, fishing intensity is generally insignificant for decreasing the population growth rates of rainbow and hybrid trout.

Electrofishing can be successful at suppressing the abundance and distribution of nonnative fish (Ertel et al. 2017). Efforts upstream of the fish migration barrier on Slough Creek, about three-quarters of a mile upstream of the Slough Creek Campground, have lowered the prevalence of rainbow and hybrid trout from 12% to 2% in recent years. However, work on the lower portions of Slough Creek, downstream of Slough Creek Campground, has recently begun and sampling shows rainbow trout are more abundant in this area due to the proximity to the confluence with Buffalo and Hidden creeks. These tributaries to Slough Creek are known spawning locations for rainbow trout and Buffalo Creek has a large population of genetically pure rainbow trout that continue to migrate downstream into Slough Creek and the Lamar River. Continued suppression is needed to curtail rainbow and hybrid trout expansion in the system. However, the complete eradication of rainbow and hybrid trout will not be attained using electrofishing because it requires numerous treatments over many years and substantial investments of funds and labor. In turn, repeated electrofishing causes more injuries and some mortality to native fish. The large spatial extent of the Lamar River and its tributaries, as well as the complexity of the habitat and terrain, allow some fish to escape removal using this method and quickly re-establish the population. Thus, electrofishing is an effective method to suppress invasive trout populations but ineffective for eradicating rainbow and hybrid trout from the Buffalo and Slough creek drainages.

Rotenone treatments would kill most fish within the treatment area, including non-target Yellowstone cutthroat trout, because this chemical formulation is highly toxic to gill-breathing organisms. The immediate effect of chemical treatment would be a short-term, adverse impact by removing Yellowstone cutthroat trout from the treatment area. Biologists would lessen impacts to Yellowstone cutthroat trout downstream by minimizing the concentration of rotenone and neutralizing it with potassium permanganate at the downstream end of the treatment area. After treatment, native fish would naturally recolonize the area from up and downstream and benefit from reduced competition, hybridization, and extirpation risk within the Lamar River watershed. However, the removal of rainbow and hybrid trout from the portion of Buffalo Creek in the park every three to five years will only slow the spread of these invasive fish in the Lamar River watershed; not stop it completely. Rainbow trout that persist in the headwaters of Buffalo Creek in the Absaroka-Beartooth Wilderness will continue to disperse downstream into the park. Following rotenone treatments, the NPS would not reintroduce genetically unaltered Yellowstone cutthroat trout to Buffalo Creek because they would eventually be lost to interbreeding and hybridization.

Native fish restoration efforts under Alternative 1, focused on only the portion of Buffalo Creek within the park would provide only a marginal benefit to Yellowstone cutthroat trout populations, and the park would forego the opportunity to establish and secure populations of genetically pure Yellowstone cutthroat trout in an area well-suited to provide habitat refugia. Without the ability to eradicate nonnative species throughout the entire drainage and on adjacent public lands, rainbow and hybrid trout would continue to hybridize with and threaten native trout populations. Over time, lost opportunities to protect a secure population of native Yellowstone cutthroat trout would increase the overall level of risk to the long-term conservation of the species, which would become less viable and more susceptible to extirpation throughout the Greater Yellowstone Ecosystem.

Cumulative Impacts

Cumulative impacts as a result of Alternative 1, when combined with past, present, and reasonably foreseeable actions and trends as described in Section 3.1 would not have any additional adverse impacts to Yellowstone cutthroat trout. Although the NPS would not authorize the USFS to stage operations out of the park, the NPS assumes the USFS would be able to implement other components of their plan that would have an overall benefit to native Yellowstone cutthroat trout in the Buffalo Creek drainage.

Alternative 2 (Preferred Alternative)

The impacts of upstream actions by the USFS and MTFWP were described in their EA titled *Buffalo Creek Yellowstone Cutthroat Trout Conservation Project* (MTFWP and USFS 2022). Pursuant to 43 CFR 46.135, the NPS incorporates that document and the impacts described therein into this EA by reference.

The Preferred Alternative would be beneficial to the Yellowstone cutthroat trout population in the park by enabling the USFS to remove the primary source of nonnative fish upstream of the park and securing cutthroat habitat throughout the entire Buffalo Creek drainage. Initially, there would be some adverse impacts from the mortality of native Yellowstone cutthroat trout during rotenone treatments, but this mortality would not affect the overall population in the Lamar River watershed because the chemical will be neutralized before reaching Slough Creek. Overall, this alternative would benefit native Yellowstone cutthroat trout by removing a source of hybridization and gradually reversing existing levels of hybridization through stocking of genetically unaltered Yellowstone cutthroat trout. Benefits would be on the regional scale because this alternative would protect unhybridized fish in the Lamar River watershed. This alternative would also benefit Yellowstone cutthroat trout by establishing a population secure from climate-related habitat degradation.

Equipment staging and helicopter flights from the Slough Creek transfer station in Yellowstone National Park to transfer gear, fish, and personnel to support nonnative fish removal and native fish restoration throughout the Buffalo Creek drainage, including on lands administered by the USFS, would have no adverse effects on Yellowstone cutthroat trout. Likewise, movements of personnel and pack animals along existing trails through the park and camping in designated areas for short periods should have no adverse effects on Yellowstone cutthroat trout. The setting of a net pen in a portion of Buffalo Creek inside the park as a temporary fish holding facility for restocking Yellowstone cutthroat trout to the Absaroka-Beartooth Wilderness would have no effects to existing trout.

Cumulative Impacts

The Preferred Alternative, when combined with past, present, and reasonably foreseeable future actions and trends as described in Section 3.1 would not result in any additional adverse impacts to Yellowstone cutthroat trout and would likely be beneficial in the long-term.

3.3 Plankton, Macroinvertebrates, and Amphibians

Affected Environment

Planktonic or “free-floating” organisms can be found in lakes and wetlands throughout the park. These organisms include phytoplankton, which are microscopic plants, and plankton, which are microscopic animals. The phytoplankton community includes diatoms, blue-green algae, green algae, and photosynthetic flagellates. Phytoplankton are primary producers that transform sunlight and carbon dioxide into organic tissue through photosynthesis, which also produces dissolved oxygen needed by all aquatic, gill-breathing animals to survive. The 49 plankton taxa that have been identified in the park include 11 copepods, 22 cladocera, and 16 rotifer species. *Daphnia*, the most known genus of cladocera, are small plant-eating plankton that graze primarily on phytoplankton. Most plankton are preyed upon by larger macroinvertebrates and larval fish (USDI, NPS 2010).

Aquatic macroinvertebrates in the park include aquatic insects, gastropods (snails), bivalves (mussels and clams), hydracarina (water mites), annelids (segmented worms and leeches), amphipods (scuds), isopods (pillbugs), decapods (crayfish), hydroid (hydra), turbellaria (flatworms), porifera (freshwater sponge), and nematodes (unsegmented worms). Macroinvertebrates are an important food source for fish, amphibians,

and some birds and mammals. They also are important indicators of the impacts of potential stressors to water quality, such as road construction, sewage spills, and mining activities. Mayflies, stoneflies, and caddisflies are indicators of good water quality because they are typically sensitive to environmental change and most abundant in riffle habitats of streams where water quality is very good. Beetles, flies, and midges, which are typically less sensitive to environmental change and have the highest densities where water quality has been compromised by natural or human caused disturbances, are indicators of poor water quality (USDI, NPS 2010).

Five amphibians occur in the park, including boreal chorus frogs (*Pseudacris maculate*), Columbia spotted frogs (*Rana luteiventris*), plains spadefoot toads (*Spea bombifrons*), western tiger salamanders (*Ambystoma mavortium*), and western toads (*Anaxyrus boreas*). Boreal chorus frogs are common throughout the park, living in moist meadows and forests near wetlands and breeding in shallow pools or ponds during late spring. Columbia spotted frogs are widespread along or in rivers, streams, lakes, wetlands, and ponds. Eggs are usually laid in globular masses on emergent vegetation in still water. Western tiger salamanders are widespread in a variety of habitats and breed in ponds and lakes with emergent vegetation used for egg attachment. These salamanders are abundant in the northern portion of the park. Western toads are abundant in some areas and can range far from wetlands by absorbing water from puddles or moist areas. They lay eggs in warm water along lake edges, slow streams, ponds, and river backwaters (USDI, NPS 2010). In 2014, a breeding population of plains spadefoot toads was discovered in five thermally warmed pools in the Lower Geyser Basin at an elevation of about 7,220 feet (Schneider et al. 2015). These toads emerge from overwinter burrows near the pools to breed in May and most tadpoles' complete metamorphosis in the pools by mid-July. Adults can disperse up to 1.5 miles, but most remain within 400 yards of the pools. No plains spadefoot toads are known to occur in the Lamar River watershed.

Rotenone can kill larval amphibians and macroinvertebrates, such as mayflies, stoneflies, and caddisflies, which are susceptible because they breathe via gills and rotenone enters their bloodstream directly (USDI, NPS 2010). Likewise, adult and juvenile plankton are sensitive to rotenone treatments, which result in a marked decrease in the population immediately after treatment. Benthic invertebrates living in gravel or mud appear less sensitive to rotenone than those living in the water column, and larger invertebrates appear less sensitive than smaller ones. Invertebrates exposed to rotenone often dislodge and drift downstream to avoid more chemical exposure. The overall effects of rotenone would last for up to 8 hours and effects to individuals would range from negligible to death (USDI, NPS 2010).

Over the past two decades, biologists in Yellowstone have used rotenone in High Lake and East Fork Specimen Creek (2006, 2008-2009, 2021), Goose Lake (2011), Elk Creek (2012-2014), Grayling Creek (2013-2014), Soda Butte Creek (2015-2016), and the upper Gibbon River (2017-2020) to remove nonnative fish. Rotenone treatments reduced the abundance and variety of mayflies, stoneflies, and caddisflies following treatment, but did not impact overall insect diversity. Rotenone degraded quickly within streams and many macroinvertebrates escaped the treatment area by drifting downstream (Skaar et al. 2017). Macroinvertebrates experienced greater effects from the potassium permanganate neutralization than exposure to rotenone. However, the abundance and variety of mayflies, stoneflies, and caddisflies returned to pre-treatment levels at most sites within a year (Skaar et al. 2017). It is expected the abundance and variety of macroinvertebrates in Buffalo and Slough creeks would also return to pre-treatment levels within approximately 1 year.

Larval amphibians are susceptible to rotenone because they breathe via gills, while adult amphibians breathe air and are only susceptible to rotenone when drinking or standing in treated water. Research found all Columbia spotted frog tadpoles exposed to a rotenone treatment in High Lake (Yellowstone National Park) died, while non-gill-breathing juveniles and adults survived at multiple locations. During the first year following treatment, tadpole abundance increased about six-fold in the treatment area

(Billman et al. 2011, 2012). These findings suggest large-scale mortality can be avoided by conducting rotenone treatments after amphibians metamorphose to air-breathing stages. Adult amphibians would need to consume rotenone-treated prey or water that far exceeded their body weight to obtain a lethal dose (USDI, NPS 2010). Adverse effects would occur when localized fish populations are removed, and aquatic invertebrate and larval amphibian communities are reduced. While these communities should return within 1 to 2 years, wildlife feeding on this prey may be displaced until the stream recovers (USDI, NPS 2010).

Amphibian diseases such as ranavirus and chytrid fungus are widespread in Yellowstone National Park. Ranavirus has been found in tiger salamanders and Columbia spotted frogs, primarily larval amphibians (tadpoles), and implicated in frequent, large die-offs since 2002. The percentage of tadpoles sampled during 2015 to 2019 that tested positive for this disease ranged between 30 and 83% at various sites (Treanor and Cross 2022). Chytrid fungus usually appears in Columbia spotted frogs and western toads following metamorphosis and affects their ability to breathe, hydrate, maintain fluid balance, and thermoregulate. The percentage of tadpoles sampled during 2015 to 2019 that tested positive for this disease ranged between 2% and 91% at various sites (Treanor and Cross 2022). The widespread prevalence of these diseases is very concerning since amphibians are sensitive to environmental change. As a result, the Yellowstone Wildlife Health Program is continuing monitoring each summer and biologists are extremely careful to decontaminate their equipment and gear to prevent transmission (Treanor and Cross 2022).

Ongoing administrative activities such as road construction and repair and facilities maintenance could disturb soils adjacent to streams leading to increased runoff and sedimentation. Increased sedimentation would adversely affect aquatic organisms by reducing in-stream habitat and either interfering with respiration, feeding, and reproductive behavior or cause death. Park visitation is expected to increase each year as a result of population growth in nearby communities and elsewhere. Past and ongoing recreational use such as angling, camping, and hiking would continue. Angling could cause trampling of streambeds, which could lead to reduced habitat or direct mortality of some aquatic organisms. Camping and hiking could lead to soil erosion and increase sedimentation in adjacent streams and lakes which, in turn, could reduce in-stream habitat, reduce visibility for feeding, and alter behavior of some aquatic organisms temporarily.

In general, climate change is a threat to aquatic organisms by altering precipitation patterns, increasing water temperatures and the frequency of prolonged drought conditions, damaging breeding areas as a result of more frequent flood events, and exasperating the effects of disease through species populations. Some species of aquatic organisms may have a narrow range of temperature tolerances because of where they are located on the landscape such as if they inhabit high elevation, cold water habitats. Research indicates that such species may be especially vulnerable to climate change (Giersch et. al. 2015). Furthermore, as climate change alters habitat conditions, nonnative species are entering into previously uninhabitable ranges, resulting in an increasing number of predator species that prey upon and threaten aquatic organisms, and also provides opportunities for new diseases to enter into the food web and decimate native populations.

Environmental Consequences

Alternative 1 (No Action)

Under the No Action Alternative, the NPS would not authorize the use of park lands for staging and access by the USFS for implementation of their proposal to conserve native Yellowstone cutthroat trout in the Custer Gallatin National Forest. The park would continue to use the adaptive management framework provided by the 2010 Plan to employ rotenone treatments and other nonnative fish removal techniques on

Buffalo Creek. As a result, impacts to plankton, macroinvertebrates, and amphibians would be the same or similar to what is described in the Affected Environment. Applied chemicals (piscicide and potassium permanganate) would affect waters being treated and downstream portions of the treatment area; mechanical removal would only affect waters in the immediate work area. Chemical treatments would have adverse effects to plankton, aquatic invertebrates, and amphibians. Susceptibility and degree of impact would vary among species and life history stage. In general, adult and juvenile zooplankton tend to be sensitive to chemical treatments, resulting in a marked decline in their population immediately after treatment. Response by aquatic invertebrates would depend on a variety of factors including species, exposure, and method of respiration. Typically, invertebrates that are affected by chemical treatment will be dislodged and drift downstream to avoid chemical exposure. Overall effects of chemicals on individual invertebrates can range from negligible (no effect) to death. Some invertebrate taxa may be entirely removed from the population. Because aquatic invertebrate populations are dynamic and highly variable, total recovery of some invertebrate taxa would be impossible to document, but reestablishment of native fish would in the long term improve ecological function and hence diversity of these species.

Whether removal is chemical or mechanical, temporary effects may occur when localized fish populations are removed and aquatic invertebrate or larval amphibian communities are reduced. Wildlife that depends on aquatic invertebrate communities may be displaced until the stream has recovered. Larval amphibians are very susceptible to rotenone which can cause 100 percent mortality; adult amphibians do not seem to exhibit adverse effect from its application.

Electrofishing and netting may also affect plankton, aquatic invertebrates, and amphibians to a small degree by dislodging individuals, shocking individuals or from trampling. Therefore, mechanical removal efforts would have a temporary adverse impact to plankton, aquatic invertebrates, and amphibians.

Cumulative Impacts

Cumulative impacts as a result of Alternative 1, when combined with past, present, and reasonably foreseeable actions and trends as described in Section 3.1 would not have any additional adverse impacts to plankton, macroinvertebrates, and amphibians beyond those described in the Affected Environment.

Alternative 2 (Preferred Alternative)

The impacts of upstream actions by the USFS and MTFWP were described in their EA titled *Buffalo Creek Yellowstone Cutthroat Trout Conservation Project* (MTFWP and USFS 2022). Pursuant to 43 CFR 46.135, the NPS incorporates that document and the impacts described therein into this EA by reference.

There would not be any direct impacts as a result of the USFS using the park to implement native fish restoration efforts on portions of Buffalo Creek in the Absaroka Beartooth Wilderness. Equipment staging and helicopter flights from the Slough Creek transfer station in Yellowstone National Park to transfer gear, fish, and personnel to support nonnative fish removal and native fish restoration throughout the Buffalo Creek drainage, including on lands administered by the USFS, should have no adverse effects on plankton, macroinvertebrates, and amphibians. Likewise, movements of personnel and pack animals along existing trails through the park and camping in designated areas for short periods should only have temporary adverse effects on plankton, macroinvertebrates, and amphibians. The setting of a net pen in a portion of Buffalo Creek inside the park as a temporary fish holding facility for restocking Yellowstone cutthroat trout to the Absaroka-Beartooth Wilderness would have localized, minimal effects to plankton, macroinvertebrates, and amphibians given its small spatial impact and short temporal duration of less than two weeks each year for up to five years.

Cumulative Impacts

The Preferred Alternative, when combined with past, present, and reasonably foreseeable future actions and trends as described in Section 3.1 would not result in any additional long-term adverse impacts to plankton, macroinvertebrates, and amphibians beyond those described in the Affected Environment.

3.4 Grizzly Bears

Affected Environment

From the late 1950s through the 1970s, most grizzly bear (*Ursus arctos horribilis*) mortality was due to human-causes, primarily management removals of bears involved in human-bear conflicts (Craighead et al. 1988). The U.S. Fish and Wildlife Service designated the grizzly bear as threatened in the lower 48 states during 1975 due to low numbers (230 to 315) and low survival of adult females in the Greater Yellowstone Ecosystem (Knight and Eberhardt 1985). Managers in Yellowstone National Park and surrounding National Forests and States reduced bear access to human foods and increased survival by implementing food storage orders, limiting motorized access, retiring livestock allotments, and preventing the loss of secure habitat (White et al. 2017). Annual survival of adult females increased and has remained at 95% for three decades. In turn, substantial population growth occurred through the late 1990s, with range expansion continuing to present. Lower survival of cubs and yearlings, and a modest decrease in reproduction, slowed population growth in the early 2000s, and the population has been relatively constant thereafter. Evidence to date suggests the recent change in population trend was associated with high bear densities in the core of the ecosystem, rather than a decrease in food resources (van Manen et al. 2021).

Today, there are an estimated 1,069 bears (range = 953 to 1,184) occupying more than 27,200 square miles in the Greater Yellowstone Ecosystem, with enough reproductive females to sustain a viable population over the long term (van Manen et al. 2021). With more grizzly bears occupying areas outside protected parks and wilderness areas where human influence and the potential for management conflicts are greater, the primary causes of mortality have shifted to management removals for livestock depredations, self-defense kills, hunting-related incidents, vehicle strikes, and poaching in range expansion areas (van Manen et al. 2021).

Grizzly bears are habitat generalists that employ an opportunistic, omnivorous foraging strategy by using a wide range of plant and animal food sources (Gunther et al. 2014). Although grizzly bears in the Greater Yellowstone Ecosystem exhibit a high level of dietary variation, four key food groups have been identified that provide concentrations of proteins and fats that are essential sources of energy and nutrients for bears. These include ungulate biomass (obtained through direct predation as well as scavenging carcasses), spawning Yellowstone cutthroat trout, whitebark pine seeds, and army cutworm moths (Schwartz et al. 2010, Costello et al. 2016, van Manen et al. 2021). In the Greater Yellowstone Ecosystem, significant grizzly bear use of spawning Yellowstone cutthroat trout is known to occur only inside Yellowstone National Park, and use of army cutworm moths occurs in relatively small insect aggregation sites found in the Wyoming portion of the ecosystem (van Manen et al. 2021).

The Buffalo Creek drainage is within subunit 2 of the Boulder-Slough Bear Management Unit, which consists of lands within the Absaroka-Beartooth Wilderness and Yellowstone National Park (Figure 6). The subunit provides large amounts of secure habitat (98%) within 232 square miles. Secure habitat is defined as any contiguous area at least 10 acres in size and more than 500 meters from an open or gated motorized access route (road or trail) or recurring low level helicopter line during the non-denning period (March 1 – November 30; Yellowstone Ecosystem Subcommittee 2021). The foundation of the *Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area* is the protection of secure habitat inside a 9,210-square-mile Primary Conservation Area where there will be no net increase in

development, livestock grazing, or roads from circa 1998 levels (Yellowstone Ecosystem Subcommittee 2021). This area includes the entire Buffalo Creek drainage in the Absaroka-Beartooth Wilderness and Yellowstone National Park.

The states of Idaho and Wyoming have petitioned the United States Fish and Wildlife Service (USFWS) to delist grizzly bears in the Greater Yellowstone Ecosystem (State of Idaho 2022, State of Wyoming 2022). State managers have indicated they would hunt grizzly bears within portions of the Primary Conservation Area around Yellowstone National Park on national forests after delisting. Thus, human-caused mortalities would increase in the Greater Yellowstone Ecosystem and offset some of the positive contributions of habitat protection and reductions in other types of human disturbance on reproduction and survival. Per a tri-state memorandum of agreement, Idaho, Montana, and Wyoming would use total mortality rates of grizzly bears to establish annual total mortality limits for independent females, independent males, and dependent young inside the Demographic Monitoring Area. Grizzly bear hunting would be suspended in the Demographic Monitoring Area if there were less than 831 bears, which is the lower 95% confidence interval of the average of abundance estimates derived during 2002 to 2019 (Wyoming Game and Fish Commission et al. 2022).

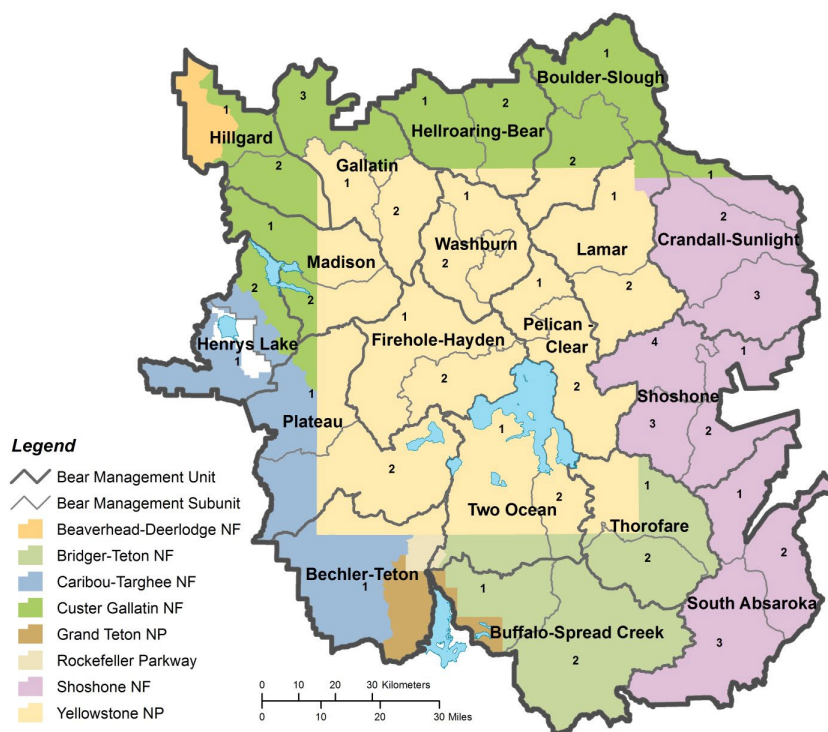


Figure 6: Grizzly Bear Conservation Areas.

The Primary Conservation Area for grizzly bears showing management unit and subunit boundaries. The Buffalo Creek drainage is within subunit 2 of the Boulder-Slough Bear Management Unit, which consists of lands within the Absaroka-Beartooth Wilderness (green) and Yellowstone National Park (tan).

Helicopter flights occasionally occur to remote watersheds to deliver equipment, personnel, and native fish for restoration efforts. Most flights over Yellowstone National Park are required to maintain an altitude of 500 feet above ground to respect wilderness values and minimize effects to visitor experience (YNP 2020). However, special use helicopter flights are allowed to be lower than this level during take-offs and landings and as necessary to meet their mission objectives. Some grizzly bears may be disturbed by these flights, with responses ranging from simple awareness, such as raising their head but otherwise

continuing their activities, to short-term disturbances or flight responses, or temporary displacement from an area. These responses may contribute to slight losses of habitat due to avoidance or displacement, disturbance of bears, and energetic costs or behavioral stress (Harding and Nagy 1980, Reynolds et al. 1986). However, if helicopter use is short in duration (a few days) and low in frequency (several trips) in an area, the disturbance should be relatively minor in intensity, not persist for long periods or through a season, and not cause injury, decrease productivity, or significantly interfere with normal behavior patterns such as breeding, feeding, or sheltering. The potential or actual effects on grizzly bears would be relaxed almost immediately once the helicopter operation is complete, with time for the recovery of any energetic costs before denning and no lingering effects to the animal's fitness.

Bears have substantial behavioral plasticity and tolerate many mechanized activities, as evidenced by several habituated roadside bears in Yellowstone National Park and other areas of the Greater Yellowstone Ecosystem. Similarly, brown bears (*Ursus arctos*) did not change their overall movement patterns during 1 to 2 hours after direct helicopter approaches by researchers in Scandinavia (Støen et al. 2010). Some bears were startled and ran a short distance before reducing their rate of movement and sometimes moving into cover to watch for danger, but bears did not change the size or overlap of their activity areas and remained within similar habitat types and terrain. These researchers concluded using helicopters infrequently for short-term activities did not influence activity areas or movements of bears. Bear home ranges in the Greater Yellowstone Ecosystem are large and fish restoration activities are generally concentrated along relatively small areas or narrow pathways that correspond to lakes (or portions thereof), rivers, and streams. Bears recognize human activity patterns and adjust their use of areas to time periods when humans are less likely to be present (Coleman et al. 2013, Loggers 2022). Thus, most bears likely have ample room within their home ranges to continue activities with a minimum of disturbance from native fish conservation activities. It is conceivable individual bears may occasionally be disturbed during years when restoration activities extend over several weeks and short-term disturbances are repeated over time. However, helicopter operations would be relatively short-term events whose effects in an area are relaxed almost immediately rather than sustained, long-term, or chronic events in the same area day after day affecting the same bear(s). As a result, occasional disturbances of grizzly bears during native fish restoration activities that cause them to run short distances likely have insignificant energetic costs with a lengthy summer and autumn period for recovery prior to denning. There is no evidence such flights have contributed to abandonment of dens, injuries of bears, or adverse demographic effects such as decrease productivity, or survival due to high energetic costs and no period for recovery (Støen et al. 2010).

Rotenone and potassium permanganate would affect waters being treated and downstream for a short distance. However, the chemical removal of fish would not directly affect wildlife in the project area because treatment concentrations of piscicides are below levels toxic to wildlife. Terrestrial organisms, such as mammals and birds, breathe air and primarily contact rotenone from drinking treated water, eating treated fish or other aquatic organisms, or standing in treated water. The ingestion of rotenone has a relatively minor effect on terrestrial animals because the enzymes and acids of their digestive systems break it down, thus limiting absorption through the lining of the intestinal tract. Laboratory studies found a 20-pound animal would have to drink more than 2,000 gallons of water treated with 50 parts per billion rotenone or eat 17,380 pounds of rotenone-treated fish to obtain a lethal dose (USDI, NPS 2010).

The chemical removal of fish, which would kill most fish present within the treatment area, could have short-term, adverse effects to grizzly bears that frequently feed on fish. These bears would need to find other food sources or move to other streams until native fish recolonize or are reintroduced to the treated waters. As mentioned previously, grizzly bears are generalists that employ an opportunistic, omnivorous foraging strategy by using a wide range of plant and animal food sources (Gunther et al. 2014). Thus, there should be minimal effects to bear nutrition and condition. Most dead fish should sink within the cold waters and decompose but some fish carcasses will wash up along the banks of lakes and streams.

These fish could take weeks to decay but would not be a health risk to bears because rotenone concentrations and toxicity in fish tissues would be extremely low (USDI, NPS 2010).

Human and stock travel will mostly occur along established trails bears may already be avoiding or on which they expect human use. Similarly, camps will occur at already established locations, when possible, and project personnel will comply with food storage orders and other regulations to prevent attracting and food-conditioning bears. As mentioned previously, bears learn human activity patterns along frequently used trails and in backcountry campsites and adjust their use of these areas to times when humans are less likely to be present (Coleman et al. 2013, Loggers 2022). Bears temporarily displaced from trails and project activities would have ample room within their home ranges to continue activities with a minimum of disturbance from native fish restoration activities.

Ongoing administrative activities, such as wildlife monitoring and management, administrative aircraft flights, road construction, and facilities maintenance, will continue. Wildlife monitoring practices are used to document various demographics of wildlife populations in the park and may cause adverse impacts ranging from generalized disturbance to sedation and handling of the animals. Noise from road construction and facilities maintenance could disturb grizzly bears in localized areas. Impacts from these disturbances could range from no impact to movement away from the immediate area. Park visitation is expected to increase each year due to population growth in nearby communities and elsewhere. As visitation increases, the likelihood of grizzly bear–human conflict also increases, which results in aversive conditioning and, in extreme cases, the killing of habituated individuals. Past and ongoing recreational use such as angling, camping, and hiking would continue across the Greater Yellowstone Ecosystem. Recreational activities including angling, hiking, and camping occur throughout the project area and could contribute to disturbances of grizzly bears which could affect feeding and resting behavior.

Environmental Consequences

Alternative 1 (No Action)

Under the No Action Alternative, the NPS would not authorize the use of park lands for staging and access by the USFS for implementation of their proposal to conserve native Yellowstone cutthroat trout in the Custer Gallatin National Forest. The park would continue to use the adaptive management framework provided by the 2010 Plan to employ rotenone treatments and other nonnative fish removal techniques on Buffalo Creek. As a result, impacts to grizzly bears would be the same or similar to what is described in the Affected Environment.

Cumulative Impacts

Cumulative impacts as a result of Alternative 1, when combined with past, present, and reasonably foreseeable actions and trends as described in Section 3.1 would not have any additional adverse impacts to grizzly bears beyond those described in the Affected Environment.

Alternative 2 (Preferred Alternative)

The impacts of upstream actions by the USFS and MTFWP were described in the USFS Plan titled *Buffalo Creek Yellowstone Cutthroat Trout Conservation Project* (MFWP and USFS 2022). Pursuant to 43 CFR 46.135, the NPS incorporates that document and the impacts described therein into this EA by reference.

The Preferred Alternative would have temporary adverse impacts to grizzly bears in the park due to disturbance or displacement caused by noise and increased human activity. Helicopter flight paths within the park would be less than about 4 miles in length to and from the boundary but the potential for disturbance would be highest during these operations. Helicopter use in the park can lead to a reduction in secure habitat due to the disturbance caused from landings in an area where such disturbance is abnormal.

The Slough Creek Transfer Station, where helicopter take-offs and landings will occur within the park, is not considered secure grizzly habitat; rather it is near a dirt road and campground where bears and other wildlife are used to human presence and activities. Furthermore, the flight paths within secure habitat will be above 500 meters.

Bears have substantial behavioral plasticity and tolerate many mechanized activities, as evidenced by several habituated roadside bears in the park. Brown bears did not change their overall movement patterns during 1 to 2 hours after direct helicopter approaches by researchers (Støen et al. 2010). Some bears were startled and ran a short distance before reducing their rate of movement and sometimes moving into cover to watch for danger, but bears did not change the size or overlap of their activity areas and remained within similar habitat types and terrain. These researchers concluded using helicopters infrequently for short-term activities does not influence activity areas or movements of bears (Støen et al. 2010).

Bear home ranges are large and native fish restoration activities are generally concentrated along relatively small areas or narrow pathways that correspond to lakes (or portions thereof), rivers, and streams. Bears can recognize human activity patterns, such as backcountry campsites, and adjust their use of areas to time periods when humans are less likely to be present (Coleman et al. 2013, Loggers 2022). Thus, most bears likely have ample room within their home ranges to continue activities with a minimum of disturbance for native fish conservation activities. It is conceivable individual bears may occasionally be displaced somewhat during years when restoration activities extend over several weeks and short-term disturbances are repeated over time. However, helicopter operations and camping would be relatively short-term events whose effects in an area are relaxed almost immediately rather than sustained, long-term, or chronic events in the same area day after day through the summer season affecting the same bear(s).

In summary, occasional disturbances of grizzly bears during native fish restoration activities in the park that cause them to run short distances likely have insignificant energetic costs with a lengthy summer and autumn period for recovery prior to denning. There is no evidence sporadic helicopter flights or short-term camping has contributed to abandonment of dens, injuries of bears, or adverse demographic effects, such as decreased productivity or survival, due to high energetic costs and no period for recovery.

Cumulative Impacts

The Preferred Alternative, when combined with past, present, and reasonably foreseeable future actions and trends as described in Section 3.1 would not result in any additional adverse impacts to grizzly bears.

3.5 Recommended Wilderness

Affected Environment

The Wilderness Act of 1964 defines wilderness as “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain ... an area of undeveloped Federal Land retaining its primeval character and influence ... which is protected and managed so as to preserve its natural conditions” (16 USC 1131, *et seq.*). Congress specifically included the NPS in the Wilderness Act and directed the NPS to evaluate all its land for suitability as wilderness. In 1972, Yellowstone completed a wilderness study and environmental impact statement (EIS) in accordance with the 1964 Wilderness Act, in which the NPS identified approximately 2 million acres, or around 90% of the park, for wilderness designation (Figure 7). The Secretary of the Interior transmitted Yellowstone’s recommendation to the President of the United States, who then recommended it to both houses of Congress for consideration as a designated wilderness area. Yellowstone submitted an additional wilderness recommendation to the Secretary of the Interior in 1978, which increased the size of

recommended wilderness by about 16,000 acres. However, Congress has yet to act on the park's wilderness recommendations.

In 1999, the NPS issued Director's Order 41 NPS to meet the 1964 Wilderness Act, directing that all lands evaluated and categorized as "designated," "recommended," "proposed," "suitable," or "study area" in the Wilderness Preservation System must be managed in such a way as to (1) not diminish their suitability as wilderness, and (2) apply the concepts of "minimum requirements" to all management decisions affecting those lands, regardless of the wilderness category. As a result, the NPS manages recommended wilderness in Yellowstone as if it were designated wilderness.

Section 2(c) of the 1964 Wilderness Act establishes the definition of wilderness. In part, Section 2(c) states that "A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Section 2 (c) goes on to further describe qualities, or "characteristics" of wilderness. "Wilderness Character" is a term that was developed by an interagency wilderness stewardship team to provide wilderness stewardship guidance to land management agencies in order to fulfill the Wilderness Act's legal mandate. *Keeping It Wild 2* (Keeping It Wild 2, 2015) defines wilderness character as "a holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments generally free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from other all lands."

To operationalize this definition and link the concept of wilderness character directly to the statutory and tangible stewardship requirements of the 1964 Wilderness Act, the interagency team (*Keeping It Wild 2*, 2015) identified and defined five tangible "qualities" of wilderness character:

- Untrammeled—wilderness ecological systems are unhindered and free from intentional actions of modern human control or manipulation
- Natural—wilderness ecological systems are substantially free from the effects of modern civilization
- Undeveloped—wilderness is essentially without structures or installations, the use of motors, or mechanical transport
- Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation—wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation
- Other Features of Value—wilderness may have unique ecological, geological, cultural, or other features of scientific, educational, scenic, or historical value



Figure 7: Yellowstone National Park Recommended Wilderness Map.

Recommended wilderness in Yellowstone National Park (light gray). The Flat Mountain, South, and Southeast “arms” of Yellowstone Lake, as well as Shoshone and Heart lakes to the west, are in recommended wilderness but are shaded blue.

Designated and recommended wilderness in the Greater Yellowstone Ecosystem is affected by continued warming and changes in precipitation and snowmelt. Average annual temperatures increased about 2.3°F from 1950 to 2018, with a longer snow-free season (Hostetler et al. 2021). In the northern portion of Yellowstone National Park these changes resulted in less snow at lower elevations, earlier snowmelt, and more frequent drought (Tercek et al. 2015, Thoma et al. 2015, Yellowstone Center for Resources 2018). The regional warming trend is predicted to continue, with an increase in mean annual temperatures of about another 2°F across all seasons, milder winters with fewer days below freezing, and more frequent drought (Hostetler et al. 2021). As mentioned previously, climate warming can degrade habitat for aquatic organisms by altering precipitation patterns, increasing water temperatures and the frequency of droughts

with lower water levels, and damaging breeding areas during flood events. Climate change in wilderness areas can also contribute to the introduction and proliferation of nonnative invasive species and increased and erratic fire behavior. Additionally, climate change has the potential to increase visitation to wilderness areas, as these areas serve as a refugia as other parts of the world experience the compounding impacts of a warming planet. As climate change continues to affect the human environment, it is likely that the public will seek out wilderness for recreational opportunities.

The following paragraphs describe the status of these recommended wilderness qualities in Yellowstone National Park.

Untrammeled

Untrammeled is defined as wilderness that is “essentially unhindered and free from the intentional actions of modern human control or manipulation,” referencing the Wilderness Act’s definition of wilderness as an area that “generally appears to have been affected primarily by the forces of nature” (Landres et al. 2015). Preserving the untrammeled quality hinges on restraint from the intentional manipulation of the biophysical environment. Recommended wilderness in Yellowstone, including the Buffalo Creek drainage and project area, is a largely untrammeled, unmanipulated landscape. Animals are generally given priority in recreation management decisions where wildlife and human activities are not compatible, and seasonal recreational use closures are implemented for some bird nesting areas, wolf denning areas, and high use bear areas (White 2016). Preserving the untrammeled quality of wilderness character largely hinges on the parks restraint in intentionally manipulating the biophysical environment. However, untrammeled character is degraded by some management to protect park resources and restore species and ecosystems (White et al. 2013). For example, the reintroduction of bison (*Bison bison*) and wolves (*Canis lupis*) were actions that intentionally manipulated the landscape, but over time these actions ultimately benefited the natural quality of wilderness character in the park by reintroducing endemic species to the landscape. Management actions that have or could occur in the Lamar River watershed include managing human-bear conflicts, controlling the spread of invasive weeds, fire suppression, research actions (such as captures for radio-collaring, grazing studies, and predator-prey investigations), and restoration actions for beavers (Smith and Tyers 2012, Tyers 2022), bison (White et al. 2015), Yellowstone cutthroat trout (Ertel et al. 2017), and wolves (Smith et al. 2020).

Undeveloped

More than 91% of Yellowstone National Park is managed as recommended wilderness and is largely void of human development and installations. However, the undeveloped quality of wilderness character in the park is degraded by the presence of backcountry cabins, roads, telecommunications infrastructure, scientific monitoring stations, fish barriers, and through the administrative use of motorized equipment and mechanical transport. A number of backcountry cabins are located throughout the park, although the recommended wilderness boundary excluded these developments for inclusion due to their nonconforming use. To the extent possible, the park implements the use of non-motorized, traditional hand tools and non-mechanical transport for administrative activities in recommended wilderness whenever possible, but motorized equipment (such as chainsaws, portable generators, explosives, etc.) must sometimes be used for the maintenance of historic cabins, trails, and campsites.

Scientific instruments including remote cameras, data loggers, tree markers, geological monitoring platforms, radio-collars, etc., are present in recommended wilderness throughout the park. Motorboats and helicopters are currently used on Yellowstone Lake and are sometimes present in portions of the lake within the park’s recommended wilderness for lake trout suppression. Helicopters may also be used in the park to fly materials and equipment to remote project areas, conduct aerial research, and for fire management activities.

The Slough Creek fish barrier is within recommended wilderness but near a two-track dirt road between the Slough Creek transfer station and the private Silver Tip Ranch within the Custer Gallatin National Forest. This two-track road was not recommended for wilderness designation because of historic use by snowmobiles and vehicles, though recent use is constrained to horse-pulled wagons.

Natural

Yellowstone National Park is at the core of the Greater Yellowstone Ecosystem, a vast landscape of 28,000 square miles home to a variety of wildlife, native plants, and geologic wonders. Surrounded by six national forests, private and reservation lands, and over 2 million acres of designated wilderness, the Greater Yellowstone Ecosystem is one of the last, largest, mostly intact temperate-zone ecosystems on earth. Wildlife in Yellowstone's recommended wilderness are untamed, free-roaming animals that live in an environment not dominated by humans and whose behaviors, movements, survival, and reproductive success are predominantly affected by their own daily decisions and natural selection (White et al. 2016). Yellowstone National Park was integral to early efforts to protect and restore bison, elk (*Cervus canadensis*), pronghorn (*Antilocapra americana*), and trumpeter swan (*Cygnus buccinator*) populations. More recent work has focused on restoring Arctic grayling, bald eagles, common loons (*Gavia immer*), Yellowstone cutthroat trout, golden eagles (*Aquila chrysaetos*), grizzly bears, peregrine falcons (*Falco peregrinus*), and wolves (White 2022). Today, the park supports intact native wildlife communities that inhabit a vast, heterogeneous landscape where they live with natural selection factors, such as competition, disease, predation, and a severe environment (White et al. 2013, White 2016).

The natural condition of the park's wilderness character is degraded by several influences, including nonnative species, which can put the long-term persistence of native species and ecological integrity at risk. Native Yellowstone cutthroat trout in the are at risk due to the detrimental effects caused by nonnative species, including lake trout, rainbow trout and hybridization. This includes the Buffalo Creek drainage, where nonnative rainbow trout are a direct threat to the native Yellowstone cutthroat trout.

Solitude or Primitive and Unconfined Recreation

Recommended wilderness in the Yellowstone National Park provides outstanding opportunities for engaging in primitive and unconfined recreation, including angling, hiking, and backcountry camping. Recommended wilderness also allows visitors to seek solitude in areas remote from the sights and sounds of human activities and demonstrate self-reliance on their skills. The Lamar River watershed offers excellent opportunities for solitude and primitive recreation, but these wilderness qualities can be degraded by overflights, maintenance projects, wildlife management activities, and increasing numbers of visitors. In addition, resource protection restrictions, such as requiring permits for overnight camping, and temporary trail or area closures, such as during fish restoration activities, interfere with unconfined recreation. Recreational facilities such as trails, bridges, and backcountry campgrounds are necessary to provide for visitor use and experience while protecting park resources, but these features also disturb unconfined recreation and diminish a sense of primitiveness and self-reliance (USDI, NPS 2019a). Restrictions on visitor use would affect unconfined recreation by restricting public access to areas in recommended wilderness near electrofishing during summer and autumn. Crews with personal gear and light equipment would hike in or be transported by stock. Visitors could see these activities and crews and equipment along streams in the recommended wilderness.

An important part of the NPS mission is to preserve the sounds of nature, which have biological and intrinsic value. Natural soundscapes predominate throughout most of the park and are characterized by quiet and stillness with low-decibel background sounds, such as wildlife calls and the sounds of wind, rain, water, and thermal features (fumaroles, geysers, mud pots). Natural soundscapes vary across the park depending on animal behaviors, elevation, proximity to thermal features and water, terrain, time of year, vegetation, weather, and other influences. Noise from human activities can mask biologically important sounds, degrade habitat, cause behavioral and physiological changes in wildlife, and interfere

with the experiences of visitors. The effects of these noises usually diminish with distance from the human-caused sources (USDI, NPS 2019).

Soundscape in the backcountry of the Lamar River watershed are characterized by natural sounds but interrupted at times by noise from angling or hiking parties, trail and cabin maintenance, overflights, and motorized traffic on the Northeast Entrance Road. Motorized equipment, such as chainsaws and generators, are occasionally used to maintain trails, campsites, telecommunications sites, and defensible space around historic structures. Helicopters are sometimes used to haul equipment, materials, and personnel to remote areas. In addition, they are used for emergency medical flights, wildland fire reconnaissance, search and rescue, and wildlife management, such as counts, classifications, and captures. During 2013 to 2017, helicopters flew an average of 400 hours each year in Yellowstone National Park for these activities. Airplanes also are used for wildlife management, such as counts and telemetry, fire detection, and search and rescue. During 2013 to 2017, fixed-wing planes flew an average of 430 hours each year in the park for these activities (YNP 2017). Planes and helicopters from outside the park also frequently fly over the drainage enroute to other destinations.

Other Features of Value

This wilderness character quality focuses on the ecological, geological, or other features of scientific, education, scenic, or historical value with wilderness. Yellowstone possesses numerous features of value, most notably the volcanic hotspot presently situated underneath the park. This volcanic hotspot has dramatically influenced the landscape in the region over the millennia, forming the Snake River Plain to the southwest, and more recently, mega eruptions in the Yellowstone area which have shaped the landscape we see today and continues to power the iconic geothermal features found throughout the park. This unique feature has been at the epicenter of volcanology research and other scientific studies for decades, providing invaluable research opportunities across multiple scientific fields. Other features of value, including intact megafauna habitat and prehistoric archaeological resources further define this wilderness quality in the park. However, none of these identified values would be impacted by this project and as a result, this wilderness quality is not further analyzed within this document.

Environmental Consequences

Alternative 1 (No Action)

Under the No Action Alternative, the NPS would not authorize the use of park lands for staging and access by the USFS for implementation of their proposal to conserve native Yellowstone cutthroat trout in the Custer Gallatin National Forest. The park would continue to use the adaptive management framework provided by the 2010 Plan to employ rotenone treatments and other nonnative fish removal techniques on Buffalo Creek. Under the No Action, adverse impacts to the natural condition of wilderness in the Lamar River watershed would increase over time due to the proliferation of nonnative rainbow trout and hybridization with native Yellowstone cutthroat trout from upstream sources in the Absaroka-Beartooth Wilderness. This could result in the eventual elimination of Yellowstone cutthroat trout from this drainage, which would be a major setback for the ecosystem and the park's mission.

Untrammeled

The No Action Alternative would have an adverse impact on the untrammeled quality of recommended wilderness because it would intentionally manipulate the biophysical environment of the Buffalo Creek drainage with the park by human-caused mortality of aquatic species in the Buffalo Creek drainage through the application of rotenone. These activities would be conducted along Buffalo Creek in the park during approximately two weeks in 3 consecutive summers within recommended wilderness. Visitors could see these activities and crews and equipment along streams in recommended wilderness.

Undeveloped

The No Action Alternative would adversely impact the undeveloped quality of recommended wilderness through the use of motorized equipment and installations in the Buffalo Creek drainage. Temporary installations, such as rotenone applicators, fish barriers, and neutralization stations would impact the undeveloped quality of the landscape during an approximate two weeks in 3 consecutive summers. The use of remote incubators for native fish embryos may impact the undeveloped quality of the landscape for several weeks for up to 5 years following removal of rainbow and hybrid trout. These impacts would cease in each stream reach once rotenone was detoxified and equipment removed from the area and cutthroat trout have been established (MFWP and USFS 2022).

Natural

The No Action Alternative would have adverse impacts on the natural quality of wilderness character by removing nonnative rainbow and hybrid trout from the drainage. Rotenone applications would lethally remove all fish and most other gill-breathing organisms from treated areas along Buffalo Creek. However, these effects would occur on less than 14 miles of stream, which equates to less than 0.5% of the 2,650 miles of flowing waters in the park. These effects would be temporary and last until the treatments were completed and amphibian, macroinvertebrate, and native fish were restored, which likely would take 1 to 3 years. Thereafter, the area would return to being primarily affected by the forces of nature (USDI, NPS 2019a).

Without the ability to remove rainbow and hybridized trout throughout the entire drainage, to include portions of Buffalo Creek within the Custer Gallatin National Forest, the source of rainbow trout will remain upstream and will continue to threaten Yellowstone cutthroat trout in the park.

Solitude and Primitive, Unconfined Recreation

The No Action Alternative would adversely impact opportunities for solitude or primitive and unconfined recreation in recommended wilderness. During project implementation, public access would be restricted near electrofishing, helicopter, and piscicide operations during late summer and early autumn for approximately two weeks in 3 consecutive summers. Solitude would be affected by noises from backcountry camps, generators, helicopters, lights, watercraft, and water pumps. Since the treatment area would be closed to the public, however, most project noise would be distant from recreationists (MFWP and USFS 2022). Most of the park's 2 million acres of recommended wilderness would be unaffected because these effects would occur on less than 14 miles of stream, which equates to less than 0.5% of the 2,650 miles of flowing waters in the park.

Cumulative Impacts

Under the no-action alternative, current management would continue in accordance with the NPS 2010 Native Fish Conservation Plan and EA, and since there would be no direct or indirect impacts to the untrammeled and undeveloped qualities and to opportunities for solitude and unconfined recreation, there would be no cumulative impacts to these qualities of wilderness character, and future conditions would be as described in the Affected Environment section. For the natural condition of recommended wilderness, when the impacts of the no-action alternative are combined with those of past, present, and reasonably foreseeable actions, the cumulative impacts would primarily be adverse since the no-action alternative would not offset ongoing impacts throughout the watershed.

Alternative 2 (Preferred Alternative)

Under the Preferred Alternative, the NPS incorporates by reference the USFS & MTFWP *Buffalo Creek Yellowstone Cutthroat Trout Conservation Project*. Recommended wilderness could have short-term and temporary adverse impacts to Yellowstone National Park recommended wilderness areas as a result of increased helicopter flights and other actions needed in support of USFS actions.

Untrammeled

The Preferred Alternative would have an indirect, adverse impact on the untrammeled quality of recommended wilderness because it would intentionally manipulate the biophysical environment of the Buffalo Creek drainage upstream of the park by removing aquatic species in the Buffalo Creek drainage through the application of rotenone in waters administered by the USFS. As rotenone travels downstream and into the park, aquatic specie mortality could be experienced, but the effects of rotenone applied in the national forest would diminish as it travels further away from the application source. These activities would be conducted along various stream reaches and in lakes during approximately two weeks in 3 consecutive summers upstream of recommended wilderness. Visitors could see these activities and crews and equipment along streams in recommended wilderness.

Natural

The Preferred Alternative would have an indirect, adverse impact on the natural quality of wilderness character by removing nonnative rainbow and hybrid trout from the drainage through the lethal removal of all fish and most other gill-breathing organisms from treated areas along Buffalo Creek. However, these effects would primarily occur outside of the park, and have indirect effects on less than 14 miles of stream, which equates to less than 0.5% of the 2,650 miles of flowing waters in the park. These effects would be temporary and last until the treatments were completed and amphibian, macroinvertebrate, and native fish were restored, which likely would take 1 to 3 years. Thereafter, the area would return to being primarily affected by the forces of nature (USDI, NPS 2019a).

Over time, The Preferred Alternative would directly benefit the natural quality of wilderness character by contributing to the operational success of Yellowstone's mission to protect and preserve indigenous and ecological processes across the Buffalo Creek drainage. Following the removal of fish, treated waters would be temporarily fishless until recolonized or restocked. Once restored, Yellowstone cutthroat trout would benefit the natural quality of recommended wilderness by restoring native community dynamics and providing increased opportunities for angling, viewing, and enjoyment of native aquatic wildlife. These benefits would be permanent and extend across the region because protecting the Lamar River watershed is one of the highest conservation priorities for Yellowstone cutthroat trout in Montana and Yellowstone National Park (MFWP 2000, 2007; USDI, NPS 2010).

Solitude and Primitive, Unconfined Recreation

The Preferred Alternative would adversely impact opportunities for solitude or primitive and unconfined recreation in recommended wilderness. During project implementation, public access would be restricted near electrofishing, helicopter, and piscicide operations during late summer and early autumn for approximately two weeks in 3 consecutive summers. Solitude would be affected by noises from backcountry camps, generators, helicopters, lights, watercraft, and water pumps. Since the treatment area would be closed to the public, however, most project noise would be distant from recreationists (MFWP and USFS 2022). Most of the park's 2 million acres of recommended wilderness would be unaffected because these effects would occur on less than 14 miles of stream, which equates to less than 0.5% of the 2,650 miles of flowing waters in the park.

Cumulative Impacts

As described above, the preferred alternative would intermittently and temporarily degrade the untrammeled quality, natural soundscapes, opportunities for solitude and unconfined recreation, and undeveloped qualities of the park's recommended wilderness for approximately 5 years. Additionally, the preferred alternative would contribute to sustained beneficial effects on the natural quality of the park's recommended wilderness by eliminating non-native species and restoring native species and aquatic ecosystems.

The past, present, and reasonably foreseeable actions described in Section 3.1 and the affected environment also have the potential to both negatively and beneficially impact recommended wilderness in the park. Because some of these actions involve the intentional control or manipulation of the biophysical environment (such as USFS, MTFWP, or other NPS fisheries management actions, wildlife management, and wildland fire management), they could degrade the untrammeled quality of wilderness character, including areas in the Buffalo Creek drainage upstream of the park. The use of mechanized equipment during these and other project activities (including maintenance and construction projects) also temporarily degrades opportunities for solitude and natural soundscapes and may result in temporary closures that affect opportunities for primitive and unconfined recreation. However, many of these cumulative actions also have beneficial impacts on the natural quality of wilderness through sustained improvement of natural resources.

As a result, when the effects of the preferred alternative are combined with the impacts of other past, present, and reasonably foreseeable future actions, there would be an overall cumulative adverse effect on untrammeled and undeveloped wilderness character, as well as opportunities for solitude and primitive and unconfined recreation. However, the preferred alternative would not notably change the type and degree of cumulative adverse impacts already occurring because it would temporarily contribute slight and intermittent effects over approximately two weeks per summer for 3 consecutive years, and then two times per year for up to 5 years; the types and levels of noise and motorized use would be similar to what occurs in the park's recommended wilderness, and effects would be limited to .6% of the total recommended wilderness in the park.

Regarding natural quality, the preferred alternative would contribute a greater degree of cumulative beneficial impact once the project is complete because it would improve the natural resources by removing non-native species, directly protecting and preserving native Yellowstone Cutthroat trout and restoring the natural aquatic community in the Lamar River Watershed.

4. CONSULTATION, AND COORDINATION

Agencies and organizations consulted in development of this document are listed below:

- **Montana State Historic Preservation Office**
- **Wyoming State Historic Preservation Office**
- **United States Fish and Wildlife Service**

Based on grizzly bear secure habitat being within the project area and the likelihood of grizzly bears being present during operations, the USFS and NPS has jointly proposed a determination of “may affect, likely to adversely affect” under Section 7 of the Endangered Species Act (ESA). A Biological Opinion has been prepared by USFWS which concurs with USFS and NPS’s determination. Consultation with the USFWS will be finalized prior to signing of the decision document.
- **Tribes Associated with Yellowstone National Park**

Assiniboine & Sioux Tribes, Fort Peck
Blackfeet Tribe
Cheyenne River Sioux Tribe
Coeur d’Alene Tribe
Comanche Tribe of Oklahoma
Confederated Salish and Kootenai Tribes
Confederated Tribes of the Colville Indian Reservation
Confederated Tribes of the Umatilla Indian Reservation
Crow Creek Sioux Tribe
Crow Tribe
Eastern Shoshone Tribe
Flandreau Santee Sioux Tribe
Gros Ventre and Assiniboine Tribes
Kiowa Tribe of Oklahoma
Little Shell Tribe of Chippewa Indians
Lower Brule Sioux Tribe
Nez Perce Tribe
Northern Arapaho Tribe
Northern Cheyenne Tribe
Oglala Sioux Tribe
Rosebud Sioux Tribe
Shoshone Bannock Tribes
Sisseton-Wahpeton Sioux Tribe
Spirit lake Sioux Tribe
Standing Rock Sioux Tribe
Turtle Mountain Band of Chippewa Indians
Yankton Sioux Tribe

APPENDIX A: ROTENONE APPLICATION AND NEUTRALIZATION

Pre-Treatment

Rotenone breaks down and loses its toxicity quickly in flowing water due to sunlight (photolysis), water (hydrolysis), binding with instream organic material, and physical disturbance. Thus, there is a decrease in the concentration of rotenone in the water with increasing distance from each treatment (drip) station and it is necessary to place additional drip stations at intervals along the stream to maintain concentrations lethal to target fish. The number and locations of drip stations are determined immediately prior to treatment based on the speed of the flowing water (travel time), water temperatures, sunlight intensity, and vertical elevation loss which can affect rotenone dilution and loss due to oxidation (Figure A1). The degradation time for rotenone in lakes ranges from one day in warm water to several weeks in cold water (USDI, NPS 2010).



Figure A1: Rotenone Treatment Dye.

An inert florescent dye is often used to determine stream flow rates prior to rotenone treatment. Dye also is applied with rotenone during each treatment to track the movement of the chemical through the water.

In addition, biologists conduct bioassays with sentinel fish to determine the effective downstream fish toxicity of a simulated treatment. By placing fish in net cages at intervals downstream of a treatment (drip) station and treating the reach of stream at the planned piscicide concentration and duration, the effective removal distance per treatment station can be estimated (Figure A2). To estimate the amount of rotenone that would be needed for actual treatments, these bioassays are performed in advance and scheduled to coincide with similar water conditions (USDI, NPS 2010).

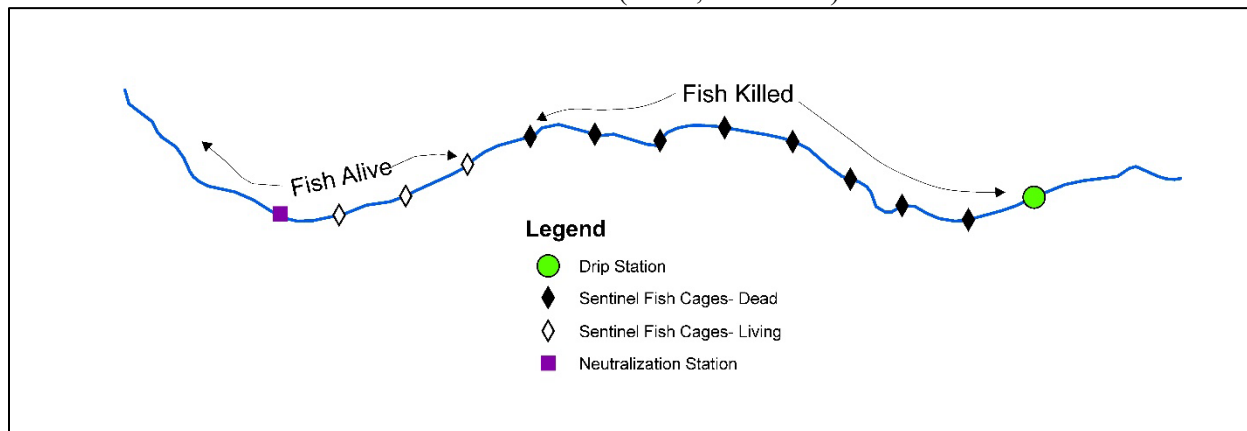


Figure A2: Generic Bioassay Setup.

Generic bioassay setup showing sentinel fish cages placed at 100-yard intervals and rotenone applied from the drip station at the planned treatment concentration and duration. The distance downstream that sentinel fish die is the effective treatment distance per drip station.

Rotenone Application

The application of rotenone to streams is usually conducted using a series of metered dispensing stations placed at specified intervals along the stream's course. These 'drip stations' often consist of a 5-gallon container filled with a rotenone (e.g., CFT-Legumine or equivalent) water mixture metered out at a constant rate to maintain the required concentration of rotenone in the stream (Figure A3). Backpack sprayers with hand-held wands can be used to apply highly diluted liquid piscicide in backwater areas along streams and along the shorelines of lakes where mixing may be incomplete due to minimal water movement. This helps ensure there are no untreated refuges and minimizes the risk of incomplete eradication of fish. A powdered rotenone, sand, and gelatin matrix is often used to treat small springs. Application of rotenone to lakes is most often accomplished using motorboats, from which the piscicide is applied as a diluted liquid formulation or a powdered piscicide is mixed with water to form a slurry and pumped into the lake. Rotenone is applied following label guidance from the Environmental Protection at a concentration of at least 1 part per million rotenone formulation (50 parts per billion active rotenone; USDI, NPS 2010).



Figure A3: Rotenone Treatment Station.

A rotenone treatment station (drip station; background downstream) with a small net holding sentinel fish placed upstream (photo foreground).

Rotenone Neutralization

Rotenone can be neutralized with potassium permanganate. This is accomplished through metered dispensation stations that apply either a concentrated liquid or pure crystals directly to piscicide-treated waters to ensure complete oxidation of the rotenone (Figure A4). The potassium permanganate application rate is determined each day using ambient streamflow data and the concentration of rotenone being applied. The potassium permanganate addition to treated water is metered to meet the recommended guidelines and allow precise adjustment as necessary. Thirty minutes of contact time is required to completely detoxify piscicides, meaning the area affected by piscicide treatment includes the distance downstream of the potassium permanganate station that can be traveled by treated water over a period of 30 minutes. Monitoring the efficacy of piscicide neutralization using potassium permanganate is

done in two ways: 1) placing sentinel fish at 30 and 60 minutes of travel time downstream from the neutralization station and monitoring them for signs of rotenone stress; and 2) measuring the potassium permanganate in the water with a pocket colorimeter (USDI, NPS 2010).



Figure A4: Rotenone Neutralization Station.

Rotenone neutralization station consisting of a steel hopper with an auger driven by an electric motor powered by a small portable gas generator. The auger meters crystalized potassium permanganate into the stream at a concentration that ensures complete oxidation (neutralization) of rotenone at the downstream end of the treatment area.

Post-Treatment

Multiple rotenone treatments are usually necessary to ensure complete removal of nonnative fish; treatments are conducted until fish are no longer detected in project waters. These repeated treatments may occur in the same year and/or across multiple years. However, most rotenone treatments last only a few hours to a few days each year; thus, the risk of chronic exposure is essentially non-existent (USDI, NPS 2010). In a few previous rotenone treatments, upwelling of fresh water within streams allowed some nonnative fish to avoid the rotenone-treated water. Drip stations were then placed at greater frequency through those reaches to complete the nonnative fish removals.

APPENDIX B: IMPACT TOPICS DISMISSED FROM FURTHER ANALYSIS

The following impact topics were dismissed from further analysis because they are not of critical importance to this proposal, do not exist in the project area, would not be affected by the proposal, or through the application of mitigation measures there would be no measurable effects from the proposal.

Air Quality and Greenhouse Gas Emissions: The park is designated as a Class I air quality area under the Clean Air Act, with the highest level of protection that allows only a small amount of additional air pollution. Air pollutants (i.e., ozone, nitrogen, sulfur, and mercury) directly impact the park by reducing visibility, contaminating vegetation, soils, and surface waters, as well as disrupting lifecycle and behavior patterns of certain wildlife species. Greenhouse gas (GHG) emissions would occur during the proposed action, primarily from helicopter flights, which require the burning of fossil fuels. Other actions associated with this project are regularly occurring, such as personnel and equipment transportation, and generator use, and would not contribute to a measurable increase in GHG levels above what is already occurring within the park. The EPA's GHG Equivalencies Calculator was used to estimate the project's GHG emissions from helicopter use based on fuel consumption. In total, the project is estimated to emit approximately 29 metric tons of carbon dioxide equivalent. Each flight will emit about 0.4 metric tons of carbon dioxide equivalent. The project is not removing carbon sinks (i.e., forests holding carbon dioxide) or contributing long-term to GHG emissions. Given existing and ongoing GHG emissions in the park from high levels of vehicle traffic and other activities, the temporary use of jet fuel-powered equipment for this project is not expected to notably affect GHG emissions in the park. The project would not undermine or cancel the benefits of ongoing efforts to reduce GHG emissions parkwide. For these reasons, air quality and greenhouse gas emission impacts have been dismissed from further analysis.

| Vehicle | Number | Fuel Usage | Total Gallons of Fuel | CO ₂ Equivalent (metric tons) |
|--------------------------|------------|-----------------|-----------------------|--|
| NPS Helicopter Flights* | 32 Flights | 45 gallons/hour | 1,440 | 12.8 |
| USFS Helicopter Flights* | 40 Flights | 45 gallons/hour | 1,800 | 16 |
| Total Fuel | | | 3,220 gallons | 28.8 |

**Type of helicopter will vary. Airbus Helicopters AS350 A-Star or equivalent (45 gallons/hour). Assume 1 flight = 1 hour.*

Archeological Resources: The 1998 Cultural Resource Management Guidelines for the NPS define archeological resources as the remains of past human activity and records documenting the scientific analysis of these remains. Neither Alternative involves ground disturbance activities that could potentially impact archeological resources. Therefore, this topic has been dismissed from further analysis. Mitigation measures are included to ensure any inadvertent discoveries of previously unknown resources are protected.

Cultural Landscapes: There are no cultural landscapes in the proposed project area and has therefore been dismissed from further analysis.

Environmental Justice: Executive Order 12898, General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to identify and address disproportionately high and adverse health or environmental effects of their programs and policies on minorities and low-income communities. Federal agencies must also follow rules set under the Environmental Justice Guidance released by the Environmental Protection Agency in 1998. None of the

alternatives proposed in this document would have negative health or environmental effects on minority or low-income communities. Therefore, this topic has been dismissed from further analysis.

Floodplains: The Alternatives in this EA do not involve construction of facilities in or adjacent to floodplains. The width of floodplains in the project area would not change. The project would not change the course of river channels, force them to re-occupy former channel segments, or inundate the channel's floodplain. The project would not cause debris loading in any river channel or floodplain or create new aboveground encroachments into floodplains. As a result, these impacts would not constitute critical actions as defined in the NPS floodplain management guides. Floodplains have, therefore, been dismissed from further analysis, and a Statement of Findings (SOF) for floodplains is not required.

Geology and Geothermal Resources: The proposed native fish conservation actions involve minimal ground disturbance and are outside of known thermal areas. Therefore, this proposal would not affect geology or geothermal resources of Yellowstone National Park and has been dismissed from further analysis.

Historic Structures: There are no historic properties within the proposed project area. Therefore, this topic has been dismissed from further analysis.

Human Health and Safety: Rotenone is registered with the EPA and approved for use as a fish toxicant (Finlayson et al. 2010). No human fatalities have been associated with rotenone used for fishery management projects (Gleason et al. 1969; CDFG 1994; Ling 2003), nor could any evidence be found of human fatalities related to antimycin. In general, research indicates that a lethal dose of rotenone ranges between 300 – 500 mg/kg for adult humans. Assuming a lethal dose of 25 mg/kg of concentrated rotenone for humans (Wood et al. 2005), a person would have to consume 500 times their body weight in treated water (50 ppb = .05 mg/kg) to achieve a lethal dose. Finlayson et al. (2001) reported that the EPA “has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment.” While the label requirements for rotenone state that public entry into the treatment area could occur immediately after application, the treatment area would be temporarily closed to visitors, warning signs would be posted, and news releases would be issued ahead of time to minimize the chance of public exposure. Only trained personnel would apply rotenone. Any risk to human safety during application would be avoided through training, personal protective equipment, and adherence to state and federal application requirements. Application requirements would also be followed when handling potassium permanganate, which can be an irritant to eyes, skin, respiratory system, and the gastrointestinal tract when handled improperly. Prior to use of any chemicals, emergencies procedures would be developed, provided to personnel, and kept on site during implementation.

Indian Trust Resources and Sacred Sites: Trust resources are those natural resources reserved by or for Indian tribes through treaties, statutes, judicial decisions, and executive orders, which are protected by fiduciary obligation on the part of the United States. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. No trust resources would be affected by this proposal, and access to the park for tribes would not be affected. Sacred sites are those places having established religious meaning and as locales of private ceremonial activities. Through previous consultation efforts with tribes, the park has not been made aware of any Indian sacred sites in the project area. Therefore, this issue is dismissed from further analysis.

Paleontological Resources: The range of alternatives proposed in this assessment would not disturb any known paleontological resources and would involve minimal ground disturbance. Thus, impacts to paleontological have been dismissed from further analysis.

Soils and Vegetation: Some disturbance of soils and vegetation from trampling is expected, primarily from accessing treatment sites along creekbanks. Mitigation measures are in place to minimize the impacts to soils and vegetation communities. Otherwise, there would be no ground disturbance or other activities that would cause noticeable or measurable impacts to soils and vegetation, and the topic has, therefore, been dismissed from detailed analysis.

Threatened and Endangered Species: Federally listed or proposed species and critical habitat identified by the USFWS that are known to occur or may occur in the park include Canada lynx (*lynx canadensis*) and Canada lynx critical habitat, grizzly bear (*Ursus arctos horribilis*), North American wolverine (*Gulo gulo*), whitebark pine (*Pinus albicaulis*), western glacier stonefly (*Zapata glacier*), and monarch butterfly (*Danaus plexippus*). Grizzly bear has been carried forward for analysis in Chapter 3 of this document due to the determination of “may affect, likely to adversely affect.” Appendix C lists the project effects determinations for federally listed and proposed terrestrial wildlife species that may occur within the project area. The NPS will provide consultation documentation as an appendix in the ensuing decision document. There are expected to be no effects to Canada lynx Critical Habitat, whitebark pine, western glacier stonefly, and monarch butterfly, and therefore, those species have been dismissed from further analysis.

Canada lynx and Critical Habitat - The USFWS designated lynx in the continental United States as threatened under the Endangered Species Act in 2000 due to inadequate protections for lynx and their habitats. They also designated critical habitat for lynx in 2009, including portions of YNP and surrounding lands in southwestern Montana and northwestern Wyoming (USDI, FWS 2009a,b). A recent review by lynx experts in Bell et al. (2016) acknowledges that lynx may be present in the Greater Yellowstone Ecosystem; however, they are likely spatially limited because of the patchy distribution of high-quality habitat and the generally low or marginal snowshoe hare densities in much of the unit. The Montana Natural Heritage Program has no observations of Canada lynx in or near the project watershed over the last 20 years; and there is no compelling evidence that the area historically or recently supported a resident, breeding lynx population (USDI, USFWS 2017). Lynx presence in the proposed project area is likely ephemeral or intermittent and related to occasional dispersing or transient lynx. If present, lynx would stick to Engelmann spruce-subalpine fir communities and remain in or close to dense forest cover and avoid forest openings and meadows.

Monarch Butterfly - The monarch butterfly is proposed for listing as a threatened species under the Endangered Species Act due to threats such as the loss and degradation of habitat, widespread use of herbicides and insecticides, logging at overwintering sites in Mexico, incompatible management of overwintering sites in California, urban development, drought, and effects of climate warming (USDI, FWS 2020b). The migratory western population in North America has been decreasing over the last 20 years due, in part, to decreases in the availability of milkweed and nectar resources. Smaller populations are more vulnerable to catastrophic events, such as extreme storms at the overwintering sites, and the number of days and the area in which monarch butterflies will be exposed to unsuitably high temperatures will increase markedly with climate warming (USDI, FWS 2020b). Monarchs need milkweed for breeding and obtain nectar from a variety of flowering plants during migration and breeding. Protection and restoration of habitat is a primary component of monarch conservation (USDI, FWS 2020b). However, there would be no impact to nectar feeding plants or host plant species as a result of this project and therefore this topic has been dismissed from further analysis.

Western glacier stonefly - The western glacier stonefly is listed as threatened due to diminishing stream flows, increasing water temperatures, and the loss of glaciers in response to climate warming (USDI, FWS 2019). The upper-most extent of high-elevation streams originating from glacial meltwater and

inhabited by the western glacier stonefly are typically fishless and would not be affected by the proposed native fish restoration projects occurring downstream. Therefore, this topic has been dismissed from further analysis.

Whitebark Pine - On January 17, 2023, the USFWS published a final rule (85 FR 77408) to list the whitebark pine as a threatened species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act). Designation of critical habitat (CH) was deemed imprudent for the whitebark pine; hence CH was not proposed. Whitebark pine exist both as an overstory and understory component within the forest communities in many regions of the park, including forest areas within the project area. No removal or damage to individuals or component parts of mature trees, seedlings, or saplings of Whitebark or other five needled pine would occur as a result of the proposed action. Therefore, the proposed action is anticipated to have no effect on whitebark pine.

Wolverine - The FWS proposed to list the wolverine as a threatened species under the Endangered Species Act in February 2013, while finding that critical habitat was not determinable at that time (USDI, FWS 2013). This wide-ranging mustelid (weasel family) naturally exists at low densities and the southern portion of its' range extends into portions of Idaho, Montana, and Wyoming. Wolverines are adapted to cold temperatures and life in environments with snow on the ground for much of the year. They are opportunistic feeders that primarily scavenge on carrion and are sensitive to human disturbance from February to May when young are born and cannot travel far (Hornocker and Hash 1981, Magoun and Copeland 1998). Current threats include climate warming, human disturbance from recreational activities, and development and transportation corridors. Wolverines are rare and sparsely distributed in YNP and adjacent national forest areas (Beauvais and Johnson 2004, Inman et al. 2007). Radio-marked wolverines selected mountainous habitats above 8,000 feet with persistent snow cover and adequate ungulates during winter to provide carrion for food (Murphy et al. 2011). In YNP, reproductive rates were low and survival rates were like estimates for other populations in the conterminous United States. Dispersal from other areas in the region may be necessary to maintain wolverines in YNP, given the low recruitment of offspring born to resident females (Murphy et al. 2011).

Noise associated with human presence, project implementation, and disturbance could displace individuals from habitat temporarily if they occur in the area. These effects would be temporary in nature. Disturbance would occur during a short period annually (up to no more than 19 days) over 10 years for treatment and restocking. Helicopter operations would occur for only 6 of those 10 years. Any potential disturbance associated with helicopter landings would be short term and temporary. Once helicopter activity is completed all activity would be free of motorized disturbance. Given the scale at which wolverines use the landscape and the availability of habitat, it is expected that wolverines would be able to adapt by shifting their use to adjacent areas and return following project completion. Use of the existing trail system and other human activity in excess of background levels may result in disturbance to wolverines that may be in the vicinity. All activity would occur outside of the critical winter denning season. These activities were determined to not be a threat to the species (USDI, USFWS 2013 and 2018)

While wolverine dispersal could be affected to some degree, these habitats are not suitable for the establishment of home ranges and reproduction and are generally not for used for foraging (USDI 2013). Any disruption of dispersal or other exploratory movements would be temporary and would occur at a small scale when compared to the large home range size of wolverines. Wolverines have been documented to persist and reproduce in areas with high levels of human use and disturbance including developed alpine ski areas and areas with motorized use of snowmobiles (Heinemeyer et al. 2012; USDI, USFWS 2013, and Heinemeyer et al. 2019). This suggests that wolverines are able to adjust their use within their home ranges to avoid disturbance (Heinemeyer et al. 2012).

Visitor Use and Experience: The proposed native fish conservation actions along streams within Yellowstone National Park would only affect about 14 miles of stream, which equates to less than 0.5% of the 2,650 miles of flowing waters in the park, and last for about two weeks during summer for 3 years. These effects of rotenone treatment would be temporary and last until amphibian, macroinvertebrate, and native fish were restored, which likely would take 1 to 3 years. Thus, there should be minimal impacts on visitor experience.

Water Quality: Both piscicide and potassium permanganate applications would reduce water clarity and contribute new chemical components to stream systems during the application period and for several hours following application. However, these effects would occur on less than 14 miles of stream, which equates to less than 0.5% of the 2,650 miles of flowing waters in the park. These effects would be temporary and last until the treatments were completed and amphibian, macroinvertebrate, and native fish were restored, which likely would take 1 to 3 years. Human consumption of water would be restricted during and immediately after treatment in accordance with Environmental Protection Agency label guidelines. In addition, repair activities at the Slough Creek barrier site, including maintenance and monitoring, would lead to small increases in turbidity downstream for a period of up to two weeks. However, the long-term effects of these actions would be negligible as described in the Alternatives section of this document. Therefore, this topic has been dismissed from further analysis.

Wetlands: The use of rotenone would not affect wetland vegetation, since rotenone is not known to be toxic to plants at the concentration that would be used (Finlayson et al. 2010). Similarly, potassium permanganate would not negatively impact wetland vegetation at the levels proposed. Chemical and mechanical removal of fish could lead to impacts to wetland resources. Both chemical and mechanical removal of fish requires use of gear such as nets or electrofishing equipment. During deployment, wetland resources would be trampled as NPS crews working in targeted areas. Chemical treatments would adversely impact fauna (aquatic invertebrates, larval amphibians) in wetland areas by killing localized populations. While these populations will return within 1 to 2 years, this adverse impact to wetland ecological function would be self-compensating because the restoration of native fish will in turn benefit wetland resources. Mechanical treatments would either temporarily displace wetland associated fauna or would shock or kill some individuals leading to temporary adverse impacts to wetland and water resources. Although it is the case that these activities would have adverse impacts, these activities would directly lead to long-term benefits of wetland resources from the restoration of native fish species. Following non-native and hybridized trout removal, pack stock and helicopters would be used to bring genetically pure native fish to the project waters. These activities also involve walking within stream channels and riparian areas which would cause minor trampling of vegetation. This trampling could be minimized by avoiding the creation of social trails through vegetation. Because trampling could be minimized and will take place for short periods of time, it is expected these activities would have minimal impacts on wetland vegetation.

Impacts to wetlands have been dismissed from detailed analysis because impacts from trampling would be minimal and would occur later in the season when wetland vegetation is entering dormancy, when it is less susceptible to the impacts of trampling. It is expected that wetland vegetation would recover without the need for restoration. Furthermore, the use of rotenone and potassium permanganate are not known to be toxic to wetland plant species. As a result, the potential impacts to wetlands are not expected to have adverse impacts on wetlands, and a SOF for wetlands is not required.

Wild and Scenic Rivers: Buffalo Creek is a tributary of Slough Creek, and the 18-mile segment of Slough Creek within the park is eligible for designation as a wild and scenic river under the Wild and Scenic Rivers Act. The “values for which a river was designated” are defined in Section 1(b) of the Wild and Scenic Rivers Act as the river’s free-flowing condition, water quality, and outstandingly remarkable values (ORVs). Slough Creek is eligible for the outstandingly remarkable values of Scenic, Recreational,

Fish, and Wildlife. Rotenone treatments applied within waters of the Buffalo Creek drainage could have some temporary impacts on Slough Creek as the applications drift downstream. However, given the neutralization time of rotenone (approximately 2 weeks), the use of rotenone would not have any measurable impact on Slough Creek's flow, water quality, or outstandingly remarkable values. Furthermore, the removal of the main source of hybridization and nonnative fish from the drainage would improve the recreational and fishing values by protecting the native Yellowstone cutthroat trout population and providing opportunities for anglers to experience native fish. Therefore, this topic has been dismissed from further analysis.

Wildlife: The park is home to roughly 2.2 million acres of habitat and a wide variety of wildlife, including many large mammals such as bison, elk, moose (*Alces alces*), pronghorn, grizzly and black bears (*Ursus americanus*), big horn sheep (*Ovis canadensis*), deer, mountain lions (*Puma concolor*), coyotes (*Canis latrans*), and wolves. A variety of other small animals and birds, including migratory bird species, are also present. Individual animals may be temporarily displaced from the immediate area during native fish conservation operations. Displacement of individual animals would occur in the immediate vicinity of active work sites for 1 – 3 weeks per year, thus impacts to animals in a given location would only last from several hours to a couple of days depending on conditions.

Chemical and mechanical methods to remove non-native fish would affect wildlife within the project watershed. Applied chemicals would affect waters being treated and downstream portions of the treatment area; mechanical removal would only affect waters in the immediate work area. Chemical removal of fish would not directly affect wildlife in a project area because treatment concentrations of piscicides are below levels toxic to wildlife except for aquatic macroinvertebrates, fish, and larval amphibians (2010 Plan, Appendix B). However, short-term impacts may occur when localized fish populations are removed and aquatic invertebrate or larval amphibian communities are reduced because the food source for some species would be reduced. Wildlife that depends on fish and aquatic invertebrate communities may be displaced until the stream has recovered. Chemical removal of fish, which would kill all fish present within the treatment area, is used when complete eradication is necessary to restore native fish populations. Mechanical removal is used to selectively remove undesirable fish species. Both methods would have some adverse effects on wildlife because the food source for some species would be reduced. However, overall impacts from fish removal activities would be minimal, given the abundance of food sources in other areas of the park unaffected by this project. Wildlife resources would benefit though when populations of native fishes are returned to park waters and when invertebrate and amphibian species repopulate treated streams.

Birds, including migratory bird species and water birds, could be temporarily disturbed and displaced from the project area during project activities due to noise and increased human presence, but those disruptions are expected to be limited to a few weeks per year. The use of rotenone would reduce, but not completely eliminate, potential food sources such as macroinvertebrates along the project area. However, avian food sources affected by rotenone treatments in the Buffalo Creek drainage would be readily available in nearby streams and lakes. Neither Alternative would have a lasting or biologically meaningful impact to bird species, no effects to bird populations, and no changes to species abundance, distribution, or composition. Furthermore, there would be no direct impacts from rotenone or potassium permanganate, since treatments concentrations would be below levels that are toxic to birds.

For the reasons discussed above, the proposed action would not have long term or adverse impacts to wildlife. Therefore, this impact topic has been dismissed from further analysis.

APPENDIX C: FEDERALLY LISTED SPECIES DISMISSED FROM FURTHER ANALYSIS

| Common Name | Status | Habitat/Range | Effects Determination |
|--|------------------------|---|--|
| Canada lynx <i>Lynx canadensis</i> | Threatened | Mesic mid- to high-elevation forests. Dense understory cover with large coarse woody debris for denning. | May affect, not likely to adversely affect – Habitat occurs in project area and in LAU and lynx may be present. |
| Canada lynx Critical Habitat | Designated | | No effect – The project does occur within Designated Canada lynx Critical Habitat. However, no actions would result in the removal or modification of critical habitat Primary Constituent Elements (PCEs). |
| Grizzly Bear <i>Ursus arctos horribilis</i> | Threatened | Coniferous and aspen forests; grasslands, shrublands, open parklands, riparian areas, and wet meadows. | May affect, likely to adversely affect – Habitat is in project area and grizzly bears may be present, stock, mechanical equipment, personnel, and helicopters will disturb bears. |
| North America Wolverine <i>Gulo</i> | Proposed Threatened | High elevation alpine and cold boreal forests that receive enough winter precipitation to reliably maintain deep persistent snow late into the warm season. | Not likely to jeopardize the continued existence of the Distinct Population Segment of the North American Wolverine - Habitat is in project area and individuals may be present. |
| Whitebark Pine <i>Pinus albicaulis</i> | Threatened | Forests at upper subalpine elevations and near tree line. | No effect – no removal or damage to individuals or component parts of mature trees, seedlings, or saplings of whitebark or other five needled pines. |
| Western glacier stonefly <i>Zapada glacier</i> | Threatened | Alpine streams formed from meltwater emanating from glaciers. | No effect – no work will occur in the upper-most extent of high-elevation streams that originate from glacial meltwater. |
| Monarch butterfly <i>Danaus plexippus</i> | Candidate | Primarily occur in upland, dry areas with milkweed for breeding and flowering plants for nectar. | No effect – no nectar feeding plants or host plant species will be removed during management activities. |

APPENDIX D: MINIMUM REQUIREMENT ANALYSIS WORKSHEET

Because both Alternatives considered in this EA would affect wilderness character and include uses prohibited under Section 4(c) of the Wilderness Act (motorized equipment and helicopter landings) within recommended wilderness, a minimum requirements analysis (MRA) is required by NPS policy (NPS Management Policies, 6.3.5). The NPS has prepared an MRA for actions that could occur within NPS recommended wilderness, provided below. In the provided MRA, the analysis identifies three alternatives. These alternatives correspond with the alternative options under the minimum requirement analysis, and do not directly correlate with the Alternatives described in this EA. Alternative 1 below describes the selected minimum tool for administering the Preferred Alternative described in this EA. Alternative 2 below describes a “fully mechanized” alternative, and Alternative 3 below describes no action. The NPS does not have the authority to produce an MRA for USFS actions, and therefore has not analyzed helicopter landings or motorized equipment within the boundaries of the Absaroka Beartooth Wilderness. The NPS incorporates the USFS Plan and the MRA analysis therein by reference.



**MINIMUM REQUIREMENT ANALYSIS WORKSHEET
YELLOWSTONE NATIONAL PARK**



YELL 5/2011

PROPOSED ACTION: Buffalo Creek Native Fish Conservation **DATE:** 2022 - 2030

LEAD PERSON(S): Todd Koel and Brian Ertel **UNIT(S):** Yellowstone National Park

PART A: Minimum Requirement (should the action be done in proposed wilderness)

| | | |
|----------|--|---|
| 1 | IS ACTION AN EMERGENCY? | Answer: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Explain: Action is not an immediate threat to human safety. It is a threat to the persistence of native Yellowstone cutthroat trout in the Lamar River drainage. |
| | YES ↓ ACT ACCORDING TO APPROVED EMERGENCY MINIMUM TOOL CRITERIA | |
| | NO ↓ | |
| 2 | DOES ACTION CONFLICT WITH PLANNED WILDERNESS GOALS, OR FUTURE DESIRED CONDITIONS? | Answer: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Explain: Under the Wilderness Act and NPS RM41 Guidelines, this action will conform to the "minimum Tool Concept." There will be short-term impacts to individuals on the Buffalo Creek trail from fish removal and stocking efforts. These impacts include noise from helicopter operations and increased stock use. There will be no long-term resource damage. |
| | YES ↓ DO NOT DO IT | |
| | NO ↓ | |
| 3 | IS ACTION PRE-APPROVED BY THE WILDERNESS AND BACKCOUNTRY OR OTHER PARK MANAGEMENT PLAN? | Answer: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Explain: NEPA – EA – Native Fish Conservation Plan and FONSI (2011). |
| | YES ↓ DO ACCORDING TO APPROVED CRITERIA | |
| | NO ↓ | |
| 4 | CAN ACTION BE ACCOMPLISHED THROUGH A LESS INTRUSIVE ACTION SHOULD BE TRIED FIRST? (Visitor Education...) | Answer: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Explain: Buffalo Creek serves as the home of the main source of rainbow trout infecting Slough Creek and the Lamar River drainage. This project will protect native YCT in the largest interconnected population left in existence. To be successful, some mechanization is required. This project will use the minimum amount to successfully complete the project. |
| | YES ↓ DO IT | |
| | NO ↓ | |
| 5 | CAN ACTION BE ACCOMPLISHED OUTSIDE OF PROPOSED WILDERNESS ACHIEVE ITS OBJECTIVES? | Answer: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Explain: The project starts in the headwaters of Buffalo Creek, in the Beartooth Absaroka Wilderness. There is no other location that this project can be conducted. |
| | YES ↓ DO IT THERE | |
| | NO ↓ DO PART B | |

| PART B: Minimum Tool (how the action should be done in proposed wilderness) | | | |
|---|--|-----------------|---|
| 6 | DESCRIBE, IN DETAIL, ALTERNATIVE TO ACCOMPLISH THE PROPOSED (These may include, primitive skill/tool, motorized, and/or combination (Use addition pages if necessary)) | | * Minimum questions to answer for each What is proposed? Where will the action take place? When will the action take place? What design and standards will apply? What methods and techniques will be used? How long will it take to complete the action? Why is it being proposed in this manner? What mitigation will take place to minimize action |
| | | GO TO NEXT STEP | |
| 7 | EVALUATE WHICH ALTERNATIVE HAVE THE LEAST OVERALL IMPACT WILDERNESS RESOURCES, AND VISITOR EXPERIENCE ** | | ** Minimum criteria used to evaluate each Biophysical effects Social/Recreational/Experiential effects Societal/Political effects Health/Safety concerns Economical/Timing considerations |
| | | GO TO NEXT STEP | |
| 8 | SELECT AN APPROPRIATE, PREFERRED ALTERNATIVE | IF | 9 ATTACH TO APPROPRIATE PROJECT PROPOSAL/CLEARANCE FORM FOR APPROVAL/DISAPPROVAL SIGNATURE |
| | | REQUIRED | |

Alternative 1: Minimal Mechanization: The Buffalo Creek project includes all waters upstream of Buffalo Creek, upstream of the confluence with Slough Creek. This will include Hidden Lake and a second small unnamed lake that connects to Hidden Lake through a small creek. Within the Yellowstone NP boundary, the project will encompass the waters from the Buffalo/Slough creek confluence to the park boundary (mainstem river is 10.4 km). The primary goal of the project is to eliminate all rainbow trout from the Buffalo Creek system, the main source of rainbow trout in the Lamar River drainage. A secondary goal is to establish a genetically pure population of Yellowstone cutthroat trout throughout Buffalo Creek, its tributary streams and Hidden Lake. The project is slated to take place beginning in 2022 and being completed by 2030. From 2022 – 2024 crews from Montana Fish, Wildlife, and Parks, National Park Service and US Forest Service will spend up to three weeks each year removing nonnative rainbow trout from Buffalo Creek, its tributary streams, and Hidden Lake. To accomplish this, the piscicide rotenone will be used to remove all nonnative fish from the project area. Potassium Permanganate (KMnO4) will be used to neutralize the rotenone and ensure that the toxicant does not extend beyond the proposed project area. The application of KMnO4 will require the use of a volumetric feeder powered by a small gas-powered generator (Honda EU1000i). This generator has a rating of 50 db under full load, which is considered a faint noise, 10 db below typical conversation noise. To transport equipment that is too large for stock to carry, helicopters will be used. Helicopter flights will initiate at the Slough Creek transfer station and shuttle equipment into the Beartooth Absaroka Wilderness area, outside of YNP boundaries. At the midpoint of the treatment each year, flights will be used to transport equipment from our mid-location camp to the lower location camp, just inside of the YNP boundary. Flights for this portion of the project will initiate in Big Timber, MT and not impact Slough Creek Campground. Stock and backpacks will be used to transport as much equipment as possible. At the completion of the project each season, flights will be used to return all equipment too large for stock or backpacks, back to the Slough Creek transfer station.

For establishment of a genetically pure Yellowstone cutthroat trout population in Buffalo Creek, fish will be stocked annually starting 2024 or 2025 (dependent on rainbow trout removal) and continue for up to five years. Because of the limited access to the upper drainage early in the season, helicopters will be used to transport fish and personnel from Big Timber, MT to just inside of the YNP boundary on Buffalo Creek. From this location, crews will hike throughout the drainage stocking fish in predetermined locations. Stocking will take place once annually using helicopters. To stock the lower drainage, fish will be transported via stock to predetermined locations. Stock cannot be used for stocking throughout the drainage because of the additional time it would take to transport fish to the upper drainage.

Under this alternative, helicopter operations would take place for approximately 7 days each year during the rainbow trout removal phase and just 2 days a year during Yellowstone cutthroat trout population establishment.

Alternative 2: Full Mechanization: Under this alternative, project objectives would remain the same as Alternative 1, but no stock or backpacks would be used to transport personnel or equipment. Conducting the project under this alternative would decrease the number of days needed to complete the project and reduce the need for personnel to carry heavy packs over long distances. Helicopter flights would more than double under this scenario causing greater impacts to visitors and wildlife.

Alternative 3: No Action. The continued presence of nonnative rainbow trout and inability to stock Yellowstone cutthroat trout into headwater locations would ultimately lead to project failure.

List preferred alternative and give justification: Alternative 1 is the preferred alternative. Allowing some use of mechanized equipment (helicopter, generator) will greatly improve the probability of success of this important project. It will also increase crew safety as large equipment (bear boxes, sentinel fish and cages, automated volumetric feeder), will significantly reduce chances of bear encounters, prevent crew members from having to transport large heavy equipment long distance over uneven ground and prevent the need to have 24 hour a day "bucket brigades" to maintain the neutralization station. As much equipment as possible will be transported using stock and backpacks, thus preserving the wilderness quality to the greatest extent possible. The ability to land aircraft at the park boundary during restocking operations will significantly increase the likelihood of successfully founding a self-sustaining, genetically pure Yellowstone cutthroat trout population. As no backcountry campsites are located within the Buffalo Creek drainage within YNP, impacts to visitors will be minimal in all designated wilderness areas.



MINIMUM REQUIREMENT ANALYSIS WORKSHEET
YELLOWSTONE NATIONAL PARK



YELL 5/2011

PROPOSED ACTION: Buffalo Creek Native Fish Conservation DATE: 2022 - 2030

LEAD PERSON(S): Todd Koel and Brian Ertel UNIT(S): Yellowstone National Park

MRA Committee Statement:

The MRA Committee recommends the implementation of the preferred alternative. Removing non-native rainbow trout and replacing with Yellowstone cutthroat trout provides long term wilderness character benefits. Due to the nature of the terrain, equipment needed for non-native removal, and sensitivity of fish stock, transportation by helicopter is necessary. The impacts to wilderness character from the helicopter flights are short term and temporary but are determined to be the minimum necessary. Transporting equipment by backpack and stock, when possible, benefits wilderness character by reducing the number of flights required.

This MRA does not address the actual process of fish removal. Fish removal operations were addressed in the Native Fish Conservation Plan Environmental Assessment (2011).

Fisheries staff should notify the Central Backcountry Office one week in advance of flight operations. Additionally, the MRA Committee requests that fisheries staff report the total number of flights and landings at the end of operations annually.

Recommended: RVP:

Todd Koel
6/1/22

YCR:

Ann Gahr
6/6/22

MAINT:

Chris Anderson
6/2/22

Chief Ranger Approval:

Chris Ertel 6/9/22

REFERENCES

- Al-Chokhachy, R., J. Alder, S. Hostetler, R. Gresswell, and B. Shepard. 2013. Thermal controls of Yellowstone cutthroat trout and invasive fishes under climate change. *Global Change Biology* 19: 3069-3081.
- Al-Chokhachy, R., B. B. Shepard, J. C. Burckhardt, D. Garren, S. Opitz, and T. M. Koel, et al. 2018. A portfolio framework for prioritizing conservation efforts for Yellowstone cutthroat trout populations. *Fisheries* 43:485-496. doi:10.1002/fsh.10137.
- Bear, E.A., T.E. McMahon, and A.V. Zale. 2007. Comparative thermal requirements of westslope cutthroat trout and rainbow trout: implications for species interactions and development of thermal protection standards. *Transactions of the American Fisheries Society* 136:1113-1121.
- Bergum, D. J., K. A. Gunther, and L. M. Baril. 2017. Birds & mammals that consume Yellowstone cutthroat trout in Yellowstone Lake and its tributaries. *Yellowstone Science* 25:86-89.
- Billman, H. G, S. St-Hilaire, C. G. Kruse, T. S. Peterson, and C. R. Peterson. 2011. Effects of rotenone on Columbia spotted frog and boreal toad tadpoles. *Transactions of American Fisheries Society* 140:919-927.
- Billman, H. G, C. G. Kruse, S. St-Hilaire, T. M. Koel, J. L. Arnold, and C. R. Peterson. 2012. Effects of rotenone on Columbia spotted frog *Rana luteiventris* during field application in lentic habitats in southwestern Montana. *North American Journal of Fisheries Management* 32:781-789.
- Bjornlie, D. D., F. T. van Manen, M. R. Ebinger, M. A. Haroldson, D. J. Thompson, and C. M. Costello. 2014. Whitebark pine, population density, and home-range size of grizzly bears in the Greater Yellowstone Ecosystem. *PLoS ONE* 9:e88160.
- Coleman, T. H., , C. C. Schwartz, K. A. Gunther, and S. Creel. 2013. Grizzly bear and human interactions in Yellowstone National Park: an evaluation of bear management areas. *Journal of Wildlife Management* 77:1311-1320.
- Cooke, S.J., and H.L. Schramm. 2007. Catch-and-release science and its application to conservation and management of recreational fisheries. *Fisheries Management and Ecology* 14:73-79.
- Costello, C. M., F. T. van Manen, M. A. Haroldson, M. R. Ebinger, S. L. Cain, K. A. Gunther, and D. D. Bjornlie. 2014. Influence of whitebark pine decline on fall habitat use and movements of grizzly bears in the Greater Yellowstone Ecosystem. *Ecology and Evolution* 4: 2004-2018.
- Costello, C. M., S. L. Cain, S. Pils, L. Frattaroli, M. A. Haroldson, and F. T. van Manen. 2016. Diet and macronutrient optimization in wild ursids: a comparison of grizzly bears with sympatric and allopatric black bears. *PLoS ONE* 11: e0153702.
- Craighead, J. J., K. R. Greer, R. R. Knight, and H. I. Pac. 1988. Grizzly bear mortalities in the Yellowstone ecosystem, 1959-1987. Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

- DeRito, J.N., A.V. Zale, and B.B. Shepard. 2010. Temporal reproductive separation of fluvial Yellowstone cutthroat trout from rainbow trout and hybrids in the Yellowstone River. *North American Journal of Fisheries Management* 30:866-886.
- Despain, D. G. 1990. Yellowstone vegetation. Robert Rinehart, Boulder, Colorado.
- Detjens, C. R., W. Voigt, J. Voigt, and T. M. Koel. 2017. Fly fishing volunteers support native fish conservation in Yellowstone. *Yellowstone Science* 25:82-84.
- Ertel, B. D., K. C. Heim, J. L. Arnold, C. R. Detjens, and T. M. Koel. 2017. Preservation of native cutthroat trout in northern Yellowstone. *Yellowstone Science* 25:35-41.
- Finlayson, B. J., S. Siepmann, and J. Trumbo. 2001. Chemical residues in surface and ground waters following rotenone application to California lakes and streams. Pages 37–53 in R. C. Cailteux, L. DeMong, B. J. Finlayson, W. Horton, W. McClay, R. A. Schnick, and C. Thompson, editors. *Rotenone in fisheries: are the rewards worth the risks?* American Fisheries Society, Trends in Fisheries Science and Management 1. Bethesda, Maryland
- Finlayson, B. and 7 co-authors. 2010. Planning and standard operating procedures for the use of rotenone in fish management, Rotenone SOP Manual. American Fisheries Society. Bethesda, MD.
- Gleason, M.N., R.E.Gosselin, H.C. Hodge, and R.P. Smith. 1969. *Clinical Toxicology of Commercial Products: Acute Toxicity* 3rd Edition. Williams & Wilkins.
- Greater Yellowstone Coordinating Committee Whitebark Pine Subcommittee. 2011. Whitebark pine strategy for the Greater Yellowstone Area. National Park Service and the U.S. Forest Service, Washington, D.C.
- Gresswell, R. E. 2011. Biology, status, and management of the Yellowstone cutthroat trout. *North American Journal of Fisheries Management* 31:782-812.
- Gunther, K. A., R. R. Shoemaker, K. L. Frey, M. A. Haroldson, S. L. Cain, F. T. van Manen, and J. K. Fortin. 2014. Dietary breadth of grizzly bears in the Greater Yellowstone Ecosystem. *Ursus* 25:60-72.
- Haroldson, M. A. 2021. Whitebark pinecone production. Pages 54-56 in F. T. van Manen, M. A. Haroldson, and B. E. Karabensh, editors. *Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2020*. U.S. Geological Survey, Bozeman, Montana.
- Heim, K. C., T. E. McMahon, S. T. Kalinowski, B. D. Ertel, and T. M. Koel. 2020. Abiotic conditions are unlikely to mediate hybridization between invasive rainbow trout and native Yellowstone cutthroat trout in a high-elevation metapopulation. *Canadian Journal of Fisheries and Aquatic Sciences* 77:1433-1445.
- Hostetler, S., C. Whitlock, B. Shuman, D. Liefert, C. Drimal, and S. Bischke. 2021. Greater Yellowstone climate assessment: past, present, and future climate change in greater Yellowstone watersheds. Montana State University, Institute on Ecosystems, Bozeman, Montana.
- Houston, D. B. 1982. *The northern Yellowstone elk herd*. Macmillan, New York, New York.

- Interagency Grizzly Bear Study Team. 2013. Response of Yellowstone grizzly bears to changes in food resources: a synthesis. Report to the Interagency Grizzly Bear Committee and Yellowstone Ecosystem Subcommittee. U.S. Geological Survey, Northern Rocky Mountain Science Center, Bozeman, Montana.
- Isaak, D., M. Young, N. David, D. Horan, and M. Groce. 2015. The cold-water climate shield: delineating refugia for preserving salmonid fishes through the 21st century. *Global Change Biology* 21:2540-2553.
- Isaak, D., M. Young, D. Nagel, D. Horan, M. Groce, and S. Parkes. 2017. Climate shield bull trout and cutthroat trout population occurrence scenarios for the western U. S. Rocky Mountain Research Station, Fort Collins, Colorado.
- Jordan, D. S. 1891. A reconnaissance of streams and lakes of Yellowstone National Park, Wyoming in the interest of the U.S. Fish Commission. *Bulletin of the U.S. Fish Commission* 9:41-63.
- Kaeding, L.R. 2010. Relative contributions of climate variation, lake trout predation, and other factors to the decline of Yellowstone cutthroat trout during the recent three decades. Dissertation. Montana State University, Bozeman, Montana, USA.
- Kendall, K.C., and R.E. Keane. 2001. Whitebark pine decline: Infection, mortality, and population trends. Pages 221-242 in D. F. Tomback, S. F. Arno, and R. E. Keane, editors. *Whitebark pine communities: ecology and restoration*. Island Press, Washington, D.C.
- Knight, R. R., and L. L. Eberhardt. 1985. Population dynamics of Yellowstone grizzly bears. *Ecology* 66:323-334.
- Koel, T. M., P. E. Bigelow, C. R. Detjens, P. D. Doepke, B. D. Ertel, D. J. MacDonald, and N. A. Thomas. 2022a. Native Fish Conservation Program, Yellowstone National Park, Report for 2019-2021, YCR-2022-02. National Park Service, Yellowstone National Park, Yellowstone Center for Resources, Mammoth, Wyoming.
- Koel, T. M., L. Kaeding, B. Ertel, and P. Bigelow. 2022b. Fish. Pages 230-231 in W. A. Marcus, J. E. Meacham, A. W. Rodman, A. Y. Steingisser, and J. T. Menke, editors. *Atlas of Yellowstone*, second edition. University of Oregon, Eugene, Oregon.
- Logan, J., W. Macfarlane, and L. Willcox. 2010. Whitebark pine vulnerability to climate-driven mountain pine beetle disturbance in the Greater Yellowstone. *Ecological Applications* 20:895-902.
- Loggers, E. A. 2022. Evaluating bear management areas in Yellowstone National Park. Thesis, Montana State University, Bozeman, Montana.
- Mattson, D. J., B. M. Blanchard, and R. R. Knight. 1991. Food habits of Yellowstone grizzly bears, 1977-1987. *Canadian Journal of Zoology* 69:1619-1629.
- MFWP [Montana Fish, Wildlife and Parks]. 2000. Cooperative conservation agreement for Yellowstone cutthroat trout within Montana. Helena, Montana.

- MFWP. 2007. Memorandum of understanding and conservation agreement for westslope cutthroat trout and Yellowstone cutthroat trout in Montana. Helena, Montana.
- MFWP and USFS [U.S. Department of Agriculture, U.S. Forest Service, Custer Gallatin National Forest]. 2022. Reclamation of Buffalo Creek for Yellowstone cutthroat trout. Final environmental assessment, Livingston, Montana. <https://www.fs.usda.gov/project/?project=59630>
- NPS, YNP [Yellowstone National Park]. 2022. Fishing regulations. Mammoth, Wyoming. <https://www.nps.gov/yell/planyourvisit/upload/2022-Fishing-Regulations.pdf>
- Newcomb, M. 2003. White pine blister rust, whitebark pine, and *Ribies* species in the Greater Yellowstone Area. Thesis, University of Montana, Missoula, Montana.
- Rhymer, J. M., and D. Simberloff. 1996. Extinction by hybridization and introgression. *Annual Review of Ecology and Systematics* 27:83-109. doi:10.1146/annurev.ecolsys.27.1.83.
- Ruhl, M. E., and T. M. Koel. 2007. Cutthroat trout restoration across Yellowstone's northern range: phase I completion report, YCR-2007-05. National Park Service, Yellowstone National Park, Wyoming.
- Schneider, D., J. J. Treanor, J. Richards, J. Wood, and E. Lee. 2015. Plains spadefoot, *Spea bombifrons*, confirmed in Yellowstone National Park. *Northwestern Naturalist* 96:227-229.
- Schullery, P. 2010. Greater Yellowstone science: Past, present, and future. *Yellowstone Science* 18:7-13.
- Schwartz, C. C., M. A. Haroldson, and G. C. White. 2010. Hazards affecting grizzly bear survival in the Greater Yellowstone Ecosystem. *Journal of Wildlife Management* 74:654-667.
- Shanahan, E., K. Legg, and R. Daley. 2017. Status of whitebark pine in the Greater Yellowstone Ecosystem. A step-trend analysis with comparisons from 2004 to 2015. Natural Resource Report NPS/GRYN/NRR—2017/1445. National Park Service, Fort Collins, Colorado.
- Shanahan, E., K. M. Legg, and H. Shovic. 2016. Whitebark pine mortality related to white pine blister rust, mountain pine beetle outbreak, and water availability. *Ecosphere* 7:e01610.10.1002/ecs2.1610.
- Shepard, B.B., R. Al-Chokhachy, T.M. Koel, M.A. Kulp, and N. Hitt. 2016. Likely responses of native and invasive fish to climate change in the Rocky and Appalachian Mountains. Pages 232-256 in A.J. Hansen, D.M. Theobald, W.B. Monahan, and S.T. Olliff, editors. *Climate change in wildlands: pioneering approaches to science and management*. Island Press, Washington, D.C., USA.
- Skaar, D. R., J. L. Arnold, T. M. Koel, M. E. Ruhl, J. A. Skorupski, and H. B. Treanor. 2017. Effects of rotenone on amphibians and macroinvertebrates in Yellowstone. *Yellowstone Science* 25:28-34.
- Smith, D. W., and D. B. Tyers. 2012. The history and current status and distribution of beavers in Yellowstone National Park. *Northwest Science* 86:276-288.
- Smith, D. W., K. A. Cassidy, D. R. Stahler, D. R. MacNulty, Q. Harrison, B. Balmford, E. E. Stahler, E. Brandell, and T. Coulson. 2020. Population dynamics and demography. Pages 77-92 in D. W. Smith, D. R. Stahler, and D. R. MacNulty, editors. *Yellowstone wolves: science and discovery in the world's first national park*. University of Chicago Press, Chicago, Illinois.

- State of Idaho, Office of the Governor. 2022. Petition: to delist grizzly bear (*Ursus arctos horribilis*) in the conterminous “lower 48” United States from the federal list of endangered and threatened wildlife because the Lower-48 listing does not meet the statutory definition of a species under the Endangered Species Act (ESA). Boise, Idaho.
- State of Wyoming, Office of the Governor. 2022. Petition: to establish the Greater Yellowstone Ecosystem (GYE) grizzly bear (*Ursus arctos horribilis*) distinct population segment (DPS) and remove the GYE grizzly bear DPS from the federal list of endangered and threatened wildlife. Cheyenne, Wyoming.
- Støen, O.-G. W. Neumann, G. Ericsson, J. E. Swenson, H. Dettki, J. Kindberg, and C. Nellemann. 2010. Behavioral response of moose *Alces* and brown bears *Ursus arctos* to direct helicopter approaches by researchers. *Wildlife Biology* 16:292-300.
- Tercek, M., A. Rodman, and D. Thoma. 2015. Trends in Yellowstone’s snowpack. *Yellowstone Science* 23:20-27.
- Thoma, D., A. Rodman, and M. Tercek. 2015. Water in balance: interpreting climate change impacts using a water balance model. *Yellowstone Science* 23:29-35.
- Thoma, D. P., E. K. Shanahan, and K. M. Irvine. 2019. Climatic correlates of white pine blister rust infection in whitebark pine in the Greater Yellowstone Ecosystem. *Forests* 10:666. <https://doi.org/10.3390/f10080666>
- Treanor, J., and P. Cross. 2022. Wildlife disease. Pages 236-237 in W. A. Marcus, J. E. Meacham, A. W. Rodman, A. Y. Steingisser, and J. T. Menke. *Atlas of Yellowstone*. University of California Press, Oakland, California.
- Tyers, D. B. 2020. Long-term trends in beaver, moose, and willow status in the southern portion of the Absaroka-Beartooth wilderness. Pages 211-213 in D. W. Smith, D. R. Stahler, and D. R. MacNulty, editors. *Yellowstone wolves: science and discovery in the world’s first national park*. University of Chicago Press, Chicago, Illinois.
- USDI [U.S. Department of the Interior], Fish and Wildlife Service [FWS]. 2009a. 12-month finding on a petition to change the final listing of the distinct population segment of the Canada lynx to include New Mexico. *Federal Register* 74:66937-66950.
- USDI, FWS. 2009b. Revised designation of critical habitat for the contiguous United States distinct population segment of the Canada lynx; final rule. *Federal Register* 74:8616-8702.
- USDI, FWS. 2013. Threatened status for the distinct population segment of the North American wolverine occurring in the contiguous United States. *Federal Register* 78:7863-7890.
- USDI, FWS. 2019. Endangered and threatened wildlife and plants; threatened species status for meltwater Lednian stonefly and western glacier stonefly with a section 4(d) rule. *Federal Register* 84:64210-64227.
- USDI, FWS. 2020. Endangered and threatened wildlife and plants; 12-month finding for the monarch butterfly. *Federal Register* 85:81813-81822.

- USDI, FWS. 2022. Threatened species status with section 4(d) rule for whitebark pine (*Pinus albicaulis*). Federal Register 87:76882-76917.
- USDI, NPS [National Park Service]. 2006. Management Policies 2006. U.S. Department of the Interior, Washington, D.C.
- USDI, NPS. 2010. Native fish conservation plan / environmental assessment. Yellowstone National Park, Mammoth, Wyoming. <https://parkplanning.nps.gov/yellnfc2011>
- USDI, NPS. 2011. Native fish conservation plan finding of no significant impact. Yellowstone National Park, Mammoth, Wyoming. <https://parkplanning.nps.gov/document.cfm?parkID=111&documentID=41145>
- USDI, NPS. 2014. Foundation document; Yellowstone National Park; Wyoming, Montana, Idaho. YELL 101/122938. Mammoth, Wyoming.
- USDI, NPS. 2019. Westslope cutthroat trout and bull trout preservation in the upper Camas drainage environmental assessment. Glacier National Park, West Glacier, Montana.
- USDI, NPS. 2020. Wilderness character building blocks. Wilderness Stewardship Division, Washington, D.C.
- USDI, NPS. 2022. Superintendent's compendium of designations, closures, permit requirements and other restrictions imposed under discretionary authority. Yellowstone National Park, Mammoth, Wyoming. <https://www.nps.gov/yell/learn/management/compendium.htm>
- Uthe, P., R. Al-Chokhachy, B.B. Shepard, A.V. Zale, and J.L. Kershner. In review. Effects of climate-driven stream factors on summer growth patterns of Yellowstone cutthroat trout. Journal of Fish Biology.
- van Manen, F. T., M. A. Haroldson, D. D. Bjornlie, M. R. Ebinger, D. J. Thompson, C. M. Costello, and G. C. White. 2016. Density dependence, whitebark pine, and vital rates of grizzly bears. Journal of Wildlife Management 80:300-313.
- van Manen, F. T., M. A. Haroldson, and B. E. Karabensh, editors. 2021. Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2020. U.S. Geological Survey, Bozeman, Montana.
- Varley, J. D. 1981. A history of fish stocking activities in Yellowstone between 1881 and 1980. Yellowstone National Park, WY. Information paper 35, Yellowstone National Park, Mammoth, Wyoming.
- Varley, J. D., and P. Schullery. 1998. Yellowstone fishes: ecology, history, and angling in the park. Stackpole Books, Mechanicsburg, Pennsylvania.
- White, P. J. 2016. Can't chew the leather anymore: musings on wildlife conservation in Yellowstone from a broken-down biologist. Outskirts Press, Parker, Colorado.

- White, P. J. 2022. Wildlife in Yellowstone: what are we trying to preserve? *Yellowstone Science* 28:96-99.
- White, P. J., R. A. Garrott, and G. E. Plumb, editors. 2013. *Yellowstone's wildlife in transition*. Harvard University Press, Cambridge, Massachusetts.
- White, P. J., K. A. Gunther, and F. T. van Manen, editors. 2017. *Yellowstone grizzly bears: ecology and conservation of an icon of wildness*. Yellowstone Forever and Yellowstone National Park, Mammoth, Wyoming.
- White, P. J., C. Geremia, R. Wallen, D. Frank, and R. Renkin. 2022. The great debate: are Yellowstone's northern grasslands overgrazed? *Yellowstone Science* 5-11.
- White, P. J., R. L. Wallen, D. E. Hallac, and J. A. Jerrett, editors. 2015. *Yellowstone bison—conserving an American icon in modern society*. Yellowstone Association, Yellowstone National Park, Mammoth, Wyoming. <https://www.nps.gov/yell/learn/management/bison-resources.htm>
- Wyoming Game and Fish Commission, Wyoming Game and Fish Department, Montana Fish and Wildlife Commission, Montana Fish, Wildlife and Parks, Idaho Fish and Game Commission, and Idaho Department of Fish and Game. 2022. Tri-state memorandum of agreement regarding the management, genetic health, and allocation of discretionary mortality of grizzly bears in the Greater Yellowstone Ecosystem. Cheyenne, Wyoming, Helena, Montana, and Boise, Idaho.
- Yellowstone Center for Resources. 2018. The state of Yellowstone vital signs and select park resources, 2017. Report YCR-2018-01. National Park Service, Yellowstone National Park, Mammoth, Wyoming.
- Yellowstone Ecosystem Subcommittee. 2021. Conservation strategy for the grizzly bear in the Greater Yellowstone Area. Interagency Grizzly Bear Committee, Bozeman, Montana.
- Yellowstone National Park. 2017. Aviation statistics. Acting Aviation Program Manager, Fire Cache, Mammoth, Wyoming.